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(54) **METHODS AND SYSTEMS FOR AUTO-CORRELATING MESSAGE TRANSFER PART (MTP) PRIORITY AND INTERNET PROTOCOL (IP) TYPE OF SERVICE IN CONVERGED NETWORKS**

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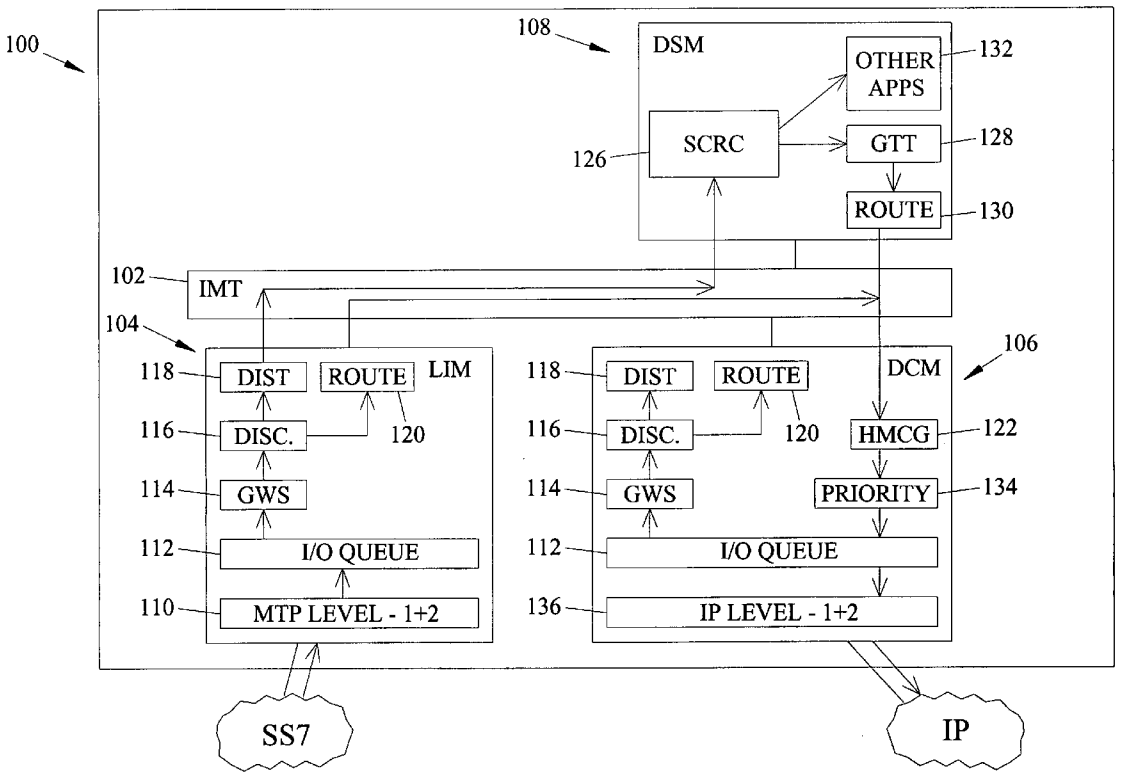
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(57) **ABSTRACT**

Methods and systems for automatically correlating signaling message priority and IP priority are disclosed. A priority level of a signaling message may be determined based on a priority parameter in the signaling message or a user based priority. The signaling message is encapsulated in an IP packet. A priority level in the IP packet is set based on the priority level determined for the signaling message.



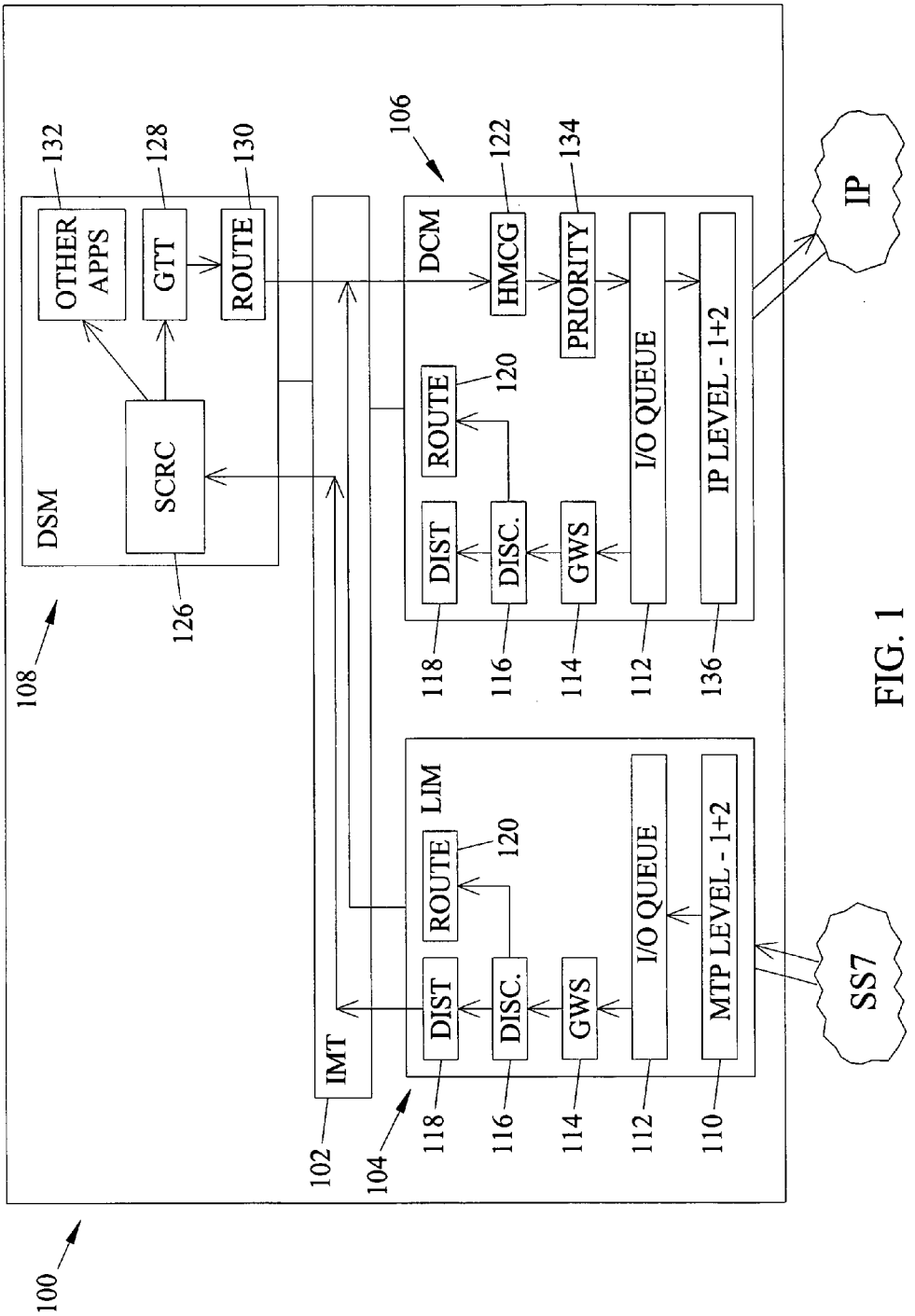

100
102
104
106
108
110
112
114
116
118
120
122
126
128
130
132
134
136
IMT
DSM
SCRC
OTHER APPS
GTT
ROUTE
DCM
HMCG
PRIORITY
I/O QUEUE
IP LEVEL - 1+2
LIM
MTP LEVEL - 1+2
DIST
DISC.
GWS
IP
SS7

