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(54) **METHOD OF TESTING TELECOMMUNICATION CONNECTIONS IN RADIO SYSTEM**

PRÜFVERFAHREN FÜR FERNSPRECHVERBINDUNGEN IN EINEM FUNKSYSTEM

PROCEDURE DE TEST DE CONNEXIONS DE TELECOMMUNICATION DANS UN SYSTEME
RADIO

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a radio system and a method of testing telecommunication connections of a network element to be installed in the radio system comprising one or more network elements, a base station controller and a network management system.

BACKGROUND OF THE INVENTION

[0002] Modern radio networks are highly complicated systems comprising several different network components, such as base stations, base station controllers, mobile services switching centres, different transmission networks and cross-connection devices. When networks extend or capacity need increases, to build radio networks and to extend existing networks is a demanding and complex procedure that requires a great deal of planning, time and work. Figure 1 illustrates an example of a radio system comprising a base station controller 100, cross-connection equipment 102, three base stations 104 to 108 and a network management unit 110. The base station 100 is connected by telecommunication connections 112 to the cross-connection equipment 102 to which, in turn, the base station 104 is directly connected, and to which the base stations 106 to 108 are coupled in series such that information supplied from the base station controller to the base station 108 is transmitted via the base station 106. By means of existing methods, each element is to be manually configured in situ one node at a time according to precalculated parameters and schemes. When the equipment is configured and switched on, the configuration parameters can only be changed in a limited manner by means of remote control from the network management unit, for example.

[0003] When network elements, either cross-connection equipment or base stations, are to be added to an existing system, for example similar to the system according to Figure 1, known remote control methods are no longer feasible. When the equipment is physically installed and connected either to an existing or built telecommunication connection with the system, the route between the base station and the base station controller must be manually configured and tested. To date, connections installed have been manually tested by means of test calls. This method is, however, susceptible to errors. The installer making the test calls does not necessarily check all connections, and some transmission errors can be inaudible to the ear. Hence, to add a new element is a time-consuming and demanding procedure also susceptible to errors. Installation personnel is necessary both on the network element installation site and simultaneously at the network control or in connection with the base station controllers. This restricts the time during which installations can be performed.

[0004] WO 95/01015 discloses a configuration method

for communication resources in a radio system.

BRIEF DESCRIPTION OF THE INVENTION

[0005] An object of the invention is thus to provide a method and a system implementing the method so as to enable the above-mentioned problems to be solved. This is achieved by the method of the invention of testing telecommunication connections of a network element to be installed in the radio system comprising one or more network elements, a base station controller and a network management system that are operatively interconnected by means of telecommunication connections comprising traffic channels and control channels, and in which system information between the network elements is transmitted in frames that are divided into time slots, and in which system the base station controller controls one or more network elements, and in which method the network element is physically connected to the system by means of the telecommunication connections. The method of the invention is characterized by the network element transmitting to the base station controller a message comprising information that the network element is ready to be tested, the base station controller initiating a testing procedure after receiving the message from the network element to be installed, and the testing comprising testing all channels between the base station controller and the network element.

[0006] The method of the invention is further characterized by the network element transmitting to the base station controller a message comprising information that the network element is ready to be tested, the base station controller initiating a testing procedure after receiving the message from the network element to be installed, and the testing comprising the transmission of a predetermined test signal pattern in both directions over each network element and base station channel, and a check of the signal pattern thus transmitted and received, and when all channels are tested, the base station controller transmitting a notification of the test having ended to the network element.

[0007] The invention further relates to a radio system comprising one or more network elements, a base station controller and a network management system that are operatively interconnected by means of telecommunication connections comprising traffic channels and control channels, and in which system information between the network elements is transmitted in frames that are divided into time slots, and in which system the base station controller controls one or more network elements that comprise network element identification information.

[0008] The system of the invention is characterized by the network element to be installed being arranged to transmit to the base station controller a message comprising information that the network element is ready to be tested, the base station controller being arranged to initiate a testing procedure after receiving the message from the network element to be installed, and the testing

comprising testing all channels between the base station controller and the network element.

[0009] The system of the invention is further characterized by the network element to be installed being arranged to transmit to the base station controller a message comprising information that the network element is ready to be tested, the base station controller being arranged to initiate a testing procedure after receiving the message from the network element to be installed, and the testing comprising the transmission of a predetermined test signal pattern in both directions over each network element and base station channel, and a check of the signal pattern thus transmitted and received, and when all channels are tested, the base station controller being arranged to transmit a notification of the test having ended to the network element.

[0010] The preferred embodiments of the invention are disclosed in the dependent claims.

[0011] The invention is based on the idea that connections are tested automatically in the installation phase. Hence, the installer does not have to make test calls manually, but the system automatically tests the connections when the connections are ready to be tested.

[0012] The method and system of the invention provide several advantages. In a preferred embodiment of the solution of the invention, a predetermined test pattern and a bit error ratio measurement thereof are used to test the connections. The method based on the bit error ratio is more accurate than the empirical method based on test calls. The solution of the invention enables also errors that are not necessarily noticed during the test calls to be found.

[0013] Network element installation into the system is automatized. The amount of necessary manual work decreases significantly. Automation enables potential errors, and, consequently, costs to be reduced. Further, the invention enables faster installations.

[0014] Network element installation requires no special and expensive training since automation also reduces the amount of necessary work on the installation site. When, after the physical installation, a network element is switched on, the network element initiates automatic installation by searching the frames received by means of the telecommunication connections for communication control channels of the groups. After the connections and the appropriate base station controller are found, and the necessary channels having automatically been allocated and branched for the use of the network element, the system can automatically test the connections and inform the installer that the connections are working, in other words that the network element is ready for the operational state.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The invention is now described in closer detail in connection with the preferred embodiments with reference to the accompanying drawings, in which

Figure 1 illustrates a described example of a radio system,

Figure 2 illustrates an Abis interface,

Figure 3 shows an example of the radio system,

Figure 4 illustrates an example of an interface between a base station controller and a network element,

Figure 5 is a flow diagram illustrating procedures necessary for building or extending the radio system, Figure 6 is a flow diagram illustrating a first example of a search for communication control channels,

Figure 7 is a flow diagram illustrating a second example of the search for communication control channels,

Figure 8 is a signal sequence chart illustrating a testing method of the invention,

Figure 9 illustrates an example of the structure of the radio system's base station controller, cross-connection equipment and base station, and

Figures 10a and 10b illustrate examples of transmission topologies.

DETAILED DESCRIPTION OF THE INVENTION

[0016] The invention will be described in the following mainly using a GSM type cellular radio system as an example without, however, being restricted thereto in any way. It will be obvious to those skilled in the art that the solution of the invention can be applied to any digital data transmission system wherein data transmission connections between the network elements are implemented using a time-divisional frame structure, the system comprising the elements disclosed in the preambles of the independent claims.

[0017] Typically, in digital systems information between the network elements is transmitted in frames comprising a plurality of time slots. For example in the digital GSM system a connection between a base station and a base station controller is called Abis interface. Typically, the connection is of a frame form and comprises 32 time slots transmitting traffic at a 64 kbit/s transmission rate, the total capacity thus being 2 Mbit/s. Figure 2 illustrates an Abis interface. Each connection between a base station and a base station controller takes up some time slots from said frame. The number of time slots per a base station varies depending on the size of the base station and the traffic channel capacity.

[0018] Figure 3 illustrates an example of a radio system comprising a network management system 300 to enable the operation and operating parameters of the network to be controlled and monitored. The system further comprises a base station controller 302 controlling the operation of base stations located in its area. By means of a gate 314 and a first telecommunication connection 306, first cross-connection equipment 308 is connected to an output gate 304 of the base station controller, and second cross-connection equipment 312 is connected to the output gate 304 of the base station control-

ler by means of a gate 322 and a second telecommunication connection 310. A base station 316 and third cross-connection equipment 318 are connected to the telecommunications gate 314 of the first cross-connection equipment by means of a gate 320. A base station 324 is connected to the gate 320 of the third cross-connection equipment 318, and a base station 326 is coupled in series with the base station 324. A base station 328 is also connected to the gate 320 of the third cross-connection equipment 318. Fourth cross-connection equipment 330 and a base station 336 are connected to the gate 322 of the second cross-connection equipment 312 by means of a gate 332. A base station 334, in turn, is connected to the fourth cross-connection equipment gate 332. The system further comprises a mobile services switching centre 340 controlling the operation of the network and transmitting calls to the other parts of the network and to other telecommunication networks, such as a public network. Telecommunication connections between the system devices, such as the connections 306, 310 or 338, can be implemented in ways known to those skilled in the art, for example by means of cabling or micro wave radios.

[0019] By means of a flow diagram shown in Figure 5, examine next necessary procedures for building or extending the radio system. In the present embodiment of the solution of the invention, most network element installation procedures are automatized, but, of course, all procedures cannot be automatized. The disposition and radio channel design of the radio system's base stations 316, 324, 326, 328, 336 and 334 must be performed in advance using the required radio network designing tools. This is executed in step 500 of Figure 5. In this step, base station locations and each base station's identification information identifying each base station controlled by the base station are determined. Subsequently, it is to be determined how much transmission capacity each base station needs over the telecommunication connections 306, 310 between the base station and the base station controller 302.

