

CAB Technical Report: CRTC Radio Policy Review 2021

Status of Digital Broadcasting Technologies for Radio

Executive Summary

1. Radio broadcasting has been operating in Canada for one hundred years; first with analog AM, then with the addition of analog FM for the last half century. Over the air radio is easy to use, ubiquitous and free.
2. Availability of additional spectrum today, especially in the FM Band, is extremely low. There is little, if any ability to add new FM frequencies in larger metropolitan areas or areas close to the U.S. border where spectrum is highly congested.
3. Consumer behaviour is changing because of the Internet and mobile communications. Radio broadcasters have adapted by distributing their programs on multiple digital platforms.
4. Most radio stations simulcast programming on an Internet audio stream, and some are experimenting with new digital broadcast platforms. These digital platforms, as well as Internet audio streams, have the ability to add enhanced content, such as logos, visuals and text. Enhanced content may assist radio stations in competing with the listener experience of other sources of audio entertainment, such as satellite radio, Spotify and Tune In.
5. HD Radio has been adopted by the United States and Mexico as a voluntary standard for digital radio broadcasting. It utilizes In-Band-On-Channel (IBOC) transmission whereby digital subcarriers are added to the analog transmission. This offers the advantages of not requiring new spectrum and backward compatibility with existing AM and FM receivers.
6. Almost 100% of the US population is within reach of at least one HD Radio station. However, after 20 years in operation, only 21% of US stations are utilizing HD Radio and only 25% of vehicles on the road include an HD Radio receiver.¹²
7. Hybrid Radio is a technology which supplements the over the air (OTA) audio broadcast with Internet delivered content. Systems have been developed which are compatible with analog FM, HD Radio, and DAB. Hybrid Radio cannot work with analog AM radio because the OTA transmission does not carry a digital signature to associate the radio station with related Internet content.
8. Auto manufacturers are increasingly integrating mobile devices into new vehicles to support a wide variety of wireless data applications. Hybrid Radio allows auto manufacturers to upgrade the radio receivers in vehicle infotainment systems with large displays and enhanced content.
9. The popularity of Smart Speakers has grown rapidly over the past few years. For many listeners, the Smart Speaker has replaced the at-home radio receiver providing Internet delivered audio streams of their favourite radio stations.
10. The introduction of any new technology is highly dependent on the availability and affordability of compatible devices. The long replacement cycle for automobiles dictates that high penetration rates for in-vehicle devices cannot be achieved for at least ten years. By contrast, Smart Speakers

¹ <https://ccbe.ca/wp-content/uploads/2020/01/Xperi-The-Future-of-Radio-CCBE-2019.pdf>

² <https://financesonline.com/number-of-cars-in-the-us/>

have experienced rapid adoption over the past three years.³ And smart phones, which can receive radio programs via Internet audio streams, benefit from rapid replacement cycles. The deployment of 5G technology for mobile is expected to continue the rate of smart phone replacement as consumers take advantage of the expanded capabilities and faster speeds with 5G.

11. Other countries that have successfully adopted digital radio broadcasting started more than a decade ago with focused efforts to support the transition. Examples include preferential licensing opportunities, AM/FM simulcast, and mandating vehicle manufacturers to include digital receivers. Some of the initiatives taken by other jurisdictions are described in Appendix B; “International Examples and Lessons Learned”
12. Digital radio broadcasting may offer opportunities to personalize the radio experience for listeners. Examples include geo-targeted content insertion such as traffic reports or emergency alerts, dynamic ad insertion, and links to podcasts. Experiments are underway in the US on FM and HD Radio stations, but the full capability will not be achieved until all-digital broadcasting is widely available.
13. Canada is nowhere near transitioning to digital radio broadcasting. Possibly, it may never occur. It would be premature to assign an “end of life” expectation on AM or FM radio at this time. AM radio suffers from ever increasing noise and interference, particularly in Metropolitan markets, which may require band-specific solutions. However, it remains unparalleled in its over the air reach in rural areas, such as across the Prairies. To a consumer, a radio receiver with a digital display is digital. For the purposes of the next seven to ten year planning horizon, policy makers should assume listeners will increasingly migrate to digital platforms. Those platforms will not be OTA digital radio broadcasting platforms – they will be fixed and wireless Internet platforms.
14. HD Radio should remain experimental in Canada until the necessary policy and regulatory changes are fully explored with the Commission and the Department of Innovation, Science and Economic Development Canada (ISED).

