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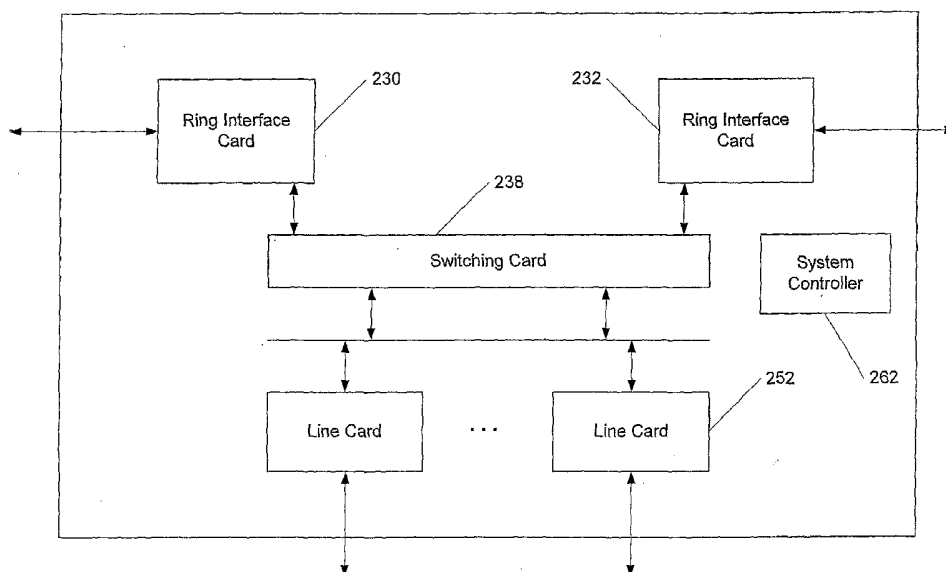
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[Continued on next page]

(54) Title: MULTIPLE SERVICES PROVISIONING IN A PACKET FORWARDING DEVICE WITH LOGICAL PORTS



(57) Abstract: Logical ports allow multiple customers to be connected to and to receive different services over a common physical port of a packet forwarding device. Such logical ports allow for customer separation and may be created based on VLAN ID and MPLS labels. In one embodiment, each service provided via a packet forwarding device is associated with a unique logical port. The logical port may span multiple physical ports.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

MULTIPLE SERVICES PROVISIONING IN A PACKET FORWARDING DEVICE WITH LOGICAL PORTS

Cross-reference to Related Application

[0001] This patent application relates to commonly-assigned U.S. Patent Application No. _____, entitled "System and Method for Providing Transparent LAN Services" filed on even date herewith, the disclosure of which is hereby incorporated by reference in its entirety.

Technical Field

[0002] The present invention relates to communication networks, and in particular to a logical port system and method.

Background

[0003] Network packet forwarding devices, such as routers, switches, multiplexers, and the like include a limited number of physical ports to which customers may connect. Different customers typically connect to different physical ports of a packet forwarding device. In addition, different services are typically provided to a given customer over different physical ports.

[0004] For example, a given customer may receive routing services over one physical port of the packet forwarding device and the same customer may receive TDM (time division multiplexing) services over another physical port of the

packet forwarding device. Hence, given a limited set of physical ports of a packet forwarding device, the packet forwarding device is limited in the number of different services and/or customers the packet forwarding device may support.

[0005] Accordingly, a need exists to provide a system and method for increasing port density at a packet forwarding device. Another need exists to provide a system and method for providing an increased number of services or providing services to an increased number of customers over a given set of ports of a packet forwarding device.

Summary

[0006] In general, the present system and method alleviate port density and permit a greater number of services to be provided over a given set of physical ports by creating logical ports. Incoming data packets on a physical port may include a VLAN ID or an MPLS (Multi-Protocol Label Switching) label. The packet forwarding device assigns the incoming data packets to a specific logical port according to the VLAN ID or the MPLS label of the incoming data packet. The packet forwarding device may also assign a specific service to each logical port. Further, different customers may be assigned separate logical ports and be connected to a common physical port.

[0007] In addition, a given logical port may include more than one physical port and may span multiple physical ports on the same slot, physical ports on different slots, or physical ports on different packet forwarding devices.

