WO 01/31949 A1

Title: A METHOD FOR THE MANAGEMENT OF SUBSCRIBER STATIONS IN A TETRA SYSTEM

The present invention relates to a TETRA system which comprises a mobile exchange (DXT), a subscriber station (1) for which a subscriber-station-specific TEI serial number is determined and which comprises means for establishing a connection to a second subscriber station (2) via the mobile exchange (DXT), or alternatively, on a direct-mode channel, and a base station (TBS1) having a data transmission connection to the mobile exchange (DXT) and comprising means for receiving the TEI serial number transmitted by said subscriber station (1) over the radio path and for forwarding the same to the mobile exchange (DXT). For more efficient management of the subscriber stations, the mobile exchange (DXT) is connected by means of a data transmission connection to an equipment register (EIR) which stores data on subscriber stations whose calls are to be handled in a predetermined manner. The mobile exchange (DXT) comprises means for transmitting the received TEI serial number to the equipment register (EIR). The equipment register (EIR) is arranged to check whether the TEI serial number received from the mobile exchange (DXT) is included in the data stored in the equipment register and to transmit a message...
A method for the management of subscriber stations in a TETRA system

The present invention relates to a TETRA (Terrestrial Trunked Radio) system and particularly to management of subscriber stations in the TETRA system.

In known TETRA systems, a TEI (Tetra Equipment Identity) serial number is determined for subscriber stations. Said TEI serial number is conveyed in specific situations from the subscriber station to the mobile exchange. Call establishment is one of these situations, when the subscriber station sends its TEI serial number over the radio path to a base station, wherefrom it is forwarded to the mobile exchange. On the basis of the TEI serial number the mobile exchange is able to identify the subscriber station concerned.

One drawback of the known TETRA systems is that they do not enable the operator to subject a given subscriber station to special monitoring, for instance. This need may arise, for instance, if the operator has doubts that a subscriber station is defective and therefore the operator would like to monitor the operation of said subscriber station. The object of the present invention is to solve the above problem and to provide a solution which enables monitoring of the subscriber stations in the TETRA system. This is achieved by a method of the invention for handling the TEI serial number of the subscriber station in the TETRA system, in which method the mobile exchange receives the TEI serial number of the subscriber station. The method of the invention is characterized by transmitting the TEI serial number in an enquiry message from the mobile exchange of the TETRA system to a GSM-EIR equipment register, whose memory maintains data on the subscriber stations whose calls are to be handled in a predetermined manner; checking whether the TEI serial number transmitted to the equipment register is included in the data stored therein; and transmitting a response message indicating the result of checking from the GSM-EIR equipment register to the mobile exchange of the TETRA system.

The invention further relates to a TETRA system comprising a mobile exchange, a subscriber station, for which is determined a subscriber-station-specific TEI serial number, and which comprises means for establishing a connection to a second subscriber station via the mobile exchange, or alternatively, on a direct-mode channel, and a base station having a data transmission connection to the mobile exchange and comprising means for receiving the TEI serial number transmitted by the subscriber station over the
radio path and forwarding the same to the mobile exchange. The TETRA sys-
tem according to the invention is characterized in that the mobile exchange is
connected via a data transmission connection to a GSM-EIR equipment regi-
ster, in which are stored data on the subscriber stations whose calls are to be
handled in a predetermined manner, which equipment register comprises
means for receiving the TEI serial number from the mobile exchange of the
TETRA system; that the mobile exchange comprises means for transmitting
the received TEI serial number to the equipment register; and that the GSM-
EIR equipment register is arranged to check whether the TEI serial number
received from the mobile exchange is included in the data stored in the
equipment register and to transmit a message indicating the result of checking
to the mobile exchange.

