



Report ITU-R M.2518-0
(11/2022)

**Terrestrial International Mobile
Telecommunications for remote sparsely
populated areas providing
high data rate coverage**

M Series
**Mobile, radiodetermination, amateur
and related satellite services**



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Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from <http://www.itu.int/ITU-R/go/patents/en> where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

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Note: This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.

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1 Introduction

The prospect of providing mobile and fixed wireless broadband services for most of the unconnected people, living in underserved rural areas, is largely related to techno-economic circumstances. As it has been indicated in the World Telecommunication/ICT Indicators Database, with 29 July 2022 data¹, 2.7 billion people are still unconnected.

This Report provides details on scenarios associated with the provisioning of enhanced mobile broadband services in sparsely populated and underserved remote areas with a discussion on enhancements of user and network equipment. Mobile broadband access in rural and remote areas can be done by various existing user equipment and additionally, broadband can be delivered also by fixed wireless access (FWA) type of consumer premises equipment (CPE). It offers technical solutions for certain deployment scenarios prevailing in developing countries and is meant to be used in accordance with the existing regulations in those countries.

2 Background

More than a billion people still live in areas that are not covered by mobile broadband networks and a significant portion of them (~95%) live in middle-income or low-income countries. One of the most significant challenges in providing users with mobile coverage is affordability in deploying and maintaining cell sites in regions with very low density of users and limited infrastructure.

For the purpose of this Report, rural areas are defined as low population density areas where agriculture dominates and only a basic infrastructure exists. Remote areas have even lower population densities and limited infrastructure. Much of the global population that is currently unconnected lives in remote locations with low population density and weak or non-existent enabling infrastructure (e.g. roads and/or electricity). All these characteristics negatively influence the expansion of mobile network in such areas as the investment remains the same. Providing affordable mobile broadband connectivity in such areas/regions is challenging.

In many countries, national policymakers have recognized the necessity to introduce policies and solutions to ensure connectivity in underserved and remote areas.

Further challenges that limit the reach of mobile broadband in sparsely populated areas are, for example, infrastructure requirements, backhaul connectivity, operation and maintenance, sparse distribution of population and so on. However, some of the remote areas have industrial plants, excavation units and mining with temporary human occupancy or shelters, which would benefit from broadband connectivity.

Remote coverage might in the future be driven by the need for national security and public safety connectivity, intelligent traffic systems, Internet of things, industry automation and end users need for home and commercial broadband services as an alternative to fibre connections. In order to fulfil the needs of remote coverage, it is important to identify viable solutions for mobile and fixed wireless broadband services.

3 Related ITU Recommendations and Reports

ITU-R Recommendations

ITU-R M.819 – International Mobile Telecommunications-2000 (IMT-2000) for developing countries

ITU-R M.1036 – Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations

¹ <https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>. The database is revised frequently.

ITU-R M.1645 – Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000

ITU-R M.2012 – Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications Advanced (IMT-Advanced)

ITU-R M.2083 – IMT Vision - Framework and overall objectives of the future development of IMT for 2020 and beyond

ITU-R M.2150 – Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2020 (IMT-2020)

ITU-R P.833 – Attenuation in vegetation

ITU-R P.2001 – A general purpose wide-range terrestrial propagation model in the frequency range 30 MHz to 50 GHz

ITU-R P.2108 – Prediction of clutter loss

ITU-R P.2109 – Prediction of building entry loss

ITU-R Reports

ITU-R M.1155 – Adaptation of mobile radiocommunication technology to the needs of developing countries

ITU-D Reports

Available at <https://www.itu.int/en/ITU-D/Study-Groups/2018-2021/Pages/Publications.aspx>

Question 1/1: Strategies and policies for the deployment of broadband in developing countries

Question 5/1: Telecommunications/ICTs for rural and remote areas

4 Solutions that support remote sparsely populated areas providing high data rate coverage

Possible technical solutions to achieve both extended coverage as well as high capacity in remote areas could be to use dual frequency bands at the same time, one lower band for the uplink (UL) and one higher band for the downlink (DL) in aggregated configurations.

Combining spectrum bands in the mid-band range (1-6 GHz) and the low-band range (below 1 GHz) on an existing grid can provide extended capacity compared to a network only using the low-band range.

An alternative technical solution to provide extended coverage in a remote area using existing or reduced number of terrestrial base station (BS) sites requires careful selection of proper locations and technical characteristics compared to configurations of suburban networks. Realizing such extended network configuration for coverage, several considerations need to be taken into account, both at a BS site and at customer premises. Considerations of accommodating BSs on high towers in sparsely populated areas could be further studied². Performance limitations usually arise in the uplink, arising from the handset designs: higher noise figure and, (due to regulation) limited transmission power of 23 dBm. Such large cell designs therefore typically rely on the use of external CPE with large gain antennas, and high processing and computation power and stable power supply.

In order to extend broadband services to remote areas, IMT systems can benefit by employing high gain antennas. One proposed solution is to use a few high-gain (up to 29.5 dBi), narrow beam x-pole

² Such opportunities rest with traditionally high tower used for analogue or digital television with an average inter-site distance (ISD) of the order of 60 km to 80 km designed to provide blanket coverage of national terrestrial television services.