UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORP., DELL INC., DELL TECHNOLOGIES INC.,
Petitioner

U.S. Patent No. 7,359,437

DECLARATION OF DR. ANDREW WOLFE, UNDER 37 C.F.R. § 1.68 IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW

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I, Andrew Wolfe, do hereby declare as follows:

I. INTRODUCTION

1. I am making this declaration at the request of Intel Corporation. in the matter of the *Inter Partes* Review of U.S. Patent No. 7,359,437 ("the '437 patent") to Hwang *et al*.

2. I am being compensated for my work in this matter at my usual hourly rate for this work. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this investigation. My compensation is not contingent on the outcome of this matter or the specifics of my testimony.

3. I have been asked to provide my opinions regarding whether claims 1-6, 8, 10-17, 19-23, 26-31, 33, 37, 39-45, 47, and 49-53 ("the Challenged Claims") of the '437 patent are unpatentable as they would have been obvious to a person having ordinary skill in the art ("POSITA") at the time of the alleged invention, in light of the prior art. It is my opinion that all of the limitations of the Challenged Claims would have been obvious to a POSITA.

4. In the preparation of this declaration, I have studied:

a. the '437 patent, Ex.1001;

b. the prosecution history of the '437 patent ("'437 File History"), Ex.1002;

c. U.S. Patent No. 5,835,498 to Kim et al. ("Kim"), Ex.1005;

d. U.S. Patent No. 5,625,644 to Myers ("Myers"), Ex.1006;

e. U.S. Patent No. 5,974,464 to Shin ("Shin"), Ex.1007;

5. In forming the opinions expressed below, I have considered:

the documents listed above;

the relevant legal standards, including the standard for obviousness, and any additional authoritative documents as cited in the body of this declaration; and

my own knowledge and experience based upon my work in the field of optical communication as described below, as well as the following materials:

f. European Patent 0241014 B1 to Asai, ("Asai"), Ex.1008; and

g. U.S. Patent No. 7,356,051 to Pasqualino, ("Pasqualino"), Ex.1009.

h. U.S. Patent No. 7,143,328 to Altmann ("Altmann"), Ex.1010

i. The Authoritative Dictionary of IEEE Standards Terms" Seventh Edition, ("IEEE Dictionary"), Ex.1011.

j. Patent Owner's Complaint, Appendix E, Ex.1012.

6. Unless otherwise noted, all emphasis in any quoted material has been added.

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

7. My qualifications and professional experience are described in my *Curriculum Vitae*, a copy of which can be found in Exhibit 1004. The following is a brief summary of my relevant qualifications and professional experience.

8. In 1985, I earned a Bachelor's degree in Electrical Engineering and Computer Science from The Johns Hopkins University. In 1987, I received a Master's degree in Electrical and Computer Engineering from Carnegie Mellon University. In 1992, I received a Ph.D. in Computer Engineering from Carnegie Mellon University. My doctoral dissertation proposed a new approach for the architecture of a computer processor.

9. I have more than 35 years of experience as a computer architect, computer system designer, personal computer graphics designer, educator, and executive in the electronics industry.

10. In 1983, I began designing touch sensors, microprocessor-based computer systems, and I/O (input/output) cards for personal computers as a senior design engineer for Touch Technology, Inc. During the course of my design projects with Touch Technology, I designed I/O cards for PC-compatible computer systems, including the IBM PC-AT, to interface with interactive touch-based computer terminals that I designed for use in public information systems.

11. I have extensive experience in the design, development, and analysis of portable computing devices including portable PCs. In the mid-late 1980s I worked as part of the development team for the Linus Write-Top, which is commonly acknowledged to be the first commercial tablet computer. I later worked on screen technology for many handheld computing devices including the Motorola Envoy and prototypes for the Apple Newton. From 1986 through 1987, I designed and built a high-performance computer system as a student at Carnegie Mellon University. From 1986 throughearly 1988, I also developed the curriculum and supervised the teaching laboratory for processor design courses.

12. At the end of 1989, I (along with some partners) reacquired the rights to the technology I had developed at Touch Technology and at AMP and founded The Graphics Technology Company. Over the next seven years, as an officer and a consultant for The Graphics Technology Company, I managed the company's engineering development activities and personally developed dozens of touch screen sensors, controllers, and interactive touch-based computer systems.

13. I have also served as a technology advisor to Motorola and to several venture capital funds in the U.S. and Europe. Currently, I am a director of Turtle Beach Corporation, providing guidance in its development of premium audio peripheral devices for a variety of commercial electronic products.

14. From 1991 through 1997, I served on the Faculty of Princeton University as an Assistant Professor of Electrical Engineering. At Princeton, I taught undergraduate and graduate-level courses in Computer Architecture, Advanced Computer Architecture, Display Technology, and Microprocessor Systems, and conducted sponsored research in the areas of embedded computing systems, multimedia, video signal processors, compiler optimization, and high performance computer architecture. I was also a principal investigator for DOD research in video technology and a principal investigator for the New Jersey Center for Multimedia Research.

15. At Princeton, I received several teaching awards, both from students and from the School of Engineering. I have also taught advanced microprocessor architecture to industry professionals in seminars sponsored by the Institute of Electrical and Electronics Engineers ("IEEE") and the Association for Computing Machinery ("ACM").

16. In 1997, I was hired to run the research efforts at S3, Inc. (which later became SONIC|blue, Inc.) and served as Chief Technology Officer there from 1999 until 2002. At the time, S3 produced the 3D graphics hardware and driver software for more than half of new PCs, worldwide. I managed our display technology group. I led the development of components for laptop computers including the IBM Thinkpad and for desktop computers as well. I also worked with the teams that developed the FrontPath wireless tablet PC and the Diamond Mako handheld computer. My work at S3/Sonic included extensive work with and development of numerous serial data communications protocols, including HDMI, DVI, LVDS, USB, RS-232, 1394, 802.3, 802.11, RAMBUS, and SD cards, among others. My experience with serial data communications protocols throughout my career has also included SATA, PCI-E, and DisplayPort. This work has included the subjects of encoding, transmitting, and storing audio and video data, as well as control data, for transmission over a serial link and packet encapsulation and decapsulation, encryption, and decryption, among many other similar subjects.

17. From 1999 through 2002, while a Consulting Professor at Stanford University, I taught computer architecture and microprocessor design to both undergraduate and graduate students.

18. Since 2002, I have operated Wolfe Consulting to provide services as a consultant on processor technology, computer systems, consumer electronics, software, design tools, and intellectual property issues. My consulting work relating to intellectual property has included serving as a testifying and consulting expert for IP and other technology-related litigation matters.

19. From 2013 to the present, I have been serving as a lecturer at Santa Clara University teaching courses on Microprocessor Systems, Integrated Circuit Design, Real-Time Computing, and Mechatronics and recently served as Faculty Senate President.

20. I have published more than fifty peer-reviewed papers in computer architecture and computer systems and IC design. I also have chaired IEEE and ACM conferences in microarchitecture and integrated circuit design and served as an associate editor for IEEE and ACM journals. I served on the IEEE Computer Society Awards committee. I am an IEEE Fellow, an IEEE Computer Society Distinguished Contributor and a Member of ACM. I am a named inventor on at least fifty-seven U.S. patents and thirty-seven foreign patents, which are listed in my curriculum vitae.

21. In 2002, I was the invited keynote speaker at the ACM/IEEE International Symposium on Microarchitecture and at the International Conference on Multimedia. From 1990 through 2005, I was an invited speaker on various aspects of technology and the PC industry at numerous industry events including the Intel Developer's Forum, Microsoft Windows Hardware Engineering Conference, Microprocessor Forum, Embedded Systems Conference, Comdex, and Consumer Electronics Show, as well as at the Harvard Business School and the University of Illinois Law School. I have been interviewed on subjects related to computer graphics and video technology and the electronics industry by publications such as the Wall Street Journal, New York Times, Los Angeles Times, Time, Newsweek, Forbes, and Fortune as well as on CNN, NPR, and the BBC. I have also spoken at dozens of universities including MIT, Stanford, University of Texas, Carnegie Mellon University, UCLA, University of Michigan, Rice University, and Duke University.

III. RELEVANT LEGAL STANDARDS

22. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the ’437 patent, I am relying on certain basic legal principles that counsel have explained to me. These principles are discussed below.

23. I understand that prior art to the ’437 patent includes patents and printed publications in the relevant art that predate the priority date of the alleged invention recited in the ’437 patent. For purposes of this Declaration, I am applying September 12, 2001, as the earliest possible priority date of the ’437 patent.

24. I have been informed that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. I have also been informed by counsel that the obviousness analysis takes into account factual inquiries including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

25. I have been informed by counsel that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include the following: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device (method, or product) in the same way; (d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (f) some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

IV. FOCUSED ANALYSIS

A. Level of Ordinary Skill in the Art

26. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems.

27. A person of ordinary skill in the art ("POSITA") in the field of the

'437 patent, as of its earliest possible filing date of September 12, 2001, had a working knowledge of the digital transmission art that is pertinent to the '437 patent. That person would have a bachelor's degree in computer science, computer engineering, electrical engineering, or equivalent training, and approximately two years' experience working in the field of digital transmissions. Lack of work experience can be remedied by additional education, and vice versa.

28. For purposes of this Declaration, in general, and unless otherwise noted, my statements and opinions, such as those regarding my experience and the understanding of a POSITA generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the field as of the priority date of the '437 patent. Unless otherwise stated, when I provide my understanding and analysis below, it is consistent with the level of a POSITA prior to the priority date of the '437 patent.

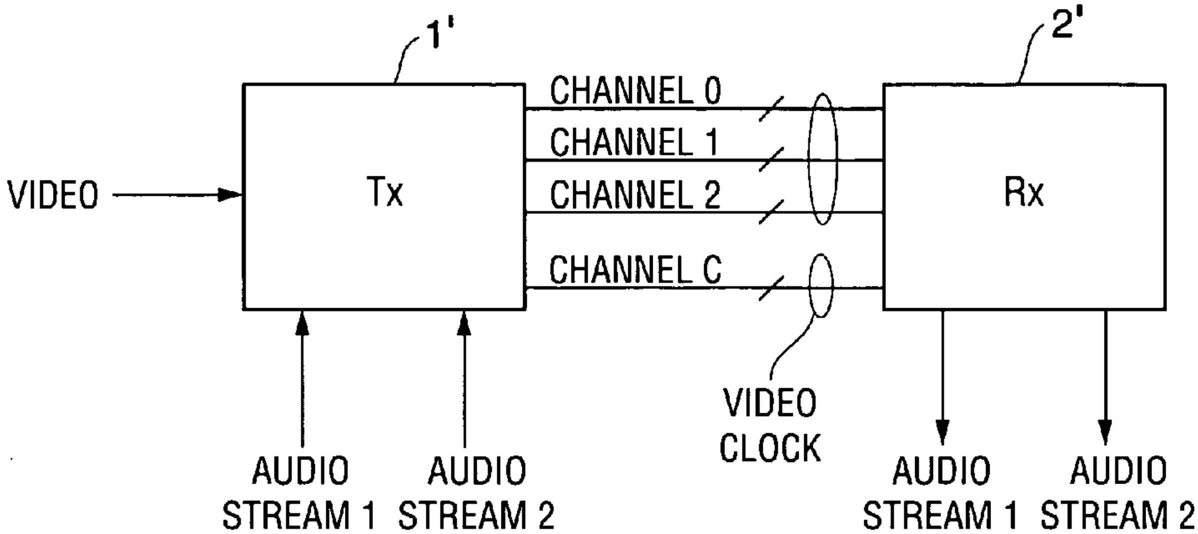
B. Technical Background

29. Before the '437 patent was filed, it was desirable to "provide for high speed communications … at very high speeds, especially in view of the large amount of data required for data communications in intensive data consuming systems using graphical or video information, multiple input-output channels, local area networks, and the like." Shin, 1:23-30. However, transmitting data at higher speeds results in "increased electromagnetic interference (EMI) as well as transmission line noise, thereby raising concerns as to safety and reliability." Shin, 1:43-46.

30. Before the '437 patent, "[v]arious techniques exist[ed] for improving the characteristics of transmission over serial links." For example, 8b/10b encoding schemes have been known since at least the early 1980's when IBM filed U.S. Patent No. 4,486,739. *See* Shin, 2:41-42. An 8b/10b encoding scheme is "operative to translate an 8 bit byte of information into 10 binary digits for transmission." Shin 2:43-45. By mapping an 8-bit value to a 10-bit value, one can select the 10-bit values that are better for transmission. Specifically, the goal of selecting specific 10-bit values to which each of the 8-bit values are mapped is to provide "DC balance, improved AC coupling, and clock recovery. *See* Shin, 2:49-57.

C. Overview of the '437 Patent

31. The '437 patent describes and claims nothing more than well-known techniques for encoding data for transmission over a serial link. The '437 patent "pertains to transmission of encoded data (e.g., one or both of video data and auxiliary data such as audio data) over a serial link, in such a manner as to reduce the bit error rate resulting from inter-symbol interference or other error-causing effects during transmission." '437 patent, 1:15-20. The '437 patent provides an example in which video and audio data are transmitted from a transmitter 1' to a receiver 2', as shown in Fig. 2 below.



’437 Patent, Fig. 1.

32. The purported novelty of the ’437 patent is that it encodes auxiliary data (e.g., audio data) more robustly than the video data: “The FIG. 2 system is identical to that of FIG. 1 [labeled prior art], except in that it is configured to encode auxiliary data (or other auxiliary data) in accordance with the invention (and also to encode video data in the same conventional manner as in the FIG. 1 system).” ’437 patent, 11:52-66.

33. The ’437 gives an example of “conventional” video encoding, including TMDS and “TMDS-like” as 8b/10b encoding. “One conventional serial link, used primarily for high speed transmission of video data from a host processor (e.g., a personal computer) to a monitor, is known as a transition minimized differential signaling interface (“TMDS” link).” ’437 patent, 1:28-32; 4:61-63. “The characteristics of a TMDS link include the following: video data are encoded and then transmitted as encoded words (**each 8-bit word of digital video data is converted to an encoded 10-bit word before transmission**).” ’437 patent, 1:34-36. In these conventional techniques, each of the 256 8-bit inputs is mapped to a 10-bit output of a “full code set.” The ’437 patent explains that “to encode 8-bit source data words, the full code word set can be the set of 10-bit code words employed in a conventional TMDS link (each such code word comprising one of 256, transition-minimized, 9-bit patterns whose most significant bit indicates that the pattern is transition-minimized, concatenated with a tenth bit indicating whether the eight least-significant bits have or have not been inverted in accordance with a DC balancing algorithm).” ’437 patent, 7:51-59.

34. The ’437 patent encodes auxiliary (e.g., audio) data more robustly by using a subset of the code words used for video. “[T]he data to be transmitted are encoded using a subset (a ‘robust subset[’]) of a full set of code words.” ’437 patent, 6:55-57. “The robust subset will sometimes be referred to herein as a “selected (or “inventive”) set of code words.” ’437 patent, 6:58-60. “The robust subset is selected such that each stream of encoded data (comprising only inventive code words) transmitted over a serial link has a bit pattern that is less susceptible to inter-symbol interference (ISI) during transmission than is the bit pattern determined by a transmitted, conventionally encoded version of the same data.” ’437 patent, 6:62-67.

35. The ’437 patent explains how to select code words that reduce inter-symbol interference. Specifically, “the inventive code words are selected to be those whose serial patterns (during transmission) have fewer contiguous zeros and ones (e.g., on the average), and thus are less susceptible to ISI during transmission, than do those code words in the full set that are not selected.” ’437 patent, 7:18-20. “Also, when the bits of the inventive code words are transmitted over a serial link as sequences of rising and falling voltage transitions, the bit pattern of each transmitted stream of the inventive code words preferably implements DC balancing (the voltage drift over time is limited).” ’437 patent, 7:28-33.

36. The ’437 patent acknowledges that “since the inventive code words are a subset of the full code word set and each inventive code word determines one source data word, the bit rate at which source data can be transmitted over the link is lower if the transmitted data are encoded using only the inventive code words than if the transmitted data are encoded conventionally using the full code word set.” ’437 patent, 7:2-9. “Thus, to encode the 8-bit source words using only the sixteen inventive code words, each 8-bit source word is split into two 4-bit portions and each 4-bit portion separately encoded as one of the inventive 10-bit code words.” ’437 patent, 7:63-69.

37. Because using the robust subset to encode data lowers the transmission rate, the ’437 patent uses the robust subset to encode auxiliary (e.g., audio) data. "In preferred embodiments, 4-bit words of auxiliary data (encoded in accordance with the invention) are transmitted during the blanking intervals at times when no control words or synchronization words are transmitted." '437 patent, 9:4-8. "auxiliary data are encoded in accordance with the invention (for transmission over a TMDS link) using a subset of the transition-minimized TMDS code words that are conventionally used to encode video data for transmission over the link." '437 patent, 11:55-59.

38. Video data is still transmitted using conventional 8b10b encoding. "The system is operable in a mode in which each transmitted video data word is conventionally encoded as a transition-minimized, 10-bit TMDS code." '437 patent, 8:59-63.

D. Claim Construction

39. It is my understanding that in order to properly evaluate the '437 patent, the terms of the claims must first be interpreted. It is my understanding that for the purposes of this *inter partes* review, the claims are to be construed under the so-called *Phillips* standard, under which claim terms are given their ordinary and customary meaning as would be understood by one of ordinary skill in the art in light of the specification and prosecution history, unless the inventor has set forth a special meaning for a term. For the purposes of providing the opinions in this declaration, it is my opinion that no terms need to be construed.

E. Key Teachings of the Prior Art

1. Audio Data in Blanking Intervals.

40. Kim describes encoding and transmitting video data (as a video data stream). Kim's video data streams are separated by blanking intervals.

> The encoder 40 preferably has a plurality of inputs and a plurality of outputs. The plurality of inputs are preferably grouped in sets. Thus, in FIG. 2, signal lines 26a, 26b, 26c, . . . 26n are each used to designate one or more signal lines of a data stream. **For example, the first primary stream is preferably a video stream including the data and control signals for display refresh** and may for example, be 28 parallel lines, 24 for data and 4 for control. The remaining signal lines 26b, 26c, … 26n can be used for other types of data, and are for example, each eight parallel lines. Those skilled in the art will realize that each signal line 26a, 26b, 26c, … 26n may be a variety of parallel signal lines. For each of the input signal lines 26a, 26b, 26c, . . . 26n, the encoder 40 preferably provides a corresponding output signal line 52a, 52b, 52c, … 52n. Each of the output signals line 52a, 52b, 52c, … 52n provides the encoded output of the signal applied to the corresponding input of the encoder 40. In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word. Thus, each of the output signals line 52a, 52b, 52c, … 52n is 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input of the multiplexor 48. The remaining output lines are 52b, 52c, … 52n are coupled to respective inputs of the data buffer 42. The encoder 40

> preferably encodes the input stream into 10-bit output streams. The word output by the encoder 40 are preferably any 10-bit words other than those identified in Appendix A as special code words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. Any number of conventional eight to 10 encoding schemes may be used in addition to the specific encoding scheme identified below with respect to FIG. 5.

Kim, 5:50-6:15.

> Still more particularly**, a video data coder 40a is provided for encoding the video data signals to a 10-bit parallel output**. Those skilled in the art will realize the video data coder 40a may be a plurality of 8-to-10bit coders depending on the number of bits used to represent the video data. **For example, the video data coder 40a may be three 8-to-10 bit coders if 24 bits of RGB data are used with 8 bits for a red channel, 8 bits for a green channel, 8 bits for a blue channel, or two 8-to-10 bit coders for 16 bits of YUV data**. An exemplary video coder 40a constructed according to the present invention is shown in Figure 5. Coders 40u, and 40v are also provided for the video control data, and the isochronous data stream. Similarly, for stream 1 to n each stream has a dedicated coder 40b to 40n, respectively, to encode each particular data stream. The coders 40b to 40n, 40u, 40v are preferably identical, and each maps the eight bit values applied on the inputs of the coders 40b to 40n to a corresponding 10-bit word according to a predefined coding scheme. An exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled

> "High-Speed Digital Video Signal Transmission System," filed on Oct. 6, 1995 and Sep. 30, 1996, which is incorporated herein by reference.

Kim, 8:44-67.

> The operation of the present invention can best be understood with reference to FIGS. 4A and 4B. **FIG. 4A is a timing diagram showing** the clock signal, **the video control and data signals that form the primary stream, data signals that for a second stream, and the serial stream produced by the embedding unit 22 and output on line 28**. One of the main purposes of the present invention is to make the embedding mechanism look transparent to the video signals and isochronous data streams. The timing of video data signals and control signals at the receiving side do not change due to the embedded signals. **The timing diagrams of FIGS. 4A and 4B correspond to the embodiment of the embedding unit shown in FIG. 3**, where the video stream has the highest priority, and thus, is sent without being disturbed by other streams. The present invention advantageously encodes the horizontal and vertical sync signal into a pair of beginning and ending isochronous transfer words thereby making much of the vertical and horizontal sync periods available multiplexing with other stream data. As shown in FIG. 4A, video control signals are sent by only sending only isochronous transfer words at the rising and falling edges of the sync signal so the period when the video control signal doesn't change its value can be used to send other data. Rising and falling edges of each video control signals have different special characters. **Data stream 1 is inserted during the horizontal blanking period and a start control word identifying the data stream 1 is used at the head of the**

> **data stream 1.** Each multimedia data stream has its own special start control word for identification. For example, stream 1 has a different data start word than that used for video start word. **If every stream buffer is emptied and no video signal enters, the scheduler sends an IDLE word for bit synchronization and word synchronization**.

Kim, 9:46-10:10.

2. Robust Encoding of Audio Data.

41. A POSITA would have recognized that audio data is more vulnerable to perceivable communication defects from data loss. *See e.g.*, Asai, 4:27-28 ("the human ear is more sensitive to errors or defects than the human eye"); Pasqualino, 11:23-25 and 10:67-11:2 (recognizing that "low bandwidth information being sent is sensitive to channel errors" and that "low bandwidth information may be...audio"). As such, it would have been obvious to a POSITA to use an encoding scheme for audio data that reduces data loss. While Kim states that the encoders 40b-40n may use 8b/10b encoding, Kim acknowledges that other coding schemes may be used. *See* Kim 5:44-50 ("For ease of understanding, the present invention will now be described in the context of encoding from eight bits to 10 bits, and decoding from 10 bits to eight bits although those skilled in the art will recognize that **the present invention may be used for various other coding rates**").

42. Myers complements Kim's disclosure by generally teaching a coding technique that reduces distortions and communication defects in audio transmission by reducing data loss. Myers, 2:50-57 (seeking to reduce "distortion of the signal and a loss of information."); *see also* Myers, 7:10-50. As detailed below, Myers teaches the selection of a subset of transmission codes such that they have DC balance (an equal number of '1's and '0's) and have fewer contiguous ones and zeros to obtain the data loss reduction. A POSITA would have been motivated to apply Myers' selection criteria to Kim's conventional techniques.

F. Motivations to Combine

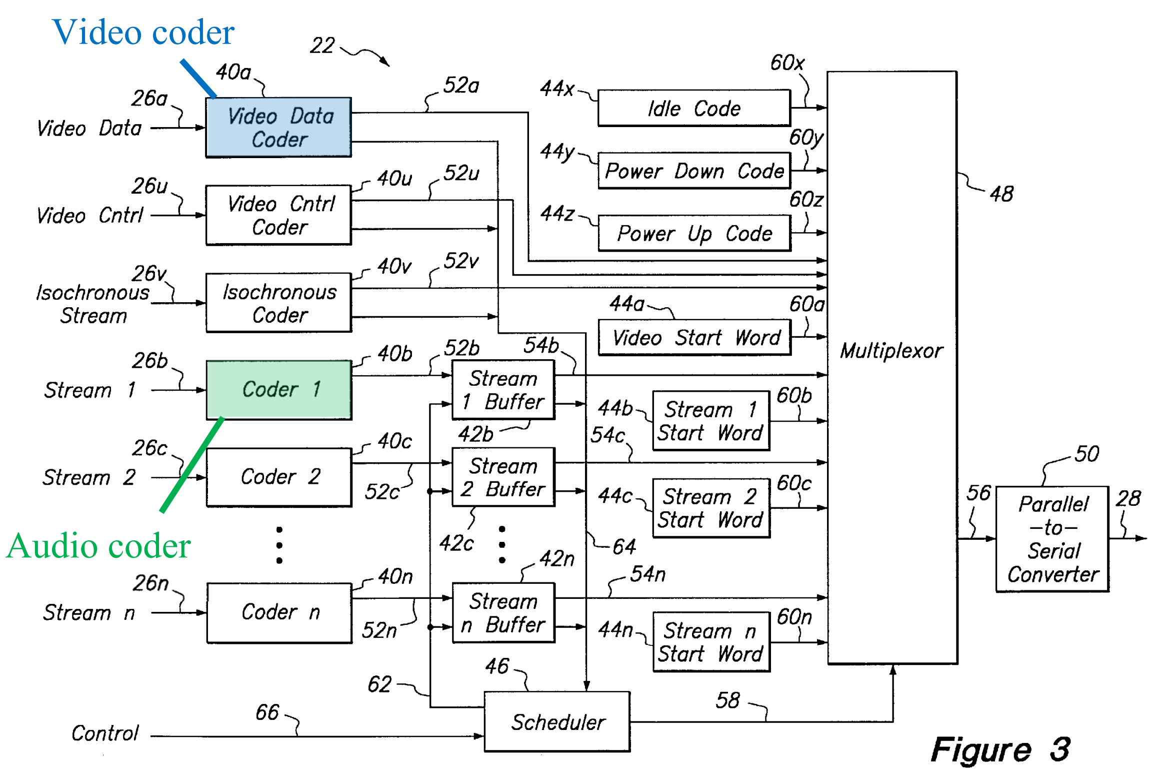
1. Reasons to Combine Shin with Kim and Myers.

43. A POSITA would have found it obvious for Kim's encoders to have the capability of applying Shin's specific 8b/10b encoding technique because Kim explicitly cites to Shin and its technique as an example of a possible encoding scheme. Kim states that "[a]n exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732, 694, entitled "High-Speed Digital Video Signal Transmission System," filed on Oct. 6, 1995, and Sep. 30, 1996, which is incorporated herein by reference." Because Kim explicitly refers to Shin as an exemplary encoding scheme, a POSITA would have had a reasonable expectation of success implementing Kim's encoders with the capability of using Shin's 8b/10b encoding scheme.

2. Reasons to Combine Kim and Shin with Myers.

44. A POSITA would have found it obvious for Kim's audio encoders (e.g., 40b-40n) to implement techniques for reducing data loss such as Myers' subset-selection technique.

45. Kim describes using conventional 8b/10b encoding schemes for encoding both video data and additional data (e.g., audio), as shown in Fig. 3 below.



Kim, Fig. 3 (annotated).

46. For encoding both video and audio, Kim "uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word." Kim, 6:1-2. Kim further states that "[a]ny number of conventional eight to 10 encoding schemes may be used." Kim, 6:13-15. While Kim states that it may use a conventional 8b/10b coding technique, such as that taught by Shin, Kim states that "other coding rates" may be used. Kim, 5:45-50. Accordingly, Kim leaves the selection of encoding schemes for both audio and video up to a POSITA.

47. When encoding audio data, a POSITA would have been motivated to look for encoding schemes that reduce the likelihood of data loss during transmission and thus provide better reliability. It was known that errors or defects in the audio transmission are more noticeable than errors in the video transmission. This is because the human ear can perceive audio glitches better than the human eye can perceive video glitches. *See e.g.*, Asai, 4:27-28 ("the human ear is more sensitive to errors or defects than the human eye"). Indeed, it was known that when transmitting both video and audio, that audio data should be encoded more robustly. *See generally,* Altmann (noting that "auxiliary data may be data that needs to be processed without error"); Pasqualino, 11:23-25 and 10:67-11:2 (recognizing that "low bandwidth information being sent is sensitive to channel errors" and that "low bandwidth information may be...audio"). I have developed numerous audio and video consumer products based on video technology. In my general experience, sporadic errors in video images can be easily concealed using simple filtering techniques in display devices, while sporadic audio errors are quite difficult to detect and conceal and are thus usually noticed by end users. One reason for this is that video data is often surrounded by redundant information in two dimensions as well as with respect to time, while audio data is one dimensional with respect to time.

48. Accordingly, POSITAs would have looked to known techniques for more robustly encoding audio data when implementing Kim's teachings. Myers describes one known example of an encoding technique that provides increased transmission reliability. In particular, Myers describes a technique for selecting a subset of the full code word set for improved transmission reliability.

49. Myers' technique uses a subset of a full code word set by using only code words that (1) are DC balanced—an equal number of 1s and 0s, (2) contain no more than two 1's or 0's in sequence, and (3) have either an "01" or "10" on each end. *See* Myers, 8:16-23. By selecting a subset of transmission codes that meet these criteria, data can be transmitted with better reliability.

50. Myers' technique seeks to reduce "distortion of the signal and a loss of information." Myers, 2:50-57. As Myers explains, using what he teaches to be inherently DC balanced codes "prevents a charge, and resulting capacitance or inductance, from building up on long transmission lines" and "permits the use of driver circuits which have lower capacity to source or sink a current, which usually has a direct effect on system cost." Myers, 7:17-27. Myers' technique further reduces data loss by avoiding too many contiguous ones or zeroes, the subset "limits the energy distribution of the transmitted signal into a minimum frequency band." Myers, 7:36-37. Moreover, "a broader distribution of energy in the frequency band, such as results from a longer run-length limit, makes it difficult to implement AC coupling without the use of higher cost hardware to prevent the loss of the lower frequency components of the transmission." Myers, 7:43-48.

51. Accordingly, because it was known that reducing data loss in audio transmission was more critical, and Myers' technique provides a way to reduce data loss in transmission, a POSITA would have been motivated to apply Myers' subset selection technique to Kim's transmission of audio data. For example, in the case where the data streams from encoders 40b-40n in Kim are used for audio, it would have been obvious to use Myers' subset-selection technique. As will be discussed in the analysis below at [41.3], application of Myers' technique to a conventionally encoded 8b/10b pool of 10-bit data values, results in a subset of 42 different 10-bit values. Some of these same values are already used by Kim's system as control words. When excluding those control words, there are 22 values remaining for use with audio data.

52. A POSITA would have found the results of the combination predictable because Myers provides step-by-step instructions as to how to select a subset. Myers' first step is to find the values with "inherent DC balance." Myers, 8:15-19. Myers' next step is to find the values that have "no more than two consecutive '1's or '0's." Myers, 8:21. Myers then describes selecting the values "that begin and end with either a '01' or '10' bit grouping." Thus, because Myers provides specific steps that can be used to narrow down Kim's conventional set of 10-bit values, a POSITA would have found the resulting subset predictable.

53. A POSITA would have had a reasonable expectation of success because both Myers and Kim relate to serial data transmission. Kim "relates to a system and method for sending multiple data signals or streams over a **serial** line." Kim, 1:25-27. Myers similarly "relates generally to data transmission ... for **serial** data communication." Myers, 1:7-12. A POSITA would have thus expected Myers' technique to work in Kim's serial transmission system as well. Additionally, a POSITA would have expected success when applying Myers' techniques to Kim's 10-bit words because "[e]ach of the methods of transmission mentioned has certain advantages and disadvantages, and the use of a particular form depends upon the requirements of the system in which it is to be utilized." Myers, 1:29-33.

54. Accordingly, the proposed combination is merely applying a known technique (Myers' subset selection) to a known method (Kim's encoding of audio data) ready for improvement to yield predictable results (transmission of audio data with better error detection and reliability).

V. DETAILED IDENTIFICATION OF HOW THE CLAIMS ARE

UNPATENTABLE

55. I have been asked to provide my opinion as to whether the Challenged Claims of the ’437 patent would have been obvious in view of the prior art. The discussion below provides a detailed analysis of how the prior art references identified below teach the limitations of the Challenged Claims of the ’437 patent.

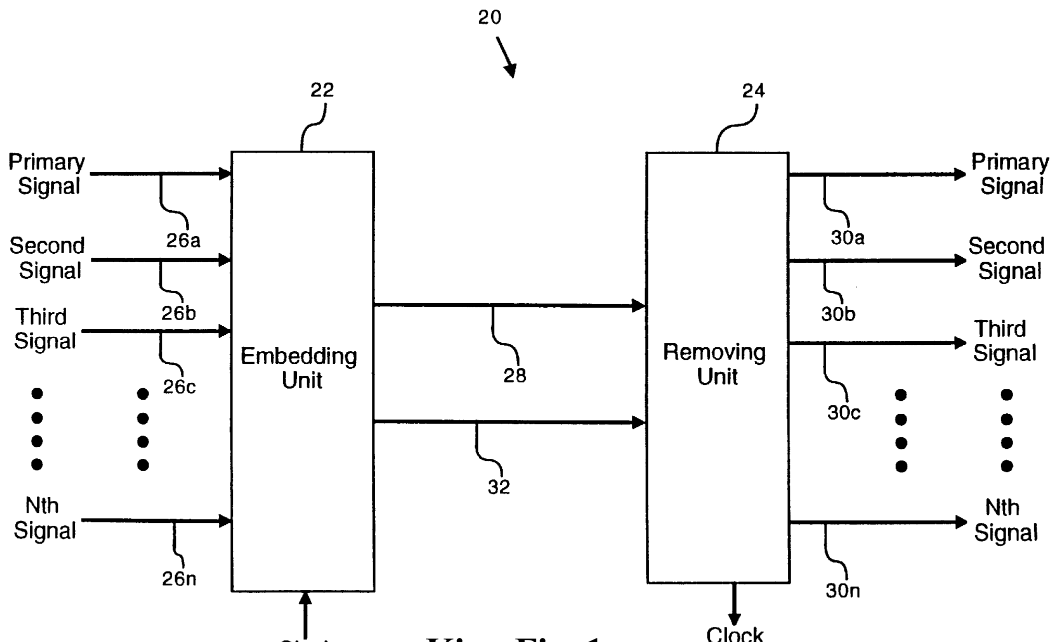
56. As part of my analysis, I have considered the scope and content of the prior art and any differences between the alleged invention and the prior art. I describe in detail below the scope and content of the prior art, as well as any differences between the alleged invention and the prior art, on an element-by-element basis for each Challenged Claims of the ’437 patent.

57. As described in detail below, the alleged invention of the Challenged Claims would have been obvious in view of the teachings of the identified prior art references as well as the knowledge of a POSITA. My analysis relies on the teachings of the prior art, and not on the physical incorporation of elements.

A. Ground 1: Claims 1-6, 8, 10-17, 19-23, 26-31, 33, 37, 39-45, 47, 49-50, and 52-53 are obvious in view of Kim, Shin, and Myers.

3. Summary of Kim.

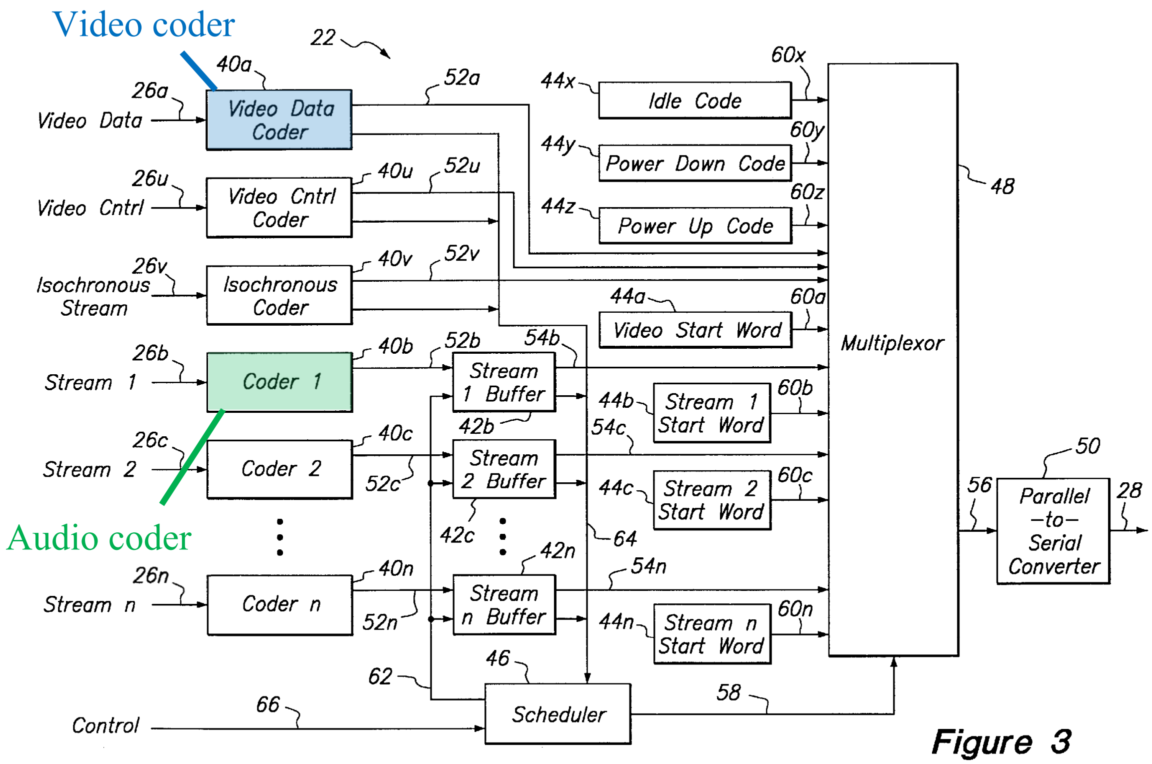
58. Kim shows that it was known to transmit encoded audio data within the blanking intervals of encoded video transmissions. Kim, like the ’437 patent, “relates to a system and method for sending multiple data signals or streams over a serial line.” Kim, 1:25-27. Kim describes sending a primary signal (e.g., video data) along with several streams of auxiliary data (e.g., audio data) over a serial transmission link, as shown in Fig. 1 below.



Kim, Fig. 1.

59. Kim refers to the transmitter as an embedding unit 22. "The embedding unit 22 mixes various data streams into a single serial data stream. The present invention will now be discussed in the context of mixing various multimedia data streams into the display refresh data (primary stream) using the unused bandwidth of horizontal and vertical blanking periods." Kim, 5:19-24. "Possible multimedia data streams that can be mixed include, but are not limited to **audio**..." Kim, 5:24-26.

60. To encode video and audio separately, Kim describes an example in which the video data is processed by a first encoder 40a and the auxiliary data is processed by separate encoders 40b-40n, as shown in Fig. 2 below.

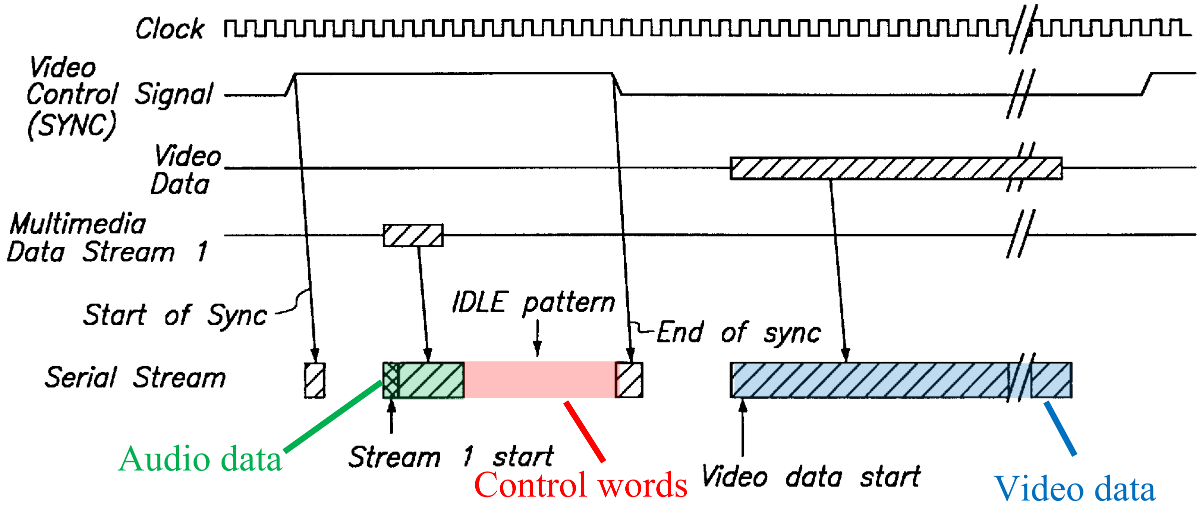


Kim, Fig. 3 (annotated).

61. Kim explains that the video data may be encoded using conventional 8b10b encoding techniques. "A video data coder 40a is provided for encoding the video data signals to a 10-bit parallel output. Those skilled in the art will realize the video data coder 40a may be a plurality of 8-to-10 bit coders depending on the number of bits used to represent the video data." Kim, 8:44-48. To provide an example of such an encoding scheme, Kim cites to and incorporate by reference U.S. Patent application No. 08/732,694, which ultimately issued as the Shin reference (discussed below).

62. The auxiliary data (which is disclosed as e.g. audio data) is encoded using separate, dedicated controllers. "[F]or stream 1 to n each stream has a dedicated coder 40b to 40n, respectively, to encode each particular data stream. The coders 40b to 40n, 40u, 40v are preferably identical, and each maps the eight bit values applied on the inputs of the coders 40b to 40n to a corresponding 10-bit word according to a predefined coding scheme." Kim, 8:56-62. While Kim provides an example in which these coders use 8b/10b encoding, Kim explains that "the present invention may be used for various other coding rates." Kim, 5:48-49.

63. Kim also teaches the feature that was deemed allowable by the Examiner—audio data and control words placed within the video blanking intervals. As shown in Fig. 4A below, stream 1 (e.g., audio) and "IDLE" control words are placed within a video blanking interval. "Data stream 1 is inserted during the horizontal blanking period and a start control word identifying the data stream 1 is used at the head of the data … If every stream buffer is emptied and no video signal enters, the scheduler sends an IDLE word for bit synchronization and word synchronization." Kim, 10:2-10.



Kim, Fig. 4A (annotated).

64. Accordingly, Kim provides evidence that the transmission sequence claimed by the '437 patent leading to its allowance, was known.

4. Summary of Myers.

65. Myers describes a technique for selecting a subset of encoder output values that reduce data loss. Myers "relates generally to data transmission codes for use in data communication systems and, more specifically, to ... transmitting and receiving such a code for serial data communication." Myers, 1:7-12. In particular, Myers "relates to a data transmission code for use in serial, digital, data communications, having predetermined desired transmission characteristics, such as DC balance [and] run-length limit." Myers, 1:12-16. Myers' technique seeks to reduce "distortion of the signal and a loss of information." Myers, 2:50-57.

66. Myers describes a technique for selecting a subset of transmission code words from a full code word set. "Each of the code words in FIG. 1 has certain bit relationships with respect to other bits within a given word, and with respect to certain bits in each of the other code words." Myers, 7:4-7. Myers describes the criteria along with the reasons for those criteria for selecting a subset of code words from the full code word set.

67. One criterion Myers uses is DC balance. "Firstly, each code word is inherently DC balanced in that each has four binary '1's and four binary '0's." Myers, 7:11-13. "This feature prevents a charge, and resulting capacitance or inductance, from building up on long transmission lines due to transmission of more bits having one value, such as a '1', than those having the other binary value, such as a '0'." Myers, 7:17-20. "DC balance permits the use of driver circuits which have lower capacity to source or sink a current, which usually has a direct effect on system cost." Myers, 7:20-23. "Also, a DC balanced code permits use of AC coupling, which can be important when considering longer transmission lines, particularly wire transmission lines, because of the potential for the development of ground loops in DC coupled systems." Myers, 7:23-27.

68. Another criterion Myers uses is avoiding too many consecutive ones or zeroes. "Secondly, each code word has a (0,1) run-length limit as there are no more than two consecutive binary '1's or '0's within a code word." Myers, 7:28-30. "Each code word also begins and ends with either a '01' or '10' bit grouping, to also provide for a (0,1) run-length limit across word boundaries. Together these bit relationships assure that a transmission of multiple code words will have a (0,1) run-length limit, regardless of how many and which combination of code words are actually transmitted." Myers, 7:30-36. "This feature limits the energy distribution of the transmitted signal into a minimum frequency band, which is narrower than codes having a longer run-length limit such as (0,3)." Myers, 7:36-39. "A broader distribution of energy in the frequency band, such as results from a longer run-length limit, makes it difficult to implement AC coupling without the use of higher cost hardware to prevent the loss of the lower frequency components of the transmission." Myers, 7:43-47.

69. Accordingly, by using a subset of transmission code words that are (1) DC balanced, (2) have fewer contiguous '1's and '0's, and (3) have a '01' or '10' at each start and end, the transmission codes that are used will prevent a charge buildup and prevent loss of data.

5. Summary of Shin.

70. Shin "relates to a DC-balanced, transition-controlled coding system in which rapid byte synchronization allows for prompt initiation of decoding." Shin, 1:14-16. In particular, Shin describes a specific encoding scheme in which a "data encoder converts 8 bits of data into 10 bits of transition controlled, DC balanced data." Shin, 5:43-45. In particular, "8-bit bytes of parallel data 14 are provided to a

DC-balanced encoder 18 operative to effect transition-controlled, DC-balanced 8B/10B coding." Shin, 8:57-60. "The resultant 10B encoded characters 22 are provided to a serializer 26 disposed to convert the 10-bit characters into a Serial data stream for transmission over a serial data link 30." Shin, 8:60-62.

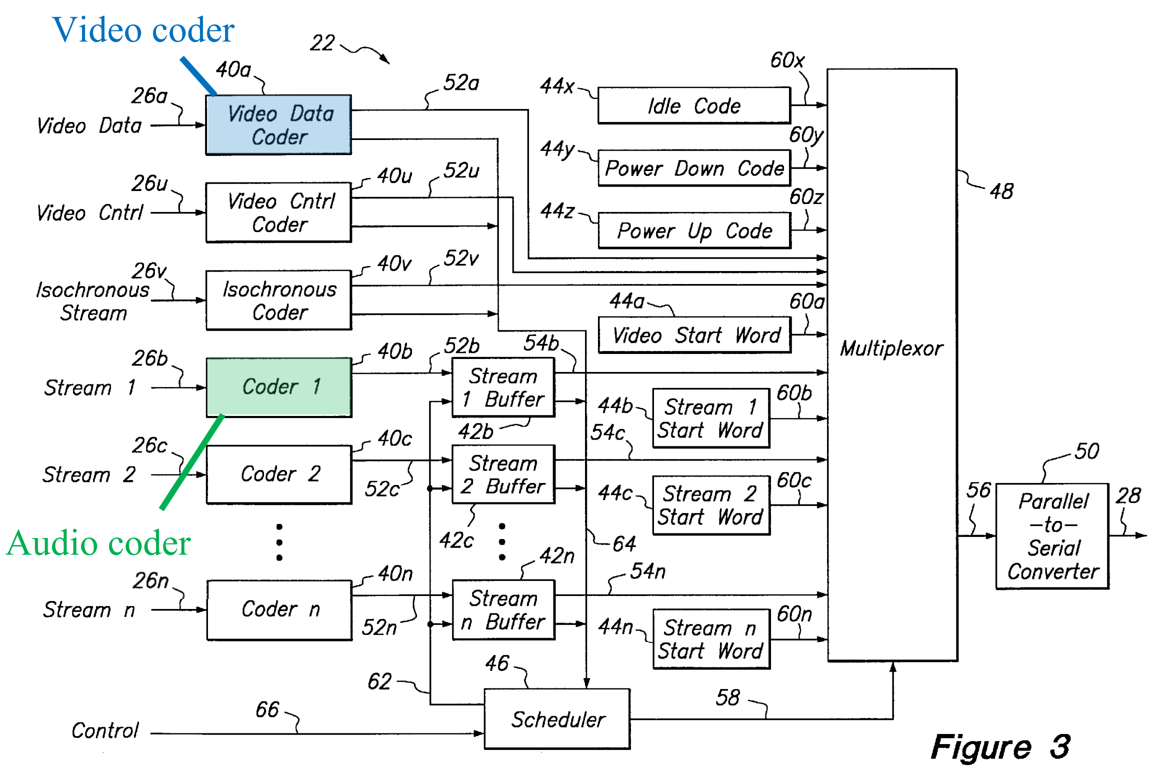
6. Reasons to Combine Shin with Kim.

