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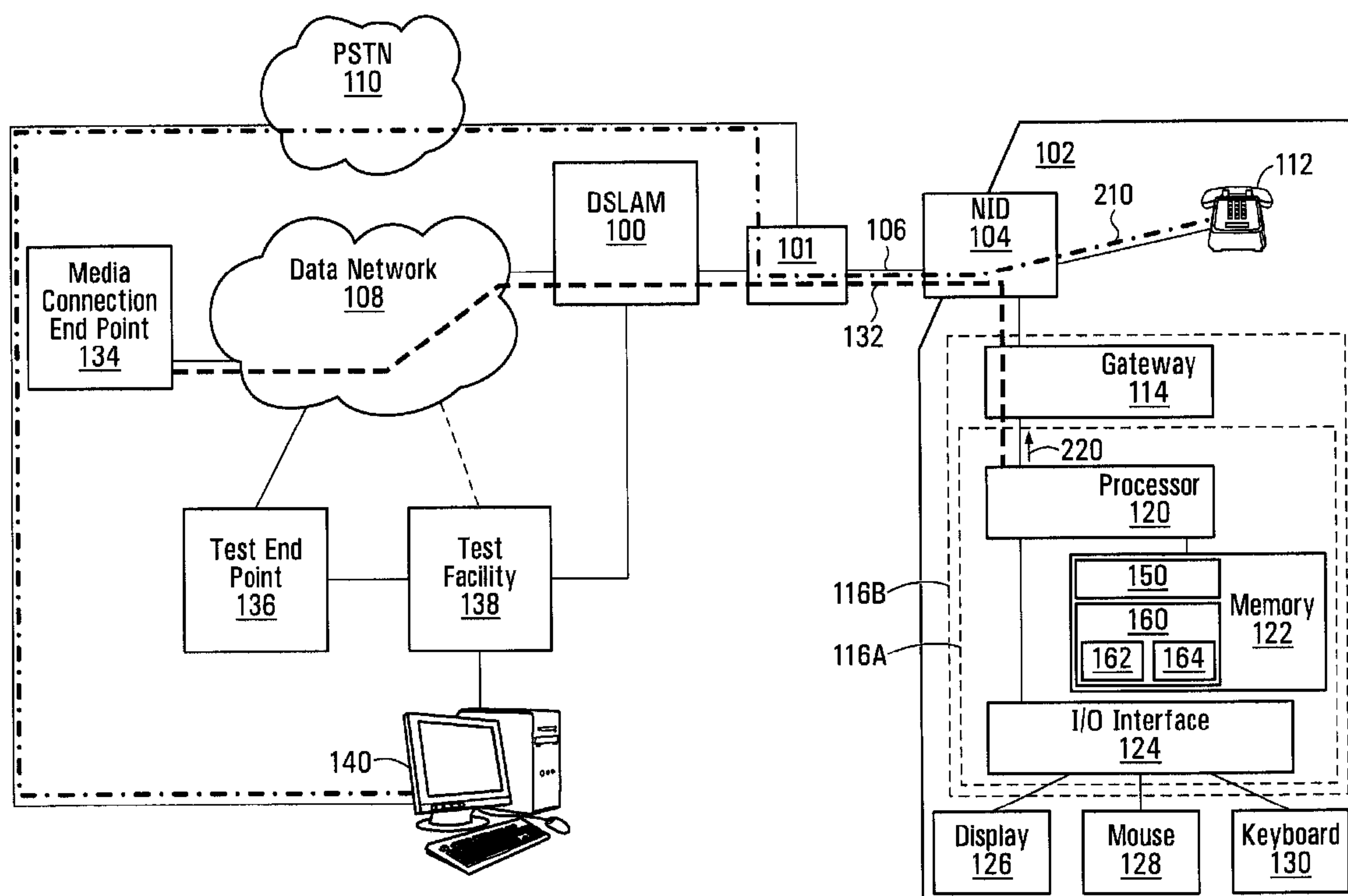
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(54) Titre : METHODES ET SUPPORT LISIBLE PAR UN ORDINATEUR PERMETTANT DE VERIFIER UNE
CONNEXION DE RESEAU A UN DISPOSITIF DE CALCUL

(54) Title: METHODS AND COMPUTER-READABLE MEDIA FOR TESTING A NETWORK CONNECTION AT A COMPUTING DEVICE



(57) **Abrégé/Abstract:**

A computer-readable medium is provided, comprising a set of instructions for execution by a processor of a computing device at a subscriber premises. The processor is operable to execute a software application that enables the computing device to participate in a media connection over a data network. Execution of the set of instructions by the processor causes the computing device to execute a method that includes performing a connectivity test over a test connection established through a gateway at the subscriber premises and over the data network; and prior to performing a connectivity test, provisioning the gateway to enable establishment of said test connection.

1 **ABSTRACT**

2

3 A computer-readable medium is provided, comprising a set of instructions for
4 execution by a processor of a computing device at a subscriber premises. The
5 processor is operable to execute a software application that enables the computing
6 device to participate in a media connection over a data network. Execution of the set
7 of instructions by the processor causes the computing device to execute a method that
8 includes performing a connectivity test over a test connection established through a
9 gateway at the subscriber premises and over the data network; and prior to performing
10 a connectivity test, provisioning the gateway to enable establishment of said test
11 connection.

12

1 **METHODS AND COMPUTER-READABLE MEDIA FOR TESTING A**
2 **NETWORK CONNECTION AT A COMPUTING DEVICE**

3
4
5 **FIELD OF THE INVENTION**

6
7 The present invention is related to communication over a network and, in particular,
8 to methods and computer-readable media for testing a network connection at a
9 computing device.

10

11 **BACKGROUND**

12

13 The telecommunications industry has advanced to the point where the majority of
14 residential and business customers can subscribe to a data network service, such as an
15 Internet service. In cases where access to a copper twisted pair is available, the
16 customer may use a modem or a home gateway located at the subscriber premises in
17 order to connect to a service provider's digital subscriber line access multiplexer
18 (DSLAM) in the data network.

19

20 Naturally, problems with the customer's connection (known as a "connectivity
21 problems") may arise. A conventional approach to troubleshooting a connectivity
22 problem reported by a customer consists of the service provider sending a service
23 technician to the customer premises. In order to verify network connectivity, the
24 service technician disconnects the customer's modem or home gateway and, in its
25 place, connects a portable computer pre-loaded with an analysis tool capable of
26 executing an array of tests. Upon completion of the tests, the service technician
27 expects to be in a position to assess the nature of the connectivity problem.

28

29 One disadvantage with the aforementioned conventional troubleshooting approach is
30 the fact that the customer's connection is not truly being tested by the service
31 technician. For example, the technician is not running the same software program as
32 the customer was running when the connectivity problem was experienced. Thus,
33 while the service technician may be able to test certain basic connectivity features, he
34 or she may be unable to diagnose the connectivity problem with a sufficient degree of
35 accuracy.

1

2 Another disadvantage with the aforementioned conventional troubleshooting approach
3 lies in the need to deploy the service technician in the first place. Specifically, not
4 only does this activity engender a delay before the connectivity problem can even
5 begin to be diagnosed, but it is considered costly in terms of the amount of labour,
6 fuel, etc. that needs to be expended each time a customer experiences a connectivity
7 problem. Moreover, the specialized test devices used by service technicians can be
8 costly as well.

9

10 Thus, it should be apparent that conventional troubleshooting techniques are
11 inadequate, especially as service providers come under increased pressure to reduce
12 costs, and also as service providers become more concerned with increasing customer
13 satisfaction.

14

15 **SUMMARY OF THE INVENTION**

16

17 A first broad aspect of the present invention seeks to provide a computer-readable
18 medium comprising a set of instructions for execution by a processor of a computing
19 device at a subscriber premises. The processor is operable to execute a software
20 application that enables the computing device to participate in a media connection
21 over a data network. Execution of the set of instructions by the processor causes the
22 computing device to execute a method that includes performing a connectivity test
23 over a test connection established through a gateway at the subscriber premises and
24 over the data network; and prior to said performing a connectivity test, provisioning
25 the gateway to enable establishment of said test connection.

26

27 A second broad aspect of the present invention seeks to provide a method for
28 execution at a computing device located at a subscriber premises. The method
29 comprises executing a software application that enables the computing device to
30 participate in a media connection over a data network; performing a connectivity test
31 over a test connection established through a gateway at the subscriber premises and
32 over the data network; and prior to said performing a connectivity test, provisioning
33 the gateway to enable establishment of said test connection.

