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| **Radiocommunication Study Groups** |  |
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| Annex 18 to Working Party 5A Chairman’s Report | |
| Working Document towards a PRELIMINARY Draft New [report/RECOMMENDATION] ITU-R M.[MS 14.5-15.35 CHAR] | |
| Characteristics of and protection criteria for systems operating in  the mobile service in the frequency range 14.5-15.35 GHz | |

M.1466

Scope

This Recommendation specifies the characteristics of and protection criteria for systems operating in the mobile service in the frequency range 14.5-15.35 GHz. These technical and operational characteristics are to be used as a guideline in analyzing compatibility between systems operating in the mobile service with systems in other services.

The ITU Radiocommunication Assembly,

considering

*a)* that antenna, signal propagation, and large bandwidth characteristics of mobile systems to achieve their functions and requirements are optimum in certain frequency bands;

*b)* that the technical characteristics of systems operating in the mobile service are determined by the purpose of the system and vary widely within frequency bands;

*c)* that representative technical and operational characteristics of systems operating in frequency bands allocated to the mobile service are required to determine the feasibility of introducing new types of systems;

*d)* that procedures and methodologies are needed to analyse compatibility between systems operating in the mobile service and systems in other services;

*e)* that mobile systems in the 14.5-15.35 GHz frequency range are used for a variety of purposes including land mobile ground-to- ground data links used to convey voice, data, or video,

noting

*a)* that the frequency range 14.5-15.35 GHz is allocated worldwide on a primary basis to the mobile service and fixed services;

*b)* that the frequency band 14.5-14.8 GHz is allocated worldwide on a primary basis to the fixed-satellite services (Earth-to-space) limited to feeder links for the broadcasting satellite service for countries outside Europe;

c) that the frequency range 14.5-15.35 GHz is allocated worldwide on a secondary basis to the space research service,

recommends

1 that the technical and operational characteristics of the systems operating in the mobile service described in Annex 1 be considered representative of those operating in the frequency band 14.5-15.35 GHz;

2that the technical and operational characteristics of the systems operating in the mobile service described in Annex 1 should be used for sharing and compatibility studies involving the frequency band 14.5-15.35 GHz;

3that the criterion of interfering signal power to mobile system receiver noise power level, *I*/*N*, of – 6 dBshould be used as the required protection level for the mobile systems, and that this represents the protection level if multiple interferers are present.

ANNEX 1

Technical and operational characteristics of systems ting in the   
mobile service in the frequency range 14.5-15.35 GHz

# 1 Introduction

In the frequency band 14.5-15.35 GHz mobile systems support a variety of useful functions including reliable transmission of large amounts of data for land mobile to land mobile voice, data, and video wideband links.

# 2 Technical characteristics of mobile systems in the frequency band 14.5‑15.35 GHz

The technical parameters of representative mobile systems operating in the frequency range 14.5‑15.35 GHz are presented in Table 1.

TABLE 1

Mobile system characteristics in the band 14.5-15.35 GHz

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Characteristics | System 1 | System 2 | System 3 | System 4 | System 5 | System 6 |
| Frequency Range (GHz) | 14.5-15.35 | 14.5-15.35 | 14.5-15.35 | 14.5-15.0 | 14.5-15.30 | 14.6-15.35 |
| Platform type | Land-mobile vehicle | Handheld | Land-mobile vehicle | Land-mobile vehicle | Land Mobile vehicle | Land Mobile vehicle |
| Modulation | 8-QAM, QPSK | BPSK | FSK | FSK | BPSK/OQPSK | BPSK/QPSK/QAM |
| Emission Designator | 50M0G1D | 18M5F9W | 4M60F9W | 20M0G7W | 2M46G1D | 40M0G7W |
| Transmit peak power (W) | 15 | 5 | 25 | 18 | 40W(mean) | 0.5W(mean) |
| Maximum data rate (Mbps) | 140 | 10 | 5 | 19 | 1.024/3.072 | 108 |
| Output device | Solid State | FET | FET | FET | FET | Gallium Arsenide Field Effect Transistor |
| Antenna pattern type | Directional | Directional | Directional | Directional | Directional | Directional |
| Antenna type | Electronically scanned circular array | Stacked Microstrip Patch | Stacked Microstrip  Patch | Stacked Microstrip Patch | Stacked Microstrip  Patch | Phased-array |
| Antenna polarization | Right-hand Circular | Linear | Linear | Linear | Horizontal and Vertical | Left Hand Circular |
| Antenna gain (dBi) | 18 | 4 | 23 | 25 | 24 | 28 |
| Antenna horizontal beamwidth (degrees) | 10 | 60 | 3 | 2.1 | 2.2 | 1.9 |
| Antenna vertical beamwidth (degrees) | 15 | 40 | 3 | 2.1 | 2.2 | 1.9 |

