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Description

TECHNOLOGY FIELD

[0001] This application is related to wireless communications.

BACKGROUND

[0002] Various approaches have been developed to allow multiple users to reuse a single timeslot in time slotted wireless systems, referred to as Multiple Users Reusing One Slot (MUROS) technologies or Voice Services Over Adaptive Multiuser Channels On One Slot (VAMOS). One such approach involves the use of orthogonal sub-channels (OSC). The OSC concept allows a wireless network to multiplex two wireless transmit/receive units (WTRUs) that are allocated the same radio resource (that is, time slot) and Global System for Mobile communication (GSM) channel, thus the capacity may be significantly improved for a number of available transceiver (TRX) hardware and possibly for the spectrum resource. Furthermore, such a feature is expected to provide voice capacity improvement for both full rate and half rate channels.

[0003] In the uplink (UL) direction, the sub-channels are separated using non-correlated training sequences. The first sub-channel uses existing training sequences, and the second sub-channel uses new training sequences. Alternatively, only new training sequences may be used on both of the sub-channels. Using OSC enhances voice capacity with negligible impact to WTRUs and networks. OSC may be transparently applied for all Gaussian minimum shift keying (GMSK) modulated traffic channels (for example, for full rate traffic channels (TCH/F), half rate traffic channels (TCH/H), a related slow associated control channel (SACCH), and a fast associated control channel (FACCH)).

[0004] OSC increases voice capacity by allocating two circuit switched voice channels (that is, two separate calls) to the same radio resource. By changing the modulation of the signal from GMSK to quadrature phase shift keying (QPSK) (where one modulated symbol represents two bits), it is relatively easy to separate two users - one user on the X axis of the QPSK constellation and a second user on the Y axis of the QPSK constellation. A single signal contains information for two different users, each user allocated their own sub-channel.

[0005] In the downlink (DL), OSC is realized in a base station (BS) using a QPSK constellation that may be, for example, a subset of an 8-PSK constellation used for enhanced general packet radio service (EGPRS). Modulated bits are mapped to QPSK symbols ("dibits") so that the first sub-channel (OSC-0) is mapped to the most significant bit (MSB) and the second sub-channel (OSC-1) is mapped to the least significant bit (LSB). Both sub-channels may use individual ciphering algorithms, such as A5/1, A5/2 or A5/3. Several options for symbol rotation may be considered and optimized by different criteria. For instance, a symbol rotation of $3\pi/8$ would correspond to EGPRS, a symbol rotation of $\pi/4$ would correspond to $\pi/4$-QPSK, and a symbol rotation of $\pi/2$ may provide sub-channels to imitate GMSK. Alternatively, the QPSK signal constellation may be designed such that it resembles a legacy GMSK modulated symbol sequence on at least one sub-channel.

[0006] Several reasons favor QPSK as a choice for the MUROS/VAMOS modulation format. First, QPSK offers robust signal-to-noise ratio (SNR) vs. bit error rate (BER) performance. Second, QPSK may be realized through existing 8-PSK-capable RF hardware. Third, QPSK burst formats have been introduced for Release 7 EGPRS-2 for Packet-Switched Services.

[0007] An alternate approach of implementing MUROS/VAMOS in the downlink involves multiplexing two WTRUs by transmitting two individual GMSK-modulated bursts per timeslot. As this approach causes increased levels of inter-symbol interference (ISI), an interference-cancelling technology such as Downlink Advanced Receiver Performance (DARP) Phase I or Phase II is required in the receivers. Typically, during the OSC mode of operation, a base station (BS) applies DL and UL power control with a dynamic channel allocation (DCA) scheme to keep the difference of received downlink and/or uplink signal levels of co-assigned sub-channels within, for example, a ± 10 dB window. The targeted value may depend on the type of receivers multiplexed and other criteria. In the uplink, each WTRU may use a normal GMSK transmitter with an appropriate training sequence. The BS may employ interference cancellation or joint detection type of receivers, such as a space time interference rejection combining (STIRC) receiver or a successive interference cancellation (SIC) receiver, to receive the orthogonal sub-channels used by different WTRUs.

[0008] OSC may be used in conjunction with frequency-hopping or user diversity schemes, either in the DL, in the UL, or both. For example, on a per-frame basis, the sub-channels may be allocated to different pairings of users, and pairings on a per-timeslot basis may recur in patterns over prolonged period of times, such as several frame periods or block periods.

[0009] Statistical multiplexing may be used to allow more than two WTRUs to transmit using two available sub-channels. For example, four WTRUs may transmit and receive speech signals over a 6-frame period by using one of two sub-channels in assigned frames.

[0010] An extension of the baseline concept called the α-QPSK modulation scheme has been introduced. The α-QPSK modulation scheme suggests a simple means of power control for the in-band and quadrature components of the QPSK symbol constellation. By using an α parameter, the relative power on the MUROS/VAMOS timeslot allocated to the first vs. the second sub-channel on the timeslot may be adjusted in a range of ± 10-15 dB relative to each other. Using this approach, the absolute power allocated by the transmitter to the composite MUROS/VAMOS transmission no longer needs to be precisely ½ power for each user (equivalent to relative power of sub-channel 1/power sub-channel 2 at 0 dB). Other more desirable power ratios may be achieved, such as when one of the MUROS/VAMOS sub-channel (user) is in better signal conditions than the other user, and a power ratio of -3 dB (or higher) would result in better performance for the weaker MUROS/VAMOS user. Together with the absolute Tx power setting of the MUROS/VAMOS composite signal on the timeslot, the α-QPSK concept would result in a relative power control component for MUROS/VAMOS users.

[0011] Another possible extension of this baseline OSC proposal suggests multiplexing of more than just a simple fixed pair of users into the very same allocated burst in all frames by extending the concept to statistical multiplexing of more than just 2 users over a period of at least several frames in a GSM multi-frame structure. At any given point in time (that is, any "burst"), not more than 2 users will transmit using the 2 available sub-channels of the OSC burst. However, when using Half Rate (HR) codecs (any WTRU required to Tx/Rx 1 out of 2 frames), statistical multiplexing of more than just 2 users can be achieved. For example, four users can Tx/Rx their HR speech signals over any given 6 frame period using one of the two available OSCs per burst, and by transmitting only in their assigned frames.

[0012] An even further possible modification to the baseline OSC proposal suggests that re-use of GSM Frequency-Hopping (FH) techniques would result in both interference averaging and the discontinuous transmission (DTX) gains for OSC and non-OSC users, with gains spread relatively equally amongst the WTRUs in the cell. Similar to the first possible modification, in any given burst (i.e., timeslot) not more than 2 users will transmit using the 2 available sub-channels of the OSC burst. However, by assigning different frequency-hopping sequences / Mobile-Allocation-Index-Offset's (MAIO's) to the different WTRUs in the cell, any WTRU may be paired with another WTRU on the next occurrence of a burst. The pattern would repeat after a certain number of frames, as a function of the FH-list. Note that this is applicable to both DL and UL directions.

[0013] With regard to the UL direction, the MUROS/VAMOS proposals and/or extensions including the Frequency-Hopping concept for statistical multiplexing handsets suggest using normal GMSK transmission with different training sequences on the same time slot to allow the BS to distinguish between the two transmissions. Each of the two handsets would transmit a legacy GMSK modulated burst, unlike the OSC DL which may use QPSK. It is assumed that the BS uses either STIRC or SIC receiver to receive orthogonal sub channels used by different WTRUs.

