

Update of the DAB system standard EN 300 401

Guidance for broadcasters and equipment makers

1 Introduction

During 2016, the WorldDAB Technical Committee completed a comprehensive review and revision of EN 300 401. This was undertaken by the TC Task Force Clean between February and June 2016 following the decision of the WorldDAB Steering Board to clarify and simplify the DAB system standard.

The aim of the work was to review the standard and identify the features that were obsolete, to clarify the description of features in order to aid interoperability, to incorporate changes that had been agreed in the interpretation of features and which were documented elsewhere and to update specific features.

This guide is aimed at providing guidance to equipment makers, both of transmission and reception equipment, and professional users of the DAB system to enable them to check and upgrade their technology in line with the changes to the standard.

The WorldDAB TC has also undertaken the creation of the DAB audio standard (identical to the definition in the previous DAB system standard) and the consequential changes to supporting TS documents to align them editorially with the new version of the system standard. The new versions of these standards have been published by ETSI and are available for download as follows:

- [EN 300 401 V2.1.1](#): DAB system standard;
- [TS 101 756 V2.1.1](#): Registered Tables;
- [TS 103 466 V1.1.1](#): DAB audio;
- [TS 102 563 V2.1.1](#): DAB+ audio;
- [TS 102 980 V2.1.1](#): DL Plus.

2 Summary of changes

Transmission modes

- Only Transmission mode I is retained; the other modes are obsolete

Audio

- The text describes the two audio coding methods, DAB audio and DAB+ audio. DAB audio coding is moved into TS 103 466, including annexes, but no technical changes have been made. The ASCTy definition is moved to the Registered Tables (TS 101 756).

Programme Associated Data

- F-PAD type "10" removed as obsolete
- Dynamic label editorially revised to incorporate the requirements for commands (including DL Plus commands) , but with no technical changes

Packet mode

- FEC for packet mode made mandatory for transmission
- Data Group CRC made mandatory for transmission

- Auxiliary Information Channel (AIC) removed as obsolete

Fast Information Channel (FIC)

- MCI signalling procedure and reconfiguration process clarified
- FIG repetition rates provided for all FIGs
- FIG 0/0 (Ensemble information): description of function of Alarm flag clarified and use of change flags for reconfigurations simplified
- FIG 0/6 (Service linking): description clarified in line with TS 103 176
- FIG 0/7 (Configuration information): additional MCI FIG for fast configuration checking
- FIG 0/8 (SCIDs): usage defined for primary service components containing data applications (and value fixed as 0) and for all secondary components
- FIG 0/9 (ECC and LTO): extension field simplified by removal of per service LTO; SIV use removed
- FIG 0/10 (date and time): long form made mandatory for transmission
- FIG 0/11 (Region definition): removed as obsolete
- FIG 0/12 (FIC redirection): removed as AIC is removed
- FIG 0/13 (User application information): changed from SI to MCI
- FIG 0/16 (Programme Number): removed as obsolete
- FIG 0/17 (Programme Type): language field removed as feature provided by FIG 0/5; second code removed; static/dynamic use clarified
- FIG 0/18 (Announcement Support): SIV use removed
- FIG 0/20 (Service Component Information): additional SI FIG for managing service lists (definition moved from TS 103 176)
- FIG 0/21 (Frequency information): Region Id and transmission mode signalling removed; DRM+ frequency signalling added
- FIG 0/22 (TII database): removed as obsolete; note that TII in the null symbol is unaffected
- FIG 0/25 (OE Announcement Support): new definition separating OE announcement feature from tuned ensemble announcement feature
- FIG 0/26 (OE Announcement Switching): new definition separating OE announcement feature from tuned ensemble announcement feature
- FIG 0/27 (FM Announcement Support): removed as obsolete
- FIG 0/28 (FM Announcement Switching): removed as obsolete
- FIG 1/3 (Region label): removed as obsolete
- FIG 1/4 (Service component label): restricted to secondary components only
- FIG 2/x (Extended labels): user defined character coding removed, maximum byte count reduced from 64 to 32, maximum segment count reduced from 8 to 2
- FIG 5/x (FIDC applications: Paging, TMC, EWS): removed as obsolete; note that TMC is carried in TPEG, EWS is supported by clearer Alarm Announcement functionality

3 Guidance for broadcasters

3.1 Introduction

For many broadcasters, the changes made to the DAB system standard will have few impacts. This is because the aim of Task Force Clean was to make sure that changes were mostly compatible with the way that DAB is actually used. However, to make the system work better, some changes need to be made to the multiplexing equipment of all broadcasters, whilst other changes will only be needed

if certain features are used. This section is therefore broken down into the essential changes for all, and for the other things to consider when deciding on the extent of the changes required.

