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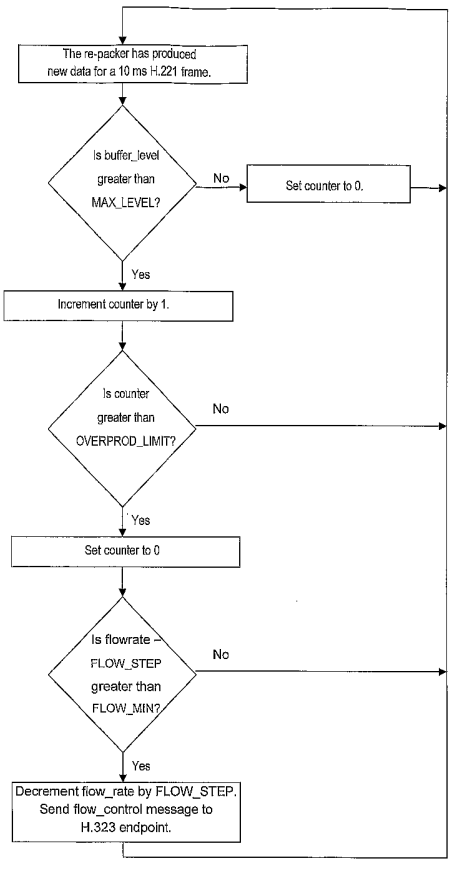
(54) Title: METHOD FOR MANAGING VARIATIONS IN A DATA FLOW RATE



(57) Abstract: The present invention discloses a method of detecting overproduction of data when an H.323 endpoint is transmitting more video or other data than initially negotiated, and makes it produce less by utilising standard flow control procedures. Flow control messages are sent periodically, incrementally instructing the H.323 endpoint to transmit lower amounts of bit rates, until the video rate received from the endpoint is equal to or lower than the initially negotiated rate, or some other fixed rate.

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METHOD FOR MANAGING VARIATIONS IN A DATA FLOW RATE

Field of the invention

The present invention relates to flow control in video-conferencing systems.

Background of the invention

Videoconferencing systems are conventionally adjusted to employ both circuit switched and packet switched networks. Thus, great efforts have been made to achieve inter-operability between circuit switched and packet switched terminals allowing interactions and communication without loss of quality or introduction of delay. A common standard for multimedia communications over circuit switched networks like ISDN is the H.320 standard from the International Telecommunications Union (ITU). The corresponding standard for packet switching is the H.323. As the present invention relates to flow control, which is an issue related to packet switching, a closer view at H.323 follows.

As already mentioned, H.323 is an umbrella recommendation from the International Telecommunications Union (ITU) that set standards for multimedia communications over packet switched network that do not provide a guaranteed Quality of Service. Such networks are pervasive on many corporate terminals and include TCP/IP and IPX over Ethernet, Fast Ethernet and Token Ring network technologies. The H.323 standard, titled: Packet-Based Multimedia Communications Systems, provides a foundation for audio, video, and data communications across IP-based networks, including the Internet. Multimedia products and applications complying with the H.323 standard are interoperable, can communicate with each other, and thus are compatible. Many sub standards make up the H.323 standard or protocol, one of which is the H.245 standard.

The H.245 standard defines the control protocol part of the H.323 standard. According to this protocol, there are several ways of altering the flow rate during a call. The most robust way is to send a flowControlCommand to the transmitting terminal. The flowControlCommand includes the fields logicalChannelNumber and maximumBitRate. The maximumBitRate indicates maximum allowed bit rate for the logical channel. The message is not rejectable, i.e. a terminal is not allowed to transmit at a higher rate after receiving the message. The flowControlCommand is i.a. used for initially setting a negotiated maximum data rate between terminals. An alternative way of altering the bit rate is to use the Logical Channel bit rate message flow. For illustrative purposes, consider a gateway using the Logical Channel bit rate messages to alter a flow rate transmitted from an EndPoint. A LogicalChannelRateRequest message is transmitted from the Gateway to the EndPoint. The message includes a logicalChannelNumber indicating the logical channel that the bit rate change request applies to, in addition to a maximumBitrate indicating, in units of 100 bit/s, the requested maximum bit rate for the logical channel. The Endpoint approves and acknowledges the request for data rate change of the specified channel by returning a LogicalChannelRateAcknowledge message including the same parameters as in the previously received LogicalChannelRateRequest message. Alternatively, if the EndPoint for some reason does not accept the requested change, the LogicalChannelRateRequest message is responded by a LogicalChannelRateReject including rejectReason indicating the reason why the request was denied.

