

# Contents

<b>Foreword</b>	<b>xi</b>
<b>Preface</b>	<b>xiii</b>
<b>List of contributors</b>	<b>xvii</b>
<b>Abbreviations</b>	<b>xxiii</b>
<b>1 Introduction</b>	<b>1</b>
1.1 General	1
1.2 Radio in the Digital Age	2
1.3 Benefits of the Eureka 147 DAB System <i>(Quality of service; Value added services; Universal system layout; Flexible multiplex configuration; Transmission efficiency)</i>	2
1.4 History of the Origins of DAB <i>(Development, Organisations and platforms such as Eureka 147; WorldDAB; Milestones of introduction)</i>	5
1.5 International Standardisation <i>(System; Audio coding; Data services; Network and transmission; Receiver; Guidelines for implementation; ETSI; IEC; ITU-R; CENELEC; CEPT; EBU)</i>	12
1.6 Relations to Other Digital Broadcasting Systems <i>(Satellite based systems Astra, Worldspace; Terrestrial Systems such as DRM, Digital television DVB-T, Digital radio in US and Japan; Web-casting)</i>	14
<b>2 System Concept</b>	<b>27</b>
2.1 The Physical Channel <i>(Multipath propagation; Doppler shifted carriers)</i>	27

2.2	The DAB Transmission System ( <i>Multicarrier modulation; Frame structure of DAB; Channel coding; Interleaving and PSK mapping; Time interleaving and overall delay; DQPSK modulation and frequency interleaving; Performance considerations</i> )	30
2.3	The DAB Multiplex ( <i>Description of the multiplex; Main service channel; Transport mechanism; FIC; Transmission frames; Logical structure; Multiplex reconfiguration</i> )	40
2.4	Conditional Access ( <i>Scrambling/descrambling; Checking/management of entitlements</i> )	48
2.5	Service Information ( <i>Basic information; Service-related information; Programme-related information; Announcements; Numerous examples; Tuning aids</i> )	50
<b>3</b>	<b>Audio Services and Applications</b>	<b>75</b>
3.1	General ( <i>MPEG Audio coding vs. 16 bit PCM</i> )	75
3.2	Audio Coding ( <i>Basic principles; Masking; Psycho-acoustic model; Filterbank; Bit allocation; Quantisation; Layer II audio bitstream; Audio decoding</i> )	76
3.3	Characteristics and Features of MPEG-1 Layer II for DAB ( <i>Audio modes; Sampling rate; Audio frame structure; Audio bit rates; Layer II vs. SBR coding technologies</i> )	84
3.4	Programme-associated Data ( <i>Dynamic Range Control DRC; Music/Speech Control; Receiving end</i> )	87
3.5	Advanced Audio Applications Using MPEG-2 Features ( <i>Multichannel audio coding; Half-sampling-rate coding; Multilingual services; Audio broadcasting for Hearing impaired</i> )	91
3.6	Quality of Service ( <i>Audio quality; Subjective assessment; Objective assessment – PEAQ</i> )	102
3.7	Error Protection and Concealment ( <i>Error protection; Concealment measures; Assessment of error performance</i> )	111
3.8	A Typical DAB Ensemble	120

3.9	Audio Levels <i>(Audio signal level alignment; Programme loudness)</i>	121
<b>4</b>	<b>Data Services and Applications</b>	<b>127</b>
4.1	General <i>(Introductory information)</i>	127
4.2	Data Service Signalling <i>(General considerations)</i>	127
4.3	Multimedia Applications with MOT <i>(Multimedia Object Transfer Protocol MOT; MOT object transport)</i>	128
4.4	Standardised MOT User Application <i>(MOT slide show; Broadcast web site; Interactive services)</i>	133
4.5	“Mobil-Info” as an Example of a Proprietary MOT User Application <i>(Presentation of video clips, news and graphic animation in a tram)</i>	137
4.6	Textual PAD Services <i>(Dynamic label; Other textual PAD services)</i>	139
4.7	Traffic Information Services and Navigation Aids <i>(Traffic massage channel TMC; TPEG; Differential GPS)</i>	140
4.8	Moving Picture Services <i>(Digital multimedia broadcast DMB; Motion PAD)</i>	143
4.9	Other Data Transmission Mechanism <i>(Transparent data channel; IP tunnelling)</i>	145
<b>5</b>	<b>Provision of Services</b>	<b>151</b>
5.1	The DAB Service Landscape <i>(Structure of DAB service organisation; Main services; Data services)</i>	151
5.2	Use of Existing Infrastructures <i>(Broadcasting operation systems; Editorial systems)</i>	157
5.3	Need for New Infrastructure <i>(Data management; Multimedia editorial tools; Data inserter)</i>	159
5.4	Relationship between DAB Data Services and RDS <i>(DAB SId vs. RDS PI code; PTy codes; DAB Announcements vs. RDS TA; DAB Dynamic label vs. Radiotext; Crossrefering DAB services from RDS)</i>	166