3.2 Essential updates

Broadcasters do not need to make any changes in regard to transmission mode, audio coding or PAD (including dynamic label).

Some updates to multiplexing equipment are required for all broadcasters because of changes to the FIC. This is especially true for those that regularly use reconfiguration, although most of these changes are needed following the publication of TS 103 176 V1.2.1 in May 2016 which includes the definition of FIG 0/20 and clear rules on the use of FIG 0/8 and FIG 1/4 to help receivers manage service lists more elegantly.

The new EN 300 401 introduces clearer rules on MCI repetition. Reconfiguration signalling has also been simplified and so all broadcasters need to update their multiplexing equipment. The changes are fully backwards compatible - i.e. the new signalling can be implemented as soon as it is available from the multiplexer manufacturer. Manufacturers are aware of the changes to both TS 103 176 and EN 300 401 and are working on software updates. Therefore, broadcasters should talk to their equipment manufacturer about availability.

FIG 0/7, a new MCI FIG, has been introduced. With the agreement of transmission equipment manufacturers, it has been decided to use the transmission of FIG 0/7 as an indication that the ensemble is fully compatible with the revised EN 300 401 V2.1.1. This will allow receiver algorithms to be tailored to take advantage of more precise rules of behaviour specified in the new version of the DAB system standard. When all aspects of the ensemble encoding are in line with EN 300 401 V2.1.1, the transmission of FIG 0/7 should begin.

The signalling of date and time (using FIG 0/10) has also been simplified: if this is a user configurable setting then the long form needs to be selected. If this is not user configurable, then an update may be required to ensure the long form is used.

The signalling of user applications requires the provision of FIG 0/13. This FIG has moved from SI to MCI with the new EN 300 401. Providing the FIG 0/13 is already signalled in conformance with EN 300 401 V1.4.1 (i.e. the X-PAD field is provided for user applications in PAD) then in many cases the move from SI to MCI does not make much difference. However, given that some updates are in any case needed for changes to MCI signalling, this change should also be requested from multiplexer manufacturers.

3.3 Other updates

Some other features are updated or removed. Broadcasters may wish to review their use of Programme Type (FIG 0/17) in order to conform to the new rules of operation. This means not using the language field and providing only one PTy, which is chosen as *either* static *or* dynamic - previously both were permitted. The use of the complementary code is withdrawn.

If announcements are used, it should be noted that in the announcement support that the alarm bit cannot be set any longer because of the new definition and operation of the Alarm flag in FIG 0/0.

For packet mode sub-channels, the use of additional FEC is now mandatory. This is not expected to require any changes as this was already routinely applied. The mandatory use of the Data Group CRC flag means that data applications should be checked for correct encoding settings.

The generation of Frequency Information (FIG 0/21) should be checked, but it is unlikely that any changes will affect current broadcasters.

The signalling of removed FIGs should also be checked: Programme Number (FIG 0/16), TII database (FIG 0/22), Region definition (FIG 0/11, FIG 1/3) and FIDC (Paging, TMC, EWS).

Broadcasters with services from different countries using SIDs with different country codes may be using the extension field in FIG 0/9 to indicate different ECCs. The simplification of this FIG is unlikely to have any impact.

4 Guidance for transmission equipment manufacturers

4.1 Introduction

The changes made to the DAB system standard will have a different impact on different products in the transmission area and this section is designed to describe the changes that apply to each broad product category. Different architectures will result in the division of features varying from this list.

4.2 DAB Transmitters

Assuming that the transmitter has either an ETI or EDI input, the only requirements change is to the modulator which needs to provide only transmission mode I. Since many modulators have a transmission mode lock in place already, the change mainly affects future modulator designs.

4.3 Audio encoders

No changes are required to audio encoders. The changes to F-PAD (deletion of F-PAD type "10") is not thought to cause any issues since the features were not used. The redrafting of dynamic label does not constitute a technical change.

4.4 Multiplexing equipment

Different architectures exist and so this section deals with the multiplexing equipment as one product category, although the impact may be different in different individual units.

There are many changes to the FIC, both to MCI and SI FIGs, and some of these changes are in addition to the changes required to implement the outcome of the Service Lists Task Force, which was published as TS 103 176 V1.2.1 in May 2016, and includes the definition of FIG 0/20 and clear rules on the use of FIG 0/8 and FIG 1/4 to help receivers manage service lists more elegantly.

