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Telecom Regulatory Authority of India

Consultation Paper

On

Issues related to Digital Radio Broadcasting in India

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Written comments on the consultation paper are invited from the stakeholders by 4th September 2017.

Counter comments, if any, may be submitted by 18th September, 2017.

Comments and counter comments will be posted on TRAI's website www.trai.gov.in.

The comments and counter comments may be sent, preferably in electronic form to, Shri S. K. Gupta, Pr. Advisor (B&CS), Telecom Regulatory Authority of India, on the e-mail pradvbcs@trai.gov.in or vk.agarwal@trai.gov.in.

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Content

Chapter 1

Introduction

1.1 Broadcasting sector primarily comprises of two sectors, namely, Television and Radio. Due to its wide coverage, portability, low set-up cost and affordability, Radio is a prevalent source for providing entertainment, information and education to the masses.

1.2 At present, terrestrial radio coverage in India is available in Frequency Modulation (FM) mode and Amplitude Modulation (AM) mode (Short Wave and Medium Wave). All India Radio (AIR) along with private sector radio broadcasters are providing terrestrial radio broadcast services throughout the country transmitting programs in AM and FM frequency bands. AIR has 420 radio stations (AM & FM) that cover almost 92% of the country by area and more than 99.20% of the country's population. Private sector radio broadcasters transmit programs in FM mode only and presently operate through 293 radio stations. Private sector radio broadcasters are licensed to operate in FM frequency band (88-108 MHz).

1.3 In Phase-I of FM Radio, the Government auctioned 108 FM radio channels in 40 cities. Out of these, only 21 FM radio channels became operational and subsequently migrated to Phase-II in 2005. Phase-II of FM Radio commenced in 2005 when a total of 337 channels were put on bid across 91 cities having population equal to or more than 3 lakhs. Of 337 channels, 222 channels became operational. At the end of Phase-II, 243 FM Radio channels were operational in 86 cities.

1.4 In Phase-III expansion of FM radio, 966 FM radio channels are to be made available in 333 cities. In the first batch of Phase-III, 135 private FM Radio channels in 69 cities were auctioned in 2015. Out of these, 96 FM Radio channels in 55 cities have been successfully auctioned[1].

[1] http://www.mib.nic.in/WriteReadData/documents/1st_Batch_FM_Phase-III_Auction_results.pdf

In the second batch of Phase-III, 266 private FM Radio channels in 92 cities were auctioned in 2016[2]. Out of these, 66 FM Radio channels in 48 cities have been successfully auctioned[3]. As on 31st March 2017, 293 FM radio stations have been made operational in 84 cities by 32 private FM Radio broadcasters.

1.5 In order to encourage radio broadcasting for the specific sections of society, the Government has allowed setting up of Community Radio Stations (CRS). CRS typically broadcast in FM band with low power transmitters restricting its coverage to the local community within approx 10 KM. There are 206 operational CRS at present.

1.6 Radio signals are presently transmitted in analog mode in the country. Analog terrestrial radio broadcasting when compared with digital mode is inefficient and suffers with operational restrictions as discussed below:

- Transmission in analog mode is susceptible to Radio Frequency (RF) interference resulting in poorer reception quality.
- Only one channel per transmitter is possible.
- Spectrally inefficient as frequency reuse is limited and radio channels require more spectrum per channel.
- Signal quality may suffer in portable environment such as moving vehicles and on handheld devices.
- No flexibility to provide any Value Added Service

1.7 Digital Radio technologies have been developed to overcome problems faced in analog transmission with exciting new capabilities and promises fast growth. Digital Radio provides a number of advantages over analog radio through utilization of advanced technologies. Some of the advantages are enumerated below:

- Better quality of signal or clear reception with high and

[2] http://mib.nic.in/WriteReadData/documents/NIA-_E-Auction_of_Second_Batch_of_Private_FM_Radio_Phase-III_Channels.pdf
[3]

consistent sound performance.

- Efficient use of allocated frequency – multiple radio channels can be broadcasted on a single frequency.
- Frequency reuse possible – to cover a large geographical area, it can offer credible "single frequency network (SFN)".
- Technical perspective – capacity to offer a range of transmission modes to broadcasters.
- Reduced transmission power requirements.
- Impact of noise is minimized and interference is reduced.
- Automatic tuning of various available private and public radio stations.
- Efficient reception of radio channels in static, portable and mobile environments such as moving vehicles, mobile phones etc.
- Value Added Services such as Emergency Program Guide, Emergency Warning Feature (EWF), updates on news and weather etc can be provided simultaneously along with program relay.
- Digitization of radio will allow the government to retrieve spectrum and re-allocate it for more efficient use.
- Possibility of Simulcast allowing broadcasters to save cost of transmitting signal in both formats, analog as well as digital formats.

1.8 Digital Radio Broadcasting has existed since quiet sometime around the world. The International Telecommunications Union (ITU) recommendations have described four major standards for broadcast of digital radio which are DAB, ISDB-TSB, HD Radio and DRM. Countries around the world are moving towards digital radio broadcasting by drawing the roadmap for switchover to digitisation broadcasting on the selected digital radio broadcasting standard.

1.9 In keeping with the pace of deployment of digital radio around the

globe, the Government in 2010 took a decisive step forward for transition from analogue radio services of AIR to digital mode of transmission. AIR conducted rigorous trials over the years and adopted the Digital Radio Mondiale (DRM) standard for low frequency band (MW and SW). It has initiated digitization of its MW and SW radio network in three phases. It has recently concluded phase-I of digitisation of its network with deployment of 37 digital (DRM) transmitters throughout the country, which are now operational and is now in the process of launching phase-II of the DRM project by offering full features/services from these DRM transmitters and further improving service quality. In phase-III, AIR, will complete transition of its radio services to the digital DRM platform, further improving the number and quality of radio services and extra features for the listeners, while also saving large amounts of transmission power every year.

1.10 While AIR is active in implementation of digital radio in MW and SW bands, there appears to be no initiative in FM radio space either by public or private FM radio broadcasters. As per the Policy Guidelines for Phase-III expansion of FM Radio broadcasting services through private agencies dated 25th July, 2011 issued by Ministry of Information and Broadcasting, maximum number of FM radio channels permitted in Category A+, Category A, Category B, Category C and Category D including 'Others' cities are 9, 6, 4, 4 and 3 respectively. Since FM is primarily used for analog transmission, there appears an understanding that frequency allocation under these policy guidelines are only for analog transmission. Analog FM technology can provide only one channel per frequency. Therefore existing FM radio channels provide limited services to their listeners. The ongoing Phase-III auction process of FM radio channels in existing cities, where FM radio channels are already operational, indicates emerging demands for additional frequencies. However, frequencies available are limited. In addition, analog radio

broadcasting is facing competition from emerging technologies and other platforms like webcasting, podcasting, Internet streaming etc.

1.11 In a competitive environment digital radio broadcasting may provide exciting new opportunities to existing private FM radio broadcasters as well as to the listeners along with a host of other value-added-services. By using digital radio broadcasting technologies, FM radio broadcasters can provide multiple channels/services on single frequency in existing FM band. This may increase availability of number of channels. However, presently there is neither any clarity in policy guidelines for Phase-III regime regarding provision of digital radio service in FM band nor the ecosystem is available which can encourage existing private FM broadcasters to move towards digital radio broadcasting.

