UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE INC.
Petitioner

v.

VEDANTI SYSTEMS LIMITED
Patent Owner

Case IPR No. Unassigned
U.S. Patent 7,974,339

# DECLARATION OF DR. JOHN R. GRINDON

## TABLE OF CONTENTS

I, Dr. John R. Grindon, declare as follows:

# I. Overview

1. I have been retained on behalf of GOOGLE INC. (the "Petitioner") for the above-captioned *Inter Partes* Review (IPR) proceeding.

2. I am being compensated for my time in connection with this IPR at my standard hourly consulting rate of $400/hour. My compensation does not depend on any outcome of this proceeding.

3. I understand that this proceeding involves U.S. Patent No. 7,974,339 ("the '339 patent," GOOG 1001) titled " Optimized Data Transmission System And Method " by Krichevsky et al. and that the '339 patent is currently assigned to Vedanti Systems Limited.

4. I have reviewed and am familiar with the specification of the '339 patent. I understand that the '339 patent resulted from U.S. Application No. 10/892,690, filed on July 16, 2002. I understand that the '339 patent has been provided as GOOG 1001. I will cite to the specification using the following format: (GOOG 1001, 1:1-10). This example citation points to the '339 patent specification at column 1, lines 1-10. Throughout this declaration, emphasis is added, unless otherwise indicated.

5. In preparing this Declaration, I have reviewed the '339 patent and considered each of the documents cited herein, in light of general knowledge in the art. In formulating my opinions, I have relied upon my experience in the relevant art. I have also considered the viewpoint of a person of ordinary skill in the art (i.e., a person of ordinary skill in the field of image processing and data transmission, defined further below in Section IV.A) prior to January 16, 2002. I am familiar with the technology at issue as of the January 16, 2002 effective filing date of the '339 patent. I am also familiar with the level of ordinary skill in the art with respect to the technology at issue as of the January 16, 2002 effective filing date.

6. I have reviewed and am familiar with the file history of the continuation application 10/892,690 filed 16 July 2004 that issued as the '339 patent. I have also reviewed and am familiar with the file history of international application PCT/US/02/00503 filed 16 January 2002 to which the '690 continuation application claim benefit, I understand copies of these file histories have been provided as exhibits GOOG 1002 and GOOG 1018.

7. I have reviewed and am familiar with the file history of a reissue application of the '339 patent. I understand a copy of this reissue application file history has been as exhibit GOOG 1017.

## II. Background and Qualifications

8. In formulating my opinions, I have relied upon my training, knowledge, and experience in the relevant art. A copy of my current *curriculum vitae* is provided as GOOG 1004, and it provides a comprehensive description of my academic and employment history.

9. I received a Bachelor of Science (B.S.) degree in Electrical Engineering from the University of Missouri at Rolla, a Master of Science (S.M.) degree in Electrical Engineering from the Massachusetts Institute of Technology, and a Doctor of Science (D.Sc.) degree in Electrical Engineering from Washington University in St. Louis.

10. During my college studies, I was awarded the Westinghouse Achievement Scholarship. I was a Hughes Masters Fellow at M.I.T. My doctoral research at Washington University was in the field of signal processing.

11. I have more than 40 years of experience in the research, analysis, design and development of electronic systems and software for acquiring, processing, analyzing, and communicating signals and images. This work includes the technology disclosed in the '339 patent. I have experience in both hardware and software for these systems, including image acquisition, image transmission and

processing, data communications, microprocessors, memory devices, software algorithm development, and digital electronics.

12. Since 1990 I have provided independent consulting in the fields of digital image processing software algorithm development and imaging systems. I have provided R&D services to Cyra Technologies, Inc., San Ramon, CA, a division of Leica Geosystems, for systems employing laser scanning and imaging to determine the three-dimensional shapes of objects. I served as a consultant to [TC]² Corporation of Cary, NC, for development of a system to digitize the 3D shape of imaged objects. For this system, I developed image processing algorithms to compute 3D shape by processing frames of image data from multiple, spatially-referenced digital video cameras. A patent was awarded for this work.

13. From 1987 until 1990, I served as Executive Vice President and Director of Research at the former Cencit, Inc. At Cencit, I created and led an engineering organization in the research and development of electronic imaging systems based upon digital video image processing electronics and software algorithms.

14. Previously, I worked with McDonnell Douglas Corporation (now Boeing). I started my career at McDonnell Douglas with the title of Engineer, and progressed through various positions of increasing responsibility to the position of

Branch Chief, Electronics. Among other things, my work there also included digital image processing research and development for autonomous Cruise Missile guidance employing on-board, computer-controlled digital video cameras.

15. I am a named inventor or co-inventor on more than five patents, both U.S. and foreign, in this and related technologies.

## III. Documents Considered

16. In formulating my opinion, I have considered the following:

| GOOG Exhibit # | *Description* |
|---|---|
| **1001** | U.S. Patent No. 7,974,339 to Krichevsky, et al. (filed July 16, 2004; issued July 11, 2011). |
| **1002** | File History for U.S. Patent No. 7,974,339. |
| **1003** | Declaration of John R. Grindon. |
| **1004** | Curriculum Vitae of John R. Grindon. |
| **1005** | U.S. Patent No. 4,791,486 to Spriggs, et al. (filed February 3, 1986; issued December 13, 1988). |
| **1006** | U.S. Patent No. 5,225,904 to Golin, et al. (filed December 4, 1991; issued July 6, 1993). |
| **1007** | Belfor, et al., "Spatially Adaptive Subsampling of Image Sequences," *IEEE Transactions on Image Processing*, Vol. 3, No. 5 (1994); pp. 492-500. |
| **1008** | U.S. Patent No. 6,529,634 to Thyagarajan, et al. (filed November 8, 1999; issued March 4, 2003). |

| **GOOG Exhibit #** | ***Description*** |
|---|---|
| **1009** | Complaint For Patent Infringement, *Vedanti Systems Limited, et al. v. Google Inc., et al.*, Case No. 1:14-cv-01029-GMS (D. Del.), filed August 9, 2014. |
| **1010** | Notice Of Voluntary Dismissal Without Prejudice Pursuant To Rule 41 Of The Federal Rules Of Civil Procedure, *Vedanti Systems Limited, et al. v. Google Inc., et al.*, Case No. 1:14-cv-01029-GMS (D. Del.), filed September 30, 2014. |
| **1011** | Complaint For Patent Infringement, *Max Sound Corporation, et al., v. Google Inc., et al.*, Case No. 3:14-cv-04412-JCS (N.D. Cal.), filed October 1, 2014. |
| **1012** | Definitions of "frame" and "pel", *Webster's New World Dictionary of Computer Terms*, 7th ed. New York: Simon and Schuster, 1999; pp. 217 and 399. |
| **1013** | Defendants' Motion to Dismiss for Failure to State a Claim, *Max Sound Corporation, et al., v. Google Inc., et al.*, Case No. 5:14-cv-04412-EFD (N.D. Cal.), filed February 9, 2015. |
| **1014** | Defendants' Reply Brief in Support of Motion to Dismiss for Failure to State a Claim, *Max Sound Corporation, et al., v. Google Inc., et al.*, Case No. 5:14-cv-04412-EFD (N.D. Cal.), filed March 30, 2015. |
| **1015** | Defendants' Preliminary Claim Constructions and Identification of Evidence, *Max Sound Corporation, et al., v. Google Inc., et al.*, Case No. 5:14-cv-04412-EFD (N.D. Cal.), served August 21, 2015. |
| **1016** | Plaintiff's Preliminary Claim Constructions and Identification of Evidence, *Max Sound Corporation, et al., v. Google Inc., et al.*, Case No. 5:14-cv-04412-EFD (N.D. Cal.), served August 21, 2015. |
| **1017** | File History for Reissue Application of U.S. Patent No. 7,974,339. |
| **1018** | File History of Parent PCT Application No. PCT/US02/00503 filed Jan. 16, 2002. |

| GOOG Exhibit # | *Description* |
|---|---|
| **1019** | Order Denying Motion to Dismiss, *Max Sound Corporation, et al., v. Google Inc., et al.*, Case No. 5:14-cv-04412-EFD (N.D. Cal.), filed May 13, 2015. |
| **1020** | Rostampour, et al., "2-D Median Filtering and Pseudo Median Filtering," Proceedings of the Twentieth Southeastern Symposium on System Theory, IEEE (March 20-22, 1988); pp. 554-557. |
| **1021** | Certificate of Service on Google Inc., *Max Sound Corporation, et al., v. Google Inc., et al.*, Case No. 5:14-cv-04412-EFD (N.D. Cal.), filed December 17, 2014. |
| **1022** | Certificate of Service on Youtube, LLC, *Max Sound Corporation, et al., v. Google Inc., et al.*, Case No. 5:14-cv-04412-EFD (N.D. Cal.), filed December 17, 2014. |
| **1023** | Certificate of Service on On2 Technologies, Inc., *Max Sound Corporation, et al., v. Google Inc., et al.*, Case No. 5:14-cv-04412-EFD (N.D. Cal.), filed December 17, 2014. |
| **1024** | U.S. Patent No. 5,418,714 to Sarver (filed April 8, 1993; issued May 23, 1995). |
| **1025** | U.S. Patent No. 6,687,410 to Brown (filed February 7, 2000; issued February 3, 2004). |
| **1026** | U.S. Patent No. 7,031,517 B1 to Le et al. (filed October 1, 1999; issued April 18, 2006). |
| **1027** | Gilbert Held, Data and Image Compression ($4^{th}$ ed., Wiley 1996). |
| **1028** | Yun Q. Shi & Huifang Sun, Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards (CRC Press, 2000). |

17. I have reviewed and am familiar with the following prior art used in the Petition for *Inter Partes* Review of the '339 patent:

> **(1) "Spatially Adaptive Subsampling of Image Sequences"** to Belfor et al. (GOOG 1007) is prior art under at least 35 U.S.C. § 102(b) because it published in September 1994 years before the earliest possible filing date of the '339 patent;
>
> **(2) U.S. Patent No. 6,529,634 B1** to Thyagarajan, et al. (GOOG 1008) is prior art under at least 35 U.S.C. § 102(e) because it was filed on November 8, 1999, years before the earliest possible filing date of the '339 patent; and
>
> **(3) U.S. Patent No. 5,225,904** to Golin (GOOG 1006) is prior art under at least 35 U.S.C. § 102(b) because it was issued on July 6, 1993, years before the earliest possible filing date of the '339 patent.

18. I have also reviewed and am familiar with the following other prior art documents:

> **(4) U.S. Patent No. 4,791,486 B2** to Spriggs et al. (GOOG 1005) is prior art under at least 35 U.S.C. § 102(b) because it issued on

December 13, 1988, years before the earliest possible filing date of the '339 patent on Jan. 16, 2002; and

**(5) U.S. Patent No. 5,418,714** to Sarver (GOOG 1024) is prior art under at least 35 U.S.C. § 102(b) because it issued on May 23, 1995, years before the earliest possible filing date of the '339 patent;

**(6) U.S. Patent No. 6,687,410 B1** to Brown (GOOG 1025) is prior art under at least 35 U.S.C. § 102(e) because it was filed February 7, 2000, before the earliest possible filing date of the '339 patent; and

**(7) U.S. Patent No. 7,031,517 B1** to Le et al. (GOOG 1026) is prior art under at least 35 U.S.C. § 102(e) because it was filed October 1, 1999, before the earliest possible filing date of the '339 patent;

**(8)** Gilbert Held, **Data and Image Compression** ($4^{th}$ ed., Wiley 1996) (GOOG 1027) is prior art under at least 35 U.S.C. § 102(b) because it was published in 1996, before the earliest possible filing date of the '339 patent;

**(9)** Yun Q. Shi & Huifang Sun, **Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards** (CRC Press, 2000) (GOOG 1028) is prior art under at least 35 U.S.C. § 102(b) because it was published in 2000, before the earliest possible filing date of the '339 patent; and

**(10) "2-D Median Filtering and Pseudo Median Filtering"** to Rostampour et al. (GOOG 1020) is prior art under at least 35 U.S.C. § 102(b) because it published in 1998, years before the earliest possible filing date of the '339 patent.

19. The '339 patent describes and claims "a system and method for transmitting data … ." (GOOG 1001, 1:32-33.) I am familiar with the technology described in the '339 patent as of its earliest possible benefit date of January 16, 2002.

20. I have been asked to provide my technical review, analysis, insights, and opinions regarding the '339 patent and the above-noted references that form the basis for the grounds of rejection set forth in the Petition for *Inter Partes* Review of the '339 patent.

## IV. Relevant Legal Standards

21. I understand that my analysis requires an understanding of the scope of the '339 patent claims. I understand that claims subject to *Inter Partes* Review are given the "broadest reasonable construction in light of the specification of the patent in which it appears." 42 C.F.R. § 42.100(b).

22. I understand that a claim is unpatentable if it is anticipated or obvious. I understand that anticipation of a claim requires that every element of a claim is

expressly or inherently disclosed in a single prior art reference. I do not render opinions regarding anticipation in connection with this proceeding.

### A. Ordinary Skill

23. I was also asked to provide an opinion regarding the skill level of a person of ordinary skill in the art of the '339 patent prior to January 16, 2002. To do so, I considered several things. For example, I considered the types of problems encountered in the art, the solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the education level of active workers in the field.

24. I understand that a person of ordinary skill in the art is one who is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity. A person of ordinary skill in the art ("POSA") would have had knowledge of the image processing and data transmission fields, and various related technologies as of January 16, 2002.

25. Applying the above understanding, it is my opinion that, as a general matter, a POSA at the time of the filing of the '339 patent would at least a B.S. degree in Electrical Engineering, Computer Engineering, Computer Science, or an equivalent field, as well as at least one year of academic or industry experience in image processing and data transmission.

26. By equivalent field, I mean that the required levels of educational and industry experience is on a sliding scale relative to each other. For example, a person of ordinary skill could have a more advanced educational degree with less industry experience.

### B. Obviousness

27. It is my understanding that a patent claim is obvious if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a POSA to which said subject matter pertains. I understand that for a single reference or a combination of references to render the claimed invention unpatentable under an obviousness rationale, a person of ordinary skill in the art must have been able to arrive at the claims by altering or combining the applied references.

28. I also understand that rationales that may support a conclusion of obviousness include: (a) combining prior art elements according to known methods to yield predictable results; (b) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; (c) simple substitution of one known element for another to obtain predictable results; (d) use of known technique to improve similar devices (methods, or products) in the same way; (e) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results.

