AUTOMATING SYSTEM CONTROL FUNCTIONS IN THE DEFENSE COMMUNICATIONS SYSTEM

MAJ Steven M. DiSilvio
John D. Edell

Defense Communications Agency
Washington, D.C. 20305

ABSTRACT

System control for the Defense Communications System (DCS) currently requires time-consuming manual efforts to consolidate status inputs and provide control responses via a highly centralized control structure. Integration within the DCS is very limited since subsystems (e.g., circuit switched voice, packet data, and transmission) in the past have typically been developed using unique, non-interoperable hardware and non-common data definition. The Defense Communications Operations Support System (DCOSS) is intended to improve the survivability, wartime effectiveness, integration and responsiveness of existing DCS system control through automation of the DCS control structure. Computers are expected to perform many of the system monitoring and real-time control functions using an integrated network of hardware and software systems.

INTRODUCTION

The mission of the Defense Communications System (DCS), managed by the Defense Communications Agency (DCA), is to provide the long-haul, point-to-point, and switched network telecommunications needed to satisfy the validated communications requirements of DOD and other authorized government agencies. The DCS consists of a number of subsystems, including circuit switched voice and data, secure voice, packet data, and message processing networks. These networks utilize terrestial, radio and satellite transmission capabilities provided by both military and commercial carriers. The objectives of DCS system control are to provide maximum utilization of available DCS resources at all times, to maintain connectivity among critical users in all levels of stress, and to assist in reconfiguring and reconstituting the DCS whenever necessary.

BACKGROUND

The DCS, as it exists today, is the starting point for the transition and evolution to the future DCS. The DCS is currently undergoing dramatic changes by taking advantage of new developments in communications technology. The Automatic Voice Network (AUTOVON) is evolving into the Defense Switched Network (DSN) which will employ a significant number of new digital switches. The DCS transmission facilities which interconnect bases and sites throughout the world are moving from analog to digital. The Defense Data Network (DDN) is being implemented to satisfy increasing digital data traffic requirements. Inter-Service/Agency Automated Message Processing Equipment (I-S/A AMPE) will be replacing the Automatic Digital Network (AUTODIN) to provide subscriber-to-subscriber formal message service, computer-to-computer communications, and command and control record traffic using DDN as the transmission backbone. Because of the rapidly expanding size and complexity of the DCS, overall control is becoming more complex and critical. There is a need to consolidate control requirements and provide an integrated method of allocating resources and correcting operational problems. The system being implemented to provide survivable, integrated and responsive system control for the DCS is called the Defense Communications Operations Support System (DCOSS).

CURRENT SYSTEM

The current DCS control system has several limitations - survivability, integration, and responsiveness. The system is based on the highly centralized control structure shown in Figure 1. The DCA Operations Center (DCAOC) located at DCA Headquarters in Washington, D.C.,

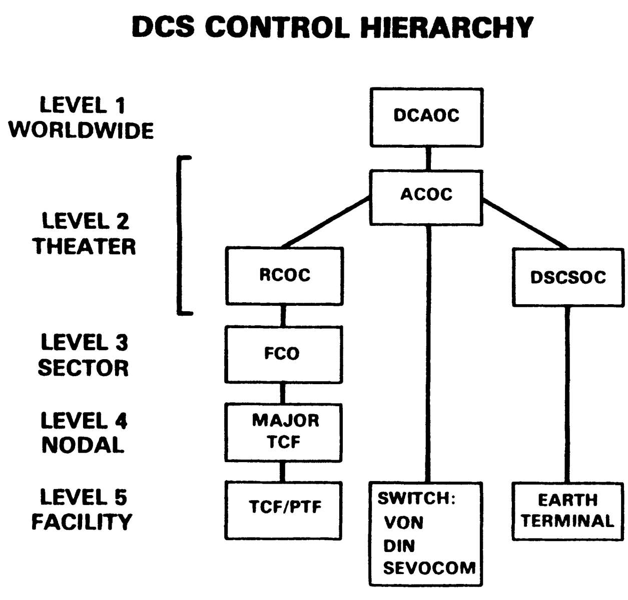

Figure 1.

provides worldwide control and direction for the DCS. The Area Communications Operations Centers (one ACOC in each theater - Europe and Pacific) are the only control centers in the theater with a span of knowledge about, and control over, all DCS telecommunications assets within the theater. If a key portion of the hierarchy (DCAOC or ACOC) is isolated or destroyed, the rest of the structure is left without its normal control direction. Without the DCAOC, the ACOC's would still be able to control their respective theaters, but they would lack the ability to consolidate information from a worldwide perspective. Similarly, the Regional Communcations Operations Centers (RCOC) would not be able to assimilate theater-wide information if the ACOC was not available. This structure limits the survivability and wartime effectiveness of the overall DCS. The current control system has very little integration since, in the past, each subsystem has been designed and implemented with its own unique control capability residing in a unique set of non-interoperable control computers. This has led to separate hardware, software and data base logistics and maintenance requirements. There are also separate floor space, operator position and operator training requirements. The data bases for each of the subsystems are often independent and non-standard creating difficulty in correlating or integrating the data between different subsystems and leading to unnecessary data duplication. The responsiveness of the current system is limited since it relies on manual control methods. Control, direction, coordination and status information are typically transferred between facilities using either teletype messages or verbal coordination among operators.

