UNITED STATES PATENT & TRADEMARK OFFICE

BEFORE THE PATENT TRIAL & APPEAL BOARD

NEC CORPORATION (JAPAN)
Petitioner

v.

ADAPTIX, INC.
Patent Owner

U.S. PATENT NO. 8,934,445

TITLE: MULTI-CARRIER COMMUNICATIONS WITH ADAPTIVE CLUSTER CONFIGURATION AND SWITCHING

FILED MAY 23, 2014
ISSUED JANUARY 13, 2015

PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1-14 OF U.S. PATENT 8,934,445 UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *ET. SEQ.*

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1003	Summons, Case No. 6:15-cv-41, Eastern District of Texas (Dkt. No. 6, April 16, 2015)
1004	Complaint, Case No. 6:15-cv-42, Eastern District of Texas (Dkt. No. 1, January 13, 2015)
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1013	U.S. Patent No. 6,473,467 to Mark Wallace ("*Wallace*")
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[1] Unless otherwise stated, all cites correspond to the original source document rather than the page indicated by the exhibit label.

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1016	Theodore Rappaport, "Wireless Communications: Principles & Practice" (1995) ("*Rappaport*") (excerpts)
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1021	U.S. Patent No. 6,067,290 to Paulraj *et al.* ("*Paulraj*")
1022	Yiyan Wu *et al.*, Orthogonal Frequency Division Multiplexing: A Multi-Carrier Modulation Scheme, IEEE Transactions on Consumer Electronics, Vol. 41, No. 3 (Aug. 1995)
1023	Prosecution History of the U.S. Patent 8,934,445 (excerpts)
1024	Wong *et al.*, "Multiuser OFDM with Adaptive Subcarrier, Bit, and Power Allocation," IEEE Journal on Selected Areas in Communications, pp. 1747-1758, October 1999

I. INTRODUCTION

NEC Corporation (Japan) ("Petitioner") requests *inter partes* review ("IPR") under 35 U.S.C. §§ 311–319 and 37 C.F.R. § 42.100 *et seq.* of Claims 1-14 of U.S. Patent No. 8,934,445 (the "'445 Patent") to Li *et al.*, titled "Multi-Carrier Communications with Adaptive Cluster Configuration and Switching." *See* Ex. 1001. The challenged '445 Patent generally relates to allocating wireless frequency channels, called "subcarriers," to subscribers. Rather than contribute any novel or non-obvious technological concepts to the state of the art, the patent's independent claims are directed merely to allocating known arrangements of subcarriers to two different subscribers. In particular, the '445 Patent claims allocating a set of subcarriers with "at least one disjoint" subcarrier and simultaneously allocating a set of subcarriers that includes "only consecutive" subcarriers. Allocating these arrangements of subcarriers was well-known in the art before the alleged priority date of the challenged patent. Ex. 1006, at ¶¶ 43-44, 55. This petition presents two prior art patents—*Gitlin* and *Wallace*—that each describe the claimed allocated arrangements of subcarriers.

The patent's dependent claims are similarly directed to standard approaches for channel allocation and associated signaling that were described in detail in prior art wireless communications textbooks. For example, numerous dependent claims are directed to sending an identification of the channels that have been

allocated to the subscriber. This is a basic, well-known concept—in order for a subscriber to know what channel(s) to use, the base station needs to inform him. Other dependent claims are directed to other basic and well-known concepts, such as informing the subscriber what coding and modulation format to use.

Petitioner submits that the Board should institute this *inter partes* review for these and additional reasons stated more fully in the following remarks.

II. RULE 42.8 MANDATORY NOTICES

A. Real Party-In-Interest (37 C.F.R. § 42.8(b)(1))

The Petitioner is NEC Corporation (Japan).

B. Related Matters (37 C.F.R. § 42.8(b)(2))

Petitioner has not been served with a complaint alleging infringement of the '445 Patent. There are three district court actions in which Adaptix, Inc. ("Adaptix") has asserted the '445 Patent:

- *Adaptix, Inc. v. Alcatel-Lucent USA, Inc. et al.*, Case No. 6-15-cv-00604 (E.D. Tex.) (filed June 25, 2015).
- *Adaptix, Inc. v. Alcatel-Lucent USA, Inc. et al.*, Case No. 6-15-cv-00041 (E.D. Tex.) (filed Jan. 13, 2015).
- *Adaptix, Inc. v. Ericsson, Inc. et al.*, Case No. 6-15-cv-00042 (E.D. Tex.) (filed Jan. 13, 2015; terminated Apr. 8, 2016).

Additionally, three petitions for *inter partes* review have been filed against the ’445 Patent:

- IPR2016-01030, Petition for *Inter Partes* Review by Alcatel-Lucent USA, Inc. (filed May 11, 2016; pending decision on institution).
- IPR2016-00997, Petition for *Inter Partes* Review by AT&T Mobility LLC. (filed May 4, 2016; pending decision on institution).
- IPR2016-00619, Petition for *Inter Partes* Review by Ericsson, Inc. (filed Feb. 12, 2016; terminated prior to determination as to whether to institute trial).

None of these prior petitions were filed by NEC.

C. Designation of Lead and Back-Up Counsel (37 C.F.R. § 42.8(b)(3))

Lead Counsel is Robert W. Busby (Reg. No. 40,930) of Morgan, Lewis & Bockius LLP. Back-up Counsel are John D. Zele (Reg. No. 39,887) and Nicholas J. Kim (Reg. No. 57,344), also of Morgan, Lewis & Bockius LLP.

D. Grounds For Standing

Petitioner hereby certifies that the patent for which review is sought is available for *inter partes* review, and that Petitioner is not barred or estopped from requesting *inter partes* review challenging the patent claims on the grounds identified herein. And as noted above, Petitioner has not been served with a complaint alleging infringement of the ’445 Patent.

E. Service Information (37 C.F.R. § 42.8(b)(4))

Papers concerning this matter may be served by mail or hand at the address below and Petitioner consents to services by electronic mail.

Mail: Robert W. Busby
Morgan, Lewis & Bockius LLP
1111 Pennsylvania Ave. NW
Washington, DC 20004-2541

Email: *robert.busby@morganlewis.com*, with cc's to *john.zele@morganlewis.com* and *nicholas.kim@morganlewis.com*

Telephone: (202) 739-5970
Facsimile: (202) 739-3001

III. STATEMENT OF THE PRECISE RELIEF REQUESTED AND THE REASONS THEREFOR

Petitioner requests *inter partes* review and cancellation of Claims 1-14 of the '445 Patent (Ex. 1001) based on the following grounds. This Petition establishes a reasonable likelihood that Petitioner will prevail in establishing that the challenged claims are unpatentable.

Ground	'445 Patent Claims	Basis for Rejection
1	1, 2, 4, 6-9, 11, 13, 14	§ 103 based on *Gitlin* and *Van Nee*
2	3, 10	§ 103 based on *Gitlin*, *Van Nee*, and *Hanzo*
3	5, 12	§ 103 based on *Gitlin*, *Van Nee*, and *Rappaport*
4	1-4, 6-11, 13, 14	§ 103 based on *Wallace*
5	5, 12	§ 103 based on *Wallace* and *Rappaport*

IV. A PERSON OF ORDINARY SKILL IN THE ART

The grounds for unpatentability submitted in this Petition are supported by the opinions of Dr. Zygmunt Haas. *See* Ex. 1006. Dr. Haas' twenty-seven year history as a PhD in electrical engineering includes over 20 years as a professor of electrical engineering and over seven years in industry at AT&T Bell Labs. Ex. 1007. Dr. Haas has authored numerous publications and has been awarded numerous patents in the field of wireless communication technology. *Id.* Notably, Dr. Haas is one of the named inventors of the *Gitlin* patent, the primary reference cited in Grounds 1-3 of this Petition. Dr. Haas is thus uniquely qualified to offer opinions as to the state of the art and invalidity of the '445 Patent, as further described in his attached curriculum vitae. *See id.*

Relative to the '445 Patent, a person of ordinary skill in the art ("POSA") is a person having at least a B.S. degree in Electrical Engineering, Computer Engineering, or equivalent training, with at least three to four years of experience in wireless communication technology or a Master's degree in electrical engineering or a similar degree, with at least two years of experience in wireless communication technology. Ex. 1006, at ¶ 17.

V. OVERVIEW OF THE '445 PATENT

The '445 Patent issued on Jan. 13, 2015, and indicates it was assigned to Adaptix, Inc. of Plano, TX. Ex. 1001. The '445 Patent issued from Application

Ser. No. 14/286,884, filed on May 23, 2014. The ’445 Patent claims priority to Application Ser. No. 09/738,086, which was filed on Dec. 15, 2000. The art presented in this Petition predates the assumed priority date of Dec. 15, 2000.

A. Summary of the Technology of the ’445 Patent

The ’445 Patent relates to allocating wireless channels, called “subcarriers,” for use in communications between a base station and multiple wireless subscribers. Ex. 1001, at Abstract. The ’445 Patent’s specification describes ways of allocating different sets of subcarriers to subscribers in order to mitigate the effects of frequency-selective fading and interference. *Id.* at (Background) 1:64-2:4 (stating that “channels are typically uncorrelated for different subscribers” and “subcarriers that are in deep fade for one subscriber may provide high channel gains for another subscriber. Therefore, it is advantageous in an OFDMA system to adaptively allocate the subcarriers to subscribers so that each subscriber enjoys a high channel gain.”).

Figure 1A of the ’445 Patent, shown below, illustrates multiple subcarriers including subcarrier 101 (shown in red) and subcarrier cluster 102 (shown in blue) of four consecutive subcarriers. Ex. 1001, at Fig. 1; 5:22-23.

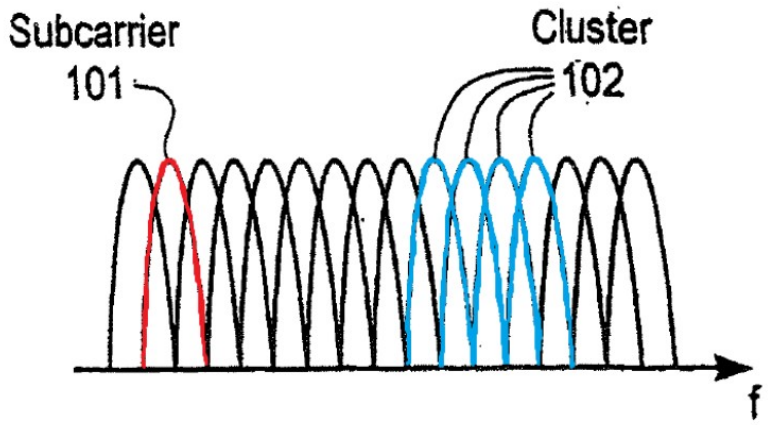


FIG. 1A

Allocating "clusters," or "sets," of subcarriers was a common and well-known technique in wireless systems at the time of the alleged invention. Ex. 1013, at Fig. 2; Ex. 1006, at ¶ 50.

The '445 Patent describes that such sets of subcarriers can "contain consecutive or disjoint subcarriers." Ex. 1001, at 5:25-26. The rationale for forming clusters of disjoint or consecutive subcarriers is based on the concept of frequency selective fading, which means that the various subcarriers within a subscribers' wideband channel may have different gains, which are also called "channel responses." Ex. 1001, at (Background) 1:64-2:7, and 11:59-62; Ex. 1006, at ¶¶ 32-33. The closer in frequency the subcarriers are, the more likely it is that they will have roughly the same response, and the further apart in frequency they are, the more likely they are to be different. Ex. 1016 at 163. This phenomenon can be measured using a concept known as a "coherence bandwidth," which describes how close subcarriers need to be to have channel responses that are the

"roughly the same" (or conversely, how far apart the subcarriers need to be for their respective channel responses to have no correlation). *See id.*

The '445 Patent describes allocating sets of subcarriers that are separated (*e.g.*, disjoint) by, for example, the coherence bandwidth so they are likely to have different channel responses and achieve "frequency diversity." Ex. 1001, at 14:34-37. The '445 Patent also contemplates that sets may include consecutive subcarriers that are likely to have the same channel response (*e.g.*, within a coherence bandwidth). Ex. 1001, at 14:30-34.