Introduction:

15. In 2020, radio broadcasting in Canada celebrated its 100th anniversary. The introduction of FM radio in the 50's further expanded the quality and program offerings across the country. The advent of the portable transistor radio in the 60's and evolution of high quality car radios made radio accessible to listeners in every aspect of their lives at home, at work, and on the move.
16. FM radio experienced rapid growth in the number of licensed stations over the past 40 years. So much so that there are no longer any more full coverage frequencies available in major markets. The lack of available channels is exacerbated by the concentration of population in Canada close to the US border where interference protections to US stations must also be respected.
17. On a case by case basis, a small number of new FM channels can be created second adjacent to existing full power stations within the same market⁴. However, such channels must be co-located with the 2nd adjacent station, have the same directional antenna characteristics and operate at

³ <https://radiconnects.ca/> “Radio on the Move 2020”

⁴ It must be noted that second adjacent FM stations within the same market are not currently permitted by ISED.

26 dB (400 times) lower power than the existing full power station.⁵ For example, a station operating second adjacent to a 100,000 Watt FM station could only transmit 250 Watts to ensure interference protection. Hence, such stations would have a very small coverage area and are generally not viable unless used for specific niche services or as a “fill in” simulcast frequency for an existing AM station.

18. In medium sized markets, a new short-spaced FM frequency can sometimes be found by using directional antenna systems or by accepting interference from existing stations. However, these approaches have been fully exploited in Southern Ontario and the lower mainland British Columbia.
19. FM frequencies are still available for small markets as long as they are remote or rural locations, far from population centres.
20. AM frequencies are available for new stations in many parts of the country, but are generally not viable or desirable for many reasons. AM has lower quality and higher susceptibility to noise and interference as compared to FM. AM transmitting facilities are extremely expensive to construct and maintain. Most often, different day-time and night-time directional antenna patterns are needed to maintain interference protections to other stations. This results in different coverage areas for the station during the day and at night. Further, AM transmitting antenna systems require a large parcel of land for the antenna towers. The high cost of real estate, as well as the requirements to maintain Safety Code 6 compliance near population centres are barriers. Finally, and an increasing issue going forward, AM is effectively incompatible with many electric vehicles. In some makes and models, the electromagnetic frequencies generated by the vehicles’ electric-powered motor causes direct interference to AM radio reception.⁶ Some auto manufacturers have chosen not to include AM radio receivers in their electric vehicles.
21. The opportunities to add more radio stations are all but gone.
22. Analog FM and AM radio is so commonplace, easy to use, and ubiquitous that free access to local news, information and entertainment is almost taken for granted. People don't think about where it comes from, just that it is always there.
23. However, the Internet, mobile communications, and particularly the smartphone are changing how we access information and entertainment of all types and changing consumer behaviour dramatically to expect that any content be available any place at any time.
24. As such, radio broadcasting has adapted to recognize that multi-platform distribution is essential. Most radio stations now simulcast their programs on Internet audio streams to augment their connection to the communities they serve, and to reach their audiences at home, at work, in-car, and on smartphones. Radio broadcasters enrich their programs with textual and visual content to stay relevant to listeners and to remain competitive against alternate sources of entertainment, such as Spotify.
25. Technologies have emerged to bridge the gap and support a future transition to digital radio broadcasting that can continue, but ultimately replace, analog radio's legacy of being easy to use, ubiquitous and free. These transitional digital platforms fall into three camps. HD Radio is one-to-

⁵ BPR-3 — Application Procedures and Rules for FM Broadcasting Undertakings, section 3.3, Table 2

⁶ <https://incompliancemag.com/will-electric-cars-make-am-radio-obsolete/>

many digital radio broadcasting transmission. Hybrid Radio is OTA radio transmission combined with an Internet back channel for enhanced and interactive content. And, Internet audio streams are one-to-one delivery of radio programs utilizing the wired and wireless Internet.

26. The following sections will discuss the emerging digital platforms in North America, the impact of device availability, and new business opportunities available via digital technology.