[0014] The above mentioned proposals are not mutually exclusive. These proposals only differ in how to achieve the goals for MUROS/VAMOS using either existing functionality, or through introducing new capability into the WTRU design.

[0015] With respect to the aforementioned second technical proposal referring to Release 6 DARP-type I receiver implementations in handsets, MUROS/VAMOS suggests that speech services may be provided to two users simultaneously over the same physical channel, or timeslot. One of these multiplexed users can be a legacy user. The legacy WTRU could be either with or without single antenna interference cancelation (SAIC) or DARP support implemented. Similarly, a new type of MUROS/VAMOS equipment will rely on DARP-like interference-type cancelation receivers. In addition, new MUROS/VAMOS equipment may be expected to support features like extended training sequences:

[0016] According to existing GSM specifications, once a Traffic Channel Full Rate (TCH/F) is assigned to a WTRU, the BS and the WTRU will start communicating with each other, at the physical layer, according to a 26-Frame Multiframe protocol. In order to convey radio related parameters and signaling, a TCH is always associated with a Slow Associated Control Channel (SACCH). Moreover, there also exists a Fast Associated Control Channel (FACCH) to convey service related signaling between the WTRU and the network. Typical messages on SACCH are System Information in DL and Measurement Report in UL. The FACCH is normally used for Handover as well as Assignment messages when the WTRU is operating on a TCH. The WTRU may also operate in a Stealing Mode such that, when needed, it may steal from traffic resources and using them for signaling purposes.

[0017] Figure 1 illustrates the mapping of TCH and SACCH on a 26-Frame multiframe according to the existing GSM standards. It should be noted also that due to the nature of the half rate configuration, the same observations as for TCH/F also apply to the half rate configurations. There is one occurrence of SACCH and one occurrence of an Idle frame per multiframe. In MUROS/VAMOS operation, each of the two (or more) WTRUs multiplexed onto a Time Slot will still need to follow the mandated multiframe configuration.

[0018] Due to the robust coding and decoding performance of MUROS/VAMOS receivers on traffic channels, the associated control channels (i.e. SACCH and FACCH) interlace into the speech multi-frame and become un-decodable well before the actual speech bursts. It is of great importance to realize that in legacy GSM networks, the actual link between the WTRU and the BS is supervised by the SACCH according to a well-known radio link failure counter in GSM called Radio Link Timeout (RLT). This means that an entity (a WTRU or BS) shall release an active connection not when the actual speech burst decoding quality degrades below an unacceptable threshold, but rather upon successive failure of decoding a SACCH. Note that the actual RLT value is signaled by the network to the WTRU. Therefore, with the advent of MUROS/VAMOS, the decoding performance of the associated control channels in the speech multiframes and their intimate linking into the radio link failure criterion constitutes the limiting factor. Accordingly, it is necessary to improve the performance of the SACCH to allow for MUROS/VAMOS operation even in weak signal or strong interference conditions.

[0019] An example of prior art can be found in a document entitled "Voice Capacity Evolution with Orthogonal Sub Channels", 3GPP DRAFT;GP-071792_VOICE_CAPACITY_EVOLUTION_BY_OSC, 3RDGENERATION PARTNERSHIP PROJECT (3GPP).

SUMMARY

[0020] This objective is achieved by a wireless transmit/receive unit as described in claim 1, a base station as described in claim 6 and a corresponding method for control channel operation in claim 11. Advantageous embodiments are described in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] A more detailed understanding may be had from the following description, given by way of example in conjunction with the accompanying drawings wherein:

[0022]

Figure 1 is a diagram of a mapping of the TCH and SACCH on a 26-Frame multiframe according to existing GSM standards;
Figure 2 is a diagram of an example scenario for the transmission of control data on the FACCH or SACCH indicating a recipient WTRU in the context of MUROS/VAMOS;
Figure 3 is a diagram of an example multiframe misalignment;
Figure 4 is a diagram of an example SACCH transmission scenario.
Figure 5 is a diagram of an example multiframe misalignment scenario with a legacy WTRU and a MUROS/VAMOS-capable WTRU;
Figure 6 is a diagram of an example multiframe misalignment applied to a half rate scenario;
Figure 7 is a flow diagram of a method for a WTRU to receive a FACCH on a sub-channel reserved for another WTRU;
Figure 8 is a diagram of an example approach for transmitting control information targeted at a WTRU in the context of OSC using layer one parameters;
Figure 9 is a diagram of an example multiframe format using a common SACCH addressed to more than one WTRU using the MUROS/VAMOS resource; and
Figure 10 is a functional block diagram of a WTRU and a BS.

DETAILED DESCRIPTION

[0023] When referred to herein, the terminology "wireless transmit/receive unit (WTRU)" includes but is not limited to a user equipment (UE), a mobile station, a fixed or mobile subscriber unit, mobile station (MS), a pager, a cellular telephone, a personal digital assistant (PDA), a computer, or any other type of user device capable of operating in a wireless environment. When referred to herein, the terminology "base station" includes but is not limited to a Node-B, a site controller, an access point (AP), or any other type of interfacing device capable of operating in a wireless environment.

[0024] The subject matter disclosed herein may be applicable to all realizations of the MUROS/VAMOS concept. They are applicable to, for example, approaches that use: (1) OSCs multiplexed signals by means of modulation, including QPSK modulation; (2) signals relying on interference-cancelling receivers which employ, for example, Downlink Advanced Receiver Performance (DARP) technology; and (3) a combination of OSC and signals relying on interference-cancelling receivers. Additionally, although examples may be provided indicating a particular modulation type, the principles described herein may equally be applied to other modulation types, including GMSK (Guassian Minimum Shift Keying), 8-Phase Shift Keying (8-PSK), 16-Quadrature Amplitude Modulation (QAM), 32-QAM, and other modulation types.

[0025] Variable SACCH misalignments may be used to improve the SACCH allocation in GERAN multiframes. For example, variable SACCH misalignments may be used in scenarios involving multiplexing with a MUROS/VAMOS capable WTRU or a legacy WTRU. According to this method, the SACCH occurrences for MUROS/VAMOS multiplexed users may be misaligned or shifted to provide the opportunity to exclusively use the full timeslot resource for a single user. Alternatively, the SACCH occurrences may be misaligned or shifted to provide a transmission opportunity to achieve better control channel decoding performance. The following examples apply to both the full rate and half rate scenarios.

[0026] Figure 2 shows a transmission scenario using a variable misalignment of control data on the FACCH or SACCH in the context of MUROS/VAMOS. Figure 2 shows a BS 200 in communication with a first WTRU 202 and a second WTRU 204. The first WTRU 202 performs 206 a resource assignment, registration, or other set up procedure as described above. The second WTRU 204 performs 208 a similar procedure. Performance of the set up procedures 206, 208 may involve communication of signals from the BS 200 to the WTRUs 202, 204 as described above, the signals indicating a relationship between the WTRUs and identifiers that will correspond to the WTRUs 202, 204 in subsequent SACCH/FACCH transmissions. The first WTRU 202 receives data 210 from the BS 200 on a first OSC in a timeslot. The second WTRU 204 receives data 212 from the BS 200 on a second OSC in the timeslot. The BS 200 generates a FACCH or SACCH transmission as described above and sends the transmission 214, 216 to both the first WTRU 202 and the second WTRU 204.

