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| **Radiocommunication Study Groups** |  |
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| **18 January 2024** |
| **English only** |
| Working Party 5A | |
| OVERVIEW of THE itu-r texts relating to the land mobile service, Including wireless access in the fixed service | |
| *(Last update: 18 January 2024)* | |



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*Contact:* [Chair, Radiocommunication Working Party 5A](https://www.itu.int/online/compass/cvc.v2.sh?topic=WP5A&head_title=List%20of%20Working%20Parties%20and%20Joint%20Task%20Group%20Chairmen%20and%20Vice-Chairmen)

# 1 Scope

This document describes the various topics that are relevant to the land mobile service (LMS), including wireless access in the fixed service, and identifies the ITU-R texts (Recommendations, Reports and Handbooks) applicable to these topics. The information included in this document is based on completed work within the ITU-R. The ongoing work on these topics is documented in the latest Working Party (WP) 5A Chair’s Report[[1]](#footnote-1).

Useful links:

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| Free online access to ITU-R Publications, Software and Databases: | <http://www.itu.int/oth/R040200003C/en> |
| Search ITU Publications: | <http://www.itu.int/en/publications/Pages/Search.aspx> |

# 2 Land mobile service

As defined in Article **1** of the Radio Regulations (RR), land mobile service is a mobile service between base stations and land mobile stations, or between land mobile stations (RR No. **1.27**). Spectrum regulatory work on the land mobile service can be subdivided into a number of different topics. Based on the past and ongoing work within the ITU on land mobile service, the following topics have been established:

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| Topic | Description |
| Spectrum sharing | Studies coexistence and compatibility between different services and systems involving land mobile service applications operating in the same or adjacent frequency bands. |
| Interference | Incorporates a number of studies dealing with the effect of unwanted energy on applications in land mobile service. |
| Technology | Recent studies about the application and implementation of land mobile equipment. |
| Public protection and disaster relief (PPDR) | Systems dealing with protection of life and property, emergency situations and with a serious disruption of functioning of society. |
| Utility radiocommunications | Radiocommunication systems and applications in the land mobile service that can be used by electric, gas, and water utilities |
| Intelligent transport systems (ITS) | Systems utilizing communications and automation technologies to improve management and efficiency of terrestrial transportation. |
| Wireless access, including radio local area networks (RLANs) | End-user radio connection(s) to broadband networks. |
| Trunked systems | High performance radio systems which provide a variety of voice and data services for professional users. |
| Cellular systems | Wireless network that enables the use of hand-held mobile stations for transmission of voice, data, and other types of contents. |
| Cordless telecommunication systems | Communication system that uses radio to connect a portable handset to a dedicated base station. |
| Personal radio | Particular radio devices for direct communication without relying on an infrastructure controller or other equipment. |
| Other systems | Paging systems, conventional systems, machine communications |

Each of these topics is largely described below, including relevant definitions and the identification of the applicable ITU-R texts available[[2]](#footnote-2).

The various definitions related to these topics of the land mobile service have been assembled to create a vocabulary of terms for the terrestrial mobile service (Recommendation [ITU-R M.1797](https://www.itu.int/rec/R-REC-M.1797/en)). Other vocabulary recommendations exist for wireless access (Recommendation [ITU-R F.1399](https://www.itu.int/rec/R-REC-F.1399/en)) and the fixed service in general (Recommendation [ITU-R F.592](https://www.itu.int/rec/R-REC-F.592/en)).

A complete list of relevant Recommendations, Reports and Handbooks is contained in the [Annex A](#Annex) to this Guide. The abbreviations and acronyms used in this Guide are listed in [Annex B](#annex_b).

# 3 Spectrum sharing

Since the frequency bands allocated to the land mobile service are shared with other radio-communication services or that some of these bands may be used by different types of systems in the land mobile service, there has been a need to develop ITU-R deliverables on dealing with the issue of sharing in relation with the land mobile service.

These ITU-R texts cover both general methodologies that can apply to various cases and specific sharing scenarios where detailed analysis and means to improve the sharing were required. In particular, Recommendation [ITU-R M.1825](https://www.itu.int/rec/R-REC-M.1825/en) provides guidance to perform sharing studies related to systems in the land mobile service. It establishes a list of parameters that characterize a system to assist in sharing studies, provides information on the methodologies that can be used for sharing analyses involving the land mobile service and describes mitigation techniques that can improve spectrum sharing.

For the purpose of sharing studies involving land mobile systems, probabilistic considerations may be required to determine the sensitivity of variations of some key parameters. Recommendation [ITU‑R M.1634](https://www.itu.int/rec/R-REC-M.1634/en) recommends the use of Monte Carlo simulation analysis methodology, among other suitable methodologies, to calculate interference probability when performing studies of interference involving terrestrial mobile service systems. More details on the Monte Carlo simulation methodology for the use in sharing and compatibility studies between different radio services and systems can be found in Report [ITU-R SM.2028](http://www.itu.int/pub/R-REP-SM.2028/en).

Since there are several frequency bands, especially below 1 GHz, in the Radio Regulations that are allocated to both the mobile and the mobile-satellite services (MSS), ITU-R produced Recommendation [ITU-R M.1039](http://www.itu.int/rec/R-REC-M.1039/en) dealing with co-frequency sharing between stations in the mobile service below 1 GHz and mobile earth stations of non-geostationary mobile-satellite systems (Earth‑space) using frequency division multiple access.

Due to the fact that many bands below 1 GHz are shared between the land mobile service and the broadcasting service (television), Report [ITU-R M.1023](http://www.itu.int/pub/R-REP-M.1023/en) was published in 1990, providing guidance on the possibility of frequency sharing between the land mobile service and the broadcasting service, in particular analogue television below 1 GHz. In addition, Recommendation [ITU-R M.1767](http://www.itu.int/rec/R-REC-M.1767/en) gives protection criterion of land mobile systems from terrestrial digital video and audio broadcasting systems in the very high frequency (VHF) (174-230 MHz) and ultra high frequency (UHF) (470‑862 MHz) shared bands allocated on a primary basis, where appropriate.

The band 1 452-1 492 MHz, allocated to the mobile service on a primary basis, is also allocated to the broadcasting-satellite service (sound) subject to the provisions of RR No. **5.345**. For that reason, Recommendation [ITU-R M.1388](http://www.itu.int/rec/R-REC-M.1388/en) deals with threshold levels to determine the need to coordinate between space stations in the broadcasting-satellite service (sound) and particular systems in the land mobile service in the band 1 452‑1 492 MHz.

In addition, it should be noted that several ITU-R texts have been developed on sharing issues related with wireless access including RLANs (see [Section 8](#_8_Wireless_Access,) for further details).

*Characteristics of systems and specific compatibility studies:* A number of Recommendations and Reports are being developed which contain characteristics of systems for sharing studies. The following ones are in force:

– Recommendation [ITU-R M.1795](http://www.itu.int/rec/R-REC-M.1795/en) provides technical and operational characteristics of land mobile service MF/HF systems for use in sharing studies.

– Recommendation [ITU-R M.1808](http://www.itu.int/rec/R-REC-M.1808/en) provides technical and operational characteristics of conventional and trunked land mobile systems to be used in sharing studies. Given the variety of those systems within the mobile service below 869 MHz, a range of parameters and typical values are provided for different analogue as well as digital systems. This Recommendation is not intended to deal with characteristics of digital cellular land mobile systems.

– Recommendation [ITU-R M.1823](http://www.itu.int/rec/R-REC-M.1823/en) provides technical and operational characteristics of digital cellular land mobile systems for use in sharing studies. It provides the relevant characteristics for some specific systems used for digital cellular land mobile communications and complements the information available in Recommendation [ITU‑R M.1073](http://www.itu.int/rec/R-REC-M.1073/en).

– Recommendation [ITU-R M.1824](http://www.itu.int/rec/R-REC-M.1824/en) provides system characteristics of television outside broadcast (TVOB), electronic news gathering (ENG) and electronic field production (EFP) in the mobile service to assist sharing studies, contains the typical operational and technical characteristics of broadcast auxiliary services (BAS)[[3]](#footnote-3), which are required for sharing studies between the BAS in the mobile service and other radiocommunication services.

– Recommendation [ITU-R M.2068](http://www.itu.int/rec/R-REC-M.2068) provides characteristics of and protection criteria for systems operating in the mobile service in the frequency range 14.5-15.35 GHz.

– Recommendation [ITU-R M.2134](https://www.itu.int/rec/R-REC-M.2134/en) provides receiver characteristics and protection criteria for systems in the mobile service in the frequency range 27.5-29.5 GHz for use in sharing and compatibility studies.

– Report [ITU-R M.2116](http://www.itu.int/pub/R-REP-M.2116/en) provides characteristics for a number of terrestrial broadband wireless access (BWA) systems, including mobile and nomadic applications, operating, in the mobile service for use in sharing studies between these terrestrial BWA systems and other fixed or mobile systems.