FIG. 1

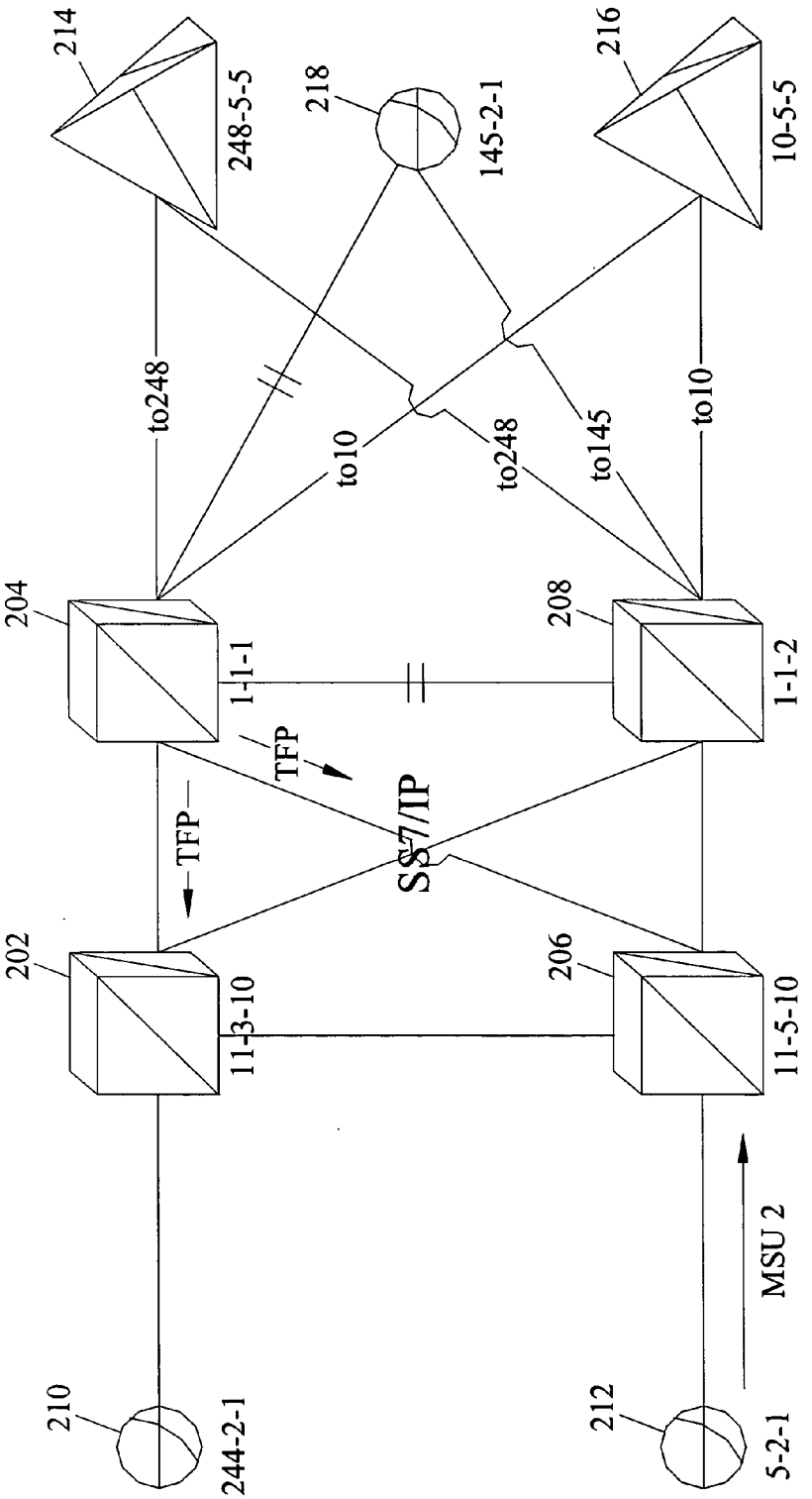

214
248-5-5
218
145-2-1
216
10-5-5
to248
to10
to10
to248
to145
to10
204
1-1-1
208
1-1-2
TFP
TFP
SS7/IP
202
11-3-10
206
11-5-10
MSU 2
210
244-2-1
212
5-2-1

FIG. 2

BIT#	0	1	2	3	4	5	6	7
	PRECEDENCE			D	T	R		

FIG. 3

BIT#	0	1	2	3	4	5	6	7
	PRECEDENCE			TOS				MBZ

FIG. 4

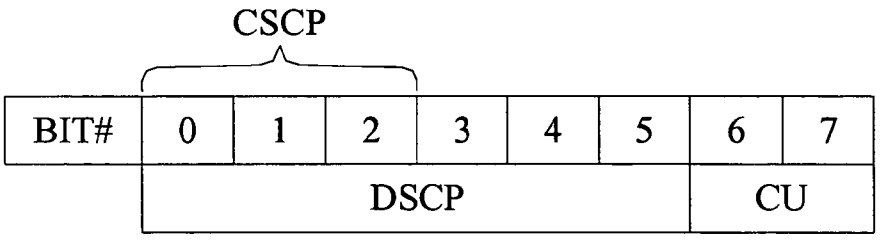


FIG. 5

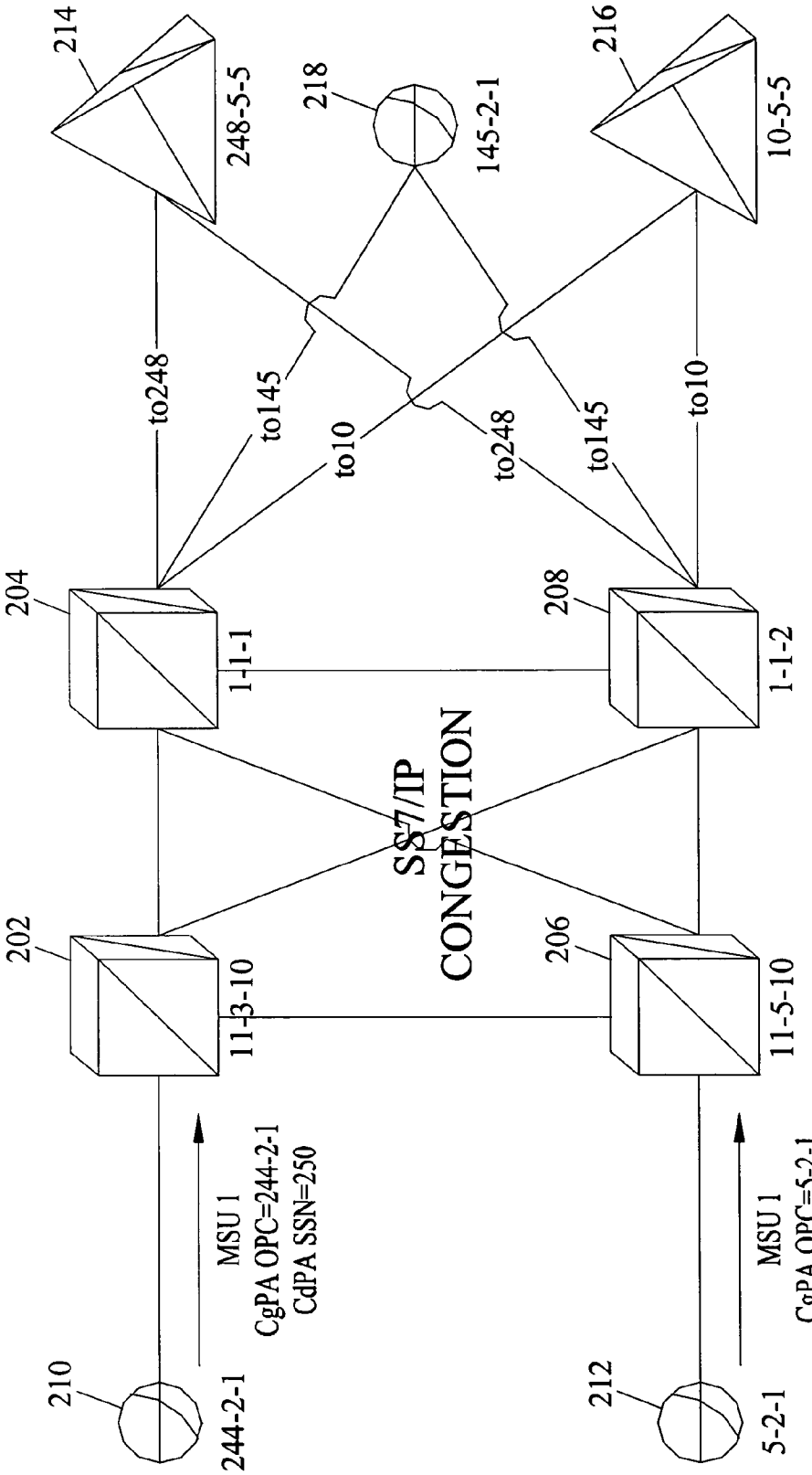

214
248-5-5
218
145-2-1
216
10-5-5
to248
to145
to10
to248
to145
to10
204
1-1-1
208
1-1-2
SS7/IP
CONGESTION
202
11-3-10
206
11-5-10
MSU 1
CgPA OPC=244-2-1
CdPA SSN=250
MSU 1
CgPA OPC=5-2-1
CdPA SSN=250
210
244-2-1
212
5-2-1