34

1 A third broad aspect of the present invention seeks to provide a method for execution
2 at a computing device located at a subscriber premises, the computing device being
3 operable for executing a software application that enables the computing device to
4 participate in a media connection over a data network. The method comprises
5 performing a connectivity test over a test connection established through a gateway at
6 the subscriber premises and over the data network; and prior to said performing a
7 connectivity test, provisioning the gateway to enable establishment of said test
8 connection.

9
10 A third broad aspect of the present invention seeks to provide a system for testing
11 connectivity over a data network. The system comprises a test end point accessible
12 via the data network; and a computing device operable for executing a software
13 application that enables the computing device to participate in a media connection
14 over the data network. The test end point is operable for issuing a test initiation
15 trigger to the computing device. The computing device is further operable for
16 responding to said test initiation trigger to effect a connectivity test over a test
17 connection established with the test end point, the computing device further operable
18 for, prior to said performing a connectivity test, provisioning the computing device to
19 enable establishment of said test connection.

20
21 These and other aspects and features of the present invention will now become
22 apparent to those of ordinary skill in the art upon review of the following description
23 of specific embodiments of the invention in conjunction with the accompanying
24 drawings.

25 26 **BRIEF DESCRIPTION OF THE DRAWINGS**

27
28 In the accompanying drawings:

29
30 Fig. 1 shows a network configuration comprising a data network and a subscriber
31 premises;

32
33 Figs. 2A-2C depict establishment of a test connection in accordance with a first non-
34 limiting embodiment of the present invention;

Fig. 3 depicts establishment of a test connection in accordance with a second non-limiting embodiment of the present invention; and

Figs. 4A-4B depict establishment of a test connection in accordance with a third non-limiting embodiment of the present invention.

It is to be expressly understood that the description and drawings are only for the purpose of illustration of certain embodiments of the invention and are an aid for understanding. They are not intended to be a definition of the limits of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

With reference to Fig. 1, there is shown a network configuration in accordance with a specific non-limiting embodiment of the present invention, comprising a DSLAM 100 connected to a subscriber premises 102 via a splitter 101 and a communication link 106, which in a non-limiting example may be a copper twisted pair. Of course, the DSLAM 100 may be connected to additional subscribers premises via other respective splitters and communication links, but these have been omitted from Fig. 1 for the sake of simplicity. The splitter 101 allows data and voice signals to coexist on the same communication link 106. The data signals are exchanged over a data network 108 via the DSLAM 100 while the voice signals are exchanged with the public switched telephone network (PSTN) 110.

In another non-limiting example, applicable to cable television networks over which Internet access is delivered, the communication link 106 can be a coaxial cable, and the DSLAM 100 in Fig. 1 can be replaced by a head-end modem (not shown). In such a case, there is no need for a connection between the head-end modem and the PSTN 110.

The subscriber premises 102 comprises a network interface device 104 for connection to the DSLAM 100 over the communication link 106. At the subscriber premises 102, the network interface device 104, which in one specific non-limiting embodiment may be embodied as a splitter in combination with a filter, connects to a POTS telephone 112 and to a gateway 114. In other specific non-limiting embodiments,

1 e.g., where the communication link 106 is a coaxial cable, the network interface
2 device 104 may simply be a connector.

3
4 In one embodiment, the gateway 114 may be implemented as a modem. In another
5 embodiment, the gateway 114 may comprise a router in combination with a modem.
6 In yet another embodiment, the gateway 114 may comprise a router, and a separate
7 modem may be connected between the network interface device 104 and the gateway
8 114. In other words, the gateway 114 may, depending on the embodiment, be
9 implemented as a modem, a router or a combination of a router and a modem.

10
11 The gateway 114 is connected to a computing device 116A, 116B. The computing
12 device 116A, 116B comprises a processor 120, a memory 122, an input/output (I/O)
13 interface 124 and a set of input/output devices for interfacing with a subscriber, such
14 as a display 126, a keyboard 130 and a mouse 128, to name a few. In some
15 embodiments, the computing device 116A does not comprise the gateway 114. In
16 other embodiments, the computing device 116B does comprise the gateway 114.

17
18 The memory 122 stores computer-readable instructions defining the operation of an
19 operating system as is known in the art, in addition to various software applications
20 that can be executed by the processor 120. One example of a software application
21 that may be stored in the memory 122 for execution by the processor 120 is a media
22 application 150. Another example of a software application that may be stored in the
23 memory 122 is a troubleshooting application 160.

24
25 The media application 150 enables the computing device 116A, 116B to participate in
26 a media connection 132 established via the gateway 114 and over the data network
27 108. The media connection 132 terminates at a media connection end point 134,
28 which may be a server or server farm (in the case of the media application 150
29 implementing an Internet browser and the media connection 132 being a data
30 connection), a VoIP telephone or a softswitch (in the case of the media application
31 150 implementing a VoIP soft client and the media connection 132 being a voice-
32 over-packet telephony connection) or a video server (in the case of the media
33 application 150 implementing an IPTV decoder and the media connection 132 being a
34 video connection).

1 In order to support the media connection 132 and other connections / sessions over the
2 data network 108, the gateway 114 employs a unique public IP address. In one
3 embodiment, the public IP address of the gateway 114 may be static. In another
4 embodiment, the public IP address of the gateway 114 may be dynamic. In the case
5 where the public IP address of the gateway is dynamic, the public IP address may be
6 assigned by an address-assigning entity from a set of available public IP addresses
7 determined by the provider of access to the data network 108. In a non-limiting
8 embodiment, such an address-assigning entity may be a server which implements
9 DHCP (Dynamic Host Configuration Protocol).

10
11 It should be appreciated that if the gateway 114 is a modem with limited intelligence,
12 then the public IP address of the gateway 114 may actually apply to the computing
13 device 116A, 116B rather than to the modem. On the other hand, if the gateway 114
14 implements a more sophisticated modem or a router that interconnects the computing
15 device 116A, 116B to one or more other devices over a local area network (LAN),
16 then the public IP address of the gateway 114 will indeed be assigned to the gateway
17 114. In these cases, a separate, "private" IP addressing scheme may be used to
18 communicate amongst the various devices in the LAN, such that the various devices,
19 including the gateway 114 and the computing device 116A, 116B, will each have a
20 private IP address. Thus, in fact, the gateway 114 may be associated with two IP
21 addresses, one of which is a public IP address and the other of which is a private IP
22 address.

23
24 For security reasons, the gateway 114 and/or the computing device 116A, 116B may
25 run a firewall that oversees operation of the media application 150 and scrutinizes the
26 data exchanged over the media connection 132. Use of a firewall in this fashion will
27 be known to those of skill in the art. The firewall may be implemented as middleware
28 operating between the operating system and the media application 150.

29
30 It is expected that the subscriber may occasionally experience problems with the
31 media connection 132. The present invention offers various possibilities for dealing
32 with connectivity problems, as will now be described.

33
34 Scenario A (Figs. 2A-2C)

1 With reference to Fig. 2A, the subscriber contacts a service technician 140 at a test
2 facility 138 for assistance. In a non-limiting example embodiment, this can be done
3 by dialing a known telephone number using the POTS telephone 112 at the subscriber
4 premises 102. Thus, a telephony link 210 is established between the subscriber and
5 the service technician 140, who is also using a telephone that may be connected to the
6 PSTN 110.

7
8 In another non-limiting example embodiment, the subscriber may contact the service
9 technician 140 using a telephone other than the POTS telephone 112. For example,
10 the subscriber may contact the service technician 140 using a cellular telephone or a
11 VoIP phone at the subscriber premises 102. In the case of a VoIP phone, and in the
12 case where the subscriber is provided with Internet access as illustrated in Fig. 1, the
13 telephony link established between the subscriber and the service technician 140 is in
14 fact a data link that travels through the DSLAM 100 in the same fashion as the media
15 connection 132.

16
17 It should be appreciated that some subscribers may be inclined to contact the service
18 technician 140 only once they have performed certain local tests on their computing
19 device 116A, 116B. Examples of local tests include emptying the computing device's
20 116A, 116B recycle bin, optimizing various Internet browser settings, clearing
21 temporary internet files, and so on. Various software tools, occasionally referred to
22 herein as "local self-help software applications", are available for executing these
23 types of local tests. For example, Bell Canada of Montreal, Quebec, Canada offers a
24 local self-help software application (NetAssistantTM) to its high-speed Internet
25 subscribers. Computer-readable instructions defining operation of the local self-help
26 software application, where one is available, can be stored in the memory 122 and
27 readable by the processor 120.

