MSE doctrinal publications: from paper to computer

Automated doctrine development will greatly speed the planning, management, and analyses of our man-machine communications systems.

by Capt. George Sherman and SFC Charles Dobbins

The Communications-Electronics Leadership Department (CELD) is developing five MSE related draft field manuals, or field circulars (FCs). The draft manuals with their titles and due dates are listed below, followed by a brief review of each.

- FC 11-36 *MSE/MSGS Architecture* Draft/3Q86 Field/4Q86
- FC 11-37 *MSE Leadership Primer* Draft/3Q87 Field/4Q88
- FC 11-38 *MSE/MSGS Mgt and Control* Draft/2Q87 Field/1Q88
- FC 11-12 *MSE Corps/Div Sig Unit Ops* Draft/3Q87 Field/4Q88
- FC 11-13 *Combat Net Radio Structure* Draft/2Q87 Field/1Q88

FC 11-36, MSE/MSGS Architecture, provides an overview of MSE and Mobile Subscriber Grid System (MSGS) architecture. Detailed information concerning MSE's relationship to corps/division architectures, deducible numbering system use, COMSEC, equipment characteristics, and typical deployment configurations is provided in the manual.

FC 11-37, MSE Leadership Primer, will provide doctrinal guidance on leadership issues peculiar to MSE, including training, interoperability, deployment, and logistics. This manual presents the Signal Corps battalion organizational doctrine. It covers MSE organizations, staffing relationships, and command and control relationships.

FC 11-38, MSE/MSGS Management and Control, will provide doctrine concerning planning, managing, and controlling MSE communications systems. The manual will discuss the system control center (SCC) and functions of the communications system planning element (CSPE), communications nodal control element (CNCE), and communications system control element (CSCE). Because the automated management tools found in the SCC will require extensive research and development, this manual will reflect a corresponding degree of complexity.

FC 11-12, MSE Corps/Division Signal Unit Operations, will provide doctrine relating specifically to unit operations in support of MSE mission accomplishment. It is designed to assist the novice platoon leader and platoon sergeant in understanding their roles and missions under MSE. It will concentrate on organization, equipment, and personnel, and discuss missions from roll-out to home station return. It will also delineate operational responsibilities and discuss theater unique operations.

FC 11-13, Combat Net Radio (CNR) Structure, will provide doctrine concerning SINCGARS and MSE radio operated in conjunction with the CNR structure. This manual, which will contain 70% SINCGARS and 30% MSE material, will offer critical information concerning frequency management decisions and SINCGARS/MSE interoperability.

CELD has been tasked by Brig. Gen. Kind, Fort Gordon deputy commander, to provide all doctrine to the field six months prior to the fielding of equipment. How well and how quickly we instruct key personnel will directly affect the production of MSE manuals.

Before proceeding, we want to emphasize that doctrine defines and describes objective system behavior. Automation tools can demonstrate this system behavior and reflect weaknesses requiring our attention. We are trying to exploit this potential. At some point our goal should be to improve doctrine-based decision cycles.

Professional development

Current training in CELD for commissioned, warrant, and noncommissioned officers includes doctrine and computer literacy. Although the level to which computer literacy is taught might differ, all students are at least familiar with current automated tools. The automated tools available to CELD are the Army Tactical Frequency System (ATFES) and the Romeo Report Analyzer (PC). With these tools, we are able to illustrate and reinforce doctrine.

ATFES is primarily an automated system engineering tool, but it can be extended for network controller needs. Using both on-line and CELD written software, ATFES becomes a very effective vehicle for teaching system level concepts. At system level, students find it easier to grasp doctrinal concepts relating to air-land battle. We reinforce these concepts, with the help of ATFES, by using corps/division map exercises. Some of the current software capabilities of ATFES include:

- Topographic radio path analysis
- Frequency management
- Circuit routing
- Radio interference analysis
- Radio systems reliability calculations
- Tech service order (TSO) generation and dissemination

There are not very many systems training mediums for CELD to use in support of professional development, but we have found one—ATFES.

