ITU-R

Handbook on Guidance for bilateral/multilateral discussions on the use of frequency range 1 350 MHz – 43.5 GHz by fixed service systems

Edition of 2015

Handbook

on

Guidance for bilateral/multilateral discussions on the use of frequency range 1 350 MHz – 43.5 GHz by fixed service systems

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Foreword

Since 1979 the issue of cross-border coordination for the fixed service is no longer addressed within the Radio Regulations. Due to the nature of electromagnetic propagation of radio waves, the necessity to ensure protection of systems in one administration from signals radiating within the territory of another administration led to the need for administrations to develop coordination agreements.

Some administrations have developed bilateral or multilateral agreements, some have developed regional agreements, others deal with this issue on a case-by-case basis.

A guide to help administrations is needed to address best practices from those administrations already having knowledge and experience in developing such agreements. Therefore this Handbook was developed to provide some examples to facilitate the sharing of fixed service deployed in the neighbouring countries.

This Handbook was developed by a Correspondence Group established for this purpose by ITU-R Working Party 5C under the guidance of Mr Alexander Klucharev (Russia) and Mr Evgeny Tonkikh (Russia).

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1 Introduction

1.1 Purpose and scope

The Handbook is developed in the effort to:

– summarize the existing technical approaches which could be used between administrations wishing to resolve compatibility issues within fixed service (FS) stations and sharing between stations of fixed service (FS);

– identify a list of the general technical parameters of FS stations which may be useful in addressing the compatibility/sharing issues;

– understand the necessity and the extent of the radio propagation conditions, relief and other details, which should be taken into account when reaching resolving FS stations compatibility/sharing.

It should be noted that according to the decision of WARC-79, border coordination of frequency assignments between FS stations by interested administrations is excluded from the Radio Regulations.

Along with that, some administrations have developed and signed multilateral agreements regulating procedures and methods for border coordination of frequency assignments to stations of FS according to Article **6** of the Radio Regulations. The HCM Agreement [1] between some European Administrations can serve as an example of such an agreement which includes procedures, methods, formats and the list of required initial data for border coordination of frequency assignments to radio relay stations in FS ("point-to-point" networks). Similar agreement for border coordination of frequency assignments to radio relay stations has been prepared by a group of African Administrations (HCM4A Agreement) [2] with technical assistance of ITU-D. Some issues concerning principles of border coordination of frequency assignments to wireless access stations ("point-to-multipoint" networks) are described in Recommendation ITU-R F.1671 and in ECC Recommendations and Reports [3, 4-10]. In such conditions interested administrations are currently negotiating and signing bilateral/multilateral agreements for border coordination of frequency assignments to stations in "point-to-multipoint" networks [11, 12].

The technical and operational information contained herein could help facilitate the sharing of FS deployed in the neighbouring countries.

This Handbook is not intended to be a replacement for any cross-border agreement between administrations.

1.2 Sharing in cross-border regions

All administrations have sovereign right to use the spectrum on the whole territory of their countries. However, radiowave propagation properties make it challenging to fully preclude signals radiation on the territory of other countries, especially when those signals are transmitted to and from the border area of the country.

This creates the issue of possible harmful interference from stations of different services of one administration into the territory and associated stations of neighbour (affected) administration. Even with technically similar systems from different sides of the border, there could be different deployments goals in which one administration may pursue more flexibility in system roll-out in the border area and other administration would seek interference protection of existing stations. This Handbook does not provide unique solutions to the aforementioned issue rather than lists some general approaches and examples of their applications to provide guidance to the administrations.

The following steps may be useful guidance for concerned administrations to resolve compatibility/sharing between stations of FS in the border area:

1) Definition of the technical parameters which may be considered as a sufficient condition for starting the process of bilateral/multilateral discussions between administrations.

1.1) Development of the interference scenario to be considered between administrations when the conditions of the defined technical parameters precipitate review by affected administrations. Determination of the necessity and the extent of radio propagation, relief and other details to be taken into account while considering specific interference scenario.

1.2) Forming the FS station parameters list which may be needed for solving the sharing/compatibility issues.

2) Discussions between administrations on a method to determine whether the specified on Step 1 criteria is exceeded.

3) Definition of possible technical and operational interference mitigation technique for FS stations.

4) Analysis and identification of actions taking into account the mitigation technique defined according to Step 3.

2 Procedure for defining the necessity of bilateral/multilateral discussion of FS station

2.1 General Method 1: Idealized course of action

The most efficient method for resolving interference of FS stations in a border region is frequency assignment planning, when neighbouring administrations possess entire information regarding parameters of planned and operated FS stations of the affected administrations. In such a case the impact of harmful interference can be calculated during bilateral/multilateral discussions of the planned FS station. And although the situation described above is not typical in cross-border discussions between administrations, such approach shows the idealized course of action process providing maximum efficiency at minimum probability of neglected harmful interference.

This approach has no difference between determination of technical conditions and the calculation to determine the mutual impact of a new or modified frequency assignment of requesting administration to stations of the affected administrations.

Let us consider cases of radio relay stations (point-to-point FS network) and fixed wireless access stations (point-to-multipoint FS network) using this approach.

To calculate the effect of harmful interference during bilateral/multilateral discussions of a planned FS station, a parameter for permissible harmful interference needs to be determined. When defining the parameter for permissible impact of harmful interference on point-to-point or point-to-multipoint FS receiving station, it is recommended to use condition of protection of the receiving station from "long-term"[1] [13] interference at a minimum (threshold) signal level.

In order to determine the exceedance conditions, that is actually the input harmful interference according to this approach, it is suggested to use permissible threshold sensitivity degradation (TD) for the victim receiver, as the parameter.

At this point, the receiver threshold sensitivity is determined as a minimum signal level providing the required quality of received signal affected by the receiver thermal noise only (for example, received signal quality is BER = 10^{-3}-10^{-6} for digital FS systems). To maintain the specified quality figure, the signal level should be increased by TD value under the combined impact of harmful interference and the receiver thermal noise.

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[1] "Long-term" interference is defined as interference with permissible level exceeded more than 1% of time. During bilateral/multilateral discussions on harmonization of planned frequency assignments to FS stations, it is recommended to use the requirement for protection from "long-term" interference not exceeded more than 20% of time.

The TD value can be derived from the equation:

$$TD = \left(N + I_{perm}(20\%)/N\right) \leq \; 10 \log\left(1 + 10^{(I_{perm}(20\%) - N)/10}\right) \tag{1}$$

where:

- TD: permissible threshold degradation of receiver sensitivity (dB)
- $I_{perm}(20\%)$: permissible input interference level exceeded no more than 20% of time (dBW)
- $N = 10\log(k \times T_0 \times B_{Rx}) + NF$: receiver noise in necessary signal bandwidth, B_{Rx} (dBW)
- NF: receiver noise factor (dB)
- $k = 1.38*10^{-23}$: Boltzmann's constant (J/K)
- $T_0 = 290$K: normal receiver noise temperature (Kelvin)
- B_{Rx}: necessary receiver bandwidth (Hz).

When estimating the "long-term" harmful interference impact during bilateral/multilateral discussions on harmonization of frequency assignments to FS stations, the recommended TD level is assumed as TD ≤ 0.5 to 1 dB.

At this point, the TD level directly corresponds to I/N. Thus, $TD = 1$ dB corresponds to $I/N = -6$ dB and $TD = 0.5$ dB corresponds to $I/N = -10$ dB.

The permissible input interference exceeded no more than 20% of time, $I_{perm}(20\%)$, can be defined as:

$$I_{perm}(20\%) = 10\lg\left(10^{\frac{TD}{10}} - 1\right) + 10\lg(kT_0B_{Rx}) + NF + MD + NFD(\Delta f) \tag{2}$$

where:

- MD: on-tune rejection (Masks Discrimination) [14], (dB)
- $NFD(\Delta f)$: off-frequency rejection (Net Filter Discrimination) [14], (dB).

$$MD = 10 * \log\frac{\int_0^\infty P(f)df}{\int_0^\infty P(f)*[H(f)]df} \approx 10 * \log\left(\frac{BTx}{BRx}\right) \tag{3}$$

$$NFD(\Delta f) = 10 * \log\frac{\int_0^\infty P(f)*[H(f)]df}{\int_0^\infty P(f)*[H(f+\Delta f)]df} \tag{4}$$

where:

- $P(f)$: power density of harmful interference
- $H(f)$: frequency selectivity of receiver
- Δf: frequency separation between the victim receiver and the interfering transmitter
- B_{Tx}: necessary radiation bandwidth of interfering transmitter
- B_{Rx}: necessary receiver bandwidth (3 dB).

$$NFD(\Delta f) = \begin{cases} 0, & \text{off} - \text{frequency rejection co} - \text{channel cases;} \\ NFD1, & \text{off} - \text{frequency rejection first adjacent} - \text{channel cases,} \end{cases} \tag{5}$$

where:

- $NFD1$: Attenuation first adjacent channel,

or permissible power flux-density (pfd) of harmful interference at the antenna input at height h_{Rx} above ground level (agl), exceeded no more than 20% of time, $PFD_{Rx}(B_{Rx}, 20\%, h_{Rx})_{perm}$:

$$PFD_{Rx}(B_{Rx}, 20\%, h_{Rx})_{perm} = 10\lg(kT_0B_{Rx}) + 10\lg\left(10^{\frac{TD}{10}} - 1\right) + NF - GRx + \\ + a_{Rx} + 20\lg f + 21.45 + MD + NFD(\Delta f) \tag{6}$$

The interference level of an interfering transmit station causing harmful interference at the input of receive station is defined as:

$$I(20\%) = P_{Tx} + G_{Tx} - a_{Tx} + G_{Rx} - a_{Rx} - L(d, f, 20\%, h_{Tx}, h_{Rx}) - a_{ant} - \\ - MD - NFD(\Delta f) \quad (7)$$

or pfd of harmful interference from the transmit station caused at the input of the receive antenna at height h_{Rx} agl, exceeded no more than 20% of time:

$$PFD_{Rx}(B_{Rx}, 20\%, h_{Rx}) = P_{Tx} + G_{Tx} - a_{Tx} - L(d, f, 20\%, h_{Tx}, h_{Rx}) - \\ - a_{ant} + 20\lg f + 21.45 - MD - NFD(\Delta f) \quad (8)$$

where:

P_{Tx}: output power of interfering transmit station (dBW)

a_{Tx}: antenna and feeder loss of transmit station (dB)

G_{Tx}: maximum antenna gain of interfering transmit station (dB)

$L(d, f, p\%, h_{Tx}, h_{Rx})$: propagation loss (dB)

d: distance between victim receive station and interfering transmit station (km)

f: operating frequency of interfering transmit station (MHz)

h_{Tx}: height of transmit antenna agl (m)

h_{Rx}: height of receive antenna agl (m)

G_{Rx}: maximum antenna gain of victim receive station (dB)

a_{Rx}: antenna and feeder loss of victim receive station (dB)

a_{ant}: attenuation of interference, due to antenna radiation pattern of interfering transmit station and radiation pattern of receive station, as well as polarizations used by transmit and receive stations (dB).

The concept of "reference band width", B_{ref}, is introduced to simplify the calculations. B_{ref} is to be selected as follows:

$$B_{ref} \leq \min(B_{Tx}, B_{Rx}) \quad (9)$$

Then, B_{ref} is to be selected according to the possible parameters of radio relay stations, and may be equal to either 1 Hz or 4 kHz or 1 MHz.

To determine the level of harmful interference at the receiver input, it is necessary to calculate propagation loss, $L(d, f, 20\%, h_{Tx}, h_{Rx})$ for known initial propagation data considering path profile and morphological data of radio-climatic zones within geographical areas under the methods given in Recommendation ITU-R P.452-14 [15] or Recommendation ITU-R P.2001 [16].

When using the methods for calculation of $L(d, f, 20\%, h_{Tx}, h_{Rx})$ described in Recommendation ITU-R P.452-14 or Recommendation ITU-R P.2001, digitized maps containing data on surface profile (topographical data) and codes of radio-climatic zones within geographical areas (morphological data) will be required for correct application of the method.

2.2 General Method 2: Application of permissible power levels

In majority of cases the complete information on FS station parameters of neighbour administrations is not available and calculation of harmful interference during bilateral/multilateral discussions of planned FS station is challenging. In this case, for determination of exceedance conditions for FS stations, some assumptions on possible FS station parameters at neighbour administrations are required.

Actually, replacing parameters of unknown FS stations in equations (7) and (8) by system parameters of FS stations, it is possible to pass on to determination of harmful interference on border and rest territory of the affected neighbour administration using parameters of a conditional area around FS station of requesting administration with a new or modified frequency assignment.

This section describes procedures and system parameters needed for calculation of the conditional area around FS station.

The conditional area around FS stations, when determining necessity of discussion of conditional parameters, is the area around transmit/receive station of fixed service outside of which permissible interference is not exceeded and, hence, discussion of frequency assignments is not required. Conditional area is defined on the basis of conservative or known characteristics of considered FS station and on the basis of the conservative or known initial data for propagation path and for system parameters of the unknown stations sharing the same frequency band with the FS station. Hence, the conditional area is not an exclusion area in the limits of which sharing between FS station and other stations is prohibited, but rather establishes the area for determination of necessity for detailed analysis. In most cases more detailed analysis shows that sharing within a conditional area is possible because the procedure for determination of the conditional area is based on unfavourable assumptions concerning would-be interference. For determination of conditional area it is necessary to consider two separate cases:

– transmit FS station which could cause interference to receive FS stations;

– receive station which could be interfered with transmit stations of other services.

Considering that definition of conditional area is based on the concept of permissible harmful interference to receive station in the FS, propagation loss in order to limit interference level is defined by "minimum required loss" along propagation path, which should be equal or exceeded no less than *p*% = 20% of time. Hence, conditional distance, d_{cond}, taking into account equations (1), (2), (7) and (9), may be derived from the following equation:

$$L(d_{cond.}, f, 20\%, h_{Tx}, h_{Rx}) = P_{Tx}\left(B_{ref}\right) + G_{Tx} - a_{Tx} - a_{ant} + G_{Rx} - a_{Rx} - \\ - MD - NFD(\Delta f) - I(20\%)_{perm} \quad (10)$$

or taking into account equations (1), (5), (8) and (9):

$$L(d_{\mathrm{cond}}, f, 20\%, h_{Tx}, h_{Rx}) = P_{Tx}\left(B_{ref}\right) + G_{Tx} - a_{Tx} - a_{ant} - \\ - MD - NFD(\Delta f) + 20\lg f + 21{,}45 - PFD_{Rx}\left(B_{ref}, 20\%, h_{Rx}\right)_{perm} \quad (11)$$

where:

$P_{Tx}\left(B_{ref}\right)$: output power of transmit station within reference bandwidth, B_{ref} (dBW/B_{ref})

$PFD_{Rx}\left(B_{ref}, 20\%, h_{Rx}\right)_{perm}$: power flux-density within reference bandwidth, B_{ref}, which can be exceeded no more than *p*% of time at the input of receive antenna at the height H_{Rx} (dBW(/Hz × m^2)).

2.2.1 Determination of conditional area using conservative initial data for propagation path

When defining necessity for bilateral/multilateral discussions of the FS station based on the known parameters of this station, system parameters of the unknown FS station and conservative initial data for propagation path, the calculated conditional area for all distances over full azimuth angle around the transmit, $d_{cond}(\alpha_{Tx})$, or receive, $d_{cond}(\alpha_{Rx})$ FS station is taken as conditional parameter.

The conservative initial data for propagation path does not contain path profile data and considers the following mechanisms of interference propagation: line-of-sight, diffraction over spherical Earth, and troposcatter.

Each calculated conditional distance for each certain azimuth from the location of the notified station, $d_{cond}(\alpha_{Tx})$, or $d_{cond}(\alpha_{Rx})$ is defined under constant specified orientation of notified station antenna, and orientation of unknown station towards the location of the notified station.

Using the conditional trigger for the FS transmit station, equation (8) will take the following form:

$$L(d_{cond}(\alpha_{Tx}), f, 20\%, h_{Tx}, h_{Rx}) = P_{Tx}(B_{ref}) + G_{Tx} - a_{Tx} - a_{Tx\,ant}(\chi_{Tx}) + G_{Rx} - \\ - a_{Rx} - MD - NFD(\Delta f) - I(20\%)_{perm} \quad (12)$$

or for equation (9):

$$L(d_{cond}(\alpha_{Tx}), f, 20\%, h_{Tx}, h_{Rx}) = P_{Tx}(B_{ref}) + G_{Tx} - a_{Tx} - a_{Tx\,ant}(\chi_{Tx}) - \\ - MD - NFD(\Delta f) + 20\lg f + 21.4 - PFD_{Rx}(B_{ref}, 20\%, h_{Rx})_{perm} \quad (13)$$

where:

χ_{Tx}: off-axis angle of transmit antenna (degrees).

Off-axis angle of transmit antenna, χ_{Tx} , is defined by equation:

$$\chi_{Tx} = \arccos(\cos(\varepsilon_{Tx}) \cos(\varepsilon_{TxRx}) \cos(\alpha_{TxRx} - \alpha_{Tx}) + \sin(\varepsilon_{Tx}) \sin(\varepsilon_{TxRx})) \quad (14)$$

where:

ε_{Tx}: elevation of main beam of transmit station

ε_{TxRx}: elevation of direction from transmit station to receive station

α_{Tx}: azimuth of main beam of transmit station

α_{TxRx}: azimuth of direction from transmit station to receive station.

Initial data:

A) Data on the known transmitter of station:

1) Planned transmit frequency, f_{Tx} (GHz);

2) Geographic coordinates of the FS station:

– Latitude φ_{Tx}: (degrees, minutes, seconds);

– Longitude: ψ_{Tx} (degrees, minutes, seconds);

3) Antenna height above ground level, h_{Tx} (m);

4) Azimuth of antenna main beam, α_{Tx} (degrees);

5) Elevation of antenna main beam, ε_{Tx} (degrees);

6) –3 dB antenna beam width, θ_{Tx}, in horizontal plane (only for sectoral antennas of point-to-multipoint (PMP) central stations);

7) Maximum antenna gain, G_{Tx} (dBi);

8) Antenna radiation pattern, $aTx_{ant}(\chi_{Tx})$ (dB) (Recommendation ITU-R F.699 [17] for stations of PP network and user terminals (UT) of PMP network; Recommendation ITU-R F.1336 [18] for base stations (BS) of PMP network);

9) e.i.r.p. of the transmit station in the reference bandwidth (dBW × MHz);

10) Reference bandwidth, B_{ref} (MHz);

11) Radius of service area (only for PMP central stations), Rad, km.

B) System data on the unknown receiver of station (Table A1-1):

1) Planned receive frequency, f_{Rx} = f_{Tx} (GHz);

2) Antenna height above ground level, h_{Rx} (m);

3) Maximum antenna gain, G_{Rx} (dBi);

4) Receiver noise figure NF_{Rx} (dB);

5) Reference bandwidth, B_{ref} (MHz).

C) Digitized maps, containing coordinates of borders between geographical areas of administrations, administration designations (codes) in geographical areas[2].