FIG. 6

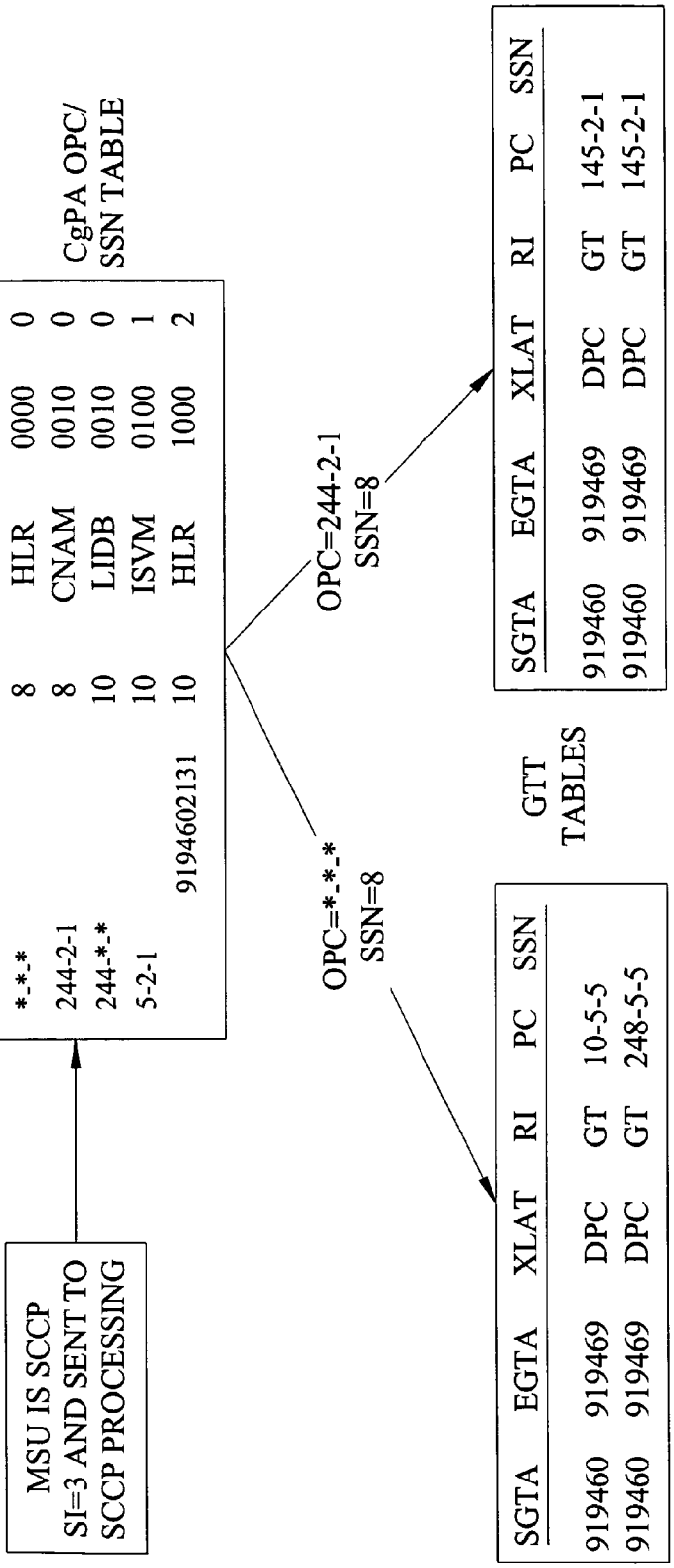

MSU IS SCCP
SI=3 AND SENT TO
SCCP PROCESSING
CgPA OPC/
SSN TABLE
CgPA OPC
CgPA ADDRESS
CgPA SSN
SERVICE
IPTOS
PRI
--*
8
HLR
0000
0
244-2-1
8
CNAM
0010
0
244-*-*
10
LIDB
0010
0
5-2-1
10
ISVM
0100
1
9194602131
10
HLR
1000
2
OPC=*-*-*
SSN=8
OPC=244-2-1
SSN=8
GTT
TABLES
SGTA
EGTA
XLAT
RI
PC
SSN
919460
919469
DPC
GT
10-5-5
919460
919469
DPC
GT
248-5-5
SGTA
EGTA
XLAT
RI
PC
SSN
919460
919469
DPC
GT
145-2-1
919460
919469
DPC
GT
145-2-1

FIG. 7

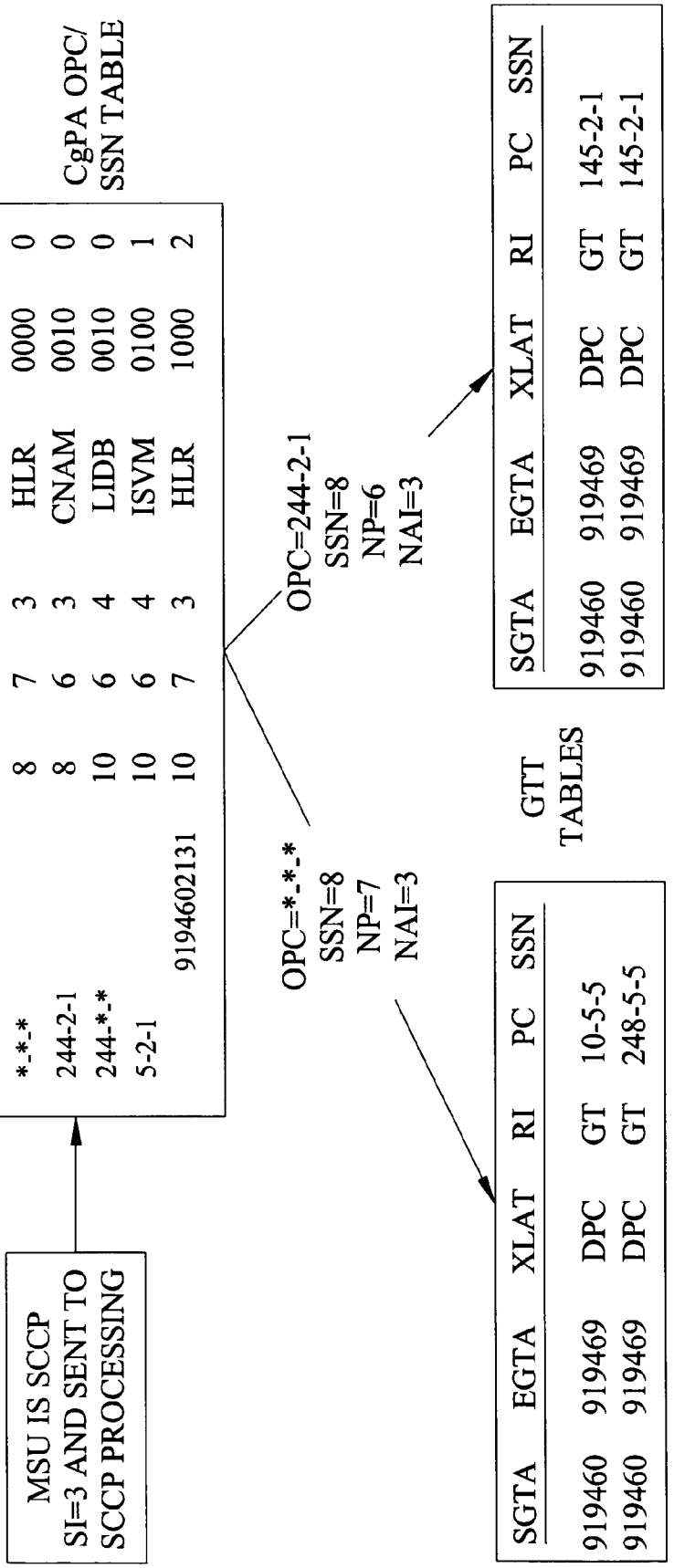

MSU IS SCCP
SI=3 AND SENT TO
SCCP PROCESSING
CgPA OPC
CgPA ADDRESS
CgPA SSN
NP
NAI
SERVICE
IPTOS
PRI
--*
244-2-1
244-*-*
5-2-1
9194602131
8
8
10
10
10
7
6
6
7
3
3
4
4
3
HLR
CNAM
LIDB
ISVM
HLR
0000
0010
0010
0100
1000
0
0
0
1
2
CgPA OPC/
SSN TABLE
OPC=*-*-*
SSN=8
NP=7
NAI=3
OPC=244-2-1
SSN=8
NP=6
NAI=3
GTT
TABLES
SGTA
EGTA
XLAT
RI
PC
SSN
919460
919460
919469
919469
DPC
DPC
GT
GT
10-5-5
248-5-5
SGTA
EGTA
XLAT
RI
PC
SSN
919460
919460
919469
919469
DPC
DPC
GT
GT
145-2-1
145-2-1

FIG. 8

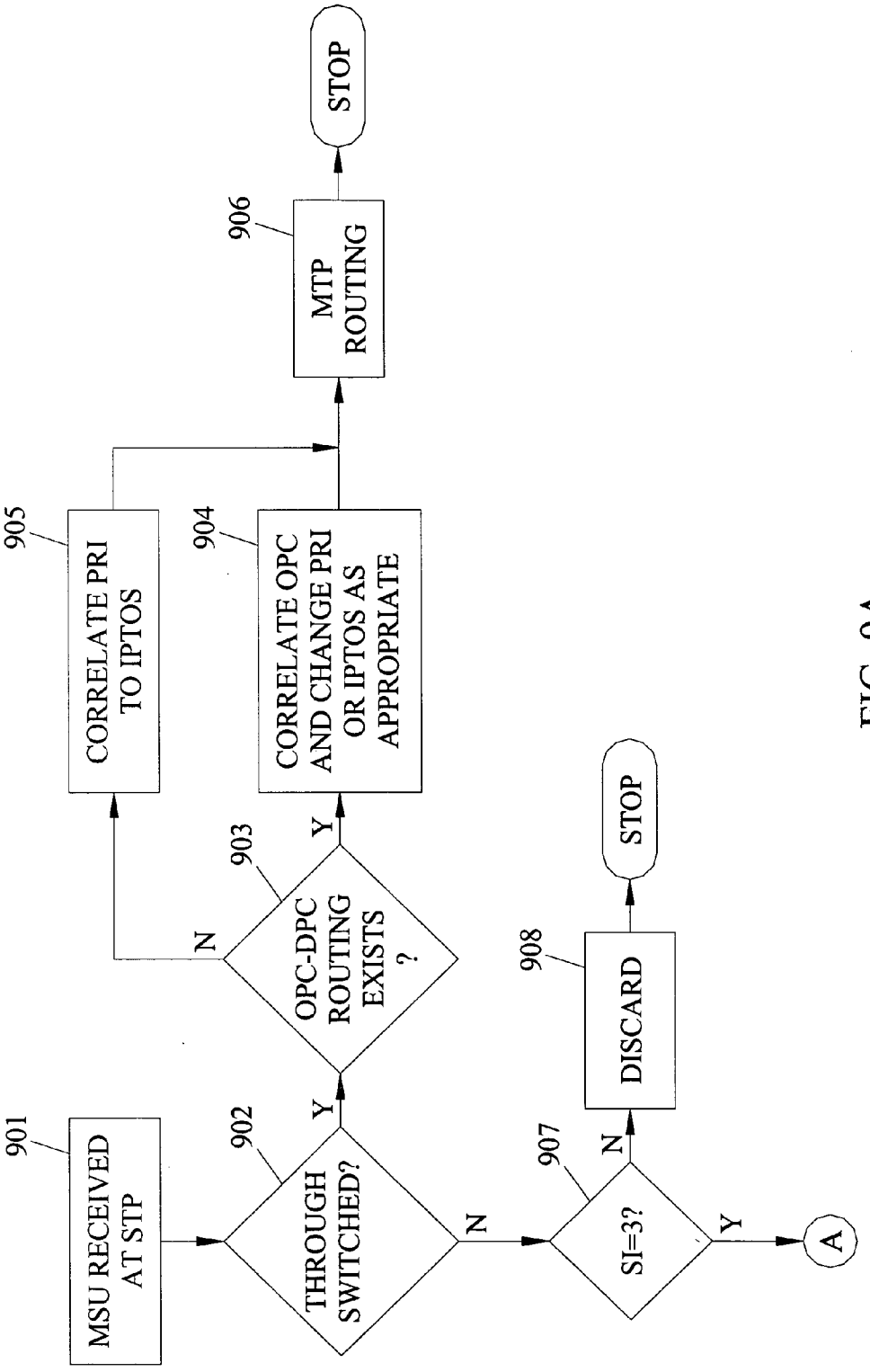

MSU RECEIVED AT STP
901
THROUGH SWITCHED?
902
Y
N
OPC-DPC ROUTING EXISTS ?
903
Y
N
CORRELATE OPC AND CHANGE PRI OR IPTOS AS APPROPRIATE
904
CORRELATE PRI TO IPTOS
905
MTP ROUTING
906
STOP
SI=3?
907
N
Y
DISCARD
908
STOP
A

