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Foreword

This Technical Specification (TS) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE 1: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

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The Eureka Project 147 was established in 1987, with funding from the European Commission, to develop a system for the broadcasting of audio and data to fixed, portable or mobile receivers. Their work resulted in the publication of European Standard, ETSI EN 300 401 [1], for DAB (see note 2) which now has worldwide acceptance.

NOTE 2: DAB is a registered trademark owned by one of the Eureka Project 147 partners.

The DAB family of standards is supported by World DAB, an organization with members drawn from broadcasting organizations and telecommunication providers together with companies from the professional and consumer electronics industry.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The present document is one of a set associated with DAB. ETSI EN 300 401 [1] describing the transmitted signal, the interface between the broadcaster's transmitters and the listener's receiver. The associated documents, ETSI EN 300 797 [2], ETSI EN 300 798 [3] and ETSI ETS 300 799 [4] describe additional interfaces, which can be used by broadcasters or network providers to build DAB collection and distribution networks. In particular the document ETSI EN 300 797 [2] establishes a standard way for transporting Service Components, Service Information and control messages between two entities in a DAB collection network. Because of the openness and flexibility of the Service Transport Interface (STI) standard there is uncertainty regarding the implementation of it. This applies to interoperability between devices from different suppliers. Practical broadcast scenarios do not always require to implement the full standard, which creates the problem that different suppliers might implement different subsets of ETSI EN 300 797 [2].

To overcome this problem and to fully exploit the great potential of the DAB system, the subject of the present document is to describe implementation levels of the STI standard and to outline their usage.

1 Scope

The present document establishes guidance in implementation and usage of the functionality described in the STI standard ETSI EN 300 797 [2]. Subsets of the STI standard, called STI Levels, are defined in order to make interoperable solutions possible for different suppliers of STI devices. The present document defines the minimum functionality an upstream or downstream entity provides on each level to be considered compliant with that level.

This version of the present document is aligned with V2.1.1 of ETSI EN 300 401 [1].

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI EN 300 401 (V2.1.1): "Radio broadcasting systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers".

[2] ETSI EN 300 797: "Digital Audio Broadcasting (DAB); Distribution interfaces; Service Transport Interface (STI)".

[3] ETSI EN 300 798 (V1.1.1): "Digital Audio Broadcasting (DAB); Distribution interfaces; Digital baseband In-phase and Quadrature (DIQ) interface".

[4] ETSI ETS 300 799 (1997): "Digital Audio Broadcasting (DAB); Distribution interfaces; Ensemble Transport Interface (ETI)".

[5] Recommendation ITU-T G.704: "Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels".

[6] Recommendation ITU-T G.703: "Physical/electrical characteristics of hierarchical digital interfaces".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] IETF RFC 1700 (October 1994): "Assigned Numbers", STD 2, Reynolds, J. and J. Postel.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ETSI EN 300 401 [1], ETSI EN 300 797 [2] and the following apply:

STI Level: subset of overall STI functionality described by ETSI EN 300 797 [2]

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 300 401 [1], ETSI EN 300 797 [2] and the following apply:

API	Application Programming Interface
DNS	Dynamic Name Server
EP	Ensemble Provider
IANA	Internet Assigned Numbers Association
IP	Internet Protocol
ISDN	Integrated Services Digital Network
SP	Service Provider
TCP	Transport Control Protocol
VPN	Virtual Private Network

4 STI Levels

4.0 Introduction

The STI Levels describe the STI functionality, i.e. STI-D stream types and STI-C message sets and their usage, that STI entities shall provide to be considered STI level compliant. The levels shall be subsets of ETSI EN 300 797 [2] with respect to STI-D(LI) and STI-C(LI) functionality.

A total of three levels is defined. The level requiring the least functionality is called level 1. Higher levels shall fully comprise the lower ones. The levelling proposed in the present document is only valid for the logical part of ETSI EN 300 797 [2] and does not apply to physical interfaces. Thus an STI capable device may be equipped with one or more physical interfaces, each being capable of providing one of the STI Levels as defined in the present document.

4.1 STI-D(LI) Stream Types

4.1.0 General

The STI-D(LI) data stream types classified in ETSI EN 300 797 [2], clause 4.2, are divided into two parts, basic stream types and optional stream types.

4.1.1 Basic Stream Types

4.1.1.0 Definition

Basic stream types are:

- MSC sub-channel audio stream service component;
- MSC sub-channel data stream service component;

- MSC sub-channel data stream made of one or more packet mode service components (and padding);
- FIC FIG stream Service Information.

Table 1 shows which TID and TIDext shall be supported.

Table 1: TID/TIDext supported as basic stream types

TID	TIDext	Significance
0	0	MSC audio stream
	1	MSC data stream
	2	MSC packet mode stream
4	0	Service Information

4.1.1.1 MSC sub-channel streams

The basic stream types shall provide correct handling of individual MSC streams as described in ETSI EN 300 797 [2], clause 5.9.1.

4.1.1.2 FIC FIG stream

The basic stream types shall provide correct handling of FIC FIG streams carried in STI-D(LI) as described in ETSI EN 300 797 [2], clause 5.9.3.

4.1.2 Optional Stream Types

Other stream types than those defined as basic are optional on all STI Levels:

- MSC sub-channel contribution packet mode data service component;
- FIC FIG stream CA information;
- FIC FIB stream asynchronous FIB insertion;
- FIC FIB stream synchronous FIB insertion.