[0008] Further, each logical port may include SLA (Service Level Agreements) or QoS (Quality of Service) associated

with the logical port, thereby permitting different QoS to be provided to different logical ports on the same or different physical ports. Accordingly, according to some embodiments of the present invention, each service is associated with a logical port.

[0009] A logical port is used to identify and manage multiple sets of flows across a single interface. The logical port provides a common set of abstractions that can support delivery of a variety of services, allowing the variety of services to share common lower level mechanisms. In one embodiment, the logical port comprises one of a number of interfaces on a physical interface, such as a physical port.

[0010] Logical ports may have a one-to-one mapping to services, such that each logical port supports either a different type of service or services for different customers. Thus, a single customer may have multiple logical ports supporting multiple associated services. Higher-level services can use logical ports as a way to gather statistics on a logical port basis.

[0011] A logical port defines a group of packets according to certain pre-defined criteria. The logical ports behave similar to a physical port in terms of traffic service. The logical ports permit multiple customers to be connected to a single physical port of a node. The logical ports also permit different services to be provided to a customer over a single physical port. Thus, the logical ports help alleviate port density problems.

[0012] Additional details regarding the present system and method may be understood by reference to the following

detailed description when read in conjunction with the accompanying drawings.

Brief Description of the Drawings

[0013] FIG. 1 illustrates a communication network in accordance with an embodiment of the present invention.

[0014] FIG. 2 illustrates details of a FIG. 1 node in accordance with an embodiment of the present invention.

[0015] FIG. 3 is a functional diagram illustrating system architecture.

[0016] Common reference numerals are used throughout the drawings and detailed description to indicate like elements.

Detailed Description

[0017] FIG. 1 illustrates a network 100 in accordance with one embodiment of the present invention. As shown, the network 100 includes a ring 102, which interconnects nodes 104, 106, 108, 110. In one embodiment, the ring 102 may comprise a fiber optic ring having a Resilient Packet Ring (RPR) topology. In some applications, the network 100 may comprise a metro area network (MAN). Each of the nodes 104-110 may comprise a high speed routing/multiplexing device. Details of the nodes are described below and in U.S. Patent Application No. 09/518,956, the disclosure of which is hereby incorporated by reference in its entirety.

[0018] The network 100 has locations, or sites, of customer A and customer B connected thereto. As illustrated,

customer A has multiple locations 120, 122, 124, and 126. Each of these locations may comprise a LAN. The location 120 is connected to node 110, the location 122 is connected to node 108, and locations 124, 126 are connected to node 106.

[0019] In one embodiment, node 110 provides multiple services to customer A at location 120 over a single physical port of the node 110 using a logical port system and method. The node inspects incoming data packet received by the node over the single physical port and identifies a logical port identifier within data packet. Pursuant to one embodiment, the logical port identifier comprises an MPLS label associated with a logical port. Pursuant to another embodiment, the logical port identifier comprises a VLAN ID (Virtual Local Area Network Identifier). The node then uses a lookup table to identify, or determine, the logical port associated with the packet. The node then assigns a service to the packet based on the logical port to which it is assigned.

[0020] In another embodiment, nodes 108, 110 provide a single service to customer A at locations 120, 122 over a physical port of the node 110 and a physical port of the node 108 using a logical port system and method. The nodes 108, 110 each inspect incoming data packets received by the nodes 108, 110 over respective physical ports and identify the logical port identifier within each data packet. As discussed above, the logical port identifiers may comprise MPLS labels or VLAN IDs. The nodes 108, 110 then each use a lookup table to identify, or determine, the logical port associated with the packet. In this embodiment, the incoming data packets include identical logical port identifiers and are thus assigned to the same service for

the same customer, namely, customer A.

[0021] A management console 130 may also be connected to the ring 102 by a node 132. The management console 130 is used to permit network management and provisioning of the devices connected to the ring 102 as described in more detail below. In particular, the management console 130 may be used to access individual nodes 104-110 to establish logical ports thereon.

[0022] Several applications exist for the present system and method. For example, with respect to the provision of layer 1 services, the logical port may be used to setup cross connects for wire mode transports. This allows multipoint to point physical port aggregation and de-aggregation based on logical ports. Services such as Ethernet private lines (EPL), virtual leased lines (VLL), and circuit emulation services (CES), are examples of this type of service. In wire mode, MPLS label based logical ports provide layer 1 services.