The DCAOC and the ACOC's are currently supported by an automated system called the World-Wide On-Line System (WWOLS) consisting of IBM 4300 series computers at each location. The WWOLS system provides automated support to the controllers and managers of the DCS through report generation, event logging and data base capabilities. The data base system includes information for managing the DCS switched and transmission subsystems. When reports are sent to the operations centers as changes are made (circuits are added, equipment is moved, etc.), the information is stored and used to update the appropriate data base on a non-real-time (typically once per day) basis. The WWOLS data base is adequate for overall management of the DCS, but is not tailored to be used for real-time control of the network.

NEW REQUIREMENTS

The existing control structure serves the DCS well as it is presently configured, but, as previously discussed, the DCS is becoming larger and more complex. The Facility Control Offices (FCO) at the sector level of the existing hierarchy oversee Technical Control Facilities (TCF) within their sectors (areas of responsibility). New automated TCF capabilities, such as transmission monitoring and control (TRAMCON), digital patch and access systems (DPAS), and automatic circuit test systems (ACTS), are being added which will increase coordination and control activities at the FCO's and TCF's. Evolving and expanding DSN, DDN and I-S/A AMPE capabilities will also increase the control and coordination at the DCAOC and ACOC's. The current manually based DCS control system will not be capable of effectively supporting these new requirements.

OBJECTIVE CONTROL STRUCTURE

The objective control structure being implemented to rectify many of the limitations of the current system is outlined in Figure 2. The DCAOC still maintains worldwide control of the DCS while the ACOC's will have a fully capable Alternate ACOC (AACOC) within each theater. The FCO's will transition to Sub-Regional Control Facilites (SRCF) which will consolidate the original FCO transmission oriented functions with those of the switched systems within their sub-region. Computer equipment is being added at the DCAOC, ACOC and SRCF levels to provide automated information gathering and control implementation capabilities at those facilities. The ACOC's and AACOC's will employ computer equipment, the Network Control Facility (NCF), to consolidate real-time status information gathered from the SRCF's and other subsystems and provide an integrated workstation environment from which network controllers can manage all DCS subsystems. The SRCF's are centralized facilities from which the military services can operate and maintain (O&M) the nodal and base level equipment. The SRCF's also provide the technical path through which the ACOC's will manage the DCS subsystems within each sub-region. Some DCS subsystems such as the Defense Satellite Communications System Operations Center (DSCSOC), DDN Monitoring Center and I-S/A AMPE Monitoring Center will not

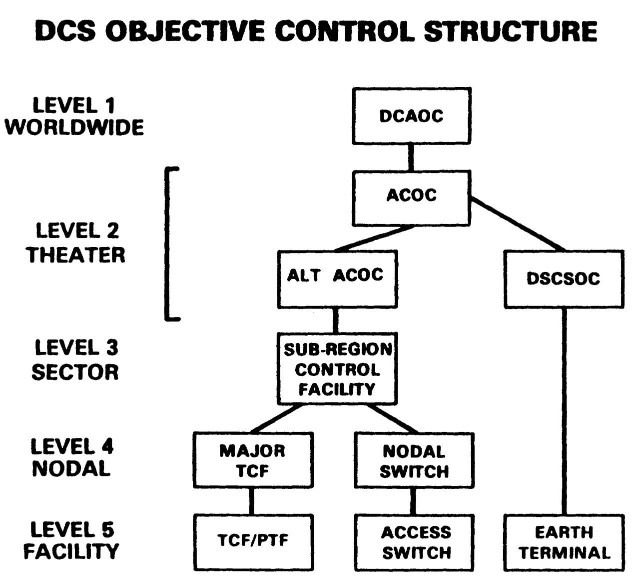

Figure 2.

be controlled through the SRCF's, but will be integrated into the control structure at the DCAOC and ACOC level of the hierarchy.