71. A POSITA would have found it obvious for Kim's encoders—which implement 8b/10b encoding—to have the capability of applying Shin's specific 8b/10b encoding technique because Kim explicitly cites to Shin and its technique as an example of a possible encoding scheme. Kim states that "[a]n exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732, 694, entitled "High-Speed Digital Video Signal Transmission System," filed on Oct. 6, 1995, and Sep. 30, 1996, which is incorporated herein by reference." Because Kim explicitly refers to Shin as an exemplary encoding scheme, a POSITA would have had a reasonable expectation of success implementing Kim's encoders with the capability of using Shin's 8b/10b encoding scheme.

7. Reasons to Combine Kim and Shin with Myers.

72. A POSITA would have found it obvious for Kim's audio encoders (e.g., 40b-40n) to implement techniques for reducing data loss such as Myers' subset-selection technique.

73. Kim describes using conventional 8b/10b encoding schemes for encoding both video data and additional data (e.g., audio), as shown in Fig. 3 below.



Kim, Fig. 3 (annotated).

74. For encoding both video and audio, Kim "uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word." Kim, 6:1-2. Kim further states that "[a]ny number of conventional eight to 10 encoding schemes may be used." Kim, 6:13-15. While Kim states that it may use a conventional 8b/10b coding technique, such as that taught by Shin, Kim states that "other coding rates" may be used. Kim, 5:45-50. Accordingly, Kim leaves the selection of encoding schemes for both audio and video up to a POSITA.

75. When encoding audio data, a POSITA would have been motivated to look for encoding schemes that reduce data loss during transmission and thus provide better reliability. It was known that errors or defects in the audio transmission are more noticeable than errors in the video transmission. This is because the human ear can perceive audio glitches better than the human eye can perceive video glitches. *See e.g.*, Asai, 4:27-28 ("the human ear is more sensitive to errors or defects than the human eye"). Indeed, it was known that when transmitting both video and audio, that audio data should be encoded more robustly. *See generally,* Altmann (noting that "auxiliary data may be data that needs to be processed without error"); Pasqualino, 11:23-25 and 10:67-11:2 (recognizing that "low bandwidth information being sent is sensitive to channel errors" and that "low bandwidth information may be...audio"). I have developed numerous audio and video consumer products based on video technology. In my general experience, sporadic errors in video images can be easily concealed using simple filtering techniques in display devices, while sporadic audio errors are quite difficult to detect and conceal and are thus usually noticed by end users. One reason for this is that video data is often surrounded by redundant information in two dimensions as well as with respect to time, while audio data is one dimensional with respect to time.

76. Accordingly, POSITAs would have looked to known techniques for more robustly encoding audio data when implementing Kim's teachings. Myers describes one known example of an encoding technique that provides increased transmission reliability. In particular, Myers describes a technique for selecting a subset of the full code word set for improved transmission reliability.

77. Myers' technique uses a subset of a full code word set by using only code words that (1) are DC balanced—an equal number of 1s and 0s, (2) contain no more than two 1's or 0's in sequence, and (3) have either an "01" or "10" on each end. *See* Myers, 8:16-23. By selecting a subset of transmission codes that meet these criteria, data can be transmitted with better reliability.

78. Myers' technique seeks to reduce "distortion of the signal and a loss of information." Myers, 2:50-57. As Myers explains, using what he teaches to be inherently DC balanced codes "prevents a charge, and resulting capacitance or inductance, from building up on long transmission lines" and "permits the use of driver circuits which have lower capacity to source or sink a current, which usually has a direct effect on system cost." Myers, 7:17-27. Myers' technique further reduces data loss by avoiding too many contiguous ones or zeroes, the subset "limits the energy distribution of the transmitted signal into a minimum frequency band." Myers, 7:36-37. Moreover, "a broader distribution of energy in the frequency band, such as results from a longer run-length limit, makes it difficult to implement AC coupling without the use of higher cost hardware to prevent the loss of the lower frequency components of the transmission." Myers, 7:43-48.

79. Accordingly, because it was known that reducing data loss in audio transmission was more critical, and Myers' technique provides a way to reduce data loss in transmission, a POSITA would have been motivated to apply Myers' subset selection technique to Kim's transmission of audio data. For example, in the case where the data streams from encoders 40b-40n in Kim are used for audio, it would have been obvious to use Myers' subset-selection technique. As will be discussed in the analysis below at [41.3], application of Myers' technique to a conventionally encoded 8b/10b pool of 10-bit data values, results in a subset of 42 different 10-bit values. Some of these same values are already used by Kim's system as control words. When excluding those control words, there are 22 values remaining for use with audio data.

80. A POSITA would have found the results of the combination predictable because Myers provides step-by-step instructions as to how to select a subset. Myers' first step is to find the values with "inherent DC balance." Myers, 8:15-19. Myers' next step is to find the values that have "no more than two consecutive '1's or '0's." Myers, 8:21. Myers then describes selecting the values "that begin and end with either a '01' or '10' bit grouping." Thus, because Myers provides specific steps that can be used to narrow down Kim's conventional set of 10-bit values, a POSITA would have found the resulting subset predictable.

81. A POSITA would have had a reasonable expectation of success because both Myers and Kim relate to serial data transmission. Kim "relates to a system and method for sending multiple data signals or streams over a **serial** line." Kim, 1:25-27. Myers similarly "relates generally to data transmission ... for **serial** data communication." Myers, 1:7-12. A POSITA would have thus expected Myers' technique to work in Kim's serial transmission system as well. Additionally, a POSITA would have expected success when applying Myers' techniques to Kim's 10-bit words because "[e]ach of the methods of transmission mentioned has certain advantages and disadvantages, and the use of a particular form depends upon the requirements of the system in which it is to be utilized." Myers, 1:29-33.

82. Accordingly, the proposed combination is merely applying a known technique (Myers' subset selection) to a known method (Kim's encoding of audio data) ready for improvement to yield predictable results (transmission of audio data with better error detection and reliability).

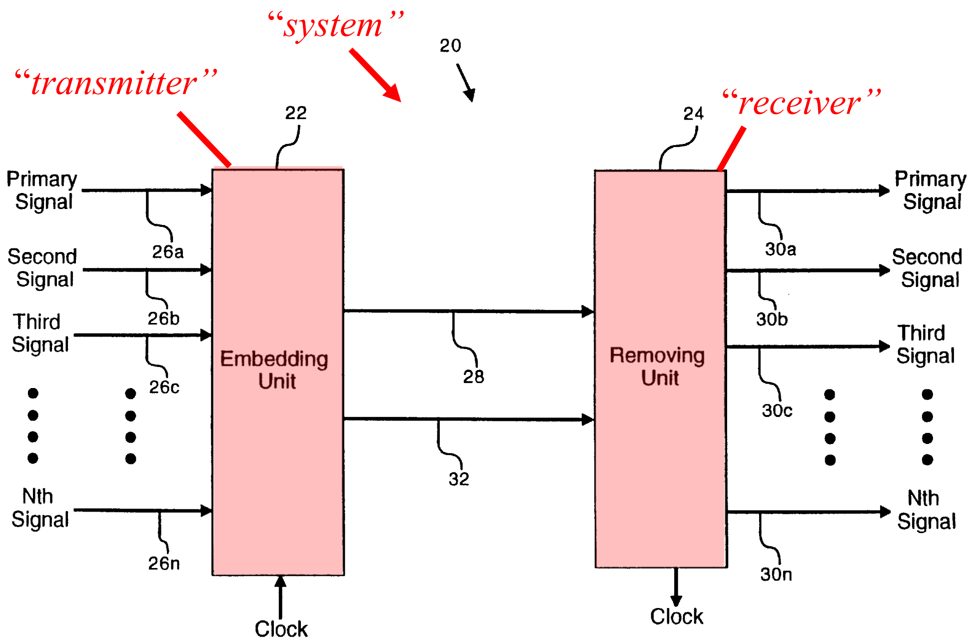
8. Claim 1

[1.0] ***A communication system, including: a receiver; a transmitter; and***

83. Kim renders this limitation obvious.

84. Kim describes a system that includes an embedding unit ("*transmitter*") and a removing unit ("*receiver*"). The system is illustrated in Fig. 1

below.



Kim, Fig. 1 (annotated).

> Referring now to FIG. 1, a block diagram of a preferred embodiment of **<u>a serial link system 20</u>** for sending an isochronous digital data stream and one or more additional digital data streams over a single serial line is shown. The serial link system 20 of the present invention preferably comprises **<u>an embedding unit 22, a removing unit 24</u>**, a single serial line 28 and a clock signal line 32.

Kim, 4:6-13.

> The embedding unit 22 preferably has a plurality of inputs and a first and second outputs. Each of the plurality of inputs is coupled to a respective input signal line 26a, 26b, 26c, 26n to receive a primary signal, preferably a video signal, a second signal, a third signal and a nth signal. Each of the inputs and corresponding input signal lines 26a, 26b, 26c, 26n is a plurality of signal lines. For example, the primary

> signal line may be a video signal that has 8 signal lines for data (8 bits of Red, 8 bits of Green, 8 bits of Blue in sequence) and signal lines for a control signals (horizontal sync, vertical sync and other control signals); and the second signal may be an eight bit data signal requiring eight signal lines. Those skilled in the art will realize that the primary signal, second signal, third signal and nth signal may each require different numbers of signal lines and that a variety of combinations may be possible. The embedding unit 22 receives the primary signal, second signal, third signal and nth signal, and encodes each signal. Then the embedding unit 22 combines the encoded signals and inserts separation signals or characters for identifying the input signal from which the encoded signals were derived. **The combination results in an encoded serial sequence that is output on the first output for transmission over the serial line 28**. The second output of the embedding unit 22 provides a clock signal used to synchronize the transmission of the encoded sequence.

Kim, 4:28-53.

> The removing unit 24 preferably has an first input, a second input and a plurality of outputs. **The first input of the removing unit 24 is coupled to serial line 28 to receive the encoded serial sequence from the embedding unit 22**. The second input of the removing unit 24 is coupled to clock line 32 to receive the clock signal from the embedding unit 22. The removing unit 24 separates the encoded serial sequence into separate signals, removes the separation characters and decodes the separate signals which are each output on a respective output of the removing unit 24. Each of the outputs of the removing unit 24 is

> coupled to a signal line 30a, 30b, 30c, 30n to output the reconstructed the primary signal, second signal, third signal and nth signal, respectively. Like the input signal lines 26a, 26b, 26c, 26n, each of the output signal lines 30a, 30b, 30c, 30n may be a plurality of signal lines. For example, the output signal lines 30a may be 25 parallel lines, the other output signal lines might be eight parallel lines. The present invention advantageously makes the embedding, transmission over the serial line 28 and clock line 32, and decoding appear completely transparent such that the signals applied to lines 26a-n are identical in content and relative timing to the signals that appear on the output lines 30a-30n.

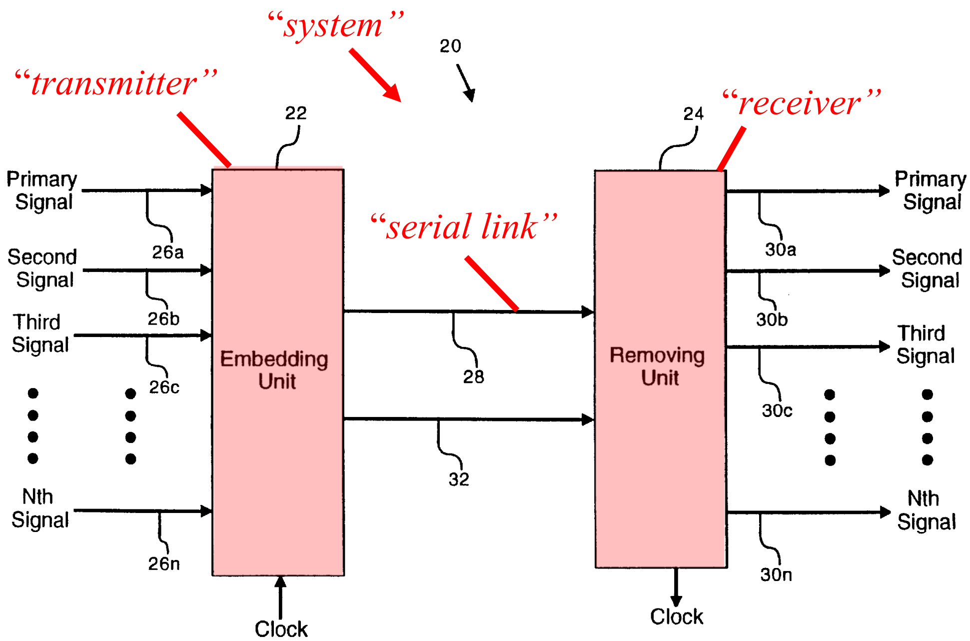
Kim, 4:54-5:9.

85. Thus, because Kim describes a serial link system 20 with an embedding unit 22 for transmitting data and a removing unit for receiving the data, Kim renders obvious a "*communication system, including: a receiver; a transmitter*."

[1.1] ***a serial link between the transmitter and the receiver, wherein the transmitter is coupled to receive input data,***

86. Kim renders this limitation obvious.

87. First, Kim's system includes a serial link between the transmitter and the receiver, as illustrated in Fig. 1 below.



Kim, Fig. 1 (annotated).

> Referring now to FIG. 1, a block diagram of a preferred embodiment of **<u>a serial link system 20</u>** for sending an isochronous digital data stream and one or more additional digital data streams over **<u>a single serial line is shown</u>**. The serial link system 20 of the present invention preferably comprises an embedding unit 22, a removing unit 24, **<u>a single serial line 28 and a clock signal line 32</u>**.

Kim, 4:6-13.

88. **Second**, Kim's embedding unit ("*transmitter*") is coupled to input lines to receive data.

> **<u>The embedding unit 22 preferably has a plurality of inputs and a first and second outputs. Each of the plurality of inputs is coupled to a respective input signal line 26a, 26b, 26c, 26n to receive a primary signal, preferably a video signal, a second signal, a third</u>**

> **signal and a nth signal**. Each of the inputs and corresponding input signal lines 26a, 26b, 26c, 26n is a plurality of signal lines. For example, the primary signal line may be a video signal that has 8 signal lines for data (8 bits of Red, 8 bits of Green, 8 bits of Blue in sequence) and signal lines for a control signals (horizontal sync, vertical sync and other control signals); and the second signal may be an eight bit data signal requiring eight signal lines. Those skilled in the art will realize that the primary signal, second signal, third signal and nth signal may each require different numbers of signal lines and that a variety of combinations may be possible. The embedding unit 22 receives the primary signal, second signal, third signal and nth signal, and encodes each signal. Then the embedding unit 22 combines the encoded signals and inserts separation signals or characters for identifying the input signal from which the encoded signals were derived. The combination results in an encoded serial sequence that is output on the first output for transmission over the serial line 28. The second output of the embedding unit 22 provides a clock signal used to synchronize the transmission of the encoded sequence.

Kim, 4:28-53.

89. **Third**, Kim's embedding unit 20 includes an encoder 40 (comprising encoders 40b-40n) that has inputs 26b-26n for receiving data streams ("*words of input data*"), including audio streams for example.

> **The encoder 40 preferably has a plurality of inputs** and a plurality of outputs. The plurality of inputs are preferably grouped in sets. Thus, in Figure 2, signal lines 26a, 26b, 26c, . . . 26n are each used to designate

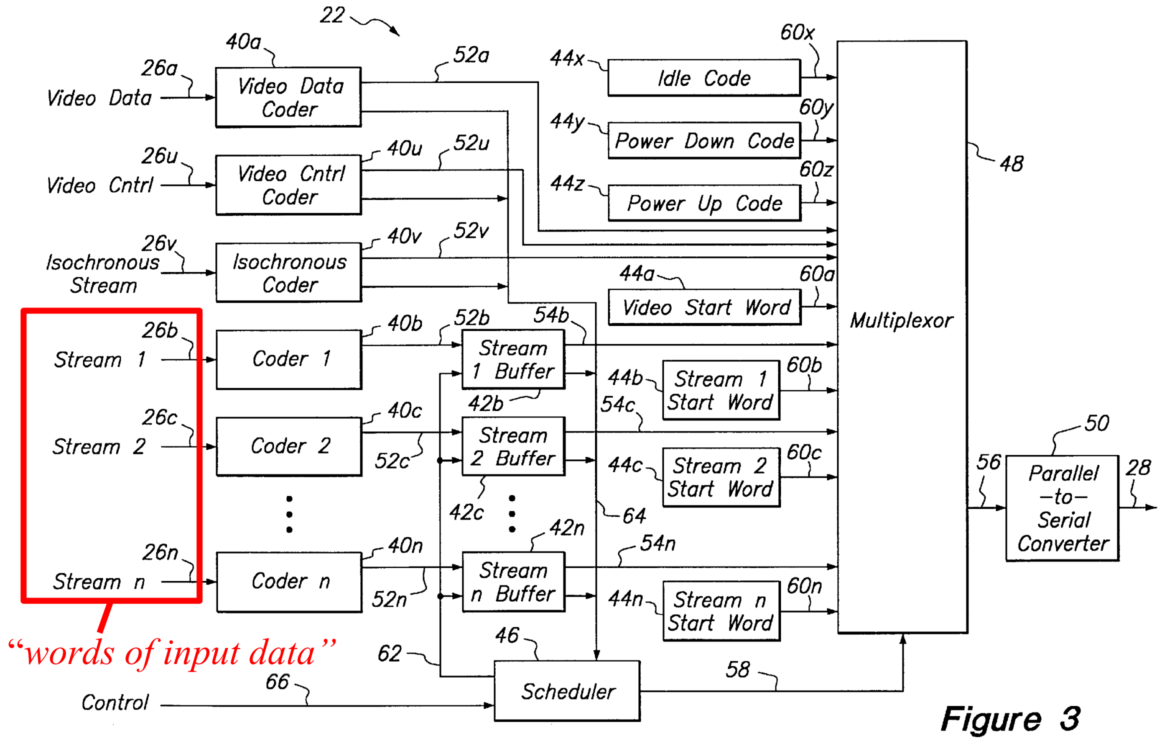
one or more signal lines of a data stream. For example, the first primary stream is preferably a video stream including the data and control signals for display refresh and may for example, be 28 parallel lines, 24 for data and 4 for control. **The remaining signal lines 26b, 26, . . . 26n can be used for other types of data**, and are for example, each eight parallel lines. Those skilled in the art will realize that each signal line 26a, 26b, 26c, . . . 26n may be a variety of parallel signal lines. For each of the input signal lines 26a, 26b, 26, . . . 26n, the encoder 40 preferably provides a corresponding output signal line 52a, 52b, 52c, . . . 52n. Each of the output signals line 52a, 52b, 52c, . . . 52n provides the encoded output of the signal applied to the corresponding input of the encoder 40. **In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word**. Thus, each of the output signals line 52a,52b, 52c, ... 52n is 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input of the multiplexor 48. The remaining output lines are 52b, 52c, . . . 52n are coupled to respective inputs of the data buffer 42. The encoder 40 preferably encodes the input stream into 10-bit output streams. The word output by the encoder 40 are preferably any 10-bit words other than those identified in Appendix A as special code words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. **Any number of conventional eight to 10 encoding schemes may be used** in addition to the specific encoding scheme identified below with respect to Figure 5.

Kim, 5:50-6:16.

90. As shown in Kim's Fig. 3, each of the different encoders 40b-40n process Streams 1-n, respectively, of input data.

> Still more particularly, a video data coder 40a is provided for encoding the video data signals to a 10-bit parallel output. Those skilled in the art will realize the video data coder 40a may be a plurality of 8-to-10bit coders depending on the number of bits used to represent the video data. For example, the video data coder 40a may be three 8-to-10 bit coders if 24 bits of RGB data are used with 8 bits for a red channel, 8 bits for a green channel, 8 bits for a blue channel, or two 8-to-10 bit coders for 16 bits of YUV data. An exemplary video coder 40a constructed according to the present invention is shown in Figure 5. Coders 40u,and 40v are also provided for the video control data, and the isochronous data stream. **Similarly, for stream 1 to n each stream has a dedicated coder 40b to 40n, respectively, to encode each particular data stream**. The coders 40b to 40n, 40u, 40v are preferably identical, and each maps the eight bit values applied on the inputs of the coders 40b to 40n to a corresponding 10-bit word according to a predefined coding scheme. An exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled "High-Speed Digital Video Signal Transmission System," filed on Oct. 6, 1995 and Sep. 30, 1996, which is incorporated herein by reference.

Kim, 8:44-67.



Kim, Fig. 3 (annotated).

91. Kim explains that the input data streams may include, for example, audio data that is received as 8 bits of information. I will thus refer to Kim's multimedia data streams 1-n as "audio data streams" or "audio data."

> The present invention will now be discussed in the context of mixing various multimedia data streams into the display refresh data (primary stream) using the unused bandwidth of horizontal and vertical blanking periods. **Possible multimedia data streams that can be mixed include, but are not limited to audio** I/O, keyboard and mouse, I2C bus (serial bus for peripheral components), Universal Serial Bus and P1394 data. The separation between data streams is done by inserting special characters defined in a line coding scheme. By exploiting the available bandwidth of current high speed serial links, the present

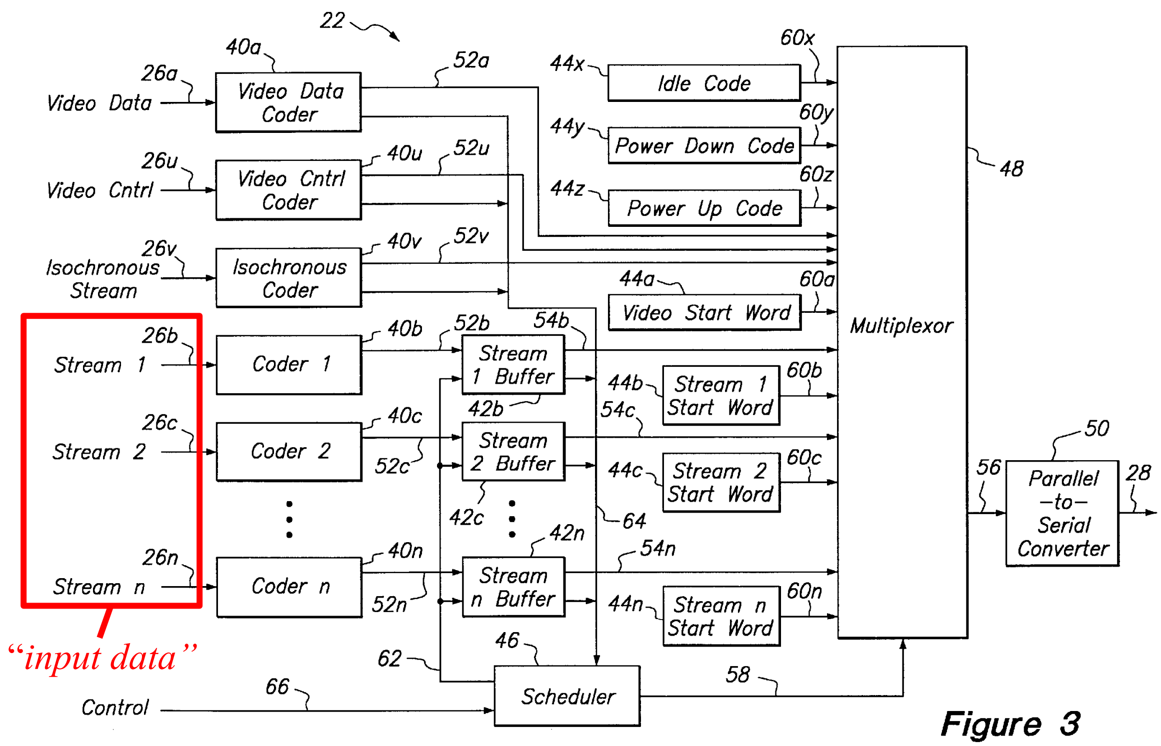
> invention advantageously can send the coded stream such that embedding of multiple data streams is possible. In general, the embedding unit 22 receives a plurality of data streams. **For each of the data streams, n [e.g., 8] bits of information** to be transmitted are encoded to k [e.g., 10] bits, where k is larger than n, and then sent serially bit by bit over the serial line 28. 2k data words can be defined using k bits. Since 2n data words represented by n bit parallel data streams can be mapped into a subset of the 2k data words, 2k - 2n data words remain after mapping for use as special codes. Once the parallel streams have been encoded into k-bit words and other control words are created and inserted, the encoded words and control words are multiplex and serially. sent on line 28 one bit at a time. For ease of understanding, the present invention will now be described in the context of encoding from eight bits to 10 bits, and decoding from 10 bits to eight bits although those skilled in the art will recognize that the present invention may be used for various other coding rates.

Kim, 5:21-49.

92. Thus, Kim's system includes a serial line, and the transmitter is coupled to receive input signals, which renders obvious "*a serial link between the transmitter and the receiver, wherein the transmitter is coupled to receive input data.*"

[1.2] configured to generate a sequence of selected code words by encoding the input data, and

93. **First**, Kim's embedding unit 22 generates encoded data by encoding input data for audio streams. A detailed illustration of the embedding unit is shown in Fig. 3 below.



Kim, Fig. 3 (annotated).

> **The embedding unit 22 preferably has a plurality of inputs** and a first and second outputs. **Each of the plurality of inputs is coupled to a respective input signal line 26a, 26b, 26c, 26n to receive a primary signal**, preferably a video signal, a second signal, a third signal and a nth signal. Each of the inputs and corresponding input signal lines 26a, 26b, 26c, 26n is a plurality of signal lines. For example, the primary signal line may be a video signal that has 8 signal lines for data (8 bits of Red, 8 bits of Green, 8 bits of Blue in sequence) and signal lines for a control signals (horizontal sync, vertical sync and other control signals); and the second signal may be an eight bit data signal requiring

> eight signal lines. Those skilled in the art will realize that the primary signal, second signal, third signal and nth signal may each require different numbers of signal lines and that a variety of combinations may be possible. The embedding unit 22 receives the primary signal, second signal, third signal and nth signal, and encodes each signal. Then the embedding unit 22 combines the encoded signals and inserts separation signals or characters for identifying the input signal from which the encoded signals were derived. <u>**The combination results in an encoded serial sequence that is output on the first output for transmission over the serial line 28**</u>. The second output of the embedding unit 22 provides a clock signal used to synchronize the transmission of the encoded sequence.

Kim, 4:28-53.

94. **Second**, Kim's encoders 40b-40n encode the audio data streams ("*input data*") to generate encoded data ("*generate a sequence of selected code words*"). Thus, any of Kim's encoders generates a sequence of selected code words.

> <u>**Similarly, for stream 1 to n each stream has a dedicated coder 40b to 40n, respectively, to encode each particular data stream**</u>. The coders 40b to 40n, 40u, 40v are preferably identical, and each maps the eight bit values applied on the inputs of the coders 40b to 40n to a corresponding 10-bit word according to a predefined coding scheme. An exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled "High-Speed Digital Video

> Signal Transmission System," filed on Oct. 6, 1995 and Sep. 30, 1996, which is incorporated herein by reference.

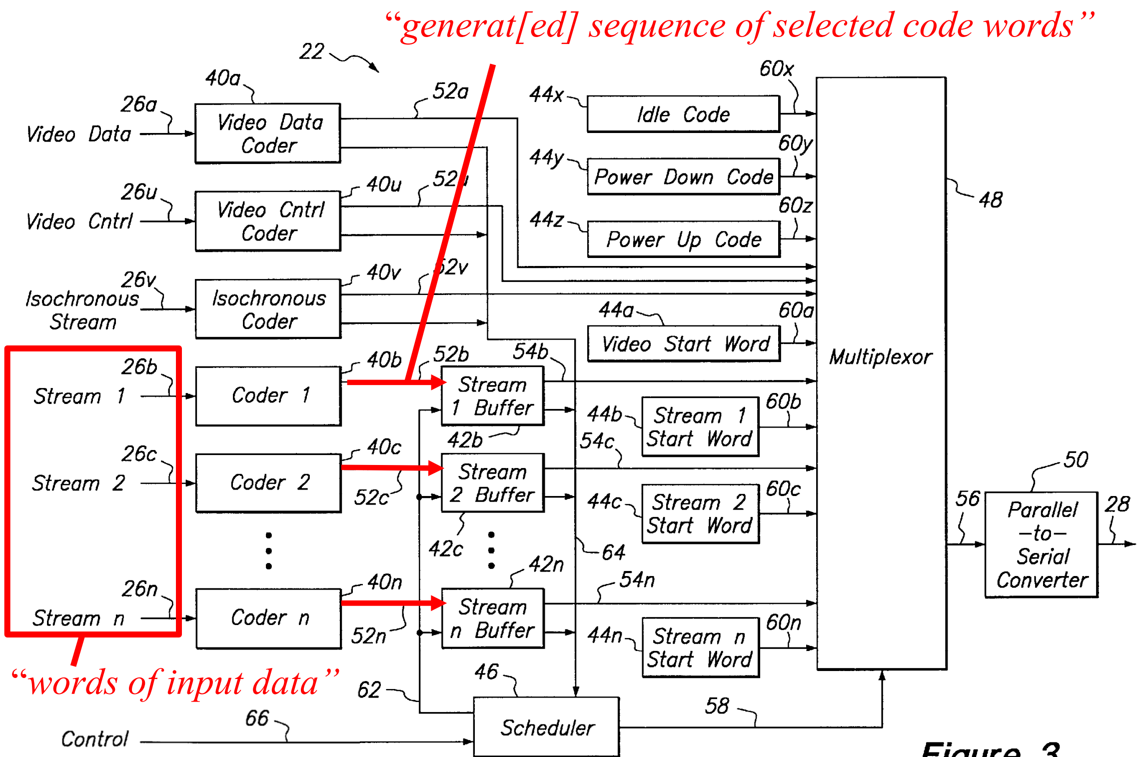
Kim, 8:44-67.

95. As illustrated at Fig. 3, Kim's coders 40b to 40n perform 8b10b encoding to generate a sequence of "10-bit words" (illustrated with an arrow) that are output along lines 52b-52n, respectively.

> Those skilled in the art will realize that each signal line 26a, 26b, 26c, ... 26n may be a variety of parallel signal lines. **For each of the input signal lines 26a, 26b, 26c, ... 26n, the encoder 40 preferably provides a corresponding output signal line 52a, 52b, 52c, ... 52n. Each of the output signals line 52a, 52b, 52c, ... 52n provides the encoded output of the signal applied to the corresponding input of the encoder 40**. In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word. Thus, each of the output signals line 52a, 52b, 52c, ... 52n is 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input of the multiplexor 48. The remaining output lines are 52b, 52c, ... 52n are coupled to respective inputs of the data buffer 42. The encoder 40 preferably encodes the input stream into 10-bit output streams. **The word output by the encoder 40 are preferably any 10-bit words** other than those identified in Appendix A as special code words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. Any number of

conventional eight to 10 encoding schemes may be used in addition to the specific encoding scheme identified below with respect to FIG. 5.

Kim, 5:59-6:16.



Kim, Fig. 3 (annotated).

96. Because the output words are selected from a code word set, they are "*selected*" words as claimed.

97. Thus, Kim's embedding unit encodes input data into selected code words for audio data, which renders obvious "*configured to generate a sequence of selected code words by encoding the input data*."

[1.3] ***configured to transmit the sequence of selected code words to the receiver over the serial link,***

98. **First**, as explained above at [1.0], Kim's embedding unit 22 ("*transmitter*") transmits encoded data over the serial line ("*serial link*"). "The combination results in an encoded serial sequence that is output on the first output for transmission over the serial line 28." Kim, 4:28-53.

99. **Second,** for the reasons explained above at [1.2], the encoded data includes a "*sequence of selected code words*."

100. Thus, Kim's embedding unit encodes audio data streams as selected code words for transmission over a serial line, which renders obvious "*configured to transmit the sequence of selected code words to the receiver over the serial link*."

[1.4] ***wherein each of the selected code words is a member of a robust subset of a full code word set,***

101. Kim in combination with Myers renders this limitation obvious.

102. **First**, as discussed at limitation [41.2], Kim's encoders 40b-40n may receive 8-bit input audio data and "*generate[] a sequence of selected code words*."

103. **Second**, Kim in combination with Myers teaches that the "*selected code words*" are "*a robust subset of the full code word set*." A POSITA would have recognized that audio data is more vulnerable to communication defects. *See e.g.*, Asai, 4:27-28 ("the human ear is more sensitive to errors or defects than the human eye"); Pasqualino, 11:23-25 and 10:67-11:2 (recognizing that "low bandwidth information being sent is sensitive to channel errors" and that "low bandwidth information may be...audio"). As such, it would have been obvious to a

POSITA to use an encoding scheme for audio data that reduces communication defects. While Kim states that the encoders 40b-40n may use 8b/10b encoding, Kim acknowledges that other coding schemes may be used. *See* Kim 5:44-50 ("For ease of understanding, the present invention will now be described in the context of encoding from eight bits to 10 bits, and decoding from 10 bits to eight bits although those skilled in the art will recognize that **the present invention may be used for various other coding rates**").

104. Myers complements Kim's disclosure by generally teaching a coding technique that reduces distortions and communication defects in audio transmission by reducing data loss. Myers, 2:50-57 (seeking to reduce "distortion of the signal and a loss of information."); *see also* Myers, 7:10-50. As detailed below, Myers teaches the selection of a subset of transmission codes such that they have DC balance (an equal number of '1's and '0's) and have fewer contiguous ones and zeros to obtain the data loss reduction. A POSITA would have been motivated to apply Myers' selection criteria to Kim's conventional encoding scheme for audio data to reduce distortion and data loss.

105. In more detail, Myers provides a technique for selecting a subset of code words. The subset is selected using three steps: selecting words that (1) are DC balanced—an equal number of 1s and 0s, (2) contain no more than two 1's or 0's in sequence, and (3) have either an "01" or "10" on each end.

> **The first step** 10 in this selection method is to select a first **subset** containing all of the code words from the 256 possibilities which have exactly four '1's and four '0's, to ensure inherent DC balance. From this subset, **a second step 12** is to select a second **subset** containing the code words having no more than two consecutive '1's or '0's is selected. The **third step 14** is to select a third **subset** of code words, from the second subset, that begin and end with either a '01' or '10' bit grouping.

Myers, 8:16-23.

106. A POSITA would have found it obvious to apply Myers' subset-selection technique to Kim's encoders that encode the audio data for the reasons explained above at VII.A.3. Applying Myers' subset-selection technique to Kim's 10-bit transmission words results in a subset of 10-bit values that have (1) DC balance, (2) no more than two consecutive 1's or 0's criteria, and (3) start and end values of "01" or "10." The result of this subset-selection technique is a "*subset of the full code word set*."

107. As an example, applying Myers' subset-selection technique to the full code word set described in Shin (*See* [41.2]) results in a limited code word set comprised of 42 different 10-bit values, as shown in Table 1 below. As identified in the Notes column, some of these 42 values correspond to Kim's control words (e.g., isochronous words, IDLE words, or data stream separation words) and the rest are available to use for audio or other auxiliary data.

Count	Decimal	Binary	Notes
1	301	0100101101	Subset of Full Code Word Set
2	309	0100110101	Subset of Full Code Word Set
3	310	0100110110	Isochronous
4	333	0101001101	Subset of Full Code Word Set
5	341	0101010101	Subset of Full Code Word Set
6	342	0101010110	IDLE
7	345	0101011001	Subset of Full Code Word Set
8	346	0101011010	IDLE
9	357	0101100101	Subset of Full Code Word Set
10	358	0101100110	Isochronous
11	361	0101101001	Subset of Full Code Word Set
12	362	0101101010	IDLE
13	405	0110010101	Subset of Full Code Word Set
14	406	0110010110	Isochronous
15	409	0110011001	Subset of Full Code Word Set
16	410	0110011010	Isochronous
17	421	0110100101	Subset of Full Code Word Set
18	422	0110100110	Isochronous
19	425	0110101001	Subset of Full Code Word Set
20	426	0110101010	IDLE
21	434	0110110001	Isochronous
22	589	1001001101	Separation

23	597	1001010101	IDLE
24	598	1001010110	Subset of Full Code Word Set
25	601	1001011001	Separation
26	602	1001011010	Subset of Full Code Word Set
27	613	1001100101	Separation
28	614	1001100110	Subset of Full Code Word Set
29	617	1001101001	Separation
30	618	1001101010	Subset of Full Code Word Set
31	661	1010010101	IDLE
32	662	1010010110	Subset of Full Code Word Set
33	665	1010011001	Separation
34	666	1010011010	Subset of Full Code Word Set
35	677	1010100101	IDLE
36	678	1010100110	Subset of Full Code Word Set
37	681	1010101001	IDLE
38	682	1010101010	Subset of Full Code Word Set
39	690	1010110010	Subset of Full Code Word Set
40	713	1011001001	Separation
41	714	1011001010	Subset of Full Code Word Set
42	722	1011010010	Subset of Full Code Word Set

108. As indicated in the Table, eight of the 42 values correspond to the 10-bit values Kim uses as IDLE words, as shown in Kim's Appendix A.

APPENDIX A

Sample Control Words

IDLE Words

0101010110
0101011010
0101101010
0110101010
1010101001
1010100101
1010010101
1001010101

109. Six of the 42 10-bit values correspond to Isochronous Data Transfer Words, as shown in the highlighted numbers below.

Isochronous Data Transfer Words
0010101110
0010110110
0010111010
0011010110
0011011010
0011101010
0100101110
0100110110
0100111010
0101001110
0101011100
0101100110
0101101100
0101110010
0101110100
0110010110
0110011010
0110100110
0110101100
0110110010
0110110100

110. Additionally, six more of the 42 10-bit words are used for Data Stream Separation Words, as shown by the highlighted numbers below.

Data Stream Separation Words
1000101011
1000101101
1000110101
1001001011
1001001101
1001010011
1001011001
1001100101
1001101001
1010001011
1010001101
1010010011
1010011001
1010100011
1010110001
1011000101
1011001001
1011010001
1100010101
1100100101
1100101001
1101000101
1101001001
1101010001

111. Accordingly, 20 of the 42 10-bit words are used by Kim as control words, leaving 22 different 10-bit words available for sending data. These 42 10-bit values for data transmission correspond to a "*subset*" of Shin's conventional full code word set. As explained above at [41.1], Kim incorporates by reference Shin, which describes an example of a conventional 8b/10b encoding scheme and provides a list of the 10-bit output words. As shown in the figures below, each of the 42 10-bit values match up with one of Shin's output values.

00000000, 0 => 101010101, 7
00000001, 1 => 101010100, 6
00000010, 2 => 101010111, 5
00000011, 1 => 101010110, 6
00000100, 2 => 101010001, 5
00000101, 3 => 101010000, 4
00000110, 2 => 101010011, 5
00000111, 1 => 101010010, 6
00001000, 2 => 101011101, 5
00001001, 3 => 101011100, 4
00001010, 4 => 000001010, 4
00001011, 3 => 101011110, 4
00001100, 2 => 101011001, 5
00001101, 3 => 101011000, 4
00001110, 2 => 101011011, 5
00001111, 1 => 101011010, 6
00010000, 2 => 101000101, 5
00010001, 3 => 101000100, 4
00010010, 4 => 000010010, 4
00010011, 3 => 101000110, 4
00010100, 4 => 000010100, 4
00010101, 5 => 000010101, 5
00010110, 4 => 000010110, 4
00010111, 3 => 101000010, 4
00011000, 2 => 101001101, 5
00011001, 3 => 101001100, 4
00011010, 4 => 000011010, 4
00011011, 3 => 101001110, 4
00011100, 2 => 101001001, 5
00011101, 3 => 101001000, 4
00011110, 2 => 101001011, 5
00011111, 1 => 101001010, 6
00100000, 2 => 101110101, 5
00100001, 3 => 101110100, 4
00100010, 4 => 000100010, 4
00100011, 3 => 101110110, 4
00100100, 4 => 000100100, 4
00100101, 5 => 000100101, 5
00100110, 4 => 000100110, 4
00100111, 3 => 101110010, 4
00101000, 4 => 000101000, 4
00101001, 5 => 000101001, 5
00101010, 6 => 000101010, 6
00101011, 5 => 000101011, 5
00101100, 4 => 000101100, 4
00101101, 5 => 000101101, 5
00101110, 4 => 000101110, 4
00101111, 3 => 101111010, 4
00110000, 2 => 101100101, 5
00110001, 3 => 101100100, 4
00110010, 4 => 000110010, 4
01101011, 5 => 001101011, 5
01101100, 4 => 001101100, 4
01101101, 5 => 001101101, 5
01101110, 4 => 001101110, 4
01101111, 3 => 100111010, 4
01110000, 2 => 100100101, 5
01110001, 3 => 100100100, 4
01110010, 4 => 001110010, 4
01110011, 3 => 100100110, 4
01110100, 4 => 001110100, 4
01110101, 5 => 001110101, 5
01110110, 4 => 001110110, 4
01110111, 3 => 100100010, 4
00110011, 3 => 101100110, 4
00110100, 4 => 000110100, 4
00110101, 5 => 000110101, 5
00110110, 4 => 000110110, 4
00110111, 3 => 101100010, 4
00111000, 2 => 101101101, 5
00111001, 3 => 101101100, 4
00111010, 4 => 000111010, 4
00111011, 3 => 101101110, 4
00111100, 2 => 101101001, 5
00111101, 3 => 101101000, 4
00111110, 2 => 101101011, 5
00111111, 1 => 101101010, 6
01000000, 2 => 100010101, 5
01000001, 3 => 100010100, 4
01000010, 4 => 001000010, 4
01000011, 3 => 100010110, 4
01000100, 4 => 001000100, 4
01000101, 5 => 001000101, 5
01000110, 4 => 001000110, 4
01000111, 3 => 100010010, 4
01001000, 4 => 001001000, 4
01001001, 5 => 001001001, 5
01001010, 6 => 001001010, 6
01001011, 5 => 001001011, 5
01001100, 4 => 001001100, 4
01001101, 5 => 001001101, 5
01001110, 4 => 001001110, 4
01001111, 3 => 100011010, 4
01010000, 4 => 001010000, 4
01010001, 5 => 001010001, 5
01010010, 6 => 001010010, 6
01010011, 5 => 001010011, 5
01010100, 6 => 001010100, 6
01010101, 7 => 001010101, 7
01010110, 6 => 001010110, 6
01010111, 5 => 001010111, 5
01011000, 4 => 001011000, 4
01011001, 5 => 001011001, 5
01011010, 6 => 001011010, 6
01011011, 5 => 001011011, 5
01011100, 4 => 001011100, 4
01011101, 5 => 001011101, 5
01011110, 4 => 001011110, 4
01011111, 3 => 100001010, 4
01100000, 2 => 100110101, 5
01100001, 3 => 100110100, 4
01100010, 4 => 001100010, 4
01100011, 3 => 100110110, 4
01100100, 4 => 001100100, 4
01100101, 5 => 001100101, 5
01100110, 4 => 001100110, 4
01100111, 3 => 100110010, 4
01101000, 4 => 001101000, 4
01101001, 5 => 001101001, 5
01101010, 6 => 001101010, 6
10100011, 4 => 010100011, 4
10100100, 5 => 010100100, 5
10100101, 6 => 010100101, 6
10100110, 5 => 010100110, 5
10100111, 4 => 010100111, 4
10101000, 5 => 010101000, 5
10101001, 6 => 010101001, 6
10101010, 7 => 010101010, 7
01111000, 2 => 100101101, 5
01111001, 3 => 100101100, 4
01111010, 4 => 001111010, 4
01111011, 3 => 100101110, 4
01111100, 2 => 100101001, 5
01111101, 3 => 100101000, 4
01111110, 2 => 100101011, 5
01111111, 1 => 100101010, 6
10000000, 1 => 111010101, 6
10000001, 2 => 111010100, 5
10000010, 3 => 111010111, 4
10000011, 2 => 111010110, 5
10000100, 3 => 111010001, 4
10000101, 4 => 010000101, 4
10000110, 3 => 111010011, 4
10000111, 2 => 111010010, 5
10001000, 3 => 111011101, 4
10001001, 4 => 010001001, 4
10001010, 5 => 010001010, 5
10001011, 4 => 010001011, 4
10001100, 3 => 111011001, 4
10001101, 4 => 010001101, 4
10001110, 3 => 111011011, 4
10001111, 2 => 111011010, 5
10010000, 3 => 111000101, 4
10010001, 4 => 010010001, 4
10010010, 5 => 010010010, 5
10010011, 4 => 010010011, 4
10010100, 5 => 010010100, 5
10010101, 6 => 010010101, 6
10010110, 5 => 010010110, 5
10010111, 4 => 010010111, 4
10011000, 3 => 111001101, 4
10011001, 4 => 010011001, 4
10011010, 5 => 010011010, 5
10011011, 4 => 010011011, 4
10011100, 3 => 111001001, 4
10011101, 4 => 010011101, 4
10011110, 3 => 111001011, 4
10011111, 2 => 111001010, 5
10100000, 3 => 111110101, 4
10100001, 4 => 010100001, 4
10100010, 5 => 010100010, 5
11011011, 4 => 011011011, 4
11011100, 3 => 110001001, 4
11011101, 4 => 011011101, 4
11011110, 3 => 110001011, 4
11011111, 2 => 110001010, 5
11100000, 1 => 110110101, 6
11100001, 2 => 110110100, 5
11100010, 3 => 110110111, 4
11100011, 2 => 110110110, 5
11100100, 3 => 110110001, 4
11100101, 4 => 011100101, 4
11100110, 3 => 110110011, 4
11100111, 2 => 110110010, 5
11101000, 3 => 110111101, 4
11101001, 4 => 011101001, 4
11101010, 5 => 011101010, 5
11101011, 4 => 011101011, 4
11101100, 3 => 110111001, 4
11101101, 4 => 011101101, 4
11101110, 3 => 110111011, 4
11101111, 2 => 110111010, 5
11110000, 1 => 110100101, 6
11110001, 2 => 110100100, 5
11110010, 3 => 110100111, 4
11110011, 2 => 110100110, 5
11110100, 3 => 110100001, 4
11110101, 4 => 011110101, 4
11110110, 3 => 110100011, 4
11110111, 2 => 110100010, 5
11111000, 1 => 110101101, 6
11111001, 2 => 110101100, 5
11111010, 3 => 110101111, 4
11111011, 2 => 110101110, 5
11111100, 1 => 110101001, 6
11111101, 2 => 110101000, 5
11111111, 0 => 110101010, 7
Total Tr: 1176
10101011, 6 => 010101011, 6
10101100, 5 => 010101100, 5
10101101, 6 => 010101101, 6
10101110, 5 => 010101110, 5
10101111, 4 => 010101111, 4
10110000, 3 => 111110101, 4
10110001, 4 => 010110001, 4
10110010, 5 => 010110010, 5
10110011, 4 => 010110011, 4
10110100, 5 => 010110100, 5
10110101, 6 => 010110101, 6
10110110, 5 => 010110110, 5
10110111, 4 => 010110111, 4
10111000, 3 => 111101101, 4
10111001, 4 => 010111001, 4
10111010, 5 => 010111010, 5
10111011, 4 => 010111011, 4
10111100, 3 => 111101001, 4
10111101, 4 => 010111101, 4
10111110, 3 => 111101011, 4
10111111, 2 => 111101010, 5
11000000, 1 => 110010101, 6
11000001, 2 => 110010100, 5
11000010, 3 => 110010111, 4
11000011, 2 => 110010110, 5
11000100, 3 => 110010001, 4
11000101, 4 => 011000101, 4
11000110, 3 => 110010011, 4
11000111, 2 => 110010010, 5
11001000, 3 => 110011101, 4
11001001, 4 => 011001001, 4
11001010, 5 => 011001010, 5
11001011, 4 => 011001011, 4
11001100, 3 => 110011001, 4
11001101, 4 => 011001101, 4
11001110, 3 => 110011011, 4
11001111, 2 => 110011010, 5
11010000, 3 => 110000101, 4
11010001, 4 => 011010001, 4
11010010, 5 => 011010010, 5
11010011, 4 => 011010011, 4
11010100, 5 => 011010100, 5
11010001, 6 => 011010101, 6
11010110, 5 => 011010110, 5
11010111, 4 => 011010111, 4
11011000, 3 => 110001101, 4
11011001, 4 => 011011001, 4
11011010, 5 => 011011010, 5

112. Accordingly, whichever one or more 10-bit values from the 42 selected values are used will be a "*subset of the full code word set*."