1.12 Accordingly, TRAI has, *suo-motu*, initiated this consultation process in order to seek stakeholders' comments on various issues relating to development of an eco-system for deployment of FM radio broadcasting by private FM radio broadcasters.

1.13 The consultation paper has been divided into five chapters. Chapter 2 gives an overview of existing scenario of Radio Broadcasting in India. Chapter 3 examines various available digital radio broadcasting technologies and also highlights international scenario on deployment of these digital technologies. Chapter 4 discusses various issues relating to digital radio broadcasting. Chapter 5 summarizes all the issues for consultation.

Chapter 2

Overview of Digital Radio Broadcasting in India

Radio Broadcasting Services by AIR

2.1 Radio broadcasting in the country commenced in 1923 with the first radio program comprising of music and talks shows broadcasted by the Radio Club of Bombay, a private venture. This was followed by formation of Calcutta Radio Club but soon these stations had to shut down due to lack of financial upkeep. On 23rd July 1927, Indian Broadcasting Company Ltd (IBC), a private company, reached an agreement with the Government of India to set up and operate two radio stations, one at Bombay and Calcutta each. In 1930, on experimental bases, the government took over the broadcasting services in India and the Indian Broadcasting Service was established. In 1936, the Indian Broadcasting Service was renamed as All India Radio (AIR).

2.2 AIR has experienced a remarkable growth over the years. Today, AIR has grown to become one of the largest organizations in the world having about 420 radio stations. Till now AIR has installed 610 radio transmitters, which include 188 AM (140 MW and 48 SW) and 422 FM transmitters providing radio broadcasting services to 99.18 percent of the population of India with a coverage of 92 percent of the total geographical area. It also provides overseas broadcasts services for listeners across the world.

2.3 In keeping with the pace of deployment of digital radio around the globe, the Government in 2010, took a decisive step forward for transition from analogue radio services to digital mode of transmission. AIR has initiated digitization of its radio network by deploying DRM transmitters in a phased manner. AIR decided to replace 37 MW and 5 SW old analog transmitters by DRM

transmitters. AIR has also made a plan to convert its relatively new 36 MW and 4 SW analog transmitters to DRM transmitters by replacing/upgrading some parts of the existing transmitters (**Annexure-I**). In first phase AIR has replaced its 35 old MW and 2 SW analog transmitters by DRM transmitters. These transmitters are now operational[4] (**Annexure-II**). In MW band, AIR is operating in two modes, pure digital mode and simulcast mode. In simulcast mode transmitters carry out both analog and digital transmission according to timings of present analog operations. In SW band, broadcasting services are being provided to different countries over the globe such as Europe, U.K etc.

Radio Broadcasting Services by Private FM broadcasters

2.4 Until 2000, AIR, the public service broadcaster, was the sole radio broadcaster in the country. In the year 2000, looking at the changing market dynamics, the government took an initiative to open the FM radio broadcast for private sector participation. As brought out earlier, at the end of March 2017, the tally of operational private FM radio stations has reached to 293 stations.

Community Radio Stations

2.5 Along with the public broadcaster AIR and private FM radio, Community Radio Stations (CRS) are present in India, each serving a local and well defined community, with a focus on the day to day concerns of its audience and satisfy their specific information and entertainment needs.

2.6 The Government announced its policy for the grant of permission for setting up of CRS in December 2002. Initially, permissions were aimed at well established educational institutions, including IITs/IIMs, with certain restrictions. The first CRS in the country became operational on 1st February, 2004 at Anna University, Chennai. The permission

[4] http://allindiaradio.gov.in/Oppurtunities/Tenders/Documents/Revised%20update%20for%20DRM%20Transmitters%2021april%202017.pdf

period was fixed at three years, under this policy. CRS operate in FM frequency band.

2.7 In December 2006, the Government announced a revised policy for CRS, bringing non-profit community based organizations, apart from educational institutes, under its ambit. The period of permission was also enhanced from three years to five years.

2.8 As on December 2016, 255 licenses were issues in the country for setting up of community radio stations. Of which 201 community radio stations are operating throughout the nation.

Chapter 3

Digital Radio Broadcasting Technologies and International Scenario

3.1 Digital radio broadcasting was first introduced in European countries, and thereafter in United States of America, Netherlands, France and various other countries. The evolution and adoption of digital radio broadcasting standards have been influenced by the existing transmission technologies used, chosen standards and infrastructure. Countries around the world have chosen different standards through rigorous trials and examining the suitability of the new technology for various popular applications and ease of implementation. Digital switchover plans have been formulated keeping in view the technological options. Digital radio standards differ in terms of audio formats in addition to the modulation and transmission techniques used.

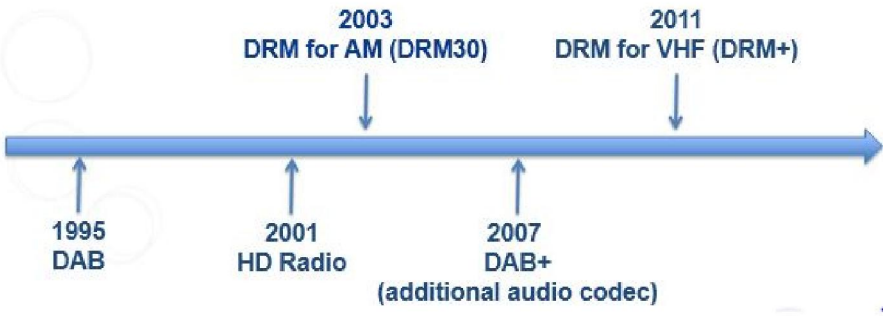
Standards for Digital Radio Broadcasting

3.2 There are four main digital terrestrial radio broadcasting standards recognized by the International Telecommunication Union:

a. DAB/DAB+,
b. ISDB-TSB,
c. HD Radio (IBOC),
d. DRM

3.3 These digital radio standards are briefly discussed in paras to follow**.** The evolution of digital radio standards is shown in the figure 1:

Figure 1: Evolution of Digital Radio Standards



A. Digital Audio Broadcasting (DAB/DAB+):

3.4 During 1980s, DAB was introduced as a research project in Europe and was gradually adopted by the different standardization bodies such as ITU and ETSI. The first country to broadcast a range of radio station through DAB was United Kingdom (UK). DAB uses a wide-bandwidth broadcast technology (described in Annexure). It operates on frequency anywhere above 20 MHz, though allocated spectrum band to DAB is Band III (174-240 MHz) and L band (1452-1492 MHz). DAB has country specific modes of transmission, operating in varied bands according to requirements.

3.5 In February 2007, DAB+ standard was introduced as an upgraded version of DAB. The forward compatibility of DAB receivers was not in line with the DAB+ receivers i.e. DAB receivers were unable to receive DAB+ programmes. The compression technique used by DAB standard is MPEG-1 Audio Layer 2 audio codec (MP2) while the newer version, DAB+, has adopted a three times more efficient audio compression technique than MP2 called eAAC+ (HE-ACC version 2 audio codec). This enhanced the received audio quality with the increase in number of available stations.

3.6 DAB/DAB+ is a popular radio technology around the world which is gaining momentum across Asia Pacific, Europe, Arab nations and South Africa. Today, DAB services reaches out to approximately 418

million people. Presently, there are approximately 2090 on air DAB services spreads across 38 countries. Over 55 million DAB/DAB+ receivers have been sold till 2016[5].

