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— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:
— *with international search report*

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(54) Title: SYSTEM AND METHOD FOR TRANSMITTING LAYERED VIDEO OVER QOS ENABLED WLANS

(57) Abstract: A system and method is disclosed for the transmission of layered video over Quality of Service (QoS) enabled wireless local area networks (WLANs) in which a flow control layer (614) is utilized to drop enhancement layer (EL) packets from a multi-layer variable rate (VR) video stream having both base layer (BL) packets (608) and enhancement layer (EL) packets (610) when a wireless network becomes congested. An exemplary system includes an encoder (602) suitable to receive and encode video data into a video bitstream comprising both base layer BL packets (608) and enhancement layer EL packets (610), a flow control layer (612) whereby one or more of the enhancement layer EL packets (610) associated with the video stream may be dropped as needed depending upon the state of a wireless medium, a scheduler (SE) (614) for scheduling the packets, and a MAC layer (616) for preparing the video stream for transmission over the air.

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SYSTEM AND METHOD FOR TRANSMITTING LAYERED VIDEO OVER QoS ENABLED WLANs

The present invention is generally directed to communications systems. More particularly, the present invention is directed to a system and method for the transmission of layered video data over Quality of Service (QoS) enabled wireless local area networks (WLANs).

The development of high quality multimedia devices, such as set-top boxes, high end televisions, digital televisions, personal televisions, storage products, personal digital assistants (PDAs), wireless Internet devices, etc., is leading to a variety of architectures and to more openness towards new features for these devices. The development of these new multimedia products ensures that the public will continue to increase its demand for multimedia services. Network designers and engineers are therefore continuing to design systems that are capable of meeting the increasing demand for both real time and non-real time multimedia transfer across integrated networks.

In recent years, the IEEE 802.11 wireless local area network (WLAN) has emerged as a prevailing technology for the (indoor) broadband wireless access for mobile/portable devices. The IEEE 802.11 Working Group has relatively recently developed 802.11e, a supplement to the 802.11 Medium Access Control (MAC) for supporting QoS, to expand the 802.11 application domain by enabling such applications as voice and video services over wireless local area networks (WLANs). The IEEE 802.11e standard offers seamless interoperability across home, enterprise, and public access networking environments, while still offering features that

meet the unique needs of each type of network. Unlike other wireless initiatives, IEEE 802.11e is the first wireless standard that spans home and business environments by adding QoS features and multimedia support to the existing IEEE 802.11 standard, while maintaining full backward compatibility with the legacy standard.

The QoS support for multimedia traffic is critical to wireless home networks where voice, audio, and video will be delivered across multiple networked home electronic devices and personal computers. Broadband service providers view QoS and multimedia-capable home networks as an essential ingredient to offering residential customers value-added services such as video on demand, audio on demand, voice over IP and high speed Internet access.

In 802.11e, a traffic specification (TSPEC), which characterizes data traffic streams (e.g., data rate, packet size, delay, jitter, service interval, etc.), is utilized as a signaling mechanism to indicate to an access point (AP) the type of wireless networking service to expect. These traffic streams are delivered to the AP subject to QoS parameters. TSPEC negotiation between peer scheduler and MAC layers provides a mechanism for controlling admission, establishment, adjustment and removal of traffic streams. Traffic stream admission control is especially important as there is limited bandwidth available in wireless medium. Bandwidth access must be controlled to avoid traffic congestion, which tends to lead to breaking established QoS and drastic degradation of overall throughput.

In the wireless transmission of video data, a scalable representation of video signals consisting of base layer (BL) packets and multiple enhancement layer (EL) packets. The BL packets provide a basic level of quality and can be decoded independently of the enhancement layer EL packets. Whereas, the enhancement layer EL packets serve only to refine the quality of the base layer BL packets and alone are not useful. Hence, as the base layer BL packets represent the most critical part of the scalable representation, the performance of streaming applications employing layered representations is sensitive to the loss of BL packets.

Wireless transmitters including video encoders generate multi-layer variable rate (VR) video streams with both base layer BL packets containing data that is critical for decoding and enhancement layer EL packets containing data that improves the quality of the video output. The packet frames are sequentially transmitted with the number thereof dependent on variable channel conditions. The packets for a frame must arrive at a receiver to be decoded by a predefined decoding time for the frame in order for the packet to be available for decoding. Thus, there is a critical time after which any un-transmitted packets for a frame may be dropped because they will not arrive at the receiver/decoder within the predefined frame decoding time.

Conventional TSPEC mechanisms allow for the transmission of variable rate VR video stream. However, such TSPEC mechanisms do not specify when to de-admit or drop an application should the wireless network be unable (due to errors) to honor the negotiated level of service. For example, the TSPEC does not specify between when a single packet is

lost and when two or more packets are lost in determining when to de-admit the data traffic stream. Thus, as it is impossible, in a wireless medium, to guarantee (in an absolute sense) that the communication channel will remain error-free and, as it is likewise impossible to specify a reasonable upper bound for packet error rate when the residual error is zero, the behavior of the scheduler and MAC layers are not fully defined if packets are lost. This means that different implementations will work differently due to at least some of the scheduler/MAC layers possibly de-admitting certain traffic streams that cannot provide the requisite QoS.

