(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 February 2006 (23.02.2006)

PCT

(10) International Publication Number
WO 2006/019380 A1

(51) International Patent Classification[7]: H04N 7/14

(21) International Application Number: PCT/US2004/023258

(22) International Filing Date: 19 July 2004 (19.07.2004)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (*for all designated States except US*): **THOMSON LICENSING S.A.** [FR/FR]; 46, Quai A. Le Gallo, F-92100 Boulogne-Billancourt (FR).

(72) Inventor; and
(75) Inventor/Applicant (*for US only*): **RICHARDSON, John, William** [US/US]; 30 Matthew Drive, Hamilton, NJ 08690 (US).

(74) Agents: **TRIPOLI, Joseph, S.** et al.; C/O Thomson Licensing Inc., 2 Independence Way Suite 200, Princeton, NJ 08540 (US).

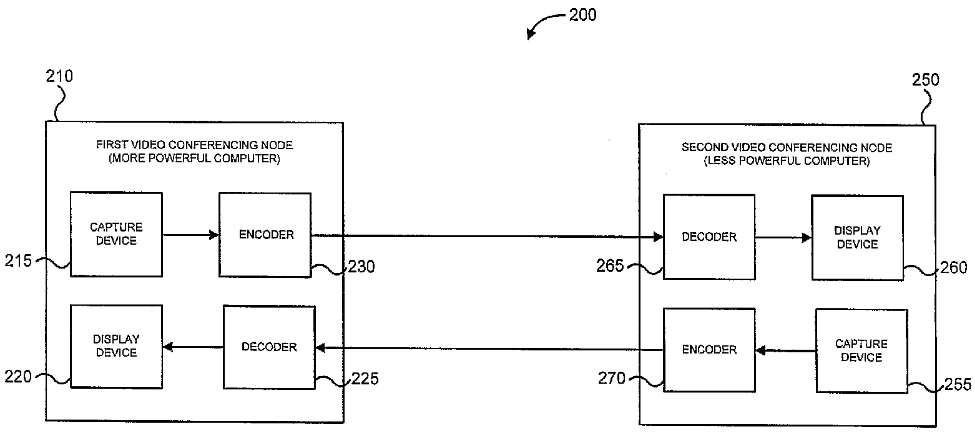
(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** NON-SIMILAR VIDEO CODECS IN VIDEO CONFERENCING SYSTEM



(57) **Abstract:** There is provided a method for conducting a videoconference between nodes connected through a network and having disparate processing power there between. The nodes have codecs such that at least one of the nodes has more than one video codec for use thereby and other ones of the nodes, if any, have at least one video codec for use thereby. At least one of the video codecs has a disparate video compression efficiency with respect to at least another one of the codecs. The method includes the step of determining (310) nodal constraints of each of the nodes. The nodal constraints include at least the processing power of each of the nodes. The method further includes the step of negotiating (315) between the nodes to identify an optimal combination of video codecs that satisfy the nodal constraints.

WO 2006/019380 A1

NON-SIMILAR VIDEO CODECS IN VIDEO CONFERENCING SYSTEM

FIELD OF THE INVENTION

The present invention generally relates to video conferencing systems and, more particularly, to the utilization of non-similar video codecs in a video conferencing system. Moreover, the present invention may also be employed with respect to similar video codecs utilizing non-similar encoding and/or decoding parameters.

BACKGROUND OF THE INVENTION

In most networks, the power of each of the computers across the network is not homogeneous. For example, some of the computers may have the latest processor having the highest processing power while other computers may have older processors having a lower processing power. The more powerful computers can handle more efficient video encoders than the less powerful computers. As used herein, the term "efficient" refers to the amount of compression that a particular type of video codec (or encoder) is capable of implementing with respect to a subject video stream.

Most video conferencing systems include hardware-based video encoders/decoders. Disadvantageously, this situation limits such video conferencing systems to only a single encoder/decoder combination and does not easily allow upgrades. These systems are typically homogenous in terms of encoding/decoding rates and do not easily allow the modification of parameters corresponding thereto.

Accordingly, it would be desirable and highly advantageous to have methods for utilizing video codecs in a video conferencing system that overcome the above-described deficiencies of the prior art.

SUMMARY OF THE INVENTION

The problems stated above, as well as other related problems of the prior art, are solved by the present invention, which is directed to a method for utilizing non-similar video codecs in a video conferencing system, and to a method for utilizing similar video codecs that involves employing different encoding and/or decoding parameters for the similar video codecs.

According to an aspect of the present invention, there is provided a method for conducting a videoconference between a plurality of nodes connected through a network and having disparate processing power there between. The plurality of nodes have a plurality of video codecs such that at least one of the plurality of nodes has more than one video codec for use thereby and other ones of the plurality of nodes, if any, have at least one video codec for use thereby. At least one of the plurality of video codecs has a disparate video compression efficiency with respect to at least another one of the plurality of codecs. The method includes the step of determining nodal constraints of each of the plurality of nodes. The nodal constraints include at least the processing power of each of the plurality of nodes. The method further includes the step of negotiating between the plurality of nodes to identify an optimal combination of video codecs that satisfy the nodal constraints from the plurality of codecs.

According to another aspect of the present invention, there is provided a method for conducting a video conference between a plurality of nodes connected through a network and having disparate processing power there between. Each of the plurality of nodes has a video codec of the same type for use thereby. The video codec is adapted such that parameters thereof may be dynamically adjusted to provide varying degrees of compression efficiency. The method includes the step of determining nodal constraints of each of the plurality of nodes. The nodal constraints include at least the processing power of each of the plurality of nodes. The method further includes the step of negotiating between the plurality of nodes to identify an optimal combination of video codec parameters that satisfy the nodal constraints from among the video codec of each of the plurality of nodes.

