Digital Radio Mondiale (DRM) – The most flexible standard for Digitizing the FM Band

Worldwide Testimony & Practical Implementation Solutions

DRM Consortium (**www.drm.org**)

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Introduction

The DRM Digital Radio Broadcasting Standard has been designed by broadcasters, for broadcasters, with the active assistance and participation of both transmitter and receiver manufacturers and other interested parties (such as regulatory bodies). It has been designed specifically as a high-quality and feature-enhanced digital replacement for the former analogue radio broadcasting standards AM and FM; as such it can be operated with the same channelling and spectrum allocations as currently employed. At the same time DRM is designed to operate smoothly alongside ongoing analogue services in all bands for the transition period – the scenario this document focusses on.

DRM is the only digital Radio standard that works in all the broadcast bands for large-area coverage – LW, MW, SW; and VHF bands for local/regional coverage – VHF band I, band II (FM band) and band III. Most of the DRM radio receivers coming in the market have provision to receive DRM in MW, SW and VHF band II (FM band). It shares the same features and listener-services across all bands – from more variety and better-quality audio to Journaline advanced text services to EWF – Emergency Warning Functionality.

DRM has received the necessary recommendations from the ITU, hence provides the international regulatory support for transmissions.

This document outlines details of several of the live DRM complexes operating in the FM band today world over and provides a summary of the most important DRM live transmission trials in the FM band. The results are a testimony of the performance of the DRM standard specifically in the FM band and cater to the wide range of requirements. Several countries across the globe have embraced DRM — owing to its performance, power & spectrum efficiency, advanced features, openness (i.e., not depending on or controlled by a single company) and flexibility — as the choice of digital radio technology for their nationwide FM digitization.

This document is structured as follows:

- General Introduction
- **Worldwide testimony of DRM transmissions in the FM band**; this includes currently ongoing transmissions, detailed on-air trials and reports, recent policies to rollout DRM services, and ITU planning parameters for DRM and FM service co-existence in VHF band II
- **An introduction to the flexibility of DRM configurations** with regards to inserting DRM services in the existing FM band without affecting ongoing analogue FM services

Note – Clarification regarding "DRM", "DRM30", "DRM+":

DRM – Digital Radio Mondiale – is the single ITU-endorsed digital radio standard suitable for all broadcast frequency bands and coverage scenarios, with an identical feature set and user experience across all bands. DRM therefore is the direct digital successor of both the former analogue transmission standards AM and FM.

In the past, the terms "DRM30" and "DRM+" were used to technically distinguish between the modulation parameters optimized for the different bands. However, this led to great confusion as "DRM+" was either seen as an independent new standard, or as a 'newer' version of the "old DRM standard", or even as providing an updated audio codec (similarly to "DAB+"). Since none of these impressions are true, DRM is now universally referred to as the single "DRM" standard. The terms "DRM30" and "DRM+" have been deprecated. Where technically required, it can be clarified as "DRM applied in the AM bands" or "DRM applied in the FM band/VHF bands", respectively.

In practice, the correct modulation parameter set on the broadcast side is automatically determined by the intended transmission frequency; and on receiver side the implementation of DRM for all bands is merely a software question, without any cost implication in terms of IP royalties. Therefore, there is no need to artificially distinguish between the configurations of the DRM signal by applying different terms.

1. Live DRM FM broadcast complexes and Field Trials

1.1 Introduction

An overview of the frequency-bands where DRM operates is shown in Figure 1. As shown in the graphic, DRM is the only digital radio standard that works in all the broadcast bands from LW, MW and SW to VHF band-I, II and III – enabling local and regional coverage scenarios as well as large-area and international services with a single standard.

