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Technical Specification

Satellite Earth Stations and Systems (SES); Satellite Component of UMTS/IMT-2000; Part 3: Spreading and modulation; Sub-part 2: A-family (S-UMTS-A 25.213)

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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 3, 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";

Sub-part 1: "G-family (S-UMTS-G 25.213)";

Sub-part 2: "A-family (S-UMTS-A 25.213)";

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 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.

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1 Scope

The present document defines the Layer 1 transport channels and physical channels 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;
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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 101 851-1-2: "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 125 101: "Universal Mobile Telecommunications System (UMTS); UE Radio transmission and Reception (FDD) (3G TS 25.101 version 3.3.0 Release 1999)".

- [7] ETSI TS 125 104: "Universal Mobile Telecommunications System (UMTS); UTRA (BS) FDD; Radio transmission and Reception (3G TS 25.104 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 Symbols and abbreviations

3.1 Symbols

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

$C_{ch,SF,n}$	n :th channelisation code with spreading factor SF
$C_{pre,n,s}$	PRACH preamble code for n :th preamble scrambling code and signature s
$C_{sig,s}$	PRACH signature code for signature s
$S_{dpch,n}$	n :th DPCCH/DPDCH uplink scrambling code
$S_{r-pre,n}$	n :th PRACH preamble scrambling code
$S_{r-msg,n}$	n :th PRACH message scrambling code
$S_{dl,n}$	DL scrambling code
C_{psc}	PSC code
$C_{ssc,n}$	n :th SSC code
UW	Unique Word

3.2 Abbreviations

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

AICH	Acquisition Indicator Channel
CCPCH	Common Control Physical Channel
CPICH	Common Pilot Channel
DCH	Dedicated Channel
DPCH	Dedicated Physical Channel
DPCCH	Dedicated Physical Control Channel
DPDCH	Dedicated Physical Data Channel
FDD	Frequency Division Duplex
Mcps	Mega Chip Per Second
OVSF	Orthogonal Variable Spreading Factor (codes)
PDSCH	Physical Dedicated Shared Channel
PICH	Page Indication Channel
PRACH	Physical Random Access Channel
PSC	Primary Synchronization Code
QPSK	Quadrature Phase Shift Keying
SCH	Synchronization Channel
SF	Spreading Factor
SSC	Secondary Synchronization Code
UE	User Equipment

4 Uplink spreading and modulation

4.1 Overview

Spreading is applied to the physical channels. It consists of two operations. The first is the channelisation operation, which transforms every data symbol into a number of chips, thus increasing the bandwidth of the signal. The number of chips per data symbol is called the Spreading Factor (SF). The second operation is the scrambling operation, where a scrambling code is applied to the spread signal.

With the channelisation, data symbol on so-called I- and Q-branches are independently multiplied with an OVSF code. With the scrambling operation, the resultant signals on the I and Q-branches are further multiplied by complex-valued scrambling code, where I and Q denote real and imaginary parts, respectively.

4.2 Spreading

4.2.1 Uplink Dedicated Physical Channels (uplink DPDCH/DPCCH)

Figure 1 illustrates the principle of the uplink spreading of DPCCH and DPDCHs. The binary DPCCH and DPDCHs to be spread are represented by real-valued sequences, i.e. the binary value "0" is mapped to the real value +1, while the binary value "1" is mapped to the real value -1. The DPCCH is spread to the chip rate by the channelisation code $C_{ch,0}$, while the n :th DPDCH called $DPDCH_n$ is spread to the chip rate by the channelisation code $C_{ch,n}$. One DPCCH and up to six parallel DPDCHs can be transmitted simultaneously, i.e. $0 \leq n \leq 6$.

