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[54] **CHANNEL RE-ASSIGNMENT METHOD FOR TIME DIVISION MULTIPLE ACCESS (TDMA) TRUNKED SYSTEMS**

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[51] **Int. Cl.**[5] **H04J 3/16**

[52] **U.S. Cl.** **370/95.3**; 370/85.7

[58] **Field of Search** 370/95.1, 95.3, 94.1, 370/85.7, 69.1; 455/34.1, 34.2, 58.2, 33.2, 33.1, 54.2; 379/63, 56, 60

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[57] **ABSTRACT**

A radio communication system controller embodies the present invention by providing extended use (**306**) of a communication resource (**106**) to a plurality of communication units. The inventive method includes the steps of assigning (**402**) a first communication resource to a first communication unit, and then temporarily configuring (**406**) the assigned communication resource as a reserved resource. The controller then receives (**408**), from a second communication unit, a request to transmit a second communication on the assigned communication resource. Lastly, the controller re-configures (**412**) the assigned communication resource to allow transmission of the second communication on the assigned communication resource.

24 Claims, 3 Drawing Sheets

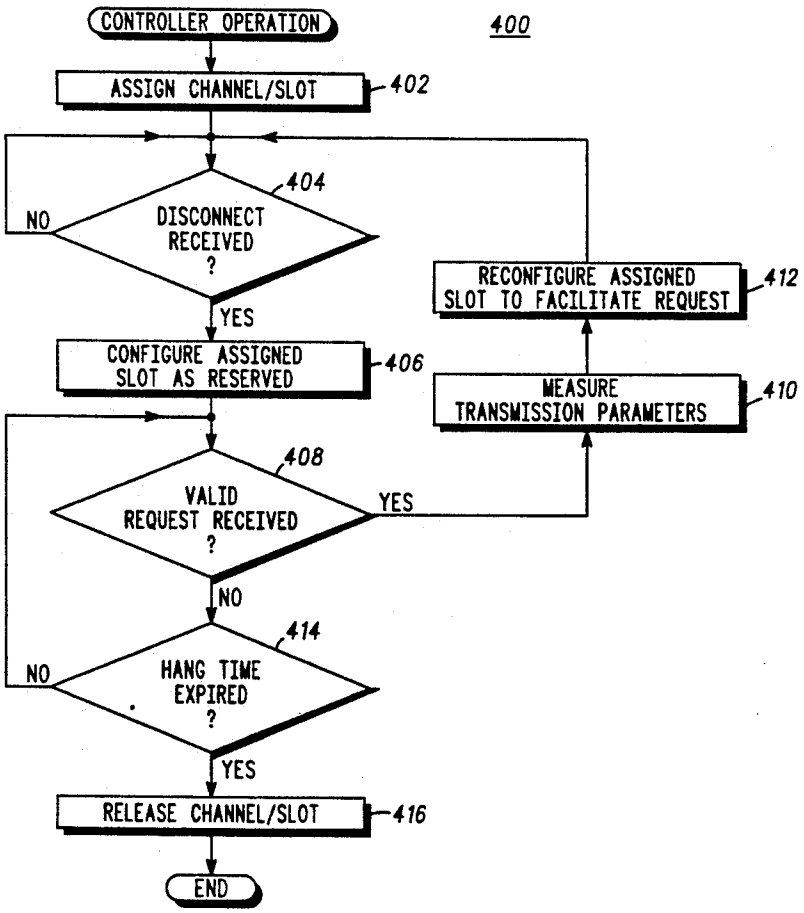


FIG. 1

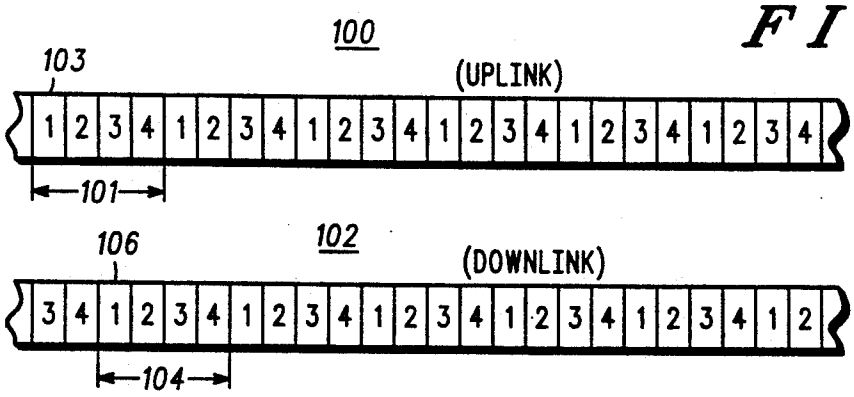


FIG. 2

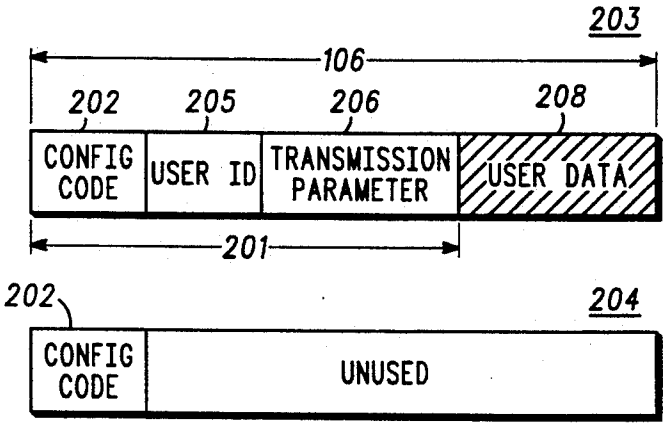


FIG. 3

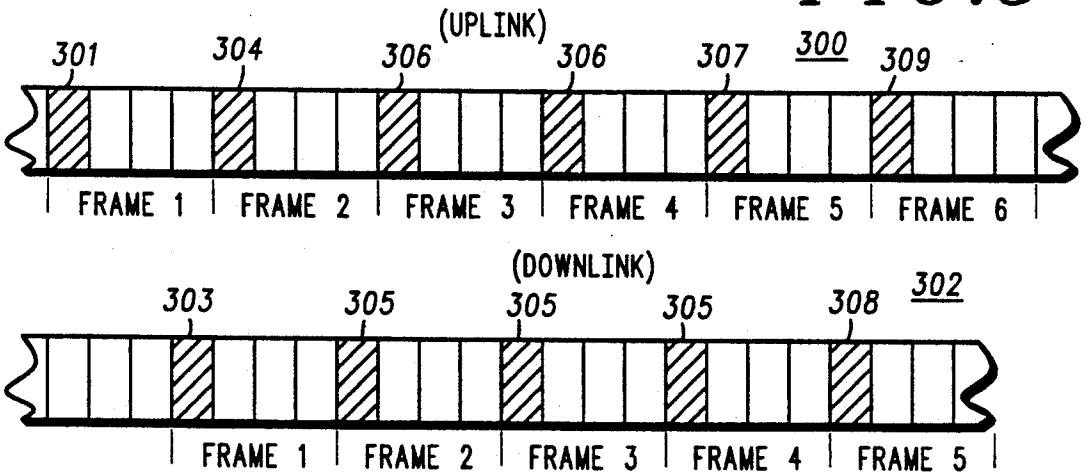


FIG. 4

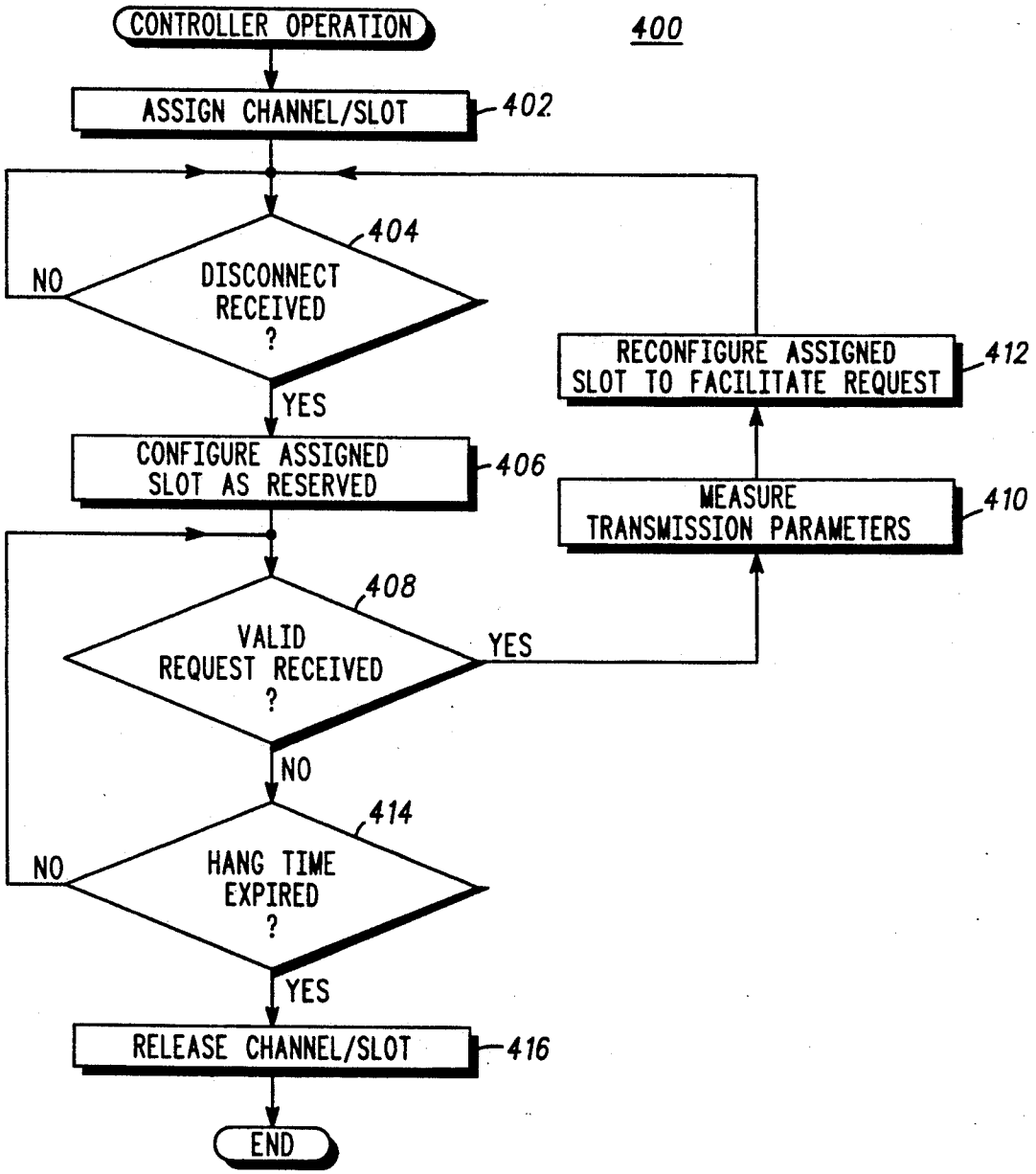
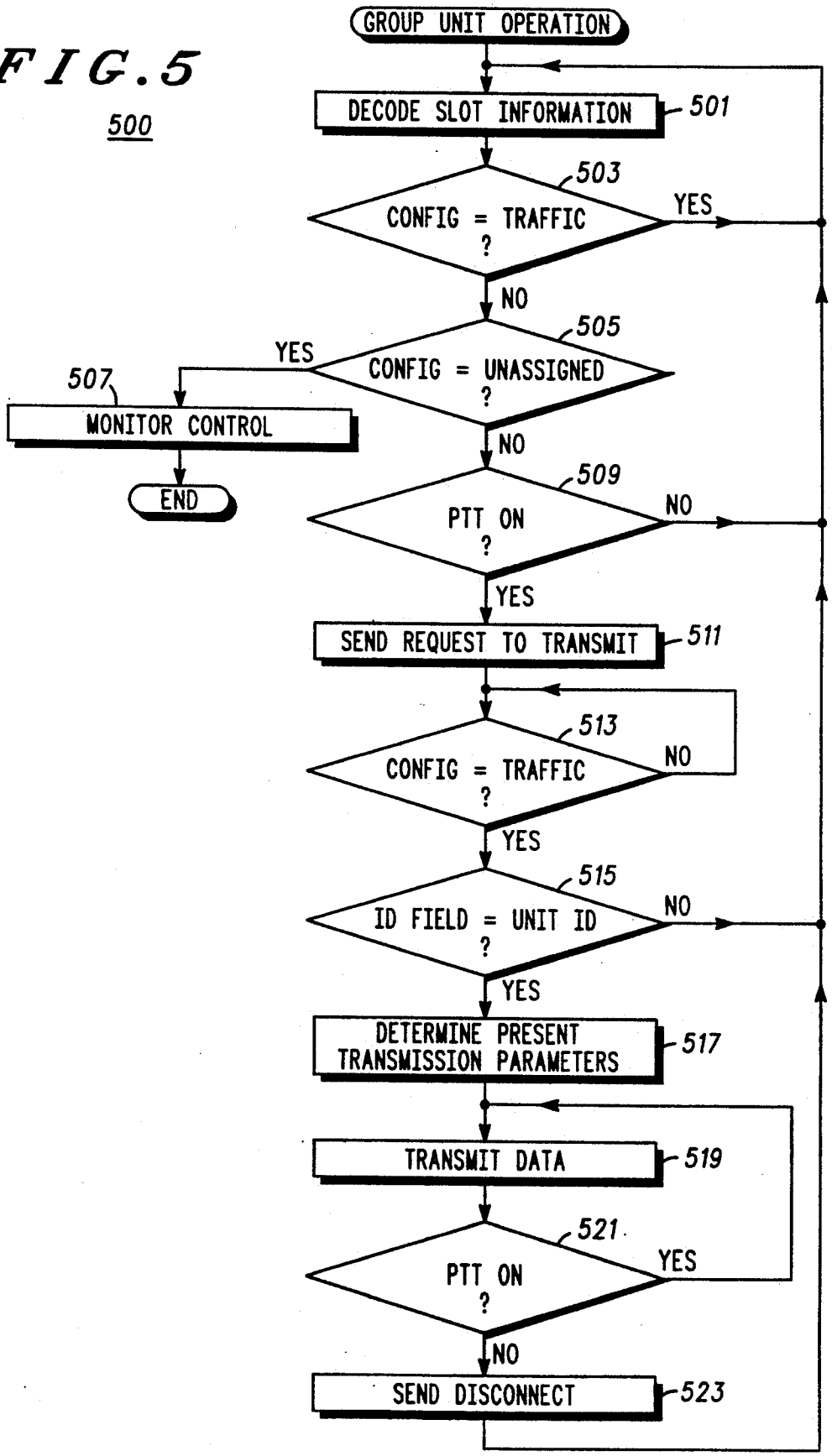


