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TECHNICAL SPECIFICATION

**Digital Audio Broadcasting (DAB);
Emergency Warning System (EWS);
Definition and rules of behaviour**

Reference

DTS/JTC-DAB-110

Keywords

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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) 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.

1 Scope

The present document defines an Emergency Warning System (EWS) for DAB which features an additional FIG for signalling the identity, status and location of an emergency with the ability for suitably equipped receivers to wake from a low-power sleep mode to provide an audio alert message targeted to the specific geographical area of concern.

The rules of implementation ensure that a reliable and consistent experience will be delivered for digital radio listeners; they provide implementation details for how the Fast Information Channel (FIC) signalling is used and how receivers will interpret and behave in response to receiving the FIC signalling.

The present document is complemented by ETSI TS 104 090 [i.1], which sets out the testing required to be performed on receivers to demonstrate conformance to correct operation.

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".

2.2 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] ETSI TS 104 090: "Digital Audio Broadcasting (DAB); Emergency Warning System (EWS); Minimum requirements and test specifications for receivers".

[i.2] OASIS Standard: "Common Alerting Protocol, V1.2, 01 July 2010".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

alert: information about a situation or incident with the potential of affecting life and well-being of humans

alert area: geographic area to which an alert applies

alert audio: short audio element containing information about an emergency situation

alert group: collection of FIG 0/15 instances that comprise the Trigger phase signalling for all simultaneous alerts

alert message: alert audio and optional associated multimedia data service components describing the emergency situation

alert set: collection of FIG 0/15 instances that comprise the Trigger or Pre-trigger phase signalling for one alert

Change Event Indication (CEI): set of FIG fields with particular values to indicate a change of database content for certain service information features

database entry: part of the service information addressed by a database key

database key: set of FIG fields that sub-divide a database for certain service information features

Emergency Warning System (EWS): infrastructure forming a signal chain to provide emergency warnings to the general public

incident: cause and subject of one or several alerts, possibly long-lived and evolving over time

ongoing alert: alert that is no longer providing switching information

power mode: power-on state of a receiver

NOTE: Power modes are "sleep", "monitor" and "audio".

tuning memory: information stored in a receiver from previous tuning actions providing details of ensembles, tuning frequencies and services

service list: feature of a radio receiver where a list of service elements is used for service selection

synchronized alert message: alert message timed to enable sleeping receivers to respond at the beginning of the alert message

NOTE: These alert messages start when the seconds count is 0.

tracked incident: incident that is recognized from the source data, either directly or indirectly, and so can support user controls for alert dismiss

user controls: all elements of a user interface of a radio receiver that are used to display service information and provide for user control

3.2 Symbols

Void.

3.3 Abbreviations

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

C/N	Current/Next
CEI	Change Event Indication
DAB	Digital Audio Broadcasting
EId	Ensemble Identifier
EWS	Emergency Warning System
FIB	Fast Information Block
FIC	Fast Information Channel
FIG	Fast Information Group
Id	Identifier
IId	Incident Identifier
MCI	Multiplex Configuration Information

OE	Other Ensemble
P/D	Process/Discard
SId	Service Identifier
SIV	Service Information Version

4 Overview

4.1 Introduction

Emergency warning systems take many forms, originating with the ringing of bells, messages from town criers and activation of warning sirens. In the modern age with extensive communication networks seemingly providing endless connectivity, it is easy to forget that natural disasters often play havoc with infrastructure that is not specifically designed to withstand the onslaught.

Alerting the public to situations that represent a danger to health and well-being has long been a feature of broadcasting - the reach and immediacy of the medium, particularly the radio medium which is consumed both in the home and workplace, and on the move - along with generally high levels of trust, particularly for public service media, and very high reliability, make radio an excellent platform for alerting the public.

The DAB EWS defined in the present document provides an effective way to provide a critical public warning function by utilizing the inherent reliability of DAB transmission infrastructure.

The DAB EWS provides alert messages which consist primarily of audio information about the nature and extent of the emergency and instructions on how to react. The alert message may also include textual information, as the dynamic label, and optionally additional multimedia content when linked to the audio service. The alert message can be targeted to a specific geographic area such that receivers within the signalled alert area will respond, even when tuned to other DAB services, other media or when in a very low-power sleep mode, yet receivers outside the signalled alert area will not respond, allowing the user to continue with their chosen activity.

The source and format of emergency information that feeds into the DAB EWS is outside the scope of the present document. It is expected that the source information for the alert messages will come from an appropriate safety authority, and that the services that carry the alert messages will be managed by appropriately trained and authorized providers. The DAB EWS works best when all DAB ensembles participate in the system. The design makes that straightforward because communication between ensembles is provided over-the-air to permit the relaying of EWS signalling.

4.2 System architecture

The DAB EWS consists of one or more DAB ensembles that carry specific signalling that both identifies the ensembles as participating in an EWS and also provides the signalling information to allow receivers to respond. Some ensembles will carry services that provide emergency alert messages, whilst others will carry only signalling information to redirect receivers to the ensemble carrying an alert message.

In order for the geographic filtering to work, every receiver needs to know where it is. The DAB EWS is designed to use a specifically designed location coding system that is light weight and highly efficient. It allows the user to provide the receiver with its location when it is set up. More sophisticated receivers may be able to derive their location themselves, for example using a wireless link, a GNSS receiver, or some other means. The location coding system permits even the simplest receiver to be able to determine if it is in or out of an emergency alert area by a simple comparison of integers. An example of the use of location codes to describe and alert area is given in annex C.

The content of the alert messages is not standardized but will typically include a description of the geographic area affected, the nature of the emergency and instructions on what to do and when to expect changes. Alert messages will be heard both by listeners who were already listening to the service before the alert message began and by those who have been redirected to it. The content of the alert message should therefore be crafted to take account of these different audience segments.

Because an emergency situation will generally develop over time, each incident is likely to consist of a number of alert messages. This sequence of messages can be linked together using an identifier, and this linking permits receiver manufacturers to offer user options to restrict responding to alert messages in specific ways, for example, not playing an alert message that has already been heard. These user options will only be available for a particular incident if the signalling permits it.

To reduce the chances that portions of alert messages will be missed by receivers that have a very low-power sleep mode, the DAB EWS requires that receivers are synchronized to DAB time. This means that all sleeping receivers will check for emergency alerts at the same time, every minute. Therefore, the system performs best when alert messages begin when sleeping receivers are checking for alerts. The system is optimized for this mode of operation.

4.3 Receiver behaviour

The required receiver behaviour is defined in clause 7 of the present document. Manufacturers are able to check that their products conform to the requirements by performing the tests specified in ETSI TS 104 090 [i.1].

5 EWS ensembles

5.1 Baseline requirements

An ensemble that participates in an EWS shall conform to the requirements of ETSI EN 300 401 [1]. It shall signal the date and time using FIG 0/10 in the long form. The date-time information provided in FIG 0/10 shall be accurate, which requires connection to a reliable source of real-time, such as GNSS or NTP. The time signalled by FIG 0/10, known as ensemble time, shall be the basis for all EWS signalling, which uses FIG 0/15.

The participating ensemble shall provide FIG 0/15 (see annex E) in order to signal the status of alerts in the ensemble and in other ensembles, as defined in clause 6.6. The content of the FIG 0/15 shall be appropriate to the alert requirements. When no alert messages are being signalled, the ensemble signals its participation in an EWS with FIG 0/15 heartbeat signalling.

The P/D flag in the type 0 header of FIG 0/15 is used for fine synchronization of receivers with a sleep function. The P/D flag of FIG 0/15 shall be set to 0 (Process) for every FIG 0/15 sent when the ensemble time has a seconds count of 0 to 29 and shall be set to 1 (Discard) for every FIG 0/15 sent when the ensemble time has a seconds count of 30 to 59. The null symbol of the transmission frame provides the time reference for the time carried in FIG 0/10 (see ETSI EN 300 401 [1], clause 14.3.3). All the 12 FIBs of a transmission frame shall be considered to relate to the same time reference (i.e. the seconds count for FIG 0/15 is the seconds value of the time reference).

An ensemble that provides alert messages shall provide FIG 0/15 signalling for each alert message it carries.

A participating ensemble that overlaps the coverage area of another participating ensemble shall provide FIG 0/15 signalling for every alert message in the overlapping other ensembles.

5.2 Information sources

An EWS ensemble that carries alert messages takes responsibility for the content and status settings of alert messages. The source or sources of information that are used to create an alert message and its signalling are not defined by the present document, but the following types of information are typically required:

- alert area;
- severity of alert;
- description of the current event;
- recommended actions;
- timeframe for development.

The ensemble shall make available the information about an alert message to other EWS ensembles with overlapping coverage areas. The present document defines a standardized way for the information exchange to take place using the FIC, but other methods are also permitted.

An EWS ensemble that provides signalling of alert messages in other ensembles shall use the information provided by the EWS ensemble that carries the alert message. This may be done by receiving and processing the FIC of the ensemble that carries the alert message, or by another method.

5.3 Receiver considerations

Ideally, all ensembles covering a particular location will participate in the DAB EWS. However, it is recognized that there may be reasons why this does not happen. The services carried in ensembles that do not participate should not be excluded from the receiver's service list, but the user shall be made aware when tuned to such services if the EWS function is inoperable (e.g. if the receiver has only a single tuner).

6 Alert signalling

6.1 Introduction

The need to signal emergency warning alerts is unpredictable, and it is possible for there to be different incidents occurring in the same geographical location at the same time. However, although these incidents may be simultaneous, only one alert message can be carried in an ensemble at a time: therefore management of the timing of the alert messages is needed.

Alert messages are carried in one ensemble but shall be signalled in all ensembles that participate in the EWS that provide coverage of the alert area. Since receivers can only play back one alert message at a time, consideration should be given as to whether coordination of alerts amongst ensembles is needed, and if so, how such coordination is managed. Such considerations are outside the scope of the present document. The signalling rules and receiver behaviour rules mean that receivers will play an alert in the tuned ensemble in preference to any alerts in other ensembles that are signalled at the same time.

A given ensemble may have more than one incident active at any given time, but it shall have only one alert message active at a time. It may signal one or more alerts that are occurring in other ensembles at any time, including when it is signalling an alert message of its own.

Alert providers have complete editorial freedom in the composition of the alert message and are encouraged to provide dynamic labels alongside the audio. SlideShows and other multimedia content is also possible, although the likely short duration of the alert message should be considered when allocating bitrate to such additional features.

The impact and intelligibility of an alert message is likely to reduce if users connect to it part-way through. For this reason, alert providers are able to indicate at which point after the first 5 seconds of the alert message that receivers will no longer evaluate it for selection.

Domestic EWS receivers are designed to respond to certain alerts even when they are in a low-power sleep state. To minimize power consumption, such receivers only monitor the DAB signal once per minute. In order to ensure that alert messages can be heard in full, even by sleep state receivers, the EWS has been designed to use real time to synchronize the evaluation of alerts by sleep state receivers.

This means that all receivers use the time, as provided by FIG 0/10, to set their monitoring cycle and all receivers will be ready to evaluate EWS signalling at the beginning of every minute, i.e. when the seconds count is equal to 0. Alert providers are therefore strongly encouraged to begin their alert messages at the very beginning of the minute in order that the maximum population of receivers will react and play back the entire alert message: these alerts are termed **synchronized alerts**.

Not all alert messages may be deemed of sufficient severity to wake-up receivers that are in a sleep state. Alerts are classified into two severity levels: Level 1 alerts are evaluated by all receivers, whereas Level 2 alerts are only evaluated by receivers that are awake.

The EWS system allows alert messages to begin at any time and receivers that are awake and tuned to an EWS ensemble, or which have an additional tuner to monitor other ensembles within the alert area, will respond in a timely way. However, receivers that are in a sleep state will only respond at the start of each minute to Level 1 alerts that are providing the necessary signalling: they will ignore all Level 2 alerts.

6.2 Source data

6.2.1 Introduction

The data for an EWS may come from many different types of agency. There may be a single national emergency centre, or there may be multiple agencies providing different kinds of data concerning weather events, security events, industrial accidents, etc. Wherever the data come from, they need to include sufficient detail for the composition of a coherent audio message and to set the values of the various data fields in the FIG 0/15 signalling.

Emergency situations tend to develop over time. After a situation has been reported initially it may evolve and warrant further alert messages over the course of several hours or days.

Different users will react differently to the content of the alert messages: for some, the information is very relevant and they will want to follow every development; for others, the information may be considered not relevant at some point due to particular circumstances. Provision is therefore made to allow users some control over the way that their receiver evaluates alerts. This provision comprises two parts: the Stage and the Incident Identifier. The Stage is used by the alert provider to signal the severity and development of the incident; the Incident Identifier to link together all the alerts that comprise a single incident.

Emergency situations are relevant to a specific geographical area and provision is made to provide alert area information to allow receivers to respond to relevant alerts. When alert area information is provided, receivers outside the alert area will not respond to the signalling.

6.2.2 Incident identification

The ensemble that carries an alert message is responsible for setting the Incident Identifier.

It is expected that in some cases, the source data will provide a reliable source of incident identification and the alert provider can use this information to allocate and maintain the Incident Identifier. In other cases, the alert provider may be able to use contextual information from the source data to associate different alerts to the same incident and so allocate and maintain the value. For these cases, known as **tracked incidents**, each subsequent alert provided for the same incident shall have the same Incident Identifier, and all stages (except ***Test***) can be assigned to a particular alert.

Each ensemble can have a maximum of 16 **tracked incidents** due to the limit of the signalling. If all 16 values of the IId have been allocated and a 17th incident begins, the alert provider shall decide which of the existing incidents shall cease to be tracked and the IId used for that incident shall be reused.

If alerts cannot be associated to an incident, then the Incident Identifier shall be assigned an arbitrary unused value, and each alert shall be signalled using only the stages ***Level 1 Start*** or ***Level 2 Start***.

6.2.3 Incident stage

When incident identification is supported by the alerting ensemble, users may be able to instruct their receiver to ignore alerts which are signalled as a repeat or update of an ongoing incident. This may be an appropriate action if the user considers that whilst the alert is geographically close to them, they are not in danger, for example, by being on high ground despite a localized flooding incident.

An incident may develop such that its severity decreases or increases, and provision is made to allow alert providers to control the response of the receiver. Typically, all receivers within the alert area will be targeted, regardless of the power state of the receiver, but an incident may develop in such a way that using the wake-up function is seen to be overly invasive. Alternatively, the incident may develop such that it is imperative to ensure that all receivers will evaluate the alert.