– Report [ITU-R M.2335](http://www.itu.int/pub/R-REP-M.2335) contains a sharing and compatibility analysis of possible amateur service stations with fixed, land mobile, and radiolocation services in the frequency band 5 250-5 450 kHz and the aeronautical mobile service in an adjacent band.

– Report [ITU-R M.2517](http://www.itu.int/pub/R-REP-M.2517) provides the coexistence scenarios between LMS and FS applications operating in the frequency range 252-296 GHz, allowing to have a possible operation in co-frequency and adjacent frequency bands.

– Report [ITU-R S.2199](http://www.itu.int/pub/R-REP-S.2199) examines the possibility of compatibility between BWA systems and fixed-satellite service (FSS) networks in the range 3 400-4 200 MHz for both co‑channel and adjacent channel operations.

# 4 Interference

The term “interference” is defined in RR No. **1.166** as “The effect of unwanted energy due to one or a combination of *emissions*, *radiations*, or inductions upon reception in a *radiocommunication* system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.”

Within the framework of the ITU-R, a number of studies have been carried out on the concept of harmful interference (RR No. **1.169**) and the ways to address it.

The main effects that characterise interference are:

– unwanted emissions (RR No. **1.146**) that consist of spurious emissions and out-of-band emissions,

– blocking of the receiver,

– effect of intermodulation products.

These effects are not necessarily specific to the land mobile service and are described in some essential ITU-R texts that have been developed within Study Group 1 and that are applicable, *inter alia*, to the land mobile service, such as Recommendation [ITU-R SM.329](https://www.itu.int/rec/R-REC-SM.329/en) on “unwanted emissions in the spurious domain”, Recommendation [ITU-R SM.1541](http://www.itu.int/rec/R-REC-SM.1541/en) on “unwanted emissions in the out-of-band domain” (where, in particular, Annex 10 provides the out-of-band emission limits for land mobile systems). Other texts from the SM series deal more specifically with intermodulation effects, in particular in relation with land mobile service, such as Recommendation [ITU-R SM.1134](http://www.itu.int/rec/R-REC-SM.1134/en) and Report [ITU-R SM.2021](http://www.itu.int/pub/R-REP-SM.2021).

In addition to those general texts, ITU-R has developed deliverables on issues related to interference that are more specific to the land mobile service.

On the complex issue of intermodulation products, Report [ITU-R M.739](http://www.itu.int/pub/R-REP-M.739) contains detailed information on the production of intermodulation products in transmitters and the intermodulation response at the output of a receiver for the land mobile service between 25 and 1 000 MHz. Recommendation [ITU-R M.1072](https://www.itu.int/rec/R-REC-M.1072/en) provides possible means to reduce interference due to intermodulation products in the land mobile service between 25 and 3 000 MHz.

Report [ITU-R M.2141](https://www.itu.int/rec/R-REC-M.2141/en) provides information on the determination of isolation for mobile radio antennas separated horizontally less than a few wavelengths in the 30 to 108 MHz bands. The study presents analytical and experimental isolation results for two antennas.

– *Propagation:* The [ITU-R Handbook](http://www.itu.int/pub/R-HDB-44-2002/en) “Terrestrial land mobile radiowave propagation in the VHF/UHF bands” (2002) gives the technical basis for predicting the radio propagation in point-to-point, point-to-area, and point-to-multipoint mobile networks.

# 5 Technology

Technology is the key enabler of all the land mobile systems and applications and over the years, a number of ITU-R Recommendations and Reports have been developed to address specific technology issues at the time. However, technology advances very quickly and, in many cases, it relates to implementation issues that are not necessarily in the scope of the work of ITU-R. Therefore, the reader should exert caution when considering the Recommendations and Reports outlined in this section; they all contain valuable information but, in some cases, the technologies may have been surpassed and due to priorities, it has not been possible to update or suppress obsolete information. This overview organizes the existing texts about technology in the following applications: channel assignments, impaired hearing solutions, transmission, public switched telephone network (PSTN) in aircrafts, antennas, and implementation technologies.

*Channel assignments:* Recommendation [ITU-R M.478](https://www.itu.int/rec/R-REC-M.478/en) gives the preferred technical characteristics for VHF and UHF land mobile equipment using F3E class of emission, including the considerations of the necessary bandwidth, the transmitter, the receiver and the station characteristics.

*Impaired hearing solutions:* Recommendation [ITU-R M.1076](https://www.itu.int/rec/R-REC-M.1076/en) recommends the technical parameters for radiocommunication systems for persons with impaired hearing and the practical application of infrared systems and audio frequency induction loops to communicating with persons with impaired hearing that should be considered for some applications.

*Transmission:*

Report [ITU-R M.2026](http://www.itu.int/pub/R-REP-M.2026/en) introduces in detail real-zero single sideband technology (RZ SSB), which is a combination of two technologies employing digital signal processing techniques; SSB modulation and phase modulation (PM) reception.

Report [ITU-R M.2117](http://www.itu.int/pub/R-REP-M.2117/en) addresses the application and implications of software-defined radio (SDR) to land mobile systems, including issues on the efficient use of spectrum using SDR techniques and adaptive control mechanisms, frequency-sharing issues relating to SDR and general technical issues.

*PSTN in aircrafts:* Report [ITU-R M.2282](http://www.itu.int/pub/R-REP-M.2282/en) deals with the general principles, technical characteristics and operational features of terrestrial systems for public mobile communications with aircraft, including descriptions of systems for public communications with aircraft in some countries in Region 1, Region 2, and Region 3.

*Antennas:* Recommendation [ITU-R M.1678](https://www.itu.int/rec/R-REC-M.1678/en) recommends aspects on the use of adaptive antenna systems. Technical details of adaptive antennas are in Report [ITU-R M.2040](http://www.itu.int/pub/R-REP-M.2040/en).

*Implementation technologies:* Report [ITU-R M.2114](http://www.itu.int/pub/R-REP-M.2114/en) defines the essential technical and operational characteristics needed to support IP applications over mobile systems. Report [ITU-R M.2117](http://www.itu.int/pub/R-REP-M.2117/en) addresses the application and implications of software defined radio to mobile systems, including, but not limited to, IMT-2000 and systems beyond, dispatch systems, ITS, public mobile systems including PPDR, and first and second generation cellular systems including their enhancements. It addresses issues on the efficient use of spectrum using SDR techniques and adaptive control mechanisms, frequency sharing issues relating to SDR and general technical issues.

*Cognitive radio systems (CRS):* Report [ITU-R M.2225](http://www.itu.int/pub/R-REP-M.2225) addresses the cognitive radio systems in the LMS above 30 MHz (excluding international mobile telecommunications (IMT)). It provides a general description of cognitive radio systems addressing technical features and capabilities, potential benefits and technical challenges. It also describes a set of deployment scenarios. Report [ITU-R M.2330](http://www.itu.int/pub/R-REP-M.2330) presents the existing, emerging and potential applications employing CRS capabilities and the related enabling technologies, including the impacts of CRS technology on the use of spectrum from a technical perspective. The description of such technologies, operational elements and their challenges are also presented. Furthermore, this Report provides high level characteristics, operational and technical requirements related to CRS technology, their performances and potential benefits. Finally, factors related to the introduction of CRS technologies and corresponding migration issues are discussed.

*Systems above 275 GHz:* Report [ITU-R M.2417](http://www.itu.int/pub/R-REP-M.2417) provides the technical and operational characteristics of land-mobile service applications in the frequency range 275-450 GHz for sharing and compatibility studies.

# 6 Mission Critical Applications

Mission critical communications are used by agencies and organizations to carry out their activities, in situations where human life, property and other values for the society are at risk, especially when time is a vital factor. Mission critical communications must always be secure, reliable and readily available and as a consequence responders cannot afford the risk of having failures in their individual and group communications (e.g., voice and data or video transmissions). Business-critical services exist in multiple industries, such as utilities, rail, natural resources, airports, ports and manufacturing.

# 6.1 Public protection and disaster relief

Radiocommunication services have become extremely important to PPDR organizations to the extent that PPDR communications are highly dependent upon a range of radiocommunication services, particularly the mobile service. Experience from recent major disaster events has shown that at times, these agencies are solely dependent on radiocommunication services as the only form of communications available. Trunked systems (see [Section 9](#_9_Trunked_Systems_1)) are often used for PPDR applications.

In order to provide effective communications, PPDR agencies and organizations have a set of objectives and requirements that include interoperability between agencies and staff in the field, reliability, functionality, security in operations and fast call set-up for rapid access to wider communication networks. Considering that the functional needs of PPDR agencies and organizations are growing, future advanced solutions used in PPDR applications will require higher data rates than narrow-band solutions predominantly in use today, along with video and multimedia capabilities.

Resolution [ITU-R 55](https://www.itu.int/pub/R-RES-R.55) provides guidance to the ITU-R Study Groups on “ITU-R studies of disaster prediction, detection, mitigation and relief.”

