

## INFORMATION NOTE

### Digital Audio Broadcasting

#### 1. Background

1.1 Digital audio broadcasting (DAB) is the generic term for broadcasting audio programmes in digital form, as against the conventional analogue "amplitude modulation" (AM) and "frequency modulation" (FM) technologies. The purpose of this information note is to provide Members of the Panel on Information Technology and Broadcasting with background information on DAB with respect to its technology, features and services, implementation difficulties, and the development of DAB in the United Kingdom (UK), Singapore and the United States (US).

1.2 The UK launched the first DAB services as early as in 1995<sup>1</sup>, while Singapore was the first country in Asia to provide commercial DAB services in 1998. The US rolled out its DAB services more recently in 2003, operating on a technology platform different from that adopted by the UK and Singapore.

#### 2. Technology of digital audio broadcasting

2.1 DAB uses digital compression techniques to compress the source material such as music, speech and radio programmes into a series of digital codes before transmission. The digitalized audio content is transmitted in a format configured for reception by appropriate receivers which convert the digital codes for audio playback with a high degree of fidelity to the original material.

#### 3. Features and services provided by digital audio broadcasting

3.1 The digital transmission of DAB makes available the following features and services:

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<sup>1</sup> According to the United Nations Educational, Scientific and Cultural Organization (1998), the first DAB services in the world were launched in September 1995 by the British Broadcasting Corporation in the UK and the Swedish Broadcasting Company in Sweden.

### Efficient use of radio spectrum

3.2 At present, a whole frequency block is needed for carrying one radio channel when using analogue technologies. In contrast, DAB enables a number of signals or streams of information to be digitally combined and transmitted as a single, complex signal (known as "multiplex") over one frequency block. Indeed, a multiplex is able to carry several stereo and/or mono radio channels, as well as data and multimedia services.<sup>2</sup> In this connection, DAB improves spectrum efficiency by allowing more services/programmes to be broadcast over a given amount of spectrum than analogue transmission.

### More choices for consumers

3.3 With the use of digital transmission technologies, DAB requires less spectrum to carry the same amount of information than the existing analogue broadcasting method. Therefore, more capacity could be made available for launching new services or allowing more operators to provide services. This should benefit consumers by enhancing competition in the market, improving service quality and widening programme choices. In particular, more opportunities could be provided for developing new niche channels to serve listeners with special interests.

### Better reception

3.4 While AM/FM technology has many inherent technical limitations, such as unreliable system performance under mobile reception conditions and susceptibility to interference, DAB technology can improve over analogue transmission with less signal distortion and interference. For example, DAB technology can reduce the potential for the broadcast to be distorted by weather conditions and radio signals bouncing off high buildings and hills.

## **4. Difficulties in the implementation of digital audio broadcasting**

4.1 One of the implementation difficulties for DAB services is the lack of global agreement on technical standards. At present, there are a number of technology standards developed for delivering DAB services, including Eureka 147, In-Band On-Channel, Terrestrial Integrated Services Digital Broadcasting and Digital Radio Mondiale. These technologies have different capabilities and spectrum requirements, and are at various levels of maturity. As such, some places may take a "wait and see" approach before committing to a particular technology for rolling out their DAB services.

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<sup>2</sup> Under DAB technology, six voice channels could be transmitted in the same radio frequency that could only carry one voice channel under the analogue environment. See Radio Television Hong Kong (2005).

4.2 Simulcasting may be another concern for the development of DAB services. Simulcasting refers to the practice of simultaneously providing identical audio services via analogue and digital transmissions. Such a practice is normally considered as a transitional arrangement bridging analogue and digital broadcasting, as initially many listeners may not be equipped to receive DAB and/or DAB coverage may not be complete. However, broadcasters may incur additional costs of operating a digital station alongside the existing analogue broadcasts if there is no significant increase in listeners and revenues. In addition, simulcasting is not a spectrum efficient arrangement with the same audio services broadcast on both analogue and digital formats. Only when it is possible to switch off the analogue component of the broadcast can any large-scale expansion of listening choices be introduced.<sup>3</sup>

## **5. Development of digital audio broadcasting in the United Kingdom**

5.1 DAB services commenced in the UK with the launch of the first national multiplex by the public service broadcaster, the British Broadcasting Corporation (BBC), in September 1995 to simulcast its existing national analogue radio stations. In October 1998, the Radio Authority (the then regulator of the radio broadcasting industry) awarded the national commercial digital multiplex licence to Digital One. Digital One went on air in November 1999, with a simulcast of three national analogue stations and a number of digital-only national stations.