[0020] Next, the radio system is configured in step 502. The radio system scheme 316 is fed into the network management system 300, which creates network objects for the base station controller, i.e. determines the network elements. At the same time, transmission groups are created; in frames that are used for communication with the network elements by the base station controller, unused consecutive time slots of the frames are divided into one or more groups. These groups can be called transmission groups. The base station controller automatically creates one time slot for each group, the time slot being used as a communication control channel as regards time slot allocation from said group. In this step, free time slots are not allocated for the use of any particular network element.

[0021] Concurrently, the mobile services switching centre 340 can be configured for new network elements.

[0022] Next, the existing transmission network of the

radio system is configured in step 504. Unused-time-slot groups are transmitted as whole groups in the frames and forwarded in the network from the output gate 304 of the base station controller to network elements to which the base stations can be connected, i.e. typically to cross-connection equipment. Assume in this example that in the figure, the time slot groups can be transmitted to the equipment 308 (and to the gate 314 thereof) and the equipment 330 (and to the gate 332 thereof). The transmission can be performed by software, for example by means of the network management system, if the transmission line 306 is suited for the transmission, or manually at the cross-connection equipment. Assume in this example that the transmission line 306 and the first cross-connection equipment 308 support the remote setting performed by software.

[0023] Assume further that the second cross-connection equipment 312 is not capable of processing time slots as whole groups in the frames. Such a situation occurs for example when the system is old, comprising old equipment lacking necessary logic and data processing capacity. This equipment and the more intelligent cross-connection equipment immediately behind the equipment must then be processed manually. Hence, in the present example, the connection from the base station controller passes to the gate 332 in the cross-connection equipment 330, and the settings are manually fixed at the cross-connection equipment 330.

[0024] The groups are transmitted as a whole from one gate to another, but the absolute group disposition in a frame may vary. This is illustrated by way of example in Figure 4.

[0025] Figure 4 shows a frame 400 in the output gate 304 of the base station controller 302, a frame 401 in the gate 314 of the first cross-connection equipment 308, and a frame 402 in the gate 332 of the fourth cross-connection equipment 330. Each frame thus comprises 32 time slots. The transmission capacity of each time slot is 64 kbit/s. The total transmission capacity of a frame is thus 2 Mbit/s. Assume that a first time slot 403 is used for transmitting link management information. Assume further that next time slots 404 are allocated to another purpose. Next time slots 406 comprise a first group of free time slots. One of the time slots in the group, preferably a last time slot 408, is used as a communication control channel of the group as regards time slot allocation from said group. Next time slots 410 of the frame 400 are, again, allocated for other connections. Next time slots 412 comprise a second group of free time slots. Again, one of the time slots of the group, preferably a last time slot 414, is used as a communication control channel of the group as regards time slot allocation.

[0026] The first free-time-slot group 406 is transmitted from the output gate 304 of the base station controller 304 to the gate 314 of the first cross-connection equipment 308. A first time slot 415 of the frame 401 in the gate 314 is used for transmitting link management information. Next time slots 416 comprise the first free-time-

slot group. A last time slot 418 of the group serves as the communication control channel. The time slot disposition of the group in the frame can thus vary in different gates.

[0027] The second free-time-slot group 412 is transmitted from the output gate 304 of the base station controller 304 to the gate 332 of the fourth cross-connection equipment 330. A first time slot 420 of the frame 402 in the gate 332 is used for transmitting link management information. Next time slots 422 comprise the first free-time-slot group. A last time slot 424 of the group serves as the communication control channel.

[0028] It is to be further noted that the free-time-slot group division shown here is only a simplified example. Naturally, in a real situation there can be more groups and they can be transmitted to cross-connection equipment in ways different from the one described above, for example several groups can be transmitted to the same cross-connection equipment.

[0029] Next, new network elements are installed in the radio system and connected to the existing transmission network in step 506. If a base station to be installed in the system is directly connected to cross-connection equipment not supporting time slot processing in groups, as the cross-connection equipment 312 in the example of Figure 3 to whose gate 322 the base station 336 is connected, the cross-connection equipment gate must be manually activated in order for the base station 336 to receive a 2Mbit/s frame over a transmission line 338.

[0030] In this step, network elements to be installed are physically connected to the system by means of telecommunication connections. If necessary, the required telecommunication connections must be built. In connection with the physical installation, network element identification information is fed into the network element to identify each base station controlled by the base station controller.

[0031] Next, connections are established between the new network elements and the base station controller in step 508. In the solution of the invention, connections are established automatically without the network element installer being compelled to perform other procedures than to switch on the element installed. In the present embodiment of the invention, the new network element, after being physically installed, is arranged to search the frames received by means of the telecommunication connections for group communication control channels and to identify free groups by means of the communication control channels found.

[0032] Whether a search for communication control channels is performed depends on whether the network element's local gate comprises 2 Mbit/s lines themselves comprising free-time-slot groups. Examine first such a case by means of a flow diagram shown in Figure 6, illustrated by the base station 336 in the figure.

[0033] In step 600, it is tested whether all input gates are checked. If not, a gate to be checked is selected in step 602, and the gate is searched for communication control channels in step 604.

[0034] In step 606, a decision is made based on the search. If no communication control channels are found in the gate, the process returns to step 600. If a channel is found, the size of the group defined by the communication control channel is inquired of the base station controller in step 608, the area is marked as a group and the information is stored in the memory.

[0035] Next, the same gate is searched for other communication control channels in step 610.

[0036] In step 612, a decision is made on the basis of the search. If a channel is found, the process proceeds to step 608. If no further communication control connections are found in the gate, the groups of the gate are stored in the memory in step 614, and the process returns to step 600.

[0037] If all gates are checked, the process proceeds from step 600 to step 616, wherein it is checked whether a communication control channel is found. If no communication control channel is found in the gates, the process exits to algorithm B, which will be described below. If a communication control channel is found, in step 618 it is inquired of the base station controller whether it accepts the network element. This is performed by transmitting the network element identification information to the base station controller. If the base station controller does not accept the network element, a connection is established to the next communication control channel, and further to the next one until each communication control channel is thus checked. Then, the process exits to algorithm B. If the base station controller accepts the network element, the network element configuration is continued controlled by the base station controller. This will be described below.

[0038] Examine next a flow diagram of Figure 7 illustrating algorithm B, which is executed when no communication control channel or 2 Mbit/s lines themselves comprising free-time-slot groups are found in the network element's local gate. In Figure 3, such base stations are illustrated by the base stations 324, 326, 328 and 334.

[0039] In step 700, the network element searches the telecommunication connections for paths to the network elements which comprise unused-time-slot groups as whole groups in the frames.

[0040] In step 702, a path to be checked is selected.

[0041] In step 704, it is inquired of a corresponding network element whether a communication control channel exists in a gate located at the end of the path to be checked.

[0042] The above-mentioned procedure to test whether the base station controller accepts the network element is performed by transmitting network element identification information, hardware configuration parameters and other information to the base station controller. After receiving the above-mentioned information from the network element, the base station controller is arranged to search its data base for the identification information, and if a corresponding identification information is found, the hardware configuration is appropriate, and a necessary

number of free time slots is found in the free-time-slot group indicated by the communication control channel, the base station can accept the network element.

[0043] If a communication control channel is found and the base station controller using the channel accepts the network element, the process can exit the algorithm, and the network element configuration is continued controlled by the base station controller. This will be described below.

[0044] If no communication control channel is found or the base station controller using the channel does not accept the network element, it is checked in step 708 whether all paths are checked; if not, the process proceeds to step 704 to check the next path. If all paths are already checked, the process returns to the beginning of the algorithm for a recheck, since, obviously, the previous check was erroneous.

[0045] When a communication control channel is found and the base station controller accepts the network element, connection establishment continues controlled by the base station controller. The base station allocates a necessary number of time slots from the free-time-slot group indicated by the communication control channel for the communication of the network element and the base station controller and transmits information about this to the network element. The time slots are marked as allocated at both ends of the connection and also at cross-connection equipment possibly located on the transmission path.

[0046] The connections between the network elements and the base station controller being thus established in step 508 of Figure 5, the process proceeds to step 510, wherein the network element is configured. The configuration is continued controlled by the base station controller. If necessary, the base station controller downloads software into the network element. The base station controller also downloads necessary radio network parameters into the network element.

[0047] Next, in the solution of the invention, the operation of the connections allocated to the network element is tested. The network element transmits to the base station controller a message comprising information that the network element is ready to be tested. The base station controller then, after receiving the message from the network element to be installed, initiates a testing procedure. The testing comprises all channels between the base station controller and the network element.

[0048] Examine an example of a testing procedure by means of a signal sequence chart shown in Figure 8. In step 800, the network element transmits to the base station controller a message indicating that it is ready to be tested. Consequently, the base station controller allocates the channels allocated to the network element for the testing in step 802. Next, the base station controller initiates the test in step 804. If more than one transceiver is in use in the network element, they all can be tested simultaneously. The time spent on testing is thus independent from the number of transceivers in the equip-

ment.

