

RECOMMENDATION ITU-R P.1144-1

**GUIDE TO THE APPLICATION OF THE PROPAGATION METHODS
OF RADIOCOMMUNICATION STUDY GROUP 3**

(1995-1999)

The ITU Radiocommunication Assembly,

considering

a) that there is a need to assist users of the ITU-R Recommendations P Series (developed by Radiocommunication Study Group 3),

recommends

1 that the information contained in Table 1 be used for guidance on the application of the various propagation methods contained in the ITU-R Recommendations P Series (developed by Radiocommunication Study Group 3).

NOTE 1 – For each of the ITU-R Recommendations in Table 1, there are associated information columns to indicate:

Application: the service(s) or application for which the Recommendation is intended.

Type: the situation to which the Recommendation applies, such as point-to-point, point-to-area, line-of-sight, etc.

Output: the output parameter value produced by the method of the Recommendation, such as path loss.

Frequency: the applicable frequency range of the Recommendation.

Distance: the applicable distance range of the Recommendation.

% time: the applicable time percentage values or range of values of the Recommendation; % time is the percentage of time that the predicted signal is exceeded during an average year.

% location: the applicable per cent location range of the Recommendation; % location is the percentage of locations within, say, a square with 100 to 200 m sides that the predicted signal is exceeded.

Terminal height: the applicable terminal antenna height range of the Recommendation.

Input data: a list of parameters used by the method of the Recommendation; the list is ordered by the importance of the parameter and, in some instances, default values may be used.

The information, as shown in Table 1, is already provided in the Recommendations themselves; however, the table allows users to quickly scan the capabilities (and limitations) of the Recommendations without the requirement to search through the text.

TABLE 1
ITU-R radiowave propagation prediction methods

| Method | Application | Type | Output | Frequency | Distance | % time | % location | Terminal height | Input data |
|-------------------|---|----------------|-------------------------|---------------------|--|---|----------------|---|--|
| Rec. ITU-R P.368 | All services | Point-to-point | Field strength | 10 kHz to 30 MHz | 1 to 10 000 km | Not applicable | Not applicable | Ground-based | Frequency Ground conductivity |
| Rec. ITU-R P.370 | Broadcasting | Point-to-area | Field strength | 30 MHz to 1 000 MHz | 10 to 1 000 km | 1, 5, 10, 50 | 1 to 99 | Tx: effective height from less than 0 m to greater than 1 200 m Rx: 1.5 to 40 m | Distance Tx antenna height Frequency Percentage time Rx antenna height Terrain clearance angle Terrain irregularity Percentage locations |
| Rec. ITU-R P.1147 | Broadcasting | Point-to-area | Sky-wave field strength | 0.15 to 1.7 MHz | 50 to 12 000 km | 10, 50 | Not applicable | Not applicable | Latitude and longitude of Tx Latitude and longitude of Rx Distance Sunspot number Tx power Frequency |
| Rec. ITU-R P.452 | Services employing stations on the surface of the Earth; interference | Point-to-point | Path loss | 700 MHz to 30 GHz | Not specified but up to and beyond the radio horizon | 0.001 to 50 Average year and worst month | Not applicable | No limits specified | Path profile data Frequency Percentage time Tx antenna height Rx antenna height Latitude and longitude of Tx Latitude and longitude of Rx Meteorological data |

TABLE 1 (continued)

| Method | Application | Type | Output | Frequency | Distance | % time | % location | Terminal height | Input data |
|-------------------|------------------------------|---------------------------------|---|--|--|---|----------------|--|--|
| Rec. ITU-R P.528 | Aeronautical mobile | Point-to-area | Path loss | 125 MHz to 15 GHz | 0 to 1 800 km (for aeronautical applications 0 km horizontal distance does not mean 0 km path length) | 5, 50, 95 | Not applicable | H1: 15 m to 20 km H2: 1 to 20 km | Distance Tx height Frequency Rx height Percentage time |
| Rec. ITU-R P.1146 | Land mobile Broadcasting | Point-to-area | Field strength | 1 to 3 GHz | 1 to 500 km | 1 to 99 | 1 to 99 | Tx ≥ 1 m Rx: 1 to 30 m | Distance Frequency Tx antenna height Rx antenna height Percentage time Percentage location Terrain information |
| Rec. ITU-R P.529 | Land mobile | Point-to-area | Field strength | 30 MHz to 3 GHz (limited application above 1.5 GHz) | VHF: 10 to 600 km UHF: 1 to 100 km | VHF: 1, 10, 50 UHF: 50 | Unspecified | Base: 20 m to 1 km Mobile: 1 to 10 m | Distance Base antenna height Frequency Mobile antenna height Percentage time Ground cover |
| Rec. ITU-R P.530 | Line-of-sight Fixed links | Point-to-point Line-of-sight | Path loss Diversity improvement (clear air conditions) XPD Outage Error performance | Approximately 150 MHz to 40 GHz | Up to 200 km if line-of-sight | All percentages of time in clear-air conditions; 1 to 0.001 in precipitation conditions ⁽¹⁾ | Not applicable | High enough to ensure specified path clearance | Distance Tx height Frequency Rx height Percentage time Path obstruction data Climate data |