5.2 The Radio Authority started the licensing of local digital multiplexes in November 1998. At present, there are about 46 local digital multiplexes operating around the UK.

5.3 The UK adopts the Eureka 147 system for DAB and has allocated seven "frequency blocks" to multiplex operators. Of the seven frequency blocks, two are awarded to the national multiplex operators (BBC and Digital One) and the other five to local multiplex operators.

### Eureka 147

5.4 Eureka 147 is a protocol for DAB developed in Europe in 1986, which is now a mature technology being deployed in many places around the world. Eureka 147 uses multiplexing techniques that can combine several different radio services into a single stream of digital data. Pictures, text and other types of data can also be transmitted using this standard. It is also designed for robust reception in urban environments where reflections of the signal from buildings may cause reception difficulties for systems such as FM.

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<sup>3</sup> See Office of Communications (2004) and British Broadcasting Corporation (2004).

### Regulatory framework

5.5 In the UK, the regulation of radio broadcasting is governed by the Broadcasting Act 1996 and the Communications Act 2003. The Broadcasting Act 1996 provides for licensing and regulation of all independent radio broadcasting in the UK (i.e. all non-BBC radio services). The Communications Act 2003 establishes the Office of Communications (Ofcom) to replace the Radio Authority as the regulator responsible for licensing and regulation of all independent radio broadcasting services, which include national, local, cable, satellite, and analogue and digital services. Ofcom's three main tasks are to plan frequencies, appoint licensees with a view to broadening listener choices, and regulate programming and advertising.

5.6 BBC radio services are not licensed by Ofcom, and instead operate under the terms of the BBC's Royal Charter and Agreement. The Royal Charter establishes BBC's constitutional status and defines its general objectives and functions. It is supported by the Agreement between BBC and the UK government, which sets out the services provided to the public and how BBC will meet its general obligations. The current Royal Charter and Agreement run from 1996 until 2006.

### Licensing regime

5.7 Ofcom has instituted a two-tier licensing regime for DAB, with separate licences issued for the operation of a multiplex and the provision of audio programmes or other content. Ofcom issues digital multiplex licences to broadcast a multiplex of programme services in digital form on either a nation-wide or local coverage basis. It also issues digital sound programme licences for providing radio programme services via a digital multiplex, as well as digital additional services licences for data services being provided on a digital multiplex.

5.8 The Broadcasting Act 1996 gives a longer term of licence for DAB in recognition of the need for commercial broadcasters and multiplex operators to build business plans that allow for a five- to seven-year break-even period. Accordingly, digital multiplex licences are granted for a period of 12 years, while digital sound programme licences and digital additional services licences are both issued for an indefinite period.

5.9 Ofcom has also put in place a licensing regime which encourages analogue stations to broadcast on DAB. National analogue licences are entitled to an automatic renewal if the licensee provides a digital simulcast of the analogue service. Meanwhile, local analogue licences can be automatically renewed if the licensee agrees to broadcast a local digital sound programme service on a local radio multiplex.

### Licence allocation

5.10 Digital multiplex licences are awarded by a "beauty contest" method, whereby Ofcom awards the nation-wide and local coverage licences in an open competition to those applicants who best meet the following statutory criteria set out in the Broadcasting Act 1996:

- (a) how much of the potential coverage area the applicant plans to serve, and by what timetable this will be achieved;
- (b) whether the applicant appears able to establish the service and maintain it during the licence period;
- (c) to what extent the new radio services proposed by the applicant appeals to a variety of tastes and interests; and
- (d) whether the applicant has behaved in a way likely to ensure fair and effective competition in contracting with those radio stations or data services which wish to appear on the multiplex.

