RESULTS OF THE DRM SIMULCAST FIELD TRIAL IN FM BAND IN THE RUSSIAN FEDERATION

June to December 2019

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0. Abstract

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 and 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 any changes in other broadcasted stations. The DRM signal was added to the combiner infrastructure, already combining more than a dozen analogue FM services onto a single antenna.

This document describes the trial and results.

Additional key words:
DRM, Digital Radio Mondiale, FM-band, VHF band-II, DRM-FM, DRM Simulcast,
FM Combiner

1. Location and environment for the trial

The trial was conducted in the Northwest region of Russian Federation from the Leningrad radio and television broadcasting center located just to the center of the city of Saint-Petersburg. The area is characterized by a mixture of dense urban, urban, suburban, and rural terrain, including the city of Saint-Petersburg, several towns, open farm-land and industrial districts. The physical geography includes open water.

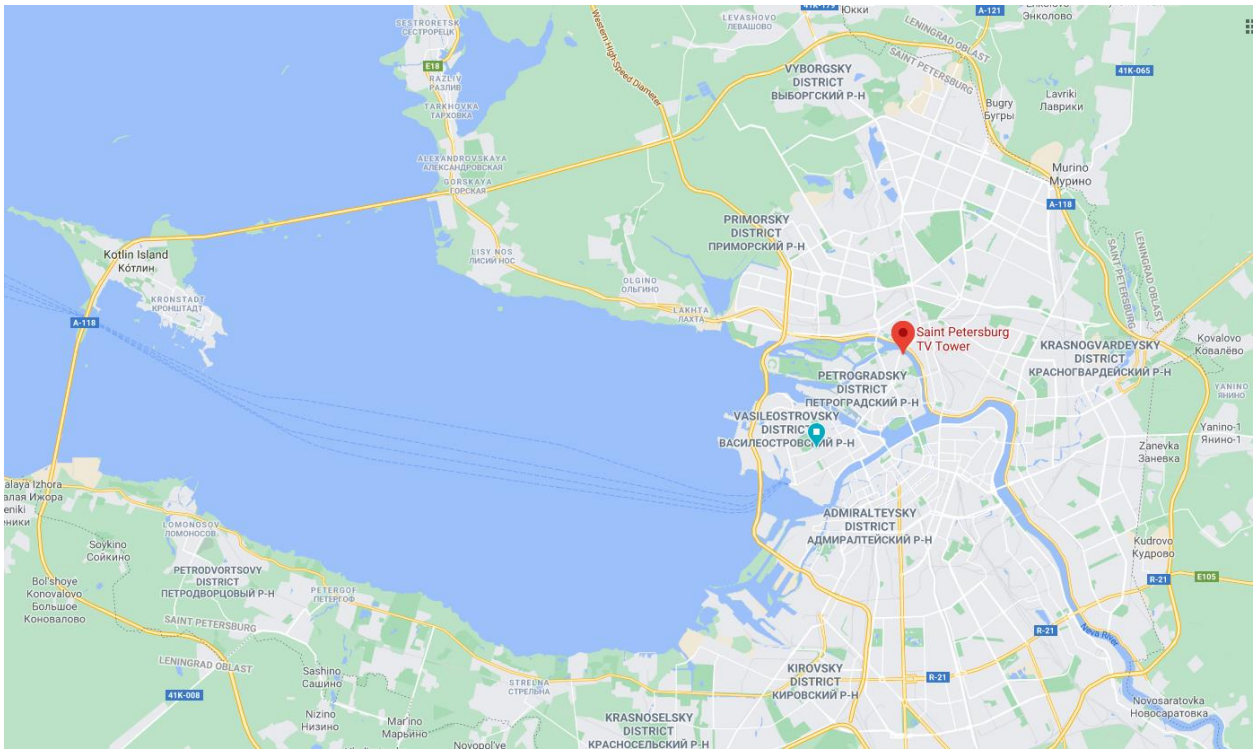

Figure 1: DRM Simulcast trial location

2. The Transmission Site

The Leningrad radio and television broadcasting center is owned and operated by Russian Television and Radio Broadcasting Network (RTRN). It is a public and commercial broadcasting site which provides transmission facilities for analogue and digital television (using the PAL and DVB-T2 standards), analogue radio (using the FM standard). The site is 2 m above sea level. The FM radio services use several antenna systems providing mixed horizontal and vertical polarization. Each antenna system is fed from a combiner, combining multiple analogue FM services. The Antenna system used during the trial height is 278 m above ground level. The antenna system provided vertical polarization.

The trial made use of the frequency permissions at 97.7 MHz and 95.75 MHz. The antenna pattern is shown in figure 4.

