

Digital Audio Broadcasting in Canada: Technology and Policy in the Transition to Digital Radio

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Abstract: This article presents an overview of digital radio policy in Canada in the period 1995 to 2005 and the attempt to implement the Eureka-147 Digital Audio Broadcasting (DAB) standard as the replacement technology for analog AM and FM broadcasting. Canada was an early adopter of this system, but unfavourable conditions have led it to largely abandon the approach in favour of a multiplatform system. The interaction between industry, government regulation, and broadcasting policy around digital radio reveals a complex situation of competing interests. Despite extensive regulatory intervention to protect Canadian interests, the pace of technological change and the dominant influence of U.S. interests have made the transitional path to digital radio even more uncertain than it was 10 years ago.

Résumé : Cet article offre un survol des politiques qui régissent la radio numérique au Canada pour la période de 1995 à 2005 et expose la tentative d'implantation de la norme *Eureka-147 Digital Audio Broadcasting* (DAB) comme technologie de remplacement pour la diffusion analogue AM et FM. Le Canada fût rapide à adopter ce système, mais des conditions défavorables l'on mené à l'abandonner en très grande partie en faveur d'un système multi plateforme. L'interaction entre l'industrie, la réglementation gouvernementale et la politique de diffusion qui touchent à la radio numérique révèle une réalité complexe composée d'intérêts concurrents. Malgré une vaste intervention en matière de réglementation visant à protéger les intérêts canadiens, le rythme des changements technologiques et l'influence dominante des intérêts américains ont rendu le passage transitoire à la radio numérique encore plus incertain qu'il ne l'était il y a 10 ans.

Keywords: Radio; Broadcasting policy; Regulation/CRTC

Introduction

Radio broadcasting is poised to undergo significant transformation over the coming years as a number of new digital broadcasting technologies offer enhanced audio quality and reception, integrated data and multimedia content, and more efficient

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use of the radio spectrum. Digital Audio Broadcasting—or DAB, as it is often known—is the most established of these technologies. Developed in Europe as the Eureka-147 standard in the mid-1980s, DAB was also adopted by Canada and widely tested in the early 1990s. Although the progression to digital forms of delivery is an agreed objective of the radio industry, there is less consensus on whether DAB offers the best means to achieve this. Despite the fact that the technical advantages of digital radio broadcasting have been amply demonstrated, its viability and future prospects remain uncertain. Patterns of development internationally are quite varied: some countries, such as the United Kingdom, continue to successfully promote DAB, but other countries in Europe are delaying implementation or even withdrawing earlier deployments. Some 10 years after the inception of DAB, its progress internationally has been patchy, and broadcasters and regulators are now evaluating a number of other approaches to the realization of a fully digital radio landscape.

In this article, I trace the background to the deployment of DAB in Canada from its initial unveiling to the end of 2005, when the first new subscription-based digital satellite services were launched. Following consideration of some of the central environmental factors for digital radio, including the regulatory regime, the market environment, the availability of the relevant receiving equipment, and audience interest, I assess the prospects for a successful transition of radio to an all-digital environment. Digital is frequently assumed to provide a natural replacement for analog systems in virtually every technological sphere. I argue, however, that as illustrated by the case of digital radio in Canada, this transition is neither simple nor certain. Following the approach of the social shaping of technology (MacKenzie & Wajcman, 1985), I argue that social factors and political considerations are manifestly central to future scenarios for broadcasting.

My focus is restricted to a critical engagement with digital radio as represented within the industry and its associated trade press, for a study of the wider issues of the consumption and use of digital radio would be beyond the scope of this article. Expert opinion from industry members in addition to the relevant regulatory frameworks for digital radio provide the primary sources for analysis. Interviews were conducted with many of the participants central to implementing digital radio in Canada, including broadcasters, policymakers, technologists, and independent analysts (listed in the acknowledgments). The industry perspective is often an important gap in the literature, and in the case of digital radio, Canada's experience has not yet been documented. This account serves in part as documentation but is also intended as a contribution to ongoing policy debates about the future of broadcasting.

Competing platforms for digital radio

Radio, the oldest of electronically broadcast mass media, stands at a particularly interesting point in its development in the early twenty-first century. Digital means of broadcasting offer new opportunities for value-added content, enhanced quality, and more efficient use of the radio spectrum (Hakanen, 1991). The European-developed Eureka-147 standard known as Digital Audio Broadcasting (DAB) is the most established of the new digital audio technologies in radio, but increasing use of the Internet and satellite forms of distribution have also contributed to a significant re-assessment of radio's future (Kozamernik, 2004). Indeed, the anticipated wide-

spread adoption of wireless broadband applications and the use of radio-like technologies to distribute multimedia content, including audio and radio on demand, have led some to question the future of radio at all and ask whether it will in due course metamorphose into a new form of information and entertainment delivery (Department of Trade and Industry, 2004).

The international context for the adoption and implementation of new digital radio technologies is a complex one (see Barboutis, 1997; Hendy, 2000; Lax, 2003; Ha, Dick, & Ryu, 2003). DAB, with the support of the European Broadcasting Union (EBU), was widely adopted in most European countries throughout the 1990s and has also been deployed in Canada, Australia, and in parts of Southeast Asia. Although not the only form of digital radio transmission, it has been described as the most revolutionary and complete system and the first big technological change in radio since the appearance of FM, stereophony, and transistors (Martinez-Costa, 2004). DAB's progress has been slow, however, in part due to sluggish governmental and regulatory support, the initial unavailability of affordable receivers, and the general lack of enthusiasm on the part of service providers to take advantage of DAB's potential for value-added content. The United Kingdom is the leading exception to this, where there has been wider market acceptance of the standard and strong incentives for content providers to develop DAB-only services. However, the decision of YLE, the Finnish public broadcaster, to shut down its DAB network in 2005 sent a warning signal to the broadcast world that DAB long-term may not be the only digital solution.

