RECOMMENDATION ITU-R F.696-2*

ERROR PERFORMANCE AND AVAILABILITY OBJECTIVES FOR HYPOTHETICAL REFERENCE DIGITAL SECTIONS FORMING PART OR ALL OF THE MEDIUM-GRADE PORTION OF AN INTEGRATED SERVICES DIGITAL NETWORK CONNECTION AT A BIT RATE BELOW THE PRIMARY RATE UTILIZING DIGITAL RADIO-RELAY SYSTEMS

(1990-1991-1997)

Scope

This Recommendation provides the error performance and availability objectives for hypothetical reference digital sections forming part or all of the medium-grade portion of an integrated services digital network connection at a bit rate below the primary rate utilizing digital radio-relay systems.

It should be noted that this Recommendation could be used only for systems designed prior to the approval of Recommendations ITU-R F.1668 in 2004 and F.1703 in 2005 for the error performance and availability objective respectively.

The ITU Radiocommunication Assembly,

considering

a) that the error performance and availability objectives for digital radio-relay systems used in the medium grade portion of the network, as specified in Fig. 1 of ITU-T Recommendation G.821, should be defined;

b) that the error performance for an international digital connection at a bit rate below the primary rate forming part of an integrated services digital network (ISDN) have been specified in ITU-T Recommendation G.821 and that this Recommendation includes the performance objectives for the medium grade portion of the network;

c) that the Recommendation ITU-R F.1189, based on ITU-T Recommendation G.826, gives error performance objectives for constant bit rate digital paths at or above the primary rate carried by digital radio-relay systems which may form part or all of the national portion of a 27 500 km hypothetical reference path (HRP);

d) that the error performance and availability objectives for digital radio-relay systems providing hypothetical reference digital sections (HRDSs) forming part of the medium grade portion of an ISDN connection at a bit rate below the primary rate should be defined;

e) that the HRDS lengths are identified in ITU-T Recommendation G.801 (see Annex 1);

f) that network performance objectives for digital sections are given in ITU-T Recommendation G.921 (see Note 1);

g) that propagation, interference, equipment failure, and other effects suggest that the performance and availability objectives should be stated statistically as a percentage of time;

h) that digital radio-relay systems in the medium grade network may operate either below or above a frequency of about 10 GHz, and therefore several types of anomalous propagation phenomena may affect the error performance and the availability of systems (see Note 2);

j) that a bit-error ratio measurement requires a certain duration of time which depends upon the magnitude of the bit-error ratio;

k) that the occurrence of periods of unavailability due to anomalous propagation conditions, interference, equipment failure, and other effects are sufficiently variable so that it is necessary to define the objectives averaged over a long period,

recommends

1 that error performance should be assessed in terms of the events errored seconds (ES) and severely errored seconds (SES) and the parameters errored second ratio (ESR) and severely errored second ratio (SESR) as defined in ITU-T Recommendation G.821 (see also Recommendation ITU-R F.594);

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* Radiocommunication Study Group 5 made editorial amendments to this Recommendation in 2012 in accordance with Resolution ITU-R 1.

2 that the error performance objectives given in Table 1 apply to each direction and to each $N \times 64$ kbit/s channel ($1 \leq N < 24$ (or < 32, respectively)) (see Note 10) of an HRDS of quality classifications 1 to 4 utilizing digital radio-relay systems and forming part of the medium grade portion of an ISDN connection. These objectives take account of fading, short-term and long-term interference (see Note 3) and all other sources of performance degradation (see Note 4) during periods for which the system is considered to be available (see Notes 2 and 5);

TABLE 1

Error performance objectives

Performance parameter	Fraction of time in any month (see Note 6)			
	Class 1 280 km	Class 2 280 km	Class 3 50 km	Class 4 50 km
SESR	0.00006	0.000075	0.00002 (see Note 7)	0.00005 (see Note 7)
ESR (see Note 9)	0.00036	0.0016	0.0016	0.004

3 that the following performance objectives apply to each direction and to each $N \times 64$ kbit/s channel ($1 \leq N < 24$ (or < 32, respectively)) (see Note 10) for the total medium grade portion at each end of an hypothetical reference connection (HRX) when this is realized entirely with digital radio-relay systems. These objectives take account of fading, short-term and long-term interference (see Note 3), and all other sources of performance degradation (see Note 4) during periods for which the system is considered to be available (see Notes 2 and 5);

3.1 that the SESR should not exceed 0.0004 in any month comprising a basic objective of 0.00015 and an additional objective of 0.00025 for adverse propagation with an integration time of 1 s (Notes 6 and 7);

3.2 that the ESR should not exceed 0.012 in any month (see Notes 6 and 9);

4 that the total bidirectional unavailability (see Note 2 and Annex 1) due to all causes for the HRDS classes 1 to 4 utilizing digital radio-relay systems and forming part of the medium grade portion of an ISDN connection shall not exceed the following values, the percentage being considered over a period of time sufficiently long to be statistically valid, this period is probably greater than one year; the period of time is under study:

– Class 1: 0.033%;

– Class 2: 0.05%;

– Class 3: 0.05%;

– Class 4: 0.1%.