These and other aspects, features and advantages of the present invention will become apparent from the following detailed description of preferred embodiments, which is to be read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating a video conferencing system 100 to which the present invention may be applied, according to an illustrative embodiment of the present invention;

FIG. 2 is a block diagram illustrating a video conferencing system 200 to which the present invention may be applied, according to another illustrative embodiment of the present invention;

FIG. 3 is a high-level block diagram illustrating a method of employing video encoders in a video conferencing session between a first video conferencing node 301 and a second video conferencing node 302, according to an illustrative embodiment of the present invention; and

FIG. 4 is a high-level block diagram illustrating a method of employing video encoders in a video conferencing session between a first video conferencing node 401 and a second video conferencing node 402, according to another illustrative embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to a method for utilizing non-similar video codecs in a video conferencing system and to a method for utilizing similar video codecs that involves employing different encoding and/or decoding parameters for the similar video codecs. As most video conferencing systems employ computers having different processing powers, the present invention advantageously takes advantage of the additional processing power available from some of these computers. Thus, for example, a participant with a more powerful computer is able to use an encoding algorithm that is more complex (i.e., more computationally intensive) than an encoding algorithm used by another participant with a less powerful computer, thereby providing the advantage of utilizing the more powerful computer to provide a more efficient (a higher degree of) compression of the video data that would otherwise be provided by the prior art. These and other advantages and features of the present invention are set forth below.

It is to be understood that the present invention may be implemented in various forms of hardware, software, firmware, special purpose processors, or a combination thereof. Preferably, the present invention is implemented as a combination of hardware and software. Moreover, the software is preferably implemented as an application program tangibly embodied on a program storage device. The application program may be uploaded to, and executed by, a machine comprising any suitable architecture. Preferably, the machine is implemented on a computer platform having hardware such as one or more central processing units (CPU), a random access memory (RAM), and input/output (I/O) interface(s). The computer platform also includes an operating system and microinstruction code. The various processes and functions described herein may either be part of the microinstruction code or part of the application program (or a combination thereof) that is executed via the operating system. In addition, various other peripheral devices may be connected to the computer platform such as an additional data storage device and a printing device.

It is to be further understood that, because some of the constituent system components and method steps depicted in the accompanying Figures are preferably implemented in software, the actual connections between the system components (or the process steps) may differ depending upon the manner in which the present invention is programmed. Given the teachings herein, one of ordinary skill in the related art will be able to contemplate these and similar implementations or configurations of the present invention.

A general description will now be given of an illustrative embodiment of the present invention with respect to FIG. 1.

FIG. 1 is a block diagram illustrating a video conferencing system 100 to which the present invention may be applied, according to an illustrative embodiment of the present invention. The video conferencing system 100 includes a first video conferencing node 110 and a second video conferencing node 150. In the illustrative embodiment of FIG. 1, the first video conferencing node 110 is implemented on a more powerful computer than that used for the second video conferencing node 150. Moreover, in the illustrative embodiment of FIG. 1, each of the video conferencing nodes includes at least one encoder. However, at least one of the encoders at the first video conferencing node 110 is more powerful than at least one of the encoders at the second video conferencing node 150, as described more fully herein after.

The first video conferencing node 110 includes a capture device 115, a display device 120, a decoder 125, and two or more encoders including a more powerful (more efficient) encoder 130. The second video conferencing node 150 includes a capture device 155, a display device 160, a decoder 165, and two or more encoders including a less powerful (less efficient) encoder 170. One or more communication mediums (not shown) may be employed in video conferencing system 100 to facilitate communication between the nodes thereof.

While both the first video conferencing node 110 and the second video conferencing node 150 each include more than two encoders, it is to be appreciated that only of the nodes need have more than one encoder for the purposes of the present invention as described more fully herein below. That is, for a determination of an optimal combination of encoders to be used by the nodes participating in a videoconference session (again, as described more fully herein below), only one of the nodes need have more than encoder so as to allow an actual selection between at least two encoders at at least one of the nodes. As the codecs shown in FIGs. 1 and 2 herein are preferably primarily software based, changing, replacing, and/or adding codecs to the systems of FIGs. 1 and 2 should be readily possible, as is known to those of ordinary skill in the art.

As used herein, the phrases “more powerful” and “less powerful”, as respectively employed with reference to encoders 130 and encoders 170, define a relationship between the respective powers of the encoders 130 and 170 such that the compression efficiency of the more powerful encoder is greater than the compression efficiency of the less powerful encoder.

It is to be appreciated that while only two videoconferencing nodes are shown with respect to FIG. 1, the present invention may be utilized with a video conferencing system having any number of videoconferencing nodes and even with a videoconferencing system having a plurality of videoconferencing nodes and a videoconferencing server. Moreover, while only some elements of a videoconferencing node are shown with respect to nodes 110 and 150, other elements as readily determined by one of ordinary skill in the related art may also be included in such nodes. For example, one or more speakers and a microphone, although omitted in FIG. 1 for the sake of brevity, will likely be present in most if not all nodes of a videoconferencing system. Thus, given the teachings of the present invention provided herein, one of ordinary skill in the related art will contemplate this and various other video conferencing systems and implementation thereof to which the present invention may be applied while maintaining the spirit of the present invention.

The participant with the more powerful computer (first video conferencing node 110) can encode his/her video using a more efficient encoder (encoder 130 which may be, e.g., an MPEG4 encoder) and the participant with the less powerful computer (second video conferencing node 150) can encode his/her video using a less efficient encoder (encoder 170 which may be, e.g., an H.263 encoder). It is to be initially noted that the present invention is not limited to the preceding encoder types and, thus, other types of video encoders may also be employed in accordance with the present invention while maintaining the spirit of the present invention.

