(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 July 2002 (18.07.2002)

PCT

(10) International Publication Number
WO 02/056609 A2

(51) International Patent Classification[7]: H04Q 7/00

(21) International Application Number: PCT/EP01/00159

(22) International Filing Date: 9 January 2001 (09.01.2001)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

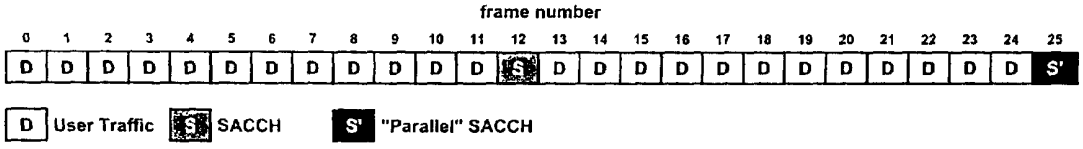
(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: RADIO TERMINAL, MODULE FOR SUCH A UNIT AND METHOD FOR TRANSMITTING ASSOCIATED CONTROL CHANNELS



(57) Abstract: The invention relates to a method for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface between at least two radio terminals of a radio communications system, said speech or data being transmitted in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in control channels associated with said at least one traffic channel. In order to allow for an improvded performance of SACCH and FACCH, it is proposed that a first and a second signalling message with identical content are transmitted in two separate that a signalling message included in a single ACCH is coded with a stronger coding. The invention relates equally to corresponding radio terminals and modules for such units.

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Radio terminal, module for such a unit and method for transmitting associated control channels.

FIELD OF THE INVENTION

The invention relates to a method for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface between at least two radio terminals of a radio communications system, said speech or data being transmitted in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in control channels associated with said at least one traffic channel. The invention equally relates to such radio terminals and modules for radio terminals.

BACKGROUND OF THE INVENTION

In radio communications systems, speech or other user data is transmitted between radio terminals, in particular between a base station of a network and a mobile station, by using Traffic Channels TCH. In order to enable an efficient voice transmission, several aspects related to the transmission, like the allocation of radio resources and handovers, have to be managed in co-operation between the network and respective mobile stations. For such a management, signalling messages must be conveyed over the

air interface in addition to user data between the network and a mobile station in both direction. The signalling messages can be transmitted independently, as long as no user data is transmitted. When traffic is ongoing, the signalling messages are transmitted in Associated Control Channels ACCH.

It is known from the state of the art to use two different kinds of ACCHs, Slow Associated Control Channels (SACCH) and Fast Associated Control Channels (FACCH). FACCHs enable a faster transmission of signalling messages than SACCHs. SACCHs are therefore used for non-urgent procedures, mainly for the transmission of the radio measurement data needed for handover decisions. FACCHs (or main DCCHs) are involved in delay sensitive mechanisms such as handover. The use of SACCHs and FACCHs is described in more detail e.g. in "GSM 03.64: Digital cellular telecommunications system (Phase 2+), Overall description of the GPRS radio interface; Stage 2", "GSM 04.18: Digital cellular telecommunications system (Phase 2+), Mobile radio interface layer 3 specification, Radio Resource Control Protocol", "GSM 04.60: Digital cellular telecommunications system (Phase 2+), General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control/ Medium Access Control (RLC/MAC) protocol", "GSM 05.08: Digital cellular telecommunications system (Phase 2+), Radio Subsystem Link Control" or "GSM 05.10: Digital cellular telecommunications system (Phase 2+), Radio Subsystem Synchronization".

Currently, speech is transmitted on Traffic Channels using only GMSK (Gaussian-filtered Minimum-Shift Keying) modulation. In GERAN (GSM/EDGE RAN; GSM: Global System for Mobile communication, EDGE: Enhanced Data rates for GSM Evolution, RAN: Radio Access Network), speech will also be transmitted using 8PSK (Phase Shift Keying) modulation. Therefore, FACCHs will be either GMSK modulated if the co-transmitted speech is GMSK modulated and 8PSK modulated if the co-transmitted speech is 8PSK modulated. SACCH/TF (Slow, TCH/Full rate-Associated Control Channels) will be GMSK modulated for both, 8PSK and GMSK modulated speech, in full rate and half rate transmission mode.

