



(72) LEE, Ronald Chi Hong, CA

(72) BERNELOT MOENS, Theodore Warren, CA

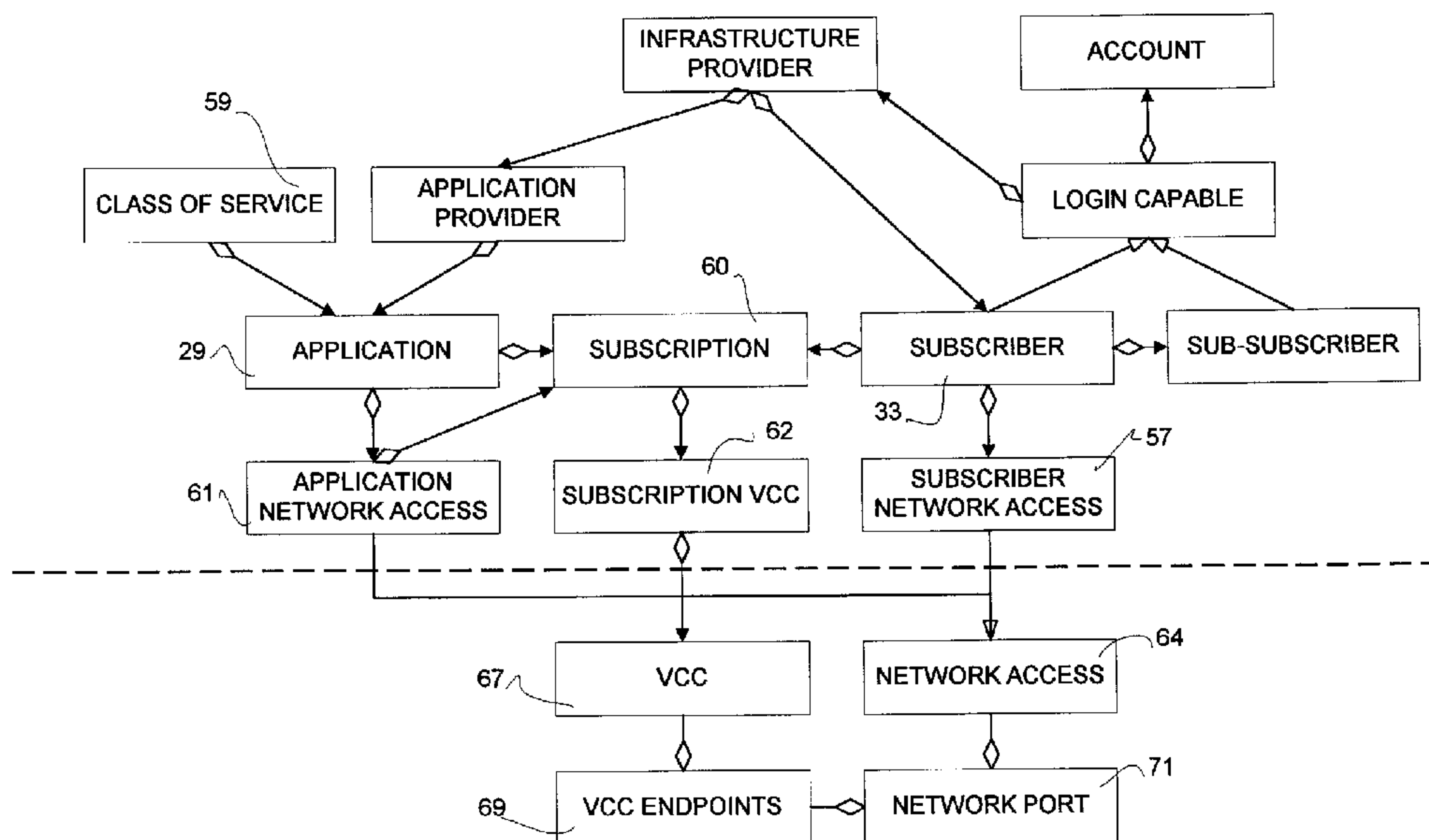
(72) SPONCHIA, Maury Richard, CA

(71) NEWBRIDGE NETWORKS CORPORATION, CA

(51) Int.Cl.⁶ H04L 12/24

(54) **SYSTEME DE GESTION DES ABONNEMENTS POUR RESEAU
DE TRANSMISSION DE DONNEES**

(54) **SUBSCRIPTION MANAGEMENT SYSTEM FOR DATA
COMMUNICATION NETWORK**



(57) A network management system allows operators to set up subscriptions to services for network users. The subscriptions each associate a subscriber object and an application object. The subscriber object contains information about the subscriber's network connection. The application object contains information about the application's network connection. The operator does not need to work with low level information such as physical port numbers to create a subscription. The system automatically sets up one or more virtual channel connections as needed to provide the application to the subscriber. The system can be easier to operate accurately than current systems. The system may track and accumulate statistics on a service-by-service basis. The statistics may be used to bill for individual services even if several different virtual channel connections are used to provide each service.

- 31 -

Abstract of the Disclosure

A network management system allows operators to set up subscriptions to services for network users. The subscriptions each associate a subscriber object and an application object. The subscriber object contains information about the subscriber's network connection. The application object contains information about the application's network connection. The operator does not need to work with low level information such as physical port numbers to create a subscription. The system automatically sets up one or more virtual channel connections as needed to provide the application to the subscriber. The system can be easier to operate accurately than current systems. The system may track and accumulate statistics on a service-by-service basis. The statistics may be used to bill for individual services even if several different virtual channel connections are used to provide each service.

SUBSCRIPTION MANAGEMENT SYSTEM **FOR DATA COMMUNICATION NETWORK**

Technical Field

5

This invention relates to the management of data communication networks. In particular the invention relates to systems and methods for facilitating the creation and maintenance of connections between subscribers and services provided by way of a data communication network.

Background

There is a need for systems which can be used to provide services to users connected to data communication networks. Services may include things such as video-on-demand, audio-on-demand, on-line games and amusements, or Internet access, which are provided by a service provider, to subscribers who are connected to a data communications network.

20

The currently accepted approach to setting up the network connections needed to provide such services is tedious, requires technically skilled personnel and is susceptible to errors. First, the physical port to which the subscriber is attached to the network must be identified. Next, the service's connection requirements, including bandwidth, must be studied to determine what sort of connection is needed. Appropriate connections from one or more of the service provider's servers to

- 2 -

the subscriber's physical port can then be established. The connections must be monitored for billing purposes and billing information must be accumulated and associated with the subscriber.

5

Existing network management tools such as the MainStreetXpress™ 46020™ network manager available from Newbridge Networks Corporation of Kanata, Ontario, Canada provide for the centralized management of network connections
10 but operate at a low level. Such management tools allow an operator to configure network nodes, cards and modules and manage links and paths throughout a network from a single location. The operator must still, however, have reasonably advanced technical knowledge of the network and must
15 manipulate physical port addresses and other similarly low level information to set up a service for a subscriber.

Another problem with existing network management tools is that they track network statistics in a manner which
20 provides the information necessary to make "wholesale" sales of network bandwidth but do not provide sufficient information to conveniently bill on a selective basis for particular services provided over the network. The inability of existing network management systems to collect the information necessary to bill
25 for individual services has provided an obstacle to the deployment of such services by network providers.

- 3 -

Summary of the Invention

This invention provides a management system for a data communication network. The management system allows
5 for the creation of subscriptions which each relate a subscriber to a service. The management system can create communication channels needed to provide the subscription to the subscriber automatically. It is not necessary for a human operator of the management system to provide low level information about the
10 network each time a subscription is created.

In one aspect of the invention, the management system comprises a plurality of application objects each corresponding to an application available on a data
15 communication network and each specifying a network connection point for the corresponding application. The application objects may be stored in a database accessible to the system. The system also comprises a plurality of subscriber objects each corresponding to a subscriber having a connection
20 to the data communication network, each subscriber object specifying a network connection point for the corresponding subscriber. The subscriber objects may also be stored in the database. The system has a user interface which permits a user to create a subscription object associating one of the subscriber
25 objects and one of the application objects. The system includes a network manager which creates in the data communication

- 4 -

network a communication channel for each subscription object. The communication channel connects the network connection point for the subscriber of the subscription object and the network connection point for the application of the subscription
5 object. In the case of an ATM network the communication channel is a virtual channel connection ("VCC"). In the case of a frame relay network the communication channel may be a frame relay path ("FRP").