113. **Second**, the subset of code words resulting from Myers' subset-selection technique is a "*robust subset*" because the selected code words provide better protection against data loss. In particular, using Myers's subset selection technique results in a subset of code words that prevent a charge from buildup up along the transmission lines, and allows for "AC coupling without the use of higher cost hardware to prevent the loss of the lower frequency components of the transmission." Myers, 7:10-50.

> Firstly, each code word is inherently DC balanced in that each has four binary '1's and four binary '0's. This code is preferably implemented where logic '1' values may be represented by a positive voltage, and logic '0' values are represented by a negative or zero voltage, transmitted along on a transmission line which is usually a wire or wires, however, other types of transmission media may be utilized. **This feature prevents a charge, and resulting capacitance or inductance, from building up on long transmission lines due to transmission of more bits having one value, such as a '1' than those having the other binary value, such as a '0'**. DC balance permits the use of driver circuits which have lower capacity to source or sink a current, which usually has a direct effect on system cost. Also, a DC balanced code permits use of AC coupling, which can be important when considering longer transmission lines, particularly wire

> transmission lines, because of the potential for the development of ground loops in DC coupled systems.
>
> Secondly, each code word has a (0,1) run-length limit as there are no more than two consecutive binary '1's or '0's within a code word. Each code word also begins and ends with either a '01' or '10' bit grouping, to also provide for a (0,1) run-length limit across word boundaries, Together these bit relationships assure that a transmission of multiple code words will have a (0.1) run-length limit, regardless of how many and which combination of code words are actually transmitted. **<u>This feature limits the energy distribution of the transmitted signal into a minimum frequency band, which is narrower than codes having a longer run length limit</u>** such as (0.3). **<u>Minimizing the frequency band requires lower cost hardware to process a signal when it is transmitted or received. Also, the run-length limit permits the code to be used effectively in systems where the transmission lines are AC coupled</u>**. A broader distribution of energy in the frequency band, such as results from a longer run-length limit, makes it difficult to implement **<u>AC coupling without the use of higher cost hardware to prevent the loss of the lower frequency components of the transmission</u>**. Finally, this run-length limit permits the code to also be used for a clocking function in applications where a code-based clocking function is desired or required.

Myers, 7:10-50.

114. Accordingly, by narrowing the conventional set of 8b/10b code words according to Myers' subset-selection technique, a more robust subset can be achieved.

115. Myers' subset-selection technique is similar to the subset-selection techniques described in the '437 patent:

> In preferred embodiments, **the inventive code words are selected to be those whose serial patterns (during transmission) have fewer contiguous zeros and ones (e.g., on the average), and thus are less susceptible to ISI during transmission**, than do those code words in the full set that are not selected (e.g., the average number of contiguous zeros and ones, per code word, of the inventive code words is less than the average number of contiguous zeros and ones, per code word, of the code words in the full set that are not selected as the inventive code words). Also, when the bits of the inventive code words are transmitted over a serial link as sequences of rising and falling voltage transitions, the bit pattern of **each transmitted stream of the inventive code words preferably implements DC balancing** (the voltage drift over time is limited).

'437 patent, 7:18-34.

116. Thus, Kim's encoders 40b-40n for audio streams may encode input data using any known coding scheme, including Myer's subset-selection technique that utilizes a subset of more robust values to prevent data loss, which renders obvious "*wherein each of the selected code words is a member of a robust subset of the full code word set.*"

117. I note that Kim teaches a "*wherein each of the selected code words is* *a member of a robust subset of the full code word set*" under Patent Owner's interpretation of this term as well. As explained at [41.1], Patent Owner interprets this term as follows: "A full code word set comprise 2^{10}=1024 codewords of 10 bits." Patent Owner further interprets the "*robust subset*" as the output of "ANSI standard 8B/10B" coding. *See* Ex.1012, 6. Under that interpretation of the phrase, Kim teaches the "*robust subset*" because the possible 10-bit outputs of Kim's conventional 8b/10b encoding techniques are a subset of 1024. *See supra* [41.1]-[41.3]; Kim, 5:50-6:16; Shin, 20:11-23:60.

[1.5] ***the input data can be encoded as a conventional sequence of code words of the full code word set, and***

118. Kim's input 8-bit audio data streams on lines 26b-26n are capable of being encoded using conventional sequence of "10-bit words" using eight-to-ten bit encoding schemes ("*can be encoded as a conventional sequence of code words of the full code word set*").

> In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded10-bit word. Thus, each of the output signals line 52a,52b, 52c, ... 52n is 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input of the multiplexor 48. The remaining output lines are 52b, 52c, . . . 52n are coupled to respective inputs of the data buffer 42. The encoder 40 preferably encodes the input stream into 10-bit output streams. The word output by the encoder 40 are preferably any 10-bit words other than those identified in Appendix A as special code

> words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. **Any number of conventional eight to 10 encoding schemes may be used** in addition to the specific encoding scheme identified below with respect to Figure 5.

Kim, 5:67-6:16; *see also* Kim, 5:59-60 ("The word output by the encoder 40 are preferably any 10-bit words.") Kim's disclosed conventional eight-to-ten bit encoding may be referred to in the art as "8b/10b" encoding.

119. Kim also incorporates by reference an additional patent (Shin) which it cites as an example of a conventional encoding scheme that can be used for encoders 40b to 40n.

> An exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled "High-Speed Digital Video Signal Transmission System," filed on Oct. 6, 1995, and Sep. 30, 1996, which is incorporated herein by reference.

Kim, 8:61-67.

120. Additionally, I note that the '437 patent characterizes in the background section that 8b/10b encoding is "conventional."

> There are several conventional TMDS-like links…. An example of an encoding algorithm … in a TMDS-like link, is IBM 8b10b coding.

'437 patent, 4:50-63.

121. Third, Kim's encoders—using conventional 8b/10b encoding techniques—produce 10-bit words that are part "*of a full code word set*." The range of possible outputs of a conventional 8b/10b is a "*full code word set*." An example of a full code word set is provided by Shin and shown in the table below. [1]

[1] Note that Shin lists only the last 9-bits of the 10-bit values. But, Shin explains that if the first bit of the 9-bit value is a '1', then a '0' is added at the front of to make the full 10-bit value. Conversely, if a '0' is at the front of the 9-bit value, a '1' is added to the front to make the full 10-bit value. *See* Shin, 13:1-8.

New Coder Mapping - high Transition Control Mode
ASCII, Tr => New-Code, Tr

00000000, 0 => 101010101, 7
00000001, 1 => 101010100, 6
00000010, 2 => 101010111, 5
00000011, 1 => 101010110, 6
00000100, 2 => 101010001, 5
00000101, 3 => 101010000, 4
00000110, 2 => 101010011, 5
00000111, 1 => 101010010, 6
00001000, 2 => 101011101, 5
00001001, 3 => 101011100, 4
00001010, 4 => 000001010, 4
00001011, 3 => 101011110, 4
00001100, 2 => 101011001, 5
00001101, 3 => 101011000, 4
00001110, 2 => 101011011, 5
00001111, 1 => 101011010, 6
00010000, 2 => 101000101, 5
00010001, 3 => 101000100, 4
00010010, 4 => 000010010, 4
00010011, 3 => 101000110, 4
00010100, 4 => 000010100, 4
00010101, 5 => 000010101, 5
00010110, 4 => 000010110, 4
00010111, 3 => 101000010, 4
00011000, 2 => 101001101, 5
00011001, 3 => 101001100, 4
00011010, 4 => 000011010, 4
00011011, 3 => 101001110, 4
00011100, 2 => 101001001, 5
00011101, 3 => 101001000, 4
00011110, 2 => 101001011, 5
00011111, 1 => 101001010, 6
00100000, 2 => 101110101, 5
00100001, 3 => 101110100, 4
00100010, 4 => 000100010, 4
00100011, 3 => 101110110, 4
00100100, 4 => 000100100, 4
00100101, 5 => 000100101, 5
00100110, 4 => 000100110, 4
00100111, 3 => 101110010, 4
00101000, 4 => 000101000, 4
00101001, 5 => 000101001, 5
00101010, 6 => 000101010, 6
00101011, 5 => 000101011, 5
00101100, 4 => 000101100, 4
00101101, 5 => 000101101, 5
00101110, 4 => 000101110, 4
00101111, 3 => 101111010, 4
00110000, 2 => 101100101, 5
00110001, 3 => 101100100, 4
00110010, 4 => 000110010, 4
01101011, 5 => 001101011, 5
01101100, 4 => 001101100, 4
01101101, 5 => 001101101, 5
01101110, 4 => 001101110, 4
01101111, 3 => 100111010, 4
01110000, 2 => 100100101, 5
01110001, 3 => 100100100, 4
01110010, 4 => 001110010, 4
01110011, 3 => 100100110, 4
01110100, 4 => 001110100, 4
01110101, 5 => 001110101, 5
01110110, 4 => 001110110, 4
01110111, 3 => 100100010, 4
00110011, 3 => 101100110, 4
00110100, 4 => 000110100, 4
00110101, 5 => 000110101, 5
00110110, 4 => 000110110, 4
00110111, 3 => 101100010, 4
00111000, 2 => 101101101, 5
00111001, 3 => 101101100, 4
00111010, 4 => 000111010, 4
00111011, 3 => 101101110, 4
00111100, 2 => 101101001, 5
00111101, 3 => 101101000, 4
00111110, 2 => 101101011, 5
00111111, 1 => 101101010, 6
01000000, 2 => 100010101, 5
01000001, 3 => 100010100, 4
01000010, 4 => 001000010, 4
01000011, 3 => 100010110, 4
01000100, 4 => 001000100, 4
01000101, 5 => 001000101, 5
01000110, 4 => 001000110, 4
01000111, 3 => 100010010, 4
01001000, 4 => 001001000, 4
01001001, 5 => 001001001, 5
01001010, 6 => 001001010, 6
01001011, 5 => 001001011, 5
01001100, 4 => 001001100, 4
01001101, 5 => 001001101, 5
01001110, 4 => 001001110, 4
01001111, 3 => 100011010, 4
01010000, 4 => 001010000, 4
01010001, 5 => 001010001, 5
01010010, 6 => 001010010, 6
01010011, 5 => 001010011, 5
01010100, 6 => 001010100, 6
01010101, 7 => 001010101, 7
01010110, 6 => 001010110, 6
01010111, 5 => 001010111, 5
01011000, 4 => 001011000, 4
01011001, 5 => 001011001, 5
01011010, 6 => 001011010, 6
01011011, 5 => 001011011, 5
01011100, 4 => 001011100, 4
01011101, 5 => 001011101, 5
01011110, 4 => 001011110, 4
01011111, 3 => 100001010, 4
01100000, 2 => 100110101, 5
01100001, 3 => 100110100, 4
01100010, 4 => 001100010, 4
01100011, 3 => 100110110, 4
01100100, 4 => 001100100, 4
01100101, 5 => 001100101, 5
01100110, 4 => 001100110, 4
01100111, 3 => 100110010, 4
01101000, 4 => 001101000, 4
01101001, 5 => 001101001, 5
01101010, 6 => 001101010, 6
10100011, 4 => 010100011, 4
10100100, 5 => 010100100, 5
10100101, 6 => 010100101, 6
10100110, 5 => 010100110, 5
10100111, 4 => 010100111, 4
10101000, 5 => 010101000, 5
10101001, 6 => 010101001, 6
10101010, 7 => 010101010, 7

-continued

01111000, 2 => 100101101, 5
01111001, 3 => 100101100, 4
01111010, 4 => 001111010, 4
01111011, 3 => 100101110, 4
01111100, 2 => 100101001, 5
01111101, 3 => 100101000, 4
01111110, 2 => 100101011, 5
01111111, 1 => 100101010, 6
10000000, 1 => 111010101, 6
10000001, 2 => 111010100, 5
10000010, 3 => 111010111, 4
10000011, 2 => 111010110, 5
10000100, 3 => 111010001, 4
10000101, 4 => 010000101, 4
10000110, 3 => 111010011, 4
10000111, 2 => 111010010, 5
10001000, 3 => 111011101, 4
10001001, 4 => 010001001, 4
10001010, 5 => 010001010, 5
10001011, 4 => 010001011, 4
10001100, 3 => 111011001, 4
10001101, 4 => 010001101, 4
10001110, 3 => 111011011, 4
10001111, 2 => 111011010, 5
10010000, 3 => 111000101, 4
10010001, 4 => 010010001, 4
10010010, 5 => 010010010, 5
10010011, 4 => 010010011, 4
10010100, 5 => 010010100, 5
10010101, 6 => 010010101, 6
10010110, 5 => 010010110, 5
10010111, 4 => 010010111, 4
10011000, 3 => 111001101, 4
10011001, 4 => 010011001, 4
10011010, 5 => 010011010, 5
10011011, 4 => 010011011, 4
10011100, 3 => 111001001, 4
10011101, 4 => 010011101, 4
10011110, 3 => 111001011, 4
10011111, 2 => 111001010, 5
10100000, 3 => 111110101, 4
10100001, 4 => 010100001, 4
10100010, 5 => 010100010, 5
11011011, 4 => 011011011, 4
11011100, 3 => 110001001, 4
11011101, 4 => 011011101, 4
11011110, 3 => 110001011, 4
11011111, 2 => 110001010, 5
11100000, 1 => 110110101, 6
11100001, 2 => 110110100, 5
11100010, 3 => 110110111, 4
11100011, 2 => 110110110, 5
11100100, 3 => 110110001, 4
11100101, 4 => 011100101, 4
11100110, 3 => 110110011, 4
11100111, 2 => 110110010, 5
11101000, 3 => 110111101, 4
11101001, 4 => 011101001, 4
11101010, 5 => 011101010, 5
11101011, 4 => 011101011, 4
11101100, 3 => 110111001, 4
11101101, 4 => 011101101, 4
11101110, 3 => 110111011, 4
11101111, 2 => 110111010, 5
11110000, 1 => 110100101, 6
11110001, 2 => 110100100, 5
11110010, 3 => 110100111, 4
11110011, 2 => 110100110, 5
11110100, 3 => 110100001, 4
11110101, 4 => 011110101, 4
11110110, 3 => 110100011, 4
11110111, 2 => 110100010, 5
11111000, 1 => 110101101, 6
11111001, 2 => 110101100, 5
11111010, 3 => 110101111, 4
11111011, 2 => 110101110, 5
11111100, 1 => 110101001, 6
11111101, 2 => 110101000, 5
11111111, 0 => 110101010, 7
Total Tr: 1176
10101011, 6 => 010101011, 6
10101100, 5 => 010101100, 5
10101101, 6 => 010101101, 6
10101110, 5 => 010101110, 5
10101111, 4 => 010101111, 4
10110000, 3 => 111110101, 4
10110001, 4 => 010110001, 4
10110010, 5 => 010110010, 5
10110011, 4 => 010110011, 4
10110100, 5 => 010110100, 5
10110101, 6 => 010110101, 6
10110110, 5 => 010110110, 5
10110111, 4 => 010110111, 4
10111000, 3 => 111101101, 4
10111001, 4 => 010111001, 4
10111010, 5 => 010111010, 5
10111011, 4 => 010111011, 4
10111100, 3 => 111101001, 4
10111101, 4 => 010111101, 4
10111110, 3 => 111101011, 4
10111111, 2 => 111101010, 5
11000000, 1 => 110010101, 6
11000001, 2 => 110010100, 5
11000010, 3 => 110010111, 4
11000011, 2 => 110010110, 5
11000100, 3 => 110010001, 4
11000101, 4 => 011000101, 4
11000110, 3 => 110010011, 4
11000111, 2 => 110010010, 5
11001000, 3 => 110011101, 4
11001001, 4 => 011001001, 4
11001010, 5 => 011001010, 5
11001011, 4 => 011001011, 4
11001100, 3 => 110011001, 4
11001101, 4 => 011001101, 4
11001110, 3 => 110011011, 4
11001111, 2 => 110011010, 5
11010000, 3 => 110000101, 4
11010001, 4 => 011010001, 4
11010010, 5 => 011010010, 5
11010011, 4 => 011010011, 4
11010100, 5 => 011010100, 5
11010001, 6 => 011010101, 6
11010110, 5 => 011010110, 5
11010111, 4 => 011010111, 4
11011000, 3 => 110001101, 4
11011001, 4 => 011011001, 4
11011010, 5 => 011011010, 5

Mean Tr: 4.59

New Coder Mapping - Low Transition
Control Mode
ASCII, Tr => New-Code, Tr

00000000, 0 => 000000000, 0
00000001, 1 => 000000001, 1
00000010, 2 => 000000010, 2
00000011, 1 => 000000011, 1
00000100, 2 => 000000100, 2
00000101, 3 => 000000101, 3
00000110, 2 => 000000110, 2
00000111, 1 => 000000111, 1
00001000, 2 => 000001000, 2
00001001, 3 => 000001001, 3
00001010, 4 => 101011111, 3
00001011, 3 => 000001011, 3
00001100, 2 => 000001100, 2
00001101, 3 => 000001101, 3
00001110, 2 => 000001110, 2
00001111, 1 => 000001111, 1
00010000, 2 => 000010000, 2
00010001, 3 => 100010001, 3
00010010, 4 => 101000111, 3
00010011, 3 => 000010011, 3
00010100, 4 => 101000001, 3
00010101, 5 => 101000000, 2
00010110, 4 => 101000011, 3
00010111, 3 => 000010111, 3
00011000, 2 => 000011000, 2
00011001, 3 => 000011001, 3
00011010, 4 => 101001111, 3
00011011, 3 => 000011011, 3
00011100, 2 => 000011100, 2
00011101, 3 => 000011101, 3
00011110, 2 => 000011110, 2
00011111, 1 => 000011111, 1
00100000, 2 => 000100000, 2
00100001, 3 => 000100001, 3
00100010, 4 => 101110111, 3
00100011, 3 => 000100011, 3
00100100, 4 => 101110001, 3
00100101, 5 => 101110000, 2
00100110, 4 => 101110011, 3
00100111, 3 => 000100111, 3
00101000, 4 => 101111101, 3
00101001, 5 => 101111100, 2
00101010, 6 => 101111111, 1
00101011, 5 => 101111110, 2
00101100, 4 => 101111001, 3
00101101, 5 => 101111000, 2
00101110, 4 => 101111011, 3
00101111, 3 => 000101111, 3
00110000, 2 => 000110000, 2
00110001, 3 => 000110001, 3
00110010, 4 => 101100111, 3
01101011, 5 => 100111110, 2
01101100, 4 => 100111001, 3
01101101, 5 => 100111000, 2
01101110, 4 => 100111011, 3
01101111, 3 => 100111010, 3
01110000, 2 => 001101111, 2
01110001, 3 => 001110000, 3
01110010, 4 => 001110001, 3
01101011, 3 => 100100111, 3
01110100, 4 => 001110011, 3
01110101, 5 => 100100001, 2
01110110, 4 => 100100000, 3
01110111, 3 => 100100011, 3
01111000, 2 => 001111000, 2
01111001, 3 => 001111001, 3
01111010, 4 => 100101111, 3
01111011, 3 => 001111011, 3
01111100, 2 => 001111100, 2
01111101, 3 => 011111101, 3
01111110, 2 => 001111110, 2
01111111, 1 => 001111111, 1
10000000, 1 => 010000000, 1
10000001, 2 => 010000001, 2

00110011, 3 => 000110011, 3
00110100, 4 => 101100001, 3
00110101, 5 => 101100000, 2
00110110, 4 => 101100011, 3
00110111, 3 => 000110111, 3
00111000, 2 => 000111000, 2
00111001, 3 => 000111001, 3
00111010, 4 => 101101111, 3
00111011, 3 => 000111011, 3
00111100, 2 => 000111100, 2
00111101, 3 => 000111101, 3
00111110, 2 => 000111110, 2
00111111, 1 => 000111111, 1
01000000, 2 => 001000000, 2
01000001, 3 => 001000091, 3
01000010, 4 => 100010111, 3
01000011, 3 => 001000011, 3
01000100, 4 => 100010001, 3
01000101, 5 => 100010000, 2
01000110, 4 => 100010011, 3
01000111, 3 => 001000111, 3
01001000, 4 => 100011101, 3
01001001, 5 => 100011100, 2
01001010, 6 => 100011111, 1
01001011, 5 => 100011110, 2
01001100, 4 => 100011001, 3
01001101, 5 => 100011000, 2
01001110, 4 => 100011011, 3
01001111, 3 => 001001111, 3
01010000, 4 => 100000101, 3
01010001, 5 => 100000100, 2
01010010, 6 => 100000111, 1
01010011, 5 => 100000110, 2
01010100, 6 => 100000001, 1
01010101, 7 => 100000000, 0
01010110, 6 => 100000011, 1
01010111, 5 => 100000010, 2
01011000, 4 => 100001101, 3
01011001, 5 => 100001100, 2
01011010, 6 => 100001111, 1
01011011, 5 => 100001110, 2
01011100, 4 => 100001001, 3
01011101, 5 => 100001000, 2
01011110, 4 => 100001011, 3
01011111, 3 => 001011111, 3
01100000, 2 => 001100000, 2
01100001, 3 => 001100001, 3
01100010, 4 => 100110111, 3
01100011, 3 => 001100011, 3
01100100, 4 => 100110001, 3
01100101, 5 => 100110000, 2
01100110, 4 => 100110011, 3
01100111, 3 => 001100111, 3
01101000, 4 => 100111101, 3
01101001, 5 => 100111100, 2
01101010, 6 => 100111111, 1
10100011, 4 => 111110110, 3
10100100, 5 => 111110001, 2
10100101, 6 => 111110000, 1
10100110, 5 => 111110011, 2
10100111, 4 => 111110010, 3
10101000, 5 => 111111101, 2
10101001, 6 => 111111100, 1
10101010, 7 => 111111111, 0
10101011, 6 => 111111110, 1
10101100, 5 => 111111001, 2
10101101, 6 => 111111000, 1
10101110, 5 => 111111011, 2
10101111, 4 => 111111010, 3
10110000, 3 => 010110000, 3
10110001, 4 => 111100100, 3
10110010, 5 => 111100111, 2
10110011, 4 => 111100110, 3
10110100, 5 => 111100001, 2

10000010, 3 => 010000010, 3
10000011, 2 => 010000011, 2
10000100, 3 => 010000100, 3
10000101, 4 => 111010000, 3
10000110, 3 => 010000110, 3
10000111, 2 => 010000111, 2
10001000, 3 => 010001000, 3
10001001, 4 => 111011100, 3
10001010, 5 => 111011111, 2
10001011, 4 => 110111110, 3
10001100, 3 => 010001100, 3
10001101, 4 => 111011000, 3
10001110, 3 => 010001110, 3
10001111, 2 => 010001111, 2
10010000, 3 => 010010000, 3
10010001, 4 => 111000100, 3
10010010, 5 => 111000111, 2
10010011, 4 => 111000110, 3
10010100, 5 => 111000001, 2
10010101, 6 => 111000000, 1
10010110, 5 => 111000011, 2
10010111, 4 => 111000010, 3
10011000, 3 => 010011000, 3
10011001, 4 => 111001100, 3
10011010, 5 => 111001111, 2
10011011, 4 => 111001110, 3
10011100, 3 => 010011100, 3
10011101, 4 => 111001000, 3
10011110, 3 => 010011110, 3
10011111, 2 => 010011111, 2
10100000, 3 => 010100000, 3
10100001, 4 => 111110100, 3
10100010, 5 => 111110111, 2
11011011, 4 => 110001110, 3
11011100, 3 => 011011100, 3
11011101, 4 => 110001000, 3
11011110, 3 => 011011110, 3
11011111, 2 => 011011111, 2
11100000, 1 => 011100000, 1
11100001, 2 => 011100001, 2
11100010, 3 => 011100010, 3
11100011, 2 => 011100011, 2
11100100, 3 => 011100100, 3
11100101, 4 => 110110000, 3
11100110, 3 => 011100110, 3
11100111, 2 => 011100111, 2
11101000, 3 => 011101000, 3
11101001, 4 => 110111100, 3
11101010, 5 => 110111111, 2
11101011, 4 => 110111110, 3
11101100, 3 => 011101100, 3
11101101, 4 => 110111000, 3
11101110, 3 => 011101110, 3
11101111, 2 => 011101111, 2
11110000, 1 => 011110000, 1
11110001, 2 => 011110001, 2
11110010, 3 => 011110010, 3
11110011, 2 => 011110011, 2
11110100, 3 => 011110100, 3
11110101, 4 => 110100000, 3
11110110, 3 => 011110110, 3
11110111, 2 => 011110111, 2
11111000, 1 => 011111000, 1
11111001, 2 => 011111001, 2
11111010, 3 => 011111010, 3
11111011, 2 => 011111011, 2
11111100, 1 => 011111100, 1
11111101, 2 => 011111101, 2
11111110, 1 => 011111110, 1
11111111, 0 => 011111111, 0
Total Tr: 616
Mean Tr: 2.41

10110101, 6 => 111100000, 1
10110110, 5 => 111100011, 2
10110111, 4 => 111100010, 3
10111000, 3 => 010111000, 3
10111001, 4 => 111101100, 3
10111010, 5 => 111101111, 2
10111011, 4 => 111101110, 3
10111100, 3 => 010111100, 3
10111101, 4 => 111101000, 3
10111110, 3 => 010111110, 3
10111111, 2 => 010111111, 2
11000000, 1 => 011000000, 1
11000001, 2 => 011000001, 2
11000010, 3 => 011000010, 3
11000011, 2 => 011000011, 2
11000100, 3 => 011000100, 3
11000101, 4 => 110010000, 3
11000110, 3 => 011000110, 3
11000111, 2 => 011000111, 2
11001000, 3 => 011001000, 3
11001001, 4 => 110011100, 3
11001010, 5 => 110011111, 2
11001011, 4 => 110011110, 3
11001100, 3 => 011001100, 3
11001101, 4 => 110011000, 3
11001110, 3 => 011001110, 3
11001111, 2 => 011001111, 2
11010000, 3 => 011010000, 3
11010001, 4 => 110000100, 3
11010010, 5 => 110000111, 2
11010011, 4 => 110000110, 3
11010100, 5 => 110000001, 2
11010101, 6 => 110000000, 1
11010110, 5 => 110000011, 2
11010111, 4 => 110000010, 3
11011000, 3 => 011011000, 3
11011001, 4 => 110001100, 3
11011010, 5 => 110001111, 2

Shin, 20:11-23:60 (listing all input and output values for the high-transition mode 8b/10b encoding scheme).

122. Thus, Kim's disclosure of providing 8-bit input audio data words capable of being encoded as conventional sequence (using 8b10b encoding) of 10-bit code words of the available code word set renders obvious "*the input data can be encoded as a conventional sequence of code words of the full code word set.*"

123. I note that Kim teaches a "*full code word set*" under Patent Owner's interpretation of this term as well. It has been explained to me that Patent Owner interprets this term as follows: "A full code word set comprise 2^{10}=1024 codewords of 10 bits." Ex.1012, 5. Under that interpretation of the phrase, Kim alone would disclose a "*full code word set*" because Kim's encoders generate 10-bit output words. *See* Kim, 5:50-6:16.

[1.6] ***the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words,***

124. Kim in combination with Myers renders this limitation obvious.

125. Kim's encoders 40b-40n, using Myers' more robust subset-selection technique, produce 10-bit words that are "*less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words*." For the reasons explained above, Myers' subset of codewords use fewer contiguous '1's and '0's, thus making them less susceptible to inter-symbol interference and other data loss attributable to "longer strings of consecutive binary digits." Myers, 3:8-12. Additionally, "each code word also begins and ends with either a '01' or '10' bit grouping, to also provide for a (0,1) run-length limit across word boundaries." Myers, 7:30-32. Thus, the number of contiguous '1's and '0's across word/symbol[2] boundaries is limited as well. *See* Myers, 2:40-57. Thus, by use fewer contiguous '1's and '0's, Myers' technique reduces inter-symbol interference.

126. Myers' subset-selection technique reduces inter-symbol interference in the same way as the '437 patent. The '437 patent itself acknowledges that fewer contiguous 1's and 0's will reduce inter-symbol interference:

> In preferred embodiments, **the inventive code words are selected to be those whose serial patterns (during transmission) have fewer contiguous zeros and ones (e.g., on the average), and thus are less susceptible to ISI during transmission**, than do those code words in the full set that are not selected (e.g., the average number of contiguous zeros and ones, per code word, of the inventive code words is less than the average number of contiguous zeros and ones, per code word, of the

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[2] A POSITA would have understood that a "symbol" simply refers to the 10-bit encoded word. Ex.1015, 3 ("symbol ... (6) A 10-bit, 8B/10B encoded byte.

> code words in the full set that are not selected as the inventive code words).

’437 patent, 7:18-34.

127. Accordingly, because Myers’ subset-selection technique produces code words with fewer contiguous 1’s and 0’s, Myers’ technique reduces inter-symbol interference in the manner claimed.

128. Thus, Kim’s encoders 40b-40n—implementing Myers’ subset-selection technique—reduce inter-symbol interference and thus render obvious “*the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words.*”

129. Kim also teaches “*wherein each of the selected code words is a member of a robust subset of the full code word set*” under Patent Owner’s interpretation of this term. Patent Owner alleges that less susceptibility to inter-symbol interference is met by “symbol-level DC balancing.” *See* Ex.1012, 6. Under that interpretation of the phrase, Kim in combination with Myers teaches code words that are “*less susceptible to inter-symbol interference*” because Myers’ subset is DC balanced. *See e.g.* Myers, 8:16-23.

[1.7] *wherein the input data are auxiliary data,*

130. Kim’s “multimedia data streams” are “*auxiliary data*” as described in the '437 patent. The '437 patent explains that "[t]he expression 'auxiliary data' is used in a broad sense herein to denote digital audio data or any other type of data other than video data and timing information for video data (e.g., a video clock)." '437 patent, 5:22-25. Kim similarly describes its invention "in the context of mixing various multimedia data streams into the display refresh data (primary stream) using the unused bandwidth of horizontal and vertical blanking periods." Kim, 5:20-27. "Possible multimedia data streams that can be mixed include, but are not limited to audio I/O, keyboard and mouse, IC bus (serial bus for peripheral components)." Kim, 5:20-27.

131. Thus, Kim's input multimedia data streams which may be audio data streams renders obvious "*wherein the input data are auxiliary data*."

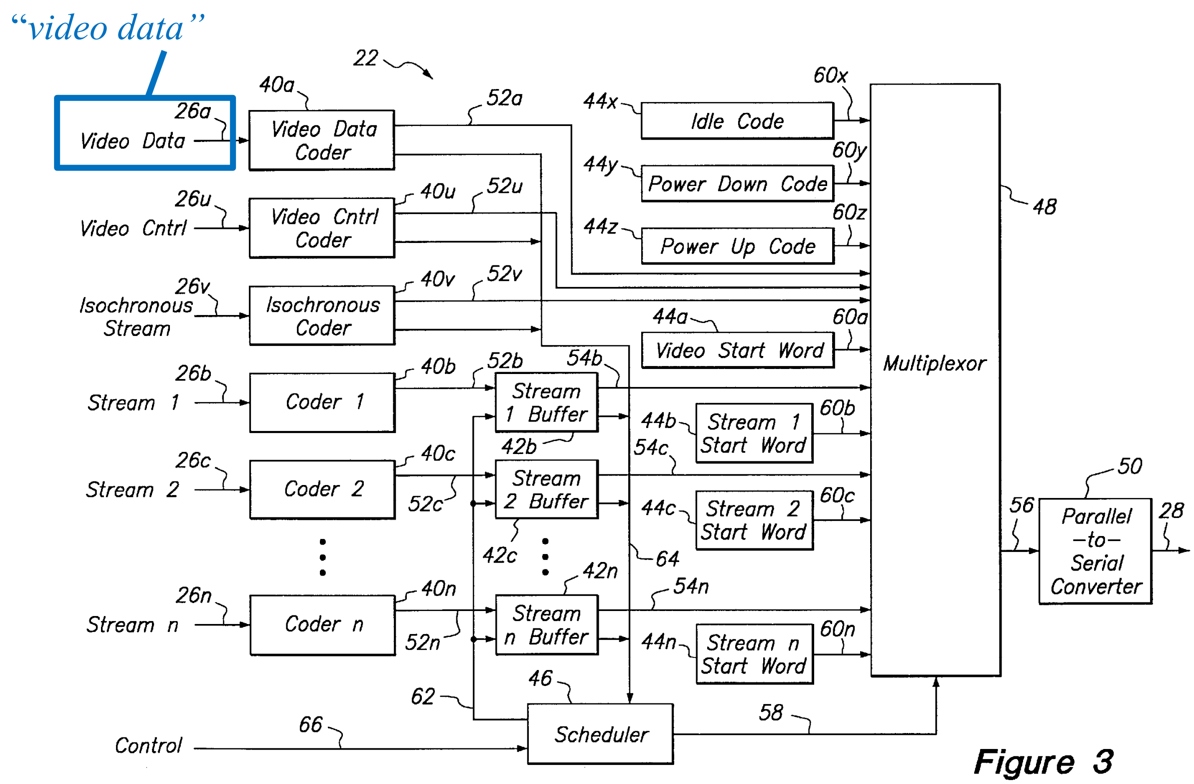
[1.8] ***the transmitter is coupled to receive video data and configured to generate a sequence of video code words by encoding the video data, and***

132. **First**, Kim's embedding unit 22 is configured to receive video data on signal line 26a.

> The encoder 40 preferably has a plurality of inputs and a plurality of outputs. The plurality of inputs are preferably grouped in sets. Thus, in FIG. 2, signal lines 26a, 26b, 26c, . . . 26n are each used to designate one or more signal lines of a data stream. **For example, the first primary stream is preferably a video stream including the data and control signals for display refresh** and may for example, be 28 parallel lines, 24 for data and 4 for control. The remaining signal lines

> 26b, 26c, . . . 26n can be used for other types of data, and are for example, each eight parallel lines. Those skilled in the art will realize that each signal line 26a, 26b, 26c, . . . 26n may be a variety of parallel signal lines. For each of the input signal lines 26a, 26b, 26c, . . . 26n, the encoder 40 preferably provides a corresponding output signal line 52a, 52b, 52c, . . . 52n. Each of the output signals line 52a, 52b, 52c, ... 52n provides the encoded output of the signal applied to the corresponding input of the encoder 40. In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word. Thus, each of the output signals line 52a, 52b, 52c, ... 52n is 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input of the multiplexor 48. The remaining output lines are 52b, 52c, ... 52n are coupled to respective inputs of the data buffer 42. The encoder 40 preferably encodes the input stream into 10-bit output streams. The word output by the encoder 40 are preferably any 10-bit words other than those identified in Appendix A as special code words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. Any number of conventional eight to 10 encoding schemes may be used in addition to the specific encoding scheme identified below with respect to FIG. 5.

Kim, 5:50-6:15.



Kim, Fig. 3 (annotated).

133. Second, Kim teaches that video code words are generated by an encoder 40a that encodes video data. *See* Kim, 8:44-67. Kim teaches encoding and transmitting video data ("*video code words*") as a video data stream. "For example, the first primary stream is preferably a video stream including the data and control signals for display refresh." Kim, 5:50-6:15. A "video data coder 40a is provided for encoding the video data signals to a 10-bit parallel output." Kim, 8:44-67. For example, the video data coder 40a may be three 8-to-10 bit coders if 24 bits of RGB data are used with 8 bits for a red channel, 8 bits for a green channel, 8 bits for a blue channel, or two 8-to-10 bit coders for 16 bits of YUV data." Kim, 8:44-67.

134. Thus, Kim's encoding of video data as a sequence of video code words renders obvious "*the transmitter is coupled to receive video data and configured to generate a sequence of video code words by encoding the video data.*"

[1.9] ***the transmitter is configured to transmit to the receiver over the serial link a first burst of the video code words followed by a burst of the selected code words followed by a second burst of the video code words,***

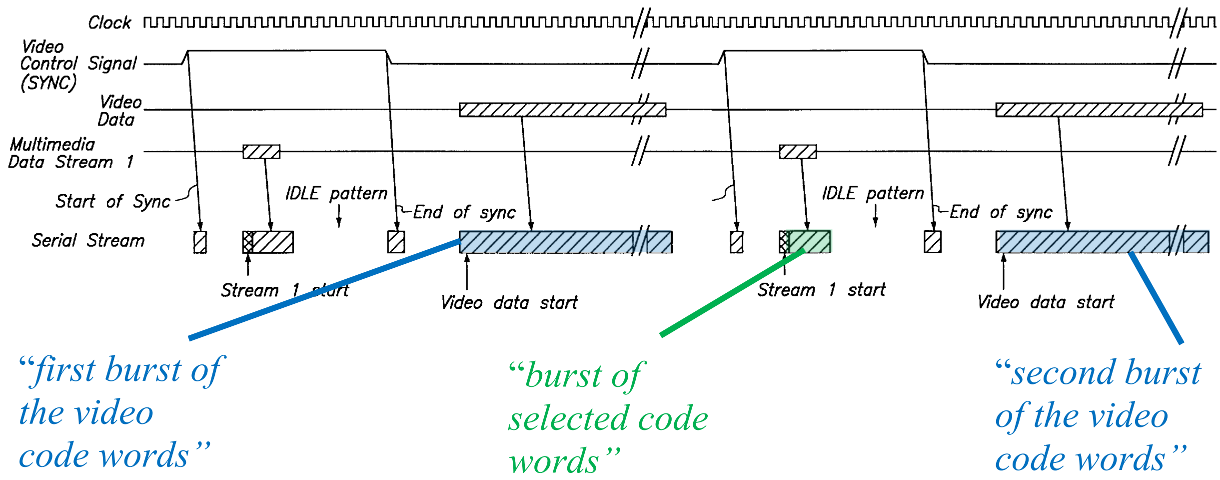
135. **First**, as explained above at [1.0], Kim's system includes a transmitter.

136. **Second**, for the reasons explained above at [1.8], Kim teaches encoding and transmitting video data ("*video code words*") as a video data stream ("*burst[s] of video data*"). Kim, 5:50-6:15; 8:44-67.

137. **Third**, for the reasons explained above at [1.2] and [1.3], Kim's encoders 40b-40n encode an audio data stream as "*selected code words*." Because the selected code words are transmitted as a stream, they are a "***burst** of selected code words*" as claimed.

138. **Fourth**, Kim teaches transmitting video data ("*a first burst of the video code words*"), audio data ("*the burst of the selected code words*"), and more video data ("*a second burst of the video control words*") in the order claimed. Fig. 4A is shown below in a repeated manner, given that the illustrated sequence is repeatedly transmitted over the serial link, as would be understood by a POSITA.

See Ex.1005, 9:45-10:25 (describing Fig. 4a as part of a data **stream**).



Kim, Fig. 4A (modified, annotated).

139. As shown in Fig. 4A above, stream 1 audio data ("*burst of selected code words*") is positioned between a stream of video data ("*first burst of the video code words*") and the more video data ("*second burst of the video code words*"). "FIG. 4A is a timing diagram showing the clock signal, the video control and data signals that form the primary stream, data signals that for a second stream, and the serial stream produced by the embedding unit 22 and output on line 28." Kim, 9:46-10:10. "The timing diagrams of FIGS. 4A and 4B correspond to the embodiment of the embedding unit shown in FIG. 3." Kim, 9:46-10:10. "Data stream 1 is inserted during the horizontal blanking period and a start control word identifying the data stream 1 is used at the head of the data stream 1." Kim, 9:46-10:10.

140. Thus, Kim's transmission of the audio data stream 1 in the blanking period between bursts of video code words renders obvious "*the transmitter is configured to transmit to the receiver over the serial link a first burst of the video code words followed by a burst of the selected code words followed by a second burst of the video code words*."

[1.10] ***wherein each of the video code words is a member of the full code word set and at least one of the video code words is not a member of the robust subset.***

141. First, for the reasons explained above at [1.2], Kim's encoders are capable of encoding data using conventional 8b/10b encoding. As explained above at V.A.5, a POSITA would have been motivated to apply Myers' subset-selection technique to the audio data. However, the video data encoder 40a in Kim may still use conventional 8b/10b encoding that utilizes the full code set. "Still more particularly, a video data coder 40a is provided for encoding the video data signals to a 10-bit parallel output." Kim, 8:44-67.

142. Accordingly, because Kim's system separately encodes video data using conventional 8b/10b encoding techniques, "*each of the video code words is a member of the full code word set*" as claimed.

143. Second, there are some video code words from the full code word set that are not part of Kim's subset using Myers' technique. For example, the code words shown below are an exemplary full code word set. The highlighted words below correspond to the 22 non-control words that Meet Myers's subset criteria. As can be seen, most of the available code words are *not* a member of Myers' subset ("*at least one of the video code words is not a member of the robust subset*").

