



E.522

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

QUALITY OF SERVICE, NETWORK MANAGEMENT AND TRAFFIC ENGINEERING

NUMBER OF CIRCUITS IN A HIGH-USAGE GROUP

ITU-T Recommendation E.522

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation E.522 was published in Fascicle II.3 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 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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NUMBER OF CIRCUITS IN A HIGH-USAGE GROUP

1 Introduction

For the economic planning of an alternate routing network the number of circuits in a high-usage group should be determined so that the annual charges for the whole network arrangement are at a minimum. This is done under the constraint that given requirements for the grade of service are fulfilled. In the optimum arrangement, the cost per erlang of carrying a marginal amount of traffic over the high-usage route or over the alternative route is the same.

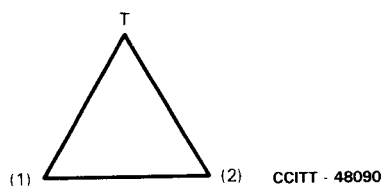


FIGURE 1/E.522

The optimum number of high-usage circuits, n , from one exchange (1) to another exchange (2) is therefore obtained from the following expression when the overflow traffic is routed over a transit exchange T (route 1-T-2, see Figure 1/E.522).

$$F_n(A) = A \{E_{1,n}(A) - E_{1,(n+1)}(A)\} = M \times \frac{\text{annual charge (1-2)}}{\text{annual charge (1-T-2)}}$$

A is the traffic flow offered, for the relation “1-2”, in the Erlang loss formula for a full availability group. The expression $F_n(A)$ gives the marginal occupancy¹⁾ (improvement function) for the high-usage group, if one more circuit were added.

M is the *marginal utilization factor*²⁾ for the final route “1-T-2” (which has nothing to do with cost ratio), if one additional circuit were provided. The annual charges are marginal charges for adding one additional circuit to route “1-2” and likewise to route “1-T-2”.

Planning of an alternate routing network is described in the technical literature (see [1] to [10]).

Annual charge as used in this Recommendation refers to investment costs.

2 Recommended practical method

2.1 Field of application

It must be recognized that the conditions applying to alternative routing will vary widely between the continental network and the intercontinental network. Significant differences between the two cases apply to the length and cost of circuits, the traffic flow and the different times at which the busy hours occur. The method described attempts to take account of these factors in so far as it is practicable to do so in any simplified procedure.

¹⁾ Marginal occupancy is often called LTC (last trunk capacity).

²⁾ Marginal utilization is often called ATC (additional trunk capacity).

2.2 Traffic statistics

The importance of reliable traffic estimates should be emphasized. Traffic estimates are required for each of the relations in question, for both the busy hour of the relation and for the busy hour of each link of the routes to which the traffic overflows. Since this may be affected by the high-usage arrangements finally adopted, it will be necessary to have traffic estimates for each relation covering most of the significant hours of the day. This applies particularly to the intercontinental network where the final routes carry traffic components with widely differing busy hours.

2.3 Basis of the recommended method

The method is based on a simplification of the economic dimensioning equations described under 1. Introduction. The simplifying assumptions are:

- i) the ratios of the alternative high-usage annual charges are grouped in classes and a single ratio selected as representative for each class. This is acceptable because total network costs are known to be relatively insensitive to changes in the annual charges ratio;
- ii) the marginal utilization factor M applicable to the overflow routes is regarded as constant within a range of circuit group sizes;

Size of group (number of circuits)	Value of M
For less than 10	0.6
For 10 or more	0.8

- iii) each high-usage group will be dimensioned against the cheapest alternative route to which traffic overflows. (That is, the effect of parallel alternative routes is ignored.)

Where greater precision is required in either network or individual route dimensioning, more sophisticated methods may be employed (see [5] and [7]).

2.4 Determination of cost ratio

In continental and intercontinental working, the number of circuits to be provided in high-usage circuit groups depends upon the ratio of the annual charges estimated by the Administrations involved. The annual charge ratio (see Table 1/E.522) is defined as:

$$R = \frac{\text{annual charge of one additional circuit on the alternative route}}{\text{annual charge of one additional circuit on the high - usage route}}$$

The “annual charge of one additional circuit on the alternative route” is calculated by summing:

- the annual charge per circuit of each link comprising the alternative route, and
- the annual charge of switching one circuit at each intermediate switching centre.

When a third Administration is involved, it may be necessary to calculate the annual charge for switching at the intermediate centre from the transit switching charge per holding minute³⁾. This may be done as follows:

Annual charges for switching = $M \times 60 \times F \times 26 \times 12 \times$ transit switching charge per holding minute.

In the calculation of the conversion factor F from busy hour to day, its dependence on the traffic offered to the high usage route, the overflow probability and the time difference should be taken into account. As a guideline, Table 1/E.522, which is calculated using the standard traffic profiles of Table 1/E.523, may be used.

³⁾ It may be necessary to calculate transit switching charge per holding minute from charge per conversation minute (efficiency factor is described in Recommendation E.506).