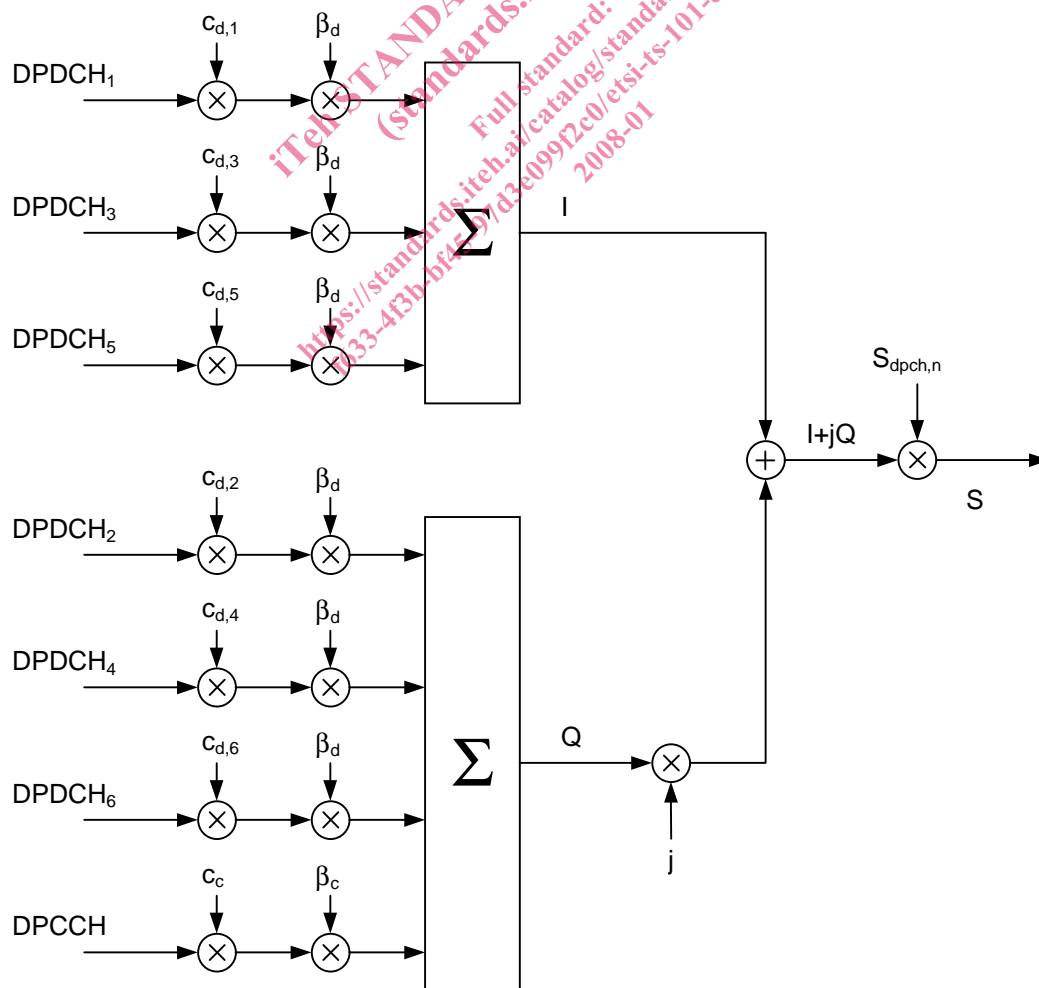


Figure 1: Spreading/modulation for uplink DPCCH and DPDCHs

After channelisation, the real-valued spread signals are weighted by gain factors, β_c for DPCCH and β_d for all DPDCHs.

At every instant in time, at least one of the values β_c and β_d has the amplitude 1,0. The β -values are quantized into 4 bit words. The quantization steps are given in table 1.

Table 1: The quantization of the gain parameters

Signalling values for β_c and β_d	Quantized amplitude ratios β_c and β_d
15	1,0
14	14/15
13	13/15
12	12/15
11	11/15
10	10/15
9	9/15
8	8/15
7	7/15
6	6/15
5	5/15
4	4/15
3	3/15
2	2/15
1	1/15
0	Switch off

After the weighting, the stream of real-valued chips on the I and Q-branches are then summed and treated as a complex-valued stream of chips. This complex-valued signal is then scrambled by the complex-valued scrambling code $S_{\text{dpcch},n}$. The scrambling code is applied aligned with the radio frames, i.e. the first scrambling chip corresponds to the beginning of a radio frame.

4.2.2 PRACH

4.2.2.1 PRACH preamble part

The PRACH preamble part consists of a complex-valued code, described in clause 4.3.3.

4.2.2.2 PRACH message part

Figure 2 illustrates the principle of the spreading and scrambling of the PRACH message part, consisting of data and control parts. The binary control and data parts to be spread are represented by real-valued sequences, i.e. the binary value "0" is mapped to the real value +1, while the binary value "1" is mapped to the real value -1. The control part is spread to the chip rate by the channelisation code c_c , while the data part is spread to the chip rate by the channelisation code c_d .