Emergency warnings and more...

Lindsay Cornell, BBC
ABU DBS, Kuala Lumpur, 4 March 2024

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Disasters: Designing a new Emergency Warning System (EWS)

- Following severe flooding in 2021, German authorities and broadcasters discussed the role of DAB+ in future warning infrastructure
- The German radio industry published a proposal in 2022
- WorldDAB was asked to internationalise an EWS and produce technical specifications for receiver compliance (October 2022)

The request from the Digital Radio Germany Association

Alert Messages

- Spoken message for essential information: where, when, what to do
- The Alarm Announcement feature, including the OE signalling, used to inform receivers when an alert is active

Sleep and Wake-up

- Receivers to have a sleep mode which monitors a DAB ensemble for alert signalling
- Receivers to wake-up to play the audio when an alarm announcement is detected, retuning to another ensemble if needed
- Receivers to retune to the alarm announcement if playing a different service

Receiver testing

- Create an ETSI standard describing tests that ensure that receivers react correctly to the EWS signalling
- This technical standard to be the basis for a compliance scheme with a recognisable Mark to be used on product packaging

Analysis by the WorldDAB Technical Committee: Task Force-Emergency Warning Systems

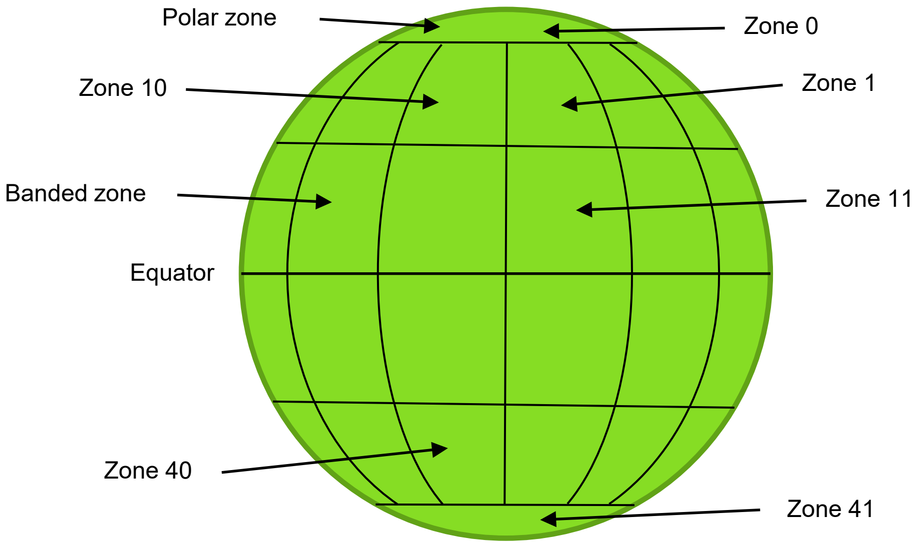
- The TF reviewed the proposed operation and requirements from Germany and identified some key issues:
  - Emergencies do not generally have the same alert area as a DAB ensemble coverage area
  - Using the existing alarm announcement signalling has legacy implications
  - Random sleep timing will lead to some lost audio at the start of an announcement
- The TF has responded by creating a novel location coding system…
  - Globally applicable
  - Lightweight with high coding efficiency
- … defining brand new signalling for EWS…
  - Identification of participating ensembles
  - Alert stage, importance, location
- … and designing a wake-up synchronisation scheme to minimise audio loss