B. Digital Radio Mondiale (DRM)

3.7 Digital Radio Mondiale (DRM) is a high quality standard for digital terrestrial radio broadcasting specially designed for switchover to digital radio broadcasting from the current analog radio broadcasting. It operates in two modes across all the radio frequency bands i.e. AM and the FM/VHF bands. The two modes of operation in DRM are:

- DRM30: This mode covers the AM broadcast bands below 30 MHz
- DRM+: This mode covers the radio spectrum above 30 MHz till Band III (174-230 MHz) with FM broadcast (Band II -87.5-108 MHz) at the center.

3.8 DRM30 system uses AM broadcast frequency bands and is based on signal bandwidths of 9 kHz or 10 kHz. It consists of modes which utilize wider bandwidths of 18 kHz or 20 kHz as well as modes requiring 4.5 kHz or 5 kHz of bandwidth. DRM+ requires a narrow bandwidth and is intended to suit FM broadcast band plan with 100 kHz of inter channel frequency gap. DRM allows broadcasting of single or small numbers of audio services together with bit rates ranging from 37 kbps to 186 kbps, allowing four services simultaneously. This allows DRM to operate parallel to analog transmission.

3.9 DRM system provides ability to switch depending on the strength of reception and perceived audio quality. It provides three kinds of audio codecs namely Advanced Audio Codec (ACC), Code Excited Linear Prediction (CELP) and Harmonic Vector Excitation Coding (HVXC),

[5] WorldDAB Global Summary : https://www.worlddab.org/public_document/file/876/Global_Summary_06.04.17.pdf?1491491968

which vary in quality, bit rate requirement and its application. CELP and HVXC are designed for speech-only services requiring lower bit rates, while ACC provides highest quality. DRM system provides low data rates at high quality by utilizing MPEG xHE-ACC and ACC with PS (Parametric Stereo) and SBR (Spectral Band Replication). The modulation technique and channel coding used are Quadrature Amplitude Modulation (QAM) and Coded Orthogonal Frequency-Division Multiplexing (COFDM) respectively. The DRM+ system is designed for use in any of the VHF Bands I, II and III, each containing its own channel raster[6].

C. HD Radio (In-band on-channel)

3.10 HD Radio is a terminology used for IBiquity's in-band on-channel (IBOC) digital radio technology. A digital signal is embedded "on-frequency" immediately above and below a standard analog signal, and the audio and data is transmitted through the AM and FM radio stations, hence providing to listeners ,the same program, with either HD (less noisy digital radio) or standard analog radio broadcast (a standard sound quality). Through a single radio station, HD radio format offers a simultaneous broadcast of one or more programs additionally to the program being transmitted over the analog channel of the radio stations.

3.11 United States in 2002, designated HD Radio, as a digital radio broadcasting system approved by the Federal Communications Commission (FCC). HD Radio also known as NRSC-5 was the sole system approved for AM and FM radio broadcasting in USA.

3.12 HD radio transmission uses COFDM pooled with codec techniques to compress the sound signals. HD Radio AM hybrid mode can transmit

[6] The channel raster is the basic 'grid' on which the frequency allocations for different services are laid out.

40 and 60 kbps of data. IBOC can be either combined with analogue signal in the same channel or OFDM only. In the LF/MF frequency bands, AM-OFDM mode has bandwidth of 30 kHz while all OFDM modes comprise of 20 kHz bandwidth.

D. Integrated Services Digital Broadcasting for Terrestrial Sound Broadcasting (ISDB-Tsb)

3.13 The ISDB-Tsb is a standard for digital radio broadcasting developed in Japan to deliver high-quality sound and data broadcasting with high consistency and provide flexibility, expandability, and commonality for multimedia broadcasting using terrestrial networks. It uses OFDM modulation (particularly band segmented transmission (BST) - OFDM), robust two-dimensional time-frequency interleaving and concatenated error correction codes to produce superior sound quality even at low bit rates. ISDB-T system specified for digital terrestrial television (DTT) and ISDB-Tsb have commonality in physical layer. The system has an extensive range of transmission parameters such as carrier modulation scheme, coding rates of the inner error correction code, and length of time interleaving. ISDB-Tsb embraces MPEG-2 systems and can use high compression audio coding methods such as MPEG-2 ACC. It has commonality and interoperability with many other systems which have adopted MPEG-2 such as ISDB-S, ISDB-T, DVB-S and DVB-T. ISDB-TSB can be operated either as a single transmission with a bandwidth of around 0.5 MHz or 1.5 MHz or as fragment of a full channel ISDB-T transmission in channel bandwidth of either 6,7 or 8 MHz[7].

3.14 The table 1 shows the comparison between different Digital Radio standards with the bandwidths allocated, frequency bands, Audio compression.

[7] https://www.itu.int/en/ITU-D/Technology/Documents/Broadcasting/TrendsinBroadcasting.pdf

Table 1: Comparison between Digital Radio Standards

Standard	ITU-R Recommendation	Audio compression	Transmission technology	RF bandwidth	Frequency range
DAB	Rec. BS.1114-7; System A	MPEG-layer II	Multi-carrier (OFDM)	1.5 MHz	VHF Band III 1.5 GHz
DAB+	Rec. BS.1114-7; System A	HE-AAC	Multi-carrier (OFDM)	1.5 MHz	VHF Band III 1.5 GHz
ISDB-TSB	Rec. BT.1114-7; System F	MPEG Layer II Dolby AC-3 and HE-AAC	Multi-carrier (segmented OFDM)	0.5 MHz or 1.5 MHz	VHF Band III 2.6 GHz
HD Radio (IBOC)	Rec. BT.1114-7; System C	HD-codec	Multi-carrier (OFDM)	400 kHz	VHF Band II
	Rec. BT.1514-2	HE-AAC	Multi-carrier (OFDM)	20 or 30 kHz	MF
DRM30	Rec. BT.1514-2	HE-AAC	Multi-carrier (OFDM)	9 or 10 kHz and multiples	LF/MF/HF
DRM+ (DRM Mode E)	Rec. BT.1114-7 System G	HE-AAC	Multi-carrier (OFDM)	100 kHz	VHF Band I Band II Band III

Source: ITU Report - Trends in broadcasting: An overview of developments

International Status of Radio Broadcasting Services

3.15 In order to avail various benefits of digitization, countries the world over have started undertaking initiatives to accelerate digital terrestrial migration by formulating national plans towards setting up of Digital Radio Broadcasting infrastructure and switching off analog terrestrial services. Many countries viz. Norway, Denmark, Switzerland, USA and Japan have led from the front and launched different radio standards according to the need. Some of them have even announced digital switchover dates. The switchover process has observed a steady advancement with some countries such as Germany, Netherlands being digital embracers while some countries such as Spain, Sweden and Ireland have wait and watch mind-set. USA and Japan have successfully implemented their own digital radio standards.

DAB/DAB+

3.16 In 1995, public DAB services were first launched in Norway and UK. Over the years, the DAB services were expanded to Austria, Germany, Denmark, Switzerland, Malta and Netherlands. Driven through wide variety of programming, not offered in FM radio, countries such as England, Scotland, Wales, Northern Ireland gained substantial listenership by the year 2005. Moreover, with the advent of DAB+, upbringing of new technologies have reduced the transmission costs per programme and also enhanced capacity. In 2009, Australia fruitfully launched DAB+ services. In Hong Kong, five DAB channels were launched in 2012. In Kuwait, regular services of DAB+ were launched in 2014 and now cover 90 percent of the population.

