



European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report*

DESCRIPTION

METHODS, SYSTEMS, AND COMPUTER PROGRAM PRODUCTS FOR POINT CODE PROXYING BETWEEN SIGNALING POINTS

5

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application Serial No. 60/930,627, filed May 17, 2007, and U.S. Patent Application Serial No. 11/890,552 filed August 6, 2007; the disclosures of each which are incorporated herein by reference in their entireties.

10

TECHNICAL FIELD

The subject matter described herein relates to establishing connections between signaling points in a communications network. More particularly, the subject matter described herein relates to methods, systems, and computer program products for providing point code proxying between signaling points.

15

BACKGROUND

In SS7 networks, signaling points or nodes are typically identified by one or more point codes. Point codes are used for signaling message addressing, signaling message routing and signaling link alignment. In signaling message addressing for message origination, a signaling point may be provisioned with the point code to use in the destination point code (DPC) field of signaling messages that the signaling point originates and sends to another signaling point. Signaling message routing involves selecting a linkset over which a received message should be forwarded based on the DPC value of the message. Signaling message routing is typically effected by performing a lookup in a route table to identify the linkset associated with the destination point code in the signaling message. Route tables may be provisioned by a network operator when a node is brought into service.

20

25

30

Signaling link alignment is the process by two nodes connected to each end of the signaling link agree on timing in order to delineate boundaries of messages sent over the signaling link. In SS7 networks, signaling link alignment is performed by message transfer part (MTP) level 2. When a signaling link is misaligned, the two nodes connected to each end of the link

cannot properly delineate message boundaries. Link alignment involves the sending of link status signaling units (LSSUs) to establish the proper message boundaries on a signaling link. Signaling link alignment must be performed before traffic can be sent over a signaling link. Signaling link alignment is performed on a per-link basis and must be performed before traffic can be sent over a signaling link.

In order to provision a node for signaling link alignment, the node needs to know the point code of the node connected to the far end of a signaling link. This is accomplished by having an operator manually provision the point code of the node connected to the far end of the signaling link. Because this point code is typically the node that is directly adjacent to the signaling node being provisioned, this point code is often referred to as the adjacent point code (APC).

Under current network architectures, when two nodes are directly connected, the point code that each node uses in addressing and sending messages to the other node is the same as the point code that each node uses for link alignment. Figure 1A illustrates this configuration. In Figure 1A, signaling point **100** is connected to signaling point **102** by signaling linkset **104**.

For example, signaling points **100** and **102** may be end office or tandem office switches that are connected via signaling linkset **104**. In the illustrated example, it is assumed that signaling point **100** is identified by point code A and signaling point **102** is identified by point code B. For alignment of signaling links in linkset **104**, signaling point **100** is provisioned with point code B as the adjacent point code. Similarly, signaling point **102** is provisioned with point code A for alignment of signaling links in signaling linkset **104**. For originating messages to signaling point **102**, signaling point **100** is configured to use the same point code that it uses for link alignment, i.e., point code B. Signaling point **102** is provisioned to address messages to signaling point **100** using point code A.

In order to simplify network connections, it may be desirable to insert an intermediate node in between signaling points **100** and **102** to perform signaling message routing. For example, a signaling message routing node may be used to simplify interconnections between nodes that are connected in star or

mesh topologies where every node has a direct linkset interconnection with every other node. In the present example, a signaling message routing node replaces a single direct linkset interconnection between two nodes. Referring to Figure 1B, a signaling message routing node **106**, which may be a signal transfer point, is inserted between nodes **100** and **102**. It is also assumed that signaling message routing node **106** is operated by an operator of one network, labeled "home network" in Figure 1B and that signaling point **100** is operated by a different network operator, whose network is labeled "foreign network". In Figure 1B, linkset **104** illustrated in Figure 1A has been replaced by linksets **108** and **110**. In the home network, the operator of signaling point **102** must provision a new adjacent point code with signaling point **102** for link alignment purposes. In the illustrated example, this point code is point code C, which identifies signaling message routing node **106**. Similarly, the operator of the foreign network must also provision point code C for link alignment purposes. Neither network operator is required to change the point code for sending messages between nodes A and B.

One problem with the scenario illustrated in Figure 1B for the operator of the home network is that the operator of the home network may not be able to force the operator of the foreign network to change the adjacent point code on every signaling link connected to the home network. Even if the operator of the home network can force the operator of the foreign network to change all of the adjacent point codes, this operation may be burdensome on the operator of the foreign network because the foreign network may have hundreds of switches and therefore hundreds of adjacent point codes to reconfigure.

The problem of requiring the operator of the foreign network to re-provision multiple adjacent point codes for link alignment purposes is illustrated in Figures 2A and 2B. In Figure 2A, signaling point **100** in the foreign network is directly connected via linksets **112**, **114**, and **116** to switches **102A**, **102B**, and **102C** in the home network. In the home network, switches **102A**, **102B**, and **102C** are connected in a mesh configuration via signaling links **118**, **120**, and **122**. In this situation, it may be desirable for the operator of the home network to replace the mesh interconnection where each node is connected to

every other node with an interconnection including signaling message routing node **106**, as illustrated in Figure 2B.

In Figure 2B, routing node **106** is connected to signaling points **102A**, **102B**, and **102C** via linksets **122**, **124**, and **126**. Routing node **106** is
5 connected to signaling point **100** via linkset **127**. The adjacent point code on signaling point link **127** from the perspective of node **100** must be changed from point codes B1, B2, and B3 to C, the point code of signaling message routing node **106**. The operator of the foreign network may be unwilling to make these changes or may at the least charge the operator of the home
10 network for making these changes. Accordingly, requiring that the APC be changed is undesirable. In addition, as the number of interconnected nodes between the foreign and home networks increases, the amount of work that must be performed by the operator of the foreign network upon changes in the interconnections increases.

15 Accordingly, in light of these difficulties, there exists a need for facilitating migration of signaling linksets from direct interconnection between nodes to interconnection via one or more intermediate nodes that reduces the burden on the network operators with regard to provisioning of point codes for link alignment purposes.

20 Another problem that is related to the problem of requiring reprovisioning of adjacent point codes for link alignment purposes during link migration is the problem of providing IP signaling link interconnection to remote nodes. Currently, most SS7 signaling links are time division multiplexed (TDM) based. It may be desirable to migrate this older TDM-based equipment to IP-based
25 equipment, because the IP-based equipment is lower in cost on a per signaling link basis. However, smaller operators may be unwilling to replace an installed base of TDM equipment with IP equipment due to the one-time cost of such replacement. Accordingly, edge nodes are often used to convert between TDM-based signaling links and IP-based signaling links. An edge node may be
30 a relatively inexpensive (as compared to switching office upgrades) piece of equipment whose function is to convert between TDM-based signaling message transport and IP-based signaling message transport. Placing an edge node in between two signaling points may present the same adjacent

point code reprovisioning problem described above with regard to TDM-based signaling links because the edge node, when used with reliable SIGTRAN protocols, requires its own point code, which adjacent nodes must provision for link alignment. In addition, in non-North-American networks that use ITU SS7 protocols, point codes are scarce. Thus, a new point code may not be available for the edge device.

Figures 3A and 3B illustrate these problems in more detail. In Figure 3A, nodes **100** and **102** are connected via a TDM signaling linkset **104** as illustrated in Figure 1A. In Figure 3B, TDM-based signaling linkset **104**, is replaced by a TDM linkset between signaling point **100** and edge device **128** and an IP link between edge device **128** and signaling message routing node **106**. Edge device **128** uses the point code D to identify itself. Edge device **128** includes a TDM interface that connects to TDM linkset, which connects to linkset **104** with signaling point **100**. In addition, edge device **128** includes an MTP2-user peer-to-peer adaptation layer (M2PA) interface that connects to SS7 over IP linkset **130**, which connects to signaling message routing node **106**. One problem with using the M2PA protocol is that it requires point codes on each end of an M2PA signaling link. Accordingly, the operator of node **100** must provision a new point code, point code D, for link alignment on linkset **104**. Similarly, the operator of signaling point **102** must provision a new point code, point code C, for link alignment on signaling linkset **132**. Thus, the same problems described above with regard to TDM-based interfaces of requiring the reprovisioning of adjacent point codes for link alignment purposes occurs in IP networks as well. In addition, in international networks, point codes may be scarce, meaning that a separate point code may not be available for edge device **128**.

Accordingly, in light of these difficulties, there exists a need for methods, systems, and computer program products for point code proxying between signaling points.

SUMMARY

The subject matter described herein includes methods, systems, and computer program products for point code proxying. According to one method,

a direct linkset interconnection between first and second signaling points is migrated to an interconnection including signaling message routing node. At the signaling message routing node, a point code of the second signaling point is proxied for link alignment with the first signaling point. Messages received
5 from the first signaling point that are addressed to the point code of the second signaling point are routed to the second signaling point.

