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CCITT

THE INTERNATIONAL
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TELEPHONE NETWORK AND ISDN

QUALITY OF SERVICE, NETWORK MANAGEMENT AND TRAFFIC ENGINEERING

INTERNATIONAL NETWORK MANAGEMENT – GENERAL INFORMATION

Recommendation E.410

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.410 was revised by Study Group II and was approved under the Resolution No. 2 procedure on the 30th October 1992.

CCITT NOTE

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

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Recommendation E.410

INTERNATIONAL NETWORK MANAGEMENT – GENERAL INFORMATION

(revised 1992)

1 Introduction

The demand for international telephone service continues to increase substantially. This increasing demand has been met by advances in both technology and operational techniques. The growth of traffic has also required the development of larger transmission systems and exchanges to provide the capacity to meet the required grade of service. With the continued growth of the international automatic service, direct supervision and control over traffic has decreased since operators are no longer involved in establishing most calls.

In addition to the above, the introduction of larger digital transmission and switching systems, along with common channel signalling, has resulted in an international telephone network which is highly interconnected and interactive, and which has become increasingly vulnerable to overload and congestion. This overload and congestion can occur with little or no advance warning.

A number of events may arise which can have a serious effect on the international telephone service. Among these events are

- failures of international or national transmission systems;
- failures of international or national exchanges;
- planned outages of transmission systems and exchanges;
- abnormal increases in traffic demand. The events which give rise to such traffic demand may be foreseen (e.g. national or religious holidays, international sporting events) or unforeseen (e.g. natural disasters, political crises);
- focussed overloads, and in particular, mass-calling;
- difficulties in meeting the requirements of international traffic resulting (for example) from delays in the provision of additional circuits or equipment;
- congestion in connected networks.

These events can lead to congestion which, if uncontrolled, may spread and thus seriously degrade the service in other parts of the international network. Considerable benefits can be derived for the international network as a whole if prompt action is taken to control the effect on service of such events.

In addition, as the telephone network migrates toward ISDN, interworking with other networks will develop. With interworking, failure or congestion in one network, or in the interface between networks, can have an adverse impact on the performance of the connected network(s).

The above considerations have led to the development of "international network management", which encompasses all the activities necessary to reduce the effect on service of any situation affecting unfavourably the international telephone network, and in the future, the ISDN.

Note – Much of the guidance on international network management may be applicable in national networks.

2 Definition of international network management

international network management is the function of supervising the international network and taking action when necessary to control the flow of traffic.

Network management requires real-time monitoring and measurement of current network status and performance, and the ability to take prompt action to control the flow of traffic.

3 Objective of network management

The objective of network management is to enable as many calls as possible to be successfully completed. This objective is met by maximizing the use of all available equipment and facilities in any situation through the application of the principles given below.

4 Principles of international network management

4.1 *Utilize all available circuits*

There are periods when, due to changing traffic patterns, the demand for service cannot be met by the available circuits in the normal routing. At the same time, many circuits to other locations may be idle due to differences in calling patterns caused by time zones, local calling habits, or busy season variations. After negotiation and agreement amongst the Administrations affected, some or all of the unusually heavy traffic can be redirected to this idle capacity for completion.

4.2 *Keep all available circuits filled with traffic which has a high probability of resulting in effective calls*

The telephone network is generally circuit-limited; therefore the number of simultaneous effective calls is strongly influenced by the number of available circuits. However, ineffective calls can occupy circuit capacity which would otherwise be available for effective calls. Therefore identifying those call attempts which are likely to be ineffective because of a situation in the network (e.g. a failure), and reducing them as close to their source as possible, will allow circuit capacity to be available for call attempts which have a higher probability of being effective.

4.3 *When all available circuits are in use, give priority to calls requiring a minimum number of circuits to form a connection*

When telephone networks are designed using automatic alternate routing of calls, efficient operation occurs when traffic loads are at or below engineered values. However, as traffic loads increase above the engineered value, the ability of the network to carry effective calls decreases since an increased number of calls require two or more circuits to form a connection. Such calls increase the possibility of one multi-link call blocking several potential calls.

Thus automatic alternate routing should be restricted to give preference to direct routed traffic during periods of abnormally high demand.

4.4 *Inhibit switching congestion and prevent its spread*

A large increase in switching attempts can result in switching congestion when the switching capacity of an exchange is exceeded. If the switching congestion is left uncontrolled, it can spread to connected exchanges or networks and cause a further degradation of network performance. Controls should be applied which inhibit switching congestion by removing attempts from the congested exchange which have a low chance of resulting in a succesful call.

Note – Network management assumes that the network is adequately engineered to meet the normal levels of traffic.

5 Benefits derived from international network management

Among the benefits to be derived from international network management are

5.1 Increased revenue which is derived from an increase in successful calls.

5.2 Improved service to the customer. This can lead, in turn, to

- improved customer relations;
- stimulation of customer calling rate;
- increased customer acceptance of new services.

5.3 More efficient use of the network. This can result in

- an increased return on the capital invested in the network;
- an improvement in the ratio of effective to ineffective calls.

5.4 Greater awareness of the actual status and performance of the network. Such awareness can lead to

- a basis by which network management and maintenance priorities can be established;
- improved network planning information;
- improved information on which future capital investment in the network can be decided;
- improved public relations.