Requirements for a universal location coding system

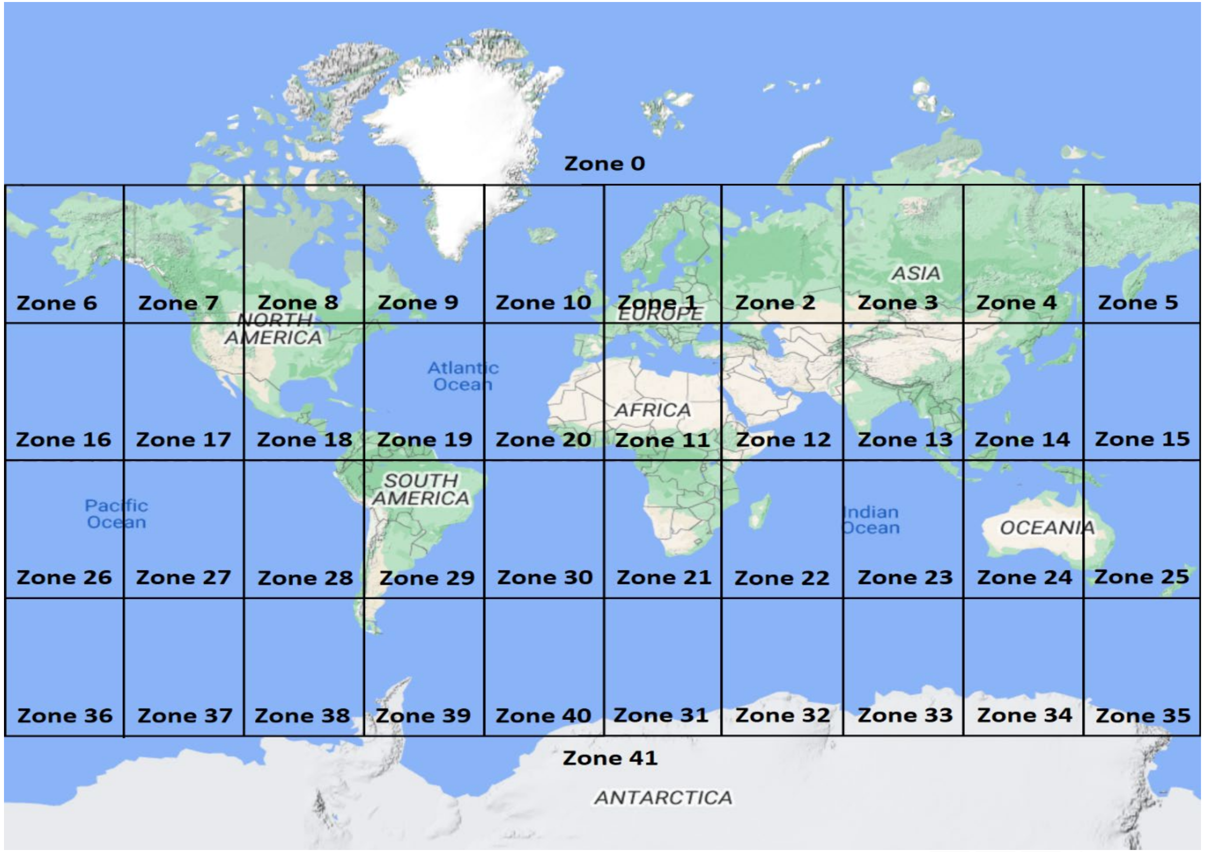
- Can be used anywhere in the world
  - Does not rely on national or regional location systems
- Has high coding efficiency
  - Localisation must be able to be transported efficiently in the DAB signalling channel
- Has a simple algorithmic determination
- Is applicable to low-cost devices
  - No complex operations in the device
  - No need for additional capabilities in a domestic (static) device (like GNSS)
  - Easy user programming of its location

Basic concept

- The earth is divided into areas using a hierarchy of spherical rectangles
- The first division is into a number of “zones”
  - The zones are of equal polar coordinate dimensions
  - They should be of the right “granularity”
- The solution has 42 zones each $36^\circ \times 36^\circ$