5.11 The Broadcasting Act 1996 also sets out additional criteria which Ofcom must consider when awarding the nation-wide and local coverage digital multiplex licences. When considering the application for a nation-wide digital multiplex licence, Ofcom will also examine (i) the extent to which the award of the nation-wide licence to the applicant can promote the development of DAB in the UK, and (ii) how the applicant plans to encourage listeners to invest in new digital radio sets. For the application for a local multiplex licence, Ofcom will consider the extent of local demand or support for the applicant's proposal.

### Licence conditions

5.12 Multiplex operators are required to comply with the licence conditions set out by Ofcom when rolling out their services in the UK. For example, both national and local multiplex operators are allowed to carry broadcast data, but they cannot apply more than 20% of the multiplex capacity to non-programme associated services. The licence conditions also include the provision which stipulates the minimum bit-rate<sup>4</sup> that must be used for each service on the multiplex. Furthermore, multiplex operators are also obliged to comply with the "must carry" obligations, under which the holder of a multiplex licence may have to reserve some capacity on the multiplex to carry at least one BBC local service.

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<sup>4</sup> Bit-rate is the rate at which digital information is carried within a specified communication channel. Generally speaking, a higher bit-rate provides better audio quality, but a lower bit-rate allows for more services to be accommodated in a given amount of spectrum.

5.13 Both digital sound programme licensees and digital additional services licensees are required to comply with the licence conditions set out in the Ofcom Broadcasting Code. The Code, which came in force on 25 July 2005, covers areas such as:

- (a) fairness – broadcasters must avoid unjust or unfair treatment of individuals or organizations in programmes;
- (b) privacy – broadcasters must avoid any unwarranted infringement of privacy in programmes and in connection with obtaining material included in programmes;
- (c) protecting the under 18s against material that might seriously impair their physical, mental or moral development;
- (d) adequate protection for members of the public from harmful and/or offensive material; and
- (e) sponsorship and use of advertisements in programmes.

#### Roll-out of digital audio broadcasting services

5.14 According to Ofcom<sup>5</sup>, digital radio is further developed in the UK in terms of the number of stations providing DAB services and consumer take-up than in any other European market.

#### *Coverage*

5.15 In the UK, digital radio coverage has improved rapidly in recent years, with the majority of population (over 89%) being covered by at least one multiplex and most by three or more multiplexes (the national commercial, the national BBC and local commercial multiplexes) as at July 2005.

5.16 There are currently 48 digital multiplexes transmitted by DAB in the UK: two national multiplexes and 46 local multiplexes. BBC's national multiplex carries a simulcast of its five analogue network stations as well as five digital-only stations and the BBC World Service. In addition, BBC is piloting two data services which provide an electronic programme guide<sup>6</sup>, and travel and traffic information. The other national multiplex operator, Digital One, carries a simulcast of three independent national analogue stations and five-digital only stations. A data service offering games, background information and interactive applications is being piloted on the Digital One network.

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<sup>5</sup> See Office of Communications (2004).

<sup>6</sup> Electronic programme guide is an electronic version of a printed programme guide, providing free and useful programme information to listeners in advance prior to broadcast.

5.17 Local DAB commercial services are available from the 46 local multiplexes around the UK. Digital versions of the relevant BBC local radio services are also carried on the appropriate local commercial multiplexes. A total of 196 digital radio stations were carried on local multiplexes at end-April 2005.

5.18 Urban areas typically have around 30 stations available through DAB digital radio (11 BBC, eight Digital One, and around seven to 10 on each relevant local multiplex). However, rural areas tend to have fewer stations, as the allocation of spectrum for DAB has been concentrated on maximizing the number of digital services which could be provided in most of the major population centres of the UK.