There is therefore a need in the art for an apparatus and method that cooperates with existing TSPEC mechanisms to maintain a layered video transmission connection over unreliable wireless channels.

The present invention addresses the above-noted need and other disadvantages and/or shortcomings associated with the transmission of layered video data over unreliable wireless channels by providing a mechanism to use existing TSPEC signaling in 802.11 along with a flow control algorithm to effectuate flexibility in the presence of time varying channels, and make use of layered representations to improve overall picture quality. In an illustrative embodiment of the present invention, the flow control operates to drop enhancement layer EL packets that will not arrive at the receiver for decoding prior to the frame decoding time. Hence, the packet scheduler may then schedule the base layer BL packets and remaining enhancement layer EL packets for transmission without the need to determine whether the traffic stream should be de-admitted for inadequate QoS. Thus, in accordance with a beneficial feature of the

present invention, the flow control feature provides means for effectively transmitting layered video data over unreliable wireless channels.

A method according to an illustrative aspect of the present invention, is provided for transmitting layered video over QoS enabled wireless local area networks in which a flow control layer is utilized to drop enhancement layer EL packets from a multi-layer variable rate VR video stream having both base layer BL packets and enhancement layer EL packets when a wireless network becomes congested. A system according to another exemplary aspect of the present invention, includes an encoder suitable to receive and encode video data into a video bitstream with both base layer BL packets and enhancement layer EL packets, a flow control layer whereby one or more of the enhancement layer EL packets associated with the video stream may be dropped as needed depending upon the state of a wireless medium, a scheduler SE for scheduling the packets, and a MAC layer for preparing the video stream for transmission over the air.

Additional and/or alternative aspects, features and advantages of the present invention will become apparent with reference to the following detailed description of an exemplary embodiment thereof.

For a better understanding of the present invention, reference is made to the following detailed description considered in conjunction with the accompanying drawings, in which:

FIG. 1 schematically illustrates an exemplary prior art extended service set of a wireless local area network (WLAN);

FIG. 2 schematically illustrates seven prior art Open Systems Interconnection (OSI) network layers;

FIG. 3 schematically illustrates an exemplary prior art frame format for IEEE 802.11e QoS data;

FIG. 4 schematically illustrates an exemplary prior art frame format for an IEEE 802.11e Traffic Specification Element;

FIG. 5 schematically illustrates an exemplary prior art architecture of a QoS wireless station; and

FIG. 6 schematically illustrates an exemplary embodiment of a system and method in accordance with the present invention.

With reference to FIG. 1, a prior art exemplary extended service set 100 of a wireless local area network (WLAN) is illustratively shown. The extended service set 100, as shown, includes a host 110, a distribution system 120, a first Quality of Service (QoS) basic service set (QBSS) 130, and a second Quality of Service (QoS) basic service set (QBSS) 140. A typical QBSS 130, 140 includes a number of wireless QoS stations (QSTA) 150 utilizing the same Medium Access Control (MAC) protocol and which compete for access to the same shared medium. Each QBSS 130, 140 can be either isolated or operatively connected to the distribution system 120.

As shown in FIG. 1, each QBSS 130, 140 is connected to the distribution system 120 through a Quality of Service (QoS) Access Point (QAP) 160. The QAP 160 is a wireless QoS station operatively connectable to the distribution system 120. The QAP 160 conventionally operates as a bridge between the QBSS 130, 140 and the distribution

system 120. The MAC protocol of the QBSS 130, 140 can be fully distributed and/or controlled via a central coordination function within the QAP 160 of the QBSS 130, 140.

With reference now to FIG. 2, seven prior art Open Systems Interconnection (OSI) network layers are illustratively shown. Each of these layers is well known in the art and is included here for reference purposes. The first layer is a Physical Layer 200. The Physical Layer 200 is the initial layer of the OSI model and it operates at a bit stream or binary level. The Physical Layer 200 focuses on the electrical impulses and radio signals that pass through and within the actual physical network structure. The second layer is a Data Link Layer 210. The Data Link Layer 210 is conventionally responsible for packet handling, specifically regarding bit level packet encoding and decoding. The Data Link Layer 210 also deals with transmission protocol knowledge and aspects of error checking regarding the Physical Layer 200. The Data Link Layer 210 divided into two sub-layers, the Media Access Control Layer (MAC Layer) which controls access and permission restrictions to the date traveling on the layer, and the Logical Link Control Layer (LLC Layer) which is responsible for frame synchronization, flow control and error checking. The third layer is a Network Layer 220. The Network Layer 220 is responsible for the direction and movement of the data within the network. The fourth layer is a Transport Layer 230. The Transport Layer 230 is primarily responsible for ensuring complete and effective data movement between end systems and hosts. The fifth layer is a Session Layer 240. The Session Layer 240 manages and coordinates connections between different applications

interacting with the network and its data. The sixth layer is a Presentation Layer 250. The Presentation Layer 250 is primarily responsible for the accurate interpretation and display of incoming and outgoing data. Finally, the seventh layer is an Application Layer 260. The Application Layer 260 is responsible to provide support for end user processes (e.g., address issues of quality of service).

