Method, system and apparatus for telecommunications control

What is claimed is:

A method of operating a processing system to control a packet communication system for a user communication, the method comprising:

- receiving a signaling message for the user communication from a narrowband communication system into a signaling processing system;
- processing the signaling message in the signaling processing system to generate a query message;
- transferring the query message from the signaling processing system to a service processing system;
- processing the query message in the service processing system to select a network code that identifies a network element to provide egress from the packet communication system for the user communication and to generate a response message indicating the network code;
- transferring the response message indicating the network code from the service processing system to the signaling processing system;
- processing the response message in the signaling processing system to generate a control message indicating the network code; and
- transferring the control message indicating the network code from the signaling processing system to the packet communication system.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to telecommunications and more specifically to communications control processing in telecommunications signaling.

2. Description of the Prior Art

Telecommunications systems establish a communications path between two or more points to allow the transfer of information between the points. The communications path typically comprises a series of connections between network elements. The network elements are typically switches. Switches provide the primary means where different connections are associated to form the communications path. Communication control is the process of setting up a communications path between the points. Communication control comprises the selection of network elements such as switches or other devices which will form part of the communications path. Communication Switches control these selections. Switches select the connections that comprise the communications path. Switches also select the network elements which form an actual part of that communications path. By selecting these network elements, a switch is often selecting the next switch that will make further selections. Switches accomplish communication control.

The correspondence between communication control and a communications path is well known in the art. A common method used in communication control is signaling among switches. One method by which a first point requests a communications path to a second point is by signaling a first switch with an off-hook signal followed by dual tone multifrequency (DTMF) signals. The first switch will typically process those signals and will select other network elements such as a second switch. The first switch signals the second switch and establishes a connection between the switches. The second switch then selects the next network element, signals that network element, and establishes a connection to that network element. This process is well known in the art. The connections and signaling thus proceed from switch to switch through the network until a communications path is established between the first and second points.

Some networks transmit signaling information from the switches to other signaling devices. In these cases, the switches typically must be modified through the use of Signaling Point (SP) hardware and software in order to convert the language of the switch into the language used by these other signaling devices. One signaling device is a Service Control Point (SCP). An SCP processes signaling queries from a switch. An SCP only answers a switch query after the switch has become a part of the communications path. SCPs support the communication control which is directed by the switch.

Additionally, signaling may pass through other signaling devices, such as Signal Transfer Points (STPs), which route the signaling. An STP is typically a high-speed packet data switch which reads portions of the signaling information and either discards or routes the information to a network element. The signal routing operation of the STP is based on the signaling information that is specified by the switch. STPs route signaling information, but STPs do not modify or otherwise process the signaling information. An example of the above described system is Signaling System #7 (SS7) technology. Thus, signaling devices only are used to support switches in communication control.

Broadband systems, such as Asynchronous Transfer Mode (ATM) may use extensions of existing SS7 signaling to allow ATM switches to direct communication control. However, broadband systems may also utilize different communication control methods. ATM switches may transfer ATM cells which contain signaling to other ATM switches. As with the other switch types however, ATM switches also perform the dual task of communication control and forming a part of the communications path.

Some switches use API switching which employs remote central processing units (CPUs). These switches only receive switch information from the remote CPUs and not signaling. The protocols used for information transfer between the switch and the remote CPU are proprietary among vendors and are incompatible between the switches of different vendors.

Some digital cross-connect (DCS) equipment employ centralized control systems. These systems, however, only provide relatively static switching fabrics and do not respond to signaling. Instead of establishing connections in response to signaling, DCS cross-connections are established in response to network configuration needs. Network

elements and connections are pre programmed into the network and are not selected in response to signaling from a point outside of the network.

At present, while communication control and the communications path are distinct from one another, both are dependent on the switch. The performance of both of these tasks by switches places limitations on a telecommunications network. One such limitation can be illustrated by one difficulty encountered in combining narrowband networks and broadband networks. Broadband networks are advantageous for data transmission because virtual permanent connections can be mapped through a network and bandwidth allocated on demand. Narrowband switches are advantageous for voice, in part, due to the many features which have been developed in conjunction with these switches. These features benefit both the user and the network through added efficiency and quality. Examples are "800" platforms, billing systems, and routing systems. However for broadband networks, the development of these features is incomplete and does not provide the functionality of current narrowband features. Unfortunately, narrowband switches do not have the capacity, speed, and multimedia capabilities of broadband switches. The resulting combination is separate overlay networks. Typically, narrowband traffic remains within the narrowband network, and broadband traffic remains within the broadband network.