Originally, SACCH and FACCH were designed for Full Rate speech Traffic Channels (TCH/FR) and later on for Enhanced Full Rate speech Traffic Channels (TCH/EFR) used in GSM. When the Adaptive Multi Rate (AMR) speech codecs were introduced for GSM in "GSM 05.03: Digital cellular telecommunications system (Phase 2+), Channel Coding", the same ACCHs were re-used.

The different AMR speech codecs aim at adapting the coding scheme to the link level quality. In a bad environment, a low speech codec with a low coding rate will be used, whereas in a good environment, a higher speech codec can be used with a higher coding rate. AMR thereby allows worse channel conditions for user data transmission as compared to traditional TCH/FR and TCH/EFR. As mentioned above, the channel coding of the ACCHs, however, was not adapted

accordingly. As a consequence, while AMR allows data transmission under worse conditions, the block error rate of the ACCHs increases under such conditions. Therefore, more retransmissions are needed for the ACCHs and the transmission delay is increased, reducing the overall system performance.

SUMMARY OF THE INVENTION

It is an object of the invention to provide methods, radio terminals and modules for such radio terminals which allow for an improved control signalling based on signalling messages controlling speech or data transmission over an air interface during user data transmission between two radio terminals of a radio communications system. It is moreover an object of the invention to provide a 26-multiframe which allows for an improved control signalling.

This object is reached on the one hand with a method for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface between at least two radio terminals of a radio communications system, said speech or data being transmitted in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in control channels associated with said at least one traffic channel, wherein a first and a second signalling message with identical content are transmitted in two separate associated control channels.

On the other hand, the object is reached with a radio terminal for a radio communications system and with a module for such a radio terminal, either including for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface to at least one other radio terminal of the radio communications system, said speech or data being transmitted in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in control channels associated with said at least one traffic channel, means for inserting signalling messages with identical content into two different associated control channels.

The object is moreover reached with a corresponding radio terminal for a radio communications system, including for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface from at least one other radio terminal of the radio communications system, said speech or data being transmitted in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in control channels associated with said at least one traffic channel, means for receiving two different associated control channels with signalling messages with identical content and means for evaluating said signalling messages. A corresponding module for such a radio terminal also comprises means for evaluating two received signalling messages with identical contents.

The invention proceeds from the idea that the performance of the signalling can be improved by increasing the coding of the signalling messages. The invention therefore proposes to transmit the same message twice, thereby improving the link performance of the control channels. Increasing the coding implies more coded data which needs to be transmitted. The second signalling message can be transmitted in particular at a position that has not been used until now or that does not significantly affect the speech quality. With the method and the radio terminal of the invention, the performance of the transmission of signalling messages in control channels can be increased, since a radio terminal receiving the two signalling messages with identical content can evaluate more redundant information.

The object of the invention is equally reached with a method for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface between at least two radio terminals of a radio communications system, said speech or data being transmitted in coded form in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in coded form in at least one control channel associated with said at least one traffic channel, wherein said signalling messages are coded for transmission with a coding rate depending on the coding rate used for coding of said data or speech.

A corresponding radio terminal for a radio communications system, including for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface to at least one other radio terminal of the radio communications system, said speech or data being transmitted in coded form in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in coded form in at least one control channel associated with said at least one traffic channel, means for coding said signalling messages with a coding rate depending on the coding rate used for coding said user data or speech. A corresponding module for such a radio terminal also includes means for coding a signalling message with a coding rate depending on the coding rate used for coding user data or speech that is to be transmitted.

Since it is proposed that the coding rate used for the signalling messages is adapted to the coding rate used for the user data, the coding of the signalling messages can be changed with the quality of the transmission path if the coding of the user data is. This means, if the coding rate used for coding speech or data to be transmitted is decreased, the coding rate for coding the signalling messages is decreased as well. Therefore, also this method and radio terminal are suited to improve the signalling performance. The first method and radio terminal of the invention, however, have the advantage that the receiving radio terminal can always try to decode the signalling message from the first control channel sent without waiting

for the second control channel, which does not introduce a delay, while in the second method and radio terminal the coded signalling message has to be received completely before decoding is possible.

