Effective systems management is dependent on two factors—visibility of the data required for systems management and a structured, disciplined management system to effectively utilize this information. Discussed in this paper are two programs to assist in dealing with these factors. These host programs use VSAM data bases and are accessed via CICS/VS or IMS/VS. The programs provide applications to assist in problem management, change management, network configuration, and problem determination. These functional application tools are described in terms of their content and their relationships with the overall systems management tasks.

Systems management

by R. A. Bird and C. A. Hofmann

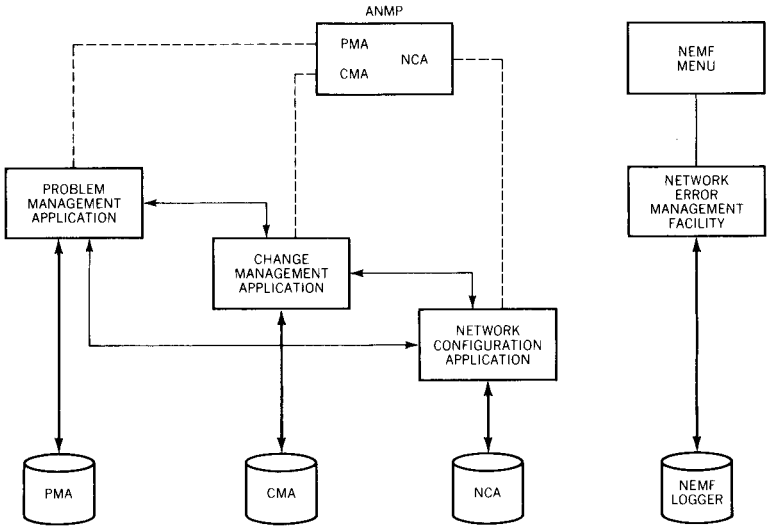
There has been a trend toward increasing complexity in the on-line systems environment. Increased demands have been placed upon the data processing organization to expand application systems and the supporting communications network. High systems availability is dictated by the more critical nature of the supported user environment.

To aid in on-line systems management, regardless of installation size, a set of management tools known as Account Network Management Program (ANMP) and a problem determination application called Network Error Management Facility (NEMF) have been developed.

The Account Network Management Program (shown schematically in Figure 1) has been developed to provide a cohesive set of programs that address the complexities of systems management. Through our knowledge of customer requirements and an understanding of the key processes required to perform effective systems management, we have developed the concept of providing a single package to address the key areas of systems management.

From the beginning we believed that such a program must provide on-line interactive support of the entire system. We ascer-

Figure 1 System management menu structure



tained from many studies concerning systems problem determination that the key areas that had to be addressed were problem, change, and configuration management. All studies showed that the interrelationship of these three functions is mandatory to effectively manage a system. Another key area prevalent in all our studies was that of problem determination. Again we believed that this support had to provide on-line interactive access to error data for the entire system. The Network Error Management Facility (NEMF) was developed to provide network problem determination in environments not covered by the Network Problem Determination Application (NPDA) and to provide consistent NPDA support in non-SNA environments that would help our customers with their migration to Systems Network Architecture (SNA) and NPDA.

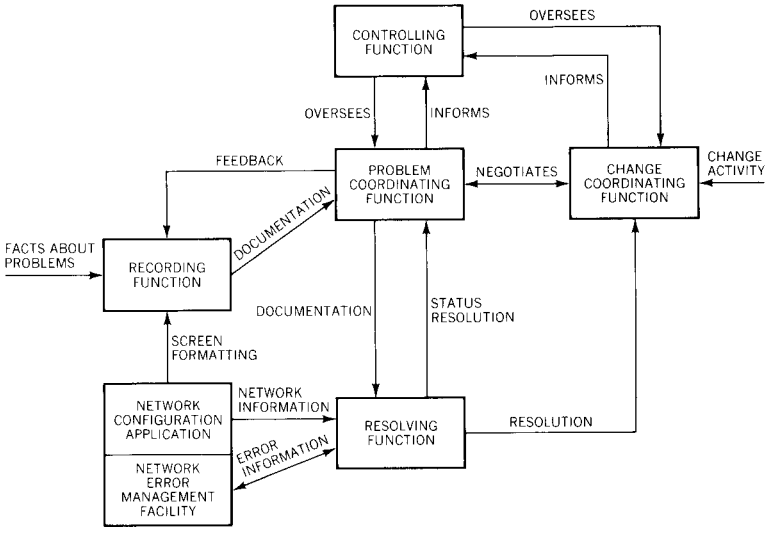
Account Network Management Program overview

ANMP is an integrated group of applications that enable a user to achieve effective systems management. These applications provide the following support:

- Problem management
- Change management
- Network configuration

The applications provided by ANMP allow the type of management functions organization illustrated in Figure 2 to be implemented. This is a disciplined approach to information handling and is outlined in Reference 1.

Figure 2 Installation management functions



A menu structure is utilized to gain entry into the desired application. Once entry is made into ANMP, transfer between applications is possible using the acronym of the desired application.

