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Sounding the Future: Digital Radio and CD-Quality Audio

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[1] Chapter Four

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Central to the early effort to win acceptance for DAB in the early 1990s was an extensive process of promotion of the many claimed advantages of the new broadcasting technology. Digital radio broadcasting under the Eureka 147 DAB project offered many technical enhancements – more efficient use of the spectrum, improved transmission methods, and lower running costs – features that were attractive to industry professionals, broadcasting organisations, regulators and spectrum planners. But digital radio was also designed as a consumer proposition offering audiences a new and improved listening experience with ease of tuning, reliable reception, text and data services, interactive features, and significantly, ‘CD-quality’ audio. The promise of digital radio was to be ‘the sound of future’. Notwithstanding ongoing debates about the actual audio performance of the DAB system, this chapter revisits some of the early claims for a radio listening experience of unsurpassed quality. An emphasis on DAB’s audiophile credentials was, and continues to be, an important component of the marketing strategy for digital radio. This chapter contextualises DAB’s promise to offer ‘perfect sound’, locating it within the broader historical context of digitalization and audio fidelity. The ambition to extend and improve radio was a central tenet of the founding vision for DAB, and a

core element of this was a profound belief in the importance and perfectability of its sound. How such an emphasis has proved to be so fragile and whether this is out of step with listeners' expectations and experiences are questions addressed in the following.

[2] The Sound of the Future

The development of Digital Audio Broadcasting (DAB), or Eureka 147, in the early 1990s was accompanied by a tremendous optimism bouyed by its technical achievements concerning the potential for innovative new dimensions to radio as a medium. A key feature of this was its promise of exceptional audio quality. The many promotional claims for its advanced and superior quality emphasised that DAB was the 'sound of the future', echoing previous historical breakthroughs in technology including the development of FM, the compact disc or, previously, the long playing vinyl record, which similarly promised a major advance in the quality of the audio signal, enhancing the listener's enjoyment and providing an experience of audio fidelity not previously available.

A Canadian government report in 1995, *The Sound of the Future,* for instance, proclaimed that:

> Digital radio *is* the sound of the future. It will be the best sound on the airwaves before the end of this century because digital radio has the potential to deliver CD-quality audio, interference-free sound. (Task Force on Digital Radio 1995)

The trade press characterised DAB as the 'perfect sound machine' and likened its launch in the United Kingdom to the change to 625-line transmissions and the introduction of colour television in the 1960s, with a promise of hi-fi stereo-sound quality up to compact disc standard with the combined robustness of Long Wave (Fox 1994).

As noted by Ala-Fossi (this volume), the development of DAB Eureka technology should be seen within a broader process of digitalization that dominated technical broadcasting development in the late 1980s and early 1990s. As the intended replacement technology for AM and FM radio broadcasting (Hoeg and Lauterbach 2001), the system promised a host of innovations and benefits for both broadcasters and listeners. Using the newly developed digital techniques of audio encoding and compression, listeners could avail themselves of some of the best audio technology of the time, equivalent to that used in the Compact Disc format as well as in the digital stereo sound system for terrestrial and satellite television, and in other consumer audio products such as digital compact cassette and digital audio tape (DAT). While the immediate objective of DAB might have been to improve FM's susceptibility to interference, especially in mobile conditions (see Chapter Three), one of the consequences was unrivalled quality of audio in mobile reception conditions, making the car entertainment system the equivalent of a high-end home stereo system (Shelswell et al. 1991; Lau et al. 1992). In Chapter Three, Lax notes the frequent references to driving across Europe without the need to retune the radio. As one contemporary account has it:

> Imagine driving the length of Britain, over the Channel and across Europe, listening all the time to the same radio station. The sound is in digital stereo, which gives it the same quality as that from a compact disc. There is no interference, and none of the fading and fluttering that normally blemish reception as you drive past tall buildings, over hills and down valleys. There is no need to keep retuning the radio because the chosen station remains on the same frequency throughout Europe – although, of course, you could retune to alternative national, international or local stations if you wanted to. (Fox 1991)

