

Liaison To: TSG-N2
From: TSG-S4 (Codec Working Group)
cc: S2, R3, TSG-CN
Subject: Response to N2 LS on Tandem Free and Out of Band Transcoder Control

1. Introduction

S4 welcome the activities aiming through Out-of-Band means at enabling Tandem Free Calls. This will enable Tandem Free Operation from Call Set-up to Call Release in a very clean way.

S4 has looked and analyzed the N2 Liaison Statement (N2-99976) and especially its attached technical report.

The rest of this document contains comments on the mentioned technical report as well as some issues that S4 believe should be considered by N2 when developing the specifications related to the Out-of-Band control of the Transcoders.

S4 would appreciate if N2 could keep them informed on the progress of N2 activities on the control of the Transcoders.

2. Proposed Definitions

In order to avoid future misunderstanding and clarify the content of this and future liaisons, S4 would like to propose the following definitions for Tandem Free related items. If acceptable, S4 will propose to TSG-SA to include these definitions in the relevant 3GPP vocabulary document:

Transcoder (TC): Physical device present in the network responsible for the transcoding of the speech data between two speech codecs or coding schemes (The Transcoder may also include other functions, i.e. Rate Adaptation in GSM).

Tandem Free Operation (TFO): Configuration of a Speech or Multimedia call for which Transcoders are physically present in the communication path but transcoding functions are disabled or partially disabled. The Transcoders may perform control and/or protocol conversion functions.

In-Band Transcoder Control: Capability for a system to control the operation mode of a Transcoder through in-band signaling, embedded in the speech frame. For example, in GSM, the speech codec in use and DTX parameters are provided in-band by the BTS to the transcoder, on a call per call basis, to control the operation mode of the transcoder.

In-Band TFO Protocol or In-Band TFO: Inter-Transcoder protocol first standardized for the GSM system, allowing the Transcoders to recognize the tandem free capability of the remote end, to identify a potential codec mismatch and establish when possible Tandem Free Operation. The protocol messages are carried through bit-stealing before TFO establishment and embedded in the synchronization pattern after TFO establishment.

Transcoder Free Operation (TrFO): Configuration of a Speech or Multimedia call for which Transcoders are not present in the communication path.

Out-of-Band Transcoder Control: Capability of a system to control the operation mode of a Transcoder on a call per call basis through out-of-band signaling. The operation mode should

at least include the codec type and associated parameters (DTX activation, allowed set of codec modes when a Multi-Rate codec is used...). Out-of-Band Transcoder Control is required to establish Transcoder Free Operation (TrFO).

Out-of-Band TFO: Possibility to establish Tandem Free Operation through Out-of-band signaling. We could envisage establishing TFO through out-of band signaling but leave the Transcoder in the communication path to monitor external events and revert to a normal configuration if required. If this option is kept, the out-of-band control protocol will end up by either bypassing the transcoders or including the transcoders without activating the transcoding functions.

3. Comments on the Out-of-Band / In-Band Comparison

The comments in this section must be considered as additional information to sections 7 and 8 of the technical report 3G TR ab.cde produced by N2.

Service Limitation

In-Band TFO was developed for speech services only as required by the TFO stage 1 document (see GSM 02.53). The protocol could also be extended to services requiring more than 64 kbps transmission links. This need has not been expressed so far. S4 still recognize that TFO was first developed for speech telephony services and not for Multimedia calls. Nevertheless it should be noted that In-Band signaling has been used in Multimedia for a long time. In ITU-T H.324 and H.323, transcoding functions are avoided using the capabilities offered by the [in-band] H.245 control channel.

The transmission saving capability (i.e. 8 or 16 kbps) has been taken into account in In-band TFO (see GSM 08.62) and a specific annex (B) has been dedicated to this.

In-Band TFO assumes 64 kbps links, but since it is In-Band it is independent of the transport network assuming that this Transport Network will either transport the 64 kbps or if used for transmission saving too, will transport the 8 or 16 kbps stream.

