

CCITT

E.731

(10/92)

METHODS FOR DIMENSIONING RESOURCES OPERATING IN CIRCUIT SWITCHED MODE



Recommendation E.731

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation E.731 was prepared by Study Group II and was approved under the Resolution No. 2 procedure on the 30th of October 1992.

CCITT NOTES

- 1) In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized private operating agency.
- 2) A list of abbreviations used in this Recommendation can be found in Annex A.

© ITU 1993

All rights reserved. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the ITU.

Recommendation E.731**METHODS FOR DIMENSIONING RESOURCES OPERATING
IN CIRCUIT SWITCHED MODE***(1992)***1 Introduction**

This Recommendation provides methods for dimensioning resources operating in circuit switched mode in the ISDN.

It proposes the use of traditional telephone dimensioning methods complemented with specific techniques that should be used for those ISDN issues that are widely at variance with the traditional telephone traffic models. Techniques for the following ISDN issues are provided:

- Multi-slot connection;
- Service protection methods;
- Attribute negotiation;
- Service reservation;
- Multipoint connections.

2 Evolution of network dimensioning methods**2.1 Telephone traffic modelling**

All telephone network dimensioning procedures are based on mathematical models that approximate the statistical behaviour of telephone traffic in large populations. These models allow straightforward characterization of the traffic demand and network dimensioning by adopting simplifying assumptions concerning:

- stationarity of the traffic process during the reference period;
- call attempt inter-arrival times;
- call holding times;
- disposition of blocked or delayed call attempts;
- dependency of call attempts and holding times from network state and other call attempts.

For example, in the most commonly used Erlang loss formula, the following assumptions are used:

- stationary traffic process during the reference period;
- poissonian arrival of call attempts;
- general distribution of call holding times;
- blocked calls cleared;
- independence of call attempts and holding times on network state and other call attempts.

Assumptions are not actual descriptions of individual caller behaviour, but give rise to statistical patterns that have been experimentally observed to closely approximate the aggregate traffic flows in real telephone networks.

The history of telephone network dimensioning can be viewed as primarily the extension of a few basic traffic models to a widening range of applications, including the development of techniques to replace situations not entirely consistent with the basic models by “equivalent” situations that permit continued application of the same techniques.

The E.520-Series Recommendations provide telephone network dimensioning methods based on traditional traffic modelling.

2.2 *Impact of ISDN circuit switched mode*

Narrow-band ISDNs will evolve from the PSTN and the basic network structure for the circuit switched mode will be identical to that of the PSTN.

However, many ISDNs will offer circuit switched services with modes of operation that are at variance with underlying assumptions of traditional telephone traffic models. For example multi-slot services require different amounts of network resources for different call attempts, an aspect that is not considered in traditional telephone traffic models.

The technologies being introduced in conjunction with ISDN can result in new traffic patterns as well. For example, automatic repetition terminals coupled with fast network signalling may result in a sequence of closely spaced, correlated call attempts that cannot be represented by the independence assumptions in traditional telephone traffic models.

2.3 *Evolution of ISDN dimensioning*

ISDN is an open, permissive concept with a very large range of development paths. Many of the services and features presently identified might never materialize in quantity, and new services and features not yet described might dominate future ISDN evolution. In this situation new traffic models should not be introduced until actual experience indicates system behaviour to be sufficiently approximated.

This Recommendation provides specific dimensioning techniques that should be used for services and features that are widely at variance with the traditional telephone traffic models and are anticipated to affect resource requirements in at least part of ISDN networks. The decisions of when and where to apply these techniques in evolving ISDN structures will be a major challenge for traffic engineering specialists in individual Administrations.

3 **Multi-slot connections**

3.1 *Completely partitioned circuit groups*

Consider a circuit group serving M independent traffic components, with different arrival rates, holding times and bandwidth (equivalently circuit or bit rate) requirement. A call of the component m requires d_m circuits to be carried. The straightforward approach to achieve specified grades of service for different traffic components is to split total circuit group into M parts. The capacity of each part is dedicated to its corresponding traffic component.

Required circuit group capacity for each traffic component should be found to achieve the GOS target. Standard dimensioning methods described in the E.520-Series Recommendations can be used for calculations of required circuit group capacity. Those calculations are based on the traffic defined as $A'_m = \lambda_m \cdot h_m$, λ_m being the call arrival rate and h_m the holding time (see Recommendation E.712, § 3.5), thus without accounting for the bandwidth requirement d_m . Consequently, the required circuit capacity C_m for part m of the traffic is expressed as follows:

$$C_m = N_m \cdot d_m$$

where N_m denotes the value calculated by using methods described in the E.520-Series Recommendations.

Total circuit capacity C is given by the sum of the capacities dedicated to each traffic component.

$$C = \sum_{m=1}^M C_m$$