00000000, 0 => 101010101, 7
00000001, 1 => 101010100, 6
00000010, 2 => 101010111, 5
00000011, 1 => 101010110, 6
00000100, 2 => 101010001, 5
00000101, 3 => 101010000, 4
00000110, 2 => 101010011, 5
00000111, 1 => 101010010, 6
00001000, 2 => 101011101, 5
00001001, 3 => 101011100, 4
00001010, 4 => 000001010, 4
00001011, 3 => 101011110, 4
00001100, 2 => 101011001, 5
00001101, 3 => 101011000, 4
00001110, 2 => 101011011, 5
00001111, 1 => 101011010, 6
00010000, 2 => 101000101, 5
00010001, 3 => 101000100, 4
00010010, 4 => 000010010, 4
00010011, 3 => 101000110, 4
00010100, 4 => 000010100, 4
00010101, 5 => 000010101, 5
00010110, 4 => 000010110, 4
00010111, 3 => 101000010, 4
00011000, 2 => 101001101, 5
00011001, 3 => 101001100, 4
00011010, 4 => 000011010, 4
00011011, 3 => 101001110, 4
00011100, 2 => 101001001, 5
00011101, 3 => 101001000, 4
00011110, 2 => 101001011, 5
00011111, 1 => 101001010, 6
00100000, 2 => 101110101, 5
00100001, 3 => 101110100, 4
00100010, 4 => 000100010, 4
00100011, 3 => 101110110, 4
00100100, 4 => 000100100, 4
00100101, 5 => 000100101, 5
00100110, 4 => 000100110, 4
00100111, 3 => 101110010, 4
00101000, 4 => 000101000, 4
00101001, 5 => 000101001, 5
00101010, 6 => 000101010, 6
00101011, 5 => 000101011, 5
00101100, 4 => 000101100, 4
00101101, 5 => 000101101, 5
00101110, 4 => 000101110, 4
00101111, 3 => 101111010, 4
00110000, 2 => 101100101, 5
00110001, 3 => 101100100, 4
00110010, 4 => 000110010, 4
01101011, 5 => 001101011, 5
01101100, 4 => 001101100, 4
01101101, 5 => 001101101, 5
01101110, 4 => 001101110, 4
01101111, 3 => 100111010, 4
01110000, 2 => 100100101, 5
01110001, 3 => 100100100, 4
01110010, 4 => 001110010, 4
01110011, 3 => 100100110, 4
01110100, 4 => 001110100, 4
01110101, 5 => 001110101, 5
01110110, 4 => 001110110, 4
01110111, 3 => 100100010, 4

00110011, 3 => 101100110, 4
00110100, 4 => 000110100, 4
00110101, 5 => 000110101, 5
00110110, 4 => 000110110, 4
00110111, 3 => 101100010, 4
00111000, 2 => 101101101, 5
00111001, 3 => 101101100, 4
00111010, 4 => 000111010, 4
00111011, 3 => 101101110, 4
00111100, 2 => 101101001, 5
00111101, 3 => 101101000, 4
00111110, 2 => 101101011, 5
00111111, 1 => 101101010, 6
01000000, 2 => 100010101, 5
01000001, 3 => 100010100, 4
01000010, 4 => 001000010, 4
01000011, 3 => 100010110, 4
01000100, 4 => 001000100, 4
01000101, 5 => 001000101, 5
01000110, 4 => 001000110, 4
01000111, 3 => 100010010, 4
01001000, 4 => 001001000, 4
01001001, 5 => 001001001, 5
01001010, 6 => 001001010, 6
01001011, 5 => 001001011, 5
01001100, 4 => 001001100, 4
01001101, 5 => 001001101, 5
01001110, 4 => 001001110, 4
01001111, 3 => 100011010, 4
01010000, 4 => 001010000, 4
01010001, 5 => 001010001, 5
01010010, 6 => 001010010, 6
01010011, 5 => 001010011, 5
01010100, 6 => 001010100, 6
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01010110, 6 => 001010110, 6
01010111, 5 => 001010111, 5
01011000, 4 => 001011000, 4
01011001, 5 => 001011001, 5
01011010, 6 => 001011010, 6
01011011, 5 => 001011011, 5
01011100, 4 => 001011100, 4
01011101, 5 => 001011101, 5
01011110, 4 => 001011110, 4
01011111, 3 => 100001010, 4
01100000, 2 => 100110101, 5
01100001, 3 => 100110100, 4
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01100011, 3 => 100110110, 4
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10101001, 6 => 010101001, 6
10101010, 7 => 010101010, 7

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01111001, 3 => 100101100, 4
01111010, 4 => 001111010, 4
01111011, 3 => 100101110, 4
01111100, 2 => 100101001, 5
01111101, 3 => 100101000, 4
01111110, 2 => 100101011, 5
01111111, 1 => 100101010, 6
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10000010, 3 => 111010111, 4
10000011, 2 => 111010110, 5
10000100, 3 => 111010001, 4
10000101, 4 => 010000101, 4
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10001000, 3 => 111011101, 4
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10001010, 5 => 010001010, 5
10001011, 4 => 010001011, 4
10001100, 3 => 111011001, 4
10001101, 4 => 010001101, 4
10001110, 3 => 111011011, 4
10001111, 2 => 111011010, 5
10010000, 3 => 111000101, 4
10010001, 4 => 010010001, 4
10010010, 5 => 010010010, 5
10010011, 4 => 010010011, 4
10010100, 5 => 010010100, 5
10010101, 6 => 010010101, 6
10010110, 5 => 010010110, 5
10010111, 4 => 010010111, 4
10011000, 3 => 111001101, 4
10011001, 4 => 010011001, 4
10011010, 5 => 010011010, 5
10011011, 4 => 010011011, 4
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10011110, 3 => 111001011, 4
10011111, 2 => 111001010, 5
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11011110, 3 => 110001011, 4
11011111, 2 => 110001010, 5
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11110001, 2 => 110100100, 5
11110010, 3 => 110100111, 4
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11110110, 3 => 110100011, 4
11110111, 2 => 110100010, 5
11111000, 1 => 110101101, 6
11111001, 2 => 110101100, 5
11111010, 3 => 110101111, 4
11111011, 2 => 110101110, 5
11111100, 1 => 110101001, 6
11111101, 2 => 110101000, 5
11111111, 0 => 110101010, 7
Total Tr: 1176

10101011, 6 => 010101011, 6
10101100, 5 => 010101100, 5
10101101, 6 => 010101101, 6
10101110, 5 => 010101110, 5
10101111, 4 => 010101111, 4
10110000, 3 => 111110101, 4
10110001, 4 => 010110001, 4
10110010, 5 => 010110010, 5
10110011, 4 => 010110011, 4
10110100, 5 => 010110100, 5
10110101, 6 => 010110101, 6
10110110, 5 => 010110110, 5
10110111, 4 => 010110111, 4
10111000, 3 => 111101101, 4
10111001, 4 => 010111001, 4
10111010, 5 => 010111010, 5
10111011, 4 => 010111011, 4
10111100, 3 => 111101001, 4
10111101, 4 => 010111101, 4
10111110, 3 => 111101011, 4
10111111, 2 => 111101010, 5
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11000001, 2 => 110010100, 5
11000010, 3 => 110010111, 4
11000011, 2 => 110010110, 5
11000100, 3 => 110010001, 4
11000101, 4 => 011000101, 4
11000110, 3 => 110010011, 4
11000111, 2 => 110010010, 5
11001000, 3 => 110011101, 4
11001001, 4 => 011001001, 4
11001010, 5 => 011001010, 5
11001011, 4 => 011001011, 4
11001100, 3 => 110011001, 4
11001101, 4 => 011001101, 4
11001110, 3 => 110011011, 4
11001111, 2 => 110011010, 5
11010000, 3 => 110000101, 4
11010001, 4 => 011010001, 4
11010010, 5 => 011010010, 5
11010011, 4 => 011010011, 4
11010100, 5 => 011010100, 5
11010001, 6 => 011010101, 6
11010110, 5 => 011010110, 5
11010111, 4 => 011010111, 4
11011000, 3 => 110001101, 4
11011001, 4 => 011011001, 4
11011010, 5 => 011011010, 5

144. Thus, Kim's encoding of video data with code words that don't meet Myers' subset criteria renders obvious "*wherein each of the video code words is a member of the full code word set and at least one of the video code words is not a member of the robust subset.*"

9. Claim 2

[2.1] ***The system of claim 1, wherein the transmitter is also coupled to receive control bits,***

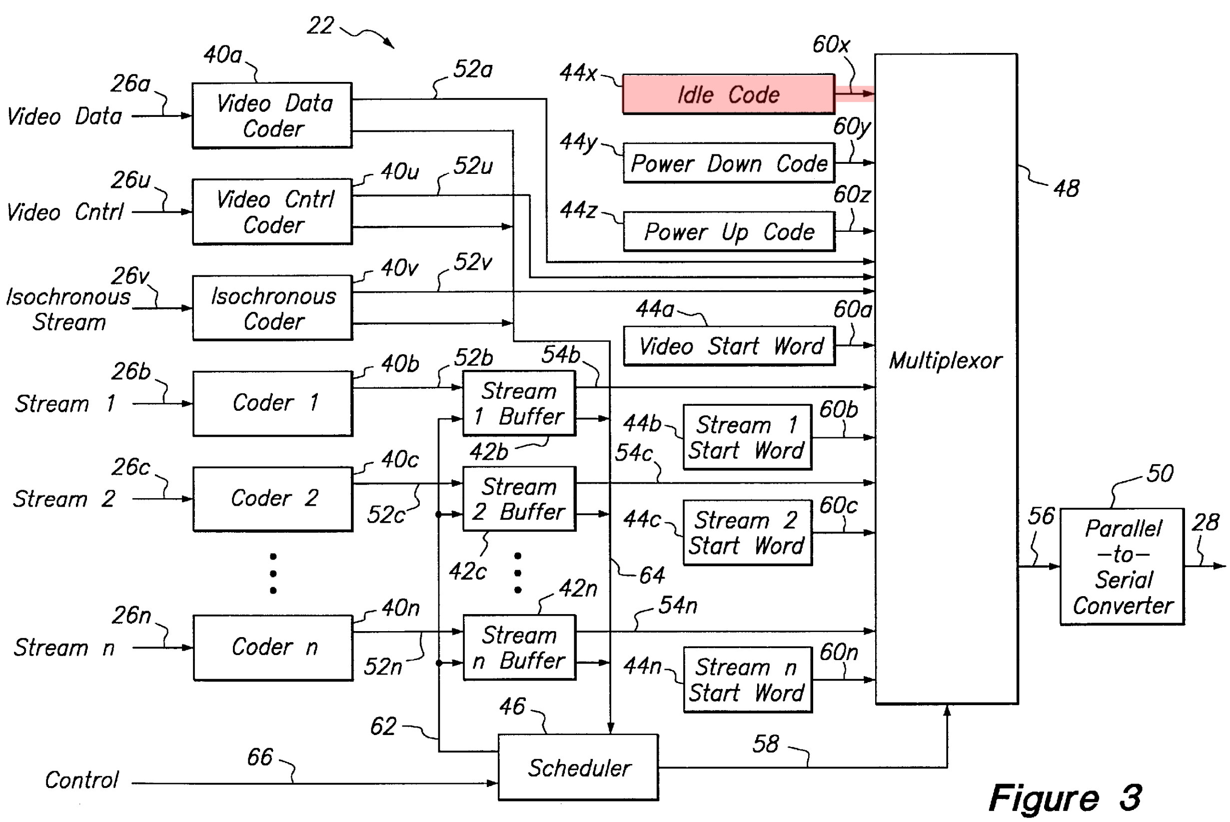
145. **First**, Kim explains that the embedding unit 22 receives control signals ("*control bits*").

> The embedding unit 22 preferably has a plurality of inputs and a first and second outputs. Each of the plurality of inputs is coupled to a respective input signal line 26a, 26b, 26c, 26n to receive a primary signal, preferably a video signal, a second signal, a third signal and a nth signal. Each of the inputs and corresponding input signal lines 26a, 26b, 26c, 26n is a plurality of signal lines. For example, the primary signal line may be a video signal that has 8 signal lines for data (8 bits of Red, 8 bits of Green, 8 bits of Blue in sequence) and signal lines for **a control signals** (horizontal sync, vertical sync **and other control signals**); and the second signal may be an eight bit data signal requiring eight signal lines. Those skilled in the art will realize that the primary signal, second signal, third signal and nth signal may each require different numbers of signal lines and that a variety of combinations may be possible. The embedding unit 22 receives the primary signal, second signal, third signal and nth signal, and encodes each signal. Then the

embedding unit 22 combines the encoded signals and inserts separation signals or characters for identifying the input signal from which the encoded signals were derived. The combination results in an encoded serial sequence that is output on the first output for transmission over the serial line 28. The second output of the embedding unit 22 provides a clock signal used to synchronize the transmission of the encoded sequence.

Kim, 4:28-53.

146. Kim describes an IDLE code generator 44x: "The first control code generator 44x is coupled to an input of the multiplexor 48 via line 60a to provide the IDLE word." Kim, 9:27-28.



Ex.1005, Fig. 3 (annotated).

147. While Kim describes the IDLE code generator generally, Kim is silent as to the mechanism by which the IDLE code generator selects a particular IDLE code word. Kim discloses that there are eight different IDLE words.

Sample Control Words
IDLE Words
0101010110
0101011010
0101101010
0110101010
1010101001
1010100101
1010010101
1001010101

Kim, 19:37-48.

148. A POSITA would have found it obvious to generate one of the eight IDLE words by encoding a set of control signals (i.e., control bits), as taught by Shin. Shin thus provides evidence that it was known to generate a particular control word by encoding a set of control bits to select a particular control word: "As shown in FIG. 3, each encoder unit will encode ... 2-bit of control signals using the encoder described in the previous section." Shin, 6:33-36. Shin thus describes using a 2-bit control signal to select one of four different control words (2^2=4), shown below. Shin, 10:35-40.

1100101010 1101001010 1101010010 1101010100

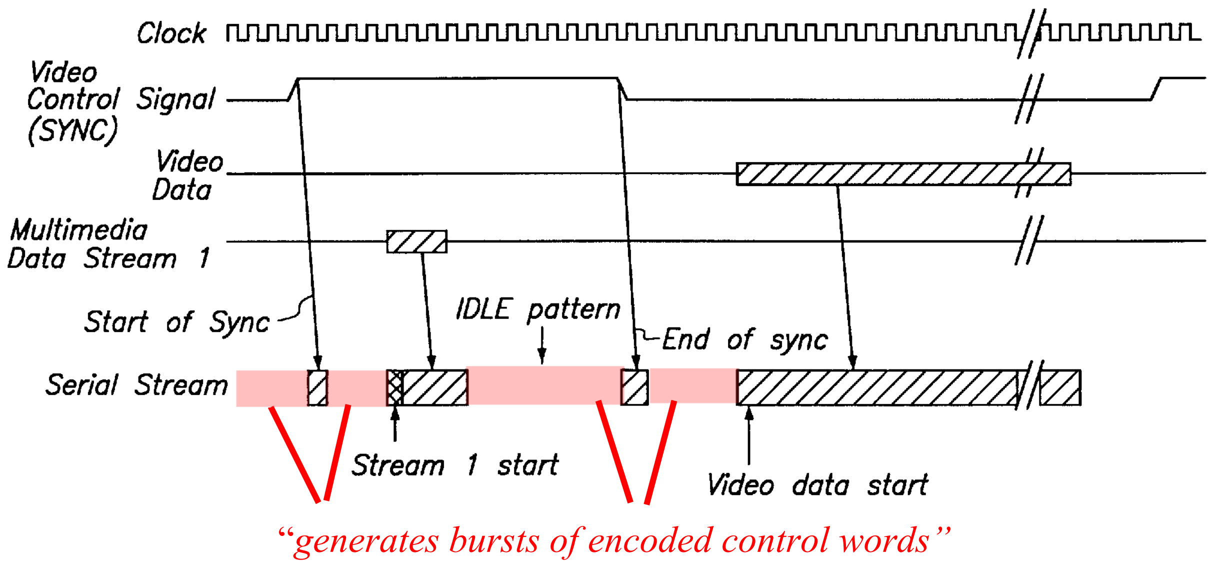
149. Accordingly, a POSITA would have found it obvious to generate control words using a set of control signals (i.e., control bits) to select a particular control word. Because Kim's IDLE words consist of eight different values, three control bits are used to generate one of the control words (2^3=8). Thus, by converting three control bits into a 10-bit IDLE word, Kim teaches generating encoded control words "*by encoding control bits*" as claimed.

150. Thus, Kim's embedding unit which is configured to receive control signals that may be control bits as evidenced by Shin, renders obvious "*wherein the transmitter is also coupled to receive control bits*."

[2.2] ***configured to generate bursts of encoded control words by encoding the control bits, and***

151. **First**, Kim's system generates "*bursts*" of IDLE control words by repeatedly transmitting the IDLE control words between different types of data streams. "If there are no data words or isochronous data transfer words to be sent, the scheduler 46 sends controls the multiplexor 48 such that an IDLE word is transmitted." Kim, 8:16-18; *see also* Kim, 10:56-64. "The IDLE words are noted below in Appendix A. An idle pattern is a continuous sequence of one of the idle words and its inverse. An exemplary idle pattern is: 0110101010100101010101101010101001010101010110101010101001010101." Kim, 14:32-44; *see also* Fig. 6.

152. Accordingly, Kim generates multiple idle words between data transmissions, as shown below in annotated Fig. 4. Each of these repeated idle words together teach "*bursts of encoded control words*" as claimed.

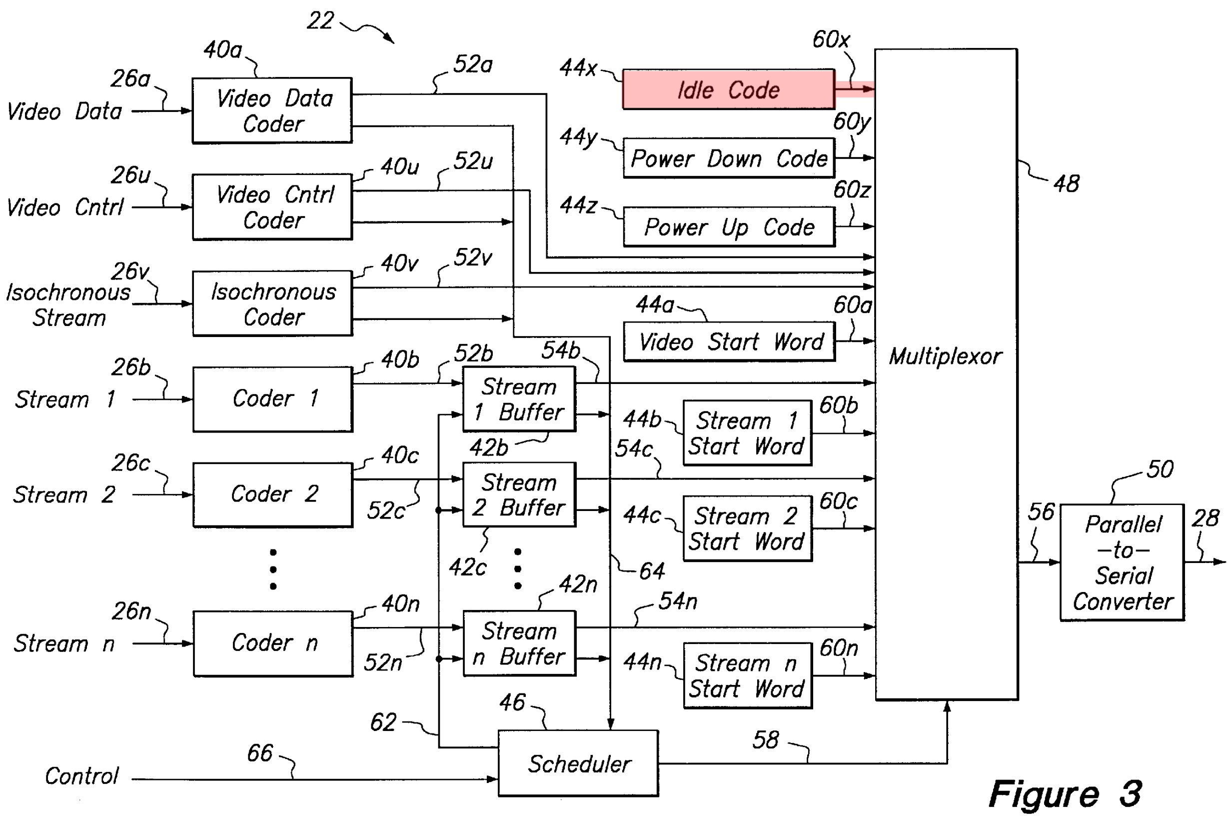


Kim, Fig. 4A (annotated).

153. **Second**, Kim generates the encoded control words by "*encoding control bits*." As explained above at [2.1], Kim's encoder 44x may select an IDLE word using control signals in the form of control bits. By converting three control bits into a 10-bit IDLE word, Kim's IDLE word generator 44x generates encoded control words "*by encoding control bits*" as claimed.

154. Kim discloses that the control words are generated by "*encoding control bits*" because each IDLE control word is a set of bits encoded via 8b/10b encoding. Kim, 7:15-16 ("Appendix A shows an example selection of special control words for an 8 bit/10 bit encoding."), 19:37-48 (Appendix A, identifying "IDLE Words" as 8bit/10bit encoded control words). In other words, Kim renders this limitation obvious because Kim's IDLE words are part of a "selection of special characters for the 8 bit/10 bit encoding scheme." Kim, 6:67-7:45. Because the IDLE words are a product of Kim's 8b/10b encoding scheme, whatever inputs that dictate the placement of Kim's IDLE words are "*control bits*" as claimed. Thus, Kim's 8b/10b encoding scheme, which includes IDLE words, teaches generating encoded control words "*by encoding control bits*" as claimed.

155. To the extent that the "*control bits*" refer to the control signals used to select a particular control word, Kim and Shin render obvious encoding such control bits to generate control words, as well. As described above, Kim describes an IDLE code generator 44x: "The first control code generator 44x is coupled to an input of the multiplexor 48 via line 60a to provide the IDLE word." Kim, 9:27-28.



Ex.1005, Fig. 3 (annotated).

156. While Kim describes the IDLE code generator generally, Kim is silent as to the mechanism by which the IDLE code generator selects a particular IDLE code word. Kim discloses that there are eight different IDLE words.

Sample Control Words
IDLE Words
0101010110
0101011010
0101101010
0110101010
1010101001
1010100101
1010010101
1001010101

Kim, 19:37-48.

157. A POSITA would have found it obvious to generate one of the eight IDLE words by encoding a set of control signals (i.e., control bits), as taught by Shin. Shin discloses generating a particular control word by encoding a set of control bits: "As shown in FIG. 3, each encoder unit will encode ... 2-bit of control signals using the encoder described in the previous section." Shin, 6:33-36. Shin thus describes encoding a 2-bit control signal to generate one of four different control words (2^2=4), shown below. Ex.1007, 10:35-40.

1100101010
1101001010
1101010010
1101010100

158. Accordingly, a POSITA would have found it obvious to generate control words by encoding a set of control signals (i.e., control bits). Specifically, because Kim's IDLE words consist of eight different values, a POSITA would find it obvious that three control bits could be encoded to generate one of the control words (2^3=8). Thus, by converting three control bits into a 10-bit IDLE word, Kim teaches generating encoded control words "*by encoding control bits*" as claimed.

159. Thus, Kim's repeated transmission of 10-bit IDLE words, which may be generated by encoding control bits as described by Shin, renders obvious "*configured to generate bursts of encoded control words by encoding the control bits*."

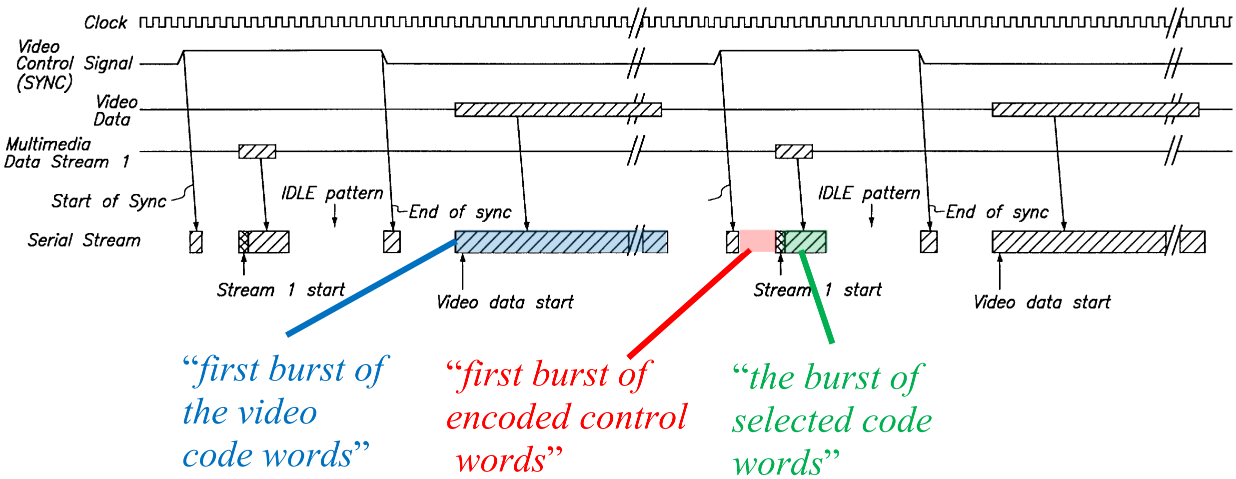
[2.3] ***configured to transmit to the receiver over the serial link a first burst of the encoded control words between the first burst of the video code words and the burst of the selected code words, and***

160. **First**, as explained above at [1.1], Kim's system transmits data over a serial link.

161. **Second**, for the reasons explained above at [2.2], Kim teaches "*bursts of encoded control words*."

162. **Third**, for the reasons explained above at [1.8]-[1.10], Kim teaches "*the first burst of the video code words and the burst of the selected code words*."

163. **Fourth**, Kim teaches transmitting video data ("*a first burst of the video code words*"), control data ("*a first burst of the encoded control words*"), and audio data ("*the burst of the selected code words*") in the order claimed. Fig. 4A is shown below in a repeated manner, given that the illustrated sequence is repeatedly transmitted over the serial link. *See* Kim, 9:45-10:25 (describing Fig. 4a as part of a data stream).



Kim, Fig. 4a (modified, annotated).

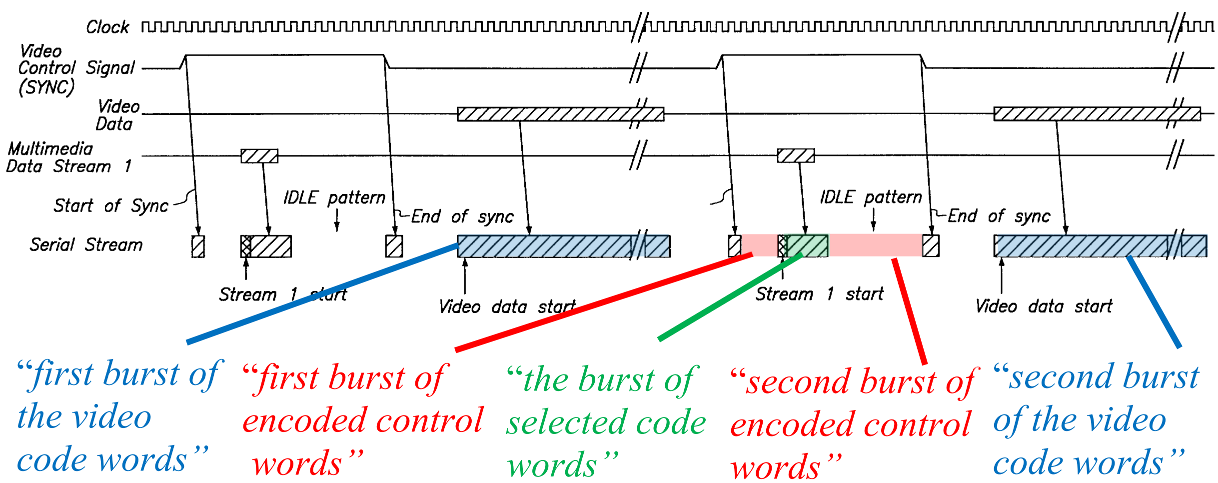
164. As shown in Fig. 4A above, there is an IDLE period ("*first burst of encoded control words*") positioned between a stream of video data ("*first burst of the video code words*") and the encoded stream 1 (e.g. audio data) ("*the burst of selected code words*"). Kim, 9:46-10:10. "Data stream 1 is inserted during the horizontal blanking period and a start control word identifying the data stream 1 is used at the head of the data stream 1." Kim, 9:46-10:10. "If every stream buffer is emptied and no video signal enters, the scheduler sends an IDLE word for bit synchronization and word synchronization." Kim, 9:46-10:10.

165. Thus, Kim's transmission of audio data between bursts of video data renders obvious "*configured to transmit to the receiver over the serial link a first burst of the encoded control words between the first burst of the video code words and the burst of the selected code words*."

[2.4] a second burst of the encoded control words between the burst of the selected code words and the second burst of the video code words.

166. First, for the reasons explained above at [2.3], Kim teaches transmitting video data ("*burst of the video code words*"), control data ("*burst of the encoded control words*"), and a data stream ("*the burst of the selected code words*").

167. Second, Kim teaches transmitting video data ("*a second burst of the video code words*"), control data ("*a second burst of the encoded control words*"), and audio data ("*the burst of the selected code words*") in the order claimed.



Kim, Fig. 4A (modified, annotated).

168. As shown in Fig. 4A above, additional IDLE words ("*second burst of* *encoded control words*") are positioned between the encoded audio data ("*the burst of the selected code words*") and the subsequent stream of video data ("*second burst of the video code words*"). *See* Kim, 9:46-10:10.

169. Thus, Kim's transmission of a second burst of IDLE control words between the audio data stream and a subsequent video stream renders obvious "*a second burst of the encoded control words between the burst of the selected code words and the second burst of the video code words*."

10. Claim 3

[3.1] *The system of claim 2, wherein the selected code words include at least one guard band word, the burst of the selected code words has an initial word, and the initial word is the guard band word.*

170. Kim renders this limitation obvious.

171. **First**, as described above at [1.3] and [1.4], Kim's device includes an encoder (e.g., 40b) for encoding audio data into "*selected code words*," which may be encoded using Myers' subset-selection technique.

172. **Second,** some of words in Myers' subset as applied to Kim ("*selected code words*") correspond to Kim's data separation words ("*guard band word[s]*"). As explained above at [1.4], six of Kim's data stream separation words meet Myers' subset criteria.

Data Stream Separation Words
1000101011
1000101101
1000110101
1001001011
1001001101
1001010011
1001011001
1001100101
1001101001
1010001011
1010001101
1010010011
1010011001
1010100011
1010110001
1011000101
1011001001
1011010001
1100010101
1100100101
1100101001
1101000101
1101001001
1101010001

173. Because Kim in combination with Myers teaches using data separation words that are part of the subset, Kim and Myers teach "*the selected code words include at least one guard band word*" as claimed.

174. Kim's data separation words are the same as the guard band words described and claimed in the '437 patent. The '437 patent explains that "a 'guard band' word [] is transmitted at the start or end (or the start and end) of a burst of encoded data (to identify the leading and/or trailing edge of the burst) or at the start or end (or at the start and end) of each burst of encoded data of a specific type." '437 patent, 8:23-27. Kim's data separation words perform the same function: "The third type of control word is a data stream separation word, which separates between multiple contexts of data streams and indicates the start or end of a certain type of data transfer." Kim, 6:58-61. Accordingly, Kim's data separation word teaches a "*guard band word*" as claimed.

175. **Third**, Kim's audio data streams ("*selected code words*") include a data separation word ("*guard band word*") at the start ("*the burst of the selected code words has an initial word, and the initial word is the guard band word*").

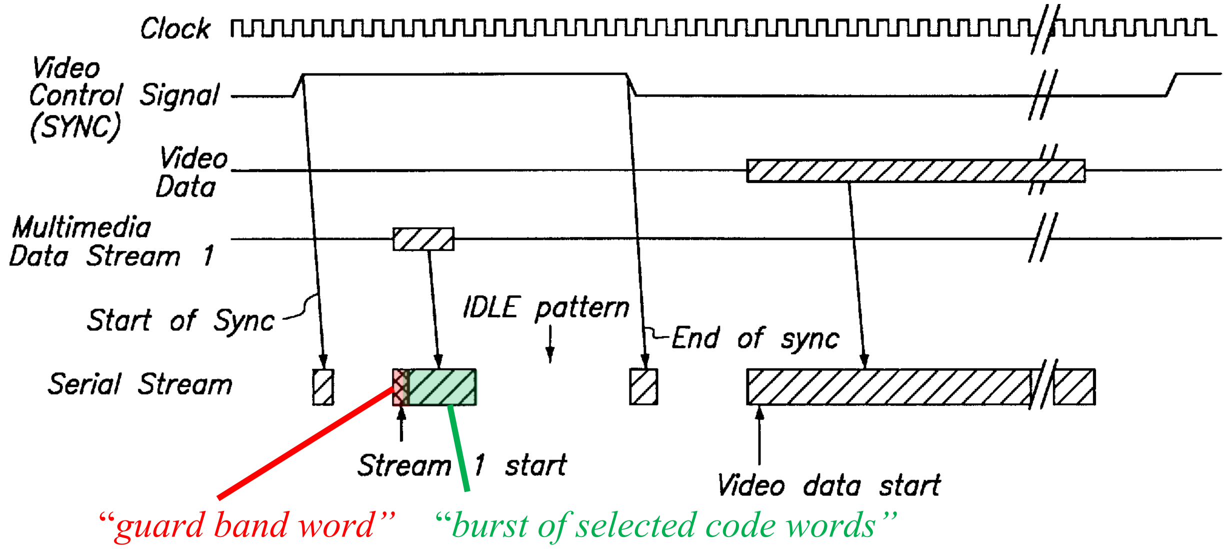
> Data stream 1 is inserted during the horizontal blanking period and **a start control word identifying the data stream 1 is used at the head of the data stream 1**. Each multimedia data stream has its own special start control word for identification. For example, stream 1 has a different data start word than that used for video start word.

Kim, 10:2-8.

176. Kim also refers to the start control word as a data stream separation word:

> **The control words used to separate data streams and for other control functions are provided by the control code generator 44**. In the preferred embodiment, the control code generator 44 is a series of hard wired word or character values the each are coupled to a respective multiplexor input. The present invention provides a unique control and separation scheme in which four categories of special or control words are used. An exemplary set of control words are provided in Appendix A. The first type of control word is the IDLE word. The IDLE word is transmitted over the serial link 28 when there is not data from any of

the data streams to be sent. The purpose of the idle word is to make enough transitions during preamble period so that the receiving circuit can obtain bit synchronization and to make the word synchronization easy. The second type of control word is the isochronous data transfer word. These control words indicate the transfer of time critical data such as timing control signals of video or other data. The isochronous special word can be sent at any time without interfering with the other streams. **The third type of control word is a data stream separation word, which separates between multiple contexts of data streams and indicates the start or end of a certain type of data transfer**. The fourth type of control word is the link shut down word, which is used when the embedding unit 22 shuts down and to let data recipients to know the end of data transmission. If the removing unit 24 receives link shutdown character, it can go into power down mode or idle state. Any special character selection which satisfies above conditions can be used for this invention. As have been noted above, a preferred implementation for the above encoding scheme is an 8 bit/10 bit encoding.



Kim, Fig. 4A (annotated).

177. Thus, Kim's placement of a data separation word (that meets Myers' subset selection criteria) at the start of the audio data stream 1 renders obvious "*wherein the selected code words include at least one guard band word, the burst of the selected code words has an initial word, and the initial word is the guard band word.*"

11. Claim 4

[4.1] ***The system of claim 2, wherein the selected code words include at least one guard band word, the burst of the selected code words has an initial set of words, and each word of the initial set of words is one said guard band word.***

178. **First**, as described above at [3.1], Kim teaches using data separation words to indicate the start or end of a streaming sequence.

179. **Second**, it would have been obvious for the guard band words to be repeated, as evidenced by Myers. Myers describes using control words at the start and end of a message—similar to Kim's data stream separation words. Additionally, Myers explains that there may be multiple control words ("*an initial set of words*") at the start of a message.

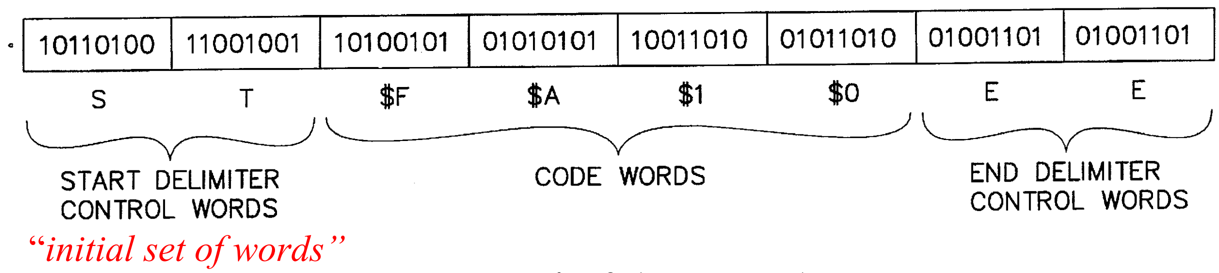
> Transceiver module 54 may also transmit control words along with a code word, or plurality of code words, to provide for certain control functions. Typically, such control words are used at the beginning and end of a message, comprising a plurality of code words, to delimit its start and finish. **A start delimiter control word, or plurality of code words, may be transmitted immediately prior to the transmission of a code word or words**, such that other network devices 40 are alerted that data is forthcoming over the transmission medium. Similarly, an end delimiter control word, or plurality of code words, may be transmitted immediately after the transmission of a code word or words, such that other network devices 40 know that they have received a complete transmission. For the code of FIG. 1, each transmission of a cord [sic] word or words from a network device is preceded by S and T, the first and second start delimiter control words, and is followed by two Es, the end delimiter control word.

Myers, 11:13-30.

> For the code of FIG.1, an example of a typical data stream is shown in FIG. 9. For the transmission module to transmit the data stream, hex address $FA10, **the device first delimits the stream with the S and T, the first and second start delimiter control words**. Next, the encoded code words corresponding to the data words hex F (15), A

> (10), 1 and 0 are transmitted. Finally, the transmission of EE, the end delimiter control word completes the transmission of the data stream.

Myers, 13:40-48.



Myers, Fig. 9 (annotated).

180. A POSITA would have found it obvious to use known options for transmitting data stream separation words—using one or more control words to indicate the start or end of a stream. Providing repeated guard band words helps to ensure that a guard band word is not missed by the receiver. Applying Myers' repeated start word technique to Kim's data separation start word is merely applying a known technique to a known method to yield predictable results.

181. Thus, Kim's use of data stream separation words (that meets Myers' subset selection criteria) at the start of the audio stream, which may be repeated as taught by Myers, renders obvious "*wherein the selected code words include at least one guard band word, the burst of the selected code words has an initial set of words, and each word of the initial set of words is one said guard band word.*"

12. Claim 5

[5.1] ***The system of claim 2, wherein the selected code words include at least one guard band word, the burst of the selected code words has a final word, and the final word is the guard band word.***

182. First, as explained above at [3.1], Kim and Myers teach "*wherein the selected code words include at least one guard band word*."

183. Second, while Kim illustrates the data separation word at the *start* of the data stream 1, Kim explains that the data stream separation word ("*guard band word*") is placed at the *end* of the data stream as well. "The third type of control word is a **<u>data stream separation word</u>**, which separates between multiple contexts of data streams and **<u>indicates the</u>** start or **<u>end</u>** of a certain type of data transfer." Kim, 6:58-61.

184. Thus, Kim's placement of a data separation word (that meets Myers' subset selection criteria) at the end of the audio data stream renders obvious "*wherein the selected code words include at least one guard band word, the burst of the selected code words has a final word, and the final word is the guard band word*."

13. Claim 6

[6.1] ***The system of claim 2, wherein the selected code words include at least one guard band word, the burst of the selected code words has a final set of words, and each word of the final set of words is one said guard band word.***

185. First, as described above at [5.1], Kim teaches using data separation words to indicate the start or end of a streaming sequence.

186. Second, it would have been obvious for the guard band words to be repeated, as evidenced by Myers. Myers describes using control words at the start and end of a message—similar to Kim's data stream separation words. Additionally, Myers explains that there may be multiple control words ("*a final set of words*") at the end of a message.

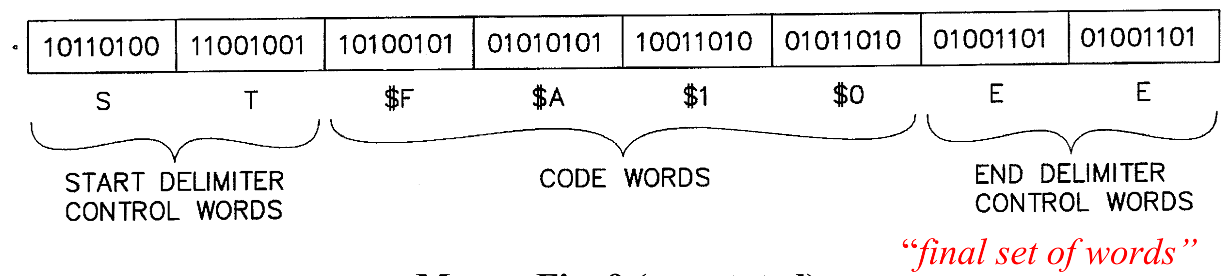
> Transceiver module 54 may also transmit control words along with a code word, or plurality of code words, to provide for certain control functions. Typically, such control words are used at the beginning and end of a message, comprising a plurality of code words, to delimit its start and finish. A start delimiter control word, or plurality of code words, may be transmitted immediately prior to the transmission of a code word or words, such that other network devices 40 are alerted that data is forthcoming over the transmission medium. **Similarly, an end delimiter control word, or plurality of code words, may be transmitted immediately after the transmission of a code word or words**, such that other network devices 40 know that they have received a complete transmission. For the code of FIG. 1, each transmission of a cord [sic] word or words from a network device is preceded by S and T, the first and second start delimiter control words, and is followed by two Es, the end delimiter control word.

Myers, 11:13-30.

> For the code of FIG.1, an example of a typical data stream is shown in FIG. 9. For the transmission module to transmit the data stream, hex

> address $FA10, the device first delimits the stream with the S and T, the first and second start delimiter control words. Next, the encoded code words corresponding to the data words hex F (15), A (10), 1 and 0 are transmitted. **Finally, the transmission of EE, the end delimiter control word completes the transmission of the data stream**.

Myers, 13:40-48.



Myers, Fig. 9 (annotated).

187. A POSITA would have found it obvious to use known options for transmitting data stream separation words—using one or more control words to indicate the start or end of a stream.

188. Thus, Kim's placement of a data separation word (that meets Myers' subset selection criteria) at the end of the audio stream, which may be repeated as taught by Myers, renders obvious "*wherein the selected code words include at least one guard band word, the burst of the selected code words has a final set of words, and each word of the final set of words is one said guard band word*."

14. Claim 8

[8.1] ***The system of claim 2, wherein the selected code words include at least two***

guard band words, including a first guard band word and a second guard band word, the second burst of the video code words has an initial word, the initial word of the second burst of the video code words is the first guard band word, the burst of the selected code words has an initial word, and the initial word of the burst of the selected code words is the second guard band word.

189. **First**, for the reasons explained above at [3.1], Kim and Myers teach that the "*selected code words*" include "*guard band words*."

190. **Second**, Kim teaches that video streams include data stream separation words at the start as well. Thus, the data stream separation word at the start of the video stream teaches "*the initial word of the second burst of the video code words is the first guard band word*."

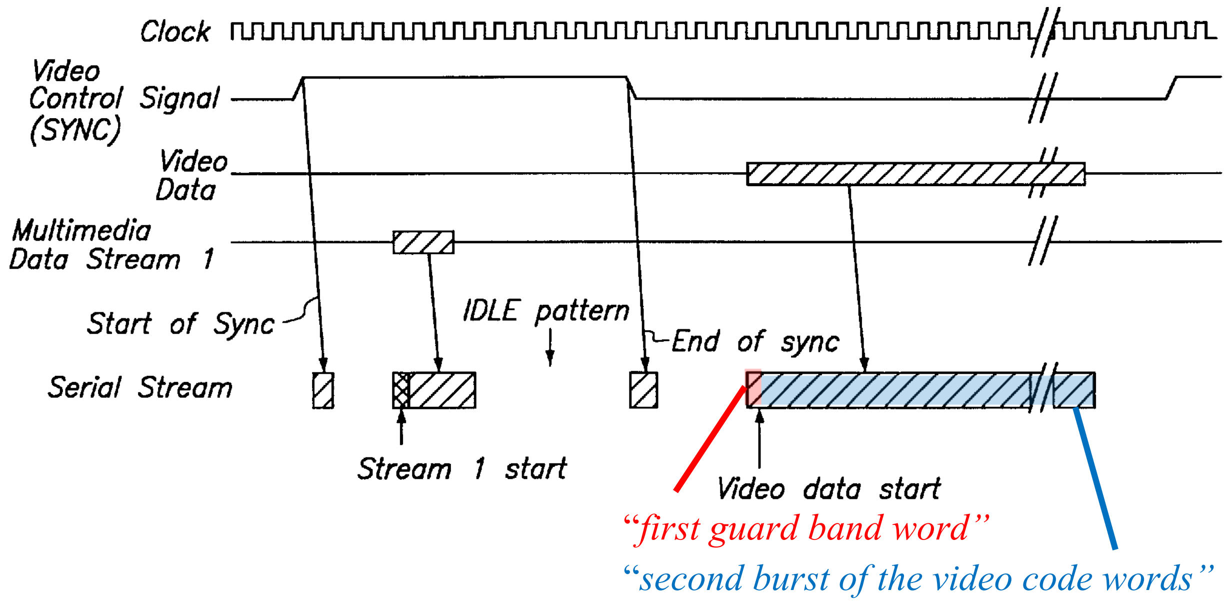
> The embodiment shown in FIG. 3 includes a plurality of control code generators 44a, 44b, 44c . . . 44n, 44x, 44y, 44z. The first control code generator 44x is coupled to an input of the multiplexor 48 via line 60a to provide the IDLE word. Additional control code generators 44y and 44z are provided for supplying the shut down link code and start up link code to the multiplexor via lines 60y, 60z, respectively. **<u>The remaining control code generators 44a, 44b, 44c . . . 44n provides respective data stream separation words, one for each stream</u>**. Each of the control code generators 44a, 44b, 44c. . . 44n, 44x, 44y, 44z is preferably hard wired to provide the 10-bit words that are used for the IDLE word, start-up link word, shut-down link word, **<u>video start word</u>**, stream 1 start word, etc. in accordance with the encoding scheme. The isochronous transfer words are generated directly by the video coder 40a. Those skilled in the art will realize that in an alternate embodiment, a data input of the multiplexor 48 could be coupled to a data output of

> the scheduler 46, and that in such an alternate embodiment the scheduler 46 would generated and provide these codes words as necessary.

Kim, 9:25-45.

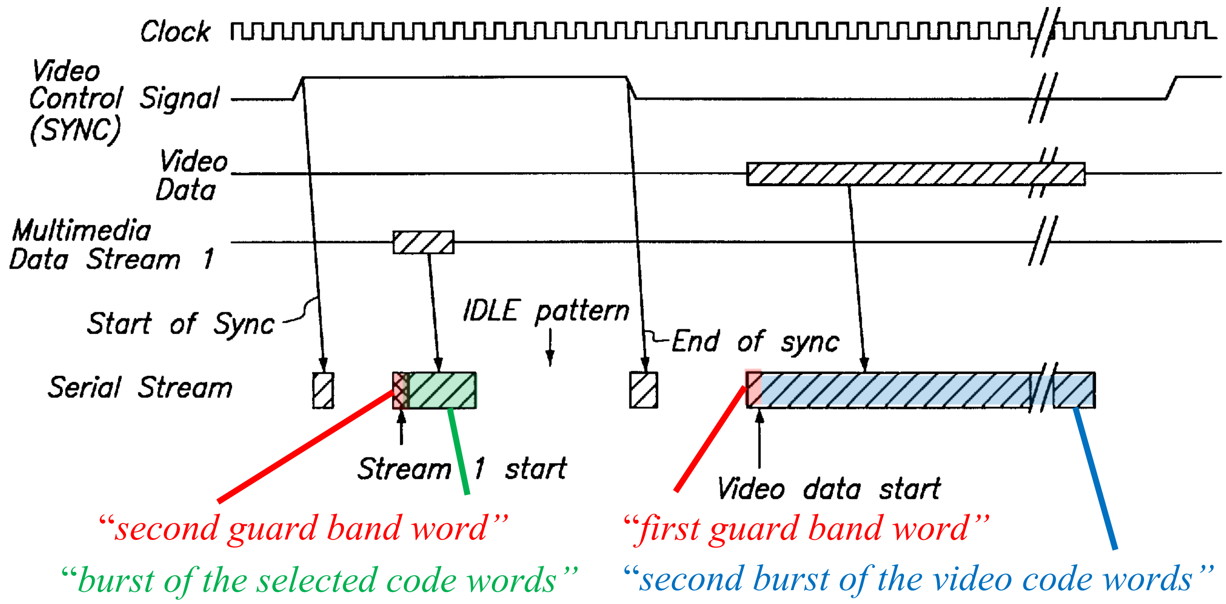
> Each multimedia data stream has its own special start control word for identification. **For example, stream 1 has a different data start word than that used for video start word**. If every stream buffer is emptied and no video signal enters, the scheduler sends an IDLE word for bit synchronization and word synchronization.

Kim, 10:5-11.



Kim, Fig. 4A (annotated).

191. Second, for the reasons explained above at [3.1], Kim describes placing a data stream separation word ("*second guard band word*") at the start of stream 1 ("*burst of the selected code words*").



Kim, Fig. 4A (annotated).

192. Thus, Kim's placement of data stream separation words at the start of both the audio data stream 1 (which meets Myers' subset selection criteria) and the video data stream renders obvious "*wherein the selected code words include at least two guard band words, including a first guard band word and a second guard band word, the second burst of the video code words has an initial word, the initial word of the second burst of the video code words is the first guard band word, the burst of the selected code words has an initial word, and the initial word of the burst of the selected code words is the second guard band word.*"

15. Claim 10

[10.1] ***The system of claim 1, wherein the input data are auxiliary data,***

193. *See* [1.7].

