

RECOMMENDATION ITU-R F.1501

**COORDINATION DISTANCE FOR SYSTEMS IN THE FIXED SERVICE (FS)
INVOLVING HIGH-ALTITUDE PLATFORM STATIONS (HAPSs) SHARING
THE FREQUENCY BANDS 47.2-47.5 GHz AND 47.9-48.2 GHz WITH
OTHER SYSTEMS IN THE FIXED SERVICE**

(Question ITU-R 212/9)

(2000)

The ITU Radiocommunication Assembly,

considering

- a) that WRC-97 designated the bands 47.2-47.5 GHz and 47.9-48.2 GHz for use by HAPSs in the FS;
- b) that, subject to the provisions of Resolution 122 (Rev.WRC-2000), these bands are also allocated for use by the fixed, fixed-satellite and mobile services;
- c) that frequency sharing for fixed-service systems using HAPSs and other systems in the FS is being considered in ITU-R;
- d) that there may be a requirement to establish criteria for determining coordination distances within which detailed sharing arrangements would need to be considered, or that there may be a requirement to specify predetermined coordination distances,

recommends

- 1 that Annex 1 should be used for the determination of coordination distance or as a basis for establishing a predetermined coordination distance between stations operating in a high-altitude platform network (HAPN) and other stations in the FS.

ANNEX 1

Coordination distance for systems involving the use of HAPSs

1 Geometrical coordination distance

For an initial assessment, it may be appropriate to use a coordination distance based on the above-the-horizon visibility (including atmospheric refraction) between a HAPS and other stations in the conventional FS or in HAPN.

The following predetermined coordination distance (measured from the sub-HAPS point) should be adopted between a HAPS and ground terminals of other systems in the conventional FS or in different HAPNs:

$$150 + (141.6 - 0.274 h) \sqrt{h} \quad \text{km} \quad (1)$$

where h is the HAPS altitude (km) above sea level in the 20-50 km range.

The following predetermined coordination distance (measured from the sub-HAPS point) should be adopted between HAPSs in different systems:

$$(141.6 - 0.274 h_1) \sqrt{h_1} + (141.6 - 0.274 h_2) \sqrt{h_2} \quad \text{km} \quad (2)$$

where h_1 and h_2 are the HAPS altitude (km) above sea level of two systems, both in the 20-50 km range.

2 Coordination distance using typical system parameters and representative propagation conditions for the bands of 47.2-47.5 GHz and 47.9-48.2 GHz

2.1 Minimum propagation attenuation due to atmospheric gases

2.1.1 Attenuation between a HAPS and ground terminals

In the path between a HAPS and ground terminals of other systems in the conventional FS or in different HAPN, atmospheric gases including water vapour cause attenuation, which depends on the distribution along the path of meteorological parameters such as temperature, pressure and humidity, and thus varies with the geographic location of the site, the month of the year, the height of a ground terminal above sea level, the elevation angle of the slant path and the operating frequency.

According to Recommendation ITU-R SF.1395, the following numerical formulae can be used for estimating minimum slant path attenuation in the 47 GHz band where:

$A_L(h, \theta)$, $A_M(h, \theta)$ and $A_H(h, \theta)$: total atmospheric absorption loss (dB) for the low-latitude (within 22.5° of the Equator), mid-latitude (greater than 22.5°, but less than 45° from the Equator) and high-latitude (45° or more from the Equator) areas, respectively;

h and θ : ground terminal antenna altitude above sea level (km) and elevation angle (degrees), respectively.

The approximation was carried out for $0 \leq h \leq 3$ km and $0 \leq \theta \leq 90^\circ$. The actual elevation angle may be determined from the elevation angle developed under free space propagation conditions using the method in Recommendation ITU-R F.1333. For actual elevation angles below 0° , the attenuation for 0° should be used.

Frequency band 47.2-47.5 GHz

In this frequency band, the attenuation is larger at higher frequencies and, therefore, the following formulae give the attenuation at 47.2 GHz.

$$A_L(h, \theta) = 52.43/[1 + 0.7364\theta + 0.03601\theta^2 - 0.001099\theta^3 + 0.8024 \times 10^{-5}\theta^4 + h(0.2624 + 0.2479\theta) + h^2(0.08130 + 0.02637\theta)] \quad (3a)$$

$$A_M(h, \theta) = 47.00/[1 + 0.7004\theta + 0.03568\theta^2 - 0.001081\theta^3 + 0.7878 \times 10^{-5}\theta^4 + h(0.2527 + 0.1970\theta) + h^2(0.05539 + 0.03239\theta)] \quad (3b)$$

$$A_H(h, \theta) = 46.70/[1 + 0.6872\theta + 0.03637\theta^2 - 0.001105\theta^3 + 0.8087 \times 10^{-5}\theta^4 + h(0.2472 + 0.1819\theta) + h^2(0.04858 + 0.03221\theta)] \quad (3c)$$

Frequency band 47.9-48.2 GHz

In this frequency band, the attenuation is larger at higher frequencies and, therefore, the following formulae give the attenuation at 47.9 GHz.

$$A_L(h, \theta) = 57.90/[1 + 0.7262\theta + 0.03534\theta^2 - 0.001074\theta^3 + 0.7826 \times 10^{-5}\theta^4 + h(0.2576 + 0.2382\theta) + h^2(0.07645 + 0.02443\theta)] \quad (4a)$$

$$A_M(h, \theta) = 53.06/[1 + 0.6962\theta + 0.03555\theta^2 - 0.001076\theta^3 + 0.7840 \times 10^{-5}\theta^4 + h(0.2495 + 0.1940\theta) + h^2(0.05420 + 0.03176\theta)] \quad (4b)$$

$$A_H(h, \theta) = 53.21/[1 + 0.6864\theta + 0.03632\theta^2 - 0.001103\theta^3 + 0.8073 \times 10^{-5}\theta^4 + h(0.2476 + 0.1812\theta) + h^2(0.04791 + 0.03191\theta)] \quad (4c)$$