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Technical Specification

GEO-Mobile Radio Interface Specifications;
Part 6: Speech coding specifications;
Sub-part 5: Vocoder: Discontinuous Transmission (DTX);
GMR-1 06.031

Reference

DTS/SES-001-06031

Keywords

CNIP, DTX, GMR, GSM, GSO, interface, MES, mobile, MSS, radio, satellite, S-PCN, VAD

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TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,226,084	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,715,365	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,826,222	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,754,974	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,701,390	US

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Ericsson Mobile Communication	Improvements in, or in relation to, equalisers	GB	GB 2 215 567	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Power Booster	GB	GB 2 251 768	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Receiver Gain	GB	GB 2 233 846	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Transmitter Power Control for Radio Telephone System	GB	GB 2 233 517	GB

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Hughes Network Systems		US	Pending	US

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	2.4-to-3 KBPS Rate Adaptation Apparatus for Use in Narrowband Data and Facsimile Communication Systems	US	US 6,108,348	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Cellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic ThroughputCellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic Throughput	US	US 5,717,686	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Enhanced Access Burst for Random Access Channels in TDMA Mobile Satellite System	US	US 5,875,182	
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,314	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,315	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Mutual Offset High-argin Forward Control Signals	US	US 6,072,985	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Spot Beam Pairing for Reduced Updates	US	US 6,118,998	US

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Foreword

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

The contents of the present document are subject to continuing work within TC-SES and may change following formal TC-SES approval. Should TC-SES modify the contents of the present document it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 1.m.n

where:

- the third digit (n) is incremented when editorial only changes have been incorporated in the specification;
- the second digit (m) is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The present document is part 6, sub-part 5 of a multi-part deliverable covering the GEO-Mobile Radio Interface Specifications, as identified below:

Part 1: "General specifications";

Part 2: "Service specifications";

Part 3: "Network specifications";

Part 4: "Radio interface protocol specifications";

Part 5: "Radio interface physical layer specifications";

Part 6: "Speech coding specifications";

Sub-part 1: "Speech Processing Functions; GMR-1 06.001";

Sub-part 2: "Vocoder: Speech Transcoding; GMR-1 06.010";

Sub-part 3: "Vocoder: Substitution and Muting of Lost Frames; GMR-1 06.011";

Sub-part 4: "Vocoder: Comfort Noise Aspects; GMR-1 06.012";

Sub-part 5: "Vocoder: Discontinuous Transmission (DTX); GMR-1 06.031";

Sub-part 6: "Vocoder: Voice Activity Detection (VAD); GMR-1 06.032";

Part 7: "Terminal adaptor specifications".

Introduction

GMR stands for GEO (Geostationary Earth Orbit) Mobile Radio interface, which is used for mobile satellite services (MSS) utilizing geostationary satellite(s). GMR is derived from the terrestrial digital cellular standard GSM and supports access to GSM core networks.

Due to the differences between terrestrial and satellite channels, some modifications to the GSM standard are necessary. Some GSM specifications are directly applicable, whereas others are applicable with modifications. Similarly, some GSM specifications do not apply, while some GMR specifications have no corresponding GSM specification.

Since GMR is derived from GSM, the organization of the GMR specifications closely follows that of GSM. The GMR numbers have been designed to correspond to the GSM numbering system. All GMR specifications are allocated a unique GMR number as follows:

GMR-n xx.zyy

where:

xx.0yy (z=0) is used for GMR specifications that have a corresponding GSM specification. In this case, the numbers xx and yy correspond to the GSM numbering scheme.

xx.2yy (z=2) is used for GMR specifications that do not correspond to a GSM specification. In this case, only the number xx corresponds to the GSM numbering scheme and the number yy is allocated by GMR.

n denotes the first (n=1) or second (n=2) family of GMR specifications.

A GMR system is defined by the combination of a family of GMR specifications and GSM specifications as follows:

- If a GMR specification exists it takes precedence over the corresponding GSM specification (if any). This precedence rule applies to any references in the corresponding GSM specifications.