FIG. 9A

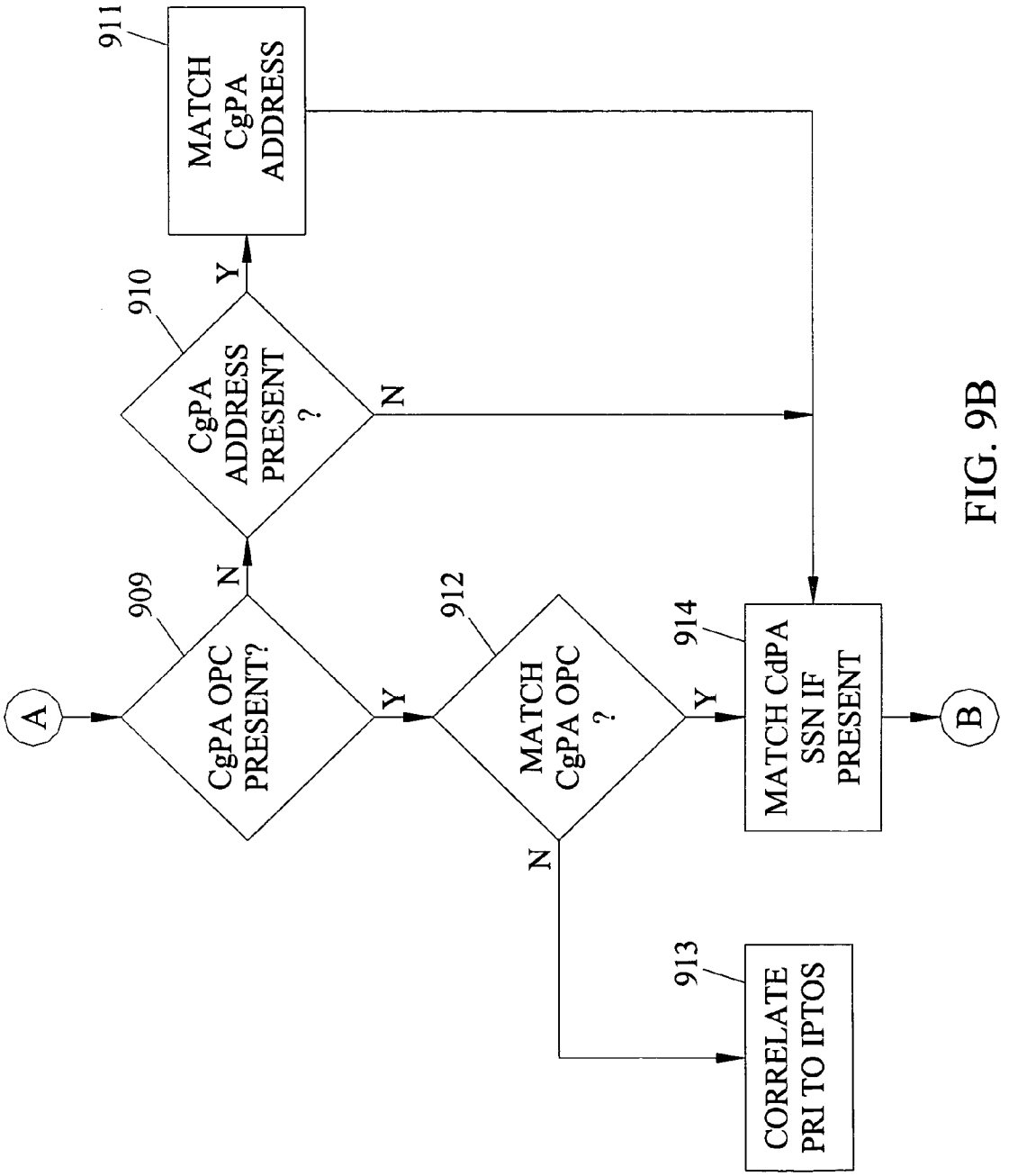

A
909
CgPA OPC PRESENT?
N
Y
910
CgPA ADDRESS PRESENT ?
Y
N
911
MATCH CgPA ADDRESS
912
MATCH CgPA OPC ?
Y
N
913
CORRELATE PRI TO IPTOS
914
MATCH CdPA SSN IF PRESENT
B

FIG. 9B

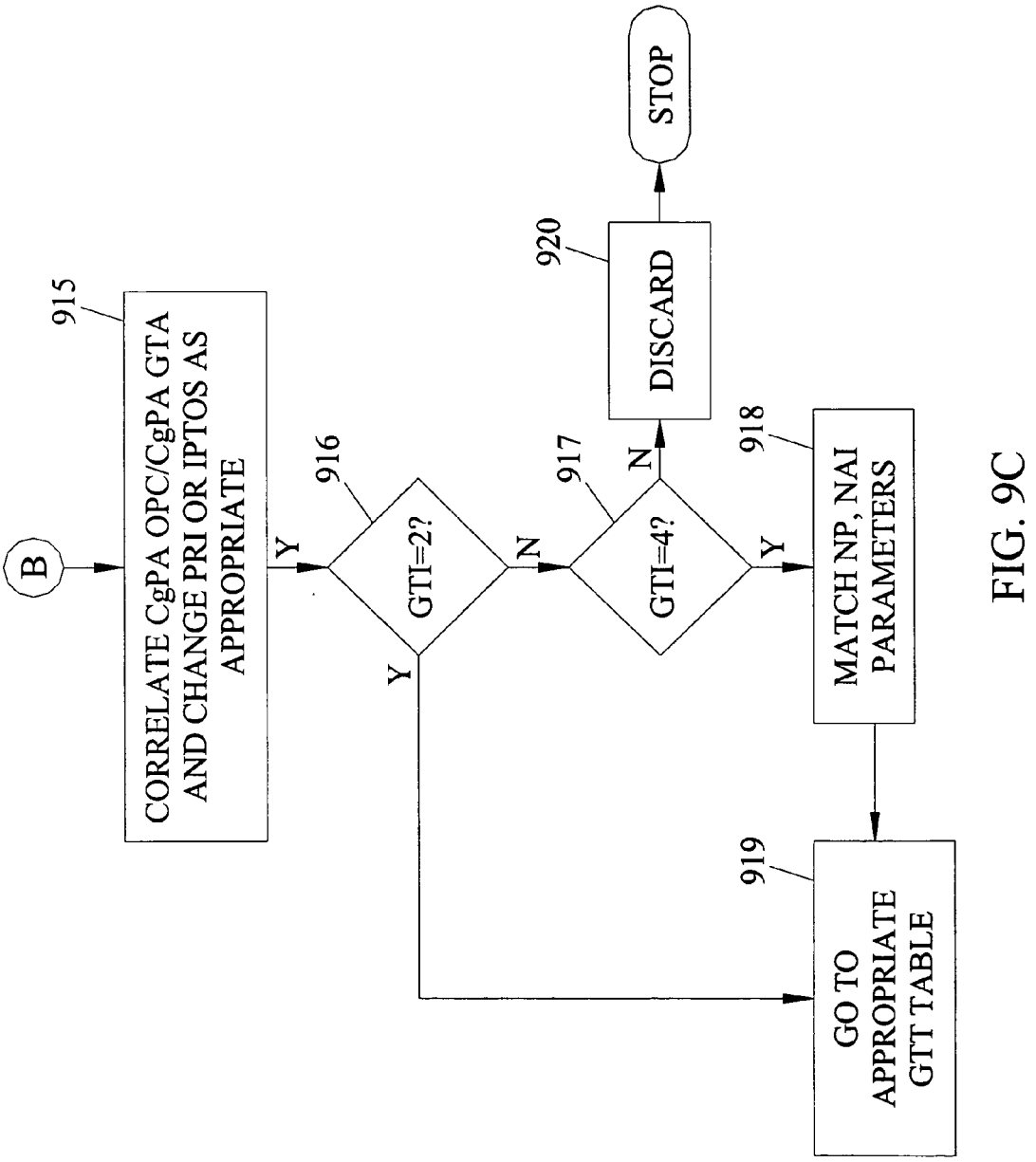

B
915
CORRELATE CgPA OPC/CgPA GTA AND CHANGE PRI OR IPTOS AS APPROPRIATE
916
GTI=2?
Y
N
917
GTI=4?
N
Y
920
DISCARD
STOP
918
MATCH NP, NAI PARAMETERS
919
GO TO APPROPRIATE GTT TABLE

FIG. 9C

METHODS AND SYSTEMS FOR AUTO-CORRELATING MESSAGE TRANSFER PART (MTP) PRIORITY AND INTERNET PROTOCOL (IP) TYPE OF SERVICE IN CONVERGED NETWORKS

TECHNICAL FIELD

[0001] The present invention related to determining message priority in converged networks. More particularly, the present invention provides a system and method for setting the priority of a transport packet based on parameters of a message being transported.

