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TELEPHONE NETWORK AND ISDN

QUALITY OF SERVICE, NETWORK MANAGEMENT AND TRAFFIC ENGINEERING

DIMENSIONING AT A CIRCUIT GROUP WITH MULTI-SLOT BEARER SERVICES AND OVERFLOW TRAFFIC

ITU-T Recommendation E.527

(Previously "CCITT Recommendation")

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation E.527 was prepared by ITU-T Study Group 2 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 21st April 1995.

NOTE

In this Recommendation, the expression “Administration” is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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SUMMARY

This Recommendation complements Recommendation E.526 “Dimensioning a circuit group with multi-slot bearer services and no overflow inputs”. It relates to dimensioning a circuit group with multi-slot bearer services and overflow traffic. It is assumed that the overflow group has full availability, without the use of service protection methods.

Recommendation E.527

DIMENSIONING AT A CIRCUIT GROUP WITH MULTI-SLOT BEARER SERVICES AND OVERFLOW TRAFFIC

(Geneva, 1995)

1 Introduction

This Recommendation complements Recommendation E.526. It relates to dimensioning a circuit group with multi-slot bearer services and overflow traffic. It is assumed that the overflow group has full availability, without the use of service protection methods.

Partial traffic streams will be expressed on the one hand in calls as in Recommendation E.524, and on the other in busy circuits as in Recommendation E.526. It is assumed that each partial overflow traffic is the only one to be offered to a first-choice circuit group, where the number of circuits is a multiple of the number of time slots used. The method presented is derived from [1].

2 Notations

For partial overflow traffic of nº, i (i = 1, ..., x):

- number of simultaneous time slots: d_i
- traffic intensity (in calls): b_i
- traffic intensity (in circuits): $(b_i \cdot d_i)$
- overflow function: $\rho_i\,(n)$
- peakedness factor: $z_i = \dfrac{\text{variance}}{\text{mean}}$ (of traffic)
- probability of partial blocking: B_i
- equivalent capacity (in calls): n_i

For the first-choice circuit group of nº, i

- number of circuits: m_i
- offered traffic intensity (in calls): a_i
- probability of overflow: $p_i = E_{m_i/d_i}\,(a_i)$ where $E_n(a)$ is the Erlang loss formula. We have the relationship: $b_i = a_i\,p_i$, and (m_i/d_i) is a whole number.

For the overflow group

- number of circuits: N
- total traffic intensity (in calls): $b = \sum_{i=1}^{x} b_i$
- total traffic intensity (in circuits): $M = \sum_{i=1}^{x} b_i d_i$
- reduction factor: Z_0
- time congestion: Π

3 Determination of equivalent capacity n_i

The "overflow function" $\rho_i(n)$ is defined by the following recurrent process, derived from recurrent process (2-1) in 2.2/E.524:

$$\rho_i(0) = p_i = E_{m_i/d_i}, \quad \frac{n}{\rho_i(n)} = \left(\frac{m_i}{d_i} + n - a_i\right) + a_i\rho_i(n-1) \tag{3-1}$$

The *equivalent capacity* n_i (in calls) is the solution of the following set of equations, derived from the set (2-2) of Recommendation E.524:

$$\frac{n_i}{N} = \frac{a_i\rho_i(n_i) / D_i(n_i+1)}{\sum_{k=1}^{x} a_k d_k \rho_k(n_k) / D_k(n_k+1)}, \; i = 1, \ldots, x \tag{3-2}$$

with

$$D_i(n) = 1 + a_i[\rho_i(n) - \rho_i(n-1)] \tag{3-3}$$

The only modification is the addition of the term d_k to the denominator of (2b). The *peakedness factor* z_i is given by the expression:

$$z_i = D_i(1) \tag{3-4}$$

NOTE – For direct traffic we have: $m_i = 0$, $b_i = a_i$, $\rho_i(n) = D_i(n) = 1$.

4 Time congestion Π

The expression (3) in Annex A/E.526 becomes:

$$\Pi = B_1 \approx \left(\frac{1}{Z_0}\right) \cdot E_{N/Z_0}(M / Z_0) \tag{4-1}$$

the reduction factor becoming:

$$Z_0 = \frac{\sum_{i=1}^{x} a_i d_i^2 \rho_i(n_i)}{\sum_{i=1}^{x} b_i d_i} \tag{4-2}$$

$E_n(a)$ is the Erlang loss formula with n fractional. It will be remembered that Π is equal to the blocking probability B_1 of a direct traffic ($m_i = 0$) with simple time slots ($d_i = 1$) and arrivals conforming to Poisson's law.

5 Influence of multiple time slots

The factor $H_i(d_i)$ is the same as the factor H_i in Annex A/E.526. We thus obtain, for the blocking probability of partial traffic stream n°, i:

$$B_i = B_1 \cdot H_i(d_i) \text{ with } H_i(d_i) = \frac{K^{d_i} - 1}{K - 1} \tag{5-1}$$

where the term K is defined as:

$$K = \left[\frac{N}{M}\right]^{1/Z} \text{ with: } V = \sum_{i=1}^{x} b_i d_i^2 \text{ and } Z = \frac{V}{M} \tag{5-2}$$

6 The second overflow

Formula (2-4) in 2.2/E.524 now gives, for the intensity of *the second partial overflow* O_i (in calls):

$$O_i = a_i \rho_i(n_i) H_i(d_i) \times \prod \tag{6-1}$$

Similarly, formula (2-5) modified gives, for the partial grade of service equalization:

$$\rho_i(n_i) \cdot H_i(d_i) = C \tag{6-2}$$

where C is an economically suitable constant.

NOTE – This equalization is only possible for a fairly low d_i. For video communications (large d_i) it is necessary to have recourse to service protection methods.

7 Field of application

This approximate method may be used for:

$$d \leq 10, z \leq 3 \tag{7-1}$$

8 Processing time and programming effort

The values given in Table 2/E.524 can be kept approximately.

Reference

[1] LE GALL (P.): Overflow traffic combination and cluster engineering, *Proc. ITC-11*, paper 2.2 B-1, Kyoto 1985.