DIGITAL RADIO – A GLOBAL PERSPECTIVE

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ABSTRACT

Digital Radio has been a technology with the ability to deliver exciting new capabilities and great promise of growth but has seen various rates of adoption with various standards in different geography's. This paper will discuss the status of implementation and usage of digital radio systems including; HD radio, DAB/DAB+, DRM/DRM+ and other digital delivery methods used for radio delivery. Specific information will be explored in countries such as Australia, Korea, China, UK, Germany, Norway and others as they chart a course to their digital radio future. The paper will also discuss the proposed analog shut off of FM radio in some countries. This discussion is based on real world experience with projects Harris has been involved with around the world.

CURRENT SITUATION

Transition to digital broadcasting as one that most people think of as being related to television, since many countries have adopted official selections of broadcast standards, and set a analog shut off date to conclude analog broadcasts. In most countries radio broadcast continues to be analog with the beginning of a conversion process to digital. Digital Radio has seen steady growth in multiple countries around the world with different approaches used by broadcasters and governments alike. There have been few countries setting analog sunset dates yet but instead offering digital and the already in place analog broadcasts. In this paper we will review the progress of digital radio broadcasting in the various regions around the world.

STANDARDS CONSIDERED

There are three main standards used for digital radio around the world which include HD Radio, DAB/DMB and DRM. Each of these standards operate in a wide range of frequency bands and with different levels of support for analog and digital broadcasting in the same spectrum. All three are digital transmission systems designed primarily for radio using OFDM technology to create a platform of robust transmission and psycho-acoustic audio coding for efficiency. While this is not intended to be a paper about the technical operation of each standard we will quickly examine each as a reminder of their approach to delivering digital radio broadcast.

HD radio, a system developed by iBiquity Digital, uses a broadcasters existing spectrum in either the AM – medium wave band, or VHF FM band II to deliver both analog and digital radio broadcasts. Broadcasters can, in this way, provide a seamless blend from analog to digital and back again for the main digital – HD1 program which is typically a simulcast for the analog format. In addition to the replication of the analog program content, HD radio can deliver several additional digital audio programs and useful data services such as real-time traffic, iTunes Tagging and Artist Experience which are just a few examples. HD radio is typically deployed a single users system, all the content generally comes from one broadcaster who owns the host analog frequency. Typically a single transmitter provides coverage for a large city.

DAB has three versions for radio; DAB, with MPEG layer 2 audio; DAB+, with HE AAC audio; and DMB radio, also with HE AAC audio. The DMB variant can also deliver mobile TV, and indeed this was its original purpose; around 40 million DMB-TV terminals have been sold in South Korea. DAB principally uses band III- high band VHF CH 7-13 and L-Band spectrum, although it could be deployed in other frequency bands too. Coverage from a single high power transmitter can cover a large city; however this can be extended by using multiple transmitters in a single frequency network (SFN). DAB uses approximately 1.5MHz of RF bandwidth per transmission on which one can multiplex around 10-12 DAB services or 16-30 DAB+ services depending on the audio coding. DAB is typically used to deliver program content from multiple broadcasters in a shared infrastructure approach. In fact in many places a single multiplex or two may carry all the existing analog broadcasters, and new digital only channels that would otherwise have taken multiple analog transmitters. DAB operates in a digital only mode, and does not support analog broadcasts on the same frequency.

DRM has two versions DRM30 and DRM+, both of which, in different ways can support simultaneous operating of analog and digital broadcasting on adjacent frequencies using common equipment. DRM30 uses the frequencies below 30 MHz and is designed to fit within the ITU AM spectrum mask in 9 and 10 kHz channels, although it also has modes that can use 18 or 20 kHz channels giving more capacity or more ruggedness. Coverage can be very large, and indeed can be out-of-area, using the sky-wave propagation characteristic of the MF and HF bands. DRM+ is designed for the VHF bands, using 100 kHz per transmission. The DRM system can also be configured as an SFN to enhance coverage, and allows multiple audio channels similar in number to HD Radio, but this feature is practically limited to DRM+ due to the more limited bandwidth of the lower DRM 30 frequency range.

