All drawings appearing in this Recommendation have been done in Autocad.

Recommendation E.850[1])

CONNECTION RETAINABILITY OBJECTIVE FOR THE INTERNATIONAL TELEPHONE SERVICE[2])

Introduction

This Recommendation is one of a set of Recommendations, comprising Recommendations E.810, E.830, E.845, E.850 and E.855 concerned with the accessibility, retainability and integrity of telephone services.

considering

(a) that "premature release" is defined in Recommendation E.800 as the event that an established connection will be released for a reason other than intentionally by any of the parties involved in the call;

(b) that premature release is a measure of connection retainability;

(c) that a prematurely released connection is considered high in annoyance as perceived by telephone users;

(d) that the probability of a premature release is a function of network component failure intensity and call holding time;

(e) that the objective should take account of the expectations and tolerances of users to the premature release impairment as well as the capabilities of current technology;

(f) that the objective might not be met at the present time but should be viewed as a long–term goal;

(g) that the objective should take into account the concerns of network planners and system designers, provide useful guidance to each, and it can be used by Administrations in a consistent way to measure connection retainability performance;

(h) that connection retainability is defined in Recommendation E.800,

recommends

---

1) Formerly G.181, in *Red Book*, Fascicle III.1.

2)

Some of the terms in this Recommendation, for example, the noun "measure", are used in the sense of their definition given in Recommendation E.800.

1 Definitions

A **prematurely released telephone connection** is known as a cutoff call when the connection is completely broken, or

1) when a single interruption occurs lasting for longer than ten seconds which causes the transmission quality of the connection to be unsuitable for voice communications;
2) when a succession of interruptions occur lasting less than ten seconds where the product of the average duration of each interruption and the frequency of occurrence (i.e., average number of interruptions/seconds) exceeds 0.005.

2 A measure to quantifyxe ""§ telephone connection retainability performance

The measure to be used shall be the complement of connection retainability, namely the probability of a prematurely released telephone connection when normalized to a call holding time of one minute (*Pr*). The estimator of the premature release probability is the premature release call ratio (*Pre*) which is defined as:

where *N* is the number of telephone calls successfully established in some period of time, *T* is the mean call holding time in minutes and *RN* is the number of telephone calls successfully completed out of such *N* calls (see Annex A and Annex B).

3 Overall objective forxe ""§ premature release probability

The provisional objective for the normalized premature release probability (*Pr*) shall be such that the performance is better than the values given below:

for typical international connections:

$$2 \times 10–4 £ Pr £ 4 \times 10–4,$$

for 90th percentile international connections:

$$4 \times 10–4 £ P`r £ 8 \times 10–4$$

for worst case international connections:

$$8 \times 10–4 £ P"r £ 1.6 \times 10–3.$$

Note 1 – It is intended to establish a single value for *Pr*, *P`r* or *P"r* in the future.

Note 2 – The typical 90th percentile and worst case connections mentioned above shall

be assumed to be those hypothetical reference connections (HRXs) given in Recommendation E.830.

Note 3 – See Annex B.

4 Allocation of the overall objective

It is desirable, for planning purposes, to allocate the overall objective for a typical connection to the national systems and the international chain of the HRX. The overall objective is given by:

$$Pr = Prn1 + Prn2 + Pri$$

where *Prn*1 and *Prn*2 are the premature release probabilities for originating and terminating national systems respectively and *Pri* is the premature release probability of the international chain. The allocation of the overall objective to national systems and international chain shall be as follows:

$$Prn1 = Prn2 = a\ Pri.$$

Note 1 – a is provisionally recommended as being equal to 2. Thus, for example, if:

$$Pr = 3 \times 10–4$$

then

$$Prn1 = Prn2 = 1.2 \times 10–4$$

and

$$Pri = 0.6 \times 10–4.$$

Note 2 – Further allocation of the overall objective to the circuits and exchanges used in a connection might also be desirable.

Note 3 – Objectives for the permissible probability of premature release of an established telephone connection in Integrated Digital Networks (IDNs) and mixed (analogue/digital) networks, due to transit digital or local and combined local/transit exchange malfunctions, are specified in the Recommendations Q.504 or Q.514.

ANNEX A
(to Recommendation E.850)

Relationship between thexe ""§ premature release probability and its estimator

The following relationship exists between the premature release probability normalized to a 1–minute holding time (*Pr*) and its estimator *Pre*:

, if such limit exists.

On the other hand, for the purpose of network design, the probability of a premature release with a mean call holding time of *T* minutes, $P(Z, T)$, can be expressed using the formula:

$$P(Z, T) =$$

where

and *Zi* is the average number of failures per minute of an *i* component in the hypothetical connection between two users as shown in Figure A–1/E.850. The connection holding time and the time between failures for the individual components are assumed to be exponentially distributed.

Figure A–1/E.850 - T0201430-88

In practice, Z « T–1 and therefore Pr can be approximated as follows:

$$Pr = P(Z, T)T=1 = \text{» .}$$

Also, the following relationship exists:

.

ANNEX B
(to Recommendation E.850)

A method to estimate thexe ""§ premature release probability for an international telephone connection

In this annex, a method is described which can be used to estimate the premature release probability for an international telephone connection.

The method is based on placing end–to–end test calls, whose mean holding time is T in minutes, and observing those which are prematurely released due either to transmission or switching failures, or transmission interruptions lasting longer than ten seconds.

From the results of Annex A, it follows that the simple estimator of Pr is:

.

If it can be reasonably assumed that the occurrence or non–occurrence of a premature release for each of the test calls constitutes independent events, then the binomial sampling theory can be used to derive confidence intervals for Pr, and to determine minimum sample sizes (N).

In particular, it would be required that N be chosen such that:

$$Pr \{ | (RN/N) – PrT | £ e\ PrT/100 \} ^3 a/100$$

where e is the estimation error in percent, and a is the confidence level in percent. Writing $P = Pr \times T$, it follows from the central limit theorem that, for large N,

$$/ \ ^3 Za \qquad \text{(B–1)}$$

where Za is the root of the equation:

.

Neglecting terms of order $P2$, the inequality (B–1) becomes:

$$N \geq (100\ Za/e)2/P \qquad \text{(B–2)}$$

In this last formula, P is generally not known. As an example, however, if we have to verify that P is in conformity with the overall objectives of typical connections (see § 3), such that P is in the order of $3 \times 10–4$, then a choice of a = 90% and e = 40% would lead to $N \geq 56\ 720$.

Similar calculations based on varying assumptions are reproduced in Figure B–1/E.850.

Based on these results, it is proposed that for an average holding time of T = 1 min, N = 60 000. For other values of T (in minutes), $N = 60\ 000/T$.

Figure B–1/E.850 - CCITT 89360

Bibliography

TORTORELLA (M.): The Bell System Technical Journal, *Cutoff calls and telephone equipment reliability*, Vol. 60, No. 8, pp. 1861–1890, October 1981.