None of these concepts described by the '445 Patent reveal any novel or non-obvious concept that was not already well-known by the prior art. The concept that a wideband channel experiences frequency selective fading, as described in the '445 Patent was a concept that was well-known to practitioners within the art at the time of alleged invention. Ex. 1001, at (Background) 1:64-2:7; Ex. 1006, at ¶¶ 32-33, 42; Ex. 1016, at 335. In particular, it was well-known that subcarriers that are close together (*e.g.*, within a coherence bandwidth) are likely to have the same or a similar channel response and that those that are spread apart are likely to have uncorrelated channel responses. Ex. 1006, at ¶¶ 32-33; Ex. 1016, at 335.

Further, allocating sets of subcarriers that were spread by more than a coherence bandwidth in order to achieve frequency diversity was a standard, and

indeed textbook, approach to allocating wireless channels at the time of the alleged invention. Ex. 1006 at ¶¶ 33, 91; *see also* Ex. 1016, at 335. Likewise, allocating sets of consecutive subcarriers was well-known in the art at the time of the alleged invention. Ex. 1006, at ¶ 43. Moreover, there is nothing novel about combining these two approaches to channel allocation. The concept of allocating to a user a set of subcarriers that are consecutive together while allocating to a different user a different set of subcarriers that are disjoint was far from novel at the priority date of the '445 Patent. Both primary references—*Gitlin* and *Wallace*—teach these concepts. Claims 1-14 are thus directed to, at most, standard prior art techniques for allocating subcarriers in a frequency selective channel. Ex. 1006, at ¶ 55.

B. The Challenged Claims of the '445 Patent

The claims challenged in this Petition include two independent claims: 1 and 8. Independent Claim 1 recites a method that includes, in part, "allocating to a first subscriber ***a first set of subcarriers***," "***at least one subcarrier*** of the plurality of subcarriers ***being disjoint in frequency*** from another subcarrier of the plurality of subcarriers ***to obtain frequency diversity***."[2] The method also includes "allocating to a second subscriber ***a second set of subcarriers***" that "***includ[es] only consecutive subcarriers***," where data transmissions of the first subscriber and the second subscriber occur "***simultaneously***" using their respective allocated sets of

[2] Unless stated otherwise, emphasis in this document is added by Petitioner.

subcarriers. Independent Claim 8 is a parallel apparatus claim that includes a base station with a controller configured to perform substantially the same steps as those recited by independent Claim 1.

The dependent claims add various concepts directed to standard and well-known signaling techniques that were known and described in the prior art at the time of the alleged invention. Ex. 1006, at ¶ 56. For example, Claims 2, 4, 6, 9, 11, and 13 are directed to the well-known technique of informing the subscriber of its allocated subcarriers so that the subscriber knows which subcarriers to use in subsequent data transmission. As another example, Claims 3 and 10 are directed to the well-known technique of informing the subscriber of the particular coding and modulation format to use for its allocated channel(s) so the subscriber can decode transmissions on the allocated channel(s). Claims 5 and 12 further specify that the set of subcarriers with the disjoint subcarrier should be spread further than a coherence bandwidth, and Claims 7 and 14 claim a "channel coding across" the subcarriers; both concepts that were well known in the art.

C. Prosecution History

No substantive prior art rejections were issued during the prosecution of the patent application that lead to the '445 Patent. The patent application was filed with a TrackOne request, which was granted on Jun. 20, 2014. During the prosecution of the '445 Patent, the Patent Owner submitted over 1,400 references,

including over 800 non-patent references totaling over 68,000 pages, over 200 foreign patent documents, and over 400 U.S. patent documents. *See* Ex. 1001. The Patent Owner made no attempt to explain the significance of any materials to the Examiner, let alone point out the specific combinations proposed by the current Petition. *See* Ex. 1024. Although *Gitlin*, *Wallace*, and *Van Nee* are cited on the face of the patent (along with over 1,400 other references), these references were not relied on by the Examiner during prosecution. *Id.*

VI. CLAIM CONSTRUCTIONS

For *inter partes* review, the challenged claims must be given their broadest reasonable construction in light of the specification of the ’445 Patent.

A. Independent Claim Preambles Are Not Limiting

For the purposes of this Petition, the Board should find that these preambles are not limiting. The preamble of independent Claim 1 of the ’445 Patent recites “[a] method of allocating sets of subcarriers, each of the sets of subcarriers including a plurality of subcarriers, by a base station which communicates with a plurality of subscribers using an orthogonal frequency-division multiple access (OFDMA) system.” Independent Claim 8 is a parallel apparatus claim directed to a “base station” that includes similar preamble language as Claim 1.

Generally, a claim preamble is not limiting. *In re Wertheim*, 541 F.2d 257 (CCPA 1976). “Nonetheless, the preamble may be construed as limiting if it recites

essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim." *American Med. Sys., Inc. v. Biolitec, Inc.*, 618 F.3d 1354, 1358 (Fed. Cir. 2010). "If the preamble is reasonably susceptible to being construed to be merely duplicative of the limitations in the body of the claim (and was not clearly added to overcome a [prior art] rejection), we do not construe it to be a separate limitation." *Id.* at 1359. Here, the preamble recitation of "allocating sets of subcarriers, each of the sets of subcarriers including a plurality of subcarriers" is entirely duplicative to the "first set of subcarriers" and "second set of subcarriers" appearing in the body of the claim, each of which is required to include a plurality of subcarriers. No portion of the claim relies on the preamble for antecedent basis.

The only non-duplicative recitation in the preambles is that the method and apparatus respectively are intended to be used in an OFDMA system. This is merely a statement of intended use. *See* M.P.E.P. 2111.02 (stating that if the "preamble merely states, for example, the purpose or intended use of the invention . . . then the preamble is not considered a limitation."). There is also no suggestion in the prosecution history that "OFDMA" was relied on to overcome prior art.

B. OFDMA

The preambles of independent Claims 1 and 8 each recite an "OFDMA system." To the extent the PTAB concludes that the preamble is limiting, the Board should construe OFDMA to mean "a multiple access scheme, where

multiple subscribers simultaneously use different orthogonal frequency division multiplexed (OFDM) frequencies."

Petitioner's BRI is consistent with the specification. The specification states that OFDMA "is another method for multiple access, ***using the basic format of OFDM***. In OFDMA, ***multiple subscribers simultaneously use different subcarriers***, in a fashion similar to FDMA." Ex. 1001, at 1:51-56. The "basic format of OFDM" refers to "an efficient modulation scheme for signal transmission over frequency-selective channels. ***In OFDM***, a wide bandwidth is divided into ***multiple narrowband subcarriers***, which are arranged to be ***orthogonal*** to one another." Ex. 1001, at 1:35-39. Accordingly, the specification supports Petitioner's construction.

C. Subcarriers

The challenged claims recite the term "subcarriers" (Claims 1, 2, 4, 5, 6, 7, 8, 9, 11, 12, 13, and 14). The context of the challenged claims requires allocating a first set of "subcarriers" to a first subscriber and allocating a second set of "subcarriers" to a second subscriber. *See* Ex. 1001, at 17:7-21.

In recognition that the term "subcarriers" is not limited to OFDMA and consistent with a broadest reasonable interpretation, the Board should construe "subcarriers" to mean "***narrower bandwidth frequency channels of a wider system bandwidth***." This BRI is consistent with how the term as used in the '445

Patent and with the ordinary meaning of the term. *See* Ex. 1001, at 1:37-38 ("[A] wide bandwidth is divided into multiple narrowband subcarriers[.]"); Ex. 1001, at 1:39-40. Fig. 1A of the '445 Patent specification illustrates this concept by showing that a subcarrier is a narrower bandwidth frequency channel of a wider system bandwidth. Ex. 1001, 1:15-19; Fig. 1A (annotated to highlight an individual subcarrier in red).

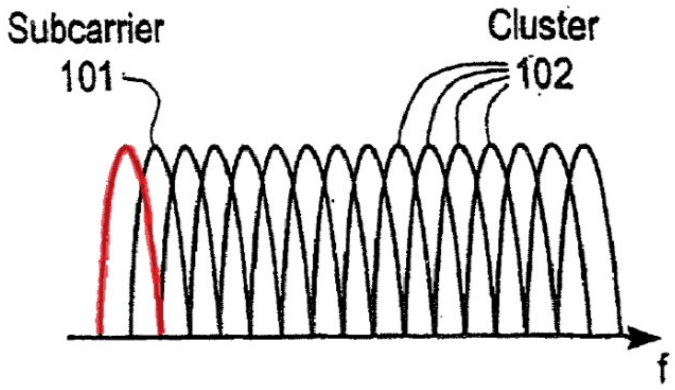


FIG. 1A

The Board should specifically reject any argument by the Patent Owner that the term "subcarriers" is limited to OFDM or OFDMA subcarriers, which are merely a specific type of subcarrier. Ex. 1006, at ¶¶ 62-64. Consistently, the specification recognizes that in OFDM the subcarrier is "arranged to be orthogonal," which indicates the existence of other, non-orthogonal subcarriers. Ex. 1001, at 1:37-40 ("In OFDM, a wide bandwidth is divided into multiple narrowband subcarriers, which are arranged to be orthogonal with each other."); Ex. 1006, at ¶ 63. Consistently, the '445 Patent also recognizes that subcarriers are also used in (non-orthogonal) FDMA systems. Ex. 1001, at 1:53-56 ("In OFDMA,

multiple subscribers simultaneously use different subcarriers, ***in a fashion similar to frequency division multiple access (FDMA)***."). It would thus be understood that the term "subcarrier" is not limited to a specific embodiment where adjacent subcarriers are orthogonal. Ex. 1006, at ¶¶ 62-64; *see also* Ex. 1011, at 22 (describing that ordinary FDM had "banks of ***subcarrier*** oscillators").

D. "A First Identification"

Claims 2 and 3 recite "a first identification provided from the base station to the subscriber." Claim 2 requires that the "first identification" identify the "allocation of the first set of subcarriers," while Claim 3 further requires that the "first identification includes a modulation and coding format to be used by the subscriber for the first data transmission to the subscriber." Claims 9 and 10 include similar limitations, respectively, to Claims 2 and 3.

Petitioner submits that a BRI of "first identification" is "***information about the first subscriber's subcarriers***." Ex. 1006, at ¶¶ 65-67. Petitioner also submits that the "a" immediately preceding the "first identification" should be construed as "one or more" under a BRI. The plain language of the claims supports that the ***first*** identification includes information about the ***first*** subscriber; the claims clearly use the label "first" to associate the "***first*** identification" with the "***first*** subscriber," similarly to how "second" associates the "second identification" with the "second subscriber" in Claim 4. Ex. 1006, at ¶ 66. The '445 Patent does not

describe specific embodiments of the claimed "first identification," but more generally states that the base station "***informs*** the subscribers about the subcarrier allocation and the coding/modulation rates to use." Ex. 1001, at 3:58-60; 6:33-39; 11:33-37.

Importantly, under a BRI, the '445 Patent claims and specification does not support a finding that "***a*** first identification" should be limited to a ***single*** message (*i.e.*, in Claims 3 and 10). *See Baldwin Graphic Systems, Inc. v. Siebert, Inc.*, 512 F.3d 1338, 1342-43 (Fed. Cir. 2008) (stating that "'a' or 'an' can mean 'one or more' is best described as a rule, rather than merely as a presumption or even a convention."). In the absence of any contrary evidence and consistent with the broadly disclosed examples in the specification, "a first identification" should be construed as "one or more" first identifications. *See id.* at 1343.

