Radiocommunication Study Groups

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Digital Radio Mondiale

RESULTS OF THE DRM FIELD TRIAL IN BAND I IN TURIN, ITALY

Introduction

Radio Maria carried out a field trial of the DRM system in band I in the Piedmont region of northern Italy, including city of Turin during January to April 2011. The DRM system was tested in a typical reception environment with a wide variety of reception conditions. This document describes the trial and results.

Proposal

That the observations and measurements of the DRM system in the VHF bands reported in this document be used in furtherance of the acceptance of Digital Radio Mondiale (DRM) as digital system G in Recommendation ITU-R BS.1114 as given in **Annex 6** of Working Party 6A Chairman's Report (Document **6A/454)** and that they be used to develop a Working Document towards a Preliminary Draft New Report ITU-R BS.[DRM+] which will gather together appropriate field trial data and so provide a reference document on the capabilities of DRM+.

CONTENTS

1 Test Description

The following document discusses the field measurements made in an around the city of Turin to measure the quality of the DRM signal. The transmitter is located on a hill in the east of Turin, which corresponds to the followings coordinates in latitude and longitude: 45°3'3.12"N and 7°41'46.03"E.

The signal was transmitted with 40 W ERP using a ground plane antenna at the highest position of the site tower. The parameters used for Main Service Channel of the DRM+ transmission were 4-QAM at protection level 0, corresponding to a code rate of 1/4. The service parameters are set to transmit only audio. Table 1 summarizes the transmission parameters along with the DRM signal configuration.

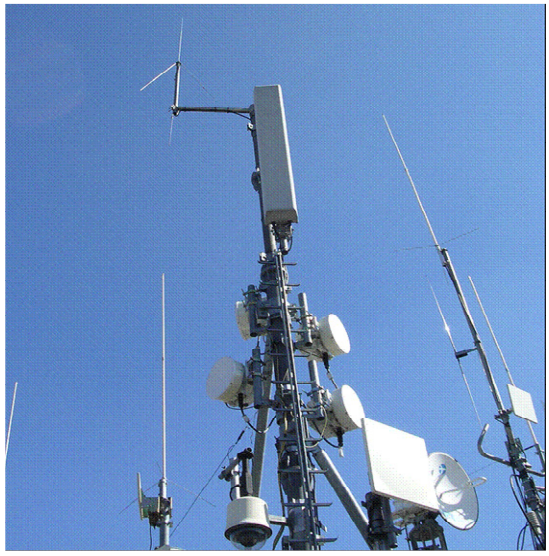
TABLE 1

Parameters of the transmission

Modulation	4-QAM
Code Rate	0.25
Frequency	55.8 MHz
Power	40 W erp
Transmitting Antenna	Ground plane (omnidirectional)

FIGURE 1

Transmitting antenna



The transmitter is located in Villa Gualino, a high point above the city of Turin. Despite the omni-directional nature of the antenna, the local terrain constrains the signal to the east and south.