FIG. 5

500



CHANNEL RE-ASSIGNMENT METHOD FOR TIME DIVISION MULTIPLE ACCESS (TDMA) TRUNKED SYSTEMS

FIELD OF THE INVENTION

The invention relates, in general, to radio communication systems, and in particular, to communication systems which employ a time division multiple access (TDMA) signalling protocol.

BACKGROUND OF THE INVENTION

Trunked radio frequency (RF) communication systems are well known in the art. In such systems, a plurality of subscribers (e.g., mobiles, portables, consoles) share a limited number of communication resources, e.g., channels. In particular, channels are typically assigned to requesting subscribers by a communication resource controller, which request and assignment are exchanged via a common control channel. The controller might assign a channel to an individual subscriber for a single transmission such that, at the end of the subscriber's transmission, the channel is re-assigned to another subscriber (i.e., so-called transmission trunking).

In the alternative, the controller might assign a channel to a group of subscribers for engaging in a conversation, and keep the channel assignment active until completion of, or a substantial pause in, the conversation. That is, the assigned channel is not made available for re-assignment until the end of the conversation is anticipated. A conversation may include multiple transmissions from multiple subscribers and is referred to in the art as a message. Accordingly, this form of channel assignment is referred to as message trunking.

Subscribers attempting to engage in a conversation on a transmission trunked system are required to execute channel assignment request procedures for each transmission. Such procedures may result in significant transmission delay, particularly if an idle channel is not available at the time of the request. Message trunking eliminates the channel assignments within a conversation. Hence, message trunking presents benefits to the communication system users by allowing conversations to proceed in a more efficient and natural manner.

Prior art systems have attempted to offer message trunked services by appending a time delay, known as the "hang-time", to the end of each subscriber transmission. In these systems, the controller extends the assignment (i.e., leaves it open for another subscriber belonging to the group who wishes to transmit) for a predetermined period, or so-called hang-time. If no new transmission is begun by the completion of the hang-time, the system controller terminates the channel assignment. As long as the time intervals between successive transmissions are less than the hang-time, message trunking is effectuated.

During the course of a conversation, the communication controller typically receives transmissions from multiple subscribers. Each transmission may exhibit substantially different transmission characteristics, e.g., propagation delay, power level, etc. These differences are at least partially due to the subscribers being located at substantially different distances from the communications controller. Today's message trunked communication, e.g., frequency division multiplex (FDM) systems, simply accept each new transmission, and its associated transmission characteristics. Accordingly, the prior art method for accomplishing message trunking works well only for systems which are relatively robust with respect to differences in transmission characteristics between multiple subscribers. A new method is required for systems which are more sensitive to differences in subscriber transmission characteristics.

Communication systems employing time division multiple access (TDMA) signalling are well known. These systems divide an RF resource into a series of recurring time frames which are further divided into time-slots, as shown in FIG. **1**. Time-slots **103**, occurring periodically in time frames **101**, constitute the communication channels of interest. As earlier described, the controller assigns a channel (i.e., time-slot) to a group of subscribers to enable a conversation among subscribers belonging to the group. That is, group members communicate (i.e., transmit and receive) information among themselves using the assigned time-slot. Unlike FDM systems, however, the timing of each subscriber transmission in a TDMA system must be strictly controlled to avoid interference among subscribers transmitting on adjacent time-slots. In particular, even slight differences in transmission parameters, e.g., propagation delay, power level, cause an undesirable level of inter-slot interference.

Many known systems control subscriber timing by enabling the controller to measure the arrival time of the received request on the control channel, and adjusting the timing prior to the first transmission on the assigned channel. However, this measurement is only applicable to the subscriber submitting the initial request for a channel assignment. Subsequent transmissions from other group members (i.e., which demonstrate substantial differences in transmission timing from the initiating subscriber) can cause interference with the time-slots adjacent to the assigned time-slot. Similarly, excessive power levels of uplink transmissions may cause interference among adjacent time-slots, resulting in performance degradation. Control of transmission power levels from the initiating subscriber, therefore, would help to enhance system performance.

Accordingly, there exists a need for a radio communication system which is able to maintain efficient usage of available communication resources, while limiting undesirable interference among those resources. In particular, a TDMA system which provides message trunking for group calls, would be an improvement over the prior art. That is, by reserving an assigned time-slot for the group members, and updating transmission parameters for each transmission, a TDMA radio system would not be constrained by foregoing limitations of today's systems.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a simplified graphical representation of an uplink data frame sequence and a downlink data frame sequence, as is well known in the art.

FIG. **2** shows a simplified graphical representation of a downlink slot, in accordance with the present invention.

FIG. **3** shows a simplified graphical representation of an uplink data stream and a downlink data stream, in accordance with the present invention.

FIG. **4** shows a simplified flow diagram depicting the operation of a radio communication system controller, in accordance with the present invention.

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