To support user functionality and different levels of alert severity, the stage of the alert is signalled. Incidents begin at ***Level 1 Start*** if they are targeted at all receivers, or ***Level 2 Start*** if they are targeted at only those receivers that are already outputting audio. The Incident Identifier associated with this ***Start*** stage is then used for all subsequent alert messages for this incident. When a ***Start*** stage is received, receivers clear the alert user controls for that Incident Identifier. Incidents may move between ***Levels*** as they develop.

An alert provider may use a ***Repeat*** stage to indicate that the same information has already been provided by the previous alert message associated with this Incident Identifier. Receivers with user control functionality can then identify repeated alert messages.

An alert provider may use an ***Update*** stage to indicate that new information about an incident that is ongoing is contained in the alert message. Receivers with user control functionality that permits entire incidents to be skipped can then act appropriately.

The choice of whether a ***Repeat*** stage or ***Update*** stage is appropriate to an ongoing incident is an editorial decision by the alert provider, but whenever the information about an incident changes, the ***Update*** stage should be signalled.

The ***Level 1 Critical*** stage overrides all user alert controls and ensures that the alert message is evaluated by all receivers, regardless of their power state. However, it does not clear the user alert controls: for this function the ***Level 1 Start*** stage is used.

EXAMPLE 1: An unexploded wartime bomb is discovered during construction of a new building. The device is found in the early afternoon. After examination by police and bomb disposal experts, it is decided to evacuate only a part of the city, but to inform the whole city as traffic disruption will result. The first alert of the incident is signalled as ***Level 1 Start*** with location codes covering the whole city. As the situation develops and more knowledge is gained, alerts at stages ***Level 1 Update*** and ***Level 1 Repeat*** are signalled. Listeners that feel they are not affected - because they live in another part of the city and do not plan to leave their home for a while - can use the dismiss function of their receiver to stop further interruptions. As night falls, the incident is still ongoing, but the majority of city inhabitants have been informed and so know to stay away from the evacuation area. It is decided at 21:00 to only provide alerts to those already listening to the radio, whichever service they choose, and so subsequent alerts are signalled using ***Level 2 Update*** or ***Level 2 Repeat*** stages. At 07:30 the following morning, further checking of the site by bomb disposal experts reveals a second device. It is decided that this warrants a change back to alert all receivers, even those whose owners had dismissed the incident, and so an alert is signalled using the ***Level 1 Critical*** stage. After two hours, the decision is taken to move to ***Level 2*** alerts again.

EXAMPLE 2: In a low mountain range, the weather forecast predicts heavy rainfall for the next 3 days. There is a risk of local flooding. In the following days, the radio warns about the upcoming weather situation as part of the normal news broadcasts without EWS signalling. The population is called upon to pay greater attention.

Towards midday on the third day it becomes clear that the heavy rainfall will lead to widespread flooding, particularly in settlements at the confluence of side valleys. The first alert for this weather event occurs at 15:00, signalled as ***Level 1 Start*** with location codes that include the affected settlements. As precipitation continues to increase, several ***Level 1 Update*** and ***Level 1 Repeat*** messages are sent. Towards the evening, the weather situation seems to ease somewhat, and further alert messages use ***Level 2 Update*** and ***Level 2 Repeat*** stages. Evacuations have so far only been necessary in a few parts of the affected settlements and have taken place in good time before localized flooding occurred.

At 02:00 the threat situation suddenly increases dramatically. Several water waves enter a reservoir at the same time, and a technical failure of a weir gate together cause the water level in the reservoir to rise dangerously. There is imminent danger of a dam bursting, which would result in a 10 m-high flood-wave downstream. A new alert message is issued for the immediate evacuation of the endangered valleys as ***Level 1 Critical*** and with a significantly expanded alert area using a bigger location code set. There is a risk of widespread flooding along all downstream valleys, which could result in numerous deaths. The situation remains very critical for the next 10 hours, and all alert messages are issued and repeated at regular intervals as ***Level 1 Critical***. The situation is later mitigated as it becomes possible to reduce the water pressure in the reservoir by controlled release of water. Once this is complete, further alert messages are signalled as ***Level 2 Update*** and ***Level 2 Repeat***, which provide further information about the current status of the danger until the situation changes back to normal.

EXAMPLE 3: At around 21:00, simultaneous suicide terror attacks take place at three entrance gates to a fully occupied football stadium. Initially, a ***Level 1 Start*** message with location codes for the area of the stadium and the immediate surroundings is sent. It reports the current situation and asks the population to avoid the area around the stadium or to remain in the stadium until further notice. The developing situation in the area around the stadium is then reported at short intervals of a few minutes as ***Level 1 Update*** or ***Level 1 Repeat*** messages with unchanged location codes.
At 21:20, in another, more distant part of the city, further attacks take place at the same time in several places, including a theatre. For these new events, the authority triggers a new warning ***Level 1 Start*** message with location codes that match these attack locations. Since a direct connection to the previous events at the football stadium is not immediately apparent, the new warning message is sent under a different **Incident Id**. Here too, ***Level 1 Update*** or ***Level 1 Repeat*** messages are sent out at regular intervals as the situation develops.
As the night progresses, more terror attacks occur at various locations in the city, making it clear to the authorities that all the events are connected. Therefore, the next warning message is sent as ***Level 1 Start*** using a new **Incident Id**, and with location codes that cover the entire city area. The following alert messages are sent as ***Level 1 Update*** and ***Level 1 Repeat***. As the situation eases, further warnings are sent as ***Level 2 Update*** and ***Level 2 Repeat*** until the warning situation has reduced to such an extent that alert messages no longer need to be sent. A final ***Level 2 Update*** message is issued informing the population that there is no longer an immediate risk of attacks, but that they should continue to remain vigilant.

An additional stage, the ***Test*** stage, may be used to indicate that the alert message is part of a test exercise for special receivers. These alerts are not evaluated by consumer receivers.

6.2.4 Alert area

By default, the alert area is the entire coverage area of the ensemble carrying the alert message: in this case no location codes are signalled. However, a specific alert area can be signalled by including location codes. To permit complex alert areas to be signalled, multiple location codes can be provided: the alert area is the sum of all the areas described by the set of location codes signalled. There is a limit to the total number of location codes that can be provided for an alert, which is limited by the maximum number of bytes that the location codes can occupy in a single FIG 0/15 instance and the maximum of four FIG 0/15 instances that are permitted in an alert set. The alert area provided in the source data has to be transformed from its incoming format to the DAB location code format and within the limits of capacity. Annex D provides a generic method to make the transformation.

6.3 Forms of FIG 0/15

6.3.1 Introduction

FIG 0/15 is used for all aspects of signalling the EWS. The definition of the structure of FIG 0/15 is given in annex E. The P/D flag shall be set according to clause 5.1.

An alert message is carried in one of the subchannels of the ensemble. The audio content of the alert message, the timing and the setting of all the control and information fields of the FIG 0/15 signalling is the responsibility of the alert provider and is derived from the incoming alert source data. Other ensembles that also carry signalling for the same alert derive the timing and setting of all the control and information fields of their FIG 0/15 signalling from that given by the alert provider, either through an EWS management system or from off-air monitoring.

The signalling of an alert message has four phases, although some phases may be omitted in specific circumstances. The phases are as follows:

- **Pre-trigger:** may be used to deliver alert signalling to other ensembles, not evaluated by consumer receivers;
- **Trigger:** used to provide the identity, status and location information of the alert so that receivers can evaluate whether the alert message shall be played;
- **Sustain:** used to signal the continuation of the alert message after the Trigger phase has ended;
- **End:** used to signal the end of the alert message.

For other ensembles, only the Trigger phase signalling is provided.

When there are no alerts active in the ensemble and no alerts in Trigger phase in other ensembles with overlapping coverage areas, the "no alert" form, known as the **Heartbeat**, is signalled.

6.3.2 Heartbeat form

In the Heartbeat form, the type 0 field of FIG 0/15 is empty.

6.3.3 Trigger form

In the Trigger form, the type 0 field of FIG 0/15 contains the Id field and the Status field and may contain a number of Location codes.

Up to four FIG 0/15 instances of the Trigger form may be used to fully describe the alert area: the content of the Id field and Status field (except for the Last flag) shall be identical for each instance. Collectively these instances are known as an **alert set**.

6.3.4 Pre-trigger form

The Pre-trigger form may be used for inter-ensemble communication. It is identical to the Trigger form except for an additional field to define the start second.

6.3.5 Sustain and End form

In the Sustain and End form, the type 0 field of FIG 0/15 contains the Id field only.

6.4 Describing an alert message carried in the ensemble

6.4.1 Introduction

Signalling is used to provide Trigger phase information that allows receivers to evaluate whether the alert message shall be played. Trigger signalling is provided for a minimum of 5 seconds for every alert.

Alert providers can decide the point where receivers will stop evaluating whether an alert will be played. At this point, the signalling changes from Trigger phase to Sustain phase.

At the end of the alert message, End phase signalling is provided.

To permit other ensembles to provide correctly timed OE Trigger phase signalling, Pre-trigger phase signalling may be provided. Alternatively, an EWS management system may be used.

6.4.2 Id field

The Id field contains the 2-bit phase field and the 6-bit SubChId field. It is present for all signalling phases. For the "Pre-trigger" phase only, it contains two additional fields, the 2-bit Rfa field and the 6-bit Sec field.

The Phase field shall indicate the phase of the alert.

The SubChId field shall indicate the subchannel in the ensemble that carries the alert message. If the subchannel is introduced in a reconfiguration preceding an alert, the reconfiguration shall be completed by the time the Trigger phase signalling starts.

The Rfa field, when present, shall be set to 0.

The Sec field, when present, shall indicate the seconds count at which OE Trigger phase signalling shall start. The special value 63 shall be used to indicate an alert starting at seconds count 0 with a Trigger phase duration of 5 seconds.

6.4.3 Status field

The Status field shall only be present when the Phase field is set to "Pre-trigger" or "Trigger".

The Status field contains the Last flag, the Stage field and the Incident Identifier (IId) field.

The Last flag provides a control function and is not part of the alert information: it shall be set according to clause 6.6.

The Stage field indicates the stage of an incident. The first alert of an incident shall set the stage to either ***Level 1 Start***, which targets all receivers, or ***Level 2 Start***, which targets only receivers already outputting audio.

If the alert is part of a tracked incident, then subsequent alerts for the same incident, identified by the IId, may set the Stage field to any value except ***Test*** (see clause 6.2.3).

The Stage field is also used to indicate a test alert: the stage ***Test*** shall only be used for specific test activities.

The Incident Identifier (IId) provides the reference to an incident. The IId shall remain constant throughout the entire lifecycle of the incident as it permits receivers to provide users with options to ignore repeated and/or updated alert messages in an ongoing incident. The ensemble provider shall manage the use of IIds in the ensemble (see clause 6.2.2).

The Incident Identifier has no meaning for test alerts and may be used as private data by the test provider.

6.4.4 Location codes

Location codes shall only be present when the Phase field is set to "Pre-trigger" or "Trigger".

The alert area is signalled using zero (complete ensemble coverage area) or more location codes, as defined in annex F. Location codes are of variable length. Location codes shall occupy a maximum of 25 bytes in any given FIG 0/15 instance. An alert area may require between one and four FIG 0/15 instances to describe, known as an **alert set**.

The FIG 0/15 coding of location codes allows for efficient transport by the use of sub-coding: the translation of an alert area into a set of location codes that fulfil the limit of four FIG 0/15 instances is illustrated in annex D.

The NFF field is not part of the location code but is used to help receivers determine the completeness of the **alert set**; the last FIG 0/15 instance in an **alert set** has NFF = 0.

6.5 Describing an alert message in other ensembles

6.5.1 Introduction

Other ensembles signalling is used to provide Trigger phase information that allows receivers to evaluate whether the alert message in the other ensemble shall be played.

Only Trigger phase signalling is provided for alerts in other ensembles with coverage areas that overlap the coverage area of the ensemble. The information to generate the Trigger phase signalling may come from an EWS management system or it may come from off-air monitoring device(s) tuned to other ensembles and decoding their Pre-trigger and Trigger phase signalling.

An ensemble that monitors the signal of another ensemble can use the received Pre-trigger phase FIG 0/15 information, when available, to construct the FIG 0/15 OE signalling and provide it from the seconds count indicated in the Sec field. OE Trigger phase signalling shall continue to be provided whilst Trigger phase signalling for the alert is being received.

> NOTE: Due to processing delays, OE Trigger phase signalling may be provided for a short period longer than the Trigger phase signalling in the ensemble carrying the alert message.

If an EWS management system is used, the information is provided by the management system ahead of time instead of providing Pre-trigger phase signalling and precise timing can be assured.

6.5.2 Id field

The Id field is set to the Ensemble Identifier (EId) of the ensemble that carries the alert message.

6.5.3 Status field

The Stage field and the Incident Identifier (IId) shall be set to exactly the same values as provided by the ensemble carrying the alert message.

The Last flag provides a control function and shall be set according to clause 6.6.

6.5.4 Location codes

The Location codes shall be set to exactly the same values as provided by the ensemble carrying the alert message.

6.6 Insertion rules for FIG 0/15

6.6.1 Introduction

The EWS provides a low-power monitoring function for receivers which is synchronized to real time. The insertion rules for FIG 0/15 are designed to allow receivers to evaluate alerts as efficiently as possible.

The nominal repetition rate of FIG 0/15 is all information once per second, but due to the variable number of simultaneous alerts at any given time, and the variable number of FIG 0/15 instances needed to signal each alert, the FIC capacity used by FIG 0/15 may vary considerably. One or more FIBs might be used per transmission frame to carry FIG 0/15, and these FIBs can contain one or more FIG 0/15 instances.

The timing of FIG 0/15 at the minute's edge is important as this is the time when sleeping receivers enter monitor mode. It is strongly recommended that transmission equipment ensures that FIG 0/15 is inserted into the first transmission frame that starts at or after the minute's edge in order to allow receivers in monitor mode to evaluate the alert situation as quickly as possible. More generally, inserting FIG 0/15 into the first transmission frame of each second is recommended.

A new alert message can only begin in an ensemble when there is no alert message already active; alerts may begin in other ensembles at any time.

Alerts may provide Pre-trigger phase signalling, which shall begin 5 seconds before the start of the Trigger phase signalling for the alert, to allow other ensembles to provide OE Trigger phase signalling from the start of the alert message.

Pre-trigger and Trigger phase signalling is provided using alert sets of between one and four instances of FIG 0/15.