An alternative protocol to H.323 is the SIP (Session Initiation Protocol) protocol. In current SIP standard, altering the flow rate during a call is carried out by transmitting a ReInvite message to the EndPoint. The ReInvite message carries the same information as the Invite message, including a so-called CapSet, which is used at call set up. Thus, the ReInvite message also includes

maximum allowed bit rate, and consequently, transmitting a ReInvite message with a new maximum allowed data rate leaving the other data unchanged will have the same effect as the flowControlCommand in H.323.

A gateway provides a connection between the IP and the circuit switched side of the communication path between endpoints in a multimedia conference. Seen from the endpoints residing at the IP side, the endpoints at the circuit switched side are virtually being converted to IP endpoints, and vice versa. The main tasks of the gateway is consequently to translate and re-pack the data stream across the networks in real-time. The packets transmitted from the H.323 endpoints are temporarily stored in a buffer before they are fetched and arranged in H.320 frames of a fixed size.

The translation process from H.323 to H.320 in the gateway is accomplished by extracting raw video data from packets specified by RFC2032 (H.261 over RTP), RFC2190 (H.263 over RTP) and RFC 2429(H.263+ over RTP) and forwarding this raw data to a so-called BCH encoder.

When translating in the opposite direction from H.320 to H.323 the process is a lot more complex because the packetization schemes described in the RFC's mentioned above have strict rules about where a packet split may occur. Specifically packet splits are allowed at Picture, Group Of Block (GOB) and Macro Block (MB) level. It is most desirable to have splits occur at Picture and GOB level because a split on MB level has some associated overhead due to the need to transmit some video decoder state information along with the video data.

A conventional implementation uses variable length decoding to determine the location and length of Groups Of Blocks (GOB) in the video stream. When it has found a GOB, it processes the corresponding bits by using the number of

bits in the GOB (a), the number of available bits in the current packet (b) and the maximum packet size(c), to choose one of the following actions:

- If a<=b, append the GOB to the current packet
- If a>b and a<=c Transmit the current packet and append the GOB to a new packet
- If a>b and a>c Transmit the current packet and transmit the GOB using less optimal macroblock level packetization.

These three rules optimize packetization to fit the entire GOB in a packet if possible while also combining several GOBs in one packet where possible. This is desirable because GOB aligned packets have less overhead and few large packets require less processing overhead than many small packets.

In addition to the above rules, packets are also transmitted when the last GOB in a picture is added to a packet. This additional rule prevents the gateway to accumulate unwanted delay.

H.323 endpoints and H.320 endpoints connected together in a gateway unit are not able to use end-to-end flow-control because the H.320 protocol does not support it. However, flow-control can be used between the gateway and the H.323 endpoint. Only the flow-control messages from the gateway to the H.323 endpoint will have any effect. A typical scenario e.g. in known H320/H323 Gateways from Polycom and Ezenia is that the gateway initially will send flow-control messages to the H.323 endpoint to adjust the video data rate produced to the available capacity in the outgoing H.320 connection from the gateway. It is not possible to flow control the H.320 endpoint because the H.320 protocol simply doesn't support this. This means that the H.320

could produce more video than the H.323 endpoint supports. Only the flow-control messages from the gateway to the H.323 endpoint will have any effect. The effect will depend on flow-control support in the H.323 endpoint.

A problem then occurs when the H.323 endpoint for some reason starts to transmit data to the gateway at a higher bit rate than initiated by the flow-control. This may occur because of defects in the endpoint, loss of data settings or a drifting or incorrect wall clock. The gateway will then not be able to capture data to H.320 frames as fast as the buffer is filled up. In the first instance, this implies increasingly larger delays in the data transmission because the payload will spend longer time in the buffer, which will be crucial to real-time applications like videoconferencing. Additionally, at some point, the upper fill limit of the buffer will be reached. When the upper fill limit is reached, the gateway has no other choice than rejecting subsequent incoming data. The result of this is loss of data appearing for the user of the H.320 endpoint as i.a. picture artefacts.