VII. SUMMARY OF THE TEACHINGS OF THE PRIOR ART

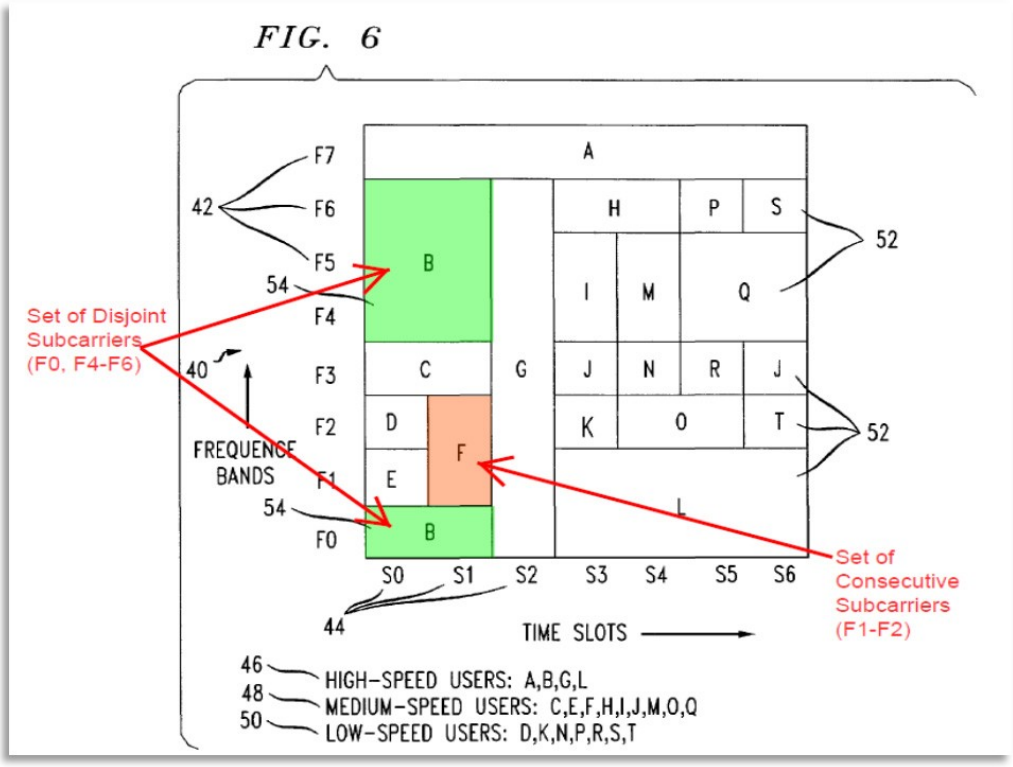
The prior art relied on in this petition discloses the alleged basis for novelty of the '445 Patent—namely, allocating a first set of consecutive subcarriers to one subscriber and simultaneously allocating a second set of disjoint subcarriers to another subscriber for use in data transmissions.

A. Gitlin

U.S. Patent No. 6,018,528 to Rich Gitlin ("*Gitlin*") was filed on Apr. 28, 1994, issued on Jan. 25, 2000, and is titled "System and Method for Optimizing

Spectral Efficiency Using Time-Frequency-Code Slicing." Ex. 1010. Because *Gitlin* was filed and published before the earliest claimed priority date, it is prior art under at least pre-AIA 35 U.S.C. §§ 102(a) and 102(e).

Gitlin discloses the ability to divide wireless bandwidth into time and frequency domains in order to assign time-frequency slices to users who may have varying access rates and user-application requirements. Ex. 1010, at Abstract. The frequency bandwidth of the system, for example, may be divided into different narrower frequency channels called "tones," and particular subscribers may be allocated a set of "tones" (*i.e.*, sets of subcarriers) according to their individual data transmission requirements. *Id.* at 5:47-60. The tones of *Gitlin* are equivalent to the claimed subcarriers at least because the tones are narrower bandwidth frequency channels of a wider system bandwidth. *See id.* at Fig. 6; 5:57-60. *Gitlin* discloses that sets of consecutive subcarriers and sets of disjoint subcarriers may be allocated to different users simultaneously. *See id.* at Fig. 6, Users B and F (as annotated).



For example, Figure 6 of *Gitlin* illustrates that in timeslot "S1" "user F" is allocated a set of contiguous frequencies "F1" and "F2" and "user B" is allocated a set of frequencies "F0", "F4," "F5," and "F6" that include "at least one subcarrier . . . disjoint in frequency from another subcarrier" (*e.g.*, "F0" is disjoint in frequency from "F4," "F5," and "F6." Ex. 1010, at Fig. 6, 3:43-46, and 5:46-60.

Gitlin further recognizes the specific benefit from "disjoint" subcarriers heralded by the '445 Patent of mitigating the effects of frequency-selective fading, stating that "tones may be scheduled in possibly non-contiguous frequency slots within one or more time slots, as, for example, for User B in FIG. 6. ***In fact, it has been found that spreading the frequency allocations of a high-speed user may offer some propagation benefits (e.g., a reduction in the degradation from***

frequency selective multipath fading)." Ex. 1010, at 6:10-16. *Gitlin*'s teaching to make non-contiguous (*i.e.*, disjoint) frequency allocations to achieve "propagation benefits" to is the same as "obtain[ing] frequency diversity." Ex. 1006, at ¶ 74.

Gitlin therefore teaches the alleged novelty of the '445 Patent, including the allocation of the first set of consecutive subcarriers and the second set of "disjoint" subcarriers, as recited by Claims 1 and 8. As will be discussed in greater detail in the analysis below, *Gitlin* also discloses the basic concept of informing the subscribers of the set of subcarriers allocated by the base station (Claims 2, 4, 9, and 11). *See* Ex. 1010, at 4:57-58; 61-64.

B. Van Nee

"OFDM for Wireless Multimedia Communications" is a book by Richard Van Nee and Ramjee Prasad ("*Van Nee*"), which was published and available to the public at least as early as Oct. 7, 1999. Ex. 1008 at ¶¶ 16-18. It is therefore prior art under pre-AIA 35 U.S.C. §§ 102(a) and 102(b).

Van Nee describes the advantages of using OFDM as a modulation technique and of OFDMA as a multiple access system. Ex. 1011, at 213. *Van Nee* discloses that OFDMA "is equal to ordinary frequency division multiple access (FDMA); however, OFDMA avoids the relatively large guard bands that are necessary in FDMA to separate different users." *Id.*

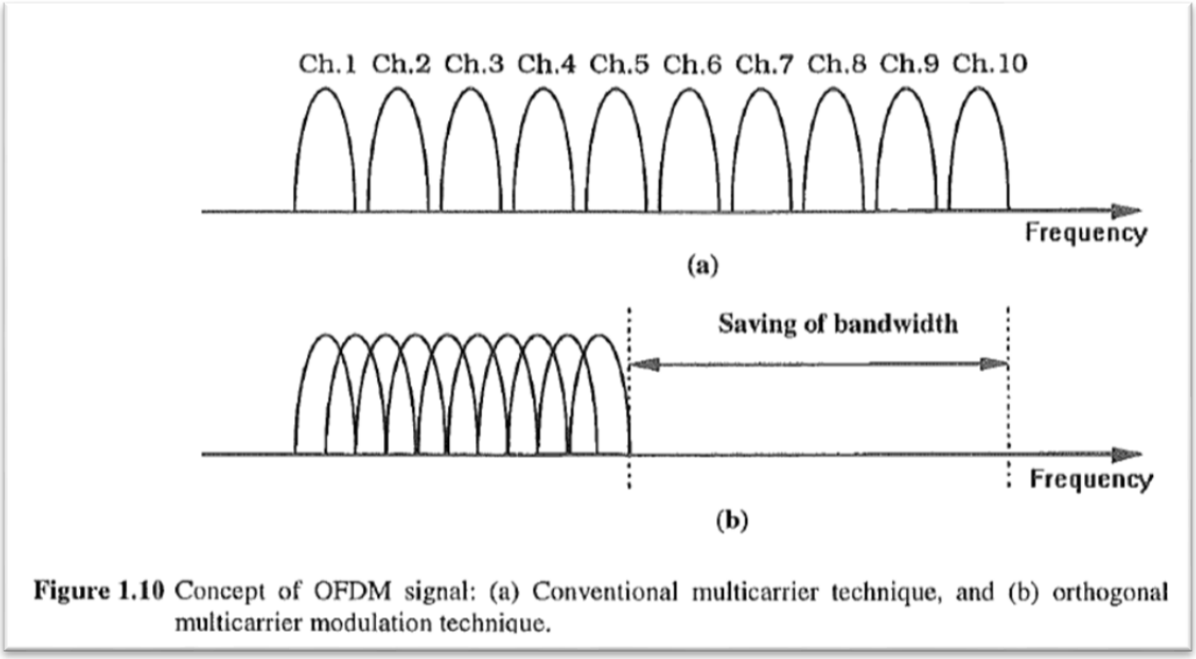


Figure 1.10 Concept of OFDM signal: (a) Conventional multicarrier technique, and (b) orthogonal multicarrier modulation technique.

The use of OFDM in OFDMA systems is what allows for the elimination of guard bands, resulting in greater spectral efficiency ("saving of bandwidth") relative to non-orthogonal FDMA systems, as illustrated by Figure 1.10 of *Van Nee* (reproduced above). *Id.* at 22; Ex. 1006, at ¶¶ 23-27, 83.

In other words, *Van Nee* taught that OFDMA is essentially equivalent to non-orthogonal FDMA from a multiple access perspective, but with the advantage of eliminating the guard bands due to the ability to remove guard bands in OFDM. Ex. 1006, at ¶¶ 82-85. Further, *Van Nee* describes that OFDMA has the advantage of being a "very flexible multiple access scheme," and that includes a "larger system capacity," is "flexible in terms of required bandwidth," is "suited . . . for support of large data rates," and could be implemented using a single transceiver in the receiver unit. Ex. 1011, at 22-23, 227-228. *Van Nee* also teaches concepts

recited in the dependent claims of the ’445 Patent, including: channel coding across subcarriers (Claims 7 and 14) and informing subscribers of their allocated subcarriers (Claims 2, 4, 9, and 11). *Id.* at 53. *Van Nee* teaches that coding across subcarriers was “essential” in OFDM/OFDMA systems. *Id.* at 53.

One of ordinary skill in the art would have been motivated to follow the teachings of Van Nee to implement known dynamic channel allocation techniques, known signaling techniques, and known subcarrier groupings from ordinary FDMA systems in OFDMA in order to obtain the advantages of OFDMA. Ex. 1006, at ¶¶ 80-87.

C. Hanzo

“Single- and Multi-carrier Quadrature Amplitude Modulation” is a book by L. Hanzo *et al.* entitled (“*Hanzo*”), which was published and available to the public at least as early as Dec. 17, 1999. Ex. 1008 at ¶¶ 19-21. *Hanzo* is therefore prior art under at least pre-AIA 35 U.S.C. § 102(a).

Hanzo includes a chapter on “Adaptive Single- and Multi-user OFDM Techniques” that teaches a textbook approach to coding and modulation that includes informing the subscriber of the particular coding and modulation format to be used (Claims 3 and 10). *Hanzo* teaches that “transmission parameters can be adapted to the anticipated channel condition, such as the modulation and coding rates.” Ex. 1014, at 556. *Hanzo* also notes that “the resulting set of parameters

has to be communicated to the receiver in order to successfully demodulate and decode the OFDM symbol." *Id.* at 558. *Hanzo* also teaches that adaptive coding and modulation can "improve the [bit error rate] BER performance." *Id.* at 556.

D. Rappaport

Spreading the frequency allocations by more than a coherence bandwidth (Claims 5 and 12) is the textbook approach for achieving frequency diversity, as shown by a book on wireless communications by Theodore Rappaport entitled "Wireless Communications: Principles & Practice," first edition ("*Rappaport*"). Ex. 1016. *Rappaport* was published by Prentice Hall PTR and was available to the public at least at least as early as Nov. 30, 1995. Ex. 1008 at ¶¶ 22-24. *Rappaport* is therefore prior art under at least 35 U.S.C. §§ 102(a) and (b).

According to Rappaport, spreading the frequency allocations by more than a coherence bandwidth is the underlying rationale for achieving frequency diversity. Ex. 1016, at 335 ("[f]requency diversity transmits information on more than one carrier frequency. The rationale of this technique is that frequencies separated by more than the coherence bandwidth will not experience the same fades."). Spreading the frequencies by more than a coherence bandwidth was therefore a well-known concept before the filing of the '445 Patent. Ex. 1006, at ¶ 91.

E. Wallace

U.S. Patent No. 6,473,467 to Mark Wallace ("*Wallace*") was filed on Mar. 30, 2000, issued on Oct. 29, 2002, and is entitled "Method and Apparatus for Measuring Reporting Channel State Information In a High Efficiency, High Performance Communications System." Ex. 1013. Because Wallace was filed before the claimed priority date of the '445 Patent, it qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(e).