[0027] Figure 3 is a diagram of an example OSC multiframe misalignment. In this example, the mapping of SACCH and the Idle frame occurrences may be swapped for the MUROS/VAMOS capable WTRU. Referring to Figure 3, a first WTRU may use a first OSC multiframe 310 when using MUROS/VAMOS resources. A second WTRU may use an OSC multiframe 320 when using the same MUROS/VAMOS resource. In the first OSC multiframe, the SACCH frame is in slot 12 and the Idle frame is in slot 25. In the second OSC multiframe 320, the SACCH frame and the Idle frame are swapped such that the SACCH frame is in slot 25 and the Idle frame is in slot 12. This swapping of the SACCH and Idle frames allows both WTRUs to decode the SACCH and allow MUROS/VAMOS operation in weak signal and/or strong interference conditions.

[0028] Figure 4 is a diagram of an example SACCH transmission scenario 400. Based on the OSC multiframe misalignment described above, transmission of the SACCH to the first WTRU may be performed using the full power per timeslot, or a more robust modulation type such as GMSK. The BS 410 informs the MUROS/VAMOS capable WTRUs 420, 430, for example, during the channel assignment phase, that a SACCH frame and Idle frame are swapped in the multiframe configuration 440. The BS 410 then sends a SACCH frame in each of the two OSC frames in every multiframe 450, one for the first WTRU 460 and another one for the second WTRU 470. It is important to realize that, when doing so, the BS may choose to transmit a GMSK burst during the SACCH frame with higher power as opposed to a QPSK burst since one of the WTRUs always assumes that this frame is an idle one.

[0029] In the event that two MUROS/VAMOS capable WTRUs are multiplexed in the same timeslot, both of them must be notified by the network about the applied SACCH/Idle configuration. When a legacy WTRU is assigned to use MUROS/VAMOS resources along with a MUROS/VAMOS-capable WTRU, the legacy WTRU must use the legacy multi-frame format (SACCH in frame 13), whereas the MUROS/VAMOS-capable WTRU uses the modified format (SACCH in frame 26).

[0030] Figure 5 is an example of a full rate multiframe misalignment scenario 500 in a wireless communication system with legacy WTRUs and MUROS/VAMOS-capable WTRUs. Referring to Figure 5, WTRU1 510 and WTRU2 520 are two WTRUs paired on a channel multiframe, where WTRU1510 is a legacy WTRU and WTRU2 520 is a MUROS/VAMOS-capable WTRU. As shown in Figure 5, the SACCH frame for WTRU1 510 is shifted forward to frame 14, and the SACCH frame for WTRU2 520 is shifted to frame 25. The depicted frame shift of the SACCH is for illustration only and it is understood that the shift is variable. Additionally, the number of frames of the shift may change from multiframe to multiframe. Figure 6 is an example of a multiframe misalignment that may be adapted for a half rate scenario applying similar principles as described above.

[0031] An alternative method of improving the SACCH performance includes applying a power offset in the transmit power level of the SACCH frames when compared to the TCH frames. The power offset may be configurable, or a fixed rule-based power offset compared to either one or more reference frames.

[0032] In yet another alternate method, the SACCH performance may be improved by modifying a radio link failure criterion used in legacy GSM networks such that the radio link failure criterion does not rely on the associated control channels, or at least, not exclusively. For example, an RLT criterion may be used as a threshold for the number of RLT failures before a call is dropped. In this example, the RLT criterion may be modified to check against missed SACCH decodings and/or link quality, such as bit error rate (BER) or other representative quality measures, as observed on the traffic channel. The RLT criterion may be relaxed through increasing the RLT value for WTRUs operating in MUROS/VAMOS environments.

[0033] In another embodiment, stealing flags may be used to indicate resource sharing among OSCs assigned to different WTRUs for control channel transmission. Figure 7 is a flow diagram of a method 700 for a WTRU to receive a FACCH on a sub-channel reserved for another WTRU. The WTRU receives 701 a frame. The frame may be a voice frame or a FACCH control frame. The WTRU analyzes 702 the frame to check if stealing flags are set to indicate a FACCH transmission. If the stealing flags are not set, the WTRU does not decode 704 for a FACCH transmission. If the stealing flags are set to indicate a FACCH transmission, then the WTRU decodes 708 the FACCH transmission on sub-channels of one or more WTRUs with which it is multiplexed. Alternatively, the WTRU may decode the FACCH transmission on its own sub-channel as well as the sub-channel of one or more other WTRUs. In another alternative, resource stealing from the other OSC may be used to convey the associated control channel (SACCH or FACCH) to a WTRU.

[0034] Stealing flags may indicate not only the presence of the FACCH, but also which OSC the FACCH is carried on. For example, where QPSK or 16-QAM is used, the two stealing flag bits may indicate an OSC based on the following organization: "00" indicates a speech frame; "01" indicates a FACCH on a first OSC; and "11" indicates a FACCH on a second OSC. The specific code points may of course be changed as their meanings are implementation details.

[0035] Alternatively, rules may be defined to determine when a FACCH for a first WTRU may be carried on the OSC allocated for a second WTRU. For example, the first WTRU may search for a FACCH addressed to it by decoding a second WTRU's OSC at every Nth occurrence or according to a pre-determined assignment pattern. A WTRU may decode SACCH transmissions on the other OSC to determine if a message for it is carried there when multi-frame structures for individual WTRUs or groups of WTRUs are offset compared to those corresponding to other OSCs.

[0036] An identifier indicating a recipient WTRU of a SACCH or FACCH message may be realized in layer one, layer two, or layer three messages, used individually or in combination. For example, a portion of an identifier may be carried in layer two, while another portion of the identifier may be carried in layer three. As a more specific example, a stealing flag may indicate the presence of the FACCH to a WTRU, and/or indicate a sub-channel on which the FACCH should be received. The FACCH message itself may then also include an indicator according to any of the embodiments described above that identifies the WTRU as the recipient.

[0037] Figure 8 is a flow diagram of an example approach to sending control information targeted at a WTRU in the context of OSC using layer one parameters. In the DL, a BS transmits System Information messages to WTRUs over the majority of the SACCH lifetime. In most instances, the layer three information included in the System Information message is the same for all of the WTRUs multiplexed on a same timeslot using OSC. However, there are also two layer one parameters (the Timing Advance (TA) and the Power Command (PC)) that are sent in LAPDm frames used for SACCH. These two parameters are appended as two octets by layer one onto the LAPDm frames for SACCH. Therefore, although the layer three contents of the System Information messages may be the same for multiple WTRUs multiplexed onto a timeslot, the layer one parameters may be different for the different WTRUs.