[0023] With respect to the provision of layer 2 services, the logical support functions as if a physical port were set in a TLS (Transparent LAN Services) mode. Packets incoming on the logical port interface would be switched based on the layer 2 destination MAC address. This provides aggregation and de-aggregation service at layer 2. Thus, traffic may be aggregated using logical ports for each domain. Additional details regarding TLS mode are disclosed in U.S. Patent Application entitled "System and Method for Providing Transparent LAN Services" filed on even date herewith and incorporated herein by reference above.

[0024] With respect to the provision of layer 2.5 services,

the logical port functions to support aggregation and de-aggregation services using MPLS labels. The MPLS label of an incoming packet is examined to forward the data packet. It is to be noted that the MPLS label ranges may also be used to specify logical ports for offering layer 1 services. The mode of the logical port determines whether it forwards using layer 1 or layer 2.5.

[0025] With respect to layer 3 services, a logical port would support aggregation and de-aggregation using layer 3 header information. In this mode, also referred to as routing mode, incoming packets are routed based on the destination IP address of each incoming packet.

[0026] FIG. 2 illustrates details of one of the nodes of FIG. 1, which may be similarly configured. Node 108 is shown as an example. As illustrated, the node 108 includes ring interface cards 230 and 232, a switching card 238, line cards 252, and a system controller 262. The ring interface cards 230 and 232 convert the incoming optical signals on fiber optic cables 234 and 236 to electrical digital signals for application to switching card 238. In one embodiment, the ring interface cards 230, 232 may be implemented as a single card. Additional details regarding the ring interface cards 230 and 232 and the node 108 are disclosed in U.S. Patent Application No. 09/519,442, entitled "Dynamically Allocated Ring Protection and Restoration Technique" filed March 3, 2000, the disclosure of which is hereby incorporated by reference in its entirety.

[0027] FIG. 3 is a functional diagram 300 illustrating system architecture. The functional diagram 300 includes system controller applications 302, a control plane framework 304, and line card applications 306. The system

controller applications 302 may run on the system controller 262 of FIG. 2 and include the following modules: a management interface 310, a shelf manager 312, a system port manager 314, a policy manager 316, and a classifier 318.

[0028] In general, the classifier 318 verifies the configuration of the newly-created logical port and downloads necessary information (e.g., vlan_id or mpls label, port mode, actions to be taken for incoming/outgoing packets on the specified logical port) to the associated line card(s).

[0029] The management interface 310 may comprise a graphical user interface (GUI) based interface that permits a user at the management console 130 (FIG. 1) to remotely configure, monitor, and manage the associated node. The shelf manager 312 receives data from the management interface 310, stores the information for persistency, and forwards the information to the system port manager 314. The system port manager 314 handles the creation and the management of a logical port. The system port manager 314 specifies the mode, the administrative state, the IP address, and the MAC address of the logical port and communicates with the classifier 318.

[0030] The shelf manager 312 provides the interface to management of the system or node resources. The resources may include the cards, ports and configuration information.

[0031] The system port manager 314 provides a uniform abstraction for managing port behavior across various line card interfaces.

[0032] The classifier 318 and policy manager 316 manage the information related to creation of logical ports and the

actions associated with them. The policy manager 316 in addition also handles the communication between the switching card 238 and the line cards 252.

[0033] The shelf manager 312 on receipt of a request for creation/deletion of a logical port from the management interface 310, initiates actions to interact with the classifier 318 and port manager 314 to create/delete the logical port. The shelf manager 312 also stores/deletes the information related to the logical port in a persistent database (not shown).

[0034] The policy manager 316 in turn initiates a set of actions that get communicated to the line card port manager 320 of each line card 252 (FIG. 2) to provision the logical port at the ingress of the physical ports. The policy manager 316 also handles the policy rules applied on a logical. The policy manager 316 is responsible for storing/restoring policy rules from the database (not shown) and interacts with the classifier 318 to download policy applied on a logical port.

