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(54) COUPLING MULTIPLE LOW DATA RATE LINES TO EFFECT HIGH DATA RATE COMMUNICATION

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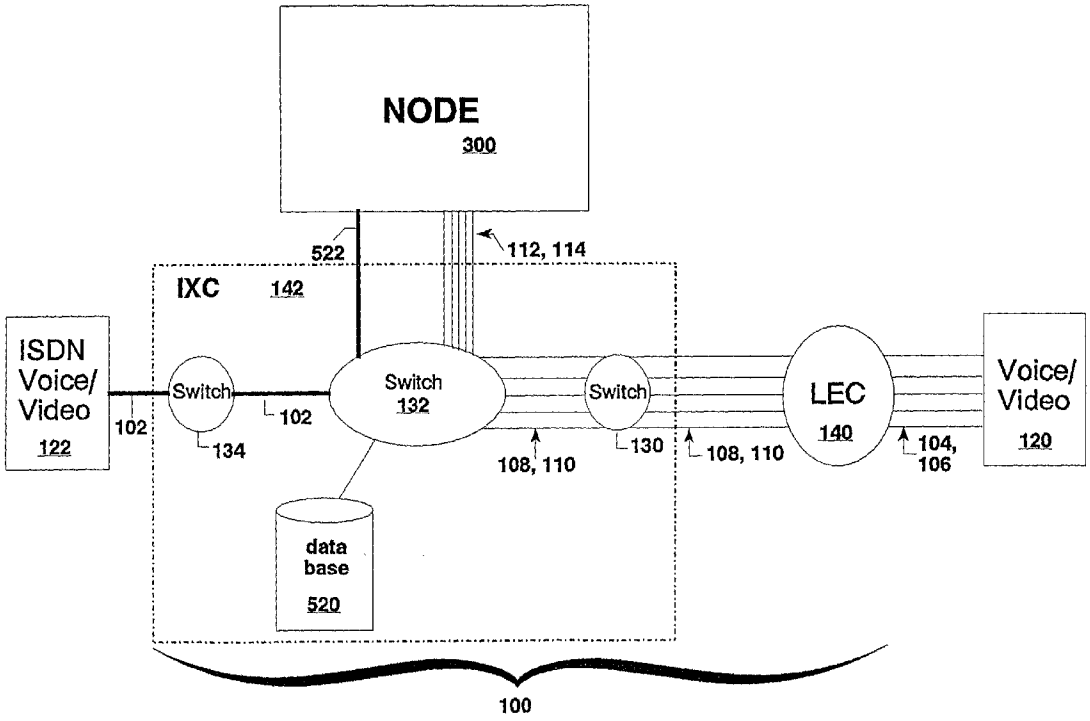
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(57) ABSTRACT

Apparatus for linking multiple baseband telephone lines to provide broadband communication. The apparatus comprises a broadband port, a plurality of baseband ports, and a controller. The broadband port provides connection to a broadband device or broadband communication line. The baseband ports provide connection to baseband communication lines. The controller integrates baseband data streams accepted at the baseband ports into a broadband data stream for transmission at the broadband port, and/or demultiplexes a broadband data stream received at the broadband port into baseband streams for transmission at the baseband ports. The baseband data include message data corresponding to the message data of the broadband stream, and control data describing an interrelationship among the message data, for controlling integrating of said baseband message data. The invention allows an individual to use multiple plain old telephone service (POTS) lines in combination to emulate the capability of a broadband line.



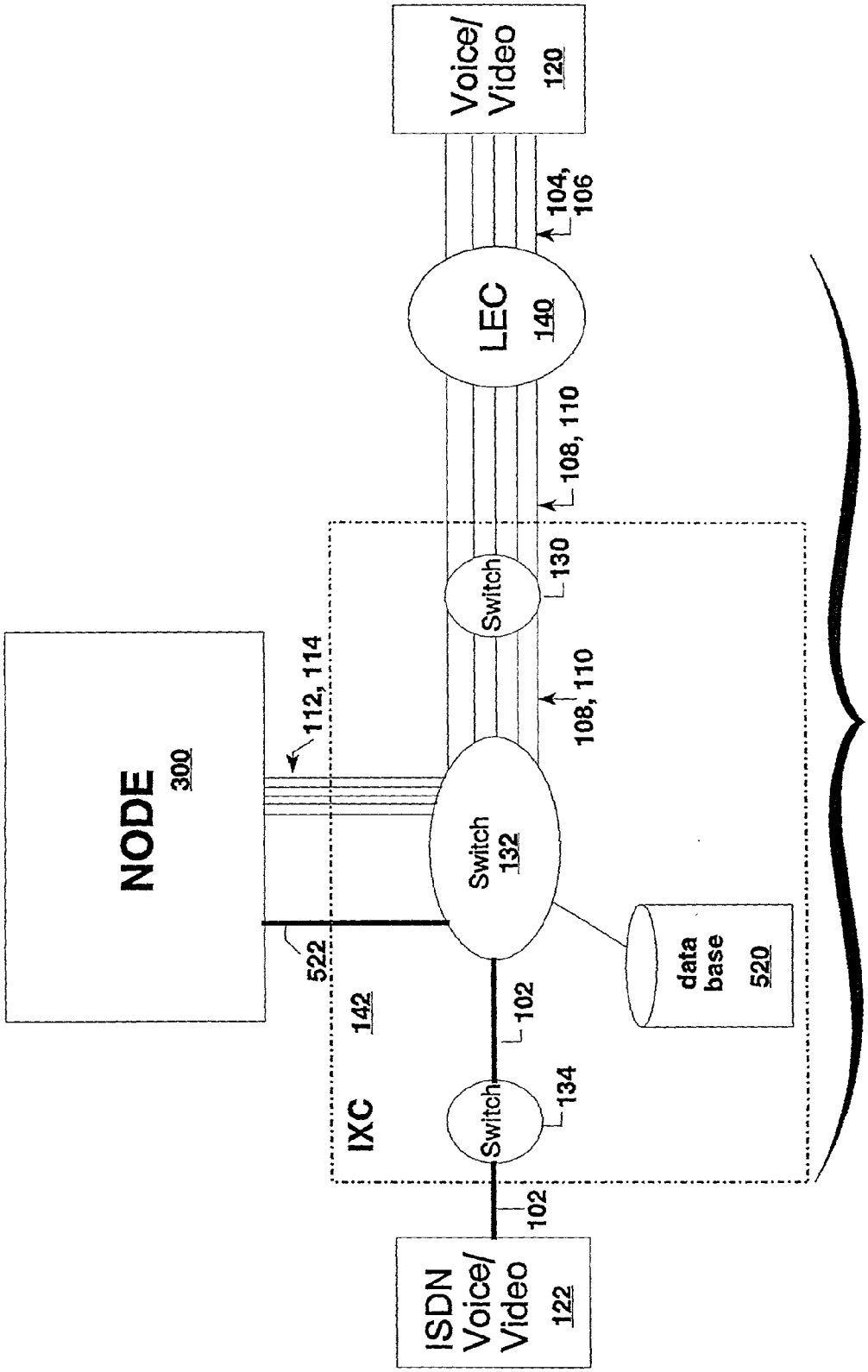

Voice/
Video
120
104,
106
LEC
140
108, 110
Switch
130
108, 110
NODE
300
112, 114
Switch
132
data
base
520
522
142
102
IXC
Switch
134
102
ISDN
Voice/
Video
122
100