According to another aspect, the subject matter described herein includes a system for point code proxying. The system includes first and second signaling link interfaces for migrating a direct linkset interconnection
10 between first and second signaling points to an interconnection including a signaling message routing node. The system includes a point code proxying function for proxying a point code of the second signaling point for link alignment with the first signaling point. A routing function routes messages received from the first signaling point that are addressed to the point code of
15 the second signaling point to the second signaling point.

According to another aspect, the subject matter described herein includes an edge device with point code proxying capability. The edge device includes a time division multiplexed (TDM) signaling link interface for interfacing with a TDM-based signaling linkset. The edge device further includes an
20 Internet protocol (IP)-based signaling link interface for interfacing with an IP-based signaling linkset. The edge device further includes a point code proxying function for proxying a point code of a node reachable via the IP-based signaling linkset for alignment of signaling links in the TDM-based signaling linkset and for proxying a point code of a node reachable via the TDM-based
25 signaling linkset for link alignment of signaling links in the IP-based signaling linkset.

The subject matter described herein for providing point code proxying between signaling points may be implemented using a computer program product comprising computer executable instructions embodied in a computer
30 readable medium. Exemplary computer readable media suitable for implementing the subject matter described herein includes disk memory devices, programmable logic devices, application specific integrated circuits, and downloadable electrical signals. In addition, a computer readable medium

that implements the subject matter described herein may be distributed across multiple physical devices and/or computing platforms.

BRIEF DESCRIPTION OF THE DRAWINGS

5 Preferred embodiments of the subject matter described herein will now be explained with reference to the accompanying drawings of which:

Figure 1A is a network diagram illustrating direct interconnection of two nodes via a signaling linkset;

10 Figure 1B is a network diagram illustrating interconnection between two nodes in different networks using a signaling message routing node and different linksets;

Figure 2A is a network diagram illustrating interconnection of multiple nodes in different networks through direct linkset connections;

15 Figure 2B is a network diagram illustrating interconnection of multiple nodes in different networks using a signaling message routing node;

Figure 3A is a network diagram illustrating direct interconnection of two nodes in different networks via TDM signaling links;

Figure 3B is a network diagram illustrating interconnection of nodes in different networks using an edge device and M2PA signaling links;

20 Figure 4 is a block diagram illustrating interconnection of two nodes in different networks via a signaling message routing node that proxies a point code to the other node on one of the linksets according to an embodiment of the subject matter described herein;

25 Figure 5 is a network diagram illustrating interconnection of multiple nodes in different networks via a signaling message routing node where the signaling message routing node point proxies multiple point codes of nodes in one network on linksets that interconnect with nodes in another network according to an embodiment of the subject matter described herein;

30 Figure 6 is a network diagram illustrating point code proxying and interconnection of different networks using M2PA links and an edge device according to an embodiment of the subject matter described herein;

Figure 7 is a block diagram illustrating a signaling message routing node for proxying point codes on first and second IP-based signaling linksets according to an embodiment of the subject matter described herein;

Figure 8 is a flow chart illustrating an exemplary process for point code proxying according to an embodiment of the subject matter described herein;

Figure 9 is a network diagram illustrating linkset outages and their effects in a point code proxying environment according to an embodiment of the subject matter described herein;

Figure 10 is a block diagram illustrating an exemplary internal architecture of a signaling message routing node for providing point code proxying according to an embodiment of the subject matter described herein; and

Figure 11 is a block diagram illustrating an exemplary internal architecture for edge device with point code proxying capabilities according to an embodiment of the subject matter described herein.

DETAILED DESCRIPTION

Methods, systems, and computer program products for point code proxying are disclosed. Figure 4 is a network diagram illustrating an exemplary system for point code proxying when a signaling message routing node is used to replace a direct interconnection via a linkset between signaling nodes in different networks according to an embodiment of the subject matter described herein. Referring to Figure 4, signaling points **100** and **102** may be any type of SS7 signaling points, such as switches, databases, or signal transfer points. Signaling points **100** and **102** are assumed to have been formerly directly connected via a single linkset **104**, as illustrated in Figure 1A. It is assumed that the operator of the home network adds signaling message routing node **400** to replace the direct linkset interconnection so that signaling points **100** and **102** are now connected via linkset **104A**, linkset **104B**, and signaling message routing node **400**. Signaling message routing node **400** may be a signal transfer point either with or without SS7/IP gateway functionality. As will be described in more detail, an edge device may be utilized to connect the home network and the foreign network via IP signaling links. However, for

purposes of this example, it is assumed that linksets **104A** and **104B** are TDM-based SS7 signaling linksets.

In the illustrated example, it is assumed that signaling point **100** is identified by point code A, signaling point **102** is identified by point code B, and signaling message routing node **400** is identified by point code C. It is also assumed that when signaling points **100** and **102** were directly interconnected, signaling point **100** used point code B for link alignment on former signaling linkset **104** that interconnected the two nodes. According to one exemplary aspect of the subject matter described herein, rather than requiring the operator of the foreign network to re-provision signaling point **100** to use a new adjacent point code, i.e., point code C, for link alignment on linkset **104A**, signaling message routing node **400** proxies the point code of signaling point **102** on linkset **104A**. Signaling message routing node **400** may also proxy the point code of signaling point **100** on linkset **104B**. However, such dual proxying may not be necessary when the same network operator controls both signaling message routing node **400** and signaling point **102** and can configure or reconfigure either node. However, it may be desirable to proxy the point code of signaling point **100** on linksets in the home network if multiple direct interconnections between the networks are being replaced to reduce the amount of work required to be performed by the home network operator.

For message origination, signaling point **100** uses the same point code, i.e., point code B, to send messages to signaling point **102**. When signaling message routing node **400** receives a message addressed to point code B, signaling message routing node forwards the message on linkset **104B**. Thus, using point code proxying, the operator of the foreign network is not required to re-provision signaling point **100** for link alignment or message origination purposes when a direct interconnection is replaced by a signal transfer point and different linksets.

Figure 5 illustrates an example where signaling message routing node **400** proxies multiple point codes from the home network to signaling point **100** in the foreign network. In this example, it is assumed that the configuration in Figure 5 replaces direct interconnection as illustrated in Figure 2A. In Figure 5, it is assumed that nodes **102A**, **102B**, and **102C** in the home network

respectively use point codes B1, B2, and B3. Signaling message routing node **400** uses point code C, and node **100** uses point code A. When the direct interconnection is replaced with signaling message routing node **400**, rather than requiring the operator of the foreign network to reprovision adjacent point codes on signaling linksets **112**, **114**, and **116**, signaling message routing node **400** proxies point codes B1, B2, and B3 on signaling linksets **112**, **114**, and **116**. As a result, signaling point **100** can use the same point codes B1, B2, and B3, previously used for link alignment when the nodes were directly connected to signaling point **100**. For message origination, signaling point **100** uses point codes B1, B2, and B3 to send messages to nodes **102A**, **102B**, and **102C**.

In the examples described above, it is assumed that the linksets being replaced are TDM linksets. However, the subject matter described herein for proxying point codes may also be used with IP based signaling links where each end of the signaling link is required to have a point code for link alignment purposes. One IP based technology where signaling links are required to have point codes on each end for link alignment purposes is MTP2-user peer-to-peer adaptation layer (M2PA). M2PA is an adaptation layer that resides between the SS7 MTP layers and an IP transport layer, such as stream control transmission protocol (SCTP). M2PA is desirable because it provides reliability mechanisms, such as message sequencing, changeover, changeback, as provided by the SS7 MTP layer 2 protocol. However, the subject matter described herein is not limited to M2PA. Any suitable adaptation layer protocol that requires each end of a signaling link to have a point code for link alignment purposes is intended to be within the scope of the subject matter described herein.

Figure 6 illustrates an example of point code proxying in an environment where IP-based signaling links are utilized. Referring to Figure 6, it is assumed that the home network and the foreign were formerly connected via a single TDM linkset, as illustrated in Figure 1. However, in this example, the foreign network is assumed to be a remote network of a small carrier that may be unwilling to invest in the equipment to reconfigure signaling point **100** to include IP based facilities. Accordingly, an edge device **600** may be utilized for these

purposes. Edge device **600** interfaces with a TDM signaling linkset **104** connected to signaling point **100** and an M2PA-based signaling linkset **602** connected to signaling message routing node **400**. Nodes **100** and **102** are identified point codes A and B, as previously described.

5 In prior implementations of edge device **600**, edge device **600** would have its own separate point code, as illustrated in Figure 3B. However, according to an embodiment of the subject matter described herein, edge device **600** may proxy point code B on signaling linkset **104** for link alignment purposes and may also proxy point code A on signaling linkset **602** for link
10 alignment purposes. This dual proxying allows nodes **100** and **102** to use the same point codes they previously used for link alignment. Signaling message routing node **400** may proxy point code B on signaling linkset **602** and may also proxy point code A on signaling linkset **604**. Thus, node **100** is not required to re-provision the adjacent point code for link alignment on linkset **104**. Similarly,
15 signaling point **102** is not required to re-provision its adjacent point code for link alignment on signaling linkset **604**. Because edge device **600** proxies two point codes, no additional point codes are required to provide IP connectivity to the operator of the remote network. As a result, point codes are conserved.