Resolution [**646 (Rev.WRC-19)**](https://www.itu.int/oth/R0A0600009E/en)encourages administrations to use harmonized frequency ranges for PPDR, including broadband PPDR, and provides both globally as well as regionally harmonized ranges and Resolution [**647 (Rev.WRC-19)**](https://www.itu.int/oth/R0A0600001B/en) provides additional instructions on the radiocommunication aspects, including spectrum-management guidelines, for early warning, disaster prediction, detection, mitigation and relief operations relating to emergencies and disasters.

Recommendation [ITU-R M.1042](https://www.itu.int/rec/R-REC-M.1042/en) “Disaster communications in the amateur and amateur-satellite services” provides guidance on the roles of the amateur and amateur satellite services in providing communications during disaster situations.

Recommendation [ITU-R M.1637](http://www.itu.int/rec/R-REC-M.1637/en) “Global cross-border circulation of radiocommunication equipment for use in emergency and disaster relief situations” offers guidance to facilitate the global circulation of radiocommunication equipment in emergency and disaster relief situations including the need for plans and procedures to be in place before a possible disaster event in order to facilitate the speedy authorization of the use of such equipment.

Recommendation [ITU-R M.1746](http://www.itu.int/rec/R-REC-M.1746/en) addresses system interoperability and harmonized frequency channel plans for the protection of property using data communication.

Recommendation [ITU-R M.1826](http://www.itu.int/rec/R-REC-M.1826/en) addresses harmonized frequency channel plans in the band 4 940‑4 990 MHz for broadband public protection and disaster relief radiocommunications in Regions 2 and 3.

Recommendation [ITU-R M.2009](http://www.itu.int/rec/R-REC-M.2009/en) “Radio interface standards for use by public protection and disaster relief operations in accordance with Resolution **646 (WRC‑15)**” identifies radio interface standards applicable for PPDR operations in some parts of the UHF band.

Recommendation [ITU-R M.2015](http://www.itu.int/rec/R-REC-M.2015/en) “Frequency arrangements for public protection and disaster relief radiocommunication systems in accordance with Resolution **646 (Rev.WRC‑15)**” provides guidance on frequency arrangements for public protection and disaster relief radiocommunications in certain regions in some of the bands identified in Resolution **646 (Rev.WRC-15)**.

Report [ITU-R M.2085](http://www.itu.int/pub/R-REP-M.2085/en) “Role of the amateur and amateur-satellite services in support of disaster mitigation and relief” is intended to document the role of the amateur and amateur-satellite services in provision of radiocommunications in support of disaster mitigation and relief. It includes information developed after the South-East Asia tsunami in December 2004.

Report [ITU-R M.2377](http://www.itu.int/pub/R-REP-M.2377/en) “Radiocommunication objectives and requirements for Public Protection and Disaster Relief (PPDR)” defines the PPDR objectives and requirements for the implementation of future advanced solutions to satisfy the operational needs of PPDR organizations. Specifically, it addresses:

– the categorization of operational, technical and functional objectives and requirements relating to PPDR systems;

– the use of PPDR systems, not only in terms of generic capabilities, but also as they vary according to narrowband, wideband and broadband capabilities;

– the development of mobile broadband PPDR services and applications enabled by the evolution of advanced broadband technologies;

– the efficient and economical use of the radio spectrum; and

– the needs of developing countries.

Report [ITU-R M.2415](http://www.itu.int/pub/R-REP-M.2415/en) “Spectrum needs for Public Protection and Disaster Relief (PPDR)”, addresses the estimation of the spectrum needs for PPDR by providing:

– a method of estimating the amounts of spectrum;

– system scenarios and assumptions;

– validation of the method with respect to existing applications; and

– examples of different national and/or regional spectrum needs for narrowband, wideband and broadband PPDR systems.

# 6.2 Utilities

Utility Radiocommunications systems are wireless systems used by utilities for voice and data communications to support their electricity, water or gas operations. Modern society relies so much on electricity that, without power, it would cease to function. Modern society is at a point where it cannot afford to have a power outage (due to either a storm or a cyberattack), which not only causes a direct loss of electrical supplies, but has a consequential impact on water supplies, sewage disposal, refrigeration, delivery of other energy sources such as oil and gas and other services essential for life.

Report [ITU-R M.2533](http://www.itu.int/pub/R-REP-M.2533) describes radiocommunication systems and applications in the land mobile service that can be used by electric, gas, and water utilities, and highlights how utilities can utilize these systems to support their needs for mobile voice and data communications as well as fixed wireless access.

# 7 Intelligent transport systems

Intelligent transport systems (ITS) are defined as systems utilizing the combination of computers, communications, positioning, and automation technologies to improve the safety, management, and efficiency of terrestrial transportation. Work on ITS within the ITU was initiated in 1995, due to a significant increase in traffic on the roads, along with the growing need to integrate new technologies into land transport systems. At that time, ITS was referred to as Transport Information and Control Systems (TICS). In 2003, the term ‘TICS’ was replaced by ‘ITS’, due to the more prevalent use of the term ‘ITS’ within the industry; however, the definition remains the same for both terms.

Recommendation [ITU-R M.1890](http://www.itu.int/rec/R-REC-M.1890) provides the objectives and radio requirements of ITS. This Recommendation establishes a framework or foundation for subsequent studies and output that are technology (such as dedicated short range communications (DSRC), collision avoidance radar, or ITS millimetre wave radiocommunication) or application specific.

Dedicated short range communications, a fundamentally unique application to ITS, use non-voice radiocommunication techniques to transfer data over short distances between a roadside infrastructure and mobile units. Recommendation [ITU-R M.1453](http://www.itu.int/rec/R-REC-M.1453/en) describes the technical and operational characteristics of DSRC for ITS applications in the 5 725-5 875 MHz (centre frequency 5.8 GHz) industrial, scientific and medical (ISM) band.

Another important application of ITS is the use sensor technologies for the monitoring and identifying of objects near vehicles. It was determined that radar using radio waves is suitable for this application. Subsequently, Recommendation [ITU-R M.1452](https://www.itu.int/rec/R-REC-M.1452) covers vehicular collision avoidance radar operating in the 76-77 GHz and 77-81 GHz bands, as well as integrated millimetre wave radiocommunication systems for ITS applications in the 57-66 GHz range for vehicle-to-vehicle radiocommunications and radiocommunications between the vehicle and roadside infrastructure.

Recommendation [ITU-R M.2057](http://www.itu.int/rec/R-REC-M.2057/en) provides system characteristics of automotive radars operating in the frequency band 76-81 GHz for intelligent transport systems applications.

Recommendation [ITU-R M.2084](http://www.itu.int/rec/R-REC-M.2084/en) recommends specific radio interface standards and technical specifications for vehicle-to-vehicle and vehicle-to-infrastructure communications, which includes two-way communications between vehicle and infrastructure, for ITS applications. The technical characteristics described in this Recommendation are based on current ITS applications in the mobile service.

Recommendation [ITU-R M.2121](http://www.itu.int/rec/R-REC-M.2121/en) provides guidance on harmonized frequency bands to be used by ITS and encourages administrations to use harmonized frequency bands for ITS applications.

Report [ITU-R M.2228](http://www.itu.int/pub/R-REP-M.2228) provides characteristics, requirements and status of advanced ITS radiocommunications in various countries.

Report [ITU-R M.2444](http://www.itu.int/pub/R-REP-M.2444) provides examples of arrangements for ITS deployments in certain regions and countries to assist administrations in their planning for deployment of ITS within their jurisdictions and to assist in improving traffic management and safe driving.

Report [ITU-R M.2445](http://www.itu.int/pub/R-REP-M.2445) addresses the usages of ITS radiocommunication applications, such as vehicle-to-infrastructure, vehicle-to-vehicle, vehicle-to-pedestrian communications for traffic safety related and traffic efficiency applications as well as electronic tolling systems and automotive radars for collision avoidance in ITU Member States. This report identifies current and planned usage of ITS technologies, frequency bands, status of standardization, applications and deployments in ITU Member States.

Report [ITU-R M.2534](http://www.itu.int/pub/R-REP-M.2534) provides Connected Automated Vehicle (CAV) terminology, descriptions of radiocommunication methods and radiocommunication systems for CAV, as well as radiocommunication requirements and initial spectrum needs for CAV. The status of global development of CAV is also included. The scope of this Report is focused on the ad hoc, short range radiocommunication for Intelligent Transport Systems (ITS) among vehicles, and among vehicles and infrastructure.

Report [ITU-R M.2395](http://www.itu.int/pub/R-REP-M.2395) focuses on a case study of measurement results of radio communication characteristics between train and ground stations in the millimetric wave frequency ranges for some railway deployment scenarios, in order to assess, among others, the impacts of 1) future broadband transmission and 2) high mobility of more than 300 km/h in millimetric wave frequency ranges, on current and future railway radiocommunication systems.

Report [ITU-R M.2418](http://www.itu.int/pub/R-REP-M.2418) addresses the architecture, applications, technologies and operational scenarios of Railway Radiocommunication Systems between Train and Trackside (RSTT) for all types of trains (e.g., high-speed trains, passenger trains, freight trains, and metro trains).

