参考資料４

INTERNATIONAL TELECOMMUNICATION UNION

RADIOCOMMUNICATION STUDY GROUPS

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Radiocommunication Study Group 3

QUESTIONS ASSIGNED TO RADIOCOMMUNICATION STUDY GROUP 3

Radiowave propagation

Attached please find the list of Questions assigned to Radiocommunication Study Group 3.
The following extract from Resolution ITU-R 5 gives the definition of categories of Questions:

C: Conference oriented Questions associated with work related to specific preparations for, and decisions of, world and regional radiocommunication conferences:

C1: very urgent and priority studies, required for the World Radiocommunication Conference to be held within the next two-year period;

C2: urgent studies, expected to be required for other Radiocommunication Conferences.

S: Questions which are intended to respond to:

– matters referred to the Radiocommunication Assembly by the Plenipotentiary Conference, any other conference, the Council, the Radio Regulations Board (see Note 1);

– advances in radiocommunication technology or spectrum management;

– changes in radio usage or operation:

S1: urgent studies which are intended to be completed within two years;

S2: important studies, necessary for the development of radiocommunications;

S3: required studies, expected to facilitate the development of radiocommunications.

/AP: Alternative approval procedure.

NOTE 1 – Where appropriate, Questions maintained (but unmodified) have been editorially updated. In such cases, the version number and date of the Question have remained unchanged.

QUESTIONS ASSIGNED BY THE RADIOCOMMUNICATION ASSEMBLY TO STUDY GROUP 3

Radiowave propagation

QUESTION ITU-R 201-3/3

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)

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 solar heating and 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 Question 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, rain, hail, 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 and seasonal basis?

4 What model best describes the diurnal and seasonal variations in the clear-sky level on a satellite-to-ground link?

5 How do the climatology and natural variability of the rain process affect attenuation and interference predictions, especially for tropical regions?

6 What models best describe the relationship between atmospheric parameters and radiowave characteristics (amplitude, polarization, phase, angle of arrival, etc.)?

7 What methods based on meteorological information can be used in the statistical prediction of signal behaviour, especially for percentages of time from 0.1 to 10%, taking into account the composite effect of various atmospheric parameters?

8 What procedures can be used to evaluate data quality, accuracy, statistical stability and confidence levels?

9 What method can be used to forecast propagation conditions during consecutive periods of 24 hours during any season anywhere in the world?

NOTE 1 – Priority will be given to studies relating to § 3, 4, 5, 7 and 9.

further decides

1 that the results of the above studies should be included in one or more Recommendations and/or Reports;

2 that the above studies should be completed by 2010.

Category: S2

QUESTION ITU-R 202-3/3

Methods for predicting propagation over the surface of the Earth

(1990-2000-2007)

The ITU Radiocommunication Assembly,

considering

a) that the presence of obstacles on the propagation path may modify, to a large extent, the mean value of the transmission loss, as well as the fading amplitude and characteristics;

b) that, with increase in frequency, the influence of the detailed roughness of the surface of the Earth as well as that of vegetation and natural or man-made structures on or above the surface of the Earth becomes more significant;

c) that propagation over high mountain ridges is sometimes of great practical importance;

d) that diffraction and site shielding are of practical significance in interference studies;

e) that the increase in performance and storage capacity of computers, permits the development of detailed digital terrain and clutter data bases;

f) that the field strength of the ground wave for frequencies between 10 kHz and 30 MHz is given in Recommendation ITU-R P.368, and a computer implementation, GRWAVE, is available from the Radiocommunication Study Group 3 Web page;

g) that information on the phase of the ground-wave mode is required;

h) that information on ground conductivity is often available in digital form;

j) that seasonal variation of ground-wave propagation has been observed,

decides that the following Question should be studied

1 What is the influence of terrain irregularities, vegetation and buildings, the existence of conducting structures and seasonal variability, both for locations within the service area around a transmitter and for the evaluation of interference at much greater distances, on the transmission loss, polarization, group delay and angle of arrival?

2 What is the additional transmission loss in urban areas?

3 What is the screening provided by obstacles near a terminal, taking into account the propagation mechanisms over the path?

4 What are the conditions under which obstacle gain occurs and the short-term and long-term variations of transmission loss under these conditions?

5 What are suitable methods and formats for describing the detailed roughness of the surface of the Earth including topographic features and man-made structures?

6 How can terrain data bases, together with other detailed information on terrain features, vegetation and buildings be applied in the prediction of attenuation, time delay, scatter and diffraction?