### *Consumer take-up*

5.19 In the UK, there has been a rapid take-up of DAB digital radio sets<sup>7</sup> since the start of 2003, with the total cumulative sales of DAB digital radio sets jumping to 1.3 million units at end-2004 from 470 000 units at end-2003. As a corollary, the percentage of the UK households owning at least one DAB product increased to 4%<sup>8</sup> from 2% over the same period.<sup>9</sup>

5.20 The rapid take-up of DAB digital radio sets has been attributable to the availability of more affordable models in the market, which is made possible by advances in chip technology and processing power. In particular, the launch of the first sub-£100 (HK\$1,430)<sup>10</sup> portable digital radio in July 2002 received favourable response from the UK customers.<sup>11</sup> In 2004, the average price of DAB digital radio sets fell below £100 (HK\$1,430), with some models being available for less than £50 (HK\$715). The growth of DAB radio sales has also been driven by the increasing range of receivers available to the public. At end-2004, there were 149 models of receiver available to consumers, compared with 15 at early-2002.

5.21 Awareness of DAB among consumers has also increased substantially in recent years. According to a survey commissioned by the Digital Radio Development Bureau<sup>12</sup>, consumer awareness of DAB in the UK stood at 59% of the adult population, or 29 million people, in January 2005. This represented an increase of 16 percentage points in consumer awareness from 43% in January 2004.<sup>13</sup>

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<sup>7</sup> A DAB digital radio set is referred to any type of product capable of receiving DAB services, such as portable radio, clock radio and boombox.

<sup>8</sup> See Digital Radio Development Bureau & Digital One (2005).

<sup>9</sup> According to a forecast, the cumulative sale of DAB digital radio sets would reach 2.8 million units by end-2005 and 20 million units by end-2009. The household penetration rate would increase to 8% by end-2005 and further to 40% by end-2009. See Digital Radio Development Bureau & Digital One (2005).

<sup>10</sup> The calculation was based on the average exchange rate of HK\$14.3 per British pound in 2004.

<sup>11</sup> Previously, the average price for a Eureka receiver in the UK ranged between £150 (HK\$2,145) and £250 (HK\$3,575). See Department of Communications, Information Technology and the Arts (2004).

<sup>12</sup> The Digital Radio Development Bureau is an industry body that aims to promote and encourage the take-up of digital radio in the UK. It is funded by both BBC and commercial multiplex operators.

<sup>13</sup> See Digital Radio Development Bureau (2005).

## **6. Development of digital audio broadcasting in Singapore**

6.1 DAB services commenced in Singapore on 19 November 1999, when the MediaCorp Radio launched Asia's first commercial multiplex – SmartRadio – to carry a simulcast of six FM stations. The Singapore Broadcasting Authority, the then regulator of the broadcasting industry, chose Eureka 147 as the technical standard for DAB after an intensive evaluation of the digital broadcasting technologies available.

6.2 In January 2001, Rediffusion (Singapore's sole subscription radio broadcaster) received its DAB broadcast service licence to simulcast its two analogue pay radio channels, Gold and Silver, on the multiplex operated by MediaCorp Radio. In April 2005, Rediffusion was awarded another licence to provide the world's first DAB subscription service and operate its own multiplex.

### Regulatory framework

6.3 In Singapore, radio broadcasting is governed by the Media Development Authority of Singapore Act and the Broadcasting Act. The Media Development Authority of Singapore Act establishes the Media Development Authority of Singapore (MDA) as the promoter and regulator of the media industry in Singapore. MDA was formed on 1 January 2003 from the merger of the Singapore Broadcasting Authority, the Films and Publications Department and the Singapore Film Commission.

6.4 The Media Development Authority of Singapore Act also sets out the powers, functions and duties of MDA. In particular, MDA is responsible for:

- (a) exercising licensing and regulatory functions in respect of media services in Singapore;
- (b) encouraging, promoting and facilitating the development of the media industry in Singapore;
- (c) maintaining fair and efficient market conduct as well as effective competition in the media industry in Singapore;
- (d) ensuring that media services in Singapore are maintained at a high standard in all respects and, in particular, in respect of the quality, balance and range of subject matter of their content; and
- (e) developing codes of practice to safeguard content/technical standards and fair market conduct in the media industry, and monitoring compliance with such codes.