Report [ITU-R M.2442](http://www.itu.int/pub/R-REP-M.2442) addresses the technical and operational characteristics and the spectrum usage of current and planned RSTT as well as the studies on spectrum needs of RSTT. Detailed information on RSTT in some administrations is also provided in annexes.

Report [ITU-R M.2500](https://www.itu.int/pub/R-REP-M.2500) provides results of sharing and compatibility studies between high-speed railway radiocommunication system between train and trackside operating in the bands 92-94 GHz, 94.1-100 GHz and 102-109.5 GHz, and EESS (active), EESS (passive) and RAS operating in these or adjacent bands. The results of analyses contained within this Report are limited to the RSTT system and deployment described therein.

Finally, [Volume 4](http://www.itu.int/pub/R-HDB-49/en) of the ITU-R Handbook on *Land Mobile (including Wireless Access)*, provides a tutorial on ITS, with specific examples of ITS applications. This Volume also complements the Recommendations completed to date and provides examples of ITS applications and on-going work.

# 8 Wireless access, including RLANs

[Wireless access](https://www.itu.int/net/ITU-R/index.asp?category=study-groups&rlink=rwp8a-was&lang=en) has been defined as end-user radio connection(s) to broadband networks. In the 1990s, cellular mobile technologies became attractive to support fixed telephone access in many areas. ITU-R has recommended a vocabulary for wireless access (Recommendation [ITU-R F.1399](http://www.itu.int/rec/R-REC-F.1399/en)).

## 8.1 Fixed wireless access

One of the origins of fixed wireless access (FWA) is perhaps in the use of mobile-derived cellular technologies to provide wireline access replacement to the PSTN, which became very attractive in the 1990s. A recommendation established the basic system requirements and performance objectives for fixed wireless access using mobile-derived technologies offering telephony and data communication services (Recommendation [ITU-R F.757](http://www.itu.int/rec/R-REC-F.757/en)).

Two important considerations for the successful deployment of FWA systems are the frequency bands that can be used for such an application and the quality of service (QoS) requirements, particularly if FWA is to be considered as a competitive alternative to wireline access.

Recommendation [ITU-R F.1400](http://www.itu.int/rec/R-REC-F.1400/en) specifies performance and availability requirements and objectives for fixed wireless access to public switched telephone network. These requirements are based on ITU‑T Recommendations and are given for three classes of telecommunication services in terms of the supported bit rates. Recommendation [ITU-R F.1490](http://www.itu.int/rec/R-REC-F.1490/en) provides generic requirements for FWA systems mainly from the point of view of integration with the core network.

Recommendation [ITU-R F.1401](http://www.itu.int/rec/R-REC-F.1401/en) describes general characteristics of the bands in the frequency spectrum that may be used for FWA systems and it also provides considerations for the identification of possible frequency bands, including examples of Recommendations dealing with spectrum sharing studies. This Recommendation includes the identification of mobile service bands for fixed wireless access.

To facilitate the deployment of FWA systems from a regulatory perspective, it is desirable to specify the frequency arrangements in terms of blocks rather that by carrier, which was the traditional way previously. Recommendation [ITU-R F.1488](http://www.itu.int/rec/R-REC-F.1488/en) recommends the frequency block arrangements for FWA systems in the range 3 400-3 800 MHz, and it is perhaps the first recommendation specifying frequency arrangements in terms of blocks. Other examples of frequency block arrangements are reflected also in Recommendations [ITU-R F.748](http://www.itu.int/rec/R-REC-F.748/en) and [ITU-R F.749](http://www.itu.int/rec/R-REC-F.749/en) which handle radio-frequency arrangements in the frequency ranges of 25-28 GHz and 36‑40.5 GHz, respectively. Furthermore, Recommendation [ITU-R F.1519](http://www.itu.int/rec/R-REC-F.1519/en) specifies general principle of the block arrangements.

Specific frequency sharing considerations for FWA systems are addressed in a number of recommendations, including:

– Recommendation [ITU-R F.1402](http://www.itu.int/rec/R-REC-F.1402/en), which recommends frequency sharing criteria between a land mobile wireless access (MWA) system and a fixed wireless access (FWA) system using the same equipment type as the MWA system.

– Recommendation [ITU-R F.1489](http://www.itu.int/rec/R-REC-F.1489/en), which recommends a methodology for assessing the level of operational compatibility between FWA and radiolocation systems when sharing the band 3.4-3.7 GHz.

– Recommendation [ITU-R F.1518](http://www.itu.int/rec/R-REC-F.1518/en), which recommends a spectrum requirement methodology for FWA and MWA networks using the same type of equipment, when coexisting in the same frequency band.

– Recommendation [ITU-R F.1613](http://www.itu.int/rec/R-REC-F.1613/en), which recommends operational and deployment restrictions for FWA systems in Region 3 to ensure the protection of systems in the Earth exploration-satellite service (EESS) (active) and the space research service (active) in the band 5 250-5 350 MHz.

There is also a standard for fixed BWA radio transmission systems based on cable modem standards, given in Recommendation [ITU-R F.1499](http://www.itu.int/rec/R-REC-F.1499/en).

Recommendation [ITU-R F.1763](http://www.itu.int/rec/R-REC-F.1763) specifies radio interface standards for BWA systems in the fixed service operating below 66 GHz.

There are a number of other recommendations and reports that contain elements applicable to both wireless access in the fixed service and fixed systems. These are included in the [Annex A](#Annex) but they are not described in this guide unless specific aspects need to be highlighted.

From a practical perspective many aspects of the deployment of FWA systems are covered in [Volume 1](https://www.itu.int/pub/R-HDB-25) of the ITU-R Handbook on *Land Mobile (including Wireless Access)*.

## 8.2 Nomadic wireless access

The major usage within the category nomadic wireless access (NWA) is for RLANs. Elimination of the cables in a conventional wired network has obvious attractions: for example, in a commercial environment there may be considerable savings in both cost and time to install a network. However, a number of factors have driven the demand for RLANs further:

– Domestic broadband installations are particularly suited to using RLANs as a means of providing cheap, flexible, connectivity to multiple computers used in the home.

– The increasing use of portable computers, for both business and domestic use and the increase in flexible working practices, e.g., nomadic workers using laptop PC’s not just in the office and home, but in hotels, conference centres, airports, trains, and planes.

More information on RLANs can be found in Recommendation [ITU-R M.1450](http://www.itu.int/rec/R-REC-M.1450/en), which recommends characteristics of broadband radio local area networks.

In anticipation of greater demand as usage increases in terms of both applications and users, the ITU‑R conducted studies supporting the primary allocation of spectrum in the 5 GHz bands at WRC‑03. This required the use of innovative interference mitigation techniques to facilitate sharing with existing users of these bands. Results from this work are detailed in relevant Recommendations and Reports listed below:

– Recommendation [ITU-R M.1454](http://www.itu.int/rec/R-REC-M.1454/en), which recommends equivalent isotropically radiated power (e.i.r.p.) density limit and operational restrictions for RLANs or other wireless access transmitters in order to ensure the protection of feeder links of non-geostationary systems in the mobile-satellite service in the frequency band 5 150-5 250 MHz.

– Recommendation [ITU-R M.1651](http://www.itu.int/rec/R-REC-M.1651/en), which recommends a method for assessing the required spectrum for broadband NWA systems including radio local area networks using the 5 GHz band.

– Recommendation [ITU-R M.1652](http://www.itu.int/rec/R-REC-M.1652/en), which recommends a dynamic frequency selection (DFS) in wireless access systems including radio local area networks for the purpose of protecting the radiodetermination service in the 5 GHz band.

– Report [ITU-R M.2115](http://www.itu.int/pub/R-REP-M.2115/en) consolidates the DFS test methodology used and findings across several administrations, as shown in several annexes to the report. Information is provided on the test methodologies in place in various administrations and/or regional groups to test compliance with DFS requirements. These procedures may be updated over time, and as technology evolves. As a result, web links are provided (in some cases) to the test methodologies themselves, so that the most up-to-date information may be obtained. Recommendation [ITU-R M.1653](http://www.itu.int/rec/R-REC-M.1653/en), which recommends operational and deployment requirements for wireless access systems including radio local area networks in the mobile service to facilitate sharing between these systems and systems in the EESS (active) and the space research service (active) in the band 5 470‑5 570 MHz within the 5 460-5 725 MHz range.

– Report [ITU-R M.2034](http://www.itu.int/pub/R-REP-M.2034/en), which addresses the impact of radar detection requirements of dynamic frequency selection on 5 GHz wireless access system receivers.

– Recommendation [ITU-R M.1739](http://www.itu.int/rec/R-REC-M.1739/en) provides protection criteria for wireless access systems (WAS), including RLANs, operating in the mobile service in accordance with Resolution **229 (Rev.WRC-12)**, for the purposes of carrying out compatibility studies with services or applications from which WAS/RLAN systems are to be protected.

