The term management implies the achievement of objectives through effective use of resources. Management style relates to the various approaches used in pursuit of those same objectives. There can be various management tools contributing to an effective management solution. In this article we will be discussing one such tool.

This management tool reflects an approach to communication systems management in which the management functions are physically separated from the host computers driving a communications network. These management functions are packaged on a small IBM *processor base (i.e., sidestream processor) and designed for use in a centralized network management center environment. The management functions included in this sidestream processor tool relate to problem management, change management, project scheduling and tracking, network control, and network configuration.*

A sidestream approach using a small processor as a tool for managing communication systems

by J. R. Leach and R. D. Campenni

Today, numerous advancements in teleprocessing are resulting from rapid technological breakthroughs. However, these positive enhancements in selected areas such as functional capability and lower component costs are often accompanied by such negative factors as more costly skilled labor and management complexity. Thus, it is important to exercise good management discipline in the areas of system planning, system development, and system operation. Technology can also benefit the management system through automated management functions and lower costs for management tools. The use of such management tools almost becomes mandatory if a stable situation is desired in a continually growing telecommunications environment.

One can generally characterize the teleprocessing environment of today as inadequate in real management discipline. However, successful management systems have existed since the early 1960s (e.g., SAGE, Ballistic Missile Early Warning System, NASA

Manned Spaceflight Systems, FAA Air Traffic Enroute System, multiple Department of Defense Command and Control Systems, multiple Airline Reservation Systems, etc.) in the teleprocessing area without benefit of today's technology. The difference between then and now appears to be one of clear recognition of objectives and a willingness to pay the associated price.

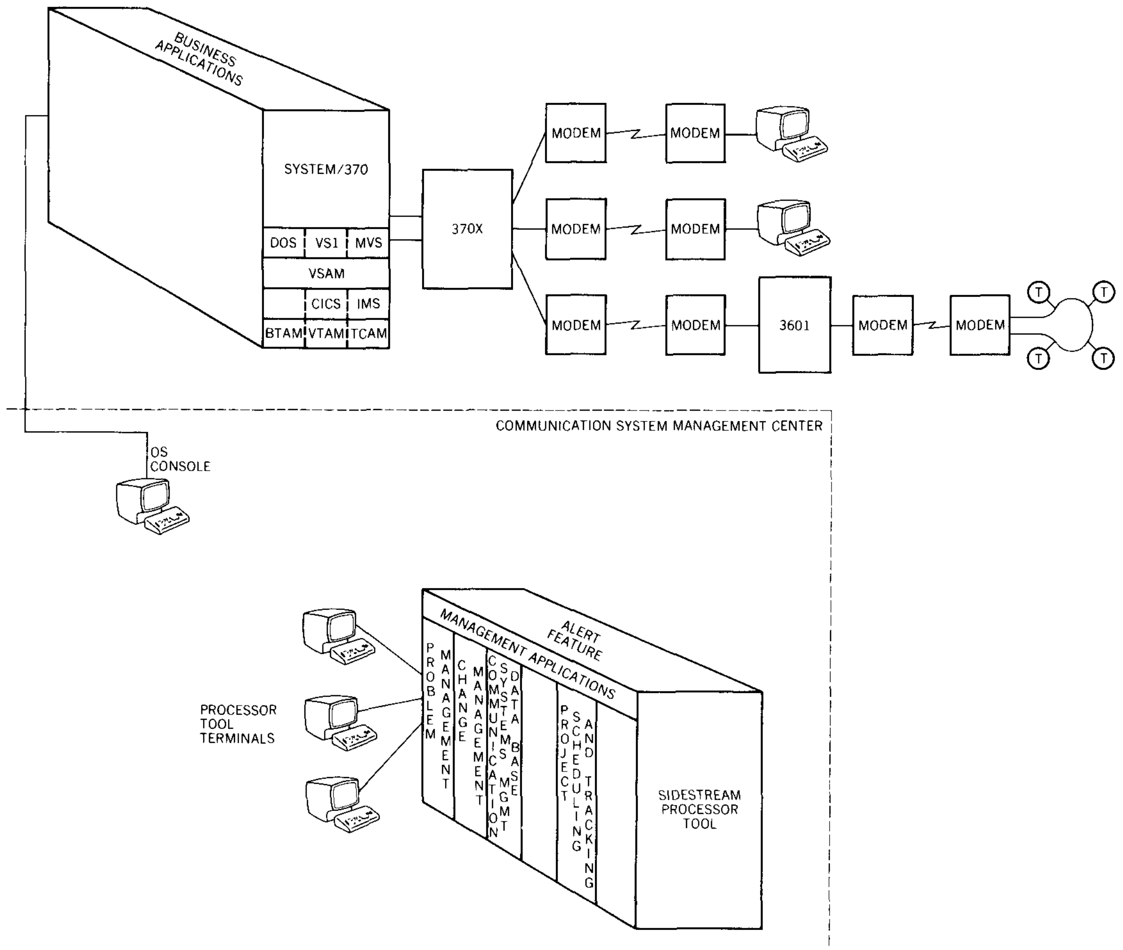
The prototype management tool, which we call a "sidestream" processor tool (based on use of an IBM Series/1) as discussed in this paper, has benefited from past experience. It is also an outgrowth of a study between IBM and a customer where the management objectives and associated price were clearly understood. The management tool was planned, developed, and tested in concert with the application system. Thus it had its own project nature and emerged as an operational tool at the same time as the application system became operational. This tool was designed to automate many of the labor-intensive management activities associated with a large teleprocessing environment. Heretofore, many of these activities were done manually by the data processing organization. The tool was also designed to complement a centralized management organization in a network management center environment, other tools such as digital and analog communications test facilities, product-oriented problem determination procedures, and other generalized operational procedures. This total management approach has put the customer in the position of being an experienced system manager and fully confident that he can satisfy the expanding service level objectives of his corporate organization.

