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| **Radiocommunication Study Groups** |  |
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| **15 February 2022** |
| **English only** |
| Saudi Arabia (Kingdom of), United Arab Emirates | |
| sharing and compatibility studY Between Mobile and broadcasting Services For Rural Scenario in preparation  for WRC-23 agenda item 1.5 | |
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# 1 Introduction

ITU-R Resolution **235 (WRC-15)** calls for review of the spectrum use and needs within the frequency band 470-960 MHz in Region 1, and to take appropriate regulatory actions including potential allocation to Mobile Service and/or identification of IMT within the whole band, or parts thereof. It resolves to invite ITU-R, after the 2019 World Radiocommunication Conference and in time for the 2023 World Radiocommunication Conference:

1. to review the spectrum use and study the spectrum needs of existing services within the frequency band 470-960 MHz in Region 1, in particular the spectrum requirements of the broadcasting and mobile, except aeronautical mobile, services, taking into account the relevant ITU Radiocommunication Sector (ITU-R) studies, Recommendations and Reports;

2. to carry out sharing and compatibility studies, as appropriate, in the frequency band 470-694 MHz in Region 1 between the broadcasting and mobile, except aeronautical mobile, services, taking into account relevant ITU-R studies, Recommendations and Reports;

This contribution provides analysis of the sharing studies between IMT system under Mobile Service (MS) and DTTB system under Broadcasting Service (BS). The parameters were selected from the relevant ITU Recommendations and Reports including ITU R-REP-BT.2383, ITU R-REP-M.2292, etc., to simulate systems under study. Co-channel scenarios are considered as well as variations in certain parameters for rural environment. The coexistence studies are conducted to evaluate any possible interference from IMT based transmitters (base-station) into Digital Terrestrial Television Broadcasting (DTTB) receivers.

# 2 Proposal

The co-signing Administration(s) present the following sharing study between IMT system under Mobile Service (MS) and DTTB system under Broadcasting Service (BS) to evaluate any possible interference from IMT based transmitters (base-station) into Digital Terrestrial Television Broadcasting (DTTB) receivers in rural scenario. The study and associated results are requested to be included in the working document/material on sharing and compatibility studies in the frequency band 470-694 MHz in Region 1 (Annex 2 to Document [6-1/77](https://www.itu.int/md/R19-TG6.1-C-0077/en)).

New Study

Results of New SHARING STUDY BETWEEN MOBILE AND BROADCASTING SERVICES FOR RURAL SCENARIO

# 1 Study Parameters, Deployment Scenario, and Propagation Models

The sharing and compatibility studies are carried out using the relevant ITU-R propagation models in the simulation including Recommendations ITU-R P.1546-6, ITU-R P.2108-0 and ITU-R P.1812-4.

Monte Carlo simulations were conducted to evaluate interference probability based on the protection criteria of the carrier to interference + noise ratio (C/I+N), where the victim transmitter and its distance to the victim receiver is also taken into account. This methodology is more indicative of the actually experienced interference and its impact, if any, that I/N criteria, which does not consider the desired received signal strength (dRSS) at the victim Rx from the victim Tx which may be strong enough to overcome any interfering signal strength and provide satisfactory services.

As such, this study examined the interference with variations in distance from the victim Tx to victim Rx, starting by placing the DTTB Rx at the edge of the coverage area of the DTTB Tx and varying the distance to consider different dRSS values and calculate the corresponding C/I+N.

In addition, the co-channel interference from multiple IMT Base-stations (One Tier with 7 TX stations and 21 sectors) to DTTB Rx has been further investigated by studying the impact of varying several parameters on the probability of interference and any coordination distance requirement.

The simulations cover the following scenarios:

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| --- | --- | --- | --- |
| Scenario | Area Type | Interference Type | Deployment |
| IMT Tx into DTTB Rx | Rural | Co-Channel | 100% Outdoor IMT Tx  100% Outdoor DTTB Rx |

The DTTB systems’ characteristics are summarized in the following table.

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| --- | --- |
| **Broadcasting System Parameters** | |
| **Input Power (Tx) (kW)** | High: 200 |
| **Coverage Radius (km)** | 38 |
| **Antenna Height (Tx) (m)** | 300 |
| **Antenna Pattern (Tx)** | ITU-R BT.419-3 |
| **Antenna Gain (Rx) (dBd)** | 9.15 |
| **Antenna Gain (Rx) (dBi)** | 9.15 |
| **Antenna Height (Rx) (m)** | 10 |
| **Antenna Pattern (Rx)** | ITU-R BT.419-3 |
| **Bandwidth (MHz)** | 8 |
| **C/N+I (dB)** | 20 |

The baseline parameters of terrestrial component of IMT for sharing and compatibility studies are considered in accordance with ITU Working Party (WP) 5D liaison statement (LS) (Doc. [5D/28](https://www.itu.int/md/R19-WP5D-C-0028/en)). Some IMT characteristics are summarized in the following table as well:

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| --- | --- |
| **IMT BS Parameters** | |
| **Propagation Model** | ITU R P.1546-6 |
| **Frequency (MHz)** | 600 |
| **Bandwidth (MHz)** | 10 |
| **Cell Radius (km)** | 8 |
| **Antenna Pattern** | Rec. ITU-R F.1336-3 |
| **Number of Interferers** | 7 sites with 21 sectors |

# 2 Results and Conclusions

The study is conducted with the parameters available in the tables above; additional simulations with some other variable parameters are conducted to analyze their effect.

The results of probability of interference for each case with respect to the distance are provided in the tables below:

## 2.1 Scenario of Co-Channel Interference from multiple IMT Base-stations into DTTB Rx in rural environment with baseline parameters

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| --- | --- |
| Probability of Interference (C/N+I) | |
| Distance (km) | DTTB HPHT Tx |
| 1 | 48.10% |
| 1.5 | 19.00% |
| 2 | 0.00% |

## 2.2 Analysis of varying factors on the scenario of Co-Channel Interference from IMT Base-station Tx to DTTB Rx

The impact of varying several parameters on the analysis of the co-channel interference from IMT Base-station Tx to DTTB Rx is investigated to study their effect on the probability of interference.

Case (1): Sharing results considering DTTB Rx height of 1.5m

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| --- | --- |
| Distance (km) |  |
| 0.4 | 83.40% |
| 0.6 | 72.80% |
| 0.8 | 60.40% |
| 1 | 48.70% |
| 1.2 | 35.60% |
| 1.4 | 21.80% |
| 1.6 | 11.20% |
| 1.8 | 3.00% |
| 2 | 0.00% |

Case (2): Sharing results considering variable location of DTTB Rx

|  |  |
| --- | --- |
| Distance (km) |  |
| 0.4 | 17.50% |
| 0.6 | 10.00% |
| 0.8 | 5.90% |
| 1 | 2.80% |
| 1.2 | 1.10% |
| 1.4 | 0% |

Case (3): Sharing results considering variable IMT Tx power

|  |  |
| --- | --- |
| Distance (km) |  |
| 0.5 | 7.9% |
| 1 | 1.80% |

# 3 Summary

This study analyzed the probability of interference occurrence and any potential coordination distance between IMT and DTTB systems to ensure no harmful impact on the broadcasting receivers within the co-channel scenarios. The results showed that coordination distance can be below 1 km.

It has been noted that some parameters are considered as the worst case scenario such as the 100% outdoor BS receivers. However and in reality, the majority of BS receivers will be indoor which will have much less interference probability.

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