4.2 STI Level 1

4.2.0 General

This clause defines the minimum functionality required by an STI upstream or downstream entity to be considered conformant to STI Level 1. Only STI-D(LI) basic stream types are supported. Control message exchange between upstream and downstream entities is not included. Therefore no support of STI-C(LI) messages is required. Usage of this level shall assume a configuration agreement between the upstream and downstream entities.

4.2.1 STI-D(LI) requirements

All basic stream types as defined in clause 4.1.1 shall be supported in downstream entities. At least one basic stream type shall be supported in upstream entities.

4.2.2 STI-C(LI) requirements

In STI Level 1 no setup and control messages can be exchanged between an upstream and downstream entity. Therefore no support of STI-C(LI) shall be required.

4.3 STI Level 2

4.3.0 General

This clause defines the minimum functionality required by an STI upstream or downstream entity to be considered conformant to STI Level 2. The minimum functionality required in level 1 shall be comprised on this level. On STI Level 2 the possibility to exchange certain STI-C(LI) messages between upstream and downstream entities shall be supported. Extending the functionality provided on STI Level 1, STI Level 2 supports seamless and coordinated dynamic reconfiguration as well as the usage of FIG files.

4.3.1 STI-D(LI) requirements

The STI-D(LI) requirements of STI Level 1 shall be comprised, i.e. all basic stream types as defined in clause 4.1.1 shall be supported in downstream entities. At least one basic stream type shall be supported in upstream entities.

4.3.2 STI-C(LI) requirements

In STI Level 2 exchange of control messages shall be supported. The required functionality comprises seamless dynamic reconfiguration of the DAB multiplex initiated by the upstream entity, the possibility to define new configurations, exchange of error messages and frame counter information. FIG files in addition to FIG streams may be used to provide FIC content. Therefore the following message classes, as defined in ETSI EN 300 797 [2], shall be supported:

- Action messages, i.e. message class **ACTION**;
- Configuration messages, i.e. message class **CONFIG**;
- FIG file messages, i.e. message class **FIGFILE**;
- Information messages, i.e. message class **INFORMATION**;
- Supervision messages, i.e. message class **SUPERVISION**.

NOTE: Only the reconfiguration initiation by the upstream entity is mandatory. The possibility of reconfiguration enforcement on upstream entities from the downstream entity is optional. This means that not all the functionality of message class ACTION is required (see also annex A).

4.4 STI Level 3

4.4.0 General

This clause defines the minimum functionality required by an STI upstream or downstream entity to be considered conformant to STI Level 3. The minimum functionality required on the lower levels shall be comprised on this level. Extending the functionality provided on STI Level 2, STI Level 3 supports the possibility to exchange STI-C(LI) messages of the RESOURCE class between upstream and downstream entities.

4.4.1 STI-D(LI) requirements

The STI-D(LI) requirements of STI Levels 1 and 2 shall be comprised, i.e. all basic stream types as defined in clause 4.1.1 shall be supported in downstream entities. At least one basic stream type shall be supported in upstream entities.

4.4.2 STI-C(LI) requirements

In STI Level 3 exchange of control messages shall be supported. The STI-C(LI) requirements of STI Levels 1 and 2 shall be comprised. STI Level 3 shall also handle scarce DAB resources. Therefore the following message class, as defined in ETSI EN 300 797 [2], shall be supported:

- Resource messages, i.e. message class **RESOURCE**.

NOTE: MSC sub-channel packet mode data contribution is an option. Therefore the PACKCON message does not need to be supported.

4.5 Connecting entities of different STI Levels

The present document describes three levels of functionality when using ETSI EN 300 797 [2]. Because of the hierarchical definition of levels, lower levels have limitations that shall be considered when connecting entities of different STI Levels. These limitations are listed in table 2.

Table 2: Functional limitations of the STI Levels

STI Level	Limitation
1	• co-ordination of dynamic reconfiguration is not supported • only asynchronous SI insertion is possible
2	• DAB ensemble resource co-ordination based on RESOURCE messages is not supported
3	• reconfiguration enforcement on an upstream entity by a downstream entity is not supported • FIC FIB streams are not supported • FIC FIG stream CA are not supported • FIB grids are not supported • MSC packet mode data contribution is not supported • handling of CA FIGs
NOTE: Limitations listed on a higher level also apply to lower levels.	

When using STI Level 1 or 2 on an STI connection, the upstream and downstream entity shall agree on the following items to be able to use the full functionality of these STI Levels:

- transmission channel capacity that the upstream entity can use;
- streams that the upstream entity is entitled to use;
- identifiers that the upstream entity is entitled to use;
- FIGs that the upstream entity is entitled to use;
- announcement parameters that the upstream entity is entitled to use.

Annex A (informative): Implications of STI level definitions on device functionality

A.1 Introduction

This annex gives guidance in using the STI Levels defined in clause 4 of the present document to achieve functional interoperability of STI devices.

A DAB collection network has a hierarchical tree structure as given in ETSI EN 300 797 [2] clause 4.4.2, figure 7, by a representative example. Figure A.1.1 repeats this network example, outlining the different roles STI devices can play in such a network. The roles are:

1) Ensemble Provider: EP:

   - The Ensemble Provider device, e.g. ensemble multiplexer, always forms the root entity of a DAB collection network.

2) Service Provider (upstream entity): SP_{UE}:

   - A Service Provider device, which has only STI outputs, forms a leaf entity in the DAB collection network.

3) Service Provider (upstream and downstream entity): $SP_{DE/UE}$:

   - A Service Provider device having both STI inputs and outputs forms an intermediate entity in the DAB collection network. It has passing and processing functionality with respect to STI.