When applying the conditional parameter for FS station receiver, equation (10) will take the following form:

$$L(d_{cond}(\alpha_{Rx}), f, 20\%, h_{Tx}, h_{Rx}) = P_{Tx}(B_{ref}) + G_{Tx} - a_{Tx} - a_{Rx_{ant}}(\chi_{Rx}) - \\ -MD - NFD(\Delta f) - G_{Rx} - a_{Rx} - I(20\%)_{perm} \quad (15)$$

or for equation (11):

$$L(d_{cond}(\alpha_{Rx}), f, 20\%, h_{Tx}, h_{Rx}) = P_{Tx}(B_{ref}) + G_{Tx} - a_{Tx} - a_{Rx_{ant}}(\chi_{Rx}) - \\ -MD - NFD(\Delta f) + 20\lg f + +21{,}4 - PFD_{Rx}(B_{ref}, 20\%, h_{Rx})_{perm} \quad (16)$$

where:

χ_{Rx}: off-axis angle of receive antenna (degrees).

Off-axis angle of receive antenna, χ_{Rx}, is defined by equation:

$$\chi_{Rx} = \arccos(\cos(\varepsilon_{Rx}) \cos(\varepsilon_{RxTx}) \cos(\alpha_{RxTx} - \alpha_{Rx}) + \sin(\varepsilon_{Rx}) \sin(\varepsilon_{RxTx})), \quad (17)$$

where:

ε_{Rx}: elevation of main beam of receive station

ε_{RxTx}: elevation of direction from receive station to transmit station

α_{Rx}: azimuth of main beam of receive station

α_{RxTx}: azimuth of direction from receive station to transmit station.

Initial data:

A) Data on the known receiver of radio relay station:

1) Planned receive frequency, f_{Rx} (GHz);

2) Geographic coordinates of the FS station:

– Latitude: φ_{Rx} (degrees, minutes, seconds);

– Longitude: ψ_{Rx} (degrees, minutes, seconds);

3) Antenna height above ground level, h_{Rx} (m);

4) Azimuth of antenna main beam, α_{Rx} (degrees);

5) Elevation of antenna main beam, ε_{Rx} (degrees);

6) –3 dB antenna beamwidth, θ_{Rx}, in horizontal plane (only for sectoral antennas of PMP central stations);

7) Maximum antenna gain, G_{Rx} (dBi);

8) Antenna and feeder loss, a_{Rx} (dB);

9) Antenna radiation pattern, $a_{Rx_{ant}}(\chi_{Rx})$ (dB) (Recommendation ITU-R F.699 [17] for stations of PP network and terminal stations of PMP network; Recommendation ITU-R F.1336 [18] for central stations of PMP network);

10) Reference bandwidth, B_{ref} (MHz);

11) Receiver noise figure NF_{Rx} (dB);

12) Radius of service area (only for PMP central stations), Rad, km.

[2] Recommended use of ITU Digitized World Map (IDWM), which may be obtained in the Radiocommunication Bureau.

B) System data on the unknown transmitter of station (Table A1-1):

1) Planned transmit frequency, f_{Tx} = f_{Rx} (GHz);

2) Antenna height above ground level, h_{Tx} (m);

3) Maximum antenna gain, G_{Tx} (dBi);

4) e.i.r.p. of the transmit station in the reference bandwidth (dBW × MHz);

5) Reference bandwidth, B_{ref} (MHz).

C) Digitized maps, containing coordinates of borders between geographical areas of administrations, administration designations (codes) in geographical areas[3].

Number and coordinates of user terminal locations, which are modeling distribution of user terminals in a service area of BS in “point-to- multipoint” network, azimuths of directions to user terminals from BS location in the BS antenna sector are defined in accordance with the following rules:

– user terminals are located on the circumference around BS location with the radius equal to the radius of BS service area Rad, km;

– number of user terminals is defined by width of BS antenna sector, θ_{Tx}. Each BS antenna sector, multiple of conditional sector width of 60 degrees, contains one user terminal. Number of user terminals in BS antenna sector, N_{user}, azimuths of directions to each of them, $\alpha_{user\ i}$, and distances between BS and UT locations depending on antenna sector width, θ_{Tx}, and azimuths of main lobe, α_{Tx}, are shown in Table 1;

TABLE 1

Width of BS antenna sector, θ_{Tx} (degrees)	**Number of UT, N_{user}, in BS sector**	**Azimuth, $\alpha_{user\ i}$, from BS to UT$_i$, in the BS sector (degrees)**
$0 < \theta_{Tx} \leq 60$	1	$\alpha_{user\ i1} = \alpha_{Tx}$
$60 < \theta_{Tx} \leq 120$	2	$\alpha_{user\ 1} = \alpha_{Tx} - \theta_{Tx}/4$; $\alpha_{user\ 2} = \alpha_{Tx} + \theta_{Tx}/4$
$120 < \theta_{Tx} \leq 180$	3	$\alpha_{user\ 1} = \alpha_{Tx}$; $\alpha_{user\ 2} = \alpha_{Tx} - \theta_{Tx}/3$; $\alpha_{user\ 3} = \alpha_{Tx} - \theta_{Tx}/3$
$180 < \theta_{Tx} \leq 240$	4	$\alpha_{user\ 1} = \alpha_{Tx} - \theta_{Tx}/8$; $\alpha_{user\ 2} = \alpha_{Tx} - 3\theta_{Tx}/8$; $\alpha_{user\ 3} = \alpha_{Tx} + \theta_{Tx}/8$; $\alpha_{user\ 4} = \alpha_{Tx} + 3\theta_{Tx}/8$
$240 < \theta_{Tx} \leq 300$	5	$\alpha_{user\ 1} = \alpha_{Tx}$; $\alpha_{user\ 2} = \alpha_{Tx} - \theta_{Tx}/5$; $\alpha_{user\ 3} = \alpha_{Tx} - 2\theta_{Tx}/5$; $\alpha_{user\ 4} = \alpha_{Tx} + \theta_{Tx}/5$; $\alpha_{user\ 5} = \alpha_{Tx} + 2\theta_{Tx}/5$
$300 < \theta_{Tx} \leq 360$	6	$\alpha_{user\ 1} = \alpha_{Tx} - \theta_{Tx}/12$; $\alpha_{user\ 2} = \alpha_{Tx} - 3\theta_{Tx}/12$; $\alpha_{user\ 3} = \alpha_{Tx} - 5\theta_{Tx}/12$; $\alpha_{user\ 4} = \alpha_{Tx} + \theta_{Tx}/12$; $\alpha_{user\ 5} = \alpha_{Tx} + 3\theta_{Tx}/12$; $\alpha_{user\ 6} = \alpha_{Tx} + 5\theta_{Tx}/12$

[3] Recommended use of ITU Digitized World Map (IDWM), which may be obtained in the Radiocommunication Bureau.

– coordinates of user terminal location: latitude, φ_{user}, and longitude, ψ_{user}, are defined from the known coordinates of BS: latitude, φ_{Tx}, and longitude, ψ_{Tx},[4] azimuth to the user terminal, $\alpha_{user\ i}$, distance between them, Rad, are defined by the following formulas[5]:

latitude:

$$\varphi_{user\ i} = \sin^{-1}(\sin\varphi_{Tx} \times \cos D1 + \cos\varphi_{Tx} \times \sin D1 \times \cos\alpha_{user\ i}) \quad (18)$$

where:

$D1$: $(R_{user} \times 180)/(6371.1 \times \pi)$

R_{user}: Rad.

longitude:

$$\psi_{user\ i} = \begin{cases} (\psi_{Tx} + \cos^{-1}((\cos D1 - \sin\varphi_{Tx} \times \sin\varphi_{user\ i})/(\cos\varphi_{Tx} \times \cos\varphi_{user\ i})), for\ \ \alpha_{user\ i} < 180 \\ \psi_{Tx} - \cos^{-1}((\cos D1 - \sin\varphi_{Tx} \times \sin\varphi_{user\ i})/(\cos\varphi_{Tx} \times \cos\varphi_{user\ i})),\ for\ \ \alpha_{user\ i} > 180 \\ \psi_{Tx}, \qquad for\ \ \alpha_{user\ i} = 0,\ or\ \alpha_{user\ i} = 180, \text{or}\ \alpha_{user\ i} = 360 \end{cases} \quad (19)$$

Azimuth of direction from user terminal location to the BS location, $\alpha_{Ts\text{-}i}$, is calculated by the formula:

$$\alpha_{Ts\text{-}i} = \begin{cases} [360 - \cos^{-1}\frac{\sin\varphi_{Tx} - \sin\psi_{user\ i} \times \cos D1}{\cos\varphi_{user\ i} \times \sin D1}]\ ,\ for\ \ \psi_{user\ i} \geq \psi_{Tx} \\ [\cos^{-1}\frac{\sin\varphi_{Tx} - \sin\psi_{user\ i} \times \cos D1}{\cos\varphi_{user\ i} \times \sin D1}], \qquad for\ \ \psi_{user\ i} < \psi_{Tx} \end{cases} \quad (20)$$

Propagation losses $L(d_{cond}(\alpha_{Tx}), f, 20\%, h_{Tx}, h_{Rx})$ or $L(d_{cond}(\alpha_{Rx}), f, 20\%, h_{Tx}, h_{Rx})$ are calculated for conservative initial data for propagation path without considering the path profile and for propagation above land.

Such a parameter has the following merits: adaptability to known parameters of the planned FS station, frequency of evaluated harmful interference. Disadvantage of the parameter is great amount of complex calculations of harmful interference and permissible interference to the receiver. Sections A.3 and A.7 give examples of the approach without using data on path profile.

2.2.2 Determination of conditional area based on the known initial data on the propagation path

When defining necessity for bilateral/multilateral discussion of the FS radio based on the known parameters of this station, system parameters of the unknown FS station and conservative initial data for propagation path, the calculated conditional area for all distances over full azimuth angle around the transmit, $d_{cond}(\alpha_{Tx})$, or receive, $d_{cond}(\alpha_{Rx})$ FS station is taken as conditional parameter.

Each calculated conditional distance for each certain azimuth from the location of the notified station, $d_{cond}(\alpha_{Tx})$ or $d_{cond}(\alpha_{Rx})$ is defined under constant specified orientation of notified station antenna, and orientation of unknown station towards the location of the notified station.

Determining conditional area around station, propagation losses $L(d_{cond}(\alpha_{Rx}), f, 20\%, h_{Tx}, h_{Rx})$ are calculated for known initial propagation data considering path profile and morphological data of radio-climatic zones within geographical areas under the method given in Recommendation ITU-R P.452-14 or Recommendation ITU-R P.2001.

When using this method for calculation of $L(d_{cond}(\alpha_{Tx}), f, 20\%, h_{Tx}, h_{Rx})$ or $L(d_{cond}(\alpha_{Rx}), f, 20\%, h_{Tx}, h_{Rx})$, according to Recommendation ITU-R P.452-14 [15] or Recommendation ITU-R P.2001 [16] digitized maps containing data on surface profile (topographical data) and codes of

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[4] Receiving Base Station will have the following coordinates: $\varphi_{Rx} = \varphi_{Tx}$ and $\psi_{Rx} = \psi_{Tx}$.

[5] $\cos^{-1}$ and $\sin^{-1}$ have a meaning of arccos and arcsin correspondingly.

radio-climatic zones within geographical areas (morphological data) will be required for correct application of the method for calculation of losses using these Recommendations.

This method has the following merit: adaptability to known parameters of the planned radio relay station. Using data on interference propagation path (taking into account path profile and morphological data on radio-climatic zones within geographical areas) improves practical accuracy of calculated conditional area around notified radio relay station.

Disadvantage of the parameter is great amount of complex calculations of harmful interference and permissible interference to the receiver. Annexes A5 and A9 give examples of the approach.

2.3 General Method 3: Application of coordination distances

When defining necessity for bilateral/multilateral discussion of the FS station, based on the known system parameters of coordinated station, system parameters of the unknown FS station and conservative initial data for propagation path, the maximum conditional distance $d_{cond}max$ is taken as conditional parameter, provided that equiprobable mutual orientation of station antennas covers not less than 99% of cases.

For this case equation (8) will take the following form:

$$L(d_{cond}max, f, 20\%, h_{Tx}, h_{Rx}) = P_{Tx}(B_{ref}) + G_{Tx}(\chi 0_{Tx}) + G_{Rx}(\chi 0_{Rx}) - \\ -MD - NFD(\Delta f) - I(20\%) \quad (21)$$

Equation (9) in this case will be as follows:

$$L(d_{cond}max, f, 20\%, h_{Tx}, h_{Rx}) = P_{Tx}(B_{ref}) + G_{Tx}(\chi 0_{Tx}) + \\ -MD - NFD(\Delta f) + 20lgf + 21{,}45 - PFD_{Rx}(B_{ref}, 20\%, h_{Rx})_{perm} \quad (22)$$

where:

$G_{Tx}(\chi 0_{Tx})$: transmit antenna gain in the direction of off-axis angle $\chi 0_{Tx}$

$G_{Rx}(\chi 0_{Rx})$: receive antenna gain in the direction of off-axis angle $\chi 0_{Rx}$.

We assume that $\chi 0_{Tx} = \chi 0_{Rx} = \chi 0$.

Propagation path loss $L(d_{cond}\ max, f, 20\%, h_{Tx}, h_{Rx})$ for this case is calculated using conservative initial data for propagation path without considering path profile and for propagation above land. Also the following mechanisms of interference propagation were considered: line-of-sight, diffraction over spherical Earth, and troposcatter.

Initial data for use of conditional distance are:

1) Planned transmit (receive) frequency f_{Tx}, (f_{Rx}), GHz;

2) Geographic coordinates for the location of FS station:

   i) Latitude φ_{Tx}: (degrees, minutes, seconds);

   ii) Longitude ψ_{Tx}: (degrees, minutes, seconds).

3) Digitized maps, containing coordinates of borders between geographical areas of administrations, administration designations (codes) in geographical areas[6].

Table 2 shows maximum conditional distances, $d_{cond}\ max$, calculated for system parameters of FS stations from Table A1-1 and A2-1 of sections A.1 and A.2 for specified frequency bands.

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[6] Recommended use of ITU Digitized World Map (IDWM), which may be obtained in the Radiocommunication Bureau.

TABLE 2

Frequency bands	Maximum conditional distance[7] $d_{cond}\ max$ (km)
> 1 000-5 000 MHz	300
> 5 000-10 000 MHz	170
> 10 000 MHz – 12 GHz	100
> 12-20 GHz	100
> 20-24.5 GHz	80
> 24.5-30 GHz	80
> 30-39.5 GHz	80
> 39.5-43.5 GHz	80

Then, the maximum conditional distance from Table 2 is used to determine necessity in coordination of any notifying radio relay station depending on notified frequency assignment and real minimum distance from the territories of foreign administrations.

The procedure for defining necessity in bilateral/multilateral discussions consists of calculation of conditional area around the notifying transmit or receive radio relay station, with the coordinates of the area centre coinciding with the location of the radio relay station, and the radius of conditional contour equal to the maximum conditional distance from Table 2 for the frequency band which covers the planned frequency assignment of the station. In cases when calculated conditional area overlaps territory of foreign administration, the bilateral/multilateral discussion is necessary; in opposite cases, discussion is not necessary.

Advantages of this criterion are universality and simplicity of use.

Its disadvantage is the inherent considerable redundancy in distance, frequency and power. The technical parameter for estimated harmful interference depends on distance and does not take into account real parameters of the known station. That is why only insignificant number of stations really require discussion compared to the whole number of stations selected using this criterion.

Sections A.3 to A.5 and A.7 to A.9 give examples of using conditional distance.

2.4 Two-step procedure for defining the necessity of bilateral/multilateral discussion of FS station

The two-step procedure for defining necessity of bilateral/multilateral discussion is simple in use and simultaneously providing high practical accuracy method for calculation of conditional area around FS station, using combination of the above mentioned methods.

The procedure consists of the following two steps:

Step 1 of the procedure uses the parameter of conditional distance, presented as a table of maximum conditional distances for specified frequency bands which correspond to notifying frequency assignments, and derived for conservative system parameters of stations and using conservative initial data for the interference propagation path. If the resulting use of the conditional distance criterion shows that station bilateral/multilateral review is not required, then the two-step procedure is completed. If the resulting use of the parameter shows that bilateral/multilateral review may be required, the procedure goes to its second step. The first step of the procedure will select FS stations for which bilateral/multilateral review is not required in 99% of cases.

[7] Conditional distances were calculated for interference parameters and criteria, as well as for FS station parameters from Table A1-1 of section A.1 (PP network) and Table A2-1 of section A.2 (PMP network).

Step 2 of the procedure uses the parameter based on the conditional area for FS stations for which conditional distance parameter confirmed necessity of bilateral/multilateral review. Calculation of conditional area at the second step of the procedure uses known parameters of the planned FS station, system parameters of unknown FS station and conservative initial data (simplified calculation of losses), or known parameters of planned station, system parameters of unknown FS station and known initial data for propagation path (detailed calculation of losses).

Advantages of this two-step procedure are the simplicity of its use at the first step and high practical accuracy of determining bilateral/multilateral review necessity according the results of the second step of the procedure.

Sections A.3 and A.10 give examples of using the two-step procedure to determine the necessity of a bilateral/multilateral review of frequency assignments to FS stations.

3 Examples of agreement between concerned administrations

In the examples of agreements described below, the principle of subdivision of a frequency band into preferred and non-preferred frequency blocks [4, 7, 8] is used.

In this case, wireless access stations in border area of an administration can use frequency assignments without coordination with other party provided that the power flux density (pfd) $PFD_{Rx}(B_{Rx}, 20\%, h_{Rx})_{perm}$ of interference produced on the borderline between countries and within the territory of neighbour administration is limited to:

– the pfd that does not exceed the $PFD_{Rx}(B_{Rx}, 20\%, h_{Rx})_{perm\ A} = A$ within their preferred frequency blocks;

– the pfd that does not exceed the $PFD_{Rx}(B_{Rx}, 20\%, h_{Rx})_{perm\ B} = B < A$ within preferred frequency blocks of other party (or not using the frequency assignments within preferred frequency blocks of other party.

The value of A is defined in the absence of interference in the first adjacent receiving channel using the equation (6) with $NFD=NFD1$.

The value of B is defined in the absence of interference in the co-channel also using equation (6), but with $NFD=0$.

The pfd of harmful interference $PFD_{Rx}(B_{Rx}, 20\%, h_{Rx})$ from transmitting station produced at the receiving antenna input is defined using equation (8).

For reference purposes, provisions of some of the existing multilateral agreements for cross-border coordination of FWA PMP systems are introduced below as an example. In this list, only the principles of calculation methods and criteria are reported.

a) Agreement between Austria, France, Germany, Liechtenstein and Switzerland on the frequency coordination for systems for the fixed wireless access (FWA) in the bands 3 410-3 600 MHz [4]

Signed: 15 August 2000 (Only in French and German languages).

Principle: Use of preferential frequencies based on the Recommendation CEPT/ERC/REC 14-03 and according to some geographical boundaries.

Limit: Spectrum power flux-density (PFD) not exceeding –122 dBW/(MHz × m^2) at a distance of 15 km inside the neighbouring country for the use of a preferential frequency or at the border for the use of a non-preferential frequency.

Calculation: Based on ITU-R P.452-8 based on the free space propagation.