[0035] Accordingly, a logical port may be established by a user at the management console 130 (FIG. 1) by accessing the management interface 310 (FIG. 3). Then, using the management interface 310 the user may request a new logical port. In establishing a new logical port, the management interface 310 receives a request for a new logical port from the user. The request may include specification of whether the logical port is to be MPLS label based, or VLAN ID based, and may specify the physical port over which the logical port will be provided. The request may also include specification of data rate limits associated with the logical port. The management interface 310 then forwards

this information to the shelf manager 312, which provides this information to other of the system controller modules. Lastly, this information is downloaded to a line card manager 320 for control of the associated line card.

[0036] The new logical port is then provisioned via the management interface 310. To provision the new logical port, a user at the management console 130 (FIG. 1) then specifies a customer, a service, and a quality of service (QoS) for the new logical port. At this point, the new logical port is established and provisioned.

[0037] The above-described embodiments of the present invention are meant to be merely illustrative and not limiting. Thus, those skilled in the art will appreciate that various changes and modifications may be made without departing from this invention in its broader aspects. Therefore, the appended claims encompass all such changes and modifications as fall within the scope of this invention.

Claims

What is claimed is:

- 1 1. A method of providing multiple services over a
2 single physical port of a packet forwarding device, the
3 method comprising:
 - 4 providing a lookup table associating a set of
5 logical port identifiers with a set of logical ports;
 - 6 receiving a first incoming packet at a physical
7 port of a packet forwarding device, the first incoming
8 packet having a first port identifier;
 - 9 assigning a first logical port to the first
10 incoming packet based on the first port identifier of
11 the first incoming packet using the lookup table, the
12 first logical port being associated with a first
13 service;
 - 14 receiving a second incoming packet at the physical
15 port of the packet forwarding device, the second
16 incoming packet having a second port identifier, the
17 second port identifier being different from the first
18 port identifier;
 - 19 assigning a second logical port to the second
20 incoming packet based on the second port identifier of
21 the second incoming packet using the lookup table, the
22 second logical port being associated with a second
23 service, the second service comprising a service
24 different from the first service;
 - 25 forwarding the first incoming packet in accordance
26 with the first service;

27 forwarding the second incoming packet in
28 accordance with the second service.

1 2. The method of claim 1, wherein the logical port
2 identifiers each comprise a VLAN ID.

1 3. The method of claim 1, wherein the logical port
2 identifiers each comprise an MPLS label.

1 4. The method of claim 1, wherein the first and
2 second services are selected from a group including voice
3 service, routing service, point-to-point service, layer 1
4 service, layer 2 service, layer 3 service, and MPLS service.

1 5. The method of claim 1, wherein the first service
2 is provided to a first customer and the second service is
3 provided to a second customer.

1 6. A method for providing link aggregation across
2 separate physical ports, the method comprising:

3 providing a lookup table associating a set of
4 logical port identifiers with a set of logical ports;

5 receiving a first incoming packet at a first
6 physical port, the first incoming packet having a first
7 port identifier;

8 assigning a first logical port to the first
9 incoming packet based on the first port identifier of
10 the first incoming packet using the lookup table, the
11 first logical port being associated with a first
12 service;