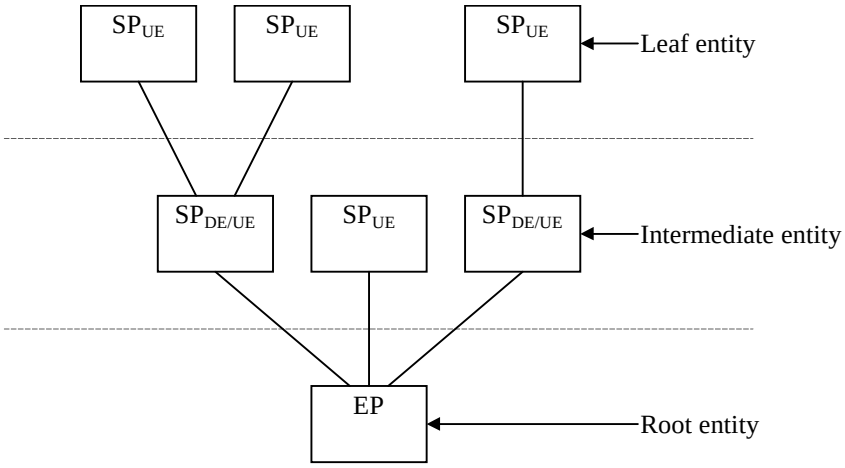

Figure A.1.1: Tree structure of the hierarchical DAB collection network

As defined in ETSI EN 300 797 [2], each entity is uniquely identified by either SPID or EPID.

Each single input or output of a device is characterized by the STI Level it can process or generate. An STI connection between an output (upstream entity of the STI connection) of one device and an input (downstream entity of the STI connection) of another device can then be characterized by the resulting STI Level, which is the lower level of the two involved.

In order not to loose functionality or even information on the path from a leaf to the root entity, the following relation should be kept for each connection in the path.

The upstream entity's STI Level should be lower than or equal to the downstream entity's STI Level to be able to use the upstream entity’s complete functionality. In case an upstream entity with an STI Level higher than the downstream entity's is used on an STI connection, the upstream entity is likely to receive PRERROR UKN messages as defined in ETSI EN 300 797 [2] when issuing messages which are not part of the downstream entity's STI Level.

NOTE: Clause A.2 describes the different roles in the network in detail and outlines their implications on STI functionality and the interoperability aspects.

A.2 Minimum STI device functionality

A.2.1 Ensemble Provider (EP)

A.2.1.0 General

The Ensemble Provider defines the possible range of functionalities in a DAB collection network. These may include decentralized control and signalling, DAB resource control and consistency checking. The Ensemble Provider dynamically generates the resulting DAB multiplex signal.

The most important EP functions are (in the context of an STI based collection network):

a) processing of all basic stream types as defined in clause 4.1.1;

b) the EP defines the exact time instant for execution of a multiplex reconfiguration and provides control data needed by its upstream entities to support the reconfiguration according to ETSI EN 300 797 [2];

c) so-called list FIGs as defined in ETSI EN 300 401 [1] are detected in FIG files and processed accordingly. For instance regarding FIG 0/6, 0/21 and 0/24, additional signalling of Service Information Version/Change Event Indication (SIV/CEI) is implemented;

d) in case that STI based resource co-ordination is supported in the collection network, it is primarily up to the EP to define resources (both transmission and coding resources) and to provide consistency checks to make sure that its upstream entities cannot interfere with one another.

A.2.1.1 STI Level 1

a) STI-D(LI) implications:

- All basic STI-D stream types are processed according to the local configuration of the respective EP entity (see b).

b) STI-C(LI) implications:

- No STI-C connection exists, which implies that specification of (re)configuration is done by some other means, for instance by a (proprietary) local API or user interface.
- Optionally this may also comprise local generation of Service Information to be signalled in addition or alternatively to FIG stream(s) contained in STI-D.

c) General network implications:

- restricted solution;
- no communication between EP and SP via STI-C;
- DAB collection network operation is co-ordinated without use of STI.

A.2.1.2 STI Level 2

a) STI-D(LI) implications:

- All basic STI-D stream types are processed according to configuration information exchanged via STI-C and thus extending the STI Level 1 functionality. Coordinated, seamless, dynamic reconfiguration based on current/next configuration as negotiated via STI-C between EP and SP is implemented.

b) STI-C(LI) implications:

- An STI-C connection is available providing the subset of messages according to the STI Level 2 definition. This implies that the specification/reception of configurations and the acceptance of dynamic reconfigurations via STI-C is implemented (procedure as described in ETSI EN 300 797 [2], annex E). The possibility of the downstream entity enforcing a reconfiguration on the upstream entity is not mandatory. When connected to an STI Level conformant upstream entity, an EP should not issue an RCONFIG DEF message without prior reception of RCONFIG REQ from the upstream entity. The latter mechanism may only be used in case it is agreed between the entities in addition to the STI Levels.

- Additionally complete support of FIG file usage (USEFIGF and FIGFILE messages as defined in ETSI EN 300 797 [2] as well as the respective FIG processing) is implemented.

c) General network implication:

- STI Level 2 provides an STI solution essentially based on bi-directional communication between the EP and directly connected SPs via STI-C;

- network operation can be remotely controlled to a certain extent by SPs, supported by STI;

- no co-ordination of ensemble resources (coding and transmission capacity) is supported via STI on this level.