Parameters to be exchanged: According to Annex 3 of the Agreement (transmitter frequency, receiver frequency, date of bringing into use, name of station, country, geographical coordinates, height of the site, designation of emission, power delivered to the antenna; maximum radiated power; directivity of antenna, azimuth of maximum radiation; elevation angle of maximum radiation, angular with of the radiation main lobe, polarisation; maximum antenna gain, height of the antenna above ground and remarks) . Formats according to ITU-R form T11.

Technical provisions: Relevant ETSI standards apply. According to Recommendations ITU-R F.1399 and F 1401, PMP and PP are to be considered as FWA systems.

b) Agreement between the Administrations of Belgium, France, Germany, Luxembourg and the Netherlands on the frequency coordination for systems for the fixed wireless access (FWA) in the bands 24 .549-25.221 GHz and 25.557-26.229 GHz [4]

Signed: 3 April 2000.

Principle: Use of preferential frequencies based on Recommendation CEPT/T/R 13-02 and according to some geographical boundaries.

Limit: Spectrum power flux-density (PFD) not exceeding –105 dBW/(MHz × m²) at a distance of 15 km inside the neighbouring country for the use of a preferential frequency or at the border for the use of a non-preferential frequency.

Calculation: Based on ITU-R P.452-8 based on the free space propagation and an atmospheric attenuation of 0.21 dB/km.

Parameters to be exchanged: According to Annex 3 of the Agreement (transmitter frequency, receiver frequency, date of bringing into use, name of station, country, geographical coordinates, height of the site, designation of emission, power delivered to the antenna; maximum radiated power; directivity of antenna, azimuth of maximum radiation; elevation angle of maximum radiation, angular with of the radiation main lobe, polarisation; maximum antenna gain, height of the antenna above ground and remarks). Formats according to ITU-R form T11.

Technical provisions: According to Recommendations ITU-R F.1399 and F.1401, PMP and PP are to be considered as FWA systems.

c) Agreement between Austria, France, Germany, Liechtenstein and Switzerland on the frequency coordination for systems for the fixed wireless access (FWA) in the bands 24.4-25.053 GHz and 25.5-26 .061 GHz [4]

Signed: 15 August 2000 (Only in French and German languages).

Principle: Use of preferential frequencies based on Recommendation CEPT/T/R13-02 Annex B and according to some geographical boundaries.

Limit: Spectrum power flux-density (PFD) not exceeding –105 dBW/(MHz × m²) at a distance of 15 km inside the neighbouring country for the use of a preferential frequency or at the border for the use of a non-preferential frequency.

Calculation: Based on ITU-R P.452-8 based on the free space propagation.

Parameters to be exchanged: According to Annex 3 of the Agreement (transmitter frequency, receiver frequency, date of bringing into use, name of station, country, geographical coordinates, height of the site, designation of emission, power delivered to the antenna; maximum radiated power; directivity of antenna, azimuth of maximum radiation; elevation angle of maximum radiation, angular with of the radiation main lobe, polarisation; maximum antenna gain, height of the antenna above ground and remarks). Formats according to ITU-R form T11.

Technical provisions: According to Recommendations ITU-R F.1399 and F.1401, PMP and PP are to be considered as FWA systems.

d) Agreement between the Russian Federation and the Republic of Poland concerning the use of the 24.5-26.5 GHz frequency band by stations in the FS in the border areas [11]

Signed: 28 August 2009.

Principle: Use of preferential frequencies based according to some geographical boundaries.

Limit: The power flux-density (PFD) does not exceed a value of –102 dBW/(MHz × m^2) at 20 m antenna height above ground level on the border line between two countries and in the territory of a neighbouring country.

The Parties may use the preferential frequency block of other Party, if the power flux-density (PFD) does not exceed a value of –119 dBW/MHz × m^2 at 20 m antenna height above ground level at the border line between two countries and in the territory of a neighbouring country.

Calculation: Based on the latest approved version of Recommendation ITU-R P.452.

The limits of the below indicated PFD values (power flux-density) shall not be exceeded during more than 20% of time.

Parameters to be exchanged: According to ITU-R form T11.

e) Agreement between the Russian Federation and the Republic of Poland concerning the use of the 10.15-10.30/10.50-10.65 GHz MHz frequency band by stations in the FS in the border areas [12]

Signed: 28 August 2009.

Principle: Use of preferential frequencies based according to some geographical boundaries.

Limit: The power flux-density (PFD) does not exceed a value of –102 dBW/(MHz × m^2) at 20 m antenna height above ground level on the border line between two countries and in the territory of a neighbouring country.

The Parties may use the preferential frequency block of other Party, if the power flux-density (PFD) does not exceed a value of –119 dBW/MHz × m^2 at 20 m antenna height above ground level at the border line between two countries and in the territory of a neighbouring country.

Calculation: Based on the latest approved version of Recommendation ITU-R P.452.

The limits of the below indicated PFD values (power flux-density) shall not be exceeded during more than 20% of time.

Parameters to be exchanged: According to ITU-R form T11.

Abbreviations and acronyms

BS	Base station
FS	Fixed service
FWA	Fixed wireless access
pfd	Power flux-density
PMP	Point-to-multipoint system
PP	Point-to-point system
UT	Unit terminal

References

[1] HCM Agreement – Agreement on the co-ordination of frequencies between 29.7 MHz and 43.5 GHz for the fixed service and the land mobile service

[2] HCM4A Agreement – Cross-border frequency coordination: Harmonized calculation method for Africa

[3] Recommendation ITU-R F.1671 – Guidelines for a process to address the deployment of area-licensed fixed wireless systems operating in neighbouring countries

[4] ECC Report 76 – Cross-border coordination of multipoint fixed wireless systems in frequency bands from 3.4 GHz to 33.4 GHz

[5] ECC Report 33 – The analysis of the coexistence of point-to-multipoint FWS cells in the 3.4-3.8 GHz band

[6] ERC Report 99 – The analysis of the coexistence of two FWA cells in the 24.5-26.5 GHz and 27.5-29.5 GHz bands

[7] ECC/REC/(04)05 – Guidelines for accommodation and assignment of multipoint fixed wireless systems in frequency bands 3.4-3.6 GHz and 3.6-3.8 GHz

[8] ECC/REC/(01)04 – Recommended guidelines for the accommodation and assignment of multimedia wireless systems (MWS) and point-to-point (P-P) fixed wireless systems in the frequency band 40.5-43.5 GHz

[9] ECC Report 32 – Mechanisms to improve co-existence of multipoint (MP) systems

[10] Recommendation ITU-R F.1498 – Deployment characteristics of fixed service systems in the band 37-40 GHz for use in sharing studies

[11] Agreement between the Telecommunications Administrations of the Russian Federation and the Republic of Poland concerning the use of the 24 500-26 500 MHz frequency band by stations in the fixed service in the border areas

[12] Agreement between the Telecommunications Administrations of the Russian Federation and the Republic of Poland concerning the use of the 10 150-10 300/10 500/10 650 MHz frequency bands by stations in the fixed service in the border areas

[13] Recommendation ITU-R F.758-5 – System parameters and considerations in the development of criteria for sharing or compatibility between digital fixed wireless systems in the fixed service and systems in other services and other sources of interference

[14] Recommendation ITU-R SM.337-6 – Frequency and distance separations

[15] Recommendation ITU-R P.452-15 – Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz

[16] Recommendation ITU-R P.2001-1 – A general purpose wide-range terrestrial propagation model in the frequency range 30 MHz to 50 GHz

[17] Recommendation ITU-R F.699-7 – Reference radiation patterns for fixed wireless system antennas for use in coordination studies and interference assessment in the frequency range from 100 MHz to about 70 GHz

[18] Recommendation ITU-R F.1336-4 – Reference radiation patterns of omnidirectional, sectoral and other antennas for the fixed and mobile service for use in sharing studies in the frequency range from 1 GHz to about 70 GHz.

ANNEX A

Case studies and examples

A.1 Generalized parameters of radio-relay stations FS (PP network)

TABLE A1-1

Frequency band (GHz)		1...5	5...10	10…12	12…20	20…24.5	24.5…30	30…39.5	39.5…43.5
Parameters and interference criteria	***p*%**	20	20	20	20	20	20	20	20
	***TD* (dB)**	0.5...1	0.5...1	0.5...1	0.5...1	0.5...1	0.5...1	0.5...1	0.5...1
Parameters of transmitter of the interfering station	P_{Tx} ($B_{Tx\ ref}$) **(dB(W/B_{ref}))**	–16…7	10	–16…–7	–45…5	–28…–10	–53…–30	–68…–23	–16…–9
	G_{Tx} **(dBi)**	16…42	32…48	36…49	37…49	35…40	32…40	34…45	34…40
	$B_{Tx\ ref}$ [8] **(MHz)**	1	1	1	1	1	1	1	1
	h_{Tx} **(m)**	37.5…50	37.5…50	37.5…50	37.5…50	37.5…50	37.5…50	37.5…50	37.5…50
Parameters of receiver of the interfered station	G_{Rx} **(dBi)**	16…42	32…48	36…49	37..49	35…40	32...40	34...45	34…40
	***NF* (dB)**	2…7	2.5…8	3…10	5…10	6…8	6…8	6…8	5...8
	$B_{Rx\ ref}$ [9] **(MHz)**	1	1	1	1	1	1	1	1
	h_{Rx} **(m)**	37.5…50	37.5…50	37.5…50	37.5…50	37.5…50	37.5…50	37.5…50	37.5…50

8 $B_{Tx\ ref}$ (MHz) – reference frequency band of transmitter.

9 $B_{Rx\ ref}$ (MHz) – reference frequency band of receiver.

A.2 Generalized parameters of fixed wireless access stations FS (PMP network)

TABLE A2-1

Frequency band (GHz)		1…5	5…10	10…12	24.5…29.5	39.5…43.5
Parameters and interference criteria	***p*%**	20	20	20	20	20
	***TD* (dB)**	0.5...1	0.5…1	0.5...1	0.5...1	0.5...1
BS						
Parameters of transmitter of the interfering station	P_{Tx} ($B_{Tx\ ref}$) (dB(W/B_{ref}))	–6.5…10.5	–6.5…10.5	–12…–3	–25.3…–18.1	–6…0
	G_{Tx} (dBi)	10…18	10…18	15…18	12…15	12…16
	***Rad* (km)**	1…15	1…10	1…10	1…9	1…3
	$B_{Tx\ ref}$ (MHz)	1	1	1	1	1
	h_{Tx} (m)	20…50	20…50	20…50	20…50	20…50
Parameters of receiver of the interfered station	G_{Rx} (dBi)	10…18	10…18	15…18	12…15	15
	***NF* (dB)**	3.4	3…4	4.5…5	6…8	7…8
	$B_{Rx\ ref}$ (MHz)	1	1	1	1	1
	H_{Rx} (m)	20…50	20…50	20…50	20…50	20…50
UT						
Parameters of transmitter of the interfering user terminal	P_{Tx} ($B_{Tx\ ref}$) (dB(W/B_{ref}))	–17.5…1.5	–17.5…1.5	–12…–5	–35.3…–18.1	–12…–10
	G_{Tx} (dBi)	8…27	8…27	13…18	32…35	30…34
	$B_{Tx\ ref}$ (MHz)	1	1	1	1	1
	H_{Tx} (m)	5…20	5…20	5…20	5…20	5…20
Parameters of receiver of the interfered user terminal	G_{Rx} (dBi)	8…27	13…18	13…18	32…35	30…34
	***NF* (dB)**	3…4	3…4	4.5…5	6…8	7…8
	$B_{Rx\ ref}$ (MHz)	1	1	1	1	1
	H_{Rx} (m)	5…20	5…20	5…20	5…20	5…20

A.3 An example of using conditional distance as a parameter for bilateral/multilateral discussions on frequency assignments to radio-relay station (PP network)

A frequency assignment to the radio-relay station is planned for bringing into use with the following input data:

1) Transmitting frequency planned to be used f_{Tx} = 15.047 GHz;

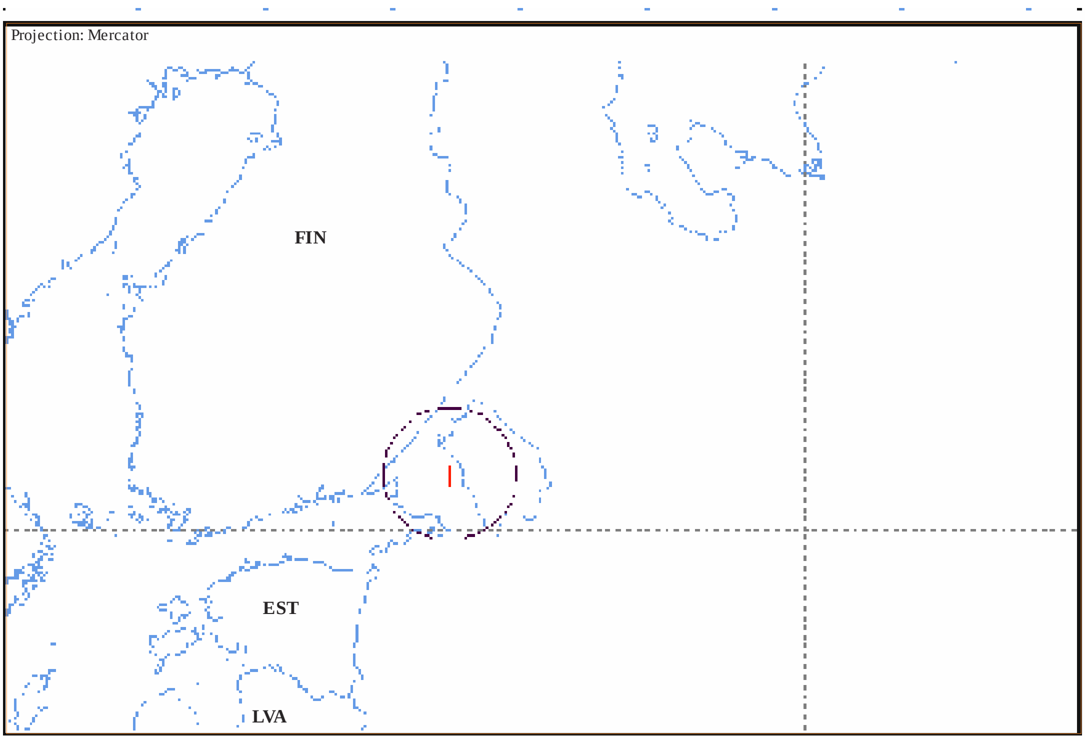
2) Radio-relay station location coordinates:

   i) Latitude φ_{Tx}: 60°45´11´´N

   ii) Longitude ψ_{Tx}: 30°8´29´´E.

Figure A3-1 and Table A3-1 specify the results of determining minimum distances from a planned transmitting radio-relay station location to geographical country borders on the basis of station location coordinates and the digital map with country border coordinates based on the ITU Digitized World Map (IDWM).

FIGURE A3-1



Guid-bilat A3- 01

TABLE A3-1

Administration with which the discussion considerations may be required	Coordinates of the location of a radio-relay station in the process of notification: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of FS station (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
FIN	30°8´29´´E 60°45´11´´N	74.8	318.4	29°12´49´´E 61°15´12´´N

A comparison between a particular value of minimum distance from the location of planned transmitting radio-relay station to geographical borders of countries (Table A3-1) and the coordination distance from Table 2, which is of 100 km for the frequency band from 12 to 20 GHz, shows that the bilateral discussion on frequency assignments with the Administration of Finland may be required.

A.4 An example of using a conditional area around transmitting radio-relay station which is formed on the basis of conservative data on propagation path to determine whether bilateral/multilateral discussions on frequency assignments is required

A frequency assignment to the radio-relay station is planned for bringing into use with the following input data:

A) Data on the known radio-relay transmitter:

1) transmitting frequency planned to be used f_{Tx} = 15.047 GHz;

2) radio-relay station location coordinates:

i) latitude φ_{Tx}: 60°45´11´´ N;

ii) longitude ψ_{Tx}: 30°8´29´´ E;

3) antenna height above the Earth level h_{Tx} = 54 m;

4) azimuth of antenna main beam α_{Tx} = 214°;

5) elevation angle of antenna main beam ε_{Tx} = 0°;

6) maximum antenna gain G_{Tx} = 42.7 dBi;

7) antenna pattern $aTx_{ant}(\chi_{Tx})$, dB – (Rec. ITU-R F.699-7);

8) e.i.r.p. of a transmitting station in the reference bandwidth = 35.75 dBW × MHz;

9) reference bandwidth B_{ref} = 1 MHz.

B) Generalized data on unknown radio-relay receiver (Table A1-1):

1) receive frequency planned to be used $f_{Rx} = f_{Tx}$ = 15.047 GHz;

2) antenna height above the Earth level h_{Rx} =50 m;

3) maximum antenna gain G_{Rx} = 45 dBi;

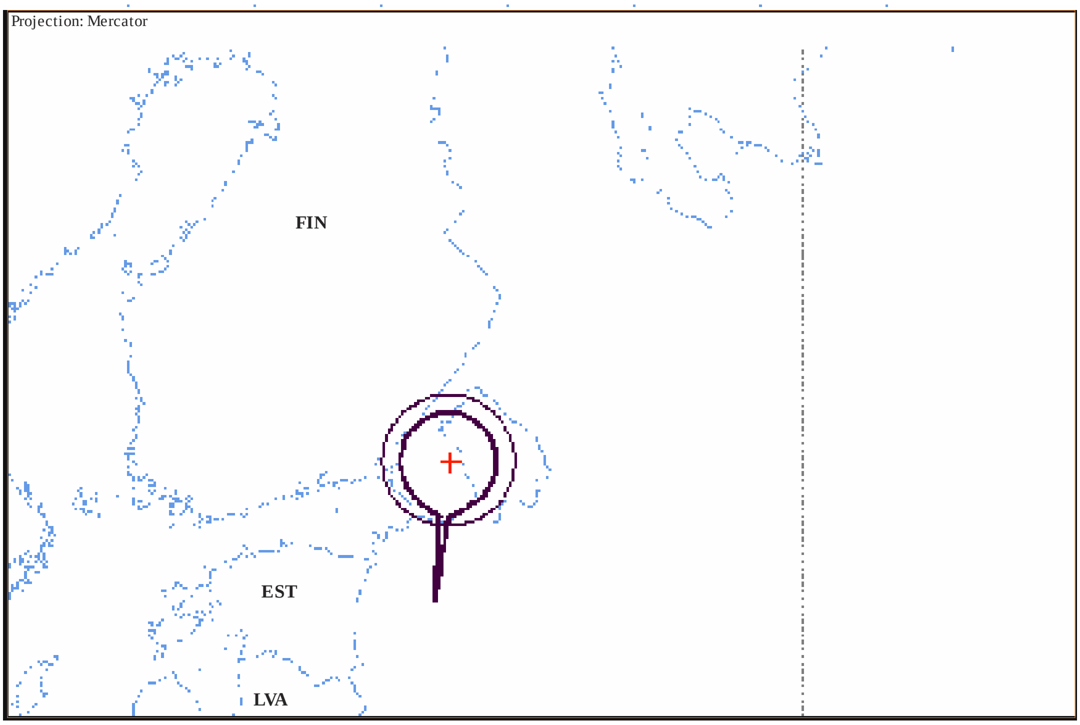
4) receiver noise figure NF_{Rx} = 4.5 dB;

5) reference bandwidth $B_{ref.}$ = 1 MHz.

