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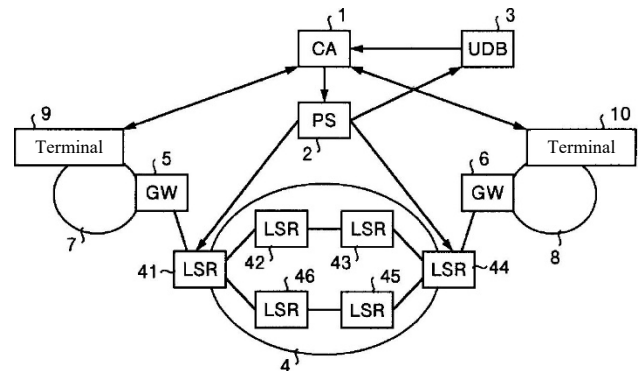
(54) TITLE OF THE INVENTION Network policy control system and policy server used therein

PROBLEM

To obtain a network control system capable of autonomously determining a transfer path when an edge label switch router in an IP core network receives a stream.

RESOLUTION MEANS

The system includes a call control device 1 which performs processing for establishing a session between two terminals 9, 10 accommodated in different label switch routers 41 to 46 in an IP core network 4, a policy server 2 which performs resource reservation if a virtual communication path capable of accommodating a CoS and resource capacity of a stream exists, based on the address and CoS of the source and destination terminals of the stream transmitted in the session, in response to a resource reservation request from the call control device 1 when a session is established, and first stage label switch routers 41, 44 which determine a virtual communication path that matches the destination address and CoS stored in the packets of the stream and transfer the stream according to the virtual communication path.



CLAIMS

[Claim 1] A network policy control system, comprising:
an IP core network having a plurality of label switching routers;
two terminals stored in different label switching routers in the IP core network; and a call control device for establishing a session between the two terminals;

further comprising a policy server including:
virtual communication path defining means for defining a virtual communication path, which is specified by a combination of a first stage label switching router, a last stage label switching router and a service class in the IP core network, and which is composed of one or more label switched paths;
virtual communication path setting means for setting the virtual communication path in the label switching router; and
resource reserving means for selecting a virtual communication path that accommodates a stream from the virtual communication path defining means based on the address and service class of a source and destination terminal of the stream transmitted in a session in response to a resource reservation request from the call control device when a session is established between the two terminals, and reserving resources when a determination is made that the remaining resource capacity of the selected virtual communication path can accommodate the resource capacity of the stream;

wherein
a first stage label switching router that first receives a stream from the terminal determines a virtual communication path that matches the destination address and service class stored in the packets of the stream, and transfers the stream in accordance with the virtual communication path.

[Claim 2] The network policy control system according to claim 1, further comprising:

a user information database for storing user information including a terminal address, a service class, and a line resource capacity of a terminal accommodated in the label switching router;

wherein

the call control device includes resource reservation requesting means for acquiring a service class and line resource capacity to be applied to the stream of the session acquired from the user information to create a resource reservation request, which is transmitted to the policy server, when receiving a session establishment request/response between the two terminals.

[Claim 3] The network policy control system according to claim 1 or 2, wherein the resource reserving means further has a function of adding the line resource capacity to the virtual communication path and ensuring the service class and line resource capacity of the stream in the virtual communication path, when a determination is made that the remaining resource capacity of the virtual communication path cannot accommodate the line resource capacity of the stream.

[Claim 4] The network policy control system according to any one of claims 1 to 3, wherein the service class further includes a delay class that classifies the delay time required for the stream to travel from the input to the output of the IP core network.

[Claim 5] The network policy control system according to any one of claims 1 to 4, wherein
the line resource capacity is defined by a line resource capacity class that is classified according to the capacity of the guaranteed line resource; and
the resource reserving means has a function of selecting, from the selected virtual communication paths, a label switched path having a remaining resource capacity that is sufficiently larger than the resource capacity corresponding to the line resource capacity class.

[Claim 6] A network policy control system, comprising:
an IP core network having a plurality of label switching routers;
two terminals stored in different label switching routers in the IP

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core network; and a call control device for establishing a session between the two terminals, the network policy control system controlling transmission of a stream via a VPN established between the two terminals;

further comprising a policy server containing:

a label switched path defining means for defining a label switched path in which a required resource capacity and a destination network are set for each VPN; and

a label switched path setting means for selecting a label switched path accommodating the stream from the label switched path defining means when a session is established between the two terminals, and setting the label switching router so that the stream is transferred to the label switched path, when a determination is made that the line resource capacity of the stream can be accommodated in the line resource capacity allocated to the VPN of the selected label switched path;

wherein

the label switching router constructs a VPN on a set label switched path and transfers the stream.

[Claim 7]

A network policy control system for establishing a session in two terminals stored in different label switching routers in the IP core network having a plurality of label switching routers, and performing policy control of the transmitted stream, further comprising a policy server including:

a user information database for storing user information including a terminal address, a service class, and a line resource capacity of a terminal accommodated in the label switching router, and assigning a VPN identifier for each VPN;
a call control device including a resource reservation requesting means for acquiring from the user information database a service class and a line resource capacity to be applied to a stream to be transmitted to a session corresponding to the VPN identifier, and creating the resource reservation request which is transmitted to the policy server, when receiving a session establishment request/response including a VPN identifier between the two terminals;

virtual communication path defining means for defining a virtual communication path, which is specified by a combination of a first stage label switching router, a last stage label switching router and a service class in the IP core network, which is composed of one or more label switched paths, and in which a line resource capacity for each VPN is specified;

virtual communication path setting means for setting the virtual communication path in the label switching router; and
resource reserving means for selecting a virtual communication path from the virtual communication path defining means, conforming with the address and service class of a source and destination terminal of the stream transmitted in a session in response to a resource reservation request from the call control device when a session is established between the two terminals, and reserving resources when a determination is made that the remaining resource capacity of the corresponding VPN of the selected virtual communication path can accommodate the resource capacity of the stream;

wherein

a first stage label switching router that first receives a stream from the terminal determines a virtual communication path that matches the destination address and service class stored in the packets of the stream, and transfers the stream in accordance with the virtual communication path.

[Claim 8] A network policy control system comprising:
networks accommodated in different label switching routers in an IP core network; an intra-VPN user information database installed in the VPN for storing user information including an address, a service class, and a line resource capacity of the network for each network, with a VPN identifier assigned to each VPN; an intra-VPN call control device accommodated in each of the different networks; a call control device that establishes a session between two terminals existing in the different networks; and a call control device and policy server that perform transmission control of a stream between the two terminals; wherein

the intra-VPN call control device includes means for acquiring a service class/line resource capacity and a VPN identifier to be applied to the stream corresponding to the VPN identifier from the user information in the intra-VPN user information database provided in the network to which the terminal belongs, when receiving a session establishment request/response including a VPN identifier from a terminal in a network accommodated by the intra-VPN call control device, for attaching and transferring to the session establishment request/response;

the call control device includes resource reservation requesting means for transmitting a resource reservation request for the stream to the policy server when a session establishment request/response to which the service class/line resource capacity and VPN identifier are attached is received from the intra-VPN call control device;

the policy server includes:

virtual communication path defining means for defining a virtual communication path, which is specified by a combination of a first stage label switching router, a last stage label switching router and a service class in the IP core network, which is composed of one or more label switched paths, and in which a line resource capacity for each VPN is specified;

virtual communication path setting means for setting the virtual communication path in the label switching router; and
resource reserving means for selecting a virtual communication path from the virtual communication path defining means, conforming with the address and service class of a source and destination terminal of the stream in response to a resource reservation request from the intra-VPN call control device, and reserving resources when a determination is made that the remaining resource capacity of the corresponding VPN of the selected virtual communication path can accommodate the resource capacity of the stream; and

the first stage label switching router that stores the terminal determines a virtual communication path that matches the destination address and service class stored in the stream from the terminal, and transfers the stream in accordance with the virtual communication path.

[Claim 9] A network policy control system, comprising:
an IP core network having a plurality of label switching routers; two terminals accommodated in different label switching routers; a secondary call control device that performs an initial transfer process of a session establishment request/response from the two terminals in the IP core network; and a secondary policy server associated with each of the secondary call control devices; wherein

the secondary call control device includes means for transmitting a resource reservation request for a stream whose destination is a terminal accommodated in the other secondary call control device to the secondary policy server associated with the secondary call control device, upon receiving a session establishment request/response;

the secondary policy server includes means for selecting a label switched path for accommodating the stream when receiving the resource reservation request from the secondary call control device associated with the secondary policy server, and setting the label switching router to transfer the stream to the label switched path when a determination is made that the selected label switched path can accommodate the stream; and
when a session between the two terminals is established, the secondary policy server sets a label switched path that specifies a transfer procedure for the stream for the label switching router.

[Claim 10] A network policy control system, comprising:
 an IP core network having a plurality of label switching routers;
 two terminals accommodated in the different label switching routers;
 a secondary call control device accommodating the two terminals and performing an initial transfer process of a session establishment request/response from the two terminals in the IP core network;
 a secondary policy server associated with each of the secondary call control devices; and a user information database storing user information including a terminal address, a service class, and a line resource capacity of the terminals accommodated in the label switching routers;
 the secondary call control device including:
 means for acquiring a service class/line resource capacity to be applied to a stream having a terminal accommodated in another secondary call control device as a destination from the user information database when receiving a session establishment request/response, which is then attached to the session establishment request/response and transferred; and
 means for transmitting the resource reservation request for the stream to the secondary policy server associated with the secondary call control device;
 wherein

the secondary policy server includes resource reserving means for selecting a virtual communication path that matches the addresses and service class of the source and destination terminals of the stream in response to the resource reservation request from the secondary call control device associated with the secondary policy server, and for reserving resources when a determination is made that the remaining resource capacity of the selected virtual communication path can accommodate the resource capacity of the stream; and
 the resource reservation process for a stream having one terminal as a destination is performed by a secondary call control device and a secondary policy server stored in the terminal on the source side of the stream.

[Claim 11] A network policy control system, comprising:
 networks accommodated in different label switching routers in an IP core network; an intra-VPN user information database installed in the VPN for storing user information including an address, a service class, and a line resource capacity of the networks for each network, with a VPN identifier assigned to each VPN; an intra-VPN call control device accommodated in each of the different networks; a secondary call control device accommodated in the intra-VPN call control device; and a secondary policy server associated with each of the secondary call control devices; wherein
 the intra-VPN call control device includes means for acquiring a service class/line resource capacity and a VPN identifier to be applied to the stream corresponding to the VPN identifier from the user information in the intra-VPN user information database provided in the network to which the terminal belongs, when receiving a session establishment request/response including a VPN identifier from a terminal in a network accommodated by the intra-VPN call control device, for attaching and transferring to the session establishment request/response;
 the secondary call control device includes resource reservation requesting means for transmitting a resource reservation request for the stream to the secondary policy server associated with the secondary call control device, when a session establishment request/response to which the service class/line resource capacity and VPN identifier are attached is received from the intra-VPN call control device;
 the secondary policy server includes resource reserving means for selecting a virtual communication path that matches the addresses and service class of the source and destination terminals of the stream in response to the resource reservation request, and for reserving resources when a determination is made that the remaining resource capacity of the associated

VPN of the selected virtual communication path can accommodate the resource capacity of the stream; and
 the stage label switching router that stores the terminal determines a virtual communication path that matches the destination address and service class stored in the stream from the terminal, and transfers the stream in accordance with the virtual communication path.

[Claim 12] The network policy control system according to any one of claims 9 to 11, further comprising:

a call control device that collectively manages the secondary call control devices in the network policy control system, and a policy server that collectively manages the secondary policy servers.

[Claim 13] The network policy control system according to any one of claims 9 to 12, wherein the secondary policy server can be associated with a plurality of secondary call control devices.

[Claim 14] The network policy control system according to any one of claims 9 to 11, wherein the secondary call control device and the secondary policy server are provided in the same device.

[Claim 15] The network policy control system according to any one of claims 9 to 11, wherein the secondary call control device and the secondary policy server are provided in the same label switching router.

[Claim 16] A policy server for a network policy control system having

an IP core network having a plurality of label switching routers, two terminals stored in different label switching routers in the IP core network, and a call control device for establishing a session between the two terminals;

the policy server comprising:

virtual communication path defining means for defining a virtual communication path, which is specified by a combination of a first stage label switching router, a last stage label switching router and a service class in the IP core network, and which is composed of one or more label switched paths;

virtual communication path setting means for setting the virtual communication path in the label switching router; and

resource reserving means for selecting a virtual communication path that accommodates a stream from the virtual communication path defining means based on the address and service class of a source and destination terminal of the stream transmitted in a session in response to a resource reservation request from the call control device when a session is established between the two terminals, and reserving resources when a determination is made that the remaining resource capacity of the selected virtual communication path can accommodate the resource capacity of the stream.

[Claim 17] The policy server according to claim 16, wherein the virtual communication path defining means provides a function for determining a line resource capacity for each VPN in the virtual communication path.

[Claim 18] A policy server for a network policy control system including
an IP core network having a plurality of label switching routers, two terminals stored in different label switching routers in the IP core network, and a call control device for establishing a session between the two terminals, the network policy control system controlling transmission of a stream via a VPN established between the two terminals;

the policy server comprising:

a label switched path defining means for defining a label switched path in which a required resource capacity and a destination network are set for each VPN; and
label switched path setting means for selecting a label switched path accommodating the stream from the label switched path
defining means when a session is established between the two terminals, and setting the label switching router so that the stream is transferred to the label switched path, when a determination is made that the line resource capacity of the stream can be accommodated in the line resource capacity allocated to the VPN of the selected label switched path.

DETAILED DESCRIPTION OF THE INVENTION

[0001]

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a network policy control system capable of guaranteeing the communication quality of a session stream in an IP network having a label switching router, and a policy server used therein.

[0002]

CONVENTIONAL TECHNOLOGY

A conventional technique related to a quality of service (QoS) guarantee method for communication using Voice over Internet Protocol (VoIP) in a conventional IP (Internet Protocol) network is a method for setting a communication quality guaranteed path for VoIP and a network management system disclosed in Japanese Unexamined Patent Application Publication No. 2001-274833. The method of setting the VoIP communication quality guaranteed path disclosed in the conventional technology aims to guarantee the QoS for a VoIP stream on an MPLS (Multi Protocol Label Switching)/IP network.

[0003] FIG. 44 is a diagram depicting the configuration of a system that performs packet transfer by MPLS and guarantees QoS in an IP network 117 disclosed in the conventional technology. The system depicted in FIG. 44 includes a call control device 101, edge label switching routers (denoted as Edge LSR in FIG. 44) 112, 115, media gateways (denoted as MG) 113, 114, a label switching MPLS server 120, and core label switching routers (denoted as Core LSR) 123 to 127. Here, edge label switching routers 112 and 115 accommodate media gateways 113 and 114 which accommodate telephone sets 128 and 129. Furthermore, the call control device 101 is a device that controls calls between telephone sets. Note that in the following description, label switching router is abbreviated as LSR.

[0004] When a telephone set 128 makes a call to telephone set 129, a session is established via the call control device 101. On the other hand, the voice data from telephone set 128 to telephone set 129 is converted from voice data to a VoIP stream in the media gateways 113 and 114, and the VoIP stream is transferred on an IP network 117 between the media gateways 113 and 114.

[0005] Next, a QoS guarantee for the VoIP stream in this system is described. First, when telephone set 128 makes a call to telephone set 129 and establishes a VoIP connection between media gateway 113 and media gateway 114, the call control

device 101 requests the MPLS server 120 to reserve resources for transferring the VoIP stream only if QoS guarantee is required. If a QoS-guaranteed label switched path (hereinafter referred to as LSP) capable of accommodating the VoIP stream has already been set between edge LSR 112 and edge LSR 115, the MPLS server 120 sets a filter condition for edge LSR 112 and edge LSR 115 to pass the VoIP stream through the LSP. Furthermore, if the resources of the QoS-guaranteed LSP are insufficient to accommodate the VoIP stream, or if a QoS-guaranteed LSP is not set between edge LSR 112 and edge LSR 115, an instruction is given to edge LSR 112 and edge LSR 115 to set a QoS-guaranteed LSP, and the VoIP stream is accommodated in the set LSP, thereby providing a QoS guarantee.

[0006]

PROBLEM TO BE SOLVED BY THE INVENTION

However, with the conventional technology described above, when receiving a VoIP stream, the edge LSRs 112 and 115 are unable to autonomously determine which LSP provides which QoS in order to transfer, and therefore require setting from the MPLS server 120. In other words, when a call is made between telephone sets 128 and 129, or in other words, when a session is established, the MPLS server 120 must set up an LSP including QoS for transmitting a VoIP stream between telephone sets 128 and 129 to edge LSRs 112 and 115, or in other words, filter conditions must be set to determine which LSP should be transferred the received packet. Furthermore, the MPLS server 120 must set the filter conditions in the LSR and manage the remaining resource capacity for each LSP, which causes an excessive burden on the MPLS server 120.

[0007] Furthermore, if the IP network 117 is a network capable of accommodating a plurality of VPNs, there is a problem that resource management cannot be performed for each VPN (Virtual Private Network). Furthermore, as the network size increases, the number of calls is expected to become immense. However, with the conventional method of setting up a communication quality guaranteed path for VoIP, a sequence occurs between the call control device 101, the MPLS server 120, and the edge LSRs 112 and 115 each time a session is established, which causes a problem of excessive load.

[0008] The present invention has been made in consideration of the foregoing, and a primary object is to provide a network control system and a policy server for use therein that can independently determine which LSP should be transferred a stream when an edge LSR receives a stream transmitted between two terminals in different networks.

[0009] Furthermore, a second object of the present invention is to provide a network control system capable of managing resources for each of a plurality of VPNs in an IP network capable of accommodating a plurality of VPNs, and a policy server for use therewith.

[0010] A third object of the present invention is to provide a network policy control system and a policy server for use therewith that are capable of suppressing excessive load on a call control device even when the number of calls increases.

[0011]

MEANS FOR SOLVING THE PROBLEM

In order to achieve the aforementioned object, the network policy control system of the present invention, includes: an IP core network having a plurality of LSRs; two terminals stored in different LSRs in the IP core network; and a call control device for establishing a session between the two terminals; further comprising a policy server including: virtual communication path defining means for defining a virtual communication path, which is specified by a combination of a first stage LSR, a last stage LSR and a service class in the IP core network, and which is composed of one or more label switched paths; virtual communication path setting means for setting the virtual communication path in the LSR; and resource reserving means for selecting a virtual communication path that accommodates a stream from the virtual communication path defining means based on the address and service class of a source and destination terminal of the stream transmitted in a session in response to a resource reservation request from the call control device when a session is established between the two terminals, and reserving resources when a determination is made that the remaining resource capacity of the selected virtual communication path can accommodate the resource capacity of the stream; wherein a first stage LSR that first receives a stream from the terminal determines a virtual communication path that matches the destination address and service class stored in the packets of the

stream, and transfers the stream in accordance with the virtual communication path.

[0012] The present invention provides a network policy control system including an IP core network having a plurality of LSRs, two terminals accommodated in different LSRs in the IP core network, and a call control device which performs processing for establishing a session between the two terminals, in which a virtual communication path that matches the destination address and service class stored in the packets of the stream is determined by a first stage LSR which first receives a stream from the terminal, and the stream is transferred in accordance with the virtual communication path. Herein, a virtual communication path is defined by the virtual communication path defining means of the policy server, which is specified by a combination of a first stage LSR, a last stage LSR, and a service class in the IP core network, and is composed of one or more LSPs. Moreover, the virtual communication path is set in the LSR by the virtual communication path setting means.

Furthermore, the resource reserving means selects a virtual communication path that accommodates a stream from the virtual communication path defining means based on the address and service class of a source and destination terminal of the stream transmitted in a session in response to a resource reservation request from the call control device when a session is established between the two terminals, and reserves resources when a determination is made that the remaining resource capacity of the selected virtual communication path can accommodate the resource capacity of the stream.