Satellite digital radio has made its greatest impact in the United States, where two companies, XM Satellite Radio and Sirius, have been licensed to provide services on a pay-subscription basis. Serving a potential audience of 270 million, satellite radio offers a commercial-free, digital alternative to existing radio services and is primarily aimed at in-car listening, which accounts for some 50% of radio listenership in the United States. The reluctance of the Federal Communications Commission in the United States to disrupt the established and highly successful FM radio market led to its decision to adopt the IBOC or in-band, on-channel system (Ala-Fossi & Stavitsky, 2003). This is an approach that integrates analog and digital signals within the same transmission, thereby using existing spectrum but without the addition of new services. Now branded as HD or high-definition radio, the IBOC system is something of a hybrid, making the transition to digital easier but limiting what it can offer. Another digital radio standard aimed at the re-utilization of the AM band (short, medium, and long wave) is Digital Radio Mondiale (DRM). It promises near-FM quality with the capacity to integrate data and text on existing AM frequencies. Offering improved reception and functionality over analog AM, DRM is a technically successful, non-proprietary system but one that awaits regulatory, market, and broadcaster support.

While not directly a competing broadcast technology, the impact of the Internet on radio has also been significant, and use of the Internet as a means of providing added information and on-demand services has been central to most broadcasters' digital strategy (Evans, 2001). The global reach of the Internet and its widespread adoption in everyday life has opened new possibilities for distribution of radio content as well as the creation of new Internet-only, online radio services. The Internet's interactive features allow greater personalization of radio content and

may point toward the medium's future but are not considered by broadcasters a replacement for the one-way, point-to-multipoint wireless transmission that defines radio. However, emerging technologies utilizing digital transmission to provide mobile multimedia services and broadband access such as Digital Multimedia Broadcasting, or DMB, may provide another technological enhancement for radio in the future (Kozamernik, 2004).

Adoption of Digital Audio Broadcasting (DAB) in Canada

Canada, as Chouinard, Conway, Stacey, and Trenholm have observed (1994), has more often been a follower than a leader in the development of new broadcast technologies. Yet in the case of digital radio, Canada was an enthusiastic "early adopter" and within the North American context led the field in digital radio broadcasting during the 1990s. As early as 1989, an ad hoc advisory group under the auspices of the Canadian Association of Broadcasters (CAB) began to advocate the idea of a national strategy to implement the transition of the national broadcasting system from analog to digital. The group, comprising public broadcasters in the form of the Canadian Broadcasting Corporation (CBC) and private broadcasters represented by CAB as well representatives of the Department of Communications, considered the various options available and organized demonstrations of the Eureka-147 DAB system in 1990 (Chouinard et al., 1994). Following the success of these trials and the enthusiasm expressed across the radio sector for the project, a governmental Task Force for the Introduction of Digital Radio in Canada was established in 1992 to advise on all relevant technical, policy, and regulatory matters. It issued its report in 1994, outlining detailed plans for the relevant coverage and service issues as well as making recommendations on the policy and regulatory implications (Task Force on Digital Radio, 1995). Digital Radio Research Inc. (DRRI, later Digital Radio Roll-Out Inc.) was established from the original consortium of private broadcasters and the CBC, for the purpose of financing and managing facilities for digital radio research and assuming responsibility as the official body mandated to promote digital radio in Canada. Following the lead of the International Telecommunications Union, which in 1994 recommended the Eureka-147 system as the global technical standard for terrestrial and satellite radio broadcasting, Industry Canada formally adopted Eureka-147 as the standard for digital broadcasting in Canada and allocated 40MHz of spectrum in the L-band range (1452-1492 MHz) for new broadcast services.

From the start, digital radio broadcasting and the Eureka-147 standard was intended to be a replacement technology, and therefore much of the planning for its implementation was based around compatibility with existing services. Radio was viewed as being in a period of transition at the end of which analog systems of transmission and reception would be completely replaced by digital technology. In order to facilitate the transition, existing radio licence holders would be given priority access to the digital radio band. The development of a new band for radio broadcasting was also viewed as a good way to enable expansion in the sector. There was little capacity left for FM development, and AM, with its inferior sound quality, could in one transitional move be upgraded to a much superior system. The policy governing the introduction of digital radio was published by the government regulator, the Canadian Radio-television and Telecommunications Commission

(CRTC), in 1995 and outlined a two-staged approach whereby the Commission would first license digital radio undertakings on this transitional basis (CRTC, 1995). Later, a public process would be initiated to consider all aspects of digital radio broadcasting in the longer term. The policy involved granting licences to all incumbent operators who wished to use digital facilities to provide a simulcast of their existing services, licences that would remain in effect until a long-term digital radio policy was developed. Licence holders would have some opportunity during the transitional period to develop separate programming for their digital services, limited to 14 hours per week. Applications for new licences or for additional services would only be considered on a case by case basis and subject to the Commission's policy of supporting the existing radio market.

