



Radiocommunication Bureau (BR)

Administrative Circular
CACE/921

22 August 2019

To Administrations of Member States of the ITU, Radiocommunication Sector Members, ITU-R Associates participating in the work of the Radiocommunication Study Group 3 and ITU Academia

Subject: **Radiocommunication Study Group 3 (Radiowave propagation)**
– **Approval of 1 new ITU-R Question and 6 revised ITU-R Questions**

By Administrative Circular CACE/899 of 18 June 2019, 1 draft new ITU-R Question and 6 draft revised ITU-R Questions were submitted for approval by correspondence in accordance with Resolution ITU-R 1-7 (§ A2.5.2.3).

The conditions governing this procedure were met on 18 August 2019.

The texts of the approved Questions are attached for your reference in Annexes 1 to 7 and will be published by the ITU.



Mario Maniewicz
Director

Annexes: 7

Distribution:

- Administrations of Member States of the ITU and Radiocommunication Sector Members participating in the work of Radiocommunication Study Group 3
- ITU-R Associates participating in the work of Radiocommunication Study Group 3
- ITU Academia
- Chairmen and Vice-Chairmen of Radiocommunication Study Groups
- Chairman and Vice-Chairmen of the Conference Preparatory Meeting
- Members of the Radio Regulations Board
- Secretary-General of the ITU, Director of the Telecommunication Standardization Bureau, Director of the Telecommunication Development Bureau

Annex 1

QUESTION ITU-R 235/3

Impact of engineered electromagnetic surfaces on radiowave propagation

(2019)

The ITU Radiocommunication Assembly,

considering

- a)* that engineered electromagnetic surfaces (EEMSs) have the ability to enhance or attenuate the transmission and reception of electromagnetic signals;
- b)* that EEMSs are being developed to extend the communications range, shape the coverage area, and mitigate the risk of interference;
- c)* that EEMSs are expected to be of great importance for future wireless systems and networks particularly international mobile telecommunications (IMT) and wireless local area networks (WLANs);
- d)* that EEMSs can be more cost and energy efficient than the deployment of additional access points or base stations;
- e)* that advances in EEMSs could reduce the demand for additional spectrum for future wireless systems and networks;
- f)* that EEMSs could be deployed predominantly as part of building materials and/or furnishing materials;
- g)* that the presence of EEMSs could modify, to a large extent, the propagation characteristics along the communications path;
- h)* that the electrical properties of surface materials as well as the orientation, design, and structure of the EEMS impact signal reflections and frequency selectivity;
- i)* that the modelling of signal reflections from EEMSs is of great significance for service coexistence and spectrum sharing between radiocommunication services and between service providers;
- j)* that the availability of EEMS databases will facilitate the development of appropriate site-specific propagation models,

noting

- a)* that Recommendation ITU-R P.526 provides guidance on calculation methods for obstacle diffraction effects, including those due to building materials and structures;
- b)* that Recommendation ITU-R P.530 provides propagation data and prediction methods required for the design of terrestrial line-of-sight systems;

- c) that Recommendation ITU-R P.1238 provides propagation data and prediction methods for the planning of indoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz;
- d) that Recommendation ITU-R P.1407 provides information on various aspects of multi-path propagation;
- e) that Recommendation ITU-R P.1411 provides propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz;
- f) that Recommendation ITU-R P.1812 provides a propagation prediction method for terrestrial point-to-area services in the frequency range 30 MHz to 3 GHz;
- g) that Recommendation ITU-R P.2040 provides guidance on the effects of building materials and structures on radiowave propagation above about 100 MHz;
- h) that Recommendation ITU-R P.2109 provides statistical models for building entry loss,
decides that the following Questions should be studied

- 1 What are suitable methods to describe the detailed characteristics of the EEMSs particularly reflectors and frequency selective structures?
- 2 Which deterministic and statistically-based methods can be used to model reflection of electromagnetic signals from EEMSs?
- 3 Which deterministic and statistically-based methods can be used to model propagation of electromagnetic signals through frequency selective EEMSs acting as band-stop or band-pass filters?
- 4 How do frequency selective EEMSs in buildings impact indoor-to-outdoor and outdoor-to-indoor transmissions and what is the effect on building entry/exit loss?
- 5 What is the influence of EEMSs such as reflectors and frequency selective surfaces on the transmission loss, diffraction loss, clutter loss, shadowing and polarization, including polarization mismatch loss, delay spread, and angular spread?
- 6 How can EEMS databases, together with other detailed information of the propagation path be applied to predict signal attenuation, time delay, scatter, diffraction, and other propagation characteristics?
- 7 In which way does the use of higher frequencies, particularly in the millimetre wave spectrum, impact the modelling of EEMSs (for key parameters such as surface roughness and conductivity)?

further decides

that the results of the above studies should be included in ITU-R Recommendations and/or Reports and that the above studies should be completed by 2023.

