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The prospects for digital radio – policy and technology for a new broadcasting system

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The prospects for digital radio – policy and technology for a new broadcasting system

Abstract

Digital audio broadcasting is a major innovation in radio, one which is at its most advanced in Europe. It has the potential to deliver high quality audio reception and to significantly increase the capacity of the radio spectrum, with the possibility of an expansion of both the range and diversity of radio programming. Nevertheless, here and elsewhere it remains relatively unknown and under-adopted in comparison with other consumer technologies like digital television. This article examines the origins of digital radio, and considers how this technology is expected to become a mass communications technology, eventually supplanting analogue radio. However, in its present form, there is little that is novel currently being offered on digital radio, and the economic and political contexts in which it is being developed may encourage further concentration of ownership and reduce diversity of choice in listening. Unlike previous innovations then, such as FM broadcasting, there appear to be few compelling advantages of digital radio which will persuade listeners to adopt this new technology. If this new technological system is to succeed, alternative uses must be found for it, and one area for which it might be suited is mobile data communications. The article concludes by suggesting that this might mean that radio becomes of secondary importance to this potentially lucrative application of digital audio broadcasting technology.

Keywords

Broadcasting, digital, radio, policy, technology.

Prospects for digital radio – policy and technology for a new broadcasting system

Introduction

Digital transmission is claimed to be the most significant innovation in broadcast radio since the development of frequency modulation (FM) in the 1950s. With an increase in the number of stations and superior sound quality, digital radio is seen as a natural successor to FM, which itself offered a dramatic leap in sound quality over amplitude modulation (AM). Given that analogue technologies are being superseded by digital in almost every other sector of communications, it is also seen as inevitable that this should be replicated in radio. Broadcasting industries, governments and other regulators around the world are preparing to back this new development, and it is in the European countries that digital radio is at the most advanced stage.

Nevertheless, it remains the case that digital radio ownership lags far behind other comparators in the media and communications world – for instance, in October 2002 digital TV was in 9.7m (39.5 per cent) of the UK's homes, whereas the number of digital radio receivers sold was estimated to be fewer than 70,000 (0.3 per cent of homes, assuming only one receiver per household), a pattern replicated in all countries where the two technologies exist. However, digital radio figures are hard to come by: in the UK, while digital TV figures are collated by the regulating body, the Independent Television Commission, at the end of 2002 neither the radio regulator, the Radio Authority, nor the industry audience measurement organization, Rajar, were collecting data on digital radio.

This lack of data about radio is itself telling, a lack of interest reflected in published research or in the wider culture (Lewis 2000). The future of digital radio broadcasting seems far from assured. Once more a comparison with digital television is revealing – the UK government White Paper on Communications sets out criteria for its aim of switching off analogue TV signals by 2010, but switch-off of analogue radio is not even mentioned (DTI 2000). Yet the increased capacity offered by the technology's adoption creates the potential for an expanded range of radio services, both local and national, offering a greater diversity of forms and voices. But the evidence so far is that digital radio, in ways similar to developments in digital TV, is being introduced as a purely commercial technology which will remain in the hands of the existing broadcasters. The removal of the constraint of spectrum availability has coincided with the diminution of other restrictions, for instance on station ownership. Broadcasting is seen increasingly as an industry which needs less rather than more regulation.

In this paper I review the development of digital radio to the present day, and discuss how the various political, economic and technological decisions have inter-related. Aspects of this early 'history' of digital radio point to possible scenarios which could have significant consequences for the meaning and uses of radio. Most of the detail is taken from the UK, but the discussion also applies to other European countries currently implementing digital radio systems. The recent confirmation that broadcasters in the USA, the country with the world's largest market for radio receivers, intend to adopt a completely different digital radio system further complicates the picture, and the implications will be discussed briefly.

A definition of digital radio

We should be clear about what we mean by 'digital radio'. In this discussion, it refers to the use of digital signals, as opposed to analogue, in the transmission path of broadcast radio. The

use of digital signals for transmission distinguishes this conception of digital radio from both digital radio production systems and from analogue radio receivers with digital tuning and digital displays: neither of these latter developments, which have existed for some years now, requires the purchase of a new receiver in order to listen to radio, whereas the transmission of radio by digital signals requires listeners to purchase new receiving equipment to decode those transmissions.

Digital radio thus described can include transmission via satellite or cable and, although radio listening continues to be heavily dominated by the terrestrial platform in all parts of the world, there are a number of other ways of receiving digital radio. For example, all digital TV satellite and cable broadcasters also include radio stations in their package of channels. A satellite system operated by World Space delivers digital radio to conventional-looking radio receivers with a small satellite antenna attached to the top. In the USA, two companies, XM and Sirius, compete for in-car listeners with subscription-based satellite radio services. However, unlike the new terrestrial systems, none of these are expected, or intended, to replace existing transmissions to become the principal mode of radio listening, instead having rather limited application. For example, listening via a cable TV system must be confined to the room housing the TV, whereas one of radio's distinguishing characteristics is its portability. Consequently, these alternative sources of digital radio are likely to make up a relatively small percentage of total radio listening. In considering the possibilities for the future of digital radio then, developments in terrestrial transmission are the most significant, and this discussion will be confined to this platform.

