

# PLANNING PARAMETERS FOR DAB IN VHF BAND III

Over the last few years, Digital Radio has increasingly been adopted, with the DAB<sup>1</sup> system being the most widespread standard. Many countries, especially in Europe, are extending and updating their existing DAB networks to enhance their radio offerings, to meet the higher quality expectations of listeners and to reduce energy consumption. This guide provides a quick overview of the main parameters to be considered for DAB network planning in VHF Band III.

### BACKGROUND

In May 2018, the EBU published technical report TECH 3391 [1], jointly developed with Broadcast Networks Europe (BNE), providing comprehensive guidance on key elements that are necessary to plan and design a DAB network in VHF Band III. The core update of DAB planning parameters focused on:

- C/N values
- Receiver noise figure
- Antenna gain relative to half dipole
- Allowance for man-made noise
- Building entry loss and its standard deviation
- Location variation standard deviation
- Adjacent channel protection ratios

TECH 3391 even includes specific implementation scenarios as developed in some countries and several annexes with detailed topics of interest not publicly available elsewhere. The aim of this summarized guide is to provide a quick overview of the main parameters used for DAB network planning in VHF Band III. For more details, please consult [1].

### RECEPTION MODES

Fixed rooftop reception is generally not considered a relevant scenario for digital radio. In most cases, DAB networks are planned for portable or mobile reception: six reception modes are considered, as listed in Table 1, covering portable and mobile reception scenarios for handheld, kitchen radio and vehicle installed devices.

	Reception mode	Channel model		Receiver type	Antenna Type*	High speed 120 km/h
1	Mobile reception (MO)	Rural	RA 6	Mounted inside the car and connected to the car antenna	Mounted outside the vehicle	Yes
2	Portable outdoor reception (PO)	Urban/ Sub-urban	TU 12	Stand-alone (table top or kitchen type)	Built-in (folded or telescopic)	No
3	Portable indoor reception (PI)	Urban/ Sub-urban	TU 12	Stand-alone (table top or kitchen type)	Built-in (folded or telescopic)	No
4	Handheld portable outdoor reception (PO-H/Ext)	Urban/ Sub-urban	TU 12	Handheld (e.g. smartphone type)	External (e.g. wired headset or telescopic)	No
5	Handheld portable indoor reception (PI-H/Ext)	Urban/ Sub-urban	TU 12	Handheld (e.g. smartphone type)	External (e.g. wired headset or telescopic)	No
6	Handheld mobile reception (MO-H/Ext)	Rural	RA 6	Handheld (e.g. smartphone type)	External (e.g. wired headset or telescopic)	Yes

**Table 1: Summary of reception modes considered in this document**

\*For more details on receiver and antenna types considered in this document, see [1].

Annex 1 provides, as an example, some selected planning parameters and the resulting signal levels for DAB in VHF Band III, with reference to the six reception modes introduced in Table 1.

## COVERAGE PREDICTION HEIGHT

All relevant scenarios for DAB assume reception at no less than 1.5 m above ground level (a.g.l.). Predictions for different heights (e.g. 10 m a.g.l.) require the application of a height loss correction factor,  $L_h$  (dB), for the calculation of minimum median power flux density (see [2] for further details).  $L_h$  depends on the frequency and the receiving environment and can be derived by using the methodology proposed in the Recommendation ITU-R P.1546 [3], as shown in Table 2 for different receiving environments and some typical clutter heights.

Receiving environment	Reference frequency [MHz]	Representative clutter height [m]	Height loss $L_h$ from ITU-R P.1546 methodology [dB]
Dense urban	200	30	22
Urban	200	20	19
Suburban	200	10	12
Rural	200	10	12

**Table 2: Height loss for different environment classes and typical clutter heights**

For planning purposes, height loss values can be calculated using the methodology proposed in [3] with relevant clutter heights for the country or the area under examination.

## TRANSMISSION MODE

The latest version of the DAB standard published in 2017 by ETSI [4] includes only Transmission Mode I, which is primarily intended to be used for terrestrial Single Frequency Networks (SFNs) and Multiple Frequency Networks (MFNs) in VHF Bands. Table 3 lists the main characteristics of this transmission mode and the considered protection level for network planning.

