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APPLICANTS

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NOTE-DISCLAIMER
The term of this patent shall not extend beyond the expiration date of Pat. No. pending

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TITLE

METHOD, SYSTEM AND APPARATUS FOR TELECOMMUNICATIONS CONTROL

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DISCLAIMER LABEL

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A terminal disclaimer has been entered and recorded under 35 U.S.C. 253 in this file.

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PATENT APPLICATION

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INITIALS ______

CONTENTS

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	3.	Disclosure Statement	Dec 7 1995
	4.	Ltr to Draftsman	Dec 7 1995
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	7.	Interview Summary	Feb 26, 1997
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	10.	Disclosure Statement	April 18 1997
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EXAMINER		540	2/20/96
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INDEX OF CLAIMS

Claim Final	Claim Original	Date				10/11/96	[illegible]		[illegible]
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	7				107			257	
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	9				109				
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	11				111				
	12				(112)				
	13				113				
	14				114				
	15				115				
	16				116				
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	18				118				
	19				119				
	20				120				
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	22				122				
	23				123				
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Claim Final	Claim Original	Date				10/11/96	[illegible]		[illegible]
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	(62)				162			212	
	63				163			213	
	(64)				164			214	
	65				165			215	
	66				166			216	
	67				167			217	
	68				168	✓		218	
	69				169	O		219	
	70				170	O		220	
	71				171	✓		221	
	72				172	O		222	
	73				173	O		223	
	74				174	O	✓	224	
	75				(175)			225	
	76				(176)			226	
	77				(177)			227	
	78				(178)			228	
	79				179			229	
	80				180			230	
	81				181			231	
	82				182			232	
	83				183			233	
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	(86)				186			236	
	87				187			237	
	88				188			238	
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	90				190			240	
	91				191			241	
	92				192			242	
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SYMBOLS

- ✓ .... Rejected
- = ... Allowed
- \- (Through numberal) Canceled
- \+ .... Restricted
- N .... Non-elected
- I .... Interference
- A .... Appeal
- O .... Objected

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INDEX OF CLAIMS

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	12		(112)		69	212			
	13		113		70	213			
	14		114		71	214			
	15		115		72	215			
	16		116		73	216			
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	18		118		75	218			
	19		119		76	219			
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	40	20	140		97	240			
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	67		167						
	68		168						
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	70		170						
	71	28	(171)	=					
	72	29	172						
	73	30	173						
	74	31	174						
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	76	33	(176)						
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	79	36	179						
	80	37	180						
	81	38	181						
	82	39	182						
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	(85)	42	185						
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	87	44	187						
	88	45	188						
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	90	47	190						
	91	48	191						
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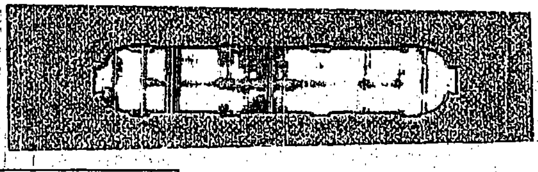

SEARCHED

Class	Sub.	Date	Exmr.
370	58.2, 68.1, 110.1, 60, 60.1, 94.1, 94.2	10/8/96	RB
379	220, 229, 230		
	updated search		
370	384, 410, 524, 522, 264	2/10/98	pm

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.
370	384, 410, 524, 522, 264	2/10/98	pm
379	220, 229, 230		

SEARCH NOTES

	Date	Exmr.
SPO Search	10/8/96	RB

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METHOD, SYSTEM AND APPARATUS FOR TELECOMMUNICATIONS CONTROL

BACKGROUND

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 control also comprises the selection of the connections between the network elements. Together, the network elements and connections which are selected make up the communications path. Typically, a plurality of different network element and connection selections may be possible for any one communications path between points.

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

3

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

4

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

5

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

6

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.

7

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.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, claims, and drawings where:

Figure 1 is a block diagram of a version of the invention.
Figure 2 is a block diagram of a version of the invention.
Figure 3 is a block diagram of a version of the invention.
Figure 4 is a logic diagram of a version of the invention.
Figure 5 is a flow diagram of a version of the invention.
Figure 6 is a flow diagram of a version of the invention.
Figure 7 is a flow diagram of a version of the invention.
Figure 8 is a flow diagram of a version of the invention.