FIG. 3 schematically illustrates a prior art frame format 300 for IEEE 802.11e Quality of Service (QoS) data. Each single QoS data frame carries a Traffic Identifier (TID) value that identifies the priority of the frame for prioritized QoS or the corresponding traffic stream for parameterized QoS. To carry such information, the IEEE 802.11e QoS data frame header includes a two (2) octet QoS control field 310. The QoS control field 310 uses four (4) bits to indicate the TID value and also carries some other QoS related information. Typically, two types of QoS action management frames are defined to set up, modify, and delete traffic streams. The first type includes Add TS Request and Response QoS action frames setting up and/or modifying a QoS stream. The second type includes Delete TS Request and Response QoS action frames for deleting a QoS stream. Each QoS action management frame indicates the Traffic specification (TSPEC) information element to communicate the corresponding QoS requirements and traffic specifications.

An illustrative prior art frame format for a Traffic Specification (TSPEC) Element is schematically shown in FIG. 4. The TSPEC Element 400 contains the set of parameters that define the characteristics and QoS expectations of a unidirectional traffic stream, in the context of a particular

wireless station (WSTA), for use by a Hybrid Coordinator (HC) and wireless stations (WSTAs), in support of a parameterized QoS traffic transfer. The conventional TSPEC Element information field includes the items shown in FIG. 4. The TSPEC Element 400 allows a set of parameters more extensive than may be needed, or may be available, for any particular instance of parameterized QoS traffic. The fields are set to zero (0) for any unspecified parameter values. The recommended parameters of the TSPEC Element include: the average bit rate for packet transfer, the maximum allowed delay for packet transport, nominal packet size, packet transport prioritization, maximum packet size, maximum data burst size at peak rate, minimum phy rate, and maximum bit rate for packet transfer. The TSPEC negotiation between peer MAC Layers provides a mechanism for controlling admission, establishment, adjustment and removal of traffic streams. This traffic stream admission becomes important when there is limited bandwidth available in a wireless medium in order to minimize traffic congestion, which can cause established QoS to be broken and significant degradation in overall throughput.

Turning now to FIG. 5, an exemplary prior art architecture 500 of a Quality of Service (QoS) wireless station (QSTA) is illustratively shown. As shown, a Station Management Entity (SME) 502 extends from the Application Layer 260 to the Physical Layer 200. The Physical Layer 200, as shown, is represented by Physical Layer Convergence Protocol (PLCP) 504 and Physical Layer Management Entity (PLME) 506. A Media Access Control Layer (MAC Layer) 508 is located above the Physical Layer Convergence Protocol (PLCP) 504 and a MAC Layer Management Entity

(MLME) 510 is located above the Physical Layer Management Entity (PLME) 506. The MLME 510, as shown, includes a Bandwidth Manager (BM) 512 and a Scheduling Entity (SE) 514. A Designated Subnet Bandwidth Manager (DSBM) 516 is located above the MLME 510. The DSBM 516 is capable of communicating with a Logical Link Control Layer (LLC Layer) 518, the MLME 510, and the SME 502. The LLC Layer 518, as shown, is located above MAC Layer 508. The LLC Layer 518 includes a Classification Entity (CE) 520 and a Flow Control (FC) 522. Any of a variety of Intermediate Layers 524 may be located above the LLC Layer 518. An Application Layer 526, in turn, is located above the Intermediate Layers 524. The MAC Layer 508, as shown, includes a Hybrid Coordination Function (HCF) 528. The Hybrid Coordination Function (HCF) 528 has a Hybrid Coordinator (HC) 530. The MAC Layer 508 also includes an Enhanced Distributed Coordination Function (EDCF) 532. The HCF 528 and the EDCF 532 are typically located in the QAP 160.

The EDCF 532 is based on a listen-before-talk protocol called Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) where a frame can be transmitted after listening to the channel for a random amount of time. Conventionally, the CSMA/CA provides differentiated channel access to frames of different priorities as labeled by a higher layer. Due to the nature of the distributed contention based channel access along with the uncertainty of the wireless medium, the EDCF 532 cannot guarantee any rigid QoS. For example, in the transmission of layered video data over unreliable wireless channels, when the capacity of the wireless medium drops below the minimum bitrate of compressed data

some data packets will be lost or dropped and the QoS thereby compromised. That is, the signaling accomplished via the TSPEC, which allows for the transmission of variable bitrate (VBR) video, does not take into account when to de-admit an application, when the wireless network, due to errors, is unable to honor the negotiated QoS. Thus, if even one data packet is lost, the TSPEC signaling is unable to determine whether or not the application should be de-admitted. Consequently, some of the scheduler (e.g., the SE 514) and MAC layers (e.g., the MAC Layer 508) will not be fully defined when data packets are lost and/or when the requisite QoS is not provided. This means that different applications will operate in an unpredictable manner.