[0049] The base station controller transmits a test initiation command 806 to each transceiver of the network element. The network element acknowledges 808 each message separately and tests each transceiver 810. Testing is preferably performed such that the network element transmits a predetermined test signal pattern to the base station controller over the channel to be tested, the base station controller transmitting the test pattern received back to the network element. The network element tests the correctness of the test pattern. In step 812, the network element transmits the test result to the base station controller, which acknowledges 814 the message. The message 812 is transmitted separately towards each transceiver in random order. Correspondingly, the acknowledgement 814 of each message of the network element message is supplied separately.

[0050] In a preferred embodiment of the invention, a pseudo-random sequence can be used as a test signal pattern, the pseudo-random sequence being generated from a seed number. The signal pattern is known in advance (determined by the seed number), and its length can be 511 bits, for example. The bit error ratio describing connection quality can be measured in reception.

[0051] Next, the base station controller sets the network element to perform an Abis loop test in step 816. The signalling channels are also tested in this step. The base station controller transmits a measurement command 818 to the network element, which replies by an acknowledgement message 820. The network element performs a test 822 and transmits the results in a message 824 to the base station controller. The base station controller acknowledges 826 the message. There can also be a plurality of these message pairs 824-826, depending on the number of connections to be tested.

[0052] When all tests are performed, the base station controller transmits a message to the network element. The message indicates that the network element can continue to be configured into the operational state.

[0053] In the network element installation phase, the installer can connect the monitoring means to the network element. The monitoring means are the terminal enabling the network element and the network to be controlled and monitored. Simultaneously with being transmitted to the base station controller, the network test results can also be transferred to the monitoring means to be seen by the installer. Consequently, the installer can, when necessary, immediately correct installation or configuration errors emerged in the event of error.

[0054] In another embodiment of the invention, the base station controller transmits a predetermined test signal pattern to the network element over the channel to be tested. The network element transmits the test pattern received back to the base station controller and the base station controller tests the correctness of the test pattern.

[0055] Again referring to Figure 5, in step 512 the network element configuration is documented. If the network

element passes the tests conducted by the base station controller, the element installer is notified of this. The base station controller informs the network management system of the new network element and the time slots allocated thereto. The network element is now ready to be used.

[0056] It is to be noted here that the above-described network element configuration procedure is only one example to which the method of the invention can be applied. The order in which some of the above-mentioned functions can be performed may vary.

[0057] Examples of the structure of the base station controller, cross-connection equipment and base station of the radio system in accordance with the invention are illustrated for the relevant parts in Figure 9. The base station controller 302 comprises a control unit. The base station controller further comprises transmission equipment 902 by means of which it is connected 904 to the cross-connection equipment 308. The cross-connection equipment 308 typically comprises a control unit 906 and transmission equipment 908 by means of which it is connected 910 to the base station 316. The base station 316 typically comprises transmission equipment 912, a control unit 914, radio frequency parts 916 by means of which a desired signal is transmitted to mobile telephones via an antenna 918. The control units 900, 906 and 914 are typically implemented by means of general processors, signal processors or memory elements.

[0058] Procedures required by the method of the invention in the base stations and the base station controller can preferably be performed by software by means of commands stored in control processors. The base station controllers, cross-connection equipment and base stations of the radio system naturally also comprise other components than the ones shown in Figure 9, as is obvious to those skilled in the art, but being irrelevant to the invention they are not shown in Figure 9.

[0059] Furthermore, the solution of the invention is not restricted to the transmission topologies shown in Figure 3, as is obvious to those skilled in the art. Figures 10a and 10b illustrate further examples of transmission topologies. In Figure 10a, the system comprises the base station controller 302 connected to a base station 1000, connected, in turn, to a base station 1002 and cross-connection equipment 1004. The cross-connection equipment 1004 is connected to base stations 1006 and 1008.

[0060] In Figure 10b, the system comprises the base station controller 302 connected to cross-connection equipment 1012. The cross-connection equipment 1010 is connected to second cross-connection equipment 1012, and the second cross-connection equipment 1010 is connected to a base station 1014. The figure also illustrates a loop connection 1018 which enables the maintenance of the connection between the network elements and the base station controller to be secured.

[0061] Although the invention has been described above with reference to the examples in accordance with the accompanying drawings, it is obvious that the inven-

tion is not restricted thereto but it can be modified in many ways within the scope of the inventive idea disclosed in the attached claims.

Claims

1. A method of testing telecommunication connections of a network element to be installed in a radio system comprising one or more network elements (316, 324, 326, 328, 334, 336), a base station controller (302) and a network management system (300) that are operatively interconnected by means of telecommunication connections comprising traffic channels and control channels, and in which system information between the network elements is transmitted in frames that are divided into time slots, and in which system the base station controller (302) controls one or more network elements, and in which method the network element is physically connected to the system by means of the telecommunication connections, **characterized by** the network element searching frames received by means of said telecommunication connections for control channels, the base station controller automatically allocating channels for the the network element, the network element transmitting to the base station controller a message comprising information that the network element is ready to be tested, the base station controller initiating a testing procedure after receiving the message from the network element to be installed, and the testing comprising testing all channels between the base station controller and the network element.
2. A method as claimed in claim 1, **characterized by** the testing comprising the transmission of a predetermined test signal pattern in both directions over each network element and base station channel, and a check of the signal pattern thus transmitted and received, and when all channels are tested, the base station controller transmitting a notification of the test having ended to the network element.
3. A method as claimed in claim 1 or 2, **characterized by** the network element transmitting the predetermined test signal pattern to the base station controller over the channel to be tested, the base station controller transmitting the test pattern received back to the network element, the network element testing the correctness of the test pattern and informing the base station controller of the result concerning said channel.
4. A method as claimed in claim 1 or 2, **characterized by** the base station controller transmitting the pre-

- determined test signal pattern to the network element over the channel to be tested, the network element transmitting the received test pattern back to the network element, the base station controller testing the correctness of the test pattern. 5
5. A method as claimed in claim 3 or 4, **characterized by** all lines being tested simultaneously when the connection between the network element and the base station controller comprises lines with frames implemented by a plurality of transceivers. 10
6. A method as claimed in claim 5, **characterized by** different time slots of each line with frames being tested consecutively. 15
7. A method as claimed in any one of the preceding claims, **characterized by** some of the radio system's network elements (324, 326) being interconnected coupled in series by means of the telecommunication connections. 20
8. A method as claimed in claim 1 or 2, **characterized by** the network elements being the system's base stations. 25
9. A method as claimed in claim 1 or 2, **characterized by** the testing being performed in the phase of installation in which the base station controller has allocated time slots for the use of communication between the network element and the base station controller, informed the network element of the allocated time slots and transferred the necessary software in the network element to the network element. 30
10. A method as claimed in claim 1 or 2, **characterized by** connecting monitoring means to the network element in connection with the installation, and the network element transmitting the predetermined test signal pattern to the base station controller over the channel to be tested, the base station controller transmitting the test pattern received back to the network element, the network element testing the correctness of the test pattern and informing the base station controller and the network element's monitoring means of the result concerning said channel. 35
11. A radio system comprising one or more network elements (316, 324, 326, 328, 334, 336), a base station controller (302) and a network management system (300) that are operatively interconnected by means of telecommunication connections comprising traffic channels and control channels, and in which system information between the network elements is transmitted in frames that are divided into time slots, and in which system the base station controller controls 40
- one or more network elements that comprise network element identification information, **characterized by** the network element to be installed being arranged to search frames received by means of said telecommunication connections for control channels, the base station controller being arranged to automatically allocate channels for the the network element, the network element to be installed being arranged to transmit to the base station controller a message comprising information that the network element is ready to be tested, the base station controller being arranged to initiate a testing procedure after receiving the message from the network element to be installed, and the testing comprising testing all channels between the base station controller and the network element. 45
12. A system as claimed in claim 11, **characterized by** the testing comprising the transmission of a predetermined test signal pattern in both directions over each network element and base station channel, and a check of the signal pattern thus transmitted and received, and when all channels are tested, the base station controller being arranged to transmit a notification of the test having ended to the network element. 50
13. A system as claimed in claim 11 or 12, **characterized by** the network element being arranged to transmit the predetermined test signal pattern to the base station controller over the channel to be tested, the base station controller being arranged to transmit the test pattern received back to the network element, and the network element being arranged to test the correctness of the test pattern and to inform the base station controller of the result concerning said channel. 55
14. A system as claimed in claim 11 or 12, **characterized by** the base station controller being arranged to transmit the predetermined test signal pattern to the base station controller over the channel to be tested, the network element being arranged to transmit the test pattern received back to the network element, and the base station controller being arranged to test the correctness of the test pattern.
15. A base station in a radio system comprising one or more base stations (316, 324, 326, 328, 334, 336), a base station controller (302) and a network management system (300) that are operatively interconnected by means of telecommunication connections comprising traffic channels and control channels,

and in which system information between the base stations is transmitted in frames that are divided into time slots, and in which system the base station controller controls one or more base stations that comprise network element identification information, **characterized by** the base station to be installed being arranged to search frames for control channels, transmit to the base station controller a message comprising information that the network element is ready to be tested, execute with the base station controller a testing procedure initiated by the base station controller after receiving the message from the base station, and the testing comprising testing all channels between the base station controller and the base station.

