

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
TYLER DIVISION

ADAPTIX, INC.,	)	
	)	
Plaintiff,	)	
	)	Civil Action 6:12-cv-017
v.	)	JURY TRIAL DEMANDED
AT&T MOBILITY LLC., et al.	)	
	)	
Defendants.	)	
ADAPTIX, INC.,	)	
	)	
Plaintiff,	)	
	)	Civil Action 6:12-cv-020
v.	)	JURY TRIAL DEMANDED
PANTECH WIRELESS, INC., et al.	)	
	)	
Defendants.	)	
ADAPTIX, INC.,	)	
	)	
Plaintiff,	)	
	)	Civil Action 6:12-cv-120
v.	)	JURY TRIAL DEMANDED
CELLCO PARTNERSHIP d/b/a VERIZON	)	
WIRELESS, et al.	)	
	)	
Defendants.	)	

EXPERT REPORT OF THOMAS FUJA, Ph. D.
REGARDING INVALIDITY OF U.S. PATENT NOS. 6,947,748 AND 7,454,212

EXHIBIT 2101

Sprint Spectrum L.P. et al.
v. Adaptix, Inc.
IPR2016-00824

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I. GENERAL MATTERS

A. Introduction

1. I have been retained as an expert by AT&T Mobility LLC (“ATTM”), LG Electronics, Inc. and LG Electronics U.S.A., Inc. (“LG”), Pantech Wireless, Inc. (“Pantech”), and Cellco Partnership d/b/a Verizon Wireless (“Verizon”) (collectively, “Defendants”) in the above-captioned actions. I expect to testify at trial regarding the matters set forth in this Report, if asked about these matters by the Court or by the parties’ attorneys.

2. I understand that the plaintiff Adaptix, Inc. (“Adaptix”) has asserted that Defendants infringe U.S. Patent Nos. 6,947,748 (the “’748 Patent”) and 7,454,212 (the “’212 Patent”) (collectively, the “Asserted Patents”). I have been informed that Adaptix is asserting claims 6-9, 11, and 19-22 of the ’748 Patent and claims 1-4, 8-13, 15-16, 18-21, and 23-30 of the ’212 Patent (collectively, the “Asserted Claims”). I have been informed by counsel for Defendants that the Court has already determined that claims 2-4 of the ’212 Patent are invalid as indefinite, and I do not address them in this Report. I have been informed that the Court has not granted Adaptix leave to assert claims 2 and 20 of the ’212 Patent, but I address claim 20 in this Report because claim 21 (which is asserted) depends from claim 20.

3. I have been asked to provide my expert opinion as to the validity of the Asserted Claims of the ’748 and ’212 Patents. In my opinion, all the Asserted Claims of the ’748 and ’212 Patents are invalid. As explained in greater detail below, the Asserted Claims of both patents are anticipated and/or would have been obvious to a person of ordinary skill at the time of the alleged inventions, including in light of prior art such as prior patents, publications, and systems.

4. At any trial in this matter, I may provide and rely on visual aids and demonstrative exhibits to explain my opinions, the technology described in the Asserted Patents,

the state of the art at the time each patent was filed, and the prior art. Examples may include claim charts, drawings, excerpts from patent specifications, file histories, interrogatory responses, deposition testimony and exhibits, charts, models, diagrams, videos, and animated or computer-generated videos. My testimony may include relevant background materials including materials related to wireless communications, techniques for channel estimation and resource allocation in Orthogonal Frequency Division Multiplexing (“OFDM”) and Orthogonal Frequency Division Multiple Access (“OFDMA”) systems, and related matters.

5. I am also prepared to testify, if appropriate, on matters raised in cross-examination; to rebut, as necessary, matters raised (in reports, depositions, and/or court testimony) by Adaptix experts; and to address other related matters raised at trial.

B. Qualifications and Professional Experience

6. I have summarized in this section my educational background, career history, publications, and other relevant qualifications. My Curriculum Vitae, which includes my qualifications as well as my publications within the last ten years, is attached as Exhibit A. A list of my previous testimony at trial or by deposition is attached as Exhibit B.

1. Educational Background

7. I received a Bachelor of Science degree in Electrical Engineering and a Bachelor of Science degree in Computer Engineering from the University of Michigan in 1981. I received a Master of Engineering degree and a Ph.D. in Electrical Engineering from Cornell University in 1983 and 1987, respectively.

2. Career History

8. I am a Professor of Electrical Engineering and the Chairman of the Department of Electrical Engineering at the University of Notre Dame. I joined the Notre Dame faculty in

August 1998 as an Associate Professor and was promoted to Professor in August 2001. I have been the Chairman of the Department of Electrical Engineering since July 2006.

9. Prior to joining Notre Dame, I was on the faculty at the University of Maryland in College Park, Maryland. I joined the University of Maryland in 1987 and was promoted to Associate Professor of Electrical Engineering there in 1993.

10. My research addresses the problem of reliably transmitting information over unreliable and/or constrained communication channels. A focus of my research is the design and analysis of error control codes and coded modulation schemes and the use of those codes for forward error control and/or ARQ-based communications. In particular, my research on ARQ-based communication addresses the problem of adaptively changing modulation and/or coding parameters based on feedback provided by the receiver.

11. As a professor, I have taught a variety of undergraduate and graduate courses that include digital communications, information theory, coding theory, wireless communications, 4G cellular technology, bandwidth-efficient communications, probability, signals and systems, and circuits.

12. During the Spring 2014 semester, I taught a course at Notre Dame entitled, “Wireless Communications and the 4G Cellular Standard.” This course focused on the techniques employed in the LTE standard for cellular communications, and LTE standard documents (*e.g.*, Technical Specifications) were used as course texts. The course was taken by both undergraduate and graduate students in electrical engineering.

13. I have supervised graduate students who completed fifteen Ph.D. dissertations and fifteen Master’s theses under my direction. The students whom I supervised have gone on to take positions at a variety of academic institutions as well as leading technology companies.

14. From January 1997 to July 1998, I was the Program Director for Communications Research at the U.S. National Science Foundation (“NSF”). I was responsible for the NSF’s support of research in physical-layer communication systems, including modulation, coding, compression, multiple access, and information theory. My role was to solicit and evaluate research proposals from university faculty and small businesses and make decisions regarding which proposals would receive NSF funding. My research budget was \$5 million to \$6 million per year.

15. In addition to my teaching and research responsibilities, I have served as a consultant for several companies. Some of these consulting engagements were focused on design—*e.g.*, I designed a new method for embedding data in the inter-frame vertical blanking interval (“VBI”) during television broadcasts by Public Broadcasting System (“PBS”) stations – while others (such as the current engagement) have related to intellectual property issues.

3. Publications and Professional Activities

16. I have authored approximately 150 publications and presentations in the field of digital communications and related topics. These papers have been published in journals such as IEEE Transactions on Communications, IEEE Transactions on Information Theory, IEEE Transactions on Vehicular Technology, IEEE Transactions on Wireless Communications, and European Transactions on Telecommunications. I have made presentations at dozens of national and international conferences and symposia.

17. I am a member of and have been actively involved in a number of professional organizations. For example, I have served as President and as a member of the Board of Governors for the Information Theory Society of the Institute of Electrical and Electronics Engineers (“IEEE”), and I have also served as Associate Editor of that organization’s journal. I have organized numerous technical sessions for conferences and symposia on topics including

mobile communications, error correcting codes, and computer memories. In addition, I have regularly reviewed papers for various journals and conferences and proposals for the National Science Foundation.

18. I have received several awards over the course of my career, including the Ruth and Joel Spira Award for Excellence in Teaching from the Department of Electrical Engineering at Notre Dame in 2007 and 2008, the 2002 Kaneb Teaching Award from Notre Dame, and the 1989 Presidential Young Investigator Award from the National Science Foundation. In 2004, I was elected a Fellow of the IEEE, a designation that can be awarded to no more than one-tenth of one percent of the Institute's membership in any year.

C. Expertise

19. The '748 and '212 Patents generally relate to wireless communications. Based on my education and professional experience, I am an expert in the field of wireless communications as relevant for the '748 and '212 Patents and have been an expert in this field since before the applications for the patents were filed with the United States Patent and Trademark Office ("USPTO"). I am familiar with how a person having ordinary skill in the art would have understood and used the terminology found in these patents at the time of their filing and with the state of the prior art.

D. Compensation

20. I am being compensated for my services in this matter at the rate of \$575 per hour. My compensation is not contingent upon the opinions I render or the outcome of this litigation.

II. BASIS OF OPINIONS FORMED

A. Summary of Materials Reviewed

21. Among the materials I have reviewed in forming my opinions are the '748 and '212 Patents, the prosecution file histories for the '748 and '212 Patents, prior art, various documents produced by Adaptix and Defendants in this litigation, deposition testimony, interrogatory responses, the Court's claim construction order, and any other documents cited in this Report. I have also relied on my professional and academic experience. A full list of materials that I have reviewed relating to this case is attached as Exhibit C. I reserve the right to rely upon additional materials as I become aware of them, and to revise my analysis and opinions to the extent necessary based on any such new materials.

B. Review and Analysis

22. My opinions are based in part on my review and analysis of the above mentioned documents and materials. I have also relied on my education, experience, and knowledge of basic engineering principles and wireless communication systems and techniques.

23. I have also relied on my review of Adaptix's infringement contentions. Some of my opinions regarding invalidity are based on claim scope as applied by Adaptix in its infringement contentions. These opinions should not be construed as an agreement or admission with regard to claim scope.

24. I reserve the right to revise my opinions as my investigation continues and to supplement my opinions, if required, in response to further discovery, new information and opinions provided by Adaptix's expert(s), or decisions made by this Court or other courts.

C. Understanding of the Law

25. I am not an attorney. For the purposes of this Report, I have been informed about certain aspects of the law that are relevant to my analysis and opinion.

26. I have been informed by counsel for Defendants of certain legal principles relevant to my invalidity analysis and opinions. I have used my understanding of those principles in forming the opinions set forth in this Report. My understanding of those principles is summarized below. I understand that invalidity analysis is a two-step process. First, the Asserted Claims are construed to ascertain their proper scope. Second, the construed claims are compared to the prior art.

1. Claim Construction

27. I have been informed and understand that a claim construction analysis begins with the ordinary meaning of a claim term, and there is a presumption that the term carries its plain and ordinary meaning to persons of ordinary skill in the art. I have also been informed and understand that the most important sources for determining the meaning of a claim term are the claims, the specification (or “written description”), and the prosecution history of the patent at issue, which collectively is called “intrinsic evidence.” I have been further informed and understand that the meaning of a claim term may also be guided by “extrinsic evidence,” such as dictionaries, treatises, and inventor testimony.

28. It is my understanding that an inventor may define a claim term in either the specification or prosecution history that is different from the term’s ordinary meaning. I have been informed that the meaning of a claim term may also be modified if the patentee clearly and unequivocally disavowed a broader meaning of the term in either the patent specification or the prosecution history.

29. I understand that district courts in both the Northern District of California and the Eastern District of Texas have construed certain claim terms in the Asserted Patents as set forth in the table below:

Claim Term	EDTX Construction	NDCA Construction
“SINR” (’748 Patent, claims 6, 8, 19, & 21; ’212 Patent, claim 19)	“Signal-to-Interference-plus-Noise Ratio” (stipulated construction)	“ <u>S</u> ignal-to- <u>I</u> nterference-plus- <u>N</u> oise <u>R</u> atio” (stipulated construction)
“pilot symbols” (’748 Patent, claims 6, 8, 19, & 21; ’212 Patent, claims 1 & 18)	“symbols, sequences, or signals known to both base station and subscriber” (stipulated construction)	“symbols, sequences, or signals known to both base station and subscriber” (stipulated construction)
“clusters of subcarriers” (’748 Patent, claims 6, 11, 19, & 21; ’212 Patent, claims 13 & 18)	“at least two logical units of subcarriers” (stipulated construction)	“at least two logical units of subcarriers” (stipulated construction)
“selecting” (’748 Patent, claim 6 & 8; ’212 Patent, claim 1)	“choosing” (stipulated construction)	“choosing” (stipulated construction)
“intra-cell traffic load balancing” (’748 Patent, claim 11)	“balancing cluster usage within a cell of a base station” (stipulated construction)	“balancing cluster usage within a cell of a base station”
“select[ing] a set of candidate subcarriers” (’748 Patent, claims 6, 8, 19 & 21; ’212 Patent, claims 1 & 18)	“choos[ing] a set of subcarriers that the subscriber requests for use”	“Selecting” = “Choosing.” All other terms: plain and ordinary meaning

Claim Term	EDTX Construction	NDCA Construction
“subcarriers [of/from] the set of subcarriers selected by the [first] base station” (’748 Patent, claims 6, 8, 19 & 21; ’212 Patent, claims 1 & 18)	“subcarriers that the base station has chosen from the set of candidate subcarriers selected by the subscriber”	“Subcarriers that the base station has chosen from the set of candidate subcarriers selected by the subscriber”
“index indication of a candidate cluster with it[s] SINR value” (’748 Patent, claims 6 & 19)	“identifier (ID) of a chosen candidate cluster of subcarriers accompanied by its SINR value”	“Identifier (ID) of a chosen candidate cluster of subcarriers with its SINR value.”
“SINR value” (’748 Patent, claims 6 and 19)	“Signal-to-Interference-plus-Noise Ratio measurement”	“Calculation based on the Signal-to-Interference-plus-Noise Ratios of the cluster’s subcarriers”
“a system employing orthogonal frequency division multiple access (OFDMA)” (’748 Patent, claims 6 and 8; ’212 Patent, claim 1)	Plain and ordinary meaning	“OFDMA”: orthogonal frequency division multiple access All other terms: plain and ordinary meaning
“subcarrier allocation for OFDMA” (’748 Patent, claim 11)	Plain and ordinary meaning	“OFDMA”: orthogonal frequency division multiple access All other terms: plain and ordinary meaning
“OFDMA subcarriers” (’748 Patent, claims 11, 19, and 21; ’212 Patent, claim 18)	Plain and ordinary meaning	“OFDMA”: orthogonal frequency division multiple access; All other terms: plain and ordinary meaning

Claim Term	EDTX Construction	NDCA Construction
“arbitrarily ordering” (’748 Patent, claims 6 & 19; ’212 Patent, claims 13 & 28)	“order[ed/ing] in an order not known by the base station”	“Order[ed/ing] in a manner not previously defined”

30. My opinions in this Report as to the validity of the Asserted Claim are based on the Eastern District of Texas constructions. I have performed a validity analysis of the Asserted Claims under the Northern District of California constructions in Case Nos. Case Nos. 5:13-cv-1776, -1777, -1778, -1844, and -2023 in a separate report, and my conclusions regarding the invalidity of the Asserted Claims are the same. With regard to claim language not construed by the Court, I viewed that language from the perspective of one of ordinary skill in the art at the effective filing date of each patent. I understand that the person of ordinary skill in the art would have reviewed the intrinsic evidence, including the claim language, the patent specification, and the prosecution history. I further understand that the person of ordinary skill in the art would be familiar with other material (such as contemporaneous dictionaries) not in the written record of the patent.

2. Legal Standards Relating to Invalidity

a. Presumption of Validity and Burden of Proof

31. I have been informed and understand that a patent claim is presumed valid, and that a challenger must establish invalidity by “clear and convincing evidence.” I have been further informed and understand that, to prove an assertion by “clear and convincing evidence,” the party with the burden of proof must demonstrate that it is substantially more likely than not that the assertion is true.

32. I have been informed and understand that invalidity must be demonstrated on a claim-by-claim basis. Therefore, for example, to prove that a claim is invalid in view of the prior art, the prior art must disclose each limitation recited in the claim clearly and convincingly. I have also been informed and understand that to prove invalidity of a dependent claim, the prior art must clearly and convincingly disclose each limitation of the dependent claim, as well as each limitation of each other claim from which the claim depends.

33. I have been informed and understand that the examiner at the USPTO is presumed to have reviewed and understood all prior art of record during the prosecution of a patent.

b. Anticipation

34. I have been informed and understand that a patent claim is invalid if it is “anticipated” by prior art. I have been informed and understand that proof of anticipation requires a finding that a single prior art reference, device, or method discloses each limitation of the claim at issue, either expressly or inherently. I have been informed and understand that a limitation is inherently disclosed by a prior art reference if the reference must necessarily function in accordance with, or include, the limitation in the context of patented technology.

35. I have been informed and understand that a patent claim is anticipated if there is clear and convincing evidence that, before the date of the claimed invention, the invention set forth in the claim was known or used by others in the United States; described in a patent published anywhere in the world; described in a printed publication anywhere in the world; or described in a patent application filed in the United States, as long as the USPTO ultimately published the application and/or granted it as a U.S. patent.

36. I have also been informed and understand that a patent claim is anticipated if there is clear and convincing evidence that, more than one year before the filing date of the patent, the

claimed invention was in public use or on sale in the United States; patented anywhere in the world; or described in a printed publication anywhere in the world.

37. I have been informed and understand that material not explicitly contained in a single prior art document may still be considered for purposes of anticipation if that material is incorporated by reference into the document. I have been informed and understand that multiple documents describing a single prior art system may be considered together for purposes of anticipation by that system.

c. Obviousness

38. I have been informed and understand that a patent claim is invalid if it would have been obvious to a person of ordinary skill in the art at the time of the claimed invention. I have been further informed and understand that a claimed invention is not patentable if differences between it and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the pertinent art. I have been informed and understand that factors relevant to the determination of obviousness include the scope and content of the prior art, the level of ordinary skill in the art at the time of the invention, differences between the claimed invention and the prior art, and “secondary considerations” or objective indicia of non-obviousness.

39. I have been informed and understand that a single reference alone can render a patent claim obvious, if any differences between the reference and the claim would have been known or obvious to a person of ordinary skill in the art at the time of the alleged invention. That is, if the person of ordinary skill could have adapted the reference to meet the claims of the patent by applying known concepts to achieve expected results, then the patent claims are rendered obvious by that reference.

40. I have been informed and understand that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I have been further informed and understand that when a patent claim simply arranges old elements with each performing the same function it had been known to perform, and yields no more than one of ordinary skill would expect from such an arrangement, the combination is obvious.

41. I have been informed and understand that a patent claim composed of several limitations is not obvious merely because each limitation was independently known in the prior art. Hindsight reasoning is not an appropriate basis for combining references to form an obviousness combination. I have been further informed and understand that it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine multiple prior art references.

d. Secondary Considerations

42. I have been informed that various “secondary considerations” (sometimes referred to as objective indicia of non-obviousness) may support a determination of non-obviousness and that such secondary considerations must be considered as part of an obviousness analysis. I have been informed that even strong evidence of secondary considerations may not be sufficient to rebut a strong showing of obviousness. I have been informed that the patentee bears the burden of showing the existence and effect of secondary considerations of non-obviousness, after which the burden of coming forward with rebuttal evidence shifts to the party arguing obviousness.

43. I have been informed that the following secondary considerations may indicate non-obviousness:

- Commercial success: a showing of commercial success for products that practice the patent.

- Copying: evidence that others, including the accused infringer, copied the patented invention.
- Long-standing problem or need: evidence of a persistent problem or need in the art that was resolved by the patented invention.
- Prior failure: evidence that others have tried and failed to solve the problem or failed to provide the need resolved by the claimed invention.
- Commercial acquiescence of competitors: the willingness of industry to license the patent at issue.
- Skepticism: evidence that those of ordinary skill in the art were skeptical as to the merits of the invention, or even taught away.
- Praise: evidence of praise directed to an invention by others in the field.
- Unexpected results: evidence that those of ordinary skill in the art were surprised by the capabilities of the claimed invention.

44. I have also been informed that the near-simultaneous invention by others can be evidence that a claimed invention is obvious. I have further been informed and understand that the patentee bears the burden of showing a “nexus” between the claimed invention and the evidence proffered on secondary considerations (*e.g.*, proof of commercial success of a product that practices the claimed invention is not enough; there must be evidence that the commercial success resulted, at least in part, from the claimed invention).

e. On-Sale Bar (§102(b))

45. I have been informed and understand that a patent claim is invalid if the claimed invention was “on sale in this country, more than one year prior to the date of the application for patent in the United States.” I have been informed that the “on-sale bar” applies when two conditions are satisfied before the critical date (*i.e.*, one year before the priority filing date). First, the product must be the subject of a commercial offer for sale. I have been informed that the “offer for sale” prong requires the application of traditional contract law principles.

46. Second, the invention must be ready for patenting. I am informed that this requirement may be satisfied by proof of reduction to practice before the critical date or by proof that prior to the critical date the inventor had prepared drawings or other descriptions of the invention that were sufficiently specific to enable a person skilled in the art to practice the invention. I have been informed that subsequent completion of an invention after the critical date does not relate back to the date of an earlier offer of sale.

f. Public Use Bar (§102(b))

47. I have been informed and understand that a patent claim is invalid if the claimed invention was “in public use ... in this country, more than one year prior to the date of the application for patent in the United States.” I have been informed that the “public use bar,” like the “on sale bar,” requires that the claimed invention be ready for patenting prior to the critical date. I have been informed that whether a use is “public” is a highly fact dependent analysis that depends on such factors as confidentiality restrictions, the existence of non-disclosure agreements, the number of people involved, the nature of the activity, the extent to which the use of the product informs an observer about the features of the claimed invention, confidentiality obligations imposed on members of the public who observed the use, and whether some or all of the invention was maintained as proprietary, confidential, and/or trade secret.

48. I have been informed that there is not a *per se* threshold on the number of people who must observe use of the invention to make such a use “public.” I have been informed, however, that a greater number of people make a determination of publicity more likely and that a use involving only a small number of people makes such use less likely to be “public.”

g. Prior Use/Knowledge (§102(a))

49. I have been informed and understand that a patent claim is invalid if the claimed invention “was known or used by others in this country ... before the invention thereof by the

applicant for patent.” I have been informed that, to be invalidating, the knowledge or use must be accessible to the public and that similar factors to those identified above for the §102(b) “public use bar” are to be considered when evaluating public accessibility under §102(a).

h. Prior Invention (§102(g)(2))

50. I have been informed and understand that a patent claim is invalid if, before the patentee’s conception of the claimed invention, “the invention was made in this country by another inventor who had not abandoned, suppressed, or concealed it” and that “[i]n determining priority of invention ... there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.”

51. I have been informed that an invention is not “made” until there has been both conception and reduction to practice. I have been informed that conception requires an inventor to form in his or her mind a definite and particular idea of a complete and operative invention, including every feature of the claim at issue. I have been informed that only people, not companies, can “conceive” of an invention for purposes of § 102(g)(2). I have been informed that conception is incomplete where there is only a general goal or research plan to pursue or where a series of experimental failures suggest the idea is not yet definite or achievable. I have been informed that conception cannot be established without corroborating evidence beyond the alleged prior inventor’s testimony.

52. I have been informed that there are two types of reduction to practice: actual reduction to practice (*e.g.*, when all the limitations of the claimed invention are embodied in a physical or tangible form that has been sufficiently tested to demonstrate it works for its intended purpose) and constructive reduction to practice (*e.g.*, by the filing of a patent application).

53. I have been informed that the critical period for diligence for a first conceiver but second reducer to practice begins not at the time of conception of the first conceiver but just prior to the entry in the field of the party who was first to reduce to practice and continues until the first conceiver reduces to practice. I have been informed that reasonable diligence must be shown in the United States.

54. I have been informed that for an invention to have been “made in this country,” it is necessary that the work constituting the reduction to practice must be performed in the United States.

i. Derivation (§102(f))

55. I have been informed and understand that a patent claim is invalid if the named inventor “did not himself invent the subject matter sought to be patented.”

56. I have further been informed and understand that to establish derivation for purposes of §102(f), one must establish both prior “conception” of the invention by another and “communication” of that conception to the patentee.

57. As noted above, I have been informed that “conception” is the formation in the mind of the inventor of a definite and permanent idea of a complete and operative invention. I have also been informed and understand that the “communication” must be sufficient to enable one of ordinary skill in the art to make the patented invention.

j. Indefiniteness

58. I have been informed and understand that a patent claim is indefinite, and thus invalid, if the claim (when viewed in light of the specification and prosecution history) fails to inform those skilled in the art about the scope of the invention with “reasonable certainty.” I have also been informed and understand that a patent must be precise enough to afford clear notice of what is claimed, so that the public is apprised of what is still open to them.

59. I have been informed and understand that the Supreme Court recently ruled that a claim is not definite merely because it may be amenable to construction and is not insolubly ambiguous, and emphasized that the definiteness requirement mandates clarity.

3. Level of Ordinary Skill in the Art

60. I have been informed and understand that the level of ordinary skill in the relevant art at the time of the invention is relevant to inquiries such as the meaning of claim terms, the meaning of disclosures found in the prior art, and the reasons one of ordinary skill in the art may have for combining references.

61. I have been informed and understand that factors that may be considered in determining the level of ordinary skill include: (1) the education of the inventor; (2) the type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) education level of active workers in the relevant field. I have been further informed and understand that a person of ordinary skill in the art is also a person of ordinary creativity.

62. In my opinion, based on the materials and information I have reviewed, and on my knowledge and experience in the technical areas relevant to the '748 and '212 Patents, the person of ordinary skill in the art would have had either a Bachelor's degree in electrical engineering or a similar degree, with at least three to four years of experience in wireless communication technology or other communication-related technology, or a Master's degree in electrical engineering or a similar degree, with at least two years of experience in wireless communication technology or other communication-related technology. I was at all relevant times a person of (at least) ordinary skill in the art relevant to the '748 and '212 Patents.

4. Priority Date

63. I have been informed and understand that a U.S. patent may claim “priority” to the filing date of one or more earlier filed applications. I have been informed that the “effective filing date” is the earliest priority date to which a claim is entitled and that such date is relevant for determining what qualifies as prior art. I understand that a claim must have written description support in the application(s) to which it claims priority to be entitled to an earlier effective filing date. I have been informed that the priority date determination is done on a claim-by-claim basis and that claims in the same patent may have different priority dates.

D. Summary of Opinions

64. After examining the Asserted Claims, specifications, and file histories of the ’748 and ’212 Patents, and materials constituting or relating to the prior art, I have concluded that each of the Asserted Claims is invalid as anticipated and/or rendered obvious by the prior art. The reasons for these conclusions are set forth in more detail below. These conclusions are based upon my understanding of the Asserted Claims, taking into account the Court’s claim constructions, the prior art, the knowledge of one of ordinary skill in the art at the relevant time, and my education and experience.

65. In Section III, I provide an overview of the relevant technology and the state of the art at the time of the alleged inventions of the ’748 and ’212 Patents, including the prior art that serves as the basis for my invalidity opinions. In Section V, I provide a summary of the Asserted Patents.

66. In Sections VI through XIV, I analyze the Asserted Claims of the ’748 Patent and explain why each element is disclosed by each prior art product, reference, or combination of references. In Sections XV through XXXV, I do the same for the Asserted Claims of the ’212

Patent. I expect to testify concerning the process I undertook in arriving at the opinions expressed herein.

67. For purposes of this Report, I have been asked to assume by counsel for Defendants that the priority date for all Asserted Claims is December 15, 2000. I understand that Adaptix's 30(b)(6) witness confirmed that Adaptix does not contend that the conception and reduction to practice of any claimed invention in the '212 or '748 patents occurred earlier than December 15, 2000, the filing date of the application that led to the '748 Patent. (Deposition of Curtis Dodd, Mar. 20, 2014 ("Dodd Dep.") at 66.)

68. I further understand that Adaptix's 30(b)(6) witness testified that Adaptix is unaware of any documents regarding the conception of the inventions claimed in the '212 or '748 patents, or any documents from before December 15, 2000 regarding any actual reduction to practice of the inventions claimed in the '212 or '748 patents. (*Id.* at 67-68.)

69. I also understand that Adaptix's 30(b)(6) witness testified that Adaptix has no specific information about how the named inventors got the ideas for what is described in the '212 or '748 patents, and that Adaptix is unaware of any information regarding whether the inventors reduced to practice any of the inventions claimed in the '212 or '748 patents prior to December 15, 2000. (*Id.* at 70-71.)

III. TECHNOLOGY BACKGROUND AND STATE OF THE ART

70. If asked to testify at trial in this matter, I may provide a tutorial concerning certain technology relevant to the '748 and '212 Patents, including the matters set forth in this Report. For purposes of any such tutorial, I may use demonstratives, such as charts, overheads, videos, computer graphics, samples, and other visual or audio aids, and may address the topics below, as well as other basic aspects of wireless communications, cellular telephony, mobile phones,

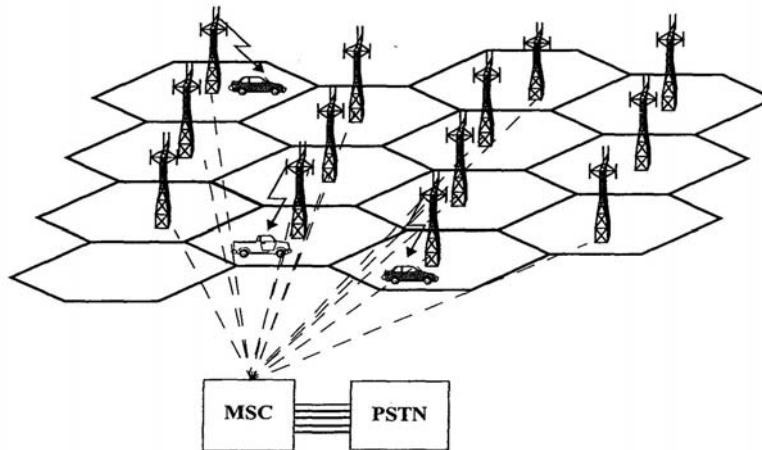
smartphones, and other communication devices. Any such tutorial may also address any technical issues that Adaptix's expert(s) raise in expert reports.

71. The discussion below provides a brief overview of wireless communications and the state of the art at the priority date of the Asserted Patents.

A. Cellular Networks and Methods for Multiple Access

72. A digital communication system is a means of conveying a sequence of binary digits – 1s and 0s, also known as bits – from one place (the transmitter) to another place (the receiver). This is useful because most modern electronic devices such as computers and cell phones use bits to represent information. For instance, a mobile phone encodes the speech spoken into its microphone and the “clicks” entered onto its keypad or touchscreen as a sequence of 1s and 0s, which it then transmits to the closest cell tower.

73. In a cellular system for mobile communications, a geographic area is broken into “cells,” and a “base station” is assigned to each cell to communicate (via radio) with the mobile units in that cell. The figure below shows a representative overview of a cellular system circa 1996. Here, each of the base stations (represented by a cell tower) communicates with both the mobile devices (represented by cars) and the Mobile Switching Center (MSC), which in turn provides connectivity to the Public Switched Telephone Network (PSTN). (Figure from “Wireless Communications: Principles and Practice,” T. Rappaport, Prentice Hall, 1996.)



74. Cellular systems have been operating in the U.S. for more than 30 years. The Advanced Mobile Phone System (AMPS) was an analog (non-digital) system first deployed in Chicago in 1983. The 1990's saw a conversion to "2nd Generation" (2G) digital technology – in which the transmitted signal represents a sequence of 1's and 0's – and 2G was followed by "3rd Generation" (3G) rollouts in the early 2000s. The ongoing deployment of LTE (Long Term Evolution) mobile communications represents the so-called "Fourth Generation" (4G) of cellular technology.

75. To enable many different mobile devices and base stations to share the same radio environment, some form of "multiple access" must be employed in a cellular system. A multiple access scheme is a means of creating many different communication channels – a "communication channel" being a means or "path" over which data can be transmitted – and allocating those channels to different transmitter/receiver pairs in a way that keeps their interference with one another to an acceptable level. Among the multiple access schemes that have been used in 2G and 3G cellular systems are these:

- Frequency division multiple access (FDMA) – A technique by which different channels are created by assigning non-overlapping spectral allocations (frequencies) to different transmitter/receiver pairs, much like the way different commercial FM radio stations in the same geographic area are assigned non-overlapping "slices" of the radio spectrum.

- Time division multiple access (TDMA) – A technique by which different channels are created by assigning different intervals in time, allowing different transmitter/receiver pairs to “take turns” making use of the transmission medium.
- Code division multiple access (CDMA) – A technique by which different channels are created through the use of spreading codes – *i.e.*, each channel is associated with a unique fixed-length sequence of +1 and -1-valued pulses, each such sequence (or spreading code) being “toggled” positively or negatively to convey logical 1’s and 0’s. These sequences are jointly designed in a way that minimizes (or eliminates) the interference that transmission over each such channel presents to the others.

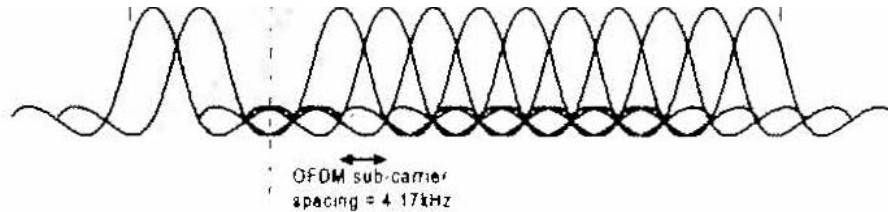
76. Each of the 2G and 3G cellular standards developed over the last 25 years required a multiple access protocol; these have included combinations of FDMA, TDMA, and CDMA. For example, in the original Global System for Mobile (GSM) 2G European standard, the spectrum was divided into multiple non-overlapping 200 kHz radio channels (FDMA), and each radio channel could accommodate up to eight subscribers via TDMA. *See, e.g.*, GSM 05.01 version 6.1.1 Release 1997, Section 5.

77. Although not new, a different multiple access protocol – orthogonal frequency division multiple access (OFDMA) – is used in 4G technology. OFDMA is coupled to the transmission technology known as orthogonal frequency division multiplexing (OFDM), and to understand OFDMA requires understanding OFDM.

78. In an OFDM system, the transmitted signal conveys data distributed across multiple modulated “sub-carriers,” each such sub-carrier being a signal component centered at a particular frequency. In an OFDM transmission system, these sub-carriers are permitted to “overlap” with one another in the frequency domain – although the overlapping is done in a carefully specified way that maintains the sub-carriers’ orthogonality. (Here, “orthogonality” is a mathematical relationship between the modulated sub-carriers that allows each to carry data without interfering with the other sub-carriers, even though their spectral (frequency) representations overlap.) The net effect is an efficient implementation of multiple “bit pipes” –

i.e., multiple independent means of communicating bits (1's and 0's) from the transmitter to the receiver, one “bit pipe” for each sub-carrier.

79. Below is a figure from UMTS 30.06 v. 3.0.0 (“UMTS UTRA Concept Evaluation”) that shows how subcarriers are arranged across the frequency spectrum in an OFDM transmission system. The spacing between subcarriers in this example is 4.17 kHz.



80. OFDM as a transmission technology has several advantages in a wireless environment. Because high-speed data is distributed over multiple sub-carriers, the data assigned to each individual sub-carrier is communicated at a much slower rate, allowing it to be recovered using relatively simple (and inexpensive) means; this follows from the orthogonality of the sub-carriers, which (as noted above) permits each sub-carrier to operate as an independent “bit pipe.” Moreover, by spreading data across multiple sub-carriers and adding redundancy in the form of an error control code, an OFDM system provides an effective means of ameliorating frequency-selective fading – a phenomenon in which signal components at particular frequencies are reduced (or even eliminated) relative to components at other frequencies. If one sub-carrier is faded, the reliable data on the other sub-carriers enables the error control code to recover the data transmitted on the faded sub-carrier.

81. OFDMA is a technique through which a communication system employing OFDM transmission technology can share the transmission medium among multiple different users. Specifically, in OFDMA, different users are allocated different sets of sub-carriers at any given time—*i.e.*, allocations are made in the “time/frequency grid.” So, for example, if a base

station in a cellular system employing OFDMA wishes to transmit data to (say) 50 different mobile phones using (say) 1250 sub-carriers spaced 15 kHz apart, then the base station transmits a signal occupying $1250 \times 15,000 = 18.75$ MHz of spectrum, and those 1250 sub-carriers are allocated by the base station among the 50 different users. For example, a “fair” base station might use 25 sub-carriers to carry information to each user, and since 25 sub-carriers/user times 50 users yields 1250 sub-carriers, such an allocation would make use of all of the sub-carriers the base station has available. Of course, other assignments are possible – for instance, assigning more sub-carriers to users requiring high data rate services (such as video), while assigning fewer sub-carriers to users requiring only speech services. [REDACTED]

[REDACTED]

[REDACTED]

B. Channel Measurements and Resource Allocation

82. It is self-evident that, when a mobile unit – also referred to as a “mobile station” (MS) or “user equipment” (UE) or a subscriber unit – is allocated a channel with which to communicate with the base station (BS), the quality of that channel should meet certain minimal requirements. For example, in a voice call, the speech quality is important, while for data communications, maintaining an acceptable level of data integrity is important. Thus, in virtually any channel allocation scheme certain measurements of channel quality are taken prior to allocation and those measurements play a role in determining which channels are allocated to which mobile units.

83. In assigning downlink (base-to-mobile) channels, what is important is the quality perceived at the mobile unit. Therefore, downlink channel allocation schemes typically require some kind of measurement made at the mobile unit, followed by feedback in the form of a report

of those measurements transmitted back to the base station; then, the base station, having received feedback from one or more mobile units, assigns downlink channels to the mobile units requiring an assignment. These steps — measure-report-assign — are found in virtually every cellular system ever deployed in at least two contexts: they occur at start-up, when a mobile unit turns on and receives its initial assignment of resources, and they occur in the context of a handover, when a mobile unit changes its connection to the network, either through the same base station (“intra-cell handover”) or through a different base station (“inter-cell handover”).

84. Each of the cellular telephone systems developed over the past 30 years (whether first generation, second generation (2G), third generation (3G), or fourth generation (4G)) have required a similar protocol of measure-report-assign. For example, in the second-generation GSM cellular system, the following description is included:

The overall handover process is implemented in the MS [mobile station], BSS [base station subsystem] and MSC [mobile switching center]. Measurement of radio subsystem downlink performance and signal strengths received from surrounding cells, is made in the MS. These measurements are signalled to the BSS for assessment. The BSS measures the uplink performance for the MS being served and also assesses the signal strength of interference on its idle traffic channels. Initial assessment of the measurements in conjunction with defined thresholds and handover strategy may be performed in the BSS. Assessment requiring measurement results from other BTS or other information resident in the MSC, may be performed in the MSC.

ETSI 300 911, “Digital Cellular Telecommunications System (Phase 2+); Radio Subsystem Link Control,” at 9, June 1998 (GSM 05.08 version 5.6.1).

85. Similarly, in the second-generation IS-95 system:

The mobile station searches for pilots on the current CDMA frequency assignment to detect the presence of CDMA Channels and to measure their strengths. When the mobile station detects a pilot of sufficient strength that is not associated with any of the Forward Traffic Channels assigned to it, it sends a Pilot Strength Measurement Message to the base station. The base station can then assign a Forward Traffic Channel associated with that pilot to the mobile station and direct the mobile station to perform a handoff.

TIA/EIA/IS-95-A, “Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System,” at 6-171, May 1995 (DOC0018293).

86. While the process of measure-report-assign occurs naturally in the context of start-up or inter-cell handoffs, the dynamic assignment of channels – allocating and de-allocating channels to users to accommodate transmission conditions and user demand – is a technique with more general applications. For instance, in U.S. Patent No. 5,491,837 (“Method and System for Channel Allocation Using Power Control and Mobile-Assisted Handover Measurements”) filed in March 1994 (“Haartsen ’837”), inventor Haartsen proposes:

a method for dynamically allocating channels in a communication system which maximizes system capacity while minimizing the transmitted power of the mobile radiotelephones. It is a further object of the present invention to take advantage of measurements made by the mobile radiotelephone in determining link quality.

(Haartsen ’837 at 3:35-41.)

87. This process of measure-report-assign is naturally applied in the context of an OFDM/OFDMA system. At any point in time, a user is allocated (via the OFDMA protocol) some subset of the sub-carriers for data transmission; by monitoring the channel quality associated with the sub-carriers, the mobile unit can provide the base station with an ongoing indication of which sub-carrier channels it “prefers” and the base station can, in turn, make assignments based on the feedback it receives and also on system demand. This approach – often called dynamic channel assignment (DCA) or dynamic packet assignment (DPA) – enables the allocation to be optimized on an ongoing basis, and not just on the time scale of handovers.

88. An example of DCA in the context of OFDMA is provided by the German patent DE 198 00 953 C 1 (“Method and Wireless Communication System for Allocating Wireless Resources to a Wireless Interface”) by Ritter (“Ritter”). The Ritter patent application was filed in January 1998, and it describes the same measure-report-assign process described above –

albeit specifically in the context of OFDM/OFDMA and applying the process to clusters of sub-carriers that it refers to as a “segment.” See Ritter at 2 (“Thus a number of subcarriers and therefore a segment of a frequency spectrum may be allocated for the communication connection between base station and mobile station.”).

89. Here is how Ritter proposes this process be carried out:

The method and wireless communication system in accordance with the invention result from an OFDMA multicarrier method and the use of a number of subcarriers (oc), which are allocated for communication connection between a base station (BS) and a mobile station (MS), and comprises the following steps:

- o Measurement of the quality of various segments (S...) of the frequency spectrum by each mobile station (MS),
- o Determination of at least one segment (Sx..Sa...Sm...) preferred for its own communication connection by each mobile station (MS) and transmission of a corresponding message to the base station (BS),
- o Evaluation of the information received from the mobile station (MS) by the base station (BS) and allocation of a segment (Sx, Sa, Sm) for the respective communication connection to each mobile station (MS) depending on the evaluation,
- o Transmission of a message about the allocated segment (Sx, Sa, Sm) to each mobile station (MS) by the base station (BS).

Ritter at 1.

90. Similarly, in the late 1990s, Justin Chuang and Nelson Sollenberger of AT&T Laboratories published a series of papers and patents disclosing an OFDM/OFDMA system employing dynamic channel assignment as a successor to the then-emerging 3G cellular standards. Notably, in their paper “Wideband Wireless Data Access Based on OFDM and Dynamic Packet Assignment,” published in the Proceedings of the 1999 Wireless Communications and Networking Conference (the “Sollenberger Article”), Chuang and Sollenberger proposed such a system with the same measure-report-assign process described above:

The basic protocol for a downlink comprises four steps: (1) a packet page from a base station to a terminal; (2) *rapid* measurements of resource usage by a terminal using the *parallelism* of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with *each* radio resource; and (4) selection of resources by the base and transmission of the data.

(Sollenberger Article at 758-759.) Here, steps (2), (3), and (4) comprise the measure-report-assign process that has been used so widely in the context of cellular systems for decades.

C. Formats for Measurement Reporting

91. When a mobile station sends measurement data back to the base station, it must do so in a format specified in the system standards; this is required to ensure that the measurements are interpreted correctly at the base station.

92. There are two broad approaches to measurement reporting that have both been practiced in the standards:

- The channels for which measurements are reported – and the order in which they are reported – are established prior to the actual reporting. In this way, each reported measurement need not be accompanied by an identifier or index to indicate the channel that is being reported; the channel is identified by its position within the list of measurements.
- The channels being reported on and/or the order in which their measurements are reported are not established prior to the actual reporting. Under this scenario, it is required that each measurement be accompanied by an indicator or index that identifies the channel to which the measurement applies.

93. The relative benefit of these two approaches depends on the kinds of measurements being made – *e.g.*, how often the list changes, how often the measured values change, how much it “costs” to send the identifier information, etc.

94. As an example in the context of cellular communications, in the second-generation IS-95A standards, there are two protocols for reporting measurement results that illustrate the two different approaches described above.

95. The “Power Measurement Report Message” is a message sent from the mobile station to the base station, and it is described on p. 6-230 of the IS-95A standard. The format for the Power Measurement Report Message is shown below.

6.7.2.3.2.6 Power Measurement Report Message

When the mobile station sends a *Power Measurement Report Message*, it shall use the following variable-length message format:

Field	Length (bits)
MSG_TYPE ('00000110')	8
ACK_SEQ	3
MSG_SEQ	3
ACK_REQ	1
ENCRYPTION	2
ERRORS_DETECTED	5
PWR_MEAS_FRAMES	10
LAST_HDM_SEQ	2
NUM_PILOTS	4
NUM_PILOTS occurrences of the following field:	
PILOT_STRENGTH	6
RESERVED	0 - 7 (as needed)

96. It is seen that, while the number of measurements included in the message is indicated in a message field (NUM_PILOTS), there is nothing to indicate which pilots are being reported on; each PILOT_STRENGTH field contains only a six-bit number containing the number $-2 \times 10 \times \log_{10}[PS]$, where “PS is the strength of the pilot, measured as specified in 6.6.6.2.2.”

97. So how does the base station know how to interpret these measurements – *i.e.*, how does it know which pilots they refer to? The IS-95A standard explains:

The mobile station shall include one occurrence of this field [PILOT_STRENGTH] for each pilot in the Active Set. If the Active Set contains more than one pilot, the mobile station shall include the pilot strengths in the same order as in the Handoff Direction Message that determined the current Active Set. (emphasis added.)

98. So the order of the reported measurements is specified by an earlier message – in this case the “Handoff Direction Message” – making unnecessary the inclusion of indices or indicators that identify the reported-upon pilots.

99. In contrast, the “Pilot Strength Measurement Message” is described on p. 6-228 of the IS-95A standard. It, also, is a message sent from the mobile station to the base station, and it reports measurements taken with regard to the pilots in the Active Set and pilots in the Candidate Set. The format of the Pilot Strength Measurement Message is described below.

6.7.2.3.2.5 Pilot Strength Measurement Message

When the mobile station sends a *Pilot Strength Measurement Message*, it shall use the following variable-length message format:

Field	Length (bits)
MSG_TYPE ('00000101')	8
ACK_SEQ	3
MSG_SEQ	3
ACK_REQ	1
ENCRYPTION	2
REF_PN	9
PILOT_STRENGTH	6
KEEP	1
Zero or more occurrences of the following record:	
PILOT_PN_PHASE	15
PILOT_STRENGTH	6
KEEP	1
RESERVED	0 - 7 (as needed)

100. For the Pilot Strength Measurement Message, we see that each PILOT_STRENGTH field containing measurement data is preceded by an identifier – the first identifier being REF_PN and the others being PILOT_PN_PHASE. In each case, “PN” refers to the pseudo-noise sequence that is used to scramble the transmitted signal at each base station; while all the base stations use the same PN sequence for scrambling, the sequences transmitted by base stations in the same geographic are offset from one another – *i.e.*, they have a different “phase” – and it is that phase that identifies the base station.

101. So in the Pilot Strength Measurement Message, the first measurement reported is for the pilot associated with the base station identified by the REF_PN field, described as follows:

The mobile station shall set this field [REF_PN] to the PN sequence offset of the pilot used by the mobile station to derive its time reference, relative to the zero offset PN sequence in units of 64 PN chips.

See IS-95A at 6-228.

102. The other measurements are associated with the pilots identified in the PILOT_PN_PHASE fields, described as follows:

The mobile station shall set this field [PILOT_PN_PHASE] to the phase of the pilot PN sequence relative to the zero offset pilot PN sequence of this pilot, in units of one PN chip, as specified in 6.6.6.2.4.

See IS-95A at 6-229.

103. It is therefore seen that the Pilot Strength Measurement Message includes with each measured value it reports an index or indicator that identifies the pilot it is reporting on. This is in contrast to the Power Measurement Report Message, which includes no such index or indicator to identify the reported-upon pilots but rather relies on the order established by the previously-transmitted Handoff Direction Message.

IV. OVERVIEW OF PRIOR ART REFERENCES

104. In this section, I provide an overview of the four primary references and two of the secondary references. This prior art includes patents, technical articles, and functioning systems.

A. Ritter

105. Gerhard Ritter is listed as the sole inventor of German patent DE 198 00 953 C 1 (“Ritter”), entitled, “Method and Wireless Communication System for Allocating Wireless Resources to a Wireless Interface.” The Ritter application was filed January 13, 1998, and the

patent was published July 29, 1999. Thus, Ritter constitutes prior art with respect to the asserted patents under 102(a) and (b). (See Ritter, DOC0018152 – DOC0018164.) Ritter is art of record in the file histories of the '748 and '212 Patents.

106. The abstract of Ritter states:

The method and wireless communication system in accordance with the invention result from an OFDMA multicarrier method and the use of a number of subcarriers (oc), which are allocated for communication connection between a base station (BS) and a mobile station (MS), and comprises the following steps:

- Measurement of the quality of various segments (S...) of the frequency spectrum by each mobile station (MS),
- Determination of at least one segment (Sx..Sa...Sm...) preferred for its own communication connection by each mobile station (MS) and transmission of a corresponding message to the base station (BS),
- Evaluation of the information received from the mobile station (MS) by the base station (BS) and allocation of a segment (Sx, Sa, Sm) for the respective communication connection to each mobile station (MS) depending on the evaluation,
- Transmission of a message about the allocated segment (Sx, Sa, Sm) to each mobile station (MS) by the base station (BS).

(Ritter, Abstract.)

107. Thus, Ritter discloses the “measure-report-assign” steps referenced in the “Technology Background” section. The first of the four above steps requires that each mobile station measure the quality of the available downlink channels, while the second step requires that the mobile station issue a report to the base station about its measurements. And finally, the third and fourth steps require that the base station assign a channel to the mobile station and inform the mobile station about that allocation.

108. Ritter explicitly describes its transmission technology as OFDM and its multiple access technology as OFDMA. Moreover, Ritter uses the term “segment of a frequency

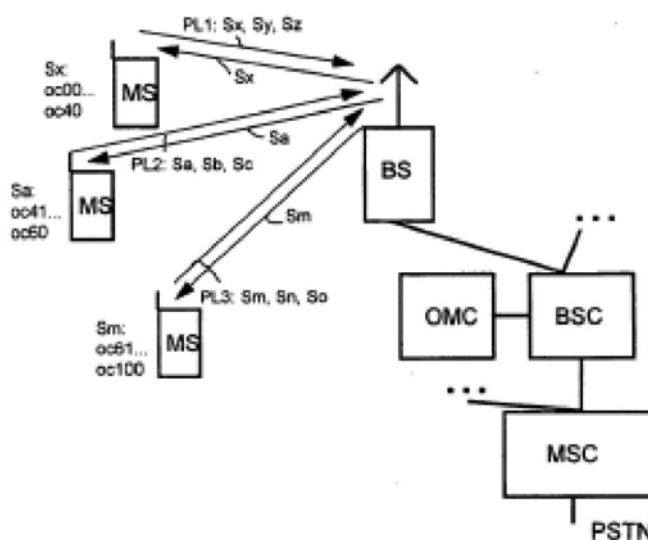
spectrum” – or more succinctly, “segment” – to refer to the subcarriers that are allocated to establish channels between the base station and the various mobile units.

Thus a number of subcarriers and therefore a segment of a frequency spectrum may be allocated for the communication connection between base station and mobile station.

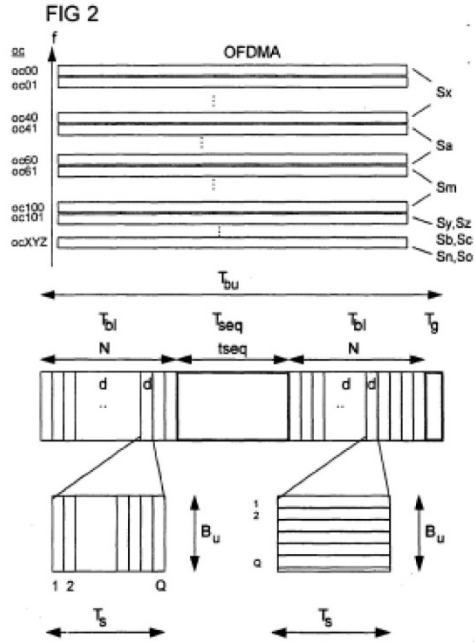
(Ritter at 2.)

109. An embodiment of Ritter is illustrated in Figure 1, reproduced below. In this illustration, three mobile stations (designated “MS”) are in communication with a base station (“BS”). The base station provides connectivity with the public switched telephone network (PSTN) via a base station controller (BSC) and a mobile switching center (MSC).

FIG 1



110. In the system illustrated above, the labels that begin with “S” – i.e., Sx, Sy, Sz, Sa, Sb, Sc, Sm, Sn, and So – refer to spectral segments corresponding to a set of sub-carriers in an OFDMA system. This is shown in Figure 2 (reproduced below), in which segment Sx refers to sub-carriers oc00 through oc40, while segment Sa refers to sub-carriers oc41 through oc60, and Segment Sm refers to sub-carriers oc61 through oc100.



111. Referring again to Figure 1, Ritter discloses an embodiment in which each mobile station “determines at least one segment preferably suitable for its own communication connection and transmits a corresponding message to the base station BS.” Ritter, at 3. In the example illustrated by Figure 1, the first mobile station identifies three “suitable” segments – segments S_x and S_y and S_z – and it transmits a message indicating as much to the base station:

In the present example the first mobile station finds a segment S_x with the subcarriers $oc00 \dots oc40$ as the segment most suitable for it. In addition it determines S_y , S_z as additional segments preferably suitable for its own communication connection. Messages regarding the segments S_x , S_y , S_z are entered into a priority list $PL1$, numbered according to their suitability for the communication connection, and sent to the base station BS .

(Ritter at 3.)

112. This same process of identifying (or “selecting”) suitable segments is applied to the other two mobile stations in the example illustrated by Figure 1:

In a similar manner, the second mobile station establishes a segment Sa with the subcarriers oc41...oc60 as the most suitable segment for it. In addition it determines segments Sb, Sc as additional segments preferred for its own communication connection. Messages about the segments Sa, Sb, Sc are entered

into a priority list PL2, numbered according to their suitability for the communication connection, and likewise transmitted to the base station BS.

The third mobile station MS served by the base station BS also determines a segment Sm with the subcarriers oc61...oc100 as the segment best suited for its communication connection. In addition it enters segments Sn, So as additional segments preferably suited for its own communication connection in a priority list PL3. The messages regarding these three segments Sm, Sn, So, which are numbered corresponding to their suitability for the communication connection in the priority list PL3, are likewise subsequently sent by it [the mobile station] to the base station BS.

(Ritter at 3-4.)

113. The base station, having now received reports from the three mobile stations in its coverage area, uses that information (and other information it has available to it) to assign segments to mobile stations. This is done by transmitting an appropriate message to each mobile station.

The base station BS evaluates all of the information received from the mobile stations MS and, depending on the evaluation of each mobile station, allocates a segment for the respective communication connection. The base station sends a message regarding the respectively allocated segment to each mobile station. In the present example it is assumed that each mobile station MS can have the most suitable segment that it desires allocated to it. This also depends on the transmission conditions and/or the load on the wireless cell served by the base station BS according to specifications of the operation and maintenance center OMC or the base station control BSC for wireless resource management. Thus the first mobile station MS receives the segment Sx, the second mobile station MS the section Sa and the third mobile station MS the segment Sm, in each case with the corresponding OFDMA subcarriers co... allocated by the base station.

(Ritter at 4.)

B. The Sollenberger Publications

114. Nelson Sollenberger and Justin (Che-I) Chuang were employed as researchers at AT&T Laboratories in Holmdel, NJ in the late 1990s. In that role, they investigated methods for increasing data rates in cellular networks beyond what was being developed in the context of so-called “3G” systems.

115. Two pieces of prior art authored by Sollenberger that are particularly relevant to the patents in suit are these:

- U.S. Patent No. 6,052,594, Justin Che-I Chuang and Nelson Ray Sollenberger, “System and Method for Dynamically Assigning Channels for Wireless Packet Communications,” filed April 30, 1997, issued April 18, 2000 (the “Sollenberger Patent”); and
- J. Chuang and N. Sollenberger, “Wideband Wireless Data Access Based on OFDM and Dynamic Packet Access,” Proceedings of the 1999 Wireless Communications & Networking Conference, September 21, 1999 (the “Sollenberger Article”)

116. The Sollenberger Patent constitutes prior art with respect to the Asserted Patents under at least §102(a). The Sollenberger Article paper constitutes prior art with respect to the Asserted Patents under at least §102(b). The Sollenberger Patent is art of record in the file histories of the ’748 and ’212 Patents. The Sollenberger Article is not art of record in the file histories of the ’748 and ’212 Patents, although a similar publication by Sollenberger is.

117. The abstract of the Sollenberger Patent reads in part:

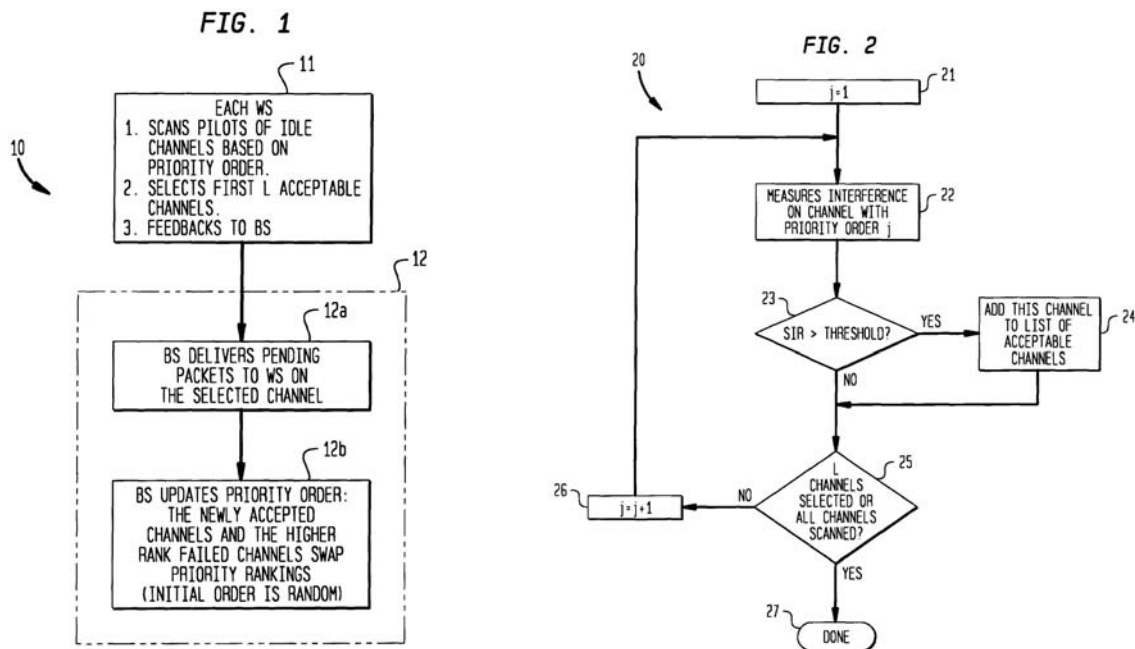
A method and system for controlling media access in which a paging message is transmitted from a base station to a wireless station when a data packet is received for downlink transmission to the wireless station ... In response to the paging message, a level of each of a plurality of pilot frequency signals is detected at the wireless station. Each pilot frequency corresponds to a downlink traffic channel and is transmitted by base stations to which the downlink traffic channel is assigned. The wireless station generates a list of preferred traffic channels based on a priority order of traffic channels and on detected levels of the pilot frequency signals, and transmits the list to the associated base station. A downlink traffic channel is assigned for downlink transmitting the received data packet to the wireless station based on the list of preferred traffic channels and updates a channel priority order list at the base station.

(Sollenberger Patent, Abstract.)

118. It is thus seen that the Sollenberger Patent discloses the “measure-report-assign” steps referenced in the “Technology Background” section: The “level” – meaning signal strength – of a pilot signal corresponding to a downlink channel is measured, and then a report

describing “a list of preferred traffic channels” is generated at the wireless station and transmitted to the base station, and finally the base station assigns a downlink channel to that wireless station.

119. Figures 1 and 2 from the Sollenberger Patent (reproduced below) illustrate the basic steps that are disclosed.



120. Figure 1 indicates that each WS (“wireless station”) scans pilots of unassigned (“idle”) channels in “priority order” and selects the first L channels that are “acceptable,” providing feedback on those L channels to the base station. Armed with that information, the base station then selects a channel and delivers the pending data packets to the selected channel, at which point the base station – having made an assignment that may affect the priority with which future channels are assigned – updates its priority list.

121. Figure 2 provides an example of how the scanning process could be executed at the wireless station. The wireless station considers the idle channels in priority order and checks whether each one, in turn, has a signal-to-interference ratio (SIR) that exceeds a particular

threshold; this threshold would be chosen to provide the required quality of service to the wireless station. Each channel with an SIR that exceeds the threshold is added to a list of “acceptable” channels; this process continues until either L acceptable channels have been identified or no more channels are available for scanning.

122. The purpose of establishing (and updating) a list in “priority order” is to enable the base station to “learn” the better channels over time and prioritize those channels over poorer channels during subsequent scans; once a channel has been deemed “acceptable” during a scan, it will likely remain “acceptable” during the next scan – assuming it is not assigned for use by the base station – and so it should be prioritized over other channels that were not deemed acceptable. The basic principle is this: When “looking” for good channels, one should “look” where good channels have already been found.

123. The Sollenberger Patent discloses a broad range of transmission and multiple access technologies. To provide context relating to the kind of interference mitigation provided by the Sollenberger Patent, the inventors reference GSM systems with TDMA technology (Sollenberger Patent at 2:16-31) as well as Cellular Digital Packet Data (CDPD) systems employing Carrier Sense Multiple Access/Collision Detection (CSMA/CD) (Sollenberger Patent at 3:65-4:16) and OFDM (Sollenberger Patent at 2:47-58).

124. In contrast, the Sollenberger Article focuses on OFDM and OFDMA technologies:

In this paper, we consider OFDM to overcome physical layer barriers for attaining high bit-rates, and we consider DPA [dynamic packet assignment] to enable aggressive packet access with high spectrum efficiency.

(Sollenberger Article at 757.)

125. Here, “dynamic packet access” is the term used in both the Sollenberger Article and the Sollenberger Patent (collectively, the “Sollenberger Publications”) to describe the

ongoing assignment (and reassignment) of channels to users based on measurements taken at the mobile station. The Sollenberger Article specifically suggests “OFDM based physical-layer techniques and DPA based medium access control (MAC) techniques for realizing the proposed wideband OFDM system” (Sollenberger Article at 757), indicating that the two techniques are complementary:

Interference avoidance or dynamic channel assignment (DCA) has been used in some systems, but generally as a means of automatic channel assignment or local capacity enhancement. Some of the reasons for not fully exploiting the large potential capacity gain of DCA are the difficulties introduced by rapid channel reassignment and intensive receiver measurements required by a high performance DCA algorithm. OFDM is promising in overcoming these challenging implementation issues. To achieve the potential of DCA gain, channel reassignments must take place at high-speed to avoid rapidly changing interference. Dynamic Packet Assignment (DPA) based on properties of an OFDM physical layer is proposed which reassigns transmission resources on a packet by packet basis using high-speed receiver measurements to overcome these problems. Having orthogonal subchannels well defined in time-frequency grids, OFDM has a key advantage here with the ability to rapidly measure interference or path loss parameters *in parallel* on all candidate channels, either directly or based on pilot tones.

(Sollenberger Article at 758.)

126. The proposed method of “reassign[ing] transmission resources on a packet by packet basis” using OFDM subchannels “well defined in time-frequency grids” is OFDMA. The Sollenberger Article proposes a specific OFDMA structure with these properties:

- The transmitted OFDM signal occupies 4.224 MHz composed of 528 sub-carriers spaced 8 kHz apart.
- The 528 sub-carriers are organized into 22 clusters, each cluster containing 24 sub-carriers and occupying 192 kHz.
- In time, each OFDM symbol has a duration of 125 μ s, and there is a guard band of 31.25 μ s between OFDM symbols, meaning that OFDM symbols are transmitted every 156.25 μ s. Thus an OFDM frame of 128 consecutive OFDM symbols lasts for 20.0 ms.
- The 20.0 ms frame is broken into 24 OFDM symbols containing signaling (overhead) information and 104 data-bearing OFDM symbols; moreover, the

104 data-bearing symbols are broken into eight time slots of 13 OFDM symbols each.

(Sollenberger Article at 759.)

127. The resulting time/frequency structure is shown in Figures 1 and 2 from the Sollenberger Article, reproduced below.

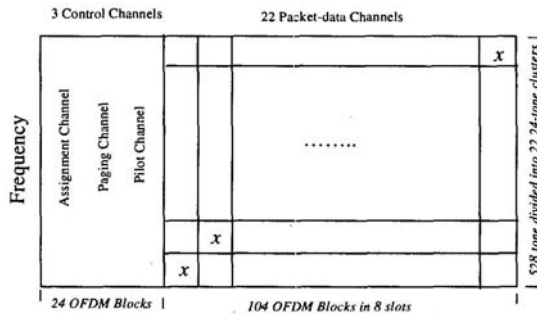


Figure 1. Division of radio resources in time and frequency domains to allow DPA for high peak-rate data services

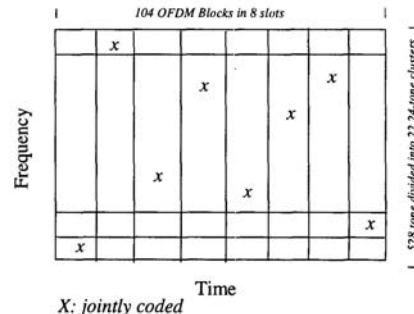


Figure 2. Coding of radio resource with clustered OFDM and frequency hopping in a frame

128. Figure 1 shows an exemplary arrangement of the time/frequency grid proposed in the Sollenberger Article. What follows is a description of Figure 1, taken from the Sollenberger Article:

The control channel functions are defined in [3]. This allows flexibility in channel assignment while providing 24 blocks of control overhead to perform the DPA procedures. Each tone-cluster would contain 22 individual modulation tones plus 2 guard tones. Of the 13 OFDM blocks in each traffic slot, two blocks are used as overhead, including a leading block for synchronization and a trailing block as guard time for separating consecutive time slots. A single radio resource is associated with a frequency-hopping pattern, by which the packets are transmitted using 8 different tone clusters in each of the 8 traffic slots.

(Sollenberger Article at 759)

129. Figure 2 illustrates how such a hopping pattern can be defined by specifying eight time/frequency units in each 20.0 ms frame. Each unit consists of a cluster of 24 tones in the frequency domain and 13 OFDM intervals (2.03125 ms) in the time domain, and each frequency-hopping pattern provides access to eight such units per 20.0 ms frame.

Coding across 8 traffic slots for user data, as shown in Figure 2, exploits frequency diversity which gives sufficient coding gain for performance

enhancement in the fading channel. This arrangement supports 22 resources in frequency that can be assigned by DPA. Taking into account overhead for OFDM block guard time, synchronization, slot separation and DPA control, a peak data-rate of 2.1296 (3.3792x 22/24 x 11/13 x 104/128) Mb/s is available for packet data [sic] services using all 22 radio resources, each of 96.8 kb/s.

(Sollenberger Article at 759.) The Sollenberger Article further explains that “[u]p to 20 users can be simultaneously assigned, one resource each, using different hopping patterns that are free from collisions.” (Sollenberger Article at 758.)

130. The Sollenberger Article reference, like the Sollenberger Patent, includes a clear description of the “measure-report-assign” steps described above and in the “Technology Background” section of this Report:

The basic protocol for a downlink comprises four basic steps: (1) a packet page from a base station to a terminal; (2) rapid measurements of resource usage by a terminal using the *parallelism* of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with *each* radio resource; and (4) selection of resources by the base and transmission of the data.”

(Sollenberger Article at 758-759.) Here, steps (2), (3), and (4) reflect the measure-report-assign process.

C. Project Angel System

1. Introduction

131. The Project Angel system was an OFDMA wireless communication system developed by AT&T Wireless in the mid-1990s through the early 2000s. [REDACTED]

[REDACTED]

[REDACTED]

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137. Thus, the Project Angel system is prior art under at least §102(a) because the invention was “known or used by others in [the United States]” prior to the alleged invention of the Asserted Patents and §102(b) because the Project Angel system was “in public use or on sale in this country, more than one year prior to the date of the application” for the Asserted Patents.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

2. Technical Documentation and Summary

138. [REDACTED]

[REDACTED]

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139. [REDACTED]

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[REDACTED]

[REDACTED] I have

been informed by counsel for Defendants and understand that it is appropriate to rely on more than one document describing a single system for purposes of anticipation analysis under §102(a) (prior use and knowledge) and §102(b) (on-sale and public use bars) based on that prior art system. Additional documents describing various aspects of the Project Angel system include:

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

140. [REDACTED]

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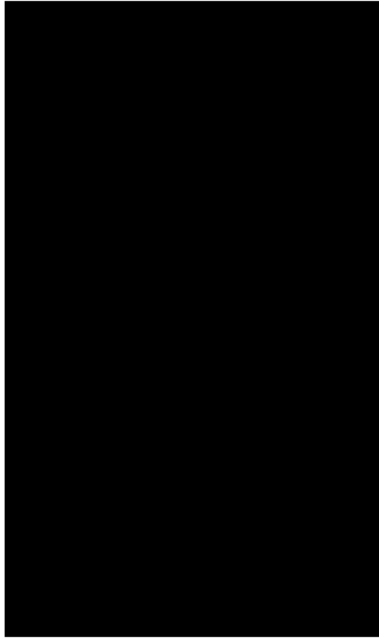
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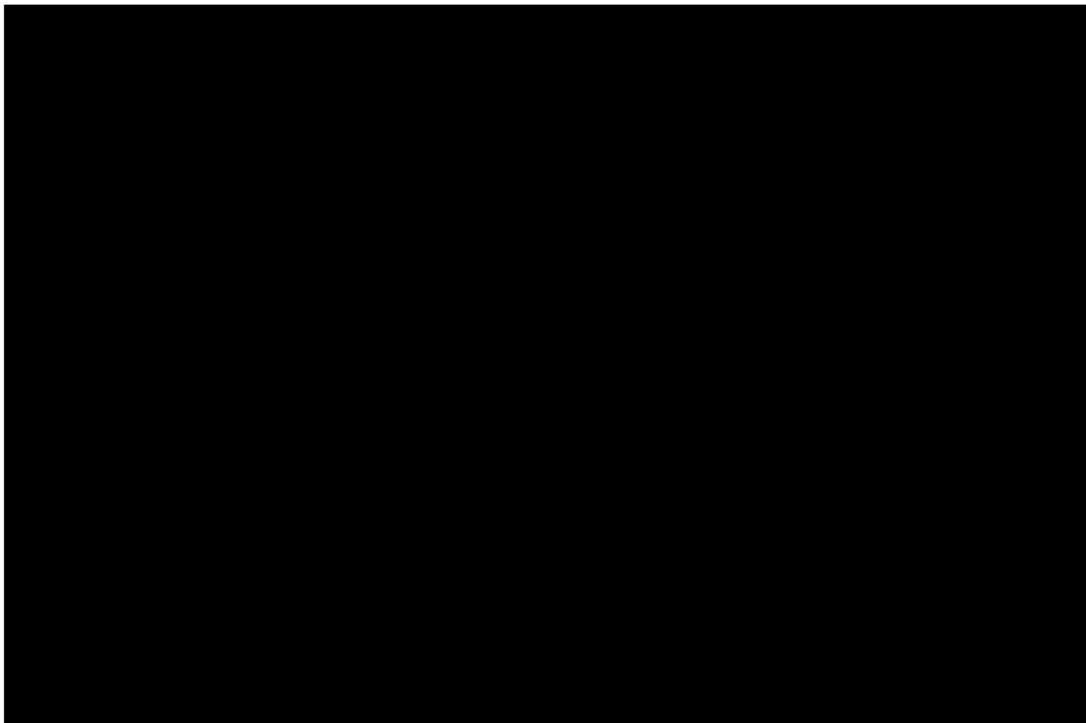
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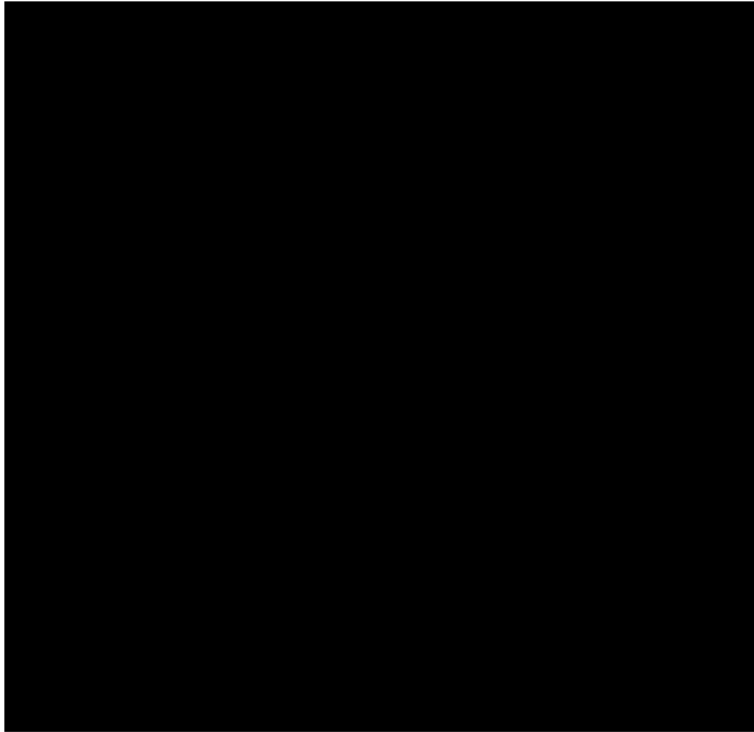
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**3. Development of the Project Angel System Development and Facts
Relating to the Invalidity of the Asserted Patents**

156. As set forth on a claim-by-claim basis below, the Project Angel system is invalidating prior art to the Asserted Claims of the '748 Patent under §102(a) and §102(b). The Project Angel system anticipates and/or renders obvious each of the Asserted Claims of the '748 and '212 Patents. The following additional facts relate to my analysis of the Project Angel System.

a. On-Sale Bar (§102(b))

157. Both the '748 and '212 Patents have a priority filing date of December 15, 2000. I understand that the §102(b) critical date is one year earlier, December 15, 1999. The Project

Angel system (including both voice and data services) was on sale in the United States no later than fall 1999, prior to the critical date of December 15, 1999. Specifically, following years of work developing proof of concept systems, prototypes units, and data characterization trials, voice and data service using the Project Angel system was offered for sale and sold to paying customers in the Dallas, TX market no later than September of 1999. [REDACTED]

[REDACTED]

[REDACTED]

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A horizontal bar chart consisting of 20 black bars of varying lengths. The bars are arranged vertically. The lengths of the bars vary significantly, with some being very short and others nearly spanning the width of the chart area. There are several bars that start with a gap from the left edge, indicating zero or missing values for those categories. The bars are solid black and have no labels or titles.

[REDACTED]

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in interest, Broadstorm. I have been informed that those documents include [REDACTED]
[REDACTED]. I have also been informed that Broadstorm is the original
assignee of the asserted '212 and '748 patents.

As noted above, the technical details of AT&T's Project Angel system are found in a variety of
documents, including [REDACTED]. As further
noted above, [REDACTED] pre-date the December 15,
2000 priority dates of the asserted '212 and '748 patents.

165. I understand that beginning at least as early as April 2000, Dr. Hui Liu, a named
inventor of the '212 and '748 patents, began communicating with and recruiting AT&T
engineers to Broadstorm, including Project Angel engineers Messrs. Jim Hite, Pal Meiyappan
and Liang Hong. [REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

166. I have further been informed by counsel for Defendants that Adaptix has not
preserved and produced metadata associated with documents relating to Broadstorm's conduct in
obtaining, possessing, and using Project Angel materials. I have been informed that discovery is
ongoing in this matter. Accordingly, I reserve the right to provide an opinion regarding whether
the patented subject matter of the '212 and '748 patents is derived from Project Angel materials,
upon consideration of any further discovery or testimony or other evidence, including any issues
raised by Adaptix experts, or based upon interpretations of any claim term different from those
proposed in this Report.

167. Thus, although in my opinion limitations of at least the Asserted Claims are disclosed by the [REDACTED], an additional basis for invalidity (*i.e.*, derivation) may exist with respect to the Asserted Claims. Therefore, I reserve the right to provide an opinion regarding whether the patented subject matter of the '212 and '748 patents is derived from Project Angel to the extent additional facts relevant to this issue are discovered (including any issues raised by Adaptix experts, or based upon interpretations of any claim term different from those proposed in this Report).

e. Prior Invention (§102(g)(2))

168. As noted above, the Project Angel system was an OFDMA wireless communication system developed by AT&T Wireless in the mid-1990s through the early 2000s.

[REDACTED]

[REDACTED]

[REDACTED]

169. [REDACTED]

[REDACTED]

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175. Thus, although in my opinion, as discussed in detail below, limitations of the Asserted Claims are disclosed by [REDACTED], an additional basis for invalidity by prior invention may exist with respect to the Asserted Claims. Therefore, I reserve the right to amend or supplement my opinions, as well as the basis for my opinions, based upon the nature and content of the documentation, data, proof, and other evidence or testimony that Adaptix or its experts may present or based on any additional facts or other information provided to me in this matter.

176. I have further been informed that Adaptix did not preserve and produce metadata associated with documents relating to Broadstorm's conduct in obtaining, possessing, and using Project Angel materials. Accordingly, I reserve the right to provide an opinion regarding whether the patented subject matter of the '212 and '748 patents was "made in this country by another inventor," including by persons associated with Project Angel, upon consideration of any further discovery or testimony or other evidence, including any issues raised by Adaptix experts, or based upon interpretations of any claim term different from those proposed in this Report.

* * *

177. A timeline of several important events involving the Project Angel system is provided below. [REDACTED]

[REDACTED]

[REDACTED]

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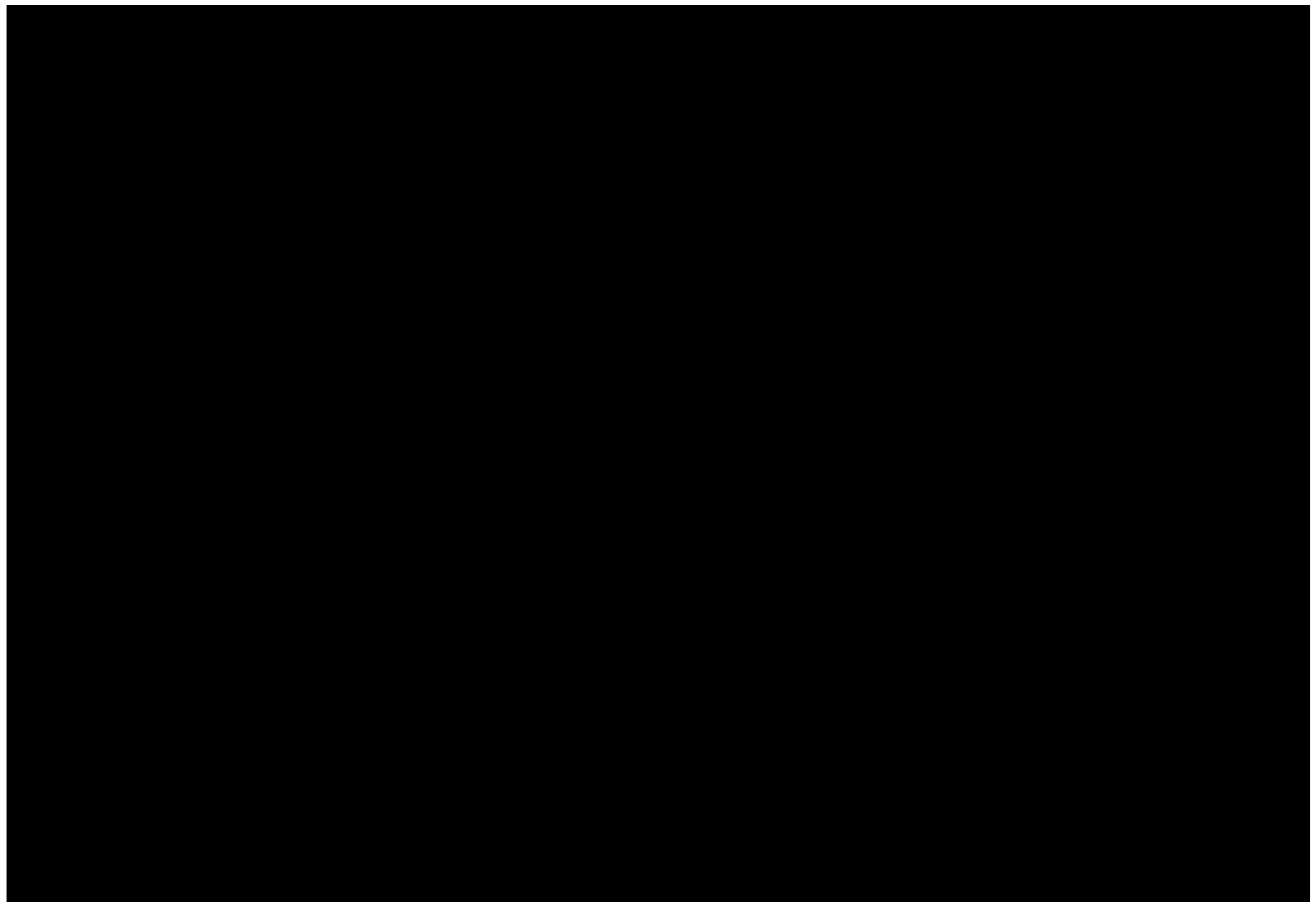
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D. U.S. Patent Nos. 6,721,569 and 6,701,129 Issued to Hashem, et al.

178. Bassam Hashem, David Steer, and Shalini Periyalwar are listed as the inventors of two patents that were filed in September 2000 and assigned to Nortel Networks Limited of St. Laurent, CA.

179. U.S. Patent No. 6,701,129 (“Hashem ’129” or “’129 Patent”) was filed on September 27, 2000 and issued on March 2, 2004. It is titled “Receiver Based Adaptive Modulation Scheme.” U.S. Patent No. 6,721,569 (“Hashem ’569” or “Hashem ’569”) was filed on September 29, 2000 (two days after the Hashem ’129 patent application) and issued April 13, 2004. It is titled “Dynamic Sub-Carrier Assignments in OFDM Systems.” Hashem ’569 incorporates by reference Hashem ’129. Hashem ’569 at 7:4-7. Both patents constitute prior art under §102(a) and (e). Neither Hashem ’569 nor the ’129 Patent are art of record in the file histories of the ’748 and ’212 Patents.

180. The abstract of Hashem ’569 describes it in part as follows:

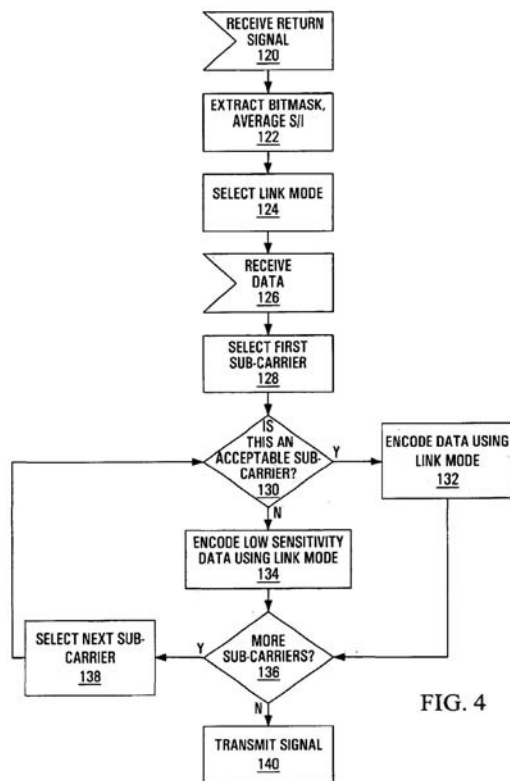
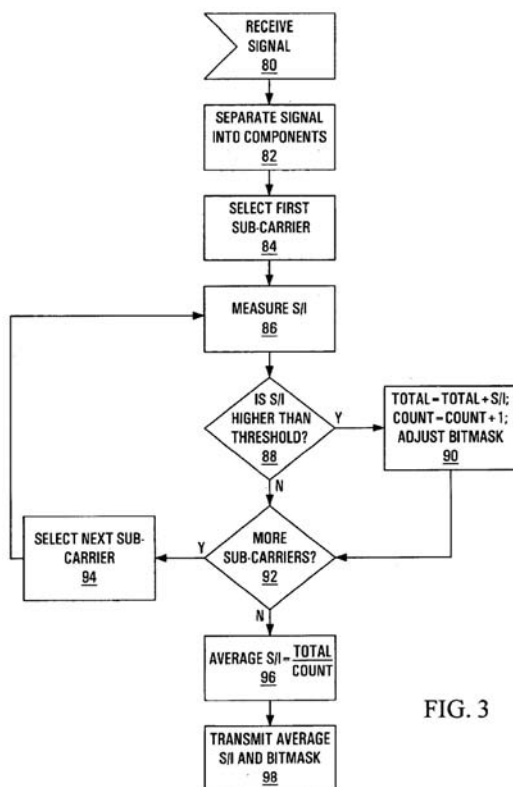
A method and apparatus are provided for selecting and signaling the identity of sub-carriers to be used for transmission of data in a radio communication system, and for using other sub-carriers. A remote unit determines which sub-carriers are acceptable for use in data transmission by comparing the signal to interference ratio of each subcarrier with a threshold. A base station transmits data over the acceptable sub-carriers at the optimum Link Mode or Link Modes.

(Hashem ’569, Abstract.)

181. More specifically, Hashem ’569 proposes a number of embodiments in which channel quality and interference measurements for OFDM sub-carriers are taken at a remote unit, and those measurements are processed to form a report that is fed back to the base station, where it is used to map data onto sub-carriers.

182. In one embodiment, that report takes the form of a “bitmask” that identifies the sub-carriers that are deemed “acceptable” – *i.e.*, that have a signal-to-interference ratio (SIR) that

exceeds some threshold value – along with the average measured SIR of the acceptable sub-carriers. The base station uses that information to map regular data onto the acceptable sub-carriers – and also map low-sensitivity (and less important) data onto the unacceptable sub-carriers. The algorithm executed by the remote unit in this embodiment is shown in Figure 3 from Hashem '569, reproduced below. Also shown below (in Figure 4 from Hashem '569) is the algorithm executed at the base station in response to the report received from the remote unit.



183. Referring to Figure 3 above, the referenced “bitmap” is a sequence of bits that identifies which sub-carriers are acceptable and which are not; in the illustrative example provided in Hashem '569, a bitmap of “111110000111” would correspond to a sequence of twelve sub-carriers, of which the first five and the last three are acceptable, while the sixth-through-ninth sub-carriers are not acceptable. (Hashem '569 at 4:62-65.)

184. Referring to Figure 4 above, the “Link Mode” refers to “a set of at least one transmission parameter, such as a modulation level, a coding rate, a symbol rate, a transmission power level, antenna directional parameters, or space-time coding parameters.” (Hashem ’569 at 4:11-15.) An appropriate link mode is determined by channel quality and may thus (in the context of Hashem ’569) be ascertained from the measurements made at the remote unit. For example, a very high average SIR among the acceptable channels indicate a very good quality channel, with little interference; such a channel may support bandwidth-efficient modulation (conveying multiple bits per transmitted symbol) and/or a high coding rate (with relatively little redundancy in the transmitted signal). In contrast, an average SIR that indicates the “acceptable” channels are just barely acceptable may require a less-efficient modulation format with more redundancy and lower coding rate.

185. Hashem ’569 discloses several variations on the embodiment described above, including these:

- A system in which sub-carrier measurements and assignments are made not on individual sub-carriers but on “groups of sub-carriers.” This is justified because “[s]ub-carriers having carrier frequencies close to each other will usually have similar channel qualities, so determining whether an entire group of sub-carriers is an acceptable group or an unacceptable group will offer a good approximation to correctly defining the individual sub-carriers as acceptable or unacceptable.” See Hashem ’569 at 8:23-29. Thus, Hashem ’569 discloses “clusters” which each have multiple sub-carriers.
- A system in which the remote unit (not the base) ascertains which link mode is appropriate for the acceptable sub-carriers. The remote unit can then send a “reference to the optimum Link Mode to the base station.” Hashem ’569 at 7:3. An efficient means of doing so is disclosed in the ’129 patent described below.
- A system in which “[a] different Link Mode can be used for each acceptable sub-carrier if the Link Modes are calculated by the remote unit and transmitted to the base station.” In this embodiment, two separate pieces of data are sent: “The sequence of numbers identifying the acceptable sub-carriers and the values by which the base station can determine the Link

Modes can be sent along the return channel separately, or can be combined....” (Hashem ’569 at 7:25-27.)

186. The ’129 patent is entitled “Receiver Based Adaptive Modulation Scheme,” and it describes a protocol through which changes in downlink OFDM transmission parameters – *i.e.*, downlink link modes – can be efficiently implemented. This is done by making measurements at the remote unit and ascertaining (at the remote unit) which link mode is appropriate; then, a signal is transmitted from the remote unit to the base that specifies the difference between the current link mode and the desired link mode, that difference enabling the base to adjust its transmission parameters using a modest investment of uplink transmission resources. As noted above, the ’129 patent is explicitly invoked in the specification of Hashem ’569 and incorporated by reference therein.

187. Figures 3 and 4 from the ’129 patent are reproduced below. They describe the algorithms carried out at the remote unit and the base station, respectively, using one of the embodiments disclosed in the ’129 patent.

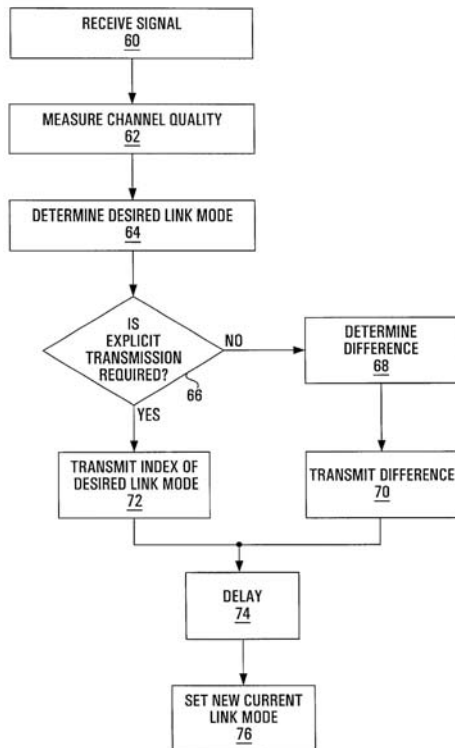


FIG. 3

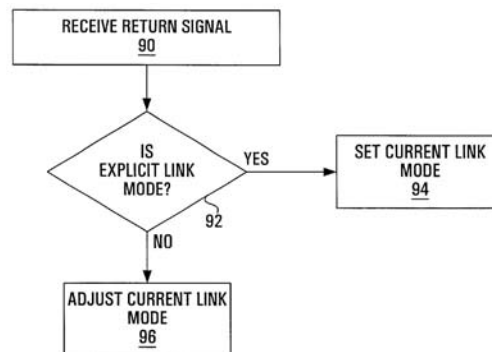


FIG. 4

188. Figure 3 discloses the remote unit measuring channel quality and determining a desired set of transmission parameters – *i.e.*, a desired link mode (LM). The remote unit then determines whether it will transmit the desired link mode explicitly – by sending an index into a table of link modes, for example – or whether it will transmit the difference between the index of the current link mode and the desired link mode. According to the specification of the ’129 patent, “[t]he decision at step 66 is based on a predefined condition, for example whether a preset multiple of transmissions have occurred. For example, the remote unit may transmit the index to the desired LM every tenth transmission.” (’129 Patent at 5:47-51.) The outcome of this decision may be indicated in a flag bit that is transmitted along with the desired link mode. (See ’129 Patent at 5:54-57.) Once the desired link mode has been communicated (either explicitly or differentially), the remote unit waits a requisite amount of time (“Delay”) until the

effect of the change has propagated to the base unit, and it then begins receiving data using the new LM.

189. The corresponding operation at the base station is shown in Figure 4 above. The base receives the update signal and first ascertains (via the transmitted flag bit) whether what was transmitted was an explicit indication of the desired LM or a differential indication. It then interprets the signal appropriately – as either an explicit index into a table of link modes or a difference between the current link mode index and that of the desired link mode – and adjusts the link mode appropriately.

190. An example of a table of link modes is provided in Figure 2 from the '129 patent, reproduced below.

S/I (dB)	MODULATION	CODING
3.1	QPSK	1/2
5.9	QPSK	3/4
7.7	QPSK	7/8
11.1	16-QAM	2/3
13.5	16-QAM	5/6
14.4	64-QAM	1/2
18.0	64-QAM	3/4
20.1	64-QAM	7/8

FIG. 2

191. This table discloses eight link modes. Each table entry indicates a modulation format and a coding rate, along with the SIR required to support that rate. For example, with an SIR of 3.1 dB or greater, it is possible to provide acceptable performance using QPSK modulation and a rate-1/2 code – *i.e.*, 1.0 data bit per transmitted symbol. By comparison, to

employ 16-QAM modulation with a rate-5/6 code – an effective rate of 3.33 data bits per transmitted symbol – requires an SIR of at least 13.5 dB.

192. To differentially encode LM table entries is to transmit the difference in the index between the current LM and the desired LM. For example, if the current downlink LM is 16-QAM with rate-2/3 coding (2.67 bits/symbol), but the SIR has deteriorated to the point where QPSK with rate-7/8 coding (1.75 bits/symbol) is desired, the remote unit would transmit “-1” as the difference, because the desired LM is one entry before the entry of the current LM. This protocol is efficient because the desired LM will tend to change slowly, so encoding changes will typically require fewer bits than encoding explicit LM indices.

193. The '129 patent explicitly discloses the use of pilot symbols transmitted from the base station to the remote unit to enable the measurement of the SIR at the remote unit.

A blinking pilot signal provides one method by which the digital signal processor 34 may determine the signal to interference ratio. The base station transmits a pilot signal on some sub-carriers, referred to as pilot sub-carriers, and regular traffic on other sub-carriers, referred to as signal sub-carriers. The base station turns the pilot signal on and off in successive symbols in one or more of the pilot sub-carriers. Referring to FIG. 5 [shown below], a method by which the digital signal processor 34 determines the signal to interference ratio of a pilot sub-carrier is shown.

('129 Patent at 7:12-21.)

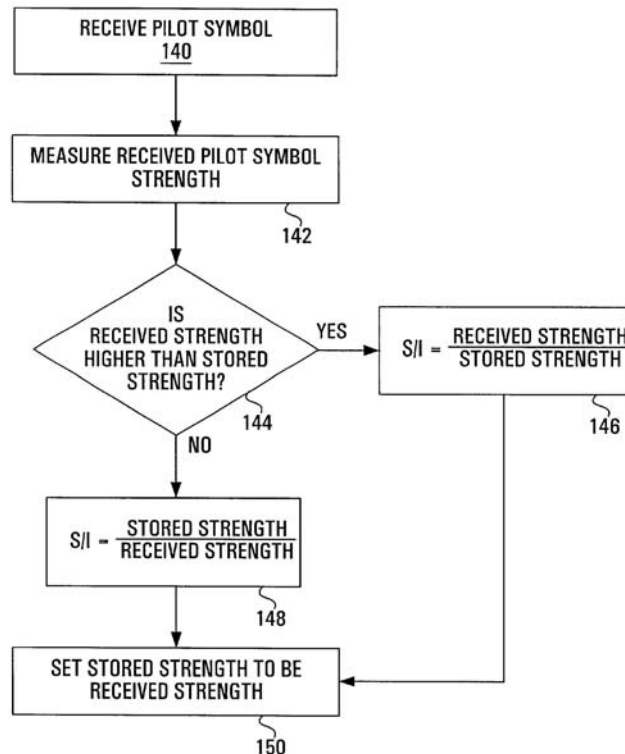


FIG. 5

194. An alternate method for measuring the SIR based on pilot symbols is described in the passage below and illustrated in Figure 6 from Hashem '129, reproduced below.

Rather than turning a pilot signal on and off in successive symbols, the base station may transmit a sequence of symbols which are turned on followed by a sequence of symbols which are turned off. The sequence of symbols which are turned on may have a different number of symbols than the sequence of symbols which are turned off. In such a case, the digital signal processor determines the signal to interference ratio using a method as shown in FIG. 6. The method of FIG. 6 is similar to that shown in FIG. 5, except that step 144 is replaced by steps 152 and 154.

('129 Patent at 7:64-8:6.)

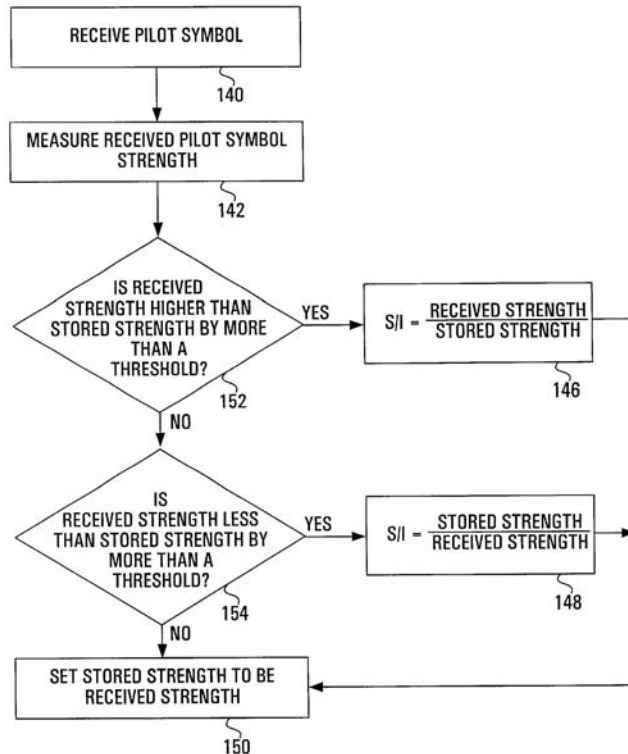


FIG. 6

E. The IS-95A Standard

195. The term “IS-95” and its variants (*e.g.*, IS-95A, IS-95B) are used to describe a second-generation cellular standard that was developed and deployed in the U.S. during the 1990s. Unlike its 2G contemporaries (IS-54 and GSM), IS-95 used Code Division Multiple Access (CDMA) to enable multiple users to share the same spectral resources. By using a combination of orthogonal Walsh sequences and pseudo-noise (PN) sequences, IS-95 systems were able to implement a “frequency reuse factor” of one – meaning that adjacent base stations could use the same frequencies at the same time when communicating with their mobile units.

196. This Report shall refer to the IS-95 elements described in the document, “Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System,” denoted TIA/EIA/IS-95-A and dated May 1995 (“IS-95A”). This document describes the radio system parameters and the call processing procedures that enable an “IS-95

compliant” mobile station to communicate with an “IS-95 compliant” base station regardless of the manufacturer of either. The IS-95A standard is not art of record in the file history of the ’748 and ’212 Patents, although certain CDMA patents and publications were considered by the examiner.

197. The IS-95A system used radio frequencies between 824 MHz and 894 MHz partitioned into radio channels 1.25 MHz wide. Each such radio channel was itself shared among multiple users via CDMA. Focusing on the downlink (or “forward”) transmission, the IS-95A architecture can be described as follows:

- Sixty-four Walsh sequences – each 64 bits long – are used to create 64 orthogonal forward channels.
 - o One “Pilot Channel”
 - o Up to one “Synch Channel”
 - o Up to seven “Paging Channels”
 - o A number of “Forward Traffic Channels” used to convey user data.
- The resulting channels, which have been “spread” to 1.2288×10^6 chips/sec, are then “scrambled” (bit-wise XORed) with a pilot PN sequence. All base stations use the same pilot PN sequence, but they differ in their “phase offset” – *i.e.*, two different base stations in the same geographic area are using different parts of the same pilot PN sequence at the same time. Thus, the pilot PN phase offset serves to identify the base station.

198. The figure below, taken from IS-95A, illustrates this architecture.

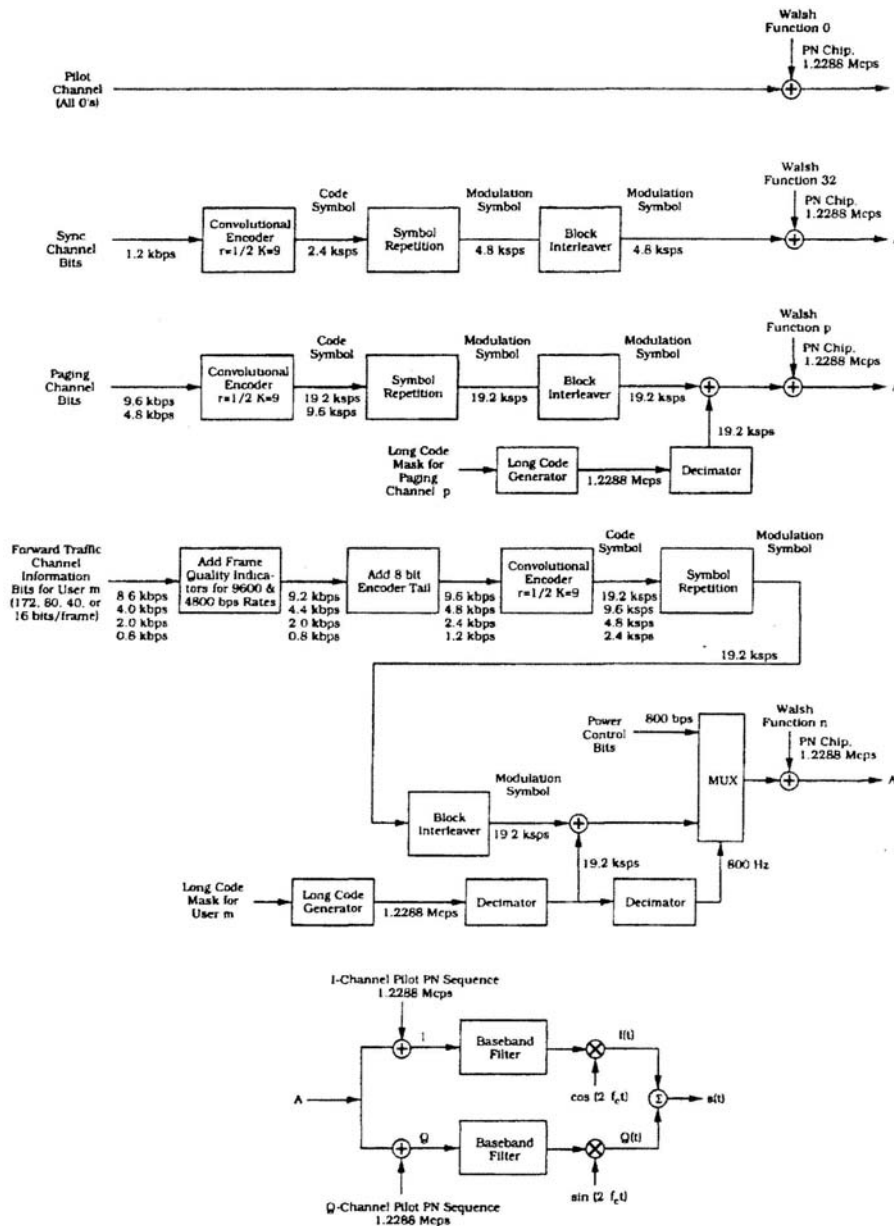


Figure 7.1.3.1-1. Forward CDMA Channel Structure

(IS-95A at 7-2.)

199. CDMA employs “soft handoffs,” in which a mobile station (MS) passes from the coverage area of one base station (BS) to another, but retains its connection to the “old” BS even as it establishes a connection with the “new” BS. Thus, in CDMA, a mobile station may be connected to multiple base stations at the same time; this is formalized in IS-95A using the term

“Active Set”: “The set of pilots associated with the CDMA Channels containing Forward Traffic Channels assigned to a particular mobile station.” (IS-95A at 1-1.)

200. While the IS-95A standard uses the term “Active Set” to identify the forward resources (channels) associated with a particular mobile station, it uses the term “Candidate Set” to identify the forward resources that could be – i.e., are good enough to be – associated with a particular mobile station. (“Candidate Set: The set of pilots that have been received with sufficient strength by the mobile station to be successfully demodulated, but have not been placed in the Active Set by the base station.”) (IS-95A at 1-3.)

201. Thus, at any given time, associated with each MS are at least these two sets: The Active Set, identifying downlink channels actively being used by the MS, and the Candidate Set, identifying potential downlink channels that could be used by the MS. The movement of channels between the Active Set and the Candidate Set constitute soft handoffs under the IS-95A standard.

202. As mentioned in the “Technology Overview” section, the IS-95A standard offers different means through which the mobile station can report forward channel quality measurements to the base station. Notably, the “Pilot Strength Measurement Message” is a message transmitted from the mobile station to each of the base stations in its Active Set that reports the strength with which the MS has received the pilots in both its Active Set and its Candidate Set:

6.7.2.3.2.5 Pilot Strength Measurement Message

When the mobile station sends a *Pilot Strength Measurement Message*, it shall use the following variable-length message format:

Field	Length (bits)
MSG_TYPE [00000101]	8
ACK_SEQ	3
MSG_SEQ	3
ACK_REQ	1
ENCRYPTION	2
REF_PN	9
PILOT_STRENGTH	6
KEEP	1
Zero or more occurrences of the following record:	
PILOT_PN_PHASE	15
PILOT_STRENGTH	6
KEEP	1
RESERVED	0 - 7 (as needed)

(IS-95A at 6-228.)

203. Among the fields that are included in the Pilot Strength Measurement Message are these:

- MESSAGE_TYPE: Setting this field to “00000101” indicates that this message is a Pilot Strength Measurement Message.
- REF_PN: This field identifies one particular pilot – the pilot used by the MS to derive its time reference. It identifies the pilot via its phase offset. (See IS-95A at 6-228.)
- PILOT_STRENGTH: This field identifies the received strength of the pilot identified in REF_PN.

204. Moreover, there is one occurrence of PILOT_PN_PHASE and one occurrence of PILOT_STRENGTH for each pilot in the Active Set and the Candidate Set – not including the pilot already reported in REF_PN and PILOT_STRENGTH above.

- PILOT_PN_PHASE: “The mobile station shall set this field to the phase of the pilot PN sequence relative to the zero offset pilot PN sequence of this pilot, in units of one PN chip, as specified in 6.6.6.2.4” (IS-95A at 6-229.)
- PILOT_STRENGTH: “The mobile station shall set this field to $2 \times 10 \times \log_{10} PS^J$, where PS is the strength of this pilot, measured as specified in 6.6.6.2.2.” (IS-95A at 6-229.)

205. The role of the Pilot Strength Measurement Message in assigning forward channels to a particular MS is simple: It is the mechanism through which the MS provides feedback to the base station, alerting the base station to the presence of strong candidates for the downlink channel. For example, IS-95A discloses:

“The mobile station searches for pilots on the current CDMA frequency assignment to detect the presence of CDMA Channels and to measure their strengths. When the mobile station detects a pilot of sufficient strength that is not associated with any of the Forward Traffic Channels assigned to it, it sends a Pilot Strength Measurement Message to the base station. The base station can then assign a Forward Traffic Channel associated with that pilot to the mobile station and direct the mobile station to perform a handoff.”

(IS-95A at 6-171; *see also* IS-95A §§ 6.6.6.2.2 and 6.6.6.2.5.2.)

F. U.S. Patent No. 5,491,837, Issued to Haartsen, et al.

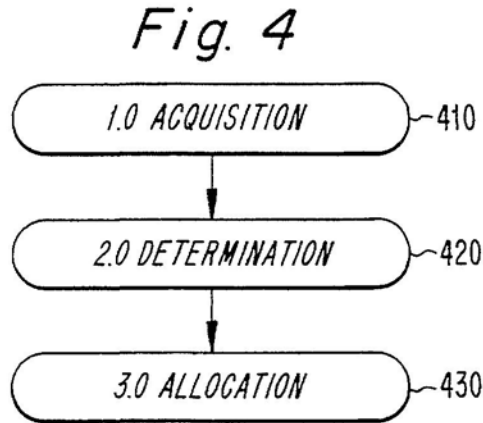
206. Jacobus Haartsen is the named inventor of U.S. Patent No. 5,491,837 (“Haartsen ’837” or “’837 Patent”) filed in March 1994 and assigned to Ericsson, Inc. of Research Triangle Park, NC. The patent’s title is “Method and System for Channel Allocation Using Power Control and Mobile-Assisted Handover Measurements,” and it constitutes prior art under §102(b).

207. The abstract of Haartsen ’837 describes it in part as follows:

A method and system for the adaptive allocation of channels within a radio communication system, specifically a cellular network, is presented. The allocation method takes advantage of measurements made by the mobile radiotelephone and allocates channels based on the carrier to interference ratio.

(Haartsen ’837, Abstract.)

208. More specifically, Haartsen ’837 proposes a three-step process through which radio channels are allocated from a pool of channels. This process is illustrated in Figure 4 from Haartsen ’837 reproduced below.