The shortcomings in today's management systems and the realization that automation of management styles may not be solved with a single universal tool is clear from past experience where user requirements demanded diverse hardware products, multiple operating systems, multiple data base access methods, and multiple data communications access methods. As a result, IBM has tested a number of different approaches to communications management tools. Some of these tools are based on the traditional host computer application environment (i.e., mainstream) as discussed in other papers.[1,2] Another approach is the sidestream processor tool prototype being discussed here. This prototype includes functions as discussed in the following section.

Prototype design

A total management system has to address the system planning, system development, and system operation processes. Within these distinct processes there must be components to address problem management, change management, installation management, project management, performance management, account-

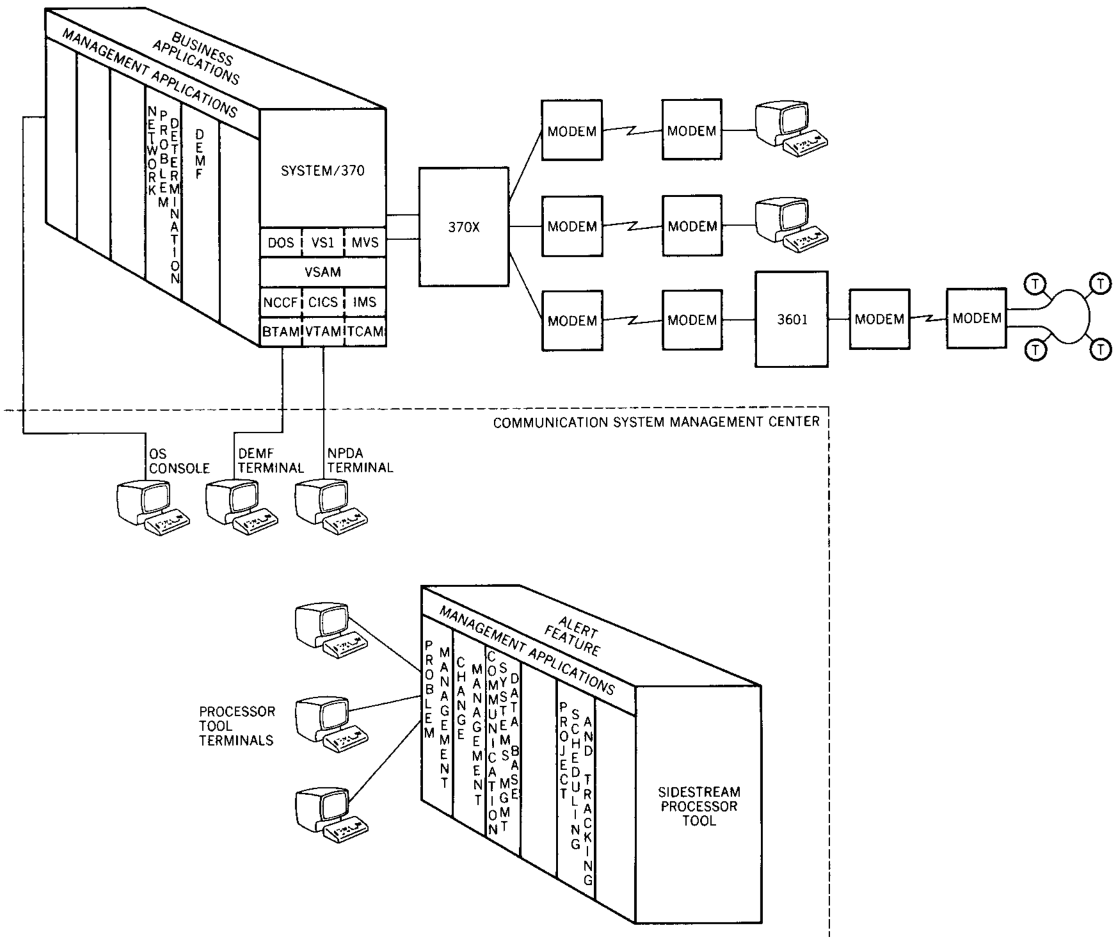
Figure 1 Sidestream approach



ing management, security management, recovery management, operations management, etc. With the sidestream small processor tool we are focusing on an *integrated* approach to problem, change, and installation management relative to the systems operation process (Figure 1). These particular areas have special significance because (1) they are major cost elements today for any teleprocessing servicer and (2) there has not been an effective integrated approach to problem and change management.

It should also be noted that a sidestream approach is complementary to a mainstream approach (Figure 2). In this illustration those management functions that are best integrated into the host (i.e., network problem determination application, display exception monitoring facility (DEMF), network performance appli-

Figure 2 Sidestream approach complementary to mainstream approach



cation, interactive problem control system, etc.) are shown complementing the sidestream approach to form an overall system management approach.

The specific philosophy which guided the design of the prototype is summarized as follows:

1. *Addresses all components of a communication system*—A communication system consists of *all* system-related components. We define a component as anything that, when not functioning properly, impacts the end user. Included are terminals, modems, lines, multiplexers, storage devices, processors, system software, and application software used to support a network. Also included are the sources of power,

air-conditioning, water chillers, and numerous operational procedures because their failures can also impact the end user.

2. *Anticipation of problems*—Problems must be approached realistically with the realization that they will occur. Procedures should be in place to minimize their impact. This, of course, is true for any computer system. However, when the computer system is contained in one location and a select group of computer operations personnel (e.g., user help, host control, network control, master terminal operator) interface to it, outages can be more easily managed, and the end user can be shielded from a number of problems.