29. I also understand that when considering the obviousness of a patent claim, one may consider whether a teaching, suggestion or motivation to combine the references exists so as to avoid impermissibly applying hindsight when considering the prior art. I understand this test should not be rigidly applied, but that the test can be important to avoiding such hindsight.

30. I also understand that any secondary considerations of nonobviousness must be considered. I understand that secondary considerations must have a nexus to the claim and that even substantial evidence of secondary considerations may not overcome a strong prima facie showing of obviousness.

## V. State of the Art

31. By 2002 and prior to the time of invention, all the technology at issue in the '339 patent was broadly applied and well known by developers in image processing and image transmission. No individual elements of the '339 claims were novel at the time of the alleged invention, and there was nothing novel about the manner in which those elements were combined in the claims. Further, there were no technological barriers to combining these elements to form the claimed invention. Indeed, the topics of digital image processing and image transmission have been rapidly growing areas of research and development since the 1960s. (GOOG 1024, Preface.) In addition, digital image sequence processing has been an active area of research since at least the 1980s. (*Id.*) Both pixel sampling and

subdivision into variable sized regions with different level of detail – two aspects called out as features in the '339 patent and its prosecution before the examiner – were well-known by 2002, as will be shown.

### A. Sampling

32. Sampling of images was known well before 2002, the earliest priority date of the '339 patent. For example, inter-frame processing was well known at an early date. In one conditional replenishment technique, a present grey level pixel value and its position information are transmitted for pixels that change by more than a threshold between frames. (*See e.g.,* GOOG 1028, pp. 68-69.)

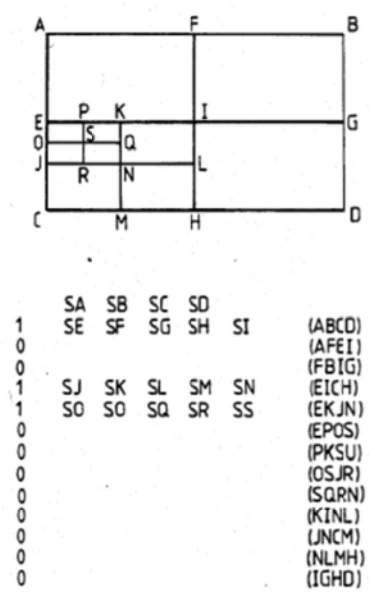
33. Representing a block of pixels for transmission with a reduced number of pixels in intraframe processing was also well known in the prior art. For example, one such approach is to represent an entire pixel block with a single value. (GOOG 1020, 5:54-6:32.) In this approach, a block, whether it is 4x4, 5x5, 8x8, or any other suitable size, is represented by one pixel value, such as a mean value of the pixel values of a block. (*Id.*, 3:7-8.) This yields an optimized data stream that is, for example, $1/16^{th}$, $1/25^{th}$, or $1/64^{th}$ of the size of an un-optimized block for 4x4, 5x5, or 8x8 blocks, respectively.

34. The key to implementing this approach is to select a single pixel value that is "a reasonable approximation to the value of all pixels within the block." (*Id.*,

6:1-2.) One approach is to calculate a mean value of all pixels in the block. (*Id.*, 2-5.) Also, other methods of selecting a single pixel from among those within a block (subsampling) to represent the pixel block were well known in the art. For example, the median filter was well known. In a median filter, "the value of pixel is replaced by the median value of a set of pixels in its local neighborhood." (GOOG 1020, p.554.)

35. Another type of image sampling involves transmitting only the corner values of blocks. For example, one method transmits blocks where "all picture elements (pels) are represented by values linearly interpolated from the corner values at A, B, C and D." (GOOG 1005, 2:26-35.) In this way, an entire image can be approximated with only a few pixel values, for example the corner values of the block as illustrated below:

*Fig.6.*



(*Id.*, FIG. 6.)

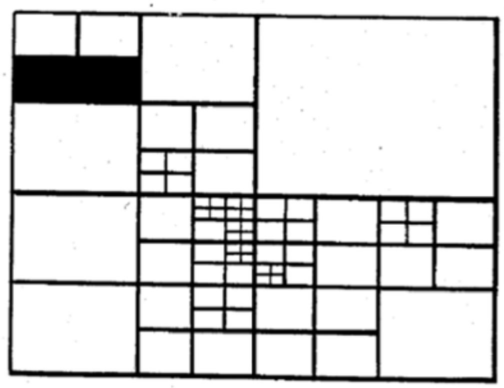
### B. Variable block sizes

36. Image segmentation algorithms were well known in the art too. These algorithms included block subdivision algorithms that segment an image into variable sized blocks. For example, the above mentioned image transmission method of Spriggs also utilizes variable block sizes. First, Spriggs determines the level of detail of a region (also called a block) according to the variation of pixels across the block using an interpolation comparison. (*Id.*, 2:26-35.)

37. In an embodiment, Spriggs makes the determination by first generating an interpolated block from the four corners of the block (Operation 1). (*Id.*, 2:26-35, "The first step in coding is to calculate a new block in which all picture elements (p[ix]els) are represented by values linearly interpolated from the corner values at A, B, C and D.") This interpolated block represents the block that a decoder would hypothetically generate if the block under consideration were represented by the corner values. Spriggs compares each pixel of the actual block to this hypothetical block to determine if the representation is accurate enough. (*Id.*, 2:32-35, "This new block is compared with the original and if no differences are found in excess of a certain threshold, t, then the process moves to operation 2.")

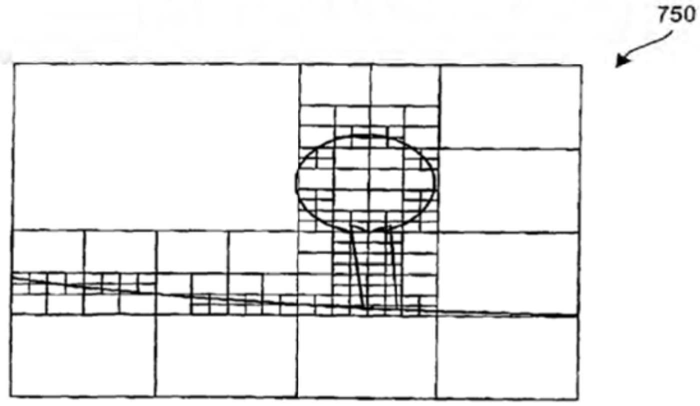
38. Blocks that have high detail as determined by this test require further subdividing. (GOOG 1005, 2:51-54.) In this way Spriggs explains "the greatest number of subdivisions will occur at edges or over fine detail." (*Id.*, 2:56-57.) This recursive process generates a nested series of blocks and sub-blocks:

Fig.3.



(*Id.*, FIG. 3.)

39. Although Spriggs does not use the term, Spriggs' disclosure suggests what is often referred to in the art as "quad tree" segmentation. The quad-tree approach for segmenting an image into variable block sizes is named for the way it is used to divide blocks. The way it is done is explained here with reference to "Le." (GOOG 1026, 10:63-66.) The quad-tree segmentation method begins with the entire frame, and recursively subdivides into four smaller sub-blocks based on a decision process. (*Id.*, 11:53-12:40.) This produces a nested sub-block structure such as:




Splitting Final State

Fig. 7E

(*Id.*, FIG. 7E.)

40. In one example, the decision process is based on contrast "determined by calculating the difference between the minimum and maximum luminance values of the pixels in the [block]." (*Id.*, 11:55-57.) When a block exceeds a threshold contrast, it is sub-divided into four smaller blocks, and the process recursively repeats on each sub-block. (*Id.*, 12:1-40.)

41. Other methods of segmentation using blocks of varying sizes were well-known in the prior art. For example, in one segmentation method, "the block size is adaptively selected based on the characteristics of the image pixel data [with l]arge blocks … used for homogeneous data [and s]maller blocks … utilized for detailed data." (GOOG 1019, 4:12-18.) In this way, the method "is adaptable to variations in pixel region activity." (*Id.*, 4:48-60.) Image transmission is optimized

because "[l]arge block sizes with few data bits are utilized to encode pixel estimation errors in the homogeneous regions of pixel data where most of the data has the same value[, and s]maller blocks are utilized for nonhomogeneous regions which manifest a large quantity of detail." (*Id.*) This method is referred to as "Block Adaptive Interpolative Coding (BAIC)." (*Id.*, 7:56-60.)

## VI. The '339 patent

42. The '339 patent describes and claims "a system and method for transmitting data … ." (GOOG 1001, 1:32-33.) The specification introduces system 100 as "allow[ing] data such as video data to be transmitted in manner that does not require the data to compressed." (*Id.*, 2:41-45.) In this way, the '339 disclosure purports to provide "many important technical advantages" as data can be transmitted without compressing at the sending end or decompressing at the receiving end. (*Id.*, 1:53-57.)

43. System 100 for transmitting data 100 is made up of a data transmission system 102 and data receiving system 104 coupled over a communications medium 114 as shown in FIG.1:

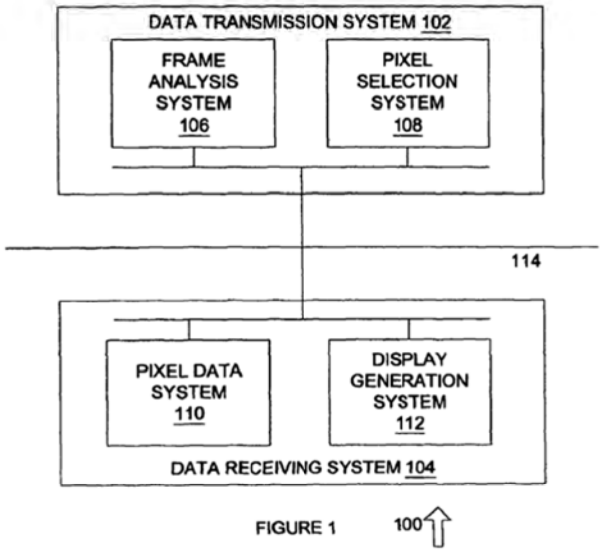



FIGURE 1

(*Id.*, FIG. 1.)

44. "Data transmission system 102 includes frame analysis system 106 and pixel selection system 108, each of which can be implemented in hardware, software or a suitable combination…and which can be one or more software systems operating on a general purpose processing platform." (*Id.*, 2:65-3:3). Likewise, data receiving system 104 includes pixel data system 110 and display generation system 112 each of which is implemented in hardware, software or a suitable combination. (*Id.*, FIG. 1, 3:35-40.)

45. In operation, data transmission system 102 can receive frames of video data and select pixels of data for transmission that are needed to allow the frames of video data to be viewed by the human eye. (*Id.*, 3:16-19.) The number of pixels selected depends upon whether regions of a frame have high or low detail

and can be decided on a region-by-region basis. (*Id.*, 3:23-34.) More particularly, matrix size data and selected pixel data from locations within a matrix or other region can be transmitted for a frame. (*Id.*, 3:51-4:22, and FIG. 5)

46. Frame analysis system 106 analyses an image frame and generates "region data, such as a uniform matrix size that is used to divide the frame into a predetermined set of matrices." (*Id.*, 1:44-46.) Frames can be divided into uniform size blocks such as "a 10x10 matrix" or "matrices varying in size, such as from a 1x1 matrix to a 5x5 matrix or greater" ( *Id.*, 3:62 and 4:2-3).

47. The size and configuration of blocks of matrices are based on the level of detail within the block. ( *Id.*, 5:21-6:3.) In this way, "the amount of pixel data required to transmit image data or other suitable data for perception by a human eye or other suitable applications can be determined." ( *Id.*, 5:29-32.) The amount of pixel data required to reproduce a block is determined by "pixel variation" within a block. ( *Id.*, 5:54.) The pixel variation tolerance can be set "such that in areas having low information con[t]ent, the matrix size is increased whereas in areas having high information content the matrix size is decreased." (GOOG 1001, 8:63-67.) That is, there will be more numerous, smaller matrices generated in areas of high detail and fewer, larger matrices generated in areas of low detail.

48. Pixel selection system 108 selects a subset of pixels from each predefined matrix or other region to transmit in an "optimized" data transmission system. (*Id.*, 4:11-13.) Pixel selection system 108 also generates "pixel location data within the matrix, such that the pixel can be regenerated at a predetermined location, at a random location, or in other suitable manners." (*Id.*, 4:18-21.)

49. At the receiving end, pixel data system 110 "receives matrix data and pixel data and assembles frame data." (*Id.*, 4:31-33.) "Display generation system 112 receives frames of data from pixel data system 110 and generates video data, audio data, graphical data, textual data, or other suitable data for user by a user." (*Id.*, 43:44-47.) Further description of the systems and methods are provided with respect to system modules of FIGs. 2-4, the methods in the flowcharts of FIGs. 5-8, and the examples of uniform and non-uniform matrix segmentation in FIGs. 9 and 10.

### A. Claims Considered

50. I have considered claims 1, 6, 7, 9, 10, 12, and 13. The independent claims are 1, 7, and 10.

51. Claim 1 (notations a-f added) recites:

| Claim Language |
| --- |

| |
|---|
| (a) A system for transmitting data transmission comprising: |
| (b) a analysis system receiving frame data and generating region data comprised of high detail and or low detail; |
| (c) a pixel selection system receiving the region data and generating one set of pixel data for each region forming a new set of data for transmission; |
| (d) a data receiving system receiving the region data and the pixel data for each region and generating a display; |
| (e) wherein the data receiving system comprises a pixel data system receiving matrix definition data and pixel data and generating pixel location data; |
| (f) wherein the data receiving system comprises a display generation system receiving pixel location data and generating display data that includes the pixel data placed according to the location data. |

52. Claim 6 depends from claim 1 and further recites: "wherein the pixel selection system comprises a pixel identification system generating pixel location data based on a location of the set of pixel data associated with each of the regions."

53. Claim 13 depends from claim 1 and further recites: "wherein the frame analysis system comprises a pixel variation system receiving two or more

sets of pixel data and generating the region data based on pixel variation data from the two or more sets of pixel data."

54. Claim 7 (notations a-f added) recites:

| **Claim Language** |
|---|
| (a) A method for transmitting data comprising: |
| (b) receiving frame data; |
| (b) generating optimized matrix data from the frame data; |
| (c) selecting one of two or more sets of pixel data based on the optimized matrix data; |
| (d) wherein receiving frame data comprises receiving an array of pixel data; |
| (e) wherein generating the optimized matrix data from the frame data comprises setting a matrix size based on pixel selection data; |
| (f) and transmitting the selection pixel data and the optimized matrix data by assembling the optimized matrix data and the selection pixel data into a generated display frame. |

55. Claim 9 depends from claim 7 and further recites: "wherein transmitting the pixel data and the matrix data comprises transmitting an array of pixel data and uniform matrix size data."