AMERICAS

The Americas (North and South America) include a wide range of countries and economic situations with differing levels of digital radio deployment. One thing that is typically common amongst these countries broadcasters is the common ownership of both the license and the transmission facility along with content generation. This differs form other parts of the world where one entity creates the content, and another owns and operates the transmission systems.

United States

The United States has chosen the HD Radio standard of digital radio for operation on both the AM an FM bands. Broad adoption has taken place lead by many of the large commercial groups and public radios stations in markets both large and small with the rollout starting in 2004. Currently over 88% of the population can receive HD radio broadcasts (approximately 249M people). This is accomplished by over 2100 stations on the air in over 270 of the measured radio markets.

In addition to the main HD channel, an extensive number of new channels have been launched using the multi channel capability of FM HD Radio. At the present, there are 1,334 multicast channels, of those 1,077 are HD2, 244 are HD3 and 18 are HD4. This addition channel capacity offers up to 70 channels of free over the air radio services depending on the market. On the receiver front there are nearly 6 million HD Radio receivers are now in the marketplace. A total of 22 automakers have now publicly announced their plans to incorporate HD Radio Technology in over 100 models by year end with more than 50 featuring HD Radio receivers as standard equipment. There are over 10,000 brick-and-mortar stores and online outlets offer HD Radio products with selection of over 100 different HD Radio receivers currently on the market.

Canada

Canada has had a mixed past with digital radio. The Canadian market started the deployment of DAB in L Band in the 1990's with poor coverage and even less consumer adoption. These services basically were a complete simulcast of those already available on analog services. The limited product offering coupled with very limited availably of L band receivers proved to be too much to continue the operations, and Canada broadcasters ceased operation of the DAB multiplexes. The Canadian Broadcasting Corporation (CBC) began HD Radio testing in September 2006, focusing on transmissions from Toronto and Peterborough, Ontario. The Canadian Radio-Television and Telecommunications Commission (CRTC) has since revised its policy on digital radio to allow HD Radio operations pursuant to Public Notice CRTC 2006-160.

Mexico

Mexico has, over the years, tested all of the discussed digital radio systems, DRM, DAB and HD Radio. Despite some commercial interests in DAB, the limited availability of L Band and VHF Band III spectrum impacted the suitability of this format. After much evaluation, and taking in to consideration the adoption in the United States, in June 2011, COFETEL, Mexico's spectrum regulating agency, finalized the regulatory process selecting HD Radio Technology as a digital radio standard for the AM and FM bands in Mexico. Currently approximately 20% of the nation's population can receiver HD radio broadcast from station broadcasting in Mexico and addition stations from across the boarder in the United States. There are about 20 stations are currently broadcasting or in the process of converting using HD Radio Technology.

Brazil

Brazil has been seen as an early adopter of digital radio broadcasting in the South American region. This mirrors the leadership roil it has been taking in digital TV conversion. Since the first HD Radio station went on in September, 2005, about 25 stations in Brazil have converted to the technology covering an area of 30 million people. In addition to HD radio, there has been some interest in DRM and to that end there have been several DRM Tests over the last 5 years. Most recently there were tests in DRM30, medium wave with TV Cultura and CBN (Radio Globo) in Sao Paulo low and high power. Tests were also conducted using DRM+ in the FM band with UFMG and Itatiaia in Belo Horizont low and high power. The shortwave band was also evaluated in this period of testing with DRM30 testing in November and December of 2011. The continued operation of HD Radio and the latest tests of DRM have been supporting the Brazil Ministry of Communications as they are currently evaluating formal authorization of digital radio operations in the country.

Other countries

There are other countries in the region that have had a mix of regular operation and trials in the various forms of digital radio.

Argentina – AM HD Radio technology was tested in 2004 with initial trials in Buenos Aires. Further testing of the technology was conducted in early 2007.

Colombia – Caracol Radio conducted tests of FM HD Radio technology in 2008-09 in Bogota.