[0013] The network policy control system according to the next invention, provides the aforementioned invention with: user information database for storing user information including a terminal address, a service class, and a line resource capacity of a terminal accommodated in the LSR; wherein the call control device includes resource reservation requesting means for acquiring a service class and line resource capacity to be applied to the stream of the session acquired from the user information to create a resource reservation request, which is transmitted to the policy server, when receiving a session establishment request/response between the two terminals.

[0014] With the present invention, the user information database stores user information including the terminal address, service class, and line resource capacity of the terminals accommodated in the LSR. In addition, when a session establishment request/response between the two terminals is received by the resource reservation requesting means of the call control device, the service class and line resource capacity to be applied to the stream of the session acquired from the user information are acquired, and the resource reservation request is created and transmitted to the policy server.

[0015] The network policy control system according to the next invention provides the invention with resource reserving means having a function of adding a line resource capacity to the virtual communication path when a determination is made that the remaining resource capacity of the virtual communication path cannot accommodate the line resource capacity of the stream, and reserving the service class and line resource capacity of the stream in the virtual communication path.

[0016] With the present invention, the resource reserving means adds the line resource capacity to the virtual communication path and ensures the service class and line resource capacity of the stream in the virtual communication path, when a determination is made that the remaining resource capacity of the virtual communication path cannot accommodate the line resource capacity of the stream.

[0017] The network policy control system of the next invention is the aforementioned invention, wherein the service class further includes a delay class that classifies the delay time required for the stream to travel from the input to the output of the IP core network.

[0018] With the present invention, the service class includes a delay class that classifies the delay time from input of the stream to the IP core network until output.

[0019] The network policy control system according to the next invention is the aforementioned invention where the line resource capacity is defined by a line resource capacity class that is classified according to the capacity of the guaranteed line resource; and the resource reserving means has a function of selecting, from the selected virtual communication paths, an LSP having a remaining resource capacity that is sufficiently larger than the resource capacity corresponding to the line resource capacity class.

[0020] With the present invention, the line resource capacity is defined by a line resource capacity class that is classified according to the capacity of the guaranteed line resource. Furthermore, the resource reserving means selects an LSP having a remaining resource capacity that is sufficiently larger than the resource capacity corresponding to the line resource capacity class from among the selected virtual communication paths.

[0021] A network policy control system according to the next invention includes: an IP core network having a plurality of label switching routers; two terminals stored in different label switching routers in the IP core network; and a call control device for establishing a session between the two terminals, the network policy control system controlling transmission of a stream via a VPN established between the two terminals; and further includes a policy server containing: a label switched path defining means for defining an LSP in which a required resource capacity and a destination network are set for each VPN; and label switched path setting means for selecting an LSP accommodating the stream from the label switched path defining means when a session is established between the two terminals, and setting the label switching router so that the stream is transferred to the LSP, when a determination is made that the line resource capacity of the stream can be accommodated in the line resource capacity allocated to the VPN of the selected LSP;

wherein the label switching router constructs a VPN on a set LSP and transfers the stream.

[0022] The present invention provides a network system, including:

an IP core network having a plurality of LSRs; two terminals stored in different LSRs in the IP core network; and a call control device for establishing a session between the two terminals, the network policy control system controlling transmission of a stream via a VPN established between the two terminals. First, the label switched path defining means of the policy server defines an LSP in which the required resource capacity and the destination network are set for each VPN. Next, when a session between two terminals is established by the label switched path setting means of the policy server, an LSP accommodating the stream is selected by the label switched path defining means, and if a determination is made that the line resource capacity of the stream can be accommodated in the line resource capacity allocated to the VPN of the selected LSP, the LSR is set to transfer the stream to that LSP. Furthermore, the LSR establishes a VPN on the set LSP and transfers the stream.

[0023] The network policy control system according to the next invention is a network policy control system for establishing a session in two terminals stored in different LSRs in the IP core network having a plurality of LSRs, and performing policy control of the transmitted stream, further including a policy server including: a user information database for storing user information including a terminal address, a service class, and a line resource capacity of a terminal accommodated in the LSR, and assigning a VPN identifier for each VPN; a call control device including a resource reservation requesting means for acquiring from the user information database a service class and a line resource capacity to be applied to a stream to be transmitted to a session corresponding to the VPN identifier, and creating the resource reservation request which is transmitted to the policy server, when receiving a session establishment request/response including a VPN identifier between the two terminals; virtual communication path defining means for defining a virtual communication path, which is specified by a combination of a first stage LSR, a last stage LSR and a service class in the IP core network, which is composed of one or more LSPs, and in which a line resource capacity for each VPN is specified; virtual communication path setting means for setting the virtual communication path in the LSR; and resource reserving means for selecting a virtual communication path from the virtual communication path defining means, conforming with the address and service class of a source and destination terminal of the stream transmitted in a session in response to a resource reservation request from the call control device when a session is established between the two terminals, and reserving resources when a determination is made that the remaining resource capacity of the corresponding VPN of the selected virtual communication path can accommodate the resource capacity of the stream; wherein a first stage LSR that first receives a stream from the terminal determines a virtual communication path that matches the destination address and service class stored in the packets of the stream, and transfers the stream in accordance with the virtual communication path.

[0024] In a network system including a user information database, a call control device, and a policy server, in which a session is established between two terminals accommodated in different LSRs in an IP core network including a plurality of LSRs, and policy control of the stream to be transmitted is performed, the first stage LSR that first receives the stream from the terminal determines a virtual communication path that matches the destination address, service class, and VPN identifier stored in the packets of the stream, and the stream is transferred in accordance with the virtual communication path. Here, the user information database stores user information including the terminal addresses, service class, and line resource capacity of the terminals accommodated in the LSR, with a VPN identifier assigned for each VPN. Furthermore, the call control device is also provided with resource reservation requesting means, and when a session establishment request/response including a VPN identifier between the two terminals is received by the resource reservation requesting means, the service class and line resource capacity to be applied to the stream to be transmitted to the session corresponding to the VPN identifier are acquired from the user information database, the resource reservation request is created, and then transmitted to the policy server. Furthermore, the policy server is provided with virtual communication path defining means, virtual communication path setting means, and resource reserving means. The virtual communication path setting means defines a virtual communication path that is specified by a combination of a first stage LSR, a last stage LSR and a service class in the IP core network, is composed of one or more LSPs, and has a line resource capacity set for each VPN. The virtual communication path setting means sets the defined virtual communication path in the LSR. The resource reserving means selects a virtual communication path that conforms to the address, service class, and VPN identifier of a source and destination terminal of the stream transmitted in a session from the virtual communication path defining means, in response to a resource reservation request from the call control device when a session is established between the two terminals, and reserves resources when a determination is made that the remaining resource capacity of the VPN corresponding to the selected virtual communication path can accommodate the resource capacity of the stream. Furthermore, the first stage LSR that first receives the stream from the terminal determines a virtual communication path that matches the destination address, service class, and VPN identifier stored in the packets of the stream, and transfers the stream along that virtual communication path.

[0025] The network policy control system according to the next invention is a network policy control system including: networks accommodated in different LSRs in an IP core network; an intra-VPN user information database installed in the VPN for storing user information including an address, a service class, and a line resource capacity of the network for each network, with a VPN identifier assigned to each VPN; an intra-VPN call control device accommodated in each of the different networks; a call control device that establishes a session between two terminals existing in the different networks; and a call control device and policy server that perform transmission control of a stream between the two terminals; wherein the intra-VPN call control device includes means for acquiring a service class/line resource capacity and a VPN identifier to be applied to the stream corresponding to the VPN identifier from the user information in the intra-VPN user information database provided in the network to which the terminal belongs, when receiving a session establishment request/response including a VPN identifier from a terminal in a network accommodated by the intra-VPN call control device, for attaching and transferring to the session establishment request/response;

the call control device includes resource reservation requesting means for transmitting a resource reservation request for the stream to the policy server when a session establishment request/response to which the service class/line resource capacity and VPN identifier are attached is received from the intra-VPN call control device; the policy server includes: virtual communication path defining means for defining a virtual communication path, which is specified by a combination of a first stage LSR, a last stage LSR and a service class in the IP core network, which is composed of one or more LSPs, and in which a line resource capacity for each VPN is specified; virtual communication path setting means for setting the virtual communication path in the LSR; and resource reserving means for selecting a virtual communication path from the virtual communication path defining means, conforming with the address, service class, and VPN identifier of a source and destination terminal of the stream in response to a resource reservation request from the intra-VPN call control device, and reserving resources when a determination is made that the remaining resource capacity of the corresponding VPN of the selected virtual communication path can accommodate the resource capacity of the stream; and the first stage LSR that stores the terminal determines a virtual communication path that matches the destination address, service class, and VPN identifier stored in the stream from the terminal, and transfers the stream in accordance with the virtual communication path.

[0026] The present invention provides a network policy control system, including: networks accommodated in different LSRs in an IP core network; an intra-VPN user information database installed in the VPN for storing user information including an address, a service class, and a line resource capacity of the networks for each network, with a VPN identifier assigned to each VPN; an intra-VPN call control device accommodated in each of the different networks; a secondary call control device accommodated in the intra-VPN call control device; a call control device that establishes a session between two terminals existing in different networks; and a call control device and policy server that control the transmission of streams between the two terminals; wherein the first stage LSR storing the terminal determines a virtual communication path that matches the destination address, service class and VPN identifier stored in the stream from the terminal, and the stream is transferred according to the virtual communication path. Herein, the intra-VPN call control device acquires a service class/line resource capacity and a VPN identifier to be applied to the stream corresponding to the VPN identifier from the user information in the intra-VPN user information database provided in the network to which the terminal belongs, when receiving a session establishment request/response including a VPN identifier from a terminal in a network accommodated by the intra-VPN call control device, which is then attached and transferred to the session establishment request/response. Furthermore, the call control device includes resource reservation requesting means, which transmits a resource reservation request for the stream to the policy server, when a session establishment request/response to which the service class/line resource capacity and VPN identifier are attached is received from the intra-VPN call control device. Furthermore, the policy server provides virtual communication path defining means, virtual communication path setting means, and resource reserving means. The virtual communication path defining means defines a virtual communication path that is specified by a combination of a first stage LSR, a last stage LSR and a service class in the IP core network, is composed of one or more LSPs, and has a line resource capacity set for each VPN. The virtual communication path is set in the LSR by the virtual communication path setting means. Furthermore, the resource reserving means selects a virtual communication path that conforms to the address, service class, and VPN identifier of a source and destination terminal of the stream from the virtual communication path defining means, in response to a resource reservation request from the intra-VPN call control device, and reserves resources when a determination is made that the remaining resource capacity of the VPN corresponding to the selected virtual communication path can accommodate the resource capacity of the stream.

[0027] The network policy control system according to the next invention is a network policy control system, including: an IP core network having a plurality of LSRs; two terminals accommodated in different LSRs; a secondary call control device that performs an initial transfer process of a session establishment request/response from the two terminals in the IP core network; and a secondary policy server associated with each of the secondary call control devices; wherein the secondary call control device includes means for transmitting a resource reservation request for a stream whose destination is a terminal accommodated in the other secondary call control device to the secondary policy server associated with the secondary call control device, upon receiving a session establishment request/response; the secondary policy server includes means for selecting an LSP for accommodating the stream when receiving the resource reservation request from the secondary call control device associated with the secondary policy server, and setting the LSR to transfer the stream to the LSP when a determination is made that the selected LSP can

accommodate the stream; and when a session between the two terminals is established, the secondary policy server sets an LSP that specifies a transfer procedure for the stream for the LSR.

[0028] The present invention provides a network policy control system including: an IP core network having a plurality of LSRs; two terminals accommodated in different LSRs; a secondary call control device that performs an initial transfer process of a session establishment request/response from the two terminals in the IP core network; and a secondary policy server associated with each of the secondary call control devices; wherein an LSP that specifies the transferring procedure for the stream is set for the LSR by the secondary policy server when a session is established between the two terminals. Herein, the secondary call control device transmits a resource reservation request for a stream whose destination is a terminal accommodated in the other secondary call control device to the secondary policy server associated with the secondary call control device, upon receiving a session establishment request/response. Furthermore, the secondary policy server selects an LSP for accommodating the stream when receiving the resource reservation request from the secondary call control device associated with the secondary policy server, and sets the LSR to transfer the stream to the LSP when a determination is made that the selected LSP can accommodate the stream.

[0029] The network policy control system according to the next invention is a network policy control system, including: an IP core network having a plurality of LSRs; two terminals accommodated in the different LSRs; a secondary call control device performing an initial transfer process of a session establishment request/response from the two terminals in the IP core network; a secondary policy server associated with each of the secondary call control devices; and a user information database storing user information including a terminal address, a service class, and a line resource capacity of the terminals accommodated in the LSRs; the secondary call control device including: means for acquiring a service class/line resource capacity to be applied to a stream having a terminal accommodated in another secondary call control device as a destination from the user information database when receiving a session establishment request/response, which is then attached to the session establishment request/response and transferred; and means for transmitting the resource reservation request for the stream to the secondary policy server associated with the secondary call control device; wherein the secondary policy server includes resource reserving means for selecting a virtual communication path that matches the addresses and service class of the source and destination terminals of the stream in response to the resource reservation request from the secondary call control device associated with the secondary policy server, and for reserving resources when a determination is made that the remaining resource capacity of the selected virtual communication path can accommodate the resource capacity of the stream; and the resource reservation process for a stream having one terminal as a destination is performed by a secondary call control device and a secondary policy server stored in the terminal on the source side of the stream.

[0030] The present invention provides a network policy control system including: an IP core network having a plurality of LSRs; two terminals accommodated in different LSRs; a secondary call control device that performs an initial transfer process of a session establishment request/response from the two terminals in the IP core network; a secondary policy server associated with each of the secondary call control devices; and a user information database that stores user information including terminal addresses, service class and line resource capacity of the terminals accommodated in the LSRs; wherein resource reservation processing for a stream having one terminal as the destination is performed by the secondary call control device and secondary policy server accommodated in the terminal on the source side of the stream. Herein, the secondary call control device includes: means for obtaining from the user information database the service class/line resource capacity to be applied to a stream whose destination is a terminal accommodated in the other secondary call control device upon receiving a session establishment request/response, which is then attached to the session establishment request/response and transferred; and means for transmitting a resource reservation request for the stream to the secondary policy server associated with the secondary call control device. Furthermore, the secondary policy server includes resource reserving means for selecting a virtual communication path that matches the addresses and service class of the source and destination terminals of the stream in response to the resource reservation request from the secondary call control device associated with the secondary policy server, and for reserving resources when a determination is made that the remaining resource capacity of the selected virtual communication path can accommodate the resource capacity of the stream.

[0031] The network policy control system according to the next invention is a network policy control system, including: networks accommodated in different LSRs in an IP core network; an intra-VPN user information database installed in the

VPN for storing user information including an address, a service class, and a line resource capacity of the networks for each network, with a VPN identifier assigned to each VPN; an intra-VPN call control device accommodated in each of the different networks; a secondary call control device accommodated in the intra-VPN call control device; and a secondary policy server associated with each of the secondary call control devices; wherein the intra-VPN call control device includes means for acquiring a service class/line resource capacity and a VPN identifier to be applied to the stream corresponding to the VPN identifier from the user information in the intra-VPN user information database provided in the network to which the terminal belongs, when receiving a session establishment request/response including a VPN identifier from a terminal in a network accommodated by the intra-VPN call control device, for attaching and transferring to the session establishment request/response; the secondary call control device includes resource reservation requesting means for transmitting a resource reservation request for the stream to the secondary policy server associated with the secondary call control device, when a session establishment request/response to which the service class/line resource capacity and VPN identifier are attached is received from the intra-VPN call control device; the secondary policy server includes resource reserving means for selecting a virtual communication path that matches the address, service class, and VPN identifier of the source and destination terminals of the stream in response to the resource reservation request, and for reserving resources when a determination is made that the remaining resource capacity of the associated VPN of the selected virtual communication path can accommodate the resource capacity of the stream; and the stage LSR that stores the terminal determines a virtual communication path that matches the destination address, service class, and VPN identifier stored in the stream from the terminal, and transfers the stream in accordance with the virtual communication path.

[0032]

The present invention provides a network policy control system, including: networks accommodated in different LSRs in an IP core network; an intra-VPN user information database installed in the VPN for storing user information including an address, a service class, and a line resource capacity of the networks for each network, with a VPN identifier assigned to each VPN; an intra-VPN call control device accommodated in each of the different networks; a secondary call control device accommodated in the intra-VPN call control device; and a secondary policy server associated with each of the secondary call control devices; wherein the LSR storing the terminal determines a virtual communication path that matches the destination address, service class and VPN identifier stored in the stream from the terminal, and the stream is transferred in accordance with the determined virtual communication path. Herein, the intra-VPN call control device acquires a service class/line resource capacity and a VPN identifier to be applied to the stream corresponding to the VPN identifier from the user information in the intra-VPN user information database provided in the network to which the terminal belongs, when receiving a session establishment request/response including a VPN identifier from a terminal in a network accommodated by the intra-VPN call control device, which is then attached and transferred to the session establishment request/response. Furthermore, the secondary call control device includes resource reservation requesting means, which transmits a resource reservation request for the stream to the secondary policy server associated with the secondary call control device, when a session establishment request/response to which the service class/line resource capacity and VPN identifier are attached is received from the intra-VPN call control device. Furthermore, the secondary policy server includes resource reserving means for selecting a virtual communication path that matches the address, service class, and VPN identifier of the source and destination terminals of the stream in response to the resource reservation request, and for reserving resources when a determination is made that the remaining resource capacity of the VPN corresponding to the selected virtual communication path can accommodate the resource capacity of the stream.

[0033] The network policy control system of the next invention is the invention, further including a call control device that collectively manages the secondary call control devices in the network policy control system, and a policy server that collectively manages the secondary policy servers.

[0034] With the present invention, the secondary call control devices in the network policy control system are collectively managed by the call control device, and the secondary policy servers are collectively managed by the policy server.

[0035] The network policy control system according to the next invention is the invention, wherein the secondary policy server can be associated with a plurality of secondary call control devices.

[0036] With the present invention, a plurality of secondary call control devices are associated with each other by the secondary policy server.

[0037] The network policy control system according to the next invention is the aforementioned invention, wherein the secondary call control device and the secondary policy server are provided in the same device.

[0038] With the present invention, the secondary call control device and the secondary policy server are provided in the same device.

[0039] The network policy control system according to the next invention is the aforementioned invention, wherein the secondary call control device and the secondary policy server are provided in the same LSR.

[0040] With the present invention, the secondary call control device and the secondary policy server are provided in the same LSR.

[0041] The policy server of the next invention is a policy server for a network policy control system having an IP core network having a plurality of label switching routers, two terminals stored in different label switching routers in the IP core network, and a call control device for establishing a session between the two terminals; the policy server including: virtual communication path defining means for defining a virtual communication path, which is specified by a combination of a first stage label switching router, a last stage label switching router and a service class in the IP core network, and which is composed of one or more label switched paths; virtual communication path setting means for setting the virtual communication path in the label switching router; and resource reserving means for selecting a virtual communication path that accommodates a stream from the virtual communication path defining means based on the address and service class of a source and destination terminal of the stream transmitted in a session in response to a resource reservation request from the call control device when a session is established between the two terminals, and reserving resources when a determination is made that the remaining resource capacity of the selected virtual communication path can accommodate the resource capacity of the stream.

[0042] The present invention provides a policy server including virtual communication path defining means, virtual communication path setting means, and resource reserving means, which is a policy server for a network policy control system having an IP core network having a plurality of label switching routers, two terminals stored in different label switching routers in the IP core network, and a call control device for establishing a session between the two terminals. First, the virtual communication path defining means defines a virtual communication path, which is specified by a combination of a first stage label switching router, a last stage label switching router and a service class in the IP core network, and which is composed of one or more label switched paths. Next, the virtual communication path is set in the label switching router by the virtual communication path setting means. Furthermore, the resource reserving means selects a virtual communication path that accommodates a stream from the virtual communication path defining means based on the address and service class of a source and destination terminal of the stream transmitted in a session in response to a resource reservation request from the call control device when a session is established between the two terminals, and reserves resources when a determination is made that the remaining resource capacity of the selected virtual communication path can accommodate the resource capacity of the stream.