56. Claim 10 (notation a-f, added) recites:

| **Claim Language** |
|---|
| (a) A method for transmitting data comprising: |
| (b) dividing an array of pixel data into two or more regions; |
| (c) selecting a set of pixel data from each region; |
| (d) wherein dividing the array of pixel data comprises dividing the array of pixel data into two or more matrices having a uniform size; |
| (e) wherein dividing the array of pixel data comprises dividing the array of pixel data into two or more matrices having two or more different sizes; |
| (f) and transmitting the region data and the selection pixel data for each region by assembling the region data and the selection pixel data into a generated display frame. |

57. Claim 12 depends from claim 10 and further recites: "wherein transmitting the region data and the pixel data for each region comprises transmitting matrix data and the pixel data for each matrix."

**B. Prosecution History**

58. The application leading to the '339 patent was filed on July 16, 2004 as a continuation of an international application, PCT/US02/00503, filed Jan. 16, 2002. (GOOG 1002, p. 1.)

59. To distinguish the prior art during prosecution, Applicants made many remarks and maintained that their claimed invention transmits data without compression. (See, e.g., Jan. 24, 2011 Amendment, Id., 591 ("**the generated set of pixel data is <u>selected directly</u> … and will be transmitted <u>without any further processing, due to the fact that the applicants['] invention does not compress nor decompress data</u>.**") (emphasis in original).)

60. This emphasis on optimization without compression was part of an extensive back and forth with the examiner and highlighted with remarks and text entered in each independent claim preamble at allowance. (See April 41, 2011 Amendment After Allowance and Examiner's Interview Summary of April 1, 2011 agreement with Applicants, Id., 634 and 642.)

61. Applicants also characterized their invention as varying a size of a matrix or region based on its pixel variation to reduce the amount of data transmitted. In the Jan. 24, 2011 Supplemental Amendment Applicants reproduced FIGs. 6 and 10 in full and said **"[t]he present invention employs an algorithm in**

**which nearby pixel values are compared. If the difference between pixels exceeds a threshold that means that the picture is changing (e.g., changing spatially or temporally) rapidly; accordingly, a smaller <u>region size</u> is selected, <u>with --one pixel or one set meaning zero, one or more pixels</u>, being transmitted for that region. If the difference between the pixels does not exceed the threshold, that means that the picture is changing (spatially or temporally) slowly, and only a small amount of data will need to be transmitted...; accordingly, a larger matrix size is selected."** (emphasis in original.) (Id., 585-589.)

62. I also understand in a concurrent litigation it has been argued that the printed '339 patent claims do not reflect the final claims allowed by the Examiner. In particular, several limitations made or required during prosecution have been argued as omitted as shown in redlined form in Defendants' Motion to Dismiss for Failure to State a Claim (denied). (GOOG 1013, pp. 3-4, GOOG 1014, GOOG 1019.)

63. A reissue application was filed June 4, 2013 with the assent of assignee Vedanti Systems Ltd.; however, it was abandoned after claims 1-13 were rejected based on a defective oath/declaration. Patent Owner admitted an error in claim scope, namely that the "issued independent claims were limited by features

of decoder claims." (GOOG 1017, p. 15.) However, I understand Patent Owner made no attempt to correct errors in the printed claims from the original prosecution as reflected in its letter of express abandonment (GOOG 1017, p. 47.)

### C. Claim Construction

64. I understand that the claims should be interpreted under the broadest reasonable interpretation from the perspective of one of ordinary skill in the art in light of the specification.

65. I also understand that there are meaningful textual differences between the claims as printed in the '339 patent and the claims allowed during prosecution. For the purposes of my opinion here, I construe the challenged claims as printed under a broadest reasonable interpretation.

66. I further understand that regardless of whether the challenged claims are indefinite, for the purposes of an inter partes review, a broadest reasonable interpretation may be applied. For the purposes of my opinion, I provide a broadest reasonable interpretation of the claims as best I can.

67. I construe several claim terms here: frame data, region, high detail and/or low detail, pixel variation data, matrix, matrix data/matrix definition data, optimized matrix data, pixel selection data and analysis system. Each of these is addressed below.

### 1. "frame data"

68. I understand the term "frame data" to mean "image comprised of pixel data." A POSA would recognize that a "frame" is "one of the still images that, when played at a rapid speed …, produces the illusion of continuous motion." (GOOG 1012, 217.) A POSA would further recognize that a "still image" in animation and video fields is comprised of pixel data. Pixel data is "[t]he smallest element (a picture element) that a device can display and out of which the displayed image is constructed." (*Id.*, 408.) However, as used in the '339 patent, the term "frame" is not limited to the video context, but is used to refer to a single image as well. This is consistent with the specification that recites "frame data, such as a frame of video data," indicating that frame data can be either a still image or a portion of motion video. (GOOG 1001, 1:42-43.)

69. I further understand that this is how the term "frame data" is used in the claims and specification of the '339 patent. Each of the claims 1, 7 and 10 uses the term frame or frame data in the context of pixel data and display. For example, claim 1 recites "a analysis system receiving frame data" in the same context as a "pixel selection system" and a "data receiving system" for "generating a display." (GOOG 1001, Claim 1.) Claim 7 recites "frame data" in the context of "selecting one of two or more sets of pixel data" and "assembling … a generated display

frame." (*Id.*, Claim 7.) Similarly, claim 10 recites "… assembling the region data and the selection pixel data into a generated display frame."

70. The specification also supports this construction explaining that "[t]he system includes a frame analysis system receiving frame data, such as a frame of video data… ." (GOOG 1001, 1:42-43.) The specification continues on to recite other forms of data, such as "audio data, graphical data, text data, or other suitable data," but I understand the claims to be directed to the embodiment where frame data is only an "image comprised of pixel data" such as "a frame of video data." (GOOG 1001, 1:43-44.)

71. A POSA would recognize that the terms "pixel" and "pel" are interchangeable, with "pel" being an abbreviation for "pixel." (GOOG 1012, p.399.) The term "pel" has since lost favor, but both "pixels" and "pels" have the same meaning. (*Id.*)

### 2. "region"

72. I understand the term "region" to mean a "division of a frame." The term "region" has no universal meaning to one of ordinary skill in the art and its meaning must be derived from the context in which it is used. Here, the term "region" is used in the claims to refer to a division of a frame and can include, for example, a matrix. For example, claim 1 recites "receiving frame data and

generating region data." (GOOG 1001, Claim 1.) Similarly, claim 10 recites "dividing an array of pixel data into two or more regions." (*Id.*, Claim 10.) Because I understand "frame data" to mean "image comprised of pixel data," and "an array of pixel data" is also comprised of pixel data, the way the term "region" is used in claim 10 informs me that a "region" is a "division of a frame."

73. The specification also supports my understanding of the term "region." The abstract and summary of the invention refer to dividing the frame. (Id., Abstract and 1:40-49.) In numerous others places in the specification, regions are described with references to examples of these regions as being composed of one or more matrices that divide a frame. (*See*, *e.g.*, *id.*, 3:56-4:10.) Pixel selection is made from a "matrix or other region." (*Id.*, 4:16.) The specification also refers to "regions within the frame." (Id., 6:21.) The specification further recites a "method 700 for selecting a pixel within a region," implying that regions contain pixels. (*Id.*, 9:5-6.) Other references in the specification refer to selecting pixels in regions such as a "pixel identification system 306 [that] can identify a uniform pixel location within each matrix or other region…" (*Id.*, 6:67-7:1). "Region data" is described as defining "one or more regions within a frame." (Id., 9:52-54.)

### 3. "high detail" / "low detail"

74. To the extent their meaning can be ascertained under a broadest reasonable interpretation, I understand the term "high detail" to mean "amount of

variation between pixels exceeds a predetermined tolerance," and the term "low detail" to mean "amount of variation between pixels does not exceed the same or another predetermined tolerance." To a POSA this amount of variation includes an amount of variation between pixels of a given small separation such as adjacent pixels – the example provided in the specification (GOOG 1001, 5:48-53 and 8:27-31). Again, the terms "high detail" and "low detail" have no inherent meaning to a POSA, so their meanings must be derived from the context in which they are used. Here, the terms' usage in the claims indicates that "high detail" and "low detail" are used in connection with frame data because claim 1 recites, for example, "receiving frame data and generating region data comprised of high detail and or low detail." (*Id.*, Claim 1.) Because I understand "frame data" to mean "image comprised of pixel data," claim 1 suggests "high detail" and "low detail" are used in relation to pixel data.

75. Turning to the specification, a "[p]ixel variation system" is described that "determines the level of detail required based on variations in pixel data." (GOOG 1001, 5:21-22.) This "pixel variation system" determines the level of detail in an image by "compar[ing] two adjacent pixels to determine whether the amount of variation between those two adjacent pixels exceeds a predetermined tolerance." (GOOG 1001, 5:27-29.) This is the only specific example given in the '339 specification as to how to determine detail. Thus, as used in the '339 patent, I

understand "high detail" to mean "amount of variation between pixels exceeds a predetermined tolerance," and the term "low detail" to mean "amount of variation between pixels does not exceed the same or another predetermined tolerance."

**4. "pixel variation data"**

76. I understand the term "pixel variation data" to mean "difference in pixel data between pixels including, for example, between adjacent pixels." A POSA would recognize in the context of the '339 patent that this includes, for example, a difference between values of pixels of a given small separation such as between adjacent pixels.

77. The specification of the '339 patent does not expressly define the term "pixel variation data." Similarly, the claims of the '339 patent do not provide further definition beyond reciting the term as an input to the "matrix size system." (Claim 2.)

78. However, the specification supports this construction. For example, the "matrix size system" can receive "pixel variation data from pixel variation system 202…" (GOOG 1001, 5:58-59. The "pixel variation system" determines the level of detail in an image by "compar[ing] two adjacent pixels to determine whether the amount of variation between those two adjacent pixels exceeds a predetermined tolerance." (*Id.*, 5:27-29.) Such variation between adjacent pixels is

the sole explicit example provided in the specification (*Id.*, 5:48-53 and 8:27-31). Thus the proper meaning here of "pixel variation data" is "difference in pixel data between pixels including, for example, between adjacent pixels" because that is how the term is used in the specification.

### 5. "matrix"

79. I understand the term "matrix" is construed as a "region with square or rectangular dimensions" within the context of the '339 patent. As understood in light of the proper construction of "region," a POSA would understand "matrix" to include a region of a frame consisting of a square or rectangular ordered array of pixel data.

80. This meaning is consistent with examples of matrices in the specification such as "from a 1x1 matrix to a 5x5 matrix or greater." (*Id.*, 4:1-3.) In another example, "the size of the matrices can be nonsymmetrical, such that an NxM matrix can be used where N and M are integer values that are not equivalent." (*Id.*, 4:3-6.) Matrices consistent with this meaning are also depicted in FIGs. 9 and 10:

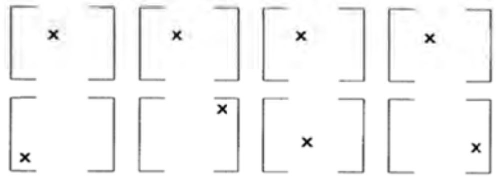


FIGURE 9 900

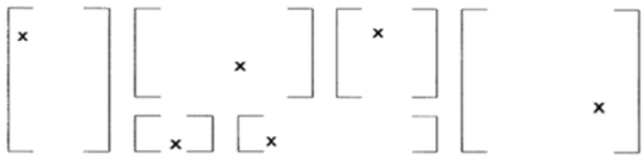


FIGURE 10 1000

(*Id.*, FIGs. 9-10.)

81. As used in the '339 patent, the values that comprise matrices are pixels. For example, the specification refers to "pixel data for the matrix" (*id.*, 9:22-23) and "matrix segmentation of an array of pixel data" (*id.*, 10:20). Therefore, the proper meaning of the term "matrix" under a broadest reasonable interpretation is "region with square or rectangular dimensions."

### 6. "matrix definition data" / "matrix data"

82. I understand the terms "matrix definition data" (claim 1) and "matrix data" (claims 7, 9 and 12) in the context of the '339 patent to mean "uniform matrix dimensions or non-uniform matrix dimensions and sequences." In this context, a POSA would understand "sequences" to include the location of matrices in a frame. These meanings are consistent with examples of data for square or rectangular matrices in the specification. (*See*, *e.g.*, GOOG 1001, FIGS. 9-10.)

Pixel data system 110 is described as receiving "matrix data" which can be a matrix size identifier for uniformly sized matrices for a frame or a matrix map data "such that a sequence of matrices and the size of each matrix can be determined." (*Id.*, 4:32-39.)

### 7. "optimized matrix data"

83. To the extent the meaning can be ascertained under a BRI the term "optimized matrix data" is "matrix data generated based on pixel variation data." In the context of the '339 patent, a POSA would understand this to include, for example, matrix data that is generated so as to maintain pixel variation data within a predetermined tolerance. This meaning is consistent with the specification's description of selecting a square or rectangular matrix size for a data optimization region based on predetermined pixel variation tolerances. (*Id.*, 3:51-4:10.) Such pixel variation data construed under a BRI in light of the specification can include differences between adjacent pixels. (*Id.*, 8:24-31.)

### 8. "pixel selection data"/"selection pixel data"

84. I understand the terms "pixel selection data" (claim 7) and "selection pixel data" (claims 7, 10) and in the context of data generated for transmission by a "pixel selection system" (claim 1), is properly construed as "selected pixel data transmitted without any further processing for each region in a frame." A POSA would understand this is consistent with the usage of the term in the specification.

For example, "… data transmission system 102 can receive frames of video data, and can select pixels of data for transmission … ." (GOOG 1001, 3:16-17; See also, Abstract, 1:46-52, 3:13-34, 4:11-31, 6:25-7:9, 7:55-62, 8:44-48, 9:5-41, Fig. 7, Fig. 9, Fig. 10, cl. 7, cl. 10.) The present invention is characterized in the Summary of the Invention as "not requir[ing] data to be compressed at the sending end and decompressed at the receiving end. The present invention uses data optimization to transmit only the data that is necessary for the application, such that decompression of the data on the receiving end is not required." (GOOG 1001, 1:55-60).