6.5 MDA is also responsible for administering the Digital Technology Development Scheme to support the development of digital technologies in Singapore, including DAB. Under the Scheme, an eligible applicant can receive a grant from MDA to cover up to 50% of the project cost incurred in the development of digital broadcasting.

6.6 The Broadcasting Act regulates the operation of and ownership in broadcasting services and apparatus in Singapore. For example, Section 44 of the Act restricts foreign equity ownership in a local broadcasting company to not more than 49%. The Broadcasting Act also empowers MDA to grant, modify, suspend and cancel broadcasting service licences, and issue codes of practice in relation to broadcasting standards or standards of programmes and advertisements.

### Licensing regime

6.7 Same as the UK, MDA has adopted a two-tier licensing regime which grants separate licences to multiplex operators and content providers. The licences issued for operating DAB services in Singapore fall into three categories, namely:

#### *DAB multiplex licence*

6.8 The multiplex licence accompanies the allocation of a DAB frequency block to a multiplex operator. The licence establishes the role of the multiplex operator as the party responsible for ensuring a good mix of services on the multiplex and efficient bit-rate management.

#### *DAB broadcast service licence*

6.9 The DAB broadcast service licence is the licence issued to content providers for offering digitalized audio services on a multiplex.

#### *Class licence*

6.10 The class licence covers the whole range of data and multimedia services supported by DAB, including programme associated and non-programme associated data. A class licence regime is an automatic licensing framework under which there is no need for data service operators to approach MDA individually for approval to start their services. Instead, they are only required to ensure that the services provided comply with the conditions specified for the class licence, which could be found in the website of MDA.

6.11 DAB multiplex licences are awarded for an eight-year period, while DAB broadcast service licence are issued for a five-year period. There is no stipulated licence period for class licences.

#### Licence allocation

6.12 The licensing of DAB service operators follows the "beauty contest" method, whereby licences are awarded to the applicants who best meet the criteria set by MDA.

6.13 Companies applying for a commercial DAB multiplex/service licence in Singapore must submit their applications to MDA with details on the following areas:

- (a) organization and corporation information;
- (b) financial projection for the first five years of operations and detailed plan for the financing of annual capital expenditures and working capital requirements;
- (c) programming, such as the characteristics of the channel (e.g. mass or niche), the target audience and the projected average listenership, and sources of programmes (in-house and/or outsourced);
- (d) technical specifications for broadcasting apparatus;
- (e) strategic partnership, including a description of the role, proposed contribution and track record of each strategic partner; and
- (f) information on how to facilitate the digital receiver take-up rate in Singapore, such as the manufacturers the applicants will work with and the number of receiver sets to be rolled out.

#### Licence conditions

6.14 Multiplex operators are required to comply with the licence conditions set out by MDA when providing their services in Singapore. For example, they are required to carry at least five audio services on each multiplex, and can only devote up to 35% of each multiplex for data services. Furthermore, the multiplex operators will have to ensure a 98% nation-wide coverage, and offer access and interconnection to those radio stations or data services who wish to broadcast on their multiplex.

6.15 Licensees of DAB broadcasting services must adhere to the radio programme code and the radio advertising code. The radio programme code stipulates that radio programmes should not include any material that is against the public interest, public order, or national harmony, or offends good taste or decency. Meanwhile, the radio advertising code requires all claims and comparisons made in advertisements to be presented truthfully and lawfully. The claims and comparisons must be capable of substantiation and should not in any way deceive or mislead listeners.

6.16 Data service operators must comply with the conditions specified for the class licence posted in the MDA website. These conditions include compliance with the codes of practice which MDA may issue from time to time, and ensuring that the service provided (i) is not against the public interest, public order or national harmony, or (ii) offends good taste or decency.