The radio terminals of the invention can be in particular base stations of a radio communications network and mobile stations suited to communicate with such a network.

Preferred embodiments of the invention become apparent from the subclaims.

The two signalling messages with identical content can be coded differently or identically for the two control channels. If both are coded identically, there is no need for an extra signalling to indicate that a different coding is used.

The evaluation of received signalling messages in the receiving radio terminal can be carried out in particular by soft combining of the two messages. Such a soft combining may be proceeded, however, by an attempt to decode at least the first signalling message separately. If a separate decoding of the first or possibly of the second signalling message was successful, a soft combining is not necessary.

The methods, the radio transmission and receiving units and the modules according to the invention can be employed for an improved transmission of any kind of control channels associated to at least one traffic channel. In particular,

it can be employed in a TDMA (Time Division Multiple Access) radio communications system for improving the transmission only of SACCHs or only of FACCHs or for an improved transmission of both. Performance problems arise mainly with SACCHs, but FACCHs appear to be problematic as well on full rate channels, when the lowest AMR modes are used.

In GSM/EDGE systems, 26-multiframes including 26 TDMA frames are used for carrying TCHs for speech and SACCH/Ts and FACCHs for signalling. Among the frames of each 26-multiframe, one is not used to transmit or receive. This frame composed of idle slots will be referred to in the following "idle frame". It gives a mobile station used as receiving or transmitting radio terminal enough time to perform a pre-synchronisation based on received signalling channel (SCH) bursts of cells neighbouring the cell to which a base station belongs, which base station constitutes a second radio terminal with which a connection for data transmission is established. Once the mobile station has finished the pre-synchronisation with all neighbouring cells, i.e. when no other tasks are necessary during the idle frame, the idle slot corresponding to the timeslot used for the at least one traffic channel to which the control channels are associated can be used to convey additional signalling. In a preferred embodiment of the invention, this idle slot is used for transmitting the second signalling message in a "parallel" control channel, which improves the link level performance of control channels. This is suited in particular for SACCH transmissions.

More specifically, each SACHH message is encoded into four bursts, and each burst is transmitted as a part of a signalling message in a 26-multiframe. Therefore, four 26-multiframes are needed to send a complete SACCH message. In each multiframe, the first 12 frames and the 14th to 25th frames are used for carrying TCHs. In addition, depending on the subchannel used, either the respective 13th frame or the respective 26th frame is used for carrying one of the bursts of a SACCH signalling message. It is proposed to use the respective other frame, used in the state of the art as idle frame, for carrying a corresponding burst of a second SACCH signalling message with identical contents as the first SACCH signalling message. If the 13th frame is used for the first SACCH, the 26th frame of the same multiframe is used for the second SACCH. If the 26th frame is used for the first SACCH, the 13th frame of the following multiframe is used for the second SACCH. Beginning with frame 0 as first frame in the first 26-multiframe used for a SACCH message, this would be frames 12, 38, 64 and 90 for the bursts of a first signalling message and frames 25, 51, 77 and 103 for the bursts of a second signalling message; alternatively frames 25, 51, 77 and 103 are used for the bursts of the first signalling message and frames 38, 64, 90 and 116 for the bursts of the second signalling message. Such a 26-multiframe also reaches the object of the invention, since it enables the transmission of two signalling messages with identical content and thereby an increase of the coding.

The last burst of the second signalling message in the parallel SACCH carried on frame 103 or 116 may not be read because of delay constraint of the SACCH of which the cycle is 480 ms.

Either the parallel SACCH uses a new coding, or each burst of the first signalling message is simply used again as corresponding burst of the parallel SACCH with the second signalling message.

If the idle slot is used for a second SACCH, the second transmitted signalling message can be employed in different ways.