10 The operator who creates the subscription object does not need to deal with low level information such as physical port numbers. Thus the invention ameliorates some of the disadvantages of prior art systems which are identified above. The capacity and other quality of service parameters for the
15 virtual channel connection are preferably included in the application object for each application so that the system automatically creates an appropriate communication channel for each subscription.

20 Preferred embodiments of the system track statistics for each communication channel used in the delivery of a subscribed service to a subscriber. The statistics are associated with subscriptions. The statistics may be used to bill the subscriber for the service even if several different
25 communication channels are used to provide the service. The management system preferably includes a statistics collector.

- 5 -

The statistics collector collects statistics regarding those communication channels of the data communication network which correspond to each subscription. The management system comprises means for selecting and aggregating statistics for all
5 of one or more communication channels used in the provision of a service according to a subscription over a selected period.

The invention also provides a method for managing the provision of services to users of a data communications
10 network. The method comprising, in a computer system: storing in a database accessible to the computer system subscriber information identifying a plurality of subscribers and application information identifying one or more applications available to the subscriber; receiving user input identifying one
15 subscriber and one application to be associated as a subscription; retrieving from the database a subscriber network connection point from the subscriber information for the one subscriber and an application network connection point from the application information for the one application; and, creating a
20 virtual channel connection in the data communications network extending between the subscriber network connection point and the application network connection point. The virtual channel connection is created automatically between the correct endpoints without the requirement for an operator to manually
25 specify points of network connection for the user or the application. The method of the invention accordingly provides a

- 6 -

simplified procedure for providing services to subscribers on a data communications network. The following specification and claims point out other aspects and benefits of the invention.

5 Brief Description of Drawings

In drawings which illustrate non-limiting embodiments of the invention,

Figure 1 is a schematic view of a data communication network comprising a service subscription manager according to
10 the invention;

Figure 1A is a schematic view of a service subscription manager according to the invention being used in the management of subscriptions on a two part data communication network;

15 Figure 2 is a schematic representation of a service subscription manager according to the invention;

Figure 3 is a representation of the relationships between some of the main objects in object oriented software embodying the invention;

20 Figure 4 is a schematic view illustrating the connection of a service selection agent to the a network equipped with a subscriber management system;

Figure 5 is a depiction of a graphical user interface of a type which may be presented to a subscriber by a service
25 selection agent according to the invention;

- 7 -

Figure 6 is a schematic view of a system for client-side load balancing according to the invention; and,

Figure 7 is a flow chart illustrating a method according to the invention.

5

Description

Figure 1 is a schematic view of a network **20**. For the purpose of illustration, network **20** is an ATM network. Network **20** could be any other suitable type of network in which communication channels can be set up between different points on the network.

Network **20** comprises a number of Asynchronous Transfer Mode ("ATM") switches **24** connected by communication lines **26**, each capable of carrying digital information. One or more service providers provide servers **28** connected to network **20** by way of suitable access devices **30**. A number of users or "subscribers" **32** are also connected to network **20** by way of suitable access devices **30**. Access devices **30** for users **32** may be, for example, Digital Subscriber Line ("DSL") modems or wireless access devices.

Servers **28** can provide one or more services or "applications" to users **32**. For example, a service might be the delivery of an audiovisual work (such as a movie) from server **28** to a particular user **32A** through network **20**. User **32A** may be

25

- 8 -

termed a subscriber who subscribes to the service provided from server 28. To enable such a service to be provided it is necessary to configure network 20 to provide a virtual channel connection ("VCC") (indicated by dashed line 40) from server 28 to the
5 access device 30A for subscriber 32A. In many typical embodiments of the invention, VCC 40 is a Permanent Virtual Connection ("PVC").

VCC 40 must have sufficient bandwidth to provide
10 the desired service. Where the service is delivery of an audiovisual work, VCC 40 must have sufficient bandwidth to carry the audiovisual work to subscriber 32A. If a service other than the delivery of an audiovisual work is provided then one or more VCCs each having an appropriate bandwidth and
15 providing an appropriate level of Quality of Service ("QoS") will need to be set up so that the service can be delivered to subscriber 32A.

VCC 40 is created by configuring switches 24. A
20 network manager 44, such as the MainStreetXpress™ 46020™ network manager, is attached to network 20. An operator of network manager 44 could configure switches 24 to provide VCC 40. To do this the operator would need to know in advance, or find out, the physical port at which access device 30A is
25 connected to network 20 as well as the bandwidth and other QoS requirements for VCC 40. The operator can enter this

- 9 -

information into network manager 44. Network manager 44 then sends commands to switches 24 to cause VCC 40 to be set up and connected. Looking up and manually entering such information can be tedious and can result in errors which either
5 impair the service or prevent the service from operating at all. The errors may be hard to locate.

This invention provides a network management system 45 which includes a service subscription manager 46
10 which communicates with one or more network managers 44 through one or more communication links 47. Communication link 47 may be provided by network 20. Service subscription manager 46 contains one or more databases 50 which associates each subscriber 32 as identified by easily ascertainable
15 information, such as name, address, telephone number or the like, with physical information needed to establish a VCC to that subscriber including port number on network 20.

In the preferred embodiment of the invention, service
20 subscription manager 46 comprises two databases 50 and 51. This provides flexibility in implementation. Database 50 contains service level information and database 51 contains technical information regarding the resources of network 20. Database 50 may contain, for example, the following
25 information about each subscriber 32: account name; password; contact information such as telephone number, e-mail address,

- 10 -

postal address; personal information; administrative status; a list of services to which the subscriber has subscribed; and an association with technical network access information which is stored in database 51. Databases 50 and 51 are preferably
5 implemented using object oriented database software.

Database 50 also associates services or “applications” provided by service providers, once again identified by easily ascertainable information such as a trade-mark, logo, provider
10 name, or the like, with information describing the one or more VCCs needed to provide the service to any one of subscribers 32. Database 50 may contain, for example, the following information for each application: application provider; name; logo; e-mail contact for trouble reports; e-mail contact for service
15 enquiries; a set of subscribers to the application; and associations to technical information about the class of service used to provide the application, and network access (application delivery point(s)) which are stored in database 51.

20 A third database (not shown) is preferably provided to track the rights that various operators of service subscription manager 46 have. For example, some operators may have rights to modify existing subscriptions but not to create new subscriptions, and so on.

25

- 11 -

An operator of system 45 can cause the VCCs necessary to provide a service to a subscriber 32A to be set up by creating a subscription in service subscription manager 46. A subscription associates a subscriber 32A with a service, for
5 example a service provided from server 28. Particulars of the subscription are then stored in databases 50 and 51.

As shown in Figure 2, service subscription manager 46 preferably comprises software 54 running on a suitable
10 network-connected computer 56. Software 54 has access to read and write to databases 50, 51 and an interface 55 to network manager 44. Service subscription manager 46 also has a user interface, which is preferably but is not necessarily a graphical user interface ("GUI") 58. The interface, for example GUI 58,
15 may be provided on computer 56 or on a separate computer connected to computer 56. When an operator creates a new subscription (which associates a service and a subscriber), software 54 generates one or more messages which are sent to network manager 44 via interface 55. The messages cause
20 network manager 44 to set up the VCC(s) required by the new service. The messages include information from databases 50 and 51 specifying the attributes of the VCC(s) required by the new service.

25 It is convenient to describe software 54 using object oriented software engineering terminology. Object oriented

- 12 -

software comprises a number of interacting software objects. Each object represents a real or abstract entity. Each object includes data which is encapsulated in the object and software which can manipulate the data and control how the object
5 interacts with other objects. Figure 3 illustrates relationships between objects of an embodiment of software 54 in Universal Modelling Language ("UML").