In Figure 6, edge device **600** proxies a point code for alignment on a
20 TDM link and another point code for link alignment on an M2PA link. In an alternate implementation, signaling message routing node **400** may be connected to M2PA links or other SIGTRAN links where link alignment is implemented and may proxy point codes on both M2PA links. Figure 7 illustrates such an embodiment. In Figure 7, signaling message routing node
25 **400** is connected to nodes **100** and **102** via M2PA signaling links. Accordingly, signaling message routing node **400** may proxy point code B of node **102** for alignment with node **100** on M2PA link **700** and may proxy point code A of node **100** for link alignment on M2PA link **702** with node B **102**. Accordingly, the point code proxying functionality of the subject matter described herein may
30 be used in all-IP networks. Like the examples described above, the point code proxying illustrated in Figure 7 can be utilized when migrating from a direct linkset interconnection (TDM-based or IP-based) between nodes **100** and **102**

and an interconnection including signaling message routing node **400**, as illustrated in Figure 4.

Figure 8 is a flow chart illustrating exemplary over-all steps for point code proxying according to an embodiment of the subject matter described herein. Referring to Figure 8, in step **800**, a direct linkset interconnection between first and second signaling points is migrated to an interconnection including a signaling message routing node. For example, referring to Figure 1A, the direct connection between nodes **100** and **102** via linkset **104** may be migrated to an interconnection involving signaling message routing node **400**, as illustrated in Figure 4.

In step **802**, at the signaling message routing node, a point code of the second signaling point is proxied for link alignment with the first signaling point. Referring again to Figure 4, point code B of signaling point **102** is proxied on linkset **104A** so that signaling point **100** can continue to use point code B as the adjacent point code on linkset **104A** for link alignment.

Also in step **802**, signaling messages received from the first signaling point that are addressed to the second signaling point are routed to the second signaling point. Referring again to Figure 4, signaling messages from signaling point **100** addressed to point code B are routed by signaling message routing node **400** from signaling point **100** to signaling point **102**.

Point code proxying requires some changes to be made to link management procedures. One such change is illustrated in Figure 9. In Figure 9, point code B of signaling point **102** is proxied on linksets **902** connected to signaling points **100₁-100₃**. Accordingly, linksets **902** are referred to as proxy linksets. Linkset **900** is referred to as a real linkset because it uses the adjacent point codes of nodes that are actually connected to each end of the linkset. In the example illustrated in Figure 8, when a failure occurs on the real linkset, all of the proxy linksets **902** must be taken out of service. The reason that proxy linksets **902** must be taken out of service is that proxy linksets are an extension of the real linkset, and an outage on the real linkset requires that the extensions of the real linkset be taken out of service. Conversely, if any of proxy linksets **902** fails, the remaining proxy linksets and real linkset **900** can remain in service.

Figure 10 is a block diagram illustrating an exemplary internal architecture for signaling message routing node **400** according to an embodiment of the subject matter described herein. Referring to Figure 10, signaling message routing node **400** may include a plurality of internal processing modules **1002**, **1004**, and **1006** connected via a bus **1008**. Each module **1002**, **1004**, and **1006** may be implemented using a printed circuit board with a communications processor, an application processor, and associated memory mounted thereon. The communications processor controls communications with other modules via bus **1008**. The application processor implements signaling functions, such as the point code proxying feature described herein. Bus **1008** may be any suitable interconnection between modules **1002**, **1004**, and **1006**. In one implementation, bus **1008** may be implemented using Ethernet.

In the illustrated example, module **1002** is a link interface module (LIM) for interfacing with TDM-based or ATM-based SS7 signaling links. Module **1002** includes an MTP level 1 function **1010**, an MTP level 2 function **1012**, an I/O buffer **1014**, a gateway screening function **1016**, a discrimination function **1018**, a distribution function **1020**, and a message routing function **1022**. MTP level 1 function performs MTP level 1 operations, such as implementing the electrical or optical interconnection with the external signaling links. MTP level 2 function **1012** performs MTP level 2 operations, such as message sequencing, timeouts, and retransmissions. MTP level 2 function **1012** may also perform signaling link alignment. Accordingly, a sub-function of MTP level 2 function may include point code proxying function **1024**. Point code proxying function **1024** may proxy the point code of a node other than that of signaling message routing node **400** for link alignment purposes. Using the example illustrated in Figure 4, point code proxying function **1024** may proxy point code B for link alignment purposes when LIM **1002** is connected to signaling point **100** and another LIM (not illustrated in Figure 10) is connected to signaling point **102**.

I/O buffer **1014** buffers inbound and outbound signaling messages for processing by other layers. Gateway screening function **1016** screens incoming signaling messages to determine whether to allow the messages into

a network. Discrimination function **1018** determines whether signaling messages require routing or internal processing by signaling message routing node **400**. Discrimination function **1018** may forward messages that require internal processing to distribution function **1020**. Distribution function **1020** may
5 distribute such messages to the appropriate internal processing module, such as database services module **1006**, for internal processing. Discrimination function **1018** may forward messages that require routing to message routing function **1022**. Message routing function **1022** may route messages based on one or more parameters in messages to the module associated with the
10 outbound signaling link. Using the configuration in Figure 4 as an example, message routing function **1022** may route messages addressed to point code B to node **102** via signaling linkset **104B**. Thus, the configuration illustrated in Figures 4 and in detail in Figure 10 allows a routable point code to be used for link alignment purposes, which was not previously allowed in signal transfer
15 point architectures.

Module **1004** comprises a data communications module (DCM) for interfacing with IP signaling links. DCM **1010** includes a physical layer function **1026**, a network layer function **1028**, a transport layer function **1030**, an adaptation layer function **1032**, and functions **1016**, **1018**, **1020**, and **1022**
20 described with regard to LIM **1002**. Physical layer function **1026** performs open systems interconnect (OSI) physical layer functions, such as controlling access to the underlying transmission medium. In one implementation, physical layer function **1026** may be implemented using Ethernet. Network layer function **1028** performs OSI network layer operations, such as message routing.
25 Network layer function **1028** may be implemented using Internet protocol (IP). Transport layer function **1030** implements OSI transport layer functions, such as providing connectionless, connection oriented, or stream oriented communication of signaling messages between adjacent nodes. Transport layer function **1030** may be implemented using transmission control protocol
30 (TCP) in applications requiring connection oriented transport, user datagram protocol (UDP) in applications requiring connectionless transport, or stream control transmission protocol (SCTP) in applications requiring stream oriented transport.

Adaptation layer **1032** performs adaptation layer operations for allowing the transport of SS7 signaling messages over IP transport. For this purpose, adaptation layer **1032** may implement of the SIGTRAN family or other family of protocols. In one example, it is assumed that adaptation layer function **1032** implements a protocol that requires a point code at each end of an IP based signaling link. An example of such a protocol is M2PA. Because a point code is required at each end of the signaling link, adaptation layer function **1032** may include a point code proxying function **1024** that proxies the point code of a node other than that of signaling message routing node **400** for link alignment purposes. Using the configuration illustrated in Figure 6 as an example, point code proxying function **1024** of DCM **1004** may proxy point code A of signaling point **100** when DCM **1004** is connected to signaling linkset **602**. LIM **1002** may proxy point code B on linkset **104** when LIM **1002** is connected to linkset **104**. Such dual proxying allows nodes that were previously directly connected to be seamlessly migrated to new SS7 or IP based signaling links without extensive reprovisioning by other network operators. In addition, point codes are conserved.

Functions **1016**, **1018**, **1020**, and **1022** of DCM **1004** perform the same functions as the correspondingly numbered functions described above with regard to LIM **1002**. Hence, a description thereof will not be repeated herein. DSM **1006** performs database-related services for SS7 signaling messages identified as requiring internal processing by node **400**. Examples of services that may be provided by DSM **1006** include global title translation (GTT), number portability translation, such as local number portability (LNP) translation, and application layer screening functions, such as mobile application part (MAP) screening. DSM **1006** includes a service selection function for identifying a service to be provided for a message that is identified as requiring internal processing by signaling message routing node **400**. Database services function **1028** provides the selected service. Once the service is provided, message routing function **1022** routes the message to the link interface module associated with the outbound signaling link.