[10.2] ***the transmitter is coupled to receive video data and configured to generate***

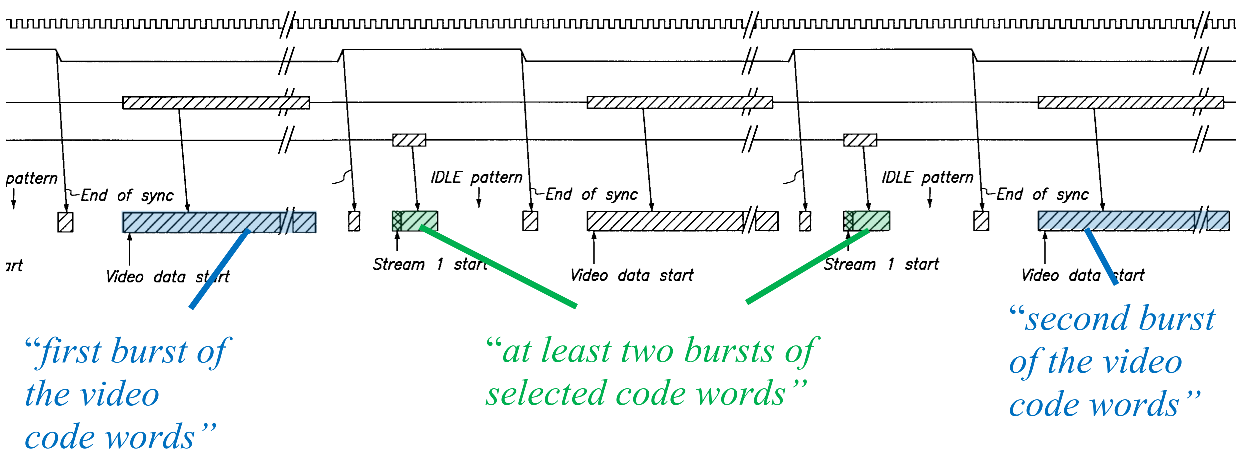
a sequence of video code words by encoding the video data, and

194. *See* [1.8].

[10.3] ***the transmitter is configured to transmit to the receiver over the serial link the first burst of the video code words followed by at least two bursts of the selected code words followed by the second burst of the video code words.***

195. **First**, for the reasons explained above at [8.1], the prior art renders this limitation obvious.

196. **Second**, it would have been obvious for there to be "*at least two bursts*" of selected code words between two sets of video data. Given that the pattern shown in Fig. 4A is repeated multiple times, there may be several bursts of data stream 1 ("*selected code words*") between two sets of video streams, as shown in the modified Fig. 4A below.



Ex.1005, Fig. 4A (modified, annotated).

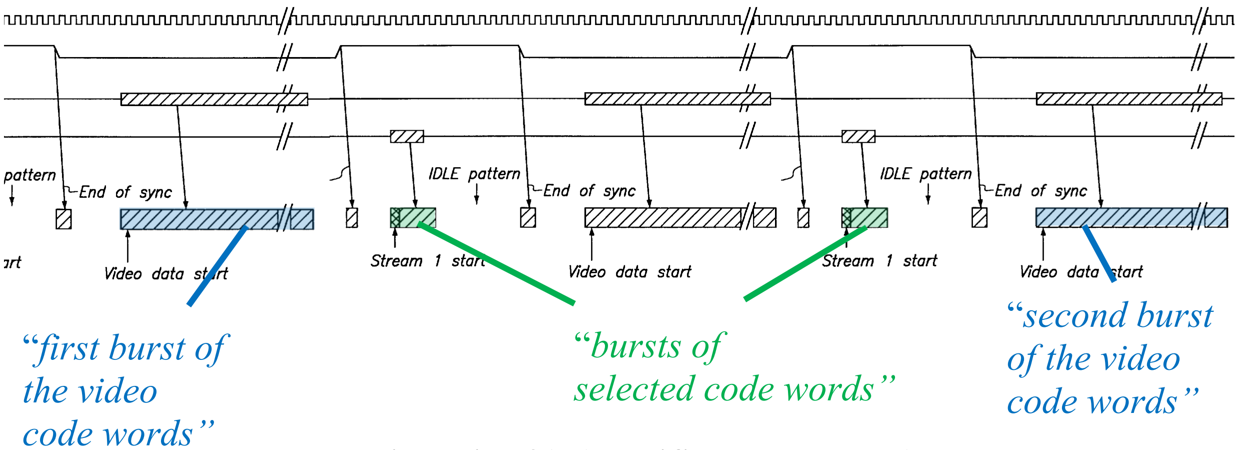
197. Thus, Kim's transmission of video code words followed by audio data stream words followed by more video code words renders obvious "*the transmitter is configured to transmit to the receiver over the serial link the first burst of the* *video code words followed by at least two bursts of the selected code words followed by the second burst of the video code words."*

16. Claim 11

[11.1] ***The system of claim 10, wherein the transmitter is also coupled to receive control bits, configured to generate bursts of encoded control words by encoding the control bits, and configured to transmit to the receiver over the serial link a first burst of the encoded control words between the first burst of the video code words and the bursts of the selected code words, and a second burst of the encoded control words between the bursts of the selected code words and the second burst of the video code words.***

198. First, for the reasons explained above at [2.1]-[2.4], the prior art renders this limitation obvious.

199. Second, this limitation differs from claim 2 by reciting "burst**s**" of selected code words rather than a "burst" of the selected code words. It would have been obvious for there to be "*bursts*" of selected code words between two sets of video data. *See* Kim, 8:10-15. Given that the pattern shown in Fig. 4A is repeated multiple times, there may be several bursts of data stream 1 ("*selected code words*") between two sets of video streams, as shown in the modified Fig. 4A below.



Kim, Fig. 4A (modified, annotated).

200. Thus, Kim's transmission of video code words followed by audio data stream words followed by more video code words renders obvious "*wherein the transmitter is also coupled to receive control bits, configured to generate bursts of encoded control words by encoding the control bits, and configured to transmit to the receiver over the serial link a first burst of the encoded control words between the first burst of the video code words and the bursts of the selected code words, and a second burst of the encoded control words between the bursts of the selected code words and the second burst of the video code words*."

17. Claim 12

[12.1] *The system of claim 11, wherein the selected code words include at least one guard band word, a first one of the bursts of the selected code words has an initial word, and the initial word is the guard band word.*

201. *See* [3.1] and [11.1]. For the reasons described at [11.1], Kim's audio data streams may include a plurality of bursts. Because each burst of audio data includes a data start word, "*a first one of the bursts*" includes a data start word.

18. Claim 13

[13.1] ***The system of claim 11, wherein the selected code words include at least one guard band word, a first one of the bursts of the selected code words has an initial set of words, and each word of the initial set of words is one said guard band word.***

202. *See* [4.1] and [11.1]. For the reasons described at [11.1], Kim's audio data streams may include a plurality of bursts. Because each burst of audio data includes a data start word, "*a first one of the bursts*" includes a data start word.

19. Claim 14

[14.0] ***A communication system, including: a receiver; a transmitter; and***

203. *See* [1.0].

[14.1] ***a serial link between the transmitter and the receiver, wherein the transmitter is coupled to receive input data,***

204. *See* [1.1].

[14.2] ***configured to generate a sequence of selected code words by encoding the input data, and***

205. *See* [1.2]

[14.3] ***configured to transmit the sequence of selected code words to the receiver over the serial link,***

206. *See* [1.3].

[14.4] ***wherein each of the selected code words is a member of a robust subset of a full code word set,***

207. *See* [1.4].

[14.5] ***the input data can be encoded as a conventional sequence of code words of the full code word set, and***

208. *See* [1.5].

[14.6] ***the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words,***

209. *See* [1.6].

[14.7] ***wherein the input data are auxiliary data,***

210. *See* [1.7].

[14.8] ***the transmitter is coupled to receive video data and configured to generate a sequence of video code words by encoding the video data, and***

211. *See* [1.8].

[14.9] ***the transmitter is configured to transmit to the receiver over the serial link a burst of the selected code words followed by a burst of the video code words,***

212. For the reasons explained above at [1.9], Kim renders obvious "*the transmitter is configured to transmit to the receiver over the serial link a burst of the selected code words followed by a burst of the video code words*."

[14.10] ***wherein each of the video code words is a member of the full code word set and at least one of the video code words is not a member of the robust subset.***

213. *See* [1.10].

20. Claim 15

[15.1] ***The system of claim 14, wherein the transmitter is also coupled to receive control bits, configured to generate bursts of encoded control words by encoding the control bits, and configured to transmit to the receiver over the serial link a burst of the encoded control words between the burst of the selected code words and the burst of the video code words.***

214. *See* [2.1]-[2.2].

21. Claim 16

[16.1] ***The system of claim 15, wherein the selected code words include at least one guard band word, the burst of the video code words has an initial word, and the initial word is the guard band word.***

215. *See* [3.1].

22. Claim 17

[15.1] ***The system of claim 15, wherein the selected code words include at least one guard band word, the burst of the video code words has an initial set of words, and each word of the initial set of words is one said guard band word.***

216. *See* [4.1].

23. Claim 19

[19.0] ***A communication system, including: a receiver; a transmitter; and***

217. *See* [1.0].

[19.1] ***a serial link between the transmitter and the receiver, wherein the transmitter is coupled to receive input data,***

218. *See* [1.1].

[19.2] ***configured to generate a sequence of selected code words by encoding the input data, and***

219. *See* [1.2].

[19.3] ***configured to transmit the sequence of selected code words to the receiver over the serial link,***

220. *See* [1.3].

[19.4] ***wherein each of the selected code words is a member of a robust subset of a full code word set,***

221. *See* [1.4].

[19.5] ***the input data can be encoded as a conventional sequence of code words of the full code word set, and***

222. *See* [1.5].

[19.6] ***the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words,***

223. *See* [1.6].

[19.7] ***wherein each of the selected code words is indicative of L binary bits, and***

224. As explained above at [18.9], Kim and Myers teach "*wherein each of the selected code words is indicative of a sequence of L binary bits*" as claimed. For similar reasons, Kim's 10-bit code words are indicative of "*a sequence of L binary bits*."

[19.8] ***the selected code words have fewer contiguous zero bits and contiguous one bits per code word on the average than do the code words of the full code word set excluding the selected code words.***

225. The code words that meet Myers' selection criteria have fewer contiguous 1's and 0's than the full code word set: "[A] second step 12 is to select a second subset containing the code words having no more than two consecutive '1's or '0's is selected." Myers, 8:18-21. "[E]ach code word has a (0,1) run-length limit as there are no more than two consecutive binary '1's or '0's within a code word." Ex.1007, 7:10-50.

226. Thus, Kim's encoders 40b-40n implementing Myers' subset-selection technique produce code words with fewer contiguous 1's and 0's than the full code word set, which obvious "*the selected code words have fewer contiguous zero bits and contiguous one bits per code word on the average than do the code words of the full code word set excluding the selected code words*."

24. Claim 20

[20.0] ***A communication system, including: a receiver; a transmitter; and***

227. *See* [1.0].

[20.1] ***a serial link between the transmitter and the receiver, wherein the transmitter is coupled to receive input data,***

228. *See* [1.1].

[20.2] ***configured to generate a sequence of selected code words by encoding the input data, and***

229. *See* [1.2].

[20.3] ***configured to transmit the sequence of selected code words to the receiver over the serial link,***

230. *See* [1.3].

[20.4] ***wherein each of the selected code words is a member of a robust subset of a full code word set,***

231. *See* [1.4].

[20.5] ***the input data can be encoded as a conventional sequence of code words of the full code word set, and***

232. *See* [1.5].

[20.6] ***the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words,***

233. *See* [1.6].

[20.7] ***wherein each of the selected code words is indicative of a different sequence of binary bits,***

234. As described above at [1.4], application of Myers' subset-selection technique to a 10-bit code set results in 42 different sequences of 10-bits, each of which corresponds to a different value. Accordingly, Kim and Myers render obvious "*wherein each of the selected code words is indicative of a different sequence of binary bits.*"

[20.8] ***the transmitter is configured to transmit the sequence of selected code words to the receiver over the serial link as a sequence of rising and falling voltage transitions, and***

235. **First**, Kim describes transmitting encoded words over a serial link ("*transmitting the sequence of selected code words over the serial link*"). "The combination results in an encoded serial sequence that is output on the first output for transmission over the serial line 28." Kim, 4:45-53.

236. **Second**, Myers explains that when transmitting binary data over a serial link such as Kim's serial link, the data is transmitted such that "logic '1' values may be represented by a positive voltage, and logic '0' values are represented by a negative or zero voltage, transmitted along on a transmission line." Ex.1007, 7:13-16. Accordingly, as the sequence of bits transitions from 0 to 1, the voltage rises. Conversely, when the sequence of bits transitions from 1 to 0, the voltage falls ("*as a sequence of rising and falling voltage transitions*").

237. Thus, Kim transmits data over a serial line, which involves rising and falling voltage levels as evidenced by Myers and thus renders obvious "*the transmitter is configured to transmit the sequence of selected code words to the receiver over the serial link as a sequence of rising and falling voltage transitions*."

[20.9] ***the selected code words have bit patterns that implement DC balancing by limiting voltage drift of the serial link during transmission of said sequence of selected code words to a predetermined amount.***

238. **First**, the subset of code words that meet Myers' criteria are DC balanced ("*the selected code words have bit patterns that implement DC balancing*"). "Firstly, each code word is inherently DC balanced in that each has four binary '1's and four binary '0's." Ex.1006, 7:10-27.

239. **Second**, by implementing DC balance, the system prevents a charge from building up ("*by limiting voltage drift of the serial link during transmission of said sequence of selected code words to a predetermined amount*"). "This feature prevents a charge, and resulting capacitance or inductance, from building up on long transmission lines due to transmission of more bits having one value, such as a '1' than those having the other binary value, such as a '0'." Ex.1007, 7:10-27.

240. Myers explains that "if a transmitted signal has a large '1'/'0' imbalance, and thus a large DC or low frequency component, this component will get filtered out, resulting in a distortion of the signal and a loss of information."

Myers, 2:50-54. By limiting the charge build-up with DC balance, and preventing loss of information, Myers's technique limits voltage drift to "*a predetermined amount*."

241. Thus, the subset of code words that meet Myers' criteria are DC balanced to prevent charge build-up and loss of information, which renders obvious "*the selected code words have bit patterns that implement DC balancing by limiting voltage drift of the serial link during transmission of said sequence of selected code words to a predetermined amount*."

25. Claim 21

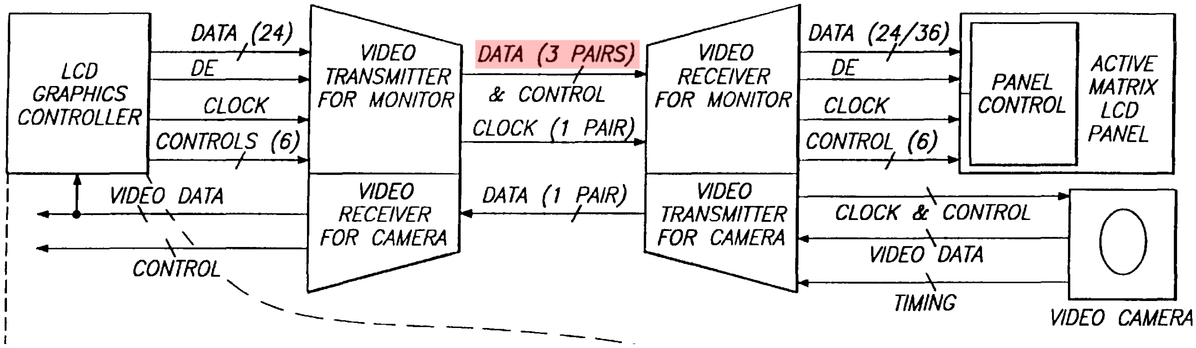
[21.0] ***A communication system, including: a receiver; a transmitter; and***

242. *See* [1.0].

[21.1] ***a serial link, a second serial link, and a third serial link between the transmitter and the receiver,***

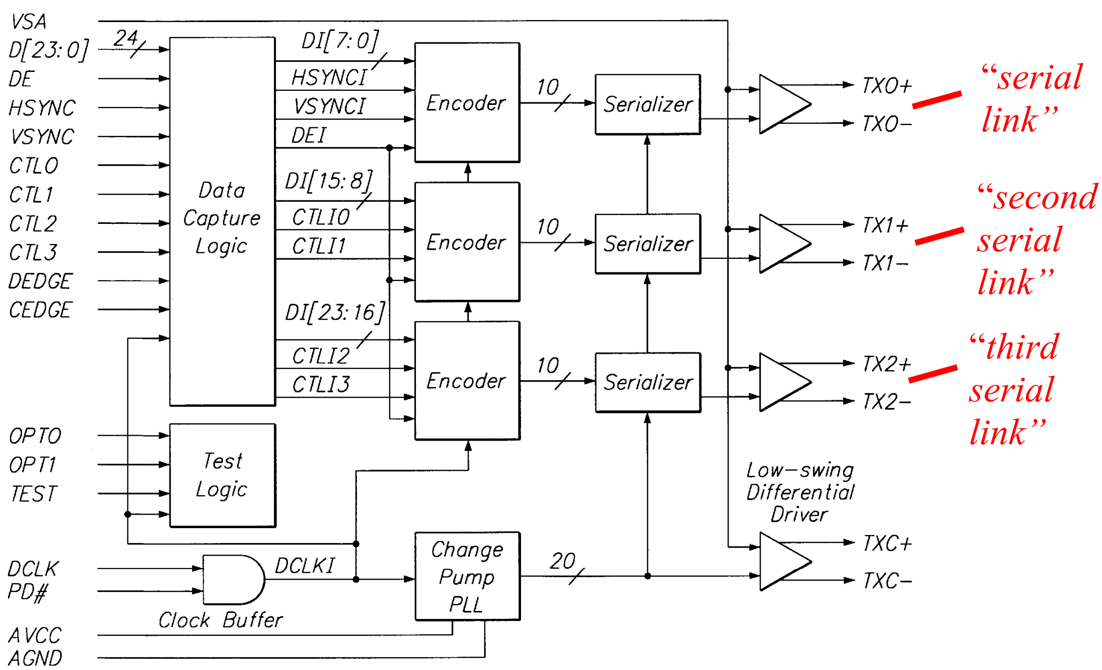
243. **First**, as described above at [1.1], Kim teaches a serial link for transmitting data between the transmitter and the receiver.

244. **Second,** it would have been obvious for Kim's serial link to be implemented as three serial links, as evidenced by Shin. Shin provides an example in which video data is transmitted over 3 separate serial links: "A digital video link is composed of 3 data lines and an accompanying clock line with a reduced, differential logic swing with a DC-balanced coding for transformer or capacitor coupling." Shin, 7:40-43.



Shin, Fig. 2 (partial, annotated).

245. Shin's three different serial links are shown in Fig. 3 below.



Shin, Fig. 3 (annotated).

246. Kim explains that video data may be composed of three separate signals (red, green, and blue).

> For example, the primary signal line may be a video signal that has 8 signal lines for data (8 bits of Red, 8 bits of Green, 8 bits of Blue in

> sequence) and signal lines for a control signals (horizontal sync, vertical sync and other control signals); and the second signal may be an eight bit data signal requiring eight signal lines. Those skilled in the art will realize that the primary signal, second signal, third signal and nth signal may each require different numbers of signal lines and that a variety of combinations may be possible.

Kim, 4:28-53.

247. Shin explains that three serial links may be used, one for each of the red, green, and blue data signals.

> Video signals are composed of three separate signals, typically RGB, along with two synchronization signals called HSYNC and VSYNC. Instead of having extra lines, those two SYNC signals are mixed with the RGB data in the coder, thereby limiting the number of data wires to three.

Shin, 8:1-5.

248. Accordingly, it would have been obvious for Kim's serial link to be implemented as three separate serial links, one for each of red, green, and blue data signals. A POSITA would have found it beneficial to use three separate links to achieve faster data transfer rates. Shin explains that "the requisite bandwidth of such interconnection systems has increased as a consequence of increased display resolution." Shin, 1:43-44. "This invention provides **a high-speed video data transmission system** capable of converting parallel video data stream and video display timing and control signals **to three high-speed serial data channels at speeds capable of supporting high-resolution displays**." Shin, 2:60-65.

249. Thus, because Kim describes a serial link, and Shin shows that it was known to implement serial links for video as three separate links, Kim and Shin render obvious "*a serial link, a second serial link, and a third serial link between the transmitter and the receiver*" as claimed.

[21.2] ***wherein the transmitter is coupled to receive input data and video data,***

250. First, as described above at [1.1], Kim's transmitter is coupled to receive input data.

251. Second, Kim's transmitter is also coupled to receive video data.

> **The encoder 40 preferably has a plurality of inputs** and a plurality of outputs. The plurality of inputs are preferably grouped in sets. Thus, in Figure 2, signal lines 26a, 26b, 26c, . . . 26n are each used to designate one or more signal lines of a data stream. **For example, the first primary stream is preferably a video stream** including the data and control signals for display refresh and may for example, be 28 parallel lines, 24 for data and 4 for control. The remaining signal lines 26b, 26, . . . 26n can be used for other types of data, and are for example, each eight parallel lines. Those skilled in the art will realize that each signal line 26a, 26b, 26c, . . . 26n may be a variety of parallel signal lines. For each of the input signal lines 26a, 26b, 26, . . . 26n, the encoder 40 preferably provides a corresponding output signal line 52a, 52b, 52c, . . . 52n. Each of the output signals line 52a, 52b, 52c, . . . 52n provides

> the encoded output of the signal applied to the corresponding input of the encoder 40. **<u>In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word</u>**. Thus, each of the output signals line 52a,52b, 52c,. .. 52nis 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input of the multiplexor 48. The remaining output lines are 52b, 52c, . . . 52n are coupled to respective inputs of the data buffer 42. The encoder 40 preferably encodes the input stream into 10-bit output streams. The word output by the encoder 40 are preferably any 10-bit words other than those identified in Appendix A as special code words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. Any number of conventional eight to 10 encoding schemes may be used in addition to the specific encoding scheme identified below with respect to Figure 5.

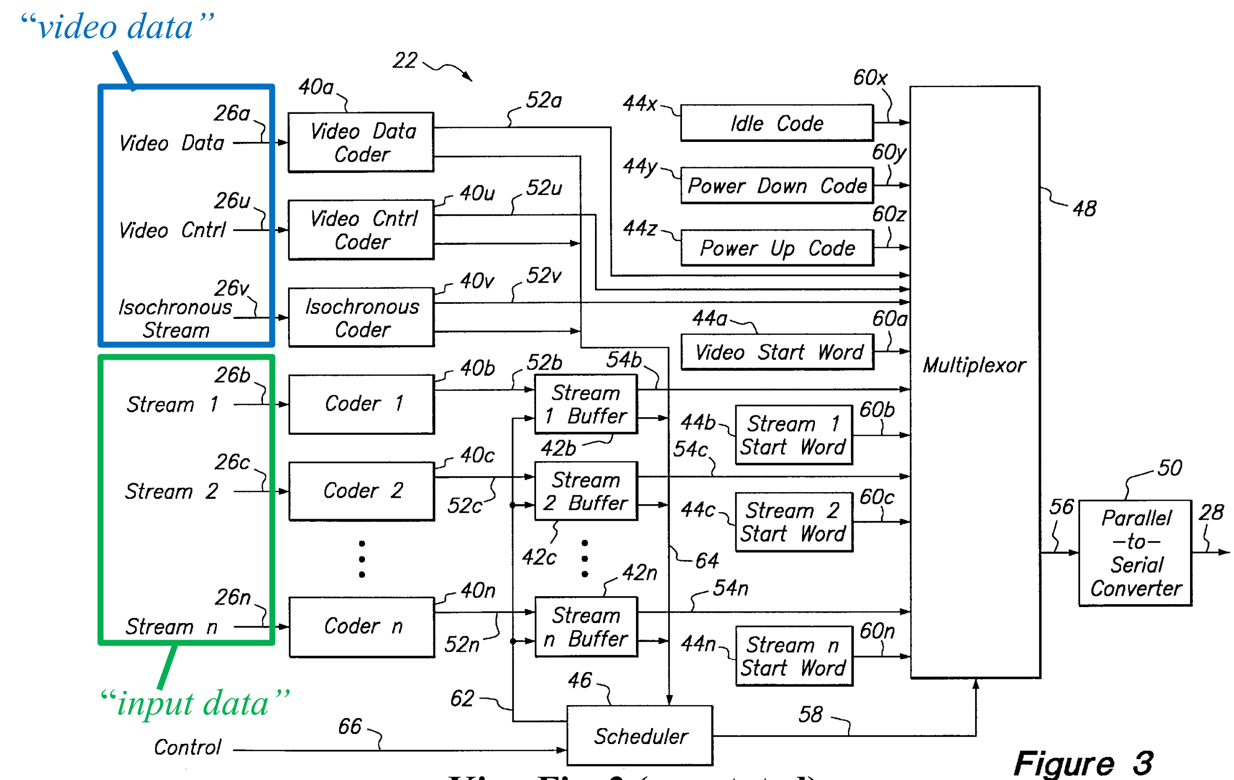
Kim, 5:50-6:16.

252. As shown in Kim's Fig. 3, each of the different encoders 40b-40n process a different stream of input data.

> **<u>Still more particularly, a video data coder 40a is provided for encoding the video data signals to a 10-bit parallel output. Those skilled in the art will realize the video data coder 40a may be a plurality of 8-to-10bit coders depending on the number of bits used to represent the video data</u>**. For example, the video data coder 40a may be three 8-to-10 bit coders if 24 bits of RGB data are used with 8 bits for a red channel, 8 bits for a green channel, 8 bits for a blue

> channel, or two 8-to-10 bit coders for 16 bits of YUV data. An exemplary video coder 40a constructed according to the present invention is shown in Figure 5. Coders 40u,and 40v are also provided for the video control data, and the isochronous data stream. Similarly, for stream 1 to n each stream has a dedicated coder 40b to 40n, respectively, to encode each particular data stream. The coders 40b to 40n, 40u, 40v are preferably identical, and each maps the eight bit values applied on the inputs of the coders 40b to 40n to a corresponding 10-bit word according to a predefined coding scheme. An exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled "High-Speed Digital Video Signal Transmission System," filed on Oct. 6, 1995, and Sep. 30, 1996, which is incorporated herein by reference.

Kim, 8:44-67.



Kim, Fig. 3 (annotated).

253. Thus, because Kim's embedding unit 22 receives video data and additional stream data, Kim renders obvious "*wherein the transmitter is coupled to receive input data and video data*."

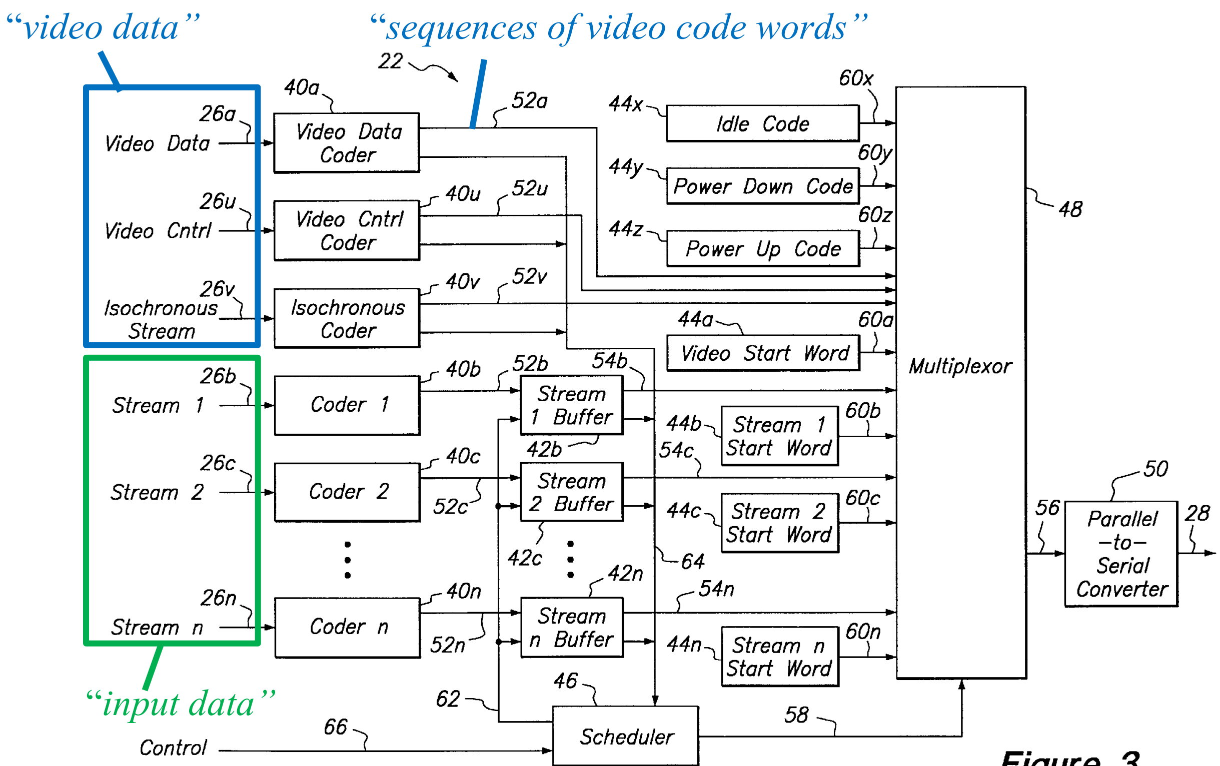
[21.3] ***configured to generate sequences of selected code words by encoding the input data and to generate sequences of video code words by encoding the video data, and***

254. **First**, as explained above at [1.2], Kim teaches "*configured to generate sequences of selected code words by encoding the input data*."

255. **Second**, Kim's embedding unit includes an encoder 40a that generates sequences of video code words by encoding the video data.

The encoder 40 preferably has a plurality of inputs and a plurality of outputs. The plurality of inputs are preferably grouped in sets. Thus, in Figure 2, signal lines 26a, 26b, 26c, . . . 26n are each used to designate one or more signal lines of a data stream. **For example, the first primary stream is preferably a video stream** including the data and control signals for display refresh and may for example, be 28 parallel lines, 24 for data and 4 for control. The remaining signal lines 26b, 26, . . . 26n can be used for other types of data, and are for example, each eight parallel lines. Those skilled in the art will realize that each signal line 26a, 26b, 26c, . . . 26n may be a variety of parallel signal lines. For each of the input signal lines 26a, 26b, 26, . . . 26n, the encoder 40 preferably provides a corresponding output signal line 52a, 52b, 52c, . . . 52n. Each of the output signals line 52a, 52b, 52c, . . . 52n provides the encoded output of the signal applied to the corresponding input of the encoder 40. **In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word**. Thus, each of the output signals line 52a,52b, 52c,. .. 52nis 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input of the multiplexor 48. The remaining output lines are 52b, 52c, . . . 52n are coupled to respective inputs of the data buffer 42. The encoder 40 preferably encodes the input stream into 10-bit output streams. The word output by the encoder 40 are preferably any 10-bit words other than those identified in Appendix A as special code words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. Any number of conventional eight to 10 encoding schemes may be used in addition to the specific encoding scheme identified below with respect to Figure 5.

Kim, 5:50-6:16.



Kim, Fig. 3 (annotated).

256. Thus, Kim generates encoded data from both the audio data streams and the video stream, which renders obvious "*configured to generate sequences of selected code words by encoding the input data and to generate sequences of video code words by encoding the video data.*"

[21.4] ***configured to transmit to the receiver over the serial link a burst of the selected code words followed by a burst of the video code words,***

257. For the reasons explained above at [1.9], Kim renders obvious "*configured to transmit to the receiver over the serial link a burst of the selected* *code words followed by a burst of the video code words*."

[21.5] ***to transmit to the receiver over the second serial link a second burst of the selected code words followed by a second burst of the video code words, and***

258. **First**, as explained above at [21.1], it would have been obvious for Kim's serial line 28 to use three separate serial links—one for each of red, green, and blue video data.

259. **Second**, because Kim describes placing additional data streams into the video blanking intervals (described above at [1.9], it would have been obvious for the encoded additional data streams ("*selected code words*") to be transmitted over the blanking intervals on any of the three serial links.

260. Thus, Kim's placement of encoded audio data within video blanking intervals of three serial links as taught by Shin renders obvious "*to transmit to the receiver over the second serial link a second burst of the selected code words followed by a second burst of the video code words*."

[21.6] ***to transmit to the receiver over the third serial link a third burst of the selected code words followed by a third burst of the video code words,***

261. **First**, as explained above at [21.1], it would have been obvious for Kim's serial line 28 to use three separate serial links—one for each of red, green, and blue video data.

262. **Second**, because Kim describes placing additional data streams into the video blanking intervals (described above at [41.6]-[41.7], it would have been obvious for the encoded additional data streams ("*selected code words*") to be transmitted over the blanking intervals on any of the three serial links.

263. Thus, Kim's placement of encoded audio data within video blanking intervals of three serial links as taught by Shin renders obvious "*to transmit to the receiver over the third serial link a third burst of the selected code words followed by a third burst of the video code words*."

[21.7] ***wherein each of the selected code words is a member of a robust subset of a full code word set,***

264. *See* [1.4]

[21.8] ***each of the video code words is a member of the full code word set, and at least one of the video code words is not a member of the robust subset, and***

265. *See* [1.10].

[21.9] ***wherein the input data determined by the burst of the selected code words can be encoded as a first conventional sequence of the code words of the full code word set,***

266. For the reasons described above at [1.5], Kim renders obvious "*wherein the input data determined by the burst of the selected code words can be encoded as a first conventional sequence of the code words of the full code word set.*"

[21.10] ***the input data determined by the second burst of the selected code words can be encoded as a second conventional sequence of the code words of the full code word set, and***

267. For the reasons described above at [1.5], Kim renders obvious "*the* *input data determined by the second burst of the selected code words can be encoded as a second conventional sequence of the code words of the full code word set.*" Regardless of which serial link the encoded additional data ("selected code words") are sent on, Kim's encoders are capable of encoding that data using conventional 8b/10b encoding techniques.

[21.11] *the input data determined by the third burst of the selected code words can be encoded as a third conventional sequence of the code words of the full code word set, and*

268. For the reasons described above at [1.5], Kim renders obvious "*the input data determined by the third burst of the selected code words can be encoded as a third conventional sequence of the code words of the full code word set.*" Regardless of which serial link the encoded audio data ("*selected code words*") is sent on, Kim's encoders are capable of encoding that data using conventional 8b/10b encoding techniques.

[21.12] *wherein said burst of the selected code words is less susceptible to inter-symbol interference during transmission over the serial link than would be the first conventional sequence,*

269. For the reasons explained above at [1.6], Kim renders obvious "*wherein said burst of the selected code words is less susceptible to inter-symbol interference during transmission over the serial link than would be the first conventional sequence.*"

[21.13] *said second burst of the selected code words is less susceptible to inter-symbol interference during transmission over the second serial link than would*

be the second conventional sequence, and

270. For the reasons explained above at [1.6], Kim renders obvious "*said second burst of the selected code words is less susceptible to inter-symbol interference during transmission over the second serial link than would be the second conventional sequence*." This is so regardless of which serial link transmits the data.

[21.14] ***said third burst of the selected code words is less susceptible to inter-symbol interference during transmission over the third serial link than would be the third conventional sequence.***

271. For the reasons explained above at [1.6], Kim renders obvious "*said third burst of the selected code words is less susceptible to inter-symbol interference during transmission over the third serial link than would be the third conventional sequence*." This is so regardless of which serial link transmits the data.

26. Claim 22

[22.1] ***The system of claim 21, wherein the transmitter is also coupled to receive control bits,***

272. *See* [2.1].

[22.2] ***configured to generate sequences of encoded control words by encoding the control bits, and***

273. *See* [2.2].

[22.3] ***configured to transmit to the receiver over the serial link a burst of the encoded control words between the burst of the selected code words and the burst***

of the video code words,

274. For the reasons provided at [2.3], Kim renders obvious "*configured to transmit to the receiver over the serial link a burst of the encoded control words between the burst of the selected code words and the burst of the video code words*."

[22.4] ***to transmit to the receiver over the second serial link a second burst of the encoded control words between the second burst of the selected code words and the second burst of the video code words, and***

275. For the reasons provided at [2.3], Kim renders obvious "*to transmit to the receiver over the second serial link a second burst of the encoded control words between the second burst of the selected code words and the second burst of the video code words*," regardless of which of the three serial links transmits the control words.

[22.5] ***to transmit to the receiver over the third serial link a third burst of the encoded control words between the third burst of the selected code words and the third burst of the video code words.***

276. For the reasons provided at [2.4], Kim renders obvious "*to transmit to the receiver over the second serial link a second burst of the encoded control words between the second burst of the selected code words and the second burst of the video code words*," regardless of which of the three serial links transmits the control words.

27. Claim 23

[23.1] ***The system of claim 21, wherein the serial link is a first video channel of a TMDS link, the second serial link is a second video channel of the TMDS link, and the third serial link is a third video channel of the TMDS link.***

277. **First**, as explained above at [21.1]-[21.2], Kim and Shin teach a serial link, a second serial link, and a third serial link that transmit video data and are thus "*video channel[s]*."

278. **Second**, Shin is directed to "**transition-controlled** coding system in which rapid byte synchronization allows for prompt initiation of decoding." Shin, 1:13-15. For example, in Shin's encoding technique, "the bits within those of the data blocks including less than a **minimum** number of logical **transitions** are selectively complemented in order that each such selectively complemented data block include in excess of the **minimum** number of logical **transitions**." Shin, 3:40-45; *see also* 3:45-54. The transmitted data is received by "three **differential** receiver circuits." Shin, 5:47-48. Accordingly, because Kim and Shin teach encoding techniques that are transition controlled, and as such the serial links that transmit the encoded the encoded data are transition minimized differential signaling ("*TMDS*") links.

279. Thus, Kim's encoders, using transition controlled techniques to transmit video data on three separate lines to differential receivers as taught by Shin, render obvious "*wherein the serial link is a first video channel of a TMDS* *link, the second serial link is a second video channel of the TMDS link, and the third serial link is a third video channel of the TMDS link*."

28. Claim 26

[26.0] ***A transmitter for use in data transmission over a serial link, said transmitter including:***

280. For the reasons explained above at [1.0], Kim renders obvious "*a transmitter for use in data transmission over a serial link*."

[26.1] ***at least one input for receiving input data;***

281. As explained above at [1.1], Kim renders obvious "*at least one input for receiving input data*." Because Kim's transmitter receives "*input data*," it has "*at least one input*" for receiving that "*input data*."

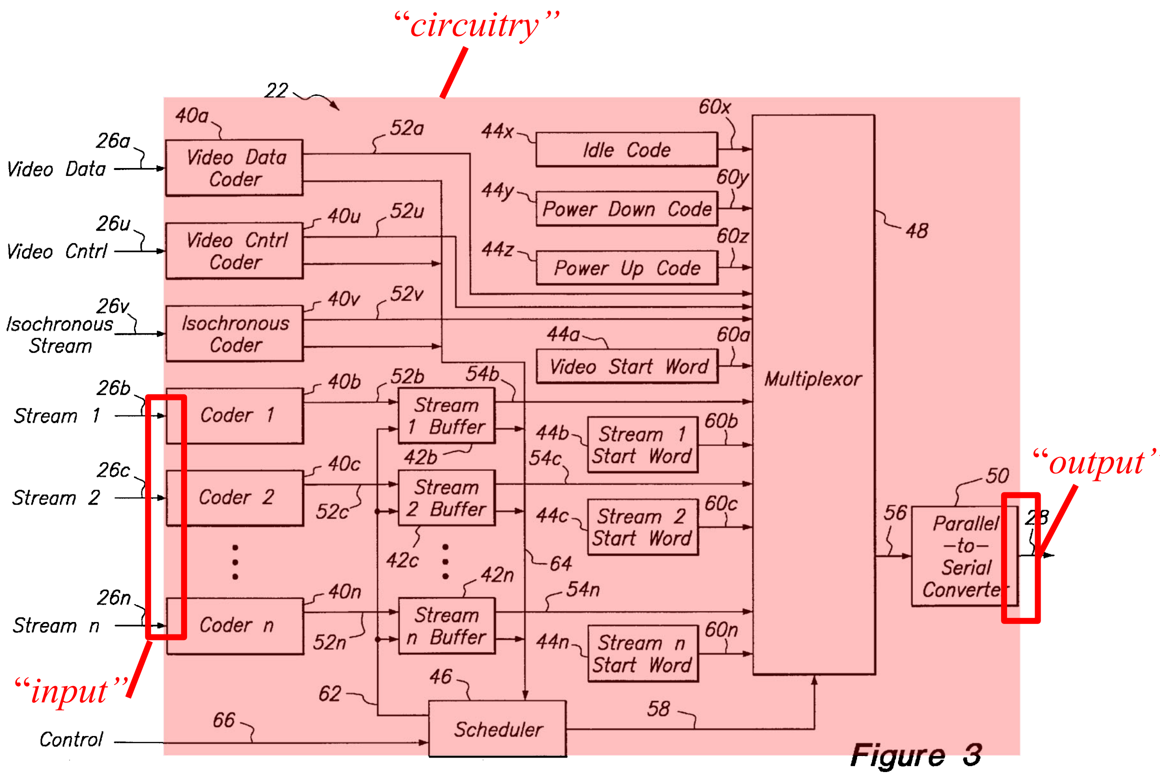
[26.2] ***an output configured to be coupled to a channel of the link; and***

282. **First**, as explained above at [1.0] and [1.1], Kim's embedding unit 22 ("*transmitter*") is coupled to a serial link 28.

283. **Second**, Kim transmits data through "channels." "However, in the present invention, multiple content of data Streams as well as all video control signals, such as HSYNC, VSYNC, DE, are also <u>**sent through display data channels**</u> by employing line coding." Kim, 4:18-22. Accordingly, by coupling the encoded data to the serial link, the data is coupled to "*a channel of the link*."

[26.3] ***circuitry, coupled to each said input and to the output, and***

284. **First**, Kim's embedding unit comprises circuitry that is coupled to the input and the output, as illustrated in Fig. 3 below.



Kim, Fig. 3 (annotated).

285. Kim describes its embedding unit as comprising circuits: "The scheduler 46 may be implemented as combinational logic, a state machine, or a programmed processor such as in an application specific integrated circuit." Kim, 10:36-40. "The coding scheme advantageously makes the separation between normal data words and special control words easy, and thus leads to a great reduction of **<u>circuits</u>**." Kim, 7:3-19.

286. **Second**, consistent with the discussion at [26.1] and [26.2], Kim's embedding unit receives data and then transmits that data over the serial line—and thus includes an input and an output.

287. Thus, because Kim's embedding unit comprises circuits, receives data through an input, and transmits data over a serial link, Kim renders obvious "*circuitry, coupled to each said input and to the output*."

[26.4] ***configured to generate a sequence of selected code words by encoding the input data and to assert the sequence of selected code words to the output in response to the input data,***

288. **First**, for the reasons explained above at [1.2], Kim renders obvious "*configured to generate a sequence of selected code words by encoding the input data*."

289. **Second**, as explained at [1.3], Kim teaches transmitting the encoded data over the serial link. Because the data is encoded from input data before being transmitted, it is transmitted "*in response to the input data*."

> The present invention overcomes the deficiencies and limitations of the prior art with a serial link system and method for sending an isochronous data stream and one or more additional data streams over a single serial line. The preferred embodiment of the serial link system advantageously eliminates the aforementioned problems with numerous high speed parallel data lines and is able to provide high speed data transfer at rates in excess of that needed for high resolution displays. The preferred embodiment of the system of the present invention comprises an embedding unit and a removing unit coupled by a serial line. **The embedding unit preferably receives a plurality of data streams, encodes the data streams and then merges the**

> **encoded data into a serial stream that is output across a serial line to the removing unit**. The removing unit receives a serial stream of data, decodes the serial stream, and then separates the decoded serial stream into separate streams thereby reconstructing the streams input to the embedding unit.

Kim, 2:13-31.

290. Thus, Kim's encoder generates encoded audio data for transmission across the serial line, which renders obvious "*configured to generate a sequence of selected code words by encoding the input data and to assert the sequence of selected code words to the output in response to the input data*."

[26.5] ***wherein each of the selected code words is a member of a robust subset of a full code word set,***

291. *See* [1.4].

[26.6] ***the input data can be encoded as a conventional sequence of code words of the full code word set, and***

292. *See* [1.5].

[26.7] ***the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words,***

293. *See* [1.6]

[26.8] ***wherein the input data include auxiliary data and video data, and***

294. **First**, as described above at [1.7], the input data includes auxiliary data.

295. **Second**, as described above at [1.9], the embedding unit 22 additionally receives video data as input data.

[26.9] ***the circuitry is configured to generate a sequence of video code words by encoding the video data, and***

296. For the reasons described above at [1.8], Kim renders obvious "*the circuitry is configured to generate a sequence of video code words by encoding the video data*."

[26.10] ***to assert to the output a first burst of the video code words followed by a burst of the selected code words followed by a second burst of the video code words,***

297. For the reasons described above at [1.9], Kim renders obvious "*to assert to the output a first burst of the video code words followed by a burst of the selected code words followed by a second burst of the video code words*."

[26.11] ***wherein each of the video code words is a member of the full code word set and at least one of the video code words is not a member of the robust subset.***

298. *See* [1.10].

29. Claim 27

[27.1] ***The transmitter of claim 26, wherein the circuitry is also coupled to receive control bits, configured to generate bursts of encoded control words by encoding the control bits, and to assert to the output a first burst of the encoded control words between the first burst of the video code words and the burst of the selected code words, and a second burst of the encoded control words between the burst of the selected code words and the second burst of the video code words.***

299. *See* [2.1]-[2.4].

30. Claim 28

[28.1] ***The transmitter of claim 27, wherein the selected code words include at least one guard band word, the burst of the selected code words has an initial word, and the initial word is the guard band word.***

300. *See* [3.1].

31. Claim 29

[29.1] ***The transmitter of claim 27, wherein the selected code words include at least one guard band word, the burst of the selected code words has an initial set of words, and each word of the initial set of words is one said guard band word.***

301. *See* [4.1].

32. Claim 30

[30.1] ***The transmitter of claim 27, wherein the selected code words include at least one guard band word, the burst of the selected code words has a final word, and the final word is the guard band word.***

302. *See* [5.1].

33. Claim 31

[31.1] ***The transmitter of claim 27, wherein the selected code words include at least one guard band word, the burst of the selected code words has a final set of words, and each word of the final set of words is one said guard band word.***

303. *See* [6.1].

34. Claim 33

[33.1] ***The transmitter of claim 27, wherein the selected code words include at least two guard band words, including a first guard band word and a second guard band word, the second burst of the video code words has an initial word, the initial word of the second burst of the video code words is the first guard band word, the burst of the selected code words has an initial word, and the initial word of the burst of the selected code words is the second guard band word.***

304. *See* [8.1].

35. Claim 37

[37.1] ***The transmitter of claim 26, wherein the circuitry is configured to assert to the output the first burst of the video code words followed by at least two bursts of the selected code words followed by the second burst of the video code words.***

305. *See* [49.2].

36. Claim 39

[39.0] ***A transmitter for use in data transmission over a serial link, said transmitter including:***

306. *See* [26.0].

[39.1] ***at least one input for receiving input data;***

307. *See* [26.1].

[39.2] ***an output configured to be coupled to a channel of the link; and***

308. *See* [26.2].

[39.3] ***circuitry, coupled to each said input and to the output, and***

309. *See* [26.3].