[0043] The policy server according to the next invention is the invention, wherein the virtual communication path defining means further includes a function of defining a line resource capacity for each VPN in the virtual communication path.

[0044] With the present invention, the virtual communication path defining means further defines the line resource capacity for each VPN in the virtual communication path.

[0045] The policy server according to the next invention is a policy server used in a network policy control system that includes: an IP core network having a plurality of label switching routers; two terminals stored in different label switching routers in the IP core network; and a call control device for establishing a session between the two terminals, the network policy control system controlling transmission of a stream via a VPN established between the two terminals; and further includes a policy server containing: a label switched path defining means for defining an LSP in which a required resource capacity and a destination network are set for each VPN; and label switched path setting means for selecting an LSP accommodating the stream from the label switched path defining means when a session is established between the two terminals, and setting the label switching router so that the stream is transferred to the LSP, when a determination is made that the line resource capacity of the stream can be accommodated in the line resource capacity allocated to the VPN of the selected LSP.

[0046] The present invention provides a policy server having a label switched path defining means and a label switched path setting means, wherein the policy server is used in a network policy control system including an IP core network having a plurality of LSRs, two terminals accommodated in different LSRs in the IP core network, and a call control device which performs processing for establishing a session between the two terminals, and which controls the transmission of a stream via a VPN constructed between the two terminals. First, the label switched path defining means defines an LSP in which the required resource capacity and the destination network are set for each VPN. Furthermore, when a session between two terminals is established by the label switched path setting means of the policy server, an LSP accommodating the stream is selected by the label switched path defining means, and if a determination is made that the line resource capacity of the stream can be accommodated in the line resource capacity allocated to the VPN of the selected LSP, the LSR is set to transfer the stream to that LSP.

[0047]

EMBODIMENTS OF THE INVENTION

A network policy control system and a policy server used therein according to preferred embodiments of the present invention are described below in detail with reference to the accompanying drawings.

[0048] Embodiment 1.

FIG. 1 is a configuration diagram depicting Embodiment 1 of a network policy control system according to the present invention. The network system includes a call control device (denoted as CA in FIG. 1) 1, a policy server (similarly denoted as PS) 2, a user information database (similarly denoted as UDB) 3, LSRs 41 to 46 which perform route processing of voice streams using MPLS (Multi Protocol Label Switching) in an IP core network 4, a gateway device (similarly denoted as GW) 5 accommodated in LSR 41, a gateway device 6 accommodated in LSR 44, an access network 7 accommodated in LSR 41, an access network 8 accommodated in LSR 44, a terminal 9 present in access network 7, and a terminal 10 present in access network 8.

[0049] In the network policy control system according to Embodiment 1, similar to the conventional technology, an LSP can accommodate a plurality of session streams (packet groups transferred over an established session). Furthermore, a protocol

for establishing/controlling a session between the terminals 9 and 10 can be a protocol such as SIP (Session Initiation Protocol), H323 recommended by ITU-T (International Telecommunication Union-Telecommunication sector), or SS7 (Signaling System 7), which has a configuration in which, when establishing a session, the calling side issues a request (hereinafter referred to as a session establishment request) and the called side returns a response to the request (hereinafter referred to as a session establishment response).

[0050] Next, a processing procedure for setting a virtual communication path to an LSR in the network system of FIG. 1 is described with reference to the flowchart of FIG. 2. First, the user information indicating the service grade of the network user is defined on the policy server 2 by the network user (step S1), and the user information is stored in the user information database 3 depicted in FIG. 3 (step 2). The user information defines flow identification information (terminal address/address mask, transport protocol type, encoding method, and the like), CoS (Class of Service, service class) indicating the service grade applied to the flow, and the required line resource capacity.

[0051] Furthermore, the network administrator defines the first stage LSR, the last stage LSR, the line resource capacity required between these first stage LSR and last stage LSR, and the virtual communication path information including CoS on the policy server 2 (step S3). In the present invention, a path specified from the virtual communication path information is called a virtual communication path. In other words, a virtual communication path is uniquely identified by the combination of [first stage LSR, last stage LSR, and CoS].

[0052] The policy server 2 stores the input information including the user information and virtual communication information, and determines a single or a plurality of LSPs to be actually set in the network from the virtual communication path information (step S4). For example, in FIG. 1, when the first stage LSR of the virtual communication path is input as LSR41 and the last stage LSR is input as LSR44, the LSPs of two routes, "LSR41-LSR42-LSR43-LSR44" and "LSR41-LSR46-LSR45-LSR44", can be considered as a structural element of the virtual communication path. Furthermore, the policy server 2 has a function of determining an optimal set of LSPs from among the LSPs by referring to a network topology database (TDB). Note that the total line resource capacity of these LSPs forming the virtual communication path is determined so as to match the line resource capacity of the virtual communication path.

[0053] FIG. 4 is a diagram depicting an example of the configuration of a virtual communication path including attribute information. Furthermore, the destination address/address mask is acquired by the policy server 2 from the network topology database. For example, in the case of a virtual communication path in which LSR 41 depicted in FIG. 1 is the first stage LSR and LSR 44 is the last stage LSR, the destination address/address mask is the destination address/address mask of the access network 8. This completes the process of setting LSPs to LSRs 41 to 46.

[0054] Furthermore, the policy server 2 sets the LSPs for each of the LSRs 41 to 46 on the IP core network in accordance with one operation by the network administrator (step S5). Specifically, the first stage LSR of the LSP is provided information about the LSP and is requested to set up the LSP using a signaling protocol such as RSVP-TE (Resource ReSerVation Protocol for Traffic Engineering, RFC (Request For Comments) 3209), and the like, which is being considered by the IETF (Internet Engineering Task Force). At this time, attribute information of the virtual communication path, including the virtual communication path identifier, resource capacity, CoS, destination address/address mask, and LSP identifier, is also set in the LSR that is the first stage LSR of any of the virtual communication paths.

[0055] Note that when setting an LSP, the LSRs 41 to 46 of each LSP set as the first stage LSR and the last stage LSR function as edge LSRs in the LSP.

[0056] Next, the procedure from establishment of a session between a call issuing terminal and a call receiving terminal in the system to the transmission of a session stream is described with reference to the flowcharts of FIG. 5 to FIG. 7. Here, an example is described in which terminal 9 makes a call to terminal 10 in FIG. 1.

[0057] First, terminal 9 transmits a session establishment request to terminal 10 (step S11), but the session establishment request is received by the call control device 1 before being transmitted to terminal 10 (step S12). The session establishment request typically includes a session identifier for uniquely identifying the session, the call issuing terminal address (address of terminal 9), the call receiving terminal address (address of terminal 10), the transport protocol used by the session stream, the port number of the transport protocol, and the encoding type. Note that in the following description, terminal 9 is referred to as the

call issuing terminal, and terminal 10 is referred to as the call receiving terminal.

[0058] The call control device 1 that receives the session establishment request compares the contents of the session establishment request with the user information database 3, for the stream from the call receiving terminal 10 of the session to the call issuing terminal 9, and acquires the CoS/line resource capacity to be applied to the stream (step S13). For example, if a stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 matches the first entry in the user information database 3 depicted in FIG. 3, the call control device 1 acquires a CoS with transfer priority class = 1 and discard priority class = 2, and a resource capacity of 10 Mbps. [0059] Furthermore, the call control device 1 transmits a resource reservation request including the session identifier, the destination terminal address, the source terminal address, CoS and resource capacity information to the policy server 2 (step S14). Herein, when the information contained in the resource reservation request is described, the session identifier is an identifier that uniquely identifies a session. Furthermore, the destination terminal address is the destination address of the stream for which a resource reservation is to be made. In this case, the resource reservation is for a stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 of the session, so the destination terminal address is the address of the call issuing terminal 9. The source terminal is the source address of the stream for which the resource reservation is made, and in this case, is the address of the call receiving terminal 10. The CoS is the CoS acquired from the user information database 3, and similarly the resource capacity is the resource capacity acquired from the user information database 3.

[0060] When the policy server 2 receives a resource reservation request (step S31), the LSR 44 that accommodates the source terminal address of the resource reservation request (in other words, the address of the call receiving terminal 10) is derived from the network topology database (step S32). In addition, the policy server 2 compares the destination address/address mask and CoS of the virtual communication path in which LSR 44 is the first stage LSR for the destination terminal address (in other words, the address of the call issuing terminal 9) and CoS included in the resource reservation request, and determines the matching virtual communication path as the virtual communication path that will accommodate the aforementioned session (step S33).

[0061] Thereafter, the policy server 2 determines whether the stream can be accommodated in the matching virtual communication path (step S34). In other words, if the remaining resource capacity of the virtual communication path is sufficient and the required resource capacity for the stream can be secured, or if the remaining resource capacity of the virtual communication path is insufficient but the resource capacity can be added by means such as increasing the resource capacity of the LSP in the virtual communication path or setting up a new LSP, a determination is made that the virtual communication path can accommodate the stream. Here, the setting to increase the resource capacity of the LSP in the virtual communication path or the setting of a new LSP is performed by the aforementioned signaling protocol for the first stage LSR of the LSP.

[0062] Furthermore, if the policy server 2 determines that the virtual communication path can accommodate the aforementioned stream (if Yes in step S34), the remaining resource capacity of the virtual communication path, acquired by subtracting the resource capacity of the aforementioned stream from the remaining resource capacity of the virtual communication path, is associated with the virtual communication path, and is stored together with the session identifier and the resource capacity of the aforementioned stream (step S35). Thereafter, the policy server 2 returns a resource reservation response (success) to the call control device 1 (step S36).

[0063] On the other hand, if the policy server 2 determines in step S34 described above that the virtual communication path cannot accommodate the stream (No in step S34), the policy server 2 returns a resource reservation response (failure) to the call control device 1 (step S37). In the steps S31 to S37, the resource reservation confirmation process is completed for the stream in the session in the direction from the call receiving terminal 10 to the call issuing terminal 9.

[0064] When the call control device 1 receives the resource reservation response from the policy server 2 (step S15), a determination is made as to whether the resource reservation response indicates success or not (step S16). If the resource reservation response indicates success (Yes in step S16), the CoS/line resource capacity acquired in step S13 is attached to the session establishment request and transferred to the call receiving terminal 10 (step S17).

[0065] On the other hand, if the resource reservation response indicates failure (No in step S16), the call control device 1 executes a failure sequence as defined in the session control protocol, such as sending a message to the call issuing terminal 9 providing notification of the session establishment response failure (step S19), and the process ends.

[0066] After receiving a session establishment request from the call control device 1 (step S18), the call receiving terminal 10 makes the necessary changes to the session establishment request to create a session establishment response, and sends the session establishment response to the call issuing terminal 9 via the call control device 1 (step S20). When a session

establishment response is received from the call receiving terminal 10 (step S21), the call control device 1 acquires from the user information database the CoS/line resource capacity to be applied to each stream of the session in the direction from the call issuing terminal 9 to the call receiving terminal 10 and from the call receiving terminal 10 to the call issuing terminal 9 (step S22). Note that, in step S22, confirmation of resource reservation for the stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 has already been performed when the session establishment request was made, but the session information was negotiated in the call receiving terminal 10, so this confirmation is also required during the session establishment response. Furthermore, a resource reservation request for the stream is sent to the policy server 2 (step S23).

[0067] Confirmation of the resource reservation for the stream of the session in the direction from the call issuing terminal 9 to the call receiving terminal 10 and from the call receiving terminal 10 to the call issuing terminal 9 in the policy server 2 is performed by the same processes as steps S31 to S37 in FIG. 7. In other words, the policy server 2 searches for a virtual communication path that can accommodate the stream, and if the virtual communication path can accommodate the stream, the policy server 2 sends a resource reservation response (success) to the call control device 1, but if the virtual communication path cannot accommodate the stream, a resource reservation response (failure) is sent.

[0068] Thereafter, when the call control device 1 receives a resource reservation response from the policy server 2 (step S24), the call control device 1 determines whether the resource reservation response indicates success or not (step S25). If a determination is made that the resource reservation response indicates success (Yes in step S25), the CoS/line resource capacity to be applied to the stream from the call issuing terminal 9 to the call receiving terminal 10 of the session acquired during the resource reservation process is attached to the session establishment response and transferred to the call issuing terminal 9 (step S26).

[0069] On the other hand, if the resource reservation response is a failure (No in step S25), a failure sequence, as defined by the session control protocol, is executed (step S28), and the process ends. As a failure sequence, for example, when the call control device 1 sends a session establishment cancellation message to the call receiving terminal 10, the call receiving terminal 10 notifies the call control device 1 of success/failure in response to the message, and the call control device 1 then performs a process of sending a message to the call issuing terminal 9 providing notification of the session establishment response failure.

[0070] After receiving the session establishment response with the CoS/line resource capacity attached (step S27), the call issuing terminal 9 recognizes that a session has been established between the call issuing terminal 9 and the call receiving terminal 10, and the session establishment process between the call issuing terminal 9 and the call receiving terminal 10 is terminated.

[0071] Thereafter, the call issuing terminal 9 recognizes that a session has been established between the call issuing terminal 9 and the call receiving terminal 10, and starts transmitting a stream to the call receiving terminal 10 during the session. At this time, the stream is transferred with a resource capacity not exceeding the resource capacity included in the session establishment response, and the CoS included in the session establishment response is added to the packets constituting the stream, and then transferred. The packet field where the CoS is set corresponds to the ToS field in IPv4 and the FlowLabel field in IPv6.

[0072] After receiving the packets constituting a stream from the call issuing terminal 9 via the gateway device 5, the LSR 41 compares the CoS and the destination address/address mask of the virtual communication path set therein with the CoS and the destination address of the packets constituting the stream, and determines a virtual communication path for transferring the stream. The virtual communication path determined by the LSR 41 matches the virtual communication path determined by the policy server 2 in step S33 of FIG. 7.

[0073] Furthermore, the first stage LSR 41 that receives the packets of the stream transfers the packets of the stream to the virtual communication path for which resources were reserved when the session was established. Here, if the virtual communication path is made of a single LSP, the stream is transferred to that LSP. Furthermore, when a virtual communication path is made of a plurality of LSPs, the stream is transferred while being scheduled for each LSP so as not to exceed the resource capacity of each LSP.

[0074] On the other hand, the call receiving terminal 10 recognizes that a session has been established between the call issuing terminal 9 and the call receiving terminal 10 at the stage of receiving the session establishment request in the aforementioned step S18. Furthermore, the call issuing terminal 9 starts transmitting packets that constitute the stream using the same processing method as the aforementioned stream transmission procedure.

[0075] The LSR 44 receives packets constituting a stream from the call receiving terminal 10 via the gateway device 6, and transfers the stream to the LSP constituting the virtual communication path using the same transfer processing method as the LSR 41 described above. In this manner, the transmission of the stream is achieved between the call issuing terminal 9 and the call receiving terminal 10.

[0076] As described above, according to Embodiment 1, a set of LSPs having the same first stage LSR, last stage LSR, and CoS is defined as a virtual communication path, and the virtual communication path for which resources are reserved for a session by the policy server 2 must match the virtual communication path determined by the first stage LSRs 41 and

44 from the destination address and CoS of the stream, thereby achieving an effect where the policy server 2 does not need to configure the edge LSRs one by one each time a session is established between the terminals 9 and 10. Furthermore, the edge LSR does not need to perform filter processing to determine whether or not to transfer a stream for each packet of the stream, and thus the load on the edge LSR is reduced.

[0077] Embodiment 2.

Next, Embodiment 2 of the present invention is described with reference to FIG. 8 to FIG. 10. Embodiment 2 is similar to the aforementioned Embodiment 1, but when the network administrator defines the CoS, the delay class is further defined by classifying the delay time required for a stream to be input to and output from the IP core network 4.

[0078] FIG. 8 is a diagram depicting an example of delay class classification, FIG. 9 is a diagram depicting an example of the configuration of a user information database 3 that includes a delay class in addition to the CoS, and FIG. 10 is a diagram depicting an example of the configuration of a virtual communication path that includes a delay class in addition to the CoS.

[0079] In the example of FIG. 8, the delay classes are divided into four stages, 1 to 4, according to the combination of the maximum delay time and the minimum delay time. Delay class 1 has a maximum delay time of 100 ms and a minimum delay time of 0, and is set for the terminal that is least tolerant of delay. Furthermore, delay class 2 has a delay time of 100 ms to 400 ms, delay class 3 has a delay time of 400 ms to 1000 ms, and delay class 4 has a delay time of 1000 ms or more.

[0080] The user information database 3 depicted in FIG. 9 also adds a delay class to the CoS of the user information database 3 depicted in FIG. 3. The maximum delay time and the minimum delay time are defined by the delay class depicted in FIG. 8.

[0081] Moreover, the virtual communication path depicted in FIG. 10 is configured such that the delay class can be further defined as an attribute in the CoS of the virtual communication path depicted in FIG. 4. The maximum delay time and the minimum delay time are also defined by the delay class depicted in FIG. 8. This delay class is used in determining the route of the LSPs that configure the virtual communication path.

Specifically, if the delay time of an LSP is calculated to be greater than the minimum delay time and less than the maximum delay time defined for the delay class, the LSP is determined as the route of the LSP that constitutes the virtual communication path. Note that the delay time is calculated by the policy server 2 and the edge LSRs 41 and 44 from a network topology database including the delay times of the line and the LSR.

[0082] Note that even when a delay class is added to the CoS, the session establishment process and policy control process are performed in accordance with the procedures described in FIG. 2 and FIGS. 5 to 7 of Embodiment 1.

[0083] In Embodiment 2, a service grade can be assigned to a user in the IP core network 4 while taking into consideration the delay time.

[0084] Embodiment 3.

Next, Embodiment 3 of the present invention is described with reference to FIG. 11 to FIG. 13. In Embodiment 3, when the network manager defines the CoS in Embodiment 2, a line resource capacity class that further classifies the resource capacity guaranteed in the IP core network 4 is defined.

[0085] FIG. 11 is a diagram depicting an example of classifying a line resource capacity class, and FIG. 12 is a diagram depicting an example of the configuration of the user information database 3 further including a line resource capacity class in addition to the CoS. It should be noted that this line resource capacity class does not define attributes for a virtual communication path.

[0086] In the example of FIG. 11, the line resource capacity classes are divided into four levels, 1 to 4, in accordance with the combination of the maximum bandwidth, the minimum guaranteed bandwidth, and the maximum burst size. Line resource capacity class 1 has a maximum bandwidth of 64 kbps, a minimum guaranteed bandwidth of 8 kbps, and a maximum burst size of 8 kbytes, and is the lowest class in terms of line resource capacity. As the line resource capacity class level increases, the content is guaranteed to a higher level. Line resource capacity class 4 has a maximum bandwidth of 16 Mbps, a minimum guaranteed bandwidth of 8 Mbps, and a maximum burst size of 8 kbytes, and is the highest class in terms of the line resource capacity. Note that a correspondence table between the line resource capacity class and the resource capacity is set in the user information database 3 and the edge LSRs 41 to 46.

[0087] The user information database 3 depicted in FIG. 12 has a configuration in which a line resource capacity class is further added to the "CoS" field of the user information database 3 depicted in FIG. 9, and the "resource capacity" field is deleted. The line resource capacity class of this "CoS" field is defined by the line resource capacity class depicted in FIG. 11.

[0088] The processing procedures for session establishment and policy control from the call issuing terminal 9 to the call receiving terminal 10 in Embodiment 3 are performed in the same manner as the processing depicted in FIGS. 5 to 7 described in the aforementioned Embodiment 1, so a description is omitted. However, in step S13 of FIG. 5 where the call control device 1, which has received a session establishment request from the call issuing terminal 9, performs resource reservation confirmation processing for the stream from the call receiving terminal 9 to the call issuing terminal 10, in Embodiment 1, the call control device 1 acquired the resource capacity directly from an entry in the user information database 3 that matches the content of the session establishment request. However, in Embodiment 3, the call control device 1 compares the content of the session establishment request with the user information database 3, and if a line resource capacity class is defined in the CoS field of the matching entry in the user information database 3, acquires the resource capacity from a correspondence table of the line resource capacity classes and resource capacities, as depicted in FIG. 11. The resource reservation confirmation process is similar for the stream in the direction from the call issuing terminal 9 to the call receiving terminal 10 and in the direction from the call receiving terminal 10 to the call issuing terminal 9 in step S22 in FIG. 6.