Using such an object oriented description permits a
10 subscriber 32 to be represented in software 54 as a subscriber object 33. Each subscriber object 33 contains or is linked to data which includes the name of the subscriber and the physical port through which the subscriber accesses network 20 (subscriber network access object 57). A service, such as the service
15 provided by server 28 may be represented as a service object 29. The service object 29 contains, or is linked to, data which includes the name of the service, the level of QoS required by the service (class of service object 59), and the physical port (or ports) through which server 28 accesses network 20 (application
20 network access object 61).

A subscription object 60 links a service object 29 and a subscriber object 33. The subscription object may contain or link to data, such as statistics on the use of the service which
25 may be used for billing purposes.

- 13 -

The subscription VCC object **62** links subscription object **60** to VCC object **67** which represents the actual VCC **40** which will be used by the subscription. VCC object **67** defines a virtual connection between endpoints specified by VCC endpoints object **69**. The VCC endpoints are determined by the network port object **71** associated with the network access **64** which is associated with each of the application network access **61** and the subscriber network access **57**. The application and subscriber network access objects each inherit the attributes of network access object **64**.

A subscription object **60**, together with the service object **29** and the subscriber object **33** which it associates, contain all of the information necessary to set up VCC **40** including the port at which subscriber **32A** connects to network **20** (from the subscriber network access object **57**), the port at which server **28** connects to network **20** (from the application network access object **61**), and the bandwidth and any other QoS requirements on VCC **40** (from the class of service object **59**). Preferably, various classes of service are predefined. Each class of service specifies QoS parameters such as: service category, peak information rate in each direction, and sustained information rate in each direction. Each application can have its own asymmetrical class of service definition. The various objects used by software **54** may be stored in databases **50** and **51**.

- 14 -

Service subscription manager **46** generates commands which cause network manager **44** to create VCCs **40**. The commands include the information needed by network manager **44** to set up VCCs **40**. Network manager **44**
5 subsequently causes switches **24** to configure themselves to provide VCCs **40**.

In some cases network manager **44** will not have control over all of network **20**. Figure 1A shows a situation
10 where a network has two portions **20A** and **20B** connected at a point of presence **POP**. Network manager **44** only has direct control over portion **20A** of the network. A separate network manager **44A** which is not under the direct control of service subscription manager **46** manages portion **20B** of the network.
15 This situation might exist, for example, where different infrastructure providers maintain portions **20A** and **20B**. If a service provider **SP1** and a subscriber **32** are both in portion **20A** of the network then network manager **44** can create the necessary communication channel **40C** directly. On the other
20 hand, if the service provider is in a different portion of the network from subscriber **32** then communication channels must be set up in both of portions **20A** and **20B**. Service subscription manager **46** directly commands network manager **44** to create a communication channel **40B** between subscriber **32** and point of
25 presence **POP**. Service subscription manager **46** also generates a work order message **49** asking that a communication channel

- 15 -

40C from point of presence **POP** to service provider **SP2** be created. The work order messages may be sent by calling a remote script from software **54**.

5 Service subscription manager **46** preferably includes a facility to enable or disable subscriptions that are set up in service subscription manager **46** without deleting the subscriptions. This facility might be used, for example, to temporarily suspend a subscription for which a subscriber's
10 payment is overdue. This facility may be provided by including an "enable" attribute in the subscription object **60**. The enable attribute can be set to one state to enable the subscription in question and set to another state to disable the subscription in question. When an operator commands software **54** to disable a
15 service, software **54** sets the "enable" attribute for the subscription in question to its disabled state and sends a command to network controller **44** instructing network controller **44** to take down the VCCs for the service in question. Preferably, service subscription manager **46** also permits
20 subscribers to turn on or off subscriptions that have been previously set up.

 In order to conserve network resources, VCCs **40** are preferably connected only when a service is in use. For example,
25 service subscription manager **46** may cause network manager **44** to connect the VCCs **40** for a particular service when a

- 16 -

subscriber 32 who has a valid subscription logs onto network 20 and is assigned a network access and enables the subscription, or when a subscription is added for a subscriber who already has a network access or when a disabled subscription for a

5 subscriber who already has a network access is enabled. The VCCs may be taken down when a subscriber 32 who has a valid and enabled subscription logs out from network 20 (and thereby removes their network access) or when an enabled subscription is cancelled or becomes disabled.

10

Preferably, service subscription manager causes the VCCs for a subscription to be enabled only when the following conditions all hold:

1. the subscriber is "enabled" (a subscriber might not be
15 enabled if the subscriber were a new subscriber, not yet completely entered into the system or if the subscriber had not paid its bills);
2. the subscription is enabled;
3. the application (service) is enabled;
- 20 4. the subscriber's network access is enabled and operational;
5. the service provider's network access is enabled and operational; and,
6. the subscriber has not turned the subscription off.

25

Network manager 44 includes a statistics collector, as is known in the art. The statistics collector may, for example,

- 17 -

be the statistics collector function of a Newbridge™ 46020 network manager. The statistics collector collects statistics regarding the usage of each VCC provided on network 20 including the volume of data transferred over the VCC and the
5 length of time that each VCC is connected. The raw information provided by the statistics collector is not directly useful for billing for services because several different VCCs may be used to provide the same service over time.

10 Service subscription manager 46 periodically receives statistics from network manager 44 and collects together the statistics that relate to VCCs used by each subscription. Service subscription manager 46 does this by identifying the VCCs used by each subscription from the
15 information in databases 50 and 51 and by searching the statistics provided by network manager 44 for statistics on those VCCs. Service subscription manager 46 then produces concise records which summarize the aggregate usage of network resources by each subscription over a selected period.
20 The records may be used by a billing system to bill subscribers 32 for usage of network 20.

 Preferably network 20 is partitioned so that the network access points for subscribers 32 and the application
25 network access points for server(s) 28 and all of the PVCs

- 18 -

between them are placed into one or more Virtual Switched Networks ("VSNs").

It is useful to provide subscribers **32** with a
5 mechanism to select and control their subscriptions. As shown
in Fig. 4, The invention provides a Service Selection Agent
("SSA") **70** which interfaces with service subscription manager
46 by way of a suitable Application Programming Interface
("API") **72**. API **72** is preferably a CORBA based API. SSA **70**
10 may be maintained and operated by a carrier who may be a
different entity than the entity which provides and operates
network **20**, network manager **44** and service subscription
manager **46**.

15 Subscribers **32** can communicate with SSA **70** by
way of a web based interface indicated by line **74**. Subscribers
can use SSA **70** to dynamically switch between different
services. For example, a subscriber **32** who had subscriptions to
both a work-at-home session and a general high-speed Internet
20 access service could use SSA **70** to dynamically switch between
these two services. When a subscriber uses SSA **70** to enable a
service, service subscription manager **46** commands network
manager **44** to connect the VCC **40** required by that service.
SSA **70** preferably also permits subscribers to sign up for new
25 subscriptions for themselves.

- 19 -

SSA 70 obtains information about the services subscribed to by each subscriber through API 72. Links to each service may be displayed on the web page of SSA 70. Figure 5 shows an example web page which could be provided by a suitable server 71 associated with SSA 70 to enable a subscriber 32 to *inter alia* select between subscribed services, enable or disable subscribed services, or to obtain information about the status of the subscriber's subscriptions. The web page of Figure 5 would be made available to a subscriber only after the subscriber had entered an account name and a password.

SSA 70 will typically have a plurality of servers 71 so that many subscribers can be serviced at the same time. SSA 70 could, for example, comprise an application running on a Netscape™ Enterprise Server. Servers 71 may invoke commands on service subscription manager 46 by way of API 72 to authenticate the identity of a subscriber 32 before allowing the subscriber 32 access to information about subscriptions via SSA 70. Servers 71 may obtain information about subscriptions of a subscriber 32 by causing service subscription manager 46 to interrogate database 50 and forward the requested information via API 72.

