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(54) RECLASSIFICATION AND PRIORITY QUEUE CONTROL

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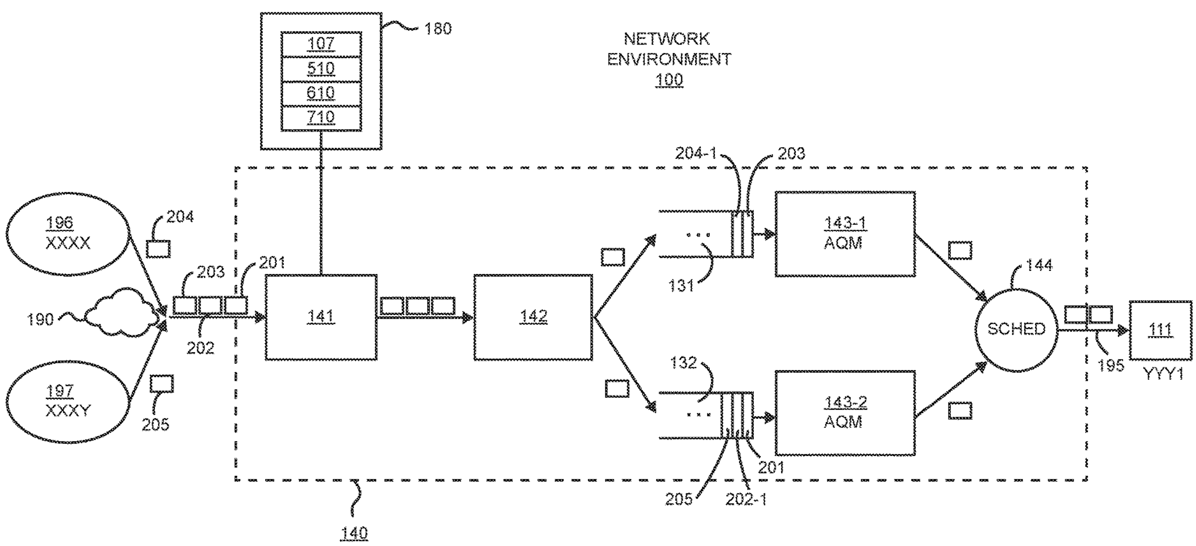
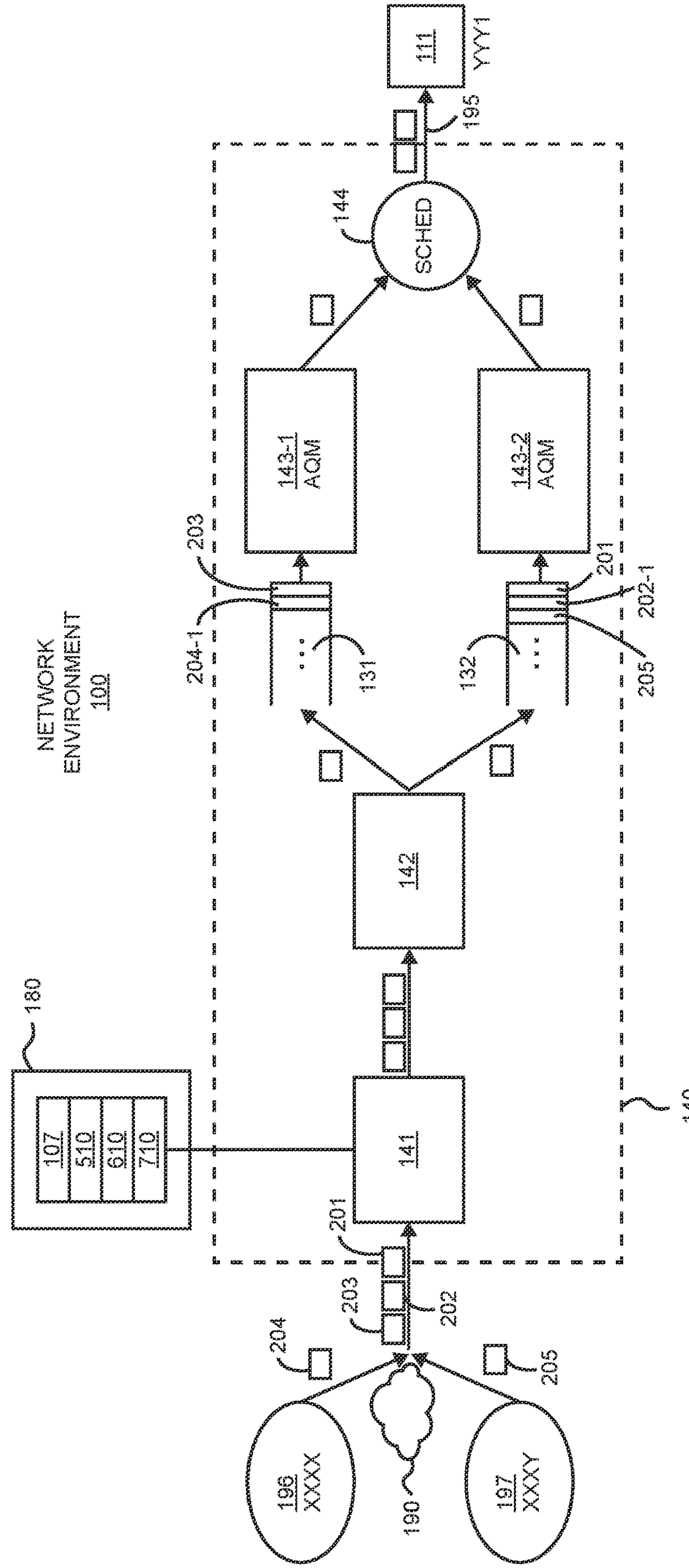
(57) **ABSTRACT**

A system as discussed herein includes communication management hardware. The communication management hardware: receives a first data packet including a first data payload, the first data packet transmitted for delivery to a destination network address; determines a first latency classification assigned to the first data packet; assigns a second latency classification to the first data packet as a substitute to the first latency classification; and forwards the first data packet for delivery to the destination network address in accordance with the second latency classification.





NETWORK ENVIRONMENT 100
180
107
510
610
710
141
142
143-1 AQM
143-2 AQM
SCHED
144
195
111
YYY1
203
204-1
131
201
202-1
205
132
140
201
203
202
204
205
196 XXXX
190
197 XXXY