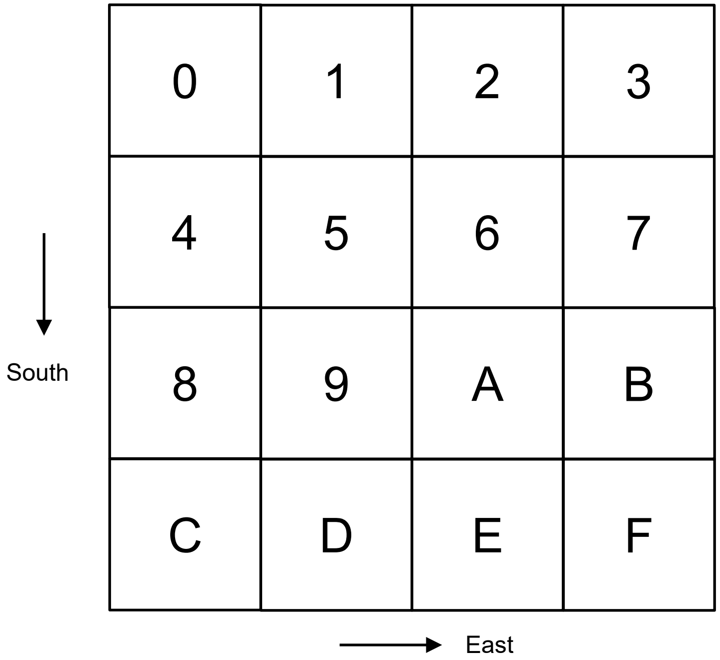


Basic concept



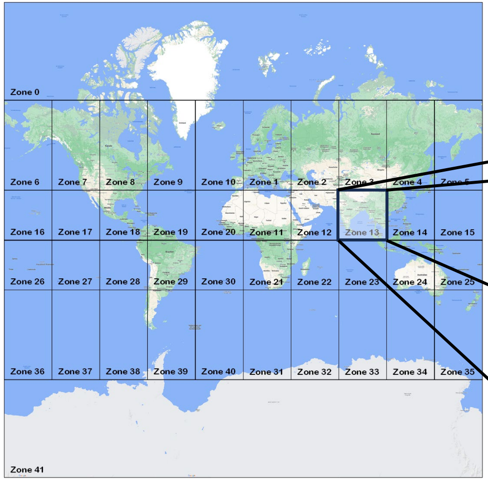
Basic concept

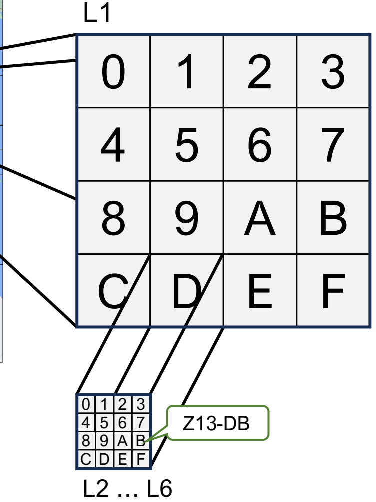
- Each spherical rectangle is divided progressively into smaller spherical rectangles to create nested divisions
- The zones are divided into sub-areas
  - The sub-areas are of equal polar coordinate dimensions
  - A binary division in both dimensions creates an efficient coding
- The area has 16 sub-areas
  - Each sub-area can be identified by a hexadecimal digit
  - The longer the code, the smaller the area it defines



Location Code

- Hierarchical based on WGS84 Coordinates
  - Granularity scales with code length
  - Shorter codes are larger 'squares'
  - Alert area defined by a set of codes
  - Receiver location uses a single code
- Universal
  - Provides for any location globally
  - No region-specific mechanisms
- Light-weight
  - Even very basic receivers can use it
  - No need for GNSS on fixed receivers
- Efficient
  - Compact encoding of arbitrary region
  - Fast transmission of alert area (<1sec)





NOTE: Mercator projection, Z1-Z40 are polar squares 36°x36°

Level	Size [°]	Size [km]
L0 – Zone	36.000	4003.0
L1	9.000	1000.8
L2	2.250	250.2
L3	0.563	62.5
L4	0.141	15.6
L5	0.035	3.9
L6	0.009	1.0

NOTE 1: Polar zones (Z0, Z41) extend 18° from pole
NOTE 2: Length of spherical rectangles is only independent from latitude in N-S direction. Given sizes apply to E-W direction only at equator.