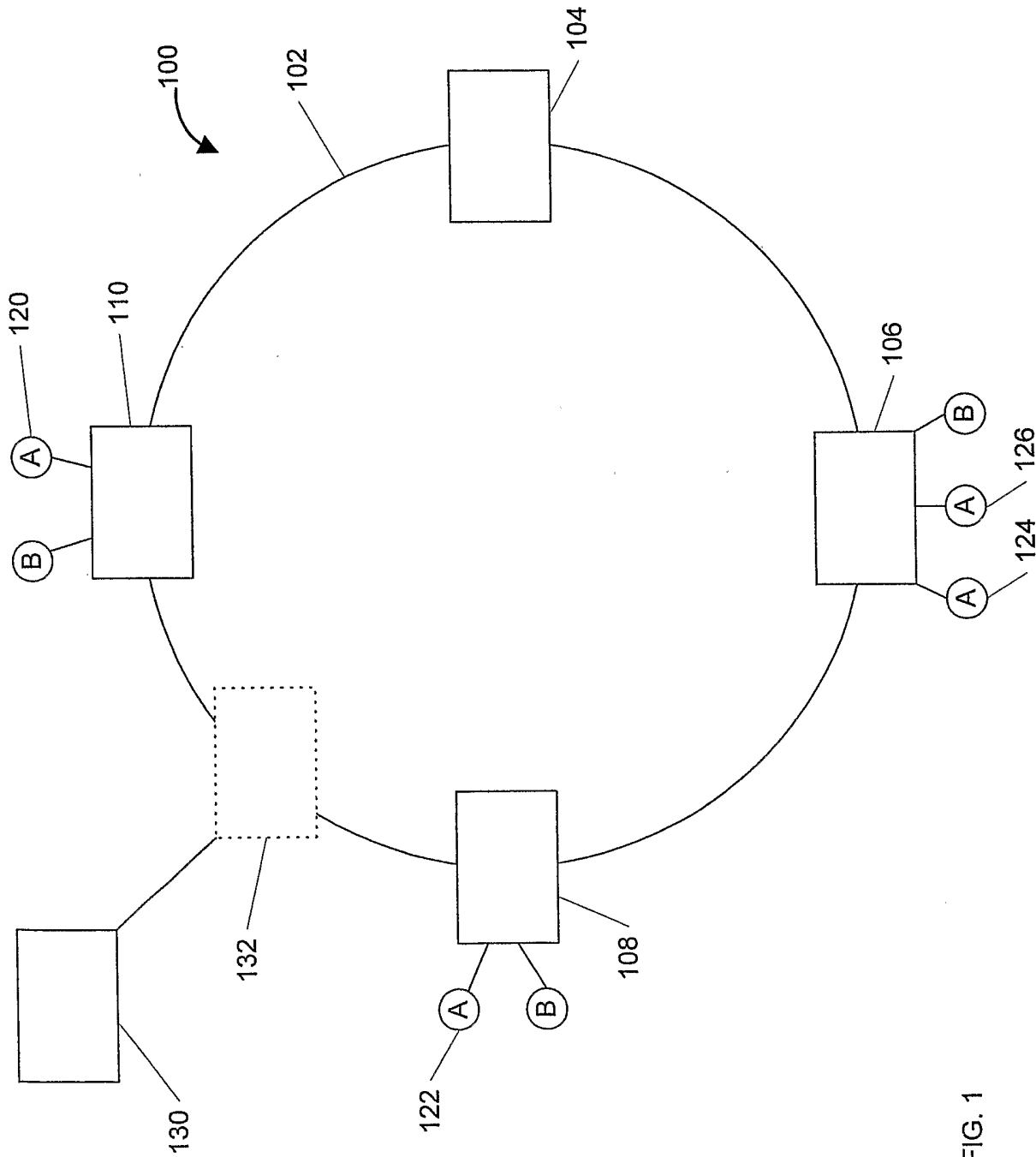
13 receiving a second incoming packet at a second
14 physical port of the packet forwarding device, the
15 second incoming packet having a second port identifier,
16 the second port identifier being identical to the first
17 port identifier;

18 assigning the first logical port to the second
19 incoming packet based on the second port identifier of
20 the second incoming packet using the lookup table, the
21 second logical port being associated with a second
22 service, the first logical port being associated with a
23 single service and a single customer.

1 7. The method of claim 6, wherein the first and
2 second physical ports comprise separate ports on a single
3 slot of a packet forwarding device.

1 8. The method of claim 6, wherein the first physical
2 port comprises a port at a first slot of a packet forwarding
3 device and the second physical port comprises a port at a
4 second slot of the packet forwarding device.

1 9. The method of claim 6, wherein the first physical
2 port comprises a port at a first packet forwarding device
3 and the second physical port comprises a port at a second
4 packet forwarding device.



