NETWORK MANAGEMENT

NETWORK MANAGER RESPONSIBILITIES

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1. PHILOSOPHY AND OBJECTIVES

1.01 Network management, very simply stated, is a ***technique to balance circuits and equipment to meet customer service demands.*** However, there is confusion surrounding the subject because few people in the Bell System have the full-time role of ***network manager.*** For the most part, this function is carried out by others as an adjunct to their basic function of network administrator, machine administrator, etc.

1.02 Regardless of the title applied, the information and data required to perform the network management function are also utilized to perform the administrative function. The following analysis defines the functions and responsibilities of the network manager and delineates the data requirements, reports, tools, etc., needed to perform those functions and carry out charged responsibility. A previous document, Network Administrator Job Responsibilities, delineated the responsibilities and functions of the network administrator. These two documents in concert will enable the Associated Companies and Long Lines to separate or merge the various responsibilities and functions to conform to their organizational structure while maintaining the basic identity of the function.

2. BASIC PRINCIPLES

A. Keep All Trunks Filled With Messages

2.01 The switching network is basically trunk limited; therefore, switching system congestion should never occur, providing that the message-nonmessage relationship is maintained. When events occur that cause an undue increase in short holding-time attempts, action must be taken to block these attempts as close to their source as possible. Blocking the nonmessage attempts will allow the network to handle more messages to the satisfaction of customers and will provide a financial return to the telephone company.

B. Utilize All Available Trunks

2.02 There are periods such as major holidays or abnormal events when, due to changing traffic patterns, the demand for service cannot be handled by the engineered pattern of trunking. When this situation occurs, it can cause excessive short holding-time attempts and resultant machine congestion due to specific trunk shortages. At the same time, many other trunks may be idle. Special equipment, such as traffic overload reroute control, route transfer keys, electronic translator consoles, etc., has been provided or is available to allow the network manager to adapt the trunking and routing pattern, which is designed for the average business day (ABD), to the pattern of traffic being applied during the special period involved.

C. Give Priority to Single Link Connections When All Available Trunks are Exhausted

2.03 The basic message network utilizes automatic alternate routing and is designed in a hierarchial structure. While very efficient when operating at or below designed levels, alternate routing loses that efficiency when the load increases above the designed level. This is caused by the increased number of attempts requiring two, three, or even more links per call. Using additional links during an overload increases the possibility of one call blocking several.

2.04 As the message capacity of the network decreases, the short holding-time attempts increase, and this increase in nonmessage attempts causes machine congestion at the tandem. Thus, during an overload when outgoing trunks from the tandem have been exhausted, the number of trunk groups to which an attempt has access should be restricted.

D. Inhibit Switching Congestion

2.05 As stated previously, the message network is trunk limited. It becomes the function of the switching machine to handle attempts being generated over these trunk groups. During ABD operation, an average message-nonmessage relationship exists per circuit which permits efficient use of circuits and machines. An undesirable increase in nonmessage attempts can and does result in congestion at the tandem. If this congestion is left unchecked, it can spread and cause a further degradation of the network. Since this congestion is the primary reason why the machine cannot serve attempts without delay and since other machines can be affected, such congestion should be inhibited.

3. ORGANIZATION

3.01 Organization for carrying out the responsibilities and performing the functions of network management depends on the level of the network involved, its sophistication, and its span of control. The specific organization required to operate a large regional or sectional center involved with electromechanical switchers, manual register data, and illuminated status boards has been established for many years, and the experience gained should be utilized for developing future organizations.

3.02 With the introduction of the electronic translator system (ETS)/peripheral bus computer (PBC), No. 4 ESS, and engineering administration data acquisition system/network management (EADAS/NM), organizations should be restructured to take full advantage of the new technological improvements as applied to network management of the nationwide network and local networks. The following guidelines should be used for the esport personnel should be assigguration of existing network management organizations.

(a) A responsible management person must be assigned the full-time responsibility of network manager.

(b) Several responsible management people should be assigned to assist the network manager in developing preplans, to assist during periods of active network management, and to assume the responsibilities of the network manager when the manager is not available.

(c) Support personnel should be assigned to assist the manager and the assistants in the collection of data and preparation of reports and to act in the manager's name when neither the manager nor the assistants are available.