Market research conducted for the BBC in 1997 suggested that among the early adopters for digital radio would be hi-fi enthusiasts and serious music fans, as well owners of new gadgets such as surround sound TV, in-car CD equipment, and newer formats such as Digital Compact Cassette (DCC) (Tuttlebee and Hawkins 1998: 265). While new stations, dynamic text and visuals would act as purchase triggers for digital radio, improved sound quality, it was believed, would be a 'post-purchase' reward that would support DAB's long term acceptance and adoption. As a result, the audiophile credentials for DAB, and the appeal to the discerning standards of critical audio listeners, became a central part of the promotional discourse for the platform. A futuristic scenario from the technical press in the mid-1990s portrays the ideal listener, enjoying the benefits of DAB as a fully integrated digital entertainment system:

> Returning home from a business trip, Doug Digital turns on his car radio and enters code 15 for classical music. After the radio selects an appropriate strong-signal digital audio broadcasting station, Doug hums along, adding his voice to the compact-disk [sic] quality sound of the selection, which is free of any interference or signal fading despite the hilly terrain. He likes the music, but cannot put his finger on what it is, so he glances down at the radio's liquid-crystal display and reads the name of the selection and the performing artists. As he travels farther away from the station's transmitting facility, the radio switches to a stronger station airing the same classical programming, without his noticing the changeover.
>
> …When Doug gets home, he and his wife have dinner and then decide to listen to a live concert of the New York Philharmonic orchestra. Doug requests the concert from the pay-per-listen digital audio radio service he subscribes to and the two settle back, listening to it in five-channel Dolby Surround on their stereo system. After the concert, Doug decides to add features to his digital audio radio system, including programming it with a "pick list" for advertising offers so that be will automatically be informed of products that interest him. (Jurgen 1996: 52)

The sketch succinctly captures both the luxury consumption habits and refined tastes of the intended listener as well as the promise of a technology that delivers, not just hi-fi sound, but information and entertainment that was ubiquitous, customisable and accessible. In market research for consumer digital radio products, over a third declared that they would be prepared to pay a premium for high quality tuners

designed for hi-fi systems (Tuttlebee and Hawkins 1998: 265). Arcam, the renowned British manufacturer of hi-fi equiment, became one of the first companies to develop audiophile quality DAB receivers, and extolled its potential to extend audiophile listening experience:

> Digital radio is one of the most exciting developments ever in radio. The crystal clear sound, utterly silent background and interference free reception delivers a new level of perfomance from broadcast sources.
> The experience of a digital broadcast of a live symphony orchestra concert is astonishing. The sound quality can transport you to the event without having to leave the comfort of your favourite armchair – truly the best seat in the house…We believe that this technology will transform the way we listen to radio…With Digital Radio, the listener can concentrate on the performance, knowing the sound quality will never vary. (Arcam 1998)

The New York Times welcomed the the new digital revolution as the 'biggest technological leap since FM technology was developed in the 1940s and 50s', offering the same 'high quality of sound – free of static and hiss – as the digital compact disks now replacing analog phonograph records' (Pollack 1990). Similar positive reviews in the press echoed this claim that DAB had made a significant breakthrough in the quality of radio receiver technology, comparing it favourably to the benefits of CD audio listening:

> DAB – or Digital Radio as it is now to be known – is a joy to listen to. Certain sections of the HiFi press have started to 'knock' the system but, in my experience, it is better than anything that has gone before. It's quiet, has good imaging, good transients and lays bare all the faults in the source material! Listen to a well balanced live concert, however, and all the best qualities will be apparent. There's an added bonus – the Radio 3 feed is free of the dynamics processing which is applied to the analogue services. The aforementioned well balanced live concert, and the records of course, have a much more natural dynamic. A very enjoyable experience. (Stokes 1998)

[2] The Digital Dream

DAB, the technical literature tells us, when used to its full potential and presented under optimal conditions, does offer ‘near CD-quality’ and a detailed, high fidelity listening experience with little need of the dynamic compression that is frequently used for FM and AM transmission (Spikofski and Klar 2003). CD-quality has indeed become the popular standard by which to measure listening quality, even if its own claims to audio fidelity have been questioned (Rothenbuhler and Peters 1997). The adoption of the Compact Disc format in the period from the 1980s on as the audio benchmark (Josse 2002) represents the culmination of an extensive, complex and sometimes controversial history of audio technology development of which DAB is a part. Nothing short of the full digitalization of the audio chain was the over-riding goal of audio technology development in this period, resulting in inter-related professional and consumer audio innovations, including new digital compression

standards, new transmission systems and different platforms for audio distribution and delivery.