   The span of control is greatly increased when terminals are attached to the computer. The computer operation is more visible, and it is more obvious to the end user when things are not working properly.

3. *Oriented toward centralized management*—The third principle of the design philosophy of the prototype is *centralized* management. All user problems must be called to one central location. This implies that it is necessary to accept anything the end user wants to categorize as a problem (this is consistent with principle 1). It also implies that the prototype is able to promptly collect the data that the user provides on the problem. The process of recording all problems in one centralized location helps to solve problems. For example, if a telephone line fails, and all the users connected to that line call the central location, the cause of the problem will be fairly evident.

4. *Separate system*—The problem management system is implemented on a computer separate from the system being managed. By being separate, the sidestream processor tool can be inserted into the communication system operational process without any disruption to the applications. The tool is not dependent on host hardware or software configurations, so the customer can change applications, hardware, or control software without disrupting the tool. The tool can in fact be used to manage such changes. It is available during most system outages. Installation and maintenance of the processor tool are not competing for resources used to run the communication system. Contention for system resources and critical programming skills is avoided. Physical network facilities (lines and modems) can be installed, tested, or reconfigured prior to attachment to the operational host CPU or to a communications multiplexer that has been properly generated for the system. This requires additional test equipment which will be discussed later under Network Control. This capability enables flexible installation/reconfiguration plans, with multiple activities being completed in parallel.

There is another subtle benefit to a separate system. On-line networks frequently have customer service, quality control, or other departments outside the data processing organization responsible for network stability. A separate system provides a tool totally controlled by that organization.

Lastly, there is an element of simplicity associated with a separate system approach. The sidestream processor tool becomes stable after installation and provides reliable service for long periods before there is a component failure. By being separate, it also frees management from addressing interactions that might occur with the business application system.

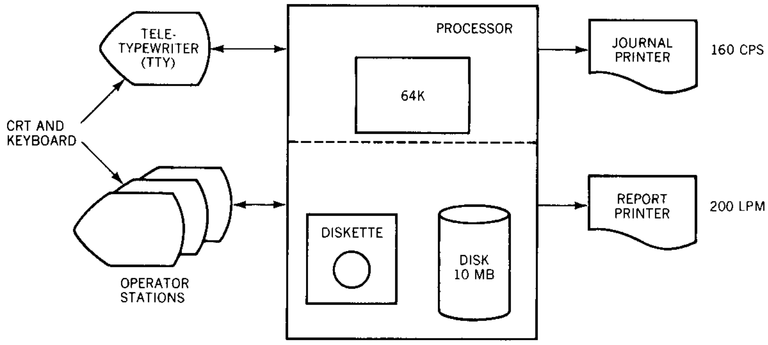
5. *Single data base*—The prototype maintains a data base reflecting the current state of the communication system including all problems and changes affecting the communication system. Any user group, customer group within the data processing organization, supplier, or contractor has access to relevant data from this data base. This will prevent each group from having a separate list of problems and priorities.