[39.4] ***configured to generate a sequence of selected code words by encoding the input data and to assert the sequence of selected code words to the output in response to the input data,***

310. *See* [26.4].

[39.5] ***wherein each of the selected code words is a member of a robust subset of a full code word set,***

311. *See* [1.4].

[39.6] ***the input data can be encoded as a conventional sequence of code words***

of the full code word set, and

312. *See* [1.5].

[39.7] ***the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words,***

313. *See* [1.6].

[39.8] ***wherein each of the selected code words is indicative of a sequence of L binary bits, and***

314. *See* [19.7].

[39.9] ***the selected code words have fewer contiguous zero bits and contiguous one bits per code word on the average than do the code words of the full code word set excluding the selected code words.***

315. *See* [19.8].

37. Claim 40

[40.0] ***A transmitter for use in data transmission over a serial link, said transmitter including:***

316. *See* [26.0].

[40.1] ***at least one input for receiving input data;***

317. *See* [26.1].

[40.2] ***an output configured to be coupled to a channel of the link; and***

318. *See* [26.2].

[40.3] ***circuitry, coupled to each said input and to the output, and***

319. *See* [26.3].

[40.4] ***configured to generate a sequence of selected code words by encoding the***

input data and to assert the sequence of selected code words to the output in response to the input data,

320. *See* [26.4].

[40.5] ***wherein each of the selected code words is a member of a robust subset of a full code word set,***

321. *See* [1.4].

[40.6] ***the input data can be encoded as a conventional sequence of code words of the full code word set, and***

322. *See* [1.5].

[40.7] ***the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words,***

323. *See* [1.6].

[40.8] ***wherein each of the selected code words is indicative of a different sequence of binary bits,***

324. *See* [20.7].

[40.9] ***the circuitry is configured to assert the sequence of selected code words as a sequence of rising and falling voltage transitions, and***

325. *See* [20.8].

[40.10] ***the selected code words have bit patterns that implement DC balancing by limiting voltage drift of the serial link during transmission of said sequence of selected code words to a predetermined amount.***

326. *See* [20.9].

38. Claim 41

[41.0] ***A method for encoding data for transmission over a serial link, said method including the steps of:***

327. To the extent that the preamble is limiting, Kim teaches the preamble.

328. **First,** Kim describes a method for encoding data for transmission over a serial link with an embedding unit 22 ("*A method for encoding data*").

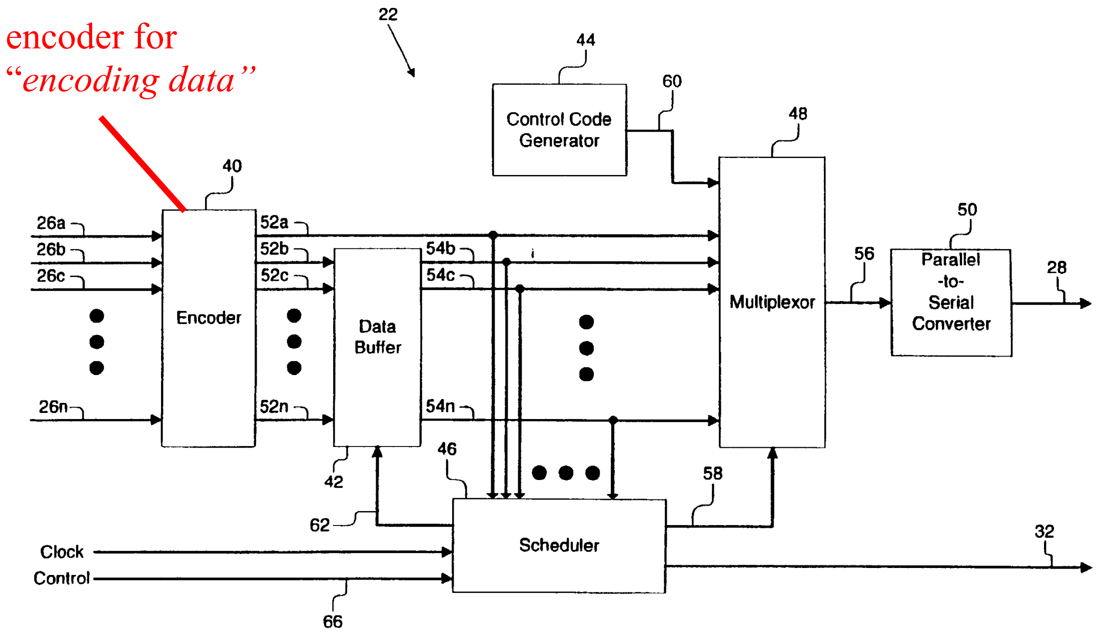
> The present invention relates generally to digital communications and interface devices in computer systems. In particular, **the present invention relates to a system and method for sending multiple data signals or streams over a serial line**.

Kim, 1:23-28.

> Referring now to FIG. 1, a block diagram of a preferred embodiment of a serial link system 20 for sending an isochronous digital data stream and one or more additional digital data streams over a single serial line is shown. **The serial link system 20 of the present invention preferably comprises an embedding unit 22**, a removing unit 24, a single serial line 28 and a clock signal line 32.

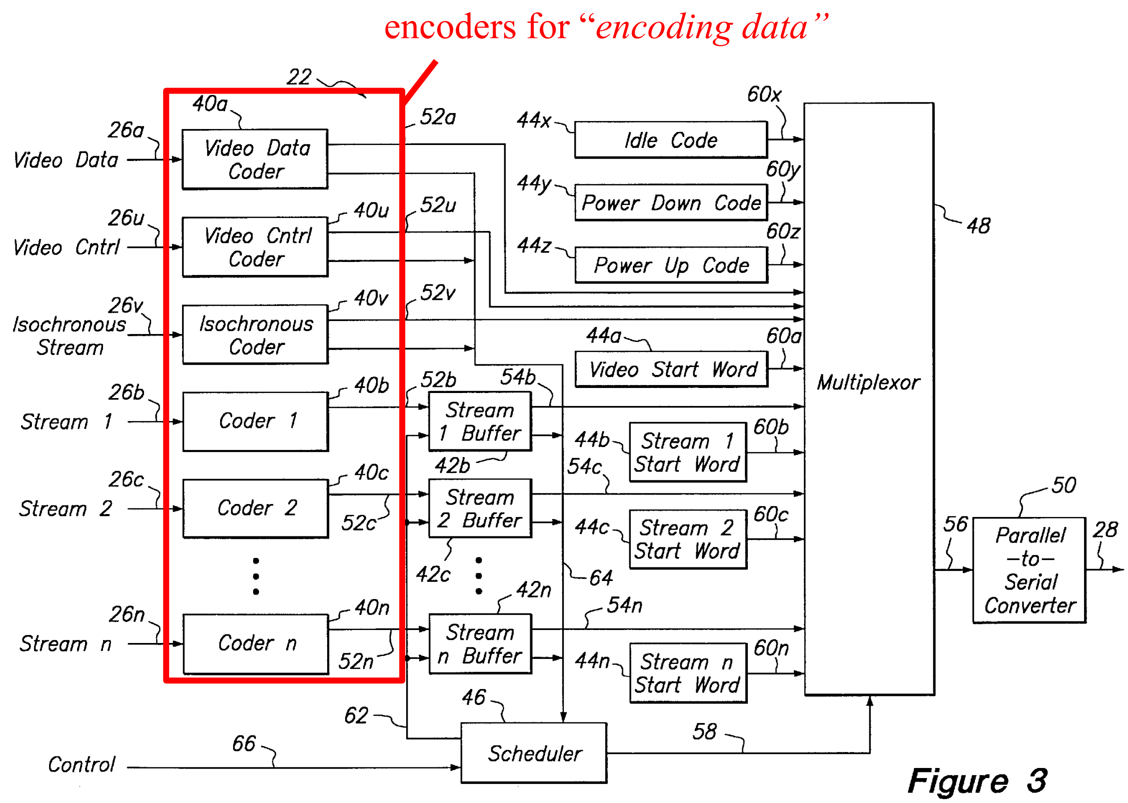
Kim, 4:6-13.

329. Kim's embedding unit 22 "receives the primary signal, second signal, third signal and nth signal, **and encodes each signal**." Kim, 4:43-45. The signals are encoded by an encoder 40 of the embedding unit: " Referring now to FIG. 2, a first and preferred embodiment of the embedding unit 22 is shown. **The embedding unit 22 preferably comprises an encoder 40**, a data buffer 42, a control code generator 44, a scheduler 46, a multiplexor 48 and a parallel-to-serial converter 50." Kim, 5:10-14. The encoder 40 is illustrated generally in Fig. 2, shown below.



Kim, Fig. 2 (annotated).

330. Kim provides a more detailed version of the embedding unit 22 and its encoder 40 in Fig. 3: "Referring now to FIG. 3, a specific embodiment of the embedding unit 22 is shown in more detail."



Kim, Fig. 3 (annotated).

331. Second, Kim's embedding unit 22 encodes data for transmission over a serial line ("*for transmission over a serial link*").

> The present invention relates generally to digital communications and interface devices in computer systems. In particular, **the present invention relates to a system and method for sending multiple data signals or streams over a serial line**.

Kim, 1:23-28.

> **<u>The present invention overcomes the deficiencies and limitations of the prior art with a serial link system and method for sending an isochronous data stream and one or more additional data streams over a single serial line</u>**. The preferred embodiment of the serial link system advantageously eliminates the aforementioned problems with

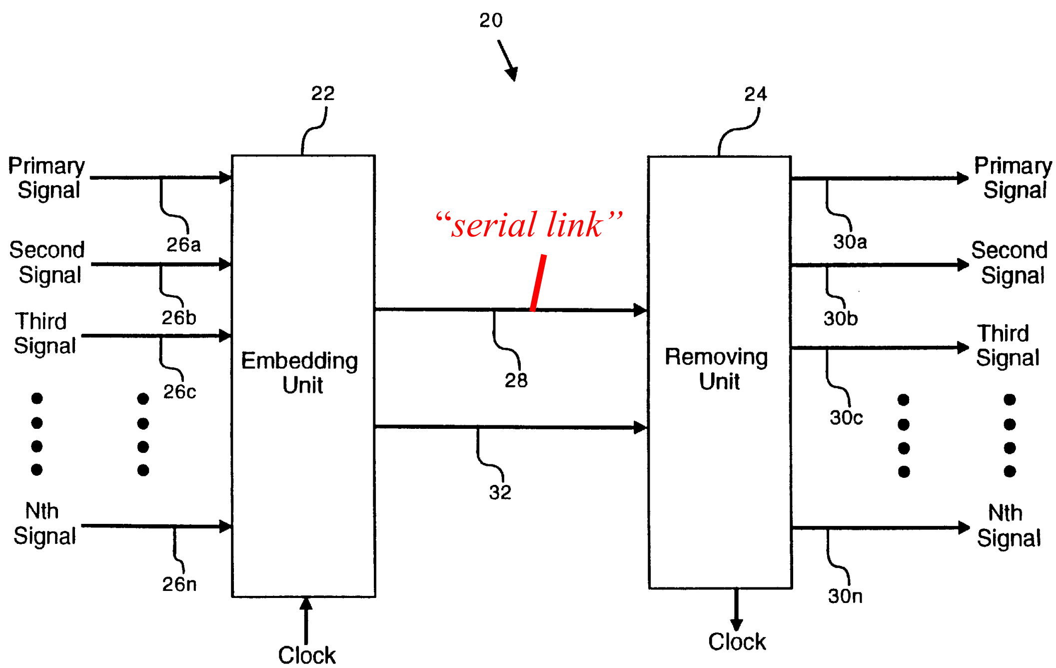
> numerous high speed parallel data lines and is able to provide high speed data transfer at rates in excess of that needed for high resolution displays. The preferred embodiment of the system of the present invention comprises an embedding unit and a removing unit coupled by a serial line. **The embedding unit preferably receives a plurality of data streams, encodes the data streams and then merges the encoded data into a serial stream that is output across a serial line** to the removing unit. The removing unit receives a serial stream of data, decodes the serial stream, and then separates the decoded serial stream into separate streams thereby reconstructing the streams input to the embedding unit.

Kim, 2:13-31.

> Referring now to FIG. 1, a block diagram of a preferred embodiment of a serial link system 20 for sending an isochronous digital data stream and one or more additional digital data streams over a single serial line is shown. **The serial link system 20 of the present invention preferably comprises** an embedding unit 22, a removing unit 24, **a single serial line 28** and a clock signal line 32.

Kim, 4:6-13; *see also* Kim, Claim 13 ("….**the encoder has data that is ready to be transmitted**…").

332. Kim illustrates a serial link system 20 at Fig. 1, reproduced below, where the embedding unit 22 transmits the encoded data stream (illustrated as an arrow) over the "serial line 28" ("*serial link*").



Ex.1005, Fig. 1 (annotated).

333. Thus, Kim's method for encoding data (using an embedding unit) for transmission over a serial line renders obvious "*[a] method for encoding data for transmission over a serial link,*" as recited in the preamble.

[41.1] ***(a) providing words of input data capable of being encoded as a conventional sequence of code words of a full code word set;***

334. Kim renders this limitation obvious.

335. **First**, Kim discloses "*providing words of input data*" by teaching that embedding unit 20 includes an encoder 40 (comprising encoders 40b-40n) that has inputs 26b-26n for receiving data streams, including audio streams for example.

> **<u>The encoder 40 preferably has a plurality of inputs</u>** and a plurality of outputs. The plurality of inputs are preferably grouped in sets. Thus, in Figure 2, signal lines 26a, 26b, 26c, . . . 26n are each used to designate

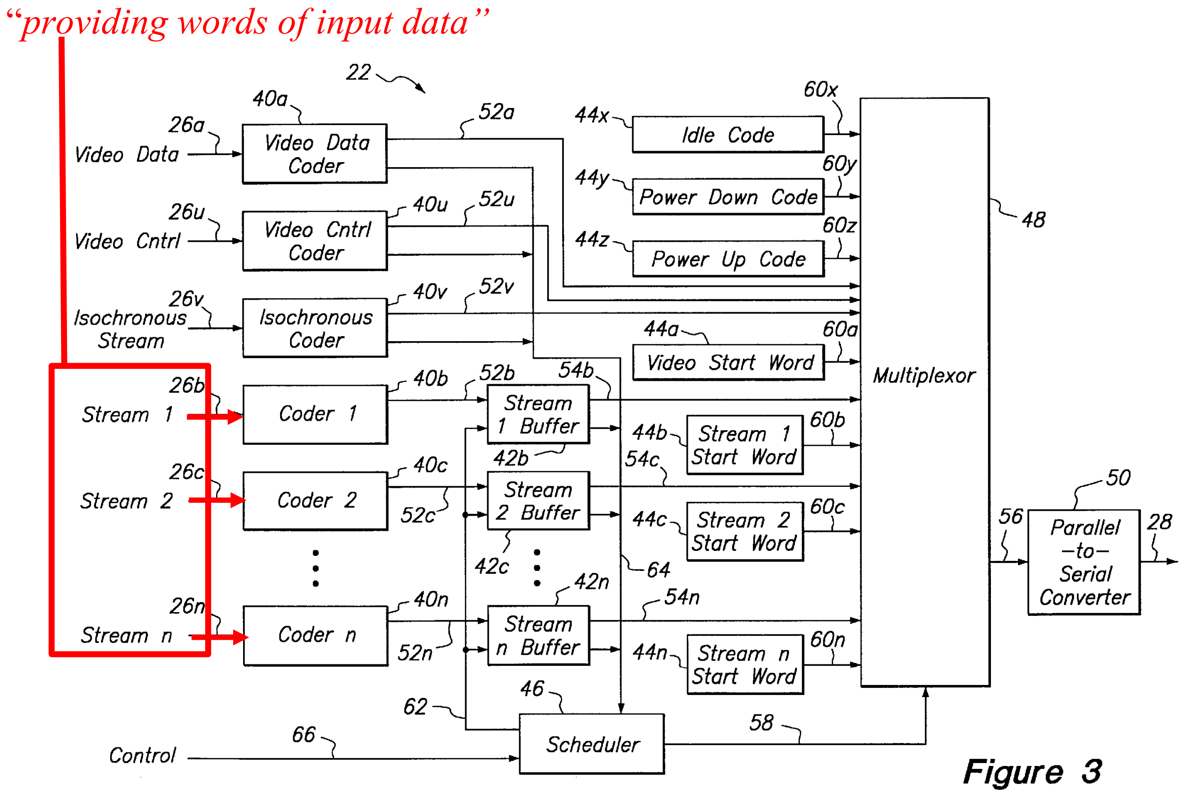
one or more signal lines of a data stream. For example, the first primary stream is preferably a video stream including the data and control signals for display refresh and may for example, be 28 parallel lines, 24 for data and 4 for control. **The remaining signal lines 26b, 26, . . . 26n can be used for other types of data**, and are for example, each eight parallel lines. Those skilled in the art will realize that each signal line 26a, 26b, 26c, . . . 26n may be a variety of parallel signal lines. For each of the input signal lines 26a, 26b, 26, . . . 26n, the encoder 40 preferably provides a corresponding output signal line 52a, 52b, 52c, . . . 52n. Each of the output signals line 52a, 52b, 52c, . . . 52n provides the encoded output of the signal applied to the corresponding input of the encoder 40. **In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word**. Thus, each of the output signals line 52a,52b, 52c, ... 52n is 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input of the multiplexor 48. The remaining output lines are 52b, 52c, . . . 52n are coupled to respective inputs of the data buffer 42. The encoder 40 preferably encodes the input stream into 10-bit output streams. The word output by the encoder 40 are preferably any 10-bit words other than those identified in Appendix A as special code words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. **Any number of conventional eight to 10 encoding schemes may be used** in addition to the specific encoding scheme identified below with respect to Figure 5.

Kim, 5:50-6:16.

336. As shown in Kim's Fig. 3, each of the different encoders 40b-40n process Streams 1-n, respectively, of input data.

> Still more particularly, a video data coder 40a is provided for encoding the video data signals to a 10-bit parallel output. Those skilled in the art will realize the video data coder 40a may be a plurality of 8-to-10bit coders depending on the number of bits used to represent the video data. For example, the video data coder 40a may be three 8-to-10 bit coders if 24 bits of RGB data are used with 8 bits for a red channel, 8 bits for a green channel, 8 bits for a blue channel, or two 8-to-10 bit coders for 16 bits of YUV data. An exemplary video coder 40a constructed according to the present invention is shown in Figure 5. Coders 40u,and 40v are also provided for the video control data, and the isochronous data stream. **Similarly, for stream 1 to n each stream has a dedicated coder 40b to 40n, respectively, to encode each particular data stream**. The coders 40b to 40n, 40u, 40v are preferably identical, and each maps the eight bit values applied on the inputs of the coders 40b to 40n to a corresponding 10-bit word according to a predefined coding scheme. An exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled "High-Speed Digital Video Signal Transmission System," filed on Oct. 6, 1995 and Sep. 30, 1996, which is incorporated herein by reference.

Kim, 8:44-67.



Ex.1005, Fig. 3 (annotated).

337. Kim explains that the input data streams may include, for example, audio data that is received as 8 bits of information. I will thus refer to Kim's multimedia data streams 1-n as "audio data streams" or "audio data."

> The present invention will now be discussed in the context of mixing various multimedia data streams into the display refresh data (primary stream) using the unused bandwidth of horizontal and vertical blanking periods. **Possible multimedia data streams that can be mixed include, but are not limited to audio** I/O, keyboard and mouse, I2C bus (serial bus for peripheral components), Universal Serial Bus and P1394 data. The separation between data streams is done by inserting special characters defined in a line coding scheme. By exploiting the available bandwidth of current high speed serial links, the present

> invention advantageously can send the coded stream such that embedding of multiple data streams is possible. In general, the embedding unit 22 receives a plurality of data streams. **For each of the data streams, n [e.g., 8] bits of information** to be transmitted are encoded to k [e.g., 10] bits, where k is larger than n, and then sent serially bit by bit over the serial line 28. 2k data words can be defined using k bits. Since 2n data words represented by n bit parallel data streams can be mapped into a subset of the 2k data words, 2k - 2n data words remain after mapping for use as special codes. Once the parallel streams have been encoded into k-bit words and other control words are created and inserted, the encoded words and control words are multiplex and serially. sent on line 28 one bit at a time. For ease of understanding, the present invention will now be described in the context of encoding from eight bits to 10 bits, and decoding from 10 bits to eight bits although those skilled in the art will recognize that the present invention may be used for various other coding rates.

Kim, 5:21-49. Kim's 8-bit input data are "*words*" of input data because Kim explains that "the decoder removes any encoding provided by the embedding unit 24 by converting the 10-bit words into their **original 8-bit word form**." Kim, 13:9-11. Accordingly, Kim's 8-bit audio data streams correspond to "*words of input data.*"

338. Second, Kim's input 8-bit audio data streams on lines 26b-26n are capable of being encoded using conventional sequence of "10-bit words" using eight-to-ten bit encoding schemes ("*capable of being encoded as a conventional* *sequence of code words*").

> In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded10-bit word. Thus, each of the output signals line 52a,52b, 52c, ... 52n is 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input of the multiplexor 48. The remaining output lines are 52b, 52c, . . . 52n are coupled to respective inputs of the data buffer 42. The encoder 40 preferably encodes the input stream into 10-bit output streams. The word output by the encoder 40 are preferably any 10-bit words other than those identified in Appendix A as special code words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. **Any number of conventional eight to 10 encoding schemes may be used** in addition to the specific encoding scheme identified below with respect to Figure 5.

Kim, 5:67-6:16; *see also* Kim, 5:59-60 ("The word output by the encoder 40 are preferably any 10-bit words.") Kim's disclosed conventional eight-to-ten bit encoding may be referred to in the art as "8b/10b" encoding.

339. Kim also incorporates by reference an additional patent (Shin) which it cites as an example of a conventional encoding scheme that can be used for encoders 40b to 40n.

> An exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled "High-Speed Digital Video

> Signal Transmission System," filed on Oct. 6, 1995, and Sep. 30, 1996, which is incorporated herein by reference.

Kim, 8:61-67.

340. Additionally, I note that the '437 patent characterizes in the background section that 8b/10b encoding is "conventional."

> There are several conventional TMDS-like links…. An example of an encoding algorithm … in a TMDS-like link, is IBM 8b10b coding.

'437 patent, 4:50-63.

341. **Third**, Kim's encoders—using conventional 8b/10b encoding techniques—produce 10-bit words that are part "*of a full code word set*." The range of possible outputs of a conventional 8b/10b is a "*full code word set*." An example of a full code word set is provided by Shin and shown in the table below. [3]

[3] Note that Shin lists only the last 9-bits of the 10-bit values. But, Shin explains that if the first bit of the 9-bit value is a '1', then a '0' is added at the front of to make the full 10-bit value. Conversely, if a '0' is at the front of the 9-bit value, a '1' is added to the front to make the full 10-bit value. *See* Shin, 13:1-8.

New Coder Mapping - high Transition Control Mode ASCII, Tr => New-Code, Tr	
00000000, 0 => 101010101, 7	00110011, 3 => 101100110, 4
00000001, 1 => 101010100, 6	00110100, 4 => 000110100, 4
00000010, 2 => 101010111, 5	00110101, 5 => 000110101, 5
00000011, 1 => 101010110, 6	00110110, 4 => 000110110, 4
00000100, 2 => 101010001, 5	00110111, 3 => 101100010, 4
00000101, 3 => 101010000, 4	00111000, 2 => 101101101, 5
00000110, 2 => 101010011, 5	00111001, 3 => 101101100, 4
00000111, 1 => 101010010, 6	00111010, 4 => 000111010, 4
00001000, 2 => 101011101, 5	00111011, 3 => 101101110, 4
00001001, 3 => 101011100, 4	00111100, 2 => 101101001, 5
00001010, 4 => 000001010, 4	00111101, 3 => 101101000, 4
00001011, 3 => 101011110, 4	00111110, 2 => 101101011, 5
00001100, 2 => 101011001, 5	00111111, 1 => 101101010, 6
00001101, 3 => 101011000, 4	01000000, 2 => 100010101, 5
00001110, 2 => 101011011, 5	01000001, 3 => 100010100, 4
00001111, 1 => 101011010, 6	01000010, 4 => 001000010, 4
00010000, 2 => 101000101, 5	01000011, 3 => 100010110, 4
00010001, 3 => 101000100, 4	01000100, 4 => 001000100, 4
00010010, 4 => 000010010, 4	01000101, 5 => 001000101, 5
00010011, 3 => 101000110, 4	01000110, 4 => 001000110, 4
00010100, 4 => 000010100, 4	01000111, 3 => 100010010, 4
00010101, 5 => 000010101, 5	01001000, 4 => 001001000, 4
00010110, 4 => 000010110, 4	01001001, 5 => 001001001, 5
00010111, 3 => 101000010, 4	01001010, 6 => 001001010, 6
00011000, 2 => 101001101, 5	01001011, 5 => 001001011, 5
00011001, 3 => 101001100, 4	01001100, 4 => 001001100, 4
00011010, 4 => 000011010, 4	01001101, 5 => 001001101, 5
00011011, 3 => 101001110, 4	01001110, 4 => 001001110, 4
00011100, 2 => 101001001, 5	01001111, 3 => 100011010, 4
00011101, 3 => 101001000, 4	01010000, 4 => 001010000, 4
00011110, 2 => 101001011, 5	01010001, 5 => 001010001, 5
00011111, 1 => 101001010, 6	01010010, 6 => 001010010, 6
00100000, 2 => 101110101, 5	01010011, 5 => 001010011, 5
00100001, 3 => 101110100, 4	01010100, 6 => 001010100, 6
00100010, 4 => 000100010, 4	01010101, 7 => 001010101, 7
00100011, 3 => 101110110, 4	01010110, 6 => 001010110, 6
00100100, 4 => 000100100, 4	01010111, 5 => 001010111, 5
00100101, 5 => 000100101, 5	01011000, 4 => 001011000, 4
00100110, 4 => 000100110, 4	01011001, 5 => 001011001, 5
00100111, 3 => 101110010, 4	01011010, 6 => 001011010, 6
00101000, 4 => 000101000, 4	01011011, 5 => 001011011, 5
00101001, 5 => 000101001, 5	01011100, 4 => 001011100, 4
00101010, 6 => 000101010, 6	01011101, 5 => 001011101, 5
00101011, 5 => 000101011, 5	01011110, 4 => 001011110, 4
00101100, 4 => 000101100, 4	01011111, 3 => 100001010, 4
00101101, 5 => 000101101, 5	01100000, 2 => 100110101, 5
00101110, 4 => 000101110, 4	01100001, 3 => 100110100, 4
00101111, 3 => 101111010, 4	01100010, 4 => 001100010, 4
00110000, 2 => 101100101, 5	01100011, 3 => 100110110, 4
00110001, 3 => 101100100, 4	01100100, 4 => 001100100, 4
00110010, 4 => 000110010, 4	01100101, 5 => 001100101, 5
01101011, 5 => 001101011, 5	01100110, 4 => 001100110, 4
01101100, 4 => 001101100, 4	01100111, 3 => 100110010, 4
01101101, 5 => 001101101, 5	01101000, 4 => 001101000, 4
01101110, 4 => 001101110, 4	01101001, 5 => 001101001, 5
01101111, 3 => 100111010, 4	01101010, 6 => 001101010, 6
01110000, 2 => 100100101, 5	10100011, 4 => 010100011, 4
01110001, 3 => 100100100, 4	10100100, 5 => 010100100, 5
01110010, 4 => 001110010, 4	10100101, 6 => 010100101, 6
01110011, 3 => 100100110, 4	10100110, 5 => 010100110, 5
01110100, 4 => 001110100, 4	10100111, 4 => 010100111, 4
01110101, 5 => 001110101, 5	10101000, 5 => 010101000, 5
01110110, 4 => 001110110, 4	10101001, 6 => 010101001, 6
01110111, 3 => 100100010, 4	10101010, 7 => 010101010, 7

-continued

01111000, 2 => 100101101, 5	10101011, 6 => 010101011, 6
01111001, 3 => 100101100, 4	10101100, 5 => 010101100, 5
01111010, 4 => 001111010, 4	10101101, 6 => 010101101, 6
01111011, 3 => 100101110, 4	10101110, 5 => 010101110, 5
01111100, 2 => 100101001, 5	10101111, 4 => 010101111, 4
01111101, 3 => 100101000, 4	10110000, 3 => 111110101, 4
01111110, 2 => 100101011, 5	10110001, 4 => 010110001, 4
01111111, 1 => 100101010, 6	10110010, 5 => 010110010, 5
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10000010, 3 => 111010111, 4	10110101, 6 => 010110101, 6
10000011, 2 => 111010110, 5	10110110, 5 => 010110110, 5
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10000110, 3 => 111010011, 4	10111001, 4 => 010111001, 4
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10010111, 4 => 010010111, 4	11001010, 5 => 011001010, 5
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10100000, 3 => 111110101, 4	11010011, 4 => 011010011, 4
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10100010, 5 => 010100010, 5	11010001, 6 => 011010101, 6
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11100001, 2 => 110110100, 5	
11100010, 3 => 110110111, 4	
11100011, 2 => 110110110, 5	
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11101101, 4 => 011101101, 4	
11101110, 3 => 110111011, 4	
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11110010, 3 => 110100111, 4	
11110011, 2 => 110100110, 5	
11110100, 3 => 110100001, 4	
11110101, 4 => 011110101, 4	
11110110, 3 => 110100011, 4	
11110111, 2 => 110100010, 5	
11111000, 1 => 110101101, 6	
11111001, 2 => 110101100, 5	
11111010, 3 => 110101111, 4	
11111011, 2 => 110101110, 5	
11111100, 1 => 110101001, 6	
11111101, 2 => 110101000, 5	
11111111, 0 => 110101010, 7	
Total Tr: 1176	

Mean Tr: 4.59

New Coder Mapping - Low Transition
Control Mode
ASCII, Tr => New-Code, Tr

00000000, 0 => 000000000, 0
00000001, 1 => 000000001, 1
00000010, 2 => 000000010, 2
00000011, 1 => 000000011, 1
00000100, 2 => 000000100, 2
00000101, 3 => 000000101, 3
00000110, 2 => 000000110, 2
00000111, 1 => 000000111, 1
00001000, 2 => 000001000, 2
00001001, 3 => 000001001, 3
00001010, 4 => 101011111, 3
00001011, 3 => 000001011, 3
00001100, 2 => 000001100, 2
00001101, 3 => 000001101, 3
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00010011, 3 => 000010011, 3
00010100, 4 => 101000001, 3
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01111001, 3 => 001111001, 3
01111010, 4 => 100101111, 3
01111011, 3 => 001111011, 3
01111100, 2 => 001111100, 2
01111101, 3 => 011111101, 3
01111110, 2 => 001111110, 2
01111111, 1 => 001111111, 1
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10000001, 2 => 010000001, 2
00110011, 3 => 000110011, 3
00110100, 4 => 101100001, 3
00110101, 5 => 101100000, 2
00110110, 4 => 101100011, 3
00110111, 3 => 000110111, 3
00111000, 2 => 000111000, 2
00111001, 3 => 000111001, 3
00111010, 4 => 101101111, 3
00111011, 3 => 000111011, 3
00111100, 2 => 000111100, 2
00111101, 3 => 000111101, 3
00111110, 2 => 000111110, 2
00111111, 1 => 000111111, 1
01000000, 2 => 001000000, 2
01000001, 3 => 001000091, 3
01000010, 4 => 100010111, 3
01000011, 3 => 001000011, 3
01000100, 4 => 100010001, 3
01000101, 5 => 100010000, 2
01000110, 4 => 100010011, 3
01000111, 3 => 001000111, 3
01001000, 4 => 100011101, 3
01001001, 5 => 100011100, 2
01001010, 6 => 100011111, 1
01001011, 5 => 100011110, 2
01001100, 4 => 100011001, 3
01001101, 5 => 100011000, 2
01001110, 4 => 100011011, 3
01001111, 3 => 001001111, 3
01010000, 4 => 100000101, 3
01010001, 5 => 100000100, 2
01010010, 6 => 100000111, 1
01010011, 5 => 100000110, 2
01010100, 6 => 100000001, 1
01010101, 7 => 100000000, 0
01010110, 6 => 100000011, 1
01010111, 5 => 100000010, 2
01011000, 4 => 100001101, 3
01011001, 5 => 100001100, 2
01011010, 6 => 100001111, 1
01011011, 5 => 100001110, 2
01011100, 4 => 100001001, 3
01011101, 5 => 100001000, 2
01011110, 4 => 100001011, 3
01011111, 3 => 001011111, 3
01100000, 2 => 001100000, 2
01100001, 3 => 001100001, 3
01100010, 4 => 100110111, 3
01100011, 3 => 001100011, 3
01100100, 4 => 100110001, 3
01100101, 5 => 100110000, 2
01100110, 4 => 100110011, 3
01100111, 3 => 001100111, 3
01101000, 4 => 100111101, 3
01101001, 5 => 100111100, 2
01101010, 6 => 100111111, 1
10100011, 4 => 111110110, 3
10100100, 5 => 111110001, 2
10100101, 6 => 111110000, 1
10100110, 5 => 111110011, 2
10100111, 4 => 111110010, 3
10101000, 5 => 111111101, 2
10101001, 6 => 111111100, 1
10101010, 7 => 111111111, 0
10101011, 6 => 111111110, 1
10101100, 5 => 111111001, 2
10101101, 6 => 111111000, 1
10101110, 5 => 111111011, 2
10101111, 4 => 111111010, 3
10110000, 3 => 010110000, 3
10110001, 4 => 111100100, 3
10110010, 5 => 111100111, 2
10110011, 4 => 111100110, 3
10110100, 5 => 111100001, 2

10000010, 3 => 010000010, 3
10000011, 2 => 010000011, 2
10000100, 3 => 010000100, 3
10000101, 4 => 111010000, 3
10000110, 3 => 010000110, 3
10000111, 2 => 010000111, 2
10001000, 3 => 010001000, 3
10001001, 4 => 111011100, 3
10001010, 5 => 111011111, 2
10001011, 4 => 110111110, 3
10001100, 3 => 010001100, 3
10001101, 4 => 111011000, 3
10001110, 3 => 010001110, 3
10001111, 2 => 010001111, 2
10010000, 3 => 010010000, 3
10010001, 4 => 111000100, 3
10010010, 5 => 111000111, 2
10010011, 4 => 111000110, 3
10010100, 5 => 111000001, 2
10010101, 6 => 111000000, 1
10010110, 5 => 111000011, 2
10010111, 4 => 111000010, 3
10011000, 3 => 010011000, 3
10011001, 4 => 111001100, 3
10011010, 5 => 111001111, 2
10011011, 4 => 111001110, 3
10011100, 3 => 010011100, 3
10011101, 4 => 111001000, 3
10011110, 3 => 010011110, 3
10011111, 2 => 010011111, 2
10100000, 3 => 010100000, 3
10100001, 4 => 111110100, 3
10100010, 5 => 111110111, 2
11011011, 4 => 110001110, 3
11011100, 3 => 011011100, 3
11011101, 4 => 110001000, 3
11011110, 3 => 011011110, 3
11011111, 2 => 011011111, 2
11100000, 1 => 011100000, 1
11100001, 2 => 011100001, 2
11100010, 3 => 011100010, 3
11100011, 2 => 011100011, 2
11100100, 3 => 011100100, 3
11100101, 4 => 110110000, 3
11100110, 3 => 011100110, 3
11100111, 2 => 011100111, 2
11101000, 3 => 011101000, 3
11101001, 4 => 110111100, 3
11101010, 5 => 110111111, 2
11101011, 4 => 110111110, 3
11101100, 3 => 011101100, 3
11101101, 4 => 110111000, 3
11101110, 3 => 011101110, 3
11101111, 2 => 011101111, 2
11110000, 1 => 011110000, 1
11110001, 2 => 011110001, 2
11110010, 3 => 011110010, 3
11110011, 2 => 011110011, 2
11110100, 3 => 011110100, 3
11110101, 4 => 110100000, 3
11110110, 3 => 011110110, 3
11110111, 2 => 011110111, 2
11111000, 1 => 011111000, 1
11111001, 2 => 011111001, 2
11111010, 3 => 011111010, 3
11111011, 2 => 011111011, 2
11111100, 1 => 011111100, 1
11111101, 2 => 011111101, 2
11111110, 1 => 011111110, 1
11111111, 0 => 011111111, 0
Total Tr: 616
Mean Tr: 2.41
10110101, 6 => 111100000, 1
10110110, 5 => 111100011, 2
10110111, 4 => 111100010, 3
10111000, 3 => 010111000, 3
10111001, 4 => 111101100, 3
10111010, 5 => 111101111, 2
10111011, 4 => 111101110, 3
10111100, 3 => 010111100, 3
10111101, 4 => 111101000, 3
10111110, 3 => 010111110, 3
10111111, 2 => 010111111, 2
11000000, 1 => 011000000, 1
11000001, 2 => 011000001, 2
11000010, 3 => 011000010, 3
11000011, 2 => 011000011, 2
11000100, 3 => 011000100, 3
11000101, 4 => 110010000, 3
11000110, 3 => 011000110, 3
11000111, 2 => 011000111, 2
11001000, 3 => 011001000, 3
11001001, 4 => 110011100, 3
11001010, 5 => 110011111, 2
11001011, 4 => 110011110, 3
11001100, 3 => 011001100, 3
11001101, 4 => 110011000, 3
11001110, 3 => 011001110, 3
11001111, 2 => 011001111, 2
11010000, 3 => 011010000, 3
11010001, 4 => 110000100, 3
11010010, 5 => 110000111, 2
11010011, 4 => 110000110, 3
11010100, 5 => 110000001, 2
11010101, 6 => 110000000, 1
11010110, 5 => 110000011, 2
11010111, 4 => 110000010, 3
11011000, 3 => 011011000, 3
11011001, 4 => 110001100, 3
11011010, 5 => 110001111, 2

Shin, 20:11-23:60 (listing all input and output values for the high-transition mode 8b/10b encoding scheme).

342. Thus, Kim's disclosure of providing 8-bit input audio data words capable of being encoded as conventional sequence (using 8b10b encoding) of 10-bit code words of the available code word set renders obvious "*providing words of input data capable of being encoded as a conventional sequence of code words of a full code word set.*"

343. I note that Kim teaches a "*full code word set*" under Patent Owner's interpretation of this term as well. It has been explained to me that Patent Owner interprets this term as follows: "A full code word set comprise 2^{10}=1024 codewords of 10 bits." Ex.1012, 5. Under that interpretation of the phrase, Kim alone would disclose a "*full code word set*" because Kim's encoders generate 10-bit output words. *See* Kim, 5:50-6:16.

[41.2] ***(b) generating a sequence of selected code words by encoding the input data,***

344. Kim renders this limitation obvious.

345. Kim's encoders 40b-40n encode the audio data streams ("*input data*") into encoded data ("*a sequence of selected code words*"). Thus, any of Kim's encoders generates a sequence of selected code words. Because the output words are selected from a code word set, they are "*selected*" words as claimed.

> **<u>Similarly, for stream 1 to n each stream has a dedicated coder 40b to 40n, respectively, to encode each particular data stream</u>**. The coders 40b to 40n, 40u, 40v are preferably identical, and each maps the eight bit values applied on the inputs of the coders 40b to 40n to a corresponding 10-bit word according to a predefined coding scheme. An exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled "High-Speed Digital Video Signal Transmission System," filed on Oct. 6, 1995 and Sep. 30, 1996, which is incorporated herein by reference.

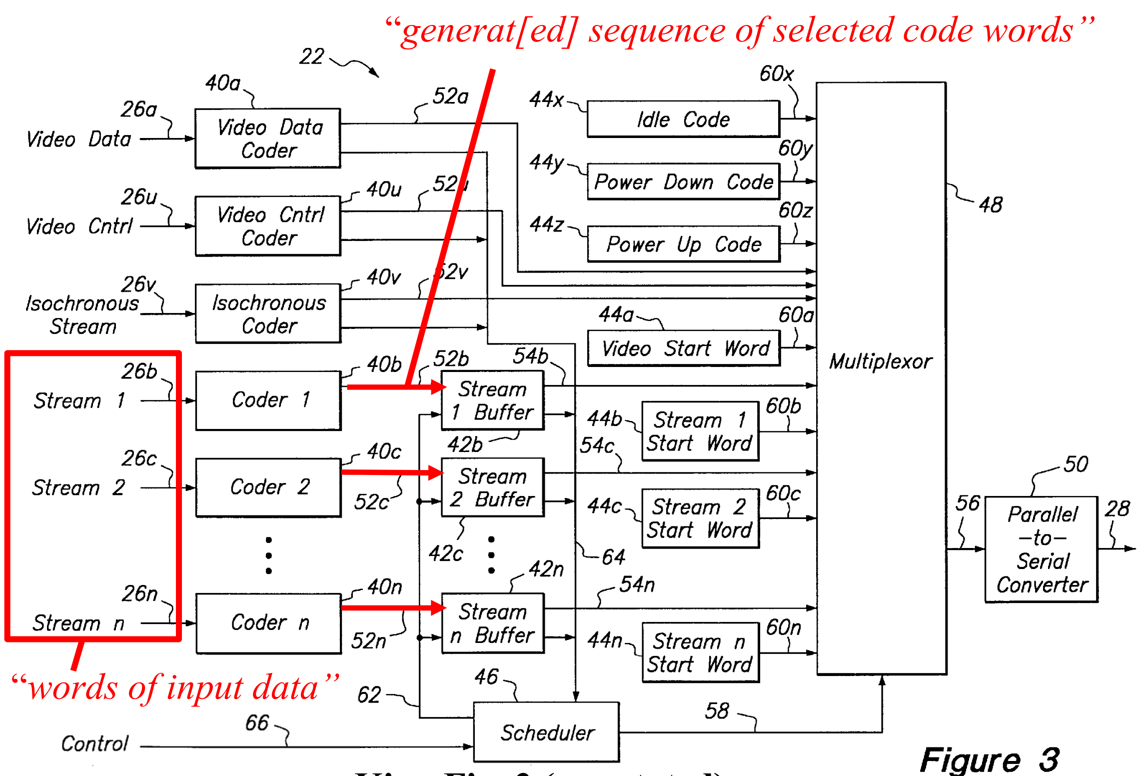
Kim, 8:44-67.

346. As illustrated at Fig. 3, Kim's coders 40b to 40n perform 8b10b encoding to generate a sequence of "10-bit words" (illustrated with an arrow) that are output along lines 52b-52n, respectively.

> Those skilled in the art will realize that each signal line 26a, 26b, 26c, ... 26n may be a variety of parallel signal lines. **<u>For each of the input signal lines 26a, 26b, 26c, ... 26n, the encoder 40 preferably provides a corresponding output signal line 52a, 52b, 52c, ... 52n. Each of the output signals line 52a, 52b, 52c, ... 52n provides the encoded output of the signal applied to the corresponding input of the encoder 40</u>**. In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word. Thus, each of the output signals line 52a, 52b, 52c, ... 52n is 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input of the

multiplexor 48. The remaining output lines are 52b, 52c, ... 52n are coupled to respective inputs of the data buffer 42. The encoder 40 preferably encodes the input stream into 10-bit output streams. **The word output by the encoder 40 are preferably any 10-bit words** other than those identified in Appendix A as special code words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. Any number of conventional eight to 10 encoding schemes may be used in addition to the specific encoding scheme identified below with respect to FIG. 5.

Kim, 5:59-6:16.



Kim, Fig. 3 (annotated).

347. Thus, Kim's disclosure of encoders 40b-40n generating a sequence of 10-bit words by encoding the 8-bit input data streams using conventional 8b10b encoding renders obvious "*generating a sequence of selected code words by encoding the input data*" as claimed.

[41.3] ***wherein each of the selected code words is a member of a robust subset of the full code word set, and***

348. Kim in combination with Myers renders this limitation obvious.

349. **First**, as discussed at limitation [41.2], Kim's encoders 40b-40n may receive 8-bit input audio data and "*generate[] a sequence of selected code words*."

350. **Second**, Kim in combination with Myers teaches that the "*selected code words*" are "*a robust subset of the full code word set*." A POSITA would have recognized that audio data is more vulnerable to communication defects from data loss. *See e.g.*, Asai, 4:27-28 ("the human ear is more sensitive to errors or defects than the human eye"); Pasqualino, 11:23-25 and 10:67-11:2 (recognizing that "low bandwidth information being sent is sensitive to channel errors" and that "low bandwidth information may be...audio"). As such, it would have been obvious to a POSITA to use an encoding scheme for audio data that reduces the likelihood of data loss. While Kim states that the encoders 40b-40n may use 8b/10b encoding, Kim acknowledges that other coding schemes may be used. *See* Kim 5:44-50 ("For ease of understanding, the present invention will now be described in the context of encoding from eight bits to 10 bits, and decoding from 10 bits to eight bits although those skilled in the art will recognize that **the present invention may be used for various other coding rates**").

351. Myers complements Kim's disclosure by generally teaching a coding technique that reduces distortions and communication defects in audio transmission by reducing data loss. Myers, 2:50-57 (seeking to reduce "distortion of the signal and a loss of information."); *see also* Myers, 7:10-50. As detailed below, Myers teaches the selection of a subset of transmission codes such that they have DC balance (an equal number of '1's and '0's) and have fewer contiguous ones and zeros to obtain the data loss reduction. A POSITA would have been motivated to apply Myers' selection criteria to Kim's conventional encoding scheme for audio data to reduce distortion and data loss.

352. In more detail, Myers provides a technique for selecting a subset of code words. The subset is selected using three steps: selecting words that (1) are DC balanced—an equal number of 1s and 0s, (2) contain no more than two 1's or 0's in sequence, and (3) have either an "01" or "10" on each end.

> **The first step** 10 in this selection method is to select a first **subset** containing all of the code words from the 256 possibilities which have exactly four '1's and four '0's, to ensure inherent DC balance. From this subset, **a second step 12** is to select a second **subset** containing the code words having no more than two consecutive '1's or '0's is selected. The **third step 14** is to select a third **subset** of code words, from the second subset, that begin and end with either a '01' or '10' bit grouping.

Myers, 8:16-23.

353. A POSITA would have found it obvious to apply Myers' subset-selection technique to Kim's encoders that encode the audio data for the reasons explained above at VIII.A.3. Applying Myers' subset-selection technique to Kim's 10-bit transmission words results in a subset of 10-bit values that have (1) DC balance, (2) no more than two consecutive 1's or 0's criteria, and (3) start and end values of "01" or "10." The result of this subset-selection technique is a "*subset of the full code word set*."

354. As an example, applying Myers' subset-selection technique to the full code word set described in Shin (*See* [41.2]) results in a limited code word set comprised of 42 different 10-bit values, as shown in Table 1 below. As identified in the Notes column, some of these 42 values correspond to Kim's control words (e.g., isochronous words, IDLE words, or data stream separation words) and the rest are available to use for audio or other auxiliary data.