Canada's support of DAB and Eureka-147 was not without controversy (Chouinard et al., 1994). Its support of a wideband transmission technology was justified on the basis of ensuring high-quality audio and maximum spectrum efficiency. The choice of wideband using L-Band spectrum was in contrast to the approach adopted elsewhere, particularly in Europe, where Band III VHF spectrum was more commonly utilized. It also set Canada apart from the United States, where L-Band was not available due to its allocation for military uses. However, Canada's decision was justified on the basis that the approach adopted would offer superior quality, that it would not interfere with existing AM/FM services, and that it offered the best potential for value-added data services. All existing AM and FM licensees were allocated frequencies in the 1452-1492 MHz L-Band, and an allotment plan was developed in each of the major metropolitan areas to allow the digital service to match as closely as possible the coverage of existing stations. This involved defining DAB coverage around the largest FM station within any given market and grouping up to five existing FM stations into a single multiplex. Replacement of wide-area AM stations was restricted to the largest equivalent, though smaller, FM coverage area. As a replacement technology, stations were licensed only to simulcast existing services and were not permitted to offer new or additional services. Equally, no new licences were to be offered for the duration of the transition, nor would any new operators be allowed to enter the market.

From the industry point of view, broadcasters' commitment to the future of radio as digital appeared solid, and there was widespread support for the view that the best course of action to develop its potential was an industry-wide, coordinated effort to oversee its development. Among the arguments offered was the fact that listeners' increasing use of CDs and other digital audio devices had created audience expectations of higher quality that only a digital system could provide. Studios and many aspects of the production process were undergoing a process of digitalization, and it appeared logical that this would, in due course, be extended to the transmission system. Technically, a digital system, it was argued, could provide a more robust and reliable service to the portable and mobile listener and in particular provide a much-improved service to the automobile listener. A further incentive for broadcasters was the potential of new digital information services, and considerable emphasis was placed on the new revenue streams that might become available with DAB's data carrying abilities.

New programming approaches for digital radio, as envisaged by DRRI, were intended to drive the development of DAB and make it a highly attractive consumer

product (Bray, 2002). These included displays of station name and format and, as the technology developed, the opportunity to display logos and other graphical information, as well as dynamic labels to display information about what was currently playing on air. Using available data capacity, stations could also offer programming enhancements, interviews, breaking news, weather forecasts, different languages, and so on. A listener, for example, could push a "tell me more" button that would provide additional information about a programming feature or an advertiser, eventually leading to interactive e-commerce applications.

According to Parnis (2000), the industry's approach should be seen in the context of a widely-held view that radio as a medium in the early 1990s was entering a period of decline and that it could be swiftly overtaken by rival digital service providers if it did not adapt to the new environment. The representative industry group, DRRI, put forward the argument that "Every communication medium is embracing the superior quality and increased capacity made possible by digital technology. In today's competitive marketplace, radio must keep pace, providing the highest quality of sound and an array of new and appealing services that ensures that radio remain a dynamic media." In this context, DAB was represented "as a revolutionary audio broadcasting technology, which dramatically improves sound quality, and signal reliability and will enable you to receive a host of new services through your radio" (DRRI, n.d.). Against the background of increasing competition from the Web and the potential threat from other digital audio services, DAB was heavily promoted as the best technology available:

DAB delivers a variety of fundamental benefits. Based on Eureka-147 technology, it has numerous advantages over both current analog transmission and the more recent audio streaming via the World Wide Web. "Digital" offers both outstanding CD quality sound and portability. It will lead to a host of data display services for the consumer including geographic positioning, traffic and weather information, advertising supplements, song credits and a good deal more. All the while the listener is treated to interference-free reception. DAB's "point to multi-point" capabilities serve to illustrate the Web's "point-to-point" limitations and afford digital radio stations the opportunity to play to a much wider audience. (Bray, 2000)

A number of important economic arguments were also put forward in favour of DAB. Following the initial investment in new transmission equipment, there would be greatly reduced operating costs for broadcasters given the much lower power requirement for DAB compared to FM and AM. The potential for new pay or subscription-based services was also an important incentive as a means to grow radio revenues. Additionally, however, there was a belief in the inevitability of the transition to digital and a fear that not being part of this would severely jeopardize radio's business foundation. As expressed by one commentator in 2000:

The success of DAB is critical to broadcast owners as the only way to protect the value of their properties. It is inevitable that AM and FM must give way to superior technology. After extensive research, the logical next step clearly appears to be DAB. Current license holders are the first to be granted the new digital licenses by the CRTC. Owners thereby continue to

hold and control an extremely valuable portion of the broadcast "real estate." (Bray 2000)

The pro-digital radio lobby could claim considerable optimism for the prospects for DAB in Canada in its initial inception phase. The groundwork and development for DAB in Canada was described as a textbook case of cooperation among the many players involved (Chouinard et al., 1994). The relatively small group at DRRRI who pioneered and championed the cause of digital radio, and DAB in particular, ensured that the technology had been perfected and standardized, the necessary spectrum had been obtained, and generally a solid foundation was in place for large scale implementation (Edwards, 2001). Once the process moved out of the planning phase and into the domain of implementation subject to market conditions and consumer behaviour, it would become more diffused and uncontrolled, but, it was hoped, with sufficient marketing, public information, and availability at a reasonable cost, consumers would be clamouring for DAB (Bray, 2000).

Digital radio was officially launched in Canada at the convention of the Canadian Association of Broadcasters, and a steady rollout of stations with DAB services proceeded in key metropolitan areas. Within a short period, there were 57 stations broadcasting in DAB, reaching 35% of the population, some 10 million listeners in Toronto, Montreal, Windsor, and Vancouver, with a further launch of DAB services in Ottawa to follow. By 2002, the CAB's vice-president of radio could confidently declare that sufficient progress had been made to claim Canada's emergence as a world leader in digital radio (Cavanagh, 2002). A major boost to the marketing of DAB was the announcement by General Motors of Canada of its plans to install DAB receivers as standard equipment in its vehicles for the 2003 model year. Also in that year, DRRRI commissioned an engineering study to extend the national coverage of DAB in a series of corridors between the major metropolitan centres. Significant progress also appeared to be underway in receiver availability: Radio Shack Canada announced it would carry a range of home and portable DAB consumer products in its stores. The development of a new DAB chip by Texas Instruments also promised greatly reduced prices, and the first DAB/FM personal receiver below the psychologically all-important \$100 became available.