3.17 Norway is the first country which started the digital switchover in January 2017 and has planned to completely shut down the analog FM by December 2017. Currently, Norway has 60 percent penetration of in-home digital radio receivers and 99 percent population coverage.

DRM

3.18 Several European countries have experimented with DRM. In Germany, UK, Vatican, Sri Lanka and France successful DRM+ trials in frequency band I, II and III have been supported. Currently, DRM+ trials are being held in Sweden.[8]

3.19 Brazil has also conducted trials of DRM technology for SW and MW radio broadcasting. It is under test phase and aim is to evaluate equipment behavior, stability and quality of signal[9].

3.20 In Indonesia, demonstrations of DRM technology were conducted in 2015 and 2016 by Indonesian public broadcaster RRI and DRM

[8] The Digital Future of FM
[9], [8] www.worldradio.com

Consortium for AM and FM bands. Recently demonstration of DRM in FM band has been conducted[10].

HD Radio

3.21 In Unites States, HD Radio, also known as IBOC, a trademarked system owned by a consortium of private companies, named iBiquity, has been implemented for digital radio broadcasting on medium wave and VHF band II. In North American countries, iBiquity has successfully achieved high penetration of HD radio technology via automotive OEM (Original Equipment Manufacturer) market.

ISDB-Tsb

3.22 Japan has adopted a standard known as ISDB-Tsb for digital radio. This is related to the ISDB-T television standard and is similar to DAB in operation. However, it has yet to progress beyond test transmissions.

3.23 Status of deployment of digital radio broadcasting in different countries is summarized in a table at **Annexure-III**. It can be noted that, implementation of digital radio broadcasting has taken place with the participation of both public and private broadcasters. In almost all the countries, number of digital radio stations operated by private broadcasters is more than those operated by public broadcaster.

Chapter 4

Issues Related to Digitization of Terrestrial Radio Broadcasting

4.1 In India, FM radio broadcasting was opened for private participation in the year 2000. A lot of water has flown since then. As on 31st March 2017, 293 FM radio stations have been made operational in 84 cities by 32 private FM broadcasters. All of these 84 cities existed in Phase-II also where FM radio channels were operational by private broadcasters implying that no new city has been added in Phase-III expansion. This also confirms that FM radio expansion has primarily concentrated in places where infrastructure is in place. As per Phase-III, after completion of Phase-III auctions, total 1209 FM radio stations are expected to be made operational in 350 cities by private broadcasters. This clearly indicates that lot of infrastructure need to be developed for FM radio to penetrate in new cities as per Phase-III policy. Low demand of FM radio channels in smaller cities has been reconfirmed from results of Phase-III auction requiring development of infrastructure facilities to roll out FM radio transmission.

4.2 In contrast to smaller cities, roll out of FM radio channels in most of the metros and big cities has been very fast. Almost all the FM radio channels in metros and big cities became operational in Phase-II and only 1or 2 channels were available for auction in Phase-III (**refer Annexure-IV**). The high level of successful bid in batch 1 of Phase-III auction for vacant FM radio channels in most of these metros and big cities, indicates emerging demand for additional frequencies. FM channel auction trends also indicate that most of vacant channels in metro and major cities have been won by already operational FM radio broadcasters. Launch of new FM radio channels brought in variety in programs being broadcasted on their already operational channels in these cities. This indicates that there is a demand for variety of programs from listeners. Demand for additional services also increases due to competition from other platforms like webcasting,

podcasting, Internet streaming etc. Such demands can be met by radio broadcasters only if they have multiple channels in a city. However, at present additional frequencies are not available in the metros and large cities.

4.3 Exhaustion of FM frequencies has been one of the reasons for migration to digital radio broadcasting in most of the countries. In addition to it, digital broadcasting brings a number of benefits including increased choice and quality, ability to transmit more channels or services for the same cost, enhanced coverage, better efficiency in spectrum use and transmission of messages combining text and images.

4.4 FM radio broadcasters may opt to migrate to digital radio broadcasting in Metro and major cities to increase number of radio channels as they see good revenue model. However, same may not be the case in smaller cities due to lack of infrastructure and business opportunities. Broadcasting infrastructure is not available in 264 new cities at present, where FM radio channels are to be made operational subsequent to Phase-III auction. In such a scenario, there could be different views regarding migration to digital radio broadcasting by private FM broadcasters in different markets. One view could be that since infrastructure is not available in 264 new cities and mostly new FM radio stations will come up in these 264 cities. It may be economically advisable to roll out digital broadcasting in all the 264 new cities at the initial level. The counter view could be that FM radio is not mature enough especially in smaller cities where neither broadcasting infrastructure has been developed nor adequate business opportunities exist. Further, it may be initially difficult to ensure adequate availability of digital radio receivers that too at affordable cost for listeners. In such a scenario, a radio broadcaster will have to incur additional expenditure in order to distribute its programs in parallel on a digital transmitter. In such a scenario, if

digital radio broadcasting is implemented in new cities without any eco-system in place, it may not become popular and may not ensure return on investment for digital radio broadcasters. They advocate that a well designed eco-system and roadmap is necessary for smooth transition from analog to digital broadcasting.

4.5 In several countries, radio broadcasters are broadcasting radio signals in simulcast mode (digital as well as analog FM) since a number of years after the launch of digital broadcasting (refer Annexure-III). Norway, which commenced digital radio service in the year 1995, is the only country which has commenced the digital switch over for radio services in January 2017.

4.6 Different options available to regulators are to facilitate migration, encourage migration, or wait & watch. In Austria, France and Poland, regulators have taken initiatives and acted as a driving force in the deployment of digital radio, even when main broadcasters were not committed. In some countries licences for analog radio broadcasting are being linked to commitments in digital radio, or their duration is being synchronized with the digital radio roll-out timetable.

4.7 Question 11-2/2 of ITU-D Study Group 2, pertains to examination of terrestrial digital sound and television broadcasting technologies and systems, including cost/benefit analyses, interoperability of digital terrestrial systems with existing analogue networks, and methods of migration from analogue terrestrial techniques to digital techniques. The study group published its final report in 2010[11], wherein following three possible approaches have been mentioned for implementation of digital audio broadcasting:

[11] https://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG02.11.2-2010-PDF-E.pdf

(i) **Full conversion**

In "full conversion' approach all existing operational broadcasters are required to migrate the existing analog radio services into digital with the aim of switching-off the analogue service at some point linked to the uptake of digital receivers. In this approach it is assumed that digital radio is primarily a replacement technology for analog radio and analog radio spectrum will be vacated after the designated switching-off date. This approach would require sufficient spectrum to accommodate the transition to digital for all existing analog broadcasting services from commencement or soon thereafter.

(ii) **Market-based approach**

Under the "market-based" approach towards implementation of digital radio, there would be limited regulation applied to broadcasting service, primarily in areas such as taste and decency and other content related requirements, technology standards, spectrum allocation and the level of interference. Essentially, the frequencies would be licensed by auction or beauty contest, and there would be no requirement to deliver a particular type of service. No specific requirements and obligations would be imposed for the conversion of existing analogue services into digital ones.