Device location

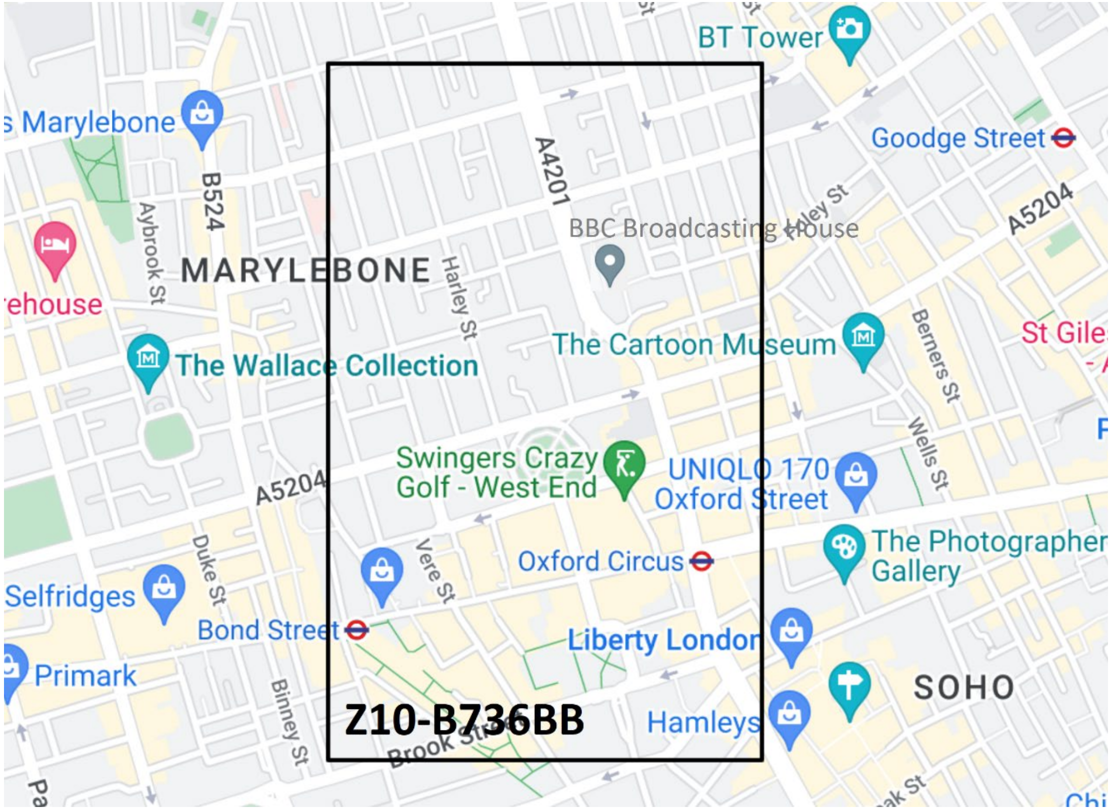
- In order to use localisation, the device needs to know its location
  - For a low-cost, static device like a kitchen radio, this probably means a user entered code, the code being generated by an app or website
  - For a higher specification device, it might be input from an app or website via Bluetooth or wifi
  - For a mobile device, for which the location is changing, GNSS is probably the best source of the location code, calculated from the WGS84 coordinates

Location coding 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 number = 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 = 10 01 00 01 10 10
  - EC = int(frac(359,8565429/36) × 4 096) = 4079 = FEF = 11 11 11 10 11 11
  - CC = 1011 0111 0011 0110 1011 1011 = B736BB
- The location code for BBC Broadcasting House is thus Zone 10, B736BB

