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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
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1 Scope

The present document specifies the Radio sub-system link control implemented in the Mobile Station (MS), Base Station System (BSS) and Mobile Switching Centre (MSC) of the digital cellular telecommunications systems GSM.

Unless otherwise specified, references to GSM also include operation in any supported band (see TS 45.005).

1.1 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
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- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 23.003: "Numbering, addressing and identification".
- [3] 3GPP TS 23.009: "Handover procedures".
- [4] 3GPP TS 23.122: "NAS Functions related to Mobile Station (MS) in idle mode".
- [5] 3GPP TS 25.101: "UE Radio transmission and reception (FDD)".
- [6] 3GPP TS 25.123: "Requirements for support of Radio Resource Management (TDD)".
- [7] 3GPP TS 25.133: "Requirements for support of Radio Resource Management (FDD)".
- [8] 3GPP TS 25.304: "UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode".
- [9] 3GPP TS 25.331: "Radio Resource Control (RRC); Protocol Specification".
- [10] 3GPP TS 26.093: "AMR Speech Codec; Source Controlled Rate operation".
- [11] 3GPP TS 43.022: "Functions related to Mobile Station (MS) in idle mode and group receive mode".
- [12] 3GPP TS 43.064: "Overall description of the GPRS Radio Interface; Stage 2".
- [13] 3GPP TS 43.246: "Multimedia Broadcast Multicast Service (MBMS) in the GERAN; Stage 2".
- [14] 3GPP TS 43.068: "Voice Group Call Service (VGCS); Stage 2".
- [15] 3GPP TS 44.004: "Layer 1; General requirements".
- [16] 3GPP TS 44.006: "Mobile Station - Base Station System (MS - BSS) interface; Data Link (DL) layer specification".
- [17] 3GPP TS 44.018: "Mobile radio interface layer 3 specification; Radio Resource Control Protocol".
- [18] 3GPP TS 44.056: "GSM Cordless Telephony System (CTS), Phase 1; CTS radio interface layer 3 specification".
- [19] 3GPP TS 44.060: "General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control (RLC) / Medium Access Control (MAC) protocol".
- [20] Void.

- [21] Void.
- [22] 3GPP TS 45.002: "Multiplexing and multiple access on the radio path".
- [23] 3GPP TS 45.003: "Channel coding"
- [24] 3GPP TS 45.005: "Radio transmission and reception".
- [25] 3GPP TS 45.010: "Radio subsystem synchronization".
- [26] 3GPP TS 45.056: "CTS-FP radio subsystem".
- [27] 3GPP TR 45.902: "Flexible Layer One".
- [28] 3GPP TS 46.011: "Full rate speech; Substitution and muting of lost frames for full rate speech channels".
- [29] 3GPP TS 46.012: "Full rate speech; Comfort noise aspect for full rate speech traffic channels".
- [30] 3GPP TS 46.031: "Full rate speech; Discontinuous Transmission (DTX) for full rate speech traffic channels".
- [31] 3GPP TS 48.008: "Mobile-services Switching Centre - Base Station System (MSC - BSS) interface, Layer 3 specification".
- [32] 3GPP TS 48.058: "Base Station Controller - Base Transceiver Station (BSC - BTS) interface; Layer 3 specification".
- [33] 3GPP TS 51.010: "Mobile Station (MS) conformity specification".
- [34] 3GPP TS 51.011: "Specification of the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface".
- [35] TIA/EIA/IS-2000-5-A: "Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems".
- [36] TIA/EIA/IS-833: "Multi-Carrier Specification for Spread Spectrum Systems on GSM MAP (MC-MAP) (Lower Layers Air Interface)".
- [37] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".
- [38] 3GPP TS 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception".
- [39] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".
- [40] 3GPP TS 36.304: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode".
- [41] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol Specification".
- [42] 3GPP TS 31.102: "Characteristics of the Universal Subscriber Identity Module (USIM) application".
- [43] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".
- [44] 3GPP TS 22.268: "Public Warning System (PWS) requirements; Stage 1".
- [45] 3GPP TS 23.251: "Network sharing; Architecture and functional description".
- [46] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 specification; Core Network Protocols - Stage 3".

- [47] 3GPP TS 25.306: "UE Radio Access capabilities".
- [48] 3GPP TR 45.926: "Solutions for GSM/EDGE BTS Energy Saving".

1.2 Abbreviations

Abbreviations used in the present document are listed in 3GPP TR 21.905.

UFPS Unique Frequency Parameter Set

1.3 Definitions

In addition to those below, abbreviations used in the present document are listed in 3GPP TR 21.905 [1].

Acceptable cell: see definition in 3GPP TS 43.022 [11].

Coverage Class: see definition in 3GPP TS 43.064 [12].

CSG Whitelist: A list provided by NAS containing all the CSG identities and their PLMN IDs of the CSGs to which the subscriber belongs, see 3GPP TS 23.122 [4].

NOTE: This list is known as "Allowed CSG List" in Rel-8 specifications.

CSG cell: The definition of CSG cell for UTRAN is given in 3GPP TS 25.304 [8]; the definition of CSG cell for E-UTRAN is given in 3GPP TS 36.304 [40].