Edge device **600** illustrated in Figure 6 may be a scaled down version of signaling message routing node **400** illustrated in Figure 10. By scaled down, it

is meant that edge device **400** may interface with a number of signaling links that is 1 to 2 orders of magnitude less than the number of signaling links with which signaling message routing node **400** interfaces. For example, signaling message routing node **400** may interface with hundreds or even thousands of signaling links while edge device **600** may interface with fewer than 10 or fewer than 100 signaling links. Signaling message routing node **400** may be a rack mounted system with multiple blades for interfacing with multiple signaling links as well as multiple other modules for providing database and other services. Edge device **600** may be a conventional "pizza box" system that includes a single processor for implementing all of the link interface functions. Figure 11 illustrates an exemplary architecture for edge device **600** according to an embodiment of the subject matter described herein. Referring to Figure 11, edge device **600** may include a central processor **1100**, memory **1102**, a TDM signaling link interface **1104**, and an IP signaling link interface **1106**. Central processor **1100** controls the over-all operation of edge device **600** and processes passages received via TDM signaling link interface **1104** and IP signaling link interface **1106**. In order to process such packets, processor **1100** may execute one or more programs stored in memory **1102**. Examples of such programs include SS7 over TDM stack **1108**, SS7 over SIGTRAN stack **1110**, and point code proxying function **1024**. For example, for messages received over TDM signaling interface **1104**, processor **1100** may process the messages by passing the messages up the layers of SS7 over TDM stack **1108**, and, if the message is destined for an IP signaling link, forwarding the message to SS7 over SIGTRAN stack **1110** for encapsulation and forwarding over IP interface **1106**. For messages received via IP signaling link interface **1106** that are intended for TDM links, processor **1100** may perform the reverse operation. If edge device **600** is connected as illustrated in Figure 6, point code proxying function **1024** may proxy point code B on TDM interface **1104** and point code A on IP interface **1106**.

It will be understood that various details of the presently disclosed subject matter may be changed without departing from the scope of the presently disclosed subject matter. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation.

CLAIMS

What is claimed is:

1. A method for point code proxying, the method comprising:
 - (a) migrating a direct linkset interconnection between first and second signaling points to an interconnection including a signaling message routing node; and
 - (b) at the signaling message routing node:
 - (i) proxying a point code of the second signaling point for link alignment with the first signaling point; and
 - (ii) routing signaling messages received from the first signaling point that are addressed to the point code of the second signaling point to the second signaling point.
2. The method of claim 1 wherein the first and second signaling points are located in different administrative domains.
3. The method of claim 1 wherein the first and second signaling points are located within the same administrative domain.
4. The method of claim 1 wherein the first and second signaling points comprise switches.
5. The method of claim 1 wherein at least one of the first and second signaling points comprises a database node.
6. The method of claim 1 migrating a plurality of direct linkset interconnections between the first signaling point and a plurality of second signaling points with the interconnection including the signaling message routing node and proxying a plurality of point codes of the second signaling points for link alignment.
7. The method of claim 1 wherein interconnection including the signaling message routing node includes a time division multiplexed (TDM)-based linkset.
8. The method of claim 1 wherein the interconnection including the signaling message routing node includes an Internet protocol (IP)-based linkset.
9. The method of claim 8 wherein the IP-based linkset comprises an MTP layer 2-user peer-to-peer adaptation layer (M2PA) linkset.

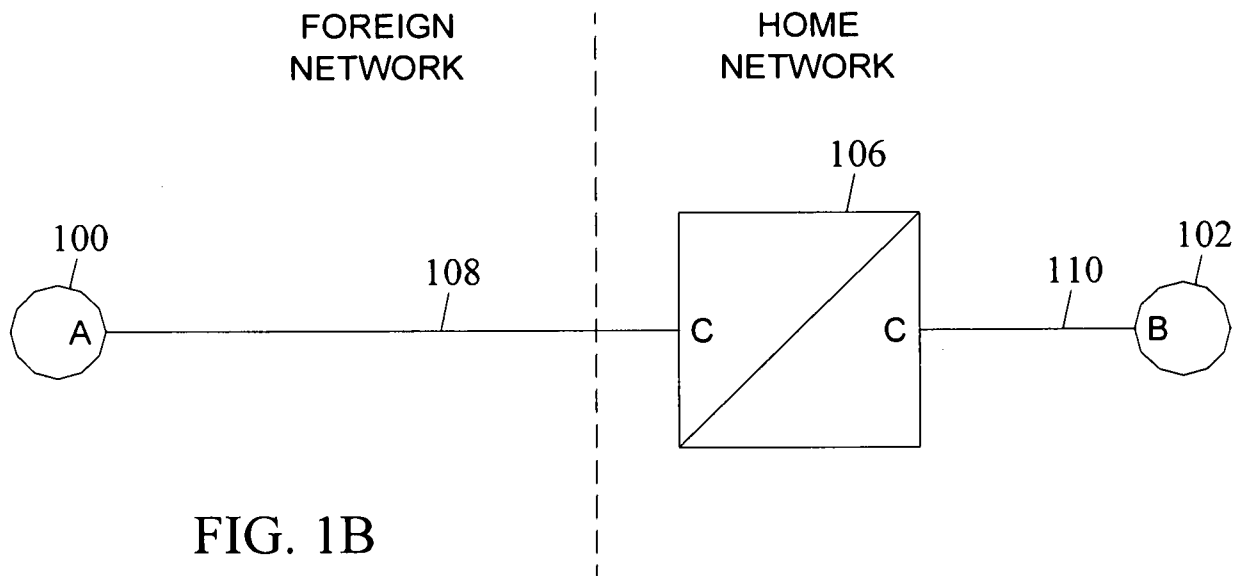
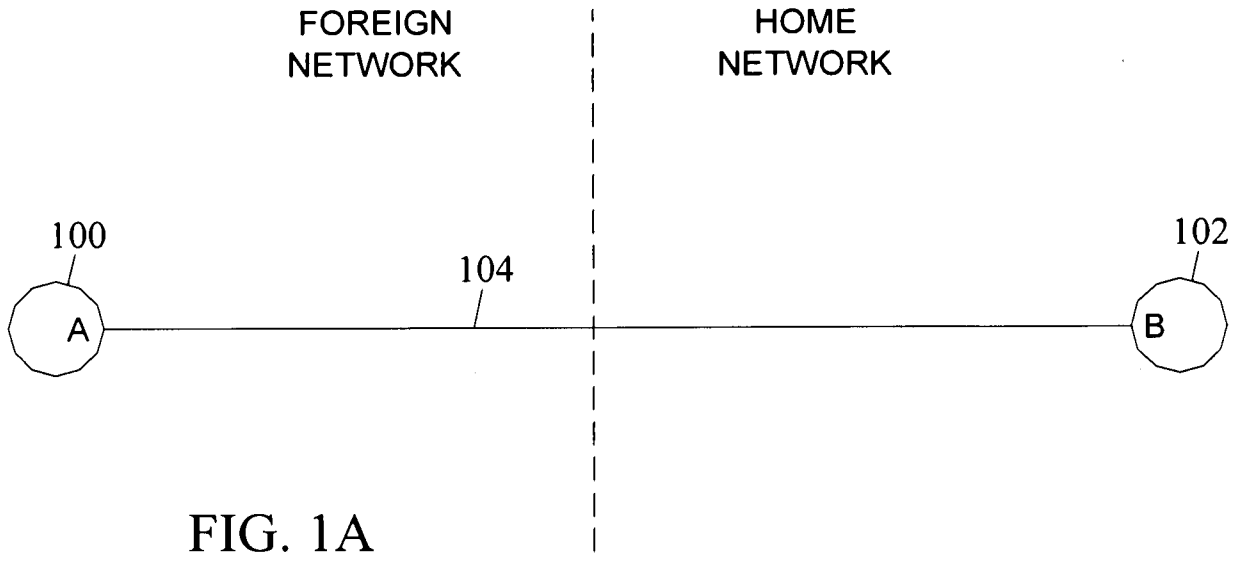
10. The method of claim 9 comprising interconnecting the first signaling point to the IP-based linkset using an edge device that proxies the point code of the second signaling point for link alignment with the first signaling point and that proxies a point code of the first signaling point on the IP based linkset for link alignment with the signaling message routing node.
11. The method of claim 1 wherein the interconnection including the signaling message routing node includes a first Internet protocol (IP) based linkset connecting the signaling message routing node to the first signaling point and a second IP-based linkset connecting the signaling message routing node to the second signaling point.
12. The method of claim 11 wherein the first and second IP-based linksets comprise SIGTRAN linksets on which link alignment is implemented.
13. The method of claim 12 wherein the first and second SIGTRAN linksets comprise MTP layer 2-user peer-to-peer adaptation layer (M2PA) linksets.
14. The method of claim 11 wherein the signaling message routing node proxies the point code of the second signaling point for link alignment with the first signaling point on the first IP-based linkset and wherein the signaling message routing node proxies the point code of the first signaling point to the second signaling point for link alignment with the second signaling point on the second IP-based linkset.
15. The method of claim 1 wherein the interconnection including the signaling message routing node includes a proxy linkset connecting the signaling message routing node to the first signaling point and a real linkset connecting the signaling message routing node to the second signaling point and wherein the method further comprises, in response to detecting failure of the real linkset or the second signaling point, taking the proxy linkset out of service.
16. A system for point code proxying, the system comprising:
- (a) first and second signaling link interfaces for migrating a direct linkset interconnection between first and second signaling points

