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

Technical Specification

**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)**

Reference
RTS/SES-00298-1-1

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

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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 G at ITU-R, in the frame of the modification of ITU-R Recommendation M.1457 [9]. This modification has been approved at ITU-R SG8 meeting in November 2005.

The present document is part 1, 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";

Sub-part 1: "G-family (S-UMTS-G 25.211)";

Sub-part 2: "A-family (S-UMTS-A 25.211)";

Part 2: "Multiplexing and channel coding";

Part 3: "Spreading and modulation";

Part 4: "Physical layer procedures";

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 geostationary (GEO), or low (LEO) or medium (MEO) earth orbiting 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 defines the Layer 1 transport channels and physical channels 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 125 201 [4], TS 125 211 [8], TS 125 302 [5] and TS 125 435 [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.

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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 101 851-2-1: "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)".

[2] 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)".

[3] ETSI TS 101 851-4-1: "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)".

[4] ETSI TS 125 201: "Universal Mobile Telecommunications System (UMTS); Physical layer - general description (3GPP TS 25.201)".

[5] ETSI TS 125 302: "Universal Mobile Telecommunications System (UMTS); Services provided by the physical layer (3GPP TS 25.302)".

[6] ETSI TS 125 435: "Universal Mobile Telecommunications System (UMTS); UTRAN Iub interface user plane protocols for Common Transport Channel data streams (3GPP TS 25.435)".

[7] ETSI TS 125 427: "Universal Mobile Telecommunications System (UMTS); UTRAN Iur/Iub interface user plane protocol for DCH data streams (3GPP TS 25.427)".

2.2 Informative references

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

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

3 Symbols and abbreviations

3.1 Symbols

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

N_{data1} The number of data bits per downlink slot in Data1 field

N_{data2} The number of data bits per downlink slot in Data2 field (If the slot format does not contain a Data2 field, $N_{data2} = 0$)

3.2 Abbreviations

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

AI	Acquisition Indicator
AS	Access Slot
AICH	Acquisition Indicator CHannel
BCH	Broadcast CHannel
CCPCH	Common Control Physical CHannel
CCTrCH	Coded Composite Transport CHannel
CPICH	Common PIlot CHannel
DCH	Dedicated CHannel
DPCCH	Dedicated Physical Control CHannel
DPCH	Dedicated Physical CHannel
DPDCH	Dedicated Physical Data CHannel
DTX	Discontinuous Transmission
FACH	Forward Access CHannel
FBI	FeedBack Information
FSW	Frame Synchronization Word
GEO	Geostationary Earth Orbit
ICH	Indicator CHannel
LEO	Low Earth Orbit
MEO	Medium Earth Orbit
MICH	MBMS Indicator CHannel
MSS	Mobile Satellite Services
NI	MBMS Notification Indicator
P-CCPCH	Primary Common Control Physical CHannel
PCH	Paging CHannel
PI	Page Indicator
PICH	Page Indicator CHannel
PRACH	Physical Random Access CHannel
PSC	Primary Synchronization Code
RACH	Random Access CHannel
S-CCPCH	Secondary Common Control Physical CHannel
SCH	Synchronization CHannel
SF	Spreading Factor

SFN	System Frame Number
SSC	Secondary Synchronization Code
TFCI	Transport Format Combination Indicator
TPC	Transmit Power Control
UE	User Equipment
USRAN	UMTS Satellite Radio Access Network

4 Services offered to higher layers

4.1 Transport channels

Transport channels are services offered by Layer 1 to the higher layers. General concepts about transport channels are described in TS 125 302 [5].

A transport channel is defined by how and with what characteristics data is transferred over the air interface. A general classification of transport channels is into two groups:

- dedicated channels, using inherent addressing of UE;
- common channels, using explicit addressing of UE if addressing is needed.

4.1.1 Dedicated transport channels

There exists only one type of dedicated transport channel, the Dedicated CHannel (DCH).

4.1.1.1 Dedicated CHannel (DCH)

The Dedicated CHannel (DCH) is a downlink or uplink transport channel. The DCH is transmitted over the entire spot or over only a part of the spot using e.g. beam-forming antennas.

4.1.2 Common transport channels

There are four types of common transport channels:

- BCH;
- FACH;
- PCH; and
- RACH.

4.1.2.1 Broadcast CHannel (BCH)

The Broadcast CHannel (BCH) is a downlink transport channel that is used to broadcast system- and spot-specific information. The BCH is always transmitted over the entire spot and has a single transport format.

4.1.2.2 Forward Access CHannel (FACH)

The Forward Access CHannel (FACH) is a downlink transport channel. The FACH is transmitted over the entire spot. The FACH can be transmitted using power setting described in TS 125 435 [6], i.e. with "Transmit Power Level" of the "FACH DATA FRAME" Frame Protocol message.

4.1.2.3 Paging CHannel (PCH)

The Paging CHannel (PCH) is a downlink transport channel. The PCH is always transmitted over the entire spot. The transmission of the PCH is associated with the transmission of physical-layer generated Paging Indicators, to support efficient sleep-mode procedures.

4.1.2.4 Random Access CHannel (RACH)

The Random Access CHannel (RACH) is an uplink transport channel. The RACH is always received from the entire spot. The RACH is characterized by a collision risk and by being transmitted using open loop power control.

4.2 Indicators

Indicators are means of fast low-level signalling entities which are transmitted without using information blocks sent over transport channels. The meaning of indicators is specific to the type of indicator.

The indicators defined in the current version of the specifications are:

- Acquisition Indicator (AI);
- Page Indicator (PI); and
- MBMS Notification Indicator (NI).

Indicators may be either boolean (two-valued) or three-valued. Their mapping to indicator channels is channel specific.