7 How can quantitative relationships and statistically-based prediction methods be developed which treat reflection, diffraction and scatter from terrain features and buildings, as well as the influence of vegetation?

8 What is the phase of the ground-wave mode?

9 How can information on ground conductivity be made available digitally as matrix or vector information?

further decides

1 that the results of the above studies should be included in Recommendations and/or Reports;

2 that the above studies should be completed by 2010.

Category: S2

QUESTION ITU-R 203-3/3

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

(1990-1993-1995-2000-2002)

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 at frequencies between 30 MHz and about 50 GHz;

b) that for terrestrial broadcasting, fixed (broadband access) and mobile services, propagation studies involve consideration of point-to-area propagation paths;

c) that present methods are based largely upon 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 for terrestrial broadcasting and fixed (broadband access) services 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,

decides that the following Question 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;
– 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

1 that the available information should be prepared as a new Recommendation.

QUESTION ITU-R 204-3/3

Propagation data and prediction methods required for terrestrial line-of-sight systems

(1990-1993-1995-1997-2000)

The ITU Radiocommunication Assembly,

considering

a) that a better knowledge of the characteristics of propagation contributes greatly to the design of economic line-of-sight systems and to the improvement of system performance and in particular:

– that the design of digital systems is largely controlled by the performance and the availability required (as related to propagation) and that periods of adverse propagation are significant to the design of digital systems;

– that amplitude and group-delay distortions across a microwave radio channel have a profound effect on the bit error ratio of digital systems,

decides that the following Question should be studied

1 What is the distribution of the value of transmission loss additional to free space resulting from multipath propagation, diffraction, precipitation and absorption, etc., for frequency bands above about 300 MHz for each month of the year, including its diurnal variation averaged over each month?

2 What propagation data may be used for station site selection and for determining the height of antennas and their radiation characteristics, including the distribution of refractive-index gradient or *k*-factor during subrefractive conditions averaged over a specified path length?

3 What data may be obtained on clear-air propagation effects (both fading and enhancements), in particular:

– the number of atmospheric and ground reflected rays during multipath propagation, and the statistical distribution of their relative amplitudes and delays;

– statistics of single-frequency fading, flat fading, selective fading (including minimum and non-minimum phase fading, in-band power differences (IBPD), in-band amplitude dispersions (IBAD) and notch depths) and composite fading (flat plus selective), and diffraction fading;

– conditional probabilities of flat fading, selective fading, delays and notch depth to determine the inter-dependence of the principal multipath parameters;

– the dependence of all the items above on:

  – path and terrain characteristics, frequency, antenna patterns and geoclimatic factors;

  – diversity (angle, space and in-band and cross-band frequency);

– degree of correlation of multipath fading on different channels on the same path and different paths in a multi-hop link?

4 What models of the tropospheric channel transfer function can be used for the computation of system performance?

5 What data may be obtained on precipitation effects, in particular:

– concurrent long-term statistical distributions of rainfall attenuation and rainfall intensity, especially in tropical regions;

– the influence of sleet and wet snow;

– long-term number of precipitation attenuation events of duration shorter than 10 s and 10 s or longer for various attenuation levels, and the mean duration of precipitation events of duration 10 s or longer in combination with long-term statistical distributions of precipitation attenuation exceedances;

– the degree of correlation of precipitation effects on different paths of the same link?

6 What precipitation parameters, in addition to rainfall intensity, can be applied to precipitation-related prediction methods to take account of different climates?

7 What refractivity parameters, in addition to, or instead of, refractivity gradient statistics in the first 100 m of the atmosphere, can be applied to clear-air prediction methods to take account of different climates?

8 What is the variation, due to clear-air propagation effects, precipitation or any other cause, of the isolation between two orthogonal polarizations?

9 What is the set of conditions that must be met to identify the period of non-faded propagation?

10 What is the frequency of occurrence and duration of fades exceeding specified values and the rate of change of received signal in these fades, noting that the time resolution of measurements to obtain these statistics must be adequate to describe the rate of variation of the propagation effects. The duration statistics should also be apportioned between events shorter than 10 s and those 10 s or longer?

11 What is the improvement to be gained using diversity systems in the presence of rain or multipath?

12 What is the improvement to be gained using diversity systems in the presence of multipath?

13 What are the cumulative effects of all propagation factors, on the overall system performance of multi-hop links (including one or more satellite hops), and the dependence of these factors on hop characteristics?