Wallace discloses allocating sets of disjoint subcarriers and allocating sets of consecutive subcarriers in an OFDMA system. In particular, *Wallace* discloses that OFDM modulation may be used to divide a wireless system bandwidth into a number of narrower frequency sub-channels (*e.g.*, subcarriers). *Id.* at 6:55-61. OFDM frequency sub-channels can be shared amongst multiple subscribers, resulting in an OFDMA system. *Id.* at 26:39-40.

Wallace goes on to describe that in its OFDMA system, the frequency sub-channels (*i.e.*, subcarriers) may be allocated to subscribers in any appropriate manner, including "transmitted over sub-channels 1 and 2 [consecutive] at time slot 1 . . . , sub-channels 4 and 6 [disjoint] at time slot 2[.]" *Id.* at 7:6-10. *Wallace* specifically contemplates that sets of disjoint sub-channels may be allocated to a subscriber for the purpose of achieving frequency diversity, stating "the data may be partitioned and transmitted over any defined set of two or more sub-bands ***to***

provide frequency diversity." *Id.* at 7:1-3. *Wallace* also teaches allocation of sets of only consecutive subcarriers. *See id. at* Fig. 2 (*e.g.*, Data 5 and 6). Given the sub- channel assignment possibilities disclosed by *Wallace*, it would have been apparent that any appropriate allocation could be made during a particular time slot, including simultaneously allocating a set of consecutive subcarriers to one subscriber and a set having one or more disjoint subcarriers to another subscriber. *See id.* at 7:6-10; Ex. 1006, at ¶¶ 95-96.

Wallace also teaches many of the common design choices presented in the dependent claims, including the basic concept of informing the subscribers of the set of subcarriers allocated by the base station (Claims 2, 4, 9, and 11). *Id.* at 28:24-27 ("Allocation and de-allocation of resources (on both the forward and reverse links) can be controlled by the system and can be communicated on the control channel in the forward link."). *Wallace* also teaches channel coding can be performed "across a set of sub-channels" as (Claims 7 and 14). *See id.* at 19:47-55. *Wallace* also teaches informing the subscriber of the coding and modulation format to use (Claims 3 and 10). *Id.* at 28:24-27.

VIII. STATEMENT OF NON-CUMULATIVE NATURE OF GROUNDS

Petitioner respectfully submits that the proposed grounds are non-cumulative and should both be instituted for the following reasons. First, while there are five grounds of rejection proposed, Petitioner has carefully limited its selection of

references to two compelling and non-cumulative primary references—*Gitlin* (covering Grounds 1-3) and *Wallace* (covering Grounds 4 and 5). Petitioner has eliminated the presentation of unnecessary grounds to reduce the burden on the Board. Second, Grounds 1-3 covering collectively Claims 1-14 are non-cumulative with Grounds 4-5 covering collectively Claims 1-14 at least because Petitioner expects that the contested issues of validity will be different with respect to each ground. The Board may weigh the persuasiveness of the parties' arguments differently with respect to each ground for different reasons. Petitioner submits that the Board should therefore institute and consider each ground before making a final decision regarding patentability.

With respect to *Gitlin*, Petitioner expects the Patent Owner to wrongly argue that its claims are limited to OFDMA and that *Gitlin* does not disclose or render obvious OFDMA.[3] Petitioner, however, contends that to the extent that the claims are construed to be limited to using OFDMA systems, it would nevertheless been obvious to do so in view of *Van Nee*. Further, Wallace also explicitly discloses OFDMA, mooting any alleged lack of disclosure of OFDMA in *Gitlin*. *See* Ex.

[3] 3Petitioner disagrees that *Gitlin* fails to disclose OFDMA, but notes that the resolution of that issue is not necessary here because Petitioner has focused the issues before the PTAB on whether *Gitlin* renders the use of OFDMA obvious in view of *Van Nee* for reasons stated in detail herein.

1013 at 26:61-66 (describing that different subscribers may simultaneously use different sets of OFDM sub-channels).

With respect to *Wallace*, Petitioner expects the Patent Owner to wrongly argue that Wallace does not render obvious "the second data transmission to occur simultaneously with the first data transmission." Petitioner, however, contends that *Wallace* clearly discloses both the first set of disjoint subcarriers and the second set of consecutive subcarriers, that different sets of subcarriers can be allocated to different users, and that the teachings of Wallace render obvious the simultaneous transmission of the claimed first and second sets of subcarriers. *Gitlin*, however, explicitly discloses these limitations. *See* Ex. 1010, at Figure 6.

For at least these reasons, Petitioner submits that the grounds (Grounds 1-3 and Grounds 4-5) presented by the Petition are not cumulative. Petitioner respectfully requests consideration and institution of each ground.

IX. IDENTIFICATION OF CHALLENGE (37 C.F.R. § 42.104(B))

Inter partes review of Claims 1-14 of the '445 Patent is requested based on the grounds of unpatentability described below.

A. GROUND 1: Claims 1-2, 4, 7-9, 11, 13, and 14 are unpatentable under 35 U.S.C. § 103(a) over *Gitlin* and *Van Nee*.

1. Claim 1 (Preamble) – "A method of allocating sets of subcarriers,"

Petitioner's BRI for "subcarriers" is: "narrower bandwidth frequency channels of a wider system bandwidth." To the extent that the preamble is found

to be limiting, *Gitlin*'s method for allocating sets of particular "time-frequency slices" of the wider system bandwidth, or "tones" (the claimed "subcarriers") meets the purported limitations of the preamble. Ex. 1010, at 3:1-5 (disclosing a system and method where the transmission resource is "divided into a plurality of time- frequency 'slices' that are allocated to users according to their various transmission requirements."); *see id.* at 5:52-60 (referring to time-frequency slices as "tones").

Gitlin clearly discloses that its time-frequency slices, or tones, are narrower "slices" of the "overall time-frequency spectrum," thus meeting Petitioner's BRI for "subcarriers." *See* Ex. 1010, at 3:66-4:3; Fig. 6. To the extent that these claims are construed to be limited to OFDMA or OFDM subcarriers, it would be obvious to use the teachings of *Gitlin* in an OFDMA system (and use OFDM or OFDMA subcarriers) as taught by *Van Nee*. Ex. 1006, at pp. 51-57.

a. Claim 1 (Preamble cont'd) – "each of the sets of subcarriers including a plurality of subcarriers,"

To the extent that the preamble is found to be limiting, *Gitlin* discloses that each user may be allocated a set that includes multiple "time-frequency slices," or "tones." Ex. 1010, at 4:65-66 (confirming that a "central control 100 can thus allocate particular time-frequency slices 52 to a given user"); *see also* 6:7-10 (noting that the "transmission speed of a user can thus determine the number of tones and, thus, the number of frequencies 42 allocated for that user"). The time-

frequency slices, or tones, allocated to users comprise the claimed sets of subcarriers, which *Gitlin* discloses may include multiple tones or frequency slices.[4]

b. Claim 1 (Preamble cont'd) – "by a base station which communicates with a plurality of subscribers using an OFDMA system, the method comprising:"

To the extent that the preamble is found to be limiting, it would have been obvious to implement the method described by *Gitlin* in a base station that uses OFDMA in view of *Van Nee*. In particular, *Gitlin* discloses that its method for allocating subcarriers is performed by a central control 100, which is the claimed base station. Ex. 1010, at 4:65-66 (stating that "central control 100 can thus allocate particular time-frequency slices 52 to a given user."). *Gitlin* also discloses that time-frequency resources may be allocated to a plurality of users (e.g., users 46, 48, and 50), which are the claimed "subscribers." *Id.* at 4:12-14.

To the extent that *Gitlin* does not explicitly disclose that its method may be performed by a base station in an OFDMA system, it would have nevertheless been obvious to use the method of *Gitlin* in an OFDMA system in view of *Van Nee*. Ex. 1006, at pp. 51-57. In particular, *Van Nee* discloses "an example OFDMA system" (Ex. 1011, at 217) in which "the transmissions of mobile users are scheduled by the base station" (*id.* at 225). Bandslots, which consist of 24

[4] *Gitlin* describes frequencies 42 as "slices." Ex. 1010, at 4:1-2.

OFDM subcarriers, can be allocated "to the base station for downlink transmission to a single terminal" or "for an uplink transmission." *Id.* at 219, 225.

It would have been obvious to combine the teachings of *Gitlin* and *Van Nee* to form an OFDMA system that uses the channel allocation method of Gitlin to allocate OFDM subcarriers for the following reasons.

Simple Substitution of One Known Element for Another

First, one rationale to support a conclusion of obviousness is where "the substitution of one known element for another yields predictable results to one of ordinary skill in the art." M.P.E.P. 2143(I)(B). To the extent Board limits the claims to OFDMA based on the preamble, *Gitlin*'s method differs from the claimed approach in the '445 Patent ***at most*** by the substitution of OFDMA with ordinary FDMA. Ex. 1006, at p. 53. OFDMA was well-known in the art to be essentially equivalent to ordinary FDMA from a multiple access perspective, as stated by *Van Nee*. Ex. 1011, at 213 (noting that with the exception of the elimination of guard bands, OFDMA "is equal to ordinary frequency division multiple access (FDMA))." One of ordinary skill could have substituted one known element (ordinary FDMA) for the other (OFDMA) and the results would have been predictable (an OFDMA system that implemented the allocation methods of *Gitlin*). M.P.E.P. 2143(I)(B); Ex. 1006, at pp. 53-54. Moreover, those predictable results would have included the known advantages of *Gitlin*'s method,

which reduces the degradation from frequency selective multipath fading by allocating disjoint frequency channels spread across the system bandwidth, and the known advantages of OFDMA, which include a "larger system capacity," "flexib[ility] in terms of required bandwidth," and "suit[ability] . . . for support of large data rates." Ex. 1010, at 6:10-16; Ex. 1011, at 227-28. Ex. 1006, at p. 54.

Explicit Teaching to Combine

Another rationale to combine includes "some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention." M.P.E.P. § 2143(I)(G). *Gitlin* expressly teaches that for contiguous frequency assignments, guard bands can be eliminated. Ex. 1010, at 5:33-37 ("Such contiguous assignments eliminate the need for guard bands between the frequencies assigned to a given user."). *Gitlin* also recognized that one of the problems with his multi-tone approach was the potential need for multiple transmitters. *Id.* at 6:20-23. *Gitlin* thus simultaneously teaches to use a modulation scheme that eliminates the need for guard bands and suggests a problem regarding a potential need for multiple transmitters.

Van Nee discloses that OFDM is one such modulation scheme that eliminates the need for guard bands and also eliminates the needs for multiple transmitters, thus providing OFDMA as the ideal multiple access choice to

implement the teachings of *Gitlin*. Ex. 1011, at 213 ("OFDMA avoids the relatively large guard bands that are necessary in FDMA to separate different users."). As discussed above, the elimination of guard bands results in greater spectral efficiency ("saving of bandwidth") as compared to ordinary FDMA systems, as illustrated by Figure 1.10 of *Van Nee*. *Id.* at 22; Ex. 1006 at ¶¶ 22-23, 31. *Van Nee* also discloses that it was well-known that OFDM transmission could eliminate the need for multiple transmitters. Ex. 1006, at pp. 55-56.

One of skill in the art would have been motivated by the teachings of *Gitlin* to use OFDMA to gain the advantages of eliminating guard bands and the ability to use a single transmitter for OFDM transmission, while retaining the advantages of the method of *Gitlin* of reducing degradation from frequency selective multipath fading by allocating disjoint frequency channels. Ex. 1006, at pp. 54-56. Such a person would have also been motivated to look to the teachings of the prior art with respect to FDMA systems due to *Van Nee*'s disclosure that OFDMA and FDMA systems are "equivalent." Ex. 1006, at pp. 55-56.

Known Technique to a Known Device to Yield Predictable Results

Another rationale to combine is: "Applying a known technique to a known device ready for improvement to yield predictable results." M.P.E.P. § 2143.

Base system: *Gitlin* discloses using controller 100 to allocate sets of time-frequency slices (*i.e.*, tones) to a plurality of users (*i.e.*, subscribers) in an FDMA

system. *Gitlin* discloses that, depending on the modulation technique, the guard bands between adjacent frequency tones can be eliminated. Ex. 1010, at 5:33-37.