The invention is based on the idea that an operator in the TETRA
system can more effectively than before manage and monitor the subscriber
stations employing the system, when the TETRA system is supplemented with
an equipment register which allows the mobile exchange to find out, on the
basis of the TEI serial number received, whether the calls of the subscriber
station in question should be handled in any particular manner predetermined
by the operator. Thus, the operator can store in the equipment register, for
instance, information that during the calls of a given subscriber station the
TETRA system carries out some extra measurements in order to provide addi-
tional information on the operation of the subscriber station. Alternatively, the
operator can store in the equipment register information that all the calls of the
subscriber station concerned should be blocked. This may be necessary, for
instance, if the subscriber station is stolen. According to the invention, the
equipment register can be provided in the TETRA system by adopting a GSM-
EIR equipment register which comprises communication means for receiving
the TEI serial number from the mobile exchange of the TETRA system and for
transmitting a message indicating the result of checking to the mobile ex-
change of the TETRA system. In this context, the GSM-EIR equipment regis-
ter (Global System for Mobile Communications, Equipment Identity Register)
refers to an EIR equipment register designed for the GSM system, the EIR
equipment register being provided with necessary means in order to be able to
communicate with the mobile exchange of the TETRA system. According to
the invention, this avoids the need to design from the very beginning a par-
ticular equipment register intended for the TETRA system. Instead of design-
ing a separate equipment register, the TETRA system can adopt the equipment register designed for the GSM system with necessary modifications to enable said equipment register to communicate with the mobile exchange of the TETRA system.

The main advantages of the system according to the invention are that the invention enables more efficient management and monitoring of the subscriber station in the TETRA system without having to design an entirely new EIR equipment for the TETRA system. Instead, it is possible to utilize the results of GSM-EIR designing to a great extent. Considerable cost savings are achieved with this solution.

The preferred embodiments of the method and TETRA system according to the invention are disclosed in the attached dependent claims 2 and 4 to 5.

In the following, the invention will be described in greater detail by way of example, with reference to the accompanying drawings, wherein

Figure 1 is a flow chart of a first preferred embodiment according to the invention; and

Figure 2 is a block diagram of a first preferred embodiment of a TETRA system according to the invention.

Figure 1 is a flow chart of a first preferred embodiment according to the invention. The flow chart of Figure 1 can be applied to a TETRA system, for instance.

In block A of Figure 1, a mobile exchange receives a TEI serial number from a subscriber station. For instance, it can be a situation where a user is making a call with the subscriber station, whereby the subscriber station, in conjunction with other signalling, transmits in a manner known per se its TEI serial number to the mobile exchange of the TETRA system.

In block B, the mobile exchange transmits the received TEI serial number to the equipment register. It is assumed in the block diagram of Figure 1 that the register is the GSM-EIR equipment register.

In block C, an enquiry message is subjected to necessary modifications in order to make it compatible with the GSM-EIR equipment register. Since the enquiry message originates from the mobile exchange of the TETRA system, it must be modified in most occasions in order that the GSM-EIR equipment register would be able to handle it.

According to the invention, the enquiry message need not be ap-
plied to the GSM-EIR register through a MAP interface, as is done in the GSM system. Instead, it is possible to retrieve from the data section of the enquiry message only the TEI serial number which will be applied to the GSM-EIR equipment register together with a message identifier. The message identifier is selected to be the same as the one used in the GSM system. Thus, the TEI serial number and the message identifier, on the basis of which the equipment register knows that it should perform a database enquiry, are applied to the GSM-EIR equipment register.

According to the invention, the equipment register maintains lists on subscriber stations such that the memory of the equipment register comprises e.g. a white list, a grey list and a black list. For instance, the TEI serial numbers of all the subscriber stations that the operator wishes to prevent from being used in the network may appear on the black list. Correspondingly, the TEI serial numbers of all the subscriber stations the use of which the operator wishes to monitor particularly closely (e.g. subscriber stations that are assumed to be defective) may appear on the grey list.

If the equipment register detects in block D that the received TEI serial number appears on one of the lists, it transmits in block E a response message which indicates the list on which the TEI serial number was found. Hence, said response message may contain information which indicates, for instance, that said TEI serial was found on the black list. When this information is conveyed to the mobile exchange, the mobile exchange prevents said subscriber station's call establishment attempt.