Even here, there are further distinctions to be made. The most developed system of digital terrestrial radio is the European Eureka 147 project, and is branded 'DAB' (for Digital Audio

Broadcasting). DAB began its development in the mid-1980s as a European Union project, and the first public transmissions began in the UK in September 1995 (three years before digital TV); by July 2002 DAB was operating in more than 30 countries around the world. However, crucially the United States has not adopted the Eureka 147 system (although Canada and Mexico have, the former enthusiastically so). Instead, USA broadcasters have favoured a digital terrestrial radio system known as In-Band On Channel (IBOC), which is completely incompatible with Eureka's DAB, and in October 2002 the Federal Communications Commission confirmed its selection of IBOC for digital terrestrial radio. IBOC transmissions can sit alongside existing analogue transmissions, occupying the same frequency bands, and so there is no additional demand on the radio spectrum as there is with DAB. Currently, however, IBOC is in its very early stages of development, and remains far less advanced than in the Eureka countries.

DAB signals are broadcast in a newly-allocated band of the radio spectrum ('Band III' in the UK, vacated by the 405-line, VHF television transmissions). DAB is intended eventually to replace existing national FM broadcasting systems in that it is designed to offer high quality audio signals carried over a transmitter network covering a whole country, so that FM transmissions on the VHF frequencies will cease. Meanwhile, in 1996, an international consortium began to apply some of the techniques of DAB to the lower frequencies of the AM bands (low, medium and high frequencies, better known as long, medium and short wave respectively). Intended to be of benefit principally to international broadcasting, this system was dubbed Digital Radio Mondiale (DRM), and gained International Telecommunication Union (ITU) approval in October 2000. Meanwhile, IBOC can operate in both the AM and FM bands, and ultimately is destined to replace analogue transmissions on both sets of frequencies.

Thus there exist multiple means of transmitting digital radio, and while these different systems evolve, care must be taken in using the term ‘digital radio’. Of the three, Eureka 147 remains the most widespread and may therefore be regarded as closest to becoming an established part of the range of radio broadcasting technologies. Henceforth, this article will use the terms DAB and digital radio interchangeably, but in each case meaning the Eureka 147 terrestrial system.

Innovation and new broadcasting systems

Digital radio increases the capacity of the radio spectrum. The potential exists for an expansion in the types of programming serving a diverse range of interests and communities at local, regional or national level, perhaps even ‘a Golden Age of public broadcasting, with the shackles of spectrum scarcity finally removed’ (McChesney 2000: 242). However, for this to come about, listeners will be required to replace their radio receivers. Yet the very success of broadcast media creates inertia: all homes nowadays possess reception equipment designed to work on a particular system and, thanks to increased reliability, those receivers can be expected to continue to function for many years before being considered for replacement. The introduction of any new system must face this obstacle.

Raymond Williams concurred with Bertolt Brecht (2000: 41) in describing the early development of radio broadcasting technology as preceding the demand for it (1990: 25). He also argued that to understand the history of technological developments, we must take into account the notion of ‘intention’; that is, in various ways, technologies are developed with some idea of an end-purpose (1990: 14). Brian Winston formulates the idea of some ‘supervening social necessity’ which must exist if a new technological innovation is to stand

any chance of success (1998: 8-9). In the case of DAB, while we are not considering a novel social form in the manner of 1920s broadcasting – most articulations of digital radio retain broadcasting as its primary purpose – it is still helpful to consider the intentions behind the new technology.

In 1986, the original Eureka project form sets out its intention thus:-

> After agreement of this [Eureka] standard, the path will be opened up for the European entertainment electronics industry to stimulate a virtually saturated market with new products for car and domestic audio broadcasting units. In turn, this will encourage considerable innovation from European microelectronics manufacturers. The drawing up of a new digital audio broadcasting standard will therefore provide a long term counterbalance to the increasing dominance of the countries of the Far East in the consumer electronics sector. Transmitter production will provide a new impetus for investment goods industries.
>
> As a new means of radio distribution the DAB system opens up new broadcasting markets in terms of coverage and services (e.g. operation of conditional access services) and even more important new markets for professional and consumer equipment. There is a good chance for worldwide adoption of these innovative systems. Due to the incompatibility with the existing systems (AM, FM) consumers have to obtain new receivers and broadcasters new transmitter networks....
>
> Introduction of DAB services will be of a major potential benefit for consumer electronic, microelectronics and telecommunications industry who suffer from saturated markets and falling prices. (Eureka 1986)

The intention is clear: a purely commercial purpose to seek competitive advantage for the European electronics industries over their Far East counterparts. The technology was to be developed in the absence of any demand – the radio market is 'virtually saturated'. Indeed, the UK Radio Advertising Bureau's acknowledges that 'the move to Digital Radio is not

currently consumer-led' (RAB 2001: 6). How is the demand to be generated? What is, in Winston's terms, the supervening social necessity for digital radio?