#### Roll-out of digital audio broadcasting services

6.17 At present, SmartRadio carries 14 radio services – six of which are digital-only stations and eight are a simulcast of the more popular FM stations. In addition to audio services, SmartRadio also transmits lifestyle, traffic and stock market information in textual form. SmartRadio's DAB services cover 100% of the population.

6.18 As mentioned above, Rediffusion has recently obtained a licence to broadcast a subscription radio service on its own multiplex. According to MDA, Rediffusion is expected to offer up to 20 channels broadcast on DAB.

6.19 MDA has not published any information on the consumer take-up of digital radio in Singapore.

## **7. Development of digital audio broadcasting in the United States**

7.1 On 11 October 2002, the Federal Communications Commission (FCC) issued *the Digital Audio Broadcasting First Report and Order* in which it approved In-Band On-Channel (IBOC) as the national standard for AM and FM radio stations to commence DAB on a voluntary and interim basis, pending the development of final operational requirements by FCC. FCC's approval has set the stage for broadcasters to move ahead with digital transmission and manufacturers to begin the development of digital radio receivers.

### In-Band On-Channel

7.2 The IBOC system, developed by iBiquity Digital Corporation<sup>14</sup>, "piggybacks" digital information on a normal AM or FM analogue signal. This allows broadcasters to operate in a "hybrid" mode, broadcasting both analogue and digital signals simultaneously on the same radio frequency. Radio stations can continue transmitting radio signals to analogue radio receivers, while digital radio receivers can "fall back" on the analogue services in areas of poor digital reception. The IBOC system also provides for the eventual phasing out of the analogue services to provide more bandwidth for higher quality digital-only services.

7.3 In addition to its simultaneous analogue and digital transmission, IBOC improves reception by substantially eliminating interference associated with analogue transmission. More importantly, FM broadcast can provide CD-like audio quality, whereas AM broadcast can have FM-like audio quality. The IBOC system also provides for transmitting data services, such as song titles and artist names, news, weather, traffic, and stock quotes, on the LCD screen of a radio receiver.

7.4 Under the IBOC system, no new allocation of spectrum is required as broadcasters can use their existing radio spectrum to broadcast new digital signals alongside existing analogue signals. While the IBOC system could be implemented relatively easily, the AM IBOC system cannot currently be used at night due to the concern over the signal interference associated with its night-time broadcast. In addition, the IBOC system is designed to duplicate the analogue transmission in digital form, with limited scope for introduction of new services (e.g. text and data services).

### Regulatory framework

7.5 The Communications Act 1934 establishes FCC to regulate interstate and international communications by radio, television, wire, satellite and cable. FCC has six bureaux, of which the Media Bureau develops, recommends and administers the policy and licensing programmes relating to the AM and FM radio broadcast in the US.

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<sup>14</sup> In August 2000, two IBOC proponents, Lucent Digital Radio Inc and USA Digital Radio Inc, merged to create iBiquity Digital Corporation. iBiquity develops, markets and licenses the proprietary IBOC platform for the direct digital conversion of existing AM and FM broadcasters. It has also formed alliance with many large broadcasting group owners and manufacturers of broadcast equipment, consumer electronics and semiconductors.

7.6 DAB in the US is also governed by FCC's *Digital Audio Broadcasting First Report and Order*, which sets out the interim requirements for AM and FM radio stations to go digital. On 20 April 2004, FCC issued a *Further Notice of Proposed Rulemaking and Notice of Inquiry* to seek comment on what rule changes and amendments are necessary for the advent of DAB in the US. In particular, FCC seeks comment on the following issues:

- (a) what changes and amendments to FCC's technical rules are necessary to further the introduction of DAB, including the proposals to allow AM night-time digital services;
- (b) what types of digital services should FCC permit radio stations to offer; and
- (c) what policies should FCC adopt to encourage broadcasters to convert from analogue-only radio services to hybrid analogue/digital radio services, and eventually, to all-digital radio services.