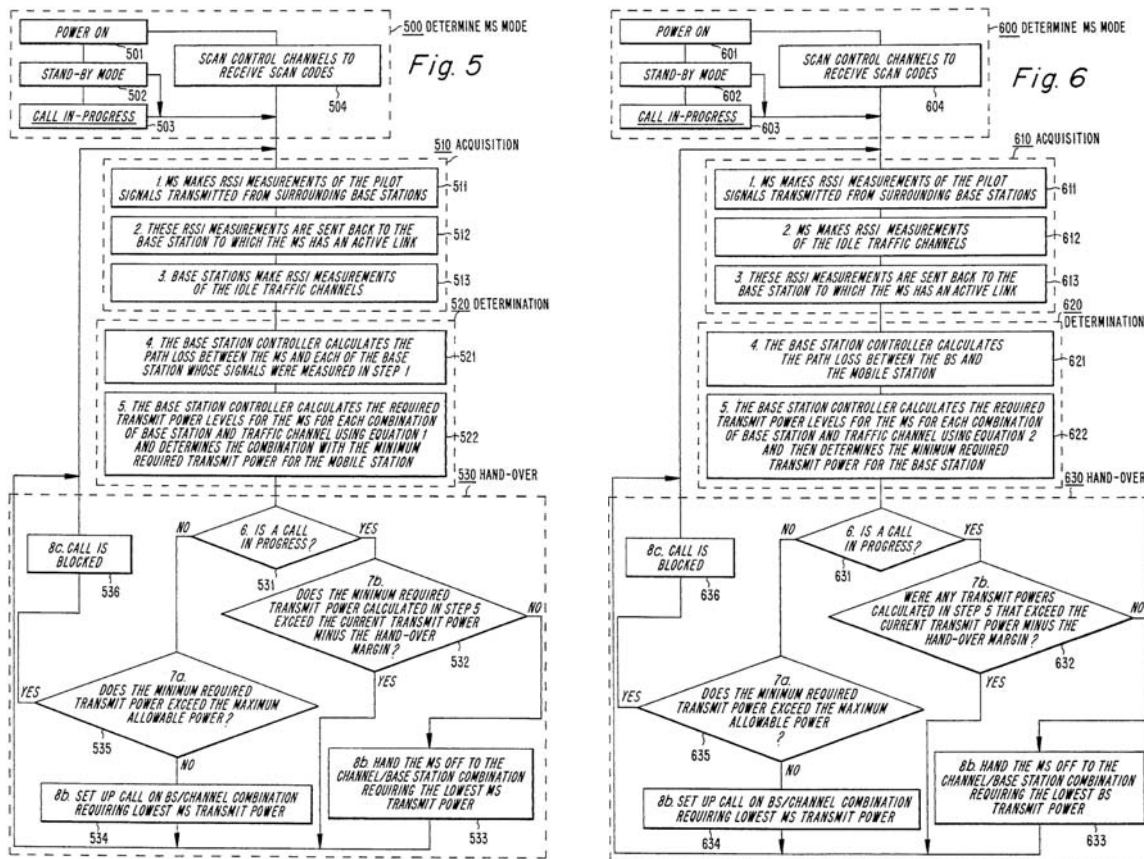


209. The first step in the process described by Haartsen '837 is the “acquisition 410 of measurement data reflecting the current conditions of the local environment.” (Haartsen '837 at 5:44-46.) This acquisition “begins with measurements of the signal power of the pilot signals broadcast from surrounding base stations.” (Haartsen '837 at 5:51-53.) This is followed by the “second acquisition phase [which] involves the measurement of RSSI on idle traffic channels (*i.e.*, the potential voice channels which may be allocated) to obtain an estimate of the interference levels.” (Haartsen '837 at 7:40-43.) These measurements – of pilot-based signal power and of interference – are then reported to the base station controller. (See Haartsen '837 at 6:66-7:4 and 7:67-8:4.)

210. The second step in the Haartsen '837 process is the “determination 420 of the most appropriate channel consistent with the measurements made during acquisition.” (Haartsen '837 at 5:47-49.) The exemplary embodiments include an example in which uplink and downlink assignments are made independently of one another, as well as another example in which uplink and downlink channels are assigned in pairs. (See Haartsen '837 at 5:6-18.)

211. The third step in the Haartsen '837 process is “channel allocation according to the predetermined criteria.” (Haartsen '837 at 54:49-50.)

212. The three steps comprising the Haartsen '837 channel allocation process are shown in Figures 5 and 6 from the patent, reproduced below. Figure 5 illustrates an exemplary embodiment of the uplink channel allocation process, while Figure 6 illustrates an exemplary embodiment of the downlink channel allocation process.



213. It should be noted that there are at least two “cut and paste” errors in Figure 6 that can be identified by referring to the corresponding text.

214. The first error is in block 622, which says: “The base station controller calculates the required transmit power levels for the MS for each combination of base station and traffic channel using equation 2 and then determines the minimum required transmit power for the base station.” (emphasis added.) However, equation 2 calculates the required transmit power for the BS, not the MS. Indeed, the error is self-evident, since Figure 6 illustrates downlink channel allocation and therefore is concerned with BS transmit power, not MS transmit power.

Moreover, in the specification Block 622 is described like this: “The base station controller then calculates the required transmit power levels for the base station for each combination of base station and traffic channel using equation (2), above, and then determines the minimum required transmit power for the base station at block 622.” (Haartsen ’837 at 11:30-34 (emphasis added).) One of ordinary skill in the art, then, would understand that the text in block 622 should read, “required transmit power for the BS.”

215. The second error is in block 634, where “requiring lowest MS transmit power...” should in fact read “requiring lowest BS transmit power...” This is again self-evident since Figure 6 illustrates downlink channel allocation, and moreover it is confirmed by the corresponding text from the specification: “If not, then the call can be set up at block 634 on the channel/base station combination which requires the lowest base station power.” (Haartsen ’837 at 11:48-50 (emphasis added).)

216. There are other elements of Haartsen ’837 that are relevant to the patents in suit.

217. First, Haartsen ’837 discloses coordination among base station controllers in making channel assignments. This is illustrated in Figure 3 from Haartsen ’837, disclosed below, which clearly shows communication between the three base station controllers (320, 330, and 340) and communication between the controllers and the MTSO (Mobile Telephone Switching Office) – and it is the MTSO that controls the acquisition part of the channel allocation process. (See Haartsen ’837 at 6:22-24.)

218. The coordination between base station controllers is called out in multiple places in Haartsen ’837. For example:

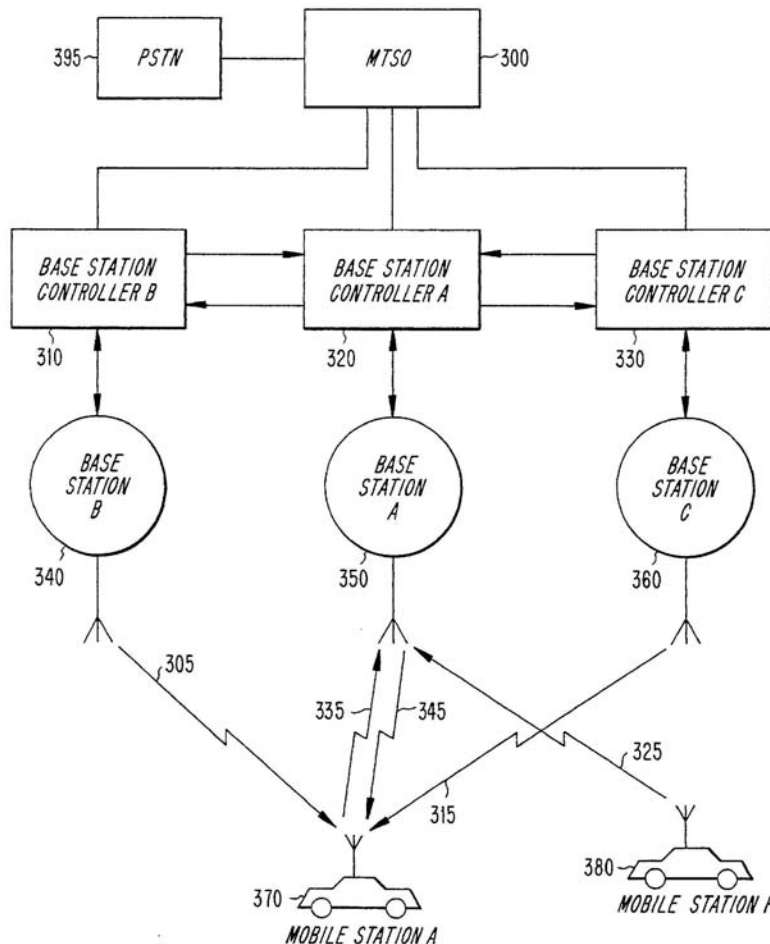
To predict the downlink interference, one should identify the base stations in a wide range around the mobile station that are transmitting on the same channel. The location of these bases and the power levels they are currently using on the considered channel must be directed to the base station controller doing the

ACAPC processing (*e.g.*, in the example of FIG. 3, this is base station controller 320.) This can be accomplished, for example, directly through the MTSO 300. Adjacent channel interference can also be included if it is corrected with the adjacent channel rejection factor.

(Haartsen '837 at 13:22-31.)

219. The specifics of this coordination are included in the algorithms illustrated in Figures 5 and 6 above, wherein the allocation and handoff processes are based on optimizing with respect to each “combination of base station and traffic channel.”

Fig. 3



220. Second, it should be noted that Haartsen '837 was motivated not only by interference issues but also by traffic load considerations:

Currently, most frequency planning is done a priori; that is a fixed frequency plan is "hard-wired" in place by each cellular system operator. This is known as fixed channel allocation, or FCA. However, as interference and traffic load are time varying, FCA is not optimal. As shown in FIG. 2(b), highways which bisect cellular boundaries may have significantly differing traffic patterns depending on location and time of day. Some roads may have significant automobile traffic in the morning and very little in the afternoon. As a result, most fixed frequency plans are not very efficient.

(Haartsen '837 at 2:2-12.)

221. Indeed, in its summary, Haartsen '837 indicates that adapting to changes in both traffic and interference patterns is fundamental to the invention:

The control scheme presented herein adapts to the current traffic and interference situation in a communication environment in order to optimize the quality of each link and maximize the overall system capacity. The status of the current traffic and interference condition is derived from measurements taken both by the mobile station and the base station.

222. Finally, it should be noted that Haartsen '837 is, in the cellular context, a relatively old patent, with a priority date of March 1994, during the early years of 2G cellular. References are made in the patent's specification to the TDMA-based IS-54B standard, which was one of the two competing 2G standards in the United States – the other being the CDMA-based IS-95 standard. However, the claim language is not specific to any standard or multiple access technology, nor are the embodiments described above.

G. U.S. Patent No. 7,072,315, Issued to Liu, et al.

223. Hui Liu, Xiadong Li, and Fuqi Mu are the named inventors of U.S. Patent No. 7,072,315 ("Liu '315" or "'315 Patent") filed in October 2000 and assigned to Adaptix, Inc. of Seattle, WA. The patent's title is "Medium Access Control for Orthogonal Frequency-Division Multiple-Access (OFDMA) Cellular Networks," and it constitutes prior art under §102(e).

Liu '315 is not art of record in the file histories of the '748 and '212 Patents.

224. The abstract of Liu '315 describes it like this:

"A method and apparatus for controlling OFDM cellular networks is describe. In one embodiment, the method comprises receiving channel characteristics and noise-plus-interference information measured at spatially distributed subscribers

and assigning traffic channels for an orthogonal frequency-division multiple-access (POFDMA) network.”

(Liu ’315, Abstract.)

225. Like the asserted patents and other prior art, Liu ’315 describes an OFDMA cellular network in which subscriber measurements are fed back to the base station and used to allocate OFDMA resources efficiently and in a way that minimizes inter-cell interference. Moreover, Liu ’315 addresses how such measurements could be used to exploit the spatial processing gain that is available at base stations employing multiple transceivers. Specifically, Liu ’315 makes this observation:

Furthermore, subscriber-initiated loading algorithms are problematic when multiple transceivers are employed as (sic) the base station, since the signal-to-noise-plus-interference (SINR) measured based on an omni-directional sounding signal does not reveal the actual quality of a particular traffic channel with spatial processing gain. In other words, a ‘bad’ traffic channel measured at the subscriber based on the omni-directional sounding signal may very well be a ‘good’ channel with proper spatial beamforming from the base station.”

(Liu ’315 at 2:14-23.)

226. Among the embodiments described in Liu ’315, then, is one in which the “multiple access control protocol controls channel information feedback from multiple subscribers to the base station, estimates spatial processing gain for both uplink... and downlink... communications, and performs joint traffic assignment.” (Liu ’315 at 4:26-31.)

227. Another embodiment in Liu ’315 discloses coordination across multiple base stations when OFDMA resources are allocated:

“In such an embodiment, in a multi-cell environment, the base station within each cell first estimates the uplink and downlink SINRs across all OFDMA traffic channels for all active and accessing subscribers. Each base station may also buffer the QoS requirements (*e.g.*, data rate, time-out, bit error rate, waiting time). Base stations in neighboring cells exchange such information before performing a traffic channel allocation jointly for multiple subscribers.”

(Liu ’315 at 6:49-57.)

228. Moreover, Liu ’315 discloses that “[t]raffic channel conditions, assignment tables, as well as QoS requirements of all accessing subscribers of

neighboring cells, may be accounted for in performing traffic channel assignment.”
(Liu ’315 at 11:37-40.)

V. SUMMARY OF THE ASSERTED PATENTS

229. The application for the ’748 Patent was filed on December 15, 2000; the application for the ’212 Patent was filed on August 8, 2005 as a continuation of the ’748 Patent. I understand that both patents are considered to have the same filing date of December 15, 2000. Moreover, both patents have the same title (“OFDMA with Adaptive Subcarrier-Cluster Configuration and Selective Loading”), the same co-inventors (Xiadong Li, Hui Liu, Kemin Li, and Wenzhong Zhang), and the same specification. The ’748 Patent issued on September 20, 2005. The ’212 Patent issued on November 18, 2008.

230. I have reviewed both the Asserted Patents and their file histories in developing an understanding of the Asserted Patents and the opinions set forth in this report. While I set forth some general observations about the Asserted Patents in this section, I may rely on any aspect of the specification or file histories as additional support for the opinions set forth herein.

A. The Specification of the Asserted Patents

231. As noted, the ’748 and the ’212 Patents share the same specification. That specification begins (in the “Background of the Invention” section) by describing the problem that the patents allegedly address:

Within one cell, the subscribers can be coordinated to have different subcarriers in OFDMA. The signals for different subscribers can be made orthogonal and there is little intracell interference. However, with aggressive frequency reuse plan, *e.g.*, the same spectrum is used for multiple neighboring cells, the problem of intercell interference arises. It is clear that the intercell interference in an OFDMA system is also frequency selective and it is advantageous to adaptively allocate the subcarriers so as to mitigate the effect of intercell interference.

(’748 Patent at 1:54-63.)

232. Each patent's "Summary of the Invention" describes the proposed solution to this problem:

A method and apparatus for subcarrier selection for systems is described. In one embodiment, the system employs orthogonal frequency division multiple access (OFDMA). In one embodiment, a method for subcarrier selection comprises a subscriber measuring channel and interference information for subcarriers based on pilot symbols received from a base station, the subscriber selecting a set of candidate subcarriers, providing feedback information on the set of candidate subcarriers to the base station, and receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber.

('748 Patent at 2:8-18.)

233. Figure 1B from the specification, reproduced below, illustrates "a flow diagram of one embodiment of a process for allocating subcarriers." ('748 Patent at 2:29-30.) Figure 1B illustrates an iterative loop in which pilot OFDM symbols are periodically transmitted and evaluated by each subscriber. The subscribers measure the Signal-to-Interference-Plus-Noise Ratios (SINRs) of the OFDMA clusters and use (in block 103) the measured SINR values to "select" one or more "candidate" cluster(s); the subscriber then transmits a report describing the "selected" clusters back to the base station, and the base station (in block 104) uses the received reports to allocate specific clusters to specific subscribers. Finally, the base station notifies each subscriber of its allocation in block 105.

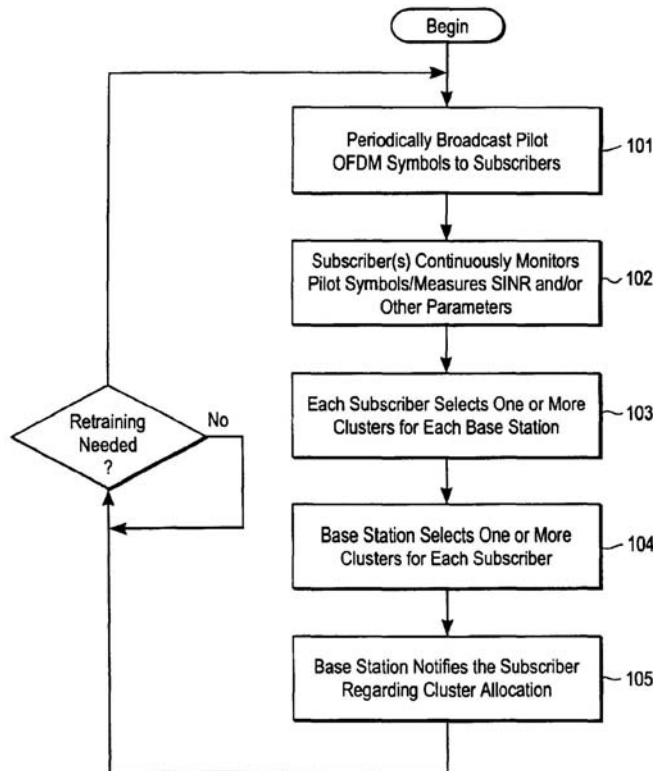


FIG. 1B

234. One example of a format that could be used by a subscriber to report its “selected” cluster(s) is provided in Figure 5, reproduced below.

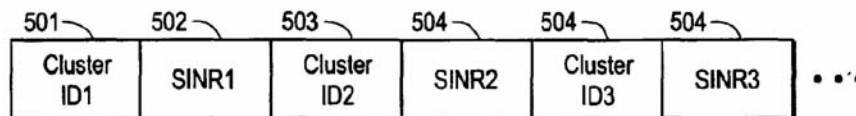


FIG. 5

235. In Figure 5, there is an SINR value associated with each cluster – *e.g.*, SINR1 is associated with the subcarrier cluster identified by Cluster ID1, while SINR2 is associated with the subcarrier cluster identified by Cluster ID2, etc. In this example, the SINR associated with a particular cluster is obtained by averaging over the subcarriers that comprise that cluster. (See '748 Patent at 10:58-59.)

236. When a base station transmits to a subscriber using one or more OFDMA cluster(s), associated with each cluster is a modulation format and an error control code; the choice of modulation and code is affected by the quality of the associated cluster – for example, by its SINR – and by a quality-of-service (QoS) constraint that must be met, such as a bit error rate (BER). In another embodiment disclosed in the specification of the asserted patents, what is fed back to the base station in the subscriber’s report is an “SINR index” that identifies the appropriate modulation/coding rate for the associated cluster: “By using an appropriate SINR indexing scheme, an SINR index may also indicate a particular coding and modulation rate that a subscriber desires to use.” (’748 Patent at 7:61-63.) Included in the specification of the asserted patents is an exemplary “coding/modulation table” (reproduced below) with seven modulation/coding combinations that provide acceptable performance at seven different SINR values:

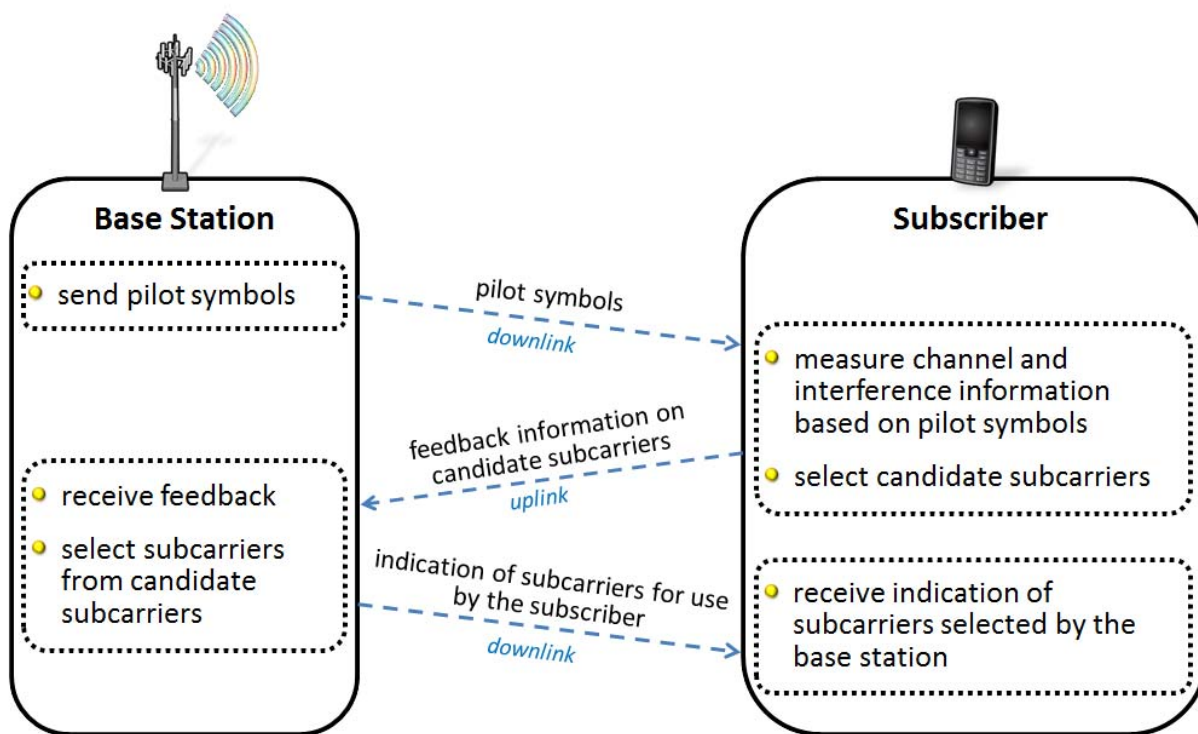
TABLE 1

Scheme	Modulation	Code Rate
0	QPSK, $\frac{1}{8}$ Spreading	$\frac{1}{2}$
1	QPSK, $\frac{1}{4}$ Spreading	$\frac{1}{2}$
2	QPSK, $\frac{1}{2}$ Spreading	$\frac{1}{2}$
3	QPSK	$\frac{1}{2}$
4	8PSK	$\frac{2}{3}$
5	16QAM	$\frac{3}{4}$
6	64QAM	$\frac{5}{6}$

B. The Claims of the Asserted Patents

237. While the Asserted Claims are analyzed individually below, it is useful to make some general observations about the nature of the Asserted Claims of the ’748 and ’212 Patents.

238. The Asserted Claims of the ’748 Patent include five independent claims – two of them method claims (6 and 8) and three of them apparatus claims (11, 19, and 21). The flow of method claim 6 is depicted graphically below:



239. The Asserted Claims of the '748 Patent also include two dependent method claims – claim 7 (which depends on 6) and claim 9 (which depends on 8) – and two dependent apparatus claims – claim 20 (which depends on claim 19) and claim 22 (which depends on claim 21).

240. There are more Asserted Claims in the '212 Patent than in the '748 Patent, but there are only two independent claims in the '212 Patent that are asserted—method claim 1 and apparatus claim 18. The primary difference between the Asserted Claims of the '212 Patent and those in the '748 Patent is that the Asserted Claims in the '212 Patent require iterative feedback and channel allocation. In other words, while the Asserted Claims of the '748 patent focus on a single allocation of subcarriers to a subscriber based on feedback received from the subscribers – as might occur when a subscriber initially connects to the network – the Asserted Claims of

the '212 Patent explicitly require “updated feedback information” that is used to allocate an “updated set of subcarriers” to the subscriber.

VI. '748 PATENT, CLAIM 6

241. Claim 6 of the '748 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 6 of the '748 Patent is reproduced below with identifiers [a], [b], [c], etc. added for ease of reference:

6. A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising:

- [a][1] a subscriber measuring channel and interference information for a plurality of subcarriers
- [a][2] based on pilot symbols received from a base station;
- [b] the subscriber selecting a set of candidate subcarriers;
- [c][1] the subscriber providing feedback information on the set of candidate subcarriers to the base station,
- [c][2] wherein providing feedback information comprises arbitrarily ordering the set of candidate of subcarriers as clusters of subcarriers, and further
- [c][3] wherein the feedback information includes an index indication of a candidate cluster with its SINR value; and
- [d] the subscriber receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber.

A. Claim 6 of the '748 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1. Introduction

242. The following analysis demonstrates claim 6 of the '748 Patent is rendered obvious by Ritter in combination with Hashem '569 or Ritter in combination with the Sollenberger Article or Ritter in combination with the IS-95A Standard. Ritter discloses the general framework for an OFDMA-based wireless communication system in which OFDM

subcarriers are selected and allocated for the purpose of communication between a subscriber and a base station. To the extent Ritter does not explicitly disclose the limitations of claim 6, it would have been obvious to a person of ordinary skill in the art to modify Ritter with the knowledge of a person of ordinary skill in the art and/or the teachings of Hashem '569 and/or the Sollenberger Article and/or the IS-95A standard as set forth below.³

243. A person of ordinary skill in the art would have been motivated to combine Ritter with Hashem '569 or the Sollenberger Article and/or the IS-95A standard to design an OFDMA system as disclosed in claim 6.

244. With regard to Hashem '569: A person of ordinary skill in the art would have been motivated to combine Ritter with Hashem '569 to design an OFDMA system as disclosed in claim 6. Both Hashem '569 and Ritter addressed the design of wireless OFDMA cellular systems during the same time frame, with the two applications of Hashem '569 filed approximately 14 months after Ritter was granted. Moreover, they addressed the same problem in the context of wireless OFDMA systems – the allocation and maintenance of subcarriers based on feedback from subscribers. Hashem '569 explicitly invokes the use of pilot symbols to measure interference – so it would have been natural to look to Hashem '569 for an alternative to the more complex interference measurement approach taken by Ritter. Moreover, while Ritter did not explicitly disclose the form of the feedback (beyond providing an a list indicating the subscriber's preferred clusters), one of skill in the art would have been motivated to look to

³ Throughout this report, unless otherwise noted, the reasons behind the motivations to combine references applies equally throughout the Asserted Claims. While additional combinations (and the basis for the motivations to make such combinations) are set forth throughout this report, I have described them only once to avoid unnecessary repetition.

Hashem '569 for an example of useful feedback in this context – and specifically the use of an index indication of a candidate cluster with a signal to interference ratio.

245. With regard to the Sollenberger Article, both Ritter and the Sollenberger Article addressed the design of wireless OFDMA cellular systems during the same time frame – Ritter being granted in July 1999 and the Sollenberger Article being published in September 1999. Moreover, they addressed the same problem in the context of wireless OFDMA systems – the allocation and maintenance of subcarriers based on feedback from subscribers. While Ritter did not disclose the use of pilot symbols to make those measurements – proposing a more sophisticated “blind” approach based on amplitude variations – the Sollenberger Article used pilots to “rapidly measure” (see Sollenberger Article at 758) the same inter-cell interference measured by Ritter, and so it would have been natural to look to the Sollenberger Article for an alternative to the more complex approach favored by Ritter.

246. With regard to IS-95A, both Ritter and IS-95A addressed the design of wireless cellular networks. Moreover, as of the Ritter filing date, the IS-95 cellular standard was one of three major 2G cellular standards in the world (along with IS-54 and GSM). As a result, the IS-95 standard was widely known to those of skill in the art during the relevant time period. Moreover, the central focus of Ritter is to allocate radio resources based on measurements conducted by the mobile station—an issue addressed in the IS-95 standards through the use of SINR measurements based on pilot symbols made at the subscriber and fed back to the base station. Therefore, it would have been natural for one of skill in the art to look to the IS-95 standard for an alternative to the more complex measurement approach taken by Ritter and for details regarding the form of the feedback – *e.g.*, while Ritter does not explicitly indicate that the SINR is part of the feedback, IS-95 would have been a natural place to look for that disclosure.

2. Preamble

247. The preamble of claim 6 of the '748 Patent reads: “**A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising.**” (’748 Patent at 17:42-44.)

248. To the extent that the preamble is a limitation, it is disclosed by Ritter. The abstract of Ritter begins as follows:

The method and wireless communication system in accordance with the invention results from an OFDMA multicarrier method and the use of . . . subcarriers (oc), which are allocated for a communication connection between a base station (BS) and a mobile station (MS). . . . (Ritter, Abstract (emphasis added).)

3. Element 6[a][1]

249. Claim element 6[a][1] of the '748 Patent reads: “**a subscriber measuring channel and interference information for a plurality of subcarriers.**”

250. Ritter discloses “a subscriber measuring channel and interference information from a plurality of subcarriers.”

251. For example, the abstract of the Ritter patent discloses this as the first of the four steps comprising the claimed invention: “Measurement of the quality of various segments (S...) of the frequency spectrum by each mobile station.” (Ritter, Abstract.) The term “segment” in Ritter is used to describe a part of the frequency spectrum that is occupied by a set of subcarriers that may be allocated to different users based (in part) on the referenced measurements. “Thus a number of subcarriers and therefore a segment of a frequency spectrum may be allocated for the communication connection between base station and mobile station.” (Ritter at 2 (emphasis added).) Thus Ritter describes making measurements to obtain “quality” information from a plurality of subcarriers. This point is made again subsequently on p. 3 of Ritter: “According to the subject of the invention, each mobile station MS measures the quality of different segments

of the frequency spectrum, wherein it receives all subcarriers in the time allocated to it, checks the quality for each individual subcarrier, and then averages the determined qualities of the subcarriers.”

252. The “quality” that Ritter refers to includes information about the associated channel and interference information. Referring to Figure 4 from Ritter (shown below), the Ritter specification states:

Fig. 4 shows a schematic representation of the amplitude modulation of the transmitted data symbols on an OFDMA subcarrier for measurement of the quality of the segments by each mobile station. By converting the interferences or noise that may occur through an amplitude modulation from data symbol to data symbol, the quality of the individual subcarriers and thus also the entire segment can be measured simply but effectively over all allocated subcarriers on the mobile station side... If interference or noise is present, the amplitudes of the individual data symbols on a certain subcarrier vary from one data symbols to the next. If there is no interference or no noise, the amplitudes of all data symbols have the same value. (Ritter at 5 (emphasis added).)

253. Thus, Ritter discloses a procedure for making measurements of the “quality” of a plurality of subcarriers, where “quality” refers to the random noise and interference that is present in the associated spectrum – i.e., it measures the “channel and interference information from a plurality of subcarriers” that is required by the claim element.

254. Thus, Ritter discloses “a subscriber measuring channel and interference information

4. Element 6[a][2]

255. Claim element 6[a][2] of the ’748 Patent reads: “**based on pilot symbols received from a base station.**”

256. This element is disclosed by Ritter in combination with Hashem ’569, or any number of similar prior art references well known to those skilled in the art at the time the patents were filed, such as the Sollenberger Article or the IS-95A standard.

257. As discussed above, Ritter discloses “a subscriber measuring channel and interference information from a plurality of subcarriers.” Specifically, Ritter discloses a procedure for making measurements of the “quality” of a plurality of subcarriers, where “quality” refers to the random noise and interference that is present in the associated spectrum – *i.e.*, it measures the “channel and interference information from a plurality of subcarriers” that is required by the claim element.

258. However, Ritter does not explicitly disclose making those measurements “based on pilot symbols received from a base station.” Measuring channel and interference based on pilot symbols received from a base station was widely known in the art at the time of the claimed invention. For example, Hashem ’569, which incorporates the ’129 patent, discloses this element explicitly. In its “Summary of the Invention,” the ’129 patent discloses:

The present invention also provides a method of determining a signal to interference ratio of a signal sub-carrier in a communication system. The communication system includes a base station which transmits a pilot signal to a remote unit over a pilot sub-carrier. The pilot signal may be either on or off. The remote unit measures a signal strength of the pilot sub-carrier when the pilot signal is on and measures a signal strength of the pilot sub-carrier when the pilot signal is off, the latter being in effect a measurement of interference in the pilot sub-carrier as there is no pilot signal. The remote unit calculates a ratio of the signal strength when the pilot signal is on to the signal strength when the pilot signal is off. (’129 Patent at 2:65–3:10.)

259. The ’129 patent refers to this approach as a “blinking” pilot symbol, and it proposes two different algorithms for computing a signal-to-interference ratio based on blinking pilot symbols transmitted from the base station. Figures 5 and 6 from the ’129 patent, reproduced below, are flow charts that disclose the two algorithms for computing the required SIR based on pilots received from a base station.

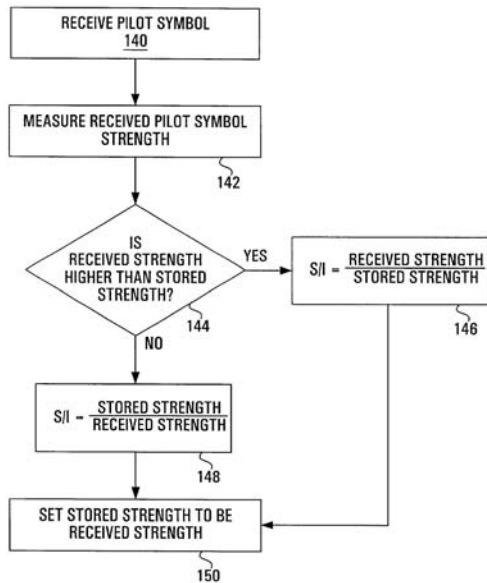


FIG. 5

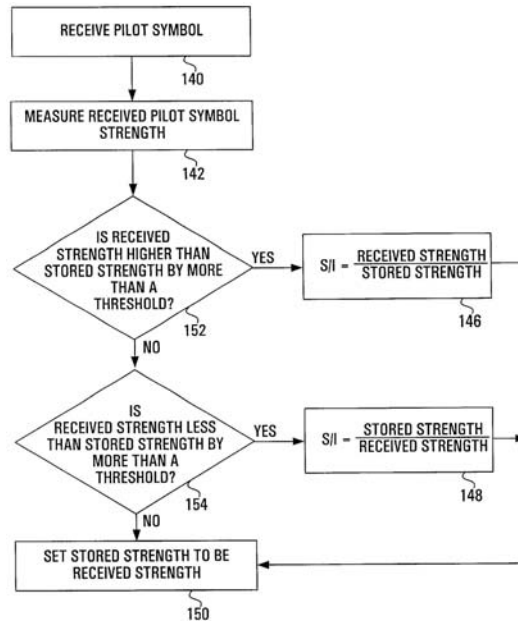


FIG. 6

260. Thus, one skilled in the art would have been motivated to combine Ritter and Hashem '569 for the purpose of “a subscriber measuring channel and interference information from a plurality of subcarriers based on pilot symbols received from a base station.”

261. Part of Ritter’s novelty is that it proposes to derive the channel and interference measurements from data symbols (which are typically unknown to the receiver in advance) rather than pilot symbols (which are typically known to the receiver in advance). Making such measurements from data is a much more challenging problem than making them from pilots; estimating channel quality without the benefit of a known transmitted signal is an example of blind processing, and it is valuable because it does not require the “overhead” implied by estimating the channel quality from known (non-data-bearing) pilot symbols.

262. To this end, one skilled in the art would have found it obvious to alternatively combine Ritter with any number of similar references for the disclosure of pilots symbols because Ritter was proposing technology relevant to the design of a mobile cellular system at a

time (late 1990s) when the use of pilot symbols received from a base station to measure channel and interference information.

263. Indeed, using pilot symbols to aid in the measurement and estimation of channel quality is a widely-used practice that predates the '748 Patent by decades. For example, the Sollenberger Article, which discloses an OFDM-based system, recites in general terms the advantages of using pilot symbols to measure interference information: "...OFDM has a key advantage here with the ability to rapidly measure interference or path loss parameters in parallel on all candidate channels, either directly or based on pilot tones." (Sollenberger Article at 758 (emphasis added).) Then, in the exemplary frame structure proposed in the Sollenberger Article, Sollenberger proposes a specific pilot structure, as shown in Figure 3.2 below:

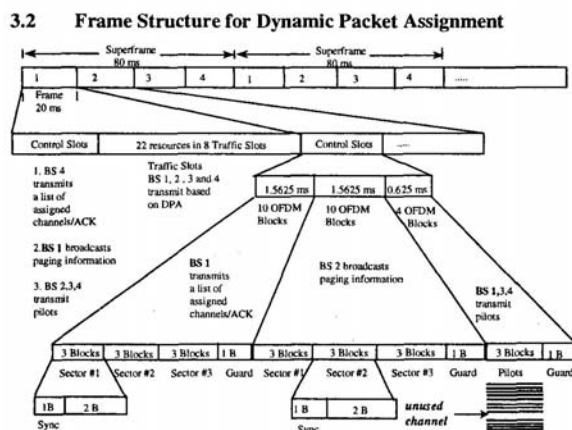


Figure 3. Staggered frame structure for downlink DPA

264. It is seen that, in each 20.0 ms frame, three base stations (in a group of four) transmit pilots that are used to enable measurements for SIR estimation, while the rotating fourth base station transmits a paging signal that is used to measure the strength of the desired signal:

This frame structure permits SIR estimation on all unused traffic slots. The desired signal is estimated by the received signal strength from the 2 OFDM blocks used for paging, while the interference can be estimated by measuring 3 blocks of received pilot signals. The pilot channels are generated by mapping all the radio resources currently in use onto corresponding pilot subchannels, thus providing an "interference map" without monitoring the actual traffic subchannels. The OFDM scheme can process many subchannels in parallel,

which provides a mechanism for very fast SIR estimation. In addition, since a total of 528 subchannels are available to map 22 resources over 3 OFDM blocks, significant diversity effects are achieved to reduce measurement errors. (Sollenberger Article at 760 (emphasis added).)

265. Thus, the Sollenberger Article also discloses “based on pilot symbols received from a base station.”

266. As noted above, there are other references one skilled in the art would have also been motivated to combine with Ritter for the use of pilot symbols received from a base station to measure channel and interference information. For example, the IS-95A standard (among many other references) discloses measurements “based on pilot symbols received from a base station.” Consider this passage from the IS-95A standard:

The mobile station assists the base station in the handoff process by measuring and reporting the strengths of received pilots.

The mobile station should use the searcher element (*see* 6.2.2.1) to compute the strength of a pilot by adding the ratios of received pilot energy per chip, E_c , to total received spectral density (noise and signals), I_0 , of at most k usable multipath components, where k is the number of demodulating elements (*see* 6.2.2.1) supported by the mobile station. (IS-95A § 6.6.6.2.2 at 6-173.)

267. The measurement as described in the passage above includes the “total received spectral density (noise and signals)” and calls that quantity I_0 . The result of the measurement is the ratio E_c/I_0 , described in the standard as “the ratio (in dB) between the pilot energy accumulated over of PN chip period (E_c) to the total power spectral density in the received bandwidth (I_0).” (IS-95A at 1-5.) Thus, the IS-95A standard discloses “a subscriber measuring channel and interference information... based on pilot symbols received from a base station.”

268. Therefore, the combination of Ritter and Hashem '569, or Ritter and the Sollenberger Article (or the IS-95A standard or any other similar reference), discloses “a subscriber measuring channel and interference information from a plurality of subcarriers based on pilot symbols received from a base station.”

5. Element 6[b]

269. Claim element 6[b] of the '748 Patent reads: **“the subscriber selecting a set of candidate subcarriers.”**

270. This element is disclosed by Ritter. Specifically, Ritter discloses that, after making the measurements described above, the mobile station takes this step:

Determination of at least one segment preferably suitable for its own communication connection by each mobile station and transmission of a corresponding message to the base station. (Ritter at 2.)

271. This “determination of at least one segment preferably suitable for its own communication connection” is Ritter’s disclosure of the required “subscriber selecting” step. Indeed, Ritter discloses that each mobile station forms its own “priority list” (composed of the “at least one segment[s]”) – or, in the language of the '748, its own “set of candidate subcarriers” – and transmits that priority list to the base station:

According to an additional embodiment of the invention, each of the mobile stations sends the base station a priority list that contains information on a most suitable segment for its own communication connection and on additional segments preferably suitable for its own communication connection. (Ritter at 3.)

272. That is, this priority list consisting of “a most suitable segment” together with “additional segments preferably suitable” compose the “set of candidate subcarriers” selected by Ritter’s subscriber, as required by this claim element.

273. Therefore, Ritter discloses “the subscriber selecting a set of candidate subcarriers.”

6. Element 6[c][1]

274. Claim element 6[c][1] of the '748 Patent reads: **“the subscriber providing feedback information on the set of candidate subcarriers to the base station.”**

275. This element is disclosed by Ritter. As noted above, Ritter discloses “Determination of at least one segment preferably suitable for its own communication connection by each mobile station and transmission of a corresponding message to the base station.” (Ritter at 2 (emphasis added).) This “transmission of a corresponding message” – a message that “corresponds” to the “at least one segment” that has been determined by the mobile station – is the “providing feedback information on the set of candidate subcarriers” that is required in this element of the ’748 claim.

276. Therefore, Ritter discloses “the subscriber providing feedback information on the set of candidate subcarriers to the base station.”

7. Element 6[c][2]

277. Claim element 6[c][2] of the ’748 Patent reads: “**wherein providing feedback information comprises arbitrarily ordering the set of candidate of subcarriers as clusters of subcarriers.**”

278. Ritter discloses “wherein providing feedback information comprises arbitrarily ordering the set of candidate of subcarriers as clusters of subcarriers.”

279. The Court has defined “arbitrarily ordering” as “ordering in an order not known by the base station.” Ritter describes the feedback as a “priority list that contains information on a most suitable segment for its own communication connection and on additional segments preferably suitable for its own communication connection.” (Ritter at 3.) As an example, Ritter describes how “Messages regarding the segments S_x, S_y, S_z are entered into a priority list PL1, numbered according to their suitability for the communication connection, and sent to the base station BS.” (Ritter at 3.)

280. In Ritter, “S_x” is “the segment most suitable for [the mobile station],” while S_y and S_z are “additional segments preferably suitable for [the MS’s] own communication

connection.” Thus, the ordering of the segments/clusters in Ritter is “according to their suitability for the communication connection” – an ordering that is neither defined nor known until the segments are measured and selected in Ritter’s “measurement” and “selection” steps. Referring to the background section, Ritter is therefore proposing an “arbitrarily ordered” form of feedback that requires an index or indicator that identifies each cluster. In other words, the manner in which Ritter reports measurements requires that the results be identifiable to the base station. Because the reporting changes over time, it cannot have be “known by the base station” before the report is received.

281. Therefore, Ritter discloses “wherein providing feedback information comprises arbitrarily ordering the set of candidate of subcarriers as clusters of subcarriers.”

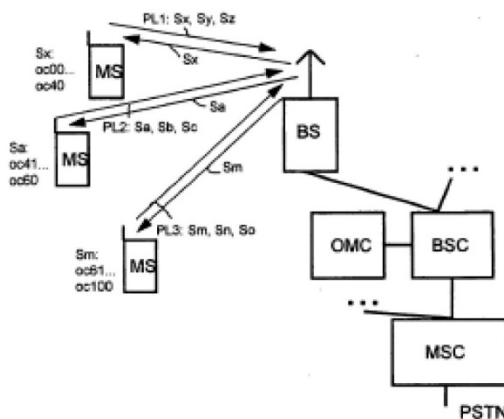
8. Element 6[c][3]

282. Claim element 6[c][3] of the ’748 Patent reads: “**wherein the feedback information includes an index indication of a candidate cluster with its SINR value.**”

283. This element is disclosed by Ritter in combination with Hashem ’569, or, alternatively, by Ritter in combination with the IS-95A standard. Ritter by itself discloses feedback information that “includes an index indication of a candidate cluster.” As noted above, Ritter discloses that the feedback provided by the mobile station to the base station is a “priority list” indicating the segments/clusters that are “suitable” for the mobile station, ordered “according to their suitability.” Because the identities of these “suitable” clusters are not known by the base station in advance of the feedback, such a priority list would include an index indication that identifies which clusters are preferred. This is seen in Figure 1 from Ritter (shown below), in which the “index indicators” S_x , S_y , and S_z are transmitted from the first mobile station, while the index indicators S_a , S_b , and S_c are transmitted from the second, and the index indicators S_m , S_n , and S_o are transmitted from the third. (As shown, S_x is the index

indicator for the subcarriers oc00 through 0c40, while Sa is the index indicator for the subcarriers oc41 through 0c60 and Sm is the index indicator for the subcarriers oc61 through 0c100.)

FIG 1



284. Ritter does not explicitly disclose the nature of the feedback beyond saying that it “provides information” about the candidate clusters in a priority ordering – *i.e.*, it does not indicate what information is provided beyond identifying the clusters. Therefore, Ritter does not explicitly disclose feedback information that includes, along with the index indication of each candidate cluster, its SINR value, as required by the claim language. Certainly it would have been obvious to include such information in the feedback – as done in the prior art.

285. For instance, this element is rendered obvious by Hashem ’569. Hashem ’569 discloses the use of a “bitmask” as an index indication of a candidate cluster – meaning a binary sequence in which a value of “1” indicates that the associated subcarrier is acceptable and a value of “0” indicates that it is not – and it discloses feedback information comprised of that bitmask along with the average signal-to-interference ratio (SIR) of the candidate cluster identified by the bitmask. (*See, e.g.*, Hashem ’569 at 4:49-65 and 7:27-37.) This form of feedback is shown in the last block (numbered 98) of the flowchart in Figure 3 from Hashem ’569, reproduced below.

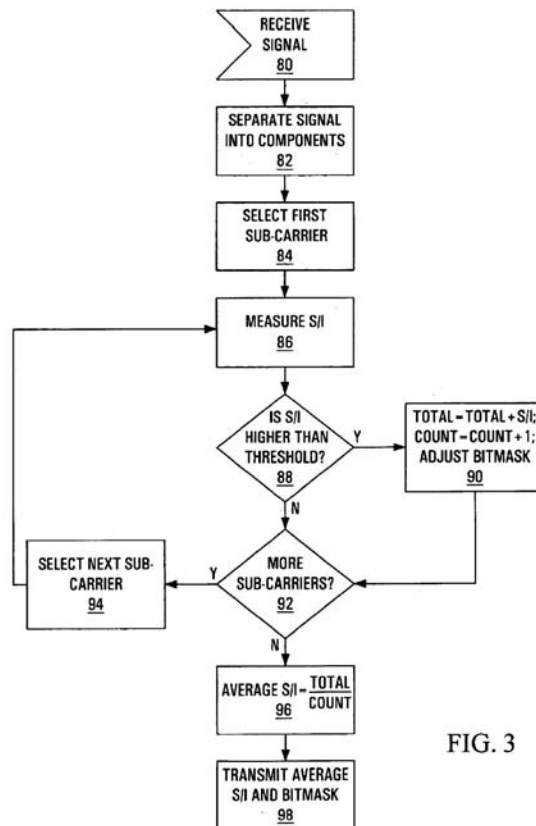


FIG. 3

286. So Hashem '569 discloses feedback information that includes an index indication of a candidate cluster with its SIR value—albeit, not its SINR value. While there is a difference between a signal-to-interference ratio (SIR) and a signal-to-interference-plus-noise ratio (SINR), it would have been obvious, in a cellular system where the dominant corruption mechanism is interference – *i.e.*, an interference-limited environment – to have used SINR rather than SIR, because the noise in such a system is small relative to the interference, and it is easier to measure SINR than to measure SIR.

287. Thus, Ritter in combination with Hashem '569 renders obvious “wherein the feedback information includes an index indication of a candidate cluster with its SINR value.”

288. Alternatively, one skilled in the art would have been motivated to combine Ritter with other prior art that explicitly discloses this limitation. For instance, IS-95A discloses a

method of providing feedback from the MS to the base station “wherein the feedback information includes an index indication of a candidate cluster with SINR value.” Referring to Section 6.7.2.3.2.5 on p. 6-228 of the IS-95A standard, the “Pilot Strength Measurement Message” is a message transmitted from the mobile station to the base station to report the quality of the channels associated with a set of pilots. Specifically, this message enables the MS to provide feedback on the strength of each pilot in the Active Set and the Candidate Set. As per the description of the message format on pp. 6-228 through 6-229, each measured pilot is indexed by a phase offset to identify it, and each reported measurement is in the form of an SINR given by E_c/I_0 :

The mobile station should use the searcher element (see 6.2.2.1) to compute the strength of a pilot by adding the ratios of received pilot energy per chip, E_c , to total received spectral density (noise and signals), I_0 , of at most k usable multipath components, where k is the number of demodulating elements (see 6.2.2.1) supported by the mobile station.” (IS-95A § 6.6.6.2.2 at 6-173.)

289. The measurement as described in the passage above includes the “total received spectral density (noise and signals)” and calls that quantity I_0 . The result of the measurement is the ratio E_c/I_0 , described in the standard as “the ratio (in dB) between the pilot energy accumulated over of PN chip period (E_c) to the total power spectral density in the received bandwidth (I_0).” (IS-95A at 1-5.) The value of I_0 thus includes both noise and interference, and so E_c/I_0 represents a signal-to-interference-plus-noise (SINR) ratio of the associated pilot channel.

290. Further, IS-95A discloses providing the feedback above in a manner that includes an index indication of a candidate channel with its SINR value, as denoted above. To see this, recall from the “Technology Background” section the IS-95A “Pilot Strength Measurement Message,” described on pp. 6-228 of the IS-95A standard. The format of the Pilot Strength Measurement Message is reproduced below.

6.7.2.3.2.5 Pilot Strength Measurement Message

When the mobile station sends a *Pilot Strength Measurement Message*, it shall use the following variable-length message format:

Field	Length (bits)
MSG_TYPE ('00000101')	8
ACK_SEQ	3
MSG_SEQ	3
ACK_REQ	1
ENCRYPTION	2
REF_PN	9
PILOT_STRENGTH	6
KEEP	1
Zero or more occurrences of the following record:	
PILOT_PN_PHASE	15
PILOT_STRENGTH	6
KEEP	1
RESERVED	0 - 7 (as needed)

291. Note that the message includes “Zero or more occurrences” of a three-field record; there is one such occurrence for every pilot in the Candidate Set and one such occurrence for every pilot in the Active Set except for the Active Set pilot from which the mobile station derives its time reference. (See IS-95A at 6-228.)

292. The first two of the three fields that are transmitted for each pilot in the Candidate Set as part of the Pilot Strength Measurement Message are “PILOT_PN_PHASE” (which identifies the base station that is transmitting the pilot) and “PILOT_STRENGTH” (which indicates the received strength of the pilot). The IS-95A standard does not define or specify the order in which the pilots in the Candidate List are to be reported; rather, the PILOT_PN_PHASE field is used to correctly interpret each measurement at the base.

293. Therefore, Ritter discloses feedback information regarding the set of candidate subcarrier clusters with an index indication, while the IS-95A standard discloses feedback information that includes both an index indication and an SINR value for each candidate

channel. In Ritter's context of OFDM, of course, the candidate channels are defined as candidate subcarrier clusters.

294. Therefore, the combination of Ritter and Hashem '569 or the combination of Ritter and the IS-95A standard discloses "and further wherein the feedback information includes an index indication of a candidate cluster with SINR value."

9. Element 6[d]

295. Claim element 6[d] of the '748 Patent reads: **"the subscriber receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber."**

296. The Court has construed the phrase "subcarriers the set of subcarriers selected by the base station" as "subcarriers that the base station has chosen from the set of candidate subcarriers selected by the subscriber."

297. This element is disclosed by Ritter. The third and fourth steps of the approach disclosed in Ritter indicate that the base station will allocate segments/clusters to the mobile stations and then transmit to the mobile stations the result of that allocation process:

- Evaluation of the information received from the mobile station (MS) by the base station (BS) and allocation of a segment (Sx, Sa, Sm) for the respective communication to each mobile station depending on the evaluation,
- Transmission of a message about the allocated segment (Sx, Sa, Sm) to each mobile station (MS) by the base station (BS). (Ritter, Abstract.)

298. As noted above, the feedback from Ritter's mobile station consists of a "[d]etermination of at least one segment (Sx..Sa...Sm...) preferred for its own communication connection."

299. Thus, the last two steps in Ritter's approach disclose exactly what is required by element 6[d]—that the base station choose a "set of subcarriers... for use by the subscriber" and

that an indication of the base station's selection be received by the subscriber. In Ritter, this is the allocation of a selected "segment (Sx, Sa, Sm)" to "each mobile station," followed by the "transmission of a message about the allocated segments... to each mobile station by the base station."

300. Therefore, Ritter discloses "the subscriber receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber."

B. Claim 6 of the '748 Patent is Rendered Obvious by the Sollenberger Publications

1. Introduction

301. The following analysis demonstrates claim 6 of the '748 Patent is rendered obvious by the Sollenberger Article and the Sollenberger Patent.

302. A person of ordinary skill in the art would have been motivated to combine the Sollenberger Article and the Sollenberger Patent to design an OFDMA system as disclosed in claim 6. The two references were the product of the same two researchers – *i.e.*, Sollenberger and Chuang are the co-authors of the Sollenberger Article and are co-inventors of the Sollenberger Patent. Both references address the same problem – that of dynamic channel allocation in the context of a cellular network. While the Sollenberger Patent presents addresses this problem in a more general context, the Sollenberger Article focuses on subcarrier allocation in an OFDMA system.

2. Preamble

303. The preamble of claim 6 of the '748 Patent reads: "**A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising.**"

304. To the extent that the preamble is a limitation, it is disclosed by, at least, the Sollenberger Article. In the abstract of the Sollenberger Article, this is disclosed:

This paper discusses packet data transmission rates of 2 to 5 Mb/s in macrocellular environments and up to 10 Mb/s in microcellular and indoor environments... Dynamic packet assignment for high efficiency resource management and packet admission; OFDM at the physical layer with interference suppression are discussed.

(Sollenberger Article at 757 (emphasis added).)

305. One of ordinary skill in the art would understand that “OFDM at the physical layer” coupled with “dynamic packet assignment for high efficiency resource management” refers to a system employing OFDMA. This is made more explicit subsequently in Section 2.2 (“MAC-Layer Techniques”), which describes the multiple-access technology that is proposed:

“Dynamic Packet Assignment (DPA) based on properties of an OFDM physical layer is proposed which reassigns transmission resources on a packet by packet basis using high-speed receiver measurements ...”

(Sollenberger Article at 758.)

306. The Sollenberger Article discloses a method for subcarrier selection in such a system in the exemplary time-frequency frame structure described in the “Sollenberger Publications Overview” section. Specifically, the Sollenberger Article describes a system in which eight “tone clusters” – each such cluster comprised of 24 subcarriers, or “tones” – are sequentially selected and assigned to a user every 20.0 ms, according to a particular frequency-hopping pattern. (See Sollenberger Article, Section 3 – “System Parameter and Frame Structure.”) The Sollenberger Article further explains that “[u]p to 20 users can be simultaneously assigned, one resource each, using different hopping patterns that are free from collisions.” (Sollenberger Article at 758.)

307. Thus, the Sollenberger Article discloses “A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA).”

3. Element 6[a][1]

308. Claim element 6[a][1] of the '748 Patent reads: “**a subscriber measuring channel and interference information for a plurality of subcarriers.**”

309. This element is disclosed by, at least, the Sollenberger Article. As noted in the Sollenberger Publications Overview section, the Sollenberger Article describes a protocol with “four basic steps” – and the second step is “rapid measurements of resource usage by a terminal using the parallelism of an OFDM receiver.” The nature of these measurements and how they are accommodated by the exemplary frame structure is also described:

This frame structure permits SIR estimation on all unused traffic slots. The desired signal is estimated by the received signal strength from the 2 OFDM blocks used for paging, while the interference can be estimated by measuring 3 blocks of received pilot signals.

(Sollenberger Article at 760.)

310. Thus, the Sollenberger Article discloses “a subscriber measuring channel and interference information from a plurality of subcarriers.”

4. Element 6[a][2]

311. Claim element 6[a][2] of the '748 Patent reads: “**based on pilot symbols received from a base station.**”

312. This element is disclosed by, at least, the Sollenberger Article. To begin with, the Sollenberger Article observes in general terms that “...OFDM has a key advantage here with the ability to rapidly measure interference or path loss parameters in parallel on all candidate channels, either directly or based on pilot tones.” (Sollenberger Article at 758 (emphasis added).) Then, in the exemplary frame structure proposed in the Sollenberger Article, the authors propose a specific pilot structure, as shown in Figure 3.2 reproduced below:

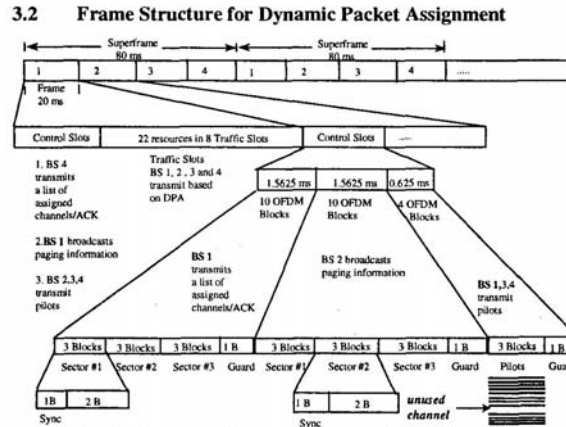


Figure 3. Staggered frame structure for downlink DPA

313. The nature of how the pilot signals are used for estimating interference is also described:

It is seen that, in each 20.0 ms frame, three base stations (in a group of four) transmit pilots that are used to enable measurements for SIR estimation, while the rotating fourth base station transmits a paging signal that is used to measure the strength of the desired signal:

This frame structure permits SIR estimation on all unused traffic slots. The desired signal is estimated by the received signal strength from the 2 OFDM blocks used for paging, while the interference can be estimated by measuring 3 blocks of received pilot signals. The pilot channels are generated by mapping all the radio resources currently in use onto corresponding pilot subchannels, thus providing an "interference map" without monitoring the actual traffic subchannels. The OFDM scheme can process many subchannels in parallel, which provides a mechanism for very fast SIR estimation. In addition, since a total of 528 subchannels are available to map 22 resources over 3 OFDM blocks, significant diversity effects are achieved to reduce measurement errors.

(Sollenberger Article at 760 (emphasis added).)

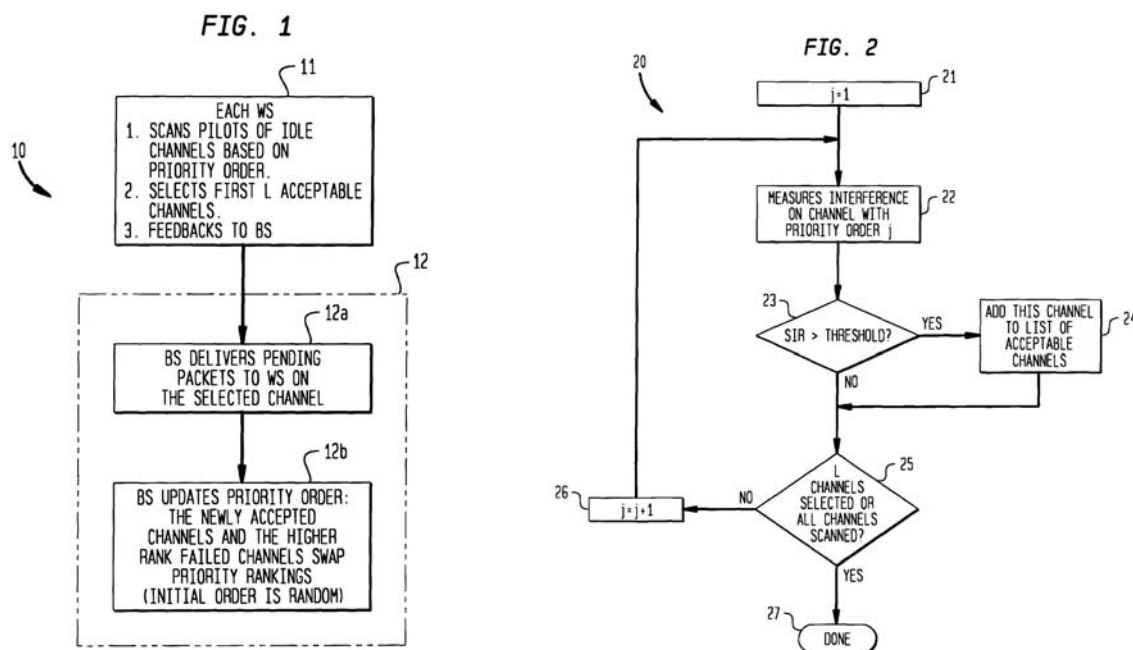
314. Thus, the Sollenberger Article discloses “based on pilot symbols received from a base station.”

5. Element 6[b]

315. Claim element 6[b] of the ’748 Patent reads: “**the subscriber selecting a set of candidate subcarriers.**”

316. This element is disclosed by the Sollenberger Patent and/or the Sollenberger Article.

317. As described above in the Sollenberger Publications Overview section, the Sollenberger Patent describes a method in which a set of L candidate subcarriers – potentially fewer than all the subcarriers – are selected by the subscriber, as shown Figures 1 and 2 from the Sollenberger Patent, reproduced below:



318. As depicted above, these figures illustrate a method in which each WS (“wireless station”) selects the first L “acceptable” channels. One skilled in the art would understand this selection of acceptable channels, when implemented in an OFDMA system like the Sollenberger Article, to include selecting a set of candidate subcarriers. Thus, Figure 1 illustrates how this selection occurs in the context of the subcarrier selection carried out jointly between the base station and the mobile station, while Figure 2 illustrates the iterative process by which the selection of candidate subcarriers occurs at the mobile station.

319. Alternatively, under Adaptix's apparent infringement theory that providing feedback on all possible subcarriers necessarily constitutes "selecting" all the subcarriers, this element is also disclosed by the Sollenberger Article:

The basic protocol for a downlink comprises four basic steps: (1) a packet page from a base station to a terminal; (2) rapid measurements of resource usage by a terminal using the parallelism of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with each radio resource; and (4) selection of resources by the base and transmission of the data. (Sollenberger Article at 758-759.)

320. As noted above, in the Sollenberger Article, the proposed protocol is for the subscriber terminal to generate a "short report" regarding the channel quality associated "with each radio resource." Therefore, to the extent that "selecting a set of candidate subcarrier" covers a method in which all the subcarriers are selected, the Sollenberger Article explicitly covers that case.

321. Thus, the Sollenberger Patent and/or the Sollenberger Article disclose "the subscriber selecting a set of candidate subcarriers."

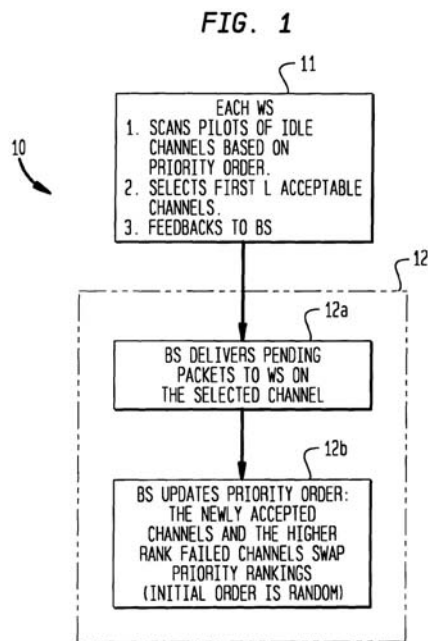
6. Element 6[c][1]

322. Claim element 6[c][1] of the '748 Patent reads: "**the subscriber providing feedback information on the set of candidate subcarriers to the base station.**"

323. This element is disclosed by the Sollenberger Patent and/or the Sollenberger Article.

324. As discussed above, the Sollenberger Patent discloses a method in which each WS ("wireless station") selects the first L "acceptable" channels, which one skilled in the art would understand to be candidate subcarriers in an OFDMA system like the Sollenberger Article. Further, as shown in Figure 1 from the Sollenberger Patent (reproduced below), each wireless station, having scanned the pilots and selected the first L acceptable channels as

candidates, then “Feedbacks to BS” the information that the base station needs to make its channel assignments:



325. The feedback is also described in the specification of the Sollenberger Patent:

A feedback channel is then used for informing a base station of acceptable channels. To avoid more than one wireless station in the same cell from selecting the same acceptable channel, a list of more than one acceptable channel is provided by the wireless station.

...

The wireless station selects the first L acceptable channels and sends a feedback message to the base station providing the list of L acceptable channels for the wireless station.

(Sollenberger Patent at 8:2-7, 40-42.)

326. Thus, the Sollenberger Patent discloses “the subscriber providing feedback information on the set of candidate subcarriers to the base station.”

327. Alternatively, under Adaptix’s apparent infringement theory, this element is also disclosed by the Sollenberger Article. As noted above, the Sollenberger Article discloses “the subscriber providing feedback information” through the generation of “a short report from the

terminal to the base station of the potential transmission quality associated with *each* radio resource.” (Sollenberger Article at 759.)

328. Thus, the Sollenberger Patent and/or the Sollenberger Article disclose “the subscriber providing feedback information on the set of candidate subcarriers to the base station.”

7. **Element 6[c][2]**

329. Claim element 6[c][2] of the ’748 Patent reads: “**wherein providing feedback information comprises arbitrarily ordering the set of candidate of subcarriers as clusters of subcarriers.**”

330. This element is disclosed by the Sollenberger Patent and/or the Sollenberger Article.

331. As noted above, the Sollenberger Patent discloses the subscriber selecting a set of candidate subcarriers and providing feedback information on the set of candidate subcarriers to the base station; specifically, it discloses the subscriber selecting and providing feedback on L candidate subcarriers, where the L selected candidates are the first L “acceptable” candidates found when the subscriber scans them in “priority order.” While the Sollenberger Patent discloses how the subcarrier clusters are to be ordered for scanning – “in priority order” – it does not disclose how they are to be ordered for feedback. Moreover, there is no way to know in advance which subcarrier clusters have been selected due to the method by which the L subcarrier candidate clusters are selected—based on whether each measured SIR does (or does not) exceed a threshold. There is no express disclosure of how the selection is indicated to the base station, but one skilled in the art would have been motivated to provide feedback only on the selected candidate clusters and provide an index indication to identify them.

332. Thus, the Sollenberger Patent and/or the Sollenberger Article disclose “wherein providing feedback information comprises arbitrarily ordering the set of candidate of subcarriers as clusters of subcarriers.”

8. Element 6[c][3]

333. Claim element 6[c][3] of the ’748 Patent reads: “**wherein the feedback information includes an index indication of a candidate cluster with its SINR value.**”

334. This element is rendered obvious by, at least, the Sollenberger Patent. As indicated above, the Sollenberger Patent discloses the subscriber selecting and providing feedback on L candidate subcarriers, where the L selected candidates are the first L “acceptable” candidates found when the subscriber scans them in “priority order.” As depicted above, in Figure 2, the wireless station uses “an index variable j” to scan channels in priority order, measures the SIR on each channel, compares the measured SIR to a predetermined threshold, and adds the channel to a list of acceptable channels if the SIR is above the predetermined threshold. (See Sollenberger Patent at 9:1-40 (describing process).)

335. Although not explicitly discussed in the Sollenberger Patent, one of ordinary skill in the art would understand that the feedback from the wireless station could include, for example, the “index variable j” identifying each channel in the list of acceptable channels (*e.g.*, candidate cluster) with the SIR measurement of each channel calculated by the wireless station. To the extent SIR is not “an SINR value,” one of ordinary skill in the art would have understood that Signal-to-Interference Ratio (SIR) and Signal-to-Interference-plus-Noise Ratio (SINR) are related channel quality measurements. For example, when measuring SINR, if the power of the noise is much smaller than the power of the interference, then the noise term is nearly zero, and the SINR measurement is closely approximated by an SIR measurement. One of ordinary skill in the art would have been familiar with both SIR and SINR measurements and would have been

motivated to modify the Sollenberger Patent to use SINR measurements, instead of SIR measurements, in order to more accurately measure the quality of the channels.

336. Thus, the Sollenberger Patent renders obvious “wherein the feedback information includes an index indication of a candidate cluster with SINR value.”

9. Element 6[d]

337. Claim element 6[d] of the ’748 Patent reads: “**the subscriber receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber.**”

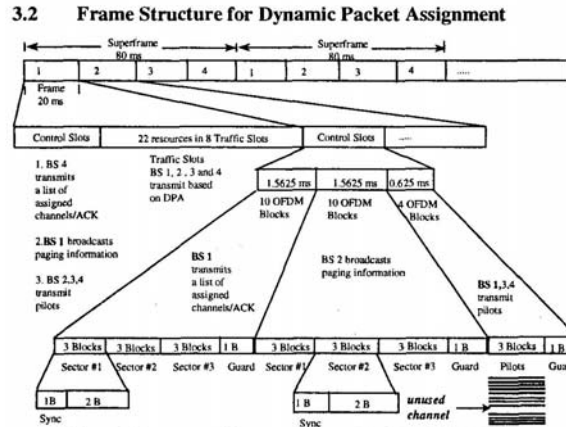
338. The Court has construed the phrase “subcarriers of the set of subcarriers selected by the base station” as “subcarriers that the base station has chosen from the set of candidate subcarriers selected by the subscriber.”

339. This element is rendered obvious, at least, by the Sollenberger Article. As noted above, the Sollenberger Article describes a protocol with four basic steps:

The basic protocol for a downlink comprises four basic steps: (1) a packet page from a base station to a terminal; (2) rapid measurements of resource usage by a terminal using the parallelism of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with each radio resource; and (4) selection of resources by the base and transmission of the data.

(Sollenberger Article at 758-759 (emphasis added).)

340. The last of the four steps indicates that the resources (or subcarriers) are selected by the base station for use by the subscriber. Moreover, Figure 3.2 from the Sollenberger Article, reproduced below, indicates that the “list of assigned channels” is transmitted from the base station to the mobile stations in the coverage area of the base station, one base station in each frame and four base stations in each “superframe” of 80.0 ms.



341. The Sollenberger Article does not expressly disclose whether the “selection of resources by the base” must be subcarriers that the base station has chosen from the set of candidate subcarriers selected by the subscriber. However, one skilled in the art would understand that one implementation of the method disclosed in the Sollenberger Article would include “an indication of subcarriers of the set of subcarriers selected by the base station.” Alternatively, under Adaptix’s apparent interpretation of the court’s claim construction order and infringement theory that any indication of subcarriers satisfies this limitation, the Sollenberger Article would expressly disclose this element.

342. Thus, the Sollenberger Article discloses or renders obvious “the subscriber receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber.”

C. Claim 6 of the ’748 Patent is Rendered Obvious by Hashem ’569 Alone or in Combination with Ritter

1. Introduction

343. The following analysis demonstrates claim 6 of the ’748 Patent is rendered obvious by Hashem ’569 or Hashem ’569 in combination with Ritter. As noted above, Hashem ’569 was filed on September 29, 2000 and incorporates by reference Hashem ’129,

which had been filed two days earlier. (Hashem '569 at 7:4-7.) Hashem '569 issued April 13, 2004, and is titled "Dynamic Sub-Carrier Assignments in OFDM Systems." The '129 patent issued on March 2, 2004, and is titled "Receiver Based Adaptive Modulation Scheme." Both patents constitute prior art under §102(a) and (e).

344. Hashem '569 proposes a number of embodiments in which channel quality and interference measurements for OFDM sub-carriers are taken at a remote unit, and those measurements are processed to form a report that is fed back to the base station, where it is used to map data onto sub-carriers. Hashem '569 notes that, "[a]lthough the invention has been developed for use with systems which employ [OFDM], it is possible that the invention could be used with other systems which employ multiple sub-carriers simultaneously, and the invention is therefore considered to be limited to OFDM systems." (Hashem '569 at 9:12-17.)

345. To the extent Hashem '569 does not explicitly disclose the limitations of claim 6, it would have been obvious to a person of ordinary skill in the art to modify Hashem '569 with the teachings of Ritter, the Sollenberger Article, the IS-95A standard, and/or the knowledge of a person of ordinary skill in the art.

346. A person of ordinary skill in the art would have been motivated to combine Hashem '569 with Ritter, the Sollenberger Article, and/or the IS-95A standard to design an OFDMA system as disclosed in claim 6.

347. With regard to Ritter: A person of ordinary skill in the art would have been motivated to combine Hashem '569 with Ritter to design an OFDMA system as disclosed in claim 6. Both Hashem '569 and Ritter addressed the design of wireless OFDMA cellular systems during the same time frame, with the two applications of Hashem '569 filed approximately 14 months after Ritter was granted. Moreover, they addressed the same problem

in the context of wireless OFDMA systems – the allocation and maintenance of subcarriers based on feedback from subscribers. Ritter explicitly invokes the general framework used by a base station to adaptively allocate “segments” of OFDMA network resources in a wireless OFDMA cellular system – so it would have been natural to look to Ritter for an alternative (or in addition to) to the disclosures in the Hashem ’569. One of skill in the art would have been motivated to look to Ritter for an example of useful techniques well-suited to the measurement and allocation of clusters.

348. With regard to the Sollenberger Article, a person of ordinary skill in the art would have been motivated to combine Hashem ’569 with the Sollenberger Article to design an OFDMA system as disclosed in claim 6 for reasons similar to those set forth above. For example, both Hashem ’569 and the Sollenberger Article addressed the design of wireless OFDMA-based cellular systems during the same time frame – the two applications for Hashem ’569 being filed in September 2000, and the Sollenberger Article being published in September 1999. Moreover, they addressed the same problem in the context of wireless OFDM-based systems – the allocation and maintenance of subcarriers based on feedback from subscribers. Like Hashem ’569, the Sollenberger Article used pilots to measure (Sollenberger Article at 758) the same inter-cell interference at the mobile device as that measured by Hashem ’569. Thus, it would have been natural to look to the Sollenberger Article for an alternative to the more complex approach favored by the Sollenberger Article.

349. With regard to IS-95A: A person of ordinary skill in the art would have been motivated to combine Hashem ’569 with the IS-95A standard to design an OFDMA system as disclosed in claim 6. Both Hashem ’569 and IS-95A addressed the design of wireless cellular networks. Moreover, as of the filing date for the two applications of Hashem ’569, the IS-95

cellular standard was one of three major 2G cellular standards in the world (along with IS-54 and GSM). As a result, the IS-95 standard was widely known to those of skill in the art during the relevant time period. Moreover, the central focus of Hashem '569 is to evaluate inter-cell interference information and adaptively allocate radio resources (including the corresponding coding and modulation rates) based on measurements conducted by the mobile station—an issue addressed in the IS-95 standards through the use of SINR measurements based on pilot symbols made at the subscriber and fed back to the base station. Therefore, it would have been natural for one of skill in the art to look to the IS-95 standard for an alternative (or supplement) to the OFDMA approach taken by Hashem '569.

2. Preamble

350. The preamble of claim 6 of the '748 Patent reads: “**A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising.**”

351. To the extent that the preamble is a limitation, it is satisfied by Hashem '569. The abstract of Hashem '569 reads: “A method and apparatus are provided for selecting and signaling the identity of sub-carriers to be used for transmission of data in a radio communication system[.]” (Hashem '569, Abstract (emphasis added).) Moreover, the transmission system is unambiguously OFDM, as can be seen from the title of the patent (“Dynamic Sub-Carrier Assignments in OFDM Systems”) and in the specification: “Although the invention has been developed for use with systems which employ Orthogonal Frequency Division Multiplexing, it is possible that the invention could be used with other systems...” (Hashem '569 at 9:11-15 (emphasis added).)

352. As noted in the “Technology Overview” section, OFDMA is the multiple access technology applied in an OFDM transmission system when different users are assigned different

subcarriers. For example, Hashem '569 discloses that "OFDM systems can use 1000 sub-carriers" which could service multiple remote units at the same time. (Hashem '569 at 2:8-9.) Additionally, Hashem '569 states that "Although the invention has been developed for use with systems which employ Orthogonal Frequency Division Multiplexing, it is possible that the invention could be used with other systems which employ multiple sub-carriers simultaneously, and the invention is therefore considered not to be limited to OFDM systems." (Hashem '569 at 9:12-17; *see also* '129 Patent at 2:11-14.) Thus, a person of ordinary skill in the art would understand Hashem '569 to disclose "A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA)."

3. Element 6[a][1]

353. Claim element 6[a][1] of the '748 Patent reads: "**a subscriber measuring channel and interference information for a plurality of subcarriers.**"

354. This element is disclosed by Hashem '569. As noted in the "Hashem Overview" section, the first step in the disclosed process is to measure the signal to interference ratio of each sub-carrier. This is done in the sub-carrier analysis processor, which Figure 1 of Hashem '569 indicates is part of the remote unit – *i.e.*, "the subscriber."

The sub-carrier analysis processor 26 [of the remote unit] measures a signal to interference ratio (S/I) of each sub-carrier signal. (Hashem '569 at 4:27-29.)

355. In its analysis of the flow chart shown in Figure 3, Hashem '569 indicates that the SIR of each sub-carrier is measured as part of an iterative loop:

At step 86 the S/I of the sub-carrier signal of the selected sub-carrier is measured. ... If at step 92 there are further subcarriers, then at step 94 the next sub-carrier is selected and 55 the algorithm returns to step 86 to measure the S/I of sub-carrier signal of the next sub-carrier. (Hashem '569 at 5:46-57.)

356. Moreover, Figure 3 (reproduced below) is a "flow chart of a method by which a remote unit determines and conveys information concerning acceptable sub-carriers to a base

station.” (Hashem ’569 at 3:56-58.) As noted above, “remote unit” is the terminology used in Hashem to indicate what the asserted claim refers to as the “subscriber.”

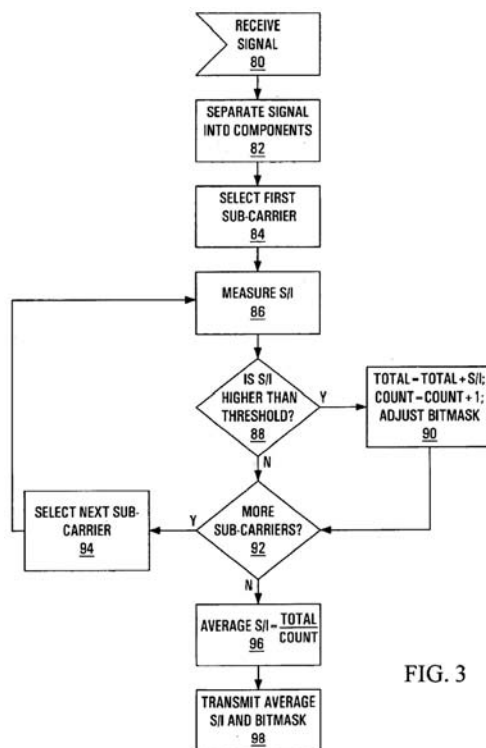


FIG. 3

357. The remote unit performs channel and interference measurements “for a plurality of subcarriers.” Hashem ’569 states that “OFDM systems can use 1000 sub-carriers[.]” (Hashem ’569 at 2:8-9.) With reference block 94 in Fig. 3, the ’569 explains that “[i]f at step 92 there are further sub-carriers, then at step 94 the next sub-carrier is selected and the algorithm returns to step 86 to measure the S/I of subcarrier signal of the next sub-carrier.” (Hashem ’569 at 5:54-57.)

358. Thus, Hashem ’569 discloses “a subscriber measuring channel and interference information from a plurality of subcarriers.”

4. Element 6[a][2]

359. Claim element 6[a][2] of the ’748 Patent reads: “**based on pilot symbols received from a base station.**”

360. This element is disclosed by Hashem '569. Because the application for Hashem '129 is incorporated into Hashem '569, any disclosure in the '129 patent is disclosed in Hashem '569. In its "Summary of the Invention," the '129 patent discloses:

The present invention also provides a method of determining a signal to interference ratio of a signal sub-carrier in a communication system. *The communication system includes a base station which transmits a pilot signal to a remote unit* over a pilot sub-carrier. The pilot signal may be either on or off. The remote unit measures a signal strength of the pilot sub-carrier when the pilot signal is on and measures a signal strength of the pilot sub-carrier when the pilot signal is off, the latter being in effect a measurement of interference in the pilot sub-carrier as there is no pilot signal. The remote unit calculates a ratio of the signal strength when the pilot signal is on to the signal strength when the pilot signal is off. ('129 Patent at 2:65-3:10 (emphasis added).)

361. The '129 patent refers to this approach as a "blinking" pilot symbol, and it proposes two different algorithms for computing a signal-to-interference ratio based on blinking pilot symbols transmitted from the base station. Figures 5 and 6 from the '129 patent reproduced below, are flow charts that disclose the two algorithms for computing the required SIR based on pilots received from a base station.

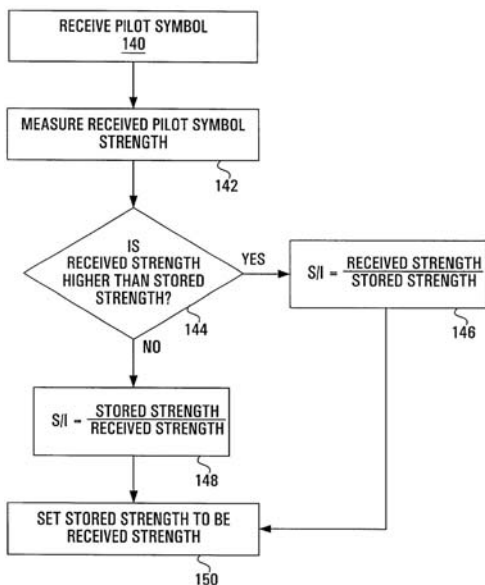


FIG. 5

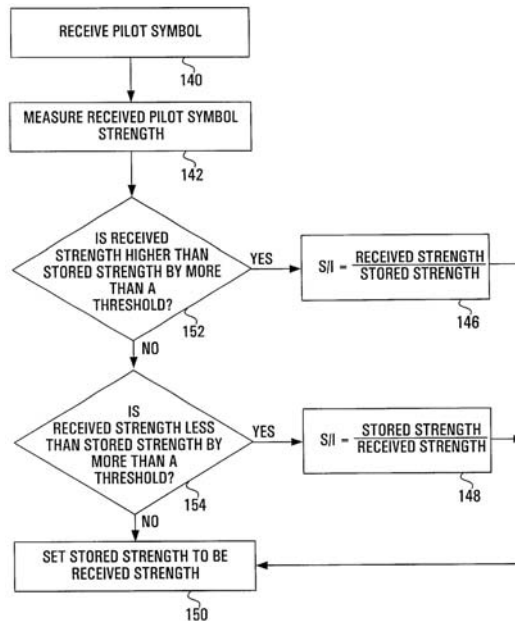


FIG. 6

362. Thus, Hashem '569 discloses “based on pilot symbols received from a base station”

5. Element 6[b]

363. Claim element 6[b] of the '748 Patent reads: “**the subscriber selecting a set of candidate subcarriers.**”

364. This element is disclosed by Hashem '569. In its “Summary of the Invention,” Hashem '569 states: “The present invention provides a method of selecting and signalling the identity of acceptable groups of sub-carriers in a radio communication system.” (Hashem '569 at 2:24-25 (emphasis added).) More specifically, Hashem '569 describes a method for selecting a set of candidate subcarriers based on whether their measured SIR is above or below a threshold value:

The sub-carrier analysis processor 26 compares the S/I of each sub-carrier signal with a threshold to determine which sub-carriers are acceptable sub-carriers. Acceptable sub-carriers are sub-carriers for which the measured S/I of the corresponding sub-carrier signal is higher than the threshold. Sub-carriers for which the measured S/I of the corresponding sub-carrier signal is not higher than the threshold are unacceptable sub-carriers. (Hashem '569 at 4:29-36.)

365. Thus the sub-carriers deemed “acceptable” in Hashem '569 are the “selected” set of candidate subcarriers required by the claim element, while the “unacceptable” sub-carriers are the ones that are not selected according to the claim element. Moreover, this selection process is carried out in the sub-carrier analysis processor, which is a component in the remote unit – or what the claim language refers to as the subscriber – as indicated in Figure 1 from Hashem '569, reproduced below.

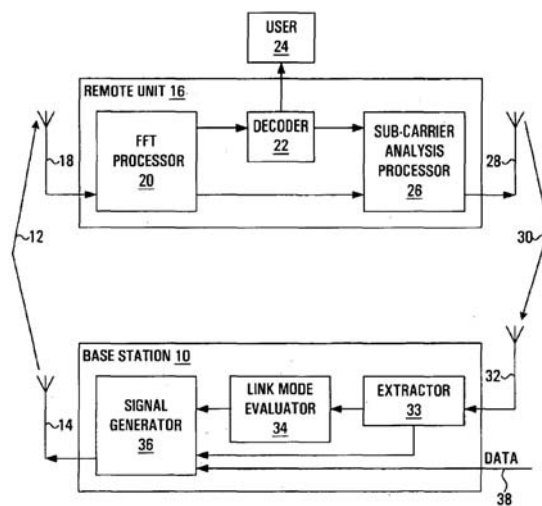


FIG. 1

366. Thus, Hashem '569 discloses “the subscriber selecting a set of candidate subcarriers.”

6. Element 6[c][1]

367. Claim element 6[c][1] of the '748 Patent reads: “**the subscriber providing feedback information on the set of candidate subcarriers to the base station.**”

368. This element is disclosed by Hashem '569. Specifically, in Figure 3 (reproduced below) the remote unit (“subscriber”) generates a bitmask identifying the acceptable sub-carriers and the average SIR of the same; then, in the final step of Figure 3, the remote unit transmits both the bitmask and the average SIR – thus providing the required feedback to the base station.

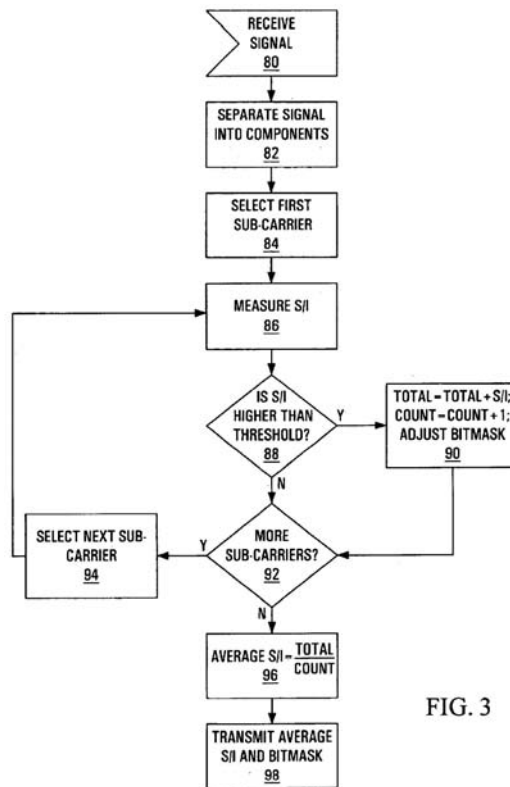


FIG. 3

369. Hashem '569 discloses other forms of feedback as well. For example, rather than a bitmask and average SIR, Hashem '569 proposes a feedback mechanism in which “the remote unit calculates the optimum Link Mode itself and transmits a reference to the optimum Link Mode to the base station.” (Hashem '569 at 7:1-3.) In such a system, the feedback would be comprised of a bitmask and one or more indices – either explicit or differential, as explained in the “Hashem Background” section with regard to the '129 patent – that identify the link mode to be used on one or more sub-carrier or groups of sub-carriers.

370. Thus, Hashem '569 discloses “the subscriber providing feedback information on the set of candidate subcarriers to the base station”.

7. Element 6[c][2]

371. Claim element 6[c][2] of the '748 Patent reads: “**wherein providing feedback information comprises arbitrarily ordering the set of candidate of subcarriers as clusters of subcarriers.**”

372. Hashem '569 renders this limitation obvious.

373. The Court has defined “arbitrarily ordering” as “ordering in an order not known by the base station.” In one embodiment, the feedback information in the '569 contains two separate pieces of information relating to subcarrier selection. (*See, e.g.*, Hashem '569 at 2:66-3:3 and 7:27-51.) For example, Hashem '569 states that the feedback report contains “a sequence of numbers, each number corresponding to one group of sub-carriers, **and** at least one value by which the base station can determine at least one Link Mode.” (Hashem '569 at 2:67-3:3; *see also id.* at 7:31-35 (“The sequence of numbers identifying the acceptable sub-carriers and the values by which the base station can determine the Link Modes can be **sent along the return channel separately**, or can be combined by forming the sequence of numbers from the sub-carrier Link Mode of each acceptable sub-carrier and one or more distinct values identifying unacceptable sub-carriers”).) Thus, one piece of feedback information “identif[ies] the acceptable sub-carriers” and a separate piece of information is a “value by which the base station can determine the Link Modes.” (*Id.*)

374. One format Hashem '569 discloses for sending feedback information is a “bitmask” in which the subcarrier feedback is sent for each and every subcarrier (or group of subcarriers) in an order that **is** known by the base station. (*See* Hashem '569 at 6:16-24 (“If the selected sub-carrier was the sixth sub-carrier, then a comparison of the sub-band number and the bitmask would produce a value of ‘0’ since that is the value of the sixth bit[.]”); *see also id.* at 6:16-21 and 8:21-44.) While this particular feedback technique does not expressly disclose this

element, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the feedback report in Hashem '569 to arbitrarily order the candidate subcarriers for at least two reasons: (1) eliminating reporting on non-candidate subcarriers (*i.e.* “unacceptable” subcarriers) would reduce reporting overhead (a stated goal of Hashem '569 (see Hashem '569 at 6:49, 7:1-3, and 8:21-23)) and (2) Hashem '569 already disclosed the use of a subcarrier identifier that was separate from the Link Mode reference, thus disclosing functionality related to this element.

375. The presence of a separate subcarrier identifier in Hashem '569 is significant because it could be easily modified to be used as an index to uniquely identify any subcarrier (or group of subcarriers) regardless of the order in which the “acceptable” subcarriers were reported to the base station. Implementing such a change where the feedback order is not known in advance by the base station was well within the grasp of a person of ordinary skill in the art at the time of the invention and would achieve the readily recognizable and expected result of reduced overhead reporting. Thus, Hashem '569 renders it obvious to “arbitrarily order[]” the selected subcarriers in a feedback report (*i.e.*, “ordering in an order not known by the base station”).

376. Alternatively, the combination of Hashem '569 and Ritter renders this element obvious. Ritter describes the feedback as a “priority list that contains information on a most suitable segment for its own communication connection and on additional segments preferably suitable for its own communication connection.” (Ritter at 3.) As an example, Ritter describes how “Messages regarding the segments S_x, S_y, S_z are entered into a priority list PL1, numbered according to their suitability for the communication connection, and sent to the base station BS.” (*Id.*)

377. In Ritter, “Sx” is “the segment most suitable for [the mobile station],” while Sy and Sz are “additional segments preferably suitable for [the MS’s] own communication connection.” Thus, the ordering of the segments/clusters in Ritter is “according to their suitability for the communication connection” – an ordering that is neither defined nor known until the segments are measured and selected in Ritter’s “measurement” and “selection” steps. Referring to the background section, Ritter is therefore proposing an “arbitrarily ordered” form of feedback that requires an index or indicator that identifies each cluster; because the order in which Ritter reports his measurements requires that the results of those measurements be known – and that order changes over time – it cannot have been “previously defined.” As set forth above, one skilled in the art would have found it obvious to combine Ritter and Hashem ’569.

8. Element 6[c][3]

378. Claim element 6[c][3] of the ’748 Patent reads: **“wherein the feedback information includes an index indication of a candidate cluster with its SINR value.”**

379. This element is disclosed and rendered obvious by Hashem ’569. As noted above, Hashem ’569 discloses the use of a “bitmask” as an index indication of a candidate cluster – which could be a binary sequence in which a value of “1” indicates that the associated subcarrier (or group of subcarriers) is a candidate cluster and a value of “0” indicates that it is not – and it discloses feedback information comprised of that bitmask along with the average signal-to-interference ratio (SIR) of the candidate cluster identified by the bitmask. (See Hashem ’569 at 2:66-3:3; 7:27-51; 8:21-44 and 7:7-10 (“The return signal can be viewed more generally as including a sequence of numbers identifying acceptable sub-carriers, and a value by which the base station can determine an optimum Link mode.”).) This form of feedback is shown in the last block (numbered 98) of the flowchart in Figure 3 from Hashem ’569, reproduced below.

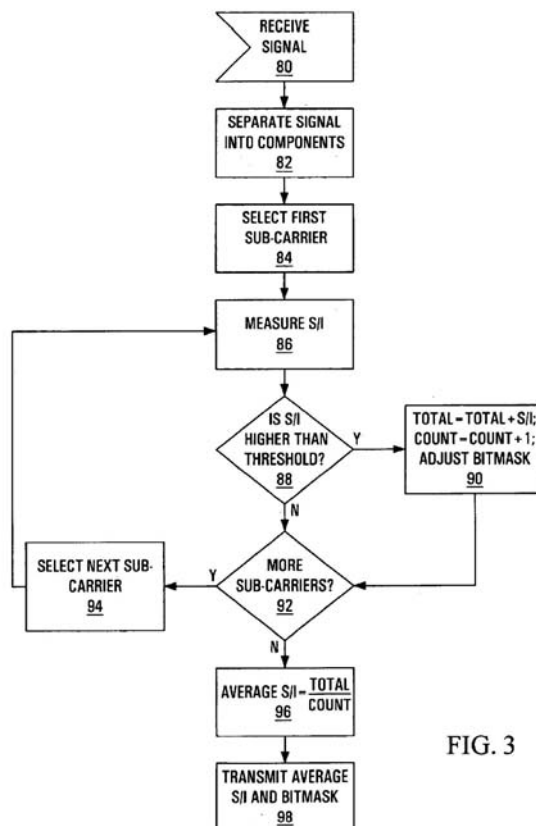


FIG. 3

380. So Hashem '569 discloses feedback information that includes an index indication of a candidate cluster with its SIR value—not its SINR value. (Hashem '569 at 4:53-55 (“The return signal 30 includes the average S/I of acceptable sub-carriers and a sequence of numbers identifying the acceptable sub-carriers.”).) While there is a difference between a signal-to-interference ratio (SIR) and a signal-to-interference-plus-noise ratio (SINR), it would have been obvious, in a cellular system where the dominant corruption mechanism is interference – *i.e.*, an interference-limited environment – to have used SINR rather than SIR, because the noise in such a system is small relative to the interference, and it is easier to measure SINR than to measure SIR. Hashem '569 expressly discloses that “[t]he various embodiments have been described using a S/I as a measure of channel quality [but] *[o]ther measures of channel quality could be used* and an average channel quality reported to the base station, as long as the channel quality is

such that an optimum Link Mode can be determined.” (Hashem ’569 at 8:45-48 (emphasis added).)

381. Thus, Hashem ’569 discloses “and further wherein the feedback information includes an index indication of a candidate cluster with its SINR value.”

9. Element 6[d]

382. Claim element 6[d] of the ’748 Patent reads: “**the subscriber receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber.**”

383. The court has construed the phrase “subcarriers of the set of subcarriers selected by the base station” as “subcarriers that the base station has chosen from the set of candidate subcarriers selected by the subscriber.”

384. This element is satisfied or rendered obvious by Hashem ’569 in two ways. First, in describing the prior art, Hashem ’569 describes a system in which the subscriber receives from the base station a set of optimum transmission parameters that were based on the feedback provided by the subscribers:

The remote unit sends a signal back to the base station reporting the channel quality. Using the channel quality report received from the remote unit, the base station calculates a set of optimum transmission parameters which the base station will use in its next transmission of data. However, the base station must first send the set of new optimum transmission parameters to the remote unit using the previous transmission parameters. The remote unit receives the set of new optimum transmission parameters, interpreting the signal using the previous transmission parameters. (Hashem ’569 at 1:39-49 (emphasis added).)

385. One skilled in the art would understand that one implementation of the prior art method disclosed would include “an indication of subcarriers of the set of subcarriers selected by the base station.” Alternatively, under Adaptix’s apparent interpretation of the court’s claim construction order and infringement theory that any indication of subcarriers satisfies this

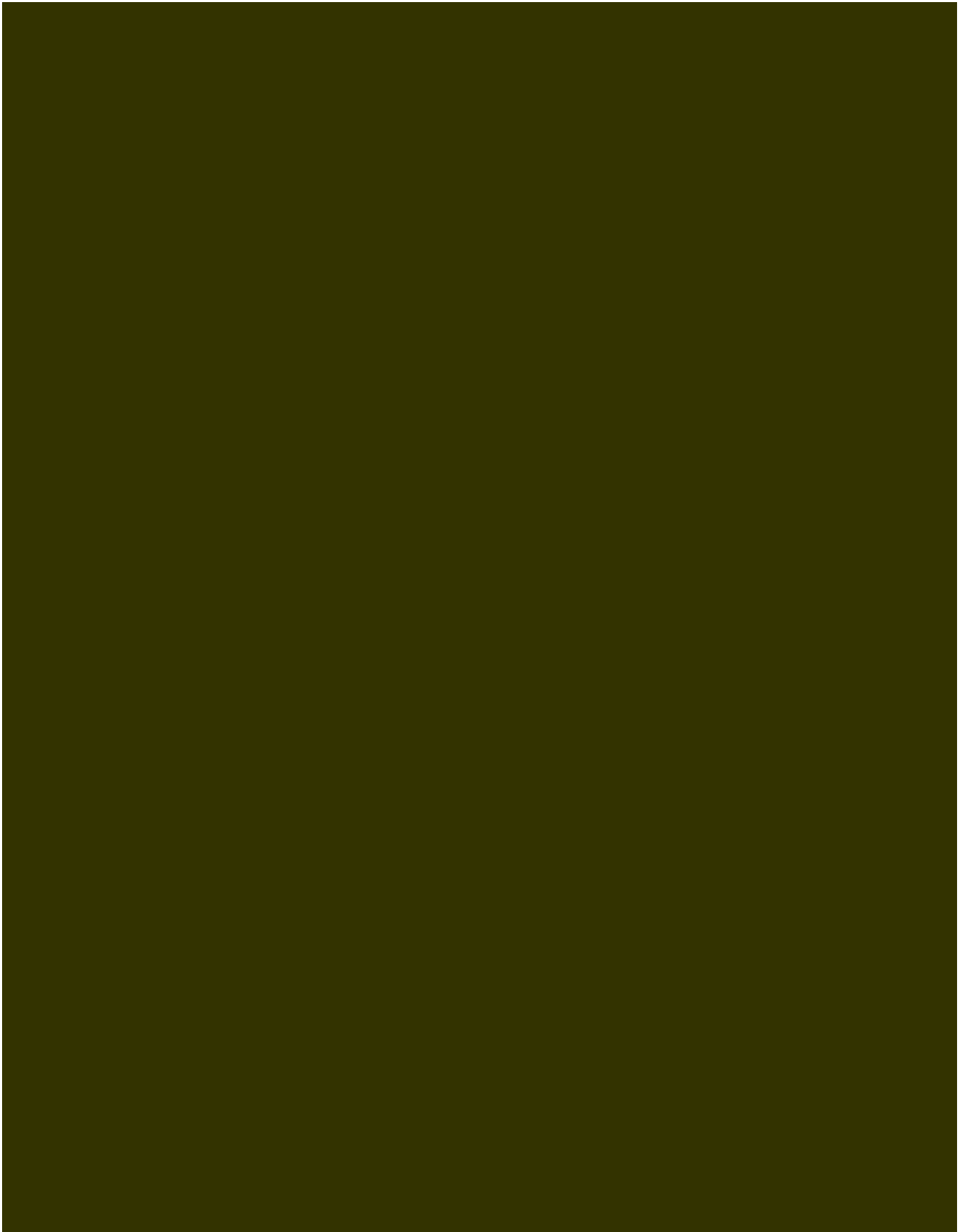
limitation, Hashem '569 expressly discloses this element. That the “set of subcarriers selected by the base station” comes from the candidate subcarriers is disclosed in Hashem '569 at 5:20-21: “The new signal [sent from the base station] only codes the data 38 over the acceptable subcarriers.”

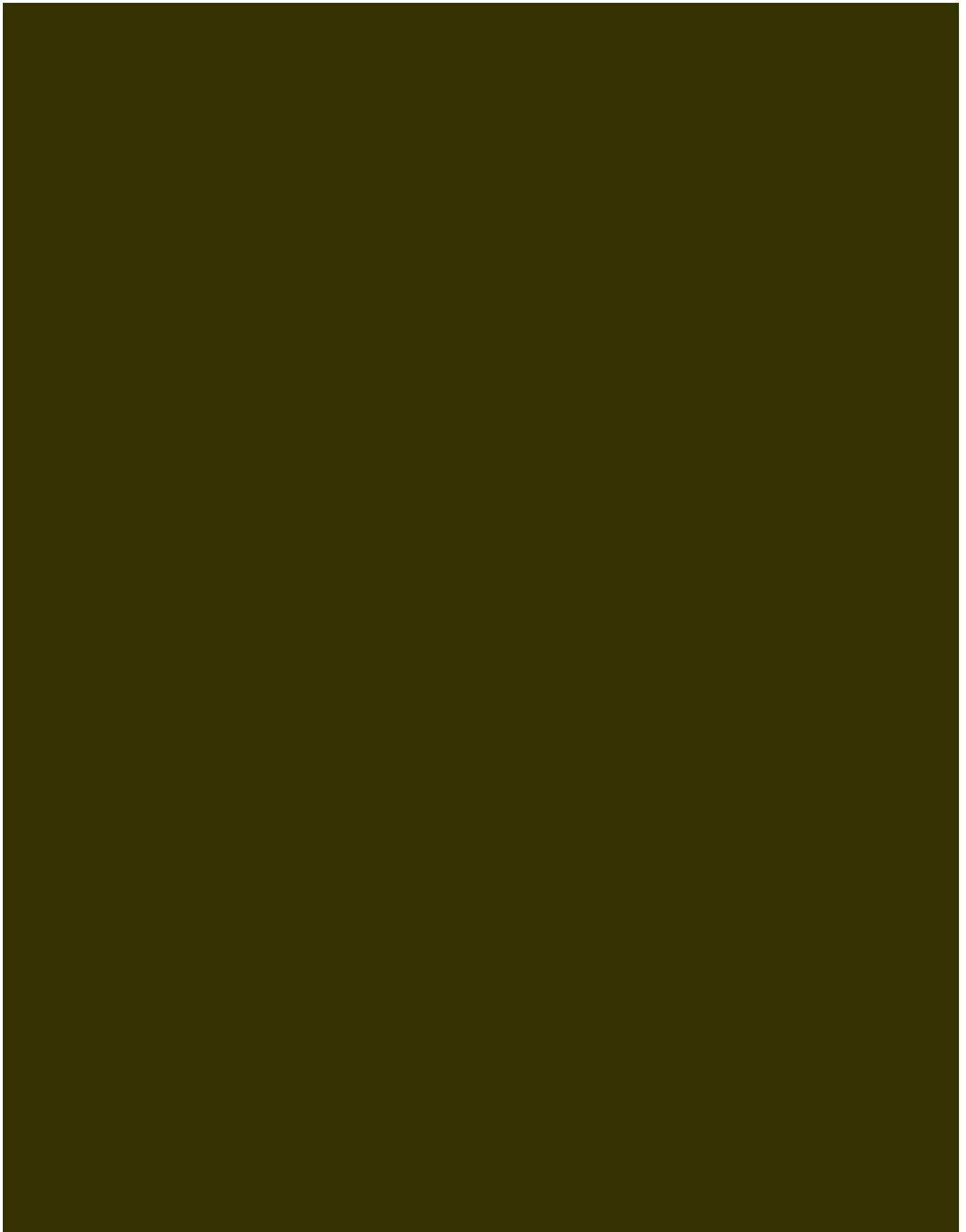
386. Second, Hashem '569 goes on to propose as part of its invention a more sophisticated technique that does not require the subscriber to receive this indication; specifically, Hashem '569 describes a system in which the optimum transmission parameters are determined by the subscriber (rather than by the base station based on measurements provided by the subscriber):

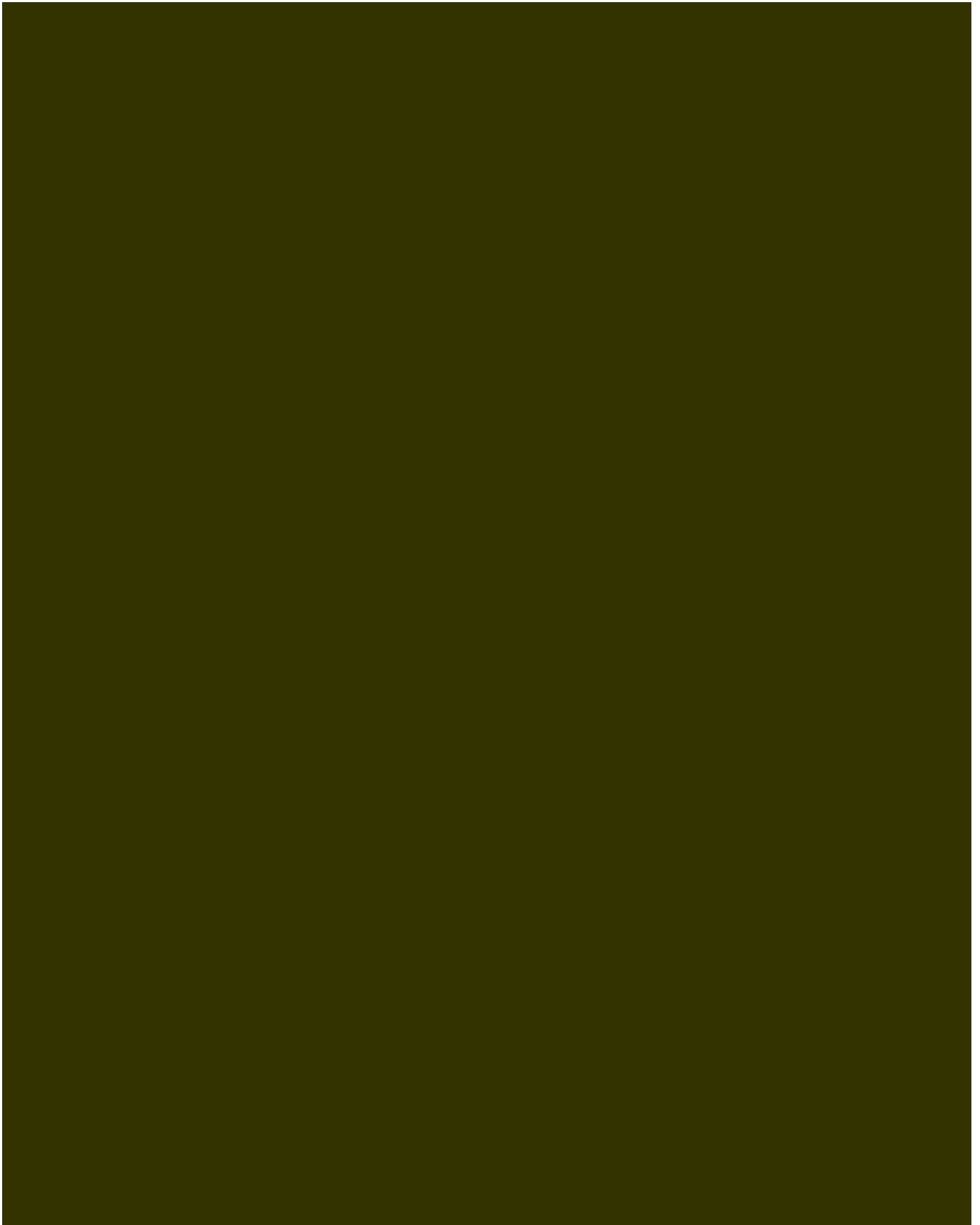
Overhead on the forward link from the base station to the remote unit can be reduced if the remote unit calculates the optimum Link Mode itself, using an algorithm similar to that used by the Link Mode evaluator 34. After a delay sufficient to allow the return signal 30 to reach the base station and to allow the signal 12 carrying a frame encoded using the optimum Link Mode to reach the remote unit, the decoder 22 decodes frames using the optimum Link Mode. The base station need not transmit the optimum Link Mode to the remote unit. (Hashem '569 at 6:50-59.)

