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Contents

Intellectual Property Rights	2
Foreword.....	2
Modal verbs terminology.....	2
Foreword.....	8
1 Scope	9
1.1 References	9
1.2 Abbreviations	11
1.3 Definitions	11
1.4 Restrictions.....	11
2 General	11
3 Handover	13
3.1 Overall process	13
3.2 MS measurement procedure	13
3.3 BSS measurement procedure.....	13
3.4 Strategy	13
4 RF power control.....	14
4.1 Overall process	14
4.2 MS implementation	14
4.2.1 General.....	14
4.2.2 (EC-)RACH	15
4.2.2.1 Random access procedure when EC operation is not enabled	15
4.2.2.2 Random access procedure when EC operation is enabled	16
4.3 MS power control range	16
4.4 BSS implementation.....	17
4.4.1 VAMOS subchannel power control for BSS in downlink	17
4.5 BSS power control range.....	17
4.6 Strategy	17
4.7 Timing	17
4.7.1 Normal Power Control.....	17
4.7.2 Fast Power Control	18
4.7.3 Enhanced Power Control	18
4.8 Dedicated channels used for a voice group call or voice broadcast.....	18
5 Radio link failure.....	19
5.1 Criterion	19
5.2 MS procedure	19
5.3 BSS procedure.....	20
6 Idle mode tasks.....	20
6.1 Introduction	20
6.2 Measurements for normal cell selection	21
6.3 Measurements for stored list cell selection.....	22
6.4 Criteria for cell selection and reselection	22
6.4.1 C1 path loss criterion	22
6.4.2 C2 reselection criterion	24
6.4.3 C4 criteria	25
6.4.4 Disabling of EC operation	25
6.5 Downlink signalling failure	25
6.6 Measurements for Cell Reselection.....	26
6.6.0 General.....	26
6.6.1 Monitoring of received signal level and BCCH data.....	26
6.6.1.1 Applicability.....	26
6.6.1.2 Monitoring of received signal level	26
6.6.1.3 Monitoring of BCCH data and BSIC decoding.....	27
6.6.1.4 Determination of available PLMNs	27

6.6.1.5	Requirements for synchronization and reading of BCCH data	27
6.6.1a	Reduced Monitoring of received signal level and (EC-)BCCH data	27
6.6.1a.1	General	27
6.6.1a.2	Monitoring of the serving cell	28
6.6.1a.3	Criteria for triggering measurements for cell re-selection	28
6.6.1a.4	Monitoring of non-serving cells	29
6.6.2	Path loss criteria and timings for cell re-selection	29
6.6.3	Cell reselection algorithm for SoLSA	30
6.6.4	Measurements on cells of other radio access technologies	30
6.6.5	Algorithm for cell re-selection from GSM to UTRAN based on cell ranking	35
6.6.6	Algorithm for inter-RAT cell re-selection based on priority information	36
6.6.7	Cell selection and re-selection to CSG cells and hybrid cells	39
6.6.7.1	Cell re-selection to CSG cells	39
6.6.7.1a	Cell re-selection to hybrid cells	40
6.6.7.2	Manual CSG ID selection	40
6.7	Release of TCH, SDCCH and DBPSCH	40
6.7.1	Normal case	40
6.7.2	Call re-establishment	41
6.8	Abnormal cases and emergency calls	41
6.9	RLA_EC signal level and SLA measurements	42
6.9.1	General	42
6.9.2	Physical parameters	42
6.9.3	Statistical parameter	42
6.9.4	Accuracy requirements	43
6.9.5	Void	43
6.9a	RLA_GC signal level measurements	43
6.9a.1	General	43
6.9a.2	Physical parameter	43
6.9a.3	Statistical parameter	43
6.9a.4	Accuracy requirements	43
6.10	Coverage class selection for EC-GSM-IoT	43
6.10.1	General	43
6.10.2	Downlink coverage class selection	43
6.10.3	Uplink coverage class selection	44
6.10.4	Coverage class adaptation for EC-CCCH	45
6.10.5	Downlink coverage class update	45
7	Network pre-requisites	46
7.1	BCCH carriers	46
7.2	Identification of surrounding BSS	47
7.2.1	General	47
7.2.2	Identification of surrounding BSS for handover measurements	48
7.3	Handover measurements on other radio access technologies	49
7.4	Handover measurements on UTRAN CSG cells and hybrid cells	52
8	Radio link measurements	53
8.1	Signal level	53
8.1.1	General	53
8.1.2	Physical parameter	53
8.1.3	Statistical parameters	54
8.1.4	Range of parameter	54
8.1.5	Measurement quantity for other radio access technologies	55
8.1.5.1	UTRAN FDD	55
8.1.5.2	UTRAN TDD	55
8.1.5.3	cdma2000	55
8.1.5.4	E-UTRAN FDD	55
8.1.5.5	E-UTRAN TDD	57
8.2	Signal quality	57
8.2.1	General	57
8.2.2	Physical parameter	57
8.2.3	Statistical parameters	57
8.2.3.1	RXQUAL	57