DESCRIPTION

Telecommunications systems establish communications paths between points which allow the points to transfer information, such as voice and data, over the communication paths. Typically, telecommunications systems are comprised of network elements and connections. A network element is a telecommunications device such as a switch, server, service control point, service data point, enhanced platform, intelligent peripheral, service node, adjunct

8

processor, network element of a different network, enhanced system or other network related device, server, center or system.

A connection is the media between two network elements that allows the transfer of information. A few examples of connections are: digital T1 lines, OC-3 optical fibers, packet connections, dedicated access lines, microwave transmission, and cellular radio. As those skilled in the art are aware, connections can be described in a range from general to specific. All of the media between two switches is a general description and might correspond to a virtual path in an ATM system or a trunk groups in a T1 system. An individual circuit between two elements is more specific and might correspond to a virtual channel in an ATM system or a DS0 circuit in a T1 system. Connections can also be described as being logical or physical. Physical connections are electrical-mechanical media. Logical connections are paths which follow physical connections, but are differentiated from one another based on format and protocol. The term "connection" includes this entire range and the meaning varies according to the context in which the term is used. The present invention could make selections encompassing the entire range of connections.

A communications path is the combination of connections and network elements that physically transfers the information between points. A communication path may be point to point, point to multi-point, or multi-point to multi-point. These points, in turn, define the ends of the communications path. Thus, a connection may also be made between a network element and a point outside the network.

Signaling is the transfer of information among points and network elements and is used to establish communications paths. An example is Signaling System # 7 (SS7). Signaling is typically transmitted over links, such as 56 kilobit lines. On the block diagrams, signaling is

9

represented by dashed lines and connections are represented by solid lines.

In Figure 1, Telecommunications System 110 comprises a communication control processor (CCP) 120 and first, second, third, fourth, fifth and sixth network elements, 131, 132, 133, 134, 135 and 136 respectively. First and second network elements, 131 and 132 respectively, are connected by first connection 141. First and third network elements, 131 and 133 are connected by both second and third connections, 142 and 143 respectively. First and fifth network elements, 131 and 135 respectively, are connected by fourth connection 144. Second and fourth network elements, 132 and 134 are connected by fifth connection 145. The third network element 133 is connected to fourth and sixth network elements, 134 and 136 by sixth and seventh connections, 146 and 147 respectively. Fourth and fifth network elements, 134 and 135 are connected by connection 148. A first point 170, which is located outside of the system 110, is connected to first element 131 by first point connection 171, and a second point 172 which is also located outside the system 110 is connected to fourth element 134 by second point connection 173. First and second points, 170 and 172 respectively and first, second, third, fourth, fifth and sixth elements 131, 132, 133, 134, 135, and 136 respectively each are linked to CCP 120 by first, second, third, fourth, fifth, sixth, seventh, and eighth links, 191, 192, 193, 194, 195, 196, 197 and 198 respectively.

As those skilled in the art are aware, a system is typically comprised of many more network elements, links, connections and points, but the number is restricted for clarity. Points outside of the network can take many forms, such as customer premises equipment (CPE), telephones, computers, or switches of a separate network system. In addition the system 110, may take many forms

10

such as international gateways, satellite networks, wireless networks, local exchange carriers (LECs), inter-exchange carriers (IXCs), transit networks, national networks, personal communicator systems (PCS), virtual private networks, or connection oriented networks such as local area networks (LANs), metropolitan area networks (MANs), wide area networks (WANs) to name some examples.

In operation Telecommunications System 110 is able to accept information from first point 170 and second point 172 and transmit the information over the various network elements and connections which form the communications path. System 110 is also capable of exchanging signaling with first point 170 and second point 172 over the first link 191 and second link 192.

On a standard call that establishes a communications path from first point 170 to second point 172, first point 170 will signal Telecommunications System 110 that it requests the communications path. This signaling is directed to CCP 120 over first link 191. CCP 120 processes the signaling and selects at least one network characteristic in response to the signaling. Network characteristics might be network elements, connections, network codes, applications, or control instructions to name a few examples. The selected network characteristic typically comprises one of a plurality of network elements and/or connections. The CCP 120 generates signaling which is preferably new signaling reflecting the selection. CCP 120 then transmits the signal to at least one of a plurality of network elements before that network element has applied the signal.