Dominican Republic – Raíces FM initiated the first FM HD Radio operations in the country in late 2008. Two more stations have since begun regular digital broadcasts. INDOTEL, the national spectrum regulator, has announced that any station can use HD Radio technology on a provisional basis, and plans to announce an official national standard in the near future.

Jamaica – Radio Jamaica (RJR) began operating full time with both HD Radio AM and FM signals in the city of Kingston in 2008.

Panama – HD Radio on-air testing/demonstrations started in late 2008 and Panama's President signed a bill into law on 12 May 2009 making the HD Radio system the official (and only) digital radio standard in that country. Antena8 100.1 is already operating in Panama City, with several more stations preparing to convert to digital broadcasting.

It is also important to note that there are several broadcasts offered in the shortwave band using DRM technology that target the region. These broadcasts typically are for short periods of time ranging from one hour to several hours a few times a week.

ASIA PACIFIC

The Asia pacific region is one that is very active in digital radio broadcasts. All of the stands we are discussing have activity in the area with regular broadcasts in multiple countries. Several Asia countries also use varying standards of mobile TV which also carry radio programs and enjoy broad adoption.

Australia

Australia had deployed digital radio primarily using the DAB+ standard in band III, and secondarily using the DRM format for global shortwave transmission and trials. In many Australia ways is a poster child of a digital radio launch with broad cooperation of government and commercial broadcasters to take the product to market. Results to date include

- Two years on full power in five cities covering 60% of Australia's population
- 1 million listeners to DAB+ per wk
- More than 605,000 digital radios sold by end September 2011
- Up to 20 new digital only stations in each market
- More than 100 different DAB+ receivers on sale in 800 retail stores plus online

Australia's unique harmonised approach with all industry stakeholders coming together to launch and rollout Digital Radio has been a great success and provides a roadmap for other countries starting to rollout. The elements of their successful launch include spectrum policy to assist broadcasters in the transition, efficient coverage design featuring high power transmission a united industry approach, new & compelling content, affordable receivers which are available at a variety of retailers and finally carefully planned marketing & PR strategy.

On the DRM front, ABC Radio Australia broadcasts 3 hours daily in DRM in the Short Wave band from Brandon to Papua New Guinea and to the Pacific islands. Network operator Broadcast Australia is

installing 2 DRM ready shortwave transmitters of 100 kW, one in Shepparton (due to go on air in January 2012) and one in Tennant Creek to prepare for addition broadcast around the region.

China

China has been operating all three standards with differing levels of success over the past number of years. SARFT (State Administration of Radio, Film, and Television) has operated DRM in both the Shortwave and Medium wave bands for over 10 years. Broadcasts are offered for a portion of the day and aimed at listeners outside of the country in some cases. Despite a long record of DRM broadcasts, there is not a wide availability of receivers locally.

HD Radio has been on the scene since 2007 in China with close collaboration with SARFT to evaluate and operate test systems. Harris deployed FM and AM systems with SARFT to conduct field trials including operation from the CCTV tower in Beijing starting in 2008. Evaluation of the HD radio system has lead to SARFT collaboration with iBiquty to specify a digital radio standard for China based in part on the HD radio technology. iBiquity has partnered with Chinese technology developer Digital Wave and others to form HuaSheng Technologies, a Chinese joint venture to design and commercialize a China-specific digital radio system.

SARFT,selected DAB for the industrial standard in May 2006. DMB/DAB is now on air in 11 cities across the country. With the Guangzhou launch of commercial services in 2007, the Ministry of Industry and Information (MII) decided to issue licenses for DMB in mobile phones to facilitate the delivery of digital radio and mobile TV. Beijing Jolon, the biggest local broadcaster in Beijing has been operating a network of Harris DAB transmitters since 2008 delivering digital radio and mobile TV content. In 2010 they launched 'Push Radio' based on DAB.. Beijing Jolon broadcast 30 hours - or 25 program channels every day through Push Radio.16 Audio programs are broadcast 15 times per day and downloaded onto receivers. Value added services such as news, data and slideshow have been provided into the Push Radio services. Beijing Jolon has upgraded their latest generation receivers to support DAB+. Coverage is currently available in the following provinces: Guangzhou, Beijing (approximate coverage: 12 million people), Shanghai (expected coverage: 15 million people), Dalian (expected coverage: 5.4 million people), Henan, Hangzhou, Shengyang, Jiangsu, Shenzhen, Changsha and Kunming.