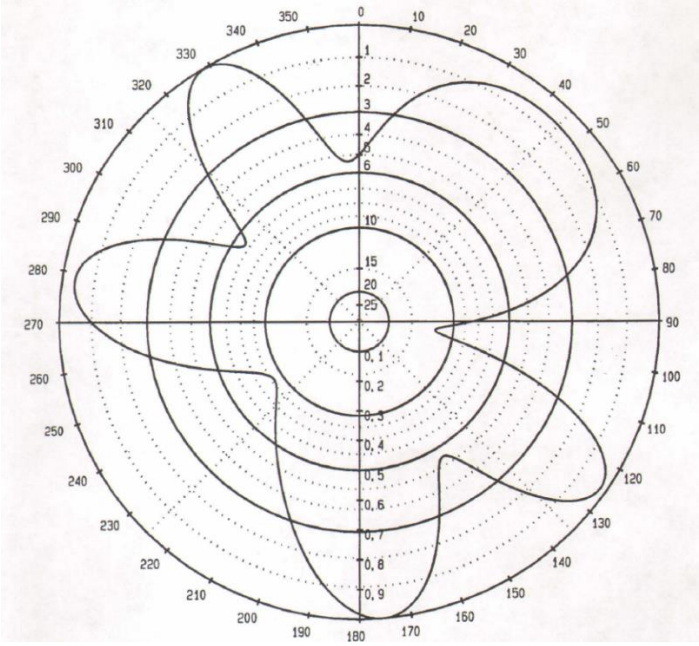

Figure 4: Antenna pattern of antenna

3. Transmission Equipment

The block diagram of the equipment configuration is shown in figure 5. The analogue FM transmitter formerly used for the FM 95.9 MHz service was removed and replaced by the DRM Simulcast transmitter and associated equipment. The main audio source for the trial was the Comedy Radio, which was broadcasted simultaneously as an analogue FM service and a DRM service. This allowed a direct comparison to be made between the analogue FM and DRM coverage. The audio signal for FM and DRM transmission was processed by Omnia.9 processor. This allowed a direct comparison not only of the coverage but also of the sound quality of the analogue FM and DRM transmission.

In addition to the Comedy Radio, two more radio stations were broadcast in the multiplex. There are three audio service were transmitted in the DRM multiplex: Comedy Radio, Avto Radio and Europa Plus. Each audio service was broadcast with text messages, Journaline advanced text service, station logos, and album covers.

The output of the DRM Simulcast transmitter was fed to a coaxial switch, which was then fed into high power combiner and antenna. The coaxial switch provided quick transition from the formerly used by the Comedy Radio FM service to the DRM Simulcast transmitter without the changing on existing infrastructure.