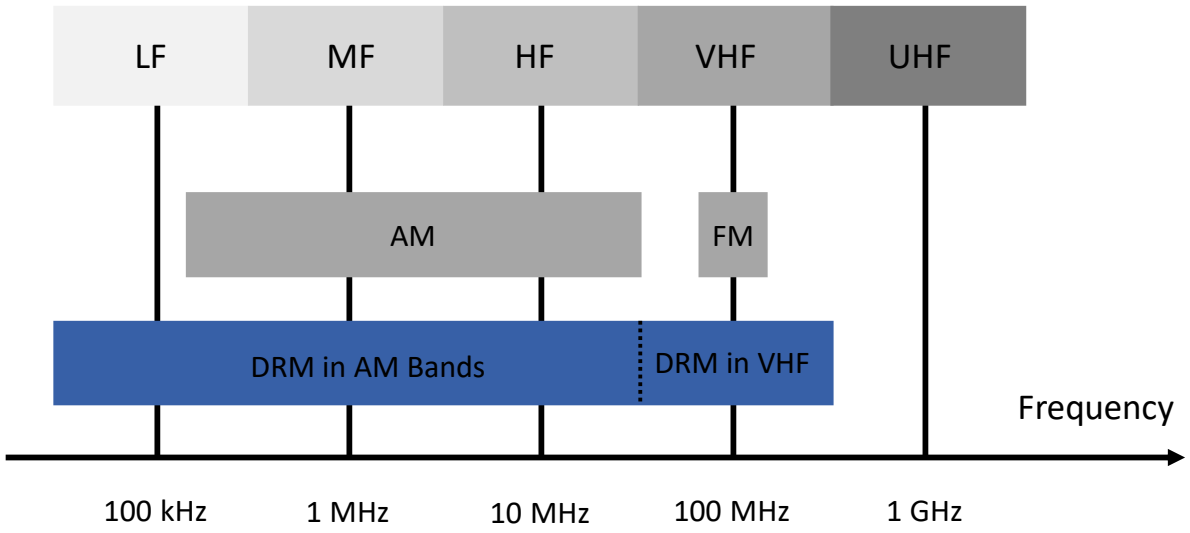

Figure 1.1: DRM is the digital radio standard for all bands, and AM/FM successor

For the physical transmission, the DRM standard describes a number of different operating modes (i.e. modulation parameter sets), which is broadly categorized into two groups as follows:

DRM transmissions in the AM bands below 30 MHz providing large-area and international coverage: 4 different robustness modes allow the DRM signal to be tailored for the AM broadcast bands with their very diverse propagation characteristics, enabling regional up to international service coverage.

DRM transmissions in the VHF bands above 30 MHz (incl. FM band) for local and regional services: A dedicated robustness mode is optimized for transmissions in the VHF bands, focussed on the FM broadcast band, and used for local to regional service coverage.

Apart from these optimized robustness parameter sets and the resulting varying capacity for audio and data content, the Service Layer features of DRM as experienced by the listener are identical for all operating modes, irrespective of the transmission frequency.

This Chapter introduces some of the live DRM complexes and provides a summary of the most important DRM trials in FM bands. Extensive DRM FM tests and field trials have been conducted across the globe and several countries have adopted DRM for digitizing FM band. The results are testimony of the performance of DRM system in all the supported bands and cater to the wide range of requirements. Several countries across the globe have embraced DRM—owing to its performance, power & spectrum efficiency, advanced features and flexibility— as the choice of digital radio technology for its nationwide FM digitization.

This chapter contains the following information:

- Section 1.2 introduces several countries carrying out live transmissions of DRM services in the FM band as pilot transmissions after extensive trials.
- Section 1.3 lists some of the sophisticated DRM trials carried out in the past in the FM band. Detailed reports are referenced and mostly available with ITU.
- Section 1.4 lists some countries that recently adopted policies to operate DRM services in FM band – in preparation or already issued
- Section 1.5 references the ITU network planning parameters for DRM in FM band

1.2 Live DRM FM broadcast complexes

1.2.1 Indonesia

The setup operates DRM in simulcast mode (DRM + analogue FM from a single transmitter).

Description

In June and August 2020, Radio Republic Indonesia (RRI) installed and commissioned five digital radio transmitters in the FM band, using the Digital Radio Mondiale (DRM) FM digital radio standard. Subsequent to that, the Indonesian Ministry of Information and Communication (Kominfo) conducted tests on the DRM FM transmissions of RRI. RRI is planning to provide full DRM digital radio coverage to its audiences for local services (in the FM band) as well as for regional and nationwide services (including the medium wave band). RRI has installed and commissioned 5 DRM FM transmitters and are live today.
The list of DRM stations that are live in Indonesia as of today:

- Painan West Sumatra Province, 97.9 MHz, 1 kW
- Labuhan West Java Province, 94.9 MHz, 1 kW
- Pelabuhan Ratu West Java Province, 93.7 MHz, 1 kW
- Cilacap Central Java Province, 98.6 MHz, 1 kW
- Labuan Bajo East Nusa Tenggara, 93.5 MHz, 1 kW

Correspondence

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1.2.2 Russia

The setup operates DRM in Simulcast mode (DRM + analogue FM from a single transmitter).

Description

After the very successful St Petersburg trial in 2019 (see St Petersburg, Russia, below) Radio Sputnik (formerly known as Voice of Russia) re-launched the simulcast transmission of analogue FM & DRM FM in 2020.