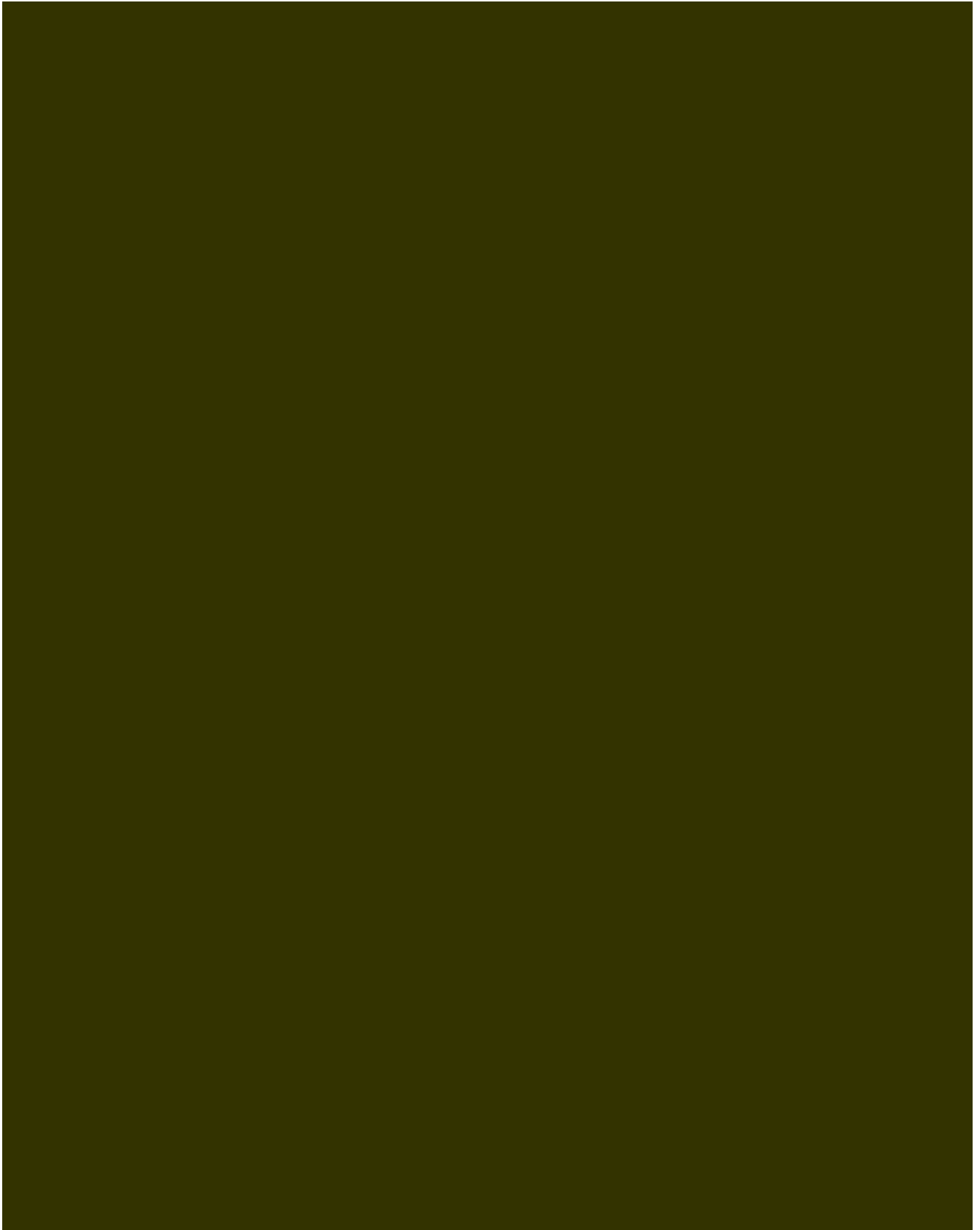
387. More generally, it would have been obvious to one of ordinary skill in the art for the base station, having received feedback from the subscriber regarding the suitability of candidate subcarriers, to have selected subcarriers and to have sent an indication of the set of subcarriers to the subscriber.

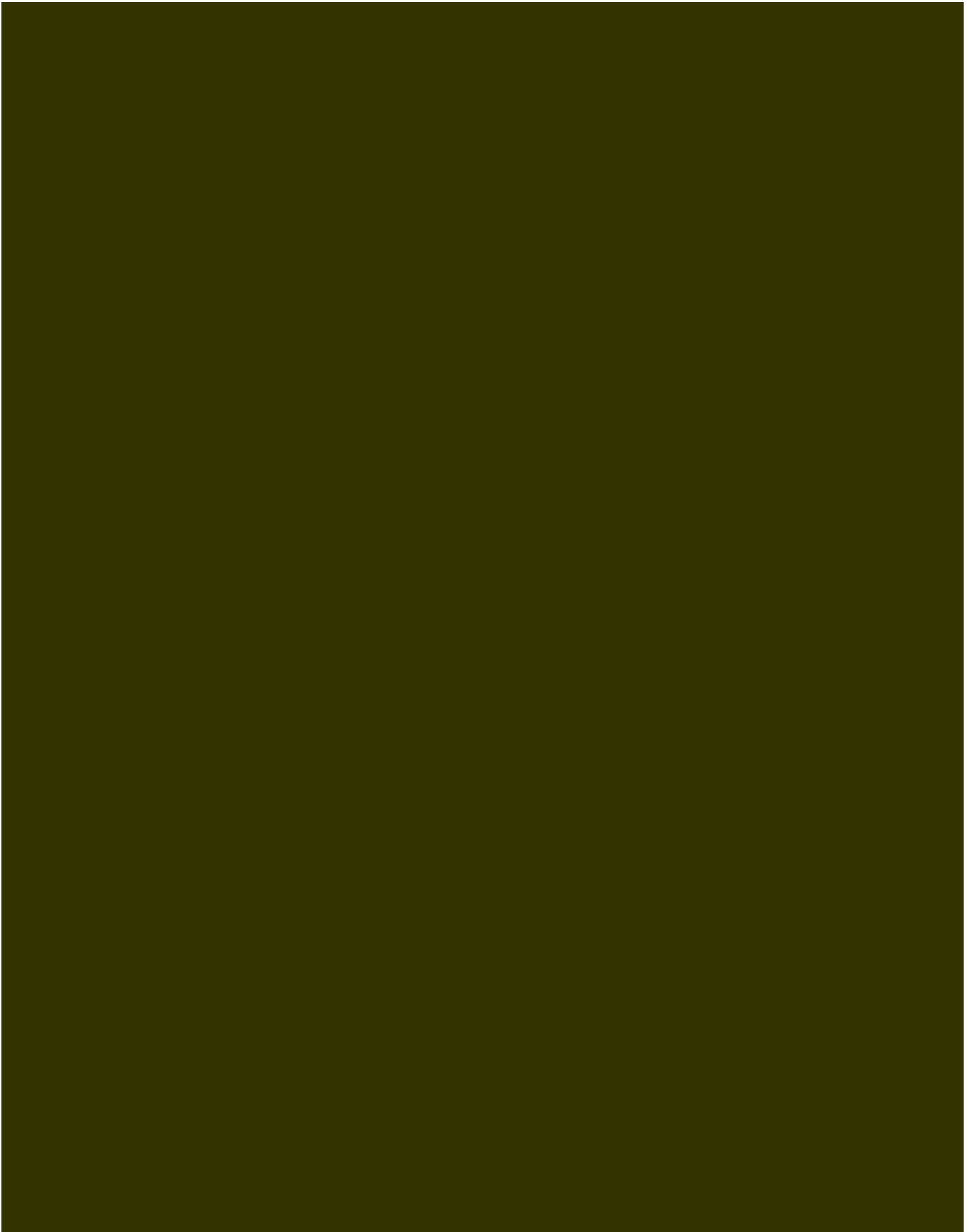
388. Thus, Hashem '569 discloses or renders obvious “the subscriber receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber.”

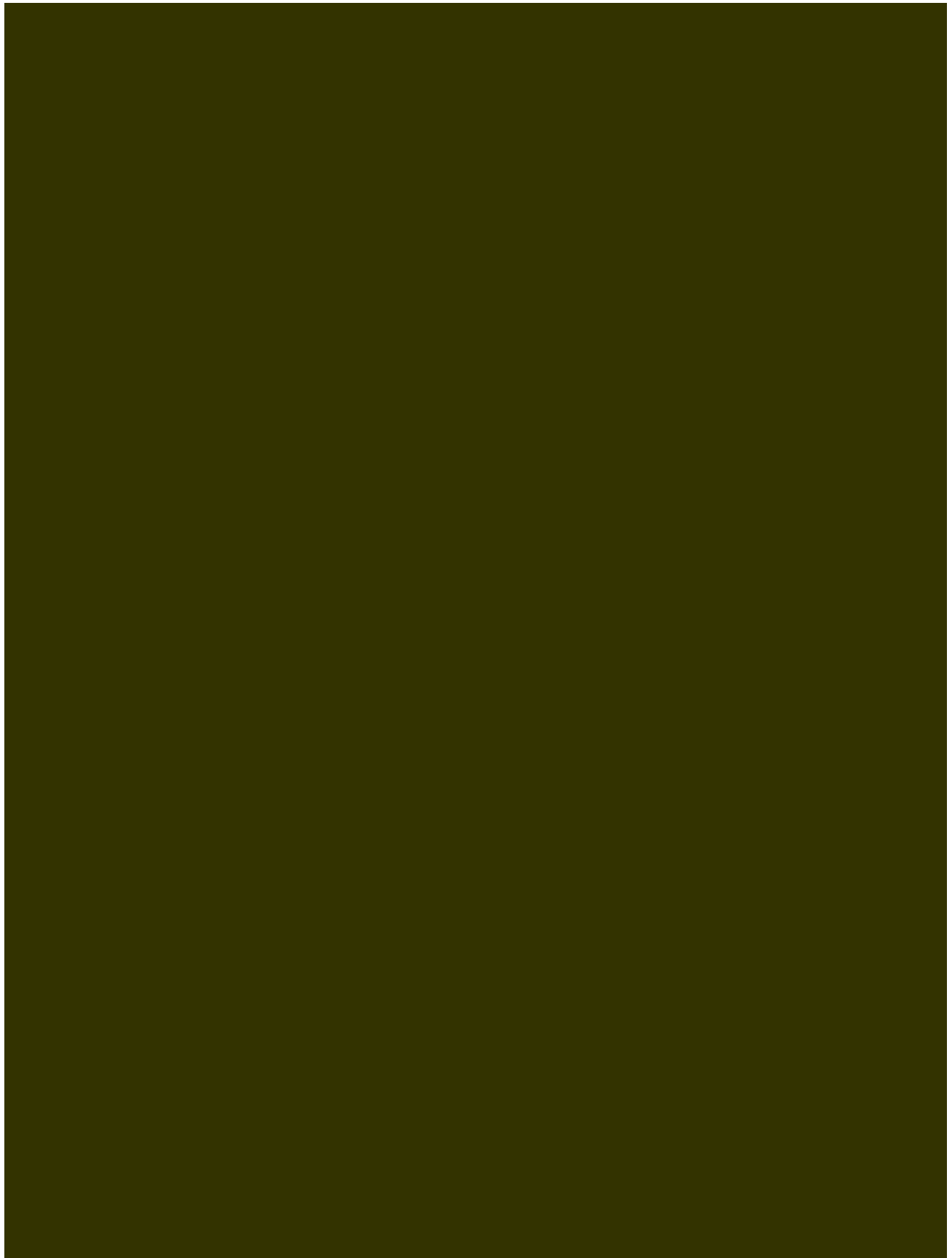


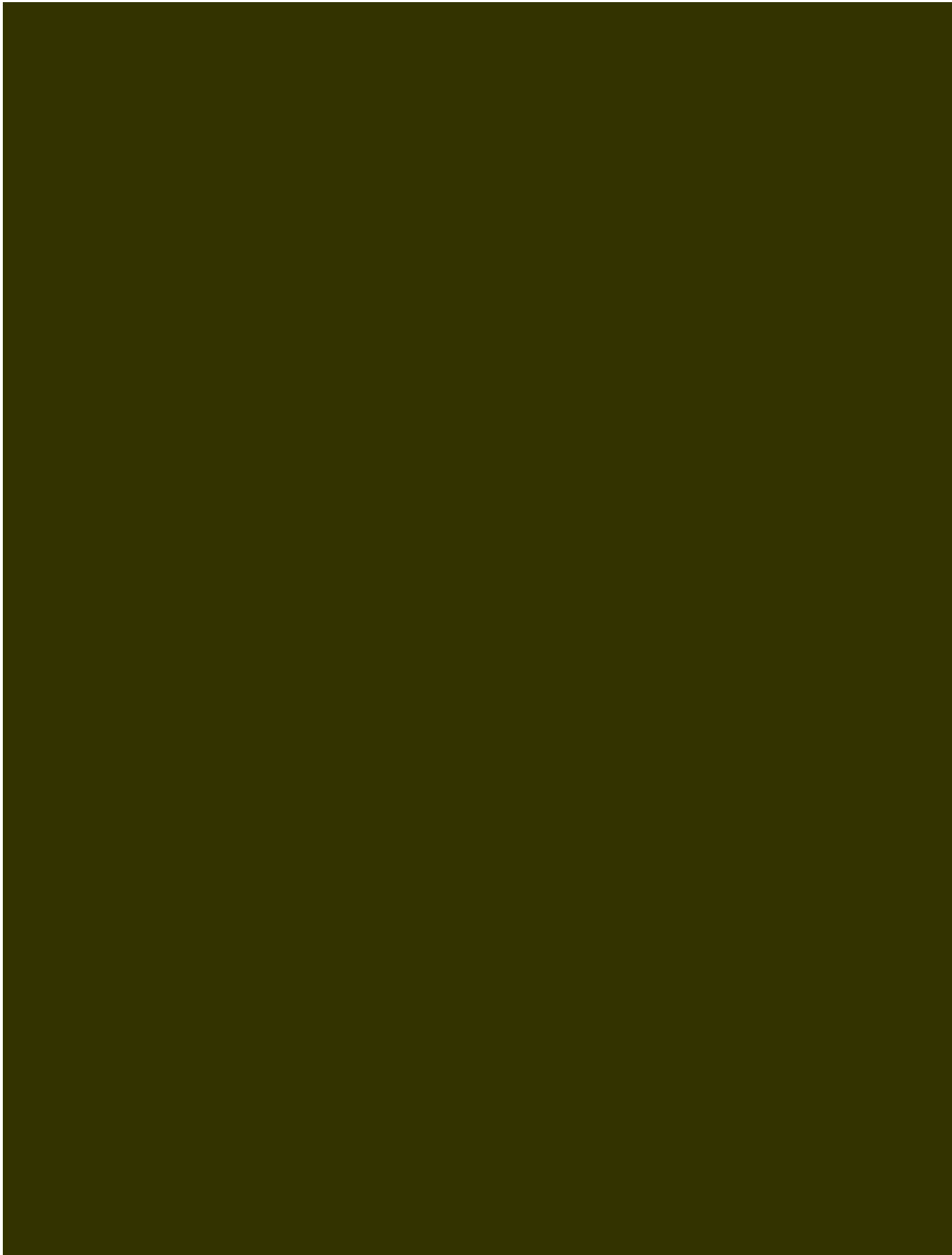


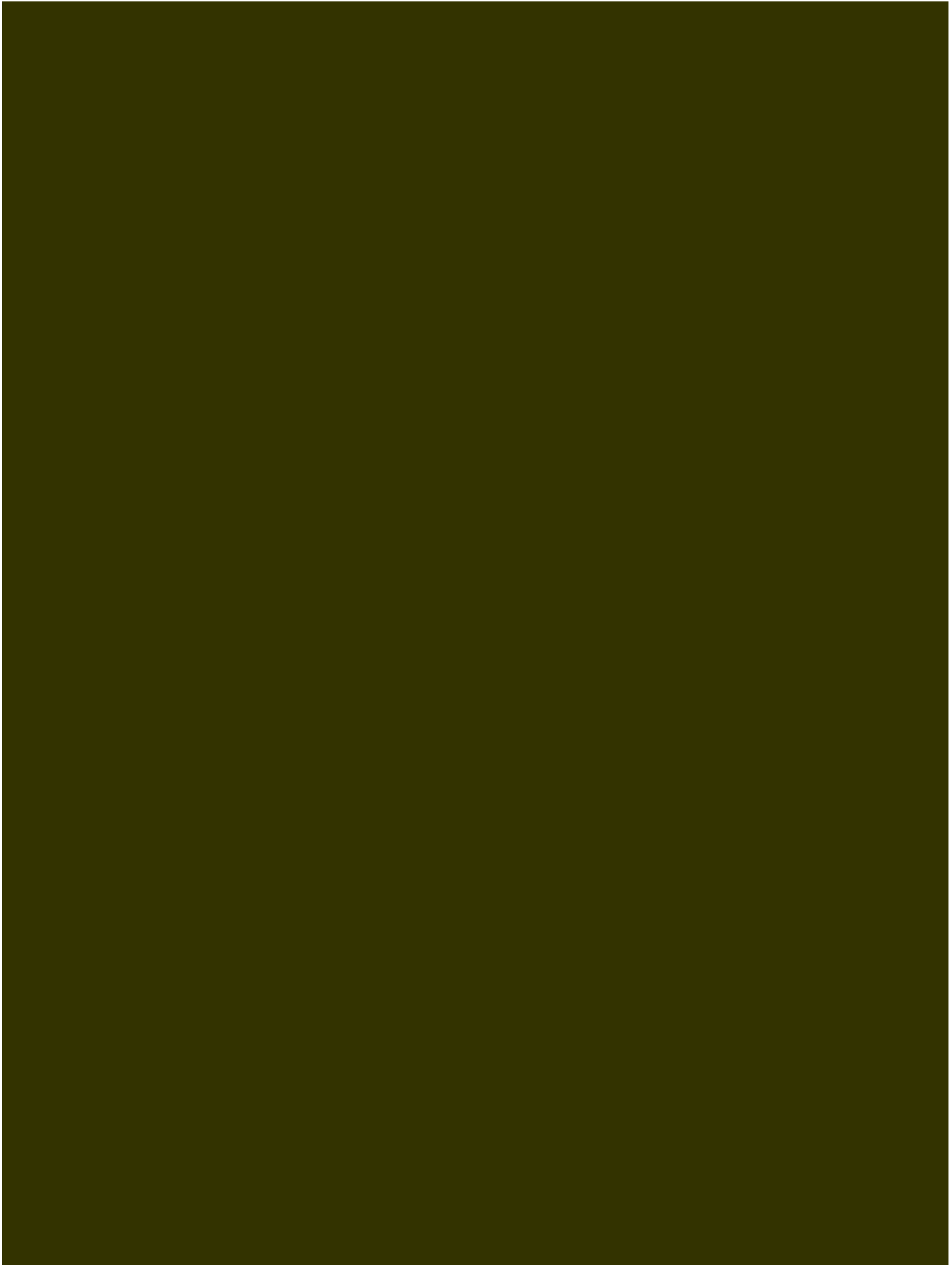


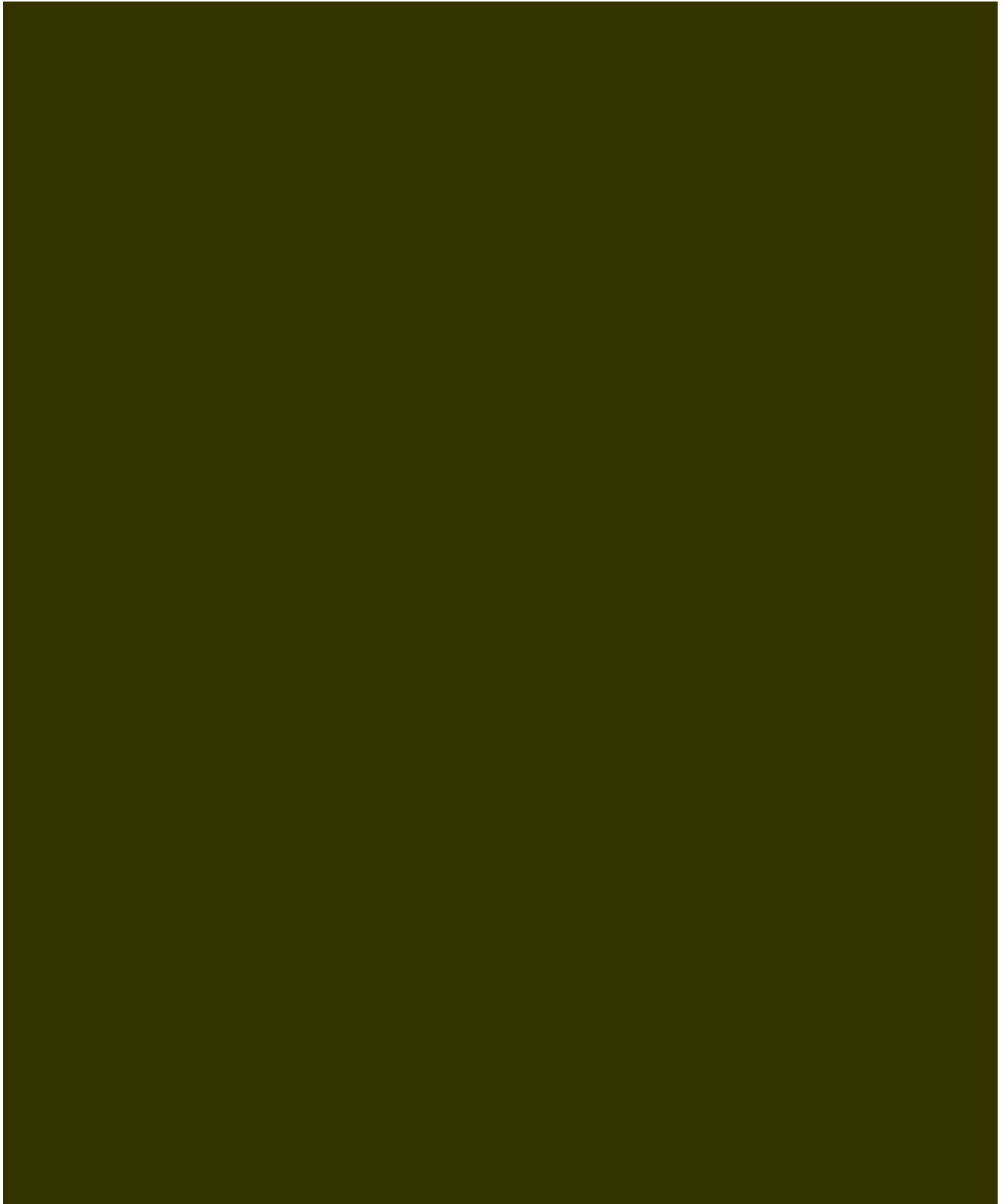


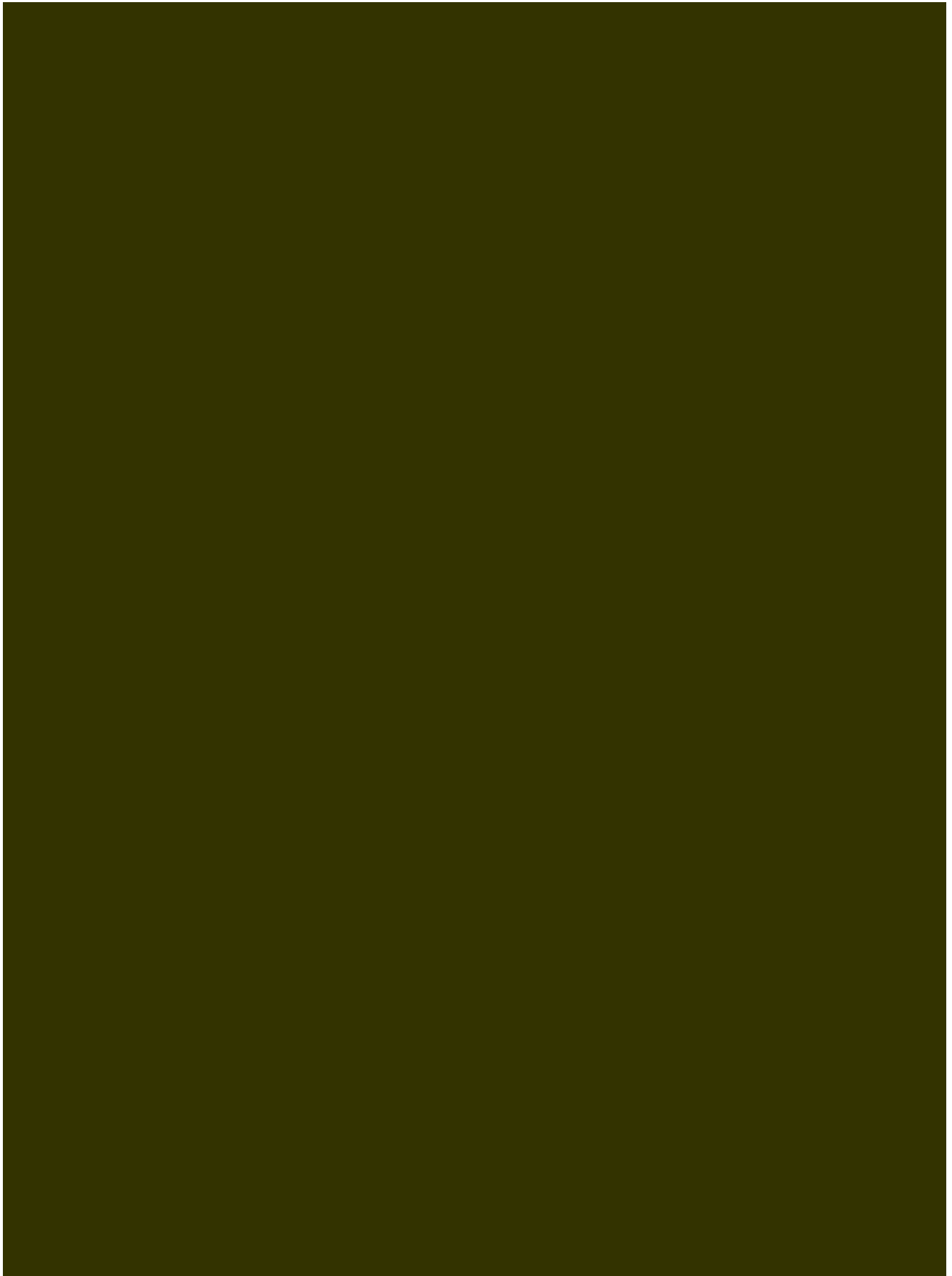


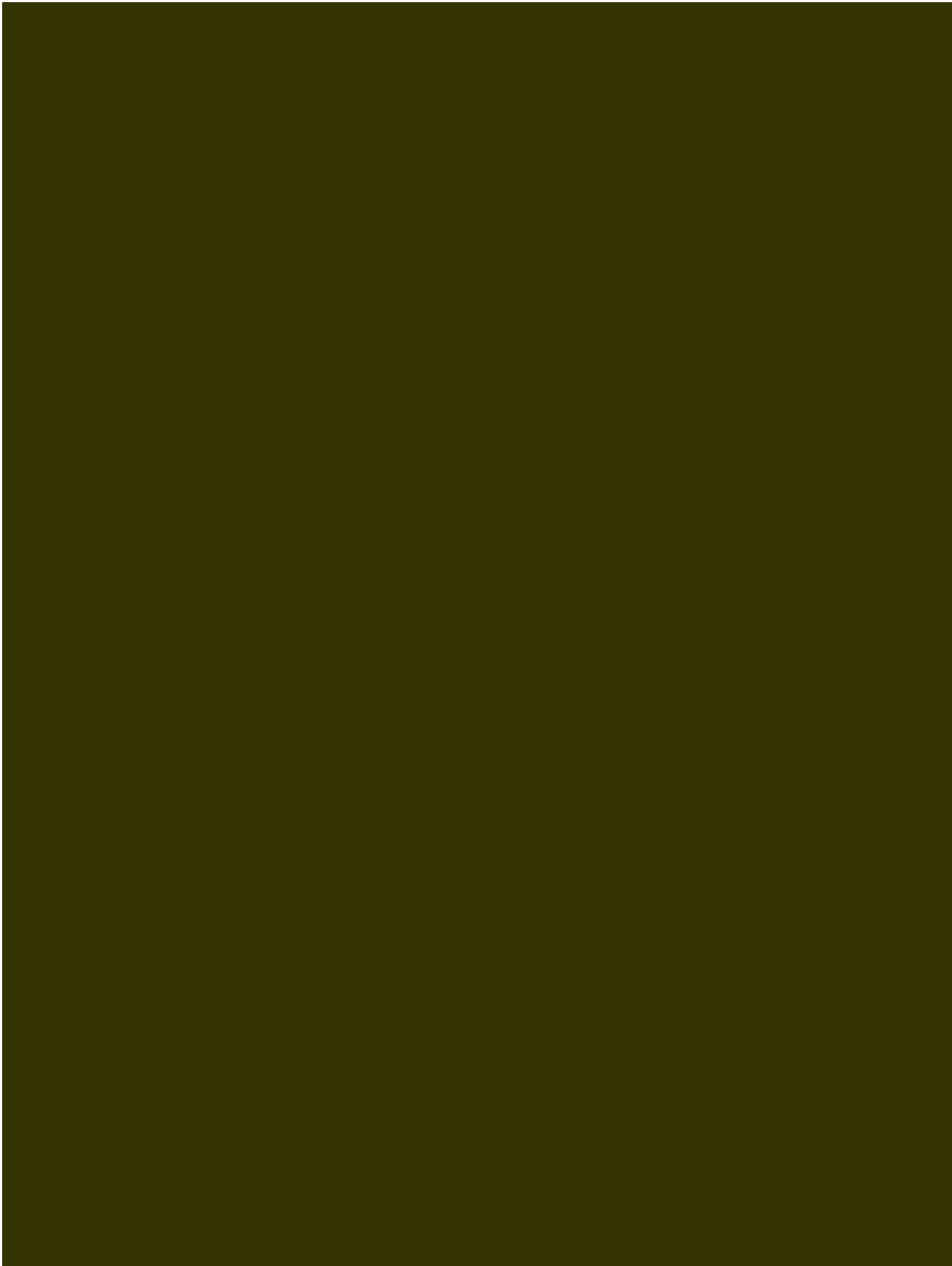


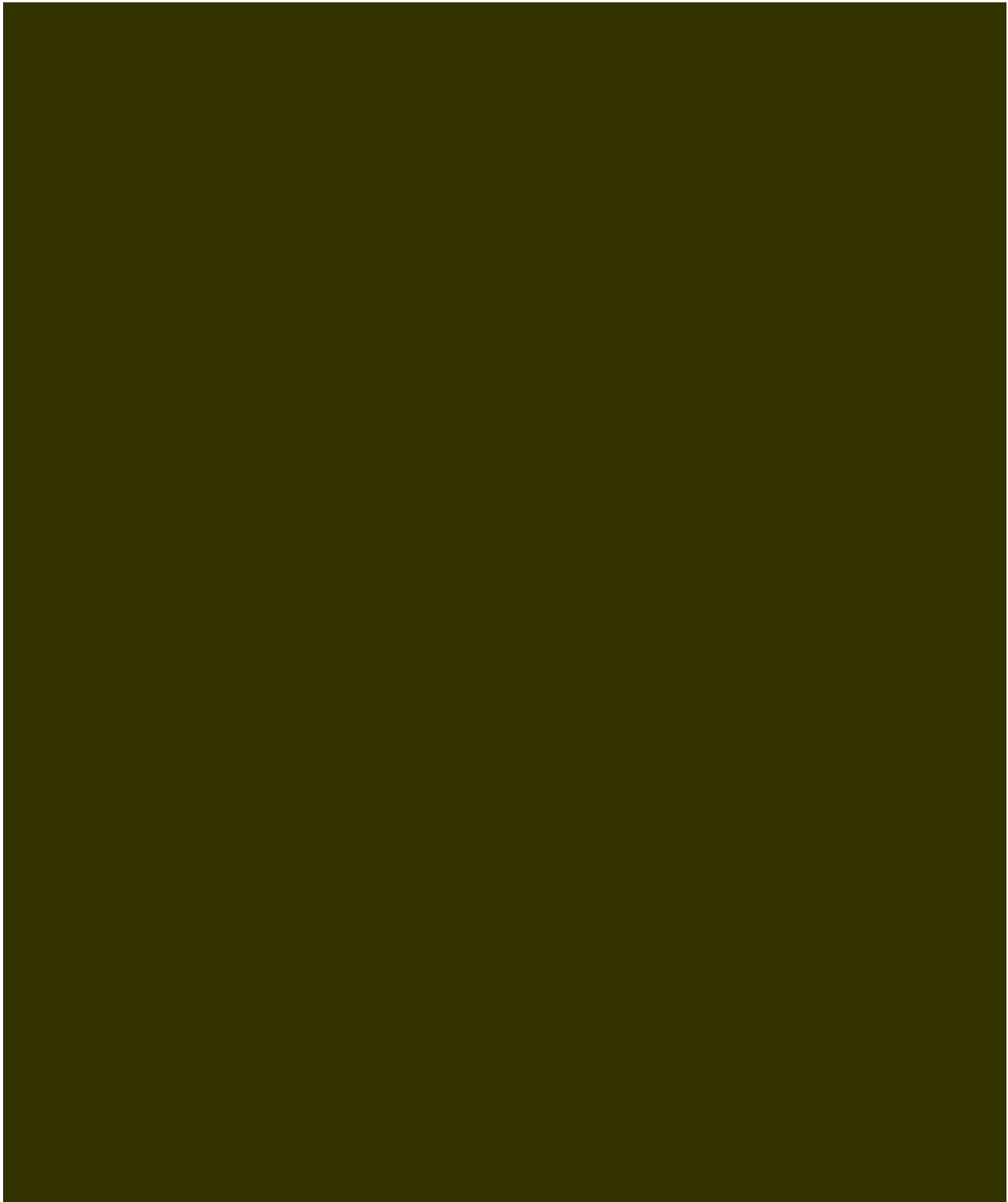


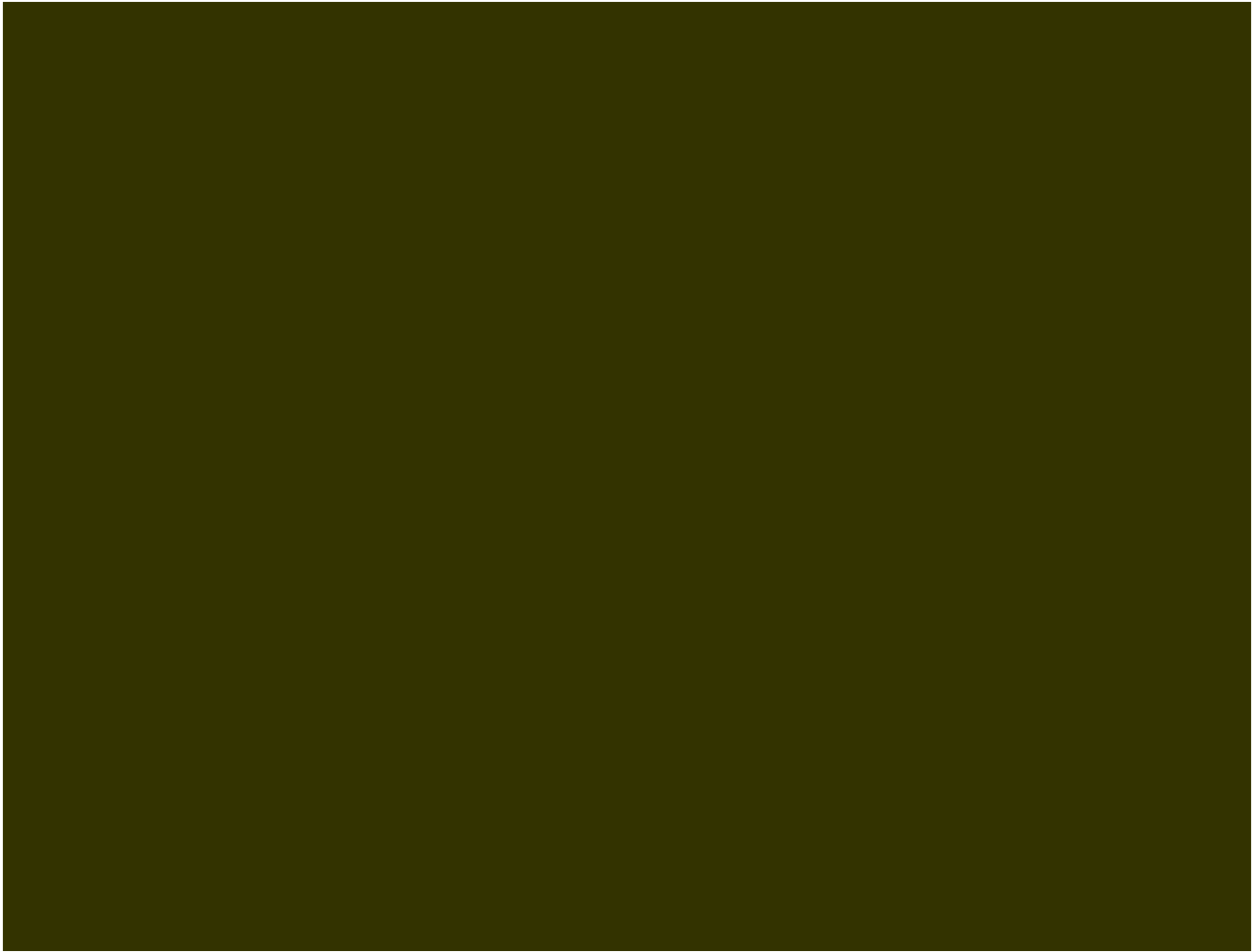


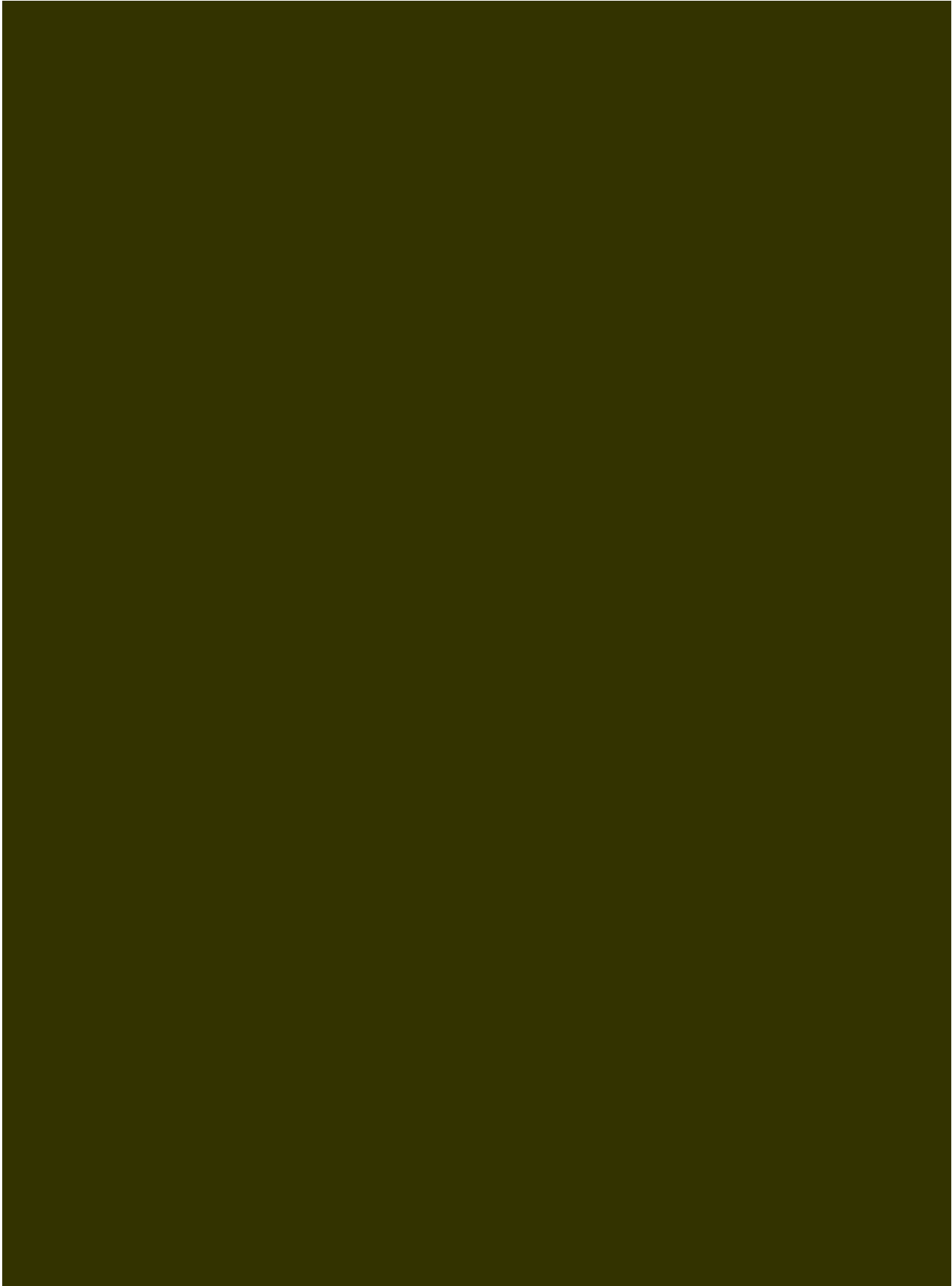


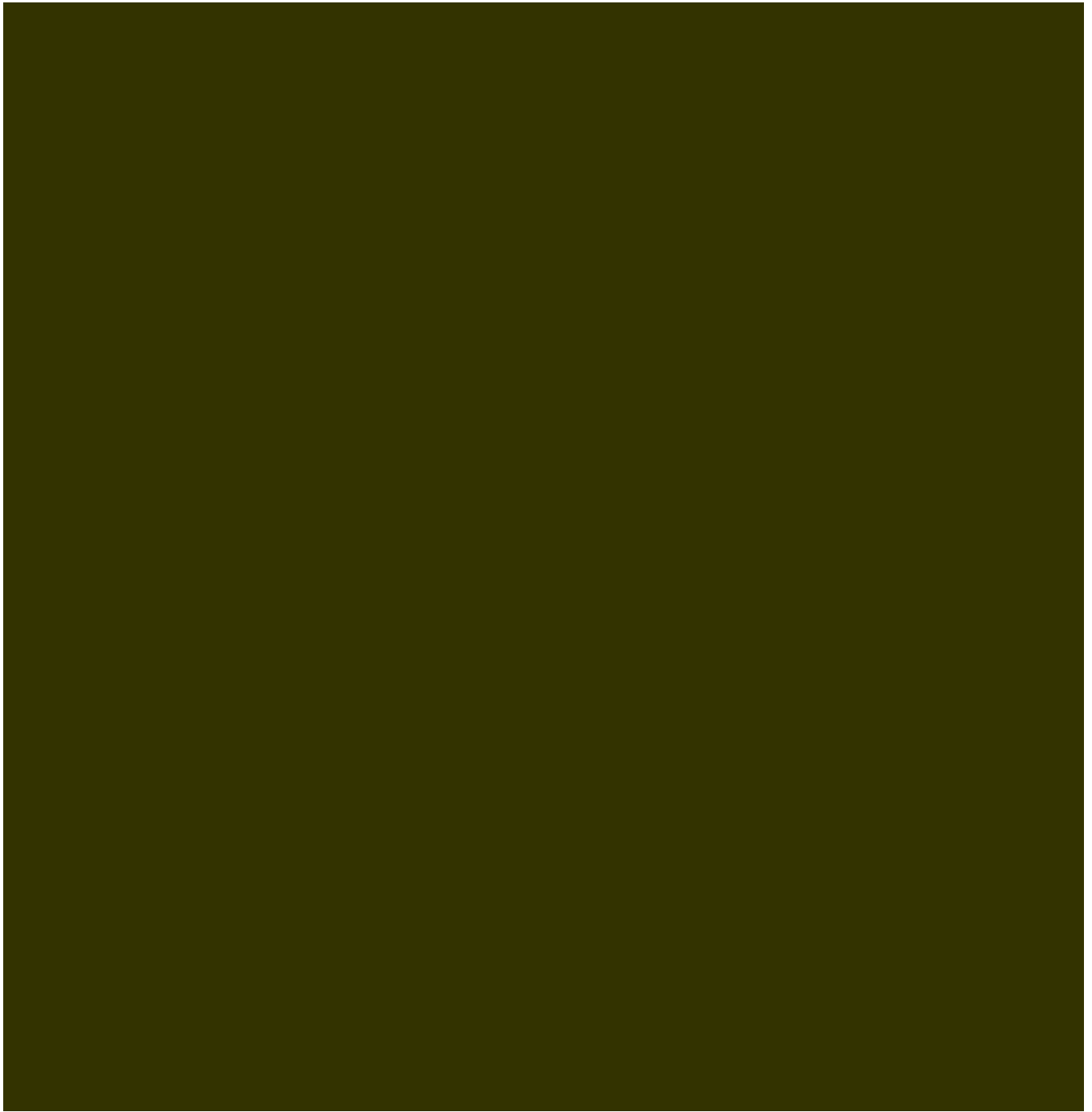


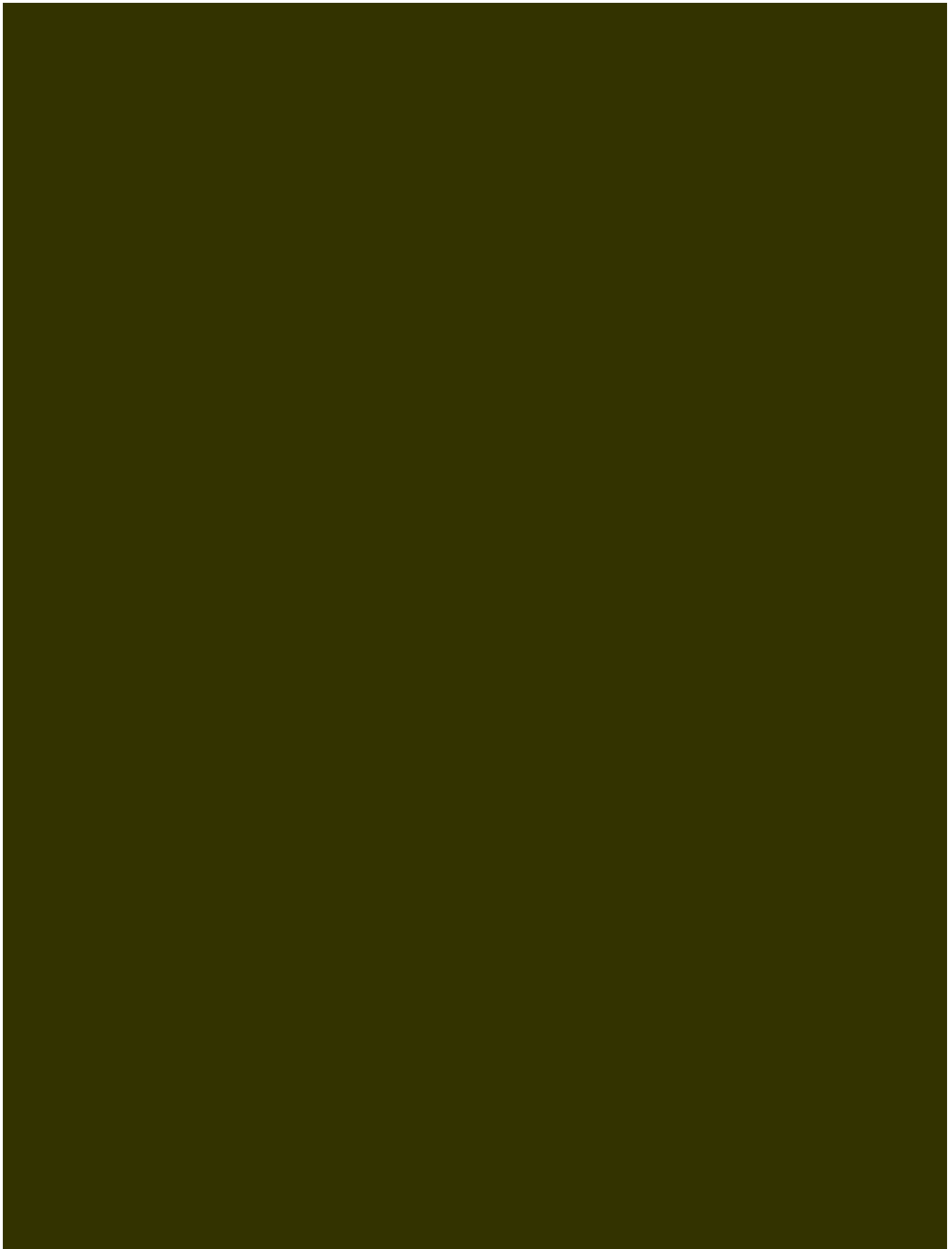






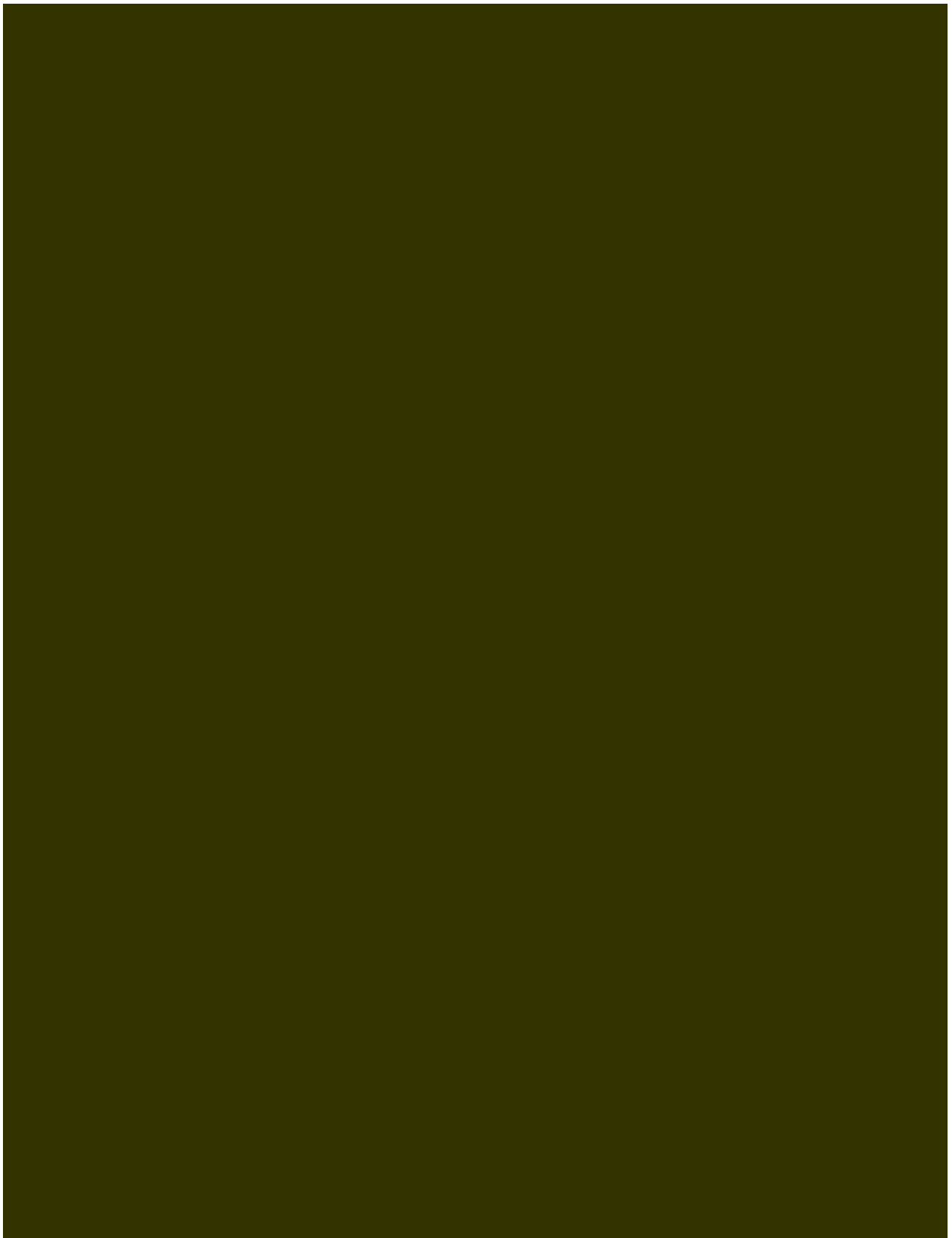




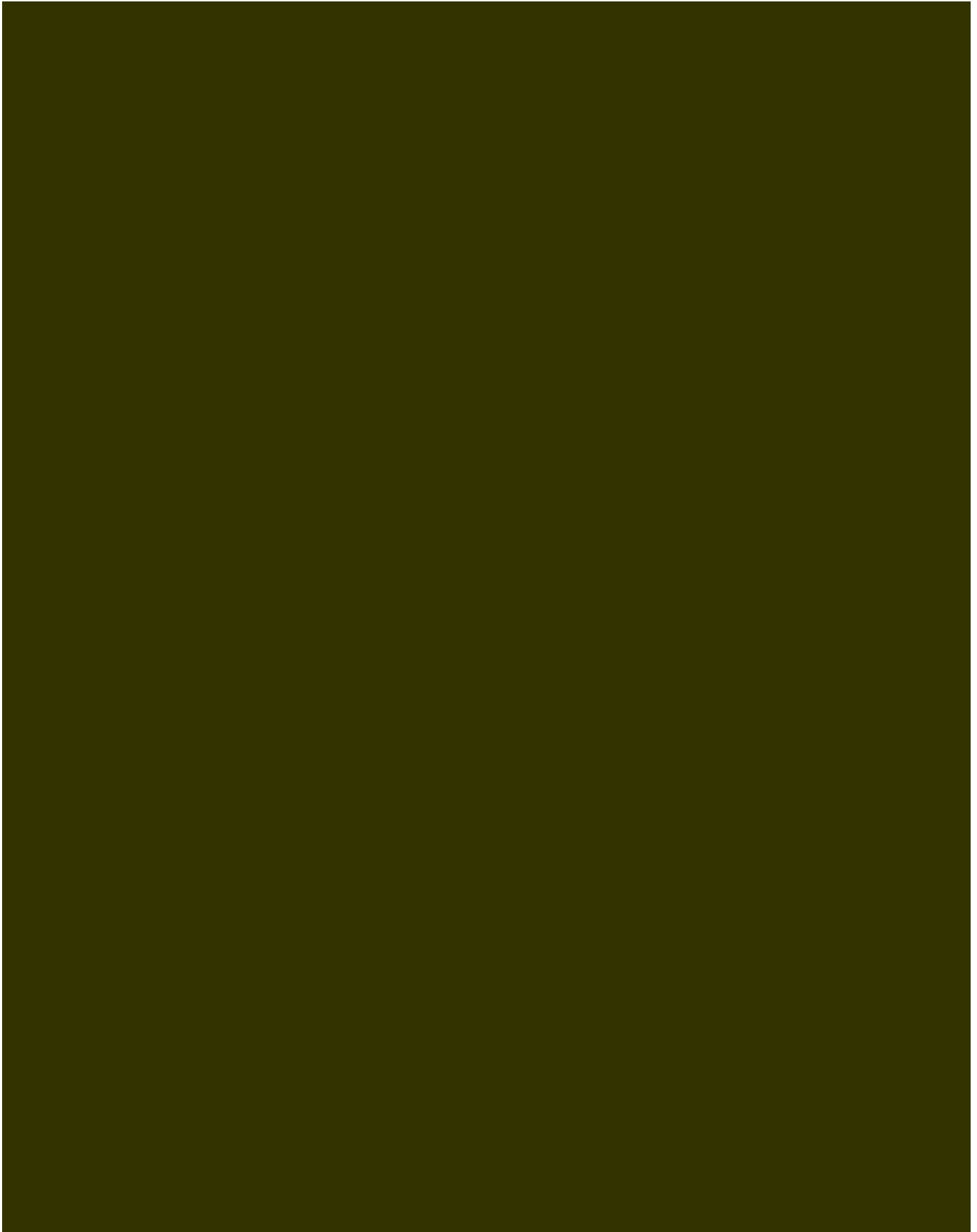


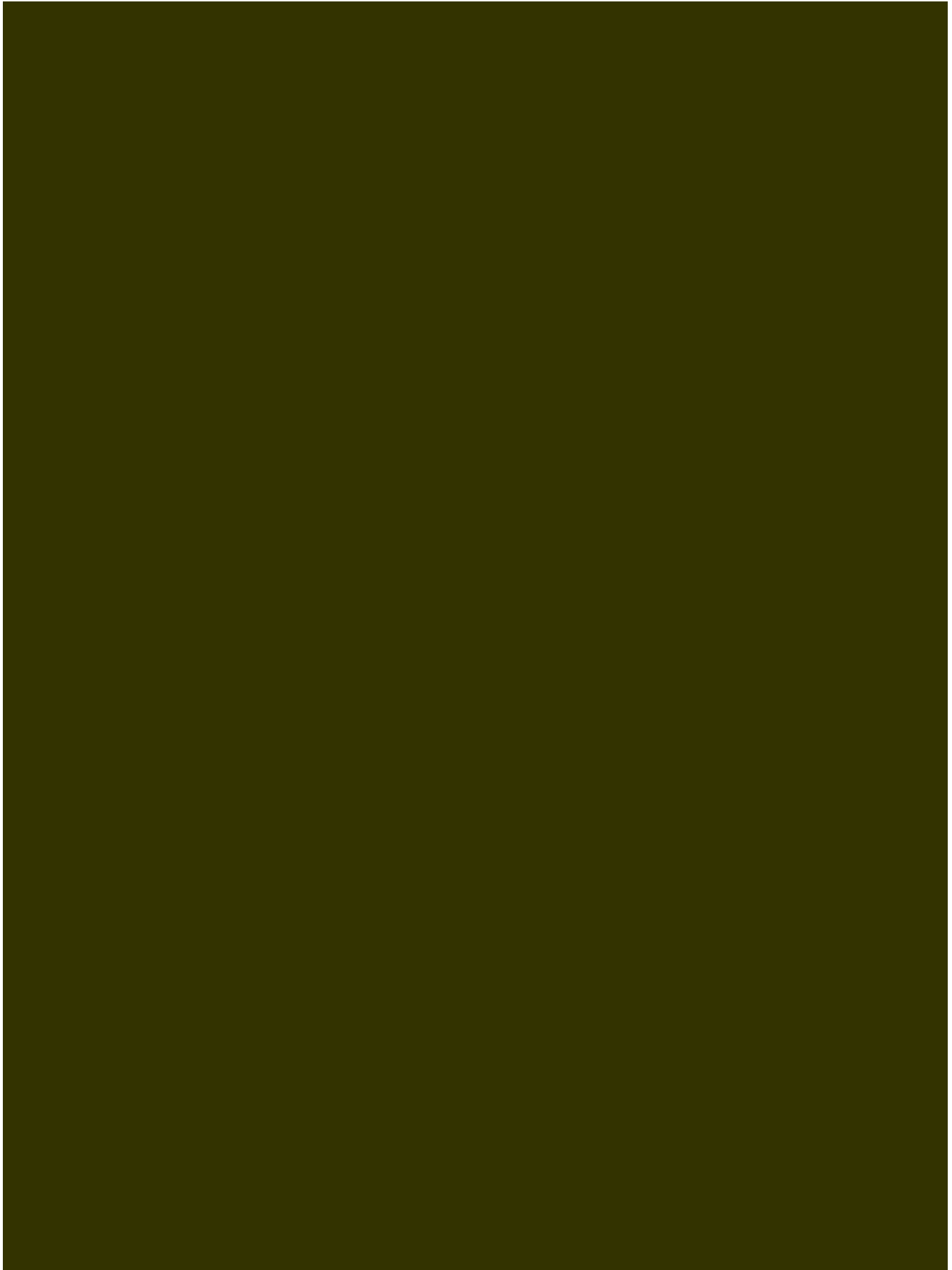


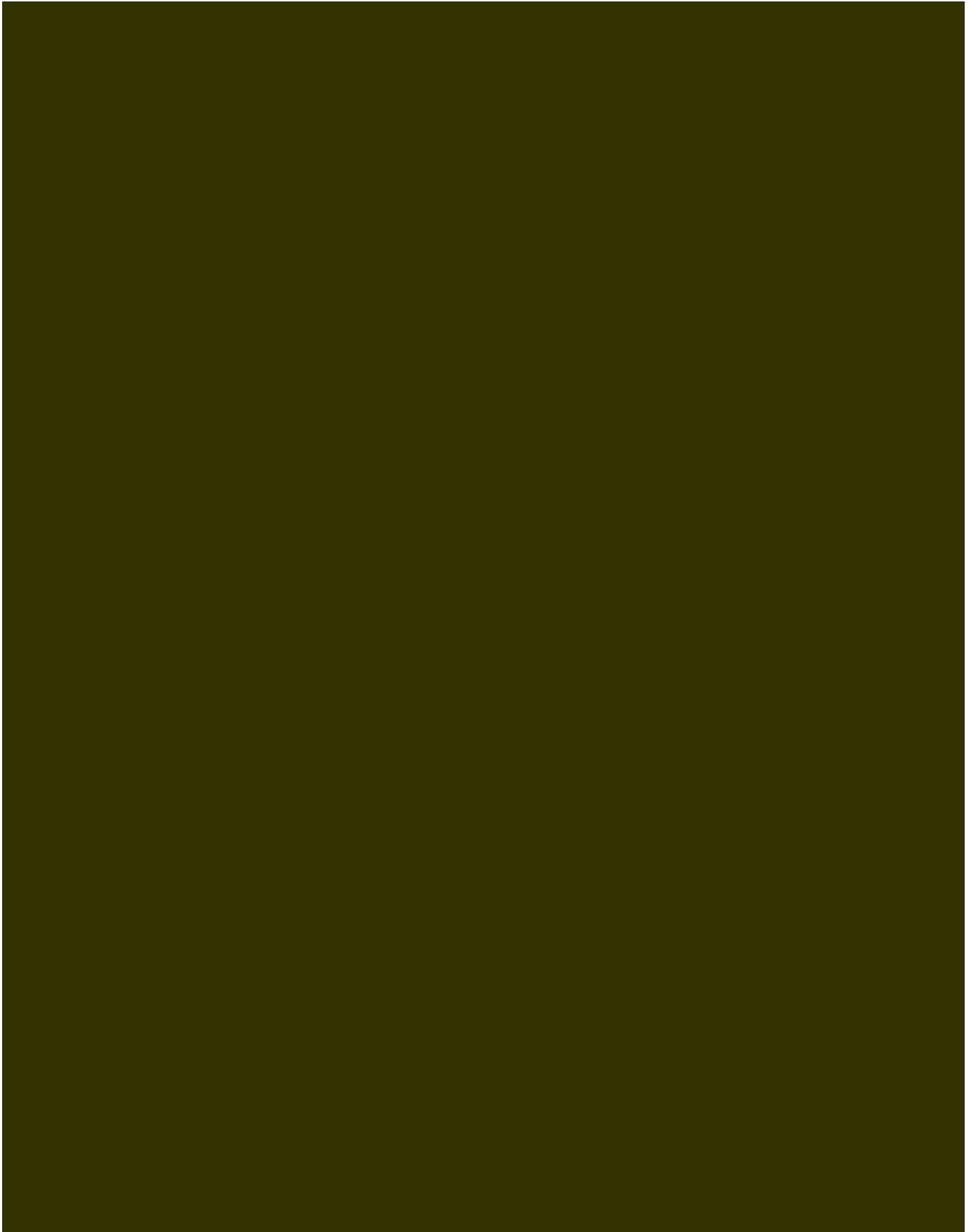


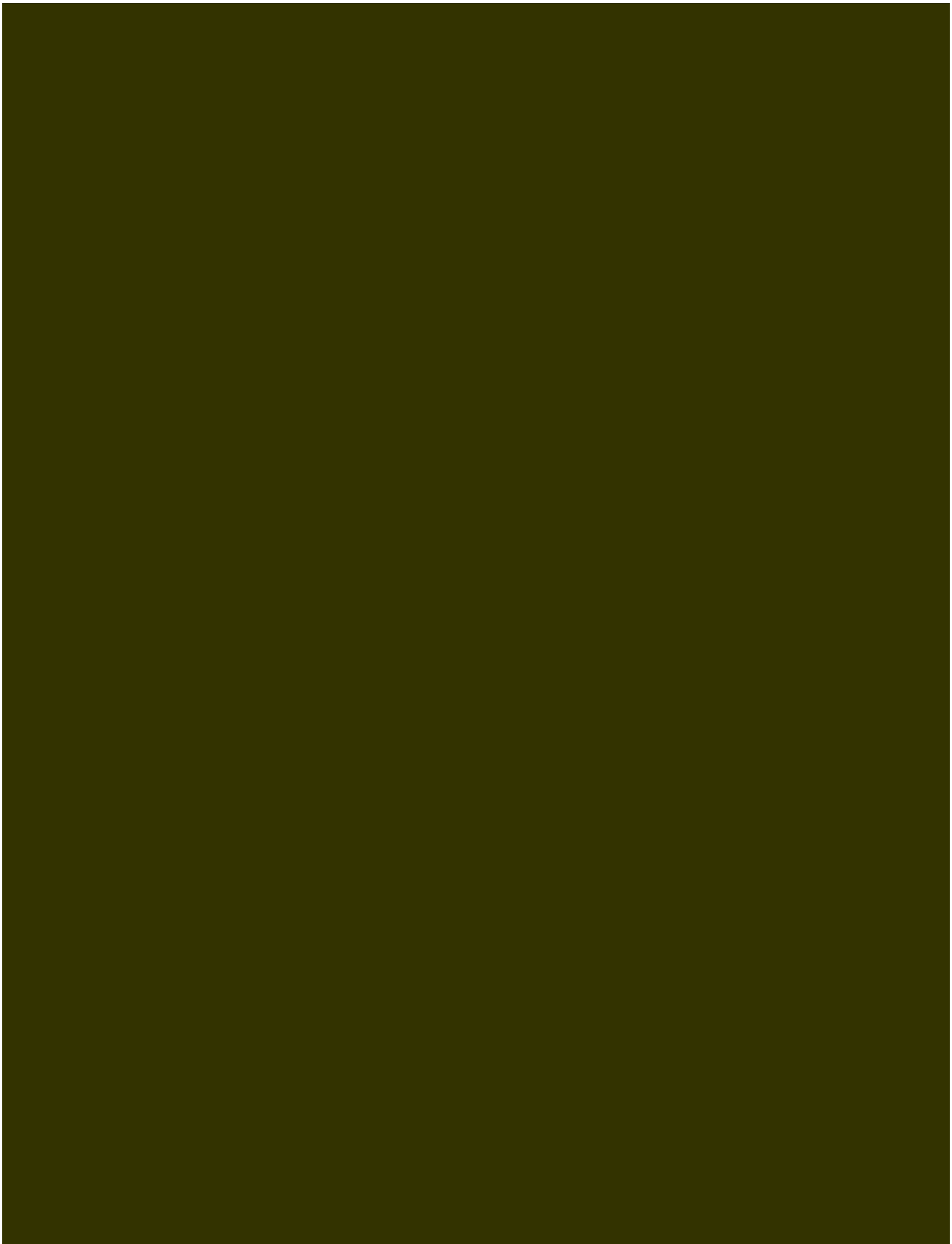


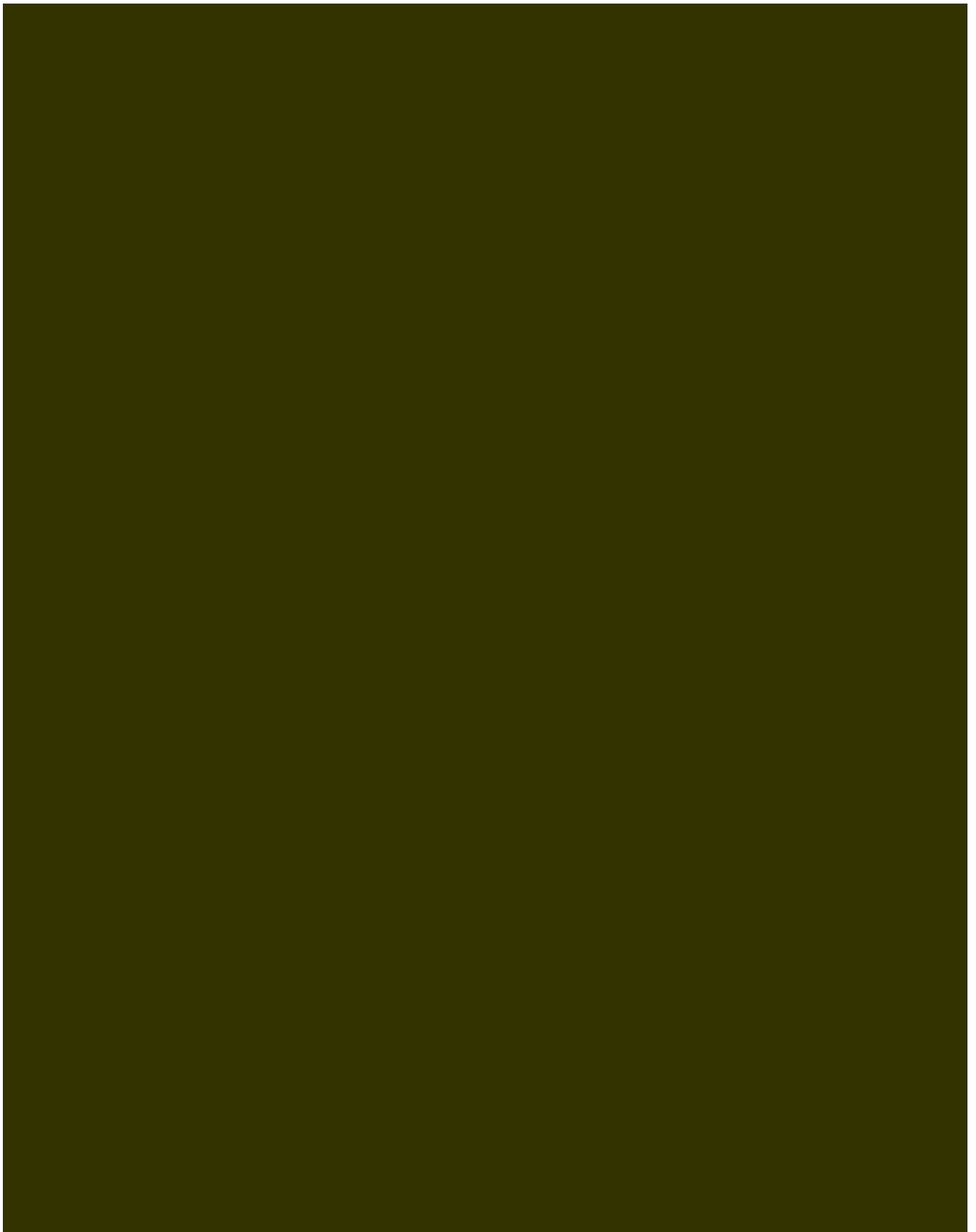




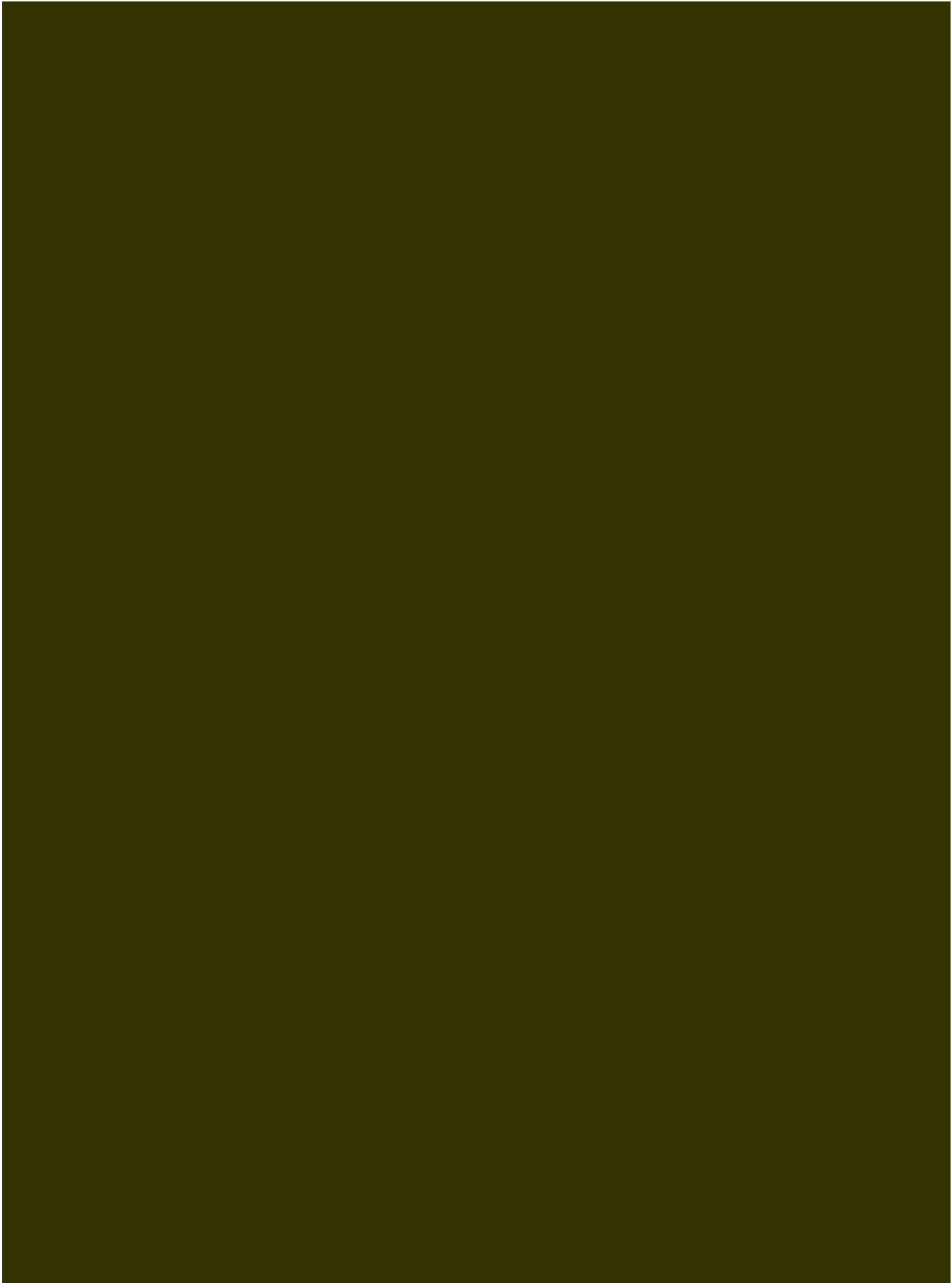


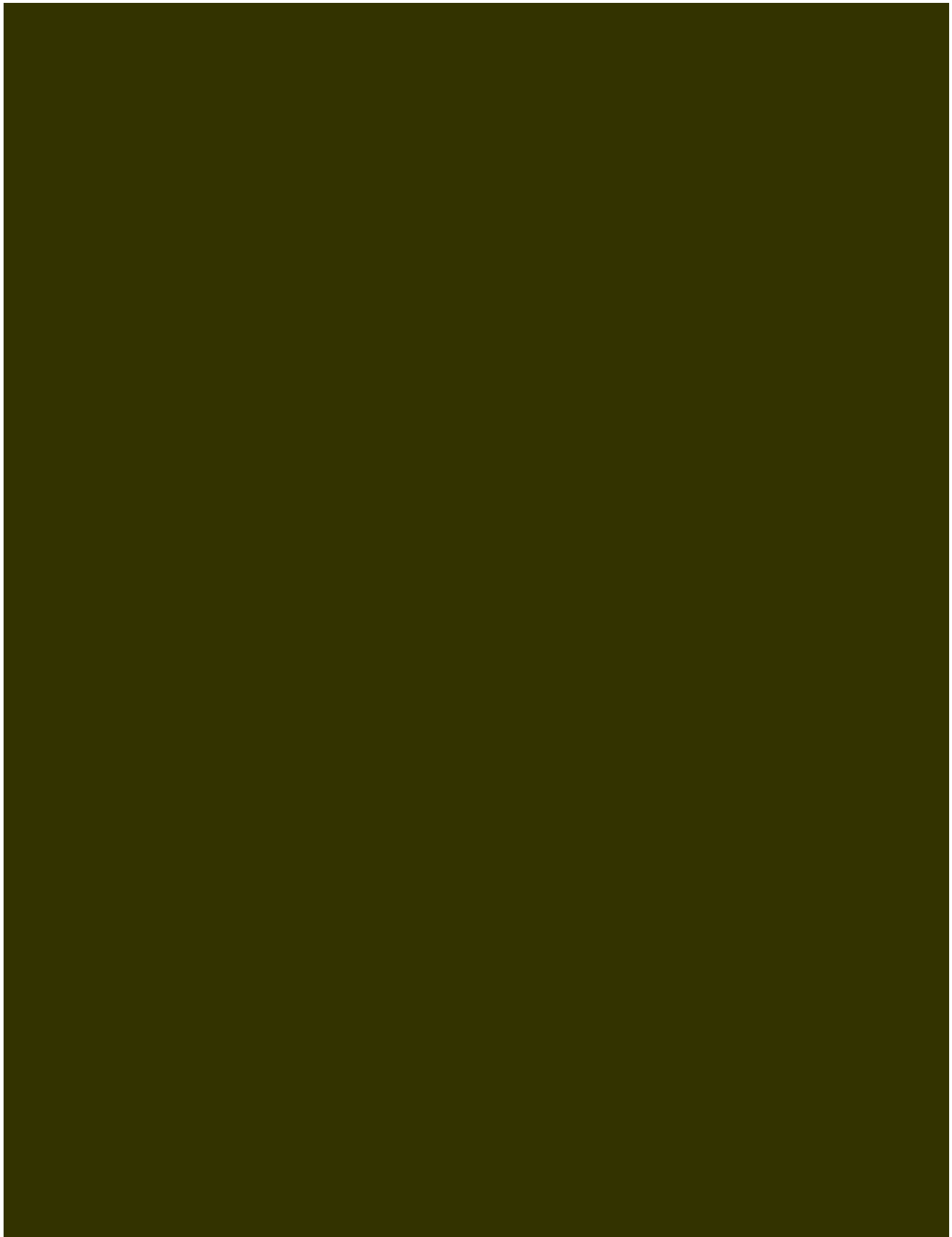


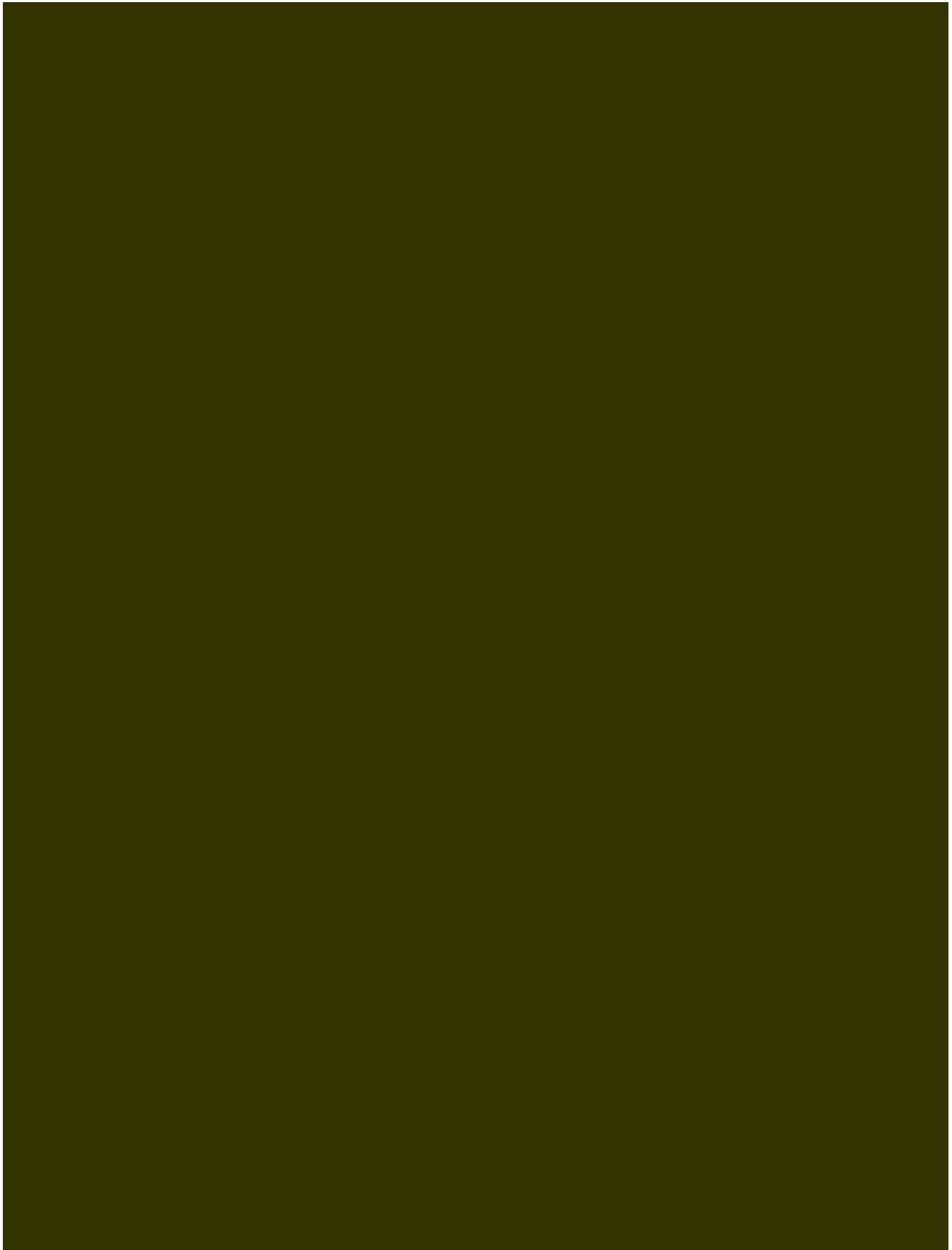












which Hashem '569 defines as “a set of at least one transmission parameter, such as a modulation level, a coding rate, a symbol rate, a transmission power level, antenna directional parameters, or space-time coding parameters.” (Hashem '569 at 4:11-15 (emphasis added).)

448. For example, Hashem '569 discloses sending an indication of a Link Mode for each acceptable sub-carrier:

A different Link Mode can be used for each acceptable sub-carrier if the Link Modes are calculated by the remote unit and transmitted to the base station. In this embodiment, the remote unit transmits more than one value by which the base station can determine more than one Link Mode, preferably as a sequence of references to sub-carrier Link Modes. The sequence of numbers identifying the acceptable sub-carriers and the values by which the base station can determine the Link Modes can be sent along the return channel separately, or can be combined by forming the sequence of numbers from the sub-carrier Link Mode of each acceptable sub-carrier and one or more distinct values identifying unacceptable sub-carriers.

(Hashem '569 at 7:25-37.)

449. Moreover, Hashem '569 discloses extending this approach to sending an indication of a Link Mode for each group of sub-carriers in a sequence of groups – *i.e.*, one Link Mode for each cluster.

Overhead can be further reduced if the sub-carriers are grouped into groups of sub-carriers by the components of the remote unit and the base station... Furthermore, in the embodiment in which the remote unit calculates more than one Link Mode, the remote unit can calculate a group Link Mode for each acceptable group of sub-carriers.

(Hashem '569 at 8:21-23 and 8:35-38.)

450. From these references, it is clear that Hashem '569 discloses the required element. Further, Hashem '129 – which is incorporated by reference into the '569 patent – brings even more specificity to the disclosures described above. It does this through its example of a table of link modes, reproduced below.

S/I (dB)	MODULATION	CODING
3.1	QPSK	1/2
5.9	QPSK	3/4
7.7	QPSK	7/8
11.1	16-QAM	2/3
13.5	16-QAM	5/6
14.4	64-QAM	1/2
18.0	64-QAM	3/4
20.1	64-QAM	7/8

FIG. 2

451. This “table of Link Modes” (’129 Patent at 3:27) discloses three fields for every element in the table. The “S/I” field indicates the minimum signal-to-interference ratio required to offer that mode at an acceptable performance level. The “Modulation” field indicates the form of modulation to be used in that mode. The “Coding” field indicates the channel coding rate to be employed in that mode.

452. It is notable that the “table of Link Modes” disclosed in the ’129 patent is similar in nature and content to the “coding/modulation table” that is provided as an example in the ’748, shown below.

TABLE 1

Scheme	Modulation	Code Rate
0	QPSK, 1/8 Spreading	1/2
1	QPSK, 1/4 Spreading	1/2
2	QPSK, 1/2 Spreading	1/2
3	QPSK	1/2
4	8PSK	2/3
5	16QAM	3/4
6	64QAM	5/6

453. The claim element requires “sending an indication of coding and modulation rates.” The coding rate is explicitly defined in the table of Link Modes from Hashem ’569 – *e.g.*, the entry “3/4” refers to a rate-3/4 code, which transmits four bits to represent three data bits,

with one bit of redundancy for every four bits transmitted. The modulation entry implies a rate as well; a modulation that uses M symbols to convey information represents $\log_2(M)$ bits with each symbol. So quaternary phase-shift keying (QPSK), which has M=4 possible transmitted symbols, conveys $\log_2(4)=2$ bits/symbol, while 64-QAM conveys $\log_2(64)=6$ bits/symbol. Taking into account both the rate of the code as well as the rate of the modulation format yields an effective rate – e.g., 16-QAM and a rate-2/3 channel code conveys $4 \times (2/3) = 2.67$ data bits per symbol, while 64-QAM and a rate-3/4 code conveys $6 \times (3/4) = 4.5$ data bits per symbol.

454. As noted above, a person of ordinary skill in the art would have been motivated to combine Ritter with Hashem '569 because they were addressing the same basic technical challenges during the same time frame; to the extent that Ritter did not disclose details about the feedback reports, it would have been natural to look to Hashem '569 to disclose the indication of Link Modes generally and coding and modulation rates specifically.

455. Thus, Ritter in combination with Hashem '569 renders obvious the limitation “wherein each index is indicative of a coding and modulation rate.”

B. Claim 7 of the '748 Patent is Rendered Obvious by the Sollenberger Publications in Combination with Hashem '569

456. Claim 7 of the '748 Patent reads: “**The method defined in claim 6 wherein each index is indicative of a coding and modulation rate.**”

457. The Sollenberger Patent and Sollenberger Article do not expressly disclose this element. However, this element is rendered obvious by the Sollenberger Article and/or the Sollenberger Patent, in combination with Hashem '569.

458. As discussed above, the Sollenberger Patent discloses the wireless station uses “an index variable j” to scan channels in priority order, measures the SIR on each channel, compares the measured SIR to a predetermined threshold, and adds the channel to a list of

acceptable channels if the SIR is above the predetermined threshold. (See Sollenberger Patent at 9:1-40 (describing process).) Also discussed above, the Sollenberger Patent further discloses the subscriber providing feedback on the L candidate subcarriers to the base station. (See, e.g., Sollenberger Patent, Fig. 1.)

459. To the extent the Sollenberger Patent does not expressly disclose providing feedback “wherein each index is indicative of a coding and modulation rate,” it would have been obvious to a person of ordinary skill in the art to modify the feedback disclosed in the Sollenberger Patent, using the teachings in Hashem, to include this element.

460. As discussed previously, Hashem ’569 (which incorporates by reference Hashem ’129) discloses feedback from the remote unit to the base station that includes an indication of the “Link Mode,” which Hashem ’569 defines as “a set of at least one transmission parameter, such as a modulation level, a coding rate, a symbol rate, a transmission power level, antenna directional parameters, or space-time coding parameters.” (Hashem ’569 at 4:11-15 (emphasis added).). Further, as previously discussed, Hashem ’569 discloses “the remote unit can calculate a group Link Mode for each acceptable group of sub-carriers.” (Hashem ’569 at 8:37-38.)

461. Thus, Hashem ’569 discloses “wherein each index is indicative of a coding and modulation rate.”

462. A person of ordinary skill in the art would have been motivated to combine the Sollenberger Article and/or the Sollenberger Patent with Hashem ’569, at least in part, because each reference addressed the design of wireless OFDMA cellular systems during the same time frame. Moreover, each addressed the same problem in the context of wireless OFDMA systems – a method for identifying “acceptable” resources (e.g., subcarriers or channels). (Hashem ’569,

Abstract; Sollenberger Patent, Fig. 2.) Further, the Sollenberger Article proposes the “dynamic packet assignment” and “adaptive modulation and coding” as techniques to provide wideband OFDM packet wireless data access, indicating that the two techniques are complementary:

Dynamic packet assignment, an OFDM physical layer, *adaptive modulation and coding*, space-time coding and interference suppression, and smart antennas *are proposed as techniques to provide wideband OFDM packet wireless data access* in macrocellular and microcellular environments. (Sollenberger Article at 761, emphasis added))

463. One of ordinary skill in the art would understand that modifying the DPA protocol disclosed in the Sollenberger Patent – to include feedback containing Hashem’s “group Link Mode” – could increase the efficiency of a system using adaptive modulation and coding.

464. Thus, the Sollenberger Article and/or the Sollenberger Patent, in combination with Hashem ’569, renders obvious “wherein each index is indicative of a coding and modulation rate”.

C. Claim 7 of the ’748 Patent is Rendered Obvious by Hashem ’569

465. Claim 7 of the ’748 Patent reads: “**The method defined in claim 6 wherein each index is indicative of a coding and modulation rate.**”

466. Hashem ’569 (which incorporates by reference the ’129 patent) discloses this element. Specifically, Hashem ’569 discloses feedback from the remote unit to the base station that includes an indication of the “Link Mode,” which Hashem ’569 defines as “a set of at least one transmission parameter, such as a modulation level, a coding rate, a symbol rate, a transmission power level, antenna directional parameters, or space-time coding parameters.” (Hashem ’569 at 4:11-15 (emphasis added).)

467. In the following passage, Hashem ’569 discloses sending an indication of a Link Mode for each acceptable sub-carrier:

A different Link Mode can be used for each acceptable sub-carrier if the Link Modes are calculated by the remote unit and transmitted to the base station. In this embodiment, the remote unit transmits more than one value by which the base station can determine more than one Link Mode, preferably as a sequence of references to sub-carrier Link Modes. The sequence of numbers identifying the acceptable sub-carriers and the values by which the base station can determine the Link Modes can be sent along the return channel separately, or can be combined by forming the sequence of numbers from the sub-carrier Link Mode of each acceptable sub-carrier and one or more distinct values identifying unacceptable sub-carriers.

(Hashem '569 at 7:25-37.)

468. Moreover, Hashem '569 discloses extending this approach to sending an indication of a Link Mode for each group of sub-carriers in a sequence of groups – *i.e.*, one Link Mode for each cluster.

Overhead can be further reduced if the sub-carriers are grouped into groups of sub-carriers by the components of the remote unit and the base station... Furthermore, in the embodiment in which the remote unit calculates more than one Link Mode, the remote unit can calculate a group Link Mode for each acceptable group of sub-carriers.

(Hashem '569 at 8:21-23 and 8:35-38.)

469. From these references, it is clear that Hashem '569 discloses the required element. In addition, Hashem '129 – which is incorporated by reference into Hashem '569 – brings even more specificity to that disclosure. It does this through its example of a table of link modes, reproduced below.

S/I (dB)	MODULATION	CODING
3.1	QPSK	1/2
5.9	QPSK	3/4
7.7	QPSK	7/8
11.1	16-QAM	2/3
13.5	16-QAM	5/6
14.4	64-QAM	1/2
18.0	64-QAM	3/4
20.1	64-QAM	7/8

FIG. 2

470. This “table of Link Modes” (’129 Patent at 3:27) discloses three fields for every element in the table. The “S/I” field indicates the minimum signal-to-interference ratio required to offer that mode at an acceptable performance level. The “Modulation” field indicates the form of modulation to be used in that mode. The “Coding” field indicates the channel coding rate to be employed in that mode.

471. It is notable that the “table of Link Modes” disclosed in the ’129 patent is similar in nature and content to the “coding/modulation table” that is provided as an example in the ’748, shown below.

TABLE 1

Scheme	Modulation	Code Rate
0	QPSK, 1/8 Spreading	1/2
1	QPSK, 1/4 Spreading	1/2
2	QPSK, 1/2 Spreading	1/2
3	QPSK	1/2
4	8PSK	2/3
5	16QAM	3/4
6	64QAM	5/6

472. The claim element requires “sending an indication of coding and modulation rates.” The coding rate is explicitly defined in the table of Link Modes from Hashem ’569 – *e.g.*, the entry “3/4” refers to a rate-3/4 code, which transmits four bits to represent three data bits,

with one bit of redundancy for every four bits transmitted. The modulation entry implies a rate as well; a modulation that uses M symbols to convey information represents $\log_2(M)$ bits with each symbol. So quaternary phase-shift keying (QPSK), which has M=4 possible transmitted symbols, conveys $\log_2(4)=2$ bits/symbol, while 64-QAM conveys $\log_2(64)=6$ bits/symbol. Taking into account both the rate of the code as well as the rate of the modulation format yields an effective rate – e.g., 16-QAM and a rate-2/3 channel code conveys $4 \times (2/3) = 2.67$ data bits per symbol, while 64-QAM and a rate-3/4 code conveys $6 \times (3/4) = 4.5$ data bits per symbol.

473. Thus, Hashem '569 discloses “wherein each index is indicative of a coding and modulation rate.”

D. Claim 7 of the '748 Patent is Rendered Obvious by the Project Angel System Alone or in Combination with Hashem '569

474. Claim 7 of the '748 Patent reads: “**The method defined in claim 6 wherein each index is indicative of a coding and modulation rate.**”

475. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

477.

[REDACTED]

[REDACTED]

[REDACTED]

478. Hashem '569 (which incorporates Hashem '129 by reference) discloses a remote unit providing feedback to a base station that includes both information for channel selection and information for "Link Mode" determination. For example, Hashem '569 states:

The return signal [from the remote unit] can be viewed more generally as including a sequence of numbers identifying acceptable sub-carriers, and a value by which the base station can determine an optimum Link Mode. ... Alternatively, if the remote unit determines the optimum Link Mode itself, then the value may be a reference to the optimum Link Mode. If the optimum Link Mode is one of a set of allowed Link Modes agreed upon by the base station and the remote unit prior to a transmission, the reference may be an index to the optimum Link Mode within the set of allowed Link Modes.

(Hashem '569 at 7:7-18.)

479. The feedback from a remote unit to the base station that includes an indication of the "Link Mode," which the '569 defines as "a set of at least one transmission parameter, such as a modulation level, a coding rate, a symbol rate, a transmission power level, antenna directional parameters, or space-time coding parameters." (Hashem '569 at 4:11-15 (emphasis added).)

480. The '129 patent states that "[a]t the remote unit, a desired LM is determined from amongst the sequence of allowed LMs based on the channel quality." ('129 Patent at 2:54-56.) This is illustrated in the figure below from the '129 patent.

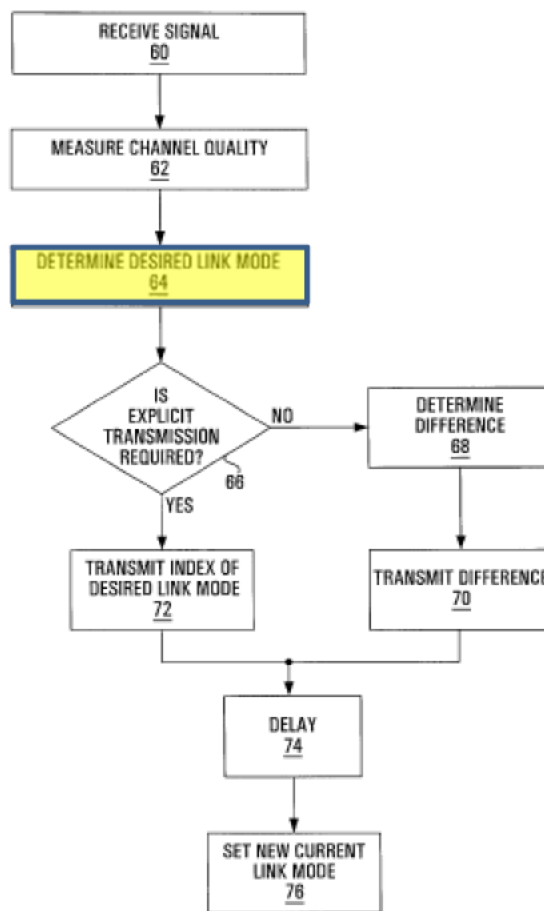


FIG. 3

481. Hashem '569 discloses sending an indication of a Link Mode for each acceptable sub-carrier:

A different Link Mode can be used for each acceptable sub-carrier if the Link Modes are calculated by the remote unit and transmitted to the base station. In this embodiment, the remote unit transmits more than one value by which the base station can determine more than one Link Mode, preferably as a sequence of references to sub-carrier Link Modes. The sequence of numbers identifying the acceptable sub-carriers and the values by which the base station can determine the Link Modes can be sent along the return channel separately, or can be combined by forming the sequence of numbers from the sub-carrier Link Mode of each acceptable sub-carrier and one or more distinct values identifying unacceptable sub-carriers.

(Hashem '569 at 25-37.)

482. Moreover, Hashem '569 discloses extending this approach to sending an indication of a Link Mode for each group of sub-carriers in a sequence of groups – *i.e.*, one Link Mode for each cluster.

Overhead can be further reduced if the sub-carriers are grouped into groups of sub-carriers by the components of the remote unit and the base station... Furthermore, in the embodiment in which the remote unit calculates more than one Link Mode, the remote unit can calculate a group Link Mode for each acceptable group of sub-carriers.

(Hashem '569 at 8:21-23 and 8:35-38.)

483. It is clear that Hashem '569 discloses the required element. However, Hashem '129 – which is incorporated by reference into Hashem '569 – brings even more specificity to that disclosure. It does this through its example of a table of link modes, reproduced below.

S/I (dB)	MODULATION	CODING
3.1	QPSK	1/2
5.9	QPSK	3/4
7.7	QPSK	7/8
11.1	16-QAM	2/3
13.5	16-QAM	5/6
14.4	64-QAM	1/2
18.0	64-QAM	3/4
20.1	64-QAM	7/8

FIG. 2

484. This “table of Link Modes” ('129 Patent at 3:27) discloses three fields for every element in the table. The “S/I” field indicates the minimum signal-to-interference ratio required to offer that mode at an acceptable performance level. The “Modulation” field indicates the form

of modulation to be used in that mode. The “Coding” field indicates the channel coding rate to be employed in that mode.

485. It is notable that the “table of Link Modes” disclosed in the ’129 patent is similar in nature and content to the “coding/modulation table” that is provided as an example in the ’748 Patent, shown below.

TABLE 1

Scheme	Modulation	Code Rate
0	QPSK, 1/8 Spreading	1/2
1	QPSK, 1/4 Spreading	1/2
2	QPSK, 1/2 Spreading	1/2
3	QPSK	1/2
4	8PSK	2/3
5	16QAM	3/4
6	64QAM	5/6

486. The claim element requires “sending an indication of coding and modulation rates.” The coding rate is explicitly defined in the table of Link Modes from Hashem ’569 – *e.g.*, the entry “3/4” refers to a rate-3/4 code, which transmits four bits to represent three data bits, with one bit of redundancy for every four bits transmitted. The modulation entry implies a rate as well; a modulation that uses M symbols to convey information represents $\log_2(M)$ bits with each symbol. So quaternary phase-shift keying (QPSK), which has M=4 possible transmitted symbols, conveys $\log_2(4)=2$ bits/symbol, while 64-QAM conveys $\log_2(64)=6$ bits/symbol. Taking into account both the rate of the code as well as the rate of the modulation format yields an effective rate – *e.g.*, 16-QAM and a rate-2/3 channel code conveys $4 \times (2/3) = 2.67$ data bits per symbol, while 64-QAM and a rate-3/4 code conveys $6 \times (3/4) = 4.5$ data bits per symbol.

487. [REDACTED]

[REDACTED]

[REDACTED]

VIII. '748 PATENT, CLAIM 8

488. Claim 8 of the '748 Patent is reproduced below with identifiers [a], [b], [c], etc. added for ease of reference:

8. A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising:

- [a][1] a subscriber measuring channel and interference information for a plurality of subcarriers
- [a][2] based on pilot symbols received from a base station;
- [b] the subscriber selecting a set of candidate subcarriers;
- [c] the subscriber providing feedback information on the set of candidate subcarriers to the base station;
- [d] the subscriber sending an indication of coding and modulation rates that the subscriber desires to employ for each cluster; and
- [e] the subscriber receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber.

A. Independent Claim 8 of the '748 Patent and Related Claims are Indefinite

489. I understand that this Court has considered whether claims 8 and 9 of the '748 Patent, and claims 9 and 10 of the '212 Patent are indefinite because the term “each cluster” is not amenable to construction. I understand that this Court applied a “narrowing construction” by interpreting the word “cluster” in claims 8-9 of '748 Patent and claims 9-10 of '212 Patent as referring to a logical unit that contains at least two physical subcarriers. (*See, e.g.*, Report and Recommendation at 16, Case No. 6:12-cv-0017 (E.D. Tex.), Mar. 24, 2014 (Dkt. 182); *see also* Order Adopting Magistrate’s Report and Recommendation, (Dkt. 197).)

490. I have been informed and understand that the Supreme Court recently ruled that a claim is not definite merely because it may be amenable to construction and not insolubly ambiguous, and emphasized that the definiteness requirement mandates clarity. It is my opinion that claims 8-9 of '748 Patent and claims 9-10 of '212 Patent are indefinite because the term “each cluster,” when viewed in light of the specification and prosecution history, fails to inform those skilled in the art about the scope of the invention with reasonable certainty.

491. The term “cluster” does not appear in the preceding elements of these claims, and therefore the phrase “each cluster” does not have an antecedent basis. Instead, the antecedent

claim limitations refer to various sets or pluralities of subcarriers. Therefore, the claims are ambiguous as to which subcarriers belong to “each cluster.”

492. I have reviewed the common specification of the ’748 and ’212 Patents to determine how the phrase is used by the inventors. The term “cluster” is defined in both the ’212 and ’748 Patents as a “logical unit that contains at least one physical subcarrier,” and that can contain consecutive or non-consecutive subcarriers. (’212 Patent at 5:15-17; ’748 Patent at 5:10-12.) This definition, however, does not tell me which of the subcarriers in the preceding claim limitations are part of “each cluster.” There are a number of possibilities of which set or plurality of subcarriers could be considered part of “each cluster” in order to meet this claim.

493. For example, the claim steps contain a number of actions for measuring, selecting, and providing indications for particular subcarriers and/or sets of subcarriers. They then require a subscriber to take certain actions for “each cluster,” while failing to indicate which preceding “subcarriers” belong to “each cluster.” Thus, numerous questions remain about the scope of the claim because it is unclear which subcarriers constitute the cluster of subcarriers for which the claims require specific actions.

494. Thus, claims 8 and 9 of the ’748 Patent, and claim 9 of the ’212 Patent, are indefinite. Notwithstanding, I have adopted the Court’s narrowing construction and Adaptix’s apparent interpretation of this limitation for purposes of my analysis of ’748 Patent claim element [8][d], and dependent claim 9, and ’212 Patent claims 9 and 10 as set forth below. Based on that construction, it is my opinion that claim 8 of the ’748 Patent is anticipated and/or rendered obvious by the prior art as described below.

B. Claim 8 of the '748 Patent is Anticipated and/or Rendered Obvious by Hashem '569

1. Introduction

495. The following analysis demonstrates claim 8 of the '748 Patent is anticipated and/or rendered obvious by Hashem '569. Because the application for the '129 patent is incorporated into Hashem '569, any disclosure in the '129 patent is disclosed in Hashem '569.

2. Preamble

496. The preamble of claim 8 of the '748 Patent reads: “**A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising.**”

497. This element is satisfied by the disclosure set forth at '748 Patent claim 6 preamble.

3. Element 8[a][1]

498. Claim element 8[a][1] of the '748 Patent reads: “**a subscriber measuring channel and interference information for a plurality of subcarriers.**”

499. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

4. Element 8[a][2]

500. Claim element 8[a][2] of the '748 Patent reads: “**based on pilot symbols received from a base station.**”

501. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

5. Element 8[b]

502. Claim element 8[b] of the '748 Patent reads: “**the subscriber selecting a set of candidate subcarriers.**”

503. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

6. Element 8[c]

504. Claim element 8[c] of the '748 Patent reads: “**the subscriber providing feedback information on the set of candidate subcarriers to the base station.**”

505. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

7. Element 8[d]

506. Claim element 8[d] of the '748 Patent reads: “**the subscriber sending an indication of coding and modulation rates that the subscriber desires to employ for each cluster.**”

507. This element is disclosed by Hashem '569. Specifically, Hashem '569 discloses feedback from the remote unit to the base station that includes an indication of the “Link Mode,” which Hashem '569 defines as “a set of at least one transmission parameter, such as a modulation level, a coding rate, a symbol rate, a transmission power level, antenna directional parameters, or space-time coding parameters.” (Hashem '569 at 4:11-15 (emphasis added).)

508. In the following passage, Hashem '569 discloses sending an indication of a Link Mode for each acceptable sub-carrier:

A different Link Mode can be used for each acceptable sub-carrier if the Link Modes are calculated by the remote unit and transmitted to the base station. In this embodiment, the remote unit transmits more than one value by which the base station can determine more than one Link Mode, preferably as a sequence of references to sub-carrier Link Modes. The sequence of numbers identifying the

acceptable sub-carriers and the values by which the base station can determine the Link Modes can be sent along the return channel separately, or can be combined by forming the sequence of numbers from the sub-carrier Link Mode of each acceptable sub-carrier and one or more distinct values identifying unacceptable sub-carriers.

Hashem '569 at 7:25-37.

509. Moreover, Hashem '569 discloses extending this approach to sending an indication of a Link Mode for each group of sub-carriers in a sequence of groups – *i.e.*, one Link Mode for each cluster.

Overhead can be further reduced if the sub-carriers are grouped into groups of sub-carriers by the components of the remote unit and the base station... Furthermore, in the embodiment in which the remote unit calculates more than one Link Mode, the remote unit can calculate a group Link Mode for each acceptable group of sub-carriers.

(Hashem '569 at 8:21-23 and 8:35-38.)

510. From these references, it is clear that Hashem '569 discloses the required element. In addition, the '129 patent – which is incorporated by reference into Hashem '569 – brings even more specificity to that disclosure. It does this through its example of a table of link modes, reproduced below.

S/I (dB)	MODULATION	CODING
3.1	QPSK	1/2
5.9	QPSK	3/4
7.7	QPSK	7/8
11.1	16-QAM	2/3
13.5	16-QAM	5/6
14.4	64-QAM	1/2
18.0	64-QAM	3/4
20.1	64-QAM	7/8

FIG. 2

511. This “table of Link Modes” (’129 Patent at 3:27) discloses three fields for every element in the table. The “S/I” field indicates the minimum signal-to-interference ratio required to offer that mode at an acceptable performance level. The “Modulation” field indicates the form of modulation to be used in that mode. The “Coding” field indicates the channel coding rate to be employed in that mode.

512. It is notable that the “table of Link Modes” disclosed in Hashem ’129 is similar in nature and content to the “coding/modulation table” that is provided as an example in the ’748, shown below.

TABLE 1

Scheme	Modulation	Code Rate
0	QPSK, $\frac{1}{8}$ Spreading	$\frac{1}{2}$
1	QPSK, $\frac{1}{4}$ Spreading	$\frac{1}{2}$
2	QPSK, $\frac{1}{2}$ Spreading	$\frac{1}{2}$
3	QPSK	$\frac{1}{2}$
4	8PSK	$\frac{2}{3}$
5	16QAM	$\frac{3}{4}$
6	64QAM	$\frac{5}{6}$

513. The claim element requires “sending an indication of coding and modulation rates.” The coding rate is explicitly defined in the table of Link Modes from Hashem ’569 – *e.g.*, the entry “3/4” refers to a rate-3/4 code, which transmits four bits to represent three data bits, with one bit of redundancy for every four bits transmitted. The modulation entry implies a rate as well; a modulation that uses M symbols to convey information represents $\log_2(M)$ bits with each symbol. So quaternary phase-shift keying (QPSK), which has M=4 possible transmitted symbols, conveys $\log_2(4)=2$ bits/symbol, while 64-QAM conveys $\log_2(64)=6$ bits/symbol. Taking into account both the rate of the code as well as the rate of the modulation format yields an effective rate – *e.g.*, 16-QAM and a rate-2/3 channel code conveys $4 \times (2/3) = 2.67$ data bits per symbol, while 64-QAM and a rate-3/4 code conveys $6 \times (3/4) = 4.5$ data bits per symbol.

514. Thus, Hashem ’569 discloses “the subscriber sending an indication of coding and modulation rates that the subscriber desires to employ for each cluster.”

8. Element 8[e]

515. Claim element 8[e] of the '748 Patent reads: “**the subscriber receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber.**”

516. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

C. **Claim 8 of the '748 Patent is Rendered Obvious by the Work of Ritter in combination with Hashem '569**

1. Introduction

517. The following analysis demonstrates claim 8 of the '748 Patent is rendered obvious by Ritter in combination with Hashem '569.

