

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HULU, LLC
AMAZON.COM, INC, and
NETFLIX, INC.,
Petitioners,

v.
REALTIME ADAPTIVE STREAMING LLC,
Patent Owner.

Case No. IPR2018-01187
Patent 9,769,477

DECLARATION OF JAMES A. STORER, PH.D.

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I, James A. Storer, declare as follows:

1. My name is James A. Storer. I am a Professor of Computer Science at Brandeis University and a member of the Brandeis Center for Complex Systems. I have prepared this report as an expert witness retained by Amazon.com, Inc., Hulu, LLC and Netflix, Inc., (hereinafter “Petitioners”). In this report I give my opinions as to whether certain claims of U.S. Patent No. 9,769,477 (“the ’477 Patent”) are invalid. I provide technical bases for these opinions as appropriate.

2. This report contains statements of my opinions formed to date and the bases and reasons for those opinions. I may offer additional opinions based on further review of materials in this case, including opinions and/or testimony of other expert witnesses. I make this declaration based upon my own personal knowledge and, if called upon to testify, would testify competently to the matters contained herein.

I. BACKGROUND AND QUALIFICATIONS

3. I have summarized in this section my educational background, career history, publications, and other relevant qualifications. My full curriculum vitae is attached as Appendix 1 to this declaration.

4. I am an expert in the field of computer algorithms, including data communications and network computing, data compression, data and image retrieval, storage and processing of large data sets, and image / video processing. I

have studied, taught, practiced, and researched in the field of Computer Science for over thirty years. Currently, I am Professor of Computer Science at Brandeis University in Waltham, Massachusetts, where I have been on the faculty since 1981.

5. I received my Doctor of Philosophy (Ph.D.) degree in the field of Computer Science from Princeton University in 1979. I received my Masters of Arts (M.A.) degree in Computer Science from Princeton University and my Bachelor of Arts (B.A.) degree in Mathematics and Computer Science from Cornell University.

6. After receiving my Ph.D. degree, I worked in industry as a researcher at AT&T Bell Laboratories from 1979 to 1981 before joining the faculty of Brandeis University.

7. I have been involved in computer science research since 1976. My research has been funded by a variety of governmental agencies, including the National Science Foundation (NSF), National Aeronautics and Space Administration (NASA), and Defense Advanced Research Projects Agency (DARPA). In addition, I have received government Small Business Innovation Research (SBIR) funding, as well as numerous industrial grants.

8. I regularly teach courses in software and hardware technology for data compression and communications (including text, images, video, and audio) at both the undergraduate and graduate level, and in my capacity as co-chair of the

Annual Data Compression Conference, I regularly referee academic papers in these areas. In addition, much of my consulting activity has been in the areas of software and hardware for consumer electronic devices, including cell phones/PDAs (including cellular technology), smartphones, digital cameras, digital video and audio recorders, and personal computers (“PCs”), as well as devices for communications over the Internet.

9. I am the author of two books: *An Introduction to Data Structures and Algorithms* and *Data Compression: Methods and Theory*. Both books have been used as references for undergraduate level computer science courses in universities. I am the editor or co-editor of four other books, including *Hyperspectral Data Compression* and *Image and Text Compression*.

10. I have three issued U.S. patents that relate to computer software and hardware (two for which I am sole inventor and one for which I am co-inventor). I am the author or co-author of well over 100 articles and conference papers.

11. In 1991, I founded the Annual Institute of Electrical and Electronics Engineers (IEEE) Data Compression Conference (DCC), the first major international conference devoted entirely to data compression, and have served as the conference chair since then. This conference continues to be the world’s premier venue devoted to data compression research and development.

12. I routinely serve as referee for papers submitted to journals such as, for example, JACM, SICOMP, Theoretical CS, Computer Journal, J. Algorithms, Signal Processing, JPDC, Acta Informatica, Algorithmica, IPL, IPM, Theoretical CS, J. Algorithms, Networks, IEEE J. Robotics & Automation, IEEE Trans. Information Theory, IEEE Trans. Computers, IEEE Trans. Image Processing, Proceedings of the IEEE, IBM J. of R&D, and J. Computer and System Sciences.

13. I have served as guest editor for a number of professional journals, including Proceedings of the IEEE, Journal of Visual Communication and Image Representation, and Information Processing and Management. I have served as a program committee member for various conferences, including IEEE Data Compression Conference, IEEE International Symposium on Information Theory, Combinatorial Pattern Matching (CPM), International Conference on String Processing and Information Retrieval (SPIRE), Conference on Information and Knowledge Management (CIKM), Conference on Information Theory and Statistical Learning (ITSL), Sequences and Combinatorial Algorithms on Words, Dartmouth Institute for Advanced Graduate Studies Symposium (DAGS), International Conference on Language and Automata Theory and Applications (LATA), DIMACS Workshop on Data Compression in Networks and Applications, and Conference on Combinatorial Algorithms on Words.

A. Compensation

14. For my efforts in connection with the preparation of this declaration I have been compensated at my standard rate for this type of consulting activity. My compensation is in no way contingent on the results of these or any other proceedings relating to the above-captioned patent.

B. Materials and Other Information Considered

15. I have considered information from various sources in forming my opinions. I have reviewed and considered each of the exhibits listed in the attached Appendix 2 (Appendix of Exhibits) in forming my opinions.

II. UNDERSTANDING OF THE LAW

16. I have applied the following legal principles provided to me by counsel in arriving at the opinions set forth in this report.

A. Legal Standard for Prior Art

17. I am not an attorney. I have been informed by attorneys of the relevant legal principles and have applied them to arrive at the opinions set forth in this declaration.

18. I understand that the petitioner for *inter partes* review may request the cancelation of one or more claims of a patent based on grounds available under 35 U.S.C. § 102 and 35 U.S.C. § 103 using prior art that consists of patents and printed publications.

1. Anticipation and Prior Art

19. I understand that § 102 specifies when a challenged claim is invalid for lacking novelty over the prior art, and that this concept is also known as “anticipation.” I understand that a prior art reference anticipates a challenged claim, and thus renders it invalid by anticipation, if all elements of the challenged claim are disclosed in the prior art reference. I understand the disclosure in the prior art reference can be either explicit or inherent, meaning it is necessarily present or implied. I understand that the prior art reference does not have to use the same words as the challenged claim, but all of the requirements of the claim must be disclosed so that a person of ordinary skill in the art could make and use the claimed subject-matter.

20. In addition, I understand that § 102 also defines what is available for use as a prior art reference to a challenged claim.

21. Under § 102(a), a challenged claim is anticipated if it was patented or described in a printed publication in the United States or a foreign country before the challenged claim’s date of invention.

22. Under § 102(b), a challenged claim is anticipated if it was patented or described in a printed publication in the United States or a foreign country more than one year prior to the challenged patent’s filing date.

23. Under § 102(e), a challenged claim is anticipated if it was described in published patent application that was filed by another in the United States before the challenge claim's date of invention, or was described in a patent granted to another that was filed in the United States before the challenged claim's date of invention.

24. I understand that a challenged claim's date of invention is presumed to be the challenged patent's filing date. I also understand that the patent owner may establish an earlier invention date and "swear behind" prior art defined by § 102(a) or § 102(e) by proving (with corroborated evidence) the actual date on which the named inventors conceived of the subject matter of the challenged claim and proving that the inventors were diligent in reducing the subject matter to practice.

25. I understand that the filing date of patent is generally the filing date of the application filed in the United States that issued as the patent. However, I understand that a patent may be granted an earlier effective filing date if the patent owner properly claimed priority to an earlier patent application.

26. I understand that when a challenged claim covers several structures, either generically or as alternatives, the claim is deemed anticipated if any of the structures within the scope of the claim is found in the prior art reference.

27. I understand that when a challenged claim requires selection of an element from a list of alternatives, the prior art teaches the element if one of the alternatives is taught by the prior art.

B. Obviousness

28. I understand that even if a challenge claim is not anticipated, it is still invalid if the differences between the claimed subject matter and the prior art are such that the claimed subject matter would have been obvious to a person of ordinary skill in the pertinent art at the time the alleged invention.

29. I understand that obviousness must be determined with respect to the challenged claim as a whole.

30. I understand that one cannot rely on hindsight in deciding whether a claim is obvious.

31. I also understand that an obviousness analysis includes the consideration of factors such as (1) the scope and content of the prior art, (2) the differences between the prior art and the challenged claim, (3) the level of ordinary skill in the pertinent art, and (4) “secondary” or “objective” evidence of non-obviousness.

32. Secondary or objective evidence of non-obviousness includes evidence of: (1) a long felt but unmet need in the prior art that was satisfied by the claimed invention; (2) commercial success or the lack of commercial success of the

claimed invention; (3) unexpected results achieved by the claimed invention; (4) praise of the claimed invention by others skilled in the art; (5) taking of licenses under the patent by others; (6) deliberate copying of the claimed invention; and (7) contemporaneous and independent invention by others. However, I understand that there must be a relationship between any secondary evidence of non-obviousness and the claimed invention.

33. I understand that a challenged claim can be invalid for obviousness over a combination of prior art references if a reason existed (at the time of the alleged invention) that would have prompted a person of ordinary skill in the art to combine elements of the prior art in the manner required by the challenged claim. I understand that this requirement is also referred to as a “motivation to combine,” “suggestion to combine,” or “reason to combine,” and that there are several rationales that meet this requirement.

34. I understand that the prior art references themselves may provide a motivation to combine, but other times simple common sense can link two or more prior art references. I further understand that obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and that a motivation to combine references may come from market forces.

35. I understand obviousness to include, for instance, scenarios where known techniques are simply applied to other devices, systems, or processes

to improve them in an expected or known way. I also understand that practical and common-sense considerations should be applied a proper obviousness analysis. For instance, familiar items may have obvious uses beyond their primary purposes.

36. I understand that the combination of familiar elements according to known methods is obvious when it yields predictable results. For instance, obviousness bars patentability of a predictable variation of a technique even if the technique originated in another field of endeavor. This is because design incentives and other market forces can prompt variations of it, and predictable variations are not the product of innovation, but rather ordinary skill and common sense.

37. I understand that a particular combination may be obvious if it was obvious to try the combination. For example, when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within her or her technical grasp. This would result in something obvious because the result is the product not of innovation but of ordinary skill and common sense. However, I understand that it may not be obvious to try a combination when it involves unpredictable technologies.

38. It is further my understanding that a proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art, not just the patentee. Accordingly, I understand that any need or problem known in the

field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

39. It is my understanding that the Manual of Patent Examining Procedure §2143 sets forth the following as exemplary rationales that support a conclusion of obviousness:

40. Combining prior art elements according to known methods to yield predictable results;

41. Simple substitution of one known element for another to obtain predictable results;

42. Use of known technique to improve similar devices (methods, or products) in the same way;

43. Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;

44. Choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;

45. Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art;

46. 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.

47. A person of ordinary skill in the art looking to overcome a problem will often use the teachings of multiple publications together like pieces of a puzzle, even though the prior art does not necessarily fit perfectly together. Therefore, I understand that references for obviousness need not fit perfectly together like puzzle pieces. Instead, I understand that obviousness analysis takes into account inferences, creative steps, common sense, and practical logic and applications that a person of ordinary skill in the art would employ under the circumstances.

48. I understand that a claim can be obvious in light of a single reference, if the elements of the challenged claim that are not explicitly or inherently disclosed in the reference can be supplied by the common sense of one of skill in the art.

49. I understand that obviousness also bars the patentability of applying known or obvious design choices to the prior art. One cannot patent merely substituting one prior art element for another if the substitution can be made with predictable results. Likewise, combining prior art techniques that are interoperable with respect to one another is generally obvious and not patentable.

50. In sum, my understanding is that obviousness invalidates claims that merely recite combinations of, or obvious variations of, prior art teachings using understanding and knowledge of one of skill in the art at the time and motivated by the general problem facing the inventor at the time. Under this analysis, the prior art references themselves, or any need or problem known in the field of endeavor at the time of the invention, can provide a reason for combining the elements of or attempting obvious variations on prior art references in the claimed manner.

C. Legal Standard for Claim Construction

51. I understand that before any invalidity analysis can be properly performed, the scope and meaning of the challenged claims must be determined by claim construction.

52. I understand that a patent may include two types of claims, independent claims and dependent claims. I understand that an independent claim stands alone and includes only the limitations it recites. I understand that a dependent claim depends from an independent claim or another dependent claim. I understand that a dependent claim includes all the limitations that it recites in addition to the limitations recited in the claim (or claims) from which it depends.

53. In comparing the challenged claims to the prior art, I have carefully considered the patent and its file history in light of the understanding of a person of skill at the time of the alleged invention.

54. I understand that to determine how a person of ordinary skill would have understood a claim term, one should look to sources available at the time of the alleged invention that show what a person of skill in the art would have understood disputed claim language to mean. It is my understanding that this may include what is called “intrinsic” evidence as well as “extrinsic” evidence.

55. I understand that, in construing a claim term, one should primarily rely on intrinsic patent evidence, which includes the words of the claims themselves, the remainder of the patent specification, and the prosecution history. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims when the intrinsic evidence itself is insufficient. I understand that extrinsic evidence may include principles, concepts, terms, and other resources available to those of skill in the art at the time of the invention.

56. I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else. I understand that to determine whether a term has special meaning, the claims, the patent specification, and the prosecution history are particularly important, and may show that the inventor gave a term a particular definition or intentionally disclaimed, disavowed, or surrendered claim scope.

57. I understand that the claims of a patent define the scope of the rights conferred by the patent. I understand that because the claims point out and distinctly claim the subject matter which the inventors regard as their invention, claim construction analysis must begin with and is focused on the claim language itself. I understand that the context of the term within the claim as well as other claims of the patent can inform the meaning of a claim term. For example, because claim terms are normally used consistently throughout the patent, how a term is used in one claim can often inform the meaning of the same term in other claims. Differences among claims or claim terms can also be a useful guide in understanding the meaning of particular claim terms.

58. I understand that a claim should be construed not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the entire specification. I understand that because the specification is a primary basis for construing the claims, a correct construction must align with the specification.

59. I understand that the prosecution history of the patent as well as art incorporated by reference or otherwise cited during the prosecution history are also highly relevant in construing claim terms. For instance, art cited by or incorporated by reference may indicate how the inventor and others of skill in the art at the time of the invention understood certain terms and concepts. Additionally,

the prosecution history may show that the inventors disclaimed or disavowed claim scope or further explained the meaning of a claim term.

60. With regard to extrinsic evidence, I understand that all evidence external to the patent and prosecution history, including expert and inventor testimony, dictionaries, and learned treatises, can also be considered. For example, technical dictionaries may indicate how one of skill in the art used or understood the claim terms. However, I understand that extrinsic evidence is considered to be less reliable than intrinsic evidence, and for that reason is generally given less weight than intrinsic evidence.

61. I understand that in general, a term or phrase found in the introductory words or preamble of the claim, should be construed as a limitation if it recites essential structure or steps, or is necessary to give meaning to the claim. For instance, I understand preamble language may limit claim scope: (i) if dependence on a preamble phrase for antecedent basis indicates a reliance on both the preamble and claim body to define the claimed invention; (ii) if reference to the preamble is necessary to understand limitations or terms in the claim body; or (iii) if the preamble recites additional structure or steps that the specification identifies as important.

62. On the other hand, I understand that a preamble term or phrase is not limiting where a challenged claim defines a structurally complete invention in

the claim body and uses the preamble only to state a purpose or intended use for the invention. I understand that to make this determination, one should review the entire patent to gain an understanding of what the inventors claim they invented and intended to encompass in the claims.

63. I understand that 35 U.S.C. § 112 ¶ 6 created an exception to the general rule of claim construction called a “means plus function” limitation. These types of terms and limitations should be interpreted to cover only the corresponding structure described in the specification, and equivalents thereof. I also understand that a limitation is presumed to be a means plus function limitation if (a) the claim limitation uses the phrase “means for”; (b) the “means for” is modified by functional language; and (c) the phrase “means for” is not modified by sufficient structure for achieving the specified function.

64. I understand that a structure is considered structurally equivalent to the corresponding structure identified in the specification only if the difference between them are insubstantial. For instance, if the structure performs the same function in substantially the same way to achieve substantially the same result. I further understand that a structural equivalent must have been available at the time of the issuance of the claim.

III. LEVEL OF ORDINARY SKILL IN THE ART

65. In determining the characteristics of a hypothetical person of ordinary skill in the art of the '477 Patent at the time of the claimed invention,¹ I considered several things, including various prior art techniques relating to data compression, the type of problems that such techniques gave rise to, and the rapidity with which innovations were made. I also considered the sophistication of the technologies involved, and the educational background and experience of those actively working in the field at the time. I also considered the level of education that would be necessary to understand the '477 Patent. Finally, I placed myself back in the relevant period of time and considered the engineers and programmers that I have worked with and managed in the field of video coding and decoding. I came to the conclusion that a person of ordinary skill in the field of art of the '477 Patent would have been a person with a bachelor's degree in mechanical engineering, electrical engineering, computer science, or a similar field with at least two years of experience in data compression or a person with a master's degree in mechanical

¹ I considered the level of ordinary skill in the art on February 13, 2001, the earliest claimed priority date for the '477 Patent. I understand that Petitioners are not aware of any claim by the Patent Owner that the '477 Patent is entitled to an earlier priority date.

engineering, electrical engineering, computer science, or a similar field with a specialization in data compression. A person with less education but more relevant practical experience may also meet this standard.

IV. OVERVIEW OF THE TECHNOLOGY

A. Overview of the '477 Patent

66. The '477 Patent describes an arrangement of existing data compression algorithms for “compressing and decompressing based on the actual or expected throughput (bandwidth) of a system employing data compression.” Ex. 1001 at 9:27–31. The '477 Patent states that “dynamic modification of compression system parameters so as to provide an optimal balance between execution speed of the algorithm (compression rate) and the resulting compression ratio, is highly desirable.” Ex. 1001 at 1:64–67. The '477 Patent also describes “bottlenecks” in the throughput of a system and purports to address them by activating or deactivating different compression algorithms applied to data input to or output from a compression system. Ex. 1001 at 10:3-8. The '477 Patent notes that asymmetric algorithms provide “a high compression ratio (to effectively increase the storage capacity of the hard disk) and fast data access (to effectively increase the retrieval rate from the hard disk).” Ex. 1001 at 13:39-45. On the other hand, symmetric routines “compris[e] a fast compression routine.” Ex. 1001 at 14:40-43. In one embodiment, a controller “tracks and monitors the throughput . . . of the data

compression system 12.” Ex. 1001 at 10:54-57. When the throughput of the system falls below a predetermined threshold, the system generates control signals to enable/disable different compression algorithms. Ex. 1001 at 10:55-58.

67. I understand that the “Background” of a patent application typically describes the relevant field and the prior art available at the time surrounding the filing of a patent application, and thus, that the Applicant has admitted that those systems are in the prior art. I note that the ’477 Patent specification admits that some of the claim limitations, such as arithmetic coding (Claims 2, 11, and 20) and content-dependent compression (Claims 10 and 11) were already known in the prior art.

68. I note that the ’477 Patent describes different “popular compression techniques” that were known in the prior art. Ex. 1001 at 5:11. Specifically, the ’477 Patent admits that arithmetic compression was known and that arithmetic coding was a “popular compression technique [that] possesses the highest degree of algorithmic effectiveness.” Ex. 1001 at 5:11-12.

69. The ’477 Patent also admits that content-dependent compression, as recited in Claims 10 and 11, was well-known in the prior art. The ’477 Patent incorporates into its specification the disclosure of US Patent No. 6,195,024 (“the ’024 Patent”)—a patent with an application filing date in 1998. Ex. 1001 at 5:45-50; Ex. 1021 Face. The ’024 Patent admits that “there are many conventional content

dependent” compression techniques in the prior art and even presents the below “diagram of a content dependent high-speed lossless data compression and decompression system/method according to the prior art.” Ex. 1021 at 5:54-56, 2:41-45.

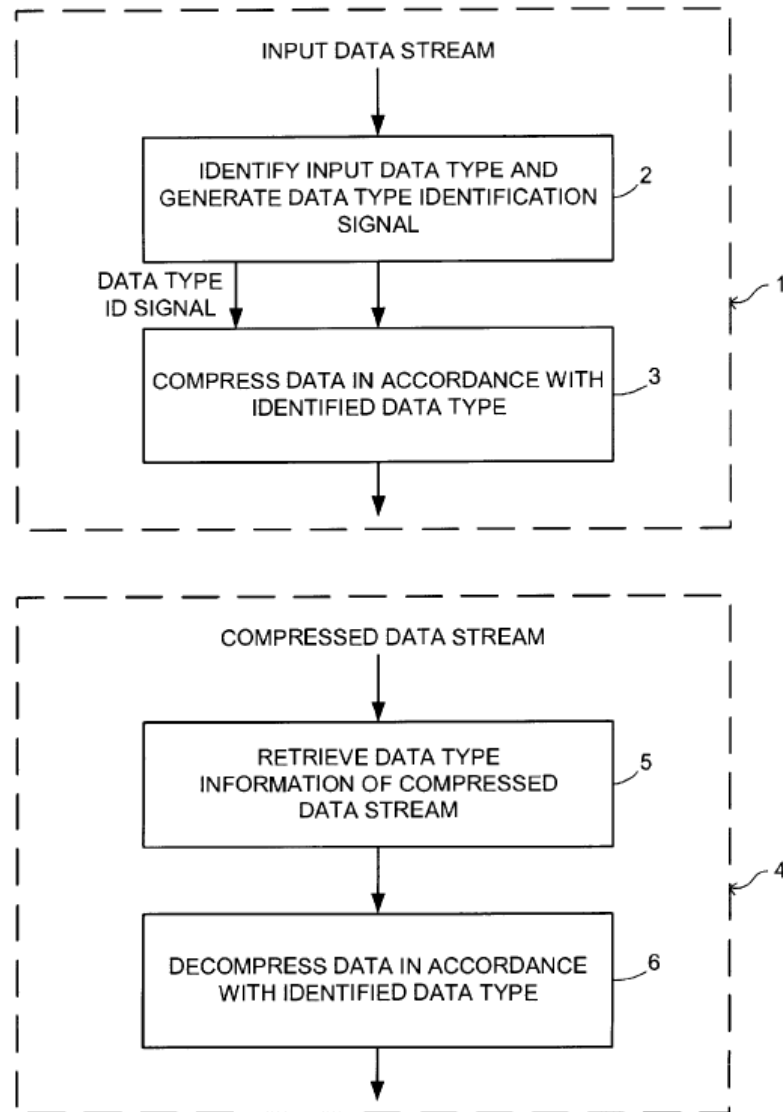


FIG. 1
PRIOR ART

70.