Winston in fact identifies three categories of social necessity in the development of new technologies. The first is a need created by the development of another technological system – the growth of the railways created an opportunity for the development of the telegraph, for example. The second type occurs where a group of social changes directly stimulates demand for new products to serve those changes – the rise of the modern business corporation stimulating demand for office technologies. His third category is the 'strictly commercial' need, as opposed to any wider social need, for example when a new product such as the compact disc or Minidisc is launched into an uncertain market. According to Winston, of the three this third category is 'less certain in guaranteeing diffusion and producing less significant innovation than either the consequences of social change or the effects of other technological advances' (1998: 9). This classification of different kinds of social necessity is useful when we consider the position of radio. The origins of radio broadcasting in the 1920s chimed with other social changes such as the growth in mass media offering more news and entertainment than ever, increasing personal mobility and a tendency towards the nuclear rather then extended family (Williams 1990; Winston 1998, Crisell 2002). It is possible to see radio here as satisfying needs greater than the purely commercial – it fulfils Winston's second criterion. At the end of the twentieth century, critics of the role of the media in democratic society have suggested a new set of social needs: the increasing commercialization of existing mass media, which debases political debate and marginalizes dissent, creates a need for new media channels (for example, Curran 2000; McChesney 2000; Tumber 2001). The diminution of the problem of spectrum scarcity brought about the digital radio provides a technical, if not a political, means to address this need – as McChesney puts it, 'the new

communication technologies could be employed to provide local, regional, and national nonprofit channels operating by different institutional setups – some state-run, some community-based, some by elected boards, some by the workers' (2000: 241-2).

However, as conceived in the Eureka proposal, there is to be none of this. Instead, digital radio is intended principally to satisfy a commercial need, conferring commercial advantage upon the European electronics industry over its Asian competitors. Established in this way, in a political and economic context which emphasizes the commercial imperative, digital radio falls into Winston's third category, one which is the least likely to develop successfully. Clearly the industry faces a challenge in diffusing this new radio technology, and the degree to which DAB has been advanced in Europe and elsewhere varies considerably.

The state of European digital radio

While DAB operates in all continents of the world, it is in Europe that it is most advanced: all Western European countries have DAB services and Europe contains the countries with the highest DAB coverage (with the sole exception of Singapore, with 100 per cent coverage). Within Europe, in almost all cases there are both public service and commercial stations on DAB. In most countries, these are simulcasts of existing analogue stations, but usually there is also a small number of digital-only services. However there is a large variation in the level of service. In Ireland, for example, after trials between 1999 and 2001, a full DAB service failed to follow because of the lack of cheap receivers; meanwhile, at the other extreme, 98 per cent of Belgium's population could receive DAB signals by March 2002, and in Germany the switch off of analogue radio between 2010 and 2015 has even been tentatively proposed (World DAB 2002a).

The Eureka system requires radio stations to be bundled together for transmission in what are known as frequency multiplexes. A single multiplex will typically carry between four and ten radio stations together in a single, broad frequency channel. This has implications for the organization of radio networks, and the way in which the UK system has developed serves as a useful illustration.

The new Band III frequencies made available for UK digital radio were divided up into seven multiplexes. Two of these were earmarked for national, networked broadcasting, the other five for local or regional broadcasting, based geographically more-or-less on the existing areas currently covered by local and regional analogue radio. While public service broadcaster, the BBC, was given one of the national multiplexes to carry its collection of, then, five national radio stations, all other multiplexes were to be commercially run. But in the commercial sector there was no BBC-equivalent, an organization owning a collection of radio stations. Instead, commercial radio stations, both national and local in any given area, are singly-owned (although across the country many local stations might be owned by the same company). These analogue commercial stations, like the BBC, are responsible for both the programming and the transmission of their own station's output. But on the introduction of digital broadcasting a new tier of commercial organization came into being – the multiplex operator – which would be awarded the licence to run the multiplex and transmit digital radio. These multiplex operators and the commercial radio stations would now need to contract with each other to transmit digital stations. The UK's second national multiplex licence (after the BBC's) was awarded in 1998 by the Radio Authority to Digital One, a new company formed from GWR, which already had interests in national and local commercial radio stations, and NTL, the cable and terrestrial transmission company. In fact, Digital One was the sole bidder in what was intended to be a competition for the multiplex licence, in

contrast with three companies bidding one year earlier for digital terrestrial TV licences, a disparity which prompted speculation in the media about the viability of digital radio.

Nevertheless, Digital One began transmissions in 1999, initially covering 65 per cent of the UK population. Its multiplex carried the three existing analogue national commercial stations and seven additional, digital-only stations. To encourage existing analogue stations to invest in digital broadcasting equipment, the Radio Authority guaranteed automatic renewal of their analogue broadcasting licences on commencing digital transmissions.

The Radio Authority has also advertised licences for local and regional multiplexes since 1999, and by October 2002 had awarded 37 licences. Although five frequency blocks are available for local broadcasting, the need to avoid overlap between regions on the same frequency means that most areas of the country will typically fall within the range of two local or regional multiplexes in addition to the two national multiplexes. Ultimately, most listeners should be able to receive between 30 and 40 radio stations, between two and three times more than are typically available on the analogue system. The conditions on these commercial licences guarantee that existing analogue BBC local radio stations will have a place on the local multiplex in its service area, but there is no such guarantee for analogue commercial stations. This means that a DAB listener might hear for the first time local/regional stations which were previously not available in that area, but which were available (in analogue) elsewhere in the country; at the same time, that digital radio listener might no longer receive some local stations which continue only in analogue. In addition, there are a number of new, digital-only local services. Thus the ‘menu’ of radio stations is changed.

The county of Lancashire in Northern England serves as an illustration of this change. It is covered by two local/regional multiplexes, in addition to the two national multiplexes. These local multiplexes simulcast around six local or regional stations already available in the county in analogue (as well as the local BBC station). Stations new to the area include XFM, a station available on analogue only in London, but now carried on the Central Lancashire local digital multiplex (as well as other multiplexes around the country); there are another five or so stations in this category carried between the two local multiplexes. Meanwhile, independently-owned local analogue stations in the area, 2BR for example, which cover quite localized as opposed to regional audiences, are not carried on any digital multiplex. Finally, around six digital-only stations, such as Smooth and Urban Choice, are carried only on the local digital multiplexes (but these are not 'local' stations – like XFM, they can be heard on local multiplexes around the country). Hence there is a change not only in the number of available stations, but also in the localization of listening, with a tendency towards broader coverage and more networking of content.