6. *User advocate*—A final and key principle of the design philosophy is that the communication system management staff must view itself as a user advocate as opposed to a data processing center advocate. Many of the sidestream processor tool functions are oriented to this attribute. Flexible formats, alerts, scripts, and data base are major examples of the end-user advocate.

Sidestream processor tool physical configuration

In order to achieve the sidestream approach design objectives of environment independence, establishment organizational structure independence, and high tool availability, it was decided to implement the basic management functions on a physically separate and dedicated processor. To achieve the objectives of cost effectiveness, it was decided to use a small processor with expansion capabilities in processor speeds, storage sizes, I/O peripherals, etc. Figure 3 illustrates one potential configuration with three operator stations; however, up to 14 operator stations can be attached to a single processor, if so required. Also, to achieve customer productivity through use of lower skill levels (e.g., fewer technicians and no programmers), a turnkey package of control and application software was integrated into diskette format. Customer access to flexible function is achieved via utility functions which allow easy format specification for problem management, change management, configuration management, report generation, alert values, authorizations, etc. Lastly, a predefined starter system was packaged on optional diskettes to allow tool

Figure 3 Processor tool components



K = KILO (1000)
MB = MEGABYTES (1 MILLION BYTES OR CHARACTERS)
CPS = CHARACTERS PER SECOND
LPM = LINES PER MINUTE

installation and production use within a short period. For example, with the prototype we were able to install a system in as little time as one hour.

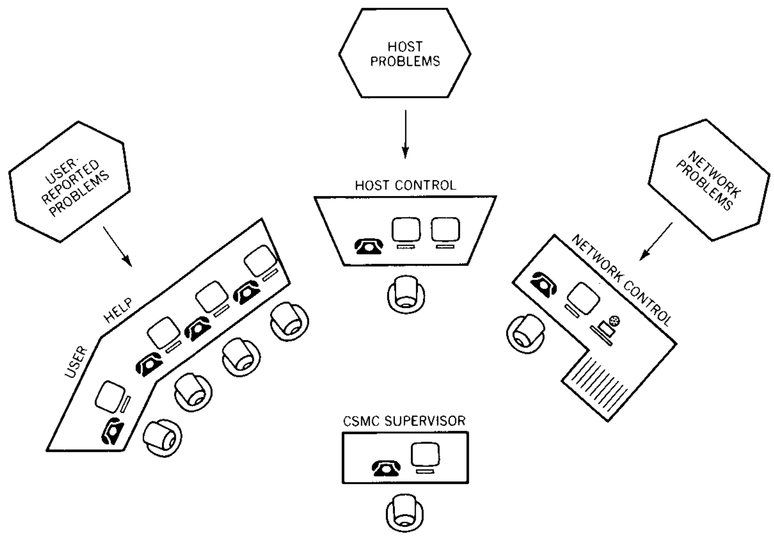
The communication system management center

A focal point where all problems are managed is of primary importance to problem recognition. Ideally, a communication system management center is the entity in an organization that provides this focal point. The small processor containing the software for the sidestream processor tool is physically located in this center. Communication system problems, changes, and projects will be managed within this entity. One way to organize this center for communication system management is to have the primary host console and the various system consoles that apply to the communication system located in the center.

The organization and staffing is hierarchical and reflects the four key functions of the center. See Figure 4.

1. *User Help* is the entry point for user-reported problems. People in this function understand the operation of the end users' terminals and possess good verbal communication skills. They have responsibility to log the reported problems and perform first-level problem determination. They resolve operational problems or identify the correct problem resolver capable of further problem determination. It is helpful if these people are technically conversant but they need not necessarily be technicians. Experience has shown that a large percentage of network problems can be handled by the user help function without assistance from technicians. This relieves the

Figure 4 Problem flow in the communication system management center



host operator and the teleprocessing experts from the routine phone work they have traditionally done, thereby allowing these highly skilled people to focus on problems requiring their talents.

2. *Host Control* is the operator or operators who are actually running the on-line systems. Locating this group in the center allows easy interface to all people involved with the communication system. This is important to sustained operation and the coordination of problems.
3. *Network Control* is responsible for the physical communications network. This function will be discussed in detail later.
4. The *Center Supervisor* oversees the process of resolving problems. The supervisor is also the destination of management alerts and a safety valve for user complaints.

These functions do not necessarily represent individuals. The number of people in a management center will depend on the size of the communication system and the organizational structure of the data processing center.