14 How can the contributions from the various propagation effects be apportioned to performance and availability?

15 What are the relevant short-term propagation considerations for bringing a system into service?

NOTE 1 – Priority will be given to studies relating to § 3, 4, 7, 12 and 14.

QUESTION ITU-R 205-1/3

Propagation data and prediction methods required for trans-horizon systems

(1990-1993-1995)

The ITU Radiocommunication Assembly,

considering

a) that, in the planning of a digital communication network, it is necessary to define the overall system performance and availability achieved for a given percentage of the time;

b) that designers of radio systems in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands require to know, from the viewpoint of sustained satisfactory operation, the tropospheric propagation characteristics and the resulting transmission loss that is not exceeded for a large percentage of the time for each particular frequency band, over the distance corresponding to the service range, which may extend from about 100 km to more than 500 km;

c) that the planning of systems requires a knowledge of the distribution curves, as functions of time, of the transmission loss for the most unfavourable month of the climatic zone under consideration;

d) that the bandwidth of the system may be limited by the nature of the mode of propagation employed,

decides that the following Question should be studied

1 What is the distribution in time of the basic transmission loss (see Recommendation ITU-R P.341), in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands, for each month of the year (the value of the path antenna gain being specified). The recording should be performed with an instrument having a time constant of 1 s (other time constants may be used, should it appear desirable, but in all cases the time constant used should be specified) and special importance should be attached to the quasi-maximum and quasi-minimum values of the transmission loss or field strength?

2 For given levels, what are the percentages of time corresponding to the worst month and corresponding to the whole year?

3 What are the hours of the day for which the greatest transmission loss may usually be expected?

4 What is the dependence of the distributions on the climatic zone in which the path under consideration is located, and which distinct climatic zones should be taken into consideration (in view of the paucity of data relating to propagation in climates other than temperate, administrations are urged to give special attention to the collection of data relating to other types of climate)?

5 What is the dependence of the distributions on the frequency, on the distance between the stations, on the angle of elevation of the antennas at each terminal and on the nature of the terrain over which the path passes?

6 What are the limitations imposed on the bandwidth of the system by the propagation process (diffraction, partial reflection, scattering, etc.)?

7 What models can be used, in particular:

– to describe the dispersive behaviour of the transmission channel particularly for digital systems;

– for the prediction of system performance and availability degradation?

8 What is the degree of correlation of fading on different radio channels on the same path and different paths in a multi-hop link?

9 What is the improvement to be gained using diversity (space, angle, frequency and polarization)?

NOTE 1 – Priority will be given to studies relating to § 7.

QUESTION ITU-R 206-3/3

Propagation data and prediction methods for fixed- and broadcasting-satellite services

(1990-1993-1995-1997-2000)

The ITU Radiocommunication Assembly,

considering

a) that, in the design of fixed- and broadcasting-satellite services, an accurate knowledge of the distributions in time and space of radiowave propagation phenomena in the lower atmosphere, and of their dependence on various factors, is important to the determination of system performance and of interference to and from space stations;

b) that radiowave propagation data for the fixed- and broadcasting-satellite services are restricted to certain areas and link parameters (e.g. frequency, polarization, elevation angle) and that further data are needed,

decides that the following Question should be studied

1 What is the long-term statistical distribution in time and space, including consideration of diurnal aspects and the worst month, of:

– co-polar attenuation (CPA), tropospheric scintillation, and cross-polar discrimination (XPD) induced by constituents in the lower atmosphere;

– refraction, beam divergence, and incoherence of radiowaves passing through the lower atmosphere?

2 What is the dependence of these distributions on the antenna size, frequency, polarization, angle of elevation, geographic latitude, rain climate, and atmospheric composition, as well as the effects of terrain, vegetation, and man-made structures, on these distributions?

3 What method should be used for the prediction of these distributions, and their dependence on the above parameters, in particular low elevation angle effects?

4 What precipitation parameters, in addition to rainfall intensity, can be applied to precipitation-related prediction methods to take account of different climates?

5 What are the statistical characteristics of building and vehicle signal entry loss, and how does the loss depend on frequency, path elevation angle, and the location within the structure or vehicle?

6 What refractivity parameters, in addition to, or instead of, refractivity gradient statistics in the first 100 m of the atmosphere, can be applied to clear-air prediction methods to take account of different climates?