The exact same equipment and settings of 2019 is being used. But this time the focus of transmissions is shifted away from reception and coverage measurements to the commercial aspects of DRM FM and new business opportunities which arise from the utilization of data applications.

The antenna system is at a height of 278 m above ground level and the permitted frequencies are used for the simulcast signal. The exciter is configured to allow for a narrow simulcast with analogue FM and DRM spaced at 150 kHz and a wider mode using a separation of 200 kHz between analogue FM and the DRM signals.

The transmitter is set to radiate at 95.9 MHz FM signal with a transmit power of 3 kW and DRM signal with a transmit power of 800 W simultaneously.

Correspondence

Mr Sergei Sokolov
CEO/General Manager & Co-Owner, Digiton Systems Ltd.
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1.2.3 Hanover, Germany

Description

DRM FM transmission at 95.2 MHz. The transmitter is running at 18 W ERP. The antenna is mounted at 70 m above ground. The coverage of this transmitter is 12 km to 25 km depending on the DRM modes.

Correspondence

Mr Stefan Galler
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1.2.4 Erlangen, Germany

Description

Funklust, which was initiated a part of Campusradio bit eXpress, is the campus radio of Friedrich-Alexander-University in cooperation with Fraunhofer IIS Erlangen. The DRM FM transmission operates continuously at 87.7 MHz with a power level of 10 W. The DRM transmission covers the city of Erlangen and surrounding areas.

The content consists of the radio service Funklust with associated text messages, Journaline advanced text service, Slideshow images and service logos, along with a regularly auto-activated EWF demo (Emergency Warning Functionality).

Figure 1.2: DRM content broadcasted on-air in Erlangen, Germany via Funklust

Correspondence

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1.2.5 Pakistan

Description

Pakistan Broadcasting Corporation (PBC) adopted DRM standard for AM and FM band by the approval of its Board of Directors (BoD) in 2020. PBC tested the DRM

standard on FM band successfully three times (101.4 MHz). First as a cold test on dummy load, second on professional receiver and third on a consumer level receiver.

Correspondence

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1.3 List of successful DRM FM field trials

1.3.1 Hanover, Germany

Objective

Analyze the DRM FM system performance within the scope of the pilot project “Digital radio broadcast for local area with DRM system”

Description

To analyse system performance, a field trial was carried out within the scope of the pilot project "Digital radio broadcast for local area with the system DRM". The trial was carried out between the Niedersächsische Landesmedienanstalt (NLM) and the Institute of Communications Technology of the University of Hanover. The measurements were made in the city of Hanover, Germany and its surroundings in winter/spring 2009/10. For detailed trial report please refer to the below reference.

Summary of Results

- Test Frequency – 95.2 MHz
- Antenna Setup – 70 m above ground; 30 W ERP

Mode	Field Strength (dBµV/m)*	SNR (dB)	Mobile Reception	Coverage (KM)
4 QAM	30	10	Good	15
16 QAM	46	18	Good	15

*In comparison, FM stereo signal needed a field strength of 66 dBµV/m for similar reception quality.

Reference

Annex A.1

1.3.2 Colombo, Sri Lanka

This trial operated DRM in combiner mode along with analogue FM services.

Objective

Demonstrate the functionality of DRM in FM band.

Description

The first DRM FM trial in Asia Pacific was conducted successfully in Colombo, Sri Lanka in November 2010. The DRM Consortium members contributed their expertise and equipment to the trial to enable the system to be tested in a real commercial environment with a variety of different reception conditions. These trials aimed at comparing DRM FM and analogue FM. Additionally, coverage measurements and feature assessment were made. Please follow the below reference for a detailed report.

Summary of Results

- Test Frequency – 87.6 MHz; 95.6 MHz
- Output Power – 47 W ERP

Mode	Field Strength (dBµV/m)*	Mobile Reception	Coverage (KM)
4 QAM	35	Good	18
16 QAM	50	Good	10

*In comparison, FM stereo signal needed a field strength of 66 dBµV/m for similar reception quality.

Reference

Annex A.2

1.3.3 Hanover, Germany

Objective

To ascertain the functionality of DRM FM operating in a Single Frequency Network (SFN).

Description

DRM is capable of transmitting in a single frequency network (SFN) in FM bands. Here several transmitters can work on the same frequency, due to a guard interval added after every symbol, differences in time of arrival from the different transmitters do not decrease the performance. This offers the possibility of covering a big area with several transmitters on only one frequency, which saves bandwidth and simplifies frequency planning significantly. It also enhances the reception quality in areas with obstacles as buildings, hills or mountains. In order to prove the functionality of DRM FM operating in an SFN a field test was set up in Hanover. Measurements were made in urban areas, to analyze and compare the performance of a one-antenna system and a SFN setup with the same power. In addition, the behavior in the overlapping area of the two transmitters and the coverage of the SFN setup were analyzed. A detailed report with measurement data is available in the below reference.