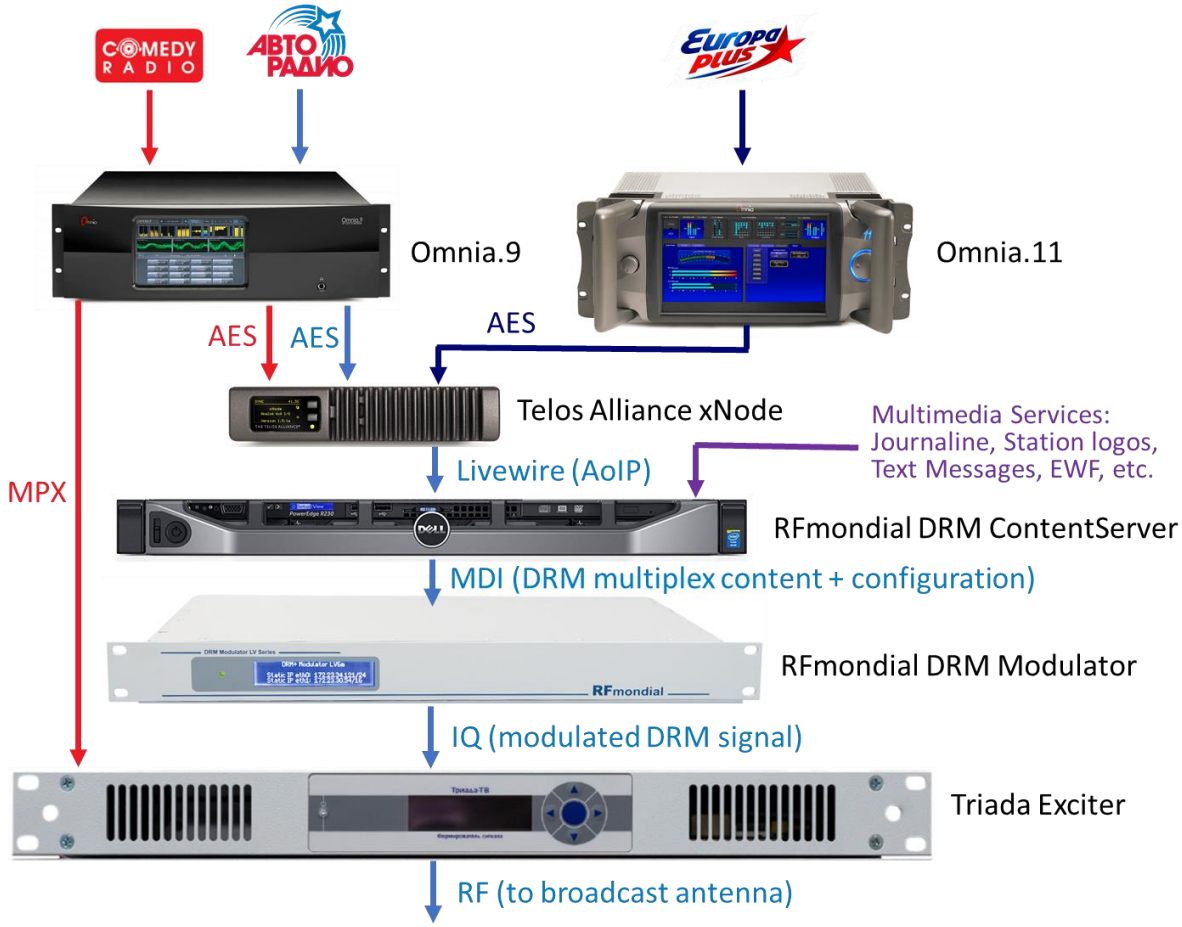

Figure 5a: Block diagram of the equipment configuration (simplified)

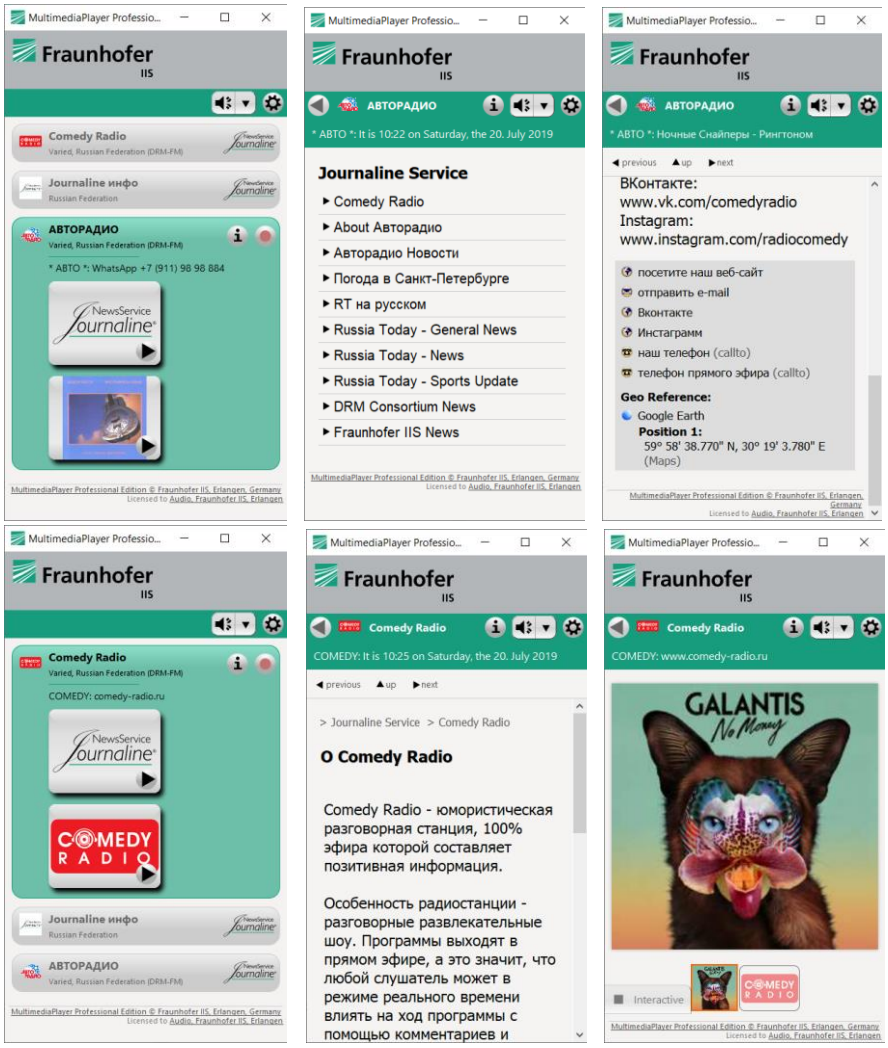

Figure 5b: Content examples of the DRM services with Journaline and Slideshow

The Triada Exciter was configured to allow two DRM Simulcast parameter sets to be switched to air – a more narrowband mode using DRM Simulcast with FM and DRM spaced 150 kHz and a wider band mode using 200 kHz space for FM and DRM signals separation.

The RFmondial DRM ContentServer was connected to the RFmondial modulator, which in turn fed the Triada Polyus PT5 transmitter. 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.