- to an interconnection including a signaling message routing node;
- (b) a point code proxying function for proxying a point code of the second signaling point for link alignment with the first signaling point; and
- 5 (c) a routing function for routing messages received from the first signaling point that are addressed to the point code of the second signaling point to the second signaling point.
17. The system of claim 16 wherein the first and second signaling points are located in different administrative domains.
- 10 18. The system of claim 16 wherein the first and second signaling points are located within the same administrative domain.
19. The system of claim 16 wherein the first and second signaling points comprise switches.
- 15 20. The system of claim 16 wherein at least one of the first and second signaling points comprises a database node.
21. The system of claim 16 comprising a plurality of signaling link interfaces for migrating a plurality of direct linkset interconnections between the first signaling point and a plurality of second signaling points with the interconnection including the signaling message routing node and a plurality of point code proxying functions for proxying a plurality of point codes of the second signaling points for link alignment.
- 20 22. The system of claim 16 wherein the interconnection including the signaling message routing node comprises a time division multiplexed (TDM)-based linkset.
- 25 23. The system of claim 16 wherein the interconnection including the signaling message routing node comprises an Internet protocol (IP)-based linkset.
24. The system of claim 23 wherein the interconnection including the signaling message routing node comprises a SIGTRAN linkset on which point code proxying is implemented.
- 30 25. The system of claim 24 wherein the SIGTRAN linkset comprises an MTP layer 2-user peer-to-peer adaptation layer (M2PA) linkset.

26. The system of claim 23 comprising an edge device for proxying the point code of the second signaling point to the first signaling point for link alignment purposes and for proxying a point code of the first signaling point on the IP-based linkset for link alignment purposes.
- 5 27. The system of claim 16 wherein the first and second signaling link interfaces comprise IP signaling link interfaces for interconnecting the first and second signaling points using first and second IP-based linksets.
28. The system of claim 27 wherein the first and second IP-based signaling linksets comprise MTP layer 2-user peer-to-peer adaptation layer (M2PA) linksets.
- 10 29. The system of claim 27 wherein the point code proxying function is adapted to proxy the point code of the second signaling point for link alignment with the first signaling point on the first IP-based linkset and to proxy the point code of the first signaling point for link alignment with the second signaling point on the second IP-based signaling linkset.
- 15 30. The system of claim 16 wherein the interconnection including a signaling message routing node includes a proxy linkset connecting the signaling message routing node to the first signaling point and a real linkset for connecting the signaling message routing node to the second signaling point and wherein the point code proxying function is adapted to take the proxy linkset out of service in response to detecting failure of the real linkset or the second signaling point.
- 20 31. An edge device with point code proxying capability, the edge device comprising:
- 25 (a) a time division multiplexed (TDM) signaling link interface for interfacing with a TDM-based signaling linkset;
- (b) an Internet protocol (IP)-based signaling link interface for interfacing with an IP-based signaling linkset; and
- 30 (c) a point code proxying function for proxying a point code of a node reachable via the IP-based signaling linkset for alignment of signaling links in the TDM based signaling linkset and for proxying a point code of a node reachable via the TDM based

signaling linkset for link alignment of signaling links in the IP-based signaling linkset.

- 5
32. The edge device of claim 31 wherein the IP-based signaling link interface comprise a SIGTRAN signaling link interface on which link alignment is implemented.
33. The edge device of claim 32 wherein the SIGTRAN signaling link interface comprises an MTP layer 2-user peer-to-peer adaptation layer (M2PA) interface.
- 10
34. A computer program product comprising computer executable instructions embodied in a computer readable medium for performing steps comprising:
- (a) migrating a direct linkset interconnection between first and second signaling points to an interconnection including a signaling message routing node; and
- 15
- (b) at the signaling message routing node:
- (i) proxying a point code of the second signaling point for link alignment with the first signaling point; and
- (ii) routing signaling messages received from the first signaling point that are addressed to the point code of the second signaling point to the second signaling point.
- 20



