FreeMile

FreeMile V-band Online Path Calculator

Overview

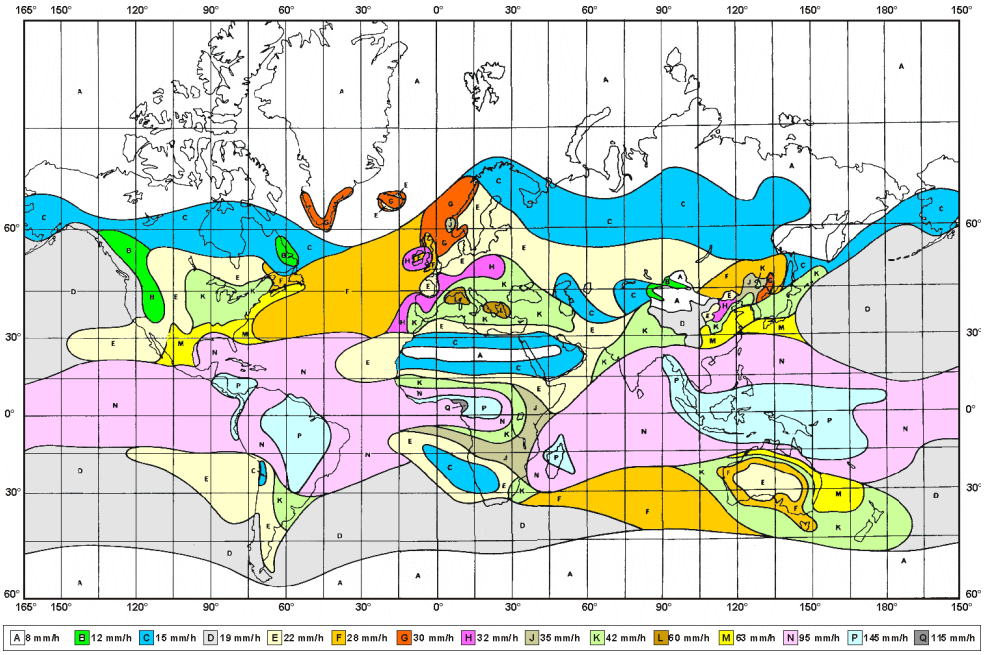
The present document describes SAF Tehnika proprietary V-band Online Path Calculator - a **point-to-point**[1] radio link calculation tool designed to detect various parameters, such as **link availability, fade margin, received signal level**, essential for planning and installing digital microwave data transmission systems in 60 GHz frequency range. The Path Calculator assists system designers in selecting an antenna size and a frequency channel for achieving a desired throughput, considering the link distance and climatic conditions. It provides a means of evaluation the possibility to establish a reliable and efficient data transmission with **Freemile 60** radio equipment.

The V-band Online Path Calculator is designed as a web tool. Its algorithm is based on the following **ITU-R recommendations**:

- ITU-R P.530-16 (Propagation data and prediction methods required for the design of terrestrial line-of-sight systems)
- ITU-R P.676 (Attenuation by atmospheric gases)
- ITU-R P.838 (Specific attenuation model for rain for use in prediction methods)

To perform a calculation, some parameters' values should be either known in advance or selected as appropriate:

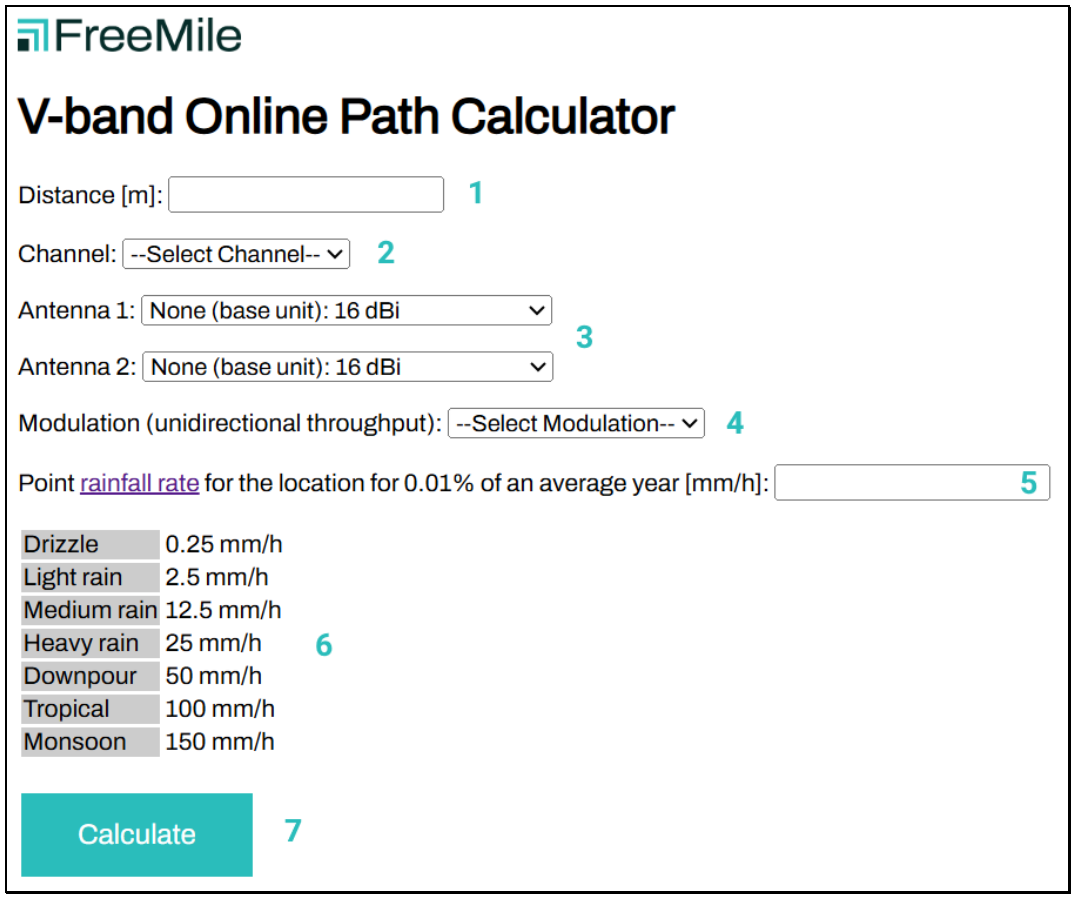
- **Distance** in meters between the sites.
- Frequency **channel**.
- **Antenna** model with the corresponding gain at each site.
- Required link **throughput** which depends on a modulation.
- Point **rainfall rate** for the location for 0.01% of an average year. Any value can be specified, for example, estimated from the ITU rain zone map as shown below:



[1] Please note that point-to-multipoint calculations are not supported by this Path Calculator

First Step – Data Input

After the calculation result is received, it is possible to judge whether selected parameters ensure the necessary system performance in terms of link availability, fade margin, received signal level, etc. If a customer requires higher availability or fade margin, it is possible to readjust antenna models, modulation or frequency channel until the desired level is achieved.