In reference to Figure 1 shown above, the '024 Patent describes a system that identifies an input data type and compresses the data in accordance with the identified data type. Thus, it is my opinion that the '024 Patent, as incorporated by reference into the disclosure of the '477 Patent, admits that content-dependent compression amounts to merely compressing data with an algorithm based on a data type. It is also my opinion that the '477 Patent admits that content-dependent compression was well-known in the prior art.

B. Observations on the '477 Patent

71. I note that the '477 Patent is directed to managing and applying existing compression algorithms, which the '477 Patent describes as “popular” and were universally known and well understood before the earliest priority date of the '477 Patent. *See* Ex. 1001 at 5:11-21. For example, the '477 Patent admits that arithmetic coding was a “popular compression technique [that] possesses the highest degree of algorithmic effectiveness.” Ex. 1001 at 5:11-12. I find this admission in the '477 Patent to be particularly notable given that Claims 2, 11, and 20 claim the use of arithmetic coding as somehow novel.

72. The '477 Patent also describes general categories of well-known algorithms such as dictionary-based algorithms like Lempel-Ziv, table-based algorithms like Huffman coding, as well as other well-known algorithms like run-length coding, in addition to arithmetic coding as discussed above. Ex. 1001 at 10:9-

19; 5:11-21. The '477 Patent also describes basic properties of these well-known algorithms. These basic properties would have been routinely considered by a POSITA charged with designing any compression system. For example, the '477 Patent divides its compression algorithms into two well-known and generally understood categories of compression algorithms:

In the following description of preferred embodiments, *two categories of compression algorithms are defined—an "asymmetrical" data compression algorithm and a "symmetrical" data compression algorithms*. An asymmetrical data compression algorithm is referred to herein as one in which the execution time for the compression and decompression routines differ significantly. In particular, with an asymmetrical algorithm, either the compression routine is slow and the decompression routine is fast or the compression routine is fast and the decompression routine is slow. Examples of asymmetrical compression algorithms include dictionary based compression schemes such as Lempel-Ziv.

On the other hand, a "symmetrical" data compression algorithm is referred to herein as one in which the execution time for the compression and the decompression routines are substantially similar. Examples of symmetrical algorithms include table-based compression schemes such as Huffman. For asymmetrical algorithms, the total execution time to perform one

compress and one decompress of a data set is typically greater than the total execution time of symmetrical algorithms. But an asymmetrical algorithm typically achieves higher compression ratios than a symmetrical algorithm.

Ex. 1001 at 9:60 – 10:14.

73. I note that this information would have been well-known to a POSITA. Specifically, a POSITA would have understood the performance characteristics of at least these compression algorithms and would have experience in leveraging these properties in designing compression systems. For example, Huffman coding was introduced in the 1950's and has been widely known and used since then as both a stand-alone compression method and as part of well-known and widely used data compression standards such as JPEG, H.261, H.263, MPEG1, and MPEG2. Similarly, Lempel-Ziv based compression methods have been well known since the late 1970's and have been incorporated into well-known and widely used data compression standards such as V.42bis, PKZIP, LZW, and GZIP. A POSITA would also have a core understanding of asymmetry and would attempt to leverage asymmetric coding principles in algorithm implementations when appropriate. For example, a person of ordinary skill in the art would have been well aware for example, that MPEG2 compression is asymmetric when the encoder performs substantial computation for motion compensation that is not done by the decoder,

and that Lempel-Ziv compression is asymmetric when the encoder performs substantial computation to search a history buffer that is not done by the decoder.

74. A POSITA would have understood that audio and video compression/encoding is one application of compression that involves asymmetries between the compression/encoding process and decompression/decoding process. For example, compressing/encoding video is generally much more computationally complex (and slower to execute) than decompressing/decoding for several reasons. Motion prediction is typically used, which involves determining pixel movement between the current frame and a reference frame (or frames). The search for the location of a best possible match of a particular block in the current frame to a block in a reference frame (possibly at the 1/2 pixel resolution) can be computationally expensive (as compared to the decoder simply receiving this information). Motion prediction is useful for video compression/encoding because less data may be needed to represent moving of pixels between frames than is needed to encode two frames in their entirety. Video compression is typically lossy, where there is a tradeoff between the visual quality of the video after it has been decompressed and the size of its compressed representation. Another example of asymmetry in video encoding/compression is when, after residual pixel data from motion compensation is transformed using a mathematical function (*e.g.*, MPEG2 uses the DCT – discrete cosine transform), the resulting transformed values are quantized by the encoder (the

lossy step of the video compression computation). This quantization step may employ significant computation in order to optimize the quantization choices in a way that best preserves quality/appearance while also providing data that can be best compressed by the final lossless step (*e.g.*, in MPEG2 that final step is a combination of run-length and Huffman coding) to minimize the size of the data.

75. A POSITA would have appreciated the benefits of using asymmetric compression techniques in video applications for several reasons. For example, in traditional producer-consumer video applications, the producer compresses and transmits the video and the consumer receives, decompresses, and views the video. In such an application, the consumer may have significantly more limited processing capability than the producer. In addition, the producer may wish to distribute the video to many consumers, and hence it may be desirable to have available and devote the computational resources to make the best possible compressed representation to minimize transmission and/or decoding time. A POSITA therefore would have appreciated that a reduction in decoding complexity would have been desirable in these fields in particular. *See* Ex. 1009 (Spanias Book) at 81; Ex. 1010 (Westwater Book) at 7.

76. I find this notable because the '477 Patent claims the basic use of these well-known properties of compression algorithms as somehow novel. I understand that the claims recite “asymmetric” data compression encoders and

algorithms. Ex. 1001 at cls. 1, 20. But, as discussed above, asymmetric compression would have been obvious to a POSITA at the relevant time, particularly in the context of video and audio compression. It is my opinion that mere use of asymmetric algorithms would not have been a patentable distinction at the relevant time.

77. The '477 Patent does not describe or claim any new or novel compression algorithms, encoders, or the like, and instead only makes use of well-known generic data compression encoders. Selection of well-known compression algorithms based on various conditions such as the bandwidth of a communication channel, parameters or attributes of data, and frequency of access of the data were routine and conventional considerations that were well-known in the field. *see generally* Ex. 1005; Ex. 1007; Ex. 1009 (Spanias Book) at 13 (stating the goal of audio coding is to obtain a compact digital representation for efficient transmission or storage).

78. Despite the general thrust of the subject matter of the '477 Patent—making a selection from prior art compression algorithms based on well-known principles—I find it notable that the detailed description of the '477 Patent only discusses 3 compression algorithms (Huffman, run-length, and Lempel-ziv). Arithmetic is discussed only in the “Description of Related Art” section of the specification. I would also note that '477 Patent does not describe how any of the

compression algorithms are implemented or how to connect the compression algorithms to each other or any other component of a system.

79. It is also notable that the Title and claims of the '477 Patent both predominantly target video data compression (*e.g.*, the Title of the '477 Patent is “Video Data Compression Systems”), but the detailed description is bereft of any disclosure regarding compressing video data, much less how a compression algorithm might be selected for video data. I note that “Video” data is explicitly recited 28 times in the claims of the '477 Patent and is implicated in every single claim (either by direct recitation or by dependency). But “video” data is only discussed once in the detailed description, where it is only referenced (two times) in discussing a user interface that is removed from any description of compression algorithm selection. Ex. 1001 at 20:16-25.

80. I also find it notable that image data is implicated either by direct recitation or by dependency in 19 claims of the '477 Patent. Image data is not discussed at all in any part of the detailed description. In fact, the word “image” is completely missing from the detailed description of the '477 Patent.

81. I note that Claim 17 recites a “video or image data profile.” The specification is completely devoid of any mention of either a “video data profile” or an “image data profile.”

82. I note that Claims 7 and 23 recite that “data parameters,” which I understand are used in selecting one or more data compression encoders as recited in Claims 1 and 20, comprise “a resolution of the data blocks.” I find it notable that the detailed description is completely devoid of any reference to data “resolution.” Similarly, Claims 8 and 24 recite that the “data parameters” comprise “a data transmission rate of the data blocks.” I find it notable that the detailed description is completely silent on how an encoder might be selected based on a data transmission rate of data blocks.

83. I note that the detailed description of the '477 Patent amounts to a mere five and a half pages of text and just 5 Figures. Ex. 1001 at Cols. 9-20, Figs. 1-4B (showing start of “Detailed Description” in column 9 and ending in column 20). The vast majority of this text is addressed primarily to data storage rather than data transmission or communication. I find it particularly notable that this limited disclosure has supported issuance of 205 claims in eight U.S. Patents, and there is at least one patent application currently pending. *See also* U.S. Patent Nos. 7,386,046, 8,054,879, 8,867,610, 8,553,759, 8,897,356, 8,929,442, 8,934,535 (issued Patents related to the '477 Patent and claiming priority to common U.S. Provisional Patent Application 60/268,394).

V. THE '477 PATENT

A. Challenged Claims

84. The '477 Patent issued on September 19, 2017. Ex. 1001. I understand that Petitioners are challenging the validity of Claims 1-6, 9, 10, 11-14, 20-22, and 25-27 of the '477 Patent in the Petition for *Inter Partes* Review to which this declaration will be attached. Those claims are reproduced in Appendix 3 attached hereto. While this Petition and declaration are directed to the challenged claims, I have considered Claims 1-29 of the '477 Patent, as well as portions of the '477 Patent prosecution history in forming my opinions.

B. Prosecution History

85. I reviewed the prosecution file history of the '477 Patent (Ex. 1002) and am aware of the following facts. On October 6, 2015, the '477 Patent application was filed as a U.S. Patent Application that claimed priority to U.S. Provisional Patent Application No. 60/268,394, which was filed February 13, 2001. Ex. 1001.

86. I understand that Japanese Patent Application Publication No. H11331305 to Imai *et al.* ("Imai"), European Patent Application No. EP 905,939 to Pauls *et al.* ("Pauls"), and International PCT Patent Application Publication No. WO 98/40842 to Chao *et al.* ("Chao") were neither cited to nor considered during prosecution of the '477 Patent because no U.S. or foreign counterpart of any of these references are listed on the face of the '477 Patent. In addition, I am not aware of

any of these references, or any corresponding U.S. or foreign counterparts, being discussed in any Office Action. *See generally*, Ex. 1002.

VI. CLAIM CONSTRUCTION

87. For purposes of this inter partes review, I have considered the claim language, specification, and portions of the prosecution history, to determine the meaning of the claim language as it would have been understood by a person of ordinary skill in the art at the time of the invention. I understand that traditionally there have been two different standards for claim construction that may be applied by the Patent Trial and Appeal Board. The “broadest reasonable interpretation” is the standard that has traditionally been applied to claim construction issues when considering claims during prosecution and in post-grant proceedings. Under a BRI approach, a claim term is given its broadest reasonable interpretation in view of the specification from the view point of a person of ordinary skill in the art. The “plain and ordinary meaning” or *Phillips* standard has traditionally been applied in district court litigation and in post-grant proceedings (when the claims will expire before the post-grant proceedings are completed). Under a plain and ordinary meaning approach, a claim term is given its plain and ordinary meaning in view of the specification from the view point of a person of ordinary skill in the art.

88. I understand that the BRI approach may give a claim term a broader meaning than its plain and ordinary meaning. I have been asked to consider

the claim terms and analyze invalidity using the broadest reasonable interpretation of the claims and the plain and ordinary meaning of the claims. Having considered the prior art grounds presented in this petition for the challenged claims, it is my opinion that there are no material differences between the BRI and plain and ordinary meaning of the claim language as applied to these prior art grounds.

A. “asymmetric data compression encoder[s]”

89. Based on my review of the claims and specification of the '477 Patent, it is my opinion that a POSITA would have understood that “asymmetric data compression encoder(s)” means “an encoder(s) configured to utilize a compression algorithm in which the execution time for the compression and decompression routines differ significantly.” I note that, although the '477 Patent does not describe an “asymmetric data compression encoder,” it provides an express definition for an “asymmetrical data compression algorithm.” The '477 Patent states: “[a]n asymmetrical data compression algorithm is referred to herein as one in which the execution time for the compression and decompression routines differ significantly.” Ex. 1001 at 10:12-23.

90. I also note that the specification gives examples of asymmetric and symmetric algorithms, stating that “dictionary-based compression schemes such as Lempel-Ziv” are asymmetric, while “table-based compression schemes such as Huffman” are symmetric. Ex. 1001 at 10:19-20. Based on my review of the claims

and specification of the '477 Patent, it is my opinion that a POSITA would have understood “asymmetric data compression encoder[s]” to mean “an encoder(s) configured to utilize a compression algorithm in which the execution time for compression and decompression differs significantly.”

B. “data block”

91. Based on my review of the claims and specification of the '477 Patent, it is my opinion that a POSITA would have understood “data block” to mean “a unit of data comprising more than one bit.” I note that the term “data block” is used consistently in the claims to refer to a unit of data that is compressed by a compression algorithm. Ex. 1001 at 21:57-22:66, cls. 1, 9, 19, and 25. This suggests that a data block must be capable of being compressed. I would also note that the specification explains that “[d]ata compression is widely used to reduce the amount of data required to process, transmit, or store a given quantity of information,” which would have indicated to a POSITA that a data block must be a unit large enough for there to be a chance to realize a reduction in size through compression Ex. 1001 at 2:52-54. The smallest unit of digital data representation is a bit, and the information contained in a single bit cannot be represented through compression with fewer bits. A data block must therefore be more than one bit in length so that it can be compressed as claimed.

92. The '477 Patent specification also supports this construction. The specification of the '477 Patent describes “block structured disk compression” as operating on blocks of data that are either “fixed” or “variable in size.” Ex. 1001 at 7:19-21. I note that the specification also states that data blocks can represent files, and that “[a] single file usually is comprised of multiple blocks, however, a file may be so small as to fit within a single block.” Ex. 1001 at 7:21-23. Also, the specification goes on to discuss the pros and cons of smaller and larger data block sizes. Ex. 1001 at 7:11-13. The specification also contemplates units of data that comprise more than one bit that are stored in its system. Ex. 1001 at FIG. 4B (stating “2 bits” are reserved for a sector map “type” definition, and “3 bits” are reserved for “c type”). The specification’s discussion of various data block sizes, including file-sized data blocks and data units as small as 2 bits, are consistent with Petitioners’ proposed construction.

93. I understand that the '477 Patent incorporates by reference U.S. Patent No. 6,195,024 (“the '024 Patent”). It is my opinion that the disclosure of the '024 Patent uses the term “data block” in a manner that is consistent with this proposed construction:

It is to be understood that the system processes the input data streams in data blocks that may range in size from individual bits through complete files or collections of multiple files. Additionally, the data block size may be

fixed or variable. The counter module [] counts the size of each input data block (i.e., the data block size is counted in bits, bytes, words, any convenient data multiple or metric.

Ex. 1021 at 7:9-15.

94. I further understand that the Patent Owner² has twice stipulated to a similar construction of this term in district court proceedings. Ex. 1013 at 34; Ex. 1014 at 40 (both evidencing Patent Owner’s agreement that “data block” means “a single unit of data, which may range in size from individual bits through complete files or collection of multiple files”). It is my opinion that Patent Owner’s prior constructions of this phrase further support this proposed construction.

VII. SUMMARY OF THE PRIOR ART

95. There are a number of patents and publications which constitute prior art to the ‘477 Patent. I have reviewed and considered the following prior art patent publication and patents.

A. Imai (Exhibit 1004)

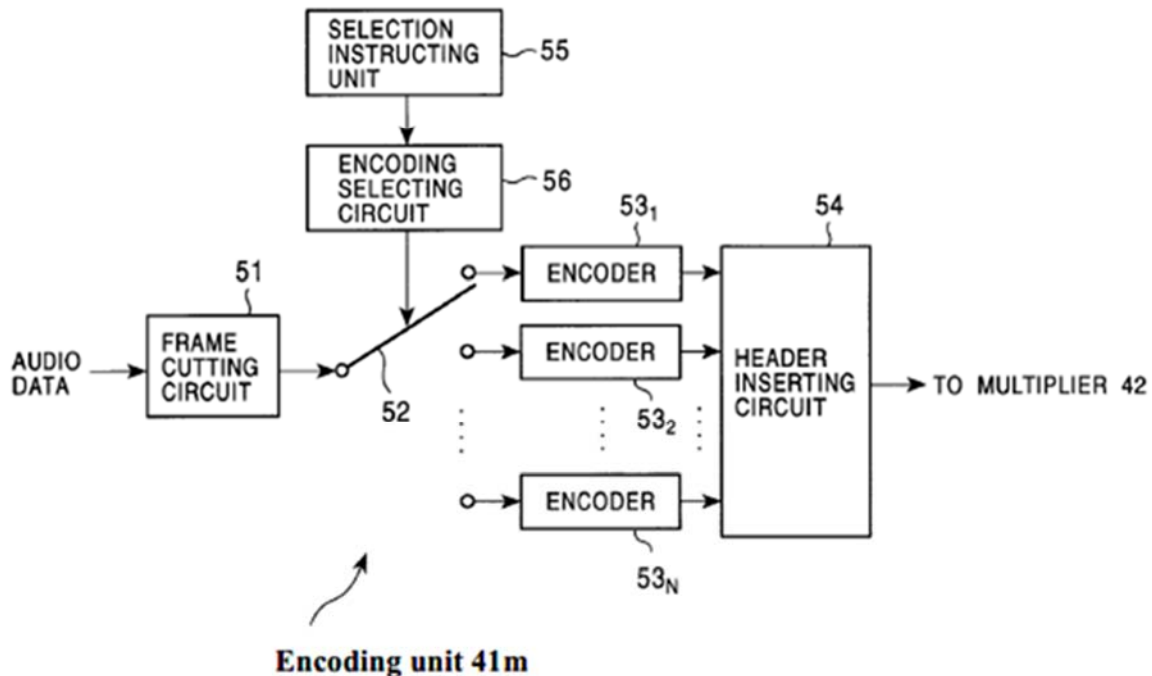
96. I understand that Exhibit 1004 is Japanese Patent Application Publication No. H11331305 to Imai *et al.* (“Imai”) published November 30, 1999. I

² The entity in the cited proceeding is Patent Owner’s parent, Realtime Data, LLC, which wholly owns Realtime Adaptive Streaming LLC.

understand that Exhibit 1005 is a certified English translation of Imai, and that Exhibit 1006 is U.S. Patent No. 6,507,611, which is an English-language counterpart of Imai. I have reviewed both the translated Japanese Patent Application to Imai as well as the U.S. Patent to Imai. I found the technical disclosures in each reference to be substantively the same, and I believe every portion that I cite from the translated Japanese Patent Application also appears in the U.S. Patent. I understand that Imai was not cited or considered during prosecution of the '477 Patent.

97. Imai is directed to encoding digital data including audio and video data for transmission in a manner that enables real time decompression and reproduction at a client. Ex. 1005 at [0001], [0006], [0172]. After receiving a request for digital data from a client, Imai's "frame cutting circuit" cuts the requested digital data into "units of frame" having a length that is suitable for coding or for transmission on a network. Ex. 1005 at [0130], [0066]. It is my opinion that Imai's "units of frame" are units of data bits or digital data blocks on which Imai's compression and transmission system operates. For example, Imai teaches that the data input may be "data," which in this context would mean binary data, or it may be a digitized audio input, which would also be data in binary format.

FIG. 5



98. Switch 52 supplies each individual digital data “frame” output from the frame cutting circuit to a selected one of a plurality of available encoders 53₁ to 53_N. Ex. at 1005 at [0066]. Selection instructing unit 55 selects an appropriate “one from a plurality of coding methods corresponding to the encoders 53₁ to 53_N. . . and then instructs the encoding selecting circuit 56 to select the decided coding method.” Ex. 1005 at [0070]. Imai’s encoders comprise asymmetric compression algorithms including the MPEG layer 1, MPEG layer 2, and MPEG layer 3 compression algorithms, as well as the ATRAC and ATRAC2 compression algorithms. Ex. 1005 at [0067]; *see* Ex. 1009 (Spanias Book) at 81 (stating that the underlying MPEG and ATRAC “architectures” are similar in that they are both

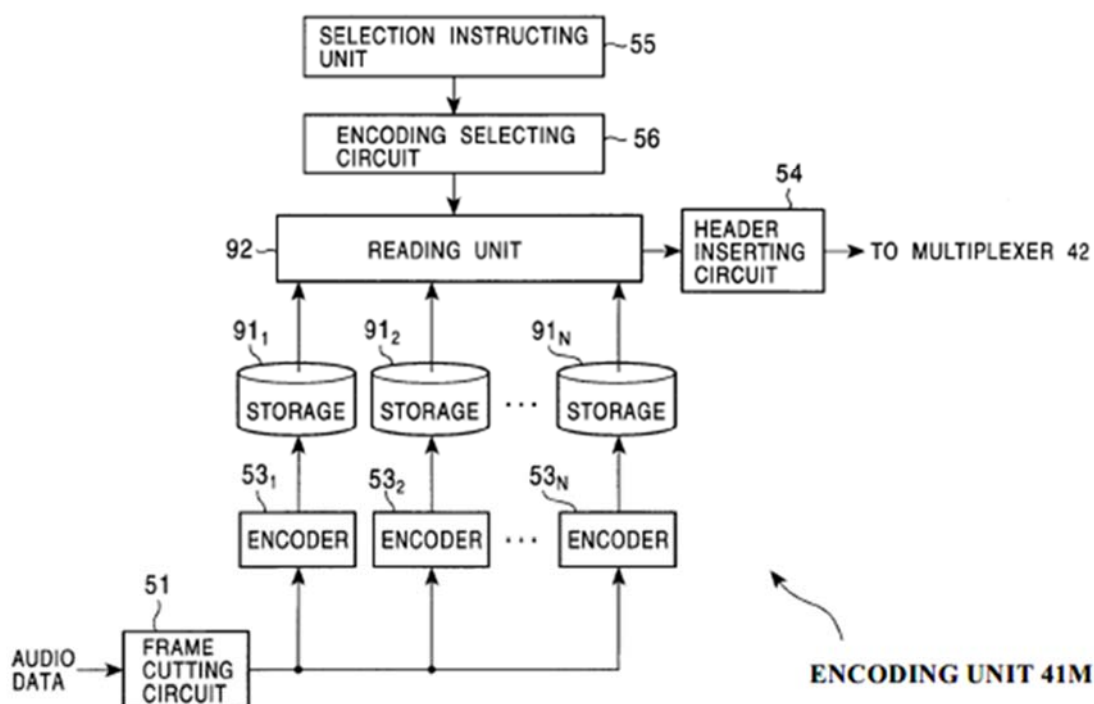
asymmetric); Ex. 1010 (Westwater Book) at 7 (stating that the MPEG standard uses asymmetric compression algorithms); Ex. 1011 (Salomon Book) at 11 (stating that MPEG layer 3, or MP3, is an asymmetric algorithm). I am personally familiar with the MPEG layer 1, MPEG layer 2, MPEG layer 3, ATRAC, and ATRAC 2 algorithms, and know that each is a compression algorithm.