Figure 1

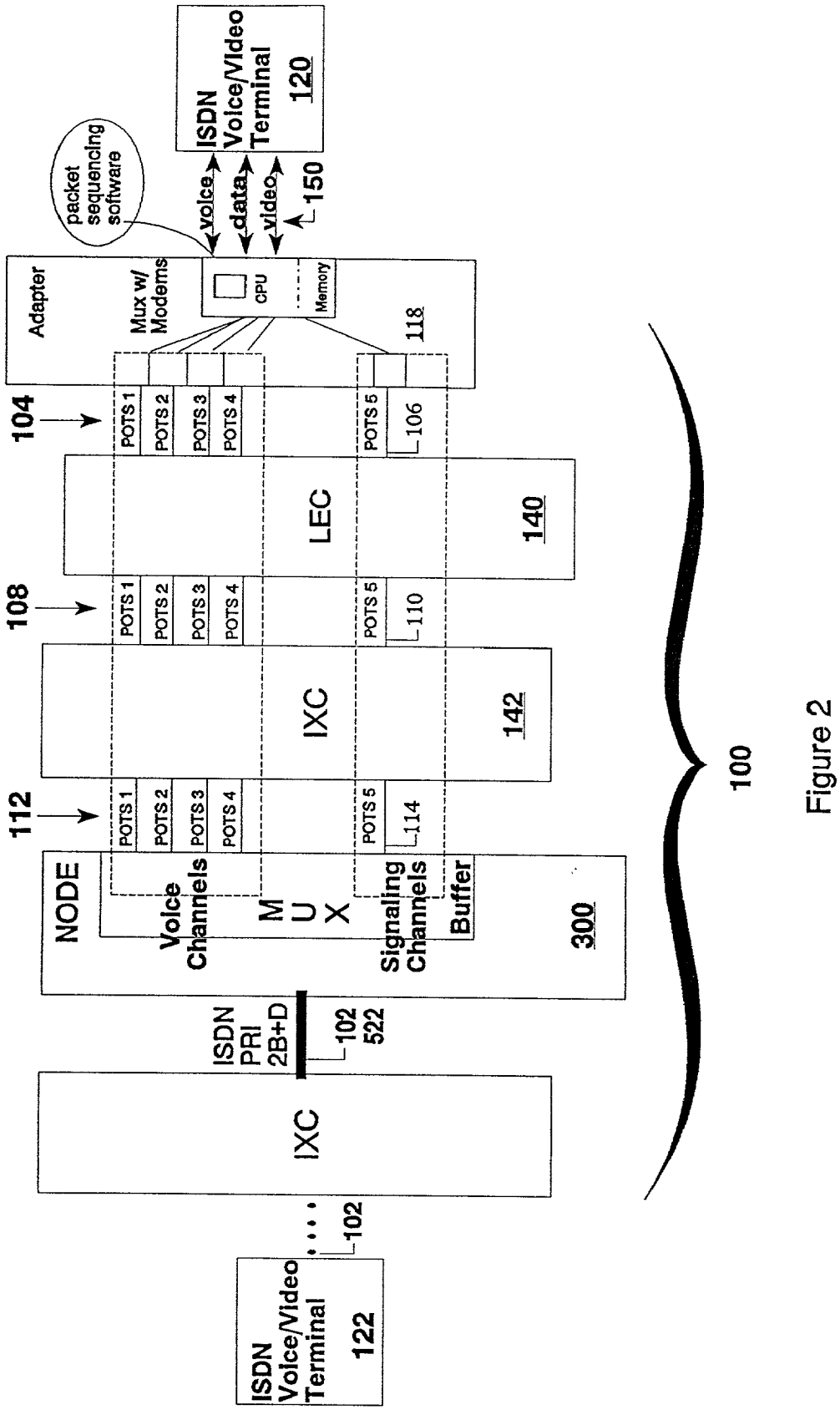

ISDN Voice/Video Terminal 120
packet sequencing software
voice
data
video
150
Adapter
Mux w/ Modems
CPU
Memory
118
104
POTS 1
POTS 2
POTS 3
POTS 4
POTS 5
106
LEC
140
108
110
IXC
142
112
114
NODE
Voice Channels
M U X
Signaling Channels
Buffer
300
ISDN PRI 2B+D
102
522
IXC
102
ISDN Voice/Video Terminal 122
100