Patentansprüche

1. Verfahren zum Überprüfen von Telekommunikationsverbindungen eines Netzwerkelements, das in einem Funksystem installiert werden soll, umfassend ein oder mehrere Netzwerkelemente (316, 324, 326, 328, 334, 336), eine Basisstationssteuerung (302) und ein Netzwerkverwaltungssystem (300), die mittels Telekommunikationsverbindungen umfassend Verkehrskanäle und Steuerkanäle betriebsfähig miteinander verbunden sind, und wobei in dem System Informationen zwischen den Netzwerkelementen in Rahmen übertragen werden, die in Zeitfenster aufgeteilt sind, und wobei in dem System die Basisstationssteuerung (302) ein oder mehrere Netzwerkelemente steuert, und wobei in dem Verfahren das Netzwerkelement physikalisch mit dem System durch die Telekommunikationsverbindungen verbunden ist, **dadurch gekennzeichnet, dass**

- das Netzwerkelement Rahmen nach Steuerkanälen durchsucht, die mittels der Telekommunikationsverbindungen empfangen worden sind;
- die Basisstationssteuerung automatisch Kanäle für das Netzwerkelement zuweist;
- das Netzwerkelement an die Basisstationssteuerung eine Nachricht überträgt, die Informationen umfasst, dass das Netzwerkelement bereit ist, überprüft zu werden;
- die Basisstationssteuerung einen Überprüfungsvorgang einleitet, nachdem die Nachricht von dem zu installierenden Netzwerkelement empfangen worden ist; und
- das Überprüfen ein Überprüfen aller Kanäle zwischen der Basisstationssteuerung und dem Netzwerkelement umfasst.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet,**

zeichnet, dass

- das Überprüfen das Übertragen eines vorbestimmten Testsignalumusters in beiden Richtungen über jedes Netzwerkelement und jeden Basisstationskanal, und eine Überprüfung des somit übertragenen und empfangenen Signalmusters umfasst; und
- die Basisstationssteuerung eine Benachrichtigung darüber, dass die Überprüfung beendet ist, an das Netzwerkelement überträgt, wenn alle Kanäle überprüft worden sind.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**

- das Netzwerkelement das vorbestimmte Testsignalumuster über den zu überprüfenden Kanal an die Basisstationssteuerung überträgt;
- die Basisstationssteuerung das empfangene Testsignalumuster zurück an das Netzwerkelement überträgt;
- das Netzwerkelement die Richtigkeit des Testumusters überprüft und die Basisstationssteuerung über das Ergebnis informiert, das den Kanal betrifft.

4. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**

- die Basisstationssteuerung das vorbestimmte Testsignalumuster über den zu überprüfenden Kanal an das Netzwerkelement überträgt;
- das Netzwerkelement das empfangene Testmuster zurück an das Netzwerkelement überträgt;
- die Basisstationssteuerung die Richtigkeit des Testumusters überprüft.

5. Verfahren nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass**

- alle Leitungen gleichzeitig überprüft werden, wenn die Verbindung zwischen dem Netzwerkelement und der Basisstationssteuerung Leitungen mit Rahmen umfasst, die durch eine Vielzahl von Sende/Empfängereinrichtungen implementiert sind.

6. Verfahren nach Anspruch 5, **dadurch gekennzeichnet, dass**

- verschiedene Zeitfenster jeder Leitung mit Rahmen nacheinander überprüft werden.

7. Verfahren nach irgendeinem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass**

- einige der Netzwerkelemente (324, 326) des Funksystems mittels der Telekommunikationsverbindungen in Reihenschaltung miteinander verbunden sind.
8. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**
- die Netzwerkelemente die Basisstationssteuerungen des Systems sind.
9. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**
- das Überprüfen in der Phase der Installation ausgeführt wird, in der die Basisstationssteuerung Zeitfenster für die Verwendung einer Kommunikation zwischen dem Netzwerkelement und der Basisstationssteuerung zugewiesen, das Netzwerkelement über die zugewiesenen Zeitfenster informiert und die notwendige Software in dem Netzwerkelement an das Netzwerkelement übertragen hat.
10. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**
- Überwachungsmittel mit dem Netzwerkelement in Verbindung mit der Installation verbunden werden; und
- das Netzwerkelement das vorbestimmte Testsignalmuster über den zu überprüfenden Kanal an die Basisstationssteuerung überträgt;
- die Basisstationssteuerung das empfangene Testmuster zurück an das Netzwerkelement überträgt;
- das Netzwerkelement die Richtigkeit des Testmusters überprüft und die Basisstationssteuerung und die Überwachungsmittel des Netzwerkelements über das Ergebnis informiert, die den Kanal betreffen.
11. Funksystem, umfassend ein oder mehrere Netzwerkelemente (316, 324, 326, 328, 334, 336), eine Basisstationssteuerung (302) und ein Netzwerkverwaltungssystem (300), die über Telekommunikationsverbindungen umfassend Verkehrskanäle und Steuerkanäle betriebsfähig miteinander verbunden sind, und wobei in dem System Informationen zwischen den Netzwerkelementen in Rahmen übertragen werden, die in Zeitfenster aufgeteilt sind, und wobei in dem System die Basisstationssteuerung ein oder mehrere Netzwerkelemente steuert, die Netzwerkelement-Identifizierungsinformationen aufweisen, **dadurch gekennzeichnet, dass**
- das Netzwerkelement, das installiert werden soll, eingerichtet ist, Rahmen, die mittels der Telekommunikationsverbindungen empfangen werden, nach Steuerkanälen zu durchsuchen;
- die Basisstationssteuerung eingerichtet ist, automatisch Kanäle für das Netzwerkelement zuzuweisen;
- das Netzwerkelement, das installiert werden soll, eingerichtet ist, an die Basisstationssteuerung eine Nachricht zu übertragen, umfassend Informationen darüber, dass das Netzwerkelement bereit ist, überprüft zu werden;
- die Basisstationssteuerung eingerichtet ist, einen Überprüfungsvorgang einzuleiten, nachdem die Nachricht von dem Netzwerkelement, das installiert werden soll, empfangen worden ist; und
- das Überprüfen ein Überprüfen aller Kanäle zwischen der Basisstationssteuerung und dem Netzwerkelement umfasst.
12. System nach Anspruch 11, **dadurch gekennzeichnet, dass**
- das Überprüfen die Übertragung eines vorbestimmten Testsignalmusters in beiden Richtungen über jedes Netzwerkelement und jeden Basisstationskanal, und ein Überprüfen des somit übertragenen und empfangenen Signalmusters umfasst; und
- die Basisstationssteuerung eingerichtet ist, eine Benachrichtigung darüber, dass die Überprüfung beendet ist, an das Netzwerkelement zu übertragen, wenn alle Kanäle überprüft sind.
13. System nach Anspruch 11 oder 12, **dadurch gekennzeichnet, dass**
- das Netzwerkelement eingerichtet ist, das vorbestimmte Testsignalmuster über den zu überprüfenden Kanal an die Basisstationssteuerung zu übertragen;
- die Basisstationssteuerung eingerichtet ist, das empfangene Testmuster zurück an das Netzwerkelement zu übertragen; und
- das Netzwerkelement eingerichtet ist, die Richtigkeit des Testmusters zu überprüfen und die Basisstationssteuerung über das Ergebnis zu informieren, das den Kanal betrifft.
14. System nach Anspruch 11 oder 12, **dadurch gekennzeichnet, dass**
- die Basisstationssteuerung eingerichtet ist, das vorbestimmte Testsignalmuster über den zu überprüfenden Kanal an die Basisstationssteuerung zu übertragen;
- das Netzwerkelement eingerichtet ist, das empfangene Testmuster zurück an das Netzwerkelement zu übertragen; und

- die Basisstationssteuerung eingerichtet ist, die Richtigkeit des Testmusters zu überprüfen.

15. Basisstation in einem Funksystem, umfassend ein oder mehrere Basisstationen (316, 324, 326, 328, 334, 336), eine Basisstationssteuerung (302) und ein Netzwerkverwaltungssystem (300), die über Telekommunikationsverbindungen umfassend Verkehrskanäle und Steuerkanäle betriebsfähig miteinander verbunden sind, und wobei in dem System Informationen zwischen den Basisstationen in Rahmen übertragen werden, die in Zeitfenster aufgeteilt sind, und wobei in dem System die Basisstationssteuerung eine oder mehrere Basisstationen steuert, die Netzwerkelement-Identifizierungsinformationen aufweisen,
dadurch gekennzeichnet, dass die zu installierende Basisstation eingerichtet ist, um

- Rahmen für Steuerkanäle zu suchen;
- eine Nachricht an die Basisstationssteuerung zu übertragen, die Information umfasst, dass das Netzwerkelement bereit ist, überprüft zu werden;
- mit der Basisstationssteuerung einen Prüfungsvorgang auszuführen, der von der Basisstationssteuerung eingeleitet wird, nachdem die Nachricht von der Basisstation empfangen wird;

und

- das Überprüfen aller Kanäle zwischen der Basisstationssteuerung und der Basisstation umfasst.