99. Imai's selection instructing unit analyzes various factors to decide which compression algorithm to select and apply to each individual data frame. For example, Imai teaches assessing client processing ability by analyzing the client's processing of "dummy data packets" to determine client resources that are "employed for [] other process[es]" and resources that are available. Ex. 1005 at [0099]-[0100]. Imai's selection instructing unit also determines characteristics of the uncompressed data and selects a compression algorithm accordingly. For example, in the context of audio data, Imai's processor identifies portions of the digital data that has instrument sounds, and other portions that have vocal sounds. Ex. 1005 at [0102]. The selection instructing unit accounts for these variations in selecting a suitable coding method. *Id.* Imai additionally describes a detailed process for deriving a transmission rate of a network communication channel by timing the transmission and receipt of data packets between the client and server. Ex. 1005 at [0149]-[0150]. Thus, Imai teaches assessing at least (1) the processing ability of the client (Ex. 1005 at [0088]-[0100]), (2) the transmission rate of the network (Ex. 1005

at [0149]-[0160]), and (3) parameters or attributes of the requested data (Ex. 1005 at [0102]) in selecting the compression algorithm to apply.

100. Imai also teaches another variation of its compression system with reference to FIG. 16:

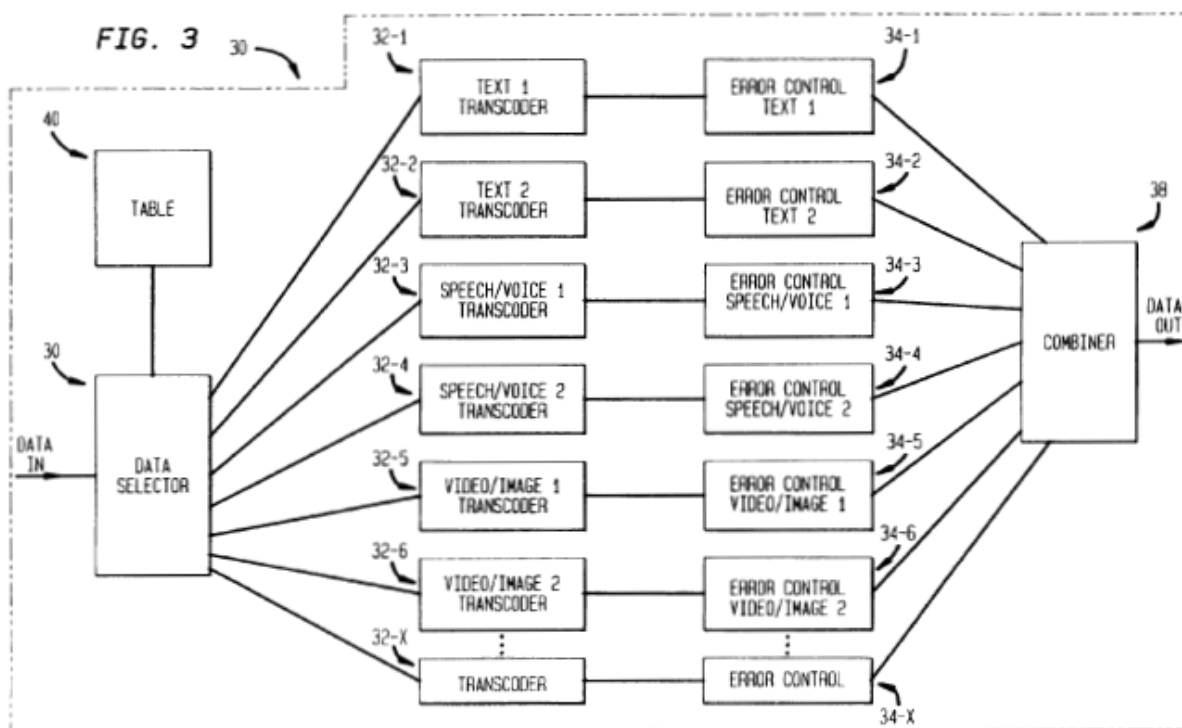
FIG. 16



Here, Imai teaches that the output of encoders 53₁ to 53_N are stored at the server in order to increase the processing “scale” of Imai’s server by eliminating the need to encode in response to each request. Ex. 1005 at [0165], [0167], [0170]. In this embodiment, data blocks are compressed with each compression algorithm once and then retrieved and transmitted multiple times according to the throughput of the channel and client processing constraints. Ex. 1005 at [0165], [0167], [0169].

B. Pauls (Ex. 1007)

101. I understand that Exhibit 1007 is European Patent Application No. EP 905,939 to Pauls *et al.* (“Pauls”), that published in 1999 and was assigned to Lucent Technologies. Pauls describes “improving data transfer performance over communications networks connecting data networks and users using adaptive communications formatting.” Ex. 1007 at Abstract. Pauls explains that adaptive communications formatting involves “encoding (or compressing)” data to “reduce the amount of data being transmitted” using “transcoding techniques.” Ex. 1007 at [0003]. Pauls describes selecting one from a plurality of encoders based on various data parameters, such as the throughput of a communication channel, and Pauls has extensive teachings on selecting between different asymmetric video encoders. Ex. 1007 at [0010], FIG. 3.



102. Pauls states that the particular transcoders applied are selected based upon factors such as the “nature of the communications network,” the type of data being transmitted, and the preferences of the user. *See* Ex. 1007 at [0003]. Pauls states that a relevant factor with respect to the nature of the communication channel is “the available bandwidth” and the “bit rate” of the network. Ex. 1007 at [0013].

103. Pauls teaches that a system may have more than one video/image transcoder. *See* FIG. 3. Pauls explains that different transcoders are more effective than others for particular data types. Ex. 1007 at 0017. For example, Pauls teaches that the input video may be in an MPEG or MPEG2 format, and that H.263 may be an effective transcoding technique. Ex. 1007 at [0017], [0024], & FIG. 5.

Furthermore, H.263 had the option of forming the compressed video data using an arithmetic compression algorithm. Ex. 1020 at 69-76 (Annex E – Syntax Based Arithmetic Coding Mode).

104. Pauls teaches that “[t]he communication network 16 connects the user 14 to the access server 20 . . . [and u]pon connecting to the access server 20, the user 14 can retrieve data from the host 22.” Ex. 1007 at [0006]. Pauls teaches “[t]he data (or file) is retrieved via a bitstream from the host 22 to the access server 20 to the user 14.” Ex. 1007 at [0008]. Pauls teaches that “[a]t the access server 20, the data is formatted using a mixture of transcoding techniques and error control schemes to facilitate data transmission within acceptable quality levels.” Ex. 1007 at [0008].

C. Chao (Ex. 1016)

105. I understand that Exhibit 1016 is International PCT Patent Application Publication No. WO 98/40842 to Chao *et al* (“Chao”), which published in 1998. Chao teaches a compression system for compressing video or image data employed in “‘video on demand’ systems, such as video servers” for “streaming video” in “real-time.” Ex. 1016 at 4:29-35. Chao’s video data is compressed using an entropy coding technique of either “arithmetic, run length, or Huffman encoding.” Ex. 1016 at 7:5-8. Chao also teaches having a particular entropy compression algorithm applied where it is “selected at run-time by the user, based on the desired

compression ratio and the amount of time required to get the selected level of compression.” Ex. 1016 at 14:19-25.

VIII. INVALIDITY

106. Based on my review and analysis of the materials cited herein, my opinions regarding the understanding of a person of ordinary skill in the art before February 2001, and my training and experience, it is my opinion that:

- Claims 1, 3-5, 10, and 12-14 of the '477 Patent are obvious in view of Imai.
- Claims 1, 3-6, and 9-14 of the '477 Patent are obvious in view of Pauls.
- Claims 1, 3-6, and 9-14 of the '477 Patent are obvious based on Imai in view of Pauls.
- Claims 2, 11, 20-22, and 25-27 of the '477 Patent are obvious based on Imai in view of Pauls and Chao.

107. The reasons for my conclusions are explained more fully below.

108. For the purposes of my analysis, I have assumed that Imai, Pauls, and Chao are each prior art to the '477 Patent.

109. With respect to each claim, I have considered the limitations of the claim as a whole, and did not simply determine whether each limitation can be found in the prior art. For dependent claims, this means that I have considered how the additional limitations recited by the dependent claim fit with the limitations recited in the parent claim. In this declaration, I have included headings that recite

the relevant claim language as an aid to the reader. However, I have considered the claims as they appear in the patent, and any errors in the headings or recitations of the claim language or unintentional and do not affect my analysis.

110. Furthermore, I have analyzed obviousness from the standpoint of a POSITA at the time of the invention, which is February 2001. I am not aware of any reasons for why my analysis would change if the date of invention is found to have been within a few years of that date.

A. Claims 1, 3-5, 10, and 12-14 of the '477 Patent are obvious in view of Imai

111. It is my opinion that Imai renders obvious Claims 1, 3-5, 10, and 12-14 of the '477 Patent in view of the general knowledge of a POSITA and/or the teachings provided by Imai's other embodiments. I understand that Petitioners are unaware of any objective evidence of non-obviousness (also known as secondary evidence of nonobvious) for the challenged claims. In addition, I am not personally aware of any objective evidence of non-obviousness for the challenged (e.g., praise, long-felt but unmet need, etc.).

1. Independent Claim 1 is Obvious

- 1. A system, comprising:**
a plurality of different asymmetric data compression encoders, wherein each asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to utilize one or more data compression algorithms, and wherein a first asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to compress data blocks containing video or image data at a higher data compression rate than a second asymmetric data compression encoder of the plurality of different asymmetric data compression encoders; and
one or more processors configured to: determine one or more data parameters, at least one of the determined one or more data parameters relating to a throughput of a communications channel measured in bits per second; and
select one or more asymmetric data compression encoders from among the plurality of different asymmetric data compression encoders based upon, at least in part, the determined one or more data parameters.

112. I note that Claim 1 includes a preamble directed to “[a] system.”

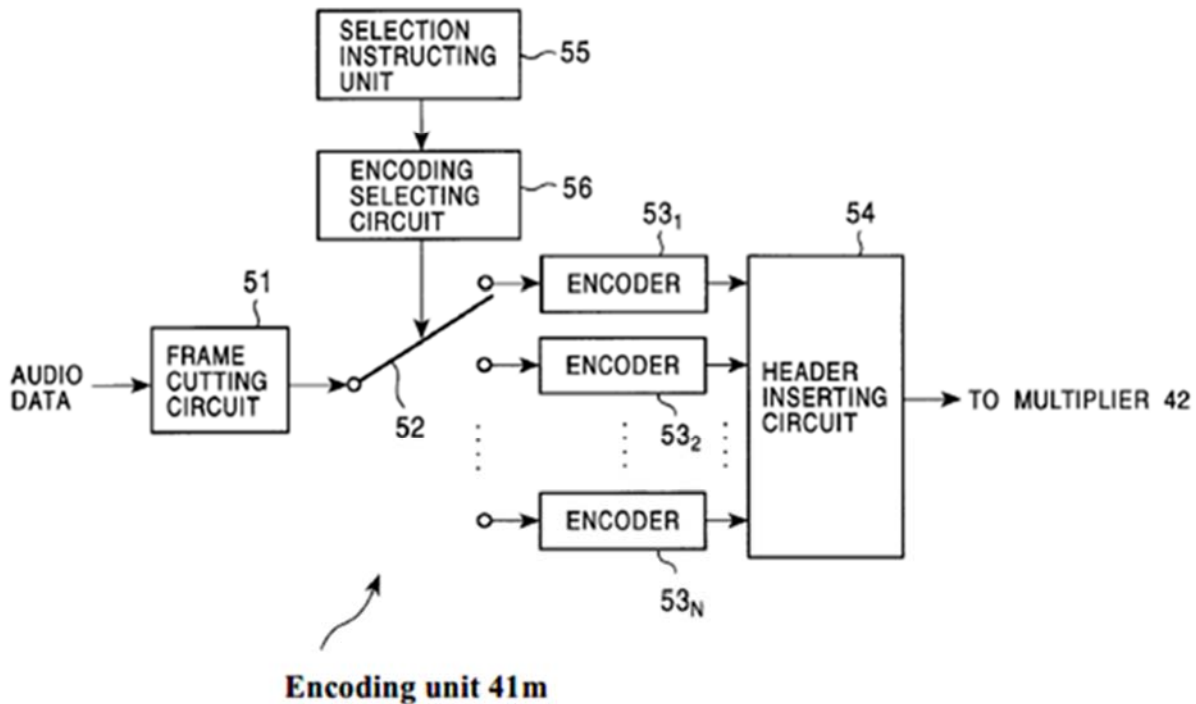
Imai teaches “a transmission system” for compressing data. Ex. 1005 at [0050], [0051]. It is my opinion that Imai’s “transmission system” teaches the system as recited in Claim 1.

1[a] a plurality of different asymmetric data compression encoders, wherein each asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to utilize one or more data compression algorithms,

113. I note that Imai teaches “a plurality of coding methods corresponding to the encoders 53₁ to 53_N.” Ex. 1005 at [0070]. Imai’s encoders 53₁

to 53_N employ “different coding methods from each other” and are thus different encoders. Ex. 1005 at [0067].

FIG. 5



Ex 1005 at [0067].

114. I also note that Imai states that the coding methods employed by each encoder include:

linear PCM (Pulse Code Modulation), ADPCM (Adaptive Differential PCM), layers 1, 2, 3 of MPEG (Moving Picture Experts Group), ATRAC (Adaptive Transform Acoustic Coding), ATRAC 2, and HVXC (Harmonic Vector Excitation Coding). Stated otherwise, in the embodiment, the encoders 53_1 to 53_N are prepared by

using encoders which perform encoding of the audio signal with various coding methods.

Ex. 1005 at [0067], [0068-0071].

Of these coding methods, at least MPEG layers 1, 2, and 3, ATRAC, and ATRAC 2 are each data compression algorithms. *See* Ex. 1015 at 2:25-34 (describing ATRAC compression); Ex. 1022 at 4:19-21 (describing audio MPEG layers 1, 2, and 3 compression); Ex. 1005 at [0068] (stating that MPEG layer 3 and ATRAC 2 provide a high compression rate).

115. I note that each of these algorithms would have been well-known to a POSITA as audio *compression* algorithms. My opinions are supported by at least the Spanias book on audio compression, which states the following:

Audio coding or audio compression algorithms are used to obtain *compact digital representations of high-fidelity (wideband) audio signals* for the purpose of efficient transmission or storage. The *central objective in audio coding is to represent the signal with a minimum number of bits* while achieving transparent signal reproduction.

Ex. 1009 (Spanias Book) at 13. Thus, although Imai refers generally to “encoders” and “coding methods,” a POSITA would have understood that Imai teaches using compression encoders because coding is a term of art in the industry that encompasses compression algorithms, and Imai states that at least ATRAC 2 and MPEG layer 3 are examples of coding methods that “provide[] a high compression

rate” and thus compress input data. Ex 1005 at [0068]. With respect to ATRAC and MPEG layers 1 and 2, it was commonly known in the field that these were all compression algorithms. *See* Ex. 1015 at 2:25-34 (describing ATRAC compression); Ex. 1022 at 4:19-21 (describing MPEG layers 1, 2, and 3 compression). A POSITA would additionally have understood that Imai’s “encoders” are data compression encoders that employ or use different data compression methods or algorithms because these algorithms use less bits to represent the input data stream.

116. Moreover, it was generally accepted in the field of data compression that “the central objective in audio coding is to represent the signal with a minimum number of bits,” which is another way of expressing compression. Ex. 1009 (Spanias Book) at 13. Thus, it is my opinion that Imai’s teachings regarding selecting from a plurality of encoders that implement coding methods including MPEG layers 1, 2, and 3, ATRAC, and ATRAC 2 teaches a plurality of data compression encoders, wherein each data compression encoder is configured to utilize one or more data compression algorithms.

117. I note that Imai’s encoders comprise a plurality of different *asymmetric* data compression encoders that utilize data compression algorithms. Ex. 1005 at [0067]. Specifically, MPEG layers 1, 2, and 3, and the ATRAC and ATRAC 2 compression algorithms are each different asymmetric data compression algorithms that are each used by Imai’s encoders.

118. A POSITA would have understood that audio codecs in general rely on asymmetric encoding principles, and particularly that the emphasis in audio encoding applications would be on reducing decoder complexity. Ex. 1009 (Spanias Book) at 18-19 (“Usually, most of the audio codecs rely on the so-called asymmetric encoding principle. This means that the codec complexity is not evenly shared between the encoder and the decoder (typically, encoder 80% and decoder 20% complexity), with more emphasis on reducing the decoder complexity.”). Like the MPEG family, ATRAC compression algorithms are asymmetric compression algorithms because the execution time for the compression and decompression of these algorithms differ significantly. Ex. 1009 (Spanias Book) at 81 (“Like the MPEG family, the ATRAC architecture decouples the decoder from psychoacoustic analysis and bit-allocation details. Evolutionary improvements are therefore possible without modifying the decoder structure. An added benefit of this architecture is asymmetric complexity, which enables inexpensive decoder implementations.”); Ex. 1010 (Westwater Book) at 7. The ATRAC family of compression algorithms, including ATRAC 2, use an asymmetric architecture that separates the implementation details of the encoder from the decoder, such as psychoacoustic analysis and bit-allocation. Ex. 1009 (Spanias Book) at 81. This architecture allows for more sophisticated encoding strategies which are performed with access to higher performance computing resources (*e.g.*, a computing device or special

purpose recording/encoding device) without modifying the complexity of the decoding strategies, which are typically performed with less sophisticated implementations. Ex. 1009 (Spanias Book) at 81. This architecture additionally provides for the release of more complex or enhanced “evolutions” of compression or encoding methods without requiring a reciprocal update to the decoding hardware or software. Ex. 1009 (Spanias Book) at 81.

119. The asymmetric architecture is also advantageous for “write-once, read-many” applications. These aspects of asymmetric algorithms in general, and specifically the ATRAC compression algorithm, is advantageous for, and contributes to their use in, inexpensive decoder implementations such as the Sony MiniDisc player. Ex. 1009 (Spanias Book) at 80-82 (“The ATRAC algorithm, developed by Sony for use in its rewriteable Mini-Disc system, combines subband and transform coding to achieve nearly CD-quality coding of 44.1 kHz 16-bit PCM input data at a bit rate of 146 kb/s per channel An added benefit of [the ATRAC] architecture is asymmetric complexity, which enables inexpensive decoder implementations.”).



120. ATRAC 2 is also built on this asymmetric architecture and is therefore also an asymmetric compression algorithm. The MPEG family of audio compression algorithms, including MPEG layers 1, 2, and 3, is also built on a similar architecture where the compressor executes a substantially more complex algorithm (requiring more time and or more computational resources) and the decompressor is relatively simple and fast. Ex. 1009 (Spanias Book) at 81 (“Like the MPEG family, the ATRAC architecture decouples the decoder from psychoacoustic analysis and bit-allocation details. Evolutionary improvements are therefore possible without modifying the decoder structure. An added benefit of this architecture is asymmetric complexity, which enables inexpensive decoder implementations.”); Ex. 1011 (Salomon Book) at 11 (“A compression method where the compressor executes a slow, complex algorithm and the decompressor is simple is a natural choice when files are compressed into an archive, where they will be decompressed and used very often, such as mp3 audio files on a CD.”).

121. Asymmetric compression encoders, such as MPEG layer 3, would have been “a natural choice when audio files are compressed into an archive, where they will be decompressed and used very often” because they would have enabled devices with a wide array of capabilities (*e.g.*, mobile, low-complexity battery powered devices) to decompress the archived files. Ex. 1011 (Salomon Book) at 11 (“A compression method where the compressor executes a slow, complex algorithm and the decompressor is simple is a natural choice when files are compressed into an archive, where they will be decompressed and used very often, such as mp3 audio files on a CD.”). In addition, sophisticated devices would have been able to access the archived files faster and more efficiently. It is therefore my opinion that Imai’s configuration of a plurality of different encoders is a plurality of asymmetric data compression encoders that are each configured to utilize one or more data compression algorithms. Ex. 1005 at [0067].

122. I would also note here that a POSITA would have understood Imai’s teachings to be equally applicable to video given the explicit guidance provided in Imai and the general knowledge of a POSITA. Ex. 1005 at [0172]. I note that video is a well-known asymmetric application that realizes the same benefits from compression with asymmetric encoders and algorithms as those discussed above with respect to audio applications. Ex. 1012 (Le Gall ACM Publication) at 5. A POSITA would therefore have known to configure Imai’s

compression and transmission teachings with a plurality of different asymmetric data compression encoders that are configured to utilize one or more asymmetric data compression algorithms for much the same reasons as discussed above with respect to audio applications. Ex. 1012 (Le Gall ACM Publication) at 5. With respect to video encoding, the video compression encoders, standardized in the MPEG / H.26x series of ITU-T recommendations (including MPEG1, MPEG2, and H.263), would have been commonly known as asymmetric encoders because they provide complex algorithms for compression and simpler algorithms for decompression. Ex. 1010 (Westwater Book) at 7 (“First, video compression standards, MPEG and H.261/H.263, are described. They both use asymmetric compression algorithms, based on motion estimation. Their encoders are much more complex than decoders.”).

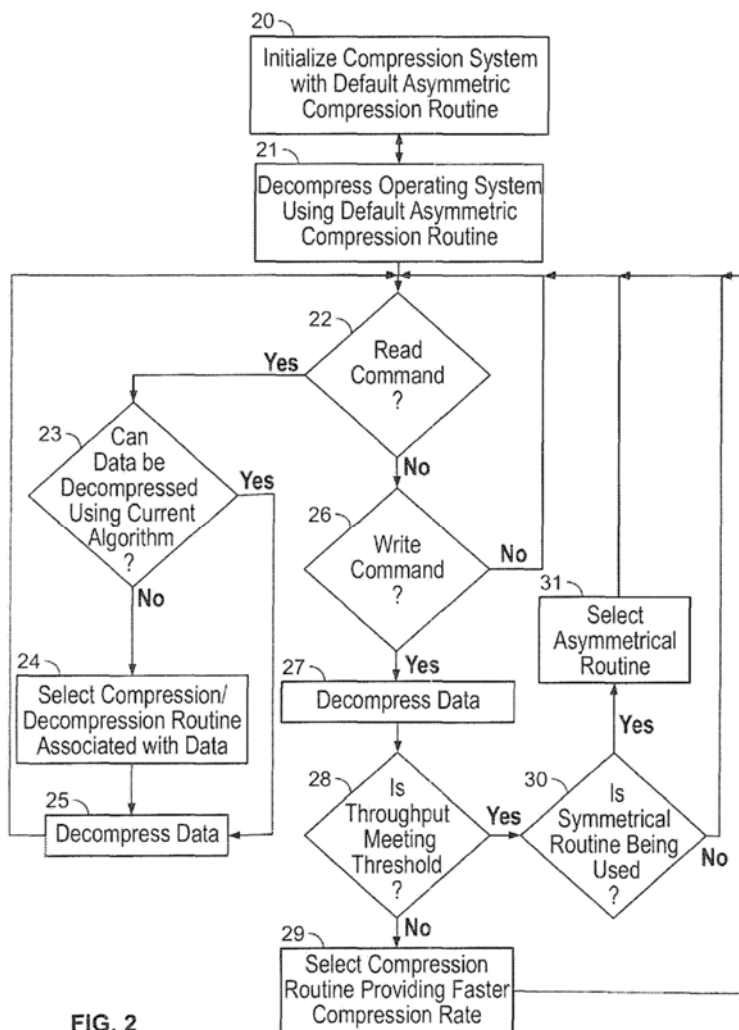
123. It is my opinion that a POSITA would have been motivated to configure Imai’s encoding system with a plurality of MPEG video encoders to realize the benefits of asymmetric complexity in its digital distribution system. As noted above, Imai teaches that “the present invention is also applicable to other signals such as video signals.” Ex. 1005 at [0172]. Incorporating video encoders was well within the skill of a POSITA because audio and video applications frequently overlapped, and many of the standard encoder technologies handled both. It is therefore my opinion that Imai renders this limitation obvious.