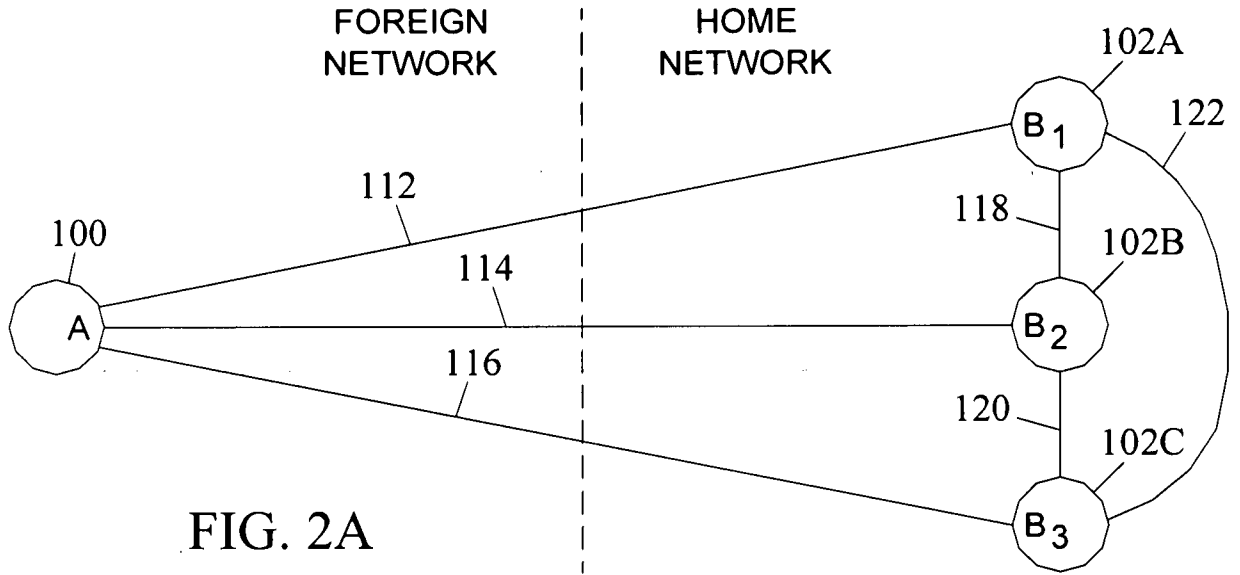


FIG. 2A

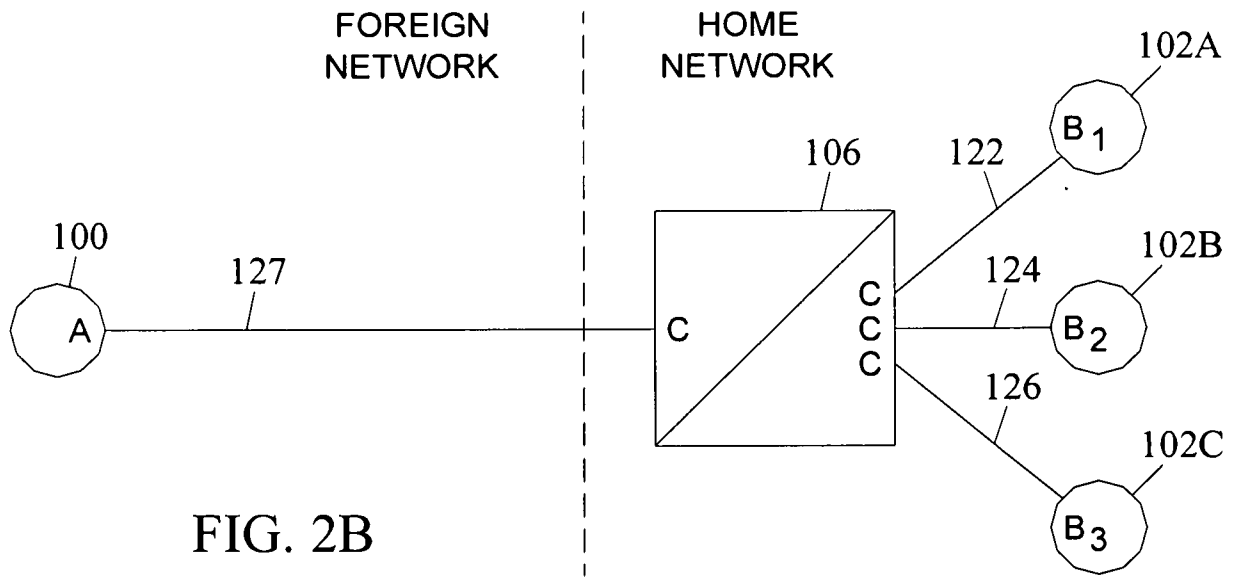


FIG. 2B

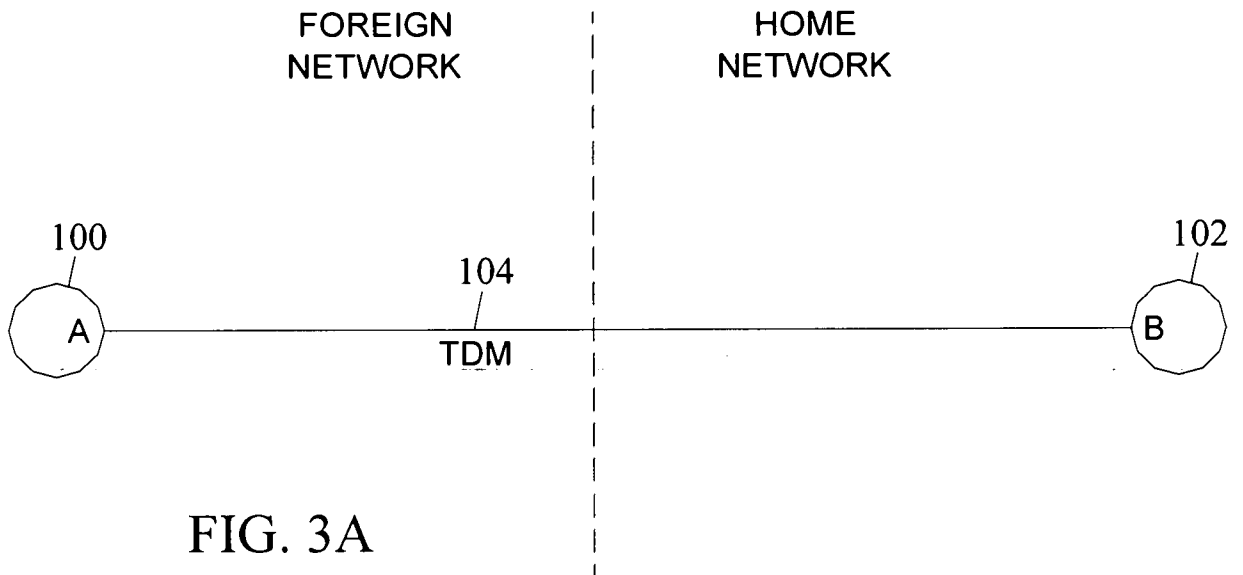


FIG. 3A

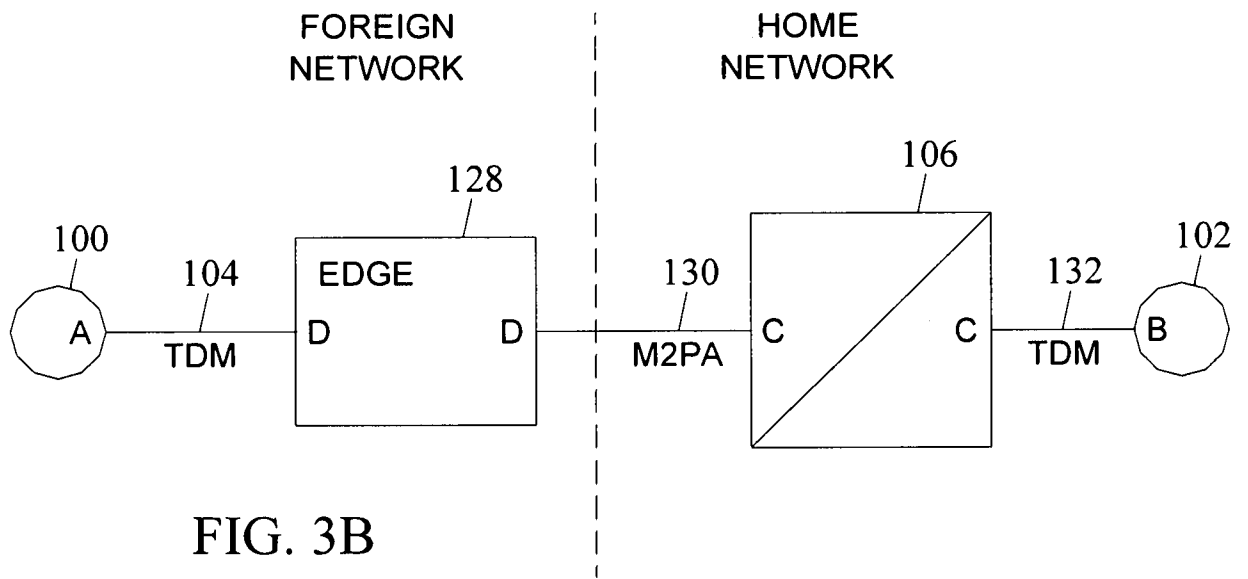


FIG. 3B