What went wrong for DAB in Canada?

Despite the many positive early indications, DAB in the 10-year period from 1995 to 2005 did not live up to expectations or develop as the mass consumer technology as expected. By 2006, there were officially only 73 licensed DAB stations in Canada, of which 62 were fully operational: 25 in Toronto, 15 in Vancouver, 12 in Montreal, 6 in Windsor, and 4 in Ottawa, serving nearly 11 million potential listeners. Listenership for all stations was low, however, and was not even monitored by official audience measurement. DAB receivers were still not readily available whether for home, portable, or car use. Industry professionals expressed disillusionment and regarded the years since 1995 as an unproductive, stalled, or even failed period of development. In common with the experience of other countries, the prospects for digital radio based on a single platform such as Eureka-147 looked more and more unlikely. The reasons for this stalled development are varied and call into question some of the initial assumptions made about the rollout of DAB in Canada. Additional external factors also intervened, over which it could be said

there was very little control. However, some important lessons arise from the Canadian experience of digital radio that find resonances elsewhere and can inform a consideration of the future of radio as a medium. Specific reasons underpinning the failure of DAB in Canada can be grouped under three headings: the lack of consumer response; sectoral or industry responses; and policy issues.

Lack of consumer response

In the first place, it is clear that there was a very poor consumer response to the development of DAB in Canada, and at no time within the period 1995 to 2005 could it be said that digital radio firmly took hold. There was poor awareness of the service, and, indeed, even of the existence of the new technology or its potential benefits for radio listening. There were particular difficulties with the supply of receiver equipment, and it was erroneously assumed that a range of equipment would follow the adoption of DAB in Europe. Despite the promotional activity of DRRI as the mandated body to create awareness of DAB and its benefits, the fact that receivers were largely unavailable or difficult to source proved extremely damaging to the prospects of an early take-up of DAB. Initial costs of around \$2,000 for high-end consumer receivers gave DAB an elite image that subsequently proved difficult to shake off. Lower-cost receivers, once they were available, performed poorly, adding further difficulties to any potential increase in supply of receiver equipment. The issue of receiver availability remains a crucial issue for digital radio in that with an installed base of approximately 75 million AM/FM receivers, Canadian consumers need very compelling reasons to change to a new and relatively untested technology.

With poor availability of consumer receivers and in many instances poor quality of available technology, the much-heralded enhanced features of the digital radio listening experience proved to be unattainable or below expectations. The assumption that the promise of enhanced, CD-like audio quality would be the unique selling feature of the new technology proved unfounded in nearly all markets and especially so in Canada. Some industry figures maintain that this was a failure of marketing, but it remained a “chicken and egg” problem compounded by a lack of interest on the part of manufacturers to invest in new product lines without greater consumer demand. As well, many of the promised additional services did not arrive, with most stations simply offering simulcasts of their analog services. Despite initial enthusiasm for the possibilities of data services, with the exception of those provided by CHUM, none really materialized.

Of particular significance to the Canadian market was the ultimate failure of the automotive manufacturing sector to offer DAB as a standard feature in its cars. Given the importance of in-car radio listening in North America generally, the tie-in with OEM (or original equipment manufacturers) for the automotive sector was crucial to the successful adoption of DAB. The surprise success of DRRI in getting a commitment from General Motors Canada for installation of DAB receivers in its 2003 models proved short-lived when difficulties emerged over supply of equipment and in engineering a segregation of the Canadian market for those areas where DAB was available. According to DRRI's president at the time, what General Motors required was a commitment and a timetable for the rollout on a national level of DAB to enable GM to commission digital receivers as standard equipment

across their entire range (Duff Roman, Vice-President, Industry Affairs and Digital Radio Operations, CHUM Limited, personal communication, July 27, 2005). When this wasn't forthcoming, General Motors withdrew their support and with the rest of the sector began to adopt a "wait and see" approach.¹ As a result, the only option available for DAB in-car listening was an after-market installation of a new receiver, which proved unpopular, adding to the low profile of DAB in the marketplace.

Faltering industry support

With regard to the radio sector in general, a question mark over the decision to adopt Eureka-147 began to emerge once it became clear that a different approach was to be adopted by the United States. Canada's decision to adopt DAB was made in the knowledge that this would not be followed in the United States, for most of that spectrum was unavailable or had already been allocated for military purposes. The initial response of the National Association of Broadcasters (NAB) in the United States to DAB and Eureka-147 had been positive, and the system was acknowledged to have performed well in all tests. Difficulties arose as early as 1992, however, when the implications of developing a replacement technology for the U.S. market were considered. Major concern was expressed about the impact of a new technology on existing FM stations, particularly in the most developed markets. Under pressure from industry interests, therefore, policy in the United States was constrained by the need to develop a digital system that would not disrupt the existing service in any way. The fact that DAB was a European-originated technology, ill-equipped to meet the different needs of the U.S. market, in addition to the potential disruptive spectrum allocation difficulties that might be experienced, ensured that by 1992 DAB was off the agenda.²

In due course, the adoption of IBOC, the proprietary in-band, on-channel technical solution developed by iBiquity Digital Corporation, placed Canada and the United States at odds, with radically different approaches to digital radio broadcasting (Federal Communications Commission, 2002). It was assumed that as radio was primarily a local medium, the fact that competing and incompatible systems were being used either side of the border would not be too significant a matter. Experience has shown, however, that it is difficult for Canada to pursue a different course to its near neighbour, and unquestionably the adoption of IBOC in the United States contributed to the growing unease among industry members in Canada about the wisdom of their DAB policy. In spite of the fact that the Eureka-147 DAB approach was acknowledged to be technically superior, many industry executives came to accept that successful implementation of IBOC in the United States would present a new scenario for considering its suitability for Canada.