[0038] Figure 8 shows layer one parameters sent to the WTRUs in an OSC pair in alternating SACCH frames. The first WTRU 802 performs 806 a resource assignment, registration, or other set up procedure to coordinate communications with the BS 800. The second WTRU 804 performs 808 a similar procedure. Performance 806, 808 of the set up procedures may involve the transmission of signals from the BS 800 to the WTRUs 802, 804 for coordinating the reception and interpretation of layer one parameters as described in further detail below. For example, the set up procedures may involve data transmitted from the BS 800 to the WTRUs 802, 804 indicating that SACCH frames will include layer one parameters for the two WTRUs 802, 804 on an alternating basis. The first WTRU 802 receives data 810 from the BS 800 on a first OSC in a timeslot. The second WTRU 804 receives data 812 from the BS 800 on a second OSC in the timeslot. The BS 800 generates a first SACCH transmission containing layer one parameters such as the TA and PC parameters as described above, with the intended recipient being the first WTRU, and the frame is received 814 by the first WTRU 802. The first WTRU 802 processes 816 the control data in the frame including the layer one parameters and reacts accordingly. The second WTRU may or may not also receive and process the first SACCH frame (not depicted), though it will be configured to ignore the layer one parameters included in the frame. The BS 800 generates the next SACCH frame to contain layer one parameters intended for the second WTRU 804 and transmits 818 the second SACCH frame. The second SACCH frame is received and the layer one parameters are processed 820 by the second WTRU 804, and the second WTRU 804 reacts accordingly. The second SACCH frame may or may not be received and processed by the first WTRU (not depicted), but the first WTRU 802 may be configured to ignore the layer one parameters included in the frame. This method may then continue, with alternating SACCH transmissions including layer one parameters for the two WTRUs 802, 804.

[0039] In addition to alternating SACCH transmissions as shown in Figure 8, the SACCH transmissions may be sent according to various other orders and transmission patterns. As shown in Figure 8, the rules for associations between the orders of the SACCH and the intended recipients may be signaled during a set up procedure as described in Figure 8. Alternatively, the rules may be derived implicitly based on known parameters.

[0040] Further, a rule associating a particular SACCH occurrence with either a single WTRU or group may be used. For example, a first WTRU may decode the SACCH at predetermined occurrences, but will disregard the layer one parameters received at these occurrences because they are intended for a second WTRU. The first WTRU also decodes the SACCH at other predetermined occurrences, but does act on the layer one parameters received at these other occurrences. The sets of predetermined occurrences may or may not overlap.

[0041] Figure 9 is a diagram of an example multiframe format 900 using a common SACCH addressed to more than one WTRU using a MUROS/VAMOS timeslot. The multiframe 900 includes 26 frames, some of which are control channel frames 910. Each frame is divided into 8 timeslots, and each timeslot may be divided into a plurality of sub-channels, for example a first OSC 920 and a second OSC 930.

[0042] In a first example, information specific to a particular WTRU, such as layer one information containing TA and PC, may be multiplexed in several occurrences of the control channel frame 910. Since only a single SACCH or FACCH is required, the number of channel bits available is doubled for increased channel coding. Alternatively, the same number of channel coded bits may be achieved using a more robust modulation type such as GMSK. It is possible to apply this method to interlace or schedule either exclusively, or a combination of a certain number of individual SACCHs addressed to a WTRU, with a certain number of common SACCHs addressed to more than one WTRU, for example using a first OSC 920 for WTRU1 and a second OSC 930 for WTRU2. Alternatively, a Repeated SACCH and/or Repeated FACCH feature 810 may be used in conjunction with MUROS/VAMOS operation.

[0043] Alternatively, a higher number of occurrences per multi-frame (or time period) than in legacy GSM speech multiframes is used for the associated control channels 910 in conjunction with MUROS/VAMOS operation. The increased number of transmission opportunities may in turn be used to provide more decoding opportunities to the WTRU (and therefore, increase the chance not to meet the radio link timeout criteria), or to increase the channel coding and improve upon decoding robustness.

[0044] In yet another alternative, Incremental-redundancy, Repetition and/or Chase Combining methods may be used for the associated control channels when used in conjunction with MUROS/VAMOS mode of operation. These may be employed upon successive occurrences of SACCH or FACCH.

[0045] Figure 10 is a functional block diagram of a WTRU 1000 and a BS 1050 configured in accordance with the methods described above. The WTRU 1000 includes a processor 1001 in communication with a receiver 1002, transmitter 1003, and antenna 1004. The processor 1001 may be configured to process misaligned or shifted FACCH and SACCH messages as described above. The BS 1050 includes a processor 1051 in communication with a receiver 1052, transmitter 1053, antenna 1054, and a channel allocator 1055. The channel allocator 1055 may be part of the processor 1051, or it may be a separate unit in communication with the processor 1051. The channel allocator 1055 may be configured to generate misaligned or shifted FACCH and SACCH messages as described above. The WTRU 1000 may include additional transmitters and receivers (not depicted) in communication with the processor 1001 and antenna 1004 for use in multi-mode operation, as well as other components described above. The WTRU 1000 may include additional optional components (not depicted) such as a display, keypad, microphone, speaker, or other components.

[0046] Although features and elements are described above in particular combinations, each feature or element can be used alone without the other features and elements or in various combinations with or without other features and elements. The methods or flow charts provided herein may be implemented in a computer program, software, or firmware incorporated in a computer-readable storage medium for execution by a general purpose computer or a processor. Examples of computer-readable storage mediums include a read only memory (ROM), a random access memory (RAM), a register, cache memory, semiconductor memory devices, magnetic media such as internal hard disks and removable disks, magneto-optical media, and optical media such as CD-ROM disks, and digital versatile disks (DVDs).

[0047] Suitable processors include, by way of example, a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Arrays (FPGAs) circuits, any other type of integrated circuit (IC), and/or a state machine.

[0048] A processor in association with software may be used to implement a radio frequency transceiver for use in a wireless transmit receive unit (WTRU), user equipment (UE), terminal, base station, radio network controller (RNC), or any host computer. The WTRU may be used in conjunction with modules, implemented in hardware and/or software, such as a camera, a video camera module, a videophone, a speakerphone, a vibration device, a speaker, a microphone, a television transceiver, a hands free headset, a keyboard, a Bluetooth® module, a frequency modulated (FM) radio unit, a liquid crystal display (LCD) display unit, an organic light-emitting diode (OLED) display unit, a digital music player, a media player, a video game player module, an Internet browser, and/or any wireless local area network (WLAN) or Ultra Wide Band (UWB) module.

PATENTKRAV

1. Trådløs sende-/modtageenhed, WTRU, (420, 430, 1000) omfattende:
en modtager (1002) som er konfigureret til at modtage et signal, der omfatter en første ortogonal underkanal, OSC, og en anden OSC, hvor den første OSC og den anden OSC muliggør multipleksering af to WTRU'er (420, 430) på en enkelt tidsplads af en multiramme, hvor signalet modtages under multirammen, der omfatter flere rammer, hvor hver af de første OSC og den anden OSC indeholder en ledig ramme og en styreramme, og hvor en ledig ramme knyttet til den første OSC modtages på samme tid som en styreramme, der er knyttet til den anden OSC, og en styreramme der er knyttet til den første OSC modtages på samme tid som en ledig ramme, der er knyttet til den anden OSC, og
en processor (1001) som er konfigureret til at afkode den styreramme, der er knyttet til den første OSC eller den styreramme, som er knyttet til den anden OSC.

2. WTRU ifølge krav 1, hvor den styreramme, der er knyttet til den første OSC eller den styreramme, som er knyttet til den anden OSC, er en langsom associeret styrekanalramme, SACCH-ramme, eller en hurtig associeret styrekanalramme, FACCH-ramme.

3. WTRU ifølge krav 1, hvor modtageren er konfigureret til at modtage den multiramme, der indeholder langsom associeret styrekanalinformation, SACCH-information, i to rammer.