5.5 Protection of revenue and important services, particularly during severe network situations.

6 Network management functions

Network management encompasses all of the activities necessary to identify conditions which may adversely affect network performance and service to the customer, and the application of network controls to minimize their impact. This includes the following functions:

a) monitoring the status and performance of the network on a real-time basis, which includes collecting and analyzing relevant data;

b) detecting abnormal network conditions;

c) investigating and identifying the reasons for abnormal network conditions;

d) initiating corrective action and/or control;

e) cooperating and coordinating actions with other network management centres, both domestic and international, on matters concerned with international network management and service restoration;

f) cooperating and coordinating with other work areas (e.g. maintenance, operator services or planning) on matters which affect service;

g) issuing reports of abnormal network situations, actions taken and results obtained to higher authority and other involved departments and Administrations, as required;

h) providing advance planning for known or predictable network situations.

7 Cooperation and coordination

Effective network management depends on the prompt availability of information indicating when and where a problem is occurring, and a trained group working in cooperation with all parts of the telecommunications organization. Just as there is a need for coordination in planning and building the network, there also is a need for coordination in managing it. The network is such that equipment malfunctions or overloads frequently produce unacceptable performance at a distance from the physical location of the problem. Therefore, those who monitor and manage the network, both nationally and internationally, must cooperate to ensure satisfactory service.

Network management is highly technical in nature, and depends on the skill and creativity of those who share an understanding of network management philosophy, objectives, terminology, tools and techniques. These items are specified in Recommendations E.410 through E.415, and provide a basis for the cooperation and coordination which are a vital part of network management.

8 Further Recommendations on network management

8.1 Recommendation E.411 provides operational guidance for network management including

- status and performance parameters;
- expansive and protective traffic controls;
- criteria for application of controls.

8.2 Recommendation E.412 provides information on network management controls

- traffic to be controlled;
- exchange controls;
- automatic controls;
- status of controls;
- operator controls.

8.3 Recommendation E.413 provides guidance on planning for events such as

- peak calling days;
- failures of transmission systems;
- failures of exchanges;
- failures of common channel signalling systems;
- mass-calling situations;
- disasters;
- introduction of new services.

8.4 Recommendation E.414 provides guidance on the functional elements of a network management organization which need to be identified internationally as contact points. These comprise

- planning and liaison;
- implementation and control;
- development.

8.5 Recommendation E.415 provides Network Management guidance for Common channel Signalling System No. 7

This includes

- surveillance of signalling network status and performance;
- response to common channel signalling network failures.

8.6 It is emphasized that it is not necessary to meet the full scope of these Recommendations to achieve some benefit from the application of network management, particularly when getting started. However, the Recommendations do provide detailed information over a wide range of techniques, some of which can be implemented readily, whilst others may require considerable planning and design effort. Additional information may also be found in the handbook on Quality of service, network management and maintenance [1].

Reference

[1] CCITT Manual *Quality of service, network management and maintenance*, ITU, Geneva, 1984.

ANNEX A

(to Recommendation E.410)

Terminology for network management[1)]

A.1 circuit

A transmission means which allows communication between two exchanges. A national circuit connects two exchanges in the same country. An international circuit connects two international exchanges in different countries (in Recommendation E.600 exchanges are normally defined as points).

A.2 circuit group

The set of all switched circuits which directly interconnect one exchange with another.

A.3 circuit sub-group

A set of circuits within a circuit group which are uniquely identifiable for operational or technical reasons. A circuit group may consist of one or more circuit sub-groups.

A.4 destination code

A destination code is identified by the digits used in analysing and processing the call. This may be defined to whatever accuracy necessary.

A.5 destination

A country, an area, an exchange or other location, or a special service, in which the called subscriber is located and that may be specified within the country. A destination is identified by one or more destination codes.

A.6 bid

An attempt to obtain a circuit in a circuit group or to a destination. A bid may be successful or unsuccessful in seizing a circuit in that circuit group or to that destination.

A.7 seizure

A seizure is a bid for a circuit in a circuit group which succeeds in obtaining a circuit in that circuit group.

A.8 answer signal

An information sent in the backward direction indicating that the call is answered. (Based on Recommendation Q.254.)

A.9 holding time

The time interval between seizure and release of a circuit or switching equipment.

A.10 busy-flash signal (sent in the backward direction)

This information is sent to the outgoing international exchange to show that either the circuit group, or the called subscriber, is busy (Signalling Systems No. 4 and No. 5, see Recommendations Q.120 and Q.140):

Note – In Signalling Systems No. 6 and No. 7, there is no busy-flash signal. However, the equivalent of busy-flash can be roughly approximated through the aggregation of specific backward failure signals such as circuit group congestion, national network congestion and subscriber busy.

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1) Definitions are given to clarify the terminology used for network management and are mainly based on Recommendation E.600, unless otherwise stated.

A.11 **traffic relation**

The traffic between a particular origin and a particular destination.

A.12 **traffic routing**

The selection of circuit groups, for a given traffic relation; this term is applicable to the selection of circuit groups by switching systems or operators, or for planning.

A.13 **traffic attributs**

Parameters relate to the call which may be needed in the call process (for ISDN see Recommendation E.172), for example: time of day, Transmission Medium Requirement (TMR).

A.14 **routing element**

For a destination code and specific call attributes, the routing elements consists of a list and selection rules of all possible outgoing circuit sub-groups.

Note – The notation of routing blocks may be used for practical implementation of routing elements in switching systems. Its definition and use depends on each specified swiching system.

A.15 **routing table**

The routing table in an exchange is the set of all the routing elements, for all destination codes.

A.16 **origin**

The location of the calling customer premises equipment. This may be specified to whatever accuracy is necessary.