Another automated system which will soon be available to CELD is the Battlefield Electronic CEOI System (BECS). BECS is an automated communications electronics operating instruction (CEOI) tool currently written in the Pascal programming language and able to execute on a hand-held computer. CELD is awaiting the arrival of BECS hardware and software, which will be used in teaching Signal Officer Advanced, Signal Officer Basic, Warrant Officer, and Advanced Non-Commisioned Officer courses.

CELD instructors have developed software that simulates telemetry gathering/archiving and performs network load/performance analysis. Telemetry is defined as measuring, transmitting, receiving, and recording values translated electronically from a distance. Most communicators recognize telemetry as "residuals," "star reports," and "romeo reports." Some of our students have been exposed to Codex technical control sensor systems installed in fixed station facilities. Using TTC-39, romeo reports, a database, and the Pascal programming language, students are presented with calculations and graphical analysis to support automated network management doctrine suggested in *FC 24-9*. Our goal is to teach students more about automated telemetry gathering and analysis and to relate these processes to the doctrine of network management.

We have stressed the use of automated tools because of the major automation effort that is occuring in MSE. The SCC, for instance, will provide visual display units and on-line databases, with real-time, tabular, and graphical system status reporting. Since our equipment is getting smarter, we need to develop doctrine that is smarter.

MSE automated systems control center (SCC)

By automating all the traditional CSCE/CSPE/CNCE functions, MSE will affect the way we plan, manage, and analyze our communications systems. It's obvious that if the CSCE is affected, then doctrine must be developed that takes advantage of our new automated management tools. We have already discussed telemetry and the special capabilities of ATFES. MSE's SCC will perform as an integrated system incorporating telemetry (reporting, management, and analysis) and ATFES capabilities (frequency management, topological database management, profiling, planning, and information dissemination). The SCC will provide a realistic platform for the development of doctrine.

The SCC will be a highly automated facility able to access the MSE system network through any node center (NC). The SCC will facilitate system management and control tasks by providing computer assisted tools and the capability to disseminate operational orders and directives as well as to receive messages and reports. (See Figure 1.)

The principal computer assisted tools will facilitate:

- Automated frequency management
- Terrain analysis and path profiling
- System activation and reconfiguration
- Making equipment status reports
- Monitoring link and network load status
- Unit database management

Automated frequency management

The SCC will provide application programs that will help develop frequency plans covering the line-of-sight (LOS) radio, the DTH radio, and the MSRT/combat net radio. The SCC will manage the LOS radio using three frequency plans. Frequency plans one and two will permit the SCC to support the assignment of up to 300 pairs of LOS radio links. Frequency plan three will permit the SCC to support the assignment of up to 50 pairs of DTH radio links. The band used for a specific LOS radio link will be selected by the SCC operator. Primary and alternate frequencies will also be assigned for each combat radio net in the corps. Additionally, the SCC automatically will generate radio net call signs and be able to prepare a CEOI for each radio net. These CEOIs will be reproduced at a separate facility—which will not be part of the SCC—for distribution in the Corps.

Automated terrain analysis and path profiling

The heart of this automatic function will be digitized maps stored on tape cassettes. The cassettes, which will use the digitized map capability of the