BACKGROUND ART

[0002] Signaling system number 7 (SS7) is widely used as the signaling protocol in telecommunication networks. Each SS7 message is assigned one of four congestion priorities, which may be used to determine how each message is handled based on the current capacity of each signaling route. Typically, user messages, such as those for call setup and teardown, are assigned a lower priority than network management messages.

[0003] In converged networks, portions of the network use the Internet protocol (IP) to transport signaling messages, while other portions of the network use SS7 to transport signaling messages. For example, IP may be used for message transfer between signal transfer points (STP) in the network, and SS7 may be used to communicate with end-points, or vice-versa. In one implementation, an STP may receive an SS7 message from a service switching point (SSP), encapsulate the SS7 message in an IP packet, and transfer the received SS7 message to another STP using IP. However, once the SS7 message is encapsulated in an IP packet, the priority level of the SS7 message cannot be determined by examining the IP packet header. In the event that the IP network becomes congested, the delivery of high priority SS7 messages may be delayed since all IP encapsulated SS7 messages may be treated with the same priority level.

[0004] In addition, most SS7 user messages are considered low priority and are treated the same. However, users may wish to ensure that their messages are handled in a timely fashion, especially when the network is experiencing abnormal conditions, such as congestion. While a user may be willing to pay for preferred service, there is currently no provision to enable tiers of service in an SS7/IP network.

[0005] Accordingly, there is a need to provide a system and method to assign a priority to an IP packet based on the priority of the SS7 message that is encapsulated in the packet.

[0006] There is also a need to provide a system and method to indicate a desired level of service for an SS7 user message and reflect the desired level of service in the IP packet in which the SS7 user message is encapsulated.

DISCLOSURE OF THE INVENTION

[0007] Methods and systems for automatically correlating signaling message priority and IP priority are disclosed. A priority level of a signaling message may be determined based on a priority parameter in the signaling message or a user based priority. The signaling message is encapsulated in an IP packet. A priority level in the IP packet is set based on the priority level determined for the signaling message.

[0008] In accordance with another aspect of the invention, a signaling gateway includes a first interface module operatively coupled to a first network. The first interface module is capable of receiving a signaling message from the first network. The first interface module routes the signaling message to a second interface module associated with an outbound signaling link. The second interface module includes a priority determination process for determining a priority of the message in a first protocol and mapping the priority in the first protocol to a second protocol, the second interface module may encapsulate the received signaling message in a packet of the second protocol, set the priority information in the packet, and transmit the packet on the second network.

[0009] Accordingly, it is an object of the invention to provide methods and systems for assigning a priority to an IP packet based on a priority parameter of the signaling message that is encapsulated in the packet.

[0010] It is another object of the invention to provide methods and systems for determining priority of a signaling message based on a calling or called party parameter in the signaling message and for setting the priority of an IP packet that encapsulates the signaling message based on the priority determined for the signaling message.

[0011] Some of the objects of the invention having been stated hereinabove, and which are addressed in whole or in part by the present invention, other objects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** is a block diagram illustrating an exemplary internal architecture of a signaling gateway (SG) according to an embodiment of the present invention;

[0013] **FIG. 2** is a diagram of an exemplary converged network;

[0014] **FIG. 3** is a diagram of the type of service field as defined by RFC 791;

[0015] **FIG. 4** is a diagram of the type of service fields as defined by RFC 1349;

[0016] **FIG. 5** is a diagram of the differentiated services (DS) field as defined by RFC 2474;

[0017] **FIG. 6** is a diagram of an exemplary converged network;

[0018] **FIG. 7** depicts exemplary message parameters for ANSI formatted messages;

[0019] **FIG. 8** depicts exemplary message parameters for ITU formatted messages; and

[0020] **FIGS. 9A-9C** are a flow diagram of an exemplary process for correlating signaling priority and IP type of service.

DETAILED DESCRIPTION OF THE INVENTION

[0021] The present invention includes methods and systems for correlating SS7 message priority to IP type of

service parameters. In one implementation, the methods and systems for correlating priority may be implemented in a signaling message routing node, such as a signal transfer point or a signaling gateway. **FIG. 1** is a block diagram illustrating an exemplary internal architecture of a signaling gateway (SG) **100** according to an embodiment of the present invention. SG **100** may include signaling system no. 7 (SS7) signal transfer point (STP) functionality for processing SS7 messages and Internet protocol (IP) functionality for processing IP messages. In a particular embodiment, SG **100** may comprise an Eagle® SS7/IP gateway available from Tekelec of Calabasas, Calif.

[**0022**] In the illustrated embodiment, SG **100** includes an interprocessor message transport (IMT) bus **102**, which provides a reliable transport mechanism for transporting messages between modules in SG **100**. IMT bus **102** may include a dual-ring, counter-rotating bus so that traffic may be re-routed in response to a module failure. A number of cards or processing modules may be coupled to IMT bus **102**. These cards or processing modules may include an SS7-capable link interface module (LIM) **104**, an IP-capable data communication module (DCM) **106**, and a database services module (DSM) **108**. Each of the modules may be physically connected to IMT bus **102** such that signaling and other messages may be routed internally between all active cards or modules.

[**0023**] As used herein the term "module" may include a hardware component, a software component, a firmware component or any combination thereof. For example, a module may be a chip, such as an ASIC, designed to perform a specific function. Alternatively, a module may be a part of a computer program that performs a specific function or a module may be a microprocessor programmed to perform a specific function.

[**0024**] In one implementation, each module includes a printed circuit board having an application processor and a communications processor mounted thereon. The application processor on each module may be programmed to perform a telecommunications processing function. For example, the application processor on database services module **108** may be configured to provide database services, such as global title translation (GTT). The communications processor on each module may be programmed to perform link-level communications with other modules via IMT bus **102**.

[**0025**] For simplicity of illustration, only single LIM, DCM, and DSM cards are included in **FIG. 1**. However, it should be appreciated that the distributed, multi-processor architecture of the SG node **100** facilitates the deployment of multiple LIM, DCM, DSM and other cards, all of which may be simultaneously connected to and communicating via IMT bus **102**.

[**0026**] Focusing now on the functions of LIM card **104**, in the illustrated embodiment, LIM **104** includes a number of sub-components including an SS7 MTP level 1 and 2 process **110**, an I/O buffer or queue **112**, a gateway screening (GWS) process **114**, an SS7 MTP level 3 discrimination process **116**, a distribution process **118**, and a routing process **120**. MTP level 1 and 2 process **110** provides the facilities necessary to send and receive digital data over a particular physical medium. MTP level 1 and 2 process **110** also performs error detection, error correction and sequenced delivery of SS7 message packets from the SS7 network. I/O queue **112** provides for temporary buffering of incoming and outgoing signaling message packets. GWS process **114** examines received message packets and determines whether the messages should be allowed into SG **100** for processing and/or routing. Gateway screening may include examining the destination point code of the received MSU to determine whether the MSU is to be allowed into a network for which SG **100** routes messages.

[**0027**] Discrimination process **116** performs a discrimination function, effectively determining whether an incoming SS7 message packet requires internal processing or is simply to be through-switched, i.e., routed to another node. This determination may be made by examining a destination point code in the message. If the destination point code is set to the point code of routing node **100**, discrimination process **116** may determine that the message requires internal processing. If the destination point code is not set to the point code of routing node **100**, discrimination process **116** may determine that the message is required to be through-switched.

[**0028**] In addition to examining the destination point code in a received message, discrimination process **116** may also examine the service indicator in a message to determine whether the message is an SCCP message. If the destination point code in the message is set to the point code of routing node **100** and the service indicator indicates that the message is an SCCP message, discrimination process **116** may forward the message to distribution process **118**. Distribution process **118** handles the internal routing of SS7 message packets that require additional processing prior to final routing. If discrimination process **116** determines that a message should be through switched, discrimination process **116** forwards the message to routing process **120**. Routing process **120** routes signaling messages to the appropriate outbound signaling links based on destination point codes in the messages.

[**0029**] Database services module (DSM) **108** receives SS7 message packets from the distribution process **118** on the LIM **104**. In the illustrated embodiment, DSM **108** includes a signaling connection routing controller (SCRC) **126** that is responsible for routing SCCP messages to the appropriate application on the DSM **108**. For example, SCCP messages requiring global titled translation would be routed from the SCRC **126** to the global title translation (GTT) application **128**. As is known to the art, global title translation involves resolving a called party address to the point code and subsystem number of an intermediate or final destination. Once the point code is determined, the message is sent to the routing application **132** for delivery to the processing module associated with the outbound signaling link, such as DCM **106**. It should be appreciated that the SCRC **126** may direct SCCP messages to other applications **130** on the DSM **108**, as well. Examples of other SCCP applications that may be provided by DSM **108** include mobile application part (MAP) screening, G-FLEX™ service, and G-PORT™ service. MAP screening involves screening of messages based on MAP parameters in the message, e.g., to control routing of messages at the MAP level. G-FLEX™ is a feature available on STPs manufactured by Tekelec of Calabasas, Calif. for translating called party information in mobile signaling messages to point codes of mobile services nodes, such as home location registers (HLRs) and short message

service centers (SMSCs). G-PORT™ is a feature available on STPs available from Tekelec of Calabasas, Calif. for relaying mobile signaling messages relating to home HLRs for calls to ported-in subscribers and for responding on behalf of a home network HLR for ported-out subscribers.

[0030] Data communication module (DCM) **106** converts incoming IP-encapsulated SS7 messages into SS7 format and encapsulates outgoing SS7 messages in IP packets. In the illustrated embodiment, DCM **106** includes an HMCG process **122** that is responsible for monitoring congestion on the associated DCM linksets and internally communicating this link congestion information to peer processes on other modules via IMT bus **102**.