Problem recording, coordinating, and resolving are functions provided by the Problem Management Application (PMA). The scheduling of changes to the overall system, as well as the coordination of any changes, is addressed by the Change Management Application (CMA). The Network Configuration Application (NCA) provides a data base in which to record the topology of the network. This application can be used to determine the location of a failing component and to assist in network problem determination. Each application provides batch reporting facilities that can be tailored to the needs of the particular user.

Network Error Management Facility overview

Network Error Management Facility (NEMF) provides on-line interactive access to network error data. This application enables a user to perform effective network problem determination for the Network Control Program (NCP), the Emulater Program (EP), and channel-attached devices.

ANMP and NEMF planning

During our planning phase, we identified the following required functions for successful systems management.

Problem Management depends on a discipline that includes the reporting, tracking, and resolution of problems. All the accounts we studied had some type of problem management in place. The

most common problem management method we observed used manual procedures and reports, with weekly status meetings that included the vendors. In addition to manual procedures, some customers had installed the DOS Incident Reporting and Tracking Field Developed Program (FDP) or the OS Problem Tracking FDP, or had written their own on-line application to aid in automating problem management. We found that regardless of the method used, if a discipline was in place, the account appeared to run better. However, those customers who used an on-line program with management reports appeared to keep the discipline in place on a continuous basis, as opposed to those who re-emphasized it after each major outage.

Change Management, like problem management, was used by every account we studied. Change management was found to exist either as a manual system that had been formalized, or it was a responsibility of an individual who frequently depended on memory and notes. We found that the success each installation had in meeting target dates for installing changes was very dependent on the change management discipline. As in problem management, the degree of discipline frequently depended on the elapsed time since the last change that resulted in a major outage.

Network Configuration management and network configuration planning were also disciplines found in all systems studied. The installations studied had manual procedures that included complex wall charts, detail books, and hand-written notes. Network configuration management and planning includes such functions as providing information for access method generation, and acquiring inventory control, maintenance status, communication circuit, and modem information.

Problem Determination depends on a discipline that includes the capture and analysis of network data. In our studies, we found that some customers had installed the Display Exception Monitoring Facility (DEMF) or the Facility Error Recognition System (FERS) to provide a problem determination capability. Another important activity in this area was found to be the development of the Network Problem Determination Application and Network Communication Control Facility (NPDA/NCCF) to collect and display network error data and provide network control functions. Even with these efforts under way, some additional short-term development was required to provide network problem determination in environments not covered by NPDA and to provide consistent NPDA support in non-Systems Network Architecture (i.e., non-SNA) environments that would help customers with their migration to SNA and NPDA.

To achieve problem management, we decided to use the DOS Incident Reporting and Tracking FDP as a base, and enhance it so

that it would address both network and systems problem management. There was no similar product to build on for change management. Nevertheless, we decided we could use the new problem management application as a base and modify the code to support the change management requirements. Again there was no product to build on for network configuration. To replace manual methods, we decided to allow entry into an interactive data base for all the detail information on each network component. We believed this application should provide a path search capability and a map program. This would be particularly important for systems with alternate-path capability.

CICS/VS and IMS/VS were considered the most appropriate vehicles for implementing these applications because the required data base and data communications functions would be included in the systems management products that were being developed. Consideration was also given to data base design in each application so that management reports would require as little rewriting as possible to convert them from the CICS/VS version to the IMS/VS version. Since the VSAM data base would be used, both the CICS/VS and IMS/VS versions must be able to access the same file with no changes. For ease of testing, each application was to be written to do a prescribed set of functions when called. Also, all serviceability provided by CICS/VS and IMS/VS to the application programmer was to be used.

In addition to the security provided by CICS/VS and IMS/VS, it was planned that each application provide its own level of password protection. This additional level of security would allow the user to decide to whom authority should be given to update and change the files, as well as who should receive access to applications.

To handle network problem determination, we used the DEMF method of trapping network error data for OS and developed a new method for DOS. We designed the data base, screen layouts, error descriptions and probable cause analysis to be as compatible as possible with NPDA. To support this concept, we depended on the same access method enhancements for VTAM and TCAM as would be required for NPDA. The product was designed to allow ease of migration to NPDA and NCCF while providing interim support.

ANMP and NEMF design

problem management

To provide for generalized problem management, we first looked at problem tracking sheets gathered from various accounts to determine which data field should be provided. We also studied data sheets in published account management planning guides and the

data fields being carried in the Interactive Problem Control System (IPCS) problem records. After all the data collected had been analyzed, we designed data entry screens for systems and network problem management that would be used for both data entry and data display.