Figure 2

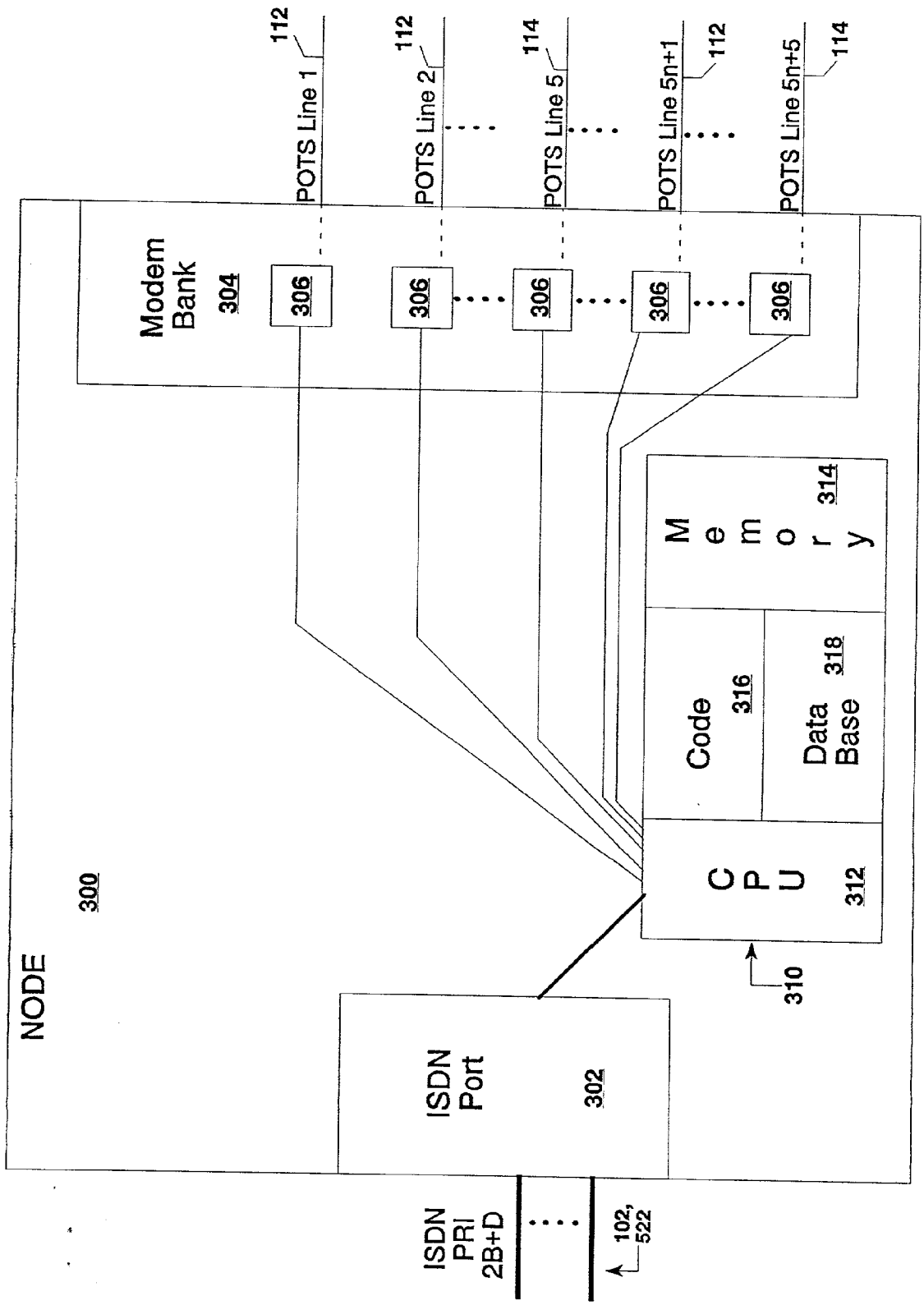

NODE
300
ISDN Port
302
ISDN PRI 2B+D
102, 522
CPU
312
310
Code
316
Data Base
318
Memory
314
Modem Bank
304
306
POTS Line 1
POTS Line 2
POTS Line 5
POTS Line 5n+1
POTS Line 5n+5
112
114

Figure 3

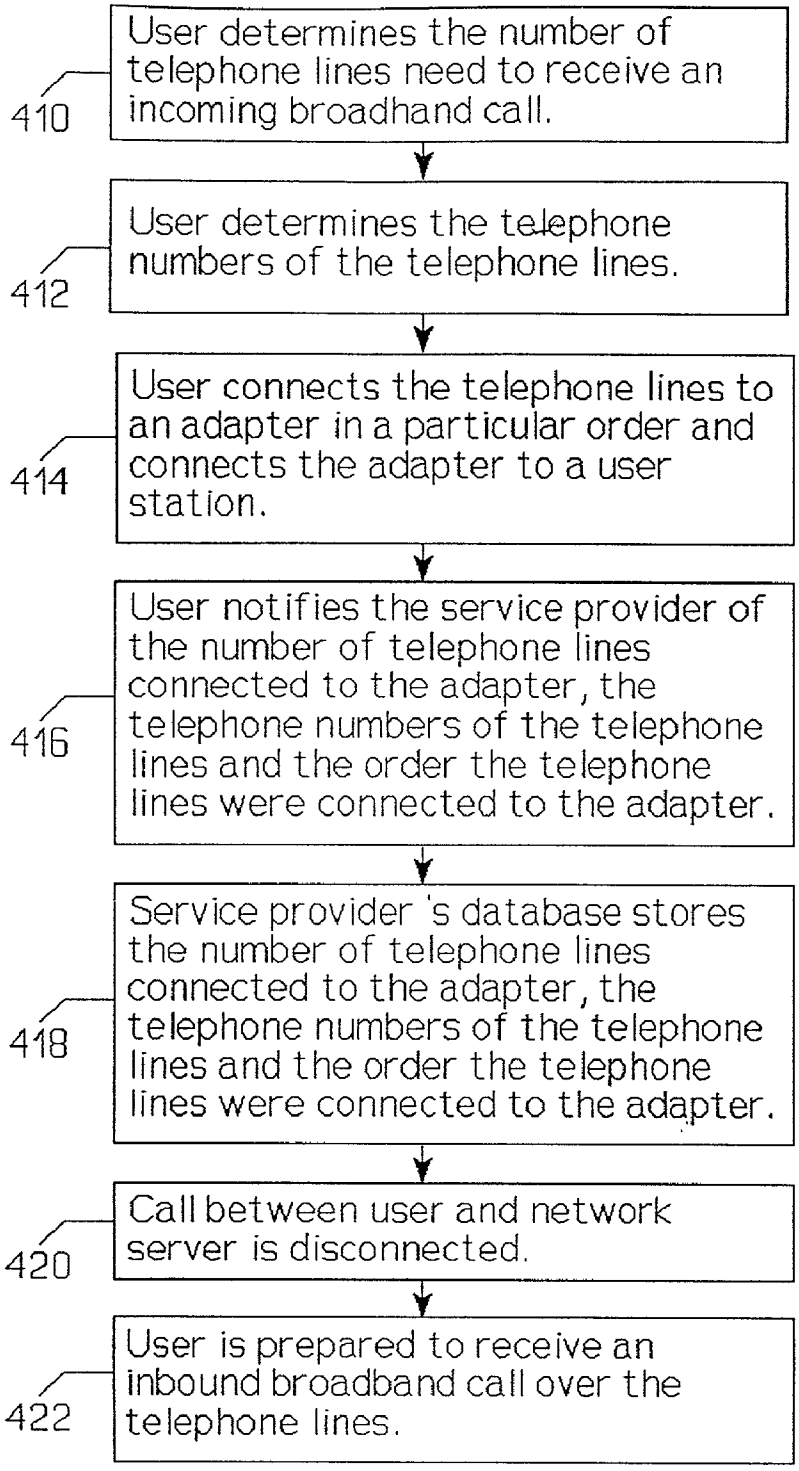

User determines the number of telephone lines need to receive an incoming broadhand call.
410
User determines the telephone numbers of the telephone lines.
412
User connects the telephone lines to an adapter in a particular order and connects the adapter to a user station.
414
User notifies the service provider of the number of telephone lines connected to the adapter, the telephone numbers of the telephone lines and the order the telephone lines were connected to the adapter.
416
Service provider 's database stores the number of telephone lines connected to the adapter, the telephone numbers of the telephone lines and the order the telephone lines were connected to the adapter.
418
Call between user and network server is disconnected.
420
User is prepared to receive an inbound broadband call over the telephone lines.
422