Emerging Digital Platforms in North America

HD Radio

27. HD Radio is a proprietary digital radio system developed in the United States for FM and AM broadcasting. It is owned by Xperi, formerly iBiquity, and available to radio stations under licence agreement. The system utilizes in band on channel (IBOC) transmission to combine digital sidebands into the existing analog FM or AM channel. All-digital modes of operation are now available for both FM and AM broadcasting bands.
28. No new spectrum is required for HD radio because digital subcarriers are combined with the analog transmission on the same broadcast channel. Hence, the system is backward compatible with existing analog receivers. Although digital equipment must be purchased, and sometimes modifications to the antenna system are required, no new tower infrastructure is needed.
29. HD Radio provides theoretical advantages over analog FM and AM. HD Radio offers greater immunity to noise and interference within the core coverage area. On FM, HD Radio can add up to three multicast program services along with the host station, as well as some capacity for datacasting 3rd party applications. The ability to include program associated data content, such as text, logos and visuals, is greatly enhanced compared to the limited text crawl on FM stations using RBDS.
30. The North American Broadcasters Association (NABA) announced support for a voluntary North American Digital Radio Standard in 2017.⁷ A position paper was developed by the NABA Radio Committee's Digital Radio Working Group and focuses on why NABA supports both HD Radio technology and a continental approach.
31. At the request of the CAB and the Radio Advisory Board of Canada, ISED commissioned the Communications Research Centre to conduct a technical study of the compatibility of analog FM and HD Radio. The CRC published its report, "Compatibility Study – Analog and HD Radio Broadcasting Systems in the 88 – 108 MHz Band", in February 2019.
32. The CRC report states, "The conclusions of this analysis indicate that, when all BPR-3 technical rules are respected, HD Radio operations would not negatively impact the reception of the analog FM broadcast on the same and adjacent channels within the protected service contours of existing analog FM assignments. However, where short-spaced analog FM assignment pairs exist, turning on HD Radio broadcast would create impairments to the analog reception of short-spaced stations."

⁷ <https://nabanet.com/naba-supports-voluntary-north-american-digital-radio-standard/>

33. While this is a positive result regarding the general usability of HD Radio on FM in Canada, it was out of scope of the study to evaluate the extent to which short spaced stations would be impaired by interference.
34. There are at least 75 pairs of short spaced FM stations across Canada that do not meet all the technical rules of BPR-3, either through the use of directional antennas or negotiated interference agreements. This number does not include Low Power FM stations or short spacings to US assignments. Hence, it is not clear how many existing FM stations would be negatively impacted by new interference, or may not be able to fully utilize HD Radio to the same extent as others.
35. The measurement data of a number of HD Radio receivers in the CRC study validated that a digital power of -14 dBc with respect to the analog signal performed well in analog and digital modes. The higher power of -10 dBc did create deterioration in analog audio quality (self-interference) in some receivers. Some experimental HD Radio stations in Canada have received listener complaints of self-interference, but mostly noticed on older models of FM receivers.
36. A number of Canadian FM stations have been testing HD Radio for the last five years through experimental authorizations issued by ISED. Currently, there are 34 Canadian FM stations in 14 markets broadcasting in HD Radio, as listed in Appendix A. HD Radio broadcasts of at least one station are available to more than 50% of the population. These stations are also broadcasting 47 multicast program services. Combined, there are 81 HD Radio digital program services. The vast majority of programs are simulcasts of existing FM and AM stations.
37. Xperi estimates that there are currently 3.3M cars in Canada equipped with HD Radio receivers, representing about 13% of vehicles on the road. Just over 33% of new vehicles sold now include an HD Radio receiver.
38. While the technical benefits of HD Radio described above have been evident, a number of practical challenges have presented themselves as well. Hence, the experience with HD on the part of most Canadian broadcasters has been lack-lustre, if not disappointing.
39. HD Radio technology favours the host analog FM station. As one drives out of the station's coverage area, the receiver will begin to lose digital reception and fall over to the analog signal. Unfortunately, there is no linkage or way to associate HD Radio multicast programs with analog simulcasts, which have been mostly AM stations. For digital multicast programs, the signal suffers from drop outs, then goes silent, as one drives out of the core coverage area.
40. Equally, it is extremely difficult to educate listeners and promote HD Radio, as illustrated on the web site of AM station 680News, CFTR in Toronto.⁸ The instructions read, "Determine if you have HD radio. Not sure? Check your car manual or scan our list of car manufacturers below. Tune your radio to the FM band and find KiSS 92.5. Switch to HD channel 2 — that's where you'll find 680 NEWS. Remember to add us to your presets — that'll make it easy to listen to 680 NEWS in HD Radio whenever you get into the car!"
41. This challenge is compounded because some of the current HD Radio receivers display the call letters of the host FM station at the same time as the multicast HD station.

