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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:
H04Q 7/04, H04B 7/26	A1	WO 94/05125
		(43) International Publication Date: 3 March 1994 (03.03.94)

(21) International Application Number: PCT/FI93/00324

(22) International Filing Date: 17 August 1993 (17.08.93)

(30) Priority data:
923708 18 August 1992 (18.08.92) FI

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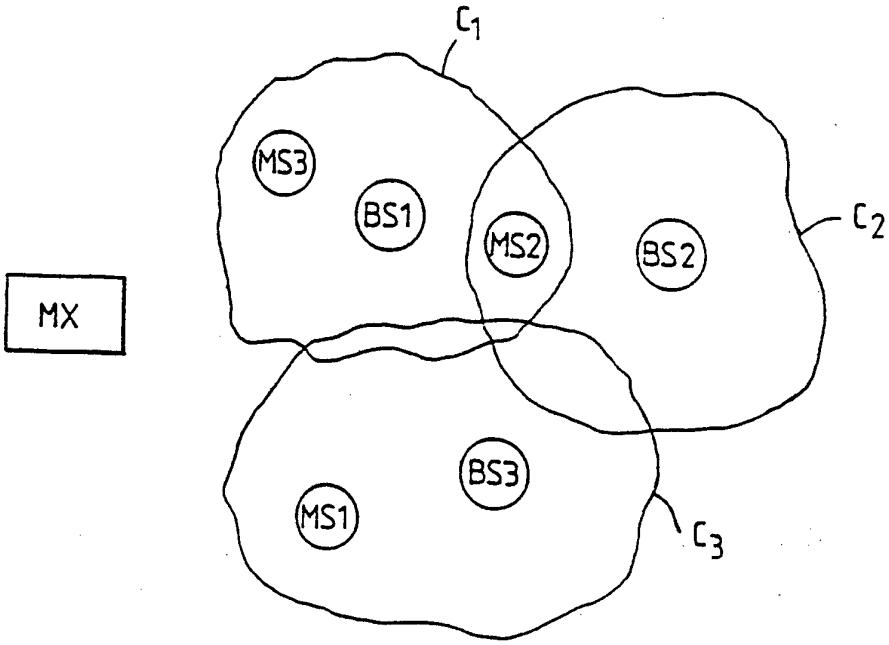
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(81) Designated States: AU, JP, NO, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: A RADIO SYSTEM AND A DATA TRANSMISSION IN A RADIO SYSTEM



(57) Abstract

The invention relates to a radio system and a method of transmitting data in a radio system, in which each base station (BS) has a radio channel operating as a call channel for signalling between the base station (BS) and mobile radio stations (MS). User data can be transmitted on control channels among the actual control signalling, but the data transmission may block the control channel and prevent the normal operation of the control channel. In the invention, the radio system comprises for the user data transmission at least one radio channel operating like a control channel, but transmitting signalling that prevents the mobile stations from selecting the radio channel as a control channel.

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A radio system and a data transmission in a radio system

Field of the Invention

The invention relates to radio systems and particularly to a data transmission in radio systems.

Background of the Invention

For radio telephone systems according to the recommendations MPT1343 and 1327 published by the British Department of Trade and Industry (DTI) is defined a transmission of Short Data Messages (SDM) and Extended Data Messages (EDM) on a control channel among other control signalling. SDM transmission can be utilized for two-way transmission of short alphanumeric text messages or application-specific data over the network between two subscriber terminals or other devices, such as computers etc. A single SDM may include predetermined groups of characters and a corresponding maximum number of characters. An EDM comprises four interconnected SDMs at the maximum. However, since the data communication takes place on the control channel among the normal control signalling, it is associated with the drawback that the control channel is blocked in relatively simple applications already, which causes interference in the control signalling and even endangers the speech traffic of the system. For this reason, the data transmission capacity provided in this manner remains very low. For a more efficient data transmission, a separate free-format data transmission using external modems has been defined for the radio systems according to MPT1343 and 1327. For each modem call, a traffic channel is reserved in a normal way, whereby control signalling does not interfere the data transmis-

sion during the modem call. However, it is expensive and unnecessarily complicated for the customer to use external modems and to reserve an entire traffic channel, when the data transmission is occasional and requires relatively low capacity, but more than the standard SDM/EDM transmission is able to deliver.