Functionally, we designed the application to provide the following support:

- On-line creation and updating
- Search capability
- Exception criteria and reporting
- Unlimited comment capability
- Ability to handle multiple assignments
- Cross-reference of problems to changes
- Batch reports for management
- History file supported by batch reports

change management

Change management design was accomplished in much the same way as the problem management design. First, we identified the data fields that should be tracked on changes during the installation process. We then designed the application to provide the following support:

- On-line creation and updating
- Search capability
- Cross-reference to problems
- Project scheduling capability
- User-defined editing
- Unlimited comments
- Approver/reviewer facility
- Exception notification and criteria
- Batch reports for management
- History file supported by batch reports

In order to use as much as possible of the problem management application code, the design of the change management data base was the same as that for problem management, with the exception of an approver/reviewer file.

network configuration

Network configuration design presented the greatest challenge because we had no other program to build upon. We designed screens and the data base structure to support configuration data for terminals, links, controllers, and CPUs. We also designed a path file to keep track of the connections of each of the components, and screens to display the path information.

problem determination

The Network Error Management Facility design was divided into two parts, logger design and display design.

For *logger design*, we planned the data base so that it would be kept to a manageable size. It could be updated or displayed with a minimal number of I/Os, and would be self-generating, i.e., requiring no system generation. It would provide on-line interactive problem determination, error description, and probable cause analysis of each recorded error.

We kept the data base to a manageable size simply by restricting the overall size of the data base or number of records for each network component. The limiting of the number of records for each component initially appeared to be the least desirable approach to size because, when we looked at error data, it appeared that certain types of errors tended to be very repetitive and might overlay previously logged data. To avoid this, we decided to keep an occurrence count of repetitive errors and the last 16 sequences of errors. This technique would allow the user to look at the types of errors that were occurring when a problem was reported.

To limit the I/O operations, we elected to keep an in-core index of the data base, which is rewritten to DASD each time a new component (terminal, control unit, etc.) is recognized and added. Also, the header, history, and up to sixteen error records for each network component would all be contained within one block. As a result, the logging of a record usually requires only one read and one write to VSAM file, except in the case of the addition of a new component. Only a VSAM read is required to retrieve the data concerning a network component.

For *display design*, we decided to make the screen format appear as similar as possible to the screens being designed for Network Problem Determination Application (NPDA) for the devices that both would support. The following support would be provided: display of error data for Emulator Program (EP) and Network Control Program (NCP)-attached devices and lines, and error data about locally (channel)-attached teleprocessing devices. Also, data would be displayed by total error count (historical) showing total traffic, permanent errors, temporary errors, and secondary errors. Most recent errors would be displayed by date and time, the occurrence count, operation being performed, and error description and probable cause. Detail event would show a full description of the operation, error, and probable cause (including a hex display of the error record). A scan command would provide total error count data base information from various search parameters, and a print program command would be used for reports.

Functional content

Problem Management Application (PMA)

The Problem Management Application (PMA) is designed to guide the user through a logical series of events that minimize problem

Figure 3 Basic Problem Management Application screen

```
*************************** PROBLEM MANAGEMENT APPLICATION ************************

PROBLEM NO :N222008
   STATUS:O            TYPE:HDW      PRIORITY:2      REPORTED BY:COMPTON
   DATE  :01/17/79     TIME:16:35    OUTAGE  :       TRACKED BY :TOWNSEND
***FAILURE INFORMATION  ----------------------------------------------------------
   SYSTEM:4-PLEX  COMP:TERM      ERR CD:H12          SYSTEM IMPACT:
   CIRCUIT  :IFDC80328  TERM TYPE:3277    ADDR:C2    NETWORK NAME :J6ØØ
   TERM LOC :TORONTO              CLUSTER NAME:CRIJJ6Ø     IPCS # :
   DESC:  STRANGE CHARACTERS ON SCREEN, RESPONSE TIME PROBLEMS
***PROBLEM ASSIGNMENTS Ø2----------------------------------------------------------
   ASGN NO:Ø1    ASSIGN:TPSUPP       LOC:TORONTO      CONTACT:PARKS
   ASTATUS:O  NOTIFY:01/17  16:35       ARRIVE:01/17  16:40   FINISH:
   DESC:  ANALYSIS OF TERMINAL/LINE
***PROBLEM COMMENTS Ø1-------------------------------------------------------------
   CMNT:01/17/79  16:40 - STRANGE CHARACTERS ON SCREEN AND POOR
   CMNT:                  RESPONSE TIME REPORTED
   CMNT:                - NO LINE PROBLEMS DETECTED ... TERMINAL RECORD INDICATES
   CMNT:                  DATA CHECKS - IBM CE TO SITE
***RESOLUTION INFORMATION  --------------------------------------------------------
   RESOLVER   :                TARGET DATE :        DUP CNT:    NO:
   CLOSED DATE:        TIME:   CAUSE CODE  :        CHANGE REQUEST:
   DESC.

COMMAND => CMA   N=NEXT,E=END,PA/PC=PAGE,AA/AC=ADD,CM=CHNG REQ,I=IPCS,PROB NO
```

resolution time by ensuring the accurate reporting and management of a problem. The Problem and Change Management Applications both feature selection menus, preformatted screens, search capabilities, edit fields, management reports, on-line entry and display, exception notification, detail or summary browse capability, history files, and security protection. After the user is signed on to IMS or CICS, the applications can be selected by entering ANMP. This brings up a *master menu* from which the application of interest can be selected. ANMP is designed in such a way that no new problems or changes can be entered without a valid password. When the correct password has been entered, the operator can proceed to select the problem manager.