#### Licensing regime

7.7 There is no requirement for AM and FM stations to obtain new licences from FCC in order to broadcast on DAB.

#### Licence allocation

7.8 IBOC allows existing radio stations to convert from analogue to digital transmission without having to switch frequencies, meaning that no new allocation of spectrum is required and hence, no new licences are issued to deploy the services.

#### Licence conditions

7.9 While no additional licences are required for DAB, FCC has placed some restrictions on the use of the IBOC system, including that a radio station is required to notify FCC within 10 days of commencing digital broadcasting, and that users of the AM IBOC system are restricted to daytime use only, subject to further testing.

### Roll-out of digital audio broadcasting services

7.10 IBOC digital radios using iBiquity's standard are now marketed under the brand "High Definition (HD) Radio" to highlight the quality of reception. The commercial roll-out of HD radio technology started in 2003 when many AM and FM stations around the country began digital broadcasting. At present, about 1 072 AM and FM stations in the US are licensed to broadcast on HD radio technology, and 622 of them are on air. As a reference, there were a total of 13 599 AM/FM stations at end-September 2005.

7.11 FCC has not published any information on the consumer take-up of HD radio in the US.

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**References**

1. British Broadcasting Corporation. (2004) *DCMS Review of DAB Digital Radio: The BBC Submission*. Available from: [http://www.bbc.co.uk/info/policies/pdf/dab\\_review.pdf](http://www.bbc.co.uk/info/policies/pdf/dab_review.pdf) [Accessed 19 December 2005].
2. *Broadcasting Act*. (2005) Available from: [http://agcvldb4.agc.gov.sg/non\\_version/cgi-bin/cgi\\_retrieve.pl?actno=REVED-28&doctitle=BROADCASTING%20ACT%0A&date=latest&method=part](http://agcvldb4.agc.gov.sg/non_version/cgi-bin/cgi_retrieve.pl?actno=REVED-28&doctitle=BROADCASTING%20ACT%0A&date=latest&method=part) [Accessed 19 December 2005].
3. Commerce, Industry and Technology Bureau. (2000) *Digital Terrestrial Broadcasting in Hong Kong: A Consultation Paper*. Available from: <http://www.info.gov.hk/archive/consult/2001/digital-e.doc> [Accessed 19 December 2005].
4. Commerce, Industry and Technology Bureau. (2003) *Second Consultation on Digital Terrestrial Broadcasting in Hong Kong*. Available from: <http://www.info.gov.hk/archive/consult/2004/dtt-e.pdf> [Accessed 19 December 2005].
5. Commercial Radio Companies Association. (2005) *An Introduction to Commercial Radio*. Available from: [http://www.crca.co.uk/documents/IntroCommRadio\\_2005\\_000.pdf](http://www.crca.co.uk/documents/IntroCommRadio_2005_000.pdf) [Accessed 19 December 2005].
6. Department of Communications, Information Technology and the Arts. (2004) *Report of the Digital Radio Study Group*. Available from: [http://www.dcita.gov.au/\\_\\_data/assets/word\\_doc/23361/DSRG\\_report\\_March\\_2004.doc](http://www.dcita.gov.au/__data/assets/word_doc/23361/DSRG_report_March_2004.doc) [Accessed 19 December 2005].
7. Digital Radio Development Bureau. (2005) *Press Release: DRDB Releases Revised UK Five-Year Forecast*. 1 September. Available from: [http://www.drdb.org/index.php?internalPage=arch.php&internalHeaderPage=arch\\_hd.html](http://www.drdb.org/index.php?internalPage=arch.php&internalHeaderPage=arch_hd.html) [Accessed 19 December 2005].
8. Digital Radio Development Bureau & Digital One. (2005) *2005 Digital Radio Five Year Forecast*.
9. Federal Communications Commission. (2002) *Digital Audio Broadcasting First Report and Order*. Available from: [http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/FCC-02-286A1.pdf](http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-02-286A1.pdf) [Accessed 19 December 2005].