1[b]	wherein a first asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to compress data blocks containing video or image data at a higher data compression rate than a second asymmetric data compression encoder of the plurality of different asymmetric data compression encoders
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124. The '477 Patent uses the term “data compression rate” to refer to the execution or algorithmic speed of a compression encoder or, in other words, throughput as a measure of the amount of input data a compressor can compress and make available per unit of time at a given compression ratio. To start, passages of the specification equate execution speed with the data compression rate. For example, at the end of the background section, the '477 Patent states that it would be desirable to have “a system and method that would provide dynamic modification of compression system parameters so as to provide an optimal balance between *execution speed of the algorithm (compression rate)* and the resulting compression ratio” Ex. 1001 at 2:63-67.

125. The '477 Patent's discussion of FIG. 2 gives examples of switching between “fast” and “slow” data compression rates, where a “fast” data compression rate is associated with a fast symmetric algorithm, and a “slow” data compression rate is associated with an asymmetric data compression algorithm. First, FIG. 2 is described as “a flow diagram of a method for providing bandwidth sensitive data compression/decompression according to one aspect of the present

invention.” Ex. 1001 at 9:10-12. FIG. 2 is notable because it includes a step 29 labeled “Select Compression Routine Providing Faster Compression Rate”:



126. The '477 Patent gives selecting a “fast symmetric compression algorithm” as one example of performing the “select compression routine providing faster compression rate” step:

During the process of compression and storing the compressed data, the controller will track the throughput to determine whether the throughput is meeting a

predetermined threshold (step 28). For example, the controller may track the number of pending disk accesses (access requests) to determine whether a bottleneck is occurring. If the throughput of the system is not meeting the desired threshold (e.g., the compression system cannot maintain the required or requested data rates)(negative determination in step 28), then the controller will command the data compression system to utilize a compression routine providing faster compression (e.g., a fast symmetric compression algorithm) (step 29) so as to mitigate or eliminate the bottleneck.

Ex. 1001 at 14:11-24.

127. Continuing the discussion, the '477 Patent states that if the system's threshold is met or exceeded, that the controller will switch to a "slow (highly efficient) asymmetrical compression algorithm":

If, on the other hand, the system throughput is meeting or exceeding the threshold (affirmative determination in step 28) and the current algorithm being used is a symmetrical routine (affirmative determination in step 30), in an effort to achieve optimal compression ratios, the controller will command the data compression system to use an asymmetric compression algorithm (step 31) that may provide a slower rate of compression, but provide efficient compression.

This process is repeated such that whenever the controller determines that the compression system can maintain the required/requested data throughput using a slow (highly efficient) asymmetrical compression algorithm, the controller will allow the compression system to operate in the asymmetrical mode.

Ex. 1001 at 14:25-38.

128. Furthermore, the detailed description also states that the “rate of compression” relates to throughput:

a controller for tracking the throughput of the system and generating a control signal to select a compression routine based on the system throughput. In a preferred embodiment, when the controller determines that the system throughput falls below a predetermined throughput threshold, the controller commands the data compression engine to use a compression routine providing a faster rate of compression so as to increase the throughput.

Ex. 1001 at 8:10-18.

Assuming that the client or device receiving the compressed data can operate sufficiently fast so that decompression can keep up with the incoming compressed data, the compression rate is the number of bits per second of data that is processed and compressed by the encoder and produced by the decoder by decompression.

129. This meaning is consistent with the construction of a similar term in U.S. Patent No. 6,601,104 that is incorporated by reference into the '477 Patent.

In litigation involving the '104 Patent, the term “compression rate” was construed by the district court. Ex. 1024 at 11. The term appeared in claims 1, 13, and 25 of the '104 Patent. Ex. 1024 at 7, 10.

130. Claim 1 of the '104 Patent recites:

1. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for providing accelerated data storage and retrieval, said method steps comprising:

receiving a data stream at an input data transmission rate which is greater than a data storage rate of a target storage device;

compressing the data stream at a compression rate that increases the effective data storage rate of the data storage device; and

storing the compressed data stream in the target storage device.

Ex. 1024 at 7.

131. The district court found that “compression rate” means “compressor throughput as a measure of the amount of input data a compressor can compress and make available for storage per unit of time at a given compression ratio.” Ex. 1024 at 11. However, unlike claims 1, 13, and 25 of the '104 Patent, the claims of the '477 Patent do not all contain a “storing” requirement or the

requirement of “a compression rate that increases the effective data storage rate of the data storage device.” Thus, a POSITA would understand that “compression rate” in the context of the ’477 Patent is “throughput as a measure of the amount of input data a compressor can compress and make available per unit of time at a given compression ratio.”

132. It is also my opinion that a POSITA would have understood that different implementations of the same algorithm can result in different speeds or data compression rates. I note, however, that the ’477 Patent is devoid of any discussion of how to calculate execution speeds or data compression rates, how to implement different encoders at all, or how to implement encoders to operate at different execution speeds or data compression rates.

133. It is my opinion that Imai renders obvious the limitation of “a first asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to compress data blocks containing video or image data at a higher data compression rate than a second asymmetric data compression encoder of the plurality of different asymmetric data compression encoders.” Imai states that it is directed to compressing, transmitting, receiving, and decompressing time series digital signals (such as audio) in real time:

The present invention is related to a transmitting apparatus and method, a receiving apparatus and method, and a providing medium, more particularly, the present

invention is related to a transmitting apparatus and method, a receiving apparatus and method, and a providing medium which are suitably used, for example, in the case of encoding and transmitting time series digital signals such as audio signals, and receiving and decoding the digital signals to reproduce them in real time on the receiving side.

Ex. 1005 at [0001].

134. A POSITA would have understood that Imai teaches that the execution speed of the encoder/compressor, the execution speed of the decoder/decompressor, and the bandwidth connecting both must be sufficiently high or the system will fail to achieve real time reproduction. For example, Imai teaches that even if there is sufficient bandwidth, the complexity of the compression algorithm and the speed of the decompressor affects whether real time reproduction can be achieved:

In addition, although a system of Internet or any other network is designed so as to avoid the transmission of the coded data from becoming too late as far as possible, it is nevertheless sometimes difficult to decode and reproduce audio signals in real time due to, e.g., the ability of hardware and the decoding method of a decoder on the receiving side.

In other words, for example, when the coding method of an encoder on the transmitting side is complex, the

decoding method of a decoder for decoding the coded data, which has been encoded by the encoder, is also usually complex. In such a case, if hardware on the receiving side has not a processing ability capable of coping with the complex decoding method, decoding of audio signals would be too late for the start of reproduction thereof. In addition, the processing time required for the decoder to decode the coded data is greatly affected by the processing ability of hardware on the receiving side, accordingly, if the processing ability of hardware on the receiving side is lower than expected by the transmitting side, the time taken for decoding the coded data would be longer than expected by the transmitting side, thus resulting in a difficulty in decoding and reproducing the audio signals in real time.

Ex. 1005 at [0004]-[0005].

135. Similarly, Imai teaches that the server (i.e. transmitting apparatus) must have sufficient available processing resources to support an additional client, or else the server should refuse a connection request:

In addition, the server 1 is constructed so as to confirm, for example, whether the number of client terminals connected to the network at present is within a processing ability of the server 1 itself, or whether a large load possibly impeding stable communication is not applied, and to establish a communication link between the server

1 and the client terminal 3 if the client terminal 3 is in a condition capable of executing the processing without problems, or to reject the connection between the server 1 and the client terminal 3 if not so.

Ex. 1005 at [0087].

136. Imai's solution to these problems is to provide a number of encoder/decoders that implement a number of different encoding methods, including coding methods that differ in the amount of computation required, which is directly related to execution speed or data compression rate:

The encoders 53₁ to 53_N (N is two or more) are constructed to encode the audio signal with different coding methods from each other (for example, linear PCM (Pulse Code Modulation), ADPCM (Adaptive Differential PCM), layers 1, 2, 3 of MPEG (Moving Picture Experts Group), ATRAC (Adaptive Transform Acoustic Coding), ATRAC 2, and HVXC (Harmonic Vector Excitation Coding)). Stated otherwise, in the embodiment, the encoders 53₁ to 53_N are prepared by using encoders which perform encoding of the audio signal with various coding methods, including a method which provides a relatively large (high) bit rate of the resulting coded data, but can reproduce an audio signal with relatively good reproducibility, a method which can provides a relatively small (low) bit rate of the resulting coded data, but reproduces an audio signal with relatively poor

reproducibility, *a method which requires a larger amount of computation for decoding* (such a method usually also requires a larger amount of computation for coding), *a method which requires a not so large amount of computation for decoding*, and a method particularly suitable for coding a voice (human voice).

Ex. 1005 at [0067].

137. In my analysis of the previous claim limitation, I have explained how MPEG layer 3, ATRAC and ATRAC 2 are each asymmetric compression algorithms. A POSITA would have understood that an encoder implementing any one of these compression algorithms would have a different execution speed from another encoder that implements a different one of the compression algorithms, and therefore at least one encoder would perform at a higher data compression rate. In other words, it would have been obvious because if two encoders performed exactly the same computational steps, then they would be, by definition, implementing the same algorithm. In addition, it is only a remote possibility (i.e., it is exceedingly unlikely) that two different implementations of even the same compression algorithm would have the same execution speed or data compression rate. Thus, it is even more unlikely that two different compression encoders that each implement a different compression algorithm would have the same execution speed or data compression rate. It is well-known in computer science that the structure and ordering of computational steps of a program has an impact on the execution speed.

This principle explains where there is significant research and development activity in developing performance-optimizing compilers, teaching programmers how to write code in a manner that runs faster, and companies developing their own implementations of well-known algorithms. Moreover, the fact that two different encoders (e.g., encoders that implement different compression algorithms) would have a different execution/algorithmic speed can be illustrated with hardware-based encoders, where algorithmic differences would result in different architectures, and execution speed would depend, for example, on the number and arrangement of logic gates.

138. Moreover, Imai makes it clear that each encoder will have different execution speeds. For example, after discussing asymmetric compression algorithms such as MPEG layer 3, ATRAC and ATRAC 2, Imai teaches that ATRAC is an example of a relatively faster compression algorithm, which would produce compressed data at a higher data compression rate: “One example of the coding method, which requires a not so large amount of computation for decoding, is ATRAC.” Ex. 1005 at [0068].

139. In addition, Imai compares and contrasts different asymmetric data compression encoders in terms of their “compression rate,” and identifies several asymmetric data compression algorithms that “provide[] a high **compression rate**,” referring to MPEG layer 3 and ATRAC 2 as “example[s].” Ex. 1005 at [0068].

This passage teaches a plurality of asymmetric data compression encoders that include a first encoder that uses an asymmetric compression algorithm (MPEG layer 3) and is configured to compress data at a higher compression rate than a second encoder using another asymmetric algorithm (ATRAC 2). Ex. 1005 at [0068–0067]. Imai explains that ATRAC 2 can encode at various compression rates (*e.g.*, “64 Kbps, 32K bps, 24 Kbps”). Ex. 1005 at [0069]. A POSITA would have appreciated from Imai’s various teachings that the different asymmetric data compression encoders have different data compression rates, with some encoders having higher rates than others.

140. In addition, a POSITA would have found this limitation obvious in view of Imai’s teaching of an embodiment where all of the encoders use a single asymmetric compression algorithm (ATRAC 2) but differ in their output data rates:

In addition, here, it is here assumed that even in the case of the encoders all employing, *e.g.*, ATRAC 2 only, if bit rates are different from each other, this means the use of “different coding methods”. Therefore, here, for example, all the encoders 53₁ to 53_N perform encoding with ATRAC 2, while data rates of coded data outputted from the encoders are 64 Kbps, 32 Kbps, 24 Kbps, . . . , respectively. Ex. 1005 at [0069].

141. A POSITA would have understood that a simple and straightforward way to create compressed blocks at different data output rates would

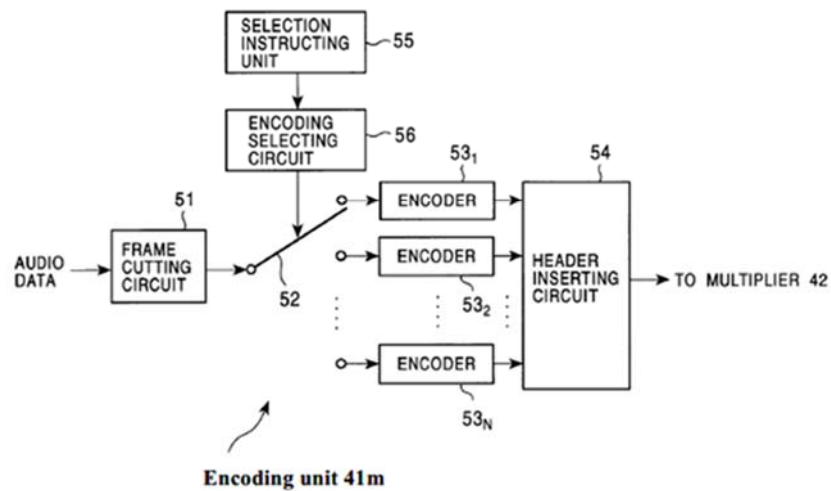
be to modify the execution speed of the algorithm. For example, a 32 kbps encoder could be created using a 64 kbps encoder that runs at half its normal execution speed. It would follow that the 64kbps encoder would have a higher data compression rate than the 32 kbps encoder.

142. In addition, Imai compares and contrasts different asymmetric data compression encoders in terms of their “compression rate,” and identifies several asymmetric data compression algorithms that “provide[] a high compression rate,” referring to MPEG layer 3 and ATRAC 2 as “example[s].” Ex. 1005 at [0068]. This passage teaches a plurality of asymmetric data compression encoders that include a first asymmetric data compression encoder that uses an asymmetric compression algorithm (MPEG layer 3) that is configured to compress data at a higher compression rate than a second asymmetric data compression encoder using an asymmetric algorithm (ATRAC 2). Ex. 1005 at [0068]-[0067]. Imai explains that ATRAC 2 can encode at various compression rates (e.g., “64 Kbps, 32K bps, 24 Kbps”). Ex. 1005 at [0069]. Imai also teaches using asymmetric MPEG layer 3 to compress data at a higher data compression rate than ATRAC 2 (e.g., at 24Kbps). Imai provides further examples of differing compression rates. Thus, Imai’s numerous configurations of encoders having different compression rates teaches this concept.

143. A POSITA would have also found it obvious to select among different encoders having higher and lower data compression rates to better match the incoming data stream to the throughput of the communication channel. Imai explains that the transmission rate of a communication channel between the server and client “varies due to the amount of traffic” being sent across the channel, and that this can impact the ability of the client to reproduce the transmitted signals in real-time. Ex. 1005 at [0145]. Accordingly, Imai selects a “coding method which can provide the coded data having a bit rate not higher than the detected transmission rate.” Ex. 1005 at [0146], Abstract, [0180] (selecting a “coding method capable of providing the coded data having a bit rate corresponding to the detected transmission rate of the transmission line”). A POSITA would have recognized that adjusting the output rate of the compression encoder would impact the throughput of the compression encoder, particularly if the compression ratio of the encoder is fixed.

144. It is also my opinion that Imai teaches that the asymmetric data compression encoders are configured to compress data blocks. In Imai, a client requests signals from a server. Ex. 1005 at [0086]. FIG. 5 depicts Imai’s compression system at the server:

FIG. 5



145. After receiving a request for signals, data blocks are framed from the data input into Imai's server through its frame cutting circuit. Ex. 1005 at [0066].

Imai teaches that the frame cutting circuit:

cuts the audio signal (audio data) from the audio signal input circuit 31 in units of frame having a predetermined length (e.g., a length suitable for coding made by encoders 53₁ to 53_N, or a length suitable for packet (network packet) transmission via the network 2), and then supplies resulting frames to a switch 52.

Ex. 1005 at [0066].

Thus, Imai's frame cutting circuit receives digital data requested by the client and "cuts" the digital data into data blocks of a length suitable for compressing or for creating network transmission packets. Each "unit of frame" is a data block.

146. While the foregoing passage expressly refers to audio data, it would have been obvious to perform the step using data blocks containing video, based upon the POSITA's knowledge and Imai's express teaching that video signals could be substituted for audio signals. It is also my opinion that a POSITA's general knowledge would have encompassed performing this limitation using data blocks containing video in view of Imai's express teaching that video signals could be substituted for audio signals. Specifically, I note that Imai states that “while *audio signals* are processed in the illustrated embodiment, the present invention is also applicable to other signals, such as *video signals*, other types of time-series signals, and signals being not in time series.” Ex. 1005 at [0172]. This teaching of Imai would have suggested to a POSITA what was already obvious—that while the embodiments in Imai use digital audio data as an example, Imai's teachings present a framework for compressing many types of digital data. A POSITA would have understood that video, image, or other data-specific compression algorithms could be included with or in place of the various generic audio encoders and compression algorithms that Imai teaches. As I previously noted, the '477 Patent does not discuss any implementation details for any encoder/compressor, or any of the many steps necessary to process an incoming audio signal or data and turn it into compressed data blocks, other than at a high-level. This further confirms that low-level

implementation details were within the skill of a POSITA at the time of the invention.

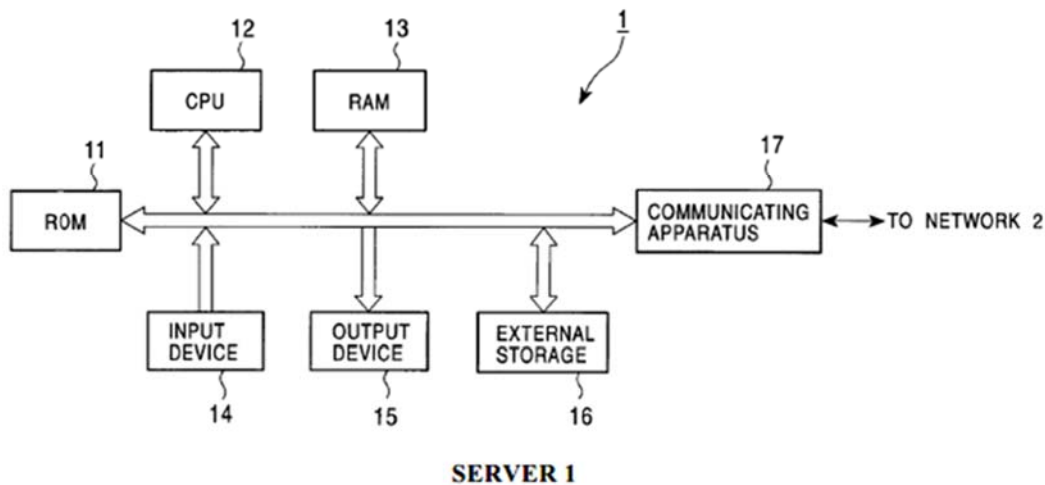
147. In my opinion, it would have been a well-known common practice to a POSITA at the relevant time to be knowledgeable on and readily apply the teachings from audio, video, and image data compression fields to various applications. This is in part because audio, video, and image compression techniques were intrinsically related. For example, both have benefited from similar underlying technology such as mathematical transforms. Additionally, standard video compression encoders included audio compression encoders, since audio is an integral part of most video content. For example, MPEG audio layers 1, 2, and 3, which are audio compression algorithms explicitly referenced by Imai, were developed as a part of video compression standard projects that pre-date the '477 Patent (the MPEG1 standard). It is my opinion that a POSITA would have necessarily been familiar with at least the associated audio compression techniques. It would have been common for a POSITA to readily consult and utilize teachings from these related techniques, even without Imai's explicit suggestion to do so. It is therefore my opinion that Imai renders this limitation obvious.

1[c] one or more processors configured to:

148. I note that Imai teaches that its "CPU 12 decides which one of the coding methods executed in the encoders 53₁ to 53_n is used." Ex. 1005 at [0100].

A POSITA would have understood that Imai's CPU is a controller that is configured to execute the compression and transmission functions of the server. It is therefore my opinion that Imai renders this limitation obvious.

FIG. 2



149. I note that even though Figs. 4 and 5 of Imai depicts particular “circuits,” Imai discloses that:

FIG. 4 shows an exemplified *functional construction* of the server 1 in the FIG. 2. In addition, *the illustrated construction is basically realized upon the CPU 12 executing the application programs* stored in the external storage 16.

Ex. 1005 at [0057]. Imai states that the same is true for FIG. 5, which is an “exemplified construction of the coding unit 41_m in FIG. 4. Ex. 1005 at [0065]. A POSITA would thus understand that although circuits are depicted in the figures,

that the compression and transmission system disclosed in Imai is implemented by an underlying CPU or controller as part of a computing server that controls both the selection of algorithms and compression. In other words, Imai teaches that its disclosed invention could be implemented by running specialized software on a general-purpose computer. Implementing a compression system in such a configuration would have been a generally understood common practice to a POSITA.

1[d] determine one or more data parameters, at least one of the determined one or more data parameters relating to a throughput of a communications channel measured in bits per second

150. I note that Imai determines numerous data parameters, including parameter relating to a throughput of a communications channel. Specifically, Imai recognizes that the transmission rate of the communication channel used to transmit the coded data from server to client “varies due to the amount of traffic” being sent across the channel, and that this can impact the ability of the client to reproduce the transmitted signals in real time. Ex. 1005 at [0145]. It would have been well-known at the relevant time that the bandwidth of transmission lines would be inherently unstable due to a variety of factors including saturated networks, failing or malfunctioning network equipment, and physical limitations of the communication medium. A POSITA would have been familiar with the variations in transmission throughput due to these and other factors because compression was often used in

applications that relied on inherently unstable communication channels, such as cellular and satellite digital signal transmission, and other wired and wireless methods.

