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1 Foreword

ETSI Technical Reports (ETRs) are informative documents resulting from ETSI studies which are not appropriate for European Telecommunications Standard (ETS) or Interim - European Telecommunications Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use of ETSs or I-ETSs, or which is immature and not yet suitable for adoption as an ETS or I-ETS.

This ETR has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

2 Introduction

The purpose of this Technical Report is to give the mechanisms for deriving overall Network Performance from the performance characteristics of individual components. ETSI Technical Report 003 [4] complements this document by describing the methods for deriving Quality of Service from Network Performance.

3 Scope

This Technical Report applies to network performance parameters in circuit switched networks.

The performance of Private Telecommunication Networks (PTNs) are not covered by this Technical Report.

4 References

[1] CCITT Recommendation E.600 (1988): Terms and definitions of traffic engineering

[2] CCITT Recommendation E.800 (1988): Quality of service and dependability vocabulary

[3] CCITT Recommendation E.550 (1988): Grade-of-service and new performance criteria under failure conditions in international telephone exchanges

[4] ETR 003 (August 1990): General aspects of quality of service and network performance in digital networks, including ISDN

5 Relationships between network component performances and network performance parameters

These relationships are presented in Figure 1. This Figure shows the different steps in the calculation of global parameters (network performance parameters) from network components characteristics.

In order to simplify these calculations, it is necessary to make use of network models, reference connections, etc. , for the purpose of illustrating typical configurations (or worst cases).

The vocabulary used in this figure complies with the definitions given in CCITT Recommendation E.600 [1] for the terms indicated by a star, and with the definitions given in CCITT Recommendation E.800 [2] (and its supplement) for the terms indicated by two stars.

The meaning of the main concepts used in this figure is explained hereafter.

5.1 Reference connection

A reference connection is a hypothetical association of resources providing means for communication between two or more devices in a telecommunication network. A reference connection is required for the derivation of aspects of Network Performance related to the user information transfer phase (including primary parameters such as propagation delay and derived parameters such as retainability and transmission performance).

5.2 Reference traffic relation

A reference traffic relation is a particular traffic flow between an origin and a given destination. It concerns the portion of the network which is used to establish a connection between the origin and the destination under consideration.

For example, for an international traffic flow between terminal equipment in two countries, the network portion is the portion of the network model that can be used to carry the considered traffic between the two terminal equipments. This network portion could be divided into a number of network fabrics:

- the originating national network fabric

- the international network fabric

- the destination national network fabric.

In addition, originating and destination private networks may be involved. An example of a division of a network into network fabrics is given in Figure 2.

For a given service, the probability for a successful connection depends on the traffic relation under consideration. Consequently, reference traffic flows are required to evaluate Network Performance aspects related to the access phase (including primary parameters such as connection set-up delay and derived parameters such as accessibility for establishing the physical connection).

5.3 The concept of network model

A network model is required to describe in a simplified manner the behavior of a (circuit switched) network under traffic load and in the presence of failures.

The probability that a call attempt fails depends on both the traffic at the time of the call attempt and the amount of resources available for the connection required at the same time.

As a consequence, in order to describe the behavior of a network in the presence of failures, it is necessary to evaluate:

- their effect, which requires the description of the network model in terms of traffic engineering (logical network model)

- their probabilities, which require the description of the network in terms of its components (physical network).

5.3.1 Logical network

A logical network is a means to evaluate the effect of failures in the physical network. It is made-up of nodes interconnected by circuit groups (see CCITT Recommendation E.600 [1] clause 3.5), also called trunk groups, in a hierarchical order. It shows the traffic load of each circuit group (busy hour). If a circuit group is subdivided into circuit subgroups (see CCITT Recommendation E.600 [1] clause 3.6) which are routed on separate links, then they must be distinguished in the logical network. The consequence of a failure on a link between two nodes will result in a reduction of the amount of circuits available between these nodes.

Thus, the derivation of the effect of each failure (link or node) in terms of blocking probability can be made by combining the traffic load and the reduced capacity of the network to handle the considered traffic load.

5.3.2 Physical network

The physical network describes the way in which the logical network is implemented.

It is made of exchanges and of transmission links, the implementation of which is to be described in details: multiplexers, digital sections and their length, protection rules and topology.

The failure probability of a link can be derived from the availabilities of its constituent components, taking in account the protection measures in that link.

The physical network should also provide information on the architecture of the exchanges to allow the evaluation of the probabilities of their main failure modes.

5.4 Exchange "availability"

Exchange availability is a set of probabilities reflecting the possible failed states of an exchange. Among these states, three categories can be found:

- complete exchange failure

- partial failures resulting in capacity reduction in all traffic flows to the same extent

- partial failures in which traffic flows to or from a particular point are disturbed.

The concept of exchange availability requires further study. Consideration should be given to CCITT Recommendation E.550 [3].