[0089] The transfer process of the stream packets of the LSR after the streams are transmitted from the call issuing terminal 9

and the call receiving terminal 10 is described with reference to the flow chart of FIG. 13.

[0090] When a session is established from the call issuing terminal 9 to the call receiving terminal 10, the call issuing terminal 9 and the call receiving terminal 10 start transmitting streams in the same manner as in Embodiment 1 described above. At this time, after receiving the stream (step S41), LSR 41 and LSR 44, which are the first stage LSRs of the virtual communication path, compare the CoS excluding the destination address/address mask and the line resource capacity class of the virtual communication path set by LSR 41, 44 and the CoS excluding the destination address and the line resource capacity class of the packets constituting the stream (step S42), and determine the virtual communication path for transferring the stream (step S43). For example, when the information depicted in FIG. 12 is set in the LSR, a virtual communication path with transfer priority class = 1, discard priority class = 2, and delay class = 3 is determined.

[0091] Furthermore, the resource capacity is acquired from the line resource capacity class of the CoS included in the stream and the correspondence table between the line resource capacity class and the resource capacity as depicted in FIG. 11 (step S44). Thereafter, QoS control is performed on the stream in accordance with the acquired CoS (step S45).

[0092] For example, when the line resource capacity class of the stream is set to 3, LSRs 41 and 44 set an LSP having a remaining bandwidth sufficiently larger than the minimum guaranteed bandwidth of 1 Mbps from among the searched virtual communication paths as the transfer destination of the stream, as depicted in FIG. 11. Thereafter, the minimum guaranteed bandwidth (1 Mbps) is subtracted from the remaining bandwidth of the set LSP. Furthermore, the stream is shaped such that a maximum bandwidth of 8 Mbps, a minimum guaranteed bandwidth of 1 Mbps, and a maximum burst size of 8 kbytes are guaranteed.

[0093] Thereafter, if transfer of the stream is not performed for a prescribed period of time between the set LSPs, a setting for ensuring the line resource capacity for the stream is released in the LSP. In other words, the minimum guaranteed bandwidth (1 Mbps) subtracted at the time of setting is added to the remaining bandwidth of the LSP.

[0094] As described above, in accordance with Embodiment 3, more finely tuned stream QoS control can be achieved in the edge LSR of the virtual communication path by classifying the line resource capacity based on a combination of the maximum bandwidth, the minimum guaranteed bandwidth, and the maximum burst size, and defining the CoS.

[0095] Embodiment 4.

Next, Embodiment 4 of the present invention is described with reference to FIGS. 14 to 17. Embodiment 4 provides a network policy control system in which an IP core network has a function for accommodating a plurality of VPNs, and is capable of managing resources for each VPN.

[0096] FIG. 14 is a configuration diagram depicting Embodiment 4 of a network policy control system according to the present invention. The network system includes a call control device (denoted as CA in FIG. 14) 1, a policy server (similarly denoted as PS) 2, LSRs 41 to 46 which perform route processing of session streams using MPLS in an IP core network 4, a gateway device (similarly denoted as GW) 5-1 to 5-n accommodated in LSR 41, a gateway device 6-1 to 6-n accommodated in LSR 44, an access network 7-1 to 7-n accommodated in LSR 41, an access network 8-1 to 8-n accommodated in LSR 44, a terminal 9 present in access network 7-1, and a terminal 10 present in access network 8-1.

[0097] Next, a method of processing resource management for each VPN in communication using the VPN via the IP core network 4 is described.

[0098] The network administrator defines an LSP on the policy server 2 and sets the defined LSP in the LSRs 41 to 46 present on the IP core network 4. During this setting, the required line resource capacity and destination network are defined for each VPN.

[0099] Here, the procedure for establishing the session and controlling the policy when terminal 9 makes a call to terminal 10 is described with reference to the flowcharts of FIG. 15 and FIG. 16.

[0100] First, terminal 9 transmits a session establishment request to terminal 10 (step S51), but the session establishment request is received by the call control device 1 before being transmitted to terminal 10 (step S52). At this time, the VPN-ID set by terminal 9 is added to the session establishment request and transmitted. Note that in the following description, terminal 9 is referred to as the call issuing terminal, and terminal 10 is referred to as the call receiving terminal.

[0101] The call control device 1 that has received the session establishment request performs resource reservation processing for the stream of the session in the direction from the call receiving terminal 10 to the call issuing terminal 9 (step S53). The resource reservation process is performed by the call control device 1 sending to the policy server 2 a resource reservation request for a stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 of the session, the request including a session identifier, the call issuing terminal address, the call receiving terminal address, the line resource capacity required for the stream, and a VPN-ID.

[0102] After receiving a resource reservation request (step S71), the policy server 2 determines a candidate LSP to accommodate the stream (step S72), and determines whether the LSP can accommodate the stream by comparing the resource capacity allocated to the VPN of the LSP with the resource capacity required for the stream (step S73). If an LSP exists that has sufficient resources to accommodate the stream (Yes in step

S73), the first stage LSR 44 of the LSP is set to transfer the stream to this LSP (step S74), and a resource reservation response (successful) is returned to the call control device 1 (step S75).

[0103] On the other hand, if an LSP that has sufficient resources to accommodate the stream does not exist in step S73 (No in step S73), a resource reservation response (failure) is returned to the call control device 1 (step S76). The resource reservation process for the stream is completed by the policy server 2 in processing steps S71 to S76.

[0104] When the call control device 1 receives the resource reservation response from the policy server 2 (step S54), a determination is made as to whether or not the resource reservation response indicates success (step S55). If the resource reservation response indicates success (Yes in step S55), the call control device 1 transfers the session establishment request to the call receiving terminal 10 (step S56). On the other hand, if the resource reservation response indicates failure (No in step S55), the call control device 1 executes a failure sequence, which is defined in the session control protocol (step S57).

[0105] After receiving the session establishment request from the call control device 1 (step S58), the call receiving terminal 10 returns a session establishment response to the call issuing terminal 9 (step S59). However, even in this case, the session establishment response is received by the call control device 1 before being sent to the call issuing terminal 9 (step S60).

[0106] After receiving the session establishment response, the call control device 1 sends a resource reservation request to the policy server 2 for each stream of the session in the direction from the call issuing terminal 9 to the call receiving terminal 10 and in the direction from the call receiving terminal 10 to the call issuing terminal 9 based on information included in the session establishment response, and performs resource reservation processing (step S61). The resource reservation process is performed in the policy server 2 in steps S71 to S76 of FIG. 17, and then the resource reservation response is sent to the call control device 1.

[0107] When the call control device 1 receives the resource reservation response from the policy server 2 (step S62), a determination is made as to whether or not the resource reservation response indicates success (step S63). If the resource reservation response indicates success (Yes in step S63), the session establishment response is transferred to the call issuing terminal 9 (step S64). Furthermore, the call issuing terminal 9 receives the session establishment response, and the session establishment process ends. On the other hand, if the resource reservation response in step S63 indicates failure (No in step S63), the call control device 1 executes a failure sequence, which is defined in the session control protocol (step S66).

[0108] When the call issuing terminal 9 receives the session establishment response, and when the call receiving terminal 10 receives the session establishment request, the terminals start transmitting the session stream. The session stream is transferred to the LSP in the LSRs 41 and 44 based on the set information.

[0109] As described above, according to Embodiment 4, resource management can be performed for each VPN in the IP core network 4.

[0110] Embodiment 5.

Next, Embodiment 5 of the present invention is described with reference to FIGS. 18 to 24. Embodiment 5 provides a network policy control system in which an IP core network has a function for accommodating a plurality of VPNs, and is capable of managing resources for each VPN.

[0111] FIG. 18 is a configuration diagram depicting Embodiment 5 of a network policy control system according to the present invention. With this network policy control system, a user information database (referred to as UDB in FIG. 18) 3 is further added to the configuration of FIG. 14 in Embodiment 4, but other configurations are the same as in FIG. 14, so a description thereof is omitted.

[0112] Next, a method of processing resource management for each VPN in the IP core network 4 is described.

[0113] A processing procedure for setting a virtual communication path to an LSR in the network system of FIG. 18 is described with reference to the flowchart of FIG. 19. First, a network administrator inputs user information for each VPN on the policy server 2 (step S81), and the user information is stored for each VPN in the user information database 3 depicted in FIG. 20 (step S82). The user information stored in the user information database is basically the same as the configuration of the user information database 3 depicted in FIG. 3 of Embodiment 1, but the user information database 3 of embodiment 5 differs in that a plurality of pieces of information, such as flow identification information, CoS, the required line resource capacity, and the like, are defined for each VPN.

[0114] Thereafter, the network administrator defines virtual communication path information including the first stage LSR, last stage LSR, required line resource capacity, and CoS on the policy server 2 (step S83). The definition of the virtual communication path is basically the same as the method of defining a virtual communication path in Embodiment 1, but the resource capacity and the destination address/address mask must be defined for each VPN. The policy server 2 stores the virtual communication path information, determines from the virtual

communication path information a plurality of LSPs or a single LSP to be actually set in the network (step S84), and sets the LSP group in each of the LSRs 41 to 46 on the network.

[0115] FIG. 21 is a diagram depicting an example of the configuration of a virtual communication path including attribute information. The configuration of the virtual communication path is basically the same as the configuration of the virtual communication path depicted in FIG. 4 of Embodiment 1, so a description of the portions having the same configuration is omitted. The difference from the configuration of the virtual communication path depicted in FIG. 4 of Embodiment 1 includes the resource capacity and the destination address/address mask, which are defined for each VPN.

[0116] Next, a processing procedure for establishing a VPN between a call issuing terminal and a call receiving terminal in the system and transferring a session stream is described with reference to the flowcharts of FIG. 22 to FIG. 24.

[0117] First, terminal 9 transmits a session establishment request with an attached autonomously set VPN-ID to terminal 10 (step S91), but the session establishment request is received by the call control device 1 before being transmitted to terminal 10 (step S92). Note that in the following description, terminal 9 is referred to as the call issuing terminal, and terminal 10 is referred to as the call receiving terminal.

[0118] The call control device 1, which has received a session establishment request with an attached VPN-ID, acquires the VPN-ID contained in the session establishment request for the stream from the call receiving terminal 10 to the call issuing terminal 9 of the session, compares the content of the session establishment request with the VPN column in the user information database 3, and acquires the CoS/line resource capacity of the VPN to be applied to the stream (step S93). Furthermore, the call control device 1 then sends these, together with the call issuing terminal address, call receiving terminal address, and an identifier that uniquely identifies the session (hereinafter referred to as a session identifier) contained in the session establishment request, to the policy server 2 as a resource reservation request for the stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 of the session (step S94).

[0119] After receiving the resource reservation request (step S111), the policy server 2 searches for a virtual communication path by the same method as in steps S32 and S33 depicted in FIG. 7 of Embodiment 1 (steps S112 and S113). Thereafter, a determination is made as to whether the session can be accommodated in the virtual communication path (step S114). In other words, if the remaining resource capacity allocated to the VPN of the virtual communication path is sufficient, or if the remaining resource capacity allocated to the VPN of the virtual communication path is insufficient but the resource capacity can be added by increasing the resource capacity of the LSP in the virtual communication path or by setting a new LSP, the policy server 2 determines that the virtual communication path can accommodate the stream (Yes in step S114). Furthermore, the policy server 2 subtracts the resource capacity required for the session from the remaining resource capacity allocated to the VPN of the virtual communication path, and stores the session identifier and the resource capacity in association with the virtual communication path (step S115). Thereafter, a resource reservation response (success) is returned to the call control device 1 (step S116). On the other hand, if a determination is made in step S114 that the remaining resource capacity allocated to the VPN of the virtual communication path cannot accommodate the session (No in step S114), the policy server 2 returns a resource reservation response (failure) to the call control device 1 (step S117). In the steps S111 to S117, the resource reservation confirmation process is completed for the stream in the session in the direction from the call receiving terminal 10 to the call issuing terminal 9.

[0120] When the call control device 1 receives the resource reservation response from the policy server 2 (step S95), a determination is made as to whether or not the resource reservation response indicates success (step S96). If the resource reservation response indicates success (Yes in step S96), the call control device 1 attaches the CoS/line resource capacity acquired in step S93 to the session establishment request, which is then transferred to the call receiving terminal 10 (step S97). On the other hand, if the resource reservation response indicates failure (No in step S96), the call control device 1 executes a failure sequence, which is defined in the session control protocol (step S98).

[0121] After receiving the session establishment request (step S99), the call receiving terminal 10 sends a session establishment response with an attached autonomously set VPN-ID (step S100) to the call issuing terminal 9, but the session establishment response is received by the call control device 1 before being received by the call issuing terminal 9 (step S101).

[0122] After receiving the session establishment response, the call control device 1 acquires the VPN-ID in the session establishment response and acquires the VPN CoS/line resource capacity for each stream of the session in the direction from the call issuing terminal 9 to the call receiving terminal 10 and from the call receiving terminal 10 to the call issuing terminal 9 (step S102). Furthermore, the call control device 1 transmits a resource reservation request to the policy server 2 for each stream of the session from the call issuing terminal 9 to the call receiving terminal 10 and from the call receiving terminal 10 to the call issuing terminal 9 (step S103), and performs a resource reservation confirmation process. The resource reservation confirmation process performed by the policy server 2 is the same as the process in steps S111 to S117 of FIG. 24 described above, and therefore a description thereof is omitted.

[0123] When the call control device 1 receives the resource reservation response from the policy server 2 (step S104), a determination is made as to whether or not the resource reservation response indicates success (step S105). If the resource reservation response indicates success (Yes in step S105), the call control device 1 attaches the CoS and resource

capacity to be applied to the stream from the call issuing terminal 9 to the call receiving terminal 10 of the session acquired in step S102, which is then transferred to the call issuing terminal 9 (step S106), and thus the call issuing terminal 9 receives the session establishment response (step S107). On the other hand, if the resource reservation response indicates failure (No in step S105), the call control device 1 executes a failure sequence, which is defined in the session control protocol (step S108).

[0124] At this time, similarly to the case of the aforementioned Embodiment 1, when the call issuing terminal 9 receives the session establishment response and when the call receiving terminal 10 receives the session establishment request, the terminals each start transmitting a session stream.

[0125] When LSR 41, which is the first stage LSR of the stream transmitted from the call issuing terminal 9 to the call receiving terminal 10, receives the session stream from the call issuing terminal 9, the LSR 41 determines a virtual communication path for transferring the session stream, similar to the case of Embodiment 1. Furthermore, a VPN-ID label is acquired from the receiving interface number of the session stream, and the VPN-ID label is set as a second label in each packet that constitutes the session stream. Note that the label of the LSP to be transferred is set in the top label. The LSP for transferring is determined by the same method as in Embodiment 1, and the session stream is transferred via the VPN determined by the VPN-ID.

[0126] On the other hand, when LSR 44, which is the first stage LSR of the stream transmitted from the call receiving terminal 10 to the call issuing terminal 9, receives the session stream from the call receiving terminal 10, the session stream is transferred to the LSP by the same method as in LSR 41 described above.

[0127] As described above, according to Embodiment 5, the virtual communication path information where the service class is graded for a session established between the terminals 9 and 10 is set in the LSRs 41 to 46 together with the policy server 2. Therefore, the policy server 2 reserves resources for the virtual communication path when a session is established, and the LSRs 41 to 46 are configured to autonomously transfer the session stream in accordance with the virtual communication path. As a result, the policy server 2 does not need to individually perform setting in each of the edge LSRs 41 and 44 when a session is established, so the load on the policy server 2 can be reduced. Furthermore, resource management can be performed for each VPN in the IP core network 4.

[0128] Embodiment 6.

Next, Embodiment 6 of the present invention is described with reference to FIGS. 25 to 28. The present embodiment 6 provides a network policy control system having a network configuration in which, when terminals 9, 10 in access networks 7-1 to 7-n, 8-1 to 8-n establish a session via an IP core network 4, information in the VPN, such as user information and the like, is not disclosed to the outside.

[0129] FIG. 25 is a configuration diagram depicting Embodiment 6 of a network policy control system according to the present invention. The network system is configured to further include an intra-VPN policy server (referred to as VPS in FIG. 25) 25 that performs policy control in the VPN, intra-VPN user information databases (referred to as VUDB) 23, 24 for storing user information in the VPN, and intra-VPN call control devices (referred to as VCA) 21, 22 that accommodate VPN access networks 7-1 to 7-n, 8-1 to 8-n in the network system described by FIG. 14 of Embodiment 4.

[0130] Here, the VPN administrator defines user information of system users who do not want their user information to be made public on the VPN policy server 25, and sets the defined user information in the VPN user information databases 23, 24 provided in each access network of the VPN. Furthermore, the VPN-ID of the VPN that is handled by the intra-VPN call control devices 21 and 22 is set in the intra-VPN call control device. In the example of FIG. 25, VPN 1 is set up between terminal 9 in access network 7-1 and terminal 10 in access network 8-1, so "1" is set as the VPN-ID in intra-VPN call control devices 21 and 22.

[0131] Next, the procedure for establishing a session using a VPN between a call issuing terminal and a call receiving terminal in this system is described with reference to the flowcharts of FIG. 26 to FIG. 28. Here, in FIG. 25, a case is described as an example where terminal 9 in access network 7-1 originates a call to terminal 10 in access network 8-1, and establishes a VPN.

[0132] Terminal 9 transmits a session establishment request to terminal 10 (step S120). The session establishment request is first received by the intra-VPN call control device 21 (step S121). After receiving a session establishment request, the intra-VPN call control device 21 compares the content of the session establishment request with the intra-VPN user information database 23 in the access network 7-1, acquires the CoS/line resource capacity and VPN-ID to be applied to the session stream, and transfers this information together with the session establishment request (step S122). Note that in the following description, terminal 9 is referred to as the call issuing terminal, and terminal 10 is referred to as the call receiving terminal.

[0133] When the call control device 1 receives a session establishment request from the intra-VPN call control device 21, which includes the CoS/line resource capacity and VPN-ID to be applied to the session stream (step S123), the call control device 1 uses the information contained in the session establishment request to generate a resource reservation request for the stream in the direction from the call receiving terminal

10 to the call issuing terminal 9, and sends the resource reservation request to the policy server 2 (step S124). Furthermore, the resource reservation confirmation process described in steps S111 to S117 of Embodiment 5 in FIG. 24 is performed on the stream of the session in the direction from the call receiving terminal 10 to the call issuing terminal 9.

[0134] When the call control device 1 receives the resource reservation response from the policy server 2 (step S125), a determination is made as to whether or not the resource reservation response indicates success (step S126). If the resource reservation response indicates success, (Yes in step S126), a session establishment request is transferred (step S127). On the other hand, if the resource reservation response indicates failure (No in step S126), the call control device 1 executes a failure sequence, which is defined in the session control protocol (step S128).

[0135] After receiving the session establishment request via the intra-VPN call control device 22 (step S129), the call receiving terminal 10 returns a session establishment response to the call issuing terminal 9 (step S130).

[0136] After receiving a session establishment response from the call receiving terminal 10 (step S131), the intra-VPN call control device 22 compares the content of the session establishment response with the intra-VPN user information database 24 in the access network 8-1, acquires the CoS/line resource capacity and VPN-ID to be applied to the session stream, and transfers this information together with the session establishment response (step S132).

[0137] After receiving the session establishment response from the intra-VPN call control device 22 (step S133), the call control device 1 generates a resource reservation request for the stream in the direction from the call issuing terminal 9 to the call receiving terminal 10 of the session and from the call receiving terminal 10 to the call issuing terminal 9 from the information included in the session establishment response, which is then sent to the policy server 2 (step S134). The policy server 2 performs the resource reservation confirmation process described in steps S111 to S117 of Embodiment 5 in FIG. 24 for the stream in the direction from the call issuing terminal 9 to the call receiving terminal 10 and from the call receiving terminal 10 to the call issuing terminal 9 of this session.