Category: S3

Annex 2

QUESTION ITU-R 201-7/3

Radiometeorological data required for the planning of terrestrial and space communication systems and space research application

(1966-1970-1974-1978-1982-1990-1995-2000-2007-2012-2016-2019)

The ITU Radiocommunication Assembly,

considering

- a)* that the characteristics of the tropospheric radio channel depend on a variety of meteorological parameters;
- b)* that statistical predictions of radiopropagation effects are urgently required for planning and design of radiocommunication and remote sensing systems;
- c)* that, for the development of such predictions, knowledge of all atmospheric parameters affecting channel characteristics, their natural variability and their mutual dependence is needed;
- d)* that the quality of measured and suitably analysed radiometeorological data is one of the determinants of the ultimate reliability of propagation prediction methods that are based on meteorological parameters;
- e)* that an accurate knowledge of the clear-sky level on a satellite-to-ground link is important in developing the margin required to enable a telecommunications service to operate satisfactorily under adverse propagation conditions;
- f)* that the clear-sky level on a satellite-to-ground link can fluctuate significantly both diurnally and seasonally due to atmospheric effects;
- g)* that interest exists in extending the range of frequencies used for telecommunication and remote sensing purposes;
- h)* that propagation conditions should be known as well as possible during the process of bringing into service (BIS) of radio-relay equipment,

decides that the following Questions should be studied

- 1 What are the distributions of tropospheric refractivity, its gradients and their variability, both in space and time?
- 2 What are the distributions of atmospheric constituents and particles, such as water vapour and other gases, clouds, fog, precipitation, aerosols, sand, etc., both in space and time?
- 3 What is the magnitude of the variations in clear-sky level on a satellite-to-ground link that can occur on a diurnal, monthly and seasonal basis?
- 4 How do the climatology and natural variability (year-to-year, seasonal, monthly and diurnal variations, long-term variations) of all atmospheric constituents affect attenuation and interference predictions?

- 5 What models best describe the relationship between atmospheric parameters and radiowave characteristics (amplitude, polarization, phase, angle of arrival, etc.)?
- 6 What methods based on meteorological information can be used in the statistical prediction of signal behaviour, especially for percentages of time from 0.01 to 99%, taking into account the composite effect of various atmospheric parameters?
- 7 What procedures can be used to evaluate data quality, accuracy, statistical stability and confidence levels?
- 8 What methods can be used to perform physical based simulations and to forecast propagation conditions during any season for periods of time ranging from a few hours to a few days anywhere in the world using numerical weather prediction methods?
- 9 What methods based on meteorological information can be used in the statistical prediction of signal behaviour, especially extreme events with a long return period?

further decides

- 1 that the results of the above studies should be included in one or more Recommendations and/or Reports;
- 2 that the information about radioclimatological parameters should be given in worldwide digital maps with the highest possible accuracy and spatial resolution;
- 3 that the long-term time variability of radioclimatological parameters should be investigated;
- 4 that the above studies should be completed by 2023.

Category: S2

Annex 3

QUESTION ITU-R 203-8/3

Propagation prediction methods for terrestrial broadcasting, fixed (broadband access) and mobile services using frequencies above 30 MHz

(1990-1993-1995-2000-2002-2009-2012-2017-2019)

The ITU Radiocommunication Assembly,

considering

- a)* that there is a continuing need to improve and develop field strength prediction techniques for the planning or establishing of terrestrial broadcasting, fixed (broadband access) and mobile services using frequencies above 30 MHz;
- b)* that for terrestrial broadcasting, fixed (broadband access) and mobile services, propagation studies involve consideration of point-to-area and multipoint-to-multipoint propagation paths;
- c)* that present methods are based largely upon measurement data and there is a continuing need for measurements within this range of frequencies from all geographical regions, especially developing countries, to increase the accuracy of the prediction techniques;
- d)* that the increasing use of frequencies above 10 GHz requires that prediction methods should be developed to meet these new requirements;
- e)* that digital systems involving wideband transmission are being introduced to both broadcasting and mobile services;
- f)* that reflected signals must be taken into account in the design of digital radio systems;
- g)* that there are increasing demands for frequency sharing between these and other services;
- h)* that the maximum speed of high speed transportation (using expressway, railway) is increasing up to 500 km/h,