At any given moment, there may be an alert message being carried in the ensemble (in either Trigger phase or Sustain phase), an alert message about to start (in Pre-trigger phase), an alert message just ended (in End phase), or no alert message at all. Similarly, in other ensembles with overlapping coverage areas, there may be one or more alert messages in Trigger phase that need signalling in this ensemble as OE alerts. Alerts in Trigger phase in the tuned ensemble and in overlapping other ensembles shall be composed into an **alert group**. The first **alert set** of the alert group shall be the alert set corresponding to the tuned ensemble (if it exists), with the alert sets from other ensembles following in any order. The alert group will be empty whenever there are no alerts in Trigger phase.

The alert group shall be composed at the start of each minute, and alert groups are generally composed at the start of each subsequent second, corresponding with the nominal repetition rate. However, for the first 5 seconds of any alert, the signalling of alert groups is continuous: in this case the next alert group shall be composed immediately after the final FIG 0/15 of the previous alert group has been signalled.

It is recommended to allocate sufficient space in the FIC for alert groups to be completely signalled in less than one second, but if this is not possible, for example when the number of concurrent alerts is high, the alert group may require more than one second to transmit: in this case the next alert group shall be composed immediately after the final FIG 0/15 of the previous alert group has been signalled. Once the alert group is able to be completely signalled in less than one second again, the composition of the alert group returns to the start of each second.

For every composed alert group, FIG 0/15 signalling shall be provided according to the rules described in this clause 6.6.

Examples of FIG 0/15 insertion are given in annex B.

6.6.2 Alert group is empty

When the alert group is empty it means that there are no alerts that require evaluation by receivers and consequently no Trigger phase signalling to provide (tuned or other ensembles).

If there is an ongoing alert message in the ensemble, then Sustain phase signalling shall be provided at a nominal repetition rate of once per second. The C/N flag shall be set to 1.

If an alert message has just ended, then End phase signalling shall be provided at a nominal repetition rate of once per transmission frame for 2 seconds. The C/N flag shall be set to 1.

If neither of these situations exists, then the Heartbeat form of FIG 0/15 is signalled at a nominal repetition rate of once per second.

In addition, if signalling is used for inter-ensemble communication and an alert message will begin in the ensemble, then Pre-trigger phase signalling shall be provided at a nominal repetition rate of the complete alert set once per second for three seconds and at an insertion rate of one FIG 0/15 instance per transmission frame. The Last flag of the last instance of FIG 0/15 of the alert set shall be set to 1; the Last flag of all other instances of FIG 0/15 of the alert set shall be set to 0.

6.6.3 Alert group is not empty

When the alert group is not empty it means that there are alerts that require evaluation by receivers and consequently Trigger phase signalling shall be provided (tuned and/or other ensembles).

Except when the seconds count is 59, the alert group shall be signalled completely.

When the seconds count is 59, alert group signalling shall be terminated **before the end of the second, regardless of whether the entire alert group has been signalled** to ensure that receivers entering monitor mode operate correctly.

The Last flag of the last instance of FIG 0/15 of the alert group shall be set to 1; the Last flag of all other instances of FIG 0/15 of the alert group shall be set to 0. The alert group shall be signalled at a minimum insertion rate of one FIG 0/15 instance per transmission frame.

In addition to the alert group signalling, the following signalling shall also be provided as required:

- if there is an ongoing alert message in the ensemble, then Sustain phase signalling shall be provided at a nominal repetition rate of once per second. The C/N flag shall be set to 0;
- if an alert message has just ended, then End phase signalling shall be provided at a nominal repetition rate of once per transmission frame for 2 seconds. The C/N flag shall be set to 0;
- if signalling is used for inter-ensemble communication and an alert message will begin in the ensemble, then Pre-trigger phase signalling shall be provided at a nominal repetition rate of the complete alert set once per second for three seconds and at an insertion rate of one FIG 0/15 instance per transmission frame. The Last flag of the last instance of FIG 0/15 of the alert set shall be set to 1; the Last flag of all other instances of FIG 0/15 of the alert set shall be set to 0.

NOTE: If Sustain phase or End phase is provided when the alert group is not empty, it means that only OE Trigger phase alerts are signalled.

6.7 Signal chain tests

If testing of the EWS is required in a similar way to a fire alarm drill, then the same kind of procedure for planning and informing the public is required so as not to cause unnecessary alarm. In this case an alert with the Stage field set to either ***Level 1 Start*** or ***Level 2 Start*** shall be used, with the alert message describing clearly that this is a test.

To permit testing of the EWS without causing consumer receivers to respond, a test alert message can be provided.

The Stage field shall be set to ***Test*** with all other fields set as required.

Since the test message will be carried in a normal service component (even if carried in a temporary service), the test message will be selectable for listening on consumer receivers, but consumer receivers will not evaluate the test message as an alert.

7 Receiver behaviour and response

7.1 Receiver types

It is envisaged that the addition of EWS functionality in a receiver does not reduce the design options manufacturers may use. Therefore, many types of receivers are feasible. The minimum requirements for receivers are the subject of ETSI TS 104 090 [i.1].

Different types of receivers will have different operating models and capabilities. Whenever the EWS signals location codes to describe alert areas, receivers need to know their location in order to determine if the alert is relevant: the method by which the receiver acquires and maintains its location is not defined, but as a minimum it needs to know the DAB location code that corresponds to its current position on the earth's surface. For a domestic receiver this may be achieved via a set-up procedure in the user interface or via a wireless data transfer protocol; for a mobile receiver this is most likely to be achieved through a GNSS receiver. The conversion of a WGS84 coordinate pair to a DAB location code is described in annex F. Annex A describes the format for a manually entered receiver location code.

Receivers with a single DAB tuner need to be aware of all receivable ensembles by performing regular scans. This is because in order to respond to an alert message they need to be tuned to an EWS ensemble: if the alert message is carried by another EWS ensemble then the receiver needs to know whether that ensemble is receivable before retuning - otherwise listening may be unnecessarily interrupted resulting in a poor user experience.

Receivers with more than one DAB tuner can perform background scans to enable them to be aware of which ensembles are receivable. A minimum of two DAB tuners is essential for mobile receivers to be able to play one service whilst remaining aware of all receivable ensembles.

Fixed and portable receivers shall implement a set of power modes that allow the receiver to respond to alert messages even when the device is not being used. The operation and timing of the transition of these power modes are specified by the present document.

In-vehicle receivers are not expected to react to alert messages when the vehicle is unoccupied.

7.2 Fixed and portable receivers

7.2.1 Single DAB tuner receivers

Single tuner receivers can only respond to EWS alert messages when they are tuned to an EWS ensemble. This means that if the user selects a DAB service carried on an ensemble that does not participate in the EWS, no alert signalling will be received and so the receiver will be unaware of alerts. This also applies if the same tuner is used for reception of other broadcast services. Users shall be advised via the user interface of EWS capable receivers whenever the user makes a service selection that disables the EWS alert functionality.

7.2.2 Power modes

7.2.2.1 Introduction

DAB receivers come in many forms - some are DAB only, whilst others include clock functions, FM reception, and other audio playback.

7.2.2.2 Sleep mode

In this mode the receiver is not outputting audio. This is the lowest power mode.

During sleep mode, the receiver shall ensure that a timer operates, synchronized to the time provided by FIG 0/10. The function of the timer is to initiate a transition to monitor mode such that the receiver is able to decode the FIC of the selected EWS ensemble at the beginning of each minute. The receiver shall begin the transition in sufficient time, according to its own architecture.

7.2.2.3 Monitor mode

In this mode the receiver is not outputting audio.

The DAB tuner is tuned to an EWS ensemble and is able to decode the FIC. If FIC reception errors are experienced, the receiver shall not return to sleep mode prematurely: Trigger phase signalling repeats continuously for 5 seconds and during this period the receiver shall endeavour to capture a complete **alert group** (unless a matching alert is found). If FIC reception errors continue, the receiver shall behave as if no FIG 0/15 has been received (see below).

During monitor mode, which shall be fully operational when the seconds count changes from 59 to 0, the receiver shall check that it is still aligned to the minute's edge by reference to the CIF count contained in FIG 0/0, which is present in every transmission frame. If alignment has been lost, it shall be reestablished by resynchronising to the time provided by FIG 0/10.

All FIG 0/15 instances containing Pre-trigger phase signalling shall be ignored.

The receiver shall examine the content of the FIG 0/15 instances it receives that have the P/D flag in the FIG type 0 header set to 0 (Process). It shall ignore any FIG 0/15 instances it receives that have the P/D flag in the FIG type 0 header set to 1 (Discard).

If a FIG 0/15 instance containing the Heartbeat is examined, it tells the receiver that there are no alerts to be evaluated: the receiver shall return to sleep mode.

If a FIG 0/15 instance containing Sustain phase or End phase signalling is examined and the C/N flag is set to 1, it tells the receiver that there are no alerts to be evaluated: the receiver shall return to sleep mode.

If a FIG 0/15 instance containing Sustain phase or End phase signalling is examined and the C/N flag is set to 0, it tells the receiver that there are OE alerts to be evaluated: the receiver shall wait for the next instance of FIG 0/15.

If a FIG 0/15 instance containing Trigger phase signalling is examined, it shall be evaluated. If an alert match is found (see clause 7.5), the receiver shall transition to alert mode (see clause 7.6) and play out the alert message. If an alert match is not found, then if the last flag is set to 0, the receiver shall evaluate the next instance of FIG 0/15, else it shall return to sleep mode.

If no FIG 0/15 is received within 10 seconds, then the ensemble has ceased to be an EWS ensemble and it shall be removed from the list of EWS ensembles. The receiver shall retune to the next best candidate EWS ensemble and determine if this new ensemble provides FIG 0/15: if so the receiver synchronizes its sleep timer using the time provided by FIG 0/10 and returns to sleep mode with the new EWS ensemble as its monitoring ensemble; if not, the process of finding a new EWS ensemble shall continue until either a new EWS ensemble has been found, or all candidates have been exhausted. If no EWS ensemble is found, the receiver shall rescan the whole DAB band: for the purpose of the rescan the setting of the P/D flag is ignored. If no EWS ensemble is found on rescan, the receiver shall repeat the scan process after one hour.

7.2.2.4 Audio mode

In this mode the receiver is outputting audio.

The receiver enters audio mode as a response to a user action.

In audio mode, the receiver shall as far as possible use the DAB tuner to evaluate FIG 0/15 for matching alert messages. If access to the DAB tuner is not available, or if the user has selected a DAB service which is not carried in an EWS ensemble, then the receiver shall indicate to the user that the EWS function is inoperable.

If a FIG 0/15 instance containing Trigger phase signalling is received, it shall be evaluated. If an alert match is found (see clause 7.5), the receiver shall transition to alert mode (see clause 7.6) and play out the alert message. If an alert match is not found, then the receiver continues with its current audio playback.

If no FIG 0/15 is received within a period of 10 seconds, then the ensemble has ceased to be an EWS ensemble and it shall be removed from the list of EWS ensembles.

If FIG 0/15 is received and the ensemble is not on the list of EWS ensembles, it shall be added to the list.

When the receiver leaves audio mode as a response to a user action, and the tuned ensemble is an EWS ensemble, that ensemble should be selected as the EWS ensemble to monitor.

7.2.3 Initialization procedure

When the receiver is switched on for the first time (or after a system reset), it shall determine its location, either by requesting the user to input the corresponding DAB location code (see annex A), or by another means. If the only means the receiver has for knowing its location is via a user entered location code, and the user does not enter such a code, the receiver shall only evaluate alerts that are signalled without location codes, i.e. whole ensemble alerts. It is recommended that the receiver reminds the user to enter the code whenever the receiver is put into use.

The receiver shall scan all DAB frequencies and acquire the service list and using the status of FIG 0/15 signalling in each ensemble, mark all ensembles with FIG 0/15 signalling as EWS ensembles. Since the nominal repetition rate of FIG 0/15 signalling is once per second or faster, the determination can be made in a timely fashion. Metrics of signal quality should also be made in order to determine a suitable EWS ensemble to monitor whenever the receiver is in monitor mode: stronger signals should be preferred.

The initial selection of the EWS ensemble to monitor shall be made according to quality metrics, but a user option to select which EWS ensemble is preferred may be offered by providing the ensemble label to the user of each EWS ensemble that meets the minimum reception quality. Such user preference may be due to administrative boundaries, language, or other factors. If no EWS ensembles are found, then the receiver is unable to respond to EWS alerts and the receiver shall indicate to the user that the EWS function is inoperable.

Once the EWS ensemble has been selected, it shall be tuned to, and the sleep timer shall be synchronized to the time provided by FIG 0/10. The CIF count, provided in every transmission frame by FIG 0/0, shall be recorded for the first transmission frame that corresponds to the seconds count of zero: this allows for a simple alignment check at each monitoring period as 1 minute contains exactly 2 500 CIFs.

7.3 Mobile receivers

7.3.1 Tuner capability

An EWS mobile receiver requires a minimum of two DAB tuners. This allows it to play out audio and at the same time monitor other DAB ensembles for alert signalling and to determine whether a matched alert message is receivable.

7.3.2 Location awareness

A mobile receiver shall have a means to know its geographical location to a precision of at least 100 m. Typically, a GNSS receiver will be suitable.

7.3.3 Audio mode

An in-vehicle receiver shall be active whenever the vehicle is occupied.

A mobile receiver that is not an in-vehicle receiver may offer options for availability of the EWS function.

The receiver shall monitor the FIC of an EWS ensemble on a regular cycle to evaluate FIG 0/15 for matching alert messages. If the EWS ensemble is no longer receivable, the receiver shall seek another EWS ensemble for monitoring. The monitoring period shall include the time at which the seconds count is 0 as this is when synchronized alert messages will begin and FIG 0/15 with Trigger phase information is most likely to be present. Receivers shall also monitor the FIC of an EWS ensemble at other times, since an alert message might not be synchronized and so begin at any time.

If a FIG 0/15 instance containing Trigger signalling is received, it shall be evaluated. If an alert match is found (see clause 7.5), the receiver shall transition to alert mode (see clause 7.6) and play out the alert message. If an alert match is not found, then the receiver continues with its current function.

If no FIG 0/15 is received within 10 seconds, then the ensemble has ceased to be an EWS ensemble and it shall be removed from the list of EWS ensembles: another EWS ensemble shall be selected to monitor.

If FIG 0/15 is received and the ensemble is not on the list of EWS ensembles, it shall be added to the list.

7.4 User settings

7.4.1 Alert message playback control

Receivers may offer user settings to allow users to control the playback of certain alert messages.

7.4.2 Dismiss user controls

A "dismiss repeats" function may be offered which when engaged by the user will prevent the playing of alert messages for the same incident that have the stage ***Level 1 Repeat*** or ***Level 2 Repeat***.

A "dismiss incident" function may be offered which when engaged by the user will prevent the playing of further alert messages for the same incident that have the stage ***Level 1 Update***, ***Level 1 Repeat***, ***Level 2 Update***, or ***Level 2 Repeat***.