One problem that can occur is that one or more of servers 71 may be over utilized. Subscribers connected to the over utilized servers 71 will experience slow response times. At

- 20 -

the same time, other ones of servers 71 may be idle or only lightly utilized. Preferred embodiments of the invention provide client-side load balancing to more evenly distribute subscribers among servers 71. Figure 6 illustrates apparatus for providing
5 client-side load balancing in the invention. Figure 6A illustrates a method 90 of client-side load balancing according to the invention.

As shown in Figure 6, a user runs user software 80
10 to connect to one of service selection servers 71 of SSA 70. User software 80 may be, for example, a JAVA applet running on a subscriber's network connected computer. Software 80 interrogates a name server 82 which returns an address for one of service selection servers 71 as indicated by line 84 (step 91).
15 Software 80 then connects to the assigned service selection server 71 as indicated by line 85 (step 92). Name server 82 is designed to assign service selection servers 71 to subscribers in such a fashion that a roughly equal number of subscribers are serviced by each service selection server 71. Suitable hardware
20 and software for implementing name server 82 is known to those skilled in the art and is available off the shelf from various parties and will therefore not be described herein.

The foregoing scheme does not take into account the
25 fact that some subscribers may place much higher demands on a service selection server 71 than other subscribers. The invention

- 21 -

provides a timer 86 in user software 80. A user uses GUI 58A to enter commands for processing at service selection server 71, the commands are forwarded to service selection server 71 by the user's computer under the control of software 80 (step 93).

5 Timer 86 monitors the time taken by the service selection server 71, to which the software 80 is connected, to respond to certain commands (step 94). If the response time becomes excessive (i.e. the response time exceeds a threshold time) then user software 80 sends a request to name server 82 that it be connected to a

10 different service selection server 71 (step 95). Currently available name servers 82 support requests from client software to be connected to a different server. The threshold time may be a preset value which is provided in user software 80 or may be a value which is computed from previous response times

15 experienced by software 80. Name server 82 returns the address of a different service selection server 71 for the user software 80 to connect to (step 96). Name server 82 may select the different service selection server 71 randomly from other available service selection servers 71. User software 80 then connects to

20 the new service selection server 71 (step 97). The result is that the loads on service selection servers 71 tend to become balanced because user software 80 which is experiencing unacceptable response times from a service selection server 71 will switch to a different service selection server 71.

- 22 -

While the invention has been described above with reference to a network subscription management system, the invention also provides a method **100** for managing the provision of services to users of a data communications network.

5 The method is performed in a computer system. As shown in Figure 7, the method begins with storing in database **50** accessible to computer system **56** subscriber information identifying a plurality of subscribers and application information identifying one or more applications available to the

10 subscriber (indicated by **110**). The method continues with receiving user input identifying one subscriber and one application to be associated as a subscription (indicated by **112**). When the subscription has been made, the method retrieves from database **50** a subscriber network connection point from

15 the subscriber information for the one subscriber and an application network connection point from the application information for the one application (indicated by **114**). The method finishes by automatically creating a virtual channel connection (VCC **40**) in the data communications network **20**.

20 The VCC extends between the subscriber network connection point and the application network connection point.

As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and

25 modifications are possible in the practice of this invention without departing from the spirit or scope thereof. For example,

- 23 -

the invention may be used in non-ATM networks. Various specific types of hardware and software may be used in the implementation of the invention. The method for balancing loads on service selection servers 71, which is described above,
5 may be used to balance loads on other kind of web servers. Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.

- 24 -

WHAT IS CLAIMED IS:

1. A management system for a data communication network,
the management system comprising:
 - 5 a) a plurality of application objects each corresponding
to an application available on a data communication
network and each specifying a network connection
point for the corresponding application;
 - b) a plurality of subscriber objects each corresponding
10 to a subscriber having a connection to the data
communication network, each subscriber object
specifying a network connection point for the
corresponding subscriber;
 - c) a user interface permitting an operator to create a
15 subscription object associating one of the subscriber
objects and one of the application objects; and,
 - d) a network manager for creating in the data
communication network at least one communication
channel for each subscription object, the
20 communication channel connecting the network
connection point for the subscriber of the
subscription object and the network connection point
for the application of the subscription object.
- 25 2. The management system of claim 1 wherein the
application objects each contain information specifying a

- 25 -

quality of service level for the communication channel and the network manager is adapted to create the communication channel having the specified quality of service level.

5

3. The management system of claim 2 wherein the quality of service level includes a peak bit rate for communications over the communication channel in a direction from the subscriber to the application and a different peak bit rate for communications over the communication channel in a direction from the application to the subscriber.

10

4. The management system of claim 1 wherein each subscription has a status, the system includes means for an operator to set the status to enabled or disabled and the network manager is adapted to cause the data communication network to disconnect the communication channel for a subscription whenever the status of the subscription is disabled.

15

20

5. The management system of claim 4 comprising a service subscription agent, the service subscription agent comprising a user interface accessible to a subscriber, the user interface providing a control whereby the subscriber may change the status of any of one or more subscriptions

25

- 26 -

of that subscriber from enabled to disabled or from disabled to enabled.

- 5 6. The management system of claim 1 comprising a statistics collector, the statistics collector collecting statistics regarding communication channels of the data communications network, the management system comprising means for selecting and aggregating statistics for all of one or more communications channels used in the
10 provision of a service of a subscription over a selected period.
- 15 7. The management system of claim 1 wherein the data communications network comprises an ATM network and the communication channels are virtual channel connections.
- 20 8. The management system of claim 1 wherein no virtual channel connection is associated more than one subscription.
- 25 9. The management system of claim 5 wherein the network comprises a name server and the service selection agent comprises a plurality of service selection servers and a plurality of user software capable of connecting to the service selection servers, wherein the user software

- 27 -

comprises a timer connected to measure a response time taken for a connected service selection server to respond to a command and the user software is adapted to request from the name server a connection to a different service selection server if the measured response time exceeds a threshold time.

- 5
10. A method for managing the provision of services to users of a data communications network, the method comprising,
- 10 in a computer system:
- a) storing in a database accessible to the computer system subscriber information identifying a plurality of subscribers and application information identifying one or more applications available to the subscriber;
 - 15 b) receiving user input identifying one subscriber and one application to be associated as a subscription;
 - c) retrieving from the database a subscriber network connection point from the subscriber information for the one subscriber and an application network connection point from the application information for the one application; and,
 - 20 d) creating a communications channel in the data communications network extending between the subscriber network connection point and the application network connection point.
- 25

- 28 -

11. The method of claim 10 wherein the data communications network comprises an ATM network and the communications channel comprises a virtual circuit connection.
- 5
12. The method of claim 11 wherein the application information comprises information specifying a quality of service level for the virtual circuit connection and creating the communication channel comprises creating a virtual circuit connection having the specified quality of service level.
- 10
13. The method of claim 12 wherein the quality of service level includes a peak bit rate for communications over the communication channel in a direction from the subscriber to the application and a different peak bit rate for communications over the communication channel in a direction from the application to the subscriber.
- 15
- 20 14. The method of claim 11 comprising disconnecting the communication channel for a subscription whenever:
- 25
- (a) the corresponding subscriber is not enabled;
 - (b) the subscription is not enabled;
 - (c) the corresponding application is not enabled;
 - (d) a network access for the subscriber is not enabled and operational; or

- 29 -

(e) a network access for the application provider is not enabled.

- 5 15. The method of claim 10 comprising providing a service selection agent comprising a user interface accessible to a subscriber, the user interface providing a control whereby the subscriber may change the status of one or more subscriptions of that subscriber from enabled to disabled or from disabled to enabled.
- 10 16. The method of claim 15 wherein the service selection agent comprises a plurality of service selection servers and the method includes connecting user software to a service selection server; measuring a response time of the service selection server; and, connecting the user software to a different one of the service selection servers if the measured response time exceeds a threshold time.
- 15 17. The method of claim 10 comprising collecting statistics regarding communication channels of the data communications network and periodically selecting and aggregating statistics for all of one or more communications channels associated with each subscription.

