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Herrmann

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(54) **WIRELESS NETWORK WITH A DATA EXCHANGE ACCORDING TO THE ARQ METHOD**

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H04L 12/28 (2006.01)
H04L 12/56 (2006.01)
H04L 1/18 (2006.01)

(52) **U.S. Cl.** **370/349**; 370/394; 370/471

(58) **Field of Classification Search** 370/349, 370/394, 471, 474
See application file for complete search history.

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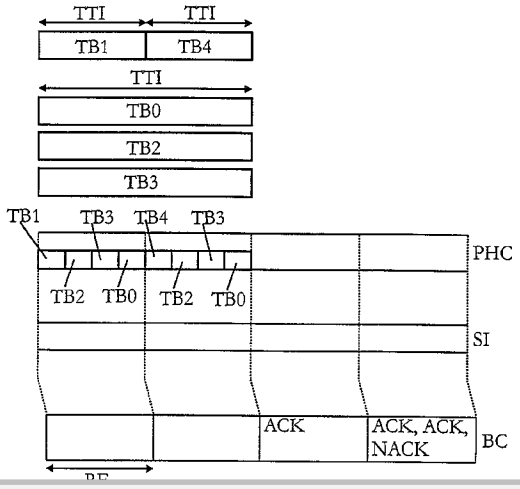
Primary Examiner—Melvin Marcelo

(57) **ABSTRACT**

The invention relates to a wireless network comprising a radio network controller and a plurality of assigned terminals, which are provided for exchanging data according to the hybrid ARQ method of type II or III and each form a receiving and/or transmitting side. A physical layer of a transmitting side is arranged for

- storing coded transport blocks in a memory, which blocks contain at least a packet data unit delivered by the assigned radio link control layer and can be identified by a packet data unit sequence number,
- storing abbreviated sequence numbers whose length depends on the maximum number of coded transport blocks to be stored and which can be shown unambiguously shown in a packet data unit sequence number, and for
- transmitting coded transport blocks having at least the assigned abbreviated sequence numbers.
- a physical layer of a receiving side is provided for testing the correct reception of the coded transport block and for sending a positive acknowledge command to the transmitting side over a back channel when there is correct reception and a negative acknowledge command when there is error-affected reception.