Location coding example

- The location of BBC Broadcasting House within Zone 10, B736BB



Presentation format

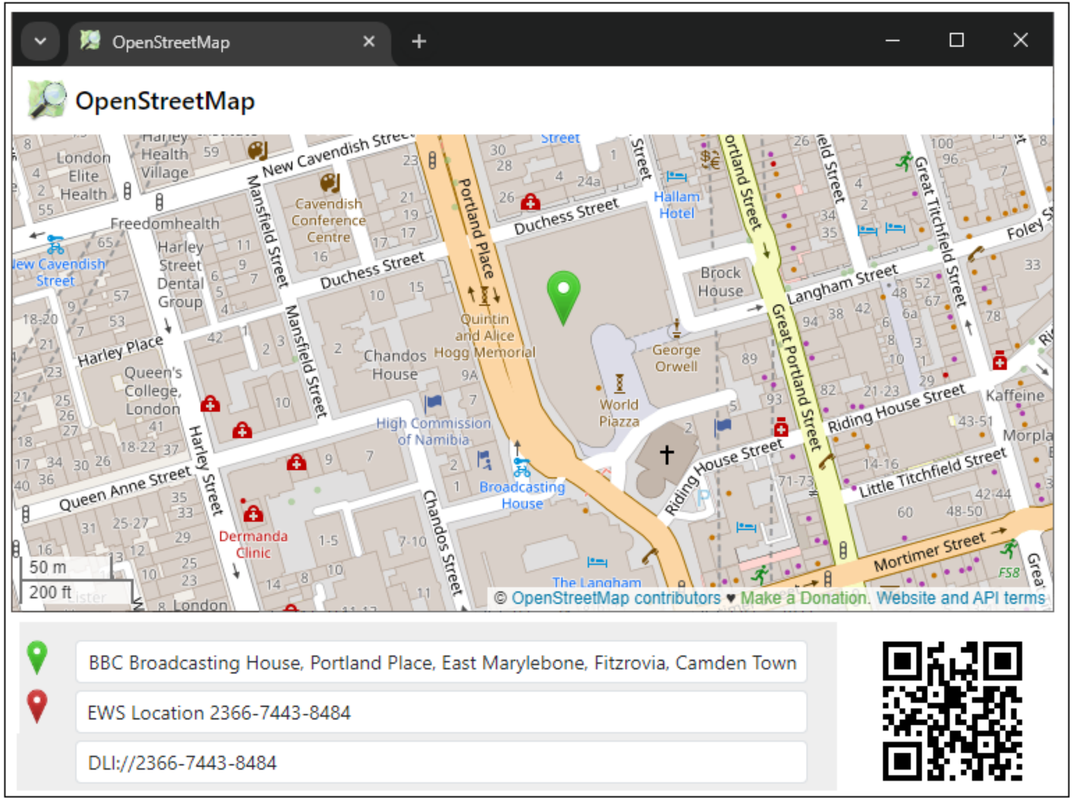
- The coding of DAB location codes optimised for signalling efficiency, but it is not very human friendly
- The presentation format is designed for entry on receivers with basic user controls, such as up/down/select functionality
- The DAB location code at maximum resolution is a 30-bit binary coded integer
  - The most significant 6 bits represent the zone
  - 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
- 1 is added to each octal digit to give the symbols “1” to “8” and the blocks separated with hyphens

Presentation format - example

- The location code for BBC Broadcasting House is Zone 10, 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