Summary of Results

- Test Frequency - 95.2 MHz
- Antenna Setup - One antenna was located at the university of Hanover (height: 70 m above ground), the other one at the headquarters of the Trade Fair Hanover (height: 100 m above ground) at a distance of 9.2 km.
- This FN trial showed that a single frequency network with two transmitters with the DRM FM system works very well. A setup with two transmitters with only 1 W each could cover around 20 km diameter with a robust 4-QAM modulation. A good stereo audio quality was possible down to a field strength of around 35 dBµV/m.

Reference

Annex A.3

1.3.4 Edinburgh, United Kingdom

This trial operated DRM in combiner mode along with analogue FM services.

Objective

Extensive DRM test in FM band in real environment.

Description

The DRM Consortium carried out a high-power field trial of the DRM system in the FM band in the central Scotland area, centered on the city of Edinburgh, in the United Kingdom during January to May 2011. The DRM Consortium members contributed their expertise and equipment to the trial to enable the system to be tested in a real

commercial environment with a wide variety of reception conditions. The BBC provided project management and measuring effort for the trial. The trial report was submitted to the ITU-R WP6A meeting in May 2011. Please follow the below reference for the detailed report.

Summary of Results

DRM in FM band was extensively tested in the UK in a highly credible 'real environment'. The frequency and antenna system were previously used by a commercial FM station. A large number of measurements were taken over an extended period and extensive geography with a calibrated receiving system and analysis was performed on the data. The trial has shown that DRM FM is capable of excellent coverage in good quality at reduced power levels compared with FM and that as expected 4-QAM was more robust than 16-QAM. Urban coverage was superior to FM, especially in the more rugged 4-QAM mode, because despite a few dropouts, the overall subjective experience was found to be better than that of FM with noise, clicks and fuzz. The audio decoding method includes error concealment algorithms to fade-out to silence when audio frame errors are detected and fade-in again when the error rate falls. In rural areas, the coverage was also excellent although terrain shielding did cause some audio failure, although this was comparable to the experience with FM from the co-sited transmitters.

Reference

Annex A.4

1.3.5 Vatican City State, Italy

This trial operated DRM in Simulcast mode (DRM + analogue FM from a single transmitter).
This trial operated DRM in combiner mode along with analogue FM services.

Objective

Test and verify the performance of DRM FM in a difficult interference scenario and check the compatibility with existing infrastructure.

Description

In December 2011, Vatican Radio carried out some broadcasting tests of DRM in the VHF Band II at 103.8 MHz. The aim of the tests was to verify the performance of DRM FM in a difficult

interference scenario such as the FM VHF band II in Rome and to check the compatibility of the

Digital technology with existing antenna arrays having complex RF coupling systems such as the one located in the Vatican. The frequency used was assigned to the Vatican in the GE84 Agreement and was chosen for two main reasons: it is not used during a few timeslots in the morning and it suffers from some strong interferences coming from stations operating at 103.7 MHz and 104.0 MHz located close to Rome. The tests were carried out taking into account the normal programs schedule. During the tests, the digital transmitter was connected to the antenna feeder via a changeover, leaving the analogue transmitter in stand-by. The antenna array is a complex system: four FM transmitters at different power levels share the same antenna with elliptical polarization and Omni-directional horizontal radiation pattern. For the details of the results and considerations, please follow the reference below.

Summary of Results

- Mobile reception of a low power DRM FM broadcasting transmitter was investigated in the very congested FM environment of the urban area of Rome.
- Acceptable stereo coverage in mobile reception conditions has been verified in areas where predicted field strength is comparable with 44 dBµV/m and interference is negligible.
- Using the most robust configuration for DRM FM, it has been possible to achieve better coverage with a full stereo program than the one achieved with an analogue FM signal.
- The overall subjective listening experience was better than that of FM interfered with by splashes coming from adjacent stations.
- In view of a possible transition of existing analogue FM services to digital technology it has been found that the use of DRM in FM has the following merits:
- possibility to re-use the existing antenna system without any particular precaution, except the one relevant to the maximum peak envelope power of the digital signal.
- No modification of the target service area as a consequence of re-using the existing antennas; this means that the original “shape” of the target service area remains unmodified with benefits for those local broadcasters that have their main audience in a specific service area.
- Possibility to use SFN techniques, with the attendant benefits for regional operators who may be able to re-use the frequency to achieve regional coverage