⁸ <https://www.680news.com/680-news-in-hd-radio/>

42. Possibly, further evolution of the HD Radio standard and future implementations of HD Radio receivers will make improvements to station discovery and overall listener experience.
43. In 2019, the CAB conducted a test with Numeris to measure the audience listening to HD Radio, and in so doing obtain an indication of the penetration of HD Radio receivers.
44. The results were disappointing. There was no correlation between HD Radio listening and morning/afternoon drive times when in-car listening (featuring the greatest penetration of HD receivers) is at its peak. Most importantly, the percentage of out-of-home audience listening on HD Radio was in the range of 8%-17% for the FM host stations (consistent with Xperi's estimate), but almost zero for multicast signals (namely, AM simulcasts).
45. The fact that there was virtually no listening to the AM simulcasts on the HD Radio multi-cast channels suggests that without automatic switching between analog signals and HD (as is the case for the FM host but not AM to FM multicast), consumers will not take advantage of any theoretical improvement in signal quality or reception offered by HD.
46. Statistics Canada reports that there were just over 25M vehicles registered on the road in 2019.⁹ New vehicle sales have remained consistent at approximately 2M per year from 2017 to 2019.¹⁰
47. The fact that the average replacement cycle of vehicles in Canada is about 12.5 years presents another huge challenge in introducing HD Radio, or any new technology, that is targeted to in-car reception.
48. At the current rate of 33% of new vehicles equipped with HD Radio, penetration will never exceed 33% and take 12.5 years to achieve. The most optimistic scenario, if all new vehicles are equipped, 100% penetration will still take another 10 years. Note that these penetration estimates only relate to in-car listening and do not address listening to radio at home, at work or with a portable radio. There are very few table top or portable HD Radio receivers manufactured or sold.
49. By comparison, the inclusion of HD Radio in new vehicles in the US has recently surpassed 50%¹¹, but even if that percentage continues to grow it will take at least ten years until HD Radio is prevalent in most vehicles on the road.
50. HD Radio is a proprietary technology owned by Xperi, a publicly traded US corporation. To use the technology for full-time broadcasting, radio stations must pay fees to Xperi. The licensing model is that the host FM or AM station pays an annual fee plus a percentage of revenue for any multi-cast channels. As HD Radio has not been adopted as a voluntary standard in Canada, Xperi has waived the fees for stations that have experimental authorizations from ISED.
51. In-car tuning continues to represent a significant proportion of total radio listening¹², and this trend is expected to continue in the medium to long term.
52. The penetration rates described in paragraphs 31 and 37 demonstrate that HD Radio is not a panacea or silver bullet to address the short to medium term challenges facing radio stations,

⁹ <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2310006701>

¹⁰ <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2010000201>

¹¹ <https://ccbe.ca/wp-content/uploads/2020/01/Xperi-The-Future-of-Radio-CCBE-2019.pdf>

¹² <https://radioconnects.ca/> Radio on the Move 2020

and especially not for AM stations or new program services. It will take many years to achieve sufficient receiver penetration in vehicles for listenership to reach scale.

Hybrid Radio

53. Hybrid Radio is a technology which augments the over the air (OTA) audio broadcast with Internet delivered content. Proprietary and internationally standardized systems have been developed which are compatible with analog FM, HD Radio, and DAB.
54. Hybrid Radio cannot work with analog AM radio because the OTA transmission does not include a digital identifier to associate the radio station with the Internet delivered content.
55. An early version of Hybrid Radio, called Next Radio, was launched to target the FM chip embedded in many models of smartphones. The service failed in part because Next Radio was unable to garner sufficient support from radio broadcasters in the US. But, the primary reason was that Apple refused to enable and activate the FM radio receiver in iPhones.¹³ The Apple iPhone holds a large market share of mobile devices in Canada and the US.
56. More recently, auto manufacturers have shown interest to incorporate Hybrid Radio into the large display infotainment systems now prevalent in new vehicles.
57. Audi and BMW are the first manufacturers to launch Hybrid Radio in North America. Several models were introduced in the fall 2020. Daimler (Mercedes-Benz) has announced that it will offer Hybrid Radio in the near future.
58. This is seen as an important step to maintain the prominence of radio in the car dashboard. The enhanced content such as station logos, visuals and text, delivered via wireless Internet, may assist radio stations in competing with non-broadcast entertainment sources.
59. A feature of Hybrid Radio is service following. This enables the receiver to switch between the OTA broadcast signal and the simulcast audio stream when the signal quality is poor either in areas of reception drop outs or when exiting the coverage area of the radio station.
60. Hybrid Radio is targeted at in-car radio reception. Hence, broadcasters face the same challenges as HD Radio to achieve device penetration and scale. Even more so because this technology is at the beginning of its adoption curve. It will take some years for all auto manufacturers to incorporate Hybrid Radio receivers. Then, many more years, possibly decades, for new vehicles with Hybrid Radio to saturate the marketplace.

Internet Audio Streaming

61. Many FM and AM radio stations have been simulcasting their programs on Internet audio streams for several years. The audio streams can be listened to on a number of popular devices including PC's, tablets, smart phones, and more recently via wireless Internet in "connected cars".
62. Radio stations have developed individual applications (apps) for their stations so that listeners can save the app on the home screen of their PC or smart phone. In addition, apps have been developed to aggregate many radio station streams together so that listeners can save their

¹³ <https://www.iphoneincanada.ca/news/apple-should-activate-iphone-fm-radio-chip/>

favorites and easily discover new stations. Examples include Radioplayer, iHeart Radio and Stingray.