FIGURE 2

View towards the west from the transmitter location showing the city of Turin

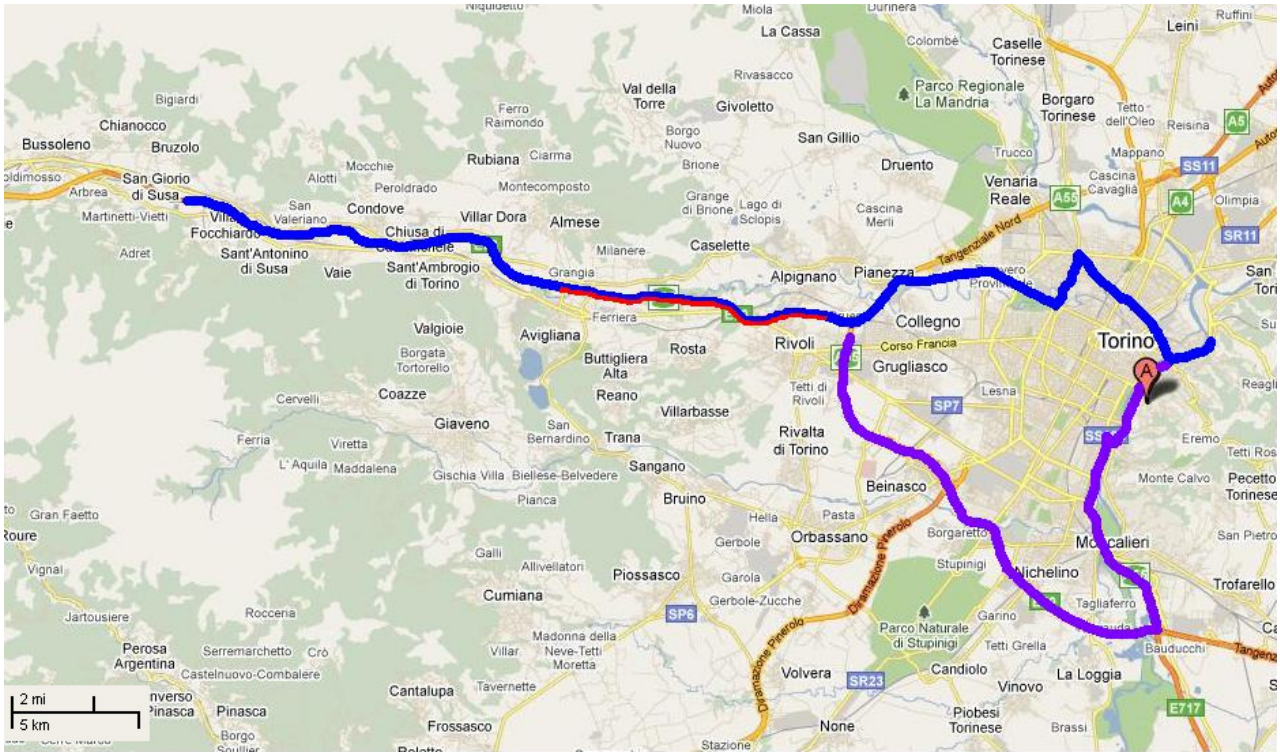
1.1 Service Area Description

There are three environments along the routes. Mostly, the routes pass through suburban environments. We can find as well other kind of environments like industrial and rural environments and open areas.

In the following figure all the routes are shown. The transmitter is located in Villa Gualino, which is marked with the red marker "A" on the right side of the map.

FIGURE 3

Location of the trial showing test routes. "A" is the transmitter; the blue line shows route 1, the red line route 2 and the purple line route 3



1.1.1 Route 1: Blue

This route goes through the city to finish in the rural environment. The route is about 40 km long and starts close to the transmitter. The minimum distance of the route from the transmitter is 1.8 km and the maximum is 38 km. On this route the following parameters have been measured: Audio frame availability, Audio Unit availability, Signal to Noise Ratio (S/N) and Modulation Error Ratio (MER).

1.1.2 Route 2: Red

This route is a part of route 1 and includes a tunnel section of road. In this case the length of the route is 12 km approximately, being the minimum distance from the transmitter of 12 km and the maximum of 25 km. In this route the following parameters have been measured: Audio frame availability, Audio Unit availability, Signal to Noise Ratio and Received Signal Strength.

1.1.3 Route 3: Purple

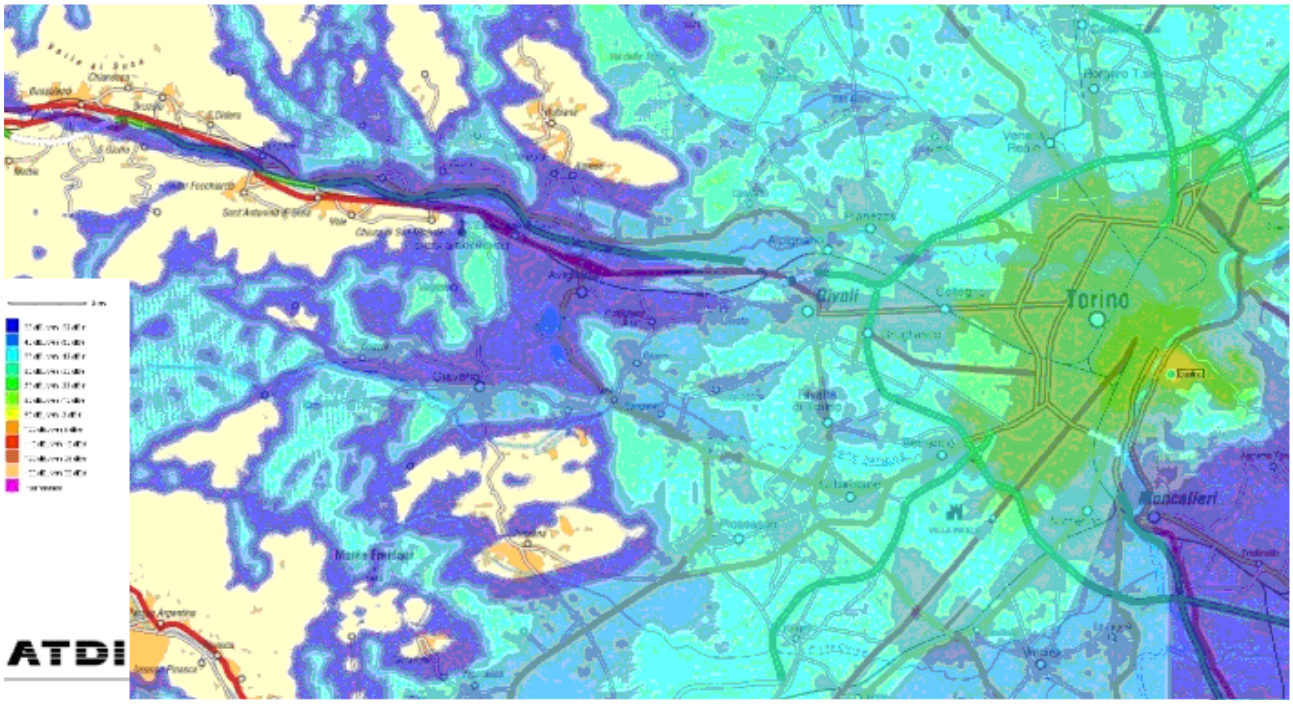
The third route surrounds the city centre. It is 33 km long and the maximum distance away from the transmitter is 12 km. The route passes close to transmitter, just 500 metres. In this route, the same parameters are measured as in route 1, Audio frame availability, Audio Unit availability, Signal to Noise Ratio (S/N) and Modulation Error Ratio (MER).