Any intelligent interface between the two networks would require that signaling information be transmitted between narrowband switches and broadband switches. At present, the ability of these switches to signal each other is limited. These switch limitations create a major obstacle in any attempt to interface the two networks. It would be advantageous if narrowband and broadband networks could interwork through an intelligent interface to establish a communications path between points. At present, the interface between narrowband and broadband networks remains a rigid access pipe between overlay systems.

The reliance on switches to both perform communication control and to form the a part of the communications path results in impediments to developing improved networks. Each time a new network element, such as a broadband switch, is introduced, a telecommunications network may be forced to delay integrating the network element into its network until standardization of signaling and interface protocols are developed for the switches. At present, there is a need for a portion of the communication control processing to be independent of the switches that form a part of the communications path.

SUMMARY

An embodiment of the present invention solves this need by providing a method, system, and apparatus for communication control processing that is located externally to the switches that make the connections. The method includes receiving a first signal into a processor which is located externally to the switches in a network comprised of network elements. The processor selects a network characteristic in response to the first signal. The processor then generates a second signal reflecting the network characteristic and transmits the second signal to at least one network element. This transmission occurs

before that network element has applied the first signal. Examples of network characteristics are network elements and connections, but there are others. Examples of signaling are Signaling System #7 or broadband signaling. The processor may also employ information received from the network elements or operational control when making selections. In one embodiment, the method includes receiving the first signal into a network from a point and routing the first signal to the processor.

The present invention also includes a telecommunications processing system which comprises an interface that is external to the switches and is operational to receive and transmit signaling. The processing system also includes a translator that is coupled to the interface and is operational to identify particular information in the received signaling and to generate new signaling based on new information. The processor also includes a processor that is coupled to the translator and is operational to process the identified information from the translator in order to select at least one network characteristic. The processor provides new information to the translator reflecting the selection. The identified information is used in the processor before it is used in the particular network elements that receive the new signaling.

The present invention also includes a telecommunications network comprised of a plurality of network elements wherein at least one network element is a switch, and a plurality of connections between the network elements. The network also includes a processor located externally to the switches which is operable to receive a first signal, to select at least one network characteristic in response to the first signal, and to generate a second signal reflecting the selection. The network also includes a plurality of links between the processor and the network elements which are operable to transmit the second signal to at least one network element before that network element has applied the first signal.

The present invention also includes a telecommunications signaling system for use in conjunction with a plurality of telecommunication switches. This system comprises a plurality of signaling points and a signaling processor. The signaling processor is linked to the signaling points and resides externally to the switches. The signaling processor is operational to process signaling and to generate new signaling information based on the processing. The new signaling is transmitted over the links to multiple signaling points. In one embodiment, the new signaling information is comprised of different signaling messages and the different signaling messages are transmitted to different signaling points.

In another embodiment, a plurality of the signaling points each reside in a different switch and are directly coupled to a processor in the switch that directs a switching matrix in the switch in response to signaling processed by the signaling point. The signaling processor is operational to direct the switching matrixes of multiple switches by signaling multiple signaling points. The signaling processor is also operational to signal multiple points in response to signaling from a single source, and to signal a point in response to signaling from multiple sources.

Broadband telecommunications system

Abstract

The invention is a system for providing virtual connections through an ATM interworking multiplexer on a call-by-call basis. A signaling processor receives signaling for a call and selects the virtual connection for the call. The signaling processor generates control messages that identify the selection and transfers the control messages to the ATM interworking multiplexer that accepted the access connection for the call. The multiplexer converts user information from the access connection into ATM cells for transmission over the virtual connection in accord with the control messages.