4. WTRU ifølge krav 1, hvor modtageren er konfigureret til at modtage den multiramme, der indeholder lag tre nyttedatainformation og to lag et parametre.

5. WTRU ifølge krav 1, hvor den styreramme der er knyttet til den første OSC flyttes til en tilstødende tidsplads på den første OSC.

6. Basisstation, BS, (410, 1050) omfattende:
en kanalfordeler (955), som er konfigureret til at generere et signal, der omfatter en første ortogonal underkanal, OSC, og en anden OSC, hvor den første OSC og den anden OSC muliggør multipleksering af to trådløse sende-/modtageenheder, WTRU'er, på en enkelt tidsplads af en multiramme, og
en sender (1053) som er konfigureret til at sende signalet i multirammen, der omfatter flere rammer,
k e n d e t e g n e t ved, at hver af den første OSC og den anden OSC indeholder en ledig ramme og en styreramme, og
hvor senderen er indrettet til sende en ledig ramme, der er knyttet til den første OSC på samme tid som en styreramme knyttet til den anden OSC, og en styreramme knyttet til den første OSC på samme tid som en ledig ramme knyttet til den anden OSC.

7. BS af ifølge krav 6, hvor den styreramme der er knyttet til den første OSC, eller den styreramme der er knyttet til den anden OSC er en langsom associeret styrekanalramme, SACCH-ramme eller en hurtig associeret styrekanalramme, FACCH-ramme.

8. BS af ifølge krav 6, hvor senderen er konfigureret til at sende den multiramme der indeholder langsom associeret styrekanalinformation, SACCH-information, i to rammer.

9. BS af ifølge krav 6, hvor senderen er konfigureret til at sende den multiramme der indeholder lag tre nyttedatainformation og to lag et parametre.

10. BS af ifølge krav 6, hvor kanalfordeleren er konfigureret til at flytte styrerammen, der er knyttet til den første OSC til den tilstødende tidsplads på den første OSC.

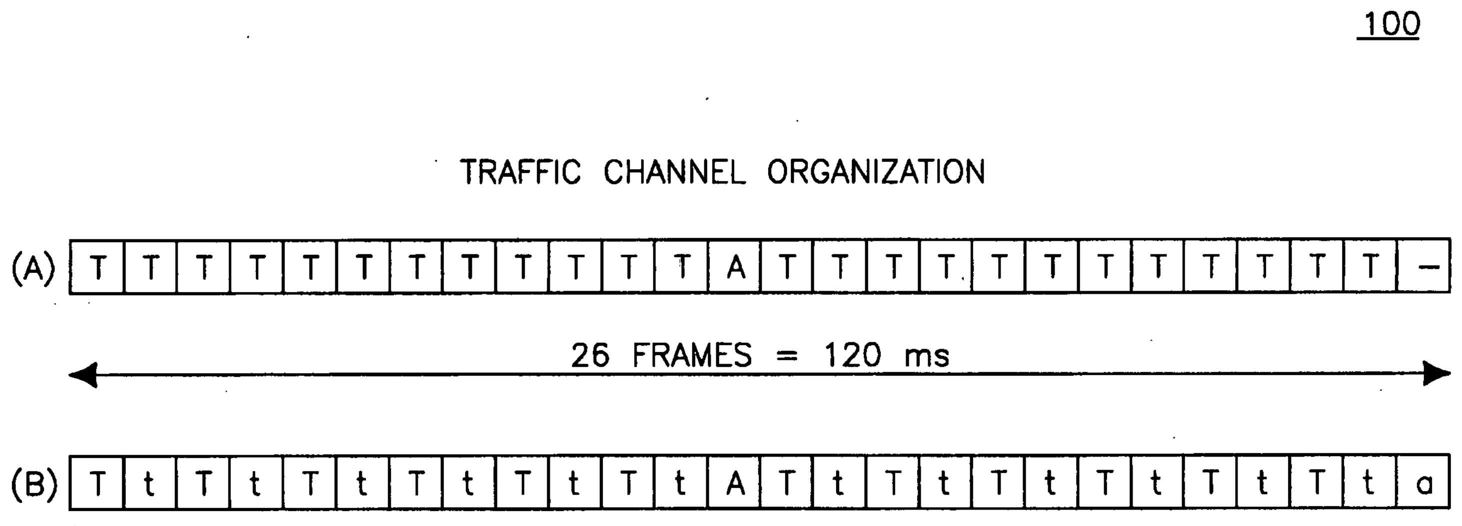
11. Fremgangsmåde til betjening af styrekanal omfattende at:
generere et signal, der omfatter en første ortogonal underkanal, OSC, og en anden OSC, hvor den første og den anden OSC muliggør multipleksering af to trådløse sende-/modtageenheder, WTRU'er på en enkelt tidsplads af en multiramme, og
at sende signalet i multirammen, der omfatter flere rammer,
k e n d e t e g n e t ved, at hver af den første OSC og den anden OSC indeholder en ledig ramme og en styreramme, og
hvor en ledig ramme knyttet til den første OSC sendes på samme tid som en styreramme knyttet til den anden OSC, og en styreramme knyttet til den første OSC sendes på samme tid som en ledig ramme knyttet til den anden OSC.

12. Fremgangsmåde ifølge krav 11, hvor den styreramme, der er knyttet til den første OSC eller den styreramme, som er knyttet til den anden OSC, er en langsom associeret styrekanalramme, SACCH-ramme, eller en hurtig associeret styrekanalramme, FACCH-ramme.

13. Fremgangsmåde ifølge krav 11, hvor den sendte multiramme indeholder langsom associeret styrekanalinformation, SACCH-information, i to rammer.

14. Fremgangsmåde ifølge krav 11, hvor den sendte multiramme indeholder lag tre nyttedatainformation og to lag et parametre.

15. Fremgangsmåde ifølge krav 11, hvor den styreramme, der er knyttet til den første OSC, flyttes til en tilstødende tidsplads på den første OSC.



(A) CASE OF ONE FULL RATE TCH
T, t: TDMA FRAME FOR TCH
—: IDLE TDMA FRAME
(B) CASE OF TWO HALF RATE TCHs
A, a: TDMA FRAME FOR SACCH/T