FIG. 1

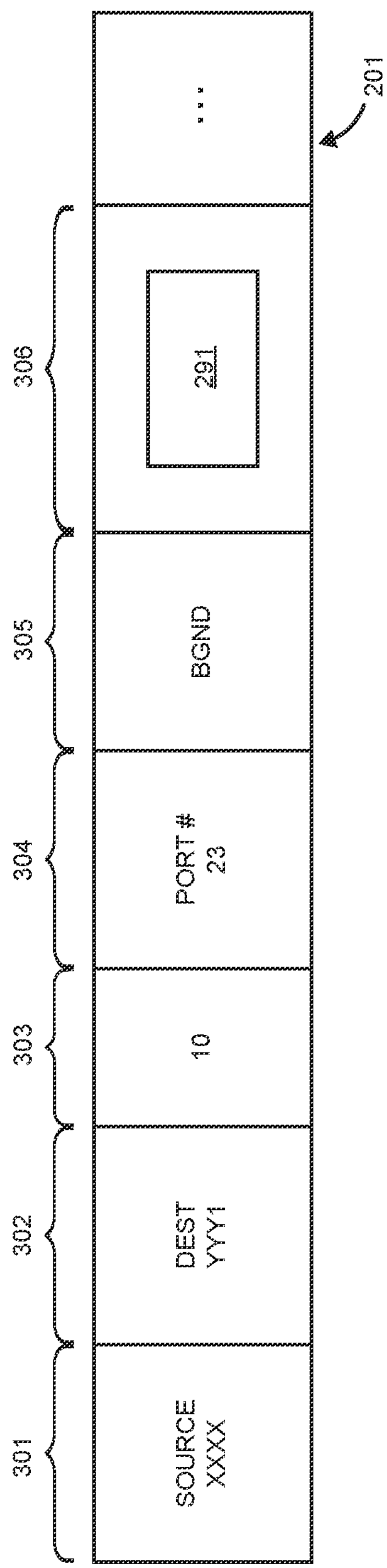

201
...
291
306
BGND
305
PORT #
23
304
10
303
DEST
YYY1
302
SOURCE
XXXX
301

FIG. 2

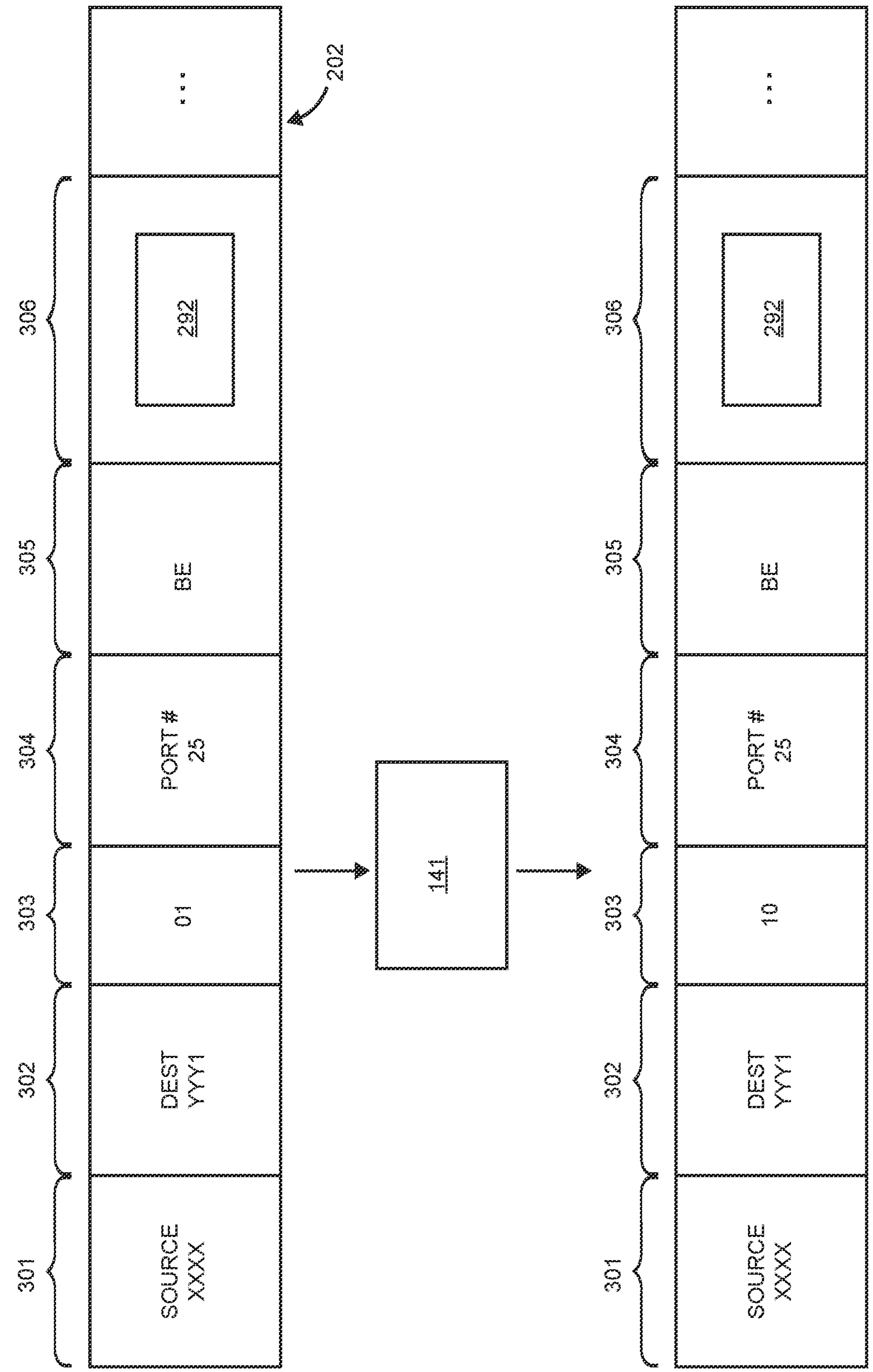
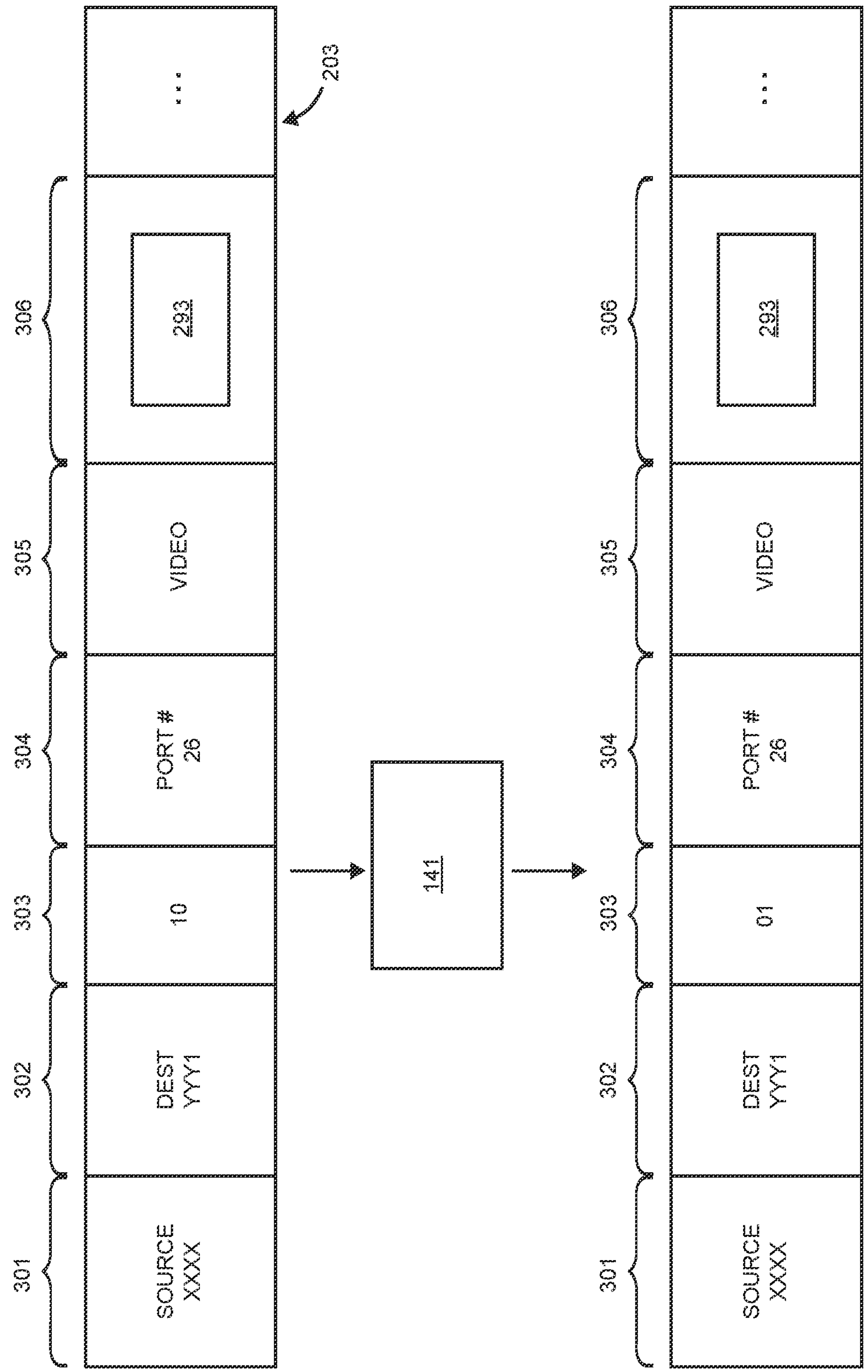

202
301
302
303
304
305
306
SOURCE XXXX
DEST YYY1
01
PORT # 25
BE
292
...
141
202-1
SOURCE XXXX
DEST YYY1
10
PORT # 25
BE
292
...

FIG. 3



203
301
302
303
304
305
306
SOURCE XXXX
DEST YYY1
10
PORT # 26
VIDEO
293
...
141
203-1
01

FIG. 4

TAG VALUE	CODE NAME	DESCRIPTION
00	NON -ECT	NON ECN-CAPABLE TRANSPORT
01	ECT(1) LL	L45-CAPABLE TRANSPORT
10	ECT(0) HL	ECN-CAPABLE TRANSPORT
11	CE	CONGESTION EXPERIENCED

510

FIG. 5

610

PORT #	LATENCY LEVEL
⋮	⋮
21	LL
23	HL
25	HL
26	LL
27	HL
⋮	⋮

FIG. 6

DATA TYPE	LATENCY ASSIGNMENT
VIDEO	LL
BGND	HL
AUDIO/VOICE	LL
BEST EFFORTS	HL
⋮	⋮

710

FIG. 7

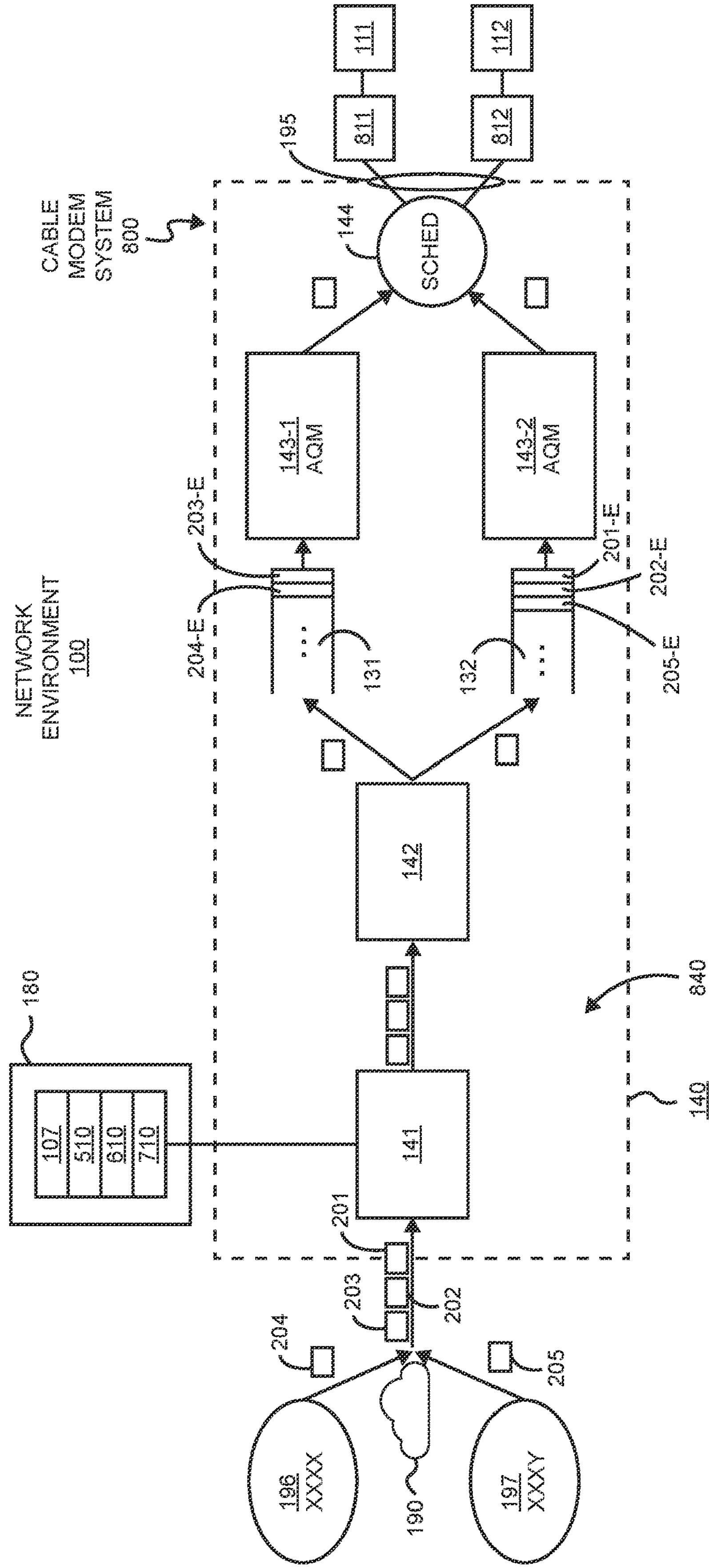

NETWORK ENVIRONMENT 100
CABLE MODEM SYSTEM 800
180
107
510
610
710
141
142
143-1 AQM
143-2 AQM
144
SCHED
195
811
812
111
112
131
132
201-E
202-E
203-E
204-E
205-E
840
140
201
202
203
204
205
190
196 XXXX
197 XXXY