Figure 4

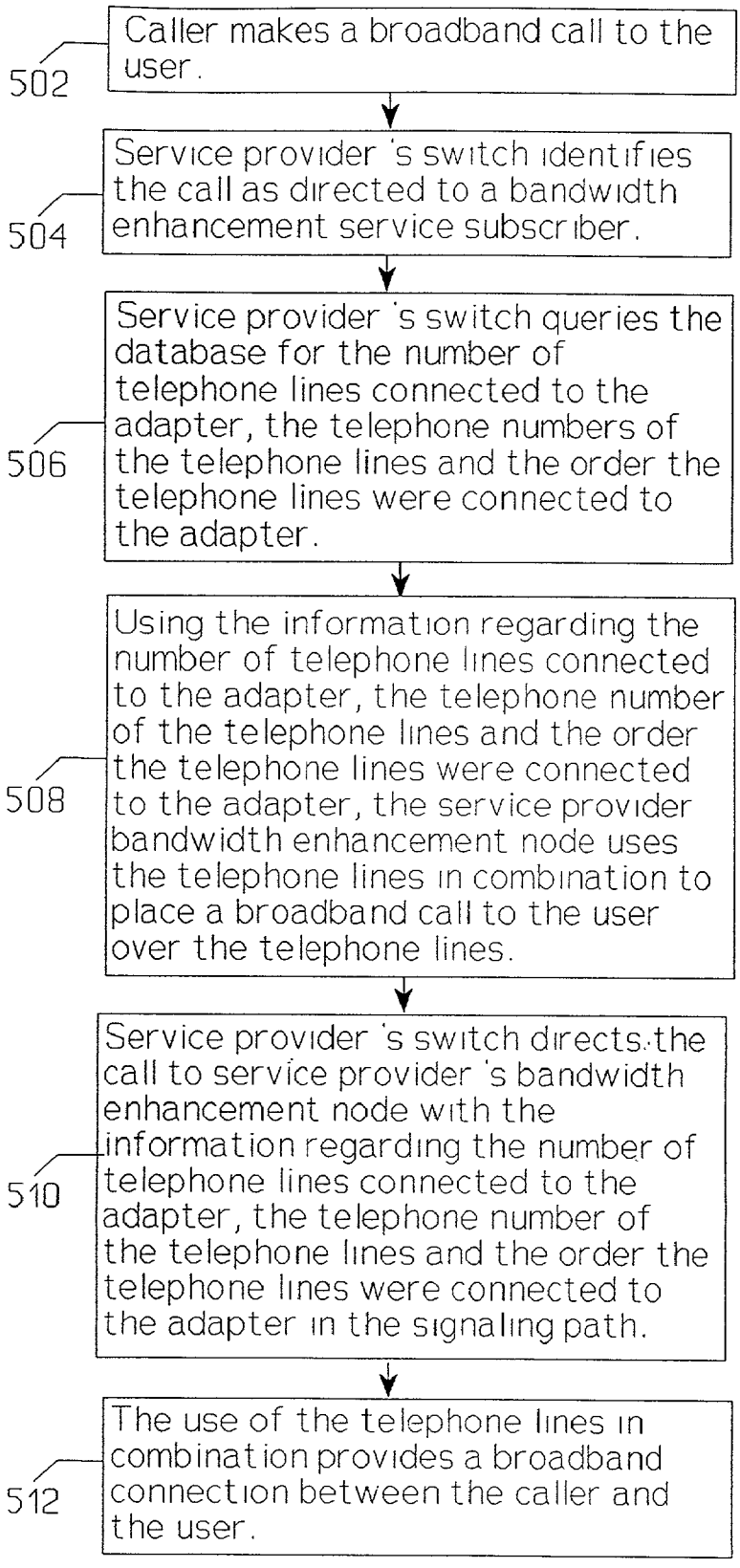

Caller makes a broadband call to the user.
502
Service provider 's switch identifies the call as directed to a bandwidth enhancement service subscriber.
504
Service provider 's switch queries the database for the number of telephone lines connected to the adapter, the telephone numbers of the telephone lines and the order the telephone lines were connected to the adapter.
506
Using the information regarding the number of telephone lines connected to the adapter, the telephone number of the telephone lines and the order the telephone lines were connected to the adapter, the service provider bandwidth enhancement node uses the telephone lines in combination to place a broadband call to the user over the telephone lines.
508
Service provider 's switch directs the call to service provider 's bandwidth enhancement node with the information regarding the number of telephone lines connected to the adapter, the telephone number of the telephone lines and the order the telephone lines were connected to the adapter in the signaling path.
510
The use of the telephone lines in combination provides a broadband connection between the caller and the user.
512

Figure 5

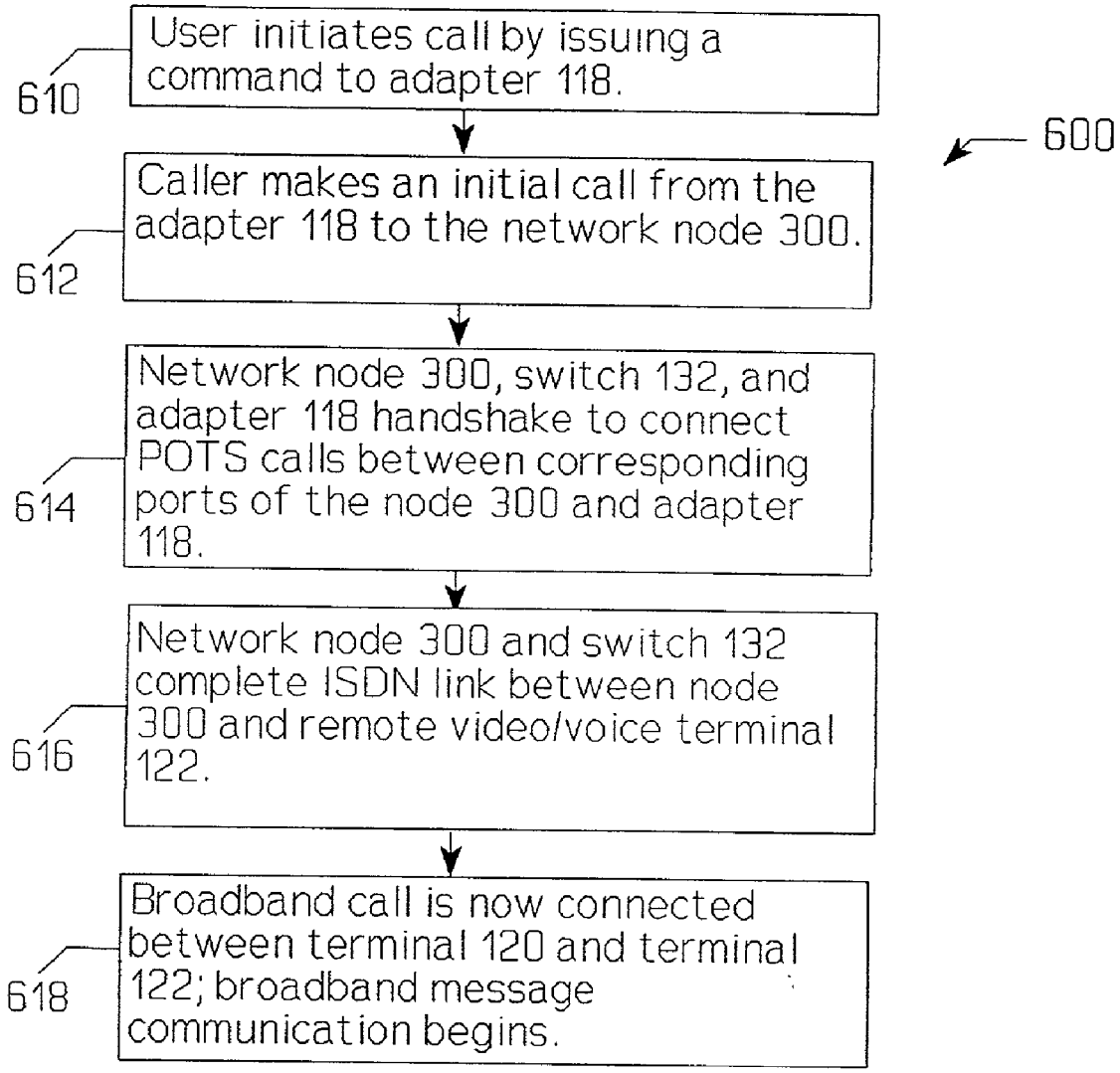

User initiates call by issuing a command to adapter 118.
610
600
Caller makes an initial call from the adapter 118 to the network node 300.
612
Network node 300, switch 132, and adapter 118 handshake to connect POTS calls between corresponding ports of the node 300 and adapter 118.
614
Network node 300 and switch 132 complete ISDN link between node 300 and remote video/voice terminal 122.
616
Broadband call is now connected between terminal 120 and terminal 122; broadband message communication begins.
618