Reference

Annex A.5

1.3.6 New Delhi, India

Objective

To test the functionality of DRM in VHF Band II

Description

The first ever DRM in VHF band II trial measurements in New Delhi, India, was organized jointly by All India Radio (AIR) and Digital Radio Mondiale (DRM) Consortium. The trial took place as part of a week-long workshop on DRM technology (23rd-27th May 2011), covering crucial issues of planning, transition, simulcast, content and receivers. For the DRM FM trial in New Delhi, a single test frequency of 100.1 MHz carried three program channels - Gold DRM (FM), Rainbow DRM (FM) and AIR news in Journaline. Reception quality was measured using a test vehicle going in four directions from central New Delhi where the transmitter was installed. Two test modes were measured - robust 4-QAM and high capacity 16-QAM. For detailed description of the DRM FM system parameters, system setup, equipment used and measured results please follow the reference below.

Summary of Results

- The functionality of the DRM standard particularly for the VHF bands (DRM FM) could be presented with the field trial in the FM band II.
- Two live radio programs (FM Rainbow and FM Gold), a Journaline text information service and a PRBS test sequence were transmitted.
- Measurements were conducted in four radial directions from the transmitter located at All India Radio.
- The trial has shown that DRM in the FM band is capable of good coverage at reduced power levels compared to analogue FM.

Reference

Annex A.6

1.3.7 Belo Horizonte, Brazil

This trial operated DRM in combiner mode along with analogue FM services.

Objective

To assess the coverage and reception quality in different environmental conditions

Description

DRM FM trials was conducted by the National Metrology Institute (Inmetro) in collaboration with the broadcaster Rádio Itatiaia LTDA, DRM Consortium and the National Autonomous University of Mexico with support from Anatel, Brazilian Communication Company (EBC), RF Mondial, Nautel, Grupo de TSR research from UPV / EHU, TDF and Fraunhofer IIS, under the supervision of the Ministry of Communications. The tests were carried out at the station of Rádio Itatiaia LTDA in Belo Horizonte. The tests were conducted to assess the coverage and reception quality in different environmental conditions. For detailed report and results please follow the below reference.

Summary of Results

The DRM FM signal was transmitted in the simulcast mode combined in the air with a separation of 200 kHz between the carrier of the analogue FM signal and the central carrier of the digital DRM FM. The transmission power of the analogue FM signal was 19.9 kW, and the digital signal DRM was 500 W. Coupling the analogue FM and DRM FM systems in their respective transmission antennas, the FM EIRP signal was 28 kW, and the DRM FM signal was 513 W. Thus, the protection ratio (power ratio between the FM and DRM FM signals in the air) was 17.4 dB. During the measurement campaign, an FM receiver was used to assess analogue reception and for comparison purposes with the reception of the DRM FM signal. During the tests, measurements were taken in situations of static reception and mobile reception. The measurements covered two types of routes, namely: radial routes, in which when moving the vehicle away from the point of transmission, and circular routes. Radial routes were designed to assess the transmission coverage area, while circular routes were used to assess reception in different environments. The DRM technology allows the use of different modulations with parameters that must be chosen according to the propagation environment in which the broadcaster wishes to transmit. As a result, in this work, two transmission modes were chosen, one more robust based on 4 QAM modulation, and the other with greater capacity (data rate), using 16 QAM modulation.

- The test results were very good in the overall assessment. Within the city of Belo Horizonte, the coverage area of interest to the broadcaster, the results were very good for both transmission modes and for static and mobile reception.
- For 4 QAM mode, In the city, within a 15 km radius of the transmitter, static and mobile receptions were almost error-free. Coverage reached 25 km with 98% good reception. Further coverage was available until 50 km with 95% good reception.
- The 16 QAM mode showed slightly lower results. In the city, the reception presented the same behaviour as the 4 QAM mode, except for a small shadow

area. The coverage area for mobile reception was around 20-25 km from the transmitter, with some shadows.

- The field strength thresholds were in the range of 35 to 40 dBµV/m for the 4 QAM mode and around 40 dBµV/m for the 16 QAM mode.
- The indoor reception with the 4 QAM mode was excellent. In 16 QAM mode, only one point presented a bad result. In comparison the FM signal was equivalent in reception quality but with a field intensity threshold of around 60 dBµV/m.
- Comparing the reception of analogue and digital signals, the main conclusion was that the coverage area of the digital signal is slightly better, or at least equal, with a 17.4 dB less power. Reception thresholds are around 20 dB lower for the digital signals.