7 What methods should be used to take account of both the simultaneous and the long-term cumulative effects of radiowave propagation mechanisms occurring at the same time along the same path (e.g. tropospheric scintillation and rain attenuations)?

8 What is:

– the frequency of occurrence and duration of fades exceeding specified values and the rate of change of received signals in these fades;

– the proportion of fades occurring during the available time as defined in Recommendation ITU-R F.557?

9 What information is required on the dynamics of the propagation medium to enable impairment countermeasure techniques (e.g. up-link power control, site diversity, depolarization, pre-compensation and resource sharing) to be designed?

10 How is link performance affected in the case of a varying elevation angle?

NOTE 1 – Priority is to be given to studies relating to § 3, 4 and 5.

QUESTION ITU-R 207-3/3

Propagation data and prediction methods for satellite mobile and radiodetermination services above about 0.1 GHz

(1990-1993-1995-1997-2000)

The ITU Radiocommunication Assembly,

considering

a) that there is a requirement for methods to estimate the field strength or the transmission loss when planning mobile and radiodetermination services using satellites;

b) that a number of administrations are studying satellite systems for aeronautical and maritime safety, radiodetermination, communication and control;

c) that there is considerable interest in providing personal communication services to handheld terminals with mobile-satellite systems;

d) that for VHF, UHF and SHF systems involving satellites, both the ionosphere and troposphere may affect propagation, as well as reflections from the ground, sea and/or man-made structures;

e) that for land mobile-satellite systems, blockage and shadowing will affect propagation;

f) that there is a requirement for propagation data and modelling for all path elevation and azimuth angles, especially for systems employing constellations of non-geostationary satellites;

g) that knowledge of fade-duration and non-fade-duration distributions is of particular importance to satellite mobile and radiodetermination systems;

h) that a number of mobile-satellite systems sharing the same frequency band will be introduced;

j) that wideband fading and delay-spread are important aspects of the propagation channel which must be taken into account in the design of digital systems,

decides that the following Question should be studied

1 To what extent does the field strength or transmission loss depend on the nature of terrain, the effects of vegetation and man-made structures, antenna location, frequency, polarization, angle of elevation and climate; and how do these factors affect the selection of frequencies and wave polarization for such systems?

2 What are the effects of the local environment for handheld terminals and personal communication systems?

3 What are the effects due to multipath propagation and Doppler frequency changes, and how do these depend on the parameters listed in § 1?

4 What is the most suitable form of prediction method, for each radio service, for use in the preparation of national and international frequency plans?

5 What are the characteristics and effects of land- or sea-reflection and multipath fading on communication or radiodetermination signals transmitted by satellites, both geostationary and otherwise, for the use of land vehicles, aircraft and ships?

6 What propagation data may be collected for modelling, statistical characterization and mitigation of tropospheric and multipath-induced impairments, especially for low elevation angle slant paths, as a function of sea or land surface state (wave height or terrain irregularity), satellite elevation angle, antenna radiation pattern, local site clearance and environment, including terrain and vegetation blockage and shadowing and frequency?

7 What is the method for estimating signal-to-interference ratio where both wanted and unwanted signals are affected by multipath fading?

NOTE 1 **–** Priority will be given to studies relating to § 1 and 2.

QUESTION ITU-R 208-3/3

Propagation factors in frequency sharing issues affecting fixed-satellite services and terrestrial services

(1990-1993-1995-2002-2005)

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) 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 Question 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?

NOTE 1 – Priority will be given to studies relating to §§ 2, 5, 6, 8, 9 and 10.

Category: S2

QUESTION ITU-R 209/3

Variability and risk parameters in system performance analysis

(1993)

The ITU Radiocommunication Assembly,

considering

a) that for the proper planning of terrestrial and Earth-space links it is necessary to have appropriate parameters for the formulation of performance criteria of radiocommunication systems;

b) that the “average annual worst month” has been defined as the long-term statistic relevant to performance criteria referring to “any month”;

c) that due to the stochastic nature of propagation effects in radiocommunication systems there is a need for information on variability of these effects, with respect to the long-term statistic, for various periods of reference;

d) that there is a need for an unambiguous formulation of variability parameters to allow proper cost and performance trade-offs to be made in the analysis of system reliability, availability and quality,

decides that the following Question should be studied

1 What is the variation of propagation effects with respect to the long-term cumulative statistic for various periods of reference?

2 What are the periods of reference to be specified for the formulation of risk parameters associated with the variation of propagation statistics?