The system and method according to a beneficial feature of the present invention provides a mechanism to use the TSPEC with a flow control algorithm to accomplish flexibility in the presence of time varying channels and to make use of the layered video representation to improve overall picture quality. For example, with reference to FIG. 6, an exemplary flow control algorithm 600 is illustratively shown in which an image/video encoder 602 suitable to receive and encode video data 604 into a video bitstream, and more preferably, a multi-layer variable rate digital video bitstream with frames 606 having a predefined number of Base Layer (BL) packets 608 and a predefined number of Enhancement Layer (EL) packets 610. The BL packets 608 preferably contain data that is critical for decoding and the EL packets 610 preferably contain data that improves that quality of the video.

As shown, the packets 608, 610 for each frame 606 are transmitted before those of a following frame. Additionally, as the packets 608, 610 for each frame 606 must arrive at a receiver/decoder within a predetermined time frame (i.e., a frame decoding time) in order to qualify for decoding and as the number of packets 608, 610 that can be transmitted depends, at least in part, on variable channel conditions, for each frame 606 the BL packets 608 are preferably transmitted before the EL packets 610 so that the critical BL packets 608 are more likely to arrive within the predetermined time frame and the communication channel thereby maintained.

The data stream, once encoded, is transmitted to a Flow Control (FC) Layer 612 whereby one or more packets of a video frame may be dropped as needed depending upon the state of the wireless medium (e.g., congested or not congested) so as to preserve the connection. For example, as shown, the FC layer 612 preferably drops one or more EL packets 610 when the wireless network becomes overly congested. This may be determined in any of a variety of different ways including, for instance, setting a predetermined EL and/or BL Layer buffer occupancy value (i.e., a value suitable to ensure effective communication in unreliable wireless networks). Thus, if the predetermined buffer occupancy value is exceeded, one or more EL Layers are dropped as needed to stay connected. Alternatively, the EL packet 610 can be transmitted within a predefined delay from the BL packet 608. The predefined delay is preferably less than an overall end-to-end delay so as to ensure that if the

EL packet 610 is transmitted it is guaranteed to be received by the receiver/decoder within the predetermined time frame for decoding.

The FC Layer 612 sends the BL packets 608 and any remaining EL packets 610 to a scheduler (SE) 614, which preferably schedules the packets 608, 610 for transmission to a MAC Layer Management Entity (MLME) 616. Since the SE 614 schedules/transmits a fewer number of packets depending on communication channel conditions, the scheduler preferably need not drop any packets and/or determine whether or not to de-admit an application irrespective of communication channel conditions. The MLME 616, as shown, preferably operates as a TSPEC interface whereby a TSPEC with modified minimum bitrate 618 can preferably be transmitted over the air.

Having identified and described various aspects and/or features of the present invention, it will be understood that the above described embodiment as well as the various aspects and features thereof are merely exemplary and that a person skilled in the art may make many variations and/or modifications without departing from the spirit and scope of the present invention. All such variations and modifications are intended to be included within the scope of the invention as defined in the appended claims.

WHAT IS CLAIMED IS:

1. A signaling method for the transmission of layered video over Quality of Service (QoS) enabled wireless local area networks (WLANs) comprising the steps of: providing a multi-layer variable rate (VR) video stream with base layer (BL) packets (608) and enhancement layer (EL) packets (610); and utilizing a flow control (612) to drop one or more EL packets (610) when a wireless network becomes congested.

2. The method of claim 1, further comprising the steps of: providing a scheduler (614); and utilizing said scheduler (614) to schedule the BL packets (608) and remaining EL packets (610) for transmission.

3. The method of claim 1, wherein said flow control (612) determines when to drop one or more EL packets (610).

4. The method of claim 3, wherein said flow control operates to drop one or more EL packets (610) when a predetermined buffer occupancy of either or both the BL packets (608) and the EL packets (610) exceeds a predefined value.

5. The method of claim 3, wherein said flow control (612) operates to drop one or more EL packets (610) when such EL packets (610) fail to be transmitted within a predefined time period.

6. The method of claim 5, wherein said predefined time period is measured from the time a BL packet (608) is sent.

7. The method of claim 6, wherein said predefined time period is less than a predefined end-to-end frame delay for a frame (606) to be available for decoding.

8. A system comprising: an encoder (602) suitable to receive and encode video data into a video bitstream having frames (606) of a predefined number of base layer (BL) packets (608) and a predefined number of enhancement layer (EL) packets (610), a flow control layer (612) whereby one or more of said enhancement layer EL packets (610) associated with said video stream may be dropped as needed depending upon the state of a wireless medium, and a scheduler (SE) (614) for scheduling said packets (608, 610).

9. The system of claim 8, wherein said video stream is a multi-layer variable rate digital video bitstream.

10. The system of claim 8, wherein said encoded video stream is transmitted from said encoder (602) to said flow control layer (612) via a wireless transmitter.

11. The system of claim 8, wherein said flow control layer (612) drops said one or more enhancement layer EL packets (610) when said wireless medium becomes congested.

12. The system of claim 8, wherein said base layer BL packets (608) and any remaining enhancement layer EL packets (610) are sent from said flow control layer (612) to said scheduler SE (614).

