ETSI TS 101 851-4-1 V2.1.1 (2008-01)

Technical Specification

Satellite Earth Stations and Systems (SES);
Satellite Component of UMTS/IMT-2000;
Part 4: Physical layer procedures;
Sub-part 1: G-family (S-UMTS-G 25.214)

Reference
RTS/SES-00298-4-1

Keywords
interface, MES, MSS, radio, satellite, UMTS

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
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

Individual copies of the present document can be downloaded from:
http://www.etsi.org

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, please send your comment to one of the following services:
http://portal.etsi.org/chaircor/ETSI_support.asp

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The present document is specifying the Satellite Radio Interface referenced as SRI Family G at ITU-R, in the frame of the modification of ITU-R Recommendation M.1457 [13]. This modification has been approved at SG8 meeting in November 2005.

The present document is part 4, sub-part 1 of a multi-part deliverable covering Satellite Earth Stations and Systems (SES); Satellite Component of UMTS/IMT-2000; G-family, as identified below:

Part 1: "Physical channels and mapping of transport channels into physical channels";

Part 2: "Multiplexing and channel coding";

Part 3: "Spreading and modulation";

Part 4: "Physical layer procedures";

Sub-part 1: "G-family (S-UMTS-G 25.214)";

Sub-part 2: "A-family (S-UMTS-A 25.214)";

Part 5: "UE Radio Transmission and Reception";

Part 6: "Ground stations and space segment radio transmission and reception".

Introduction

S-UMTS stands for the Satellite component of the Universal Mobile Telecommunication System. S-UMTS systems will complement the terrestrial UMTS (T-UMTS) and inter-work with other IMT-2000 family members through the UMTS core network. S-UMTS will be used to deliver 3rd generation Mobile Satellite Services (MSS) utilizing either low (LEO) or medium (MEO) earth orbiting, or geostationary (GEO) satellite(s). S-UMTS systems are based on terrestrial 3GPP specifications and will support access to GSM/UMTS core networks.

NOTE 1: The term T-UMTS will be used in the present document to further differentiate the Terrestrial UMTS component.

Due to the differences between terrestrial and satellite channel characteristics, some modifications to the terrestrial UMTS (T-UMTS) standards are necessary. Some specifications are directly applicable, whereas others are applicable with modifications. Similarly, some T-UMTS specifications do not apply, whilst some S-UMTS specifications have no corresponding T-UMTS specification.

Since S-UMTS is derived from T-UMTS, the organization of the S-UMTS specifications closely follows the original 3rd Generation Partnership Project (3GPP) structure. The S-UMTS numbers have been designed to correspond to the 3GPP terrestrial UMTS numbering system. All S-UMTS specifications are allocated a unique S-UMTS number as follows:

S-UMTS-n xx.yyy

Where:

- The numbers xx and yyy correspond to the 3GPP-numbering scheme.
- n (n = A, B, C, etc.) denotes the family of S-UMTS specifications.

An S-UMTS system is defined by the combination of a family of S-UMTS specifications and 3GPP specifications, as follows:

- If an S-UMTS specification exists it takes precedence over the corresponding 3GPP specification (if any). This precedence rule applies to any references in the corresponding 3GPP specifications.

  NOTE 2: Any references to 3GPP specifications within the S-UMTS specifications are not subject to this precedence rule.

  EXAMPLE: An S-UMTS specification may contain specific references to the corresponding 3GPP specification.

- If an S-UMTS specification does not exist, the corresponding 3GPP specification may or may not apply. The exact applicability of the complete list of 3GPP specifications shall be defined at a later stage.

1 Scope

The present document specifies the characteristics of the physical layer procedures used for family G of the satellite component of UMTS (S-UMTS-G).