In one embodiment, CCP 120 selects the network elements and the connections that comprise the communications path. However, first point 170 will typically seize first point connection 171 contemporaneously with signaling. This initial connection

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could also be selected by CCP 120 from the available possibilities after the signaling by first point 170. Assuming first point 170 has seized first point connection 171 to first element 131, CCP 120 selects one, a plurality, or all of the remaining network elements and connections to further establish a communications path to second point 172.

CCP 120 determines which element should be connected to first element 131. CCP 120 could select either second element 132 or third element 133. If third element 133 is selected, CCP 120 may also select the connection to third element 133 from among second and third connections, 142 and 143 respectively. If third connection 143 is selected, CCP 120 will signal first element 131 over third link 193 to further the communications path to third element 133 over third connection 143.

CCP 120 may then make further selections to complete the communications path. As the possibilities have been limited for clarity, CCP 120 would make the selections and signal the elements as follows. CCP 120 would signal third element 133 over fifth link 195 to further the communications path to fourth element 134 over sixth connection 146. CCP 120 would signal fourth element 134 over sixth link 196 to further the communications path to second point 172 over second point connection 173. CCP 120 would also signal second point 172 over second link 192 of the communications path available through second point connection 173. In this way, the communications path requested by first point 170 is selected by CCP 120 and signaled to the elements. Throughout this process, CCP 120 may receive status messages and signaling from the elements to support its processing. This status messaging may be transmitted and received over links, connections, or other communication means.

In another embodiment, CCP 120 may select only the

12

network elements and not the connections. The elements would select the connections to use based on the network element selected by CCP 120. For this embodiment, the main difference from the above example is that CCP 120 would instruct first element 131 to further the communications path to third element 133, but first element 131 would select the actual connection used from among second and third connections, 142 and 143, respectively. First element 131 may signal CCP 120 over third link 193 of its selection so that CCP 120 may signal third element 133 of the connection over fifth link 195. In this embodiment, CCP 120 would specify the network elements to the elements, which in turn, would select the connections between those network elements.

There are situations in which the selection of a network element and the selection of a connection signify the same thing. On Figure 1 for example, instructing first element 131 to use first connection 141 is synonymous with an instruction to connect to second element 132. This is because the connection inevitably connects to the element. The selection of a connection may effectively select a network element, and the selection of a network element may effectively select a connection (or a group of specific connections) to that network element.

One skilled in the art will recognize that the selection process can be distributed among the CCP and the elements. The CCP might select all the network elements, a portion of the network elements, or none of the network elements leaving the switches to select the remainder. The CCP might select all of the connections, a portion of the connections, or none of the connections, again leaving the elements to select the remainder. The CCP may select combinations of the above options, but the CCP will always select at least one network characteristic.

In another embodiment, first point 170 may want to

13

access a other network elements such as servers, platforms or operator centers. For example, such elements could be located at either fifth or sixth network elements 135, and 136 respectively. CCP 120 will receive signaling from first point 170 over first link 191 indicating this request, and first point 170 will typically seize first point connection 171 to first element 131. Again CCP 120 will select network elements. If sixth element 136 is selected, CCP 120 could select a communications path from first element 131 through either second element 132 to fourth element 134 and then to third element 133, or through a direct connection from first element 131 to third element 133. If CCP 120 selects the latter, it would signal first element 131 to further the communications path to third element 133, and it would signal third element 133 to further the communications path to sixth element 136. As discussed in the above embodiments, CCP 120 may also select the connections, or the elements may be left with that task.

As is known in the art, in-band signaling is typically used in many user to network connections, such as the local loop. This is because only one connection or link is typically provided to the user premises and thus, the signaling must be placed on the actual communications path. The initial network switch typically removes the signaling from the communications path and transfers it to an out-of-band signaling system. The current invention is fully operational in this context. Although the switch may receive the signaling initially, it will only route the signaling to the CCP for processing. Even if in-band signaling is used within the network, the switches could remove signaling from the communications path and route it to the CCP for processing in accord with the present invention.