FIG. 8

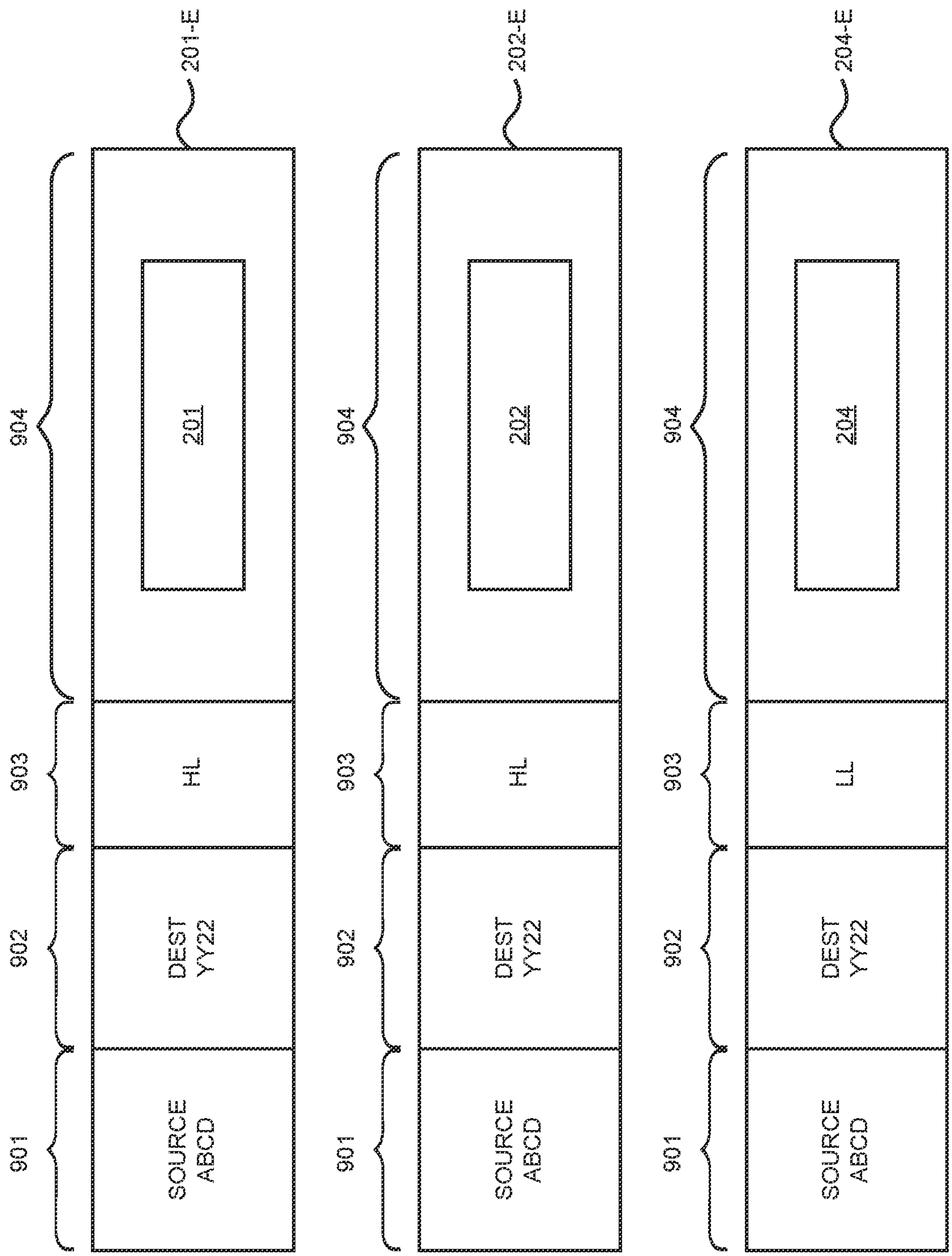

201-E
202-E
204-E
901
902
903
904
SOURCE ABCD
DEST YY22
HL
HL
LL
201
202
204

FIG. 9

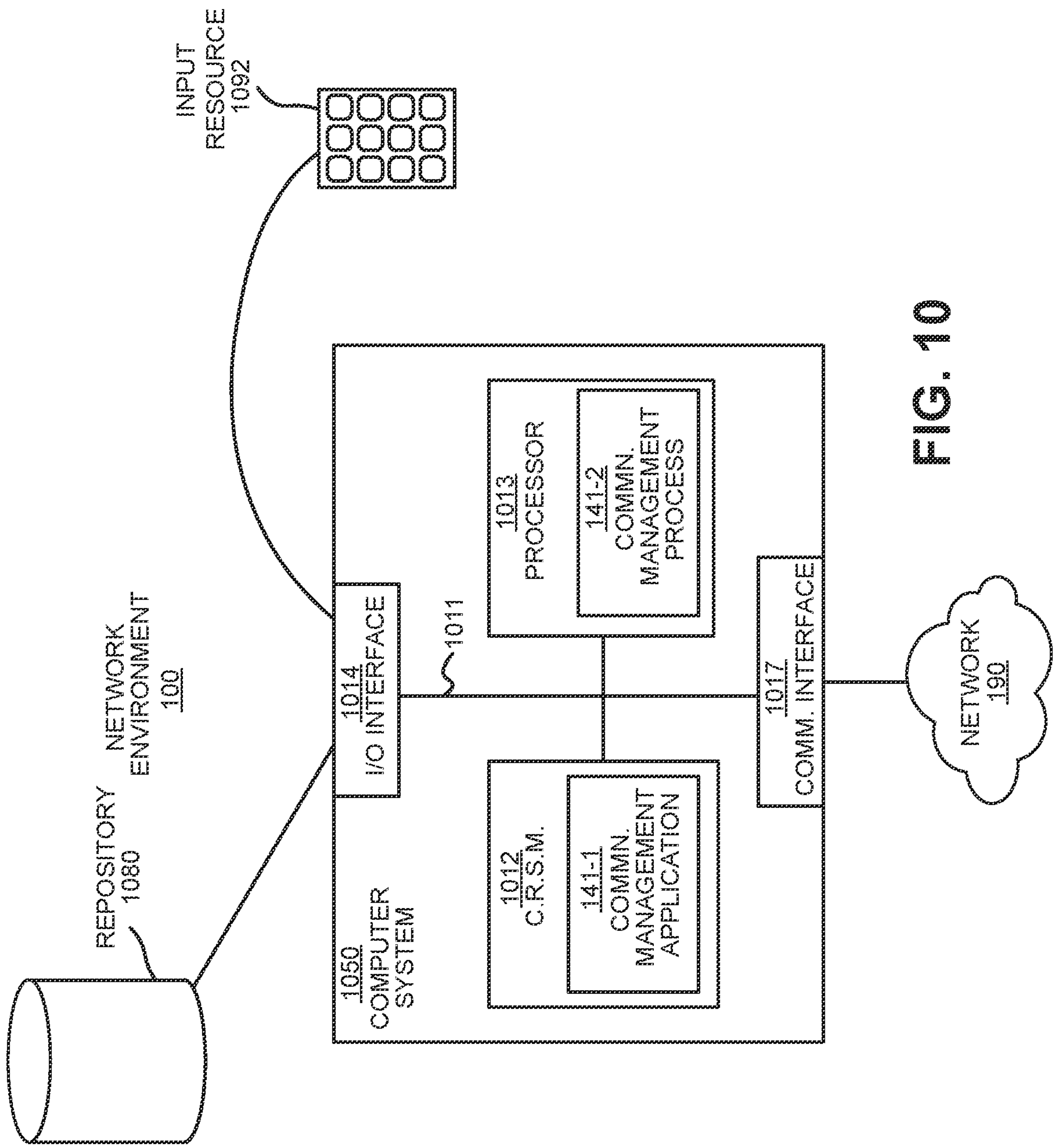

INPUT RESOURCE 1092
NETWORK ENVIRONMENT 100
REPOSITORY 1080
1014 I/O INTERFACE
1011
1013 PROCESSOR
141-2 COMMN. MANAGEMENT PROCESS
1050 COMPUTER SYSTEM
1012 C.R.S.M.
141-1 COMMN. MANAGEMENT APPLICATION
1017 COMM. INTERFACE
NETWORK 190

FIG. 10

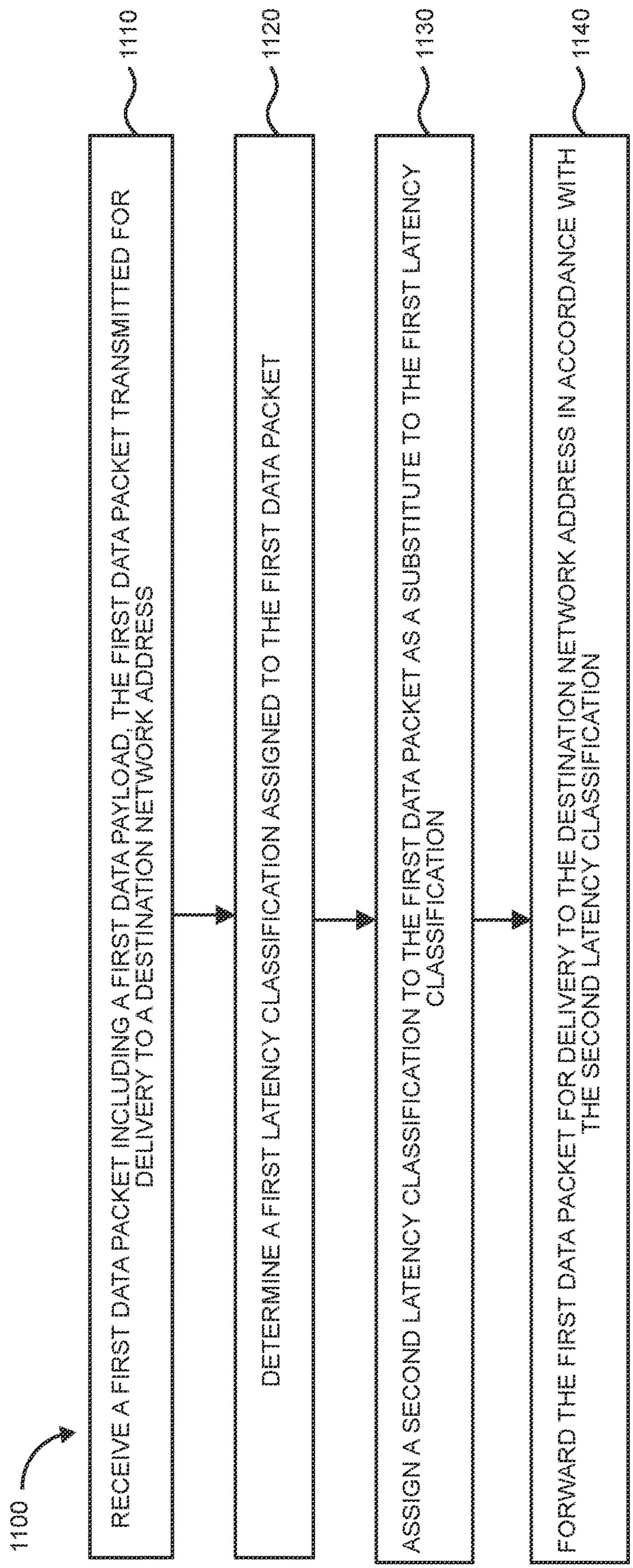

1100
RECEIVE A FIRST DATA PACKET INCLUDING A FIRST DATA PAYLOAD, THE FIRST DATA PACKET TRANSMITTED FOR DELIVERY TO A DESTINATION NETWORK ADDRESS
1110
DETERMINE A FIRST LATENCY CLASSIFICATION ASSIGNED TO THE FIRST DATA PACKET
1120
ASSIGN A SECOND LATENCY CLASSIFICATION TO THE FIRST DATA PACKET AS A SUBSTITUTE TO THE FIRST LATENCY CLASSIFICATION
1130
FORWARD THE FIRST DATA PACKET FOR DELIVERY TO THE DESTINATION NETWORK ADDRESS IN ACCORDANCE WITH THE SECOND LATENCY CLASSIFICATION
1140

FIG. 11

RECLASSIFICATION AND PRIORITY QUEUE CONTROL

BACKGROUND

[0001] L4S, or Low Latency, Low Loss, Scalable throughput, and Secure communication, is a conventional approach to managing Internet traffic and Quality of Service (QOS) to improve communication parameters such as performance, efficiency, and security.