FIG. 1

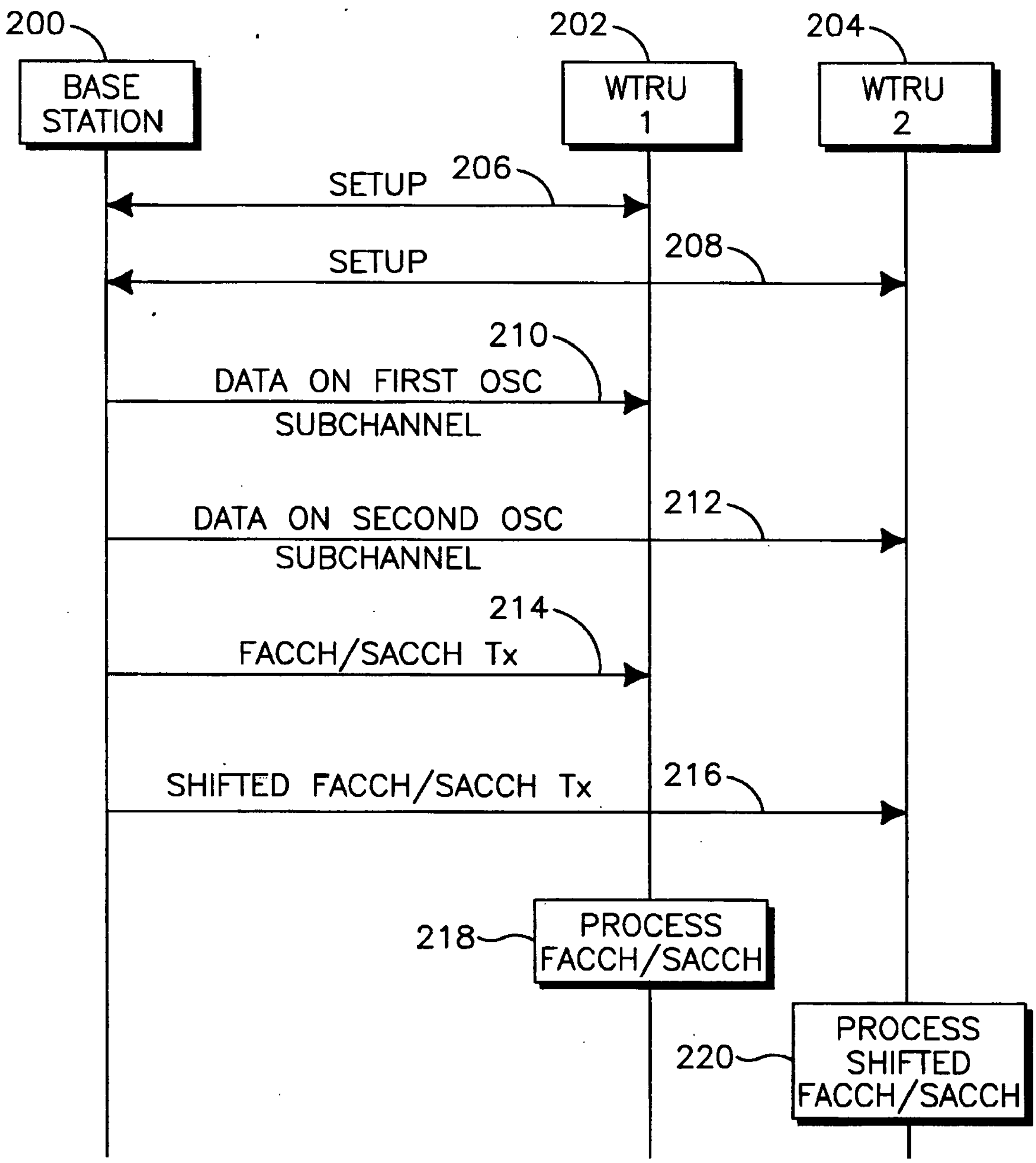

200
BASE STATION
202
WTRU 1
204
WTRU 2
SETUP
206
SETUP
208
210
DATA ON FIRST OSC SUBCHANNEL
DATA ON SECOND OSC SUBCHANNEL
212
214
FACCH/SACCH Tx
SHIFTED FACCH/SACCH Tx
216
218
PROCESS FACCH/SACCH
220
PROCESS SHIFTED FACCH/SACCH

FIG. 2

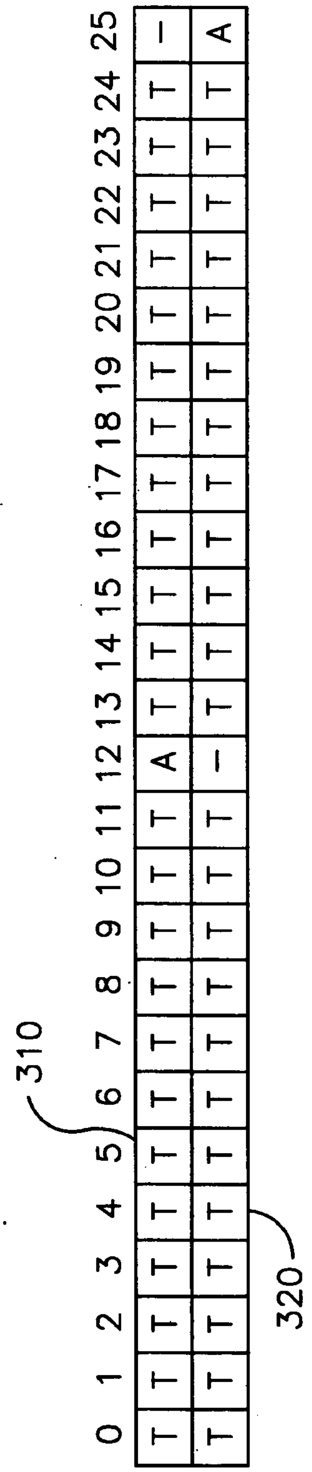

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
T T T T T T T T T T T T A T T T T T T T T T T T T –
T T T T T T T T T T T T – T T T T T T T T T T T T A
310
320