In the downlink, an involved base station constituting a first, transmitting radio terminal preferably always sends a parallel SACCH on the idle frame. A mobile station constituting a second, receiving radio terminal, can then use this parallel SACCH in addition to the existing SACCH whenever no pre-synchronisation is needed, i.e. when no other tasks are necessary during the frames with the second signalling message. Alternatively, the network can indicate via the base station that the mobile station may defer pre-synchronisation operations if the SACCH performance needs to be improved. As a result, the mobile station uses the "parallel" SACCH also during pre-synchronisation if necessary. In a further possibility, the mobile station is generally allowed to defer neighbour cell synchronisation procedures when a previous SACCH data block was lost. Idle frames can be allowed to be used for SACCH performance

enhancements after a lost SACCH frame even during pre-synchronisation in order to guarantee that at least every other SACCH frame can be correctly decoded. Each lost SACCH frame can, e.g., result in allowing a decoding of the second SACCH channel for several SACCH messages. Eventually however, sufficient time for neighbour cell synchronisation too must be allowed.

In the uplink, a mobile station used as a first, transmitting radio terminal preferably sends the parallel SACCH on the idle frame whenever no pre-synchronisation is required. The involved base station constituting a second, receiving radio terminal would then use this additional information whenever it is received, i.e. whenever the mobile has managed to send it. Alternatively, the base station can send a command to the mobile station to request the transmission of an additional SACCH via the idle frame when at least one SACCH message has already been lost. Here, even if used with AMR, the employment of a second SACCH does not depend on the AMR mode used but directly on the performance of the original SACCH. This implies, however, a specific signalling for the command.

For FACCHs, it is known to steal speech or data frames of 20 ms for transmitting a signalling message when needed. In order to increase the coding of the signalling messages, it is proposed to steal two speech or data frames of 20ms for sending two FACCH, the second one conveying the same information as the first one. Advantageously but not necessarily, the two stolen frames are consecutive frames,

which is better for the speech quality and for a reduced FACCH delay.

The solution proposed for FACCHs requires a stealing of 40ms of speech or data frames instead of 20 ms. But FACCH signalling messages are a relatively rare phenomenon and their effect on overall speech quality is not very important. Consequently, also with stealing 40 ms, the speech quality should not be degraded.

In a preferred embodiment of the proposed method and the proposed radio terminal based on a change of the coding rate used for a single signalling message, the coding can be twice higher than in known transmissions: While a high coding rate is used for the coding of data or speech, the coding rate used for the coding of the signalling messages is high, in particular equal to the coding rate used in the state of the art. While a low coding rate is used for the coding of data or speech, in contrast, the signalling messages are coded with a coding rate twice lower. Additionally, it is preferred for FACCH signalling messages that a diagonal interleaving, other than block or rectangular, over 12 bursts is used for inserting the coded signalling message into the FACCH.

The proposed methods, radio terminals and modules are particularly suited for an employment with AMR. The transmission of signalling messages with an increased coding can be restricted to low AMR transmission, in case of FACCH to lowest AMR transmission. Such a restriction does not

decrease the performance of the transmission of signalling messages, since higher AMR is only used with transmission paths of higher quality, in which few signalling messages are lost or not usable anyhow. In addition, the employment of the proposals of the invention can be restricted to the full rate mode, since the mentioned problem with the system performance occurs mainly in the full rate mode. The reason for this is that in the half rate mode, the same coding as in the full rate mode is used for SACCH and FACCH, while AMR speech channels are twice less encoded. The employment of the proposals of the invention does not have to be restricted to the full rate mode, though. For suited control channels, in particular for FACCHS, also an employment with a half rate mode and even a quarter rate mode is possible.

The invention can be used in particular in GERAN.

BRIEF DESCRIPTION OF THE FIGURES

In the following, the invention is explained in more detail with reference to drawings, of which

Fig. 1 shows a 26-multiframe used in full rate mode with one SACCH;

Fig. 2 shows a 26-multiframe used in full rate mode with two SACCHs according to the invention; and

Fig. 3 shows two rows with consecutive multiframes used in full rate mode with two FACCHs according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows an example of a 26-multiframe used in GSM/EDGE systems. Such multiframes can be used for transmitting user data like speech from a base station of a radio communications network to a mobile station and vice versa.