10 Claims, 3 Drawing Sheets



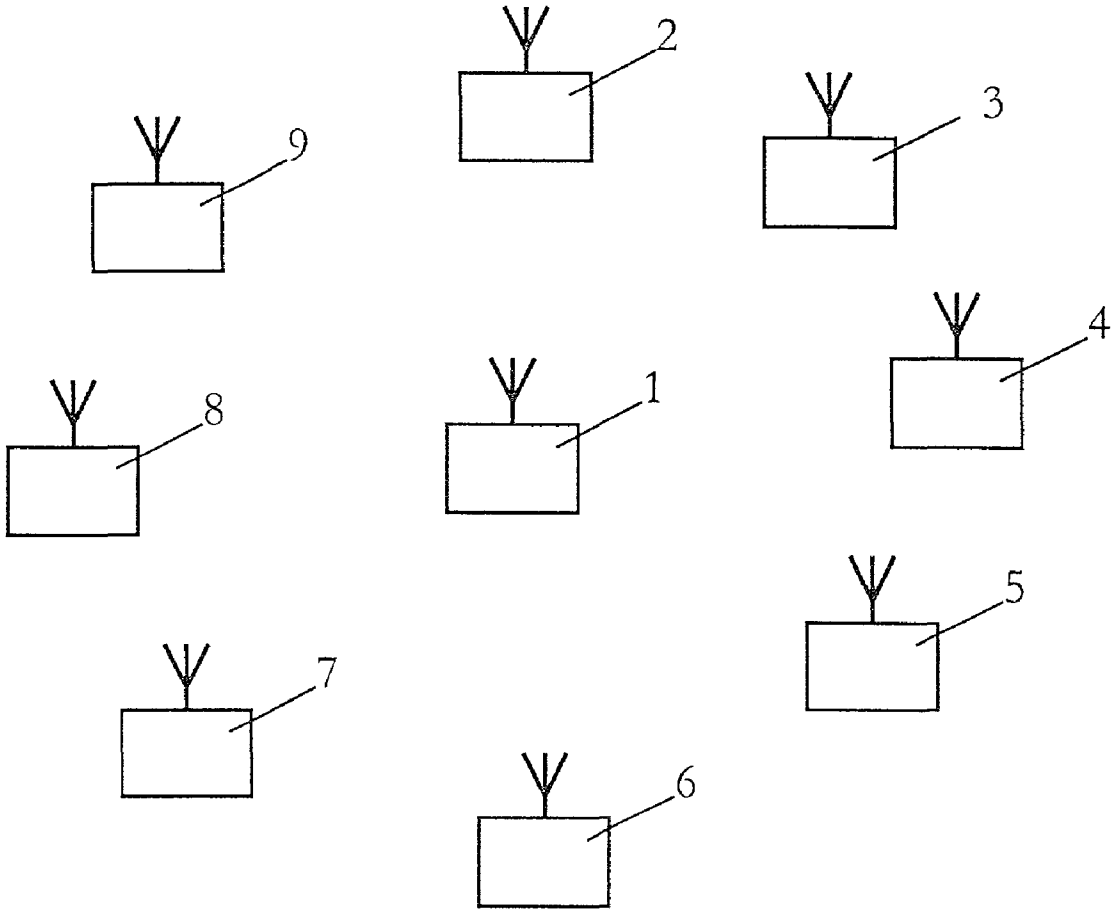


FIG. 1

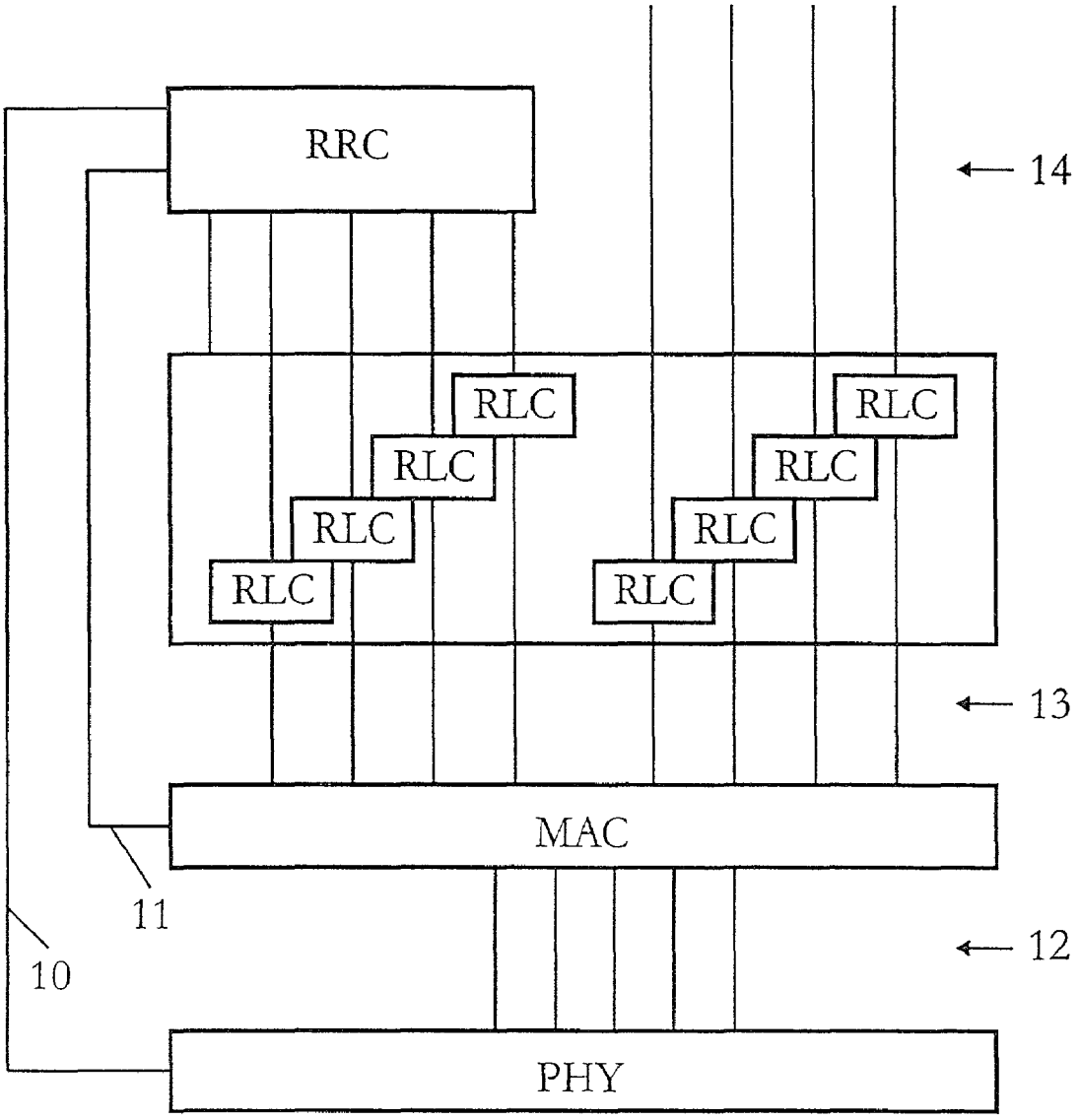


FIG. 2

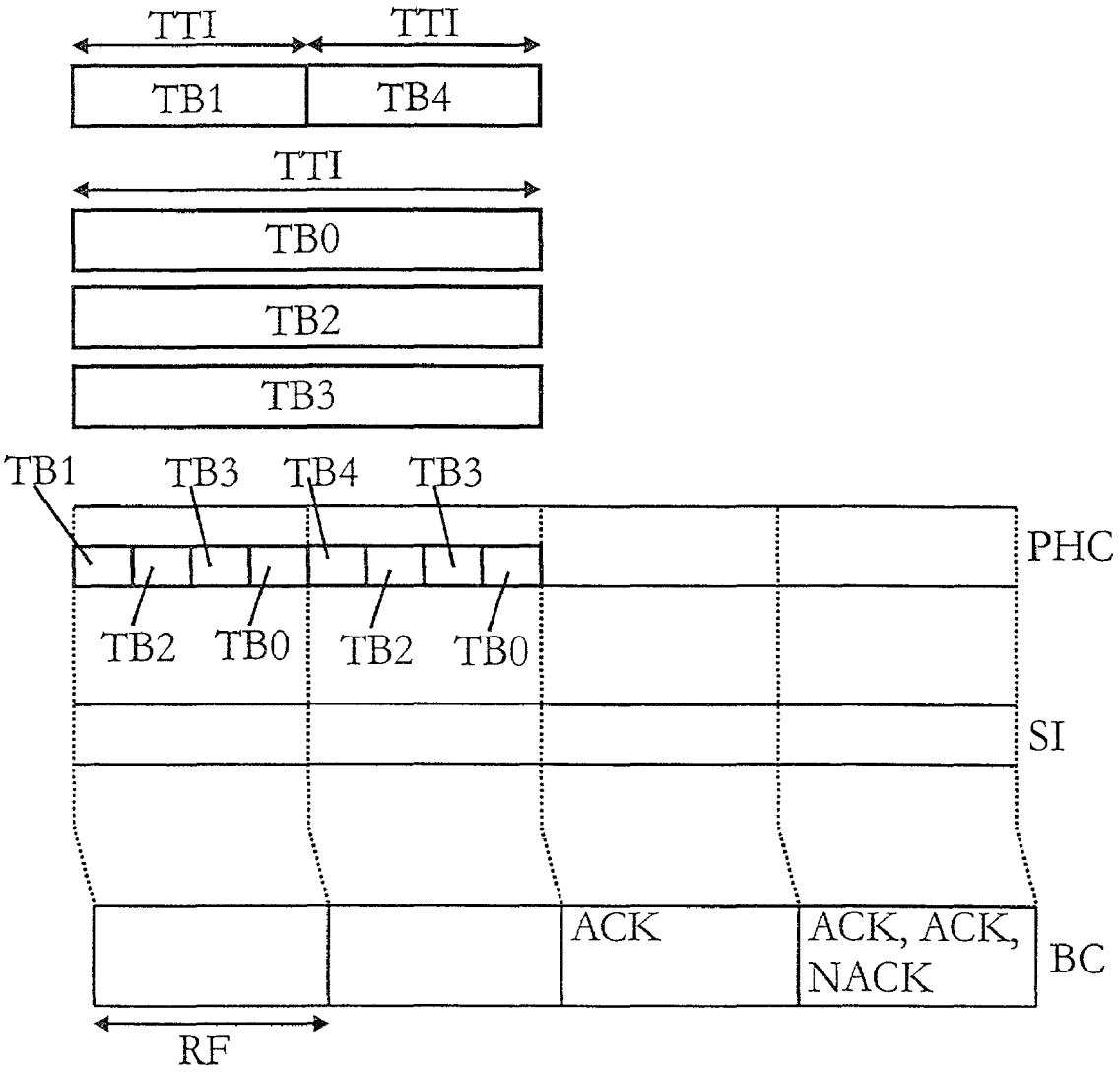


FIG. 3

WIRELESS NETWORK WITH A DATA EXCHANGE ACCORDING TO THE ARQ METHOD

The invention relates to a wireless network comprising a radio network controller and a plurality of assigned terminals, which are each provided for exchanging data and which form a receiving and/or transmitting side.