Reference

Annex A.7

1.3.8 Westbury, Johannesburg, South Africa

This trial operated DRM in combiner mode along with analogue FM services.

Objective

To assess that there is no interference to adjacent analogue FM transmission from DRM FM transmission and evaluation of the propagation characteristics

Description

The Westbury Community Development Centre Trust (WECODEC), license holder of Kofifi FM 97.2, a community radio station in Westbury, South-West Johannesburg, with support from the BBC World Service, Fraunhofer Institute for Integrated Circuits, RFmondial and others, initiated a trial broadcast project to evaluate DRM Digital Radio Mondiale in the VHF Bands (also known as Mode E or DRM FM). A 2-fold trial frequency spectrum license was issued by ICASA for Johannesburg on 101.25 MHz and Carnarvon on 64.0 MHz and became effective on 03 March 2017 for a period of 8 months in which the Johannesburg trial was conducted. Mobile measurements have taken place in 8 radial directions as well as various additional mobile measurement excursions with both professional and (pre-) consumer receiver equipment. The main technical objectives of the trial – acquiring evidence of no interference with adjacent FM transmissions and evaluation of the propagation characteristics of the signal – have successfully been achieved. The trial also looked at spectrum efficiency and evaluated the socio-economic benefits for the Westbury community and South Africa and its broadcasters and listeners.

Summary of Results

- DRM signal was transmitted at 101.25 MHz. This frequency is a part of dead frequency which cannot be used for analogue FM. This DRM transmission did not interfere the adjacent frequencies RSG Pretoria on 101.0 MHz and RSG Brixton on 101.5 MHz and also vice versa. Hence it was demonstrated that the existing dead FM spectrum can accommodate a large number – only in Johannesburg around 50(!) – additional DRM radio programs without impacting or need of restacking any existing FM services
- Audio reception in DRM FM was better than analogue FM with same transmitter infrastructure. The power needed for DRM FM was low compared to analogue FM to establish similar coverage

Reference

Annex A.8

1.3.9 Batam, Indonesia

This trial operated DRM in Simulcast mode (DRM + analogue FM from a single transmitter).
This trial operated DRM in combiner mode along with analogue FM services.

Objective

To measure the coverage of DRM FM in comparison to analogue FM.

To ascertain that there is no interruption to analogue FM by DRM FM during simulcast transmission.

Description

In order to test the benefits and advantages of DRM in Band II (VHF FM), the Directorate of Technology and New Media Radio Republik Indonesia and DRM Consortium has conducted a trial of DRM FM digital radio broadcasting for local coverage on May 16, 2017 to May 18, 2017 at TVRI Transmission Station Batam - Riau Islands. The trial aimed to ascertain the simulcast operation of analogue FM and DRM FM and predict the coverage. For detailed report, please follow the reference below.

Summary of Results

- Simulcast transmission (DRM FM and Analog FM) with a single transmitter was proven. The analogue FM was at 105.1 MHz while DRM signal was transmitted at 105.25 MHz. The respective transmitter power was 2.5 kW for Analog FM while 0.2 kW for DRM FM.

- Good quality indoor and mobile reception was observed at 40 dBµV / m signal strength.
- The coverage area of DRM FM was wider than Analog FM with only 10% of analogue FM transmitter power.
- There was no disturbance by DRM FM to the adjacent analogue transmissions at 105.1 MHz and 105.5 MHz

Reference

Annex A.9

1.3.10Saint Petersburg, Russia

This trial operated DRM in Simulcast mode (DRM + analogue FM from a single transmitter).
This trial operated DRM in combiner mode along with analogue FM services.

Objective

To measure the coverage of DRM FM and verify coverage predictions.

To ascertain that there is no interruption to analogue FM by DRM FM during simulcast transmission.

Description

Digiton Systems carried out a high-power field trial of the DRM system in DRM Simulcast mode by order of the Russian Television and Radio Broadcasting Network (RTRN) in the FM band in the Saint-Petersburg city, in the Russian Federation during June to December 2019.

The DRM Consortium members (RFmondial GmbH, Fraunhofer IIS) contributed their expertise to the trial to enable the system to be tested in a real commercial environment with a wide variety of reception conditions. RTRN provided financing for the trial. Digiton Systems provided equipment, project management and measuring effort for the trial. Triada TV provided the transmitter.

European Media Group (EMG) company and GPM Radio company allowed to launch a digital DRM signal between their FM radio stations Studio 21 at 95.5 MHz and Comedy Radio at 95.9 MHz. Radio Studio 21 is a part of EMG and Comedy Radio is a part of GMP Radio.