A.2.1.3 STI Level 3

a) STI-D(LI) implications:

- In addition to STI Level 2, resources (FIC capacity and identifiers) used in SI delivered via FIG streams are supervised by the EP, based on resource allocations available for all of its upstream entities and the EP itself (see b) below).

- In practice this means at least the following:

  1) checking of FIG type consistency to TIDext of FIG stream;

  2) blocking of FIGs (type/extension) which are MCI FIGs or marked in FIGBLCK messages;

  3) no further check if 'Other Ensemble' flag is set in FIG;

  4) to avoid interference between SPs the use of the following sensitive FIG data is checked with regard to allocated resources to the respective SP:

     - Service Identifiers (SId): in FIG 0/17, 18, 20, 25 and FIG 1/1, 4, 5.
     - Component Identifiers (SubChId): in FIG 0/5.
     - Linkage set parameters (LSN and S/H and ILS): in FIG 0/6.
     - Announcement provision parameters referring to:
       a) the EP's ensemble (ClusterId and Asw and SubChId): in FIG 0/19.
       b) another ensemble (OE ClusterId and Asw): in FIG 0/26.

FIGs that do not pass these checks are not transmitted in the FIC. An FIG content error message is generated using the STERROR DEF message as defined in ETSI EN 300 797 [2] with the *ErrType* field set to "C". If the allocated mean FIC capacity of an SP is exceeded, the EP may reduce the FIG repetition rates of the respective SP. The EP should inform the SP by sending an error message using STERROR DEF with the *ErrType* field set to "I".

b) STI-C(LI) implications:

- In addition to STI level 2, ensemble resource allocation (as defined in ETSI EN 300 797 [2]) to all directly connected upstream entities are provided. The respective specifications are supported by a (proprietary) local API or user interface.

- On request, the EP is obliged to send complete information about resources allocated to an upstream entity using a resource data exchange session. The EP gives notification to the upstream entity in case of a change in resource allocation using a resource data exchange session. Configurations and FIG files are checked against the allocated resources taking into account their time of activation.

c) General network implications:

- full communication between EP and SP via STI-C;
- network operation and use of ensemble resources can be fully co-ordinated as far as supported by ETSI EN 300 797 [2] and STI Level 3.

A.2.2 Service Provider (SP)

A.2.2.0 General

Important SP functions are (in the context of an STI based collection network):

a) multiplex of service component data (audio, packet mode or stream mode data channels) and mapping into STI-D (synchronous process, fixed frame relation);

b) service signalling mapping into STI-D (asynchronous process, no fixed frame relation);

c) specification and activation of configurations and FIG files (if STI Level > 1);

d) acting on behalf of subordinate SPs (for $SP_{DE/UE}$).

A.2.2.1 Service Provider (upstream entity)

A.2.2.1.1 STI Level 1

a) STI-D(LI) implications:

- At least one of the basic STI-D stream types is generated according to a local configuration definable via a local API or user interface. If one or more FIG streams are generated to provide for static and/or dynamic Service Information then cyclic repetition of FIGs is accomplished (including SIV/CEI if respective FIGs are submitted). Care should be taken that limitations of bit rates and allocated FIC capacity are not exceeded.

b) STI-C(LI) implications:

- No STI-C connection exists, which implies that neither specification and activation of MSC (re)configuration nor use of FIG files is possible by the respective SPs using the STI. Also no error or information messages can be received.

A.2.2.1.2 STI Level 2

a) STI-D(LI) implications:

- There is no difference from STI Level 1 concerning the supported stream types. In addition, seamless dynamic reconfiguration is supported, which requires the STI-D(LI) to dynamically adapt its content to the configurations negotiated via STI-C (see b) below).

b) STI-C(LI) implications:

- An STI-C connection is available, providing the subset of messages according to the STI Level 2 definition. This implies that specification and activation of dynamic reconfigurations via STI-C are implemented (procedure as described in ETSI EN 300 797 [2], annex E). In addition support of FIG file usage (USEFIGF and FIGFILE messages as defined in ETSI EN 300 797 [2] as well as the respective FIG processing) is implemented.

- Information requests and basic error information are supported via STI-C using the message set allocated to this STI Level.

A.2.2.1.3 STI Level 3

a) STI-D(LI) implications:

- In addition to STI level 2, resource allocations received from a downstream entity via STI-C are respected in generation of STI-D(LI). STI-D(LI) streams are generated in accordance to the capacity limits defined by the downstream entity using the CHANCAP and STLIMIT messages. The content of FIG streams only use the resources defined by the downstream entity using the IDALLOC, IDLIMIT and ANNSEND messages.

b) STI-C(LI) implications:

- In addition to STI level 2, resource allocations received from a downstream entity via STI-C are respected. The extended information and error message set according to STI level 3 are supported.

A.2.2.2 Service Provider (downstream and upstream entity)

A.2.2.2.0 General

According to clause A.2.1 intermediate entities are possible which are SP devices supporting STI inputs (as downstream entity) and one STI output (as upstream entity). Such devices have to fulfil additional tasks concerning the mapping between the STI input connections (in general multiple) and the single STI output connection, depending on the respective STI Levels involved. All implications concerning upstream entity Service Providers that were stated in clause A.2.2.1 are also valid for Service Providers (downstream and upstream). Clause A.2.2.2 describes additional implications specific to the combined downstream and upstream role.