BACKGROUND

At present, Asynchronous Transfer Mode (ATM) technology is being developed to provide broadband switching capability for telecommunications calls. A call is a request for telecommunications services. Some ATM systems have used ATM cross-connects to provide virtual connections. Cross-connect devices do not have the capacity to process signaling. Signaling refers to messages that are used by telecommunications networks to set-up and tear down calls. Thus, ATM cross-connects cannot make connections on a call by call basis. As a result, connections through cross-connect systems must be pre-provisioned. They provide a relatively rigid switching fabric. Due to this limitation, ATM cross-connect systems have been primarily used to provide dedicated connections, such as permanent virtual circuits (PVCs) and permanent virtual paths (PVPs). But, they do not provide ATM switching on a call by call basis as required to provide switched virtual circuits (SVCs) or switched virtual paths (SVPs). Those skilled in the art are well aware of the efficiencies created by using SVPs and SVCs as opposed to PVCs and PVPs. SVCs and SVPs utilize bandwidth more efficiently.

ATM switches have also been used to provide PVCs and PVPs. Since PVCs and PVPs are not established on a call-by-call basis, the ATM switch does need to use its call processing or signaling capacity. ATM switches require both signaling capability and call processing capability to provide SVCs and SVPs. In order to achieve virtual connection switching on a call by call basis, ATM switches are being developed that can process calls in response to signaling to provide virtual connections for each call. These systems cause problems because they must be very sophisticated to support current networks. These ATM switches must process high volumes of calls and transition legacy services from existing networks. An example would be an ATM switch that can handle large numbers of POTS, 800, and VPN calls.

Currently, ATM multiplexers are capable of interworking traffic of other formats into the ATM format. These are known as ATM interworking multiplexers. ATM multiplexers are being developed that can interwork traffic into ATM cells and multiplex the cells for transport over an ATM network. One example of an application of these muxes is provided by T1 transport over an ATM connection. Traffic that leaves the switch in T1 format is muxed into ATM cells for transport over a high speed connection. Before the

cells reach another switch, they are converted back into the T1 format. Thus, the ATM mux is used for high speed transport. The ATM mux is not used to select virtual connections on a call-by-call basis. Unfortunately, there is not a telecommunications system that can provide ATM switching on a call by call basis without relying on the call processing and signaling capability of an ATM switch.

One solution to the above-described problems is disclosed in the parent applications cross-referenced above. This application disclosed the call by call control of the interworking point. The present invention provides enhancements and improvements to those systems.

SUMMARY

The invention includes a method of operating a telecommunications system to provide a call with a virtual connection. The invention is applicable where a user places the call by sending signaling for the call to the telecommunications system and by transmitting user information to the telecommunications system over a particular connection for the call. The telecommunications system comprises an ATM interworking multiplexer and a signaling processor coupled to the ATM interworking multiplexer. The method comprises receiving the signaling for the call into the signaling processor and processing the signaling to select the virtual connection. The method further includes generating a control message in the signaling processor to identify the particular connection and the selected virtual connection, and transmitting the control message to the ATM interworking multiplexer. The method further includes receiving the user information for the call from the particular connection into the ATM interworking multiplexer and converting the user information into ATM cells that identify the selected virtual connection in response to the control message. The method further includes transmitting the ATM cells from the ATM interworking multiplexer over the selected virtual connection.

The invention also includes a telecommunications system to provide a call received over a particular connection with a virtual connection in response to signaling for the call. The telecommunications system comprises a signaling processor operable to receive and process the signaling to select the virtual connection for the call, and to generate and transmit a control messages that identifies the particular connection and the selected virtual connection. The system further includes an ATM interworking multiplexer operable to receive user information from the particular connection, convert the user information into ATM cells that identify the selected virtual connection in response to the new signaling, and to transmit the ATM cells from the ATM interworking multiplexer over the selected virtual connection. The invention further includes a means for coupling the signaling processor and the ATM interworking multiplexer that is operable to transfer the control message from the signaling processor to the ATM interworking multiplexer. In some embodiments the system also includes an ATM cross-connect system connected to the ATM interworking multiplexer and configured to provide a plurality of virtual connections to the ATM interworking multiplexer.

In various embodiments, the invention accepts calls placed over DS0 voice connections and provides virtual connections for the calls. In this way, broadband virtual connections can be provided to narrowband traffic on a call-by-call basis without requiring the call processing and signaling capability of an ATM switch.