28
29 Under the present scenario, namely Scenario A, the service technician 140 instructs
30 the subscriber to invoke the aforementioned troubleshooting application 160. In
31 accordance with a non-limiting embodiment of the present invention, the
32 troubleshooting application 160 causes the processor 120 to execute a method in a
33 sequence of processes, namely a provisioning process 162 followed by a testing
34 process 164. During the testing process 164, a connectivity test is performed over a
35 test connection established through the gateway 114 and over the data network 108.

1 However, to enable establishment of the test connection, the provisioning process 162
2 needs to be executed first.

3
4 It is envisaged that in some embodiments, the provisioning process 162 and the
5 testing process 164 may be two parts of a common software program, namely the
6 troubleshooting application 160. In other embodiments, the provisioning process 162
7 and the testing process 164 may be embodied as distinct software programs. In still
8 other embodiments, the provisioning process 162 and the testing process 164 may be
9 components of a yet larger software program, which itself may include the
10 aforementioned local self-help software application. Thus, under the present scenario,
11 the provisioning process 162 and/or the troubleshooting application 160 may be
12 launched directly by the subscriber or from within another software application,
13 including from within the media application 150 and from within the local self-help
14 software application.

15
16 As one possible action, the provisioning process 162 may verify whether the testing
17 process 164 (i.e., that part of the troubleshooting application 160 which will later
18 perform a connectivity test) has been installed. Such a verification can be done by
19 accessing a configuration file in the memory 122, for example. If the testing process
20 164 has not been installed, instructions for execution of the testing process 164 may
21 be downloaded by contacting a server in the data network 108 at a known IP address.
22 The address of the server may be known by default, or it may be specified by the
23 service technician 140 over the telephony link 210. An installation process may
24 follow, which results in computer-readable instructions that define the testing process
25 164 being stored in the memory 122.

26
27 In addition, the provisioning process 162 may cause certain ports to be opened at the
28 gateway 114. For example, when a firewall is in use at the gateway 114, it may be
29 beneficial to open a TCP/IP port in order to make the gateway 114 visible over the
30 data network 108 using the public IP address of the gateway 114. Stated differently,
31 this action by the provisioning process 162 overrides some or all functionality of any
32 existing firewall, thereby rendering the gateway 114 visible to a test end point 136,
33 which is connected to the data network 108. Non-limiting examples of ports that may
34 be opened for this purpose include one or more of 445, 10115 and 10116.

35

1 In addition, it may be beneficial to enable Internet Control Messaging Protocol
2 (ICMP) messaging functionality at the gateway 114. ICMP is a network protocol
3 useful in Internet Protocol (IP) network management and administration. Examples
4 of ICMP messaging functionality that can be enabled include, without limitation:
5 “incoming echo request”, “incoming timestamp request”, “incoming mask request”,
6 “incoming router request”, “outgoing destination unreachable”, “outgoing source
7 quench”, “outgoing parameter problem”, “outgoing time exceeded”, “redirect” and
8 “outgoing packet too big”. It may be advantageous to enable still other protocol
9 functionality, depending on the implementation. Such protocols include, without
10 being limited to, simple object access protocol (SOAP), universal datagram protocol
11 (UDP), hypertext transfer protocol (HTTP), and so on.

12
13 In order to open the requisite TCP/IP ports and enable the appropriate protocol
14 functionality, the processor 120 may send a series of commands 220 to the gateway
15 114. Those skilled in the art will find it within the purview of their abilities to
16 generate suitable commands for this purpose and therefore no further discussion of
17 this aspect is required.

18
19 Variant 1

20
21 In a first variant, this may be the end of the provisioning process 162. The
22 service technician 140 then obtains knowledge of the public IP address of the
23 gateway 114 without assistance from the subscriber. For example, this can be
24 achieved by the service technician 140, the test end point 136 or the test
25 facility 138 accessing a database on the basis of subscriber credentials. The
26 database, which maps subscriber credentials to IP addresses, may be populated
27 and refreshed each time the subscriber accesses the data network 108.

28
29 Variant 2

30
31 In a second variant, with continued reference to Fig. 2A, the provisioning
32 process 162 proceeds to obtain the public IP address of the gateway 114. This
33 can be achieved by the processor 120 sending a series of commands 220 to the
34 gateway 114, or accessing a database in the memory 122 where the IP address
35 has been previously stored. Those skilled in the art will find it within the

1 purview of their abilities to generate suitable commands or instructions for this
2 purpose and therefore no further discussion of this aspect is required.

3
4 As shown in Fig. 2B, if the subscriber maintains the telephony link 210 with
5 the service technician 140 while the provisioning process 162 is executing, the
6 public IP address of the gateway 114 obtained in the aforementioned manner
7 can be provided to the service technician 140 in a verbal message 230
8 conveyed via the telephony link 210. Alternatively, the gateway 114 or the
9 processor 120 may send a message to the test facility 138 and/or to the test end
10 point 136 through the data network 108, such message containing the public IP
11 address of the gateway 140.

12
13 Once the service technician 140 knows the public IP address of the gateway 114, in
14 accordance with either of the above variants, the service technician 140 instructs the
15 subscriber to invoke the testing process 164. This can be done by conveying an
16 instruction over the telephony link 210. In response to invoking the testing process
17 164 (e.g., by clicking a mouse, pressing a key, touching a display, etc.), the computing
18 device 116A, 116B begins to await a handshake initiation from the test end point 136
19 to perform a connectivity test. Meanwhile, the processor 120 may continue to
20 participate in the media connection 132 that originally exhibited symptoms of a
21 connectivity problem. Alternatively, the processor 120 may terminate the media
22 connection 132.

23
24 In addition, the service technician 140 communicates with the test facility 138,
25 instructing it to coordinate a connectivity test with the computing device 116A, 116B.
26 Specifically, the test facility 138 is connected to the test end point 136 either directly
27 or through the data network 108. The test end point 136, which is pre-loaded with a
28 suite of test software, may be reachable at a known IP address. The test facility 138
29 sends a message 235 to the test end point 136 specifying the public IP address of the
30 gateway 114.

31
32 In response, the test end point 136 establishes a test connection 240 with the processor
33 120. For example, the test end point 136 may begin by initiating a handshake with the
34 processor 120, which, by virtue of running the testing process 164, had been awaiting
35 such a handshake initiation. In accordance with an embodiment of the present

invention, the handshake initiation and the remainder of the test connection 240 may utilize the one or more ports at the gateway 114 that were opened by the provisioning process 162. This enables any firewalls on the gateway 114 to be bypassed for the purposes of the test connection 240. It can be assumed that the test end point 136 has knowledge of these ports, since the provisioning process 162 is under the control of the service provider.

At this stage, either autonomously or under the supervision of the service technician 140, the testing process 164 and the test end point 136 cooperate to carry out a connectivity test over the test connection 240 in order to measure features such as throughput, jitter, lost data, mean opinion scores (for VoIP) and media delivery index (for video over IP). Because the processor 120 may continue to participate in the media connection 132 that originally exhibited symptoms of a connectivity problem, the results of the connectivity test will be more accurate in reflecting the possible causes of the connectivity problem. It should also be appreciated that although the service technician 140 may be involved in establishing the test connection 240 and initiating the connectivity test, such supervision may be achieved remotely, without the need to deploy the service technician 140 to the subscriber premises 102.

In a non-limiting example, the connectivity test that can be carried out may include the tests enabled by the products promulgated by Ixia (<http://www.ixiacom.com>), such as IxChariotTM. Further information about the IxChariotTM product can be found at http://www.ixiacom.com/support/chariot/appnotes/The_Synergy_of_Chariot_And_Protocol_Analyzers.pdf. The contents of the aforementioned documentation is hereby incorporated by reference herein.

Upon completion of the connectivity test, and with reference to Fig. 2C, the test results can be collected by the test end point 136 and sent to the test facility 138 along a data path 250A. At the test facility 138, the test results can be presented to the service technician 140 for further analysis.

In an alternative embodiment, or in addition, the test results can be collected by the troubleshooting application 160 and conveyed to the subscriber along a path 250B that involves the display 126.

1 In another alternative embodiment, the test results can be redacted into a user-friendly
2 “report card”, which can be conveyed to the subscriber along the path 250B and
3 displayed on the display 126. It is envisaged that redaction of the test results may in
4 some embodiments comprise converting the test results into exclusively qualitative
5 data (such as pass / fail; low / medium / high), etc. It should be appreciated that the
6 provision of test results in a redacted fashion may provide the subscriber with
7 sufficient qualitative information to gauge the severity of the connectivity problem,
8 without burdening him or her with irrelevant quantitative information that may in fact
9 cause him or her to overestimate the severity of the connectivity problem.