Regarding the preceding example, it is preferable that the less powerful computer (second video conferencing node 150) be able to decode the MPEG4 video data (or other compressed video data type) in real-time and the more powerful computer (first video conferencing node 110) must be able to decode the H.263 video data (or other compressed video data type) in real-time. The properties of video codecs are that the decoders are much less computationally intensive and require less processing power than the encoders. It is therefore possible for a less powerful computer to be able to decode MPEG4 and encode H.263 simultaneously.

A general description will now be given of another illustrative embodiment of the present invention with respect to FIG. 2.

FIG. 2 is a block diagram illustrating a video conferencing system 200 to which the present invention may be applied, according to another illustrative embodiment of the present invention. The video conferencing system 200 includes a first video conferencing node 210 and a second video conferencing node 250. In the illustrative embodiment of FIG. 2, the first video conferencing node 210 is implemented on a more powerful computer than that used for the second video conferencing node 250. Moreover, each of the encoders of the first video conferencing node 110 and the second video conferencing node 150 are of the same type, but are capable of having their encoding parameters dynamically changed as described more fully herein below. It is to be appreciated that while FIG. 2 is primarily described with respect to encoding operations, the present invention is equally applicable to the video conferencing system 200 with respect to decoding operations.

The first video conferencing node 210 includes a capture device 215, a display device 220, a decoder 225, and an encoder 130. The second video conferencing node 150 includes a capture device 255, a display device 260, a decoder 265, and an encoder 170. One or more communication mediums (not shown) may be employed in video conferencing system 200 to facilitate communication between the nodes thereof.

Each participant using the video conferencing system 200 could have the same type of encoder (for encoders 130 and 170), but the parameters of the encoders are changed to respectively make each encoder less or more computationally intensive (also affecting the compression efficiency). This would allow the less powerful computer (second video conferencing node 150) to run the same codec, but it would result in a sacrifice of the efficiency of the compression. It may also prevent the ability to encode at certain higher resolutions and restrict the encoding to lower resolutions on the less powerful computer (second video conferencing node 150).

An example of a trade-off in this situation could be the more powerful participant would encode video data using MPEG4 at 352x288 (CIF) resolution (30 fps) and the less powerful participant would encode video data using MPEG4 at 160x120 (QC1F) resolution (30 fps) in contrast to another case wherein the more powerful participant would encode MPEG4 at 352x288 (CIF) resolution (30 fps) and the less powerful participant would encode H.263 at 352x288 (CIF) resolution (30 fps).

Another alternative would be for the more powerful participant to encode MPEG4 at 352x288 (CIF) resolution (30 fps) and the less powerful participant would encode MPEG4 at 352x288 (CIF) resolution (15 fps).

It is to be appreciated that while only two videoconferencing nodes are shown with respect to FIG. 2, the present invention may be utilized with a video conferencing system having any number of videoconferencing nodes and even with a videoconferencing system having a plurality of videoconferencing nodes and a videoconferencing server. Moreover, while only some elements of a videoconferencing node are shown with respect to nodes 210 and 250, other elements as readily determined by one of ordinary skill in the related art may also be included in such nodes. For example, one or more speakers and a microphone, although omitted in FIG. 2 for the sake of brevity, will likely be present in most if not all nodes of a videoconferencing system. Thus, given the teachings of the present invention provided herein, one of ordinary skill in the related art will contemplate this and various other video conferencing systems and implementation thereof to which the present invention may be applied while maintaining the spirit of the present invention.

Thus, a video conferencing system to which the present invention may be applied should include multiple codecs at each (or, at the least, more than one codec at at least one) video conferencing node, or a single type of codec (at each of the nodes) with many parameters (for example, but not limited to, features and options) that can be changed to vary the computational complexity of the encoder and, thus, the compression efficiency. The video conferencing application will also need to detect the type of computer and processing power of the computer the video conferencing application has been installed on. This information can be sent to the video conferencing server (and/or to other participating nodes, e.g., in a system not having a dedicated video conferencing server) when a node starts the video conferencing application. With this information, it will allow two nodes to negotiate and find an optimal combination of codecs that best fits the constraints of the computer processing power.

FIG. 3 is a high-level block diagram illustrating a method of employing video encoders in a video conferencing session between a first video conferencing node 301 and a second video conferencing node 302, according to an illustrative embodiment of the present invention. It is to be appreciated that while the method of FIG. 3 is shown and described herein with respect to two video conferencing nodes, it may readily be applied to more than two video conferencing nodes, while maintaining the spirit and scope of the present invention.

Nodal constraints of the first video conferencing node 301 and the second video conferencing node 302 are determined (step 310). The nodal constraints include, at the least, the processing power, of each respective node. The processing power may be characterized by, but is not limited to, for example, processor type, processor speed, available memory (RAM and otherwise), available bandwidth, and so forth. Moreover, the nodal constraints may include, for example, user preferences as described herein below.

It is to be appreciated that many of the above constraints may apply not only to the computer itself at which the node is represented but also elements of the computer such as the video adapter card, which may have its only processor, memory, and so forth. Given the teachings of the present invention provided herein, one of ordinary skill in the related art will contemplate these and various other constraints applicable to the present invention while maintaining the spirit thereof. It is to be appreciated that the phrase "nodal constraints" is also used interchangeably herein to represent capabilities and preferences of a given node/computer/client to which the present invention may be applied. Moreover, it is to be appreciated that the terms node, computer, and client are used interchangeably herein.