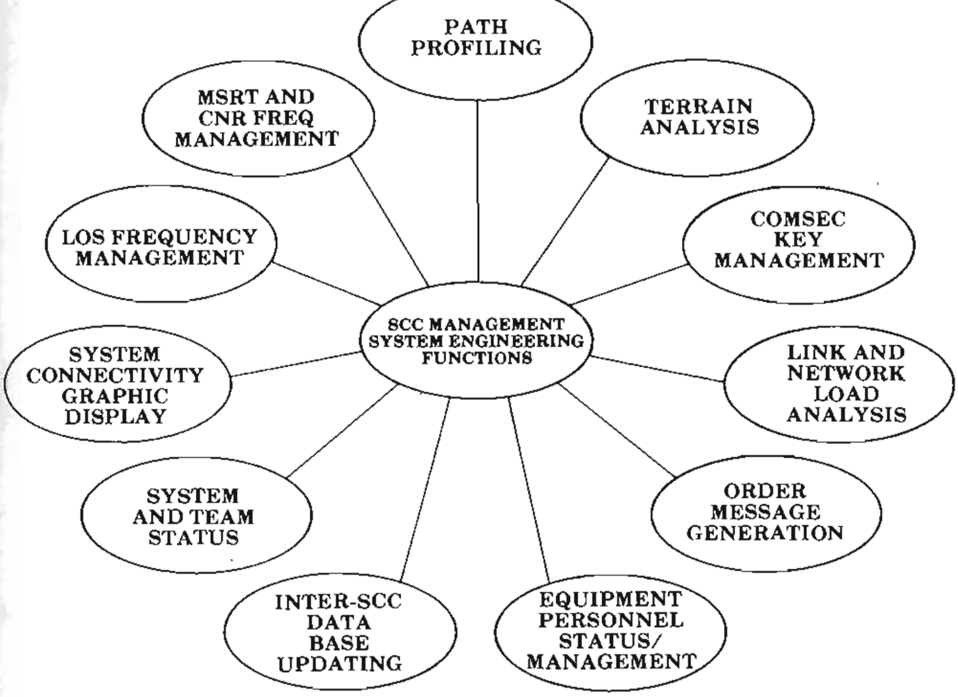


Figure 1. System control center functions

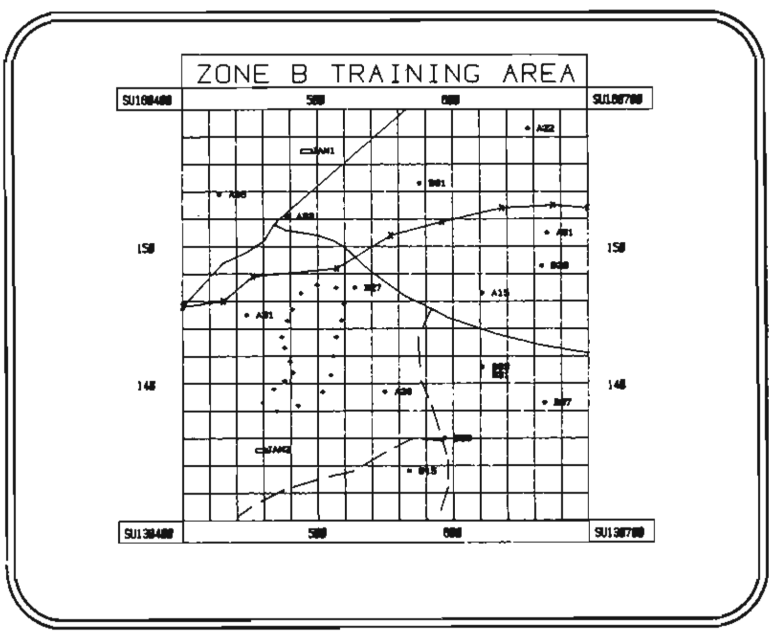


Figure 2. Typical simulator exercise deployment

U.S. Defense Mapping Agency, will be modified at a post deployment software support (PDSS) facility to include additional terrain features that are not normally a part of digitized maps. A tape cassette reader will be used to load the digitized map into the SCC database. The SCC will maintain a menu of available maps, which will include the reference of each map based on the coordinates of the map's southwest point, as well as the maximum and average altitude of the map, the map longitude, and the cassette upon which the map will be found.

The maps also will have information concerning the selected high points. Each map may contain up to 36 high points. Information contained on each high point will include grid coordinates, altitude, degree of cover or concealment, conditions of accessability (type of road and type/number of vehicles supported), and date and time the high point was last visited. (See Figure 2.)