1.2 Coverage Prediction

Using the transmitter location and transmission parameters, the coverage to be expected was predicted. The result is shown in Figure 4. The effects of the hills that the transmitter is situated on can be seen with field strength being severely limited to the south of the transmitter beyond Moncalieri.

FIGURE 4

Coverage prediction



1.3 Measurement Methodology

The measurement system is based on a professional DRM+ receiver by RFmondial and a monopole antenna. The antenna is installed on top of a vehicle roof. The RSCI parameters were recorded for later analysis and plotting.

FIGURE 5

Measuring vehicle

2 Results

2.1 Overall Coverage

Considering all routes together the coverage of the transmitter has a radius of 28 km. Taking into account the 3 routes, the total length is round 68 km. 90% of the route presents excellent reception. The urban parts of the area are covered perfectly, without any dropouts. There are some exceptions where the coverage is lost due to tunnels and underground crossroads.

2.1.1 Route 1

FIGURE 6

Route 1. Audio quality values

The coverage in this route is generally very good. The reception is correct for a 91.5% of its length. The coverage is lost in a tunnel, located in the middle of the route. As the route goes outside the service area, some dropouts appear (further than 30 km from the transmitter). Analyzing the locations where the audio dropouts are noticeable, a MER (S/N) threshold has been identified as 11 dB.

2.1.2 Route 2

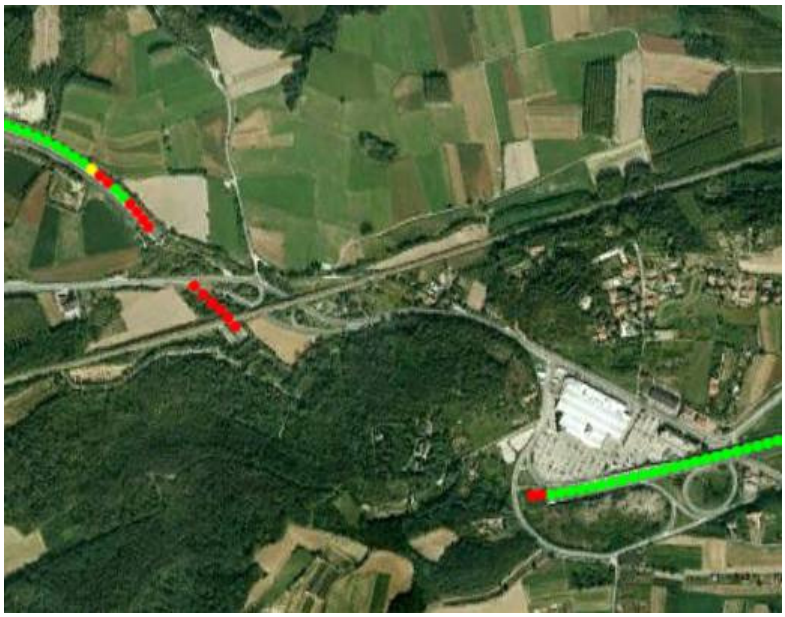
FIGURE 7

Route 2. Audio quality values

The coverage is again excellent except for the same tunnel as the one in Route 1. In this case, 91.6% of the route has excellent reception. The remaining 8.4% corresponds to the above mentioned tunnel, as shown in more detail in Figure 8.