(iii) **Managed introduction**

Managed introduction approach stands somewhere between the full conversion and market-based approaches. While full replication of analogue services would not necessarily be envisaged at the start of digital rollout, a long term objective would be to ensure conversion of any analogue service into digital until analogue switch off. Priority access to digital capacity could be provided to incumbent analogue broadcasters, possibly on a voluntary basis, who will replicate their analogue services and facilitate the development of innovative services.

4.8 The report also mentions following phases for migration to digital terrestrial audio broadcasting;

- **Phase one**: Introduction of Digital Audio Broadcasting
- **Phase two**: The Simulcast Period
- **Phase three:** Analog cut off

Issues for consultation:

4.9 **Is there a need to encourage or facilitate introduction of digital radio transmission at present? If so, what measures do you suggest and in which market?**

4.10 **Is there a need to frame a roadmap for migration to digital radio broadcasting for private FM broadcasters? If yes, which approach, mentioned in para 4.7, should be adopted? Please give your suggestions with justification.**

4.11 **Should the date for digital switch over for radio broadcasting in India need to be declared? If yes, please suggest the date with suitable justification. If no, please give reason to support your view.**

4.12 In India, the public broadcaster AIR has already started migration to digital broadcasting by replacing and upgrading its MW and SW transmitters with digital transmitters. AIR has not indicated any plan for digitalization of its FM transmitters. There appears to be no initiative for digital broadcasting by private FM radio broadcasters. As per the Policy Guidelines for Phase-III expansion of FM Radio broadcasting, any private company, who intend to provide FM radio broadcasting service, is required to take part in the auction of FM channels conducted by MIB. Only after successful bidding for a FM channel, the company becomes eligible for signing Grant of Permission Agreement (GOPA) with MIB for providing FM radio

broadcasting services. The period of permission is 15 years. The Policy Guidelines for Phase-III specifically mentions FM radio broadcasting and does not permit use of any digital technology.

4.13 National Frequency Allocation Plan-2011 issued by Wireless Planning and Coordination (WPC) wing of Department of Telecommunications has identified the following frequency bands for private FM radio broadcasting and digital audio broadcasting:

"IND15 Frequency spots in the frequency bands 88-100 MHz and 103.8-108 MHz for private FM broadcasting have been specifically identified.

IND23 Digital Audio Broadcasting (DAB) may be considered in the frequency band 174-230 MHz initially in the four Metro cities and further introduction of DAB could be considered on a case-by-case basis taking into account interference potentiality aspects."

4.14 Accordingly, FM radio broadcasting services by private radio broadcasters are provided in frequency band 88 – 108 MHz.

4.15 As discussed in chapter 3, various digital radio broadcasting technologies have been developed for different frequency bands. A comparison of digital audio broadcasting standards currently recommended by ITU is given in Table 1. It can be noted that in Band II i.e. 88 – 108 MHz, IBOC and DRM+ technologies can be used for digital broadcasting. Whereas in Band III i.e. 174-230 MHz, DAB, DAB+, ISDB-TSB and DRM+ technologies can be used for digital broadcasting. As per NFAP 2011, digital broadcasting in India can be permitted in 174-230 MHz band. Therefore suitable technologies for digital broadcasting in India seem to be DAB, DAB+, ISDB-TSB and DRM+. The bandwidth for these technologies is also mentioned in

Table 1. Spectrum requirement for use of these technologies may need to be carried out.

4.16 Digital radio broadcasting technologies can be deployed using two methods for transmission - in-band and out-of-band. In-band methods use the existing analog frequency bands, while out-of-band methods use additional frequency bands. DRM+ and IBOC (HD Radio) use in-band method, whereas DAB and DAB+ use out-of-band method. Out-of-band methods are able to enlarge the throughput of data and enable provisioning of various application services to broadcasters[12]. In the in-band method, digital signal can be transmitted in the frequency gap which is the guard band between analog FM signals. This may enable deployment of digital technologies in the same band that is used for analog FM broadcasting at present. This will enhance the ease of implementation and facilitate simultaneous operation of both analog and digital signal. However, there is a restriction in data throughput and there could be interference problem because of coexistence with analog FM broadcastings. Therefore, prior to use of any digital technology interference study may need to be carried out.

4.17 In most of the countries DAB or DAB+ technology has been adopted for digital broadcasting as a replacement of analog FM broadcasting. In US, IBOC technology (HD Radio) has been adopted. Whereas trials for DRM+ technologies have been undertaken in some countries. In India, AIR has adopted DRM30 technology for replacement of its MW and SW transmitters. At present coverage of MW broadcasting of AIR is approximately 98% by population whereas the coverage of FM broadcasting of AIR and private broadcasters is approximately only 50% by population. In such a scenario a sizable population may use

[12] IEEE Transactions on Broadcasting, March 2013 : Laboratory Trials and Evaluations of In-Band Digital Radio Technologies: HD Radio and DRM+ - *Myung-Sun Baek, Sora Park, Geon Kim, Yong-Hoon Lee, Hyoung-Soo Lim, Yun-Jeong Song, Chae-Hun Im, and Yong-Tae Lee, Member, IEEE*

DRM receivers in future for listening to MW services of AIR. If same digital technology is used for replacement of analog FM broadcasting, listeners may continue to use the same digital receivers, which may help the existing radio broadcasters to sustain their revenue. In case different digital technology is used for replacement of analog FM broadcasting, people may be required to buy a separate receiver which may not be feasible for many listeners and may impact the revenue of radio broadcasters. The other option could be use of multi-standard receivers, in case different digital technology is adopted for replacement of FM broadcasting.

4.18 Another issue is related to availability of digital receivers. At present very limited digital receivers are available and that too at very high prices. In case existing private FM broadcasters migrate to digital broadcasting, they may be required to broadcast both analog and digital signal simultaneously in order to sustain their revenue at least till digital receiver eco-system is developed and becomes cost effective as their business model is dependent on advertisements which is directly linked to number of listeners. Development of the receiver eco-system will be crucial for migration to digital radio broadcasting which will directly depend on choice of technology. Hence, to facilitate migration to digital radio broadcasting, the technology suitable for Indian scenario will have to be decided for smoother transition. Stakeholders have to take a call on technology which has to be adopted along with concerted efforts to quickly develop receiver ecosystem.

Issue for consultation:

4.19 **Is present licensing framework or regulatory framework is restrictive for migration to digital radio broadcasting? Please explain with justification.**

4.20 **Should single digital radio technology be adopted for entire country or choice of technology should be left to radio broadcasters? Support your reply with Justification.**

4.21 **In case a single digital radio broadcast technology is to be adopted for the entire country, which technology should be adopted for private FM radio broadcasting? Please give your suggestions with detailed justification.**

4.22 **How issues of interference and allocation of appropriate spectrum allocation can be settled in case the option to choose technology is left to radio broadcasters?**

4.23 In Phase III, ascending e-auction of channels has been adopted, which is underway. Total 966 FM radio channels have been made available for auction in Phase-III. As already mentioned in chapter 2, after completion of auction of two batches of channels in Phase-III, 162 channels have been successfully bid. Therefore, 804 channels are yet to be auctioned in Phase-III.