The 26-multiframe comprises 26 TDMA frames 0 to 25. Frames 0 to 11 and frames 13 to 24 are used to carry Traffic Channels TCH, indicated in figure 1 within the respective frames with a D, for speech. Frame 12 is used to carry a SACCH/T (Slow, TCH-Associated Control Channel), indicated in figure 1 within frame 12 with an S, for signalling messages that are to be transmitted during ongoing data traffic. TDMA frame 25 is a frame I with so called idle slots. This frame I is not used for transmission or reception. It rather gives the mobile station enough time to perform pre-synchronisation, for which the mobile station looks for the signalling channel SCH bursts of cells neighbouring the cell to which the base station belongs. Once the mobile station has finished the pre-synchronisation with all neighbouring cells, the spare time provided by the idle slots is no longer necessary.

Figure 2 shows a similar 26-multiframe which is used in an embodiment of the method according to the invention alternatively or in addition to the 26-multiframe of figure 1.

In figure 2, a SACCH and 24 TCHs are distributed to frames 0 to 24 of the 26-multiframe in the same way as to frames 0 to 24 of the 26-multiframe of figure 1. In addition, however, the same signalling message included in the SACCH in frame 12 is transmitted in a second SACCH using frame 25, which provided the idle slots in the multiframe of figure 1. The second SACCH is indicated in figure 2 with an S' within frame 25 instead of the I in figure 1. The signalling message is mapped on the idle slot corresponding to the timeslot used for the traffic channels to which the control channels are associated. The signalling message included in the second SACCH is coded differently by using a different polynomial than the one used for the coding of the same message included in the first SACCH using frame 12.

In the downlink, the base station always sends a parallel SACCH in frame 25 as shown in figure 2, and the mobile station uses this parallel SACCH in addition to the existing SACCH whenever no pre-synchronisation is needed. During pre-synchronisation, the contents of frame 25 are usually simply ignored, the multiframe leaving therefore just as much time for the pre-synchronisation procedures as the known 26-multiframes.

In addition, however, the network indicates via the base station, whether the mobile station may defer the ongoing pre-synchronisation operations in case the SACCH performance needs to be improved. As a result, the mobile station can

use both SACCHs whenever needed also during pre-synchronisation.

In the uplink, the mobile station sends in frame 25 idle slots as indicated in figure 1 during pre-synchronisation operations and a parallel SACCH as shown in figure 2 whenever no pre-synchronisation is required. The base station uses the additional information whenever it is received.

The second signalling message can be used in the receiving radio terminal, mobile station or base station, by soft combining. This means that the soft output bits which contain the first signalling message are combined with the soft output bits containing the second signalling message. Actually, this allows to use the same coding for both SACCHs transmitted or to use different codings in order to improve the performance when the information is decoded.

Figure 3 shows frames used for full rate transmission of user data like speech from a base station of a radio communications network to a mobile station and vice versa.

16 frames 0, 1, 2, 3, etc. forming parts of two consecutive multiframes are depicted in two rows, the first one shown above the second one. Usually, both rows contain only the speech frames that are to be transmitted in full rate mode. In the situation in figure 3, however, in both rows, a coded signalling message is inserted in a first FACCH 30, 30' and the same coded signalling message is additionally inserted

in a second FACCH 31, 31', each of the frames used for the FACCHs being indicated with an F. For the two FACCHs 30, 30', 31, 31', in each row consecutive speech frames of 20 ms were stolen. The remaining frames are further on used for speech, indicated within the frames with "0"s, "1"s and "5"s. The FACCHs 30, 30', 31, 31' are distributed diagonally interleaved as known for single FACCHs.

Whenever the lowest AMR modes are used and a handover message is sent, two consecutive FACCH 30, 30', 31, 31' are transmitted carried in frames stolen as shown in figure 3. Since the second FACCH 31, 31' contains a copy of the message in the first FACCH 30, 30', the receiving station can first try to decode the first FACCH 30, 30'. If it fails and a further FACCH 31, 31' is present, the receiving station can then try to decode the second FACCH 31, 31' separately or using soft combining, in particular if also a separate decoding of the second FACCH 31, 31' was not successful. When a higher AMR mode is used, only one FACCH 30, 30' is transmitted as known from the state of the art, since the risk of loosing it is not too high.

Claims

1. A method for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface between at least two radio terminals of a radio communications system, said speech or data being transmitted in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in control channels associated with said at least one traffic channel, wherein a first and a second signalling message with identical content are transmitted in two separate associated control channels.