10
11 The subscriber may choose to keep the test results to himself or herself.
12 Alternatively, the subscriber may verbally convey the displayed test results to the
13 service technician 140 over the telephony link 210. With knowledge of the test
14 results, the service technician 140 may be in a position to recommend action that will
15 remedy the connectivity problem initially reported by the subscriber.

16
17 At this stage, the testing process 164 may be terminated. This can occur in response
18 to recognizing that the test results have been displayed to and acknowledged by the
19 subscriber. Alternatively, this can occur in response to a signal received from the test
20 end point 136. Still alternatively, this can occur in response to receipt of user input
21 via the mouse 128 or keyboard 130, for example, which signals a desire to exit the
22 troubleshooting application 160. The troubleshooting application 160 may cause the
23 processor 120 to execute several final steps to undo the effects of the provisioning
24 process 162. Specifically, by issuing a set of commands 260 to the gateway 114,
25 previously opened TCP/IP ports may be closed and previously enabled protocol
26 functionality (e.g., ICMP, SOAP, UDP or HTTP messaging functionality) may be
27 disabled or returned to the previous state. Those skilled in the art will find it within
28 the purview of their abilities to generate suitable commands for this purpose and
29 therefore no further discussion of this aspect is required.

30
31 Scenario B (Fig. 3)

32
33 In this scenario, the test connection, rather than being initiated by the test end point
34 136, is initiated by the gateway 114 or the processor 120. To this end, there is no
35 need for interaction between the subscriber and the service technician 140, although it

1 may be reassuring to the subscriber or otherwise beneficial to maintain telephonic
2 contact between the subscriber and the service technician.

3
4 Accordingly, with reference to Fig. 3, when the subscriber detects a connectivity
5 problem, the subscriber invokes the troubleshooting application 160 from the
6 computing device 116A, 116B (e.g., by providing subscriber input via the mouse 128
7 or keyboard 130). It is recalled that the troubleshooting application 160 comprises the
8 provisioning process 162 and the testing process 164. As part of the provisioning
9 process 162, the processor 120 sends a series of commands 310 to the gateway 114,
10 which cause the requisite TCP/IP ports to be opened and the appropriate protocol
11 functionality to be enabled at the gateway 114.

12
13 Next, the processor 120 proceeds with the testing process 164, which involves
14 establishing a test connection 320 with the test end point 136 via the gateway 114 and
15 over the data network 108. In order to enable the processor 120 to establish the test
16 connection 320, the processor 120 obtains the IP address of the test end point 136. In
17 one non-limiting example, the IP address of the test end point may be hard coded into
18 the testing process 164 or accessed from a local source (e.g., look-up table) in the
19 computing device 116A, 116B. In another non-limiting example, as part of the testing
20 process 164 (or the provisioning process 162), the processor 120 may request the IP
21 address of the test end point 136 from a known device. The known device in question
22 may be a data server (not shown) that provides the computing device 116A, 116B
23 with access to the data network 108, and thus its identity will be known to the
24 processor 120.

25
26 The testing process 164 and the test end point 136 then cooperate to carry out a
27 connectivity test over the test connection 320 as previously described, i.e., in order to
28 measure features such as throughput, jitter, lost data, mean opinion scores (for VoIP)
29 and media delivery index (for video over IP). Because the processor 120 may
30 continue to participate in the media connection 132 that originally exhibited
31 symptoms of a connectivity problem, the results of the connectivity test will be more
32 accurate in reflecting the possible causes of the connectivity problem. It should also
33 be appreciated that there is no need to deploy a service technician to the subscriber
34 premises 102.

1 Upon completion of the connectivity test, the test results can be collected by the
2 troubleshooting application 160 and conveyed to the subscriber via the display 126.
3 As previously mentioned, the test results can be redacted into a user-friendly report
4 card. Alternatively, as part of the troubleshooting application 160, the processor 120
5 may analyze the test results to determine the severity of the connectivity problem.
6 The processor 120 may send a message via the gateway 114 and the data network
7 108, such message (which can be referred to as a "trouble ticket") including an
8 indication of the severity of the connectivity problem as well as the subscriber
9 afflicted with this connectivity problem. The trouble ticket may be sent to the test
10 facility 138. Upon receipt of the trouble ticket, the service technician 140 can begin
11 addressing the connectivity problem and/or may call the subscriber to request further
12 information regarding the connectivity problem.

13

14 In one embodiment, upon receipt of the trouble ticket at the test facility 138, the test
15 facility 138 could automatically trigger a call between the subscriber and either the
16 service technician 140 or a call center for technical support. In this case, the
17 telephone number to contact the subscriber could be accessed from a database that
18 links subscriber identifiers with subscriber contact telephone numbers. Alternatively,
19 the telephone number to contact the subscriber could be received from the subscriber
20 after prompting the subscriber through the display 126. In this case, the subscriber
21 could type in the preferred contact telephone number using the keyboard 130, and the
22 processor 120 could send the received contact telephone number to the test facility
23 138 via the data network 108 either within the trouble ticket or in a separate message.
24 The call between the subscriber and either the service technician 140 or the call center
25 can be accomplished through (a) the initiation of two voice call legs, one to the
26 subscriber and one to the service technician 140 or the call center; and (b) bridging of
27 the two voice call legs together. It should be understood that these call legs could be
28 initiated via the PSTN 110 or through VoIP connections.

29

30 The subscriber may choose to keep the test results to himself or herself.
31 Alternatively, the subscriber may verbally convey the displayed test results to the
32 service technician 140 over a telephony link. With knowledge of the test results, the
33 service technician 140 may be in a position to recommend action that will remedy the
34 connectivity problem initially reported by the subscriber.

35

At this stage, the testing process 164 may be terminated. This can occur in response to recognizing that the test results have been displayed to and acknowledged by the subscriber. Alternatively, this can occur in response to a signal received from the test end point 136. Still alternatively, this can occur in response to receipt of user input via the mouse 128 or keyboard 130, for example, which signals a desire to exit the troubleshooting application 160. The troubleshooting application 160 may cause the processor 120 to execute several final steps to undo the effects of the provisioning process 162. Specifically, by issuing a set of commands to the gateway 114, previously opened TCP/IP ports may be closed and previously enabled protocol functionality (e.g., ICMP, SOAP, UDP or HTTP messaging functionality) may be disabled or returned to the previous state. Those skilled in the art will find it within the purview of their abilities to generate suitable commands for this purpose and therefore no further discussion of this aspect is required.

Scenario C (Figs. 4A-4B)

In this scenario, the service technician 140 is involved, but the subscriber does less work than in the previous scenarios or potentially no work at all. Specifically, with reference to Fig. 4A, the service technician 140 establishes a private path 410 between the test facility 138 and the gateway 114. Specifically, this may be achieved by providing a connection between the test facility 138 and a management port on the DSLAM 100. The service technician 140 then instructs the test facility 138 to trigger the gateway 114 to issue a command 420 to the processor 120 (e.g., via the operating system). In an embodiment of the present invention, the command 420 serves to invoke the troubleshooting application 160.

It is recalled that the troubleshooting application 160 comprises the provisioning process 162 and the testing process 164. As part of the provisioning process 162, and with reference to Fig. 4B, the processor 120 sends a series of commands 430 to the gateway 114, which cause the requisite TCP/IP ports to be opened and the appropriate protocol functionality to be enabled at the gateway 114.

Next, the processor 120 proceeds with the testing process 164, which involves establishing a test connection 440 with the test end point 136 via the gateway 114 and over the data network 108. In order to enable the processor 120 to establish the test

1 connection 440, the processor 120 obtains the IP address of the test end point 136. In
2 one non-limiting example, the IP address of the test end point may be hard coded into
3 the testing process 164 or accessed from a local source (e.g., look-up table) in the
4 computing device 116A, 116B. In another non-limiting example, as part of the testing
5 process 164 (or the provisioning process 162), the processor 120 may request the IP
6 address of the test end point 136 from a known device. The known device in question
7 may be a data server (not shown) that provides the computing device 116A, 116B
8 with access to the data network 108, and thus its identity will be known to the
9 processor 120. In yet another non-limiting example, the IP address of the test end
10 point 136 may be provided by the test facility 138 over the private path 410.

11

12 The testing process 164 and the test end point 136 then cooperate to carry out a
13 connectivity test over the test connection 440 as previously described, i.e., in order to
14 measure features such as throughput, jitter, lost data, mean opinion scores (for VoIP)
15 and media delivery index (for video over IP). Because the processor 120 may
16 continue to participate in the media connection 132 that originally exhibited
17 symptoms of a connectivity problem, the results of the connectivity test will be more
18 accurate in reflecting the possible causes of the connectivity problem. It should also
19 be appreciated that there is no need to deploy the service technician 140 to the
20 subscriber premises 102.