151. Imai teaches that its server is “designed to detect the transmission rate of the network” and select a “coding method which can provide the coded data having a bit rate not higher than the detected transmission rate.” Ex. 1005 at [0146], [Solution means], [0180] (selecting a “coding method capable of providing the coded data having a bit rate corresponding to the detected transmission rate of the transmission line”). Specifically, Imai’s server derives the “transmission rate B (bps) of the network” used to transmit compressed digital data. Ex. 1005 at [0149].

152. It is my opinion that Imai’s discussion of a “transmission rate” of the network refers to a measure of a throughput of a communication channel. A transmission rate of a network would generally refer to a measure of some amount or quantity of data that is able to be transmitted over a network during some period of time. Similarly, the throughput of a communication channel would refer to the amount of data that is able to be transmitted over a communication channel. A POSITA would have understood that Imai’s network would include communication channels. For example, Imai states that the network may include the Internet, ISDN, or PSTN networks, which are each comprised of numerous communication channels to connect terminals. Ex. 1005 at [0051]. It is therefore my opinion that a POSITA

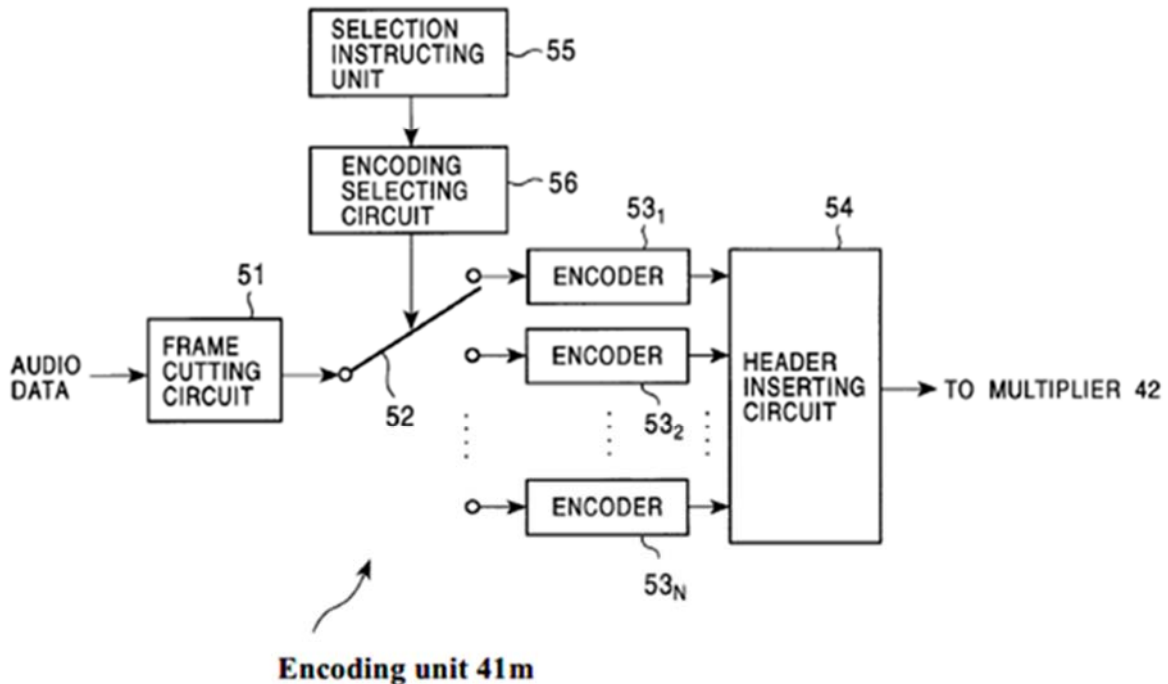
would have understood that a transmission rate as discussed in Imai refers to a throughput of a communication channel.

153. Although a POSITA in 2001 would certainly know of many different ways to determine the throughput of a communications channel, Imai explains a process for deriving the transmission rate of the network using the time it takes to transmit a data packet having a known size across the network. Ex. 1005 at [0149- 0150]; *see* Ex. 1005 at [0151- 0153]. Imai teaches that the transmission rate is determined periodically throughout transmission of the requested data, and that the encoding method is selected to “provide the coded data having a bit rate not higher than the detected transmission rate of the network.” Ex. 1005 at [0146], [0152], [0154]-[0160]. Thus, Imai teaches selecting a compression algorithm based on the determined throughput of the communication channel. Thus, it is my opinion that Imai renders this limitation obvious.

1[e] select one or more asymmetric data compression encoders from among the plurality of different asymmetric data compression encoders based upon, at least in part, the determined one or more data parameters.

154. I note that Imai teaches a selection instructing unit 55 that selects an appropriate “one from a plurality of coding methods corresponding to the encoders 53₁ to 53_N . . . and then instructs the encoding selecting circuit 56 to select the decided coding method.” Ex. 1005 at [0070].

FIG. 5



As discussed above, Imai recognizes that the transmission rate of the communication channel used to transmit the coded data from server to client “varies due to the amount of traffic” being sent across the channel, and that this can impact the ability of the client to reproduce the transmitted signals in real-time. Ex. 1005 at [0145].

Thus, in view of the above problem, the server 1 is designed to detect the transmission rate of the network 2 at the time of transferring data between the server 1 and the client terminal 3, and to change the encoding schedule so as to include the coding method which can provide the coded data having a bit rate not higher than the detected transmission rate of the network 2.

Ex. 1005 at [0146]. Thus, Imai teaches selecting an asymmetric data compression encoder from a plurality based on a determined data parameter that relates to throughput to ensure the output from the encoder has an acceptable bit rate. Ex. 1005 at [0146], [0152], [0154- 0160]. It is therefore my opinion that Imai teaches selecting one or more asymmetric data compression encoders based on the determined data parameters.

2. Dependent Claims 3 and 4 are Obvious

- | | |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | The system of claim 1, wherein the throughput of the communications channel comprises: an estimated throughput of the communications channel. |
| 4 | The system of claim 1, wherein the throughput of the communications channel comprises: an expected throughput of the communications channel. |

155. As discussed above, Imai teaches determining a data parameter relating to a throughput of a communications channel, and specifically teaches deriving a transmission rate of a network. I note that Imai's determined transmission rate is an "*estimated* value of the transmission rate." Ex. 1005 at [00151]. It is my opinion that the "estimated value of the transmission rate" is a data parameter that estimates the throughput of the communications channel.

156. Imai also explains that its transmission rate can be estimated in several ways, including an estimate that accounts for "a period of time from the time when the server 1 receives the request from the client terminal 3 to the time when it

transmits the data in response to the request, and a period of time from the time when the client terminal 3 receives the data from the server 1 to the time when it transmits the next request are ignored,” Ex. 1005 at [0151]. I note that Imai explains that using the lower estimate provides for a margin in case the bit rate of the coded data exceeds the estimated transmission rate. Ex. 1005 at [0151]. Using this throughput estimate, Imai selects a data compression encoder to apply in transmitting data across the communication channel. Ex. 1005 at [0146]. It is therefore my opinion that Imai’s estimated value of the transmission rate teaches an estimated throughput of the communication channel.

157. Imai also teaches the use of a “Resource Reservation Protocol” that allocates some minimum amount of “reserved band[width]” until disconnection of the communication link. Ex. 1005 at [0145], [0162]. According to Imai, use of this protocol provides an expected throughput of the network so that the encoder can be selected accordingly during the reservation period. Ex. 1005 at [0162]. It is my opinion that Imai’s use of the Resource Reservation Protocol teaches selecting a data compression encoder to apply based on an expected throughput of the communication channel.

158. I note that given Imai’s in-depth teachings regarding determining a transmission rate of a communication channel, that selecting a compression encoder based on both “estimated throughput” and “expected throughput” would

have been obvious because Imai's throughput estimate is also an expected value of the transmission rate or throughput of the communication channel at a future time that is used to inform the selection of a data compression encoder that will output data at that time. It is therefore my opinion that Imai renders these limitations obvious.

3. Dependent Claim 5 is Obvious

5 The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to compress the data blocks containing video or image data for output at different data transmission rates measured in bits per second to produce a plurality of compressed data blocks.

159. As discussed above, Imai recognizes that the transmission rate of the communication channel used to transmit the coded data from server to client “varies due to the amount of traffic” being sent across the channel, and that this can impact the ability of the client to reproduce the transmitted signals in real time. Ex. 1005 at [0145]. Imai selects a “coding method which can provide the *coded data having a bit rate not higher than the detected transmission rate.*” Ex. 1005 at [0146], [0180] (selecting a “coding method capable of providing the coded data having a bit rate corresponding to the detected transmission rate of the transmission line”). But Imai also teaches that the throughput of the communications channel can fluctuate, and that the selection of Imai's encoders changes “so as to include the encoding method which provides the coded data having a bit rate not larger than the

transmission rate.” Ex. 1005 at [0154]. Therefore, it is my opinion that in selecting a data compression encoder, Imai teaches the selection of one or more asymmetric data compression encoders according to the instantaneous bit rate of the communication channel at each time.

160. I note that Imai also teaches that the plurality of encoders may each use the same asymmetric compression algorithm, but each encoder is implemented differently to compress the data blocks for output at different data transmission rates:

In addition, here, it is here assumed that even in the case of the encoders all employing, e.g., ATRAC 2 only, if bit rates are different from each other, this means the use of “different coding methods”. Therefore, here, for example, all the encoders 53_1 to 53_N perform encoding with ATRAC 2, while data rates of coded data outputted from the encoders are 64 Kbps, 32 Kbps, 24 Kbps, . . . , respectively. Ex. 1005 at [0069].

Thus, Imai teaches a configuration in which a plurality of different encoders implement variations of ATRAC2 asymmetric compression to produce output data block streams at different transmission rates.

161. It is my opinion that a POSITA would have appreciated, from this example and the other examples set out in the teachings of Imai, that it is advantageous to configure the one or more asymmetric data compression encoders

to output compressed data blocks at *different rates* to support changing the bit rate of a compressed output data stream when the throughput of the communications channel connecting the client and server changes. Indeed, this is the specific context that Imai contemplates in the “[p]roblems to be solved by the invention.” Ex. 1005 at [0003].

162. I would also note that Imai teaches that the selected one selected one or more asymmetric data compression encoders produce a plurality of compressed data blocks. Ex. 1005 at [0070]-[0071] (explaining how each frame output from the frame cutting circuit 51 is supplied to an encoder for coding and then output with a separate header for each frame). I would also note that Imai describes that its units of frame are suitable for coding and transmission in “network packets.” Ex. 1005 at [0066]. It is therefore my opinion that Imai teaches production or output of a plurality of compressed data blocks.

4. Dependent Claim 12 is Obvious

12	The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to perform compression in real-time or substantially real-time.
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163. Imai teaches a “transmission system” designed to encode requested data in such a manner that “the client terminal 3 decodes the coded data and reproduces the original audio signals in *real time*, for example (so-called streaming reproduction).” Ex. 1005 at [0051]. As discussed above, it would have

been obvious to apply Imai's teachings directed to real-time audio encoding to the video context because Imai explicitly taught this as well as considering the knowledge of a POSITA. Specifically, Imai teaches that by detecting the transmission rate of the transmission line and selecting a compression algorithm "capable of providing the coded data having a bit rate corresponding to the detected transmission rate, . . . transmission of the coded data can be avoided from becoming too late" when "decoding and reproducing the coded data in real time." Ex. 1005 at [0180]; *see* Ex. 1005 at [0094]-[0095]; [0100]; [0122]-[0123]; [0160]; [0180]; [0181].

164. It is my opinion that a POSITA would have understood that compressing and transmitting data for real-time reproduction on a client would utilize real-time or substantially real-time compression. This would enable the data to be provided to the client in real-time. A POSITA would also have known how to incorporate asymmetric video compression algorithms that operate in real-time because hardware and software implemented real-time asymmetric video encoders were readily available by 2001. Ex. 1010 (Westwater Book) (1997 book titled "Real-Time Video Compression Techniques and Algorithms" describing MPEG, H.261/H.263 "asymmetric compression algorithms").

5. Dependent Claims 13 and 14 are Obvious

- | | |
|-----------|----------------------------------------------------------------------------------------------------|
| 13 | The system of claim 1, wherein the communications channel comprises: a distributed network. |
| 14 | The system of claim 13, wherein the distributed network comprises: the Internet. |

165. Imai explains that the communication channel, or network 2, is a network such as the Internet:

In this transmission system, when a request for time series digital signals, e.g., digital audio signals, is issued from a client terminal 3 to a server 1 ***via a network 2 such as Internet***, ISDN (Integrated Service Digital Network) or PSTN (Public Switched Telephone Network), the server 1 encodes the requested audio signals with a predetermined coding method, and resulting coded data is transmitted to the client terminal 3 via the network 2.

Ex. 1005 at [0051].

A POSITA would have appreciated that the internet is a form of a distributed network. Specifically, the client server architecture configuration of Imai is a classic distributed networking example where the client and server are connected by a network and the client requests data and computing resources that are processed by the server for distribution to the client. It is therefore my opinion that Imai teaches a distributed network. It is also my opinion that Claim 13 is also satisfied because Claim 14 states that the Internet is a form of distributed network. Accordingly,

because Imai explicitly references the its transmission channels encompass the Internet, Imai teaches both of these limitations.

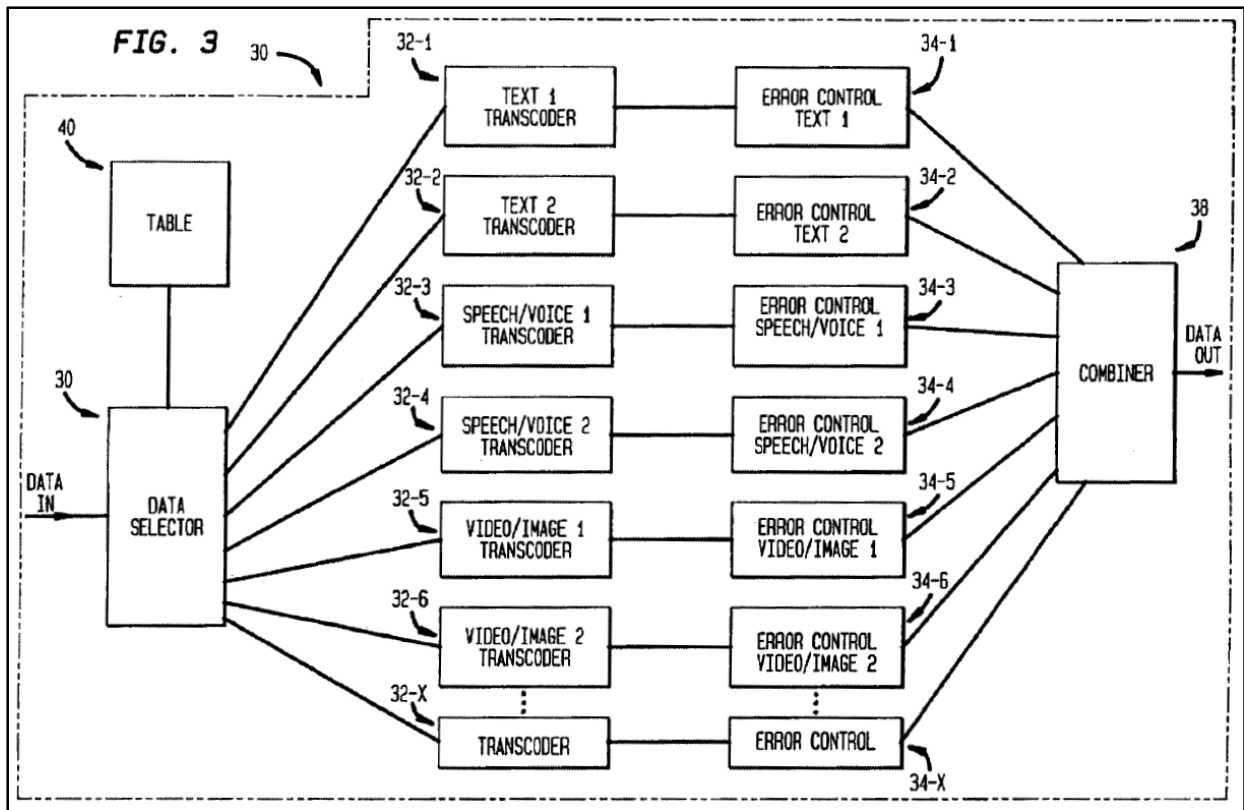
B. Claims 1, 3-6, and 9-14 of the '477 Patent are obvious in view of Pauls

166. It is my opinion that Pauls renders obvious Claims 1, 3-6, and 9-14 in view of the general knowledge of a POSITA and/or the teachings provided by Pauls' other embodiments. I understand that Petitioners are unaware of any objective evidence of non-obviousness for the challenged claims. In addition, I am not personally aware of any objective evidence of non-obviousness for the challenged.

1. Independent Claim 1 is Obvious

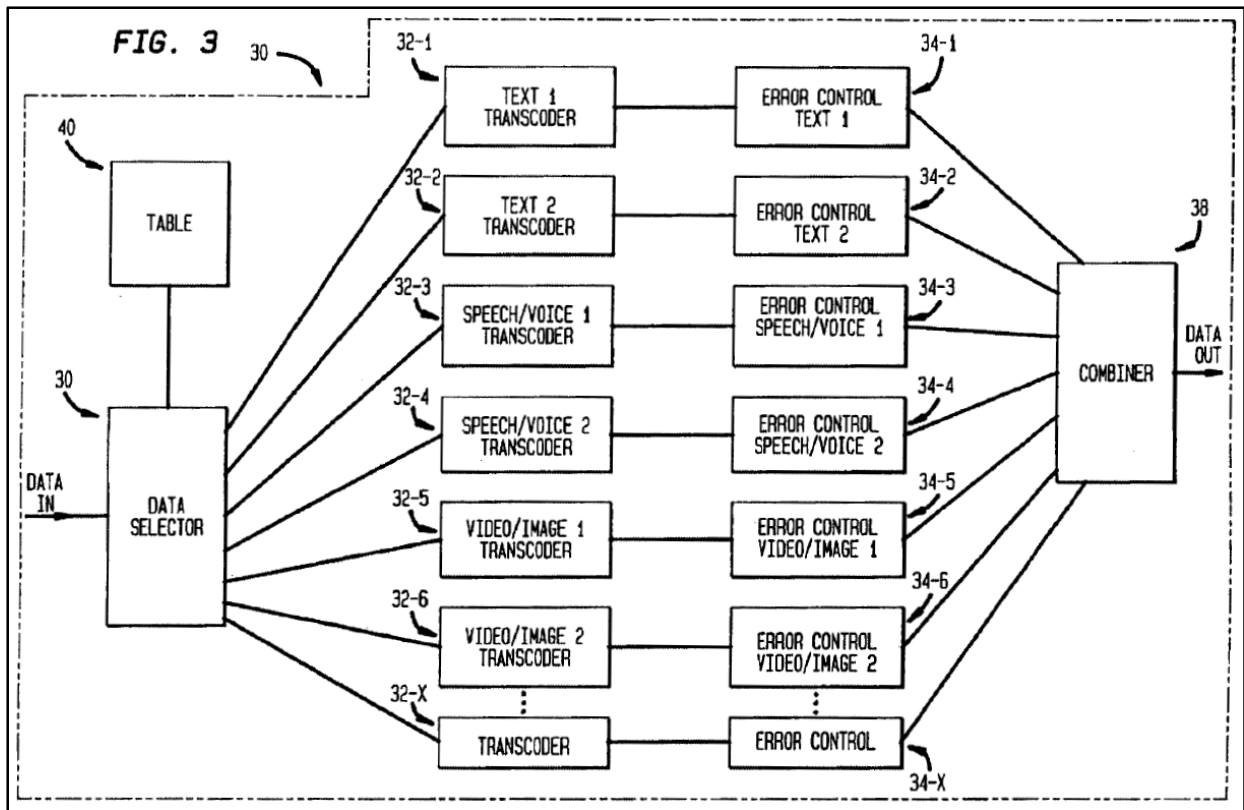
1. **A system, comprising:**
 a plurality of different asymmetric data compression encoders, wherein each asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to utilize one or more data compression algorithms, and wherein a first asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to compress data blocks containing video or image data at a higher data compression rate than a second asymmetric data compression encoder of the plurality of different asymmetric data compression encoders; and
 one or more processors configured to: determine one or more data parameters, at least one of the determined one or more data parameters relating to a throughput of a communications channel measured in bits per second; and
 select one or more asymmetric data compression encoders from among the plurality of different asymmetric data compression encoders based upon, at least in part, the determined one or more data parameters.

167. I understand the preamble of Claim 1 recites a “system.” Pauls discloses a “system.” Specifically, I note that Pauls teaches an “access server” or “host” that are implemented in computers. Ex. 1007 at [0005]. The access server performs “adaptive communications formatting.” See Ex. 1007 at [0009]. I note that Figure 3 depicts an embodiment of the access server, which “comprises a data selector 30, a plurality of text, speech/voice and video/image transcoding techniques 32-*n* (i.e., transcoding techniques for text, speech/voice and video/image data types) . . . and a combiner 38 for multiplexing formatted data.” Ex. 1007 at [0019]. It is therefore my opinion that Pauls teaches a “system” as set forth in Claim 1.



1[a] a plurality of different asymmetric data compression encoders, wherein each asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to utilize one or more data compression algorithms,

168. Pauls states that “[t]he access server 20 comprises a data selector 30, *a plurality of text, speech/voice and video/image transcoding techniques 32-n* (i.e., transcoding techniques for text, speech/voice and video/image data types), a plurality of text, speech/voice and video/image error control schemes 34-n (i.e., error control schemes for text, speech/voice and video/ image data types) and a combiner 38 for multiplexing formatted data.” Ex. 1007 at [0019] (emphasis added). The “access server” and the plurality of different transcoders 32-n are depicted in FIG. 3:



169. I note that Pauls teaches that the transcoders implement “[t]ranscoding techniques [that] include encoding algorithms for encoding (or compressing) the data.” Ex. 1007 at [0010]. Pauls identifies several compression algorithms that may be used:

Algebraic Code Excited Linear Prediction (ACELP), Vector Sum Excited Linear Prediction (VSELP), Enhanced Variable Rate Coder (EVRC), *h.263 (which is a set of guidelines being considered by the International Telecommunications Union for implementation into standards)*, pkzip (by PKWare, Inc.), *MPEG and MPEG2 (Moving Pictures Experts Group)*, and JPEG (Joint Pictures Experts Group) are some examples of encoding algorithms which are well-known in the art.

Ex. 1007 at [0010].

