

RECOMMENDATION ITU-R S.579-6

Availability objectives for hypothetical reference circuits and hypothetical reference digital paths when used for telephony using pulse code modulation, or as part of an integrated services digital network hypothetical reference connection, in the fixed-satellite service operating below 15 GHz

(Question ITU-R 73/4)

(1982-1986-1992-1994-1997-2001-2005)

Scope

This Recommendation deals with Availability objectives for hypothetical reference circuits and hypothetical reference digital paths when used for telephony using pulse code modulation, or as part of an integrated services digital network hypothetical reference connection, in the fixed-satellite service operating below 15 GHz. It is based on the availability objectives specified in some ITU-T Recommendations.

The Recommendation has been updated in order to appropriately reflect the new changes in associated ITU-T Recommendations. A new section in the Annex is introduced to give guidance on the way to apply Recommendation ITU-R P.1623 to compute the statistics of fade attenuation due to propagation.

The ITU Radiocommunication Assembly,

considering

- a) that the hypothetical reference circuit (HRC), as defined in Recommendation ITU-R S.352, and the hypothetical reference digital path (HRDP), as defined in Recommendation ITU-R S.521, in the FSS are intended as a guide to designers and planners;
- b) that the equipment availability (including the space station) is dependent on reliability performance, maintainability performance and maintenance support performance;
- c) that the availability of an HRC or an HRDP is determined by the equipment availability and the effects of propagation on the link;
- d) that the unavailability due to propagation has two components, the exceedance of an attenuation threshold and the frequency of such exceedances;
- e) that it is desirable to apply similar availability objectives to cable, radio-relay and fixed-satellite systems;
- f) that ISDN traffic can be carried at rates below, at and above the primary rate (1.544 Mbit/s or 2.048 Mbit/s),

recommends

1 that the availability of an HRC or HRDP in the FSS should be defined by the following formula:

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

where:

$$\text{Unavailability} = \frac{\text{unavailable time}}{\text{required time}} \times 100 \quad \%$$

(1)

where the required time is defined as the period of time during which the user requires the circuit or digital path to be in a condition to perform a required function, and unavailable time is the cumulative time of circuit or digital path interruptions within the required time;

2 that the unavailability of an HRC or HRDP in the FSS due to equipment should be not more than 0.2% of a year;

3 that the unavailability due to propagation should be not more than:

3.1 0.2% of any month for one direction of an HRDP in the FSS (see Note 6);

3.2 0.1% of any year (referring to the term of “any year”, see Note 11 of Recommendation ITU-R S.353) for one direction of an HRC in the FSS;

4 that a link in the FSS defined between the ends of the HRC or HRDP in Recommendations ITU-R S.352 and ITU-R S.521 should be considered unavailable if one or more of the conditions in *recommends* 4.1 to 4.5 below exist at either of the receiving ends of the link for 10 consecutive seconds or more (see Note 5). (A period of unavailable time begins when one of the conditions in *recommends* 4.1 to 4.5 persists for a period of 10 consecutive seconds. These 10 seconds are considered to be unavailable time. The period of unavailable time terminates when the same condition ceases for a period of 10 consecutive seconds. These 10 seconds are considered to be available time.):

4.1 for analogue transmission the wanted signal is received at the far end at a level 10 dB or more below its expected level;

4.2 for analogue transmission, the unweighted noise power in a telephone channel at a point of zero relative level, with 5 ms integration time is higher than 10^6 pW0;

4.3 for digital transmission the digital signal is interrupted (i.e. alignment or timing is lost);

4.4 for digital transmission below the primary rate (1.544 Mbit/s or 2.048 Mbit/s), the bit error ratio (BER), averaged over 1 s, exceeds 10^{-3} ;

4.5 for digital transmission at or above the primary rate (1.544 Mbit/s or 2.048 Mbit/s), each second is considered to be a severely errored second (SES) event. An SES is defined as a second which contains $\geq 30\%$ errored blocks or at least one severely disturbed period (SDP) (see ITU-T Recommendation G.826);

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

NOTE 1 – The unavailability of analogue multiplexing equipment is not taken into account. The unavailability of digital multiplexing equipment in the earth station is included in *recommends* 2.

NOTE 2 – This Recommendation only applies to digital traffic (below, at and above the primary rate) transported within the plesiochronous digital hierarchy (PDH) or the synchronous digital hierarchies (SDH) and combinations thereof (see ITU-T Recommendation G.823).

NOTE 3 – Periods of degraded performance lasting less than 10 consecutive seconds, during which conditions in *recommends* 4.1 to 4.5 exist, are considered available time and are taken into account in the application of error performance Recommendations.

NOTE 4 – All outages due to solar eclipses and interference from the Sun are included as part of the unavailable time in *recommends* 2 when they occur during the required time. The impact of solar interference during the required time can be minimized by operational measures since these events can be accurately predicted. See Annex 1 and Recommendation ITU-R S.1525.

NOTE 5 – Availability calculations should explicitly take into account mean time between failures, mean time for resumption of service and precautions taken to mitigate interruptions and impairments of satellite performance including the use of reserve channels and back-up systems.

NOTE 6 – A percentage of unavailability for any month is assumed to correspond to a period of any year by a conversion factor of 5, i.e. 0.2% of any month would correspond to 0.04% of any year (referring to the term of “any year”, see Note 11 of Recommendation ITU-R S.353). This conversion factor is discussed in Annex 1 to Recommendation ITU-R S.614.

Annex 1

1 Definition of availability

In the context of an end-to-end connection, availability comprises a number of component parts, and these are discussed in ITU-T Recommendation G.106. As applied to the satellite HRC and HRDP, availability is concerned only with equipment availability and effects of propagation.

2 General considerations

A variety of factors may have an impact on availability:

- mean time between interruptions;
- total interruption over a long period (e.g. a year);
- total interruption time over a worst period (e.g. any month);
- mean duration of interruption;
- the rate of occurrence (e.g. measured on an hourly basis);
- the statistical distribution of interruptions (e.g. attenuation, duration, frequency of occurrence).

3 Unavailability due to equipment

A number of different causes of interruption are included under this heading. They are:

- satellite-related effects, including partial or complete failure of any of the systems on board, plus eclipse outages;
- earth-station related effects, including failure of any equipment as far as the terrestrial network interface, outages caused by human error, Sun transits and the effects of natural disasters.

4 Unavailability due to propagation

Studies of the impact of propagation on availability require the separation of short breaks of less than 10 consecutive seconds which are covered by performance recommendations, and those of 10 consecutive seconds or more which contribute to unavailability. In this respect an “availability factor” has been used which can be defined as:

$$\text{Availability factor} = \frac{\text{total time for which outages of } < 10 \text{ s duration occur}}{\text{total time for which all outages occur}} \times 100\%$$

The meaning of “outages” depends on whether an analogue or digital circuit is considered, and a precise definition in each case is given in *recommends* 4.