By default, or if these user settings are not offered via the user interface, then the user settings are false and playback will be unaffected.

The user settings are applicable to the incident identified by the combination of the Ensemble Id (EId) and the Incident Identifier (IId). For alert messages carried in the tuned ensemble, the EId is provided by FIG 0/0; for alert messages carried in other ensembles the EId is provided in the Id field of FIG 0/15.

When an alert message with the stage ***Level 1 Start*** or ***Level 2 Start*** is received, the user settings corresponding to that EId + IId are reset to "false" because this indicates a new incident. Since IIds are periodically reused, consideration should be given to a time-out period for user controls for an incident: if the IId has not been received for a certain period of time (perhaps one week), then the user controls should be reset for that EId + IId combination.

7.4.3 Monitor mode user controls

A user function may be offered to users to instruct a receiver with sleep mode to evaluate a Level 2 alert as if it was signalled as the corresponding Level 1 alert. This could be linked to the time of day, so that Level 2 alerts signalled during certain hours only are evaluated when the receiver is in monitoring mode.

By default, or if this user setting is not offered via the user interface, then the user setting is false and playback will be unaffected (i.e. the receiver will react according to the signalled stage).

A user function may be offered to users to prefer an EWS ensemble to use in monitor mode. The user is offered the list of EWS ensembles currently receivable by displaying their Ensemble Labels. The ordering of the list could be made by such metrics as signal quality and ECC + country code.

7.5 Alert matching

7.5.1 Introduction

Alert matching shall be performed either when the received FIG 0/15 OE flag is 0 and the Phase field is set to "Trigger", or when the OE flag is 1 (all OE signalling is Trigger phase signalling).

Various criteria exist to determine if a signalled alert message will be played out: only when all the matching criteria are positive shall the alert message be played. The order of the matching process is arbitrary but can be optimized.

7.5.2 Receivability matching

If the OE flag is set to 0 then the alert message is carried in the tuned ensemble. The Id field identifies the subchannel that carries the audio of the alert message. If the subchannel is present in the FIG 0/1 MCI, receivability matching is positive, if not, it is negative.

NOTE: A receiver cannot rely on stored configuration information when it has been in sleep mode because a reconfiguration may have occurred: the count field in FIG 0/7 provides for simple determination of a changed configuration.

If the OE flag is set to 1 then the alert message is carried in another ensemble. Single tuner receivers shall determine whether the ensemble referenced by the EId in the Id field exists within tuning memory: if it is, receivability matching is positive, if not, it is negative. Receivers with multiple tuners shall confirm that the ensemble referenced by the EId in the Id field is receivable: if it is, receivability matching is positive, if not, it is negative.

7.5.3 Stage matching

Stage matching depends on the value of the Stage field and the value of user settings (if provided) as shown in table 1.

Table 1: Stage matching

Stage	User setting for this EId + IId	Match for receivers in Audio mode	Match for receivers in Monitor mode (see note)
Level 1 Start	n/a	Positive	Positive
Level 1 Update	Incident dismiss (EId + IId) = false	Positive	Positive
	Incident dismiss (EId + IId) = true	Negative	Negative
Level 1 Repeat	Repeat dismiss (EId + IId) = false and Incident dismiss (EId + IId) = false	Positive	Positive
	Repeat dismiss (EId + IId) = true or Incident dismiss (EId + IId) = true	Negative	Negative
Level 1 Critical	n/a	Positive	Positive
Level 2 Start	n/a	Positive	Negative
Level 2 Update	Incident dismiss (EId + IId) = false	Positive	Negative
	Incident dismiss (EId + IId) = true	Negative	Negative
Level 2 Repeat	Repeat dismiss (EId + IId) = false and Incident dismiss (EId + IId) = false	Positive	Negative
	Repeat dismiss (EId + IId) = true or Incident dismiss (EId + IId) = true	Negative	Negative
Test	n/a	Negative	Negative
NOTE: If a user setting to instruct the receiver to evaluate Level 2 alerts as Level 1 alerts is active then the Level 1 row shall be evaluated.			

7.5.4 Location matching

If the alert signalling does not include any location codes, then the alert area is the entire ensemble coverage area. In this case, the location match is automatically positive.

If the alert signalling includes location codes, the receiver compares the first location code in the **alert set** to the location code of its current position. For a fixed or portable receiver this is the location code captured at initialization, for a mobile receiver it is the location code computed from the GNSS received data: the same receiver location code shall be used for all location codes in the **alert set**. If the zone and digits common to both codes (left-aligned) are identical, the location match is positive and location matching terminates. If the zone and digits common to both codes (left-aligned) do not match, the next location code in the **alert set** is compared, and so on until either the location match is positive, or all location codes have been tested and a location match has not been found: in this case the location match is negative. Receivers can determine whether all FIG 0/15 instances have been evaluated for an **alert set** by means of the C/N flag and the NFF field.

EXAMPLE: An alert set contains the location codes: Z1:91F, Z1:92C, Z1:953, Z1:960. The receiver location code is Z1:92CB81. The zone and digits of the receiver location code truncated to the same number of digits as the received location codes provide a match for Z1:92C, so the location match is positive on the second comparison and the final two location codes are not compared.

7.6 Alert mode

7.6.1 Preparation

After an alert match is positive, the receiver shall store its functional status in memory to allow for a seamless return to that status after the alert playback is terminated.

7.6.2 Tuned ensemble alerts

The receiver shall play the audio from the subchannel indicated by the Id field. To determine whether the audio is coded as DAB audio or DAB+ audio it is necessary to find the SubChId in the FIG 0/2 MCI. If the alert audio carries PAD applications (for example, dynamic label or SlideShow), or the service includes data service components, these should be presented according to the capabilities of the receiver. The service label of the alert service shall be displayed.

The alert audio shall be played within 5 s of the alert match decision.

The receiver shall not delay audio playback if the service label is not yet available.

NOTE: Although the service label will often be available from tuning memory, the alert service may have been introduced by an ensemble reconfiguration.

The alert shall continue to be played whilst the Trigger or Sustain phase signalling with the same SubChId is received, unless the alert is terminated by the user (see clause 7.6.4).

7.6.3 Other ensemble alerts

The receiver shall attempt to retune to the ensemble indicated by the Id field using the information in its tuning memory. If the ensemble cannot be tuned, the receiver shall return to the previous functional state.

NOTE: Receivability matching has already been performed, so if the ensemble cannot be tuned, the receiver should review the state of its tuning memory.

Once tuned, the FIC shall be decoded and the MCI and FIG 0/15 information evaluated. Any Trigger phase or Sustain phase FIG 0/15 instance with the OE flag set to 0 provides the identity of the subchannel carrying the alert audio in the Id field. If no FIG 0/15 is received, or the subchannel does not exist in the FIG 0/1 MCI, the receiver shall return to the previous functional state.

The receiver then follows the process for the tuned ensemble alert (clause 7.6.2).

7.6.4 Terminating an alert

Receivers may offer various user functions to terminate the playback of an alert before it is completed. The user functions may be:

- to terminate the currently playing alert only;
- to terminate the currently playing alert and engage the "dismiss repeats" function to prevent future playback of repeated messages of the currently playing incident (identified by the EId + IId);
- to terminate the currently playing alert and engage the "dismiss incident" function to prevent future playback of repeated and updated messages of the currently playing incident (identified by the EId + IId).

During alert playback, the user may operate a user function to terminate the alert playback.

The end of the alert message is usually signalled using FIG 0/15 with OE set to 0 and the Phase field set to "End", but in exceptional circumstances, when another alert message in the same ensemble immediately follows, the "End" phase is replaced by the "Trigger" phase of the new alert: the receiver shall terminate the alert playback.

Whether alert playback is terminated by the user or by reaching the end of the alert message, audio playback shall be stopped and the receiver shall evaluate FIG 0/15 and determine if any other alerts are being signalled. If no such alerts are being signalled, the receiver shall return to the stored prior functional state; if such alerts are signalled, they shall be evaluated appropriately according to the type of receiver and if a match is found shall be played; otherwise the receiver shall return to the stored prior functional state. However, it shall be ensured that the receiver does not restart playing an alert that the user has terminated.

Annex A (normative): DAB location code presentation format

A.1 Introduction

The coding of DAB location codes in FIG 0/15 is optimized for signalling efficiency, but it is not very human friendly. This annex describes the way that location codes are to be presented and used in the consumer setting, for example, for a user to be able to enter the location code at receiver set-up.

The presentation format is designed to be suitable for entry on receivers with basic user controls, such as up/down/select functionality. Therefore, the number of symbols is restricted and the symbols are grouped into blocks.

A.2 Conversion process

The DAB location code at maximum resolution is a 30-bit binary coded integer. The most significant 6 bits represent the zone and the least significant 24 bits represent the six digits of the location code.

The modulo-61 division of the 30-bit integer produces a 6-bit checksum. The checksum is appended to create a 36-bit integer.

This 36-bit integer is separated into three blocks of four octal digits.

A.3 Presentation format

The presentation format consists of three groups of four symbols, separated with the hyphen character. The symbols used are the digits 1 to 8. Each octal digit (value range 0 to 7) is converted to a presentation symbol by adding 1 to give the symbols "1" to "8".

EXAMPLE 1: The location code for BBC Broadcasting House is Z10:B736BB.
In binary: Zone 10 = 001010; B736BB = 1011 0111 0011 0110 1011 1011.
As a 30-bit binary integer: 001010101101110011011010111011.
In decimal: 179 779 259.
The modulo 61 checksum (in decimal): 59.
The modulo 61 checksum (in binary): **111011**.
The 36-bit integer: 001010101101110011011010111011**111011**.
The three block, 4-digit octal representation: 1255 6332 7373.
The presentation code: 2366-7443-8484.

EXAMPLE 2: The location code for Svalbard Museum is Z0:152FF1.
In binary: Zone 0 = 000000; 152FF1 = 0001 0101 0010 1111 1111 0001.
As a 30-bit binary integer: 000000000101010010111111110001.
In decimal: 13 885 529.
The modulo 61 checksum (in decimal): 47.
The modulo 61 checksum (in binary): **101111**.
The 36-bit integer: 000000000101010010111111110001**101111**.
The three block, 4-digit octal representation: 0005 2277 6157.
The presentation code: 1116-3388-7268.

NOTE: The generation of the location codes in these examples is given in annex F.

A.4 URI definition

To enable "smart" devices to use the presentation format, a URI is defined as follows:

- DLI://<presentation code>

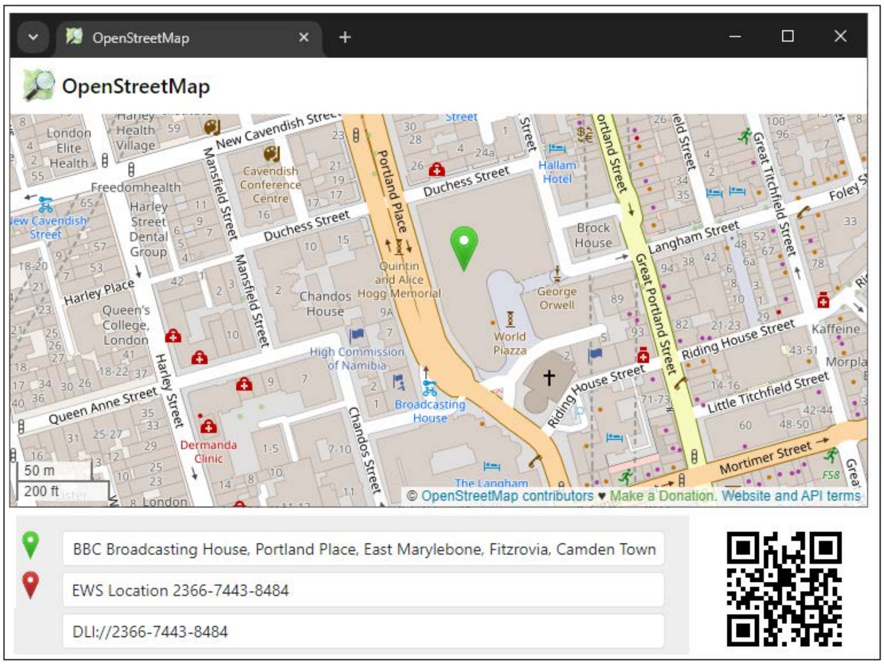
Table A.1 shows the examples above in URI format with illustrative QR codes.

Table A.1: Example of URI coding and QR code presentation of examples above

Location	URI encoded location string	QR code for location
BBC Broadcasting House Z10:B736BB	DLI://2366-7443-8484	
Svalbard Museum Z0:152FF1	DLI://1116-3388-7268	

A.5 Possible webpage or app implementation example

To provide users with the location code to input into their receiver, a map-based implementation could be devised. Figure A.1 shows an example.



NOTE: Map data is available under the Open Database License, see Copyright and License | OpenStreetMap.

Figure A.1: Example of map-based webpage to provide presentation format location code

Annex B (informative): Example of EWS signalling

Figure B.1 illustrates the coverage areas of three ensembles, A, B and C which all participate in an EWS.

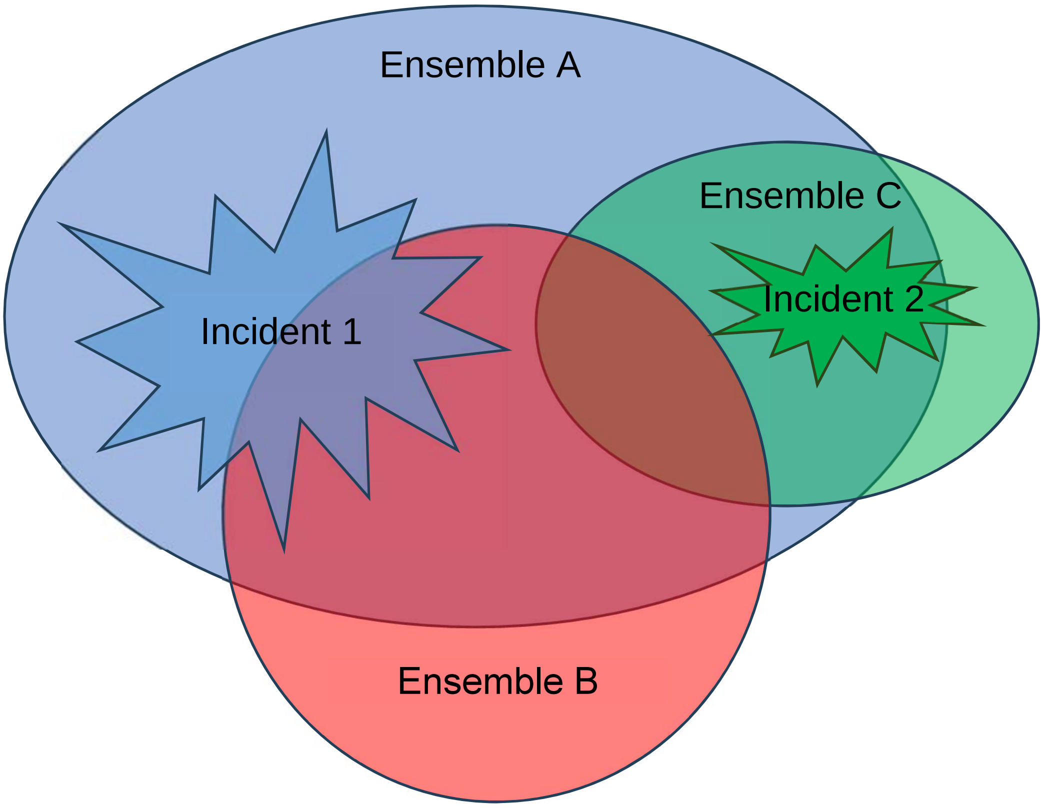


Figure B.1: Coverage areas of ensembles A, B and C, and incidents 1 and 2

Ensembles A and C will each make synchronized alerts at the beginning of the next minute - ensemble A will make an alert concerning incident 1 and ensemble C will make an alert concerning incident 2. The coverage areas of the ensembles overlap, and so each ensemble signals all the alerts provided by these three ensembles.