63. Each of these aggregation apps has its own advantages. Radioplayer includes the broadest collection of commercial, community and public radio stations. iHeart Radio promotes many live events. Stingray bundles its radio stations together with its audio service, Stingray Music, covering multiple music genres.
64. Audio streaming over the wired and wireless Internet allows radio stations to enhance programming with visuals and text, as well as introduce interactivity such as contests or links to podcasts.
65. In “connected cars”, apps such as Apple Car Play and Android Auto allow listeners to hear, and see, content from their personal smart phone using the speakers and large display of the car infotainment system.

Devices

66. Delivering radio programming over the multiple platforms described above is entirely dependent on the availability and affordability of compatible devices.
67. For analog FM and AM radio, there is an existing installed base of car radios, table radios, portable radios, hi-fi systems and clock radios that has evolved over one hundred years of broadcasting. However, the popularity and availability of a stand-alone radio receiver, a dedicated device, has diminished.
68. In the case of audio streaming, listening to radio is possible because it is available on a device that is primarily used for many other purposes; the PC at work, the Smart Speaker at home, the smart phone when mobile, and now the “connected car”.
69. In Canada, Smart Speaker ownership has grown from 4% to 25% in just 2 ½ years.¹⁴ Smart Speakers have a wide variety of uses including smart home management, making phone calls, Internet searches such as weather, sports scores etc, as well as streaming audio services such as radio. But, there are three predominant vendors; Amazon Alexa, Google Assistant and Apple Siri. This requires radio streaming aggregators, such as iHeart Radio and Radioplayer, to certify their apps and negotiate access with each vendor.
70. Similarly, Canadians use their smart phones for just about everything, including streaming of radio stations. But, the availability of high speed data is not as consistent or ubiquitous across the country as OTA radio broadcasting. A bigger barrier to radio consumption on smart phones is the cost of data usage by consumers. Heavy data users may be able to absorb the data usage within an unlimited data plan. But, light to moderate users would need to add 3-5 GB of data to their mobile service plan if they listen to radio regularly on the move. It is unlikely that the smart phone will ever be a ubiquitous and “free” means to access radio without strong incentives to mobile service operators.
71. Auto manufacturers have developed a host of wireless data applications for vehicles, which have evolved into the “connected car”. These include software updates for onboard computers,

¹⁴ <https://radioconnects.ca/> Radio on the Move 2020

remote diagnostics, GPS, WiFi hotspots for Internet access, and more. The availability of wireless data in vehicles has expanded infotainment systems in the dashboard to include multiple entertainment sources beyond FM and AM radio. The introduction of Hybrid Radio will assist broadcasters to hold on to the prominence of radio in the dashboard, but it will take many many years to achieve because of the long replacement cycle for new vehicles to enter the marketplace.

New business opportunities

72. Digital delivery of radio comes hand in hand with greater competition, but also creates future opportunities to better serve listeners and advertisers.
73. The two way capability of the Internet and Hybrid Radio allow for personalization and interactivity. Unique content can be inserted for sub-groups of listeners based on their needs, interests and preferences. Geo-targeted content may include traffic and weather reports tailored to the listener's driving route or GPS location. Micro-targeted content may include warnings of transit delays or an accident ahead. Dynamic insertion of advertising could be targeted to the listener's profile, interests or location.
74. To a less granular degree, digital radio broadcasting is capable of geo-targeted content insertion. Single frequency networks of multiple transmitters can fill the service area of a radio station instead of one high power, high tower transmitter.
75. In the US, some companies are beginning to use these techniques on single frequency networks for analog FM and HD Radio. But, the presence of analog signals makes the endeavor complex. Often, there will be trade-offs of interference or poor reception in certain areas within the station coverage. Wide spread use of single frequency networks for geo-targeted content will not be viable until radio transmission is fully digital.

Conclusion/summary

76. The pathway to a fully digital future for radio is still unclear. Radio broadcasters will continue to deliver programs on multiple technology platforms and to multiple devices to meet audience preferences for listening at home, at work, portable (mobile) and in the car.
77. What is clear is that the adoption of new digital radio broadcasting technology to replace analog FM and AM radio will take at least another 10-15 years to reach widespread receiver/device penetration.
78. In the meantime, FM radio remains a viable transmission medium to satisfy listeners' needs.
79. However, there are distinct and separate challenges for AM radio stations. AM transmission can cover large geographic regions and deliver important, sometimes the only, radio service in parts of the country. As well, AM radio stations dominate the news, talk and sports formats in large population centres, but suffer from increasingly poor reception quality caused by noise and interference. The absence of AM receivers in some new electric vehicles is an ominous warning of what may lie ahead.
80. Further, AM radio stations cannot achieve the same benefits or opportunities as FM stations from HD Radio and Hybrid Radio.