Thus, preferably the CCP processes signaling before it

14

is applied or processed by the switch such as to select connections or generate queries. Preferably, no or minimal changes are made to the signaling prior to the signaling being received by the CCP so that the CCP receives the signaling in the same format as a switch would receive the signaling. The CCP may also process the signaling in that format. The switches make their selections based on the CCP selections, thus the switch selections clearly occur after the CCP has processed the signaling. As such, the switch may route signaling to the CCP, but the switch does not apply the signaling. Some examples of a switch applying the signaling would be selecting network elements or triggering and generating queries for remote devices.

In one of the above embodiments, the switches did not select the network elements and connections, initiate the signaling, or otherwise control the communication. The switches only followed the instructions of the CCP and actually made the connections that furthered the communications path. In one embodiment, the switches were allowed to select the actual connections used, but even these selections were based on CCP selections.

As illustrated above, the CCP allows a telecommunications network to separate communication control from the communications path. In prior systems, the switches would select the network elements and the connections, as well as, actually providing a part of the actual connection. As a result, prior systems are restricted to the communication control capabilities provided by the switches. Prior systems have used remote devices, such as an SCP, to support switch control, but the remote device only answered queries in response to the switches processing of the signal. These remote devices do not process the signaling before the switch had already applied the signaling. By using the CCP, telecommunications systems can control communications independently of the capability of the switches to accomplish both tasks.

Figure 2 shows a block diagram of another embodiment of the present invention. CCP 250 and network 210 are shown. CCP 250 is a communications control processor. CCP 250 could be integrated into network 210, but need not be and is shown separately for clarity. Network 210 could be any type of telecommunications network that operates using network elements, signaling, and connections. Examples would be LECs, IXCs, LANs, MANs, WANs, and Cellular Networks, but there are others. Additionally, network 210 could be narrowband, broadband, packet-based, or a hybrid. Network 210 is capable of providing communications paths between points both inside and outside of network 210. CCP 250 and network 210 are linked by link 214 and are able to signal each other in order to establish these paths.

Additionally, user 220 and user 230 are shown and are also capable of signaling. Examples of users 220 and 230 might be telephones, computers, or even switches in another telecommunications network. Users 220 and 230 are connected to network 210 by connections 222 and 232 respectively. Users 220 and 230 are linked to CCP 250 by links 224 and 234 respectively. Signaling may be transmitted over links 224 and 234. If in-band signaling is employed on connections 222 and 232, network 210 would separate at least a portion of the signaling out-of-band and transmit it to CCP 250 over link 214.

Also shown are various network elements. As with CCP 250, these elements could also be integrated into network 210, but are shown separately for clarity. These network elements are: networks 260, operator centers 262, enhanced platforms 264, video servers 266, voice servers 268, and adjunct processors 270. This is not an exclusive list. Those skilled in the art will recognize these network elements and their functions, as well as the many other

16

types of telecommunications devices, such as billing servers, that are applicable in this situation.

Each network element is connected to network 210 by connection 212. Connection 212 represents several actual connections between the network elements (260-270) and different elements in network 210. One bus-type connection is shown for purposes of clarity, but those skilled in the art are familiar with many actual types of connections to use. Additionally link 256 is shown from CCP 250 to the network elements (260-270). Link 256 is similarly represented as a bus-type link for clarity, and multiple links are actually used, although some network elements may not even require links. Link 214 has been simplified for clarity in the same fashion.

In one embodiment, user 220 may desire to establish a communications path to user 230. CCP 250 would make the appropriate selections and signal the network elements in network 210 as discussed with regard to the embodiments of Figure 1. As a result, a communications path would be established from user 220 to user 230 through network 210 and connections 222 and 232.

In another embodiment, user 220 may desire to access one of the various network elements (260-270). User 220 will typically seize connection 222 to network 210 and generate signaling. Both in-band signaling on connection 222 and out-of-band signaling on link 224 would be directed to CCP 250. By processing the signaling, CCP 250 can select any of the network elements (260-270) and control the communications through network 210 and connection 212 to the network elements (260-270).

For example, should user 220 desire to connect to a video server and another network, user 220 would signal the request. The signaling would be directed to CCP 250 over link 224, or over connection 222 and link 214 as discussed above. CCP 250 would process the signaling and make the

17

appropriate selections. CCP 250 would signal network 210 and video servers 266 of its selections. As a result, a communications path would be set-up from user 220 to video servers 266.