One such argument made in favour of accepting IBOC in Canada illustrates the change in thinking around the transition to digital radio. Some technical experts conceded, that IBOC might in fact be "good enough" as a system and could in fact be an expedient solution to making the transition to digital, while building on the success of FM and the wide consumer satisfaction with the quality it provides. While admitting that IBOC has a lower bit rate compared to DAB and much less data handling capacity, these same experts pointed out that for all that the additional features DAB promised, none had proven to be of significant interest to listeners.

IBOC, by contrast, could be argued to focus on the core characteristic of radio as localized audio programming. Should IBOC, or HD Radio as it became known, succeed in providing an enhanced listening experience attractive to listeners, then the Canadian industry, executives argued, would be foolish not to follow suit. Such an argument would gain even greater currency should IBOC prove sufficiently successful and with sufficient penetration of reception equipment to promote discussion of an analog switch-off date, as with the case of digital television.

Further objections to DAB likewise began to be raised following DRRI's engineering study to extend its coverage. The proposal to establish a transmission network in a series of corridors between major metropolitan centres to reach a broader section of the population emerged as a prohibitively expensive proposition. Three corridors had been identified: one in the Vancouver region, a Calgary to Edmonton corridor, and a Windsor to Quebec City corridor, which, when combined with the existing metropolitan coverage, would achieve 65% to 75% coverage of the Canadian population at a cost of \$145 million. Interestingly, the corridor study clearly revealed that the kind of coverage achieved with DAB was very similar to the coverage of a cellular infrastructure, with high-field strength areas near the transmitter and then two or three zones of lower-strength signal. The practicalities of using DAB as a replacement technology for the more powerful 'C' Class FM 100kW transmitters began to look more and more improbable in the Canadian topography, or at least at a cost-to-coverage ratio that made little sense.

A further element weakening the prospects for a successful implementation of DAB in Canada was the actual level of support the project received from industry. Although there was strong initial enthusiasm for what DAB had to offer in the early 1990s and a high level of initiative and support lent by private broadcasters to the project, DAB's failure to take off either internationally or in the Canadian market led to a gradual cooling of enthusiasm if not outright withdrawal of support. Once the United States had decisively rejected DAB, an analogy began to be drawn with the ill-fated AM stereo technology that had been unsuccessfully pioneered in the 1980s and in which the industry had suffered some major losses. Thus, doubts began to be expressed at a relatively early stage despite the fact that the industry had agreed to digital transition policy and a strategy for its implementation. The actual investment made by individual radio companies in DAB remained relatively small compared to their ongoing investment in analog transmission systems, giving the lie to the official endorsement of a digital future. The restructuring of DRRI and the termination of its promotional and marketing activities in 2004 was formal acknowledgment of the changed attitude toward DAB. Effectively subsumed within the Canadian Association of Broadcasters, DRRI would continue to have a monitoring and advisory role on existing spectrum allocation, but did not plan any new initiatives for the advancement of DAB in Canada (DRRI, 2004).

The overall rather restrained level of industry support for DAB was in particular evidence in the relatively low profile adopted by CBC, the national public broadcaster. In contrast to the United Kingdom, where the BBC has played a leading role in the development and rollout of the technology, or Singapore, where the Singapore Broadcast Authority has likewise been at the forefront of DAB implementation, CBC has been a participant rather than a leader in DAB. A member of the original Task Force for the Introduction of Digital Radio and a 50% partner in

DRRI, CBC was an active and equal participant in industry efforts to steer the sector toward the digital domain. However, CBC was not a champion of DAB in the sense of pioneering new program strategies or lending major promotional support to the project. DAB was effectively co-opted as one of a number of options in an overall new media strategy that included the Web, subscription digital audio services via cable, and more recently satellite broadcasting. Due in part to the downsizing of the engineering function within CBC (Lavers, 2006), the emphasis for the Corporation was a programming one, based on a commitment to make programming available across all new platforms, not just DAB (O'Neill, 2006). Although CBC now experiments with newer applications such as Digital Multimedia Broadcasting using DAB technology, its interest in digital terrestrial radio per se has waned considerably.

Failures on the policy front

Industry participants have argued that the policy developed for the transition to digital, while perhaps appropriate for the time, was based on a number of assumptions that proved erroneous over the succeeding years and led to wrong decisions being taken for the Canadian radio industry.

The central feature of the policy toward a digital transition was that DAB would be a *replacement* technology for analog AM and FM transmission. This approach was determined by the industry itself and had its origins in the desire to improve the quality of AM broadcasting, which continues to be an important feature of the Canadian broadcast landscape. Industry representatives were also concerned that unless the digital transition was managed on the basis of a replacement of the existing transmission network, a licensing round for L-Band spectrum would be likely to bring new entrants into the industry, thereby challenging existing interests. In a not dissimilar situation to the United States, where incumbents based their entire strategy on preventing any new competition and, for this reason, adopted a system that worked within the existing waveband, the Canadian strategy was based on the assumption that a rapid transition would take place and that all existing broadcasters would migrate to the digital domain.