FIGURE 8

Coverage lost due to a tunnel



The received signal strength has also been measured along this route. Except for the tunnel, signal strength values are higher than the theoretical threshold for the DRM mode under study, which is set at 27.41 dBµVm^{-1}.

The MER and S/N parameters behave very similarly to the ones in route 1. In this case, according to the values along this route, the S/N threshold is set on 10 dB. In this case the threshold has been obtained using the values around the only dropout section (entrances of the tunnel).

2.1.3 Route 3

FIGURE 9

Route 3. Audio quality values

The reception is good in 87% of the route, being this route the worst case in this test. This degraded performance was also expected. The route crosses an area outside the expected service area, without direct line of sight from the transmitter, beyond the town of Moncalieri, due to terrain shielding from the mountains to the south of the transmitter. However, the coverage in the urban area is good. The threshold of S/N and MER in this route can be defined on 13 dB.

FIGURE 10

Line-of-sight prediction with measured coverage

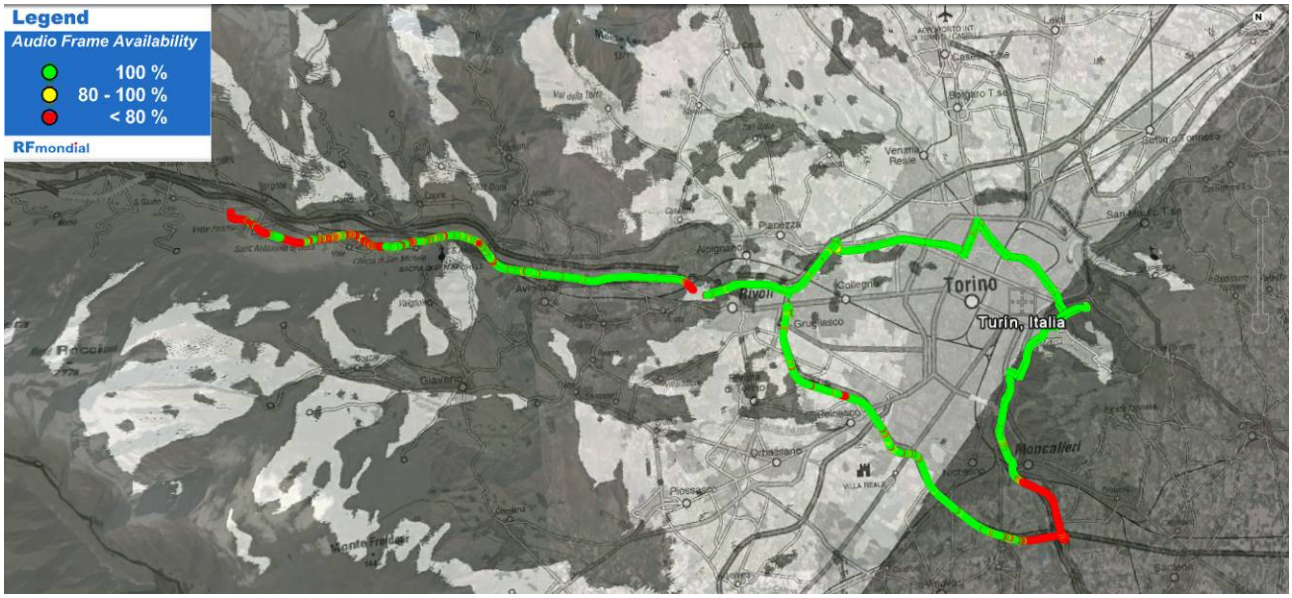


Figure 10 shows a terrain based line-of-sight prediction. White areas have line-of-sight to the transmitter, whilst grey areas do not.

2.2 Audio Quality

Audio quality in urban environments is good. The only degradations identified have been a tunnel and underground crossroads.

2.3 Performance Thresholds

Based on the empirical data, the MER (SNR) thresholds have been obtained in the range from 10 to 13 dB.

3 Conclusions

The audio quality in urban environments is very good, so the system works correctly. MER (SNR) thresholds have been obtained in the range from 10 to 13 dB. The coverage dropouts within the service area are all associated to tunnels and underground crossroads. The service area is about 30 km from the transmitter.

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