problem recording

The five functions that can be selected from the PMA menu are termed create record, update record, display record, summary browse, and detailed browse. The selection of create record brings up the network screen shown in Figure 3. Figure 4 illustrates the system screen. After the identification of a problem, all information relevent to that problem can be recorded in the upper section of the screen. The date and time are assigned by PMA. Failure information varies between the network screen and the system screen because the type of information is quite different for the two environments. Once the information is recorded, it is then available in an interactive mode to all other affected departments that have the responsibility for the resolution of the problem, e.g., the network problem determination group or the network operations group.

problem coordinating

The middle area of the preformatted screen is used for the coordination of the problem. In many cases, a problem may reside in

Figure 4 System Problem Management Application screen

```
******************  PROBLEM MANAGEMENT APPLICATION  ************************

PROBLEM NO:
   STATUS:OP        TYPE:         PRIORITY:         REPORTED BY:
   DATE   :         TIME:         OUTAGE   :        TRACKED BY :
***FAILURE INFORMATION ----------------------------------------------------
   SYSTEM:          COMP:          ERR CD:          SYSTEM IMPACT:
   JOB    :         STEP:         APPLICATION:             RERUN :
   DOC    :                                                 IPCS #:
   DESC   :
***PROBLEM ASSIGNMENTS   NN-----------------------------------------------
   ASGN NO:       ASSIGN:         LOC:             CONTACT:
   ASTATUS:       NOTIFY:         ARRIVE:          FINISH:
   DESC:
***PROBLEM COMMENTS   NN---------------------------------------------------
   CMNT:
   CMNT:
   CMNT:
   CMNT:
***RESOLUTION INFORMATION   -----------------------------------------------
   RESOLVER   :                  TARGET DATE:        DUP CNT:     NO:
   CLOSED DATE:       TIME:      CAUSE CODE :        CHANGE REQUEST:
   DESC:

COMMAND =>N        N=NEXT,E=END,PA/PC=PAGE,AA/AC=ADD,CM=CHNG,I=IPCS,PROB NO
```

more than one area; it could be a problem of hardware, software, or communications, or a user problem. The problem assignments field is pageable and allows the tracking of multiple assignments independently. Comments fields are provided and are also pageable. Since the coordination process continues throughout a problem, suitable updates and comments can also be made. In many cases, large accounts have difficulty in doing accurate outage analysis because a chronology of events during the resolution of a problem is not accurately recorded.

problem resolution

The bottom area of the screen is for resolution information and provides a description of the resolution. If the problem results in a required change, control can be transferred to the Change Management Application and a change scheduled. The problem number is automatically recorded against the change. Upon transfer back, the change request number is recorded as part of the problem record, thereby providing a cross-reference.

browse function

After the problems have been entered, they can be displayed either in summary browse or detail browse format. The summary browse screen displays only the problem number and the status and failure information. Problems that are outstanding over user-defined criteria have the problem number intensified. This is an essential requirement for large networks where an average of thirty to forty problems a day is not unusual. Prioritization is necessary so that problems with the highest impact are addressed first.

All fields on the screen, with the exception of the comments field, are editable and searchable. Equipment performance and vendor response are key areas that must be tightly controlled to provide maximum system availability. The Problem Management Application edit fields can be set up for all vendors. When this feature is coupled with the PMA search capabilities, the generation of specific reports for vendor response and system measurement is readily available. The majority of well-organized accounts currently use manual systems in the preparation of vendor and equipment analysis reports, which involves paper work and consumes a large amount of customer resource.

consolidated problem management

Consolidated problem management is the concept around which the PMA application has been developed. It is not necessary to have multiple problem management systems when it is possible, through proper design, to consolidate all necessary information into one system. To meet the criterion for a single problem manager, PMA provides support for both systems and network problems. In addition, for those installations that utilize the Interactive Problem Control System (IPCS) as a software manager, PMA has been designed to track problems in which IPCS is also used. Upon selection of the IPCS command, the comments fields are replaced with fields required to track software problem resolution. The result, as far as the consolidated problem manager is concerned, is that all problems are recorded and are available either on line or by batch reports. This provides a total look at the complete installation and attached network. Inasmuch as PMA operates as a CICS or IMS application, it is possible, where multiple installations are part of a total network, to utilize one site as the consolidated problem manager. Other locations can input and display problems remotely.

historical information

There is a history file in PMA that can be accessed through batch utility programs. It is possible to build any desired report by using data stored in the history file. An analysis is possible of such items as the number of modem or line failures during the last year, vendor response time over a particular period, and information pertaining to the resolution of a problem that may have reappeared. Many problems on a network are those of rediscovery, and consume large amounts of resources that PMA can greatly reduce through proper use of its functions.