25

- 30 -

18. The method of claim 17 wherein the data communications network comprises an ATM network and the communication channels are virtual channel connections.
- 5 19. A method for balancing loads between a plurality of web servers, the method comprising:
- 10 a) providing a plurality of web servers, a name server, and a plurality of clients;
- b) connecting each of the clients to one of the web servers;
- 15 c) at each client, measuring a response time of the connected web server; and,
- d) requesting from the name server a connection to a different one of the web servers if the response time exceeds a threshold time.

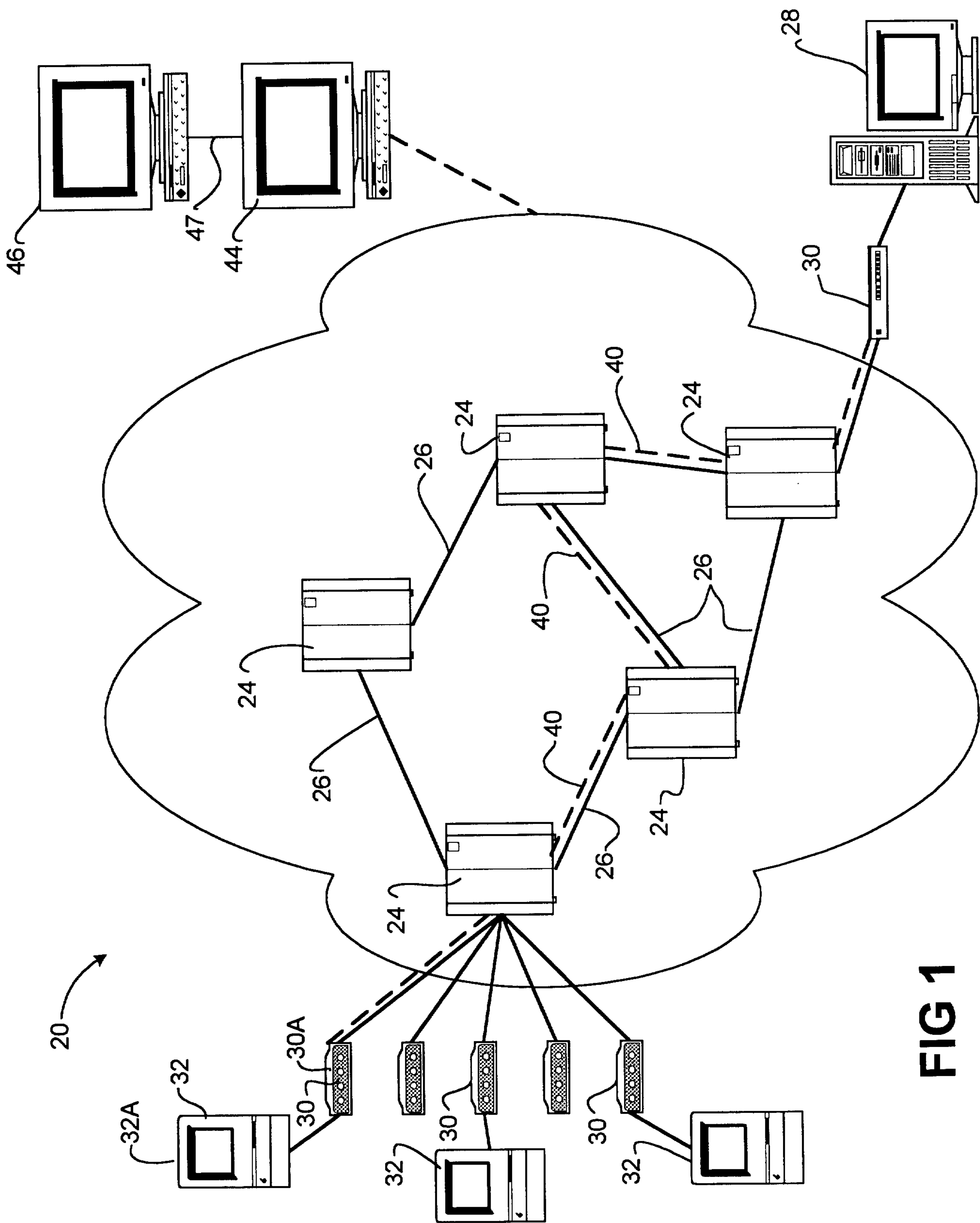


FIG 1

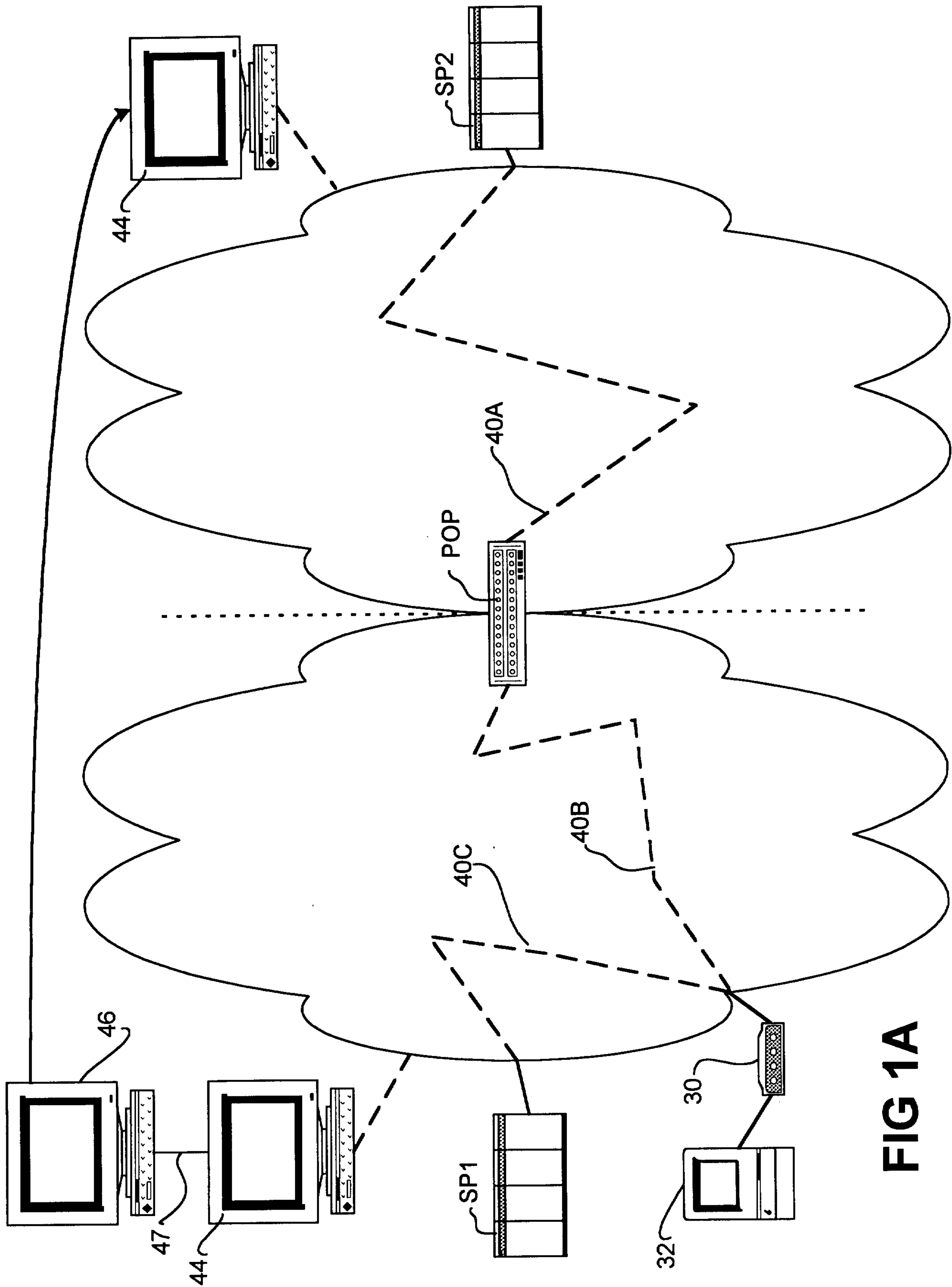
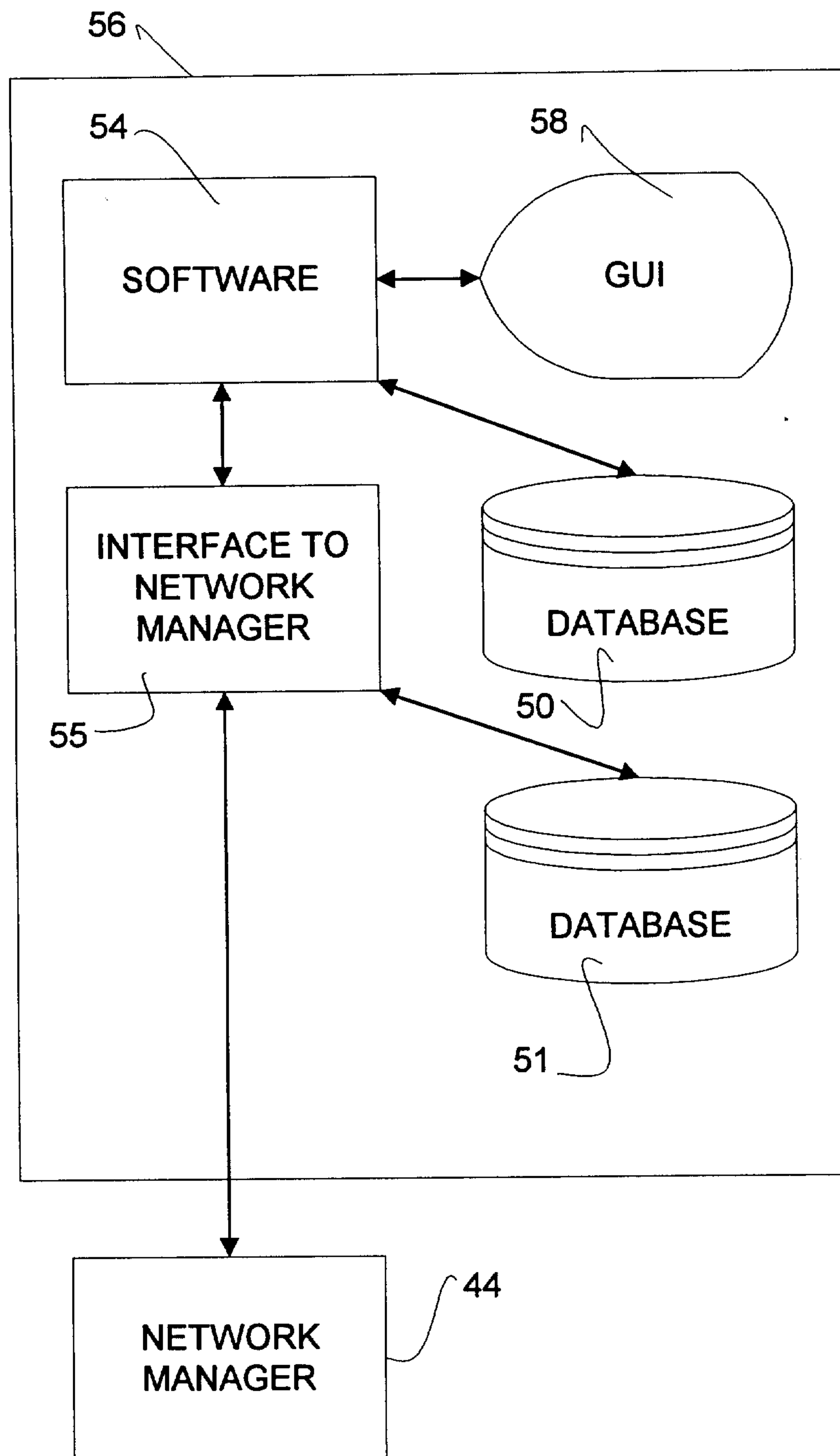


FIG 1A

**FIG 2**

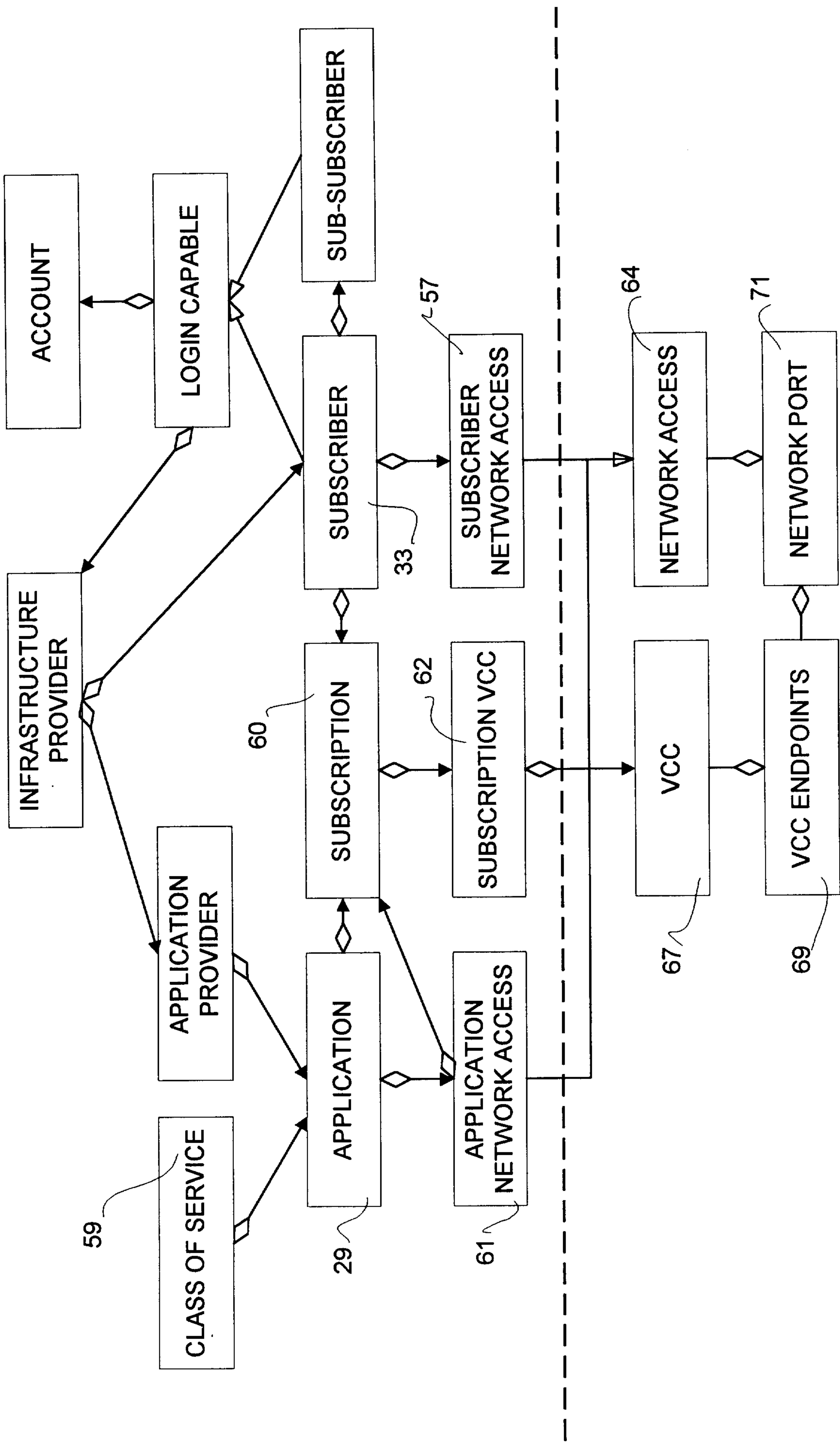
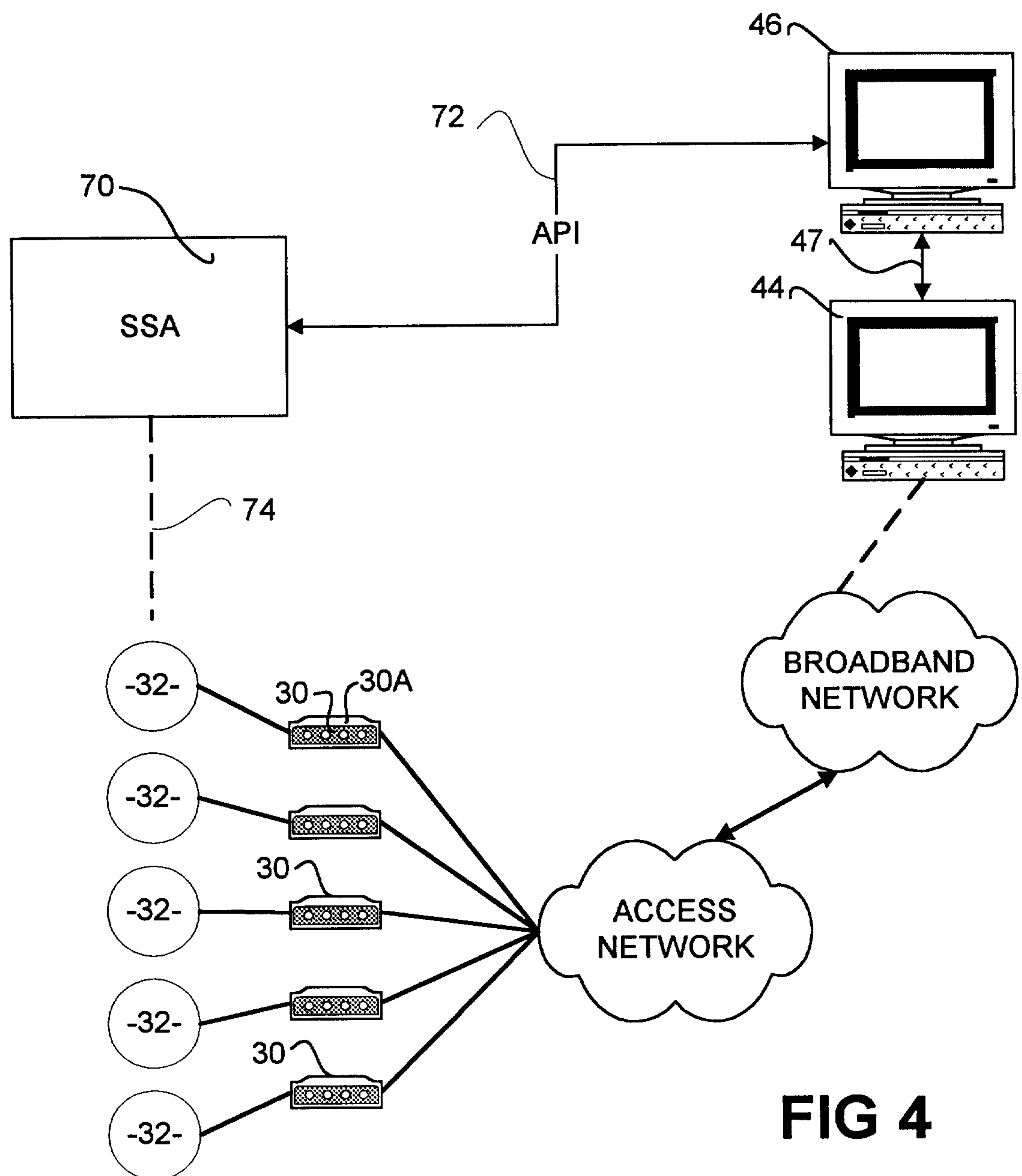