21

22 It should be noted that this scenario, namely Scenario C, permits the troubleshooting
23 application 160 to be invoked by the service technician 140, without requiring
24 subscriber participation and without requiring the subscriber to be in telephonic
25 communication with the service technician 140. This can allow for more efficient
26 human resource allocation and service prioritization by the service provider.

27

28 Upon completion of the connectivity test, and similarly to what was described herein
29 above with reference to Scenario A, the test results can be collected by the test end
30 point 136 and sent to the facility 138. At the test facility 138, the test results can be
31 presented to the service technician 140 for further analysis. With knowledge of the
32 test results, the service technician 140 may be in a position to recommend action that
33 will remedy the connectivity problem initially reported by the subscriber.

34

1 In an alternative embodiment, or in addition, the test results can be collected by the
2 troubleshooting application 160 and conveyed to the subscriber via the display 126 in
3 the form of an alert. As mentioned previously, the test results may be redacted into a
4 user-friendly report card, which can be conveyed to the subscriber via the display 126.
5

6 At this stage, the testing process 164 may be terminated. This can occur in response
7 to recognizing that the test results have been displayed to and acknowledged by the
8 subscriber. Alternatively, this can occur in response to a signal received from the test
9 end point 136. Still alternatively, this can occur in response to receipt of user input
10 via the mouse 128 or keyboard 130, for example, which signals a desire to exit the
11 troubleshooting application 160. The troubleshooting application 160 may cause the
12 processor 120 to execute several final steps to undo the effects of the provisioning
13 process 162. Specifically, by issuing a set of commands to the gateway 114,
14 previously opened TCP/IP ports may be closed and previously enabled protocol
15 functionality (e.g., ICMP, SOAP, UDP or HTTP messaging functionality) may be
16 disabled or returned to the previous state. Those skilled in the art will find it within
17 the purview of their abilities to generate suitable commands for this purpose and
18 therefore no further discussion of this aspect is required.
19

20 While specific embodiments of the present invention have been described and
21 illustrated, it will be apparent to those skilled in the art that numerous modifications
22 and variations can be made without departing from the scope of the invention as
23 defined in the appended claims.
24

WHAT IS CLAIMED IS:

1. A computer-readable medium comprising a set of instructions for execution by a processor of a computing device at a subscriber premises, the processor being operable to execute a software application that enables the computing device to participate in a media connection over a data network, wherein execution of the set of instructions by the processor causes the computing device to execute a method that includes:
 - performing a connectivity test over a test connection established through a gateway at the subscriber premises and over the data network;
 - prior to said performing a connectivity test, provisioning the gateway to enable establishment of said test connection.
2. The computer-readable medium defined in claim 1, wherein the computing device comprises the gateway.
3. The computer-readable medium defined in claim 1, wherein the gateway is implemented as a router.
4. The computer-readable medium defined in claim 1, wherein the gateway is implemented as a modem.
5. The computer-readable medium defined in claim 1, the method further comprising receiving a handshake initiation from a test facility via the gateway, wherein said provisioning the gateway is performed in response to receipt of said handshake initiation.
6. The computer-readable medium defined in claim 1, the method further including, prior to said performing a connectivity test, performing a local test of the computing device without involving the data network.
7. The computer-readable medium defined in claim 1, the method further including, prior to said performing a connectivity test, downloading from a server in the data network a set of instructions for running the connectivity test.
8. The computer-readable medium defined in claim 1, the method further including, prior to said performing a connectivity test, downloading from a server in the data network a set of instructions for effecting said provisioning.
9. The computer-readable medium defined in claim 1, wherein said provisioning the gateway is effected in response to input received from a user of the computing device.

- 1 10. The computer-readable medium defined in claim 9, wherein said input comprises
2 at least one of a mouse click, a key stroke and a pen stroke.
- 3 11. The computer-readable medium defined in claim 1, wherein said provisioning the
4 gateway is effected in response to a trigger received from said software
5 application.
- 6 12. The computer-readable medium defined in claim 1, the processor being operable
7 to execute a local diagnostic application, wherein said provisioning the gateway is
8 effected in response to a trigger received from said local diagnostic application.
- 9 13. The computer-readable medium defined in claim 1, wherein the test connection is
10 established with a test apparatus reachable over the data network.
- 11 14. The computer-readable medium defined in claim 1, wherein said provisioning the
12 gateway comprises communicating with the gateway to open a TCP/IP port at the
13 gateway.
- 14 15. The computer-readable medium defined in claim 14, wherein said provisioning
15 the gateway comprises communicating with the gateway to enable at least one of
16 ICMP, SOAP, UDP and HTTP messaging at the gateway.
- 17 16. The computer-readable medium defined in claim 1, wherein said provisioning the
18 gateway comprises communicating with the gateway to obtain a public IP address
19 assigned to the gateway.
- 20 17. The computer-readable medium defined in claim 16, the method further
21 comprising sending the public IP address to a test facility via the gateway.
- 22 18. The computer-readable medium defined in claim 1, the method further including
23 collecting results reflective of an outcome of the connectivity test.
- 24 19. The computer-readable medium defined in claim 18, the method further including
25 causing said results to be displayed by a display device at the subscriber premises.
- 26 20. The computer-readable medium defined in claim 19, the method further including
27 redacting said results prior to causing said results to be displayed by the display
28 device.
- 29 21. The computer-readable medium defined in claim 20, wherein redacting said
30 results comprises rendering the results exclusively qualitative.
- 31 22. The computer-readable medium defined in claim 18, the method further including
32 causing said results to be sent to a test facility reachable over the data network.
- 33 23. The computer-readable medium defined in claim 1, the method further including,
34 upon completion of said connectivity test, provisioning the gateway to disable said
35 test connection.

- 1 24. The computer-readable medium defined in claim 23, wherein said provisioning
2 the gateway to disable said test connection comprises communicating with the
3 gateway to close a previously opened TCP/IP port at the gateway.
- 4 25. The computer-readable medium defined in claim 24, wherein said provisioning
5 the gateway to disable said test connection comprises communicating with the
6 gateway to disable at least one of ICMP, SOAP, UDP and HTTP messaging at the
7 gateway.
- 8 26. The computer-readable medium defined in claim 1, wherein the media connection
9 is at least one of a voice connection, a video connection and a data connection.
- 10 27. A method for execution at a computing device located at a subscriber premises,
11 comprising:
- 12 - executing a software application that enables the computing device to
13 participate in a media connection over a data network;
 - 14 - performing a connectivity test over a test connection established through a
15 gateway at the subscriber premises and over the data network;
 - 16 - prior to said performing a connectivity test, provisioning the gateway to enable
17 establishment of said test connection.
- 18 28. The method defined in claim 27, wherein said performing a connectivity test is
19 effected during execution of said software application.
- 20 29. The method defined in claim 27, further comprising:
- 21 - invoking a local diagnostic application to diagnose a local problem affecting
22 the computing device without involving the data network.
- 23 30. The method defined in claim 29, wherein said provisioning the gateway is
24 triggered by said local diagnostic application.
- 25 31. The method defined in claim 27, wherein said provisioning the gateway is
26 triggered by receipt of input from a user of said computing device.
- 27 32. The method defined in claim 31, wherein said input from a user is received in
28 response to the user entering into communication with a service technician.
- 29 33. The method defined in claim 27, further comprising receiving a handshake
30 initiation from a test facility via the gateway, wherein said provisioning the
31 gateway is performed in response to receipt of said handshake initiation.
- 32 34. The method defined in claim 27, the method further including, prior to said
33 performing a connectivity test, performing a local test of the computing device
34 without involving the data network.