Released in 1982, the CD audio standard was the result of a long term collaboration between Sony and Phillips to provide a replacement for the LP, or long playing vinyl format, that had dominated the music industry and recorded music consumption since the 1950s (Immink 1998; 2007). The compact disc introduced a number of radically different elements into audio technology: firstly, the use of digital data to store and process the audio signal; secondly, error correction to make the signal robust; and thirdly, the use of optical, non-contact pick-up to read the signal on the disc (Pohlman 1992: 8) all of which had the effect of overturning nearly a century of analogue audio evolution and setting an entirely different trajectory for its future development. In parallel with the development of analogue audio recording techniques, a series of milestones in digital audio includes the development of digital audio sampling in 1928, the development of pulse code modulation in 1937, and further extensive related developments in computing and digital signal processing in the post second world war period. Working digital audio recording systems were demonstrated by Sony and Japanese broadcaster NHK in 1969 and by the early 1970s the BBC was using digital recorders for master recording (Pohlman 1992: 10). Drawing on their respective experiments with different forms of optical storage for audio and video content, including the Laservision system, Sony and Philips agreed in 1979 to collaborate on the design of the compact disc system, and formally introduced it to Europe and Japan in 1982.

The perfectability of audio recording and reproduction through digital means may be seen as a further dimension of what Vincent Mosco (2005) has referred to as the 'digital sublime' – a mythic belief in the power of new digital technology to open up a new world of possibilities. This unswerving belief in the power of engineering and scientific progress, the 'technological sublime' reviewed by David Nye (1994) and earlier by Leo Marx (1964), was captured in CD's marketing slogan, 'Perfect Sound Forever', conveying all the hype and the exaggeration attached to what was at best a compromised technical solution. The compact disc format, now over twenty-five years old, has never been wholly accepted among some audiophiles or audio purists, and was a source of major frustration for those who found its sound to be 'clinical' or 'harsh' compared to the analogue 'warmth' and musicality of older analogue technology (Harley 1998: 255). In the audio world, a schism was effectively created between diehards who believed only in analogue methods and proponents of digital audio fidelity (see Rothenbuhler and Peters 1997; Kessler and Harris 2005: 207). Such disputes aside, the success of the CD in entirely displacing, from the late 1980s on, the distribution of pre-recorded music on LP vinyl and audio cassette is indisputable and remarkable (Hansman et al. 1999; Goode 2002). Later enhancements to high end CD audio technology, as well as development of next generation high definition digital audio formats such as Super Audio CD (Aarts et al. 2004), have retained the utopian goal of perfect digital audio reproduction for the consumer market.

Against this background, the audio technology developed as part of the DAB standard can be seen as part of a general movement towards making the benefits of digital

audio available across the full entertainment spectrum, in this case within the broadcasting transmission chain, and to complete a process of digitalization that had been well established in all other aspects of audio recording, storage and reproduction. Given the large quantities of data involved in CD audio sampling (16 bit audio sampled at a frequency of 44.1 KHz), methods of compression and reduction of the amount of data to be transmitted were essential to making digital audio transmission systems possible. Some of the most important work on audio compression standards and on encoding and decoding audio signals was undertaken within the Eureka 147 consortium, in particular by the Institut für Rundfunktechnik (IRT) and by the Fraunhofer Institute, in developments that led ultimately to the development of the MP-3 algorithm (Musmann 2006; Sterne 2006; Fraunhofer IIS 2008). Pursuing a goal of being able to transmit high quality digital audio over ISDN lines, researchers at the Fraunhofer Institute developed a number of encoding schemes to make digital audio transmission more manageable. The Moving Picture Experts Group (MPEG), established in 1988 as a working group of the International Standardisation Organisation (ISO) to assess compression standards for digital audio and video, approved in 1992 the MPEG-1 compression standard, comprising three distinct components (Layers 1, 2 and 3). The more complex Layer 3, to be later known as MP-3, was first used for professional applications in radio stations and studios for ISDN transmission, but laid the foundations for a global revolution of music storage on PC and portable media players, transmission over the Internet and in peer-to-peer file sharing. The somewhat less complex Layer 2, or MP-2, was selected by DAB as the audio format for digital audio broadcasting services. MP-2 was developed as a psycho-acoustic compression algorithm, or in other words, used