8.2.3.2	MEAN_BEP and CV_BEP	58
8.2.4	Range of parameter RXQUAL	59
8.2.5	Range of parameters MEAN_BEP and CV_BEP	60
8.3	Aspects of discontinuous transmission (DTX)	64
8.4	Measurement reporting	65
8.4.1	Measurement reporting for the MS	65
8.4.1a	Measurement reporting for the MS in FPC mode	67
8.4.1b	Measurement reporting for the MS in EPC mode	67
8.4.2	Measurement reporting for the MS on a SDCCH	68
8.4.3	Additional cell reporting requirements for multi band MS	68
8.4.4	Common aspects for the MS on a TCH, a SDCCH or a DBPSCH	69
8.4.5	Measurement reporting for the BSS	69
8.4.6	Extended measurement reporting	69
8.4.7	Additional cell reporting requirements for multi-RAT MS	70
8.4.8	Enhanced Measurement Reporting	71
8.4.8.1	Reporting Priority	72
8.4.8.2	Measurement Reporting	73
8.4.8.3	NBR_RCVD_BLOCKS for FLO	74
8.4.9	Requirements for measurement and reporting of CSG cells and hybrid cells	74
8.5	Absolute MS-BTS distance	75
8.5.1	General	75
8.5.2	Physical parameter	75
9	Control parameters	76
10	GPRS mode tasks	87
10.1	Cell Re-selection	87
10.1.0	General	87
10.1.1	Monitoring the received signal level and PBCCH data	88
10.1.1.0	General	88
10.1.1.1	Packet idle mode or MAC-Idle state	88
10.1.1.2	Packet transfer mode or MAC-Shared state	89
10.1.1.2a	Broadcast/multicast receive mode	90
10.1.1.3	Monitoring cells of other radio access technologies	91
10.1.2	Cell Re-selection Criteria	95
10.1.3	Cell Re-selection Algorithm	96
10.1.3.1	Abnormal cell reselection	97
10.1.3.2	Algorithm for cell re-selection from GSM to UTRAN based on cell ranking	98
10.1.3.3	Algorithm for inter-RAT cell re-selection based on priority information	99
10.1.3.4	Cell selection and re-selection to CSG cells and hybrid cells	99
10.1.4	Network controlled Cell re-selection	99
10.1.4.1	Measurement reporting	100
10.1.4.2	Cell re-selection command	104
10.1.4.3	Exceptional cases	104
10.1a	Measurement and Reporting of CSG Cells and hybrid cells	104
10.2	RF Power Control	105
10.2.1	MS output power	105
10.2.2	BTS output power	107
10.2.3	Measurements at MS side	108
10.2.3.1	Deriving the C value	108
10.2.3.1.1	Packet idle mode or MAC-Idle state	108
10.2.3.1.2	Packet transfer mode or MAC-Shared state	109
10.2.3.1.2.1	MS that have not enabled EC operation	109
10.2.3.1.2.2	MS that have enabled EC operation	110
10.2.3.2	Derivation of Channel Quality Report	111
10.2.3.2.1	Packet transfer mode or MAC-Shared state	111
10.2.3.2.2	Void	114
10.2.3.2.3	Measurement reporting	114
10.2.3.2.4	Measurement reporting - additional requirements for downlink dual carrier	115
10.2.3.2.5	Measurement reporting - additional requirements for downlink multi carrier	116
10.2.3.3	Range of parameters MEAN_BEP and CV_BEP for EGPRS2	116
10.2.4	Measurements at BSS side	120