[0031] DCM **106** may also include a priority determination process **134**. As discussed in greater detail below, priority determination process **134** may determine the priority of an outgoing SS7 message based on message parameters, such as originating point code (OPC), calling party address (CgPA) OPC, CgPA global type address (GTA), and subsystem number (SSN), or based on MTP level 3 priority parameters included in the message. The message priority determined by the priority determination process **134** may be used to place the outgoing message in I/O queue **112**. As discussed in greater detail below, the determined priority may also be used by the IP process **126** to set the values of the type of service octet of the IP header, and in particular the precedence bits in the type of service fields.

[0032] As the SS7 communication protocol and the IP communication protocol are not inherently compatible, all SS7 message packets that are to be sent into the IP network are first encapsulated within an IP routing envelope prior to transmission over the IP network and decapsulated before being transmitted over the SS7 network. This IP encapsulation and decapsulation is performed by IP process **136**. IP process **136** may include physical layer functionality, network layer functionality, transport layer functionality, and transport adapter layer functionality. The physical layer functionality may include any suitable physical layer function for communicating IP packets over an underlying network. In one implementation, the physical layer functionality may include Ethernet functionality. The network layer functionality may include IP functionality. The transport layer functionality may include any suitable transport layer for reliable, stream-oriented delivery of signaling messages. Exemplary transport layer protocols suitable for use with embodiments of the present invention include TCP, UDP, and SCTP. The transport adapter layer functionality may include TALI, SUA, M2PA, M3UA, or other suitable transport adapter layer protocols, such as SIP, as described in the correspondingly named IETF Internet drafts and RFCs.

[0033] In addition to forwarding outbound messages over an IP network, DCM **106** receives inbound IP messages. In one implementation, DCM **106** receives IP encapsulated messages. IP process **136** may remove the IP and transport layers and any transport adapter layers from each incoming SS7 message. The message is then passed up the MTP stack and processed in a manner similar to SS7 messages received by LIM **104**. In the illustrated example, DCM **106** includes gateway screening process **114**, discrimination process **116**, distribution process **118**, and routing process **120**. These processes perform the same functions as the correspondingly numbered processes described above with regard to LIM **104**.

[0034] As previously noted, each SS7 message is assigned one of four priority levels. The priority of an SS7 message may be determined by examining the two priority bits in the Service Indicator Octet (SIO) of the SS7 message. These priority bits are set in accordance with the message priority, as defined by American National Standards Institute (ANSI) TI. III. 5, Annex A, which is reproduced in pertinent part at the end of the Detailed Description of the Invention. The message priority may also be determined in the SCCP layer using, for example, the importance field.

[0035] If the capacity of each signaling route is exceeded, procedures may be implemented that limit signaling traffic by selectably controlling the delivery of messages according to the priority of each message. For example, messages having a priority level that is lower than the current congestion level may be discarded. Thus, the priority of a message may determine the timeliness of the delivery of the message or whether the message is delivered at all.

[0036] **FIG. 2** is a diagram of an exemplary converged network. The network includes four STPs **202**, **204**, **206**, **208** interconnected by an IP network. Service switching point (SSP) **210** is connected to STP **202** by a conventional SS7 link. Similarly, SSP **212** is connected to STP **206** by a conventional SS7 link. Signal control points (SCPs) **214** and **216** are each connected to STPs **204** and **208** by SS7 links. Likewise, SSP **218** is connected to STPs **204** and **208** by an SS7 link.

[0037] As indicated by the broken signaling links in **FIG. 2**, STP **204** is unable to reach SSP **218**. In response, STP **204** may broadcast a transfer prohibited signal (TFP) to adjacent nodes in the network, such as STPs **202**, **206**, and **208**. The TFP message has a priority of level 3. However, once the TFP message is encapsulated in an IP packet, the message is treated as having the same priority as all of the other IP packets being transmitted. If the routers inside the IP network become congested, they may discard important SS7 signaling messages while processing lower priority SS7 or other IP traffic that the carrier may consider to be of lesser importance. As a result, other nodes in the network will not be aware of the condition of the links between STP **204** and SSP **218** and may continue transmitting messages to STP **204** destined for SSP **218** that STP **201** may not be able to deliver. These messages may be discarded once the message queues of STP **204** become full.

[0038] In accordance with one aspect of the invention, the priority of the SS7 message is mapped to the type of service (TOS) octet of the IP routing envelope used to encapsulate the SS7 message before it is transmitted over the IP network. In particular, the value of the precedence field, which denotes the importance or priority of the IP datagram, may be set according to the corresponding MTP priority value.

[0039] It should be appreciated that the type of service octet in the IP header has various definitions as described in, for example, Internet Engineering Task Force (IETF) RFC 791, RFC 1349, and RFC 2474. Although each of these documents define portions of the type of service octet differently, the three precedence bits appear in the same location and are consistently defined. For example, RFC

2474 redefines the TOS octet as a differentiated services code point. The first three bits define a class selector code point (CSCP), which designates the per-hop behavior of the packet. The CSCP is designed to backward compatible with the precedence field of the TOS octet.

[0040] **FIG. 3** is a diagram of the type of service octet as defined by RFC 791. Bits **0**, **1**, and **2** are indicated as the precedence field. RFC 791 defines eight levels of precedence, with routine messages having the lowest precedence and network control messages having the highest precedence. Bits **3**, **4**, and **5** are used to indicate a desired type of service in terms of delay, throughput, and reliability, as shown in Table 1.

TABLE 1

Bit	Description	Parameters
3	Delay (D)	0 = Normal Delay 1 = Low Delay
4	Throughput (T)	0 = Normal Throughput 1 = High Throughput
5	Reliability (R)	0 = Normal Reliability 1 = High Reliability

[0041] **FIG. 4** is a diagram of the type of service field as defined by RFC 1349. As previously indicated, bits **0**, **1**, and **2** are the precedence bits. Bits **3-6** define the desired type of service as shown in Table 2.

TABLE 2

Bit				
3	4	5	6	Description
1	0	0	0	Minimize Delay
0	1	0	0	Maximize Throughput
0	0	1	0	Maximize Reliability
0	0	0	1	Minimize Monetary Cost
0	0	0	0	Normal Service

[0042] RFC 1349 defines the type of service field as a single enumerated value rather than as a set of independently definable bits. For example, the type of service field as defined by RFC 791 permits a user to select more than one type of service parameter (e.g., low delay and high throughput). In contrast, the type of service field as defined by RFC 1349 does not define each type of service bit independently. Thus, it is not possible to select more than one type of service parameter.

[0043] **FIG. 5** is a diagram of the differentiated services (DS) field as defined by RFC 2474. Bits **0-5** are defined as a differentiated services code point (DSCP). The DSCP is used to select the per-hop behavior (PHB) that a packet experiences at each node. Bits **6** and **7** are currently unused and are ignored by differentiated services compliant nodes when determining the PHB to apply to the received packet. Bits **0**, **1**, and **2** are defined as a class selector code point (CSCP). The CSCP field is designed to be backwards compatible with the precedence field in the TOS octet. Therefore, it is possible to map the CSCP to the PHB irrespective of bits **3-5** of the DSCP field to yield a network that is compatible with IP precedence use. For example, a DSCP of "001010" could map to the same PHB as a DSCP of "001000".

[0044] In accordance with one aspect of the invention, the message priority of various protocol levels may be correlated or modified to synchronize the message priority fields so that the message gets equal treatment at various protocol levels. Although the embodiments of the present invention are described in relation to SS7, most signaling protocols carry a field to designate the priority of the message. Thus, the invention should not be limited to the SS7 protocol.

[0045] In typical implementations, buffers for the different protocol layers are independent of each other. Therefore, there is a need to make sure that the message priorities are equivalent at different protocol layers. In accordance with one aspect of the invention, the message priority of the IP layer is correlated with the message priority at the signaling layer. Table 3 shows an exemplary mapping of MTP priority to IP priority.

TABLE 3

MTP	RFC 791				RFC 1349		RFC 2474
Priority	Precedence	D	T	R	Precedence	TOS	DSCP
0	001	0	1	1	1	0010	001xxx
1	010	0	1	1	2	0010	010xxx
2	011	0	1	1	3	0010	011xxx
3	100	0	1	1	4	0010	100xxx

[0046] It should be appreciated that the priority levels shown in Table 3 may be configurable by the user so that unique network translation schemes may be implemented. The capability of setting the priority of the IP packet may be provided for through-switched traffic as well as global title translation traffic, and may be set on the outbound link prior to transmission.

[0047] As previously noted, most SS7 user messages, such as SCCP, ISUP, TCAP, or MAP messages, are considered low priority and network resources or user messages are allocated on a first come, first served basis. Thus, as network resources become unavailable, for example, due to congestion, low priority user messages are frequently discarded in favor of higher priority network management messages.

[0048] **FIG. 6** is a diagram of an exemplary converged network. The network components are described above with respect to **FIG. 2** and a description thereof need not be repeated here. The network shown in **FIG. 6** is experiencing congestion at the IP layer. A first message is being sent from SSP **210** toward STP **202**, and a second message is being sent from SSP **212** toward STP **206**. Upon receiving the message, the respective STP processes the received message and determines to which node the message should be forwarded. Each message is placed in the I/O queue of the respective STP for transmission across the IP network to the next node. As previously discussed, the MTP priority of messages encapsulated in IP packets may be reflected in the type of service octet of the IP packet. However, since most user traffic has a low priority, it is likely that at least some of the packets carrying user messages are being discarded. Thus, the operator of the SS7/IP network may desire to specify a particular signaling priority and/or IP TOS based upon who is sending the message, thereby providing a more through class of service to the end user.