Figure B.2 shows the progression of the FIG 0/15 signalling made in each ensemble at the start of the alerts. Before the alert begins, all ensembles are signalling the Heartbeat once per second to identify themselves as EWS ensembles. Ensemble A and ensemble C each carry a synchronized alert message and so signal all phases of tuned ensemble signalling, beginning with the Pre-trigger phase at seconds count = 55 using the special Sec field value of 63. This signalling is received off-air and fed to the FIC generators of the other ensembles to construct their OE signalling. Starting at seconds count = 0, ensembles A and C signal Trigger phase signalling for their own alert followed by OE signalling for the alert in the other ensemble, and ensemble B signals OE signalling for both alerts. In each case, the two alert sets may have one to four FIG 0/15 instances to provide the alert area, and the two alert sets form the alert group. The signalling of the alert group is repeated continuously until seconds count = 4 (inclusive). Due to the length of the alert group, the trigger signalling spills into the beginning of seconds count = 5. Ensembles A and C then begin signalling Sustain phase at a rate of once per second until the end of the alert message, and ensemble B signals the Heartbeat.

Figure B.3 shows a later period where the alert concerning incident 1 has ended. In ensemble C, the alert concerning incident 2 comes to its end during seconds count = 42, with End phase signalling provided rapidly for two seconds. An update is made concerning incident 1 in ensemble A at seconds count = 44 and the ensemble signals Pre-trigger phase signalling from seconds count = 39 until seconds count = 41 (inclusive) with the Sec field set to 44. Ensemble A signals trigger phase continuously from seconds count = 45 for 5 seconds and then signals trigger phase at once per second for 1 additional second due to the length of the start jingle. Ensembles B and C provide OE signalling from seconds count = 44: in ensemble C the OE Trigger phase signalling overlaps with the End phase signalling. The OE signalling in ensembles B and C continue longer than the trigger phase signalling in ensemble A dues to processing delays between off-air reception of ensemble A and FIC encoding.

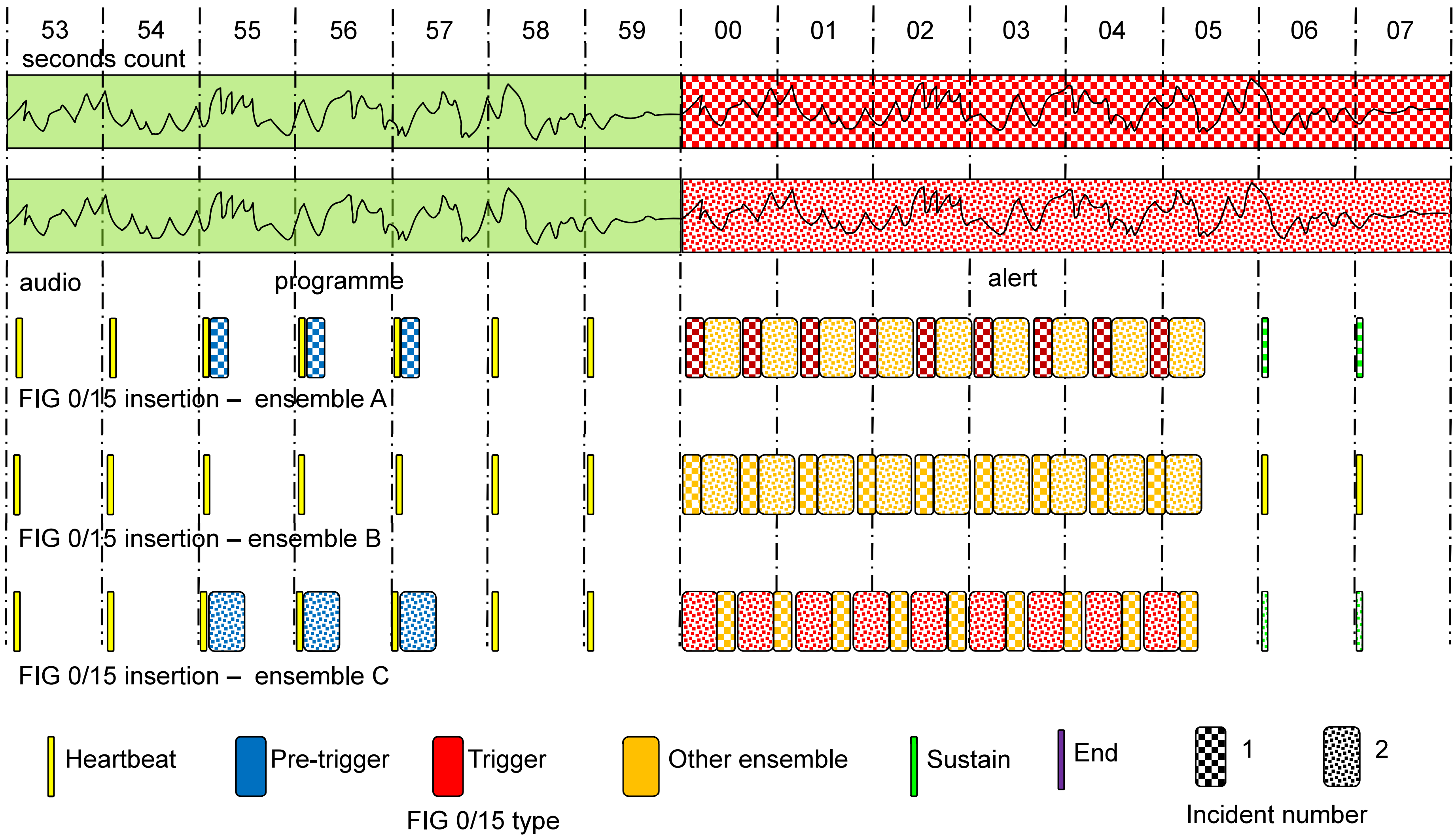


Figure B.2: FIG 0/15 signalling in ensembles A, B, and C: start of synchronized alerts for incidents1 and 2

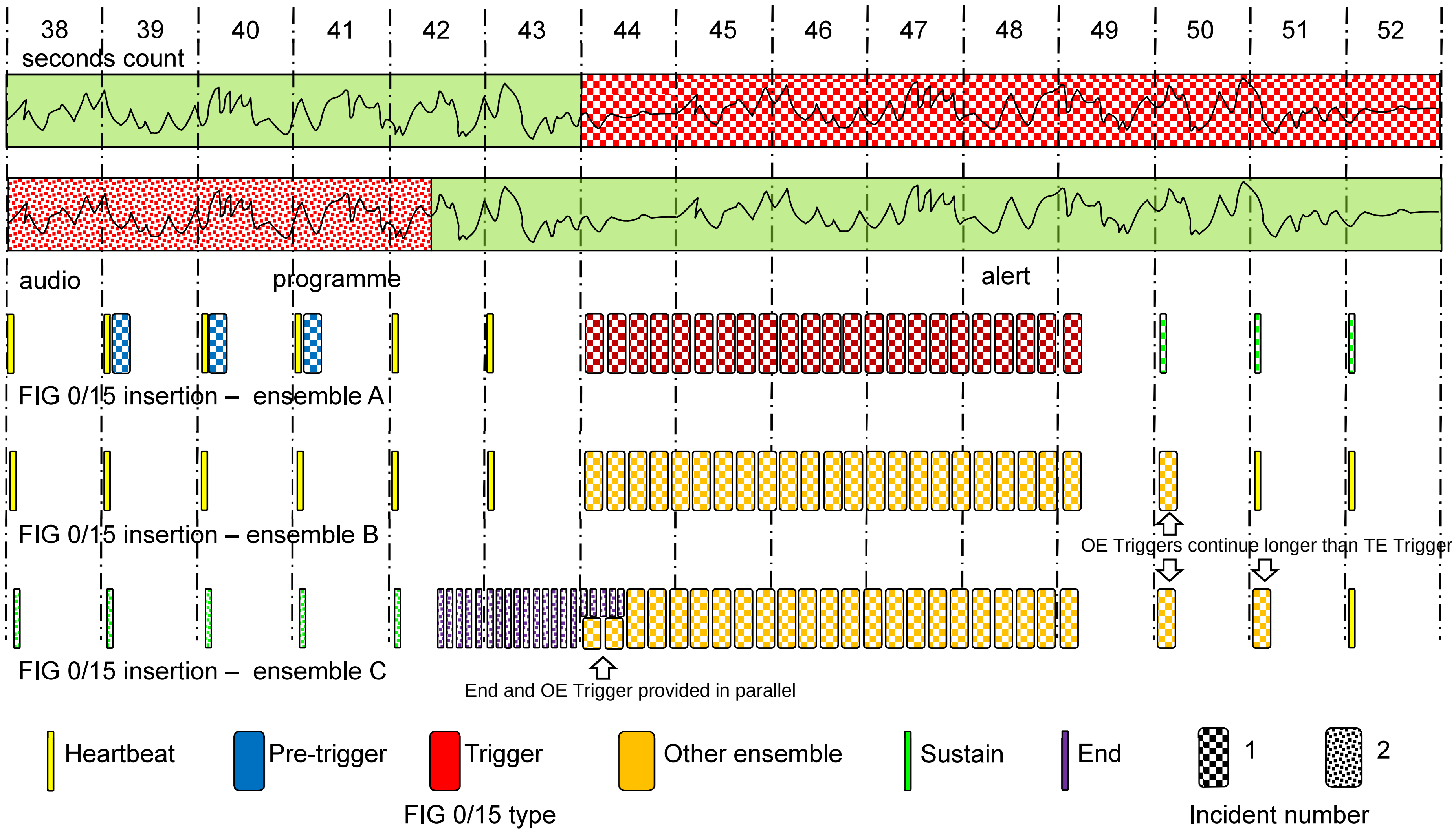


Figure B.3: FIG 0/15 signalling in ensembles A, B, and C: end of alert for incident 2 and start of a new alert for incident 1

Annex C (informative): Example of coding an alert area

Figure C.1 shows an approximation of the official service area of the Cardiff and Newport ensemble in the United Kingdom (red area). It also shows an approximation of the overspill area (pink area) where good reception is a consequence of geography and transmitter antenna patterns. The ensemble area is in Zone 10, which extends from (36, -36) to (72, 0). The first division of Zone 10 produces areas of 9° × 9° and the second of 2,25° × 2,25°. The area shown in figure C.1 extends from (49,5, -4,5) to (51,75, -2,25) and is identified by location code Z10:B6. It is divided into 16 sub-areas, which are labelled.

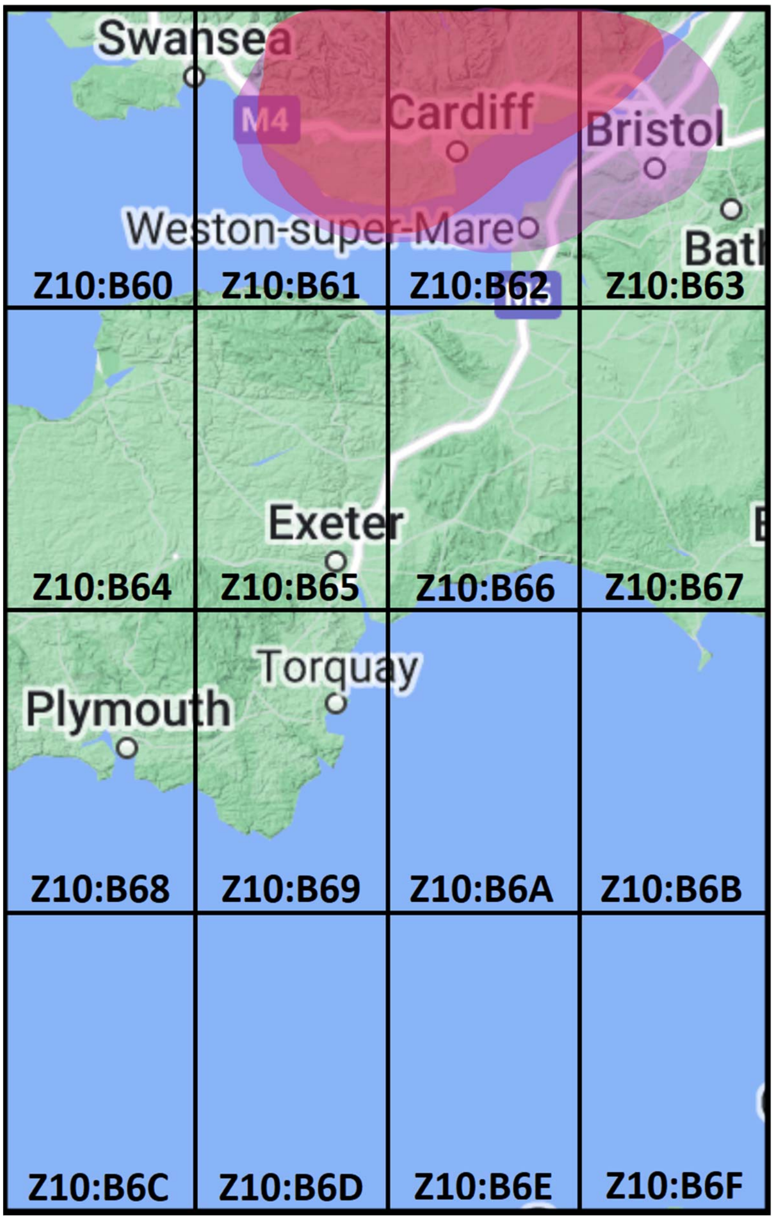


Figure C.1: Coverage of Cardiff-Newport ensemble within the Z10:B6 spherical rectangle (Map source: © 2024 Google)

It can be seen that for this location (about 51° N) that the spherical rectangles have an aspect ratio of about 2:3 (cos 51° = 0,6293).