Such a wireless network is known from the document "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Report on Hybrid ARQ Type II/III (Release 2000), 3G TR 25.835 V0.0.2, TSG-RAN Working Group 2 (Radio L2 and Radio L3), Sophia Antipolis, France, 21–15 August 2000". For the secured transmission of data a method is used here which is called the hybrid ARQ-method type II or III (ARQ=Automatic Repeat Request). The data sent in Packet Data Units (PDU) by the Radio Link Control layer (RLC layer) are additionally provided for the error correcting coding with an error control through repetition of transmission. This means that in the case of an error-affected reception of a packet data unit packed in a transport block coded by one of the assigned physical layers, the received packet data unit affected by error is sent anew. With the hybrid ARQ method type I the received packet data unit affected by error is rejected and an identical copy is requested anew. With the hybrid ARQ methods types II and III the received packet data unit affected by error is buffered and, after additional incremental redundancy relating to the received packet data unit, decoded together with the received packet data unit affected by error. Since only incremental redundancy and not the whole error-affected packet data unit is transmitted anew, the amount of data to be transmitted anew is reduced. With the ARQ method type II the incremental redundancy is useless without the buffered (error-affected) packet, with the ARQ method type III the incremental redundancy can be decoded also without the buffered (error-affected) packet. The coded transport blocks are sent over at least one transport channel. A message about the error-free reception in said document is sent only when the receiving RLC layer establishes on the basis of the so-called RLC sequence number that packet data units are lacking, even if the physical layer has already recognized the packet data unit as being error-affected. This means that the packet data unit is to be buffered over long time spaces until an incremental redundancy is requested and then, after a successful decoding, the reception may be acknowledged as correct, especially when the receiving side is the network side, while the physical layer and the RLC layer are usually located on different hardware components. In addition to the packet data units contained in the transport blocks, the RLC sequence numbers of the packet data unit and a redundancy version are to be transmitted in synchronism with the coded transport block when the hybrid ARQ methods of type II or III are implemented. This transmission is generally effected over a clearly better protected transport channel to safeguard that this information is error-free already at first reception. The information is decisive if after a repetition of transmission with incremental redundancy the buffered (error-affected) packet data unit is decoded together with the incremental redundancy, because the incremental redundancy is to be assigned to the respective packet data unit via the redundancy version.

It is an object of the invention to provide a wireless network in which error-affected data repeatedly to be trans-

The object is achieved by the following features by the wireless network mentioned in the opening paragraph which comprises a radio network controller and a plurality of assigned terminals which are each provided for exchanging data and which form each a receiving and/or transmitting side:

A physical layer of a transmitting side is provided for

storing coded transport blocks in a memory, which blocks contain at least a packet data unit which is delivered by the assigned radio link control layer and can be identified by a packet data unit sequence number,

storing abbreviated sequence numbers whose length depends on the maximum number of coded transport blocks to be stored and which can be shown unambiguously in a packet data unit sequence number, and for

transmitting coded transport blocks having at least the assigned abbreviated sequence number and

a physical layer of a receiving side is provided for testing the correct reception of the coded transport block and for sending a positive acknowledge command to the transmitting side over a back channel when there is correct reception and a negative acknowledge command when there is error-affected reception.

The wireless network according to the invention may be, for example, a radio network according to the UMTS standard (UMTS=Universal Mobile Telecommunication System). With this system, when, for example, data are transmitted according to the ARQ method of type II or III, the transmission of an acknowledge command over a back channel unknown thus far between a physical layer of a transmitting side (for example, a radio network controller) and the physical layer of a receiving side (for example, a terminal) provides that a correct or error-affected transmission of a transport block is announced to the transmitting side much more rapidly than known until now. As a result, a repetition of transmission with incremental redundancy may be effected rapidly. This enables the receiving side to buffer the received coded transport block affected by error clearly more briefly, because the additional redundancy necessary for the correct decoding is available at an earlier instant. In this manner, the memory capacity or memory area needed on average for buffering received coded transport blocks affected by error is also reduced.

The use of abbreviated sequence numbers reduces the extent of information that is required to be additionally transmitted for managing the transport blocks and packet data units and simplifies the assignment of the received acknowledge command to the stored transport blocks. The physical layer of a receiving side is provided here for sending a positive or negative acknowledge command with the abbreviated sequence number of the correctly or received transport block affected by error over the return channel.

In lieu of transmitting the abbreviated sequence number, an abbreviated sequence number of a transport block which a received acknowledge command relates to can also implicitly be determined based on the length of time between the transmission of the transport block and the reception of the acknowledge command and on the transmission sequence of the acknowledge command in case of a plurality of received acknowledge commands. This is made possible in a simple manner in that a transmission of the transport blocks is provided in radio frames and in that the transmission of an acknowledge command from the transmitting side to the

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