Change Management Application (CMA)

In today's environment, particularly on large systems, changes brought about by software applications and relocation of equipment are frequent and require effective coordination to minimize the effect on the system. The Change Management Application (CMA) allows the effective and efficient management of change in

a disciplined and orderly manner. Change control is a very complex process where numerous user groups are involved. When all the required groups are not notified or not involved in ensuring the successful implementation of a change, the results can greatly reduce systems availability. Figure 5 illustrates the different areas that may be involved in the change process.

entering CMA

Entry into the Change Management Application can be accomplished by proceeding through the master menu selection or by transfer of control from another ANMP application. Upon entry into the Change Management Application, the CMA indicates the large amount of function present within the Change Management Application.

change scheduling

After scheduling the create change request, the operator is presented with the CMA basic screen shown in Figure 6, which the user then formats with the information pertaining to the scheduled change. All pertinent information is recorded, including the actual components that are to be changed, the person who requires the change, the person who is coordinating the change, the location where the change is to occur, the approvers and reviewers who are involved, the type of change with a brief description of its content, and a list of any dependent activities.

change coordination

As previously discussed, the number of persons or departments involved in a change can be large, depending on the complexity of the change. CMA allows scheduling of multiple change activities, which ensures that any number of vendors or departments can be individually tracked and all dependencies reviewed. An example of change coordination might be a memory upgrade. Some of the activities required would be those of ensuring that the correct parts for the upgrade have been ordered and will be on site, notification of the vendor to provide necessary personnel, and notification of the operations staff and end users of the hours during which the system will not be available. Test time has to be allocated so that the system is properly checked out after the installation of the change. A check must be made of the main frame to determine that the machine is at the correct engineering level to accept the upgrade. Using the pageable change activity facility of CMA, all these dependencies may be tracked individually and yet tied to the same change. Since the fields are editable and searchable, it is possible for the change coordinator to monitor the process of the change interactively. He may have reports generated for use in tracking the change, or as working documents by the various vendors and departments involved.

reviewers and approvers

In addition to the features previously outlined as part of the Problem Management Application, the change manager also has an approver's and reviewer's function. This facility allows all individuals involved with change control to be assigned a system

Figure 5 Change dependencies

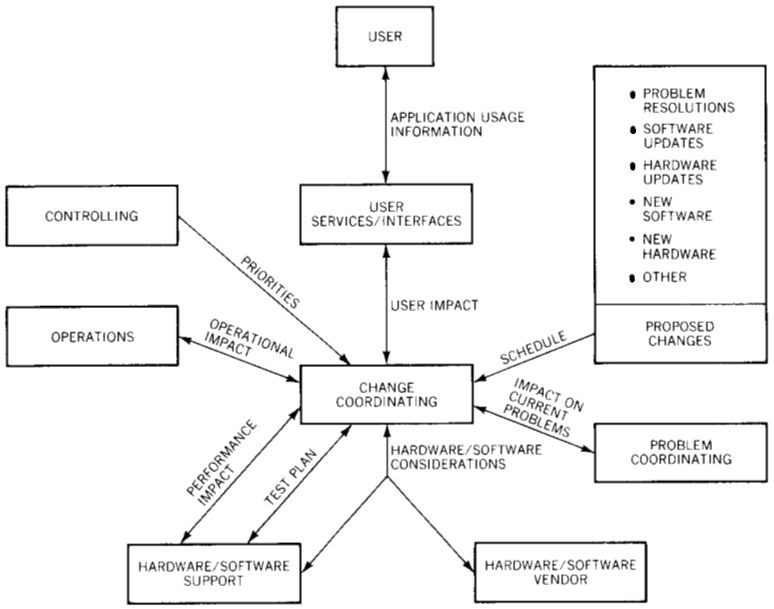


Figure 6 Basic Change Management Application screen

```
************************** CHANGE MANAGEMENT APPLICATION **************************

CHANGE NO:              SELECT:
  STATUS:O          TYPE:     LEVEL:     PRIORITY:     FORM NO :        APPROVAL:
  COMPONENT  :                           LOCATION:                PROBLEM NO :
  REQUESTOR  :                        ENTRY DATE : 01/18/79  LAST UPDATE:
  COORDINATOR:                        TARGET DATE  :           CLOSED DATE: MM/DD/YY
  REASON CODE:      SYSID/CODE:
  DESC:
**CHANGE ACTIVITIES     ------------------------------------------------------------
  ACT NO  :    VENDOR/DEPT:         LOC:          CONTACT:
  ASTATUS :    ATYPE:        SCH DATE: MM/DD/YY  HH:MM    DURATION: DD:HH:MM
  LEVEL   :    CODE :        ACT DATE: MM/DD/YY  HH:MM    DURATION: DD:HH:MM
  DEP ACT :    NODE :        SW COMP :                    HW COMP :
  DESC:
  FLBK:
**DEPENDENCIES          ------------------------------------------------------------
  CHG/CODE:
**CHANGE COMMENTS
  CMNT:
  CMNT:
  CMNT:
  CMNT:

COMMAND = > N     N=NEXT,E=END,PA/PC=PAGE,AA/AC=ADD,PROBLEM OR CHANGE NO
```

identification (ID) and a change code that signifies the types of changes they are involved with. For example, systems programmers are involved with any changes to the operating system, access method, or network control program. A table is built that divides all changes on the system or network into specific types.