When an emergency situation arises in Cardiff, the authorities wish to provide a warning to those affected, whilst not disturbing others, especially since the overspill area is some distance away. Therefore, location codes need to be provided to identify the valid area of the alert. It can be seen that Cardiff is located in sub-area 2. Figure C.2 provides an enlargement of this sub-area.

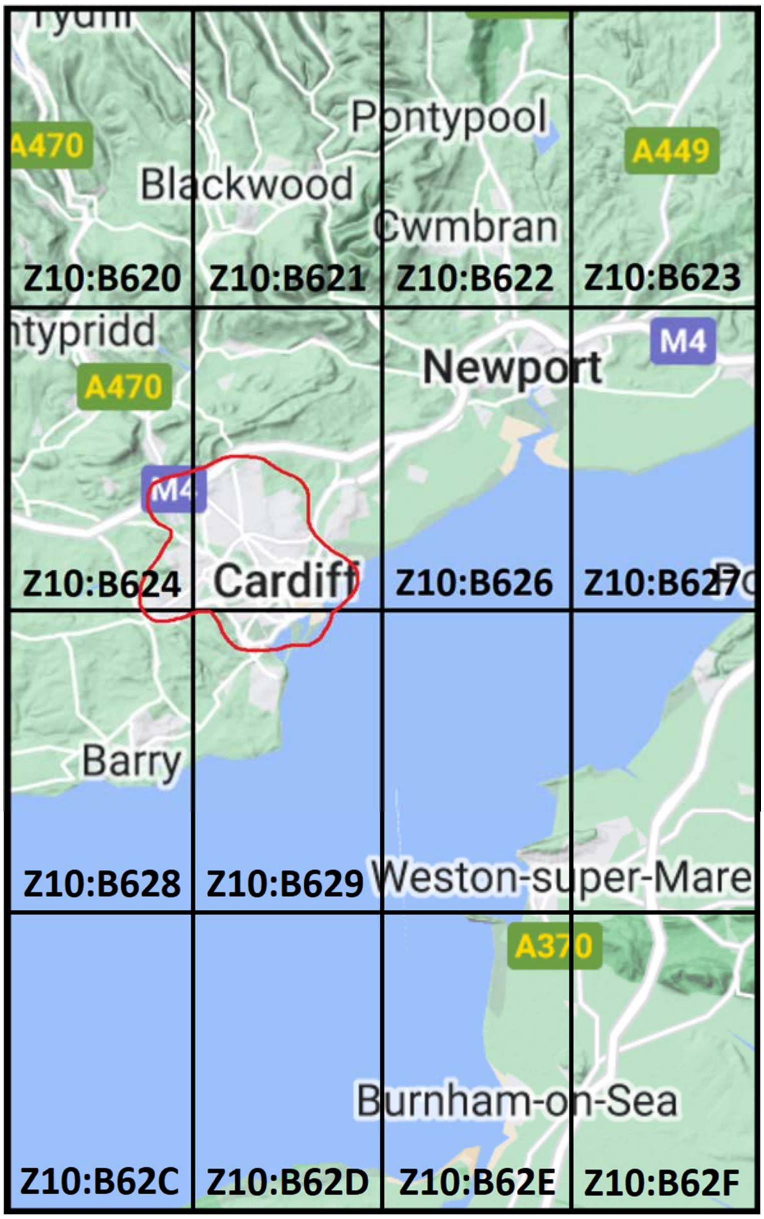


Figure C.2: Cardiff alert area within the Z10:B62 spherical rectangle (Map source: © 2024 Google)

It can be seen that the alert area is contained within four sub-areas of the Z10:B62 spherical rectangle. Figure C.3 provides an enlarged view of the alert area.

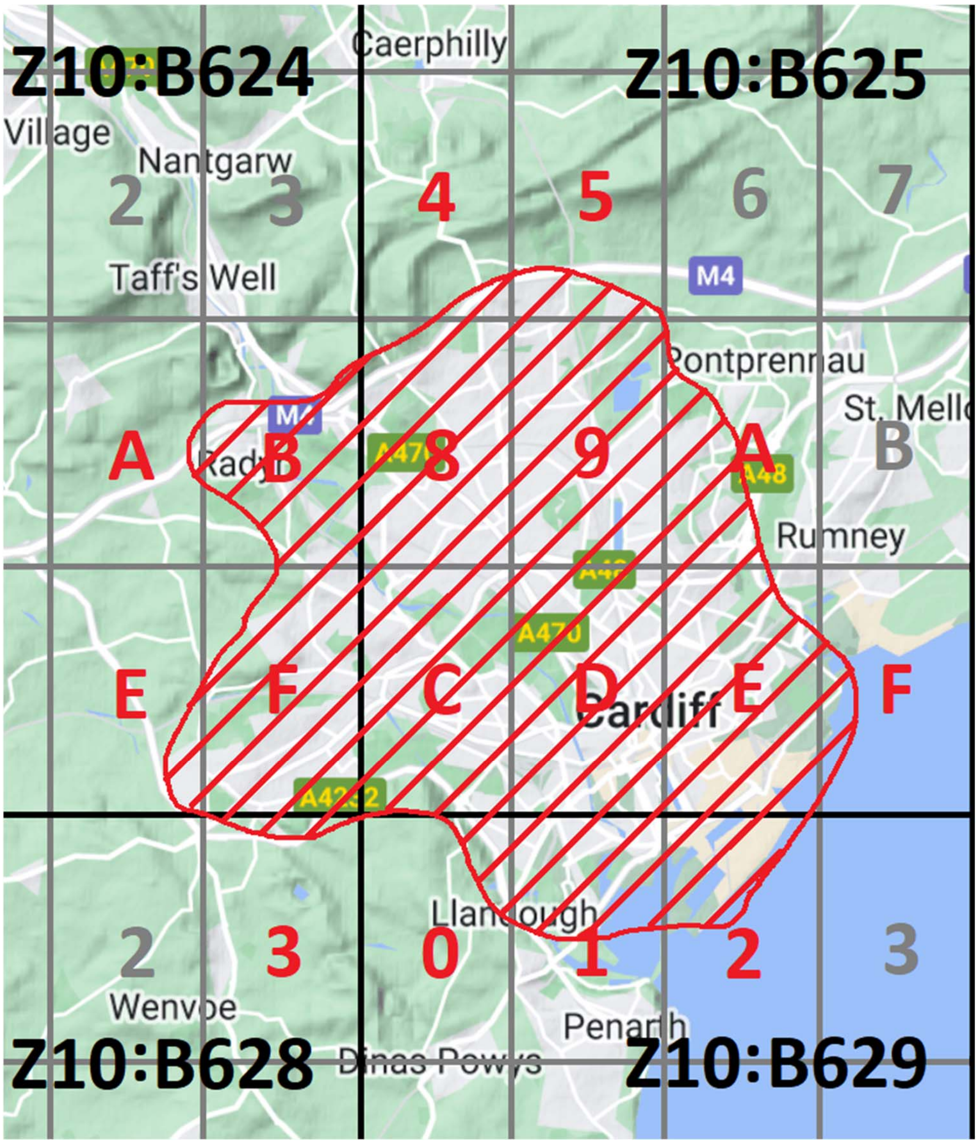


Figure C.3: Cardiff alert area detail
(Map source: © 2024 Google)

The alert area consists of 17 spherical rectangles with 5-digit location codes (in this location, each spherical rectangle with a 5-digit code is approximately 4 km north-south by 2,5 km east-west).

Since the area is within four 4-digit location codes, the area can be coded successfully by using sub-codes. The alert area is coded with four location codes (LC) as follows:

- LC1: Zone = 10; SCF = 1; Num Digits = 3; Digit 1 = B; Other digits = 624; Padding = 0; Sub-codes = CC00.
- LC2: Zone = 10; SCF = 1; Num Digits = 3; Digit 1 = B; Other digits = 625; Padding = 0; Sub-codes = F730.
- LC3: Zone = 10; SCF = 0; Num Digits = 4; Digit 1 = B; Other digits = 6283.
- LC4: Zone = 10; SCF = 1; Num Digits = 3; Digit 1 = B; Other digits = 629; Padding = 0; Sub-codes = 0007.

LC3 is coded without the use of sub-codes as there is only one sub-area inside the alert area. The location codes use a total of 22 bytes (3 × 6 + 4 bytes). The four location codes therefore fit into a single FIG 0/15.

Annex D (informative): Alert area translation method

D.1 Introduction

The alert area is the geographical area in which users are presented with the alert message by the matching algorithm in the EWS receiver. The alert area may be the entire coverage area of the DAB ensemble, or it may be an area defined by use of DAB location codes. In the latter case, the maximum number of location codes that can be signalled is limited in order to ensure that the alert area is signalled in a timely way.

The raw alert information will typically be provided by a national authority and the source format most commonly uses the CAP standard [i.2]. The CAP standard specifies alert areas as polygons or circles, using co-ordinate systems, or as geocodes which have national encoding formats such as SAME or SHN. For many national formats official public domain area definitions exist, so that a highly accurate geographic polygon can be obtained from an administrative entity identifier by way of dereferencing.

A DAB EWS has a coverage area within which suitable receivers can respond to signalled alerts. The coverage area of the DAB EWS is the superposition of all the DAB ensembles that participate in the EWS.

Every incident will be relevant to a particular geographical area. This alert area may be deemed to be sufficiently close to one of the coverage areas of a participating EWS ensemble that the entire ensemble area is appropriate as the alert area, or it may be that the alert area does not correspond to any EWS ensemble coverage area, in which case the alert area will be described by the use of location codes. The general recommendation is that the ensemble that carries the alert message has a coverage area that is greater than the full extent of the alert area.

A DAB EWS may be centrally managed, in which case the assignment of incidents to ensembles will be a matter of the management system, or it may be managed in a distributed way, whereby ensembles manage their own provision of incidents. In the latter case, there is the possibility that more than one EWS ensemble could choose to carry an alert for the same incident, although the precise content of the alert messages will be different in some ways.

The alert source information will usually be provided by a responsible institution and will be the result of an administrative decision and may also represent a sovereign act that is legally protected. As such the process to translate the source alert area into DAB location codes should not reduce the spatial extent.

A DAB location code identifies a spherical rectangle; the dimensions of the spherical rectangle are defined by the number of digits that make up the location code - the larger the number of digits, the smaller the area of the spherical rectangle identified. The DAB alert area is therefore the addition of all the spherical rectangles described by a set of location codes needed to include the entire alert area described by the source data.

The DAB alert area is necessarily different from the source alert area. The translation procedure ensures that the output set of location codes completely includes the source alert area, except if it can be numerically shown that the source alert area overlaps a location code only by a miniscule amount: in this case the location code can be omitted from the output set of location codes.

This annex contains a reference encoding procedure for generating a set of location codes that adheres to the EWS signalling constraints that allow a maximum of four location code fields, each with a maximum length of 25 bytes.

D.2 Translation procedure

D.2.1 Generating the source data polygon(s)

Whatever the format of the source alert data, each alert area needs to be accurately mapped to one or more polygons using the WGS84 coordinate system, as this is the basis of the DAB location coding system. In the process described in this annex, each alert area is assumed to be described by such polygons using WGS84 coordinates. For source data defined in a coordinate system other than WGS84, a coordinate transform is applied to the source data before the translation procedure. The process aims to provide the best fit to the source alert area within the capacity constraints of the signalling whilst ensuring that accuracy requirements are met.

The alert area defined in the alert source information is accurately mapped to one or more polygons, each consisting of a line string of geographic points, each expressed as a pair of polar coordinates defined by WGS84 latitude and longitude.

D.2.2 Generating the location code set

D.2.2.1 Introduction

The translation procedure consists of four steps. The algorithm is defined on an abstract level in natural language as to not limit the implementation beyond the requirements.

The "level" describes the number of hexadecimal digits in the location code and thus the size of the area described: level 1 (L1) has one digit and describes the largest area; level 6 (L6) has six digits and describes the smallest area.

D.2.2.2 Initial parent level determination

From the source data polygon(s), determine the dimensions (in degrees) of the latitude extent and the longitude extent of the alert area: the latitude extent is the difference between the minimum and maximum values of all the geographic points of the polygon(s), similarly the longitude extent. The smallest extent (either latitude or longitude) determines the initial parent level as given by table D.1.

Table D.1: Initial parent level from smallest extent

Smallest extent, E	E > 9°	9° ≥ E > 2,25°	2,25° ≥ E > 0,5625°	0,5625° ≥ E > 0,140625°	0,140625° ≥ E
Parent level	L1	L2	L3	L4	L5

D.2.2.3 Generating the parent set of location codes

The parent set is the set of location codes at the parent level that when taken together completely include the alert area as defined by the source data polygon. If the parent set contains more location codes than the count threshold defined in table D.2, the parent level is reduced by one (that is, it now describes a larger spherical rectangle) and a new parent set at the new parent level is generated.

Table D.2: Count thresholds at parent level

Parent Level	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
Count Threshold	24	24	20	20	16	-

D.2.2.4 Generating the child set of location codes

The child level is set at one level greater than the parent level (that is it describes a smaller spherical rectangle). The child set is the set of location codes at the child level that when taken together completely include the alert area as defined by the source data polygon(s). If the child set contains fewer than, or an equal number of location codes to, the count threshold defined in table D.3, the child level is increased by one (that is, it now describes a smaller spherical rectangle) and a new child set at the new child level is generated.

Table D.3: Count thresholds at child level

Child Level	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
Count Threshold	-	24	20	20	16	16

D.2.2.5 Removing the "miniscule" location codes

When a location code in the child set overlaps the source data polygon(s) by only a miniscule amount, the inclusion of the location code becomes disproportionate because the vast majority of the area described is outside the source alert area. The overlap between the alert areas defined by the source data polygon(s) and a location code exists if any point of the alert area lies within the location code spherical rectangle. To avoid this situation, location codes in the child set are discarded if they overlap by an area that is smaller than the area threshold. The area threshold is a fraction of the spherical rectangle area with a numerator of 1 and the denominator according to the location code level as defined in table D.4.