NOTE: Any references to GSM specifications within the GMR specifications are not subject to this precedence rule. For example, a GMR specification may contain specific references to the corresponding GSM specification.

- If a GMR specification does not exist, the corresponding GSM specification may or may not apply. The applicability of the GSM specifications is defined in GMR-1 01.201 [8].

1 Scope

The present document defines the DTX function that is used in the GMR-1 system. In addition, an overview of the interface with related functions such as voice activity detection (VAD) and comfort noise insertion (CNI) is provided.

2 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 and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] GMR-1 01.004 (ETSI TS 101 376-1-1): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 1: Abbreviations and acronyms; GMR-1 01.004".

[2] GMR-1 06.010 (ETSI TS 101 376-6-2): "GEO-Mobile Radio Interface Specifications; Part 6: Speech coding specifications; Sub-part 2: Vocoder: Speech Transcoding; GMR-1 06.010".

[3] GMR-1 06.011 (ETSI TS 101 376-6-3): "GEO-Mobile Radio Interface Specifications; Part 6: Speech coding specifications; Sub-part 3: Vocoder: Substitution and Muting of Lost Frames; GMR-1 06.011".

[4] GMR-1 06.012 (ETSI TS 101 376-6-4): "GEO-Mobile Radio Interface Specifications; Part 6: Speech coding specifications; Sub-part 4: Vocoder: Comfort Noise Aspects; GMR-1 06.012".

[5] GMR-1 05.008 (ETSI TS 101 376-5-6): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 6: Radio Subsystem Link Control; GMR-1 05.008".

[6] GMR-1 06.032 (ETSI TS 101 376-6-6): "GEO-Mobile Radio Interface Specifications; Part 6: Speech coding specifications; Sub-part 6: Vocoder: Voice Activity Detection (VAD); GMR-1 06.032".

[7] GMR-1 06.001 (ETSI TS 101 376-6-1): "GEO-Mobile Radio Interface Specifications; Part 6: Speech coding specifications; Sub-part 1: Speech Processing Functions; GMR-1 06.001".

[8] GMR-1 01.201 (ETSI TS 101 376-1-2): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 2: Introduction to the GMR-1 Family; GMR-1 01.201".

[9] GMR-1 05.005 (ETSI TS 101 376-5-5): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 5: Radio Transmission and Reception; GMR-1 05.005".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions given in GMR-1 01.004 [1] and the following apply:

Voice Activity Detection (VAD): method of classifying short segments of speech as either "voice" or "background noise." The decision is based upon comparing the current level and spectral characteristics of the input signal with that of a typical level and spectral characteristics

Comfort Noise Insertion (CNI): method of synthesizing low-level noise on the receive side during breaks in voice transmission. To increase the perceived voice quality, the synthesized noise has characteristics that are similar to the background noise present on the transmit side

Forward Error Correction (FEC): method of introducing redundancy to binary data that allows for the detection and/or correction of errors introduced during transmission of that data

V/UV(Voiced/Unvoiced): each spectral band is declared either "voiced" or "unvoiced", depending upon the amount of periodic energy in that band. This voicing decision is frequently referred to as a V/UV decision

frame: data representing a full 40 msec of continuous data input to or output from the vocoder. The frame data may consist of model parameters, quantized bits, FEC encoded channel data, or speech samples at various points in the vocoder

subframe: data representing 10 msec of continuous data input to or output from the vocoder, or the result of processing that data through various points in the vocoder. For example, "The second subframe of model parameters is passed to the quantizer" is a valid use of the term as is "The decoder outputs one subframe of 8 kHz speech samples"

subframe number: each frame is composed of four consecutive subframes that are each assigned a subframe number. The first, second, third, and fourth subframes within a frame are assigned subframe numbers 0, 1, 2, and 3 respectively

quantizer-frame: data representing the 20 msec of continuous vocoder data that is formed by combining subframes 0 and 1 or subframes 2 and 3

quantizer-frame number: each frame is composed of two consecutive quantizer-frames that are each assigned a quantizer frame number. The first and second quantizer-frames within a frame are assigned quantizer-frame numbers 0 and 1 respectively

voice frame: 40-msec frame that contains some voice data but no tone data. It may also contain comfort noise data