analysis of human auditory perception capabilities and limitations to produce an efficient means of removing the unnecessary parts of the audio signal. The claim for both MP-2 and MP-3 was to produce near CD-quality at greatly reduced data levels.

DAB was not the only service heralding the sound of the future using the newly developed digital technologies of compression and transmission in the early 1990s. The concept of digital music transmission over satellite and terrestrial systems developed strong industry currency, and a number of major initiatives in addition to DAB were proposed. Firstly, as a precursor to later satellite radio services, companies such as Digital Cable Radio and the Digital Music Company in the United States and CBC's Galaxy service in Canada began to offer subscription-based digital music services via cable television lines, with multiple channels offering different genres of music services and simulcasts of major pay-per-listen events, such as headline concerts and sporting events (Pollack 1990; Walker 1991). At the same time, proposals for satellite transmission to both home and in-car receivers were also being actively developed. Sirius Satellite Radio, now merged with its erstwhile rival XM Radio, began life in 1990 as Satellite CD Radio and proposed a digital radio service that would be broadcast by satellites to listeners with special receivers, earning its revenues from charging subscription fees. Based on the idea that the future of music and audio entertainment would be driven by the near unlimited choice through multiple channels, CD-quality audio, and exclusive contracts with stars from the entertainment world and for certain sports events, Sirius and XM Satellite Radio subsequently invested billions of dollars in satellite technologies and programming available across North America and on the Internet. Such developments in the context

of rapid digitalization and reconceptualisation of how audio services might adapt to new technological possibilities were likened at the time of their development to HDTV issues for radio: a transitional moment in which whole aspects of the service would be reconsidered, involving enormous potential disruption for the industry, but which were an inevitable and necessary stage in order to prosper in the digital future.

[2] 'Worse than FM'

Of the many claims for digital radio's supposed enhancements, none has been quite as controversial as that of its supposed CD-quality sound, and no other feature has attracted the same degree of ire and listener frustration as the audio quality of DAB. From a technical point of view, DAB digital radio sounds excellent when transmitted at the originally-envisaged bitrate of 320kbps (Spikofski and Klar 2003). More often than not, however, bit-rates are determined the minimum necessary for acceptable listening, not the maximum or even the recommended levels for effective audio performance. The fact that more content can be offered by reducing the bitrate per station on a digital mulitplex has meant that broadcasters (and consumers) have tended to prefer quantity over quality. Multiple bit streams and compression, therefore, are extended to the highest acceptable limit resulting in a quality of transmission that is frequently perceived as 'worse than FM'.

Critics of digital audio and digital radio have not been slow to air their views on the failings of DAB in this regard. Decrying the rising popularity of reduced bit-rate systems such as MP-2 or MP-3 which use compression as the basis for storage or transmission, *Stereophile,* the leading US audiophile journal, argued in 1992 that we

might one day lament the passing of the ‘golden age’ of digital audio ‘when consumer formats (CD and DAT) contained a bitstream that was an exact bit-for-bit duplicate of the original studio master recording—not a digitally compressed, filtered, copy-resistant version whose sound is "close enough" to the original’ (Mitchell 1992). Compression, the magazine’s editorial continued, is antithetical to the spirit of high end audio and has more to do with practical and economic goals—making recorded signals available to consumers in formats that are more compact, portable or affordable. The difficulty with glossy compression algorithms based on psycho-acoustic perceptual coding, it was argued, is that while they economize on data streams by eliminating that part of the audio which most listeners won’t actually hear, this is an approximation for ‘some listeners in most situations’. The compact disc in this sense represents the limits of compromise between a mass consumer format whose signal delivery can also satisfy critical listeners. Reduced bit rate schemes such as MP-3 for audio purists are simply unacceptable and in all cases exhibit a noticeable deterioration in audio quality. Comparing a satellite radio feed to the original CD source, one *Stereophile* reviewer commented:

> The MP3 sounded flat, dull, and lifeless in comparison ... The sense of air and space was lost, and, consequently, the emotional impact was drowned… Even the performance suffered—the singers sounded as if they had become tired and sloppy. (Atkinson 2008)

A vocal albeit minority audience response to issues of the audio quality of DAB transmissions prompted regulators and other agencies to investigate complaints about

its performance, as well as to assess how important quality of audio was to listeners. Technical assessments of the audio quality are difficult to achieve, and are normally based on a combination of objective and subjective tests of programme loudness levels and perceived audio quality. A study of German DAB transmission quality found that, despite high bitrates, broadcasters frequently employed audio processing in inappropriate ways – usually in attempt to boost the signal's apparent loudness over its competitors – that greatly degraded the audio signal with little concern for music fidelity (Spikofski and Klar 2003).

In the United Kingdom, a lack of available frequencies, combined with a general explosion of media choice, also resulted in a reduction of bitrate per station to add more choice, with a consequent reduction in audio quality. In some instances this has led to an outcry about the poor quality of DAB. An article by Jack Schofield, for instance, published in the Guardian's Technology section (23 November 2006 "The future of UK radio is now in your hands") was severely critical of DAB's audio quality and of the future for the standard. In it, he criticised the outdated and inefficient MP-2, arguing that audio coding had progressed through MP-3, AAC and now AAC+. Accordingly, particularly given that other countries had rejected DAB in favour of new better standards such as DAB+, the United Kingdom should now follow likewise. Extensive discussion of DAB quality issues became a recurring theme of BBC discussion programmes, the quality press and the blogosphere, in which a variety of known performance issues have been highlighted and criticised. The UK blog *Digital Radio Tech*, for instance, continued the audiophile theme of unacceptable DAB audio, listing its shortcomings as:

- Very poor top-end (high-frequency) response (because using 128kbps instead of the preferred 192kbps cuts off the higher frequencies)
- Dull sound due to the poor top-end response
- Muffled sound due to the lack of accuracy at which the audio samples are encoded at due to the low bit rates used
- Lack of stereo image and instruments all meld together to form a messy, muddled "wall of sound"
- Swishy vocals
- Sibilant speech (when people pronounce 'ss' or 'sh' sounds they come out sounding ‘lispy’).

  (Digital Radio Tech 2006)

Respondents to the blog echoed all of the above and more, one correspondent commenting that:

> To my ears the DAB sound is plain awful. Harsh and tinged with low level hash that makes listening fatiguing. I have sampled a few DAB radios and they all have this nasty quality…So if Apple can achieve very aceptable results with 128kb audio why not DAB? (Digital Radio Tech 2006)

Such vocal public criticism prompted Ofcom, the UK regulator, to independently assess the extent to which members of the public were concerned about the apparent poor audio performance of DAB broadcasts. In its consultation for *The Future of Radio,* over 70% of responses had in some way questioned the audio quality of DAB

broadcasting, raising, among other issues, that as long as DAB appeared to be inferior to existing FM services, there could be no question of a switch-off of analogue radio transmission (Ofcom 2007). Respondents also queried what appeared to be the retrograde step of broadcasting some DAB services in mono (when stereo FM was the norm), as well as arguing for the adoption of better codecs such as AAC and DAB+ (Ofcom 2007: 113). Ofcom consequently undertook its own independent research into consumer perceptions to ascertain whether there was widespread dissatisfaction with the quality of DAB transmission, or whether it was confined to a small number of audiophiles. The research found that for the vast majority (over 80%), the sound quality of DAB was excellent or very good, a response that was the same for both regular DAB listeners as well as those who were also Hi-Fi owners. Respondents were also asked to rate DAB sound quality compared with FM, and similarly high numbers supported the view that DAB sounded at least as good or better. 94% of all DAB listeners said it was at least as good as FM, with 77% saying it was better than FM. Only 3% thought it was worse than FM.