It is based on the FDD mode of UTRA defined by TS 125 211 [4], TS 125 212 [9], TS 125 213 [10], TS 125 215 [11], TS 125 214 [5], TS 125 331 [12] and TS 125 433 [6] and adapted for operation over satellite transponders.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
    - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
    - for informative references.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ETSI TS 101 851-1-1: "Satellite Earth Stations and Systems (SES); Satellite Component of UMTS/IMT-2000; Part 1: Physical channels and mapping of transport channels into physical channels; Sub-part 1: G-family (S-UMTS-G 25.211)".

[2] ETSI TS 101 851-2-1: "Satellite Earth Stations and Systems (SES); Satellite Component of UMTS/IMT-2000; Part 2: Multiplexing and channel coding; Sub-part 1: G-family (S-UMTS-G 25.212)".

[3] ETSI TS 101 851-3-1: "Satellite Earth Stations and Systems (SES); Satellite Component of UMTS/IMT-2000; Part 3: Spreading and modulation; Sub-part 1: G-family (S-UMTS-G 25.213)".

[4] ETSI TS 125 211: "Universal Mobile Telecommunications System (UMTS); Physical channels and mapping of transport channels onto physical channels (FDD) (3GPP TS 25.211)".

[5] ETSI TS 125 214: "Universal Mobile Telecommunications System (UMTS); Physical layer procedures (FDD) (3GPP TS 25.214)".

[6] ETSI TS 125 433: "Universal Mobile Telecommunications System (UMTS); UTRAN Iub interface Node B Application Part (NBAP) signalling (3GPP TS 25.433)".

[7] ETSI TS 125 101: "Universal Mobile Telecommunications System (UMTS); User Equipment (UE) radio transmission and reception (FDD) (3GPP TS 25.101)".

[8] ETSI TS 125 133: "Universal Mobile Telecommunications System (UMTS); Requirements for support of radio resource management (FDD) (3GPP TS 25.133)".

2.2 Informative references

[9] ETSI TS 125 212: "Universal Mobile Telecommunications System (UMTS); Multiplexing and channel coding (FDD) (3GPP TS 25.212)".

[10] ETSI TS 125 213: "Universal Mobile Telecommunications System (UMTS); Spreading and modulation (FDD) (3GPP TS 25.213)".

[11] ETSI TS 125 215: "Universal Mobile Telecommunications System (UMTS); Physical layer; Measurements (FDD) (3GPP TS 25.215)".

[12] ETSI TS 125 331: "Universal Mobile Telecommunications System (UMTS); Radio Resource Control (RRC); Protocol specification (3GPP TS 25.331)".

[13] ITU-R Recommendation M.1457 (2006): "Detailed specifications of the radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

L1 combining period: interval of contiguous radio frames when S-CCPCH clusters may be soft combined

S-CCPCH cluster: one or more S-CCPCHs on different RLs, all containing identical physical channel bits

NOTE: S-CCPCHs in an S-CCPCH cluster are synchronized such that the delay between the earliest and latest arriving S-CCPCH at the UE is no more than 296 chips.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AICH	Acquisition Indicator CHannel
ASC	Access Service Class
BCH	Broadcast CHannel
CCPCH	Common Control Physical CHannel
CCTrCH	Coded Composite Transport CHannel
CPICH	Common PIlot CHannel
CRC	Cyclic Redundancy Check
DL	DownLink
DPCCH	Dedicated Physical Control CHannel
DPCH	Dedicated Physical CHannel
DPDCH	Dedicated Physical Data CHannel
DTX	Discontinuous Transmission
GEO	Geostationary Earth Orbit
LEO	Low Earth Orbit
MEO	Medium Earth Orbit
MICH	MBMS Indicator CHannel
MSS	Mobile Satellite Services
PCA	Power Control Algorithm
P-CCPCH	Primary Common Control Physical CHannel