[0002] In general, LAS has been primarily developed to address some limitations and challenges associated with traditional networking protocols, particularly in real-time applications, such as online gaming, video conferencing, and augmented reality/virtual reality (AR/VR) applications. In other words, one goal of conventional LAS data packet marking and forwarding is to reduce the amount of time that respective data packets wait in a queue before being transmitted to a corresponding destination.

BRIEF DESCRIPTION

[0003] One downside of LAS is the temptation by a sender to request LAS handling for all types of traffic, which, in reality, can adversely impact the user experience of applications with varying sensitivity levels. Specifically, low-sensitive applications such as AR/VR and online gaming would suffer, as would queue-dependent applications like file downloads in a case of misuse. Presently, no effective mechanism exists for Internet Service Providers (ISPs) to designate which traffic should be designated as LAS and which should not.

[0004] To address the shortcomings of conventional techniques, a communication management resource as discussed herein can be configured to provide adjustments to the quality of service or, more specifically, latency as discussed herein of handling data packets. For example, the communication management resource can be configured to receive a first data packet including a first data payload, the first data packet transmitted for delivery to a destination network address of a corresponding communication device. The communication management resource determines a first latency classification assigned to the first data packet in any suitable manner. As a substitute to the first latency classification, the communication management resource assigns a second latency classification to the first data packet. In accordance with the second latency classification, the communication management resource then forwards the first data packet for delivery to the destination network address.

[0005] In accordance with further examples as discussed herein, the communication management resource can be configured to analyze one or more aspects of the first data packet. The communication management resource then selects the second latency classification as the substitute to the first latency classification based on the analysis of the first data packet. In one example, the communication management resource replaces the first tag value in the first data packet with a second tag value; the first tag value indicates the first latency classification; the second tag value indicates the second latency classification. The substitution of the first latency classification with the second latency classification changes latency handling of the corresponding first data packet.

[0006] Yet further, note that the first latency classification supports a first latency (i.e., the delay time of storing the first data packet before transmitting) of communicating the first data packet to the destination network address; the second latency classification supports a second latency of communicating the first data packet to the destination network address. The second latency may be less than the first latency. In such an instance, the operation of switching the latency assigned to the first data packet from the first latency to the second latency may decrease an amount of time it takes to communicate the respective first data packet to a recipient.

[0007] Conversely, the second latency (i.e., the delay time of storing the data packet before forwarding it) may be greater than the first latency. In such an instance, the operation of switching the latency assigned to the first data packet from the first latency to the second latency may increase the amount of time it takes to communicate the respective first data packet to a recipient.

[0008] In still further examples, forwarding of the first data packet by the communication management resource may include the communication management resource transmitting the first data packet to classifier hardware; the classifier hardware can be configured operative to store the first data packet in one of multiple queues depending upon the second latency classification assigned to the first data packet.

[0009] In accordance with further examples, assignment of the second latency classification to the data packet includes the communication management resource or other suitable entity substituting first bit information (tag value) in the first data packet with second bit information, the first bit information specifying the first latency classification, the second bit information (tag value) specifying the second latency classification.

[0010] In yet further examples as discussed herein, the communication management resource or other suitable entity can be configured to analyze first bit information in the first data packet. Assume that the first bit information specifies information such as a port number associated with the delivery of the first data packet to the destination network address. The port number indicating a particular type of data in the first data payload, the particular type assigned the second latency classification.

[0011] In still further examples, determination of the first latency classification assigned to the first data packet includes the communication management resource or other suitable entity inspecting a data field of the first data packet, the data field including bit information specifying the first latency classification.

[0012] Yet further, to support forwarding of the first data packet for delivery to the destination network address in accordance with the second latency classification, the communication management resource can be configured to store the first data packet in a second data delivery queue instead of a first data delivery queue. The second data delivery queue provides a different latency of storing the first data packet that the first data delivery queue. In one example, the first data delivery queue is configured to store first data packets assigned the first latency classification; the second data delivery queue is configured to store second data packets assigned the second latency classification.

[0013] Techniques as discussed herein are useful over conventional techniques. For example, one or more implementation of a communication management resource and corresponding operations as discussed herein provide better use of a respective wireless network to more efficiently convey data.

[0014] Note that any of the resources as discussed herein can include one or more computerized devices, mobile communication devices, sensors, servers, base stations, wireless communication equipment, communication management systems, controllers, workstations, user equipment, handheld or laptop computers, or the like to carry out and/or support any or all of the method operations disclosed herein. In other words, one or more computerized devices or processors can be programmed and/or configured to operate as explained herein to carry out the different embodiments as described herein.

[0015] Yet other embodiments herein include software programs to perform the steps and operations summarized above and disclosed in detail below. One such embodiment comprises a computer program product including a non-transitory computer-readable storage medium or any computer readable hardware storage medium on which software instructions are encoded for subsequent execution. The instructions, when executed in a computerized device (hardware) having a processor, program and/or cause the processor (hardware) to perform the operations disclosed herein. Such arrangements are typically provided as software, code, instructions, and/or other data (e.g., data structures) arranged or encoded on a non-transitory computer readable storage medium such as an optical medium (e.g., CD-ROM), floppy disk, hard disk, memory stick, memory device, etc., or other medium such as firmware in one or more ROM, RAM, PROM, etc., or as an Application Specific Integrated Circuit (ASIC), etc. The software or firmware or other such configurations can be installed onto a computerized device to cause the computerized device to perform the techniques explained herein.

[0016] Accordingly, embodiments herein are directed to a method, system, computer program product, etc., that supports operations as discussed herein.

[0017] One embodiment includes computer readable storage hardware having instructions stored thereon. The instructions, when executed by corresponding computer processor hardware, cause the computer processor hardware (such as one or more co-located or disparately processor devices or hardware) to: receive a first data packet including a first data payload, the first data packet transmitted for delivery to a destination network address; determine a first latency classification assigned to the first data packet; assign a second latency classification to the first data packet as a substitute to the first latency classification; and forward the first data packet for delivery to the destination network address in accordance with the second latency classification instead of the first latency classification.

[0018] The ordering of the steps above has been added for clarity sake. Note that any of the processing steps as discussed herein can be performed in any suitable order.

[0019] Other embodiments of the present disclosure include software programs and/or respective hardware to perform any of the method embodiment steps and operations summarized above and disclosed in detail below.

[0020] It is to be understood that the system, method, apparatus, instructions on computer readable storage media, etc., as discussed herein also can be embodied strictly as a software program, firmware, as a hybrid of software, hardware and/or firmware, or as hardware alone such as within a processor (hardware or software), or within an operating system or a within a software application.

[0021] As discussed herein, techniques herein are well suited for use in the field of controlling conveyance of data packets in a network environment. However, it should be noted that embodiments herein are not limited to use in such applications and that the techniques discussed herein are well suited for other applications as well.

[0022] Additionally, note that although each of the different features, techniques, configurations, etc., herein may be discussed in different places of this disclosure, it is intended, where suitable, that each of the concepts can optionally be executed independently of each other or in combination with each other. Accordingly, the one or more present inventions as described herein can be embodied and viewed in many different ways.

[0023] Also, note that this preliminary discussion of embodiments herein (BRIEF DESCRIPTION OF EMBODIMENTS) purposefully does not specify every embodiment and/or incrementally novel aspect of the present disclosure or claimed invention(s). Instead, this brief description only presents general embodiments and corresponding points of novelty over conventional techniques. For additional details and/or possible perspectives (permutations) of the invention(s), the reader is directed to the Detailed Description section (which is a summary of embodiments) and corresponding figures of the present disclosure as further discussed below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. **1** is an example diagram illustrating a network environment implementing data packet flow management as discussed herein.

[0025] FIG. **2** is an example diagram illustrating data packet analysis as discussed herein.

[0026] FIG. **3** is an example diagram illustrating data packet analysis and modification as discussed herein.

[0027] FIG. **4** is an example diagram illustrating data packet analysis of the modification as discussed herein.

[0028] FIG. **5** is an example diagram illustrating different data forwarding control codes as discussed herein.

[0029] FIG. **6** is an example diagram illustrating mapping of port number information associated with a data packet to latency assignment information as discussed herein.

[0030] FIG. **7** is an example diagram illustrating mapping of data packet type information to latency assignment information as discussed herein.

[0031] FIG. **8** is an example diagram illustrating implementation of a cable modem system supporting dynamic queueing and corresponding forwarding of data packets as discussed herein.

[0032] FIG. **9** is an example diagram illustrating generation of multiple encapsulated data packets forwarded in a cable modem system as discussed herein.

[0033] FIG. **10** is an example diagram illustrating example computer hardware and software operable to execute operations as discussed herein.

[0034] FIG. **11** is an example diagram illustrating a method as discussed herein.

[0035] The foregoing and other objects, features, and advantages of the invention will be apparent from the following more particular description of preferred embodiments herein, as illustrated in the accompanying drawings in which like reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale, with emphasis instead being placed upon illustrating the embodiments, principles, concepts, etc.

DETAILED DESCRIPTION

[0036] Now, more specifically, with reference to the drawings, FIG. **1** is an example diagram illustrating a network environment implementing data packet flow management as discussed herein.