81. Hence, the time horizon to solve the challenges facing FM and AM radio stations may be different.
82. Analog FM and AM broadcasting will need to continue for the foreseeable future while broadcasters pursue digital multi-platform solutions.
83. A flexible, supportive regulatory environment will be necessary for the transition to digital radio broadcasting to be successful.

Kirk Nesbitt, CAB Technical Advisor, CAB Technical Coordinating Committee, March 29, 2021

Appendix A

List of HD Radio Stations in Canada



HD RADIO™ CANADA ROLLOUT

As of January 25, 2021

ON-AIR

AUDIO PROGRAMMING

Stations Converted: 34

- ✓ AM: 0
- ✓ FM: 34
- ✓ Multicast: 47 [HD2/HD3/HD4: 26/15/6]

Total Digital Channels: 81

Artist Experience® Station Logos and Cover art

- ✓ Stations: Logo 10,
- ✓ Total Channels: Logo 30, Cover Art 16

Emergency Alerts: forthcoming

OTA TRAFFIC SERVICES

HERE/BTC

- ✓ CING, Hamilton-Toronto Metro
- ✓ CFMI, Vancouver
- ✓ CKRY, Calgary

TTWN iHeart Media/Bell Media:

- ✓ CHQM, Vancouver
- ✓ CJMJ, Ottawa
- ✓ CITE, Montreal
- ✓ CIRV, Toronto
- ✓ CKFM, Toronto

CURRENT AUDIO PROGRAM DETAILS

<p>CISA 101.3 MHz Toronto, Ontario HD1 Multilingual (20+ languages per week) Hindi, Tamil, Punjabi, Urdu and other Indian languages, African and Eastern European HD2 Tamil HD3 Hindi & Urdu HD4 Punjabi</p> <p>CIND 88.1 MHz Toronto, Ontario HD1 Alternative HD2</p> <p>CKIS 91.5 MHz Toronto, Ontario HD1 Kiss FM /Non Stop Hits HD2 CFTR AM 680 News HD3 CJCL 590 AM SportsNet: The Fan</p> <p>CHUM 104.3 MHz Toronto, Ontario HD1 Today's Best Music HD2 CHUM AM 1050 kHz TSN</p> <p>CKFM 99.9 MHz Toronto, Ontario HD1 Virgin Radio, Toronto's #1 Hit Music Station HD2 CFRB AM 1010 News Talk</p> <p>CBLA 99.1 MHz Toronto, Ontario HD1 CBC Radio One</p> <p>CFMZ 107.3 MHz Toronto, Ontario HD1 Classical HD2 CFMX HD3 - Various</p> <p>CFPT 106.5 MHz Toronto, Ontario HD1 First Peoples Radio</p> <p>CIRV 88.9 MHz Toronto, Ontario HD1 South Asian HD2 South Asian HD3 South Asian HD4 South Asian</p> <p>CIBC 90.3 MHz Toronto, Ontario HD1 Radio Canada's Ici Musique network HD2 CBC Ici Première CIBC 850</p> <p>CING 95.3 MHz Hamilton, Ontario HD1 Fresh FM Hamilton's Hit Music Station HD2 CFMJ AM 640 - News/Talk HD3 CHML AM 900 - News/Talk</p>	<p>CHIX 94.7 MHz Hamilton, Ontario HD1 KX 94.7 New Country HD2 Jazz HD3 92.9 The Grand</p> <p>CHRR 104.7 MHz Woodstock, Ontario HD1 Heart 104.7 HD2 - Classic Country</p> <p>CFMS 105.9 MHz Markham, Ontario HD1 105.9 The Region HD2 South Asian HD3 Farsi HD4 Chinese</p> <p>CJRX 95.9 MHz Ajax, Ontario HD1 KX96 New Country HD2 - The Wave (Jazz) HD3 CKDO Durham's Classic Hit</p> <p>CKPC 92.1 MHz Brantford, Ontario HD1 Jewel 92 HD2 - Z103.5 HD3 CKPC AM HD4 CFWC</p> <p>CKXW 99.5 MHz Kitchener, Ontario HD1 - Classic Hits</p> <p>CBD 91.5 MHz Ottawa, Ontario HD1 CBC Radio One</p> <p>CBDF 90.7 MHz Ottawa, Ontario HD1 Ici Radio Canada Première</p> <p>CFPO 95.7 MHz Ottawa, Ontario HD1 First Peoples Radio HD2 First Peoples Radio HD3 First Peoples Radio HD4 First Peoples Radio</p> <p>CJMJ 100.3 MHz Ottawa, Ontario HD1 Majic 100.3 Today's Best Variety HD2 CFRA 580 News Talk Radio HD3 TSN 1200 Sports Network</p> <p>CBF 95.1 MHz Montreal, Quebec HD1 Ici Radio Canada Première HD2 Ici Musique: Classique</p>	<p>CITE 107.3 MHz Montreal, Quebec HD1 - Montage Rouge FM HD2 CJAD 800 News Talk Radio HD3 TSN Radio 690 Montreal</p> <p>CHAA 103.3 MHz Longueuil, Quebec HD1 Adult Contemporary HD2 Country HD3 - Tourist Info</p> <p>CFGL 105.7 MHz Montreal, Quebec HD1 Rythme FM</p> <p>CKRY 105.1 MHz Calgary, Alberta HD1 Country 105 HD2 CHQR AM 770 -News/Talk</p> <p>CISF 107.7 MHz Surrey, British Columbia HD1 Pulse</p> <p>CJCN 91.5 MHz Surrey, British Columbia HD1 Ethnic HD2 Ethnic</p> <p>CBU 2 88.1 MHz Vancouver, British Columbia HD1 CBC Radio One Network</p> <p>CJAX 96.9 MHz Vancouver, British Columbia HD1 Jack FM HD2 CKWX AM 1130 News</p> <p>CFMI 101.1 MHz Vancouver, British Columbia HD1 Rock 101 - Greatest Hit's of 70's, 80's and 90's HD2 CKNW AM 980 - News/Talk</p> <p>CHBE 107.3 MHz Victoria, British Columbia HD1 Virgin Radio (Hot AC) HD2 News/Talk (CFAX Simulcast) HD3 Sports Radio (CKST Simulcast) HD4</p> <p>CHLG 104.3 MHz Vancouver, British Columbia HD1 LG104.3 60's, 70's 80's HD2 CKZZ</p> <p>CHQM 103.5 MHz Vancouver, British Columbia HD1 QMFM Today's Best Variety/Soft Rock HD2 CKST AM 1040 Sports TSN HD3 CFTE AM 1410 Sports TSN</p>
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Appendix B