The audio processor, DRM ContentServer, modulator and transmitter were each connected via an ethernet hub to the GPM Radio technical IT network. This allowed remote control and monitoring of the equipment permitting mode changes as required during the measuring process. It also ensured that the DRM system was monitored 24/7 by the GPM Radio central control facility.

The existing infrastructure with existing combiner was used during the trial test.

Figure 6: The DRM Simulcast transmitter, audio processor and DRM ContentServer (in the right rack cabinet below)

4. Acceptance Tests

Radio Frequency Permits for 95.7 MHz and 95.75 MHz were issued by the Russian Federation regulator, The Federal Service for Supervision of Communications, Information Technology and Mass Media (Roskomnadzor), for the duration of the trial.

Prior to the start of transmissions, RTRN and GPM Radio representatives visited the transmission site to carry out an acceptance test to ensure that existing analogue FM services using the same combiner and antenna infrastructure would not suffer as a result of the introduction of the DRM Simulcast trial service. A full compliance test was carried out to ensure that no spurious intermodulation products or out-of-band emissions were radiated that could impact on other broadcast services or to aeronautical services using the spectrum immediately above the FM band. The full test procedure was followed, starting with measuring the transmitter into a dummy load, and continuing through the transmission chain. No problems were found with the installation and permission to begin the trial was given.

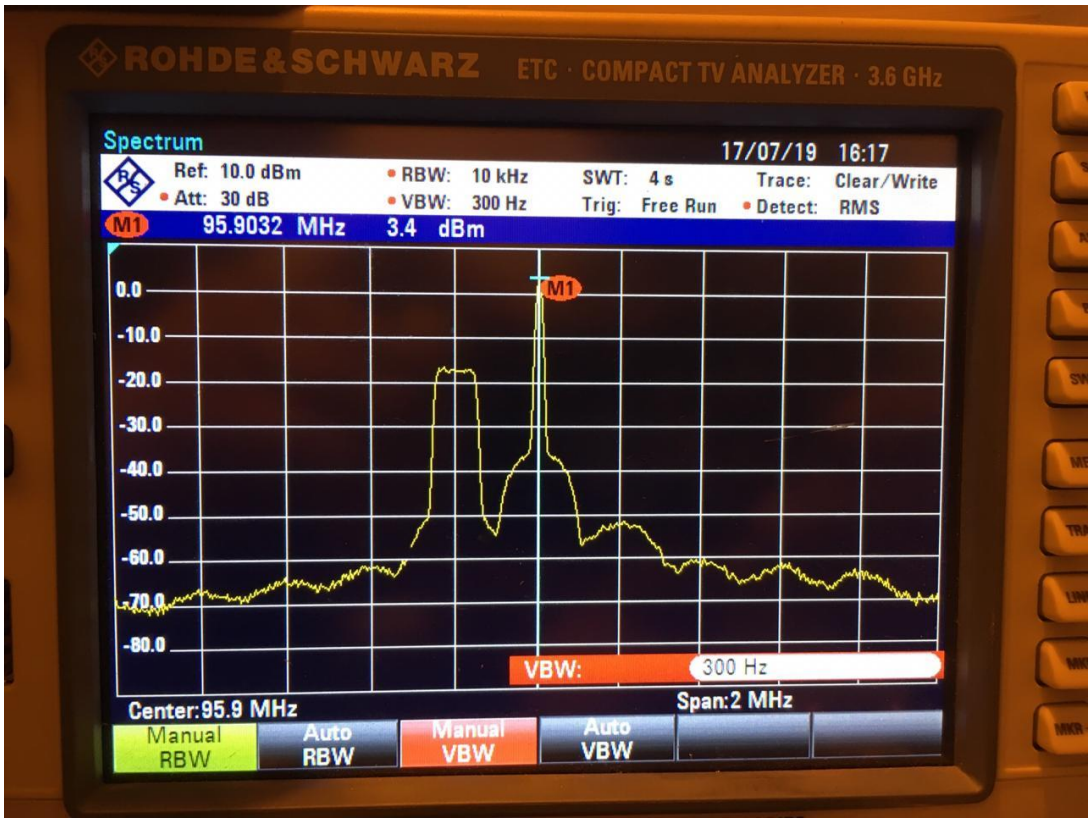

Figure 7: Measuring the DRM Simulcast transmitter into a dummy load prior to the start of transmissions

5. Receiving Equipment

Mobile measurements were carried out using Digiton Systems measuring vehicles. These were a Mitsubishi Outlander and Hyundai Solaris. For measurements used RFmondial Model RF-SE19 receiver and Kathrein K 51 16 4/510 351 receiving antenna. Additionally, Android multimedia systems with SDR Dongle and Fraunhofer DRM MultimediaPlayer Radio App software was installed in the Mitsubishi Outlander. A consumer receiver Gospell GR-216 was also used.