The Disclosure of the Invention

The object of the present invention is to increase substantially the transmission capacity of SDM/EDM-type transmission in a radio system and to avoid additional costs due to the external modems.

According to the invention, a radio system, comprising mobile radio stations and a plurality of base stations, each base station having a radio channel operating as a call channel for signalling between the base station and mobile radio stations, the mobile radio stations being capable of transmitting user data on control channels among the actual control signalling, is characterized in that the radio system comprises for said user data transmission at least one radio channel operating like a control channel, but transmitting control signalling, which prevents the mobile stations from selecting said radio channel as a control channel.

The basic idea of the present invention is that a mobile radio station is always commanded to a predetermined control channel (which may be referred to a data channel) for a SDM/EDM transmission. As far as the radio system is concerned, this data channel operating like a control channel is similar to the actual control channel, but the system code transmitted in its signalling and defining the current radio system for the mobile stations is selected in such a way that none of the mobile radio stations can

select this radio channel to be the control channel. A plurality of mobile stations may communicate simultaneously on such a data channel and perform data transmission in the same way as on a normal control channel. The data channel lacks, however, all such normal control signalling that is not required for SDM/EDM transmission, and therefore, the capacity of the data transmission does not need to be restricted because of the control signalling. Naturally, such a control channel reserved for data transmission can also be blocked, if there is a sufficient amount of data transmission, but even then the speech traffic, which is generally considered the most important form of traffic in the radio telephone networks, is not endangered. Moreover, several channels can be reserved for the data traffic, depending on the need of capacity.

By means of the invention, a novel mode of transmitting data is provided between a normal SDM/EDM transmission and a conventional modem call. The system differs from a radio system conforming strictly with MPT1343/1327 therein that, in connection with SDM/EDM calls, the network control shall be capable of commanding the mobile radio stations always to a predetermined dedicated data channel. Accordingly, changes are required only in the network control and small additional changes in the software of the radio telephone.

The invention relates further to a method of transmitting data in a radio system, comprising mobile radio stations and a plurality of base stations, each base station having a radio channel operating as a control channel for signalling between the base station and mobile radio stations, in which method a mobile radio station requests permission to send user

data by sending a request message on the control channel to a base station, the base station grants a permission to send user data by sending an acknowledgement message on the control channel and the mobile radio station sends a user data message in response to the reception of the acknowledgement message. The method is characterized in that, after having received the request to send user data from the mobile radio station, the base station sends the mobile radio station a command to go for a data transmission to the radio channel operating like a control channel, but reserved only for said user data transmission.

The invention relates also to a method of transmitting data in a radio system, comprising mobile radio stations and a plurality of base stations, each base station having a radio channel operating as a call channel for signalling between the base station and mobile radio stations, in which method a base station sends a packet data transmission request on the control channel to a mobile station and the mobile station sends an acknowledgement message to the base station on the control channel. The method is characterized in that, after having received the acknowledgement message from the mobile radio station on the control channel, the base station sends to the mobile radio station a command to go for a data transmission to the radio channel operating like a call channel, but reserved only for data transmission.

A Brief Description of the Drawings

The invention will now be explained in more detail by means of illustrating embodiments with reference to the attached drawings, in which

Figure 1 illustrates one radio system, to which the invention is applied, and

Figure 2 illustrates a connection between a mobile telephone exchange and a base station, and

Figure 3 and 4 are signalling diagrams of some data transmission transactions according to the invention.

A Detailed Description of the Invention

Figure 1 shows a radio telephone system, in which a geographic area covered by the system is divided into smaller radio areas, viz. radio cells C1, C2 and C3, in such a way that adjacent cells have abutting or overlapping peripheral areas. Each cell C1, C2 and C3 includes at least one fixed multichannel transceiver equipment BS1, BS2 and BS3, referred to a base station herein. Base stations BS1, BS2 and BS3 are connected by fixed links, such as cables, to a mobile telephone exchange MX, which thus controls several base stations BS. For speech connections or data connections, frequency channels are allocated for the cells for radio connection with mobile subscriber stations in the cells, i.e. with radio telephones MS, in such a manner that at least cells close to each other have different frequencies simultaneously in use.