Indicators are transmitted on those physical channels that are Indicator CHannels (ICH).

5 Physical channels and physical signals

Physical channels are defined by a specific carrier frequency, scrambling code, channelization code (optional), time start and stop (giving a duration) and, on the uplink, relative phase (0 or $\pi/2$). Scrambling and channelization codes are specified in TS 101 851-3-1 [2]. Time durations are defined by start and stop instants, measured in integer multiples of chips. Suitable multiples of chips also used in specification are:

Radio frame: A radio frame is a processing duration which consists of 15 slots. The length of a radio frame corresponds to 38 400 chips.

Slot: A slot is a duration which consists of fields containing bits. The length of a slot corresponds to 2 560 chips.

The default time duration for a physical channel is continuous from the instant when it is started to the instant when it is stopped. Physical channels that are not continuous will be explicitly described.

Transport channels are described (in more abstract higher layer models of the physical layer) as being capable of being mapped to physical channels. Within the physical layer itself the exact mapping is from a Composite Coded Transport CHannel (CCTrCH) to the data part of a physical channel. In addition to data parts there also exist channel control parts and physical signals.

5.1 Physical signals

Physical signals are entities with the same basic on-air attributes as physical channels but do not have transport channels or indicators mapped to them. Physical signals may be associated with physical channels in order to support the function of physical channels.

5.2 Uplink physical channels

5.2.1 Dedicated uplink physical channels

There are three types of uplink dedicated physical channels, the uplink Dedicated Physical Data CHannel (uplink DPDCH) and the uplink Dedicated Physical Control CHannel (uplink DPCCH).

The DPDCHand DPCCH are I/Q code multiplexed (see TS 101 851-3-1 [2]).

The uplink DPDCH is used to carry the DCH transport channel. There may be zero, one, or several uplink DPDCHs on each radio link.

The uplink DPCCH is used to carry control information generated at Layer 1. The Layer 1 control information consists of known pilot bits to support channel estimation for coherent detection, Transmit Power-Control (TPC) commands, FeedBack Information (FBI), and an optional Transport-Format Combination Indicator (TFCI). The transport-format combination indicator informs the receiver about the instantaneous transport format combination of the transport channels mapped to the simultaneously transmitted uplink DPDCH radio frame. There is one and only one uplink DPCCH on each radio link.

Figure 1 shows the frame structure of the uplink DPDCH and the uplink DPCCH. Each radio frame of length 10 ms is split into 15 slots, each of length T_{slot} = 2 560 chips, corresponding to one power-control period. The DPDCH and DPCCH are always frame aligned with each other.

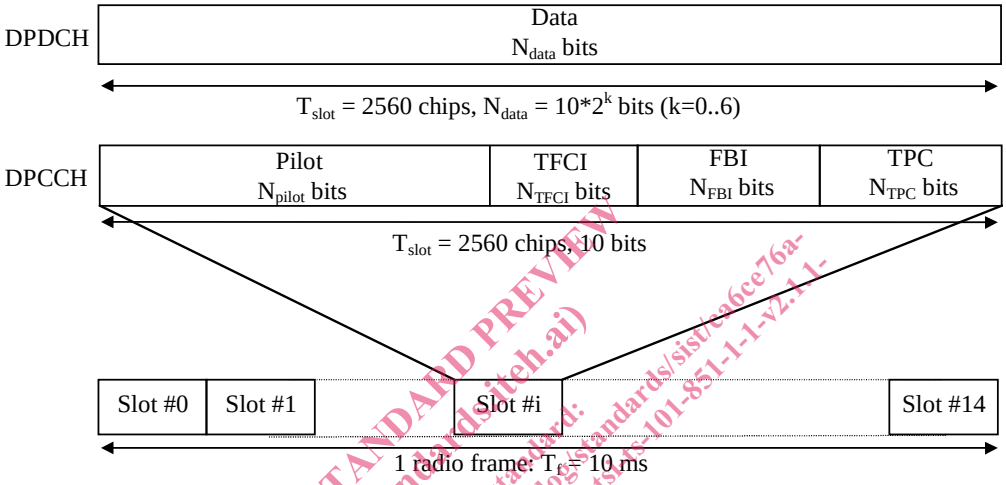

Figure 1: Frame structure for uplink DPDCH/DPCCH

The parameter k in figure 1 determines the number of bits per uplink DPDCH slot. It is related to the spreading factor SF of the DPDCH as SF = 256 / 2^k. The DPDCH spreading factor may range from 256 down to 4. The spreading factor of the uplink DPCCH is always equal to 256, i.e. there are 10 bits per uplink DPCCH slot.

The exact number of bits of the uplink DPDCH and the different uplink DPCCH fields (N_{pilot}, N_{TFCI}, N_{FBI} and N_{TPC}) is given by tables 1 and 2. What slot format to use is configured by higher layers and can also be reconfigured by higher layers.

The channel bit and symbol rates given in tables 1 and 2 are the rates immediately before spreading. The pilot patterns are given in tables 3 and 4, the TPC bit pattern is given in table 5.

The FBI bits are used to support techniques requiring feedback from the UE to the USRAN Access Point, including Spot Selection Diversity Transmission (SSDT). The structure of the FBI field is shown in figure 2 and described below.

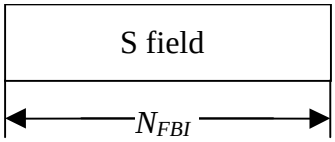

Figure 2: FBI field

The S field is used for SSDT signalling. It consists of 0 bit, 1 bit or 2 bits. The total FBI field size N_{FBI} is given by table 2. If total FBI field is not filled with S field, FBI field shall be filled with "1". The use of the FBI fields is described in detail in TS 101 851-4-1 [3].