The Ofcom research concluded that there was little evidence that the majority of the public supported the view that DAB audio quality standards were inferior to FM or had deteriorated to the extent claimed by audiophiles. This, the regulator added, was not to say that such criticisms are wrong or misplaced; it was simply that their expectations of audio standards were not shared by the vast majority of listeners (Ofcom 2007: 115). On the face of it, the vocal minority of audiophile critics was just that – a minority – and in the trade off between capacity and audio quality, the provision of new services at lower but acceptable bit-rates had been deemed to be the

better strategy. With respect to the issue of the adoption of newer compression technologies in DAB+, the Ofcom strategy document observed that the implementation of AAC coding did not on its own imply improved sound quality. Given that sound quality is a function of the bit-rate used by the broadcaster to transmit the signal, DAB+ would add extra capacity but ultimately the broadcaster (or multiplex operator) would have to 'make a trade-off between the number of services (audio or data) fitted in to the multiplex and the sound quality of those services' (Ofcom 2007: 115).

[2] Conclusion

DAB's 'sound of the future' promise was a bold and ambitious declaration produced by the first promoters of Eureka 147 keen to establish a new vision for radio in the latter part of the twentieth century. The utopian promise of a 'perfect sound machine' to match the marketing slogan for CD, 'Perfect Sound Forever', was formulated in an historical context when digitalization appeared both to resolve technical issues or constraints found in older analogue processes, and to herald new, more creative and interactive possibilities of making content available. The experience of DAB, as discussed in this chapter, suggests that such claims were not necessarily wrong or invalid within the context within which DAB evolved and developed; rather that its implementation alongside related developments in digital audio technology created a range of possibilities, including new and previously unimagined ones, that conflicted with the original founding vision of what DAB Eureka 147 was trying to achieve.

Among the many unintended consequences of the development of efficient compression technologies and means of distributing digital audio, was the ease with which digital audio files of acceptable and 'good enough' quality could be stored, streamed and shared on the Internet, with momentous consequences for the music industry and for the social production and consumption of recorded music. The fact that DAB digital radio was effectively caught in the cross-fire of a massive reorganisation of the music industry distribution model, with an extended preoccupation with management of digital rights, did not assist the case of DAB's inherent potential for higher quality audio transmission.

As industry sources quote, the experience of market implementation of DAB wherever it has been launched is to the effect that listeners wanted new additional services and a new value proposition to make an investment in digital radio. Audio quality on its own was not, as the original developers envisaged, sufficient to encourage interest of market take-up. In an era when new media services offered extensive choice and capacity, the primary focus for successful digital radio implementation, to the exclusion of maximising audio quality, was on providing additional content, new channels and services unavailable on traditional analogue radio. The primacy of the audio experience was clearly no longer the focal point of attention and had to take second place alongside rival competing services available online, and for personalised mobile media consumption.

Against this background, the resilience of FM radio as a robust and reliable medium can be better understood. As in the case of the replacement of the analogue LP vinyl

format by CD, FM has proven to be much more resilient than originally imagined, and analogue switch off is not a realistic prospect in any existing market at this time. In response, the industry has sought to provide added value and a new dimension to digital radio offerings by suggesting a new era of high resolution, downloadable formats, and multichannel surround sound transmissions and downloads. Given that it is only a question of bandwidth and storage capacity that sets limits on today's compressed, low-resolution audio, companies such as DTS have launched experimental broadcasts and webacasts looking ahead to high quality audio multicasting over broadband, particularly once fast connections over 8Mbs become more commonplace (Iverson 2004; Barbour 2005). Whether this proves to be a qualitative leap forward and a transformational paradigm for digital radio in the next decade, or another false dawn, remains to be determined.

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