Processor tool implementation

The processor tool is implemented through four major elements:

1. Problem management
2. Change management
3. Project scheduling and tracking
4. Network control

Problem management

Problems in the communication system are divided into two categories: (1) major outages and (2) service degradation.

The first category is the loss of a major facility, such as the outage of a telephone line, multiplexer, or CPU. People in the organization usually have the expertise to manage major outages. What is often ignored are individual minor "irritants" that collectively contribute to service degradation. Such irritants include problems with the operation of the hardware and software, and poor performance by operators and by suppliers of various services.

Service degradation and major outages have equal impact on user satisfaction, and evaluating the effectiveness of a communication system exclusively from reports and statistics generated by host programs may result in missing what is actually happening. An evaluation of the performance of all factors involved with system operation must be based on how the end user views the communication system. System degradation is addressed by the processor tool just as effectively as it addresses major outages.

We now discuss four components essential to the processor tool problem management system. They are: (1) a structured approach, (2) alerts, (3) assisting the center operator, and (4) a complete record of problem activity.

structured approach

When the user calls to report a problem, the user help operator opens a problem record on the processor tool and selects the appropriate problem category. Categories may include host hardware, host software, remote hardware, facilities, line, modems, procedures, the tool itself, etc.

These categories were previously defined by the organization managing the communication system. Unique express formats can also be designed to enhance quick and meaningful data capture. At the time these categories were originally generated, unique data fields were defined for each category. We also note here that decisions can be made to specify attributes for each data field, namely length, use, required versus optional, fixed versus variable length, numeric versus alphanumeric, and default values. These fields will now be displayed to the user help operator to prompt for relevant data.

After recording the data needed from the user, the operator then examines the data base for additional data needed to complete the problem record. If sufficient information is available at this point, the operator will assign the problem to a specific problem resolver. If the correct problem solver is not known at this time, the problem will be assigned to another individual in the management center for further problem determination or to the center supervisor if management action is required.

alerts

The steps just discussed could be carried out in a manual system. However, in a manual system paper can get misplaced, problems can go unresolved, and schedules can be missed. To assist in the tracking of problems, the processor tool provides an *automatic*, three-stage alert facility. The alert is a notification to the center operator and ultimately to management that some situation requires attention.

The first-stage alert notifies the operator that it is time to follow up on the progress of a problem. An alert does not create havoc in managing the communication system. It simply notifies operators that it is time to review the progress of a problem.

A second-stage alert escalates notification to the operator's supervisor if no action was taken by an operator after a first-stage alert. Management is now involved in time to *act* rather than *react*. In similar fashion, an automatic third-stage alert escalates notification to another management hierarchical level if no action was taken by either the operator or the next supervisory level. Alerts are also recorded in the problem record history to allow for audit trail analysis.

There are three conditions that will cause alerts: (1) time exception, (2) reopened problem, and (3) excessive reassignment.

A time exception occurs if no action is taken within a designated period of time. If the management center calls for service and the supplier fails to respond within the established time period, a first-stage alert is issued. A second-stage alert is issued if no corrective action is taken within a subsequent designated period of time. Finally, if there is still no corrective action, a third-stage alert is issued.

When a problem is logged in the processor tool as resolved, it is closed. If the same problem reoccurs, it may be reopened. Reopening a closed problem causes a second-stage alert because from the end user's perspective, it is an aged problem, and it should also be worthy of management review. Management attention will help to minimize abuse of the alert feature by premature operator closing action to avoid the alert function.

Excessive reassignment occurs when no one problem solver will take responsibility for a situation. An alert is issued if a problem is reassigned four times.

assisting the center operator

The gathering of relevant data for problem management is accomplished through system prompts to the operator. If the operator is unsure of what to enter in the data collection fields or who should receive the problem, additional operator prompting is available through a feature called *scripts*. Scripts are user-defined programs written in a simple English-like language, which run in the processor tool. When an operator calls a script, text is displayed or questions are presented on the center operator's display terminal. The operator's response determines the path to the next question. More text may be displayed or another question asked. Answers to script-prompted questions may be automatically inserted in the appropriate data collection fields in the problem data collection format. A script may also contain information that could be used to circumvent or even solve the caller's problem. In this mode, the script functions as a problem determination procedure and/or a problem recovery procedure. Scripts may also present a menu of options. The operator selects one of the options, which results in other scripts being invoked. New center operators are apt to become productive more quickly through the use of scripts.

problem activity record

All problems are logged and tracked. No problem record can be deleted. Updating a problem record always adds to the record; it never rewrites any part of the record. The complete record provides data for basic status reports. In addition, the data is gathered and formatted for convenient processing by the host computer. Host data reduction programs can process the information to produce reports for management evaluation and trend analysis.