Revendications

1. Méthode de test de liaisons de télécommunication d'un élément de réseau destiné à être installé dans un système radio comprenant un ou plusieurs éléments de réseaux (316, 324, 326, 328, 334, 336), un contrôleur de station de base (302) et un système de gestion de réseau (300) qui sont interconnectés de manière opérative au moyen de liaisons de télécommunication comprenant des canaux de trafic et des canaux de contrôle, et dans lequel système des informations entre les éléments de réseaux sont transmises dans des trames qui sont divisées en tranches de temps et dans lequel système le contrôleur de station de base (302) contrôle un ou plusieurs éléments de réseaux, et dans laquelle méthode l'élément de réseau est physiquement connecté au système au moyen des liaisons de télécommunication, **caractérisée en ce que** l'élément de réseau recherche des trames reçues au moyen desdites liaisons de télécommunication pour des canaux de contrôle,

le contrôleur de station de base alloue automatiquement des canaux pour l'élément de réseau, l'élément de réseau transmet au contrôleur de station de base un message comprenant des informations indiquant que l'élément de réseau est prêt à être testé, le contrôleur de station de base lance une procédure de test après avoir reçu le message de l'élément de réseau à installer, et le test comprend le test de tous les canaux entre le contrôleur de station de base et l'élément de réseau.

2. Méthode selon la revendication 1, **caractérisée en ce que**

le test comprend la transmission d'une configuration de signaux de test prédéterminée dans les deux directions en passant par chaque élément de réseau et chaque canal de station de base et un contrôle de la configuration de signaux ainsi transmise et reçue, et lorsque tous les canaux sont testés, le contrôleur de station de base transmet une notification de fin de test à l'élément de réseau.

3. Méthode selon la revendication 1 ou la revendication 2, **caractérisée en ce que**

l'élément de réseau transmet la configuration de signaux de test prédéterminée au contrôleur de station de base en passant par le canal à tester, le contrôleur de station de base retransmet la configuration de test reçue à l'élément de réseau, l'élément de réseau contrôle que la configuration de test est correcte et informe le contrôleur de station de base du résultat concernant ledit canal.

4. Méthode selon la revendication 1 ou la revendication 2, **caractérisée en ce que**

le contrôleur de station de base transmet la configuration de signaux de test prédéterminée à l'élément de réseau en passant par le canal à tester, l'élément de réseau retransmet la configuration de test reçue à l'élément de réseau, le contrôleur de station de base contrôle que la configuration de test est correcte.

5. Méthode selon la revendication 3 ou la revendication 4, **caractérisée en ce que** toutes les lignes sont testées simultanément lorsque la liaison entre l'élément de réseau et le contrôleur de station de base comprend des lignes avec des trames mises en oeuvre par une pluralité d'émetteurs/récepteurs.

6. Méthode selon la revendication 5, **caractérisée en ce que** les différentes tranches de temps de chaque ligne avec des trames sont testées consécutivement.

7. Méthode selon l'une quelconque des revendications

précédentes, **caractérisée en ce que** certains des éléments de réseaux du système radio (324, 326) sont interconnectés selon un couplage en série au moyen des liaisons de télécommunication.

8. Méthode selon la revendication 1 ou la revendication 2, **caractérisée en ce que** les éléments de réseaux sont les stations de base du système.
9. Méthode selon la revendication 1 ou la revendication 2, **caractérisée en ce que** le test s'effectue dans la phase d'installation dans laquelle le contrôleur de station de base a alloué des tranches de temps pour l'utilisation de la communication entre l'élément de réseau et le contrôleur de station de base, informé l'élément de réseau des tranches de temps allouées et transféré le logiciel nécessaire dans l'élément de réseau à l'élément de réseau.
10. Méthode selon la revendication 1 ou la revendication 2, **caractérisée en ce que** des moyens d'analyse sont connectés à l'élément de réseau en liaison avec l'installation et **en ce que** l'élément de réseau transmet la configuration de signaux de test prédéterminée au contrôleur de station de base en passant par le canal à tester, le contrôleur de station de base retransmet la configuration de test reçue à l'élément de réseau, l'élément de réseau contrôle que la configuration de test est correcte et informe le contrôleur de station de base et les moyens d'analyse de l'élément de réseau du résultat concernant ledit canal.
11. Système radio comprenant un ou plusieurs éléments de réseaux (316, 324, 326, 328, 334, 336), un contrôleur de station de base (302) et un système de gestion de réseau (300) qui sont interconnectés de manière opérative au moyen de liaisons de télécommunication comprenant des canaux de trafic et des canaux de contrôle, et dans lequel système des informations entre les éléments de réseaux sont transmises dans des trames qui sont divisées en tranches de temps, et dans lequel système le contrôleur de station de base contrôle un ou plusieurs éléments de réseaux qui comprennent des informations d'identification d'éléments de réseau, **caractérisé en ce que** l'élément de réseau à installer est agencé pour rechercher des trames reçues au moyen desdites liaisons de télécommunication pour des canaux de contrôle, le contrôleur de station de base est agencé pour allouer automatiquement des canaux pour l'élément de réseau, l'élément de réseau à installer est agencé pour transmettre au contrôleur de station de base un message comprenant des informations indiquant que l'élément de réseau est prêt à être testé,

le contrôleur de station de base est agencé pour lancer une procédure de test après avoir reçu le message de l'élément de réseau à installer, et le test comprend le test de tous les canaux entre le contrôleur de station de base et l'élément de réseau.

12. Système selon la revendication 11, **caractérisé en ce que** le test comprend la transmission d'une configuration de signaux de test prédéterminée dans les deux directions en passant par chaque élément de réseau et chaque canal de station de base et un contrôle de la configuration de signaux ainsi transmise et reçue, et lorsque tous les canaux sont testés, le contrôleur de station de base est agencé pour transmettre une notification de fin de test à l'élément de réseau.
13. Système selon la revendication 11 ou la revendication 12, **caractérisé en ce que** l'élément de réseau est agencé pour transmettre la configuration de signaux de test prédéterminée au contrôleur de station de base en passant par le canal à tester, le contrôleur de station de base est agencé pour retransmettre la configuration de test reçue à l'élément de réseau, et l'élément de réseau est agencé pour contrôler que la configuration de test est correcte et pour informer le contrôleur de station de base du résultat concernant ledit canal.
14. Système selon la revendication 11 ou la revendication 12, **caractérisé en ce que** le contrôleur de station de base est agencé pour transmettre la configuration de signaux de test prédéterminée au contrôleur de station de base en passant par le canal à tester, l'élément de réseau est agencé pour retransmettre la configuration de test reçue à l'élément de réseau, et le contrôleur de station de base est agencé pour contrôler que la configuration de test est correcte.
15. Station de base dans un système radio comprenant une ou plusieurs stations de base (316, 324, 326, 328, 334, 336), un contrôleur de station de base (302) et un système de gestion de réseau (300) qui sont interconnectés de manière opérative au moyen de liaisons de télécommunication comprenant des canaux de trafic et des canaux de contrôle, et dans lequel système des informations entre les stations de base sont transmises dans des trames qui sont divisées en tranches de temps, et dans lequel système le contrôleur de station de base contrôle une ou plusieurs stations de base qui comportent l'information d'identification d'élément de réseau, **caractérisé en ce que** la station de base installée est

arrangée pour:

rechercher des trames pour des canaux de contrôle,
transmettre au contrôleur de station de base un message comprenant des informations indiquant que l'élément de réseau est prêt à être testé,
lancer une procédure de test avec le contrôleur de station de base initiée par le contrôleur de station de base après avoir reçu le message de la station de base, et
le test comprend le test de tous les canaux entre le contrôleur de station de base et la station de base.

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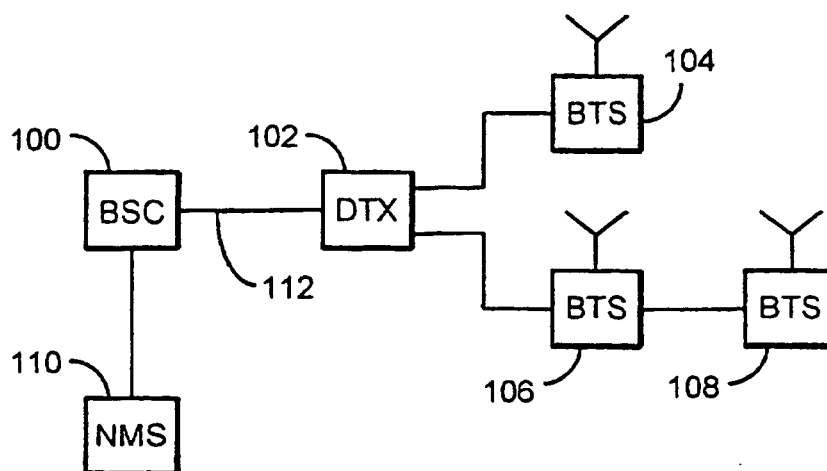