Additionally, CCP 250 would control communications to the other network which is represented by networks 260. Networks 260 could be any other form of telecommunications network -- either public or private. CCP 250 would make the appropriate selections to further the communications path over connection 212 and network 210 to networks 260. Upon signaling from CCP 250, the connections comprising the communications path would be made. Networks 260 would also be signalled by CCP 250 over link 256. As such a communication path is set up from user 230 to video servers 266 and on to networks 260.

There may also be several devices represented by particular network element shown on Figure 2. CCP 250 could also select the particular device to access. For example, take the situation in which voice servers 268 represents 20 individual voice server devices split among three different locations. On each call, CCP 250 could select the actual voice server device which should be used on that call and control the communications through network 210 and connection 212 to the selected device. Alternatively, CCP 250 may only be required to select group of devices, for instance at a particular location, instead of the actual device.

As is known, large telecommunication networks are comprised of numerous network elements, connections, and links. The present invention is suitable for use in this context. Figure 3 shows a version of the present invention in the context of a large network. Typically, this network would be comprised of several broadband switches, narrowband switches, muxes, signal transfer points (STPs), Service Control Points (SCPs), operator centers, video

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servers, voice servers, adjunct processors, enhanced services platforms, connections, and links. For purposes of clarity, only a few of these possibilities are shown on Figure 3. For the same reason, connections and links are not numbered.

Figure 3 shows Telecommunications Network 310 which is comprised of STP 340, STP 345, CCP 350, SCP 355, broadband switches 360, 362, 364, and 366, interworking units 361 and 365, narrowband switches 370 and 375, and muxes 380, 382, 384, and 386. Aside from CCP 350, these elements of a large network are familiar to one skilled in the art and examples of the of these network elements are as follows: STP -- DSC Communications Megahub; SCP -- Tandem CLX; broadband switch -- Fore Systems ASX-100; narrowband switch -- Northern Telecom DMS-250; and mux -- Digital Link PremisWay with CBR module.

In at least one embodiment, the broadband switches are equipped with signaling interworking units. These units translate SS7 messages into B-ISDN messages. In that event, the CCP could transmit SS7 to the broadband switches which could convert the signals properly. Interworking is discussed in ITU-TS Recommendation Q.2660, "B-ISDN, B-ISUP to N-ISUP Interworking".

When user information passes from a broadband network to a narrowband network, it typically must pass through a mux. Muxes can convert transmitted information back and forth between narrowband and broadband formats. In at least one embodiment, each broadband connection on one side of a mux corresponds to a narrowband connection on the other side of the mux. In this way, the CCP can track connections through the mux. If the communication path is on a given narrowband connection entering the mux, it will exit the mux on its corresponding broadband connection. This correspondence allows the CCP to identify connections on each side of the mux based on the entry connection.

19

Muxes are typically placed at any interface between narrowband and broadband connections.

As long as the connections correspond through the mux, the CCP can track the communication path properly. Alternatively, the connections may not correspond. In that case, signaling links between the muxes and the CCP would be required for the devices to communicate and allow the CCP to track the communication path.

Additionally, Telecommunications Network 310 includes the connections and links which are not numbered. These connections and links are familiar to those skilled in the art. Some examples of possible connections are switched digital lines, satellite links, microwave links, cellular links, and dedicated digital lines, but there are others. The signaling links are typically data links, such as 56 kilobit lines. The signaling may employ SS7, Broadband, C6, C7, CCIS, Q.933, Q.931, T1.607, Q.2931, B-ISUP or other forms of signaling technology. The present invention is fully operational with the many variations which are well known in the art. Additionally, it is also known that a direct link between two devices can be used instead of an STP for signal routing.

Outside of Telecommunications Network 310 are first point 320, second point 330, LEC switch 325, LEC switch 335, LEC STP 328, and LEC STP 338. These devices are shown along with their links and connections. First point 320 is connected to LEC switch 325. LEC switch 325 is linked to LEC STP 328 which routes signaling from LEC switch 325. LEC switch 325 is also connected to mux 380 of Telecommunications Network 310. LEC STP 228 is linked to STP 340 of Telecommunications Network 310.