TABLE 1 (continued)

| Method | Application | Type | Output | Frequency | Distance | % time | % location | Terminal height | Input data |
|------------------|---------------------------------|-----------------------------------|---|---------------|----------------------------|---|----------------|---------------------|--|
| Rec. ITU-R P.533 | Broadcasting Fixed Mobile | Point-to-point | Basic MUF Sky-wave field strength Available receiver power Signal-to-noise ratio LUF Circuit reliability | 2 to 30 MHz | 0 to 40 000 km | All percentages | Not applicable | Not applicable | Latitude and longitude of Tx Latitude and longitude of Rx Sunspot number Month Time(s) of day Frequencies Tx power Tx antenna type Rx antenna type |
| Rec. ITU-R P.534 | Fixed Mobile Broadcasting | Point-to-point via sporadic E | Field strength | 30 to 100 MHz | 0 to 4 000 km | 0 to 50 | Not applicable | Not applicable | Distance Frequency |
| Rec. ITU-R P.616 | Maritime mobile | As for Recommendation ITU-R P.370 | | | | | | | |
| Rec. ITU-R P.617 | Trans-horizon fixed links | Point-to-point | Path loss | > 30 MHz | 100 to 1 000 km | 20, 50, 90, 99, and 99.9 | Not applicable | No limits specified | Frequency Tx antenna gain Rx antenna gain Path geometry |
| Rec. ITU-R P.618 | Fixed satellite | Point-to-point | Path loss. Diversity gain and (for precipitation condition) XPD | 1 to 55 GHz | Any practical orbit height | 0.001-5 for attenuation; 0.001-1 for XPD | Not applicable | No limit | Meteorological data Frequency Elevation angle Height of earth station Separation and angle between earth station sites (for diversity gain) Antenna diameter and efficiency (for scintillation) Polarization angle (for XPD) |

TABLE 1 (end)

| Method | Application | Type | Output | Frequency | Distance | % time | % location | Terminal height | Input data |
|------------------|--------------------------------------|---------------------------------|--|--------------------|----------------------------|--|----------------|---------------------|--|
| Rec. ITU-R P.620 | Earth station frequency coordination | Coordination distance | Distance of which the required propagation loss is achieved | 100 MHz to 105 GHz | up to 1 200 km | 0.001 to 50 | Not applicable | No limits specified | Minimum basic transmission loss Frequency Percentage of time Earth-station elevation angle |
| Rec. ITU-R P.680 | Maritime mobile satellite | Point-to-point | Sea-surface fading Fade duration Interference (adjacent satellite) | 0.8-8 GHz | Any practical orbit height | To 0.001% via Rice-Nakagami distribution Limit of 0.01% for interference ⁽¹⁾ | Not applicable | No limit | Frequency Elevation angle Maximum antenna boresight gain |
| Rec. ITU-R P.681 | Land mobile satellite | Point-to-point | Path fading Fade duration Non-fade duration | 0.8 to 20 GHz | Any practical orbit height | Not applicable Percentage of distance travelled 1 to 80% ⁽¹⁾ | Not applicable | No limit | Frequency Elevation angle Percentage of distance travelled Approximate level of optical shadowing |
| Rec. ITU-R P.682 | Aeronautical mobile satellite | Point-to-point | Sea-surface fading | 1 to 2 GHz | Any practical orbit height | To 0.001% via Rice-Nakagami distribution ⁽¹⁾ | Not applicable | No limit | Frequency Elevation angle Polarization Maximum antenna boresight gain Antenna height |
| Rec. ITU-R P.684 | Fixed | Point-to-point | Sky-wave field strength | 30 to 500 kHz | 0 to 40 000 km | 50 | Not applicable | Not applicable | Latitude and longitude of Tx Latitude and longitude of Rx Distance Tx power Frequency |
| Rec. ITU-R P.843 | Fixed Mobile Broadcasting | Point-to-point via meteor-burst | Received power Burst rate | 30 to 100 MHz | 100 to 1 000 km | 0 to 5 | Not applicable | Not applicable | Frequency Distance Tx power Antenna gains |

⁽¹⁾ Time percentage of outage; for service availability, subtract value from 100.