Table D.4: Area thresholds

Level	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
Area threshold (1/N)	-	4096	1024	256	64	16

The output set of location codes is the result of discarding the miniscule location codes from the child set. The output set is the encoded alert area and is used for output formation.

D.2.3 Output formation

The alert area is carried in FIG 0/15 using a formatted set of location codes. In the output set, all the location codes are at the same level, which is the output level. The level below the output level is called the stem level (that is, it has one fewer hexadecimal digit). For efficient coding in the FIG 0/15, location codes can be grouped together using the stem level and sub-coding.

The output set of location codes is grouped into sub-sets sorted by the stem level location code: if location codes in the output set share a common stem level code, they fall into the same group. Every group has up to 16 location codes, only different in the last hexadecimal digit. Each group is then encoded to a format that depends on the group size, as defined in table D.5.

Table D.5: Location code format in output

Group size	**1**	**2 to 15**	**16**
Encoded format	Output level	Stem level with subcode	Stem level

If the group has one location code, it is encoded as a single location code at the output level as this is the most efficient coding. If a group has more than one and fewer than 16 location codes, the group is coded as the stem level location code with a sub-code field that has one bit set for every location code in the group determined by its last digit. If a group has 16 location codes, it is coded as a single location code at stem level.

NOTE: The translation procedure is defined such that the number of groups will never exceed the parent level threshold. This guarantees that the entire output set can be transmitted within four FIG 0/15 instances.

Annex E (normative): Definition of FIG 0/15 EWS information

The EWS information description is encoded in Extension 15 of FIG type 0 (FIG 0/15). Figure E.1 shows the structure of the EWS information field which is part of the Type 0 field (see also ETSI EN 300 401 [1], figure 7). FIG 0/15 signals participation of an ensemble in an EWS, and the status and localization for EWS audio alerts that are carried in the tuned ensemble or in another ensemble. The alert area, when smaller than the complete ensemble coverage area, is defined by the use of location codes (see annex F). In order to allow complex alert areas to be signalled, a set of FIG 0/15s can be signalled: the set comprises between one and four FIG 0/15 instances. One or more alerts may be signalled concurrently: in this case there will be a set of one to four FIG 0/15s for each alert; the complete collection of FIG 0/15s that describe the current alert information is known as an alert group.

The FIG type 0 flags (see ETSI EN 300 401 [1], clause 5.2.2.1) are used as follows: C/N flag - SIV; OE flag - OE; P/D flag - special definition.

The P/D flag is used to ensure synchronization between the transmission equipment and receiving equipment that operates a sleep mode. It shall be set as follows:

- 0: Process
- 1: Discard

This feature shall use the SIV signalling (see ETSI EN 300 401 [1], clause 5.2.2.1). The database shall be divided by use of a database key. Changes to the database shall not be signalled using the CEI mechanism, because an alert database only exists during the alert.

A special form of FIG 0/15 is used as a heartbeat indicator (control function, C/N flag is set to 1) to identify that the ensemble is part of an EWS and will carry alert information when alerts are active. The heartbeat form has an empty type 0 field and is identified by the length field of the FIG type 0 header being equal to 1. The OE flag shall be set to 0. The heartbeat form of FIG 0/15 shall not be transmitted when alerts are signalled.

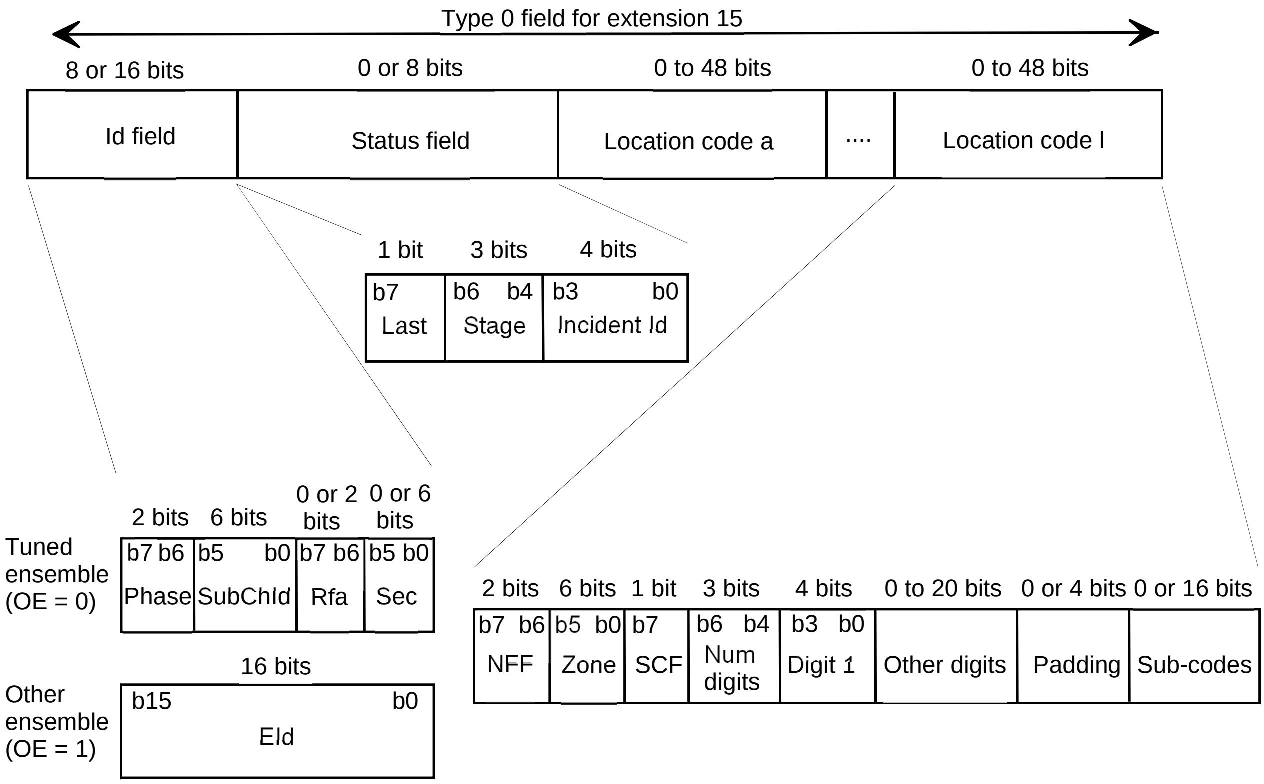


Figure E.1: Structure of EWS information field

The following definitions apply:

Id field: this 8- or 16-bit field shall contain the identity of the alert audio service component or the ensemble that carries the alert audio service component. The OE flag in the FIG type 0 header field (see ETSI EN 300 401 [1], clause 5.2.2.1) shall determine if the service component is in the tuned ensemble or another ensemble. The following definitions apply:

- **Phase:** this 2-bit field shall indicate the phase of the tuned ensemble alert, as follows:

  0 0: Pre-trigger;

  0 1: Trigger;

  1 0: Sustain;

  1 1: End.

- **SubChId:** this 6-bit field shall identify the sub-channel which contains the audio service component carrying the audio alert.

- **Rfa:** this 2-bit field shall only be present when the Phase field = Pre-trigger. The bits are reserved for future addition and shall be set to 0.

- **Sec:** this 6-bit field, coded as an unsigned binary integer, shall only be present when the Phase field = Pre-trigger and shall contain the seconds count corresponding to the start of the Trigger phase.

- **EId (Ensemble Identifier):** this 16-bit field shall identify the other ensemble that carries the audio alert.

Status field: this 8-bit field, when present, shall provide information about the alert. The following definitions apply:

- **Last:** this 1-bit flag shall indicate if this is the last FIG 0/15 to be signalled in this alert group as follows:

  0: not the last FIG 0/15 of the alert group

  1: the last FIG 0/15 of the alert group

- **Stage:** this 3-bit field shall indicate the stage of the EWS alert, as follows:

  0 0 0: Level 1 Start

  0 0 1: Level 1 Update

  0 1 0: Level 1 Repeat

  0 1 1: Level 1 Critical

  1 0 0: Level 2 Start

  1 0 1: Level 2 Update

  1 1 0: Level 2 Repeat

  1 1 1: Test

- **Incident Identifier (IId):** this 4-bit field, coded as an unsigned binary integer, shall identify an incident that is composed of a series of audio alerts. The value is assigned by the ensemble that carries the audio alert and shall be maintained through the various stages of an incident.

Location code: these $n \times 8$-bit fields define the geographic area that the EWS alert applies to. The areas specified are additive. If no location codes are provided then the alert is relevant to the entire ensemble coverage area. The number of location codes carried is not specified, but location codes fill the rest of the FIG 0/15 specified by the length field of the FIG 0/15 header. The following definitions apply:

- **NFF:** this 2-bit field, expressed as an unsigned binary number in the range 0 to 3, shall indicate the number of FIG 0/15s for this alert set which follow in order to signal the complete alert area.

NOTE 1: NFF is not part of the location code, it is provided for determining the integrity of the complete alert area.

NOTE 2: When the C/N flag in the type 0 header is set to 0, (NFF + 1) indicates the total number of FIG 0/15s in the alert set.

- **Zone:** this 6-bit field, expressed as an unsigned binary number, shall identify the global zone as defined in annex E.
- **SCF:** this 1-bit flag shall indicate whether the Sub-codes field is present or not, as follows:

  0: Sub-codes field is absent: the location code contains a single spherical rectangle.

  1: Sub-codes field is present: the location code contains 2 to 15 spherical rectangles.

- **Num digits:** this 3-bit field, expressed as an unsigned binary number, shall indicate the number of digits, in the range 0 to 5, contained in the subsequent Other digits field.

NOTE 3: When SCF=1, the smallest spherical rectangles are sub-coded and Num digits is in the range 0 to 4.

- **Digit 1:** this 4-bit field shall specify the most significant digit of the location code (see annex E). The special value 0 may be used for the polar zones to indicate the entire zone.
- **Other digits:** this 0- to 20-bit field shall only be present when the Other digits field is greater than 0. It shall contain all the remaining digits of the location code when SCF = 0 and all but the least significant digit of the remaining digits when SCF = 1.

NOTE 4: When SCF=1, the smallest spherical rectangles are sub-coded and so there are a maximum of 4 other digits.

- **Padding:** this 4-bit field shall only be present when Num digits is an odd number. All bits shall be set to 0.
- **Sub-codes:** this 16-bit flag field shall only be present when the SCF flag is set to 1. It shall specify between 2 and 15 spherical rectangles that are the sub-areas of the area specified by the zone and coded digits. The definition of the sub-areas is given in annex E. The use of sub-codes permits efficient coding of a more precisely defined area to be specified. The flags shall be coded as follows:

  b_i (i = 0 to 15)

  0: sub-area i is not part of alert area

  1: sub-area i is part of alert area

NOTE 5: For 1 spherical rectangle, the coding efficiency is greater by including the least significant digit in the Other digits field; for 16 spherical rectangles, the sub-coding is not required as all sub-areas are part of the alert area.

The database key comprises the **OE** flag (see ETSI EN 300 401 [1], clause 5.2.2.1) and the **Id field**.

There is no Change Event Indication (CEI).

When no alert is signalled, the heartbeat form of FIG 0/15 shall be used to indicate that the ensemble is part of the EWS.

NOTE 6: If multiple EWS alerts are active concurrently, the capacity of the FIC for all other features could be reduced. Receivers may expect that the nominal repetition rates of FIG 0/15 and of other FIGs may be affected.

Annex F (normative): DAB location coding

F.1 Introduction

Incidents and activities will rarely affect the same area as the coverage area of a particular DAB ensemble, and in many cases DAB ensembles have overlapping coverage areas. DAB location coding is applicable to any place on earth and uses a hierarchy of spherical rectangles (that is, rectangles defined in terms of polar coordinates). Each location code has a variable length with the first level of the code identifying the largest area, with each subsequent level identifying a sub-division of the previous level. The longer the code, the finer the spatial resolution. By providing a set of location codes, any arbitrary area may be described.

A location code consists of a top-level zone using 6-bits and up to six sub-division levels, each using 4-bits, to form location codes with a maximum length of 30 bits and a minimum length of 10 bits (zone plus one sub-division). The maximum spatial resolution of the scheme is 977 m north-south. In the east-west direction, the spatial resolution is 978 m at the equator and 302 m at 72° latitude. This level of precision is appropriate for a broadcast system. Each digit removed from the end of the location code reduces the spatial resolution by factor four, and increases the area described by a factor of 16.

F.2 Coordinates

In WGS84, the latitude is 0° at the equator, 90° at the north pole and -90° at the south pole, and the longitude is given as the position east of the Greenwich meridian, with 0° at the meridian and increasing positively eastwards to 180° and negatively westwards to -180°.

To make calculations simpler for determining the location code, the WGS84 coordinates are translated using a simple mapping to use positive numbers only.

The WGS84 latitude is translated to the Southerly Extent (SE) by subtracting the WGS84 latitude from 90°; thus the north pole becomes 0°, the equator 90° and the south pole 180°.

The WGS84 longitude is translated to the Easterly Extent (EE) by adding 360° to negative values only; thus, for example, -10° becomes 350°.

F.3 Division into zones

The top level of the hierarchy is a zone. There are 42 zones, as shown in figure F.1:

- 40 banded zones, which are spherical rectangles 36° × 36°; and
- 2 polar zones, also 36° × 36°, which extend 18° from the poles.

The vast majority of the populated area of the globe is contained within the banded zones, that is between 72°N and 72°S from the equator.

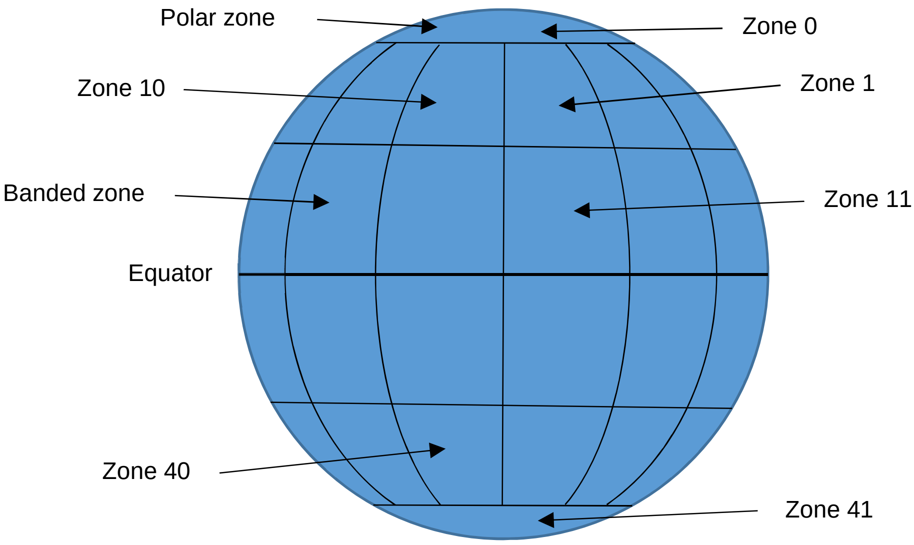


Figure F.1: Representation of the zones

The north polar zone is zone 0; the south polar zone is zone 41. The banded zones are numbered 1 to 40, in four rows of 10 zones, moving southwards and eastwards.