Summary of the invention

The features defined in the independent claims enclosed characterize this arrangement and method.

In particular, the present invention discloses a method of adjusting a flow rate of data transmitted from a first packet switched H.323 or SIP configured video conference terminal and received in a second packet switched H.323 or SIP configured video conference terminal, temporarily storing the received data in one or more buffers in the second packet switched video conference terminal before being captured for further processing, the method further comprising the following steps, after each data capturing from said one or more buffers: comparing a fill level of the one or more buffers with a predefined level, if said

fill level is lower than said predefined level, then resetting a counter, if said fill level is greater than said predefined level, then incrementing said counter, and comparing said counter with a predefined counter limit, if said counter is greater than said predefined counter limit, then resetting said counter, and decreasing the flow rate of the transmitted data by transmitting a flow control message from the second to the first packet switched terminal instructing the first packet switched terminal to decrease the flow rate according to a flow rate value included in said flow control message..

Brief description of the drawings

In order to make the invention more readily understandable, the discussion that follows will refer to the accompanying drawing,

Figure 1 is a flow sheet illustrating a preferred embodiment of the present invention.

Best modes of carrying out the invention

In the following, the present invention will be discussed by describing a preferred embodiment, and by referring to the accompanying drawings. However, people skilled in the art will realize other applications and modifications within the scope of the invention as defined in the enclosed independent claims.

The present invention provides automatically detection of overproduction of data when e.g. an H.323 endpoint is transmitting more video or other data than what initially was negotiated, and make it produce less by utilising the above described message flow for data rate changes or other flow control mechanisms. In the case of H.323, flowControlCommand or LogicalChannelRateRequest messages are periodically transmitted to the endpoint in question

with incrementally lower amounts of maximumBitrate, until the video rate received from the endpoint is equal to or lower than the initially negotiated rate, or some other fixed rate.

The method of the present invention is particularly useful in gateways. The overproduction of video data is detected in the gateway by periodically observing the amount of data in the incoming buffer. If the amount of data is more than a certain limit for a defined time-period, the endpoint is considered to be overproducing. The data limit for the buffer is preferably set in proportion to the outgoing H.320 video rate.

When overproduction is detected, a new flowControlCOmmand or LogicalChannelRateRequest message is sent to the H.323 endpoint. The bit-rate is then decreased by a constant amount. The time-period for observing a buffer level over the limit should be predefined.

A preferred embodiment of the present invention will now be described referring to the flow sheet of figure 1. The data flow of interest is the video data transmitted from a H.323 EndPoint to a H320/H323 Gateway. The Gateway is repacking the payload of the incoming video data to H.320 frames of 10 ms duration being able to carry a constant amount of video data. Thus, at intervals of 10ms, the video re-packer is asked to produce data to fit into a 10ms (H.221) frame. A Counter keeps track of the number of data capturing events from the buffer since last time the fill level of the buffer was below a predefined level.

After the re-packer has produced data for a H.221 frame, a buffer_level, indicating the fill level of the video buffer temporarily storing the incoming video data for the EndPoint, is checked. If buffer_level is below a predefined Max_Level, the Counter is reset and the procedure waits for the re-packer to produce new data for another H.221 frame,

but if not, the Counter is incremented. In this example, Max_Level is the max amount of video data in a 10ms H.221 frame.

Then, the Counter itself is investigated, and if it is below a predefined Overprod_Level, the procedure waits for the re-packer to produce new data for another H.221 frame. If not, the H.323 EndPoint is considered to overproduce. The Counter is reset, and the data flow rate of the video data transmitted from the H.323 EndPoint is stepped down by a predefined amount as indicated of the parameter Flow_Step. In this example, Flow_Step is a constant of 16kbit. The decrementing of the data flow rate is carried out by transmitting a flowControlCOmmand or a LogicalChannelRateRequest message including a maximumBitrate of the current flow rate minus Flow_Step, and a logicalChannelNumber indicating the logical channel of video data. However, before the decrementing takes place, it has to be checked if the current flow rate minus Flow_Step is lower than a predefined Flow_Min. If that is the case, the decrementing is bypassed and the procedure waits for the re-packer to produce new data for another H.221 frame. The reason for this is to make sure that the actual video data rate transmitted from the H.323 EndPoint never is set to zero.