Figure 2 illustrates an example of an interconnection between the mobile telephone exchange MX and a base station BS. The mobile telephone exchange includes several Base Station Interface Units (BSIU), each of which operates as a link between a Call Control Computer (CCC) and a radio Channel Unit (ChU) of the base station. Each base station comprises several radio channel units ChU, each of which includes a radio transceiver. A channel unit ChU may operate on

(at) one predetermined radio channel (frequency) or the mobile telephone exchange MX may allocate channels dynamically call by call by commanding the channel unit ChU to operate on the desired radio channel of the system.

An interface unit (BSIU) has four main tasks: to control access to the radio channel relating to the unit, to convert and transmit forward messages between radio units, i.e. channel units ChU, and the call control computer CCC, to connect the speech paths from the exchange MX to the radio channel as well as to control and monitor the operation of the base station. One BSIU controls one channel, which may be either a traffic channel or a control channel used by the system for control signalling, such as call setup signalling. The signalling on the control channel preferably conforms to MPT1327. Typical signalling comprises connection request messages sent by the base station and the radio telephone to each other and acknowledgements thereof as well as commands, sent by the base station, to go to a certain traffic channel for a call.

MPT1343, Section 14, defines transmission of short data messages on a control channel between radio telephones MS and a mobile telephone exchange MX over a base station BS. This defined data transmission makes it possible to send HEAD messages including free-format data on the control channel in both directions, i.e. from MS to MX and from MX to MS. Herein, the term "HEAD message" means both a HEAD address code word and associated data code words. The procedures defined in MPT1343, Section 14, support the solution according to which one segment of free-format data is sent. A segment is such an amount of free-format data that can be included in one HEAD

message, as has been defined in MPT1327, Paragraph 3.1. However, it is possible to link up to four segments to each other.

A data transmission according to the specification MPT1343 takes places on a control channel as follows, when an MS is sending over MX to another MS. A calling radio unit MS requests a permission to send a short data message (SDM) by sending to a base station BS a Random Access Request (RQC) message on the control channel, which message is addressed to another radio unit, to a device in a fixed network or to a data service. The base station BS relays the message further to the mobile exchange MX. The mobile exchange MX checks the availability of the called radio unit (addressed to) by using a general availability check message AHY, before sending the calling radio unit MS a Short Data invitation message AHYC (defined in MPT1343, Paragraphs 5.5.3.2.1 and 5.5.3.2.8) on the same control channel over BS. The calling radio unit MS sends on the same control channel to the base station BS and further to the mobile exchange MX a HEAD message and up to four appended data code words. Then the mobile exchange MX forwards the data by retransmitting the same HEAD message to the called radio unit MS, which shall respond with an acknowledgement according to the procedures outlined in MPT1343, Section 14. MX sends the calling radio unit an acknowledgement to advise the receipt of the HEAD message by the called radio unit. If a group of radio units instead of a single radio unit is called, the radio units in the group do not acknowledge the HEAD message, in which case MX sends the calling radio unit an acknowledgement telling whether MX has received the HEAD message and sent it forward to the group.

If the calling MS sends data to a subscriber of the fixed network, the signalling concerning the called MS is naturally omitted from the above, and MX forwards the data to the subscriber of the fixed network.

If MX itself transmits data or delivers data from a subscriber of the fixed network, the signalling concerning the calling MS is naturally omitted from the above.

In the present invention, interference in signalling relating to call establishment and maintenance, and thereby interference in speech traffic due to the SDM/EDM transmission are prevented by reserving for data transmission a dedicated control channel, on which is sent no more control signalling than what is necessary for providing a data transmission. This signalling includes a so-called ALOHA message, which gives the radio units MS monitoring the control channel a permission to send the above-mentioned RQC message to a base station BS. Signalling messages sent by the system include an SYS code indentifying the system, on the basis of which code the radio units MS know that the radio channel belongs to their own system. The SYS code used on the control channel reserved for data transmission according to the invention is selected in such a way that no one of the radio units MS is able to select this radio channel as a control channel for monitoring and performing other signalling than signalling relating to SDM/EDM transmission. The use of the SYS code and the selection of the control channel are described in MPT1327, Section 9.

The invention will be illustrated in the following by using as an example a SDM/EDM transmission from an MS over the radio system to another MS.