A.2.2.2.1 STI Level 1 (downstream entity)

For a Service Provider device with STI Level 1 at the downstream entity side any of the STI Levels 1 to 3 can be used at the upstream entity side:

a) STI-D(LI) implications:

- All basic STI-D stream types are processed according to the local configuration (see b) below).

b) STI-C(LI) implications:

- No STI-C connection exists, which implies that specification of (re) configurations is done by some other means, for instance by a (proprietary) local API or user interface.

A.2.2.2.2 STI Level 2 (downstream entity)

For a Service Provider device with STI Level 2 at the downstream entity side STI Levels 2 or 3 can be used at the upstream entity side:

a) STI-D(LI) implications:

- All basic STI-D stream types are processed and mapped into the STI-D output stream according to configuration information exchanged via STI-C and thus extending the STI Level 1 functionality.

b) STI-C(LI) implications:

- An STI-C connection is available providing the subset of messages according to the STI Level 2 definition. This implies that the specification/reception of configurations and the acceptance of dynamic reconfigurations via STI-C are implemented (procedure as described in ETSI EN 300 797 [2], annex E). The possibility of the downstream entity enforcing a reconfiguration on the upstream entity is not mandatory. When connected to an STI Level conformant upstream entity, an $SP_{DE/UE}$ should not issue an RCONFIG DEF message without prior reception of RCONFIG REQ from the upstream entity. The latter mechanism may only be used in case it is agreed between the entities in addition to the STI Levels.

- Additionally complete support of FIG file usage (USEFIGF and FIGFILE messages as defined in ETSI EN 300 797 [2] as well as the respective FIG processing) is implemented.

NOTE: The support of dynamic reconfigurations implies a mapping to and from the upstream entity side of the device and coordination of the reconfiguration with the following downstream entity.

A.2.2.2.3 STI Level 3 (downstream entity)

For a Service Provider device with STI Level 3 at the downstream entity side STI Level 3 can be used at the upstream entity side:

a) STI-D(LI) implications:

- In addition to STI Level 2, resources should be supervised by the $SP_{DE/UE}$, based on resource allocations available for all of its upstream entities and the $SP_{DE/UE}$ (see b) below).

b) STI-C(LI) implications:

- In addition to STI level 2, resources allocated at a downstream entity are shared between the upstream direction SPs and the $SP_{DE/UE}$ device. The respective specifications are supported by a (proprietary) local API or user interface.

- On request, the $SP_{DE/UE}$ sends complete information about resources allocated to an upstream entity using a resource data exchange session. The $SP_{DE/UE}$ gives notification to the SP in case of a change in resource allocation using a resource data exchange session. Configurations are checked against the allocated resources taking into account their time of activation.

Annex B (informative): Examples of DAB collection networks

B.1 Introduction

This annex shows some general examples on how STI devices can be used in DAB collection networks.

B.2 Examples

B.2.1 Example 1

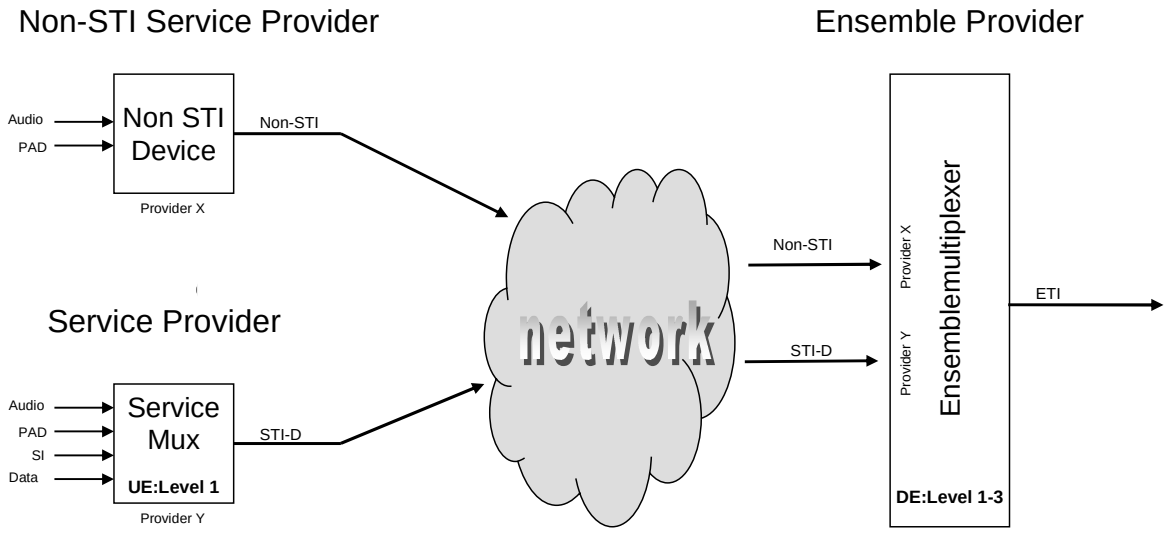

Figure B.2.1.1: Example over DAB collection network

Two Service Providers, one delivering a non-STI stream, the other delivering STI Level 1, are connected to an ensemble multiplexer.

The non-STI Provider's DAB conformant audio streams, including PAD, are inserted into the ETI signal generated by the ensemble multiplexer. All SI related to the non-STI streams is generated by the ensemble multiplexer. STI functionality cannot be used.

As the other Service Provider delivers signals according to STI Level 1, the connection to the ensemble multiplexer is STI Level 1 based, irrespective of the ensemble multiplexer's STI Level. The lowest STI Level defines the useable functionality, in this example the upstream entity's STI Level 1.