Hong Kong

Broadcasters in Hong Kong will begin to broadcast 18 channels in DAB+ on a 24 hour basis beginning in 2012. The Government has issued DAB+ licenses to three commercial operators - DBCHK (formerly Wave Media), Metro Broadcast and Phoenix U. The number of DAB+ channels (each of 64 kbps) being expected to be 7, 3, 3, respectively. Government broadcaster RTHK will get 5 channels, making a total on Mux 11C in VHF Band III of 18. In total nearly HK$1 billion will be invested in DAB+ in Hong Kong for the first six years. Harris has delivered VHF DAB transmitters for us on the primary network to be deployed at the 7 existing FM hilltop sites, for expediency. Additional gap-fillers will be implemented later. RTHK will operate and maintain the network on behalf of the Consortium.

South Korea

South Korea is most notable for the largest deployment of DAB/DMB used primarily as Mobile TV, but also delivering several digital audio programs. Sales of devices in this market have been strong reaching approximately 40M devices. A mix of national and regional muxes offer services in VHF band III. South Korea is also evaluating standards for digital radio deployment by both in and out of the FM band II frequency range. Systems under evaluation in addition to DAB/DMB are DRM, DRM+ and HD Radio. It is expected that a selection will be made in 2012 as to the approach to supplement the current DAB DMB deployments.

India

India with its vast population could be a large market for digital radio adoption. India has announced adoption of DRM as the selected standard for deployment. DRM has been operating in country first as trials in SW conducted successfully in 2007 and later as a regular service started from SW Transmitter in Delhi on 16th January 2009. Most recently starting in Oct.2011 All India Radio increased DRM SW transmissions by 8.25 hours to approx. 16 hours/day. Government broadcaster All India Radio announced they will be renewing and replacing all MW (AM) transmitters with DRM30 (76 transmitters) and adding two new high power (1 MW) HF transmitters for international broadcasting (one scheduled for Jan 2012). They will be evaluating DRM+ for broad adoption after evaluating the outcome of the DRM+ trial completed in Delhi – May 2011.

Other countries

Malaysia government broadcaster RTM (Radio TV Malaysia) has installed 3 DRM ready shortwave transmitters of 100 kW in Kajang, Malaysia and have begun regular DRM30 transmissions. In June 2010, Malaysia's regulator, the MCMC awarded three blocks of L-Band spectrum to Asia Media, a broadcasting, advertising and digital media company. Asia Media will use the spectrum to broadcast up to twelve T-DMB channels, including radio and data services, as well as mobile TV. Malaysia's public broadcaster, RTM, launched a DAB+ trial in Kuala Lumpur in 2010. This multiplex carries 15 audio services, all of which are simulcasts of existing FM stations.

In New Zealand, Radio New Zealand International installed a 100 kW DRM shortwave broadcast transmitter in Rangitaiki several years ago Currently, Radio New Zealand International broadcasts 20 hours per day in DRM to all the Pacific islands. Starting with the successful testing on 106.1 MHz from the Skytower in Auckland, the Radio Broadcasters Association (RBA) initiated a comprehensive trial of HD Radio technology in December 2006. The aim of the trial was to assess the coverage potential of the HD Radio system and to make a recommendation on the suitability of the technology for adoption. In addition network operator Kordia has been conducting DAB trials in Band III.

In Thailand BBC World Service operates a 250 kW DRM shortwave transmitter in Nakhon Sawan, and in March 2006, an HD Radio system was installed for a public radio network targeting mass transit commuters in Bangkok by installing HD Radio receivers in public buses.

Philippines – The first HD Radio station in the Philippines began broadcasting on November 9, 2005. The Philippines National Telecommunications Commission finalized its rules for FM digital radio operations on November 11, 2007. About 10 HD Radio stations are currently operating.