STP 340 is linked to STP 345. The other links are as follows. STPs 340 and 345 are linked to CCP 350. CCP 350 is linked to interworking units 361 and 365 of broadband switches 360 and 364 respectively. CCP 350 is linked to

20

broadband switches 362 and 366, and narrowband switch 375. STP 345 is linked to narrowband switch 370 and SCP 355. STP 345 is also linked to LEC STP 338 which is linked to LEC switch 335.

Mux 380 is connected to broadband switch 360. Broadband switch 360 is connected to broadband switches 362 and 364. Broadband switch 362 is connected to mux 384 which is connected to narrowband switch 375. Broadband switch 364 is connected to mux 382 which is connected to narrowband switch 370. Broadband switches 362 and 364 are both connected to broadband switch 366. Broadband switch 366 is connected to mux 386 which is connected to LEC switch 335. LEC switch 335 is connected to second point 330.

When a call is placed from first point 320 that requires the use of Telecommunications Network 310, LEC switch 325 will typically seize a connection to Telecommunications Network 310 and generate a signal containing call information. At present, this signal is in SS7 format and the seized connection is a DS0 port. The signal is transmitted to LEC STP 328 which transfers it on to STP 340. LEC switch 325 also extends the communication path over the seized connection. These LEC components and the process of establishing communication paths between a point, a LEC, and an IXC are familiar to those skilled in the art.

Telecommunications Network 310 accepts the communication path on the narrowband side of mux 380. The present invention can also accept broadband calls that do not require a mux, but typically, calls from a LEC will be narrowband. Mux 380 converts the call to broadband and places it on the broadband connection that corresponds to the seized connection. The communication path extends to broadband switch 360 through mux 380.

STP 340 transfers the signal from LEC STP 328 to STP

21

345 which, in turn, routes the signal to CCP 350. Also, CCP 350 accepts status messages from the broadband and narrowband switches over standard communications lines, and may query SCP 355 for information. Any suitable database or processor could be used to support CCP 350 queries. CCP 350 uses this information and its own programmed instructions to make communication control selections. For calls that require narrowband switch treatment, CCP 350 will select the narrowband switch.

Preferably, CCP 350 can select any narrowband switch in Telecommunications Network 310. For example, it may extend the communication path through the broadband network to a narrowband switch across the network for processing, or it may extend the communication path to a narrowband switch connected to the broadband switch that originally accepts the communication path. Additionally, no narrowband switch may be required at all. For clarity, all of the switches representing these possibilities are not shown on Figure 3.

CCP 350 will select at least one network characteristic in response to the signaling. Typically, this will be the network elements or connections that will make the communication path. As discussed with regard to the above embodiments, CCP 350 may select only the network elements and allow the switches to select the connections, or the selections can be distributed among the two. For example, CCP 350 may only select some of the network elements and connections and allow the switches to select some of the network elements and connections. CCP 350 might only select the narrowband switches and allow the broadband switches to select the broadband switches that will make the communication path. CCP 350 can also select other network characteristics, such as applications and control instructions.

In one embodiment, CCP 350 will select the narrowband

22

switches to process particular calls and the DS0 ports on those switches which will accept these calls. The broadband switches will select the broadband switches and the broadband connections to the DS0 port. Restricted to the possibilities depicted on Figure 3, CCP 350 may select either narrowband switch 370 or narrowband switch 375 to process the call. Assuming CCP 350 selects narrowband switch 370, it would also select a DS0 port on narrowband switch 370 to accept the connection. CCP 350 would then signal broadband switch 360 through interworking unit 361 to further the communications path to the selected DS0 port on narrowband switch 370.