Fig. 1

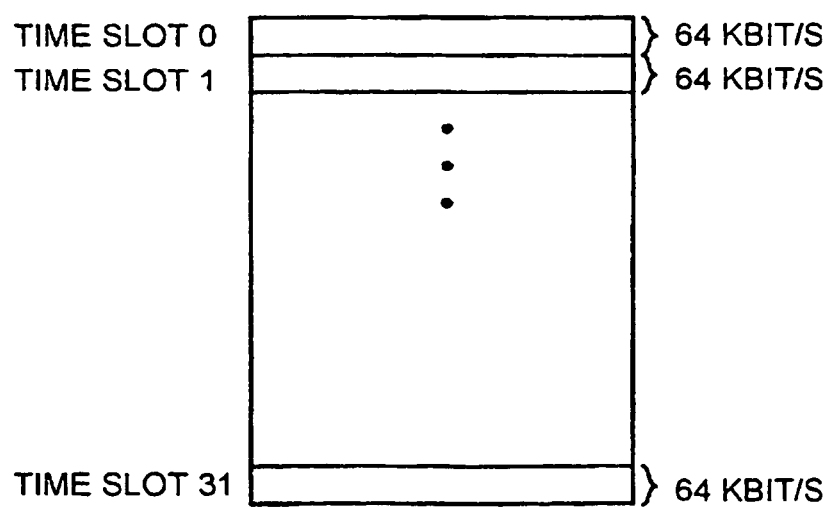


Fig. 2

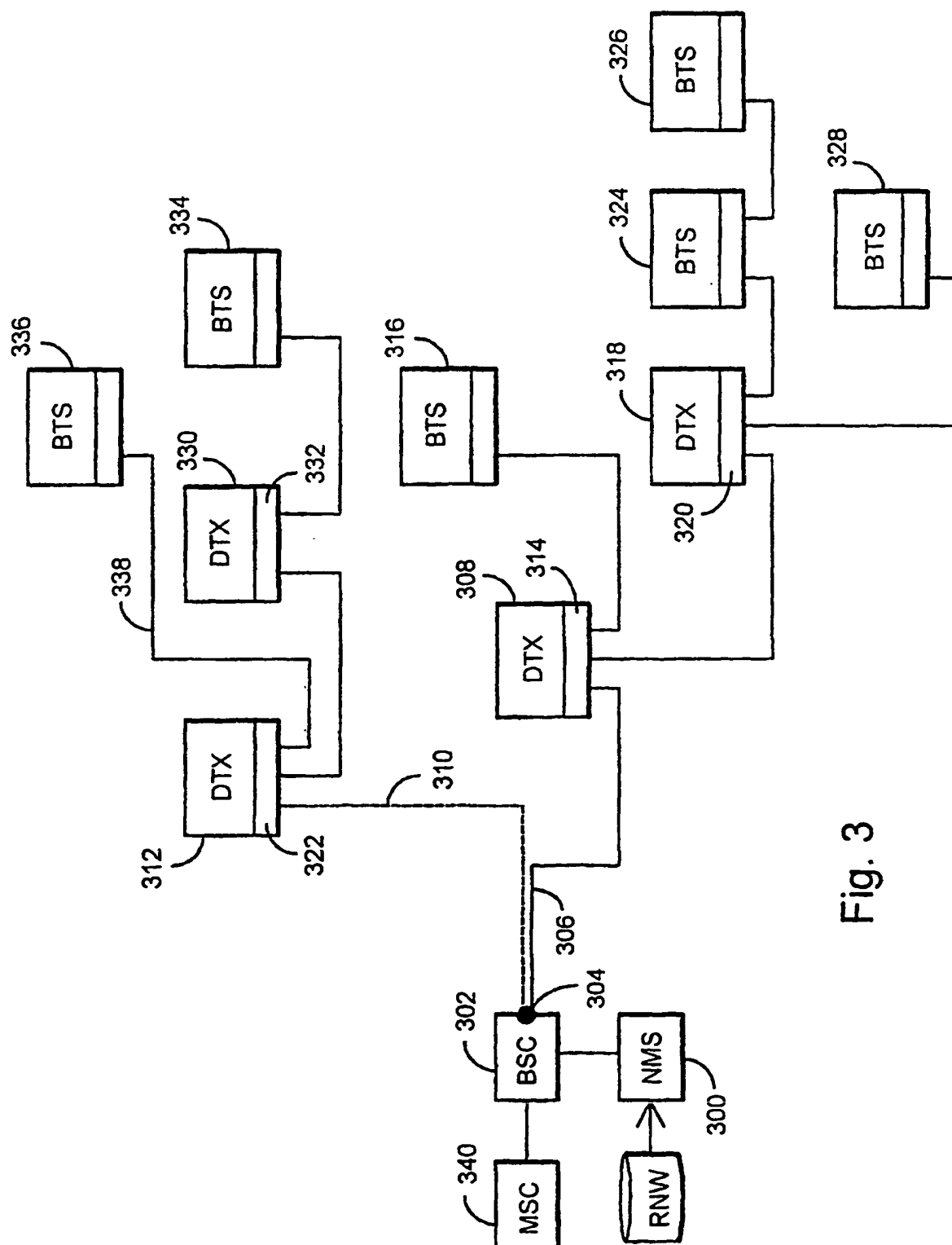


Fig. 3

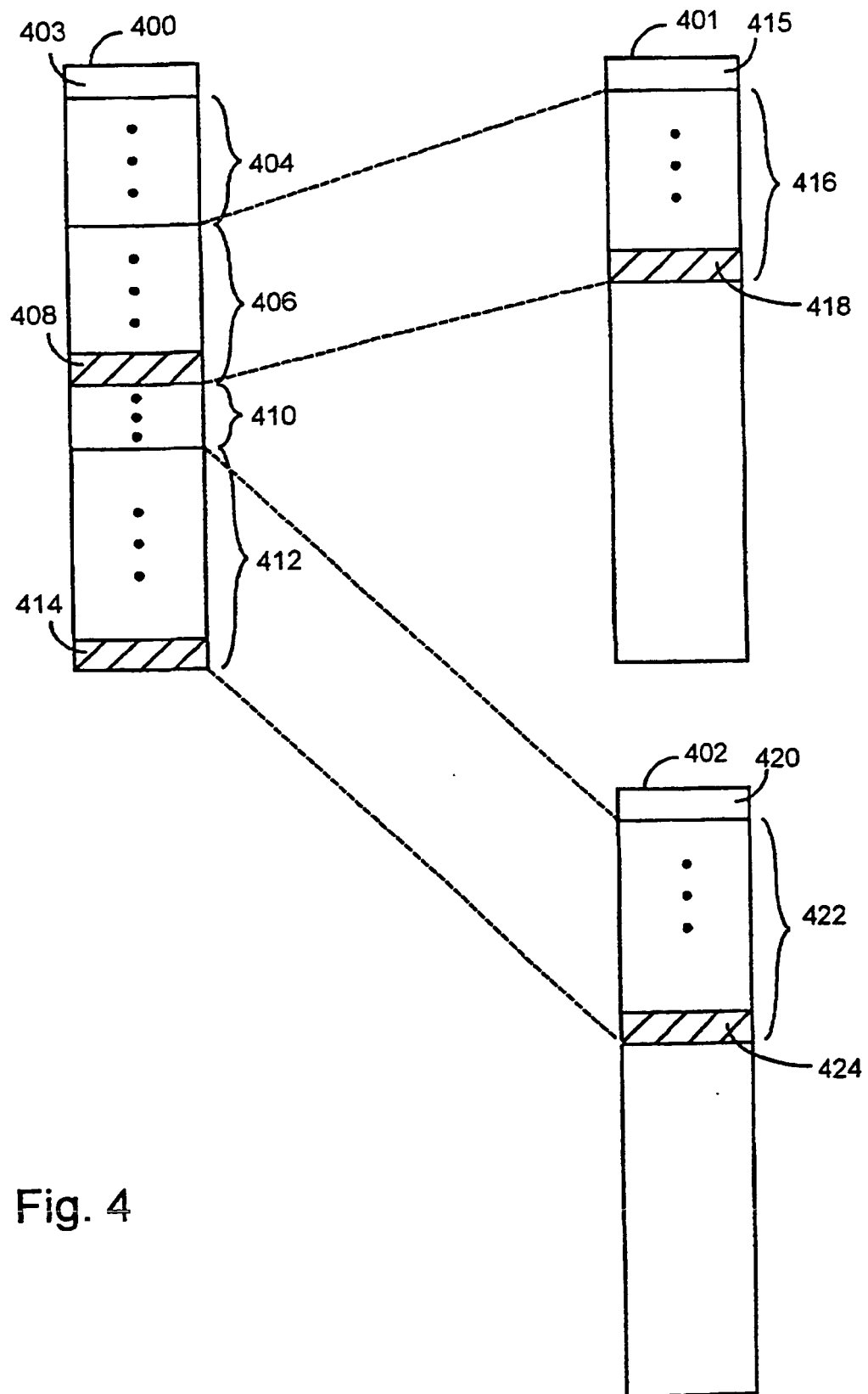


Fig. 4

