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SERIES E: OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS

International telephone network management and checking of service quality – International network management

NETWORK MANAGEMENT CONTROLS

Reedition of CCITT Recommendation E.412 published in the Blue Book, Fascicle II.3 (1988)

NOTES

1 CCITT Recommendation E.412 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.

Recommendation E.412

NETWORK MANAGEMENT CONTROLS

1 Introduction

1.1 Network management controls provide the means to alter the flow of traffic in the network in support of the network management objectives given in Recommendation E.410. Most network management controls are taken by or in the exchange (see Recommendation Q.542), but certain actions can be taken external to the exchange. This Recommendation provides specific information on network management controls and gives guidance concerning their application. However, it should be noted that the suggested use for each network management control is given only for the purpose of illustration. Other controls, separately or in combination, may be more appropriate in any given situation.

1.2 The application or removal of network management controls should be based on network performance data which indicates that action is required in accordance with the network management principles in Recommendation E.410, § 4. Performance data will also measure the effect of any network management control taken, and will indicate when a network management control should be modified or removed (see Recommendations E.41I and E.502).

1.3 Controls can be activated or removed in an exchange by input from a network management operations system or by direct input from a terminal. In some cases, controls can be activated automatically either by external or internal stimulus, or when a parameter threshold has been exceeded. [The automatic congestion control (ACC) system is an example (see § 4.1).] When automatic control operation is provided, means for human override should also be provided.

2 Traffic to be controlled

2.1 *Type of traffic*

Exchanges should be capable of applying a range of network management controls (see Recommendation Q.542). For increased flexibility and precision, there is considerable advantage when the effect of a control can be limited to a particular specified traffic element.

The operating parameters of a control can be defined by a set of traffic attributes. As shown in Figure 1/E.412, these parameters include distinctions based on the origin of the traffic, for example customer-dialled, operator-dialled, transit or other such classification as may be specified by the Administration. These can be further classified by type of service, particularly for ISDN.

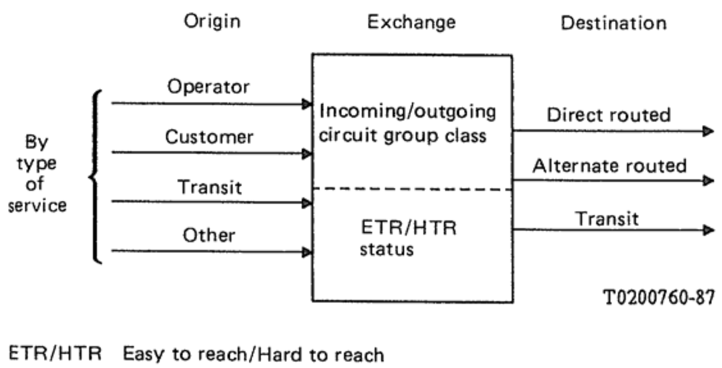


FIGURE 1/E.412

Traffic distinction for controls

Additional attributes can be specified based on information which may be available in the exchange. For example, incoming/outgoing circuit group class, or hard-to-reach status of destinations (see § 2.2) can be used. Further distinctions can be based on the outgoing traffic type, for example direct routed, alternate routed or transit.

In general, the more attributes that can be specified for a control, the more precise will be its effect.

Note — Precision is of vital importance, particularly in the case of protective controls.

2.2 *Hard-to-reach (HTR) process*

2.2.1 A hard-to-reach process for network management will enable exchanges to automatically make more efficient use of network resources during periods of network congestion by improving the performance of network management controls. This improved performance is derived from the ability to distinguish between destinations that are easy to reach (ETR) and destinations that are hard-to-reach (HTR), (e.g., destinations with a low answer bid ratio) and applying heavier controls to HTR traffic. This distinction can be based on:

i) internal performance measurements within the exchange and/or the network management operations system;

ii) similar information gathered and reported by other exchanges;

iii) historical and current observations of network performance by network managers.

The network manager should have the ability to set the threshold for HTR determination in the exchange or network management operations system, and to assign a destination as HTR regardless of its actual status.

2.2.2 *Controlling traffic based on HTR status*

When a call to a destination that is on the HTR list is being routed and a network management control on HTR traffic is encountered, the call should be controlled according to the relevant parameters. If a destination is considered HTR, it normally should be HTR for all outgoing circuit groups.

Additional details of the hard-to-reach process can be found in Recommendation Q.542.

2.3 *Methods for specifying the amount of traffic to be controlled*

2.3.1 *Call percentage control*

There is considerable advantage when exchange controls can be activated to affect a variable percentage of traffic (for example 10%, 25%, 50%, 75% or 100%).

2.3.2 *Call rate control*

An ability to set an upper limit on the maximum number of calls to be allowed to access the network during a specified period of time is of particular advantage.