## 8.3 Mobile wireless access

Mobile wireless access (MWA) systems have the capabilities to support not only mobile, but also fixed and nomadic applications. These systems support a wide range of applications in urban, suburban and rural areas for both generic broadband internet data and real-time data, including applications such as voice and videoconferencing.

Recommendation [ITU-R M.1801](http://www.itu.int/rec/R-REC-M.1801/en) “Radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz” identifies specific radio interface standards for BWA systems in the mobile service operating below 6 GHz. The standards included in this Recommendation are capable of supporting users at broadband data rates, taking into account the ITU‑R definitions of “wireless access” and “broadband wireless access” found in Recommendation [ITU‑R F.1399](https://www.itu.int/rec/R-REC-F.1399/en). Using this Recommendation, manufacturers and operators should be able to determine the most suitable standards for their needs.

Report [ITU-R M.2378](http://www.itu.int/pub/R-REP-M.2378) “Operational guidelines for the deployment of broadband wireless access systems for local coverage operating below 6 GHz” deals with a specific operation concept of local coverage for BWA systems in frequency bands below 6 GHz. From a technical point of view, this Report is intended to provide some operational guidelines for the deployment of BWA systems for local coverage in the frequency bands above those frequencies typically used for macro cell deployments. The study in this Report addresses technical analysis of local coverage, modelling of categorized operational scenarios and analysis to investigate possibilities of enhancing operational flexibilities. Taking advantage of properties of local coverage, the study focuses on flexible and efficient operation of BWA systems such as multi-standard radio operation and increasing degree of freedom in operational conditions. Possibilities are presented for flexible operation of BWA systems under certain operational conditions of local coverage.

## 8.4 Multiple gigabit wireless systems

Multiple gigabit wireless systems (MGWS) radiocommunication networks can be used in short‑range, line-of-sight and non-line-of-sight circumstances. Total communication range and performance will vary depending on the environment, but multiple gigabit performance is typically expected at ranges around 10 m for in-room use. These networks can be deployed with an access point as in existing wireless local area network (WLAN) deployments or without such an infrastructure such as in both WLAN in ad hoc mode and wireless personal area network (WPAN).

When access points are used, they are mounted indoor with service covering home or an office space with a nomadic user terminal typically also used indoor, i.e., the entire WLAN system would be used in indoor environment.

When access points are not used, MGWS devices are allowed to communicate by setting up direct links for data exchange between the devices/equipment. Typical applications include equipment to equipment (e.g., laptop to projector) and a consumer electronics (CE) device to a kiosk, and it may be assumed that usage would predominantly be indoors.

Recommendation [ITU-R M.2003](http://www.itu.int/rec/R-REC-M.2003/en) provides general characteristics and radio interface standards for Multiple Gigabit Wireless Systems in frequencies around 60 GHz.

Report [ITU-R M.2227](http://www.itu.int/pub/R-REP-M.2227) describes applications, deployment scenarios, technical characteristics, and specifications of MGWS.

## 8.5 Wide-area sensor and actuator network systems

Wide-area sensor and/or actuator network (WASN) systems support machine-to-machine communications to a large number of sensors and/or actuators.

Recommendation [ITU-R M.2002](http://www.itu.int/rec/R-REC-M.2002/en) provides the objectives, system characteristics, functional requirements, service applications and fundamental network functionalities for mobile WAS providing communications to a large number of ubiquitous sensors and/or actuators scattered over wide areas in the land mobile service. The key objective of WASN systems is to support machine-to-machine service applications irrespective of machine location.

Report [ITU-R M.2224](http://www.itu.int/pub/R-REP-M.2224) provides detailed information for system design policy, the wireless applications and examples of WASN systems for information sharing.

# 9 Trunked systems

Analogue trunked systems were developed in the 1980s as a way of achieving more spectrally efficient dispatch land mobile systems that could also be interconnected with the PSTN. Analogue trunked systems are no longer being deployed.

Digital trunked systems of the type that were developed in the 1990s are described in Report [ITU-R M.2014](http://www.itu.int/pub/R-REP-M.2014/en) revised in 2016, entitled “Digital land mobile systems for dispatch traffic”.

Descriptions of the technical and operational characteristics of trunked systems are summarised in [Volume 3](http://www.itu.int/pub/R-HDB-47/en) “Dispatch and Advanced Messaging Systems” of the Land Mobile Handbook published by the ITU-R in 2005.

# 10 Cellular systems[[4]](#footnote-4)

Cellular systems started operations in the early 1980s to support public communications for mobile users. The first-generation systems used bulky analogue radio equipment and could only be used in vehicles. The services provided by cellular systems became very successful and as technology advanced, including the use of digital techniques, better systems were deployed that enable the use of hand-held mobile stations. These second-generation systems using digital transmission techniques started to be deployed in the early 1990s. Their integration is covered in Recommendation [ITU-R M.1074](http://www.itu.int/pub/R-REP-M.1074) and Report [ITU-R M.1157](http://www.itu.int/pub/R-REP-M.1157/en). Report [ITU-R M.1156](http://www.itu.int/pub/R-REP-M.1156/en) covers various generic and specific aspects of these public land mobile cellular telephone systems. The adaptation of mobile radiocommunication technology to the needs of developing countries is addressed in Report [ITU-R M.1155](http://www.itu.int/pub/R-REP-M.1155/en). The characteristics of digital cellular land mobile telecommunication systems are collected in Recommendation [ITU-R M.1073](http://www.itu.int/rec/R-REC-M.1073/en), which has undergone revisions over the years to reflect the latest standards (the most recent one is dated 2012).

IMT-2000 are third-generation systems that started to be deployed in the year 2000, and recommendations and guidance for the evolution of pre-IMT-2000 systems towards IMT-2000 are provided in Recommendation [ITU-R M.1308](http://www.itu.int/rec/R-REC-M.1308/en) and [Volume 2](https://www.itu.int/pub/R-HDB-30) of the Land Mobile Handbook.

Recommendation [ITU-R M.1767](http://www.itu.int/rec/R-REC-M.1767/en) establishes a protection criterion of land mobile systems from terrestrial digital video and audio broadcasting systems in the VHF (174-230 MHz) and UHF (470‑862 MHz) shared bands allocated on a primary basis, where appropriate. It provides the methodology and formulas to assess the maximum allowable field strength of digital terrestrial broadcasting signals into the land mobile system bandwidth, also taking into account the case of potential partial overlap in frequencies between both systems. Some examples are provided to illustrate the use of this methodology. In addition, for some specific types of land mobile systems and specific types of interfering digital television signals, measured values of protection ratios are included.

Report [ITU-R M.2264](http://www.itu.int/pub/R-REP-M.2264) provides guidance on the development of frequency arrangements for systems operating in large contiguous bandwidths in the mobile service, with a view to assisting administrations on spectrum planning issues.

# 11 Cordless telecommunication systems

Cordless telecommunication systems, including cordless telephones, provide the ability to communicate in areas of up to a few hundred meters and can be connected to the public switched telephone network. A recommendation and a report cover the characteristics of such systems:

– Recommendation [ITU-R M.1033](http://www.itu.int/rec/R-REC-M.1033/en), *Technical and operational characteristics of cordless telephones and cordless telecommunication systems*.

– Report [ITU-R M.1025](http://www.itu.int/pub/R-REP-M.1025/en), *Technical and operating characteristics of cordless telephones*.

# 12 Personal radio

Personal radio refers to the use of personal radio devices for direct communications without a central controller or infrastructure network. These systems are sometimes referred to as wireless ad-hoc networks or wireless peer-to-peer networks. Currently, there are no recommendations or reports in force on this topic.

# 13 Other systems (paging systems, conventional systems, machine communications)

*Paging systems:* In the 1980s and 1990s, a solution emerged to reach people but with the advances in and widespread deployment of cellular systems, dedicated paging systems have fallen in disuse. However, advanced paging functions are integrated with other communication systems. Recommendation [ITU‑R M.584](http://www.itu.int/rec/R-REC-M.584/en) describes the operational characteristics, including codes and formats, of the prevailing systems in the 1980s and 1990s. A more recent handbook, [Volume 3](http://www.itu.int/pub/R-HDB-47/en) of the Land Mobile Handbook, describes some advanced messaging systems.

*Conventional digital land mobile radio:* Report [ITU-R M.2474](https://www.itu.int/pub/R-REP-M.2474) deals with the technical and operational characteristics of conventional (non-cellular) digital land mobile radio (CDLMR) systems that provide capabilities required for specific user groups/applications, such as governmental, mining, health, hospitality, transportations, disaster relief, industrial, manufacturing, construction, etc. This report also includes information on approaches to frequency assignments for CDLMR.