During the trial the existing transmitter infrastructure was used without changes to other broadcast stations.

The Antenna system used during the trial is at a height of 278 m above ground level and the permitted frequencies of 97.7 MHz and 97.75 MHz were used.

The exciter was configured to allow for a narrow simulcast with analogue FM and DRM spaced at 150 kHz and a wider mode using a separation of 200 kHz between analogue FM and the DRM signals.

The transmitter was set to radiate at 95.9 MHz FM signal with a transmit power of 3 kW and DRM signal with a transmit power of 800 W simultaneously.

Summary of Results

DRM Simulcast mode in VHF Band was extensively tested in the Russian Federation in a highly credible ‘real environment’. The frequency and antenna system were previously used by a commercial FM station. A large number of measurements were taken over an extended period and extensive geography with a calibrated receiving system and analysis was performed on the data.

- The trial has shown that for DRM Simulcast with frequency offset 150 kHz DRM digital signal does not interfere with analogue FM signal with power difference up to -10 dB. For frequency offset 200 kHz DRM the digital signal does not interfere with the analogue FM signal at any power values that the transmitter could provide.
- There was no disturbance by DRM FM to the adjacent analogue transmissions at 105.1 MHz and 105.5 MHz
- **Measured coverage area even exceeded prediction.**
- Commercial broadcasters support the DRM Simulcast mode as an alternative to the DAB+ standard. Because DRM Simulcast allows to keep FM broadcasting and launch terrestrial digital radio broadcasting in the same frequency range. DRM multiplexes can be launched between existing FM radio stations without interfering with them. To do this, it can use one transmitter and existing combiner and antenna system.
- Sound quality is comparable to existing FM radio stations. It is recommended to use MPEG-4 xHE-AAC with a bit rate of at least 30 kbps.
- All the equipment which is necessary for the DRM Simulcast in FM band (87.5-108.0 MHz) is commercially available in the market. This ensures reliable operation for a long time.

Reference

Annex A.10

1.3.11 Pelabuhan Ratu & Jakarta Pusat, Indonesia

This trial operated DRM in Simulcast mode (DRM + analogue FM from a single transmitter).
This trial operated DRM in Multi-DRM mode from a flex-transmitter.

Objective

Evaluation of DRM in VHF Band II as part of digital radio planning and commission.

Description

RRI conveyed their plan to conduct DRM trial during the KOMINFO-RRI coordination meeting on 13-16 November 2019 in Denpasar, Bali. RRI submitted the proposal for the mentioned trial on 27 November 2019 to the Minister of KOMINFO. Minister KOMINFO issued Decree No.348 Year 2020 pertaining to the mentioned trial. Evaluation on DRM VHF Band II was jointly conducted by Directorate of Spectrum Policy and Planning, Regional Spectrum Monitoring Office of Jakarta, Regional Spectrum Monitoring Office of Bandung, Regional Spectrum Monitoring Office of Tangerang, Radio Republik Indonesia (RRI). The trials were held in two parts.

First part was conducted at Pelabuhan Ratu, Sukabumi covering the following evaluation scenarios

- coverage FM vs DRM (+audio quality)
- simulcast FM vs DRM (+audio quality), 150 kHz spacing between FM center and DRM center, same transmitter and antenna
- DRM vs DRM (+audio quality), 100 kHz spacing between DRM centers

while the second part of the trial was conducted at Jakarta Pusat addressing the following situations:

- Independent transmitter DRM vs FM (+audio quality), 200 kHz spacing between FM center and DRM center
- DRM at 107.9 MHz vs aeronautical (+audio quality)
- Emergency Warning Functionality (EWF)

Based on the successful trials RRI has installed and commissioned 5 DRM FM transmitters and are live today. RRI is further planning to provide full DRM digital radio coverage to its audiences for local services (in the FM band) as well as for regional and nationwide services (including the medium wave band).

Summary of Results

- The coverage of 1 kW FM carrier power (antenna height of 40 meters) could be served by 50 Watt DRM (same antenna and tower). DRM audio quality was better than FM
- There was no interference from DRM FM to the adjacent analogue FM
- No harmful interference occurred within simulcast FM & DRM (combined transmitter). During the test, FM vs DRM carrier power was locked to 10:1 (Δf = 150 kHz). Both DRM FM and analogue FM audio were received well.
- No harmful interference occurred within DRM & DRM with Δf = 100 kHz. Both DRM audio [services] received were very good. There is no issue of adjacent channel interference between two separate DRM of the similar power level
- DRM was transmitted at 107.9 MHz, very close to aeronautical band at 108.0 MHz. No DRM harmful spurious emission was identified on aeronautical band (108-137 MHz)
- Emergency Warning Functionality (EWF) was working well when the receiver is ON (broadcasting the audio).