International Examples and Lessons Learned

DAB in Canada

84. Canada adopted digital radio broadcasting using the DAB standard in 1998. New spectrum was allocated in the L Band (1452-1492 MHz) as a replacement band for both FM and AM radio stations. DAB stations were launched in Montreal, Toronto and Vancouver which simulcast existing analog radio stations.
85. The initiative did not succeed and radio stations did not renew their DAB licences after fourteen years of operation. The failure of DAB in Canada can be attributed to several factors.
86. It was expected that several European countries were on track to launch DAB at the same time. But, ultimately only the United Kingdom proceeded. The timing was wrong.
87. The UK launched DAB using the VHF Band and other countries that launched later were primarily interested in the VHF Band. This left the Canadian L Band spectrum for DAB as an outlier.
88. There were no receivers. Receiver manufacturers had little interest in providing L Band capability in DAB receivers for a country with a relatively small population.
89. Receiver manufacturers, and particularly auto manufacturers, view North America as a single market. Automobiles and electronic devices available in Canada are typically the same as or a subset of products sold in the much larger US market. The DAB rollout in Canada alone was unsuccessful in overcoming that single market approach.
90. The construction of DAB transmitting facilities required all new equipment and infrastructure. There was little overlap with FM infrastructure and no overlap with AM transmitting facilities.

United States – FM translators and preferential licensing opportunities

91. The US Federal Communications Commission (FCC) adopted FM and AM HD Radio in 2002¹⁵. As of September 2020, there were 10,900 FM stations in the US.¹⁶ Currently, Xperi estimates there are 2264 FM HD Radio stations delivering 4,457 digital programs. About 66 million vehicles have HD Radio representing almost ¼ of total vehicles on the road¹⁷.
92. The FCC in the US has supported a digital transition for radio by allowing all stations, both FM and AM, to license and operate FM rebroadcasting stations. These lower power FM rebroadcasting stations, called “FM translators”, can be used within the main coverage or to extend the broadcast area. They are most often used to simulcast the programming of AM stations or digital HD Radio programs to preserve listenership and to migrate audiences during the digital transition.

¹⁵ First Report and Order, 17 FCC Rcd at 20004

¹⁶ <https://www.fcc.gov/document/broadcast-station-totals-september-30-2020>

¹⁷ <https://financesonline.com/number-of-cars-in-the-us/>

93. The FCC has offered exclusive windows to AM stations to apply for FM translators in advance of opening up to competing applications.
94. Most recently, the FCC has approved all-digital AM broadcasting as a voluntary standard¹⁸. This is practical in the US because AM stations wishing to switch to all-digital mode can maintain their existing audience via their analog FM translators.