5.5	Electronic Programme Guide (EPG) for DAB ( <i>Development; Data formatting; Transportation and compressing; Data management; Launch of EPG; User interface</i> )	176
5.6	Possible New Audio Services ( <i>Dynamic reconfiguration; Secondary services; Announcement channels for “Near Radio on Demand”; Announcement switching; Mailbox radio</i> )	183
<b>6</b>	<b>Collection and Distribution Networks</b>	<b>187</b>
6.1	General ( <i>Requirements; Ensemble multiplexer; Broadcast network; Implementation</i> )	187
6.2	The Collection Network ( <i>Service Transport Interface STI; Network architecture; Operation; STI implementation levels; Integration of non-STI service providers; Advanced features</i> )	193
6.3	The Distribution Network ( <i>Ensemble Transport Interface ETI; Network architecture; Operation</i> )	208
6.4	Example of Implementation ( <i>Operational scenario; Service provider profile; Equipment; Experience</i> )	212
<b>7</b>	<b>The Broadcast Side</b>	<b>221</b>
7.1	General ( <i>Scope and structure of the chapter</i> )	221
7.2	Radio Frequency Propagation Aspects ( <i>The impaired RF channel; Propagation models; Propagation model for DAB; Building penetration losses</i> )	221
7.3	Introduction to DAB Networks ( <i>FM vs. DAB Networks; SFNs with DAB; Advantages of SFNs</i> )	231
7.4	Particularities of Single frequency networks (SFN) ( <i>COFDM principles; Time and frequency synchronisation; Coverage of SFNs; Gap fillers; TII features</i> )	235
7.5	DAB Transmitters ( <i>Signal processing of a COFDM modulator; D/A conversion; RF upconversion; Amplification and filtering</i> )	241

7.6	Coverage Planning <i>(Field strength, interference and delay considerations; Detailed planning; Examples of SFNs in Band III and L-band)</i>	246
7.7	Coverage Evaluation and Monitoring of SFNs <i>(Parameters; BER measurements; Timing adjustment and monitoring of SFNs)</i>	255
7.8	Frequency Management <i>(General aspects; Allocation of frequencies)</i>	260
<b>8</b>	<b>The Receiving Side</b>	<b>265</b>
8.1	General <i>(Normative receiver requirements; Receiver architecture overview)</i>	265
8.2	RF Front-end <i>(Requirements; Analogue front end architecture; Future developments)</i>	268
8.3	Digital Baseband Processing <i>(Digital front-end; OFDM demodulation; DPQSK demodulation; Deinterleaving; Viterbi decoding; Synchronisation)</i>	276
8.4	Audio Decoder <i>(Decoder architecture; Normative requirements)</i>	281
8.5	Interfaces <i>(Data interfaces; Control interfaces)</i>	283
8.6	Integrated Circuits for DAB <i>(Jessi DAB chip sets; D-Fire chip-set)</i>	284
8.7	Receiver Overview <i>(Car radios; Home tuners; PC based receivers; Portable receivers; Reference receivers)</i>	293
8.8	Operating a DAB Receiver – the Human–Machine Interface <i>(Requirements; Programme type PTy; Announcements; Frequency and service following; DAB receivers for new types of services)</i>	294
	<b>Appendices</b>	<b>299</b>
	<b>Appendix 1:</b> DAB Parameters for Modes I, II, III and IV <i>(Physical system parameters and relations)</i>	299
	<b>Appendix 2:</b> Digital Radio (DAB): Status of Introduction World-wide <i>(DAB implementations in Europe, Africa, America, Asia and Australia)</i>	301

<b>Appendix 3:</b> Frequencies for Terrestrial and Satellite DAB Transmission ( <i>CEPT frequency tables for Europe, Canada and Australia</i> )	305
<b>Bibliography</b>	<b>309</b>
Standards and Related Documents	309
Publications	313
Further Reading	320
Internet Links	321
<b>Index</b>	<b>323</b>