The regulatory framework for digital radio built upon this assumption and, as a result, "transitional" licenses were issued to all licence holders who wished to upgrade their transmission services to digital, on the understanding that this was for the purposes of simulcasting existing signals over the transitional period. The difficulty was that no timeline was put in place, and the rollout of DAB from the start was ill-defined. From a regulatory point of view, the CRTC had agreed upon a two-staged process. In the first instance, experimental licences granted stations the right to use a digital channel for simulcasting, but they were prohibited from using the ancillary data channels available for programming or for any service that would compete with the primary programming signal. A broad process of public consultation was intended to follow, initially estimated within a period of three years, to develop the long-term digital radio policy (CRTC, 1995).

The lack of flexibility for experimentation with new content derived in part from ownership rules restricting companies from owning more than two AM and two FM holdings in any one market. The transitional licence was not considered an additional service for ownership purposes, at least for the transitional period.

Substantial new programming would, however, constitute a new service, and incumbents who wished to develop new digital-only services would have to relinquish some of their valuable existing analog services. The CRTC, having granted incumbents priority access to new digital channels in the first place, could not increase that allocation further for the purposes of experimental digital programming and, in any event, had to protect the public interest and ensure diversity in the broadcast landscape. What emerged subsequently, therefore, was a form of regulatory paralysis, with an initial allocation of spectrum and licensing and no further room for manoeuvre until substantial progress had been made in the development of a proven service.

This transitional regime, in effect, continued indefinitely, and not until 2006 was a consultative process or a longer-term strategy for digitalization considered. The restrictions placed on experimental licences remained in effect during this period, preventing the development of new programming services and limiting additional content to alphanumeric text. Few, if any, new entrants were licensed, and the lack of any permanent licensing structure meant a lack of interest on the part of investors in developing new digital services on the DAB platform.

The issue of stand-alone licences for DAB has been a contentious one and illustrates the kind of stalemate that the industry's digital policy found itself in. Interestingly, the pressure for additional, digital-only licences came not from within the mainstream broadcast sector but from the field of ethnic broadcasting. With an expanding diverse and multicultural population, an increasing demand for the provision of new ethnic broadcast services continues to be experienced. The Broadcasting Act 1991 requires that Canadian broadcasting "should reflect the multicultural and multiracial nature of Canadian society" and makes provision for a distinct category of ethnic programming with a diverse range of services utilizing over-the-air and specialized networks (CRTC, 1999). Over half the population of the greater metropolitan area of Toronto, for instance, is comprised of ethnically diverse communities, with some 55 distinct ethnic groups and more than 45 languages. Although in 2006 there were six full-service ethnic radio stations, there continues to be strong demand for new services. Additional niche ethnic broadcasting has been provided by the use of SCMO (subsidiary communications multiplex operation) services, using ancillary spectrum capacity available on FM and leased by existing broadcast licence holders. Special receiving equipment is required for the service, but its success, as demonstrated by the large number of SCMO operations in the Greater Toronto Area, illustrates the potential of new channels using dedicated technology for specific niche applications or community uses.

In 2003, the first stand-alone DAB radio service, Sur Sagar Radio Inc., was licensed in the Toronto area to deliver a service to the South Asian community in the region, broadcasting in Punjabi, Hindi, Urdu, and Gujarati as well as in English. The Canadian Association of Broadcasters objected to the license application on the basis that stand-alone licences were not appropriate given the embryonic stage of the DAB sector (CRTC, 2003). The CAB feared, and argued as such with the CRTC, that opening up the licensing of stand-alone digital stations would start a "gold rush" for spare spectrum, before the business case had been established or proven. It appealed again to the market-driven approach outlined in *A Policy to Govern the Introduction of Digital Radio* (CRTC, 1995), which protected the cur-

rent structure of the industry pending a full and complete transition to digital. In reply, Sur Sagar Radio Inc. argued that a new approach to digital radio was required, based on program innovation and led by new entrants to the market, in order to counteract the stalled implementation of digital radio. In strongly worded terms, Sur Sagar Radio Inc. argued that the spectrum was "public property, not the private reserve of those who have experimented." Its case was supported by the CRTC, who argued that "offering an entire schedule of unique programming for a specialized audience adds value to digital radio and could advance the rollout of the special receiver equipment necessary to receive such programming." The offering of this one-off ethnic digital radio licence was a key decision that suggested important consequences for a reorientation of DAB policy. Operational difficulties have to date, however, hindered the development of the Sur Sagar service, and the success of its implementation remains uncertain.³

A coda of sorts to this phase of DAB in Canada is provided by the proposal of CHUM Ltd., the communications conglomerate, to provide a subscription radio service across Canada on a DAB network. Satellite radio made a high-profile entry into the Canadian market in 2005 when both the XM and Sirius platforms were licensed to operate their subscription service under revised Canadian broadcasting regulations (O'Neill, 2006). With knowledge of the impending entry of both satellite giants, a third application for a terrestrial digital subscription service was submitted by CHUM and also approved though subsequently never launched. Controversially, where the bulk of the satellite's music service of over 100 channels was not subject to the normal Canadian content regulations, CHUM's proposal as a terrestrial service was licensed under the normal content rules for all Canadian broadcast services.

CHUM's proposal was for a terrestrial DAB service with conditional access, providing 50 channels initially, subsequently growing to 100 channels, for a monthly subscription fee of \$9.95. CHUM signed a technology agreement with equipment manufacture RadioScape for specially designed receivers that could also be used to pick up regular, non-subscription DAB channels. Receivers would also include a card slot for adding removable memory for recording, a RAM cache for live-pause and replay features, and an integrated receiver/MP3 player aimed at the youth market. In order to achieve the density required to allow a 50-channel service in addition to current DAB allocations for AM and FM replacement, data compression ratios would be reduced to 128 kilobits per second for stereo from its current 256 kbps. Compression technologies providing an approximate doubling of spectral efficiency as well as the possible allocation of additional spectrum were also proposed (Pizzi, 2004).

