

RECOMMENDATION ITU-R M.828-1*

**DEFINITION OF AVAILABILITY FOR COMMUNICATION
CIRCUITS IN THE MOBILE-SATELLITE SERVICE (MSS)**

(Question ITU-R 85/8)

(1992-1994)

The ITU Radiocommunication Assembly,

considering

- a) that the availability of communication circuits in the mobile-satellite service (MSS) needs to be defined as a guide to designers and planners and in order to provide a basis for interference criteria;
- b) that the approach used to define availability in the fixed-satellite service is not applicable to communication circuits in the mobile-satellite services because, *inter alia*, the MSS circuits are generally established on a demand assignment basis;
- c) that the service link availability depends *inter alia* on the mobile earth station (MES) location, at the time a communications circuit is sought and for the duration of the communication;
- d) that sometimes different system components are utilized for system access and for communications;
- e) that the equipment availability (including the space station) is dependent on reliability, performance and maintainability;
- f) that the availability of communication circuits is determined by the combined effects of equipment and propagation availability,

recommends

1. that the overall availability of communications circuits should be defined in terms of access availability and communications availability by using as a basis the availability of the components (see Note 1) comprising the access channel and the communication circuits as follows:
 - space station;
 - feeder-link radio path and service-link radio path under line-of-sight conditions (see Note 2) and,
 - earth stations (land earth stations (LES), mobile earth stations (MES) and other related earth stations should be included);
2. that the availability of communication circuits in the mobile-satellite services should be defined by the following formula:

$$\text{Availability} = (100 - \text{Unavailability})(\%)$$

where unavailability represents the cumulative percentages of time of circuit interruption caused by all the components. In the mobile-satellite systems, unavailability is approximately represented by the following formula (see Note 3):

$$\begin{aligned} \text{Unavailability} = & \text{Unavailability (space station)} + \\ & \text{Unavailability (radio path)} + \\ & \text{Unavailability (earth station) (see Note 4)} \end{aligned}$$

where unavailability of each component is calculated by the formula:

$$\text{Unavailability (component)}(\%) = (100 - \text{Availability (component)})(\%).$$

* This Recommendation should be brought to the attention of the Telecommunication Standardization Sector.

Availability (component) represents the availability of each component and is calculated by the following formula:

$$A \text{ (component)} = \frac{(\text{scheduled operating time}) - (\text{duration of circuit interruption})}{(\text{scheduled operating time})} \times 100\%$$

where the scheduled operating time of the components is defined as the period of time during which the user requires a circuit to be in a condition to perform a required function at a specified level of performance; and the duration of circuit interruption is defined as the period of time during which a communication circuit experiences one of the following conditions for more than 10 consecutive seconds. (A period of circuit interruption begins when one of the following conditions persists for a period of 10 consecutive seconds. Circuit unavailability begins at the beginning of this corrupted 10 s interval. The period of circuit interruption time terminates when the same condition ceases for a period of 10 consecutive seconds. Circuit availability resumes at the beginning of this non-interrupted 10 s interval):

- the communication circuit cannot be established;
- the wanted signal entering one end of the channel is not received at the other end;
- for an analogue-type circuit, the unweighted subjectively equivalent noise power in the hypothetical telephone reference circuit (HTRC) (Recommendation ITU-R M.547) exceeds a defined limit;
- for a digital-type circuit, an information bit error ratio (BER) in the appropriate hypothetical reference digital path (HRDP) (Recommendation ITU-R M.827) worse than a defined limit occurs;

3. that the following Notes should be regarded as part of this Recommendation.

Note 1 – Component refers to either a single component or an ensemble of components in a redundancy configuration.

Note 2 – Line-of-sight conditions should include ionospheric, tropospheric events and multipath fading. Persistent, heavy shadowing should, in general, be excluded from the requirement but it should be considered in designing the system. In the case of the land mobile-satellite service (LMSS), light shadowing due to trees and foliage etc. should be included in the calculation of the availability.

Note 3 – The availabilities for the space station, earth stations and radio path are assumed to be statistically independent.

Note 4 – MES, LES and other related earth stations should be included.

Note 5 – This Recommendation does not apply to the aeronautical mobile-satellite (R) service (AMS(R)S). AMS(R)S circuit availability is an area for further study.