Vietnam – Voice of Vietnam (VOV) commenced AM and FM HD Radio transmissions in Hanoi in June, 2008 including multicasting, in anticipation of making HD Radio technology a standard. In February, 2009, a joint trial with VOV and the Asia Pacific Broadcast Union (ABU) took place in Hanoi. Trial operations continue in Hanoi and Ho Chi Minh City (Saigon). VTV has been broadcasting DAB/DMB services on air in Ho Chi Minh City since Dec 2010 with 3 transmitters covering the city area

Sri Lanka - Deutsche Welle operated a 300 kW shortwave DRM transmitter in Trincomalee to broadcast BBC World Service and Deutsche Welle programs. DRM+ Trial has been held in Colombo (successful trial and workshop) - December 2010.

Bangladesh – Dhaka FM 90.4 commenced regular HD Radio operations on 1 January 2012.

Indonesia – HD Radio systems on both MW-AM and VHF-FM have been tested in Jakarta and Surabaya respectively. The MW-AM station is a fully operating religious broadcast network; the VHF-FM station was part of HD Radio trials in Jakarta. The Indonesian government has announced an official decree that

Indonesia has chosen the Eureka-147 family, which includes DAB and DAB+ for digital radio and DMB for radio and mobile TV as the national standard for digital radio. DAB/DMB trials have been running in the capital, Jakarta, since 2006. There are currently four services on air. The trial is operated by the regulator and MNC, the largest media company in Indonesia. Further tests are planned for Bandung, Medan and Surabaya.

There are also other broadcasts ranging from one to several hours a week on varying short wave stations featuring DRM technology.

EUROPE, MIDDLE EAST & AFRICA

Digital radio has a strong base and support in this region. The region has a wide range of operators and broadcasters, who have differing approaches to radio, but in general have been implementing and have plans to implement digital radio. It should be noted with interests that there are several countries in this region that not only have plans to launch or have launched digital radio, but that they also have plans a dates for the shut off of analog radio. In a part of the world that has rising energy costs, and where most countries have extensive radio networks, consolidation to digital offers significant cost advantages. At the recent conference European Union Commissioner Neelie Kroes reaffirmed the EU's commitment to pan-European digital radio saying: "Radio must not be left behind in the digital revolution". "I want radio to be at the forefront of [another] revolution: the digital revolution",

United Kingdom

The United Kingdom is often viewed as a leader in digital radio adoption of DAB with their extensive government and commercial digital radio networks. The BBC and commercial broadcasters offer service that reaches virtually all of the population of the UK with several channels of digital radio. Digital radio is also broadcast over the DVB based digital TV networks. In most parts of the UK listeners can receive several channels of BBC programming both nation and local along with a mix of national and local commercial radio broadcasts on the DAB platform.

RAJAR, the audience measurement company, shows that listening to digital platforms now accounts for 28.2% of all radio listening, an increase of 14% since Q3 2011. Digital listening hours are up to a record 304 million hours, up 16% from 262 million hours in Q3 2010. Ownership of DAB digital radios in the home is up 12% year on year, with almost two in five of the population (39.4%) or 20.5 million adults, living in a household with a set. 23 million people now listen to digital radio each week, with digital reach across all platforms increasing by 12% year on year. Of all radio listeners, 48.4% now listen via a digital platform each week, an increase of 2.4 million people year on year.

The UK Government published its final Digital Britain report which outlined the way forward to an all digital radio broadcast approach. In conjunction with the Digital Radio Working Group, it is suggested that these criteria could be met between 2015 and 2020 and therefore a switchover could occur as early as 2017 ending most analog FM radio broadcast in the UK. It should be noted much of the analog medium wave AM broadcast have been ended and moved to FM for some time.