Figure 6

# COUPLING MULTIPLE LOW DATA RATE LINES TO EFFECT HIGH DATA RATE COMMUNICATION

## TECHNICAL FIELD

[0001] The invention relates to a method and apparatus for connecting high data rate telephone calls over conventional low data rate telephone lines.

## BACKGROUND OF THE INVENTION

[0002] Communication network subscribers have the option of subscribing to plain old telephone service (POTS) or high data rate service, e.g. ISDN (integrated services digital network). POTS is suitable for voice communication, low data rate data communications, and computer transmission via modem and facsimile. ISDN service is suitable for high data rate data communications, e.g. high data rate computer transmissions and video.

[0003] To have access to the greater data rate of ISDN service, a subscriber must make arrangements before he needs the high data rate to have the ISDN service connected. In many situations, however, the individual does not have the option to have ISDN service connected, e.g. when calling from a public area. ISDN service has the additional disadvantages that the subscriber (a) has to pay to have the ISDN line installed and (b) has to pay a monthly fee for the ISDN connection in excess of that for a POTS connection.

## SUMMARY OF THE INVENTION

[0004] The invention provides method and apparatus by which a telephone subscriber can obtain the benefits of high data rate communication using low data rate (baseband) POTS telephone lines. Individuals using the invention will be able to take advantage of higher data rate communication on demand, from any location with multiple POTS lines installed, and without being charged for connection to ISDN service.

[0005] In general, in one aspect, the invention features a broadband port for connection to a broadband device or broadband communication line; baseband ports for connection to baseband communication lines; a controller for integrating baseband data streams accepted at said baseband ports into a broadband data stream for transmission at said broadband port, said accepted baseband data including message data for conveyance at said broadband port and control data describing an interrelationship among the message data received on said baseband ports, and for demultiplexing a broadband data stream received at the broadband port into a plurality of baseband data streams for transmission at the baseband ports.

[0006] The advantages of the invention include the following. A broadband call can be placed to or from a location where no broadband line is available. For instance, in an airport, a user could use two or four adjoining pay stations to connect a broadband call.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0007] **FIGS. 1 and 2** are block diagrams of a telephone network, including apparatus in accordance with the invention.

[0008] **FIG. 3** is a block diagram of a node in accordance with the invention.

[0009] **FIG. 4** is a flowchart showing setting up a node and adapter within a network.

[0010] **FIGS. 5 and 6** are flowcharts showing connection of ISDN calls over POTS lines.

## DESCRIPTION

[0011] Referring to FIGS. **1-2**, the invention allows a telephone user to tie together several POTS lines, and thereby achieve high data rate communications over low data rate POTS lines. In the embodiment of FIGS. **1-2**, the high data rate data ordinarily carried over an ISDN line **102** of a telephone network **100** are parceled out over four POTS lines **104, 108, 112**; a fifth POTS line **106, 110, 114** is used to coordinate the data of the other four **104, 108, 112**. This tying together is accomplished by two cooperating devices: an adapter **118** at the user's location, and a node **300** that is part of network **100**. The user's ISDN terminal **120** connects to one side of the adapter; the five POTS lines **104, 106** connect to the other. The five POTS lines **104, 106** connect through POTS lines **108, 110, 112, 114** to node **300**.

[0012] Node **300** interfaces POTS lines **112, 114** to ISDN line **102**. For data bound from local terminal **120** to remote device **122** (right-to-left in **FIGS. 1 and 2**), node **300** uses the coordination data of fifth POTS line **114** to reassemble data on the other four lines **112** into a single ISDN stream; this stream is delivered to a remote ISDN device **122** in the conventional fashion over ISDN line **102**. Similarly, data from the remote device **122** travel on a conventional ISDN line (left-to-right **FIGS. 1 and 2**) to reach node **300**. Node **300** apportions these high-rate data among the four POTS lines **112**, and transmits coordination data on the fifth POTS line **114**. When these data reach adapter **118**, adapter **118** uses coordination data of fifth POTS line **106** to reassemble the original data stream. Adapter **118** presents the reassembled data to ISDN terminal **120** as if they had arrived on a conventional ISDN line.

[0013] A conventional network **100** includes POTS lines **104-114** and ISDN PRI (primary rate interface) lines **102** that are routed through a number of switches **130, 132, 134** from a local terminal **120** to a remote device **122**. The lines included in this connection will typically be owned by several different carriers, e.g., a local exchange carrier (LEC) **140** and an inter-exchange carrier (IXC) **142**. The network lines will include an ISDN PRI line **102** and POTS lines **104-114**.

[0014] Conventionally, a voice/video device **122** that requires ISDN communication is connected to an ISDN line **102** of network **100**. Such ISDN devices can include computer or video terminals or any other type of system that requires a ISDN connection.

[0015] A user who wishes to use a ISDN device, e.g., a voice/video terminal **120**, but who has no ISDN line **102** reaching his location, uses adapter **118** to connect his voice/video terminal **120** to the POTS lines **104, 106** of network **100**. Terminal **120** is connected to adapter **118**, typically using voice, data, and video lines **150**, or a line having transmission characteristics essentially similar to those of an ISDN line **102**. Adapter **118** acts as a multiplexer/demultiplexer: when terminal **120** generates data for trans-

mission over network **100**, adapter **118** disassembles the ISDN data stream received on lines **150** into four data streams, and transmits these four low data rate streams over POTS lines **104**. An additional data stream, that includes data to control the reassembly of the four data streams into a single ISDN data stream, is generated by adapter **118** and transmitted over a fifth POTS line **106**.

[**0016**] In the embodiment of **FIG. 2**, the message data of the original ISDN line **102**, **150** are carried on four POTS lines **104**, **108**, **112** with a fifth POTS line **106**, **110**, **114** carrying coordination data. The number of POTS lines **104**, **108**, **112** used in any particular embodiment will vary with the data rates required by the communication between terminal **120** and device **122** and the data rate capacity of the individual POTS lines. Because an ISDN line has a capacity of 112,000 bits/sec, many devices use this as the maximum data rate at which they will transmit. Four POTS lines, at 28,800 bits/sec. each, are sufficient, collectively, to meet the 112,000 bits/sec. capacity requirement. Devices that have higher data rates would require more POTS lines, and devices that have lower data rates could use fewer. Similarly, as POTS modem rates improve, fewer lines will be required to provide the data rate of a single ISDN line.