Figure A4-1 shows the results of determining conditional area of planned transmitting radio-relay station.

Since none of the neighbouring countries fall within the conditional area, the bilateral/multilateral discussion of the frequency assignment to the transmitting radio-relay station is not needed.

FIGURE A4-1



Guid-bilat A4- 01

A.5 An example of using a conditional area around transmitting radio-relay station, which is calculated on the basis of available data on propagation path to determine whether the bilateral/multilateral discussion is required

A frequency assignment to the radio-relay station is planned for bringing into use with the following input data:

A) Data on the known radio-relay transmitter:

1) transmitting frequency planned to be used f_{Tx} = 15.047 GHz;

2) FS station location coordinates:

i) latitude φ_{Tx}: 60°45´11´´ N;

ii) longitude ψ_{Tx}: 30°8´29´´ E;

3) antenna height above the Earth level h_{Tx} = 54 m;

4) azimuth of antenna main beam α_{Tx} = 214°;

5) elevation angle of antenna main beam ε_{Tx} = 0°;

6) maximum antenna gain G_{Tx} = 42.7 dBi;

7) antenna pattern $aTx_{ant}(\chi_{Tx})$, dB – (Rec. ITU-R F.699-7);

8) e.i.r.p. of a transmitting station in the reference bandwidth = 35.75 dBW × MHz;

9) reference bandwidth B_{ref} = 1 MHz.

B) Generalized data on unknown radio-relay receiver (Table A1-1):

1) receive frequency planned to be used f_{Rx} = f_{Tx} = 15.047 GHz;

2) antenna height above the Earth level h_{Rx} = 50 m;

3) maximum antenna gain G_{Rx} = 45 dBi;

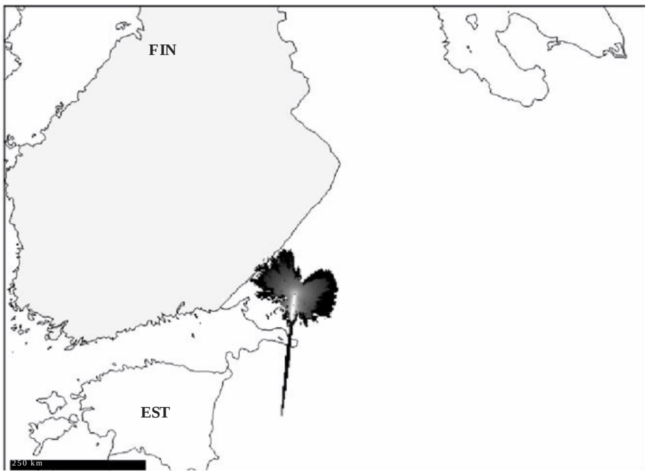
4) receiver noise figure NF_{Rx}= 4.5 dB;

5) reference bandwidth B_{ref} = 1 MHz.

Figure A5-1 shows the results of determining conditional area of planned transmitting radio-relay station.

The conditional area affects the territory of the Administration of Finland, therefore the bilateral discussion of the frequency assignment to the transmitting radio-relay station may be required.

FIGURE A5-1



Guid-bilat A5- 01

A.6 An example of using a two-step procedure to determine whether the bilateral/multilateral review of frequency assignments to radio-relay stations is required (PP network)

Frequency assignments to the radio-relay transmitters are planned for bringing into use with the following input data:

Transmitter No. 1

1 transmitting frequency planned to be used f_{Tx} = 15.047 GHz;

2 FS station location coordinates:

– latitude φ_{Tx}: 60°45´11´´ N;

– longitude ψ_{Tx}: 30°8´29´´ E.

Transmitter No. 2

1 transmitting frequency planned to be used f_{Tx} = 14.557 GHz;

2 FS station location coordinates:

– latitude φ_{Tx}: 59°435´46´´ N;

– longitude ψ_{Tx}: 29°31´59´´ E.

Transmitter No. 3

1 transmitting frequency planned to be used f_{Tx} = 14.557 GHz;

2 FS station location coordinates:

– latitude φ_{Tx}: 61°6´41´´ N;

– longitude ψ_{Tx}: 32°54´38´´ E.

Transmitter No. 4

1 transmitting frequency planned to be used f_{Tx} = 15.047 GHz;

2 FS station location coordinates:

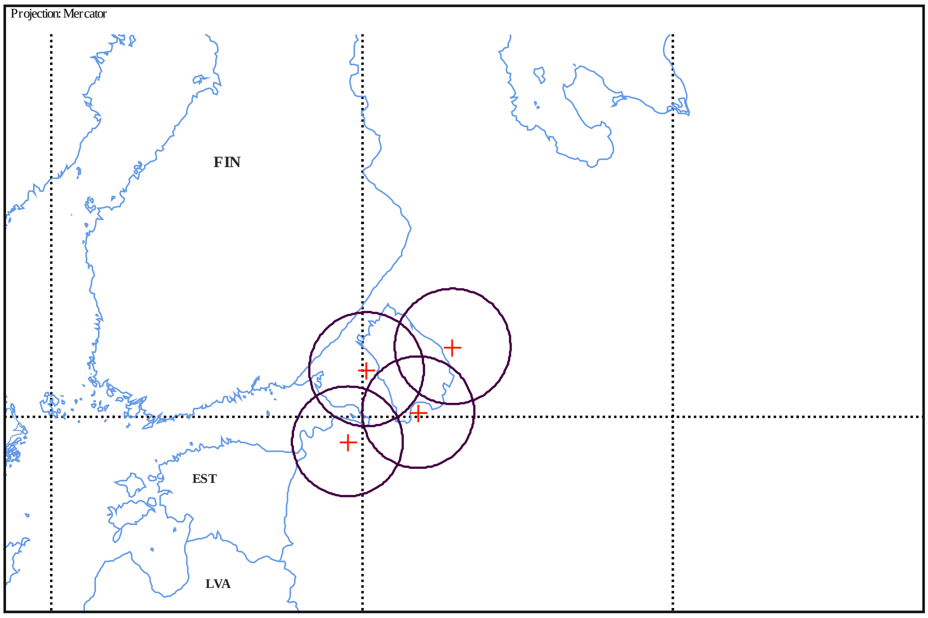
– latitude φ_{Tx}: 60°3´57´´ N;

– longitude ψ_{Tx}: 31°47´59´´ E.

The first step of two-step procedure under criteria No. 1

Figure A6-1 and Table A6-1 give the results of determining the minimum distance from planned transmitting station locations to neighbouring country borders on the basis of input data on station location coordinates and the digital map with country border coordinates based on the ITU Digitized World Map (IDWM).

FIGURE A6-1



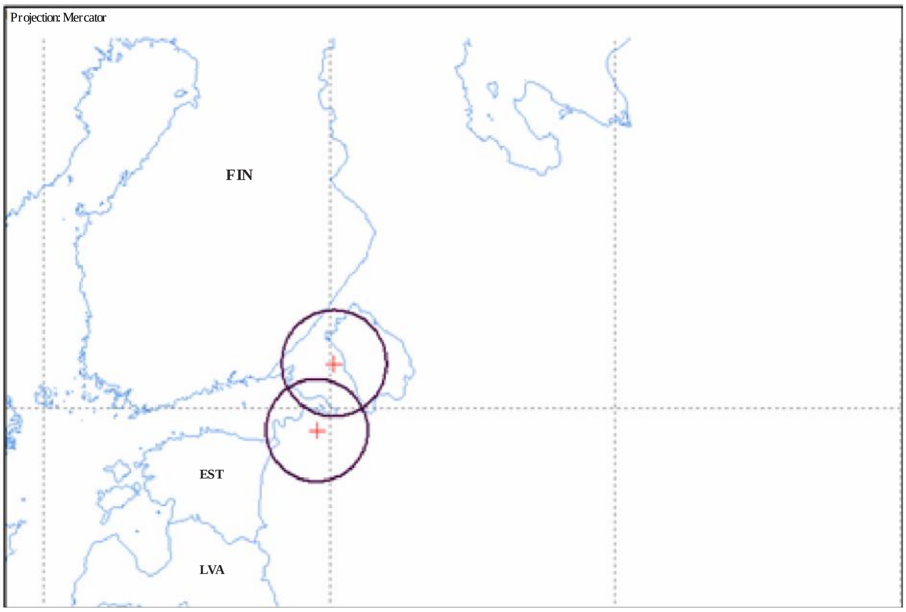
Guid-bilat A6- 01

TABLE A6-1

Transmitter of radio-relay station	Administration with which the discussion on frequency assignment may be required	Coordinates of the location of a radio-relay station in the process of notification: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of FS station (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
No. 1	FIN	30°8´29´´E 60°45´11´´N	74.8	318.4	29°12´49´´E 61°15´12´´N
No. 2	EST	29°31´59´´E 59°35´46´´N	79.2	256.2	28°10´26´´E 59°25´8´´N
No. 3	FIN	32°54´38´´E 61°6´41´´N	166.5	309.7	30°27´4´´E 62°2´42´´N
No. 4	FIN	31°47´59´´E 60°3´57´´N	193.1	314.3	29°12´49´´E 61°15´12´´N
	EST	31°47´59´´E 60°3´57´´N	215.6	252.1	28°10´26´´E 59°25´8´´N

A comparison between particular values of minimum distances from locations of planned transmitting radio-relay stations to geographical borders of countries (Table A6-1) and the coordination distance from Table 2, which is of 100 km for the frequency band from 12 to 20 GHz, shows that the review and discussion of transmitters No. 1 and No. 2 with the Administration of Finland may be required. The review and discussion of transmitters No. 3 and No. 4 is not required. Therefore the second step of a two-step procedure will define the conditional area for transmitters No. 1 and No. 2 only (Figure A6-2 and Table A6-2).

FIGURE A6-2



Guid-bilat A6- 02

TABLE A6-2

Transmitter of radio-relay station	Administration with which the discussion on frequency assignment may be required	Coordinates of the location of a radio-relay station in the process of notification: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of FS station (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
No. 1	FIN	30°8´29´´E 60°45´11´´N	74.8	318.4	29°12´49´´E 61°15´12´´N
No. 2	EST	29°31´59´´E 59°35´46´´N	79.2	256.2	28°10´26´´E 59°25´8´´N

Second step of a two-step procedure for transmitter No. 1

A) Data on the known radio-relay transmitter:

1) transmitting frequency planned to be used f_{Tx} = 15.047 GHz;

2) FS station location coordinates:

i) latitude φ_{Tx}: 60°45´11´´ N;

ii) longitude ψ_{Tx}: 30°8´29´´ E;

3) antenna height above the Earth level h_{Tx} = 54 m;

4) azimuth of antenna main beam α_{Tx} = 214°;

5) elevation angle of antenna main beam ε_{Tx} = 0°;

6) maximum antenna gain G_{Tx} = 42.7 dBi;

7) antenna pattern $a_{Tx_{ant}}(\chi_{Tx})$, dB – (Rec. ITU-R F.699-7);

8) e.i.r.p. of a transmitting station in the reference bandwidth = 35.75 dBW × MHz;

9) reference bandwidth B_{ref} = 1 MHz.

B) Generalized data on unknown radio-relay receiver (Table A1-1):

1) Receive frequency planned to be used $f_{Rx} = f_{Tx}$ = 15.047 GHz;

2) antenna height above the Earth level h_{Rx} = 50 m;

3) maximum antenna gain G_{Rx} = 45 dBi;

4) receiver noise figure NF_{Rx} = 4.5 dB;

5) reference bandwidth B_{ref} = 1 MHz.

Figure A6-3 shows the conditional area of radio-relay transmitter No. 1 based on conservative input data of propagation way.

Since this conditional area does not affect any territories of neighbouring countries, the review and discussion of frequency assignment to this transmitting radio-relay station is not required.

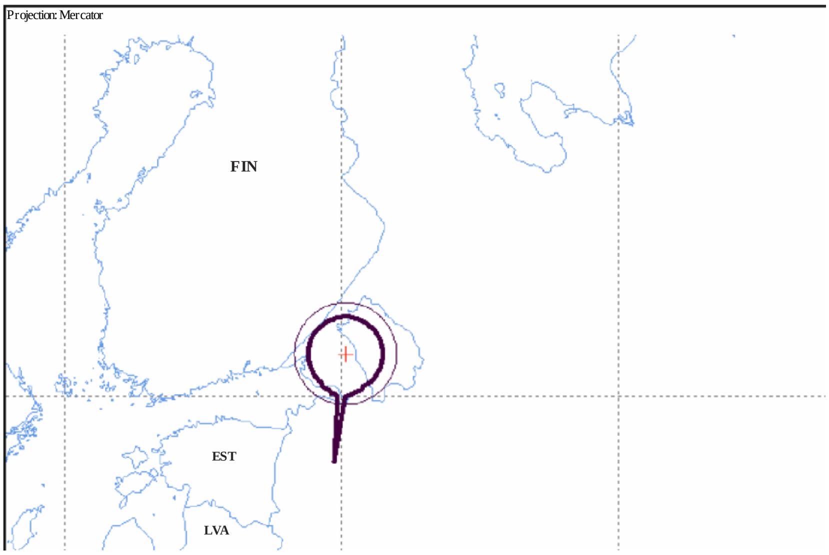
Figure A6-4 shows the conditional area of radio-relay transmitter No. 1 based on real data of propagation way.

This conditional area affects the territory of Finland, therefore the review and discussion of frequency assignment to this radio-relay station may be required.

Thus, depending on the chosen radiowaves' propagation way model (i.e. taking into account a profile of a terrestrial surface, morphological these radio climatic zones in a certain geographical zone or not) it can be concluded two mutually opposite conclusions about frequency assignments review necessity for radio relay station No. 1 transmitter with Finish Administration.

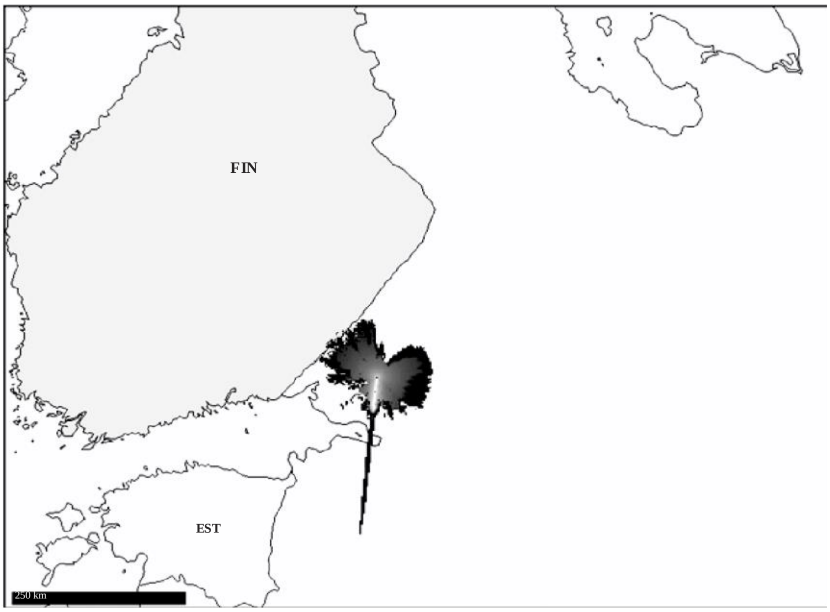
The preference is recommended to give models on the basis of real (known) data about propagation way (if these data are available and can be used). Conditional zone drawn on real (known) data about propagation way yields most almost significant results on determination of frequency assignments review necessity.

FIGURE A6-3



Guid-bilat A6- 03

FIGURE A6-4



Guid-bilat A6- 04

Second step of a two-step procedure for transmitter No. 2

A) Data on the known radio-relay transmitter:

1) transmitting frequency planned to be used f_{Tx} = 14.557 GHz;

2) FS station location coordinates

i) latitude φ_{Tx}: 59°35´46´´;

ii) longitude ψ_{Tx}: 29°31´59´´;

3) antenna height above the Earth level h_{Tx} = 24 m;

4) azimuth of antenna main beam α_{Tx} = 231.6°;

5) elevation angle of antenna main beam ε_{Tx} = 0°;

6) maximum antenna gain G_{Tx} = 38 dBi;

7) antenna pattern $a_{Tx_{ant}}(\chi_{Tx})$, dB (Rec. ITU-R F.699-7);

8) e.i.r.p. in the reference bandwidth of a transmitting station = 31.25 dBW × MHz;

9) reference bandwidth B_{ref} = 1 MHz.

B) Generalized data on unknown radio-relay receiver (Table A1-1):

1) receive frequency planned to be used $f_{Rx} = f_{Tx}$ = 14.557 GHz;

2) antenna height above the Earth level h_{Rx} = 50 m;

3) maximum antenna gain G_{Rx} = 45 dBi;

4) receiver noise figure NF_{Rx} = 4.5 dB;

5) reference bandwidth B_{ref} = 1 MHz.

Figure A6-5 shows the conditional area of radio-relay transmitter No. 2 based on conservative input data of propagation way.

The conditional area affects the territory of Estonia therefore the review and discussion of frequency assignment to the transmitting radio-relay station may be required.

Figure A6-6 shows the conditional area of radio-relay transmitter No. 2 based on real data of propagation way.

The conditional area affects the territory of Estonia therefore the review and discussion of frequency assignment to the transmitting radio-relay station may be required.

Due to drawn conditional area affects the territory of Estonia regardless of the chosen model of propagation way therefore the review and discussion of frequency assignment to the transmitting radio-relay station No. 2 with impacted administration may be required.