Whereas, if the equipment register detects in block D that the received TEI serial number does not appear on any list, it transmits a response message which indicates that the TEI serial number is unknown.

In block G, the response message is modified compatible with the mobile exchange of the TETRA system. According to the invention, the response message need not be transmitted via a MAP interface of the GSM-EIR equipment register to the mobile exchange of the TETRA system. Instead, according to the invention means can be arranged in the equipment register, by which means the GSM-EIR equipment register is able to transmit response message data to the mobile exchange of the TETRA system by means of the signalling protocol used by said system. According to the invention, the GSM-EIR equipment register may comprise communication means for using two different signalling protocols. In practice, one or more computer programs may
constitute said communication means.

Figure 2 is a block diagram of a first preferred embodiment of the TETRA system according to the invention.

Figure 2 shows a TETRA system part which comprises a mobile exchange DXT, two base stations TBS1 and TBS2, a home location register HLR and an equipment register EIR. Unlike in Figure 2, the equipment register EIR can be connected to the home location register HLR.

The subscriber stations 1 and 2 of the TETRA system can establish a connection to one another either on a direct-mode channel (having a direct radio connection to one another), or alternatively, via the base stations TBS1 and TBS2 and the mobile exchange DXT.

When the subscriber station 1 establishes a call via the base station TBS1 and the mobile exchange DXT, the TEI serial number of the subscriber station is conveyed to the mobile exchange DXT in conjunction with other signalling. According to the invention, the mobile exchange DXT then transmits an enquiry message containing the TEI serial number to the equipment register EIR.

The equipment register in Figure 2 is a GSM-EIR register that is modified according to the invention in order to enable it to cooperate with the mobile exchange of the TETRA system.

In the GSM system, IMEI (International Mobile station Equipment Identity) identifiers of the subscriber stations are stored in a database in the EIR equipment register. The IMEI identifier comprises a 6-digit TAC (Type Approval Code), a 2-digit FAC (Final Assembly Code), a 6-digit SRN (Serial Number) and a 1-digit SP (Spare). The TEI serial number used in the TETRA system is almost identical with the IMEI identifier, i.e. it comprises a 6-digit TAC (Type Approval Code), a 2-digit FAC (Final Assembly Code), a 6-digit ESN (Electronic Serial Number) and a 1-digit SPR (Spare). Hence, the TEI serial number used in the TETRA system can be stored in the GSM-EIR register according to the invention.

However, the GSM and the TETRA systems may use mutually different signalling protocols. In other words, if the interface between the equipment register EIR and the GSM mobile exchange is MAP, the TETRA system, instead, can use another interface which hereinafter, by way of example, will be called a PUP (Professional mobile radio User Part) interface. In view of this, the equipment register EIR in Figure 2 is provided with communication means
3 and 4 in order to enable the equipment register EIR to communicate both with the GSM mobile exchange and the TETRA mobile exchange (in practice, the EIR equipment register is arranged either in the GSM system or in the TETRA system, whereby either the communication means 3 or 4 are out of use). In practice, the communication means 3 and 4 can be implemented as a computer program.

Since the TETRA system of Figure 2 utilizes the GSM-EIR equipment register, said equipment register also provides an interface to a CEIR (Central Equipment Identity Register) equipment register. The CEIR is a common, centralized equipment register of different networks where data of a plurality of operators can be collected. In practice, the equipment registers can be implemented such that each operator has in its network a dedicated EIR equipment register where the operator maintains data on the subscriber stations. The mobile exchange (or mobile exchanges, if more than one) of the operator performs subscriber station enquiries from the EIR equipment register of the operator. However, the EIR equipment register of each operator communicates with the centralized CEIR equipment register, to which the subscriber station data of all operators are conveyed from the EIR equipment register, and correspondingly, the CEIR equipment register conveys all subscriber station data entered therein to the EIR equipment registers of different operators so as to keep the subscriber station data of these registers updated.