For preventing e.g. data bursts to trigger an oversized reduction of the flow rate, a mechanism intercepting at least the most common events producing data burst should preferably be introduced. As an example, consider the case of a H.323 conference call where the endpoints have different call rates. The endpoint with the lowest call-rate will initially send a flow-control message to the other endpoints to make them produce at the low rate. However, this will not prevent a short period of over-production. This start burst may trigger the overflow detection mechanism of the present invention to reduce the flow rate more than necessary. To avoid this, the Gateway

could be configured to always increase the flow rate to the outgoing H.320 rate a defined time-period after a video-channel is opened.

The present invention handles H.323 endpoints (or endpoints adjusted to similar standards) that produce consistently more video data (or other multimedia data) relative to the flow-control initiated rate.

In other words, the present invention makes a gateway work with consistently overproducing H.323 endpoints preventing buffer overflow and data loss. In this way, build ups of delays and picture artefacts may be avoided or strongly reduced.

The invention is not restricted to flow control between endpoint and gateway only, but may be utilise an end-to-end context, or between MCU and EndPoint as well. The invention is neither restricted to the H.323 standard, but it could also be useful in connection with other similar standards, e.g. the SIP standard. In case of the SIP standard, the flowControlCOmmand used in the description related to H.323 is replaced with a ReInvite message as described in the background section. The present invention applies for any message or method in future version of the SIP and H.323 standard that is used for flow control.

Patent claims

1. A method of adjusting a flow rate of data transmitted from a first packet switched H.323 or SIP configured video conference terminal and received in a second packet switched H.323 or SIP configured video conference terminal, temporarily storing the received data in one or more buffers in the second packet switched video conference terminal before being captured for further processing, characterized in

after each data capturing from said one or more buffers,

comparing a fill level of the one or more buffers with a predefined level,

if said fill level is lower than said predefined level, then

resetting a counter,

if said fill level is greater than said predefined level, then

incrementing said counter, and

comparing said counter with a predefined counter limit,

if said counter is greater than said predefined counter limit, then

resetting said counter, and

decreasing the flow rate of the transmitted data by transmitting a flow control message from the second to the first packet switched terminal instructing the first packet

switched terminal to decrease the flow rate according to a flow rate value included in said flow control message.

2. A method according to claim 1, c h a r a c t e r i z e d i n that the second packet switched video conference terminal is a gateway.

3. A method according to the claim 1 or 2, c h a r a c t e r i z e d i n that the flow rate is decreased by a predefined constant value.

4. A method according to claim 3, c h a r a c t e r i z e d i n the following steps prior to the step of decreasing the flow rate:

comparing a difference between the flow rate and said predefined constant value with a predefined lower flow rate limit,

carrying out the step of decreasing the flow rate only if said difference is greater that said predefined lower flow rate limit.

5. A method according to one of the claims 2 - 4, c h a r a c t e r i z e d i n that said gateway is a H.323/H.320 gateway and said predefined level is equal to a maximum amount of data in a H.320 frame, into which data captured from the one or more buffers is inserted.

6. A method according to claim 5, c h a r a c t e r i z e d i n that said data is video, audio and/or other multimedia data transmitted from the first packet switched video conference terminal to a circuit switched terminal via the second packet switched video conference terminal in a video conference.