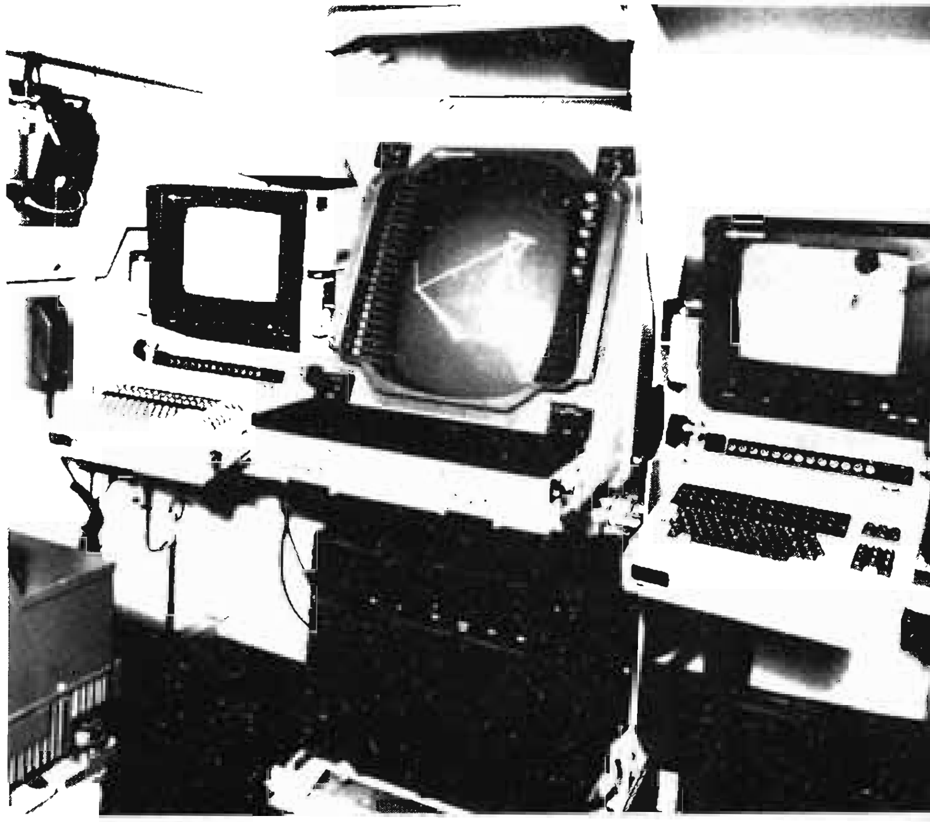
These digitized maps will be used when an LOS radio link is automatically engineered. The SCC processor will automatically engineer the path between the two terminals to determine if there is any obstruction in the path. If no obstructions are identified, the processor will continue with the LOS radio link engineering. If an obstruction is found, the operator will be notified. The operator should then request that the SCC identify and display all the high points within a radius of either terminal. Based on these high points, the operator can have the SCC investigate alternate locations for the terminals.

System activation and reconfiguration

The SCC will automatically perform area network activation and reconfiguration, including transmission link activation and deactivation. To accomplish these tasks, the SCC will automatically perform LOS frequency engineering, path profiling, terrain analysis, order message generation, and updating of the database and system connectivity graphic display.

The SCC operators will use visual display unit (VDU) workstations to input the minimum information from which the SCC automatically configures the network. With these workstations, the operators will be able to create all the tasks required to configure and reconfigure the MSE System. They thus will design tasks necessary to open and close internodal and extension node LOS radio links; open and close node centers (NCs), extension nodes, and radio access unit (RAU) links; and direct the movement of NCs, extension nodes, and RAU and LOS terminals.

After a task is approved, a tasking message will be automatically transmitted to the appropriate NC management shelter. After the NCs complete the task, the shelter operator will transmit a status report to the SCC. This report will automatically update the SCC database and graphic display.



