RECOMMENDATION ITU-R F.594-4*

ERROR PERFORMANCE OBJECTIVES OF THE HYPOTHETICAL REFERENCE DIGITAL PATH FOR RADIO-RELAY SYSTEMS PROVIDING CONNECTIONS AT A BIT RATE BELOW THE PRIMARY RATE AND FORMING PART OR ALL OF THE HIGH GRADE PORTION OF AN INTEGRATED SERVICES DIGITAL NETWORK

(Question ITU-R 134/9)

(1982-1986-1990-1991-1997)

Scope

This Recommendation provides the error performance objectives of the hypothetical reference digital path (HRDP) for radio-relay systems providing connections at a bit rate below the primary rate and forming part or all of the high grade portion of an integrated services digital network. This Recommendation also provides the guidance on the factors in determining performance requirements for digital radio-relay systems used in HRDP.

It should also be noted that this Recommendation could be used only for systems designed prior to the approval of Recommendation ITU-R F.1668 in 2004.

The ITU Radiocommunication Assembly,

considering

a) that the error performance objectives of digital radio-relay systems should be defined;

b) that the definition of the allowable error performance of the hypothetical reference digital path (HRDP) is necessary for the design and construction of radio-relay systems;

c) that propagation and other effects suggest that the error performance should be stated statistically as a fraction of time;

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

e) that the effect of error burst phenomena and jitter may need to be taken into account;

f) that during normal operation, periods of high bit error ratio will occur which will cause short interruptions (see Note 8);

g) that the error performance objectives for an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network (ISDN) have been specified by the ITU-T (see ITU-T Recommendation G.821);

h) that Recommendations ITU-R F.1092 and ITU-R F.1189, based on ITU-T Recommendation G.826, give error performance objectives for constant bit rate digital path at or above the primary rate carried by digital radio-relay systems which may form part of the international and national portions, respectively, of a 27 500 km hypothetical reference path;

j) that the HRDP defined in Recommendation ITU-R F.556 corresponds to the “high-grade performance” specified in ITU-T Recommendation G.821 and for which the ITU-T has established a rule of apportionment of the total impairment allowance,

recommends

1 that the following performance objectives are stated for each direction of the $N \times 64$ kbit/s ($1 \leq N < 24$ (or < 32 respectively)) HRDP specified in Recommendation ITU-R F.556 (see Note 1);

2 that fading, interference and all other sources of performance degradation are taken into account in establishing the values given below;

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

3 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 Recommendation ITU-T G.821 (see Note 2);

4 that the ESR should not exceed 0.0032 in any month;

5 that the SESR should not exceed 0.00054 in any month;

6 that Annex 1 should be used for guidance on factors which need to be taken into account in determining performance requirements for digital radio-relay systems applied to the HRDP.

NOTE 1 – *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.

NOTE 2 – Error performance events and parameters are defined in the ITU-T Recommendation G.821, as follows:

– ES: 1s period in which one or more bits are in error.

– SES: 1s period which has a bit error ratio $\geq 1 \times 10^{-3}$.

– ESR: ratio of ES to total seconds in available time during a fixed measurement interval.

– SESR: ratio of SES to total seconds in available time during a fixed measurement interval.

NOTE 3 – The output bit stream from a digital radio-relay system may suffer from jitter. The effect of jitter on the error performance of digital radio-relay systems requires further study. The general issues of jitter are addressed by the ITU-T.

NOTE 4 – This Recommendation relates to the HRDP. The values given are for use by the system designer, and it is not intended that they should be quoted in specifications of equipment or used for acceptance tests.

NOTE 5 – Contributions from multiplex equipment are not included on the basis that they are negligible in comparison with the contribution from transmission systems (see ITU-T Recommendation G.821).

NOTE 6 – The Recommendation applies only when the system is considered to be available in accordance with Recommendation ITU-R F.557 and includes SESs which persist for periods of less than 10 consecutive seconds. Periods of SESs which persist for 10 consecutive seconds duration or longer are taken into account by Recommendation ITU-R F.557.

NOTE 7 – The limits given in § 5 are based upon the 10 s unavailability criteria given in Recommendation ITU-R F.557, and therefore will not necessarily include all forms of degradations in performance due to adverse propagation. Degradations due to adverse propagation which persist for 10 s or longer will be limited by the requirements of Recommendation ITU-R F.557.

NOTE 8 – Adverse propagation conditions can result in a decrease and/or distortion of the wanted signal as well as an increase in the level of interfering signals.

NOTE 9 – The requirements are intended to meet the relevant performance objectives of ITU-T Recommendations G.821 and G.921 under all normally envisaged operating conditions.

ANNEX 1

Factors to be taken into account when determining performance requirements for digital radio-relay systems applied to the HRDP

This Annex considers factors which need to be taken into account in determining performance requirements for digital radio-relay systems applied to the HRDP.

1 SESR objective

In ITU-T Recommendation G.821 the ITU-T states that:

– for a 27 500 km hypothetical reference connection (HRX) the SESR should not exceed 0.002 in any month;

– the SESR of the 25 000 km high grade portion of the HRX should not exceed 0.0004 in any month. In addition, an allowance of 0.0005 is given to a 2 500 km HRDP for radio-relay systems to take account of adverse propagation conditions.

Therefore, for a 2 500 km HRDP, the SESR should not exceed 0.00054 (i.e., 0.0005 + 0.00004, where 0.00004 has been obtained by linearly scaling the 0.0004 objective allocated to the 25 000 km high grade portion of the HRX).

With advances in high speed data transmission services, some users may require higher transmission quality than specified above. In particular, users may become concerned with the frequency and duration of circuit interruptions. Although it is difficult to predict the frequency of such breaks from a knowledge of the design of radio-relay systems, it may be appropriate to reduce the SESR objective by considering whether the additional ITU-T Recommendation G.821 allowance for adverse propagation may be discarded. If this is the case, it will be necessary to include advanced technology in the design of radio-relay systems to achieve such high performance without compromising the economics of the system.