3 Exchange controls

Network management controls may be applied in exchanges to control traffic volume or to control the routing of traffic. The resulting effect on traffic of these controls may be expansive or protective, depending on the control used, its point of application and the traffic element selected for control.

3.1 *Traffic volume controls*

Traffic volume controls generally serve to control the volume of traffic offered to a circuit group or destination. These include the following:

3.1.1 *Destination controls*

3.1.1.1 *Code blocking*

This control bars routing for a specific destination on a percentage basis. Code blocking can be done on a country code, an area code, an exchange identifying code or an individual line number. The last of these is the most selective control available.

Typical application: Used for immediate control of focussed overloads or mass-calling situations.

3.1.1.2 *Call-gapping*

This control sets an upper limit on the number of call attempts allowed to be routed to the specified destination in a particular period of time (for example, no more than 5 call attempts per minute). Thus, the number of call attempts that are routed can never exceed the specified amount.

Typical application: Used for the control of focussed overloads, particularly mass-calling to an individual line number. A detailed analysis may be required to determine the proper call-rate parameters.

3.1.2 *Cancellation of direct routing*

This control blocks the amount of direct routed traffic accessing a circuit group.

Typical application: Used to reduce traffic to congested circuit groups or exchanges where there is no alternate routed traffic.

3.1.3 *Circuit directionalization*

This control changes both-way operated circuits to incoming operated circuits, either on a percentage basis or by a specified number of circuits. At the end of the circuit group for which access is inhibited, this is a protective action, whereas at the other end of the circuit group (where access is still available), it is an expansive action.

Typical application: To enhance the flow of traffic outward from a disaster area while inhibiting incoming traffic. To have an effect, it is recommended that the minimum amount of directionalization be at least 50%.

3.1.4 *Circuit turndown/busying/blocking*

This control removes one-way and/or both-way operated circuits from service, either on a percentage basis or by a specified number of circuits.

Typical application: Used to control exchange congestion when no other control action is available.

3.1.5 *Specialized volume controls*

Both the automatic congestion control (ACC) system and the selective circuit reservation control (SCR) are volume controls, but due to their specialized nature, they are described separately in § 4.1 and § 4.2.

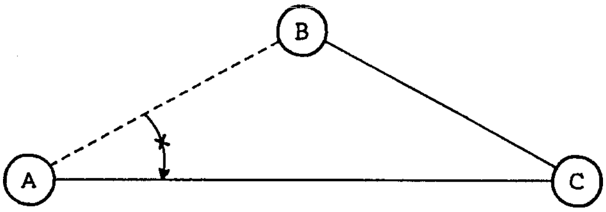
3.2 *Routing control*

Routing controls are used to control the routing of traffic to a destination, or to or from a circuit group. However, it should be noted that in some cases a routing control may also affect the volume of traffic. Controls which are applied to circuit groups may also be applied to circuit sub-groups, when appropriate.

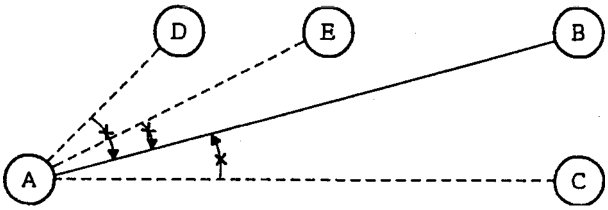
3.2.1 *Cancellation of alternative routing*

Two versions of this control are possible. One version prevents traffic from overflowing *FROM* the controlled circuit group: alternative routing from (ARF). The other version prevents overflow traffic from all sources from having access *TO* the controlled circuit group: alternative routing to (ART). See Figure 2/E.412.

Typical application: There are many uses for this control. These include controlling alternative routing in a congested network to limit multi-link connections, or to reduce alternative routed attempts on a congested exchange.



a) "Alternative Routing From" (ARF) cancellation on A-B circuit group



b) "Alternative Routing To" (ART) cancellation on A-B circuit group

FIGURE 2/E.412

Examples of alternative routing cancellation

3.2.2 *Skip*

This control allows traffic to bypass a specified circuit group and advance instead to the next circuit group in its normal routing pattern.

Typical application: Used to bypass a congested circuit group or distant exchange when the next circuit group can deliver the call attempts to the destination without involving the congested circuit group or exchange. Application is usually limited to networks with extensive alternative routing. When used on both-way circuit groups it has an expansive effect on traffic flow in the opposite direction.

3.2.3 *Temporary alternative routing*

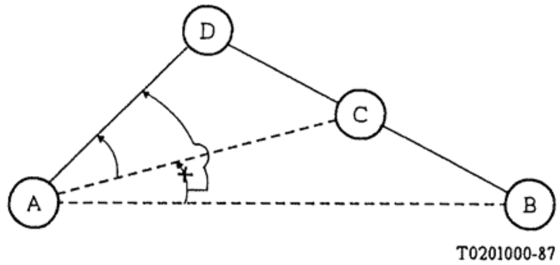
This control redirects traffic from congested circuit groups to other circuit groups not normally available which have idle capacity at the time.