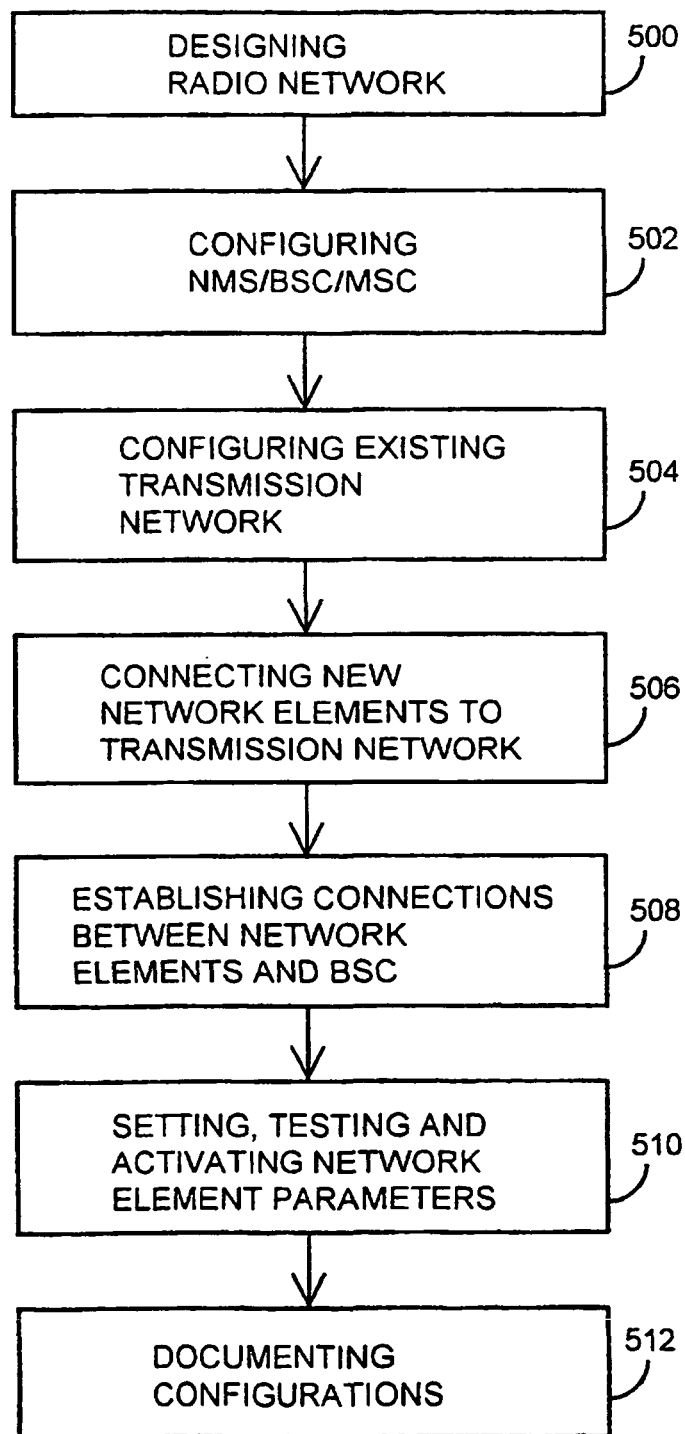


Fig. 5

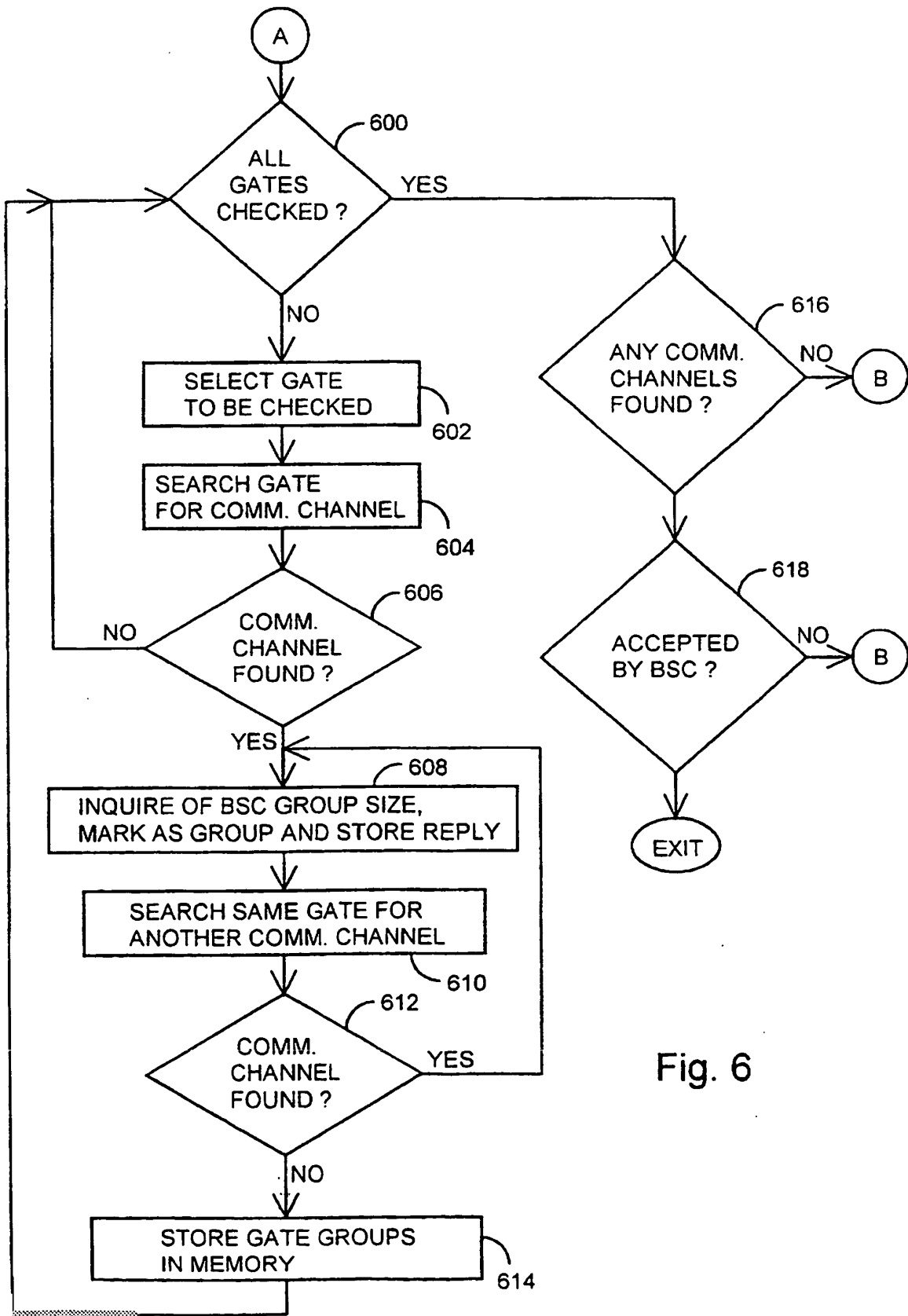


Fig. 6

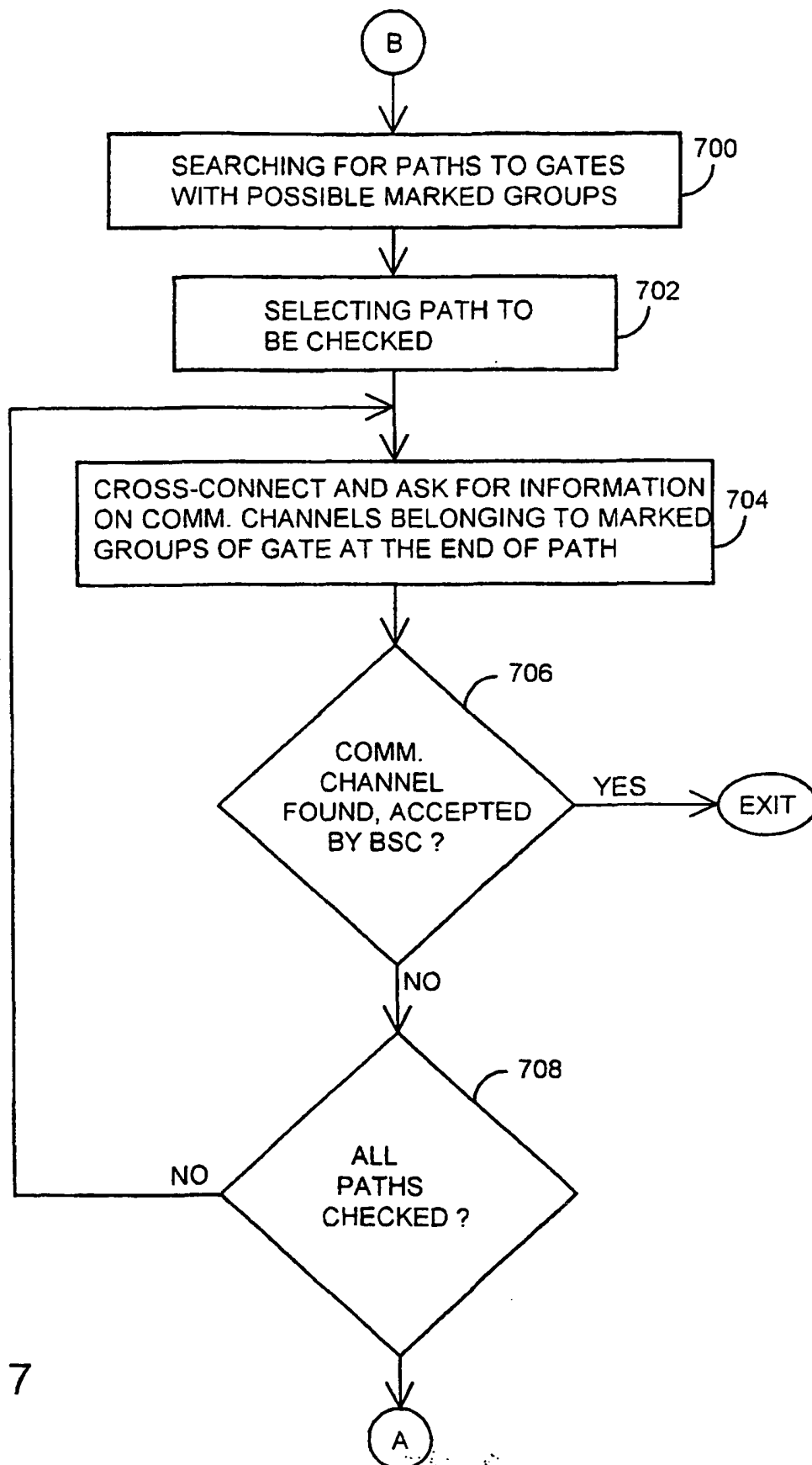


Fig. 7

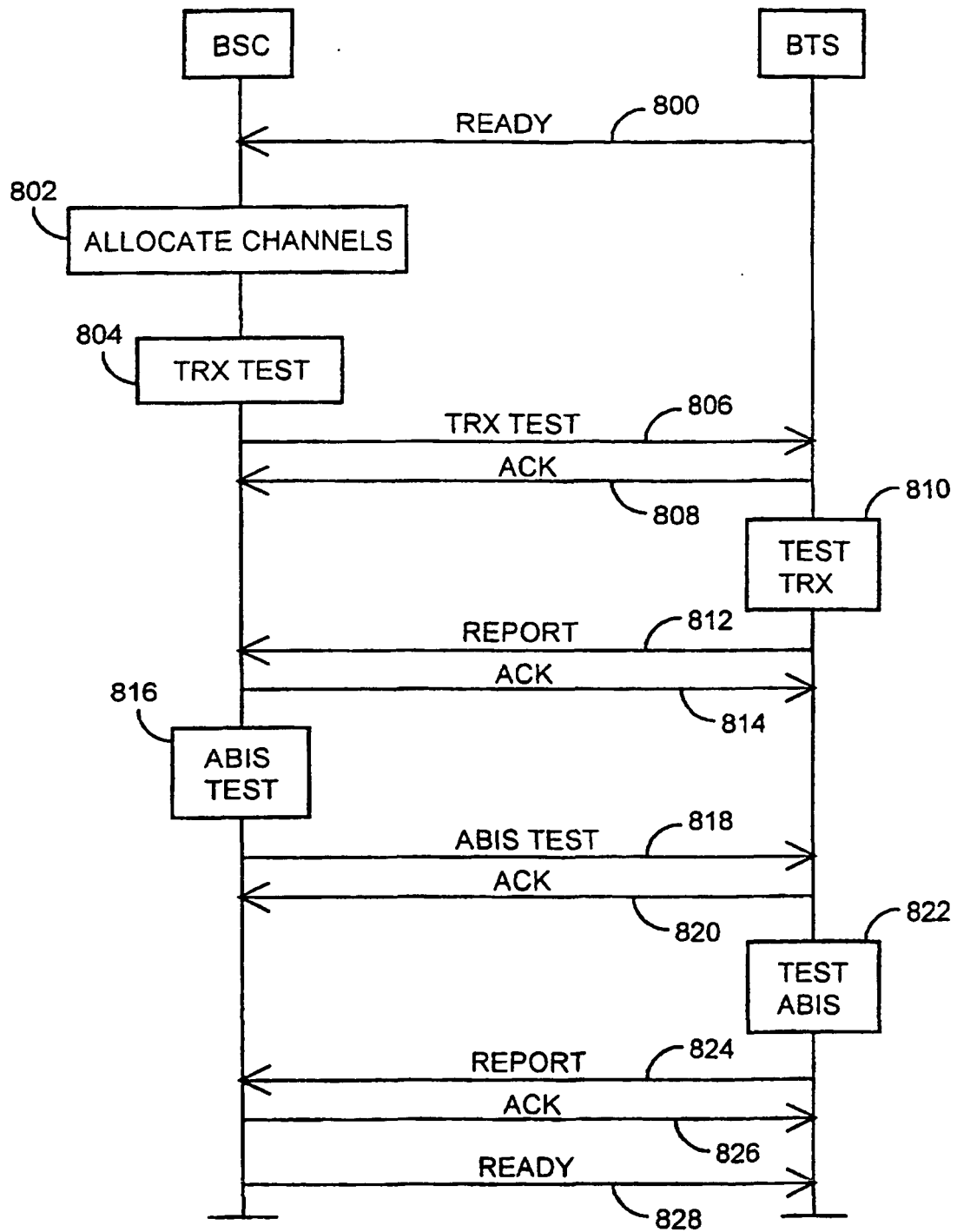