85. This construction is also consistent with remarks made by Applicants during the original prosecution arguing data transmission without compression or decompression. (See, e.g., GOOG 1002, Supp. Amendment, dated Jan. 24, 2011 at 17-18, and Amendment, dated Dec. 27, 2010, at 18.)

**9. "analysis system"**

86. I understand the "analysis system" in claim 1, line 1 should be construed under a BRI as "frame analysis system" consistent with frame analysis system 106 in FIGs. 1 and 2 of the specification and to provide antecedent basis for the term in dependent claims 2 and 3, line 1.

## VII. Analysis

87. Below, I will describe the relevant disclosures of Belfor in view of Thyagarajan in further view of Golin, and how they would have been combined to show each feature of the challenged claims.

### A. Claims 1, 6, 7, 9, 10, 12, and 13 are obvious over Belfor in view of Thyagarajan in further view of Golin

#### 1. Overview of Belfor

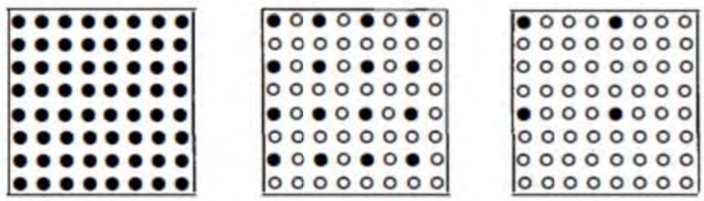
88. Like the '339 patent, Belfor teaches data reduction and selecting pixels by subsampling an image, wherein the sampling density within a given region of the image depends upon the level of detail of the image within that region. To achieve this, Belfor first divides the image into "blocks," and applies one of a number of sampling "lattices" to each of the blocks. The lattices select pixels from the block by subsampling the block at the sampling points in the lattice. Explained in terms of the '339 patent, with reference to Fig. 4 of Belfor, a sampling lattice of Belfor contains an array of sampling points. The lattice can be thought of as being divided into matrices, with one sampling point in each matrix, like the '339 patent. The size of the matrices within a given lattice depends upon the sampling density. The sampling lattices vary in sampling density. "In detailed regions, a dense sampling lattice is used, and in regions with little detail, a sampling lattice with only a few pixels is used." (GOOG 1007, 492, 495, Fig. 4.) The matrices within the lattice thus vary in size according to the level of detail or pixel variation in a block,

as in the '339 patent. Belfor teaches it was well known to subsample an image to reduce data being transmitted. "By discarding a part of the pixels, the image can be transmitted more efficiently." (GOOG 1007, 492.) "In a subsampling data compression system, the remaining pixels after subsampling are transmitted or forwarded to subsequent coding or processing stages." (*Id.,* 493.) Note that in this prior art reference, unlike the '339 patent alleges, the term "compression" is used broadly to describe subsampled data.

89. Belfor teaches spatially adaptive techniques were well known where the number of pixels selected varied according to the level of detail in each region. "In a spatially adaptive subsampling scheme, the image is subdivided into square blocks, and each block is represented by a specific sampling lattice. In detailed regions, a dense sampling lattice is used, and in regions with little detail, a sampling lattice with only a few pixels is used." (*Id.*)

90. Belfor further teaches a "spatially adaptive subsampling scheme [where] the subsampling lattice is adapted to the local spatial frequency content of an image sequence." (*Id.*, Abstract.) Here, the term "spatial frequency content" corresponds to "level of detail" in the '339 patent. In Belfor, an image is "subdivided into square blocks, and each block is represented by a specific spatial sampling lattice." (*Id.*, 492.) The "sampling lattice" is "implemented by simply

discarding those pixels not present in the new lattice." (*Id.*, 493.) It is the "remaining pixels after subsampling [that] are transmitted… ." (*Id.*) For example, the solid dots are the pixels that are transmitted in three different sampling lattices, which Belfor designates as "modes":



Mode 1 Mode 2 Mode 3

(*Id.*, Fig. 4.)

91. Belfor discloses both "fixed" and "spatially adaptive" subsampling. (*Id.*, 495.) "Fixed" subsampling is where all blocks are subsampled using the same lattice, i.e., a basic subsampling or decimation of the whole image. (*Id.*, 492-4.) However, Belfor recognizes that "[i]deally, each block should be sampled with a sampling lattice optimally suited for that particular block." (*Id.*, 495.) In "spatially adaptive" subsampling, for each block "a criterion function that reflects the quality of the block for a particular mode" is employed to choose the sampling lattice used. (*Id.*) Belfor discloses using an "interpolation module" to evaluate the quality criterion to choose the sampling lattice. (*Id.*) Belfor further discloses a heuristic

method based on rate-distortion theory using the interpolation module to allocate subsampling modes among blocks. (*Id.*, 495-6.)

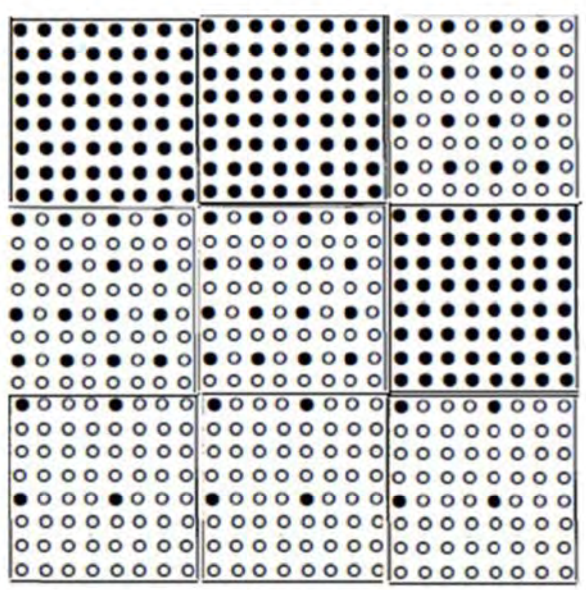
92. In addition to setting a block size, for each block Belfor describes setting a sampling frequency for each block. Here, the spacing of samples in the sampling lattice indicates the sampling frequency. "Another consideration in a practical system is the sampling lattice to be used for each block. Ideally, each block should be sampled with a sampling lattice to be used for each block." (*Id.*) In an example Belfor continues to describe using a set of possible sampling lattices or modes "designed in such a way to give good coverage of the range of all necessary spatial frequencies." (*Id.*) Belfor then describes the examples of modes of FIG. 4 giving "different data reduction factors," adjusting for level of detail and varying block size as follows:

> "For instance, in mode 3, only four pixels are kept out of 64 pixels giving a data reduction factor of 16. Mode 1 can be used for highly detailed regions, whereas mode 3 can be used for areas with a slowly varying luminance. The number of possible modes is affected by the block size because for decreasing block size, the number of

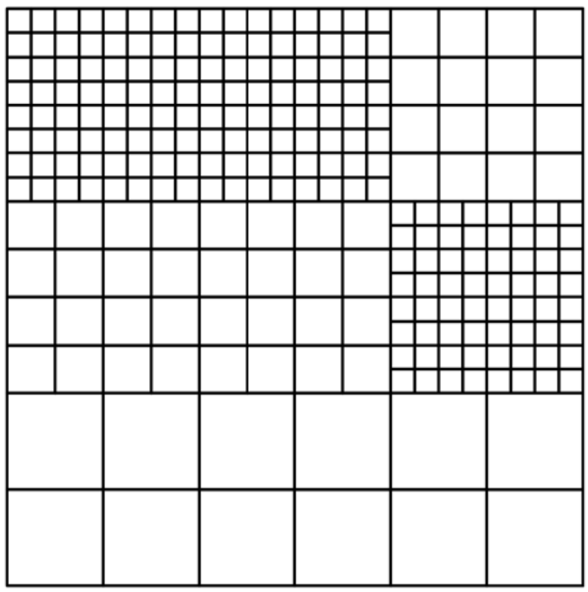
possible sampling lattices within the block decreases as well." (*Id.*)

### 2. Overview of the Combination of Belfor in view of Thyagarajan and further in view of Golin

93. Belfor sets a block size and then selects a sampling frequency or mode for each block. In this way, more pixels are selected in regions of high detail and less are selected in regions of lower detail as described above. Because Belfor describes setting a block size and sampling frequency for each block of frame, a POSA would understand that the regions (and matrices) in which pixels are sampled varies in size across the frame. For instance, this variation in matrix or region size occurs when different modes are selected in different blocks even when the blocks are set at the same size. For example, consider a hypothetical image frame consisting of nine regions as defined by Belfor:



94. Note that in this example there are some contiguous groups of blocks that use the same sampling lattice, thus forming variable sized regions of the image wherein the sampling density is the same, as disclosed in the '339 patent. Each block in such an image could be modeled in terms of smaller matrices, of size according to the sampling lattice. In this way, Belfor may teach or suggest regions of varying dimensions. For example:



95. Depending on the particular claim of the '339 patent, Patent Owner may argue that Belfor's selection of a single block size and different sampling frequencies for each block does not constitute matrices or regions that vary in size according to pixel variation relative to a threshold including for example a difference between adjacent pixels. Belfor in view of Thyagarajan further in view of Golin however teach using different block sizes sized according to pixel

variation which combined with Belfor render the challenged claims obvious. Thyagarajan teaches block size assignment to be even more spatially adaptive to pixel variation. Golin teaches using the difference in pixels as a particular roughness test for pixel variation. All three references are analogous art in the same field of endeavor data transmission and address problems relating to data reduction. Like Belfor, Thyagarajan discloses reducing image data to be transmitted. Thyagarajan discloses an image transmission scheme using "contrast adaptive coding to achieve further bit rate reduction" by "assigning more bits to the busy areas and less bits to the less busy areas." (GOOG 1008, 4:17-24.) Busy areas, for example, are "areas such as object boundaries and high-contrast texture," while less busy areas are "flat relatively slow varying areas." (*Id.*, 4:19-21.)

96. In Thyagarajan, "[a] block size assignment element in the encoder selects the block or sub-block of an input block of pixels to be processed. The selection is based on the variance of pixel values. Blocks with variances larger than a threshold are subdivided, while blocks with variances smaller than a threshold are not subdivided." (*Id.*, Abstract, 6:5-12.) The blocks discussed in Thyagarajan are equivalent to the regions or matrices of the '339 patent because both are a "division of a frame." (*See* section VI.C.2, above.) In examples, whether a block is subdivided depends on block and sub-block mean values falling into ranges and block variance compared to thresholds. (*Id.*, 3:4-9, 5:53-7:12, and FIG.2.)

Advantages of using this "block size assignment based on pixel variance" include it is perceptually based, can achieve outstanding quality in reconstructed images, and allows greater flexibility in controlling bit rate and quality. (*Id.*, 9:7-37.) Areas, or blocks, as disclosed by Thyagarajan can have differing dimensions. (*Id.*, 4:66-5:3, "although block sizes are discussed herein as being NxN in size, it is envisioned that various block sizes may be used. For example, a NxM block size may be utilized where both N and M are integers with M being either greater than or less than N.") To achieve variable block sizes, Thyagarajan discloses use of "quad trees," explained below. For example, an image may be divided into blocks having many different dimensions:

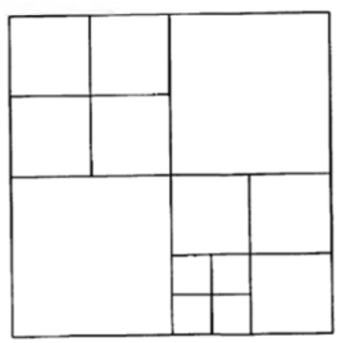


FIG. 3A

(*Id.*, Fig. 3A.)

97. Belfor discloses a block transmission scheme that is capable of transmitting a range of block sizes, as evidenced by Belfor's disclosure of selecting the right block size. (GOOG 1007, 495, "The size of the blocks is an important

system parameter.") Belfor even recognizes the challenge in selecting a single block size because "[i]f large blocks are chosen, … the ability to adapt to the local spatial frequency contents would be lost" and using small blocks "cause[s] a large overhead …" (*Id.*) Thus, a POSA implementing Belfor's image transmission would be motivated by Belfor's identification of this block size problem to find a better block subdividing method. One such method is the method taught by Thyagarajan that combines the advantages of using both large blocks and small blocks. Thyagarajan's method balances the advantages and disadvantages of both small blocks and large blocks by "assigning more bits to the busy areas and less bits to the less busy areas." (GOOG 1008, 4:17-24.)

98. The block subdivision of Thyagarajan is a simple substitution for the block size determination of Belfor. Specifically, rather than selecting a single block size for the entire image, a POSA would substitute Thyagarajan's quad-tree blocking method for use with Belfor's block encoding. A POSA would recognize that the DCT technique of Thyagarajan is merely another block encoding method, similar to the block encoding method of Belfor. (GOOG 1008, 3:53-60.) Furthermore, the block definition of Thyagarajan would be compatible with a variety of block encoders, including the block encoding method of Belfor. In addition, a POSA would understand Belfor's disclosure to be compatible with a range of block sizes because Belfor discusses setting a size of block as a system

parameter. (GOOG 1007, 495.) That would inform a POSA that while Belfor uses a 16x16 size block in the disclosure, other size blocks would also be compatible with the lattice subsampling method disclosed. Belfor contemplates the issue of more flexible region definition: "The ideal case would be to segment the image into regions that require the same spatial sampling frequency and sample each region according to this frequency." (*Id.*) However, the Belfor disclosure indicates that this method would requires a "large amount of side information," so square blocks are used instead. (*Id.*) However, a POSA when considering Thyagarajan's disclosure, would recognize that the quad-tree method disclosed by Thyagarajan is a compromise between amorphous regions and uniform blocks. Quad-tree decomposition allows for some flexibility beyond uniform block sizes but is also transmitted in an efficient manner, thereby avoiding the "large amount of side information" that Belfor indicates is undesirable.

99. Patent Owner may allege that this block subdivision of Belfor in view of Thyagarajan is based on a derived mean value not a direct comparison of an amount of variation between pixels like the difference between adjacent pixels example of the '339 patent (GOOG 1001, 3:53-56.) However, directly comparing adjacent pixels to make a block subdivision decision was also well-known and explicitly taught by Golin.