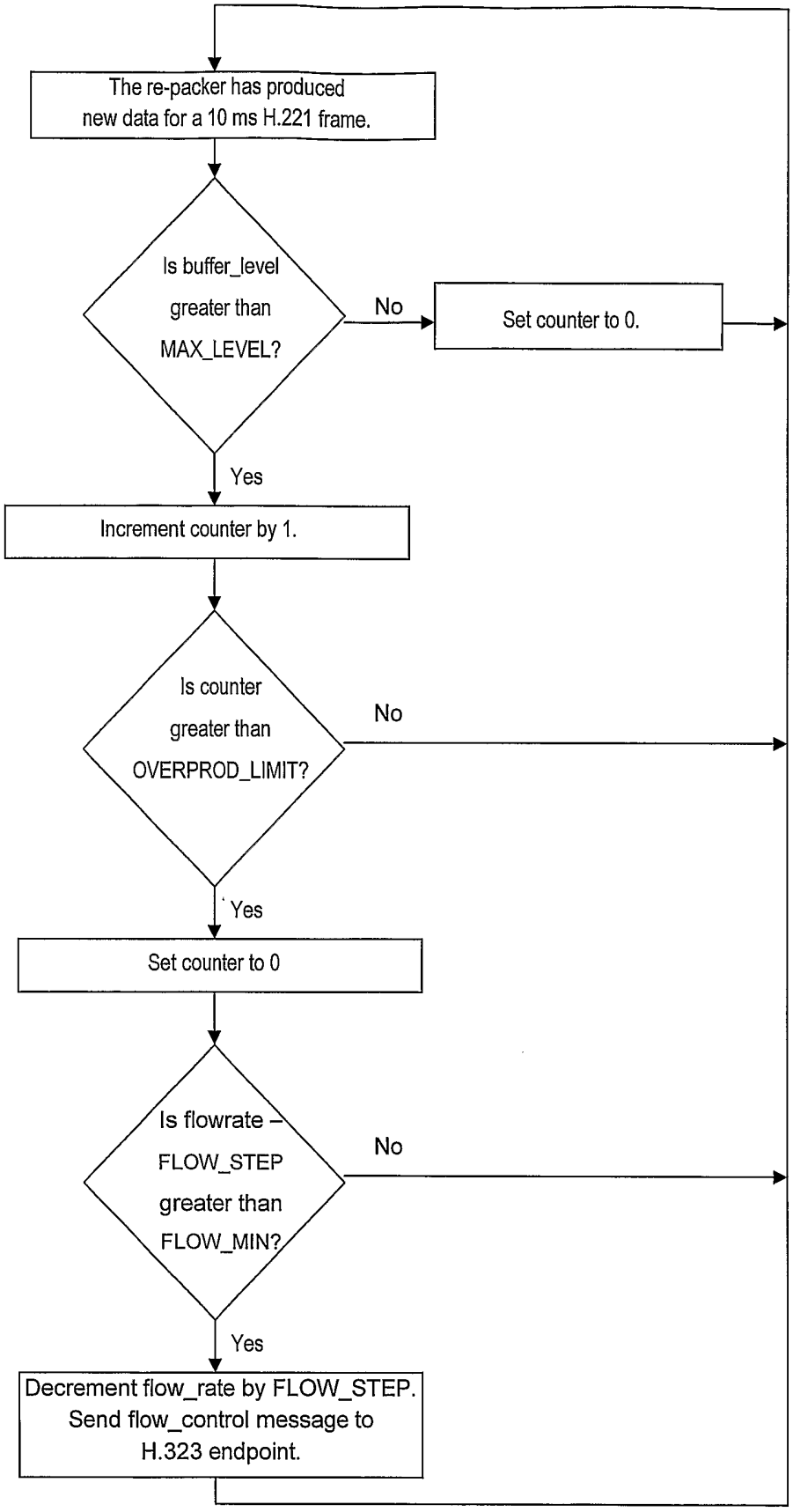
The re-packer has produced new data for a 10 ms H.221 frame.
Is buffer_level greater than MAX_LEVEL?
No
Set counter to 0.
Yes
Increment counter by 1.
Is counter greater than OVERPROD_LIMIT?
No
Yes
Set counter to 0
Is flowrate – FLOW_STEP greater than FLOW_MIN?
No
Yes
Decrement flow_rate by FLOW_STEP. Send flow_control message to H.323 endpoint.

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 2004/000144

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04N 7/15 // H04L 12/56
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)

IPC7: H04N, H04L

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

SE,DK,FI,NO classes as above

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

EPO-INTERNAL, WPI DATA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5812699 A (ZHU, C. ET AL), 22 Sept 1998 (22.09.1998), the whole document ---	1-6
A	US 20030074674 A1 (MAGLIARO, M.M.), 17 April 2003 (17.04.2003), abstract ---	1-6
P,A	US 6606112 B1 (FALCO, M.A.), 12 August 2003 (12.08.2003), figure 1, claim 1 ---	1-6
A	US 5600646 A (POLOMSKI, M.D.), 4 February 1997 (04.02.1997), figures 9,24, claim 3, abstract ---	1-6

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 2004/000144

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 20030058836 A1 (EVEN, R.), 27 March 2003 (27.03.2003) --	1-6
A	US 6065131 A (ANDREWS, L.P. ET AL), 16 May 2000 (16.05.2000) --	1-6

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