Change management

A specific change may or may not be desirable, but any change can be catastrophic if unmanaged. Every installation has a procedure for handling change. The procedure may be an informal one in which there is an oral communication that a change needs to be made and that it should be done by a specific time. If there are no objections, the change is implemented. Most data processing organizations have a change management system with more structure than the informal one just mentioned. Included with a request for a specific change may be an estimation of its priority and the schedule for its implementation. The proposed change is then reviewed. This review process may involve one person or many people at a regularly scheduled meeting.

Change management as implemented in the sidestream processor tool will *enhance* an existing change management system, not replace it. If a formalized change management system does not exist, the processor tool provides an automated change management system. The functions addressed are:

1. *Change Request*—A person requesting a change enters the request through the tool. The change request is assigned to a specific category, and the reviewers associated with that cate-

gory are automatically assigned and notified. The user-defined formats will capture all relevant change data (e.g., description prerequisites, impact, backout procedures, etc.).

2. *Prioritization and Scheduling*—When the change request is entered in the tool, key operational dates are recorded. These dates indicate when each stage (review, test, implementation) should be completed. Reports will be *automatically* generated for distribution. Text of specific changes will be generated for individuals responsible for reviewing changes of a given category. A calendar of all planned and implemented changes will be printed for general distribution. This calendar is used to identify conflicts in the schedule and communicate the status of changes in the communication system.
3. *Change Review*—Reports provided by the processor tool enable changes to be individually reviewed. Approvals and disapprovals are entered into the system. The change requester is automatically notified of disapprovals. If all reviewers approve the change request, those individuals and departments affected by the change will receive printed notification.
4. *Implementation*—Implementing the change also involves testing and planning fallback procedures. This data should be entered into the change request record. When a change has been tested or implemented, those affected are notified.
5. *Alerts*—If the review, test, or implementation date specified passes without indicating to the processor tool that the phase was successfully completed, an alert will be automatically issued. These dates may be altered to reflect changing conditions. Thus, alerts tend to establish discipline for the change process.
6. *Problem Management and Changes*—There is a clear relationship between changes and problems in communication systems management. Resolving problems often entails change. However, changes can cause problems. By maintaining a history of implemented changes, the change management facility becomes an integral part of problem management. A display of selected changes from the change history file is available during problem determination. If a change appears to have caused a problem, the backup or bypass procedures included in the change request record could be an interim solution. A field may be defined in the change record to indicate that this change is a result of a specific problem. A field may also be included in the problem record to indicate that this problem is a result of a specific change. Reports can be generated to indicate the quality of the change review process and cost of particular changes.

Some benefits of the automated approach are that it:

- Provides a tool to facilitate communication to concerned parties.

- Provides a preview of changes to expedite the review process.
- Provides a vehicle to detect potential conflicts in scheduled changes.
- Enhances problem management by providing a central source for information related to changes in the communication system.
- Provides a means to record the effect of changes on the communication system.

Project scheduling and tracking

Some communication system changes are simple, one-step procedures; others involve a series of tasks or steps that must be completed before the change is implemented. Changes requiring a series of tasks are projects. Project scheduling and tracking is a tool to assist in more effective project management.

Project management in the general sense may be divided into planning and execution phases. Several tools are available to aid in planning the project. Technicians are available who understand how to execute the plan. What is sometimes poorly handled is the process that connects these two phases: scheduling project tasks and tracking their implementation. This process involves assigning resources and monitoring the tasks to avoid conflicts as discussed below.

Establish a plan—A project plan is developed using the traditional tools. The project tasks are identified, and the duration of each task is estimated. This information is entered into the processor tool. Once the project plan has been entered, a project start date is specified. The system then creates a working plan, identifying the various tasks to be completed by specific dates.

Project control point—A project that involves installing new equipment in the network may require electrical, heating, air-conditioning, and telephone changes, all involving different suppliers. Data indicating the schedule and sequence of these activities is carried in the project record.

When a subcontractor or supplier finishes a task, that information is called to the communication system management center and recorded in the project record. Everyone working on the project will have the most current data available, thus preventing conflicts. If completions are not recorded within the specified time, an alert is *automatically* issued.

Repetitive projects—Some projects are repetitive. For example, if a new terminal is to be installed in several locations within the communication system or a new version or release of a control problem is to be installed in every communications controller in the communication system, the same project plan may be reused. A master plan is developed and entered in the system as before. Multiple projects can now be created simply by entering a different start date for each new working plan.

The purpose of project scheduling and tracking is to enhance management control. This system will automate the record-keeping function and provide a single point for contact. The schedules, alerts, and the periodic progress reports generated will give management better control over the progress of a project.