By October 2002, Digital One's national multiplex was available to over 80 per cent of the UK population, the BBC's to 65 per cent; in addition, by January 2002, 45 per cent of the population could, like Lancashire, receive at least two local and/or regional multiplex transmissions (Thomas 2002).

Similar arrangements of the digital radio broadcasting system are found throughout Europe, with multiplex operators entering into contracts with radio stations to deliver national and local transmission, with coverage rates varying from 25 per cent of the population (France) to 98 per cent in Belgium – with the notable exception of Ireland, as already mentioned, where DAB transmissions have currently ceased.

The demand for digital radio

The provision of parallel radio services, two bands of frequencies carrying substantially identical content in both analogue and digital form, is uneconomic and unsustainable in the long term. The ultimate aim is that analogue radio transmissions should be switched off and completely replaced by digital, and the UK's promotional body, the Digital Radio Development Bureau (DRDB), is committed to lobbying the government to set a date for switch off (Mason 2001). However, this is expected to take a number of years, even decades. While analogue television last saw a new service launch in 1997, new eight-year licences for analogue radio continue to be awarded (predominantly on FM), and plans for further launches are well developed (Radio Authority 2003). Analogue radio is a clear commercial success, but it is unlikely that digital radio will generate significant revenue in the medium term for its backers – the UK's Commercial Radio Companies Association anticipates no return on DAB for at least ten years (CRCA 2002). The costs of setting up, expanding and maintaining digital transmission facilities means that there is a clear incentive to speed up listeners' adoption of digital radio receivers. Yet their high cost has limited take up, and the fragility of the market is illustrated by the fact that broadcasters in Ireland, Sweden and Switzerland have scaled back DAB services in the absence of a proven market for DAB receivers (World DAB 2002a).

This is an age-old problem in broadcasting, and is once more evident in the debates in many countries about how soon analogue television signals might be switched off in favour of digital. Previous incentives for listeners and viewers to purchase new receivers have included the promise of better sound or picture quality (for example in switching from AM to FM radio, or mono to colour TV in the 1960s) or additional content or new kinds of programming

(new UK local radio stations on FM only; underground or ‘free form’ FM radio stations in the US). Eventually of course, when it may be assumed that only a few listeners and viewers would be deprived of their signals, the ‘old’ system is switched off and the transition to the new is complete. For example, by the early 1990s, all AM transmission of BBC radio had ceased in favour of FM (other than Radio 4’s long wave transmission); and in 1985, 405-line TV transmissions on the VHF band ended – typically switch-off of an old system has occurred two, three or even four decades after the launch of the new one.

The transition process from analogue to digital radio is made still more complex by the fact that the number of (analogue) radio receivers owned is far greater than ever before – there were an estimated 531 million throughout Europe in 1997, or alternatively, more than 3.5 per household in the UK (Unesco 1999). What then are the incentives for listeners to make the transition from analogue to digital radio?

The World DAB Forum, the international body of broadcasters established to co-ordinate and promote DAB, lists the following incentives (World DAB 2002b):-

- ‘CD sound quality ... pure undistorted sound.’
- ‘Easy programme selection’: no need to search for station frequencies.
- ‘Perfect reception’: no interference, good mobile reception, no need to retune on the move.
- ‘One receiver does it all!’ DAB can transmit data along with the audio.

The BBC highlights (BBC 2002a):-

- ‘More radio stations.’

- ‘Good sound and no interference’, ‘pure, clear sound’ and no retuning for mobile reception.
- ‘Text, data and pictures.’

Meanwhile, Digital One’s list of incentives include (Digital One 2002)

- ‘A richer choice.’ More stations to choose from.
- ‘Hear the difference.’ ‘No interference. No hiss or fade ... pure, clear sound’.
- ‘No need to retune.’
- ‘Check text’, ‘the latest financial, travel and weather news.’

Finally, the Digital Radio Development Bureau lists (DRDB 2002):-

- ‘An abundance of new digital only stations.’
- ‘Improved sound quality.’
- ‘No frequencies’, making sets easy to tune.
- ‘No interference and no retuning.’
- ‘Text, data and even pictures.’

Hence it appears agreed that the key drivers of the new technology are the increased number of stations and the sound quality, followed by ease of tuning and the capacity to send text. But are these expectations likely to be sufficiently persuasive?