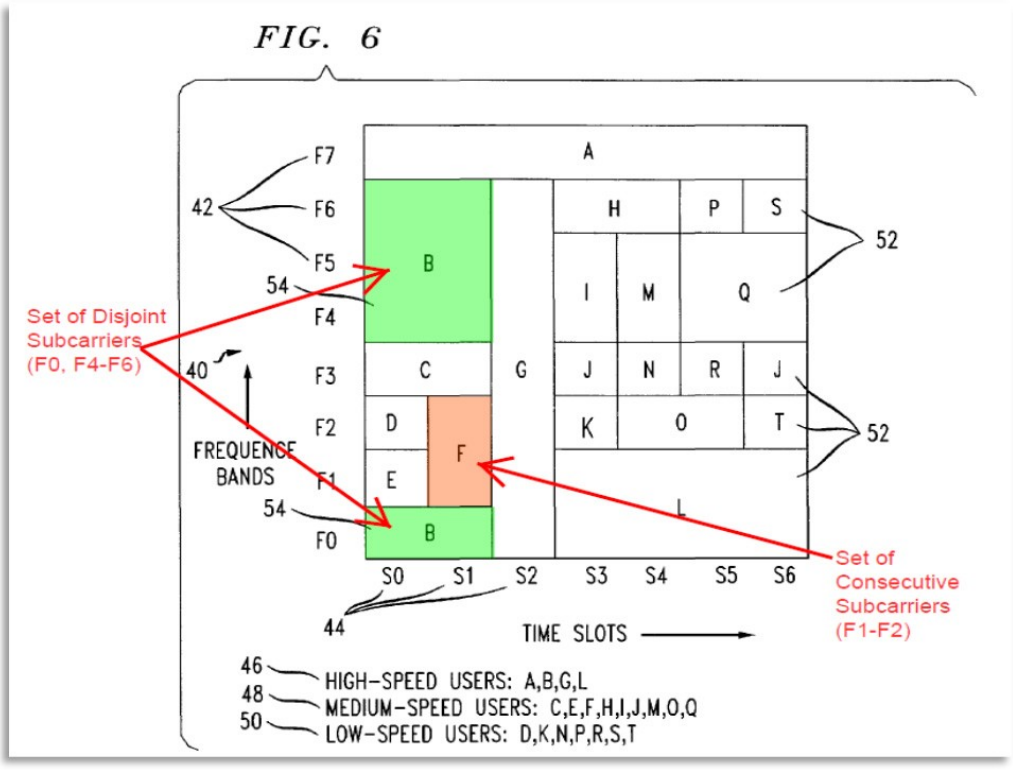
Known technique: As shown by *Van Nee*, an OFDMA system in which a base station allocates sets of OFDM subcarriers to different mobile terminals (*i.e.*, subscribers) was well known. Chapter 9 of *Van Nee* discusses in detail an example OFDMA system that was proposed for use in the 3G world standard by the European Telecommunications Standards Institute (ETSI) in 1997. *Id.* at 217. *Van Nee* describes that OFDMA is a "very flexible multiple access scheme," and that includes a "larger system capacity," is "flexible in terms of required bandwidth," and is "suited . . . for support of large data rates." *Id.* at 227-228.

Predictable results and improved system: A person of ordinary skill would have been motivated to implement an OFDMA system to take advantage of the numerous advantages of OFDMA described by *Van Nee* to obtain the predictable results of an improved system that included OFDMA as taught by *Van Nee* and the channel allocation methods taught by *Gitlin*. Ex. 1006, at pp. 56-57. As such, OFDMA would have been an obvious and desirable design choice for a person of ordinary skill seeking to implement a wireless communications system at the time of the earliest priority date of the '445 Patent. Ex. 1006, at p. 57.

c. Claim 1 – "allocating to a first subscriber a first set of subcarriers to be used for a first data transmission to the first subscriber, the allocated first set of subcarriers including a plurality of subcarriers at

least one subcarrier of the plurality of subcarriers being disjoint in frequency from another subcarrier of the plurality of subcarriers"

Figure 6 of *Gitlin*, shown annotated by Petitioner, discloses allocating to a first subscriber (user B) a first set of disjoint subcarriers (frequency tones F0, F4, F5, and F6) to be used for a first data transmission. *Gitlin* confirms that as a high speed user 46, user B will have access to "higher data rates [that] will be available to high speed users 46." Ex. 1010, at 6:4-5. Thus it would be understood that User B's set of subcarriers are to be used for a first "high speed" data transmission. Ex. 1006, at p. 64. The set consisting of F0 and F4-F6 represents a plurality of subcarriers where at least one subcarrier (F0) is disjoint in frequency from another subcarrier (F4) of the plurality of subcarriers. Ex. 1006, at pp. 62-68.



d. Claim 1 – "to obtain frequency diversity"

Gitlin discloses that the disjoint set of subcarriers (F0 and F4-F6) may be allocated to User B in non-contiguous (*i.e.*, disjoint) frequency slots to obtain a reduction in degradation from frequency selective multipath fading (*i.e.*, frequency diversity). *See* Ex. 1010, at 6:10-16 ("These tones may be scheduled in possibly non-contiguous frequency slots within one or more time slots, as, for example, for user B in FIG. 6. In fact, it has been found that ***spreading the frequency allocations of a high-speed user may offer some propagation benefits (e.g., a reduction in the degradation from frequency-selective multipath fading)***.") One of ordinary skill would understand that reducing the degradation from frequency-selective multipath fading by allocating non-contiguous frequencies is the same as obtaining frequency diversity. Ex. 1006, at pp. 64-65.

e. Claim 1 – "allocating to a second subscriber a second set of subcarriers to be used for a second data transmission to the second subscriber,"

Figure 6 of *Gitlin*, reproduced above as annotated by Petitioner, discloses allocating to a second subscriber (user F) a second set of subcarriers (frequency tones F1 and F2) to be used for a second data transmission (with "medium speed" data rates). Ex. 1010, at Fig. 6. One of ordinary skill would understand that, as compared to high speed users 46 who have access to higher data rates (Ex. 1010, at 6:4-6), medium speed users 48, such as User F, will have access to medium data

rates. Ex. 1006, at pp. 65-66. Thus, it would be understood that User F's set of subcarriers are to be used for a second "medium speed" data transmission. Ex. 1006, at p. 66.

f. Claim 1 – "the second data transmission to occur simultaneously with the first data transmission to the first subscriber using the first set of subcarriers"

As shown by Figure 6, the first data transmission to User B occurs in time slots S0 and S1, while the second data transmission to User F occurs in time slot S1. During time slot S1, the data transmission of consecutive subcarriers to User F occurs simultaneously with the data transmission of disjoint subcarriers to User B.

g. Claim 1 – "the allocated second subcarriers including only consecutive subcarriers."

As shown above in Figure 6 as annotated by Petitioner, the second subcarriers allocated to User F (tones F1 and F2) are consecutive. Tones F1 and F2 are the only tones allocated to User F in that time period.

2. Claim 2 – "The method of claim 1, wherein the allocation of the first set of subcarriers is identified by a first identification provided from the base station to the first subscriber."

Gitlin discloses the method of Claim 1. Petitioner's BRI for "first identification" is: "*information about the first subscriber's subcarriers*." The limitations of Claim 2 are directed to a basic implementation detail that requires the subscriber to be informed of the allocated set of subcarriers in order to use them. *Gitlin* discloses these elements and explains that the "central controller 100

may then award particular time-frequency slice 52 allocations to the individual users 46, 48, 50" thus informing them of their respective allocated time-frequency slices. *See* Ex. 1010, at 4:57-58. *Gitlin* further describes that "users may align themselves to their assigned time-frequency slices through appropriate signal configuration and/or modulation." Ex. 1010, at 4:61-64. These "awards" of frequency allocations disclosed by *Gitlin* constitute the claimed identification of information about the assigned time-frequency slices in order for the users to then align themselves to their assigned time-frequency slices. Ex. 1006, at pp. 68-70. This process is used to inform, for example, User B and User F of their allocations as shown in Figure 6. *Id.* at 69-70.

3. Claim 4 – "The method of claim 1, wherein the allocation of the second set of subcarriers is identified by a second identification provided from the base station to the second subscriber."

Gitlin discloses the method of Claim 1, as discussed above. As discussed with respect to Claim 2, *Gitlin* discloses that central controller 100 informs each of the individual users (including Users B and F) of their assigned sets of subcarriers by awarding allocations to them. Ex. 1006, at pp. 70-71; Ex. 1010, at 4:57-58.

4. Claim 6 – "The method of claim 1, wherein the allocated first set of subcarriers is specified by a cluster index."

Gitlin discloses the method of Claim 1 as discussed above. Gitlin discloses partitioning the overall time-frequency spectrum into frequency bands, which are

respectively indexed as F0, F1, . . . FN. Ex. 1010, at 4:1-3; *see also id.* at Fig. 6. As discussed above with respect to Claim 2, *Gitlin* also discloses informing the subscriber of the allocated set of subcarriers. It would have been obvious to use the identifiers "F0, F1, . . . FN" together as a group to create a "cluster index" to specify which set of subcarriers has been awarded to the subscriber. Ex. 1006, at pp. 71-73.

5. Claim 7 – "The method of claim 1, wherein the first data transmission to the first subscriber includes channel coding across the plurality of subcarriers of the allocated first set of subcarriers."

Gitlin discloses the method of Claim 1 as discussed above. *Gitlin* also discloses a form of "multi-tone transmission" that includes channel coding across subcarriers. Specifically, *Gitlin* discloses that "two bits can be transmitted as one 4-ary symbol using 2-tone modulation instead of two symbols on a binary channel." Ex. 1010, at 5:44-46. *Gitlin* also discloses that "higher data rates will be available to higher-speed users 46 by signaling on a combination of tones." *Id.* at 6:4-6. Signaling on a combination of tones and/or using one 4-ary symbol using 2-tone modulation discloses channel coding across multiple subcarriers, which would apply to User B (as a high speed user 46). Ex. 1006, at p. 73.

To the extent that *Gitlin* is found to not explicitly disclose these limitations, it would have nevertheless been obvious to perform channel coding across multiple subcarriers in view of *Van Nee*. Ex. 1006, at pp. 74-75. *Van Nee* discloses that

"[F]orward-error correction coding is essential. By using ***coding across the subcarriers***, errors of weak subcarriers can be corrected up to a certain limit that depends on the code and the channel. A powerful coding means that the performance of an OFDM link is determined by the average received power, rather than by the power of the weakest subcarrier." Ex. 1011, at 53.

Obviousness Rationale

As discussed above, it would have been obvious to combine *Gitlin* and *Van Nee* to form an OFDMA system. It would have further been obvious to include channel coding across subcarriers in the combined *Gitlin-Van Nee* system based on: "Applying a known technique to a known device ready for improvement to yield predictable results." M.P.E.P. § 2143.

Base system: *Gitlin* discloses using controller 100 to allocate sets of time-frequency slices, or tones, to a plurality of users (i.e., subscribers) in an FDMA system. Ex. 1010, at 4:57-58. *Gitlin* discloses a base system that signals on a combination of tones and using 2-tone modulation. Ex. 1010, at 5:35-45. It would have been obvious to combine this to arrive at an OFDMA system implementing the methods of *Gitlin* for the same reasons discussed above with respect to Claim 1. Ex. 1006, at pp. 52-57.

Known technique: *Van Nee* discloses that forward-error correction is essential in OFDM systems. Ex. 1011, at 53. *Van Nee* further discloses that

channel coding across subcarriers allows for errors of weak subcarriers to be corrected up to a certain limit that depends on the code and the channel. Ex. 1011, at 53. *Van Nee* further discloses that this is a way to improve the performance of an OFDM link from the performance of the weakest subcarrier to the performance of the average subcarrier. Ex. 1011, at 53.

Predictable results and improved system: One of ordinary skill would have been motivated to include forward-error correction, because as *Van Nee* states that it is essential. Ex. 1006, at pp. 74-75. One would have been motivated to include channel coding across subcarriers because *Van Nee* discloses this as a method to implement forward-error correction. Ex. 1006, at pp. 74-75. This would have resulted in an improved system that included all the advantages of OFDMA and the advantages of forward-error correction discussed above.