[0138] When the call control device 1 receives the resource reservation response from the policy server 2 (step S135), a determination is made as to whether or not the resource reservation response indicates success (step S136). If the resource reservation response indicates success, (Yes in step S136), a session establishment response is transferred (step S137). On the other hand, if the resource reservation response indicates failure (No in step S136), the call control device 1 executes a failure sequence, which is defined in the session control protocol (step S138), and the session establishment process is terminated.

[0139] The call issuing terminal 9 receives the session establishment response via the intra-VPN call control device 21 (step S139), and a VPN is established between the call issuing terminal 9 and the call receiving terminal 10.

[0140] During the aforementioned process, when the call issuing terminal 9 receives the session establishment response, and when the call receiving terminal 10 receives the session establishment request, the terminals start transmitting the session stream. The method of transferring the session stream in the LSRs 41 and 44 is the same as that in Embodiment 5, and therefore a description thereof is omitted.

[0141] As described above, according to embodiment 6, the VPN user information database is provided in the access network of each VPN, so the user information is not disclosed to the outside, and security is maintained for the management of user information. Furthermore, an ID number (identifier) is assigned to each VPN, so a VPN-ID does not need to be set for each terminal, which has the effect of facilitating management of VPNs.

[0142] Embodiment 7.

Next, Embodiment 7 of the present invention is described with reference to FIG. 29 to FIG. 33. Embodiment 7 provides a network policy control system and method capable of distributing excessive load between a call control device, a policy server, and an edge LSR in response to an increase in the number of calls in a large-scale network.

[0143] FIG. 29 is a configuration diagram depicting Embodiment 7 of a network policy control system according to the present invention. This network system adds to the configuration of the network system described in FIG. 1 of embodiment 1, secondary policy servers 33, 34 that control edge LSRs 41, 44, and secondary call control devices 31, 32 associated with the secondary policy servers 33, 34. The remaining portion of the configuration is the same as in FIG. 1, so a description thereof is omitted.

[0144] The secondary call control devices 31 and 32 are call control devices in the IP core network 4 that initially relay session establishment requests and responses issued by terminals 9 and 10 in the access networks 7 and 8 accommodated by edge LSRs 41 and 44. Furthermore, secondary policy servers 33 and 34 are provided for the secondary call control devices 31 and 32, respectively. Note that the call control device 1 manages the plurality of secondary call control devices 31, 32, and the policy server 2 manages the plurality of secondary policy servers 33, 34, by associating the plurality of secondary call control devices 31, 32 in the IP core network 4 with the plurality of secondary policy servers.

[0145] Next, a method of processing resource management for each VPN in the IP core network 4 is described.

[0146] The process of setting an LSP for an LSR in the network system of FIG. 29 is described with reference to the flowcharts of FIG. 30 to FIG. 33. Here, an example of an operation where terminal 9 makes a call to terminal 10 is described.

[0147] Terminal 9 transmits a session establishment request to terminal 10 (step S141), but the session establishment request is received by secondary call control device 32 via secondary call control device 31 and the call control device 1 (step S142).

Based on the information contained in the received session establishment request, the secondary call control device 32 sends to the secondary policy server 34 a resource reservation request including the session identifier, call issuing terminal address, call receiving terminal address, and the line resource capacity required for the stream, for the stream of the session in the direction from terminal 10 to terminal 9 (step S143). In the following description, terminal 9 is referred to as the call issuing terminal, and terminal 10 is referred to as the call receiving terminal 10.

[0148] After receiving a resource reservation request (step S171), the secondary policy server 34 determines a candidate LSP to accommodate the stream (step S172), and determines whether the LSP can accommodate the stream by comparing the resource capacity of the LSP with the resource capacity required for the stream (step S173). If the LSP has sufficient resources (Yes in step S173), the secondary policy server 34 sets the first stage LSR of the LSP (LSR 44 in the case of FIG. 29) to transfer the aforementioned stream to the LSP (step S174), and returns a resource reservation response (success) to the secondary call control device 32 (step S175). On the other hand, if the LSP does not have a sufficient resource capacity (No in step S173), the secondary policy server 34 returns a resource reservation response (failure) to the secondary call control device 32 (step S176). The resource reservation process by the secondary policy server 34 is completed in steps S171 to S176.

[0149] When the secondary call control device 32 receives the resource reservation response (step S144), a determination is made as to whether or not the resource reservation response indicates success (step S145). If the resource reservation response indicates success, (Yes in step S145), a session establishment request is transferred to the call receiving terminal 10 (step S146). On the other hand, if the resource reservation response indicates failure (No in step S145), a failure sequence is executed as defined in the session control protocol (step S147).

[0150] After receiving the session establishment request (step S148), the call receiving terminal 10 returns a session establishment response to the call issuing terminal 9 (step S149).

[0151] The session establishment response is first received by the secondary call control device 32 (step S150), and based on the information contained in the session establishment response, the secondary call control device 32 sends a resource reservation request for the stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 of the session to the secondary policy server 34, similar to when the session establishment request was received (step S151).

[0152] After receiving the resource reservation request from the secondary call control device 32, the secondary policy server 34 performs the resource reservation confirmation process described in steps S171 to S176 of FIG. 33, and sends the resource reservation response to the secondary call control device 32.

[0153] When the secondary call control device 32 receives the resource reservation response from the secondary policy server 34 (step S152), a determination is made as to whether or not the resource reservation response indicates success (step S153). If the resource reservation response indicates success, (Yes in step S153), a session establishment response is transferred (step S154). On the other hand, if the resource reservation response indicates failure (No in step S153), a failure sequence is executed as defined in the session control protocol (step S155).

[0154] The session establishment response sent from the secondary call control device 32 is received by the secondary call control device 31 via the call control device 1 (step S156). Based on the information included in the session establishment response, the secondary call control device 31 transmits a resource reservation request for the stream of the session from the call issuing terminal 9 to the call receiving terminal 10 to the secondary policy server 33 (step S157).

[0155] After receiving a resource reservation request from the secondary call control device 31, the secondary policy server 33 performs resource reservation processing for the stream from the call issuing terminal 9 to the call receiving terminal 10 by the same method as the resource reservation confirmation process described in steps S171 to S176 of FIG. 33, and sends a resource reservation response to the secondary call control device 31.

[0156] When the secondary call control device 31 receives the resource reservation response (step S158), a determination is made as to whether or not the resource reservation response indicates success (step S159). If the resource reservation response indicates success, (Yes in step S159), a session establishment response is transferred to the call issuing terminal 9 (step S160), and the call issuing terminal 9 receives the session establishment response (step S161). On the other hand, if the resource reservation response indicates failure (No in step S159), the secondary call control device 31 executes a failure sequence, which is defined in the session control protocol (step S162).

[0157] In the process, when the call issuing terminal 9 receives the session establishment response, and when the call receiving terminal 10 receives the session establishment request, the call issuing terminal 9 and the call receiving terminal 10 each start transmitting a session stream. Here, the session stream is

transferred to the LSP in the LSRs 41 and 44 based on the information set in the aforementioned steps.

[0158] As described above, with the present embodiment 7, the resource reservation confirmation process associated with a session establishment request is processed by the secondary call control device and secondary policy server, and the processing load is distributed, leading to an effect of being able to respond to an increase in the number of calls.

[0159] Embodiment 8.

Next, Embodiment 8 of the present invention is described with reference to FIG. 34 to FIG. 38. Embodiment 8 provides a network policy control method capable of distributing excessive load between a call control device, a policy server, and an edge LSR in response to an increase in the number of calls in a large-scale network.

[0160] FIG. 34 is a configuration diagram depicting Embodiment 8 of a network policy control system according to the present invention. This network system has a configuration in which user information databases 35 and 36 are provided for each of the secondary call control devices 31 and 32 in the network system described in FIG. 29 of Embodiment 7. The remaining portion of the configuration is the same as in FIG. 29, so a description thereof is omitted.

[0161] In this system, the network administrator stores user information in user information databases 35 and 36 on the policy server 2 in the same manner as in Embodiment 1. However, the user information databases 35 and 36 are installed in response to the secondary call control devices 31 and 32.

[0162] Herein, the process of setting an LSP for LSRs 41 to 46 in the network system of FIG. 34 is described with reference to the flowcharts of FIG. 35 to FIG. 38. Here, an example of an operation where terminal 9 makes a call to terminal 10 is described.

[0163] First, the terminal 9 transmits a session establishment request to the terminal 10 (step S181). The session establishment request is received by the secondary call control device 32 via the secondary call control device 31 and the call control device 1 (step S182). The secondary call control device 32 compares the contents of the session establishment request with the user information database 36, acquires the CoS/line resource capacity to be applied to the stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 of the session (step S183), and then sends a resource reservation request for the stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 to the secondary policy server 34 (step S184).

[0164] The secondary policy server 34 performs resource reservation processing for the stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 in a manner similar to the resource reservation confirmation process described in steps S31 to S37 of FIG. 7 in the aforementioned embodiment 1, and transmits a resource reservation response to the secondary call control device 32.

[0165] When the secondary call control device 32 receives the resource reservation response from the secondary policy server 34 (step S185), a determination is made as to whether or not the resource reservation response indicates success (step S186). If the resource reservation response indicates success, (Yes in step S186), a session establishment request is transferred to the call receiving terminal 10 (step S187). On the other hand, if the resource reservation response indicates failure (No in step S186), a failure sequence is executed as defined in the session control protocol (step S188).

[0166] After receiving the session establishment request from the secondary call control device 32 (step S189), the call receiving terminal 10 returns a session establishment response to the call issuing terminal (step S190).

[0167] After receiving the session establishment response (step S191), the secondary call control device 32 compares the contents of the session establishment response with the user information database 36, acquires the CoS/line resource capacity to be applied to the stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 of the session (step S192), and then sends a resource reservation request for the stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 to the secondary policy server 34 (step S193). Note that the resource reservation process has already been performed in the direction from the call receiving terminal 10 to the call issuing terminal 9, so the session information is negotiated when the call receiving terminal 10 receives the session establishment request and returns the session establishment response, and the resource reservation process is performed in the direction from the call receiving terminal 10 to the call issuing terminal 9.

[0168] After receiving a resource reservation request from the secondary call control device 32, the secondary policy server 34 performs a resource reservation confirmation process in the direction from the call receiving terminal 10 to the call issuing terminal 9 in a manner similar to the process described in steps S31 to S37 of FIG. 7 in embodiment 1, and sends a resource reservation response to the secondary call control device 32.

[0169] When the secondary call control device 32 receives the resource reservation response from the secondary policy server 34 (step S194), a determination is made as to whether or not the resource reservation response indicates success (step S195). If the resource reservation response indicates success, (Yes in step S195), a session establishment response is transferred (step S196). On the other hand, if the resource reservation response indicates failure (No in step S195), a failure sequence is executed as defined in the session control protocol (step S197).

[0170] The session establishment response sent from the secondary call control device 32 is received by the secondary call control device 31 via the call control device 1 (step S198). Upon receiving the session establishment response, the secondary call control device 31 compares the contents of the session establishment response with the user information database 35, acquires the CoS/line resource capacity to be applied to the stream in the direction from the call issuing terminal 9 to the call receiving terminal 10 of the session (step S199), and then transmits a resource reservation request to the secondary policy server 33 for the stream in the direction from the call issuing terminal 9 to the call receiving terminal 10 of the session (step S200).

[0171] After receiving a resource reservation request from the secondary call control device 31, the secondary policy server 33 performs a resource reservation confirmation process for the stream from the call issuing terminal 9 to the call receiving terminal 10 of the session, in a manner similar to the process described in steps S31 to S37 of FIG. 7 in embodiment 1, and sends a resource reservation response to the secondary call control device 31.

[0172] When the secondary call control device 31 receives the resource reservation response (step S201), a determination is made as to whether or not the resource reservation response indicates success (step S202). If the resource reservation response indicates success, (Yes in step S202), a session establishment response is transferred to the call issuing terminal 9 (step S203), and the call issuing terminal 9 receives the session establishment response (step S204). On the other hand, if the resource reservation response indicates failure (No in step S202), a failure sequence is executed as defined in the session control protocol (step S205).

[0173] In the process, when the call issuing terminal 9 receives the session establishment response, and when the call receiving terminal 10 receives the session establishment request, the call issuing terminal 9 and the call receiving terminal 10 each start transmitting a session stream. Moreover, the method of transferring the session stream in the LSR is the same as in Embodiment 1, so a description thereof is omitted.

[0174] As described above, according to Embodiment 8, the virtual communication path information where the service class is graded for a session established between the terminals 9 and 10 is set in the LSRs 41 to 46 together with the policy server 2. Therefore, the policy server 2 reserves resources for the virtual communication path when a session is established, and the LSRs 41 to 46 are configured to autonomously transfer the session stream in accordance with the virtual communication path. As a result, the policy server 2 does not need to individually perform setting in each of the edge LSRs 41 and 44 when a session is established, so the load on the policy server 2 can be reduced.

Furthermore, filtering for each session stream is not required in the edge LSR, so the load is reduced accordingly. Furthermore, the resource reservation confirmation process accompanying a session establishment request is processed by the secondary call control device and the secondary policy server, so the load of the processes performed by these devices can be distributed.

[0175] Embodiment 9.

Next, Embodiment 9 of the present invention is described with reference to FIG. 39 to FIG. 43. Embodiment 9 provides a network policy control system that has a network configuration in which information in the VPN, such as user information and the like, is not disclosed to the outside when terminals 9, 10 in the access networks 7-1 to 7-n, 8-1 to 8-n establish a session via the IP core network 4, and that can distribute excessive loads between call control devices, policy servers, and edge LSRs in response to an increase in the number of calls in a large-scale network.

[0176] FIG. 39 is a diagram depicting Embodiment 9 of a network policy control system according to the present invention. This network system adds to the configuration of the network system described in FIG. 25 of embodiment 6, secondary policy servers 33, 34 that control edge LSRs 41, 44, and secondary call control devices 31, 32 associated with the secondary policy servers 33, 34. Furthermore, these devices are the same as those depicted in FIG. 34 of Embodiment 8, and other portions of the configuration are the same as those depicted in FIG. 25, so a description thereof is omitted. Note that the call control device 1 manages a plurality of secondary call control devices 31 and 32, and the policy server 2 manages a plurality of secondary policy servers 33 and 34.

[0177] Here, the procedure for establishing a VPN in the network system of FIG. 39 is described with reference to the flowcharts of FIG. 40 to FIG. 43. Here, an example of an operation where terminal 9 makes a call to terminal 10 is described.

[0178] The terminal 9 transmits a session establishment request to the terminal 10 (step S210). In the following description, terminal 9 is referred to as the call issuing terminal, and terminal 10 is referred to as the call receiving terminal. The session establishment request is first received by the intra-VPN call control device 21 (step S211). After receiving a session establishment request, the intra-VPN call control device 21 compares the content of the session establishment request with the intra-VPN user information database 23 in the access network 7-1, acquires the CoS/line resource capacity and VPN-ID to be applied to the session stream, and transfers this information together with the session establishment request (step S212).

[0179] The transmitted session establishment request is received by the secondary call control device 32 via the secondary call control device 31 and the call control device 1 (step S213). After receiving the session establishment request, the secondary call control device 32 generates a resource reservation request for the stream of the session in the direction from the call receiving terminal 10 to the call issuing terminal 9, based on the information contained in the session establishment request, which is then transmitted to the secondary policy server 34 (step S214). Furthermore, the secondary policy server 34 performs a resource reservation confirmation process for the stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 of the session, in the same manner as the process described in steps S111 to S117 in FIG. 24 in Embodiment 5. However, the policy server 2 performs the process in FIG. 5, so the process of steps S111 to S117 in Embodiment 9 is performed by the secondary policy server 34 associated with the secondary call control device 32.

[0180] When the secondary call control device 32 receives the resource reservation response from the secondary policy server

34 (step S215), a determination is made as to whether or not the resource reservation response indicates success (step S216). If the resource reservation response indicates success, (Yes in step S216), the secondary call control device 32 transfers the session establishment request (step S217). On the other hand, if the resource reservation response indicates failure (No in step S216), the call control device executes a failure sequence, which is defined in the session control protocol (step S218).

[0181] The session establishment request transferred by the secondary call control device 32 is received by the call receiving terminal 10 via the intra-VPN call control device 22 (step S219). The call receiving terminal 10 that has received the session establishment request returns a session establishment response to the call issuing terminal 9 (step S220).

[0182] The session establishment response transmitted by the call receiving terminal 10 is received by the intra-VPN call control device 22 (step S221). After receiving a session establishment response, the intra-VPN call control device 22 compares the content of the session establishment request with the intra-VPN user information database 24 in the access network 8-1, acquires the CoS/line resource capacity and VPN-ID to be applied to the session stream, and transfers this information together with the session establishment request (step S222).

[0183] After receiving the session establishment response (step S223), the secondary call control device 32 generates a resource reservation request for the stream of the session from the call receiving terminal 10 to the call issuing terminal 9 based on the information contained in the session establishment response, and transmits the resource reservation request to the secondary policy server 34 to perform a resource reservation confirmation process (step S224). Furthermore, the secondary policy server 34 performs a resource reservation confirmation process for the stream in the direction from the call receiving terminal 10 to the call issuing terminal 9 of the session, in the same manner as the process described in steps S111 to S117 in FIG. 24 in Embodiment 5.

However, the policy server 2 performs the process in FIG. 5, so this process is performed by the secondary policy server 34 associated with the secondary call control device 32.

[0184] When the secondary call control device 32 receives the resource reservation response from the secondary policy server 34 (step S225), a determination is made as to whether or not the resource reservation response indicates success (step S226). If the resource reservation response indicates success, (Yes in step S226), the secondary call control device 32 transfers the session establishment response (step S227). On the other hand, if the resource reservation response indicates failure (No in step S226), the secondary call control device 32 executes a failure sequence, which is defined in the session control protocol (step S228).

[0185] The session establishment response sent by the secondary call control device 32 is received by the secondary call control device 31 via the call control device 1 (step S229). After receiving the session establishment response, the secondary call control device 31 generates a resource reservation request for the stream of the session from the call issuing terminal 9 to the call receiving terminal 10, and transmits the resource reservation request to the secondary policy server 33 to perform the resource reservation confirmation process (step S230). Furthermore, in the same manner as the process described in steps S111 to S117 in FIG. 24 of Embodiment 5, the resource reservation confirmation process is performed for the stream in the direction from the call issuing terminal 9 to the call receiving terminal 10 of the session. However, the policy server 2 performs the process in FIG. 5, so this process is performed by the secondary policy server 33 associated with the secondary call control device 31.

[0186] When the secondary call control device 31 receives the resource reservation response from the secondary policy server 33 (step S231), a determination is made as to whether or not the resource reservation response indicates success (step S232). If the resource reservation response indicates success, (Yes in step S232), the secondary call control device 31 transfers the session establishment response (step S233). On the other hand, if the resource reservation response indicates failure (No in step S232), the secondary call control device 31 executes a failure sequence, which is defined in the session control protocol (step S234).

[0187] Furthermore, the session establishment response sent by the secondary call control device 31 is received by the call issuing terminal 9 via the intra-VPN call control device 21 (step S235).

[0188] In the process, when the call issuing terminal 9 receives the session establishment response, and when the call receiving terminal 10 receives the session establishment request, the call issuing terminal 9 and the call receiving terminal 10 each start transmitting a session stream. Moreover, the method of transferring the session stream in the LSR is the same as in Embodiment 1, so a description thereof is omitted.