2. Preamble

518. The preamble of claim 8 of the '748 Patent reads: “**A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising.**”

519. This element is satisfied by the disclosure set forth at '748 Patent claim 6 preamble.

3. Element 8[a][1]

520. Claim element 8[a][1] of the '748 Patent reads: “**a subscriber measuring channel and interference information for a plurality of subcarriers.**”

521. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

4. Element 8[a][2]

522. Claim element 8[a][2] of the '748 Patent reads: **“based on pilot symbols received from a base station.”**

523. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

5. Element 8[b]

524. Claim element 8[b] of the '748 Patent reads: **“the subscriber selecting a set of candidate subcarriers.”**

525. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

6. Element 8[c]

526. Claim element 8[c] of the '748 Patent reads: **“the subscriber providing feedback information on the set of candidate subcarriers to the base station.”**

527. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

7. Element 8[d]

528. Claim element 8[d] of the '748 Patent reads: **“the subscriber sending an indication of coding and modulation rates that the subscriber desires to employ for each cluster.”**

529. Ritter discloses a process for channel allocation in which “the mobile station MS send their priority lists PL1 ... PL3 with the messages about preferably several preferred suitable segments ...” (Ritter at 5 col.1 ¶ 2.) Ritter does not expressly disclose coding and modulation rates that Ritter’s mobile stations “desire to employ” for the preferred suitable segments that Ritter selects. However, Hashem '569, which incorporates by reference the '129 patent, does

disclose feedback from the remote unit to the base station that includes an indication of the “Link Mode,” which the ’569 defines as “a set of at least one transmission parameter, such as a modulation level, a coding rate, a symbol rate, a transmission power level, antenna directional parameters, or space-time coding parameters.” (Hashem ’569 at 4:11-15 (emphasis added).)

530. For example, Hashem ’569 discloses sending an indication of a Link Mode for each acceptable sub-carrier:

A different Link Mode can be used for each acceptable sub-carrier if the Link Modes are calculated by the remote unit and transmitted to the base station. In this embodiment, the remote unit transmits more than one value by which the base station can determine more than one Link Mode, preferably as a sequence of references to sub-carrier Link Modes. The sequence of numbers identifying the acceptable sub-carriers and the values by which the base station can determine the Link Modes can be sent along the return channel separately, or can be combined by forming the sequence of numbers from the sub-carrier Link Mode of each acceptable sub-carrier and one or more distinct values identifying unacceptable sub-carriers. (Hashem ’569 at 7:25-37.)

531. Moreover, Hashem ’569 discloses extending this approach to sending an indication of a Link Mode for each group of sub-carriers in a sequence of groups – *i.e.*, one Link Mode for each cluster.

Overhead can be further reduced if the sub-carriers are grouped into groups of sub-carriers by the components of the remote unit and the base station... Furthermore, in the embodiment in which the remote unit calculates more than one Link Mode, the remote unit can calculate a group Link Mode for each acceptable group of sub-carriers.” (Hashem ’569 at 8:21-23 and 8:35-38.)

532. From these references, it is clear that Hashem ’569 discloses the required element. Further, Hashem ’129 – which is incorporated by reference into Hashem ’569 – brings even more specificity to the disclosures described above. It does this through its example of a table of link modes, reproduced below.

S/I (dB)	MODULATION	CODING
3.1	QPSK	1/2
5.9	QPSK	3/4
7.7	QPSK	7/8
11.1	16-QAM	2/3
13.5	16-QAM	5/6
14.4	64-QAM	1/2
18.0	64-QAM	3/4
20.1	64-QAM	7/8

FIG. 2

533. This “table of Link Modes” (’129 Patent at 3:27) discloses three fields for every element in the table. The “S/I” field indicates the minimum signal-to-interference ratio required to offer that mode at an acceptable performance level. The “Modulation” field indicates the form of modulation to be used in that mode. The “Coding” field indicates the channel coding rate to be employed in that mode.

534. It is notable that the “table of Link Modes” disclosed in Hashem ’129 is similar in nature and content to the “coding/modulation table” that is provided as an example in the ’748, shown below.

TABLE 1

Scheme	Modulation	Code Rate
0	QPSK, 1/8 Spreading	1/2
1	QPSK, 1/4 Spreading	1/2
2	QPSK, 1/2 Spreading	1/2
3	QPSK	1/2
4	8PSK	2/3
5	16QAM	3/4
6	64QAM	5/6

535. The claim element requires “sending an indication of coding and modulation rates.” The coding rate is explicitly defined in the table of Link Modes from Hashem ’569 – *e.g.*, the entry “3/4” refers to a rate-3/4 code, which transmits four bits to represent three data bits,

with one bit of redundancy for every four bits transmitted. The modulation entry implies a rate as well; a modulation that uses M symbols to convey information represents $\log_2(M)$ bits with each symbol. So quaternary phase-shift keying (QPSK), which has M=4 possible transmitted symbols, conveys $\log_2(4)=2$ bits/symbol, while 64-QAM conveys $\log_2(64)=6$ bits/symbol. Taking into account both the rate of the code as well as the rate of the modulation format yields an effective rate – *e.g.*, 16-QAM and a rate-2/3 channel code conveys $4 \times (2/3) = 2.67$ data bits per symbol, while 64-QAM and a rate-3/4 code conveys $6 \times (3/4) = 4.5$ data bits per symbol.

536. Thus, Hashem '569 discloses “the subscriber sending an indication of coding and modulation rates that the subscriber desires to employ for each cluster.”

537. As noted above, a person of ordinary skill in the art would have been motivated to combine Ritter with Hashem '569 because they were addressing the same basic technical challenges during the same time frame; to the extent that Ritter did not disclose details about the feedback reports, it would have been natural to look to Hashem '569 to disclose the indication of Link Modes generally and coding and modulation rates specifically.

8. Element 8[e]

538. Claim element 8[e] of the '748 Patent reads: “**the subscriber receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber.**”

539. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

D. Claim 8 of the '748 Patent is Rendered Obvious by the Sollenberger Publications in Combination with Hashem '569

1. Introduction

540. The following analysis demonstrates claim 8 of the '748 Patent is rendered obvious by the Sollenberger Article and/or the Sollenberger Patent, in combination with Hashem '569. The Sollenberger Publications disclose a dynamic packet assignment (DPA) protocol for ongoing assignment (and reassignment) of channels to users in an OFDMA system, based on measurements taken at the mobile stations. To the extent the Sollenberger Publications do not explicitly disclose the limitations of claim 8, it would have been obvious to a person of ordinary skill in the art to modify the publications of the Sollenberger publications with the teachings of Hashem '569.

541. A person of ordinary skill in the art would have been motivated to combine the Sollenberger Article and/or the Sollenberger Patent with Hashem '569, at least in part, because each reference addressed the design of wireless OFDMA cellular systems during the same time frame. Moreover, each addressed the same problem in the context of wireless OFDMA systems – a method for identifying “acceptable” resources (*e.g.*, subcarriers or channels). (Hashem '569, Abstract; Sollenberger Patent, Fig. 2.) Further, the Sollenberger Article proposes the “dynamic packet assignment” and “adaptive modulation and coding” as techniques to provide wideband OFDM packet wireless data access s, indicating that the two techniques are complementary:

Dynamic packet assignment, an OFDM physical layer, ***adaptive modulation and coding***, space-time coding and interference suppression, and smart antennas ***are proposed as techniques to provide wideband OFDM packet wireless data access*** in macrocellular and microcellular environments. (Sollenberger Article at 761 (emphasis added).)

542. While the Sollenberger Publications do not explicitly disclose the feedback containing an indication of a coding and modulation rate, one of skill in the art would have been

motivated to look to Hashem '569 for an example of useful feedback in this context – and specifically the use of coding and modulation rates well-suited to the measured cluster.

2. Preamble

543. The preamble of claim 8 of the '748 Patent reads: “**A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising.**”

544. This element is satisfied by the disclosure set forth at '748 Patent claim 6 preamble.

3. Element 8[a][1]

545. Claim element 8[a][1] of the '748 Patent reads: “**a subscriber measuring channel and interference information for a plurality of subcarriers.**”

546. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

4. Element 8[a][2]

547. Claim element 8[a][2] of the '748 Patent reads: “**based on pilot symbols received from a base station.**”

548. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

5. Element 8[b]

549. Claim element 8[b] of the '748 Patent reads: “**the subscriber selecting a set of candidate subcarriers.**”

550. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

6. Element 8[c]

551. Claim element 8[c] of the '748 Patent reads: **“the subscriber providing feedback information on the set of candidate subcarriers to the base station.”**

552. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

7. Element 8[d]

553. Claim element 8[d] of the '748 Patent reads: **“the subscriber sending an indication of coding and modulation rates that the subscriber desires to employ for each cluster.”**

554. The Sollenberger Patent and the Sollenberger Article do not expressly disclose this element. However, this element is rendered obvious by the Sollenberger Article and/or the Sollenberger Patent, in combination with Hashem'569.

555. As discussed above, the Sollenberger Patent discloses the wireless station uses “an index variable j” to scan channels in priority order, measures the SIR on each channel, compares the measured SIR to a predetermined threshold, and adds the channel to a list of acceptable channels if the SIR is above the predetermined threshold. (See Sollenberger Patent at 9:1-40 (describing process).) Also discussed above, the Sollenberger Patent further discloses the subscriber providing feedback on the L candidate subcarriers to the base station. (See, e.g., Sollenberger Patent, Fig. 1.)

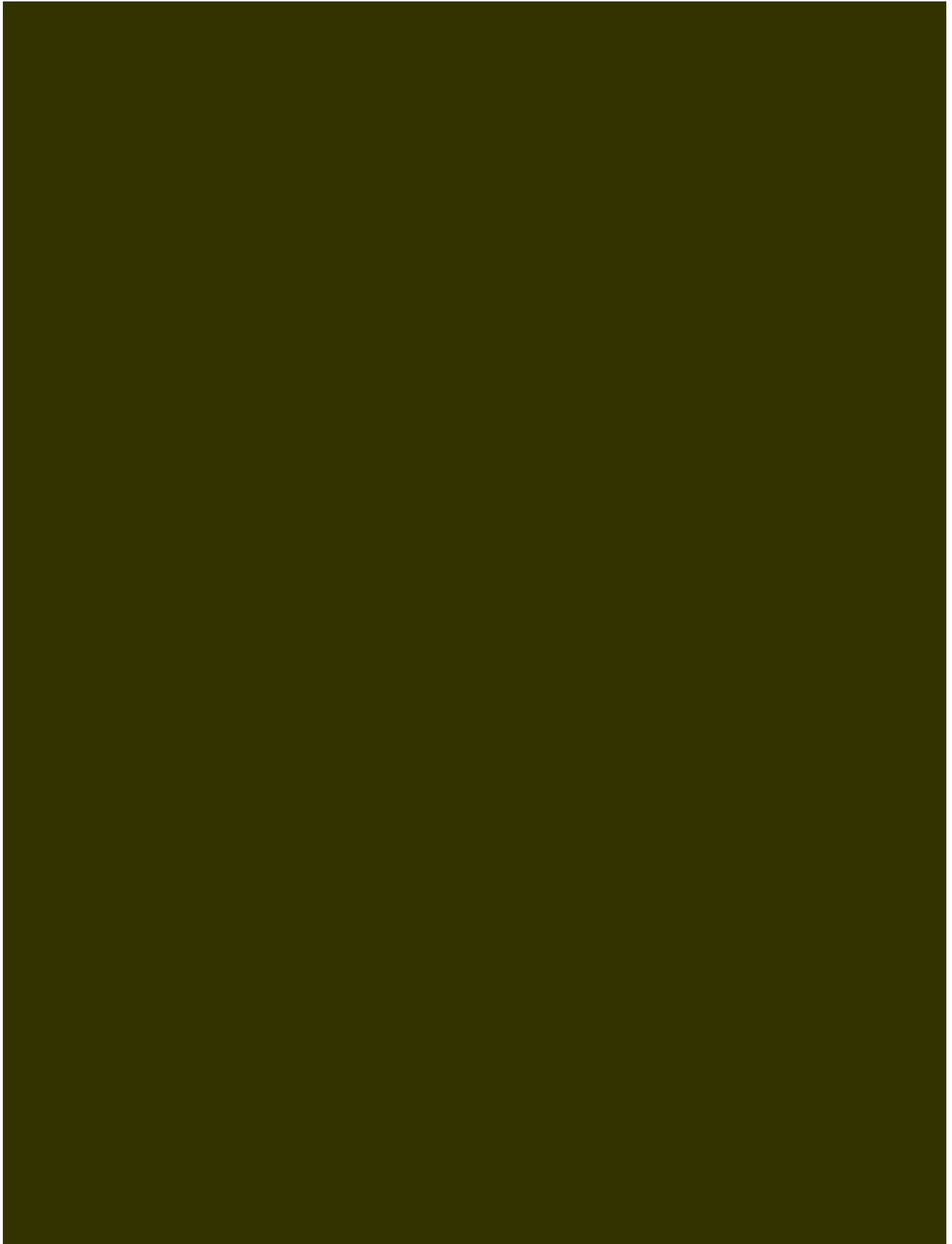
556. To the extent the Sollenberger Patent does not expressly disclose providing feedback “wherein each index is indicative of a coding and modulation rate,” it would have been obvious to a person of ordinary skill in the art to modify the feedback disclosed in the Sollenberger Patent, using the teachings in Hashem, to include this element.

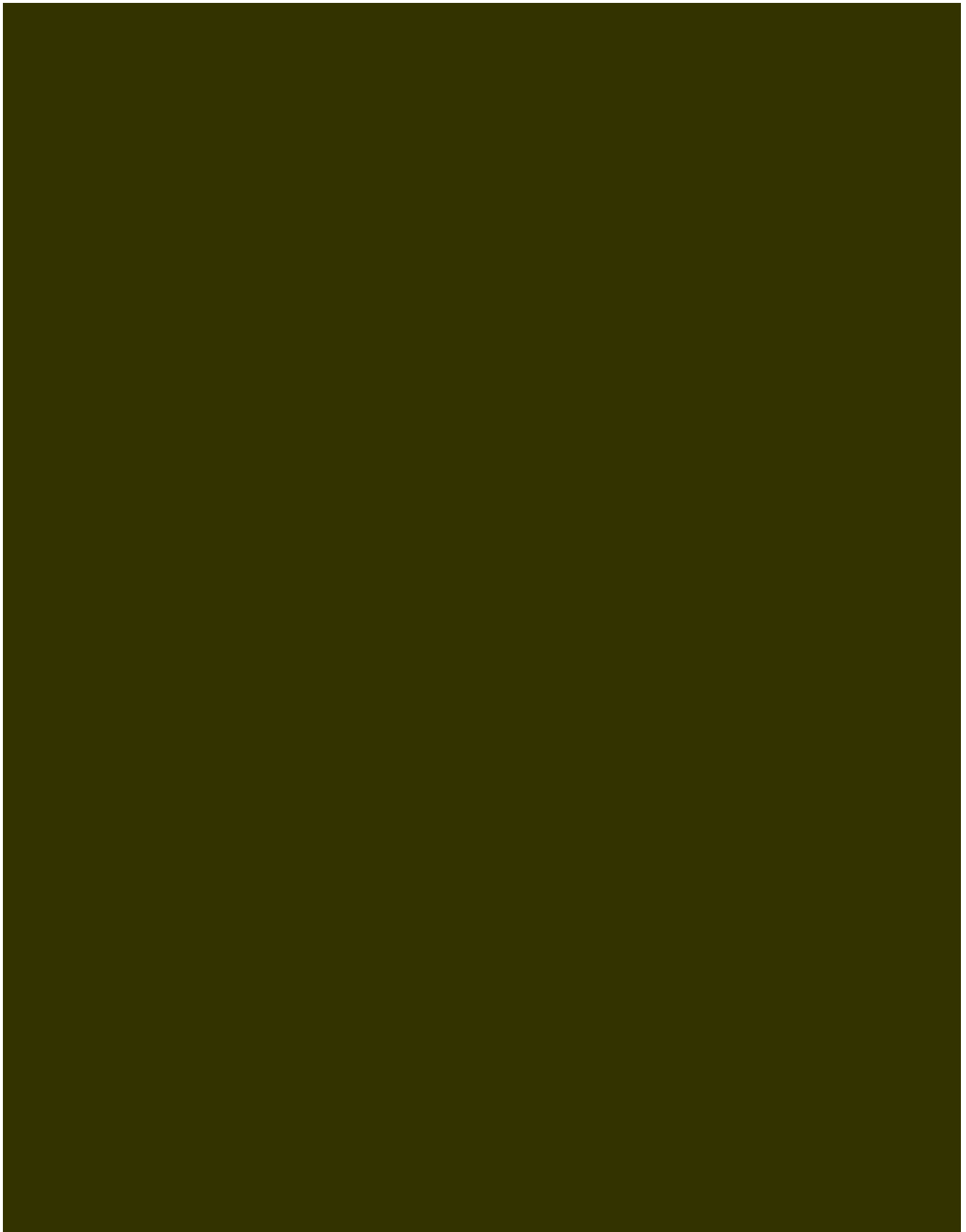
557. As discussed previously, Hashem '569 (which incorporates by reference Hashem '129) discloses feedback from the remote unit to the base station that includes an indication of the “Link Mode,” which Hashem '569 defines as “a set of at least one transmission parameter, such as a modulation level, a coding rate, a symbol rate, a transmission power level, antenna directional parameters, or space-time coding parameters.” (Hashem '569 at 4:11-15 (emphasis added).) Further, as previously discussed, Hashem '569 discloses “the remote unit can calculate a group Link Mode for each acceptable group of sub-carriers.” (Hashem '569 at 8:37-38).)

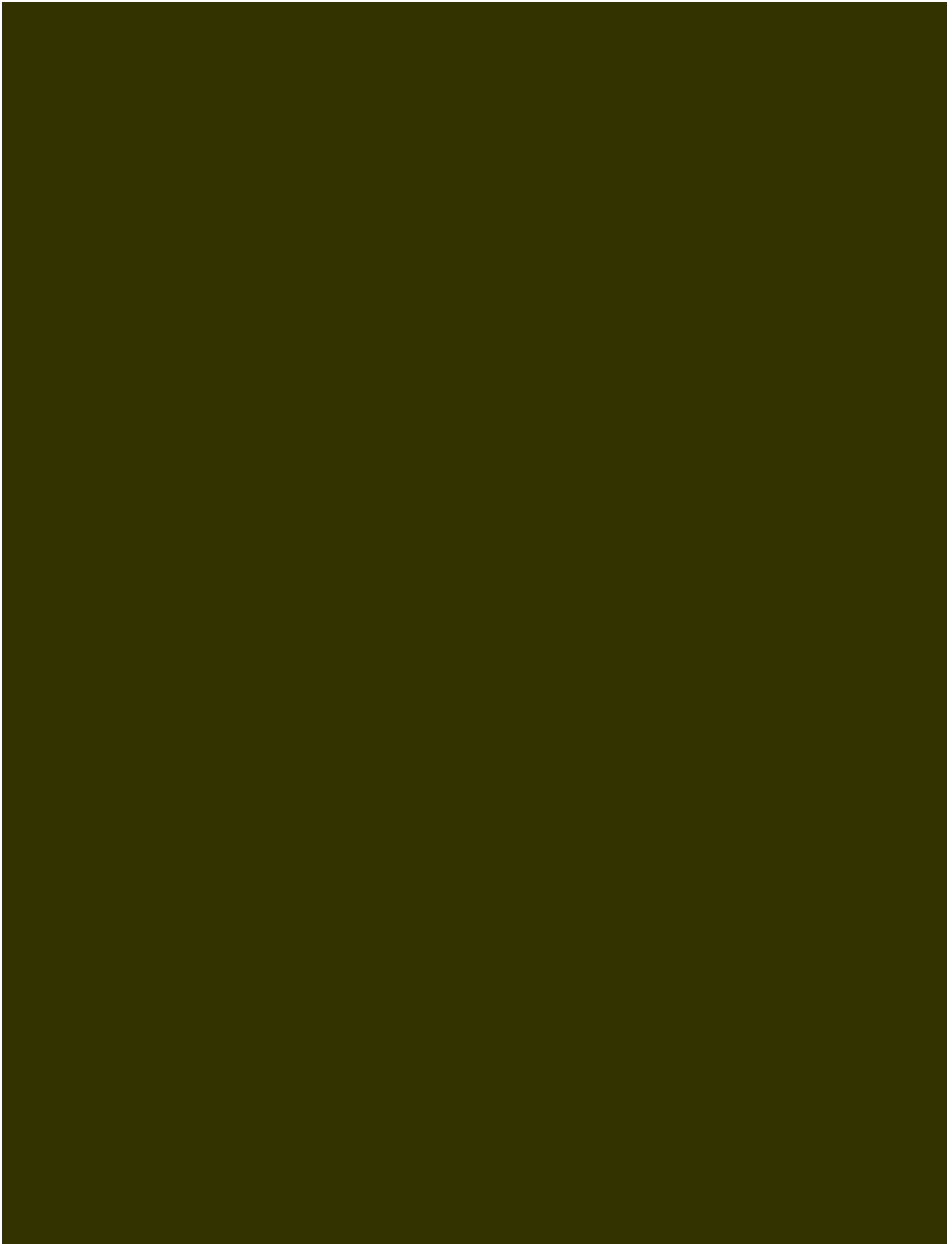
558. Thus, Hashem '569 discloses “wherein each index is indicative of a coding and modulation rate.”

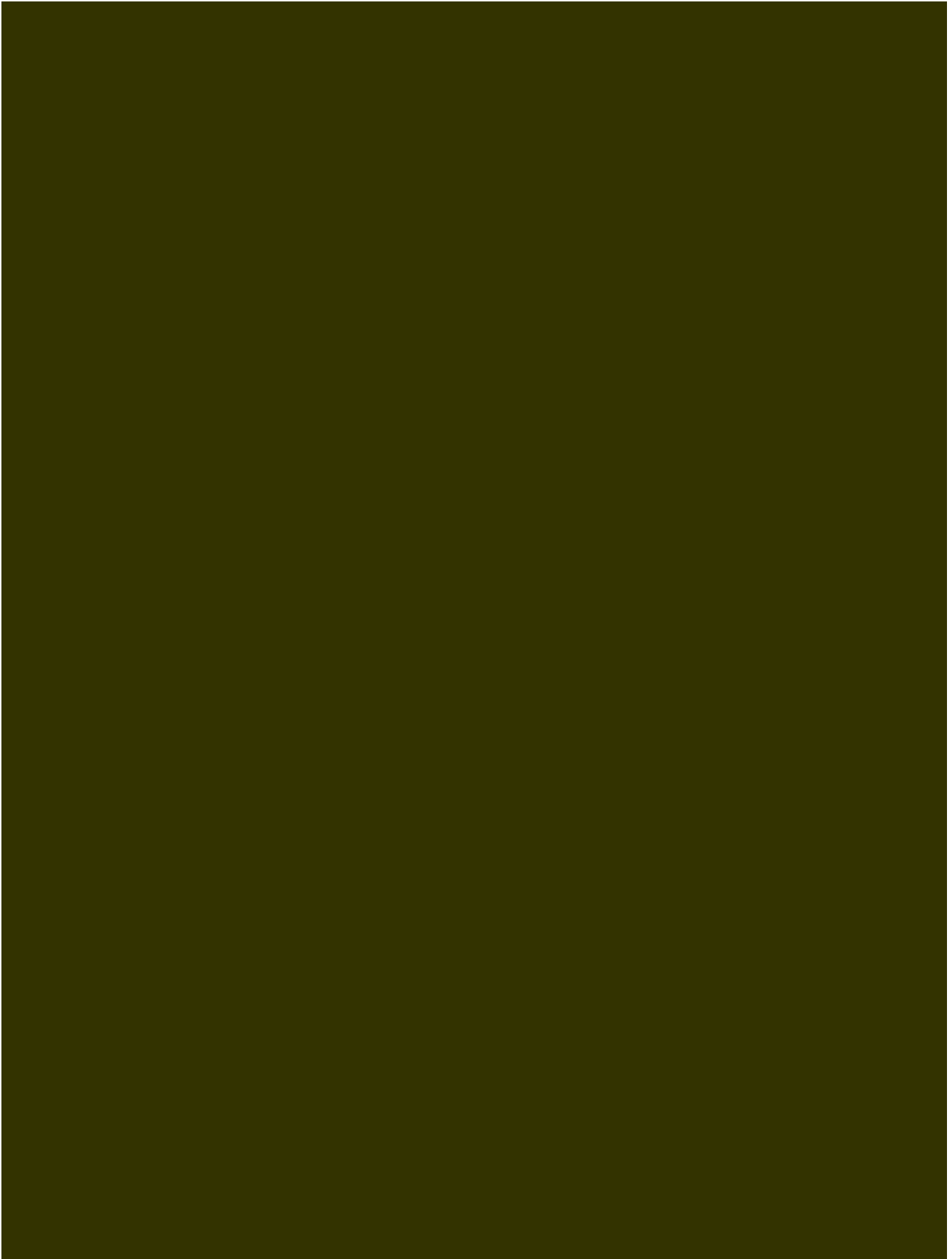
559. As noted above, a person of ordinary skill in the art would have been motivated to combine Sollenberger Article and/or the Sollenberger Patent with Hashem '569 at least in part because each reference addressed the design of wireless OFDMA cellular systems during the same time frame. Moreover, each addressed the same problem in the context of wireless OFDMA systems – a method for identifying “acceptable” resources (*e.g.*, subcarriers or channels). (Hashem '569, Abstract; Sollenberger Patent, Fig. 2.) Further, the Sollenberger Article proposes the “dynamic packet assignment” and “adaptive modulation and coding” as techniques to provide wideband OFDM packet wireless data access s, indicating that the two techniques are complementary:

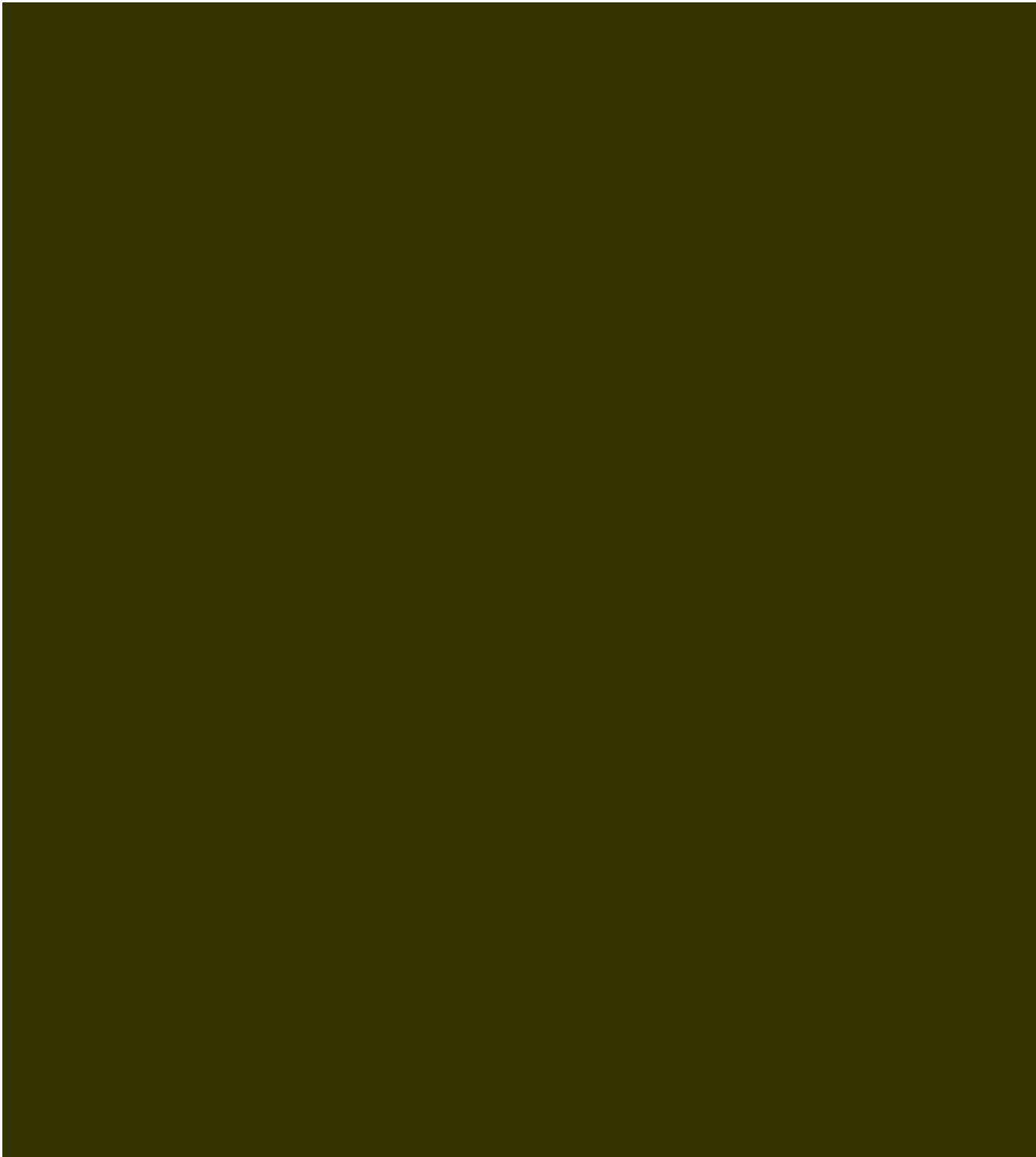
Dynamic packet assignment, an OFDM physical layer, ***adaptive modulation and coding***, space-time coding and interference suppression, and smart antennas ***are proposed as techniques to provide wideband OFDM packet wireless data access*** in macrocellular and microcellular environments. (Sollenberger Article at 761 (emphasis added).)



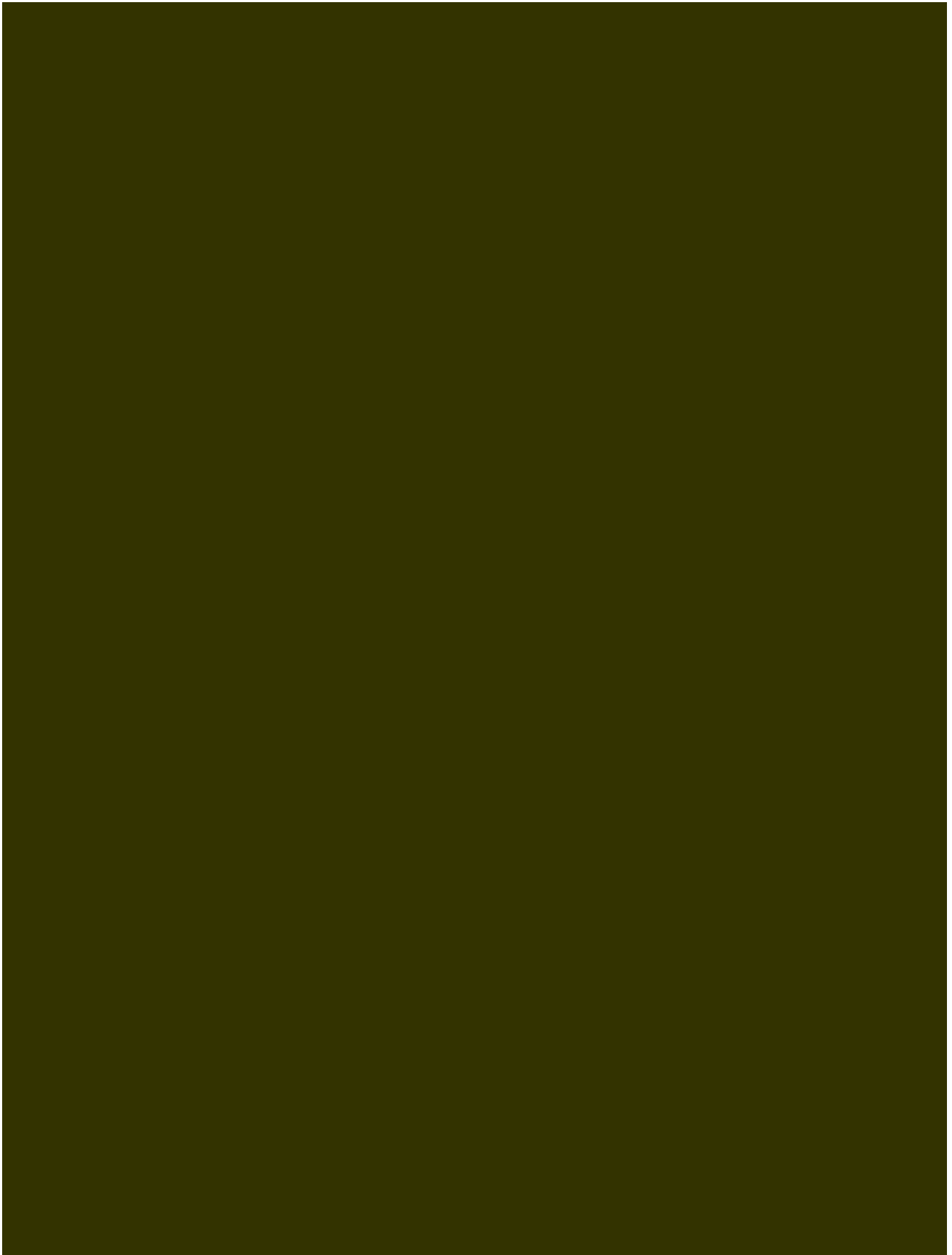












B. Claim 9 of the '748 Patent is Anticipated and/or Rendered Obvious by Hashem '569

591. Claim 9 of the '748 Patent reads: “**wherein the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.**”

592. The S/I index in Figure 2 of the '129 patent (which is incorporated by reference in Hashem '569) renders obvious the requirement of claim 9 that “the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.” As previously discussed, the S/I index is directly mapped to particular coding and modulation rates as shown in Fig. 2 from the '129 patent, pasted below.

S/I (dB)	MODULATION	CODING
3.1	QPSK	1/2
5.9	QPSK	3/4
7.7	QPSK	7/8
11.1	16-QAM	2/3
13.5	16-QAM	5/6
14.4	64-QAM	1/2
18.0	64-QAM	3/4
20.1	64-QAM	7/8

FIG. 2

593. As set forth above, it would have been obvious to a person of ordinary skill in the art to use an SINR index instead of the S/I index to indicate coding and modulation rates. Indeed, Hashem '569 notes that an S/I is simply an exemplary channel quality metric. (See, e.g., '129 Patent at 1:43-44.). Hashem '569 itself expressly discloses that “[t]he various embodiments have been described using S/I as a measure of channel quality [but] *[o]ther measures of channel quality could be used* and an average channel quality reported to the base

station, as long as the channel quality is such that an optimum Link Mode can be determined.”
(Hashem ’569 at 8:45-48 (emphasis added).)

594. A further example of the basis for why it would have been obvious to a person of ordinary skill in the art to use an SINR index instead of the S/I index of the ’129 patent is the widely known use of an SINR index in the IS-95A standard.

595. As discussed above, the IS-95A standard discloses feedback information that includes an “index indication of a candidate cluster with its SINR value.” Specifically, IS-95A discloses a method of providing feedback from the MS to the base station in the form of an SINR index. Referring to Section 6.7.2.3.2.5 on p. 6-228 of the IS-95A standard, the “Pilot Strength Measurement Message” is a message transmitted from the mobile station to the base station to report the quality of the channels associated with a set of pilots. Specifically, this message enables the MS to provide feedback on the strength of each pilot in the Active Set and the Candidate Set. As per the description of the message format on pages 6-228 through 6-229, each measured pilot is indexed by a phase offset to identify it, and each reported measurement is in the form of an SINR given by E_c/I_0 :

The mobile station should use the searcher element (see 6.2.2.1) to compute the strength of a pilot by adding the ratios of received pilot energy per chip, E_c , to total received spectral density (noise and signals), I_0 , of at most k usable multipath components, where k is the number of demodulating elements (see 6.2.2.1) supported by the mobile station.” (IS-95A, Section 6.6.6.2.2 at 6-173)

596. The measurement as described in the passage above includes the “total received spectral density (noise and signals)” and calls that quantity I_0 . The result of the measurement is the ratio E_c/I_0 , described in the standard as “the ratio (in dB) between the pilot energy accumulated over of PN chip period (E_c) to the total power spectral density in the received bandwidth (I_0).” (IS-95A at 1-5.) The value of I_0 thus includes both noise and interference, and

so E_c/I_0 represents a signal-to-interference-plus-noise (SINR) ratio of the associated pilot channel.

597. IS-95A discloses providing the feedback above in a manner that includes an index indication of a candidate channel with its SINR value, as denoted above. To see this, recall from the “Technology Background” section the IS-95A “Pilot Strength Measurement Message,” described on page 6-228 of the IS-95A standard. The format of the Pilot Strength Measurement Message is reproduced below.

6.7.2.3.2.5 Pilot Strength Measurement Message

When the mobile station sends a *Pilot Strength Measurement Message*, it shall use the following variable-length message format:

Field	Length (bits)
MSG_TYPE ('00000101')	8
ACK_SEQ	3
MSG_SEQ	3
ACK_REQ	1
ENCRYPTION	2
REF_PN	9
PILOT_STRENGTH	6
KEEP	1
Zero or more occurrences of the following record:	
PILOT_PN_PHASE	15
PILOT_STRENGTH	6
KEEP	1
RESERVED	0 - 7 (as needed)

598. Therefore, the widely known IS-95A standard discloses feedback information that includes both an index indication and an SINR value for each candidate channel. In the context of Hashem '569, of course, the index would include not only an indication of an SINR, but also of a coding and modulation rate desired for use. Thus, it would have been obvious to one of ordinary skill that Hashem '569 discloses the element “wherein the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.”

C. **Claim 9 of the '748 Patent is Rendered Obvious by Ritter in Combination with Hashem '569**

599. Claim 9 of the '748 Patent reads: “**wherein the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.**”

600. As set forth above, Ritter does not expressly disclose the indication of coding and modulation rates required in Claim 8 of the '748 Patent. However, Ritter in combination with Hashem '569 renders Claim 8 obvious. See Section VIII.C. Based on the same reasoning, the combination of Ritter and Hashem '569 renders claim 9 obvious because Hashem '569 discloses “wherein the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.” See Section IX.B

601. Specifically, the S/I index in Figure 2 of Hashem '129 (which is incorporated by reference in Hashem '569) renders obvious the requirement of claim 9 that “the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.” As previously discussed, the S/I index is directly mapped to particular coding and modulation rates as shown in Fig. 2 from the '129 patent, pasted below.

S/I (dB)	MODULATION	CODING
3.1	QPSK	1/2
5.9	QPSK	3/4
7.7	QPSK	7/8
11.1	16-QAM	2/3
13.5	16-QAM	5/6
14.4	64-QAM	1/2
18.0	64-QAM	3/4
20.1	64-QAM	7/8

FIG. 2

602. As set forth above, it would have been obvious to a person of ordinary skill in the art to use an SINR index instead of the S/I index to indicate coding and modulation rates. Indeed, Hashem '569 notes that an S/I is simply an exemplary channel quality metric. (*See, e.g.,* '129 Patent at 1:43-44.).

603. Thus, it would have been obvious to one skilled in the art to combine the teachings of Ritter and Hashem '569 to satisfy the limitations of claim 9.

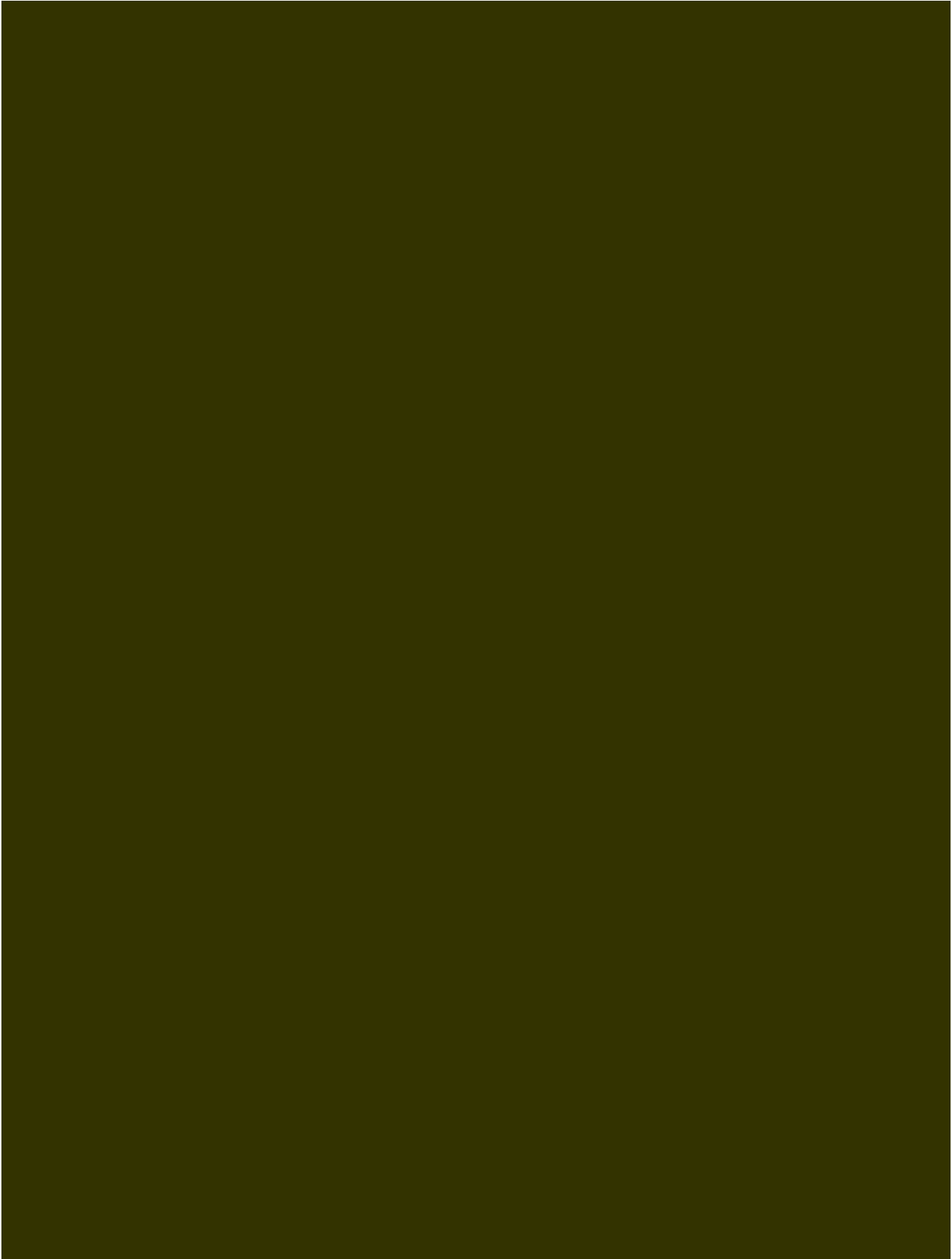
D. Claim 9 of the '748 Patent is Rendered Obvious by the Sollenberger Publications in Combination with Hashem '569

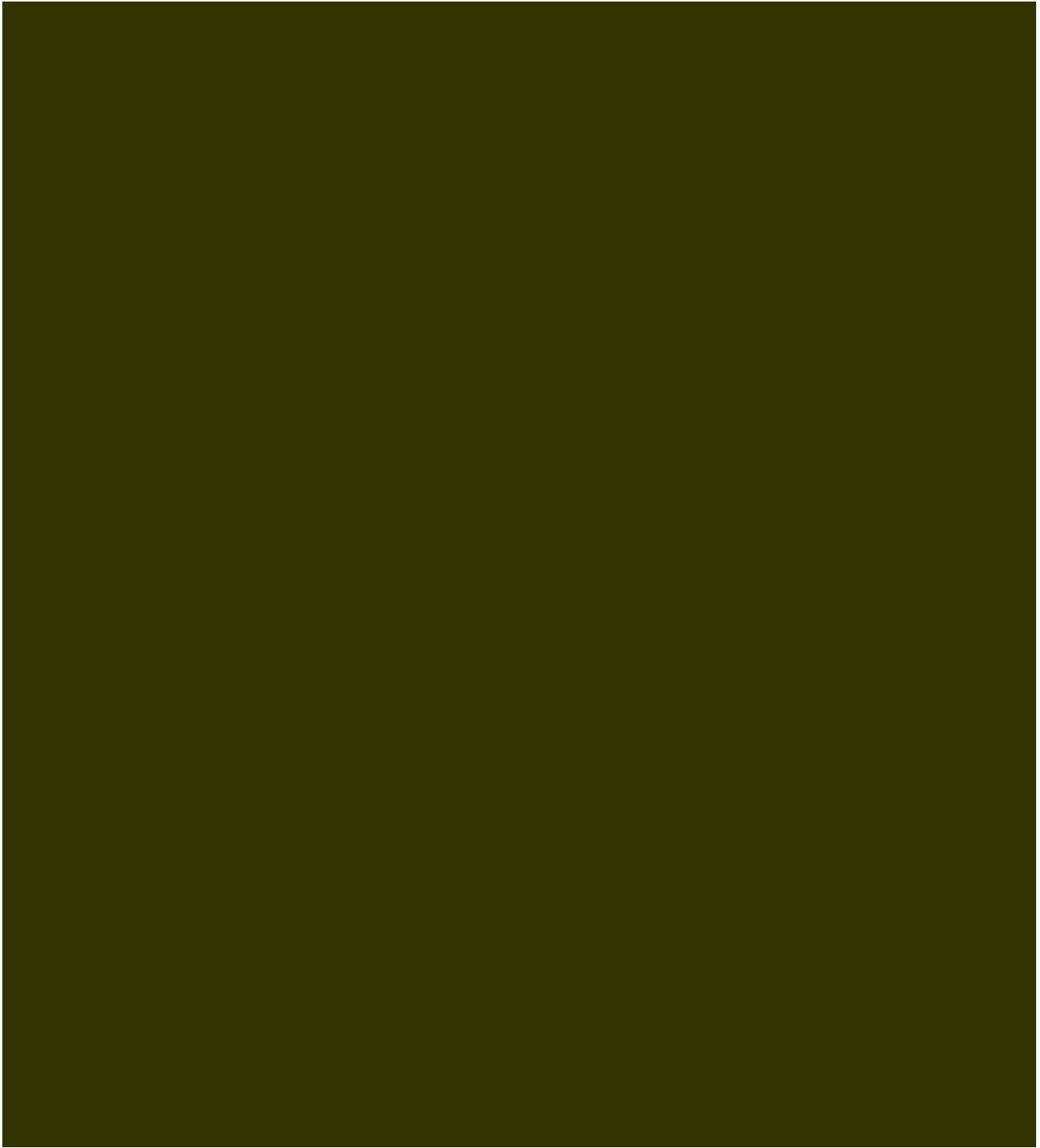
604. Claim 9 of the '748 Patent reads: “**wherein the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.**”

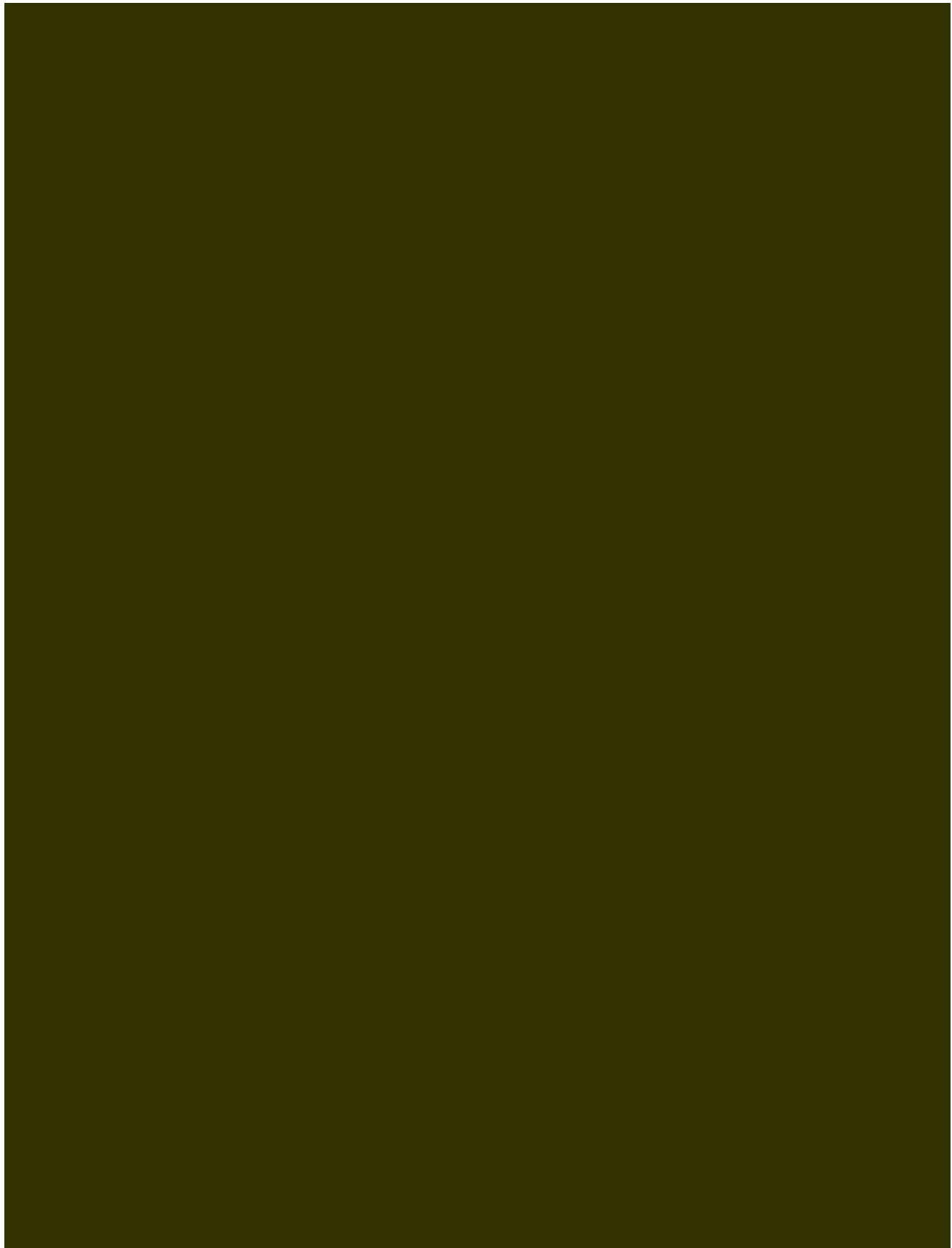
605. As discussed above, the Sollenberger Patent discloses the wireless station uses “an index variable j” to scan channels in priority order, measures the SIR on each channel, compares the measured SIR to a predetermined threshold, and adds the channel to a list of acceptable channels if the SIR is above the predetermined threshold. (*See* Sollenberger Patent at 9:1-40 (describing process).) Also discussed above, the Sollenberger Patent further discloses the subscriber providing feedback on the L candidate subcarriers to the base station. (*See, e.g.,* Sollenberger Patent, Fig. 1.)

606. The Sollenberger Patent does not expressly disclose providing feedback “wherein the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.” However, it would have been obvious to a person of ordinary skill in the art to modify the feedback disclosed in the Sollenberger Patent, using the teachings in Hashem '569, to include this element.

607. As previously discussed in sections IX.B above, the S/I in Figure 2 of Hashem '129 renders obvious the requirement of claim 9 that “the indication of coding and







X. '748 PATENT, CLAIM 11

614. Claim 11 of the '748 Patent is reproduced below with identifiers [a], [b], [c], etc. added for ease of reference:

11. An apparatus comprising:

- [a] a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers; and
- [b][1] a first base station in the first cell, in response to receiving inter-cell interference information, coordinates with other cells to make a cluster assignment decision,
- [b][2] the first base station performing subcarrier allocation for OFDMA to allocate OFDMA subcarriers in clusters to the plurality of subscribers based on inter-cell interference avoidance and intra-cell traffic load balancing in response to the feedback information.

A. Independent Claim 11 of the '748 Patent Is Indefinite

615. I understand that this Court has considered whether claim 11 of the '748 Patent is indefinite because it claims both an apparatus, and also requires certain method steps be performed well. I understand that the Court concluded that Defendants did not establish that claim 11 was indefinite by clear and convincing evidence.

616. I have been informed and understand that the Supreme Court recently ruled that a claim is not definite merely because it may be amenable to construction and not insolubly ambiguous, and emphasized that the definiteness requirement mandates clarity. It is my opinion that claim 11 of the '748 Patent is indefinite because, when viewed in light of the specification and prosecution history, it fails to inform those skilled in the art about the scope of the invention with reasonable certainty.

617. Independent Claim 11 of the '748 Patent is an apparatus claim. Claim 11 includes language, however, that requires certain method steps to be performed as well. For instance,

claim 11 requires that the first base station “coordinates with other cells to make a cluster assignment decision,” as well as requiring that the first base station “performing subcarrier allocation for OFDMA to allocate OFDMA subcarriers in clusters to the plurality of subscribers based on inter-cell interference avoidance and intra-cell traffic load balancing.”

618. It is my opinion that these claim limitations are not describing capabilities or functionality of the base station, but instead describe actions that must be performed in order to meet the claim language. I have been informed and understand that the Federal Circuit has found that an apparatus claim is not definite when it also includes method steps.

619. Therefore, it is my opinion that claim 11 of the '748 Patent is indefinite because it does not provide reasonable certainty as to what is required to practice the claim (*e.g.*, whether infringement occurs when one creates an apparatus that allows a base station to coordinate with other cells and perform subcarrier allocation based on inter-cell interference avoidance and traffic load balancing, or whether infringement occurs when the base station actually coordinates with other cells and performs subcarrier allocation based on inter-cell interference avoidance and traffic load balancing).

620. Notwithstanding, I have evaluated claim 11 of the '748 Patent under Adaptix's apparent interpretation of the claim. Based on that interpretation, it is my opinion that claim 11 of the '748 Patent is anticipated and/or rendered obvious by the prior art as described below.

B. Claim 11 of the '748 Patent is Rendered Obvious by Ritter In Combination With Haartsen '837 or Liu '315

1. Introduction

621. The following analysis demonstrates that claim 11 of the '748 Patent is rendered obvious by Ritter in combination with Haartsen '837 and also by Ritter in combination with Liu '315. Ritter discloses the general framework for an OFDMA-based wireless communication

system in which OFDM subcarriers are selected and allocated for the purpose of communication between a subscriber and a base station. To the extent Ritter does not explicitly disclose the limitations of claim 11, it would have been obvious to a person of ordinary skill in the art to modify Ritter with the teachings of Haartsen '837 or with the teachings of Liu '315.

622. A person of ordinary skill in the art would have been motivated to combine Ritter with Haartsen '837 to design an OFDMA system as disclosed in claim 11. Both Ritter and Haartsen '837 addressed the design of wireless cellular systems – and, more specifically, the problem of dynamic resource allocation in such a wireless cellular system. While Ritter addresses the mitigation of inter-cell interference in an OFDMA system through the use of feedback from a subscriber to the base station to which it is connected, Haartsen '837 considers a broader range of solutions to the same problem in an earlier generation TDMA cellular system – including that of coordination among base stations. It would therefore have been natural for one of skill in the art to look to the techniques described by Haartsen '837 to enhance the performance of the OFDMA system described by Ritter.

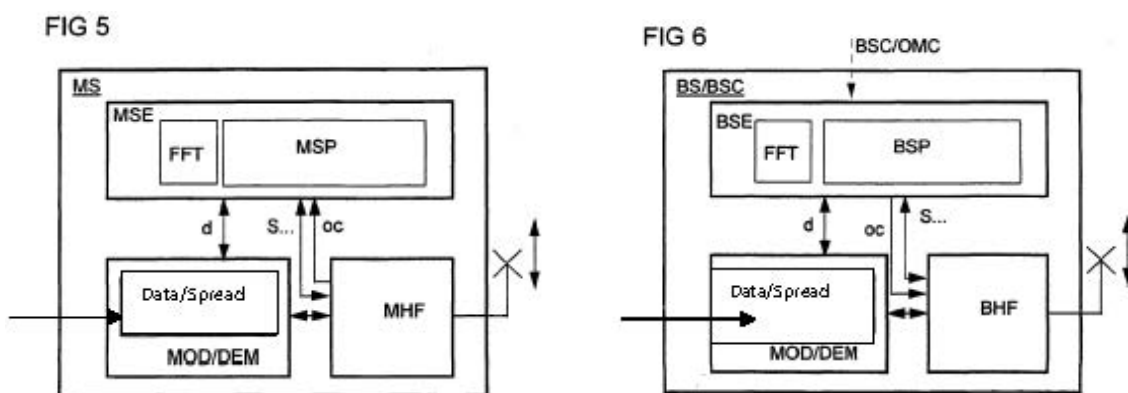
623. Similarly, a person of ordinary skill would have been motivated to combine Ritter with Liu '315 to design an OFDMA system as disclosed in claim 11. Both Ritter and Liu '315 addressed the design of wireless OFDMA cellular systems – and, more specifically, the problem of dynamic resource allocation in such an OFDMA wireless cellular system. They both considered the same basic framework for addressing that problem – that of making subscriber-based measurements and feeding those measurements back to the base station to aid in resource allocation. It would have been natural for one of skill in the art to look to Liu '315 for extensions to the Ritter approach applicable to systems with base stations comprised of multiple transceivers (for beam-forming) and to systems that enable coordination among base stations.

2. Preamble

624. The preamble of claim 11 reads: “**An apparatus comprising.**”

625. To the extent that the preamble is a limitation, it is disclosed by Ritter.

Specifically, Ritter discloses a “mobile station MS for supporting the method and wireless communication system according to the invention... in Fig. 5, while Fig. 6 shows a corresponding base station or base station control BSC.” Figures 5 and 6 from Ritter are reproduced below.



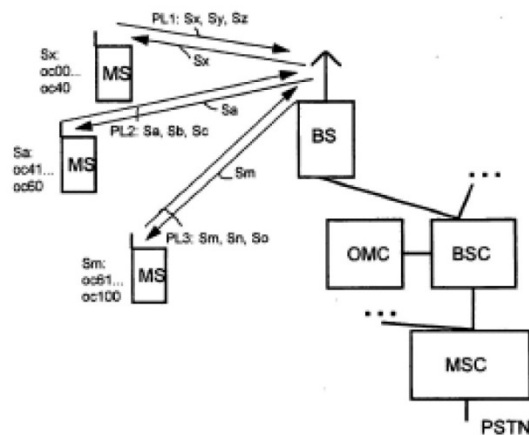
626. Thus, Ritter discloses “an apparatus.”

3. Element 11[a]

627. Claim element 11[a] of the '748 Patent reads: “**a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.**”

628. This element is disclosed by Ritter. As shown in Figure 1 below taken from Ritter, it discloses a plurality – in this case three – subscribers, represented by the three mobile stations designated “MS”.

FIG 1



629. Also in the above figure is the feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers. These are indicated by the three priority lists – the first labeled “PL1: Sx, Sy, Sz” to indicate the clusters of subcarriers desired for use by the first MS, the second labeled “PL2: Sa, Sb, Sc” to indicate the clusters of subcarriers desired for use by the second MS, and the third labeled “PL3: Sm, Sn, So” to indicate the clusters of subcarriers desired for use by the third MS. Ritter discloses:

In the present example the first mobile station finds a segment Sx with the subcarriers oc00... oc40 as the segment most suitable for it. In addition it determines Sy, Sz as additional segments preferably suitable for its own communication connection. Messages regarding the segments Sx, Sy, Sz are entered into a priority list PL1, numbered according to their suitability for the communication connection, and sent to the base station BS.

In a similar manner, the second mobile station establishes a segment Sa with the subcarriers oc41... oc60 as the most suitable segment for it. In addition it determines segments Sb, Sc as additional segments preferred for its own communication connection. Messages about the segments Sa, Sb, Sc are entered into a priority list PL2, numbered according to their suitability for the communication connection, and likewise transmitted to the base station BS.

The third mobile station MS served by the base station BS also determines a segment Sm with the subcarriers oc61... oc100 as the segment best suited for its communication connection. In addition it enters segments Sn, So as additional segments preferably suited for its own communication connection in a priority list PL3. The messages regarding these three segments Sm, Sn, So, which are numbered corresponding to their suitability for the communication connection in

the priority list PL3, are likewise subsequently sent by it [the mobile station] to the base station BS.

(Ritter at 2-3.)

630. Thus, Ritter discloses “a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers”.

4. Element 11[b][1]

631. Claim element 11[b][1] of the ’748 Patent reads: “**a first base station in the first cell, in response to receiving inter-cell interference information, coordinates with other cells to make a cluster assignment decision.**”

632. This element is disclosed by Ritter in combination with Haartsen ’837 or Liu ’315.

633. As described above, Ritter discloses an apparatus in which inter-cell interference information – in the form of a priority list of subcarrier segments that are sufficiently “suitable” – is fed back from each mobile station to its base station. Ritter makes clear that a segment’s “suitability” is determined at least in part by the extent to which it is subject to inter-cell interference:

Through the improved frequency resource allocation method (smart frequency hopping approach) according to the invention, interferences, especially the intercellular interferences that are critical in wireless communication systems and the inter-symbol interferences, can be taken into consideration and at least reduced or eliminated altogether. (Ritter at 4, col. 2 ¶ 3.)

634. Ritter further discloses that this feedback is used by the first base station to make cluster assignment decisions.

The base station BS evaluates all of the information received from the mobile stations MS and, depending on the evaluation of each mobile station, allocates a segment for the respective communication connection. (Ritter at 4, col. 4 ¶ 2.)

635. Thus, Ritter discloses the base station both receiving and evaluating “intercellular interferences.” Ritter does not disclose the base station “coordinates with other cells to make a cluster assignment decision. However, a person of ordinary skill in the art would have been motivated to combine the teaching of Ritter with those of Haartsen ’837 or Liu ’315 to disclose this element.

636. Haartsen ’837 describes a method of “adaptive channel allocation” through which channel assignments are made across multiple cells from a common “pool” of channels:

Adaptive channel allocation, or ACA, is a method of dynamically allocating frequencies throughout a cellular system to maximize system capacity. Under an ACA scheme, more frequencies would be allocated to busy cells from more lightly loaded cells. In addition, the channels can be allocated such that all links have satisfactory quality. (Haartsen ’837 at 2:21-26.)

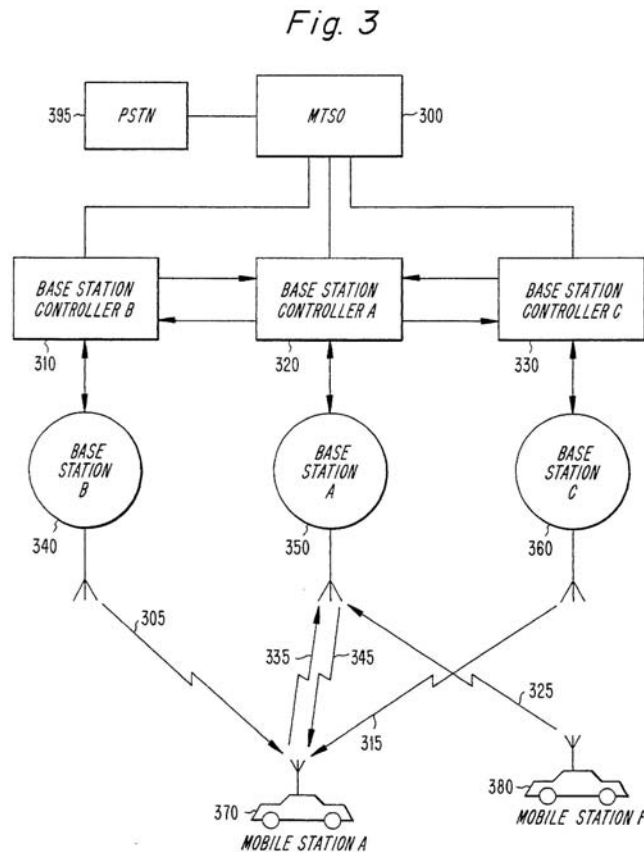
637. Indeed, the Haartsen ’837 describes a system in which interference measurements are shared between base stations to coordinate channel allocation:

The channel allocation scheme described by this invention makes use of periodic measurements performed both by one or more base stations and/or by one or more mobile stations to determine the best channel under the current radio environment. (Haartsen ’837 at 5:31-35.)

638. The exchange of uplink interference information between base stations to coordinate channel allocation is described as follows:

639. “The average uplink interference level on channel K at base J is represented by $I_{up}(J,K)$. The I_{up} values of all idle channels, K, at base J are now sent via the base station controller of base station J to the base station controller of the base station to which the considered mobile station is currently connected. For the example shown in FIG. 4 [sic], this means that the values measured on idle channels by base stations A, B and C (i.e., $I_{up}(A,K)$, $I_{up}(B,K)$, and $I_{up}(C,K)$, respectively) are sent to base station controller 320 of base A.” (Haartsen ’837 at 7:66-8:8.)

640. Figure 3 – incorrectly identified as “FIG. 4” in the above passage – is shown below. It illustrates the communication between the base station controllers (310, 320, and 330) that enables coordination between cells for channel allocation.

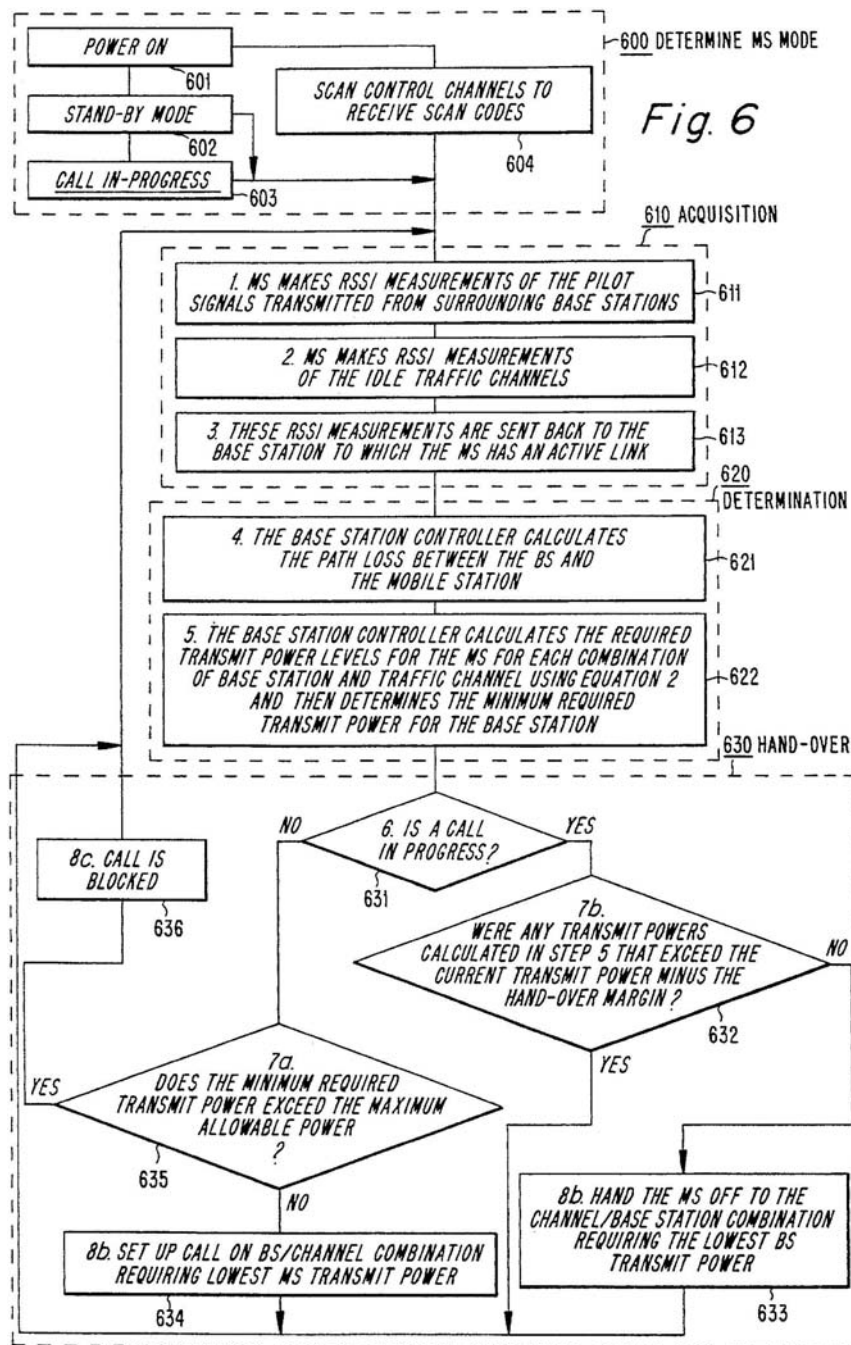


641. With regard to the downlink channel allocation, the Haartsen’837 reads:

“Assuming that the uplink and downlink channels can be independently allocated, the procedure for assigning the downlink is similar to that described above for assigning the uplink.”

(Haartsen ’837 at 10:56-59.) In particular, Figure 6 from the Haartsen ’837 (reproduced below) illustrates that the mobile station measures the received signal strength (RSSI) from pilot signals transmitted by base stations in the vicinity, and those measurements are “sent back to the base station to which the MS has an active link.” The base station then coordinates with other cells by selecting the optimal “BS/channel combination” – *i.e.*, it uses the information provided by the

other cells to select the base station and the channel combination that it will use to provide downlink capabilities.



642. Further, the Haartsen '837 discloses the advantages of coordination amongst base stations as part of both predicting interference as well as conducting adaptive allocation of downlink resources. For example:

To predict the downlink interference, one should identify the base stations in a wide range around the mobile station that are transmitting on the same channel. The location of these bases and the power levels they are currently using on the considered channel, must be directed to the base station controller doing the ACAPC processing (e.g., in the example of FIG. 3, this is base station controller 320.) This can be accomplished, for example, directly through the MTSO 300. Adjacent channel interference can also be included if it is corrected with the adjacent channel rejection factor. (Haartsen '837 at 13:22-30.)

643. Thus, Ritter disclose a first base station in the first cell, in response to receiving inter-cell interference information, making a cluster assignment. Haartsen '837 discloses a first base station in the first cell, in response to receiving inter-cell interference information, coordinating with other cells to make a channel assignment. But in Ritter's OFDM context, making a channel assignment is equivalent to making a cluster assignment.

644. Like Haartsen '837, Liu '315 also discloses coordination among cells when making a cluster assignment decision.

“In such an embodiment, in a multi-cell environment, the base station within each cell first estimates the uplink and downlink SINRs across all OFDMA traffic channels for all active and accessing subscribers. Each base-station may also buffer the QoS requirements (e.g., data rate, time-out, bit error rate, waiting time). Base-stations in neighboring cells exchange such information before performing a traffic channel allocation jointly for multiple subscribers.” (Liu '315 at 6:49-57 (emphasis added).)

645. Moreover, Liu '315 discloses that “[t]raffic channel conditions, assignment tables, as well as QoS requirements of all accessing subscribers of neighboring cells, may be accounted for in performing traffic channel assignment.” (Liu '315 at 11:37-40.)

646. As such, Liu '315 sets forth an entire system disclosing the limitations of this element:

[E]ach subscriber is subject to interference from neighboring cells in a multi-cell setup. ***To increase, and potentially maximize, the spectral efficiency for ever-changing traffic, coordination among base-stations and subscribers is considered in traffic channel assignment.*** FIG. 2 illustrates that the channel gain for different channels changes based on the subcarrier being examined. For example, while channels 1 and 2 has good gain at certain subchannels, they also

have poorer gains at others. *The present invention makes intelligent decisions about channel assignments for multi-users so that multiple channels are jointly allocated to multiple subscribers based on which channels have desirable characteristics (e.g., higher gains, lower interference, etc.) for each particular subscriber.*

(Liu '315 at 7:50-63 (emphasis added).)

647. Thus, both Ritter in combination with Haartsen '837, and Ritter in combination with Liu '315 discloses “a first base station in the first cell, in response to receiving inter-cell interference information, coordinates with other cells to make a cluster assignment decision.”

5. Element 11[b][2]

648. Claim element 11[b][2] of the '748 Patent reads: “**the first base station performing subcarrier allocation for OFDMA to allocate OFDMA subcarriers in clusters to the plurality of subscribers based on inter-cell interference avoidance and intra-cell traffic load balancing in response to the feedback information.**”

649. This element is disclosed by Ritter. As noted above in claim element 11[b][1], Ritter discloses (or renders obvious) the first base station allocating OFDMA subcarriers in clusters to subscribers based on inter-cell interference avoidance – *i.e.*, based on a priority list of subcarrier segments that exhibit sufficiently small inter-cell interference. However, Ritter also discloses that the assignments can be based on other factors as well – including the nature of the load in the cell:

The change in segments of the frequency spectrum also takes conditions into consideration the transmission conditions (high levels of disturbances and interferences) as well as the load on the wireless resources (time slots, frequencies, spreading codes) in the wireless cell. (Ritter at 6 col. 1 ¶ 3 (emphasis added).)

650. Thus, Ritter discloses “the first base station performing subcarrier allocation for OFDMA to allocate OFDMA subcarriers in clusters to the plurality of subscribers based on inter-

cell interference avoidance and intra-cell traffic load balancing in response to the feedback information.”

651. Alternatively, to the extent Ritter does not disclose this element, one skilled in the art would have known to modify Ritter to satisfy this element, or would have been motivated to combine Ritter with the teachings of Haartsen ’837. For example, Haartsen ’837 clearly teaches inter-cell interference avoidance. *See* element 11[b][1].

652. As noted above, Haartsen ’837 discloses the advantages of coordination amongst base stations as part of both predicting interference as well as conducting adaptive allocation of downlink resources. But Haartsen ’837 also discloses a base station allocation scheme that not only accounts for inter-cell interference, it also adapts to balance traffic load in the cell:

The control scheme presented herein adapts to the current traffic and interference situation in a communication environment in order to optimize the quality of each link and maximize the overall system capacity. The status of the current traffic and interference condition is derived from measurements taken both by the mobile station and the base station. (Haartsen ’837, at 3:45-50.)

653. As evidenced by the disclosures of Ritter and Haartsen ’837, a base station performing subcarrier allocation based on both inter-cell interference avoidance as well as intra-cell traffic load conditions in order to maximize the efficiency of the system was known to those skilled in the art at the time of the claimed inventions. Thus, one of ordinary skill in the art would know to modify Ritter, or alternatively would have been motivated to combine Ritter with Haartsen ’837 for “the first base station performing subcarrier allocation for OFDMA to allocate OFDMA subcarriers in clusters to the plurality of subscribers based on inter-cell interference avoidance and intra-cell traffic load balancing in response to the feedback information.”

C. Claim 11 of the '748 Patent is Rendered Obvious by the Sollenberger Publications in Combination with Haartsen '837 or Liu '315

1. Introduction

654. The following analysis demonstrates that claim 11 of the '748 Patent is rendered obvious by the Sollenberger Publications in combination with the Haartsen '837 and/or by the Sollenberger Publications in combination with Liu '315. The Sollenberger Publications disclose the general framework for an OFDMA-based wireless communication system in which OFDM subcarriers are selected and allocated for the purpose of communication between a subscriber and a base station. To the extent the Sollenberger Publications do not explicitly disclose the limitations of claim 11, it would have been obvious to a person of ordinary skill in the art to modify the Sollenberger Publications with the teachings of Haartsen '837 or Liu '315.

655. A person of ordinary skill in the art would have been motivated to combine the Sollenberger Publications with Haartsen '837 to design an OFDMA system as disclosed in claim 11. The Sollenberger Publications and Haartsen '837 each addressed the design of wireless cellular systems – and, more specifically, the problem of dynamic resource allocation in such a wireless cellular system. While the Sollenberger Publications address the mitigation of inter-cell interference in an OFDMA system through the use of feedback from a subscriber to the base station to which it is connected, Haartsen '837 considers a broader range of solutions to the same problem in an earlier generation TDMA cellular system – including that of coordination among base stations. It would therefore have been natural for one of skill in the art to look to the techniques described by Haartsen '837 to enhance the performance of the OFDMA system described by the Sollenberger Publications.

656. Similarly, a person of ordinary skill would have been motivated to combine the Sollenberger Publications with Liu '315 to design an OFDMA system as disclosed in claim 11.

The Sollenberger Publications and Liu '315 each addressed the design of wireless OFDMA cellular systems – and, more specifically, the problem of dynamic resource allocation in such an OFDMA wireless cellular system. The references considered the same basic framework for addressing that problem – that of making subscriber-based measurements and feeding those measurements back to the base station to aid in resource allocation. It would have been natural for one of skill in the art to look to Liu '315 for extensions to the protocol described in the Sollenberger Publications applicable to systems with base stations comprised of multiple transceivers (for beam-forming) and to systems that enable coordination among base stations.

2. Preamble

657. The preamble of claim 11 reads: “**An apparatus comprising.**”

658. To the extent that the preamble is a limitation, it is disclosed by, at least, the Sollenberger Patent. The Sollenberger Patent discloses a “base station [that] is one of a plurality of base stations” and “wireless stations communicating with the base station.” (Sollenberger Patent at 6:60-7:9.)

659. Thus, the Sollenberger Patent discloses “an apparatus.”

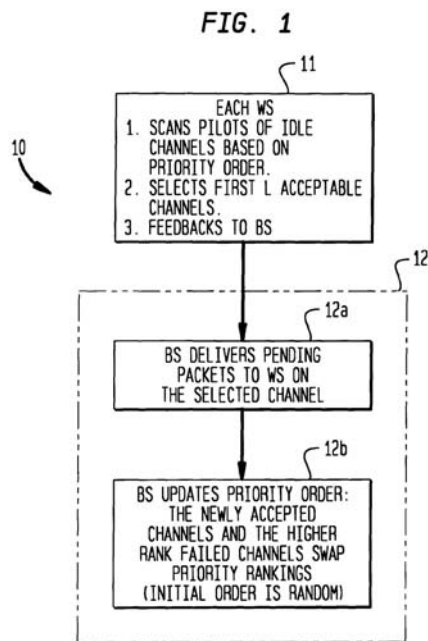
3. Element 11[a]

660. Claim element 11[a] of the '748 Patent reads: “**a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.**”

661. This element is disclosed by, at least, the Sollenberger Patent.

662. As discussed above, the Sollenberger Patent discloses a method in which each WS (“wireless station”) selects the first L “acceptable” channels. Further, as shown in Figure 1 from the Sollenberger Patent (reproduced below), each wireless station, having scanned the

pilots and selected the first L acceptable channels desired for use, then “Feedbacks to BS” the information that the base station needs to make its channel assignments.



663. Thus, the Sollenberger Patent discloses “a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.”

4. Element 11[b][1]

664. Claim element 11[b][1] of the ’748 Patent reads: “**a first base station in the first cell, in response to receiving inter-cell interference information, coordinates with other cells to make a cluster assignment decision.**”

665. This element is disclosed by, at least, the Sollenberger Article in combination with the Haartsen ’837 or Liu ’315.

666. As noted above, the Sollenberger Article describes a protocol with four basic steps:

The basic protocol for a downlink comprises four basic steps: (1) a packet page from a base station to a terminal; (2) *rapid* measurements of resource usage by a terminal using the *parallelism* of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with *each* radio resource; and (4) selection of resources by the base and transmission of the data. (Sollenberger Article at 758-759.)

667. The second step is “rapid measurements of resource usage by a terminal using the parallelism of an OFDM receiver.” As previously discussed, the nature of these measurements and how they are accommodated by the exemplary frame structure is also described:

This frame structure permits SIR estimation on all unused traffic slots. The desired signal is estimated by the received signal strength from the 2 OFDM blocks used for paging, while the interference can be estimated by measuring 3 blocks of received pilot signals. (Sollenberger Article at 760.)

668. Meanwhile, the last of the four steps indicates that the resources (or clusters) are assigned by the base station, as required by this element. Moreover, Figure 3.2 from the Sollenberger Article, reproduced below, indicates that the “list of assigned channels” is transmitted from the base station to the mobile stations in the coverage area of the base station, one base station each frame and four base stations in each “superframe” of 80.0 ms.

3.2 Frame Structure for Dynamic Packet Assignment

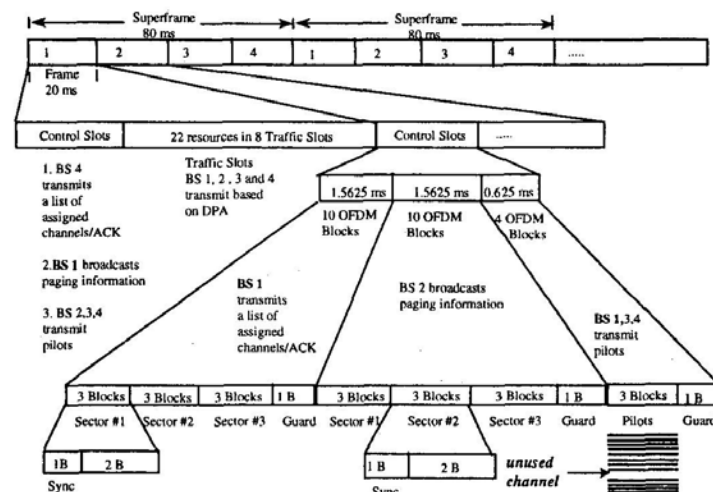


Figure 3. Staggered frame structure for downlink DPA

669. Thus, one of ordinary skill in the art would understand that the Sollenberger Article discloses a first base station in the first cell, in response to receiving inter-cell interference information, making a cluster assignment decision.

670. However, Sollenberger Article does not disclose the base station “coordinates with other cells to make a cluster assignment decision.” Nonetheless, a person of ordinary skill in the art would have been motivated to combine the teaching of Sollenberger Article with those of Haartsen ’837 or Liu ’315 to disclose this element.

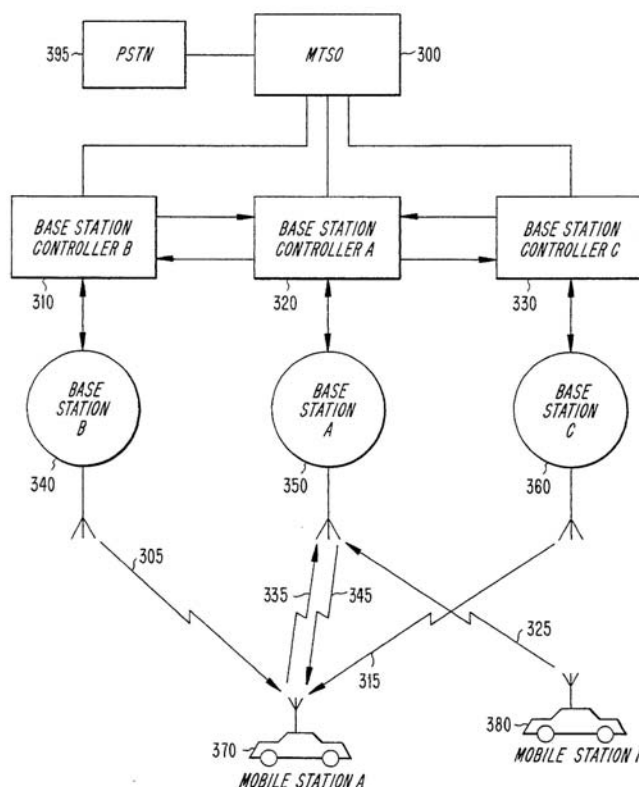
671. First, the Sollenberger Article discloses “[t]he frame structures of adjacent base stations are staggered in time, *i.e.*, neighboring base stations sequentially perform the four different DPA functions outlined above with a pre-determined rotational schedule. This avoids collisions of channel assignments.” (Sollenberger Article at 759.) This disclosure does not expressly satisfy “coordinates with other cells to make a cluster assignment decision.” It does disclose a need for base station to account for (and avoid) possible collisions of channel assignments. Thus, one of ordinary skill in the art would have been motivated to combine the teachings of Sollenberger Article with Haartsen ’837 or Liu ’315.

672. As discussed above, Haartsen ’837 teaches another way to avoid collisions of channel assignments between neighboring base stations is through a system in which interference measurements are shared between base stations to coordinate channel allocation:

The channel allocation scheme described by this invention makes use of periodic measurements performed both by one or more base stations and/or by one or more mobile stations to determine the best channel under the current radio environment. (Haartsen ’837 at 5:31-35.)

673. Figure 3 of Haartsen ’837, reproduced below, illustrates the communication between the base station controllers (310, 320, and 330) that enables coordination between cells for channel allocation:

Fig. 3



674. Further, Haartsen '837 discloses the advantages of coordination amongst base stations as part of both predicting interference as well as conducting adaptive allocation of downlink resources. For example:

To predict the downlink interference, one should identify the base stations in a wide range around the mobile station that are transmitting on the same channel. The location of these bases and the power levels they are currently using on the considered channel, must be directed to the base station controller doing the ACAPC processing (*e.g.*, in the example of FIG. 3, this is base station controller 320.) This can be accomplished, for example, directly through the MTSO 300. Adjacent channel interference can also be included if it is corrected with the adjacent channel rejection factor. (Haartsen '837 at 13:22-30.)

675. Further, like Haartsen '837, Liu '315 also discloses coordination among cells when making a cluster assignment decision.

“In such an embodiment, in a multi-cell environment, the base station within each cell first estimates the uplink and downlink SINRs across all OFDMA traffic channels for all active and accessing subscribers. Each base-station may also buffer the QoS requirements (*e.g.*, data rate, time-out, bit error rate, waiting time).

Base-stations in neighboring cells exchange such information before performing a traffic channel allocation jointly for multiple subscribers.” (Liu ’315 at 6:49-57 (emphasis added).)

676. Moreover, Liu ’315 discloses that “[t]raffic channel conditions, assignment tables, as well as QoS requirements of all accessing subscribers of neighboring cells, may be accounted for in performing traffic channel assignment.” (Liu ’315 at 11:37-40.)

677. As such, Liu ’315 sets forth an entire system disclosing the limitations of this element:

[E]ach subscriber is subject to interference from neighboring cells in a multi-cell setup. ***To increase, and potentially maximize, the spectral efficiency for ever-changing traffic, coordination among base-stations and subscribers is considered in traffic channel assignment.*** FIG. 2 illustrates that the channel gain for different channels changes based on the subcarrier being examined. For example, while channels 1 and 2 has good gain at certain subchannels, they also have poorer gains at others. ***The present invention makes intelligent decisions about channel assignments for multi-users so that multiple channels are jointly allocated to multiple subscribers based on which channels have desirable characteristics (e.g., higher gains, lower interference, etc.) for each particular subscriber.***

(Liu ’315 at 7:50-63 (emphasis added).)

678. Thus, one of ordinary skill in the art would have been motivated to combine the Sollenberger Article with Haartsen ’837 or Liu ’315 for the element “a first base station in the first cell, in response to receiving inter-cell interference information, coordinates with other cells to make a cluster assignment decision.”

5. Element 11[b][2]

679. Claim element 11[b][2] of the ’748 Patent reads: “**the first base station performing subcarrier allocation for OFDMA to allocate OFDMA subcarriers in clusters to the plurality of subscribers based on inter-cell interference avoidance and intra-cell traffic load balancing in response to the feedback information.**”

680. This element is disclosed by, at least, the Sollenberger Article. As noted above, the Sollenberger Article describes a protocol with four basic steps:

“The basic protocol for a downlink comprises four basic steps: (1) a packet page from a base station to a terminal; (2) *rapid* measurements of resource usage by a terminal using the *parallelism* of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with *each* radio resource; and (4) selection of resources by the base and transmission of the data.” (Sollenberger Article at 758-759 (emphasis in original).)

681. The Sollenberger Article further discloses the subscribers “*are fairly allocated* as many unused radio channels as possible provided the SIR exceeds 10 dB for resources.” (Sollenberger Article at 760 (emphasis added).) One of ordinary skill in the art would understand that a fair allocation would be based, at least in part, on balancing cluster usage within the cell of the base station.

682. Thus, the Sollenberger Article discloses “the first base station performing subcarrier allocation for OFDMA to allocate OFDMA subcarriers in clusters to the plurality of subscribers based on inter-cell interference avoidance and intra-cell traffic load balancing in response to the feedback information.”

683. Alternatively, to the extent the Sollenberger Article does not disclose this element, one skilled in the art would have known to modify the Sollenberger Article to satisfy this element, or would have been motivated to combine the Sollenberger Article with the teachings of Haartsen ’837. For example, Haartsen ’837 clearly teaches inter-cell interference avoidance. See element 11[b][1].

684. As noted above, Haartsen ’837 discloses the advantages of coordination amongst base stations as part of both predicting interference as well as conducting adaptive allocation of downlink resources. But Haartsen ’837 also discloses a base station allocation scheme that not only accounts for inter-cell interference, it also adapts to balance traffic load in the cell:

The control scheme presented herein adapts to the current traffic and interference situation in a communication environment in order to optimize the quality of each link and maximize the overall system capacity. The status of the current traffic and interference condition is derived from measurements taken both by the mobile station and the base station. (Haartsen '837, at 3:45-50.)

685. As evidenced by the disclosures of the Sollenberger Article and Haartsen '837, a base station performing subcarrier allocation based on both inter-cell interference avoidance as well as intra-cell traffic load conditions in order to maximize the efficiency of the system was known to those skilled in the art at the time of the claimed inventions. Thus, one of ordinary skill in the art would know to modify the Sollenberger Article, or alternatively would have been motivated to combine the Sollenberger Article with Haartsen '837 for “the first base station performing subcarrier allocation for OFDMA to allocate OFDMA subcarriers in clusters to the plurality of subscribers based on inter-cell interference avoidance and intra-cell traffic load balancing in response to the feedback information.”

D. Claim 11 of the '748 Patent is Rendered Obvious by Hashem '569 in Combination with Haartsen '837 or Liu '315

1. Introduction

686. The following analysis demonstrates that claim 11 of the '748 Patent is rendered obvious by Hashem '569 in combination with Haartsen '837 and also by Hashem '569 in combination with Liu '315. Hashem '569 discloses the general framework for an OFDMA-based wireless communication system in which OFDM subcarriers are selected and allocated for the purpose of communication between a subscriber and a base station. To the extent Hashem '569 does not explicitly disclose the limitations of claim 11, it would have been obvious to a person of ordinary skill in the art to modify Hashem '569 with the teachings of the '837 or Liu '315.

687. A person of ordinary skill in the art would have been motivated to combine Hashem ’569 with Haartsen ’837 to design an OFDMA system as disclosed in claim 11. Both Hashem ’569 and Haartsen ’837 addressed the design of wireless cellular systems – and, more specifically, the problem of dynamic resource allocation in such a wireless cellular system. While Hashem ’569 addresses the mitigation of inter-cell interference in an OFDM system through the use of feedback from a subscriber to the base station to which it is connected, Haartsen ’837 considers a broader range of solutions to the same problem in an earlier generation TDMA cellular system – including that of coordination among base stations. It would therefore have been natural for one of skill in the art to look to the techniques described by Haartsen ’837 to enhance the performance of the OFDMA system described by Hashem ’569.

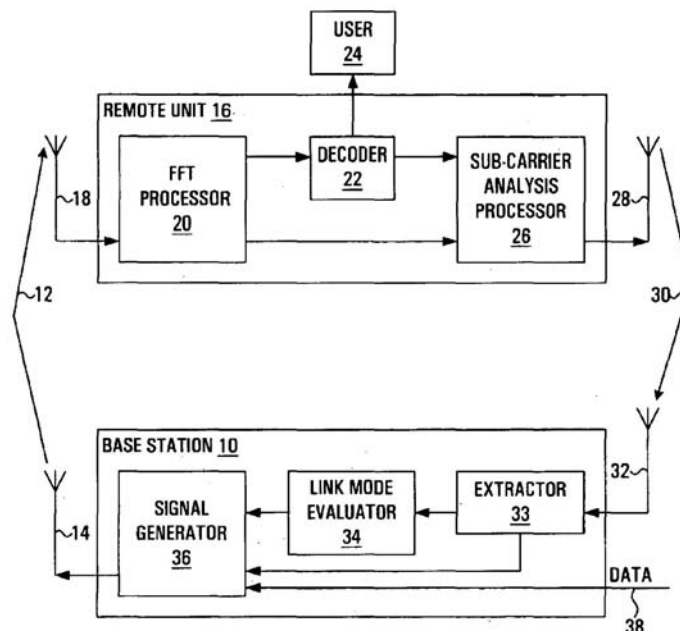
688. Similarly, a person of ordinary skill would have been motivated to combine Hashem ’569 with Liu ’315 to design an OFDMA system as disclosed in claim 11. Both Hashem ’569 and Liu ’315 addressed the design of wireless OFDMA cellular systems – and, more specifically, the problem of dynamic resource allocation in such an OFDMA wireless cellular system. They both considered the same basic framework for addressing that problem – that of making subscriber-based measurements and feeding those measurements back to the base station to aid in resource allocation. It would have been natural for one of skill in the art to look to Liu ’315 for extensions to Hashem ’569 approach applicable to systems with base stations comprised of multiple transceivers (for beam-forming) and to systems that enable coordination among base stations.

2. Preamble

689. The preamble of claim 11 reads: “**An apparatus comprising.**”

690. To the extent that the preamble is a limitation, it is disclosed by the Hashem ’569, which incorporates by reference the ’129 patent. Specifically, Hashem ’569 discloses “a portion

of a radio communication system in which the invention is implemented” in Fig. 1. Figure 1 from Hashem ’569 is reproduced below.



691. The apparatuses disclosed in Figure 1 above include a base station (10) and a remote unit (16). Within the base station and remote unit are apparatuses such as the Link Mode evaluator (34) which “may be any computing apparatus containing logic for executing the described functionality” (Hashem ’569 at 9:23-24) as well as a signal generator (36), extractor (33), FFT processor (20), decoder (22), and sub-carrier analysis processor (26).

692. Thus, Hashem ’569 discloses “an apparatus”.

3. Element 11[a]

693. Claim element 11[a] of the ’748 Patent reads: “**a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.**”

694. This element is rendered obvious by Hashem ’569. Specifically, in Figure 3 (reproduced below) each remote unit (“subscriber”) generates a bitmask identifying the

acceptable sub-carriers and the average SIR of the same; then, in the final step of Figure 3, the remote unit transmits both the bitmask and the average SIR – thus providing the required feedback to the base station.

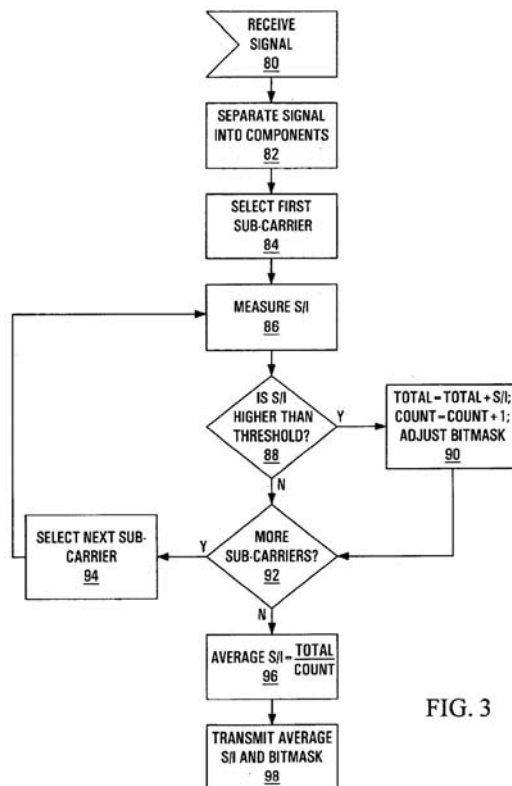


FIG. 3

695. Hashem '569 discloses other forms of feedback from each subscriber as well. For example, rather than a bitmask and average SIR, Hashem '569 proposes a feedback mechanism in which “the remote unit calculates the optimum Link Mode itself and transmits a reference to the optimum Link Mode to the base station.” (Hashem '569 at 7:1-3.) In such a system, the feedback would be comprised of one or more indices – either explicit or differential, as explained in the background section with regard to the '129 patent – that identify the link mode to be used on one or more sub-carrier or groups of sub-carriers.

696. Further, one skilled in the art would find it obvious that the disclosure of a remote unit generating feedback in a cell to include a “plurality of subscribers.” For example,

Hashem '569 discloses a particular technique for selecting and adjusting transmission parameters in a digital radio communication system. Hashem '569 is titled “dynamic subcarrier assignment in OFDM systems,” and expressly notes that its “invention relates to digital radio communication systems.” (Hashem '569 at 1:6-8.) One skilled in the art would immediately understand the teachings of Hashem '569 to relate to systems to include multiple subscribers. Indeed, the '129 patent discloses a prior art system capable of “adaptively adjust[ing] their directional patterns towards the remote *units*.” ('129 Patent at 2:6-8 (emphasis added).) Moreover, Hashem '129 states that “[s]ystems which employ OFDM can use 1,000 sub-carriers” (col. 2:38-39) which is sufficient to support voice connections on multiple remote units.

697. Thus, Hashem '569 renders obvious “a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers”.

4. Element 11[b][1]

698. Claim element 11[b][1] of the '748 Patent reads: “**a first base station in the first cell, in response to receiving inter-cell interference information, coordinates with other cells to make a cluster assignment decision.**”

699. This element is rendered obvious by Hashem '569 in combination with Haartsen '837 or Liu '315.

700. As described above, Hashem '569 discloses an apparatus in which inter-cell interference information – in the form of a bitmask identifying the subcarriers that exhibit sufficiently low inter-cell interference, together with the average signal-to-interference (SIR) ratio of those subcarriers – is fed back from each mobile station to its base station. Hashem '569 further discloses that this feedback is used by the first base station to make cluster assignment decisions.

At step 130 the base station determines whether the selected sub-carrier is an acceptable sub-carrier by comparing the sub-band number of the sub-carrier with the sequence of numbers [received from the mobile station]... If at step 130 the base station determines that the selected sub-carrier is an unacceptable sub-carrier, then at step 132 the data is encoded for transmission over the selected sub-carrier using the optimum Link Mode. If at Step 130 the base station determines that the selected sub-carrier is an unacceptable sub-carrier, then at step 134 low sensitivity data is encoded for transmission over the selected sub-carrier using the optimum Link Mode. Alternatively, at step 134 regular data could be encoded for transmission over the selected sub-carrier at a second Link Mode having a lower transmission rate than the optimum Link Mode, or no data could be encoded for transmission over the selected sub-carrier and the transmission power of the selected sub-carrier diverted to other sub-carriers.” (Hashem ’569 at 6:12-16 and 6:26-39.)

701. Thus, Hashem ’569 discloses a first base station in the first cell, in response to receiving inter-cell interference information, making a cluster assignment decision.

702. However, Hashem ’569 does not disclose the base station “coordinates with other cells to make a cluster assignment decision.” Nonetheless, a person of ordinary skill in the art would have been motivated to combine the teaching of Hashem ’569 with those of Haartsen ’837 or Liu ’315 to disclose this element.

703. As discussed above, Haartsen ’837 describes a method of “adaptive channel allocation” through which channel assignments are made across multiple cells from a common “pool” of channels:

Adaptive channel allocation, or ACA, is a method of dynamically allocating frequencies throughout a cellular system to maximize system capacity. Under an ACA scheme, more frequencies would be allocated to busy cells from more lightly loaded cells. In addition, the channels can be allocated such that all links have satisfactory quality. (Haartsen ’837 at 2:21-26.)

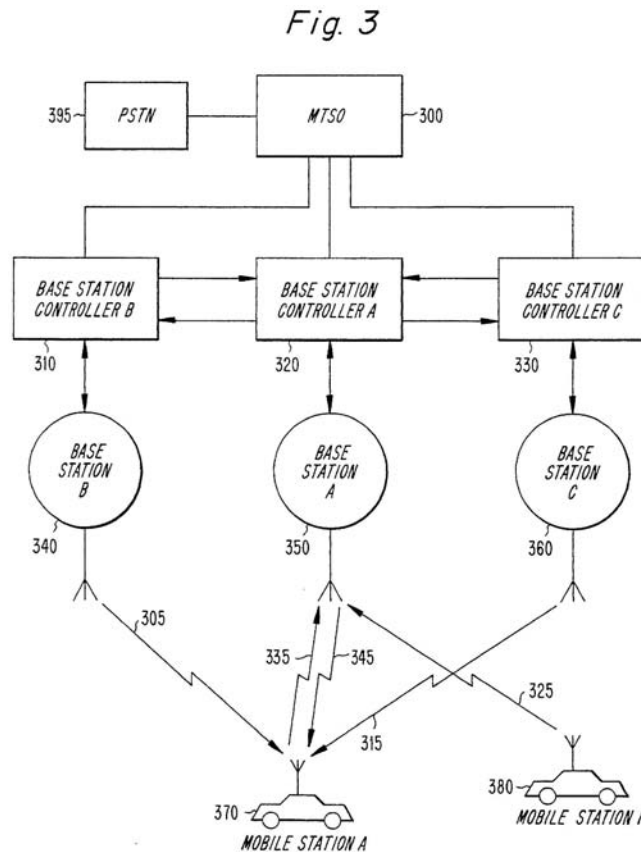
704. Indeed, Haartsen ’837 describes a system in which interference measurements are shared between base stations to coordinate channel allocation:

The channel allocation scheme described by this invention makes use of periodic measurements performed both by one or more base stations and/or by one or more mobile stations to determine the best channel under the current radio environment. (Haartsen ’837 at 5:31-35.)

705. The exchange of uplink interference information between base stations to coordinate channel allocation is described as follows:

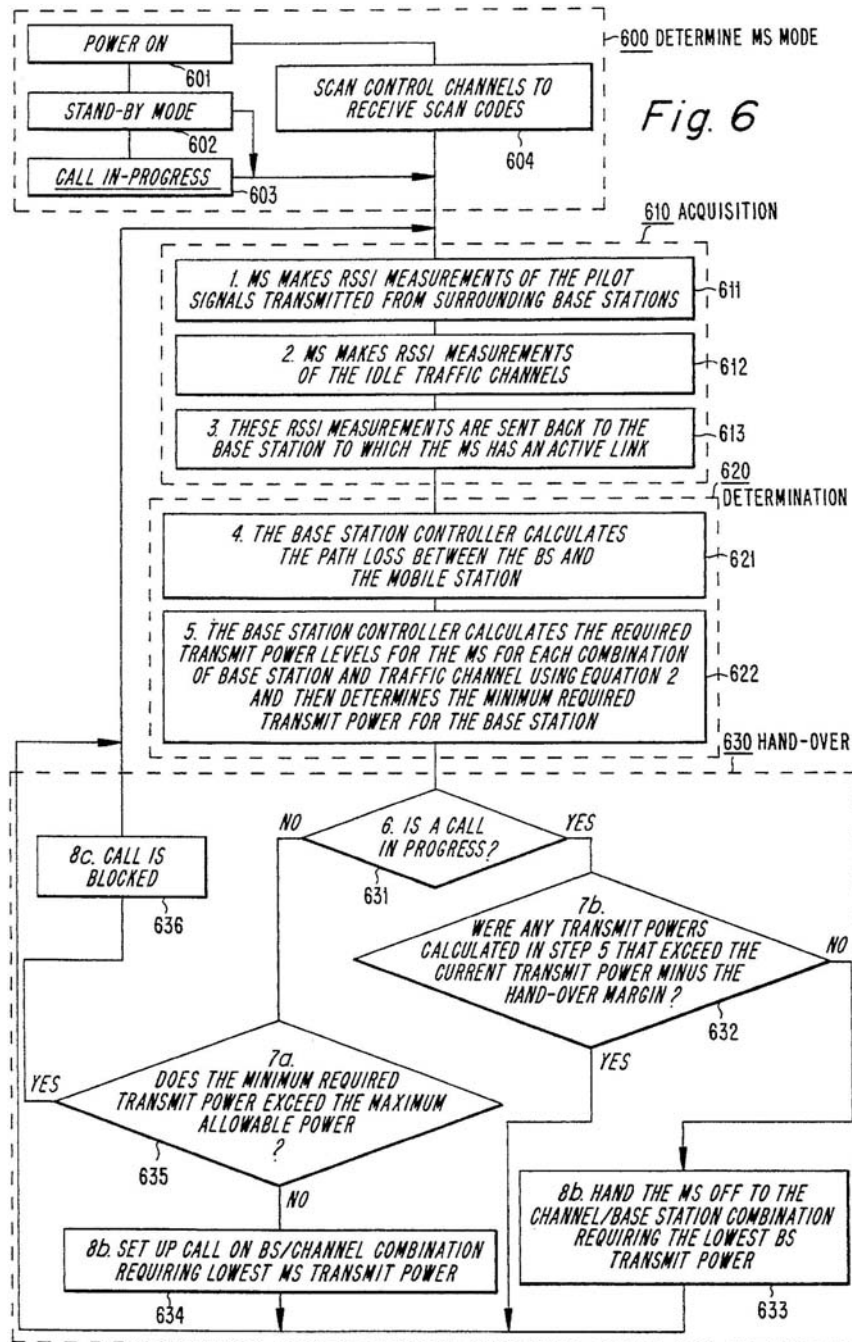
The average uplink interference level on channel K at base J is represented by $I_{up}(J,K)$. The I_{up} values of all idle channels, K, at base J are now sent via the base station controller of base station J to the base station controller of the base station to which the considered mobile station is currently connected. For the example shown in FIG. 4 [sic], this means that the values measured on idle channels by base stations A, B and C (i.e., $I_{up}(A,K)$, $I_{up}(B,K)$, and $I_{up}(C,K)$, respectively) are sent to base station controller 320 of base A. (Haartsen '837 at 7:66 – 8:8.)

706. Figure 3 – incorrectly identified as “FIG. 4” in the above passage – is shown below. It illustrates the communication between the base station controllers (310, 320, and 330) that enables coordination between cells for channel allocation.



707. With regard to the downlink channel allocation, Haartsen '837 says, “Assuming that the uplink and downlink channels can be independently allocated, the procedure for assigning the downlink is similar to that described above for assigning the uplink.”

(Haartsen '837 at 10:56-59.) In particular, Figure 6 from Haartsen '837 (reproduced below) illustrates that the mobile station measures the received signal strength (RSSI) from pilot signals transmitted by base stations in the vicinity, and those measurements are “sent back to the base station to which the MS has an active link.” The base station then coordinates with other cells by selecting the optimal “BS/channel combination” – *i.e.*, it uses the information provided by the other cells to select the base station and the channel combination that it will use to provide downlink capabilities.



708. Further, Haartsen '837 discloses the advantages of coordination amongst base stations as part of both predicting interference as well as conducting adaptive allocation of downlink resources. For example:

To predict the downlink interference, one should identify the base stations in a wide range around the mobile station that are transmitting on the same channel. The location of these bases and the power levels they are currently using on the

considered channel, must be directed to the base station controller doing the ACAPC processing (e.g., in the example of FIG. 3, this is base station controller 320.) This can be accomplished, for example, directly through the MTSO 300. Adjacent channel interference can also be included if it is corrected with the adjacent channel rejection factor. (Haartsen '837 at 13:22-30.)

709. Thus, Hashem '569 disclose a first base station in the first cell, in response to receiving inter-cell interference information, making a cluster assignment. Haartsen '837 discloses a first base station in the first cell, in response to receiving inter-cell interference information, coordinating with other cells to make a channel assignment. But in Hashem's OFDM context, making a channel assignment is equivalent to making a cluster assignment.

710. Likewise, Liu '315 also discloses coordination among cells when making a cluster assignment decision.

“In such an embodiment, in a multi-cell environment, the base station within each cell first estimates the uplink and downlink SINRs across all OFDMA traffic channels for all active and accessing subscribers. Each base-station may also buffer the QoS requirements (e.g., data rate, time-out, bit error rate, waiting time). Base-stations in neighboring cells exchange such information before performing a traffic channel allocation jointly for multiple subscribers.” (Liu '315 at 6:49-57 (emphasis added).)

711. Moreover, Liu '315 discloses that “[t]raffic channel conditions, assignment tables, as well as QoS requirements of all accessing subscribers of neighboring cells, may be accounted for in performing traffic channel assignment.” (Liu '315 at 11:37-40.)

712. As such, Liu '315 sets forth an entire system disclosing the limitations of this element:

[E]ach subscriber is subject to interference from neighboring cells in a multi-cell setup. ***To increase, and potentially maximize, the spectral efficiency for ever-changing traffic, coordination among base-stations and subscribers is considered in traffic channel assignment.*** FIG. 2 illustrates that the channel gain for different channels changes based on the subcarrier being examined. For example, while channels 1 and 2 has good gain at certain subchannels, they also have poorer gains at others. ***The present invention makes intelligent decisions about channel assignments for multi-users so that multiple channels are jointly allocated to multiple subscribers based on which channels have desirable***

characteristics (e.g., higher gains, lower interference, etc.) for each particular subscriber.

(Liu '315 at 7:50-63 (emphasis added).)

713. Thus, one of ordinary skill would have been motivated to combine Hashem '569 with Haartsen '837 or Liu '315 for “a first base station in the first cell, in response to receiving inter-cell interference information, coordinates with other cells to make a cluster assignment decision.”