6. Claim 8

Independent 8 is a parallel apparatus claim to independent Claim 1 and recites substantially similar limitations to Claim 1. Claim 8 is directed to a base station that communicates with a plurality of subscribers that includes a "controller configured to" perform the method steps of independent Claim 1. *Gitlin* discloses that its channel allocation method may be implemented by a "controller." Ex. 1010, at 4:51-61. As such, *Gitlin* renders obvious Claim 8 for substantially similar reasons to independent Claim 1. Ex. 1006, at pp. 75-77.

7. Claim 9 – "The base station of claim 8, further comprising: receive/transmit circuitry configured to: provide the first subscriber with a first identification identifying the allocated first set of subcarriers."

Claim 9 of the '445 Patent recites substantially similar limitations as Claim 2. As such, *Gitlin* renders obvious Claim 9 for similar reasons as those discussed with reference to Claim 2. Dependent Claim 9 recites that a "receive/transmit circuitry" performs the limitations of Claim 2. *Gitlin* discloses that its channel allocation method may be implemented by a "controller" that can "allocate particular time- frequency slices to a given user." Ex. 1010, at 4:51-61. *Gitlin*'s disclosure of a controller allocating time-frequency slices to a user of a communications transmission medium would be understood by one of ordinary skill in the art to disclose receive/transmit circuitry to convey the allocation to the user. Ex. 1006, at p. 77. One of ordinary skill in the art would understand that the base station in *Gitlin* inherently must contain receive/transmit circuitry capable of the claimed functions in order to receive requests from a user and then allocate time-frequency slides to the user. *Id.*

8. Claim 11 – "The base station of claim 8, further comprising: receive/transmit circuitry configured to: provide the second subscriber with a second identification identifying the allocated second set of subcarriers."

Claim 11 of the '445 Patent recites substantially similar limitations as Claim 4. As such, *Gitlin* renders obvious Claim 11 for similar reasons as those

discussed with reference to Claim 4. Dependent Claim 11 recites that a "receive/transmit circuitry" performs the limitations of Claim 4. *Gitlin* discloses that its channel allocation method may be implemented by a "controller" that can "allocate particular time-frequency slices to a given user." Ex. 1010, at 4:51-61. *Gitlin*'s disclosure of a controller allocating time-frequency slices to a user of a communications transmission medium would be understood by one of ordinary skill in the art to disclose receive/transmit circuitry to convey the allocation to the user. As discussed above, one of ordinary skill in the art would understand that the base station in *Gitlin* inherently must contain receive/transmit circuitry capable of the claimed functions in order to receive requests from a user and then allocate time-frequency slides to the user. Ex. 1006, at p. 77.

9. Claim 13 – "The base station of claim 8, wherein the allocated first set of subcarriers is specified by a cluster index."

Gitlin renders obvious Claim 13 for similar reasons to those discussed with respect to Claim 6.

10. Claim 14 – "The base station of claim 8, wherein the first data transmission to the first subscriber includes channel coding across the plurality of subcarriers of the allocated first set of sub carriers."

Gitlin renders obvious Claim 14 for similar reasons to those discussed with respect to Claim 7.

B. GROUND 2: Claims 3 and 10 are unpatentable under 35 U.S.C. § 103(a) over *Gitlin*, *Van Nee*, and *Hanzo*.

1. Claim 3 – "The method of claim 2, wherein the first identification includes a modulation and coding format to be used by the first subscriber for the first data transmission to the first subscriber."

Petitioner's BRI for "first identification" is: "information about the first subscriber's subcarriers." *Gitlin* discloses the method of Claim 2 as discussed above. These limitations are directed to a basic well-known concept that includes informing the subscriber of what coding and modulation format to use to decode the assigned subcarriers. Ex. 1006, at pp. 79-81. *Gitlin* discloses that "[h]igher-level modulations are also possible in the system and method according to the invention." Ex. 1010, at 6:33-34. *Gitlin* thus suggests that the skilled artisan is capable of choosing to implement higher level modulation schemes. Ex. 1006, at pp. 79-80. It would have been immediately obvious to inform the user of the coding and modulation rate to allow the user to correctly decode and demodulate the data. Ex. 1006, at pp. 79-81.

For example, *Van Nee* discloses an OFDMA system with adaptive coding and modulation rates. Ex. 1011, at 220 (describing a system using "variable code rates in the range of 1/4 to 3/4" and that can support "QPSK and 8-PSK" modulation schemes). One of ordinary skill would have immediately recognized the benefits of implementing adaptive coding and modulation as described by *Van*

Nee, as well as the necessity of informing the subscriber of the particular coding and modulation rate to use so that the subscriber can properly transmit/receive information on the assigned subcarriers. Ex. 1006, at pp. 81-82.

Hanzo includes a chapter on "Adaptive Single- and Multi-user OFDM Techniques," which teaches that "transmission parameters can be adapted to the anticipated channel condition, such as the modulation and coding rates." Ex. 1014, at 556. *Hanzo* also stresses that "the resulting set of parameters ***has to be communicated*** to the receiver in order to successfully demodulate and decode the OFDM symbol." *Id.* at 558. *Hanzo* also teaches that adaptive coding and modulation can "improve the BER performance." *Id.* at 556.

As discussed above, it would have been obvious to combine *Gitlin* and *Van Nee* to form an OFDMA system. It would have further been obvious to include an identification of the coding and modulation rate in the combined *Gitlin-Van Nee* system as taught by based on: "Applying a known technique to a known device ready for improvement to yield predictable results." M.P.E.P. § 2143; Ex. 1006, at pp. 81-82.

Base system: *Gitlin* discloses using controller 100 to allocate sets of time-frequency slices, or tones, to a plurality of users (*i.e.*, subscribers) in an FDMA system. *Gitlin* suggests the possibility of using higher modulation rates in its method and system.

Known technique: *Van Nee* discloses adaptive coding and modulation in an OFDMA system. *Hanzo* further describes that adaptive coding and modulation "improves BER performance," and that the user has to be informed of the coding and modulation to use in order to correctly decode and demodulate the data.

Predictable results and improved system: One of ordinary skill would have been motivated to include adaptive coding and modulation as disclosed by *Van Nee*, because *Hanzo* reveals that it improves BER performance. Ex. 1006, at pp. 81-82. One would have been further motivated to include an identification of what coding and modulation rate to use in order to have a functioning system that allowed the user to correctly decode and demodulate the transmitted data. Ex. 1006, at pp. 81-82.

2. Claim 10 – "The base station of claim 9, wherein the first identification includes a modulation and coding format to be used by the first subscriber for the first data transmission to the first subscriber."

Gitlin renders obvious Claim 10 for similar reasons to those discussed with respect to Claim 3.

C. GROUND 3: Claims 5 and 12 are unpatentable under 35 U.S.C. § 103(a) over *Gitlin, Van Nee,* and *Rappaport.*

1. Claim 5 – "The method of claim 1, wherein the allocated first set of subcarriers includes two or more subcarriers spread farther apart than a coherence bandwidth of a respective channel."

Gitlin discloses the method of Claim 1 as discussed above. The '445 Patent states that the "coherence bandwidth" is "the bandwidth within which the channel response remains roughly the same." Ex. 1001, at 11:59-62. *Gitlin* teaches and/or renders obvious, particularly in view of *Rappaport*, that the first set of subcarriers (F0, F4-F6) are spread farther apart than a coherence bandwidth. Ex. 1006, at pp. 83-86. Specifically, *Gitlin* teaches that "spreading the frequency allocations of a high-speed user may offer some propagation benefits (*e.g.*, a reduction in the degradation from frequency-selective multipath fading)." Ex. 1010, at 6:12-16.

Rappaport describes that spreading frequencies by at least a coherence bandwidth is the basic rational underlying the concept of frequency diversity. Ex. 1016, at 335. Specifically, in a subchapter called "6.10 Diversity Techniques," in a subsection titled "6.10.5 Frequency Diversity," *Rappaport* explains that "[f]requency diversity transmits information on more than one carrier frequency. The rationale behind this technique is that frequencies separated by more than the coherence bandwidth of the channel will not experience the same fades." Ex. 1016, at 335. *Rappaport* confirms that a coherence bandwidth is "a statistical

measure of the range of frequencies over which the channel can be considered 'flat' (*i.e.*, a channel which passes all spectral components with approximately equal gain and linear phase)."

As discussed above, it would have been obvious to combine *Gitlin* and *Van Nee* to form an OFDMA system that allocates a set of disjoint subcarriers. It would have further been obvious to allocate a set of two or more disjoint subcarriers spread farther apart than a coherence bandwidth of a respective channel in the combined *Gitlin-Van Nee* system as taught by *Rappaport* to obtain frequency diversity based on: "Applying a known technique to a known device ready for improvement to yield predictable results." M.P.E.P. § 2143; Ex. 1006, at pp. 85-86.

Base system: *Gitlin* discloses allocating a set of disjoint subcarriers. Ex. 1010, at Fig. 6 (user B allocated F0, F4-F6).

Known technique: *Rappaport* describes that spreading frequencies by at least a coherence bandwidth is the basic rational underlying the concept of frequency diversity. Ex. 1016, at 335. *Rappaport* explains that "[f]requency diversity transmits information on more than one carrier frequency. The rationale behind this technique is that frequencies separated by more than the coherence bandwidth of the channel will not experience the same fades." Ex. 1016, at 335.

Predictable results and improved system: One of ordinary skill would have been motivated to spread subcarriers in the set of disjoint subcarriers described by *Gitlin* by more than the coherence bandwidth of the channel to achieve frequency diversity as taught by *Rappaport*, because using only frequencies inside the coherence bandwidth would expose each of the frequencies used for the transmission to the likelihood of having the same frequency-selective fading, and would likely ***not*** achieve frequency diversity. Ex. 1006, at pp. 85-86.

2. Claim 12 – "The base station of claim 8, wherein the allocated first set of subcarriers includes two or more subcarriers spread farther apart than a coherence bandwidth of a respective channel."

Gitlin renders obvious Claim 12 for similar reasons to those discussed with respect to Claim 5.

D. GROUND 4: Claims 1-4, 6-11, 13, and 14 are unpatentable under 35 U.S.C. § 102(e) over *Wallace*.

1. Claim 1 (Preamble) – "A method of allocating sets of subcarriers,"

As discussed above, Petitioner's BRI for "subcarriers" is: "narrower bandwidth frequency channels of a wider system bandwidth." To the extent that the preamble is found to be limiting, *Wallace* discloses a method of allocating different sets of OFDM sub-channels (*e.g.*, subcarriers). *See* Ex. 1013, at 6:55-58 ("With OFDM modulation, the overall transmission channel is essentially divided into a number of (L) ***parallel sub-channels*** that ***are used*** to transmit the same or

different data"); 26:61-66 (describing that OFDM "sub-channels can be allocated to a single data user or divided among multiple data users."); 7:1-14 ("The ***data may be*** partitioned and ***transmitted over any defined set of two or more sub-bands . . . Transmission of data over different sub-channels over time*** can improve the performance of a communications system experiencing frequency selective fading and channel distortion. Other benefits of ***OFDM modulation*** are described below."); 26:61-66 (describing that OFDM "sub-channels can be ***allocated*** to a single data user or ***divided among multiple data users***."). Sets of sub-channels are equivalent to sets of "subcarriers" at least because *Wallace* discloses that sub-channels are used to modulate a particular sub-band within the operating bandwidth (*id.* at 6:6-10) and that the sub-bands are used collectively to form an OFDM symbol that modulates the entire system bandwidth (*id.* at 10:33-37).

a. Claim 1 (Preamble cont'd) - "each of the sets of subcarriers including a plurality of subcarriers,"

To the extent that the preamble is found to be limiting, *Wallace* discloses that using OFDM modulation, the data may be partitioned and transmitted over defined sets of two or more sub-bands (the sets include a plurality of subcarriers). Ex. 1013, at Figure 2.

b. Claim 1 (Preamble cont'd) - "by a base station which communicates with a plurality of subscribers using an OFDMA system, the method comprising:"

To the extent that the preamble is found to be limiting, *Wallace* discloses that a base station may be used to perform its allocation method, for example, by disclosing that a base station may be used "in scheduling the use of the forward and reverse links." Ex. 1013, at 18:55-60. *Wallace* discloses that such a base station can use OFDM modulation to share OFDM sub-channels amongst multiple users simultaneously, which is an OFDMA system. Ex. 1013, at 26:39-40 ("OFDM modulation can also afford extra flexibility in sharing the system bandwidth, W, ***among multiple users***."); *see also* 26:61-66 (describing that OFDM "sub-channels can be allocated to a single data user or ***divided among multiple data users***.").