Presentation example

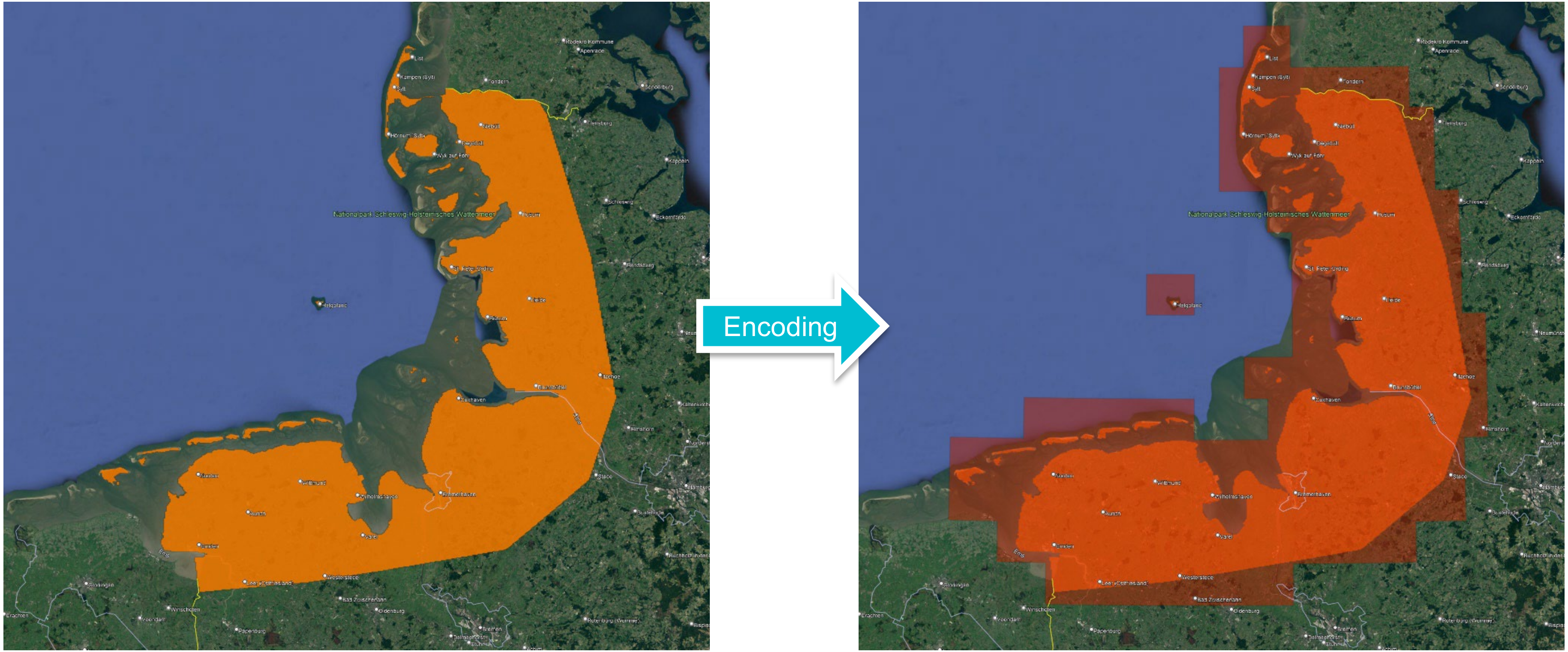
- We envisage a web page or app would provide users with the means to easily generate their receiver presentation code



Alert area

- The alert area will be represented by a number of location codes
  - Shorter location codes represent larger areas
- The device compares its location code with each location code provided in the FIC that represents the alert area
  - Because of the code hierarchy, if a received alert area location code has fewer than 6 digits, only the corresponding digits of the device's location code are compared: if they match then the device is located within the alert area – the additional digits describe an area within the shorter code

Example: Severe weather warning for Northern Germany



Requirements for sleep/monitor/wake

- Sleep state must consume almost no power
  - So as many functions as possible need to be switched off
- Monitor state must be as short as possible
  - The information to make a decision needs to be there quickly
- The audio message should be heard in full, even when switching from another DAB signal
  - So the receiver monitoring period needs to be aligned with the start of alert signalling

Basic concept for sleep/monitor/wake

- The alert signalling is time aligned
  - DAB provides a time signal with ms accuracy
- Devices all enter the monitor state together
  - The information for all alerts is processed and devices decide based on their location and knowledge of available DAB signals whether to start playing the audio alert
- Alerts ideally are made at the start of a minute (i.e. when the seconds count is 00)
  - But the system will also work if an alert is made at any time, but with loss of audio replay for sleeping devices

Thank you

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