[**0017**] Travelling over the POTS lines **104-114** of the network **100**, these five POTS lines reach node **300**, located in network **100**. The geographical location of node **300** is immaterial; the switches **130-134** will arrange a continuous circuit from adapter **118** to node **300** as part of connecting the call.

[**0018**] To support adapter **118**, the telephone network incorporates node **300**. Node **300** has the capability to reassemble the four data streams on POTS lines **112**, using control and coordination information from POTS line **114**, into a single ISDN data stream for transmission over ISDN line **102**.

[**0019**] In another embodiment, the message data and coordination data are distributed evenly over voice lines **104-114**. For instance, a 56 Kbits/sec data stream can be carried over three voice lines, each carrying 28,800 bits/sec. In this configuration, each of the three lines carry a third of the message data and a third of the coordination data. The data would be grouped in packets, and each third packet would be sent over each of the three lines: line **1** might carry packets **0**, **3**, **6**, **9**, **12**, . . . , line **2** might carry packets **1**, **4**, **7**, **10**, **13**, . . . and line **3** might carry packets **2**, **5**, **8**, **11**, **14**, . . . The framing header of each packet would bear a synchronization stamp, for instance, a 16-bit field incremented from 0 to 65,535, circularly. At the receiving end, the packets are buffered, until they can be processed in synchronization stamp order.

[**0020**] ISDN PRI line **102** connects node **300** to a remote voice or video device **122**. Line **102** is routed from node **300** to remote device **122** through several switches **134**. Typically ISDN line **102** will include segments owned by two or more different carriers, just as lines **104-114** were owned by the LEC **140** and IXC **142**. Device **122** receives the data on line **102** and displays them as video, or presents them as sound, as agreed by the local terminal **120** and remote device **122**.

[**0021**] Data produced by remote device **122** will be transmitted to the network over ISDN line **102** to node **300**. Node **300** will disassemble data **102** into four low data rate data streams **112**, plus a fifth stream of coordination data **114**. POTS lines **104-114** will convey these data back to adapter **118**. Adapter **118** will use coordination data received on fifth POTS line **106** to reassemble the four low-data rate streams **104** into a single ISDN stream **150**. This ISDN stream will then be conveyed to the local terminal **120**, for appropriate display or presentation.

[**0022**] **FIG. 3** shows a more detailed block diagram of node **300**. Node **300** has an ISDN port **302** for connection to ISDN line **102**. For each POTS line **112**, **114** to be connected to node **300**, node **300** has a modem and POTS port **306**. The modems and ports together form a modem bank **304**. In some embodiments, node **300** might have one ISDN port **302** and five POTS modem ports **306**. In other embodiments, node **300** might have several ISDN ports **302**, and roughly five times as many POTS modem ports **306**, so that node **300** can route several calls between several pairs of terminals **120** and devices **122** simultaneously.

[**0023**] For conveying data from/to modem bank to/from ISDN port **302**, node **300** has a data processor **310**. Data processor **310** includes a CPU **312** and a memory **314**. Memory **314** includes a database memory **318** and storage for the program code executed by CPU **312**. Database **318** stores information about the connections and interrelationships between the POTS lines **112**, **114** and the ISDN lines **102**. For example, database **318** might store information recording that POTS ports one through five are connected to ISDN line number three and store the phone numbers of the lines to which POTS ports one through five are connected to. CPU **312** executes software that reads the coordination data received on POTS line **114** and uses them to reassemble the message data received on POTS lines **112** for transmission on ISDN line **102**. CPU **312** also executes software that disassembles data received at ISDN port **302** and transmits them at the appropriate POTS ports **306**. Each POTS port **306** has a buffer to store received message data temporarily, until the reassembly information is received over the fifth POTS line. Similarly, the buffers hold outgoing message data until the coordination of the streams is completed. The multiplexing and demultiplexing functions are performed by CPU **312** according to methods used by multiplexers and demultiplexers in conventional telephone circuit switches.

[**0024**] At the level of detail of the block diagram of **FIG. 3**, adapter **118** is essentially similar to the node **300** shown in **FIG. 3**, except that adapter **118** has only one set of POTS lines and one ISDN line, rather then the n sets of POTS lines and n ISDN lines shown in **FIG. 3**. Indeed, both adapter **118** and node **300** could be two "boxes" of the same model (of course one, adapter **118**, would be physically located at the local user's location, and the other, node **300**, would be geographically located at the convenience of the carrier) though the programming of the two CPU's might differ slightly.

[**0025**] **FIG. 4** illustrates a setup phase, where a user informs the telephone service provider of the existence of adapter **118**, and its configuration relative to network **100**. **FIG. 5** illustrates the steps of connecting a ISDN call over network **100**, using the information provided during the setup phase of **FIG. 4**. **FIG. 6** illustrates connecting a call from terminal **120** to device **122**.

[**0026**] Referring primarily to **FIG. 4** and secondarily to **FIGS. 1, 2** and **3**, to connect adapter **118** to network **100**, in

step **410**, the user determines the number of telephone lines needed to convey an ISDN call. This determination will consider the baud rate of the ISDN line that is to be emulated and the baud rate of the individual POTS lines. With this number in hand, the user ensures that a sufficient number of POTS lines are installed. In the remaining steps of the method, either the phone numbers of node **300** and lines **112-114** are determined and stored in a memory of adapter **118**, or else the phone numbers of lines **104-106** of adapter **118** are determined and stored in a memory of node **300**. It may be advantageous to do both.

[**0027**] In step **412**, the user determines the telephone numbers of the telephone lines he intends to use to send or receive a ISDN call. In step **414**, the local user connects the POTS lines **104**, **106** to adapter **118**. In some embodiments, the user notes the correspondence between the phone numbers of the lines and the ports of the adapter to which the lines are connected, so that node **300** and adapter **118** can agree which signals are to be transmitted on which lines.

[**0028**] In step **416**, the local user notifies the communication service provider **142** of the number of telephone lines **104** connected to adapter **118** and the telephone numbers of those telephone lines. In the embodiments discussed above, the user also notifies the provider of the correspondence between the telephone numbers and the adapter ports to which the lines are connected. The user can so notify the communication service provider **142** through any suitable means, e.g. a telephone call. In step **418**, the communication service provider **142** stores into database **520** the number of the telephone lines **104**, **106** connected to adapter **118**, the telephone numbers of the telephone lines **104**, **106** and the order the telephone lines were connected to adapter **118**. In step **420**, the call between local terminal **120** and the communication service provider is disconnected. Adapter **118** is now prepared to receive an inbound ISDN call over the telephone lines **104**, **106** (step **422**).

[**0029**] In some embodiments, steps **412-418** are automated. The user need not take special care to record the correspondence between the phone numbers and the ports of adapter **118**. In these embodiments, the adapter has a processor and memory. As a multi-POTS-line ISDN call is being connected, the node's CPU **312** will communicate with the processor at adapter **118**. This communication will establish the correspondence between node ports **306** and the respective ports of adapter **118**. In one family of such embodiments, steps **414**, **416**, and **418** might proceed as follows. The user stores all of the phone numbers of the adapter POTS ports into the memory of adapter **118**, and gives a "setup network" command to adapter **118**. Adapter **118** then calls the network using one of its POTS lines **106**, e.g., reaching CPU **312** of node **300**. Over this call, adapter **118** tells node **300** the number of POTS lines connected, and the phone numbers of lines **104**, **106**. This information is stored in database **520**.