EC-GSM-IoT: Extended Coverage GSM for Internet of Things.

EC-GSM-IoT cell: A cell supporting EC-GSM-IoT.

EC operation: See definition in 43.064 [12].

Hybrid cell: The definition of hybrid cell for UTRAN is given in 3GPP TS 25.304 [8]; the definition of hybrid cell for E-UTRAN is given in 3GPP TS 36.304 [40].

Network sharing: network sharing is an optional feature that allows different core network operators to connect to the same shared radio access network (see 3GPP TS 23.251 [45]). When network sharing is in use within a given cell, the network broadcasts within system information the PLMN identities of the PLMNs sharing the cell. A mobile station supporting network sharing uses this information for its PLMN (re)selection processes and indicates the selected PLMN to the BSS.

Power Efficient Operation (PEO): see definition in 3GPP TS 43.064 [12].

Suitable cell: see definition in 3GPP TS 43.022 [11].

Unique Frequency Parameter Set: defined by a single ARFCN or a MA. In case of a radio frequency channel assigned a frequency parameter set consisting of a single ARFCN, the UFPS is defined by that ARFCN. In case of a radio frequency channel assigned a frequency parameter set consisting of a MA, MAIO and HSN, that radio frequency channel belong to the same UFPS as other radio frequency channels assigned the same MA.

1.4 Restrictions

Independently of what is stated elsewhere in this and other 3GPP specifications, mobile station support for PBCCH and PCCCH is optional for A/Gb-mode of operation. The network shall never enable PBCCH and PCCCH.

2 General

The radio sub-system link control aspects that are addressed are as follows:

- Handover;
- RF Power control in *A/Gb mode*, including fast power control for E-TCH and enhanced power control for TCH and O-TCH;

- RF Power control in *Iu mode*, including fast power control for E-TCH and enhanced power control for DBPSCH (in MAC-Dedicated and MAC-DTM states);
- Radio link Failure;
- Cell selection and re-selection in Idle mode, in Group Receive mode, in GPRS mode, in broadcast/multicast receive mode and in EC operation and PEO (see 3GPP TS 43.022);
- Coverage class selection in EC operation;
- CTS mode tasks.

NOTE: A distinction is made between *A/Gb mode* and *Iu mode* only when necessary. Procedures and mechanisms described in this TS apply to both modes of operation unless otherwise stated. In *Iu mode*, unless otherwise stated, DBPSCH covers TCH, PDTCH and FLO.

Handover is required to maintain a call in progress as a MS engaged in a point-to-point call or with access to the uplink of a channel used for a voice group call passes from one cell coverage area to another and may also be employed to meet network management requirements, e.g. relief of congestion.

Handover may occur during a call from one TCH or multiple TCHs (in the case of multislot configuration) to another TCH or multiple TCHs. It may also occur from DCCH to DCCH or from DCCH to one or multiple TCH(s), e.g. during the initial signalling period at call set-up. Additionally in *Iu mode*, handover may occur in MAC-Dedicated and MAC-DTM states:

- on PDTCH or multiple PDTCHs (in the case of multislot configuration) on DBPSCH(s) to another PDTCH or multiple PDTCHs on DBPSCH(s);
- for FLO, from one DBPSCH or multiple DBPSCHs (in the case of multislot configuration) to another DBPSCH or multiple DBPSCHs.

The handover may be either from channel(s) on one cell to other channel(s) on a surrounding cell, or between channels on the same cell which are carried on the same frequency band. Examples are given of handover strategies, however, these will be determined in detail by the network operator.

For a multiband MS, the handover described is also allowed between any channels on different cells which are carried on different frequency bands, e.g. between a GSM 900/TCH and a DCS 1 800/TCH. Handover between two co-located cells, carried on different frequency bands, is considered as inter-cell handover irrespective of the handover procedures used.

For a multi-RAT MS, i.e. an MS supporting multiple radio access technologies, handover is allowed between GSM and other radio access technologies.

NOTE: At handover, the MS will normally not be able to verify the PLMN of the target cell and will thus assume that the same system information apply after the handover unless the network provides new system information.

Adaptive control of the RF transmit power from an MS and optionally from the BSS is implemented in order to optimize the uplink and downlink performance and minimize the effects of co-channel interference in the system.

The criteria for determining radio link failure are specified in order to ensure that calls which fail either from loss of radio coverage or unacceptable interference are satisfactorily handled by the network. Radio link failure may result in either re-establishment or release of the call in progress. For channels used for a voice group call, a radio uplink failure results in the freeing up of the uplink.

Procedures for cell selection and re-selection whilst in Idle mode (i.e. not actively processing a call), are specified in order to ensure that a mobile is camped on a cell with which it can reliably communicate on both the radio uplink and downlink. The operations of an MS in Idle Mode are specified in 3GPP TS 43.022.

Cell re-selection is also performed by the MS when attached to GPRS, except when the MS simultaneously has a circuit switched connection. Optional procedures are also specified for network controlled cell re-selection for GPRS. Cell re-selection for GPRS is defined in subclause 10.1.

For a multi-RAT MS, cell selection and re-selection is allowed between GSM and other radio access technologies.