Of the possible routes, broadband switch 360 would be left to select the other broadband switches and connections to use. Assuming the route directly to broadband switch 364 is selected, broadband switch 360 would further the communications path to that switch. Broadband switch 360 would also signal broadband switch 364 of the communication path. Broadband switch 364 would further the communication path to through mux 382 to access the specified DS0 port on narrowband switch 370. This is accomplished by corresponding the connections through the mux as discussed above. CCP 350 will signal narrowband switch 370 of the incoming communication path. This signal is routed by STP 345. Narrowband switch 370 will process the call on the specified DS0 port. Typically, this would include billing and routing the call. Narrowband switch 370 may also query SCP 355 to aid in application of services to the call. For example, narrowband switch 370 may retrieve an "800" translation from SCP 355. As a result of the processing, narrowband switch 370 will switch the call and generate a new signal which may include routing information. The signal is sent to CCP 350 through STP 345. The communication path is furthered on a new connection back to broadband switch 364 through mux 382. CCP 350 may use the

23

information in the signal, SCP information, network element information, operational instructions, and/or its own routing logic to make new selections for the call. The network element information and operational instructions could be signalled to CCP 350 or delivered over standard data lines.

In one embodiment, the selection of a network characteristic will include the selection of a network code. Network codes are the logical addresses of network elements. One such code is a destination code that facilitates egress from Telecommunications System 310. The destination code typically represents a network element that is connected to a LEC switch. Once a destination is selected, CCP 350 will signal broadband switch 364 of its selections and the communication path will be furthered through the broadband network accordingly. In the current example this could be through broadband switch 366 and mux 386. The communication path would be furthered to the specified port on LEC switch 335. Typically, this involves the seizure of a connection on the LEC switch by the IXC.

In one embodiment, whenever broadband switch 366 extends a communication path to mux 386, it is programmed to signal CCP 350 of the broadband connection it has selected. This allows CCP 350 to track the specific DS0 port on the LEC switch that has been seized. CCP 350 would signal LEC switch 335 through STP 345 and LEC STP 338 of the incoming call on the seized DS0 connection. As a result, LEC switch 335 would further the communication path to second point 330.

It can be seen from the above disclosure that the present invention allows a telecommunications network to employ a broadband network to make call connections. By using muxes to convert calls and a CCP to analyze signaling, this broadband network remains transparent to the networks of other companies. An example of such a

24

transparent interface is between an interexchange carrier (IXC) network and a local exchange carrier (LEC) network. Similarly the network will be transparent if deployed in only a portion of a single company's network infrastructure.

In the above embodiment, the LEC seizes an IXC DS0 port and signals to an IXC STP. The mux and the CCP convert the call and analyze the signal appropriately. No changes in other existing carrier systems, such as LEC systems, are required.

Additionally the narrowband switch receives the call and signal in its own format and switches the call. Although the switch may "think" the call is routed over a trunk to another narrowband switch, the call actually goes right back to the mux and broadband switch that sent the call. The narrowband switch is used to apply features to the call, i.e. billing, routing, etc. The broadband network is used to make the substantial portion of the call connection. The CCP may use narrowband switch call processing information to make selections.

The CCP performs many functions. In one embodiment, it accepts signaling from a first point or LEC and provides appropriate signals in accord with the communication control selections it has made. These selections are network characteristics. The CCP may select network elements such as switches, servers, or network codes. The CCP may select connections, such as DS0 circuits and ports. The CCP may select particular telecommunications applications to be applied to the communications path. The CCP may select particular control instructions for particular devices. The CCP may also receive information from entities such as SCPs, operational control, or switches to aid in its selections.

The CCP is a processing system, and as such, those skilled in the art are aware that such systems can be

25

housed in a single device or distributed among several devices. Additionally, multiple devices with overlapping capabilities might be desired for purposes of redundancy. The present invention encompasses these variations. One such operational system would be multiple pairs of CCPs located regionally within a telecommunications system. Each machine would be equally capable of communication control. One example of a CCP device would be a Tandem CLX machine configured in accord with this disclosure of the present invention.

A signaling point handles the signaling for a switch. Switches which are used to route calls typically have a signaling point which is directly coupled to a processor in the switch. This processor controls a switching matrix in the switch in response to the signaling processed by the signaling point. Thus, there is typically a one to one correspondence of a signaling point for each switch and matrix.

The CCP is not directly coupled to one switch, one switch processor (CPU), or one switching matrix. In contrast, the CCP has the capability of directing a plurality of switches. Thus, the CCP can direct multiple switch matrixes by signaling multiple signaling points.