- 1 35. The method defined in claim 27, further including, prior to said performing a
2 connectivity test, downloading from a server in the data network a set of
3 instructions for running the connectivity test.
- 4 36. The method defined in claim 27, further including, prior to said performing a
5 connectivity test, downloading from a server in the data network a set of
6 instructions for effecting said provisioning.
- 7 37. The method defined in claim 27, wherein the test connection is established with a
8 test apparatus reachable over the data network.
- 9 38. The method defined in claim 27, wherein provisioning the gateway comprises
10 communicating with the gateway to open a TCP/IP port at the gateway.
- 11 39. The method defined in claim 38, wherein said provisioning the gateway comprises
12 communicating with the gateway to enable ICMP messaging at the gateway.
- 13 40. The method defined in claim 27, wherein said provisioning the gateway comprises
14 communicating with the gateway to obtain a public IP address assigned to the
15 gateway.
- 16 41. The method defined in claim 40, further comprising sending the public IP address
17 to a test facility via the gateway.
- 18 42. The method defined in claim 27, the method further including, upon completion of
19 said connectivity test, provisioning the gateway to disable said test connection.
- 20 43. The method defined in claim 42, wherein said provisioning the gateway to disable
21 said test connection comprises communicating with the gateway to close a
22 previously opened TCP/IP port at the gateway.
- 23 44. The method defined in claim 43, wherein said provisioning the gateway to disable
24 said test connection comprises communicating with the gateway to disable ICMP
25 messaging at the gateway.
- 26 45. The method defined in claim 27, further including collecting results reflective of
27 an outcome of the connectivity test.
- 28 46. The method defined in claim 45, further including causing said results to be
29 displayed by a display device at the subscriber premises.
- 30 47. The method defined in claim 46, further including redacting said results prior to
31 causing said results to be displayed by the display device.
- 32 48. The method defined in claim 47, wherein redacting said results comprises
33 rendering the results exclusively qualitative.
- 34 49. The method defined in claim 45, further including causing said results to be sent
35 to a server reachable over the data network.

1 50. The method defined in claim 27, wherein the media connection is at least one of a
2 voice connection, a video connection and a data connection.

3 51. A method for execution at a computing device located at a subscriber premises,
4 the computing device being operable for executing a software application that
5 enables the computing device to participate in a media connection over a data
6 network, the method comprising:

- 7 - performing a connectivity test over a test connection established through a
8 gateway at the subscriber premises and over the data network;
- 9 - prior to said performing a connectivity test, provisioning the gateway to enable
10 establishment of said test connection.

11 52. A system for testing connectivity over a data network, the system comprising:

- 12 - a test end point accessible via the data network;
- 13 - a computing device operable for executing a software application that enables
14 the computing device to participate in a media connection over the data
15 network,
- 16 - the test end point operable for issuing a test initiation trigger to the computing
17 device;
- 18 - the computing device further operable for responding to said test initiation
19 trigger to effect a connectivity test over a test connection established with the
20 test end point, the computing device further operable for, prior to said
21 performing a connectivity test, provisioning the computing device to enable
22 establishment of said test connection.