5. Element 11[b][2]

714. Claim element 11[b][2] of the '748 Patent reads: “**the first base station performing subcarrier allocation for OFDMA to allocate OFDMA subcarriers in clusters to the plurality of subscribers based on inter-cell interference avoidance and intra-cell traffic load balancing in response to the feedback information.**”

715. This element is disclosed by Hashem '569 in combination with Haartsen '837 or Liu '315. As noted above, Hashem '569 discloses the first base station allocating OFDMA subcarriers in clusters to subscribers based on inter-cell interference avoidance – *i.e.*, based on a bitmask identifying clusters that exhibit sufficiently small inter-cell interference, together with their average SIR. Haartsen '837 discloses that the assignments can be based on other factors as well – including the nature of the load in the cell. “Under an ACA scheme, more frequencies would be allocated to busy cells from more lightly loaded cells.” (Haartsen '837 at 2:23-26.)

716. Similarly, Liu '315 discloses making assignments based on multiple factors, including inter-cell interference avoidance and intra-cell traffic load balancing, in response to the feedback information. For example, Liu '315 discloses each base station accounting for traffic load balancing:

“Each base station may also buffer the QoS requirements (*e.g.*, data rate, time-out, bit error rate, waiting time). Base stations in neighboring cells exchange such

information before performing a traffic channel allocation jointly for multiple subscribers.” (Liu ’315 at 6:52-57.)

717. Further, Liu ’315 discloses that “[t]raffic channel conditions, assignment tables, as well as QoS requirements of all accessing subscribers of neighboring cells, may be accounted for in performing traffic channel assignment.” (Liu ’315 at 11:37-40.)

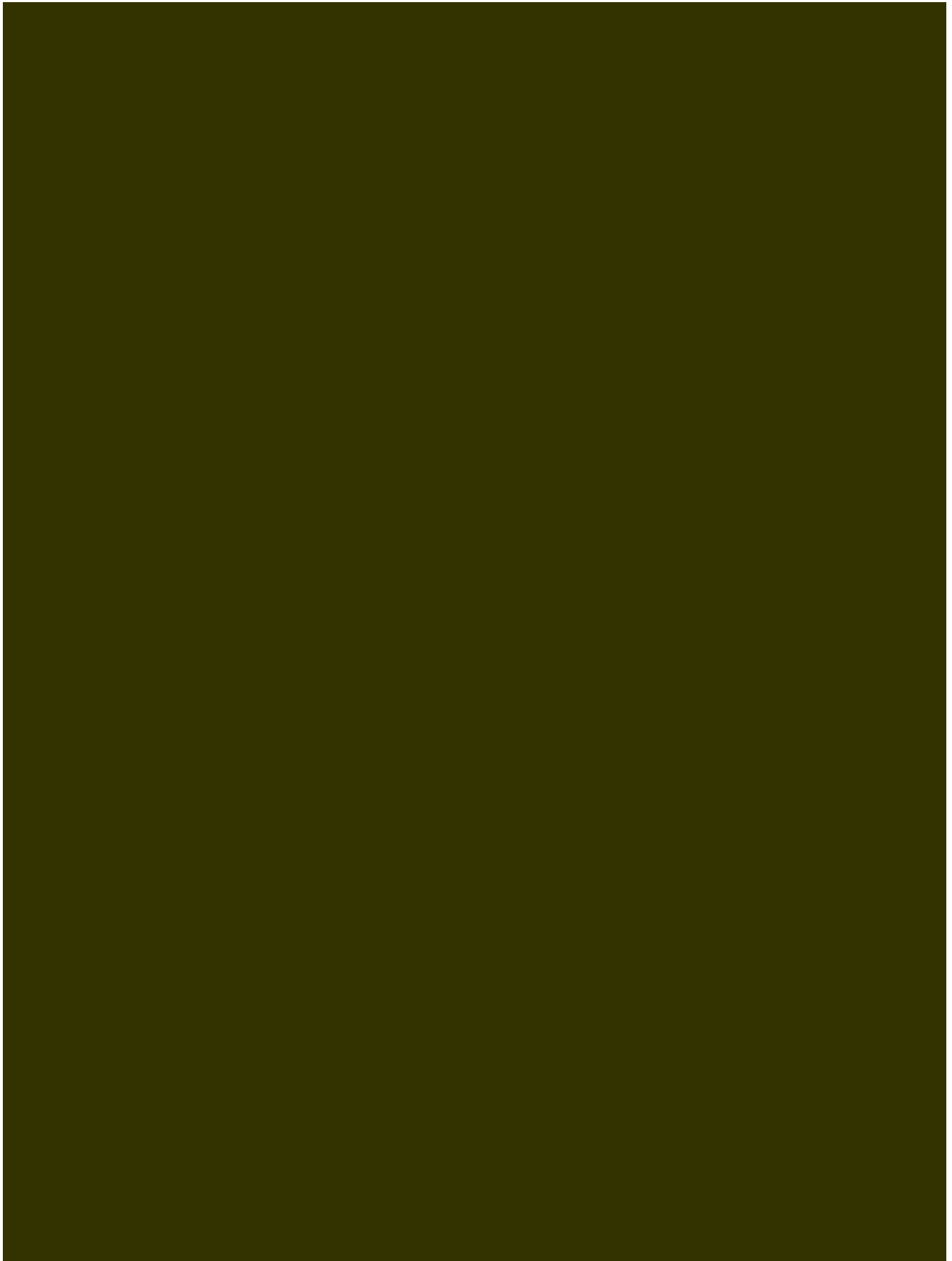
718. Finally, Liu expressly discloses the base station accounting for inter-cell interference during the process of allocating OFDMA resources. “A medium access control protocol is described that centralizes broadband channel characteristics and noise-plus-interference information measured at spatially distributed subscribers and assigns traffic channels for orthogonal frequency division multiple access (OFDMA) network.” (Liu ’315 at 4:19-23.) Liu ’315 further discloses that “[t]he broadband spatial channel estimates, *together with the measured channel and noise-plus-interference information feedback* from the access subscribers, *are used by the multi-user traffic channel allocator to determine a traffic channel assignment* and code and modulation combination for each of the accessing subscribers.” (Liu ’315 at 5:41-46 (emphasis added).)

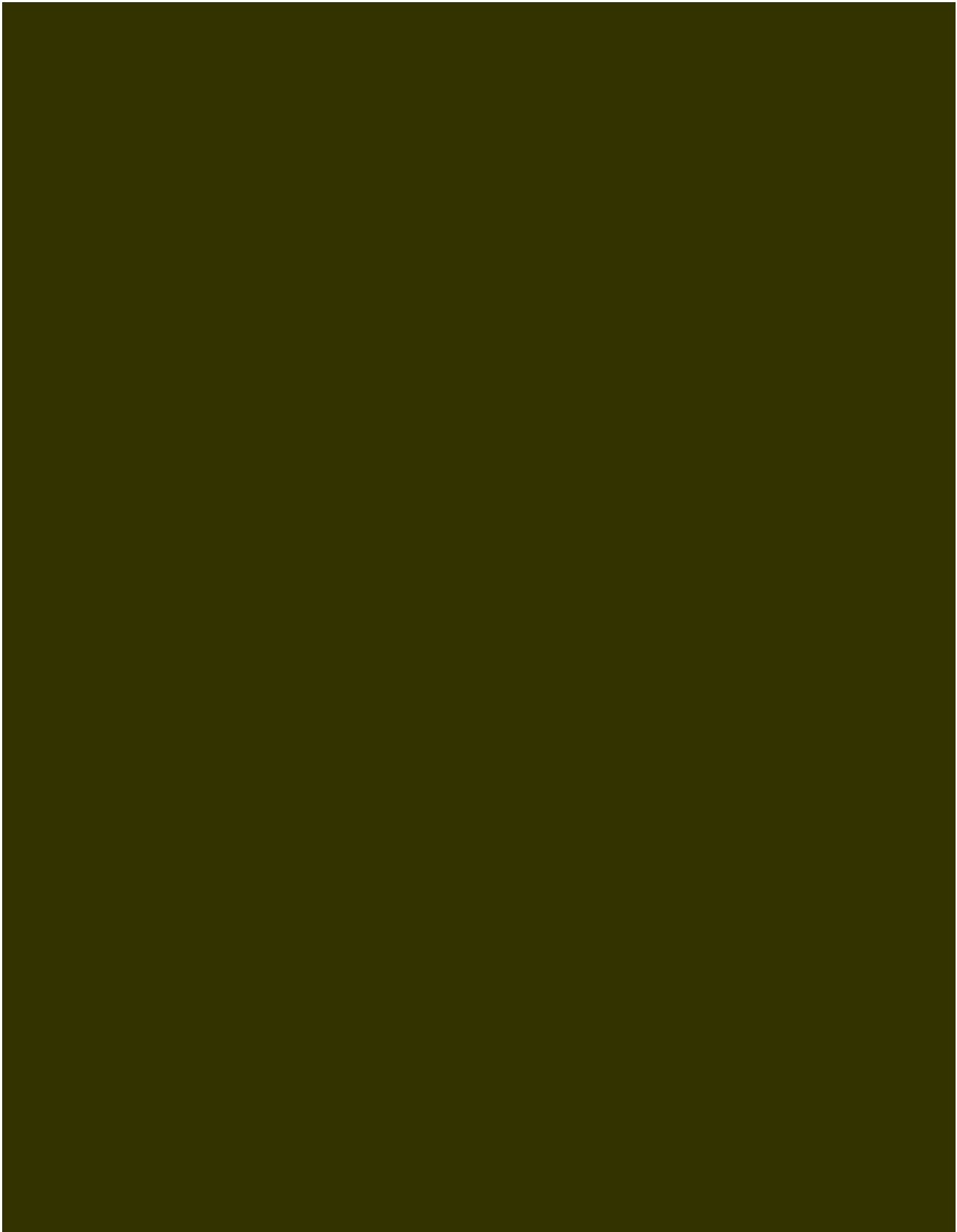
719. Thus, Hashem ’569 in combination with Haartsen ’837 or Liu ’315 satisfies the base station allocating subcarriers based on inter-cell interference avoidance. Further, to the extent the disclosures above do not satisfy the element “and intra-cell traffic load balancing in response to the feedback,” Haartsen ’837 discloses this element.

720. For example, Haartsen ’837 discloses a base station allocation scheme that not only accounts for inter-cell interference, it also adapts to balance traffic load in the cell:

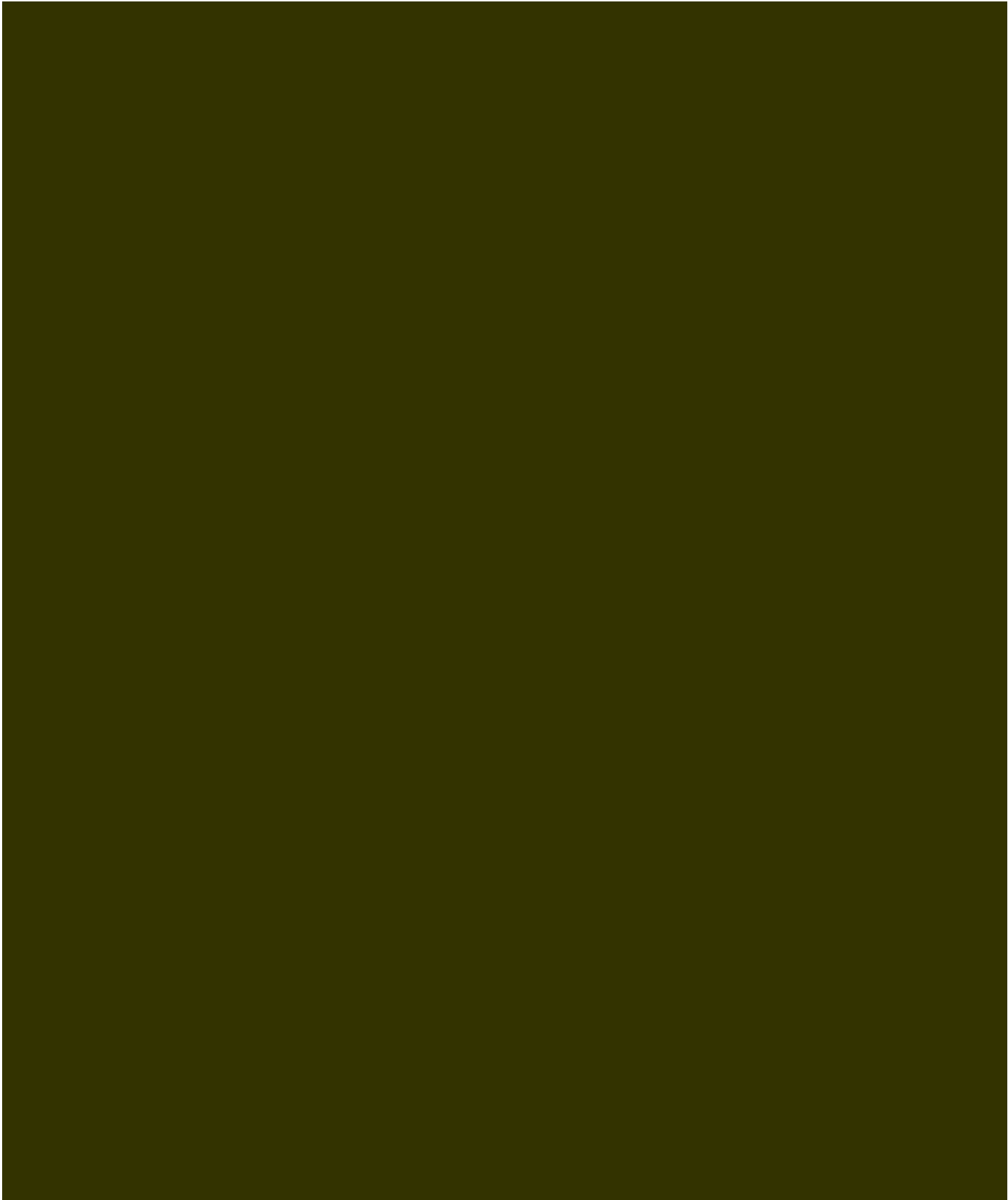
The control scheme presented herein adapts to the current traffic and interference situation in a communication environment in order to optimize the quality of each link and maximize the overall system capacity. The status of the current traffic and interference condition is derived from measurements taken both by the mobile station and the base station. (Haartsen ’837, at 3:45-50.)

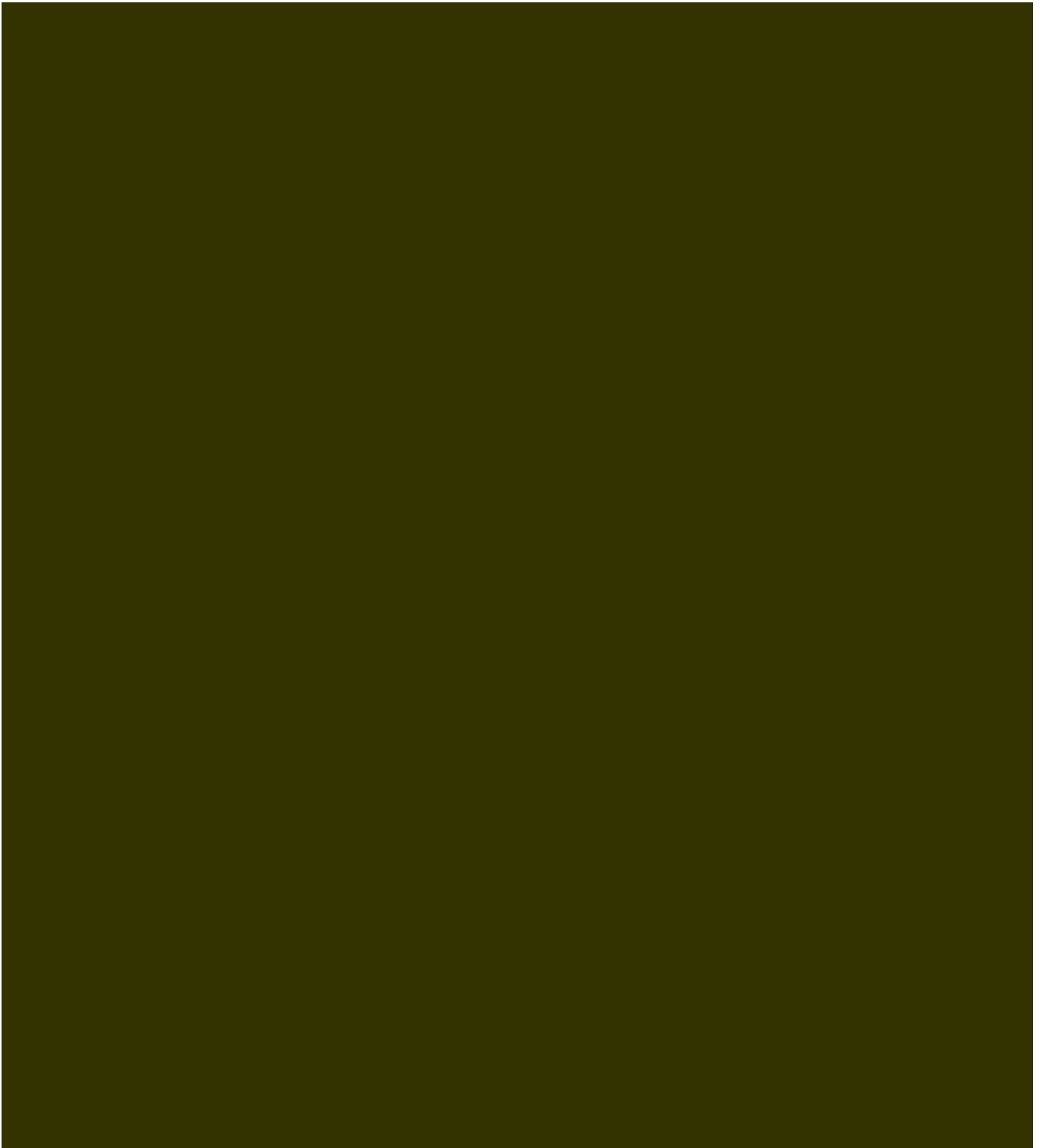


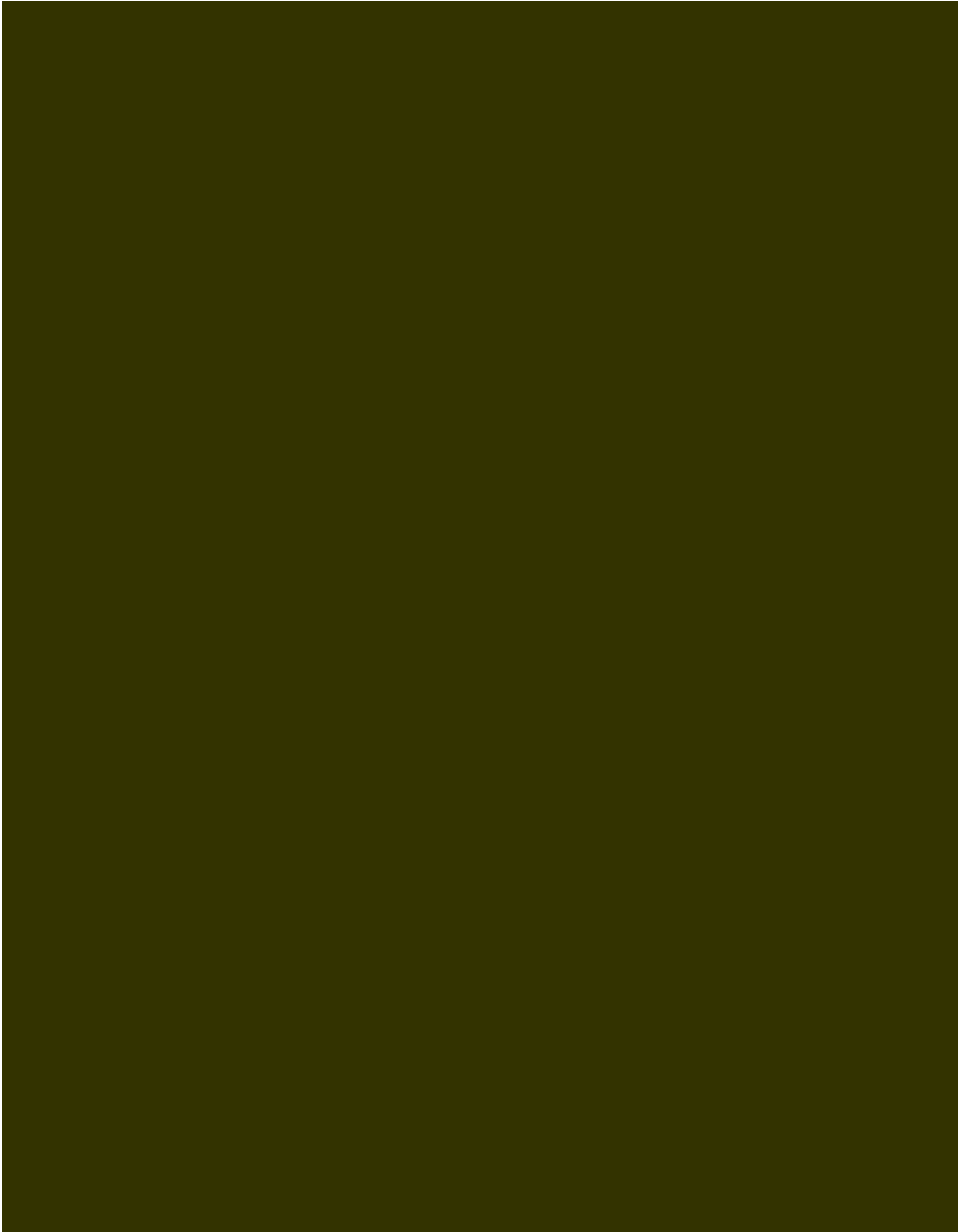


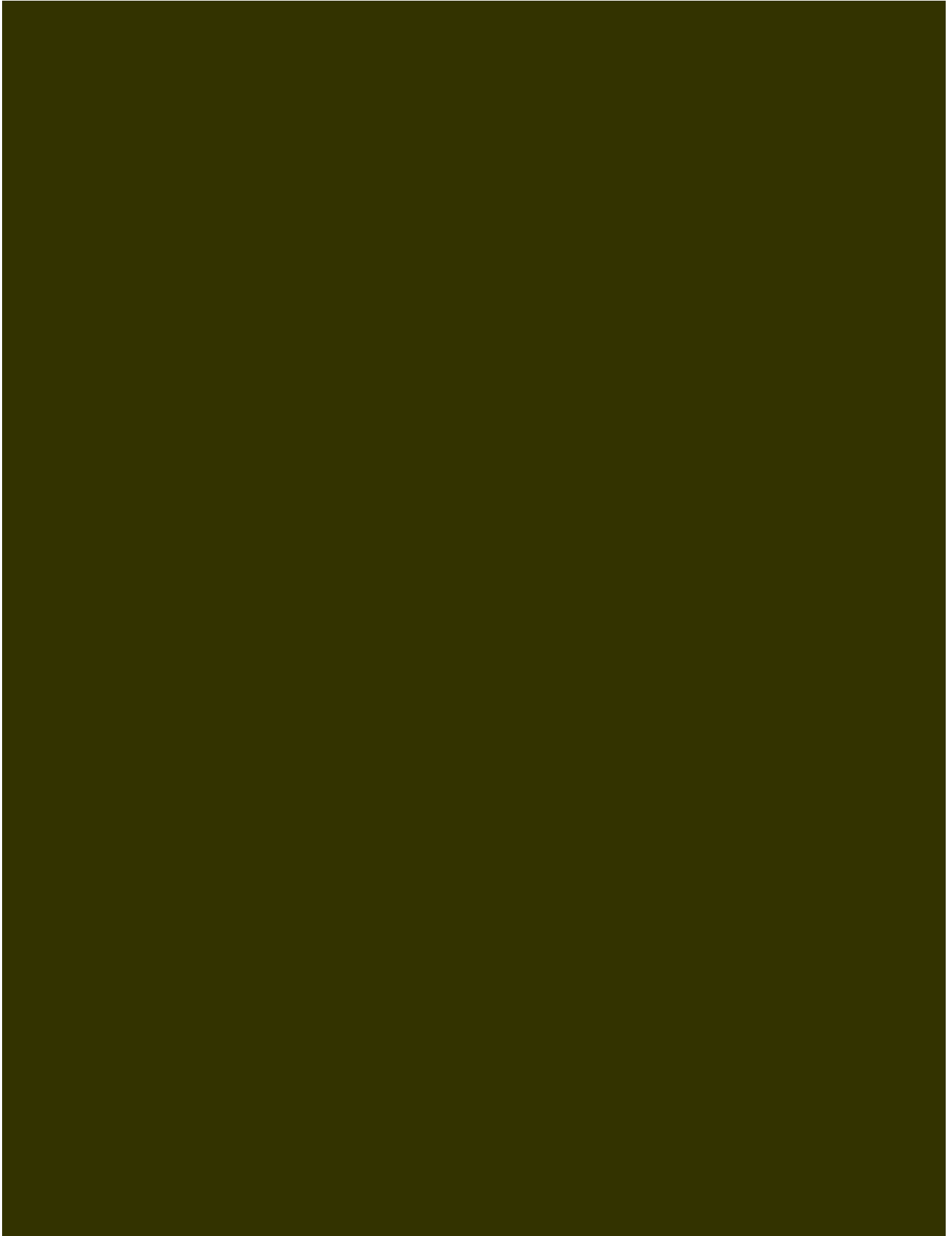


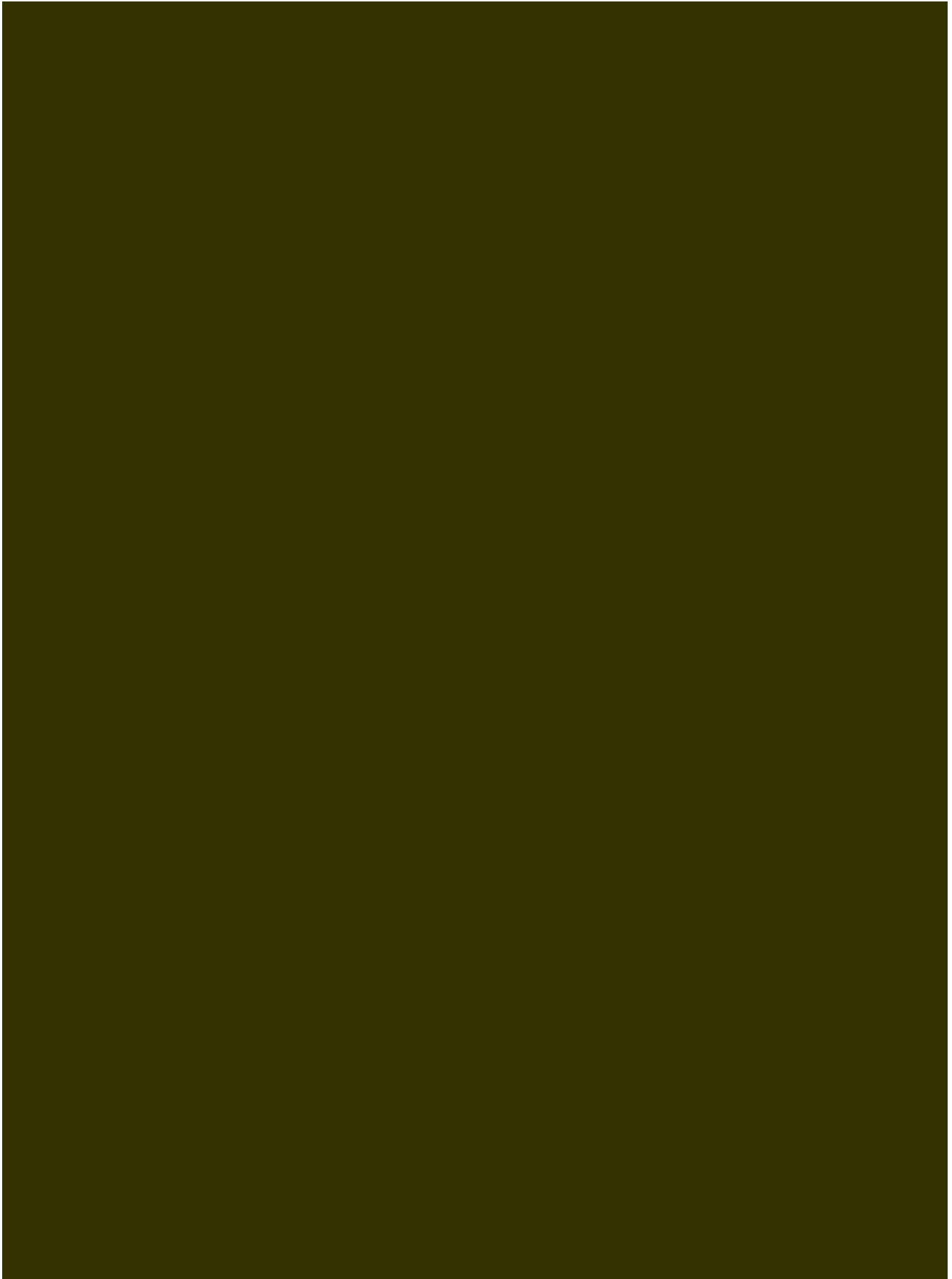


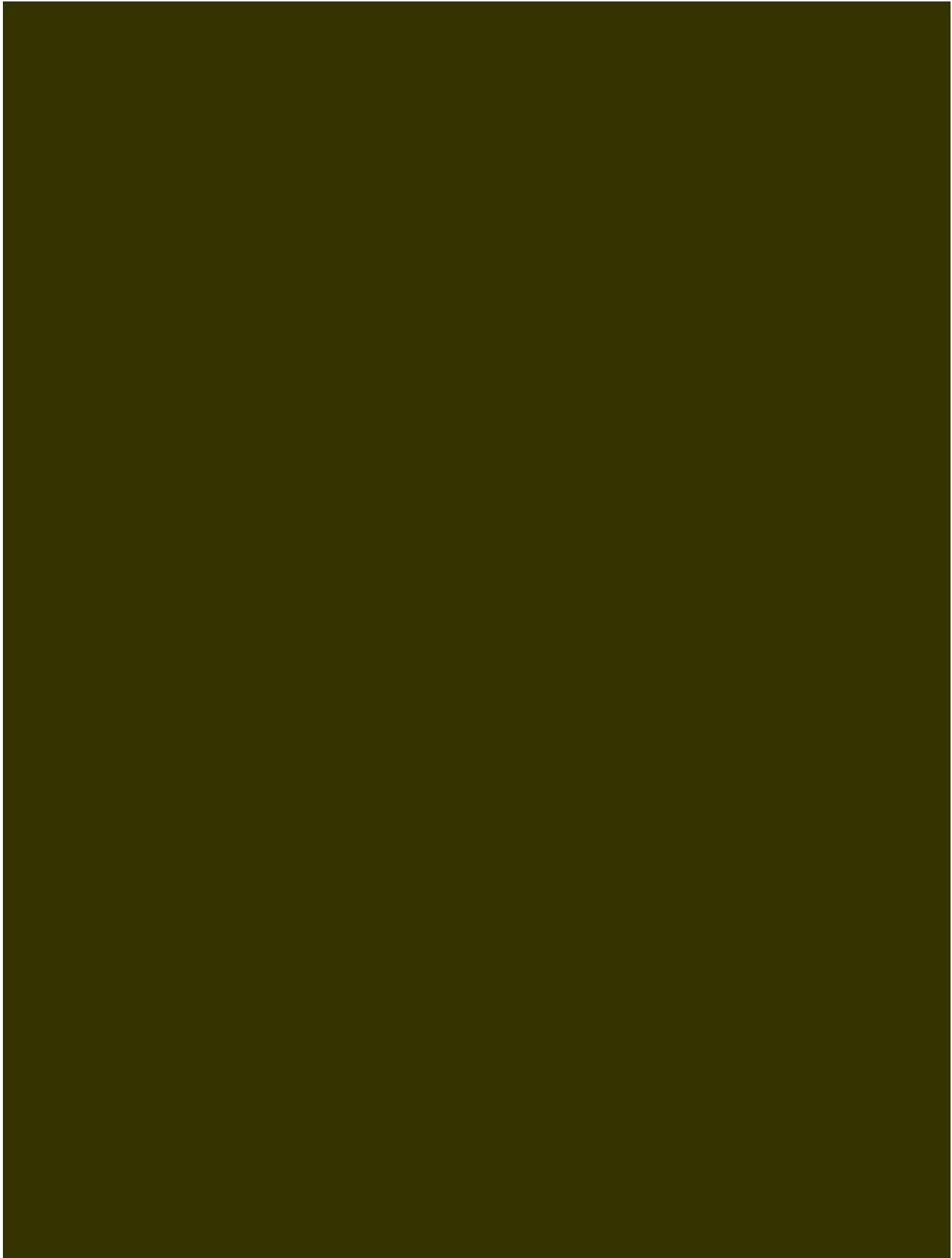




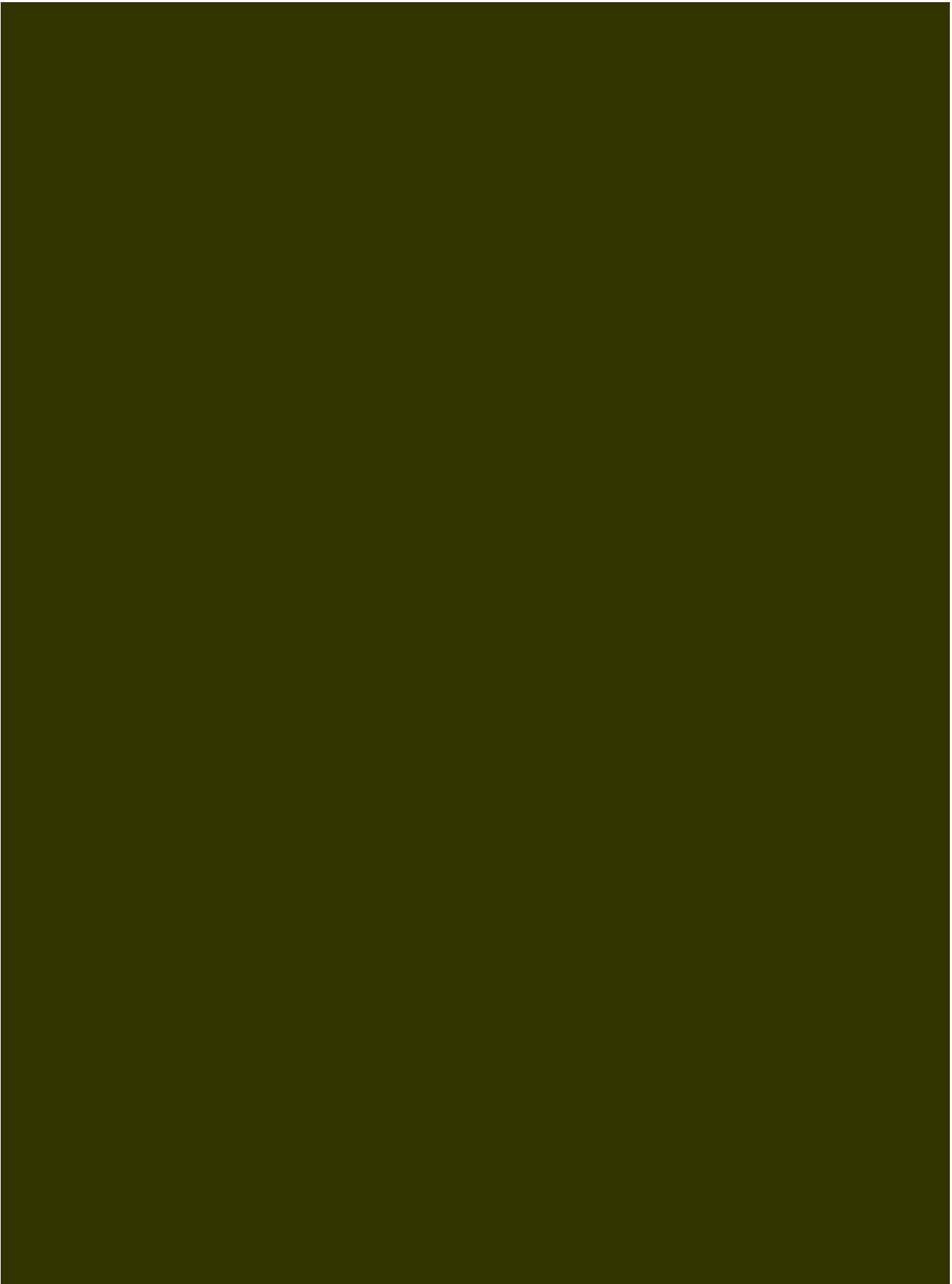




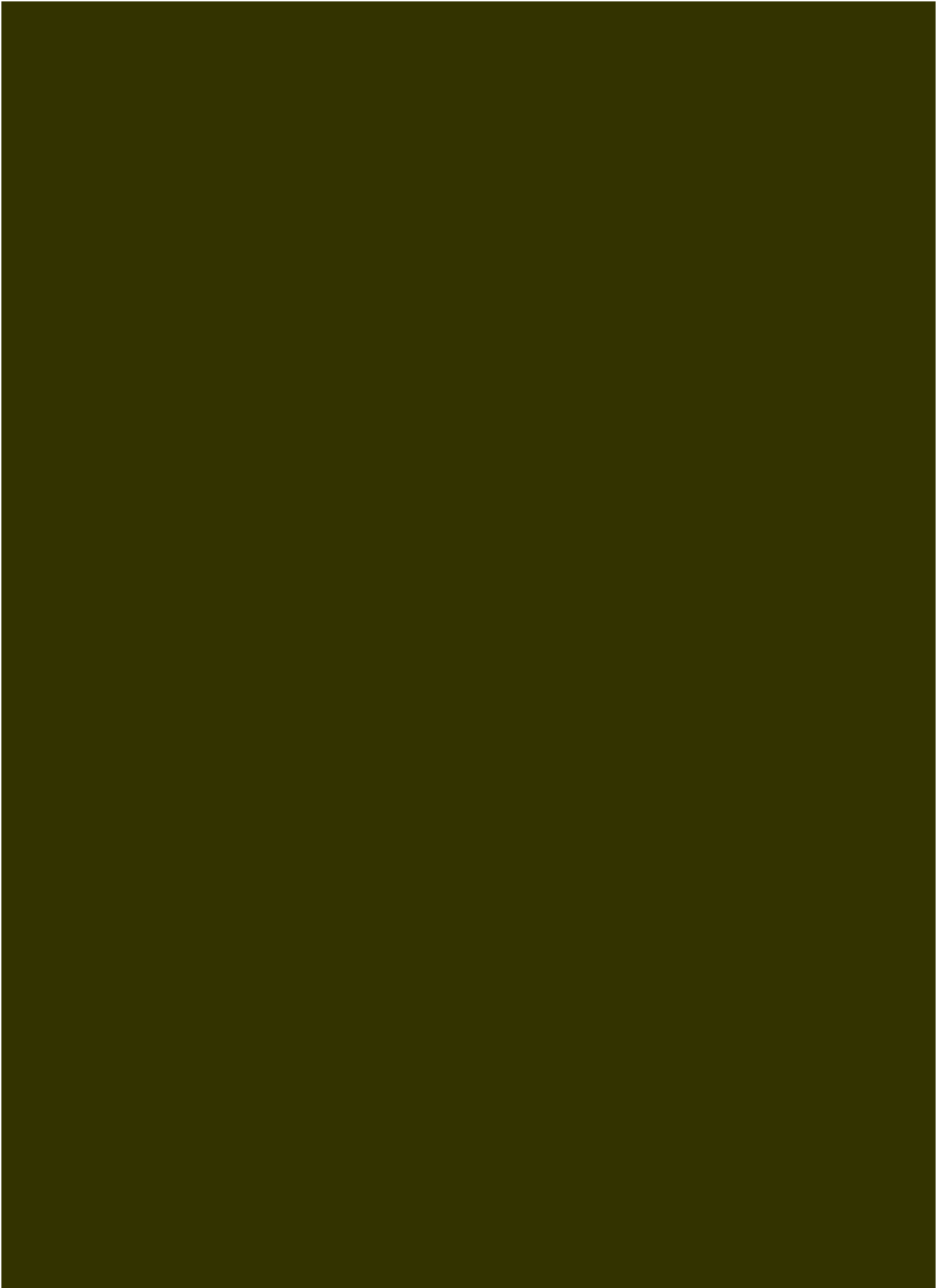
















XI. '748 PATENT, CLAIM 19

760. Claim 19 of the '748 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 19 of the '748 Patent is reproduced below with identifiers [a], [b], [c], etc. added for ease of reference:

19. An apparatus comprising:

- [a] a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers; and
- [b] a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers;
- [c][1] each of a plurality of subscribers to measure channel and interference information for the plurality of subcarriers
- [c][2] based on pilot symbols received from the first base station and
- [c][3] at least one of the plurality of subscribers to select a set of candidate subcarriers from the plurality of subcarriers, and
- [c][4] the one subscriber to provide feedback information on the set of candidate subcarriers to the base station and to
- [c][5] receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the one subscriber,
- [c][6] wherein the plurality of subscribers provide feedback information that comprises an arbitrarily ordered set of candidate subcarriers as clusters of subcarriers, and further
- [c][7] wherein the feedback information includes an index indication of a candidate cluster with its SINR value.

A. Claim 19 of the '748 Patent is Rendered Obvious by Ritter in Combination with the Sollenberger Article and/or the IS-95A Standard

1. Introduction

761. The following analysis demonstrates claim 19 of the '748 Patent is rendered obvious by Ritter in combination with the Sollenberger Article and/or the IS-95A Standard.

2. Preamble

762. The preamble of claim 19 reads: “**An apparatus comprising.**”

763. To the extent the preamble is a limitation, this element is satisfied by the disclosure set forth at '748 Patent claim element 11 preamble.

3. Element 19[a]

764. Claim element 19[a] of the '748 Patent reads: “**a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.**”

765. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

4. Element 19[b]

766. Claim element 19[b] of the '748 Patent reads: “**a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers.**”

767. This element is disclosed by Ritter. Ritter discloses the general framework for an OFDMA-based wireless communication system in which OFDM subcarriers are selected and allocated for the purpose of communication between a subscriber and a base station. For example, the abstract of Ritter begins as follows:

“The method and wireless communication system in accordance with the invention result from an OFDMA multicarrier method and the use of a number of subcarriers (oc), which are allocated for a communication connection between a base station (BS) and a mobile station.”

(Ritter, Abstract (emphasis added).)

768. Further, as noted above, Ritter discloses the first base station allocating OFDMA subcarriers in clusters to subscribers based on feedback from the mobile station. Specifically, Ritter uses the term “segment of a frequency spectrum” – or more succinctly, “segment” – to refer to the “clusters” subcarriers that are allocated to establish channels between the base station and the various mobile units.

Thus a number of subcarriers and therefore a segment of a frequency spectrum may be allocated for the communication connection between base station and mobile station.

(Ritter at 2.)

769. Thus, Ritter discloses “a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers.”.

5. Element 19[c][1]

770. Claim element 19[c][1] of the ’748 Patent reads: “**each of a plurality of subscribers to measure channel and interference information for the plurality of subcarriers.**”

771. This element is satisfied by the disclosure set forth at ’748 Patent claim element 6[a][1].

6. Element 19[c][2]

772. Claim element 19[c][2] of the ’748 Patent reads: “**based on pilot symbols received from the first base station.**”

773. This element is satisfied by the disclosure set forth at ’748 Patent claim element 6[a][2].

7. Element 19[c][3]

774. Claim element 19[c][3] of the ’748 Patent reads: “**at least one of the plurality of subscribers to select a set of candidate subcarriers from the plurality of subcarriers.**”

775. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

8. Element 19[c][4]

776. Claim element 19[c][4] of the '748 Patent reads: “**the one subscriber to provide feedback information on the set of candidate subcarriers to the base station.**”

777. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

9. Element 19[c][5]

778. Claim element 19[c][5] of the '748 Patent reads: “**and to receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the one subscriber.**”

779. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

10. Element 19[c][6]

780. Claim element 19[c][6] of the '748 Patent reads: “**wherein the plurality of subscribers provide feedback information that comprises an arbitrarily ordered set of candidate subcarriers as clusters of subcarriers.**”

781. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][2].

11. Element 19[c][7]

782. Claim element 19[c][7] of the '748 Patent reads: “**wherein the feedback information includes an index indication of a candidate cluster with it SINR value.**”

783. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][3].

B. Claim 19 of the '748 Patent is Rendered Obvious by the Sollenberger Publications

1. Introduction

784. The following analysis demonstrates claim 19 of the '748 Patent is rendered obvious by the Sollenberger Publications.

2. Preamble

785. The preamble of claim 19 reads: “**An apparatus comprising.**”

786. To the extent the preamble is a limitation, this element is satisfied by the disclosure set forth at '748 Patent claim element 11 preamble.

3. Element 19[a]

787. Claim element 19[a] of the '748 Patent reads: “**a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.**”

788. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

4. Element 19[b]

789. Claim element 19[b] of the '748 Patent reads: “**a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers.**”

790. This element is disclosed by, at least, the Sollenberger Article. As noted above, the Sollenberger Article describes a protocol with four basic steps:

The basic protocol for a downlink comprises four basic steps: (1) a packet page from a base station to a terminal; (2) *rapid* measurements of resource usage by a terminal using the *parallelism* of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with *each* radio resource; and (4) **selection of resources by the base and transmission of the data.** (Sollenberger Article at 758-759 (emphasis added).)

791. The last of the four steps indicates that the resources are selected by the base for use by the subscriber, as required by this element. Moreover, Figure 3.2 from the Sollenberger Article, reproduced below, indicates that the “list of assigned channels” is transmitted from the base station to the mobile stations in the coverage area of the base station, one base station each frame and four base stations in each “superframe” of 80.0 ms.

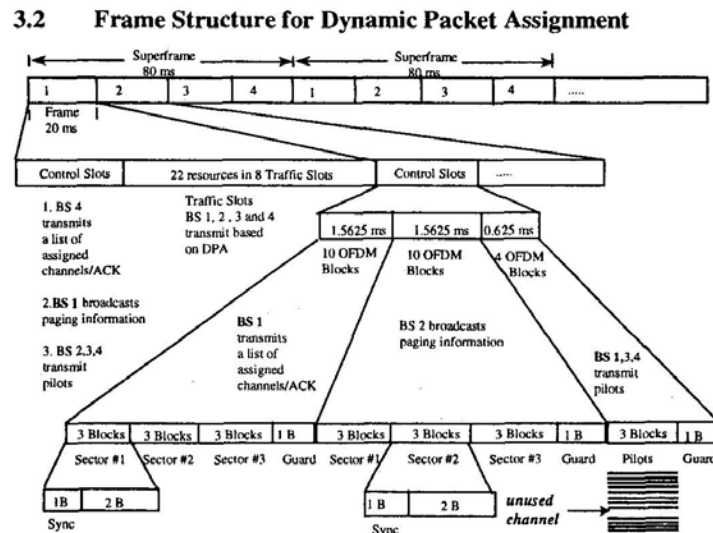


Figure 3. Staggered frame structure for downlink DPA

792. Furthermore, as discussed above, the Sollenberger Article describes a system in which eight “tone clusters” – each such cluster comprised of 24 subcarriers, or “tones” – are sequentially selected and assigned to a user every 20.0 ms, according to a particular frequency-hopping pattern. (See Sollenberger Article, Section 3 – “System Parameters and Frame Structure.”) The Sollenberger Article further explains that “[u]p to 20 users can be simultaneously assigned, one resource each, using different hopping patterns that are free from collisions.” (Sollenberger Article at 758.)

793. Thus, the Sollenberger Article discloses “a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers.”

5. Element 19[c][1]

794. Claim element 19[c][1] of the '748 Patent reads: “**each of a plurality of subscribers to measure channel and interference information for the plurality of subcarriers.**”

795. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

6. Element 19[c][2]

796. Claim element 19[c][2] of the '748 Patent reads: “**based on pilot symbols received from the first base station.**”

797. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

7. Element 19[c][3]

798. Claim element 19[c][3] of the '748 Patent reads: “**at least one of the plurality of subscribers to select a set of candidate subcarriers from the plurality of subcarriers.**”

799. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

8. Element 19[c][4]

800. Claim element 19[c][4] of the '748 Patent reads: “**the one subscriber to provide feedback information on the set of candidate subcarriers to the base station.**”

801. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

9. Element 19[c][5]

802. Claim element 19[c][5] of the '748 Patent reads: “**and to receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the one subscriber.**”

803. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

10. Element 19[c][6]

804. Claim element 19[c][6] of the '748 Patent reads: “**wherein the plurality of subscribers provide feedback information that comprises an arbitrarily ordered set of candidate subcarriers as clusters of subcarriers.**”

805. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][2].

11. Element 19[c][7]

806. Claim element 19[c][7] of the '748 Patent reads: “**wherein the feedback information includes an index indication of a candidate cluster with it SINR value.**”

807. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][3].

C. **Claim 19 of the '748 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter**

1. Introduction

808. The following analysis demonstrates claim 19 of the '748 Patent is rendered obvious by Hashem '569 alone or in combination with Ritter.

2. Preamble

809. The preamble of claim 19 reads: “**An apparatus comprising.**”

810. To the extent the preamble is a limitation, this element is satisfied by the disclosure set forth at '748 Patent claim element 11 preamble.

3. Element 19[a]

811. Claim element 19[a] of the '748 Patent reads: **“a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.”**

812. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

4. Element 19[b]

813. Claim element 19[b] of the '748 Patent reads: **“a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers.”**

814. Hashem '569 renders this element obvious alone or alternatively in combination with Ritter.

815. The summary of the invention of Hashem '569 describes: “The present invention provides a method of selecting and signaling [sic] *the identity of acceptable groups of sub-carriers in a radio communication system. A remote unit receives a signal as more than one sub-carrier signal from a base station.*” (Hashem '569 at 2:25-29 (emphasis added).) Further, following the remote unit feedback process, Hashem '569 discloses “[t]he base station allocates for data transmission at one of the Link Modes the sub-carriers which belong to the groups of sub-carriers within the set of acceptable groups of sub-carriers.” (Hashem '569 at 3:12-15.)

816. Moreover, the transmission system is unambiguously OFDM, as can be seen from the title of the patent (“Dynamic Sub-Carrier Assignments in OFDM Systems”) and in the specification: “Although *the invention has been developed for use with systems which employ*

Orthogonal Frequency Division Multiplexing, it is possible that the invention could be used with other systems...” (Hashem ’569 at 9:11-15 (emphasis added).)

817. As noted in the “Technology Overview” section, OFDMA is the multiple access technology applied in an OFDM transmission system when different users are assigned different subcarriers. It would have been obvious to one of ordinary skill in the art to use a Hashem’s disclosure of a base station allocating groups of OFDM subcarriers to a plurality of subscribers in the context of OFDMA.

818. Alternatively, this element is disclosed by Hashem ’569 in combination with Ritter. As set forth above, one of ordinary skill in the art would have been motivated to combine the teachings of Hashem ’569 with Ritter to develop a wireless OFDMA system.

819. Ritter discloses the general framework for an OFDMA-based wireless communication system in which OFDM subcarriers are selected and allocated for the purpose of communication between a subscriber and a base station. For example, the abstract of Ritter begins as follows:

The method and wireless communication system in accordance with the invention result from an OFDMA multicarrier method and the use of a number of subcarriers (oc), which are allocated for a communication connection between a base station (BS) and a mobile station (MS).

(Ritter, Abstract (emphasis added).)

820. Further, as noted above, Ritter discloses the first base station allocating OFDMA subcarriers in clusters to subscribers based on feedback from the mobile station. Specifically, Ritter uses the term “segment of a frequency spectrum” – or more succinctly, “segment” – to refer to the “clusters” subcarriers that are allocated to establish channels between the base station and the various mobile units.

Thus a number of subcarriers and therefore a segment of a frequency spectrum may be allocated for the communication connection between base station and mobile station.

(Ritter at 2.)

821. Thus, Hashem '569 alone discloses and renders obvious “a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers.” Alternatively, Hashem '569 in combination with Ritter discloses this element.

5. Element 19[c][1]

822. Claim element 19[c][1] of the '748 Patent reads: “**each of a plurality of subscribers to measure channel and interference information for the plurality of subcarriers.**”

823. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

6. Element 19[c][2]

824. Claim element 19[c][2] of the '748 Patent reads: “**based on pilot symbols received from the first base station.**”

825. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

7. Element 19[c][3]

826. Claim element 19[c][3] of the '748 Patent reads: “**at least one of the plurality of subscribers to select a set of candidate subcarriers from the plurality of subcarriers.**”

827. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

8. Element 19[c][4]

828. Claim element 19[c][4] of the '748 Patent reads: “**the one subscriber to provide feedback information on the set of candidate subcarriers to the base station.**”

829. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

9. Element 19[c][5]

830. Claim element 19[c][5] of the '748 Patent reads: “**and to receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the one subscriber.**”

831. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

10. Element 19[c][6]

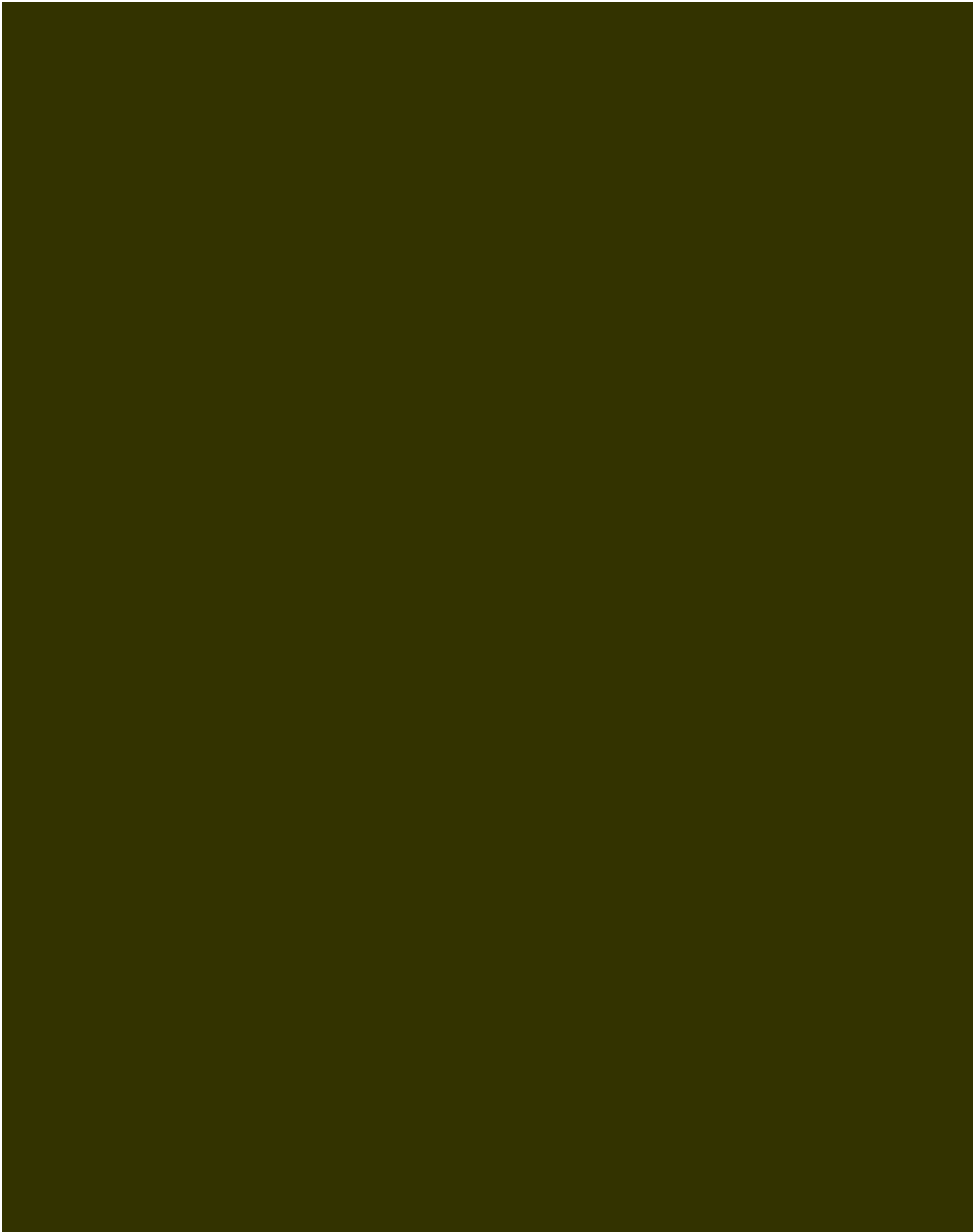
832. Claim element 19[c][6] of the '748 Patent reads: “**wherein the plurality of subscribers provide feedback information that comprises an arbitrarily ordered set of candidate subcarriers as clusters of subcarriers.**”

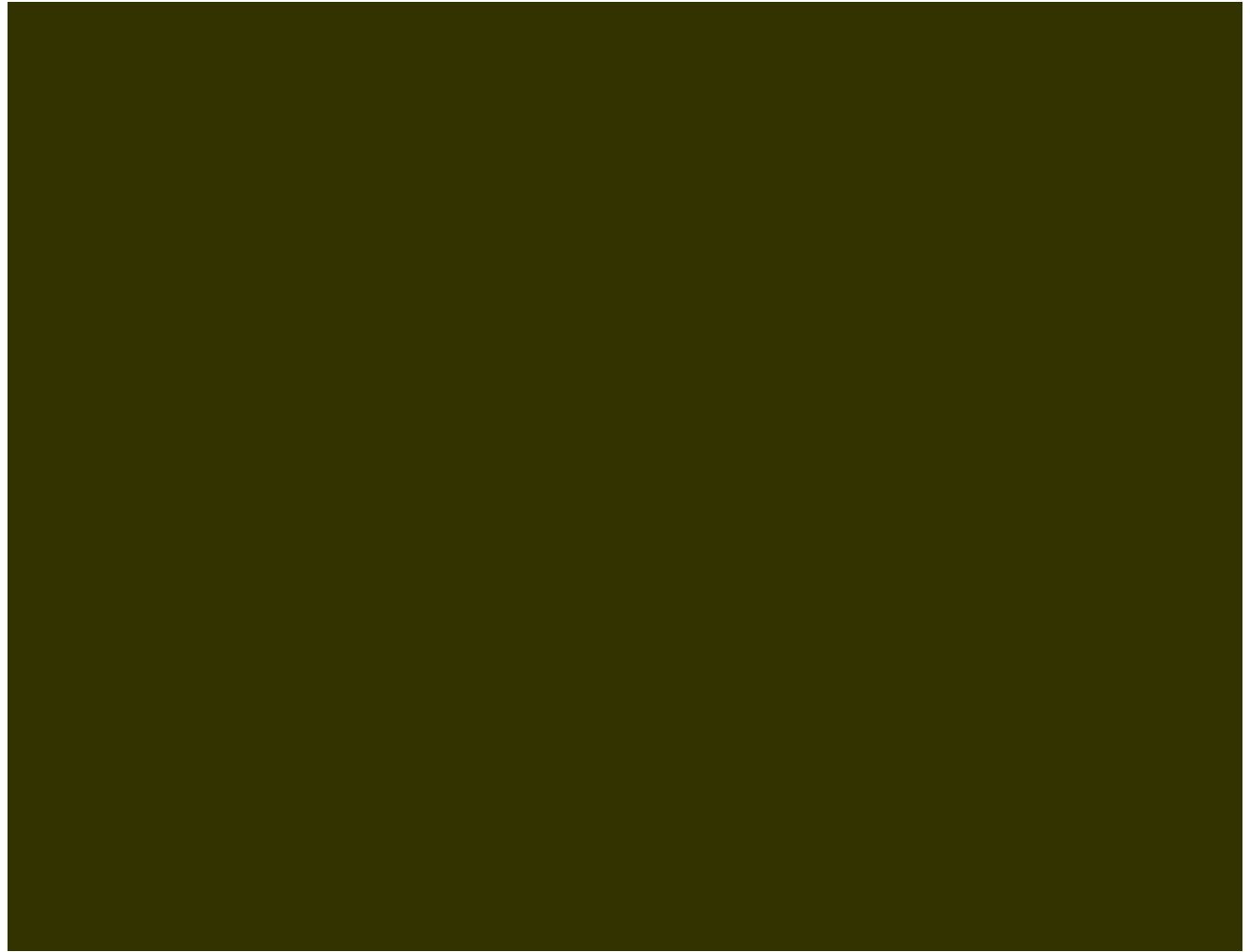
833. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][2].

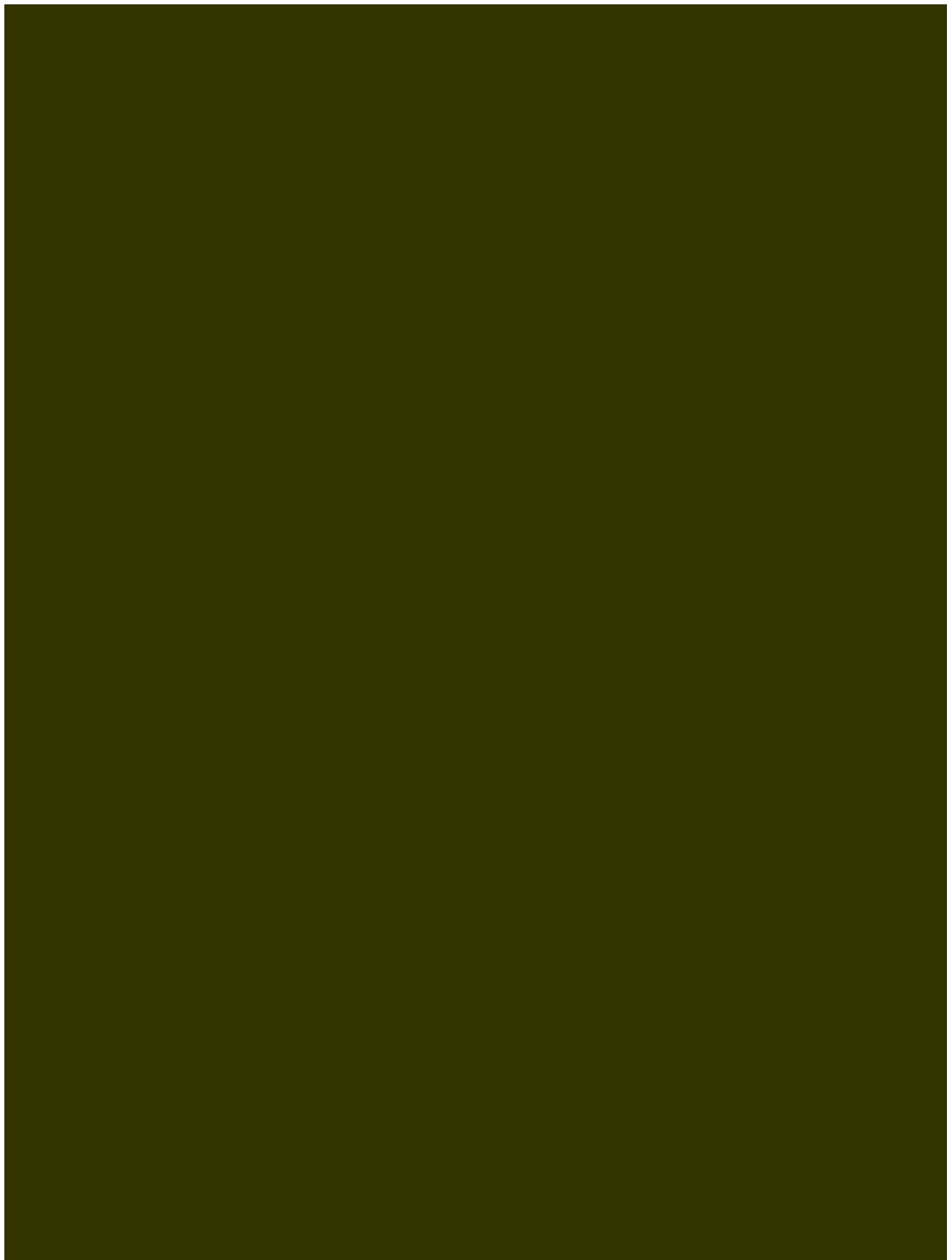
11. Element 19[c][7]

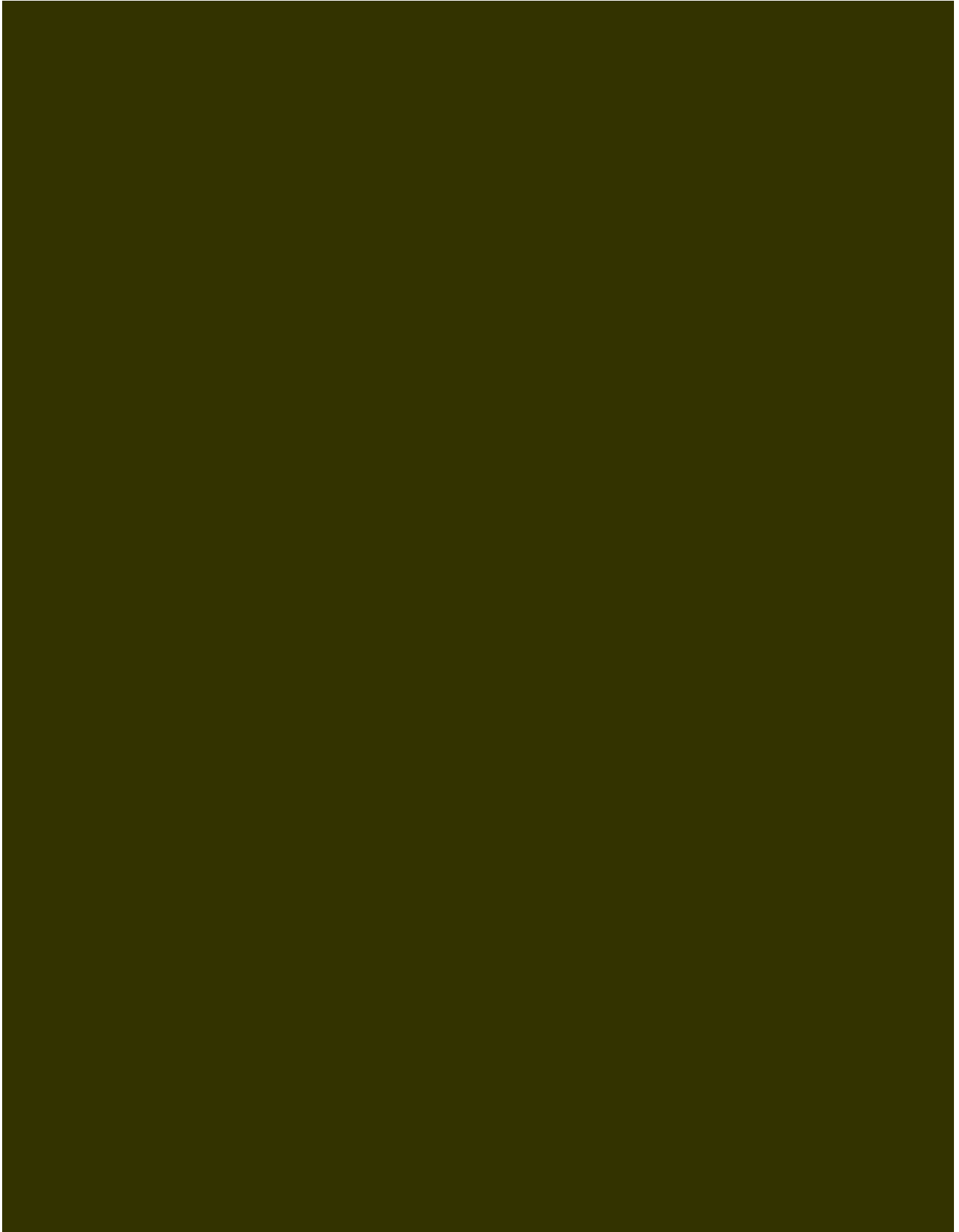
834. Claim element 19[c][7] of the '748 Patent reads: “**wherein the feedback information includes an index indication of a candidate cluster with it SINR value.**”

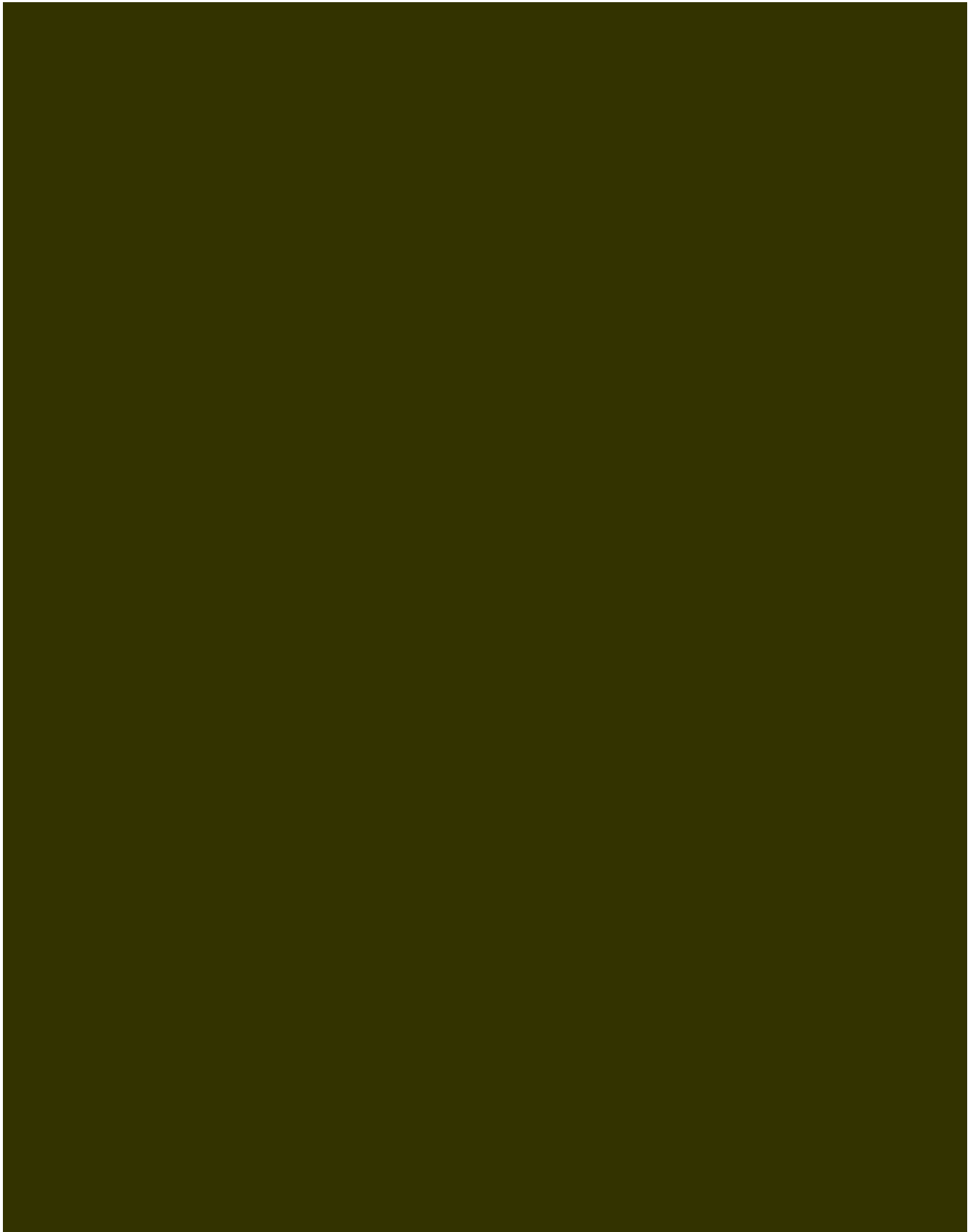
835. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][3].











A. Claim 20 of the '748 Patent is Rendered Obvious by Ritter in Combination with Hashem '569

858. Claim 20 of the '748 Patent reads: **“The apparatus defined in claim 19 wherein each index is indicative of a coding and modulation rate.”**

859. This element is satisfied by the disclosure set forth at '748 claim element 7.

B. Claim 20 of the '748 Patent is Rendered Obvious by the Sollenberger Publications in Combination with Hashem '569

860. Claim 20 of the '748 Patent reads: **“The apparatus defined in claim 19 wherein each index is indicative of a coding and modulation rate.”**

861. This element is satisfied by the disclosure set forth at '748 claim element 7.

C. Claim 20 of the '748 Patent is Rendered Obvious by Hashem '569

862. Claim 20 of the '748 Patent reads: **“The apparatus defined in claim 19 wherein each index is indicative of a coding and modulation rate.”**

863. This element is satisfied by the disclosure set forth at '748 claim element 7.

D. Claim 20 of the '748 Patent is Rendered Obvious by the Project Angel System Alone or in Combination with Hashem '569

864. Claim 20 of the '748 Patent reads: **“The apparatus defined in claim 19 wherein each index is indicative of a coding and modulation rate.”**

865. This element is satisfied by the disclosure set forth at '748 claim element 7.

XIII. '748 PATENT, CLAIM 21

866. Claim 21 of the '748 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 21 of the '748 Patent is reproduced below with identifiers [a], [b], [c], etc. added for ease of reference:

21. An apparatus comprising:

- [a] a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers; and
- [b] a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers;
- [c][1] each of a plurality of subscribers to measure channel and interference information for the plurality of subcarriers
- [c][2] based on pilot symbols received from the first base station and
- [c][3] at least one of the plurality of subscribers to select a set of candidate subcarriers from the plurality of subcarriers, and
- [c][4] the one subscriber to provide feedback information on the set of candidate subcarriers to the base station and to
- [c][5] receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the one subscriber,
- [c][6] wherein the one subscriber sends an indication of coding and modulation rates that the one subscriber desires to employ.

A. Claim 21 of the '748 Patent is Rendered Obvious by Ritter In Combination with the Sollenberger Article or the IS-95A Standard, and/or Hashem '569

1. Introduction

867. The following analysis demonstrates claim 21 of the '748 Patent is rendered obvious by Ritter in combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard.

2. Preamble

868. The preamble of claim 21 reads: “**An apparatus comprising.**”

869. This element is satisfied by the disclosure set forth at '748 Patent claim 11 preamble.

3. Element 21[a]

870. Claim element 21[a] of the '748 Patent reads: “**a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.**”

871. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

4. Element 21[b]

872. Claim element 21[b] of the '748 Patent reads: “**a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers.**”

873. This element is satisfied by the disclosure set forth at '748 Patent claim element 19[b].

5. Element 21[c][1]

874. Claim element 21[c][1] of the '748 Patent reads: “**each of a plurality of subscribers to measure channel and interference information for the plurality of subcarriers.**”

875. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

6. Element 21[c][2]

876. Claim element 21[c][2] of the '748 Patent reads: “**based on pilot symbols received from the first base station.**”

877. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

7. Element 21[c][3]

878. Claim element 21[c][3] of the '748 Patent reads: “**at least one of the plurality of subscribers to select a set of candidate subcarriers from the plurality of subcarriers.**”

879. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

8. Element 21[c][4]

880. Claim element 21[c][4] of the '748 Patent read: “**the one subscriber to provide feedback information on the set of candidate subcarriers to the base station and to**”

881. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

9. Element 21[c][5]

882. Claim element 21[c][5] of the '748 Patent reads: “**receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the one subscriber.**”

883. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

10. Element 21[c][6]

884. Claim element 21[c][6] of the '748 Patent reads: “**wherein the one subscriber sends an indication of coding and modulation rates that the one subscriber desires to employ.**”

885. This element is satisfied by the disclosure set forth at '748 Patent claim element 8[d].

B. Claim 21 of the '748 Patent is Rendered Obvious by the Sollenberger Publications, in Combination with Hashem '569

1. Introduction

886. The following analysis demonstrates claim 21 of the '748 Patent is rendered obvious by the Sollenberger Publications, in combination with Hashem '569.

2. Preamble

887. The preamble of claim 21 reads: “**An apparatus comprising.**”

888. This element is satisfied by the disclosure set forth at '748 Patent claim 11 preamble.

3. Element 21[a]

889. Claim element 21[a] of the '748 Patent reads: “**a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.**”

890. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

4. Element 21[b]

891. Claim element 21[b] of the '748 Patent reads: “**a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers.**”

892. This element is satisfied by the disclosure set forth at '748 Patent claim element 19[b].

5. Element 21[c][1]

893. Claim element 21[c][1] of the '748 Patent reads: “**each of a plurality of subscribers to measure channel and interference information for the plurality of subcarriers.**”

894. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

6. Element 21[c][2]

895. Claim element 21[c][2] of the '748 Patent reads: “**based on pilot symbols received from the first base station.**”

896. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

7. Element 21[c][3]

897. Claim element 21[c][3] of the '748 Patent reads: “**at least one of the plurality of subscribers to select a set of candidate subcarriers from the plurality of subcarriers.**”

898. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

8. Element 21[c][4]

899. Claim element 21[c][4] of the '748 Patent read: “**the one subscriber to provide feedback information on the set of candidate subcarriers to the base station and to**”

900. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

9. Element 21[c][5]

901. Claim element 21[c][5] of the '748 Patent reads: “**receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the one subscriber.**”

902. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

10. Element 21[c][6]

903. Claim element 21[c][6] of the '748 Patent reads: “**wherein the one subscriber sends an indication of coding and modulation rates that the one subscriber desires to employ.**”

904. This element is satisfied by the disclosure set forth at '748 Patent claim element 8[d].

C. **Claim 21 of the '748 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter**

1. Introduction

905. The following analysis demonstrates claim 21 of the '748 Patent is rendered obvious by Hashem '569 alone or in combination with Ritter.

2. Preamble

906. The preamble of claim 21 reads: “**An apparatus comprising.**”

907. This element is satisfied by the disclosure set forth at '748 Patent claim 11 preamble.

3. Element 21[a]

908. Claim element 21[a] of the '748 Patent reads: “**a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.**”

909. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

4. Element 21[b]

910. Claim element 21[b] of the '748 Patent reads: “**a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers.**”

911. This element is satisfied by the disclosure set forth at '748 Patent claim element 19[b].

5. Element 21[c][1]

912. Claim element 21[c][1] of the '748 Patent reads: “**each of a plurality of subscribers to measure channel and interference information for the plurality of subcarriers.**”

913. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

6. Element 21[c][2]

914. Claim element 21[c][2] of the '748 Patent reads: “**based on pilot symbols received from the first base station.**”

915. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

7. Element 21[c][3]

916. Claim element 21[c][3] of the '748 Patent reads: “**at least one of the plurality of subscribers to select a set of candidate subcarriers from the plurality of subcarriers.**”

917. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

8. Element 21[c][4]

918. Claim element 21[c][4] of the '748 Patent read: “**the one subscriber to provide feedback information on the set of candidate subcarriers to the base station and to**”

919. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

9. Element 21[c][5]

920. Claim element 21[c][5] of the '748 Patent reads: “**receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the one subscriber.**”

921. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

10. Element 21[c][6]

922. Claim element 21[c][6] of the '748 Patent reads: “**wherein the one subscriber sends an indication of coding and modulation rates that the one subscriber desires to employ.**”

923. This element is satisfied by the disclosure set forth at '748 Patent claim element 8[d].

D. Claim 21 of the '748 Patent is Rendered Obvious by the Project Angel System in Combination with Hashem '569

1. Introduction

924. The following analysis demonstrates claim 21 of the '748 Patent is rendered obvious by the Project Angel system in combination with Hashem '569.

2. Preamble

925. The preamble of claim 21 reads: “**An apparatus comprising.**”

926. This element is satisfied by the disclosure set forth at '748 Patent claim 11 preamble.

3. Element 21[a]

927. Claim element 21[a] of the '748 Patent reads: “**a plurality of subscribers in a first cell to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscribers.**”

928. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

4. Element 21[b]

929. Claim element 21[b] of the '748 Patent reads: “**a first base station in the first cell, the first base station to allocate OFDMA subcarriers in clusters to the plurality of subscribers.**”

930. This element is satisfied by the disclosure set forth at '748 Patent claim element 19[b].

5. Element 21[c][1]

931. Claim element 21[c][1] of the '748 Patent reads: “**each of a plurality of subscribers to measure channel and interference information for the plurality of subcarriers.**”

932. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

6. Element 21[c][2]

933. Claim element 21[c][2] of the '748 Patent reads: “**based on pilot symbols received from the first base station.**”

934. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

7. Element 21[c][3]

935. Claim element 21[c][3] of the '748 Patent reads: “**at least one of the plurality of subscribers to select a set of candidate subcarriers from the plurality of subcarriers.**”

936. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

8. Element 21[c][4]

937. Claim element 21[c][4] of the '748 Patent read: “**the one subscriber to provide feedback information on the set of candidate subcarriers to the base station and to**”

938. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

9. Element 21[c][5]

939. Claim element 21[c][5] of the '748 Patent reads: “**receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the one subscriber.**”

940. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

10. Element 21[c][6]

941. Claim element 21[c][6] of the '748 Patent reads: “**wherein the one subscriber sends an indication of coding and modulation rates that the one subscriber desires to employ.**”

942. This element is satisfied by the disclosure set forth at '748 Patent claim element 8[d].

XIV. '748 PATENT, CLAIM 22

943. Claim 22 of the '748 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 22 of the '748 Patent reads: “The apparatus defined in claim 21 wherein the indication of coding and modulation rates comprised an SINR index indicative of a coding and modulation rate.”

A. Claim 22 of the '748 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 and/or the IS-95A Standard

944. Claim 22 of the '748 Patent reads: “**The apparatus defined in claim 21 wherein the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.**”

945. This element is satisfied by the disclosure set forth at '748 Patent claim 9.

B. Claim 22 of the '748 Patent is Rendered Obvious by the Sollenberger Publications in Combination with Hashem '569

946. Claim 22 of the '748 Patent reads: “**The apparatus defined in claim 21 wherein the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.**”

947. This element is satisfied by the disclosure set forth at '748 Patent claim 9.

C. Claim 22 of the '748 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

948. Claim 22 of the '748 Patent reads: “**The apparatus defined in claim 21 wherein the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.**”

949. This element is satisfied by the disclosure set forth at '748 Patent claim 9.

D. Claim 22 of the '748 Patent is Rendered Obvious by the Project Angel System in Combination with Hashem '569

950. Claim 22 of the '748 Patent reads: “**The apparatus defined in claim 21 wherein the indication of coding and modulation rates comprises an SINR index indicative of a coding and modulation rate.**”

951. This element is satisfied by the disclosure set forth at '748 Patent claim 9.

XV. '212 PATENT, CLAIM 1

952. Claim 1 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 1 of the '212 Patent is reproduced below with identifiers [a], [b], [c], etc. added for ease of reference:

1. A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising:

[a][1] a subscriber unit measuring channel and interference information for a plurality of subcarriers

- [a][2] based on pilot symbols received from a base station;
- [b] the subscriber unit selecting a set of candidate subcarriers;
- [c] the subscriber unit providing feedback information on the set of candidate subcarriers to the base station;
- [d] the subscriber unit receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber unit; and
- [e][1] the subscriber unit submitting updated feedback information, after being allocated the set of subcarriers to be allocated an updated set of subcarriers, and thereafter
- [e][2] the subscriber unit receiving another indication of the updated set of subcarriers.

A. Claim 1 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1. Introduction

953. The following analysis demonstrates claim 1 of the '212 Patent is rendered obvious by Ritter in combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard.

2. Preamble

954. The preamble of claim 1 reads: **“A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising.”**

955. This element is satisfied by the disclosure set forth at '748 Patent claim 1 preamble.

3. Element 1[a][1]

956. Claim element 1[a][1] of the '212 Patent reads: **“a subscriber unit measuring channel and interference information for a plurality of subcarriers.”**

957. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

4. Element 1[a][2]

958. Claim element 1[a][2] of the '212 Patent reads: “**based on pilot symbols received from a base station.**”

959. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

5. Element 1[b]

960. Claim element 1[b] of the '212 Patent reads: “**the subscriber unit selecting a set of candidate subcarriers.**”

961. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

6. Element 1[c]

962. Claim element 1[c] of the '212 Patent reads: “**the subscriber unit providing feedback information on the set of candidate subcarriers to the base station.**”

963. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

7. Element 1[d]

964. Claim element 1[d] of the '212 Patent reads: “**the subscriber unit receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber unit.**”

965. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

8. Element 1[e][1]

966. Claim element 1[e][1] of the '212 Patent reads: “**the subscriber unit submitting updated feedback information, after being allocated the set of subcarriers to be allocated an updated set of subcarriers.**”

967. This element is disclosed by Ritter. Ritter discloses the flexibility of its OFDMA system through determining the most suitable segments for communication and modifying those suitable segments as required:

The flexibility of the method according to the invention is especially advantageously utilized if the base station assigns to the mobile stations segments of the frequency spectrum with different bandwidths or if different numbers of time slots are allocated for the transmission of the data symbols in the allocated segments. ***In this way the most suitable segments for communication can be determined at any given time for individual communication connections that differ from one another, and modified as needed.***

(Ritter at 2 col. 2 ¶ 6 (emphasis added).)

968. Ritter’s disclosure of individually modifying and improving the allocation determinations based on the most suitable segments thus discloses “the subscriber unit submitting updated feedback information, after being allocated the set of subcarriers to be allocated an updated set of subcarriers.” See, e.g., Ritter at 2 col. 2 ¶ 3 (“In this process the quality of the specific communication connection plays a decisive role with regard to the frequency situation, which according to the method of the invention is ***individually modified after determination of the most suitable segments*** in each mobile station served by the base station and thus improved.”). One skilled in the art would understand that Ritter discloses the subscriber updating the feedback information in order to “individually modif[y]” the allocation of the most suitable segments.

969. Alternatively, to the extent Ritter does not disclose this element, Ritter in combination with the Sollenberger Article satisfies this element. For example, the Sollenberger Article describes the re-allocation of sub-carriers is carried out on a packet-by-packet basis:

To achieve the potential of DCA gain, channel reassignments must take place at high-speed to avoid rapidly changing interference. Dynamic Packet Assignment (DPA) based on properties of an OFDM physical layer is proposed which reassigns transmission resources on a packet by packet basis using high-speed receiver measurements to overcome these problems.

(Sollenberger Article at 758.)

970. Thus, the Sollenberger Article requires that the measure-report-assign process detailed above with respect to elements 1[a] to 1[d] be repeated “on a packet by packet basis using high-speed receiver measurements.”

971. Indeed, the Sollenberger Article specifically identifies the problems in the prior art that made such ongoing measuring and reallocation difficult – “Some of the reasons for not fully exploiting the large potential capacity gain of DCA are the difficulties introduced by rapid channel reassignment and intensive receiver measurements required by a high performance DCA algorithm.” And it refers to OFDM as “promising in overcoming these challenging implementation issues” because of OFDM’s “key advantage... the ability to measure interference or path loss parameters in parallel on all candidate channels[.]” (Sollenberger Article at 758.)

972. The exemplary system disclosed in Sollenberger Article uses 20 ms frames organized into 80 ms “superframes,” with four adjacent base stations sharing the first part of each 20 ms frame to be used for control information on a “staggered schedule.”

At the beginning of each frame, the control channels for both the uplink and downlink jointly perform the four DPA procedures, described in Section 2.2, sequentially with a pre-determined staggered schedule among adjacent base stations.

(Sollenberger Article at 760.)

973. The above-referenced “DPA procedures, described in Section 2.2” include four steps:

(1) a packet page from a base station to a terminal; (2) rapid measurements of resource usage by a terminal using the parallelism of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with each radio resource; and (4) selection of resources by the base and transmission of the data.

(Sollenberger Article at 758-759.)

974. The third of these steps discloses the required element. The “short report from the terminal to the base station” is the required “updated feedback,” and the fact that this process is carried out “at the beginning of each frame” means that it is an ongoing process that continues after the initial allocation – *i.e.*, that it occurs “after being allocated the set of subcarriers to be allocated an updated set of subcarriers.” Therefore, Sollenberger Article discloses “the subscriber unit submitting updated feedback information, after being allocated the set of subcarriers to be allocated an updated set of subcarriers.” As set forth above, one skilled in the art would have been motivated to combine the teachings of Ritter with Sollenberger Article.

975. Thus, Ritter discloses “the subscriber unit submitting updated feedback information, after being allocated the set of subcarriers to be allocated an updated set of subcarriers.” Alternatively, Ritter in combination with Sollenberger Article discloses this element.

9. Element 1[e][2]

976. Claim element 1[e][2] of the ’212 Patent reads: “**the subscriber unit receiving another indication of the updated set of subcarriers.**”

977. This element is disclosed by Ritter. Ritter discloses the flexibility of its OFDMA system through determining the most suitable segments for communication and modifying those suitable segments as required:

The flexibility of the method according to the invention is especially advantageously utilized if the base station assigns to the mobile stations segments of the frequency spectrum with different bandwidths or if different numbers of time slots are allocated for the transmission of the data symbols in the allocated segments. ***In this way the most suitable segments for communication can be determined at any given time for individual communication connections that differ from one another, and modified as needed.***

(Ritter at 2 col. 2 ¶ 6 (emphasis added).)

978. Ritter's process of individually modifying and improving the allocation determinations based on the most suitable segments thus discloses "and thereafter, the subscriber unit receiving another indication of the updated set of subcarriers." (See, e.g., Ritter at 2 col.2 ¶ 3 ("In this process the quality of the specific communication connection plays a decisive role with regard to the frequency situation, which according to the method of the invention is ***individually modified after determination of the most suitable segments*** in each mobile station served by the base station and thus improved.").) One skilled in the art would understand that Ritter discloses updating the indication of the set of subcarriers in order to "individually modif[y]" the allocation of the most suitable segments.

979. Alternatively, to the extent Ritter does not disclose this element, Ritter in combination with the Sollenberger Article satisfies this element. For example, Figure 3.2 from the Sollenberger Article (reproduced below) shows the downlink frame structure in the exemplary system disclosed in the Sollenberger Article. In this system, each 20 ms frame includes "Control Slots" in which one base station transmits its "list of assigned channels" to the subscribers in its coverage area – thus disclosing the required element of "the subscriber unit receiving another indication of the updated set of carriers." (As noted above, base stations are

organized into groups of four adjacent stations that share control slots, so during each 80 ms “superframe” every base station gets to transmit its updated set of subcarriers exactly once.)

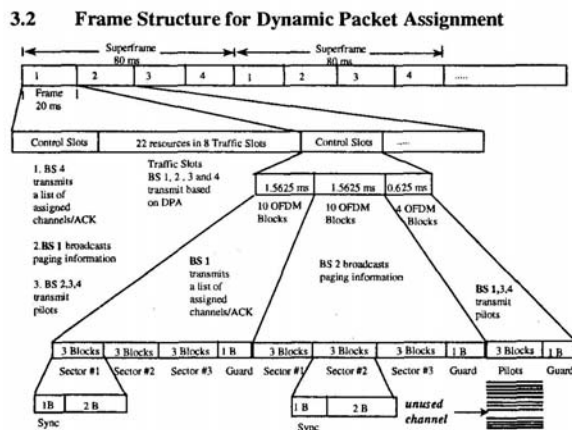


Figure 3. Staggered frame structure for downlink DPA

980. This figure illustrates that the base station transmits – and therefore the subscriber unit receives – an indication of the updated set of carriers in the form of “a list of assigned channels.” This process occurs on a packet-by-packet basis, in which the subscriber unit sends a “short report” (feedback) about the potential transmission quality associated with each radio resource in the control slots at the beginning of each uplink frame, and then the base stations send “a list of assigned channels” to the subscriber units at the beginning of each downlink frame. The Sollenberger Article therefore discloses “and thereafter the subscriber unit receiving another indication of the updated set of carriers.” As set forth above, one skilled in the art would have been motivated to combine the teachings of Ritter and the Sollenberger Article.

981. Thus, Ritter discloses “the subscriber unit receiving another indication of the updated set of subcarriers.” Alternatively, Ritter in combination with the Sollenberger Article discloses this element.

B. Claim 1 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1. Introduction

982. The following analysis demonstrates claim 1 of the '212 Patent is rendered obvious by the Sollenberger Patent and/or Sollenberger Article.

2. Preamble

983. The preamble of claim 1 reads: “**A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising.**”

984. This element is satisfied by the disclosure set forth at '748 Patent claim 1 preamble.

3. Element 1[a][1]

985. Claim element 1[a][1] of the '212 Patent reads: “**a subscriber unit measuring channel and interference information for a plurality of subcarriers.**”

986. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

4. Element 1[a][2]

987. Claim element 1[a][2] of the '212 Patent reads: “**based on pilot symbols received from a base station.**”

988. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

5. Element 1[b]

989. Claim element 1[b] of the '212 Patent reads: “**the subscriber unit selecting a set of candidate subcarriers.**”

990. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

6. Element 1[c]

991. Claim element 1[c] of the '212 Patent reads: **“the subscriber unit providing feedback information on the set of candidate subcarriers to the base station.”**

992. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

7. Element 1[d]

993. Claim element 1[d] of the '212 Patent reads: **“the subscriber unit receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber unit.”**

994. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

8. Element 1[e][1]

995. Claim element 1[e][1] of the '212 Patent reads: **“the subscriber unit submitting updated feedback information, after being allocated the set of subcarriers to be allocated an updated set of subcarriers.”**

996. This element is disclosed by, at least, the Sollenberger Article.

997. Elements 1[e][1] and 1[e][2] (described below) together require that steps described previously in the claim – *i.e.*, the subscriber unit providing feedback information on subcarriers, and the subscriber unit then receiving an indication of the set of subcarriers selected by the base station – be repeated on an ongoing basis. Thus, this element requires that the process employed to initially allocate subcarriers to a subscriber be carried out on an ongoing basis to adjust that allocation.

998. That is exactly what is described in the Sollenberger Article because the re-allocation of sub-carriers is carried out on a packet-by-packet basis:

To achieve the potential of DCA gain, channel reassignments must take place at high-speed to avoid rapidly changing interference. Dynamic Packet Assignment (DPA) based on properties of an OFDM physical layer is proposed which reassigns transmission resources on a packet by packet basis using high-speed receiver measurements to overcome these problems. (Sollenberger Article at 758.)

999. Thus, the Sollenberger Article requires that the measure-report-assign process detailed above with respect to elements 1[a] to 1[d] be repeated “on a packet by packet basis using high-speed receiver measurements.”

1000. Indeed, the Sollenberger Article specifically identifies the problems in the prior art that made such ongoing measuring and reallocation difficult – “Some of the reasons for not fully exploiting the large potential capacity gain of DCA are the difficulties introduced by rapid channel reassignment and intensive receiver measurements required by a high performance DCA algorithm.” And it refers to OFDM as “promising in overcoming these challenging implementation issues” because of OFDM’s “key advantage... the ability to measure interference or path loss parameters in parallel on all candidate channels...” (Sollenberger Article at 758.)

1001. Turning now to 1[e][1] above: The exemplary system disclosed in the Sollenberger Article uses 20 ms frames organized into 80 ms “superframes,” with four adjacent base stations sharing the first part of each 20 ms frame to be used for control information on a “staggered schedule.”

At the beginning of each frame, the control channels for both the uplink and downlink jointly perform the four DPA procedures, described in Section 2.2, sequentially with a pre-determined staggered schedule among adjacent base stations. (Sollenberger Article at 760.)

1002. The above-referenced “DPA procedures, described in Section 2.2” include four steps:

(1) a packet page from a base station to a terminal; (2) rapid measurements of resource usage by a terminal using the parallelism of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with each radio resource; and (4) selection of resources by the base and transmission of the data. (Sollenberger Article at 758-759.)

1003. The third of these steps discloses the required element. The “short report from the terminal to the base station” is the required “updated feedback,” and the fact that this process is carried out “at the beginning of each frame” means that it is an ongoing process that continues after the initial allocation – *i.e.*, that it occurs “after being allocated the set of subcarriers to be allocated an updated set of subcarriers.”

1004. Thus, the Sollenberger Article discloses “the subscriber unit submitting updated feedback information, after being allocated the set of subcarriers to be allocated an updated set of subcarriers.”

9. Element 1[e][2]

1005. Claim element 1[e][2] of the ’212 Patent reads: **“the subscriber unit receiving another indication of the updated set of subcarriers.”**

1006. This element is disclosed by, at least, the Sollenberger Article. Figure 3.2 from the Sollenberger Article (reproduced below) shows the downlink frame structure in the exemplary system disclosed in the Sollenberger Article. In this system, each 20 ms frame includes “Control Slots” in which one base station transmits its “list of assigned channels” to the subscribers in its coverage area – thus disclosing the required element of “the subscriber unit receiving another indication of the updated set of carriers.” (As noted above, base stations are organized into groups of four adjacent stations that share control slots, so during each 80 ms “superframe” every base station gets to transmit its updated set of subcarriers exactly once.)

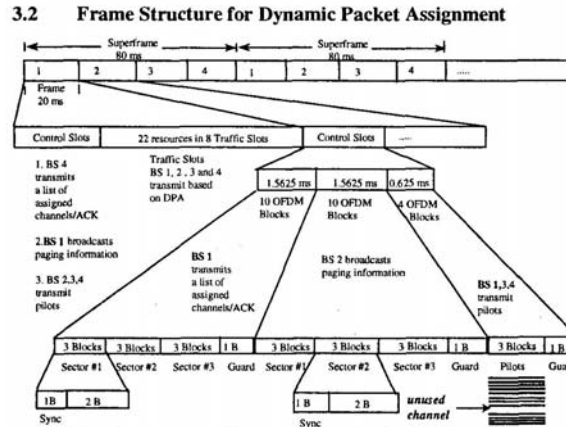


Figure 3. Staggered frame structure for downlink DPA

1007. This figure illustrates that the base station transmits – and therefore the subscriber unit receives – an indication of the updated set of carriers in the form of “a list of assigned channels”. This process occurs on a packet-by-packet basis, in which the subscriber unit sends a “short report” (feedback) about the potential transmission quality associated with each radio resource in the control slots at the beginning of each uplink frame, and then the base stations send “a list of assigned channels” to the subscriber units at the beginning of each downlink frame.

1008. Thus, the Sollenberger Article discloses “and thereafter the subscriber unit receiving another indication of the updated set of carriers.”

C. Claim 1 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1. Introduction

1009. The following analysis demonstrates claim 1 of the '212 Patent is rendered obvious by Hashem '569 or the combination of Hashem '569 and Ritter.

2. Preamble

1010. The preamble of claim 1 reads: “**A method for subcarrier selection for a system employing orthogonal frequency division multiple access (OFDMA) comprising.**”

1011. This element is satisfied by the disclosure set forth at '748 Patent claim 1 preamble.

3. Element 1[a][1]

1012. Claim element 1[a][1] of the '212 Patent reads: “**a subscriber unit measuring channel and interference information for a plurality of subcarriers.**”

1013. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][1].

4. Element 1[a][2]

1014. Claim element 1[a][2] of the '212 Patent reads: “**based on pilot symbols received from a base station.**”

1015. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[a][2].

5. Element 1[b]

1016. Claim element 1[b] of the '212 Patent reads: “**the subscriber unit selecting a set of candidate subcarriers.**”

1017. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[b].

6. Element 1[c]

1018. Claim element 1[c] of the '212 Patent reads: “**the subscriber unit providing feedback information on the set of candidate subcarriers to the base station.**”

1019. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][1].

7. Element 1[d]

1020. Claim element 1[d] of the '212 Patent reads: “**the subscriber unit receiving an indication of subcarriers of the set of subcarriers selected by the base station for use by the subscriber unit.**”

1021. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[d].

8. Element 1[e][1]

1022. Claim element 1[e][1] of the '212 Patent reads: “**the subscriber unit submitting updated feedback information, after being allocated the set of subcarriers to be allocated an updated set of subcarriers.**”

1023. This element is disclosed by Hashem '569.

1024. Elements 1[e][1] and 1[e][2] (described below) together require that steps described previously in the claim – *i.e.*, the subscriber unit providing feedback information on subcarriers, and the subscriber unit then receiving an indication of the set of subcarriers selected by the base station – be repeated on an ongoing basis. Thus, this element requires that the process employed to initially allocate subcarriers to a subscriber be carried out on an ongoing basis to adjust that allocation.

1025. But that is exactly what is described in the Hashem references. The title of Hashem '129 is “Receiver Based Adaptive Modulation Scheme,” and the specification of the '129 describes what “adaptive modulation” means:

The communication system can use adaptive modulation to adjust the transmission parameters to accommodate changes in channel characteristics over time. If a change in channel characteristics results in a higher signal to interference ratio, the transmitter can increase the modulation level or decrease the coding rate in order to obtain a higher transmission rate. If a change in channel characteristics results in a lower signal to interference ratio, the transmitter can

decrease the modulation level or increase the coding rate to maintain the acceptable bit error rate, albeit at the expense of a lower transmission rate.

(’129 Patent at 1:26-36.)

1026. Thus, Hashem 129 and Hashem ’569 describe systems that “accommodate changes in channel characteristics over time” – *i.e.*, systems in which the allocation of subcarriers (and their associated Link Modes) is carried out on an ongoing basis to accommodate the changing nature of the associated channels.

1027. Moreover, the focus of the Hashem ’129 reference is to adapt the Link Modes in an efficient manner by differentially encoding the index of the desired Link Mode, relative to the current Link Mode. “The method provides improved efficiency of a communication system by reducing the amount of overhead needed to adapt the transmission parameters to changing channel quality.” (’129 Patent at 3:11-14.) However, Hashem ’129 also discloses that “the remote unite may also periodically transmit the desired LM [Link Mode] to the base station.” (’129 Patent at 2:63-64.) This “periodic” (*i.e.*, repeating) transmission of the LM indices is to avoid error propagation due to the differential encoding – but it also emphasizes the ongoing nature of the proposed allocation scheme disclosed by Hashem.

1028. Alternatively, to the extent Hashem ’569 does not disclose this element, one skilled in the art would have been motivated to combine Hashem ’569 and Ritter to satisfy this element.

1029. As set forth above, Ritter discloses this element. For example, Ritter discloses a system capable to individually modify and improve the allocation determinations based on the most suitable segments, and thus discloses “the subscriber unit submitting updated feedback information, after being allocated the set of subcarriers to be allocated an updated set of subcarriers.” (*See, e.g.*, Ritter at 2 col. 2 ¶ 3 (“In this process the quality of the specific

communication connection plays a decisive role with regard to the frequency situation, which according to the method of the invention is *individually modified after determination of the most suitable segments* in each mobile station served by the base station and thus improved.”.) One skilled in the art would understand that Ritter discloses the subscriber updating the feedback information in order to “individually modif[y]” the allocation of the most suitable segments. One skilled in the art would have also been motivated to combine the teachings of Ritter with Hashem ’569.

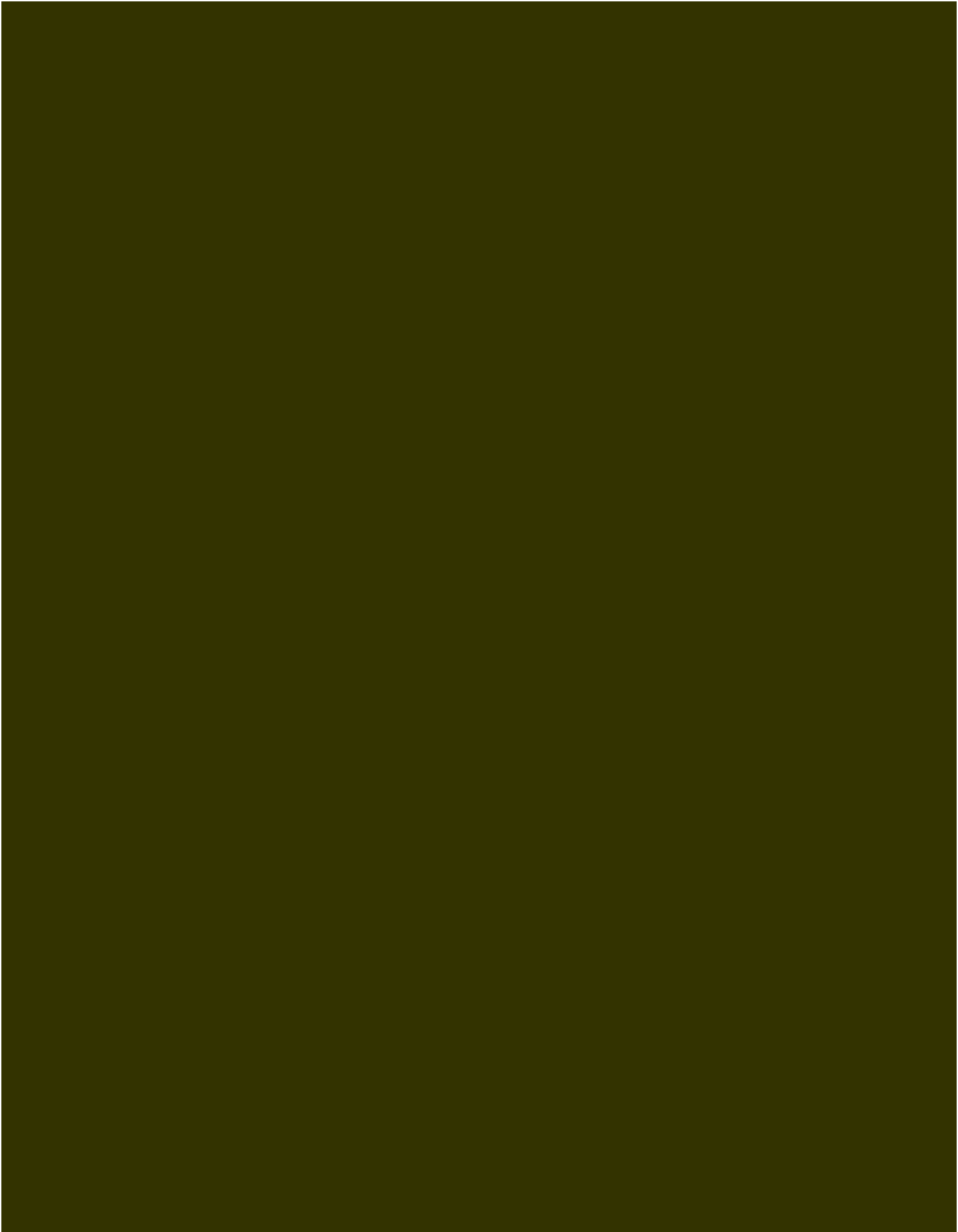
1030. Thus, Hashem ’569 discloses “the subscriber unit submitting updated feedback information, after being allocated the set of subcarriers to be allocated an updated set of subcarriers.” Alternatively, Hashem ’569 in combination with Ritter discloses this element.