It is possible to house the CCP within other telecommunication devices, even switches. Although the CCP can be primarily distinguished from a switch CPU based on physical location, this does not have to be the case. A switch CPU receives information from a signaling point and controls the matrix of a single switch. Some switches distribute the matrix among different physical locations, but the CPU controls each matrix based on information received from a single signaling point. This information is not signaling.

In contrast, the CCP receives signaling and has the ability to signal other network elements. It can

26

communicate with multiple signaling points. These signaling points provide information to the switch CPUs which control the switch matrixes. By signaling multiple signaling points, the CCP is able to direct the matrixes of multiple switches based on the signaling and other information the CCP obtains. A CCP is not associated with a single switch matrix. A CCP does not require communication path connections in order to operate.

The main capabilities of one version of a CCP are shown on Figure 4. CCP 450 comprises interface 460, translator 470 operably connected to interface 460, processor 480 operably connected to translator 470, and memory 490 operably connected to processor 480.

CCP 450 functions to physically connect incoming links from other devices such as STPs, switches, SCPs, and operational control systems. Interface 460 is functional to accept the signals off of these links and transfer the signals to translator 470. Interface 460 is also be able to transfer signaling from translator 470 to the links for transmission.

Translator 470 accepts the signaling from interface 460 and identifies the information in the signaling. Often, this will be done by identifying a known field within a given signaling message. For example, translator 470 might identify the Origination Point Code (OPC), Destination Point Code (DPC), and Circuit Identification Code (CIC) in an SS7 message. Additionally, translator 470 must be able to formulate outgoing signaling and transmit it to interface 460 for transmission. For example, translator 470 might replace the OPC, DPC, and CIC in a given SS7 message and transfer the modified SS7 message to interface 460 for transmission. Translator 510 must be equipped to manage the signaling formats it will encounter. Examples are SS7 and C7.

Processor 480 accepts the signaling information from

27

translator 470 and makes the selections that accomplish communication control. This includes the selection of the network elements and/or connections that make the communications path. Typically, selections are made through table look-ups and SCP queries. Tables are entered and queries are generated based in part on the information identified by translator 470. The table look-ups and SCP information retrieval yield new signaling information. The new information is transferred to translator 470 for formulation into appropriate signals for transmission. Algorithm solution could also be used to make selections. Processor 480 also handles various status messages and alarms from the switches and other network elements. Operational control can also be accepted. This information can be used to modify the look-up tables or selection algorithms. Memory 490 is used by processor 480 to store programming, information, and tables.

Figure 5 shows a flow diagram for the CCP for a version of the present invention. The sequence begins with the CCP receiving different types of information. Box 500 depicts the CCP accepting a signal from a first point. This signal could be in any format, such as SS7 or broadband signaling. The signal may have passed through STPs from a LEC over a signaling link, or it may also be a signal directly provided by an individual user of a network. The signal contains information about the requested communication path. An example of such information is the message type which indicates the purpose of the message. Another example of such information is set-up information such as transit network service value, bearer capability, nature of address, calling party category, address presentation restriction status, carrier selection value, charge number, and originating line information, and service code value. Other information might be a network indicator or a service indicator. Those

29.

skilled in the art are familiar with these types of information.

Other types of information might also be accessed by the CCP. The network elements, such as switches, may provide the CCP with information as shown in box 505. This information allows the CCP to select network elements and connections based on network conditions. Examples of possible types of such information could be management messages, loading, error conditions, alarms, or idle circuits. The CCP might also provide the network elements with information.

Box 510 shows that operational control might be provided. Operational control allows system personnel to program the CCP. An example of such control might be to implement a management decision to retire a particular network element. Operational control would allow the removal that element from the selection process.

The CCP processes the information is has received in box 515. Processing also entails the use of programmed instructions in the CCP, and might even include the use of information retrieved from a remote database, such as an SCP. The selections are then made as shown in box 520. These selections specify network characteristics, such as network elements and/or connections. As stated above, The CCP may only select a portion of the network characteristics and allow the points or the switches to select the remainder. It should be pointed out that the information used in processing is not limited to that which is listed, and those skilled in the art will recognize other useful information which may be sent to the CCP.

Once network characteristics are selected, the CCP will signal the points and the applicable network elements of the selections. In box 525, signals are formulated instructing the network elements of the network characteristics selected. The signals are transmitted to

29