2. Method according to claim 1, wherein the first and the second signalling message are coded differently for different control channels.

3. Method according to claim 1, wherein the first and the second signalling message are coded identically for different control channels.

4. Method according to one of claims 1 to 3, wherein the control channels are Slow Associated Control Channels in a TDMA (Time Division Multiple Access) radio communications system.

5. Method according to claim 4, wherein 26-multiframes including 26 TDMA frames are used to carry at least one Traffic Channel in the first 12 frames and in the 14th to 25th frames, and wherein a part of the first signalling message is inserted into a Slow Associated Control Channel carried in the 13th frame and a corresponding part of the second signalling message is inserted into a Slow Associated Control Channel carried in the 26th frame.

6. Method according to claim 4, wherein 26-multiframes including 26 TDMA frames are used to carry at least one Traffic Channel in the first 12 frames and in the 14th to 25th frames, and wherein a part of the first signalling message is inserted into a Slow Associated Control Channel carried in the 25th frame and a corresponding part of the second signalling message is inserted into a Slow Associated Control Channel carried in the 13th frame of the following 26-multiframe.

7. Method according to one of claims 4 to 6, wherein in a downlink data transmission, the signalling messages are transmitted from a base station used as a transmitting radio terminal to a mobile station used as a receiving radio terminal, and wherein the second signalling message is always transmitted but only used after pre-synchronisation of the mobile station with cells neighbouring the cell to which the base station belongs,

i.e. when no other tasks are necessary during the frames with the second signalling message.

8. Method according to claim 7, wherein the second signalling message is used in addition during pre-synchronisation, if allowed by the base station and when required for signalling performance.

9. Method according to claim 7 or 8, wherein the second signalling message is used in addition during pre-synchronisation, when a previous Slow Associated Control Channel message was lost.

10. Method according to one of claims 4 to 9, wherein in uplink data transmission, the signalling messages are transmitted from a mobile station used as a transmitting radio terminal to a base station used as a receiving radio terminal, and wherein the second signalling message is always transmitted when no pre-synchronisation of the mobile station with cells which are neighbouring the cell of the base station takes place.

11. Method according to one of claims 4 to 9, wherein in uplink data transmission, the signalling messages are transmitted from a mobile station used as a transmitting radio terminal to a base station used as a receiving radio terminal, and wherein the second signalling message is only transmitted after request by the base station.

12. Method according to one of claims 1 to 3, wherein the control channels are Fast Associated Control Channels (30,30',31,31') in a TDMA (Time Division Multiple Access) radio communications system.

13. Method according to claim 12, wherein frames for two consecutive Fast Associated Control Channels (30,30',31,31') are stolen from the at least one speech or data Traffic Channel for transmitting the first and the second signalling message.

14. Method according to claim 12 or 13, wherein the first and the second signalling message are transmitted whenever a new signalling message is needed.

15. Method according to one of claims 1 to 14, wherein the first and the second signalling messages are evaluated in a receiving radio terminal by soft combining of the two signalling messages.

16. A method for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface between at least two radio terminals of a radio communications system, said speech or data being transmitted in coded form in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in coded form in at least one control channel associated with said at least one traffic channel, wherein said

signalling messages are coded for transmission with a coding rate depending on the coding rate used for coding of said data or speech.

17. Method according to claim 16, wherein, while a low coding rate is used for the coding of data or speech, the signalling messages are coded with a coding rate twice lower compared to the coding rate used for the coding of the signalling messages while a high coding rate is used for the coding of data or speech.

18. Method according to claim 17, wherein said at least one control channel is at least one Fast Associated Control Channel in a TDMA (Time Division Multiple Access) radio communications system and wherein the signalling messages are transmitted in said at least one Fast Associated Control Channel diagonally interleaved over 12 bursts.

19. Method according to one of the preceding claims, used for Adaptive Multirate transmissions.

20. Method according to claim 19, used only for low Adaptive Multirate transmissions.

21. Method according to one of the preceding claims, used only for full rate mode transmissions.

22. Radio terminal for a radio communications system, including for improving the quality of control

signalling based on signalling messages controlling speech or data transmission over an air interface to at least one other radio terminal of the radio communications system, said speech or data being transmitted in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in control channels associated with said at least one traffic channel, means for inserting signalling messages with identical content into two different associated control channels.