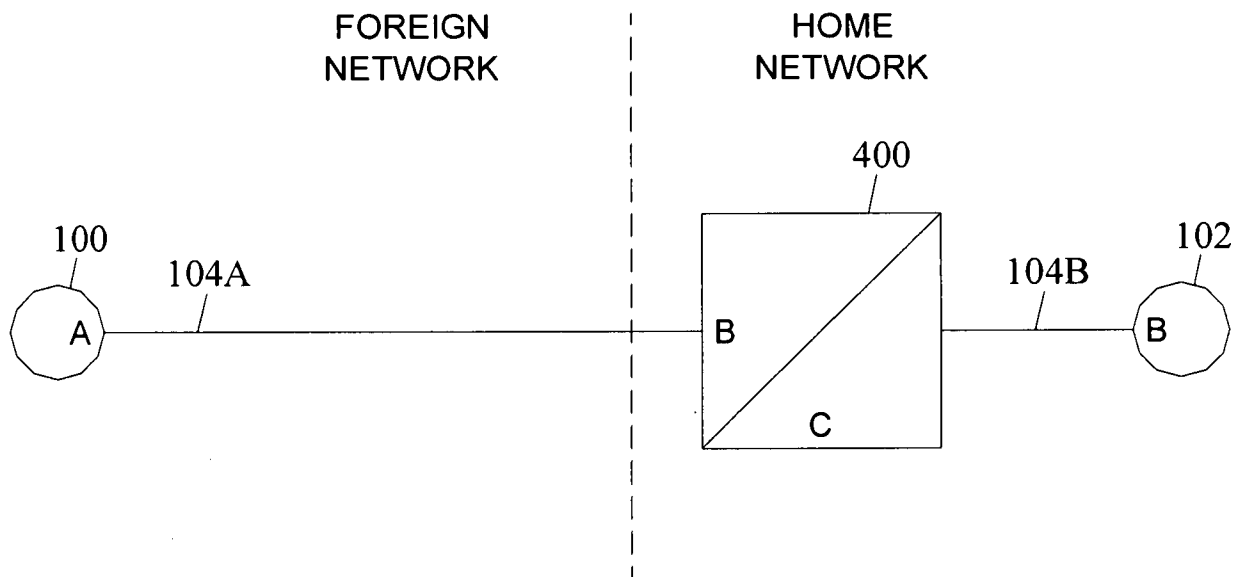


FIG. 4

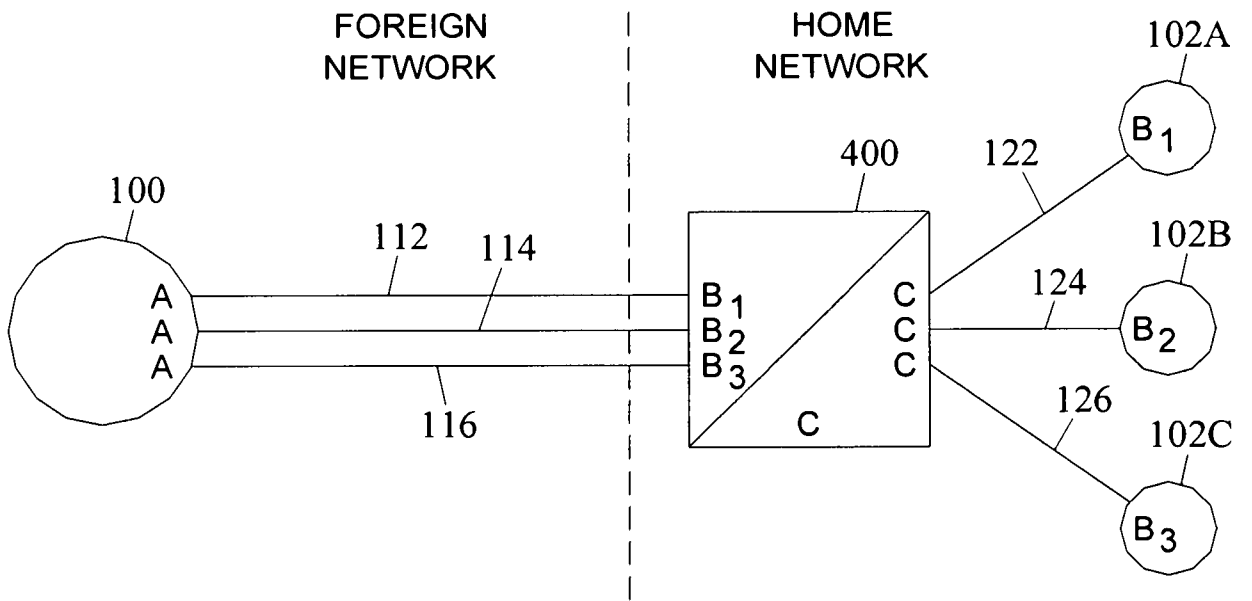


FIG. 5

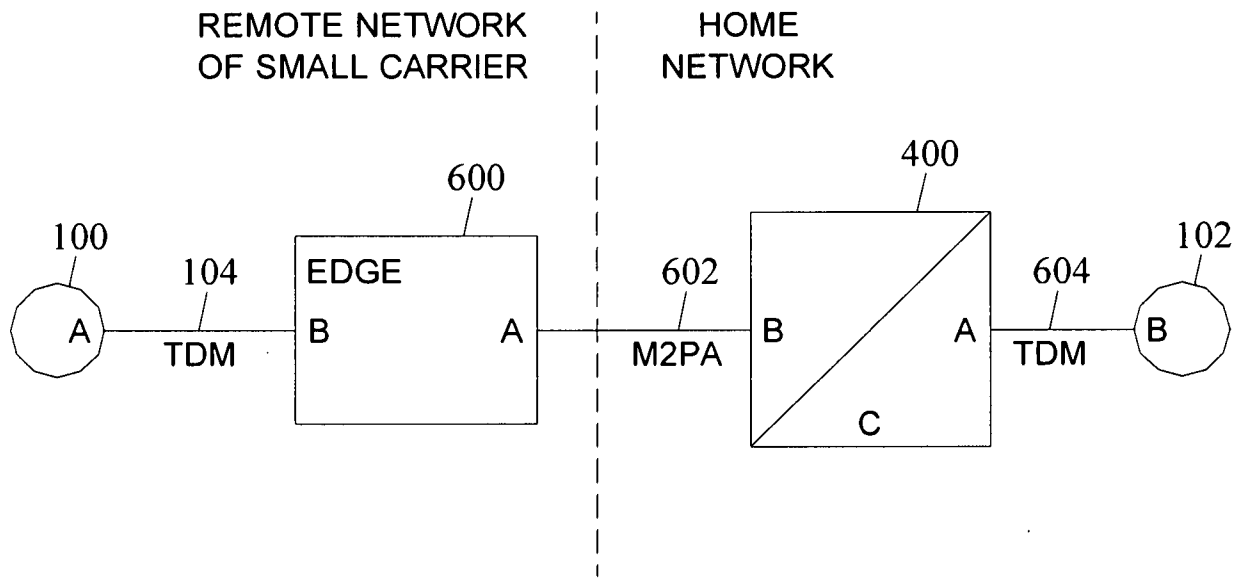


FIG. 6

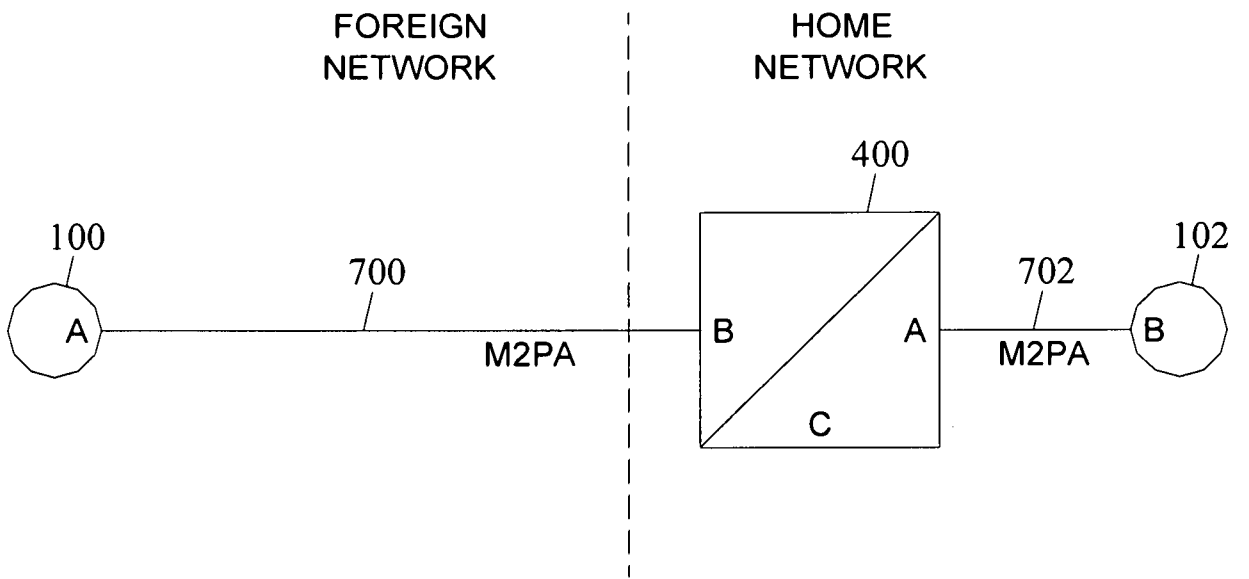


FIG. 7