It is to be understood that the above specification and the relating drawings are only intended to illustrate the present invention. It is obvious to the person skilled in the art that the invention can be varied and modified in a variety of ways within the scope and spirit of the invention set forth in the appended claims.
CLAIMS

1. A method for handling a TEI serial number of a subscriber station in a TETRA system, in which method a mobile exchange receives the TEI serial number of the subscriber station, characterized by

transmitting the TEI serial number in an enquiry message from the mobile exchange of the TETRA system to a GSM-EIR equipment register, whose memory maintains data on subscriber stations whose calls are to be handled in a predetermined manner;

checking whether the TEI serial number transmitted to the equipment register is included in the data stored therein; and

transmitting a response message indicating the result of the checking from the GSM-EIR equipment register to the mobile exchange of the TETRA system.

2. A method as claimed in claim 1, characterized by

modifying the enquiry message transmitted by the mobile exchange of the TETRA system to be compatible with the GSM-EIR equipment register; and

modifying the response message transmitted by the GSM-EIR equipment register to be compatible with the mobile exchange of the TETRA system.

3. A TETRA system comprising

a mobile exchange (DXT),

a subscriber station (1), for which a subscriber-station-specific TEI serial number is determined and which comprises means for establishing a connection to a second subscriber station (2) via the mobile exchange (DXT), or alternatively, on a direct-mode channel, and

a base station (TBS1) having a data transmission connection to the mobile exchange (DXT) and comprising means for receiving the TEI serial number transmitted by said subscriber station (1) over the radio path and forwarding the same to the mobile exchange (DXT), characterized in that the mobile exchange (DXT) is connected via a data transmission connection to a GSM-EIR equipment register (EIR), in which are stored data on subscriber stations whose calls are to be handled in a predetermined manner, which equipment register comprises means (3) for receiving the TEI serial number from the mobile exchange (DXT) of the TETRA system;
that the mobile exchange (DXT) comprises means for transmitting the received TEI serial number to the equipment register (EIR); and
that the GSM-EIR equipment register (EIR) is arranged to check whether the TEI serial number received from the mobile exchange (DXT) is included in the data stored in the equipment register and to transmit a message indicating the result of checking to the mobile exchange (DXT).

4. A TETRA system as claimed in claim 3, characterized in that said GSM-EIR equipment register (EIR) comprises means (4) for connecting it to a mobile exchange of the GSM system in order to receive an enquiry message including an IMEI serial number from the GSM mobile exchange.

5. A TETRA system as claimed in claim 3 or 4, characterized in that the data stored in the equipment register (EIR) consist of one or more lists from which appear the TEI serial numbers of the subscriber stations, and that said message indicating the result of checking indicates to the mobile exchange (DXT) the list or the lists which include the TEI serial number in question.
START

TEI SERIAL NUMBER IS RECEIVED FROM SUBSCRIBER STATION

ENQUIRY INCLUDING TEI SERIAL NUMBER IS TRANSMITTED TO GSM-EIR EQUIPMENT REGISTER

ENQUIRY IS MODIFIED COMPATIBLE WITH GSM-EIR EQUIPMENT REGISTER

IS TEI INCLUDED IN DATA STORED IN GSM-EIR EQUIPMENT REGISTER?

YES

RESPONSE IS TRANSMITTED INDICATING LIST ON WHICH TEI WAS FOUND

E

NO

RESPONSE IS TRANSMITTED INDICATING THAT TEI IS UNKNOWN

F

RESPONSE MESSAGE IS MODIFIED

G

END

FIG. 1
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/28
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)

IPC7: 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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Relevant to claim No.</th>
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<td>WO 0027153 A1 (NOKIA NETWORKS OY), 11 May 2000 (11.05.00), page 3, line 1 - line 35, abstract</td>
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<td>A</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

Date of the actual completion of the international search: 27 February 2001

Date of mailing of the international search report: 28-02-2001

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