3 What are the parameters most suited to the formulation of confidence limits and risks associated with the specification and estimation of system performance?

4 What are the procedures for the calculation of the parameters defining statistical variation of propagation effects in radiocommunication systems?

QUESTION ITU-R 211-4/3

Propagation data and propagation models for the design of short-range wireless communication and access systems and wireless local area networks (WLAN) in the frequency range 300 MHz to 100 GHz

(1993-2000-2002-2005-2007)

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. beyond IMT-2000) 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 a rapidly emerging wireless technology and may have impact on radiocommunication services;

g) 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;

h) that while multipath propagation may cause impairments, it may also be used to advantage in a mobile or indoor environment;

j) that frequencies proposed for the systems described in § a), b) and c) range from about 300 MHz to 100 GHz;

k) that there are only limited propagation measurements available in some of the frequency bands being considered for short-range systems;

l) that information regarding indoor and indoor-to-outdoor propagation may also be of interest to other services,

decides that the following Question 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 models should be used for assessing impact of UWB devices on other recognized radiocommunication services?

3 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?

4 What are the characteristics of the impulse response of the channel?

5 What effect does the choice of polarization have on the propagation characteristics?

6 What effect does the performance of the base station and terminal antennas (e.g. directivity, beam-steering) have on the propagation characteristics?

7 What are the effects of various diversity schemes?

8 What are the effects of the siting of the transmitter and receiver?

9 In the indoor environment, what is the effect of different building and furnishing materials as regards shadowing, diffraction, and reflection?

10 In the outdoor environment, what is the effect of building structures and vegetation as regards shadowing, diffraction, and reflection?

11 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?

12 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?

13 How may building entry loss be characterized for system design, and what is its effect on indoor-to-outdoor transmission?

14 What factors can be used for frequency scaling, and over what ranges are they appropriate?

15 What are the best ways of presenting the required data?

16 How may propagation channels using multiple transmitters and multiple receivers be characterised for system design?

further decides

1 that the results of the above studies should be included in one ore more Recommendations and/or Reports;

2 that the above studies should be completed by 2009.

Category: S1

QUESTION ITU-R 212-1/3

Ionospheric properties

(1978-1982-1990-1997)

The ITU Radiocommunication Assembly,

considering

a) that ionized media affect the propagation of radiowaves;

b) that the properties of the ionosphere and ionized regions beyond were described in former Reports of Study Group 3;

c) that a large number of digitized measurements are now available which cover all levels of solar activity for 3-4 solar cycles,

decides that the following Question should be studied

1 What additional information concerning the properties of the terrestrial ionosphere and ionized regions beyond facilitates the study of aspects of propagation that are important to radio systems?

2 What physical properties and what variations in the structure of the ionosphere at or near the magnetic equator have an influence on radiocommunications?

3 What improvements may be made to the mapping of ionospheric characteristics on both a global and regional basis using data and analysis techniques now available?

further decides

1 that a revision of Recommendation ITU-R P.1239 should be proposed before 2005;

2 that the available information should be prepared as a Handbook.

QUESTION ITU-R 213-1/3

The short-term forecasting of operational parameters for ionospheric and trans-ionospheric radiocommunications

(1978-1990-1993-2000-2000)

The ITU Radiocommunication Assembly,

considering

a) that accurate, quantitative short-term predictions of ionospheric variations a few hours or days in advance would permit more efficient utilization of radio frequencies and increase the reliability of radiocommunication services;

b) that, in addition to the widespread disturbances associated with major geophysical or solar events that affect the maximum plasma frequency and total electron content (TEC), there are other hour-to-hour and day-to-day ionospheric variations (which may be local in influence) whose effects on:

1) operational characteristics of HF radio systems, such as operational MUF;

2) operational characteristics of VHF/UHF radio systems, such as TEC;

3) those characteristics associated with attenuation, background noise, fading, multipath interference, group path delay, scattering, polarization rotation, dispersion, angular deviation and scintillation;

cannot be predicted by well-established techniques,

decides that the following Question should be studied

1 What are the needs and techniques for the short-term prediction (a few hours or days in advance) of operational parameters for ionospheric and trans-ionospheric radiocommunications?

2 How useful are the techniques of ionospheric sounding, TEC determination from global navigation satellite systems and channel evaluation measurements as aids in the real-time estimation of potential circuit performance and in the operational frequency management of radio circuits?

further decides

1 that appropriate information shall be prepared as a Recommendation and as a Handbook.