System control center

Equipment status reporting (telemetry)

The equipment status of each NC will be maintained at the SCC. This information will be based on a set of reports provided by the NC on an as-required basis, thus enabling the commander to know the capabilities of each NC at all times. Two messages—equipment status and incident—will be routed to the potential operator, who will review the message, edit it if required, and direct the SCC to enter the information into its database. This information can be recalled by any VDU workstation to determine the current equipment status of the NC. Two messages—failure and return-to-service—will be routed directly to the SCC processor, which will cause the automatic updating of the database and the graphic display. These will be used to provide the status of NCSs, large extension node (LEN) switches, small extension node (SEN) switches, RAUs, and their associated LOS and DTH radio equipment.

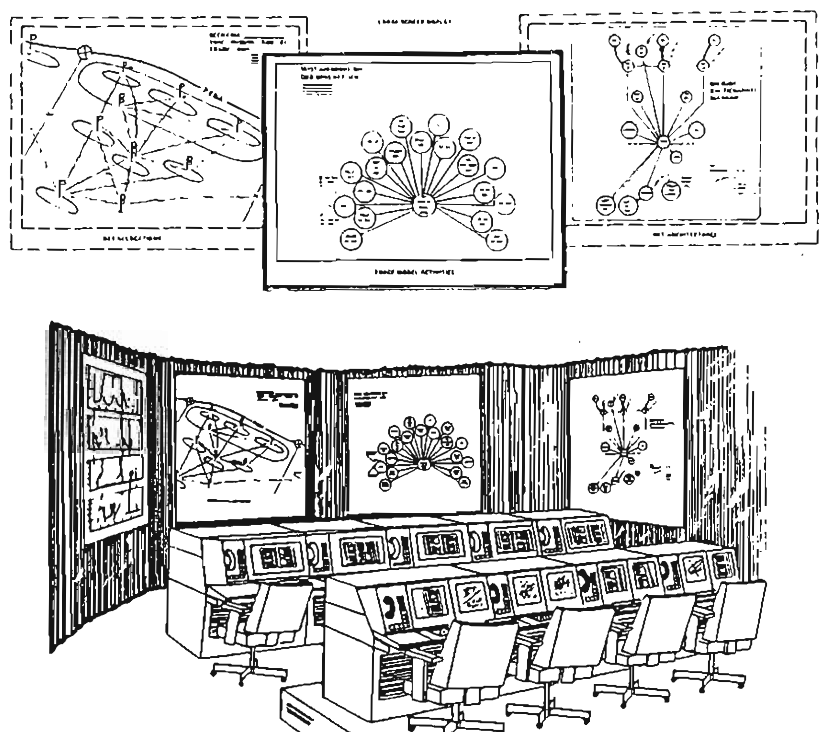
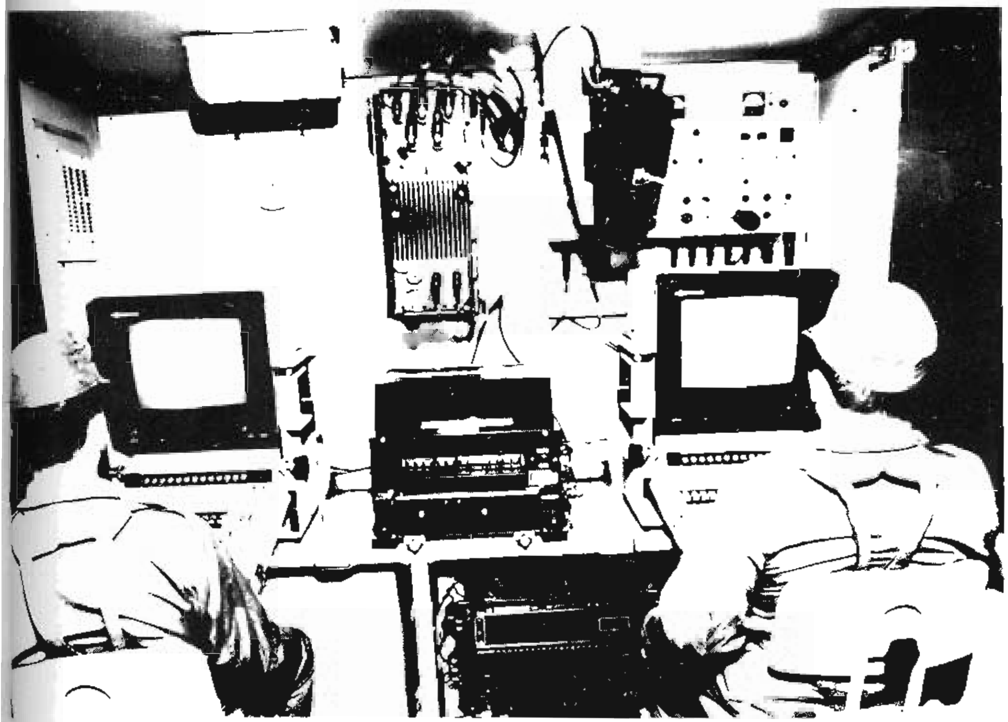