(d) Operation of the network management computer(s) and the day-to-day maintenance of the data base will be performed by support personnel that are not necesarily a part of the network manager's organization. This group, however, must coordinate very closely with the network management group.

4. RESPONSIBILITIES

4.01 The network manager is responsible for controlling and maintaining service in the network during periods of overload. These periods of overload could be caused by accelerated traffic due to peak day calling, natural disaster or serious weather problems, important unexpected national or international events, or a routine mass-calling problem. Overloads can also be caused by an unexpected loss of telephone capacity or facilities due to equipment or cable failure, both man-made and those caused by nature, and loss of facilities due to fire, flood, etc. Minimizing the degradation of service due to a shortage of trunks or switching equipment for any reason will be the responsibility of the network manager; however, this responsibility

does not supersede the authority and responsibility of others involved in network servicing and network design.

4.02 The preplanning of means, actions, and controls required to carry out the responsibility in 4.01 is an important responsibility of the network manager.

4.03 The provision of adequate service to ***essential*** users during periods of serious overload and/or disaster is the responsibility of the network manager, but the preplanning of methods and means to carry out the responsibility is shared with the network administrator and others.

4.04 Periodically, during and at the conclusion of active network management operation, the network manager will be responsible for supplying reports on the network status to higher management.

5. FUNCTIONS

5.01 The network manager shall perform the following functions:

(a) Establish and maintain parameters to monitor and control network performance.

(b) Monitor network performance.

(c) Collect and analyze network performance data.

(d) Preplan corrections for network overloads.

(e) Detect abnormal network conditions.

(f) Investigate abnormal conditions.

(g) Initiate corrective action and/or control.

(h) Communicate with other network management managers and others involved in network performance.

(i) Issue reports of network overload situations, actions, and results to higher management and other involved departments.

6. DUTIES

A. Establish and Maintain Parameters to Monitor and Control Network Performance

6.01 Parameters established to control and monitor network performance will be dependent upon the degree of sophistication existing in the involved network. If a network is rather low in the hierarchy and not too highly sophisticated, only minimal data such as trunk group peg and overflow, sender attachment delay, and dial tone speed may be gathered. If this is the case, the parameters will consist of normal and abnormal levels of percent of overflow, sender delay, and dial tone speed over 3 seconds. Additional monitoring capability may also be derived by establishing parameters for trunk, facility, and switching machine failures by individual office and by requesting that those in a position to observe the situation advise network management when a parameter is reached or exceeded.

6.02 The network may consist of the upper ranks of the hierarchy and be composed of sophisticated equipment such as No. 4 ESS, No. 4 crossbar ETS/PBC, No. 1 ESS, and/or EADAS/NM. In this situation, a much larger base of data is available and can be displayed via status boards or exception display panels and exception reports via a teletypewriter and/or a cathode ray tube (CRT). The network manager's function, however, is still very similar in that parameters must be established and maintained to assure that exception reports are timely and meaningful. Some of the exception reports available with the newer systems are based upon computed percent of overflow on trunks, computed dial tone speed, computed sender attachment delay, marker peg count, percent of ineffective machine attempts (IMA), etc.

B. Monitor Network Performance

6.03 Depending upon the level, span, and sophistication of the network, some or all of the following duties will be involved:

(a) Collect and compute raw register data on pertinent equipment, trunks, and/or facilities as required by the current situation.

(b) Monitor teletypewriter or computer output for exception-type data and/or reports.

(c) Monitor exception panel and/or status board.

(d) Communicate via telephone and/or teletypewriter messages with other network managers and/or network administrators or anyone else that can supply input on network status.

C. Collect and Analyze Network Performance Data

6.04 The collection and analyzation of network performance data are sometimes confused with similar functions performed by the network (machine) administrator; and in fact, there are many overlaps of function in this area of the task. However, the purpose for which the network manager performs these duties is much different than that of the administrator. The network manager will collect and analyze only sufficient amounts of "normal" trunk and switching machine data to allow him to preplan for peak days, overloads, or loss of trunk or switching capacity. During a period of overload and/or network management control or activity, detailed logs will be kept, and data must be collected so that a postoperative analysis can be made of what happened, what effect the controls or management had on the network, and what changes should be made in the preplans for future occurrences.