23. Radio terminal according to claim 22, further including means for coding the signalling messages that are to be inserted into two different control channels differently for said two different control channels.

24. Radio terminal according to claim 22 or 23, wherein said control channels are Slow Associated Control Channels in a TDMA (Time Division Multiple Access) radio communications system, and wherein the means for inserting the same signalling message into two different control channels are suited to insert only one signalling message into one Slow Associated Control Channel during a pre-synchronisation of the radio terminal with the cells neighbouring the cells of the other radio terminal and to insert two signalling messages with identical content into two different Slow Associated Control Channel whenever no pre-synchronisation takes place, i.e. when no other tasks

are necessary during the frames to be used for the second signalling message.

25. Radio terminal according to claim 22 or 23, wherein said control channels are Slow Associated Control Channels in a TDMA (Time Division Multiple Access) radio communications system, further including means for receiving a signal indicating that a second signalling message in a Slow Associated Control Channel is needed and for controlling the insertion of the second signalling message into a second Slow Associated Control Channel accordingly.

26. Radio terminal according to one of claims 22 to 25, wherein said control channels are Slow Associated Control Channel in a TDMA (Time Division Multiple Access) radio communications system, and wherein the means for inserting the same signalling message into two different control channels are suited to insert data or speech into Traffic Channels carried in the 1st to 12th frame of 26-multiframes including 26 TDMA frames, further data or speech into Traffic Channels carried in the 14th to 25th frame of the 26-multiframes, a part of a first signalling message into a first Slow Associated Control Channel carried in the 13th frame of the 26-multiframes, and a corresponding part of a second signalling message into a second Slow Associated Control Channel carried in the 26th frame of the 26-multiframes.

27. Radio terminal according to one of claims 22 to 26, wherein said control channels are Slow Associated Control Channel in a TDMA (Time Division Multiple Access) radio communications system, and wherein the means for inserting the same signalling message into two different control channels are suited to insert data or speech into Traffic Channels carried in the 1st to 12th frame of 26-multiframes including 26 TDMA frames, further data or speech into Traffic Channels carried in the 14th to 25th frame of the 26-multiframes, a part of a first signalling message into a first Slow Associated Control Channel carried in the 26th frame of the 26-multiframes, and a corresponding part of a second signalling message into a second Slow Associated Control Channel carried in the 13th frame of the respective following 26-multiframe.

28. Radio terminal according to claim 22 to 27, wherein said control channels are Fast Associated Control Channels in a TDMA (Time Division Multiple Access) radio communications system, further including means for receiving a signal indicating that signalling messages in Fast Associated Control Channels (30,30',31,31') are needed and for controlling a stealing of frames of 40ms of the Traffic Channels for two Fast Associated Control Channels (30,30',31,31'), into which the signalling messages are to be inserted, accordingly.

29. Radio terminal for a radio communications system, including for improving the quality of control

signalling based on signalling messages controlling speech or data transmission over an air interface to at least one other radio terminal of the radio communications system, said speech or data being transmitted in coded form in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in coded form in at least one control channel associated with said at least one traffic channel, means for coding said signalling messages with a coding rate depending on the coding rate used for coding said user data or speech.

30. Radio terminal according to claim 29, wherein the means for coding signalling messages use a twice lower coding rate while a low coding rate is used for the coding of data or speech, compared to the coding rate used for coding of the signalling messages while a high coding rate is used for the coding of data or speech.

31. Radio terminal according to claim 30, wherein said at least one control channel is at least one Fast Associated Control Channel in a TDMA (Time Division Multiple Access) radio communications system, and wherein the means for inserting the coded signalling messages that are to be transmitted in at least one control channel insert the coded signalling message diagonally interleaved in stolen user data or speech frames over 12 bursts.

32. Radio terminal for a radio communications system, including for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface from at least one other radio terminal of the radio communications system, said speech or data being transmitted in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in control channels associated with said at least one traffic channel, means for receiving two different associated control channels with signalling messages with identical content and means for evaluating said signalling messages.