FIGURE A6-5

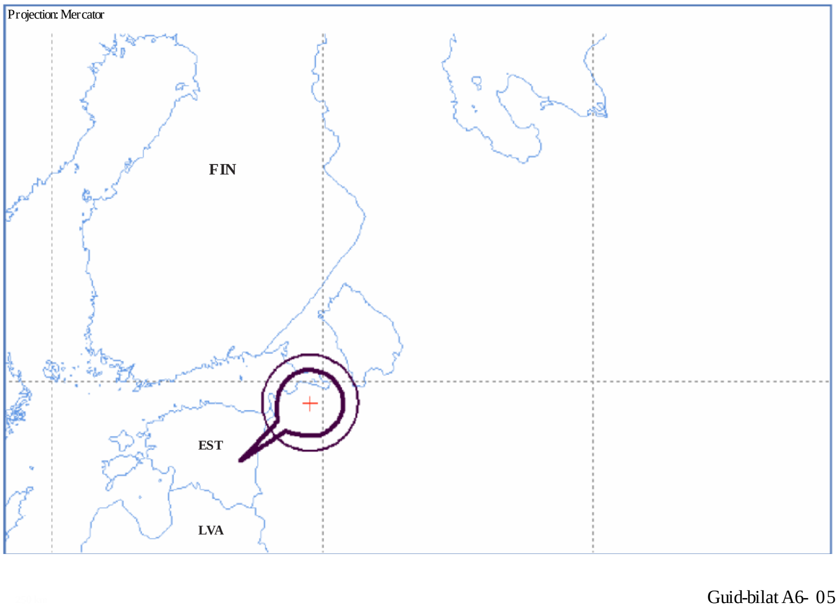
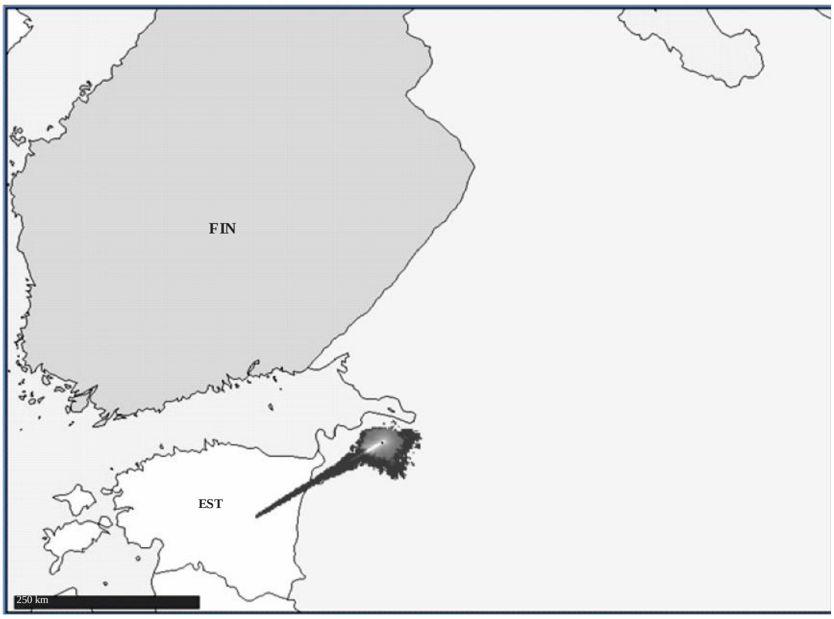


FIGURE A6-6



Guid-bilat A6- 06

A.7 An example of using conditional distances to define the necessity of discussions on frequency assignments to base stations and user terminals (PMP network)

A frequency assignment to the BS is planned with the following input data:

1 Transmitting frequencies planned to be used:

– In the first sector of antenna $f1_{Tx}$ = 24.563 GHz;

– In the second sector of antenna $f2_{Tx}$ = 24.619 GHz.

2 BS location coordinates:

– Latitude φ_{Tx}: –56°20´7´´N;

– Longitude ψ_{Tx}: –29°3´47´´E.

3 Azimuth of antenna main lobe in the first sector $\alpha1_{Rx}$ = 240°.

4 Azimuth of antenna main lobe in the second sector $\alpha2_{Rx}$ = 90°.

5 –3 dB beamwidth in the first sector in horizontal plane $\theta1_{Tx}$ = 60°.

6 –3 dB beamwidth in the second sector in horizontal plane $\theta2_{Tx}$ = 90°.

7 Radius of service area of BS, Rad = 9 km.

A frequency assignment to the user terminal operating in the service area of BS is planned with the following input data:

1 Transmitting frequencies of user terminals planned to be used:

– In the first sector of antenna $f11_{Tx}$ = 25.571 GHz;

– In the second sector of antenna $f21_{Tx}$ = 25.627 GHz.

2 User terminal (UT11) location coordinates in the first sector of BS antenna:

– Latitude φ_{Tx}: –56°17´35´´N;

– Longitude ψ_{Tx}: –28°56´19´´E.

3 Azimuth of UT antenna main lobe in the first sector of BS antenna $\alpha11_{Rx}$ = 60°.

4 First user terminal (UT21) location coordinates in the second sector of BS antenna:

– Latitude φ_{Tx}: –56°21´58´´N;

– Longitude ψ_{Tx}: –29°11´53´´E.

5 Azimuth of the first UT antenna main lobe in the second sector of BS antenna $\alpha21_{Rx}$ = 247.5°.

6 Second user terminal (UT22) location coordinates in the second sector of BS antenna:

– Latitude φ_{Tx}: –56°21´15´´N;

– Longitude ψ_{Tx}: –29°11´41´´E.

7 Azimuth of the second UT antenna main lobe in the second sector of BS antenna $\alpha22_{Rx}$ = 292.5°.

Figures A7-1 and A7-2 and Tables A7-1 to A7-4 give the results of determining the minimum distance from planned transmitting station locations to neighbouring country borders on the basis of input data using station location coordinates and the digital map with country border-line coordinates based on the IDWM.

FIGURE A7-1

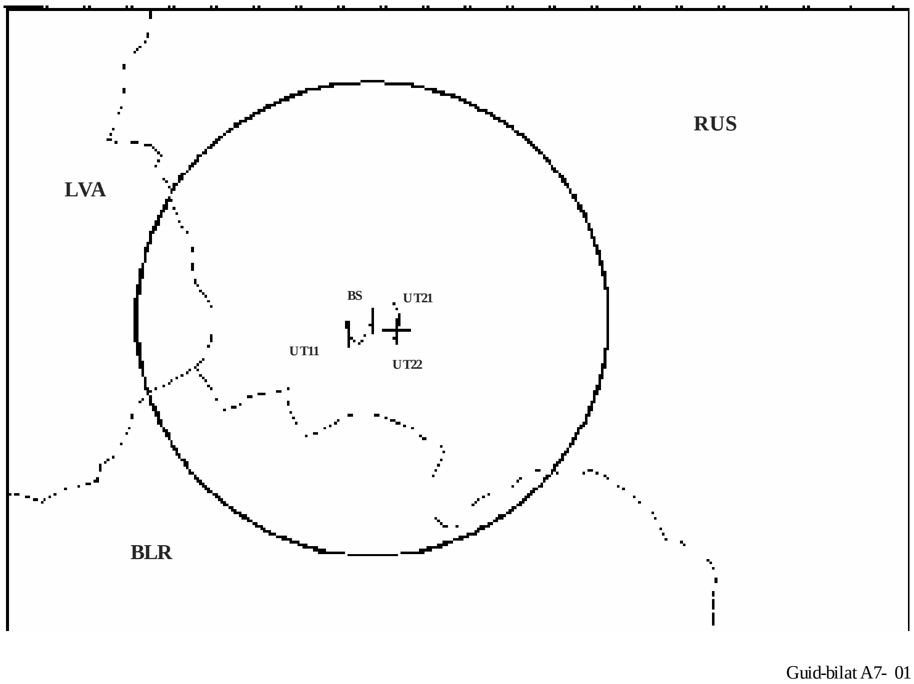
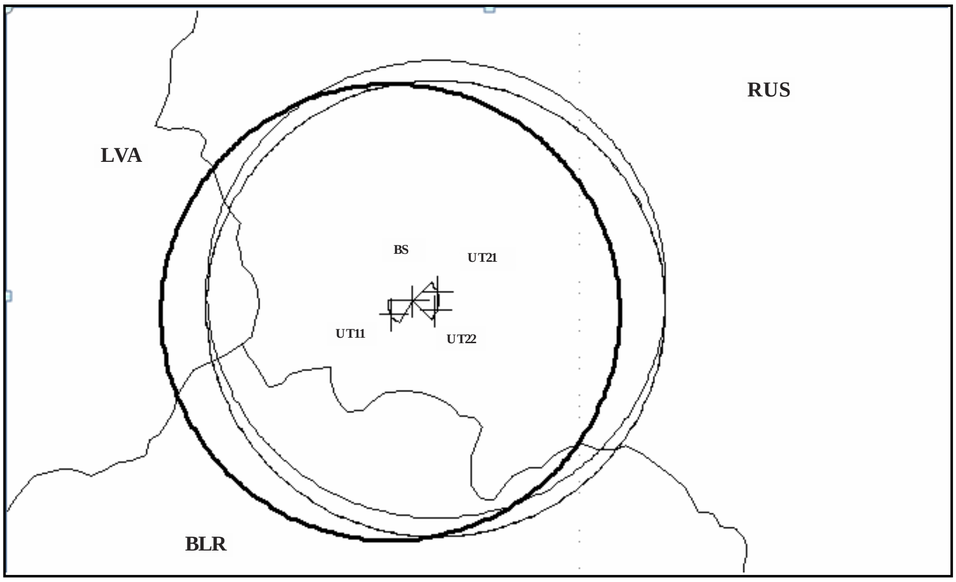


FIGURE A7-2



Guid-bilat A7- 02

TABLE A7-1

Administration with which the discussion on frequency assignment may be required	**Coordinates of the location of BS in the process of notification:** **longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)**	**Minimum distance to the border from the location of BS (km)**	**Azimuth to a minimum distance point (degrees)**	**Coordinates of minimum distance point at the border line:** **longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)**
BLR	29°3´47´´E 56°20´7´´N	31.45	181.5	29°3´0´´E 56°3´9´´N
LVA		53.8	268.7	28°11´27´´E 56°19´16´´N

TABLE A7-2

Administration with which the discussion on frequency assignment may be required	**Coordinates of the location of user terminal (UT11) in the process of notification in the first sector of BS:** **longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)**	**Minimum distance to the border from the location of UT (km)**	**Azimuth to a minimum distance point (degrees)**	**Coordinates of minimum distance point at the border line:** **longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)**
BLR	28°56´19´´ E 56°17´35´´ N	26.8	173.8	28°59´8´´ E 56°3´12´´ N.
LVA		46.3	274.2	28°11´27´´ E 56°19´16´´ N

TABLE A7-3

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of the first user terminal (UT21) in the process of notification in the second sector of BS: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of UT (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
BLR	29°11´53´´ E 56°21´58´´ N	35.9	189.5	29°6´9´´ E 56°2´52´´ N
LVA		62.3	265.8	28°11´27´´ E 56°19´16´´ N

TABLE A7-4

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of the second user terminal (UT22) in the process of notification in the second sector of BS: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of UT (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
BLR	29°11´41´´ E 56°18´15´´ N	29.1	189.4	29°7´6´´ E 56°2´47´´ N
LVA		62.0	272.2	28°11´27´´ E 56°19´16´´ N

A comparison between particular value of minimum distance from locations of planned transmitting BS and terminal stations to geographical borders of countries (Tables A7-1 to A7-4) and the conditional distance which is of 80 km for the frequency band from 24.5 to 29.5 GHz, shows that the discussion on frequency assignments with the Administrations of Belarus and Latvia may be required.

A.8 An example of using conditional area around transmitting base station and user terminals (PMP network) based on conservative data for propagation paths to define the necessity of discussions on frequency assignments

Frequency assignments to the BS and user terminals are planned for bringing into use with the following input data:

A) Data on the known BS transmitter:

1) transmitting frequency planned to be used f_{Tx} = 15.047 GHz;
   - In the first sector of antenna $f1_{Tx}$ = 24.563 GHz;
   - In the second sector of antenna $f1_{Tx}$= 24.619 GHz;
2) FS station location coordinates:
   - latitude φ_{Tx}: –56°20´7´´N;
   - longitude ψ_{Tx}: –29°3´47´´E;
3) antenna height above ground level h_{Tx} = 50 m;

4) azimuth of antenna main beam in the first sector $\alpha1_{Tx}$ = 240°;

5) azimuth of antenna main beam in the second sector $\alpha2_{Tx}$ = 90°;

6) –3 dB beamwidth in the first sector in horizontal plane $\theta1_{Tx}$ = 60°;

7) –3 dB beamwidth in the second sector in horizontal plane $\theta2_{Tx}$ = 90°;

8) elevation angle of antenna main beam in the first sector $\varepsilon1_{Tx}$ = 0°;

9) elevation angle of antenna main beam in the second sector $\varepsilon2_{Tx}$ = 0°;

10) maximum antenna gain G_{Tx} = 15 dBi;

11) antenna pattern $a_{Tx_{ant}}(\chi_{Tx})$, dB – (Rec. ITU-R F.1336-3);

12) e.i.r.p. of a transmitting station in the reference bandwidth = 3 dBW × MHz;

13) reference bandwidth B_{ref} = 1 MHz;

14) radius of BS service area Rad = 9 km.

B) Data on the known user terminal (UT11) transmitter in the first sector of BS:

1) transmitting frequency planned to be used f_{Tx} = 25.571 GHz;

2) FS station location coordinates:

– latitude φ_{Tx}: –56°20´7´´N;

– longitude ψ_{Tx}: –29°3´47´´E;

3) antenna height above ground level h_{Tx} = 20 m;

4) azimuth of antenna main beam $\alpha11_{Tx}$ = 60 degrees;

5) elevation angle of antenna main beam $\varepsilon11_{Tx}$ = 0 degrees;

6) maximum antenna gain G_{Tx} = 35 dBi;

7) antenna pattern $a_{Tx_{ant}}(\chi_{Tx})$, dB – (Rec. ITU-R F.699-7);

8) e.i.r.p. of a transmitting station in the reference bandwidth = 5 dBW × MHz;

9) reference bandwidth B_{ref} = 1 MHz.

C) Data on the known first user terminal (UT21) transmitter in the second sector of BS:

1) transmitting frequency planned to be used f_{Tx} = 25.627 GHz;

2) FS station location coordinates:

– latitude φ_{Tx}: –56°17´35´´N;

– longitude ψ_{Tx}: –28°56´19´´E;

3) antenna height above ground level h_{Tx} = 20 m;

4) azimuth of antenna main beam $\alpha21_{Tx}$ = 247.5°;

5) elevation angle of antenna main beam $\varepsilon21_{Tx}$ = 0°;

6) maximum antenna gain G_{Tx} = 35 dBi;

7) antenna pattern $a_{Tx_{ant}}(\chi_{Tx})$, dB – (Rec. ITU-R F.699-7);

8) e.i.r.p. of a transmitting station in the reference bandwidth = 5 dBW × MHz;

9) reference bandwidth B_{ref} = 1 MHz.

D) Data on the known second user terminal (UT22) transmitter in the second sector of BS:

1) transmitting frequency planned to be used f_{Tx} = 25.627 GHz;

2) FS station location coordinates:

– latitude φ_{Tx}: –56°17´35´´N;

– longitude ψ_{Tx}: –28°56´19´´E;

3) antenna height above ground level h_{Tx} = 20 m;

4) azimuth of antenna main beam $\alpha22_{Tx}$ = 247.5°;

5) elevation angle of antenna main beam $\varepsilon22_{Tx}$ = 0°;

6) maximum antenna gain G_{Tx} = 35 dBi;

7) antenna pattern $a_{Tx_{ant}}(\chi_{Tx})$, dB – (Rec. ITU-R F.699-7);

8) e.i.r.p. of a transmitting station in the reference bandwidth = 5 dBW × MHz;

9) reference bandwidth B_{ref} = 1 MHz

E) Generalized data on unknown FS receiver (Table A1-1):

1) receive frequencies planned to be used f_{Rx} = 24.563 GHz; 24.619 GHz; 25.571 GHz; 25.627 GHz;

2) antenna height above ground level h_{Rx} = 50 m;

3) maximum antenna gain G_{Rx} = 40 dBi;

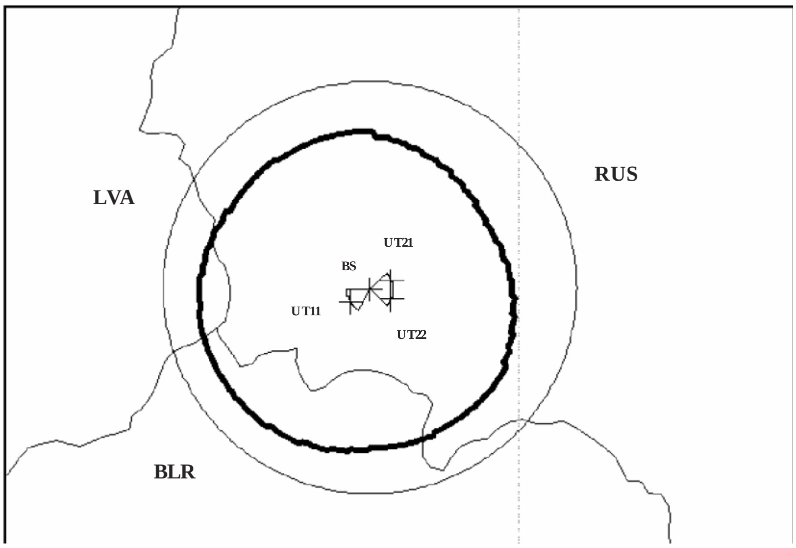
4) receiver noise figure NF_{Rx} = 6 dB;

5) reference bandwidth B_{ref} = 1 MHz.

Figure A8-1 shows the conditional area for the first sector of planned BS transmitter.

The conditional area for the first sector of planned BS transmitter with the azimuth of antenna main beam $\alpha1_{Tx}$ = 240 degrees affects the territory of Belarus and Latvia Administrations therefore the discussion of frequency assignment to the first sector of planned BS transmitter may be required.

FIGURE A8-1

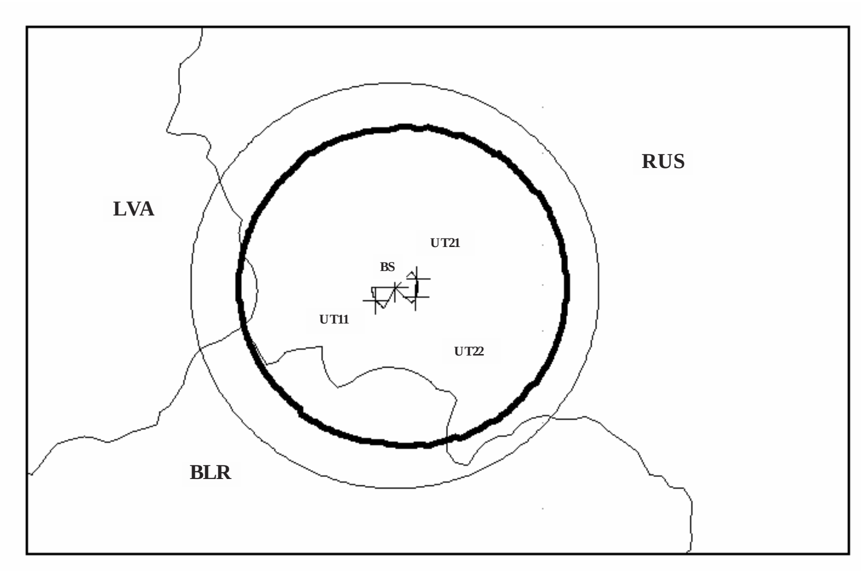


Guid-bilat A8- 01

Figure A8-2 shows the conditional area for the second sector of planned BS transmitter.

The conditional area for the second sector of planned BS transmitter with the azimuth of antenna main beam $\alpha2_{Tx}$ = 90 degrees affects the territory of Belarus and Latvia Administrations therefore the discussion of frequency assignment to the second sector of planned BS transmitter may be required.