Figure 8a: Mitsubishi Outlander measuring vehicle

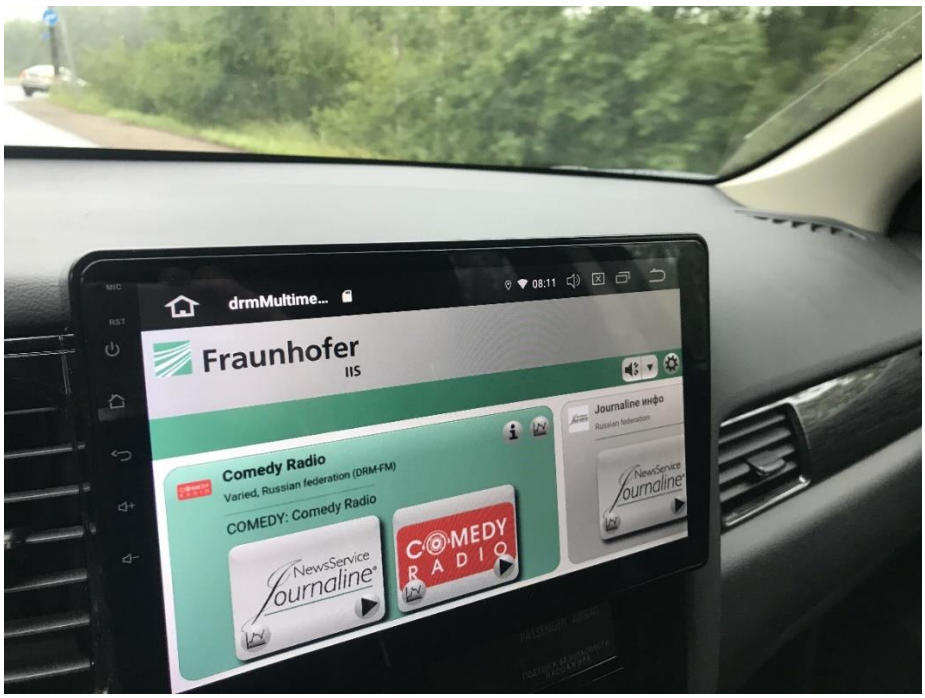

Figure 8b: Fraunhofer DRM MultimediaPlayer Radio App software was installed in Mitsubishi Outlander measuring vehicle's Android-based radio set with an external FM receiver dongle connected via USB

Figure 9: Hyundai Solaris measuring vehicle

Figure 10: Consumer receiver Gospell GR-216

6. Coverage Prediction

Recommendation ITU-R BS.1660-8 «Technical basis for planning of terrestrial digital sound broadcasting in the VHF band» was used to predict the coverage for mobile reception from the Leningrad radio and television broadcasting center antenna for a digital part of DRM Simulcast signal operating at 800W in 16-QAM, rate 1/2, exceeding a field strength of 49,57 dBμV/m at 1.5 m (green area in figure 11). Additionally, the coverage prediction for mobile reception was calculated for a configuration of 4-QAM, rate 1/3, exceeding a field strength of 42,27 dBμV/m at 1.5 m (yellow area in figure 11).