33. Radio terminal according to claim 32, further including means for determining if a pre-synchronisation with cells neighbouring the cell of the transmitting radio terminal is terminated, the means for evaluating the signalling messages evaluating the second message only after terminated pre-synchronisation, i.e. when no other tasks are necessary during the frames used for the second signalling message.

34. Radio terminal according to claim 32 or 33, further including means for determining if a second signalling message is necessary for acceptable signalling performance, the means for evaluating the signalling messages evaluating the second message if necessary for the signalling performance regardless of the termination of a pre-synchronisation of the radio terminal with the

cells neighbouring the cell of the transmitting radio terminal.

35. Radio terminal according to claim 32, further including means for determining, whether a second signalling message is needed and for requesting from the other radio terminal a second signalling message if one is needed.

36. Module for a radio terminal of a radio communications system including for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface to at least one other radio terminal of the radio communications system, said speech or data being transmitted in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in control channels associated with said at least one traffic channel, means for inserting signalling messages with identical content into two different associated control channels.

37. Module for a radio terminal of a radio communications system including for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface from at least one other radio terminal of the radio communications system, said speech or data being transmitted in at least one traffic channel of said radio communications system, and said signalling

messages being transmitted in control channels associated with said at least one traffic channel, means for evaluating two received signalling messages with identical content.

38. Module for a radio terminal for a radio communications system, including for improving the quality of control signalling based on signalling messages controlling speech or data transmission over an air interface to at least one other radio terminal of the radio communications system, said speech or data being transmitted in coded form in at least one traffic channel of said radio communications system, and said signalling messages being transmitted in coded form in at least one control channel associated with said at least one traffic channel, means for coding said signalling messages with a coding rate depending on the coding rate used for coding said user data or speech.

39. 26-multiframe for a full rate channel in a GSM/EDGE system including 26 TDMA frames, with 1st to 12th frames for transmitting Traffic Channels, 14th to 25th frames for transmitting further Traffic Channels, a 13th frame for transmitting a Slow Associated Control Channel with a part of a first signalling message, and a 26th frame for transmitting a second Slow Associated Control Channel with a corresponding part of a second signalling message having an identical content as the first signalling message.

40. 26-multiframe for a full rate channel in a GSM/EDGE system including 26 TDMA frames, with 1st to 12th frames for transmitting Traffic Channels, 14th to 25th frames for transmitting further Traffic Channels, a 26th frame for transmitting a Slow Associated Control Channel with a part of a first signalling message, and a 13th frame for transmitting a second Slow Associated Control Channel with a correspondingly preceding part of a second signalling message having an identical content as the first signalling message.

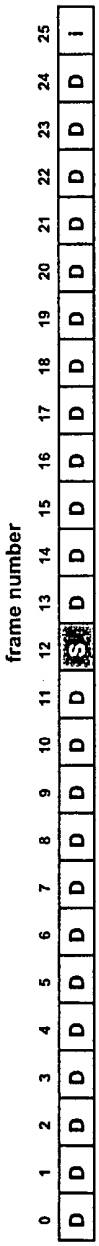

FIG. 1

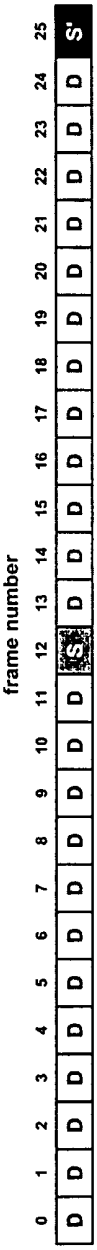

FIG. 2

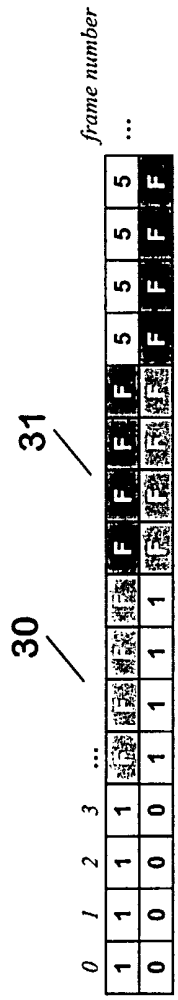

FIG. 3

30' 31'