decides that the following Questions should be studied

- 1 What field strength prediction methods can be used for terrestrial broadcasting, fixed (broadband access) and mobile services in the frequency range above 30 MHz?
- 2 How are the predicted field strengths, multipath and their temporal and spatial statistics influenced by:
 - frequency, bandwidth and polarization;
 - length and properties of the propagation path;
 - terrain features, including the possibility of long delayed reflections from off-great circle hillsides;
 - ground cover, buildings and other man-made structures;
 - atmospheric constituents;

- height and surrounding environment of the terminating antennas;
 - directivity and diversity of the antennas;
 - mobile reception, including Doppler effects;
 - the general nature of the propagation path, e.g., paths over deserts, seas, coastal areas or mountains and, in particular, in areas subject to super-refractive conditions?
- 3 To what extent are propagation statistics correlated over different paths and frequencies?
- 4 What methods and parameters best describe the coverage reliability of these analogue and digital services and what information beyond field strength data is necessary for these purposes, e.g. the “intelligence” incorporated in a frequency agile system?
- 5 What methods and parameters best describe the propagation channel's impulse response?

further decides

that the available information should be prepared as revisions to relevant Recommendations or as new Recommendations and that the above studies should be completed by 2023.

Category: S1

Annex 4

QUESTION ITU-R 208-6/3

Propagation factors in frequency sharing issues affecting space radiocommunication services and terrestrial services

(1990-1993-1995-2002-2005-2013-2019)

The ITU Radiocommunication Assembly,

considering

- a)* that propagation data for radio paths are required when planning the sharing of frequency channels in radiocommunication systems;
- b)* that, in accordance with the Radio Regulations (RR), a coordination distance or coordination area should be determined for earth stations in the frequency bands shared between space radiocommunication services and terrestrial services;
- c)* that in the calculation of coordination distances, all pertinent propagation mechanisms and system factors should be taken into account;
- d)* that in the calculation of interference between systems, more detailed consideration of the contributing propagation mechanisms is required;
- e)* that the World Radiocommunication Conference (WRC-2000) approved a revision of Appendix 7 (subsequently modified by WRC-03, WRC-07, WRC-12 and WRC-15) based on material in Recommendation ITU-R SM.1448 which in turn is based on material in Recommendation ITU-R P.620 covering the frequency range 100 MHz to 105 GHz;
- f)* that Resolution **74 (Rev.WRC-03)** describes a process to keep the technical bases of Appendix 7 current,

decides that the following Questions should be studied

- 1 What is the distribution of signal level variations (both fading and enhancement) and their duration due to:
 - diffraction;
 - atmospheric mechanisms such as ducting, precipitation scatter, troposcatter and reflecting atmospheric layers;
 - reflections from the ground and man-made structures;
 - combinations of these mechanisms?
- 2 What is the dependence of these effects on location, time, path length and frequency, taking into consideration the following points:
 - the percentage range of greatest interest is from 0.001% to 50%;
 - the reference periods of interest are worst month and average year;
 - path lengths of greatest interest are those up to 1 000 km; however, in areas where ducting is prevalent (e.g. oceans in tropical and equatorial regions) much greater distances should also be considered;
 - the frequency range of interest is approximately 100 MHz to 500 GHz?