Broadcasters in Edinburgh UK conducted DRM+ trials in FM band II in 2011 to determine if this approach was suitable for operation in the FM Band in a highly credible 'real environment'. The frequency and antenna system were previously used by a commercial FM station. The findings show that DRM+ is capable of excellent coverage in good quality at reduced power levels compared with FM, urban coverage was superior to FM, especially in the more rugged 4-QAM mode

Germany

Germany launched DAB+ on 1st August 2011, this launch was in reality are launch of digital radio in Germany as there had been DAB operations in place on the public broadcasts for several years. There are now 27 transmitters that are covering the major towns, cities and motorways reaching 40 million people and is estimated to be up to 99% of the population by 2014. There are now 14 new DAB+ stations from rock, pop, football, classical and Christian radio on air across Germany and with the national multiplex being shared between both public and private broadcasters it is expected that more new stations will be on air in the very near future.

The German Digital Radio project office (Deutchsland Digital Radio) was created to co-ordinate the efforts of all stakeholders on the national multiplex, the public broadcasters (ARD) and Deutschland Radio. Five Working Groups were created to guide all areas of digital radio development and rollout. Areas covered include: Networks, Products, Marketing and Advertising, Traffic & Travel and Automotive. A consumer on-air marketing campaign between broadcasters, manufacturers and retailers has been launched to inform the public and retail staff working in high street shops about the advantages of purchasing a digital radio.

Germany's public service financing committee, the KEF provided funding to facilitate the roll out of national DAB+ digital radio in Germany. The funds, which allowed public broadcaster Deutschland Radio, to build out a national digital radio network using DAB+ technology, were complemented by funds by the commercial broadcasters to create a joint multiplex and shared operating costs. Government draft Telecommunications Law in progress - DAB in all receivers mandatory by 2014.

In addition to the roll out of DAB+ in Germany there has been interest in using DRM+ to allow smaller stations to convert to digital radio. Trials have been operated in Kaiserslautern and Hannover from 2008-2011 in both band II and III. Radio Regenbogen began HD Radio operations on 102.8 MHz in Heidelberg on December 3, 2007 pursuant to government testing authority and operated through 2008. Extensive reports were submitted to the German regulatory agency for further consideration.

France

France has a vibrant radio market, with extensive listening to the nation broadcaster, Radio France and a wide number of commercial operators. France had selected DMB audio , a variant of the DAB/DMB standard and outlined plans for a launch, including government set conversion dates and mandatory availability of receivers. The Kessler Report on the future of digital radio in France was released this year http://www.gouvernement.fr/presse/remise-du-rapport-de-david-kessler-sur-l-avenir-numerique-de-la-radio The report outlines the reasons why digital radio has not progressed in France despite previous government regulation outlining rapid deployment and turn on dates. The reasons are mainly economic - it is felt that the business case is not strong enough for broadcasters who are currently unable to invest in new/dual networks. It does however also set out the reasons why the French market should go digital; increased coverage, more services, the saturation of FM. The publication of the Kessler report means the market can now move forward after a period of stagnation and to this end various trials are either on-air or planned a positive step towards digital radio.

Trial broadcasts are in place in several cities in France including Paris (from the Eiffel tower) and in Lyon. The RNT Lyon nine month consumer trials began in April and is due to conclude in December 2011. The trial in the Lyon area currently has 15 commercial broadcasters on two multiplexes covering 85% of the population. With a focus on consumers the trial leader VDL, a French network operator, is raising awareness of digital radio through press conferences, a consumer website (www.rntlyon.fr), in-store promotions, public events, social networking and on-air marketing/promotional campaigns.

DRM also has a place in the French radio marketplace. There are currently several broadcasts in DRM30 on shortwave, and DRM+ trials in Paris in VHF.

Norway

Norway has been operating DAB networks for both Public/Government broadcaster NRK, and a variety of commercial broadcasts providing both national and regional coverage. Approximately 80% of the population can receive DAB signals. The Government, in their recent Digital Radio Report, released 4th February 2011, has set a switch-off date for FM broadcasting of January 2017, provided certain conditions have been met.