FIGURE A8-2

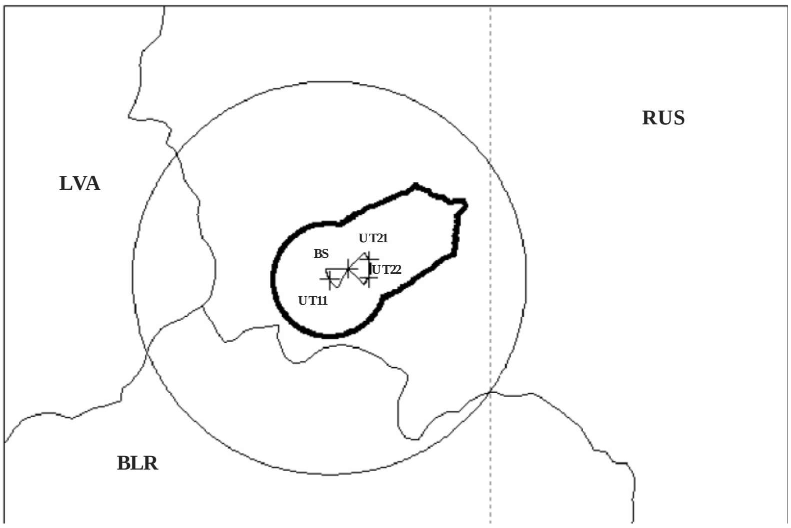


Guid-bilat A8- 02

Figure A8-3 shows the conditional area for the user terminal transmitter in the first sector of BS.

The conditional area of the user terminal transmitter for the first sector of BS with the azimuth of antenna main beam $\alpha 11_{Tx}$ = 60 degrees of planned BS transmitter does not affect the territory of any administrations therefore the discussion of frequency assignment to the second sector of BS transmitter is not needed.

FIGURE A8-3

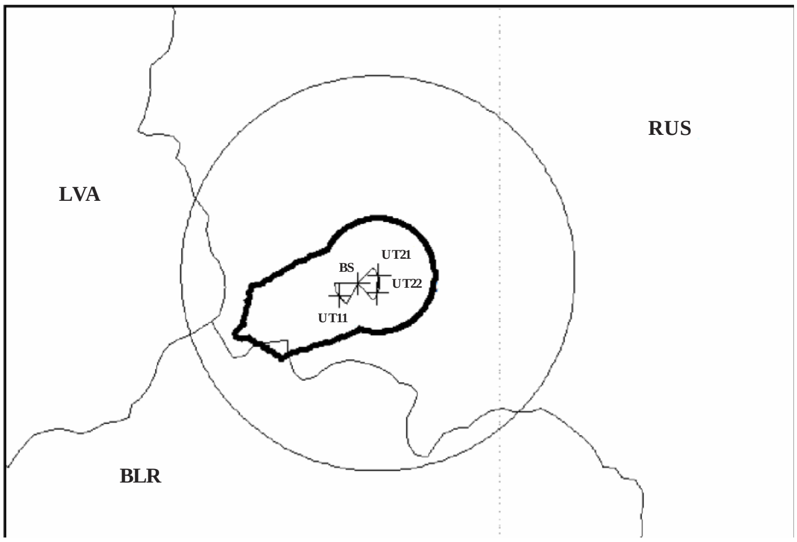


Guid-bilat A8- 03

Figure A8-4 shows the conditional area for the first user terminal transmitter in the second sector of BS.

The conditional area of the first user terminal transmitter for the second sector of BS with the azimuth of antenna main beam $\alpha 21_{Tx}$ = 247.5 degrees of planned UT transmitter affects only the territory of Belarus Administration, therefore the discussion of frequency assignment to the first transmitter in the second sector of BS may be required only with this Administration.

FIGURE A8-4

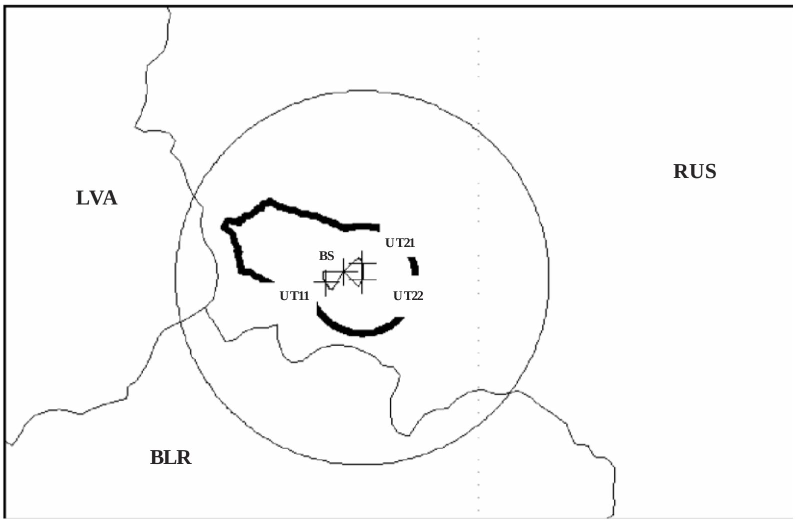


Guid-bilat A8- 04

Figure A8-5 shows the conditional area for the second user terminal transmitter in the second sector of BS.

The conditional area of the second user terminal transmitter in the second sector of BS with the azimuth of antenna main beam $\alpha 22_{Tx}$ = 292.5 degrees of planned UT transmitter does not affect the territory of any administration, therefore the discussion of frequency assignment to the second sector of BS transmitter is not needed.

FIGURE A8-5



Guid-bilat A8- 05

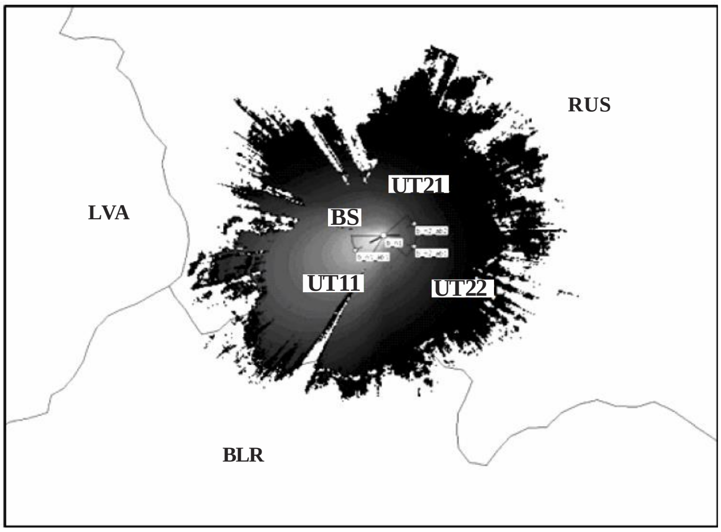
A.9 An example of using conditional area around transmitting base station and user terminals (PMP network) based on real data for propagation paths to define the necessity of bilateral/multilateral discussions of frequency assignments

Input data on planned frequency assignments to BS and user terminals is the same as in an example of section A.8.

Figure A9-1 shows the conditional area for the first sector of planned BS transmitter.

The conditional area of the first sector of antenna with the azimuth of antenna main beam $\alpha 1_{Tx}$ = 240 degrees of planned BS transmitter affects only the territory of Belarus Administration, therefore the discussion of frequency assignment to the transmitter in the first sector of BS may be required only with this Administration.

FIGURE A9-1

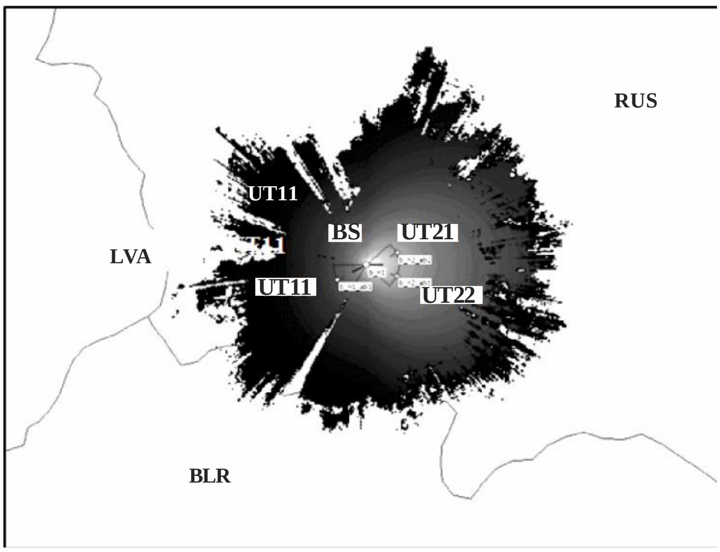


Guid-bilat A9- 01

Figure A9-2 shows the conditional area for the second sector of planned BS transmitter.

The conditional area of the second sector of antenna with the azimuth of antenna main beam $\alpha 2_{Tx}$ = 90 degrees of planned BS transmitter affects only the territory of Belarus Administration, therefore the discussion of frequency assignment to the transmitter in the second sector of BS may be required only with this Administration.

FIGURE A9-2

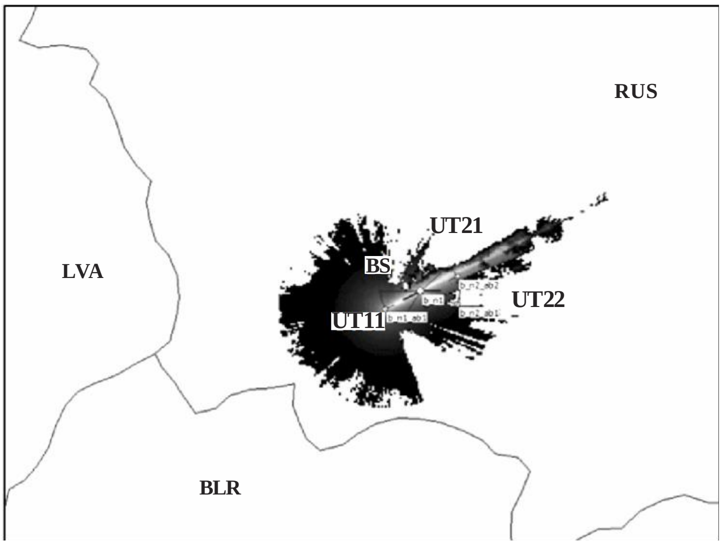


Guid-bilat A9- 02

Figure A9-3 shows the conditional area for the user terminal transmitter in the first sector of BS.

The conditional area of the user terminal transmitter in the first sector of BS with the azimuth of antenna main beam $\alpha 11_{Tx}$ = 60 degrees of planned UT transmitter does not affect the territory of any administration, therefore the discussion of frequency assignment to the first sector of BS transmitter is not needed.

FIGURE A9-3

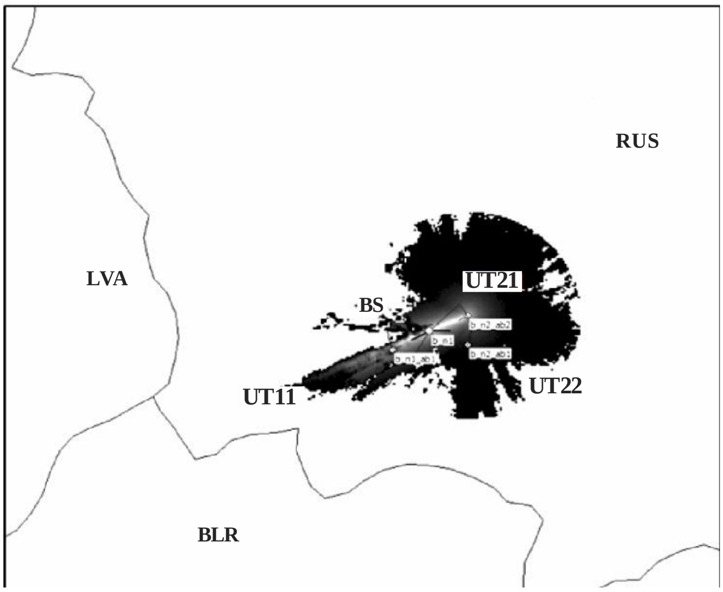


Guid-bilat A9- 03

Figure A9-4 shows the conditional area for the first user terminal transmitter in the second sector of BS.

The conditional area of the first user terminal transmitter in the second sector of BS with the azimuth of antenna main beam $\alpha 12_{Tx}$ = 247.5 degrees of planned UT transmitter does not affect the territory of any administration, therefore the discussion of frequency assignment to the first user terminal transmitter in the second sector of BS is not needed.

FIGURE A9-4

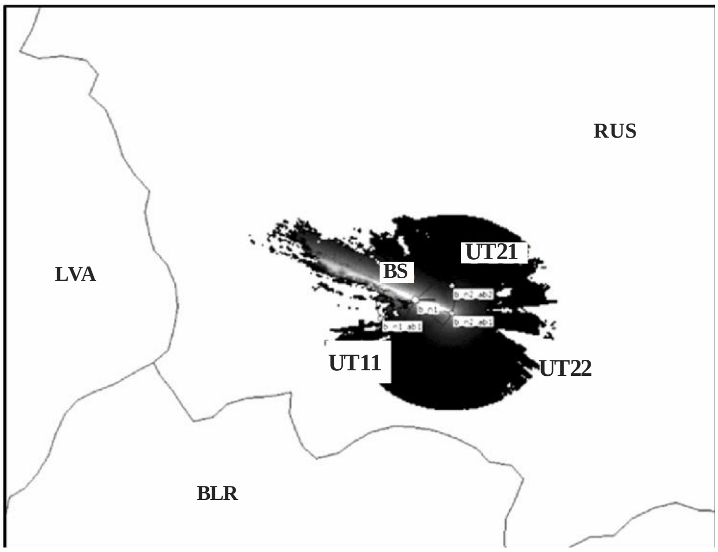


Guid-bilat A9- 04

Figure A9-5 shows the conditional area for the second user terminal transmitter in the second sector of BS.

The conditional area of the second user terminal transmitter in the second sector of BS with the azimuth of antenna main beam $\alpha 22_{Tx}$ = 292.5 degrees of planned UT transmitter does not affect the territory of any administration, therefore the discussion of frequency assignment to the second user terminal transmitter in the second sector of BS is not needed.

FIGURE A9-5



Guid-bilat A9- 05

A.10 An example of using two-step procedure to define the necessity of discussion on frequency assignments to base stations and user terminals (PMP network)

A frequency assignments to BS and user terminal transmitters in the wireless access network are planned for bringing into use with the following input data:

BS transmitter 1, first sector (BS11)

1 Transmit frequency planned to be used $f11_{Tx}$ = 10.168 GHz;

2 BS11 location coordinates:

– latitude φ_{Tx}: –57°36´9´´;

– longitude ψ_{Tx}: –29°2´57´´;

3 Azimuth of antenna main lobe in the first sector $\alpha 11_{Rx}$ = 30°;

4 –3 dB beamwidth of first sector antenna in horizontal plane $\theta 11_{Tx}$ = 120°.

BS transmitter 1, second sector (BS12)

1 Transmit frequency planned to be used $f12_{Tx}$ = 10.224 GHz;

2 BS12 location coordinates:

– latitude φ_{Tx}: –57°36´9´´;

– longitude ψ_{Tx}: –29°2´57´´;

3 Azimuth of antenna main lobe in the first sector antenna $\alpha 12_{Rx}$ = 240°;

4 –3 dB beamwidth of first sector antenna in horizontal plane $\theta 12_{Tx}$ = 120°.

BS transmitter 2, first sector (BS21)

1 Transmit frequency planned to be used $f21_{Tx}$ = 10.196 GHz;

2 BS21 location coordinates:

– latitude φ_{Tx}: –57°47´12´´;

– longitude ψ_{Tx}: –29°17´53´´;

3 Azimuth of antenna main lobe in the first sector antenna $\alpha 21_{Rx}$ = 170°;

4 3 dB beamwidth of first sector antenna in horizontal plane $\theta 21_{Tx}$ = 120°.

BS transmitter 2, second sector (BS22)

1 Transmit frequency planned to be used $f22_{Tx}$ = 10.252 GHz;

2 BS22 location coordinates:

– latitude φ_{Tx}: –57°47´12´´;

– longitude ψ_{Tx}: –29°17´53´´;

3 Azimuth of antenna main lobe in the first sector antenna $\alpha 22_{Rx}$ = 350°;

4 3 dB beamwidth of first sector antenna in horizontal plane $\theta 22_{Tx}$ = 120°.

Transmitter of the first user terminal in the first sector of BS No. 1 (UT111)

1 Transmit frequency planned to be used $f111_{Tx}$ = 10.518 GHz;

2 UT111 location coordinates:

– latitude φ_{Tx}: –57°38´51´´;

– longitude ψ_{Tx}: –29°11´41´´.

Transmitter of the second user terminal in the first sector of BS No. 1 (UT112)

1 Transmit frequency planned to be used $f112_{Tx}$ = 10.518 GHz;

2 UT112 location coordinates:

– latitude φ_{Tx}: –57°41´33´´;

– longitude ψ_{Tx}: –29°2´30´´.

Transmitter of the first user station in the second sector of BS No. 1 (UT121)

1 Transmit frequency planned to be used $f121_{Tx}$ = 10.574 GHz;

2 UT121 location coordinates:

– latitude φ_{Tx}: –57°36´9´´;

– longitude ψ_{Tx}: –28°52´53´´.

Transmitter of the second user station in the second sector of BS No. 1 (UT122)

1 Transmit frequency planned to be used $f122_{Tx}$ = 10.574 GHz;

2 UT122 location coordinates:

– latitude φ_{Tx}: –57°31´29´´;

– longitude ψ_{Tx}: –28°57´56´´.

First UT transmitter in the first sector of BS No. 2 (UT211)

1 Transmit frequency planned to be used $f211_{Tx}$ = 10.546 GHz;

2 UT211 location coordinates:

– latitude φ_{Tx}: –57°42´8´´;

– longitude ψ_{Tx}: –29°14´26´´.

Second UT transmitter in the first sector of BS No. 2 (UT212)

1 Transmit frequency planned to be used $f212_{Tx}$ = 10.546 GHz;

2 UT212 location coordinates:

– latitude φ_{Tx}: –57°43´4´´;

– longitude ψ_{Tx}: –29°24´23´´.

First UT transmitter in the second sector of BS No. 2 (UT221)

1 Transmit frequency planned to be used $f221_{Tx}$ = 10.602 GHz;

2 UT221 location coordinates:

– latitude φ_{Tx}: –57°52´16´´;

– longitude ψ_{Tx}: –29°21´21´´.

Second UT transmitter in the second sector of BS No. 2 (UT222)

1 Transmit frequency planned to be used $f222_{Tx}$ = 10.602 GHz;

2 UT222 location coordinates:

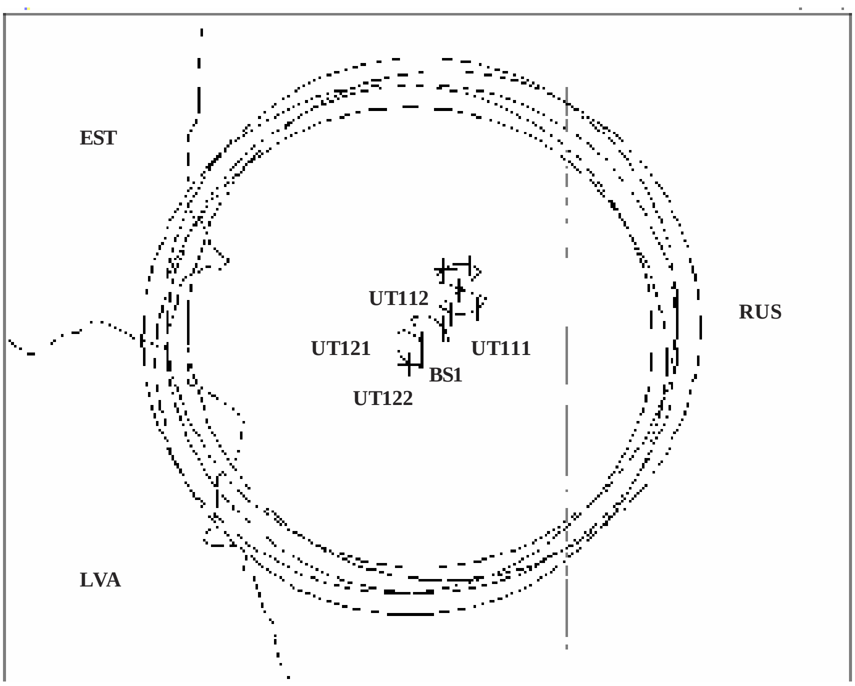
– latitude φ_{Tx}: –57°51´20´´;

– longitude ψ_{Tx}: –29°11´22´´.