DEFENSE COMMUNICATIONS OPERATIONS SUPPORT SYSTEM

The real-time computerized monitoring and control system implemented within the DCS objective control structure to support the operational control of the DCS is called the Defense Communications Operations Support System (DCOSS). Automated aids for network control, reporting, engineering, and monitoring are being employed to optimize system performance and to maximize the use of limited equipment and skilled technical resources. There will be a common family of data processing equipment at the worldwide and theater levels of the hierarchy. There will also be a common set of computer equipment at the SRCF's. A common operator workstation will be used at all control centers to allow integration of the user interface at all levels. Each subsystem controlled by DCOSS will be integrated into the standard user interface in a consistent manner to reduce training requirements and to improve operator efficiency. Application software will be developed to determine interactions and correlate data between different subsystems.

Survivability of the control system will be improved since each theater will have a fully capable backup AACOC which will assume control of the entire theater if the ACOC is not functioning. In order to ensure that the personnel and the equipment at the alternate sites are prepared to control the theater, the AACOC's will be given a continuous regional control responsibility for the elements of the DCS within their geographic region. SRCF's will also have the capability to perform critical theater-wide control functions in the event that both the ACOC and AACOC are not available. Survivability will also be improved through the use of DDN as the communications backbone for the system control information flows. DDN, being an adaptive packet switching data network, is designed to maintain a high degree of connectivity between users even during disruptions to individual nodes and links in the system. The responsiveness of the control system will be improved with the application of real-time automated capabilities to support controller requirements including status information gathering, report generation and control execution.

INTEGRATION APPROACH

The approach for integrating the control of numerous DCS subsystems can more easily be described if all of the automatic data processing equipment (ADPE) and software at all levels of the hierarchy are considered to be one entity. This is depicted in Figure 3 by the box labeled "DCOSS/WWOLS ADPE." Each subsystem will be connected to the DCOSS ADPE at some point in the structure. Subsystems connected to the SRCF's include DSN switches, TRAMCON, ACTS, DPAS, and the Data Transmission Network (DTN) which provides world-wide digital point-to-point and multipoint data circuits. Conceptually,

DCOSS CONTROL INTEGRATION APPROACH

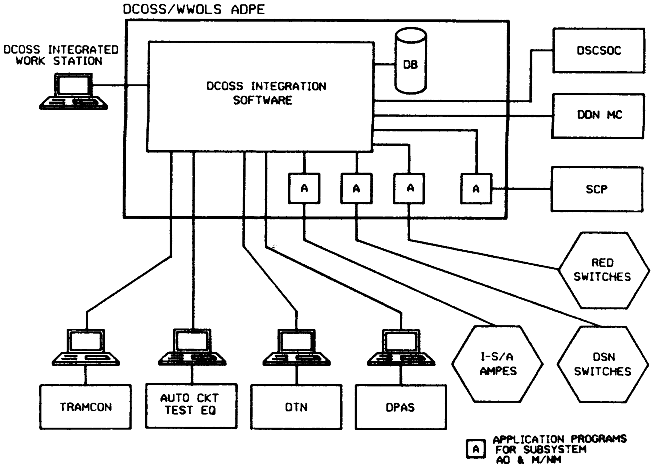

Figure 3.

each device that connects directly to DCOSS will have an application program specific to that device implemented on a DCOSS computer to properly communicate with the device. Other subsystems may require some external intelligence (such as a microcomputer) to provide a suitable interface into DCOSS. The I-S/A AMPE Monitoring Center software will be implemented on the NCF computer at the DCAOC and ACOC's. Other secure subsystems such as Red Switches and the Secure Conferencing Project (SCP), both of which deal with secure voice communications capabilities, will also be supported by DCOSS. Depending on the subsystem, these interfaces will provide everything from full interactive control to simple information gathering.

The data base required to support system control will be partly distributed and partly replicated throughout the system. There is detailed information required at the SRCF level which is not necessary at the NCF's. There is also information which must be maintained at all sites to support the full range of administration, operations and maintenance/network management (AO&M/NM) functions to be performed by DCOSS. The information gathered from the different subsystems along with commands implemented to control the networks will be correlated with the DCOSS subsystem correlation/interaction software. The data base system will automatically update the necessary locations so that real-time status displays and reports can be maintained.

Subsystem alarm status information will be displayed in a consolidated manner at the DCOSS Standard Workstations (DSW). The same DSW hardware will be used at all levels (SRCF and NCF) so that information can be presented in a similar fashion to improve operator interactions with the system. Commands and information from different systems will be translated into similar formats and the information from independent events will be correlated via the subsystem correlation/interaction software to aid controllers in resolving problems in the DCS. A high-resolution graphics display with a large screen projection unit will be provided that can present information on the status of the DCS subsystems in a pictorial manner, allowing controllers to quickly determine overall DCS system status. The graphics display will also present detailed information about specific portions of the system by using various zoom or enlarging capabilities.