<u>More stations</u>

There is no question that the capacity of a digital radio multiplex and the flexibility to vary the bit rate allocated to different stations means that most listeners will have more stations available to them. The BBC digital network for instance includes five new channels in

addition to simulcasts of its five existing analogue networks. Digital One's national network adds seven new stations, and local and regional multiplexes typically add another ten between them. But it would be harder to argue that this increase in the number of channels adds up to a greater diversity of radio listening choice. There is little change in formats, no effort to address marginal communities, or innovation in editorial control and decision making. Instead, the BBC's additional channels either replicate existing formats (music, repeated comedy and drama) or extend nationally what has previously been available regionally (World Service, Asian Network). Similarly, Digital One's new commercial stations are substantially similar to much of what is already available in analogue commercial radio (chart hits, easy listening and rock music), a pattern repeated on the local and regional multiplexes. As Hendy suggests, 'diversity cannot be taken for granted' (2000: 52). Describing the Digital One stations, he continues:-

> None of the music services could be described as anything other than mainstream; and the sport and news channels are formats which, in slightly different form, are already provided by the BBC. The choice of formats made by Digital One makes perfect (and predictable) commercial sense: we are in a world of expanded spectrum availability, but not yet in a world of infinite spectrum availability, and in these circumstances, operators are still compelled to concentrate on the most lucrative markets. (2000: 53, original emphasis)

Increased digital capacity will not be matched by increases in audience size, and this is likely to continue for the foreseeable future. 'In these circumstances – and bearing in mind digital technology's powers of instantaneous and cost-free duplication – profit margins will be best protected by the efficient recycling of programme material rather than taking on the costs of original production.' (Hendy 2000: 53). This appears to be what is happening, as the example of Lancashire illustrates.

That there is little diversity in the programming reflects the lack of diversity in the companies operating the multiplexes. Of the 29 local and regional multiplex licences awarded in England and Wales by October 2002, 26 were majority-owned by four companies (including GWR, which is also the major partner in Digital One). The remaining three were owned, either wholly or in partnership with one of these 'big four', by one other company, which was also the majority owner of two of the eight Scottish multiplexes. The remaining six Scottish multiplexes were also owned by a single company, which also owned the licence for the only multiplex in Northern Ireland. These same companies also dominate ownership of the UK's analogue commercial local radio stations (for example, Barnard 2000: 56-64), and these companies' own stations are most often the ones carried on their respective multiplexes, while other, independent analogue stations are not carried on the digital system (Fleming 2002: 28). So we see the same consolidation and concentration of ownership in digital radio that we have seen in analogue radio, both in Europe and in the US, and when commercial considerations determine content, there is a tendency to homogenization and little innovation (Hendy 2000: 24-48; McChesney 2000: 75-6).

However in the arrangement of the DAB system, the creation of a new tier of organization, the multiplex licence holder, increases the control of commercial radio companies over content. The 1996 Broadcasting Act stipulates that decisions about which stations will be carried are made by the multiplex licence holder – any new service must contract with them, and not with the Radio Authority, which is permitted to intervene only if the overall content of a multiplex appears to be too narrowly defined. This replaces the arrangement in the analogue world, where the Radio Authority decides whether a particular radio station should be awarded a licence to broadcast, and in making that selection is charged with ensuring a degree of diversity. Effectively then, control of access to radio broadcasting is passed from a

statutory regulatory body, the Radio Authority, to a new set of gatekeepers – to four commercial companies in England and Wales, or to two in Scotland and Northern Ireland – and a new entry barrier is created for new services or novel radio formats.

Undoubtedly, a segment of the audience will find some of the new stations particularly appealing, sufficiently so to purchase a DAB receiver specifically to receive those services. But this is likely to be a small number of listeners. The Radio Advertising Bureau's research casts doubt on the appeal of an increase in the number of stations, observing that the availability of more stations does not significantly increase a listener's personal 'repertoire' of stations (RAB 1997). Given the dominance and control of digital radio by the existing major radio corporations, it is questionable whether the additional capacity for new stations will result in a great deal of programming that is novel or indeed independently produced. It certainly has not done so in these relatively early days of digital radio. Should this remain the case, the availability of new services is unlikely to be the catalyst that persuades many listeners to spend considerable sums of money on DAB receivers.

Sound quality

The other significant improvement promised by digital radio is faithful, interference-free, high quality audio. Analogue reception suffers in a number of ways, some originating at the source, and others a product of the transmission process. Firstly, AM signals are limited in bandwidth, that is the full range of audio frequencies is not transmitted, and so quality is bound to suffer. For that reason, where there is a choice, AM tends to be used for speech stations, where such sacrifice is less important. Both AM and FM transmissions are susceptible to noise and hiss (AM more so than FM) and to interference from so-called multipath reception, where a radio receiver picks up a reflected signal (off a nearby building

or hill) which interferes with the directly-received signal. This is particularly a problem with mobile listening since the effect changes as one moves, degrading reception.

The use of digital systems in the recording, transmission and reception of radio signals should reduce noise and hiss and prevent multipath problems. The discrete, on or off nature of digital signals means they are less likely than analogue to be corrupted by the inevitable accumulation of electrical noise during the transmission-reception process, noise which produces background hiss in analogue systems. Multipath reception problems are also reduced by dispersing the audio data across the multiplex frequency range – any delayed signal arriving at the receiver by an alternative, reflected path either contributes to the main signal or it is effectively rejected. Finally, the capacity of the multiplex means that all stations may be broadcast at the full audio bandwidth; there is no deliberate limitation on the audio frequencies as in analogue AM stations.