100. Golin describes "quad-tree decomposition" where blocks are subdivided into smaller blocks. (GOOG 1006, 13:41.) Golin describes "a number of strategies [] for deciding when a sub-region should be split … ." (*Id.*, 13:26-27.) One strategy is the "roughness test" which detects edges within a block. (*Id.*, 13:47-64.) This test "subtract[s] the region pixels by row and by column … to detect the horizontal and vertical edges … ." (*Id.*, 20:51-55.) This is an example of a comparison of nearby pixels, including adjacent pixels, because edges occur abruptly or nearly abruptly, wherein there is little change in the values of nearby or adjacent pixels away from the edge to either side, and there is a relatively large change between pixel values at the edge. By subtracting adjacent pixels, an edge can be detected and localized. Detection of edges performed subtracting "by row" and "by column," as disclosed in Golin, indicates subtracting subsequent rows and columns, one after another. A POSA would understand that this means the rows and columns being subtracted may be adjacent. Because these are rows and columns of pixels, this is one example in Golin of directly comparing adjacent pixels. For example, "FIG. 18 illustrates a simple definition of edges, based on large changes in gray level between adjacent pixels." (*Id.*, 19:34-36.)

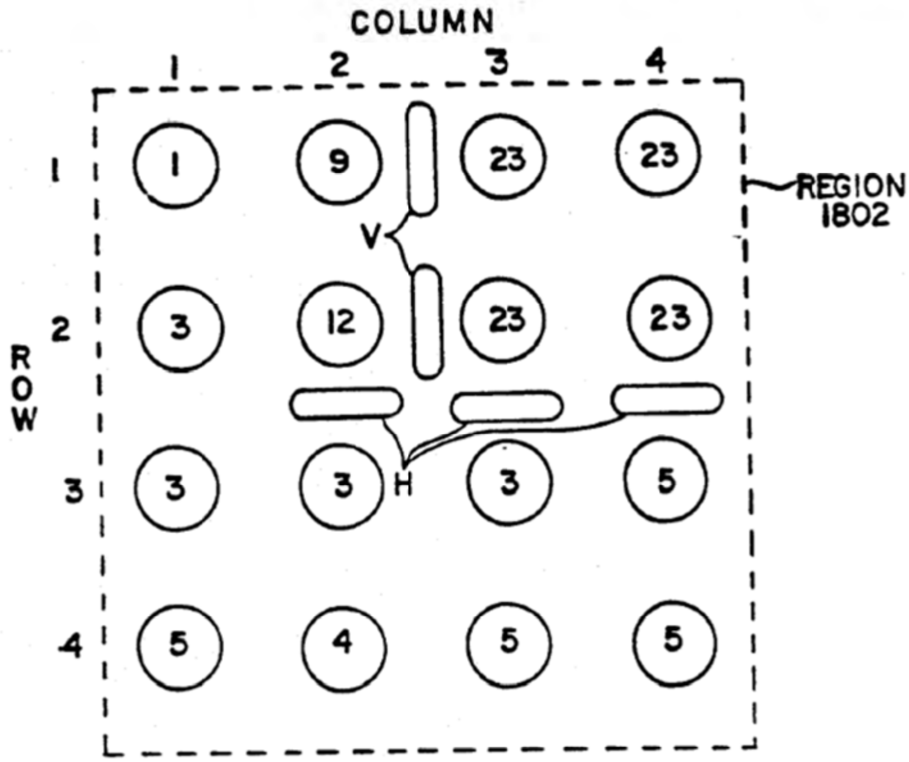



*FIG. 18*

(*Id.*, FIG. 18.)

101. In the figure above, horizontal edges as indicated by "H" occur where the difference between adjacent pixels is large, i.e., the difference between a pixel value of 12 and 3 between the pixels at coordinates [2,2] and [2,3]. (*Id.*) Similarly, the vertical edges occur where the difference between adjacent pixels is large, i.e., the difference between a pixel value of 9 and 23 between the pixels at coordinates [2,1] and [3,1]. When edges are found by comparing adjacent pixels, the block is subdivided into smaller blocks. (*Id.*, 13:61-63.) Also, Golin discloses another way of determining the slope between adjacent pixels: "Alternative definitions of

roughness are also possible. For example, one can estimate the slope between adjacent pixels by multipoint interpolation techniques". (*Id.*, 20:64-68.) (Emphasis added). A POSA would know that the slope between adjacent pixels is the difference between the adjacent pixel values divided by the pixel spacing. In thus describing another way of determining the slope between adjacent pixels, the previous disclosure must also have referred to the difference between adjacent pixels, reinforcing a POSA's understanding that it is adjacent pixels which are subtracted.

102. Both Belfor in view of Thyagarajan and Golin disclose methods of determining when to subdivide a block based on some measure of pixel variation to achieve a balance between the amount of data reduction and image quality. Thyagarajan suggests itself using pixel variation as a test for block subdivision. (GOOG 1007, "us[ing] the variance of a block as a metric in the decision to subdivide a block.")

103. For the reasons above, it would have been obvious to substitute the pixel variation detail determination of Belfor in view of Thyagarajan with the pixel variation edge detector of Golin because it is suggested by the references themselves and would have been a simple substitution of one known element (the pixel variation edge detector with threshold of Golin) for another (the contrast

method of Belfor in view of Thyagarajan) to obtain predictable results (block subdivision decisions based on adjacent pixel variation according to a predetermined tolerance).

104. As demonstrated below, the combination of Belfor in view of Thyagarajan in further view of Golin teaches all elements of claims 1, 6, 7, 9, 10, 12, and 13 of the '339 patent.

### 3. Belfor in view of Thyagarajan in further view of Golin under 35 U.S.C. §103 renders independent claim 1 obvious.

#### a) "A system for transmitting data transmission comprising"

105. Belfor teaches systems and methods for transmitting data under a BRI. Belfor describes "spatially adaptive subsampling as an image coding method." (GOOG 1007, 499.) Patent Owner may argue transmitting data means "transmitting data optimized not compressed" and should be given weight since this preamble language was discussed during the prosecution history as explained in Sec. IV.C. Regardless, this too is taught by Belfor.

106. Belfor's system "discard[s] a part of the pixels" to "transmit[ the image] more efficiently." (*Id.*, 492.) For example, the spatially adaptive coding scheme comprises an image encoder, transmitting over a channel, and a receiver to decode the image:

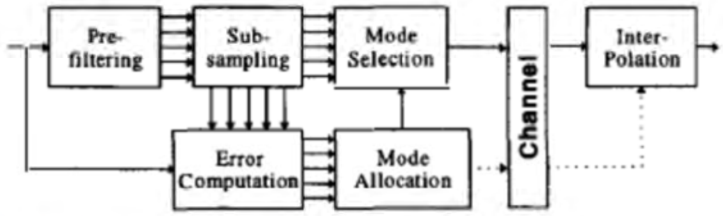



Fig. 5. General spatially adaptive coding scheme.

(*Id.*, Fig.5.)

107. Belfor's system transmits only uncompressed pixels by discarding pixels not needed for transmission and then "the remaining pixels after subsampling are transmitted or forwarded to subsequent coding or processing stages." (*Id.*, p.493.) In this way, Belfor discloses data optimization, not compression as used in the context of the '339 patent.

108. A POSA would understand Belfor teaches data optimization for data transmission without using compression, as those terms are used in the '339 patent. Compression, as used in '339 patent, is used to differentiate "data optimization." (GOOG 1001, 1:36-39.) One well-known image compression scheme is JPEG. In image compression schemes such as JPEG, each block is processed through a frequency transform such as a discrete cosine transform (DCT). Frequency transforms such as DCT produce a result that describes the frequency content of a block rather than pixel brightness directly. DCT is desirable in many applications because in most images this frequency content is concentrated in the lower

frequencies so blocks can be accurately described by transmitting only that low frequency content. The tradeoff is that frequency transforms require significant processing power to perform.

109. In certain applications, this compression may not be desirable. For example, some applications may require very low power consumption or very low latency. A POSA would recognize that in these applications a different method of image transmission may be more favorable, such as merely sampling and transmitting selected pixels from each block to describe the image within that block. As discussed in the background section, such sampling approaches are well-known in the prior art and would be known to a POSA. (See generally, GOOG 1024; GOOG 1020; GOOG 1021.) A POSA would also recognize that the type of image transmission optimization described by Belfor is an example of a sampling method, as the term is used in the '339 patent, as compared to a compression method because it does not perform a pixel transformation and transmits unchanged pixel values.

**b) "a analysis system receiving frame data and generating region data comprised of high detail and or low detail"**

110. Belfor in view of Thyagarajan in further view of Golin teaches this frame analysis system that generates region data for a division or portion of a frame having high and or low detail based on whether or not the amount of

variation between adjacent pixels exceeds a predetermined tolerance as construed under a BRI.

111. Belfor discloses "subdivid[ing the image] into square blocks. (GOOG 1007, 492.) As properly construed, frame data is an "image comprised of pixel data," and a region is a "division or portion of a frame." (Section IV.E, above.) Each square block is a division of the input image, which is comprised of pixel data. (GOOG 1007, 492, "By discarding a part of the pixels, the image can be transmitted more efficiently.") Next, each block "is represented by a specific spatial sampling lattice." (*Id.*) Some blocks are in "detailed regions" and use a "dense sampling lattice" and others are "regions with little detail" and use a "sampling lattice with only a few pixels." (*Id.*) Therefore, Belfor discloses receiving frame data (the input image) and generating region data (blocks) comprised of high detail and or low detail (some are in detailed regions and some are in regions with little detail).

112. Given that Belfor teaches dividing an image in the blocks with varying levels of details, Belfor may "generate region data comprised of high detail and or low detail" as claimed. However, Patent Owner may allege that Belfor's region data is not composed of regions of high and low detail where the amount of variation between pixels, including for example between adjacent pixels, does not

exceed a threshold under BRI. Thyagarajan, however, teaches a roughness test for block subdivision where pixels are compared to determine whether the difference exceeds a threshold. (GOOG 1008, 5:54-7:3.)

113. The regions, or blocks, as disclosed by Thyagarajan can even have differing dimensions and sizes. (*Id.*, 4:66-5:3, "although block sizes are discussed herein as being NxN in size, it is envisioned that various block sizes may be used. For example, a NxM block size may be utilized where both N and M are integers with M being either greater than or less than N.") For example, an image may be divided into blocks having many different dimensions:

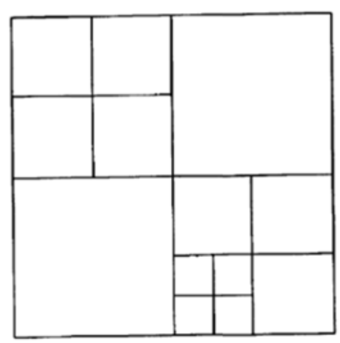


FIG. 3A

(*Id.*, Fig. 3A.)

114. Thyagarajan teaches "us[ing] the variance of a block as a metric in the decision to subdivide a block." (*Id.*, 5:56-57.) Thyagarajan teaches the variance of

a block is the square of the mean pixel value subtracted from a sum of the pixel values squared:

$$\text{var} = \frac{1}{N^2}\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}x_{i,j}^2 - \left(\frac{1}{N^2}\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}x_{i,j}\right)^2$$

(*Id.*, 5:60-65.)

115. Thus, the variance of a block is based on all pixels in the block. If the variance is greater than a threshold, the block is subdivided, and if the variance is less than the threshold the block is not subdivided. (*Id.*, 6:5-12.) Advantages of using this "block size assignment based on pixel variance" include it is perceptually based, can achieve outstanding quality in reconstructed images, and allows greater flexibility in controlling bit rate and quality. (*Id.*, 9:7-37.)

116. The block subdivision of Thyagarajan is a simple substitution for the block size determination of Belfor. Specifically, rather than selecting a single block size for the entire image, as disclosed in Belfor, a POSA would substitute Thyagarajan's quad-tree blocking method for use with Belfor's block encoding. A POSA would recognize that the DCT technique of Thyagarajan is merely another block encoding method, similar to the block encoding method of Belfor. (GOOG 1008, 3:53-60.) Furthermore, the block definition of Thyagarajan would be compatible with a variety of block encoders, including the block encoding method

of Belfor. In addition, a POSA would understand Belfor's disclosure to be compatible with a range of block sizes because Belfor discusses setting a size of block as a system parameter. (GOOG 1007, 495.) That would inform a POSA that while Belfor uses a 16x16 size block in the disclosure, other size blocks would also be compatible with the lattice subsampling method disclosed. Belfor contemplates the issue of more flexible region definition: "The ideal case would be to segment the image into regions that require the same spatial sampling frequency and sample each region according to this frequency." (*Id.*) However, the Belfor disclosure indicates that this method would requires a "large amount of side information," so square blocks are used instead. (*Id.*) However, a POSA when considering Thyagarajan's disclosure, would recognize that the quad-tree method disclosed by Thyagarajan is a compromise between amorphous regions and uniform blocks. Quad-tree decomposition allows for some flexibility beyond uniform block sizes but is also transmitted in an efficient manner, thereby avoiding the "large amount of side information" that Belfor indicates is undesirable.

117. Patent Owner may allege that block subdivision of Belfor in view of Thyagarajan is based on a derived mean value not a direct comparison of an amount of variation between pixels like the difference between adjacent pixels example of the '339 patent (GOOG 1001, 3:53-56.) However, directly comparing adjacent pixels to make a block subdivision decision was also known in the art.

118. Golin describes "quad-tree decomposition" where blocks are subdivided into smaller blocks. (GOOG 1006, 13:41.) Golin describes "a number of strategies [] for deciding when a sub-region should be split … ." (*Id.*, 13:26-27.) One strategy is the "roughness test" which detects edges within a block. (*Id.*, 13:47-64.) This test "subtract[s] the region pixels by row and by column … to detect the horizontal and vertical edges … ." (*Id.*, 20:51-55.) This is an example of a comparison of adjacent pixels because subtracting "by row" and "by column" indicates subtracting subsequent rows and columns, one after another. A POSA would understand that this means the rows and columns being subtracted are adjacent. Because these are rows and columns of pixels, this is an example of directly comparing adjacent pixels. When edges are found by comparing adjacent pixels, the block is subdivided into smaller blocks. (GOOG 1006, 13:61-63.)

119. Both Belfor in view of Thyagarajan and Golin disclose methods of determining when to subdivide a block based on some measure of pixel variation to achieve a balance between the amount of data reduction and image quality. Belfor in view of Thyagarajan uses a contrast method, and Golin uses an edge detecting adjacent pixel test.