Fig. 8

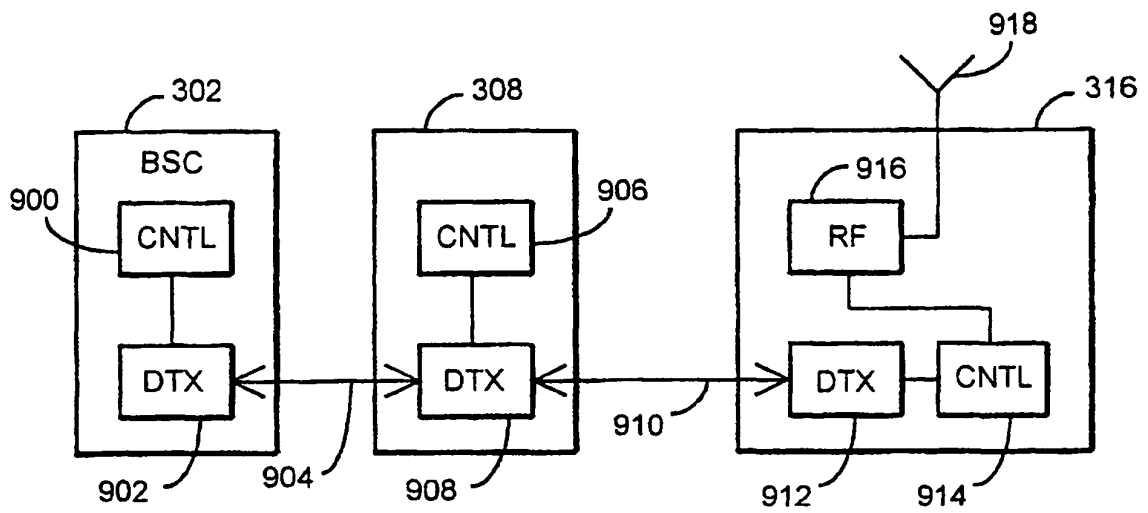


Fig. 9

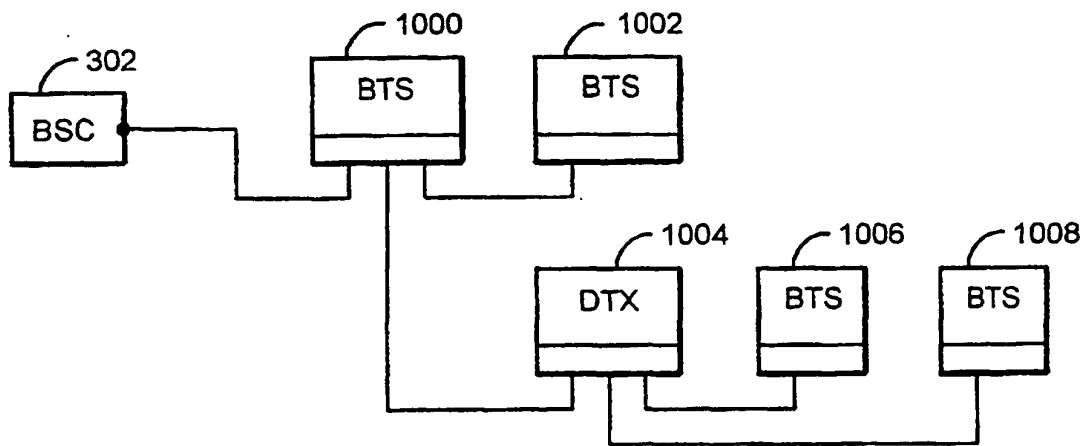


Fig. 10a

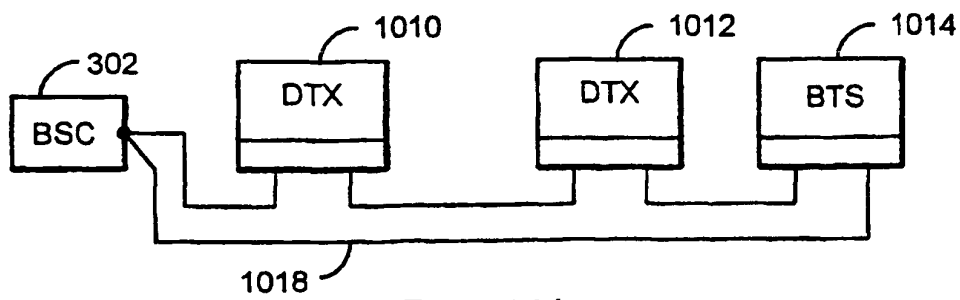


Fig. 10b