B.2.2 Example 2

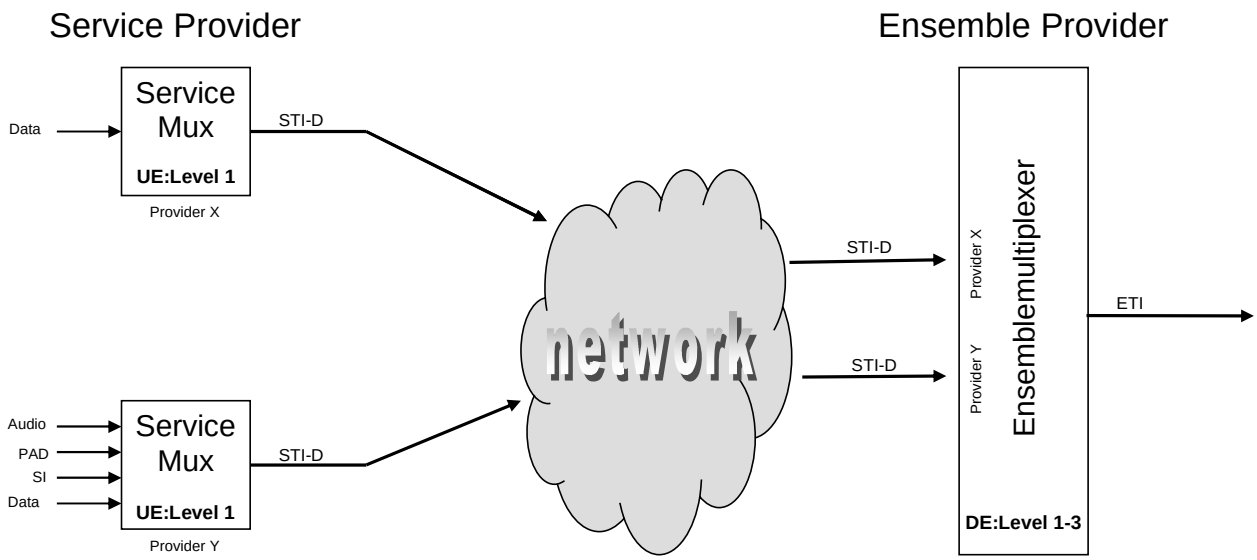

Figure B.2.2.1: Example over DAB collection network

This example shows that an upstream entity provides one or more STI-D stream types. A downstream entity is able to process all basic stream types.

B.2.3 Example 3

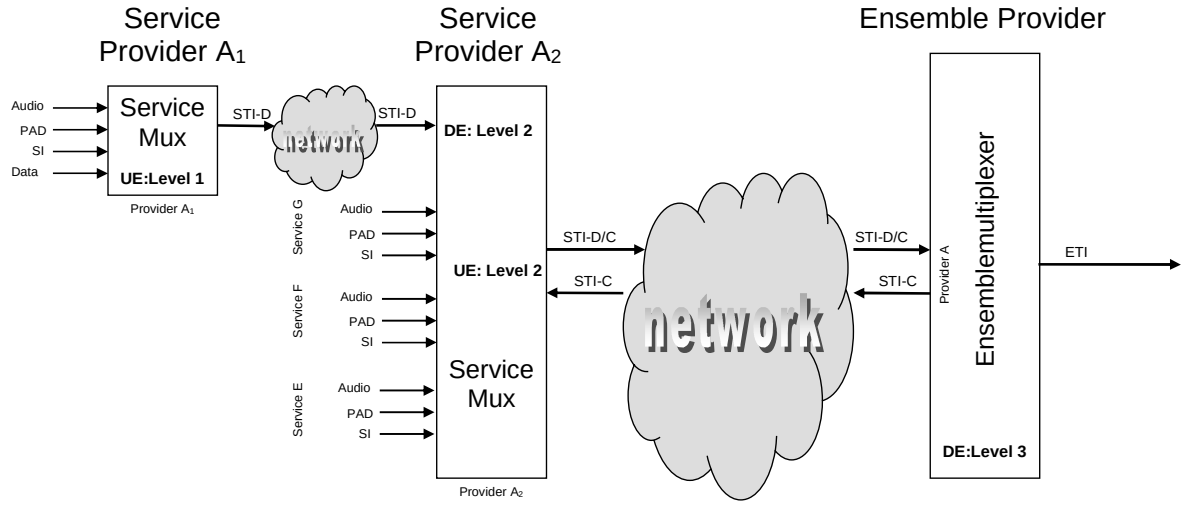

Figure B.2.3.1: Example over DAB collection network

The provider A_1 service multiplexer generates an STI-D stream. Provider A_1 is able to use all features described in STI Level 1. The provider A_2 service multiplexer receives this stream and inserts it into its STI-D stream output. Provider A_2 is able to use the whole functionality of STI Level 2.

This example shows that the lower STI Level defines the usable functionality between two entities.

