

RECOMMENDATION ITU-R S.1424

**AVAILABILITY OBJECTIVES FOR A HYPOTHETICAL REFERENCE DIGITAL PATH
WHEN USED FOR THE TRANSMISSION OF B-ISDN ASYNCHRONOUS TRANSFER
MODE IN THE FSS BY GEOSTATIONARY ORBIT SATELLITE SYSTEMS
USING FREQUENCIES BELOW 15 GHz**

(Questions ITU-R 73/4 and ITU-R 78/4)

(2000)

The ITU Radiocommunication Assembly,

considering

- a) that satellites operating in the FSS play an important role in providing reliable international digital communications;
- b) that the hypothetical reference digital path (HRDP) in the FSS is intended as a guide to designers and users;
- c) that the broadband integrated services digital network (B-ISDN) asynchronous transfer mode (ATM) semi-permanent connection availability has been specified in ITU-T Recommendation I.357;
- d) that it is desirable to be compliant with the concepts, terms and definitions related to availability as given in ITU-T Recommendation I.357;
- e) that in defining availability criterion, it is necessary to take into account all the specific characteristics of the transmission medium;
- f) that the availability for a HRDP used for the transmission of B-ISDN ATM over satellite is determined by the aggregate effects of network congestion, transmission errors, equipment failures and propagation characteristics,

recommends

- 1** that a satellite HRDP carrying B-ISDN ATM semi-permanent connection traffic meet the availability objectives set forth in ITU-T Recommendation I.357;
- 2** that the HRDPs defined in Recommendation ITU-R S.521 and the reference model defined in Recommendation ITU-R S.1420 be considered as a basis for developing methods and techniques for meeting the availability objectives of ITU-T Recommendation I.357;
- 3** that a satellite HRDP carrying B-ISDN ATM connection traffic must meet the performance objectives given in ITU-T Recommendation I.356 during the available time (see Annex 1);
- 4** that the yearly availability of a satellite HRDP (one direction) in the FSS should be greater than 99.85% (see Notes 1 to 3);
- 5** that the following Notes be regarded as part of this Recommendation.

NOTE 1 – The satellite HRDP availability objective encompasses the availability due to propagation and the earth station and spacecraft equipment availability. Based on previous studies for 14/11 GHz and 30/20 GHz band transmission paths, the yearly availability due to disturbed propagation is 99.96% to earth stations with a $G/T \geq 31.7$ dB(K⁻¹) and the availability of manned 14/11 GHz band earth stations with a $G/T \geq 31.7$ dB(K⁻¹) is 99.95%. Current information provided to the ITU-R shows that the spacecraft availability is better than 99.99%. Based on these considerations, the yearly availability for a satellite HRDP within *recommends* 4 applies to links between manned earth stations with $G/T \geq 31.7$ dB(K⁻¹). The yearly availability for a satellite HRDP within *recommends* 4 does not apply to unmanned earth stations nor to earth stations with $G/T < 31.7$ dB(K⁻¹). The yearly availability for links that originate or terminate at an unmanned earth station or at an earth station with $G/T < 31.7$ dB(K⁻¹) is for further study.

NOTE 2 – The equipment availability figures may be revised in the future once information from earth station operators and satellite system operators becomes available to the ITU.

NOTE 3 – The additional impact on system availability due to satellite-specific ATM equipment used at earth stations and of spacecraft that employ on-board processing and switching is for further study.

NOTE 4 – The availability requirements for HRDP that carry non-ATM traffic within a hypothetical reference connection (HRX) in the FSS are given in Recommendation ITU-R S.579-4.

NOTE 5 – The availability objectives for B-ISDN ATM switched connections is for further study. However, until the specific availability requirements of these type of connections are adopted by the ITU-T, the objectives given in this Recommendation may be used (see ITU-T draft Recommendation I.35av).

ANNEX 1

(Normative)

1 General considerations on B-ISDN ATM satellite connection availability

The current version of ITU-T Recommendation I.356 (B-ISDN ATM layer cell transfer performance) provides in Table 2/I.356 the QoS class definitions and the end-to-end network performance objectives. These objectives are given, for each performance parameter, as upper bounds that need to be met on a virtual channel (VC) or virtual path (VP) for the duration of the connection. ITU-T Recommendation I.356 makes no reference to the B-ISDN ATM availability requirements as this is the subject of ITU-T Recommendation I.357 (B-ISDN semi-permanent connection availability) and ITU-T draft Recommendation I.35av (B-ISDN switched virtual channel connection availability).

The objectives given in Table 2/I.356 had been based on some preliminary test results of QoS measurements of B-ISDN ATM services and applications. Generally, the results that were presented focused on the upper bound limits for service acceptability; that is, they should have specified the maximum cell loss ratio (CLR) and cell error ratio (CER) at which the applications are still acceptable but not degraded. This aspect is important since packet-based systems are generally very robust but tend to degrade rapidly in quality from being acceptable to unacceptable with a small region of marginal acceptability. The numbers provisionally adopted in Table 2/I.356 may be revised in the near future based on real operational experience and on more QoS test results of services and applications. However, to begin the interpretation of these numbers and their relationship with satellite link performance we must accept the premise that the QoS limits must be provided to the end-user for the duration of the connection. This means that these thresholds should not be exceeded during the available time. The availability threshold in satellite links is somewhat arbitrary since it is a point of reference (in terms of percentage of time) at which all network objectives are met.

There are at least two approaches to adopt a satellite link availability objective. The first approach is to develop a rigorous mathematical model to find the optimum curve (BER vs. per cent of time distribution) at which all performance and availability requirements are met. This model must account for the burst error characteristics of satellite modems and the link propagation characteristics; in addition, it must relate these characteristics to the network performance and availability definitions and objectives. The second approach is an empirical one, whereby measurements of performance and availability parameters of an actual satellite link demonstrate that all objectives are met. Although in practice it is common to use some combination of the two approaches, this Recommendation follows the second approach (see Note 1). The availability due to propagation is discussed in § 7.1 and in § 2 of Annex 2.

NOTE 1 – This approach may be amended in the future once Telecommunication Standardization SG 13 adopts objectives for ITU-T Recommendation I.357 and if subsequent mathematical models and propagation measurements demonstrate the need to change this Recommendation.