Count	Decimal	Binary	Notes
1	301	0100101101	Subset of Full Code Word Set
2	309	0100110101	Subset of Full Code Word Set
3	310	0100110110	Isochronous
4	333	0101001101	Subset of Full Code Word Set
5	341	0101010101	Subset of Full Code Word Set
6	342	0101010110	IDLE

7	345	0101011001	Subset of Full Code Word Set
8	346	0101011010	IDLE
9	357	0101100101	Subset of Full Code Word Set
10	358	0101100110	Isochronous
11	361	0101101001	Subset of Full Code Word Set
12	362	0101101010	IDLE
13	405	0110010101	Subset of Full Code Word Set
14	406	0110010110	Isochronous
15	409	0110011001	Subset of Full Code Word Set
16	410	0110011010	Isochronous
17	421	0110100101	Subset of Full Code Word Set
18	422	0110100110	Isochronous
19	425	0110101001	Subset of Full Code Word Set
20	426	0110101010	IDLE
21	434	0110110001	Isochronous
22	589	1001001101	Separation
23	597	1001010101	IDLE
24	598	1001010110	Subset of Full Code Word Set
25	601	1001011001	Separation
26	602	1001011010	Subset of Full Code Word Set
27	613	1001100101	Separation
28	614	1001100110	Subset of Full Code Word Set
29	617	1001101001	Separation

30	618	1001101010	Subset of Full Code Word Set
31	661	1010010101	IDLE
32	662	1010010110	Subset of Full Code Word Set
33	665	1010011001	Separation
34	666	1010011010	Subset of Full Code Word Set
35	677	1010100101	IDLE
36	678	1010100110	Subset of Full Code Word Set
37	681	1010101001	IDLE
38	682	1010101010	Subset of Full Code Word Set
39	690	1010110010	Subset of Full Code Word Set
40	713	1011001001	Separation
41	714	1011001010	Subset of Full Code Word Set
42	722	1011010010	Subset of Full Code Word Set

355. As indicated in the Table, eight of the 42 values correspond to the 10-bit values Kim uses as IDLE words, as shown in Kim's Appendix A.

APPENDIX A

Sample Control Words

IDLE Words

0101010110
0101011010
0101101010
0110101010
1010101001
1010100101
1010010101
1001010101

356. Six of the 42 10-bit values correspond to Isochronous Data Transfer Words, as shown in the highlighted numbers below.

Isochronous Data Transfer Words
0010101110
0010110110
0010111010
0011010110
0011011010
0011101010
0100101110
0100110110
0100111010
0101001110
0101011100
0101100110
0101101100
0101110010
0101110100
0110010110
0110011010
0110100110
0110101100
0110110010
0110110100

357. Additionally, six more of the 42 10-bit words are used for Data Stream Separation Words, as shown by the highlighted numbers below.

Data Stream Separation Words
1000101011
1000101101
1000110101
1001001011
1001001101
1001010011
1001011001
1001100101
1001101001
1010001011
1010001101
1010010011
1010011001
1010100011
1010110001
1011000101
1011001001
1011010001
1100010101
1100100101
1100101001
1101000101
1101001001
1101010001

358. Accordingly, 20 of the 42 10-bit words are used by Kim as control words, leaving 22 different 10-bit words available for sending data.

359. These 42 10-bit values for data transmission correspond to a "*subset*" of Shin's conventional full code word set. As explained above at [41.1], Kim incorporates by reference Shin, which describes an example of a conventional 8b/10b encoding scheme and provides a list of the 10-bit output words. As shown in the figures below, each of the 42 10-bit values match up with one of Shin's output values.

00000000, 0 => 101010101, 7
00000001, 1 => 101010100, 6
00000010, 2 => 101010111, 5
00000011, 1 => 101010110, 6
00000100, 2 => 101010001, 5
00000101, 3 => 101010000, 4
00000110, 2 => 101010011, 5
00000111, 1 => 101010010, 6
00001000, 2 => 101011101, 5
00001001, 3 => 101011100, 4
00001010, 4 => 000001010, 4
00001011, 3 => 101011110, 4
00001100, 2 => 101011001, 5
00001101, 3 => 101011000, 4
00001110, 2 => 101011011, 5
00001111, 1 => 101011010, 6
00010000, 2 => 101000101, 5
00010001, 3 => 101000100, 4
00010010, 4 => 000010010, 4
00010011, 3 => 101000110, 4
00010100, 4 => 000010100, 4
00010101, 5 => 000010101, 5
00010110, 4 => 000010110, 4
00010111, 3 => 101000010, 4
00011000, 2 => 101001101, 5
00011001, 3 => 101001100, 4
00011010, 4 => 000011010, 4
00011011, 3 => 101001110, 4
00011100, 2 => 101001001, 5
00011101, 3 => 101001000, 4
00011110, 2 => 101001011, 5
00011111, 1 => 101001010, 6
00100000, 2 => 101110101, 5
00100001, 3 => 101110100, 4
00100010, 4 => 000100010, 4
00100011, 3 => 101110110, 4
00100100, 4 => 000100100, 4
00100101, 5 => 000100101, 5
00100110, 4 => 000100110, 4
00100111, 3 => 101110010, 4
00101000, 4 => 000101000, 4
00101001, 5 => 000101001, 5
00101010, 6 => 000101010, 6
00101011, 5 => 000101011, 5
00101100, 4 => 000101100, 4
00101101, 5 => 000101101, 5
00101110, 4 => 000101110, 4
00101111, 3 => 101111010, 4
00110000, 2 => 101100101, 5
00110001, 3 => 101100100, 4
00110010, 4 => 000110010, 4
01101011, 5 => 001101011, 5
01101100, 4 => 001101100, 4
01101101, 5 => 001101101, 5
01101110, 4 => 001101110, 4
01101111, 3 => 100111010, 4
01110000, 2 => 100100101, 5
01110001, 3 => 100100100, 4
01110010, 4 => 001110010, 4
01110011, 3 => 100100110, 4
01110100, 4 => 001110100, 4
01110101, 5 => 001110101, 5
01110110, 4 => 001110110, 4
01110111, 3 => 100100010, 4
00110011, 3 => 101100110, 4
00110100, 4 => 000110100, 4
00110101, 5 => 000110101, 5
00110110, 4 => 000110110, 4
00110111, 3 => 101100010, 4
00111000, 2 => 101101101, 5
00111001, 3 => 101101100, 4
00111010, 4 => 000111010, 4
00111011, 3 => 101101110, 4
00111100, 2 => 101101001, 5
00111101, 3 => 101101000, 4
00111110, 2 => 101101011, 5
00111111, 1 => 101101010, 6
01000000, 2 => 100010101, 5
01000001, 3 => 100010100, 4
01000010, 4 => 001000010, 4
01000011, 3 => 100010110, 4
01000100, 4 => 001000100, 4
01000101, 5 => 001000101, 5
01000110, 4 => 001000110, 4
01000111, 3 => 100010010, 4
01001000, 4 => 001001000, 4
01001001, 5 => 001001001, 5
01001010, 6 => 001001010, 6
01001011, 5 => 001001011, 5
01001100, 4 => 001001100, 4
01001101, 5 => 001001101, 5
01001110, 4 => 001001110, 4
01001111, 3 => 100011010, 4
01010000, 4 => 001010000, 4
01010001, 5 => 001010001, 5
01010010, 6 => 001010010, 6
01010011, 5 => 001010011, 5
01010100, 6 => 001010100, 6
01010101, 7 => 001010101, 7
01010110, 6 => 001010110, 6
01010111, 5 => 001010111, 5
01011000, 4 => 001011000, 4
01011001, 5 => 001011001, 5
01011010, 6 => 001011010, 6
01011011, 5 => 001011011, 5
01011100, 4 => 001011100, 4
01011101, 5 => 001011101, 5
01011110, 4 => 001011110, 4
01011111, 3 => 100001010, 4
01100000, 2 => 100110101, 5
01100001, 3 => 100110100, 4
01100010, 4 => 001100010, 4
01100011, 3 => 100110110, 4
01100100, 4 => 001100100, 4
01100101, 5 => 001100101, 5
01100110, 4 => 001100110, 4
01100111, 3 => 100110010, 4
01101000, 4 => 001101000, 4
01101001, 5 => 001101001, 5
01101010, 6 => 001101010, 6
10100011, 4 => 010100011, 4
10100100, 5 => 010100100, 5
10100101, 6 => 010100101, 6
10100110, 5 => 010100110, 5
10100111, 4 => 010100111, 4
10101000, 5 => 010101000, 5
10101001, 6 => 010101001, 6
10101010, 7 => 010101010, 7
01111000, 2 => 100101101, 5
01111001, 3 => 100101100, 4
01111010, 4 => 001111010, 4
01111011, 3 => 100101110, 4
01111100, 2 => 100101001, 5
01111101, 3 => 100101000, 4
01111110, 2 => 100101011, 5
01111111, 1 => 100101010, 6
10000000, 1 => 111010101, 6
10000001, 2 => 111010100, 5
10000010, 3 => 111010111, 4
10000011, 2 => 111010110, 5
10000100, 3 => 111010001, 4
10000101, 4 => 010000101, 4
10000110, 3 => 111010011, 4
10000111, 2 => 111010010, 5
10001000, 3 => 111011101, 4
10001001, 4 => 010001001, 4
10001010, 5 => 010001010, 5
10001011, 4 => 010001011, 4
10001100, 3 => 111011001, 4
10001101, 4 => 010001101, 4
10001110, 3 => 111011011, 4
10001111, 2 => 111011010, 5
10010000, 3 => 111000101, 4
10010001, 4 => 010010001, 4
10010010, 5 => 010010010, 5
10010011, 4 => 010010011, 4
10010100, 5 => 010010100, 5
10010101, 6 => 010010101, 6
10010110, 5 => 010010110, 5
10010111, 4 => 010010111, 4
10011000, 3 => 111001101, 4
10011001, 4 => 010011001, 4
10011010, 5 => 010011010, 5
10011011, 4 => 010011011, 4
10011100, 3 => 111001001, 4
10011101, 4 => 010011101, 4
10011110, 3 => 111001011, 4
10011111, 2 => 111001010, 5
10100000, 3 => 111110101, 4
10100001, 4 => 010100001, 4
10100010, 5 => 010100010, 5
11011011, 4 => 011011011, 4
11011100, 3 => 110001001, 4
11011101, 4 => 011011101, 4
11011110, 3 => 110001011, 4
11011111, 2 => 110001010, 5
11100000, 1 => 110110101, 6
11100001, 2 => 110110100, 5
11100010, 3 => 110110111, 4
11100011, 2 => 110110110, 5
11100100, 3 => 110110001, 4
11100101, 4 => 011100101, 4
11100110, 3 => 110110011, 4
11100111, 2 => 110110010, 5
11101000, 3 => 110111101, 4
11101001, 4 => 011101001, 4
11101010, 5 => 011101010, 5
11101011, 4 => 011101011, 4
11101100, 3 => 110111001, 4
11101101, 4 => 011101101, 4
11101110, 3 => 110111011, 4
11101111, 2 => 110111010, 5
11110000, 1 => 110100101, 6
11110001, 2 => 110100100, 5
11110010, 3 => 110100111, 4
11110011, 2 => 110100110, 5
11110100, 3 => 110100001, 4
11110101, 4 => 011110101, 4
11110110, 3 => 110100011, 4
11110111, 2 => 110100010, 5
11111000, 1 => 110101101, 6
11111001, 2 => 110101100, 5
11111010, 3 => 110101111, 4
11111011, 2 => 110101110, 5
11111100, 1 => 110101001, 6
11111101, 2 => 110101000, 5
11111111, 0 => 110101010, 7
Total Tr: 1176
10101011, 6 => 010101011, 6
10101100, 5 => 010101100, 5
10101101, 6 => 010101101, 6
10101110, 5 => 010101110, 5
10101111, 4 => 010101111, 4
10110000, 3 => 111110101, 4
10110001, 4 => 010110001, 4
10110010, 5 => 010110010, 5
10110011, 4 => 010110011, 4
10110100, 5 => 010110100, 5
10110101, 6 => 010110101, 6
10110110, 5 => 010110110, 5
10110111, 4 => 010110111, 4
10111000, 3 => 111101101, 4
10111001, 4 => 010111001, 4
10111010, 5 => 010111010, 5
10111011, 4 => 010111011, 4
10111100, 3 => 111101001, 4
10111101, 4 => 010111101, 4
10111110, 3 => 111101011, 4
10111111, 2 => 111101010, 5
11000000, 1 => 110010101, 6
11000001, 2 => 110010100, 5
11000010, 3 => 110010111, 4
11000011, 2 => 110010110, 5
11000100, 3 => 110010001, 4
11000101, 4 => 011000101, 4
11000110, 3 => 110010011, 4
11000111, 2 => 110010010, 5
11001000, 3 => 110011101, 4
11001001, 4 => 011001001, 4
11001010, 5 => 011001010, 5
11001011, 4 => 011001011, 4
11001100, 3 => 110011001, 4
11001101, 4 => 011001101, 4
11001110, 3 => 110011011, 4
11001111, 2 => 110011010, 5
11010000, 3 => 110000101, 4
11010001, 4 => 011010001, 4
11010010, 5 => 011010010, 5
11010011, 4 => 011010011, 4
11010100, 5 => 011010100, 5
11010001, 6 => 011010101, 6
11010110, 5 => 011010110, 5
11010111, 4 => 011010111, 4
11011000, 3 => 110001101, 4
11011001, 4 => 011011001, 4
11011010, 5 => 011011010, 5

360. Accordingly, whichever one or more 10-bit values from the 42 values are used will be a "*subset of the full code word set*."

361. **Second**, the subset of code words resulting from Myers' subset-selection technique is a "*robust subset*" because the selected code words provide better protection against data loss. In particular, using Myers's subset selection technique results in a subset of code words that prevent a charge from buildup up along the transmission lines, and allows for "AC coupling without the use of higher cost hardware to prevent the loss of the lower frequency components of the transmission." Myers, 7:10-50.

> Firstly, each code word is inherently DC balanced in that each has four binary '1's and four binary '0's. This code is preferably implemented where logic '1' values may be represented by a positive voltage, and logic '0' values are represented by a negative or zero voltage, transmitted along on a transmission line which is usually a wire or wires, however, other types of transmission media may be utilized. **This feature prevents a charge, and resulting capacitance or inductance, from building up on long transmission lines due to transmission of more bits having one value, such as a '1' than those having the other binary value, such as a '0'**. DC balance permits the use of driver circuits which have lower capacity to source or sink a current, which usually has a direct effect on system cost. Also, a DC balanced code permits use of AC coupling, which can be important when considering longer transmission lines, particularly wire

> transmission lines, because of the potential for the development of ground loops in DC coupled systems.
>
> Secondly, each code word has a (0,1) run-length limit as there are no more than two consecutive binary '1's or '0's within a code word. Each code word also begins and ends with either a '01' or '10' bit grouping, to also provide for a (0,1) run-length limit across word boundaries, Together these bit relationships assure that a transmission of multiple code words will have a (0.1) run-length limit, regardless of how many and which combination of code words are actually transmitted. **<u>This feature limits the energy distribution of the transmitted signal into a minimum frequency band, which is narrower than codes having a longer run length limit</u>** such as (0.3). **<u>Minimizing the frequency band requires lower cost hardware to process a signal when it is transmitted or received. Also, the run-length limit permits the code to be used effectively in systems where the transmission lines are AC coupled</u>**. A broader distribution of energy in the frequency band, such as results from a longer run-length limit, makes it difficult to implement **<u>AC coupling without the use of higher cost hardware to prevent the loss of the lower frequency components of the transmission</u>**. Finally, this run-length limit permits the code to also be used for a clocking function in applications where a code-based clocking function is desired or required.

Myers, 7:10-50.

362. Accordingly, by narrowing the conventional set of 8b/10b code words according to Myers' subset-selection technique, a more robust subset can be achieved.

363. Myers' subset-selection technique is similar to the subset-selection techniques described in the '437 patent:

> In preferred embodiments, **the inventive code words are selected to be those whose serial patterns (during transmission) have fewer contiguous zeros and ones (e.g., on the average), and thus are less susceptible to ISI during transmission**, than do those code words in the full set that are not selected (e.g., the average number of contiguous zeros and ones, per code word, of the inventive code words is less than the average number of contiguous zeros and ones, per code word, of the code words in the full set that are not selected as the inventive code words). Also, when the bits of the inventive code words are transmitted over a serial link as sequences of rising and falling voltage transitions, the bit pattern of **each transmitted stream of the inventive code words preferably implements DC balancing** (the voltage drift over time is limited).

'437 patent, 7:18-34.

364. Thus, Kim's encoders 40b-40n for audio streams may encode input data using any known coding scheme, including Myer's subset-selection technique that utilizes a subset of more robust values to prevent data loss, which renders obvious "*wherein each of the selected code words is a member of a robust subset of the full code word set.*"

365. I note that Kim teaches a "*wherein each of the selected code words is* *a member of a robust subset of the full code word set*" under Patent Owner's interpretation of this term as well. As explained at [41.1], Patent Owner interprets this term as follows: "A full code word set comprise 2^{10}=1024 codewords of 10 bits." Patent Owner further interprets the "*robust subset*" as the output of "ANSI standard 8B/10B" coding. *See* Ex.1012, 6. Under that interpretation of the phrase, Kim teaches the "*robust subset*" because the possible 10-bit outputs of Kim's conventional 8b/10b encoding techniques are a subset of 1024. *See supra* [41.1]-[41.3]; Kim, 5:50-6:16; Shin, 20:11-23:60.

[41.4] ***the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words***

366. Kim in combination with Myers renders this limitation obvious.

367. Kim's encoders 40b-40n, using Myers' more robust subset-selection technique, produce 10-bit words that are "*less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words*." For the reasons explained above at [41.3], Myers' subset of codewords use fewer contiguous '1's and '0's, thus making them less susceptible to inter-symbol interference and other data loss. Additionally, "each code word also begins and ends with either a '01' or '10' bit grouping, to also provide for a (0,1) run-length limit across word boundaries." Ex.1006, 7:30-32.

Thus, the number of contiguous '1's and '0's across word/symbol[4] boundaries is limited as well. By reducing the charge buildup, Myers' technique reduces inter-symbol interference.

368. Myers' subset-selection technique reduces inter-symbol interference in the same way as the '437 patent. The '437 patent itself acknowledges that fewer contiguous 1's and 0's will reduce inter-symbol interference:

> In preferred embodiments, **the inventive code words are selected to be those whose serial patterns (during transmission) have fewer contiguous zeros and ones (e.g., on the average), and thus are less susceptible to ISI during transmission**, than do those code words in the full set that are not selected (e.g., the average number of contiguous zeros and ones, per code word, of the inventive code words is less than the average number of contiguous zeros and ones, per code word, of the code words in the full set that are not selected as the inventive code words).

'437 patent, 7:18-34.

369. Accordingly, because Myers' subset-selection technique produces code words with fewer contiguous 1's and 0's, Myers' technique reduces inter-symbol interference in the manner claimed.

[4] A POSITA would have understood that a "symbol" simply refers to the 10-bit encoded word. Ex.1015, 3 ("symbol ... (6) A 10-bit, 8B/10B encoded byte").

370. Thus, Kim's encoders 40b-40n—implementing Myers' subset-selection technique—reduce inter-symbol interference and thus render obvious "*the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words.*"

371. Kim also teaches "*wherein each of the selected code words is a member of a robust subset of the full code word set*" under Patent Owner's interpretation of this term. Patent Owner alleges that reduced susceptibility to inter-symbol interference is met by "symbol-level DC balancing." *See* Ex.1012, 6. Under that interpretation of the phrase, Kim in combination with Myers teaches code words that are "*less susceptible to inter-symbol interference*" because Myers' subset is DC balanced. *See e.g.* Myers, 8:16-23

[41.5] ***generating bursts of encoded control words by encoding control bits; and***

372. Kim alone and in combination with Shin renders this limitation obvious.

373. **First**, Kim describes "*control words*" such as the IDLE words produced by encoder 44x.

> **<u>The control words used to separate data streams and for other control functions are provided by the control code generator 44</u>**. In the preferred embodiment, the control code generator 44 is a series of hard wired word or character values the each are coupled to a respective

> multiplexor input. The present invention provides a unique control and separation scheme in which four categories of special or control words are used. An exemplary set of control words are provided in Appendix A. **The first type of control word is the IDLE word. The IDLE word is transmitted over the serial link 28 when there is not data from any of the data streams to be sent. The purpose of the idle word is to make enough transitions during preamble period so that the receiving circuit can obtain bit synchronization and to make the word synchronization easy**. The second type of control word is the isochronous data transfer word. These control words indicate the transfer of time critical data such as timing control signals of video or other data. The isochronous special word can be sent at any time without interfering with the other streams. The third type of control word is a data stream separation word, which separates between multiple contexts of data streams and indicates the start or end of a certain type of data transfer. The fourth type of control word is the link shut down word, which is used when the embedding unit 22 shuts down and to let data recipients to know the end of data transmission. If the removing unit 24 receives link shutdown character, it can go into power down mode or idle state. Any special character selection which satisfies above conditions can be used for this invention. As have been noted above, a preferred implementation for the above encoding scheme is an 8bit/10bit encoding.

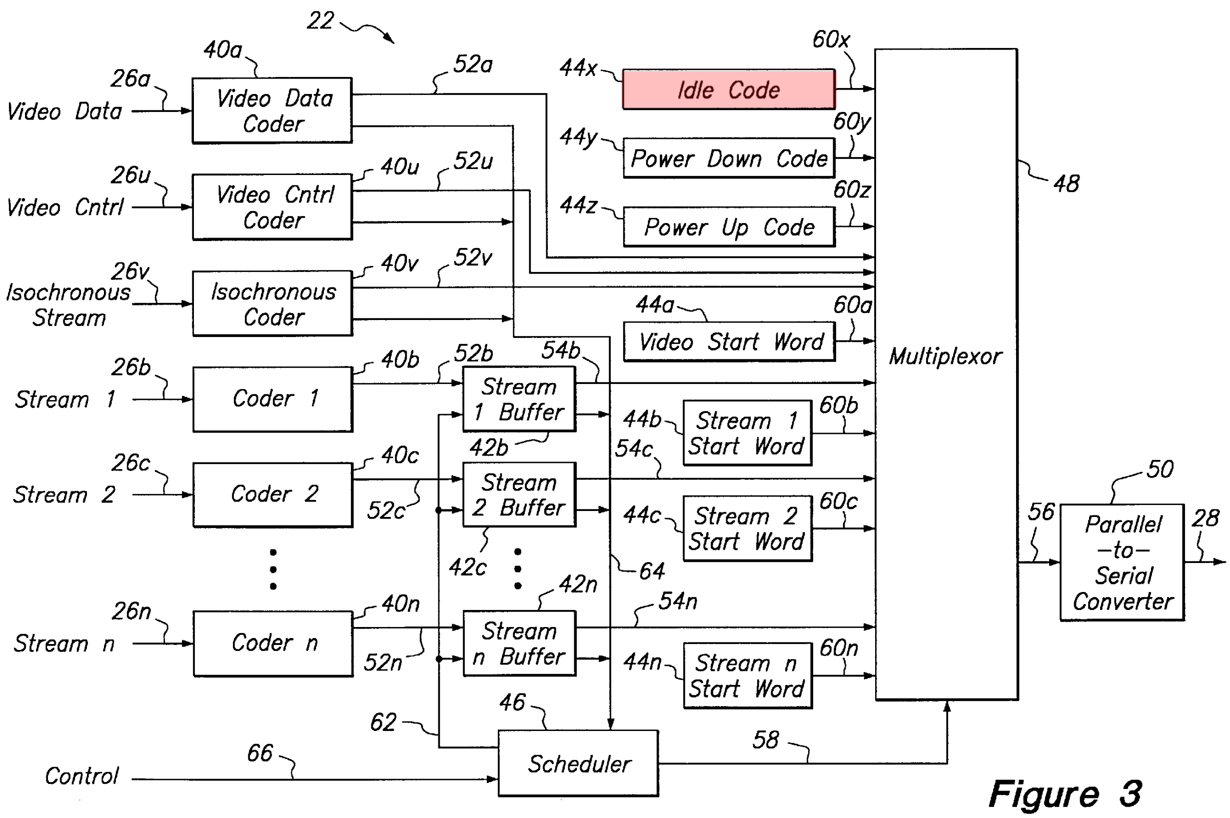
Kim, 6:39-7:2.

> **The IDLE word preferably has the following characteristics**. First, it has enough transitions for the removing unit 24 to obtain bit

> synchronization. Second, it is shift invariant for word synchronization. Third, it has an equal number of logical one bits and logical zero bits on average. Such balanced patterns are desirable, for example, when the signal path in the serial link 28 must include transformers for prevention of ground loops and common mode signal propagation. The 4 words shown in Appendix A, which have 8 data transitions within a 10 bit frame and are DC free and shift-invariant for each other, are defined as IDLE words. Anyone of the 4 words can be used. The inverted versions of the IDLE words can also be used. Word synchronization can be obtained easily by using these Words. If there are more than 15 data transitions within 2 frames, the receiver will obtain word synchronization.

Kim, 7:20-35.

374. Kim illustrates the IDLE code generator 44x in Fig. 3 below.



Kim, Fig. 3 (annotated).

The embodiment shown in FIG. 3 includes a plurality of control code generators 44a, 44b, 44c . . . 44n, 44x, 44y, 44z. **The first control code generator 44x is coupled to an input of the multiplexor 48 via line 60a to provide the IDLE word**. Additional control code generators 44y and 44z are provided for supplying the shut down link code and start up link code to the multiplexor via lines 60y, 60z, respectively. The remaining control code generators 44a, 44b, 44c . . . 44n provides respective data stream separation words, one for each stream. **Each of the control code generators 44a, 44b, 44c . . . 44n, 44x, 44y, 44z is preferably hard wired to provide the 10-bit words that are used for the IDLE word**, start-up link word, shut-down link word, video start word, stream 1 start word, etc. in accordance with the encoding scheme.

> The isochronous transfer words are generated directly by the video coder 40a. Those skilled in the art will realize that in an alternate embodiment, a data input of the multiplexor 48 could be coupled to a data output of the scheduler 46, and that in such an alternate embodiment the scheduler 46 would generated and provide these codes words as necessary.

Kim, 9:25-44.

375. Second, Kim's system "*generat[es] bursts of ... control words*" of IDLE control words by repeatedly transmitting the IDLE control words between different types of data streams.

> If there is not video data waiting to be sent, the scheduler 46 proceeds to step 610 where i is set to 1 and the scheduler 46 outputs a control signal to send the IDLE code for a predetermined number, k, of clock cycles. Then in step 612, the scheduler 46 determines whether there are any isochronous signal to be send such from the video control coder 40u or the isochronous word coder 40v and outputs a control signal to send the isochronous control words.

Kim, 10:56-64; *see also* Fig. 6.

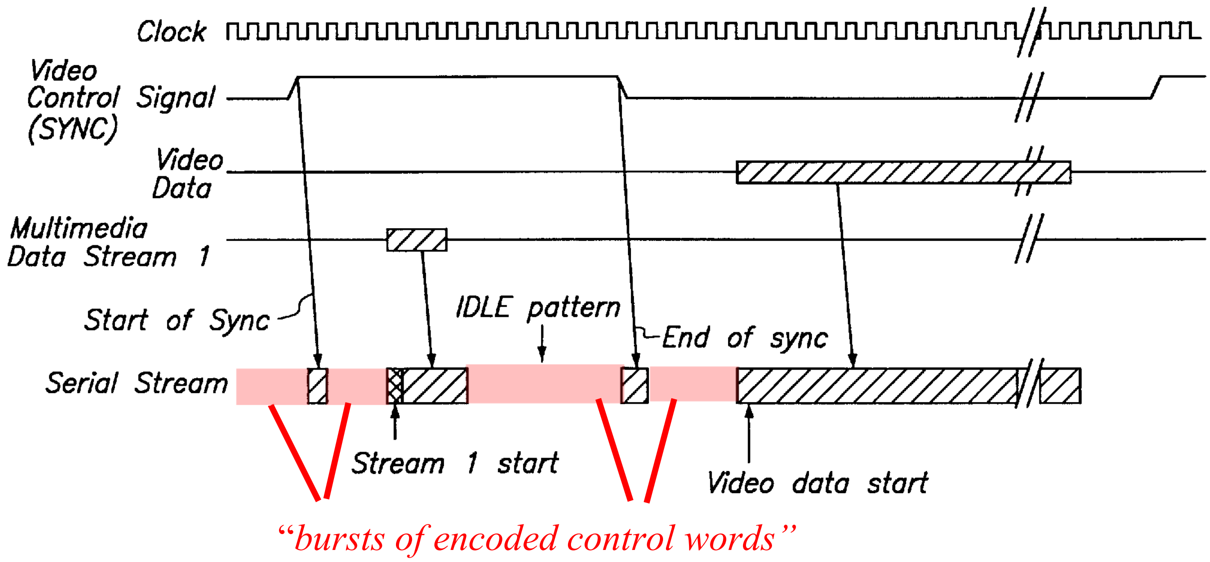
> If there are no data words or isochronous data transfer words to be sent, the scheduler 46 sends controls the multiplexor 48 such that an IDLE word is transmitted.

Kim, 8:16-18.

> The IDLE words are noted below in Appendix A. An idle pattern is a continuous sequence of one of the idle words and its inverse. An exemplary idle pattern is: 011010101010010101010110101010100101 010101101010101001010101 The word aligner 73 detects the idle pattern by looking at a 21 bit data window and counting the number of transitions within the 21 bit data window. If there are 18 transitions for two successive periods within the 21 bit data window, the IDLE pattern is detected and word alignment is performed. It is guaranteed that there cannot be 18 transitions for two successive periods within 21 bit data window for any combination of other special characters or normal data.

Kim, 14:32-44.

376. Accordingly, Kim generates multiple idle words between data transmissions, as shown below in annotated Fig. 4. Each of these repeated idle words together teach "*bursts of encoded control words*" as claimed.

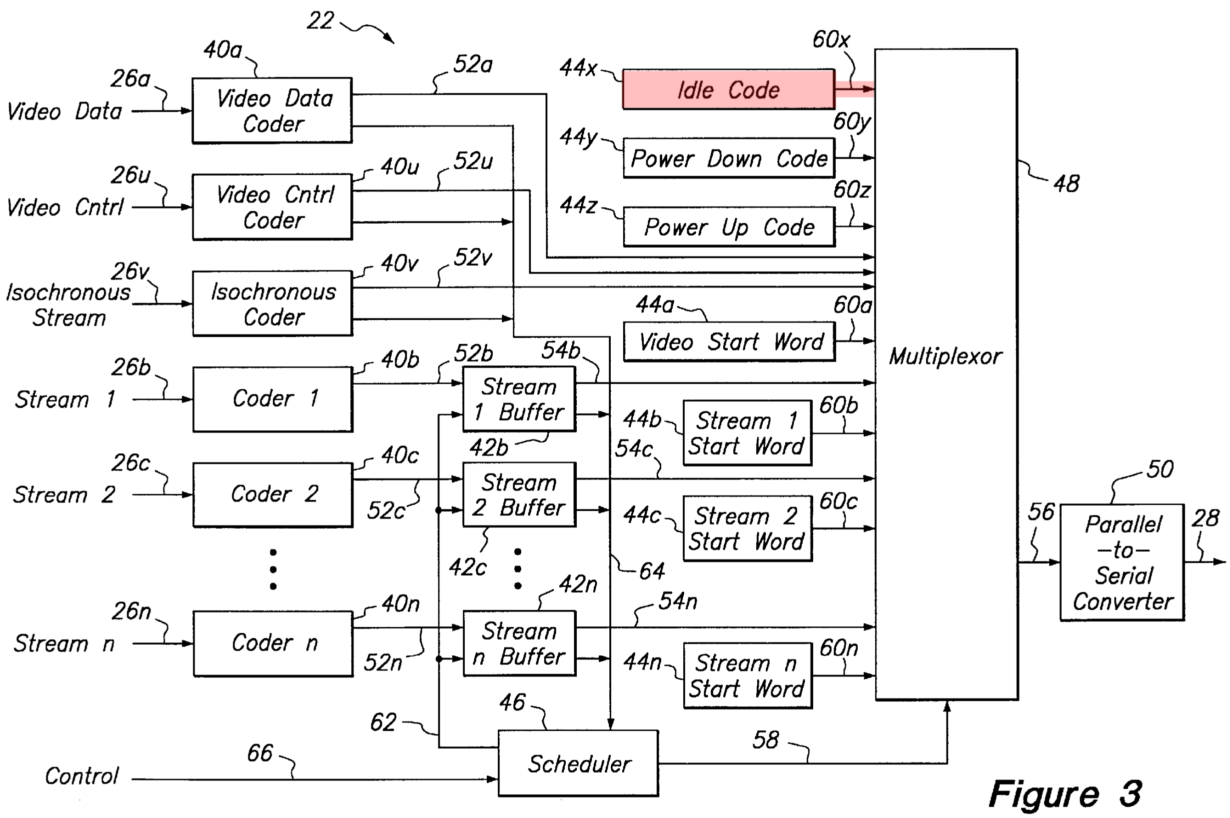


Kim, Fig. 4A (annotated).

377. **Third**, Kim discloses that the control words are generated by "*encoding control bits*" because each encoded IDLE control word is a set of bits encoded via 8b/10b encoding. Kim, 7:15-16 ("Appendix A shows an example selection of special control words for an 8 bit/10 bit encoding."), 19:37-48 (Appendix A, identifying "IDLE Words" as 8bit/10bit encoded control words).

378. In other words, Kim renders this limitation obvious because Kim's IDLE words are part of a "selection of special characters for the 8 bit/10 bit encoding scheme." Kim, 6:67-7:45. Because the IDLE words are a product of Kim's 8b/10b encoding scheme, whatever inputs that dictate the placement of Kim's IDLE words are "*control bits*" as claimed. In other words, Kim's 8b/10b encoding scheme, which includes IDLE words, teaches generating encoded control words "*by encoding control bits*" as claimed.

379. To the extent that the "*control bits*" refer to the control signals used to select a particular control word, Kim and Shin render such interpretation obvious as well. As described above, Kim describes an IDLE code generator 44x: "The first control code generator 44x is coupled to an input of the multiplexor 48 via line 60a to provide the IDLE word." Kim, 9:27-28.



Kim, Fig. 3 (annotated).

380. While Kim describes the IDLE code generator generally, Kim is silent as to the mechanism by which the IDLE code generator selects a particular IDLE code word. As described above at [41.3], Kim discloses that there are eight different IDLE words.

Sample Control Words
IDLE Words
0101010110
0101011010
0101101010
0110101010
1010101001
1010100101
1010010101
1001010101

Kim, 19:37-48.

381. A POSITA would have found it obvious to generate one of the eight IDLE words by encoding a set of control signals (i.e., control bits), as taught by Shin. Shin discloses generating a particular control word by encoding a set of control bits: "As shown in FIG. 3, each encoder unit will encode ... 2-bit of control signals using the encoder described in the previous section." Shin, 6:33-36. Shin thus describes encoding a 2-bit control signal to generate one of four different control words (2^2=4), shown below.

1100101010
1101001010
1101010010
1101010100

Shin, 10:35-40.

382. Accordingly, a POSITA would have found it obvious to generate control words by encoding a set of control signals (i.e., control bits). Specifically, because Kim's IDLE words consist of eight different values, a POSITA would find it obvious that three control bits could be encoded to generate one of the control words ($2^3=8$). Thus, by converting three control bits into a 10-bit IDLE word, Kim teaches generating encoded control words "*by encoding control bits*" as claimed.

383. Thus, Kim's repeated transmission of 10-bit IDLE words, which may be selected by using control bits as described by Shin, renders obvious "*generating bursts of encoded control words by encoding control bits.*"

[41.6] *transmitting over the link a first burst of the encoded control words between a first burst of the video code words*[5] *and the burst of the selected code words*[6]*, and*

---

[5] While the full scope of this claim limitation is not clear (e.g., due to lack of antecedent basis), whatever "*the video code words*" references would have encompassed at least the bursts of "*video code words*" disclosed by Kim.

[6] While the full scope of this claim limitation is not clear (e.g., due to lack of antecedent basis), whatever "*the burst of the selected code words*" references would have encompassed at least some portion (or the whole sequence) from the previously recited "*sequence of selected code words*" disclosed by Kim.

384. Kim renders this limitation obvious.

385. **First**, for the reasons explained above at [41.5], Kim teaches "*bursts of encoded control words.*"

386. **Second**, Kim teaches encoding and transmitting video data ("*video code words*") as a video data stream. Kim's video data streams—separated by blanking intervals, individually and together teach "*burst[s] of video data.*"

> The encoder 40 preferably has a plurality of inputs and a plurality of outputs. The plurality of inputs are preferably grouped in sets. Thus, in FIG. 2, signal lines 26a, 26b, 26c, . . . 26n are each used to designate one or more signal lines of a data stream. **For example, the first primary stream is preferably a video stream including the data and control signals for display refresh** and may for example, be 28 parallel lines, 24 for data and 4 for control. The remaining signal lines 26b, 26c, . . . 26n can be used for other types of data, and are for example, each eight parallel lines. Those skilled in the art will realize that each signal line 26a, 26b, 26c, . . . 26n may be a variety of parallel signal lines. For each of the input signal lines 26a, 26b, 26c, . . . 26n, the encoder 40 preferably provides a corresponding output signal line 52a, 52b, 52c, . . . 52n. Each of the output signals line 52a, 52b, 52c, . . . 52n provides the encoded output of the signal applied to the corresponding input of the encoder 40. In the exemplary embodiment, the present invention uses an encoding scheme that encodes eight bits of data into a corresponding encoded 10-bit word. Thus, each of the output signals line 52a, 52b, 52c, . . . 52n is 10 parallel lines. The first output of the encoder 40 is preferably coupled by line 52a to an input

> of the multiplexor 48. The remaining output lines are 52b, 52c, . . . 52n are coupled to respective inputs of the data buffer 42. The encoder 40 preferably encodes the input stream into 10-bit output streams. The word output by the encoder 40 are preferably any 10-bit words other than those identified in Appendix A as special code words used as IDLE characters, isochronous data transfer characters, data stream separation characters, and link shut down characters. Any number of conventional eight to 10 encoding schemes may be used in addition to the specific encoding scheme identified below with respect to FIG. 5.

Kim, 5:50-6:15.

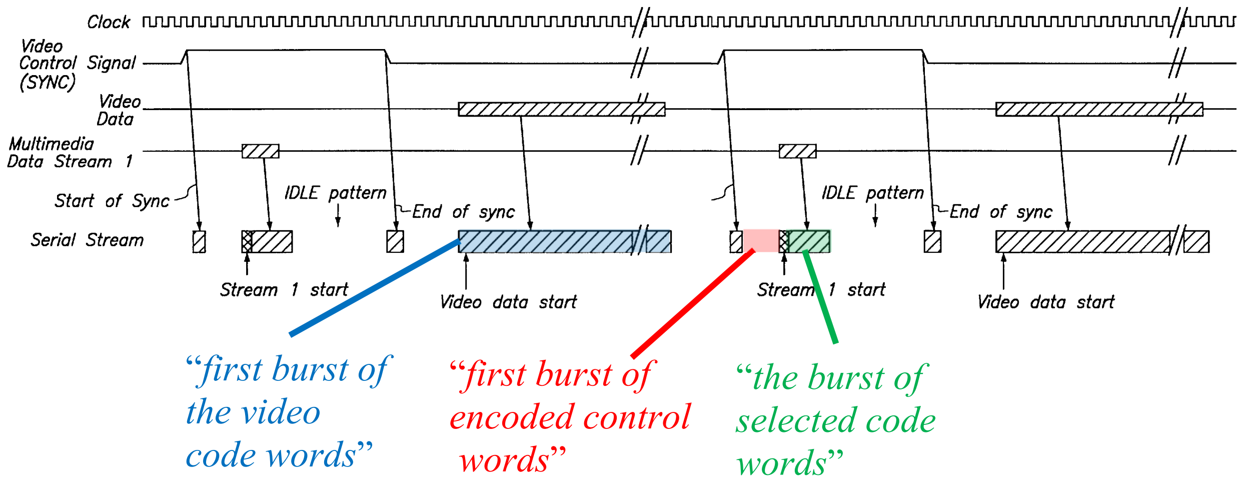
> Still more particularly**, a video data coder 40a is provided for encoding the video data signals to a 10-bit parallel output**. Those skilled in the art will realize the video data coder 40a may be a plurality of 8-to-10bit coders depending on the number of bits used to represent the video data. **For example, the video data coder 40a may be three 8-to-10 bit coders if 24 bits of RGB data are used with 8 bits for a red channel, 8 bits for a green channel, 8 bits for a blue channel, or two 8-to-10 bit coders for 16 bits of YUV data**. An exemplary video coder 40a constructed according to the present invention is shown in Figure 5. Coders 40u,and 40v are also provided for the video control data, and the isochronous data stream. Similarly, for stream 1 to n each stream has a dedicated coder 40b to 40n, respectively, to encode each particular data stream. The coders 40b to 40n, 40u, 40v are preferably identical, and each maps the eight bit values applied on the inputs of the coders 40b to 40n to a corresponding 10-bit word according to a predefined coding scheme. An exemplary encoding scheme that can be

> used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled "High-Speed Digital Video Signal Transmission System," filed on Oct. 6, 1995 and Sep. 30, 1996, which is incorporated herein by reference.

Kim, 8:44-67.

387. Third, for the reasons explained above at [41.3], Kim's encoders 40b-40n encode an audio data stream as "*selected code words*." Because the selected code words are transmitted as a stream, they are a "***burst*** *of selected code words*" as claimed.

388. Fourth, Kim teaches transmitting video data ("*a first burst of the video code words*"), control data ("*a first burst of the encoded control words*"), and audio data ("*the burst of the selected code words*") in the order claimed. Fig. 4A is shown below in a repeated manner, given that the illustrated sequence is repeatedly transmitted over the serial link, as would be understood by a POSITA. *See* Ex.1005, 9:45-10:25 (describing Fig. 4a as part of a data **stream**).



Kim, Fig. 4a (modified, annotated).

389. As shown in Fig. 4A above, there is an IDLE period ("*first burst of encoded control words*") positioned between a stream of video data ("*first burst of the video code words*") and the encoded stream 1 (e.g. audio data) ("*the burst of selected code words*").

> The operation of the present invention can best be understood with reference to FIGS. 4A and 4B. **FIG. 4A is a timing diagram showing** the clock signal, **the video control and data signals that form the primary stream, data signals that for a second stream, and the serial stream produced by the embedding unit 22 and output on line 28**. One of the main purposes of the present invention is to make the embedding mechanism look transparent to the video signals and isochronous data streams. The timing of video data signals and control signals at the receiving side do not change due to the embedded signals. **The timing diagrams of FIGS. 4A and 4B correspond to the embodiment of the embedding unit shown in FIG. 3**, where the video stream has the highest priority, and thus, is sent without being disturbed

> by other streams. The present invention advantageously encodes the horizontal and vertical sync signal into a pair of beginning and ending isochronous transfer words thereby making much of the vertical and horizontal sync periods available multiplexing with other stream data. As shown in FIG. 4A, video control signals are sent by only sending only isochronous transfer words at the rising and falling edges of the sync signal so the period when the video control signal doesn't change its value can be used to send other data. Rising and falling edges of each video control signals have different special characters. **Data stream 1 is inserted during the horizontal blanking period and a start control word identifying the data stream 1 is used at the head of the data stream 1.** Each multimedia data stream has its own special start control word for identification. For example, stream 1 has a different data start word than that used for video start word. **If every stream buffer is emptied and no video signal enters, the scheduler sends an IDLE word for bit synchronization and word synchronization**.

Kim, 9:46-10:10.

390. And for the reasons explained above at [41.5], Kim's system generates "*bursts*" of IDLE control words by repeatedly transmitting the IDLE control words between different types of data streams. Kim, 10:56-64, 8:16-18, 14:32-44; Fig. 6.

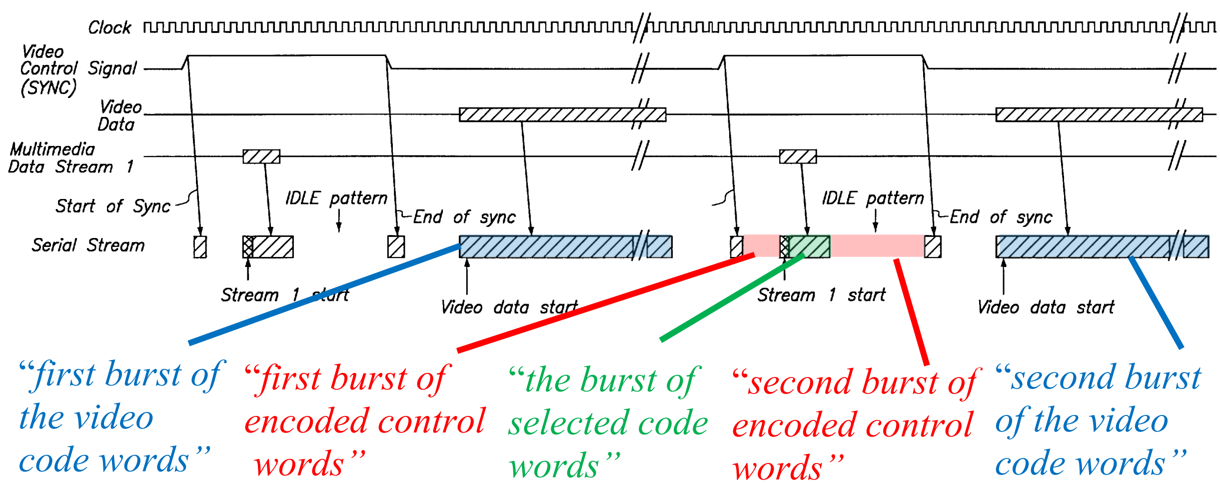
391. Thus, Kim's transmission of control words (IDLE words) placed between video data and an additional data stream (e.g., audio data) renders obvious "*transmitting over the link a first burst of the encoded control words between a* *first burst of the video code words and the burst of the selected code words*."

[41.7] *a second burst of the encoded control words between the burst of the selected code words and a second burst of the video code words.*

392. Kim renders this limitation obvious.

393. **First**, for the reasons explained above at [41.6], Kim teaches transmitting video data ("*burst of the video code words*"), control data ("*burst of the encoded control words*"), and a data stream ("*the burst of the selected code words*").

394. **Second,** Kim teaches transmitting video data ("*a second burst of the video code words*"), control data ("*a second burst of the encoded control words*"), and audio data ("*the burst of the selected code words*") in the order claimed.



Kim, Fig. 4A (modified, annotated).

395. As shown in Fig. 4A above, additional IDLE words ("*second burst of encoded control words*") are positioned between the encoded audio data ("*the burst* *of the selected code words*") and the subsequent stream of video data ("*second burst of the video code words*").