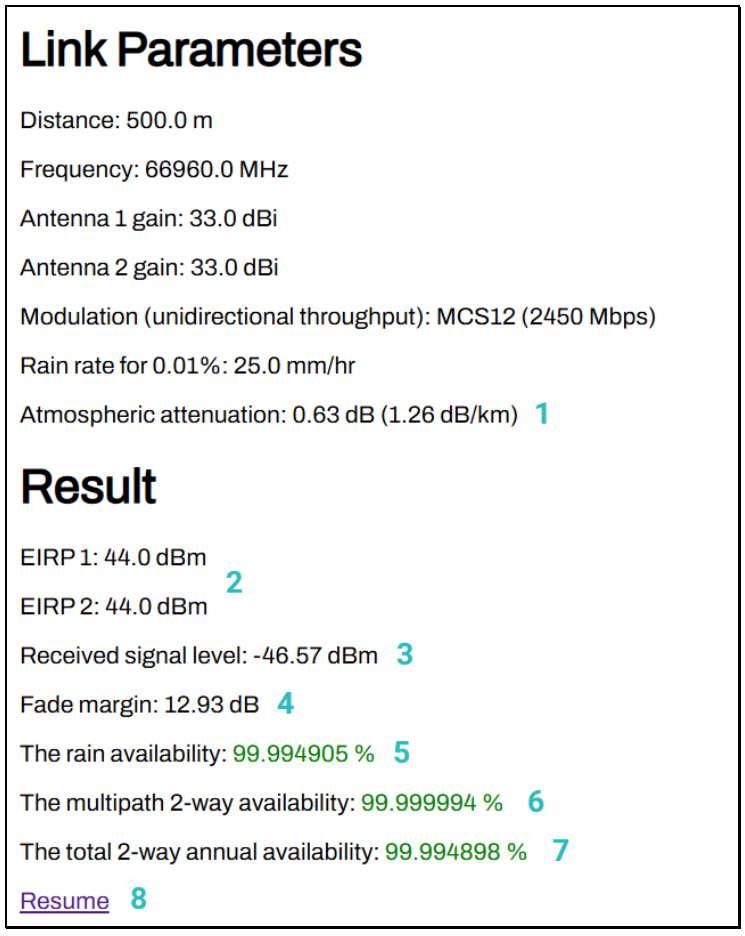
The Path Calculator web interface has the following structure:

1. Enter the link distance in meters.
2. Select the frequency channel and TX/RX frequency:
    a. 58320 MHz
    b. 60480 MHz
    c. 62640 MHz
    d. 64800 MHz
    e. 66960 MHz
    f. 69120 MHz
3. Select the antenna model with the corresponding gain at each site:
    a. None (base unit): 16 dBi
    b. 100 mm antenna: 33 dBi
    c. 150 mm antenna: 37 dBi
    d. 300 mm antenna: 42 dBi
    e. 45/90 deg scanning antenna: 30 dBi

4. Select the modulation and the corresponding unidirectional throughput:
    a. MCS1 (300 Mbps)
    b. MCS2 (600 Mbps)
    c. MCS3 (775 Mbps)
    d. MCS4 (900 Mbps)
    e. MCS5 (975 Mbps)
    f. MCS6 (1250 Mbps)
    g. MCS7 (1550 Mbps)
    h. MCS8 (1800 Mbps)
    i. MCS9 (1900 Mbps)
    j. MCS10 (2250 Mbps)
    k. MCS11 (2400 Mbps)
    l. MCS12 (2450 Mbps)
5. Select the rainfall rate value in mm/h. The linked ITU map can be used as a reference.
6. The table of typical rain rate values that can be used as a reference.
7. The “Calculate” button for showing the result.

Second Step – Getting Results

After the link information is entered, hardware and configuration choices are made. In order to view the calculation result, click the button “Calculate”.



The following link performance parameters will be returned:

1. **Atmospheric attenuation** value: overall (in dB) and per kilometer (in dB/km). This parameter depends only on the calculation frequency.
2. **EIRP** (Effective Isotropic Radiated Power) value for each site (in dBm) calculated as the maximum TX power at the given modulation/channel plus the antenna gain.
3. **Received signal level** value (in dBm).
4. **Fade margin** value (in dB).
5. The **rain annual availability** value (in %).
6. The **multipath 2-way annual availability** value (in %).
7. The **total 2-way annual availability** value (in %).
8. "**Resume**" button for resetting all previously entered parameters.

The following errors can appear after the calculation is completed:

- Error: Negative fade margin! – notifies a user that the fade margin is below zero, which means that the received signal level is below the receiver's sensitivity threshold, and thus the availability value cannot be estimated.
- Error: Failed to estimate rain fading probability! – notifies a user that some calculation parameters are outside of the ITU method limits, and thus the rain availability value cannot be estimated.