120. Both approaches input an image region to be analyzed and output a binary decision of whether to subdivide or not. Golin's approach is designed to

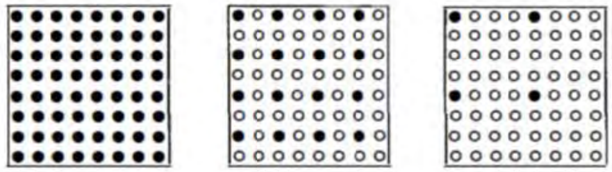
detect edges, while Belfor in view of Thyagarajan's approach is designed to minimize contrast differences between blocks. Both have relative strengths and weaknesses. Golin's approach detects "large changes in gray level between adjacent pixels" as a measure of "roughness." (GOOG 1006, 19:33-38.) This would ensure that abrupt changes are close to block boundaries. Golin also recognizes that "[a]lternative definitions of roughness are also possible." (*Id.*, 20:64.) For example, Golin suggests a "multipoint interpolation technique[ where i]f the slope is larger than a threshold and is not constant over the region, then the surface is rough." (*Id.*, 20:65-68.) Belfor in view of Thyagarajan's approach is to measure the variance of a block so that "areas with larger variances will be subdivided into smaller blocks, whereas areas with smaller variances will not be subdivided." (GOOG 1008, 3:1-3.) Because Golin's approach is narrowly tailored to edge detection, there may be blocks where Belfor in view of Thyagarajan's variance test fails while the edge test of Golin passes. For example, a block with a steep gradient where the edge threshold of Golin is never reached might still have a large enough variance to fail the variance test of Belfor in view of Thyagarajan. A POSA would be able to understand these differences and select the block detail test best suited to a particular application.

121. Therefore, it would have been obvious to substitute the pixel variation detail determination of Belfor in view of Thyagarajan with the pixel variation edge

detector of Golin because it is suggested by the references themselves and would have been a simple substitution of one known element (the pixel variation edge detector with threshold of Golin) for another (the contrast method of Belfor in view of Thyagarajan) to obtain predictable results (block subdivision decisions based on adjacent pixel variation according to a predetermined tolerance).

**c) "a pixel selection system receiving the region data and generating one set of pixel data for each region forming a new set of data for transmission;"**

122. Belfor also teaches this pixel selection system as construed under a BRI. Belfor teaches "subdivid[ing] the image into square blocks" where the blocks are a type of "region." (GOOG 1007, 495.) These blocks are then sampled "with a sampling lattice optimally suited for that particular block." (*Id.*) This sampling "can be defined as representing an image sequence on a new sampling lattice with a lower sampling density than the original lattice." (*Id.*, 492.) The "sampling lattice" is "implemented by simply discarding those pixels not present in the new lattice." (*Id.*, 493.) The "remaining pixels after subsampling are transmitted… ." (*Id.*) For example, the solid dots are the pixels that are transmitted in three different sampling lattices:

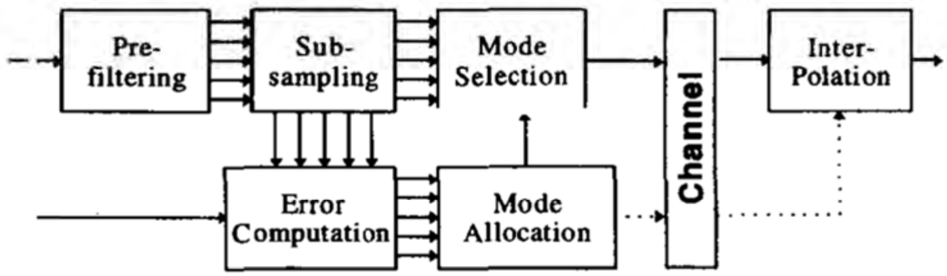



(*Id.*, Fig. 4.)

123. This subsampling is repeated for "each block," i.e., region, using a "specific spatial sampling lattice." (*Id.*, 492.) "By discarding a part of the pixels, the image can be transmitted more efficiently." (GOOG 1007, 492.) Then, "this information is transmitted to the receiver together with the pixels remaining after subsampling all blocks." (*Id.*, 495.) Therefore, Belfor discloses receiving the region data (because the sampling system operates on each block) and generating one set of pixel data (i.e., the solid dots in Fig. 4) for each region forming a new set of data for transmission (i.e., the solid dots in Fig. 4).

**d) "a data receiving system receiving the region data and the pixel data for each region and generating a display;"**

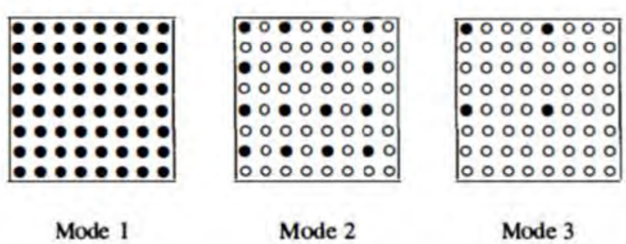
124. Belfor also teaches this data receiving system as construed under a BRI. Belfor discloses a receiving system where "the image sequence [is] reconstructed to the original sampling lattice." (*Id.*, 493.) For example, the reconstruction is everything in Fig. 5 to the right of the transmission "channel:"




(*Id.*, Fig. 5.)

125. The reconstruction is "done with an interpolation filter." (*Id.*) To interpolate the non-transmitted pixels, the receiver must know the block size and which pixels were transmitted. A POSA would understand that interpolation requires spatial information, so a receiver would necessarily need to know the location of the received pixels. (See,

126. To transmit this information, the "subsampling mode," or lattice, is "transmitted to the receiver together with the pixels remaining after subsampling all blocks." (GOOG 1007, 495.) The "subsampling mode" includes a definition of block size, e.g., the blocks illustrated in Fig. 4 are 8x8 blocks:




(GOOG 1007, Fig. 4.)

127. Therefore, Belfor discloses a data receiving system (everything to the right of the channel in Fig. 5) receiving the region data (block size and sampling lattice or mode) and the pixel data for each region (pixels remaining after subsampling all blocks) and generating a display (the image that is reconstructed).

**e) "wherein the data receiving system comprises a pixel data system receiving matrix definition data and pixel data and generating pixel location data;"**

128. The data receiving system in Belfor also includes this pixel data system receiving matrix definition data and pixel data and generating pixel location data as construed under a BRI. As discussed above, Belfor transmits block size information to the receiver. (GOOG 1007, 495.) Under the proper construction, "matrix definition data" is "data defining uniform matrix dimensions or non-uniform matrix dimensions and sequences" where matrices are "regions with square or rectangular dimensions." (Section IV.E, above.) So when Belfor discloses transmitting block size and sampling lattice/mode information, that information constitutes matrix definition data because Belfor's blocks are square.

129. Also as discussed above, Belfor discloses transmitting pixel data to the receiver. (*Id.*, 495.) The received pixels are reconstructed in the same location that they were in the original image, such as the solid dots in Fig. 4. (*Id.*, Fig. 4.) Therefore, Belfor discloses a receiver receiving matrix definition data (the block size and sampling lattice/mode) and pixel data (the transmitted pixels) and

generating pixel location data (the received pixels are placed according to the sampling lattice).

**f) "wherein the data receiving system comprises a display generation system receiving pixel location data and generating display data that includes the pixel data placed according to the location data."**

130. The data receiving system in Belfor also includes this display generation system under a BRI. At the receiver disclosed by Belfor, "the image sequence has to be reconstructed to the original sampling lattice." (GOOG 1007, 493.) This reconstruction process is "done with an interpolation filter." (*Id.*) A POSA would recognize that to interpolate an image, the received pixels would need to be placed in the same location in the reconstructed image as in the original input image. The "pixel location data" is the location of pixels within the block, such as the solid dots in Fig. 4. (GOOG 1007, Fig. 4.) Therefore, the receiver disclosed by Belfor comprises a display generation system (the mechanism by which the reconstructed image is displayed) receiving pixel location data (pixels placed within a block according to the subsampling mode) and generating display data (the reconstructed image) that includes the pixel data placed according to the location data (the pixels placed according to the subsampling lattice).

131. Belfor in view of Thyagarajan in further view of Golin under 35 U.S.C. §103 renders dependent 13 obvious.

132. Claim 13 recites "[t]he system of claim 1 wherein the frame analysis system comprises a pixel variation system receiving two or more sets of pixel data and generating the region data based on pixel variation data from the two or more sets of pixel data."

133. As described above in claim 1, Belfor in view of Thyagarajan in further view of Golin teaches subdividing a frame into regions (generating region data) based on pixel variation. (Section V.A.3.c, above.) The region subdividing system taught by Belfor in view of Thyagarajan in further view of Golin generates region data by dividing blocks into smaller blocks (*See, e.g.*, GOOG 1008, Fig. 3A.) The decision to subdivide or not is based on pixel variation data (GOOG 1006, 13:51-63.) Therefore, Belfor in view of Thyagarajan in further view of Golin teaches receiving two or more sets of pixel data (the pixel values in the frame) and generating the region data (blocks and sub-blocks, as taught by Thyagarajan) based on pixel variation data (the edge detector based on the difference between adjacent pixels taught by Golin) from the two or more sets of pixel data (using the pixel values from the frame). (*See* Section V.A.3.c, above.)

### 4. Belfor in view of Thyagarajan in further view of Golin under 35 U.S.C. §103 renders dependent claim 13 obvious.

134. Claim 13 recites "[t]he system of claim 1 wherein the frame analysis system comprises a pixel variation system receiving two or more sets of pixel data

and generating the region data based on pixel variation data from the two or more sets of pixel data."

135. As described above with respect to claim 1, Belfor in view of Thyagarajan in further view of Golin teaches generating region data comprised of high detail and or low detail. (See Sec. VII.A.3.b, above.) Belfor in view of Thyagarajan in further view of Golin also teaches a pixel variation system receiving two or more sets of pixel data and generating the region data based on pixel variation data from the two or more sets of pixel data.

136. The region subdividing system taught by Belfor in view of Thyagarajan in further view of Golin generates region data by dividing blocks into smaller blocks (See, e.g., GOOG 1008, Fig. 3A.) In the combination of Belfor in view of Thyagarajan in further view of Golin, the block subdivision, or region generation, is determined based on Golin's edge detection strategy that evaluates adjacent pixels. (GOOG 1006, 19:34-38; See also Sec. VII.A.3.b, above.) The adjacent pixels, or in the case of Golin's edge detector, adjacent rows and columns of pixels, are two or more sets of pixel data that the pixel variation data is based on. This adjacent pixel comparison is an assessment of "pixel variation data" as properly construed in the context of the '339 patent. (See Sec. VI.C.4, above.)

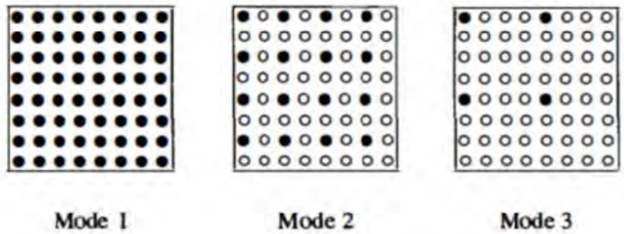
137. Therefore, Belfor in view of Thyagarajan in further view of Golin teaches a pixel variation system receiving two or more sets of pixel data (the pixel values in the frame, specifically rows and columns of pixel data) and generating the region data (blocks and sub-blocks) based on pixel variation data (the edge detector based on the difference between adjacent pixels taught by Golin) from the two or more sets of pixel data. (See Sec. VII.A.3.b, above.)

#### 5. Belfor in view of Thyagarajan in further view of Golin under 35 U.S.C. §103 renders dependent claim 6 obvious.

138. Claim 6 recites "[t]he system of claim 1 wherein the pixel selection system comprises a pixel identification system generating pixel location data based on a location of the set of pixel data associated with each of the regions."

139. As discussed above, Belfor in view of Thyagarajan in further view of Golin teaches "a pixel selection system receiving the region data and generating one set of pixel data for each region forming a new set of data for transmission." (Section V.A.3.c, above.) As described by the '339 patent, "[p]ixel location data" can be a "predetermined location [that] can be the same for each matrix or other region, such as by assigning a quadrant or other location (e.g., the first row and column position in the matrix)." (GOOG 1001, 4:23-26.) In the combination of Belfor in view of Thyagarajan in further view of Golin, the pixel location data comprises values selected for transmission, such as the solid dots in Fig. 4 of

Belfor. (GOOG 1007, Fig. 4.) These selected pixels are arranged according to a predetermined location that can be the same for each matrix, such as by assigning a location or mode:




(GOOG 1007, Fig. 4.)

140. For example, in Mode 3 with its sampling lattice, as PSOA would recognize the location expressed as pixel coordinates within the block is (1,1;1,5;5,1;5,5).

141. Therefore, Belfor in view of Thyagarajan in further view of Golin also teaches claim 6 because the "pixel location data" is merely the coordinates of the selected pixels, and the discussion above with respect to claim 1 addresses generating these values.

#### 6. Belfor in view of Thyagarajan in further view of Golin under 35 U.S.C. §103 renders independent claim 7 obvious.

##### a) "A method for transmitting data comprising:"

142. Belfor in view of Thyagarajan in further view of Golin teaches this method for transmitting data (even if the preamble means transmitting data

optimized not compressed as Patent Owner may argue), for the same reasons described above for claim 1(a). (*See* Section V.A.3.a, above.)

**b) "receiving frame data; generating optimized matrix data from the frame data"**

143. As discussed above with respect to claim 1, Belfor in view of Thyagarajan in further view of Golin teaches "a analysis system receiving frame data and generating region data comprised of high detail and or low detail." (Section V.A.3.b, above.) This element of claim 7 is essentially a re-wording of those claim elements from claim 1 as it replaces region and region data comprised of high detail and or low detail based on adjacent pixel variation with matrix and matrix data based on pixel variation data. All of these limitations in claim 7(b) here were taught by Belfor in view of Thyagarajan in further view of Golin as described above for claim 1(b). (Section V.A.3.b, above.)

144. Belfor in view of Thyagarajan in further view of Golin further teaches generating optimized matrix data from the frame data under a BRI. "Optimized matrix data" is properly construed as "matrix data generated based on pixel variation data." (Section IV.E.7, above.)

145. Belfor discloses "subdivid[ing the image] into square blocks. (GOOG 1007, 492.) As properly construed, frame data is an "image comprised of pixel data," and a region is a "division or portion of a frame." (Section IV.E, above.)