Figure 3. Modeling and simulation.

Link and network load status (telemetry)

The SCC will process and report information on LOS radio link failures, saturation, and traffic levels.



System control center

In the case of either a link failure, or a saturated link, an SCC formatted message will be transmitted by the NC management shelter operator to the SCC. The message, which will be received automatically by the SCC, will automatically update the SCC database and graphic display.

Database management—demographic profile

The management shelter operators at the NC and LEN will be able to transmit the personnel status report to the SCC. An operator will dial SCC using the NC's SCC interface equipment and then, when contact is established, transmit the message in standard format. The SCC will then route the report to the potential operator position where it can be edited and a hardcopy obtained at the teletype located in the shelter. This report will contain the current status on all the personnel assigned to the node center platoon, including extension node, RAU, and LOS assemblage personnel. The SCC operator will use this information prior to moving an NC, extension node, RAU, or LOS terminal to a new location. The report can be stored by the MSE team (e.g., NC, LEN, SEN) in the SCC's memory. Based on information from the report, demographic profiles can be developed to assist the commander in the management of his unit. These profiles may include:

- Personnel by MOS and ASI
- Personnel by skill level
- Personnel by grade
- Personnel assigned by battalion and company
- Personnel shortages and overages by unit and/or NC

The personnel demographic profile will be merged with the man-machine equipment report to provide the commander with a total picture of the personnel and equipment status of each MSE team.

Simulation

Since the SCC will be so highly automated, the major functional groups within the SCC will be able to be transferred to the simulator. (See Figure 5.) One advantage of this is that we will be using similar, if not the same, tools in both the school and the field: training and operations will relate directly to the same goals. We at CELD have recognized the potential of a simulator to train students as well as to test our doctrinal concepts. The simple research-discuss-write cycle of doctrine development can be made much more dynamic. Using modern software, we can actually implement, execute, and modify doctrinal concepts interactively. One important advantage of simulation is that it allows us to verify doctrine quickly and inexpensively and to expedite changes.

Our goal in CELD is to meet training requirements for the automated battlefield by automating doctrine development. Automated doctrine development will greatly speed the planning, management, and analysis of our man-machine communications systems. Automated doctrinal concepts and simulation have already been accepted by Fort Leavenworth, Fort Sill, Fort Huachuca, and Fort Lee. An Armywide trend is developing. Some staffs have also suggested a role for artificial intelligence (AI) in simulating and analyzing our Army doctrine. One example of AI research along this line comes from the U.S. Army Logistics Center, which uses a large scale relational database, Lisp, and OPS5 for logistics system analysis. The time is right for us to concentrate our creative and analytical skills on developing simulation and automated doctrine analysis tools. We have come a long way from the days when doctrine needed to be proved in the field over many years. The new era of doctrine development belongs to doctrine automators.

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