In order to reach analog shut off, something the government and commercial broadcaster want, they must reach the following milestones:

- Coverage. The public broadcaster NRK must achieve similar coverage to the FM-coverage (+99%) of their flagship channel P1 by 2015 for the shut-down to take place in 2017. Commercial broadcasters on the national network #1 are required to reach 90% of the population.
- Listening. 50% of the listeners must daily use a digital platform in 2015 for the date to remain Jan 2017. This does not specify market share of listening, contrary to the UK requirement, only reach. "Digital platform" also includes listening via internet and via the digital tv-network.
- In-car solution. There must be reasonably priced, well functioning in-car adaptors on the market by 2015 for the switch-over date to remain Jan 2017
- Added value for the listeners.
- If the criteria are not met in 2015, the switchover date will be moved to 2019.

After 2017, small local stations may continue on FM. The criteria for exactly which stations will have this opportunity will be specified by 2013. The report leaves it to the broadcasters to choose between DAB or DAB+ transmissions.

In Norway, there are two national DAB multiplexes on air, one of which is split into seven regional muxes. There are nine audio and one data services on the national multiplex. These are a mix of stations from the public broadcaster NRK and commercial radio operators. The seven regional multiplexes broadcast local services from NRK as well as some niche programming such as classical and folk music. In total the DAB networks offer 18 channels (DAB), with 2 additional ones available in central Oslo only (DAB+). All major FM radio channels in Norway are also available via DAB.

Denmark

Denmark is one of the most successful DAB markets in the world. With 33% of the population accessing digital services, Denmark has the highest number of DAB users per capita in the world. The public broadcaster, Danish Radio (DR) has been an enthusiastic supporter of digital radio since it began trials in 1995. Regular services have been available since 2002. In 2009, the Danish government agreed that commercial radio stations would be offered the opportunity, through a beauty contest, to broadcast on the second multiplex. This was won by a Danish consortium, with stakeholders including a newspaper group. Two multiplexes deliver 17 stations from DR, and there are two commercial stations represented on DAB: Pop FM and NOVA fm. The Danish market is now looking to the government about a decision on the future of digital radio and a possible FM switch off.

Switzerland

Switzerland has been converting to digital radio using the DAB standard for many years, and currently boasts the best coverage in Europe - Digital radio on DAB or DAB+ in Switzerland reaches over 93% of the population. Switzerland as a country has several languages spoken depending on the region of the country one is in, and the radio programming follows the local language. There are 4 public regional DAB / DAB+ multiplexes from SRG, and one commercial DAB+ multiplex in the German speaking part. These muxes provide a wide range of programming and a large number of channels. Consumers can listen to 29 programs on DAB/DAB+ in the German-speaking part of Switzerland, 12 programs on DAB/DAB+ in the French-speaking part of Switzerland, 12 programs on DAB/DAB+ in the Italian-speaking part of Switzerland and10 programs on DAB+ in the Romansh-speaking part of Switzerland. It is planed that these multiplex will all migrate to DAB+ by the end of 2012

All radio and TV retailers as well as the major chains now sell DAB+ receivers in Switzerland, and there is a huge choice of different receivers in the market. Currently there are over 900,000 receivers in the market.

VHF FM testing of HD Radio sponsored by Radio Sunshine and Ruoss AG began in Lucerne in April 2006 and operated through 2011.

An interesting note on analog shut off in a small way in Switzerland, SRG closed it's nationwide AM broadcast network over two years ago in favor of providing this programming on the DAB network. In addition to substantial reduction in transmission costs, after a several month period of reduced listenership, the program has regained the lost listeners, and in fact exceeded the levels of listening prior to the analog shut off.

Russian Federation

The Russian market is making a rapid change to digital broadcasting for both radio and television. After trials of different standards the main broadcaster RTRN has selected DRM as the digital radio standard for us on Long Wave, Medium Wave and Short Wave broadcasts. Plans announced for complete coverage of the Russian Federation with DRM30. In order to complete this coverage there will be 17 LW transmitters, 79 MW transmitters and 30 SW transmitters for domestic service. There will be additional transmitter converted for international services including approximately 82 MW and SW transmitters.

This major undertaking is in the early stages of planning and deployment, it is not clear what plans may be in place for FM conversion or analog sunset.