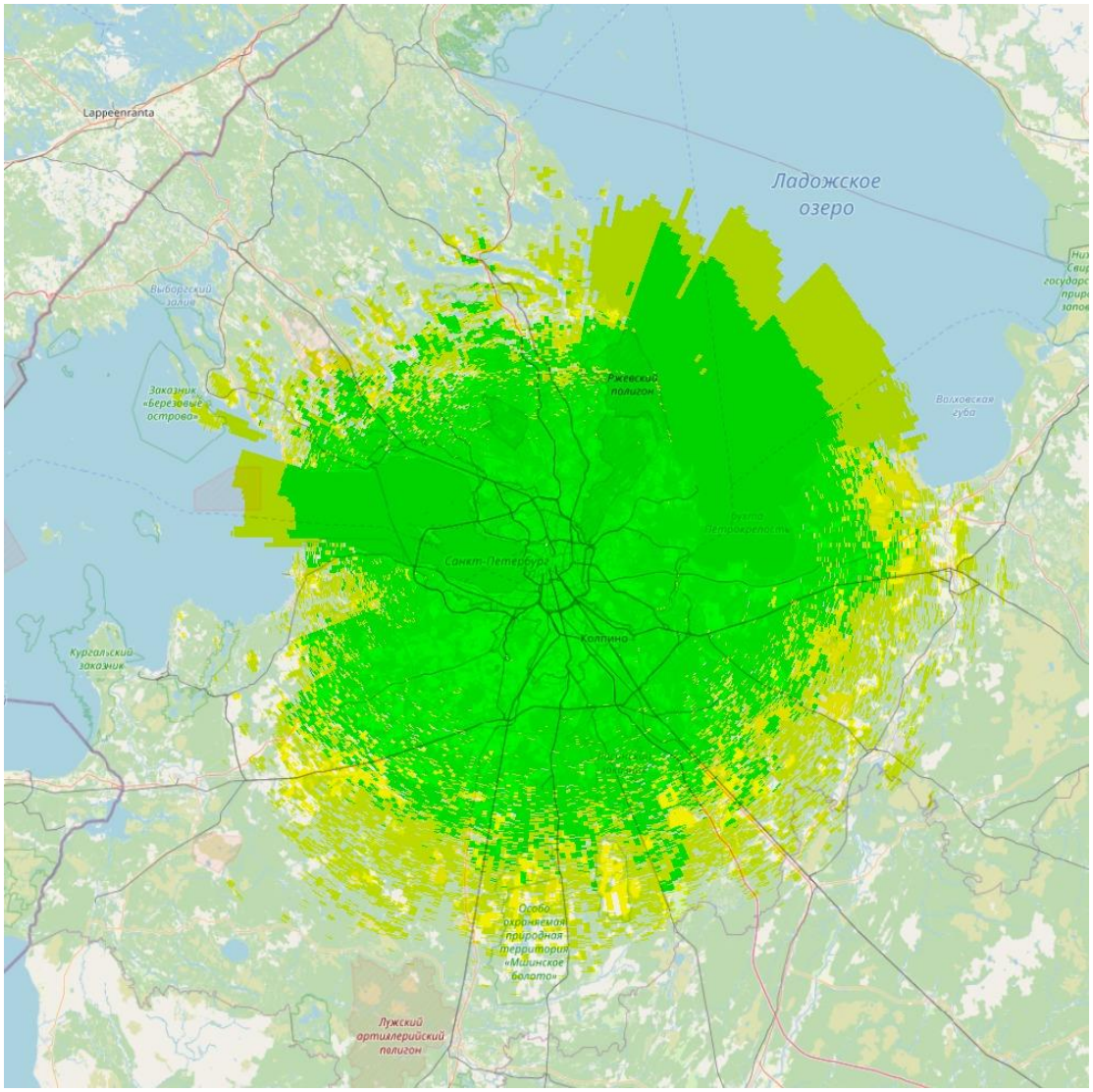

Figure 11: Predicted coverage area for the 800W DRM signal.

7. Trial Routes

Overall coverage was measured by driving along all major routes through the region, around 1500 route kilometers in total. Several roads were passed more than once as each route crossed across another.