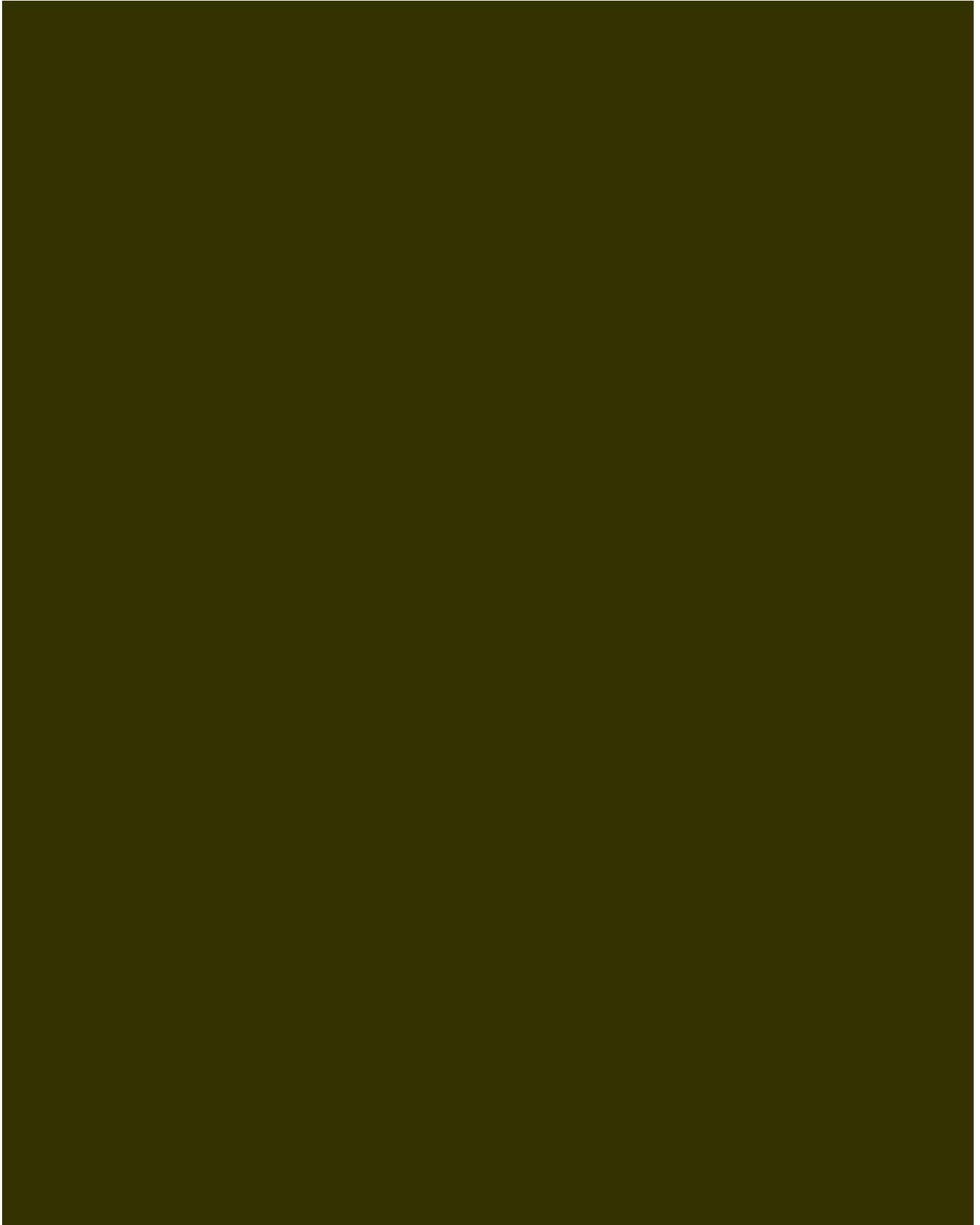
9. Element 1[e][2]

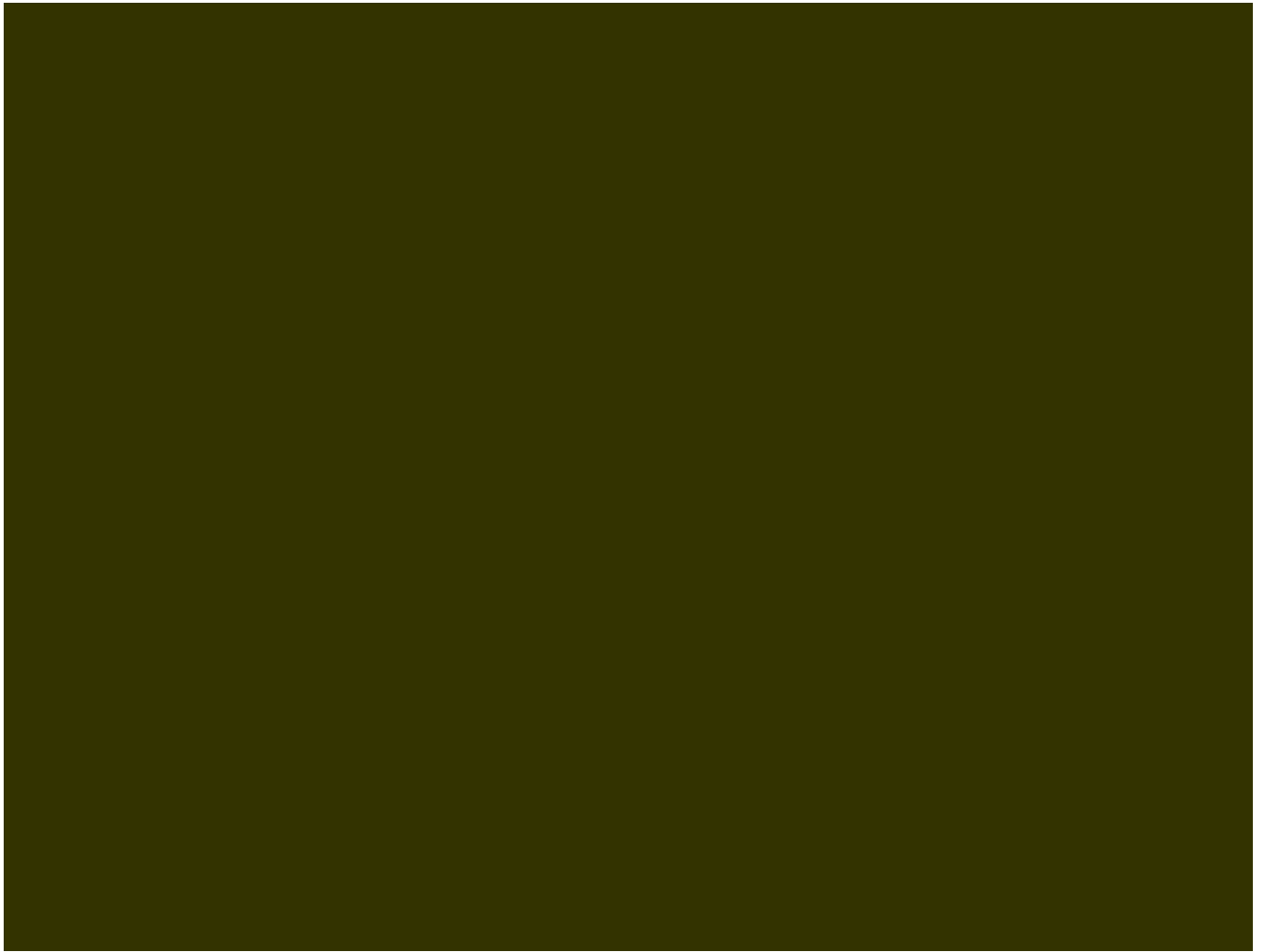
1031. Claim element 1[e][2] of the ’212 Patent reads: “**the subscriber unit receiving another indication of the updated set of subcarriers.**”

1032. This element is rendered obvious by Hashem. The disclosure is identical to that described with regard to element 1[e][1] above. The Hashem references describe an adaptive modulation scheme in which carriers are allocated and Link Modes are assigned on an ongoing basis to “accommodate changes in channel characteristics over time.” Moreover, Hashem ’129 explicitly invokes the periodic transmission of the Link Mode indices to the base station, reflecting the ongoing nature of the update process. It would have been obvious to one of skill in the art for the base station to transmit (and the subscriber to receive) the indication of the updated set of subcarriers.

1033. Alternatively, to the extent Hashem ’569 does not disclose this element, one skilled in the art would have been motivated to combine Hashem ’569 and Ritter to satisfy this element. As set forth above, Ritter discloses this element. For example, Ritter discloses a

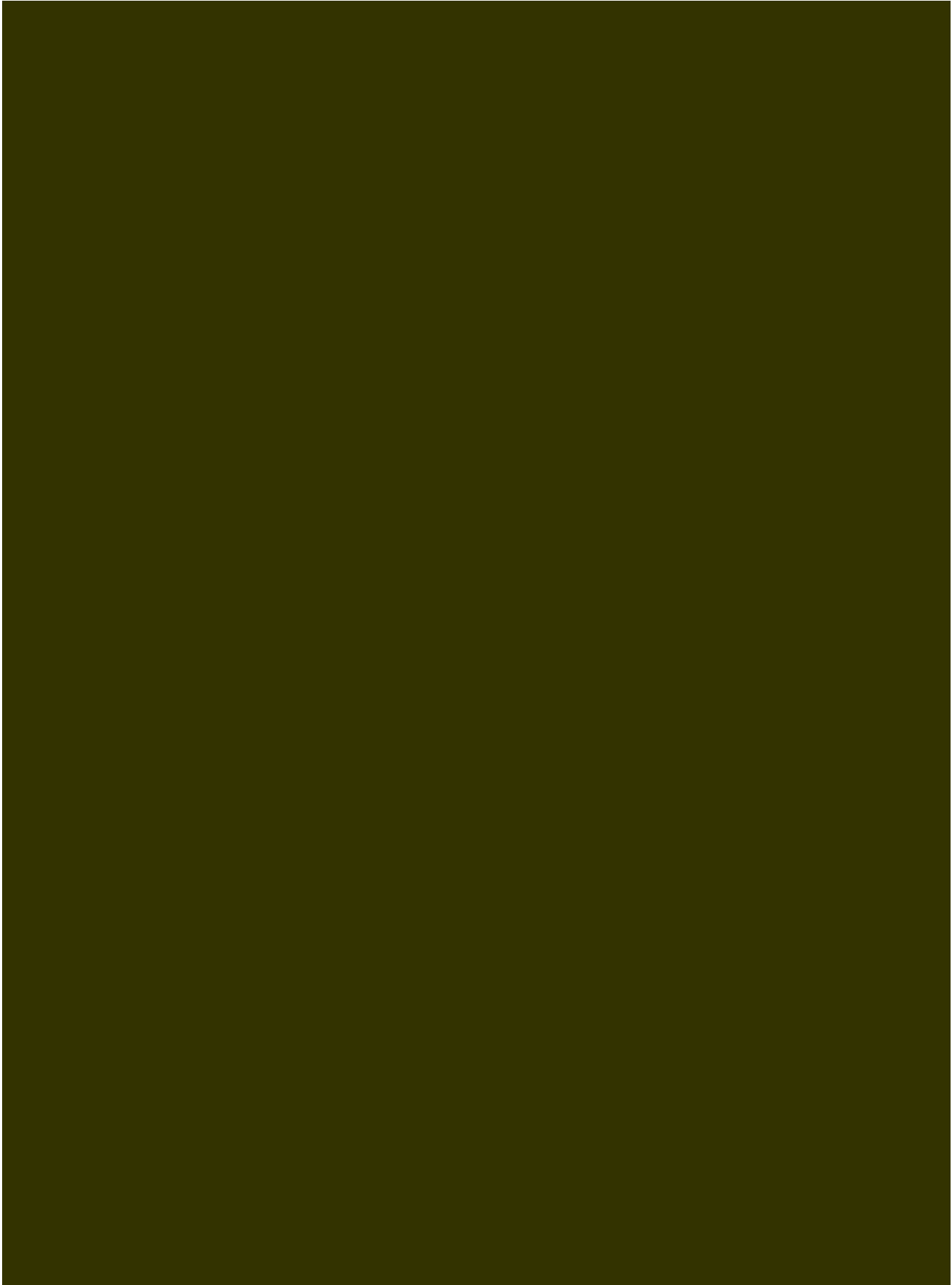


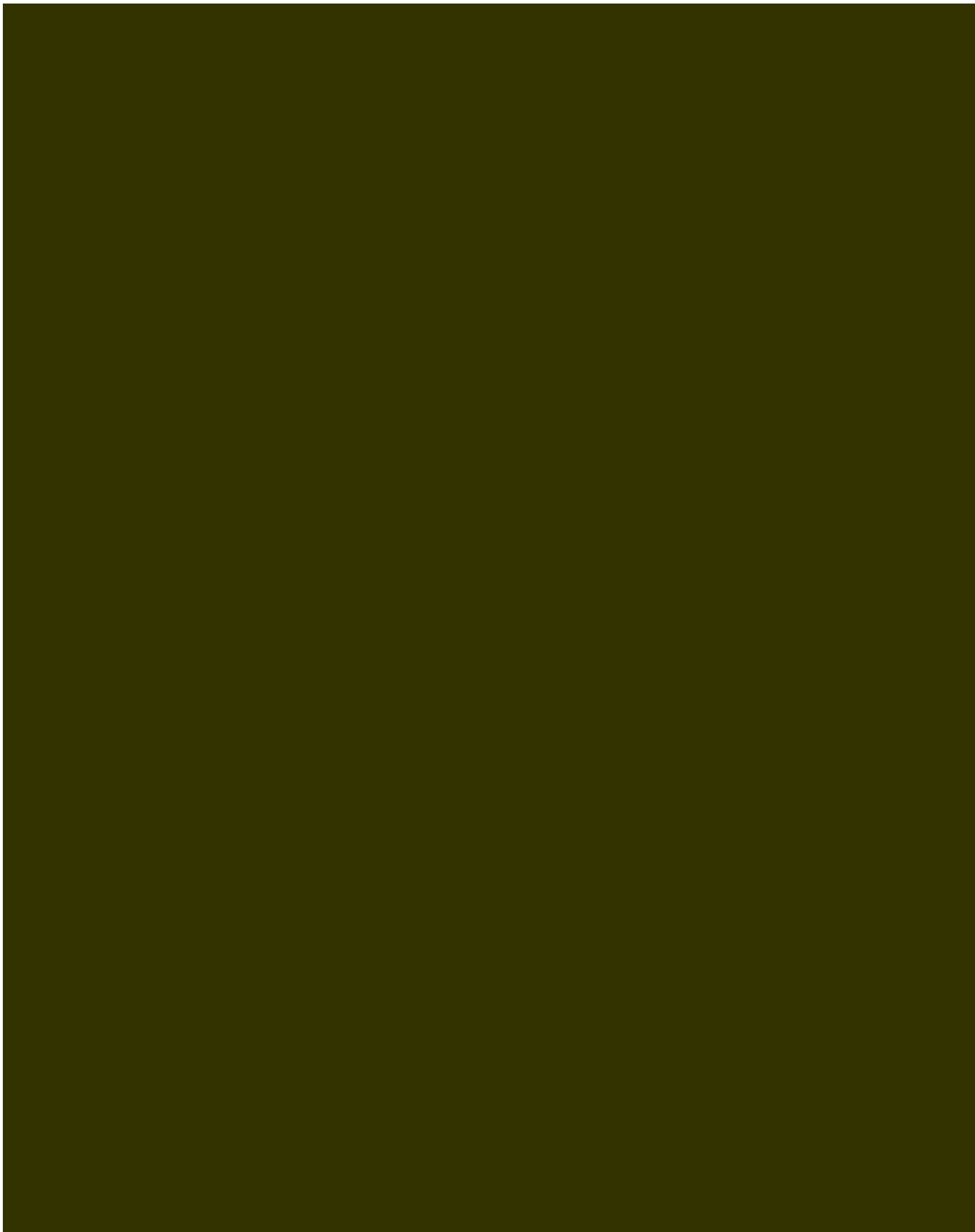


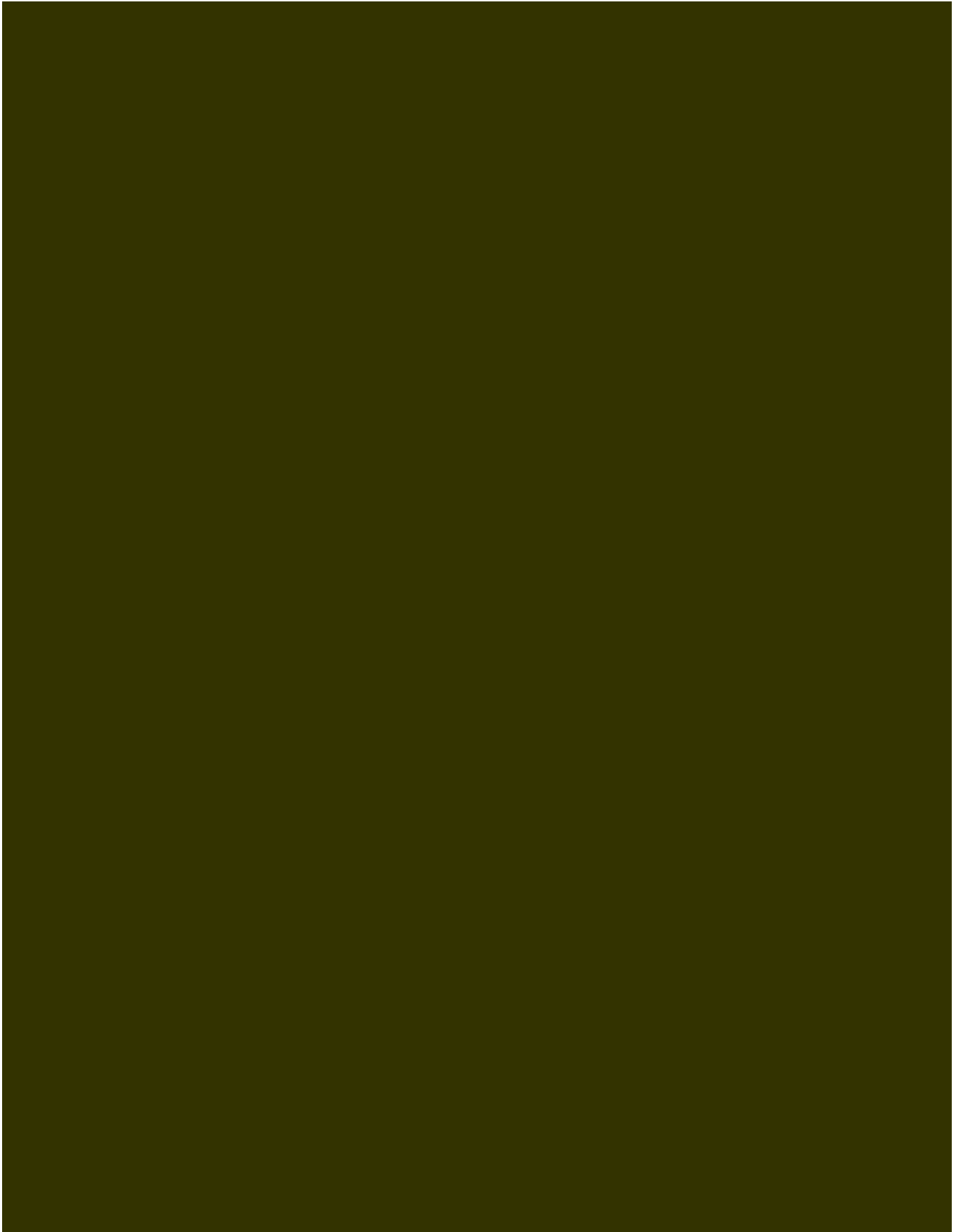


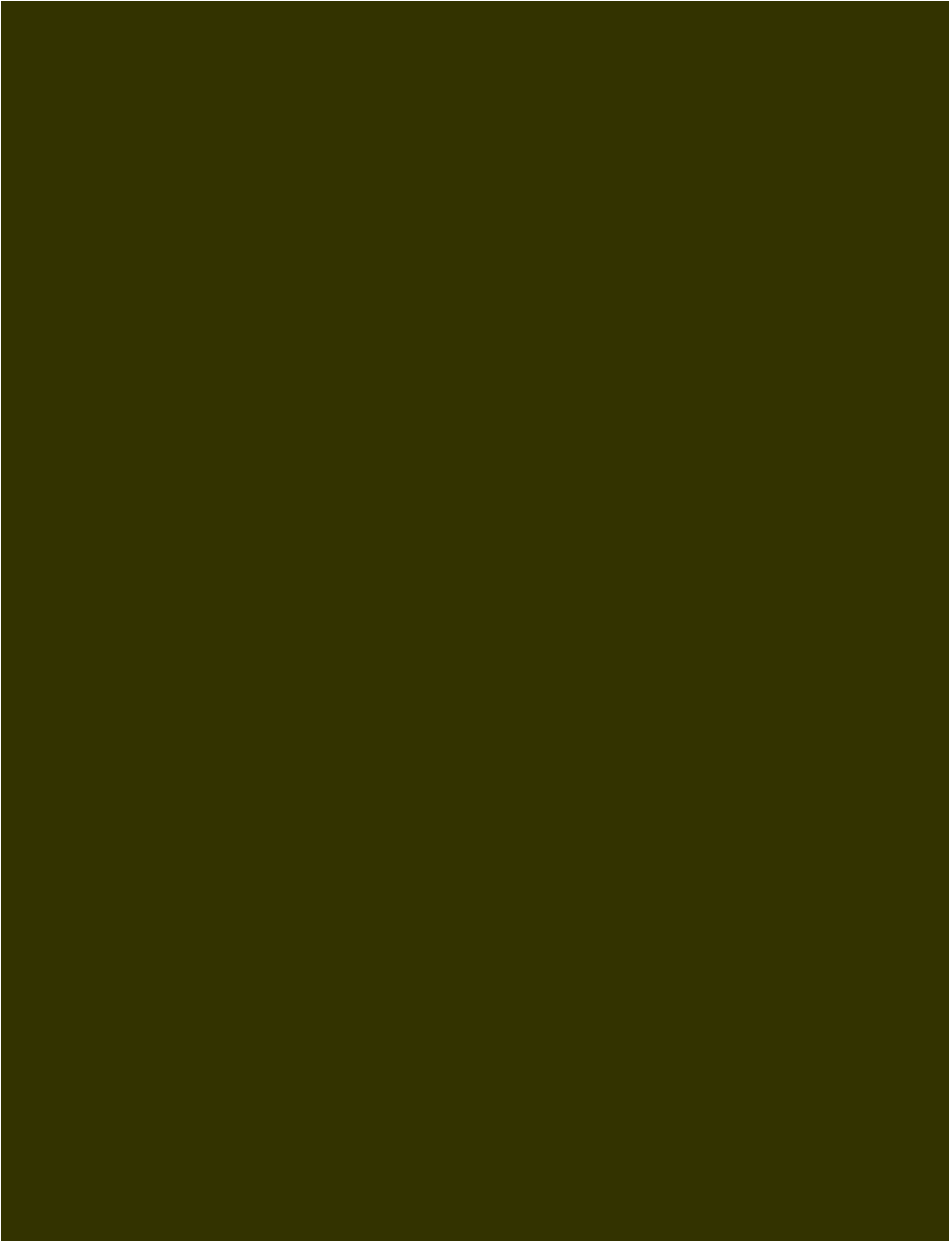












depending on the evaluation of each mobile station, *allocates a segment for the respective communication connection. ... This also depends on the transmission conditions and/or the load on the wireless cell served by the base station BS according to specifications of the operation* and maintenance center OMC or the base station control BSC for wireless resource management.” (Ritter at 4 col.1 ¶ 1.)

1059. Ritter also discloses that “[t]he *change in segments of the frequency spectrum also takes conditions into consideration the transmission conditions* (high levels of disturbances and interferences) *as well as the load on the wireless resources* (time slots, frequencies, spreading codes) in the wireless cell. These conditions are signaled to the control means BSE from the base station controller BSC or from the operation and maintenance center OMC. Then the control means BSE select the subcarriers for defining the segment according to quality features for each communication connection.” (Ritter at 6 col. 1 ¶ 2.)

1060. Thus, Ritter discloses “the base station selecting the subcarriers from the set of candidate subcarriers based on additional information available to the base station.”

B. Claim 8 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1061. Claim 8 of the '212 reads: “The method defined in claim 1 further comprising the base station selecting the subcarriers from the set of candidate subcarriers based on additional information available to the base station.”

1062. This element is disclosed by, at least, the Sollenberger Patent. As discussed above, Figures 1 and 2 from the Sollenberger Patent illustrate a method in which each WS (“wireless station”) selects the first L “acceptable” channels. The Sollenberger Patent further describes that the base station assigns channels to the wireless stations based on the lists of

acceptable channels received from all of the wireless stations having a pending channel assignment

The wireless station selects the first L acceptable channels and sends a feedback message to the base station providing the list of L acceptable channels for the wireless station. Upon receiving all acceptable channel lists from all wireless stations having a pending channel assignment, the base station assigns channels based on the received lists of acceptable channels and delivers the packets to all of the wireless stations by downlink packet transmission on the respectively assigned channels (step 12a), and simultaneously updates the channel priority order (step 12b).

(Sollenberger Patent at 8:40-49.)

1063. The lists of acceptable channels from other wireless stations are “additional information available to the base station.”

1064. Thus, the Sollenberger Patent discloses “the base station selecting the subcarriers from the set of candidate subcarriers based on additional information available to the base station.”

C. **Claim 8 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter**

1065. Claim 8 of the '212 Patent reads: **“The method defined in claim 1 further comprising the base station selecting the subcarriers from the set of candidate subcarriers based on additional information available to the base station.”**

1066. This element is disclosed by Hashem '569 (which incorporates Hashem '129).

1067. Hashem '569 discloses a system in which “[u]sing the channel quality report received from the remote unit, the station calculates a set of optimum transmission parameters which the base station will use in its next transmission of data.” (Hashem '569 at 1:41-44.) As set forth in both Hashem '569 and Hashem '129, the base station’s calculation is based on additional information available to the base station.

1068. For example, Hashem '129 discloses:

A Link Mode adjuster 46 within the base station 10 compares the sequential difference and the current base station LM to determine the desired LM from the table 18 of allowed LMs, and sets the current base station LM 16 to be the desired LM. Alternatively, if the current base station LM 16 is stored as an index to the table 18, then the Link Mode adjuster 46 can simply adjust the value of the stored index by the value of the sequential difference. The delay in adjusting the current remote unit LM 28 ensures that the current base station LM 16 and the current remote unit LM 28 are synchronized.

(Hashem '129 at 5:9-17.)

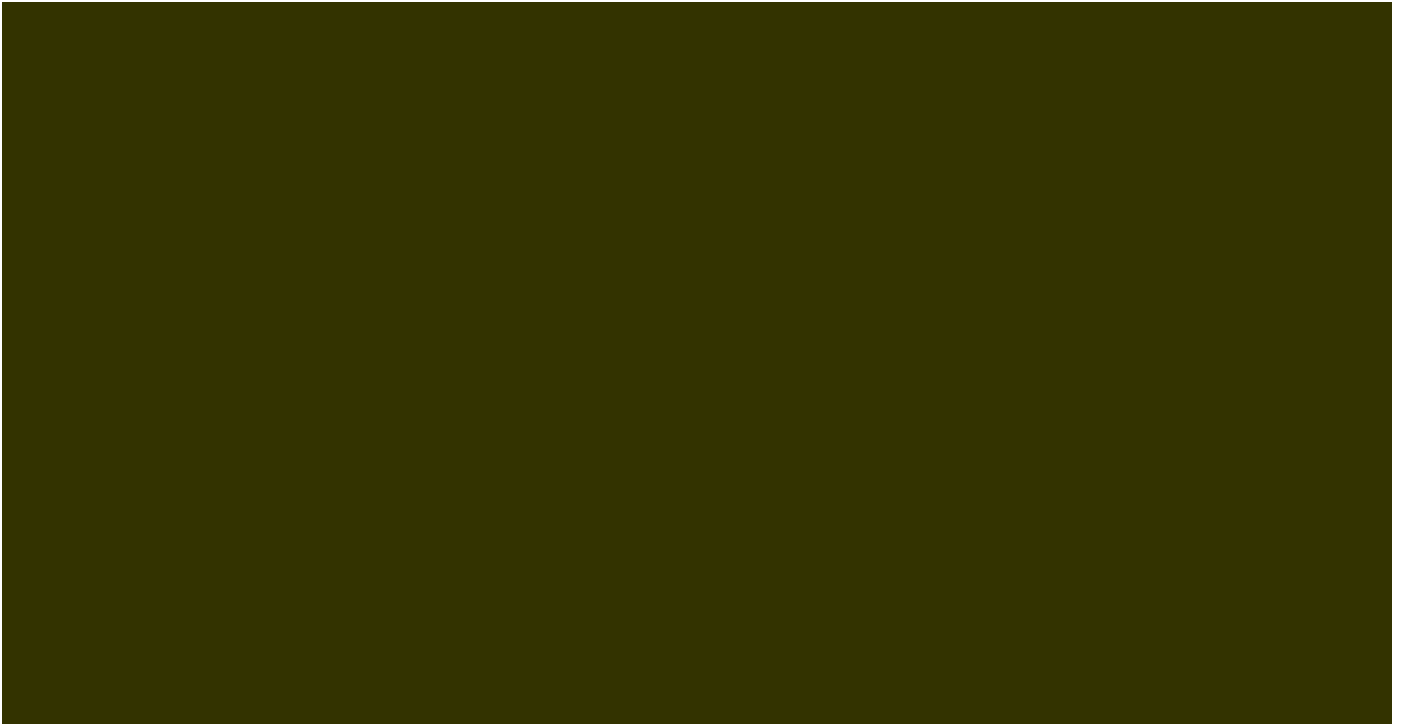
1069. This process disclosed in Hashem '129 includes adjustments to the base station allocation based on information available to the base station (*i.e.*, the index of past LM modes). Moreover, Hashem '569 discloses the base stations use of a "Link Mode evaluator" that "is a processor, and may be combined with the extractor 33. The optimum Link Mode is passed to the signal generator within the base station, along with the bitmask from the extractor and along with data which is to be transmitted." This use of the bitmask from the extractor and the use of the algorithm necessarily included in the signal generator is additional information available to the base station.

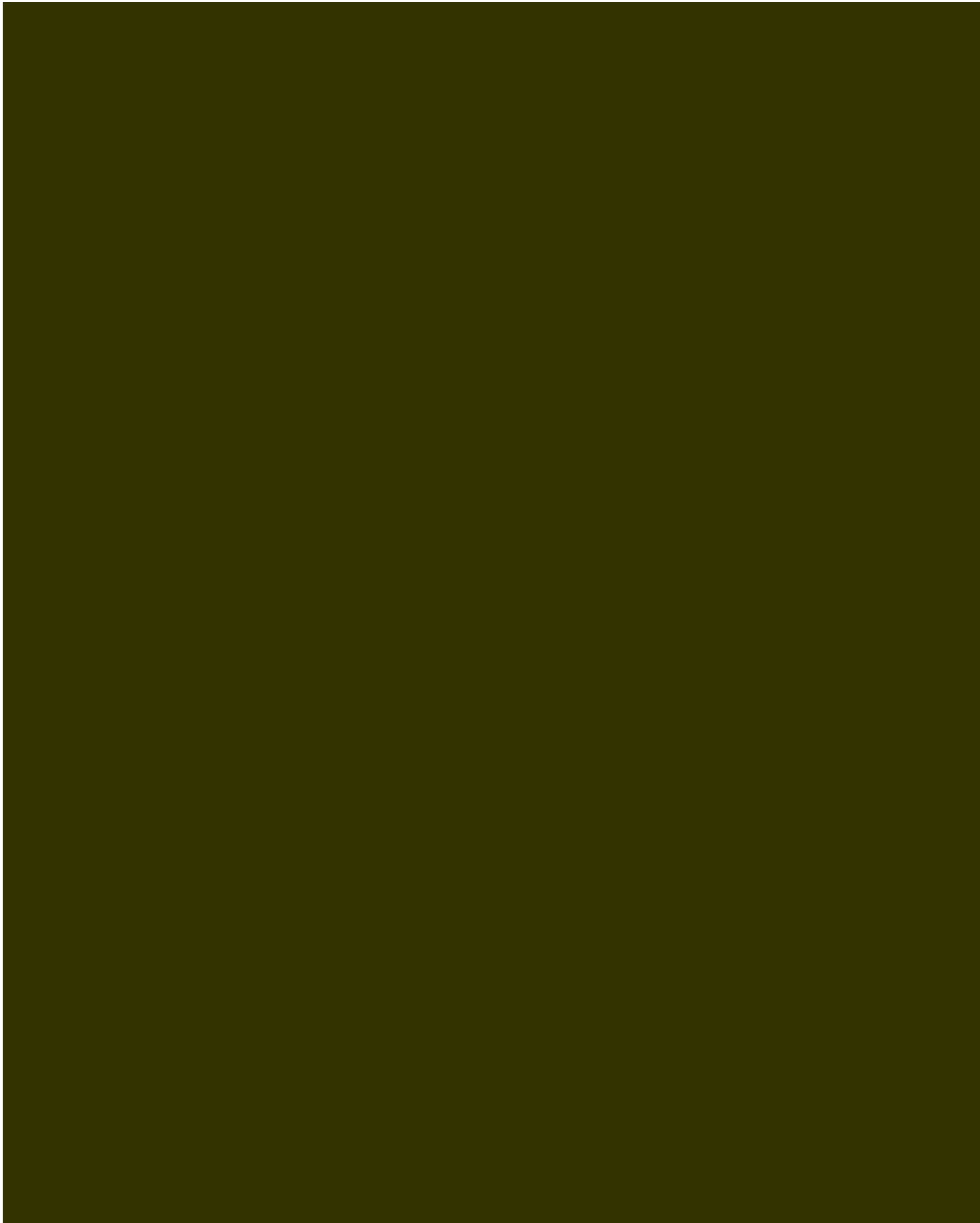
1070. This disclosure is consistent with the more general disclosure in Hashem '129 of the use of a processor in the base station containing multiple inputs and external logic:

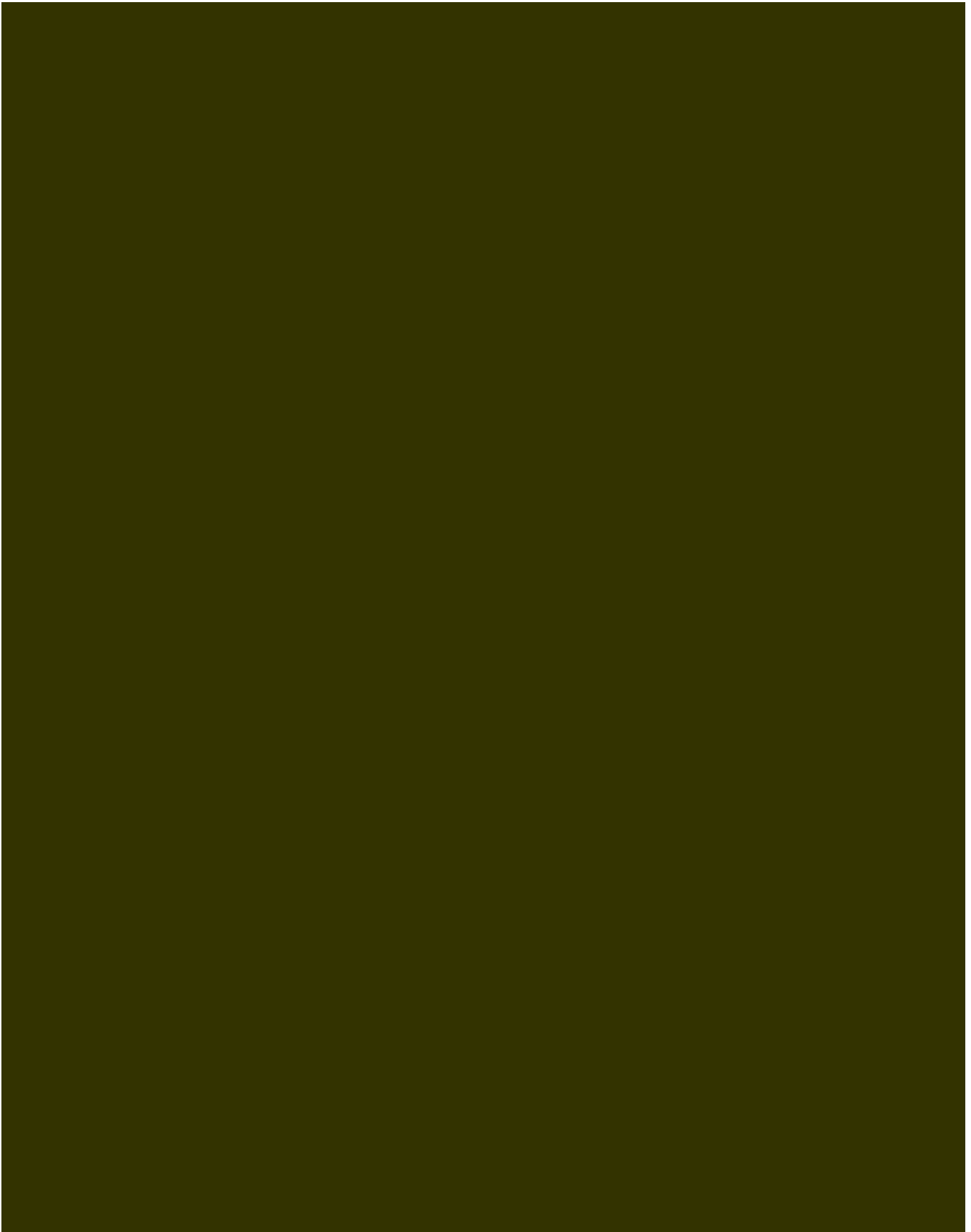
In addition, each processor described above may be any computing apparatus containing logic for executing the described functionality. For example, any of the processors may be a single processor, more than one processor, or a component of a larger processor. The logic may comprise external instructions or internal circuitry."

(Hashem '129 at 8:51-57.)

1071. Thus, Hashem '569 discloses "the base station selecting the subcarriers from the set of candidate subcarriers based on additional information available to the base station."







B. Claim 9 of the '212 Patent is Rendered Obvious by Ritter In Combination with Hashem '569 or Sollenberger Article and/or with the IS-95A Standard

1079. Claim 9 reads: “**The method defined in claim 8 wherein the additional information comprises traffic load information on each cluster of subcarriers.**”

1080. This element is disclosed by Ritter. As noted above, Ritter expressly discloses that the “base station BS evaluates all of the information received from the mobile stations MS” in conjunction with the allocation of segments.

1081. Specifically, Ritter discloses that the base station allocation of network “segments” is “*also depend[ent] on the transmission conditions and/or the load on the wireless cell served by the base station BS according to specifications of the operation* and maintenance center OMC or the base station control BSC for wireless resource management.” (Ritter at 4 col.1 ¶ 1.)

1082. Ritter further discloses that “[t]he *change in segments of the frequency spectrum also takes conditions into consideration the transmission conditions* (high levels of disturbances and interferences) as well as the load on the wireless resources (time slots, frequencies, spreading codes) in the wireless cell. These conditions are signaled to the control means BSE from the base station controller BSC or from the operation and maintenance center OMC. Then the control means BSE select the subcarriers for defining the segment according to quality features for each communication connection.” (Ritter at 6 col.1 ¶ 2.)

1083. Thus, Ritter discloses “the method defined in claim 8 wherein the additional information comprises traffic load information on each cluster of subcarriers.”

C. Claim 9 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1084. Claim 9 reads: “**The method defined in claim 8 wherein the additional information comprises traffic load information on each cluster of subcarriers.**”

1085. This element is rendered obvious by, at least, the Sollenberger Article. As discussed above, one of ordinary skill in the art would understand the Sollenberger Article to disclose a system employing OFDMA. the Sollenberger Article further discloses a process by which subscribers “are fairly allocated as many unused radio channels as possible provided the SIR exceeds 10 dB for resources.” (Sollenberger Article at 760 (emphasis added).)

1086. One of ordinary skill in the art would understand that in a system employing OFDMA, radio resources (*e.g.*, clusters of subcarriers) can only be assigned to one subscriber at a given time. Therefore, one of ordinary skill in the art would understand “traffic load information on each cluster of subcarriers” in a system employing OFDMA to refer to information indicating whether each cluster is currently being used or unused. Further, one of ordinary skill in the art would understand the process disclosed in the Sollenberger Article - for assigning unused radio channels - would require traffic load information be available to the base station when allocating channels.

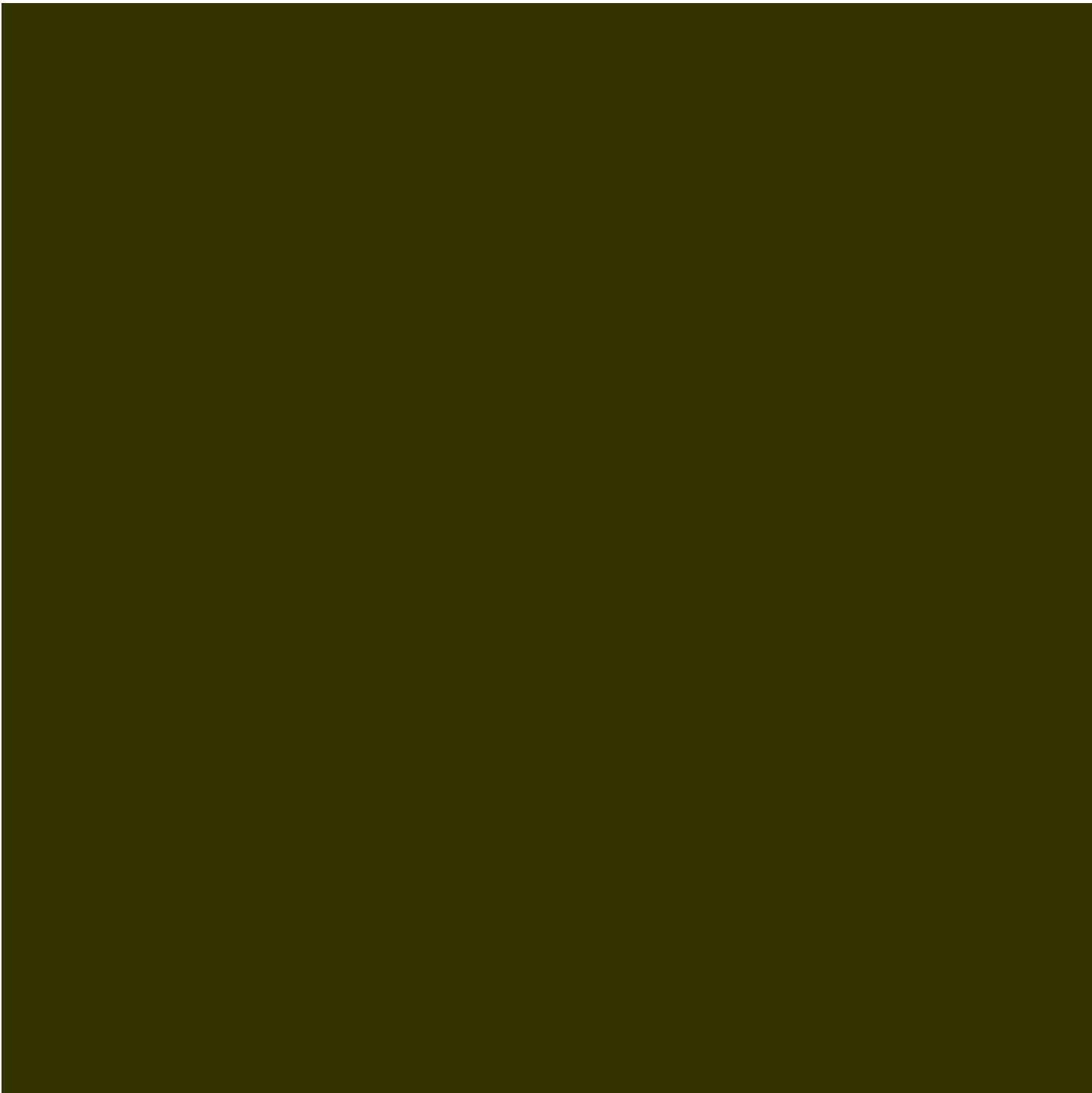
1087. Thus, the Sollenberger Article renders obvious “wherein the additional information comprises traffic load information on each cluster of subcarriers.”

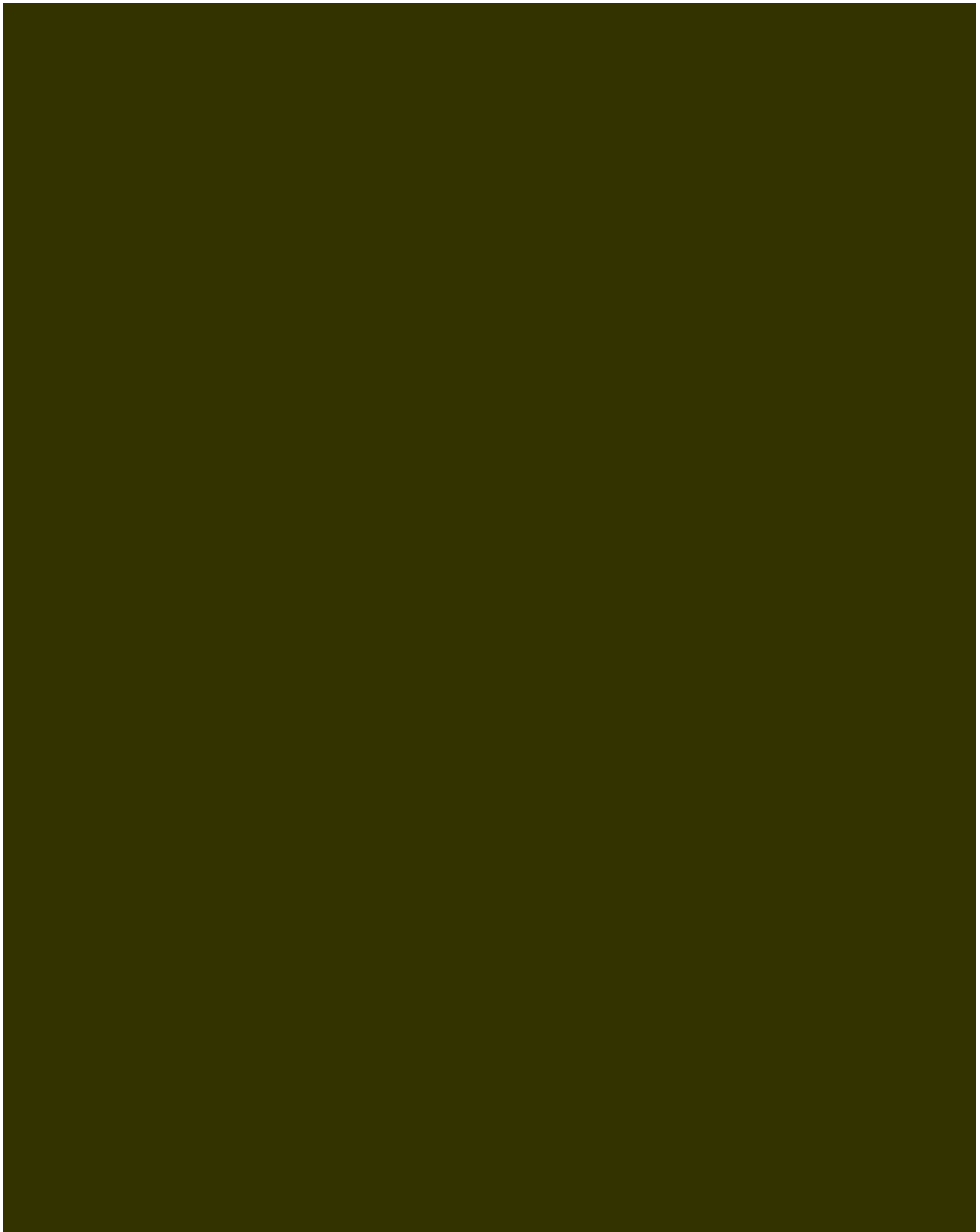
D. Claim 9 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1088. Claim 9 reads: “**The method defined in claim 8 wherein the additional information comprises traffic load information on each cluster of subcarriers.**”

1089. This element is disclosed by Hashem '569 in combination with Ritter. Hashem '569 does not expressly disclose “wherein additional information comprises traffic load information on each cluster of subcarriers.” However, as noted above, Ritter expressly discloses that the base station allocation of network “segments” (*i.e.*, clusters of subcarriers) is “***also depend[ent] on the transmission conditions and/or the load on the wireless cell served by the***







1097. Thus, the Project Angel System discloses the “method defined in claim 8 wherein the additional information comprises traffic load information on each cluster of subcarriers.”

XVIII. '212 PATENT, CLAIM 10

1098. Claim 10 of the '212 Patent reads: “The method defined in claim 9 wherein the traffic load information is provided by a data buffer in the base station.”

A. Claim 10 of the '212 Patent is Indefinite

1099. As set forth above, it is my opinion that claim 10 of the '212 Patent, which is dependent on claim 9 of the '212 Patent, is indefinite.

1100. Notwithstanding, I have adopted the Court’s narrowing construction and Adaptix’s apparent interpretation of this limitation for purposes of my analysis of '212 Patent claim 10. Based on that construction, it is my opinion that claim 10 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below.

B. Claim 10 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or Sollenberger Article and/or the IS-95A Standard

1101. Claim 10 of the '212 Patent reads: **“The method defined in claim 9 wherein the traffic load information is provided by a data buffer in the base station.”**

1102. This element is rendered obvious by Ritter. Any base station that transmits data to a mobile station, such as the base station disclosed in Ritter, contains a data buffer. A data buffer stores, for example, user data prior to such data being transmitted to a mobile station. *See* '748 Patent at 11:10-40; *see also* Sollenberger Patent at 13:20-46 (“The received packets [of data] are stored in a well-known manner in user-packet buffers 73 [after which] the received packets are sent from user-packet buffer 73 to transceiver 71 for downlink transmission to the wireless station.”). A person of ordinary skill in the art at the time of the invention would naturally have looked to a data buffer in the base station to provide traffic load information. This

is because the data buffer contains information about how much data is queued for transmission. For example, the data buffer may be empty in which case the base station may allocate any of the subcarriers selected by the mobile station. Or the data buffer may be near capacity for certain subcarriers in which case the base may allocate different subcarriers selected by the mobile station. *See, e.g.*, Ritter at 4 (“In the present example it is assumed that each mobile station MS can have the most suitable segment that it desires allocated to it. This also depends on the transmission conditions and/or the load on the wireless cell served by the base station BS according to specifications of the operation and maintenance center OMC or the base station control BSC for wireless resource management.”).

1103. Using a data buffer to provide traffic load information in a base station was well known to persons of ordinary skill in the art at the time of the invention as demonstrated by the prior art references below:

- FIG. 5A shows a set of service **flow buffers 510, 520, 530, 540** that contain sub-protocol data units for subscriber units. 20 The **scheduler uses the service flow buffers 510, 520, 530, 540 to generate the subprotocol data transmission schedule. The service flow buffers can contain different sizes of data. The scheduler addresses the service flow buffers, and forms the schedule.**” (U.S. Patent 6,400,699 (“Airy”) at 8:18-24 (filed on September 12, 2000).)
- The base-station then performs joint traffic channel assignment, based on subscribers' channel and noise plus-interference characteristics, ... Other factors, such as, for example, subscribers' data rates, time-off limitations, waiting time, **buffer status**, service type (voice, video, email, multi-media) and other QoS requirements, may be considered in conjunction with the channel and noise-plus-interference characteristics to perform joint traffic channel assignment.” (Liu ’315 at 8:44-53); (see also Liu ’315 at 6:33-47 and 6:48-57.)

1104. Ritter states that:

The change in segments of the frequency spectrum also takes conditions into consideration the transmission conditions (high levels of disturbances and interferences) **as well as the load on the wireless resources** (time slots, frequencies, spreading codes) in the wireless cell. **These conditions are signaled**

to the control means BSE from the base station controller BSC or from the operation and maintenance center OMC. Then the control means BSE select the subcarriers for defining the segment according to quality features for each communication connection.

(Ritter at 6.) Ritter expressly discloses accounting for “load on the wireless resources”—precisely the type of information a data buffer can provide—when a base station makes a segment allocation decision. Thus, it would have been obvious for a person of ordinary skill in the art to use the data buffer present in Ritter’s base station to provide information about the “load on the wireless resources.” Accordingly, Ritter alone renders obvious the limitation “wherein the traffic load information is provided by a data buffer in the base station.”

C. **Claim 10 of the ’212 Patent is Rendered Obvious by the Sollenberger Publications**

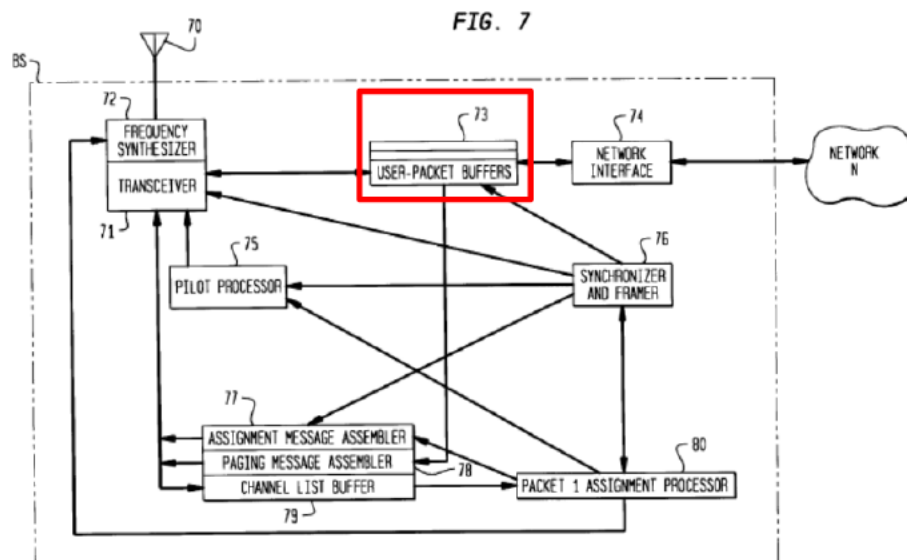
1105. Claim 10 of the ’212 Patent reads: **“The method defined in claim 9 wherein the traffic load information is provided by a data buffer in the base station.**

1106. This element is rendered obvious by the Sollenberger Publications. Any base station that transmits data to a mobile station, such as the base station disclosed in the Sollenberger Publications, contains a data buffer. A data buffer stores, for example, user data prior to such data being transmitted to a mobile station. (See ’748 Patent at 11:10-40.) Indeed, the Sollenberger Patent itself recognizes that “received packets are stored in a well-known manner in user-packet buffers 73.” (Sollenberger Patent at 13:20-21.) A person of ordinary skill in the art at the time of the invention would naturally have looked to a data buffer in the base station to provide traffic load information. This is because the data buffer contains information about how much data is queued for transmission. For example, the data buffer may be empty in which case the base station may allocate any of the subcarriers selected by the mobile station. Or the data buffer may be near capacity for certain subcarriers in which case the base may allocate different subcarriers selected by the mobile station.

1107. Using a data buffer to provide traffic load information in a base station was well known to persons of ordinary skill in the art at the time of the invention as demonstrated by the prior art references below:

- FIG. 5A shows a set of service *flow buffers* 510, 520, 530, 540 that contain sub-protocol data units for subscriber units. 20 The *scheduler uses the service flow buffers 510, 520, 530, 540 to generate the subprotocol data transmission schedule. The service flow buffers can contain different sizes of data. The scheduler addresses the service flow buffers, and forms the schedule.*” (U.S. Patent 6,400,699 (“Airy”) at 8:18-24 (filed on September 12, 2000).)
- The base-station then performs joint traffic channel assignment, based on subscribers' channel and noise plus-interference characteristics, ... Other factors, such as, for example, subscribers' data rates, time-off limitations, waiting time, *buffer status*, service type (voice, video, email, multi-media) and other QoS requirements, may be considered in conjunction with the channel and noise-plus-interference characteristics to perform joint traffic channel assignment.” (Liu ’315 at 8:44-53); (see also Liu ’315 at 6:33-47 and 6:48-57.)

1108. The Sollenberger Patent discloses a base station containing “user-packet buffers” (numeral 73) as shown in Figure 7 from the Sollenberger Patent, reproduced below:



1109. The Sollenberger Patent further discloses that the “user-packet buffers” store “received packets...for downlink transmission to wireless stations” (*i.e.*, data to be sent to a

subscriber). (Sollenberger Patent at 13:9-46. Thus, it would have been obvious for a person of ordinary skill in the art to use the data buffer present in the base station of the Sollenberger Patent to provide traffic load information that can be used by the base station when making channel allocation decisions. Accordingly, the Sollenberger Patent renders obvious the limitation “wherein the traffic load information is provided by a data buffer in the base station.”

D. Claim 10 of the '212 Patent is Rendered Obvious by Hashem '569 in Combination with Ritter

1110. Claim 10 of the '212 Patent reads: **“The method defined in claim 9 wherein the traffic load information is provided by a data buffer in the base station.”**

1111. This element is rendered obvious by Hashem '569 in combination with Ritter. Any base station that transmits data to a mobile station, such as the base station disclosed in Hashem '569, contains a data buffer. A data buffer stores, for example, user data prior to such data being transmitted to a mobile station. (See '748 Patent at 11:10-40; *see also* Sollenberger Patent at 13:20-46 (“The received packets [of data] are stored in a well-known manner in user-packet buffers 73 [after which] the received packets are sent from user-packet buffer 73 to transceiver 71 for downlink transmission to the wireless station.”).) A person of ordinary skill in the art at the time of the invention would naturally have looked to a data buffer in the base station to provide traffic load information. This is because the data buffer contains information about how much data is queued for transmission. For example, the data buffer may be empty in which case the base station may allocate any of the subcarriers selected by the mobile station. Or the data buffer may be near capacity for certain subcarriers in which case the base may allocate different subcarriers selected by the mobile station. (See, *e.g.*, Ritter at 4 (“In the present example it is assumed that each mobile station MS can have the most suitable segment that it desires allocated to it. This also depends on the transmission conditions and/or the load on the

wireless cell served by the base station BS according to specifications of the operation and maintenance center OMC or the base station control BSC for wireless resource management.”.)

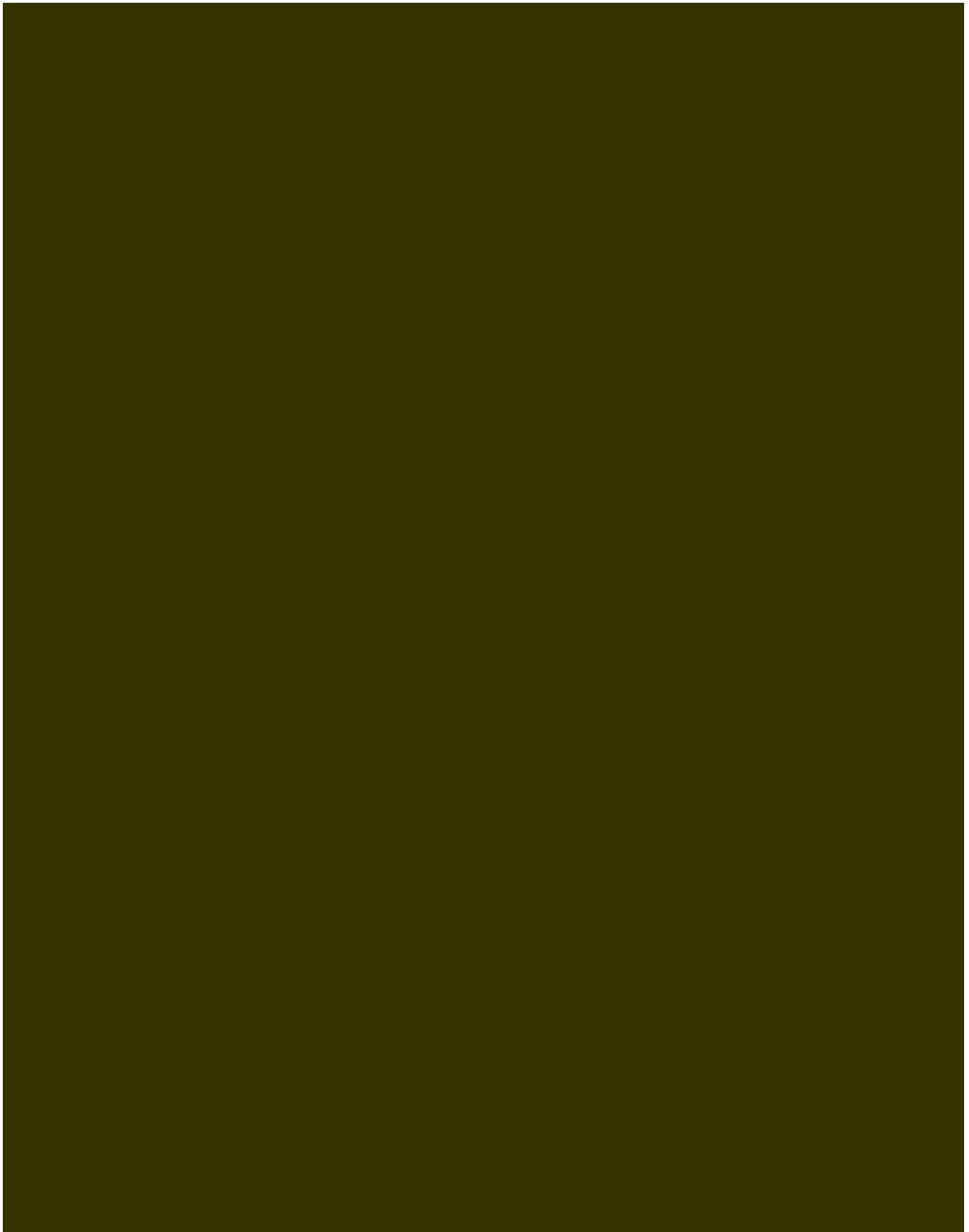
1112. Using a data buffer to provide traffic load information in a base station was well known to persons of ordinary skill in the art at the time of the invention as demonstrated by the prior art references below:

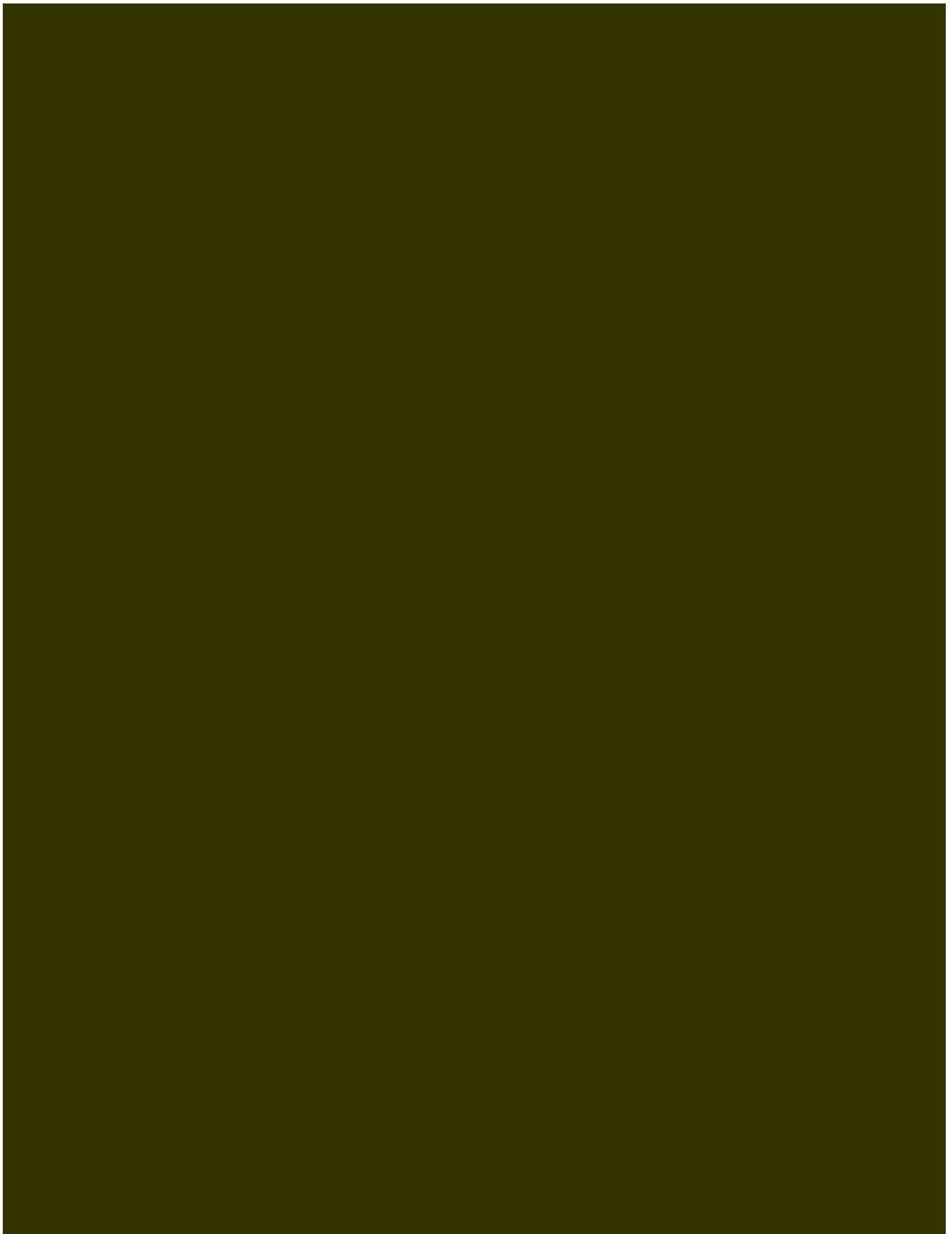
- FIG. 5A shows a set of service **flow buffers 510, 520, 530, 540** that contain sub-protocol data units for subscriber units. 20 **The scheduler uses the service flow buffers 510, 520, 530, 540 to generate the subprotocol data transmission schedule. The service flow buffers can contain different sizes of data. The scheduler addresses the service flow buffers, and forms the schedule.**” U.S. Patent 6,400,699 (“Airy”) at 8:18-24 (filed on September 12, 2000).
- The base-station then performs joint traffic channel assignment, based on subscribers' channel and noise plus-interference characteristics, ... Other factors, such as, for example, subscribers' data rates, time-off limitations, waiting time, **buffer status**, service type (voice, video, email, multi-media) and other QoS requirements, may be considered in conjunction with the channel and noise-plus-interference characteristics to perform joint traffic channel assignment.” (Liu ’315 at 8:44-53); (see also Liu ’315 at 6:33-47 and 6:48-57.)

1113. Ritter states that:

The change in segments of the frequency spectrum also takes conditions into consideration the transmission conditions (high levels of disturbances and interferences) **as well as the load on the wireless resources** (time slots, frequencies, spreading codes) in the wireless cell. **These conditions are signaled to the control means BSE from the base station controller BSC or from the operation and maintenance center OMC.** Then the control means BSE select the subcarriers for defining the segment according to quality features for each communication connection.

(Ritter at 6.) Ritter expressly discloses accounting for “load on the wireless resources”—precisely the type of information a data buffer can provide—when a base station makes a segment allocation decision. Thus, it would have been obvious for a person of ordinary skill in the art to use the data buffer present in Ritter’s base station (or Hashem ’569’s base station) to provide information about the “load on the wireless resources.” As previously discussed, a





1121. I understand this Court has invalidated claims 2-4 of the '212 Patent because the phrase "the indication" in Claim 2 lacked antecedent basis and was insolubly ambiguous. (See, e.g., Report and Recommendation at 19, Case No. 6:12-cv-00017 (E.D. Tex.), Mar. 24, 2014 (Dkt. 201).) Thus, the Court found claim 2 and its dependent claims 3-4 indefinite. The Court specifically found that independent claim 1 has two separate "indications." Therefore, since claim 2 only states "the indication," there is ambiguity as to which of the two "indications" in claim 1 are being referenced.

1122. I understand that Claims 11 and 26 were not considered by the Court, but similar to Claim 2, require the subscriber to receive "the indication" from "a downlink control channel." Therefore, I have reviewed the specification of the '212 Patent to determine how the phrase is used by the inventors. In my opinion, and as the Court noted in its Order relating to Claim 2, the specification contains no basis upon which to resolve the ambiguity in the claims. Therefore, Claims 11 and 26 do not disclose with reasonable certainty which of the two "indications" of subcarriers in claim 1 (the independent claim basis for claim 11) and claim 18 (the independent claim basis for claim 26) must be received via a downlink control channel.

1123. I have been informed and understand that the Supreme Court recently ruled that a claim is not definite merely because it may be amenable to construction and not insolubly ambiguous, and emphasized that the definiteness requirement mandates clarity.

1124. It is my opinion that the disclosure in the '212 Patent does not provide reasonable certainty for what is required to meet this claimed limitations (*i.e.*, which indication of subcarriers must be received via a downlink control channel). Therefore, Dependent Claims 11 and 26 of the '212 Patent are indefinite.

1125. Notwithstanding, I have evaluated Claim 11 of the '212 Patent under Adaptix's apparent interpretation of the claim. Based on that interpretation, claim 11 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below.

B. Claim 11 of the '212 Patent is Rendered Obvious by Ritter In Combination With the Sollenberger Article and Ritter in Combination with IS-95A

1126. Claim 11 reads: **“The method defined in claim 1 wherein the indication of subcarriers is received via a downlink control channel.”**

1127. Ritter discloses this element. Ritter expressly discloses a control means in order to establish a link between the base station and the mobile station:

[A] base station BS or a base station control BSC – ***has control means BSE with a memory device BSP*** The change in segments of the frequency spectrum also takes conditions into consideration the transmission conditions (high levels of disturbances and interferences) as well as the load on the wireless resources (time slots, frequencies, spreading codes) in the wireless cell. ***These conditions are signaled to the control means BSE from the base station controller BSC or from the operation and maintenance center OMC. Then the control means BSE select the subcarriers for defining the segment according to quality features for each communication connection.***

(Ritter at 6 col. 1 ¶ 2.)

1128. Ritter explicitly discloses that one aspect of the base station control means is to transmit allocation messages from the base station BS to the mobile stations MS:

Finally in step (6) the messages about the assigned segments S_x , S_a and S_m are transmitted to the mobile stations MS over the wireless interfaces that use the new frequency resources received in the frequency spectrum for their individual communication connections.

1129. Thus, Ritter discloses “wherein the indication of subcarriers is received via a downlink control channel.”

C. Claim 11 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1130. Claim 11 reads: “**The method defined in claim 1 wherein the indication of subcarriers is received via a downlink control channel.**”

1131. This element is disclosed by, at least, Sollenberger Article. As noted above, Sollenberger Article describes a protocol with four basic steps:

The basic protocol for a downlink comprises four basic steps: (1) a packet page from a base station to a terminal; (2) rapid measurements of resource usage by a terminal using the parallelism of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with each radio resource; and (4) selection of resources by the base and transmission of the data.

(Sollenberger Article at 758-759 (emphasis added).)

1132. The last of the four steps indicates that the resources (or subcarriers) are selected by the base for use by the subscriber. Moreover, Figure 3.2 from Sollenberger Article, reproduced below, indicates that the “list of assigned channels” is transmitted from the base station to the mobile stations in the coverage area of the base station via “control slots”.

3.2 Frame Structure for Dynamic Packet Assignment

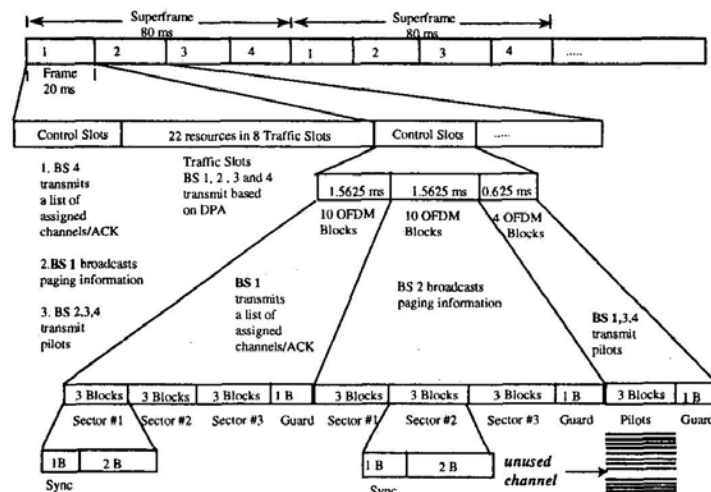


Figure 3. Staggered frame structure for downlink DPA

1133. One of ordinary skill in the art would understand the use of “control slots”, as depicted in Figure 3.2, to indicate transmission “via a downlink control channel.” Furthermore, Sollenberger Article discloses that “control channels for both the uplink and downlink jointly perform the four DPA procedures described....” (Sollenberger Article at 760.)

1134. Thus, Sollenberger Article discloses “wherein the indication of subcarriers is received via a downlink control channel.”

D. Claim 11 of the '212 Patent is Rendered Obvious by Hashem '569 in Combination with Ritter

1135. Claim 11 reads: “**The method defined in claim 1 wherein the indication of subcarriers is received via a downlink control channel.**”

1136. As a preliminary matter, claim 11 is indefinite because it is not reasonably certain to a person of ordinary skill in the art which “indication” is being referred to in claim 11. In particular, it is ambiguous whether “the indication” in claim 11 refers to “an indication” in '212 Patent claim element 1[d] or “another indication” in claim element 1[e][2]. Regardless, it would have been obvious to a person of ordinary skill in the art at the time of the invention for the base station in the Hashem '569 reference to use a downlink control channel to send a channel allocation assignment (or an updated channel allocation assignment) to the remote unit.

1137. Downlink control channels for sending control and overhead inform were well-known to persons of ordinary skill in the art at the time of the invention and before. [REDACTED]

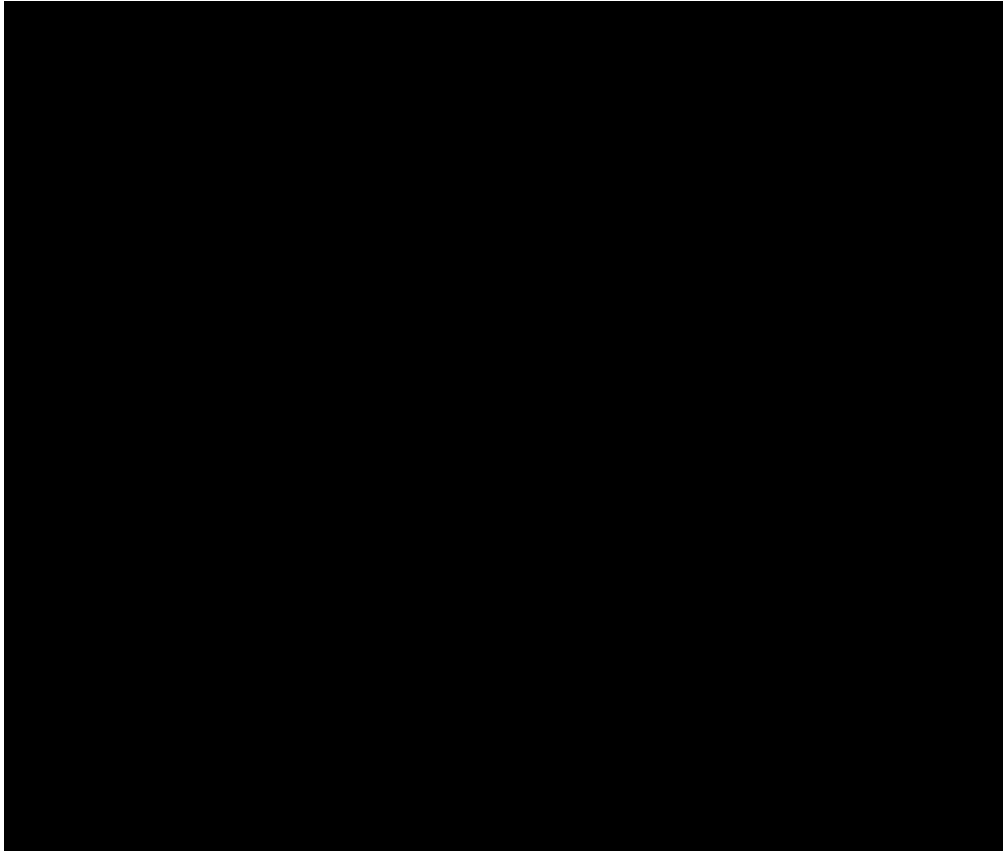
[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

below.



[REDACTED]

[REDACTED]

3.2 Frame Structure for Dynamic Packet Assignment

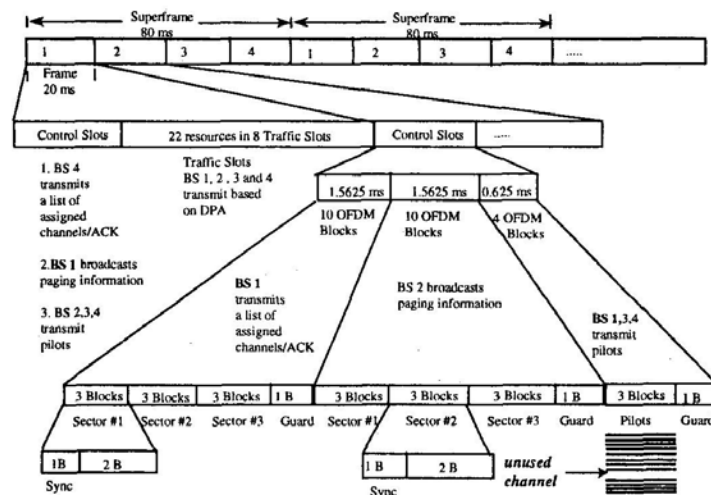


Figure 3. Staggered frame structure for downlink DPA

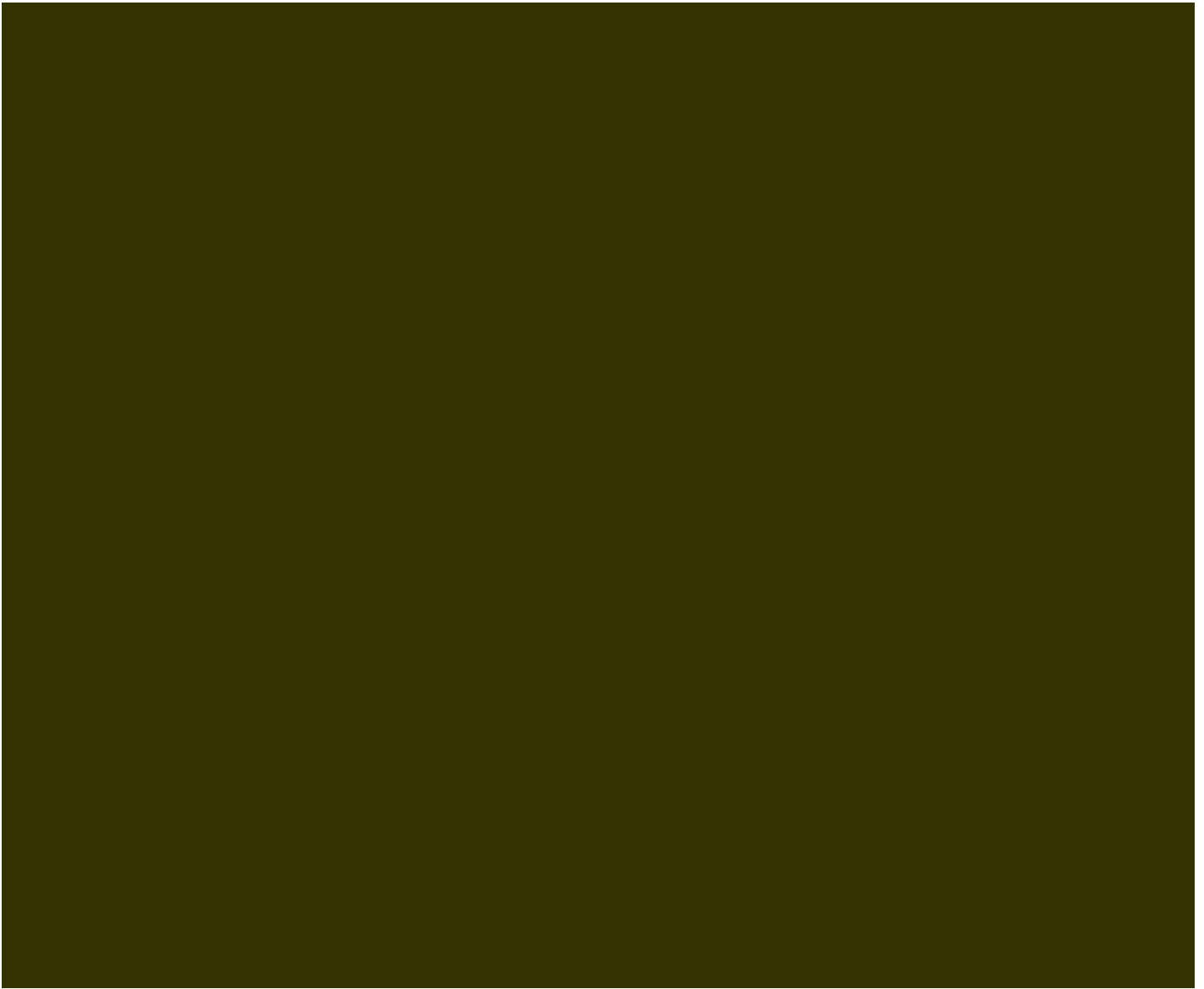
1140. The “control slots” depicted in Figure 3.2 are part of “a downlink control channel.” Furthermore, the Sollenberger Article discloses that “control channels for both the uplink and downlink jointly perform the four DPA procedures described....” (Sollenberger Article at 760.)

1141. Moreover, as explained above, a person of ordinary skill in the art would have been motivated to combine Hashem ’569 with either Project Angel or WCN99. Because both the Project Angel system and WCN99 both disclose the “downlink control channel” limitation of ’212 Patent claim 11, combining Hashem ’569 with either of these references renders claim 11 obvious.

E. Claim 11 of the ’212 Patent is Anticipated and/or Rendered Obvious by the Project Angel System.

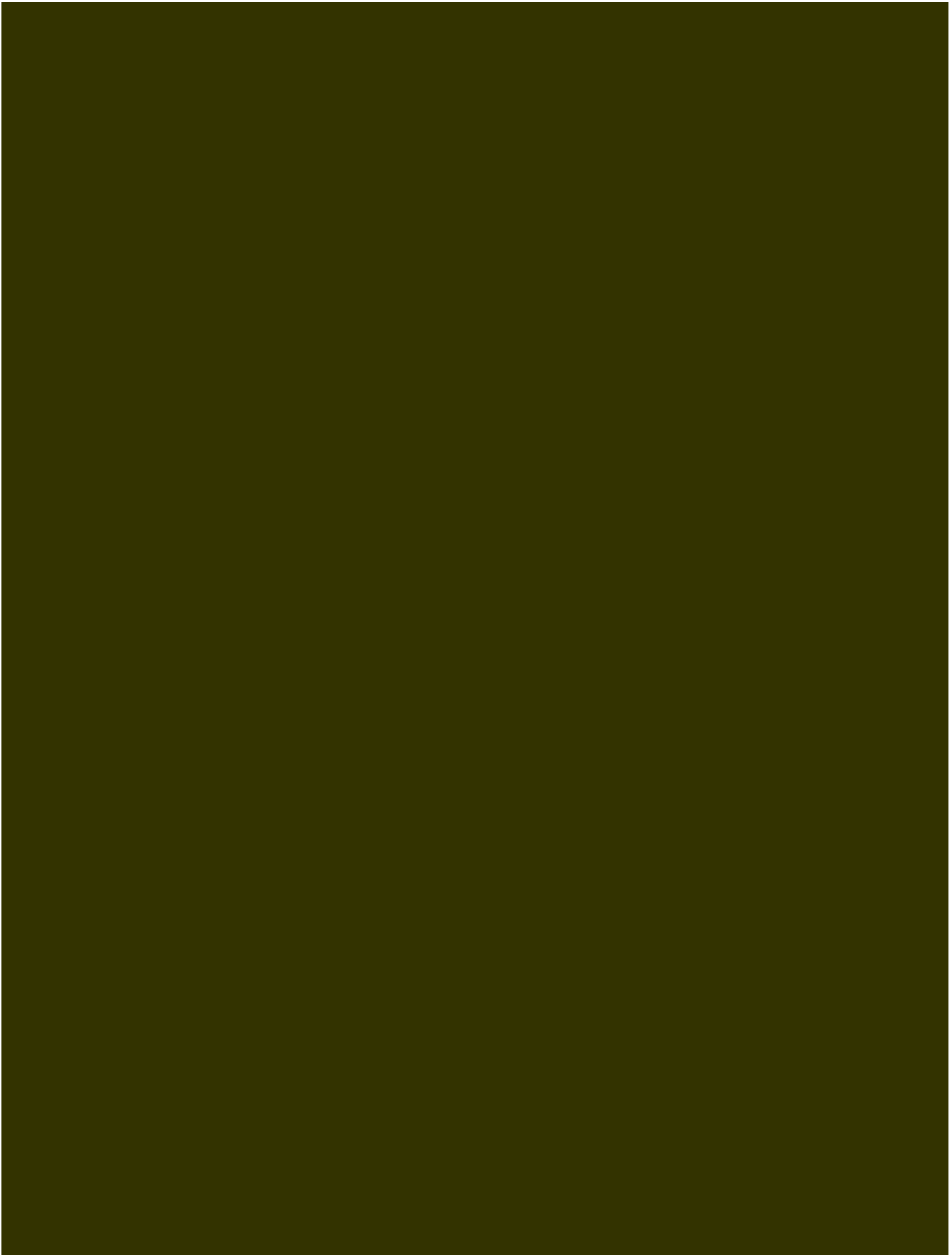
1142. Claim 11 reads: “**The method defined in claim 1 wherein the indication of subcarriers is received via a downlink control channel.**”

1143. As a preliminary matter, claim 11 is indefinite because it is not reasonably certain to a person of ordinary skill in the art which “indication” is being referred to in claim 11. In particular, it is ambiguous whether “the indication” in claim 11 refers to “an indication” in ’212









1149. Thus, the Project Angel System discloses the “method defined in claim 1 wherein the indication of subcarriers is received via a downlink control channel.”

XX. '212 PATENT, CLAIM 12

1150. Claim 12 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 12 of the '212 Patent reads: “The method defined in claim 1 wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.”

A. Claim 12 of the '212 Patent is Rendered Obvious by Ritter In Combination With the Sollenberger Article and Ritter in Combination with IS-95A

1151. Claim 12 reads: “**The method defined in claim 1 wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.**”

1152. Ritter discloses this element.

1153. Ritter discloses a system of “measurement of the quality of different segments of the frequency spectrum by each mobile station.” (Ritter at 1 col. 1.)

1154. As the first step of the system, Ritter discloses, “(1) the mobile stations MS receive in parallel all subcarriers oc in the time slot ts allocated respectively to them. For each subcarrier oc , the mobile station MS tests in an additional step (2) whether an amplitude modulation of the data symbols transmitted in the time slot is present, and thus has a measurement result regarding the quality of the respective subcarrier oc .” (Ritter at 4-5 col. 2 ¶ 4.)

1155. Thus, Ritter discloses “wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.”

B. Claim 12 of the '212 Patent is Rendered Obvious the Sollenberger Publications

1156. Claim 12 reads: “**The method defined in claim 1 wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.**”

1157. This element is disclosed by, at least, the Sollenberger Article. As noted in the Sollenberger Publications Overview section, the Sollenberger Article describes a protocol with “four basic steps”:

The basic protocol for a downlink comprises four basic steps: (1) a packet page from a base station to a terminal; (2) rapid measurements of resource usage by a terminal using the parallelism of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with each radio resource; and (4) selection of resources by the base and transmission of the data.

(Sollenberger Article at 758-759 (emphasis added).)

1158. As indicated above, in the Sollenberger Article the proposed protocol is for the subscriber terminal to conduct “rapid measurements” of “each radio resource.”

1159. Thus, the Sollenberger Article discloses “wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.”

C. Claim 12 of the ’212 Patent is Rendered Obvious by Hashem ’569 in Combination with Ritter

1160. Claim 12 reads: “**The method defined in claim 1 wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.**”

1161. Hashem ’569 discloses this limitation. Specifically, Hashem ’569 discloses that the channel and interference measurements performed by the remote unit are performed on “each sub-carrier.” Hashem ’569 at 5:65. Figure 3 from Hashem ’569, reproduced below, illustrates the S/I measurement of each cluster of subcarriers.

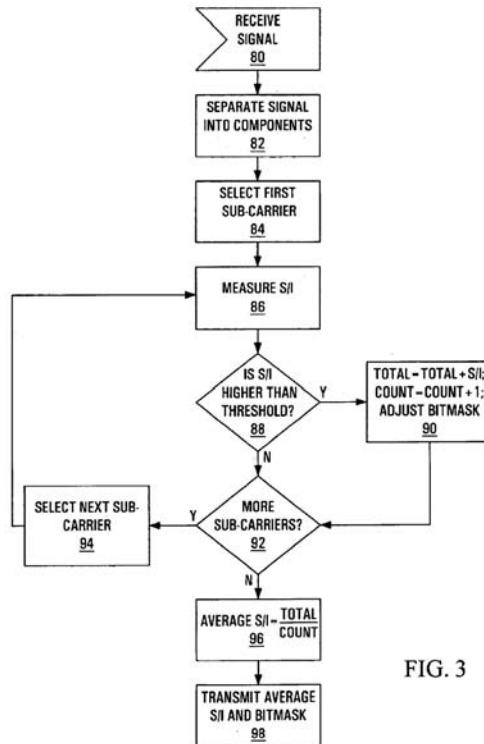


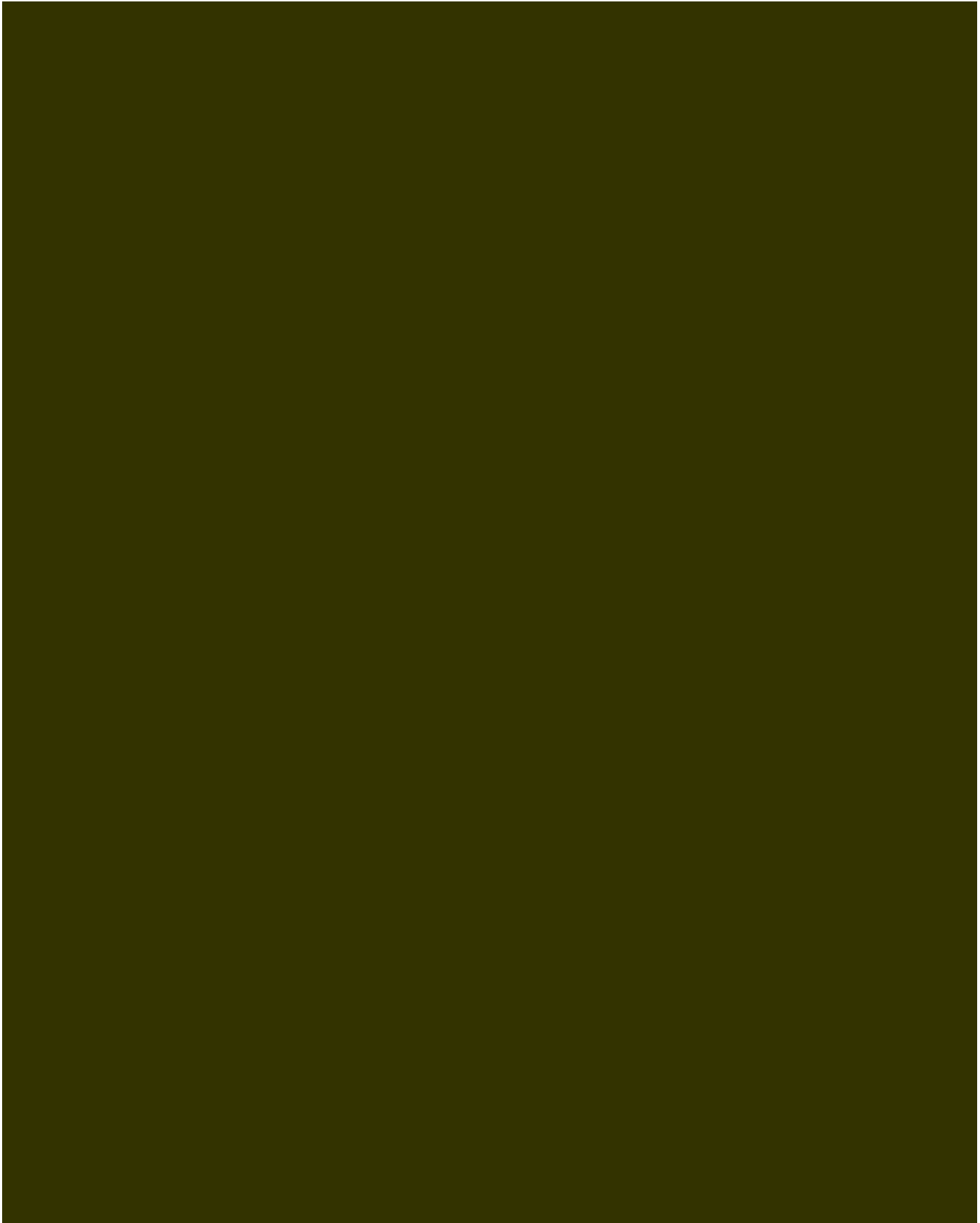
FIG. 3

1162. The iterative loop beginning at the “Measure S/I” block 86 through the “select next sub-carrier” block 94 shows that the remote unit takes S/I measurements for each subcarrier until there are no more subcarriers as indicated by block 92 (“more sub-subcarriers?”). This is explained in Hashem ’569 as follows:

The first sub-carrier is selected at step 84. At step 86 the S/I of the sub-carrier signal of the selected sub-carrier is measured. If at step 88 the measured S/I is higher than a threshold, then the selected sub-carrier is an acceptable sub-carrier. ... If at step 92 there are further subcarriers, then at step 94 the next sub-carrier is selected and the algorithm returns to step 86 to measure the S/I of sub-carrier signal of the next sub-carrier. If at step 92 there are no further sub-carriers, then at step 96 the average S/I of acceptable sub-carriers is calculated as the running total divided by the count of acceptable sub-carriers. ... **Steps 84, 92, and 94 form a loop that cycles through each sub-carrier**, although any method of measuring the S/I of each sub-carrier signal could be used.

(Hashem ’569 at 5:46-66.)

1163. Thus, Hashem ’569 discloses the “method defined in claim 1 wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.”



A. Claim 13 of the '212 Patent is Rendered Obvious by Ritter In Combination With Hashem '569 or the Sollenberger Article and/or IS-95A

1168. Claim 13 reads: “**The method defined in claim 1 wherein providing feedback information comprises arbitrarily ordering the set of candidate subcarriers as clusters of subcarriers.**”

1169. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][2].

B. Claim 13 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1170. Claim 13 reads: “**The method defined in claim 1 wherein providing feedback information comprises arbitrarily ordering the set of candidate subcarriers as clusters of subcarriers.**”

1171. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][2].

C. Claim 13 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1172. Claim 13 reads: “**The method defined in claim 1 wherein providing feedback information comprises arbitrarily ordering the set of candidate subcarriers as clusters of subcarriers.**”

1173. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][2].

D. Claim 13 of the '212 Patent is Anticipated and/or Rendered Obvious by the Project Angel System.

1174. Claim 13 reads: “**The method defined in claim 1 wherein providing feedback information comprises arbitrarily ordering the set of candidate subcarriers as clusters of subcarriers.**”

1175. This element is satisfied by the disclosure set forth at '748 Patent claim element 6[c][2].

XXII. '212 PATENT, CLAIM 15

1176. Claim 15 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 15 of the '212 Patent reads: "The method defined in claim 1 wherein providing feedback information comprises sequentially ordering candidate clusters."

A. Claim 15 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569

1177. Claim 15 reads: "**The method defined in claim 1 wherein providing feedback information comprises sequentially ordering candidate clusters.**"

1178. Ritter does not disclose this limitation. However, Hashem '569 discloses "providing feedback information comprises sequentially ordering candidate clusters." For example, Hashem '569 discloses an OFDMA system in which feedback for groups of subcarriers are reported back to the base station in sequential order (*e.g.*, by ascending frequency):

The present invention provides a method of selecting and signaling the identity of acceptable groups of sub-carriers in a radio communication system. A remote unit receives a signal as more than one sub-carrier signal from a base station. The remote unit determines a channel quality (such as a signal to interference ratio or a reciprocal of an error rate) of each group of sub-carrier signals, and compares the channel quality of each group of sub-carrier signals with a threshold. ***A sequence of numbers is generated, there being one number for each group of sub-carrier signals. Each number has a value belonging to a first set of values if the channel quality of the corresponding group of sub-carriers is above the threshold, and has a value belonging to a second set of values if the channel quality of the corresponding group of sub-carriers is not above the threshold, the two sets of values having no values in common. The first set of values may consist of the value one and the second set of values may consist of the value zero, in which case each number in the sequence has a length of one bit.*** The remote unit generates at least one value by which the base station can determine one or more Link Modes, a Link Mode being a set of transmission parameters. ***The remote unit transmits the sequence of numbers and the values by which the base station can determine the Link Mode or Link Modes.***"

(Hashem at 2:24-38.)

1179. As stated above, one skilled in the art would have been motivated to combine Ritter with Hashem '569.

1180. Thus, Ritter in combination with Hashem '569 discloses “[t]he method defined in claim 1 wherein providing feedback information comprises sequentially ordering candidate clusters.”

B. Claim 15 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1181. Claim 15 reads: **“The method defined in claim 1 wherein providing feedback information comprises sequentially ordering candidate clusters.”**

1182. This element is rendered obvious by, at least, the Sollenberger Article. As noted above, when “the set of candidate subcarriers” includes all of the subcarriers, the selection of that set and the providing of feedback information on that set is included in the Sollenberger Article description. Moreover, the Sollenberger Article provides no restriction on how the “short report from the terminal to the base station of the potential transmission quality associated with each radio resource” (Sollenberger Article at 759) is to be ordered. One of ordinary skill in the art would understand that one well-known way of ordering the resources is sequentially (*e.g.*, by ascending frequency) is the teachings of Hashem '569, as previously discussed in detail with respect to '212 Patent claim 15 for Hashem '569.

1183. Thus, the Sollenberger Article renders obvious “wherein providing feedback information comprises sequentially ordering candidate clusters.”

C. Claim 15 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1184. Claim 15 reads: **“The method defined in claim 1 wherein providing feedback information comprises sequentially ordering candidate clusters.”**

1185. Hashem '569 discloses this limitation. For example, Hashem '569 discloses an OFDMA system in which feedback for groups of subcarriers is reported by remote units to the base station in sequential order (*e.g.*, by ascending frequency):

The remote unit determines a channel quality (such as a signal to interference ratio or a reciprocal of an error rate) of each group of sub-carrier signals, and compares the channel quality of each group of sub-carrier signals with a threshold. A sequence of numbers is generated, there being one number for each group of sub-carrier signals. Each number has a value belonging to a first set of values if the channel quality of the corresponding group of sub-carriers is above the threshold, and has a value belonging to a second set of values if the channel quality of the corresponding group of sub-carriers is not above the threshold, the two sets of values having no values in common. The first set of values may consist of the value one and the second set of values may consist of the value zero, in which case each number in the sequence has a length of one bit. The remote unit generates at least one value by which the base station can determine one or more Link Modes, a Link Mode being a set of transmission parameters. The remote unit transmits the sequence of numbers and the values by which the base station can determine the Link Mode or Link Modes.

(Hashem '569 at 2:29-48 (emphasis added).)

1186. More specifically, Figure 2 of Hashem discloses the dB measurements for 12 subbands within a bandwidth. In the example given in Figure 2, a threshold of 4 dBs is used.

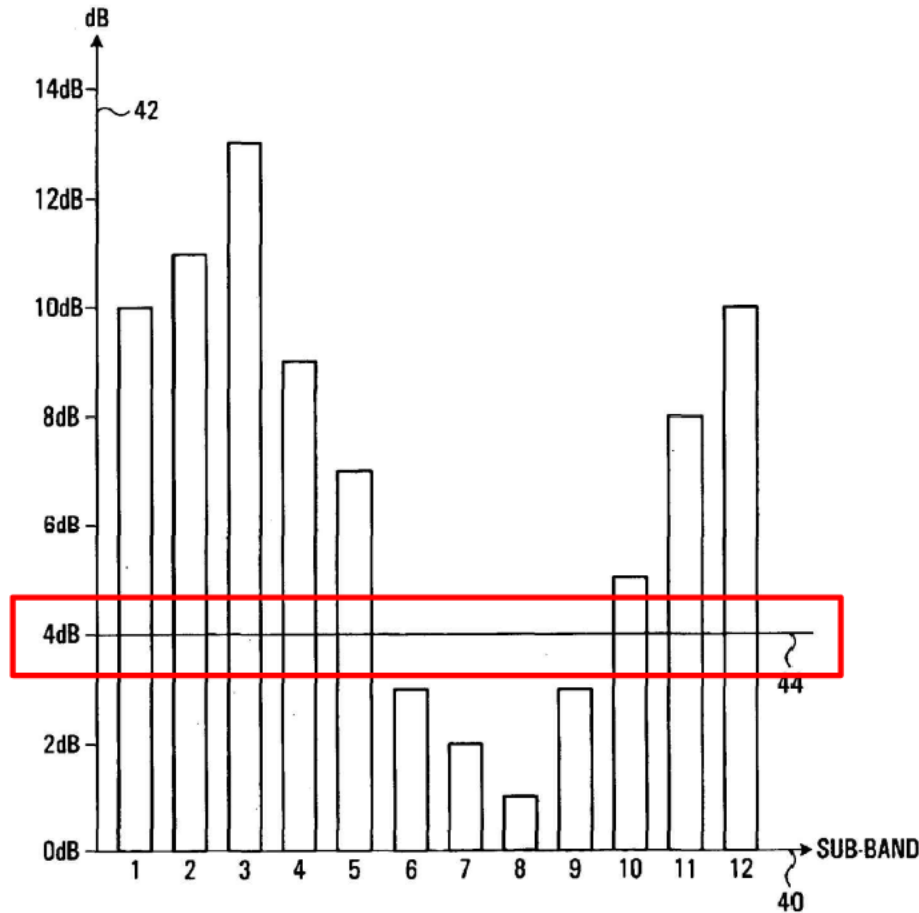


FIG. 2

1187. Using measurements like those disclosed in Figure 2, the remote unit transmits a “return signal”—*i.e.*, a feedback message—that includes a bitmask corresponding to the measured values of the various subbands within the bandwidth:

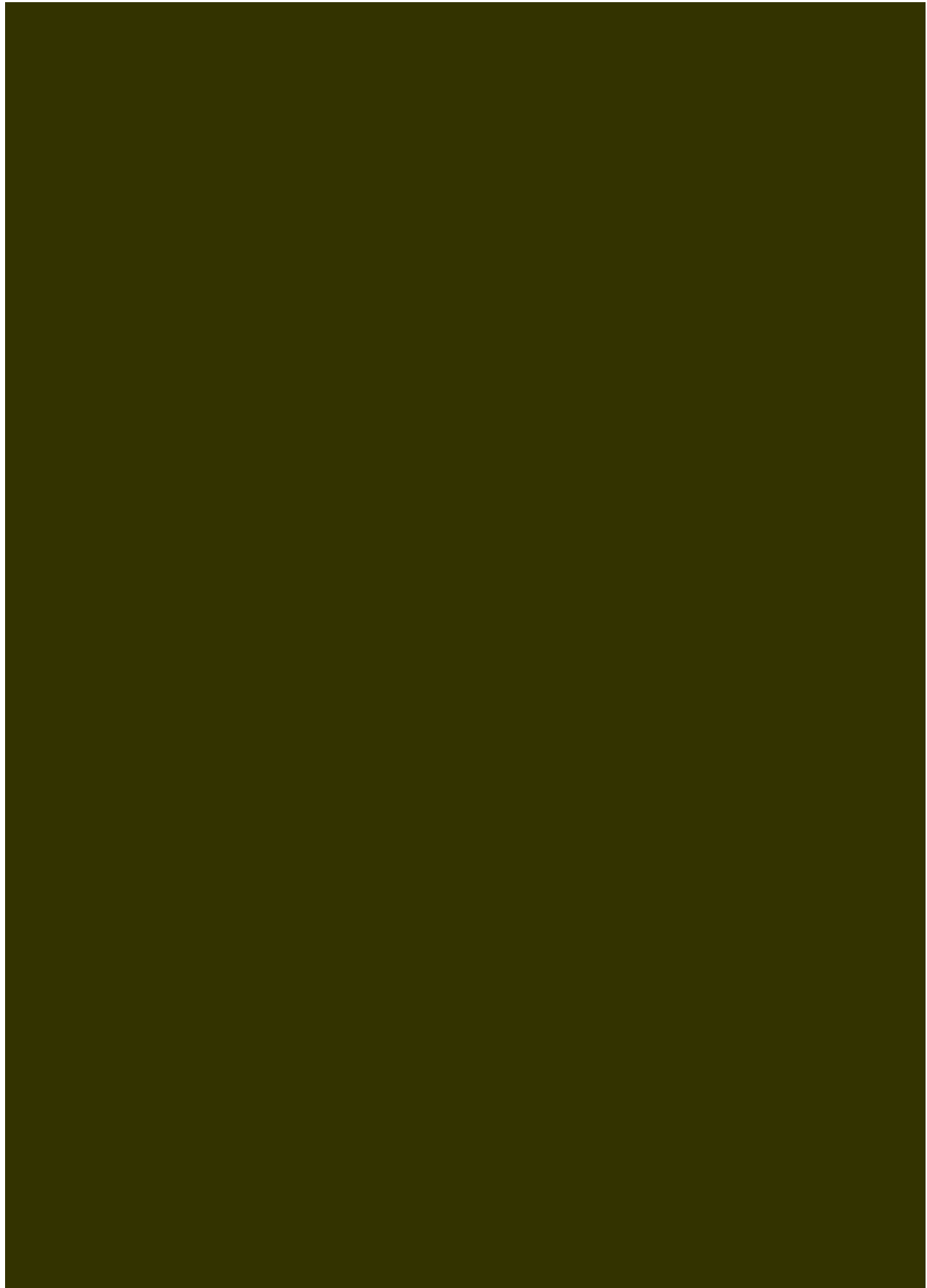
If a value of “1” is used to identify acceptable sub-carriers and a value of “0” is used to identify unacceptable sub-carriers, or the reverse, then the sequence of numbers can be a bitmask, using one bit to indicate the acceptability of each sub-carrier.

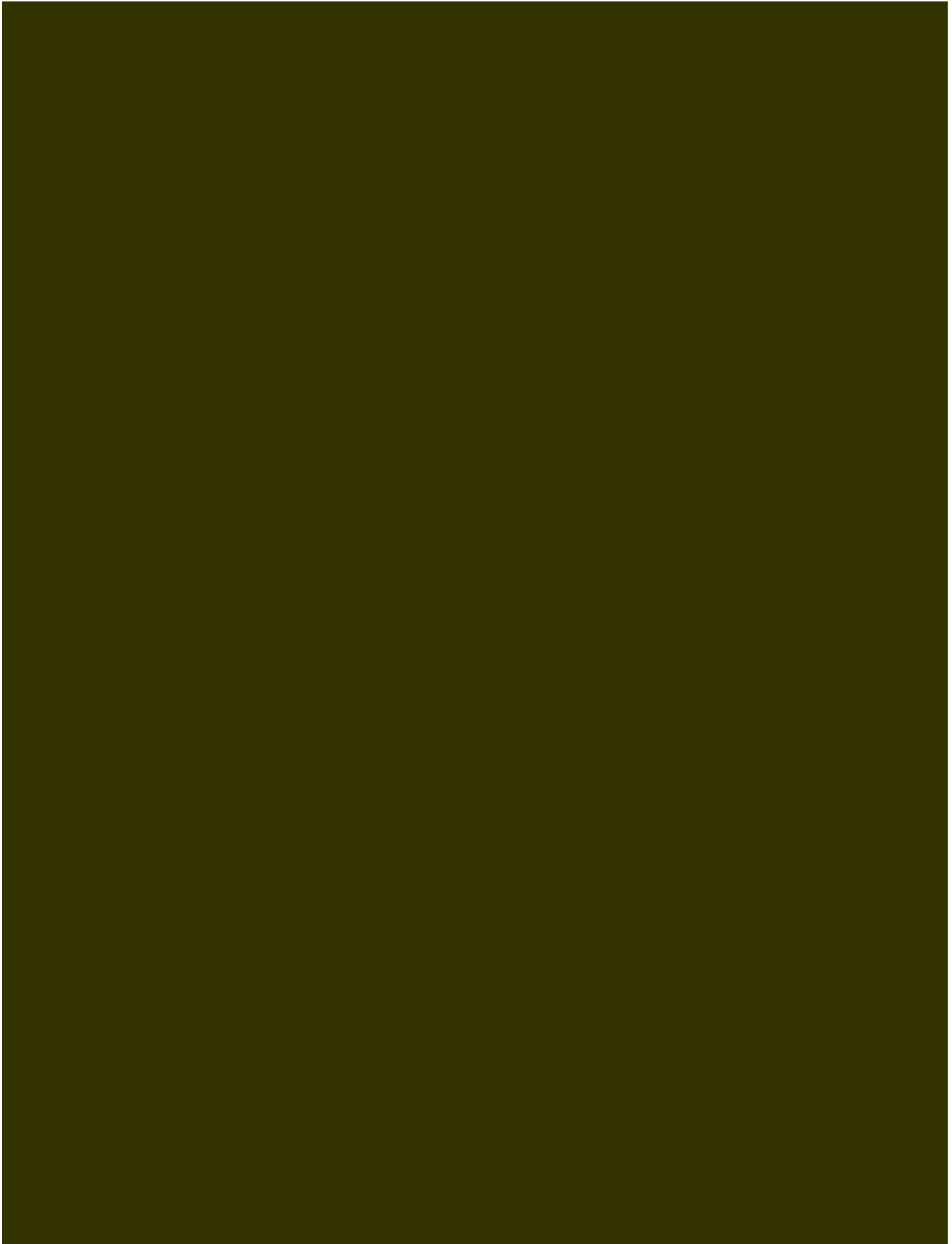
Id. at 4:55-59. “In the example of FIG. 2, the remote unit 16 would transmit an average S/I having a value of 9.1 dB and a bitmask having a value of “111110001111.” *Id.* at 4:62-65.

