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Technical Specification

Satellite Earth Stations and Systems (SES);
Satellite Component of UMTS/IMT-2000;
Part 4: Physical layer procedures;
Sub-part 2: A-family (S-UMTS-A 25.214)

Reference

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Keywords

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

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Contents

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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 A at ITU-R, in the frame of ITU-R Recommendation M.1457 [8].

The present document is part 4, sub-part 2 of a multi-part deliverable covering Satellite Earth Stations and Systems (SES); Satellite Component of UMTS/IMT-2000; A-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, …) 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. For 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 A of the satellite component of UMTS (S-UMTS-A).

It is based on the FDD mode of UTRA defined by TS 125 211 [2], TS 125 212 [3], TS 125 213 [4], TS 125 214 [5] 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.

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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 101 851-1-2: "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 2: A-family (S-UMTS-A 25.211)".

[2] ETSI TS 125 211: "Universal Mobile Telecommunications System (UMTS); Physical channels and mapping of transport channels onto physical channels (FDD) (3G TS 25.211 version 3.3.0 Release 1999)".

[3] ETSI TS 125 212: "Universal Mobile Telecommunications System (UMTS); Multiplexing and channel coding (FDD) (3G TS 25.212 version 3.3.0 Release 1999)".

[4] ETSI TS 125 213: "Universal Mobile Telecommunications System (UMTS); Spreading and modulation (FDD) (3G TS 25.213 version 3.3.0 Release 1999)".

[5] ETSI TS 125 214: "Universal Mobile Telecommunications System (UMTS); Physical layer procedures (FDD) (3G TS 25.214 version 3.3.0 Release 1999)".

[6] ETSI TS 125 331: "Universal Mobile Telecommunications System (UMTS); RRC Protocol Specification (3G TS 25.331 version 3.3.0 Release 1999)".

[7] ETSI TS 125 101: "Universal Mobile Telecommunications System (UMTS); UE Radio transmission and Reception (FDD) (3G TS 25.101 version 3.3.0 Release 1999)".

2.2 Informative references

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

3 Abbreviations

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

BCH	Broadcast Channel
CCPCH	Common Control Physical Channel
DCH	Dedicated Channel
DPCCH	Dedicated Physical Control Channel
DPCH	Dedicated Physical Channel
DPDCH	Dedicated Physical Data Channel
FACH	Forward Access Channel
FSW	Frame Synchronization Word
PRACH	Physical Random Access Channel
RACH	Random Access Channel
SCH	Synchronization Channel
SIR	Signal-to-Interference Ratio
TPC	Transmit Power Control
UE	User Equipment

4 Synchronization procedures

4.1 Initial satellite search

During cell search, the UE searches for a satellite and determines the downlink scrambling code and common channel frame synchronization of that satellite beam. A typical initial satellite beam search is described in annex A.

4.2 Common physical channel synchronization

The radio frame timing of all common physical channels can be determined after cell search. The P-CCPCH radio timing is found during cell search and the radio frame timings of all common physical channels are related to that timing as described in [1].

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.

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

- the UE estimates the DPCCH quality over the last 200 ms period to be worse than a threshold Q_{out}. This criterion shall never be fulfilled during the first 200 ms of the dedicated channel's existence. Q_{out} is defined implicitly by the relevant tests in [7];
- the last 20 transport blocks, as observed on all TrCHs using CRC, are received with incorrect CRC. In addition, over the last 200 ms, no transport block has been received with correct CRC.

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 last 200 ms period to be better than a threshold Q_{in}. This criterion shall always be fulfilled during the first 200 ms of the dedicated channel's existence. Q_{in} is defined implicitly by the relevant tests in [7];
- at least one transport block, as observed on all TrCHs using CRC, is received with correct CRC. If there is no TrCH using CRC, this criterion is always fulfilled.

How the primitives are used by higher layers is described in [6].