4.24 In such a scenario one can argue that remaining channels of Phase-III regime may be auctioned for digital radio broadcasting. However, Phase-III policy guidelines do not permit use of any other radio broadcasting technologies. Existing permission to private radio broadcasters is specifically given for FM broadcasting technology only. Therefore, for permitting use of digital technology, existing Phase-III policy guidelines may require amendment. One way could be to delink the technology used for radio broadcasting from permission granted for operating a radio channel. Any entity, who successfully bid for a frequency spot, may be allowed to use any radio broadcasting technology (either analog FM broadcasting or digital radio broadcasting).

4.25 It may be noted that all the 21 FM radio channels that became operational in Phase-I, migrated to Phase-II regime. Further, Phase-III policy also permitted FM radio channels which were operational in Phase-II regime to migrate to Phase-III regime by paying the requisite migration fee. Most of the channels which were operational in Phase-II migrated to Phase-III regime. However, it may be noted that during these migrations, only few terms and conditions of the permissions were modified. There was no change in the technology used. At present, 293 FM radio channels have been made operational by 32 private FM broadcasters using analog FM broadcasting technology.

4.26 One of the simplest methods to encourage migration to Digital Radio broadcasting can be by permitting the Private radio broadcasters to choose the technology they want to adopt for radio broadcasting (i.e FM radio broadcasting or digital radio broadcasting) and make modifications in the FM radio policy guidelines to that extent. In such scenario, an appropriate framework including terms and conditions for such migration may need to be framed. Such modifications to the policy guidelines will be applicable not only to radio channels which will be auctioned in future but will also be applicable to FM radio channels presently in operation. The radio broadcaster depending on the business model and need will be free to start migration using the allocated frequency. Radio broadcaster will also have freedom for simultaneous broadcast in both formats i.e FM and Digital broadcasting.

4.27 The important issue which may arise will relate to auction of the radio channels which can be used for digital radio broadcasting. It may be important to note that digital technologies permit multiple channels/services on a single frequency whereas in analog FM technology only one channel is possible in one frequency. In such a case, should the auction process be redesigned and each channels used for digital radio broadcasting be auctioned separately?

Alternatively, we may continue to auction the radio channels for FM radio broadcasting as being done presently and leave the option to the broadcasters to use the allocated frequency the way it suits him the most. Stakeholders can argue it differently. On one hand, it may be claimed that three radio channels for digital radio broadcasting will be given to the broadcaster at the price of one charged for FM radio broadcasting. Hence, this is against the level playing field. If, Digital radio broadcasting permits three radio channels then the broadcaster should be charged three times of the FM radio channel price. Others can argue that since Digital radio broadcasters have to invest a lot in migration and to create the ecosystem for digital radio, they have to incur additional expenditure. Therefore any gain resultant from the adoption of efficient technology should not be penalized but should be encouraged. Stakeholders' comments are invited on this issue.

Issues for consultation:

4.28 **Should the permission for operating FM channel be delinked from technology used for radio broadcasting? If yes, please provide a detailed framework with justification.**

4.29 **Should the existing operational FM radio channels be permitted to migrate to digital broadcasting within assigned radio frequency? If yes, should there be any additional charges as number of available channels in digital broadcasting will increase? Please provide a detailed framework for migration with justification.**

4.30 **Should the future auction of remaining FM channels of Phase-III be done delinking it from technology adopted for radio broadcasting? Please give your suggestions with detailed justification.**

4.31 **In case future auction of remaining FM channels of Phase-III is done delinking it from technology, should the present auction process be continued? If no, what should be the alternate auction process? Please give your suggestions with detailed justification.**

4.32 **What modifications need to be done in FM radio policy to use allocated FM radio channels in technology neutral manner for Radio broadcasting?**

4.33 Terrestrial radio broadcasting is free-to-air service. A consumer can simply procure radio receiver equipment and tune into various radio channels available in that region. The business model of radio broadcasting service is based on advertisement revenue and the rates of the advertisements are generally linked with the listenership of a particular channel. In the absence of good quality receivers that are affordable and widely available, there are no incentives for broadcasters to broadcast in digital format, which in turn may discourage the investments by receiver manufacturers. Therefore, in order to ensure adequate return on investment for radio broadcasters, adequate availability of receivers at affordable price is a must irrespective of the technology adopted for digital broadcasting.

4.34 FM Radio receivers presently used for listening to FM Radio programs can be classified into three different categories - (1) Standalone Radio receivers, (2) FM Radio receivers installed in passenger vehicles, and (3) FM Radio receivers integrated with Mobile handsets. In case of migration to digital broadcasting, digital receivers for all the above categories will need to be made available.

4.35 Subsequent to deployment of digital technology in AM band by AIR, standalone digital receivers have become available in the country. One Indian entrepreneur has also started manufacturing standalone portable digital radio receivers. However, prices of these receivers are prohibitively high as compared to existing standalone FM radio

receivers. Some automobile manufacturers have also started fitting digital radio receivers in the new models of their vehicles. But there are large number of older vehicles, in which analog FM receivers have been installed. In case of migration to digital broadcasting analog FM receivers installed in passenger vehicles may need to be replaced. For new vehicles cost of digital radio receivers may be integrated within the cost of vehicle and may not separately visible to buyer. However, replacement of radio receivers in old vehicles will entail cost.

4.36 Presently most of the mobile handsets in India have integrated FM radio receivers and is most popular medium among listeners due to its convenience and portability. There will be a need to integrate digital receivers in mobile handsets.

4.37 In absence of availability of digital radio receivers at affordable cost, listeners may not become interested in digital broadcasting services. In order to proliferate digital radio broadcasting, some measures may be required to reduce the prices of digital radio receivers for making them affordable for masses. These may include clear decision on adoption of technology, long term roadmap for migration to digital radio broadcasting, creation of core group to look into all issues and support development of ecosystem etc. Stakeholders' views are invited on this vital issue.

Issues for consultation:

4.38 **What measures should be taken to reduce the prices of digital radio receivers and develop ecosystem for migration to digital radio broadcasting?**

Other Issues:

4.39 **Stakeholders may also provide their comments on any other issue relevant to the present consultation.**

Chapter 5

Summary of issues for consultation

5.1 Is there a need to encourage or facilitate introduction of digital radio transmission at present? If so, what measures do you suggest and in which market?

5.2 Is there a need to frame a roadmap for migration to digital radio broadcasting for private FM broadcasters? If yes, which approach, mentioned in para 4.7, should be adopted? Please give your suggestions with justification.

5.3 Should the date for digital switch over for radio broadcasting in India need to be declared? If yes, please suggest the date with suitable justification. If no, please give reason to support your view.

5.4 Is present licensing framework or regulatory framework is restrictive for migration to digital radio broadcasting? Please explain with justification.

5.5 Should single digital radio technology be adopted for entire country or choice of technology should be left to radio broadcasters? Support your reply with Justification.

5.6 In case a single digital radio broadcast technology is to be adopted for the entire country, which technology should be adopted for private FM radio broadcasting? Please give your suggestions with detailed justification.

5.7 How issues of interference and allocation of appropriate spectrum allocation can be settled in case the option to choose technology is left to radio broadcasters?

5.8 Should the permission for operating FM channel be delinked from technology used for radio broadcasting? If yes, please provide a detailed framework with justification.