An optimal combination of codecs (for a system such as that shown and described with respect to FIG. 1) or parameters (for a system such as that shown and described with respect to FIG. 2) is determined for use in an upcoming video conferencing session, based on the nodal constraints determined at step 310 (step 315). The optimal combination of codecs ideally is the combination that allows for the most compression efficiency at each of the respective nodes, given the respective processing powers of each of the nodes. That is, the optimal combination of codecs ideally provides the high compression efficiency that a given node is capable of. However, since the optimal combination of codecs may also involve preferences of a given user at a given node, such preferences may alter the ideal described above. Moreover, it is further preferable if reliability (e.g., dropped frames) is not sacrificed. Another possible requirement for the optimal combination is that it allows real-time decoding at all nodes of any video streams encoded by any other ones of the nodes.

The optimal combination of codecs or parameters is then employed in the video conferencing session (step 320).

FIG. 4 is a high-level block diagram illustrating a method of employing video encoders in a video conferencing session between a first video conferencing node 401 and a second video conferencing node 402, according to another illustrative embodiment of the present invention. It is to be appreciated that while the method of FIG. 4 is shown and described herein with respect to two video conferencing nodes, it may readily be applied to more than two video conferencing nodes, while maintaining the spirit and scope of the present invention.

A HELLO message is transmitted from the first video conferencing node 401 to the second video conferencing node 402 (step 410), and a HELLO message is transmitted from the second video conferencing node 402 to the first video conferencing node 401 (step 415). The exchange of HELLO messages signifies the start of the initialization phase for exchanging capabilities between clients.

A CAPABILITIES REQUEST message is transmitted from the first video conferencing node 401 to the second video conferencing node 402 (step 420). The CAPABILITIES REQUEST message requests a receiving node to specify its capabilities and preferences. In the event that the method of FIG. 4 is implemented with respect to more than two nodes, then the CAPABILITIES REQUEST message is sent to each of the other nodes.

A CAPABILITIES RESPONSE message is transmitted from the second video conferencing node 402 to the first video conferencing node 401 (step 425). The capabilities response message is provided in response to the receipt of a CAPABILITIES REQUEST message (such as that made in step 420), and specifies details regarding the specific capabilities and preferences of the node that previously received the CAPABILITIES REQUEST message.

The capabilities may include, for example, the processing power of a given node. The processing power may be quantified, for example, by specification of a processor type (e.g., Pentium™ 4), a processor speed (e.g., 3.0 MHz), and/or so forth. The capabilities and preferences may relate to, for example, the particular compression and decompression algorithms available at a given node, encoding and decoding parameters of the compression and decompression algorithms, bit rates, and so forth. It is to be appreciated that many of these parameters and preferences are directly related to the amount of processing power that is capable of being provided by a given node. Furthermore, the capabilities and preferences may include a merit number that signifies the relative importance of a specific capability or preference to which the merit number is assigned. The specified capabilities and preferences, along with the optional merit numbers assigned thereto, are examined by each client node to determine the optimal configuration.

A CAPABILITIES REQUEST message is transmitted from the second video conferencing node 402 to the first video conferencing node 401 (step 430). A CAPABILITIES RESPONSE message is transmitted from the first video conferencing node 401 to the second video conferencing node 402 (step 435).

A FINISH message is transmitted from the first video conferencing node 401 to the second video conferencing node 402 (step 440). A FINISH message is transmitted from the second video conferencing node 402 to the first video conferencing node 401 (step 445). The FINISH message is exchanged to verify the optimal negotiation of capabilities between the clients. If a node does not happen to send a FINISH message, then the process will start over again until all nodes in the system can agree on a common set of parameters for the video conferencing session.

A video conferencing session is then conducted between the first video conferencing node 401 and the second video conferencing node 402 in accordance with the negotiated capabilities and preferences (step 450). It is to be appreciated that step 450 may include any one of steps 450A and 450B, which are directed to the cases where the nodes having different encoders available thereat and where the nodes have the same type of decoder but with variable features/options.

Thus, for example, in the case where the more powerful computer (located at the first video conferencing node 401) has a more powerful (more efficient) encoder than the less powerful computer (located at the second video conferencing node 402), then the first video conferencing node 401 will encode using the more powerful encoder while the second video conferencing node 402 will encode using the less powerful encoder (step 450A). It is to be appreciated that the preceding arrangement of using the more powerful encoder at the more powerful computer while using the less powerful encoder at the less powerful computer may be implemented even when both computers each have more than one type of encoder available for use. The negotiations performed by the above exchange of messages enable the optimal combination of encoders to be selected and used at the two or more nodes that are to participate in a videoconference. On the other hand, if both nodes have the same type of encoder, with both encoders having the capability of having features/option changed to vary the computational complexity (efficiency) of the encoder, then the parameters of the encoders are varied such that the encoder at the first video conferencing node 401 performs encoding at a higher efficiency than the encoder at the second video conferencing node 402 (step 450B).

A description will now be given of many of the attendant advantages of the present invention, that is, in using non-similar video encoding/decoding algorithms between the participants in a videoconference on a video conferencing system. The present invention provides the capability to obtain higher compression ratios, thus effectively making better usage of network resources. Moreover, the present invention provides the capability for some participants to obtain better resolution and/or higher frame rates than other participants.

Although the illustrative embodiments have been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to those precise embodiments, and that various other changes and modifications may be affected therein by one of ordinary skill in the related art without departing from the scope or spirit of the invention. All such changes and modifications are intended to be included within the scope of the invention as defined by the appended claims.

CLAIMS:

1. A method for conducting a videoconference between a plurality of nodes connected through a network and having disparate processing power there between, the plurality of nodes having a plurality of video codecs such that at least one of the plurality of nodes has more than one video codec for use thereby and other ones of the plurality of nodes, if any, have at least one video codec for use thereby, at least one of the plurality of video codecs having a disparate video compression efficiency with respect to at least another one of the plurality of codecs, the method comprising the steps of:

determining (310) nodal constraints of each of the plurality of nodes, the nodal constraints including at least the processing power of each of the plurality of nodes; and

negotiating (315) between the plurality of nodes to identify an optimal combination of video codecs that satisfy the nodal constraints from the plurality of codecs.