FIG 3

**FIG 4**

SUBSCRIPTION MANAGER

SUBSCRIBED SERVICES	STATUS
ONLINE GAMES 1	ENABLED
WORK AT HOME	DISABLED
FAST INTERNET	ENABLED
STOCK QUOTES	DISABLED

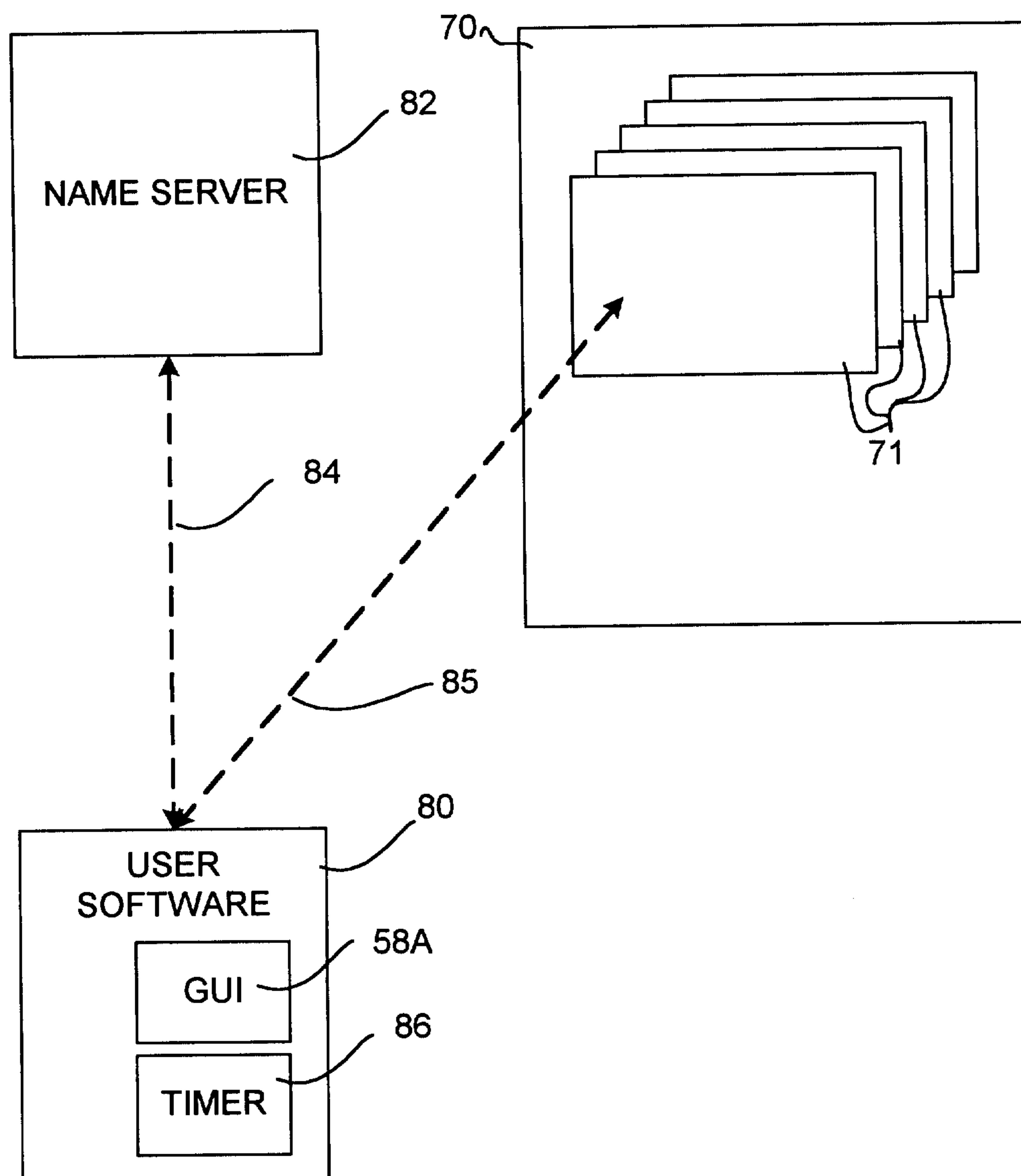
AVAILABLE UNSUBSCRIBED SERVICES
AUDIO 1
AUDIO 2
MOVIE 1
MOVIE 2
MOVIE 3
ONLINE SHOPPING
ONLINE GAMES 2
ONLINE GAMES 3
SPORTS SCORES
TELECONFERENCES

