Overview of the DAB+ System

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DAB Family of Standards
DAB+ Features
Ensemble Structure
System Structure
Network Options
The Future

Overview of the DAB+ System
Welcome to the DAB Family of Standards

One family provides the most cost effective delivery of digital radio and mobile TV

An introduction
The DAB Family of Standards

- **DAB** : 1995  Original audio with PAD and data services standard
- **T-DMB** : 2006  Added video services for Mobile TV and enhanced data streaming
- **DAB+** : 2007  Enhanced audio service efficiency

Why DAB+?

- One family provides the most cost effective delivery of digital radio and mobile TV
- 2.5 times more audio services than DAB due to the use of HE AAC+ v2
- Slightly better coverage – 1 to 2dB better than DAB – better FEC coding
- More flexibility for Programme Associated Data delivery
- PAD content has much stronger error protection
For detailed description of the DAB+ system refer to the following ETSI standards documents:

- **EN 300 401**: Main document
- **TR 101 496-1, -2, -3**: Guidelines of use and operation
- **TS 102 563**: Transport of AAC audio

See [http://www.worlddab.org](http://www.worlddab.org) or [http://www.etsi.org/standards](http://www.etsi.org/standards)
DAB+ Features

Overview of the DAB+ System
Audio - Room for Lots of Services
Australian example

Simulcast stations (AM / FM)

new DAB+ only stations

DAB+ Features
Choose the station from a list

No more need to remember the station’s frequency!!!

Easy to choose a station, listener has more information about the services available.

DAB+ Features
Programme Associated Data (PAD)
Dynamic Label Segment – Text Delivery

- Straight forward, effective
- Up to 128 characters per text segment
- All DAB+ receivers have DLS text display
- Good receivers block text display or appropriate scrolling speed

DAB+ Features
Programme Associated Data

Slideshow (SLS) Images

Further strengthens the audio message

Standalone advertising during song items

Promotion of station activities

Traffic and weather reports

Sports results and stock market information

Local news, happenings, community events

DAB+ Features
Data Services

Electronic Programme Guide (EPG)

- Very useful tool for promotion of programs, talent, competitions
- Especially useful for multilingual national broadcasters with scheduled programme slots
- Is flexible, can be station, network or ensemble based
- Some receivers can record programs for later listening

DAB+ Features
Data Services – Other

Traffic e.g. TMC and TPEG can provide up to the moment information on
• current traffic flow and congestion
• fuel locations and prices
• parking

Journaline
• Hierarchical categorised text service

Custom Applications can be developed

DAB+ Features
Ensemble Structure

Overview of the DAB+ System
Ensemble Structure

Multiple different radio stations transmitting on the same frequency

Multiple different radio stations use the same transmitter

Multiple different radio stations share the cost of that single transmission

Very flexible to ensure the broadcaster can deliver the content they provide in the most cost effective manner
Ensemble Structure

An Ensemble will typically carry multiple services from multiple radio networks, for example:

- Network 1 – 2 stations (services) 128kbps
- Network 2 – 4 stations 256kbps
- Network 3 – 3 stations 192kbps
- Network 4 – 9 stations 576kbps

**Total 18 stations 1152kbps**

- Each network can have their own allocated capacity on the ensemble
  - No other network has access to that capacity
- Each network can **reconfigure** their allocated capacity anytime without impacting the other networks’ services
  - **Pop-up services** change their name and sometimes bit rate regularly
Ensemble Structure

Network 1 allocation, e.g. 128kbps
- Station A: Sub-Channel 0, 64kbps
- Station B: Sub-Channel 1, 64kbps

Network N allocation, e.g. 192kbps
- Station X: M, 32kbps
- Station Y: M+1, 64kbps
- Station Z: M+2, 96kbps

Total Capacity = 1152kbps (FEC = EEP3A)
Ensemble Structure

Each ensemble has

- its own Ensemble Label
- its own unique Ensemble ID code
- can carry a unique identifying code of the transmitter (TII)
- a Signalling Channel – the Fast Information Channel (FIC)
  - Provides details about all services (stations) carried
    - Service labels
    - Bit rates
    - Data location in the stream
  - Provides details of all data services and PAD
  - Provides announcements and warnings
System Structure

Overview of the DAB+ System
Example DAB+ network

Studio 1
- PAD system
- Audio Encoders x N
- Local Controller
- Service Mux (Opt)

Studio N
- PAD system
- Audio Encoders x M
- Local Controller
- Service Mux (Opt)

Broadcast System
- Ensemble Controller
- EMUX
- DMUX
- Switch / Router
- Telecoms cloud
- COFDM
- Main Transmitter
- Repeater Transmitter
- Telecoms cloud

IP is generally preferred for both contribution networks and distribution networks.