5.5 Failure free trafficability

Failure free trafficability is the trafficability of a network component (circuit group or node) which is in a failure free state. This concept is useful in the initial state of network dimensioning.

5.6 Trafficability

Trafficability is the trafficability of a network component in each of its states (failed or not) under a given traffic load. Therefore it is characterized by a set of values of blocking probability each of which being associated with the probability of the corresponding state.

6. Network performance parameters

6.1 Primary parameters

6.1.1 Connection processing delays

Connection processing delays in the access phase for a given traffic relation and in the disengagement phase for a given reference connection will be specified in a further ETS.

6.1.2 Other parameters

For further study

6.2 Derived parameters

6.2.1 Accessibility

For a given traffic relation, accessibility depends on the combined effects of actual traffic load and the traffic handling capacity of the networks, which depends on the state of the network. Therefore it must be characterized by the distribution of the call attempt success probability.

Detailed specification will be given in a further ETS.

6.2.2 Retainability

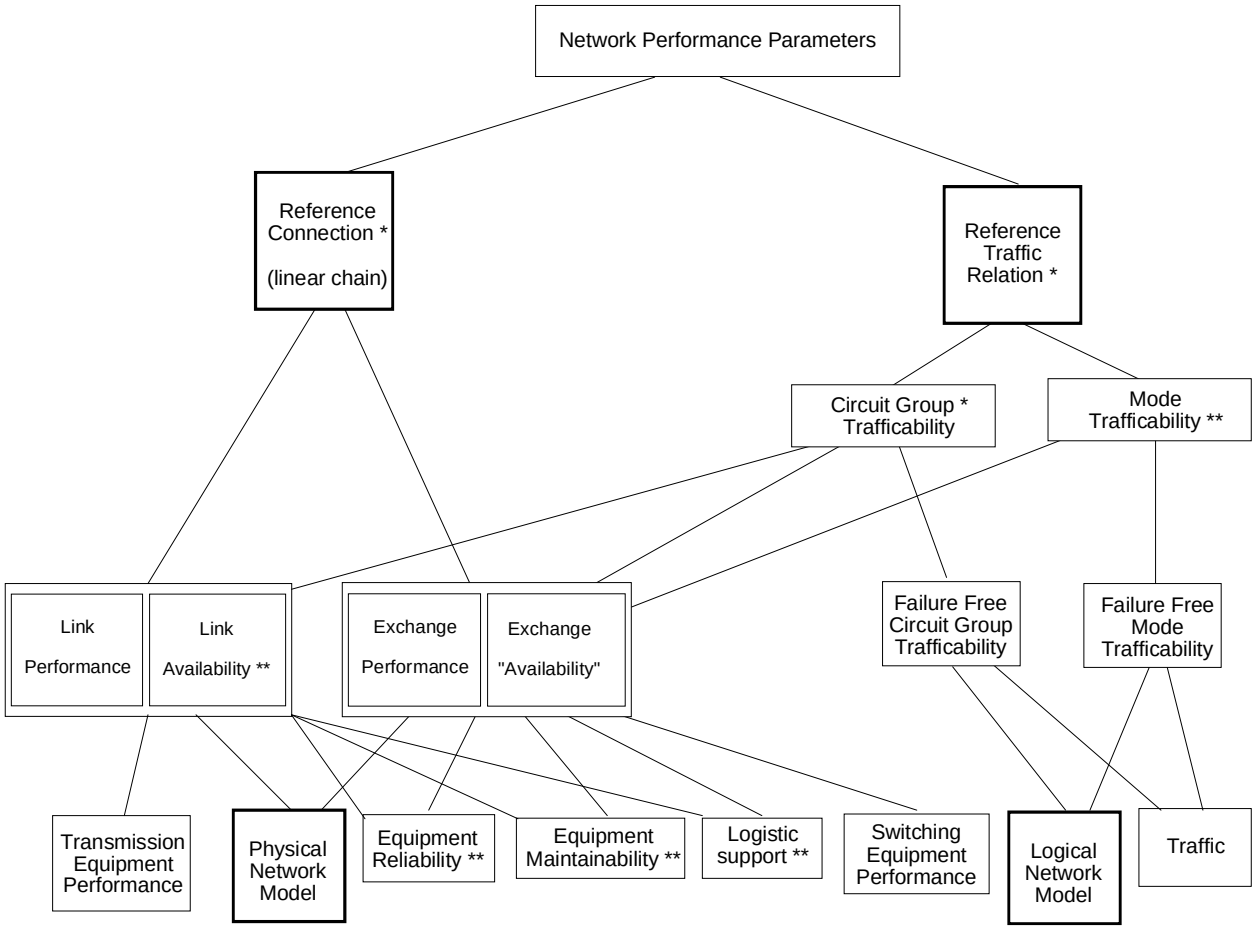
For further study

6.2.3 Transmission performance parameters

For further study

6.2.4 Other parameters

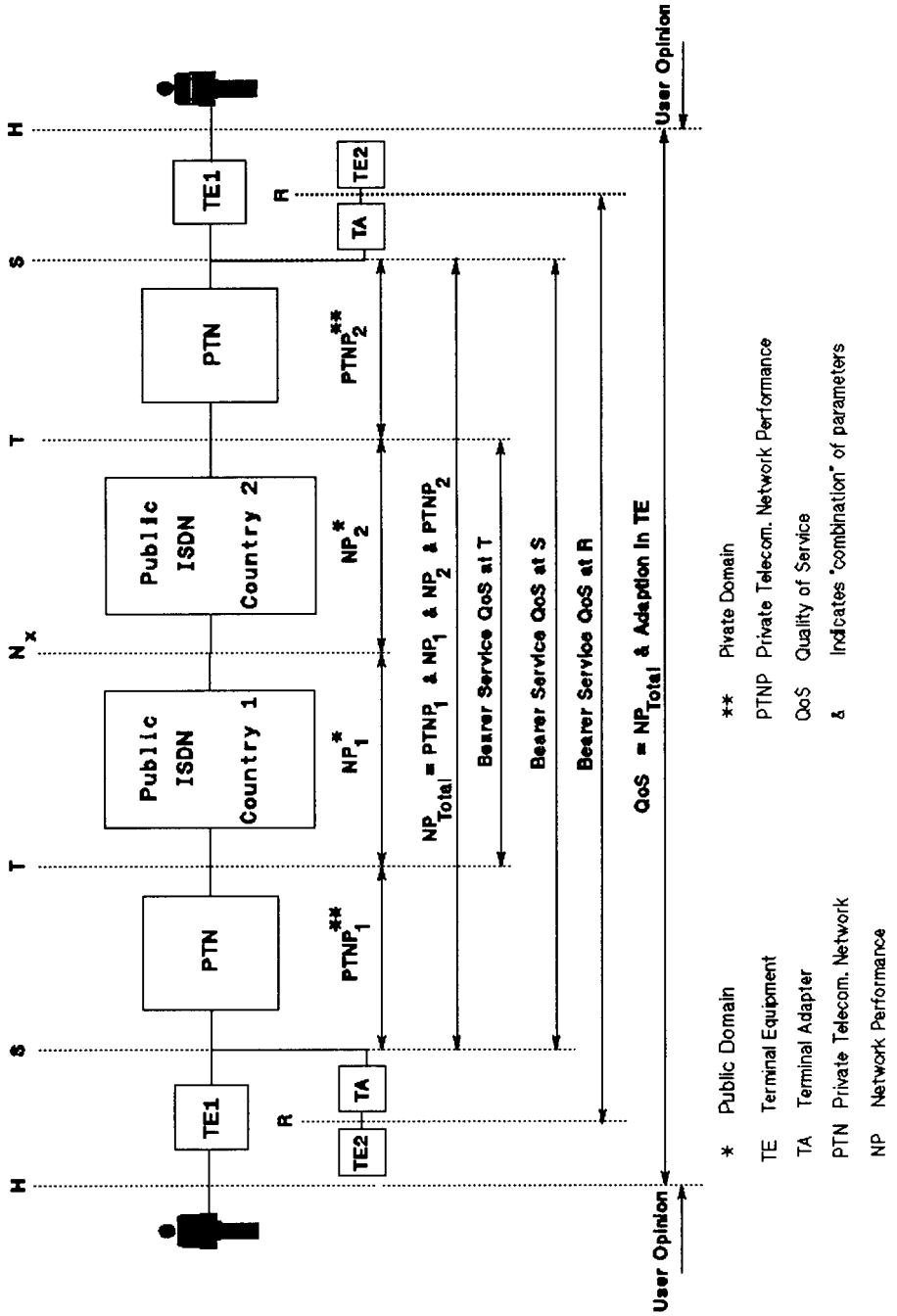
For further study



NOTE: For Candidate NP Parameters see Section 4

* Definition according CCITT rec. E.800
** Definition according CCITT rec. E.600

Figure 1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S
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TE1
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Public ISDN Country 2
Public ISDN Country 1
PTN
TE1
TA
TE2
R
PTNP2**
NP2*
NP1*
PTNP1**
NPTotal = PTNP1 & NP1 & NP2 & PTNP2
Bearer Service QoS at T
Bearer Service QoS at S
Bearer Service QoS at R
QoS = NPTotal & Adaption in TE
User Opinion
User Opinion
* Public Domain
** Private Domain
TE Terminal Equipment
PTNP Private Telecom. Network Performance
TA Terminal Adapter
QoS Quality of Service
PTN Private Telecom. Network
& Indicates "combination" of parameters
NP Network Performance

Figure 2

History

Document history	
August 1990	First Edition
March 1996	Converted into Adobe Acrobat Portable Document Format (PDF)