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10. Federal Communications Commission. (2004) *Further Notice of Proposed Rulemaking and Notice of Inquiry*. Available from: [http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/FCC-04-99A4.pdf](http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-99A4.pdf) [Accessed 19 December 2005].
  11. *iBiquity*. (2005) Available from: <http://www.ibiquity.com/> [Accessed 19 December 2005].
  12. *Media Development Authority*. (2005) Available from: [http://www.mda.gov.sg/wms.www/index\\_flash.aspx](http://www.mda.gov.sg/wms.www/index_flash.aspx) [Accessed 19 December 2005].
  13. *Media Development Authority of Singapore Act*. (2005) Available from: [http://agcvldb4.agc.gov.sg/non\\_version/cgi-bin/cgi\\_retrieve.pl?actno=REVED-172&doctitle=MEDIA%20DEVELOPMENT%20AUTHORITY%20OF%20SINGAPORE%20ACT%0a&date=latest&method=part](http://agcvldb4.agc.gov.sg/non_version/cgi-bin/cgi_retrieve.pl?actno=REVED-172&doctitle=MEDIA%20DEVELOPMENT%20AUTHORITY%20OF%20SINGAPORE%20ACT%0a&date=latest&method=part) [Accessed 19 December 2005].
  14. Ministry for Culture and Heritage. (2003) *Digital Audio Broadcasting*. Available from: <http://www.mch.govt.nz/publications/dpdab/dpdab.html> [Accessed 19 December 2005].
  15. Office for National Statistics. (2004) *UK 2005: The Official Yearbook of the United Kingdom and Northern Ireland*. Stationery Office.
  16. Office of Communications. (2004) *Radio – Preparing for the Future: Phase 1: Developing a New Framework*. Available from: [http://www.ofcom.org.uk/consult/condocs/radio\\_review/radio\\_review2/?a=87101](http://www.ofcom.org.uk/consult/condocs/radio_review/radio_review2/?a=87101) [Accessed 19 December 2005].
  17. Office of Communications. (2005a) *Radio Licensing: FAQs*. Available from: <http://www.ofcom.org.uk/media/mofaq/bdc/radio/?a=87101> [Accessed 19 December 2005].
  18. Office of Communications. (2005b) *Radio – Preparing for the Future: Phase 2: Implementing the Framework*. Available from: [http://www.ofcom.org.uk/consult/condocs/radio\\_review/radio\\_review2/radio\\_review.pdf](http://www.ofcom.org.uk/consult/condocs/radio_review/radio_review2/radio_review.pdf) [Accessed 19 December 2005].
  19. Office of Communications. (2005c) *The Communications Market 2005 – Radio*. Available from: [http://www.ofcom.org.uk/research/cm/cmpdf/cm\\_radio.pdf](http://www.ofcom.org.uk/research/cm/cmpdf/cm_radio.pdf) [Accessed 19 December 2005].
  20. Radio Television Hong Kong. (2000) *The Future of Radio Transmission is Digital*. Available from: <http://www.rthk.org.hk/mediadigest/md0009/04.html> [Accessed 19 December 2005].
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21. Radio Television Hong Kong. (2005) *Digital Sound Broadcasting in Hong Kong*. Available from: [http://www.rthk.org.hk/mediadigest/20050207\\_76\\_120324.html](http://www.rthk.org.hk/mediadigest/20050207_76_120324.html) [Accessed 19 December 2005].
22. United Nations Educational, Scientific and Cultural Organization. (1998) *World Communication Report*. Available from: <http://unesdoc.unesco.org/images/0011/001112/111240e.pdf> [Accessed 19 December 2005].
23. World DAB Forum. (2003) *Key Elements for a Regulatory Framework for Terrestrial DAB*. Available from: <http://www.worlddab.org/images/WorldDAB-321V4.pdf> [Accessed 19 December 2005].
24. World DAB Forum. (2005a) *DAB Country Reports Worldwide*.
25. World DAB Forum. (2005b) *DAB Digital Radio – Building for Success*.
26. World DAB Forum. (2005c) *DAB Roll-out Around the World*.