170. It would have been well-known that several of Pauls' data compression algorithms are asymmetric. A POSITA would have understood the term "asymmetric data compression encoders" to mean "an encoder(s) configured to utilize a compression algorithm in which the execution time for the compression and decompression routines differ significantly."

171. A POSITA would have recognized that at least the H.263, MPEG, and MPEG-2 compression algorithms are asymmetric compression algorithms because motion compensation causes the compression routine of each to require substantially more execution time than the respective decompression routine. Ex. 1010 (Westwater Book) at 7 ("video compression standards MPEG and H.261/H.263, are described. They both use asymmetric compression algorithms, based on motion estimation. Their encoders are much more complex than decoders."). Specifically, it would have been well-known that these compression algorithms involve asymmetries due to a variety of factors that complicate the encoding process, such as motion prediction, motion compensation, and transformation processes. Motion prediction, which involves determining pixel movement between the current frame and a reference frame (or frames), is typically used in the algorithms. The search for the location of a best possible match of a particular block in the current frame to a block in a reference frame (possibly at the

1/2 pixel resolution) can be computationally expensive (as compared to the decoder simply receiving this information). Motion prediction is useful for video compression/encoding because less data may be needed to represent moving of pixels between frames than is needed to encode two frames in their entirety. Video compression is typically lossy, where there is a tradeoff between the visual quality of the video after it has been decompressed and the size of its compressed representation. Another example of asymmetry in video encoding/compression is when, after residual pixel data from motion compensation is transformed using a mathematical function (*e.g.*, MPEG2 uses the DCT – discrete cosine transform), the resulting transformed values are quantized by the encoder (the lossy step of the video compression computation). This quantization step may employ significant computation in order to optimize the quantization choices in a way that best preserves quality/appearance while also providing data that can be best compressed by the final lossless step (*e.g.*, in MPEG2 that final step is a combination of run-length and Huffman coding) to minimize the size of the data.

172. It is therefore my opinion that because Pauls teaches a plurality of different transcoders that can be configured to utilize different asymmetric compression algorithms, including H.263, MPEG, and MPEG2, Pauls teaches “a plurality of different *asymmetric data compression encoders*.”

1[b]	wherein a first asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to compress data blocks containing video or image data at a higher data compression rate than a second asymmetric data compression encoder of the plurality of different asymmetric data compression encoders
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173. I note that Pauls teaches that the access server retrieves “a bit stream (or file)” from a host that is to be sent to the user. Ex. 1007 at [0008]. Pauls teaches that the bit stream or file may consist of several data types that include video and image data:

Data types include, but are not limited to, speech/voice, *video/image* and text. Each data type has one or more sub-types. Examples of speech/voice sub-types (and file extensions) include audio (.au), wave (.wav) and speech (.sp). *Examples of video/image sub-types include* tagged image format files (.tif), graphic image format files (.gif), Moving Picture Experts Group files (.mpg and .mp2).
Ex. 1007 at [0008].

It is my opinion that a POSITA would have understood that the bit stream or file containing video or image data meets the claim limitation of data blocks containing video or image data” because a bit stream or file is a “unit of data each comprising more than one bit,” and the bit stream or file represents video and image data.

174. As discussed above, the '477 Patent uses the term “data compression rate” to refer to the execution or algorithmic speed of a compression encoder or, in other words, throughput as a measure of the amount of input data a

compressor can compress and make available per unit of time at a given compression ratio. *See supra* paragraph 124 *et seq.* (discussing “data compression rate”).

175. It is my opinion that Pauls teaches using a first asymmetric data compression encoder and a second asymmetric data compression encoder where there the encoders compress video and image data at higher and lower data compression rates. H.263, MPEG, and MPEG2 are asymmetric data compression algorithms identified by Pauls. Ex. 1007 at [0010]. In my analysis of the previous claim limitation, I have explained how H.263, MPEG, and MPEG2 are each asymmetric compression algorithms.

176. Pauls explains that “[e]ach of the aforementioned encoding algorithms have associated different levels or percentages of compression.” Ex. 1007 at [0010]. For example, FIG. 5 teaches that H.263 renders video at a bit rate of 8-24 Kbps, MPEG renders video at a bit rate of 1.5 Mbps, and MPEG2 renders video at a bit rate of 2.0 Mbps. Ex. 1007 at FIG. 5. A POSITA would have appreciated that each of these well-known and widely used video compression standards have different relative rates of compression, with MPEG having the lowest compression ratio and MPEG2 and H.263 having relatively higher compression ratios. Ex. 1019 at 7-9 (comparing average compression ratios for MPEG, MPEG 2, and H.263).

177. A POSITA would have understood that an encoder implementing any one of these compression algorithms would have a different execution speed from another encoder that implements a different one of the compression algorithms, and therefore at least one encoder would perform at a higher data compression rate. In other words, it would have been obvious because if two encoders performed exactly the same computational steps, then they would be, by definition, implementing the same algorithm. In addition, it is only a remote possibility (i.e., it is exceedingly unlikely) that two different implementations of even the same compression algorithm would have the same execution speed or data compression rate. Thus, it is even more unlikely that two different compression encoders that each implement a different compression algorithm would have the same execution speed or data compression rate. It is well-known in computer science that the structure and ordering of computational steps of a program has an impact on the execution speed. This principle explains where there is significant research and development activity in developing performance-optimizing compilers, teaching programmers how to write code in a manner that runs faster, and companies developing their own implementations of well-known algorithms. Moreover, the fact that two different encoders (e.g., encoders that implement different compression algorithms) would have a different execution/algorithmic speed can be illustrated with hardware-based encoders, where algorithmic differences would result in

different architectures, and execution speed would depend, for example, on the number and arrangement of logic gates.

178. This is particularly true of at least the H.263, MPEG, and MPEG2 compression algorithms and compression encoders created to implement each of the algorithms. As I point out above, each have very different processing characteristics that impact their speed and compression throughput. For example, H.263 has a very different throughput from an MPEG 1 or MPEG 2 encoder because H.263 is typically only used for low bit video applications. In other words, in a typical application of H.263, the input video data rate appreciably lower than the types of input data rates used with an MPEG or MPEG 2 encoder. This is further reflected by the fact that H.263 can achieve much lower output bit rates on average than an MPEG or MPEG 2 encoder because the input data rate to an H.263 is lower to begin with. Accordingly, it is my opinion that it would have been obvious that different compression encoders would execute at different speeds and that one would have a higher speed (and a higher data compression rate) than another. It is therefore my opinion that Pauls renders this limitation obvious.

1[c] one or more processors configured to:

179. Pauls teaches this limitation because the access server performs “adaptive communications formatting” (Ex. 1007 at [0009]) and the access server is

a computer (Ex. 1007 at [0005]). A POSITA would have understood that a “computer” contains one or more processors.

180. I would also note that Figure 3 depicts an embodiment of the access server, which “comprises a data selector 30.” Ex. 1007 at [0019]. Pauls teaches that “[t]he data selector 30 is a device, such as a *microprocessor* with software, for selecting a transcoding technique 32-n and an error control scheme 34-n for formatting the data.” Ex. 1007 at [0019]. Based upon Pauls’ teaching that the access server is a computer and that the data selector may be a microprocessor, a POSITA would have known how to implement Claim 1 using one or more processors.

- 1[d] determine one or more data parameters, at least one of the determined one or more data parameters relating to a throughput of a communications channel measured in bits per second**
- 1[e] select one or more asymmetric data compression encoders from among the plurality of different asymmetric data compression encoders based upon, at least in part, the determined one or more data parameters.**

181. Pauls teaches that the transcoding techniques are selected based on determined parameters relating to the nature of the communications system such as the “throughput of a communications channel” (i.e., bit rate):

The particular transcoding techniques and error control schemes used to format the data should be adaptive to factors such as the *nature of the communications network*

16 connecting the user 14 to the access server 20, the preferences of the user 14, and the data type of the data, as will be discuss herein. Note that the present invention should not be limited to being adaptive to only the aforementioned factors. Other factors, such as interactivity, *bit rate and transmission delay*, may also be applicable.

Ex. 1007 at [0012] (emphasis added).

182. I have also reviewed the claims of Pauls, and I note that Pauls claims a method where “*the transcoding technique* and error control scheme are *also selected based on nature of the communications network*.” Ex. 1007 at Claim 5.

183. Pauls further explains that “[t]he nature of communications system depends on sub-factors such as . . . *the available bandwidth, the bit rate*, the signal-to-noise ratio, the bit error rate and the transmission delay. . . .” Ex. 1007 at [0013].

184. Pauls teaches that it is desirable to choose between compression algorithms to account for differences in throughput among communications technologies (such as wired versus wireless):

[T]he transmission times for data over wireless connections are typically greater than the transmission times for the same data over wired connections. The reasons for this are because wireless connections generally

have less available bandwidth, lower bit rates and longer transmission delays than wired connections. *Therefore, it may be desirable to use a transcoding technique that will encode (or compress) the data as much as possible to reduce the transmission time over wireless connections* (and perhaps some wired connections).

Ex. 1007 at [0014].

185. It is my opinion that a POSITA would have understood that a “bit rate” was conventionally measured in terms of bits per second. It is also conceivable that a POSITA would use some unit of measure derived or based therefrom (*e.g.*, kilobits per second, megabits per second). However, the generally accepted measurement of bit rate would have been rooted in bits per second. I note that a bit rate would have conventionally been measured as a unit of data over some time, and a POSITA would have understand that data rates were typically discussed in those units. Thus, it is my opinion that Pauls renders these limitations obvious.

2. Dependent Claims 3 and 4 are Obvious

3	The system of claim 1, wherein the throughput of the communications channel comprises: an estimated throughput of the communications channel.
4	The system of claim 1, wherein the throughput of the communications channel comprises: an expected throughput of the communications channel.

186. As discussed above, Pauls looks to whether the network is wired or wireless as a factor in selecting a compression encoder. Ex. 1007 at [0014]. Specifically, Pauls makes assumptions regarding the relative throughput of wired and wireless systems, explaining that wireless connections are not as good as wired connections mainly because of throughput: “[t]he reasons for this are because wireless connections generally have less available bandwidth, lower bit rates and longer transmission delays than wired connections.” Ex. 1007 at [0014]. This enables the host to improve transmission performance by tailoring the data compression format to the expected throughput of the communication line. Ex. 1007 at [0014].

187. I have also reviewed the claims of Pauls, and note that Pauls’ claim 9 requires selection of an algorithm based upon whether the network is wireless. Ex. 1007 at Claim 9. It is my opinion that it would have been obvious to a POSITA that Pauls’ teaching regarding selecting an algorithm based upon whether

a connection is wired or wireless is based upon either an estimated or expected throughput of the connection.

188. It is my opinion that this concept—selecting a data compression encoder based on whether the connection is wired or wireless and understanding that wireless connections have less available bandwidth—teaches both an estimated and expected throughput of a communications channel. This is because there is no guarantee that the bandwidth of the wireless connection is lower than that of the wired connection. There is only Pauls' estimate or expectation regarding that bandwidth that supports Pauls' compression encoder selection, in addition to the other factors discussed by Pauls.

189. It is also my opinion that estimated and expected throughput would overlap in some instances. For example, the expected throughput would overlap with the estimated throughput when the system of Pauls estimates a wireless connection and expects the connection to continue to be wireless. It is therefore my opinion that Pauls renders this limitation obvious.

3. Dependent Claim 5 is Obvious

5 The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to compress the data blocks containing video or image data for output at different data transmission rates measured in bits per second to produce a plurality of compressed data blocks.

190. Pauls teaches that the selected one or more asymmetric data compression encoders compress video data blocks for output at different data transmission rates. H.263, MPEG, and MPEG2 are asymmetric data compression algorithms identified by Pauls. Ex. 1007 at [0010]. Pauls explains that “[e]ach of the aforementioned encoding algorithms have associated different levels or percentages of compression.” Ex. 1007 at [0010]. For example, FIG. 5 teaches that H.263 renders video at a bit rate in the range of 8-24 Kbps, MPEG renders video at a bit rate of 1.5 Mbps, and MPEG2 renders video at a bit rate of 2.0 Mbps. Ex. 1007 at FIG. 5. It is my opinion that a POSITA would have appreciated that these video compression algorithms produce compressed data blocks containing video data at different transmission rates.

191. In addition, a POSITA would also have understood that “data transmission rates” are conventionally measured in terms of bits per second. It is therefore my opinion that Pauls renders this limitation obvious.

4. Dependent Claim 6 is Obvious

6. The system of claim 1, wherein at least one of the plurality of different asymmetric data compression encoders is configured to utilize a standardized data compression algorithm capable of compressing video data.

192. Pauls teaches the limitation of “wherein at least one of the plurality of different asymmetric data compression encoders is configured to utilize a standardized data compression algorithm capable of compressing video data.” Pauls expressly teaches transcoders being configured to utilize H.263, MPEG, and MPEG 2. Ex. 1007 at [0010]. It was well-known that H.263, MPEG, and MPEG 2 are standardized compression algorithms capable of compressing video data. It is also my opinion that a POSITA would have understood this fact. *See, e.g.*, Ex. 1020 (H.263 Standard); 1019 (generally comparing standardized video compression algorithms MPEG, MPEG 2, and H.263). Therefore, it is my opinion that Pauls renders this limitation obvious.

5. Dependent Claim 9 is Obvious

9. The system of claim 1, wherein at least one of the determined one or more data parameters comprises: an attribute or a value related to a format or a syntax of video or image data contained in the data blocks containing video or image data.

193. I note that Pauls teaches that “[c]ertain transcoding techniques . . . are more effective when used to format particular data types. Thus, the

transcoding techniques . . . selected to format the data should be adaptive to the data type, as will be described herein.” Ex. 1007 at [0017].

194. Pauls also teaches detecting the data type using the file extension or other information contained in the bit stream: “[t]he data selector 30 can *determine the data type using the file extension, other information contained within the bitstream*, default data types and/or a combination of the aforementioned.” Ex. 1007 at [0019]; *see also* [0008] (“The bitstream includes the data and control information. The data has associated a *filename with a file extension indicative of a data type* (and/or sub-type).”).

195. It is my opinion that a POSITA would have understood that files of different data types contain different formats or syntaxes of the data that they contain. Indeed, this enables applications to easily identify the data contained therein and process it accordingly. It is also my opinion that bitstreams also structure data in a format or syntax. For example, the H.263 standard, which is one of the transcoding techniques that Pauls teaches, contains detailed teachings regarding the precise format and syntax of H.263 compliant files and bitstreams. Ex. 1020 at 25-56. A POSITA would have recognized that a file extension is a commonly use to indicate the format or syntax used by a file stored in a file system. A POSITA also would have appreciated that the files taught by Pauls meet the data block limitation because a file is a unit of data comprising more than one bit of information. It is

also my opinion that a POSITA would have understood that Pauls' teaching regarding using "other information contained within the bitstream" to determine the data type would involve inspecting information in the bitstream related to a format or syntax of the file that those bits represent.

6. Dependent Claims 10 and 11 are Obvious

10	The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to utilize a content-dependent data compression algorithm.
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11	The system of claim 10, wherein the content-dependent data compression algorithm comprises: an arithmetic algorithm.
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196. Pauls teaches identifying the type of data to be compressed, and then selecting a suitable compression algorithm for that data type. Pauls explains that the effectiveness of compression techniques varies depending upon the data type:

Certain transcoding techniques and error control schemes are more effective when used to format particular data types. Thus, the transcoding techniques and error control schemes selected to format the data should be adaptive to the data type, as will be described herein. *Transcoding techniques include encoding algorithms for encoding or compressing particular data types:* gzip and pkzip for text data; VCELP, ASELP and EVRC for speech/voice data; and h.263 for video/image data.

Ex. 1007 at [0017].

197. I have also inspected the claims of Pauls, and I note that Pauls includes a claim to a method including the steps of “determining a data type for the data [to be transmitted]; selecting a transcoding technique . . . to format the data based on the data type; [and] encoding the data using the selected transcoding technique” Ex. 1007 at Claim 5.

198. It is my opinion that a POSITA would have understood that Pauls teaches providing multiple compression encoders that each use different compression algorithms that are particularly effective for different types of content (such as text, speech/voice data, and video data) so that a selection can be made between the encoders based upon the content of the data blocks to be compressed. Because the effectiveness of each algorithm depends upon the content of the data blocks to be compressed, a POSITA would have understood that the asymmetric data compression encoders taught by Pauls use content dependent compression algorithms. It is therefore my opinion that Pauls renders this limitation obvious.

199. It is also my opinion that Claim 11 is rendered obvious. Specifically, I note that one of the foregoing content-dependent algorithms taught by Pauls is the H.263 data compression algorithm. It is my opinion that a POSITA would have understood that H.263 has an arithmetic coding option, which uses an arithmetic algorithm for the entropy compression step. Ex. 1020 at 69-76

(describing Arithmetic Coding mode of H.263 standard). It is therefore my opinion that Pauls renders this limitation obvious.

7. **Dependent Claim 12 is Obvious**

12	The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to perform compression in real-time or substantially real-time.
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200. I note that Pauls is directed to a system for transmitting data over communications networks such as the Internet. *See* Ex. 1007 at [0005]. Pauls teaches that users may desire obtaining the “output of *a real time* recording device, such as a video camera, microphone, . . . transducers or measuring devices.” Ex. 1007 at [0007]. Pauls teaches that its invention may be applied where interactivity is desired. Ex. 1007 at [0012]. Pauls also teaches using the H.263 for video encoding. It was well-known in the art that H.263 is a video standard that was intended to support low bit-rate real-time video applications such as video conferencing. Ex. 1019 at 6. Indeed, Pauls refers to the fact that H.263 supports bit rates as low as 8-24 kbps. Ex. 1007 at FIG. 5.

201. I note that video conferencing was and remains an application where real time video is required. I would also note that the very encoding techniques taught by Pauls (H.261 (MPEG) and H.263) were used to support video conferencing applications. Ex. 1019 at 17.

202. It is therefore my opinion that a POSITA would have found it obvious that compressing data in real-time or substantially real-time is desirable for providing satisfactory access to “real time recording devices” such as video cameras, microphones, and measuring devices to support interactive applications such as video conferencing or remote telemetry. Thus, it would have been obvious to a POSITA to configure the compression encoders to achieve real-time or substantially real-time compression.

8. Dependent Claims 13 and 14 are Obvious

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|-----------|----------------------------------------------------------------------------------------------------|
| 13 | The system of claim 1, wherein the communications channel comprises: a distributed network. |
| 14 | The system of claim 13, wherein the distributed network comprises: the Internet. |

203. Pauls teaches these limitations. Pauls teaches “the communications network 16 comprises a plurality of wired and/or wireless communication systems for providing the user 14 with either a wired or a wireless connection to the access server 20.” Ex. 1007 at [0014]. Pauls FIG. 1 depicts an architecture for the system where the system “comprises a data network 12 (e.g., the Internet), a user 14, and a communications network 16.” Ex. 1007 at [0005].

204. Specifically, Pauls teaches a client server architecture, where files are requested from a host via an access server. I note this is a classic distributed networking example where the client and server are connected by a network and the

client requests data and computing resources that are processed by the server for distribution to the client. It is therefore my opinion that Pauls teaches a distributed network. It is also my opinion that Claim 13 is also satisfied because Claim 14 states that the Internet is a form of distributed network. Accordingly, because Pauls explicitly references its architecture encompasses the Internet, Pauls teaches both of these limitations. It is also my opinion that A POSITA would have understood that the Internet is a distributed network.

C. Claims 1, 3-6, and 9-14 of the '477 Patent are obvious based on Imai in view of Pauls

205. It is my opinion that Imai in view of Pauls renders obvious Claims 1, 3-6, and 9-14. As discussed above with respect to both Imai and Pauls, I understand that Petitioners are unaware of any objective evidence of non-obviousness for the challenged claims. In addition, I am not personally aware of any objective evidence of non-obviousness for the challenged.

206. I would note that Imai explicitly states that its teachings are “also applicable to other signals such as video signals,” and that a POSITA would have found it obvious to implement Imai’s configuration using video compression encoders as discussed above to render these limitations obvious. Nevertheless, it would have also been obvious to combine the express video encoding techniques taught by Pauls with the configuration of Imai. Thus, it is my opinion that the

combination of Imai and Pauls also renders obvious the limitations of Claims 1, 3-6, 9-10, and 12-14.

1. Motivation to Combine Imai and Pauls are Obvious

207. It is my opinion that a POSITA would have many motivations to combine Imai and Pauls. I note that both references describe very similar configurations and are both used for the same purpose: encoding data at a server for transmission to a client over a distributed network such as the Internet.

208. I note that both references teach encoding input data using encoding methods that achieve data compression using asymmetric techniques. Ex. 1005 at [0067], [0068]-[0071]; Ex. 1009 (Spanias Book) at 18-19 (“Usually, most of the audio codecs rely on the so-called asymmetric encoding principle. This means that the codec complexity is not evenly shared between the encoder and the decoder (typically, encoder 80% and decoder 20% complexity), with more emphasis on reducing the decoder complexity.”); Ex. 1009 (Spanias Book) at 81 (describing asymmetric nature of ATRAC and MPEG audio layers); Ex. 1007 at [0010]; Ex. 1010 (Westwater Book) at 7 (“video compression standards MPEG and H.261/H.263, are described. They both use asymmetric compression algorithms, based on motion estimation. Their encoders are much more complex than decoders.”).

209. I would also note that both references choose an encoding method based upon the type of data being transmitted. Ex. 1005 at [0067]; Ex. 1007 at [0012]. In addition, both references teach choosing the encoding method based upon a throughput of the communications channel connecting the client. Ex. 1005 at [0146]; Ex. 1007 at [0013]. Imai and Pauls also discuss implementing their inventions on known computer systems. Ex. 1005 at [0052]-[0057]; Ex. 1007 at [0005].

210. I note that although Imai provides in-depth teachings regarding audio signals and data, Imai also notes that its teachings are “also applicable to other signals such as video signals, other types of time series signals, and signals being not in time series.” Ex. 1005 at [0172]. It is my opinion that a POSITA would logically look towards other prior art references involving data encoding and video encoding techniques to create a video encoding and transmission system in light of Imai’s teachings on video encoding and the general knowledge of a POSITA. One such prior art reference is Pauls, which includes extensive teachings specific to video. *See, e.g.*, Ex. 1007 at [0017-0019].

211. It is my opinion that it would have been obvious to combine the teachings of Imai and Pauls, such as to use the video compression algorithms of Pauls with the compression selection mechanisms as taught by either Imai or Pauls. Imai and Pauls’ teachings are presented in such a manner that generic encoders can

be readily swapped in and out of the configuration. For example, Imai teaches using off-the-shelf encoders such as ATRAC, ATRAC2, and MPEG audio layers 1, 2, and 3. These encoders can be easily modified or replaced to include the compression algorithms of Pauls, and Imai's teachings are structured to support such a configuration.