- 3 How may improved models and prediction procedures be developed for precipitation scatter to determine the practical significance of this mode, and how does it depend on rainfall rate and structure and on system geometry?
- 4 What precipitation parameters, in addition to rainfall intensity and height of the 0°C isotherm, can be applied to precipitation-related prediction methods to take account of different climates?
- 5 What refractivity parameters can be applied to clear-air prediction methods to take account of different climates?
- 6 How can scatter from irregular terrain be quantified (including the effect of vegetation and man-made structures such as buildings)?
- 7 How can interaction between an antenna and the propagation medium be taken into account when considering modes of anomalous propagation (e.g. coupling into and out of ducts and the impact of use of omnidirectional, sector and high-gain antennas)?
- 8 How may site shielding be evaluated, with special emphasis on a practical procedure for calculating its magnitude in particular situations (e.g. small earth stations in urban areas)?
- 9 What is the correlation of fading and enhancements of the signal on separate radio links, and its influence on the statistics of interference?
- 10 What method best describes the differential rain attenuation statistics between a wanted path and an unwanted path?
- 11 What is a suitable method by which the total effect of the above-mentioned mechanisms can be taken into account when evaluating interference between terrestrial and Earth-space systems; in particular, what improvements can be recommended to the interference prediction methods contained in Recommendation ITU-R P.452 and to the propagation prediction procedures for determining coordination distance contained in Recommendation ITU-R P.620, including the alignment of these two methods in order to obtain consistency between the determination of coordination area and detailed evaluation of interference in individual cases?
- 12 Which are the most effective clear-air and hydrometeor-scatter propagation models to allow effective frequency coordination and interference potential evaluation between earth stations for geostationary-satellite systems and those for non-geostationary satellite systems sharing the same frequencies on a “bidirectional working” basis?
- 13 What method best describes building entry loss, that is the additional loss due to a terminal being inside a building?
- 14 What method best describes additional loss due to clutter, which refers to objects, such as buildings or vegetation, which are on the surface of the Earth but not actually terrain?
- 15 What is the correlation of interfering signals on multiple paths?

further decides

that the results of the above studies should be included in ITU-R Recommendations and/or Reports and that the above studies should be completed by 2023.

NOTE – Priority will be given to studies relating to §§ 2, 5, 6, 8, 9 and 10.

Category: S2

Annex 5

QUESTION ITU-R 211-7/3

Propagation data and propagation models in the frequency range 300 MHz to 450 GHz for the design of short-range wireless radiocommunication systems and wireless local area networks (WLAN)

(1993-2000-2002-2005-2007-2009-2015-2019)

The ITU Radiocommunication Assembly,

considering

- a)* that many new short-range personal communication systems are being developed which will operate indoors as well as outdoors;
- b)* that future mobile systems (e.g. IMT) will provide personal communications, indoors (office or residential) as well as outdoors;
- c)* that there is a high demand for wireless local area networks (WLANs) and wireless private business exchanges (WPBXs), as demonstrated by existing products and intense research activities;
- d)* that it is desirable to establish WLAN standards which are compatible with both wireless and wired telecommunications;
- e)* that short-range systems using very low power have many advantages for providing services in the mobile and personal environment;
- f)* that ultra-wideband (UWB) is an important wireless technology and may have impact on radiocommunication services;
- g)* that there is a high demand for new short-range land-mobile and fixed service applications, including WLANs in the EHF and THF bands;
- h)* that knowledge of the propagation characteristics within buildings and the interference arising from multiple users in the same area is critical to the efficient design of systems;
- i)* that while multipath propagation may cause impairments, it may also be used to advantage in a mobile or indoor environment;
- j)* that there are only limited propagation measurements available in some of the frequency bands being considered for short-range systems;
- k)* that information regarding indoor and indoor-to-outdoor propagation may also be of interest to other services,

decides that the following Questions should be studied

- 1 What propagation models should be used for the design of short-range systems operating indoors, outdoors, and indoor-to-outdoors (operating range less than 1 km) including wireless communication and access systems and WLANs?

- 2 What propagation characteristics of a channel are most appropriate to describe its quality for different services, such as:
 - voice communications;
 - facsimile services;
 - data transfer services (both high bit rate and low bit rate);
 - paging and messaging services;
 - video services?
- 3 What are the characteristics of the impulse response of the channel?
- 4 What effect does the choice of polarization have on the propagation characteristics?
- 5 What effect does the performance of the base station and terminal antennas (e.g. directivity, beam-steering) have on the propagation characteristics?
- 6 What are the effects of various diversity schemes?
- 7 What are the effects of the siting of the transmitter and receiver?
- 8 In the indoor environment, what is the effect of different building and furnishing materials as regards shadowing, diffraction, and reflection?
- 9 In the outdoor environment, what is the effect of building structures and vegetation as regards shadowing, diffraction, and reflection?
- 10 What effect does the movement of persons and objects within the room, possibly including the movement of one or both ends of the radio link, have on the propagation characteristics?
- 11 What variables are necessary in the model to account for different types of buildings (e.g. open-plan, single-storey, multi-storey) in which one or both of the terminals are situated?
- 12 How may building entry loss be characterized for system design, and what is its effect on indoor-to-outdoor transmission?
- 13 What factors can be used for frequency scaling, and over what ranges are they appropriate?
- 14 What are the best ways of presenting the required data?
- 15 What propagation models are most appropriate to evaluate the effect for system design such as Multiple Input Multiple Output (MIMO) technology?
- 16 What effect do modes of high speed transport (using expressway, railway) have on propagation characteristics?

further decides

that the results of the above studies should be included in one or more Recommendations and/or Reports and that the above studies should be completed by 2023.

