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

Recommendation E.855

CONNECTION INTEGRITY OBJECTIVE FOR INTERNATIONAL TELEPHONE SERVICE

Introduction

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

The CCITT,

considering

(a) that users of the telephone service can perceive the speech loss due to transmission interruptions with durations shorter than 10 seconds;

Note — Transmission interruptions with durations longer than or equal to 10 seconds in a conversation phase are not tolerable by telephone users (Annex A). Such transmission interruptions are considered as a premature release of the connection as defined in Recommendation E.850.

(b) that speech loss causing transmission interruptions are caused by a change beyond given limits for a given period of time in one or more parameters, e.g. power level, noise level, signal—to—noise ratio, bit error ratio, etc.;

(c) that the objective should take into account the expectations of the users for quality of voice communications as well as the capabilities of current technologies;

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

(e) that the objective should be in conformity with other Recommendations;

(f) the definition of *interruption* as given in Recommendation E.800,

recommends

1 Definitions

1.1 connection integrity for telephone service

The degree to which an established telephone connection is offered without excessive transmission interruptions.

1.2 mean time between interruptions (MTBI)

The expectation of the time between interruptions. The time between interruptions is the time duration between the end of one interruption and the beginning of the next.

1.3 mean interruption duration (MID)

The expectation of interruption duration.

1.4 **transmission interruption**

Temporary inability of the user—to—user transmission path to be provided persisting for less than 10 seconds (maximum duration) and more than another given time duration (or minimum duration) characterized by a reduction below a certain threshold in received signal power level. The minimum duration of transmission interruption and the

minimum power threshold are for further study. Transmission interruptions caused by changes beyond certain thresholds of other parameters essential to connection integrity e.g. noise level, signal—to—distortion ratio, are for further study.

2 A measure to quantify telephone connection integrity performance

The measure to be used shall be the complement of connection integrity, namely the probability of speech loss, P_i, which is tolerable to telephone users due to transmission interruptions with durations shorter than 10 s. The estimator of the speech loss probability, P_{ie}, is the ratio of accumulated transmission interruption duration to the total observation period of time.

$$P_{ie} = \sum_{i=1}^{N} TD_i/T$$

where T is the observation time and TD_i is the time duration of the i th transmission interruption of N transmission interruptions measured during T (see Annex B).

Note — There are two major parameters: time between interruptions (or frequency) and duration to specify characteristics of transmission interruptions. Those parameters should be easy to observe from the practical point of view. Actually it seems very difficult to measure very short duration of transmission interruptions in analogue networks and to separate interruptions from burst errors in digital networks.

3 Overall objective for speech loss probability

The provisional objective for P_i shall be such that the performance is better than the value given below:

$P_i = x$ (to be defined with further study)

Note — A percentage of speech loss of less than 0.5% due to transmission interruptions with durations shorter than 10 s (Annex C) in a conversation phase is assumed to be tolerable to telephone users.

4 Allocation of the overall objective

From a practical point of view, instead of P_i, the value $\frac{P_i}{1 - P_i}$ should be allocated to various network components.

The method to allocate this value is for further study.

ANNEX A

(to Recommendation E.855)

TOLERABILITY OF TELEPHONE USER TO TRANSMISSION INTERRUPTIONS LASTING SEVERAL SECONDS OR MORE

A.1 *Measure*

The time interval between the start of transmission interruption occurring in the middle of a conversation and the abandoning of the disturbed call either by a calling or a called party is used as a measure to assess or evaluate the tolerability of telephone users.

A.2 *Measuring method*

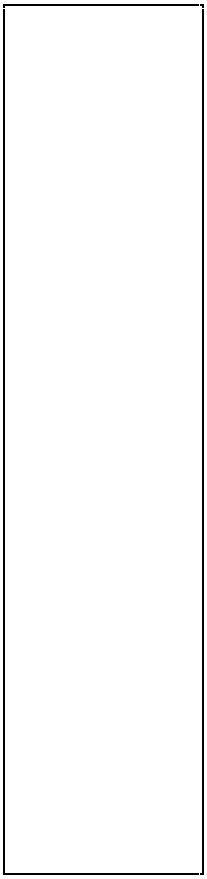
Fifty intra—office calls were selected at random and deliberately interrupted by callers soon after the calls had been established, and time intervals between the start of transmission interruption and the release of calls by the called party were measured.