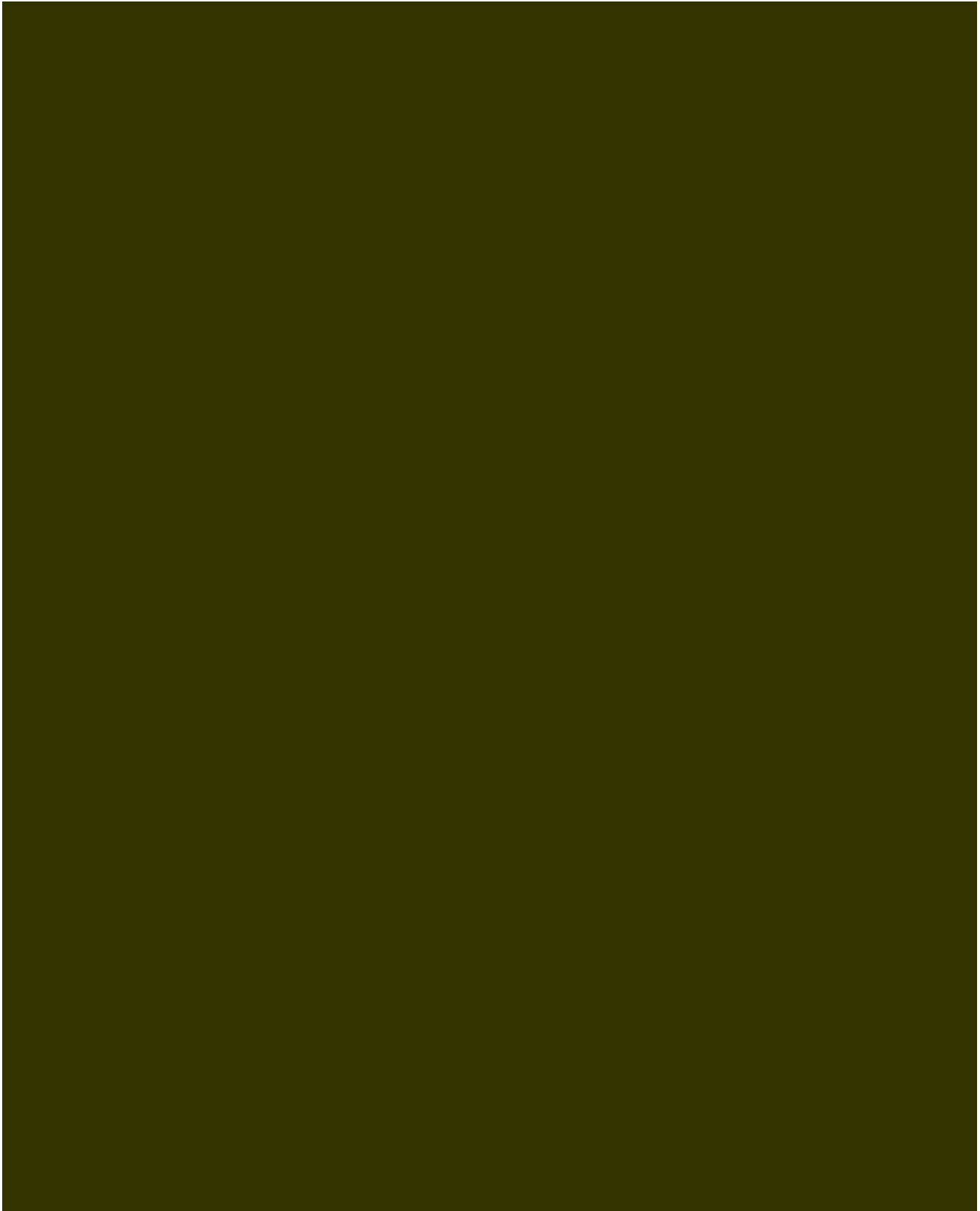
1188. Because the bit order in the bit mask corresponds to the subband order in the bandwidth, the remote unit does not need to transmit a subband index:











1199. This element is disclosed by Ritter. The third and fourth steps of the approach disclosed in Ritter indicate that the base station will allocate segments/clusters to the mobile stations and then transmit to the mobile stations the result of that allocation process:

- Evaluation of the information received from the mobile station (MS) by the base station (BS) and allocation of a segment (Sx, Sa, Sm) for the respective communication to each mobile station depending on the evaluation,
- Transmission of a message about the allocated segment (Sx, Sa, Sm) to each mobile station (MS) by the base station (BS). (Ritter, Abstract.)

1200. Thus, the last two steps in Ritter’s approach disclose exactly what is required by this element—that the base station (1) allocate a first portion of subcarriers; and (2) to establish a data link with the mobile station. In Ritter, this is the allocation of a selected “segment (Sx, Sa, Sm)” to “each mobile station,” followed by the “transmission of a message about the allocated segments... to each mobile station by the base station.”

1201. Thus, Ritter discloses “the base station allocating a first portion of the subcarriers to establish a data link between the base station and the subscriber unit.”

2. Element 16[b]

1202. Claim element 16[b] of the ’212 Patent reads: “**then the base station allocating a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.**”

1203. Ritter renders this element obvious. Ritter expressly highlights the flexibility of its OFDMA system through determining the most suitable segments for communication and modifying those suitable segments as required:

The flexibility of the method according to the invention is especially advantageously utilized if the base station assigns to the mobile stations segments of the frequency spectrum with different bandwidths or if different numbers of time slots are allocated for the transmission of the data symbols in the allocated segments. ***In this way the most suitable segments for communication can be***

determined at any given time for individual communication connections that differ from one another, and modified as needed. (Ritter at 2 col. 2 ¶ 6 (emphasis added).)

1204. Ritter’s disclosure of individually modifying and improving the allocation determinations based on the most suitable segments thus discloses the ability of the base station to modify the allocations of network bandwidth as needed to improve the system. (See, e.g., Ritter, p.2 col.2 ¶3 (“In this process the quality of the specific communication connection plays a decisive role with regard to the frequency situation, which according to the method of the invention is ***individually modified after determination of the most suitable segments*** in each mobile station served by the base station and thus improved.”).) However, Ritter does not expressly disclose the claim limitation 16[b] which requires “***and then*** the base station allocating a second portion of ***the subcarriers***.” However, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Ritter so that “the base station allocat[es] a second portion of the subcarriers to the subscriber unit to increase communication bandwidth” after having allocated the “a first portion of the subcarriers” of claim element 16[a]. One skilled in the art would have been motivated to modify the teachings of Ritter because doing so would have been a different manner of flexibly allocating subcarrier segments “as needed” to “improve” bandwidth performance.

1205. Alternatively, Adaptix appears to interpret this limitation as being satisfied even when a base station makes “an alternative” second allocation. (See Infringement Contentions, Ex. at 36.) Under such an interpretation, Ritter expressly satisfies this claim limitation. For example, as set forth above, Ritter’s process of individually modifying and improving the allocation determinations based on the most suitable segments is based on the ability to adaptively modify subcarrier allocations. (See, e.g., Ritter at 2 col. 2 ¶ 3 (“In this process the quality of the specific communication connection plays a decisive role with regard to the

frequency situation, which according to the method of the invention is *individually modified after determination of the most suitable segments* in each mobile station served by the base station and thus improved.”.) Ritter expressly discloses, as another example, that “[i]t has been found advantageous that for each mobile station *the number of allocated subcarriers can be variably adjusted in a time slot by the base station in order not only to change the segments as needed but also to change their bandwidths.*” (Ritter at 3 col.1 ¶ 2.) Ritter thus discloses this element under Adaptix’s apparent interpretation that “an alternative” allocation satisfies the limitation “and then the base station allocating a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.”

1206. Thus, Ritter renders obvious or, under Adaptix’s apparent interpretation, discloses “and then the base station allocating a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.”

B. Claim 16 of the ’212 Patent is Rendered Obvious by the Sollenberger Publications

1. Element 16[a]

1207. Claim element 16[a] of the ’212 Patent reads: “**the base station allocating a first portion of the subcarriers to establish a data link between the base station and the subscriber unit.**”

1208. This element is rendered obvious, at least, by Sollenberger Article. As noted above, Sollenberger Article describes a protocol with four basic steps:

The basic protocol for a downlink comprises four basic steps: (1) a packet page from a base station to a terminal; (2) rapid measurements of resource usage by a terminal using the parallelism of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with each radio resource; and (4) selection of resources by the base and transmission of the data.

(Sollenberger Article at 758-759 (emphasis added).)

1209. The last of the four steps indicates that the resources (or subcarriers) are selected by the base station for use by the subscriber. Moreover, Figure 3.2 from Sollenberger Article, reproduced below, indicates that the “list of assigned channels” is transmitted from the base station to the mobile stations in the coverage area of the base station, one base station each frame and four base stations in each “superframe” of 80.0 ms.

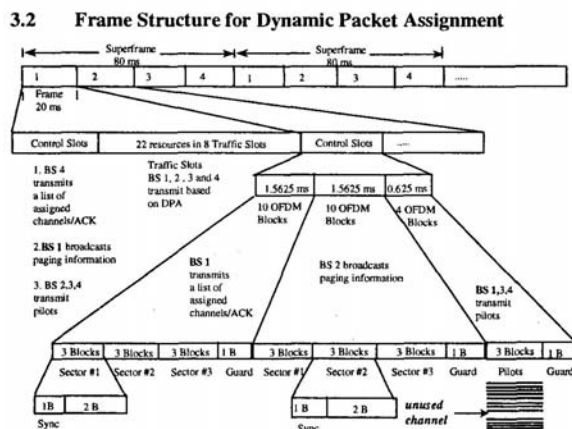


Figure 3. Staggered frame structure for downlink DPA

1210. Sollenberger Article does not expressly disclose whether the “selection of resources by the base” must be subcarriers that the base station has chosen from the set of candidate subcarriers selected by the subscriber. However, one skilled in the art would understand that one implementation of the method disclosed in Sollenberger Article would include “an indication of subcarriers of the set of subcarriers selected by the base station.” Alternatively, under Adaptix’s apparent interpretation of the court’s claim construction order and infringement theory that any indication of subcarriers satisfies this limitation, Sollenberger Article expressly discloses this element.

1211. Thus, Sollenberger Article renders obvious “the base station allocating a first portion of the subcarriers to establish a data link between the base station and the subscriber unit.”

2. Element 16[b]

1212. Claim element 16[b] of the '212 Patent reads: “**then the base station allocating a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.**”

1213. The Sollenberger Publications render this claim limitation obvious. Figure 3.2 from Sollenberger Article (reproduced below) shows the downlink frame structure in the exemplary system disclosed in Sollenberger Article. In this system, each 20 ms frame includes “Control Slots” in which one base station transmits its “list of assigned channels” to the subscribers in its coverage area – thus disclosing the required element of “the subscriber unit receiving another indication of the updated set of carriers.” (As noted above, base stations are organized into groups of four adjacent stations that share control slots, so during each 80 ms “superframe” every base station gets to transmit its updated set of subcarriers exactly once.)

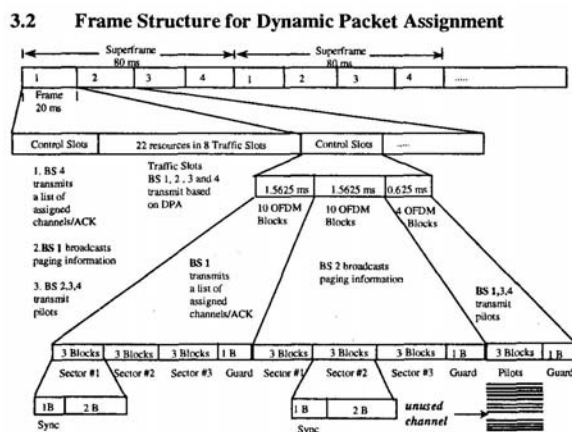


Figure 3. Staggered frame structure for downlink DPA

1214. This figure illustrates that the base station transmits – and therefore the subscriber unit receives – an indication of the updated set of carriers in the form of “a list of assigned channels”. This process occurs on a packet-by-packet basis, in which the subscriber unit sends a “short report” (feedback) about the potential transmission quality associated with each radio resource in the control slots at the beginning of each uplink frame, and then the base stations

send “a list of assigned channels” to the subscriber units at the beginning of each downlink frame.

1215. Further, Adaptix appears to interpret this limitation as being satisfied even when a base station makes “an alternative” second allocation to guarantee a bit rate or quality of service (QoS) to a subscriber. (See Infringement Contentions, Ex. A at 48.) Under such an interpretation, the Sollenberger Publications render this claim limitation obvious. For example the Sollenberger Article states that “[a]reas for further study include ... resource assignment and QoS provisioning for mixed services.” (Sollenberger Article at 761; *see also* Sollenberger Patent at 1:54-56.)

1216. Thus, the Sollenberger Publications render obvious the requirement that “the base station allocate[e] a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.”

C. **Claim 16 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter**

1. **Element 16[a]**

1217. Claim element 16[a] of the '212 Patent reads: “**the base station allocating a first portion of the subcarriers to establish a data link between the base station and the subscriber unit.**”

1218. Hashem '569 discloses this claim element. For example, Hashem '569 discloses that “[t]he base station ***allocates for data transmission at one of the Link Modes*** the sub-carriers which belong to the groups of sub-carriers within the set of acceptable groups of subcarriers.” (Hashem '569 at 3:12-15; *see also generally* '748 Patent claim element 6[d].) After an allocation is made, the base station “signal generator 36 encodes the data 38 using the optimum Link Mode, and generates a new signal” which is used to transmit data to a remote unit. (Hashem '569 at

5:16-17; *see also* Hashem '129 at 3:41-44 (“[A] base station 10 transmits a frame of data as a signal 12 through a base station transmitting antenna 14 to a remote unit 20 at a transmission rate.”), and 5:2-6 (“After a delay sufficient to allow for the propagation of the return signal to the base station 10 and for the propagation of frames encoded using the desired LM from the base station 10 to the receiver 20, the Link Mode adjuster 38 sets the current remote unit LM 28 to be the desired LM.”).) Hashem '569 further explains that “[t]he new signal only codes the data 38 over the acceptable sub-carriers.” (Hashem '569 at 5:20-21.) Thus, Hashem '569 discloses “the base station allocat[es] a first portion of the subcarriers to establish a data link between the base station and the subscriber unit.”

2. Element 16[b]

1219. Claim element 16[b] of the '212 Patent reads: “and **then the base station allocating a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.**”

1220. Hashem '569 renders this claim element obvious. For example, Hashem '569 discloses that “[t]he base station may allocate for low sensitivity data transmission sub-carriers within some of the unacceptable sub-carriers, may allocate for data transmission at a low transmission rate sub-carriers within some of the remaining unacceptable sub-carriers, ...”

Hashem '569 at 3:25-30. This allocation is **in addition** to the allocation discussed above for '212 Patent claim element 16[a] which uses the “acceptable” subcarriers. Hashem '569 further explains that:

Each unacceptable sub-carrier can be allocated for one of several uses. Zero or more of the unacceptable sub-carriers are used to transmit low sensitivity traffic encoded using the optimum Link Mode. Low sensitivity traffic can include inessential but potentially useful information, such as control bits or parity bits.

(Hashem '569 at 5:24-36.)

1221. Additionally, referring to the base station flow chart of Fig. 4, Hashem '569 discloses that:

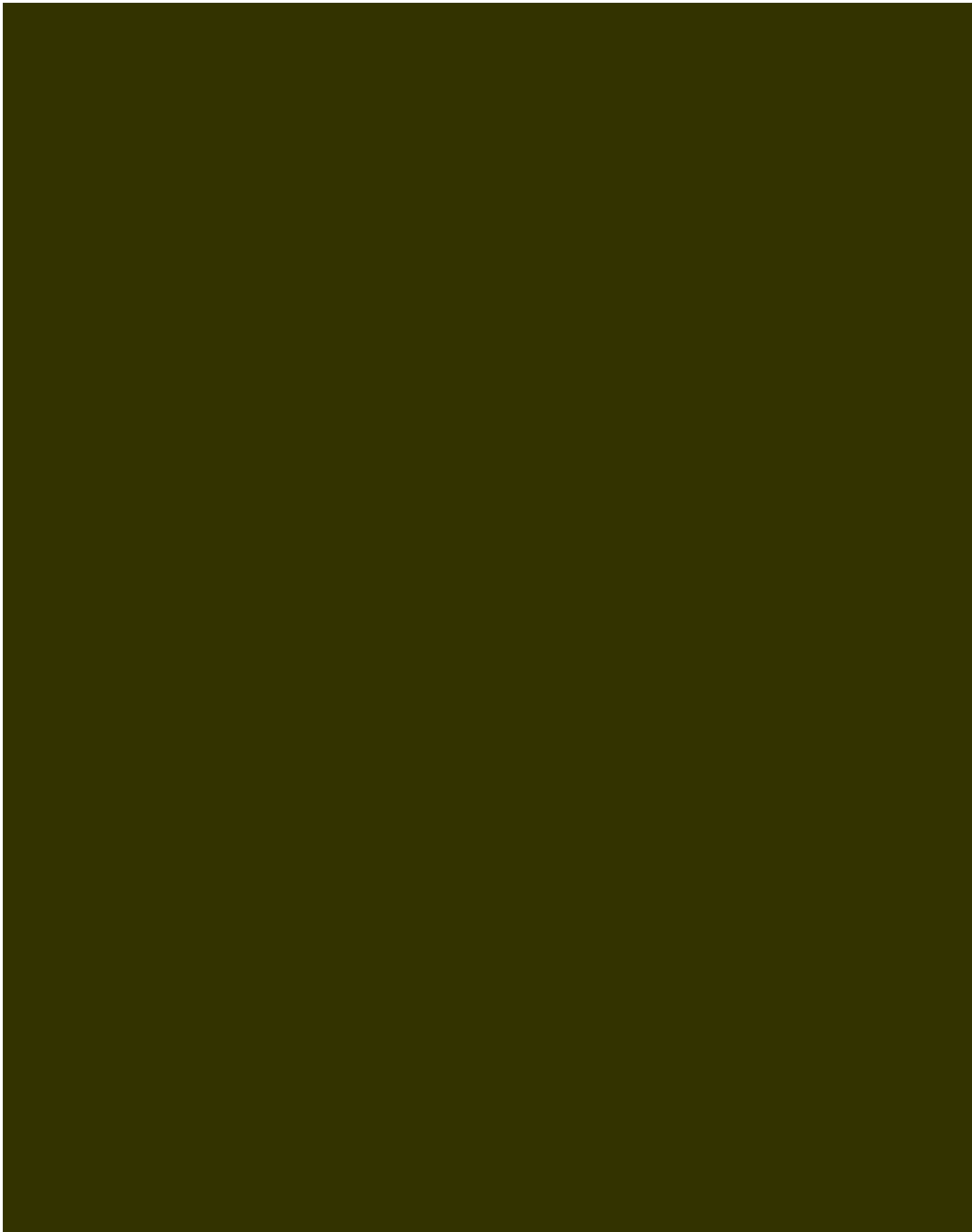
If as step 130 the base station determines that the selected sub-carrier is an unacceptable sub-carrier, then at step 134 low sensitivity data is encoded for transmission over the selected sub-carrier using the optimum Link Mode. Alternatively, at step 134 regular data could be encoded for transmission over the selected sub-carrier at a second Link Mode having a lower transmission rate than the optimum Link Mode, ...

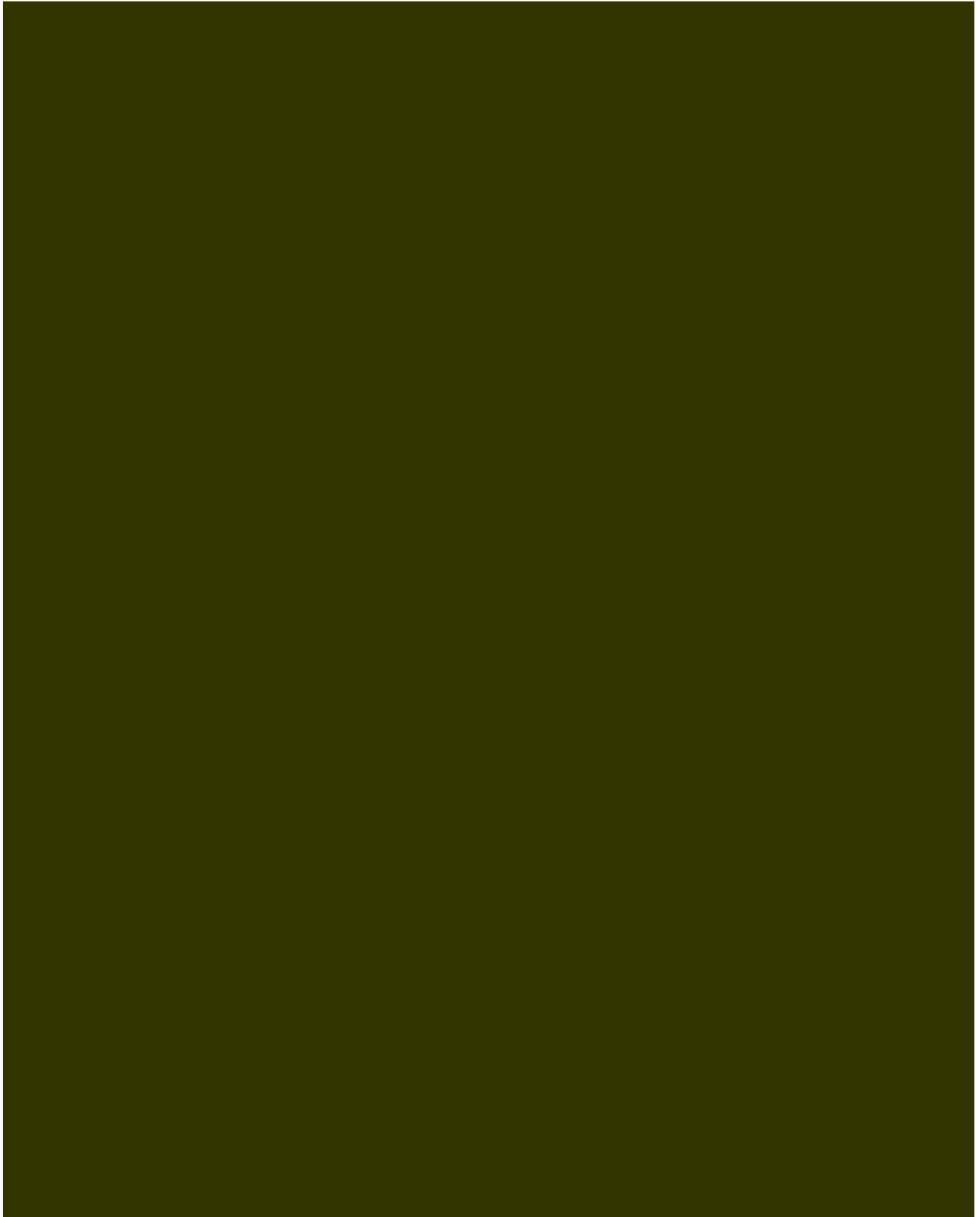
(Hashem '569 at 6:32-36.) In other words, the base station can (1) allocate a second portion of subcarriers (the “unacceptable” ones) to transmit “low sensitivity data” or (2) assign “unacceptable” subcarriers to a “second Link Mode having a lower transmission rate.” Because the “unacceptable” subcarriers are not part of the set of candidate subcarriers selected by the subscriber unit, and because they are not expressly allocated after the first allocation, Hashem '569 does not expressly satisfy claim limitation 16[b] which requires “**and then** the base station allocating a second portion of **the subcarriers**.” However, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Hashem '569 (either the second allocation that transmits at “a lower transmission rate” or the second allocation that transmits “low sensitivity data”) so that “the base station allocat[es] a second portion of the subcarriers to the subscriber unit to increase communication bandwidth” after having allocated the “a first portion of the subcarriers” of claim element 16[a]. Thus, Hashem '569 renders this element obvious.

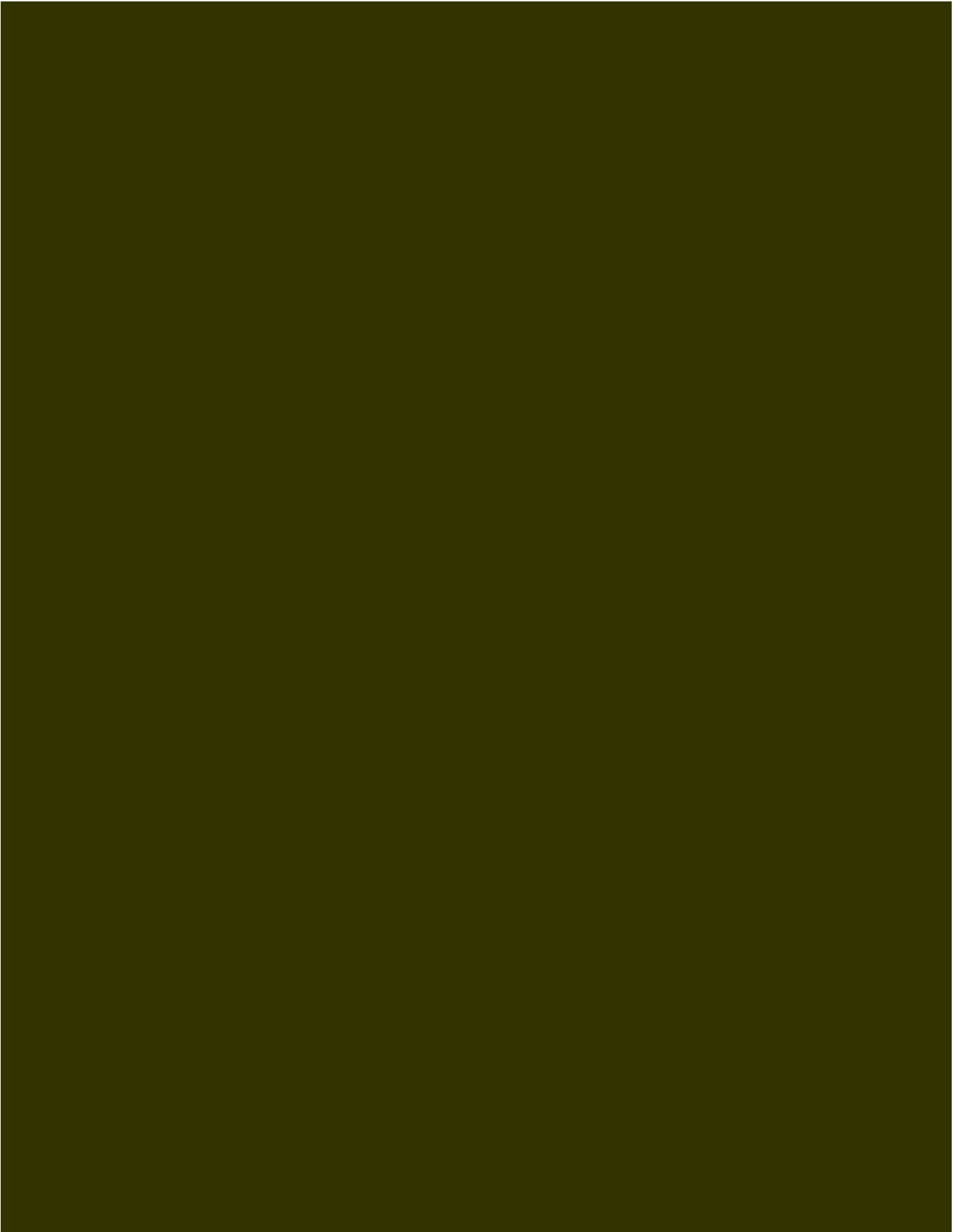
D. Claim 16 of the '212 Patent is Anticipated and or Rendered Obvious by the Project Angel System.

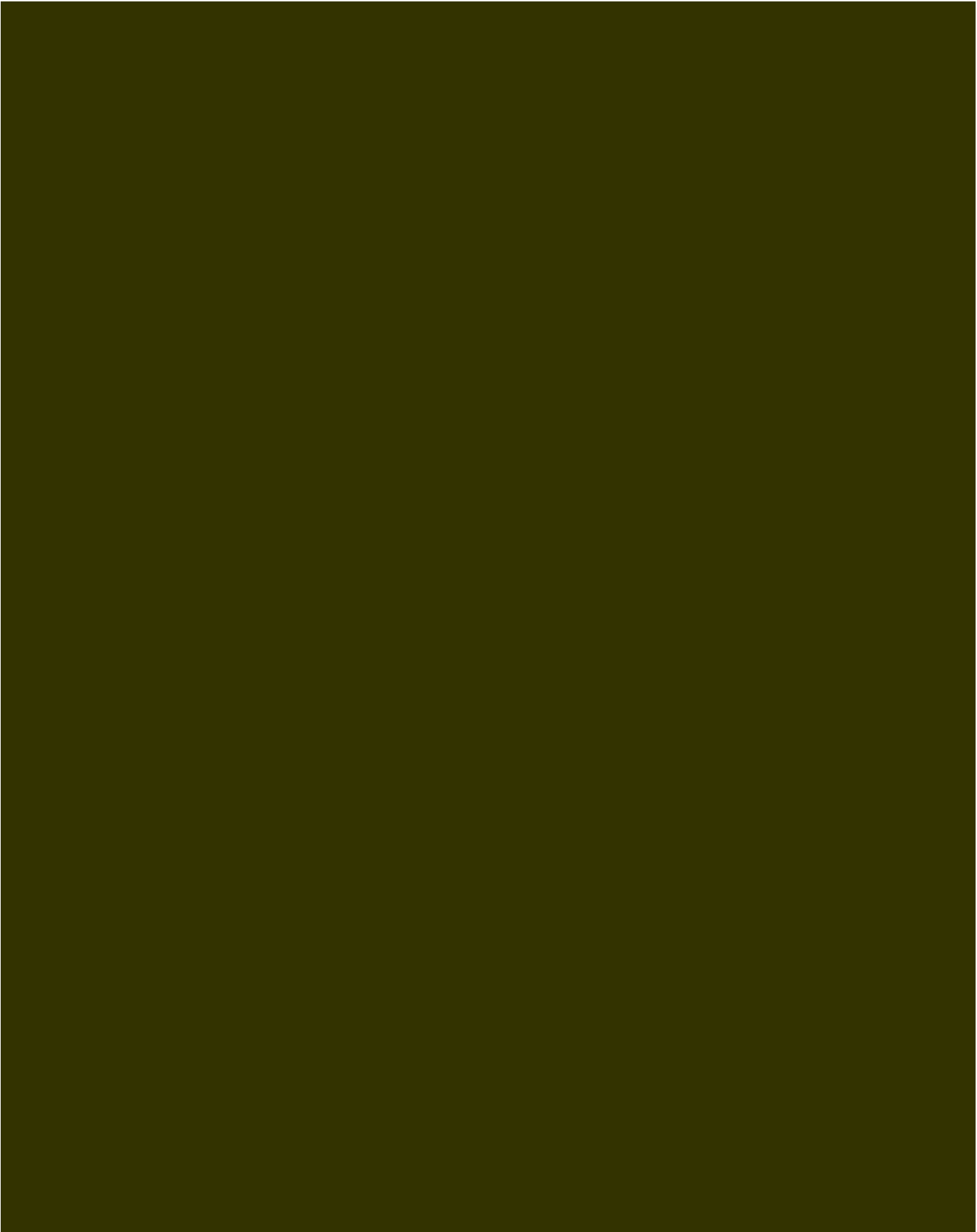
1. Element 16[a]

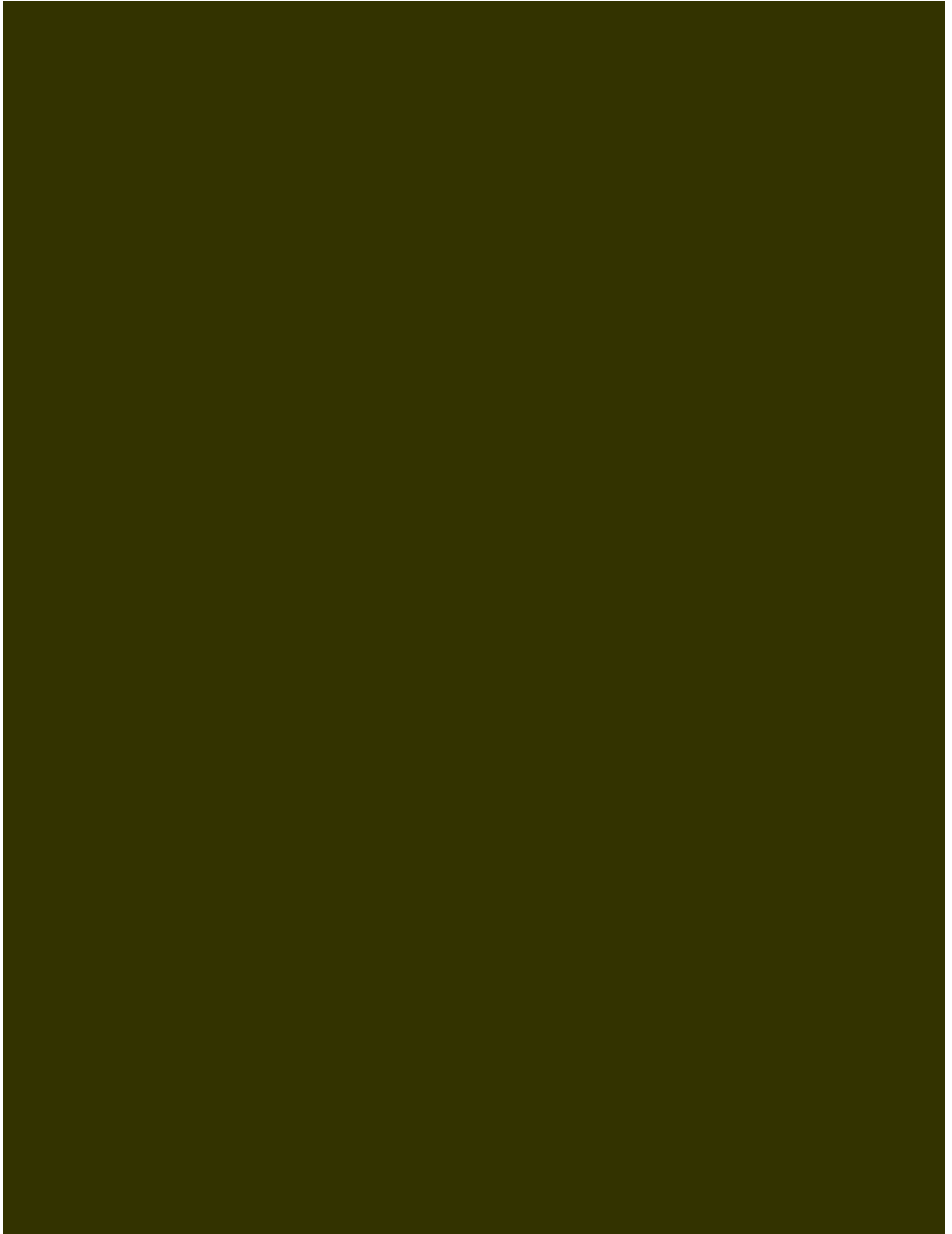
1222. Claim element 16[a] of the '212 Patent reads: “**The method defined in claim 1 further comprising: the base station allocating a first portion of the subcarriers to establish a data link between the base station and the subscriber unit.**”

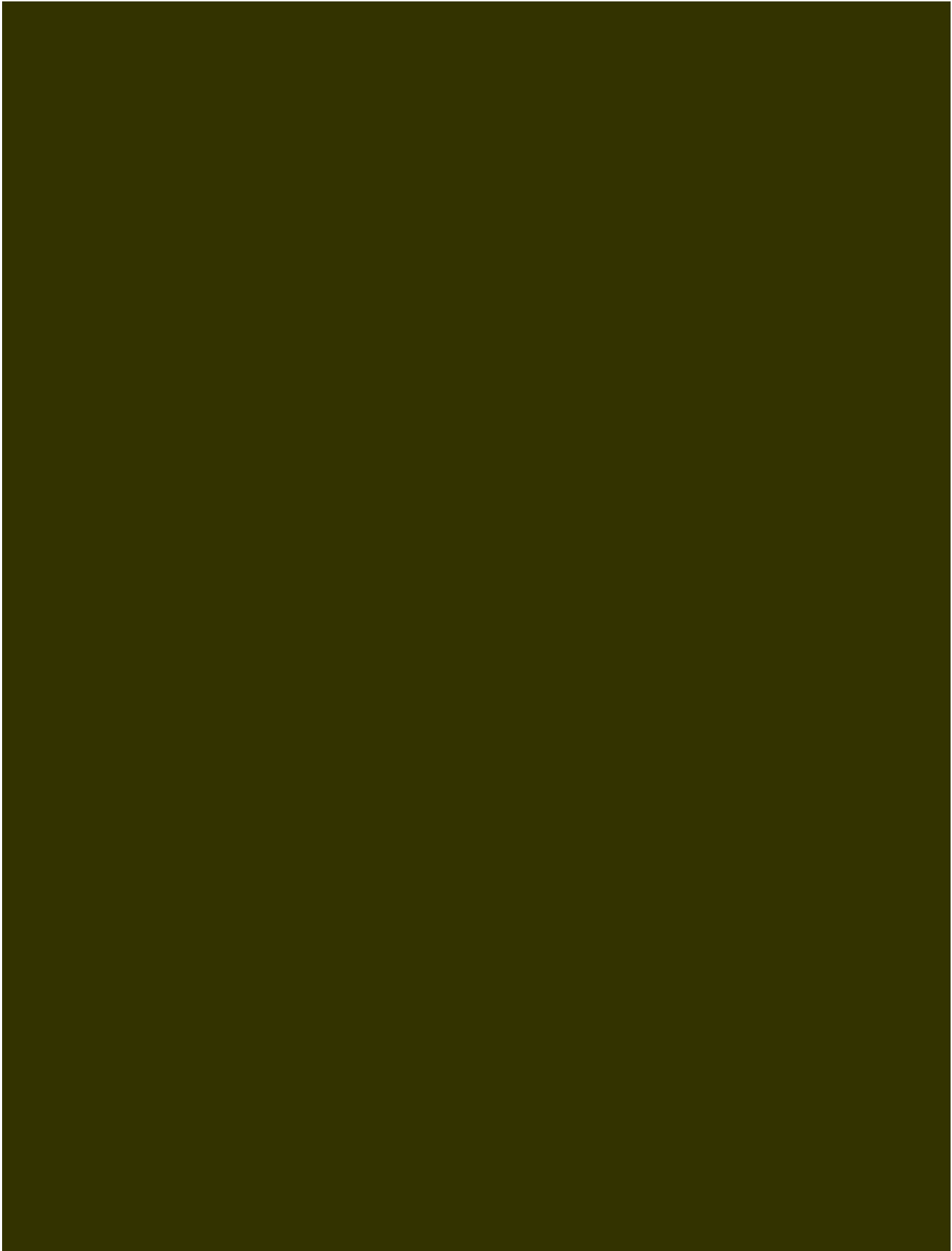


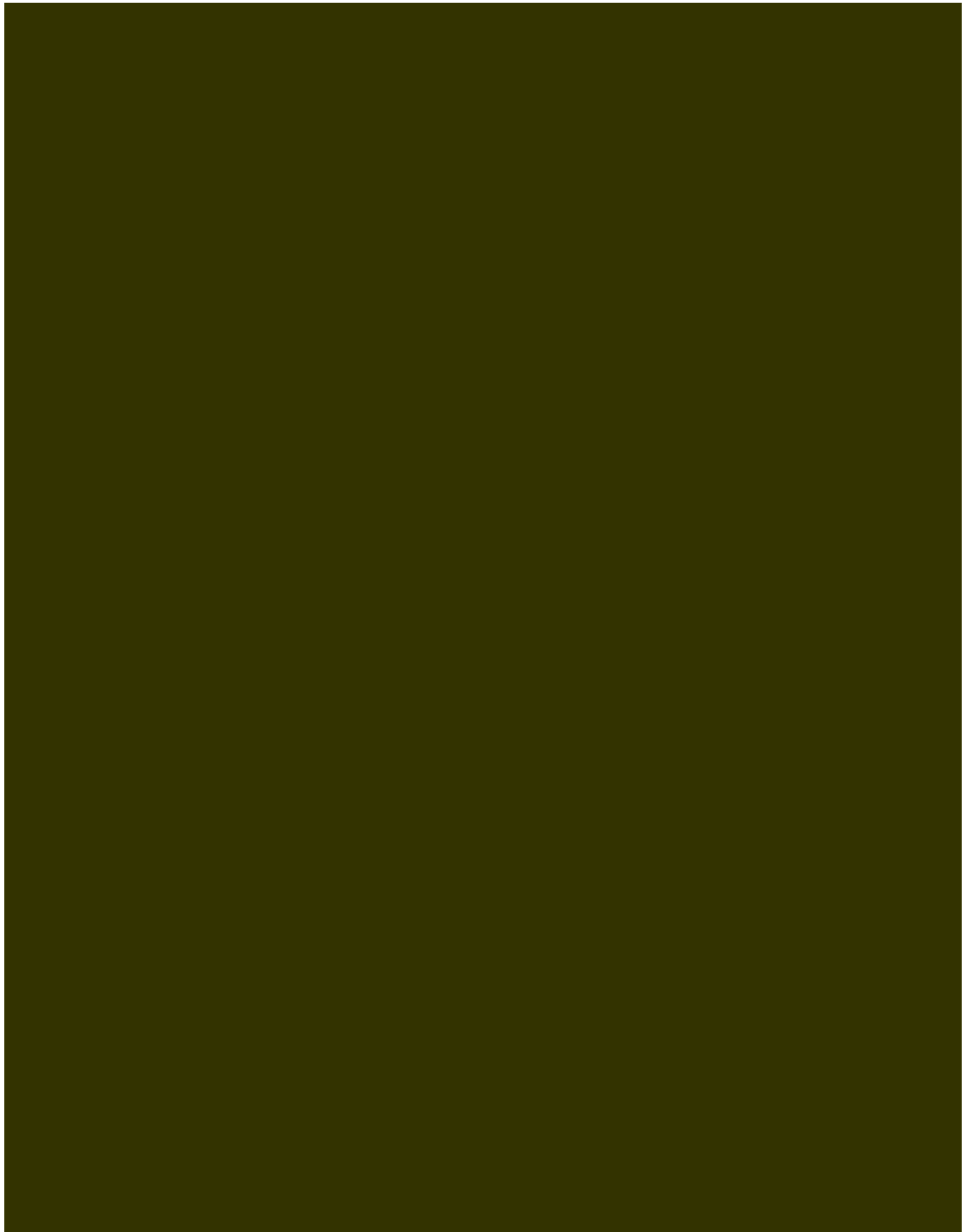












XXIV. '212 PATENT, CLAIM 18

A. Introduction

1241. Claim 18 of the '212 Patent is reproduced below with identifiers [a], [b], [c], etc. added for ease of reference:

18. An apparatus comprising:

- [a] a plurality of subscriber units in a first cell operable to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscriber units; and
- [b] a first base station in the first cell, the first base station operable to allocate OFDMA subcarriers in clusters to the plurality of subscriber units;
- [c][1] each of said plurality of subscriber units to measure channel and interference information for the plurality of subcarriers
- [c][2] based on pilot symbols received from the first base station and
- [c][3] at least one of the plurality of subscriber units to select a set of candidate subcarriers from the plurality of subcarriers, and
- [c][4] said at least one subscriber unit to provide feedback information on the set of candidate subcarriers to the base station and to
- [c][5] receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the at least one subscriber unit, and
- [c][6] wherein the subscriber unit submits updated feedback information after being allocated the set of subscriber units to receive an updated set of subcarriers and thereafter
- [c][7] receives another indication of the updated set of subcarriers.

B. Independent Claim 18 of the '212 Patent, along with the Claims Dependent Upon Claim 18, is Indefinite

1242. As an initial matter, it is my opinion that claim 18 of the '212 Patent is indefinite. In the apparatus claimed by independent claim 18, “the subscriber unit submits updated feedback information after being allocated the set of subscriber units to receive an updated set of

subcarriers and thereafter receives another indication of the updated set of subcarriers.” (’212 Patent at 18:2-5.) Asserted Claims 19-21 and 23-30 depend, directly or indirectly, on claim 18, and therefore include this same limitation.

1243. The limitation “the subscriber unit submits updated feedback information after being allocated the set of subscriber units to receive an updated set of subcarriers and thereafter receives another indication of the updated set of subcarriers” makes no sense, and fails to provide clear notice of what is claimed. In essence, the claim language requires that the base station allocate “the set of subscriber units” to subscriber units. This is entirely circular, and does not inform those skilled in the art about the scope of the claim language. Therefore, I believe that the claims that include this language are indefinite.

1244. I understand that Adaptix has recently characterized this claim limitation as an “obvious error,” and suggested that “subscriber units” in column 18, line 4 should read “subcarriers.” I disagree that one of ordinary skill in the art would conclude that this limitation is an obvious error, and the claim should actually be understood as though the term “subcarriers” appeared instead of “subscriber units.”

1245. **First**, “subscriber units” and “subcarriers” are two completely different concepts, and there is no reason that one would interpret one term to actually mean the other.

1246. **Second**, the ’212 Patent issued nearly six years ago. I understand that there is a procedure in the Patent Office that allows applicants to correct obvious errors but that, in this case, Adaptix never did so. One of ordinary skill in the art would interpret Adaptix’s lack of action to mean that there was no obvious error. I also understand that even after defendants, in their January 9, 2013 Invalidity Contentions, characterized this claim limitation as “nonsensical”

and “insolubly ambiguous,” the applicants still did not seek to correct the ’212 Patent in the Patent Office.

1247. **Third**, nothing in the prosecution history for the ’212 Patent suggests the existence of an obvious error in the claim limitation. To the contrary, the prosecution history suggests that this language used by the applicants was intended and deliberate. Specifically, during prosecution, the examiner noted, in an office action dated January 10, 2008, that in original claim 8, the language “the set of subscriber units” should be changed into “the set of subcarriers.” The applicants made this correction in a response dated April 10, 2008. However, the applicants took no action with respect to similar language in original claim 36. In fact, instead of revising the language “the set of subscriber units” in original claim 36, the applicants, in an amendment dated August 4, 2008, copied the same language of dependent claim 37 into independent claim 30, which issued as independent claim 18. The applicants’ failure to make any change to the language that issued in independent claim 18 – even after the examiner required them to correct similar language appearing in another claim – would lead one of ordinary skill to conclude that the applicants choice of language was not an obvious error but was a deliberate and considered choice. It certainly was not clear to the applicants that the language in independent claim 18 was an “obvious error.”

1248. I have been informed by counsel for Defendants that Adaptix is seeking to correct the language of claim element 18[c][6]. In particular, I have been informed that Adaptix is seeking to change the claim element 18[c][6] as follows:

wherein the subscriber unit submits updated feedback information after being allocated the set of ~~subscriber units~~ **[subcarriers]** to receive an updated set of subcarriers and thereafter receives another indication of the updated set of subcarriers.

1249. Although I believe claim 18 of the '212 Patent is indefinite, I have been asked by counsel for Defendants to use Adaptix's proposed correction for purposes of my anticipation and/or obviousness analysis set forth below. Under Adaptix's proposed correction, claim 18 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below.

C. Claim 18 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1. Preamble

1250. The preamble to claim 18 reads: "**An apparatus comprising:**"

1251. This element is satisfied by the disclosure set forth at '748 Patent claim element 11 preamble.

2. Element 18[a]

1252. Claim element 18[a] of the '212 patent reads: "**a plurality of subscriber units in a first cell operable to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscriber units.**"

1253. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

3. Element 18[b]

1254. Claim element 18[b] of the '212 patent reads: "**a first base station in the first cell, the first base station operable to allocate OFDMA subcarriers in clusters to the plurality of subscriber units.**"

1255. This element is satisfied by the disclosure set forth at '748 Patent claim element 19[b].

4. Element 18[c][1]

1256. Claim element 18[c][1] of the '212 patent reads: “**each of said plurality of subscriber units to measure channel and interference information for the plurality of subcarriers.**”

1257. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[a][1].

5. Element 18[c][2]

1258. Claim element 18[c][2] of the '212 patent reads: “**based on pilot symbols received from the first base station.**”

1259. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[a][2].

6. Element 18[c][3]

1260. Claim element 18[c][3] of the '212 patent reads: “**at least one of the plurality of subscriber units to select a set of candidate subcarriers from the plurality of subcarriers, and.**”

1261. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[b].

7. Element 18[c][4]

1262. Claim element 18[c][4] of the '212 patent reads: “**said at least one subscriber unit to provide feedback information on the set of candidate subcarriers to the base station.**”

1263. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[c].

8. Element 18[c][5]

1264. Claim element 18[c][5] of the '212 patent reads: “**receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the at least one subscriber unit.**”

1265. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[d].

9. Element 18[c][6]

1266. Claim element 18[c][6] of the '212 patent reads: “**wherein the subscriber unit submits updated feedback information after being allocated the set of subscriber units to receive an updated set of subcarriers.**”

1267. While this element renders the claim indefinite as written, under Adaptix's proposed correction this element is satisfied by the disclosure set forth at '212 Patent claim element 1[e][1].

10. Element 18[c][7]

1268. Claim element 18[c][7] of the '212 patent reads: “**receives another indication of the updated set of subcarriers.**”

1269. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[e][2].

D. **Claim 18 of the '212 Patent is Rendered Obvious by the Sollenberger Publications**

1. Preamble

1270. The preamble to claim 18 reads: “**An apparatus comprising:**”

1271. This element is satisfied by the disclosure set forth at '748 Patent claim element 11 preamble.

2. Element 18[a]

1272. Claim element 18[a] of the '212 patent reads: “**a plurality of subscriber units in a first cell operable to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscriber units.**”

1273. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

3. Element 18[b]

1274. Claim element 18[b] of the '212 patent reads: “**a first base station in the first cell, the first base station operable to allocate OFDMA subcarriers in clusters to the plurality of subscriber units.**”

1275. This element is satisfied by the disclosure set forth at '748 Patent claim element 19[b].

4. Element 18[c][1]

1276. Claim element 18[c][1] of the '212 patent reads: “**each of said plurality of subscriber units to measure channel and interference information for the plurality of subcarriers.**”

1277. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[a][1].

5. Element 18[c][2]

1278. Claim element 18[c][2] of the '212 patent reads: “**based on pilot symbols received from the first base station.**”

1279. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[a][2].

6. Element 18[c][3]

1280. Claim element 18[c][3] of the '212 patent reads: **“at least one of the plurality of subscriber units to select a set of candidate subcarriers from the plurality of subcarriers, and.”**

1281. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[b].

7. Element 18[c][4]

1282. Claim element 18[c][4] of the '212 patent reads: **“said at least one subscriber unit to provide feedback information on the set of candidate subcarriers to the base station.”**

1283. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[c].

8. Element 18[c][5]

1284. Claim element 18[c][5] of the '212 patent reads: **“receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the at least one subscriber unit.”**

1285. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[d].

9. Element 18[c][6]

1286. Claim element 18[c][6] of the '212 patent reads: **“wherein the subscriber unit submits updated feedback information after being allocated the set of subscriber units to receive an updated set of subcarriers.”**

1287. While this element renders the claim indefinite as written, under Adaptix's proposed correction this element is satisfied by the disclosure set forth at '212 Patent claim element 1[e][1].

10. Element 18[c][7]

1288. Claim element 18[c][7] of the '212 patent reads: "**receives another indication of the updated set of subcarriers.**"

1289. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[e][2].

E. Claim 18 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1. Preamble

1290. The preamble to claim 18 reads: "**An apparatus comprising:**"

1291. This element is satisfied by the disclosure set forth at '748 Patent claim element 11 preamble.

2. Element 18[a]

1292. Claim element 18[a] of the '212 patent reads: "**a plurality of subscriber units in a first cell operable to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscriber units.**"

1293. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

3. Element 18[b]

1294. Claim element 18[b] of the '212 patent reads: "**a first base station in the first cell, the first base station operable to allocate OFDMA subcarriers in clusters to the plurality of subscriber units.**"

1295. This element is satisfied by the disclosure set forth at '748 Patent claim element 19[b].

4. Element 18[c][1]

1296. Claim element 18[c][1] of the '212 patent reads: “**each of said plurality of subscriber units to measure channel and interference information for the plurality of subcarriers.**”

1297. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[a][1].

5. Element 18[c][2]

1298. Claim element 18[c][2] of the '212 patent reads: “**based on pilot symbols received from the first base station.**”

1299. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[a][2].

6. Element 18[c][3]

1300. Claim element 18[c][3] of the '212 patent reads: “**at least one of the plurality of subscriber units to select a set of candidate subcarriers from the plurality of subcarriers, and.**”

1301. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[b].

7. Element 18[c][4]

1302. Claim element 18[c][4] of the '212 patent reads: “**said at least one subscriber unit to provide feedback information on the set of candidate subcarriers to the base station.**”

1303. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[c].

8. Element 18[c][5]

1304. Claim element 18[c][5] of the '212 patent reads: “**receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the at least one subscriber unit.**”

1305. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[d].

9. Element 18[c][6]

1306. Claim element 18[c][6] of the '212 patent reads: “**wherein the subscriber unit submits updated feedback information after being allocated the set of subscriber units to receive an updated set of subcarriers.**”

1307. While this element renders the claim indefinite as written, under Adaptix's proposed correction this element is satisfied by the disclosure set forth at '212 Patent claim element 1[e][1].

10. Element 18[c][7]

1308. Claim element 18[c][7] of the '212 patent reads: “**receives another indication of the updated set of subcarriers.**”

1309. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[e][2].

F. Claim 18 of the '212 Patent is Anticipated and/or Rendered Obvious by the Project Angel System

1. Preamble

1310. The preamble to claim 18 reads: “**An apparatus comprising:**”

1311. This element is satisfied by the disclosure set forth at '748 Patent claim element 11 preamble.

2. Element 18[a]

1312. Claim element 18[a] of the '212 patent reads: **“a plurality of subscriber units in a first cell operable to generate feedback information indicating clusters of subcarriers desired for use by the plurality of subscriber units.”**

1313. This element is satisfied by the disclosure set forth at '748 Patent claim element 11[a].

3. Element 18[b]

1314. Claim element 18[b] of the '212 patent reads: **“a first base station in the first cell, the first base station operable to allocate OFDMA subcarriers in clusters to the plurality of subscriber units.”**

1315. This element is satisfied by the disclosure set forth at '748 Patent claim element 19[b].

4. Element 18[c][1]

1316. Claim element 18[c][1] of the '212 patent reads: **“each of said plurality of subscriber units to measure channel and interference information for the plurality of subcarriers.”**

1317. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[a][1].

5. Element 18[c][2]

1318. Claim element 18[c][2] of the '212 patent reads: **“based on pilot symbols received from the first base station.”**

1319. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[a][2].

6. Element 18[c][3]

1320. Claim element 18[c][3] of the '212 patent reads: **“at least one of the plurality of subscriber units to select a set of candidate subcarriers from the plurality of subcarriers, and.”**

1321. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[b].

7. Element 18[c][4]

1322. Claim element 18[c][4] of the '212 patent reads: **“said at least one subscriber unit to provide feedback information on the set of candidate subcarriers to the base station.”**

1323. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[c].

8. Element 18[c][5]

1324. Claim element 18[c][5] of the '212 patent reads: **“receive an indication of subcarriers from the set of subcarriers selected by the first base station for use by the at least one subscriber unit.”**

1325. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[d].

9. Element 18[c][6]

1326. Claim element 18[c][6] of the '212 patent reads: **“wherein the subscriber unit submits updated feedback information after being allocated the set of subscriber units to receive an updated set of subcarriers.”**

1327. While this element renders the claim indefinite as written, under Adaptix's proposed correction this element is satisfied by the disclosure set forth at '212 Patent claim element 1[e][1].

10. Element 18[c][7]

1328. Claim element 18[c][7] of the '212 patent reads: “**receives another indication of the updated set of subcarriers.**”

1329. This element is satisfied by the disclosure set forth at '212 Patent claim element 1[e][2].

XXV. '212 PATENT, CLAIM 19

1330. Claim 19 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 19 of the '212 Patent reads: “The apparatus defined in claim 18 wherein each of the plurality of subscriber units continuously monitors reception of the pilot symbols known to the base station and the plurality of subscriber units and measures signal-plus-interference-to-noise ratio (SINR) of each cluster of subcarriers.”

A. Claim 19 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1331. Claim 19 reads: “**The apparatus defined in claim 18 wherein each of the plurality of subscriber units continuously monitors reception of the pilot symbols known to the base station and the plurality of subscriber units and measures signal-plus-interference-to-noise ratio (SINR) of each cluster of subcarriers.**”

1332. Ritter discloses this limitation. As previously discussed in my analysis of '748 Patent claim elements 8[a][1]. Ritter monitors the channels by measuring channel and interference information.

1333. As previously discussed in my analysis of '748 Patent claim elements 8[a][2], Ritter does not expressly disclose monitoring pilot symbols. However, this element would have been known to a person of ordinary skill in the art, and is disclosed by Ritter in combination with Hashem '569, which incorporates Hashem '129 by reference. This element is likewise disclosed by Ritter in combination with any number of similar prior art references well known to those skilled in the art at the time the patents were filed (including the Sollenberger Article and/or IS-95A), such as the disclosure set forth at '748 claim element 6[a][2]. See Section VI.B.4.

1334. One of ordinary skill in the art would have known that using pilots to make such measurements would be an obvious choice, employed in many wireless systems. For example, Hashem '569, which incorporates Hashem '129, discloses this element explicitly. For example, in its "Summary of the Invention," Hashem '129 discloses:

The present invention also provides a method of determining a signal to interference ratio of a signal sub-carrier in a communication system. The communication system includes a base station which transmits a pilot signal to a remote unit over a pilot sub-carrier. The pilot signal may be either on or off. The remote unit measures a signal strength of the pilot sub-carrier when the pilot signal is on and measures a signal strength of the pilot sub-carrier when the pilot signal is off, the latter being in effect a measurement of interference in the pilot sub-carrier as there is no pilot signal. The remote unit calculates a ratio of the signal strength when the pilot signal is on to the signal strength when the pilot signal is off. ('129 Patent at 2:65-3:10.)

1335. Hashem '129 refers to this approach as a "blinking" pilot symbol, and it proposes two different algorithms for computing a signal-to-interference ratio based on blinking pilot symbols transmitted from the base station. Figures 5 and 6 from Hashem '129 reproduced below, are flow charts that disclose the two algorithms for computing the required SIR based on pilots received from a base station.

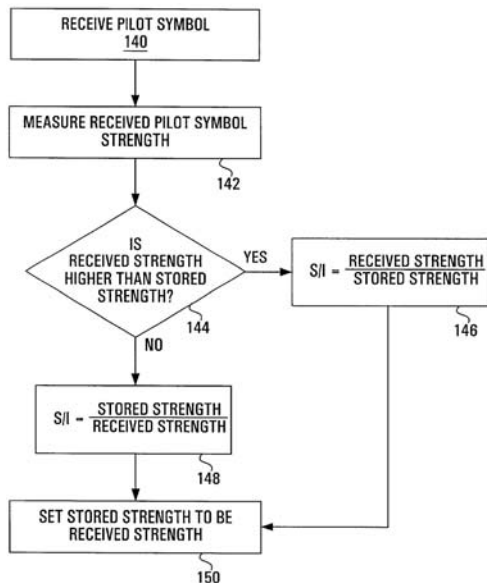


FIG. 5

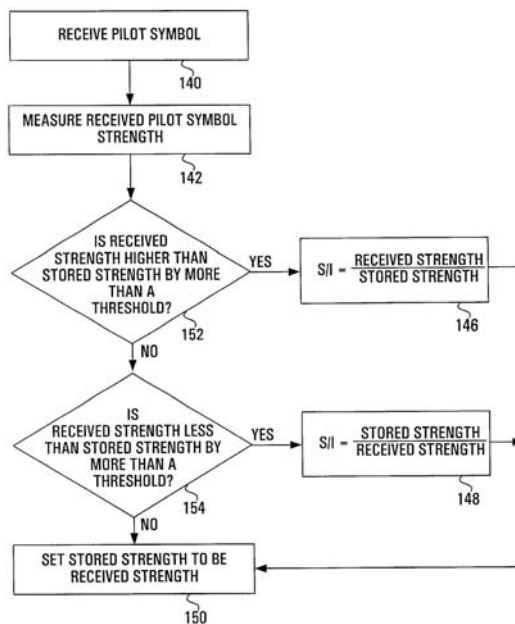


FIG. 6

1336. Therefore, the combination of Ritter and Hashem '569 discloses “a subscriber measuring channel and interference information from a plurality of subcarriers based on pilot symbols received from a base station.”

1337. Further, one skilled in the art would have been motivated to combine Ritter in the alternative with any number of similar references for the disclosure of pilots symbols because Ritter was proposing technology relevant to the design of a mobile cellular system at a time (late 1990s) when the use of pilot symbols received from a base station to measure channel and interference information. For example, the IS-95A standard (among many other references) discloses measurements “based on pilot symbols received from a base station.” Likewise, the Sollenberger Article discloses “the ability to rapidly measure interference or path loss parameters in parallel on all candidate channels, *either directly or based on pilot tones.*” (Sollenberger Article at 758.) Further evidence of these disclosures is set forth at '748 claim element 6[a][2].

1338. Furthermore, Hashem '569 discloses continuously monitoring the pilot symbols:

“In a communication system that implements adaptive modulation, the base station and the remote unit must be synchronized with respect to the transmission parameters. In current communication systems the remote unit determines a channel quality *when the remote unit receives a frame of data*. The remote unit may estimate, for example, the signal to interference ratio of the channel. The remote unit sends a signal back to the base station reporting the channel quality. *Using the channel quality report received from the remote unit, the base station calculates a set of optimum transmission parameters which the base station will use in its next transmission of data.*” (Hashem ’569 at 1:33-46.)

1339. Finally, one skilled in the art would have been motivated to combine Ritter with Hashem ’569 in order to “measures signal-plus-interference-to-noise ratio (SINR) of each cluster of subcarriers.” As noted above, Hashem ’569 discloses feedback information consisting of the average signal-to-interference ratio (SIR) of a selected candidate cluster. This form of feedback is shown in the last block (numbered 98) of the flowchart in Figure 3 from Hashem ’569, reproduced below.

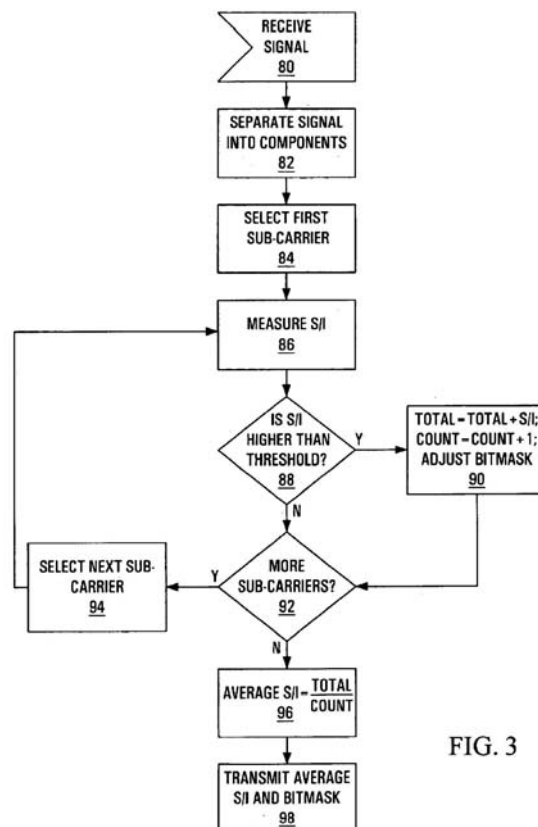


FIG. 3

1340. While there is a difference between a signal-to-interference ratio (SIR) and a signal-to-interference-plus-noise ratio (SINR), it would have been obvious, in a cellular system where the dominant corruption mechanism is interference – *i.e.*, an interference-limited environment – to have used SINR rather than SIR, because the noise in such a system is small relative to the interference, and it is easier to measure SINR than to measure SIR.

1341. As noted, the disclosure in Hashem relates to the measurement of SIR for a candidate cluster:

“The remote unit determines a channel quality (such as a signal to interference ratio or a reciprocal of an error rate) of each group of sub-carrier signals, and compares the channel quality of each group of sub-carrier signals with a threshold.” ([Hashem ’569 at 2:25-33.]

1342. Thus, Ritter in combination with Hashem ’569, or in combination with Hashem ’569 and either the Sollenberger Article or IS-95A discloses “the apparatus defined in claim 18 wherein each of the plurality of subscriber units continuously monitors reception of the pilot symbols known to the base station and the plurality of subscriber units and measures signal-plus-interference-to-noise ratio (SINR) of each cluster of subcarriers.”

B. Claim 19 of the ’212 Patent is Rendered Obvious by the Sollenberger Publications

1343. Claim 19 reads: “**The apparatus defined in claim 18 wherein each of the plurality of subscriber units continuously monitors reception of the pilot symbols known to the base station and the plurality of subscriber units and measures signal-plus-interference-to-noise ratio (SINR) of each cluster of subcarriers.**”

1344. This element is rendered obvious by, at least, the Sollenberger Article. As discussed above, the Sollenberger Article observes in general terms that “OFDM has a key advantage here with the ability to rapidly measure interference or path loss parameters in parallel on all candidate channels, either directly or based on pilot tones.” (Sollenberger Article at 758

and SINR measurements and would have been motivated to modify the Sollenberger Article to measure SINR of each traffic slot, instead of SIR, in order to more accurately measure the quality of the channels.

1347. Further, as discussed previously, the Sollenberger Article proposes “Dynamic Packet Assignment (DPA) based on properties of an OFDM physical layer is proposed which reassigns transmission resources on a *packet by packet basis* using high-speed receiver measurements...” (Sollenberger Article at 757 (emphasis added).) One of ordinary skill in the art would understand that in order to reassign transmission resources on a packet by packet basis, the terminals must “continuously monitor” reception of the pilot signals.

1348. Thus, the Sollenberger Article renders obvious “wherein each of the plurality of subscriber units continuously monitors reception of the pilot symbols known to the base station and the plurality of subscriber units and measures signal-plus-interference-to-noise ratio (SINR) of each cluster of subcarriers.”

C. Claim 19 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1349. Claim 19 reads: “**The apparatus defined in claim 18 wherein each of the plurality of subscriber units continuously monitors reception of the pilot symbols known to the base station and the plurality of subscriber units and measures signal-plus-interference-to-noise ratio (SINR) of each cluster of subcarriers.**”

1350. This element is disclosed by Hashem '129 which is incorporated by reference into Hashem '569. As previously noted, the “subscriber units” in the Asserted Claims map to the “remote units” disclosed in Hashem '569. As discussed with respect to '748 Patent claim element 11[a], Hashem '129 (and Hashem '569) discloses systems that include multiple “remote units.” (See '129 Patent at 2:3-11; *see also* Hashem '569 at 1:51-60.) Moreover, Hashem '129

states that “[s]ystems which employ OFDM can use 1,000 sub-carriers” (col. 2:38-39) which is sufficient to support voice connections on multiple remote units.

1351. As noted in the “Hashem Overview” section, the disclosed processes measure the signal to interference ratio of each sub-carrier. This is done in the sub-carrier analysis processor, which Figure 1 of Hashem ’569 indicates is part of the remote unit – *i.e.*, “the subscriber.”

The sub-carrier analysis processor 26 measures a signal to interference ratio (S/I) of each sub-carrier signal. (Hashem ’569 at 4:27-29)

1352. In its analysis of the flow chart shown in Figure 3, Hashem ’569 indicates that the SIR of each sub-carrier is measured as part of an iterative loop:

“At step 86 the S/I of the sub-carrier signal of the selected sub-carrier is measured. ... If at step 92 there are further subcarriers, then at step 94 the next sub-carrier is selected and 55 the algorithm returns to step 86 to measure the S/I of sub-carrier signal of the next sub-carrier.” (’596 Patent at 5:46-57.)

1353. Moreover, Figure 3 is a “flow chart of a method by which a remote unit determines and conveys information concerning acceptable sub-carriers to a base station.” (Hashem ’569 at 3:56-58.) As noted above, “remote unit” is the terminology used in Hashem to indicate what the asserted claim refers to as the “subscriber”.

1354. The ’129 patent discloses that subscribers “continuously monitor” of pilot symbols. For example, the ’129 patent explains that:

The present invention also provides a method of determining a signal to interference ratio of a signal sub-carrier in a communication system. ***The communication system includes a base station which transmits a pilot signal to a remote unit*** over a pilot sub-carrier. The pilot signal may be either on or off. ***The remote unit measures a signal strength of the pilot sub-carrier when the pilot signal is on and measures a signal strength of the pilot sub-carrier when the pilot signal is off***, the latter being in effect a measurement of interference in the pilot sub-carrier as there is no pilot signal. The remote unit calculates a ratio of the signal strength when the pilot signal is on to the signal strength when the pilot signal is off.

(’129 Patent at 2:65-3:10 (emphasis added); *see also id.* at 7:11-8:39.) By measuring the pilot sub-carrier both when the pilot signal is on and when the pilot signal is off, the remote units “continuously monitor” reception of pilot symbols. This is even more explicitly described in the following paragraph which explains the use of a “blinking pilot signal” in which “[t]he base station turns the pilot signal on and off in successive symbols in one or more of the pilot subcarriers.” By turning the pilot “on and off in successive symbols” in a blinking fashion the remote unit can continuously monitor the pilot symbols. Elsewhere, Hashem ’129 explains the ongoing nature of the pilot measurement process as follows:

In order to obtain a smoother estimate of the signal to interference ratio, the signal to interference ratio can be measured over more than two pilot symbols. For example, the digital signal processor may store a queue of signal strengths of three previous symbols.

(’129 Patent at 7:55-63; *see also id.* at Figs. 5 and 6 (showing two different algorithms for computing a signal-to-interference ratio based on blinking pilot symbols transmitted from the base station).)

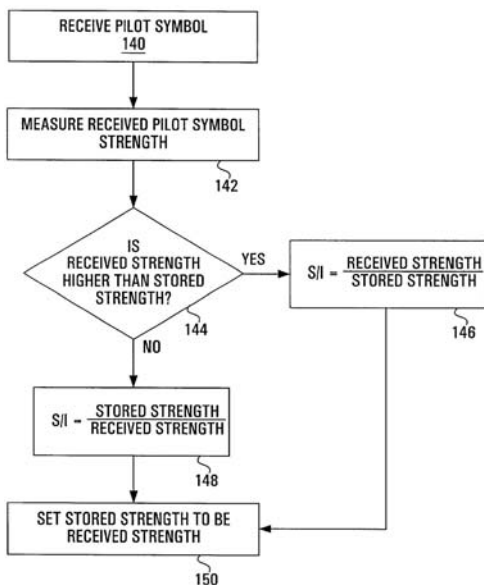


FIG. 5

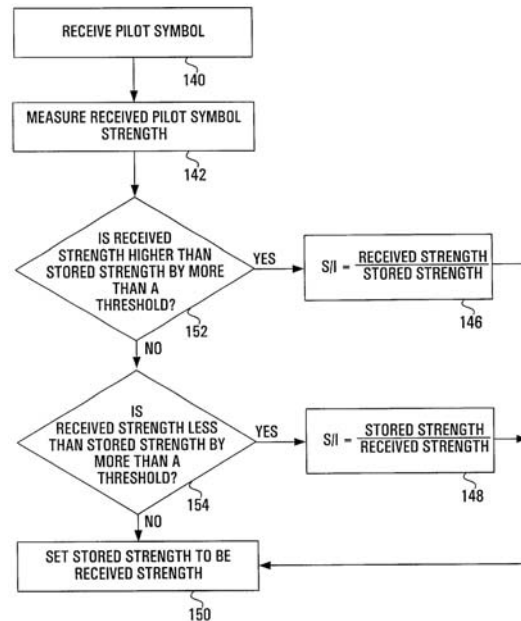


FIG. 6

1355. In addition to continuously monitoring pilot signals, the remote units in Hashem '129 also measure SINR on each cluster of subcarriers. The '212 Patent defines a cluster as “as a logical unit that contains at least one physical subcarrier.” '212 Patent at 5:15-18. I note here that the Court construed the term “clusters of subcarriers” as “at least two logical units of subcarriers” but the claim term here is different: “each cluster of subcarriers.” Figure 3 from Hashem '569, reproduced below, illustrates the S/I measurement of each cluster of subcarriers.

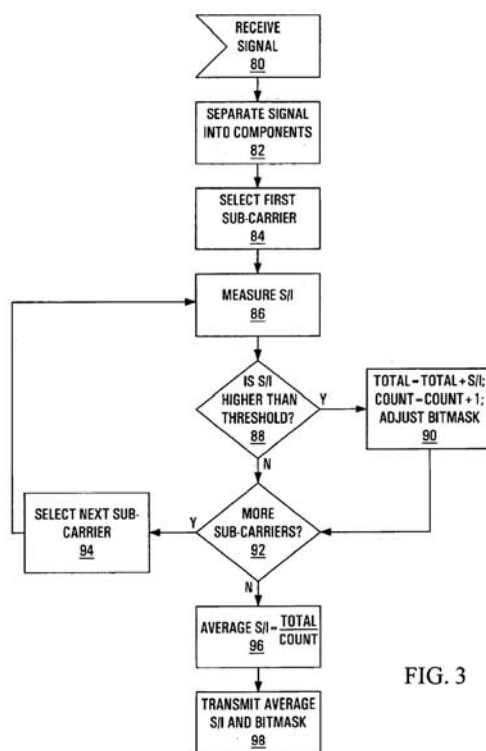
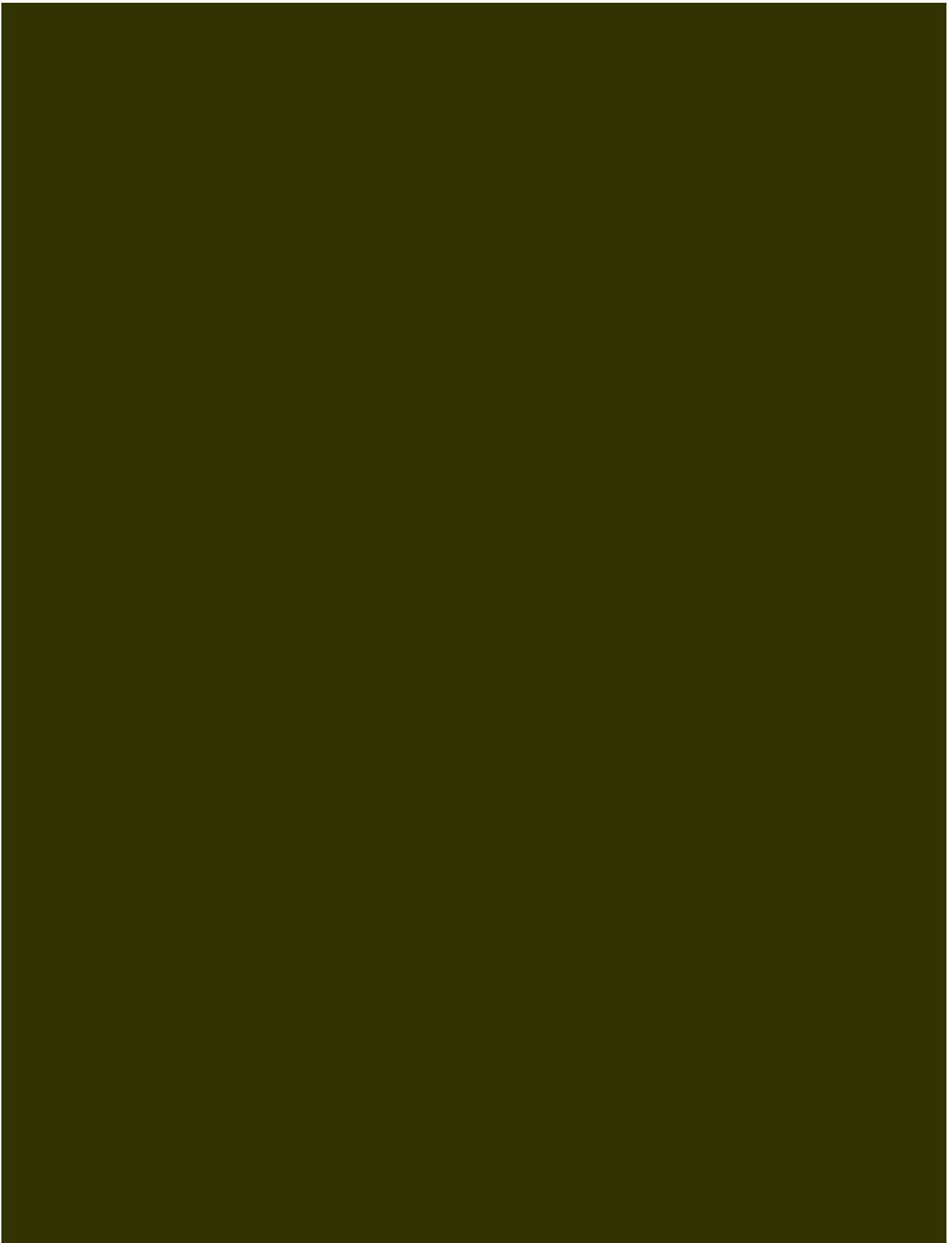
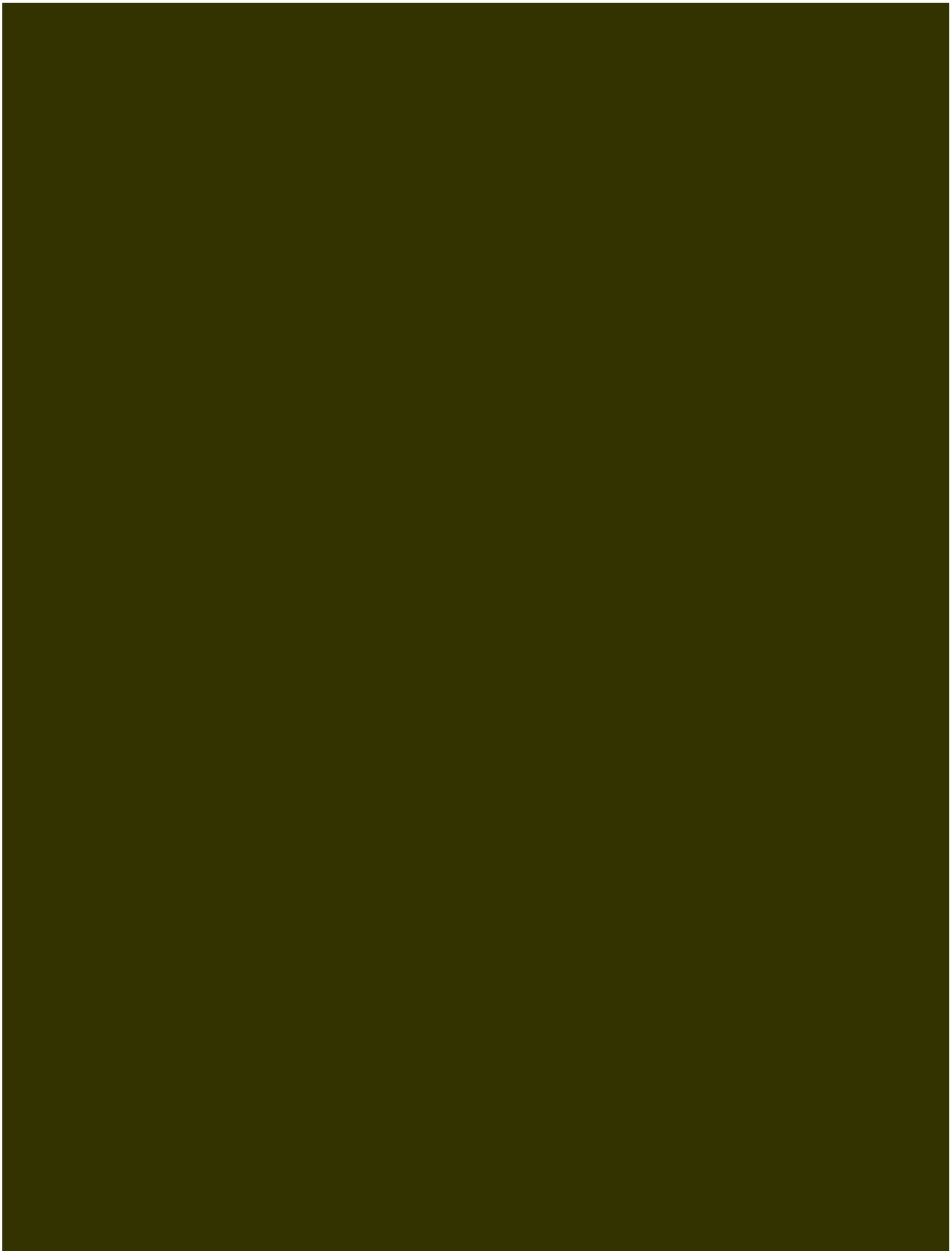
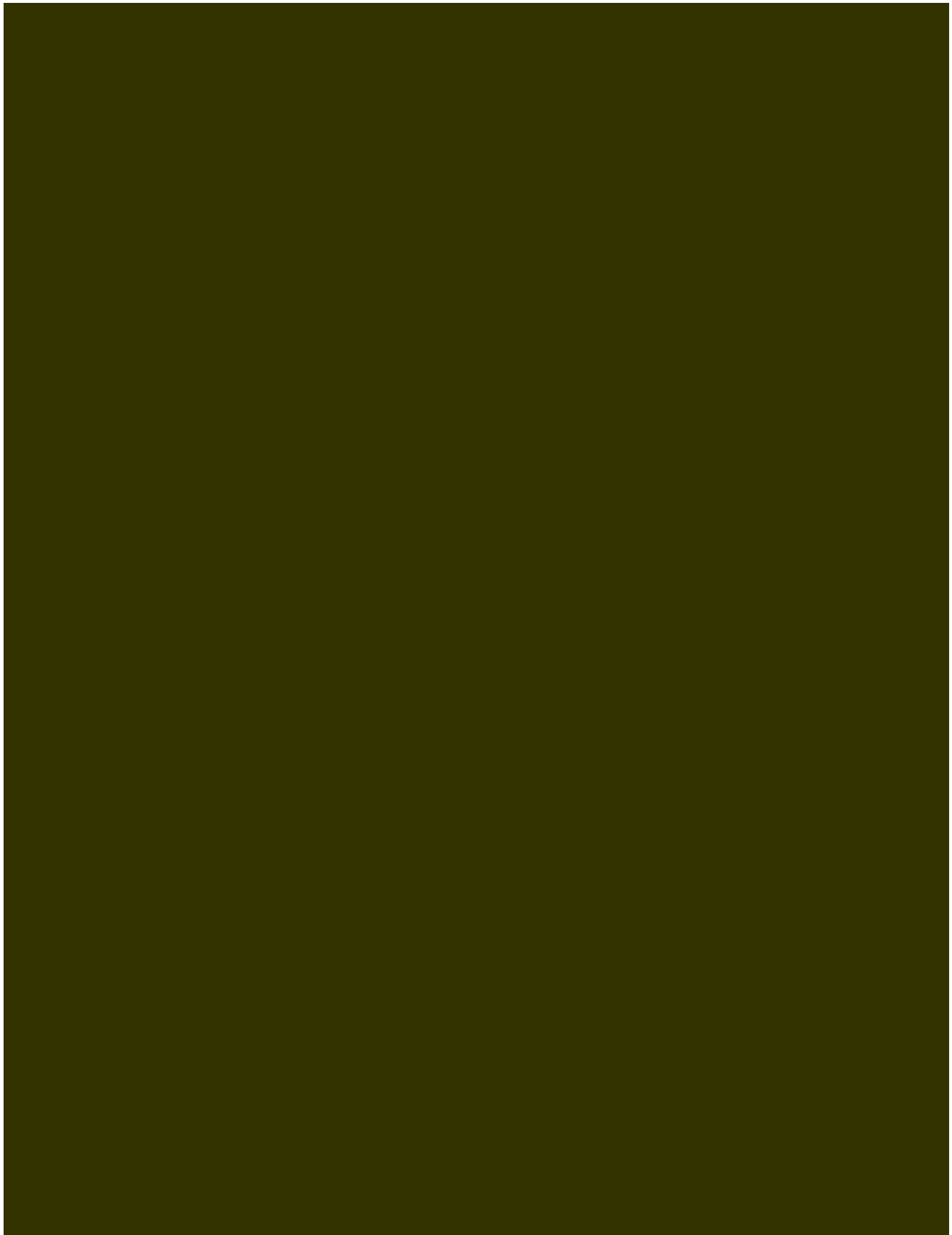


FIG. 3

1356. The iterative loop beginning at the “Measure S/I” block 86 through the “select next sub-carrier” block 94 shows that the remote unit takes S/I measurements for each subcarrier until there are no more subcarriers as indicated by block 92 (“more sub-subcarriers?”). Even if the term “cluster of subcarriers” in this claim element is read more narrowly to require “at least two logical units of subcarriers,” Hashem '569 discloses this. For example, Hashem '569 discloses that “[t]he remote unit determines a channel quality (such as a signal to interference







XXVI. '212 PATENT, CLAIM 20

1363. Although claim 20 is not asserted by Adaptix, Adaptix asserts claim 21, which is dependent on claim 20. As such, I will analyze claim 20 to the extent it is required for my analysis of claim 21.

1364. Claim 20 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 20 of the '212 Patent reads: “The apparatus defined in claim 19 wherein each of the plurality of subscriber units measures inter-cell interference, wherein the at least one subscriber unit selects candidate subcarriers based on the inter-cell interference.”

A. Claim 20 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1365. Claim 20 reads: “**The apparatus defined in claim 19 wherein each of the plurality of subscriber units measures inter-cell interference, wherein the at least one subscriber unit selects candidate subcarriers based on the inter-cell interference.**”

1366. Ritter discloses this element.

1367. As described above in '748 Patent claim element 6[a][1] and '212 Patent claim element 19, Ritter discloses an apparatus in which inter-cell interference information – in the form of a priority list of subcarrier segments that are sufficiently “suitable” – is fed back from each mobile station to its base station. In so doing, the subscriber units measures inter-cell interference (it was well-known to persons of ordinary skill in the art at the time of the invention that inter-cell interference was one of the most common sources of interference in wireless cellular communication systems). *See also* Hashem '129 at 8:10-11 (explaining that the blinking pilot measurement techniques of Fig. 6 “indicates a level of interference within the pilot sub-carrier.”). As more fully described at '748 Patent claim element 6[b], the mobile station in Ritter selects candidate subcarriers based on interference measurements. For example, Ritter makes

clear that a segment's "suitability" is determined at least in part by the extent to which it is subject to inter-cell interference:

Through the improved frequency resource allocation method (smart frequency hopping approach) according to the invention, interferences, especially the intercellular interferences that are critical in wireless communication systems and the inter-symbol interferences, can be taken into consideration and at least reduced or eliminated altogether. (Ritter at 4 col. 2 ¶ 3.)

1368. Thus, Ritter discloses "the apparatus defined in claim 19 wherein each of the plurality of subscriber units measures inter-cell interference, wherein the at least one subscriber unit selects candidate subcarriers based on the inter-cell interference."

B. Claim 20 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1369. Claim 20 reads: "**The apparatus defined in claim 19 wherein each of the plurality of subscriber units measures inter-cell interference, wherein the at least one subscriber unit selects candidate subcarriers based on the inter-cell interference.**"

1370. This limitation is disclosed by, at least, the Sollenberger Patent.

1371. The remote units in the Sollenberger Patent measure SIR as described above for '748 Patent claim element 6[a][1] and '212 Patent claim element 19. SIR, by definition, includes interference measurement information. Interference from other cells would be included in the SIR measurement. Further, as discussed with respect to '748 Patent claim element 6[b], the Sollenberger Patent discloses a method in which the wireless station uses "an index variable j" to scan channels in priority order, measures the SIR on each channel, compares the measured SIR to a predetermined threshold, and adds the channel to a list of acceptable channels if the SIR is above the predetermined threshold. (See Sollenberger Patent at 9:1-40 (describing process).)

1372. Thus, the Sollenberger Patent discloses this limitation.

C. **Claim 20 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter**

1373. Claim 20 reads: **“The apparatus defined in claim 19 wherein each of the plurality of subscriber units measures inter-cell interference, wherein the at least one subscriber unit selects candidate subcarriers based on the inter-cell interference.”**

1374. Hashem '569 discloses this element. As previously explained for '748 Patent claim element 6[a][1] and '212 Patent claim element 19, Hashem '569 discloses that each remote unit measures a signal to interference (S/I) ratio for each subcarrier. *See also* Hashem '569 at 2:28-32; *see also id.* at Fig. 3 and related discussion. In so doing, the subscriber units measures inter-cell interference (it was well-known to persons of ordinary skill in the art at the time of the invention that inter-cell interference was one of the most common sources of interference in wireless cellular communication systems). *See also* Hashem '129 at 8:10-11 (explaining that the blinking pilot measurement techniques of Fig. 6 “indicates a level of interference within the pilot sub-carrier.”). The remote unit then selects candidate subcarriers based on the inter-cell interference. This is illustrated in Fig. 2, pasted below, which shows a threshold (horizontal line 44) that serves as an S/I cutoff for the remote unit to distinguish between and select acceptable and unacceptable subcarriers. *See* Hashem '569 at 4:26-38; 5:41-6:3.

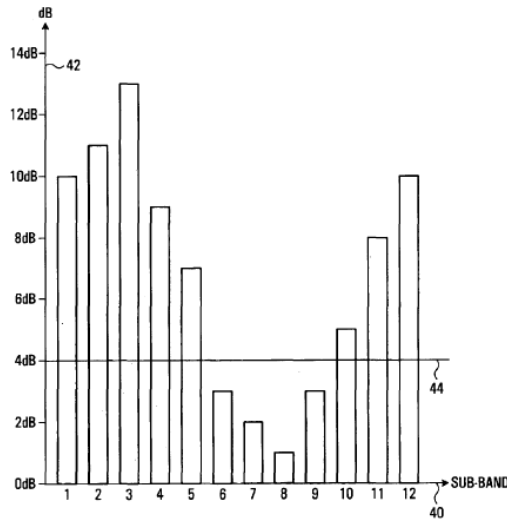


FIG. 2

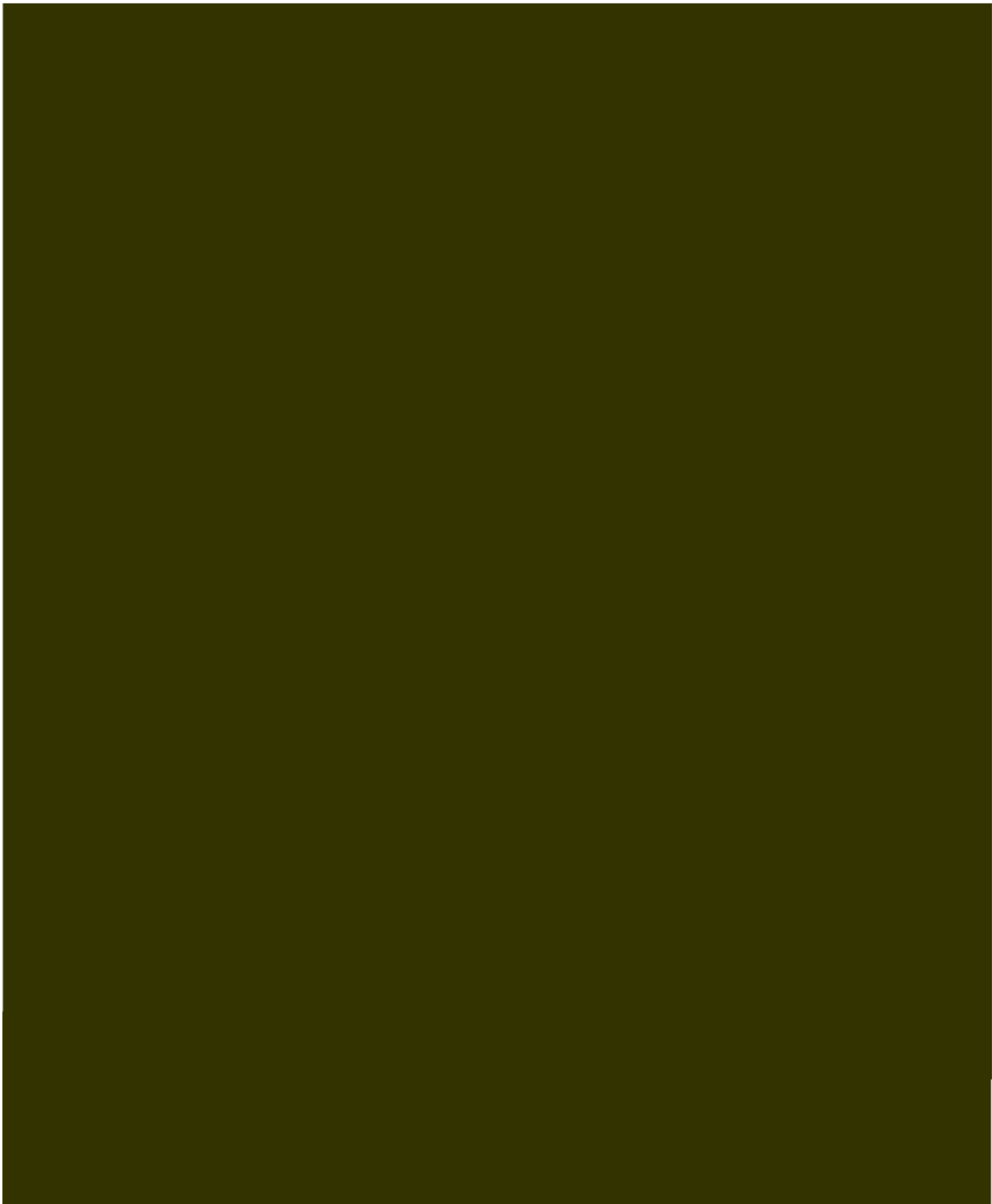
(Hashem '569, Fig. 2.)

1375. Hashem '569 explains that:

The sub-carrier signals are also passed to a sub-carrier analysis processor 26 within the remote unit. The sub-carrier analysis processor 26 measures a signal to interference ratio (S/I) of each sub-carrier signal. ***The sub-carrier analysis processor 26 compares the S/I of each sub-carrier signal with a threshold to determine which sub-carriers are acceptable sub-carriers.*** Acceptable sub-carriers are sub-carriers for which the measured S/I of the corresponding sub-carrier signal is higher than the threshold. Sub-carriers for which the measured S/I of the corresponding sub-carrier signal is not higher than the threshold are unacceptable sub-carriers.

(Hashem '569 at 4:26-38.)

1376. In this manner, Hashem '569 discloses “wherein each of the plurality of subscriber units measures inter-cell interference, [and] wherein the at least one subscriber unit selects candidate subcarriers based on the inter-cell interference.”



1383. As described above, Ritter discloses an apparatus in which inter-cell interference information – in the form of a priority list of subcarrier segments that are sufficiently “suitable” – is fed back from each mobile station to its base station. Ritter makes clear that a segment’s “suitability” is determined at least in part by the extent to which it is subject to inter-cell interference:

Through the improved frequency resource allocation method (smart frequency hopping approach) according to the invention, interferences, especially the intercellular interferences that are critical in wireless communication systems and the inter-symbol interferences, can be taken into consideration and at least reduced or eliminated altogether. (Ritter at 4 col. 2 ¶ 3.)

1384. Further, Ritter discloses the base station, after receiving feedback from a mobile station in its coverage area, uses that information (and other information it has available to it, including inter-cell interference avoidance information) to assign segments to mobile stations. This is done by transmitting an appropriate message to each mobile station.

The base station BS evaluates all of the information received from the mobile stations MS and, depending on the evaluation of each mobile station, allocates a segment for the respective communication connection. The base station sends a message regarding the respectively allocated segment to each mobile station. In the present example it is assumed that each mobile station MS can have the most suitable segment that it desires allocated to it. This also depends on the transmission conditions and/or the load on the wireless cell served by the base station BS according to specifications of the operation and maintenance center OMC or the base station control BSC for wireless resource management. Thus the first mobile station MS receives the segment S_x, the second mobile station MS the section S_a and the third mobile station MS the segment S_m, in each case with the corresponding OFDMA subcarriers co... allocated by the base station.

(Ritter at 4.)

1385. In this manner, the base station in Ritter “obtains knowledge about the wishes of all mobile stations with regard to the segment or segments most suitable for them and can make corresponding new assignments of the segments of the frequency spectrum to all mobile stations, better adapted to their transmitted needs.” (Ritter at 3 col.1. ¶ 1.)

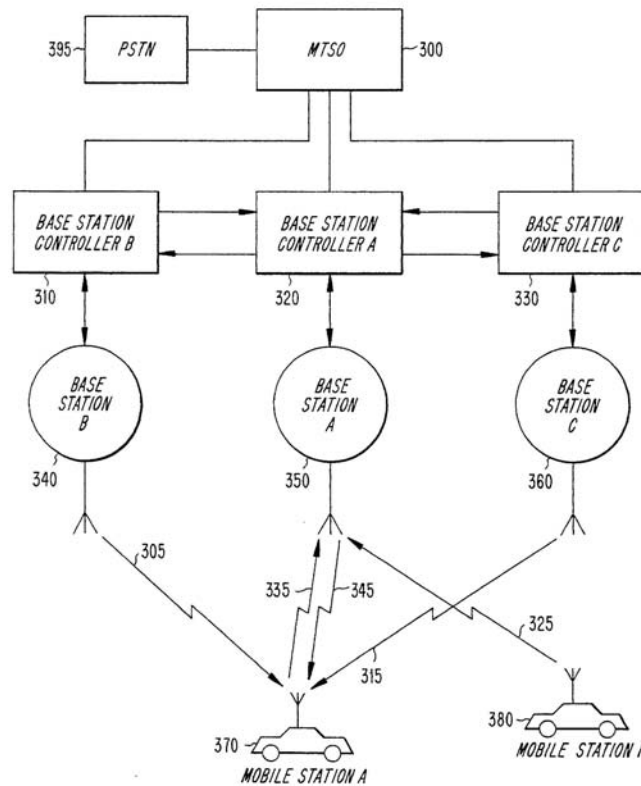
1386. Thus, Ritter discloses “the apparatus defined in claim 20 wherein the base station selects subcarriers for the one subscriber unit based on inter-cell interference avoidance.”

1387. Alternatively, to the extent Ritter does not disclose this element, one skilled in the art would have known to modify Ritter to satisfy this element, or would have been motivated to combine Ritter with the teachings of Haartsen ’837 or Liu ’315 (as discussed with respect to ’748 Patent claim element 11). For example, and as explained in my analysis for ’748 patent claim elements 11[b][1] and 11[b][2], both Haartsen ’837 and Liu ’315 teach inter-cell interference avoidance through coordination between neighboring base stations. For example, Haartsen ’837 states:

The channel allocation scheme described by this invention makes use of periodic measurements performed both by one or more base stations and/or by one or more mobile stations to determine the best channel under the current radio environment. (Haartsen ’837 at 5:31-35.)

1388. Figure 3 of Haartsen ’837, reproduced below, illustrates the communication between the base station controllers (310, 320, and 330) that enables coordination between cells for channel allocation and interference avoidance:

Fig. 3



1389. Further, Haartsen '837 discloses the advantages of coordination amongst base stations as part of both predicting interference as well as conducting adaptive allocation of downlink resources. For example:

To predict the downlink interference, one should identify the base stations in a wide range around the mobile station that are transmitting on the same channel. The location of these bases and the power levels they are currently using on the considered channel, must be directed to the base station controller doing the ACAPC processing (*e.g.*, in the example of FIG. 3, this is base station controller 320.) This can be accomplished, for example, directly through the MTSO 300. Adjacent channel interference can also be included if it is corrected with the adjacent channel rejection factor. (Haartsen '837 at 13:22-30.)

1390. Like Haartsen '837, Liu '315 also discloses coordination among cells to avoid inter-cell interference when making a cluster assignment decision.

1391. In such an embodiment, in a multi-cell environment, the base station within each cell first estimates the uplink and downlink SINRs across all OFDMA traffic channels for all

active and accessing subscribers. Each base-station may also buffer the QoS requirements (*e.g.*, data rate, time-out, bit error rate, waiting time). Base-stations in neighboring cells exchange such information before performing a traffic channel allocation jointly for multiple subscribers.

(Liu '315 at 6:49-57 (emphasis added).)

1392. Moreover, Liu '315 discloses that “[t]raffic channel conditions, assignment tables, as well as QoS requirements of all accessing subscribers of neighboring cells, may be accounted for in performing traffic channel assignment.” (Liu '315 at 11:37-40.)

1393. As such, Liu '315 sets forth an entire system disclosing the limitations of this element:

[E]ach subscriber is subject to interference from neighboring cells in a multi-cell setup. ***To increase, and potentially maximize, the spectral efficiency for ever-changing traffic, coordination among base-stations and subscribers is considered in traffic channel assignment.*** FIG. 2 illustrates that the channel gain for different channels changes based on the subcarrier being examined. For example, while channels 1 and 2 has good gain at certain subchannels, they also have poorer gains at others. ***The present invention makes intelligent decisions about channel assignments for multi-users so that multiple channels are jointly allocated to multiple subscribers based on which channels have desirable characteristics (e.g., higher gains, lower interference, etc.) for each particular subscriber.***

(Liu '315 at 7:50-63 (emphasis added).)

1394. As evidenced by the similar disclosures of Haartsen '837 and Liu '315, these techniques were generally known to those skilled in the art at the time of the claimed inventions. Thus, one of ordinary skill in the art would know to modify Ritter, or alternatively would have been motivated to combine Ritter with Haartsen '837 or Liu '315 for “wherein the base station selects subcarriers for the one subscriber unit based on inter-cell interference avoidance.”

B. Claim 21 of the '212 Patent is Rendered Obvious by the Sollenberger Publications, and Alternatively in Combination with Haartsen '837 or Liu '315

1395. Claim 21 reads: “**The apparatus defined in claim 20 wherein the base station selects subcarriers for the one subscriber unit based on inter-cell interference avoidance.**”

1396. This element is disclosed by, at least, the Sollenberger Article. As noted above, the Sollenberger Article describes a protocol with four basic steps:

The basic protocol for a downlink comprises four basic steps: (1) a packet page from a base station to a terminal; (2) rapid measurements of resource usage by a terminal using the parallelism of an OFDM receiver; (3) a short report from the terminal to the base station of the potential transmission quality associated with each radio resource; and (4) **selection of resources by the base and transmission of the data.** (Sollenberger Article at 758-759 (emphasis added).)

1397. The last of the four steps indicates that the resources are selected by the base for use by the subscriber, as required by this element. Moreover, Figure 3.2 from the Sollenberger Article, reproduced below, indicates that the “list of assigned channels” is transmitted from the base station to the mobile stations in the coverage area of the base station, one base station each frame and four base stations in each “superframe” of 80.0 ms.

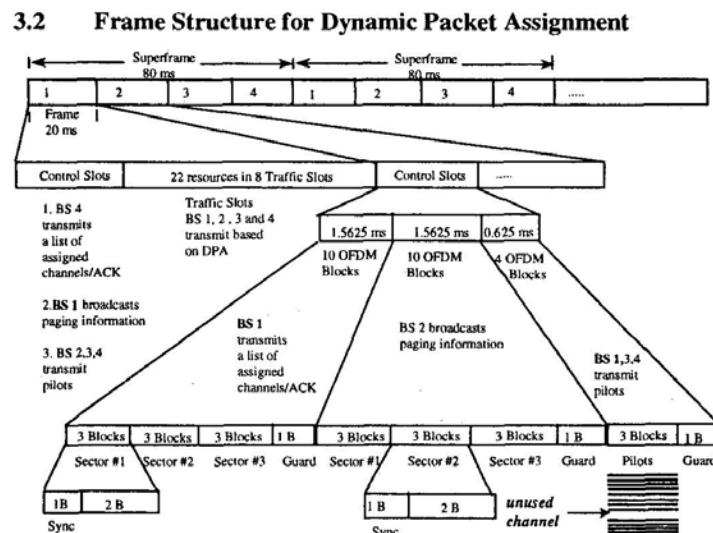


Figure 3. Staggered frame structure for downlink DPA

1398. The Sollenberger Article further discloses “[t]he frame structures of the adjacent base stations are staggered in time, *i.e.* neighboring base stations sequentially perform the four different DPA functions outlined above with a pre-determined rotational schedule. This avoids collisions of channel assignments.” (Sollenberger Article at 759.)

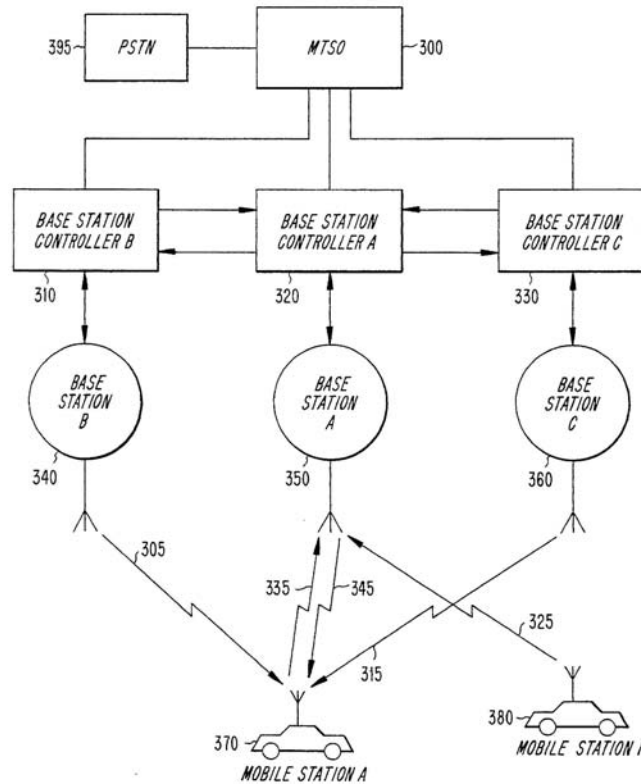
1399. Thus, the Sollenberger Article discloses “wherein the base station selects subcarriers for the one subscriber unit based on inter-cell interference avoidance.”

1400. Alternatively, to the extent the Sollenberger Article does not disclose this element, one skilled in the art would have known to modify the Sollenberger Article to satisfy this element, or would have been motivated to combine the Sollenberger Article with the teachings of Haartsen ’837 or Liu ’315 (as discussed with respect to ’748 Patent claim element 11). For example, and as explained in my analysis for ’748 patent claim elements 11[b][1] and 11[b][2], both Haartsen ’837 and Liu ’315 teach inter-cell interference avoidance through coordination between neighboring base stations. For example, Haartsen ’837 states:

The channel allocation scheme described by this invention makes use of periodic measurements performed both by one or more base stations and/or by one or more mobile stations to determine the best channel under the current radio environment. (Haartsen ’837 at 5:31-35.)

1401. Figure 3 of Haartsen ’837, reproduced below, illustrates the communication between the base station controllers (310, 320, and 330) that enables coordination between cells for channel allocation and interference avoidance:

Fig. 3



1402. Further, Haartsen '837 discloses the advantages of coordination amongst base stations as part of both predicting interference as well as conducting adaptive allocation of downlink resources. For example:

To predict the downlink interference, one should identify the base stations in a wide range around the mobile station that are transmitting on the same channel. The location of these bases and the power levels they are currently using on the considered channel, must be directed to the base station controller doing the ACAPC processing (*e.g.*, in the example of FIG. 3, this is base station controller 320.) This can be accomplished, for example, directly through the MTSO 300. Adjacent channel interference can also be included if it is corrected with the adjacent channel rejection factor. (Haartsen '837 at 13:22-30.)

1403. Like Haartsen '837, Liu '315 also discloses coordination among cells to avoid inter-cell interference when making a cluster assignment decision.

1404. In such an embodiment, in a multi-cell environment, the base station within each cell first estimates the uplink and downlink SINRs across all OFDMA traffic channels for all

active and accessing subscribers. Each base-station may also buffer the QoS requirements (*e.g.*, data rate, time-out, bit error rate, waiting time). Base-stations in neighboring cells exchange such information before performing a traffic channel allocation jointly for multiple subscribers.

(Liu '315 at 6:49-57 (emphasis added).)

1405. Moreover, Liu '315 discloses that “[t]raffic channel conditions, assignment tables, as well as QoS requirements of all accessing subscribers of neighboring cells, may be accounted for in performing traffic channel assignment.” (Liu '315 at 11:37-40.)