System parameter	Value
Number of carriers	1536
Carrier spacing [kHz]	1
Useful Symbol duration [ $\mu$ sec]	1000
Guard interval [ $\mu$ sec]	246
Total Symbol Duration [ $\mu$ sec]	1246
Protection level EEP (DAB+ audio and data)	3A2
Code rate	1/2
Net bit rate [kbit/sec]	1152

**Table 3: Characteristics of Transmission Mode I and considered protection level for planning**

## REFERENCES

- [1] EBU TECH 3391 - GUIDELINES FOR DAB NETWORK PLANNING - *Geneva, May 2018*
- [2] EBU TECH 3317 - Planning parameters for hand held reception - *Geneva, July 2007*
- [3] ITU-R Recommendation P.1546 - Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3000 MHz - *September 2013*
- [4] ETSI EN 300 401 V2.1.1 - Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers - *January 2017*

## HOW CAN YOU GET INVOLVED IN EBU'S WORK?

To follow the EBU and BNE work on Sharing and Planning Terrestrial systems, you can login to the EBU Technology & Innovation website and join the group here: <https://tech.ebu.ch/groups/sspt>

<sup>1</sup> The use of the term 'DAB' applies to both DAB and DAB+ systems. Where there is a difference in the impact on network planning between the two systems, this is explained in [1].

<sup>2</sup> For other possible choices on the protection level, please refer to [1].

## ANNEX 1

### INDICATIVE PARAMETERS AND SIGNAL LEVELS FOR PLANNING

Tables 4 and 5 show, as an example, some selected planning parameters and the resulting signal levels for DAB in VHF Band III, with reference to the six reception modes introduced in Table 1 and to the protection level considered in Table 3.

		<b>Mobile reception (MO)</b>	<b>Portable outdoor reception (PO)</b>	<b>Portable indoor reception (PI)</b>
Frequency	MHz	200	200	200
Minimum C/N required by system	dB	12.6	11.9	11.9
Receiver noise figure	dB	6	6	6
Equivalent noise bandwidth	MHz	1.54	1.54	1.54
Feeder loss	dB	0	0	0
Antenna gain relative to half dipole	dB	-5	-8	-8
Effective antenna aperture	dBm <sup>2</sup>	-10.32	-13.32	-13.32
Allowance for man-made noise	dB	0.9	1.5	5.3
Entry loss (building or vehicle)	dB	0	0	10.5
Standard deviation of the entry loss	dB	0	0	8.2
Standard deviation <sup>3</sup>	dB	4	4	9.12
Location correction factor (acceptable coverage)	dB	LP 90%	LP 70%	LP 70%
		5.12	2.08	4.74
Minimum median equivalent field strength at 1.5 m a.g.l.	dB $\mu$ V/m	<b>38.64</b>	<b>38.50</b>	<b>55.46</b>
Location correction factor (good coverage)	dB	LP 99%	LP 95%	LP 95%
		9.32	6.56	14.96
Minimum median equivalent field strength at 1.5 m a.g.l.	dB $\mu$ V/m	<b>42.84</b>	<b>42.98</b>	<b>65.68</b>

**Table 4: Planning parameters for MO, PO and PI reception modes.**

		<b>Handheld portable outdoor reception (PO-H/Ext)</b>	<b>Handheld portable indoor reception (PI-H/Ext)</b>	<b>Handheld mobile reception (MO-H/Ext)</b>
Frequency	MHz	200	200	200
Minimum C/N required by system	dB	11.9	11.9	12.6
Receiver noise figure	dB	6	6	6
Equivalent noise bandwidth	MHz	1.54	1.54	1.54
Feeder loss	dB	0	0	0
Antenna gain relative to half dipole	dB	-13	-13	-13
Effective antenna aperture	dBm <sup>2</sup>	-18.32	-18.32	-18.32
Allowance for man-made noise	dB	0.5	2.4	0.2
Entry loss (building or vehicle)	dB	0	10.5	8
Standard deviation of the entry loss	dB	0	8.2	2
Standard deviation <sup>3</sup>	dB	4	9.12	4.47
Location correction factor (acceptable coverage)	dB	LP 70%	LP 70%	LP 90%
		2.08	4.74	5.72
Minimum median equivalent field strength at 1.5 m a.g.l.	dB $\mu$ V/m	<b>42.50</b>	<b>57.56</b>	<b>54.54</b>
Location correction factor (good coverage)	dB	LP 95%	LP 95%	LP 99%
		6.56	14.96	10.42
Minimum median equivalent field strength at 1.5 m a.g.l.	dB $\mu$ V/m	<b>46.98</b>	<b>67.78</b>	<b>59.23</b>

**Table 5: Planning parameters for PO-H/Ext, PI-H/Ext and MO-H/Ext reception modes.**

<sup>3</sup> The minimum median field strength values calculated use a standard deviation value of 4.0 dB as being a representative value. However, when making field strength predictions for a particular pixel it is suggested to add the prediction error and therefore to use a standard deviation value of 5.5 dB (see [1] for further details).