First step of two-step procedure

Figure A10-1 and Tables A10-1 to A10-5 give the results of determining the minimum distance from planned transmitting BS1 and user terminals in service areas of two sectors of this BS (UT111, UT112, UT121, UT122) locations to neighbouring country borders on the basis of input data on station location coordinates and the digital map with country border coordinates based on the ITU Digitized World Map (IDWM).

FIGURE A10-1



Guid-bilat A10- 01

TABLE A10-1

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of BS1 in the process of notification: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of BS (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
EST	29°2´57´´E 57°36´9´´N	82.3	293.3	27°46´18´´E 57°53´20´´N
LVA		77.7	246.3	27°51´52´´E 57°18´56´´N

TABLE A10-2

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of the first user terminal (UT111) in the process of notification in the first sector of BS: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of UT (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
EST	29°11´41´´E 57°38´51´´N	88.6	288.2	27°46´18´´E 57°53´20´´N
LVA		87.7	245.7	27°51´52´´E 57°18´56´´N

TABLE A10-3

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of the second user terminal (UT112) in the process of notification in the first sector of BS: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of UT (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
EST	29°2´30´´E 57°41´33´´N	78.4	286.7	27°46´18´´E 57°53´20´´N
LVA		81.9	239.7	27°51´52´´E 57°18´56´´N

TABLE A10-4

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of the first user terminal (UT121) in the process of notification in the second sector of BS: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of UT (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
EST	28°52´53´´E 57°36´9´´N	73.2	296.3	27°46´18´´E 57°53´20´´N
LVA		68.7	242.7	27°51´52´´E 57°18´56´´N

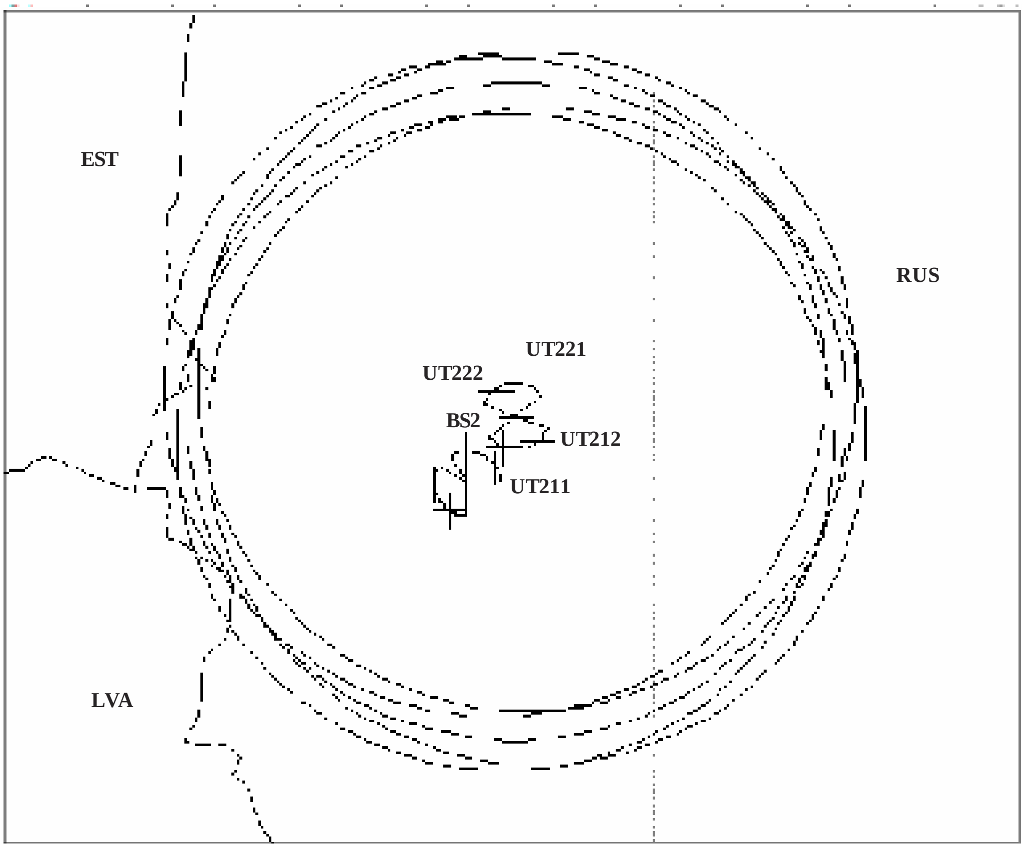
TABLE A10-5

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of the second user terminal (UT121) in the process of notification in the second sector of BS: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of UT (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
EST	28°57´56´´E 57°31´29´´N	81.7	300.2	27°46´18´´E 57°53´20´´N
LVA		69.9	251.0	27°51´52´´E 57°18´56´´N

Comparison of defined minimum distances from planned BS1 and planned user terminal (UT111, UT211, UT121, UT221) locations to geographical boarders of neighbour foreign administrations (Tables A10-1 to A10-5) with conditional distance from Table 1 which equals 100 km for frequencies from 10 to 12 GHz shows necessity of discussions on all frequency assignments with Latvian and Estonian Administrations.

Figure A10-2 and Tables A10-6 to A10-10 show calculated minimum distance from planned transmit BS2 and planned user terminal (UT211, UT212, UT221, UT222, served by two sectors of the BS2) locations to geographical boarders of neighbour foreign administrations. The calculations are based on input data of station location coordinates and digital maps containing geographical coordinates of boarders between administrations, and use IDWM.

FIGURE A10-2



Guid-bilat A10- 02

TABLE A10-6

Administration with which the discussion on frequency assignment may be required	**Coordinates of the location of BS2 in the process of notification:** **longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)**	**Minimum distance to the border from the location of UT (km)**	**Azimuth to a minimum distance point (degrees)**	**Coordinates of minimum distance point at the border line:** **longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)**
EST	29°17´53´´E 57°47´12´´N	91.1	277.8	27°46´18´´E 57°53´20´´N

TABLE A10-7

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of the first user terminal (U211) in the process of notification in the first sector of BS: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of UT (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
EST	29°14´26´´E 57°42´8´´N	89.5	284.0	27°46´18´´E 57°53´20´´N
LVA		92.8	243.0	27°51´52´´E 57°18´56´´N

TABLE A10-8

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of the second user terminal (UT212) in the process of notification in the first sector of BS: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of UT (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
EST	29°24´23´´E 57°43´4´´N	98.7	281.8	27°46´18´´E 57°53´20´´N

TABLE A10-9

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of the first user terminal (UT221) in the process of notification in the second sector of BS: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of UT (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
EST	29°21´21´´E 57°52´16´´N	93.7	271.9	27°46´18´´E 57°53´20´´N

TABLE A10-10

Administration with which the discussion on frequency assignment may be required	Coordinates of the location of the second user terminal (UT222) in the process of notification in the second sector of BS: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)	Minimum distance to the border from the location of UT (km)	Azimuth to a minimum distance point (degrees)	Coordinates of minimum distance point at the border line: longitude (degrees, minutes, seconds) latitude (degrees, minutes, seconds)
EST	29°11´22´´E 57°51´20´´N	84.0	273.1	27°46´18´´E 57°53´20´´N
LVA		98.9	236.4	27°49´0´´E 57°21´23´´N

Comparison of defined minimum distances from planned BS2 and planned user terminal (UT211, UT212, UT221, UT222) locations to geographical boarders of neighbour foreign administrations (Tables A10-6 to A10-10) with conditional distance from Table 1 which equals 100 km for frequencies from 10 to 12 GHz shows necessity of discussions on harmonization of all frequency assignments with Estonian Administration as well as discussions on harmonization of frequency assignment to first user terminal in the first sector of the second BS (UT211) and second user terminal in the second sector of the second BS (UT222) with Latvian Administration.

Second step of two-step procedure

A *System parameters for known BS transmitters:*

General parameters BS transmitters

1 Antenna height above ground level, h_{Tx} = 50 m

2 Main beam elevation of BS radiation patterns for all user terminal antennas, ε_{Tx} = 0°

3 Maximum BS antenna gain, G_{Tx} = 15 dBi

4 Radiation pattern of BS antenna is $a_{Tx_{ant}}(\chi_{Tx})$, dB (Rec. ITU-R F.1336-3)

5 e.i.r.p. = 4 dBW × MHz in the BS reference bandwidth

6 BS reference bandwidth, B_{ref} = 1 MHz

7 Radius of BS service area, Rad = 10 km.

BS1 transmitter, first sector (BS11)

1 Planned transmitting frequency, $f11_{Tx}$ = 10.168 GHz

2 BS11 location coordinates:

– Latitude φ_{Tx}: –57°36´9´´;

– Longitude ψ_{Tx}: –29°2´57´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha11_{Rx}$ = 30°

4 –3 dB antenna pattern beamwidth for the first sector in the horizontal plane, $\theta11_{Tx}$ = 120°

Transmitter of BS1, second sector (BS12)

1 Planned transmitting frequency, $f12_{Tx}$ = 10.224 GHz

2 BS12 location coordinates:

– Latitude φ_{Tx}: –57°36´9´´;

– Longitude ψ_{Tx}: –29°2´57´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha 12_{Rx}$ = 240°

4 –3 dB antenna pattern beamwidth for the first sector in the horizontal plane, $\theta 12_{Tx}$ = 120°

Transmitter of BS2, first sector (BS21)

1 Planned transmitting frequency, $f21_{Tx}$ = 0.196 GHz

2 BS21 location coordinates:

– Latitude φ_{Tx}: –57°47´12´´;

– Longitude ψ_{Tx}: –29°17´53´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha 21_{Rx}$ = 170°

4 –3 dB antenna pattern beamwidth for the first sector in the horizontal plane, $\theta 21_{Tx}$ = 120°

Transmitter of BS2, second sector (BS22)

1 Planned transmitting frequency, $f22_{Tx}$ = 10.252 GHz

2 BS22 location coordinates:

– Latitude φ_{Tx}: –57°47´12´´;

– Longitude ψ_{Tx}: –29°17´53´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha 22_{Rx}$ = 350°

4 –3 dB antenna pattern beamwidth for the first sector in the horizontal plane, $\theta 22_{Tx}$ = 120°

B *Parameters of user terminal transmitters for BS11, BS12, BS21, BS22:*

General parameters of user terminal transmitters

1 Antenna height above ground level for all user terminals, h_{Tx} = 20 m

2 Main beam elevation of radiation patterns for all user terminal antennas, $\varepsilon 11_{Tx}$ = 0°

3 Maximum antenna gain for all user terminals, G_{Tx} = 18 dBi

4 Radiation pattern of user terminal antenna is $a_{Tx_{ant}}(\chi_{Tx})$, dB, (Rec. ITU-R F.699-7)

5 e.i.r.p. = 7 dBW × MHz in the reference bandwidth for all user terminals

6 Reference bandwidth for all user terminals, B_{ref} = 1 MHz.

First user terminal transmitter in the first sector of BS1 (UT111)

1 Planned transmitting frequency, $f111_{Tx}$ = 10.518 GHz

2 UT111 location coordinates:

– Latitude φ_{Tx}: –57°38´51´´;

– Longitude ψ_{Tx}: –29°11´41´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha 111_{Rx}$ = 240°

Second user terminal transmitter in the first sector of BS1 (UT112)

1 Planned transmitting frequency, $f112_{Tx}$ = 10.518 GHz

2 UT112 location coordinates:

– Latitude φ_{Tx}: –57°41´33´´;

– Longitude ψ_{Tx}: –29°2´30´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha 112_{Rx}$ = 180°

First user terminal transmitter in the second sector of BS1 (UT121)

1 Planned transmitting frequency, $f121_{Tx}$ = 10.574 GHz

2 UT121 location coordinates:

– Latitude φ_{Tx}: –57°36´9´´;

– Longitude ψ_{Tx}: –28°52´53´´;

2 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha121_{Rx}$ = 90°

Second user terminal transmitter in the second sector of BS1 (UT221)

1 Planned transmitting frequency, $f122_{Tx}$ = 10.574 GHz

2 UT122 location coordinates:

– Latitude φ_{Tx}: –57°31´29´´;

– Longitude ψ_{Tx}: –28°57´56´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha122_{Rx}$ = 30°

First user terminal transmitter in the first sector of BS2 (UT211)

1 Planned transmitting frequency, $f211_{Tx}$ = 10.574 GHz

2 UT211 location coordinates:

– Latitude φ_{Tx}: –57°42´8´´;

– Longitude ψ_{Tx}: –29°14´26´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha211_{Rx}$ = 20°

Second user terminal transmitter in the first sector of BS2 (UT212)

1 Planned transmitting frequency, $f212_{Tx}$ = 10.574 GHz;

2 UT212 location coordinates:

– Latitude φ_{Tx}: –57°43´4´´;

– Longitude ψ_{Tx}: –29°24´23´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha212_{Rx}$ = 320°

First user terminal transmitter in the second sector of BS2 (UT221)

1 Planned transmitting frequency, $f221_{Tx}$ = 10.602 GHz

2 UT221 location coordinates:

– Latitude φ_{Tx}: –57°52´16´´;

– Longitude ψ_{Tx}: –29°21´21´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha221_{Rx}$ = 200°

Second user terminal transmitter in the second sector of BS2 (UT222)

1 Planned transmitting frequency, $f222_{Tx}$ = 10.602 GHz

2 UT222 location coordinates:

– Latitude φ_{Tx}: –57°51´20´´;

– Longitude ψ_{Tx}: –29°11´22´´;

3 Main beam azimuth of antenna radiation pattern for the first sector, $\alpha222_{Rx}$ = 140°

C *System data for an unknown radio-relay station receiver (Table A1-1):*

1 Planned receiving frequencies, $f_{Rx} = f_{Tx}$ = 10.168 GHz; 10.196 GHz; 10.224 GHz; 10.252 GHz; 10.518 GHz; 10.546 GHz; 10.574 GHz; 10.602 GHz

2 Antenna height above ground level, h_{Rx} = 50 m

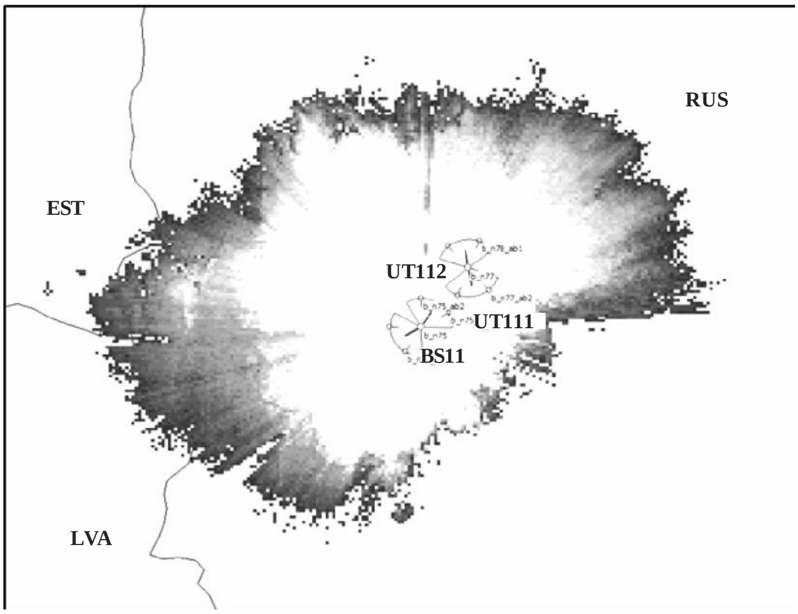
3 Maximum antenna gain, G_{Rx} = 49 dBi

4 Receiver Noise Factor, NF_{Rx} = 4 dB

5 Reference bandwidth, B_{ref} = 1 MHz.

Figure A10-3 shows conditional area around the transmitter of BS1 for the first sector (BS11).

FIGURE A10-3

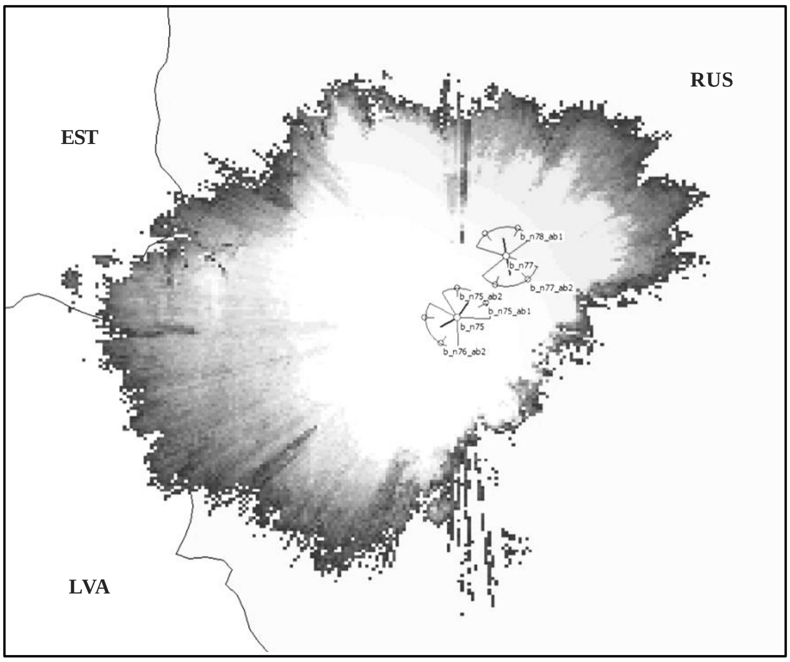


Guid-bilat A10- 03

Conditional area overlaps the territory of Estonian and Latvian Administrations, hence, there is a need in negotiations with those Administrations on harmonization of frequency assignment to BS11 (first sector).

Figure A10-4 shows conditional area around the transmitter of BS1 for the second sector (BS12).