In-Band TFO will be compatible with GSM but is likely to be also adopted by other 2G and 3G systems (i.e. IS-136, IS-95, cdma2000).

Configuration

The Hardware configuration issue is partly dependent on implementation aspects and saving can be achieved in configurations processing a high number of calls as expected in 3G systems. The monitoring of the synchronization is required independently of the fact that Out-of-Band or In-Band signaling has been used for establishing TFO. In any case, synchronization monitoring is required somewhere in the radio network or BSS for either Tandem Free Operation or Transcoder Free Operation.

Quality of Service

For in-band TFO, the impact on speech quality has been extensively evaluated through formal and informal listening tests carried out under SMG11 responsibility. No degradation was found.

The bit-stealing is done on speech calls only and not for data calls. TFO establishment starts after the circuit is opened and therefore it is known then whether it is a speech or data call.

Maintenance for future expansion

When a new codec type is introduced the existing transcoders do not need to be upgraded, in the sense that if they're not compatible this will be detected by the entity in charge of the codec mismatch resolution. If the transcoder is not upgraded the new codec type will be considered unknown and TFO not established. Alternatively, the network could decide to change transcoders to allow TFO establishment. In most cases, the core network equipment will be made of Pools of Transcoders with different capabilities.

The transit nodes can indicate what is their Preferred Codec in the current GSM TFO and this will be the case also for 3G, therefore the relocation can be done taking into account this need.

4. Potential Issues

This section lists a number of remarks and issues identified in the TR produced by N2:

- The report focuses on the signaling required to establish a Transcoder Free configuration. S4 believe that an out-of-band signaling solution should also offer the possibility to establish a Tandem Free Operation where a transcoder is inserted in the communication path but the transcoding functions are bypassed. This solution could be beneficial when TFO must be discontinued during the call (DTMF, Multiparty call activated...). In that case, the transcoder would only have to monitor the synchronization and revert to normal transcoding if commanded by the Core Network or when TFO is discontinued.
- The 3G TR ab.cde does not address the synchronization monitoring. How will that be performed in Transcoder Free Operation?
- In case of Transcoder Free Operation, which format will be used to convey the speech data? What is the compatibility with GSM?
- How could Transcoder Free Operation be implemented on an existing GSM network, providing that the TRAU is part of the BSS? or should the Core Network be equipped with internal Transcoders in that case?
- How will the management of different AMR configurations (i.e. Active Codec Modes, Supported Codec Modes, Maximum number of codec modes) be done? What is the impact on the BICC specification?
- How will the in-band signaling used in GSM for the AMR link adaptation (see GSM 05.09) be treated in case of Transcoder Free Operation between GSM and 3G?
- As for In-Band TFO, downlink DTMF will break Transcoder Free Operation and will be subject to the non-ideal transparency performances of the speech codec. S4 believe that out-of-band Layer 3 signaling for downlink DTMF should be considered.

5. Conclusion

S4 understand that certain aspects of the Physical Layer for the speech services can have some impact on TFO or TrFO independently of the Out-of-Band or In-Band approach. We feel that it is important that N2 and S4 collaborate on these aspects, especially since most of them were assessed and taken into account in the context of the In-Band TFO work carried out for GSM¹. S4 consider that the complexity of the In-band TFO protocol essentially comes from the flexibility and constraints introduced on the physical layer of the Air Interface; Maximum of 4 modes in the AMR Active Codec Set, freedom for network manufacturers to support any set of AMR codec modes, alternating transmission of Codec Mode Requests and Codec Mode Indications. It is still unclear if the UTRAN will not have similar limitations. An out-of-band protocol for TFO or TrFO will also have to consider these constraints, for 3G-3G or 2G-3G interoperability.

Furthermore we understand that TFO and TrFO may not be transparent to the RAN and we may have to involve TSG-RAN (R2 and R3) and S2.

¹ Note that the maintenance of the GSM In-Band TFO specifications is being transferred from SMG11 to S4.