P-CPICH	Primary Common PIlot CHannel
PICH	Paging Indicator CHannel
PRACH	Physical Random Access CHannel
RACH	Random Access CHannel
RAT	Radio Access Technology
RL	Radio Link
RPL	Recovery Period Length
RSCP	Received Signal Code Power
S-CCPCH	Secondary Common Control Physical CHannel
SCH	Synchronization CHannel
SFN	System Frame Number
SIR	Signal-to-Interference Ratio
SSDT	Site Selection Diversity TPC
TFC	Transport Format Combination
TFCI	Transport Frame Combination Indicator
TPC	Transmit Power Control
TTI	Transmission Time Interval
UE	User Equipment
UL	UpLink
USRAN	UMTS Satellite Radio Access Network
UTRA	UMTS Terrestrial Radio Access

4 Synchronization procedures

4.1 Spot search

During the spot search, the UE searches for a satellite beam and determines the downlink scrambling code and common channel frame synchronization of that satellite beam. How spot search is typically done is described in annex B.

4.2 Common physical channel synchronization

The radio frame timing of all common physical channels can be determined after spot search.

4.2.1 P-CCPCH radio frame timing

The P-CCPCH radio frame timing is found during spot search and the radio frame timing of all common physical channel are related to that timing as described in TS 101 851-1-1 [1].

4.2.2 S-CCPCH soft combining timing

Higher layers will provide additional timing information when S-CCPCH clusters can be soft combined. The timing information allows the UE to determine the L1 combining period that applies to each S-CCPCH cluster. The information also identifies the S-CCPCHs and the RLs in each cluster as well as which S-CCPCH clusters can be soft combined. The set of S-CCPCH clusters that can be combined does not change during an L1 combining period. When S-CCPCH clusters can be soft combined, all S-CCPCHs in the clusters shall contain identical bits in their data fields, although the TFCI fields of S-CCPCH in different clusters may be different. (TFC detection when S-CCPCH clusters may be soft combined is discussed in TS 101 851-2-1 [2].) An L1 combining period shall contain only complete TTIs. The maximum delay between S-CCPCH clusters that the UE may combine is set by UE performance requirements.

4.3 DPCCH/DPDCH synchronization

4.3.1 Synchronization primitives

4.3.1.1 General

For the dedicated channels, synchronization primitives are used to indicate the synchronization status of radio links, both in uplink and downlink. The definition of the primitives is given in the following clauses.

4.3.1.2 Downlink synchronization primitives

Layer 1 in the UE shall every radio frame check synchronization status of the downlink dedicated channels. Synchronization status is indicated to higher layers using the CPHY-Sync-IND and CPHY-Out-of-Sync-IND primitives.

The criteria for reporting synchronization status are defined in two different phases.

The first phase starts when higher layers initiate physical dedicated channel establishment (as described in TS 125 331 [12]) or whenever the UE initiates synchronization procedure A (as described in clause 4.3.2.1) and lasts until 160 ms after the downlink dedicated channel is considered established by higher layers (physical channel establishment is defined in TS 125 331 [12]). During this time out-of-sync shall not be reported and in-sync shall be reported using the CPHY-Sync-IND primitive if the following criterion is fulfilled:

- The UE estimates the DPCCH quality over the previous 40 ms period to be better than a threshold Q_{in}. This criterion shall be assumed not to be fulfilled before 40 ms of DPCCH quality measurements have been collected. Q_{in} is defined implicitly by the relevant tests in TS 125 101 [7].

The second phase starts 160 ms after the downlink dedicated channel is considered established by higher layers. During this phase both out-of-sync and in-sync are reported as follows.

Out-of-sync shall be reported using the CPHY-Out-of-Sync-IND primitive if any of the following criteria is fulfilled:

- The UE estimates the DPCCH quality over the previous 160 ms period to be worse than a threshold Q_{out}. Q_{out} is defined implicitly by the relevant tests in TS 125 101 [7].