Other countries

There have been operations in place and announcements of expansion of several radio networks to digital in much of Europe. Much of the activity in the Middle East and Africa is limited to short trials but it is expected as those countries move forward with their digital TV transition, addition focus will be made on the future of digital radio.

Czech Republic – Initial testing of the HD Radio system commenced in Prague in February 2007. DAB is currently covering 2,8 million inhabitants of the Czech Republic. The signal covers Prague and its surroundings, in Příbram, Brno and its region, and in the large part of the Moravia-Silesian region. 14 radio stations are being broadcast on the multiplex.

Bosnia – Trial and tests of HD Radio technology began in Sarajevo in March 2007.

Ukraine – The first FM HD Radio broadcasts in Kiev went on the air in October 2006 on two FM stations operated by the First Ukrainian Radio Group

Hungary – DAB+ is the digital radio standard, a multiplex on air broadcasting 7 stations to the Budapest area. The multiplex is operated by Antenna Hungaria, which also runs national TV and radio stations in Hungary. Coverage is currently at 30% of the population, but this is expected to reach 94%by the end of 2014 as Antenna Hungaria rolls out more transmitters and services.

Poland – An HD Radio trial began in Warsaw in 2006 in order to demonstrate the technology to local radio stations. In the capital, Warsaw, Emitel operates a multiplex broadcasting 12 audio services using DAB+ and one mobile TV service using DMB. It reaches 2.5 million people and airs a combination of public and commercial stations. This trial multiplex launched in November 2009.

Romania – An on-air HD Radio technology demonstration with multicast was held in Baia Mare, Romania on 23-24 October 2008 featuring broadcasters and regulators, on an FM station owned by 2M Prima Telecom. In June 2010, Radio Guerrilla 94.8 in Bucharest launched HD Radio Technology.

Netherlands – Public & Commercial national coverage – 16 commercial stations on DAB. Plans are in place to expand the networks to provide 100% coverage of the population and up to 50 channels of digital radio using DAB+ by 2017. Review of analog shut off of FM in 2015.

Belgium – Currently100% population coverage with both public and commercial channels.

Spain – Current DAB network has minimal coverage in users, plans for a re-launch using DAB+ featuring addition content.

Sweden – Plans to upgrade the current multiplex of DAB which delivers public broadcast channels to DAB+ which will complement the second mux that has 16 commercial services in DAB+. The government is now launching the licensing process to offer national and regional muxes for commercial broadcasters.

In the larger region of Europe the Middle East and Africa there have been operations of DRM in Shortwave, and short term trials for both HD Radio and DAB broadcasting.

CONCLUSION

Digital radio is alive and growing in different portions of the world, with different sets of technology standards and government regulations which may be driving the conversion rate. For the first time we are seeing countries like the UK and Norway announcing analog shut off dates for FM broadcasts. In countries that are looking at such shut offs, the reduce operating costs of a single digital network to deliver multiple channels of programming will save considerable operating costs of multiple single channel FM transmitters. These cost savings are especially large for the public government broadcasters who have outsourced their transmission operations, and are paying for third party network operators to run the FM and digital networks (these broadcasters have also seen the savings with the turn off of analog TV).

Most of Europe is in some form of digital radio conversion, with an eye to an all digital future. Asia has seen verily levels of adoption, but with the recent success of the Australian launch others have accelerated their launch of the DAB or DAB+ standard. Broadcasters in the Americas, while many have launched in the largest countries, continue to offer additional services in digital with a range of success of trial solution to commercial operation. There appears to be no discussion in this region about an analog

shut down, in part due to the use of HD radio which continues to use the same frequency and often combined transmission equipment as the host analog signal.

The adoption of digital standards seems to be favoring the DAB/DMB family of standards with wide adoption in Europe and Asia. HD Radio has commanding share of the Americas, and DRM , which had been mostly limited to Shortwave adoption , is seeing growth in three of the 4 BRIC countries, Brazil, India and Russia. Regardless of the standard selected adoption will continue to move a pace slower than the digital TV adoption until governments adopt regulation requiring a switchover.

REFERENCES & ACKNOWLEDGEMENTS

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