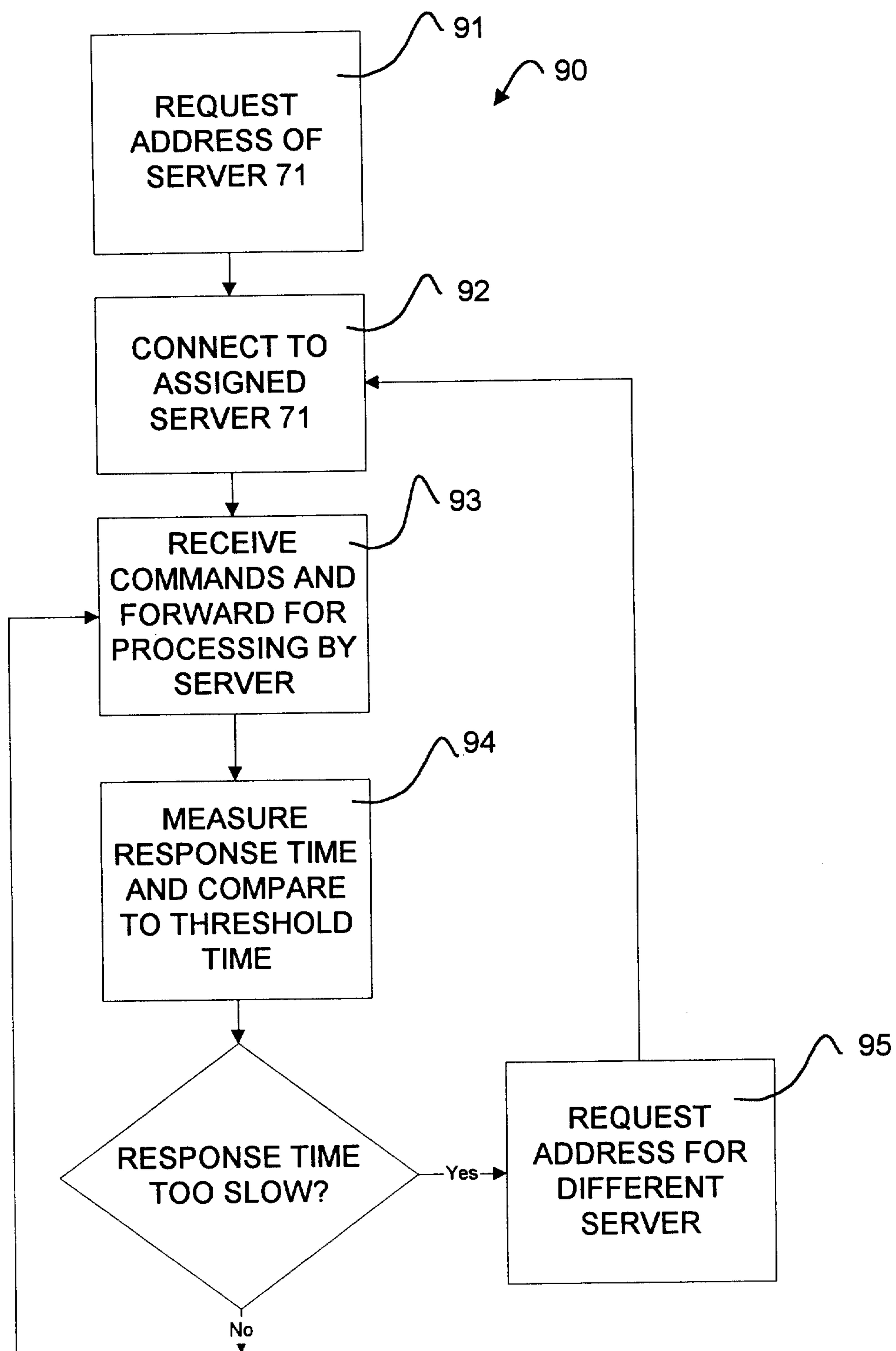
BILLING INFORMATION

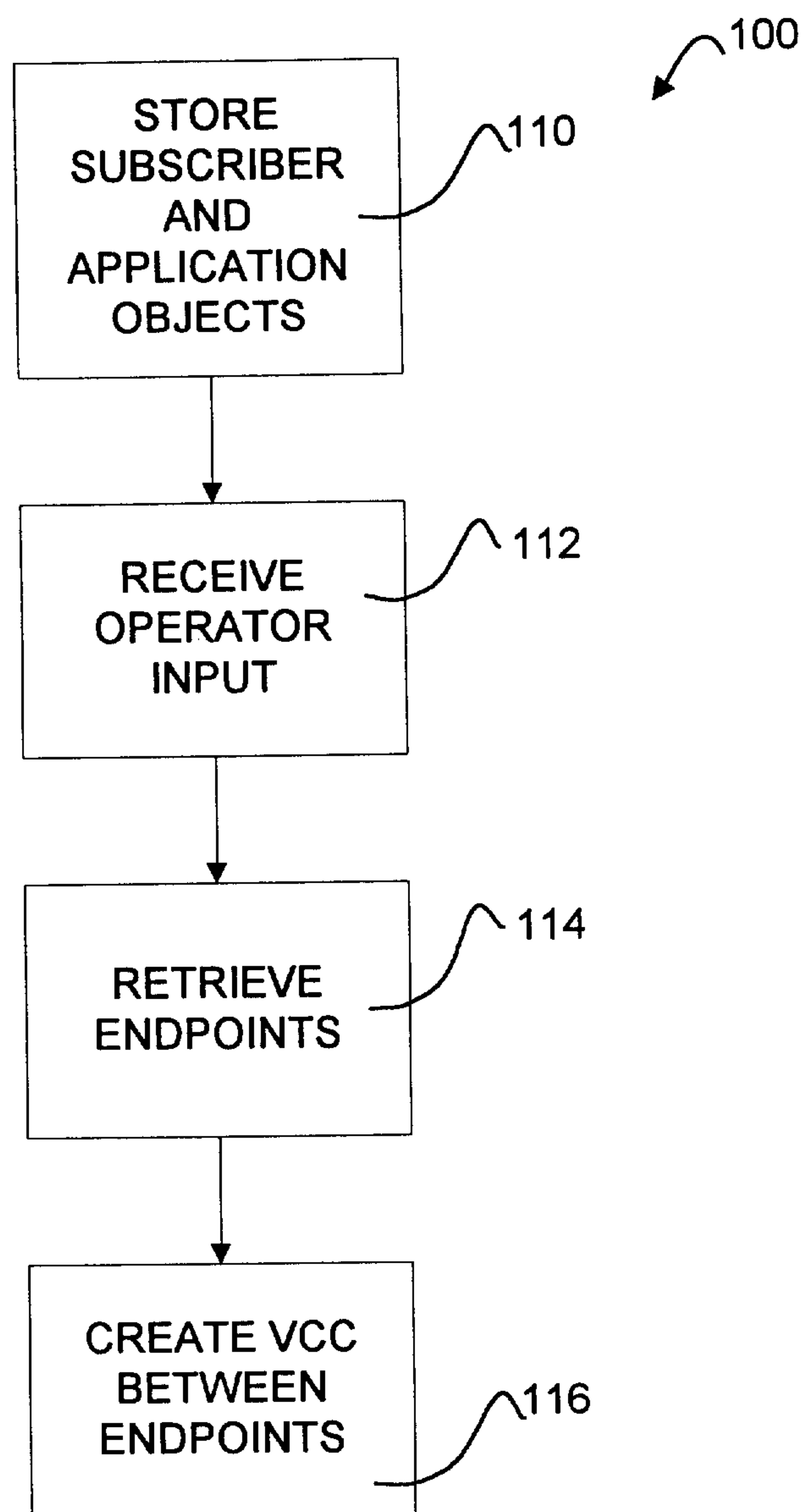
SERVICE REQUESTS

HELP

FIG 5

**FIG 6**

**FIG 6A**

**FIG 7**