*Machine-type communications:* Machine-type communications (MTC) utilize wired and wireless communication networks. The advantages of wireless technologies include reduced complexity in cabling, cable protection and plugs, increased mobility and flexibility as well as access to a “wear and tear” free transmission medium. Report [ITU-R M.2479](https://www.itu.int/pub/R-REP-M.2479) presents information on wireless industrial automation (WIA). Various typical WIA applications include factory automation, process automation, audio visual interaction, remote control, mobile robotics and vehicles, ranging from low latency applications (e.g., robotic arms) to reliable and secure applications (e.g., driverless autonomous transportation systems). This Report also presents information of the applications of MTC in Smart Grid, such as millisecond level precise load control, distribution automation, electricity information acquisition, distributed generation monitoring, electric vehicle charging stations. This Report also provides examples of frequency bands used for Internet of Things (IoT)/machine-to-machine (M2M) applications.

Annex A

All documents sorted by topic[[5]](#footnote-5)

| Type | Series | Number | Rev. | Title | Year | Relevant topic(s) |
| --- | --- | --- | --- | --- | --- | --- |
| Rec. | M. | [1073](http://www.itu.int/rec/R-REC-M.1073/en) | 3 | Digital cellular land mobile telecommunication systems | 2012 | Cellular systems |
| Rec. | M. | [1074](http://www.itu.int/rec/R-REC-M.1074/en) | 0 | Integration of public mobile radiocommunication systems | 1994 | Cellular systems |
| Rec. | M. | [1308](http://www.itu.int/rec/R-REC-M.1308/en) | 0 | Evolution of land mobile systems towards IMT‑2000 | 1997 | Cellular systems |
| Rep. | M. | [1155](http://www.itu.int/pub/R-REP-M.1155/en) | 0 | Adaptation of mobile radiocommunication technology to the needs of developing countries *(Note: with WP 5D)* | 1990 | Cellular systems |
| Rep. | M. | [1156](http://www.itu.int/pub/R-REP-M.1156/en) | 0 | Digital cellular public land mobile telecommunication systems (DCPLMTS) | 1990 | Cellular systems |
| Handbook | | [Vol.2](https://www.itu.int/pub/R-HDB-30) | 0 | Land Mobile (including Wireless Access), Volume 2: Principles and approaches on evolution to IMT‑2000 | 1997 | Cellular systems |
| Rep. | M. | [1157](http://www.itu.int/pub/R-REP-M.1157/en) | 0 | Integration of public mobile radiocommunication systems | 1990 | Cellular systems |
| Rec. | M. | [1767](http://www.itu.int/rec/R-REC-M.1767/en) | 0 | Protection of land mobile systems from terrestrial digital video and audio broadcasting systems in the VHF and UHF shared bands allocated on a primary basis | 2006 | Cellular systems  Spectrum sharing |
| Rec. | M. | [1823](http://www.itu.int/rec/R-REC-M.1823/en) | 0 | Technical and operational characteristics of digital cellular land mobile systems to be used in sharing studies | 2007 | Cellular systems  Spectrum sharing |
| Rec. | M. | [1825](http://www.itu.int/rec/R-REC-M.1825/en) | 0 | Guidance on technical parameters and methodologies for sharing studies related to systems in the land mobile service | 2007 | Cellular systems  Spectrum sharing |
| Rec. | M. | [1033](http://www.itu.int/rec/R-REC-M.1033/en) | 1 | Technical and operational characteristics of cordless telephones and cordless telecommunication systems | 1997 | Cordless telecommunication systems |
| Rep. | M. | [1025](http://www.itu.int/pub/R-REP-M.1025/en) | 1 | Technical and operating characteristics of cordless telephones | 1990 | Cordless telecommunication systems |
| Rec. | M. | [1890](http://www.itu.int/rec/R-REC-M.1890) | 1 | Operational radiocommunication objectives and requirements for advanced Intelligent Transport Systems | 2019 | Intelligent transport systems |
| Rec. | M. | [1452](http://www.itu.int/rec/R-REC-M.1452) | 2 | Millimetre wave vehicular collision avoidance radars and radiocommunication systems for intelligent transport system applications | 2012 | Intelligent transport systems |
| Rec. | M. | [1453](http://www.itu.int/rec/R-REC-M.1453/en) | 2 | Intelligent transport systems – Dedicated short range communications at 5.8 GHz | 2005 | Intelligent transport systems |
| Rec. | M. | [2057](http://www.itu.int/rec/R-REC-M.2057/en) | 1 | Systems characteristics of automotive radars operating in the frequency band 76-81 GHz for intelligent transport systems applications | 2018 | Intelligent transport systems |
| Rec. | M. | [2084](http://www.itu.int/rec/R-REC-M.2084/en) | 1 | Radio interface standards of vehicle-to-vehicle and vehicle-to-infrastructure two-way communications for Intelligent Transport System applications | 2019 | Intelligent transport systems |
| Rep. | M. | [2228](http://www.itu.int/pub/R-REP-M.2228/en) | 1 | Advanced intelligent transport systems (ITS) radiocommunications | 2015 | Intelligent transport systems |
| Rep. | M. | [2444](http://www.itu.int/pub/R-REP-M.2444) | 1 | Examples of arrangements for Intelligent Transport Systems deployments under the mobile service | 2023 | Intelligent transport systems |
| Rep. | M. | [2445](http://www.itu.int/pub/R-REP-M.2445) | 0 | Intelligent Transport Systems (ITS) usage | 2018 | Intelligent transport systems |
| Rep. | M. | [2534](http://www.itu.int/pub/R-REP-M.2534) | 0 | Connected Automated Vehicles | 2023 | Intelligent transport systems |
| Rep. | M. | [2395](http://www.itu.int/pub/R-REP-M.2395) | 0 | Introduction to railway communication systems | 2016 | Intelligent transport systems |
| Rep. | M. | [2418](http://www.itu.int/pub/R-REP-M.2418) | 0 | Description of Railway Radiocommunication Systems between Train and Trackside (RSTT) | 2017 | Intelligent transport systems |
| Rec. | M. | [2121](https://www.itu.int/rec/R-REC-M.2121/en) | 1 | Harmonization of frequency bands for Intelligent Transport Systems in the mobile service | 2023 | Intelligent transport systems |
| Rep. | M. | [2442](http://www.itu.int/pub/R-REP-M.2442) | 0 | Current and future usage of railway radiocommunication systems between train and trackside | 2018 | Intelligent transport systems |
| Handbook | | [Vol.4](http://www.itu.int/pub/R-HDB-49/en) | 1 | Land Mobile (including Wireless Access), Volume 4: Intelligent Transport Systems | 2021 | Intelligent transport systems |
| Rec. | M. | [1072](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.1072) | 0 | Interference due to intermodulation products in the land mobile service between 25 and 3 000 MHz | 1994 | Interference |
| Rec. | SM. | [1134](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.1072) | 1 | Intermodulation interference calculations in the land-mobile service | 2007 | Interference |
| Rep. | M. | [739](http://www.itu.int/pub/R-REP-M.739/en) | 1 | Interference due to intermodulation products in the land mobile service between 25 and 100 MHz | 1986 | Interference |
| Rep. | M. | [2141](http://www.itu.int/pub/R-REP-M.2141/en) | 0 | Study of the isolation between VHF land mobile radio antennas in close proximity | 2009 | Interference |
| Handbook | | [44](https://www.itu.int/pub/R-HDB-44) | 0 | Terrestrial land mobile radiowave propagation in the VHF/UHF bands | 2002 | Interference |
| Rec. | M. | [584](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.584) | 2 | Codes and formats for radio paging | 1997 | Paging systems |
| Rep. | M. | [2474](https://www.itu.int/pub/R-REP-M.2474) | 0 | Conventional digital land mobile radio systems | 2019 | Conventional systems |
| Rep. | M. | [2479](https://www.itu.int/pub/R-REP-M.2479) | 1 | The use of land mobile systems, excluding IMT, for machine-type communications | 2023 | Machine-type communications |
| Rec. | M. | [1746](http://www.itu.int/rec/R-REC-M.1746/en) | 1 | Harmonized frequency channel plans for the protection of property using data communication | 2019 | Public protection and disaster relief |
| Rec. | M. | [1042](http://www.itu.int/rec/R-REC-M.1042/e) | 3 | Disaster communications in the amateur and amateur-satellite services | 2007 | Public protection and disaster relief |
| Rec. | M. | [1637](http://www.itu.int/rec/R-REC-M.1637/e) | 1 | Global cross-border circulation of radiocommunication equipment for use in emergency and disaster relief situations | 2019 | Public protection and disaster relief |
| Rep. | M. | [2377](http://www.itu.int/pub/R-REP-M.2377/en) | 2 | Radiocommunication objectives and requirements for Public Protection and Disaster Relief | 2023 | Public protection and disaster relief |
| Rep. | M. | [2415](http://www.itu.int/pub/R-REP-M.2415/en) | 1 | Spectrum needs for Public Protection and Disaster Relief (PPDR) | 2023 | Public protection and disaster relief |
| Rep. | M. | [2085](http://www.itu.int/pub/R-REP-M.2085/en) | 1 | Role of the amateur and amateur-satellite services in support of disaster mitigation and relief | 2011 | Public protection and disaster relief |
| Rec. | M. | [2009](http://www.itu.int/rec/R-REC-M.2009/en) | 2 | Radio interface standards for use by public protection and disaster relief operations in accordance with Resolution **646 (Rev.WRC-15)** | 2019 | Public protection and disaster relief |
| Rec. | M. | [2015](http://www.itu.int/rec/R-REC-M.2015/en) | 2 | Frequency arrangements for public protection and disaster relief radiocommunication systems in accordance with Resolution **646 (Rev.WRC-15)** | 2018 | Public protection and disaster relief |
| Rec. | M. | [1826](http://www.itu.int/rec/R-REC-M.1826/en) | 1 | Harmonized frequency channel plan for broadband public protection and disaster relief operations at 4 940-4 990 MHz in Regions 2 and 3 | 2019 | Public protection and disaster relief |
| Rep. | M. | [2533](http://www.itu.int/rec/R-REC-M.2533) | 0 | Utility radiocommunications operating in the land-mobile service | 2023 | Utility radiocommunications |
| Rec. | M. | [1634](http://www.itu.int/rec/R-REC-M.1634/e) | 0 | Interference protection of terrestrial mobile service systems using Monte Carlo simulation with application to frequency sharing | 2003 | Spectrum sharing  Interference |
| Rec. | M. | [1388](http://www.itu.int/rec/R-REC-M.1388/e) | 0 | Threshold levels to determine the need to coordinate between space stations in the broadcasting-satellite service (sound) and particular systems in the land mobile service in the band 1 452-1 492 MHz | 1999 | Spectrum sharing |
| Rep. | M. | [1023](http://www.itu.int/pub/R-REP-M.1023/en) | 1 | Frequency sharing between the land mobile service and the broadcasting service (television) below 1 GHz | 1990 | Spectrum sharing |
| Rec. | M. | [1039](http://www.itu.int/rec/R-REC-M.1039/e) | 3 | Co-frequency sharing between stations in the mobile service below 1 GHz and mobile earth stations of non-geostationary mobile-satellite systems (Earth-space) using frequency division multiple access (FDMA) | 2006 | Spectrum sharing |
| Rec. | M. | [1795](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.1795) | 0 | Technical and operational characteristics of land mobile MF/HF systems | 2007 | Spectrum sharing |
| Rec. | M. | [1808](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.1808) | 1 | Technical and operational characteristics of conventional and trunked land mobile systems operating in the mobile service allocations below 869 MHz to be used in sharing studies in bands below 960 MHz | 2019 | Spectrum sharing |
| Rec. | M. | [1824](http://www.itu.int/rec/R-REC-M.1824/en) | 2 | System characteristics of television outside broadcast, electronic news gathering and electronic field production in the mobile service for use in sharing studies | 2022 | Spectrum sharing |
| Rec. | M. | [2068](http://www.itu.int/rec/R-REC-M.2068/en) | 0 | Characteristics of and protection criteria for systems operating in the mobile service in the frequency range 14.5-15.35 GHz | 2015 | Spectrum sharing |