[0189] As described above, according to embodiment 9, the VPN user information database is provided in the access network of each VPN, so the user information is not disclosed to the outside, and security is maintained for the management of user information. Furthermore, an ID number is assigned to each VPN, so there is an effect that a VPN-ID does not need to be set for each terminal. As a result, management of the VPN is simplified. Furthermore, a service grade can be assigned to a session to determine whether resources for a session stream can be secured in the IP core network without having to individually set the edge LSR every time a session is established. Furthermore, LSP setup and filtering for each session stream is not required in the edge LSR, so the load is reduced accordingly. Furthermore, the resource reservation confirmation process accompanying a session establishment request is processed by

the secondary call control device and the secondary policy server, so the load of the processes performed by these devices can be distributed.

[0190] Note that in the described embodiment, the secondary call control devices 31, 32 and the associated secondary policy servers 33, 34 and edge LSRs 41, 44 have been described as if separate devices. However, the secondary call control devices 31, 32 and the secondary policy servers 33, 34 correspond to processing units such as software, the secondary call control devices 31, 32 and the secondary policy servers 33, 34 can be configured to operate in the same device, or the secondary call control devices 31, 32 and the secondary policy servers 33, 34 can be configured to operate in the edge LSRs 41, 44.

[0191]

EFFECT OF THE INVENTION

As described above, with the present invention, an LSP specified by a combination including a first stage LSR, a last stage LSR, and a service class in an IP core network is collectively defined as a virtual communication path, so the policy server can perform policy management only on units of the virtual communication path. Furthermore, the policy server only reserves resources for the virtual communication path for the stream transmitted to the session, and does not need to perform configuration on the LSR when the session is established. As a result, the load on the policy server can be reduced. Furthermore, the LSR that becomes the first stage LSR selects a virtual communication path based on the service class and destination address acquired from the packets of the received stream, and performs only the process of transferring the stream to the selected virtual communication path. Furthermore, filtering of the received stream by the LSR, which was previously necessary, is not necessary, so the speed of the stream transfer process can be increased.

[0192]

With the next invention, a user information database is provided for storing user information including the terminal address of terminals using the service, the service class, and the line resource capacity. Therefore, the service class can be set on a per-user basis, in order to provide services suited to each user.

[0193] With the next invention, the policy server is configured to include a resource reserving means having a function of adding line resource capacity to the virtual communication path and securing the service class and line resource capacity of the stream when a determination is made that the remaining resource capacity of the selected virtual communication path cannot accommodate the line resource capacity of the stream. Therefore, even if a large number of sessions are established and the number of streams transferred in the same virtual communication path increases, the line resource capacity of the virtual communication path can be automatically increased, thereby maintaining the quality of service for users.

[0194] With the next invention, the service class is provided with a delay class that classifies the delay time required from input to output of the IP core network, so a wider variety of services can be provided to users.

[0195] With the next invention, the line resource capacity is defined by a line resource capacity class which is classified in accordance with the guaranteed line resource capacity, so the first stage LSR which first receives the stream can perform more finely tuned QoS control for the stream by using the line resource capacity class.

[0196] With the next invention, an LSP is defined in which a required resource capacity and a destination network are set for each VPN, so resource management can be performed for each VPN in an IP core network.

[0197] With the next invention, a virtual communication path is specified by a combination of a first stage LSR, a last stage LSR, and a service class, and is composed of one or more LSPs. In addition, a virtual communication path where the line resource capacity for each VPN is determined is configured to be set in the policy server and the LSR. Therefore, the policy server only reserves resources for the virtual communication path for the stream transmitted to the session, and does not need to set the LSR when the session is established. Furthermore, the policy server can perform resource management for each VPN in the IP core network. Furthermore, the LSR only needs to select a virtual communication path based on the service class, destination address, and VPN identifier acquired from the packets of the received stream, and transfer the stream to the virtual communication path. Therefore, the need to perform filtering of the received stream, which was previously necessary, is not necessary now, and thus the speed of the stream transfer process can be increased.

[0198] With the next invention, a VPN user information database is provided in the VPN, which stores user information including the address of the network to which the user terminal belongs, the service class, and the line resource capacity for each network, with a VPN identifier assigned to each VPN. Thereby, unauthorized intrusion into the user information database from outside can be prevented and the security of the VPN can be increased. Furthermore, the policy server does not need to set a VPN identifier for each terminal present on the network, so the processing load on the policy server can be reduced.

[0199] With the next invention, the system is configured to include a secondary call control device and a secondary policy server, so the processing of session establishment, which increases as the network becomes larger, is not executed by a single call control device and policy server, but by a plurality of secondary call control devices and secondary policy servers having the same functions, in order to facilitate distribution of the processing load.

[0200] With the next invention, the secondary policy server is configured to include a resource reserving means having a function of adding line resource capacity to the virtual communication path and securing the service class and line resource capacity of the stream when a determination is made that the remaining resource capacity of the selected virtual communication path cannot accommodate the line resource capacity of the stream. Therefore, even if a large number of sessions are established and the number of streams transferred in the same virtual communication path increases, the line resource capacity of the virtual communication path can be automatically increased. As a result, services can be provided to users without impeding the quality. In addition, the system is configured to include a secondary call control device and a secondary policy server, so the process of session establishment, which increases as the network becomes larger, is not executed by a single call control device and policy server, but by a plurality of secondary call control devices and secondary policy servers having the same functions, thereby enabling distribution of the processing load.

[0201] With the next invention, a VPN user information database is provided in the VPN, which stores user information including the address of the network to which the user terminal belongs, the service class, and the line resource capacity for each network, with a VPN identifier assigned to each VPN. Thereby, unauthorized intrusion into the user information database from outside can be prevented and the security of the VPN can be increased. In addition, the system is configured to include a secondary call control device and a secondary policy server, so the process of session establishment, which increases as the network becomes larger, is not executed by a single call control device and policy server, but by a plurality of secondary call control devices and secondary policy servers having the same functions, thereby enabling distribution of the processing load.

[0202] With the next invention, the secondary call control device is managed by the call control device and the secondary policy server is managed by the policy server, so the roles of each secondary call control device and secondary policy server can be shared, thereby enabling an improvement in the processing efficiency throughout the entire system.

[0203] With the next invention, the secondary policy server is configured so as to be associated with a plurality of secondary call control devices, so placement of the secondary policy servers in the system can be freely designed by taking into account the degree of the load.

[0204] With the next invention, the secondary call control device and the secondary policy server are configured to be provided in the same device, so the number of devices installed in the system can be reduced to prevent the system configuration from becoming complicated.

[0205] With the next invention, the secondary call control device and the secondary policy server are configured to be provided in the same LSR, so the number of devices installed in the system can be reduced to prevent the system configuration from becoming complicated.

[0206] With the next invention, the policy server is configured to include a resource reserving means having a function of adding line resource capacity to the virtual communication path and securing the service class and line resource capacity of the stream when a determination is made that the remaining resource capacity of the selected virtual communication path cannot accommodate the line resource capacity of the stream. Therefore, even if a large number of sessions are established and the number of streams transferred in the same virtual communication path increases, the line resource capacity of the virtual communication path can be automatically increased, thereby maintaining the quality of service for users.

[0207] With the next invention, the virtual communication path defining means of the policy server is configured to further include a function for determining the line resource capacity for each VPN in the virtual communication path, so a VPN can be constructed between networks that communicate via an IP core network.

[0208] With the next invention, the policy server is configured so that an LSP is defined in which a required resource capacity and a destination network are set for each VPN, and thus resource management can be performed for each VPN in an IP core network.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram depicting a configuration of a network policy control system according to Embodiment 1 of the present invention;

FIG. 2 is a flowchart depicting a procedure for setting a virtual communication path;

FIG. 3 is a diagram depicting an example of the configuration of a user information database;

FIG. 4 is a diagram depicting an example of the configuration of a virtual communication path including attribute information;

FIG. 5 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 1);

FIG. 6 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 2);

FIG. 7 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 3);

FIG. 8 is a diagram depicting an example of classifying a delay class of a service class (CoS) used in Embodiment 2 of the present invention;

FIG. 9 is a diagram depicting an example of the configuration of a user information database;

FIG. 10 is a diagram depicting an example of the configuration of a virtual communication path including attribute information;

FIG. 11 is a diagram depicting an example of classifying a line resource capacity in Embodiment 3 of the present invention;

FIG. 12 is a diagram depicting an example of the configuration of a user information database;

FIG. 13 is a flowchart depicting a procedure for setting a virtual communication path;

FIG. 14 is a block diagram depicting a configuration of a network policy control system according to Embodiment 4 of the present invention;

FIG. 15 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 1);

FIG. 16 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 2);

FIG. 17 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 3);

FIG. 18 is a block diagram depicting a configuration of a network policy control system according to Embodiment 5 of the present invention;

FIG. 19 is a flowchart depicting a procedure for setting a virtual communication path;

FIG. 20 is a diagram depicting an example of the configuration of a user information database;

FIG. 21 is a diagram depicting an example of the configuration of a virtual communication path including attribute information;

FIG. 22 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 1);

FIG. 23 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 2);

FIG. 24 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 3);

FIG. 25 is a block diagram depicting a configuration of a network policy control system according to Embodiment 6 of the present invention;
 FIG. 26 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 1);
 FIG. 27 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 2);
 FIG. 28 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 3);
 FIG. 29 is a block diagram depicting a configuration of a network policy control system according to Embodiment 7 of the present invention;
 FIG. 30 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 1);
 FIG. 31 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 2);
 FIG. 32 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 3);
 FIG. 33 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 4);
 FIG. 34 is a block diagram depicting a configuration of a network policy control system according to Embodiment 8 of the present invention;
 FIG. 35 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 1);

FIG. 36 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 2);
 FIG. 37 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 3);
 FIG. 38 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 4);
 FIG. 39 is a block diagram depicting a configuration of a network policy control system according to Embodiment 9 of the present invention;
 FIG. 40 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 1);
 FIG. 41 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 2);
 FIG. 42 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 3);
 FIG. 43 is a flowchart depicting a processing procedure for establishing a session between a call issuing terminal and a call receiving terminal (part 4); and
 FIG. 44 is a block diagram depicting a conventional example of a system for guaranteeing the QoS of a VoIP stream on an MPLS/IP network.

DESCRIPTION OF SYMBOLS

1. Call control device, 2. Policy server, 3, 35, 36. User information database, 4. IP core network, 5, 6. Gateway, 7, 8. Access network, 9, 10. Terminal, 21, 22. Intra-VPN call control device, 23, 24. Intra-VPN user information database, 25. Intra-VPN policy server, 31, 32. Secondary call control device, 33, 34. Secondary policy server, 41 to 46. Label switching router.

FIG. 1

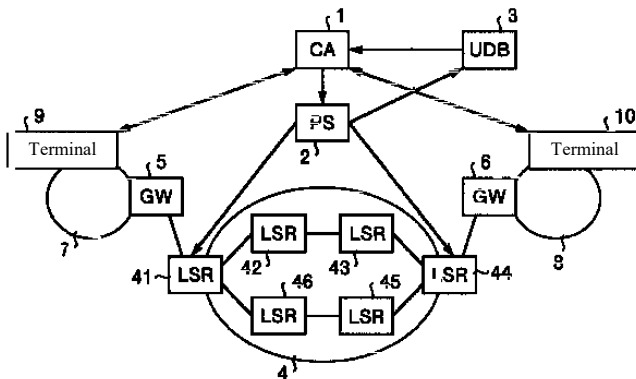


FIG. 8

Delay class

Delay Class	Maximum Delay Time	Minimum delay time
1	100ms.	0
2	400ms.	100ms.
3	1000ms.	400ms.
4	—	1000ms.

FIG. 2

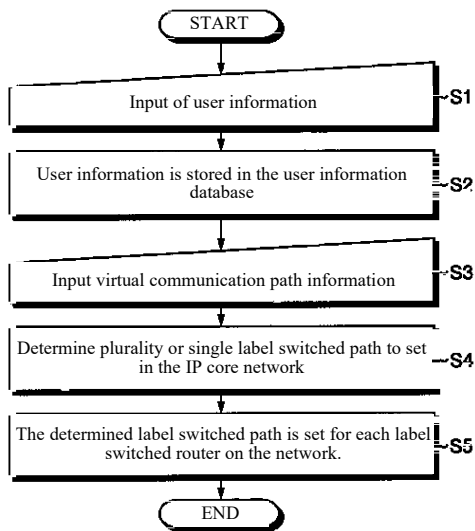


FIG. 11

•Line resource capacity class

Line resource capacity class	Maximum Bandwidth	Minimum guaranteed bandwidth	Maximum Burst Size
1	34kbps	8kbps	8kbyte
2	1Mbps	64kbps	8kbyte
3	8Mbps	1Mbps	8kbyte
4	16Mbps	8Mbps	8kbyte

FIG. 3

• User information DB

Flow identification information	CoS	Resource capacity
Address/address mask of access network 7 Address/address mask of access network 8 Transport protocol: RTP Encoding type: MPV	Transfer priority class = 1 Discard priority class = 2	10Mbps
...	...	...

FIG. 4

• Virtual communication path

VID	CoS	Resource capacity	Destination address/ address mask	LSPs that configure virtual communication path		
				LSPID	Resource capacity	Route
1	TP:1	50Mbps	Access network 8	LSR41:1	40Mbps	LSR41→LSR42→LSR43→LSR44
	...			...	...	
	LP:2			LSR41:n	10Mbps	LSR41→LSR46→LSR45→LSR44
...	...	...	...	...	...	
n	...	...	...	...	...	

VID: Virtual communication path identifier
 TP: Transfer priority class
 LP: Discard priority class

FIG. 9

• User information DB

Flow identification information	CoS	Resource capacity
Address/address mask of access network 7 Address/address mask of access network 8 Transport protocol: RTP Encoding type: MPV	Transfer priority class = 1 Discard priority class = 2 Delay class = 3	10Mbps
...	...	...

FIG. 5

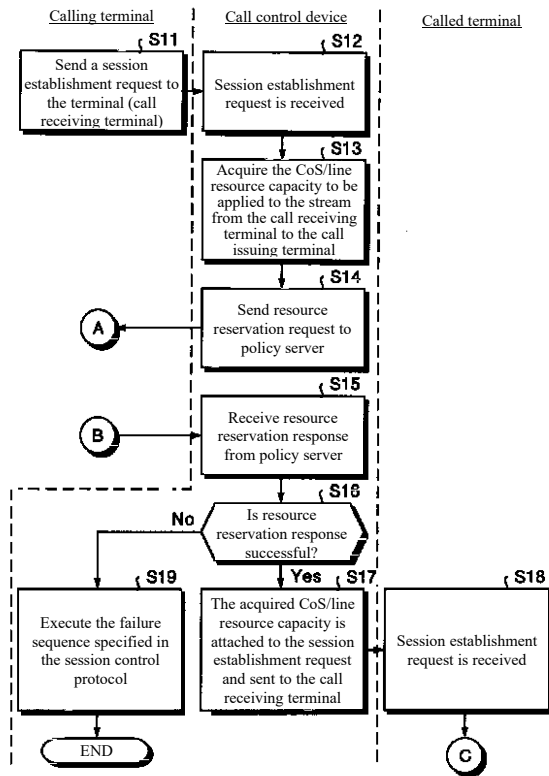


FIG. 7

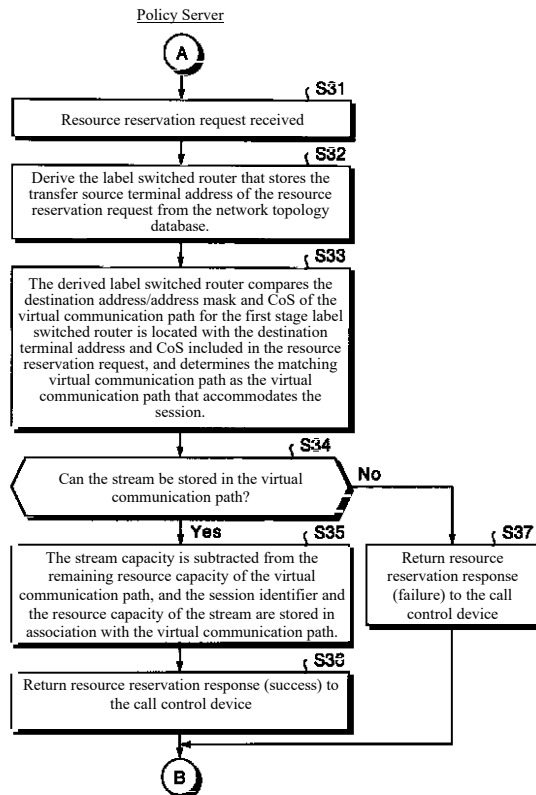


FIG. 6

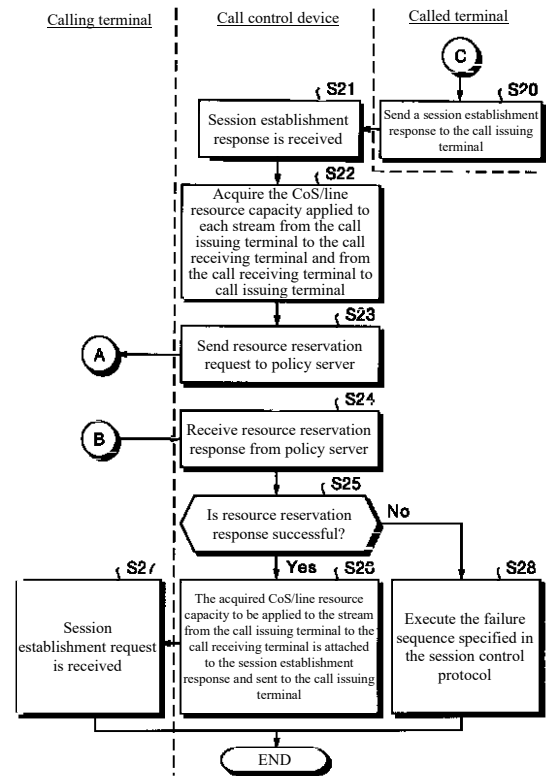


FIG. 13

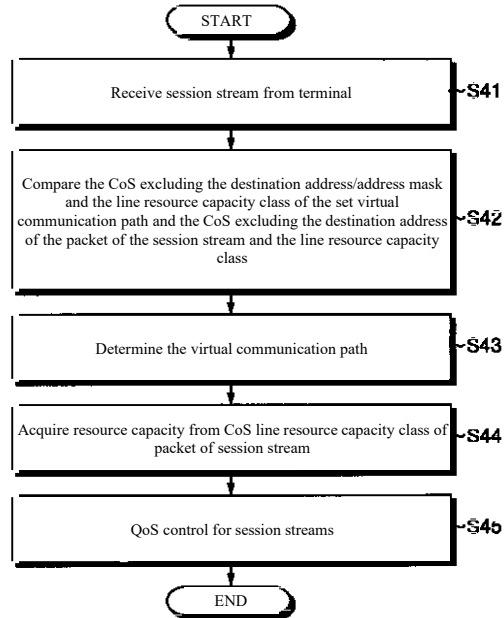


FIG. 10

• Virtual communication path

VID	CoS	Resource capacity	Destination address/ address mask	LSPs that configure virtual communication path		
				I.SPID	Resource capacity	Route
1	TP:1	50Mbps	Access network 8	LSR41:1	40Mbps	LSR41→LSR42→LSR43→LSR44
	LP:2			...	...	...
	DP:1			LS:141:n	10Mbps	LSR41→LSR46→LSR45→LSR44
...	...	...	...	...	...	...
n	...	...	...	...	...	...

VID: Virtual communication path identifier
 TP: Transfer Priority Class
 LP: Discard priority class
 P: Delay class

FIG. 12

• User information DB

Flow identification information	CoS
Address/address mask of access network 7 Address/address mask of access network 8 Transport protocol: RTP Encoding type: MPV	Transfer priority class = 1 Discard priority class = 2 Delay class = 3 Line resource capacity class = 3
...	...