Category: S3

Annex 6

QUESTION ITU-R 214-6/3

Radio noise

(1978-1982-1990-1993-2000-2007-2012-2019)

The ITU Radiocommunication Assembly,

considering

- a)* that radio noise of natural or man-made origin often determines the practical limit of performance for radio systems and thus is an important factor in planning efficient use of the spectrum;
- b)* that much has been learned about the origin, statistical characteristics, and general intensities of both natural and man-made noise, but that additional information is urgently needed, particularly for parts of the world not previously studied, while considering the increasingly rapid advances in technology, for the design, planning and operation of radiocommunications systems;
- c)* that for system design, determination of system performance and spectrum utilization factors, it is essential to determine the noise parameters appropriate in considering various modulation methods, including, as a minimum, the noise parameters described in Recommendation ITU-R P.372,

decides that the following Questions should be studied

- 1 What are the intensities and the values of other parameters of natural and man-made noise from local and distant sources, in both indoor and outdoor locations; what are the temporal and geographical variations, the dependence on antenna directivity, and the relationship to changes in geophysical phenomena, including global warming and solar activity; and how should measurements be made?
- 2 Where the radio noise has an impulsive characteristic, what are the appropriate parameters to describe the noise and how does the impulsive noise vary with frequency, location, season, etc.?

further decides

that appropriate information concerning radio noise resulting from studies within the ITU-R shall be contained in Recommendations and/or Reports and that the above studies should be completed by 2023.

Category: S2

Annex 7

QUESTION ITU-R 228-3/3*

Propagation data required for the planning of radiocommunication systems operating above 275 GHz**

(2000-2005-2019)

The ITU Radiocommunication Assembly,

considering

- a) that the spectrum in many of the frequency bands used for radiocommunication is increasingly congested and this problem is expected to get worse;
- b) that telecommunication links are being used or planned for use on some terrestrial applications at frequencies above 275 GHz;
- c) that telecommunication links are being used or planned for use on some satellite systems for inter-satellite communications at frequencies above 275 GHz;
- d) that the viability of telecommunication links operating above 275 GHz (space-to-Earth and Earth-to-space) is currently being investigated;
- e) that remote sensing and astronomical applications are using frequencies above 275 GHz;
- f) that interest exists in extending the range of frequencies used for telecommunication applications;
- g) that the focus of study of Questions by Radiocommunication Study Groups includes the following:
 - use of the radio-frequency spectrum in radiocommunication;
 - characteristics and performance of radio systems;
 - operation of radio systems;
- h) that propagation models are urgently required for planning and design of telecommunication systems at frequencies above 275 GHz,

noting

that according to No. 78 of the ITU Constitution and Note 2 of No. 1005 of the ITU Convention, study groups may adopt Recommendations without limit of frequency range,

* This Question should be brought to the attention of Radiocommunication Study Groups 1, 5 and 7.

** The frequency spectrum above 275 GHz is currently not allocated (see also No. **5.565** of the Radio Regulations).

decides that the following Questions should be studied

- 1 What models best describe the relationship between atmospheric parameters and electromagnetic wave characteristics on terrestrial, space-to-Earth and Earth-to-space links operating at frequencies above 275 GHz?
- 2 What models best describe the relationship between free-space parameters and electromagnetic wave characteristics on inter-satellite links operating at frequencies above 275 GHz?
- 3 What models best describe the relationship between atmospheric parameters and electromagnetic wave characteristics on science service links operating at frequencies above 275 GHz?
- 4 What models best describe the relationship between atmospheric parameters and the minimum practical altitude for space-to-space links operating at frequencies above 275 GHz?

further decides

that the results of studies above 275 GHz should be brought to the attention of the other Study Groups, the results of the above studies should be included in one or more Recommendations, the results related to terrestrial applications, when available, should be included in future Recommendation(s) or Report(s) and the above studies should be completed by 2023.

Category: C1