QUESTION ITU-R 214-3/3

Radio noise

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

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 needed, particularly for parts of the world not previously studied, for the planning of telecommunications 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 Question 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 directions of arrival, and the relationship to changes in geophysical phenomena, such as 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

1 that appropriate information concerning radio noise resulting from studies within the ITU-R shall be contained in Recommendations and or Reports;

2 that the above studies should be completed by 2010.

Category: S2

QUESTION ITU-R 218-3/3

Ionospheric influences on space systems

(1990-1992-1995-1997-2007)

The ITU Radiocommunication Assembly,

considering

a) that, in the case of some high-performance space systems involving satellites, ionospheric effects should be considered up to the highest frequencies in use;

b) that various satellite systems, including mobile- and navigational-satellite services, are employing non-geostationary-satellite networks,

decides that the following Question should be studied

1 How can trans-ionospheric propagation models be improved, especially to account for ionospheric changes in the short-term, and at high and low latitudes, in regard to:

– scintillation effects on phase, angle of arrival, amplitude and polarization;

– Doppler and dispersion effects;

– refraction affecting in particular the direction of arrival and also the phase and group delays;

– Faraday effect, particularly with regard to polarization discrimination;

– attenuation effects?

2 What propagation prediction methods can be derived to assist in coordination and sharing among concerned services?

3 What propagation prediction method can be derived to assist in the determination of performance characteristics of satellite services employing non-geostationary-satellite networks?

further decides

1 that Recommendation ITU-R P.531 will be revised before 2010.

NOTE 1 – Priority will be given to studies relating to § 1.

Category: S2

QUESTION ITU-R 221/3

VHF and UHF propagation by way of sporadic E and other ionization

(1990)

The ITU Radiocommunication Assembly,

considering

a) that the available information on terrestrial propagation by sporadic E and other ionization is insufficient to provide statistical data of the type needed by telecommunication engineers, especially at low and high latitudes;

b) that ionospheric irregularities including meteor ionization in the E region and the F region can affect the performance of radio systems operating in the VHF and UHF portions of the spectrum;

c) that suitable methods for estimating VHF sky-wave field strength and signal dispersion are required by:

– administrations, in connection with the establishment and operation of radio systems;

– the Radiocommunication Bureau, for further refinement of its technical standards contained within the Rules of Procedure;

– the Radiocommunication Sector, in connection with future Radiocommunication Conferences,

decides that the following Question should be studied

1 what are the mechanisms for VHF and UHF propagation by the ionosphere and how can the statistics of the propagation characteristics be predicted?

NOTE – See Recommendations ITU-R P.534 and ITU-R P.843.

QUESTION ITU-R 222-1/3

Measurements and data banks of ionospheric parameters

(1990-1993-2000-2000)

The ITU Radiocommunication Assembly,

considering

a) that measurements of signal characteristics and of the ionosphere as a propagation medium are essential for the further improvement of methods of radiowave propagation prediction,

decides that the following Question should be studied

1 What techniques for the measurement of signals and for the collection of data are suitable for use in connection with the study of improvements in ionospheric prediction methods in all relevant frequency bands?

2 What techniques for HF field strength measurement and the compilation of data banks are suitable for use in connection with the study of improvements in HF prediction methods, taking into account the need for positive identification of signals and of the need to calibrate measuring systems and antennas?

3 What routine measurement programmes including worldwide vertical sounding and TEC (total electron content) evaluation using global navigation satellites are necessary for ionospheric mapping and modelling purposes, and for studying ionospheric effects upon Earth-space propagation?

4 What data collection, analysis, standardization, compilation and dissemination procedures are needed for the creation and use of an international data bank of TEC values in the formulation of an ITU-R global TEC model?

further decides

1 that Radiocommunication Study Group 3 should develop and maintain databanks of ionospheric measurements obtained using the above techniques.