2. The method of claim 1, wherein the processing power is characterized by at least one of a processor type, a processor speed, available memory, and available bandwidth.

3. The method of claim 1, further comprising the step of conducting (450A) the videoconference using the optimal combination of video codecs such that at least one node of the plurality of nodes is encoding a video stream at a higher video compression efficiency that at least one other node of the plurality of nodes,

the at least one node having a higher processing power than the at least one other node.

4. The method of claim 3, wherein the at least one of the plurality of nodes is one of the same as and different from the at least one node, and wherein the other ones of the plurality of nodes is one of the same as and different from the at least one other node.

5. The method of claim 1, wherein the optimal combination of video codecs is determined such that each of the plurality of nodes is capable of decoding, in real-time, a video stream encoded by any of the plurality of nodes.

6. The method of claim 1, wherein at least one node of the plurality of nodes has a disparate processing power with respect to at least one other node of the plurality of nodes.

7. The method of claim 6, wherein the at least one of the plurality of nodes is one of the same as and different from the at least one node, and wherein the other ones of the plurality of nodes is one of the same as and different from the at least one other node.

8. The method of claim 1, further comprising the step of limiting an upper resolution limit on any of the video codecs having a processing power below a predefined threshold.

9. The method of claim 1, wherein the nodal constraints further include respective preferences of respective users at each of the plurality of nodes.

10. A method for conducting a video conference between a plurality of nodes connected through a network and having disparate processing power there between, each of the plurality of nodes having a video codec of the same type for use thereby, the video codec being adapted such that parameters thereof may be dynamically adjusted to provide varying degrees of compression efficiency, the method comprising the steps of:

determining (310) nodal constraints of each of the plurality of nodes, the nodal constraints including at least the processing power of each of the plurality of nodes; and

negotiating (315) between the plurality of nodes to identify an optimal combination of video codec parameters that satisfy the nodal constraints from among the video codec of each of the plurality of nodes.

11. The method of claim 10, wherein the processing power is characterized by at least one of a processor type, a processor speed, available memory, and available bandwidth.

12. The method of claim 10, further comprising the step of conducting (450B) the videoconference in accordance with the optimal combination of video codec parameters such that at least one of the plurality of nodes is encoding a video stream at a higher video compression efficiency that at least another one of the

plurality of nodes, the at least one of the plurality of nodes having a higher processing power than the at least another one of the plurality of nodes.

13. The method of claim 10, wherein the optimal combination of video codec parameters is determined such that each of the plurality of nodes is capable of decoding, in real-time, a video stream encoded by any of the plurality of nodes.

14. The method of claim 10, wherein at least one of the plurality of nodes has a disparate processing power with respect to at least another one of the plurality of nodes.

15. The method of claim 10, further comprising the step of dynamically changing (450B) the video codec parameters of the video codec of at least one of the plurality of nodes in accordance with the optimal combination of video codec parameters.

16. The method of claim 10, further comprising the step of dynamically changing (450B) the video codec parameters of the video codec of at least one of the plurality of nodes in accordance with the optimal combination of video codec parameters so as to result in a modification of a present compression efficiency of the at least one of the plurality of nodes.

17. The method of claim 10, further comprising the step of dynamically changing (450B) the video codec parameters of the video codec of at least one of the plurality of nodes in accordance with the optimal combination of video codec

parameters so as to result in the at least one of the plurality of nodes encoding more frames per second than at least another one of the plurality of nodes.

18. The method of claim 10, further comprising the step of dynamically changing (450B) the video codec parameters of the video codec of at least one of the plurality of nodes in accordance with the optimal combination of video codec parameters so as to result in the at least one of the plurality of nodes encoding at a higher resolution than at least another one of the plurality of nodes.

19. The method of claim 10, wherein the video codec parameters comprise an upper resolution limit, and the method further comprises the step of limiting the upper resolution limit on any of the video codecs having a processing power below a predefined threshold.

20. The method of claim 10, wherein the nodal constraints further include respective preferences of respective users at each of the plurality of nodes.