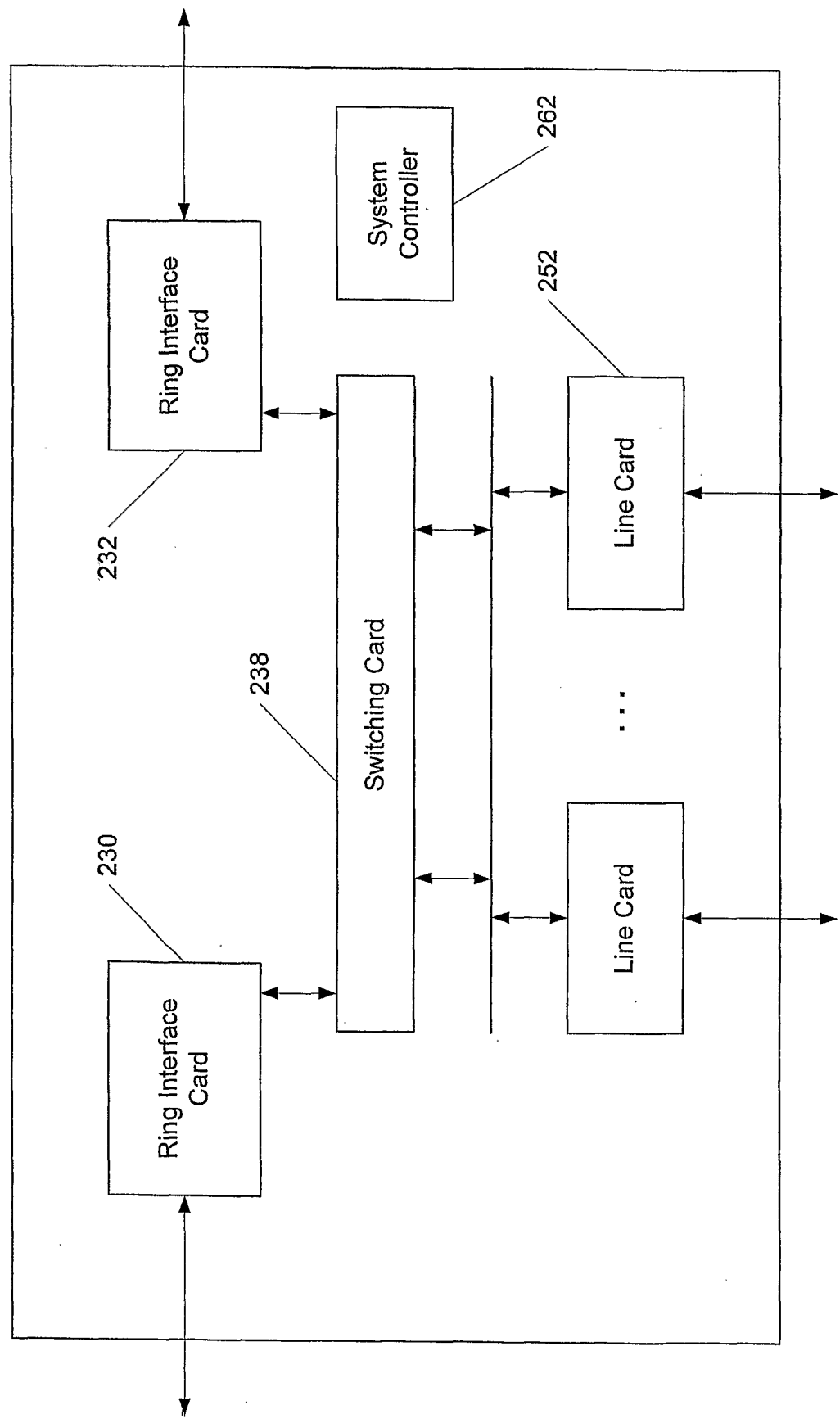


FIG. 2

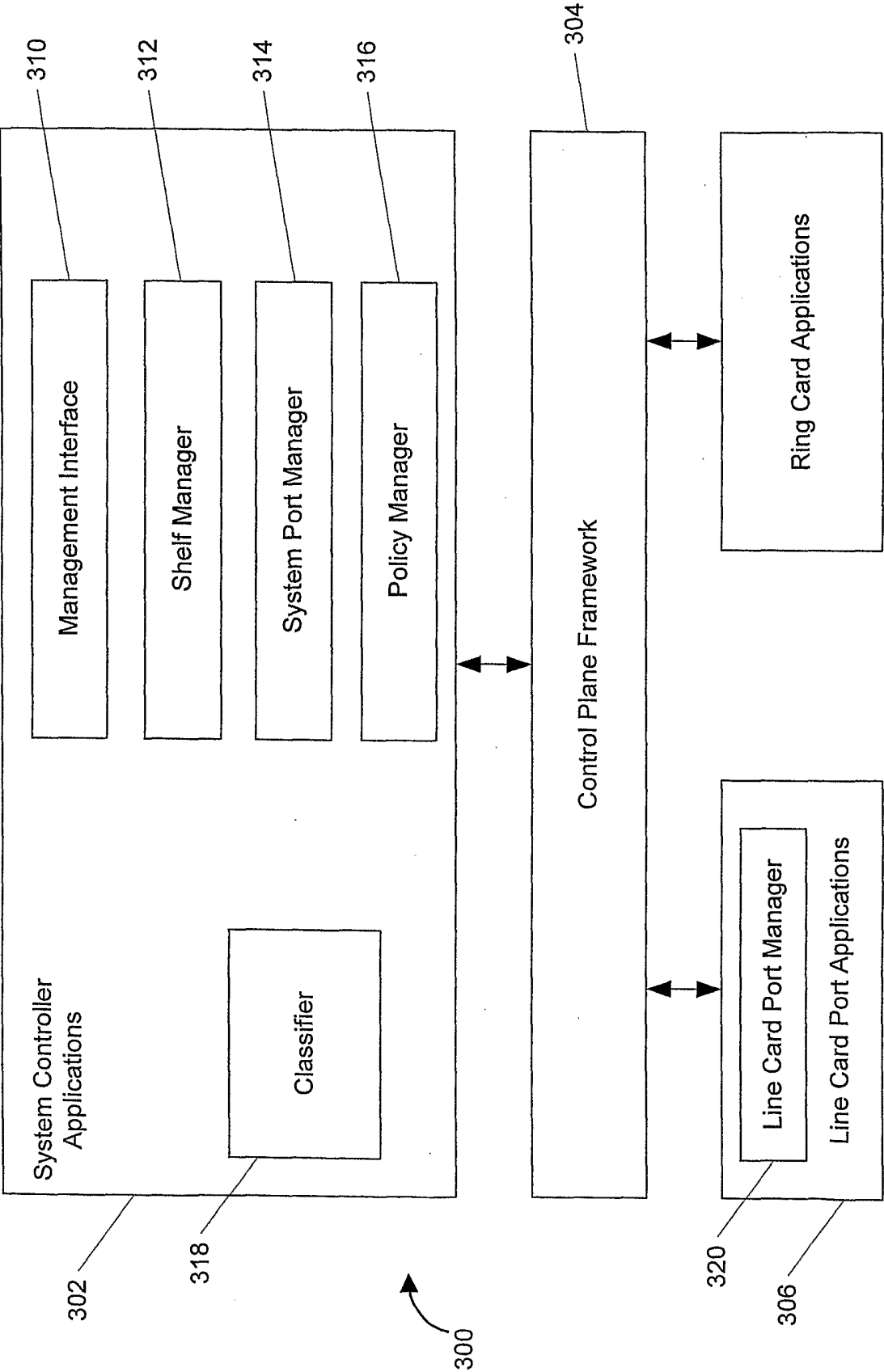


FIG. 3

INTERNATIONAL SEARCH REPORT

national Application No
PCT/US 03/24999

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/56 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L

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

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

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 978 378 A (READY DAVID C ET AL) 2 November 1999 (1999-11-02) abstract column 1, line 41 -column 2, line 65 column 3, line 5 -column 4, line 67 column 5, line 12-20 claim 1 figures 1-3, 4A, 4B ---	1-9
X	EP 1 024 642 A (NORTEL NETWORKS CORP) 2 August 2000 (2000-08-02) abstract paragraphs '0002!', '0008!', '0010!', '0018!', '0023!'-'0028!', '0030!', '0035!'-'0037! figure 6 --- -/--	1-9

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
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- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *Z* document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/24999

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2001/049739 A1 (MIYAMOTO TAKAHISA ET AL) 6 December 2001 (2001-12-06) abstract claim 1 -----	3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/24999

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US 5978378	A	02-11-1999	NONE	
EP 1024642	A	02-08-2000	US 2002188720 A1 CA 2293130 A1 EP 1024642 A2	12-12-2002 28-06-2000 02-08-2000
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