8/11

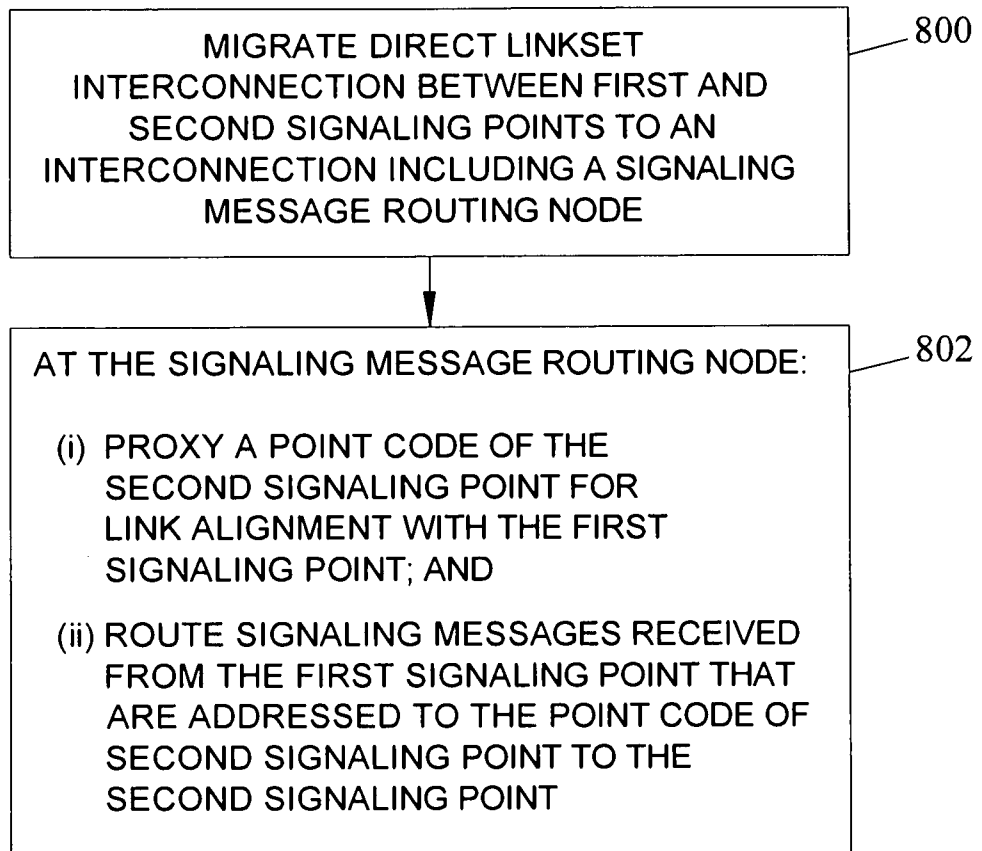


FIG. 8

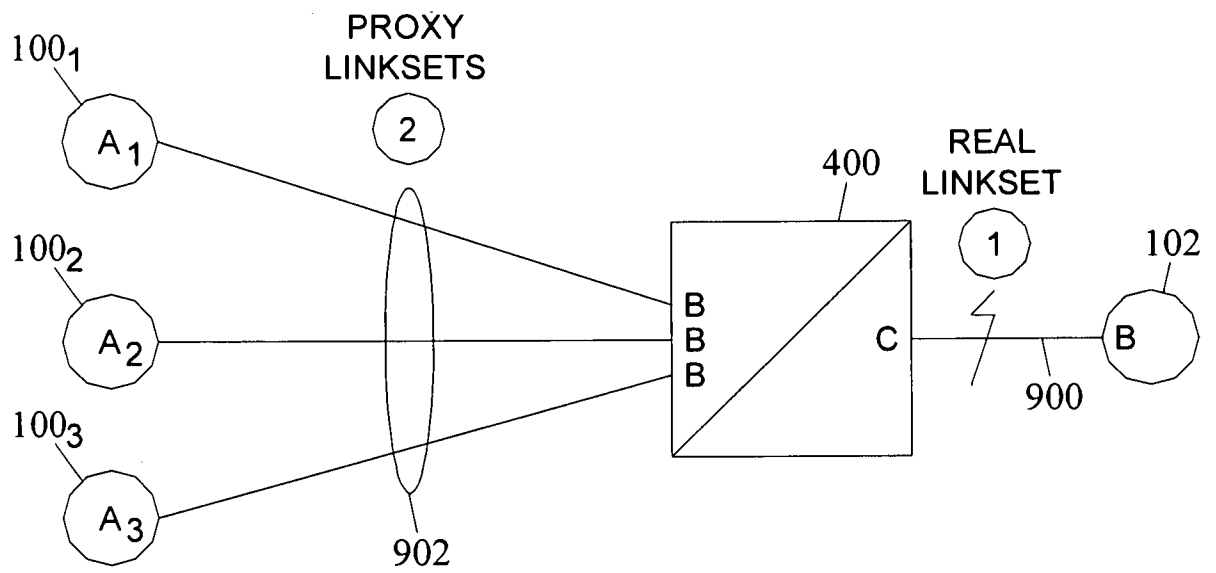


FIG. 9

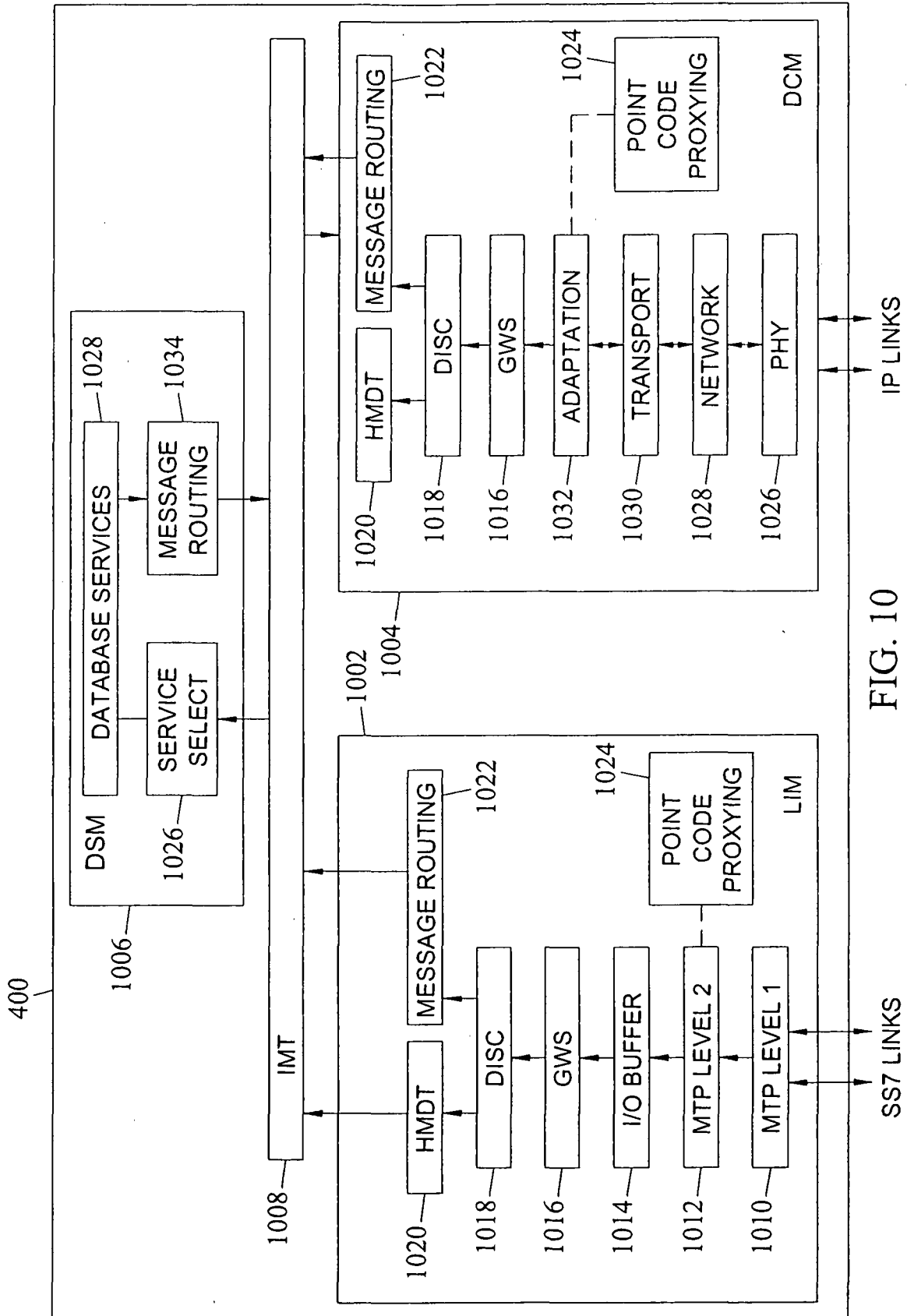


FIG. 10

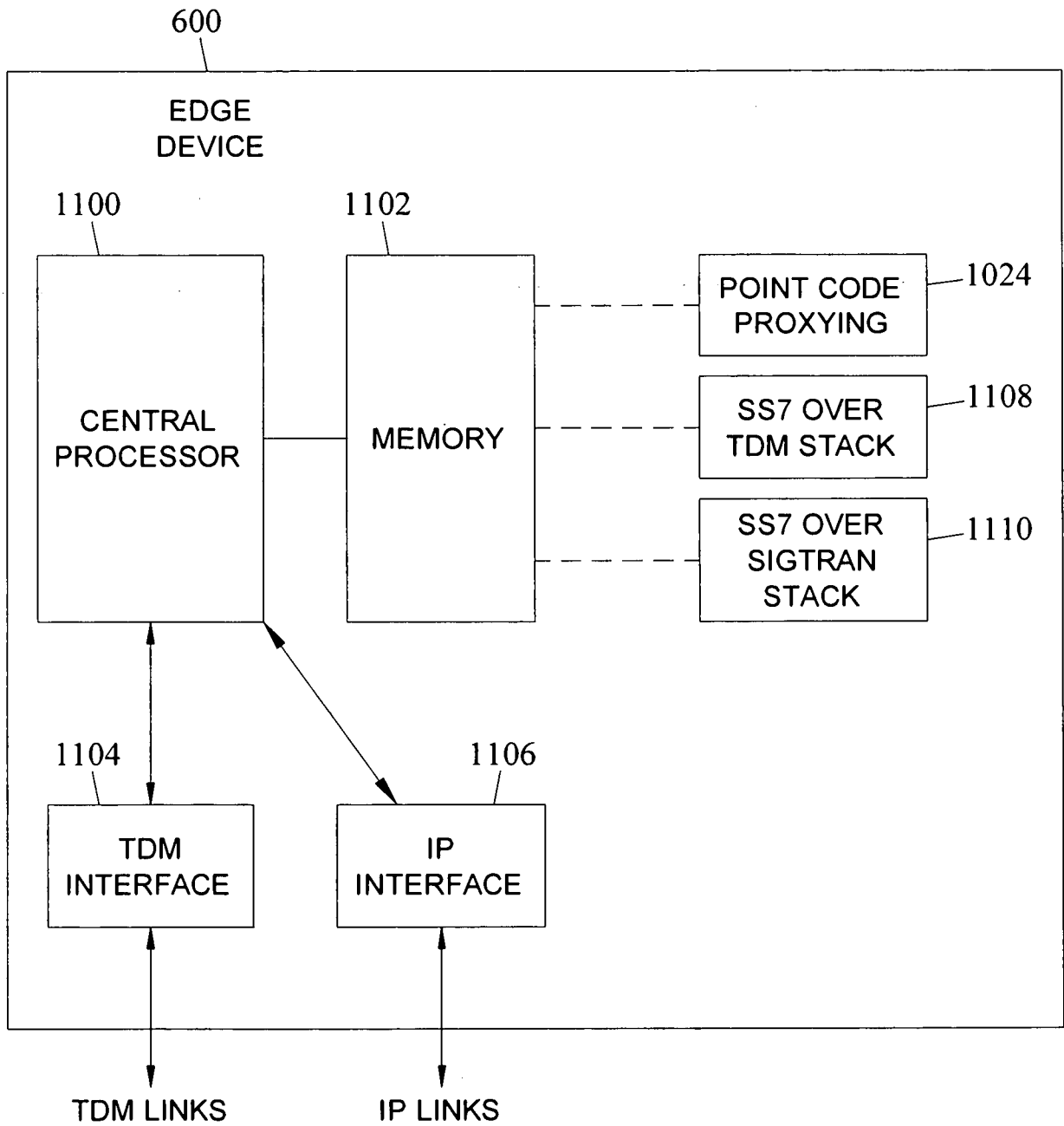


FIG. 11