SID frame: (Silence Descriptor): 20-msec frame that contains only comfort noise data. No voice or tone data may be present in a SID frame

tone frame: 40-msec frame that contains tone data. It may also contain voice data or comfort noise data

3.2 Abbreviations

Abbreviations used in the present document are listed in GMR-1 01.004 [1].

4 General

Discontinuous transmission is a mechanism that allows the radio transmitter to be switched off most of the time for the following purposes:

- to save power;
- to reduce the overall interference level on the air.

4.1 DTX-related components in the GMR-1 system

The overall DTX mechanism described in the present document requires the following functions:

- A VAD on the transmit side, which is provided as an integral part of the vocoder [7] (see GMR-1 06.032 [6]).
- Evaluation of the background acoustic noise on the transmit side, in order to transmit characteristic parameters to the receive side. This function is also provided as an integral part of the vocoder [7] (see GMR-1 06.012 [4] and GMR-1 06.010 [2]).
- Generation at the receive side of a similar noise, called comfort noise, during periods where the radio transmission is cut or seriously interrupted by errors. This function is provided as an integral part of the vocoder [7] as well (see GMR-1 06.012 [4]).

All of the DTX-related components except for the DTX handler itself are implemented internal to the vocoder algorithm in order to reduce the overall complexity of the GMR-1 system and to simplify interfacing issues between the various functions.

4.2 DTX terms used in the GMR-1 system

Clause 3 lists the definitions of terms relevant for the DTX functions, as used in the present document and the technical specifications listed in clause 2.

5 DTX from the transmit perspective

A block diagram of the transmit side DTX and related functions is shown in figure 5.1.