> The operation of the present invention can best be understood with reference to FIGS. 4A and 4B. **FIG. 4A is a timing diagram showing** the clock signal, **the video control and data signals that form the primary stream, data signals that for a second stream, and the serial stream produced by the embedding unit 22 and output on line 28**. One of the main purposes of the present invention is to make the embedding mechanism look transparent to the video signals and isochronous data streams. The timing of video data signals and control signals at the receiving side do not change due to the embedded signals. **The timing diagrams of FIGS. 4A and 4B correspond to the embodiment of the embedding unit shown in FIG. 3**, where the video stream has the highest priority, and thus, is sent without being disturbed by other streams. The present invention advantageously encodes the horizontal and vertical sync signal into a pair of beginning and ending isochronous transfer words thereby making much of the vertical and horizontal sync periods available multiplexing with other stream data. As shown in FIG. 4A, video control signals are sent by only sending only isochronous transfer words at the rising and falling edges of the sync signal so the period when the video control signal doesn't change its value can be used to send other data. Rising and falling edges of each video control signals have different special characters. **Data stream 1 is inserted during the horizontal blanking period and a start control word identifying the data stream 1 is used at the head of the data stream 1.** Each multimedia data stream has its own special start

> control word for identification. For example, stream 1 has a different data start word than that used for video start word. **If every stream buffer is emptied and no video signal enters, the scheduler sends an IDLE word for bit synchronization and word synchronization**.

Kim, 9:46-10:10.

396. Thus, Kim's transmission of a second burst of IDLE control words between the audio data stream and a subsequent video stream, Kim renders obvious "*a second burst of the encoded control words between the burst of the selected code words and a second burst of the video code words*."

39. Claim 42

[42.1] *The method of claim 41, wherein the selected code words include at least one guard band word, the burst of the selected code words has an initial word, and the initial word is the guard band word.*

397. Kim renders this limitation obvious.

398. **First**, as discussed at [41.2], Kim's device includes an encoder (e.g., 40b) for encoding audio data into "*a sequence of selected code words*." And as explained at and [41.3], the "*selected code words*" may be part of a subset of code words according to Myers' subset-selection technique.

399. **Second,** some of words in Myers' subset as applied to Kim ("*selected code words*") correspond to Kim's data separation words ("*guard band word[s]*"). As explained above at [41.3], six of Kim's data stream separation words meet Myers' subset criteria.

Data Stream Separation Words
1000101011
1000101101
1000110101
1001001011
1001001101
1001010011
1001011001
1001100101
1001101001
1010001011
1010001101
1010010011
1010011001
1010100011
1010110001
1011000101
1011001001
1011010001
1100010101
1100100101
1100101001
1101000101
1101001001
1101010001

400. Because the Kim/Myers combination teaches using data separation words that are part of the subset, Kim and Myers teach "*the selected code words include at least one guard band word*" as claimed.

401. Kim's data separation words are the same as the guard band words described and claimed in the '437 patent. The '437 patent explains that "a 'guard band' word [] is transmitted at the start or end (or the start and end) of a burst of encoded data (to identify the leading and/or trailing edge of the burst) or at the start or end (or at the start and end) of each burst of encoded data of a specific type." '437 patent, 8:23-27. Kim's data separation words perform the same function: "The third type of control word is a data stream separation word, which separates between multiple contexts of data streams and indicates the start or end of a certain type of data transfer." Kim, 6:58-61. Accordingly, Kim's data separation word teaches a "*guard band word*" as claimed.

402. **Third**, in the combination of Kim and Myers, the audio data streams ("*selected code words*") include a data separation word ("*guard band word*") at the start ("*the burst of the selected code words has an initial word, and the initial word is the guard band word*").

> Data stream 1 is inserted during the horizontal blanking period and **a start control word identifying the data stream 1 is used at the head of the data stream 1**. Each multimedia data stream has its own special start control word for identification. For example, stream 1 has a different data start word than that used for video start word.

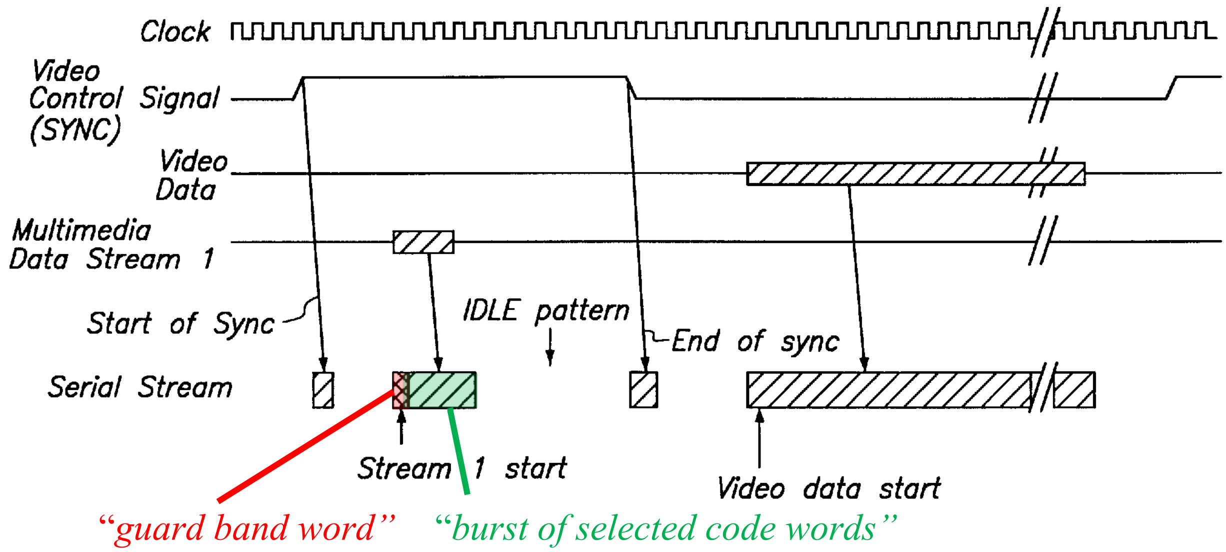
Kim, 10:2-8.

403. Kim also refers to the start control word as a data stream separation word:

> **The control words used to separate data streams and for other control functions are provided by the control code generator 44**. In the preferred embodiment, the control code generator 44 is a series of hard wired word or character values the each are coupled to a respective multiplexor input. The present invention provides a unique control and separation scheme in which four categories of special or control words are used. An exemplary set of control words are provided in Appendix A. The first type of control word is the IDLE word. The IDLE word is

> transmitted over the serial link 28 when there is not data from any of the data streams to be sent. The purpose of the idle word is to make enough transitions during preamble period so that the receiving circuit can obtain bit synchronization and to make the word synchronization easy. The second type of control word is the isochronous data transfer word. These control words indicate the transfer of time critical data such as timing control signals of video or other data. The isochronous special word can be sent at any time without interfering with the other streams. **The third type of control word is a data stream separation word, which separates between multiple contexts of data streams and indicates the start or end of a certain type of data transfer**. The fourth type of control word is the link shut down word, which is used when the embedding unit 22 shuts down and to let data recipients to know the end of data transmission. If the removing unit 24 receives link shutdown character, it can go into power down mode or idle state. Any special character selection which satisfies above conditions can be used for this invention. As have been noted above, a preferred implementation for the above encoding scheme is an 8 bit/10 bit encoding.

Kim, 6:39-7:2.



Kim, Fig. 4A (annotated).

404. Thus, Kim's placement of a data separation word (that meets Myers' subset selection criteria) at the start of the audio data stream 1 renders obvious "*wherein the selected code words include at least one guard band word, the burst of the selected code words has an initial word, and the initial word is the guard band word.*"

40. Claim 43

[43.1] ***The method of claim 41, wherein the selected code words include at least one guard band word, the burst of the selected code words has an initial set of words, and each word of the initial set of words is one said guard band word.***

405. First, as described above at [42.1], Kim teaches using data separation words to indicate the start or end of a streaming sequence, which discloses "*wherein the selected code words include at least one guard band word.*"

406. Second, it would have been obvious for the data separation words to be repeated, as evidenced by Myers. Myers describes using control words at the start and end of a message—similar to Kim's data stream separation words. Additionally, Myers explains that there may be multiple control words ("*an initial set of words*") at the start of a message.

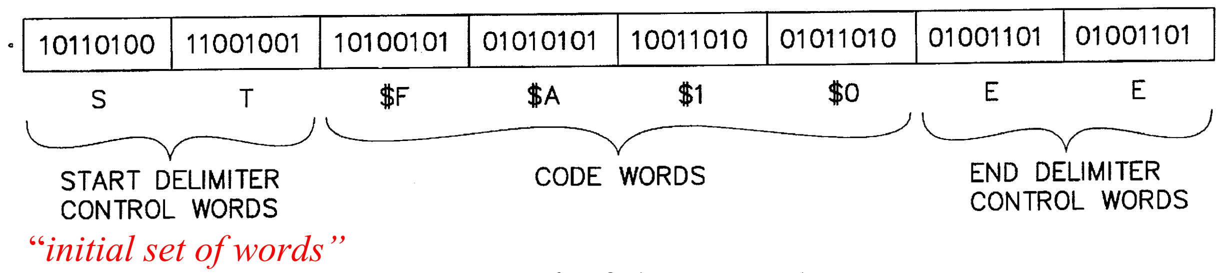
> Transceiver module 54 may also transmit control words along with a code word, or plurality of code words, to provide for certain control functions. Typically, such control words are used at the beginning and end of a message, comprising a plurality of code words, to delimit its start and finish. **<u>A start delimiter control word, or plurality of code words, may be transmitted immediately prior to the transmission of a code word or words</u>**, such that other network devices 40 are alerted that data is forthcoming over the transmission medium. Similarly, an end delimiter control word, or plurality of code words, may be transmitted immediately after the transmission of a code word or words, such that other network devices 40 know that they have received a complete transmission. For the code of FIG. 1, each transmission of a cord [sic] word or words from a network device is preceded by S and T, the first and second start delimiter control words, and is followed by two Es, the end delimiter control word.

Myers, 11:13-30.

> For the code of FIG.1, an example of a typical data stream is shown in FIG. 9. For the transmission module to transmit the data stream, hex address $FA10, **<u>the device first delimits the stream with the S and T, the first and second start delimiter control words</u>**. Next, the encoded code words corresponding to the data words hex F (15), A

> (10), 1 and 0 are transmitted. Finally, the transmission of EE, the end delimiter control word completes the transmission of the data stream.

Myers, 13:40-48.



Myers, Fig. 9 (annotated).

407. A POSITA would have found it obvious to use known options for transmitting data stream separation words—using one or more control words to indicate the start or end of a stream. Providing repeated guard band words helps to ensure that a guard band word is not missed by the receiver. Applying Myers' repeated start word technique to Kim's data separation start word is merely applying a known technique to a known method to yield predictable results.

408. Thus, Kim's use of data stream separation words (that meets Myers' subset selection criteria) at the start of the audio stream, which may be repeated as taught by Myers, renders obvious "*wherein the selected code words include at least one guard band word, the burst of the selected code words has an initial set of words, and each word of the initial set of words is one said guard band word.*"

41. Claim 44

[44.1] *The method of claim 41, wherein the selected code words include at least one guard band word, the burst of the selected code words has a final word, and the final word is the guard band word.*

409. First, as discussed at [42.1], the combination of Kim and Myers teaches using data separation words to indicate the start or end of a streaming sequence, which discloses "*wherein the selected code words include at least one guard band word*."

410. Second, while Kim illustrates the data separation word at the *start* of the data stream 1, Kim explains that the data stream separation word ("*guard band word*") is placed at the *end* of the data stream as well. "The third type of control word is a **data stream separation word**, which separates between multiple contexts of data streams and **indicates the** start or **end** of a certain type of data transfer." Kim, 6:58-61.

411. Thus, Kim's placement of a data separation word (that meets Myers' subset selection criteria) at the end of the audio data stream renders obvious "*wherein the selected code words include at least one guard band word, the burst of the selected code words has a final word, and the final word is the guard band word*."

42. Claim 45

[49.0] *The method of claim 41, wherein the selected code words include at least one guard band word, the burst of the selected code words has a final set of*

words, and each word of the final set of words is one said guard band word.

412. **First**, as discussed at [44.1], the combination of Kim and Myers teaches using data separation words to indicate the end of a streaming sequence, which discloses "*wherein the selected code words include at least one guard band word***,** *the burst of the selected code words has a final set of words*."

413. **Second**, it would have been obvious for the guard band words to be repeated, as evidenced by Myers. Myers describes using control words at the start and end of a message—similar to Kim's data stream separation words. Additionally, Myers explains that there may be multiple control words ("*a final set of words*") at the end of a message.

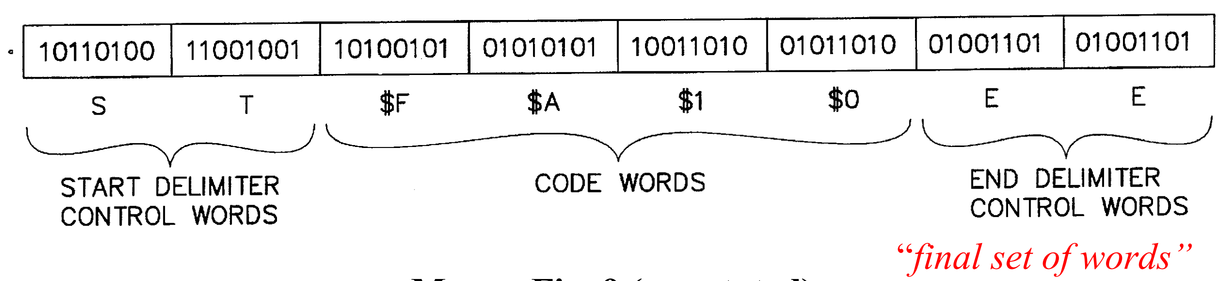
> Transceiver module 54 may also transmit control words along with a code word, or plurality of code words, to provide for certain control functions. Typically, such control words are used at the beginning and end of a message, comprising a plurality of code words, to delimit its start and finish. A start delimiter control word, or plurality of code words, may be transmitted immediately prior to the transmission of a code word or words, such that other network devices 40 are alerted that data is forthcoming over the transmission medium. **Similarly, an end delimiter control word, or plurality of code words, may be transmitted immediately after the transmission of a code word or words**, such that other network devices 40 know that they have received a complete transmission. For the code of FIG. 1, each transmission of a cord [sic] word or words from a network device is

> preceded by S and T, the first and second start delimiter control words, and is followed by two Es, the end delimiter control word.

Myers, 11:13-30.

> For the code of FIG.1, an example of a typical data stream is shown in FIG. 9. For the transmission module to transmit the data stream, hex address $FA10, the device first delimits the stream with the S and T, the first and second start delimiter control words. Next, the encoded code words corresponding to the data words hex F (15), A (10), 1 and 0 are transmitted. **Finally, the transmission of EE, the end delimiter control word completes the transmission of the data stream**.

Myers, 13:40-48.



Myers, Fig. 9 (annotated).

414. A POSITA would have found it obvious to use known options for transmitting data stream separation words—using one or more control words to indicate the start or end of a stream.

415. Thus, Kim's placement of a data separation word (that meets Myers' subset selection criteria) at the end of the audio stream, which may be repeated as taught by Myers, renders obvious "*wherein the selected code words include at* *least one guard band word, the burst of the selected code words has a final set of words, and each word of the final set of words is one said guard band word*."

43. Claim 47

[49.0] ***The method of claim 41, wherein the selected code words include at least two guard band words, including a first guard band word and a second guard band word, the second burst of the video code words has an initial word, the initial word of the second burst of the video code words is the first guard band word, the burst of the selected code words has an initial word, and the initial word of the burst of the selected code words is the second guard band word.***

416. First, as discussed at [42.1], the combination of Kim and Myers teaches using data separation words to indicate the start of a streaming sequence, which discloses "*wherein the selected code words include at least one guard band word*."

417. Second, Kim teaches that video streams include data stream separation words at the start as well. Thus, the data stream separation word at the start of the video stream teaches "*the initial word of the second burst of the video code words is the first guard band word*."

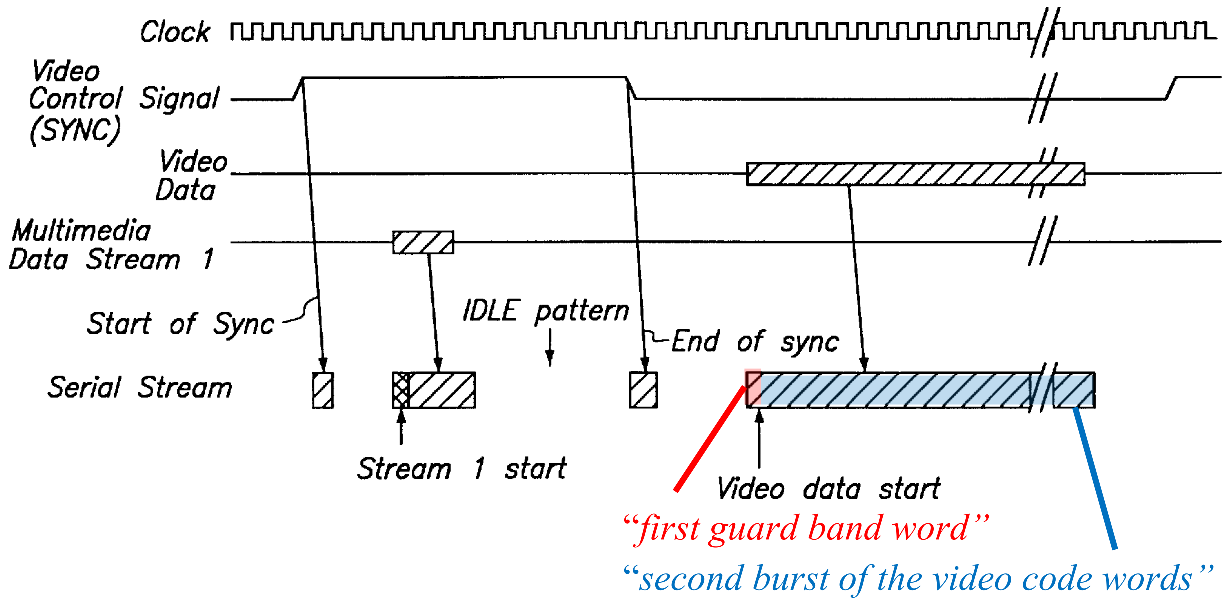
> The embodiment shown in FIG. 3 includes a plurality of control code generators 44a, 44b, 44c . . . 44n, 44x, 44y, 44z. The first control code generator 44x is coupled to an input of the multiplexor 48 via line 60a to provide the IDLE word. Additional control code generators 44y and 44z are provided for supplying the shut down link code and start up link code to the multiplexor via lines 60y, 60z, respectively. **<u>The remaining control code generators 44a, 44b, 44c . . . 44n provides respective</u>**

> **data stream separation words, one for each stream**. Each of the control code generators 44a, 44b, 44c. . . 44n, 44x, 44y, 44z is preferably hard wired to provide the 10-bit words that are used for the IDLE word, start-up link word, shut-down link word, **video start word**, stream 1 start word, etc. in accordance with the encoding scheme. The isochronous transfer words are generated directly by the video coder 40a. Those skilled in the art will realize that in an alternate embodiment, a data input of the multiplexor 48 could be coupled to a data output of the scheduler 46, and that in such an alternate embodiment the scheduler 46 would generated and provide these codes words as necessary.

Kim, 9:25-45.

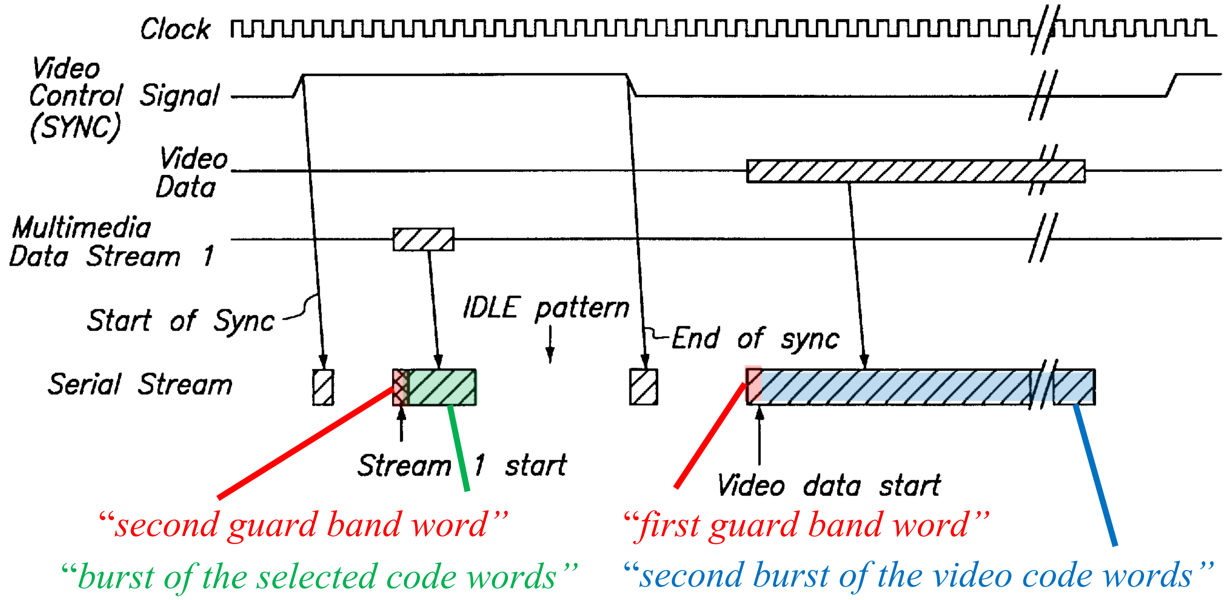
> Each multimedia data stream has its own special start control word for identification. **For example, stream 1 has a different data start word than that used for video start word**. If every stream buffer is emptied and no video signal enters, the scheduler sends an IDLE word for bit synchronization and word synchronization.

Kim, 10:5-11.



Kim, Fig. 4A (annotated).

418. Third, for the reasons explained above at [42.1], Kim describes placing a data stream separation word ("*second guard band word*") at the start of stream 1 ("*burst of the selected code words*").



Kim, Fig. 4A (annotated).

419. Thus, Kim's placement of data stream separation words at the start of both the audio data stream 1 (which meets Myers' subset selection criteria) and the video data stream renders obvious "*wherein the selected code words include at least two guard band words, including a first guard band word and a second guard band word, the second burst of the video code words has an initial word, the initial word of the second burst of the video code words is the first guard band word, the burst of the selected code words has an initial word, and the initial word of the burst of the selected code words is the second guard band word.*"

44. Claim 49

[49.0] ***The method of claim 41, wherein the input data are auxiliary data, and also including the steps of:***

420. **First**, as described above at [41.1], Kim's encoders 40b-40n encode the data streams ("*input data*") into encoded data ("*a sequence of selected code words*").

421. **Second**, Kim's "multimedia data streams" are "*auxiliary data*" as described in the '437 patent. The '437 patent explains that "[t]he expression 'auxiliary data' is used in a broad sense herein to denote digital audio data or any other type of data other than video data and timing information for video data (e.g., a video clock)." '437 patent, 5:22-25. Kim similarly describes its invention as follows:

> The present invention will now be discussed in the context of mixing various multimedia data streams into the display refresh data (primary stream) using the unused bandwidth of horizontal and vertical blanking periods. Possible multimedia data streams that can be mixed include, but are not limited to **audio** I/O, keyboard and mouse, IC bus (serial bus for peripheral components).

Kim, 5:20-27.

422. Thus, Kim's input multimedia data streams which may be audio data streams render obvious "*wherein the input data are auxiliary data*" as claimed.

[49.1] ***generating a sequence of video code words by encoding video data; and***

423. First, as described above at [41.6] and [41.7], Kim teaches "*a first burst of the video code words*" and "*a second burst of the video code words*."

424. Second, Kim teaches that these bursts of video code words are generated by an encoder 40a that encodes video data.

> **Still more particularly, a video data coder 40a is provided for encoding the video data signals to a 10-bit parallel output**. Those skilled in the art will realize the video data coder 40a may be a plurality of 8-to-10 bit coders depending on the number of bits used to represent the video data. For example, the video data coder 40a may be three 8-to-10 bit coders if 24 bits of RGB data are used with 8 bits for a red channel, 8 bits for a green channel, 8 bits for a blue channel, or two 8-to-10 bit coders for 16 bits of YUV data. An exemplary video coder 40a constructed according to the present invention is shown in FIG. 5. Coders 40u, and 40v are also provided for the video control data, and

> the isochronous data stream. Similarly, for stream 1 to n each stream has a dedicated coder 40b to 40n, respectively, to encode each particular data stream. The coders 40b to 40n, 40u, 40v are preferably identical, and each maps the eight bit values applied on the inputs of the coders 40b to 40n to a corresponding 10-bit word according to a predefined coding scheme. An exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled "High-Speed Digital Video Signal Transmission System," filed on Oct. 6, 1995 and Sep. 30, 1996, which is incorporated herein by reference.

Kim, 8:44-67.

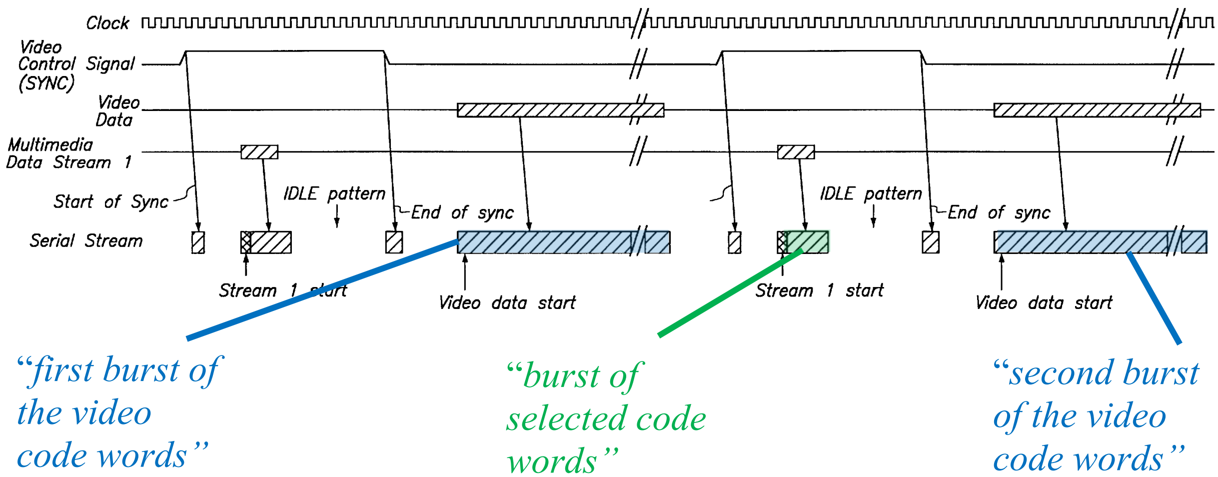
425. Thus, Kim's encoder 40a that generates video code words by encoding video data renders obvious "*generating a sequence of video code words by encoding video data*" as claimed.

[49.2] ***transmitting over the link a first burst of the video code words followed by a burst of the selected code words followed by a second burst of the video code words[7],***

---

[7] While the scope of this claim limitation is not clear (e.g., due to lack of antecedent basis), whether "*a first burst of the video code words followed by a burst of the selected code words followed by a second burst of the video code words*" refers to the "bursts" recited in [41.6] and [41.7] or to new bursts of

426. For the reasons explained above at [41.6] and [41.7], Kim renders obvious "*transmitting over the link a first burst of the video code words followed by a burst of the selected code words followed by a second burst of the video code words*."



Kim, Fig. 4A (modified, annotated).

427. Thus, Kim's transmission of video code words followed by audio data stream words followed by more video code words renders obvious "*transmitting over the link a first burst of the video code words followed by a burst of the selected code words followed by a second burst of the video code words.*"

[49.3] ***wherein each of the video code words is a member of the full code word set and at least one of the video code words is not a member of the robust subset.***

---

video and selected code words, Kim renders this limitation obvious because Kim discloses repeating the transmission sequence.

428. First, for the reasons explained above at [41.1], Kim's encoders are capable of encoding data using conventional 8b/10b encoding. As explained above at V.A.5, a POSITA would have been motivated to apply Myers' subset-selection technique to the audio data. However, the video data encoder 40a in Kim may still use conventional 8b/10b encoding that utilizes the full code set.

> Still more particularly, a video data coder 40a is provided for encoding **the video data signals to a 10-bit parallel output**. Those skilled in the art will realize **the video data coder 40a may be a plurality of 8-to-10 bit coders depending on the number of bits used to represent the video data. For example, the video data coder 40a may be three 8-to-10 bit coders if 24 bits of RGB data are used with 8 bits for a red channel, 8 bits for a green channel, 8 bits for a blue channel, or two 8-to-10 bit coders for 16 bits of YUV data**. An exemplary video coder 40a constructed according to the present invention is shown in FIG. 5. Coders 40u, and 40v are also provided for the video control data, and the isochronous data stream. Similarly, for stream 1 to n each stream has a dedicated coder 40b to 40n, respectively, to encode each particular data stream. The coders 40b to 40n, 40u, 40v are preferably identical, and each maps the eight bit values applied on the inputs of the coders 40b to 40n to a corresponding 10-bit word according to a predefined coding scheme. An exemplary encoding scheme that can be used for coders 40b to 40n is detailed on pages 18-25 and FIG. 7 of U.S. patent application Ser. Nos. 60/004,907 and 08/732,694, entitled 'High-Speed Digital Video Signal Transmission System,' filed on Oct. 6, 1995 and Sep. 30, 1996, which is incorporated herein by reference.

Kim, 8:44-67.

429. Accordingly, because Kim's system separately encodes video data using conventional 8b/10b encoding techniques, "*each of the video code words is a member of the full code word set*" as claimed.

430. **Second,** there are some video code words from the full code word set that are not part of Kim's subset using Myers' technique. For example, the code words shown below are an exemplary full code word set. The highlighted words below correspond to the 42 words that meet Myers's subset criteria. As can be seen, most of the words are *not* a member of Myers' subset ("*at least one of the video code words is not a member of the robust subset*").

00000000, 0 => 101010101, 7
00000001, 1 => 101010100, 6
00000010, 2 => 101010111, 5
00000011, 1 => 101010110, 6
00000100, 2 => 101010001, 5
00000101, 3 => 101010000, 4
00000110, 2 => 101010011, 5
00000111, 1 => 101010010, 6
00001000, 2 => 101011101, 5
00001001, 3 => 101011100, 4
00001010, 4 => 000001010, 4
00001011, 3 => 101011110, 4
00001100, 2 => 101011001, 5
00001101, 3 => 101011000, 4
00001110, 2 => 101011011, 5
00001111, 1 => 101011010, 6
00010000, 2 => 101000101, 5
00010001, 3 => 101000100, 4
00010010, 4 => 000010010, 4
00010011, 3 => 101000110, 4
00010100, 4 => 000010100, 4
00010101, 5 => 000010101, 5
00010110, 4 => 000010110, 4
00010111, 3 => 101000010, 4
00011000, 2 => 101001101, 5
00011001, 3 => 101001100, 4
00011010, 4 => 000011010, 4
00011011, 3 => 101001110, 4
00011100, 2 => 101001001, 5
00011101, 3 => 101001000, 4
00011110, 2 => 101001011, 5
00011111, 1 => 101001010, 6
00100000, 2 => 101110101, 5
00100001, 3 => 101110100, 4
00100010, 4 => 000100010, 4
00100011, 3 => 101110110, 4
00100100, 4 => 000100100, 4
00100101, 5 => 000100101, 5
00100110, 4 => 000100110, 4
00100111, 3 => 101110010, 4
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00101001, 5 => 000101001, 5
00101010, 6 => 000101010, 6
00101011, 5 => 000101011, 5
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00101101, 5 => 000101101, 5
00101110, 4 => 000101110, 4
00101111, 3 => 101111010, 4
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00110001, 3 => 101100100, 4
00110010, 4 => 000110010, 4
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01101101, 5 => 001101101, 5
01101110, 4 => 001101110, 4
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01110011, 3 => 100100110, 4
01110100, 4 => 001110100, 4
01110101, 5 => 001110101, 5
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00110100, 4 => 000110100, 4
00110101, 5 => 000110101, 5
00110110, 4 => 000110110, 4
00110111, 3 => 101100010, 4
00111000, 2 => 101101101, 5
00111001, 3 => 101101100, 4
00111010, 4 => 000111010, 4
00111011, 3 => 101101110, 4
00111100, 2 => 101101001, 5
00111101, 3 => 101101000, 4
00111110, 2 => 101101011, 5
00111111, 1 => 101101010, 6
01000000, 2 => 100010101, 5
01000001, 3 => 100010100, 4
01000010, 4 => 001000010, 4
01000011, 3 => 100010110, 4
01000100, 4 => 001000100, 4
01000101, 5 => 001000101, 5
01000110, 4 => 001000110, 4
01000111, 3 => 100010010, 4
01001000, 4 => 001001000, 4
01001001, 5 => 001001001, 5
01001010, 6 => 001001010, 6
01001011, 5 => 001001011, 5
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01001101, 5 => 001001101, 5
01001110, 4 => 001001110, 4
01001111, 3 => 100011010, 4
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01010010, 6 => 001010010, 6
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10100110, 5 => 010100110, 5
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01111111, 1 => 100101010, 6
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10000010, 3 => 111010111, 4
10000011, 2 => 111010110, 5
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10000110, 3 => 111010011, 4
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10001101, 4 => 010001101, 4
10001110, 3 => 111011011, 4
10001111, 2 => 111011010, 5
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11101010, 5 => 011101010, 5
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11101100, 3 => 110111001, 4
11101101, 4 => 011101101, 4
11101110, 3 => 110111011, 4
11101111, 2 => 110111010, 5
11110000, 1 => 110100101, 6
11110001, 2 => 110100100, 5
11110010, 3 => 110100111, 4
11110011, 2 => 110100110, 5
11110100, 3 => 110100001, 4
11110101, 4 => 011110101, 4
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11110111, 2 => 110100010, 5
11111000, 1 => 110101101, 6
11111001, 2 => 110101100, 5
11111010, 3 => 110101111, 4
11111011, 2 => 110101110, 5
11111100, 1 => 110101001, 6
11111101, 2 => 110101000, 5
11111111, 0 => 110101010, 7
Total Tr: 1176

10101011, 6 => 010101011, 6
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10101101, 6 => 010101101, 6
10101110, 5 => 010101110, 5
10101111, 4 => 010101111, 4
10110000, 3 => 111110101, 4
10110001, 4 => 010110001, 4
10110010, 5 => 010110010, 5
10110011, 4 => 010110011, 4
10110100, 5 => 010110100, 5
10110101, 6 => 010110101, 6
10110110, 5 => 010110110, 5
10110111, 4 => 010110111, 4
10111000, 3 => 111101101, 4
10111001, 4 => 010111001, 4
10111010, 5 => 010111010, 5
10111011, 4 => 010111011, 4
10111100, 3 => 111101001, 4
10111101, 4 => 010111101, 4
10111110, 3 => 111101011, 4
10111111, 2 => 111101010, 5
11000000, 1 => 110010101, 6
11000001, 2 => 110010100, 5
11000010, 3 => 110010111, 4
11000011, 2 => 110010110, 5
11000100, 3 => 110010001, 4
11000101, 4 => 011000101, 4
11000110, 3 => 110010011, 4
11000111, 2 => 110010010, 5
11001000, 3 => 110011101, 4
11001001, 4 => 011001001, 4
11001010, 5 => 011001010, 5
11001011, 4 => 011001011, 4
11001100, 3 => 110011001, 4
11001101, 4 => 011001101, 4
11001110, 3 => 110011011, 4
11001111, 2 => 110011010, 5
11010000, 3 => 110000101, 4
11010001, 4 => 011010001, 4
11010010, 5 => 011010010, 5
11010011, 4 => 011010011, 4
11010100, 5 => 011010100, 5
11010001, 6 => 011010101, 6
11010110, 5 => 011010110, 5
11010111, 4 => 011010111, 4
11011000, 3 => 110001101, 4
11011001, 4 => 011011001, 4
11011010, 5 => 011011010, 5

431. Thus, Kim's encoding of video data with code words that don't meet Myers' subset criteria renders obvious "*wherein each of the video code words is a member of the full code word set and at least one of the video code words is not a member of the robust subset.*"

45. Claim 50

[50.0] ***The method of claim 41, wherein the input data are auxiliary data, and also including the steps of:***

432. *See* [49.0].

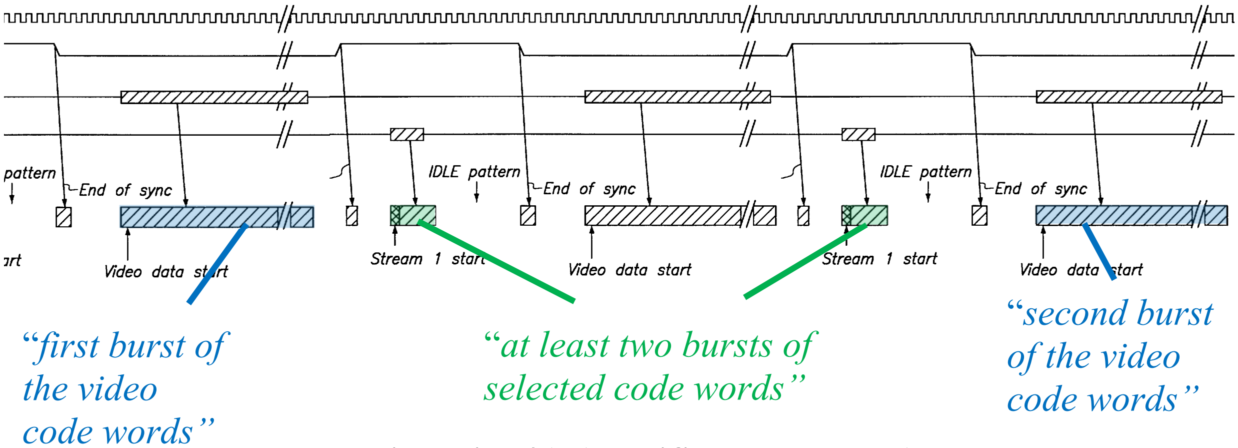
[50.1] ***generating a sequence of video code words by encoding video data; and***

433. *See* [49.1]

[50.2] ***transmitting over the link a first burst of the video code words followed by at least two bursts of the selected code words followed by a second burst of the video code words.***

434. **First**, as described above at [49.2], Myers renders obvious "*transmitting over the link a first burst of the video code words followed by at least a burst of the selected code words followed by a second burst of the video code words*."

435. **Second**, it would have been obvious for there to be "*at least two bursts*" of selected code words between two sets of video data. *See* Kim, 8:10-15. Given that the pattern shown in Fig. 4A is repeated multiple times, there may be several bursts of data stream 1 ("*selected code words*") between two sets of video streams, as shown in the modified Fig. 4A below.



Kim, Fig. 4A (modified, annotated).

436. Thus, Kim's transmission of video code words followed by multiple bursts of encoded control words followed by more video code words renders obvious "*transmitting over the link a first burst of the video code words followed by at least two bursts of the selected code words followed by a second burst of the video code words.*"

46. Claim 52

[52.0] ***A method for encoding data for transmission over a serial link, said method including the steps of:***

437. *See* [41.0].

[52.1] ***(a) providing words of input data capable of being encoded as a conventional sequence of code words of a full code word set; and***

438. *See* [41.1].

[52.2] ***(b) generating a sequence of selected code words by encoding the input data,***

439. *See* [41.2].

[52.3] ***wherein each of the selected code words is a member of a robust subset of the full code word set, and***

440. *See* [41.3].

[52.4] ***the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words,***

441. *See* [41.4].

[52.5] ***wherein each of the selected code words is indicative of a sequence of L binary bits, and***

442. As explained above at [51.5], Kim and Myers teach "*wherein each of the selected code words is indicative of a sequence of L binary bits*" as claimed. For similar reasons, Kim's 10-bit code words are "*a sequence of L binary bits*."

[52.6] ***the preferred words have fewer contiguous zero bits and contiguous one bits per code word on the average than do the non-preferred words of the full set.***[8]

443. The code words that meet Myers' selection criteria have fewer

[8] While the scope of "*the preferred words*," "*the non-preferred words*," and "*the full set*" is not clear (e.g., due to lack of antecedent basis), the claim terms would have encompassed at least the concept that the "*selected code words*" have fewer contiguous ones and zeroes than the conventional set, which is taught by Kim and Myers.

contiguous 1's and 0's than the full code word set: "[A] second step 12 is to select a second subset containing the code words having no more than two consecutive '1's or '0's is selected." Myers, 8:18-21.

> Secondly, **<u>each code word has a (0,1) run-length limit as there are no more than two consecutive binary '1's or '0's within a code word</u>**. Each code word also begins and ends with either a '01' or '10' bit grouping, to also provide for a (0,1) run-length limit across word boundaries, Together these bit relationships assure that a transmission of multiple code words will have a (0.1) run-length limit, regardless of how many and which combination of code words are actually transmitted. This feature limits the energy distribution of the transmitted signal into a minimum frequency band, which is narrower than codes having a longer run length limit such as (0.3). Minimizing the frequency band requires lower cost hardware to process a signal when it is transmitted or received. Also, the run-length limit permits the code to be used effectively in systems where the transmission lines are AC coupled. A broader distribution of energy in the frequency band, such as results from a longer run-length limit, makes it difficult to implement AC coupling without the use of higher cost hardware to prevent the loss of the lower frequency components of the transmission. Finally, this run-length limit permits the code to also be used for a clocking function in applications where a code-based clocking function is desired or required.

Myers, 7:10-50.

444. Thus, Kim's encoders 40b-40n implementing Myers' subset-selection technique produce code words with fewer contiguous 1's and 0's than the full code word set, which renders obvious "*the preferred words have fewer contiguous zero bits and contiguous one bits per code word on the average than do the non-preferred words of the full set*."

47. Claim 53

[53.0] ***A method for encoding data for transmission over a serial link, said method including the steps of:***

445. *See* [41.0].

[53.1] ***(a) providing words of input data capable of being encoded as a conventional sequence of code words of a full code word set; and***

446. *See* [41.1].

[53.2] ***(b) generating a sequence of selected code words by encoding the input data,***

447. *See* [41.2].

[53.3] ***wherein each of the selected code words is a member of a robust subset of the full code word set, and***

448. *See* [41.3].

[53.4] ***the sequence of selected code words is less susceptible to inter-symbol interference during transmission over the link than would be the conventional sequence of code words,***

449. *See* [41.4].

[53.5] ***wherein each of the selected code words is indicative of a different sequence of binary bits, and also including the step of:***

450. As described above at [41.3], application of Myers' subset-selection technique to a 10-bit code set results in 42 different sequences of 10-bit numbers, each of which corresponds to a different value. Accordingly, Kim and Myers render obvious "*wherein each of the selected code words is indicative of a different sequence of binary bits.*"

[53.6] ***transmitting the sequence of selected code words over the serial link as a sequence of rising and falling voltage transitions,***

451. Kim and Myers renders this limitation obvious.

452. **First**, Kim describes transmitting encoded words over a serial link ("*transmitting the sequence of selected code words over the serial link*").

> Then the embedding unit 22 combines the encoded signals and inserts separation signals or characters for identifying the input signal from which the encoded signals were derived. **The combination results in an encoded serial sequence that is output on the first output for transmission over the serial line 28**. The second output of the embedding unit 22 provides a clock signal used to synchronize the transmission of the encoded sequence.

Kim, 4:45-53.

453. **Second**, Myers explains that when transmitting binary data over a serial link such as Kim's serial link, the data is transmitted such that "logic '1' values may be represented by a positive voltage, and logic '0' values are represented by a negative or zero voltage, transmitted along on a transmission line." Myers, 7:13-16. Accordingly, as the sequence of bits transitions from 0 to 1, the voltage rises. Conversely, when the sequence of bits transitions from 1 to 0, the voltage falls ("*as a sequence of rising and falling voltage transitions*").

454. Thus, Kim transmits data over a serial line, which involves rising and falling voltage levels as evidenced by Myers and thus renders obvious "*transmitting the sequence of selected code words over the serial link as a sequence of rising and falling voltage transitions*."

[53.7] ***wherein the selected code words have bit patterns that implement DC balancing by limiting voltage drift of the serial link during transmission of said sequence of selected code words to a predetermined amount.***

455. Kim and Myers render this limitation obvious.

456. **First**, the subset of code words that meet Myers' criteria are taught to be DC balanced ("*the selected code words have bit patterns that implement DC balancing*").

> **<u>Firstly, each code word is inherently DC balanced</u>** in that each has four binary '1's and four binary '0's. This code is preferably implemented where logic '1' values may be represented by a positive voltage, and logic '0' values are represented by a negative or zero voltage, transmitted along on a transmission line which is usually a wire or wires, however, other types of transmission media may be utilized. This feature prevents a charge, and resulting capacitance or inductance, from building up on long transmission lines due to transmission of more bits having one value, such as a '1' than those having the other binary value, such as a '0'. DC balance permits the use of driver circuits which have lower capacity to source or sink a current, which usually has a

> direct effect on system cost. Also, a DC balanced code permits use of AC coupling, which can be important when considering longer transmission lines, particularly wire transmission lines, because of the potential for the development of ground loops in DC coupled systems.

Myers, 7:10-27.

457. Second, by implementing DC balance, the system prevents a charge from building up ("*by limiting voltage drift of the serial link during transmission of said sequence of selected code words to a predetermined amount*").

> Firstly, each code word is inherently DC balanced in that each has four binary '1's and four binary '0's. This code is preferably implemented where logic '1' values may be represented by a positive voltage, and logic '0' values are represented by a negative or zero voltage, transmitted along on a transmission line which is usually a wire or wires, however, other types of transmission media may be utilized. **This feature prevents a charge, and resulting capacitance or inductance, from building up on long transmission lines due to transmission of more bits having one value, such as a '1' than those having the other binary value, such as a '0'**. DC balance permits the use of driver circuits which have lower capacity to source or sink a current, which usually has a direct effect on system cost. Also, a DC balanced code permits use of AC coupling, which can be important when considering longer transmission lines, particularly wire transmission lines, because of the potential for the development of ground loops in DC coupled systems.

Myers, 7:10-27

458. Myers explains that "if a transmitted signal has a large '1'/'0' imbalance, and thus a large DC or low frequency component, this component will get filtered out, resulting in a distortion of the signal and a loss of information." Myers, 2:50-54. By limiting the charge build-up with DC balance, and preventing loss of information, Myers's technique limits voltage drift to "*a predetermined amount*."

459. Thus, the subset of code words that meet Myers' criteria are taught to be inherently DC balanced to prevent charge build-up and loss of information, which renders obvious "*wherein the selected code words have bit patterns that implement DC balancing by limiting voltage drift of the serial link during transmission of said sequence of selected code words to a predetermined amount*."

VI. SECONDARY CONSIDERATIONS

460. At this stage of these proceedings, it is my understanding that Petitioner has no burden to identify and rebut secondary considerations. Rather, it is my understanding that Patent Owner must first present a prima facie case for such consideration, which Petitioner should then have the chance to rebut. That said, I have considered evidence of secondary considerations that I am aware of at this time, and I am currently unaware of any evidence of secondary considerations that would support a finding of non-obviousness.

VII. CONCLUSION

461. This declaration and my opinions herein are made to the best of my knowledge and understanding, and based on the material available to me, at the time of signing this declaration. I declare that all statements made herein on 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 or Title 18 of the United States Code.

Date: 5/21/2025

Andrew Wolfe