A.3 *Results of tests*

The distribution of the durations of interruptions which forced the telephone users to give up their established calls is depicted in Figure A—1/E.855. The distribution curve is well approximated by an exponential distribution function with the mean value of 17.26 sec.

The figure shows that 50% of users released the established calls when the interruption lasted longer than 11.96 sec.

Figure A—1/E.855 - CCITT 58280



ANNEX B

(to Recommendation E.855)

RELATIONSHIP BETWEEN SPEECH LOSS PROBABILITY AND ITS ESTIMATION

The following relationship exists between the speech loss probability (P_i) and its estimator (P_{ie}):

$$\lim_{T \to \infty} P_{ie} = \lim_{T \to \infty} \sum_{k=1}^{K} \frac{TD_k}{T} = P_i$$

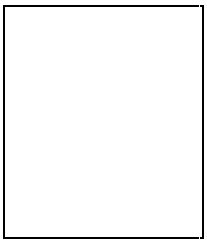
if such limit exists and where T is the observation period of time and TD_k is the duration of the k th transmission interruption of K transmission interruptions over T.

It should be noted that there is also the following relationship:

$$P_i = \frac{\rho}{1+\rho}, \rho = L\, i{=}1\, \frac{MID_i}{MTBI_i}$$

where, MID_i is the mean time duration of transmission interruption caused by the i th component of a telephone connection and $MTBI_i$ is the mean time between interruptions caused by the i th component of the connection, under the assumption that the transmission interruption duration and the time between transmission interruptions are exponentially distributed (see also Figure B—1/E.855).

Figure B—1/E.855 - T0201430-88



ANNEX C

(to Recommendation E.855)

QUALITY OF SPEECH IMPAIRED BY SHORT INTERRUPTIONS

C.1 *Measure*

The subjective opinion is used as a measure to assess or evaluate speech quality impaired by short interruptions with durations shorter than 1 s.

C.2 *Measuring method*

Recommendation P.77 was applied for this subjective evaluation with five grade opinion scores (Excellent = 4, Good = 3, Satisfactory = 2, Poor = 1 and Unacceptable = 0). The test procedure was comprised of a 40—second text tape recorded in Japanese spoken by a female, which was listened to by 20 test subjects through indoor test circuits with a transmission interruption generator.

C.3 *Test results*

The relationship between frequency and duration of transmission interruptions for a given Mean Opinion Score (MOS) is depicted in Figure C—1/E.855.

The dotted line in this figure shows the locus of "frequency × duration = 0.5%" which is considered as a permissible limit of the freeze out rate or the percentage of speech loss for designing Digital Speech Interpolation (DSI) and Time Assignment Speech Interpolation (TASI) equipment.

Note — The product of frequency and duration of the short interruption is identical to P [= MID/($MTBI$ + MID)] in Annex B.

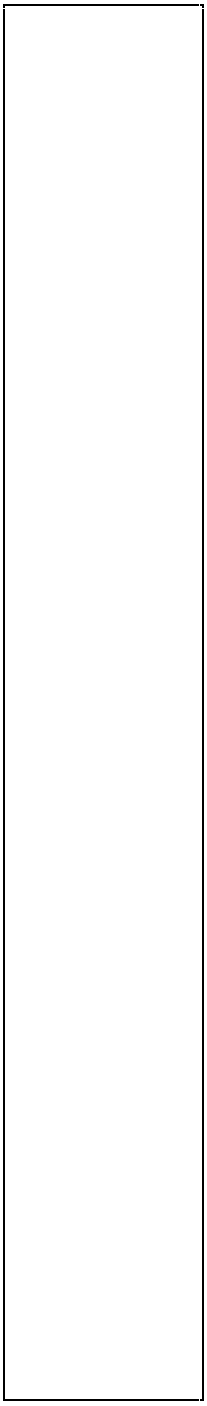



Figure C—1/E.855