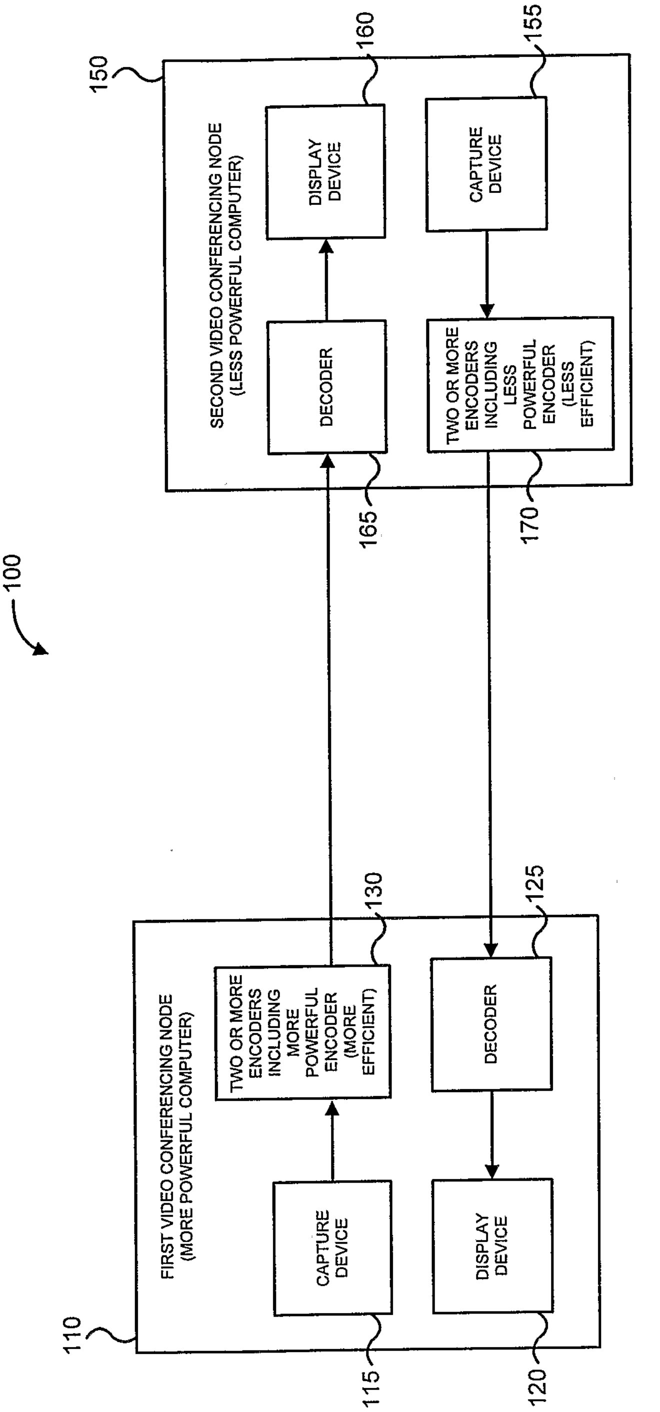

100
110
FIRST VIDEO CONFERENCING NODE (MORE POWERFUL COMPUTER)
CAPTURE DEVICE
115
TWO OR MORE ENCODERS INCLUDING MORE POWERFUL ENCODER (MORE EFFICIENT)
130
DECODER
125
DISPLAY DEVICE
120
150
SECOND VIDEO CONFERENCING NODE (LESS POWERFUL COMPUTER)
DISPLAY DEVICE
160
DECODER
165
CAPTURE DEVICE
155
TWO OR MORE ENCODERS INCLUDING LESS POWERFUL ENCODER (LESS EFFICIENT)
170

FIG. 1

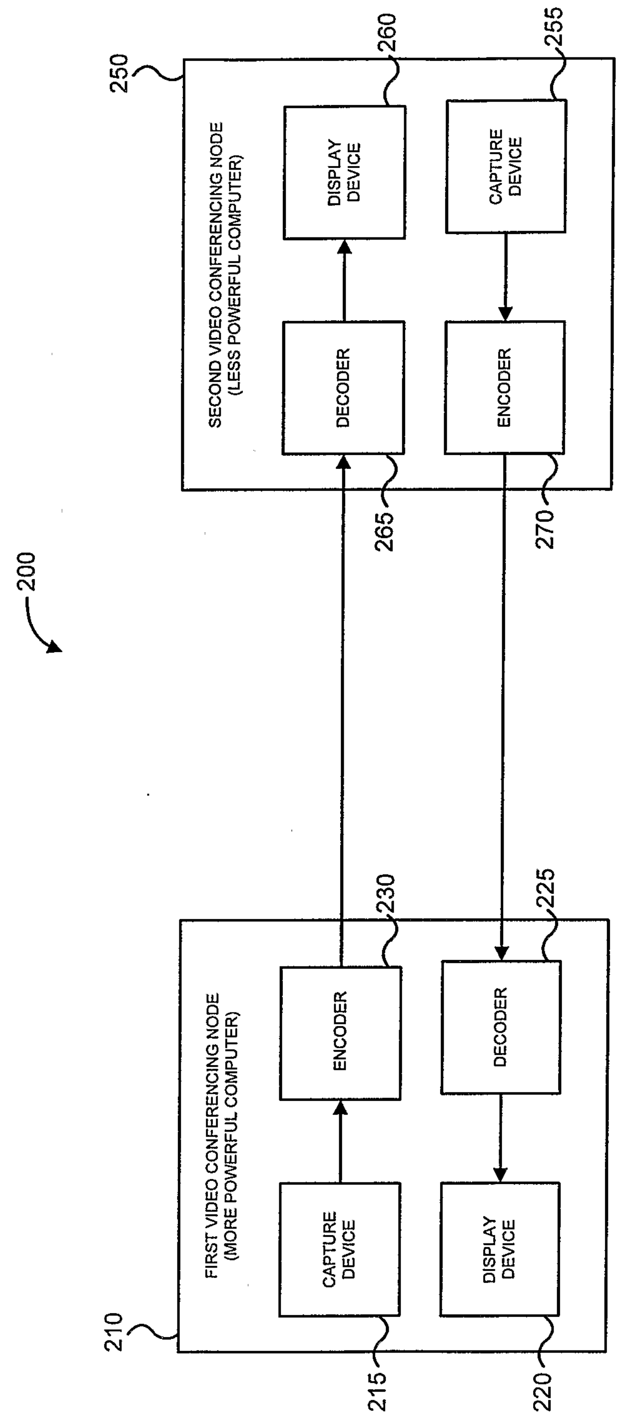

200
250
SECOND VIDEO CONFERENCING NODE (LESS POWERFUL COMPUTER)
260
DISPLAY DEVICE
255
CAPTURE DEVICE
DECODER
ENCODER
265
270
210
FIRST VIDEO CONFERENCING NODE (MORE POWERFUL COMPUTER)
230
ENCODER
225
DECODER
CAPTURE DEVICE
DISPLAY DEVICE
215
220