When a calling radio unit MS desires to perform an SDM/EDM transmission, it sends on a normal control channel (which is not said data transmission channel) in a normal manner an RQC message, in which it requests permission to send data. After the radio system has made sure that the called party of the data transmission (e.g. another radio unit) is available, the system commands both parties of the data transmission by a normal GO-TO-CHANNEL message to said radio channel operating like a control channel for performing the data transmission on that data channel. Several radio units may be allocated to the same data channel simultaneously, the accurate number of the radio units depending on the amount of data transmission. The call control CCC of the mobile exchange MX preferably controls the amount of radio units on the data channel in such a way that the effective transmission rate of the data channel per a radio unit does not decrease too low, e.g. below a predetermined threshold.

Figure 3 shows a signalling diagram illustrating an application of the present invention to a multisegment SDM/EDM transmission according to MPT1343, Section 14, between two radio units MS. At 1, a calling radio unit MS requests a SDM transmission by sending an RQC message on a normal control channel. The value of the field SLOTS of the RQC message is "11" indicating that three time slots of the channel are required for a HEAD message containing the first segment of the multisegment transmission (MST).

After having received the RQC message, at 2, the fixed network (the MXs and BSs) sends the called radio unit MS on a normal control channel an AHY message in order to check the availability of the called radio unit MS. At 3, the called MS sends on the nor-

mal control channel an ACK message to the network as an acknowledgement of the AHY message.

After this the network commands the both radio units MS for a data session to go to a radio channel reserved for data transmission and operating like a control channel by sending them on the normal control channel a GO-TO-CHANNEL command containing the number of said data transmission channel. After the radio units MS have gone to the data transmission channel, the network sends to the calling radio unit MS on the data channel an AHYC message, in which field DESC is set to state "100". The first bit of field DESC indicates that a multisegment transmission is supported. The second and third bit of the field indicate that a first data segment is requested. Field SLOTS is in state "11", which indicates that the network has reserved three time slots from the data channel for a HEAD message containing the first data segment.

At 5, the calling MS sends on the data transmission channel a HEAD message containing the first data segment. GFI field of the HEAD message indicates the data format. Field NEG = "10" indicates that two more segments will be sent. Field CSEG = "1" indicates that three time slots from the data transmission channel are required for a HEAD message containing the following segment.

At 6, the network sends the calling MS an AHYC message, in which field DESC is in state "101" requesting a HEAD message containing the second data segment. Field SLOTS is in state "11" indicating that three time slots have been reserved for the HEAD message. At 7, the calling MS sends a HEAD message containing the second data segment. Field NSEG = "01" indicates that one or several more data segment(s) will be transmitted. Field CSEG = "0" indicates that

two time slots are required for a HEAD message containing the following segment.

At 8, the network sends the calling MS an AHYC message, in which field DESC = "110" requests a HEAD message containing the third data segment. Field SLOTS is in state "10" indicating that two time slots have been reserved for the HEAD message. At 9, the calling MS sends a HEAD message containing the third segment. Field NSG will not be sent or it is in state "00" indicating that all segments have been transmitted.

At 10, the network sends the called MS a HEAD message containing the first one of said data segments on the same or another data channel. At 11, the called MS sends an ACKB message as an acknowledgement, which message indicates that the HEAD message has been received successfully.

At 12, the network sends the called MS on the data channel a HEAD message containing one of said two data segments, and the called MS acknowledges a successful reception by sending an ACK message on the data channel at 13. Then, at 14, the network sends on the data channel a HEAD message containing the last data segment to the called MS, which acknowledges the reception by sending an ACK message (at 15).

Then, at 17, the network sends the calling MS an ACK message, which indicates that the data transmission has been successfully completed (17).

After the termination of the data transmission the network sends in a GO-TO-CHANNEL message a command to MS to go back to the original control channel. It is also possible that MS is allowed to stay on the data channel operating like a call channel for a limited time after the termination of the data transmission in order to wait for a new data trans-

mission, if the network knows that it is to be expected.

Figure 4 shows a signalling diagram illustrating an application of the present invention to a multisegment SDM/EDM transmission according to MPT1343, Section 14, from the network to a radio telephone MS. At 21, the fixed network (the MXs and BSs) sends the radio unit MS on a normal control channel an AHY message in order to check the availability of the called radio unit MS. At 22, the called MS sends the network on the normal control channel an ACK message as an acknowledgement of the AHY message.

