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Technical Specification

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Universal Mobile Telecommunications System (UMTS);
Tandem Free Operation (TFO);
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Stage 2
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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
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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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1 Scope

The present document defines the stage 2 service description for Tandem Free Operation (TFO) in and between GSM and UMTS. Tandem Free Operation applies only to speech calls.

NOTE: The TFO principles are built so that they could be used as well by other systems other than GSM and UMTS.

In analogy with ITU-T Recommendations I.130 [2] and with reference to ITU-T Recommendations Q.65 VI.1 (Stage 2 of the method for the characterisation of services supported by an ISDN), the second stage of the following three-level structure is derived from a stage 1 service description.

- Stage 1 is an overall service description, from the service subscriber's and user's standpoints, that views the network as a single entity which provides services to the user.
- Stage 2 identifies the functional capabilities and information flows needed to support the service described in stage 1. Furthermore, it identifies various possible physical locations for the functional capabilities. The output of Stage 2, which is signalling system independent, is used as an input to Stage 3, the design of signalling system and switching Recommendations.
- Stage 3 defines the signalling system protocols and switching functions needed to implement the service described in stage 2.

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, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] ITU-T Recommendations I.130 (1988): "Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".

[3] 3GPP TS 22.053: "Tandem Free Operation (TFO); Service Description - Stage 1".

[4] 3GPP TS 48.060: "Digital cellular telecommunications system (Phase 2+); In-band control of remote transcoders and rate adaptors for full rate traffic channels".

[5] 3GPP TS 48.061: "Digital cellular telecommunications system (Phase 2+); In-band control of remote transcoders and rate adaptors for half rate traffic channels".

3 Definitions and abbreviations

3.1 Definitions

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

Tandem Free Operation: corresponds to the Mobile-to-Mobile calls for which the speech is not transcoded two times but only one by the Mobile Stations

For simplicity the term MS is also used when UE is meant for 3G systems. The same is valid for TRAU and TC analogously.

3.2 Abbreviations

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

IPE: In Path Equipment
TFO: Tandem Free Operation

Further abbreviations used may be found in 3GPP TR 01.04 [1].

4 Main Concepts

In-band TFO aims to remove the speech coding and decoding done in the BSS in MS-to-MS calls in order to improve the perceived speech quality. In-band TFO is established after call set-up using in-band signalling. This signalling is therefore controlled by the TRAU.

Using in-band signalling implies that the link between the TRAUs is transparent in the sense that the digital content of what is emitted by a TRAU is not modified. The so-called In Path Equipments must therefore be disabled or configured in such a way that the information (signalling and coded speech) required for Tandem Free is not altered.

5 TFO Architecture and Transmission Mechanism

5.1 TFO Access Interfaces and Reference Points

The GSM BSS reference points for TFO are described in figure 1. GSM A interface reference point applies here with the exception that speech is not in the standard 64 kbit/s PCM format and between TFO TRAUs in-band signalling is used. For speech and in-band signalling the MSC is transparent.

The UMTS core network reference points for TFO are described in figure 2. The UMTS Nb interface reference point applies here with the exception that speech is not in the standard 64 kbit/s PCM format and between TFO TRAUs in-band signalling is used. For speech and in-band signalling the Core Network is transparent.

Additional transmission equipments are taken into account. These equipments are all those which can process the PCM signal between the two peer BSS, e.g. echo cancellers, DCME. The BSS to BSS transmission is then considered transparent provided no transmission equipment along the circuit do not modify the 1 or more LSB or these transmission equipments implement a TFO "transparency mode". A specific signalling allows to remotely control in-band these equipments.

BSS-MSC out-of-band signalling consists in this version of TFO of the normal BSSMAP signalling which carries the list of acceptable speech codec that may be used for the TFO negotiation mechanism.

Use of TFO specific out-of-band mechanism is not foreseen in that version of the specification.