Typical application: To increase the number of successful calls during periods of circuit group congestion and to improve the grade of service to subscribers.

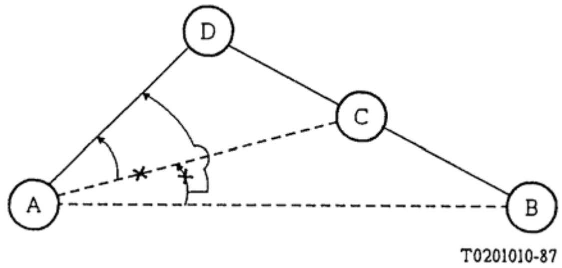
3.2.4 *Special recorded announcements*

These are recorded announcements which give special information to operators and/or subscribers, such as to defer their call to a later time.

Typical application: Used to notify customers of unusual network conditions, and to modify the calling behavior of customers and operators when unusual network conditions are present. Calls that are blocked by other network management controls can also be routed to a recorded announcement.



a) Skip alternative routing traffic on A-C circuit group



b) Skip direct and alternative routing traffic on A-C circuit group

FIGURE 3/E.412

Examples of skip

4 Automatic exchange controls

Automatic dynamic network management controls represent a significant improvement over conventional controls. These controls, which are preassigned, can quickly respond to conditions internally detected by the exchange, or to status signals from other exchanges, and are promptly removed when no longer required. Automatic control applications should be planned, taking into account the internal overload control strategy provided in the exchange software.

4.1 *Automatic congestion control system*

4.1.1 *Exchange congestion*

When a digital international/transit exchange carries traffic above the engineered level, it can experience an overload that diminishes its total call processing capability. Because of the speed of the onset of such congestion and the critical nature of the condition, it is appropriate that control be automatic. The automatic congestion control (ACC) system consists in the congested exchange sending a congestion indicator to the connected exchange(s) using common channel signalling. The exchange(s) receiving the congestion indication can respond by reducing a certain percentage of the traffic offered to the congested exchange, based on the response action selected for each application.

4.1.2 *Detection and transmission of congestion status*

An exchange should establish a critical operating system benchmark, and when continued levels of nominal performance are not achieved (e.g. due to excessive traffic), a state of congestion is declared. Thresholds should be established so that the two levels of congestion can be identified, with congestion level 2 (CL2) indicating a more severe performance degradation than congestion level 1 (CLI). When either level of congestion occurs, the exchange should have the capability to:

1) code an ACC indication in the appropriate common channel signalling messages, and

2) notify its network management centre and support system of a change in its current congestion status.

4.1.3 *Reception and control*

When an exchange receives a signal that indicates a congestion problem at a connected exchange, the receiving exchange should have the capability to reduce the number of seizures sent to the congested exchange.

An exchange should have the capability of:

1) assigning an ACC response action on an individual circuit group[1)] basis, as specified by the network manager, and
2) notifying its network management centre and support system of a change in congestion status received from a distant exchange.

There should be several control categories available in the exchange. Each category would specify the type and amount of traffic to be controlled in response to each of the received ACC indicators. The categories could be structured so as to present a wide range of response options.

For a specific ACC response category, if the received ACC indicator is set to a CLl condition then the receiving exchange could, for example, control a percentage of the Alternate Routed To (ART) traffic to the affected exchange. The action taken by the control would be to either SKIP or CANCEL the controlled calls, depending on the ACC response action that was assigned to that circuit group. In a similar manner, if a CL2 condition is indicated, then the receiving exchange could control all ART traffic and some percentage of Direct Routed (DR) traffic. Other options could include the ability to control hard-to-reach traffic, or transit traffic. In the future, control categories could be expanded to include service-specific controls. This would be particularly useful in the transition to ISDN.

Note – ACC response categories can be set locally in the exchange or by input from a network management centre, or operations system.

Table 1/E.412 is an example of the flexibility that could be achieved in response to a signal from an exchange that is experiencing congestion. In this example, different control actions would be taken based upon the distinction between ART and DR traffic types. These actions could represent the initial capabilities available with the ACC control. Other alternatives in the future could include the ability to control hard-to-reach traffic (see § 2.2), or transit traffic or to provide other controls such as call-gapping. Additional response categories could also be added to Table I/E.412 to give greater flexibility and more response options to the ACC control. It could also be possible to exclude priority calls from ACC control.