These are the technical reasons why digital broadcasters claim better audio quality. In fact, reports in the music and hi-fi press suggest that there is little difference between DAB audio quality and a well-received analogue FM signal in a hi-fi system (for example Black 2001). Indeed, the BBC digital radio Website states that ‘if you already receive good FM, the differences in sound may not be as readily apparent’ (BBC 2002b). The improvements will be more evident in areas where FM reception is weak (provided that there are DAB transmissions in that area), or when listening to stations that are on AM in the analogue system. In other circumstances, the principal improvement noticed by hi-fi enthusiasts has been the removal of dynamic range compression, or DRC (Woodyear, 2001). DRC, sometimes known as audio processing, is the deliberate boosting of the quiet parts of an audio signal to compensate for inevitably poor acoustics of most listening environments. Were we

to listen without compression to audio sources which have a large dynamic range (the range of volumes from quietest to loudest) in, for instance, a kitchen or car, we would need to continually adjust the volume control. Hence broadcasters apply DRC before transmission, upsetting some hi-fi enthusiasts who strive to make their listening environment as good as possible. In other cases, particularly pop music stations, there is intentional over-compression to make a station 'stand out' as the tuning scale is scanned (Cutmore 1988). The removal of DRC then presents a more faithful reproduction of the audio source. Ironically, for most listeners, receiving DAB without DRC will create problems with the quietest and loudest sounds, and most receivers allow the listener to re-introduce various degrees of dynamic range compression, thereby negating this advantage of DAB transmissions. Given the typical listener and her or his listening environment, it is unlikely that sound quality is the most important factor in radio listening choice. Indeed, the launch of FM transmission in 1955 gave a noticeable improvement in audio quality, yet even this proved insufficiently appealing to most listeners – even by 1972, only a minority of listeners had FM receivers (Briggs 1995: 842), and it wasn't until the early 1990s that the BBC's AM transmissions ceased (Crisell 1997: 138).

More fundamentally for the specialist listener is the effect on sound quality of the digitization process itself. The total data capacity of a digital radio multiplex, measured in 'bit rate' or kilobits per second (kbit/s), must be divided between the number of stations to be carried, as well as any other demands such as data transmission and so on. This allocation is dynamically variable –a multiplex operator may decide on occasion to carry additional stations and the bit rate allocated to existing stations is correspondingly reduced. A station's bit rate determines the audio quality, and so there is a trade off between the number of stations a multiplex can carry and their sound quality. Any assessment of sound quality

involves a degree of subjectivity, but listening tests suggest that while quality is excellent at a bit rate of 256 kbit/s, and acceptable at 192 kbit/s, there are 'annoying' artefacts at rates lower than these (Ambikairajah et al. 1997; Soulodre et al. 1998). In fact the bit rates used by the BBC and Digital One are as low as 128 kbit/s, the minimum proposed by the Radio Authority for stereo music (Radio Authority 2001: 28); some speech channels are as low as 48 kbit/s (transmitted in mono, equivalent to 96 kbit/s stereo quality). Indeed, since 2001 the BBC has systematically reduced the bit rate of its stations; in an interview on the BBC's Feedback radio programme, the Corporation's controller of new media, Simon Nelson, admitted that the quality of the stations has deliberately been reduced in order to accommodate new services (Feedback 2002). One consumer magazine claimed the BBC admitted that analogue FM quality was superior to DAB ('BBC advice' 2002). Certainly sound quality has now been demoted as the top selling point of DAB, broadcasters now placing the availability of more stations at the top of the list in promotional material. The term 'CD-quality' is nowadays not used in marketing DAB.

So even hi-fi enthusiasts, who might appreciate the absence of DRC, have had cause to question any claimed improvement in sound quality from a digital receiver, unless they happen to be in an area of both poor FM reception and adequate digital strength. It is unclear how important audio quality is to other listeners. As background sound, radio listening often takes place in poor acoustic conditions. An improvement in in-vehicle reception, while also not an ideal listening environment, might be evident in the lack of multipath interference, but only while in range of digital signals – as the vehicle reaches the limits of digital coverage, the signal breaks up before being lost altogether. Other than in a few particular sets of circumstances, then, the overall quality of DAB reception may not represent an improvement.

Again, given that the aim is to develop a market as quickly as possible for digital radio, a promotion based on the quality of the sound is unlikely to be the best way forward.

Other DAB features

Other novel features of DAB receivers highlighted by broadcasters include the ease of tuning the new radios, and the reception of text alongside the audio signal.

To find a radio station on DAB is straightforward. Within a multiplex, a given station's data is not bound to any particular frequency, and so this historic association of a radio station (and indeed its identity) with a particular frequency is gone. 'Tuning' the radio instead means selecting from the list of station names that appears on a text display screen with which all DAB receivers are fitted. With up to 40 stations available, this might become a little tedious, so most receivers also have 'presets' or memory buttons, allowing the listener to store five or ten favourite stations.

However, here there is a direct overlap between the digital and analogue receivers – for cheaper analogue receivers also commonly have preset buttons and, increasingly, the radio data system (RDS) that identifies stations by name rather than frequency. Ironically, one newly-launched DAB receiver which also incorporates an RDS tuner boasts of this analogue feature: 'tuning by name – no need to remember frequencies' (Pure Digital 2003). The Radio Listener's Guide lists 42 analogue receivers, costing from £30, which can store up to 54 stations; RDS receivers with presets cost from £40 (Woodyear 2002). For mobile reception, the benefit claimed by DAB's supporters, that the single national frequency means no retuning is needed on the move, is mirrored in analogue radio's RDS automatic retuning facility. The evidence that analogue tuning presents a serious problem for listeners, which

DAB could alleviate, is not compelling. The Radio Advertising Bureau has suggested that preset buttons and frequency scanning systems simply mean 'the repertoire [of stations accessed] becomes easier to use' rather than expanded (RAB 1997).