System Structure
HE AAC+ V2 audio encoding table combinations

<table>
<thead>
<tr>
<th>Sampling rate (kHz)</th>
<th>SBR on</th>
<th>Min</th>
<th>Max</th>
<th>Min</th>
<th>Max</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>no</td>
<td>24</td>
<td>192</td>
<td>24</td>
<td>192</td>
<td>16</td>
<td>176</td>
</tr>
<tr>
<td>24</td>
<td>yes</td>
<td>24</td>
<td>136</td>
<td>24</td>
<td>48</td>
<td>16</td>
<td>64</td>
</tr>
<tr>
<td>32</td>
<td>no</td>
<td>24</td>
<td>192</td>
<td>24</td>
<td>168</td>
<td>16</td>
<td>168</td>
</tr>
<tr>
<td>16</td>
<td>yes</td>
<td>24</td>
<td>136</td>
<td>24</td>
<td>48</td>
<td>16</td>
<td>64</td>
</tr>
</tbody>
</table>

Many combinations to allow the most cost effective delivery of different audio content types.

Coding Technologies / Dolby AAC+ implementation
DAB+ Audio Encoding

Spectral Band Replication

Efficient sample rate and bit rate reduction method

Only slight audio degradation

System Structure
DAB+ Audio Encoding

Signal Flow with outer layer FEC

Outer layer of FEC coding and interleaving provides protection for PAD – especially important to ensure robust SLS image delivery.

Figure 1: Conceptual diagram of the outer coder and interleaver
Audio - PAD

PAD for DLS and SLS delivery

XPAD size, music/speech flag, command channel

Figure 2: Coding of the PAD field

Table 10: Maximum bit rate of F-PAD and X-PAD data

<table>
<thead>
<tr>
<th>AAC core sampling rate</th>
<th>Maximum bit rate for F-PAD data (2 bytes)</th>
<th>Maximum bit rate for X-PAD data (196 bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 kHz</td>
<td>267 bps</td>
<td>26,133 bps</td>
</tr>
<tr>
<td>24 kHz</td>
<td>400 bps</td>
<td>39,200 bps</td>
</tr>
<tr>
<td>32 kHz</td>
<td>533 bps</td>
<td>52,267 bps</td>
</tr>
<tr>
<td>48 kHz</td>
<td>800 bps</td>
<td>78,400 bps</td>
</tr>
</tbody>
</table>

Typical use: SBR on @ 24kHz core sampling rate, 3 frames per super-frame, 1 super-frame per 120mS

System Structure
Audio Bit Rates v PAD Bit Rate

Need to ensure the correct balance between audio bit rate, audio settings and PAD

Audio bit rate ≈ Sub-Channel bit rate *0.9 – PAD bit rate

SLS images are best synchronised with audio using pre-delivered images and header update display triggers, either

TriggerTime = time/date or
TriggerTime = now
Signal Flow - Transmitter

DAB+ Outer layer FEC coding and interleaving here

sound service $N$

audio encoder

channel encoder

time interleaver

MUX

data encoder

channel encoder

time interleaver

MUX controller

FIC generator

sync generator

frequency interleaver

OFDM

DAB signal

Figure 4.3.1: Conceptual block diagram of the EUREKA DAB system transmitter drive
## FEC Code Rate Comparison

<table>
<thead>
<tr>
<th>FEC Code</th>
<th>Code Rate</th>
<th>Capacity (kbps)</th>
<th>Number of 64kbps channels</th>
<th>Approximate power required relative to 3A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>1/4</td>
<td>576</td>
<td>9</td>
<td>-3 to -6dB</td>
</tr>
<tr>
<td>2A</td>
<td>3/8</td>
<td>864</td>
<td>13</td>
<td>-2 to -3dB</td>
</tr>
<tr>
<td>3A</td>
<td>1/2</td>
<td>1152</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>3B</td>
<td>2/3</td>
<td>1536</td>
<td>24</td>
<td>+3dB</td>
</tr>
<tr>
<td>4A</td>
<td>3/4</td>
<td>1728</td>
<td>27</td>
<td>+6dB</td>
</tr>
</tbody>
</table>