| Rep. | M. | [2116](http://www.itu.int/publ/R-REP-M.2116/en) | 2 | Characteristics of broadband wireless access systems operating in the land mobile service for use in sharing studies | 2013 | Spectrum sharing  Wireless access, including RLANs |
| Rep. | S. | [2199](http://www.itu.int/pub/R-REP-S.2199) | 0 | Studies on compatibility of broadband wireless access systems and fixed-satellite service networks in the 3 400-4 200 MHz band | 2010 | Spectrum sharing  Wireless access, including RLANs |
| Rec. | M. | [2134](https://www.itu.int/rec/R-REC-M.2134/en) | 0 | Receiver characteristics and protection criteria for systems in the mobile service in the frequency range 27.5-29.5 GHz for use in sharing and compatibility studies | 2019 | Spectrum sharing |
| Rep. | M. | [2335](https://www.itu.int/pub/R-REP-M.2335) | 0 | Sharing and compatibility analysis of possible amateur service stations with fixed, land mobile, and radiolocation services in the frequency band 5 250-5 450 kHz and the aeronautical mobile service in an adjacent band | 2014 | Spectrum sharing |
| Rep. | M. | [2500](https://www.itu.int/pub/R-REP-M.2500) | 0 | Coexistence between high-speed railway radiocommunication system between train and trackside operating in the frequency bands 92-94 GHz, 94.1-100 GHz and 102-109.5 GHz, and radio astronomy service and Earth exploration-satellite service (EESS) (active) and EESS (passive) services | 2021 | Spectrum sharing |
| Rep. | M. | [2517](https://www.itu.int/pub/R-REP-M.2517) | 0 | Coexistence between land-mobile and fixed service applications operating in the frequency range 252-296 GHz | 2022 | Spectrum sharing |
| Rec. | M. | [478](http://www.itu.int/rec/R-REC-M.478/e) | 5 | Technical characteristics of equipment and principles governing the allocation of frequency channels between 25 and 3 000 MHz for the FM land mobile service | 1995 | Technology |
| Rec. | M. | [1076](http://www.itu.int/rec/R-REC-M.1076/e) | 1 | Wireless communication systems for persons with impaired hearing | 2015 | Technology |
| Rec. | M. | [1678](http://www.itu.int/rec/R-REC-M.1678/e) | 0 | Adaptive antennas for mobile systems | 2004 | Technology |
|  |  |  |  |  |  |  |
| Rep. | M. | [2282](http://www.itu.int/pub/R-REP-M.2282) | 0 | Systems for public mobile communications with aircraft | 2013 | Technology |
| Rep. | M. | [2026](http://www.itu.int/pub/R-REP-M.2026/en) | 0 | Adaptability of real zero single sideband technology to HF data communications  *(Note: Responsibility of WP 5C)* | 2001 | Technology |
| Rep. | M. | [2040](http://www.itu.int/pub/R-REP-M.2040/en) | 0 | Adaptive antennas concepts and key technical aspects | 2004 | Technology |
| Rep. | M. | [2114](http://www.itu.int/publ/R-REP-M.2114/en) | 0 | Key technical and operational characteristics for access technologies to support IP applications over land mobile systems | 2007 | Technology |
| Rep. | M. | [2117](http://www.itu.int/publ/R-REP-M.2117/en) | 1 | Software-defined radio in the land mobile, amateur and amateur-satellite services | 2012 | Technology |
| Rep. | M. | [2225](http://www.itu.int/publ/R-REP-M.2225/en) | 0 | Introduction to cognitive radio systems in the land mobile service | 2011 | Technology |
| Rep. | M. | [2330](http://www.itu.int/publ/R-REP-M.2330/en) | 0 | Cognitive radio systems in the land mobile service | 2014 | Technology |
| Rep. | M. | [2417](http://www.itu.int/pub/R-REP-M.2417) | 1 | Technical and operational characteristics of land-mobile service applications in the frequency range 275-450 GHz | 2022 | Technology |
| Rep. | M. | [2014](http://www.itu.int/pub/R-REP-M.2014/en) | 3 | Digital land mobile systems for dispatch traffic | 2016 | Trunked systems |
| Handbook | | [Vol.3](http://www.itu.int/pub/R-HDB-47/en) | 0 | Land Mobile (including Wireless Access), Volume 3: Dispatch and Advanced Messaging Systems | 2005 | Trunked systems  Paging systems |
| Rec. | M. | [1797](https://www.itu.int/rec/R-REC-M.1797/e) | 0 | Vocabulary of terms for the land mobile service | 2007 | Vocabulary |
| Rec. | F. | [59](https://www.itu.int/rec/R-REC-F.592/en)2 | 4 | Vocabulary of terms for the fixed service | 2007 | Vocabulary |
| Rec. | F. | [1399](http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.1797) | 1 | Vocabulary of terms for wireless access | 2001 | Vocabulary |
| Rec. | M. | [1450](http://www.itu.int/rec/R-REC-M.1450/e) | 5 | Characteristics of broadband radio local area networks | 2014 | Wireless access, including RLANs |
| Rec. | M. | [1454](http://www.itu.int/rec/R-REC-M.1454/e) | 0 | E.i.r.p. density limit and operational restrictions for RLANS or other wireless access transmitters in order to ensure the protection of feeder links of non-geostationary systems in the mobile-satellite service in the frequency band 5 150-5 250 MHz | 2000 | Wireless access, including RLANs |
| Rec. | M. | [1651](http://www.itu.int/rec/R-REC-M.1651/e) | 0 | A method for assessing the required spectrum for broadband nomadic wireless access systems including radio local area networks using the 5 GHz band | 2003 | Wireless access, including RLANs |
| Rec. | M. | [1652](http://www.itu.int/rec/R-REC-M.1652/e) | 1 | Dynamic frequency selection in wireless access systems including radio local area networks for the purpose of protecting the radiodetermination service in the 5 GHz band | 2011 | Wireless access, including RLANs |
| Rec. | M. | [1653](http://www.itu.int/rec/R-REC-M.1653/e) | 0 | Operational and deployment requirements for wireless access systems including radio local area networks in the mobile service to facilitate sharing between these systems and systems in the Earth exploration-satellite service (active) and the space research service (active) in the band 5 470-5 570 MHz within the 5 460-5 725 MHz range | 2003 | Wireless access, including RLANs |
| Rec. | M. | [1739](http://www.itu.int/rec/R-REC-M.1739/e) | 0 | Protection criteria for wireless access systems, including radio local area networks, operating in the mobile service in accordance with Resolution **229 (WRC-03)** in the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz | 2006 | Wireless access, including RLANs |
| Rec. | M. | [1801](http://www.itu.int/rec/R-REC-M.1801/en) | 2 | Radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz | 2013 | Wireless access, including RLANs |
| Rep. | M. | [2378](http://www.itu.int/pub/R-REP-M.2378) | 0 | Operational guidelines for the deployment of broadband wireless access systems for local coverage operating below 6 GHz | 2015 | Wireless access, including RLANs |
| Rec. | M. | [2002](http://www.itu.int/rec/R-REC-M.2002/en) | 0 | Objectives, characteristics and functional requirements of wide-area sensor and/or actuator network (WASN) systems | 2012 | Wireless access, including RLANs |
| Rep. | M. | [2224](http://www.itu.int/pub/R-REP-M.2224) | 0 | System design guidelines for wide area sensor and/or actuator network (WASN) systems | 2011 | Wireless access, including RLANs |
| Rec. | M. | [2003](http://www.itu.int/rec/R-REC-M.2003/en) | 2 | Multiple gigabit wireless systems in frequencies around 60 GHz | 2018 | Wireless access, including RLANs |
| Rep. | M. | [2227](http://www.itu.int/pub/R-REP-M.2227) | 2 | Use of multiple gigabit wireless systems in frequencies around 60 GHz | 2017 | Wireless access, including RLANs |
| Rep. | M. | [2034](https://www.itu.int/pub/R-REP-M.2034/en) | 0 | Impact of radar detection requirements of dynamic frequency selection on 5 GHz wireless access system receivers | 2003 | Wireless access, including RLANs |
| Rec. | F. | [748](http://www.itu.int/rec/R-REC-F.748/en) | 4 | Radio-frequency arrangements for systems of the fixed service operating in the 25, 26 and 28 GHz bands | 2001 | Wireless access, including RLANs |
| Rec. | F. | [749](http://www.itu.int/rec/R-REC-F.749/en) | 3 | Radio-frequency arrangements for systems of the fixed service operating in sub-bands in the 36-40.5 GHz band | 2012 | Wireless access, including RLANs |
| Rec. | F. | [757](https://www.itu.int/rec/R-REC-F.757/e) | 4 | Basic system requirements and performance objectives for fixed wireless access using mobile-derived technologies offering telephony and data communication services | 2011 | Wireless access, including RLANs |
| Rec. | F. | [1400](https://www.itu.int/rec/R-REC-F.1400/e) | 0 | Performance and availability requirements and objectives for fixed wireless access to public switched telephone network | 1999 | Wireless access, including RLANs |
| Rec. | F. | [1401](https://www.itu.int/rec/R-REC-F.1401/e) | 1 | Considerations for the identification of possible frequency bands for fixed wireless access and related sharing studies | 2004 | Wireless access, including RLANs |
| Rec. | F. | [1402](https://www.itu.int/rec/R-REC-F.1402/e) | 0 | Frequency sharing criteria between a land mobile wireless access system and a fixed wireless access system using the same equipment type as the mobile wireless access system | 1999 | Wireless access, including RLANs |
| Rec. | F. | [1488](https://www.itu.int/rec/R-REC-F.1402/e) | 0 | Frequency block arrangements for fixed wireless access systems in the range 3 400-3 800 MHz | 2000 | Wireless access, including RLANs |
| Rec. | F. | [1489](http://www.itu.int/rec/R-REC-F.1489/e) | 0 | A methodology for assessing the level of operational compatibility between fixed wireless access and radiolocation systems when sharing the band 3.4-3.7 GHz | 2000 | Wireless access, including RLANs  Spectrum sharing |
| Rec. | F. | [1490](https://www.itu.int/rec/R-REC-F.1490/e) | 1 | Generic requirements for fixed wireless access systems | 2007 | Wireless access, including RLANs |
| Rec. | F. | [1499](https://www.itu.int/rec/R-REC-F.1499/e) | 0 | Radio transmission systems for fixed broadband wireless access based on cable modem standards | 2000 | Wireless access, including RLANs |
| Rec. | F. | [1518](https://www.itu.int/rec/R-REC-F.1518/e) | 0 | Spectrum requirement methodology for fixed wireless access and mobile wireless access networks using the same type of equipment, when coexisting in the same frequency band | 2001 | Wireless access, including RLANs |
| Rec. | F. | [1519](http://www.itu.int/rec/R-REC-F.1519/en) | 0 | Guidance on frequency arrangements based on frequency blocks for systems in the fixed service | 2001 | Wireless access, including RLANs |
| Rec. | F. | [1613](http://www.itu.int/rec/R-REC-F.1613/e) | 0 | Operational and deployment restrictions for fixed wireless access systems in Region 3 to ensure the protection of systems in the Earth exploration-satellite service (active) and the space research service (active) in the band 5 250-5 350 MHz | 2003 | Wireless access, including RLANs |
| Rec. | F. | [1763](http://www.itu.int/rec/R-REC-F.1763/en) | 1 | Radio interface standards for broadband wireless access systems in the fixed service operating below 66 GHz | 2014 | Wireless access, including RLANs |
| Rep. | M. | [2115](http://www.itu.int/publ/R-REP-M.2115/en) | 1 | Testing procedures for implementation of dynamic frequency selection | 2009 | Wireless access, including RLANs |
| Handbook | | [Vol.1](https://www.itu.int/pub/R-HDB-25) | 0 | Land Mobile (including Wireless Access), Volume 1: Fixed Wireless Access | 2001 | Wireless access, including RLANs |
| Handbook | | [Vol.5](https://www.itu.int/pub/R-HDB-57) | 0 | Land Mobile (including Wireless Access), Volume 5: Deployment of Broadband Wireless Access Systems | 2011 | Wireless access, including RLANs |
| Rep. | M. | [2264](http://www.itu.int/publ/R-REP-M.2264/en) | 0 | Guidance for the development of band plans with contiguous bandwidths for mobile broadband applications for use in spectrum planning | 2012 | Cellular systems  Wireless access, including RLANs |