[0037] As shown in FIG. **1**, the network environment **100** includes application server resource **196**, application server resource **197**, network **190**, and communication management resource **140**. The communication management resource can be configured to include any suitable resources such as the controller **141**, classifier **142**, queue **131**, queue **132**, queue management resource **143-1**, queue management resource **143-2**, and scheduling manager **144**.

[0038] Repository **180** can be configured to store any suitable information about managing and forwarding the corresponding received data packets such as model **107**, mapping information **510**, mapping information **610**, mapping information **710**, etc.

[0039] In one example, one or more instance of the mapping information **510**, mapping information **610**, mapping information **710**, etc., are stored or captured by the model **107**.

[0040] Note that the resources as discussed herein can be implemented via hardware, software, or a combination of hardware and software. For example, the communication management resource **140** can be implemented as communication management hardware, communication management software, or a combination of communication manager hardware and communication management software; the controller **141** can be implemented as controller hardware, controller software, or a combination of controller hardware and controller software; the classifier **142** can be implemented as classifier hardware, classifier software, or a combination of classifier hardware and classifier software; queue management resource **143-1** can be implemented as queue management hardware, queue management software, or a combination of queue management hardware and queue management software: queue management resource **143-2** can be implemented as queue management hardware, queue management software, or a combination of queue management hardware queue management software; scheduler **144** can be implemented as scheduler hardware, scheduler software, or a combination of scheduler hardware and scheduler software; and so on.

[0041] As further shown in this example, the application server **196** is assigned the source network address XXXX; the application server **197** is assigned the source network address XXXY.

[0042] The application server **196** generates one or more data packets for delivery over the network **190** and through the communication management resource **140** to the corresponding communication device **111** assigned the network address YYY1. The application server **197** generates one or more data packets for delivery over the network **190** to the corresponding communication device **111**.

[0043] Each of the data packets generated by the application server **196** and the application server **197** can be tagged with a respective tag value indicating a desired latency of communicating the respective data packet from the communication management resource **140** to the communication device **111** or other suitable entity. As further discussed herein, the respective tag value or latency assignment information in the respective data packet can be used as a basis in which to determine which of the multiple queues to store the respective data packet for subsequent forwarding over the shared communication link **195** (such as parts of cable, optical fiber, hybrid fiber-coax, etc.).

[0044] In one example, the queue **131** is a so-called low latency queue; the queue **132** is a so-called high latency queue. Data packets (such as including data packet **203**) in the queue **131** are transmitted over the shared communication link **195** with less latency than data packets in the queue **132**. In other words, the queue management resource **143-1** can be configured to monitor presence of data packets such as the data packet **203** stored in the queue **131**. Each data packet stored in the corresponding queue **131** can be assigned a timestamp value indicating a time in which the corresponding data packet was stored in the queue **131**. The queue management resource **143-1** and corresponding scheduler **144** ensure that each data packet stored in the queue **131** resides in the queue **131** for less than maximum latency time T1 (such as 50 milliseconds or other suitable value) such as a low latency time threshold level. Such operations of forwarding the respective data packets in the queue **131** reduce a respective latency associated with forwarding the respective data packets to the destination **111**. In other words, the schedule **144** forwards the respective data packets in the queue **131** so that they are not stored in the queue **131** longer than the maximum latency time T1.

[0045] Additionally, data packets (such as including data packet **201**, **202-1**, **205**, etc.) in the queue **132** are transmitted over the shared communication link **195** with higher latency than the data packets in the queue **131**. In other words, the queue management resource **143-1** can be configured to monitor presence of the data packets stored in the queue **132**. The queue management resource **143-21** and corresponding scheduler **144** ensure that each data packet stored in the queue **132** resides in the queue **132** for less than maximum latency time T2 (such as 500 milliseconds or other suitable value) such as a high latency time threshold level. Such operations of forwarding the respective data packets in the queue **132** reduce a respective latency associated with forwarding the respective data packets to the destination **111**. In other words, the schedule **144** forwards the respective data packets in the queue **132** so that they are not stored in the queue **132** longer than the maximum latency time T2.

[0046] In accordance with a further example, the controller **141** receives the data packet **201** from the application server **196** in response to the application server **196** transmitting the corresponding data packet **201** to the communication device **111**. In other words, the first data packet **201** is transmitted for delivery to the communication device **121** assigned the destination network address YYY1. Further in this example, the controller **141** receives and analyzes the data packet **201**. Based on the analysis, the controller **141** determines that the application server **196** generated the respective data packet **201** with a tag value indicating a second latency classification (such as indicating that data packet **201** is assigned a higher latency). Further, based on the analysis of the data in any manner as discussed herein using one or more of model **107**, mapping information **510**, mapping information **610**, mapping information **710**, etc., the controller **141** determines that the data packet **201** is properly assigned a higher latency. In such an instance, the controller **140** forwards the data packet **201** (such as unmodified) to the classifier **142**. Via inspection, the classifier **142** determines that a respective tag value in the data packet **201** indicates a high latency classification. In response to detecting this condition of data packet **201** being assigned a high latency classification, the classifier **142** stores the data packet **201** in the queue **132**.

[0047] As further shown, the controller **141** receives the data packet **202** from the application server **196** in response to the application server **196** transmitting corresponding data packet **202** to the communication device **111**. In other words, the data packet **202** is transmitted for delivery from the application server **196** to the destination network address YYY1. Further in this example, the controller **141** receives and analyzes the data packet **202**. Based on the analysis of the data packet **202**, the controller **141** determines that the data packet **202** is improperly assigned a low latency delivery classification. In such an instance, the controller **141** modifies the corresponding data packet **202** to produce the data packet **202-1** for storage in the queue **132** instead of the queue **131**. For example, the controller **141** determines that a respective tag value in the data packet **202** improperly indicates a low latency classification. In response to detecting the data packet **202** should be tagged with a high latency classification instead of low latency classification, the controller **141** modifies the data packet **202** with substitute tag value (high latency classification) to produce the data packet **202-1**. Modification of the received data packet **202** into the data packet **202-1** ensures that the classifier **142** stores the modified data packet **202-1** in the queue **132** instead of the queue **131**.

[0048] As further shown, the controller **141** receives the data packet **204** from the application server **196** in response to the application server **196** transmitting corresponding data packet **204** to the communication device **111**. In other words, the data packet **204** is transmitted for delivery from the application server **196** to the destination network address YYY1. Further in this example, the controller **141** receives and analyzes the data packet **204**. Based on the analysis of the data packet **204**, the controller **141** determines that the data packet **204** is improperly assigned a high latency delivery classification. In such an instance, the controller **141** modifies the corresponding data packet **204** to produce the data packet **204-1** for storage in the queue **131** instead of the queue **132**. More specifically, the controller **141** determines that a respective tag value in the data packet **204** improperly indicates a high latency classification. In response to detecting the data packet **204** should be tagged with a low latency classification instead of high latency classification, the controller **141** modifies the data packet **204** with substitute tag value (low latency classification) to produce the data packet **204-1**. This ensures that the classifier **142** stores the modified data packet **204-1** in the queue **131** instead of the queue **132**.

[0049] Additional details of modifying the data packets or not modifying the data packets as further discussed below.

[0050] FIG. **2** is an example diagram illustrating data packet analysis and non-modification as discussed herein.

[0051] As shown in this example, the data packet **201** generated by and communicated from the application server **196** over the network **190** to the controller **141** includes a source network address of XXXX stored in the data field **301**, destination network address YYY1 stored in the data field **302**, data bit tag value=10 stored in the data field **303**, port #23 stored in the data field **304**, data type of BGND stored in the field **305**, and data payload **291** stored in the data field **306**.

[0052] The source network address XXXX in the data field **301** indicates the corresponding identity of the application server **196** generating and transmitting the respective data packet **201** to the mobile communication device **111**.

[0053] The destination network address YYY1 in the data field **302** indicates the identity of the communication device **111** to which the data packet **201** is transmitted.

[0054] The tag value 10 (indicating L4S-capable transport) in the data field **303** indicates that the data packet **201** is assigned a higher latency classification. See FIG. **5** where mapping of the tag value bits **01** to the high latency classification.

[0055] The port #value 23 in data field **304** indicates the corresponding port of an application executed on the communication device **111** to which the data payload **291** (in data field **306**) conveyed by the data packet **201** is communicated to the communication device **111**. In one example, the port #value 23 indicates the type of data being transmitted by the data payload **291**. In other words, the port number of the application indicates the type of data in the data payload **291**.

[0056] As previously discussed, the controller **141** can be configured to analyze the data in one or more respective data fields of the data packet **201** to determine if the marking of the data packet as a high latency data packet (in data field **303**) is appropriate or correct.

[0057] The controller **141** can be configured to implement any suitable method to determine whether the marking of the data packet with a high latency assignment is correct or not. For example, as previously discussed, the controller **141** can be configured to access the map information **510** in FIG. **5** to determine that the tag value of 01 in the data field **303** indicates that the data packet **201** is assigned a high latency classification (such as destined for storage in the queue **132**).

[0058] After determining the originally assigned high latency classification assignment, if desired, the controller **141** can be configured to implement the mapping information **610** in FIG. **6** to map the port value 23 in data field **304** to the corresponding appropriate latency classification HL. Such a mapping in the mapping information **610** confirms the type of data in the data packet **291** and that the data packet **201** is properly assigned the high latency classification as indicated by the tag value 10 stored in the data field **303**.

[0059] Additionally, or alternatively, the controller **141** can be configured to implement the mapping information **710** in FIG. **7** to map the data type information (BGND) stored in the data field **305** of the data packet **201** to the corresponding appropriate latency classification HL. Recall that the data type information in the data field **305** indicates the type of data (such as low urgency data) being transmitted by the data payload **291**. Such a mapping confirms that the data packet **201** is properly assigned the high latency classification as indicated by the tag value 10 stored in the data field **303** of the data packet **201**.

[0060] Note again that the controller **141** can be configured to implement any method to determine that the data packet **201** is properly classified as a high latency classification.

[0061] In such an instance, after confirming or verifying that the data packet **201** is properly assigned the high latency classification as originally marked by the data field **303**, the controller **141** forwards the corresponding data packet **201** to the classifier **142**. The classifier **142** determines (such as from information received from the controller **141** or the information such as data field **303** stored in the data packet **201**) that the data packet **201** is assigned a high latency classification to be stored in the queue **132** supporting the high latency data packets. Thus, the classifier **142** stores the data packet **201** in the queue **132** for subsequent delivery over the shared communication link **195** by the scheduler **144**.

[0062] FIG. **3** is an example diagram illustrating data packet analysis of the modification as discussed herein.