[0049] In accordance with another aspect of the invention, the originator's SS7 parameters are correlated to the mes-

sage priority at the signaling layer as well as the message priority of the IP layer. In one embodiment of the invention, the originator's originating point code (OPC), calling party address (CgPA) OPC, and CgPA global type address (GTA) are used to determine the priority of the message. **FIGS. 7 and 8** are exemplary global title translation database implementations for MTP priority/IP TOS correlation of SS7 signaling messages. **FIG. 7** depicts exemplary message parameters for ANSI formatted messages. **FIG. 8** depicts exemplary message parameters for ITU formatted messages. GTT databases may be implemented in any of the STP's in **FIG. 6**. For example, any of the STPs illustrated in **FIG. 6** may have an internal structure similar to that illustrated in **FIG. 1**. In such a structure, the GTT and SCCP-parameter-based priority tables illustrated in **FIGS. 7 and 8** may be implemented in GTT database **128** on DSM card **108**. In such an implementation, priority determination may be performed on DSM **108**. DSM **108** may encode priority information in the IMT message sent to DCM **106**. Priority determination process **134** may use this information to set the IP TOS octet in the outbound message.

[0050] When the first message is processed by STP **202**, it may be forwarded to the DSM **108** for global title translation and a determination of the user priority. As shown in **FIG. 7**, an SCCP message with a CgPA OPC of **244-2-1** and CdPA SSN of 8 will have a priority set to zero but the IP TOS is set to 0010 (maximum reliability). The SCCP message would leave STP **202** with a normal signaling message priority but with a higher IP TOS value. The second message received by STP **206** is similarly handled. This SCCP message, having a CgPA OPC of 5-2-1 and a CdPA SSN of 10, will have a priority field set to 1 and the IP TOS set to 0100 (maximum throughput). The second message signaling unit will leave STP **206** with a higher priority and higher IP type of service than the first message signaling unit. Thus, the second MSU will have a higher probability of being delivered than the first MSU. Although both MSU messages have the same MTP priority, the precedence and TOS bits of the IP packet are set based on the identity of the originating user. Thus, the network operator may establish different classes of service for user messages and set the priority of the user message based upon the class of service chosen by the user.

[0051] **FIGS. 9A-9C** are a flow diagram of an exemplary process for correlating signaling priority and IP type of service. Referring to **FIG. 9A**, in step **901**, the message signaling unit is received at a STP. The STP, in step **902**, determines whether the MSU should be through switched. If the MSU is to be through switched, the STP determines whether the MSU parameters match those in the OPC routing table (step **903**). As illustrated in **FIG. 8**, the OPC routing table can be used to change the routing of a signaling message based on one or more originating party parameters in the signaling message. According to the present invention, originating and/or destination party information, referred to herein as user information, can also be used to change the SS7 and/or IP priority of a message. Accordingly, if the user parameters match one or more entries in the OPC routing table, in step **904**, the STP correlates the OPC information and changes the priority and/or IP TOS as appropriate. Otherwise, in step **905**, the STP correlates the priority of the MSU to the IP TOS. For example, if the MSU is an ISUP, SCCP, OMAP, MTP, or B-ISUP message, the MTP priority values in the attached appendix may be read from the MSU and mapped to a corresponding priority value in the IP TOS octet. After completing either step **904** or step **905**, the STP routes the encapsulated MSU through the IP network to the next signaling point (step **906**).

[0052] If in step **902**, the STP determines that the MSU is not to be through switched, the STP determines if the MSU is carrying an SCCP message, for example by examining the service indicator, in step **907**. If the message is not an SCCP message, in step **908** the STP discharges the message.

[0053] If, however, the MSU is carrying an SCCP message, control proceeds to step **909** in **FIG. 9B**, where the STP determines if the calling party originating point code is present (step **909**). If not, in step **910** the STP determines if the calling party address is present. If so, in step **911**, the STP matches the calling party address against the GTT table. If either the calling party address is not present or the calling party address does not match an address in the GTT table, processing continues with step **914**, which is discussed below.

[0054] In step **909**, if the calling party OPC was present, the STP tries to match the calling party OPC against the values in the GTT table (step **912**). If no match is found, the STP correlates the priority of the MSU to the IP TOS and routes the message (step **913**). If the calling party OPC matches a value in the GTT or if the calling party address is not present or does not match a value in the GTT table, processing continues with step **914**, in which the STP matches the called party SSN if the SSN is present. After matching the called party SSN with an SSN in the GTT table, control proceeds to step **915** in **FIG. 9C**, where the STP correlates the calling party OPC and/or the calling party GTA and changes the priority or IP TOS as appropriate.

[0055] Once the priority and type of service has been determined in step **915**, the global title indicator (GTI) of the message is examined to determine the format of the global title field. In steps **916** and **917**, it is determined whether the global title indicator is 2 or 4, which indicates ANSI or ITU formatting, respectively. If the GTI equals 2, the appropriate GTT table is consulted to obtain the global title information. If the GTI equals 4, the NP and NAI parameters of the message are used to determine which GTT table to consult in step **918**. In step **919**, the selected GTT table is accessed and used to translate the called party address in the message into a point code. After the destination point code is translated, the message is routed over the signaling link associated with the translated destination point code. If the outbound signaling link is an IP link, the IP TOS octet may be set according to the value selected using the steps in **FIGS. 9A-9C**. If the outbound signaling link is an SS7 signaling link, the MTP priority may be set according to the steps in **FIGS. 9A-9C**. If the global title indicator is not equal to 2 or 4, the message is discarded in step **920**.

[0056] Accordingly, the present invention provides a system and method to assign a priority to an IP packet based on the priority of the signaling message that is encapsulated in the packet.

[0057] The present invention also provides a system and method to indicate a desired level of service for a user message and reflect the level of service in the packet in which the user message is encapsulated.

[0058] Although the examples described above relate primarily to IPv4, the present invention is not limited to

mapping SS7 priorities to IPv4 priorities. For example, the methods and systems described herein can be used to map SS7 priorities to IPv6 priorities. IPv6 priorities may be set by writing appropriate values to the traffic class octet in the IPv6 header based on an SS7 priority level and/or a user-based priority. IPv6 priorities are described in detail in IETF RFC 2474, the disclosure of which is incorporated herein by reference in its entirety.

[0059] It will be understood that various details of the invention may be changed without departing from the scope of the invention. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation, as the invention is defined by the claims as set forth hereinafter.

APPENDIX

[0060]

TABLE A1

T1.111.5 Priority Assignments for ISUP Messages

	Message Type	Priority
ACM	Address Complete	1
ANM	Answer	2
APM	Application Transport	0–1a
BLA	Blocking Acknowledgement	0
BLO	Blocking	0
CCR	Continuity Check Request	1
CFN	Confusion	0
CGB	Circuit Group Blocking	0
CGBA	Circuit Group Blocking Acknowledgement	0
CGU	Circuit Group Unblocking	0
CGUA	Circuit Group Unblocking Acknowledgement	0
COT	Continuity	1
CPG	Call Progress	1
CQM	Circuit Query	0
CQR	Circuit Query Response	0
CRA	Circuit Reservation Acknowledgement	0
CRM	Circuit Reservation	0
CVR	Circuit Validation Response	0
CVT	Circuit Validation Test	0
EXM	Exit (Intra Network Applications Only)	1
FAC	Facility	1–2b
FOT	Forward Test	1
GRA	Circuit Group Reset Acknowledgement	0
GRS	Circuit Group Reset	0
IAM	Initial Address	0
INF	Information	1
INR	Information Request	1
LPA	Loop Back Acknowledgement	1
PAM	Pass Along	0–2c
PRI	Pre-Release Information	0
REL	Release	1
RES	Resume	1
RLC	Release Complete	2
RSC	Reset Circuit	0
SGM	Segmentation	0d
SUS	Suspend	1
UBA	Unblocking Acknowledgement	0
UBL	Unblocking	0
UCIC	Unequipped Circuit Identification Code	1

aThe default value is "0." Criteria for assigning a value other than "0" is for further study.
bFurther study is needed on the exact assignment of a priority to the facility message. An assignment of 0 or 1 is given for guidance until complete service and network capability uses and needs of the facility message are determined.

[0061]

TABLE A2

T1.111.5 Priority Assignments for SCCP Messages

	Message Type	Priority
AK	Acknowledgement	0–1a
CC	Connection Confirm	1
CR	Connection Request	0–1a
CREF	Connection Refused	1
DT1	Data Form 1	0–1a
DT2	Data Form 2	0–1a
EA	Expedited Data Acknowledgement	1
ED	Expedited Data	1
ERR	Error	1
IT	Inactivity Test	1
LUDT	Long Unit Data	0–2b
LUDTS	Long Unit Data Service	0–2b
RLC	Release Complete	2
RLSD	Released	2
RSC	Reset Confirmation	1
RSR	Reset Request	1
SBR	Subsystem-Backup-Routing	0
SNR	Subsystem-Normal-Routing	0
SOG	Subsystem-Out-Of-Service-Grant	1
SOR	Subsystem-Out-Of-Service-Request	1
SRT	Subsystem-Routing-Status-Test	0
SSA	Subsystem-Allowed	3
SSP	Subsystem-Prohibited	3
SST	Subsystem-Status-Test	2
UDT	Unit Data	0–2b
UDTS	Unit Data Service	0–2b
XUDT	Extended Unit Data	0–2b
XUDTS	Extended Unit Data Service	0–2b

aThe priority of corresponding messages should match that of the connection request. Selection of the priority within the given range for the connection request is application-dependent.
bPriority 2 is reserved for OMAP use. Selection of priorities 0 and 1 is application-dependent. Priority 2 is also reserved for application used in support of calls limited to those network services or capabilities that have been approved in ANSI T1 standards to have an IAM message priority of 1 (e.g., High Probability of Completion, and Multi-level Precedence and Preemption).