The changes can be implemented immediately, because the changes have been designed not to cause any negative impact on existing receivers, but will enhance the performance of new designs.

Broadcasters are being advised to talk to their equipment manufacturer about availability of updated multiplexing equipment.

In regard to MCI, the addition of FIG 0/7 (which permits receivers to quickly recognise when a configuration change has taken place since the last MCI check), clearer rules on MCI repetition and placement, inclusion of FIG 0/13 as MCI rather than SI, and the simplification of reconfiguration signalling, means that updates are needed to the way that MCI is generated. FIG 0/8 shall only be signalled for primary service components if they carry data applications, and the SCIDs for primary service components is fixed as 0. All secondary service components have FIG 0/8 signalled and it should be noted that the repetition rate is different for audio and data service components.

The signalling of reconfigurations is also updated: it has been common practice for some time to signal all the next MCI during a reconfiguration, and this behaviour is now mandatory. The previous guidance to signal the next configuration a minimum of three times is also changed to require the next configuration to be signalled, along with the current configuration, every 192 ms during the reconfiguration period. The placing of FIG 0/0 is mandated to be the first FIG of the first FIB of the transmission frame (although it is believed that all multiplexers do this anyway), with FIG 0/7 immediately following.

With the agreement of transmission equipment manufacturers, it has been decided to use the transmission of FIG 0/7 as an indication that the ensemble is fully compatible with EN 300 401 V2.1.1. This will allow receiver algorithms to be tailored to take advantage of more precise rules of behaviour specified in the new version of the DAB system standard. When all aspects of the ensemble encoding are in line with EN 300 401 V2.1.1, the transmission of FIG 0/7 should begin.

The signalling of date and time (using FIG 0/10) has also been simplified to require that the long form is always used. If this is a user configurable setting then either the long form needs to be forced, or the setting needs to be removed from the user's control.

Some other FIG features are updated or removed: depending on the architecture, these may be part of the multiplexing equipment or may be supplied from another product.

Programme Type (FIG 0/17) has been simplified and new rules of operation have been written to ensure that only one PTy is valid for each service at any one time. This means the language field and the complementary (second) PTy code have been removed, and the PTy can now be *either* static *or* dynamic - previously both were permitted.

If announcements signalling is provided, it should be noted that in the announcement support (FIG 0/18) that the alarm bit cannot be set any longer because of the new definition and operation of the Alarm flag in FIG 0/0. The operation of the Alarm feature is redesigned: the Alarm flag in FIG 0/0 is designed to enable or disable alarm announcements for ALL services in the ensemble and obviates the need for FIG 0/18 for each service for alarm announcements. If other announcement types are provided, then FIG 0/18 is needed. In addition, new definitions are provided for OE announcements with FIG 0/25 and 0/26. OE alarm announcements use the same enable/disable feature provided by FIG 0/0. Additional work is underway in TF-Announcements to provide detailed rules of operation for announcements which will be documented as an additional clause in TS 103 176.

For packet mode sub-channels, the use of additional FEC is now mandatory. This is not expected to require any changes as this was already routinely applied. The mandatory use of the Data Group CRC flag means that data applications should be checked for correct encoding settings and user controls should be adjusted to prevent incorrect settings.

The generation of Frequency Information (FIG 0/21) should be checked, but it is unlikely that any changes will affect current broadcasters. Again, user controls may need adjusting because of the removal of transmission modes II, III and IV impacts the signalling of DAB frequencies.

Broadcasters with services from different countries using SIDs with different country codes may be using the extension field of FIG 0/9. If the extension field has been implemented to indicate services with different LTOs and ECCs, then the simplification of this FIG will need to be included - FIG 0/9 without the extension field is unaffected.

The coding of FIG 2 labels, to provide non-Latin language support, has been simplified and clarified. If generation of FIG 2 labels is already implemented, the reduction in the size of the character field to a maximum of 32 bytes and the reduction of the segment count to two should be implemented.

The signalling of removed FIGs should also be checked: Programme Number (FIG 0/16), TII database (FIG 0/22), Region definition (FIG 0/11, FIG 1/3) and FIDC - Paging, TMC, EWS (FIG 5/0, 5/1, 5/2).

5 Guidance for reception equipment manufacturers

5.1 General

The changes made to the DAB system standard will have a similar impact on all receiver products, although different architectures may affect the precise updates required. Manufacturers are advised to review the list of changes to the DAB system standard against their receiver implementation to understand potential impact to receiver performance. While due diligence has been applied to ensure no existing implementations are affected by the changes to the DAB system standard, various features received technical changes, so that transmissions conforming to the new version might reveal non-conformant implementations.