D. Preplan Corrections for Network Overloads

6.05 Planning for network overloads is the key to a smooth, efficient, responsive network management operation. Many network overload conditions can be eased by adequate preplans, such as those occurring on peak days, recurring national events such as News Election Service, or many local events such as telethons or planned radio/television give-away shows. Most overloads, however, are due to unpredictable occurrences such as earthquakes, floods, fires, major loss of telephone equipment or facilities, assassinations, etc. While events such as these cannot be predicted, the effects of them can be; therefore, plans can and must be prepared in advance to handle the additional traffic, to handle all or some of the involved traffic on alternate facilities, or to restrict traffic which will have little or no chance of completion.

6.06 Plans for peak days are, in general, expansive in nature in that routing changes, key reroutes, traffic overload reroute control, etc., are employed to take advantage of available capacity in switching and trunking to maximize message completions. Plans to handle most other types of situations are a combination of expansive and protective controls; but unless the situation occurs in an off-peak period or is of fairly short duration, the plan probably will be more protective than expansive in nature. For example, a key reroute is established to route direct traffic between points A and B via point C (via A to C to B) in event of a facility failure between A and B. During an off-peak period, there may be sufficient spare capacity between A and C, within C, and from C to B to handle all of the expected normal A-to-C and C-to-B traffic in addition to the rerouted A-to-B traffic; if so, the plan would be considered expansive. If, on the other hand, the failure occurred during a busy or peak period when the A-to-C route and/or the C-machine and/or the C-to-B route were/was working at or near capacity, restrictions (less than total access—A to C) would have to be applied to prevent overloads that could seriously affect all or several segments of the involved traffic. The plan, therefore, should be expansive but yet protective in nature.

6.07 All preplans for network overload expansive controls should be developed with a minimum of deviation from the standards outlined in the General Transmission and DDD Routing Plans and authorized by all involved (directly or indirectly) departments and/or companies before being adopted as an approved preplan. All network management preplans should include a report procedure to advise all involved departments and/or companies when the plan was put into and released from operation and should include as much data as possible relative to the effect of the plan.

6.08 If and when it becomes necessary to take action or institute expansive controls during an emergency or due to major facility failure for which no preplan has been developed, the network manager should have the authority to apply nonstandard routing and to accept some transmission penalties, if required, to provide partial service for an affected area.

6.09 Network management plans are not normally designed to be activated for administrative purposes to provide capacity that should have been provided by good network administration and/or trunk servicing. If at any time it becomes necessary to activate a network management preplan (or any other misroute plan) to offset an administrative deficiency, agreement in writing will be required

from a level specified by the affected department and/or company on a case-by-case basis.

E. Detect Abnormal Network Conditions

6.10 Data, report indicators, and/or communications received must be analyzed. Some of the indications utilized to detect abnormal network conditions are as follows:

(a) Dial tone speed

(b) Key items of common control usage

(c) Reorder and no circuit conditions

(d) Sender delays

(e) Incoming matching loss

(f) Equipment and network status indicators

(g) Exception reports and displays.

F. Investigate Abnormal Conditions

6.11 When indications are seen of a possible abnormal condition, steps should be taken immediately to investigate the reason for, extent of, and possible effect on the machine, other machines, or the network in general. The following logical-sequence steps should be taken as a result of the investigation:

(a) Determine the validity of the data. If data is found to be invalid, initiate steps that will assure the validity of future data.

(b) Decide if the indication or report is significant enough, in its own right, to require anything more than further monitoring.

(c) If investigation indicates that steps should be taken to correct, control, and/or prevent further spread of the condition, initiate corrective action and/or control and communicate with others as required.

G. Initiate Corrective Action and/or Control

6.12 Corrective and/or control actions can and will be varied by the multiplicity of events that occur within and without our sphere of control and/or influence; therefore, it would be impossible to itemize all of the actions that can or will be taken. The following steps, however, should cover the greater portion of the situations:

(a) If investigation indicates that invalid data or indicators were received, steps should be taken to have them corrected. Invalid data could be caused by defective registers, incorrect wiring, incorrect lead or register assignment, incorrect manual or computer calculations, etc.