4.3.1.3 Uplink synchronization primitives

Layer 1 in the Node B 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

The synchronization of the dedicated physical channels can be divided into two cases:

- when a downlink dedicated physical channel and uplink dedicated physical channel shall be set up at the same time;
- or when a downlink dedicated physical channel shall be set up and there already exist an uplink dedicated physical channel.

The two cases are described in clauses 4.3.2.1 and 4.3.2.2 respectively.

4.3.2.1 No existing uplink dedicated channel: initial synchronization

The assumption for this case is that a DPCCH/DPDCH pair shall be set up in both uplink and downlink, and that there exist no uplink DPCCH/DPDCH already. This corresponds to the case when a dedicated physical channel is initially set up on a frequency.

The outline of synchronization establishment procedures of the dedicated physical channel is described below.

a) The network starts the transmission of downlink DCH channels. The TPC commands transmitted by the network are set alternatively to the value Increase Power Small Step/Decrease Power Small Step. The DPDCH is transmitted only when there is data to be transmitted to the UE.

b) The UE establishes downlink DCH chip synchronization and frame synchronization based on the Primary CCPCH synchronization timing.

c) If necessary, the nominal up-link Tx frequency is pre-corrected following Doppler estimate based on the down link current estimated and nominal Rx carrier frequency and the Doppler pre-compensation information included in the BCH associated to each primary CCPCH. If more than a downlink carrier is received, the Tx frequency is the average of the individual pre-corrected Tx frequency estimates based on all received downlink primary CCPCH.

d) The uplink initial power setting is based on the open-loop estimation procedure described in clause 5.1.1.

e) The UE starts the transmission of uplink channels. To help initial uplink demodulator synchronization, the transmission starts with a preamble having the same format as the RACH preamble. $N_{preambles}$ repetition of the RACH preamble shall be used with $N_{preambles}$ being a system parameter. After $N_{preambles}$ preambles, the DPDCH/DPCH is transmitted. The DPDCH is actually transmitted only when there is data to be transmitted to the network. The transmission power of uplink channels follows the TPC commands transmitted by the network. TPC commands transmitted by the UE are based on downlink SIR measurements.

f) The network establishes uplink channel chip synchronization and frequency synchronization based on the received preamble. Once preamble acquisition is performed the uplink demodulator will simultaneously search for another preamble (if the detected preamble is not the last in the set of transmitted preambles) or for the transmission of the DPDCH/DPCCH. If a DPDCH/DPCCH is being transmitted, frame synchronization can be confirmed by exploiting the reference symbols transmitted on the DPCCH which are modulated according to a known pattern. The success of the frame synchronization confirmation is determined when the successive S_R frame synchronization is confirmed. Otherwise, frame synchronization failure is determined. Then this synchronization status information is reported to the upper layer. The transmission power of the downlink channels follows the TPC commands transmitted by the UE.

4.3.2.2 DPCCH/DPDCH diversity path synchronization

During an established DCH link the uplink demodulator is continuously searching for useful signal replicas coming from different beams of same/different satellites in simultaneous view of the same user. The reverse link signal search is simplified by the fact that the randomization code is common to all beams of all satellites but is complicated by the fact that normally the spreading sequence code length is much larger than the forward link SCH. The searcher task can be largely simplified by the approximate user location knowledge that can significantly help in reducing the search range both in time and frequency. Note that because of the DPDCH frame activation only in presence of traffic, the diversity searcher shall be able to operate on the DPCCH that is continuously transmitted typically at lower power than the DPDCH.

5 Power control

5.1 Uplink power control

5.1.1 PRACH

5.1.1.1 General

The transmitter power of UE shall be calculated by following equation:

$PRACH = L_{Perch} + I_{SAT} + \text{Constant value}$
where,
PRACH: transmitter power level in dBm,
L_{Pearch}: measured path loss in dB; it can be estimated from the *SNIR* and *N + I* power measured on the SCH and the P-CCPCH,
I_{SAT}: interference signal power level at the satellite receiver input in dBm, which is broadcast on BCH,
Constant value: This value shall be designated via Layer 3 message (operator matter).