Network control

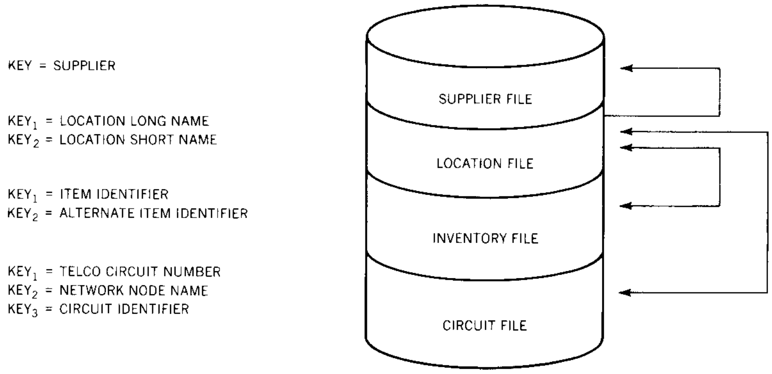
As stated earlier, network control is responsible for the physical communications components. In order to clarify this responsibility, it is necessary to make a distinction between physical problems and logical problems. Physical problems are those directly associated with physical components of the network. Examples include problems associated with the CPU, modems, lines, terminals, controllers, etc. Logical problems are those associated with program communication over the functioning physical paths.

Problem determination can be greatly simplified if the physical network integrity has been established. Over the years, many tools have been used to accomplish this. Some of these tools are audio panels, decibel meters, data line test sets, modem test sets, oscilloscopes, Electronic Industry Association (EIA) interface displays, data link character displays, and digital or voice frequency patch panels. Recently, the introduction of intelligent modems has helped remove some of the difficulties in network problem determination.

An intelligent modem has the ability to decode an address and thus recognize messages sent to it, to recognize control data, act upon commands received, and transmit specific status information about itself. Additionally, they typically have self-test capability and are capable of being looped back to the data terminal and/or the communication channel.

Communication with these intelligent modems may be accomplished in one of two ways normally referred to as mainstream or sidestream. Mainstream communication is accomplished in the normal data communication channel. Data intended for the intelligent modem is inserted directly into the flow of data normally intended for the business machine. This data insertion is accomplished by momentarily interrupting the flow of data from the business machine, or by inserting the modem data into gaps in the business machine data. The first technique requires additional code in the communication control program, whereas the second technique requires the ability in the modem to recognize gaps according to the communication protocol being used.

Figure 5 Relationships of files



Sidestream communication is accomplished outside of the normal data communication channel. Rather than use techniques that implant the modem status data within the business machine data, analog multiplexing techniques (i.e., frequency multiplexing) are used that allow the modem data and the business machine data to coexist on the same communication carrier. Coexistence is accomplished by utilizing a portion of the bandwidth that is available on a telephone line not required for the business machine data. Sidestream communication usually requires additional hardware such as a microprocessor to control the flow of data (sidestream communication cannot be used in digital transmission systems such as Dataphone® Digital Service).

The data available from these intelligent modems is of immense value when used as a problem determination tool. To list a few examples, it is possible to determine if a terminal is powered on or off by examining the "data terminal ready" lead on the EIA interface that is the interface between the business machine and the modem. By an examination of the "request to send" and "clear to send" leads it is possible to determine if a modem or a terminal is causing a streaming condition. (Streaming is a condition that exists when a multipoint terminal is transmitting continuously. A streaming terminal blocks out communication with all other terminals on a multipoint line.) The state of the "data set ready" lead can indicate whether or not a modem is in a test condition.

Additional problem determination capability exists in the ability to transmit commands to the modems. This ability can cause a modem to self-test and report the results, to transmit and receive predetermined test patterns and detect errors, to switch to standby modems, or to loop back either the phone line or the terminal. In the case of a streaming modem or terminal, it is possible to prevent transmission on that modem, thus restoring the rest of the line. Furthermore, all of these tests are controlled in the communication system management center and require no involvement of personnel at remote locations. The fact that these tests can be executed from the management center is even more significant when a remote site is either unattended or staffed by nontechnical personnel.

The recognition of a problem utilizing the intelligent modems, coupled with the problem tracking structure of the processor tool system, has the effect of making both functions more valuable than they are when used separately.

Information to support the sidestream processor tool

The processor tool maintains a data base reflecting the current state of the network. This data base consists of four files. The content of these files is summarized in Table 1.

In addition to the data required by the tool, each file provides space for information defined by the management of the center. Examples of this information are shown in Table 2.

These files are related by a set of pointers. This relationship is indicated schematically in Figure 5.