[0063] As shown in this example, the data packet **202** generated by and communicated from the application server **196** or other suitable entity over the network **190** to the controller **141** includes a source network address of XXXX stored in the data field **301**, destination network address YYY1 stored in the data field **302**, data bit tag value=01 stored in the data field **303**, port #25 stored in the data field **304**, data type value of BEST EFFORTS (BE) stored in the data field **305**, and data payload **292** stored in the data field **306**.

[0064] The source network address XXXX in the data field **301** indicates the corresponding identity of the application server **196** generating and transmitting the respective data packet **202**.

[0065] The destination network address YYY1 in the data field **302** indicates the identity of the communication device **111** to which the data packet **202** is transmitted.

[0066] The tag value 01 in the data field **303** of data packet **202** indicates that the data packet **202** is originally assigned a lower latency classification by the application server **196**. See FIG. **5** where the tag value bits **01** map to the low latency classification.

[0067] The port #value 25 in data field **304** of data packet **202** indicates the corresponding port of an software application executed on the communication device **111** to which the data payload **292** (in data field **306** of data packet **202**) conveyed by the data packet **202** is communicated to the communication device **111**.

[0068] As previously discussed, the controller **141** can be configured to analyze the data in one or more respective data fields of the data packet **202** to determine if the marking of the data packet as a low latency data packet (in data field **303** with the value 01) is appropriate or correct.

[0069] A similar manner as previously discussed, the controller **141** can be configured to implement any suitable method to determine whether the marking of the data packet **202** is correct or not.

[0070] For example, as previously discussed, the controller **141** can be configured to access the map information **510** in FIG. **5** to determine that the tag value of 01 in the data field **303** indicates that the data packet **201** is assigned a low latency classification (such as destined for storage in the queue **131**) for low latency transmission.

[0071] After determination of the original low latency classification assignment, if desired, the controller **141** can be configured to implement the mapping information **610** in FIG. **6** to map the port value 25 in data field **304** to the corresponding appropriate high latency classification HL. Such a mapping confirms that the data packet **202** is improperly assigned the low latency classification as indicated by the tag value 01 stored in the data field **303**.

[0072] Additionally, or alternatively, note that the controller **141** can be configured to implement the mapping information **710** in FIG. **7** to map the data type information (BEST EFFORTS) stored in the data field **305** of the data packet **202** to the corresponding appropriate high latency classification HL. Recall that the data type information in the data field **305** indicates the type of data being transmitted by the data payload **291**. Such a mapping confirms that the data packet **202** is improperly assigned the low latency classification as indicated by the tag value 01 stored in the data field **303**.

[0073] Note again that the controller **141** can be configured to further implement any method to determine that the data packet **202** is properly classified as a high or low latency classification.

[0074] Rather than forwarding the data packet **202** to the classifier **142** for storage in the queue **132**, the controller **141** modifies the data packet **202** to produce the data packet **202-1**. In one example, modification of the data packet **202** includes changing the value in the data field **303** from the value 01 to the value 10, to indicate that the data packet **202-1** is assigned the high latency classification for storage in the queue **132**.

[0075] In such an instance, after modifying the data packet **202**, the controller **141** forwards the corresponding data packet **202-1** to the classifier **142**. The classifier **142** determines (such as from information received from the controller **141** or the information such as data field **303** stored in the data packet **202-1**) that the data packet **202-1** is to be stored in the queue **132** supporting the high latency data packets. Thus, the classifier **142** stores the data packet **202-1** in the queue **132** for subsequent delivery over the shared communication link by the scheduler **144**. In this manner, the data packet **202** originally destined for storage in the queue **131** is instead stored in the queue **132**.

[0076] FIG. **4** is an example diagram illustrating different data forwarding control codes as discussed herein.

[0077] As shown in this example, the data packet **203** generated by and communicated from the application server **196** or other suitable entity over the network **190** to the controller **141** includes a source network address of XXXX stored in the data field **301**, destination network address YYY1 stored in the data field **302**, data bit tag value=10 stored in the data field **303**, port #26 stored in the data field **304**, data type of VIDEO stored in the data field **305**, and data payload **293** stored in the data field **306**.

[0078] The source network address XXXX in the data field **301** indicates the corresponding identity of the application server **196** generating and transmitting the respective data packet **203**.

[0079] The destination network address YYY1 in the data field **302** indicates the identity of the communication device **111** to which the data packet **203** is transmitted.

[0080] The tag value 10 in the data field **303** of data packet **203** indicates that the data packet **203** is originally assigned a lower latency classification by the application server **196**. See FIG. **5** where the tag value bits **10** map to the high latency classification.

[0081] The port #value 26 in data field **304** of data packet **203** indicates the corresponding port of an application executed on the communication device **111** to which the data payload **293** (in data field **306** of data packet **203**) conveyed by the data packet **203** is communicated to the communication device **111**.

[0082] As previously discussed, the controller **141** can be configured to analyze the data in one or more respective data fields of the data packet **203** to determine if the marking of the data packet as a high latency data packet (in data field **303** with the value 10) is appropriate or correct.

[0083] A similar manner as previously discussed, the controller **141** can be configured to implement any suitable method to determine whether the marking of the data packet **203** is correct or not.

[0084] For example, as previously discussed, the controller **141** can be configured to access the map information **510** in FIG. **5** to determine that the tag value of 10 in the data field **303** indicates that the data packet **201** is assigned a high latency classification (such as destined for storage in the queue **132**) for high latency transmission.

[0085] After determination of the original high latency classification assignment, if desired, the controller **141** can be configured to implement the mapping information **610** in FIG. **6** to map the port value 26 in data field **304** to the corresponding appropriate low latency classification LL. Such a mapping confirms that the data packet **203** is improperly assigned the high latency classification as indicated by the tag value 10 stored in the data field **303**.

[0086] Additionally, or alternatively, note that the controller **141** can be configured to implement the mapping information **710** in FIG. **7** to map the data type information (VIDEO) stored in the data field **305** of the data packet **203** to the corresponding appropriate low latency classification LL. Recall that the data type information in the data field **305** indicates the type of data being transmitted by the data payload **293**. Such a mapping confirms that the data packet **203** is improperly assigned the high latency classification as indicated by the tag value 10 stored in the data field **303**.

[0087] Note again that the controller **141** can be configured to further implement any method to determine that the data packet **203** is properly classified as a high or low latency classification.

[0088] Rather than forwarding the data packet **203** to the classifier **142** for storage in the queue **131**, as previously discussed, the controller **141** modifies the data packet **203** to produce the data packet **203-1**. In one example, modification of the data packet **203** includes changing the value in the data field **303** from the value 10 to the value 01 to indicate that the data packet **203-1** is assigned the low latency classification for storage in the queue **131**.

[0089] In such an instance, after modifying the data packet **203**, the controller **141** forwards the corresponding modified data packet **203-1** to the classifier **142**. The classifier **142** determines (such as from information received from the controller **141** or the information such as data field **303** stored in the data packet **203-1**) that the data packet **203-1** is to be stored in the queue **131** supporting the latency data packets. Thus, the classifier **142** stores the data packet **203-1** in the queue **131** for subsequent delivery over the shared communication link **195** by the scheduler **144**. In this manner, the data packet **203** originally destined for storage in the queue **132** is instead stored in the queue **131** for subsequent transmission over the shared communication link **195**.

[0090] Note further that any suitable rules stored in the model **107** or other control information stored in repository **180** can be used as a basis in which to forward the received data packets. For example, in one implementation, the communication management resource **140** and corresponding controller **141** can be configured to analyze a source that is transmitting a respective data packet. If desired, the controller **141** can be configured to default to modifying any data packets received from the source network address XXXX to a high latency classification or a low latency classification. As another example, the controller **141** can be configured to default to modifying any data packets destined for delivery to the network address YYY1 to a high latency classification or a low latency classification.

[0091] Accordingly, forwarding of the respective data packets can be based on any information found in the header data fields **301**, **302**, **303**, **304**, **305**, etc.

[0092] Yet further, the controller **141** can be configured to analyze the data payload associated with a respective received data packet to determine a type of data being transmitted by the data packet. In such an instance, forwarding of the respective data packets can be based on analysis of the respective data payload of the data packet.

[0093] FIG. **8** is an example diagram illustrating implementation of a cable modem system supporting dynamic queuing and corresponding forwarding of data packets as discussed herein.

[0094] In one example, the communication management resource **140** is implemented as a cable modem termination system **840** associated with a cable modem system **800** such as supporting communications in accordance with DOCSIS (Data Over Cable Service Interface Specification) or any other suitable communication protocol. The cable modem termination system **840** can be configured to control conveyance of communications over the shared communication link **195** to multiple different cable modems including cable modem **811** such as in a first subscriber domain, cable modem **812** such as in a second subscriber domain, etc.

[0095] Each of the subscriber domains is provided service by a respective Internet service provider operating the cable modem system **800**.

[0096] The combination of the cable modem termination system **840**, shared communication link **195**, and cable modem **811** support conveyance of communications between the network **190** and the mobile communication device **111**.

[0097] Accordingly, the proposed solution as discussed herein introduces a new software component such as the communication management resource **140** executed in the cable modem termination system **840**, which includes a controller **141** disposed in front of the classifier **142**. As previously discussed, one function of the communication management resource **140** and corresponding components (such as controller **141**, classifier **142**, queue management resource **143-1**, queue management resource **143-2**, scheduler **144**, etc.) is to ensure that the received communications **201**, **202**, **203**, **204**, **205**, etc., are communicated over the shared communication link **195** in accordance with the appropriate latency.

[0098] In one example, the communication management resource **140** classifies and categorizes received internet traffic (such as communications or data packets **201**, **202**, **203**, **204**, **205**, etc.) using machine learning and analysis. In one example, using machine learning, data packet classification and categorization by the communication management resource **140** includes applying various machine learning techniques to categorize and analyze the data flowing through computer networks to produce the model **107**.

[0099] In one example, the operations of the communication management resource **140** implementing Machine Learning (ML) and Artificial Intelligence (AI) to classify network traffic at a Cable Modem Termination System (CMTS) node include:

1. Data Collection:

[0100] Example: Collect packet capture data from the CMTS node, including details such as source and destination IP addresses, port numbers, and packet payload. This dataset will serve as the basis for training and testing the traffic classification model **107**.

2. Data Preprocessing:

[0101] Example: Remove duplicate packets and handle missing values in the packet capture data. Normalize packet sizes and convert timestamps of receiving the data packets into a consistent format for analysis.

3. Feature Engineering:

[0102] Example: Extract relevant features from the packet capture data, such as packet size distributions, inter-arrival times between packets, and the presence of specific protocol headers (e.g., HTTP, DNS).