TABLE 1/E.412

ACC control response

Congestion level	Traffic type	Response category		
		A	B	C
CL1	ART	0	0	100
	DR	0	0	0
CL2	ART	100	100	100
	DR	0	75	75

4.1.4 Any international application of ACC should be based on negotiation and bilateral agreement among the affected Administrations. This includes an agreement as to whether the controlled calls should be skipped or cancelled. Application within a national network would be a national matter. An exchange that is capable of "ACC receive and control" should not indiscriminately assign ACC to all routes since a distant exchange may be equipped for common channel signalling, but may not yet have an ACC transmit capability. This could result in invalid information in the ACC fields in the signalling messages and the inappropriate application of ACC controls at the receiving exchange. Additional details on the ACC system are in Recommendation Q.542.

[1)] In this context, the term "circuit group" refers to all of the outgoing and both-way circuit sub-groups which may directly connect the congested exchange and the responding exchange.

4.2 *Selective circuit reservation control*

4.2.1 The selective circuit reservation control enables an exchange to automatically give preference to a specific type (or types) of traffic over others (e.g., direct routed calls over alternate routed calls) at the moment when circuit congestion is present or imminent. The selective circuit reservation control can be provided with one or two thresholds, with the latter being preferred due to its greater selectivity. Specific details on the selective circuit reservation control may be found in Recommendation Q.542.

4.2.2 *General characteristics*

The selective circuit reservation control has the following operating parameters:

- a reservation threshold(s),
- a control response,
- a control action option.

The reservation threshold defines how many circuits or how much circuit capacity should be reserved for those traffic types to be given preferred access to the circuit group. The control response defines which traffic types should be given a lesser preference in accessing the circuit group, and the quantity of each type of traffic to control. The control action option defines how those calls denied access to the circuit group should be handled. The control action options for processing of calls denied access to the circuit group may be SKIP or CANCEL.

When the number of idle circuits or the idle capacity in the given circuit group is less than or equal to the reservation threshold, the exchange would check the specified control response to determine if calls should be controlled. The SKIP response allows a call to alternate-route to the next circuit group in the routing pattern (if any) while the CANCEL response blocks the call.

These parameters should be able to be set locally in the exchange for each selected circuit group or by input from a network management operations system. In addition, the network manager should have the capability to enable and disable the control, and to enable the control but place it in a state where the control does not activate (e.g., by setting the reservation threshold to zero). Further, the network manager should have the ability to set the values for the response categories.

4.2.3 *Single threshold selective circuit reservation control*

In this version of the control, only a single reservation threshold would be available for the specified circuit group.

Table 2/E.412 is an example of the flexibility that could be achieved in the control's response to circuit group congestion. In the future, other distinctions between traffic could be identified that would expand the number of traffic types in Table 2/E.412. An example would be to control hard-to-reach traffic as indicated in § 2.2, or to give preference to priority calls.

4.2.4 *Multi-threshold selective circuit reservation control*

The multi-threshold control provides two reservation thresholds for the specified circuit group. The purpose of multiple reservation thresholds is to allow a gradual increase in the severity of the control response as the number of idle circuits in the circuit group decreases. The only restriction on the assignment of reservation thresholds would be that a reservation threshold associated with a more stringent control must always be less than or equal to the reservation threshold of any less stringent control, in terms of the number of reserved circuits, or circuit capacity.

TABLE 2/E.412

An example of a single threshold selective circuit reservation
Percentage control response table

Circuit group reservation threshold	Traffic type	Response category assigned to circuit group		
		A	B	C
RT1	ART	25	50	100
	DR	0	0	25

Table 3/E.412 is an example of the flexibility that could be achieved in the control's response to circuit group congestion with a two-reservation threshold control. In the future, other distinctions between traffic could be identified that would expand the number of traffic types in Table 3/E.412. An example would be to control hard-to-reach traffic as indicated in § 2.2.

TABLE 3/E.412

An example of a two-threshold selective circuit reservation
Percentage control response table

Circuit group reservation threshold	Traffic type	Response category assigned to circuit group				
		A	B	C	D	E
RT1	ART	25	50	75	100	100
	DR	0	0	0	0	0
RT2	ART	50	75	75	100	100
	DR	0	0	25	50	100

5 Status and availability of network management controls

5.1 The exchange and/or network management operations systems should provide information to the network management centre and/or the exchange staff as to what controls are currently active and whether the controls were activated automatically or by human intervenion. Measurements of calls affected by each control should also be available (see Recommendation E.502).

5.2 To help insure the viability of network management functions during periods of exchange congestion, network management terminals (or exchange interfaces with network management operations systems), and functions such as controls, should be afforded a high priority in the exchange operating software.

6 Operator controls

Traffic operators are usually aware of problems as they occur in the network, and this information can reveal the need to control traffic. The operators can then be directed to modify their normal procedures to reduce repeated attempts (in general, or only to specified destinations), or to use alternative routings to a destination. They can also provide information to customers and distant operators during unusual situations, and can be provided with special call handling procedures for emergency calls

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