The final advantage of DAB, text transmission along with audio, requires clarification. There are two categories of text transmission. The first is audio-related text that appears on a DAB receiver's display and, in addition to showing the station name, might list song titles, perhaps even lyrics, forthcoming programmes and so on. These scroll across the display, or can be rendered static. This feature may well be a useful benefit of digital radio, but few argue that it is its most important feature. Future receivers are anticipated to extend this feature to include crude graphics, for instance station logos, pictures of presenters or artists.

The second category of data transmission, non-programme-related, is not receivable on digital radio receivers at the time of writing. As its classification implies, this data is unrelated to the station content, and indeed may be completely unrelated to radio itself. This, potentially, is an important development, and will be returned to later.

Demand in a saturated market?

To conclude, the incentives for radio listeners to switch from analogue reception to digital are not immediately overwhelming. Some features will be attractive to some listeners. Some of the new stations might be appealing to some people, but the loss of some analogue stations not carried on digital might be problematic for others. Better reception in marginal FM areas will also persuade some listeners to pay a premium for digital reception. But this will only account for a small number of listeners and, given the high cost of digital receivers, is only likely to result in a digital replacement of the main household radio receiver, others

remaining analogue. For the majority of radio listeners, the differences between the new digital radio and the 'old' analogue service are small. When FM radio began – in the 1940s in the US and 1950s in the UK – its appeal was limited. The promise of better sound quality and more stations was insufficient to persuade listeners to pay a premium for the new receivers, and the FM audience remained low compared with AM. Instead, it required the emergence of new, radical radio formats in an otherwise anodyne, commercially driven US radio landscape (Keith 2002) or ultimately the migration of simulcast (AM and FM) national BBC stations to FM-only provision in the UK in the 1980s (Barnard 2000: 15). We see little comparable innovation on digital radio, commercial priorities discouraging such risk-taking; and the continued awarding of new local and regional analogue licences, including novel 'access radio' services, does not suggest imminent migration of mainstream radio to digital-only transmission. If the ultimate aim is to switch off analogue altogether, DAB radio has a long way to go.

The difficulties are clear. As we have seen, Eureka's original project description refers to the need to 'stimulate a virtually saturated market with new products.' Commercially driven, as a pure radio service DAB is unlikely to penetrate, let alone replace, that saturated market. Thus, if the DAB system is to survive, there must be some alternative means to sustain it.

Alternatives for DAB

While in all cases the multiplex licence holders' principal sphere of activity is broadcasting, in the absence of strong growth in digital radio audiences, and thus in advertising revenues, they are likely to seek other income sources to support the consolidation of the DAB system. One possibility is conditional access, or subscription radio, a possibility highlighted in the original Eureka project proposal. Conditional access has been used for some years in digital

pay-TV. However, in contrast with television, where the acqusition of sporting and film rights encouraged the reluctant acceptance of pay-TV, there is a vast cultural barrier to be overcome in charging for radio, which has become something we expect to receive for free – indeed, the UK's licence fee for owning a radio was finally abolished in 1971. While satellite TV subscribers also receive digital radio stations, almost all stations are part of the basic subscription – paying more means more TV channels, but not more radio. Other subscription-based satellite radio services, such as World Space, or Sirius and XM in the US, remain rather specialist and have only a very small audience. In fact, in October 2002 there was only one subscription radio service operating via terrestrial DAB anywhere in the world (a Rediffusion service in Singapore). Rather than subscription income then, the most likely source of revenue is the use of the data transmission capacity of the multiplex bandwidth.

Up to twenty per cent of that bandwidth can be used for the transmission of 'additional services', that is data carrying information not related to programming. The UK Radio Authority 'anticipates that around half of this capacity will be devoted to commercial material related to the digital sound programme services' (Radio Authority 2001: 24), for example text or graphics containing music advertising. However, this limit of one half is not a statutory restriction, and the full twenty per cent could be used for 'non-radio' commercial services. The government has further indicated that there should in fact be no restriction on how much of the bandwidth could be devoted to data rather than audio (DTI 2002: 38). Thus DAB is well placed to enter the data communications market, currently served by mobile telecommunications companies. In this sector, new data services such as GPRS and UMTS (better known as 3G) are yet to reach anything like the data speeds originally anticipated – reports suggest that GPRS currently operates at maximum data speeds around 56 kbit/s, while 3G trials suggest speeds around 128 kbit/s in the most favourable conditions (Wray 2001, Milner 2001). The

downturn in the mobile telephone companies' fortunes in 2001, coupled with the huge amounts bid for the 3G licences prompting payment defaults throughout Europe (Wray 2002), is likely to further delay the development of these services, with as many as 28,000 new masts and base stations being needed to cover the UK alone (Binmore 2002, McIntosh 2002).

In comparison, DAB offers some advantage for data transmission. An allocation of twenty per cent of the multiplex bandwidth would mean a capacity for DAB data of something over 300 kbit/s, significantly higher than even 3G. A relaxation of the twenty per cent limit obviously means a much higher potential bit rate. Furthermore, DAB data is broadcast rather than point-to-point, and thus its capacity (and speed) is not degraded the more there are downloading that data. While broadcast data is, naturally, a one-way delivery, most data connections are asymmetric – far more data is downloaded to the receiving device than sent from it. So a broadcast data system would be suitable for downloading, while a conventional mobile telephone link could provide a low data rate return path. Such a system would operate in much the same way that quasi-internet services are provided on a digital satellite TV system over an asymmetric link, with downloads via satellite broadcast and a return path via modem and telephone line.