[**0030**] Alternatively, the local user can simply plug a sufficient number of phone lines into adapter **118**. When the user directs adapter **118** to perform the initialization process of **FIG. 4**, adapter **118** tests its modem ports to determine how many lines **104-106** are connected. Adapter **118** calls to node **300** on a single line, typically calling a hunt group phone number of node **300**, programmed into adapter **118**. Adapter **118** tells node **300** the number n of lines **104-106** that are connected. Node **300** responds by reserving n-**1** ports **306**, and communicating to adapter **118** the n-**1** phone numbers of the reserved lines **112**, **114** over which to connect.

[**0031**] Alternatively, the local user can simply plug a sufficient number of phone lines into adapter **118**. During the initialization process of **FIG. 4**, adapter **118** tests its modem ports to determine how many lines are connected. Adapter **118** will then call telephone node **300** over each of the connected lines, and allow a caller ID feature to identify the phone number on which the adapter is calling to CPU **312** of node **300**. Node **300** can then hang up and call back to adapter **118** on these identified lines. Adapter **118** and node **300** will exchange information to associated the lines of the broadband call with each other, and to distinguish these calls from the calls of other calls to node **300** from other adapters **118**.

[**0032**] Alternatively, when the first call is connected, node **300** can provide to adapter **118** over this first call n-**1** telephone numbers of n-**1** baseband ports **306** of node **300**, to which adapter **118** can call to connect the n-**1** additional baseband phone calls.

[**0033**] Alternatively, the n telephone numbers of n baseband ports **306** can be stored in a non-volatile memory of adapter **118**.

[**0034**] Alternatively, each adapter **118** can have a node phone number reserved to it, and all lines of adapter **118** can be phoned to node **300** on that single phone number (with call roll-over) so that the individual voice lines **104-114** of a single broad band call are associated with each other.

[**0035**] Alternatively, each adapter **118** can have a unique device ID, for instance encoded in a non-volatile ROM. When the adapter **118** calls in on the n lines, the device ID can be exchanged over the n lines so that node **300** can associate the associate the calls from a single node **118**.

[**0036**] Alternatively, when the first call is connected, node **300** can generate a unique call tag value, and communicate this to adapter **118**. As adapter **118** connects the n-**1** remaining calls to ports **306**, adapter **118** provides this call tag value to node **300**, which in turn uses the call tag value to associate the n separate baseband calls into a single group.

[**0037**] **FIG. 5** illustrates connecting a call, in the case where a call originates at remote device **122** (at the left end of **FIGS. 1 and 2**) to local terminal **120** (at the right end). Referring primarily to **FIG. 5** and secondarily to **FIGS. 1, 2** and **3**, in step **502**, the remote device makes a ISDN call over ISDN lines **102** using the procedures conventionally used to connect to any other ISDN device. Usually this ISDN call will be made over a translatable telephone number, e.g. an 800 service telephone number, such that reference to a database will be required to connect the call.

[**0038**] In step **504**, network switch **132** intercepts the call, recognizing the destination phone number as one that must be connected over multiple POTS lines rather than over an end-to-end ISDN line. Switch **132** has a database **520**, analogous to the database that translates "800" numbers into a true area code and phone number. In steps **506-510**, switch **132** uses this database to connect three call segments. A first segment, ISDN line **522**, connects switch **132** and node **300**. A second segment, over POTS lines **112**, **114**, connects node

300 and switch 132. A third segment, POTS lines 104-110, connects switch 132 to adapter 118. Steps 506-510 may be reordered relative to each other, or may be overlapped in time.

[0039] In step 506, switch 132 consults database 520 to translate the ISDN phone number dialed by remote device 122 into the telephone number of at least one of the POTS lines 104, 106 connected to adapter 118 at the local user's location. In one embodiment, database 520 stores the number of POTS lines 104, 106 connected to adapter 118, the phone number of each of these lines, and the association between each line and the corresponding port of adapter 118.

[0040] In step 508, switch 132 connects the appropriate calls over lines 104-114 in accordance with the information obtained in step 506 from database 520. As the lines 104-110 are connected, node 300 and adapter 118 will test the lines to determine their quality and capacity. For instance, some voice lines will carry a full 28.8 Kbits/sec; as discussed above, it is believed that three of these lines will readily carry the message data and coordination data for a 56 K bit/sec transmission. However, if the lines are somewhat noisy or ill-conditioned, then the set up phase of FIG. 4 may determine that a line can only carry less than 28.8 Kbits/sec, and that more than three lines are needed.

[0041] In step 510, switch 132 connects POTS segments 112 and 114 and ISDN segment 522. The number of POTS lines in segment 112 will agree with the number of POTS lines 104 determined by consultation of database 520. In making these connections, the connection of respective lines of segments 112, 114 to lines 104-110 will be made to preserve the proper association between modem ports 306 (FIG. 3) of node 300 to the POTS ports of adapter 118. For example, the coordination data line 114 of node 300 will be connected to coordination data line 106 of adapter 118, not to message data line 104.

[0042] In step 512, a high data rate call is connected between terminal 120 and device 122. Part of the call is carried over ISDN lines 102, 522, from device 122 to node 300, and part over POTS lines 104-114 from node 300 to adapter 118. Control software, primarily in switch 132, has consulted database 520 to ensure that the POTS lines 104-110 are sufficient in number to carry the data rate of ISDN line 102, and that POTS lines 104-114 connect ports of node 300 to corresponding ports of adapter 118.

[0043] In the embodiment described, steps 506, 508, and 510 are performed by switch 132. Alternatively, much of the handshaking to establish the multiple POTS connections can be performed by node 300. Similarly, database 520 of information required to connect the multiple POTS calls may reside at, or be distributed among, any of several locations. For example, FIG. 1 shows database 520 connected to switch 132. In a first alternative, much of the information of database 520 could reside in a database connected to node 300, e.g. database 318 of node 300 (FIG. 3).

[0044] In a second alternative embodiment, database 520 could store only a single one of the phone numbers of local ISDN terminal 120, and much of the remaining information could be stored in a database residing in adapter 118. In this alternative, for example, switch 132 would initially connect to adapter 118 over a single POTS line 106, 110 and switch 132; then adapter 118 and switch 132 would handshake to exchange information over this initial call, to establish the additional calls required to complete the high data rate call over multiple POTS lines. This handshaking could include, for example, adapter 118 providing to switch 132 the phone numbers of the remaining POTS ports 104 of adapter 118. Switch 132 would then connect the additional POTS calls over the phone numbers provided during the initial handshaking.

[0045] Steps 508 and 510 establish the n calls between node 300 and adapter 118, and establish a correspondence of the calls to each other. Many alternative embodiments of these steps exist, for instance those corresponding to the alternative embodiments of steps 416-418 discussed above. These alternatives will be readily understood by one of ordinary skill, without elaboration here.