Reference

Annex A.11

1.4 Countries with DRM FM policies

Recently, several countries started to endorse domestic DRM services in the FM band based on the latest ITU-endorsed digital radio standard.

1.4.1 South Africa

South Africa has issued policy direction on the introduction of Digital Radio Broadcasting. DRM digital radio standard is the choice for complementing both AM and FM analogue services.

Reference

Annex B.1

1.4.2 Russia

Based on the DRM trials and study conducted jointly by St. Petersburg State University of Telecommunications and Russian Television and Radio Broadcasting Network (RTRN), the State Commission on Radio Frequencies has decided:

1. To take into account the results of the research work "Development of recommendations for the implementation of the digital broadcasting standard DRM for VHF Bands in the Russian Federation".

2. To allocate to an indefinite circle of persons the radio frequency bands 65.9-74 MHz, 87.5-108 MHz for the creation of digital radio broadcasting networks of the DRM standard on the territory of the Russian Federation, subject to the following conditions

Reference

Annex B.2

Europe

EBU R138 version 2.0 (published in 2017) lists DAB(+) in VHF band-III as the major digital broadcasting standard for Europe, given its history and wide-spread installation, but also recommends: “For countries wishing to deploy digital radio broadcasting in **other frequency bands, such as those currently used for analogue radio broadcasting, DRM** (ETSI ES 201 980) may also be considered.”

Reference

EBU R138 „Digital Radio Deployment in Europe, Version 2.0”:
https://tech.ebu.ch/docs/r/r138.pdf

1.4.3 Pakistan

Pakistan is planning to fully digitize the state-owned Radio Pakistan with introduction of DRM Digital Radio. Further, Pakistan Broadcasting Corporation has requested that Government shall include a policy mandating all the cars to be equipped with DRM receivers in their automotive policy.

Reference:

Annex B.3

1.5 ITU Network Planning Parameters for DRM

The full network planning parameters for introducing DRM transmissions into the VHF band-II (FM band) are published by and available from ITU. Particularly for VHF band-II, this document covers interference levels DRM into DRM, FM into DRM and DRM into FM. It therefore allows for a save and interference-free rollout of DRM services in the FM band with on-going analogue FM services.

Reference

ITU-R BS.2214-5 (10/2020)

1. Annex

The documents listed below are referenced in the text and provided as attachments to this document.

A.1
DRM FM Field trials in Hanover, Germany
“DRM-FM_Hanover_Germany.pdf”

A.2
DRM FM Field trials in Colombo, Sri Lanka
“DRM-FM_Colombo_SriLanka.pdf”

A.3
DRM FM Field trials in Hanover, Germany
“DRM-FM_SFN_Hanover_Germany.pdf”

A.4
DRM FM Field trials in Edinburgh, Scotland
“DRM-FM_Edinburgh_Scotland.pdf”

A.5
DRM FM Field trials in Vatican City, Italy
“DRM-FM_VacticanCity_Italy.pdf”

A.6
DRM FM Field trials in New Delhi, India
“DRM-FM_NewDelhi_India.pdf”

A.7
DRM FM Field trials in Belo Horizonte, Brazil
“DRM-FM_BeloHorizonte_Brazil.pdf”

A.8
DRM FM Field trials in Johannesburg, South Africa
“DRM-FM_Johannesburg_SouthAfrica.pdf”

A.9
DRM FM Field trials in Batam, Indonesia
“DRM-FM_Batam_Indonesia.pdf”

A.10
DRM FM Field trials in Saint Petersburg, Russia
“DRM-FM_SaintPetersburg_Russia.pdf”

A.11
DRM FM Field trials in Indonesia
"DRM-FM_Indonesia.pdf"

B.1
South Africa policy announcement
"2020-07_DRM-FM_SouthAfrica_PolicyAnnouncement.pdf"

B.2
State Commission on Radio Frequencies (SCRF) Resolution
"2018-09_DRM-FM_Russia_PolicyAnnouncement.pdf"

B.3
Pakistan policy announcement
"2020-03_DRM-FM_Pakistan_DigitalRadioPolicyAnnouncement.pdf",
"2020-09_DRM-FM_Pakistan_DigitalRadioPolicyAnnouncement.pdf",
"2020-11_DRM-FM_Pakistan_NEWS_PolicyDRMinCars.pdf"