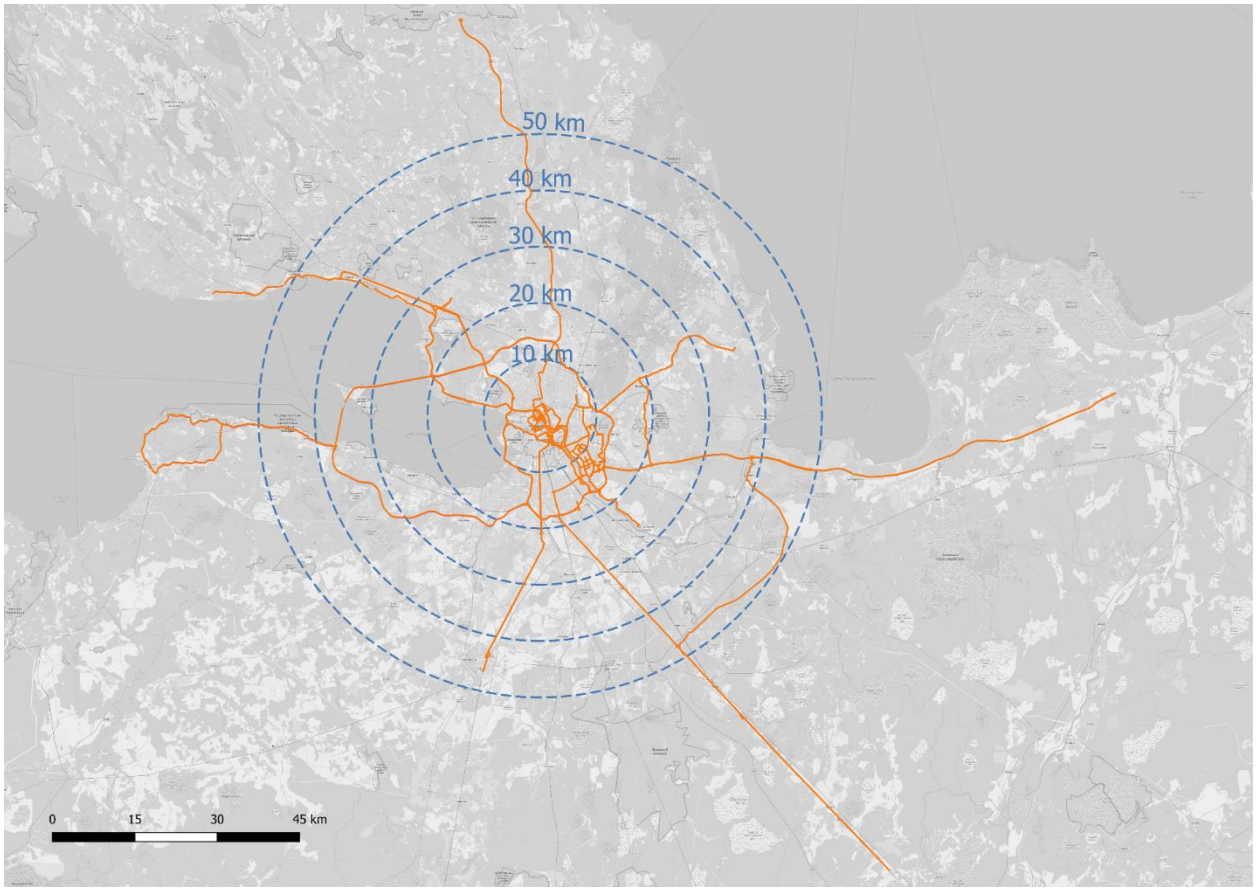

Figure 12: Trial routes

8. Results

The results of the trial are presented as a series of maps showing the quality of the audio received.

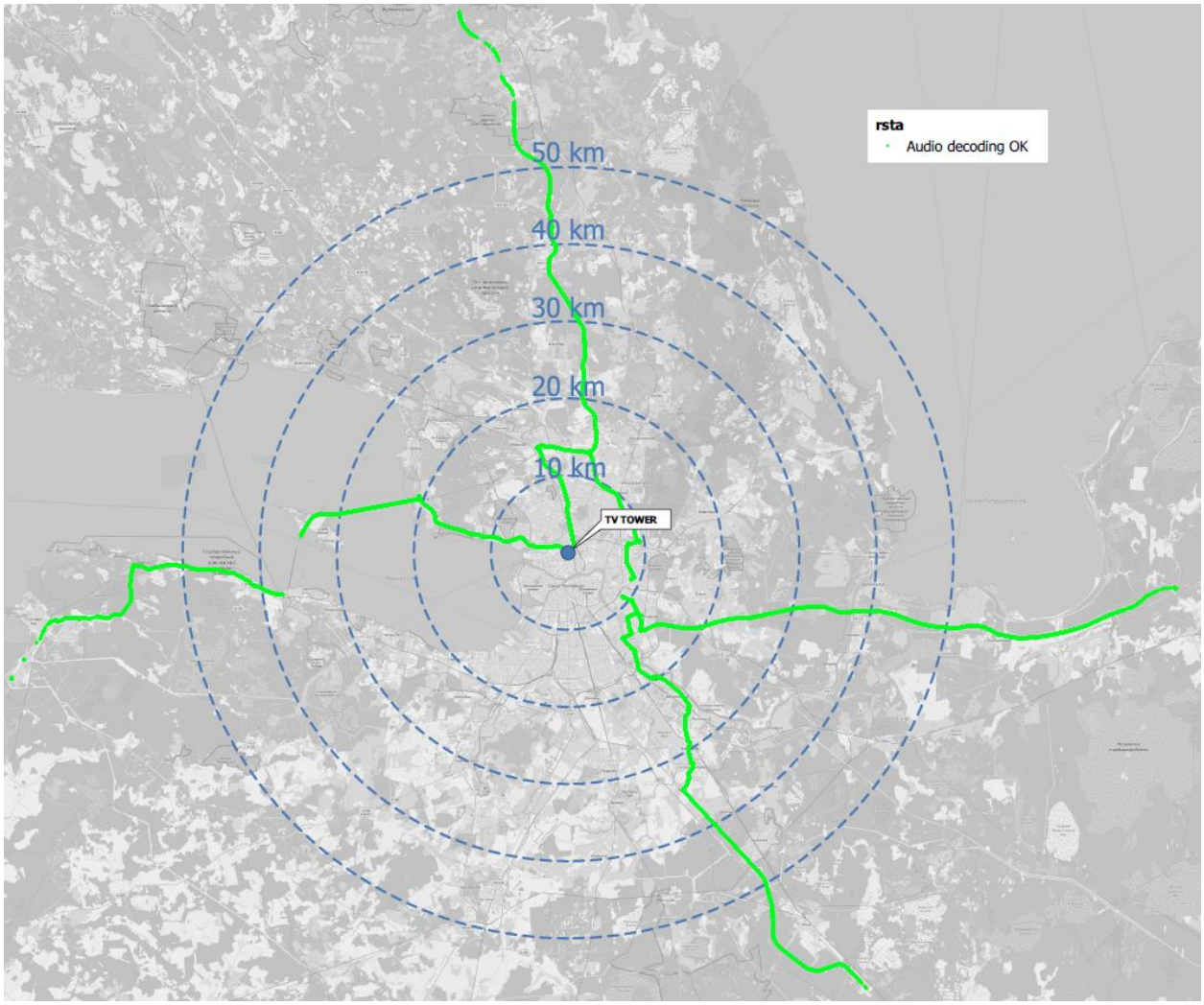

Figure 13: Demonstration of successful audio decoding along the trial route from the city Saint-Petersburg center towards the north, south, west and east. QAM 16, 800W DRM-FM, PL0.