Here, we may have identified DAB's supervening social necessity. Moreover, this might fall within Winston's second category of social need. The set of social changes which might allow DAB to succeed include the greater reliance on mobile data access and the proliferation of mobile computing and communication devices, creating a potential market identified by the mobile telecommunications companies but which they are unable yet to satisfy. Hence we may well see partnerships between multiplex operators and mobile communications

companies, the DAB multiplex licensees generating revenue by charging the mobile operators for the use of the data capacity. The industry body, the World DAB Forum is actively courting such partnerships (World DAB 2003). Alternatively, DAB multiplex companies might become competitors, offering their own data content, where subscription services for high-value content might become more viable.

Digital radio has already embraced 'convergence' in a number of ways. The manufacturers of the hardware, DAB receivers and the components within, have not been the traditional audio equipment manufacturers, but information technology companies such as Imagination Technologies, Psion, Roke Manor Research or Texas Instruments (bearing out the idea that digital radio would be led by the European electronics industry). At the same time, a number of non-broadcasting companies are partners in the multiplex operating consortia (for some very obvious reasons). These include data content company UBC Media, Carphone Warehouse, the Ford motor company. The integration of DAB chips into mobile phones has already been demonstrated, and it is quite possible that a digital car radio could become a sophisticated 'communications centre', accessing not just travel information but a whole range of business-oriented data.

Speculation about such developments is not particularly new. Some have suggested that there may be corporate mergers between multiplex operators and a mobile communications companies (Daniel 2000; Shah 2003). But while others argue that for a multiplex operator to use the DAB multiplex capacity for data might amount to unfair competition with telecommunications companies (Murroni et al. 1998: 34), rather it might be the only way to enable the DAB system to survive in order to provide any sort of radio service. As we have noted, Winston argues that a supervening social necessity arising from a separate set of social

changes (his second category) is more likely to lead to a technology's success than a purely commercially-identified need (third category). Here, in highlighting DAB's potential role in data provision in a non-radio sector, we might indeed suggest that the technology will become more widely adopted and thus its future secured.

Whither radio?

Digital broadcasting creates extra capacity in the radio spectrum. In principle, there is no reason why more capacity should not mean a greater variety of programming. Yet, at present, there is no indication of a commitment to new forms of programming on the part of the multiplex operators or of the regulator. Initiatives in analogue radio such as the UK Radio Authority's access radio projects or the US Federal Communication Commission's low power FM system have not found an equivalent role in digital radio. In fact, the deregulation implicit in the transfer of gateway control from statutory to commercial interest has long been noted as a threat to community broadcasters (Buckley 1994). Instead, it is being left to existing broadcasters, the BBC and the large commercial companies, to organize and promote DAB. It may be that, once established, DAB will find room for additional, alternative radio services, but in the short term, the broadcasters' interests will be to make DAB a successful, that is profitable, technology.

If ensuring DAB's success means emphasizing the importance of using radio spectrum for data delivery, this could be at the expense of radio itself. DAB chips are becoming integrated into personal, mobile communications equipment – if this should become the prime market in the early diffusion of DAB technology, then DAB might become identified as a communications system to which the reception of audio services is a mere adjunct. As long as analogue transmissions remain the primary means by which people receive radio, the

simultaneous transmission of radio programming via DAB might come to be viewed at best as of less importance and therefore less worthy of investment, or at worst as a waste of valuable data capacity. When the BBC's Simon Nelson states that 'radio must go digital. Radio can't be the only medium that stays in analogue', it sounds less like a statement of inevitability and more like exhortation (Feedback 2002).

Digital radio has the capacity to enhance the quality of listening in more ways than one. In expanding the range of services available, and increasing the flexibility of the provision of those services, the potential exists for a far greater variety of radio stations, from the national to the very localized community station. Entry costs for radio stations have always been relatively low, making it one of the most accessible media, and they remain low even when considering digital equipment. However, the structural organization of the digital radio industry, together with a tendency to remove regulation, has allowed it to be dominated by the existing broadcasters, principally as a commercial opportunity. The probability is that, without significant innovation and variety in content, few listeners will see any point in paying the digital premium which will remain for many years to come.

In 1974, Raymond Williams wrote of the possibilities for the future of television, based on new technologies such as cable transmission and video recording. He expressed hope that these technologies would be deployed in a manner which would enhance democracy and freedom of communication. However, he recognized that this would not happen easily, that it would need 'sustained campaigning' to wrest these tools from purely commercial interests (1990: 150). Robert McChesney also welcomes the potential of increased capacity, but states that, far more important than the technological developments, the rise of neoliberal economics and an elevation of the logic of market forces above public service obligations

means that the radio industry, and the media more generally, should be regarded as an anti-democratic force (McChesney 2000). Webster and Robins have suggested that the rhetoric of choice and of plenty, and in this context of almost limitless radio spectrum, in fact is a cover for ‘the enclosure of the future’, an attempt to deny the full possibilities offered by technological developments and secure the advantages for the existing players (Webster and Robins 1998: 42). While the new digital technology continues to be presented as the inevitable future of radio, promising untold benefits while being seen to offer little that really is new, and while it continues to develop (as perhaps it was always intended) as a purely commercial enterprise, the opportunities for securing a freer, more diverse and pluralistic radio landscape may remain as far away as ever.

8600 words

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