[0046] Referring primarily to FIG. 6 and secondarily to FIGS. 1, 2, and 3, a high data rate call from the local terminal 120 to the remote device 122 is completed in accord with method 600, using the setup information established by the method of FIG. 4. In step 610, the local user issues a command to adapter 118 to connect a call to the desired ISDN phone number of remote device 122. In step 612, adapter 118 connects a single POTS call to node 300.

[0047] In step 614, processor 312 in node 300, and processors in switch 132 and adapter 118 handshake over this single line. The processors consult database 318 in node 300, database 520 in switch 132, and a database (if any) in the memory of node 118. This handshaking establishes the number of POTS calls 104-114 required to carry the data rate of the ISDN line 102, the phone numbers which must be dialed, whether node 300 is to dial adapter 118 or vice-versa, and the correspondence between the phone numbers and ports of node 300 and adapter 118. One correspondence might be to note the order in which the lines are connected to the ports of adapter 118. For example, node 300 might provide to adapter 118 four additional phone numbers for adapter 118 to call, over which to establish the message lines 104, 106, 112. Another would be to establish this correspondence by handshaking information between node 300 and adapter 118. Another would be to associate the lines in the order that the calls are connected.

[0048] Typically, the additional POTS calls will be placed by adapter 118 to node 300 so that tolls will be billed correctly, although it is also possible that the additional POTS calls will be connected by node 300 to adapter 118. In the adapter-calls-node configuration, it is preferred that node 300 reserve the appropriate number of inbound POTS ports 306, so that these lines will be available as adapter 118 calls to connect the individual lines.

[0049] In step 616 (which may proceed in parallel with step 614), the ISDN link 102 between node 300 and remote device 122 is established.

[0050] In step 618, the ISDN call is connected between terminal 120 and device 122. ISDN message communication may now begin.

[0051] It is to be understood that the above description is only of one preferred embodiment of the invention. Numerous other arrangements may be derived by one skilled in the art, without departing from the scope of the invention. The invention is thus limited only as defined in the accompanying claims.

The invention claimed is:

**1**. A method for conveying data of a broadband telephone call, comprising the steps:

receiving a broadband data stream at a first port;

demultiplexing said broadband data stream into a first plurality of baseband data streams, and developing control signals to enable recreation of the broadband data stream from the baseband data streams with a latency that is unrelated to structure of data contained in the broadband data stream; and

transmitting said baseband data streams as well as the control signals over a second plurality of baseband channels, each of aid baseband channels having a transmission capacity less than the capacity necessary to carry said broadband data stream.

**2**. The method of claim 1 further comprising the steps of:

receiving said baseband data streams and said control signal

combining the received baseband data streams under direction of the received control signals to reassemble the broadband data stream, and

conveying said reassembled data stream to a second port.

**3**. The method of claim 1 where said control signals enable recreation of the broadband data stream from the baseband data streams with a latency that is related solely to transmission delays of the baseband data streams.

**4**. The method of claim 1 where said first plurality is equal to said second plurality.

**5**. The method of claim 1 where said second plurality is greater than said first plurality.

**6**. The method of claim 2, further comprising the step of:

establishing a correspondence between the baseband data streams and the received baseband data streams, said correspondence being reflected in said control data.

**7**. The method of claim 6, wherein said establishing of said correspondence comprises recording an order in which baseband channels are connected to baseband ports for said baseband data streams.

**8**. The method of claim 6, wherein:

said baseband data streams are partitioned between at least one control stream and at least one message streams said control stream or streams conveying primarily said control data, and said message stream or streams conveying primarily message data of said broadband data stream.

**9**. The method of claim 6 wherein said establishing of said correspondence comprises detecting an originating phone number of at least one of said baseband data streams at a receiving port for said at least one of said baseband data streams.

**10**. The method of claim 1, further comprising a step, at a time of connecting said baseband data streams, of computing a count of a number of said baseband data streams required to collectively carry said broadband data stream.

**11**. The method of claim 1, further comprising a step of notifying a communication service provider or a communications subscriber of a telephone number of a baseband port at a place of said multiplexing so that the provider or subscriber can use the telephone number to connect a broadband call.

**12**. The method of claim 1, further comprising, as part of connecting said baseband data streams, the step of consulting a non-volatile memory in which is stored at least one of the telephone numbers over which said baseband data streams is to be connected.

**13**. Apparatus for linking multiple baseband telephone lines to provide broadband communication, comprising:

a broadband port for connection to a broadband device or broadband communication line;

baseband ports for connection to baseband communication lines; and

a controller for demultiplexing a broadband data stream received at said broadband port into a plurality of baseband data streams for transmission at said baseband ports, said baseband data including message data collectively encoding said broadband data and control data describing a multiplexing interrelationship among the message data transmitted at said baseband ports.

**14**. The apparatus of claim 13, wherein said controller is further configured to integrate baseband data streams accepted at said baseband ports into a broadband data stream for transmission at said broadband port, said accepted baseband data including message data for conveyance at said broadband port and control data describing an interrelationship among the message data received on each of said baseband ports, for controlling said integrating of said received baseband message data.

**15**. The apparatus of any of claim 13, wherein said controller further comprises.

means for coordinating with a remote device over said baseband lines, said coordinating including:

connecting said baseband lines between said baseband ports and said remote device, and

establishing a correspondence between respective ones of said baseband ports of the apparatus and baseband ports of said remote device, said correspondence for use in said control data's interrelationship description.

**16**. The apparatus of claim 15, wherein:

said establishing includes noting an order in which said baseband communication lies re connected to said baseband ports.

**17**. The apparatus of claim 13, further comprising:

means for notifying a communication service provider or a communications subscriber of a telephone number of at least one of said baseband ports so that the provider or subscriber can a conventional telephone line to establish a broadband call.

**18**. The apparatus of claim 13, further comprising:

means for determining a number of said baseband lines that in combination have sufficient data capacity to carry said broadband data stream and said control data.

**19**. The apparatus of claim 13, wherein:

said baseband ports are partitioned into control ports and message ports, said controller being configured to convey said control data primarily at said control ports, and said message data primarily at said message ports.

**20**. A communications network, comprising:

first and second apparatus, each according to claim **13**;

a broadband line connecting said broadband port of said first apparatus with a broadband terminal, said broadband line being of a length requiring an amplifier or repeater; and

a plurality of baseband lines, each said baseband line connecting a baseband port of said first apparatus with a corresponding baseband port of said second apparatus, each of said baseband lines being of a length to require an amplifier or repeater.

**21**. The communications network of claim 20, further comprising:

a non-volatile memory describing the plurality of baseband ports of said first apparatus;

a switch configured to

query said memory on receipt of a call from said second apparatus; and

provide to said second apparatus a phone number at which to connect each of said plurality of baseband lines;

a call establishing means configured to connect a call to said switch, and responsive to the switch's provided phone number or numbers, to connect calls between the baseband ports of said second apparatus and the baseband ports of said first apparatus.

**22**. The communication network of claim 21, further comprising:

means for identifying the originating phone number of a call from said first to said second apparatus, and for storing said originating phone number in said non-volatile memory.

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