FIG. 3

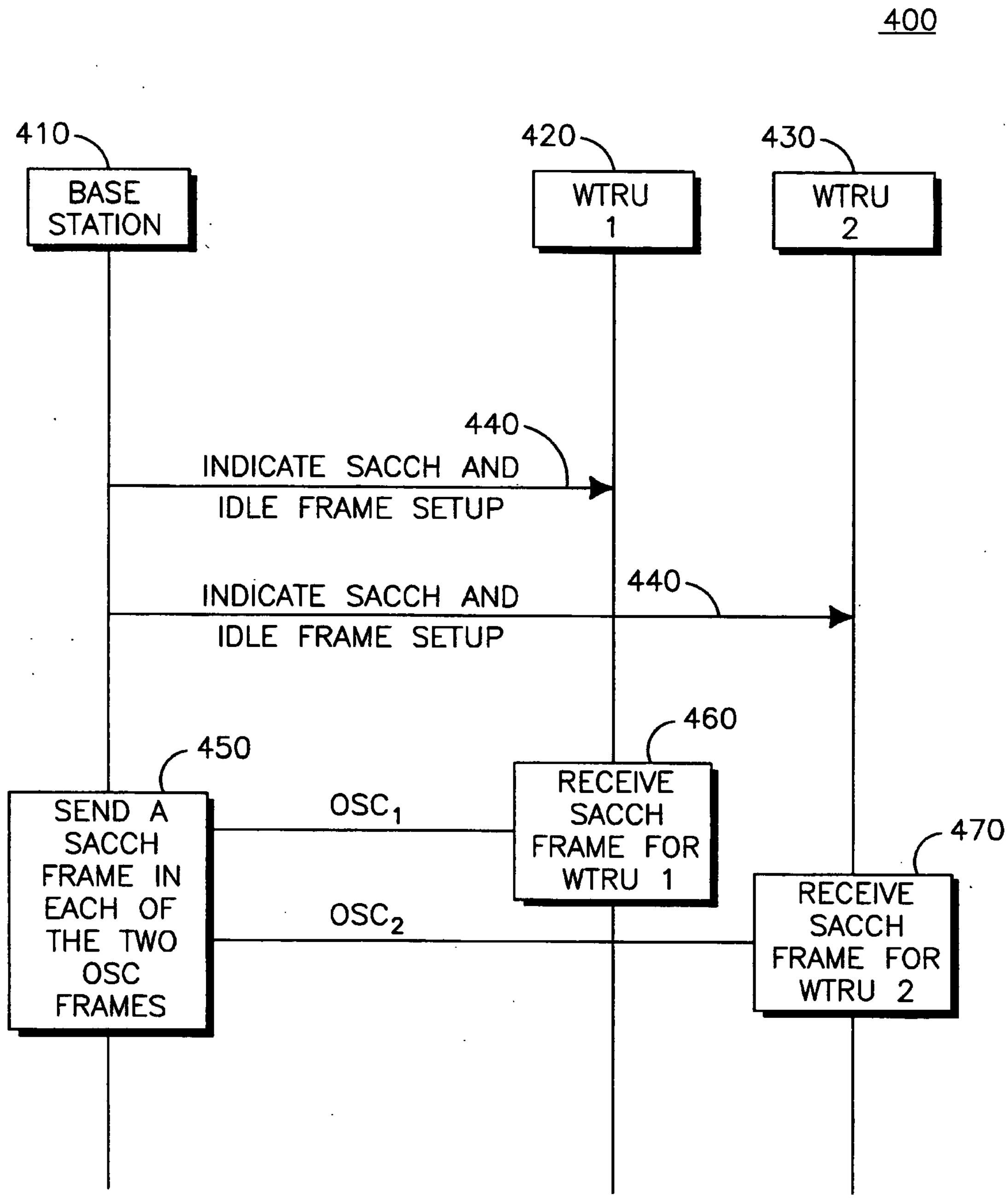

400
410
BASE STATION
420
WTRU 1
430
WTRU 2
440
INDICATE SACCH AND IDLE FRAME SETUP
440
INDICATE SACCH AND IDLE FRAME SETUP
450
SEND A SACCH FRAME IN EACH OF THE TWO OSC FRAMES
460
RECEIVE SACCH FRAME FOR WTRU 1
470
RECEIVE SACCH FRAME FOR WTRU 2
OSC1
OSC2

FIG. 4

500

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
510 WTRU1	T	T	T	T	T	T	T	T	T	T	T	T	T	S	T	T	T	T	T	T	T	T	T	T	T	T
520 WTRU2	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	S	T

FIG. 5

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
WTRU1	T		T		T		T		T		T		S	T		T		T		T		T		T		
WTRU2		T		T		T		T		T		T			T		T		T		T		T		T	S

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
WTRU3	T		T		T		T		T		T		T	S		T		T		T		T		T		
WTRU4		T		T		T		T		T		T			T		T		T		T		T		S	T

FIG. 6

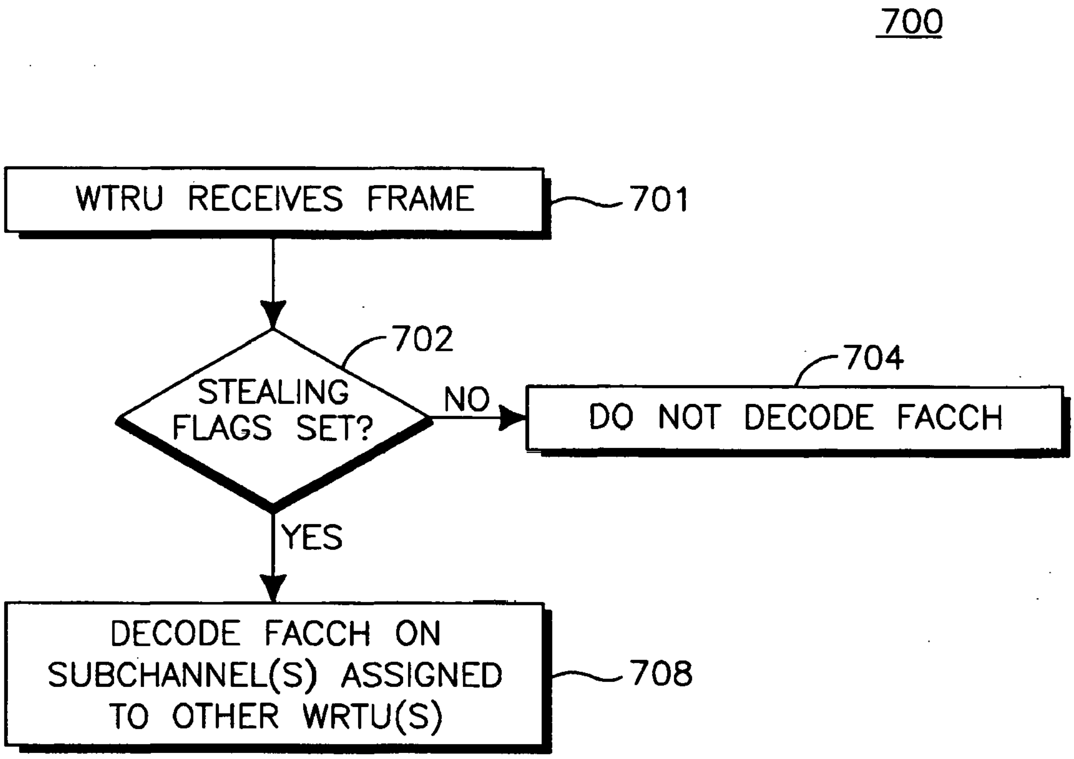

700
WTRU RECEIVES FRAME
701
702
STEALING FLAGS SET?
NO
704
DO NOT DECODE FACCH
YES
DECODE FACCH ON SUBCHANNEL(S) ASSIGNED TO OTHER WRTU(S)
708