Subsequently, the network commands the radio unit MS to go to the radio channel reserved for data transmission and operating like a call channel, by sending a GO-TO-CHANNEL command containing the number of said channel on the normal control channel.

Then, at 23 to 28, data is transmitted from the network to a radio telephone MS by a signalling similar to the signalling at 10 to 16 in Figure 3. After the termination of the data transmission, the network sends in a GO-TO-CHANNEL message a command to MS to go back to the original control channel.

The figures and the associated description are only intended to illustrate the present invention. As to the details, the radio system and the method according to the invention may vary within the scope of the attached claims.

Claims:

1. A radio system, comprising mobile radio stations (MS) and a plurality of base stations (BS), each base station having a radio channel operating as a call channel for signalling between the base station (BS) and mobile radio stations (MS), the mobile radio stations (MS) being capable of transmitting user data on control channels among the actual control signalling, c h a r a c t e r i z e d in that the radio system comprises for said user data transmission at least one radio channel operating like a control channel, but transmitting control signalling which prevents the mobile stations from selecting said radio channel as a control channel.

2. A method of transmitting data in a radio system, comprising mobile radio stations (MS) and a plurality of base stations (BS), each base station having a radio channel operating as a control channel for signalling between the base station (BS) and mobile radio stations (MS), in which method

a mobile radio station (MS) requests permission to send user data by sending a request message on the control channel to a base station (BS),

the base station (BS) grants a permission to send user data by sending an acknowledgement message on the control channel, and

the mobile radio station (MS) sends a user data message in response to the reception of the acknowledgement message, c h a r a c t e r i z e d in that, after having received the request to send user data from the mobile radio station, the base station (BS) sends the mobile radio station a command to go for a data transmission to the radio channel operating like a control channel, but reserved only for

said user data transmission.

3. A method of transmitting data in a radio system, comprising mobile radio stations (MS) and a plurality of base stations (BS), each base station having a radio channel operating as a call channel for signalling between the base station (BS) and mobile radio stations (MS), in which method

a base station (BS) sends a packet data transmission request on the control channel to a mobile station (MS), and

the mobile radio station (MS) sends an acknowledgement message to the base station (BS) on the control channel,

c h a r a c t e r i z e d in that, after having received the acknowledgement message from the mobile radio station (MS) on the control channel, the base station (BS) sends to the mobile radio station a command to go for a data transmission to the radio channel operating like a call channel, but reserved only for data transmission.

4. A method according to claim 2 or 3, c h a r a c t e r i z e d in that a mobile radio station (MS) requests permission to transmit user data to another mobile radio station, the radio network checks the availability of the other mobile radio station, and the radio network commands both mobile radio stations to the radio channel reserved for data transmission.

5. A method according to claim 2, 3 or 4, c h a r a c t e r i z e d in that several mobile base stations (MS) communicate simultaneously with the base station (BS) on said radio channel reserved for data transmission.

6. A method according to claim 5, c h a r a c t e r i z e d in that the number of mobile radio

stations (MS) communicating simultaneously on said radio channel reserved for data transmission is controlled in such a way that the effective transmission rate of said radio channel per one mobile radio station is not lower than a predetermined threshold.

7. A method according to any of the claims 1 to 6, c h a r a c t e r i z e d in that, after the termination of the data transmission, the base station (BS) sends to the mobile station (MS) a command to go back to the original control channel.

8. A method according to any of the claims 1 to 6, c h a r a c t e r i z e d in that, after the termination of the data transmission, the mobile radio station (MS) is allowed to stay on the radio channel operating like a control channel for a limited time in order to wait for a new data transmission, if such a transmission is expected.