212. It is therefore my opinion that a POSITA would have been motivated to combine the systems of Imai and Pauls to utilize the numerous video and image data compression encoders of Pauls to enable video compression in Imai's system. Additionally, a POSITA would be motivated to apply Imai's detailed teachings regarding determining the bandwidth of a communication channel to Pauls' system that selects from multiple video data compression encoders to fine-tune Pauls' video transmission system. The combination of the teachings from Imai and Pauls would have predictable results when building a data encoding and transmitted system suitable for video data. For example, a POSITA would look to Imai's more accurate estimation of transmission channel bandwidth to supplement Pauls' "nature of the communications channel" determination with the predictable results of arriving at a more accurate bandwidth estimation. As another example, a POSITA would look to Pauls' video compression encoders to provide Imai's system with the capability of encoding video data to achieve the predictable result of encoding video data in Imai's system.

213. In addition, it my opinion that a POSITA would have had a reasonable expectation of success when combining Imai and Pauls given the similarities in the systems and given that audio and video compression technologies were well-known at the time. Indeed, audio and video compression technologies are related by the fact that video compression technologies also involve audio compression because most video includes an accompanying audio track. For these reason, groups such as the Moving Picture Expert Group developed compression standards for compressing video and audio that can be used together (to compress a video stream with audio), or used separately (to compress a silent video or to compress audio only, such as with MPEG layer 3 for audio). As discussed above, Imai teaches that one factor to consider in choosing a compression algorithm is the data type and the bandwidth of the communication channel. Imai also teaches to account for user preferences where “the user manipulates the input device 24 to issue a request for the audio signals.” Ex. 1005 at [0130]. Like Imai, Pauls also teaches to base the choice of compression algorithm on the data type and the properties (“nature”) of the communication channel, as well as user preferences:

The particular sets of transcoding techniques and error control schemes selected to format the data are adaptive to factors, such as the nature of the communications network connecting a user to an access server on the data network,

the preferences of the user, and the data type of the data being transmitted to the user (or the access server).

Ex. 1007 at [0003].

214. In addition, as discussed above, both Imai and Pauls teach asymmetric compression methods as a way to speed up transmission over a communication channel. And both address the transmission of media signals, where Imai specifically notes that the techniques presented in Imai are “applicable to other signals such as video signals.” One of ordinary skill in the art would understand the similarity of purpose (effective application of compression to increase throughput from sender to receiver) and technology (choice of compression methods, including asymmetric compression methods, based on data type and channel bandwidth / properties) between Imai and Pauls. A POSITA would have been motivated to combine these two references for an overall improved system that determines a compression algorithm to apply based on data type and channel bandwidth that takes advantage of Imai's channel measurement techniques and Pauls’ teaching of transcoding to increase throughput.

2. Independent Claim 1 and Dependent Claims 6 and 9 are Obvious

- | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1. A system, comprising:
a plurality of different asymmetric data compression encoders, wherein each asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to utilize one or more data compression algorithms, and wherein a first asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to compress data blocks containing video or image data at a higher data compression rate than a second asymmetric data compression encoder of the plurality of different asymmetric data compression encoders; and
one or more processors configured to: determine one or more data parameters, at least one of the determined one or more data parameters relating to a throughput of a communications channel measured in bits per second; and
select one or more asymmetric data compression encoders from among the plurality of different asymmetric data compression encoders based upon, at least in part, the determined one or more data parameters.</p> <p>6. The system of claim 1, wherein at least one of the plurality of different asymmetric data compression encoders is configured to utilize a standardized data compression algorithm capable of compressing video data.</p> <p>9. The system of claim 1, wherein at least one of the determined one or more data parameters comprises: an attribute or a value related to a format or a syntax of video or image data contained in the data blocks containing video or image data.</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

215. As expressed in my opinion above, Imai renders obvious all the limitations of Claim 1. It is also my opinion that Claim 1 is also rendered obvious in view of the combination of Imai with Pauls. Pauls contains extensive teachings directed to video compression. Ex. 1007 at [0010]; Figs. 3, 5. Imai teaches using

well-known compression algorithms to encode data, and teaches using encoders that implement standardized audio compression algorithms such as ATRAC, ATRAC2, and MPEG layers 1, 2, and 3. Ex. 1005 at [0067]–[0068]. Pauls teaches using encoders that implement standardized video algorithms such as MPEG, MPEG2 and H.263. Ex. 1007 at [0010]. It is my opinion that a POSITA would have found it obvious to incorporate Pauls’ video-specific compression encoders into Imai using her ordinary skill because a POSITA at the time of the alleged invention would have known how to make use of off-the-shelf implementations of standards-based video encoders and could use those encoders within Imai’s multi-compressor system.

216. I understand that Claim 6 adds the requirement that at least one of the plurality of asymmetric data compression encoders uses “a standardized data compression algorithm capable of compressing video data,” and Claim 9 adds the requirement of that the encoder selection be based upon “an attribute or value related to a format or system of a video or image data.” Consistent with my opinion above, it is my opinion that these limitations are taught by Pauls. Using the same rationale, a POSITA would have found it obvious to incorporate Pauls’ video-specific teachings into a combination of Imai and Pauls. It is therefore my opinion that Imai and Pauls renders this limitation obvious.

3. Dependent Claims 3 and 4 are Obvious

3	The system of claim 1, wherein the throughput of the communications channel comprises: an estimated throughput of the communications channel.
4	The system of claim 1, wherein the throughput of the communications channel comprises: an expected throughput of the communications channel.

217. As expressed in my opinion above, Imai teaches selecting from a plurality of asymmetric data compression encoders based upon “an estimated throughput of the communications channel” or “an expected throughput of the communications channel.” Similarly, Pauls teaches selecting transcoding techniques based on determined parameters relating to the nature of the communications system such as the “throughput of a communications channel.”

218. It is also my opinion that in implementing the combined system of Imai and Pauls, a POSITA would have been motivated to use Imai’s and/or Pauls’ teachings to select an appropriate asymmetric data compression encoder based upon network throughput and applying this technique would be obvious and within the level of skill in the art, as shown by Imai and Pauls.

4. Dependent Claim 5 is Obvious

5 The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to compress the data blocks containing video or image data for output at different data transmission rates measured in bits per second to produce a plurality of compressed data blocks.

219. As expressed in my opinion above, Imai teaches all limitations of Claim 5. It is also my opinion that Claim 5 is obvious in view of the combination of Imai with Pauls, because Pauls which has extensive teachings directed to video compression.

220. Pauls also teaches all limitations of Claim 5. It is also my opinion that it would have been obvious for a POSITA to combine Pauls with Imai's teaching of multiple asymmetric data compression encoders that are each configured to output data at different rates in order to configure Pauls' video compression algorithms to do the same. Indeed, it was common practice at the time to configure encoders with different quantization parameters to meet various specific application needs. I note that Imai teaches this explicitly, in teaching using separate encoders that each "perform encoding with ATRAC 2, while data rates of coded data outputted from the encoders are 64 Kbps, 32 Kbps, 24 Kbps, . . . , respectively." Ex. 1005 at [0069]. It is my opinion that the same technique could be applied to video by selecting an appropriate encoder in view of the target data rate.

5. Dependent Claim 6 is Obvious

6. **The system of claim 1, wherein at least one of the plurality of different asymmetric data compression encoders is configured to utilize a standardized data compression algorithm capable of compressing video data.**

221. It is also my opinion that POSITA would have found it obvious to include Pauls' teaching that "at least one of the plurality of different asymmetric data compression encoders is configured to utilize a standardized data compression algorithm capable of compressing video data" in a combination of Imai and Pauls. I note that both Imai and Pauls teach using well-known compression algorithms, and a POSITA would have wanted to save time and development effort by reusing a well-known and standardized compression algorithm for video, such as the ones taught by Pauls.

222. I would also note here that I have reviewed the '477 Patent, and it identifies no reason that a POSITA could not have substituted well-known compression algorithms for any other well-known compression algorithms. Indeed, the '477 Patent does not describe any specific algorithmic implementation and only references very basic types of encoders that would have been familiar to a POSITA.

6. Dependent Claim 9 is Obvious

- 9. The system of claim 1, wherein at least one of the determined one or more data parameters comprises: an attribute or a value related to a format or a syntax of video or image data contained in the data blocks containing video or image data.**

223. It is my opinion that a POSITA would have found it obvious to include Pauls' teaching of "wherein at least one of the determined one or more data parameters comprises: an attribute or a value related to a format or a syntax of video or image data contained in the data blocks containing video or image data" in the combination of Imai and Pauls. A POSITA would have found it logical to use the format or syntax of the video or image data to select a compression encoder because there are a number of potential compression encoders that may be used in a combination of Imai and Pauls (e.g., encoders that are particularly suited for voice, text, and video), and including this capability will permit discriminating between data types and choosing a suitable compression encoder for video or image data blocks.

7. Dependent Claim 10 and 11 are Obvious

- 10. The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to utilize a content-dependent data compression algorithm.**

224. As discussed in my opinion above, Pauls teaches the use of a content-dependent compression algorithm, as well as a content-dependent

compression algorithm that includes an arithmetic algorithm. Namely, Pauls teaches using an H.263 compliant compression encoder, which has an arithmetic coding option. A POSITA would have found it obvious to use a content-dependent compression algorithm in a combination of Imai and Pauls because content dependent compression would provide better compression depending on the content within the data to be compressed. For example, Imai teaches analyzing the data to determine its content and applying a compression encoder based on the content (*e.g.*, data containing predominantly voice or instruments sounds). Ex. 1005 at [0102]. Similarly, as discussed above, Pauls teaches using a content-dependent compression algorithm that uses arithmetic coding (*e.g.*, H.263). It is therefore my opinion that Imai and Pauls render these limitations obvious.

8. Dependent Claim 12 is Obvious

12. The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to perform compression in real-time or substantially real-time.

225. I understand that Claim 12 adds the requirement that the asymmetric data compression encoders be configured to perform in “real-time or substantially real-time.” As discussed in my opinion above, Imai expressly teaches real-time reproduction of audio signals. It is also my opinion that a POSITA would have found it obvious to include real-time compression in Pauls given its teaching of encoding data from real-time data sources such as video cameras and measuring

devices and providing interactivity. Ex. 1007 at [0007], [0012]. It is therefore my opinion that it would have been obvious to a POSITA to include encoders configured to perform in “real-time or substantially real-time” in a combination of Imai and Pauls.

9. Dependent Claims 13 and 14 is Obvious

- 13. The system of claim 1, wherein the communications channel comprises: a distributed network.**
- 14. The system of claim 13, wherein the distributed network comprises: the Internet.**

226. As discussed above, Imai and Pauls each teach where the communications network is “a distributed network” and “the Internet.” It is also my opinion that a POSITA would have found it obvious to use a “distributed network” and “the Internet” as the communications network in a combination of Imai and Pauls because both references teach this configuration.

D. Claims 2, 11, 20-22, and 25-27 of the '477 Patent are obvious based on Imai in view of Pauls and Chao

227. I understand that Claims 2, 11, 20-22, and 25-27 all require at least one asymmetric encoder that uses an arithmetic algorithm. I note that Pauls teaches using asymmetric video compression algorithms including H.263 and JPEG. Ex. 1007 at [0010]. I note that in addition to being a well-known and commonly used coding method, arithmetic coding was also incorporated into well-known features of both H.263 and JPEG. Ex. 1020 at 69-76; Ex. 1008 at 32-34. It is my opinion that

the arithmetic coding modes of at least these standards in Pauls render the arithmetic coding limitations obvious. However, it is also my opinion that a POSITA could have used any number of references that disclose video encoding techniques to render the arithmetic limitations obvious. For example, it also would have been obvious to combine the teachings of Chao with Imai and Pauls. Chao teaches an asymmetric video compression algorithm that uses an arithmetic algorithm.

228. I note that arithmetic data compression encoders were well-known in the prior art years before the filing of the '477 Patent. Ex. 1018 at 14-15 (book devoting a 26 page chapter to arithmetic coding and stating that arithmetic coding has “replac[ed] Huffman coding” as the “best fixed-length coding method available” in the “last fifteen years” before its 1992 publication). I also note that the '477 Patent actually admits that arithmetic compression was not only known in the prior art, but that it was a “popular compression technique” and that it “possesses the highest degree of algorithmic effectiveness.” Ex. 1001 at 5:11-12. A POSITA would have known of arithmetic data compression encoders, understood the benefits of such an effective technique, and known that such encoders could be used to complement or as a substitute to other well-known asymmetric encoders used in Imai and Pauls.

229. I would also note that Pauls teaches using arithmetic compression algorithms, including H.263 and JPEG which both utilize an arithmetic

algorithm in their respective arithmetic coding modes. Ex. 1007 at [0010]; Ex. 1020 at 69-76 (describing Arithmetic Coding mode of H.263 standard); Ex. 1008 at 32 (“JPEG uses two techniques for entropy coding: Huffman coding and arithmetic coding.”), 49. Annex E of the 1998 H.263 standard discloses a Syntax-based Arithmetic Coding mode that uses an arithmetic algorithm to code data. Ex. 1020 at 69-76. JPEG also has an arithmetic coding mode that uses an arithmetic algorithm to code data. Ex. 1008 at 32-34 (“JPEG uses two techniques for entropy coding: Huffman coding and arithmetic coding.”), 49 (describing lossless entropy-coding by arithmetic coding).

1. Independent Claim 20 and Dependent Claim 2

- 20. A system, comprising:
a plurality of video data compression encoders;
wherein at least one of the plurality of video data compression encoders is configured to utilize an asymmetric data compression algorithm, and wherein at least one of the plurality of video data compression encoders is configured to utilize an arithmetic data compression algorithm, wherein a first video data compression encoder of the plurality of video data compression encoders is configured to compress at a higher compression ratio than a second data compression encoder of the plurality of data compression encoders; and
one or more processors configured to:
 determine one or more data parameters, at least one of the determined one or more data parameters relating to a throughput of a communications channel; and
 select one or more video data compression encoders from among the plurality of video data compression encoders based upon, at least in part, the determined one or more data parameters.**
- 2. The system of claim 1, wherein at least one of the plurality of different asymmetric data compression encoders is configured to utilize an arithmetic algorithm.**

230. I understand that independent Claim 20 and Claim 2 include all limitations of Claim 1 and have the additional requirement that “at least one of the plurality of different asymmetric data compression encoders is configured to utilize an arithmetic algorithm.” As discussed in my opinion above, both Imai alone or in view of Pauls teaches and renders obvious independent Claim 1. It is also my opinion that the combined teachings of Imai, Pauls, and Chao renders these additional limitations obvious, and a POSITA would have been motivated to

combine their teachings to incorporate the arithmetic video compression techniques of Chao into the encoding selection systems of either Imai or Pauls.

231. I note that Imai teaches selecting from a plurality of well-known, asymmetric data encoders. Ex. 1005 at [0067]-[0068]. Imai teaches that encoders 53₁ to 53_N employ “different coding methods from each other” and are thus different encoders. Ex. 1005 at [0067]. As discussed at length above, Imai also teaches that the encoders may use well-known asymmetric coding algorithms such as ATRAC 2 and MPEG layer 3.

232. As also discussed in my opinion above, Pauls also teaches selecting from a plurality of well-known, asymmetric data encoders that are suitable for video such as H.263, MPEG, and MPEG 2. I reiterate here that Pauls also teaches asymmetric data encoders that have optional arithmetic coding modes, such as H.263. Ex. 1020 at 69-76.

233. I further acknowledge again that the '477 Patent admits that arithmetic encoders are available in the prior art, and that a POSITA would be very familiar with arithmetic coding as it was generally known in the art. I also reiterate that Pauls' video and image encoders disclose arithmetic encoding. In light of this, it is my opinion that it would have been obvious to use Chao as one specific exemplar of an arithmetic video encoder that could be combined with Imai and Pauls. I note that Chao teaches an asymmetric video data compression encoder that uses an

arithmetic algorithm. Chao's compression encoder is "wavelet-based" in that it performs a wavelet transform on input digital data and discards transform coefficients falling below a threshold. Ex. 1016 at 6:35-7:4. The resultant video data from Chao is further compressed using a "arithmetic, run length, or Huffman encoding" technique. Ex. 1016 at 7:5-8. Chao teaches that the algorithm is "selected at run-time by the user, based on the desired compression ratio and the amount of time required to get the selected level of compression." Ex. 1016 at 14:19-25. I note that Chao's compression encoder is asymmetric because the transform and coefficient pruning processes only occur on the compression-side and is not implemented by the decoder, and therefore the decoder implementation is less complex. *see* Ex. 1016 at 6:35-7:4; 15:9-15.

234. It is my opinion that a POSITA would have been motivated to combine Chao's arithmetic video data compression encoder with the systems of Imai and Pauls for several reasons. Chao states that "an advantage of the present invention [is] to provide a system and method of a wavelet-based image compression that is suitable for both still and video images." Ex. 1016 at 6:27-30. Chao teaches that its approach can improve upon the compression ratio and speed of existing H.263 and MPEG encoders (Ex. 1016 at 5:3-11), which are the same standards used in Pauls. A POSITA would be motivated by these teachings of Chao to improve upon the provided encoders of the combined system of Pauls and Imai.

235. It would also have been obvious to substitute Chao's video encoder for Pauls' H.263 video encoder because it would be a simple substitution of one encoder for another to obtain the benefits from using an arithmetic coder. Ex. 1018 at 14-15 (book stating that arithmetic coding has "replac[ed] Huffman coding" as the "best fixed-length coding method available" in the "last fifteen years" before its 1992 publication). I note that the substitution proposed here is also reasonable because Pauls' H.263 is an asymmetric video encoder that has an optional arithmetic coding mode. Therefore, it is my opinion that Imai in view of Pauls and Chao renders this limitation obvious.

2. Dependent Claims 10 and 11

<p>11. The system of claim 10, wherein the content-dependent data compression algorithm comprises: an arithmetic algorithm.</p>

236. I have set forth the basis for my opinion that Pauls' H.263 data compression algorithm renders obvious Claims 10 and 11. However it is also my opinion that these claims are rendered obvious by Chao's arithmetic coding algorithm. A POSITA would have understood that Chao's video or image compression algorithm is a content-dependent algorithm for at least the reason that it teaches using a lossy compression step. I note that Chao teaches applying a wavelet-transformation to the color space of an image or video to be compressed. *See, e.g.* Ex. 1016 at 6:16–7:14. Also, Chao explains that its first embodiment is lossy because the wavelet-transformation uses "[b]oth thresholding and quantization

[that] reduce accuracy with which the wavelet coefficients are represented.” Ex. 1016 at 13:5–7. An algorithm that uses a lossy compression step is content-dependent because not all forms of content can tolerate data loss during a compression/decompression cycle and remain usable. For example, compressing a binary executable file with a lossy compression algorithm may omit key information that is required for execution without a mechanism to recover the lost data.

237. It is also my opinion that a POSITA would have recognized that Chao teaches an arithmetic coding algorithm. Specifically, Chao teaches that after performing the wavelet transformation, an entropy compression algorithm such as “arithmetic, run length, or Huffman coding, or a combination of Huffman and run length encoding” is applied. Ex. 1016 at 7:5–8.

238. It is therefore my opinion that the combination of Chao, Imai, and Pauls renders Claims 10 and 11 obvious when Chao’s compression algorithm that uses a lossy step with an arithmetic coding step is used.

3. Dependent Claims 21-22 and 25-27 are Obvious

239. I understand that dependent claims 21-22 and 25-27 depend from independent Claim 20, and are analogous to dependent Claims 3-5, 9, and 12-14 that depend from independent Claim 1. I have analyzed these claims and note that the material difference between these sets of claims is that Claim 20 and its dependents require at least one arithmetic data compression encoder. I would also note that the

additional limitations of these dependent claims do not implicate the implementation of an arithmetic encoder as taught by Imai, Pauls, and Chao. It is therefore my opinion that these limitations are rendered obvious by the teachings of Imai and Pauls for the same reasons as the analogous claim limitations set forth below:

Dependent Claim	Analogous Claim
21. The system of claim 20, wherein the throughput of the communications channel comprises: an estimated or expected throughput of the communications channel.	Claim 3, 4
22. The system of claim 20, wherein the selected one or more video data compression encoders are configured to compress one or more data blocks containing video data for different data transmission rates measured in bits per second to produce a plurality of compressed data blocks.	Claim 5
25. The system of claim 20, wherein at least one of the determined one or more data parameters comprises: an attribute or a value related to a format or a syntax of video data contained in one or more data blocks containing video data.	Claim 9
26. The system of claim 20, wherein the selected one or more video data compression encoders are configured to perform data compression in real-time or substantially real-time.	Claim 12
27. The system of claim 20, wherein the communications channel comprises: a distributed network or the Internet.	Claim 13, 14

240. With respect to Claim 21, I note that the relevant claim elements, except for the use of an arithmetic coder such as that taught in Chao, have already been addressed previously by my opinion and are not impacted by the decision to use Chao's arithmetic video encoder. It is my opinion that the substitution of Pauls' H.263 encoder with Chao would be a straight-forward replacement of a component of the overall system that does not implicate the choice of communications channel.

241. For each of Claims 22, 25, and 26, the addition of a video compression encoder that uses an arithmetic compression algorithm to the plurality of asymmetric video compression encoders does not impact the analysis of parallel Claims 5, 9, and 12 because Claims 22, 25, and 26 do not require that the video compression encoder that uses an arithmetic compression algorithm be the selected compression algorithm.

242. Lastly, for Claim 27, I note that the addition of an arithmetic coder to the combined teachings of Imai and Paul would not implicate the choice of the communications channel being a distributed network or the Internet.

243. It is therefore my opinion that Imai in view of Pauls and Chao renders each of dependent Claims 21, 22, and 25-27 obvious.

IX. RESERVATION OF RIGHTS

244. My opinions are based upon the information that I have considered to date. I am unaware of any evidence of secondary considerations with

respect to the '477 Patent that would render any of the challenged claims non-obvious. I reserve the right, however, to supplement my opinions in the future to respond to any arguments raised by the owner of the '477 Patent and to take into account new information that becomes available to me.

245. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on June 1, 2018.

By: 
JAMES A. STORER, PH.D.

APPENDIX 1: CURRICULUM VITAE OF JAMES A. STORER

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Education:

Ph.D. Princeton University, computer science (1979)

M.A. Princeton University, computer science (1977)

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Employment History:

Brandeis University, Professor of Computer Science (1993 - present)

Brandeis University, Associate Professor of Computer Science (1986 - 1992)

Harvard University, Visiting Professor of Computer Science (1987 - 1988)

Brandeis University, Assistant Professor of Computer Science (1981 - 1986)

Bell Laboratories at Murray Hill, MTS (1979 - 1981)

Research Interests:

Computer algorithms, communications and internet related computing, data compression and archiving (including text, images, video, and multi-media), storage and processing of large data sets, image retrieval, object recognition, text, image, and video processing, parallel

computing, applications of deep learning to image analysis.