13. The system of claim 8, wherein said scheduler SE (614) schedules and transmits said predefined number of base layer BL packets (608) and fewer than said predefined number of enhancement layer EL packets (610) to a MAC layer management entity (MLME) (616).

14. The system of claim 13, wherein said MAC layer management entity MLME (616) operates as a TSPEC interface whereby a TSPEC with a modified minimum bitrate can be transmitted over the air.

15. A method for transmitting layered video over quality of service (QoS) enabled wireless local area networks (WLANs) comprising the steps of:

generating a multilayered variable rate video bitstream with video frames (606) having one or more base layer BL packets (608) and one or more enhancement layer (EL) packets (610);

transmitting said multilayered variable rate video bitstream to a flow control layer (612); and

utilizing said flow control layer (612) to modify said multilayered variable rate video bitstream by dropping at least one of said one or more enhancement layer EL packets (610) when the wireless network is congested.

16. The method of claim 15, further comprising the step of transmitting said modified multilayered variable rate video bitstream to a scheduler (SE) (614) for scheduling said base layer BL packets (608) and any remaining enhancement layer EL packets (610).

17. The method of claim 16, further comprising the step of sending said scheduled packets to a MAC layer management entity (MLME) (616) for transmission over the air.

18. The method of claim 17, wherein said MAC layer management entity MLME (616) operates as a TSPEC interface whereby a TSPEC with a modified minimum bitrate can be transmitted over the air.

19. The method of claim 15, wherein said multilayered variable rate video bitstream has a reduced minimum bitrate field to maintain a communication channel over an unreliable WLAN.