c. Claim 1 - "allocating to a first subscriber a first set of subcarriers to be used for a first data transmission to the first subscriber, the allocated first set of subcarriers including a plurality of subcarriers at least one subcarrier of the plurality of subcarriers being disjoint in frequency from another subcarrier of the plurality of subcarriers"

Wallace discloses allocating a defined set of subcarriers that includes disjoint sub-channels 4 and 6 at time slot 2, and discloses allocating sets of subcarriers to different subscribers by disclosing that "data can be partitioned and transmitted over any ***defined set*** of two or more sub-bands" and that "sub-channels

can be allocated to a single data user or ***divided among multiple data users***." Ex. 1013, at 7:1-2; 7:5-10; 26:64-66. *Wallace* discloses an example of allocating to a particular subscriber unit a set of sub-channels consisting of disjoint OFDM sub- channels 4 and 6 during, for example, time slot 2. *Id.* at 7:6-10 ("[D]ata for a particular subscriber unit may be transmitted over . . . ***sub-channels 4 and 6 at time slot 2***, only sub-channel 2 at time slot 3, and so on."); *see also id.* at 6:6-10. Sub-channel 4 is "disjoint" in frequency from sub-channel 6 at least because it is separated from sub-channel 6 by sub-channel 5.

d. Claim 1 – "to obtain frequency diversity"

Wallace discloses that "the data may be partitioned and transmitted over any defined set of two or more sub-bands to provide frequency diversity." Ex. 1013, at 7:1-3; *see also id.* at 6:6-10; 6:52-58. *Wallace* thus teaches that the allocation of the disjoint set of sub-bands 4 and 6 to the particular subscriber is made to obtain frequency diversity.

e. Claim 1 – "allocating to a second subscriber a second set of subcarriers to be used for a second data transmission to the second subscriber,"

Wallace renders obvious allocating a second subscriber a second set of subcarriers to be used for a second data transmission. For example, Figure 2 illustrates two sets of subcarriers to be allocated in time slot (TS) 9 consisting of sub-channels 7-11 (called Data 5) and sub-channels 12-16 (called Data 6).

Wallace teaches that "Data 1 through 6 transmissions can represent transmissions of traffic data to ***one or more receiver units***." Ex. 1013, at 11:16-18.

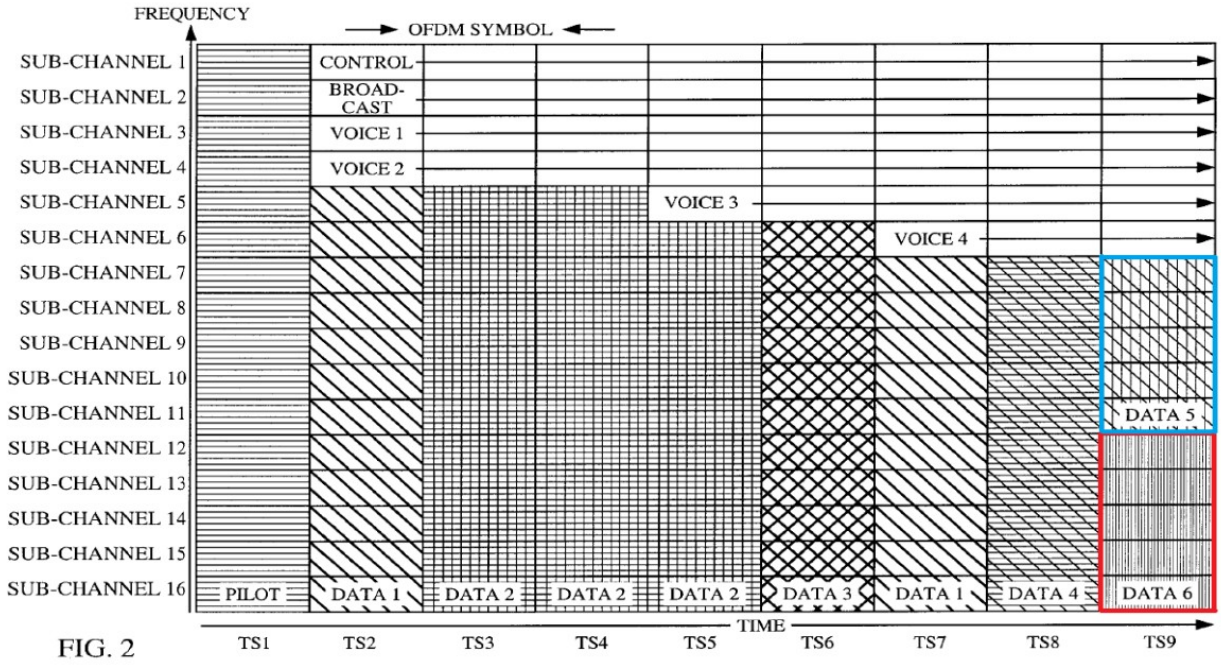


FIG. 2

As such, a person of skill in the art would understand from *Wallace* that Data 6 (sub-channels 12-16) could be allocated to a different user than sub-channels 4 and 6, discussed above with respect to element 1(c). *Id.*

f. Claim 1 – "the second data transmission to occur simultaneously with the first data transmission to the first subscriber using the first set of subcarriers"

As discussed above, *Wallace* discloses a first data transmission with a first set of disjoint sub-channels 4 and 6 to a particular first subscriber. Additionally, as discussed above, *Wallace* discloses "data" transmissions 1-6 in Fig. 2 that "can represent transmissions of traffic data to ***one or more receiver units***."). Ex. 1013, at 11:16-18. For example, *Wallace* discloses a second data transmission with a

second set of sub-channels 12-16 (Data 6) consisting of only consecutive sub-carriers (12-16) in time slot 9 of Fig. 2. Ex. 1013, at Fig. 2. Therefore, *Wallace* discloses allocating disjoint subcarriers to subscribers (Ex. 1013 at 7:5-10), allocating consecutive subcarriers to subscribers (Ex. 1013 at Fig. 2 at Data 5 and Data 6), and that different subscribers can receive different subcarrier allocations in the same timeslot (Ex. 1013 at 11:16-18, Fig. 2 at Data 5 and Data 6).

Wallace also teaches that "[t]he communication system of this invention can be designed to provide a ***multi-user, multiple access*** communications scheme ***capable of supporting subscriber units having different requirements as well as capabilities***." *Id.* at 4:64-67. For users experiencing "frequency selective fading and channel distortion," *Wallace* teaches that "[t]ransmission of ***data over different sub-channels over time*** can improve the performance." *Id.* at 7:10-13. Accordingly, *Wallace* teaches transmitting subscriber data over "different sub-channels over time," that these "different sub-channels" can include disjoint subcarriers (*id.* at 7:5-10) and consecutive subcarriers (*id.* at Fig. 2 at Data 5 and Data 6), and that a subscriber allocated disjoint subcarriers may share a timeslot with a subscriber allocated consecutive subcarriers.

Wallace further discloses allocating all available subcarriers in a timeslot. For example, Fig. 2 illustrates 16 sub-channels and 9 timeslots, where every sub-channel in every timeslot is allocated. *Id.* at Fig. 2. *Wallace* discloses that some of

the 16 OFDM sub-channels for each OFDM symbol will be used for pilot tones and control data, but that "[v]oice and data traffic can be transmitted ***in the remaining sub-channels***." *Id.* 10:66-67. *Wallace* goes on to teach that "the remaining sub-channels can be allocated to a single data user or divided among multiple data users." Ex. 1013, at 26:64-66; Ex. 1006, at pp. 93-94.

Applying these teachings, it would have been obvious to a person of skill in the art that if a particular subscriber is allocated ***disjoint*** sub-channels within a time slot (*e.g.*, sub-channels 4 and 6 discussed above), then the remaining sub-channels (*e.g.*, sub-channels 1-3, 5, and 7-16) within that time slot can be allocated to one or more other data users. Ex. 1006, at pp. 92-94. It would have been obvious to a person of skill in the art to use the sub-channel groupings described by Wallace to allocate the remaining sub-channels in the timeslot after sub-channels 4 and 6 were allocated to the first subscriber. Ex. 1006 at pp. 93-94. For example, Fig. 2 of *Wallace* illustrates example groupings of subcarriers and it would have been obvious to a person of skill in the art to use the "Data 5" or "Data 6" groupings of ***consecutive sub-channels*** to allocate the remaining sub-channels ***in the timeslot*** to additional subscribers ***after allocation of disjoint subcarriers 4 and 6*** to the first subscriber. Ex. 1013, at Fig. 2; Ex. 1006, at pp. 92-94.

g. Claim 1 – "the allocated second subcarriers including only consecutive subcarriers."

As noted in the analysis in the previous section, *Wallace* renders obvious that the allocated second subcarriers (*i.e.*, sub-channels 12-16 (Data 6)) include only consecutive subcarriers.

2. Claim 2 – "The method of claim 1, wherein the allocation of the first set of subcarriers is identified by a first identification provided from the base station to the first subscriber."

Wallace renders obvious the method of Claim 1, as discussed above. Petitioner's BRI for "first identification" is: "information about the first subscriber's subcarriers." *Wallace* teaches that information identifying a subscriber's channel allocations is sent by the system (*i.e.*, base station) to the subscriber on a control channel that communicates the allocation and de-allocation of resources. Ex. 1013, at 28:24-27 ("Allocation and de-allocation of resources (on both the forward and reverse links) can be controlled by the system and can be communicated on the control channel in the forward link.") As this teaching is readily applicable to all allocations described by *Wallace*, it would have been obvious to identify to a first subscriber the claimed allocation of the first set of subcarriers (sub-channels 4 and 6). Ex. 1006, at pp. 95-96.

3. Claim 3 – "The method of claim 2, wherein the first identification includes a modulation and coding format to be used by the first subscriber for the first data transmission to the first subscriber."

As discussed above, Petitioner's BRI for "first identification" is: "***information about the first subscriber's subcarriers***." *Wallace* renders obvious the method of Claim 2 as discussed above. *Wallace* teaches that a modulation and coding scheme is negotiated for a specific user via a common control channel before the transmission of the data. Ex. 1013, at 7:60:8-3 ("[T]he transmitter unit selects ***a modulation and coding scheme (i.e., configuration)*** from a finite set of possible configurations, which are known to the receiver units. . . . When using the diversity communications mode for a specific user (*e.g.*, for a voice call or a data transmission), the mode and/or ***configuration may be . . . negotiated (e.g., via a common channel) by the receiver unit***."). Negotiating the modulation and coding scheme via the common channel discloses information about the modulation and coding format to be used by the first subscriber to decode the subscriber's subcarriers.[5] Ex. 1006, at pp. 96-97.

4. Claim 4 – "The method of claim 1, wherein the allocation of the second set of subcarriers is identified by a second

[5] To the extent that the "first identification" is construed to be a single message, including both pieces of information in same message would have been an obvious, natural, and efficient design choice. Ex. 1006, at pp. 97-98.

identification provided from the base station to the second subscriber."

Wallace renders obvious the method of Claim 1 as discussed above. Wallace teaches that an identification of channel allocations is sent by the system (i.e., base station) to the subscriber on a control channel that communicates the allocation and de-allocation of resources. Ex. 1013, at 28:24-27 ("Allocation and de-allocation of resources (on both the forward and reverse links) can be controlled by the system and can be communicated on the control channel in the forward link."). It would have been obvious to use this method to identify the claimed allocation of the second set of subcarriers (*e.g.*, sub-channels 12-16 (Data 6 in Figure 2)). Ex. 1013, at Fig. 2; Ex. 1006, at p. 98.