5.9 Should the existing operational FM radio channels be permitted to migrate to digital broadcasting within assigned radio frequency? If yes, should there be any additional charges as number of available channels in digital broadcasting will increase? Please provide a detailed framework for migration with justification.

5.10 Should the future auction of remaining FM channels of Phase-III be done delinking it from technology adopted for radio broadcasting? Please give your suggestions with detailed justification.

5.11 In case future auction of remaining FM channels of Phase-III is done delinking it from technology, should the present auction process be continued? If no, what should be the alternate auction process? Please give your suggestions with detailed justification.

5.12 What modifications need to be done in FM radio policy to use allocated FM radio channels in technology neutral manner for Radio broadcasting?

5.13 What measures should be taken to reduce the prices of digital radio receivers and develop ecosystem for migration to digital radio broadcasting?

5.14 Stakeholders may also provide their comments on any other issue relevant to the present consultation.

List of Acronyms

Abbreviation	Description
ACC	Advanced Audio Codec
AIR	All India Radio
AM	Amplitude Modulation
BST-OFDM	Band Segmented Transmission Orthogonal Frequency Division Multiplexing
CELP	Code Excited Linear Prediction
COFDM	Coded Orthogonal Frequency-Division Multiplexing
CRS	Community Radio Station
DAB	Digital Audio Broadcasting
DRM	Digital Radio Mondiale
DTT	Digital Terrestrial Television
DVB-S	Digital Video Broadcasting - Satellite
DVB-T	Digital Video Broadcasting - Terrestrial
eAAC+	HE-ACC version 2 audio codec
ETSI	European Telecommunications Standards Institute
EWF	Emergency Warning feature
FCC	Federal Communications Commission
FM	Frequency Modulation
GOPA	Grant of Permission Agreement
HD	High Definition
HVXC	Harmonic Vector Excitation Coding
IBC	Indian Broadcasting Company Ltd.
IBOC	In-band on-channel
IIM	Indian Institutes of Management
IIT	Indian Institutes of Technology
ISDB-S	Integrated Services Digital Broadcasting - Satellite
ISDB-T	Integrated Services Digital Broadcasting-Terrestrial
ISDB-Tsb	Integrated Services Digital Broadcasting for Terrestrial Sound Broadcasting
ITU	International Telecommunication Union
Kbps	Kilobits per second
LF	Low frequency
MIB	Ministry of Information and Broadcasting

MP2	MPEG-1 Audio Layer II
MPEG	Moving Picture Experts Group
MW	Medium Wave
NFAP	National Frequency Allocation Plan
NRSC	National Radio Systems Committee
OEM	Original Equipment Manufacturer
OFDM	Orthogonal Frequency-Division Multiplexing
PS	Parametric Stereo
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
RRI	Radio Republik Indonesia
SBR	Spectral Band Replication
SFN	Single Frequency Network
SW	Short wave
TRAI	Telecom Regulatory Authority of India
UK	United Kingdom
US	United States
VHF	Very High Frequency
WPC	Wireless Planning and Coordination

Annexure-I

List of AIR Transmitters to be upgraded to DRM Transmitters[13]

Sr.No.	Name of the place	Detail of the Set-up
Conversion of existing MW transmitter to MW DRM Transmitters		
1.	Cuttack (Orissa)	300 kW MW Tr.
2.	Srinagar (J&K)	300 kW MW Tr.
3.	Imphal (Manipur)	300 kW MW Tr.
4.	Jodhpur (Rajasthan)	300 kW MW Tr.
5.	Nagpur (Maharastra)	300 kW MW Tr.
6.	Kargil (J&K)	200 kW MW Tr.
7.	Indore (MP)	200 kW MW Tr.
8.	Najibabad (UP)	200 kW MW Tr.
9.	Cuddapah(AP)	100 kW MW Tr.
10.	Delhi-B	100 kW MW Tr.
11.	Port Blair (A&N)	100 kW MW Tr.
12.	Shimla (HP)	100 kW MW Tr.
13.	Raipur (Chattisgarh)	100 kW MW Tr.
14.	Kohima (Nagaland)	100 kW MW Tr.
15.	Shillong (Meghalaya)	100 kW MW Tr.
16.	Chattarpur (Chattisgarh)	20 kW MW Tr.
17.	Ambikapur (Chattisgarh)	20 kW MW Tr.
18.	Darbhanga (Bihar)	20 kW MW Tr.
19.	Bhuj (Gujarat)	20 kW MW Tr.
20.	Jalgaon (Maharastra)	20 kW MW Tr.
21.	Ratnagiri (Maharastra)	20 kW MW Tr.
22.	Kota (Rajasthan)	20 kW MW Tr.
23.	Rewa (MP)	20 kW MW Tr.
24.	Rohtak (Haryana)	20 kW MW Tr.
25.	Hyderabad (AP)	20 kW MW Tr.
26.	Udipi (Karnataka)	20 kW MW Tr.
27.	Chennai (Tamilnadu)	20 kW MW Tr.
28.	Trivendrum (Tamilnadu)	20 kW MW Tr.

[13] http://allindiaradio.gov.in/information/technology/pages/default.aspx

29.	Tirunelveli (Tamilnadu)	20 kW MW Tr.
30.	Leh (J&K)	20 kW MW Tr.
31.	Kupwara (J&K)	20 kW MW Tr.
32.	Naushera (J&K)	20 kW MW Tr.
33.	Gangtok (Sikkim)	20 kW MW Tr.
34.	Silchar (Assam)	20 kW MW Tr.
35.	Tura (Meghalaya)	20 kW MW Tr.
36.	Aizwal (Mizoram)	20 kW MW Tr.
Replacement of MW transmitters by MW DRM transmitters		
1.	Chinsurah (WB)	1000 kW MW Tr.
2.	Rajkot (Gujarat)	1000 kW MW Tr.
3.	Jammu (J&K)	300 kW MW Tr.
4.	Jallandhar (Punjab)	300 kW MW Tr.
5.	Lucknow (UP)	300 kW MW Tr.
6.	Dibrugarh (Assam)	300 kW MW Tr.
7.	Rajkot (Gujarat)	300 kW MW Tr.
8.	Suratgarh (Rajasthan)	300 kW MW Tr.
9.	Delhi-A	200 kW MW Tr.
10.	Kolkata-A (WB)	200 kW MW Tr.
11.	Siliguri (WB)	200 kW MW Tr.
12.	Chennai-A (TN)	200 kW MW Tr.
13.	Ajmer (Rajasthan)	200 kW MW Tr.
14.	Ahmedabad (Gujarat)	200 kW MW Tr.
15.	Jabalpur (MP)	200 kW MW Tr.
16.	Bangalore (Karnataka)	200 kW MW Tr.
17.	Dharwad (Maharastra)	200 kW MW Tr.
18.	Itanagar (Ar.P)	200 kW MW Tr.
19.	Varanasi-B (UP)	100 kW MW Tr.
20.	Kolkata-B (WB)	100 kW MW Tr.
21.	Mumbai-A (Maharastra)	100 kW MW Tr.
22.	Mumbai-B (Maharastra)	100 kW MW Tr.
23.	Pune (Maharastra)	100 kW MW Tr.
24.	Patna (Bihar)	100 kW MW Tr.
25.	Ranchi (Jharkhand)	100 kW MW Tr.
26.	Panaji (Goa)	100 kW MW Tr.