23

FIG. 1

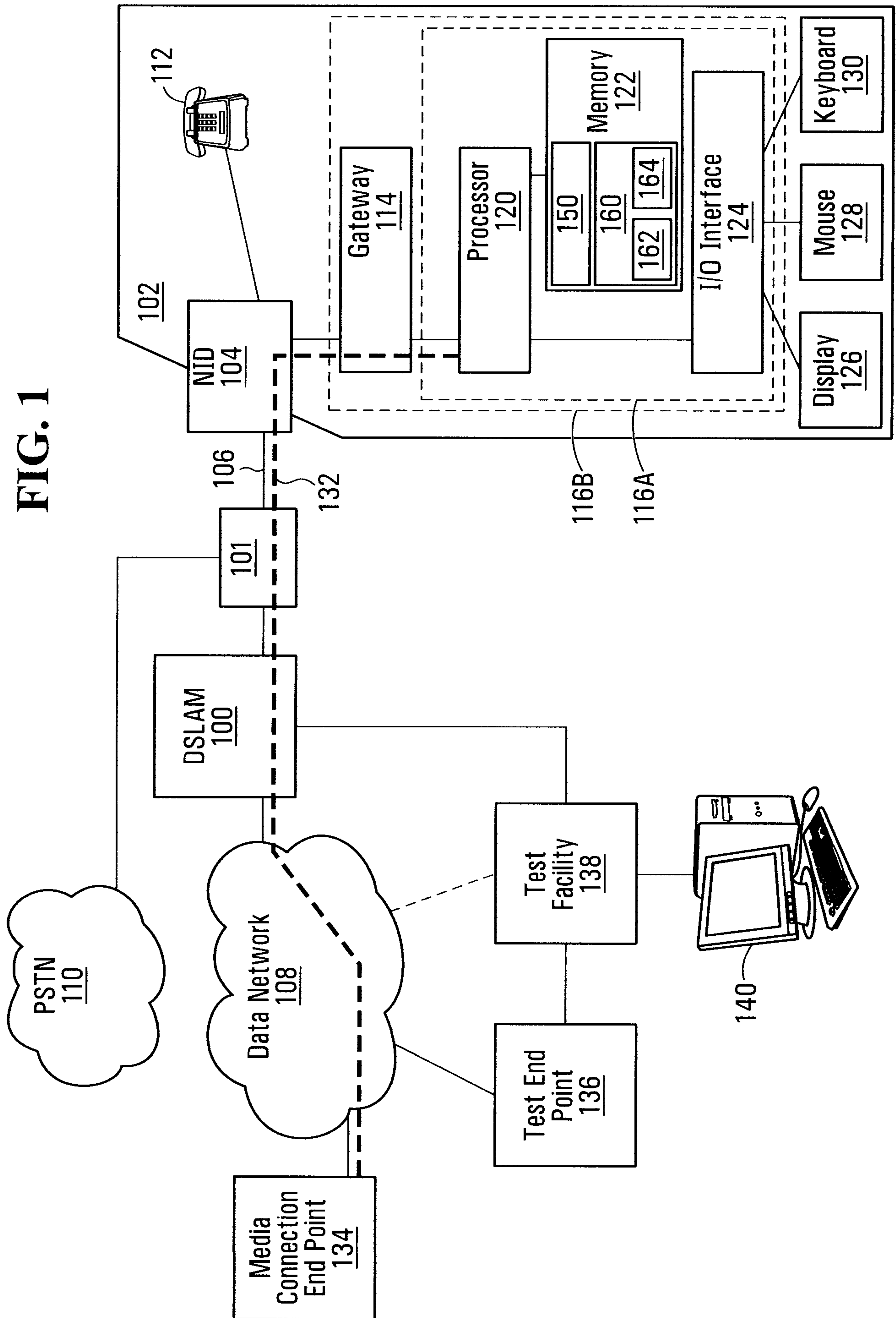


FIG. 2A

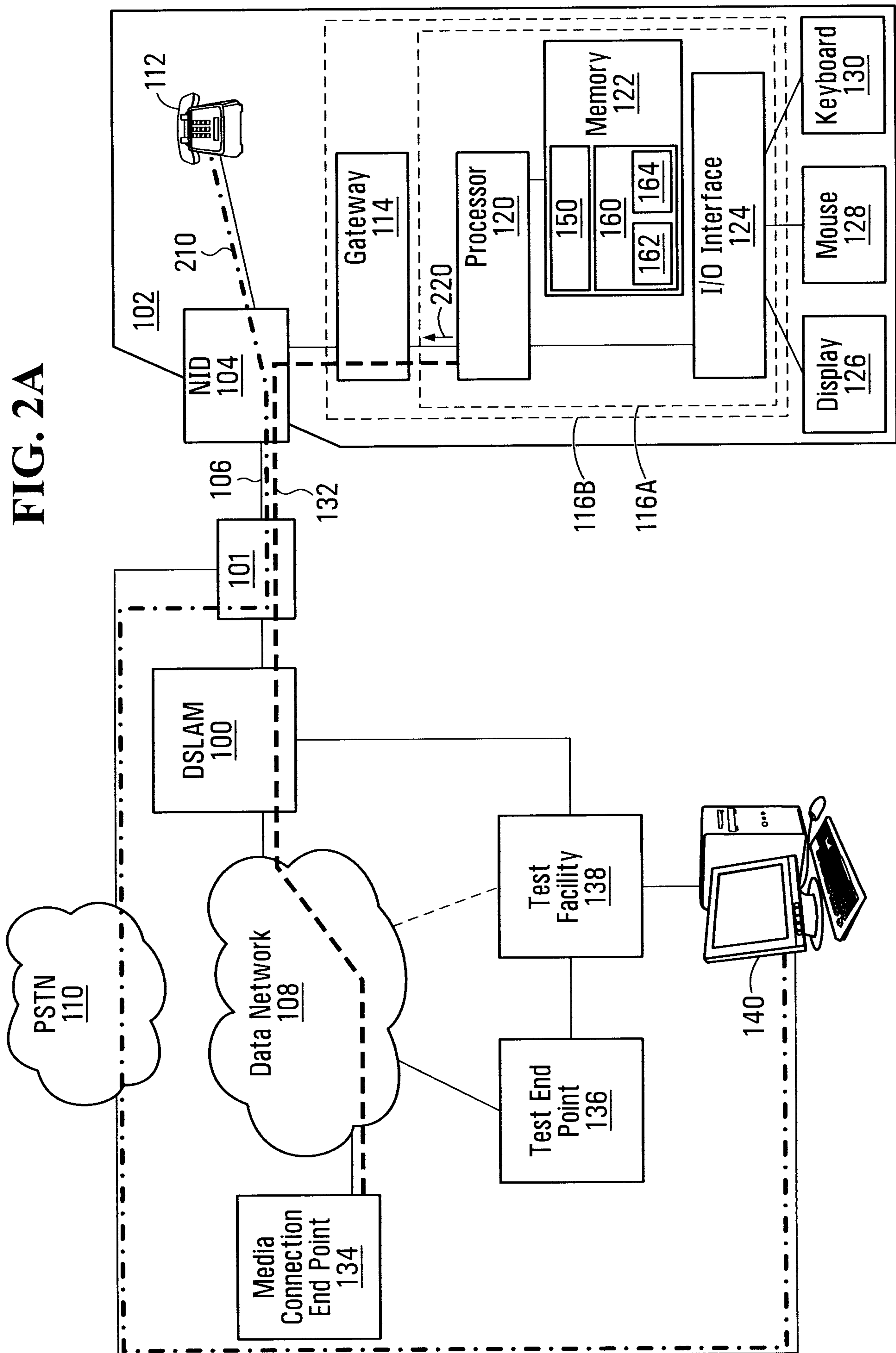


FIG. 2B

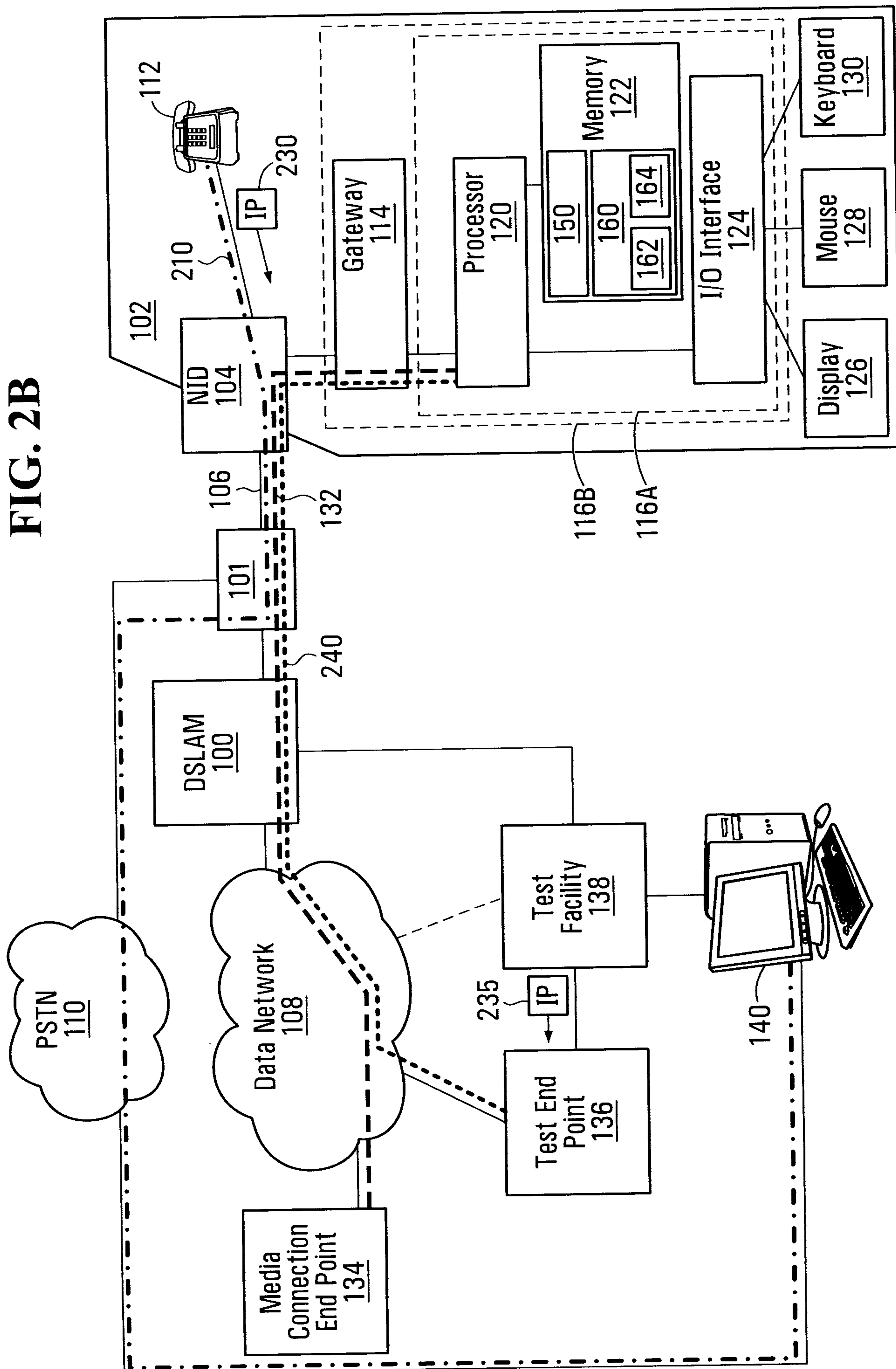