B.2.4 Example 4

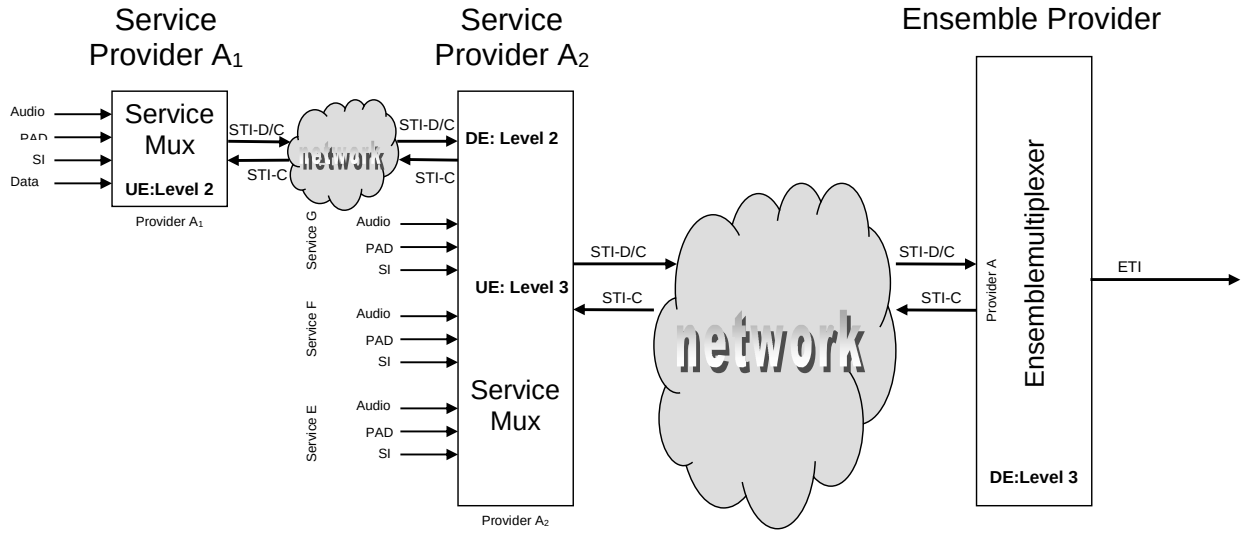

Figure B.2.4.1: Example over DAB collection network

The difference between examples 3 and 4 is the higher STI Levels of the service multiplexers.

The provider A_1 service multiplexer is able to use the functionality of STI Level 2, i.e. it is possible for provider A_1 to reconfigure its Services. The SP receives feedback concerning its actions via the STI-C channel.

The provider A_2 service multiplexer is able to use the functionality of STI Level 3, i.e. it can use the RESOURCE messages.

B.2.5 Example 5

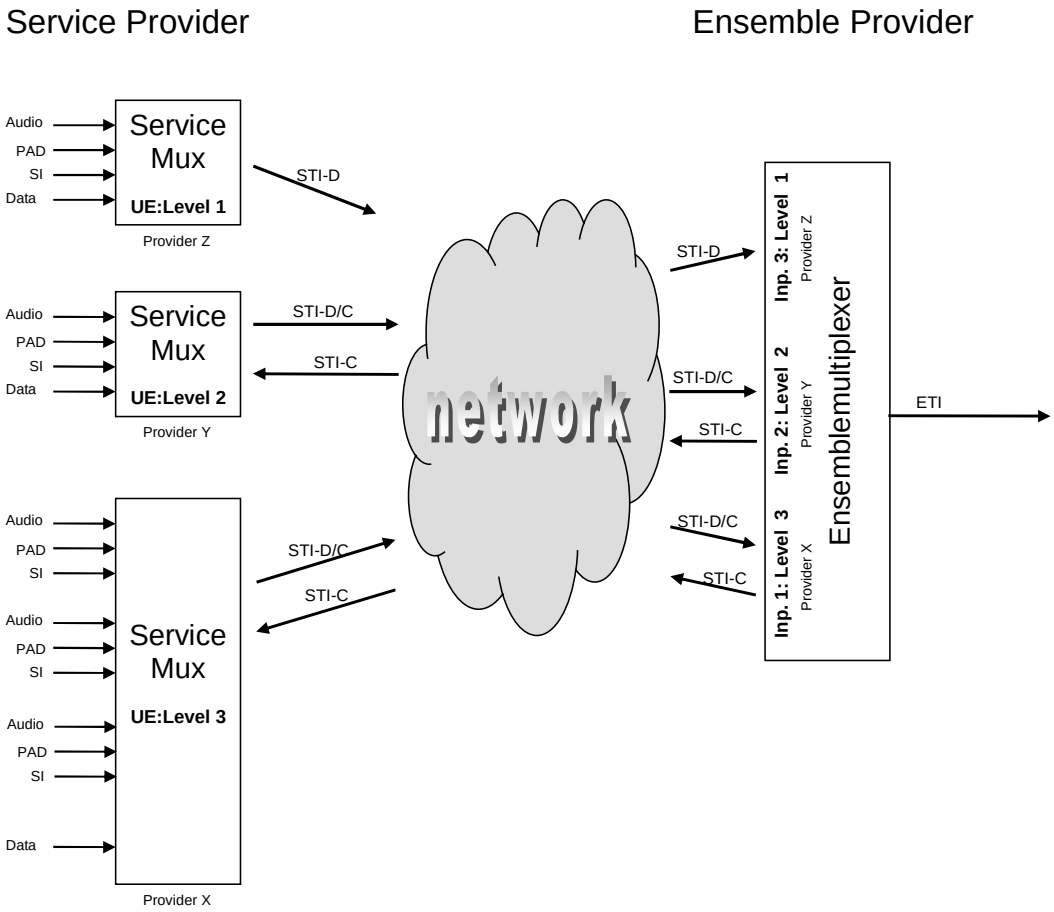

Figure B.2.5.1: Example over DAB collection network

This example shows part of a typical STI network.

It is possible that a downstream entity has inputs with different STI Levels. In this example each input of the ensemble multiplexer has an STI Level reflecting the STI Level of the corresponding service multiplexer's output.