The four data base files provide information to support the problem management effort. Each particular file has to be accessible from the reference point of the person who needs the information. Therefore, the locations and circuits are known to the system by more than one name. These names are defined by the communication system management staff.

The location file points to the inventory items at the location, the suppliers who service the location, and the circuits which are connected to the location. The circuit and inventory records point to their associated locations.

If the location is known, any inventory, supplier, or circuit associated with the location can be determined. If the circuits are known, any location on that circuit can be found. If an inventory item is known, it is easy to find the suppliers servicing it by examining the related location record and then the suppliers that service the location.

Concluding remarks

Prototype testing experiences have led the authors to the following observations in the specified areas.

Table 1 Files to support sidestream processor tool

File	Description
Location	Names each physical location in the communication system
Inventory	Identifies communication system components to be managed
Supplier	Lists the suppliers who service the communication system
Circuit	Describes the communication lines in the communication system

Table 2 Customer-provided data

File	Possible Customer-Supplied Information
Location	Primary contact, address, hours of operation, security or after hours phone numbers, etc.
Inventory	Microcode level, diskette volume identification, available back level, etc.
Supplier	Phone numbers, hours of service, dept/person to contact, service reporting procedure, etc.
Circuit	Alternate dial backup, line speed, times of availability, protocol, etc.

1. *Management objectives*—This is the key element of any management system. Data processing management must clearly state their objectives relative to delivery of data processing services to end users. When these objectives are clearly known, then monitoring for deviations can be performed effectively. Thus, a management system must be capable of recording appropriate information required for management decision making. This requirement necessitates a need for tool flexibility to cater to unique customer requirements. This flexibility is required in the areas of problem management, change management, communication system data base, and report generation. Such flexibility should allow user definition of categories, reports, data fields (i.e., names, sequences, length, required versus optional, numeric versus alphanumeric, fixed length versus variable length).

2. *Management discipline*—automated tools can contribute to improved management discipline. There are benefits from automatic notification (i.e., alerts) about management events that should have taken place. An automatic notification system contributes to increased problem management discipline

because of its increasing hierarchical visibility as it escalates. This escalation activity also contributes to shorter problem resolution times because it minimizes the errors of omission that may result in an undisciplined environment. Lastly, an active notification system contributes to increased data processing credibility with the end-user community. This credibility results from the end user's awareness that the management center operator is working the problem without benefit of additional end-user complaints. In the change management area, active notification will prevent additional costs resulting from poorly coordinated changes in a distributed processing or similar environment. Similarly, an active notification for project scheduling and tracking elements can reduce costs with unnecessary rescheduling associated with suppliers, building contractors, etc.

3. *Separate systems*—The definition of "sidestream" as discussed in this paper is based on physical separation of the management tool from the business application process. It allows data processing management to choose this approach when they might have the following environment:

   - An organizational structure that desires complete control of the management tool
   - A requirement to have tool availability when the host processing environment is unavailable
   - A requirement to have management function without regard to communication system component dependencies (i.e., no hardware/software prerequisites)
   - A requirement to have the capability to modify management function without supplier dependencies (e.g., functional enhancements via new software releases from supplier)

4. *Productivity*—Customer productivity can be considerably enhanced by a management tool that

   - Installs quickly and without requirements for highly skilled technical personnel (e.g., system programmers)
   - Allows for clerical skill levels and technical skill levels in realistic ratios
   - Can be dynamically updated by the management organization without depending on suppliers

5. *Cost Effective Tools*—Management tools must be cost effective to receive proper consideration. They must be considered relative to the potential teleprocessing growth requirements of the enterprise. Trade-off analyses must be made between manual but labor-intensive efforts and automated tools. Data processing management must be able to articulate the value relative to the communication system management re-

quirements and do the necessary planning relative to the future business environment. Too often this approach is not taken, and automated tools are pursued on an expedited basis only in crisis or disaster mode. In the absence of a crisis or a proper future plan, management usually finds it difficult to justify funding of automated management tools. For example, our prototype testing forced a trade-off analysis between the traditional manual approach and an automated tool as described in this paper which cost less than the services of one person on a life-cycle basis. It is our opinion that this may not be a difficult position for a growth-oriented enterprise that wishes to enhance management discipline.

These observations were consistent with the design philosophy of the sidestream approach. The inherent flexibility of the tool allowed for dynamic adaptation as a result of operational experience with negligible impact to the business application process. This same flexibility allowed for subsequent creation of an IBM predefined starter system for a short installation period at a subsequent test facility with the prototype. Also, the above activity was accomplished without the need for any system programmers or technical knowledge of the sidestream processor. Lastly, this automated tool has helped prototype facilities to achieve the objectives of productivity, management discipline, and resultant end-user satisfaction.

Dataphone is a registered trademark of AT&T.

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