4. Data Labeling:

[0103] Example: Manually label the collected data with traffic type categories, such as "VoIP calls," "Video streaming," or "File downloads."

5. Splitting the Data:

[0104] Example: Divide the labeled dataset into three subsets: a training set (70%), a validation set (15%), and a test set (15%). These subsets will be used to train, fine-tune, and evaluate the machine learning model **107**, respectively.

6. Model Selection:

[0105] Example: Choose an appropriate ML model **107**, such as a decision tree, a Random Forest, or a deep neural network, to classify network traffic based on the extracted features.

7. Model Training:

[0106] Example: Train the selected ML model **107** using the training dataset, allowing it to learn patterns and relationships between the extracted features and traffic types.

8. Hyperparameter Tuning:

[0107] Example: Experiment with various hyperparameters, such as the maximum depth of a decision tree or the number of layers in a neural network, using the validation dataset to optimize the model's performance.

9. Model Evaluation:

[0108] Example: Assess the model's accuracy and effectiveness in classifying network traffic by evaluating it on the test dataset. Metrics like accuracy, precision, recall, and F1-score can be calculated to gauge performance.

10. Model Deployment:

[0109] Example: Implement the trained ML model **107** within the CMTS node's network infrastructure to classify incoming traffic in real-time. For instance, the model can classify network packets as "VoIP traffic" or "Video streaming traffic" based on their features.

11. Monitoring and Maintenance:

Example: Continuously monitor the model's performance in the live network environment. If there are changes in network traffic patterns, such as the emergence of a new application or protocol, retrain the model **107** with updated data to ensure accurate classification.

[0110] Example Scenario: Use ML/AI to classify network traffic at a CMTS node. Collect historical network traffic data over several months, including packet-level information and labels indicating the traffic type (e.g., web browsing, video streaming, online gaming).

[0111] Preprocess the data by cleaning it and normalizing packet sizes. Engineer features like packet size distributions, average inter-packet arrival times, and the presence of specific keywords in the payload.

[0112] Split the data into training, validation, and test sets. Choose a neural network architecture suitable for sequence data and train it using the training data. Experiment with different learning rates and batch sizes and find the best hyperparameters using the validation set.

[0113] After achieving satisfactory performance in generation of the corresponding model **107**, the controller **141** implements the trained model **107** at the CMTS node (such as **840**) to classify incoming network traffic in real-time in a manner as previously discussed. The communication management resource **140** can be configured to regularly monitor an accuracy of the model **107** and another forwarding rules stored in the repository **180** retrain it with new data if the network's traffic patterns change significantly.

[0114] This example demonstrates the general process of using ML/AI for network traffic classification, but the specific implementation details can vary depending on the dataset, model **107** choice, and network environment.

[0115] Accordingly, as discussed herein, the Internet service provider operating the cable modem system **800** can be provided the ability to overwrite the LA settings for any traffic types, where rules for overwriting latency assignment settings is configurable by the Internet service provider.

[0116] The evolution of applications that require high throughput and low latency simultaneously has emerged. For example, HD/4K video, holographic video streaming, Augmented Reality/Virtual Reality, Robot remote control, and Cloud Gaming. All these traffic types require LAS to be activated. As previously discussed, the Internet service provider may activate or deactivate L4S settings for the received data packets.

[0117] Further, as previously discussed, the rest of the traffic types can deactivate the L4S if activated first, allowing the ISP to protect their assets (such as available bandwidth to communicate data from the cable modem termination system **840** to the downstream cable modems). More specific details of communicating respective data packets over the cable modem system **800** are discussed in following FIG. **9**.

[0118] FIG. **9** is an example diagram illustrating generation of an encapsulated data packet forwarded in a cable modem system as discussed herein.

[0119] In a similar manner as previously discussed, the controller **140** can be configured to analyze respective data packets received from one or more sources over the network **190**. In this example, the controller **140** encapsulates the received data packets for transmission over a respective cable modem system **800**.

[0120] More specifically, as shown in FIG. **9**, and with further reference to the other drawings, the controller **140** associated with the cable modem system **800** produces the encapsulated data packet **201**-E based upon reception of the data packet **201**. As previously discussed, the original data packet **201** is properly marked with a high latency assignment value. In such an instance, based on the analysis as previously discussed in FIG. **2** (such as verification that the received data packet **201** is properly marked as a high latency data packet), the controller **141** produces the encapsulated data packet **201**-E to include the original data packet **201** as well as additional header information in the data fields **901**, **902**, **903**.

[0121] In this example, the original data packet **201** communicated to the communication device **111** is stored in the data field **904** of the encapsulated data packet **201**-E. Additionally, the controller **141** produces the data packet **201**-E to include the source network address ABCD (i.e., network address assigned to the cable modem termination system **840**) in the data field **901**. If desired, the controller **141** can be configured to produce the encapsulated data packet **201**-need to include any suitable source network address such as ABCD or other suitable value. Further, the controller **141** produces the data packet **201**-E to include the destination network address YY22 (i.e., network address assigned to the cable modem **811**) in the data field **902**. The controller **141** further produces the data packet **201**-E to include a tag value HL in the data field **903**. In this example, note that the tag value HL in the data field **903** provides notification to the classifier **142** that the data packet **201**-E should be stored in the queue **132** (that is the queue **4** high latency data packets) for subsequent transmission by the scheduler **144** over the shared communication link **195** from the cable modem termination system **840** to the cable modem **811**.

[0122] In one example, upon receipt, the cable modem **811** removes the encapsulation portion of the data packet **201**-E to retrieve the original data packet **201**. In accordance with the destination network address as specified by the data packet **201**, the cable modem **811** communicates the retrieved data packet **201** to the mobile communication device **111**.

[0123] Thus, in this case, the original data packet **201** indicated a high latency classification which was the same assigned classification associated with the corresponding encapsulated data packet **201**-E as indicated in the data field **903** of the encapsulated data packet **201**-E.

[0124] As further shown in FIG. **9**, and with further reference to the other drawings, the controller **140** produces the encapsulated data packet **202**-E based upon reception of the data packet **202**. As previously discussed, the data packet **202** is improperly marked with a low latency assignment value it should be marked with a high latency assignment value. In such an instance, based on the analysis as previously discussed in FIG. **2** (such as determination that the received data packet **202** is improperly marked as a low latency data packet), the controller **141** produces the encapsulated data packet **202**-E to include the original data packet **202** as well as additional header information in the corresponding data fields **901**, **902**, **903**, for forwarding.

[0125] For example, the original data packet **202** communicated to the communication device **111** is stored in the data field **904** of the encapsulated data packet **202**-E. Additionally, the controller **141** produces the data packet **202**-E to include the source network address ABCD (i.e., network address assigned to the cable modem termination system **840**) in the data field **901**. The controller **141** produces the data packet **202**-E to include the destination network address YY22 (i.e., network address assigned to the cable modem **811**) in the data field **902**. The controller **141** further produces the data packet **202**-E to include a tag value HL in the data field **903**. Note that the tag value HL provides notification to the classifier **142** that the data packet **202**-E should be stored in the queue **132** (that is queue for high latency data packets) for subsequent transmission by the scheduler **144** over the shared communication link **195** to the cable modem **811**.

[0126] In one example, upon forwarding of the data packet to its destination, the cable modem **811** removes the encapsulation portion of the data packet **202**-E to retrieve the original data packet **202**. In accordance with the destination network address as specified by the data packet **202**, the cable modem **811** communicates the retrieved data packet **202** to the mobile communication device **111**.

[0127] Thus, in this case, the data field **303** of the original data packet **202** indicated a low latency classification which was different than the latency assignment classification as indicated by the value HL in the data field **903** of the encapsulated data packet **202**-E. In such an instance, the data packet **202** indicates low latency assignment for forwarding while the encapsulated data packet **202**-E indicates the appropriate or correct latency assignment value of HL for storage in the queue **132**. If desired, the controller **141** can be configured to produce the encapsulated data packet **202**-E to include the modified data packet **202-1** (as an alternative to the data packet **202**) in the data field **904** of the data packet **202**-E.

[0128] Accordingly, this example illustrates how an original data packet **202** can be processed and verified prior to forwarding of the data packet as an encapsulated data packet over a respective cable modem system **800**.

[0129] As further shown in FIG. **9**, and with further reference to the other drawings, the controller **140** produces the encapsulated data packet **204**-E based upon reception of the data packet **204**. As previously discussed, the data field **303** of the data packet **204** is improperly marked with a high latency assignment value. In such an instance, based on the analysis as previously discussed in FIG. **2** (such as determination that the received data packet **204** is improperly marked as a high latency data packet), the controller **141** produces the encapsulated data packet **204**-E to include the original data packet **204** as well as additional header information in the corresponding data fields **901**, **902**, **903**, for forwarding.

[0130] For example, the original data packet **204** communicated to the communication device **111** is stored in the data field **904** of the encapsulated data packet **204**-E. Additionally, the controller **141** produces the data packet **204**-E to include the source network address ABCD (i.e., network address assigned to the cable modem termination system **840**) in the data field **901**. The controller **141** produces the data packet **204**-E to include the destination network address YY22 (i.e., network address assigned to the cable modem **811**) in the data field **902**. The controller **141** further produces the data packet **204**-E to include a tag value LL in the data field **903**. Note that the tag value LL provides notification to the classifier **142** that the data packet **204**-E should be stored in the queue **131** (that is queue for low latency data packets) for subsequent transmission by the scheduler **144** over the shared communication link **195** to the cable modem **811**.

[0131] In one example, upon forwarding of the data packet **204**-E to the destination, the cable modem **811** removes the encapsulation portion of the data packet **204**-E to retrieve the original data packet **204**. In accordance with the destination network address as specified by the data packet **204**, the cable modem **811** communicates the retrieved data packet **204** to the mobile communication device **111**.

[0132] Thus, in this case, the original data packet **204** indicated a high latency classification which was different than the latency assignment classification as indicated by the value LL in the data field **903** of the encapsulated data packet **204**-E. In such an instance, the data packet **204** indicates high latency assignment for forwarding while the encapsulated data packet **204**-E indicates the appropriate or correct latency assignment value of LL for storage in the queue **131**. If desired, the controller **141** can be configured to produce the encapsulated data packet **204**-E to include the modified data packet **204-1** in the data field **904** of the data packet **204**-E.