5 that Annex 1 should be used for guidance on overall availability objectives for digital radio-relay systems in the medium grade portion of an ISDN connection.

NOTE 1 – If a real digital section is shorter, there will be no reduction of error performance allocation. If a real digital section is longer, the two different methods of performance allocation should be applied according to the section quality. In the case of systems in classes 2, 3, or 4, their overall allocation should correspond to that of an integer number of HRDS (of the same quality classification) the combined length of which is at least as long as the real section length. In the case of systems in class 1, performance objectives should be derived from a pro-rata approach in accordance with Recommendation ITU-R F.634.

NOTE 2 – The concept of unavailability of a digital radio-relay system is defined in *recommends* 3 of Recommendation ITU-R F.557.

NOTE 3 – Short-term interference is the interference due to the existence of anomalous propagation conditions, and typically consists of very high levels of interference which only occur rarely, and exist for short periods of time. Long-term interference is the interference which arises from sources within line-of-sight of the victim receiver, and is typically low in level and constant in value.

NOTE 4 – In the design of the systems, the degradation of performance due to the sharing of the spectrum with satellite systems and other services, needs to be taken into account where appropriate, and is under study.

NOTE 5 – In considering specific values for the error performance objectives of the medium grade portion at each end of the HRX, administrations may wish to take account of Note 5 to Table 2 of ITU-T Recommendation G.821 (allocation of a block allowance of 30% for the local and medium grade portion at each end of the HRX).

NOTE 6 – The term “any month” as used in this Recommendation, is defined in Recommendation ITU-R P.581. Where measurements are used to ensure compliance with this Recommendation, then propagation conditions also need to be assessed and related to propagation data representative of “any month” conditions.

NOTE 7 – In the case of the SES an allowance for adverse propagation may be added to the given objectives for HRDS classes 3 and 4. Since the full length of the medium grade portion always belongs to a national network, the apportionment of the 0.025% allowance to the individual network parts based on the national reference network model should be a matter for the administration concerned. However, it has to be ensured that this overall objective for the medium grade portion is not exceeded.

NOTE 8 – The SESR and ESR objectives includes all performance degradations other than unavailability.

NOTE 9 – Prior to the approval of Recommendation ITU-R F.1189 (1995), real digital radio-relay links forming part of the medium grade portion within an ISDN were designed by applying the error performance objectives of the earlier version of this Recommendation, (i.e. Recommendation ITU-R F.696-1, published in 1994), directly at the system bit rate. As a consequence, translation rules were suggested to normalize error performance measurement results obtained at the system bit rate to the 64 kbit/s level (see Annex 2 of Recommendation ITU-R F.634).

NOTE 10 – N is less than 24 in the 1 544 Mbit/s based hierarchy and less than 32 in the 2 048 Mbit/s based hierarchy.

ANNEX 1

Overall availability objectives for digital radio-relay systems in the medium-grade portion of an ISDN connection

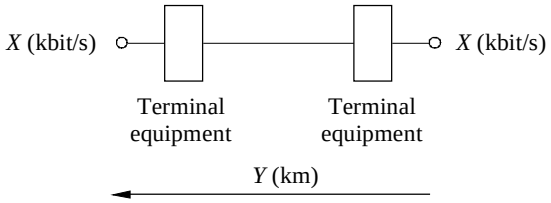
1 HRDSs

Considering that the average length of the medium-grade portion in many countries may be much less than 1 250 km and/or that its composition varies from country to country to a great extent, it may be difficult to define a single hypothetical reference digital path (HRDP) for medium-grade systems. However, it can be assumed that the whole medium-grade portion is composed of several HRDSs with different quality classifications. ITU-T Recommendation G.801 states that the introduction of such HRDS is necessary to accommodate the performance specification of transmission systems (for instance: digital line and radio equipment).

The HRDS lengths have been chosen to be representative of digital sections likely to be encountered in real operational networks, and are sufficiently long to permit a realistic performance specification for digital radio systems. The model is homogeneous in that it does not include other digital equipments such as multiplexers/demultiplexers.

FIGURE 1

Hypothetical reference digital section



Note 1 - The appropriate value for *Y* is dependent on the network application. For now the lengths of 50 km and 280 km have been identified as being necessary (see ITU-T Recommendation G.921).

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2 Availability objectives

The ITU-T has not specified availability objectives for the systems used in the medium-grade portion.

In the medium-grade portion, systems may operate in frequency bands above 10 GHz which are sensitive to rainfall. Therefore, availability objectives become highly important factors in the system design.

An unavailability objective for the class 1 HRDS may be directly derived from Recommendations ITU-R F.556 and ITU-R F.557, since this HRDS corresponds to the high-grade classification. Linear subdivision of the Recommendation ITU-R F.557 objective, down to a length of 280 km, gives an objective of 0.033% for the class 1 HRDS (280 km).

According to Recommendation ITU-R F.557, these objectives would refer to both directions of transmission and to an observation period of probably greater than one year.

For the medium-grade portion of the HRX an overall bidirectional unavailability objective between 0.2% and 0.5% is proposed, based on the theoretical calculations and the measurements carried out by administrations.