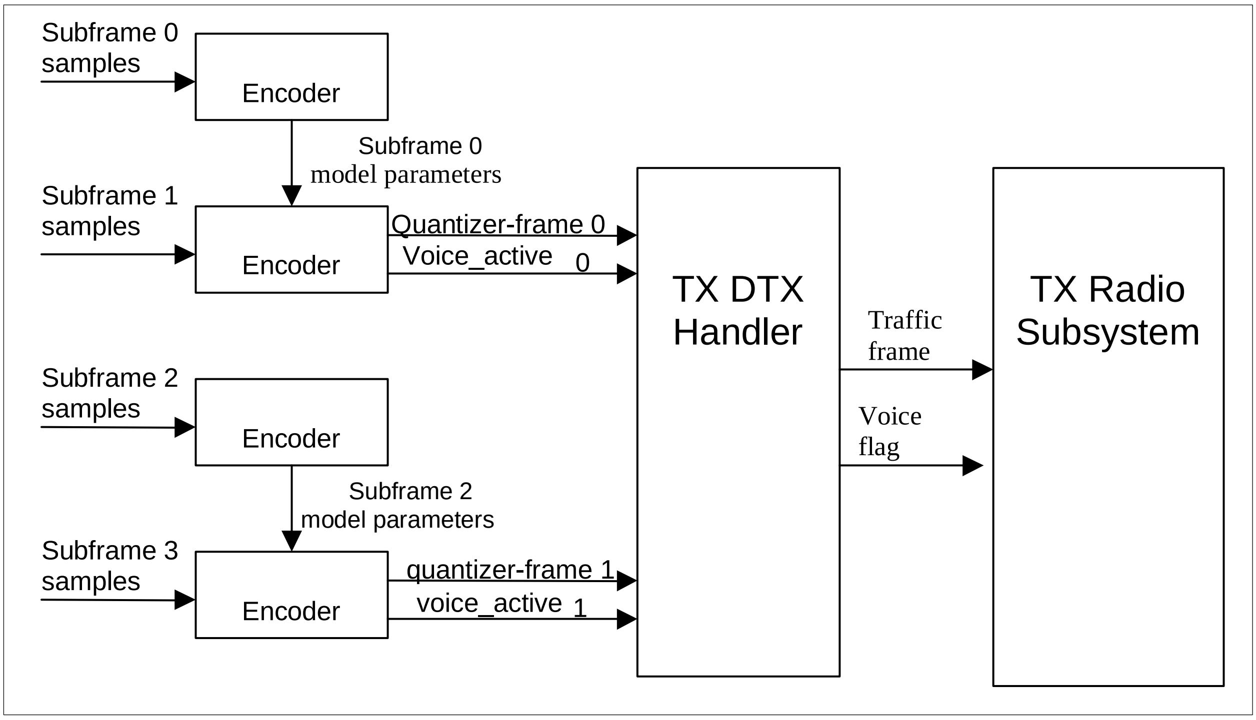

Figure 5.1: Transmit side DTX and related functions

5.1 General operation

The TX DTX handler continuously passes traffic frames, individually marked by a binary voice_flag, to the radio subsystem. Voice_flag=1 indicates that the traffic frame contains voice or the initial SID frame of a silence burst and must be transmitted by the radio subsystem, whereas voice_flag=0 indicates to the radio subsystem that the accompanying traffic frame is a SID frame.

5.2 Functions of the TX DTX handler

The VAD must be operating at all times in order to assess whether the input signal contains speech or not. The VAD decision is provided for each quantizer frame (every 20 msec). The TX DTX handler must logically "OR" the two voice_active flags output by the encoder for each 40-msec frame in order to generate the voice flag, which is passed to the RSS; i.e. voice_flag = (voice_active 0) + (voice_active 1).

The TX DTX handler concatenates (or interleaves) the two quantizer-frames input from the encoder to form a 40-msec traffic frame, which is output to the radio subsystem.

5.2.1 Functions of the TX radio subsystem

The TX radio subsystem must transmit the following traffic frames:

- All frames that have an accompanying voice_flag=1.
- Every 26th frame that has an accompanying voice_flag=0. In this case, only the final 104 bits (quantizer-frame 1) of the frame should be transmitted. The remaining bits are discarded by the TX radio subsystem.

This subsystem has the overall function that the radio transmission rate is reduced after the transmission of a SID frame when the speaker stops talking. Because only half of every 26th frame is transmitted during silence intervals, the overall channel rate is reduced by a factor of 1/52, from 5,2 kbps to 100 bps. The purpose of transmitting the SID frames is to update the generated comfort noise at the receive side. The actual transmission aspects of SID frames on the radio link is described in GMR-1 05.008 [5].

6 Receive side

A block diagram of the receive side DTX handler and related functions is shown in figure 6.1.