Mexico – FM channels assigned to existing AM stations

95. Mexico initially authorized the voluntary use of HD Radio for stations within 320 kilometers of the United States border in 2008. Later in 2011, the Mexican communications regulator Cofetel adopted HD Radio as a voluntary standard for the transmission of digital radio nationwide. Currently, there are 119 FM stations in Mexico carrying 192 program services on HD radio.
96. HD Radio broadcasts are concentrated in the four main cities in the country. Together, all digital stations cover 41% of the population, approximately 51 million people. In Mexico, there are 22 brands and 115 models that offer HD Radio receivers in new vehicles.
97. In 2017, an auction call for 191 FM frequencies was issued. Applicants who committed to launch in hybrid (analog/digital) HD Radio according to the IBOC-FM standard were given a preferential advantage in the auction. The result was the approval of 50 FM stations in hybrid HD Radio format.
98. In parallel, Mexico has embarked on a policy of assigning FM channels to existing analog AM stations wishing to migrate to analog FM.
99. In 2016, the Mexican government made the most recent change of frequencies from AM to FM in large cities. Because there are not enough frequencies for all AM stations to migrate to FM, one of the requirements was a commitment to broadcast in hybrid HD Radio format.
100. The stations that converted from AM to FM HD Radio retain full control of their broadcasts, including additional multi-cast audio channels.
101. This is seen as an important transition path for Mexican radio stations to shift listenership via simulcast and foster further migration to digital radio without sacrificing audience.
102. The Mexican government has provided further support to radio broadcasters in 2017 by regulating mobile service operators. Many makes and models of wireless phones include an integral FM radio receiver. Mobile operators are prohibited from disabling FM radio functionality in wireless phones if it is included in the device by the manufacturer.

Europe – EU mandate to include DAB in vehicles

103. More than half of the countries across Europe, 15 in total, have now also launched full time DAB digital radio broadcasting in the VHF Band. Norway has completed its transition and no longer uses FM for radio broadcasting as of December 2017.

¹⁸ <https://www.fcc.gov/document/fcc-provides-am-radio-stations-all-digital-broadcast-option-0>

104. The European Union has provided regulatory support to broadcasters by mandating that all new passenger vehicles sold must have a DAB receiver, effective December 21, 2020.¹⁹

Australia – moratorium on new entrants

105. Australia launched digital radio broadcasting in 2009 using DAB+ in the VHF Band.

106. The Australian Government provided regulatory support to existing broadcasters by putting a moratorium on new entrants to DAB+.²⁰ This has provided time for the transition to digital radio for incumbent radio stations.

Future Platforms

107. Future platforms, such as ATSC 3.0 and 5G Broadcast, may offer even better performance and greater opportunities for digital radio broadcasting.

108. ATSC 3.0 has been adopted by the FCC in the US as a voluntary standard for next generation digital television services. This is currently the most efficient digital broadcast delivery system with return channel capability via broadband. The standard utilizes Internet protocol (IP), and the same clock rate as 5G wireless. These two features are likely to simplify service following across multiple platforms and the inter-operability with 5G mobile broadband services (i.e. smart phones).

109. ATSC 3.0 is actually a suite of standards encompassing every aspect of digital broadcasting including single frequency networks, scalable error correction, digital rights management, watermarking just to name a few.

110. The ATSC 3.0 standards may provide a useful template for radio broadcasters to define the requirements for an optimal digital radio broadcasting system.

111. 5G mobile broadband service is not just about fast Internet speeds. The global 5G standards, developed by the Third Generation Partnership Project (3GPP), also include a suite of new capabilities to support a broad range of applications.

112. “5G Broadcast” is one of the included standards. Registration to the provisioning mobile service network is not required to access the broadcast content. Hence, SIM-free, free-to-air reception is possible on smart phones.²¹

113. Trials are underway in a few countries to test and demonstrate the 5G Broadcast standard for television and radio services.

114. Mobile service operators would need strong incentives to include 5G Broadcast in their networks.

¹⁹https://www.worldddb.org/system/news/documents/000/011/019/original/EECC_factsheet_December_2020.pdf?1607447316

²⁰https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp0809/09rp18#:~:text=In%20March%201998%2C%20the%20Minister,available%20to%20Australians%20by%202001.
“Howard Government framework for introduction of digital radio”

²¹https://www.researchgate.net/publication/339298352_5G_Broadcast_Release_16_is_approaching_Completing_a_new_step_to_deliver_public_service_media_with_3GPP_technology