QUESTION ITU-R 225-5/3

The prediction of propagation factors affecting systems at LF and MF including the use of digital modulation techniques

(1995-1997-2000-2007)

The ITU Radiocommunication Assembly,

considering

a) that Recommendation ITU-R P.368 presents ground-wave propagation curves for frequencies between 10 kHz and 30 MHz and that Recommendation ITU-R P.684 and Recommendation ITU-R P.1147 describe procedures for predicting sky-wave propagation at frequencies below about 150 kHz and at frequencies between about 150 and 1 700 kHz, respectively;

b) that most of these and other available prediction methods are intended primarily for narrow-band or analogue systems;

c) that under certain conditions, ground-wave and sky-wave signals of the same source may be comparable in amplitude;

d) that there is an increasing use of digital modulation techniques, including those that use fast signalling speeds or which require good phase or frequency stability;

e) that Recommendation ITU-R P.1321 summarizes some results of studies on propagation factors affecting systems using digital techniques at LF and MF;

f) that, for digital systems, information will be required of the signal level and its variation as well as of time and frequency spreads within the channel,

decides that the following Question should be studied

1 What improvements may be made to the methods of predicting the sky-wave field strength and circuit performance at frequencies below about 1.7 MHz?

2 Are there significant variations in ground-wave field strength with location or with time?

3 How does the coexistence of ground-wave and sky-wave signals affect digital systems at LF and MF?

4 What are the amplitude and phase characteristics of time and frequency spreads (multipath and Doppler) of the LF/MF sky-wave signals?

5 What are the appropriate parameters for these signal characteristics for incorporation into a measurement data bank?

6 How do the sky-wave parameters vary with time, frequency, path length and other factors?

7 What are the appropriate methods for predicting these parameters and to what extent should different prediction models be used, dependent on the modulation methods employed for the signal?

further decides

1 that the results of the above studies should be included in Recommendations and/or Reports;

2 that the above studies should be completed by 2010.

Category: S2

QUESTION ITU-R 226-3/3

Ionospheric and tropospheric characteristics along satellite-to-satellite paths

(1997-2000-2000-2007)

The ITU Radiocommunication Assembly,

considering

a) that techniques exist for monitoring tropospheric and ionospheric characteristics by means of low orbiting satellites observing GPS satellites near the Earth's limb;

b) that ionospheric effects along these paths may dominate over tropospheric effects in some situations and, for extrapolation to other scenarios, separation of these two components is necessary;

c) that intersatellite links and compatibility may be affected by the ionosphere and the troposphere,

decides that the following Question should be studied

1 How does the ionospheric content along satellite-to-satellite radio paths vary with slant path, location, height, time and solar activity?

2 How are intersatellite links affected by the ionosphere and troposphere?

3 How can the ionospheric and tropospheric effects be separated in the results of measurements on such paths?

further decides

1 that material in answer to *decides* 1 should be developed as a new Recommendation by 2010.

Category: S2

QUESTION ITU-R 227-1/3*

HF channel simulation

(2000-2002)

The ITU Radiocommunication Assembly,

considering

a) that the testing and evaluation of HF modems is more cost effective when carried out under simulated representative ionospheric conditions;

b) that detailed characteristics of the ionospheric effects on an HF channel are required in order to simulate an HF channel accurately;

c) that both narrow-band and wideband HF systems need to be tested under simulated ionospheric conditions,

decides that the following Question should be studied

1 What ionospheric situations have significant effects on an HF channel?

2 What are the characteristics relevant for the simulation of a narrow-band HF channel?

3 What are the characteristics relevant for the simulation of a wideband (e.g. 100 kHz) HF channel?

4 What values of the channel transfer function, notably the delay power profile, are characteristic of the ionosphere at different locations and times?

further decides

1 that the available information should be prepared as new Recommendations, or as revisions to existing Recommendations.

* This Question should be brought to the attention of Radiocommunications Working Party 9C.

QUESTION ITU-R 228-1/3*

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

(2000-2005)

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,

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* This Question should be brought to the attention of Radiocommunication Study Groups 1, 7 and 9.

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

decides that the following Question 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

1 that the results of studies above 275 GHz should be brought to the attention of the other Study Groups;

2 that the results of the above studies should be included in one or more Recommendations;

3 that the results related to terrestrial applications should be available by 2006, and should be included in future Recommendation(s) or Report(s).