FIG. 7

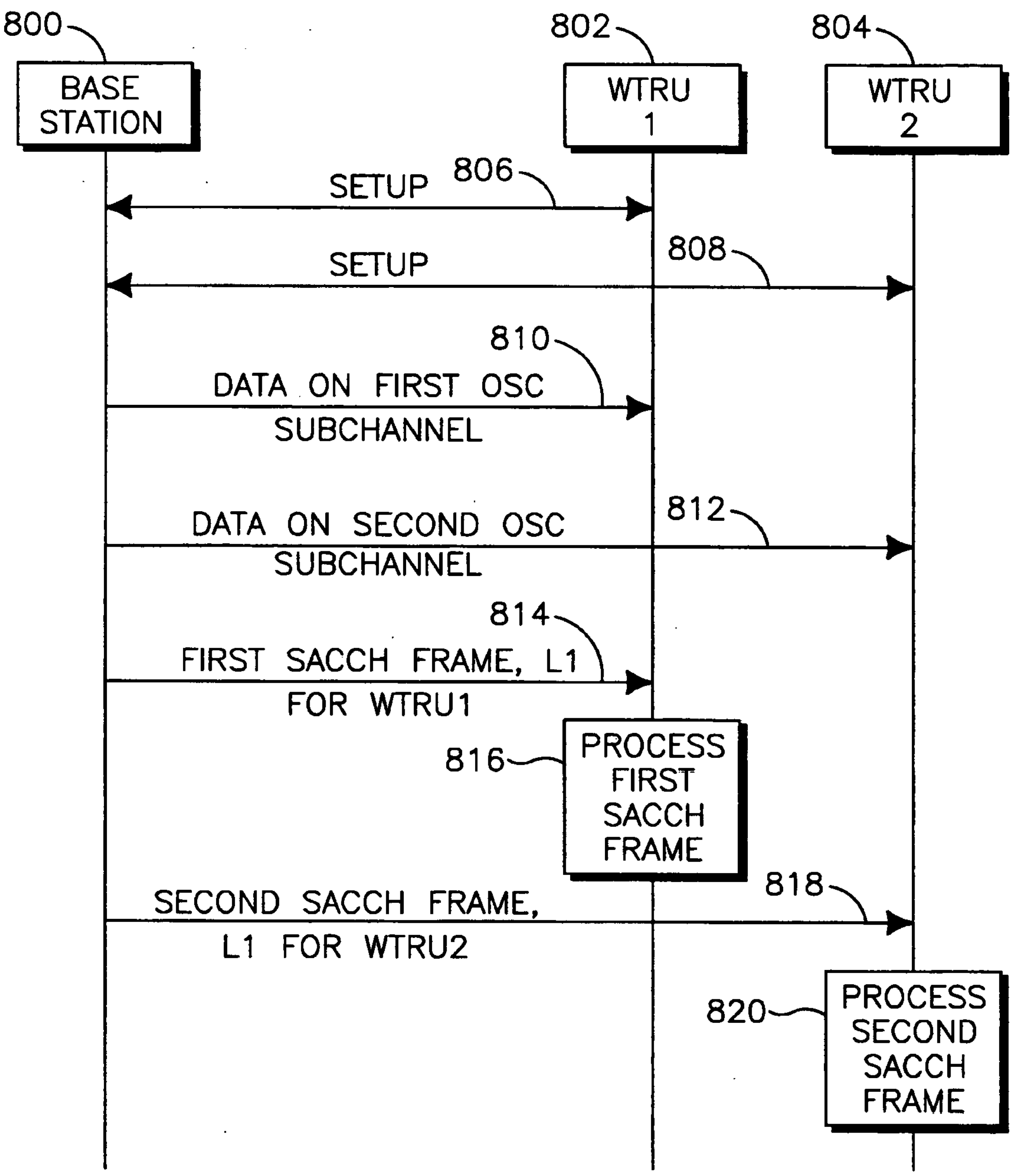

800
BASE STATION
802
WTRU 1
804
WTRU 2
SETUP
806
SETUP
808
810
DATA ON FIRST OSC SUBCHANNEL
DATA ON SECOND OSC SUBCHANNEL
812
814
FIRST SACCH FRAME, L1 FOR WTRU1
816
PROCESS FIRST SACCH FRAME
SECOND SACCH FRAME, L1 FOR WTRU2
818
820
PROCESS SECOND SACCH FRAME

FIG. 8

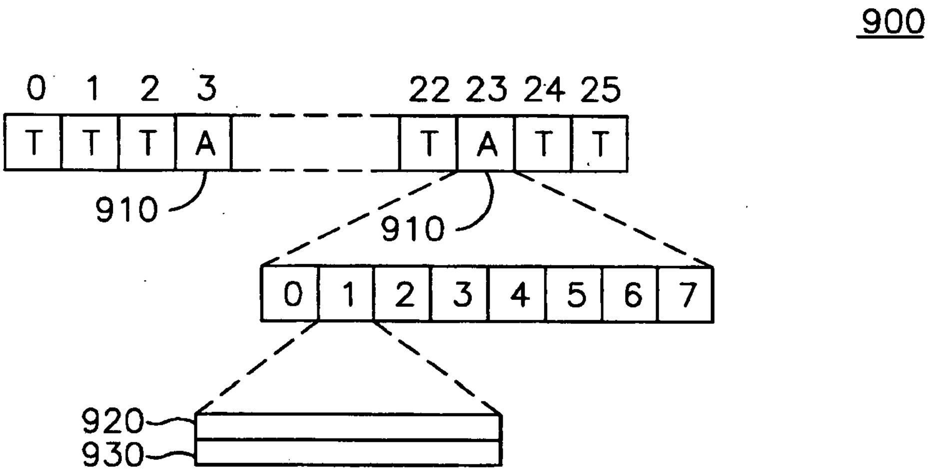


FIG. 9

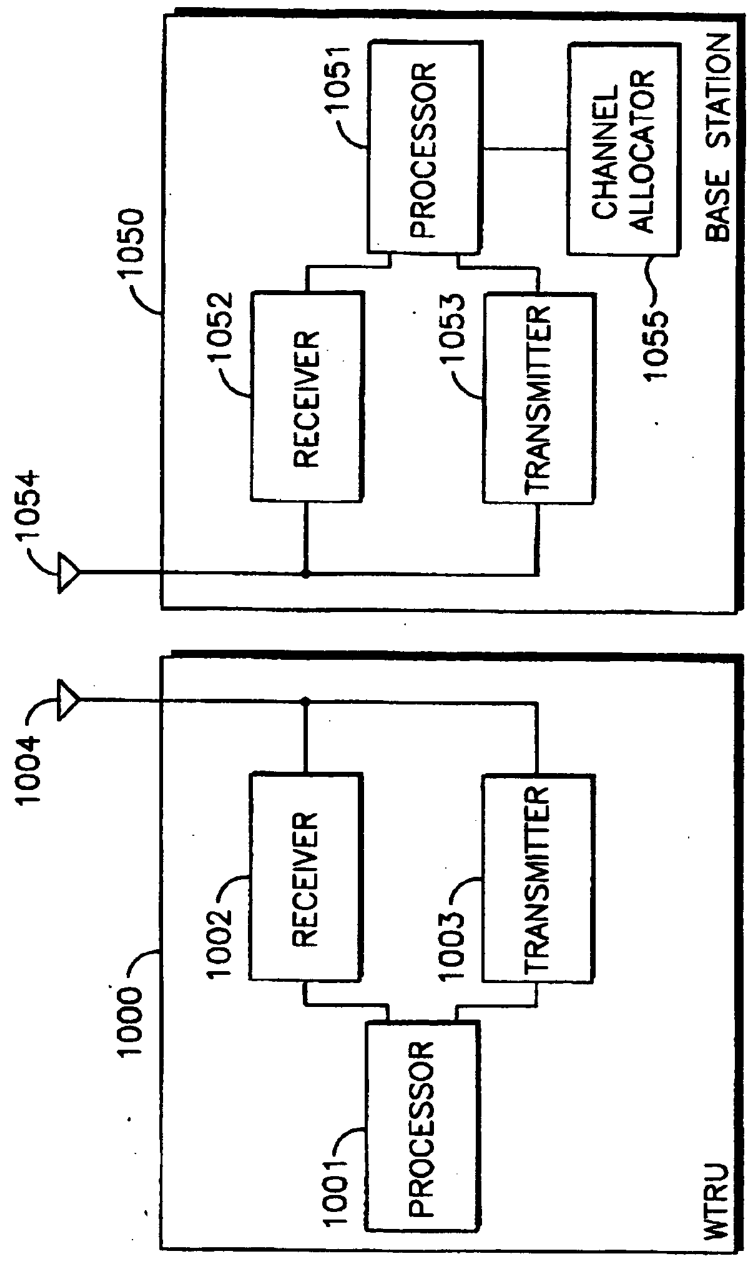

1050
1054
1051
PROCESSOR
CHANNEL
ALLOCATOR
BASE STATION
1052
RECEIVER
1053
TRANSMITTER
1055
1004
1000
1002
RECEIVER
1003
TRANSMITTER
1001
PROCESSOR
WTRU

FIG. 10