FIGURE A10-4

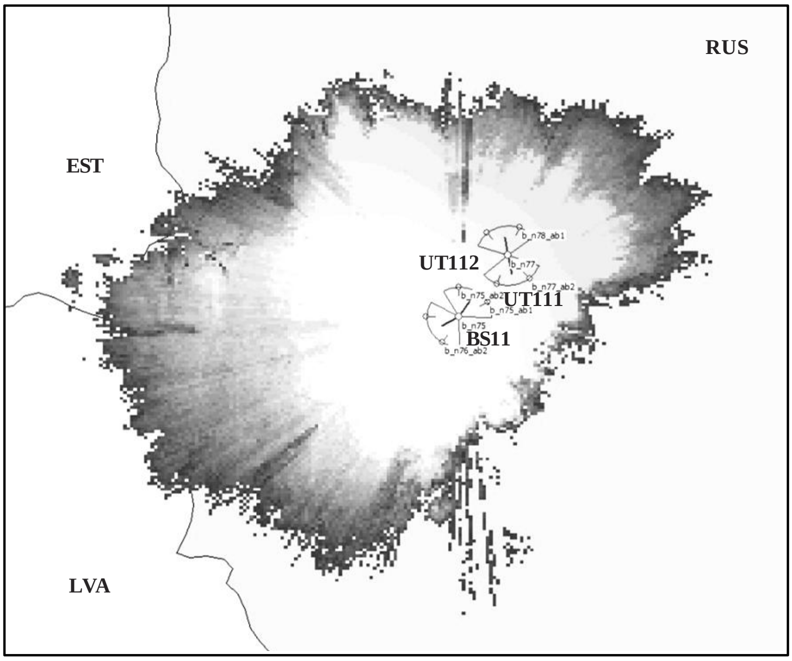


Guid-bilat A10- 04

Conditional area overlaps the territory of Estonian and Latvian Administrations, hence, there is a need in negotiations with those Administrations on harmonization of frequency assignment to BS12 (the second sector).

Figure A10-5 shows conditional area around the transmitter of the first user terminal (UT111) in the first sector of BS1.

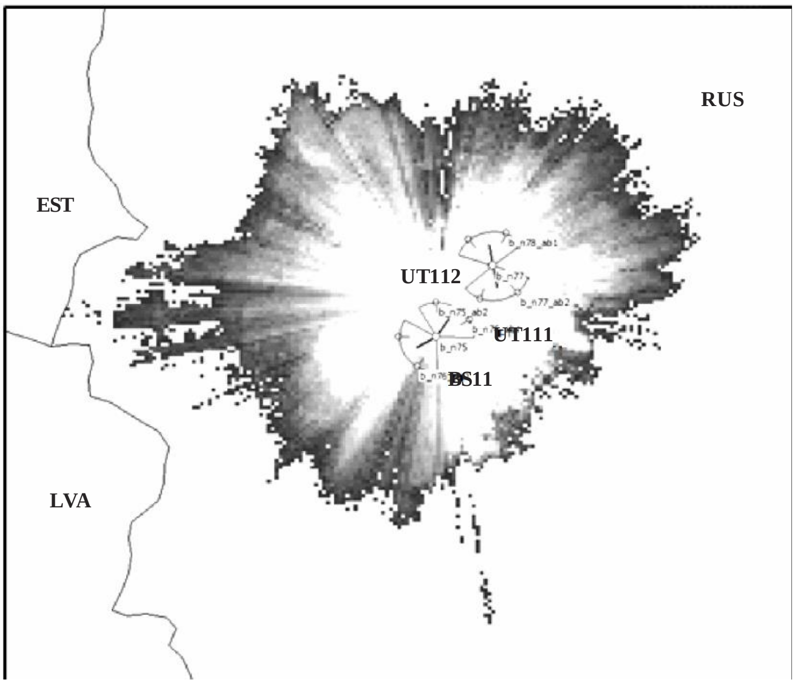
FIGURE A10-5



Guid-bilat A10- 05

Figure A10-6 shows conditional area around the transmitter of the second user terminal (UT112) in the first sector of BS1.

FIGURE A10-6

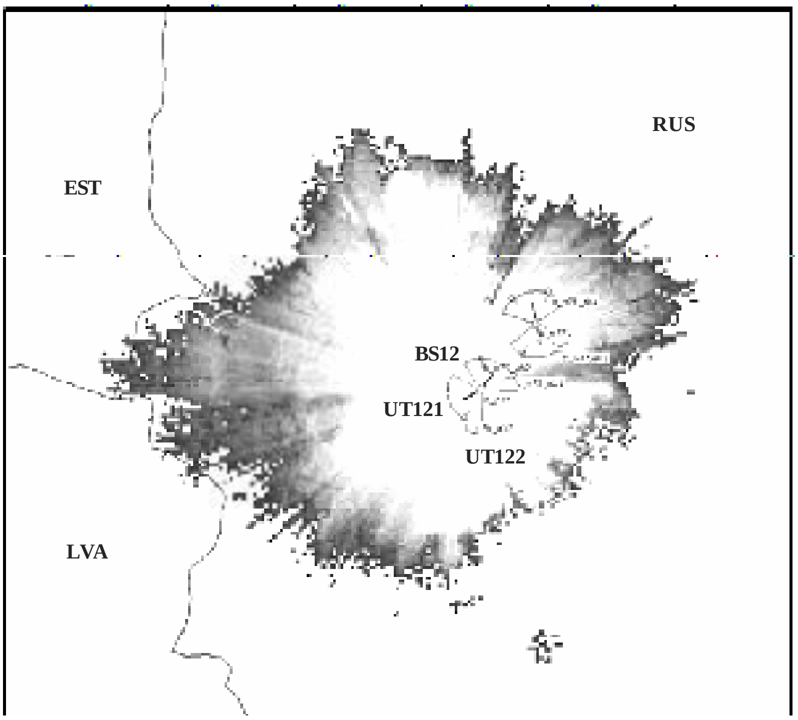


Guid-bilat A10- 06

Conditional areas around transmitters of the first and second user terminals (UT111 and UT112) in the first sector of BS1 do not overlap the territory of adjacent administrations, hence, there is no need in negotiations on frequency assignment harmonization.

Figure A10-7 shows conditional area around the transmitter of the first user terminal (UT121) in the second sector of BS1.

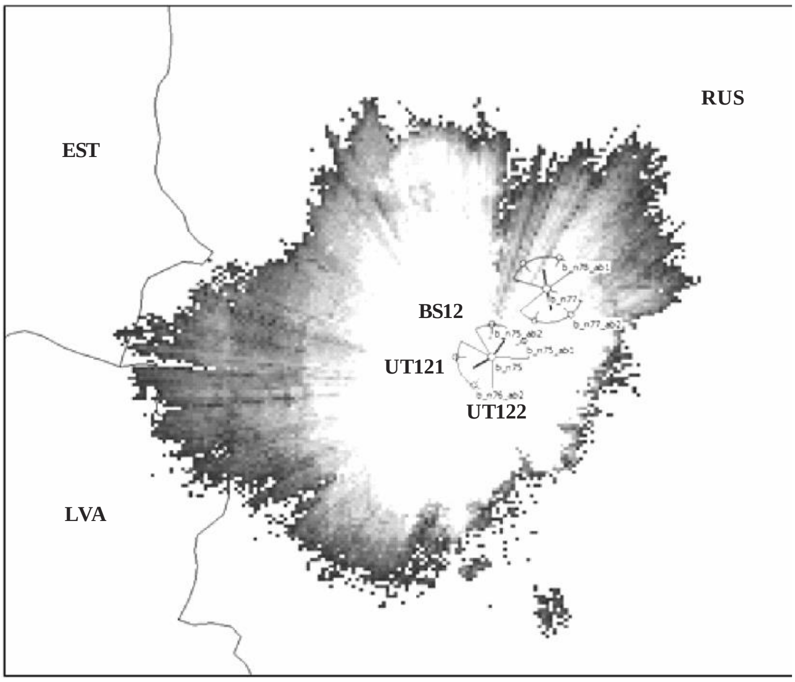
FIGURE A10-7



Guid-bilat A10- 07

Figure A10-8 shows conditional area around the transmitter of the second user terminal (UT122) in the second sector of BS1.

FIGURE A10-8

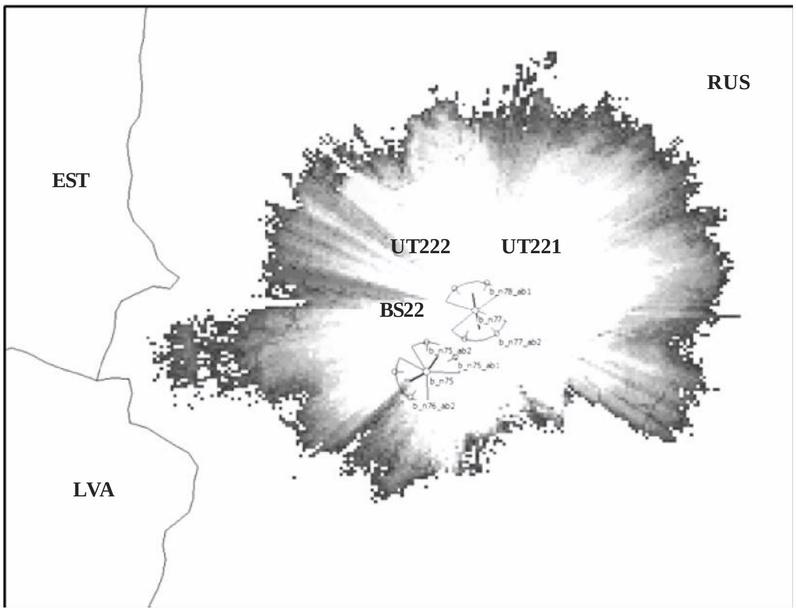


Guid-bilat A10- 08

Conditional areas around transmitters of the first and second user terminals (UT122 and UT121) in the second sector of BS1 overlap the territory of Estonia and Latvia, hence, there is a need in negotiations on frequency assignment harmonization with Estonian and Latvian Administrations.

Figure A10-9 shows conditional area around the transmitter of BS2 for the first sector (BS22).

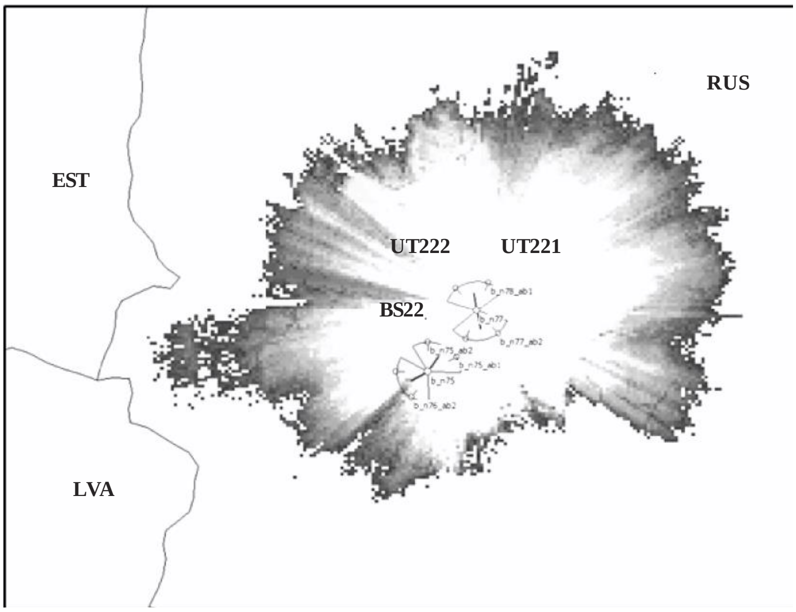
FIGURE A10-9



Guid-bilat A10- 09

Figure A10-10 shows conditional area around the transmitter of BS2 for the second sector (BS22).

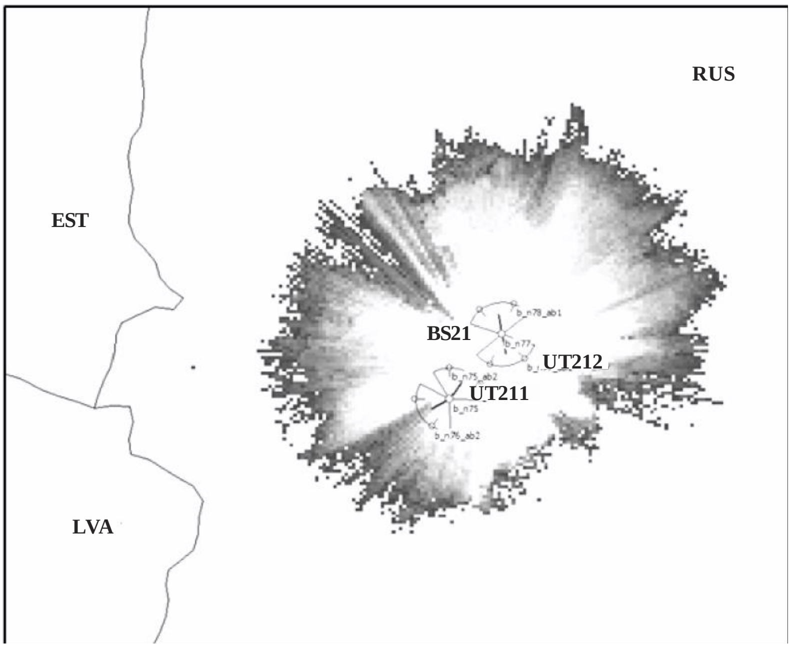
FIGURE A10-10



Guid-bilat A10-10

Figure A10-11 shows conditional area around the transmitter of the first user terminal (UT211) in the first sector of BS2.

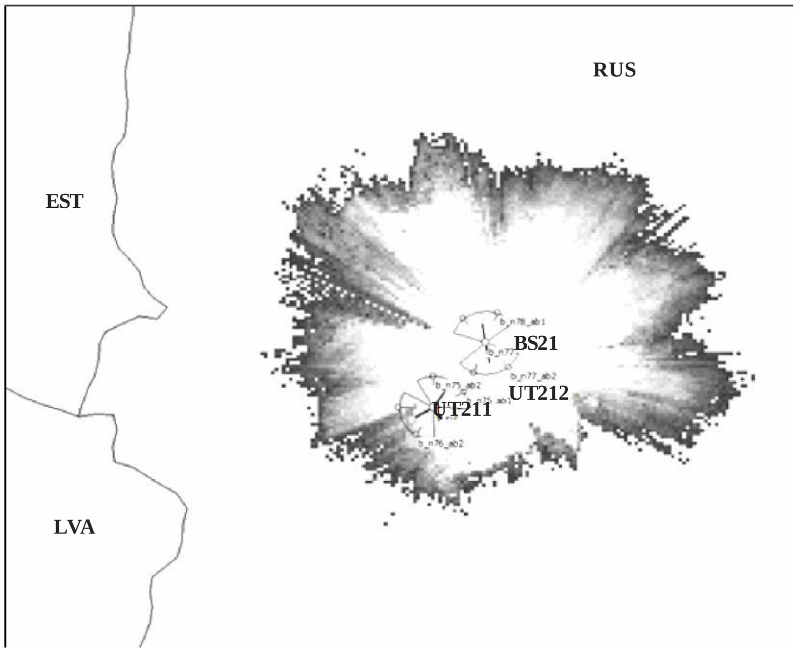
FIGURE A10-11



Guid-bilat A10-11

Figure A10-12 shows conditional area around the transmitter of the second user terminal (UT212) in the first sector of BS2.

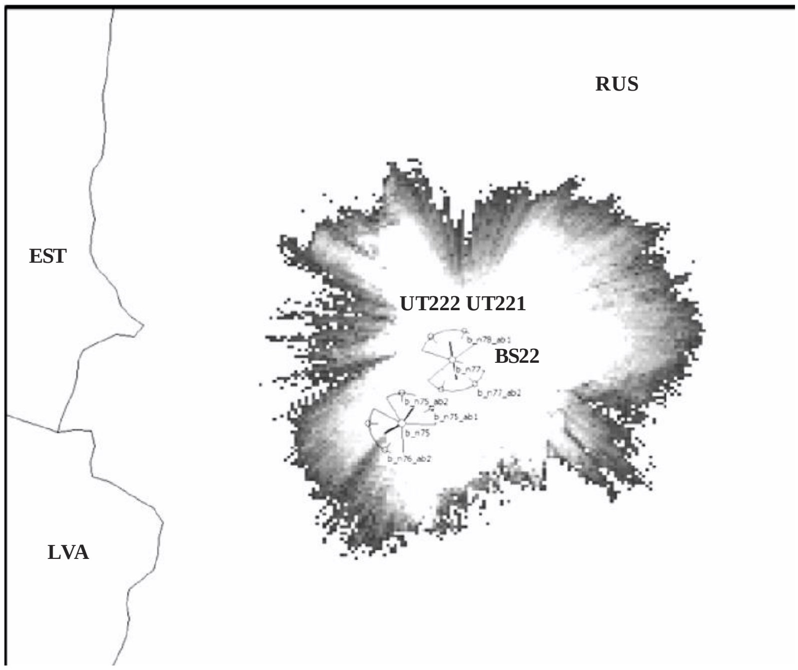
FIGURE A10-12



Guid-bilat A10-12

Figure A10-13 shows conditional area around the transmitter of the first user terminal (UT221) in the second sector of BS2.

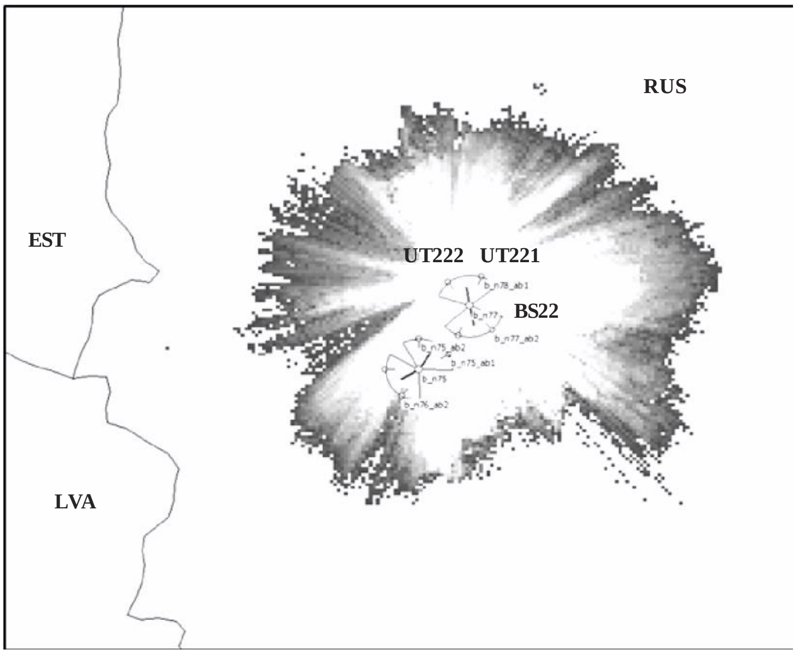
FIGURE A10-13



Guid-bilat A10-13

Figure A10-14 shows conditional area around the transmitter of the second user terminal (UT222) in the second sector of BS2.

FIGURE A10-14



Guid-bilat A10-14

Conditional areas around transmitters of user terminals and BS2 (UT211, UT212, UT221, UT222, BS21 and BS22) does not overlap the territory of adjacent administration, hence, there is no need in negotiations on frequency assignment harmonization.

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ISBN 978-92-61-15531-5 SAP id 39628

Printed in Switzerland
Geneva, 2015
Photo credits: Shutterstock