- The 20 most recently received transport blocks with a non-zero length CRC attached, as observed on all TrCHs using non-zero length CRC, have been received with incorrect CRC. In addition, over the previous 160 ms, all transport blocks with a non-zero length CRC attached have been received with incorrect CRC. In case no TFCI is used this criterion shall not be considered for the TrCH(s) not using guided detection if they do not use a non-zero length CRC in all transport formats. If no transport blocks with a non-zero length CRC attached are received over the previous 160 ms this criterion shall not be assumed to be fulfilled.

In-sync shall be reported using the CPHY-Sync-IND primitive if both of the following criteria are fulfilled:

- The UE estimates the DPCCH quality over the previous 160 ms period to be better than a threshold Q_{in}. Q_{in} is defined implicitly by the relevant tests in TS 125 101 [7].

- At least one transport block with a non-zero length CRC attached, as observed on all TrCHs using non-zero length CRC, is received in a TTI ending in the current frame with correct CRC. If no transport blocks are received, or no transport block has a non-zero length CRC attached in a TTI ending in the current frame and in addition over the previous 160 ms at least one transport block with a non-zero length CRC attached has been received with a correct CRC, this criterion shall be assumed to be fulfilled. If no transport blocks with a non-zero length CRC attached are received over the previous 160 ms this criterion shall also be assumed to be fulfilled. In case no TFCI is used this criterion shall not be considered for the TrCH(s) not using guided detection if they do not use a non-zero length CRC in all transport formats.

How the primitives are used by higher layers is described in TS 125 331 [12]. The above definitions may lead to radio frames where neither the in-sync nor the out-of-sync primitives are reported.

4.3.1.3 Uplink synchronization primitives

Layer 1 in the satellite gateway shall every radio frame check synchronization status of all radio link sets. Synchronization status is indicated to the RL Failure/Restored triggering function using either the CPHY-Sync-IND or CPHY-Out-of-Sync-IND primitive. Hence, only one synchronization status indication shall be given per radio link set.

The exact criteria for indicating in-sync/out-of-sync is not subject to specification, but could e.g. be based on received DPCCH quality or CRC checks. One example would be to have the same criteria as for the downlink synchronization status primitives.

4.3.2 Radio link establishment and physical layer reconfiguration for dedicated channels

4.3.2.1 General

Two synchronization procedures are defined in order to obtain physical layer synchronization of dedicated channels between UE and USRAN:

- Synchronization procedure A: This procedure shall be used when at least one downlink dedicated physical channel and one uplink dedicated physical channel are to be set up on a frequency and none of the radio links after the establishment/reconfiguration existed prior to the establishment/reconfiguration which also includes the following cases:
  - the UE was previously on another RAT i.e. inter-RAT handover;
  - the UE was previously on another frequency i.e. inter-frequency hard handover;
  - the UE has all its previous radio links removed and replaced by other radio links i.e. intra-frequency hard-handover;
  - after it fails to complete an inter-RAT, intra- or inter-frequency hard-handover TS 125 133 [8], the UE attempts to re-establish TS 125 331 [12] all the dedicated physical channels which were already established immediately before the hard-handover attempt. In this case only steps c) and d) of synchronization procedure A are applicable.
- Synchronization procedure B: This procedure shall be used when one or several radio links are added to the active set and at least one of the radio links prior to the establishment/reconfiguration still exists after the establishment/reconfiguration.

For existing radio links, the reconfiguration of downlink phase reference from P-CPICH or S-CPICH to dedicated pilots is not supported. For all other physical layer reconfigurations not listed above, the UE and USRAN shall not perform any of the synchronization procedures listed above.

The two synchronization procedures are described in clauses 4.3.2.3 and 4.3.2.4 respectively.

4.3.2.2 Satellite gateway radio link set state machine

In the satellite gateway, each radio link set can be in three different states: initial state, out-of-sync state and in-sync state. Transitions between the different states are shown in figure 1. The state of the satellite gateway at the start of radio link establishment is described in the following clauses. Transitions between initial state and in-sync state are described in clauses 4.3.2.3 and 4.3.2.4 and transitions between the in-sync and out-of-sync states are described in clause 4.3.3.2.