[0062]

TABLE A3

T1.111.5 Priority Assignments for OMAP Messages

	Message Type	Priority
BULK	OMAP Bulk Data Transfer (for further study)	0
FTA	Facility Test Acknowledgement	2
FTL	Facility Test Loopback	2
FTR	Facility Test Results	2
FTU	Facility Test Underway	2
LEA	Link Equipment Available	2
LEU	Link Equipment Unavailable	2
MRVA	MTP Routing Verification Acknowledgement	2a
MRVR	MTP Routing Verification Result	2
MRVT	MTP Routing Verification Test	2
SRVA	SCCP Routing Verification Acknowledgement	2
SRVR	SCCP Routing Verification Result	2
SRVT	SCCP Routing Verification Test	2

aPriority level 3 may be used optionally for intranetwork MRV and SRV messages when severe network conditions, such as congestion due to a routing problem, do not allow the test to run at priority level 2. NOTE: It is recommended that client company networks only use priority level 2 for MRV and SRV messages.

[0063]

TABLE A4

T1.111.5 Priority Assignments for MTP Messages

	Message Type	Priority
CBA	Changeback-Acknowledgement Signal	3
CBD	Changeback-Declaration Signal	3
CNP	Changeback-Not-Possible Signal	3
CNS	Connection-Not-Successful	3
COA	Changeover-Acknowledgement Signal	3
COO	Changeover-Order-Signal	3
CSS	Connection-Successful-Signal	3
DLC	Data-Link-Connection-Order	3
ECA	Emergency-Changeover-Acknowledgement Signal	3
ECO	Emergency-Changeover-Order Signal	3
LFU	Link Force Inhibit Message	3
LIA	Link Inhibit Acknowledgement Message	3
LID	Link Inhibit Denied Message	3
LIN	Link Inhibit Message	3
LLI	Link Local Inhibit Signal	3
LRI	Link Remote Inhibit Test Signal	3
LUA	Link Uninhibit Acknowledgement	3
LUN	Link Uninhibit Message	3
RCP	Route-Set-Test Cluster Prohibited Signal	3
RCR	Route-Set-Test Cluster Restricted Signal	3
RCT	Route-Set-Congestion-Test Signal	0–2a
RSP	Route-Set-Test Prohibited Signal	3
RSR	Route-Set-Test Restricted Signal	3
SLT	Signalling-Link Test Message	3
SLA	Signalling-Link Test Acknowledgement	3
TCA	Transfer-Cluster-Allowed Signal	3
TCP	Transfer-Cluster-Prohibited Signal	3
TCR	Transfer-Cluster-Restricted Signal	3
TFA	Transfer-Allowed Signal	3
TFC	Transfer-Controlled Signal	3
TFP	Transfer-Prohibited Signal	3
TFR	Transfer-Restricted Signal	3
TRA	Traffic Restart Allowed Signal	3
TRW	Traffic Restart Waiting Signal	3
UPU	User Part Unavailable Message	3

aPriority assignment is always one less than current congestion level.

[0064]

TABLE A5

T1.111.5 Priority Assignments for B-ISUP Messages

	Message Type	Priority
ACM	Address Complete	1
ANM	Answer	2
BLA	Blocking Acknowledgement	0
BLO	Blocking	0
CCE	Consistency Check End	0
CCEA	Consistency Check End Acknowledgement	0
CFN	Confusion	0
CPG	Call Progress	1
CSR	Consistency Check Request	0
CSRA	Consistency Check Request Acknowledgement	0
EXM	Exit (Intra Network Application Only)	1
FOT	Forward Transfer	1
IAA	Initial Address Acknowledgement	2
IAM	Initial Address	0
IAR	Initial Address Reject	1
RAM	Reset Acknowledgement	2
REL	Release	1
RES	Resume	1
RLC	Release Complete	2
RSM	Reset	1
SGM	Segmentation (national use)	0–2
SUS	Suspend	1
UBA	Unblocking Acknowledgement	0

TABLE A5-continued

T1.111.5 Priority Assignments for B-ISUP Messages

	Message Type	Priority
UBL	Unblocking	0
UPA	User Part Available	0
UPT	User Part Test	0

What is claimed is:

1. A method of auto-correlating signaling message priority and an Internet protocol (IP) priority in a converged network environment, comprising:

(a) determining a priority level of a signaling message based on at least one of a priority parameter in the signaling message and a user-based priority;

(b) encapsulating the signaling message in an IP packet;

(c) setting a priority level of the IP packet based on the priority level determined for the signaling message; and

(d) transmitting the IP packet to an IP network.

2. The method of claim 1 wherein the signaling message comprises an SS7 message signaling unit (MSU) and wherein determining the priority level of the signaling message based on at least one of a priority parameter and a user-based priority includes determining the priority level based on a message transfer part (MTP) priority parameter.

3. The method of claim 1 wherein the signaling message comprises an SS7 message signaling unit (MSU) and wherein determining the priority level of the signaling message based on at least one of a priority parameter in the signaling message and a user-based priority includes determining the priority level based on at least one of a calling party address and an originating point code in the SS7 MSU.

4. The method of claim 1 wherein the signaling message comprises an SS7 message signaling unit (MSU) and wherein determining the priority level of the signaling message based on at least one of a priority parameter in the signaling message and a user-based priority includes determining the priority level based on at least one of a calling party address, originating point code, and subsystem number in the SS7 MSU.

5. The method of claim 1 wherein the message comprises an SS7 network management message and wherein determining the priority level of the signaling message based on at least one of a priority parameter in the signaling message and a user-based priority includes determining the priority level based on a message transfer part (MTP) priority parameter in the network management message.

6. The method of claim 1 wherein the message comprises an SS7 call setup message and wherein determining the priority level of the signaling message includes determining the priority level based on a message transfer part (MTP) priority parameter in the call setup message.

7. The method of claim 1 wherein the message comprises an SS7 database query message and wherein determining the priority level of the signaling message includes determining the priority level based on a message transfer part (MTP) priority parameter in the database query message.

8. The method of claim 1 wherein the signaling message comprises a non-SS7 call setup message and wherein determining a priority level of the signaling message includes

determining a priority level of the signaling message based on at least one of a priority parameter and a user parameter in the non-SS7 call setup message.

9. The method of claim 1 wherein the signaling message comprises a non-SS7 network management message and wherein determining a priority level of the signaling message includes determining a priority level of the signaling message based on at least one of a priority parameter and a user parameter in the non-SS7 network management message.

10. The method of claim 1 wherein the signaling message comprises a SIP message and wherein determining a priority level of the signaling message includes determining a priority level of the signaling message based on at least one of a priority parameter and a user parameter in the SIP message.

11. The method of claim 1 wherein setting the priority level of the IP packet includes setting bits in a type of service (TOS) octet of a header portion of the IP packet.

12. The method of claim 11 wherein setting bits in the TOS octet includes setting precedence bits.

13. The method of claim 11 wherein setting bits in the TOS octet includes setting type of service bits.

14. The method of claim 11 wherein setting bits in the TOS octet includes setting precedence bits and type of service bits.

15. The method of claim 1 comprising changing the priority level of the signaling message based on at least one parameter in the signaling message.

16. The method of claim 1 wherein setting the priority level of the IP packet includes consulting a lookup table.

17. A method for mapping priority for an SS7 network management message to a priority parameter in an IP message, the method comprising:

(a) receiving an SS7 network management message;

(b) reading a priority parameter from the SS7 network management message;

(c) mapping the priority parameter in the SS7 network management message to an IP priority parameter;

(d) encapsulating the SS7 network management message in an IP packet including the IP priority parameter; and

(e) transmitting the IP encapsulated SS7 network management message.

18. A signaling gateway comprising:

(a) a first interface module operatively coupled to a first network, the first interface module being capable of receiving a signaling message from the first network;

(b) a priority determination process for determining the priority of the received signaling message based on at least one of a priority parameter in the signaling message and a user-based priority; and

(c) a second interface module operatively coupled to the priority determination process and to a second network, the second interface module being capable of encapsulating the received signaling message in a packet and transmitting the packet on the second network, wherein the priority determination process is adapted to set priority information in the packet based on the priority determined for the received signaling message.

19. The signaling gateway of claim 18 wherein the signaling message comprises an SS7 message signaling unit (MSU) and the priority determination process is adapted to examine calling party information in the SS7 MSU to determine the priority of the SS7 MSU.

20. The signaling gateway of claim 18 wherein the signaling message comprises an SS7 message signaling unit (MSU) and the priority determination process is adapted to examine an SS7 message transfer part (MTP) priority parameter to determine the priority of the SS7 MSU.

21. The signaling gateway of claim 18 wherein the signaling message comprises an SS7 network management message and the priority determination process is adapted to examine a message transfer part (MTP) priority parameter to determine the priority of the SS7 network management message.

22. The signaling gateway of claim 18 wherein the signaling message comprises a non-SS7 call setup message and wherein the priority determination process is adapted to examine a calling party parameter in the non-SS7 signaling message to determine the priority of the non-SS7 signaling message.

23. The signaling gateway of claim 18 wherein the priority determination process is adapted to change the priority parameter in the signaling message.

24. The signaling gateway of claim 18 wherein the priority determination process is adapted to examine a lookup table to determine the priority of the message.

25. The signaling gateway of claim 24 wherein the lookup table includes user-defined priority information.

26. The signaling gateway of claim 25 wherein the lookup table includes user defined priority information based on at least one of a calling party address and originating point code in the received signaling message.

27. The signaling gateway of claim 25 wherein the lookup table includes user defined priority information based upon a calling party subsystem number in the received signaling message.

28. The signaling gateway of claim 25 wherein the lookup table includes message transfer part (MTP) priority values for changing the priority of the signaling message.

29. The signaling gateway of claim 18 wherein the priority determination process resides on the second interface module.

30. The signaling gateway of claim 18 comprising a database services module operatively associated with the first and second interface modules wherein the priority determination process is located on the database services module.

* * * * *