Once the requested changes have been entered, the selection of the proper command produces a screen list of the persons who should approve or review that particular change. Changes affecting these individuals then go into a queue that can be displayed using their security IDs. This allows each department to determine the scheduled changes and the workload impact.

If the change coordinator displays the approvers and reviewers list for a particular change, the names of individuals who have not signed off are shown intensified. The approver and reviewer portion of CMA ensures that all parties are made aware of a change, and that those who have an approver responsibility have signed off before a change is implemented.

dependency

Factors that affect a change are outlined in dependency fields, and can be used to signify that other changes must be scheduled before a particular change can be installed. As an example, an engineering upgrade may be a prerequisite for the installation of additional memory.

history file

Upon the completion of a change, the experiences encountered are detailed in the comments field. This provides historical information as to the problems encountered and the amount of time involved in completing the upgrade. This information is then available in the history file and can be accessed by using the batch report facilities should the same type of change need to be implemented in the future.

Network Configuration Application

The Network Configuration Application (NCA) is a key component of ANMP because it provides on-line configuration information required for systems management.

Most systems departments maintain documentation of the network topology on a wall chart or in a book. This documentation is not always readily accessible, a condition that inhibits problem coordination and problem determination. To report a remote terminal problem, the operator must know the location of the device, the responsible vendor, and the priority to assign for resolution. An example of high priority would be "is the only teller station in a bank branch down," or "are there others available?" If the down terminal is the only terminal, a much higher priority is assigned than if one of four terminals is down.

With the advent of the Advanced Communication Function (ACF/NCP), (ACF/TCAM) and (ACF/VTAM) Multi-System Networking Feature (MSNF), a specific application may be resident in one system but may be shared by end users attached to other sys-

Figure 7 Network Configuration Application menu screen

```
****************** NETWORK CONFIGURATION APPLICATION MENU ******************

1.   DISPLAY/CHANGE TERMINAL(X)
2.   DISPLAY/CHANGE LINK(X)
3.   DISPLAY/CHANGE CONTROL UNIT(X)
4.   DISPLAY/CHANGE CPU(X)
5.   DISPLAY/CHANGE PROGRAM(X) OR LIST ALL CPU(Y) PROGRAMS
6.   DISPLAY ALL COMPONENTS CONNECTED TO(X)
7.   DISPLAY PATH(Z) FROM(X) TO(Y)
8.   DELETE PROGRAM(X)
9.   DELETE PATH(Z) FROM(X) TO(Y) OR COMPONENT(X) AND ALL PATHS TO IT
A.   ADD TERMINAL(X)
B.   ADD LINK(X)
C.   ADD CONTROL UNIT(X)
D.   ADD CPU(X)                                  ENTER PMA OR CMA
E.   ADD PROGRAM(X)                             TO TRANSFER CONTROL TO
                                                ANOTHER APPLICATION _ _ _


1              FUNCTION CODE
J62Ø_ _ _ _ _ (X) - COMPONENT OR PROGRAM NAME
_ _ _ _ _ _ _ _ (Y) - "TO COMPONENT" OR CPU NAME
_              (Z) - PATH NUMBER (DEFAULT IS 1)
```

tems. The end users do not know the system that is supporting their application or the routing required to access that application. When an application change is required, the location of the application users must be known in order to assess the impact of the change. On large networks, many components may require changes to resolve a problem or add functions. The NCA application can provide the user with all the configuration information required for systems problem and change management. It can also show the path from the terminal back to the CPU and identify all components included in the path. Entry to NCA is accomplished either from the master ANMP menu screen or by transfer from another ANMP application. Upon selection, a Menu (shown in Figure 7) defining the available functions is presented. Each function can be selected by entering the appropriate data. The configuration data contained in NCA supports effective network problem determination.

Network Error Management Facility

The Network Error Management Facility (NEMF) can be used to monitor network performance as well as to assist with network problem determination. The concepts used are similar to those provided by the Facility Error Recording System (FERS) and the Display Exception Monitoring Facility (DEMF). These two prod-

Figure 8 Individual terminal screen for Network Error Management Facility

```
********************** MOST RECENT SECONDARY ERRORS **************************
TERM                          FOR SELECTED TERMINAL                   NCP MODE

NCPNAME:  CRIJ    LINENAME:  CRIJJ6     CTRLNAME:  CRIJJ6Ø     TERMNAME:  J6ØØ
TOTAL ERRORS: 15  FROM:  01/17  7:49     TO:  01/17  16:05        PRIMARY:

SEL-#    FROM          TO          CNT  OPERATION   CAUSE   ERROR-DESCRIPTION
(01)  01/15 14:20  01/15 16:05  006     N/A      ATTACH  DATA CHK/CURSOR CHK
(02)  01/16 14:00  01/16 14:00  001     N/A      ATTACH  DATA CHK/CURSOR CHK
(03)  01/17 13:01  01/17 13:47  004     N/A      ATTACH  DATA CHK/CURSOR CHK
(04)  01/17 12:32  01/17 12:32  001     N/A      ATTACH  DEVICE NOT READY
(05)  01/17  8:59  01/17  9:15  002     N/A      ATTACH  DATA CHK/CURSOR CHK
(06)  01/17  7:49  01/17  7:49  001     N/A      ATTACH  DEVICE NOT READY

                          *** END OF DATA ***

ENTER SEL-# OR COMMAND
ENTER:  1
```

ucts allow the gathering of error information flowing in the network and make it available in an interactive mode both to the central site location and to the end user.