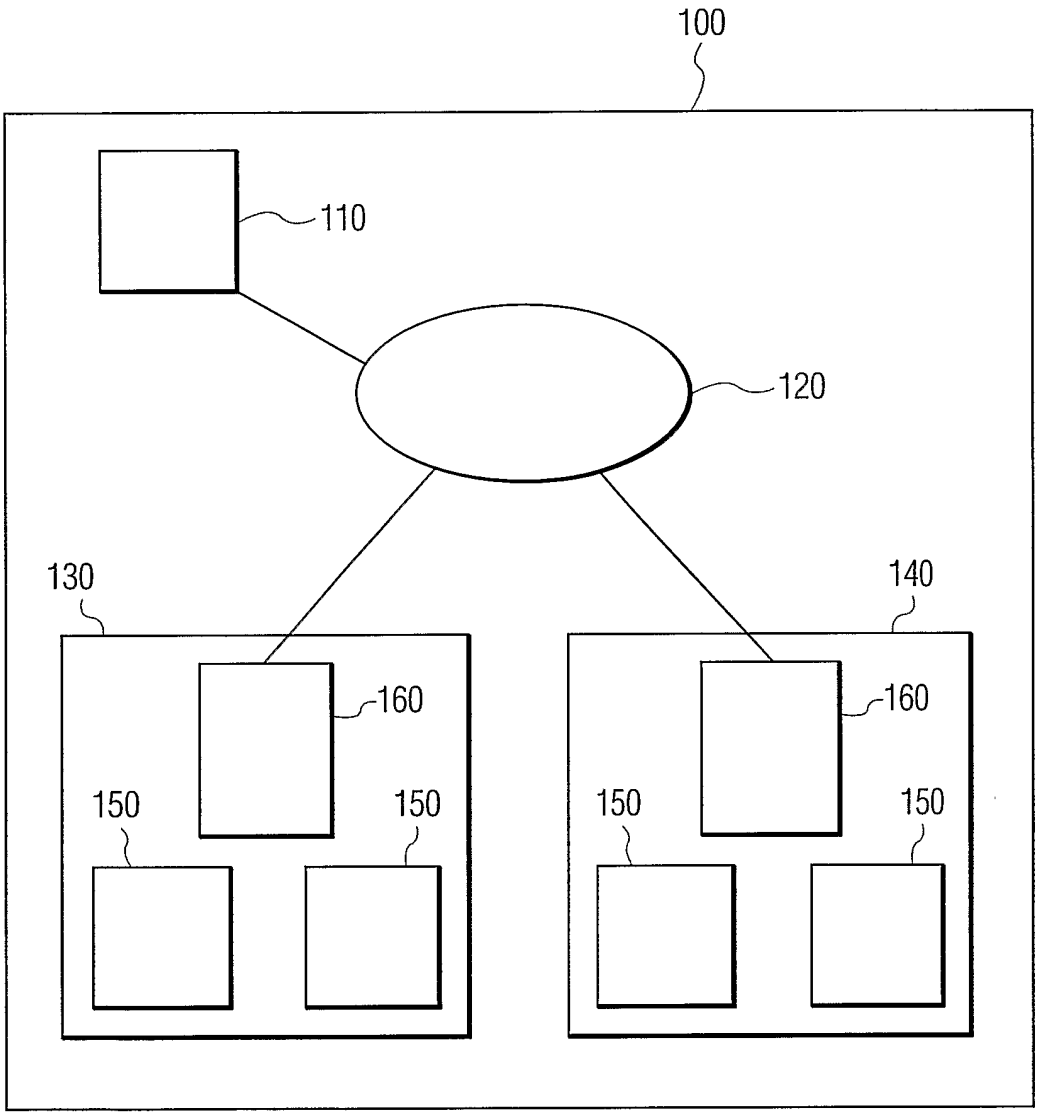

FIG. 1
PRIOR ART

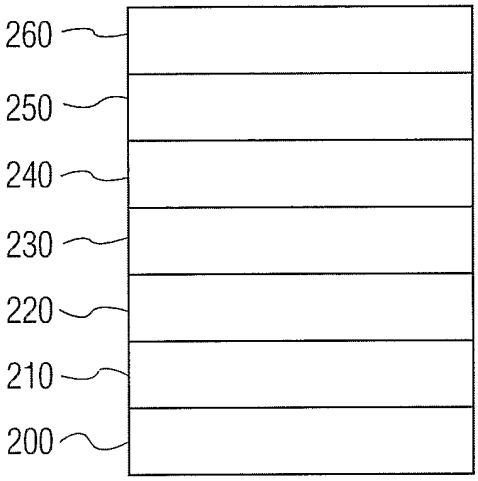

FIG. 2
PRIOR ART

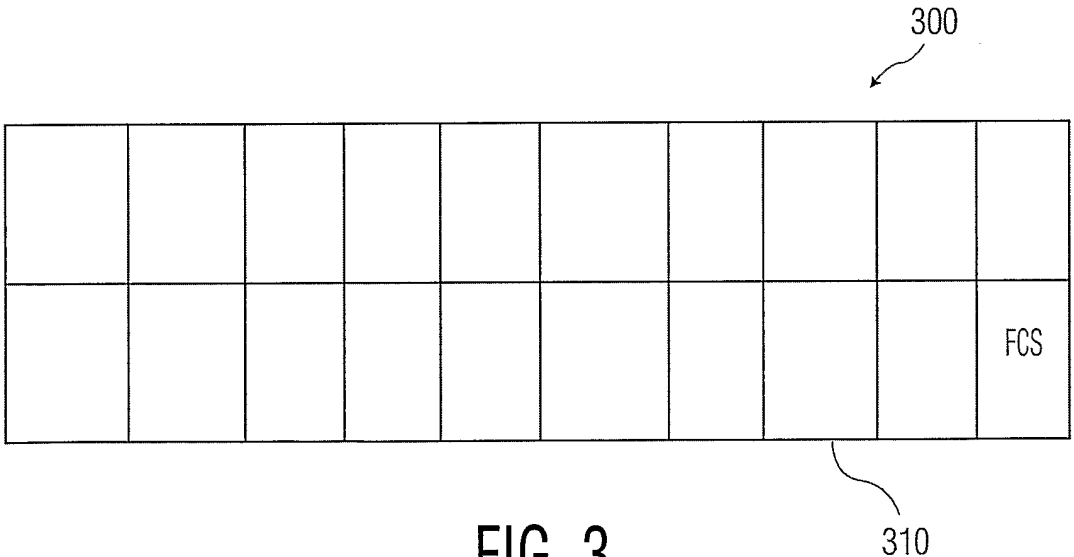

FIG. 3
PRIOR ART

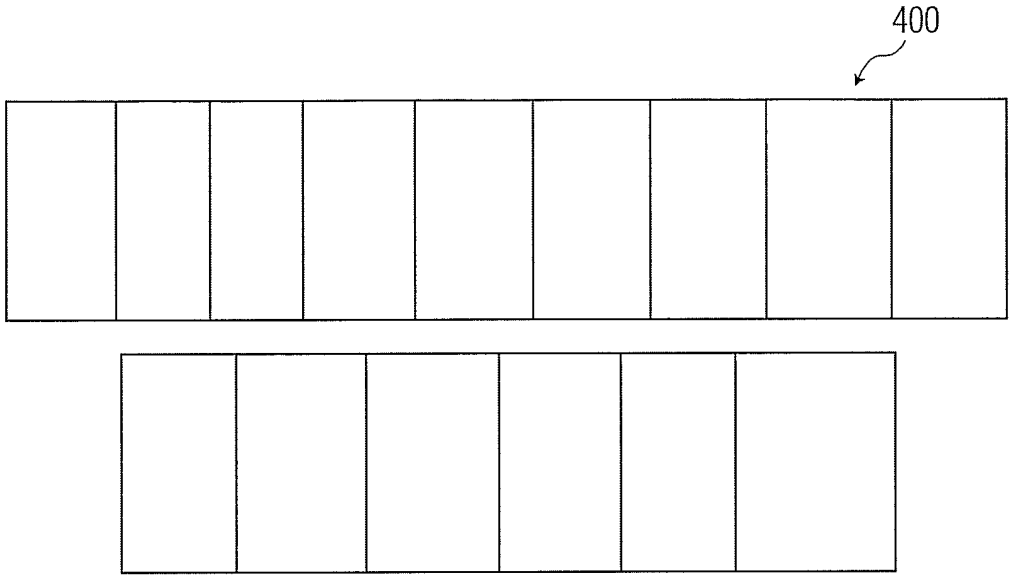

FIG. 4
PRIOR ART

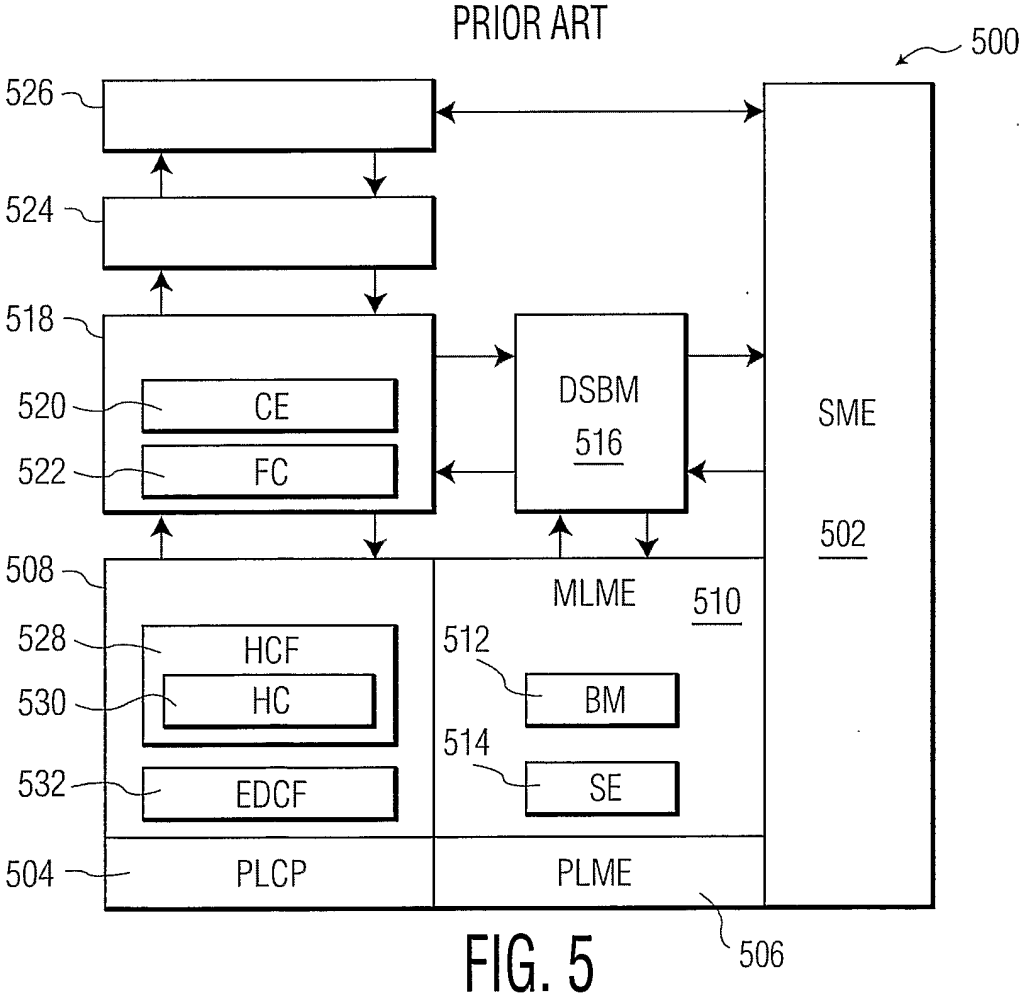

FIG. 5
PRIOR ART

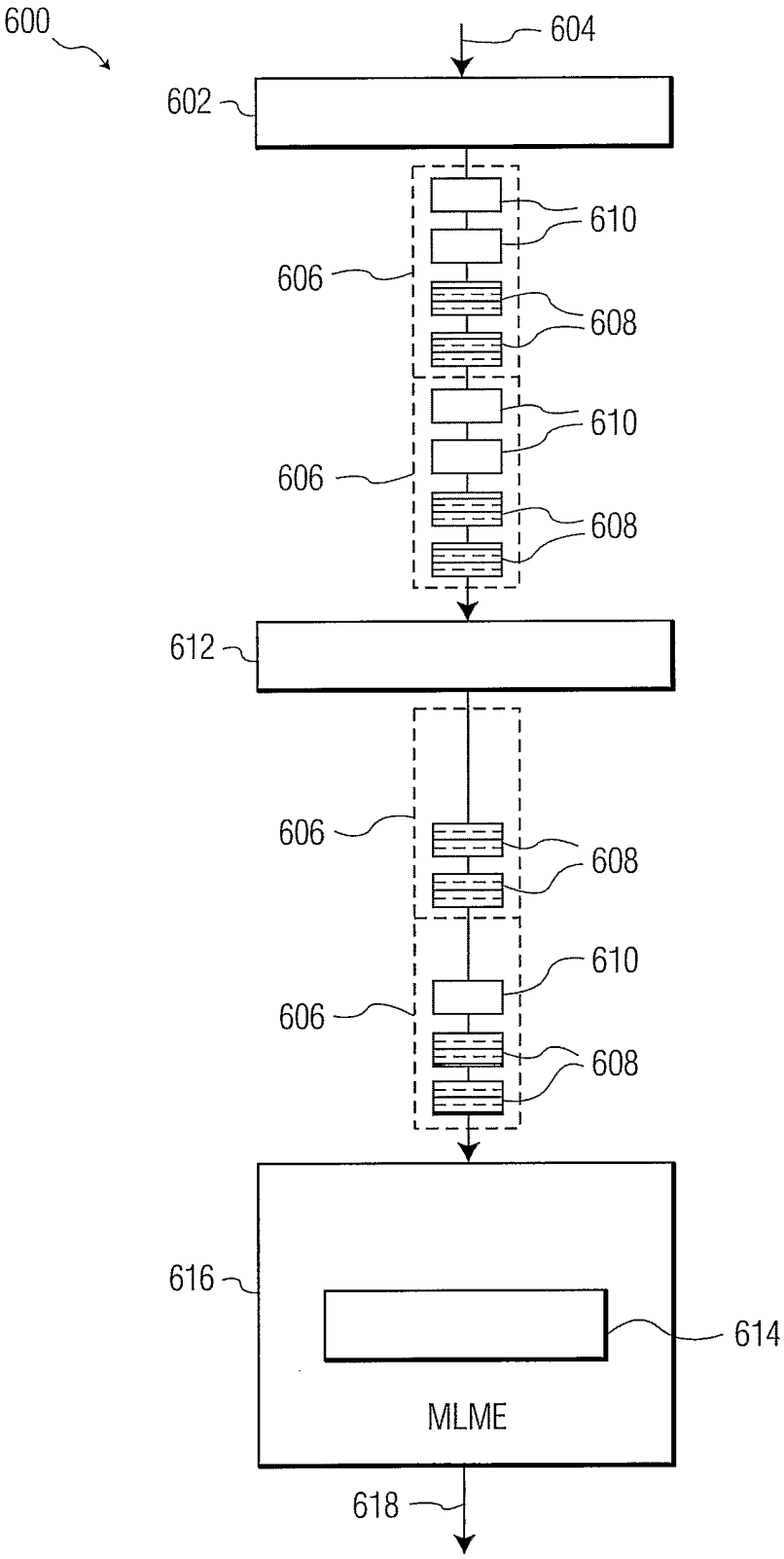
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FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB2005/053619

A. CLASSIFICATION OF SUBJECT MATTER
H04L12/28

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)
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	WO 2004/010250 A (KONINKLIJKE PHILIPS ELECTRONICS N.V; RUIZ, CARLOS; CHEN, YINGWEI; YE,) 29 January 2004 (2004-01-29)	1-3, 5-13, 15-17
Y	page 1, line 3 - line 18	4
A	page 3, line 17 - page 4, line 6 page 4, line 26 - page 6, line 12 page 7, line 7 - line 11 page 8, line 26 - page 9, line 2 page 14, line 26 - page 19, line 15	14,18,19