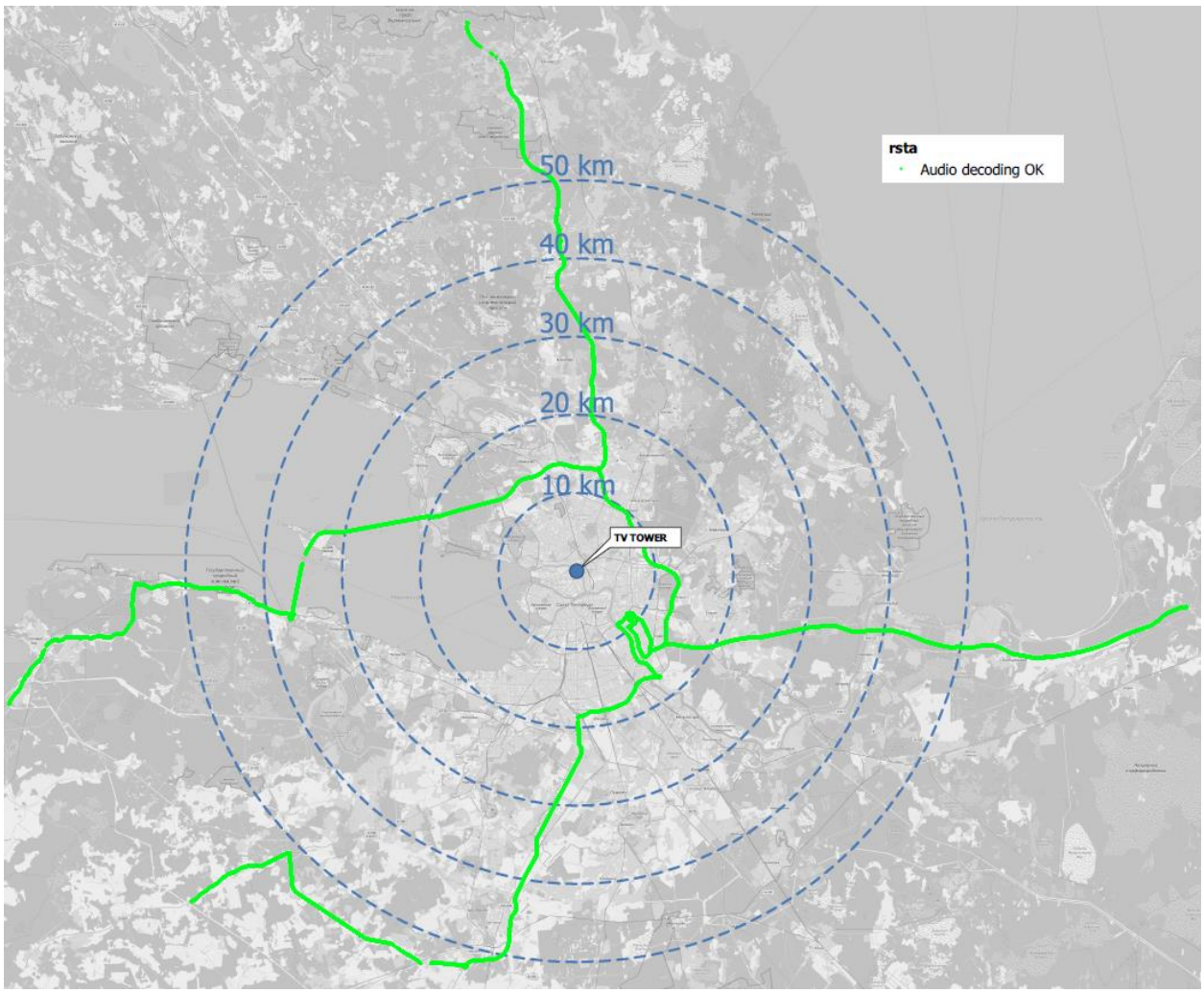

Figure 14: Demonstration of successful audio decoding along the trial route from the city Saint-Petersburg center towards the north, south, west and east. QAM 4, 800W DRM-FM, PL0.

9. Conclusion

DRM Simulcast mode in VHF Band-II I(FM 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 the analog FM signal at a power difference up to -10 dB. For a frequency offset of 200 kHz, the digital DRM signal does not interfere with the analog FM signal at any power values that the transmitter could provide.

Commercial broadcasters support the DRM Simulcast mode. 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.

For the sound quality is not worse than that of 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 87.5—108.0 MHz a band is produced commercially and is available in the market. This equipment ensures reliable operation for a long time.