FIG. 2

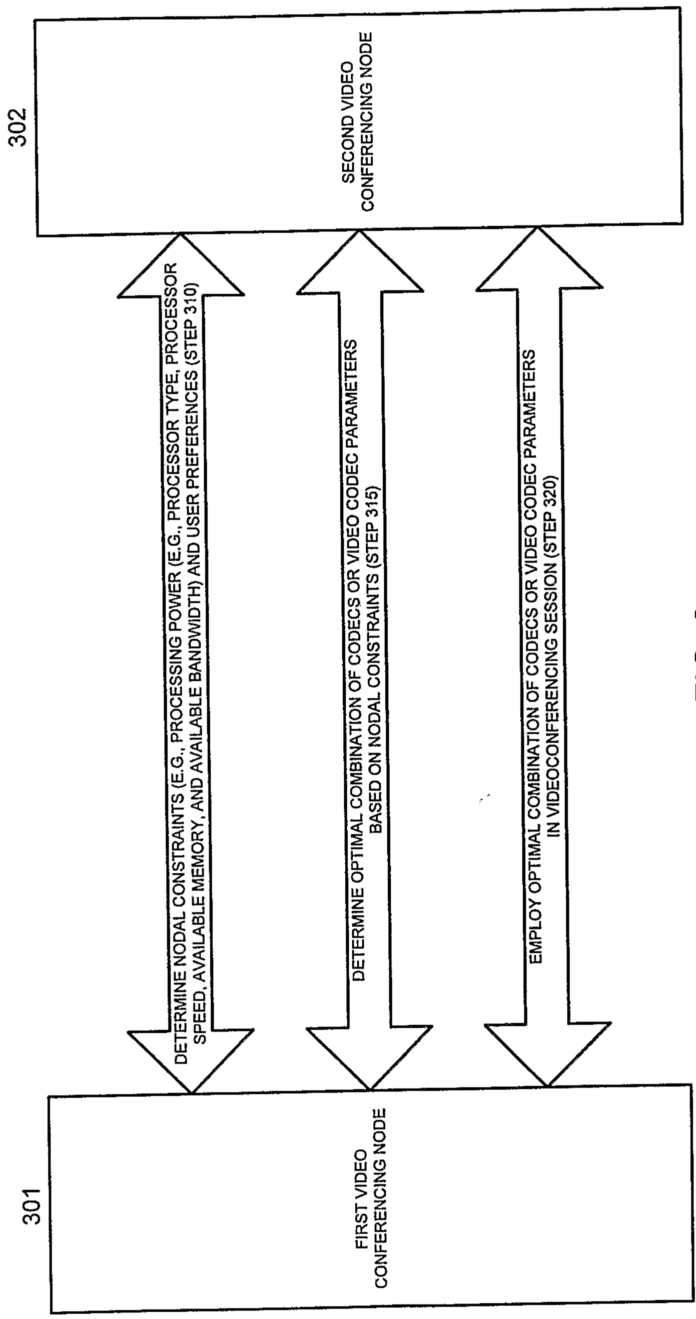

302
SECOND VIDEO CONFERENCING NODE
DETERMINE NODAL CONSTRAINTS (E.G., PROCESSING POWER (E.G., PROCESSOR TYPE, PROCESSOR SPEED, AVAILABLE MEMORY, AND AVAILABLE BANDWIDTH) AND USER PREFERENCES (STEP 310)
DETERMINE OPTIMAL COMBINATION OF CODECS OR VIDEO CODEC PARAMETERS BASED ON NODAL CONSTRAINTS (STEP 315)
EMPLOY OPTIMAL COMBINATION OF CODECS OR VIDEO CODEC PARAMETERS IN VIDEOCONFERENCING SESSION (STEP 320)
301
FIRST VIDEO CONFERENCING NODE