FIG. 2C

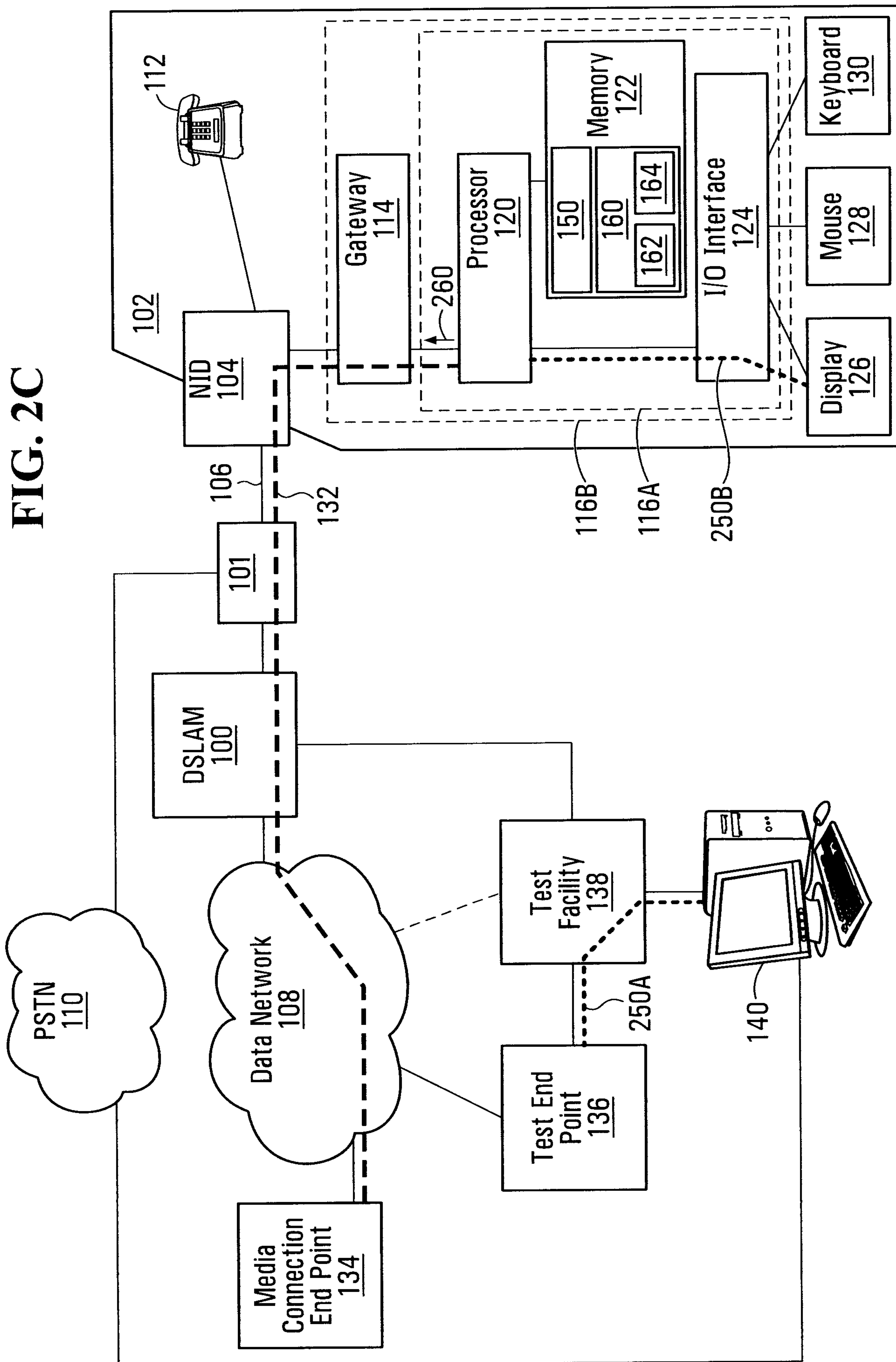


FIG. 3

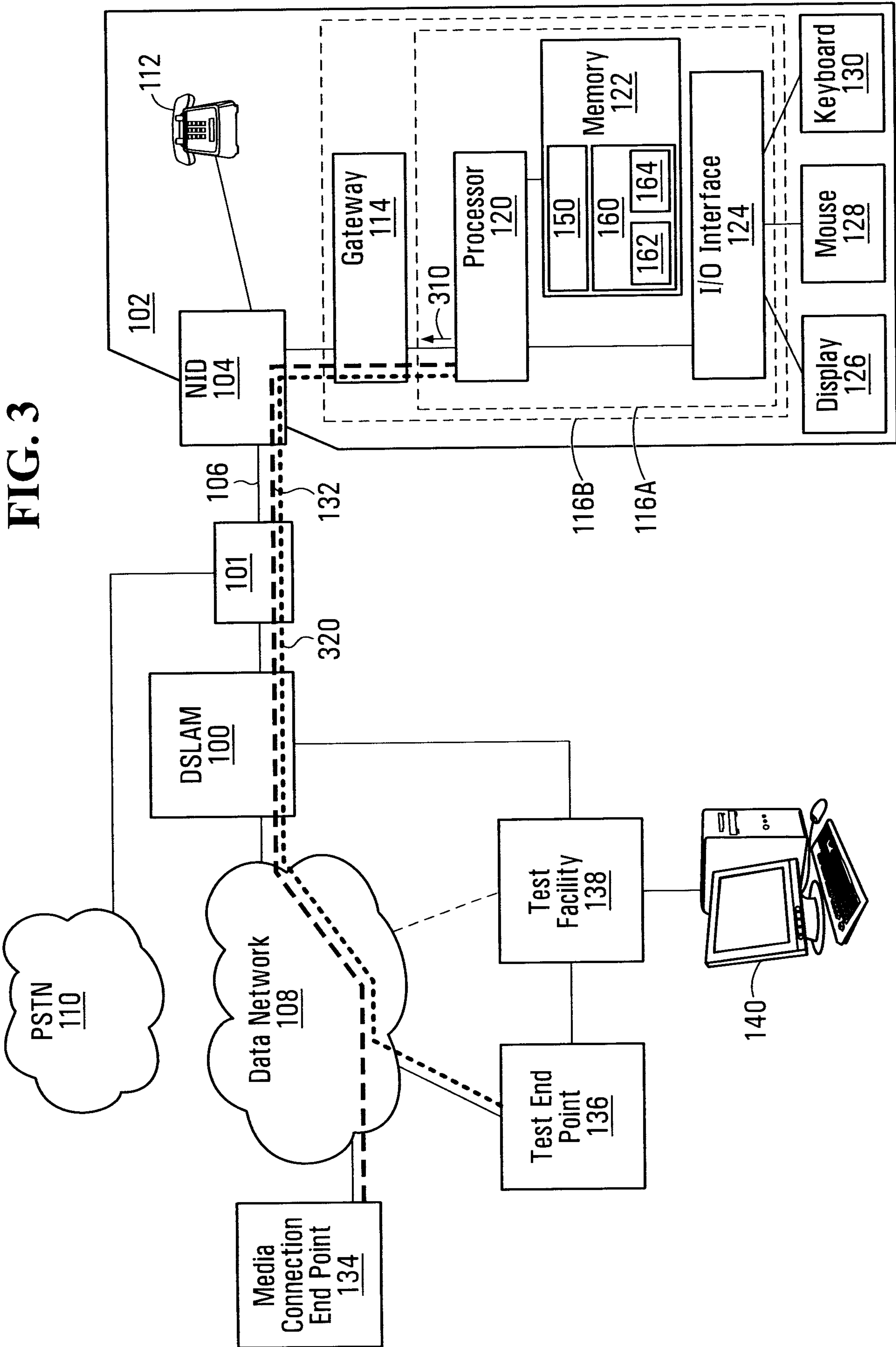


FIG. 4A

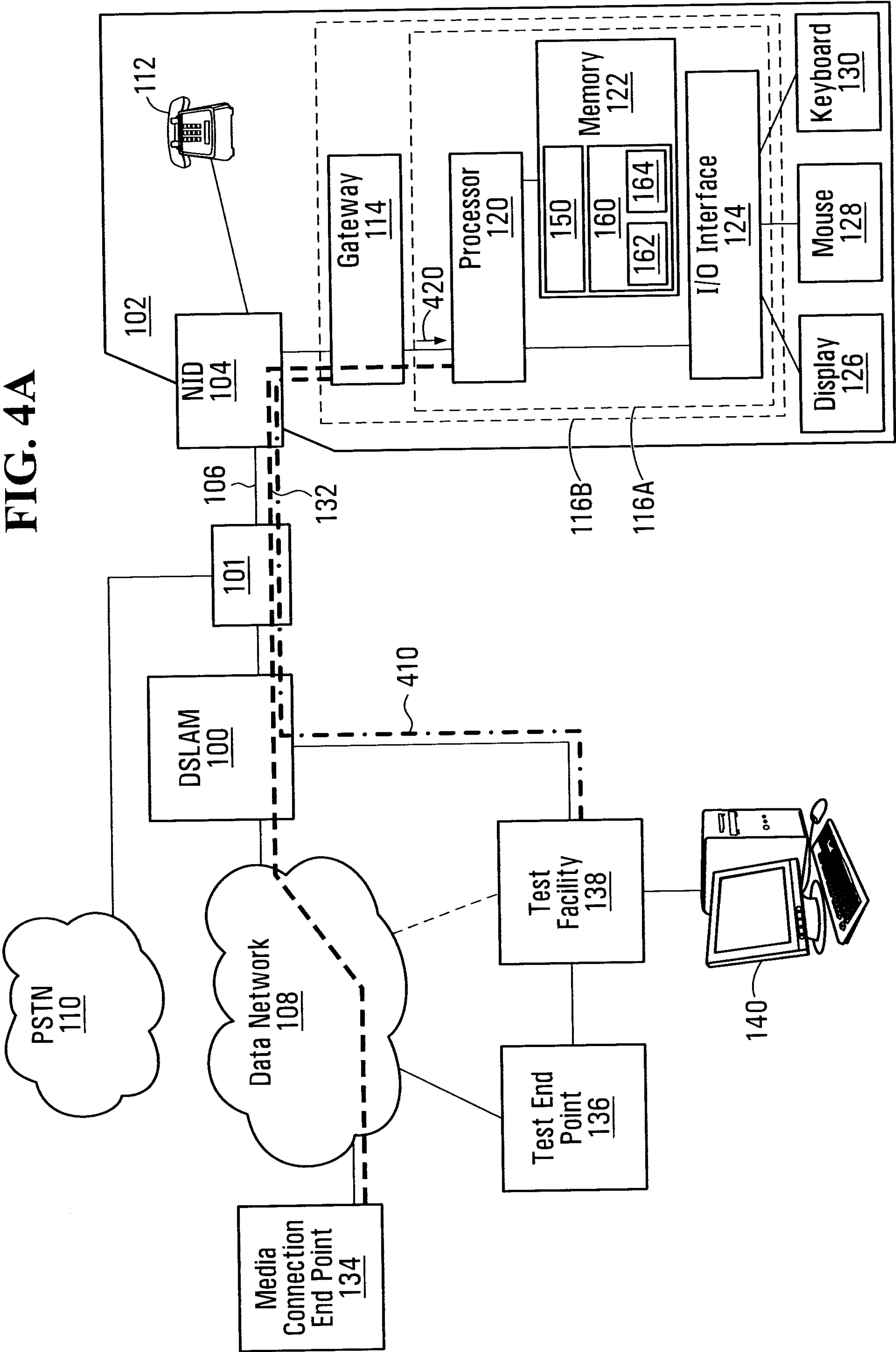


FIG. 4B