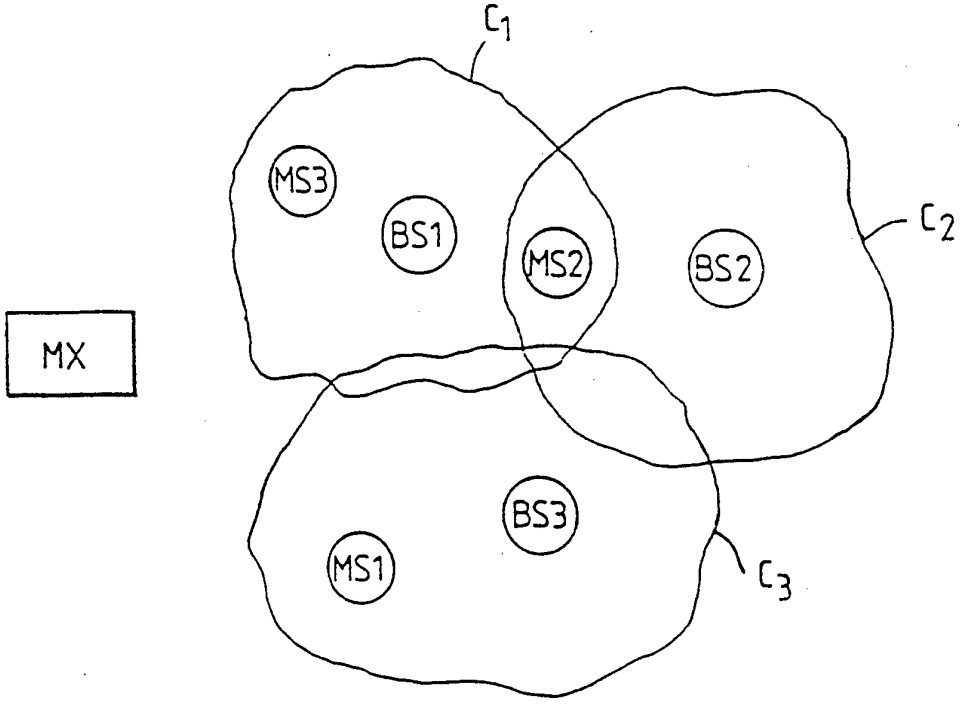


FIG. 1

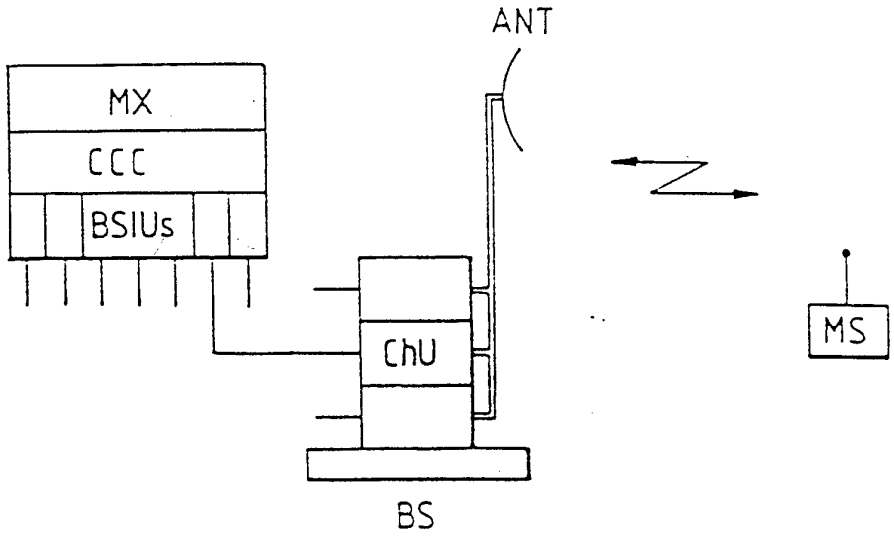


FIG. 2

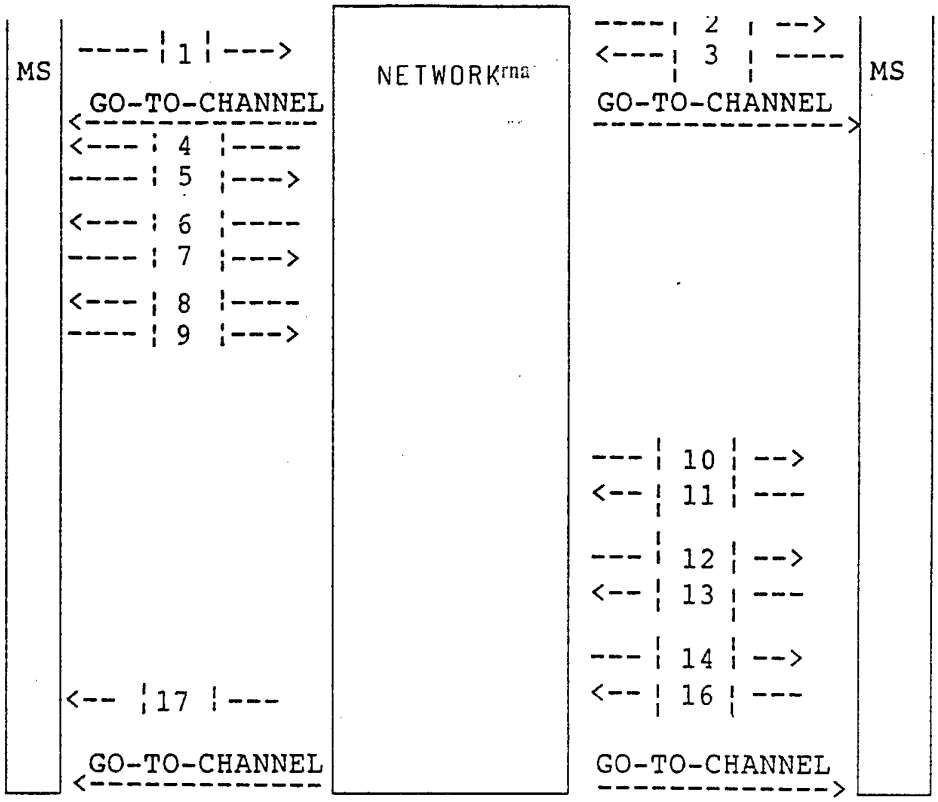

MS
NETWORK
MS
1
2
3
GO-TO-CHANNEL
GO-TO-CHANNEL
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5
6
7
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9
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11
12
13
14
16
17
GO-TO-CHANNEL
GO-TO-CHANNEL

FIG. 3

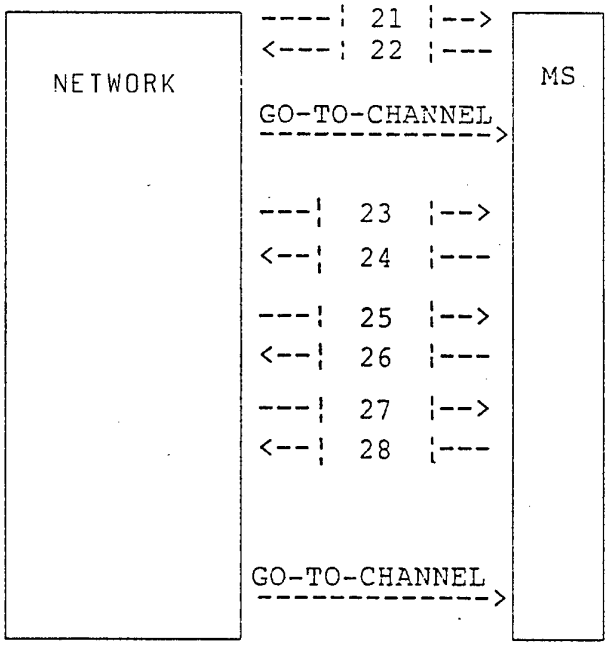

NETWORK
MS
21
22
GO-TO-CHANNEL
23
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28
GO-TO-CHANNEL

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 93/00324

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: H04Q 7/04, H04B 7/26
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: H04B, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPIL, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4837858 (S.F. ABLAY ET AL), 6 June 1989 (06.06.89), the whole document ---	1-8
A	EP, A2, 0332818 (MOTOROLA, INC.), 20 Sept 1989 (20.09.89), column 6, line 55 - column 8, line 57 --- --------	1-8

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
6 December 1993	13 -12- 1993
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Bo Gustavsson Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

16/10/93

International application No.
PCT/FI 93/00324

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4837858	06/06/89	CA-A- 1275746	30/10/90
		EP-A- 0358659	21/03/90
EP-A2- 0332818	20/09/89	JP-A- 1274524	02/11/89
		US-A- 4887265	12/12/89