Annex B

List of acronyms and abbreviations

BAS Broadcast auxiliary service

BER Bir error ratio

BWA Broadband wireless access

CDLMR Conventional digital land mobile radio

CE Consumer electronics

CRS Cognitive radio systems

DFS Dynamic frequency selection

DSRC Dedicated short range communications

EFP Electronic field production

e.i.r.p. equivalent isotropically radiated power

ENG Electronic news gathering

EESS Earth exploration-satellite service

FSS Fixed-satellite service

FWA Fixed wireless access

IoT Internet of Things

IMT International mobile telecommunications

IoT Internet of Things

ISM Industrial, scientific and medical

ITS Intelligent transport systems

LMS Land mobile service

M2M Machine-to-machine

MGWS Multiple gigabit wireless systems

MSS Mobile-satellite service

MTC Machine-type communications

MWA Mobile wireless access

NWA Nomadic wireless access

PM Phase modulation

PPDR Public protection and disaster relief

PSTN Public switched telephone network

QoS Quality of service

RLAN Radio local area network

RR Radio Regulations

RSTT Railway Radiocommunication Systems between Train and Trackside

RZ SSB Real-zero single sideband technology

SAB Services ancillary to broadcasting

SDR Software-defined radio

SSB Single sideband

TICS Transport Information and Control Systems

TVOB Television outside broadcast

UHF ultra-high frequency

VHF very high frequency

WAS Wireless access systems

WASN Wide-area sensor and actuator network

WIA Wireless industrial automation

WLAN Wireless local area network

WPAN Wireless personal area network

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1. WP 5A Chair’s Report: <http://www.itu.int/ITU-R/go/rwp5a>. [↑](#footnote-ref-1)
2. A full list of official ITU terms and definitions can be found: [Online ITU Terms and Definitions](https://www.itu.int/net/ITU-R/index.asp?redirect=true&category=information&link=terminology-database&lang=en&adsearch=&SearchTerminology=&sector=&language=all&part=abbreviationterm&kind=anywhere). [↑](#footnote-ref-2)
3. The term “BAS”, also known as services ancillary to broadcasting (SAB), is defined in Report [ITU‑R BT.2069](https://www.itu.int/pub/R-REP-BT.2069). [↑](#footnote-ref-3)
4. The terrestrial component of IMT is also part of the land mobile service, but it is outside the scope of this document; for further information see the [Guide to the use of the ITU-R texts relating to the terrestrial component of IMT](https://www.itu.int/oth/R0A060000AA/en). ITU-R WP 5D: <https://www.itu.int/ITU-R/go/rwp5d>. [↑](#footnote-ref-4)
5. The electronic version of this table can be sorted by columns as required. [↑](#footnote-ref-5)