1406. As such, Liu '315 sets forth an entire system disclosing the limitations of this element:

[E]ach subscriber is subject to interference from neighboring cells in a multi-cell setup. ***To increase, and potentially maximize, the spectral efficiency for ever-changing traffic, coordination among base-stations and subscribers is considered in traffic channel assignment.*** FIG. 2 illustrates that the channel gain for different channels changes based on the subcarrier being examined. For example, while channels 1 and 2 has good gain at certain subchannels, they also have poorer gains at others. ***The present invention makes intelligent decisions about channel assignments for multi-users so that multiple channels are jointly allocated to multiple subscribers based on which channels have desirable characteristics (e.g., higher gains, lower interference, etc.) for each particular subscriber.***

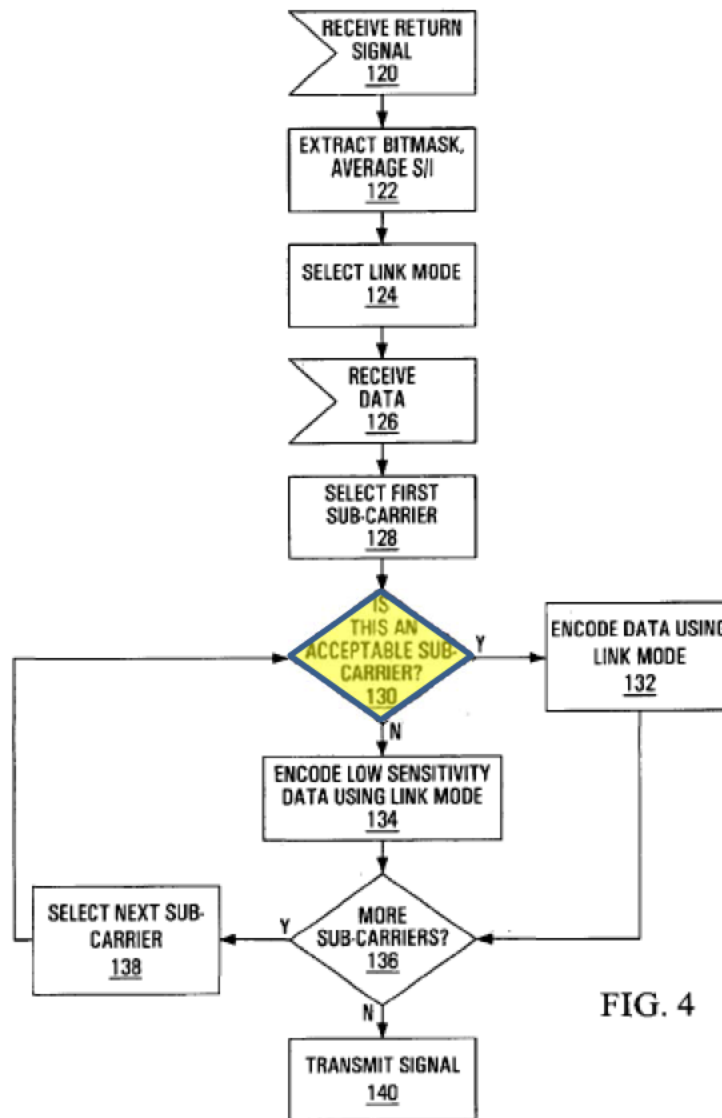
(Liu '315 at 7:50-63 (emphasis added).)

1407. As evidenced by the similar disclosures of Haartsen '837 and Liu '315, these techniques were generally known to those skilled in the art at the time of the claimed inventions. Thus, one of ordinary skill in the art would know to modify the Sollenberger Article, or alternatively would have been motivated to combine the Sollenberger Article with Haartsen '837 or Liu '315, for “wherein the base station selects subcarriers for the one subscriber unit based on inter-cell interference avoidance.”

C. Claim 21 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter, and Alternatively in Combination with Haartsen '837 or Liu '315

1408. Claim 21 reads: “**The apparatus defined in claim 20 wherein the base station selects subcarriers for the one subscriber unit based on inter-cell interference avoidance.**”

1409. Hashem '569 discloses this element. In a similar manner to how the remote unit in Hashem '569 satisfied the “select[ing] ... subcarriers based on ... inter-cell interference” limitation in '212 Patent claim 20, the base station in Hashem '569 satisfies the requirement in claim 21 that the base station selects subcarriers “based on inter-cell interference avoidance.” In particular, the remote unit reports S/I information for candidate subcarriers to the base station which includes inter-cell interference information. See Hashem '569 at 4:26-38 and 5:41-6:3. Hashem '569 discloses that the base station then determines (as is shown in step 130 of Fig. 4, pasted below), based on the S/I information, whether particular subcarriers are “acceptable.” See Hashem '569 at 6:4-48.



1410. In addition, Hashem '569 describes a system in which the subscriber receives from the base station a set of optimum transmission parameters that were based on the interference feedback provided by the subscribers:

The remote unit sends a signal back to the base station reporting the channel quality. *Using the channel quality report received from the remote unit, the base station calculates a set of optimum transmission parameters which the base station will use in its next transmission of data.* However, the base station must first send the set of new optimum transmission parameters to the remote unit using the previous transmission parameters. The remote unit receives the set of new optimum transmission parameters, interpreting the signal using the previous transmission parameters. (Hashem '569 at 1:39-49 (emphasis added).)

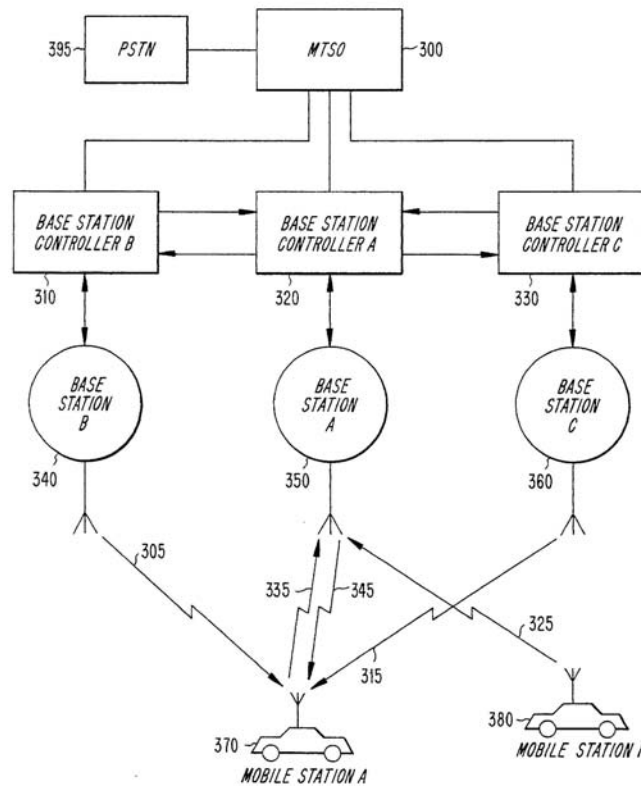
1411. Thus, Hashem '569 discloses “wherein the base station selects subcarriers for the one subscriber unit based on inter-cell interference avoidance.”

1412. Alternatively, to the extent Hashem '569 does not disclose this element, one skilled in the art would have known to modify Hashem '569 to satisfy this element, or would have been motivated to combine Hashem '569 with the teachings of Haartsen '837 or Liu '315 (as discussed with respect to '748 Patent claim element 11). For example, and as explained in my analysis for '748 patent claim elements 11[b][1] and 11[b][2], both Haartsen '837 and Liu '315 teach inter-cell interference avoidance through coordination between neighboring base stations. For example, Haartsen '837 states:

The channel allocation scheme described by this invention makes use of periodic measurements performed both by one or more base stations and/or by one or more mobile stations to determine the best channel under the current radio environment. (Haartsen '837 at 5:31-35.)

1413. Figure 3 of Haartsen '837, reproduced below, illustrates the communication between the base station controllers (310, 320, and 330) that enables coordination between cells for channel allocation and interference avoidance:

Fig. 3



1414. Further, Haartsen '837 discloses the advantages of coordination amongst base stations as part of both predicting interference as well as conducting adaptive allocation of downlink resources. For example:

To predict the downlink interference, one should identify the base stations in a wide range around the mobile station that are transmitting on the same channel. The location of these bases and the power levels they are currently using on the considered channel, must be directed to the base station controller doing the ACAPC processing (*e.g.*, in the example of FIG. 3, this is base station controller 320.) This can be accomplished, for example, directly through the MTSO 300. Adjacent channel interference can also be included if it is corrected with the adjacent channel rejection factor. (Haartsen '837 at 13:22-30.)

1415. Like Haartsen '837, Liu '315 also discloses coordination among cells to avoid inter-cell interference when making a cluster assignment decision.

1416. In such an embodiment, in a multi-cell environment, the base station within each cell first estimates the uplink and downlink SINRs across all OFDMA traffic channels for all

active and accessing subscribers. Each base-station may also buffer the QoS requirements (*e.g.*, data rate, time-out, bit error rate, waiting time). Base-stations in neighboring cells exchange such information before performing a traffic channel allocation jointly for multiple subscribers.

(Liu '315 at 6:49-57 (emphasis added).)

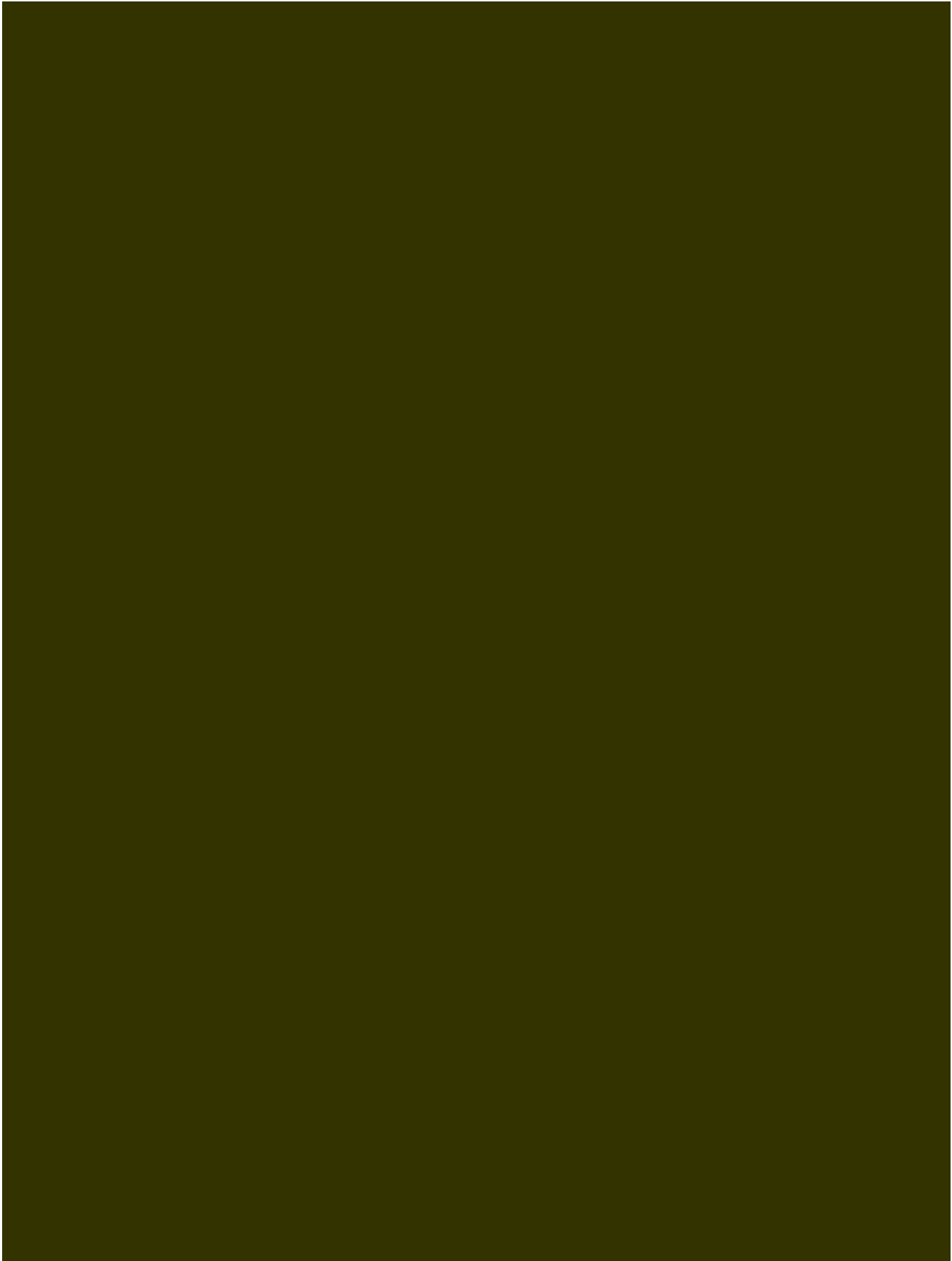
1417. Moreover, Liu '315 discloses that “[t]raffic channel conditions, assignment tables, as well as QoS requirements of all accessing subscribers of neighboring cells, may be accounted for in performing traffic channel assignment.” (Liu '315 at 11:37-40.)

1418. As such, Liu '315 sets forth an entire system disclosing the limitations of this element:

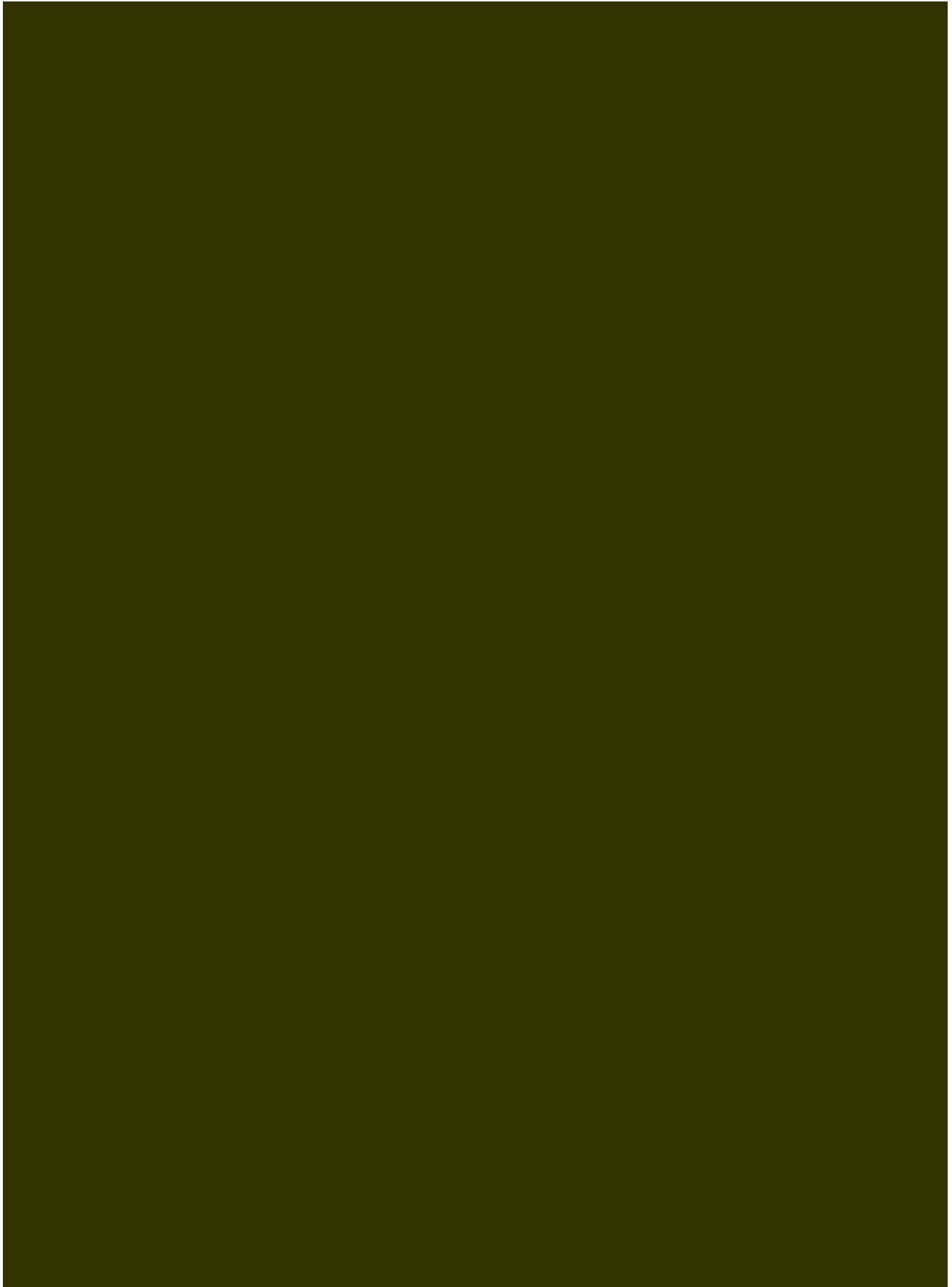
[E]ach subscriber is subject to interference from neighboring cells in a multi-cell setup. ***To increase, and potentially maximize, the spectral efficiency for ever-changing traffic, coordination among base-stations and subscribers is considered in traffic channel assignment.*** FIG. 2 illustrates that the channel gain for different channels changes based on the subcarrier being examined. For example, while channels 1 and 2 has good gain at certain subchannels, they also have poorer gains at others. ***The present invention makes intelligent decisions about channel assignments for multi-users so that multiple channels are jointly allocated to multiple subscribers based on which channels have desirable characteristics (e.g., higher gains, lower interference, etc.) for each particular subscriber.***

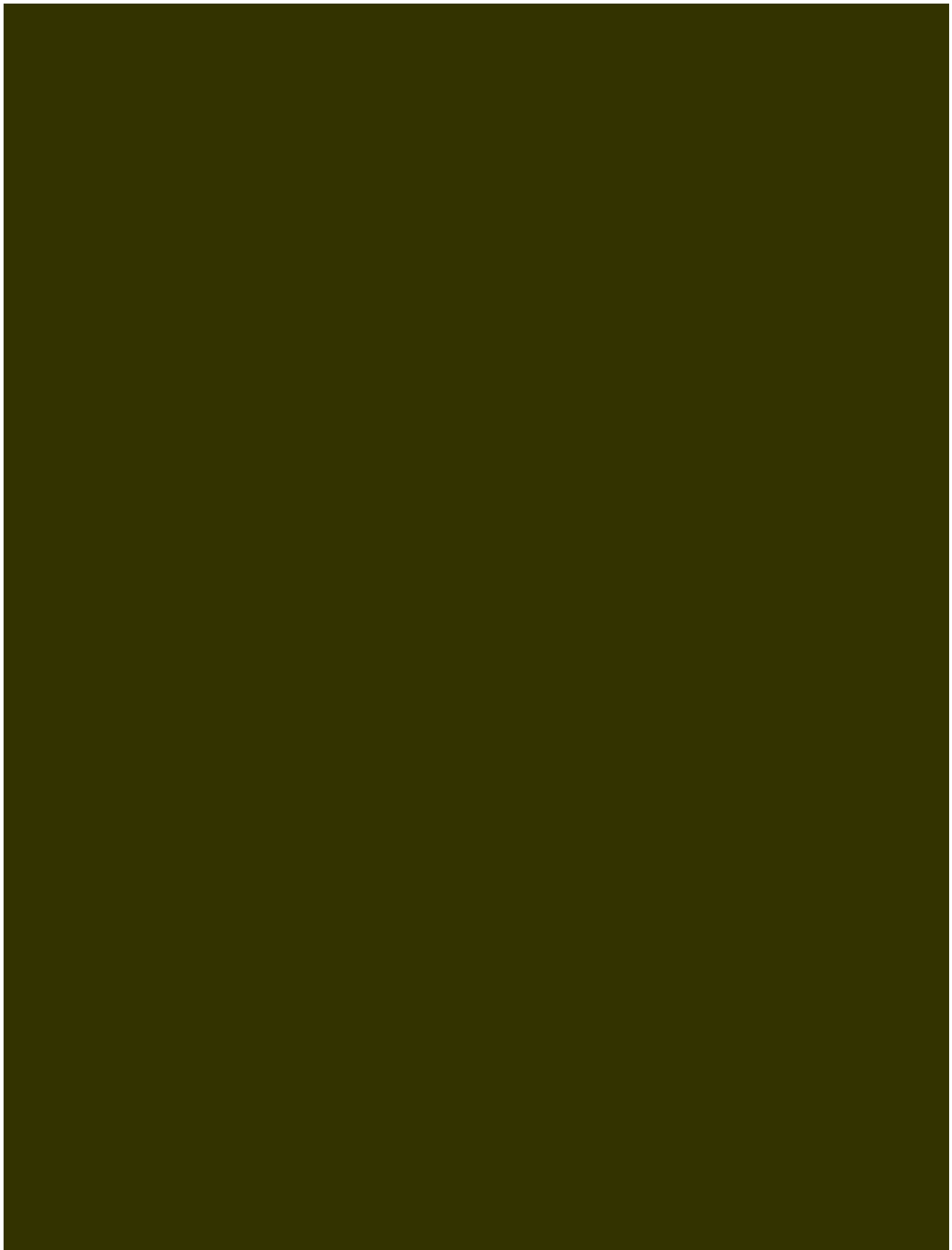
(Liu '315 at 7:50-63 (emphasis added).)

1419. As evidenced by the similar disclosures of Haartsen '837 and Liu '315, these techniques were generally known to those skilled in the art at the time of the claimed inventions. Thus, one of ordinary skill in the art would know to modify Hashem '569, or alternatively would have been motivated to combine Hashem '569 with Haartsen '837 or Liu '315 for “wherein the base station selects subcarriers for the one subscriber unit based on inter-cell interference avoidance.”









B. Claim 23 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1434. Claim 23 reads: “**The apparatus defined in claim 18 wherein the base station selects the subcarriers from the set of candidate subcarriers based on additional information available to the base station.**”

1435. This element is satisfied by the disclosure set forth at '212 Patent claim 8.

C. Claim 23 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1436. Claim 23 reads: “**The apparatus defined in claim 18 wherein the base station selects the subcarriers from the set of candidate subcarriers based on additional information available to the base station.**”

1437. This element is satisfied by the disclosure set forth at '212 Patent claim 8.

D. Claim 23 of the '212 Patent is Anticipated and/or Rendered Obvious by the Project Angel System

1438. Claim 23 reads: “**The apparatus defined in claim 18 wherein the base station selects the subcarriers from the set of candidate subcarriers based on additional information available to the base station.**”

1439. This element is satisfied by the disclosure set forth at '212 Patent claim 8.

XXIX. '212 PATENT, CLAIM 24

1440. Claim 24 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 24 of the '212 Patent reads: “The apparatus defined in claim 23 wherein the additional information comprises traffic load information on each cluster of subcarriers.”

A. Claim 24 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1441. Claim 24 reads: “**The apparatus defined in claim 23 wherein the additional information comprises traffic load information on each cluster of subcarriers.**”

1442. This element is satisfied by the disclosure set forth at '212 Patent claim 9.

B. Claim 24 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1443. Claim 24 reads: “**The apparatus defined in claim 23 wherein the additional information comprises traffic load information on each cluster of subcarriers.**”

1444. This element is satisfied by the disclosure set forth at '212 Patent claim 9.

C. Claim 24 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1445. Claim 24 reads: “**The apparatus defined in claim 23 wherein the additional information comprises traffic load information on each cluster of subcarriers.**”

1446. This element is satisfied by the disclosure set forth at '212 Patent claim 9.

D. Claim 24 of the '212 Patent is Anticipated and/or Rendered Obvious by the Project Angel System

1447. Claim 24 reads: “**The apparatus defined in claim 23 wherein the additional information comprises traffic load information on each cluster of subcarriers.**”

1448. This element is satisfied by the disclosure set forth at '212 Patent claim 9.

XXX. '212 PATENT, CLAIM 25

1449. Claim 25 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 25 of the '212 Patent reads: “The apparatus defined in claim 24 wherein the traffic load information is provided by a data buffer in the base station.”

A. Claim 25 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1450. Claim 25 reads: “**The apparatus defined in claim 24 wherein the traffic load information is provided by a data buffer in the base station.**”

1451. This element is satisfied by the disclosure set forth at '212 Patent claim element 10.

B. Claim 25 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1452. Claim 25 reads: “**The apparatus defined in claim 24 wherein the traffic load information is provided by a data buffer in the base station.**”

1453. This element is satisfied by the disclosure set forth at '212 Patent claim element 10.

C. Claim 25 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1454. Claim 25 reads: “**The apparatus defined in claim 24 wherein the traffic load information is provided by a data buffer in the base station.**”

1455. This element is satisfied by the disclosure set forth at '212 Patent claim element 10.

D. Claim 25 of the '212 Patent is Rendered Obvious by the Project Angel System

1456. Claim 25 reads: “**The apparatus defined in claim 24 wherein the traffic load information is provided by a data buffer in the base station.**”

1457. This element is satisfied by the disclosure set forth at '212 Patent claim element 10.

XXXI. '212 PATENT, CLAIM 26

1458. Claim 26 of the '212 Patent reads: “The apparatus defined in claim 18 wherein the indication of subcarriers is received via a downlink control channel between the base station and the at least one subscriber unit.”

A. Claim 26 of the '212 Patent is Indefinite

1459. As set forth above, in my analysis of claim 11 of the '212 Patent, it is my opinion that claim 26 of the '212 Patent is indefinite.

1460. Notwithstanding, I have evaluated claim 26 of the '212 Patent under Adaptix's apparent interpretation of the claim. Based on that interpretation, it is my opinion that claim 26 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below.

B. Claim 26 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1461. Claim 26 reads: “**The apparatus defined in claim 18 wherein the indication of subcarriers is received via a downlink control channel between the base station and the at least one subscriber unit.**”

1462. This element is satisfied by the disclosure set forth at '212 Patent claim element 11.

C. Claim 26 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1463. Claim 26 reads: “**The apparatus defined in claim 18 wherein the indication of subcarriers is received via a downlink control channel between the base station and the at least one subscriber unit.**”

1464. This element is satisfied by the disclosure set forth at '212 Patent claim element 11.

D. Claim 26 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1465. Claim 26 reads: “**The apparatus defined in claim 18 wherein the indication of subcarriers is received via a downlink control channel between the base station and the at least one subscriber unit.**”

1466. This element is satisfied by the disclosure set forth at '212 Patent claim element 11.

E. Claim 26 of the '212 Patent is Anticipated and/or Rendered Obvious by the Project Angel System

1467. Claim 26 reads: “**The apparatus defined in claim 18 wherein the indication of subcarriers is received via a downlink control channel between the base station and the at least one subscriber unit.**”

1468. This element is satisfied by the disclosure set forth at '212 Patent claim element 11.

XXXII. '212 PATENT, CLAIM 27

A. Introduction

1469. Claim 27 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 27 of the '212 Patent reads: “The apparatus defined in claim 18 wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.”

B. Claim 27 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1470. Claim 27 reads: “**The apparatus defined in claim 18 wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.**”

1471. This element is satisfied by the disclosure set forth at '212 Patent claim element 12.

C. Claim 27 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1472. Claim 27 reads: “**The apparatus defined in claim 18 wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.**”

1473. This element is satisfied by the disclosure set forth at '212 Patent claim element 12.

D. Claim 27 of '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1474. Claim 27 reads: “**The apparatus defined in claim 18 wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.**”

1475. This element is satisfied by the disclosure set forth at '212 Patent claim element 12.

E. Claim 27 of the '212 Patent is Anticipated and/or Rendered Obvious by the Project Angel System

1476. Claim 27 reads: “**The apparatus defined in claim 18 wherein the plurality of subcarriers comprises all subcarriers allocable by a base station.**”

1477. This element is satisfied by the disclosure set forth at '212 Patent claim element 12.

XXXIII. '212 PATENT, CLAIM 28

1478. Claim 28 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 28 of the '212 Patent reads: “The apparatus defined in claim 18 wherein the plurality of subscriber units provide feedback information that comprises an arbitrarily ordered set of candidate subcarriers as clusters of subcarriers.”

A. Claim 28 of the '212 Patent is Rendered Obvious by Ritter in Combination with Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1479. Claim 28 reads: “**The apparatus defined in claim 18 wherein the plurality of subscriber units provide feedback information that comprises an arbitrarily ordered set of candidate subcarriers as clusters of subcarriers.**”

1480. This element is satisfied by the disclosure set forth at '212 Patent claim element 13.

B. Claim 28 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1481. Claim 28 reads: “**The apparatus defined in claim 18 wherein the plurality of subscriber units provide feedback information that comprises an arbitrarily ordered set of candidate subcarriers as clusters of subcarriers.**”

1482. This element is satisfied by the disclosure set forth at '212 Patent claim element 13.

C. Claim 28 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1483. Claim 28 reads: “**The apparatus defined in claim 18 wherein the plurality of subscriber units provide feedback information that comprises an arbitrarily ordered set of candidate subcarriers as clusters of subcarriers.**”

1484. This element is satisfied by the disclosure set forth at '212 Patent claim element 13.

D. Claim 28 of the '212 Patent is Anticipated and/or Rendered Obvious by the Project Angel System

1485. Claim 28 reads: “**The apparatus defined in claim 18 wherein the plurality of subscriber units provide feedback information that comprises an arbitrarily ordered set of candidate subcarriers as clusters of subcarriers.**”

1486. This element is satisfied by the disclosure set forth at '212 Patent claim element 13.

XXXIV. '212 PATENT, CLAIM 29

1487. Claim 29 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 29 of the '212 Patent reads: "The apparatus defined in claim 18 wherein providing feedback information comprises sequentially ordering candidate clusters."

A. Claim 29 of the '212 Patent is Rendered Obvious by Ritter In Combination With Hashem '569

1488. Claim 29 reads: "**The apparatus defined in claim 18 wherein providing feedback information comprises sequentially ordering candidate clusters.**"

1489. This element is satisfied by the disclosure set forth at '212 Patent claim element 15.

B. Claim 29 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1490. Claim 29 reads: "**The apparatus defined in claim 18 wherein providing feedback information comprises sequentially ordering candidate clusters.**"

1491. This element is satisfied by the disclosure set forth at '212 Patent claim element 15.

C. Claim 29 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination with Ritter

1492. Claim 29 reads: "**The apparatus defined in claim 18 wherein providing feedback information comprises sequentially ordering candidate clusters.**"

1493. This element is satisfied by the disclosure set forth at '212 Patent claim element 15.

D. Claim 29 of the '212 Patent is Anticipated and/or Rendered Obvious by the Project Angel System

1494. Claim 29 reads: “**The apparatus defined in claim 18 wherein providing feedback information comprises sequentially ordering candidate clusters.**”

1495. This element is satisfied by the disclosure set forth at '212 Patent claim element 15.

XXXV. '212 PATENT, CLAIM 30

1496. Claim 30 of the '212 Patent is anticipated and/or rendered obvious by the prior art as described below. Claim 30 of the '212 Patent is reproduced below with identifiers [a], [b], [c], etc. added for ease of reference:

30. The apparatus defined in claim 18 wherein

[a][1] the base station allocates a first portion of the subcarriers to establish a data link between the base station and the subscriber unit; and

[a][2] then allocates a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.

A. Claim 30 of the '212 Patent is Rendered Obvious by Ritter in Combination With Hashem '569 or the Sollenberger Article and/or the IS-95A Standard

1. Element 30[a][1]

1497. Claim element 30[a][1] of the '212 Patent reads: “**the base station allocates a first portion of the subcarriers to establish a data link between the base station and the subscriber unit.**”

1498. This element is satisfied by the disclosure set forth at '212 Patent claim element 16[a].

2. Element 30[a][2]

1499. Claim element 30[a][2] of the '212 Patent reads: “**and then allocates a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.**”

1500. This element is satisfied by the disclosure set forth at '212 Patent claim element 16[b].

B. Claim 30 of the '212 Patent is Rendered Obvious by the Sollenberger Publications

1. Element 30[a][1]

1501. Claim element 30[a][1] of the '212 Patent reads: “**the base station allocates a first portion of the subcarriers to establish a data link between the base station and the subscriber unit.**”

1502. This element is satisfied by the disclosure set forth at '212 Patent claim element 16[a].

2. Element 30[a][2]

1503. Claim element 30[a][2] of the '212 Patent reads: “**and then allocates a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.**”

1504. This element is satisfied by the disclosure set forth at '212 Patent claim element 16[b].

C. Claim 30 of the '212 Patent is Rendered Obvious by Hashem '569 Alone or in Combination With Ritter

1. Element 30[a][1]

1505. Claim element 30[a][1] of the '212 Patent reads: “**the base station allocates a first portion of the subcarriers to establish a data link between the base station and the subscriber unit.**”

1506. This element is satisfied by the disclosure set forth at '212 Patent claim element 16[a].

2. Element 30[a][2]

1507. Claim element 30[a][2] of the '212 Patent reads: “**and then allocates a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.**”

1508. This element is satisfied by the disclosure set forth at '212 Patent claim element 16[b].

D. Claim 30 of the '212 Patent is Anticipated and/or Rendered Obvious by the Project Angel System

1. Element 30[a][1]

1509. Claim element 30[a][1] of the '212 Patent reads: “**the base station allocates a first portion of the subcarriers to establish a data link between the base station and the subscriber unit.**”

1510. This element is satisfied by the disclosure set forth at '212 Patent claim element 16[a].

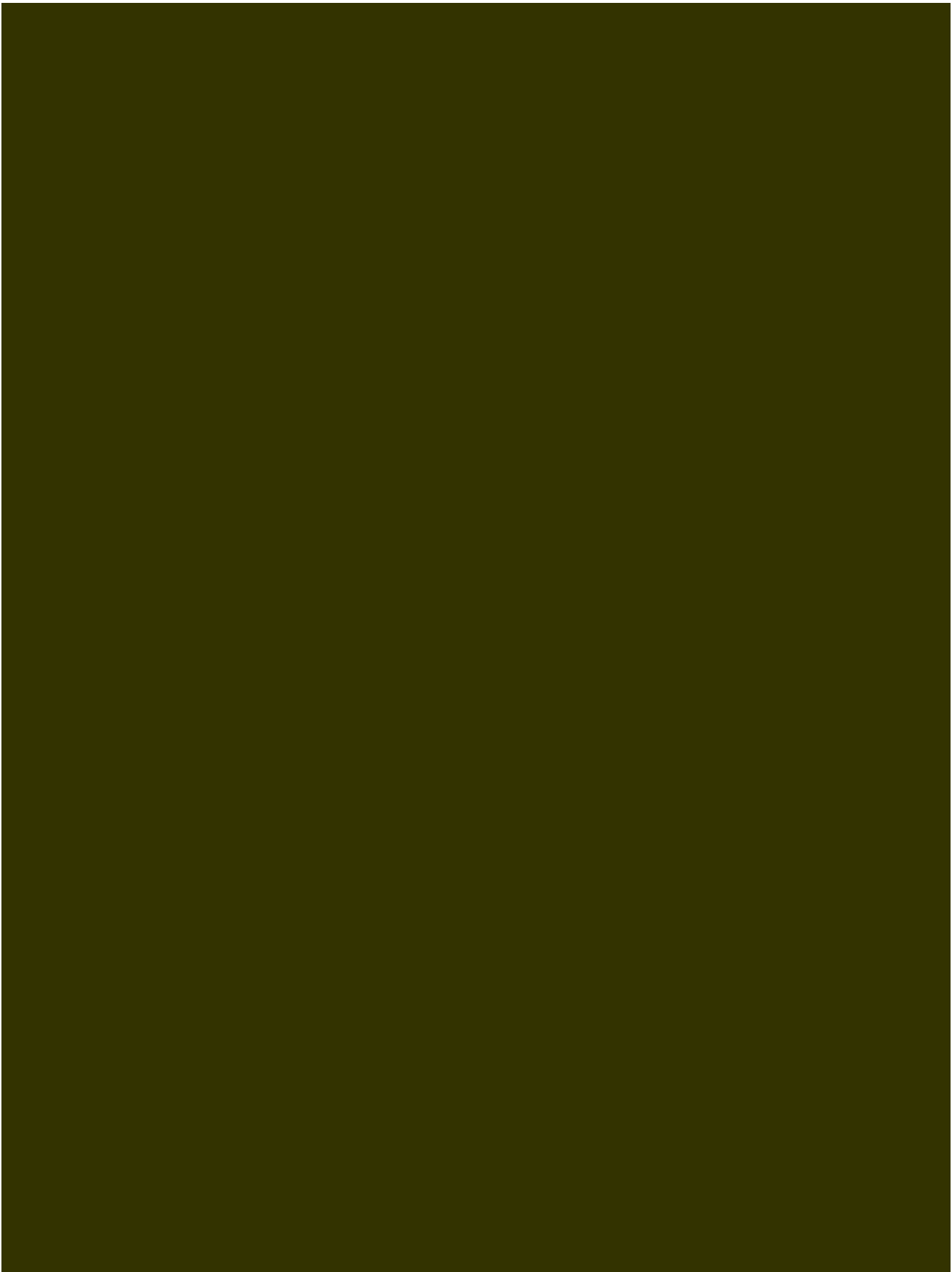
2. Element 30[a][2]

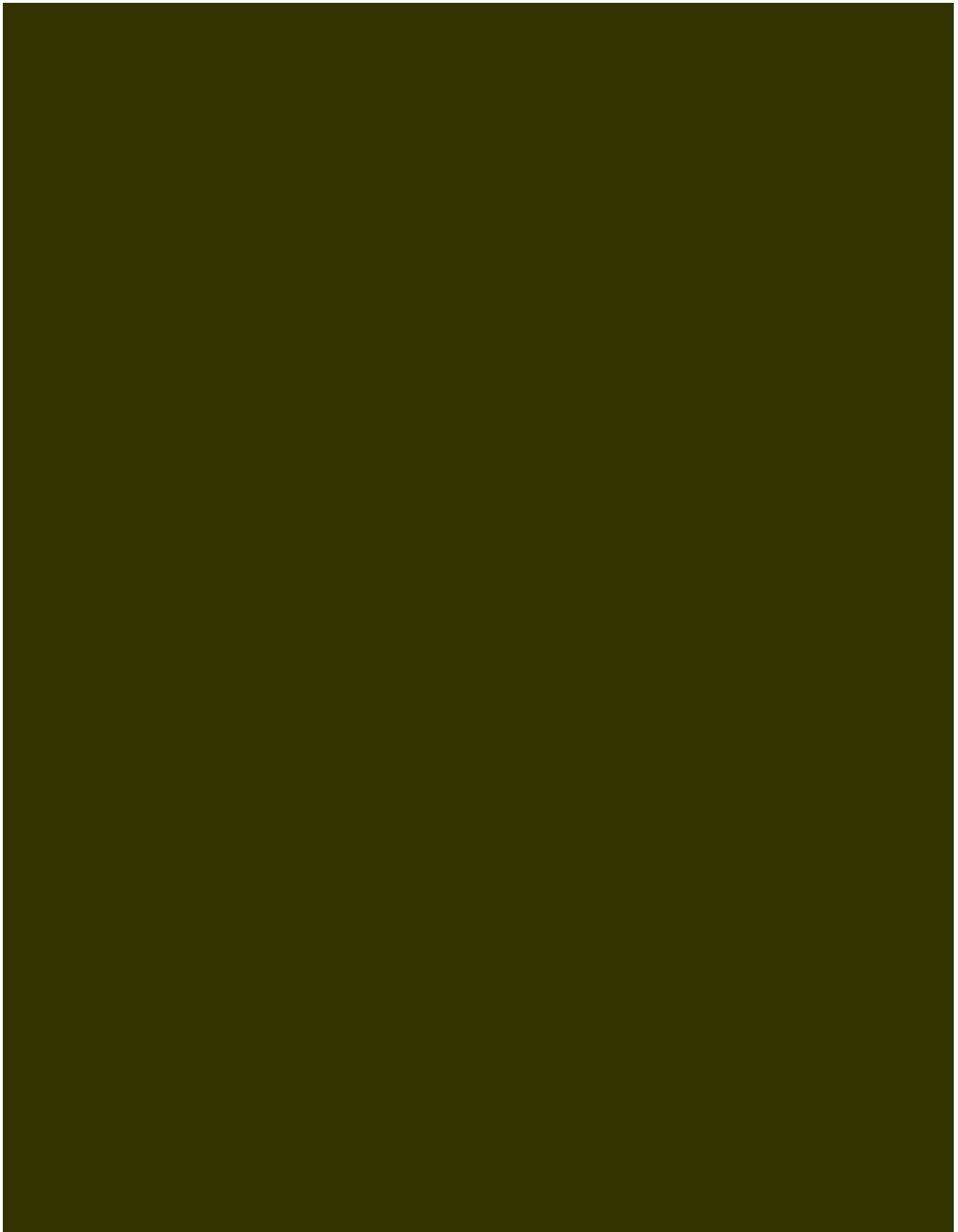
1511. Claim element 30[a][2] of the '212 Patent reads: “**and then allocates a second portion of the subcarriers to the subscriber unit to increase communication bandwidth.**”

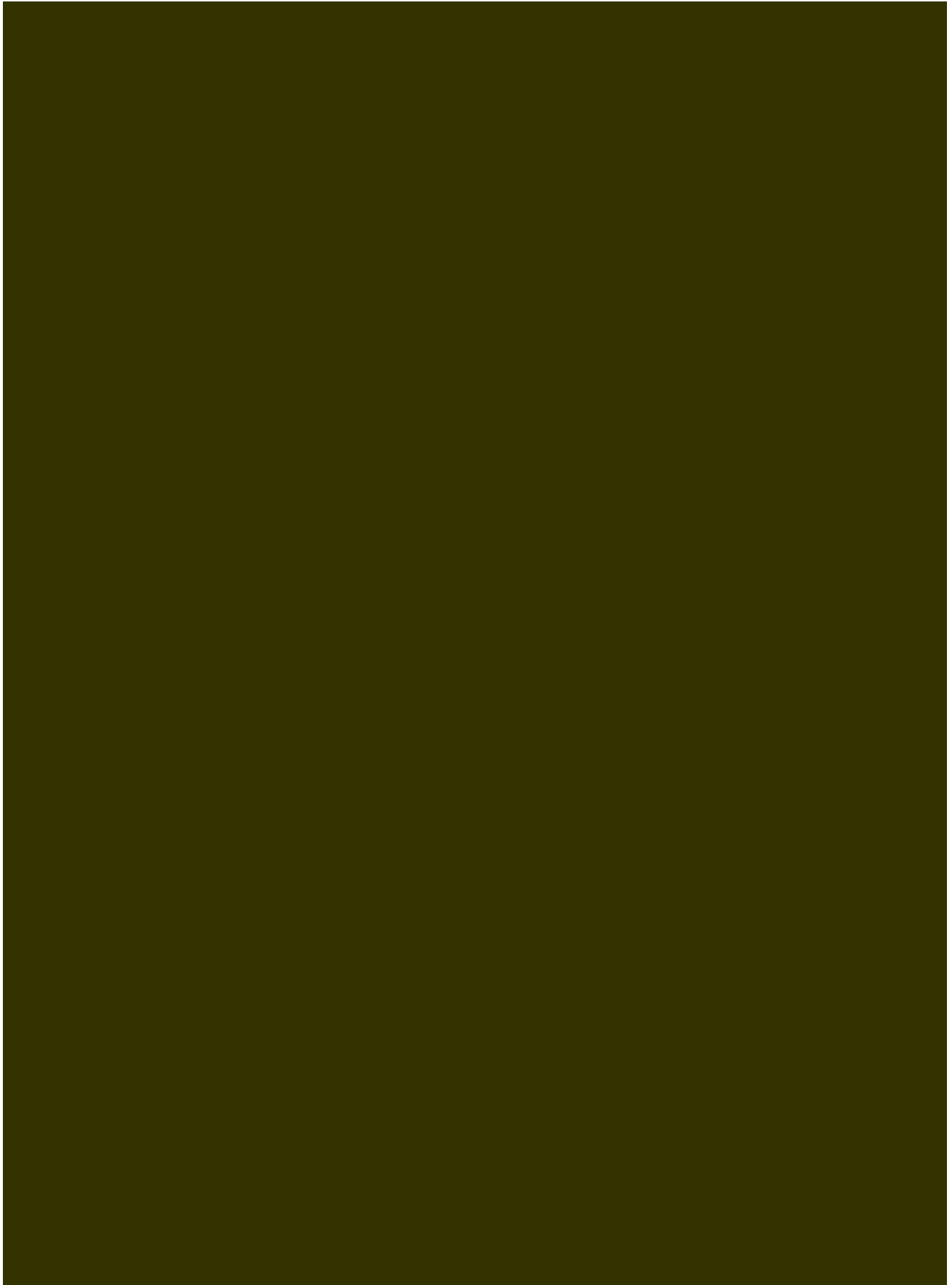
1512. This element is satisfied by the disclosure set forth at '212 Patent claim element 16[b].

XXXVI. SECONDARY CONSIDERATIONS

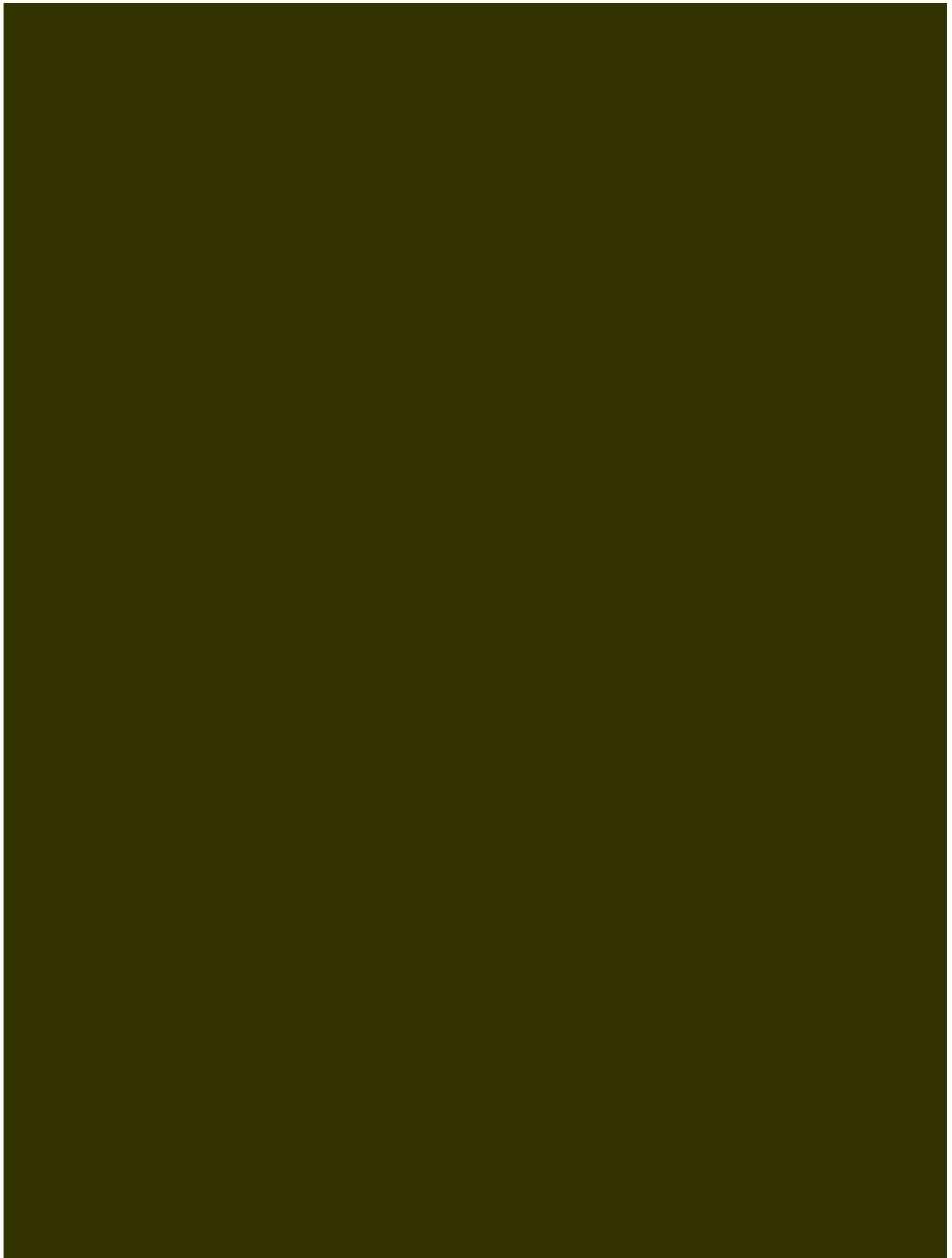
1513. As set forth above, I have been informed and understand that an obviousness analysis must take into account any evidence of “secondary considerations of nonobviousness” (or “objective indicia of nonobviousness”). These secondary considerations include the invention’s commercial success, long-felt but unresolved needs, licenses showing industry respect, the failure of others, skepticism by experts, praise by others, teaching away by others,

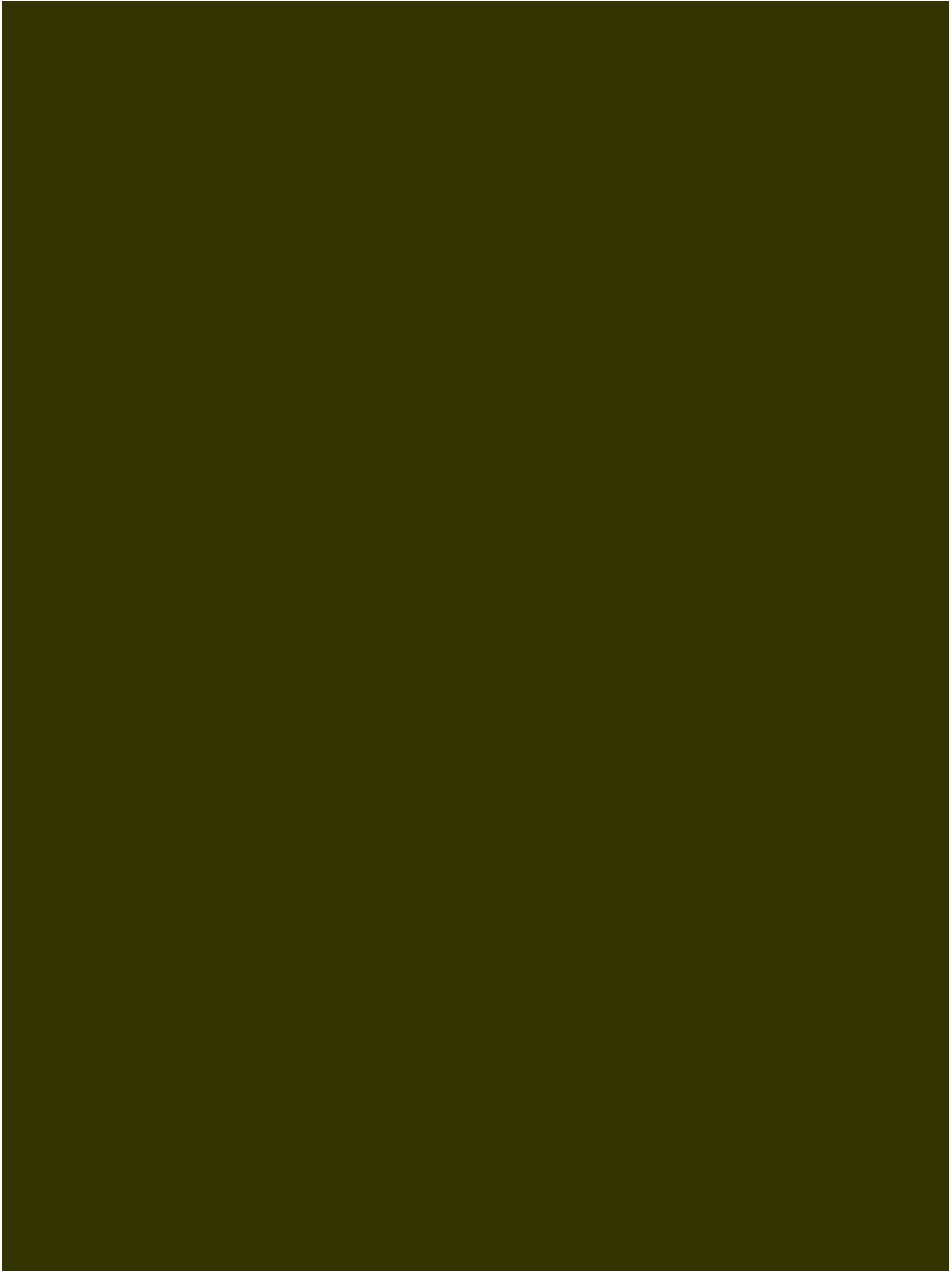


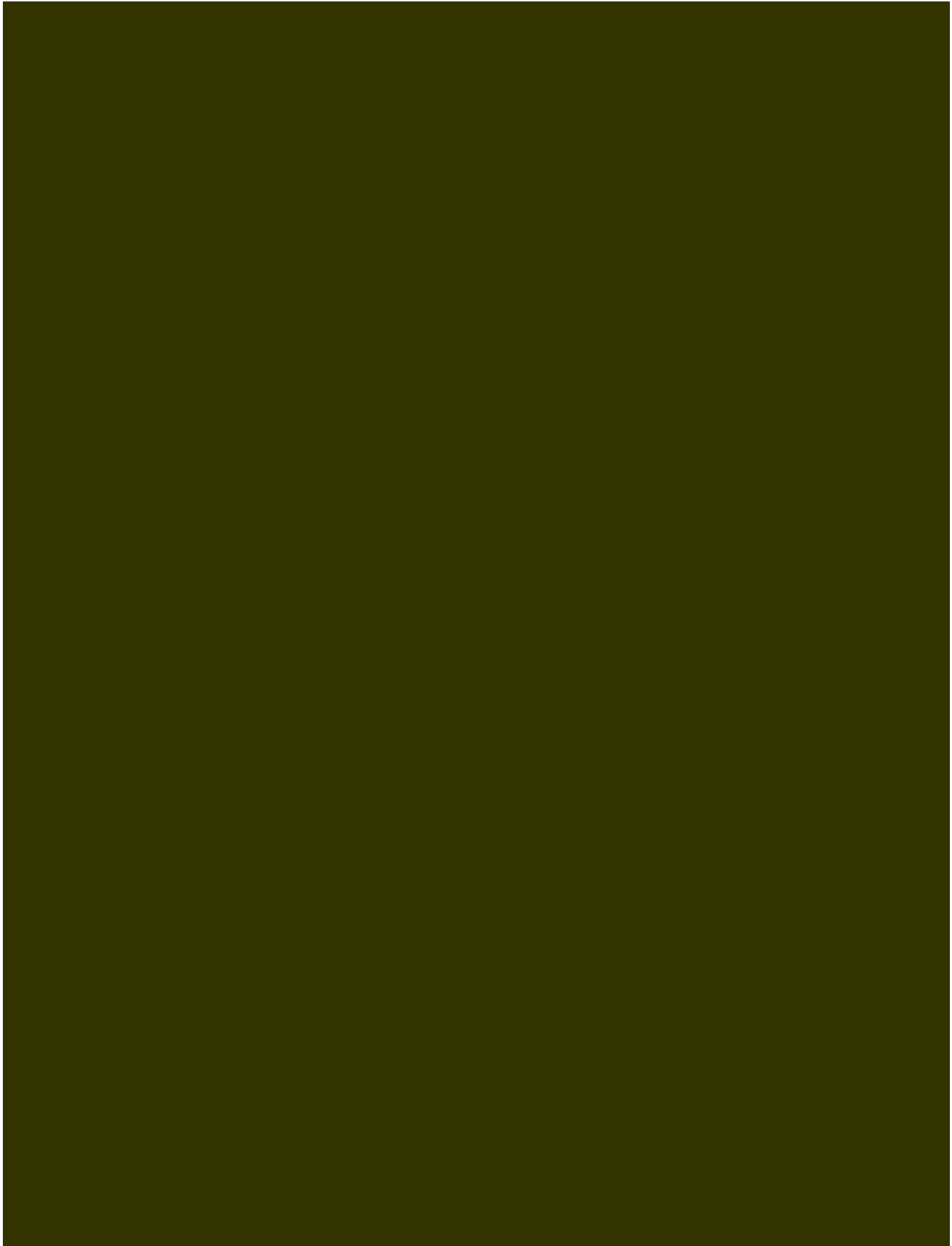














July 7, 2014

A handwritten signature in black ink, appearing to read "Thomas Fuja", is written over a horizontal line.

Thomas Fuja, Ph.D.

EXHIBIT LIST

- Exhibit A** Curriculum Vitae.
- Exhibit B** Previous Testimony.
- Exhibit C** Materials Considered.

EXHIBIT A

THOMAS E. FUJA

Department of Electrical Engineering
University of Notre Dame
Notre Dame, IN 46556
Telephone: (574) 631-7244
E-mail: tfuja@nd.edu

PROFESSIONAL EXPERIENCE

Professor and Chairman – Department of Electrical Engineering

- University of Notre Dame, Notre Dame, IN 46556
- July 2006 - present. (Associate Professor 8/98-8/01. Professor 8/01-present.)
- Research Interests: Digital communications, including channel coding, coded modulation, wireless communications, joint source/channel coding, and information theory.

Other:

- Assistant/Associate Professor of Electrical Engineering at the University of Maryland in College Park, MD from 1987 to 1998. (Assistant Professor 8/87-8/93; promoted to Associate Professor with tenure in 1993.)
- Program Director for Communications Research at the U.S. National Science Foundation, Arlington, VA. Program officer in charge of NSF's support of digital communications research, including coding, modulation, multiple access, and information theory. (January 1997 - July 1998)
- Consultant: Clients have included Eastman Kodak, Motorola, Agere, PBS National Datacast, Globespan, Broadcom, Vizio, HP, and Apple.
- Member of Technical Staff; AT&T Bell Laboratories, Holmdel, NJ 07733.
Worked in Satellite Transmission Department from February 1982 to September 1982;
worked in Loop Transmission Department from May 1983 to September 1983.

EDUCATION

Ph.D. in Electrical Engineering

- Granted May 1987 from Cornell University, Ithaca, NY 14853.
- Thesis Title: "On the Structure and Decoding of Cross Parity Check Codes for Magnetic Tape."
- Thesis Advisor: Prof. Chris Heegard.

M.Eng. in Electrical Engineering

- Granted May 1983 from Cornell University, Ithaca, NY 14853.
- Project Title: "The Computation of Bounds on the Capacity Region of the Discrete Memoryless Multiple Access Channel."

B.S. in Electrical Engineering

B.S. in Computer Engineering

- Granted *magna cum laude* December 1981 from The University of Michigan, Ann Arbor, MI 48109.

AWARDS

- Recipient of the 2007 and 2008 Ruth and Joel Spira Awards for Excellence in Teaching from the Department of Electrical Engineering at the University of Notre Dame.
- Elected Fellow of the Institute of Electrical and Electronics Engineers (IEEE) in 2004 with the citation "For contributions to error control coding."
- Recipient of 2002 Kaneb Teaching Award from the University of Notre Dame.
- Recipient of 1991 George Corcoran Memorial Award from the Department of Electrical Engineering at the University of Maryland.
- Recipient of 1989 Presidential Young Investigator award from the U.S. National Science Foundation.

RESEARCH ADVISING

Ph.D. Theses Supervised

- S. Maiya, "Cooperation and Latency in Channel Coding for Wireless Communications," University of Notre Dame, August 2011.
- S. Puducheri Sundaravaradhan, "Complexity-Feedback Tradeoffs and Capacity Results for Packet Erasure Networks," University of Notre Dame, May 2010.
- L. Xiao, "Cooperative Relaying Strategies for Wireless Communication Systems," co-advised with D. J. Costello, Jr., University of Notre Dame, December 2008.
- J. Liu, "Robust Transmission of Arithmetically Encoded Data," University of Notre Dame, August 2006.
- X. Jin, "LDPC Codes on Fading Channels: Receiver Design, Performance Analysis, and Code Design," University of Notre Dame, May 2006.
- A. Nimbalkar, "Design of High Throughput Low Complexity Turbo Codes," University of Notre Dame, May 2005.
- D. Sridhara, "Bandwidth Efficient Coded Modulation Using Low Density Parity Check Codes," University of Notre Dame, May 2003.
- T. Fazel, "Joint Source-Channel Decoding Algorithms for the 2400 bps MELP Speech Coder," University of Maryland, December 1999.
- M. Eroz, "Rate-Compatible Trellis Codes in Hybrid-ARQ and Combined Source-Channel Codes," University of Maryland, December 1996.
- S.-I. Chen, "Soft-Decision Decoding for DPSK-Modulated Wireless Voice Communication," University of Maryland, December 1996.
- S. Al-Semari, "The Design and Performance of Trellis Codes for Wireless Channels," University of Maryland, December 1995.
- F. Alajaji, "New Results on the Analysis of Discrete Channels with Memory," University of Maryland, August 1994.
- J. Gu, "New Results on Codes for Constrained Channels," University of Maryland, May 1993.
- G. Yang, "New Codes and New Approaches for Code Division Multiple Access on Optical Fiber Networks," University of Maryland, August 1992.
- S. Bross, "Trellis Coding for the Two-User Multiple-Access Channel," Univ. of Maryland, August 1991.

M.S. Theses Supervised

- L. Wei, "Bandwidth-Efficient Partnering for Cooperative Diversity," University of Notre Dame, August 2011.
- S. Maiya, "Spectral Efficiency and Its Relation to Optimal Routing Strategies in Simple Communication Networks," University of Notre Dame, May 2007.
- S. Puducheri Sundaravaradhan, "Distributed LT Codes," co-advised with Prof. Joerg Kliever, University of Notre Dame, December 2006.
- M. Mahadevan, "Distributed Source-Channel Coding of Correlated Sources," co-advised with Prof. Joerg Kliever, University of Notre Dame, August 2006.
- C. Zhang, "A Comparative Study of Quadrature Amplitude Modulation and Continuous Phase Modulation," co-advised with Prof. Yih-Fang Huang, University of Notre Dame, August 2006.
- A. Nimbalkar, "Performance of a 1200 bps Mixed Excitation Linear Predictive Speech Coder Over Noisy Communications Channels," University of Notre Dame, August 2001.
- D. Sridhara, "Performance of the U.S. Federal Standard 2.4 kbps Speech Coder Over ATM Networks," University of Notre Dame, May 2000.
- R. Chandran, "Coded Domain Enhancement of Compressed Speech," University of Notre Dame, September 1999.
- S. Moulin, "A Convolutional Code That Exploits the Residual Redundancy in a Multiband Harmonic Vocoder," University of Maryland, April 1998.
- A. Murad, "Distributed Decoding of Block Codes Through a Generalization of Majority-Logic Decoding," University of Maryland, April 1992.
- M. McEnroe, "Error Correction and Data Interleaving for First-In First-Out Memories," University of Maryland, August 1991.

- F. Alajaji, “On the Performance of Focused Error Control Codes,” University of Maryland, June 1990.
- T. Berman, “New Results on Unequal Error Protection Codes,” University of Maryland, May 1990.
- G-C. Yang, “The Effect of Error Scrubbing on the Mean-Time-to-Failure of Coded RAM Systems,” University of Maryland, November 1989.
- M. Steiner, “A Constructive Code for the Bandlimited Gaussian Noise Channel,” University of Maryland, September 1988.

EXTERNAL FUNDING

- “Spatially Coupled Sparse Codes on Graphs – Theory, Practice, and Extensions”
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: D. J. Costello, Jr. – Co-PI: T. Fuja
 - Funding for May 2012 - April 2015: \$308.0 K
- “New Directions for Graph-Based Code Design”
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: D. J. Costello, Jr. – Co-PI: T. Fuja
 - Funding for September 2008 - August 2011: \$270.0 K
- “Low Latency Code Design for Satellite Communications”
 - NASA Goddard Spaceflight Center, Greenbelt, MD
 - PI: D. J. Costello, Jr. – Co-PI: T. Fuja
 - Funding for May 2009 - April 2010: \$80.0 K
- “SystemWare: Retooling Systems Instruction in Electrical Engineering”
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: T. Fuja – Co-PIs: J. N. Laneman and M. Haenggi
 - Funding for March 2008 - December 2010: \$150.0 K
- “Power- and Bandwidth-Efficient Coding Techniques for Space and Satellite Communications”
 - NASA Goddard Spaceflight Center, Greenbelt, MD
 - PI: D. J. Costello, Jr. – Co-PI: T. Fuja
 - Funding for May 2007 - April 2009: \$85.0 K
- “Coding/Routing Interaction in Mesh Networks”
 - Motorola; Schaumburg, IL
 - University Partnerships in Research Program
 - PI: T. Fuja – Co-PI: D. J. Costello, Jr.
 - Support for August 2005 - December 2008: \$64.7 K.
- “Delay-Constrained Multihop Transmission in Wireless Networks: Interaction of Coding, Channel Access, and Routing”
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: J. N. Laneman – Co-PIs: D. J. Costello, Jr., T. Fuja, and M. Haenggi
 - Funding for July 2005 - June 2009: \$485.0 K
- “Bandwidth-Efficient Coding Techniques”
 - NASA Goddard Spaceflight Center, Greenbelt, MD
 - PI: D. J. Costello, Jr. – Co-PI: T. Fuja
 - Funding for May 2005 - August 2007: \$145.0 K
- “A Proposal for an Indiana Center for Wireless Communications and Networking”
 - Indiana Twenty-First Century Research and Technology Fund; Indianapolis, Indiana
 - PI: T. Fuja – Co-PIs: D. J. Costello, Jr., Y.-H. Huang, and J.N. Laneman
 - Sub-contract through Purdue University
 - Funding for February 2003 - February 2005: \$300 K
- “Low-Complexity Bandwidth Efficient Turbo Code Design”
 - Motorola; Schaumburg, IL
 - University Partnerships in Research Program
 - PI: D. J. Costello, Jr. – Co-PI: T. Fuja

- Support for September 2002 - August 2005: \$80.0 K.
- “Resource-Efficient Digital Communications: Research and Testbed Development in Support of OFW and JTRS”
 - U.S. Army Soldier Systems Center; Natick, MA
 - PI: T. Fuja – Co-PIs: O. Collins, D. J. Costello, Jr., and Y.-F. Huang
 - Funding for August 2002 - December 2006: \$3.432 M
- “ITR Collaborative Research: Toward Practical Graph-Based Coding Schemes For Reliable Wireless Communications”
 - PI: T. Fuja – Co-PIs: D. J. Costello, Jr., P. Massey, and J. Rosenthal
 - U.S. National Science Foundation; Arlington, Virginia
 - Funding for July 2002 - June 2008: \$1.025 M
- “Combined Research and Curriculum Development: Real-World Wireless Communications in the Graduate and Undergraduate Curriculum”
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: T. Fuja – Co-PIs: O. Collins, D. J. Costello, Jr., and Y.-F. Huang
 - Funding for June 2002 - May 2006: \$431.0 K
- “Acquisition of Instrumentation for an Experimental Radio Facility in Support of Wireless Digital Communications Research”
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: D. J. Costello, Jr. – Co-PIs: O. Collins, P. Fay, T. Fuja, and Y.-F. Huang
 - Funding for September 1999 - September 2002: \$547.6 K
- “Performance Prediction and Potential Enhancement of Federal Standard Vocoders in Emerging Multimedia FNBDT Protocol-Based Mixed Networks”
 - U.S. National Security Agency; Ft. Meade, Maryland
 - PI: T. Fuja
 - Funding for April 1999 - September 2001: \$200.0 K
- “Channel Coding Problems Associated with the Transmission of Compressed Signals Over Mobile Radio Channels”
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: T. Fuja
 - Funding for September 1996 - August 2001: \$325.2 K
- “Gemstone: An Interdisciplinary Undergraduate Program Focusing on the Implications of Technology”
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: W. Destler – Co-PIs: T. Fuja and N. Goldsman
 - Funding for September 1997 - August 2000: \$301.8 K
- “Application of Signal Processing and Dynamic Modeling Techniques to Modern Microsensors”
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: T. McAvoy – Co-PI: T. Fuja
 - Funding for August 1997 - July 2000: \$157.8 K
- “Young Scholars”
 - A program that brought 25 high school students to Maryland for six weeks in the summer to work in labs, take an engineering design class, and participate in seminars, field trips, etc.
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: T. Fuja
 - Funding for June 1996 - June 1998: \$104.1 K
- “Advanced Telecommunications/Information Distribution Research Program (ATIRP)”
 - Army Research Laboratory
 - PI: T. Fuja
 - Funding for June 1995 - June 1997: \$36.3 K

- “Error Correction R&D Applicable to Vocoders”
 - U.S. National Security Agency; Ft. Meade, Maryland
 - PI: T. Fuja
 - Funding for January 1994 - September 1998: \$200 K
- “University Research Support”
 - Digital Equipment Corporation; Maynard, Massachusetts
 - PI: T. Fuja
 - Support for August 1991 - August 1993: \$55.7 K in equipment and cash
- “Novel Error Control Techniques for the Transmission and Storage of Data” (1989 PYI Award)
 - U.S. National Science Foundation; Arlington, Virginia
 - PI: T. Fuja
 - Funding for September 1989 - February 1996: \$219.8 K
- “Fairchild Industries Scholars Program”
 - Fairchild Space Company; Germantown, Maryland.
 - PI: T. Fuja
 - Funding for August 1989 - December 1990: \$50.0 K.
- “Novel Error Control Techniques for Data Transmission and Storage”
 - Minta Martin Fund for Aeronautical Research - University of Maryland
 - PI: T. Fuja
 - Funding for June 1988 - August 1990: \$32.2 K
- “Research Core Funds Support”
 - The Systems Research Center - An NSF Engineering Research Center
 - PI: T. Fuja
 - Funding for June 1988 - June 1997: \$120.7 K

ACADEMIC SERVICE

- University of Notre Dame Service
 - Chairman of the Department of Electrical Engineering - 2006 - present.
 - Director of Graduate Studies in the Department of Electrical Engineering - 1999 - 2006.
 - Developed (with Prof. Jay Brockman) EG 111/112, a two-course “Introduction to Engineering Systems” sequence required for all first-year engineering majors at Notre Dame. (1999-2001)
 - Served on and/or chaired numerous departmental, college, and university committees.
- University of Maryland Service
 - Founding Director of Gemstone – a program for undergraduate interdisciplinary research. (1995-1997)
 - Associate Director for Education of the Institute for Systems Research, an NSF Engineering Research Center (1993-96).
 - Served on and/or chaired numerous departmental, college, and university committees.

PROFESSIONAL SERVICE

- Service to The Institute of Electrical and Electronics Engineers (IEEE)
 - Elected President of the IEEE Information Theory Society for 2002.
 - Elected (and re-elected) to the Information Theory Society’s Board of Governors 1995-2000.
 - Associate editor at large for *IEEE Transactions on Information Theory* - 1998-2001.
 - General Co-Chair - 2001 IEEE International Symposium on Information Theory, Washington DC, June 24-29, 2001.
 - General Co-Chair - 2002 IEEE Information Theory Workshop, Bangalore, India, October 20-25, 2002.
 - Technical session organizer and/or chair at numerous conferences and symposia; topics have included error correcting codes, mobile communications, coding for memories, optical communications, and trellis-coded modulation.
- Regularly review papers for various journals and proposals for the U.S. National Science Foundation.

PUBLICATIONS

A. Refereed Journals

- A1. T. Fuja and C. Heegard, "Row/Column Replacement for the Control of Hard Defects in Semiconductor RAM's," *IEEE Transactions on Computers*, Vol. C-35, No.11, pp. 996-1000, November 1986.
- A2. T. Fuja, C. Heegard, and R. Goodman, "Linear Sum Codes for Random Access Memories," *IEEE Transactions on Computers*, Vol. C-37, No. 9, pp. 1030-1042, September 1988.
- A3. T. Fuja, C. Heegard, and M. Blaum, "Cross Parity Check Convolutional Codes," *IEEE Transactions on Information Theory*, Vol. 35, No. 6, pp. 1264-1276, November 1989.
- A4. T. Fuja and C. Heegard, "Focused Codes for Channels with Skewed Errors," *IEEE Transactions on Information Theory*, Vol. 36, No. 4, pp. 773-783, July 1990.
- A5. G. Yang and T. Fuja, "The Reliability of Systems with Two Levels of Fault Tolerance: The Return of the 'Birthday Surprise'," *IEEE Transactions on Computers*, Vol. 41, No. 11, pp. 1490-1496, November 1992.
- A6. J. Gu and T. Fuja, "A Generalized Gilbert-Varshamov Bound Derived via Analysis of a Code Search Algorithm," *IEEE Transactions on Information Theory*, Vol. 39, No. 3, pp. 1089-1093, May 1993.
- A7. A. Murad and T. Fuja, "Distributed Decoding of Cyclic Block Codes Using a Generalization of Majority Logic Decoding," *IEEE Transactions on Information Theory*, Vol. 39, No. 5, pp. 1535-1545, September 1993.
- A8. F. Alajaji and T. Fuja, "The Performance of Focused Error Control Codes," *IEEE Transactions on Communications*, Vol. 42, No. 2, pp. 272-281, February 1994.
- A9. J. Gu and T. Fuja, "A New Approach to Constructing Optimal Block Codes for Runlength-Limited Channels," *IEEE Transactions on Information Theory*, Vol. 40, No. 3, pp. 774-786, May 1994.
- A10. F. Alajaji and T. Fuja, "A Communication Channel Modelled on Contagion," *IEEE Transactions on Information Theory*, Vol. 40, No. 6, pp. 2035-2041, November 1994.
- A11. G. Yang and T. Fuja, "Optical Orthogonal Codes with Unequal Auto- and Cross-Correlation Constraints," *IEEE Transactions on Information Theory*, Vol. 41, No. 1, pp. 96-106, January 1995.
- A12. F. Alajaji, N. Phamdo, N. Farvardin, and T. Fuja, "Detection of Binary Sources Over Discrete Memoryless Channels with Additive Markov Noise," *IEEE Transactions on Information Theory*, Vol. 42, No. 1, pp. 230-239, January 1996.
- A13. F. Alajaji, N. Phamdo, and T. Fuja, "Channel Codes That Exploit the Residual Redundancy in CELP-Encoded Speech," *IEEE Transactions on Speech and Audio Processing*, Vol. 4, No. 5, pp. 325-336, September 1996.
- A14. S. Al-Semari and T. Fuja, "I-Q TCM: Reliable Communication Over the Rayleigh Fading Channel Close to the Cutoff Rate," *IEEE Transactions on Information Theory*, Vol. 43, No. 1, pp. 250-262, January 1997.
- A15. L. Ratton, T. Kunt, T. McAvoy, T. Fuja, R. Cavicchi, and S. Semancik, "A Comparative Study of Signal Processing Techniques for Clustering Microsensor Data: A First Step Toward an Artificial Nose," *Sensors and Actuators B: Chemical*, Vol. 41, pp. 105-120, June 1997.
- A16. M. Eroz and T. Fuja, "A Hybrid-ARQ Systems Using Rate-Compatible Trellis Codes Designed for Fading Channels," *European Transactions on Telecommunications*, Vol. 9, No. 6, pp. 483-496, December 1998.
- A17. S. Al-Semari and T. Fuja, "Performance Analysis of Coherent TCM Systems with Diversity Reception in Slow Rayleigh Fading," *IEEE Transactions on Vehicular Technology*, Vol. 48, No. 1, pp. 198-212, January 1999.
- A18. S. Al-Semari, F. Alajaji, and T. Fuja, "Sequence MAP Decoding of Trellis Codes for Gaussian and Rayleigh Channels," *IEEE Transactions on Vehicular Technology*, Vol. 48, No. 4, pp. 1130-1140, July 1999.
- A19. T. Fazel and T. Fuja, "Robust Transmission of MELP-Compressed Speech: An Illustrative Example

- of Joint Source-Channel Decoding,” *IEEE Transactions on Communications*, Vol. 51, No. 6, pp. 973-982, June 2003.
- A20. R. M. Tanner, D. Sridhara, A. Sridharan, T. Fuja, and D. Costello, “LDPC Block and Convolutional Codes Based on Circulant Matrices,” *IEEE Transactions on Information Theory*, Vol. 50, No. 12, pp. 2966-2984, December 2004.
- A21. D. Sridhara and T. Fuja, “LDPC Codes Over Rings for PSK Modulation,” *IEEE Transactions on Information Theory*, Vol. 51, No. 9, pp. 3209-3220, September 2005.
- A22. M. Sikora, J. N. Laneman, M. Haenggi, D. J. Costello, Jr., and T. Fuja, “Bandwidth- and Power-Efficient Routing in Linear Wireless Networks,” *IEEE Transactions on Information Theory*, Vol. 52, No. 6, pp. 2624-2633, June 2006.
- A23. L. Xiao, T. Fuja, J. Kliever, and D. J. Costello, Jr., “A Network Coding Approach to Cooperative Diversity,” *IEEE Transactions on Information Theory*, Vol. 53, No. 10, pp. 3714-3722, October 2007.
- A24. S. Puducheri, J. Kliever, and T. Fuja, “On the Design and Performance of Distributed LT Codes,” *IEEE Transactions on Information Theory*, Vol. 53, No. 10, pp. 3740-3754, October 2007.
- A25. X. Jin, A. Eckford, and T. Fuja, “LDPC Codes for Non-Coherent Block Fading Channels with Correlation: Analysis and Design,” *IEEE Transactions on Communications*, Vol. 56, No. 1, pp. 70-80, January 2008.
- A26. A. Nimbalkar, T. K. Blankenship, B. Classon, T. Fuja, and D. J. Costello, Jr., “Contention-Free Interleavers for High-Throughput Turbo Decoding,” *IEEE Transactions on Communications*, Vol. 56, No. 8, pp. 1258-1267, August 2008.
- A27. L. Xiao, T. Fuja, J. Kliever, and D. J. Costello, Jr., “Error Performance Analysis of Signal Superposition Coded Cooperative Diversity,” *IEEE Transactions on Communications*, Vol. 57, No. 10, pp. 3123-3131, October 2009.
- A28. L. Xiao, T. Fuja, and D. J. Costello, Jr., “Mobile Relaying: Coverage Extension and Throughput Enhancement,” *IEEE Transactions on Communications*, Vol. 58, No. 9, pp. 2709-2717, September 2010.
- A29. S. Maiya and T. Fuja, “Cooperation via Trellis Pruning,” *IEEE Transactions on Communications*, Vol. 59, No. 6, pp. 1563-1569, June 2011.
- A30. S. Maiya, D. J. Costello, Jr., and T. Fuja, “Low Latency Coding: Convolutional Codes vs. LDPC Codes,” *IEEE Transactions on Communications*, Vol. 60, No. 5, pp. 1215-1225, May 2012.
- A31. S. Puducheri and T. Fuja, “Capacity and Coding for Two Common Wireless Erasure Relay Networks with Optimal Bandwidth Allocation,” *IEEE Transactions on Wireless Communications*, Vol. 11, No. 12, pp. 4308-4317, December 2012.
- A32. D. J. Costello, Jr., L. Dolecek, T. Fuja, J. Kliever, D. G. M. Mitchell, and R. Smarandache, “Spatially Coupled Sparse Codes on Graphs – Theory and Practice, accepted for publication in *IEEE Communications Magazine*.

B. Refereed Conference and Workshop Papers

- B1. C. Heegard and T. Fuja, “Redundancy in Semiconductor RAM’s,” Information Theory Workshop, Caesaria, Israel, June 2-6, 1984.
- B2. T. Fuja, C. Heegard, and R. Goodman, “Some Linear Sum Codes for Random Access Memories,” 1985 IEEE International Symposium on Information Theory, p. 30, Brighton, England, June 23-28, 1985.
- B3. T. Fuja and C. Heegard, “On a Class of Maximum Distance Separable Convolutional Codes,” IBM Workshop on Coding Theory, San Jose, California, August 11-12, 1986.
- B4. T. Fuja, C. Heegard, and R. Goodman, “Structure and Complexity of Linear Sum Codes,” Allerton Conference on Communications, Control, and Computing, pp. 455-464, Champaign, Illinois, October 2-4, 1986.
- B5. T. Fuja, C. Heegard, and M. Blaum, “Cross Parity Check Convolutional Codes for Magnetic Tape,” 1986 IEEE International Symposium on Information Theory, p. 42, Ann Arbor, Michigan,

October 6-9, 1986.

- B6. R. Goodman, T. Fuja, and C. Heegard, "On-Chip Error Control in VLSI RAM's," Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, California, Nov. 10-12, 1986.
- B7. T. Fuja and C. Heegard, "Focused Error Control Codes," The 1988 Conference on Information Sciences and Systems, pp. 532-537, Princeton, New Jersey, March 16-18, 1988.
- B8. T. Fuja, "The Performance of Random Access Memory Systems Employing On-Chip and Board-Level Error Control," 1988 IEEE International Symposium on Information Theory, p. 20, Kobe, Japan, June 19-24, 1988.
- B9. T. Fuja and C. Heegard, "Asymptotic Bounds for Focused Error Control Codes," Allerton Conf. on Communications, Control, and Computing, pp. 461-470, Champaign, Illinois, Sept. 28-30, 1988.
- B10. T. Fuja, "Coding for Memories with Address Faults," IBM Workshop on Coding Theory, San Jose, California, September 18-19, 1989.
- B11. T. Fuja and F. Alajaji, "The Rate/Performance Tradeoffs of Focused Error Control Codes," 1990 IEEE International Symposium on Information Theory, p. 43, San Diego, California, January 14-19, 1990.
- B12. T. Fuja, "Coding for the Address-Defect Channel," The 1990 Conference on Information Sciences and Systems, pp. 333-337, Princeton, NJ, March 21-23, 1990.
- B13. G. Yang and T. Fuja, "On the Reliability of Arrays with Two Levels of Fault Tolerance," The 1991 Conference on Information Sciences and Systems, pp. 267-272, Johns Hopkins University, Baltimore, MD, March 20-22, 1991.
- B14. A. Murad and T. Fuja, "A Generalization of Majority Logic Decoding," 1991 IEEE International Symposium on Information Theory, p. 89, Budapest, Hungary, June 23-28, 1991.
- B15. G. Yang and T. Fuja, "Bounds and Constructions for Optical Orthogonal Codes," 1991 International Symposium on Communications, Tainan, Taiwan, R.O.C., December 10-13, 1991.
- B16. J. Gu and T. Fuja, "A Generalization of the Gilbert-Varshamov Bound for Codes Over Irregular Spaces," The 1992 Conference on Information Sciences and Systems, p. 50, Princeton University, Princeton, NJ, March 18-20, 1992.
- B17. G. Yang and T. Fuja, "Optical Orthogonal Codes with Unequal Auto- and Cross-Correlation Constraints," The 1992 Conference on Information Sciences and Systems, pp. 86-90, Princeton University, Princeton, NJ, March 18-20, 1992.
- B18. J. Gu and T. Fuja, "A New Approach to Constructing Optimal Runlength Limited Block Codes," The 1992 Conference on Information Sciences and Systems, pp. 696-701, Princeton University, Princeton, NJ, March 18-20, 1992.
- B19. T. Fuja and J. Gu, "Construction of Optimal Block Codes for Runlength Constrained Channels," IEEE Workshop on Information Theory, Salvador, Brazil, June 22-26, 1992. (Invited)
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EXHIBIT B

2014-07-14 Fuja Invalidity Exp Rpt
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Exhibit B

Prior Testimony of Thomas E. Fuja, Ph.D.

	Client	Case Information
1.	Broadcom Corp.	<i>In the Matter of Certain Baseboard Processor Chips and Chipsets, Transmitter and Receiver (Radio) Chips, Power Control Chips, and Products Including Same, Including Cellular Telephone Handsets</i> , International Trade Commission, Case No. 337-TA-543 (Broadcom v. Qualcomm)
2.	Horizon Hobby, Inc.	<i>Ripmax Ltd. v. Horizon Hobby, Inc.</i> , Case No. 2:07-cv-2133 (C.D. Ill.)
3.	Vizio	<i>In the Matter of Certain Digital Televisions and Components Thereof</i> , International Trade Commission, Case No. 337-TA-789 (Vizio v. Coby Electronics Corp., et al.)
4.	Globespan Virata	<i>Globespan Virata v. Texas Instruments</i> , Case No 3-cv-02854 (D.N.J)
5.	Apple Inc.	<i>Apple Inc. v. Samsung Electronics</i> , Case No. 12-cv-630-LHK (N.D. Cal.)
6.	Agere	<i>Agere v. Broadcom Corp.</i> , Case No. 03-3138 (E.D. Pa)

EXHIBIT C

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Exhibit C

Materials Considered by Thomas Fuja Ph.D.

No.	Description	Bates Range, Web Link, or Date
1.	U.S. Patent No. 6,947,748	Exhibit B to Complaint
2.	U.S. Patent No. 7,454,212	Exhibit A to Complaint
3.	File History for U.S. Patent No. 6,947,748	DOC0000040 – DOC0000443
4.	File History for U.S. Patent No. 7,454,212	DOC0000736 – DOC1288
5.	Original Complaint for Patent Infringement, <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 6:12-cv-124, later transferred to N.D. Cal. and restyled Civ. No. 5:13-cv-01776 (Dkt. No. 1).	03/09/2012
6.	Original Complaint for Patent Infringement, <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 6:12-cv-125, later transferred to N.D. Cal. and restyled Civ. No. 5:13-cv-01777 (Dkt. No. 1).	03/09/2012
7.	Original Complaint for Patent Infringement, <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 6:13-cv-28, later transferred to N.D. Cal. and restyled Civ. No. 5:13-cv-02023 (Dkt. No. 1).	01/04/2013
8.	Apple Inc.'s Answer, Defenses, and Counterclaims to Plaintiff's Original Complaint for Patent Infringement, <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 6:12-cv-124, later transferred to N.D. Cal. and restyled Civ. No. 5:13-cv-01776 (Dkt. No. 15).	05/24/2012
9.	Apple Inc.'s Answer, Defenses, and Counterclaims to Plaintiff's Original Complaint for Patent Infringement, <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 6:12-cv-125, later transferred to N.D. Cal. and restyled Civ. No. 5:13-cv-01777 (Dkt. No. 20).	05/24/2012
10.	Apple Inc.'s Answer, Defenses, and Counterclaims to Plaintiff's Original Complaint for Patent Infringement, <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No.	02/01/2013

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No.	Description	Bates Range, Web Link, or Date
	6:13-cv-28, later transferred to N.D. Cal. and restyled Civ. No. 5:13-cv-02023 (Dkt. No. 14).	
11.	Defendants Joint L.P.R. 3-3 and 3-4 Disclosures in the cases <i>Adaptix, Inc. v. Motorola Mobility LLC, et al.</i> , Civ. No. 6:12-cv-016; -017; -019; -020; -120; -121; -124; -125.	01/10/2013
12.	Defendants Joint Amended L.P.R. 3-3 and 3-4 Disclosures in the cases <i>Adaptix, Inc. v. Motorola Mobility LLC, et al.</i> , Civ. No. 5:13-cv-01774; -01776; -01777; -01778; -01844; -02023.	01/15/2014
13.	Defendants Joint Amended L.P.R. 3-3 and 3-4 Disclosures in the cases <i>Adaptix, Inc. v. Motorola Mobility LLC, et al.</i> , Civ. No. 6:12-cv-017; -020; -120.	01/15/2014
14.	Defendants Second Supplemental Invalidity Contentions in the cases <i>Adaptix, Inc. v. Motorola Mobility LLC, et al.</i> , Civ. No. 6:12-cv-017; -020; -120.	06/16/2014
15.	Adaptix's L.P.R. 3-1 Disclosures, served in 6:12-cv-00124 (E.D. Tex.), later transferred to N.D. Cal. and restyled 5:13-cv-01776.	08/10/2012
16.	Adaptix's L.P.R. 3-1 Disclosures, served in 6:12-cv-00125 (E.D. Tex.), later transferred to N.D. Cal. and restyled 5:13-cv-01777.	08/10/2012
17.	Adaptix's Supplemental L.P.R. 3-1 Disclosures, served in the case <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 5:13-cv-01777.	08/30/2013
18.	Adaptix's Supplemental L.P.R. 3-1 Disclosures, served in the cases <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 5:13-cv-01776; -02023.	12/02/2013
19.	Adaptix's Supplemental L.P.R. 3-1 Disclosures Exhibit B, served in the cases <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No.	01/31/2014

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No.	Description	Bates Range, Web Link, or Date
	5:13-cv-01776; -01777; -02023.	
20.	Adaptix's Supplemental L.P.R. 3-1 Disclosures Exhibit A, served in the cases <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 5:13-cv-01776; -01777; -02023.	02/10/2014
21.	Adaptix's Supplemental L.P.R. 3-1 Disclosures, served in the cases <i>Adaptix, Inc. v. HTC, et al.</i> , Civ. No. 5:13-cv-01778; -01844.	12/02/2013
22.	Adaptix's Supplemental L.P.R. 3-1 Disclosures Exhibit A, served in the cases <i>Adaptix, Inc. v. HTC, et al.</i> , Civ. No. 5:13-cv-01778; -01844.	02/10/2014
23.	Adaptix's Supplemental L.P.R. 3-1 Disclosures Exhibit B, served in the cases <i>Adaptix, Inc. v. HTC, et al.</i> , Civ. No. 5:13-cv-01778; -01844.	01/31/2014
24.	Adaptix's Supplemental L.P.R. 3-1 Disclosures, served in 6:12-cv-020 (E.D. Tex.).	10/23/2013
25.	Adaptix's Supplemental L.P.R. 3-1 Disclosures, served in 6:12-cv-120 (E.D. Tex.).	11/06/2013
26.	Adaptix's Supplemental L.P.R. 3-1 Disclosures, served in 6:12-cv-017 (E.D. Tex.).	10/23/2013
27.	Claim Construction Order, Case No. 5:13-cv-01774 (N.D. Cal.) (Dkt. No. 123).	12/19/2013
28.	Memorandum Opinion and Order, Case No. 6:12-cv-00017 (E.D. Tex.) (Dkt. No. 180).	03/12/2014
29.	Report and Recommendation, Case No. 6:12-cv-00017 (E.D. Tex.) (Dkt. No. 182).	03/24/2014
30.	Order, Case No. 6:12-cv-00017 (E.D. Tex.) (Dkt. No. 197).	05/29/2014
31.	European Telecommunications Standards Institute ("ETSI"), Universal Mobile Telecommunications System (UMTS); UMTS Terrestrial Radio Access (UTRA);	DOC0007128 - DOC0007816

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No.	Description	Bates Range, Web Link, or Date
	Concept Evaluation (UMTS 30.06 version 3.0.0), TR 101 146 V3.0.0 (1997-12) (“UMTS Concept Evaluation”).	
32.	U.S. Patent No. 5,491,837 titled “Method And System For Channel Allocation Using Power Control And Mobile-Assisted Handover Measurements” issued to Jacobus C. Haartsen (“Haartsen”).	DOC0003250 - DOC0003274
33.	German Patent DE 198 00 953 C 1 titled “Method and wireless communication system for allocating wireless resources to a wireless interface” issued to Gerhard Ritter (“Ritter”).	DOC0018152 – DOC0018164 DOC0002589 - DOC0002600
34.	“Wideband Wireless Data Access Based on OFDM and Dynamic Packet Assignment” by Justin Chuang and Nelson Sollenberger (“Sollenberger Article”).	DOC0006256 - DOC0006265 DOC0007823 - DOC0007827
35.	U.S. Patent No. 6,052,594 titled “System and Method for Dynamically Assigning Channels for Wireless Packet Communications” issued to Justin Che-I Chuang and Nelson Ray Sollenberger (“Sollenberger Patent”).	DOC0003883 - DOC0003900
36.	U.S. Patent No. 5,726,978 titled “Adaptive Channel Allocation In A Frequency Division Multiplexed System” issued to Carl Magnus Frodigh et al. (“Frodigh”).	DOC0003397 - DOC0003416
37.	U.S. Patent No. 6,175,550 titled “Orthogonal Frequency Division Multiplexing System with Dynamically Scalable Operating Parameters and Method Thereof” issued to Richard D. J. Van Nee (“Van Nee”).	DOC0004048 - DOC0004058
38.	U.S. Patent No. 7,072,315 titled “Medium access control for orthogonal frequency-division multiple-access (OFDMA) cellular networks” issued to Hui Liu, Xiaodong Li, and Fuqi Mu (“Liu”). Liu issued on July 4, 2006 from an application	DOC0005144 - DOC0005144

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No.	Description	Bates Range, Web Link, or Date
	filed on October 10, 2000.	
39.	U.S. Patent No. 6,721,569 titled “Dynamic Sub-Carrier Assignment in OFDM Systems” issued to Bassam M. Hashem et al. (“Hashem ’569”). Hashem ’569 issued on April 13, 2004 from an application filed on September 29, 2000.	DOC0012602 - DOC0012614
40.	European Telecommunications Standards Institute (“ETSI”), Universal Mobile Telecommunications System (UMTS); UMTS Terrestrial Radio Access (UTRA); Concept Evaluation (UMTS 30.06 version 3.0.0), TR 101 146 V3.0.0 (1997-12) (“UMTS Concept Evaluation”). UMTS Concept Evaluation was published in December of 1997.	DOC0007128 - DOC0007816
41.	“Advanced Cellular Internet Service (ACIS)” by Leonard J. Cimini, Jr., Justin C.-I. Chuang, and Nelson R. Sollenberger (“Cimini”). Cimini was published in October 1998 in IEEE Communications Magazine.	DOC0006215 - DOC0006224
42.	“Optimum Band Allocation According to Subband Condition” by Masayuki Motegi and Ryuji Kohno (“Motegi”).	IEEE_ATTMobilityLLC000050 - IEEE_ATTMobilityLLC000054
43.	“Adaptive Multicarrier Modulation: A Convenient Framework for Time-Frequency Processing in Wireless Communications,” by Thomas Keller and Lajos Janzo (“Keller”). Keller was published on May 5, 2000, in Volume 88 of IEEE Proceedings of the IEEE.	DOC0017797 - DOC0017826
44.	U.S. Patent No. 5,956,642 titled “Adaptive Channel Allocation Method and Apparatus For Multi-Slot, Multi-Carrier Communication System” issued to Per Ake Larsson et al. (“Larsson”). Larsson issued on September 21, 1999 from an application filed on November 25, 1996.	DOC0003791 - DOC0003814
45.	“A Comparative Study Of Pilot Based Channel Estimators For Wireless OFDM”	DOC0006048 - DOC0006081

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No.	Description	Bates Range, Web Link, or Date
	by Magnus Sandell and Ove Edfors ("Sandell") published in Research Report TULEA 1996:19, Division of Signal Processing, Lulea University of Technology, September 1996.	
46.	"A Delay Profile Information Based Subcarrier Power Control Combined With A Partial Non-Power Allocation Technique For OFDM/FDD Systems" by Noriyuki Maeda, Seiichi Sampei, and Norihiko Morinaga, IEEE, 2000 ("Maeda").	DOC0006088 - DOC0006092
47.	"A Time and Frequency Synchronization Scheme for Multiuser OFDM" by Jan-Jaap van de Beek et al., ("Van de Beek II"), IEEE Journal on Selected Areas in Communications, VOL. 17, No. 11, November 1999, pp. 1900-1914.	DOC0006117 - DOC0006131
48.	"Adaptive Multicarrier Modulation: A Convenient Framework for Time-Frequency Processing in Wireless Communications by Thomas Keller and Lajos Janzo ("Keller"). Keller was published on May 5, 2000, in Volume 88 of IEEE Proceedings of the IEEE.	DOC0017797 – DOC0017826
49.	"Adaptive Sub-Carriers Control Scheme for OFDM Cellular Systems" by Fumihide Kojima, Hiroshi Harada and Masayuki Fujise ("Kojima"). Kojima published on May 18, 2000 in IEEE 51st Vehicular Technology Conference Proceedings at pg. 1065.	DOC0017883 – DOC0017887
50.	"Advanced Cellular Internet Service (ACIS)" by Leonard J. Cimini, Jr., Justin C.-I. Chuang, and Nelson R. Sollenberger ("Cimini"). Cimini was published in October 1998, IEEE Communications Magazine	DOC0006215 – DOC0006224
51.	"Capacity Comparison of an OFDM Based Multiple Access System Using Different Dynamic Resource Allocation" by M. Wahlqvist, et al. ("Wahlqvist")	DOC0006266 – DOC0006270

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No.	Description	Bates Range, Web Link, or Date
	published in Proc. Vehicular Technology Conf., Vol. 3, pp. 1664-1668, 1997.	
52.	“Channel Quality Estimation And Rate Adaptation For Cellular Mobile Radio” by Krishna Balachandran et al. (“Balachandran”), IEEE Journal on Selected Areas in Communications, July 1, 1999.	DOC0006382 – DOC0006394
53.	“Co-Channel Interference Suppression Assisted Adaptive OFDM In Interference Limited Environments” by M. Munster et al. (“Munster”) was published on September 17, 1999 in IEEE publication VTC'99, AMSTERDAM, NL.	DOC0006467- DOC0006471
54.	“Frequency and Time Division Multiple Access with Demand-Assignment Using Multicarrier Modulation for Indoor Wireless Communications Systems” by Yoshiyuki Kinugawa, et al., (“Kinugawa”) published in IEICE Trans. Commun., Vol. E77-B, No. 3, March 1994, pgs. 396-403.	DOC0006657 – DOC0006666
55.	“Improving the Capacity in Wireless Networks Through Intergrated Channel Base Station and Power Assignment” by Symeon Papavassiliou and Leandros Tassiulas (“Papavassiliou”). Papavassiliou was published by the IEEE in 1995.	DOC0006685 – DOC0006689
56.	“Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System IS-95-A,” (“IS-95A”), TIA/EIA Interim Standard, May 1995.	DOC0018293 – DOC0019036
57.	“Multiuser OFDM” by Eric Lawrey (“Lawrey”), published August 1999, Fifth International Symposium on Signal Processing and its Applications, ISSPA '99.	DOC0006721 – DOC0006724
58.	“Optimum Band Allocation According to Subband Condition” by Masayuki Motegi and Ryuji Kohno (“Motegi”). Motegi	IEEE_AT&TMobilityLLC000050 - IEEE_AT&TMobilityLLC000054

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No.	Description	Bates Range, Web Link, or Date
	published on September 18-21, 2000.	
59.	“Orthogonal Frequency Division Multiple Access Peak-to-Average Power Ratio Reduction using Optimized Pilot Symbols” by Yunjun Zhang, Abbas Yongacoglu and Jean-Yves Chouinard (“Zhang”) published Aug. 21, 2000 in IEEE publication International Conference on Communication Technology Proceedings, 2000, vol. 1, pgs. 574-577.	DOC0006793 – DOC0006796
60.	“Synchronization and Channel Estimation in OFDM Systems” by Jan-Jaap van de Beek (“Van de Beek”), Lulea University of Technology, Division of Signal Processing, Lulea, Sweden, September 1998. Also published as “Orthogonal Frequency-Division Multiplexing (OFDM)” by Jan-Jaap van de Beek, P. Odling, Sarah Kate Wilson, and P.O. Borjesson.	DOC0006842 – DOC0006999
61.	“Wideband Wireless Data Access Based on OFDM and Dynamic Packet Assignment” by Justin Chuang and Nelson Sollenberger (“Sollenberger Article”) published on September 21, 1999 in 1999 Wireless Communication & Networking Conference 757.	DOC0006256 – DOC0006256
62.	EP 0753948 (“Peeters”). Peeters issued June 7, 2006.	
63.	European Telecommunications Standards Institute (“ETSI”), Universal Mobile Telecommunications System (UMTS); UMTS Terrestrial Radio Access (UTRA); Concept Evaluation (UMTS 30.06 version 3.0.0), TR 101 146 V3.0.0 (1997-12) (“UMTS Concept Evaluation”).	DOC0007128 – DOC0007816
64.	German Patent DE 198 00 953 C 1 (“Ritter”). Ritter’s “publication date of patent granting” is July 29, 1999.	DOC0002589 – DOC0002600

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65.	PCT International Patent Application Publication No. WO 97/45966 ("Almgren"). Almgren published on December 4, 1997.	DOC0005701 – DOC0005772
66.	U.S. Patent 5,282,222 ("Fattouche"). Fattouche issued on January 25, 1994.	DOC0007990 – DOC0008025
67.	U.S. Patent 5,444,697 ("Leung"). Leung issued on June 9, 1998.	DOC0003159 – DOC0003193
68.	U.S. Patent 5,471,647 ("Gerlach"). Gerlach issued on November 28, 1995.	DOC0008026 – DOC0008035
69.	U.S. Patent 5,479,447 ("Chow"). Chow issued December 26, 1995.	DOC0003225 – DOC0003249
70.	U.S. Patent 5,491,837 ("Haartsen"). Haartsen issued on February 13, 1996.	DOC0003250 – DOC0003274
71.	U.S. Patent 5,623,484 ("Muszynski"). Muszynski issued on April 22, 1997.	DOC0003388 – DOC0003396
72.	U.S. Patent 5,726,978 ("Frodigh"). Frodigh issued on March 10, 1998.	DOC0003397 – DOC0003416
73.	U.S. Patent 5,764,699 ("Needham"). Needham issued on June 9, 1998.	DOC0003450 – DOC0003456
74.	U.S. Patent 5,867,478 ("Baum"). Baum issued February 2, 1999.	DOC0003614 – DOC0003651
75.	U.S. Patent 5,884,145 ("Haartsen II"). Haartsen II issued on March 16, 1999.	DOC0003652 – DOC0003666
76.	U.S. Patent 5,912,931 ("Matsumoto"). Matsumoto issued on June 15, 1999.	DOC0003708 – DOC0003736
77.	U.S. Patent 5,914,933 ("Cimini '933"). Cimini '933 issued on June 22, 1999.	DOC0003737 – DOC0003752
78.	U.S. Patent 5,956,642 ("Larsson"). Larsson issued on September 21, 1999.	DOC0003791 – DOC0003814
79.	U.S. Patent 6,009,332 ("Haartsen III"). Haartsen III issued on December 28, 1999.	DOC0003830 – DOC0003845
80.	U.S. Patent 6,038,450 ("Brink"). Brink issued on March 14, 2000.	DOC0008091 – DOC0008101
81.	U.S. Patent 6,047,189 ("Yun"). Yun issued on April 4, 2000.	DOC0008102 – DOC0008116

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No.	Description	Bates Range, Web Link, or Date
82.	U.S. Patent 6,052,594 (“Sollenberger Patent”). The Sollenberger Patent issued on April 18, 2000.	DOC0003883 – DOC0003900
83.	U.S. Patent 6,067,290 (“Paulraj III”). Paulraj III issued on May 23, 2000.	DOC0008117 – DOC0008168
84.	U.S. Patent 6,175,550 (“Van Nee”). Van Nee issued on January 16, 2001.	DOC0004048 – DOC0004058
85.	U.S. Patent 6,351,499 (“Paulraj II”). Paulraj II issued on February 26, 2002.	DOC0008169 – DOC0008182
86.	U.S. Patent 6,351,643 (“Haartsen IV”). Haartsen IV issued on February 26, 2002.	DOC0008183 - DOC0008199
87.	U.S. Patent 6,359,867 (“Vehmas”). Vehmas issued on March 19, 2002.	DOC0004262 – DOC0004269
88.	U.S. Patent 6,377,636 (“Paulraj”). Paulraj issued on April 23, 2002.	DOC0008200 – DOC0008220
89.	U.S. Patent 6,400,699 (“Airy”). Airy issued on June 4, 2002.	DOC0004321 – DOC0004345
90.	U.S. Patent 6,405,048 (“Haartsen V”). Haartsen V issued on June 11, 2002.	DOC0008221 – DOC0008234
91.	U.S. Patent 6,434,392 (“Posti”). Posti issued on August 13, 2002.	DOC0004360 – DOC0004365
92.	U.S. Patent 6,463,096 (“Raleigh”). Raleigh issued on October 8, 2002.	DOC0008235 – DOC0008248
93.	U.S. Patent 6,567,387 (“Dulin”). Dulin issued on May 20, 2003.	DOC0008297 – DOC0008327
94.	U.S. Patent 6,587,696 (“Ma”). Ma issued on July 1, 2003.	DOC0004522 - -DOC0004528
95.	U.S. Patent 6,647,078 (“Thomas”). Thomas issued on November 11, 2003.	DOC0004625 – DOC0004642
96.	U.S. Patent 6,694,147 (“Viswanath”). Viswanath issued on February 17, 2004.	DOC0004689 – DOC0004709
97.	U.S. Patent 6,701,129 (“Hashem ’129”). Hashem ’129 issued March 2, 2004.	DOC0004710 – DOC0004723
98.	U.S. Patent 6,721,569 (“Hashem ’569”). Hashem ’569 issued on April 13, 2004.	DOC0004724 – DOC0004736
99.	U.S. Patent 6,748,222 (“Hashem ’222”).	DOC0004748 – DOC0004759

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No.	Description	Bates Range, Web Link, or Date
	Hashem '222 issued on June 8, 2004	
100.	U.S. Patent 6,760,882 ("Gesbert"). Gesbert issued on July 6, 2004.	DOC0004760 – DOC0004773
101.	U.S. Patent 6,775,320 ("Tzannes"). Tzannes issued August 10, 2004.	
102.	U.S. Patent 6,795,424 ("Kapoor"). Kapoor issued on September 21, 2004.	DOC0004796 – DOC0004816
103.	U.S. Patent 6,862,272 ("Dulin II"). Dulin II issued on March 1, 2005.	DOC0008297 – DOC0008327
104.	U.S. Patent 6,922,445 ("Sampath"). Sampath issued on July 26, 2005.	DOC0008328 – DOC0008344
105.	U.S. Patent 6,937,557 ("Sudo"). Sudo issued August 30, 2005.	
106.	U.S. Patent 6,961,364 ("Laroia"). Laroia issued on November 1, 2005.	DOC0005067 – DOC0005081
107.	U.S. Patent 7,072,315 ("Liu"). Liu issued on July 4, 2006.	DOC0005144 – DOC0005161
108.	U.S. Patent 7,095,719 ("Wilhelmsson"). Wilhelmsson issued on August 22, 2006.	DOC0008345 – DOC0008359
109.	U.S. Patent 7,230,908 ("Vanderaar"). Vanderaar issued on June 12, 2007.	DOC0008360 – DOC0008373
110.	U.S. Patent No. 5,507,034 ("Bodin"). Bodin issued April 9, 1999.	DOC0008061 – DOC0008074
111.	United States Patent No. 5,267,261 ("Blakeney"). Blakeney issued March 5, 1992.	DOC0003070 – DOC0003098
112.	United States Patent No. 5,577,022 ("Padovani"). Padovani issued November 19, 1996.	DOC0003350 – DOC0003369
113.	FCC Test Report - Chapter 1: Attestation Statements	ATT_1024492 - ATT_1024493
114.	FCC Test Report - Chapter 11: Test Report	ATT_1024496 - ATT_1024609
115.	FCC Test Report - Chapter 1: Attestation Statements	ATT_1024494 - ATT_1024495
116.	Airlink 1.8 Interface Control Document (AICD)	AD01258082 - AD01258266

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No.	Description	Bates Range, Web Link, or Date
241.	Plaintiff's Responses and Objections to Defendants' First Set of Individual Interrogatories (Nos. 1-5) in the cases <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 5:13-cv-01776; -01777; -02023 (N.D. Cal.).	04/09/2014
242.	Plaintiff's Responses and Objections to Defendants' Second Set of Individual Interrogatories (No. 6-8) in the cases <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 5:13-cv-01776; -01777; -02023 (N.D. Cal.).	04/14/2014
243.	Plaintiff's Responses and Objections to Defendants' Third Set of Individual Interrogatories (No. 9-13) in the cases <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 5:13-cv-01776; -01777; -02023 (N.D. Cal.).	04/22/2014
244.	Plaintiff's Responses and Objections to Apple, Inc.'s Fourth Set of Individual Interrogatories (No. 14-15) in the cases <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 5:13-cv-01776; -01777; -02023 (N.D. Cal.).	05/02/2014
245.	Plaintiff's Responses and Objections to Defendants' First Set of Request for Admission (No. 1-16) in the cases <i>Adaptix, Inc. v. Motorola Mobility LLC, et al.</i> , Civ. No. 5:13-cv-01774; -01776; -01777; -01778; -01844; -02023 (N.D. Cal.).	05/02/2014
246.	Plaintiff Adaptix's First Supplemental Objections and Responses to Defendant Apple's First Set of Requests for Admission (Nos. 1-16) in the cases <i>Adaptix, Inc. v. Apple Inc., et al.</i> , Civ. No. 5:13-cv-01776; -01777; -02023 (N.D. Cal.).	05/02/2014
247.	Transcript and Exhibits for Deposition of Curtis Dodd	03/20/2014
248.	Transcript and Exhibits for Deposition of	03/21/2014

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No.	Description	Bates Range, Web Link, or Date
	Curtis Dodd	
249.	Rough Transcript for Deposition of Curtis Dodd	06/25/2014
250.	Rough Transcript for Deposition of Curtis Dodd	06/26/2014
251.	Transcript and Exhibits for Deposition of Matthew Vella	05/16/2014
252.	Transcript for Deposition of Hui Lui	06/05/2013
253.	Transcript and Exhibits for Deposition of Hui Liu	04/09/2014
254.	Rough Transcript for Deposition of Hui Lui	07/01/2014
255.	Rough Transcript for Deposition of Hui Lui	07/02/2014
256.	Transcript and Exhibits for Deposition of Michael Pisterzi	05/22/2014
257.	Transcript and Exhibits for Deposition of Timothy Montgomery	04/14/2014
258.	Transcript and Exhibits for Deposition of Vernon Fotheringham	06/02/2014
259.	Transcript and Exhibits for Deposition of Elliott Hoole	06/09/2014
260.	Transcript and Exhibits for Deposition of Palaniappan Meiyappan	04/29/2014
261.	Transcript and Exhibits for Deposition of Liang ("Leon") Hong	05/05/2014
262.	Transcript and Exhibits for Deposition of James Hite	05/06/2014
263.	Transcript and Exhibits for Deposition of Scott Prather	05/23/2014