Each square block is a division of the input image, which is comprised of pixel data. (GOOG 1007, 492, "By discarding a part of the pixels, the image can be transmitted more efficiently.") Next, each block "is represented by a specific spatial sampling lattice." (*Id.*) Some blocks are in "detailed regions" and use a "dense sampling lattice" and others are "regions with little detail" and use a "sampling lattice with only a few pixels." (*Id.*) Therefore, Belfor discloses receiving frame data (the input image) and generating matrix data (square blocks) generated based on pixel variation data (detailed regions get dense sampling lattices, and less detailed regions use less dense sampling lattices).

146. Given that Belfor teaches dividing an image in the blocks with varying levels of details, Belfor may "generat[e] optimized matrix data from [received] frame data" as claimed. However, Patent Owner may allege that Belfor's region data is not based on pixel variation data where the amount of variation between pixels, including for example between adjacent pixels, does not exceed a threshold under BRI. Thyagarajan, however, teaches a roughness test for block subdivision where pixels are compared to determine whether the difference exceeds a threshold. (GOOG 1008, 5:54-7:3.)

147. The regions, or blocks, as disclosed by Thyagarajan can even have differing dimensions and sizes. (*Id.*, 4:66-5:3, "although block sizes are discussed

herein as being NxN in size, it is envisioned that various block sizes may be used. For example, a NxM block size may be utilized where both N and M are integers with M being either greater than or less than N.") For example, an image may be divided into blocks having many different dimensions:

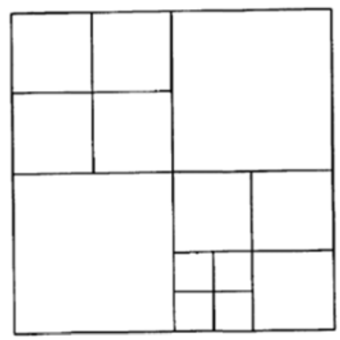


FIG. 3A

(*Id.*, Fig. 3A.)

148. Thyagarajan teaches "us[ing] the variance of a block as a metric in the decision to subdivide a block." (*Id.*, 5:56-57.) Thyagarajan teaches the variance of a block is the square of the mean pixel value subtracted from a sum of the pixel values squared. (*Id.*, 5:60-65.)

149. Thus, the variance of a block is based on all pixels in the block. If the variance is greater than a threshold, the block is subdivided, and if the variance is less than the threshold the block is not subdivided. (*Id.*, 6:5-12.) Advantages of using this "block size assignment based on pixel variance" include it is

perceptually based, can achieve outstanding quality in reconstructed images, and allows greater flexibility in controlling bit rate and quality. (*Id.*, 9:7-37.)

150. The block subdivision of Thyagarajan is a simple substitution for the block size determination of Belfor and is suggested by the references themselves.

151. Belfor discloses a block transmission scheme that is capable of transmitting a range of block sizes, as evidenced by Belfor's disclosure of selecting the right block size. (GOOG 1007, 495, "The size of the blocks is an important system parameter.") Belfor even recognizes the challenge in selecting a single block size because "[i]f large blocks are chosen, … the ability to adapt to the local spatial frequency contents would be lost" and using small blocks "cause[s] a large overhead …" (*Id.*) Thus, a POSA implementing Belfor's image transmission would be motivated by Belfor's suggestion to find a better block subdividing method that combines the advantages of using both large blocks and small blocks. Thyagarajan teaches a method of block subdivision that balances the advantages and disadvantages of both small blocks and large blocks by producing variable block sizes according to pixel variance. Substituting the blocking method of Thyagarajan for the blocking method of Belfor would be a simple substitution of one known element (the blocking method of Thyagarajan) for another (the blocking method of

Belfor) to obtain predictable results (block subdivision decisions based on pixel variation according to a predetermined tolerance).

152. Patent Owner may allege that the block subdivision of Belfor in view of Thyagarajan is based on a derived mean value not a direct comparison of an amount of variation between pixels like the difference between adjacent pixels example of the '339 patent (GOOG 1001, 3:53-56.) However, directly comparing adjacent pixels to make a block subdivision decision was also known in the art.

153. Golin describes "quad-tree decomposition" where blocks are subdivided into smaller blocks. (GOOG 1006, 13:41.) Golin describes "a number of strategies [] for deciding when a sub-region should be split … ." (*Id.*, 13:26-27.) One strategy is the "roughness test" which detects edges within a block. (*Id.*, 13:47-64.) This test "subtract[s] the region pixels by row and by column … to detect the horizontal and vertical edges … ." (*Id.*, 13:51-55.) This is an example of a comparison of adjacent pixels. When edges are found by comparing adjacent pixels, the block is subdivided into smaller blocks. (*Id.*, 13:61-63.)

154. Both Belfor in view of Thyagarajan and Golin disclose methods of determining when to subdivide a block based on some measure of pixel variation to achieve a balance between the amount of data reduction and image quality. Belfor in view of Thyagarajan uses a contrast method, and Golin uses an edge

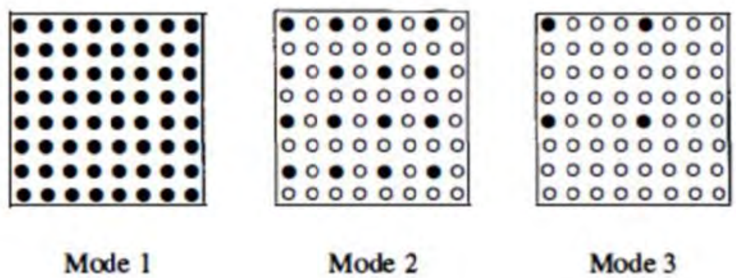
detecting adjacent pixel test. Both approaches input an image region to be analyzed and output a binary decision of whether to subdivide or not. Golin's approach is more finely tuned to detect edges, while Belfor in view of Thyagarajan's approach is designed to minimize contrast differences between blocks. Both have relative strengths and weaknesses.

155. Therefore, it would have been obvious under *KSR* to substitute the pixel variation detail determination of Belfor in view of Thyagarajan with the pixel variation edge detector of Golin because it is suggested by the references themselves and would have been a simple substitution of one known element (the pixel variation edge detector with threshold of Golin) for another (the contrast method of Belfor in view of Thyagarajan) to obtain predictable results (block subdivision decisions based on adjacent pixel variation according to a predetermined tolerance).

#### c) "selecting one of two or more sets of pixel data based on the optimized matrix data"

156. Belfor in view of Thyagarajan in further view of Golin also teaches this selecting as construed under a BRI. Belfor in view of Thyagarajan in further view of Golin teaches "a pixel selection system receiving the region data and generating one set of pixel data for each region forming a new set of data for transmission." (*See* Section V.A.3.c, above.) As discussed above, Belfor in view of

Thyagarajan in further view of Golin also teaches "optimized matrix data" which is "matrix data generated based upon [the difference in pixel data between adjacent pixels.]" (Section IV.E, above.) Belfor in view of Thyagarajan in further view of Golin further teaches selecting one of two or more sets of pixel data from this optimized matrix data. For example, Belfor discloses selecting from two or more subsampling modes the each define a different set of pixel data for transmission:




(GOOG 1007, FIG. 4.)

157. While Belfor does not disclose the optimized matrix data, as discussed above the combination of Belfor in view of Thyagarajan in further view of Golin does teach optimized matrix data. (SectionV.A.7.b, above.) The selecting of pixels for transmission disclosed by Belfor operates on blocks, and in the combination of Belfor, Thyagarajan, and Golin those blocks would be optimized matrix data. Therefore, Belfor in view of Thyagarajan in further view of Golin teaches selecting one of two or more sets (the various modes disclosed by Belfor) of pixel data based

on the optimized matrix data (the variable blocks produced by the block subdivision of Thyagarajan using Golin's edge detector).

#### d) "wherein receiving frame data comprises receiving an array of pixel data"

158. As discussed above, the proper construction of "frame data" is "image comprised of pixel data." (Section IV.E.1.) A POSA would also know that still images in digital systems such as described by Belfor comprise pixel data in a two dimensional array. (*See e.g.*, GOOG 1028, 55, "Consider the case of monochrome image encoding. The input is usually a 2-D array of gray level values…") Therefore, receiving "frame data" always comprises "receiving an array of pixel data."

159. Furthermore, this limitation is taught by Belfor in view of Thyagarajan in further view of Golin as applied to claim 1. (*See* Section V.A.3.b, above.) Belfor discloses "subdivid[ing the image] into square blocks. (GOOG 1007, 492.) As properly construed, frame data is an "image comprised of pixel data," and a region is a "division or portion of a frame." (Section IV.E, above.) Each square block is a division of the input image, which is comprised of pixel data. (GOOG 1007, 492, "By discarding a part of the pixels, the image can be transmitted more efficiently.") Therefore, Belfor in view of Thyagarajan in further view of Golin teaches receiving an array of pixel data (the input image).

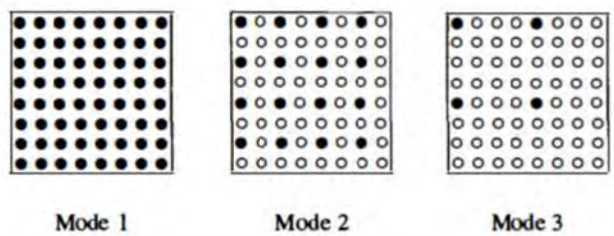
**e) "wherein generating the optimized matrix data from the frame data comprises setting a matrix size based on pixel selection data"**

160. Belfor in view of Thyagarajan in further view of Golin teaches setting a matrix size based on pixel data as claimed. As discussed above, Belfor in view of Thyagarajan in further view of Golin teaches generating optimized matrix data from the frame data. Belfor teaches setting a block size. The process taught by Thyagarajan is recursive, that is, it evaluates a block based on "perceptual characteristics," then makes the decision to subdivide based on that evaluation. (GOOG 1007, 5:29-53.) The recursive process of subdividing blocks based on contrast to different block sizes defines the "optimized matrix data." Thus, the optimized matrix data is, in part, block size information based on the content of each block, i.e., the "pixel selection data" for each block. Therefore, Belfor in view of Thyagarajan in further view of Golin teaches setting a matrix size (block size) based on pixel selection data (based in part on the pixel values within the block).

**f) "and transmitting the selection pixel data and the optimized matrix data by assembling the optimized matrix data and the selection pixel data into a generated display frame."**

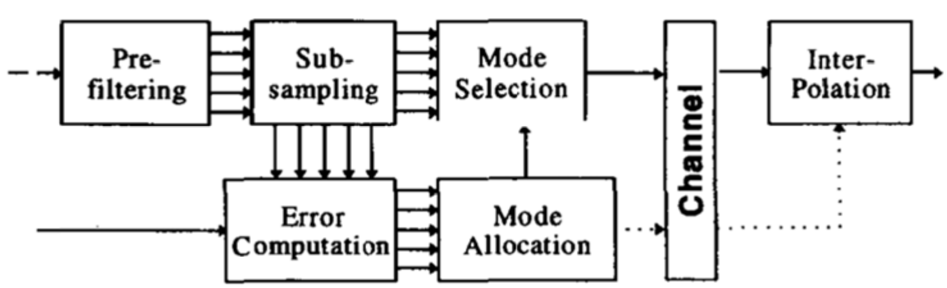
161. Belfor in view of Thyagarajan in further view of Golin teaches this transmitting step. Belfor in view of Thyagarajan in further view of Golin teaches transmitting the selected pixel values (selection pixel data) and locations as well as size information that defines block sizes (optimized matrix data) under a BRI. As

discussed above, Belfor's system "discard[s] a part of the pixels" to "transmit[ the image] more efficiently." (GOOG 1007, 492.) The "remaining pixels after subsampling are transmitted… ." (*Id.*) For example, the solid dots are the pixels that are transmitted in three different sampling lattices:



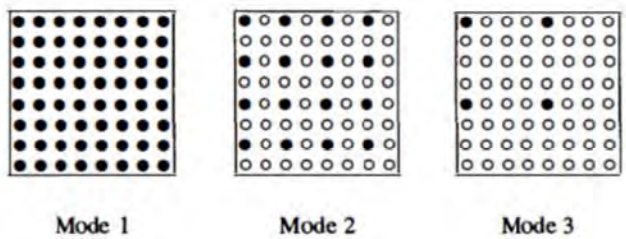

(*Id.*, Fig. 4.)

162. In the combination of Belfor in view of Thyagarajan in further view of Golin, the optimized matrix data is transmitted in the form of "quad-tree data." (GOOG 1008, 5:41-53.) Belfor further discloses a receiving system where "the image sequence [is] reconstructed to the original sampling lattice." (*Id.*, p.493.) For example, the reconstruction is everything in Fig. 5 to the right of the transmission "channel:"



(*Id.*, Fig. 5.)

163. The reconstruction is "done with an interpolation filter." (*Id.*) To interpolate the non-transmitted pixels, the receiver must know the block size and which pixels were transmitted. To transmit this information, the "subsampling mode," or lattice, is "transmitted to the receiver together with the pixels remaining after subsampling all blocks." (GOOG 1007, 495.) The "subsampling mode" includes a definition of block size, e.g., the blocks illustrated in Fig. 4 are 8x8 blocks:




(GOOG 1007, Fig. 4.)

164. Therefore, the combination of Belfor in view of Thyagarajan in further view of Golin teaches transmitting the selection pixel data (the subsampled pixels as illustrated in Belfor's FIG. 4) and the optimized matrix data (the quad-tree data blocks generated by Thyagarajan) by assembling the optimized matrix data and the selection pixel data into a generated display frame (generating the image at the receiver).

### 7. Belfor in view of Thyagarajan in further view of Golin under 35 U.S.C. §103 renders dependent claim 9 obvious.

165. Claim 9 recites "[t]he method of claim 7 wherein transmitting the pixel data and the matrix data comprises transmitting an array of pixel data and uniform matrix size data."

166. As discussed above, Belfor in view of Thyagarajan in further view of Golin teaches "transmitting the selection pixel data and the optimized matrix data." (Section V.A.7.f, above.) Belfor discloses a uniform matrix size: "we subdivide the image into square blocks … ." (GOOG 1007, 495.) Belfor also discloses selecting a subset of pixels from those blocks for transmission (*Id.*, Fig. 4.) Therefore, Belfor in view of Thyagarajan in further view of Golin teaches transmitting an array of pixel data (the solid dots in Fig. 4) and uniform matrix size data (the dimensions of the blocks, i.e. 8x8).