CHUM argued that its proposal would provide opportunities for industry involvement by content providers and, crucially, would play an instrumental role in driving penetration of digital radio by bringing to market affordable and technologically advanced receivers. Citing the contrast with the United Kingdom, where DAB has been a success story, CHUM argued that the missing Canadian element was content and that their proposal contained the appropriate mix of innovative, Canadian-produced content to realize a successful digital transition.

CHUM's proposal was really a case of "what might have been," and the industry in general considered it a spoiler application against the two dominant satellite

bids that had already made inroads into the Canadian market. While the application addressed salient issues with respect to Canada's digital radio policy and offered a pro-Canadian solution to leading the digital transition, the response of the regulator, which was to effectively let the market decide, underlined the weakness of the Canadian position. Moving the digital transition forward was effectively led by developments in the United States, initially by its rejection of DAB and development of an in-band solution, and subsequently by the encroachment of American satellite footprints into the Canadian marketplace. The fact that no special protection was afforded to CHUM's "Canadian" proposal effectively ended the strategy of migrating the industry onto the Eureka-147 platform.

Future options for DAB

Summing up what had been an unproductive 10-year period since the introduction of DAB into Canada, one radio executive candidly remarked:

I believe it was a waste of time and money and we are still sitting here with nothing. I never understood [it]. I said from day one there's no indication that consumers want replacement technology. They don't see our signal being as bad as we think they think it is. And I don't think we ever researched it correctly. In terms of our plan, which was always to put our existing stations on a new platform and transition—waste of time, money, and no demand. (Gary L. Slaight, President and CEO, Standard Broadcasting Corporation, personal communication, August 12, 2005)

Michael McEwen, former CBC radio executive and past president of the World DAB Forum, has described four market conditions required for a successful transition to digital broadcasting (McEwen, 2005). The first is spectrum availability for the proposed new digital transmission environment. The second is a commitment from broadcasters to fill that spectrum. Thirdly, listeners need a value-added incentive to buy into the service, with enhanced programming, data, and ancillary services. And fourthly, a commitment is needed from the consumer electronics industry to ensure a near-ubiquitous supply of consumer electronic devices at affordable consumer prices. Failure to meet any one of these conditions creates a barrier to a successful transition. In the case of Canada's adoption of DAB, it could be argued that there was a failure in three out of the four (Michael McEwen, Secretary General, North American Broadcasters' Association, personal communication, August 12, 2005). The assumption that the superior audio quality of DAB alone would drive the transition from analog to digital, as CD had achieved a replacement of vinyl, was unfounded. Analog broadcasting and FM in particular has proved remarkably robust and its quality such that the differentiation between DAB and good-quality FM was not significant. Rather than replacement of one platform with another, we have seen instead over the period concerned an insatiable demand for new and additional services to the extent that capacity, particularly in FM, has been reached in most major markets.

Despite this, most radio executives agree that DAB will have some role in the future of digital radio in Canada. If for no other reason than the fact that a network is in place and stations have been allocated valuable shares of L-Band spectrum, an emerging consensus suggests that a number of potential future applications are possible for DAB in Canada. Following the lead of the proposed CHUM digital sub-

scription service, many of the leading players in what is now a highly converged radio sector, with four main corporations controlling the vast bulk of the industry, are now well positioned to introduce new services as a spin-off from their conventional core broadcasting business. The barrier to such a development remains a regulatory provision that does not provide for such applications and strict ownership rules that discourage operators from deviating from analog broadcasting.

In a long-promised review of the commercial radio sector, the CRTC in 2006 formally instituted a review of the transitional digital radio policy (CRTC, 2006). Against a background of declining audiences particularly among younger listeners for conventional radio and the ongoing fragmentation of the market by satellite as well as unregulated Internet services, the need for a coherent digital policy framework had become more urgent and more complex than in 1995. Acknowledging the stalled switch-over, the CRTC asked in its call for submissions whether the replacement strategy should be reconsidered and if so what the status of existing DAB stations now in operation should be. It asked whether the policy should be modified to enable new entrants into the market, specifically if digital radio could provide better services for diverse cultural and ethnic communities, and how additional DAB spectrum might be obtained or made available. DAB, however, was no longer treated as the sole transitional digital platform, and the policy framework proposed consideration of IBOC's suitability for Canada in addition to a host of other standards, including DRM, DMB, and DVB-H. New and emerging Internet distribution platforms such as file-sharing, podcasting, downloading, audio streaming, wireless systems such as Wi-Fi and WiMAX, and the promise of Internet-based services for car reception were also acknowledged to radically change the nature of any proposed digital transition. Summing up the challenge for the Commission, it stated, "[T]he new audio programming alternatives pose an unprecedented challenge for the conventional radio sector that will require astute business decisions and a judicious regulatory approach" (CRTC, 2006).