Professional Activities:

- In 1991 I founded the Annual IEEE Data Compression Conference (DCC), the first major international conference devoted entirely to data compression, and have served as the conference chair since then.
- I am a member of the ACM and IEEE Computer Society. I routinely serve as referee for papers submitted to journals (JACM, SICOMP, Theoretical CS, J. Algorithms, Algorithms, *Signal Processing*, JPDC, Acta Inf., Algorithmica, IPL, IPM, Theoretical CS, J. Alg., Networks, IEEE J. Rob. & Aut., IEEE Trans. Inf. Theory, IEEE Trans. Comp., IEEE Trans. Image Proc., Proceedings of the IEEE, IBM J. of R&D, JCSS, etc.). I have served as an editor for *Information Processing and Management*, *Journal of Visual Communication and Image Representation*, and the *Proceedings of the IEEE*. I have served as a program committee member for various conferences, including *IEEE Data Compression Conference*, *Combinatorial Pattern Matching (CPM)*, *International Conference on String Processing and Information Retrieval (SPIRE)*, *Conference on Information and Knowledge Management (CIKM)*, *Sequences and Combinatorial Algorithms on Words, DAGS*.
- I consult in the areas of computer algorithms, data compression and communications (including text, image, and video), data storage and backup, cell phone, digital camera, and

DVR technology, image and video processing, information and image retrieval, including providing expert services for computing technology related litigation.

- I have obtained patents and SBIR funding to engage in research projects (such as high speed data compression hardware) that were not possible within the university environment, but which complemented my academic research and provided practical experience on which to base research directions

Books

Hyperspectral Data Compression

G. Motta, F. Rizzo, and J. A. Storer, Editors
Springer-Verlag, www.springer.com, November 2006
(425 pages, 6" x 9", hard-bound)
ISBN: 0-387-28579-2

This book provides a survey of recent results in the field of compression of remote sensed 3D data, with a particular interest in hyperspectral imagery. This material is intended to be of interest to researchers in a variety of areas, including multi dimensional data compression, remote sensing, military and aerospace image processing, homeland security, archival of large volumes of scientific and medical data, target detection, and image classification.

The interest in remote sensing applications and platforms (including airborne and spaceborne) has grown dramatically in recent years. Remote sensing technology has shifted from panchromatic data (a wide range of wavelengths merged into a single response), through multispectral (a few possibly overlapping bands in the visible and infrared range with spectral width of 100-200nm each), to hyperspectral imagers and ultraspectral sounders, with hundreds or thousands of bands. In addition, the availability of airborne and spaceborne sensors has increased considerably, followed by the widespread availability of remote sensed data in different research environments, including defense, academic, and commercial.

Remote sensed data present special challenges in the acquisition, transmission, analysis, and storage process. Perhaps most significant is the information extraction process. In most cases accurate analysis depends on high quality data, which comes with a price tag: increased data volume. For example, the NASA JPL's *Airborne Visible/Infrared Imaging Spectrometer* (AVIRIS, <http://aviris.jpl.nasa.gov>) records the visible and the near-infrared spectrum of the reflected light of an area 2 to 12 kilometers wide and several kilometers long (depending on the duration of the flight) into hundreds of non overlapping bands. The resulting data volume typically exceeds 500 Megabytes per flight and it is mainly used for geological mapping, target recognition, and anomaly detection. On the other hand, ultraspectral sounders such as the NASA JPL's *Atmospheric Infrared Sounder* (AIRS, <http://www-airs.jpl.nasa.gov>), which has recently become a reference in compression studies on this class of data, records thousands of bands covering the infrared spectrum and generates more than 12 Gigabytes of data daily. The major application of this sensor is the acquisition of atmospheric parameters such as temperature, moisture, clouds, gasses, dust concentrations, and other quantities to perform weather and climate forecast.

Chapter 1 addresses compression architecture and reviews and compares compression methods. Chapter 2 through 4 focus on lossless compression (where the decompressed image must be bit for bit identical to the original). Chapter 5 (contributed by the editors) describes a lossless algorithm based on vector quantization with extensions to near lossless and possibly lossy compression for efficient browsing and pure pixel classification. Chapters 6 deals with near lossless compression while Chapter 7 considers lossy techniques constrained by almost perfect classification. Chapters 8 through 12 address lossy compression of hyperspectral imagery, where there is a tradeoff between compression achieved and the quality of the decompressed image. Chapter 13 examines artifacts that can arise from lossy compression.

An Introduction to Data Structures and Algorithms

James A. Storer

Birkhäuser / Springer, www.springer.com, February 2002

(600 pages, 7" x 10", hard-bound)

ISBN 0-8176-4253-6, ISBN 3-7643-4253-6

A highly accessible format presents algorithms with one page displays that will appeal to both students and teachers of computer science. The thirteen chapters include: Models of Computation (including Big O notation), Lists (including stacks, queues, and linked lists), Induction and Recursion, Trees (including self-adjusting binary search trees), Algorithms Design Techniques, Hashing, Heaps (including heapsort and lower bounds on sorting by comparisons), Balanced Trees (including 2-3 trees, red-black trees, and AVL trees), Sets Over a Small Universe (including on-the-fly array initialization, in-place permutation, bucket sorting, bit-vectors, and the union-find data structure), Discrete Fourier Transform (including an introduction to complex numbers, development of the FFT algorithm, convolutions, the DFT on an array of reals, the discrete cosine transform, computing the DCT with a DFT of $n/2$ points, 2D DFT and DCT, and an overview of JPEG image compression), Strings (including lexicographic sorting, KMP / BM / Rabin-Karp / Shift-And string matching, regular expression pattern matching, tries, suffix tries, edit distance, Burrows-Wheeler transform, text compression examples), Graphs (including DFS / BFS, biconnected and strongly connected components, spanning trees, topological sort, Euler paths, shortest paths, transitive closure, path finding, flow, matching, stable marriage, NP-complete graph problems), Parallel Models of Computation (including the PRAM, generic PRAM simulation, the hypercube/CCC/butterfly, the mesh, and hardware area-time tradeoffs).

- Concepts are expressed clearly, in a single page, with the least amount of notation, and without the "clutter" of the syntax of a particular programming language; algorithms are presented with self-explanatory "pseudo-code".
- Each chapter starts with an introduction and ends with chapter notes and exercises that promote further learning.
- Sorting, often perceived as rather technical, is not treated as a separate chapter, but is used in many examples (including bubble sort, merge sort, tree sort, heap sort, quick sort, and several parallel algorithms). Lower bounds on sorting by comparisons are included with the presentation of heaps in the context of lower bounds for comparison based structures.
- Chapters 1-4 focus on elementary concepts, the exposition unfolding at a slower pace. Sample exercises with solutions are also provided. These chapters assume a reader with only some basic mathematics and a little computer programming experience. An introductory college-level course on data structures may be based on Chapters 1 -4 and the first half of Chapters 5 (algorithms design), 6 (hashing), and 12 (graphs).
- Chapters 5-13 progress at a faster pace. The material is suitable for undergraduates or graduates who need only review Chapters 1-4. A more advanced course on the design and analysis of algorithms may be based on these chapters.
- Chapter 13 on parallel models of computation is something of mini-book itself. The idea is to further teach fundamental concepts in the design of algorithms by exploring exciting models of computation, including the PRAM, generic PRAM simulation, HC/CCC/Butterfly, the mesh, and parallel hardware area-time tradeoffs (with many examples). A sampling of this chapter can be a fun way to end a course based on earlier portions of the book. In addition, a seminar style course can spend its first half covering this chapter in detail and then study papers from the literature.
- Apart from classroom use, this book serves as an excellent reference text on the subject of data structures, algorithms, and parallel algorithms. Its page-at-a-time format makes it easy to review material that the reader has studied in the past.

Data Compression: Methods and Theory

James A. Storer

Computer Science Press (a subsidiary of W. H. Freeman Press), 1988

(419 pages, 6" x 9", hard-bound)

ISBN 0-88175-161-8

The first two chapters contain introductory material on information and coding theory. The remaining four chapters cover some of my data compression research performed in the period 1977 - 1987 (including substantial material that has not been reported elsewhere). Chapter 3 considers on-line textual substitution methods that employ "learning" heuristics to adapt to changing data characteristics. Chapter 4 considers massively parallel algorithms for on-line methods and their VLSI implementations. Chapter 5 considers off-line methods (including the NP-completeness of certain methods). Chapter 6 addresses program size (Kolmogorov) complexity. The appendices present source code and empirical results.

Image and Text Compression

James A. Storer, Editor

Kluwer Academic Press (part of Springer), 1992

(354 pages, 6" x 9", hard-bound)

ISBN 0-7923-9243-4

This is an edited volume of papers by leading researchers in the field; topics include: vector quantization, fractals, optical algorithms, arithmetic coding, context modeling, LZ methods, massively parallel hardware (the chapter I contributed), bounds on Huffman codes, coding delay, and 2D lossless compression. Also included is a 75 page bibliography of data compression research that I compiled specifically for this book.

Proceedings Compression and Complexity

B. Carpentieri, A. De Santis, U. Vaccaro, and J. A. Storer, Editors

IEEE Computer Society Press, 1998

(400 pages, 6" x 9", hard-bound)

ISBN 0-8186-8132-2

This is an edited volume of the papers presented at the *International Conference on Compression and Complexity of Sequences*, held in Positano, Italy in 1997.

Papers address the theoretical aspects of data compression and its relationship to problems on sequences, and include contributions from the editors.

Proceedings of the Data Compression Conference

James A. Storer, Co-Chair

IEEE Computer Society Press

1991 - present (approximately 500 pages hard-bound)

I have chaired DCC since it was founded in 1991; starting in 2013 the conference leadership has been expanded; I am currently co-chair (with M. Marcellin, formally committee chair).

The DCC proceedings are co-edited with the DCC program committee chair(s), which over the years has been J. Reif (1991), M. Cohn (1992-2006), M. Marcellin (2007-2012), Ali Bilgin & Joan Serra-Sagrista (2013-present).

Each volume has ten page extended abstracts of the presentations at technical sessions and one page abstracts of presentations at the posters session. The call for papers states that topics of interest include but are not limited to:

An international forum for current work on data compression for text, images, video, audio, and related areas. Topics of interest include but are not limited to: Lossless and lossy compression algorithms for specific types of data (text, images, multi-spectral and hyper-spectral images, palette images, video, speech, music, maps, instrument and sensor data, space data, earth observation data, graphics, 3D representations, animation, bit-maps, etc.), source coding, text compression, joint source-channel coding, multiple description coding, quantization theory, vector quantization (VQ), multiple description VQ, compression algorithms that employ transforms (including DCT and wavelet transforms), bi-level image compression, gray scale and color image compression, video compression, movie compression, geometry compression, speech and audio compression, compression of multi-spectral and hyper-spectral data, compression of science, weather, and space data, source coding in multiple access networks, parallel compression algorithms and hardware, fractal based compression methods, error resilient compression, adaptive compression algorithms, string searching and manipulation used in compression applications, closest-match retrieval in compression applications, browsing and searching compressed data, content based retrieval employing compression methods, minimal length encoding and applications to learning, system issues relating to data compression (including error control, data security, indexing, and browsing), medical imagery storage and transmission, compression of web graphs and related data structures, compression applications and issues for computational biology, compression applications and issues for the internet, compression applications and issues for mobile computing, applications of compression to file distribution and software updates, applications of compression to files storage and backup systems, applications of compression to data mining, applications of compression to information retrieval, applications of compression to image retrieval, applications of compression and information theory to human-computer interaction (HCI), data compression standards including the JPEG, JPEG2000, MPEG (MPEG1, MPEG2, MPEG4, MPEG7, etc.), H.xxx, and G.xxx families.

Patents

In-Place Differential File Compression

United States patent number: 7,079,051

INVENTORS: James A. Storer and Dana Shapira

FILED: March 18, 2004

GRANTED: July 18, 2006

(23 claims, 6 of them independent)

Addresses in-place differential file compression methods that can be used in software update and backup systems.

Method and Apparatus for Data Compression

United States patent number: 5,379,036

INVENTOR: James A. Storer

FILED: April 1, 1992

GRANTED: January 1, 1995

(23 claims, 3 of them independent)

Addresses high speed parallel algorithms and hardware for data compression.

System for Dynamically Compressing and Decompressing Electronic Data

United States patent number: 4,876,541

INVENTOR: James A. Storer

FILED: October 15, 1987

GRANTED: October 24, 1989

(55 claims, 5 of them independent)

Addresses dictionary based adaptive data compression.

Computational Modeling of Rotation and Translation Capable Human Visual Pattern Recognition

U.S. Provisional Patent Application No. 60/712,596

INVENTORS: John Lisman, James A. Storer, Martin Cohn, Antonella DiLillo

FILED: August 29, 2005

(assigned to Brandeis University)

Addresses rotation and translation invariant recognition.

Mechanical puzzle with hinge elements, rope elements, and knot elements

United States Patent 8,393,623

INVENTOR: James A. Storer

FILED: October 29, 2009

GRANTED: March 12, 2013

(8 claims, 3 of them independent)

Addresses designs for a mechanical puzzle that may be realized as a puzzle game.

Papers

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- "Protecting JPEG Images Against Adversarial Attacks", IEEE Data Compression Conference 2018, 139-148 (coauthored with A. Prakash, N. Moran, S. Garber, A. DiLillo).
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- "A Two Tier Approach To Blackboard Video Lecture Summary", IMVIP - Irish Machine Vision and Image Processing Conference, Maynooth University, Ireland, 2017, pages 68-75 (coauthored with S. Garber, L. Milekic, A. Prakash, N. Moran, A. DiLillo); see http://eprints.maynoothuniversity.ie/8841/1/IMVIP2017_Proceedings.pdf.
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APPENDIX 2: MATERIALS CONSIDERED IN THE PREPARATION OF THIS DECLARATION

Exhibit No.	Description
1001	U.S. Patent No. 9,769,477 to Fallon <i>et al.</i> (“the ’477 Patent”)
1002	Prosecution File History for the ’477 Patent
1003	Declaration of Dr. James A. Storer
1004	Japanese Patent Application Publication No. H11331305 to Imai <i>et al.</i> (“Imai”).
1005	Certified English Translation of Imai
1006	U.S. Patent No. 6,507,611 to Imai <i>et al.</i> (“Imai ’611”)
1007	European Patent Application Publication No. EP0905939A2 to Pauls <i>et al.</i> (“Pauls”)
1008	Excerpt from William Pennebaker <i>et al.</i> , JPEG Still Image Data Compression Standard (Van Nostrand Reinhold, 1993)
1009	Andreas Spanias <i>et al.</i> , <i>Audio Signal Processing and Coding</i> (John Wiley & Sons, Inc., 2007)
1010	Raymond Westwater <i>et al.</i> , <i>Real-Time Video Compression Techniques and Algorithms</i> (Kluwer Academic Publishers, 1997)
1011	David Salomon, <i>A Guide to Data Compression Methods</i> (Springer-Verlag New York, Inc., 2002)
1012	Le Gall, <i>MPEG: A Video Compression Standard for Multimedia Applications</i> (April 1991)
1013	Memorandum Opinion and Order, <i>Realtime Data, LLC v. Rackspace US, Inc. et al.</i> , No. 6:16-CV-00961, Dkt. 183 (E.D. Tex. June 14, 2017)
1014	Memorandum Opinion and Order, <i>Realtime Data, LLC v. Actian Corp. et al.</i> , No. 6:15-CV-00463, Dkt. 362 (E.D. Tex. July 28, 2016)
1015	U.S. Patent No. 5,873,065 to Akagiri <i>et al.</i>
1016	International PCT Patent Application Publication No. WO 98/40842 to Chao <i>et al.</i> (“Chao”)

Exhibit No.	Description
1017	Notice of Interested Parties, Realtime Adaptive Streaming, LLC v. Hulu LLC, No. 2:17-CV-07611, Dkt. 18 (C.D. Cal. October 24, 2017)
1018	Mark Nelson, The Data Compression Book, M&T Books, 1992 (“Nelson”)
1019	J. Golston, <i>Comparing media codecs for video content</i> , Embedded Systems Conference, San Francisco, 2004.
1020	International Telecommunication Union Telecommunication Standardization Sector Recommendation H.263 (February 1998) (H.263 Standard)
1021	U.S. Patent No. 6,195,024 to Fallon (incorporated by reference into the ’477 Patent).
1022	International PCT Application Publication WO 00/51243 to Park.
1024	Report and Recommendation of U.S. Magistrate Judge, <i>Realtime Data, LLC v. Packeteer, Inc.</i> , Case No. 6:08-CV-144, Dkt. 379 (E.D. Tex. June 23, 2009).

APPENDIX 3: CHALLENGED CLAIMS

1. A system, comprising:
a plurality of different asymmetric data compression encoders,
wherein each asymmetric data compression encoder of the plurality of
different asymmetric data compression encoders is configured to utilize
one or more data compression algorithms, and
wherein a first asymmetric data compression encoder of the plurality of
different asymmetric data compression encoders is configured to compress
data blocks containing video or image data at a higher data compression
rate than a second asymmetric data compression encoder of the plurality
of different asymmetric data compression encoders; and
one or more processors configured to:

determine one or more data parameters, at least one of the determined
one or more data parameters relating to a throughput of a
communications channel measured in bits per second; and
select one or more asymmetric data compression encoders from among
the plurality of different asymmetric data compression encoders
based upon, at least in part, the determined one or more data
parameters.

2. The system of claim 1, wherein at least one of the plurality of
different asymmetric data compression encoders is configured to utilize an
arithmetic algorithm.

3. The system of claim 1, wherein the throughput of the
communications channel comprises:

an estimated throughput of the communications channel.

4. The system of claim 1, wherein the throughput of the
communications channel comprises:

an expected throughput of the communications channel.

5. The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to compress the data blocks containing video or image data for output at different data transmission rates measured in bits per second to produce a plurality of compressed data blocks.

6. The system of claim 1, wherein at least one of the plurality of different asymmetric data compression encoders is configured to utilize a standardized data compression algorithm capable of compressing video data.

7. The system of claim 1, wherein at least one of the determined one or more data parameters comprises:

a resolution of the data blocks containing video or image data.

8. The system of claim 1, wherein at least one of the determined one or more data parameters comprises:

a data transmission rate of the data blocks containing video or image data.

9. The system of claim 1, wherein at least one of the determined one or more data parameters comprises:

an attribute or a value related to a format or a syntax of video or image data contained in the data blocks containing video or image data.

10. The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to utilize a content-dependent data compression algorithm.

11. The system of claim 10, wherein the content-dependent data compression algorithm comprises:

an arithmetic algorithm.

12. The system of claim 1, wherein the selected one or more asymmetric data compression encoders are configured to perform compression in real-time or substantially real-time.

13. The system of claim 1, wherein the communications channel comprises: a distributed network.

14. The system of claim 13, wherein the distributed network comprises:

the Internet.

15. The system of claim 1, wherein the selected one or more asymmetric data compression encoders are utilized to compress the data blocks containing video or image data to create one or more compressed data blocks, and

wherein a descriptor is associated with the one or more compressed data blocks that indicates the selected one or more asymmetric data compression encoders.

16. The system of claim 1, wherein the selected one or more asymmetric data compression encoders are utilized to compress the data blocks containing video or image data to create one or more compressed data blocks, and

wherein a descriptor indicating the selected one or more asymmetric data compression encoders is included with the one or more compressed data blocks.

17. The system of claim 1, wherein at least one of the determined one or more data parameters comprises:

a video or image data profile.

18. The system of claim 1, wherein the one or more processors are further configured to encode each of the data blocks containing video or image

data with a plurality of the selected one or more asymmetric data compression encoders to create compressed data blocks.

19. The system of claim 18, further comprising:

a memory for storing the compressed data blocks.

20. A system, comprising:

a plurality of video data compression encoders;

wherein at least one of the plurality of video data compression encoders is configured to utilize an asymmetric data compression algorithm, and wherein at least one of the plurality of video data compression encoders is configured to utilize an arithmetic data compression algorithm, wherein a first video data compression encoder of the plurality of video data compression encoders is configured to compress at a higher compression ratio than a second data compression encoder of the plurality of data compression encoders; and

one or more processors configured to:

determine one or more data parameters, at least one of the determined one or more data parameters relating to a throughput of a communications channel; and

select one or more video data compression encoders from among the plurality of video data compression encoders based upon, at least in part, the determined one or more data parameters.

21. The system of claim 20, wherein the throughput of the communications channel comprises:

an estimated or expected throughput of the communications channel.

22. The system of claim 20, wherein the selected one or more video data compression encoders are configured to compress one or more data

blocks containing video data for different data transmission rates measured in bits per second to produce a plurality of compressed data blocks.

23. The system of claim 20, wherein at least one of the determined one or more data parameters are related to a resolution of one or more data blocks containing video data.

24. The system of claim 20, wherein at least one of the determined one or more data parameters comprises:

a data transmission rate of one or more data blocks containing video data.

25. The system of claim 20, wherein at least one of the determined one or more data parameters comprises:

an attribute or a value related to a format or a syntax of video data contained in one or more data blocks containing video data.

26. The system of claim 20, wherein the selected one or more video data compression encoders are configured to perform data compression in real-time or substantially real-time.

27. The system of claim 20, wherein the communications channel comprises:

a distributed network or the Internet.

28. The system of claim 20, wherein the one or more data blocks containing video data are compressed with the selected one or more video data compression encoders to create one or more compressed data blocks, and

wherein a descriptor is associated with the one or more compressed data blocks that indicates the selected one or more video data compression encoders.

29. The system of claim 20, wherein the one or more processors are configured to encode each of one or more data blocks with a plurality of the selected one or more asymmetric data compression encoders to create compressed data blocks.

**APPENDIX 4: MAPPING BETWEEN IMAI U.S. PATENT AND IMAI
(ENGLISH TRANSLATION OF JP PUBLICATION)**

Ex. 1006 - Imai U.S. Patent (Col. No.)	Ex. 1005 – Imai English Translation of JP Pub. (Paragraph Range)
Abstract	[Abstract], [Problem to be Solved], [Solution Means]
1	[0001] – [0006]
2-4	No direct mapping. <i>See generally</i> [0007] – [0049]
4-5 (Brief Description of Drawings)	Page 55 [Brief explanation of the figures]
5	[0050] – [0056]
6	[0057] – [0067]
7	[0067] – [0073]
8	[0073] – [0083]
9	[0083] – [0090]
10	[0091] – [0096]
11	[0096] – [0103]
12	[0103] – [0110]
13	[0110] – [0118]
14	[0119] – [0125]
15	[0126] – [0133]
16	[0133] – [0140]
17	[0141] – [0145]
18	[0146] – [0153]
19	[0154] – [0162]
20	[0162] – [0172]
21	[0173] – [0181]
Claims	No direct mapping. <i>See generally</i> Pages 2-20 [Claim 1] – [Claim 99].