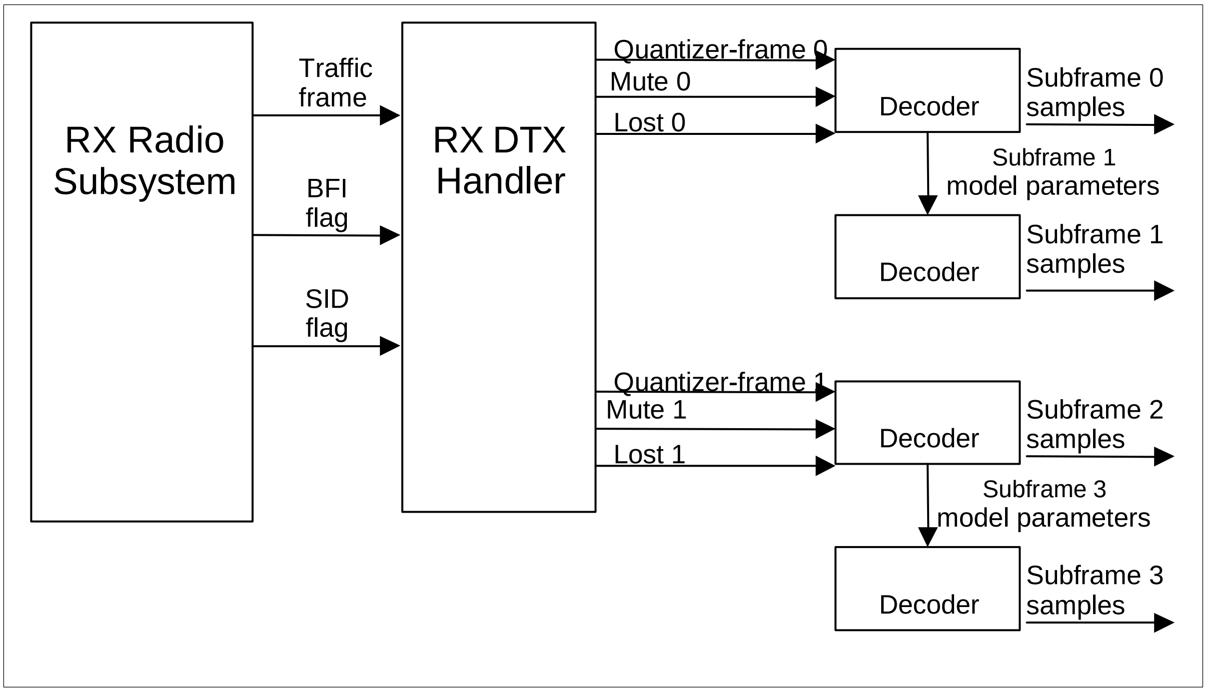

Figure 6.1: Receive side DTX and related functions

6.1 General operation

Whatever the context of the received traffic frames (voice, SID, tone, or none), the radio subsystem continuously passes them to the RX DTX handler, individually marked with two flags. These flags, BFI and SID, serve to classify the traffic frame. These flags determine how the received frame is to be processed by the Decoder, as summarized in table 6.1.

Table 6.1: Classification of traffic frames

BFI	SID	Traffic Frame Classification
0	0	Good voice frame
0	1	No frame
0	2	Good SID frame
1	0	Bad voice frame
1	1	Not allowed
1	2	Bad SID frame

6.1.1 Functions of the RX radio subsystem

The binary BFI (bad frame indication, see also GMR-1 05.005 [9]) flag indicates whether the traffic frame is considered to contain meaningful information bits (BFI=0) or not (BFI=1).

The ternary SID flag is set to 0 if a normal 208-bit voice traffic frame is received, 1 if no traffic frame is received (due to discontinuous transmission), or 2 if a 104-bit SID frame is received. Note that the combination SID=BFI=1 is not allowed and should never be indicated by the radio subsystem.

6.1.2 Functions of the RX DTX handler

The RX DTX handler is responsible for the overall DTX operation on the receive side, which shall be as follows:

- Whenever a good voice frame is detected, the DTX shall separate (or deinterleave) it to form two quantizer frames and pass them to the decoder. The mute and lost flags should both be set to 0 for both quantizer frames.
- Whenever a bad voice or a bad SID frame is detected, the substitution and muting procedure defined in GMR-1 06.011 [3] shall be applied.
- Whenever a good SID frame is received, it passes to the decoder in place of quantizer-frame 0, as defined in GMR-1 06.012 [4], which updates the decoder's comfort noise estimate. The mute flag shall be set before decoding quantizer-frame 1, which does not exist for SID frames. The lost flag should be set to 0 for both quantizer frames.
- Whenever no traffic frame is received (SID=1), the DTX shall set the mute flag before decoding quantizer-frame 0 and again prior to decoding quantizer-frame 1.

History

Document history		
V1.1.1	March 2001	Publication