Annex C (normative): Using TCP/IP as Transport Mechanism for STI-C(LI) messages

C.1 Introduction

The STI-C(TA) transport adaptation is conceptually very close to TCP/IP. Hence STI-C(LI) message transport that uses standard TCP/IP instead of STI specific transport adaptation can be defined. TCP/IP may be used as a complete, bi-directional STI control part connection.

This annex gives details on how TCP/IP shall be used for the transport of STI-C(LI) messages.

C.2 Motivation and Background

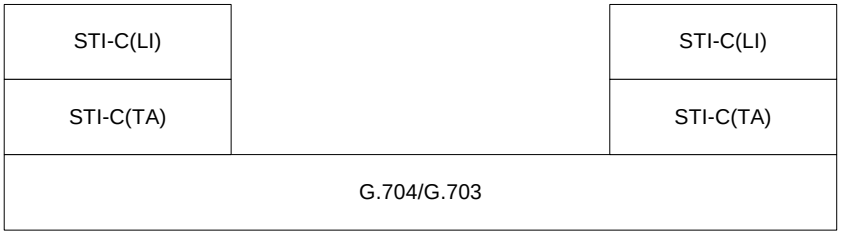

Figure C.2.1: STI-C using the STI-C(TA) over G.704 [5] or G.703 [6]

An alternative to STI-C transport via STI(PI, X) is to use TCP/IP and replace the STI-C(TA) and underlying layers with TCP/IP. The TCP protocol contains re-transmit functionality and message counting, and the TCP layer therefore replaces the STI-C(TA) layer.

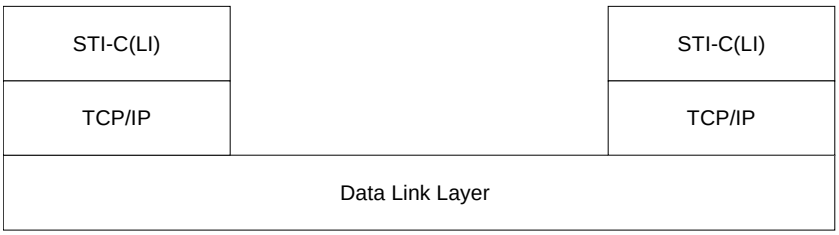

Figure C.2.2: STI-C using TCP/IP

The STI-C(LI) messages are character-based messages defined in ETSI EN 300 797 [2].

The implementation of STI-C transport via TCP/IP shall be based on sockets and uses two connections for each bi-directional STI-C link. More than one upstream entity could be handled in the standard way of handing over to another TCP port during the phase of connection establishment. The downstream entity shall identify the respective upstream entity by its IP-address or DNS-name.

NOTE: There are several ways to achieve a higher level of security using encryption and authentication:

a) a proprietary LAN with no connection to the outside world. An analogue modem or ISDN could be used to bridge long distances;

b) a VPN (Virtual Private Network) could also be used. Hardware as well as Software solutions are available on the market.

Each encryption type should use a unique port.

A simple solution from an interoperability viewpoint is to use a VPN with an external hardware box on the Ethernet link. All STI-C(LI) messages will be tunnelled through the encryption modules on each side and the sending and receiving software will not notice any difference.

There are also software solutions that will insert the VPN module into the TCP/IP protocol stack.

The encryption and authentication algorithms are not part of the STI-C specification. The VPN solution does not affect the DAB application since there are solutions that use external equipment.

C.3 Specification

NOTE: Port 1076 is defined formally by reservation for "DAB STI-C" at Internet Assigned Numbers Association (IANA), see also IETF RFC 1700 [i.1].

STI-C over TCP/IP is using port 1076 as default port with the semantics and syntax of STI-C(LI) messages specified in the standard. Other port numbers may also be used instead of the default.

Between two entities there shall be two TCP connections, each one used unidirectionally. The connection initiated by one entity shall only transport data from this entity to the other entity.

The connection may be initiated either by the upstream or the downstream entity.

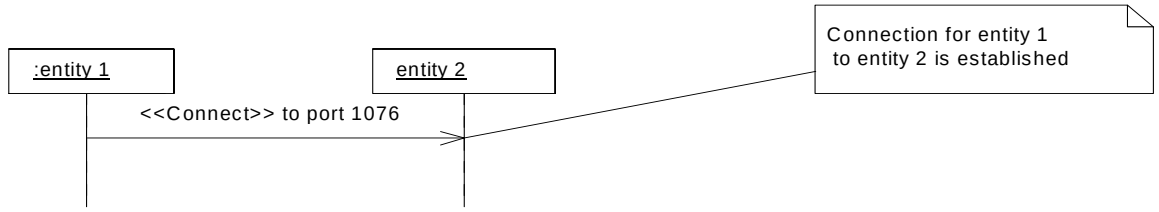

Figure C.3.1: The connection scheme

If several upstream entities shall connect to the same downstream entity, the downstream entity shall distinguish the different entities by their IP addresses. STI entities making use of STI-C(LI) via TCP/IP shall be able to define a one-to-one mapping between the IP address/DNS-name and the Service Provider Identifier (SPID) or the Ensemble Provider Identifier (EPID).

Annex D (informative): Bibliography

- IETF RFC 793 (September 1981): "Transmission Control Protocol - DARPA Internet Program Protocol Specification", Postel, J., DARPA.

History

Document history		
V1.1.1	December 2001	Publication
V1.2.1	August 2017	Publication