27.	Tiruchirapalli (TN)	100 kW MW Tr.
28.	Vijaiwada (AP)	100 kW MW Tr.
29.	Passighat (Ar.P)	100 kW MW Tr.
30.	Mumbai-C	50 kW MW Tr.
31.	Delhi-VB	20 kW MW Tr.
32.	Chennai-VB (TN)	20 kW MW Tr
33.	Bikaner (Rajasthan)	20 kW MW Tr
34.	Barmer (Rajasthan)	20 kW MW Tr
35.	Guwahati (Assam)	20 kW MW Tr
36.	Tawang (Ar.P)	20 kW MW Tr
37.	Kavaratti (Lakshadweep)	10 kW MW Tr
Replacement of SW Transmitters by DRM SW Transmitters		
1.	Banglore (Karnataka)	500 kW SW Tr.
2.	Delhi – 2 Nos.	250 kW SW Tr.
3.	Aligarh (UP) – 2 Nos.	250 kW SW Tr.
Conversion of SW Transmitters to DRM SW Transmitters		
1.	Delhi – 2 Nos.	250 kW SW Tr.
2.	Aligarh (UP) – 2 Nos.	250 kW SW Tr.

Annexure-II

Digital Transmission of AIR in Medium Wave[14]

(A) MEDIUM WAVE OPERATION IN PURE DIGITAL MODE

S. No.	Location/ Station	Duration	Frequency (kHz)	Programme Content	
				First Channel	Second Channel
1.	Chennai-C (20 kW)	0555-1705 Hrs. 1800-2310 Hrs.	783	Chennai Vividh Bharati	Chennai FM Rainbow
2.	Delhi-C (20 kW)	0555-1100 Hrs 1200-1730 Hrs. 1815-2310 Hrs.	1368	Delhi Vividh Bharati	FM Rainbow (Delhi)
3.	Rajkot	1200-1345 Hrs	1071	URDU	

(B) MEDIUM WAVE OPERATION IN SIMULCAST MODE

(Transmitters are scheduled to carry both Analog & Digital transmission as per timings of existing Analog operation)

S. No.	Location/ Station	Frequency (kHz)		Programme Content	
		Analog	Digital	Analog	Digital
1.	Ahmedabad	846	855	Ahmedabad	Rainbow India
2.	Ajmer	603	612	Ajmer	Rainbow India
3.	Bengaluru	612	621	Bengaluru	FM Gold
4.	Barmer	1458	1467	Barmer	VBS Mumbai
5.	Bikaner	1395	1404	Bikaner	VBS Mumbai
6.	Chennai-A	720	729	Chennai-A	Ragam Channel
7.	Chinsurah	594	603	Moitree Channel	ESD Services & Rainbow India

[14] http://allindiaradio.gov.in/Oppurtunities/Tenders/Documents/Revised%20update%20for%20DRM%20Transmitters%2021april%202017.pdf

8.	Delhi-A	819	828	Delhi-A	FM Gold
9.	Dharwad	765	774	Dharwad	Rainbow India
10.	Dibrugarh	567	576	Dibrugarh	VBS Mumbai
11.	Guwahati-B	1035	1044	Guwahati-B	Rainbow India
12.	Itanagar	675	684	Itanagar	Rainbow India
13.	Jabalpur	801	810	Jabalpur	Rainbow India
14.	Jallandhar	873	882	Jallandhar	FM Gold
15.	Jammu	990	999	Jammu	Rainbow India
16.	Kolkata-A	657	666	Kolkata-A	FM Gold
17.	Kolkata-B	1008	1017	Kolkata-B	FM Rainbow
18.	Lucknow	747	756	Lucknow	FM Gold
19.	Mumbai-A	1044	1053	Mumbai-A	DTH Hindi
20.	Mumbai-B	558	567	Mumbai-B	DTH Marathi
21.	Panaji	1287	1296	Panaji	FM Gold
22.	Passighat	1062	1071	Passighat	VBS Mumbai
23.	Patna	621	630	Patna	Rainbow India
24.	Pune	792	801	Pune	Rainbow India
25.	Rajkot	810	819	Rajkot	Rainbow India
26	Rajkot	1071	1080	ESD Prog.	VBS / URDU
27.	Ranchi	549	558	Ranchi	Rainbow India
28.	Siliguri	711	720	Siliguri	Rainbow India
29.	Suratgarh	918	927	Suratgarh	VBS Mumbai
30.	Tawang	1521	1530	Tawang	VBS Mumbai
31.	Trichirapalli	936	945	Trichirapalli	VBS Chennai
32.	Varanasi	1242	1251	Varanasi	VBS Mumbai
33.	Vijayawada	837	846	Vijayawada	FM Gold

Annexure-III

International scenario on deployment of Digital Radio Broadcasting[15]

Country	Standard	Launch Date	Number of Digital stations		Mode of Transmission		Network coverage (% of population)	Digital Receivers (in %)
			Public	Private	Simulcast	Digital Only		
Norway	DAB+	1995	12	41	27	26	99	71
Denmark	DAB/DAB+	2002	10	36	35	11	98	46
United Kingdom	DAB/DAB+	1995	63	261	213	111	97	57
Switzerland	DAB+	1999	17	84	17	84	99.5	43
Germany	DAB+	2011	69	92	121	40	95	13
Malta	DAB+	2008	9	31	15	25	100	-
Netherlands	DAB+	2013	27	40	40	27	95	6
Belgium	DAB/DAB+	2015	9	9	14	4	95	-
Czech Republic	DAB/DAB+	2011	13	16	20	9	58	-
Italy	DAB+	2012	29	76	88	17	76	-
France	DAB+	2014	7	84	82	9	19	-
Poland	DAB+	2013	30	6	28	8	56	-
Monaco	DAB+	2014	2	16	9	9	100	-
Brazil	DRM	DRM-30 signals have been test-broadcast by Empresa Brasil de Comunicação, Brazil's public broadcaster, on 9.740 kHz shortwave, since the end of October, 2016.						
Indonesia	DRM /DRM+	Demonstration conducted in 2015 and 2016 by Indonesian public broadcaster RRI and DRM Consortium for DRM 30 in AM bands. Recently DRM+ trials have been conducted for FM band.						

[15] EBU report: Market Insights Digital Radio 2017 and www.worldradio.com

Annexure-IV

List of vacant FM radio channels in cities of Category 'A+' and 'A' which were auctioned in batch 1 of Phase-III

City-wise list of available Channels for Phase-III

S No	Name of City	State	Total Number of Channels proposed	Existing Channels	Channels available for Phase III
Category "A+"					
1	Chennai	Tamil Nadu	9	8	1
2	Delhi	Delhi	9	8	1
3	Kolkatta	West Bengal	9	9	0
4	Mumbai	Maharashtra	9	7	2
Category "A"					
5	Ahmedabad	Gujarat	6	5	1
6	Bangalore	Karnataka	8	7	1
7	Hyderabad	Andhra Pradesh	8	4	4
8	Jaipur	Rajasthan	6	5	1
9	Kanpur	Uttar Pradesh	6	3	3
10	Lucknow	Uttar Pradesh	6	3	3
11	Nagpur	Maharashtra	6	4	2
12	Pune	Maharashtra	6	4	2
13	Surat	Gujarat	6	4	2