FIG. 14

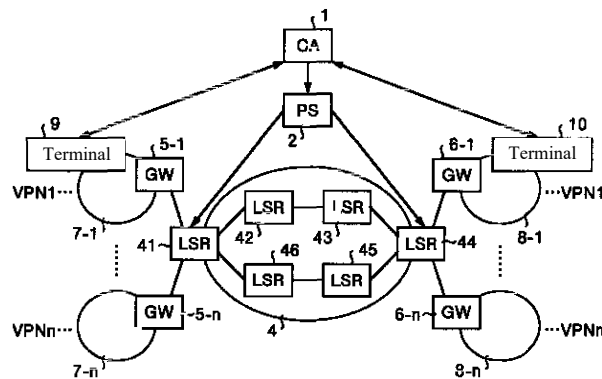


FIG. 18

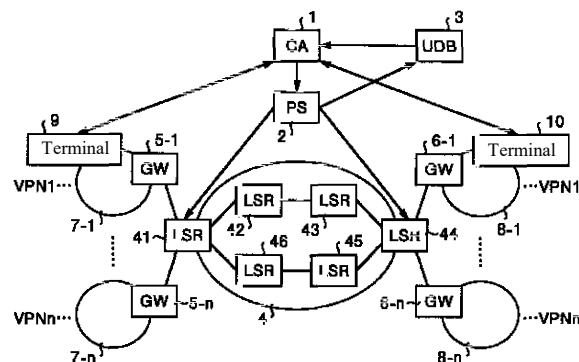


FIG. 15

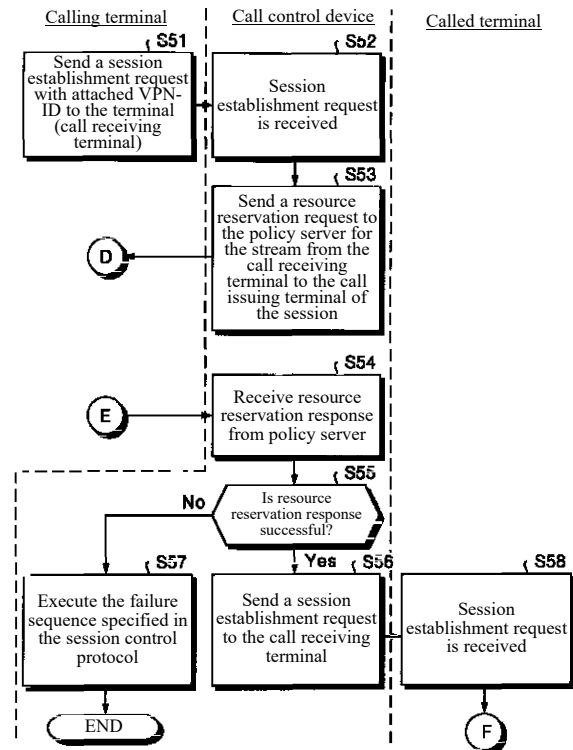


FIG. 16

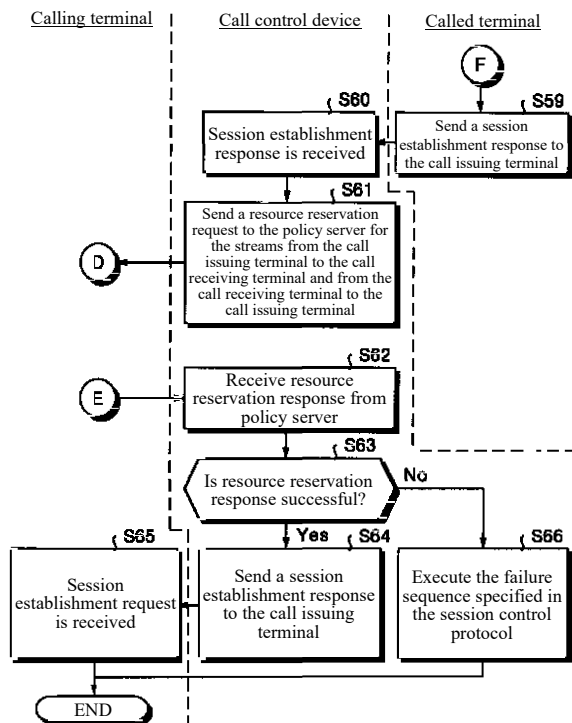


FIG. 17

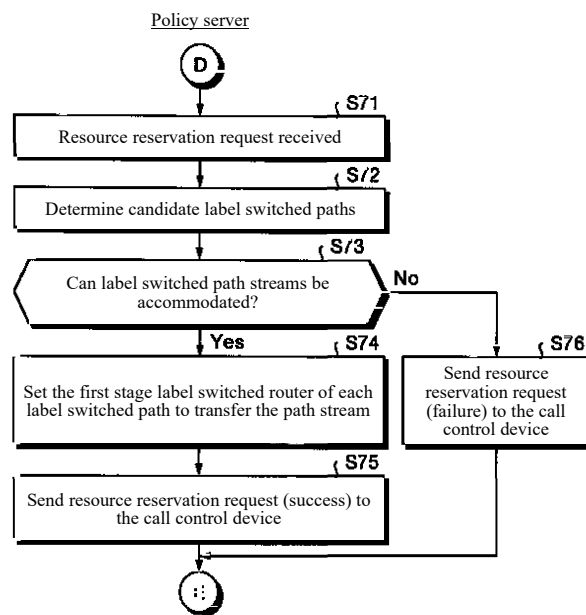


FIG. 19

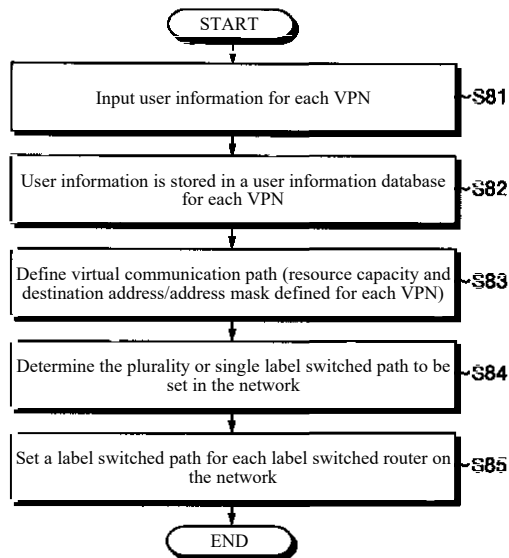


FIG. 22

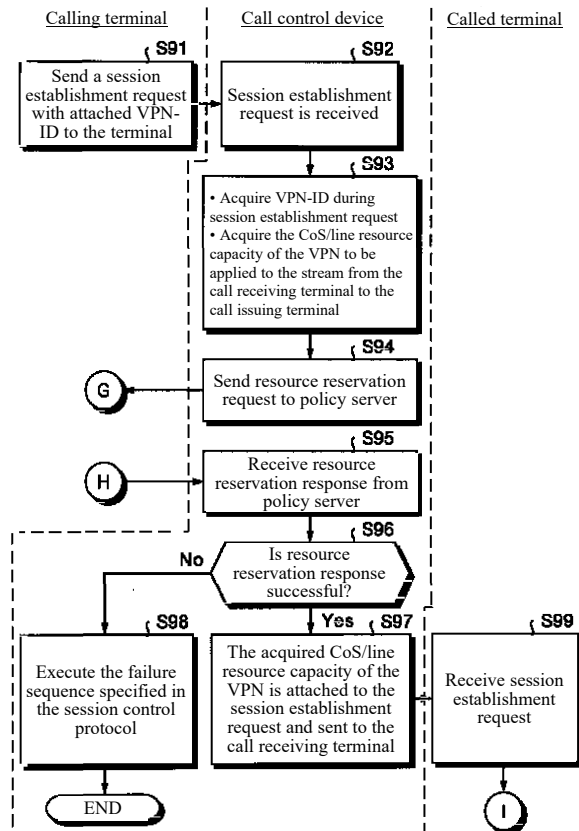


FIG. 20

• User information DB

VPN	Flow identification information	CoS	Resource capacity
1	Address/address mask of access network 7-1 Address/address mask of access network 8-1 Transport protocol: RTP Encoding type: MPV	Transfer priority class = 1 Discard priority class = 2 Delay Class = 1 Line resource capacity class = 3	10Mbps
...	...	...	...
n	...	...	...

FIG. 21

• Virtual communication path

VPN	CoS	Resource capacity		Destination address/address mask	LSPs that configure virtual communication path		
					I.SPID	Resource capacity	Route
1	TP:1	50Mbps	VPN1:20Mbps	Access network 8-1	LSR41:1	40Mbps	...
	LP:2		...	...	...	...	
	DP:1		VPNn:30Mbps	Access network 8-n	LSR141:n	10Mbps	...
...	...	...	...	...	...	...	...
n	...	...	...	...	...	...	...