Category: C1

QUESTION ITU-R 229/3

Prediction of sky-wave propagation conditions, signal intensity, circuit performance and reliability at frequencies between about 1.6 and 30 MHz, in particular for systems using digital modulation techniques

(2002)

The ITU Radiocommunication Assembly,

considering

a) that accurate, quantitative predictions of ionospheric propagation are important for planning optimum spectrum utilization;

b) that the methods for prediction of basic and operational MUFs and ray paths (see Recommendation ITU-R P.1240) are required for predicting HF sky-wave propagation characteristics and merit further improvement;

c) that a method for predicting HF sky-wave propagation characteristics is given in Recommendation ITU-R P.533, but that this method may need to be extended to meet new requirements;

d) that Recommendation ITU-R P.842 provides a method for the computation of reliability and compatibility of HF radio systems;

e) that radio system performance is influenced by variations of the amplitude and dispersion of the wanted signals, and of the background noise and interference, and this influence varies with the type of emission, particularly between analogue and digital;

f) that the available prediction methods are intended primarily for use for narrow-band or analogue systems;

g) that many HF systems use digital modulation techniques, including those which utilize fast signalling speeds or which require phase or frequency stability;

h) in particular, that a method is urgently required to estimate the performance of digital broadcasting, and that additional requirements have been identified for the planning and operation of frequency agile adaptive HF systems,

decides that the following Question should be studied

1 What improvement may be made to the methods given in Recommendation ITU-R P.1240 for the long-term prediction of basic and operational MUFs and ray paths, and their variability, from predicted ionospheric characteristics?

2 What improvements may be made to the method for the long-term estimation of sky-wave propagation conditions, signal intensity and circuit performance using predicted ionospheric characteristics?

3 What procedures should be applied for the estimation of the reliability of a radio system, considered in the presence of noise alone, and in the presence of noise and interference, including the effect of receiver noise factors?

4 What are the characteristics of time delay spread and frequency spread (multipath and Doppler shifts) of HF sky-wave signals, including fading characteristics?

5 What values of a time-delay and frequency power profiles are characteristic of the ionosphere at different locations and times, and how may the prediction of these characteristics be included within a comprehensive method?

further decides

1 that the available information should be prepared as new Recommendations, or as revisions to existing Recommendations;

2 that the methods described in the Recommendations should be available as a software package for use within the Radiocommunication Bureau and by those concerned with the planning and operation of HF systems and networks;

3 that, taking account of the important needs for this method that the work should be undertaken urgently;

4 that the results of the above should be communicated to Radiocommunication Study Groups 6 and 9.

QUESTION ITU-R 230/3*

Prediction methods and models applicable to power line telecommunications systems

(2005)

The ITU Radiocommunication Assembly,

considering

a) that power line telecommunications systems (PLT) and other wired communication systems may use base-band frequencies up to 80 MHz, and that a wide variety of PLT architectures and components will be present, even in one administrative jurisdiction;

b) that radio frequency energy will be radiated by a number of mechanisms and in several modes, particularly from unbalanced, variable impedance and poorly terminated lines;

decides that the following Question should be studied

1 What are the mechanisms in PLT systems that cause radio frequency energy to be radiated?

2 Which modelling techniques may be best used to estimate radiated energy from a generic portion of a complete network?

3 What are the effects of the position of the ground plane and other structures relative to the line on radiated energy and its spatial distribution?

4 What techniques are most appropriate in aggregating the total radiated energy in space from such a system or multitude of systems?

5 Which signal level propagation models are most appropriate in the determination of interference?

6 What advice may be given to enable practical measurement of radiating fields at short distances (within the near field)?

Category: S1

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* This Question should be brought to the attention of Radiocommunication Study Group 1 (Working Party 1A).

QUESTION ITU-R 231/3*

The effect of electromagnetic emissions from man-made sources on the performance of radiocommunication systems and networks

(2007)

The ITU Radiocommunication Assembly,

considering

a) that electromagnetic emissions occur from a wide variety of man-made sources, such as ignition systems in internal combustion engines, electrical machinery, electronic equipment and apparatus, information technology and telecommunications equipment, etc.;

b) that the reception of such emissions may affect the performance of radiocommunication systems and networks;

c) that the information on man-made noise in Recommendation ITU-R P.372 relates to the aggregated noise from all man-made sources in typical environments, and does not provide information on the emissions received from individual or identifiable sources;

d) that such emissions may be impulsive in character and cannot be adequately described in terms of an external noise factor;

e) that emissions from individual sources may become of increasing importance in determining the performance of radio systems and networks,

decides that the following Question should be studied

1 How can the distribution of the radiation from individual sources be described and measured?

2 What is the effect of electromagnetic emissions from man-made sources on the performance of radiocommunication systems and networks, and how should the effect of such emissions be described and quantified?

further decides

1 that the results of studies should be included in Recommendations and/or Reports;

2 that the above studies should be completed by 2010.

Category: S2

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* This Question should be brought to the attention of Radiocommunication Study Group 1.