Reference 2 discusses the functions of FERS and DEMF as well as their application. The need for network monitoring and the benefits of doing so are also addressed. Reference 3 discusses the functions of NPDA and NCCF, as well as their application. This article provides the background required to understand the uses of NEMF.

NEMF enhancements

NEMF provides network problem determination in SNA environments not covered by NPDA, while at the same time providing consistent NPDA support in non-SNA environments. It supports IBM 370X communications controllers operating in NCP (DOS only) or EP (DOS/OS) modes. Support is also provided for locally (channel-) attached communication products. The design of NEMF allows the hierarchical display of network errors, a detailed error description, and probable cause analysis.

entry into NEMF

To select the NEMF application, a user enters the acronym NEMF. The operator is then presented with the NEMF menu screen on which a selection is made of the desired function, such as NCP, EP, or local mode.

NCP selection

For DOS accounts, the selection of the NCP mode results in the presentation of a second menu from which it is then possible, by

Figure 9 Error detail screen for an individual terminal

```
************************ DETAIL OF SELECTED EVENT ****************************
DETAIL                      FOR THE BSC TERMINAL                      NCP MODE

NCPNAME:  CRIJ     LINENAME:  CRIJJ6     CTRLNAME:  CRIJJ6Ø     TERMNAME:  J6ØØ
    OCCURRENCE OF ERROR:  ØØ6     FROM:  01/17  14:20     TO:  01/17  16:05

OPERATION:
    NO COMMAND IN THIS TYPE OF MDR RECORD

PROBABLE CAUSE:
    SECONDARY ATTACHED DEVICE FAILURE

ERROR DESCRIPTION:
    DATA CHECK OR CURSOR CHECK HAS BEEN DETECTED BY THE DEVICE
C   D   0---2---4---6---8---10--2---4---6---8---20--2---4---6---8---30--2---4
91  13  4ØC2C6C4ØØØØØØ

ENTER SEL-# OR COMMAND
ENTER:  END
```

selecting the SCAN command option, to display the total errors for NCP-attached devices. For each NCP, it is possible to step down the network hierarchy to identify the failing line, control unit, or terminal. It is also possible to enter a single command and go directly to the suspected terminal. If the symbolic name of the terminal is not known, the Network Configuration Application (NCA) can be used to provide this information.

terminal screen

The terminal screen appears as shown in Figure 8. This screen provides all information about the terminal and its mode of operation, as well as the NCP, line, and controller names to which the terminal is attached. The total number of errors, including the time of the first error to the time of the last error, is displayed. The most recent errors are displayed in reversed chronological order. Each error entry provides an occurrence count of error, operation at time of failure, and a brief error description, along with the probable cause analysis. More detailed error information is available by selection of the detail error screen. If the error is a repetitive one, it increments the occurrence counter rather than filling the logger with duplicate error records. If the detail of the error is selected the screen format shown in Figure 9 is displayed.

detail screen and probable cause

The detail screen identifies the protocol of the terminal and the probable cause of the failure, and gives a detailed description of the operation and the error. The intent of probable cause is to direct the user to the specific network component that has failed. Probable cause information is derived from network error data

Figure 10 Change Management Application menu screen

```
************************** CHANGE MANAGEMENT APPLICATION ***************************

1.  CREATE CHANGE REQUEST                                  (1/       )
    UPDATE CHANGE REQUEST                                  (1/N.....N)
    DISPLAY CHANGE REQUEST                                 (1/N.....N)

2.  SUMMARY BROWSE                                         (2/A.....A SEL CRITERIA)
3.  DETAIL BROWSE                                          (3/A.....A SEL CRITERIA)
4.  SPECIAL BROWSE OF CHNG ACTIV'S                         (4/A.....A SEL CRITERIA)

5.  QUERY CHANGES FOR APPROVER                             (5/ID A.....A SEL CRITERIA)
6.  UPDATE APPROVALS FOR CHANGE                            (6/N.....N)
7.  ADD OR UPDATE NAMES AND ADDRESSES                      (7/ID)
8.  LIST NAMES AND ADDRESSES                               (8/ OR 8/ID)
9.  ADD OR UPDATE REVIEWERS/APPROVERS BY CHANGE TYPE       (9/CHG TYPE)

ENTER⇒1/_ _ _ _ _ _ _ _
```

and points to the network component(s) that is most likely to have caused a failure. In addition, the actual bit configuration of the error record is shown at the bottom of the screen. The concept of providing probable cause information significantly increases the usability of the product. Network operators with little teleprocessing experience can use this information when contacting a service organization.