### 8. Belfor in view of Thyagarajan in further view of Golin under 35 U.S.C. §103 renders independent claim 10 obvious.

167. Method claim 10 has some variations in the wording of its step limitations compared to claim 7 but these variations are still rendered obvious by Belfor in view of Thyagarajan in further view of Golin. Method claim 10 also recites dividing the array into "two or more matrices having a uniform size" and

"two or more matrices having two or more different sizes." (GOOG 1001, Claim 10.) This dividing is also taught and rendered obvious.

168. Belfor in view of Thyagarajan in further view of Golin teaches both multiple uniform and different size blocks:

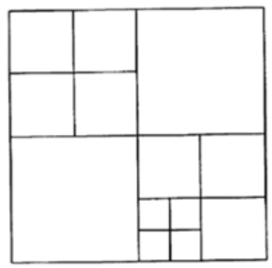


FIG. 3A

(GOOG 1008, Fig. 3A.)

169. The lower-left and upper-right blocks have a "uniform size" and the upper-left and lower-right blocks are sub-divided into blocks "having two or more different sizes." (*Id.*) (GOOG 1005, FIG. 6.) Accordingly, like claim 7 and for the reasons here, claim 10 is unpatentable for having been made obvious by Belfor in view of Thyagarajan in further view of Golin.

**a) "A method for transmitting data comprising:"**

170. Belfor teaches a method for transmitting data (even if the preamble means transmitting data optimized not compressed as Patent Owner may argue),

for the same reasons described above for claims 1(a) and 7(a). (*See* Sections V.A.3.a, 7.a.)

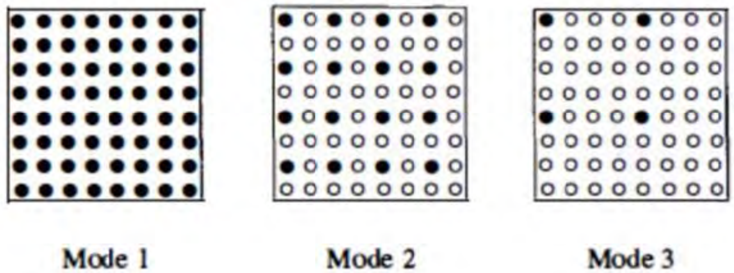
**b) "dividing an array of pixel data into two or more regions;"**

171. Belfor discloses "subdivid[ing the image] into square blocks. (GOOG 1007, 492.) Each square block is a division of the input image, which is comprised of pixel data. (GOOG 1007, 492, "By discarding a part of the pixels, the image can be transmitted more efficiently.") In this way, Belfor discloses dividing an array of pixel data (the input image) into two or more regions (blocks).

172. Belfor further teaches dividing an array of pixel data into two or more regions under a BRI. (*See* Sections V.A.3, 7, above.)

**c) "selecting a set of pixel data from each region"**

173. Belfor further teaches selecting a set of pixel data from each region. For example, Belfor discloses selecting from a number of subsampling modes the each define a different set of pixel data for each block:

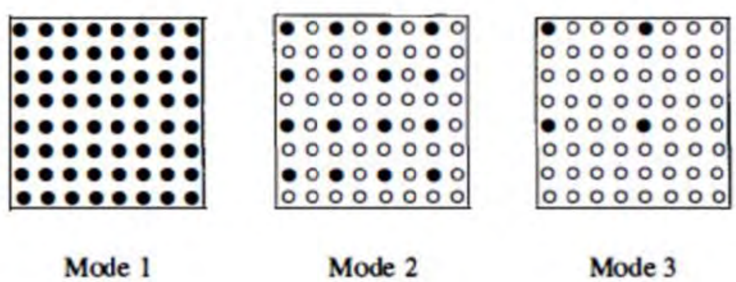


(GOOG 1007, FIG. 4.)

174. Therefore, Belfor teaches selecting one of two or more sets (the various modes disclosed by Belfor) of pixel data (*See also* Sections V.A.3, 7, above.).

**d) "wherein dividing the array of pixel data comprises dividing the array of pixel data into two or more matrices having a uniform size;"**

175. Belfor teaches such dividing. Belfor discloses matrices which are square or rectangular and have a uniform size. For example, Belfor teaches dividing the image into square blocks:




(GOOG 1007, FIG. 4.)

176. As can be seen in Fig. 4 of Belfor, the dividing includes dividing an array of pixel data into two or more matrices of uniform size, namely 8x8 pixels large. (GOOG 1007, FIG. 4.) Therefore, Belfor teaches dividing the array of pixel

data (images) into two or more matrices having a uniform size (the blocks with a uniform size).

**e) "wherein dividing the array of pixel data comprises dividing the array of pixel data into two or more matrices having two or more different sizes;"**

177. Belfor in view of Thyagarajan in further view of Golin teach this further dividing where matrices have different sizes. Belfor teaches only uniform size matrices. (See Section V.A.9.d, above.) However, Belfor recognizes that "[t]he size of the blocks is an important system parameter." (GOOG 1007, 495.) Belfor recognizes a fundamental tradeoff between block size, side information, and quality: "If large blocks are chosen, the amount of side information is low, but the ability to adapt to the local spatial frequency contents would be lost. Small blocks cause a large overhead but warrant a better adaptation." (Id.) A POSA would know that this balance between block size and image quality has been addressed in the prior art.

178. Patent Owner may argue Belfor does not teach matrices having two or more different sizes. Thyagarajan though teaches "assigning smaller block sizes (and thereby more bits) to the busy areas and larger block sizes to the relatively blank areas" to "reduce the blocking effect." (GOOG 1008, 4:32-37.) The regions, or blocks, as disclosed by Thyagarajan can have differing dimensions and sizes. (*Id.*, 4:66-5:3, "although block sizes are discussed herein as being NxN in size, it is

envisioned that various block sizes may be used. For example, a NxM block size may be utilized where both N and M are integers with M being either greater than or less than N.") An image may be divided into blocks having many different dimensions:

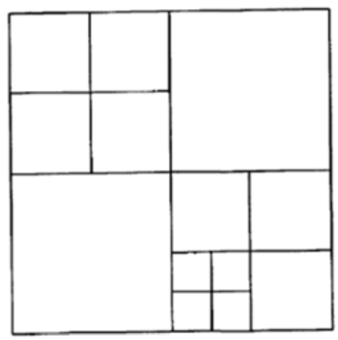


FIG. 3A

(*Id.*, Fig. 3A.)

179. For example, the lower-right quadrant of FIG. 3A contains blocks of three different sizes. The block subdivision of Thyagarajan is a simple substitution for the block size determination of Belfor.

180. Belfor discloses a block transmission scheme that is capable of transmitting a range of block sizes, as evidenced by Belfor's disclosure of selecting the right block size. (GOOG 1007, 495, "The size of the blocks is an important system parameter.") Belfor even recognizes the challenge in selecting a single block size because "[i]f large blocks are chosen, … the ability to adapt to the local

spatial frequency contents would be lost" and using small blocks "cause[s] a large overhead …" (*Id.*) Thus, a POSA implementing Belfor's image transmission would be motivated to find a better block subdividing method that combines the advantages of both large blocks and small blocks. Thyagarajan teaches a method of block subdivision that balances the advantages and disadvantages of both small blocks and large blocks by producing variable block sizes. Doing so would be a simple substitution of one known element (Thyagarajan's block size determination) for another (Belfor's uniform size blocks) to obtain predictable results (Belfor's system but with variable size blocks). A POSA would also have a reasonable expectation the combination would work because Belfor's block encoding scheme is compatible with a range of block sizes.

181. Patent Owner may allege that these dividing steps in claim 10 read as whole under BRI should be construed to include dividing based on pixel variation including for example a difference between adjacent pixels according to a predetermined tolerance. Patent Owner may allege that Belfor in view of Thyagarajan's block subdivision using block variance is based on a derived mean value and not a direct comparison of an amount of variation between pixels like the difference between adjacent pixels example of the '339 patent (GOOG 1001, 3:53-56.)

182. However, directly comparing adjacent pixels to make a block subdivision decision was also known in the art. For example, Golin describes "quad-tree decomposition" where blocks are subdivided into smaller blocks. (GOOG 1006, 13:41.) Golin describes "a number of strategies [] for deciding when a sub-region should be split … ." (*Id.*, 13:26-27.) One strategy is the "roughness test" which detects edges within a block. (*Id.*, 13:47-64.) This test "subtract[s] the region pixels by row and by column … to detect the horizontal and vertical edges … ." (*Id.*, 13:51-55.) This is an example of a comparison of adjacent pixels. When edges are found by comparing adjacent pixels, the block is subdivided into smaller blocks. (*Id.*, 13:61-63.)

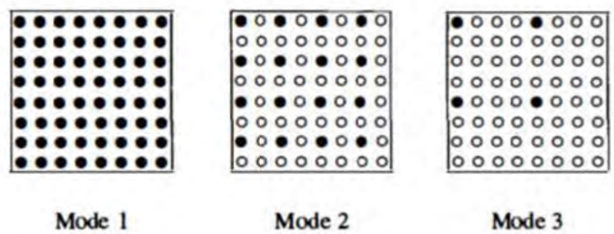
183. Both Belfor in view of Thyagarajan and Golin disclose methods of determining when to subdivide a block based on some measure of pixel variation to achieve a balance between the amount of data reduction and image quality. Belfor in view of Thyagarajan uses a contrast method, and Golin uses an edge detecting adjacent pixel test. Both approaches input an image region to be analyzed and output a binary decision of whether to subdivide or not. Golin's approach is more finely tuned to detect edges, while Belfor in view of Thyagarajan's approach is designed to minimize contrast differences between blocks. Both have relative strengths and weaknesses.

184. Therefore, it would have been obvious under *KSR* to substitute the pixel variation detail determination of Belfor in view of Thyagarajan with the pixel variation edge detector of Golin because it is suggested by the references themselves and would have been a simple substitution of one known element (the pixel variation edge detector with threshold of Golin) for another (the contrast method of Belfor in view of Thyagarajan) to obtain predictable results (block subdivision decisions based on adjacent pixel variation according to a predetermined tolerance). Although other threshold values would have been obvious to POSA according to a tradeoff between level of detail desired for a human eye viewing and block size given the teachings of Belfor in view of Thyagarajan in further view of Golin, Golin's example threshold of ten pixels even squarely meets the '339 patent's own threshold for low detail where pixels are selected every "25 pixels or less in order to create the image to be viewed by the human eye." (GOOG 1001, 3:23-26.)

**f) "and transmitting the region data and the pixel selection data for each region by assembling the region data and the selection pixel data into a display frame."**

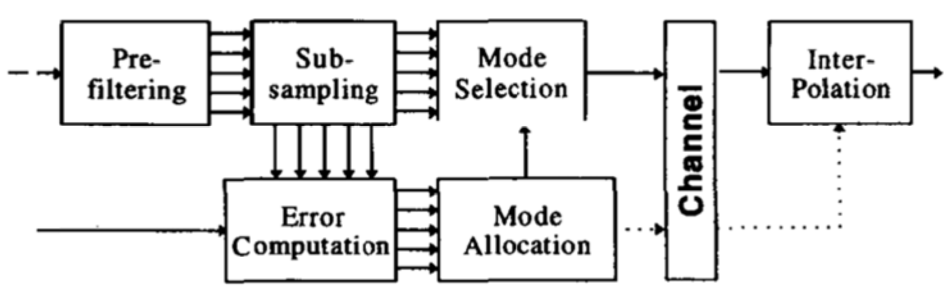
185. Belfor in view of Thyagarajan in further view of Golin teaches this transmitting step. (*See* Section V.A.7.f.) Belfor in view of Thyagarajan in further view of Golin teaches transmitting the selected pixel values (selection pixel data) and locations as well as size information that defines block sizes (optimized matrix

data) under a BRI. As discussed above, Belfor's system "discard[s] a part of the pixels" to "transmit[ the image] more efficiently." (GOOG 1007, 492.) The "remaining pixels after subsampling are transmitted… ." (*Id.*) For example, the solid dots are the pixels that are transmitted in three different sampling lattices:



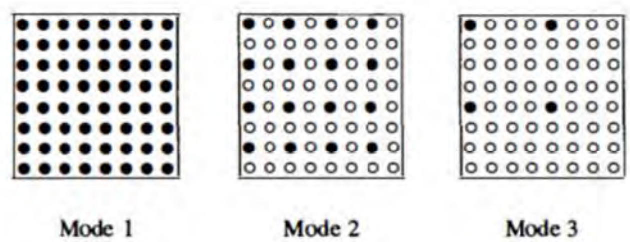

(*Id.*, Fig. 4.)

186. In the combination of Belfor in view of Thyagarajan in further view of Golin, the optimized matrix data is transmitted in the form of "quad-tree data." (GOOG 1008, 5:41-53.) Belfor further discloses a receiving system where "the image sequence [is] reconstructed to the original sampling lattice." (*Id.*, 493.) For example, the reconstruction is everything in Fig. 5 to the right of the transmission "channel:"



(*Id.*, Fig. 5.)

187. The reconstruction is "done with an interpolation filter." (*Id.*) To interpolate the non-transmitted pixels, the receiver must know the block size and which pixels were transmitted. To transmit this information, the "subsampling mode," or lattice, is "transmitted to the receiver together with the pixels remaining after subsampling all blocks." (GOOG 1007, 495.) The "subsampling mode" includes a definition of block size, e.g., the blocks illustrated in Fig. 4 are 8x8 blocks:




(GOOG 1007, Fig. 4.)

188. Therefore, the combination of Belfor in view of Thyagarajan in further view of Golin teaches transmitting the selection pixel data (the subsampled pixels as illustrated in Belfor's FIG. 4) and the optimized matrix (the quad-tree data generated by Thyagarajan) data by assembling the optimized matrix data and the selection pixel data into a generated display frame (generating the image at the receiver).

**9. Belfor in view of Thyagarajan in further view of Golin under 35 U.S.C. §103 renders dependent claim 12 obvious.**

189. Claim 12 recites "[t]he method of claim 10 wherein transmitting the region data and the pixel data for each region comprises transmitting matrix data and the pixel data for each matrix." As described above in claim 10, Belfor in view of Thyagarajan in further view of Golin teaches transmitting region data and pixel data for each region which includes transmitting matrix data and the pixel data for each matrix.

## VIII. Conclusion

190. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further 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 this 18th day of November 2015 in Hazelwood, Missouri

Respectfully submitted

John R. Grindon

John R. Grindon, D.Sc.