**Recommendation T/R 01-03 (Brussels 1980)**

# MONITORING OF SATELLITE TRANSMISSIONS

Recommendation proposed by the "Radiocommunications" Working Group T/WG 3 (R)

*Text of the Recommendation adopted by the "Telecommunications" Commission:*

"The European Conference of Postal and Telecommunications Administrations,

*considering*

(a) that from the point of view of emissions monitoring, there is a difference between operational monitoring of a particular satellite system and the more general monitoring of the use of the frequency spectrum and of cases of interference between different systems or services,

(b) that various interference paths may be seen depending on the configuration of the space or terrestrial communication systems in existence,

(c) that all cases in which at least one space or earth station causes interference or is affected by interference fall within the scope of a satellite transmission monitoring system,

(d) that the provision recommended in letter (a) of Recommendation T/R 01-02 (Interlaken 1968, revised in The Hague 1971) does not exclude the possibility of sharing the work/task of monitoring between the various Administrations so as to achieve more effective control,

(e) having noted moreover that information on this matter is available in the documentation of the CCIR,

*recommends*

1. that the main functions to be assigned to a satellite transmission monitoring system should be as follows:

   1.1. to detect and identify the causes of interference should stations in space radiocommunications be involved,

   1.2. to check the operating and technical characteristics of the emissions in cases mentioned in the above paragraph,

   1.3. to observe and record the conditions of occupancy of the frequency bands assigned, on whatever basis, to space radiocommunications services,

2. that a monitoring station required to participate in such a system should as far as possible be capable of taking the following measurements:

   2.1. measurement of frequencies,

   2.2. identification of the type of signal and measurement of the modulation characteristics,

   2.3. measurement of bandwidths and analysis of the spectral composition of the emissions,

   2.4. measurement of the power flux density,

   2.5. identification of polarisation,

   2.6. determination of the position of the source of the radiation measured,

3. that in the first instance, measurements should be taken in the frequency bands indicated in Annex I, since for economic reasons it will not initially be possible to conduct measurements throughout the entire frequency spectrum. For various reasons, Administrations will not be in a position to equip their measuring installations to cover all the frequency bands mentioned in Annex I. The CEPT Administrations should therefore harmonise their plans to equip their monitoring stations, and the activities of these stations, in such a way that it will be possible to make all the necessary measurements in all the frequency bands concerned,

4. that stations responsible for monitoring satellite transmissions should have access, in the most effective form, to all available information to date on spectrum occupancy in those bands allocated, on whatever basis, to space communications and in adjacent bands,

   To this end, stations monitoring terrestrial communications should make available to stations monitoring satellite communications, at their request, any information at their disposal in the above-mentioned fields. In addition, stations for which CEPT Administrations are responsible and which are operating in the context of such a system should exchange the information at their disposal concerning stations involved in space communications,

5. that measurements be carried out under the conditions specified in Annex II."

## Annex I

## FREQUENCY BANDS

(see No. 3. of Recommendation)

| | | | |
|---|---|---|---|
| 136 | to | 138 | MHz |
| 149 9 | to | 151 | MHz |
| 399.9 | to | 402 | MHz |
| 460 | to | 470 | MHz |
| 1,500 | to | 1,800 | MHz |
| 2,000 | to | 2,700 | MHz |
| 3,400 | to | 4,200 | MHz |
| 10.95 | to | 12.75 | GHz |

To have receivers with the necessary sensitivity, the wider of the above mentioned bands will probably have to be sub-divided.

# Left blank

## Annex II

## CONDITIONS TO BE COMPLIED WITH FOR MEASUREMENT

(see No. 5 of Recommendation)

1. Measurement of frequencies

   Equipment intended for measuring the transmission frequencies of space stations and earth stations must have an accuracy of at least $10^{-8}$ The accuracy which can be achieved in practice depends largely on the existence of a characteristic frequency in the spectrum of an emission. As regards the measurement of the frequencies of satellites in near-Earth orbit, emissions from which are consequently liable to be affected at the point of reception, by the Doppler effect, determination of the effective transmission frequency can only be achieved by recording and evaluating the Doppler curve.

2. Identification of the class of emission and measurement of the modulation characteristics

   Each Administration will decide the extent of the equipment which it will install in its satellite transmission monitoring station for the purpose of identifying the class of emission and measuring the modulation characteristics. Given the diversity of these characteristics, particularly in the case of highly complex transmission systems, no values for measurement accuracy are specified.

3. Measurement of bandwidths and analysis of the spectral composition of emissions

   The bandwidth of space station emissions is measured by application of the relevant CCIR Recommendations. If the Doppler effect is present, the possible influences of this effect must be included in the value of the indicated bandwidth. It is advisable to indicate separately the portion of bandwidth which is a function of this Doppler effect.

4. Measurement of the power flux density

   It must be possible to determine the power flux density with an accuracy of at least $\pm$ 3 dB, although an accuracy of $\pm$ 2 dB is desirable [would be preferable].

5. Identification of polarisation:

   (a) Geostationary space stations and earth stations
   For the identification of polarisation, the receiving antenna of the satellite transmission monitoring station should make it possible to select the following types of polarisation: left handed, right handed and linear. In the case of linear polarisation, the plane of the oscillation vector should be adjustable.

   (b) Satellite in near-Earth orbit
   In this case, the constraints described under (a) are regarded as a minimum. Moreover, it is desirable to have an installation making it possible to measure and indicate the polarisation characteristics on a continuous basis.

6. Determination of the position of the source of the radiation measured

   Determination of the position of geostationary space stations and space stations in near-Earth orbit can only be achieved by recording the tracking angles relative to the antenna axes (azimuth, elevation) as a function of time. Determining position on the basis of these angles is a mathematical problem.

The following table shows, for certain frequencies, the minimum accuracy of measurement of tracking angle to be achieved for each of the two antenna axes

| Frequency (GHz) | 1.5 | 2.5 | 4 | 12 |
|---|---|---|---|---|
| $\vartheta$ | 1.4 | 0.84° | 0.52° | 0.17° |
| Accuracy of measurement of tracking angles | ±0.14 | ±0.08° | ±0.05° | ±0.02° |

The values indicated in the above table are calculated on the basis of the following relationship:
Accuracy of measurement of tracking angles: $0.1 \times \vartheta$
in which $\vartheta$ is the angular opening (at medium power) of an antenna with a 10m parabolic reflector with an efficiency of 50%.
Considering that although the values for accuracy of measurement specified above do in fact make it possible to monitor the station-keeping accuracy of $\pm$ 1° required by the Radio Regulations, a reduction of this tolerance to $\pm$ 0.1° is planned, Administrations should endeavour if at all possible to improve the tracking angle measurement results.