The identity of the zone may be determined from the SE and EE values as follows:

case ($SE < 18$) zone = 0;
case ($18 \leq SE < 162$) zone = $10 \times \text{int}((SE - 18)/36) + \text{int}(EE/36) + 1$;
case ($SE \geq 162$) zone = 41;

where int indicates that only the integer part of the result is used.

Zone 1 therefore comprises the area contained within WGS84 coordinates from (36, 0) to (72, 36); zone 2 from (36, 36) to (72, 72); … ; zone 10 from (36, -36) to (72, 0); zone 11 from (0, 0) to (36, 36); and so on to zone 40 from (-72, -36) to (-36, 0). This is shown in figure F.2.

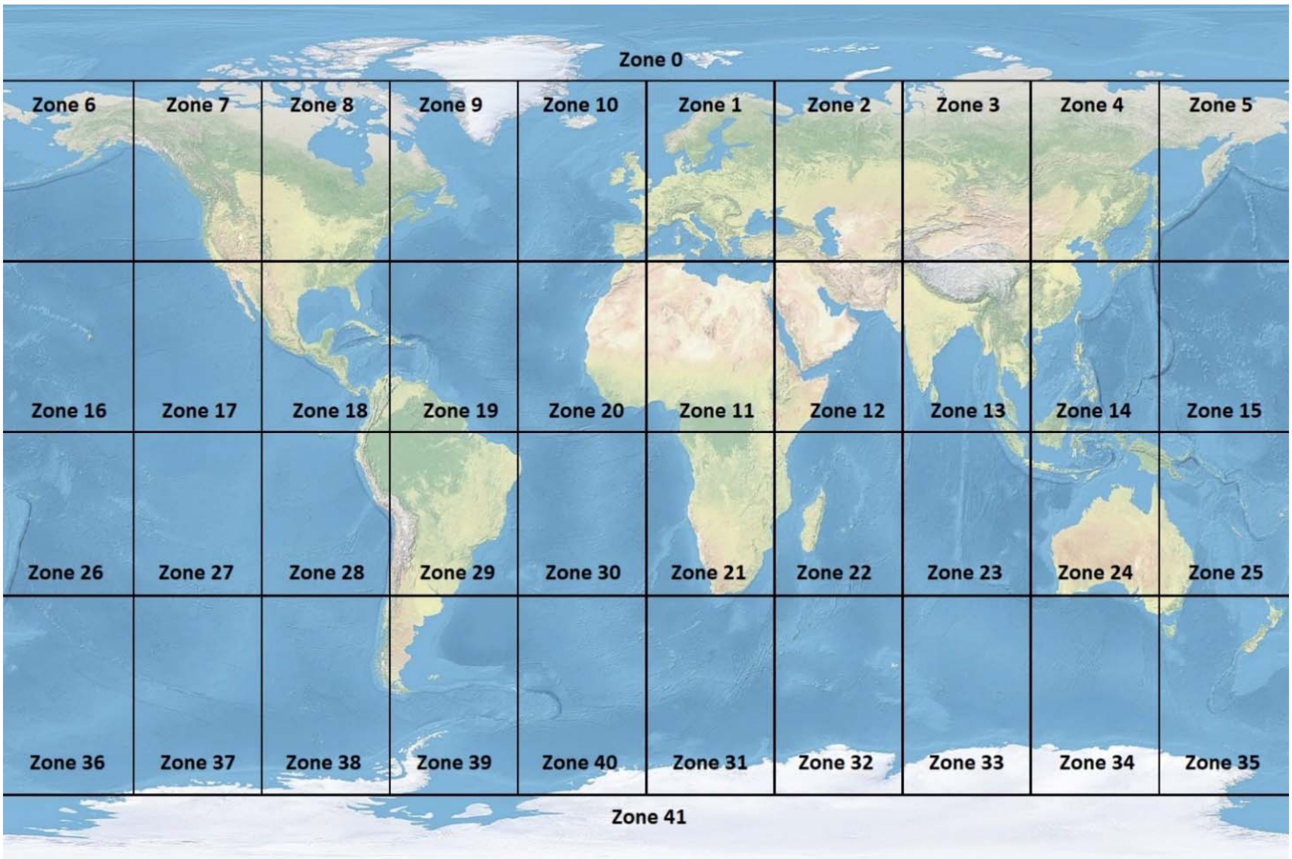


Figure F.2: Position of the zones (variant of the Mercator projection)

The polar zones have a radius of 18°, approximately 2 000 km. The zones bordering the equator are approximately 4 000 km north-south; 4 000 km at the equator, and 3 200 km at 36° from the equator, east-west. The zones adjoining the polar zones are also approximately 4 000 km north-south; 3 200 km at 36° from the equator, and 1 250 km at 72° from the equator, east-west.

F.4 Division of the banded zones

The first division of the banded zones, and all subsequent divisions, are performed as follows.

The area is divided into 16 sub-areas of equal polar co-ordinate dimensions in a 4 × 4 pattern, as shown in figure F.3. Each sub-area is numbered to identify its position, beginning at the north-west corner and moving eastwards and southwards.

NOTE: Using a 4-bit integer to identify a sub-area, the left-most (most significant) 2 bits count north-south and the right-most (least significant) 2 bits count west-east.

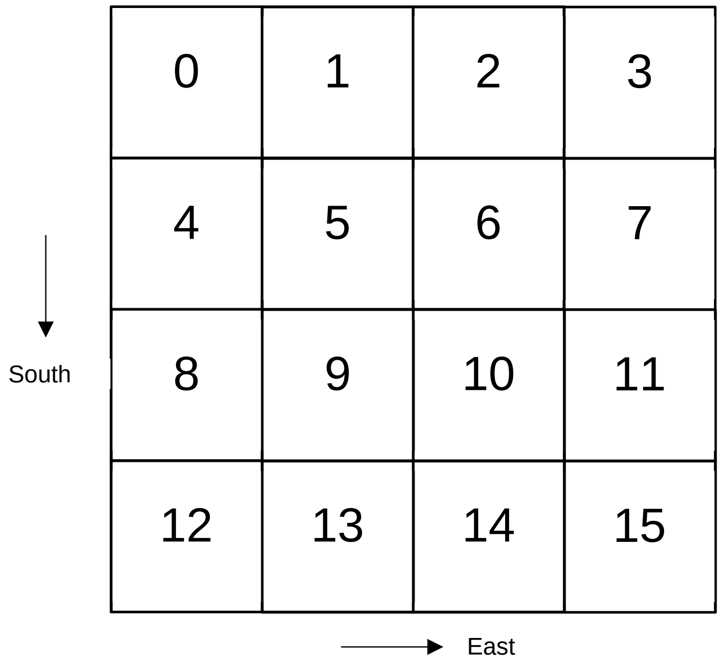


Figure F.3: Division of spherical rectangles

For any point on the earth's surface within the banded zones, the digits for the location code are calculated as follows:

> Southerly Code (SC) = int(frac((SE - 18)/36) × 2^{12}) expressed as a 12-bit integer
> Easterly Code (EC) = int(frac(EE/36) × 2^{12}) expressed as a 12-bit integer

where int indicates that only the integer part of the result is used and frac indicates that only the fractional part of the result is used.

> The Combined Code (CC) is then formed by interleaving the SC and EC, 2-bits at a time, to produce a 24-bit integer, the most significant 2-bits are from the SC, the next 2-bits from the EC, and so on. That is, the digits representing a sub-area at each level of the 24-bit integer are formed by combining piecewise 2-bits from the SC and 2-bits from the EC.

EXAMPLE: BBC Broadcasting House in London is located at WGS84 (51,5187412, -0,1434571)
First, the coordinates are translated:
SE = 90 - 51,5187412 = 38,4812588
EE = -0,1434571 + 360 = 359,8565429
Second, the zone number is calculated:
Zone = 10 × int((38,4812588 - 18)/36) + int(359,8565429/36) + 1 = 10
Third, the digits are calculated:
SC = int(frac((38,4812588 - 18)/36) × 4 096) = 2330 = $91A_{16}$ = 10 01 00 01 10 10_2
EC = int(frac(359,8565429/36) × 4 096) = 4079 = FEF_{16} = 11 11 11 10 11 11_2
CC = 1011 0111 0011 0110 1011 1011_2 = $B736BB_{16}$
The location code for BBC Broadcasting House is thus Z10:B736BB.

F.5 Division of the polar zones

The polar zones have a special coding for their first digit, because the area of a polar zone is circular. The first division of the polar zones is shown in figure F.4. Each sub-area is numbered to identify its position.

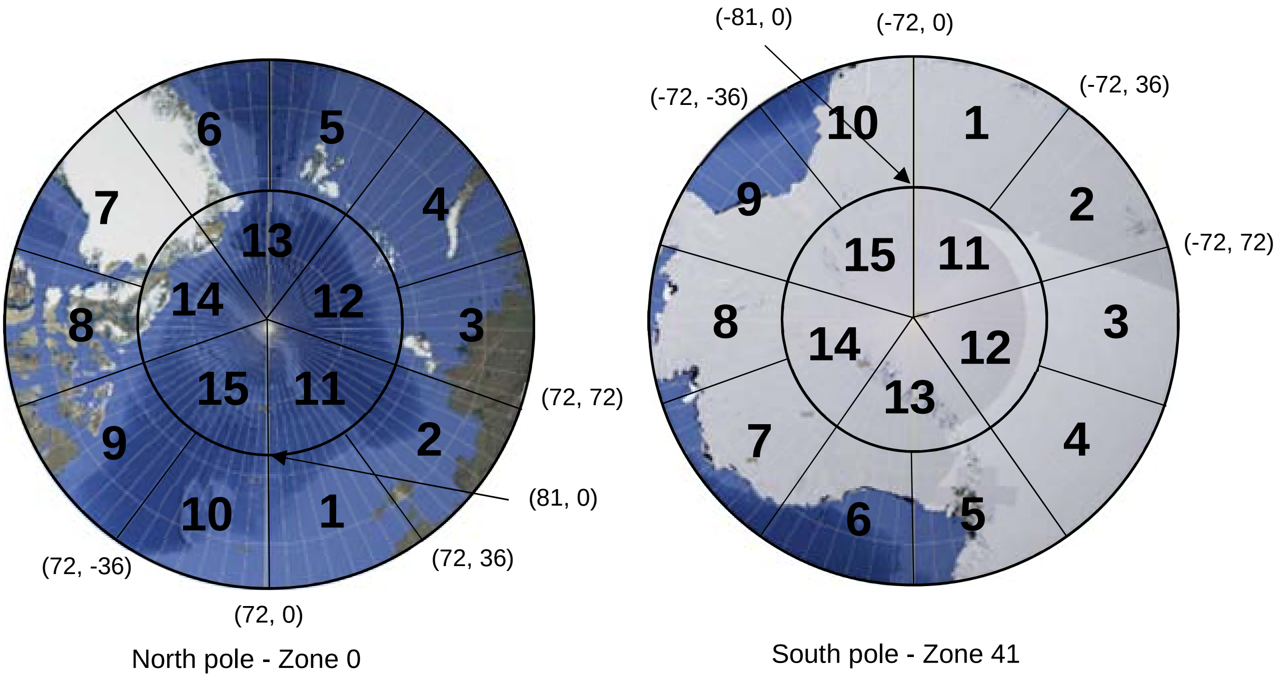


Figure F.4: First division of polar zones (WGS84 co-ordinates)

Subsequent digits are divided in the same way as for the banded zones (see figure F.3).

For any point on the earth's surface within the north polar zone, the digits for the location code are calculated as follows:

if (SE < 9) then {
Digit 1 = int(EE/72) + 11
Southerly Code (SC) = int(SE/9 × 2^{10}) expressed as a 10-bit integer
Easterly Code (EC) = int(frac(EE/72) × 2^{10}) expressed as a 10-bit integer}
else {
Digit 1 = int(EE/36) + 1
Southerly Code (SC) = int(frac((SE - 9)/9) × 2^{10}) expressed as a 10-bit integer
Easterly Code (EC) = int(frac(EE/36) × 2^{10}) expressed as a 10-bit integer};

the Combined Code (CC) is then formed by concatenating Digit 1 (most significant) with the result of interleaving the SC and EC, 2-bits at a time, to produce a 20-bit integer, the most significant 2-bits are from the SC, the next 2-bits from the EC, and so on.

For any point on the earth's surface within the south polar zone, the digits for the location code are calculated as follows:

if (SE < 171) then {
Digit 1 = int(EE/36) + 1
Southerly Code (SC) = int(frac((SE - 162)/9) × 2^{10}) expressed as a 10-bit integer
Easterly Code (EC) = int(frac(EE/36) × 2^{10}) expressed as a 10-bit integer}
else {
Digit 1 = int(EE/72) + 11
Southerly Code (SC) = int(frac((SE - 171)/9) × 2^{10}) expressed as a 10-bit integer
Easterly Code (EC) = int(frac(EE/72) × 2^{10}) expressed as a 10-bit integer};

the Combined Code (CC) is then formed by concatenating Digit 1 (most significant) with the result of interleaving the SC and EC, 2-bits at a time, to produce a 20-bit integer, the most significant 2-bits are from the SC, the next 2-bits from the EC, and so on.

NOTE: In the polar zones, the linear dimension of the edge of spherical rectangles that touch the pole is 0.

EXAMPLE: Svalbard Museum in Longyearbyen is located at WGS84 (78,222609, 15,651605)
First, the coordinates are translated:
SE = 90 - 78,222609 = 11,777391
EE = 15,651605
Second, the zone number is calculated:
Zone = 0
Third, the digits are calculated:
Digit 1 = int(15,651605/36) + 1 = 1
SC = int(frac((11,777391 - 9)/9) × 1 024) = 316 = $13C_{16}$ = 01 00 11 11 00_2
EC = int(frac(15,651605/36) × 1 024) = 445 = $1BD_{16}$ = 01 10 11 11 01_2
CC = 0001 0101 0010 1111 1111 0001_2 = $152FF1_{16}$
The location code for Svalbard Museum is thus Z0:152FF1

History

Document history		
V1.1.1	September 2024	Publication