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| --- | --- | --- | --- | --- | --- | --- |
| Antenna 1st side-lobe level (dBi) | 8 | 0 | 10 | 12 | 11 | NA |
| Antenna height (m) | 4 - 18 | 2 | 4 - 14 | 4 - 13 | NA | NA |
| Receiver IF –3 dB bandwidth (MHz) | 55 | 21 | 4 | 23 | 3 | 35 |
| Receiver noise figure (dB) | 4 | 3 | 3 | 4 | 4 | 5 |
| Minimum Sensitivity (dBm) | -93 | -98 | -105 | -97 | -106 | -94 |
| Transmitter RF emission bandwidth (MHz):  –3 dB/-20 dB | 30/55 | 10/20 | 3/6 | 12/22 | 1.5/2.4 | 20/38 |
| NA = Not available. | | | | | | |

# 3 Operational characteristics of mobile systems in the frequency range 14.5-15.35 GHz

Technology advancements in signal processing, complex modulations, antenna design, and solid‑state components are enabling the design and manufacture of communication systems in the 14.5‑15.35 GHz frequency range that are intended to be used as hand-held devices or on ground‑based mobile vehicles that can inter-operate with other ground-based vehicles while one or both of the vehicles are in motion.

Administrations use this band for mobile ground data links that convey voice, data or video, for example, in situations where there is a need to establish and maintain wideband communication among mobile vehicles and personnel providing relief and public safety to an area subjected to a catastrophic natural disaster.

The wide available bandwidth and relative ease of propagation when obstacle-free conditions exist in this frequency range allow mobile systems with data rates up to many 10’s of Mbps.

Largely because of these mission requirements, the mobile systems using or planned to use the band 14.5‑15.35 GHz tend to possess the following general characteristics:

– they typically use solid-state power-amplifier transmitters that are usually able to tune through the frequency band and use digital modulations;

– an increasing number of these systems have antenna main beams that are steerable in both azimuth and elevation using electronic beam steering techniques.

Table 1 summarizes technical characteristics of representative mobile systems deployed or planned to be deployed in the whole or portions of the band 14.5-15.35 GHz. This information is sufficient for general calculation to assess the compatibility between these mobile systems and other systems. Some or all of the mobile systems whose characteristics are presented in Table 1 possess the properties above, although they do not illustrate the full repertoire of attributes that might appear in future systems.

## 3.1 Transmitters

The mobile systems operating or planned to operate in the 14.5-15.35 GHz band typically use digital modulations. A given transmitter may be capable of radiating more than one waveform. Solid-state power amplifier output devices are typically used in the transmitters. The trend towards use of solid-state transmitters in new mobile systems will continue for the foreseeable future due to the wide bandwidth, low level of generated spurious emissions, low power consumption, and reliability of these devices.

Typical transmitter RF emission (3 dB) bandwidths of mobile systems operating or planned to operate in the band 14.5-15.35 GHz range from about 4 MHz to 50 MHz. Current transmitter peak output powers range from 5 W (37 dBm) to 25 W (44 dBm).  However, advances in solid state modules will enable systems in the near future to generate peak power outputs of 70 W – 130 W in this frequency range.

## 3.2 Receivers

The newer-generation mobile systems in the 14.5-15.35 GHz use digital modulations to enhance system performance.

The signal processing in the newer generation of mobile systems use digital phase, frequency, or amplitude modulation techniques.

## 3.3 Antennas

A variety of different types of antennas are used by systems in the 14.5-15.35 GHz band. Antennas in this band are generally of a variety of sizes and thus are of interest for applications where mobility and lightweight are important. The directional antenna pattern for mobile systems must be able cover 360° in the horizontal plane either electronically or mechanically. Sectored horn or circular phased arrays may be used to obtain 360 degree horizontal coverage. Flat-plate electronically steered antennas may require several facets or sub-antennas to achieve 360° horizontal coverage. Both horizontal and vertical polarizations are used.

Typical antenna heights for ground-based mobile vehicle systems range from 4 m to 15 m above surface level. The 4 m height is typical for operations when the antenna is configured in a stowed or retracted position while the vehicle is in motion. The 13-18 m height is typical when the vehicle is halted and an antenna mast can be extended.

Operations while the antenna is in the stowed position while the vehicle is on the move may limit the signal strength of the desired signal due to its propagation along non-line of sight paths with various obstructions. In this frequency range selection of antenna locations on elevated terrain is desirable to mitigate the effects of, e.g., foliage and buildings, etc., on electromagnetic propagation to maximize communication distances when the vehicle is operating when halted.

# 4 Protection criteria

Under noise-limited conditions, a protection criteria of I/N = –6 dB limits the increase in the noise level in the receiver to about 1 dB and corresponds to an (*I* + *N*)/*N* ratio of 1.26. The 1 dB increase in the noise level could be manifested as, e.g., a decrease in the available fade margin, a decrease in the effective coverage area where a maximum given bit error rate (BER) must be maintained, or receiver desensitisation, which would constitute significant degradation for digital receivers that must operate with very low bit error rates. The 1 dB increase represents the aggregate effect of multiple interferers, when present; the tolerable *I*/*N* ratio for an individual interferer depends on the number of interferers and their geometry, and needs to be assessed in the course of analysis of a given scenario.

The aggregation factor can be very substantial in the case of certain communication systems that have to operate in environments where there are a great number of other co-band stations.

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