In its submission to the CRTC, the Canadian Association of Broadcasters supported the abandonment of the "replacement technology" notion of digital radio broadcasting and advocated a flexible regulatory approach as the central element of a revamped policy for digital radio (CAB, 2006). A long-term strategy was required, the CAB argued, to ensure that radio of national, regional, and local interest could continue to be delivered reliably and free of charge to fixed, portable, and mobile services. Flexible arrangements enabling stations to experiment with innovative programming models and ideas would also, it argued, provide a much-needed boost for attracting listeners to digital and should include a relaxation of Canadian content regulations for digital services, at least until meaningful listenership levels were achieved. More flexible consideration of ownership rules were also advocated, to enable stations to experiment with their digital services without having to relinquish an equivalent analog property. Although new programming was proposed as a driver for any new impetus on the terrestrial digital radio broadcasting, simulcasting as appropriate was also envisaged as a means to encourage migration of analog to digital. An analogy was drawn with the migration of AM to FM in the 1950s, whereby a gradual increase of peak-listening programming was successfully transferred to the FM band once listenership began to take hold. Perhaps not surprisingly, the CAB argued that incumbents were best

positioned to provide programming services and advocated continued priority be given to existing broadcasters for digital allocations. New entrants were acknowledged to have a role, and a mechanism for releasing unused spectrum by current licence holders was proposed. More efficient use of the spectrum through advanced compression techniques and reviewing the generous data rates of 256 kbps would also free up considerable room for expansion and enable the kind of quantity envisaged for digital programming services, on a par with equivalent Internet or satellite-based services.

In advance of the formation of a new Canada-wide policy for digital broadcasting, broadcasters accept that there is unlikely to be one single approach to a digital transition. As argued by the CAB: "It is simply not realistic to assume that a successful digital transition will be no more than the replacement of the existing business with minor additions and adjustments. Nor does digital transition necessarily mean the destruction of the old business and the creation of a new one" (CAB, 2006). A successful transition to digital in the Canadian context will be based, the CAB argues, on a "good value proposition" that includes new content, affordable receivers, promotion, and competitive technical features. It will continue to include DAB as part of the equation, but it is likely to include variants of the Eureka-147 system as well options for IBOC, Internet distribution, and technologies for distribution to hand-held mobile devices.

Conclusion

Drawing together the many different issues that have arisen over the course of the transitional digital radio era in Canada, the following may be advanced as some of the principal lessons of the Canadian experience.

In the first place, the experience of Canada in attempting to implement DAB illustrates the classic disadvantage of being an early adopter of new technologies. Canada's early and leading role in DAB implementation was well established. It participated actively in the World DAB Forum, a leading Canadian executive served as the forum's president, and Canadian technologists and engineers contributed to the relevant technical standards groups. Canada succeeded in galvanizing wide industry support including relevant government, private, and public broadcaster interest and developed a coherent strategy based on the information available at the time and the context in which radio operated. However, as discussed, all of this came to nought owing to the lack of availability of receivers and insufficient development of receiver technology.

The second lesson the Canadian experience illustrates is how difficult it is for the broadcast regulatory regime or framework to keep pace with technological change. Canada's transitional digital radio policy was set in 1995 and based solely around the implementation of DAB as a replacement technology for AM and FM. It did not, or could not, take account then or subsequently of the increasingly complex technological domain that broadcasting was facing, including the development of IBOC in the United States, advances in compression technologies for transmission, Internet distribution, and new developments in multimedia broadcasting. The regulatory gap was particularly highlighted with the launch of satellite radio and the manner in which it made its entry into the Canadian broadcast environment. The licensing of the XM and Sirius satellite platforms illustrated how unprepared the

Canadian system was for effectively predatory encroachments on platforms that had not previously been planned for.

It could be argued that the handling of the digital radio transition in Canada underscores the weakness of a laissez-faire or market-driven approach. The regulatory position of the CRTC combines a responsibility to defend the public interest as well as with a mandate to respond to the business needs of the sector. Its transitional digital radio policy was based on facilitating an industry-led initiative on the way forward. The disadvantages of this approach have already been discussed, with particular reference to the potential conflicts involved when incumbents have responsibility for developing long-term policy. Neither the regulator nor the public broadcaster in the Canadian case intervened to adopt a more direct or leadership role in the rollout of a digital policy. This, arguably, is in contrast to the more successful interventionist approach adopted in the United Kingdom.

Furthermore, as illustrated by the Canadian experience, the transition to digital broadcasting is not simply a question of replacement technology. Where the debate up to and including 1995 envisaged a total migration of the radio broadcasting landscape onto a fully digital system, the reality has been shown to be much more complex. Unlike the case of television, where there is an industry momentum toward realizing a digital system and a gathering consensus around analog switch-off deadlines, the same cannot be said for radio. Digital broadcasting for the foreseeable future will be supplemental to conventional analog broadcasting, and strategies for its development will be tailored accordingly.

The history of digital radio development to date in Canada points to the rather curious conclusion that analog broadcasting, and FM in particular, remains a remarkably robust, reliable, and effective means of providing free-to-air broadcast services. Although there is an acceptance among broadcast professionals that the future is digital, it is widely acknowledged that the transition will take much longer than anyone originally thought (McEwen, 2003). The supposed greatly enhanced technical features and audio quality of DAB were not sufficient or sufficiently significant to bring about the digital transition in Canada. With the huge installed user base of at least 75 million conventional radio receivers in Canada, and given the ease with which FM receivers can be incorporated into cellphones and mobile devices, it will be a considerable time before the issue of replacement technology returns to the agenda. Indeed, the healthy state of the radio industry in Canada indicates by way of contrast how much less developed FM markets generally are in Europe and other regions and the scope that exists for further development in the analog world.

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Notes

1. A conflict would later emerge with General Motors' shareholding in XM satellite radio, in due course a competitor against DAB and conventional radio in the Canadian market. As such, GM's total support was always going to be unlikely.
2. The fate of DAB in Canada was effectively sealed by the United States at the National Association of Broadcasters in 1992 when the technology was rejected outright as "European" and "socialist" (Daphne Lavers, Delta Blue Communications, personal communication, August 4, 2005).
3. Sur Sagar Radio Inc. has subsequently applied on three successive occasions to extend the deadline for launching the service. Its most recent deadline of March 2006 has passed without a launch. See CRTC (2005).

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