FIG. 23

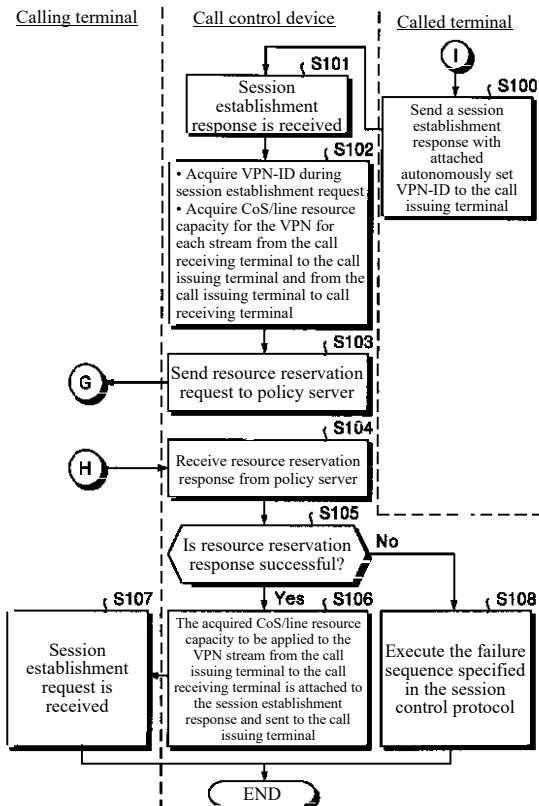


FIG. 24

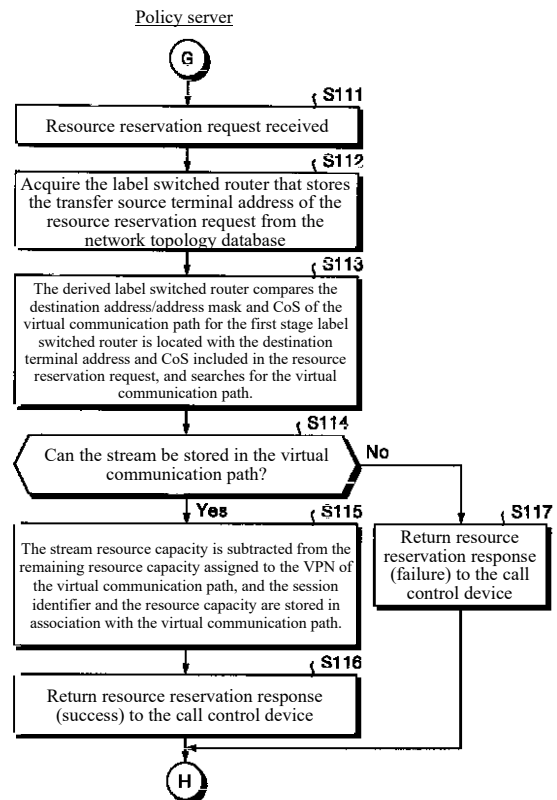


FIG. 25

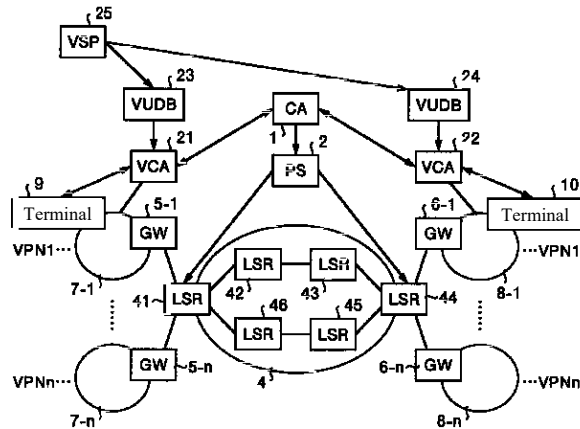


FIG. 29

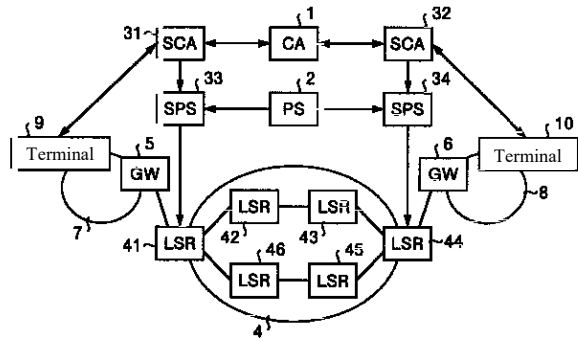


FIG. 26

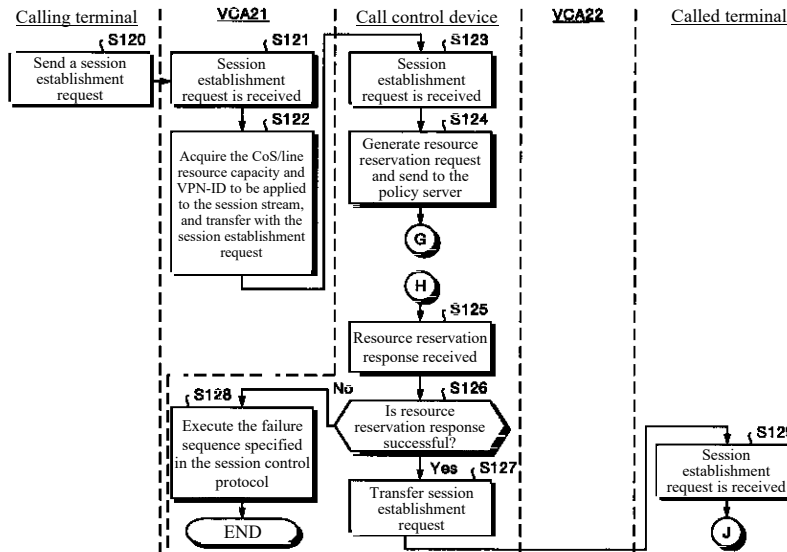


FIG. 28

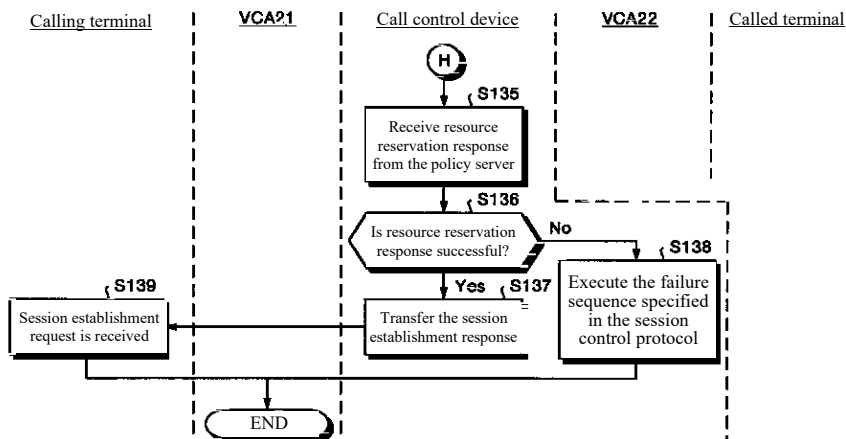


FIG. 27

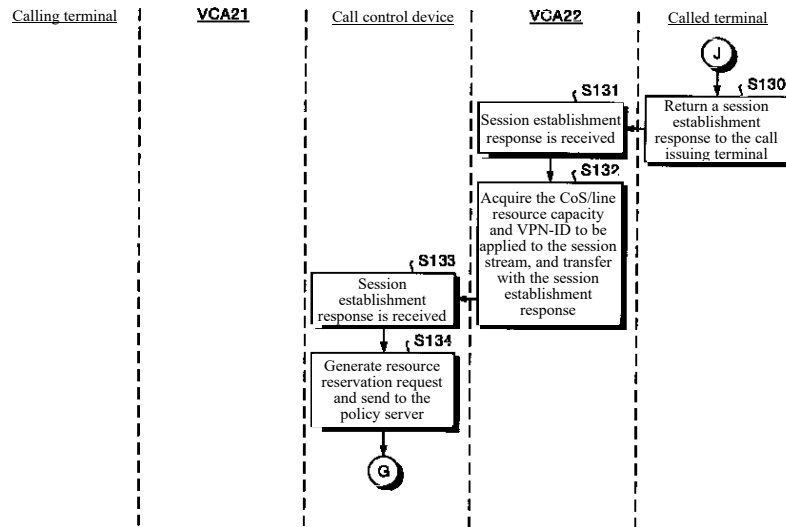


FIG. 30

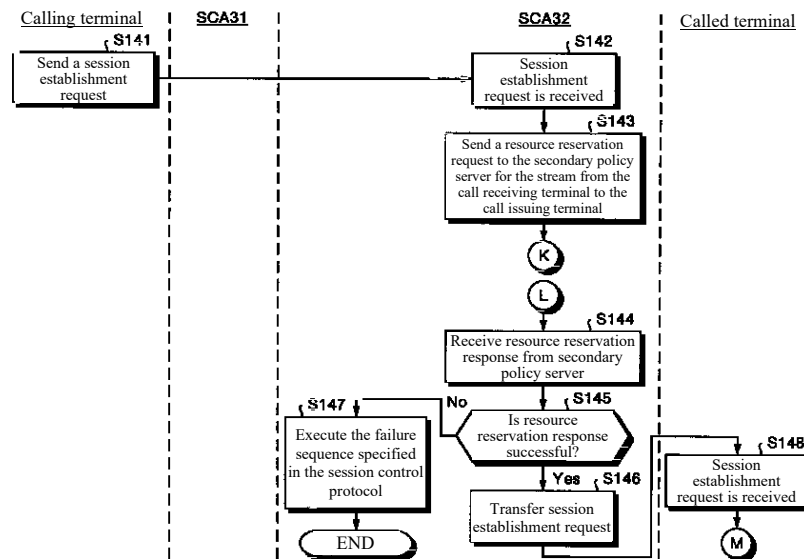


FIG. 34

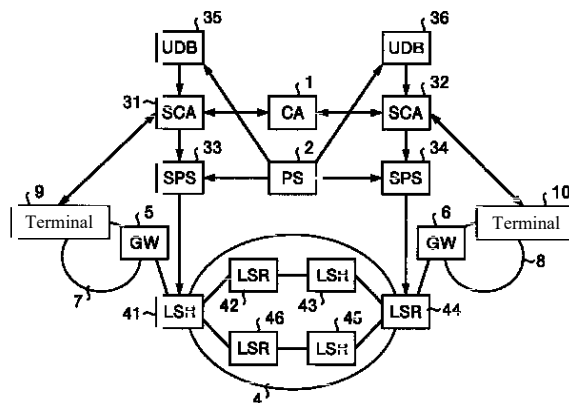


FIG. 31

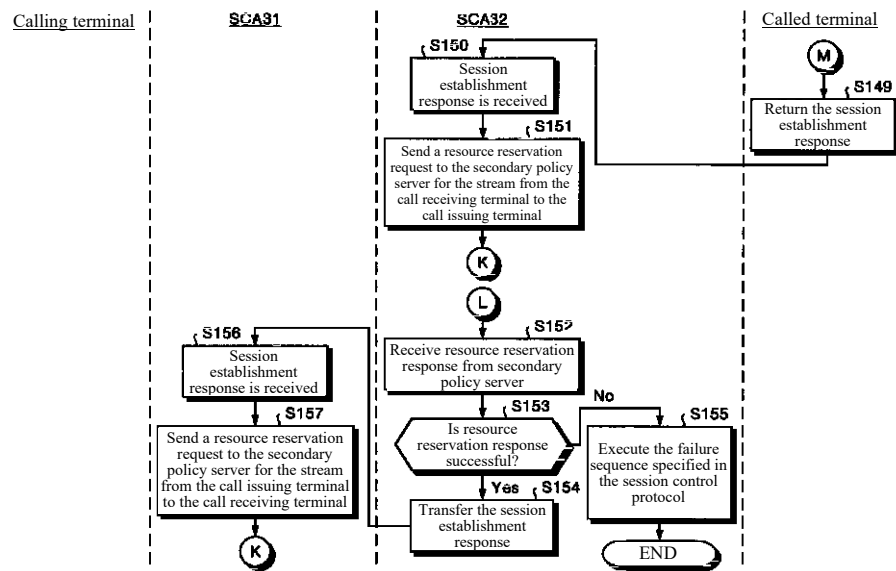


FIG. 32

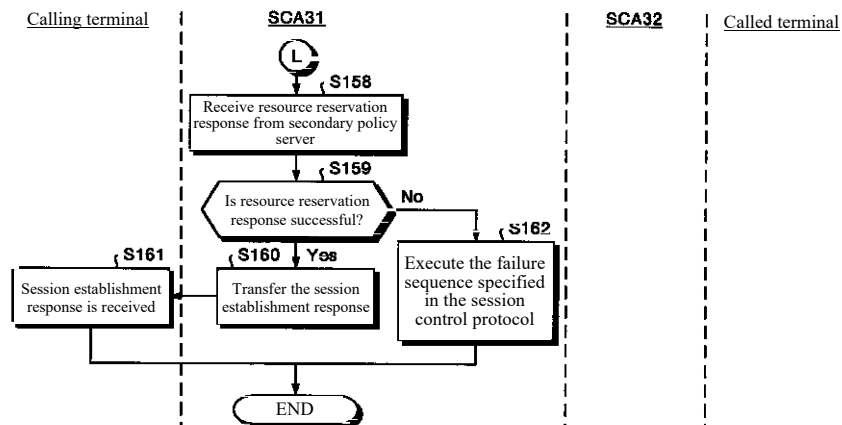


FIG. 38

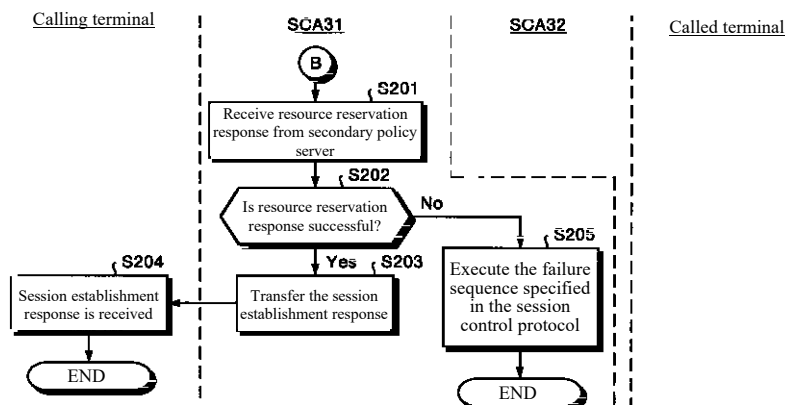


FIG. 33

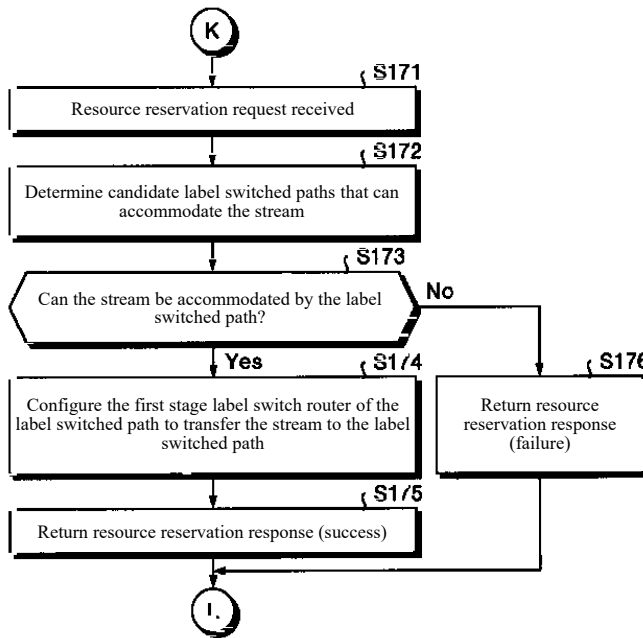


FIG. 39

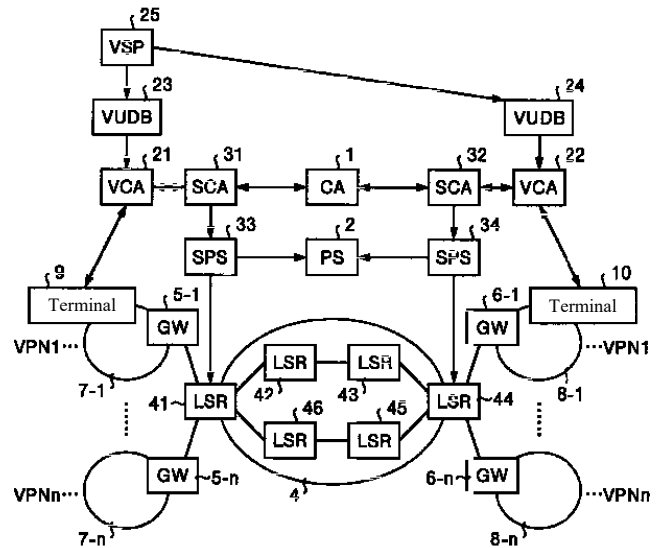


FIG. 35

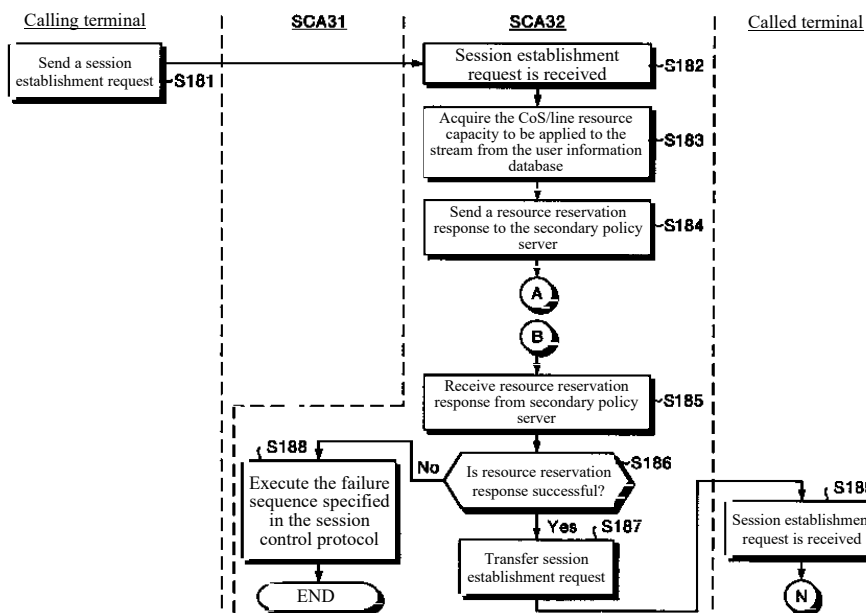


FIG. 36

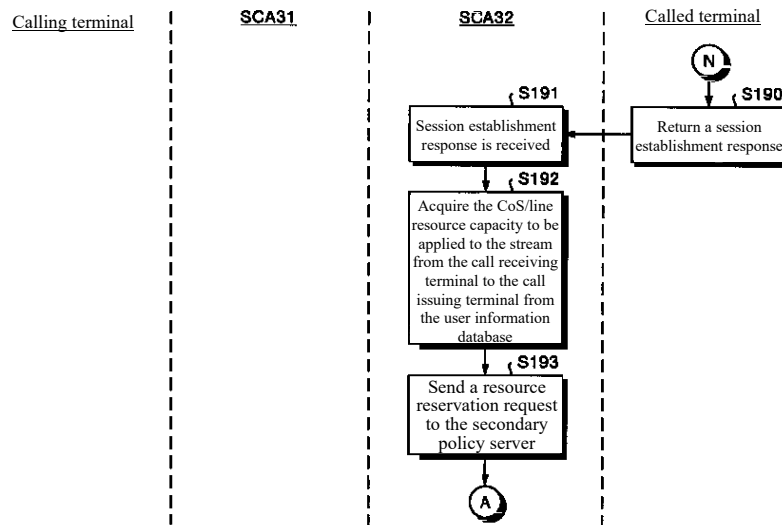


FIG. 37

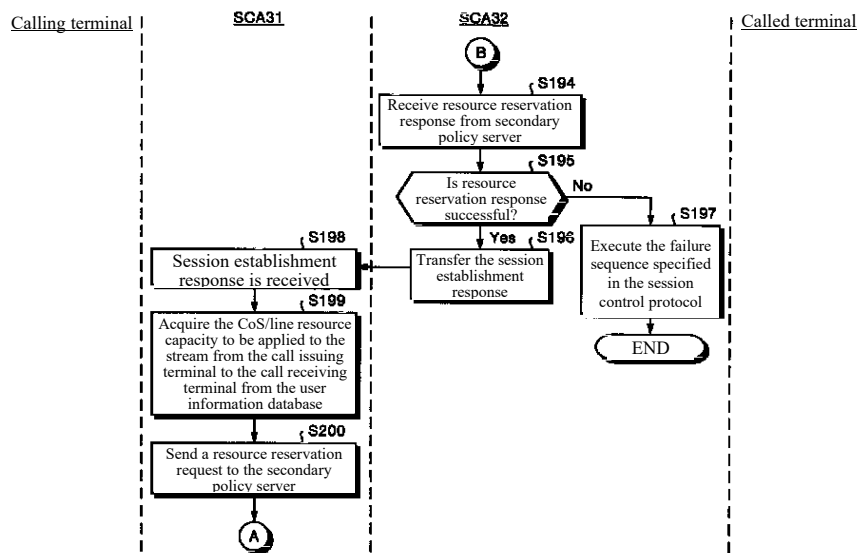


FIG. 43

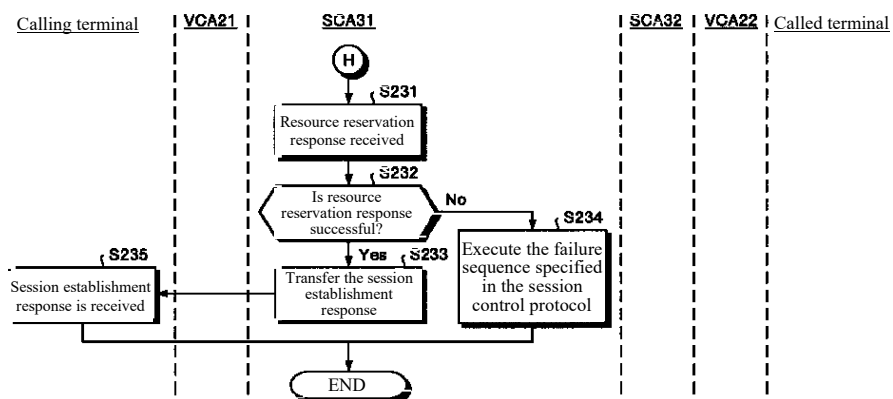


FIG. 40

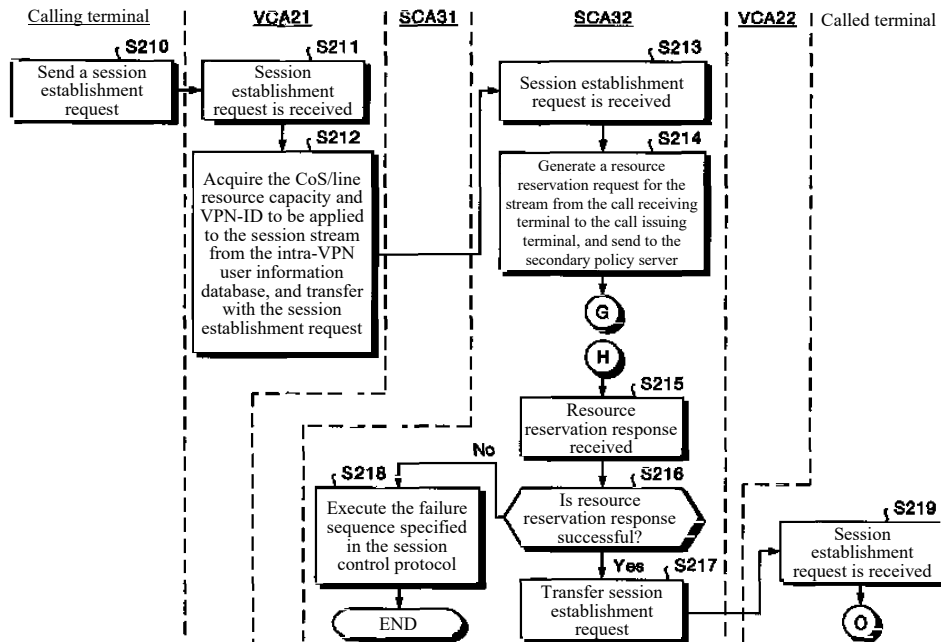


FIG. 41

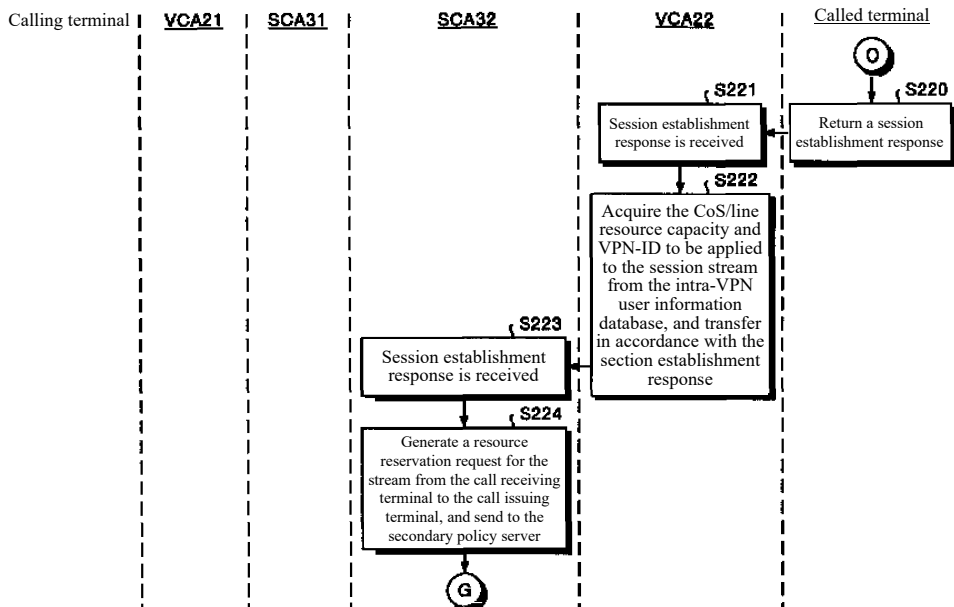


FIG. 42

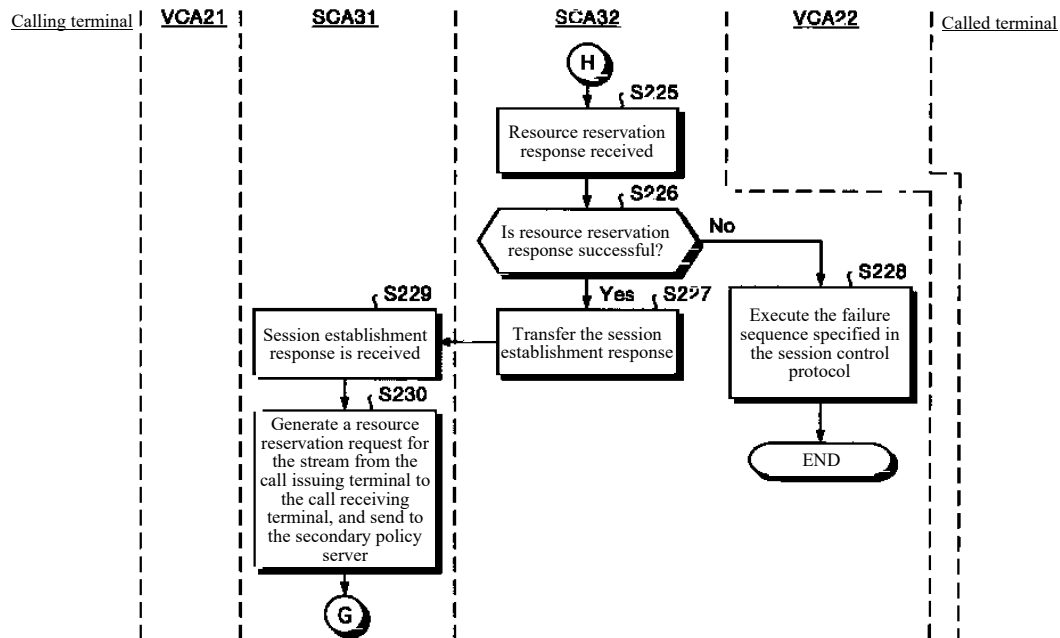
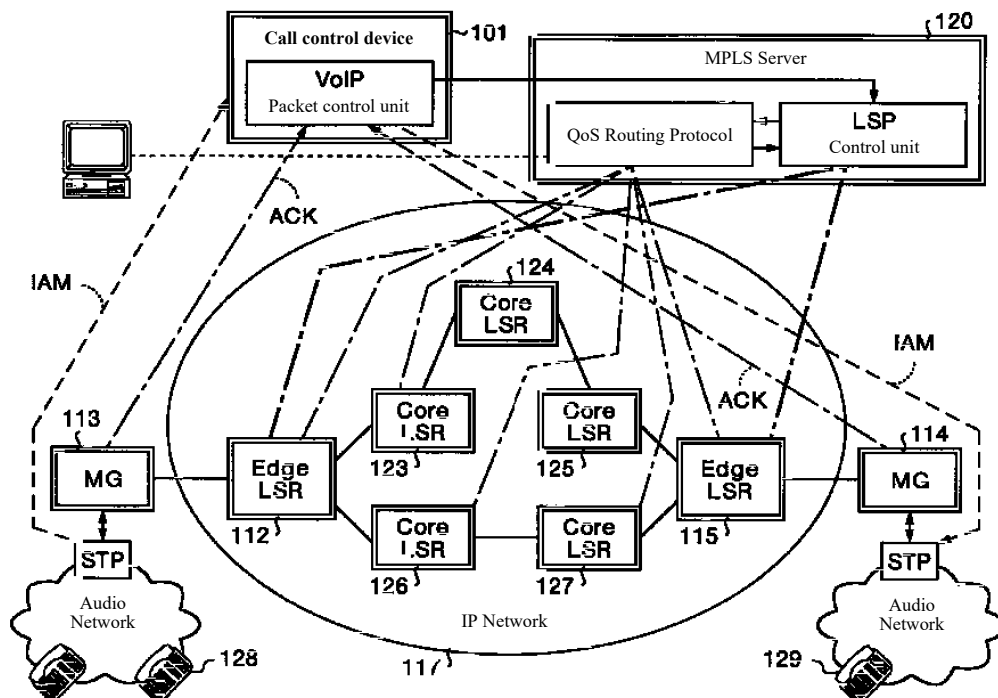


FIG. 44





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I, Dwaine Palmer, declare as follows:

1. I am a native speaker of English and am well versed in both the Japanese and English languages and have over 26 years of experience translating Japanese technical documents into English.
2. The following translation of the corresponding source text from Japanese into English is accurate and complete to the best of my knowledge.

I declare under penalty of perjury of the laws of the United States of America that the foregoing information is true and accurate to the best of my knowledge. Statements made herein are to the best of my knowledge true and are based on information that I believe to be true and further these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code.

Executed on: May 28, 2025, at 749-1 Kashio, Shimizu-ku, Shizuoka-shi, Japan

Signed by Dwaine Palmer