SUB-REGIONAL CONTROL FACILITY

The SRCF is the focal point within a DCS sub-region for gathering status information for higher levels of the control structure and for distributing network management commands from the higher levels. The SRCF's belong to and are operated by the individual military departments (MILDEP). DCA is responsible for overall operational direction and control of the DCS while the MILDEP's are responsible for the operations and maintenance of DCS subsystems. In addition to providing DCA with the technical capability to discharge its operational direction and control responsibilities, the SRCF's will also support the O&M requirements of the MILDEP's. The SRCF will provide automated tools to allow the MILDEP's to perform O&M functions from a centralized location within the sub-region for both switching and transmission systems. The major operations and maintenance functions of the SRCF are service provisioning, corrective maintenance, preventive maintenance, resource implementation, and directory service assistance. Service provisioning provides for the allocation of switch and transmission facilities in the DCS to implement service orders for such activities as adding or deleting routine switch users. Corrective maintenance is the isolation of faults and repair or replacement of defective equipment. Preventive maintenance is the testing and servicing of working equipment. Resource implementation adds new equipment and transmission facilities to the network. Dial service assistance function enables a directory assistance operator to retrieve information about a network user to assist other users. In addition, administrative functions such as record keeping, report generation and operations planning are performed at the SRCF. The centralization and automation of these functions is expected to provide the necessary capabilities to transition from the current manual methods of operation to support the increasing demands of the evolving communications requirements.

IMPLEMENTATION STATUS

There are currently two installed NCF DCOSS computers - one at the ACOC in the European theater and one at the ACOC in the Pacific theater. An SRCF test-bed has also been installed in the Pacific theater. Operational software to provide initial DSN network management and O&M capabilities is scheduled for installation in November 1986. There are two AACOC's planned (one in each theater) along with six SRCF's in the Pacific and eighteen SRCF's in the European theaters. The initial operating capability of DCOSS in 1986 will provide an integrated, menu driven network management system for DSN switch control at the NCF's and provisions for standard maintenance access to DSN switches from the SRCF's. Shortly afterward, the switch maintenance access will be improved and network management graphics capability will be added.

FUTURE CAPABILITIES

An example of the direction DCOSS is heading will give some additional insight into the types of capabilities this automated control system will provide. Figure 4 shows a simple network in which digital patch and access systems have been implemented in the DCS (still several years away). These devices have the capability to switch circuits via computer terminal commands rather than the current method of manual patch cords. In this example, the DDN network is experiencing traffic congestion. The current operational approach would be to implement restricted access to the network until the overload passed. An alternative would be to provision additional interswitch trunking between affected switches to support the additional traffic. Figure 4 depicts the latter scenario. The DDN Monitoring Center determines that additional trunking will be required between switches A and B and sends this requiest to the DCOSS. The DCOSS subsystem correlation/interaction software would then search for and select appropriate circuits, have the new circuits remotely tested by automatic circuit testing equipment, and then have the circuits installed between the DDN switches by sending computer commands to the appropriate DPAS units. The DDN could then use the new circuits to reduce the traffic congestion, notifying DCOSS when they are no longer needed. This example of a potential future capability serves to show the type of control that could be obtained with automation such as DCOSS in an increasingly digital environment. Other capabilities which may be developed in order to take advantage of new technology will include using expert system software as a tool for

DPAS CONTROL IMPLEMENTATION UNDER DCOSS
DSN/DDN DYNAMIC TRUNK PROVISIONING

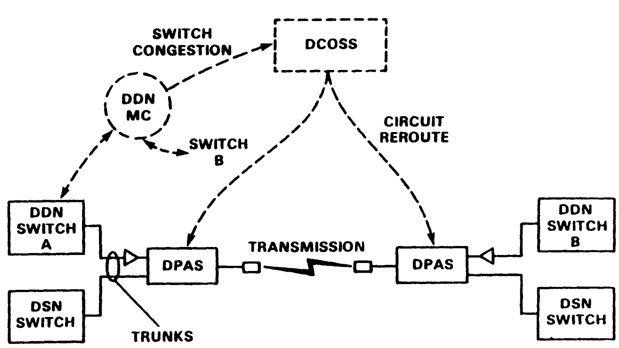

Figure 4.

diagnosing problems and assisting the controllers in making decisions.

CONCLUSIONS

Automated real-time system control is becoming critical as the expanded DCS deploys new and more sophisticated digital systems. The existing manual methods of control will soon be inadequate. DCOSS will provide an automated solution to the real-time system control requirements of the evolving DCS.

Major Steven M. DiSilvio is currently assigned as a Communications-Electronics Engineer in the Systems Integration Division, Defense Communication System Organization, Defense Communications Agency.

Mr. John D. Edell is Chief of the Systems Integration Division at DCA.