5. Claim 6 – "The method of claim 1, wherein the allocated first set of subcarriers is specified by a cluster index."

Wallace renders obvious the method of Claim 1 as discussed above. *Wallace* discloses assigning numerical values to the sub-channels. Ex. 1013 at 7:6-10 ("[D]ata for a particular subscriber unit may be transmitted over sub-channels 1 and 2 at time-slot 1 (*e.g.*, with the same data being transmitted on both sub-channels), sub-channels 4 and 6 at time slot 2, only sub-channel 2 at time slot 3, and so on."); *see also* Figure 2 (disclosing sub-channels 1 to 16). It would have been obvious and efficient for a person of skill in the art to use the numerical values of the sub-channels, grouped together, to create a "cluster index" of the sets

(*e.g.*, clusters) of sub-channels that had been awarded to the subscriber. Ex. 1006, at pp. 98-99.

6. Claim 7 – "The method of claim 1, wherein the first data transmission to the first subscriber includes channel coding across the plurality of subcarriers of the allocated first set of subcarriers."

Wallace renders obvious the method of Claim 1 as discussed above. Wallace further discloses various forms of channel coding and that the channel coding can be performed "across a set of sub-channels." Ex. 1013, at 19:47-55; 19:33-39 (describing that the "encoding may include error correction coding or error detection coding, or both, used to increase the reliability of the link. More specifically, such encoding may include, for example, interleaving, convolutional coding, Turbo coding, Trellis coding, block coding (*e.g.*, Reed-Solomon coding), cyclic redundancy check (CRC) coding, and others.").

7. Claim 8

Independent 8 is a parallel apparatus claim to independent Claim 1 and recites substantially similar limitations. As such, *Wallace* renders obvious Claim 8 for substantially similar reasons to independent Claim 1. Claim 8 is directed to a base station that communicates with a plurality of subscribers that includes a "controller configured to" perform the method steps of independent Claim 1.

Wallace discloses that its allocation method can be implemented by a base station. Ex. 1013, at 15:66-16:5 (disclosing that the "use of disjoint sub-channel

subsets can further be applied in a system wherein multiple links, *e.g.*, a propagation channel from a transmitter unit to one or more receiver units, are located in close proximity. In a system where a base station transmits signals according to sectors, the transmission area of a sector can overlap the transmission area of another sector."). Figure 3 discloses an embodiment of a base station that includes channel data processor 320 (the claimed "controller") that is configured to assign each channel data stream to one or more sub-channels. Ex. 1013, at 19:58-59 (disclosing that "data processor 320 assigns each channel data stream to one or more sub-channels.").

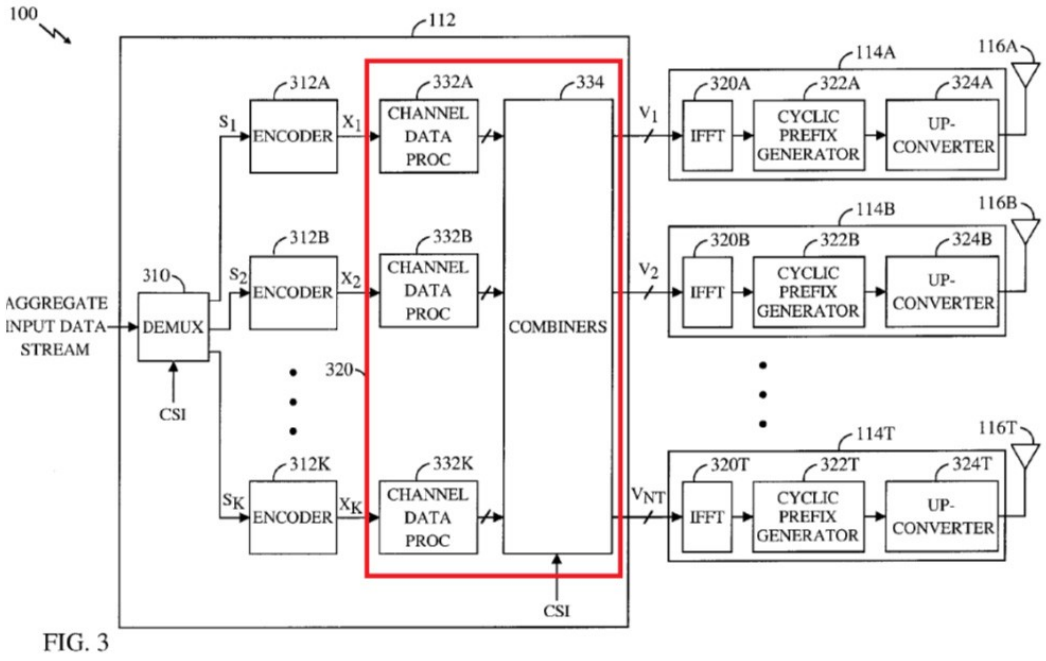


FIG. 3

Wallace goes on to describe that data processor 320 can "assign the available resources such that the system goals of high performance and high efficiency are achieved. The data transmissions are thus 'scheduled' to achieve the

system goals." *Id.* at 20:5-9. One of ordinary skill would understand that data processor 320 is an embodiment of a base station controller that makes channel assignment decisions, and that its assignment algorithm can be programmed to perform the method steps of Claim 1 discussed above. Ex. 1006, at pp. 100-02. The steps of Claim 8 are substantially similar to the method steps of Claim 1 and are disclosed for the same reasons discussed above with respect to Claim 1.

8. Claim 9 – "The base station of claim 8, further comprising: receive/transmit circuitry configured to: provide the first subscriber with a first identification identifying the allocated first set of subcarriers."

Claim 9 of the '445 Patent recites substantially similar limitations as Claim 2. As such, *Wallace* renders obvious Claim 9 for similar reasons as those discussed with reference to Claim 2.

Dependent Claim 9 recites that a "receive/transmit circuitry" performs the limitations of Claim 2. As discussed above with respect to Claim 8, Figure 3 discloses an embodiment of a base station, including a controller called "data processor 320." Data processor 320 is disclosed as a subcomponent of data processor 112, which is coupled to modulators 114 (the claimed "transmit circuitry"). *See* Ex. 1013, at Fig. 3. Figure 3 also discloses that data processor 112 is part of the receive/transmit circuitry. *See id.* at 19:22-24 ("Fig. 3 is a block diagram of a data processor 112 and modulator 114 of system 110 of Fig. 1A"); *see also id.* at 3:62-67 (confirming that "[e]ach modulator 114 further processes the

modulation symbols and generates an RF modulated signal suitable for transmission. The RF modulated signals from modulators 114a through 114t are then transmitted from respective antennas 116a through 116t over communications links 118 to system 120."); *see also* 4:28-32; 4:40-47.

One of ordinary skill in the art would understand that such a receiver unit could be implemented at the base station. Ex. 1006, at pp. 102-04. It would be readily understood to one of ordinary skill in the art that such receive/transmit circuitry would be used to inform the given user of the particular allocations as determined by data processor 320, including the claimed first set of sub-channels. Ex. 1006, at pp. 103-04.

9. Claim 10 – "The base station of claim 9, wherein the first identification includes a modulation and coding format to be used by the first subscriber for the first data transmission to the first subscriber."

Wallace renders obvious Claim 10 for similar reasons to those discussed with respect to Claim 3.

10. Claim 11 – "The base station of claim 8, further comprising: receive/transmit circuitry configured to: provide the second subscriber with a second identification identifying the allocated second set of subcarriers."

Wallace renders obvious Claim 11 for similar reasons as those discussed with reference to Claim 4. Dependent Claim 11 recites that a "receive/transmit

circuitry" performs the limitations of Claim 4. These limitations are disclosed for reasons substantially similar to those discussed with Claim 9.

11. Claim 13 – "The base station of claim 8, wherein the allocated first set of subcarriers is specified by a cluster index."

Wallace renders obvious Claim 13 for similar reasons as those discussed with reference to Claim 6.

12. Claim 14 – "The base station of claim 8, wherein the first data transmission to the first subscriber includes channel coding across the plurality of subcarriers of the allocated first set of sub carriers."

Wallace renders obvious Claim 14 for similar reasons as those discussed with reference to Claim 7.

E. GROUND 5: Claims 5 and 12 are unpatentable under 35 U.S.C. § 103(a) over Wallace and Rappaport.

1. Claim 5 – "The method of claim 1, wherein the allocated first set of subcarriers includes two or more subcarriers spread farther apart than a coherence bandwidth of a respective channel."

Wallace renders obvious the method of Claim 1 as discussed above. *Wallace* discloses that "the data may be partitioned and transmitted over any defined set of two or more sub-bands to provide frequency diversity." Ex. 1013, at 7:1-3. *Rappaport* describes that spreading frequencies by at least a coherence bandwidth is the basic rational underlying the concept of frequency diversity. Ex. 1016, at 335. Specifically, in a subchapter called "6.10 Diversity Techniques,"

in a subsection titled "6.10.5 Frequency Diversity," *Rappaport* explains that "[f]requency diversity transmits information on more than one carrier frequency. The rationale behind this technique is that frequencies separated by more than the coherence bandwidth of the channel will not experience the same fades." Ex. 1016, at 335. *Rappaport* confirms that a coherence bandwidth is "a statistical measure of the range of frequencies over which the channel can be considered 'flat' (*i.e.*, a channel which passes all spectral components with approximately equal gain and linear phase)." *Id.* at 163.

Thus, using only frequencies inside the coherence bandwidth would not be likely to achieve the benefits described by *Wallace*, as one of ordinary skill in the art would well know. Ex. 1006, at pp. 105-06. In particular, using limited frequency range would expose the transmission to frequency-selective fading and channel distortion. It would have therefore been obvious to spread the frequencies by more than a coherence bandwidth in the system of *Wallace*, particularly in the disjoint set comprising sub-bands 4 and 6.

It would have further been obvious to include two or more subcarriers spread farther apart than a coherence bandwidth of a respective channel in the set of allocated disjoint subcarriers disclosed in *Wallace* as taught by *Rappaport* based on "[a]pplying a known technique to a known device ready for improvement to yield predictable results." M.P.E.P. § 2143.

Base system: *Wallace* discloses allocating a set of disjoint subcarriers and that "the data may be partitioned and transmitted over any defined set of two or more sub-bands to provide frequency diversity." Ex. 1013, at 7:1-10.

Known technique: *Rappaport* describes that spreading frequencies by at least a coherence bandwidth is the basic rational underlying the concept of frequency diversity. Ex. 1016, at 335. *Rappaport* explains that "[f]requency diversity transmits information on more than one carrier frequency. The rationale behind this technique is that frequencies separated by more than the coherence bandwidth of the channel will not experience the same fades." Ex. 1016, at 335.

Predictable results and improved system: One of ordinary skill would have been motivated to spread subcarriers in the set of disjoint subcarriers described by *Wallace* by more than the coherence bandwidth of the channel to achieve frequency diversity as taught by *Rappaport*, because using only frequencies inside the coherence bandwidth would expose the transmission to frequency-selective fading and channel distortion. Ex. 1006, at pp. 105-06.

2. Claim 12 – "The base station of claim 8, wherein the allocated first set of subcarriers includes two or more subcarriers spread farther apart than a coherence bandwidth of a respective channel."

Wallace in view of Rappaport renders obvious Claim 11 for similar reasons as those discussed with reference to Claim 5.

X. CONCLUSION

For the reasons set forth above, there is a reasonable likelihood that Petitioner will prevail as to the invalidity of Claims 1-14 of the '445 Patent. Petitioner requests that the Board institute *inter partes* review and subsequently invalidate the challenged claims. The Director is authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this proceeding by this firm) to Morgan Lewis Deposit Account No. 50-0310.

Respectfully submitted,

May 25, 2016
Date

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), Petitioner hereby certifies, in accordance with and reliance on the word count provided by the word-processing system used to prepare this petition, that the number of words in this paper is 13,673. Pursuant to 37 C.F.R. § 42.24(a), this word count excludes the table of contents, table of authorities, grounds for standing, mandatory notices under § 42.8, certificate of service, certificate of word count, appendix of exhibits, and claim listing.

May 25, 2016
Date

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CERTIFICATE OF SERVICE

In accordance with 37 C.F.R. §§ 42.6(e) and 42.105, the undersigned certifies that on the 25th day of May, 2016, a complete and entire copy of the **PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1-14 OF U.S. PATENT 8,934,445 UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *ET. SEQ.*** ("Petition") and related documents were served on the patent owner at the correspondence address of record for the subject patent,

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Attn: Customer No. 22882

via Express Mail or by means at least as fast and reliable as Express Mail.

May 25, 2016
Date

/s/ Robert W. Busby
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