MY TERM support allows an end user to obtain the most recent error data about his terminal without having to know the name or address of the terminal.

network error analysis

The Network Error Management Facility provides the user with the capability of obtaining a snapshot view of his overall network, even though it may consist of multiple terminal types using different protocols and/or a mixture of EP and NCP teleprocessing controllers. From the end user's point of view, it is now possible to display errors at a remote terminal by using the MY TERM option illustrated on the command menu shown in Figure 10. The operator of a remote or local terminal that has access to NEMF has the ability to display errors for any attached terminal at any location in the network, regardless of protocol mixtures between the terminal used to display the errors and the terminal that is experiencing the error.

In many multi-CPU installations, there are teleprocessing networks that do not use IMS or CICS as a data base manager. In these

circumstances, if the NEMF error logger is installed on a CPU that does not have IMS or CICS, error information can be accessed from another system that does have IMS or CICS and NEMF installed, via use of the DASD shared access support.

Systems management interrelationships

Systems management tools, such as ANMP and NEMF, facilitate the development and implementation of a comprehensive management system. It is important, however, to understand the various human and physical factors and their interrelationships that make up a specific computer network. The effective management of any network requires the consideration of these factors as well as the employment of various programs to help automate and facilitate the management process.

human factors

The human factors mentioned here are those of common experience. For example, a user has expectations relative to systems function, systems access, responsiveness, and ease of use. Thus a management system must consider and address these expectations and abilities early in the design and planning process. Equally important are the establishment of communications between users and the data processing organization and the establishment of procedures for such operations as reporting, coordinating, and managing change.

A lack of consideration for human factors can have a negative effect on productivity. Some of the factors that affect productivity are the following: availability of applications, problem handling, change implementation, response time, recovery procedures, vendor interface, education, change notification and scheduling, and general assistance. All these factors are controlled more efficiently with a management system to ensure that they are in place and properly carried out.

physical factors

The understanding of each component in the data processing complex and its performance in terms of availability and in meeting the intended need is an ongoing activity. The effect of component failures must be constantly evaluated and backup and recovery procedures developed. Good problem management, including outage analysis, provides assistance in the area of impact analysis and the status of the components in the network.

Certain failures can be isolated by the failing component and notification sent to the system, whereas other types of failures tend to be more elusive. When a component fails to identify itself, data visibility in the network is required to resolve the problem. This can be accomplished through the use of error statistics, traces, dumps, or various tools or test equipment.

Information on location of each component and its status becomes critical in developing backup procedures as well as in understanding the satisfaction of specific user needs. Assistance for each component is often one of the critical areas that management systems fail to consider.

Capacity planning deals with the question of whether the service level satisfies the intended use and whether there is a margin of capacity to allow for peak periods and managed growth. Plans may be developed to project requirements over a several-year period and take into consideration possible reduction or growth in systems requirements.

Concluding remarks

The complexity of teleprocessing networks and the wide geographic distribution of both function and users has made the management task a highly critical one. The approach taken with the Account Network Management Program and the Network Error Management Facility is to provide the basic management discipline to ensure that all user requirements can be achieved. The programs by themselves cannot accomplish this objective. However, in conjunction with management commitment to establish a structured, disciplined systems management approach, we believe this objective can be achieved.

CITED REFERENCES

1. IBM Corporation, *Network Control Center Users Guide*, G226-3551, available through IBM branch offices.
2. J. B. Ford, "Enhanced problem determination capability for teleprocessing," *IBM Systems Journal* **17**, No. 3, 276-289 (1978).
3. R. A. Weingarten, "An integrated approach to centralized communications network management," *IBM Systems Journal* **18**, No. 4, 484-506 (1979).

GENERAL REFERENCES

Systems Management—A Network Perspective, G229-0282, available through IBM branch offices.

NEMF Program Description and Operation Manual, SB21-2528 (DOS/VS) and SB21-2526 (OS/VS), available through IBM branch offices.

ANMP Program Description and Operation Manual, SB21-2524 (DOS/VS) and SB21-2522 (OS/VS), available through IBM branch offices.

DOS/VS Incident Reporting and Tracking—FDP5798-CNP, Description/Operations Manual, SB21-2048 (December 1976), available through IBM branch offices.

OS/VS On-Line Problem Tracking—FDP5798-CNJ, Description/Operations Manual, SB21-2020 (December 1976), available through IBM branch offices.

Facility Error Recognition System User's Guide, G229-7031 (January 1979), available through IBM branch offices.

VSE/Interactive Problem Control System: User's Guide and Reference Manual, SC34-2015 (DOS/VSE) (March 1979), available through IBM branch offices.

Network Communications Control Facility, Licensed Program 5735-XX6, General Information Manual, GC27-0429 (October 1978), available through IBM branch offices.

Network Problem Determination Application (NPDA) General Information, Program Number 5735-XX8, GC34-2010 (October 1978), available through IBM branch offices.

J. P. Gray and T. B. McNeill, "SNA multiple-system networking," *IBM Systems Journal* **18,** No. 2, 263–297 (1979).

OS/VS Display Exception Monitoring Facility (DEMF), System Information, GC34-2002 (1977), available through IBM branch offices.

OS/VS Display Exception Monitoring Facility (DEMF) User's Guide, GC34-2003 (1977), available through IBM branch offices.

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