Payload capacity and transmit power can be traded
Stronger FEC protection = lower capacity BUT lower power for the same coverage area
Transmission Structure

Signalling and service information is sent in the Fast Information Channel

![Diagram showing the transmission frame structure](image)

- **Transmission frame**: 96mS
- **Synchronization Channel**
- **Fast Information Channel (FIC)**
- **Main Service Channel (MSC)**

- **Fast Information Blocks (FIBs)**
- **Common Interleaved Frame(s) (CIFs)**

*Figure 2: Transmission mode independent description of the FIC and MSC*
DAB+ Transmission – Australian VHF channels

Initial Band III allocation for metro cities

2 DTV channels allocated = 14MHz = 8 DAB channels = 8A, B, C, D, 9A, B, C, D
RF Spectrum

Signal bandwidth = 1536 carriers at 1kHz each => 1.535MHz
Channel bandwidth = 1.712 MHz

Figure 4.3.4: Example of DAB transmitted signal spectrum (VHF band III)

Far off adjacent power at <-60dB

Channel edge shoulders at -40dB
Network Options
Star Network

- Central multiplexing equipment
- Individual links per studio site
- Simple networking
- Stations are in control of their content
- Privacy

This architecture is often used for stand-alone / isolated installations such as single city or area transmissions
Star Network

Redundant common ensemble multiplexing and transmitters

Number of service encoders, PAD and redundancy can vary between broadcasters

Network Options
Mesh Network

- Transparent interconnect between sites
- High Redundancy and Reliability
- Typically uses a multicast enabled VPN
- Content produced at any site can be transmitted at any site

Suitable for distributed broadcast networks such as national multi-studio networks

Network Options
Monitoring Equipment - Overview

Service Monitor  |  Ensemble Recorder

ETI Monitor  |  Tx Monitor

In-Field Monitors  |  Repeaters

Listeners

Multiple monitoring points throughout the system allow rapid fault finding and rectification.

Listeners provide the ultimate feedback!!

Network Options
Network Management System

Network Management is essential for rapid fault detection and correction.

Virtually all equipment now has SNMP fault reporting.

Remote access via web interface allows best grade of service.

Network Options
Examples of DAB+ multiplexer and transmitter equipment
The Future

Overview of the DAB+ System
The Future – Hybrid Radio

Hybrid Radio combines digital radio broadcast to deliver audio and common PAD to many AND the internet to provide individual actions and services.

DL+ and CAT-SLS are examples of Hybrid Radio.

Providing More Information to listeners on demand.

Tagging and reminders for later content use.

The standards are being written now!
What is Hybrid Radio

Transmission Information from Broadcaster

Free to Air DAB+ broadcast with PAD

Telco network

Broadcast interaction

Broadcaster

WiFi connection

Bluetooth connection for browser actions

Hybrid Radio Touchscreen for basic actions

3rd Party services

Home Operation
What is Hybrid Radio

Free to Air DAB+ broadcast with PAD

DAB+ capable mobile phone can use full range of hybrid functions

Transmission Information from Broadcaster

Mobile network

Mobile internet

3rd party services

Broadcast interaction

Broadcast

World DM B
Digital Multimedia Broadcasting
Radio • Mobile TV • Multimedia • Traffic Data

Mobile Operation
More Information: Use Case Example 1 – connection to an advertiser

Hybrid Radio Use Cases

Accessing a website from a URL delivered associated with a product / service being advertised
More Information: Use Case Example 2 – Artist Information

Listeners can access more information about the current artist, tour dates, biographical info, purchase

Hybrid Radio Use Cases
More Information: Use Case Example 3 – Public Information

Accessing a website from a URL delivered associated with the information provided

Button press

Hybrid Radio Use Cases
More Information: Use Case Example 4 – Sports Results

Drives listeners to use additional broadcaster facilities, value add advertising and cross promotion

What sport is on tonight, current and previous results, betting
Overview of the DAB+ System

Summary – Top Tips

1. DAB+ is the best Digital Radio delivery system available
2. Proven technology
3. Cost effective infrastructure
4. Deployed worldwide and expanding rapidly
5. Very flexible operation for broadcasters
6. Huge range of receiver products
7. Great features including scrolling text, images, EPG and data services
8. Many new developments including Interactivity
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