10.2a	Packet-switched Handover	120
10.3	Measurement requirements	120
10.4	Control parameters	120
11	CTS mode tasks.....	128
11.1	CTS idle mode tasks.....	128
11.1.1	CTS cell selection.....	129
11.1.1.1	Synchronization and measurements for CTS cell selection	129
11.1.1.2	Initial sychronization of CTS-MS	129
11.1.2	Criterion for CTS cell selection	129
11.1.3	Monitoring of CTSBCH and CTSPCH.....	130
11.1.3.1	Monitoring of received signal level	130
11.1.3.2	Downlink beacon failure	130
11.1.3.3	Downlink paging failure	130
11.1.4	Procedures with reporting to the CTS-FP	130
11.1.4.1	AFA monitoring	130
11.1.4.2	BCCH detection	131
11.1.4.3	Observed Frequency Offset (OFO) measurement.....	131
11.2	Intra-cell handover	131
11.2.1	Overall process	131
11.2.2	CTS-MS measurement procedure.....	131
11.2.3	CTS-FP measurement procedure	131
11.2.4	Strategy	132
11.3	RF power control.....	132
11.3.1	Overall process	132
11.3.2	CTS-MS implementation.....	132
11.3.3	CTS-MS power control range.....	132
11.3.4	CTS-FP implementation	132
11.3.5	CTS-FP power control range	132
11.3.6	Strategy	133
11.3.7	Timing	133
11.4	Radio link failure.....	133
11.4.1	Criterion.....	133
11.4.2	CTS-MS procedure	133
11.4.3	CTS-FP procedure	134
11.5	Radio link measurements	134
11.5.1	Signal strength	134
11.5.1.1	General	134
11.5.1.2	Physical parameter	134
11.5.1.3	Statistical parameters	134
11.5.1.4	Range of parameter	134
11.5.2	Signal quality.....	134
11.5.2.1	General	134
11.5.2.2	Physical parameter	134
11.5.2.3	Statistical parameters	134
11.5.2.4	Range of parameter	134
11.5.3	Aspects of discontinuous transmission (DTX)	135
11.5.4	Measurement reporting for the CTS-MS on a TCH.....	135
11.6	Control of CTS-FP service range	135
11.7	Control parameters	135
12	COMPACT Mode Tasks	137
12.1	Introduction	137
12.2	Network Pre-requisites	137
12.2.1	CPBCCH carriers.....	137
12.3	COMPACT Idle Mode Tasks.....	137
12.3.1	Introduction.....	137
12.3.2	Measurements for COMPACT Cell Selection.....	138
12.3.3	Measurements for COMPACT Stored List Cell Selection	138
12.3.4	Criteria for COMPACT Cell Selection.....	138
12.3.5	Downlink Signalling Failure.....	139
12.4	COMPACT Cell Reselection	139

12.4.1	Monitoring the received signal level and CPBCCCH data.....	139
12.4.1.1	Packet idle mode or MAC-Idle state	139
12.4.1.2	Packet transfer mode or MAC-Shared state	140
12.4.2	COMPACT cell reselection criteria.....	140
12.4.3	COMPACT cell reselection algorithm.....	141
12.4.4	Network controlled Cell reselection	141
12.4.5	COMPACT cell reselection measurement opportunities	141
Annex A (informative):	Definition of a basic GSM or DCS 1 800 handover and RF power control algorithm	142
A.1	Scope	142
A.2	Functional requirement.....	142
A.3	BSS pre-processing and threshold comparisons.....	143
A.3.1	Measurement averaging process.....	143
A.3.2	Threshold comparison process	144
A.3.2.1	RF power control process	144
A.3.2.2	Handover Process	145
A.4	BSS decision algorithm.....	146
A.4.1	Internal intracell handover according to radio criteria: (Interference problems).....	146
A.4.2	Internal handover according to other criteria.....	146
A.4.3	General considerations	147
A.5	Channel allocation.....	147
A.6	Handover decision algorithm in the MSC.....	147
Annex B (informative):	Power Control Procedures.....	150
B.1	Open loop control.....	150
B.2	Closed loop control	151
B.3	Quality based control.....	151
B.4	BTS power control	152
B.5	Example.....	152
B.6	Interworking between normal and fast power control for ECSD.....	153
B.7	Interworking between normal and enhanced power control (EPC)	154
Annex C (informative):	Example Interference Measurement Algorithm	156
Annex D (informative):	Example Selection of Modulation and Coding Schemes based on Link Quality Reports.....	157
Annex E (informative):	Change history	158
History		170

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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.
- For a specific reference, subsequent revisions do not apply.
- 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.