FIG. 3

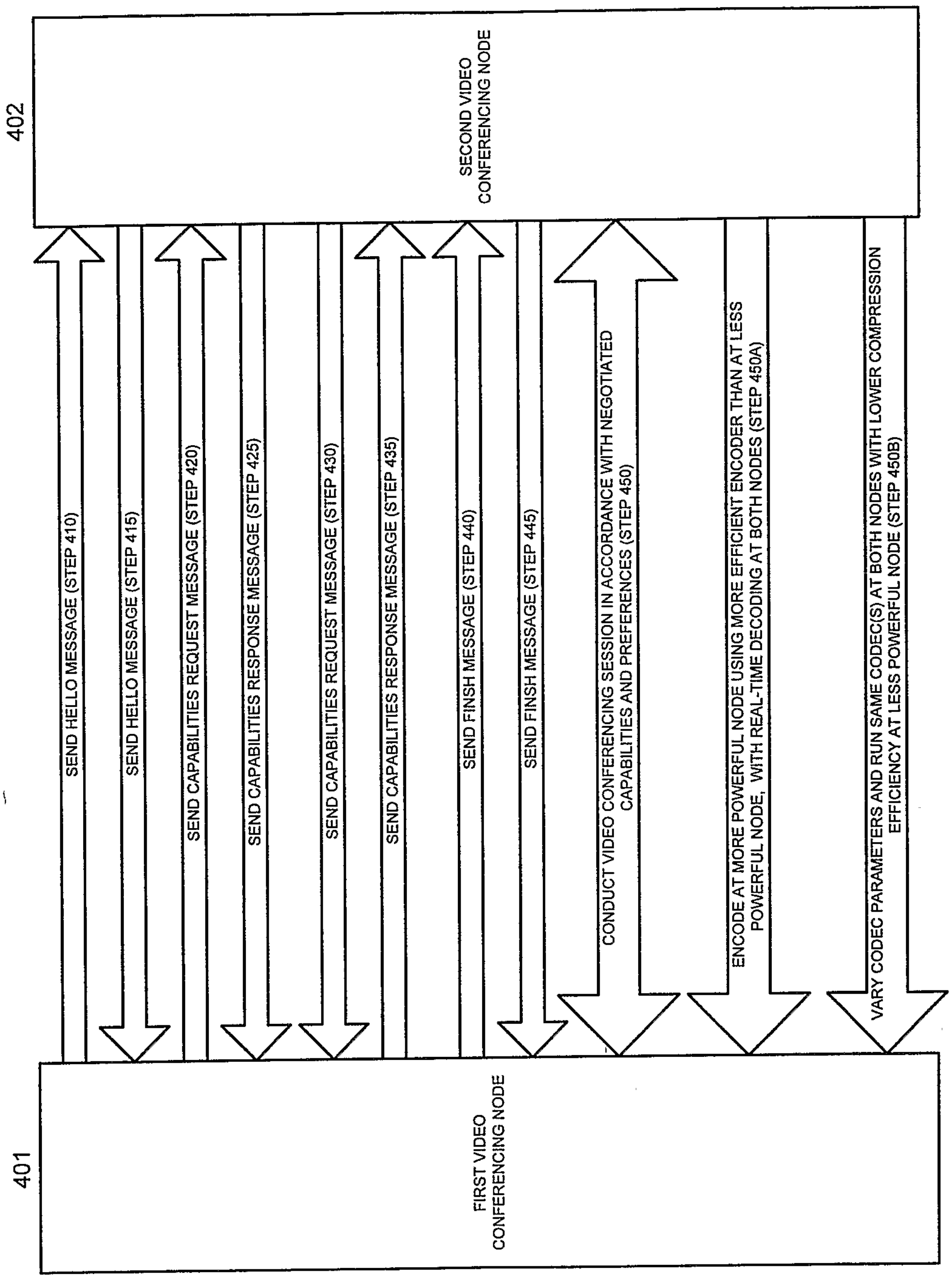

402
SECOND VIDEO CONFERENCING NODE
SEND HELLO MESSAGE (STEP 410)
SEND HELLO MESSAGE (STEP 415)
SEND CAPABILITIES REQUEST MESSAGE (STEP 420)
SEND CAPABILITIES RESPONSE MESSAGE (STEP 425)
SEND CAPABILITIES REQUEST MESSAGE (STEP 430)
SEND CAPABILITIES RESPONSE MESSAGE (STEP 435)
SEND FINSH MESSAGE (STEP 440)
SEND FINSH MESSAGE (STEP 445)
CONDUCT VIDEO CONFERENCING SESSION IN ACCORDANCE WITH NEGOTIATED CAPABILITIES AND PREFERENCES (STEP 450)
ENCODE AT MORE POWERFUL NODE USING MORE EFFICIENT ENCODER THAN AT LESS POWERFUL NODE, WITH REAL-TIME DECODING AT BOTH NODES (STEP 450A)
VARY CODEC PARAMETERS AND RUN SAME CODEC(S) AT BOTH NODES WITH LOWER COMPRESSION EFFICIENCY AT LESS POWERFUL NODE (STEP 450B)
401
FIRST VIDEO CONFERENCING NODE

FIG. 4

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 046 985 A (ALDRED ET AL) 4 April 2000 (2000-04-04) column 12, line 4 column 11, line 1 - line 36	1-20
X	US 6 278 693 B1 (ALDRED BARRY KEITH ET AL) 21 August 2001 (2001-08-21) column 13, line 35	1-20
X	US 2002/059627 A1 (ISLAM FARHAD FUAD ET AL) 16 May 2002 (2002-05-16)	1,10
A	figure 4	2-9, 11-20
X	EP 0 986 267 A (ROBERT BOSCH GMBH) 15 March 2000 (2000-03-15)	1,10
A	paragraph '0014!	2-9, 11-20

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 April 2005	28/04/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bertrand, F

INTERNATIONAL SEARCH REPORT

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 494 576 A (INTERNATIONAL BUSINESS MACHINES CORPORATION) 15 July 1992 (1992-07-15) abstract	1-20
E	US 2005/024487 A1 (CHEN WILLIAM) 3 February 2005 (2005-02-03) figure 13 figure 11	1-20
A	REID M: "Multimedia conferencing over ISDN and IP networks using ITU-T H-series recommendations: architecture, control and coordination" COMPUTER NETWORKS, ELSEVIER SCIENCE PUBLISHERS B.V., AMSTERDAM, NL, vol. 31, no. 3, 11 February 1999 (1999-02-11), pages 225-235, XP004304600 ISSN: 1389-1286 the whole document	1-20
X	ITU T H.242, 'Online! March 2004 (2004-03), XP002324192 Retrieved from the Internet: URL:www.itu.int> 'retrieved on 2005-04-12! the whole document	1-20

INTERNATIONAL SEARCH REPORT

Int onal Application No
PCT/US2004/023258

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 6046985	A	04-04-2000	GB	2318030	A	08-04-1998
US 6278693	B1	21-08-2001	GB	2312592	A	29-10-1997
US 2002059627	A1	16-05-2002	JP	10164535	A	19-06-1998
EP 0986267	A	15-03-2000	DE	19845193	A1	11-05-2000
			AT	222042	T	15-08-2002
			AU	759158	B2	10-04-2003
			AU	1030300	A	27-03-2000
			CA	2343166	A1	16-03-2000
			WO	0014966	A1	16-03-2000
			DE	59902291	D1	12-09-2002
			EP	0986267	A2	15-03-2000
			EP	1112660	A1	04-07-2001
			ES	2182576	T3	01-03-2003
			JP	2002524984	T	06-08-2002
EP 0494576	A	15-07-1992	US	5131016	A	14-07-1992
			DE	69122487	D1	07-11-1996
			EP	0494576	A1	15-07-1992
			JP	2522870	B2	07-08-1996
			JP	5160835	A	25-06-1993
US 2005024487	A1	03-02-2005	US	2005024486	A1	03-02-2005
			EP	1503595	A2	02-02-2005
			JP	2005057760	A	03-03-2005