(b) Some of the "abnormal" readings, calculations, or indicators are due to normal traffic peaking to slightly higher than normal levels or to momentary equipment failures, and no further action is required. However, when investigation [5.01 (f)] indicates that it is something more than outlined above but still not enough to require control or corrective action, further monitoring is necessary.

(c) When readings, calculations, and/or indicators require corrective or control action, one of the first decisions to be made is whether the control should be ***expansive*** or ***protective.*** Expansive controls include the manipulation of routing to divert traffic from its normal route to other facilities that have spare capacity. Protective controls (sometimes incorrectly referred to as restrictive controls) usually involve blocking or restriction of certain categories of traffic to prevent the spread of congestion.

(d) One important consideration that must be given to any type of control (expansive or protective, automatic or manual) is that the network or machines should neither knowingly be overcontrolled nor controlled longer than necessary. Surveillance must be continued in order that control can be changed or removed, as appropriate, at the proper time.

6.13 The following list of controls or control measures is presented to show some of the more important ones and the way they are normally used.

Control: Line load control (LLC)

Type: Protective

Where used: In class 5 offices

Mode of operation: Manual in electromechanical offices

Dynamic with manual override in ESS offices

Purpose: To reserve availability to serving office equipment for *essential* subscribers

Control: Subscriber overload announcement

Type: Protective

Where used: In class 5 offices

Mode of operation: Dynamic with manual override

Purpose: To space calls of nonvital nature

Control: Key reroute

Type: Expansive

Where used: In class 1 through class 5 offices

Mode of operation: Manual

Purpose: To take advantage of idle switching and trunking capacity available but not normally used for the involved traffic

Control: Recorded announcement

Type: Protective

Where used: In class 1 through class 4 offices

Mode of operation: Manual

Purpose: To advise customers of the reason the call failed and to provide operator spacing of subsequent attempts

Control: Directional reservation equipment (DRE)

Type: Protective

Where used: In class 1 through class 4 offices

Mode of operation: Dynamic with manual override

Purpose: To give preference to traffic from the higher class office on a 2-way trunk group

Control: Dynamic overload control (DOC)

Type: Protective

Where used: In No. 4 crossbar and crossbar tandem offices of class 1 through class 4

Mode of operation: Dynamic with manual override

Purpose: To give instantaneous reaction to certain impending overloads by operating automatic overload controls

Control: Automatic alternate-route cancellation

Type: Protective

Where used: In No. 4 crossbar and crossbar tandem offices of class 1 through class 4

Mode of operation: Manual

Purpose: To deny use of a trunk group to all or part of the alternate-routed traffic

Control: Selective code cancellation

Type: Protective

Where used: In ESS and No. 4 crossbar/ETS offices of class 1 through class 5

Mode of operation: Manual

Purpose: To deny access to the network specific traffic that has little or no chance of completing

Control: Traffic overload reroute control

Type: Expansive

Where used: Class 1 offices

Mode of operation: Manual

Purpose: To reroute traffic from overloaded to underloaded inter-regional center trunk groups

H. Communicate With Other Network Managers and Others Involved in Network Performance

6.14 Communication with other network managers and others involved in network performance is a prime necessity. Voice communication between network managers, both on and off network, has been the basic medium for many years with the teletypewriter being used to support the basic medium and to transmit reports, requests, and data that are best committed to hard copy and do not demand instantaneous reaction.

6.15 Another form of communication has been recently introduced to the network manager with the electronic translator system (ETS). The manager now can communicate directly with the switching machine via the teletypewriter and ETS console. The development of PBCs, EADAS/NM, and the No. 4 ESS will further expand the communication spectrum and allow the manager to communicate directly with many switching machines by using the teletypewriter and cathode ray tube (CRT) via a computer interface. This expansion of communication between the manager and the machine will greatly enhance the ability to react to and manage the network. However, it does not minimize the requirement to communicate with people. Regardless of degree of hardware sophistication, the network manager must continue to advise other network managers of action taken within his sphere of responsibility, receive information and requests for aid, assistance, and guidance, and exchange data and experiences. In addition, there is also a continuing need for the network manager to communicate with others such as the network administrator and traffic engineer so that together they can more intelligently respond to needs in the future.