[0133] Accordingly, this example illustrates how an original data packet **204** can be processed and verified prior to forwarding of the data packet as an encapsulated data packet over a respective cable modem termination system **800**. The generation of the appropriate latency assignment information for storage in the encapsulated data packets ensures that the cable modem system **800** is not improperly bogged down by this marked data packets that it happens the received or conveyance in a downlink to one or more cable modems **811**, **812**, etc. In other words, if the cable modem termination system **840** simply used markings in the originally received data packets, the blind forwarding of those data packets in the service provider network operating the cable modem system **800** may be undesirable because the packets may be improperly marked. As discussed during, the verification and potential reassignment of latency assignment information to the received data packets to produce encapsulated data packets ensures better use of the cable modem system **800** and corresponding available resources such as shared communication link **195**, etc.

[0134] FIG. **10** is an example block diagram of a computer system for implementing any of the operations as previously discussed according to embodiments herein.

[0135] Note that any of the resources (such as communication management resource **140**, communication management resource **141**, classifier **142**, queue management resource **143-1**, queue management resource **143-2**, scheduler **144**, communication device **111**, cable modem termination system **840**, cable modem **811**, cable modem **812**, etc.) as discussed herein can be configured to include computer processor hardware and/or corresponding executable instructions to carry out the different operations as discussed herein.

[0136] For example, as shown, computer system **1050** of the present example includes interconnect **1011** coupling computer readable storage media **1012** such as a non-transitory type of media or computer readable storage hardware (which can be any suitable type of resource in which digital information can be stored and or retrieved), a processor **1013** (computer processor hardware), I/O interface **1014**, and a communications interface **1017**.

[0137] I/O interface(s) **1014** supports connectivity to repository **1080** and input resource **1092**.

[0138] Computer readable storage medium **1012** can be any hardware storage device such as memory, optical storage, hard drive, floppy disk, etc. In one embodiment, the computer readable storage medium **1012** stores instructions and/or data.

[0139] As shown, computer readable storage media **1012** can be encoded with communication management application **140-1** in a respective one or more network nodes to carry out any of the operations as discussed herein.

[0140] During operation of one example, processor **1013** accesses computer readable storage media **1012** via the use of interconnect **1011** in order to launch, run, execute, interpret or otherwise perform the instructions in management application **140-1** stored on computer readable storage medium **1012**. Execution of the management application **140-1** produces management process **140-2** to carry out any of the operations and/or processes as discussed herein.

[0141] Those skilled in the art will understand that the computer system **1050** can include other processes and/or software and hardware components, such as an operating system that controls allocation and use of hardware resources to execute the management application **140-1**.

[0142] In accordance with different embodiments, note that computer system may reside in any of various types of devices, including, but not limited to, a mobile computer, a personal computer system, a wireless device, a wireless access point, a base station, phone device, desktop computer, laptop, notebook, netbook computer, mainframe computer system, handheld computer, workstation, network computer, application server, storage device, a consumer electronics device such as a camera, camcorder, set top box, mobile device, video game console, handheld video game device, a peripheral device such as a switch, modem, router, set-top box, content management device, handheld remote control device, any type of computing or electronic device, etc. The computer system **1050** may reside at any location or can be included in any suitable resource in any network environment to implement functionality as discussed herein.

[0143] Functionality supported by the different resources will now be discussed via flowchart **1000** in FIG. **10**. Note that the steps in the flowcharts below can be executed in any suitable order.

[0144] FIG. **10** is a flowchart **1000** illustrating an example method according to embodiments herein. Note that there will be some overlap with respect to concepts as discussed above.

[0145] In processing operation **1010**, the communication management resource **140** receives a first data packet including a first data payload. The first data packet is transmitted from a source such as a server resource or other suitable entity for delivery to a destination network address.

[0146] In processing operation **1020**, the communication management resource **140** determines a first latency classification assigned to the first data packet.

[0147] In processing operation **1030**, the communication management resource **140** assigns a second latency classification to the first data packet as a substitute to the first latency classification.

[0148] In processing operation **1040**, the communication management resource **140** forwards the first data packet for delivery to the destination network address in accordance with the second latency classification.

[0149] Note again that techniques herein are well suited to facilitate wireless connectivity in accordance with different available wireless services. However, it should be noted that embodiments herein are not limited to use in such applications and that the techniques discussed herein are well suited for other applications as well.

[0150] Based on the description set forth herein, numerous specific details have been set forth to provide a thorough understanding of claimed subject matter. However, it will be understood by those skilled in the art that claimed subject matter may be practiced without these specific details. In other instances, methods, apparatuses, systems, etc., that would be known by one of ordinary skill have not been described in detail so as not to obscure claimed subject matter. Some portions of the detailed description have been presented in terms of algorithms or symbolic representations of operations on data bits or binary digital signals stored within a computing system memory, such as a computer memory. These algorithmic descriptions or representations are examples of techniques used by those of ordinary skill in the data processing arts to convey the substance of their work to others skilled in the art. An algorithm as described herein, and generally, is considered to be a self-consistent sequence of operations or similar processing leading to a desired result. In this context, operations or processing involve physical manipulation of physical quantities. Typically, although not necessarily, such quantities may take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared or otherwise manipulated. It has been convenient at times, principally for reasons of common usage, to refer to such signals as bits, data, values, elements, symbols, characters, terms, numbers, numerals or the like. It should be understood, however, that all of these and similar terms are to be associated with appropriate physical quantities and are merely convenient labels. Unless specifically stated otherwise, as apparent from the following discussion, it is appreciated that throughout this specification discussions utilizing terms such as "processing," "computing," "calculating," "determining" or the like refer to actions or processes of a computing platform, such as a computer or a similar electronic computing device, that manipulates or transforms data represented as physical electronic or magnetic quantities within memories, registers, or other information storage devices, transmission devices, or display devices of the computing platform.

[0151] While this example has been particularly shown and described with references to preferred examples thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present application as defined by the appended claims. Such variations are intended to be covered by the scope of this present application. As such, the foregoing description of embodiments of the present application is not intended to be limiting. Rather, any limitations to the invention are presented in the following claims.

We claim:

1. A method comprising:

receiving a first data packet including a first data payload, the first data packet transmitted for delivery to a destination network address;

determining a first latency classification assigned to the first data packet;

assigning a second latency classification to the first data packet as a substitute to the first latency classification; and

forwarding the first data packet for delivery to the destination network address in accordance with the second latency classification.

2. The method as in claim **1** further comprising:

analyzing the first data packet; and

selecting the second latency classification as the substitute to the first latency classification based on the analysis of the first data packet.

3. The method as in claim **2** further comprising:

replacing a first tag value in the first data packet with a second tag value, the first tag value indicating the first latency classification, the second tag value indicating the second latency classification.

4. The method as in claim **1**, wherein the first latency classification supports a first latency of communicating the first data packet to the destination network address;

wherein the second latency classification supports a second latency of communicating the first data packet to the destination network address; and

wherein the second latency is less than the first latency.

5. The method as in claim **1**, wherein the first latency classification supports a first latency of communicating the first data packet to the destination network address;

wherein the second latency classification supports a second latency of communicating the first data packet to the destination network address; and

wherein the second latency is greater than the first latency.

6. The method as in claim **1**, wherein forwarding the first data packet includes:

transmitting the first data packet to classifier hardware operative to store the first data packet in one of multiple queues depending upon the second latency classification assigned to the first data packet.

7. The method as in claim **1**, wherein the assigning of the second latency classification to the data packet includes:

substituting first bit information in the first data packet with second bit information, the first bit information specifying the first latency classification, the second bit information specifying the second latency classification.

8. The method as in claim **1** further comprising:

analyzing first bit information in the first data packet, the first bit information specifying a port number associated with the delivery of the first data packet to the destination network address, the port number indicating a particular type of data in the first data payload, the particular type assigned the second latency classification.

9. The method as in claim **1**, wherein determining the first latency classification assigned to the data packet includes:

inspecting a data field of the first data packet, the data field including bit information specifying the first latency classification.

10. The method as in claim **1**, wherein forwarding the first data packet for delivery to the destination network address in accordance with the second latency classification includes: storing the first data packet in a second data delivery queue instead of a first data delivery queue;

wherein the first data delivery queue is configured to store first data packets assigned the first latency classification; and

wherein the second data delivery queue is configured to store second data packets assigned the second latency classification.

11. A system comprising:

communication management hardware operative to:

receive a first data packet including a first data payload, the first data packet transmitted for delivery to a destination network address;

determine a first latency classification assigned to the first data packet;

assign a second latency classification to the first data packet as a substitute to the first latency classification; and

forward the first data packet for delivery to the destination network address in accordance with the second latency classification.

12. The system as in claim **11**, wherein the communication management hardware is further operative to:

analyze the first data packet; and

select the second latency classification as the substitute to the first latency classification based on the analysis of the first data packet.

13. The system as in claim **12**, wherein the communication management hardware is further operative to:

replace a first tag value in the first data packet with a second tag value, the first tag value indicating the first latency classification, the second tag value indicating the second latency classification.

14. The system as in claim **11**, wherein the first latency classification supports a first latency of communicating the first data packet to the destination network address;

wherein the second latency classification supports a second latency of communicating the first data packet to the destination network address; and

wherein the second latency is less than the first latency.

15. The system as in claim **11**, wherein the first latency classification supports a first latency of communicating the first data packet to the destination network address;

wherein the second latency classification supports a second latency of communicating the first data packet to the destination network address; and

wherein the second latency is greater than the first latency.

16. The system as in claim **11**, wherein the communication management hardware is further operative to:

transmit the first data packet to classifier hardware operative to store the first data packet in one of multiple queues depending upon the second latency classification assigned to the first data packet.

17. The system as in claim **11**, wherein the communication management hardware is further operative to:

substitute first bit information in the first data packet with second bit information, the first bit information specifying the first latency classification, the second bit information specifying the second latency classification.

18. The system as in claim **11**, wherein the communication management hardware is further operative to:

analyze first bit information in the first data packet, the first bit information specifying a port number associated with the delivery of the first data packet to the destination network address, the port number indicating a particular type of data in the first data payload, the particular type assigned the second latency classification.

19. The system as in claim **11**, wherein the communication management hardware is further operative to:

inspect a data field of the first data packet, the data field including bit information specifying the first latency classification.

20. The system as in claim **11**, wherein the communication management hardware is further operative to: store the first data packet in a second data delivery queue instead of a first data delivery queue;

wherein the first data delivery queue is configured to store first data packets assigned the first latency classification; and

wherein the second data delivery queue is configured to store second data packets assigned the second latency classification.

21. Computer-readable storage hardware having instructions stored thereon, the instructions, when carried out by computer processor hardware, cause the computer processor hardware to:

receive a first data packet including a first data payload, the first data packet transmitted for delivery to a destination network address;

determine a first latency classification assigned to the first data packet;

assign a second latency classification to the first data packet as a substitute to the first latency classification; and

forward the first data packet for delivery to the destination network address in accordance with the second latency classification.

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