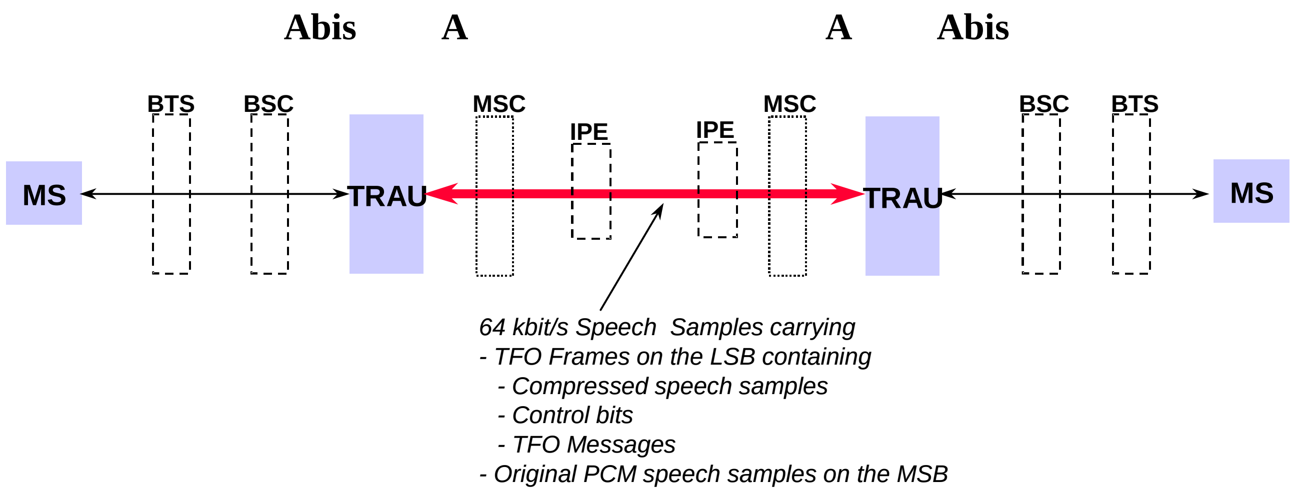

Figure 1

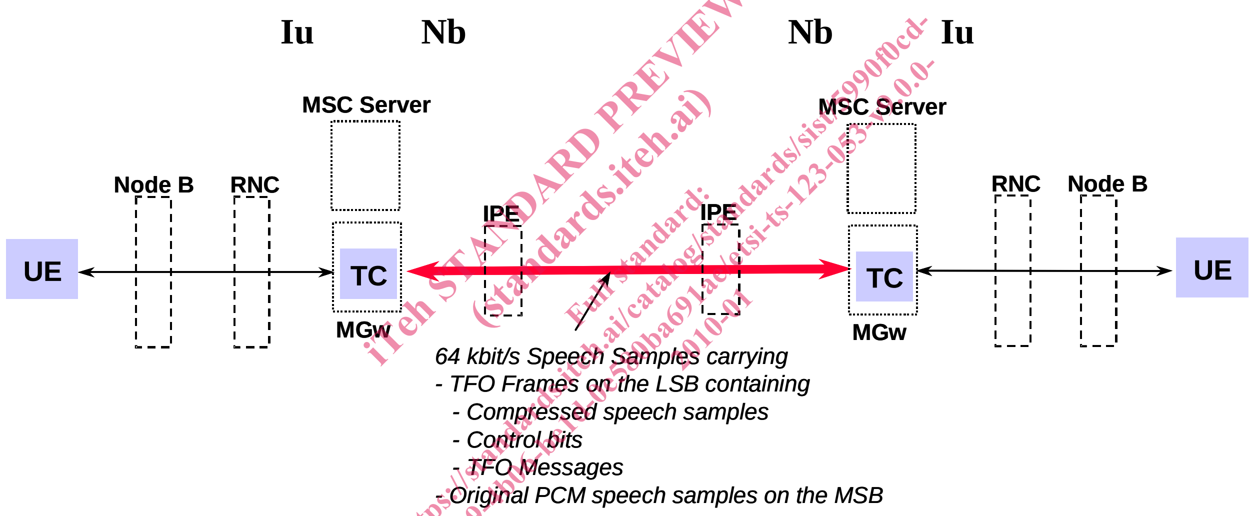

Figure 2

5.2 General In-band Transmission Mechanism for TFO

In TFO establishment mode, one bit out of 16 LSB bits is regularly stolen of the 64 kbits/s circuit. This provides for a 0,5 kbits/s channel and has been selected so that the degradation on the speech quality is inaudible.

In TFO established mode bit stealing takes place on the LSB bit/s (bit 8, 7.. 9-N; N>=1: number of stolen LSB bits) on each PCM sample. The number N of stolen LSB bit/s depends on the codec type. This provides for a N*8 kbits/s channel that allows to carry vocoded speech in TFO frames. The contents of the "unstolen" bits 1- (8-N) is normal A/µ-law information.

5.3 High-Level Functions Required for TFO

The high level functions which apply to TFO are described hereafter. Not all these functions need necessarily to be covered by the first description of TFO since some issues may be too complex to solve in an initial stage or at all.

The list of functions which are applicable to the BSS follows:

- signalling a request message (TFO_REQ) on the A interface that the TRAU supports TFO;
- signalling an acknowledgement message (TFO_ACK) that the request message has been received from the peer entity;
- monitoring request and acknowledgement messages on the A interface that the peer entity supports TFO;
- remote control of echo cancellers, DCME, ...;
- signalling of current speech codec with acknowledgement message;
- signalling of speech codec capability with acknowledgement message;
- change of current speech codec within the BSS (optional);
- sending of TFO speech frames to the A interface;
- reception of TFO speech frames from the A interface;
- conversion of a flow of TRAU frames into TFO speech frames;
- conversion of a flow of TFO speech frames into TRAU frames.

The following function applies to IPEs that may be along the 64 kbits/s circuit, such as DCME or echo cancellers equipments:

- monitoring of TFO negotiation messages;
- repetition of LSB bit 8 one time out of 16 (TFO establishment mode, i.e. reproduce at the output of the IPE the detected message);
- capability to go full or sub-64 kbit/s transparent mode and to resume normal operation based on TFO negotiation messages;
- capability to monitor and alter TFO speech frame control information (optional);
- capability to insert TFO negotiation messages (optional).

No assumption is made currently on the interactions between call set-up as seen by the MSC and TFO. This means that the initial working assumption is that TFO works independently of the Call Control in the MSC, using only a mechanisms internal to the BSS to activate and de-activate TFO operation.

6 Model of operation

6.1 Overview

The TRAU must first identify each other as TRAU that are TFO capable. Next the TRAUs must check that they are using compatible speech codec types. If they don't use compatible speech codec types they can inform the BSC in order to modify the speech codec used in the MS. If they are using a compatible speech codec type the TRAU starts to insert TFO speech frames in the LSB(s) of the PCM octet present on the A / Nb interface. These frames contain the speech parameters as obtained from the uplink TRAU frames.

6.2 TFO establishment phase

6.2.1 Sending of TFO_REQ message by a BSS

The TFO_REQ message is sent using bit stealing on bit 8, by stealing one bit out of 16. This allows to have the least possible degradation of the PCM, since the TFO_REQ message is sent even in cases where TFO will not be possible e.g. MS to PSTN call.