-/--

[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

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Date of the actual completion of the international search	Date of mailing of the international search report
23 January 2006	30/01/2006

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB2005/053619

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	RAMANUJAN R ET AL: "Traffic control mechanism to support video multicast over IP networks" MULTIMEDIA COMPUTING AND SYSTEMS '97. PROCEEDINGS., IEEE INTERNATIONAL CONFERENCE ON OTTAWA, ONT., CANADA 3-6 JUNE 1997, LOS ALAMITOS, CA, USA,IEEE COMPUT. SOC, US, 3 June 1997 (1997-06-03), pages 85-94, XP010239176 ISBN: 0-8186-7819-4	8-13
Y	page 86 pages 90-92	4
A	YIHAN LI ET AL: "The Case for Multipath Multimedia Transport over Wireless Ad Hoc Networks" BROADBAND NETWORKS, 2004. FIRST INTERNATIONAL CONFERENCE ON SAN JOSE, CA, USA 25-29 OCT. 2004, PISCATAWAY, NJ, USA,IEEE, 25 October 2004 (2004-10-25), pages 486-495, XP010750329 ISBN: 0-7695-2221-1 page 7	1-19
A	US 2004/047351 A1 (DEL PRADO PAVON JAVIER ET AL) 11 March 2004 (2004-03-11) paragraph '0006! - paragraph '0010! paragraph '0034! - paragraph '0042!; figures 1-3 paragraph '0048! - paragraph '0049!; figure 5	1-19
A	IEEE: "802.11e: Medium Access Control Enhancements for Quality of Service" IEEE P802.11E/D8.0, XX, XX, vol. 8.0.0, February 2004 (2004-02), pages 1-180, XP002283881 page 2 - page 4 page 6 - page 8 page 14 - page 15 page 164 - page 165	1-19

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IB2005/053619

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2004010250 A	29-01-2004	AU 2003254004 A1	09-02-2004
		EP 1552658 A2	13-07-2005
US 2004047351 A1	11-03-2004	AU 2003255938 A1	30-04-2004
		CN 1682493 A	12-10-2005
		EP 1540968 A2	15-06-2005
		WO 2004025972 A2	25-03-2004
		JP 2005538665 T	15-12-2005