5.2 Legacy transmissions

Because transmissions conforming to EN 300 401 V1.4.1 will continue on-air for a transition period, receivers will continue to need to deal with some deprecated features and signalling that is now considered to be for legacy implementations only. These requirements continue to exist in the DAB system standard and are suitably marked. Some previous FIG features that have been deprecated now have Rfa or Rfu bits which previously had defined functions: newly designed receivers do not need to implement the old functions but they must respect the Rfu bits as with all other definitions.

5.3 Removed features

Most of the changes to the DAB system standard remove features that were unused in transmissions and/or which were largely unimplemented in receivers. These features are deprecated and should not be supported by receivers. Receivers may safely discard or ignore deprecated FIGs; services using deprecated transmission or transport methods shall be ignored.

5.4 New features

Work in WorldDAB Task Force Service Lists resulted in the definition of FIG 0/20 and revised behaviour for FIG 0/8 and FIG 1/4. This affects in particular the identification and labelling of the primary service component. An extensive rule-set for service list management has been devised for dealing with FIG 0/20; manufacturers are advised to study the signalling options for ahead-of-time updates to the service list.

Task Force Clean has resulted in new definitions for FIG 0/7 (to help with rapid recognition of changes to ensemble configurations), and FIG 0/25 and 0/26 (for OE announcements). The function of the Alarm flag in FIG 0/0 has also been clearly defined and consequently the behaviour of receivers for alarm announcements will change. The detailed rules of behaviour for all kinds of announcements are yet to be documented, but an additional clause in TS 103 176 is planned.

5.5 Planning new products

When planning new DAB receiver products, manufacturers should ensure full compatibility with the new version of the DAB system standard (ETSI EN 300 401 V2.1.1). The updates to related TS

documents also need to be taken into account and so manufacturers should download the new versions from the ETSI website (links in section 1).

Manufacturers should look to implement decoding of the new and clarified FIGs as soon as possible and to take advantage of the improvements they offer for receiver features and performance. This includes the definition of the alarm flag in FIG 0/0, and the support for associated alarm announcements; the potential performance enhancements from support of Configuration Information (FIG 0/7) in scanning and service acquisition situations. It is recommended that support for extended labels (FIG 2/x) is added to support non-Latin languages. It is recommended to support service list management functions provided by Service Component Information (FIG 0/20). Automotive receivers may provide added user-value by support of OE Announcements (FIG 0/25, FIG 0/26).

Support for removed features may be removed from receiver implementations; manufacturers should ensure that no reliance on now deprecated features is present that could cause malfunctions or performance degradations in situations where these features are not present in transmissions.

Manufacturers planning migrating existing receiver implementations to new products are advised to study the various aspects of the new DAB system standard that received technical changes, points of particular interest are outlined in the following list:

- MCI signalling and the reconfiguration process have been modified. In particular reconfiguration types have been removed. FIG 0/13 has been changed to MCI. New receivers may take advantage of improved performance, but need to retain backwards compatibility with legacy transmissions.
- Configuration and identification of service components. The designation of the primary service component has been clarified together with the use of FIG 0/8. Implementations should be reviewed against the new DAB system standard to identify ambiguities. Note that in the new DAB system standard FIG 0/8 is not signalled for a primary service component unless it carries a data application. Assignment of labels to service components has been clarified; receivers shall only use and store properly assigned labels.
- The language field from FIG 0/17 has been removed. Receivers with support for language identification should evaluate FIG 0/5. Furthermore the option to support several Programme Types has been removed; services will now have at most one PTy code, either static or dynamic.

The SIV feature has been removed from the following two SI features.

- Country, LTO and International Table (FIG 0/9): all information for the entire ensemble is carried in a single FIG. The provision of a per-service LTO has been deprecated, receivers should use the ensemble LTO for all carried services.
- Announcement Support (FIG 0/18): all announcement support (ASu) information for one service is contained in one FIG. It shall be noted that several FIG 0/18 groups may be present providing ASu information for different services. Receivers shall identify different ASu FIGs by the SId field. The provision of ASu information for other ensembles has been deprecated.

The SIV feature provides a segmentation of available information into databases and a change detection mechanism. New receivers may safely ignore information provided in deprecated database segments, e.g. for other ensembles. While the information for the above two features is generally considered static, legacy transmissions might provide the change event signalling to signal

a time-variant ensemble configuration. New receivers are recommended to ignore the CEI signalling for FIG0/9 and FIG0/18.