Chapter 7

EPLRS User Systems

This chapter discusses the deployment and functions of the EPLRS user systems: EPLRS Very High Speed Integrated Circuit (VHSIC), EPLRS System Improvement Program (SIP), Situation Awareness Terminal (SAT), and Situation Awareness Data Link (SADL).

EPLRS VHSIC

7-1. EPLRS VHSIC RT-1719/G and RT-1720/G ADDSI are state-of-the-art, LOS, data-only digital RTs operating in the 420-450 MHz UHF frequency band.

FUNCTION

7-1. EPLRS VHSICs serve as position location, navigation, identification, and communications systems. The NCS and the RS are the primary components of the EPLRS VHSIC. The NCS is the centralized control element used for system initialization and monitoring and control of the EPLRS VHSIC network. The RS is the radio RT provided to the EPLRS VHSIC users. This radio provides secure, jam-resistant digital communications and accurate position location capabilities for the user. For secure communications with a low probability of interception and detection, RSs use–

- Frequency hopping (512 times per second).
- Spread spectrum technology (eight frequencies between 420 MHz and 450 MHz).
- Embedded COMSEC module (KIV-14).
- Adjustable power output.

7-2. The RS has BIT functions that are activated when power is turned on.

DEPLOYMENT

7-3. Like the basic EPLRS, the EPLRS VHSIC deployment concept is based on a multiple NCS community of up to four single NCS communities to support a division AO. Each community consists of up to 450 RSs. Signal corps personnel installs, operates, and maintains the NCS. Four NCSs are assigned to the EPLRS VHSIC platoon within the signal support company of the division signal battalion. The communications element of the separate brigade and armored cavalry regiment (ACR) is assigned one NCS.

7-4. Today's command, control, communications, and computer (C4) systems for signal support for division and below include a variety of new equipment and procedures. The EPLRS VHSIC effectively supports the transmission of C2 and SA data throughout the battlespace. The C2 and SA architectures are fundamental concepts underlying the functional design of the EPLRS VHSIC.

7-5. EPLRS VHSIC transmits and receives typical battlefield C2 information. SA data transmits, receives, and passes through the radio network. Because the EPLRS VHSIC has an Internet controller (INC) capability, automatic routing of C2 and SA information will be transparent to the operator.

7-6. Modern digital battlefield procedures dictate that the SINCGARS-SIP and EPLRS VHSIC radios mutually support the flow of data throughout the battlespace. Figure 7-1 shows this mutual support of data flow requirements.
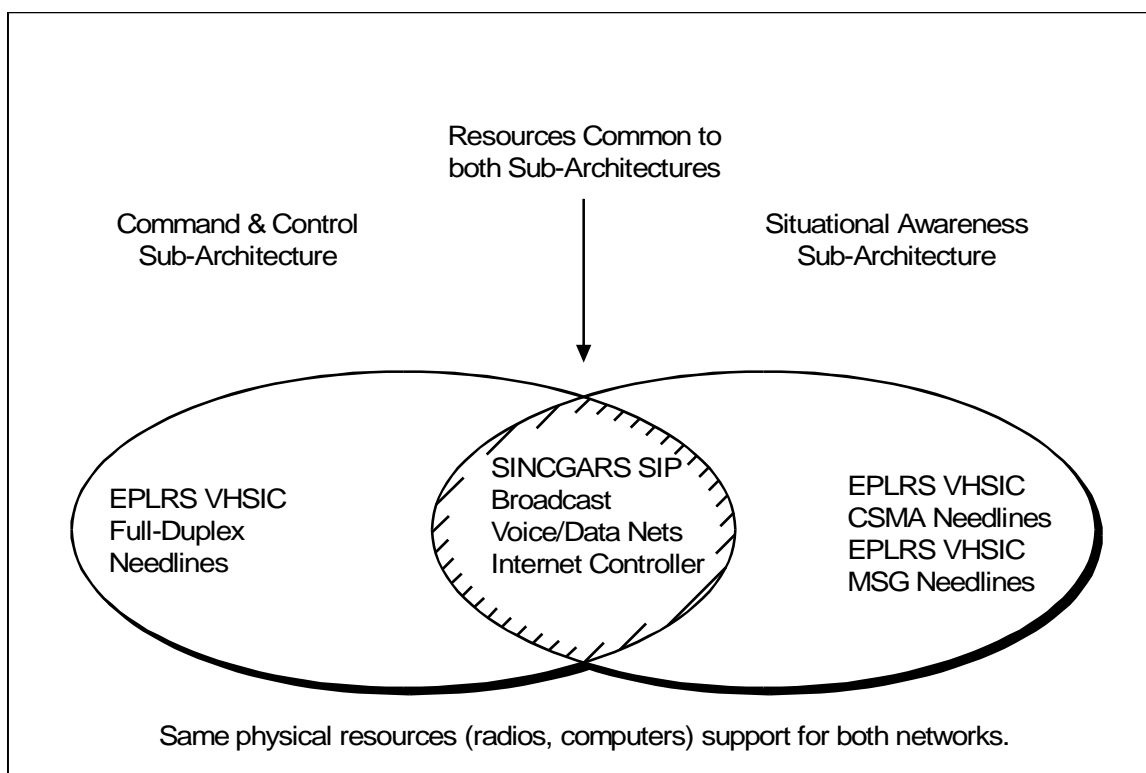

Figure 7-1. SINCGARS SIP and EPLRS VHSIC Radios Provide Mutual Support

IMPROVEMENT

7-7. EPLRS must support the C2, SA, POS/NAV, and data communication requirements of the force on the modern battlefield. In the future, it must support the evolving digitized force. The improvement represented by the advanced technology of the VHSIC makes a significant contribution to EPLRS.

7-8. The objectives of the VHSIC insertion into the RT include increasing the data throughput, improving both antijam performance and mean time between failure (MTBF), and decreasing the RTs power consumption and weight. VHSIC technology allows a reduction of the signal message processor (SMP) module and provides space for future growth within the RS.

Performance

7-9. The VHSIC chip set inserted into EPLRS RSs introduces advanced signal processing concepts into RSs through the application of high density and low power dissipation. Current secure antijam communication systems provide the required antijam protection against the defined worst-case threat at a fixed data rate. The VHSIC chip set programmability permits its adaptation to a wide range of signal processing parameters in real time. This adds three new waveform modes, thereby providing adaptive increases in traffic or antijam margin in response to changes in tactical demands.

7-10. In many situations and deployments, a large number of the communication circuits will probably not experience the worst-case jamming threat. These circuits can employ the maximum throughput waveform mode and still be ready in real-time to respond to more severe jamming threats. Conversely, high priority messages on critical circuits under severe jamming can use the maximum EP waveform mode for greater antijam protection.

Waveform Modes

7-1. The spread spectrum burst transmission waveform modes used in the VHSIC RS allow data transfer between units in the network at rates from 80 to 240 data bits per transmission burst. Increased antijam protection is added to each waveform mode by additional error correction coding. Figure 7-1 shows a comparison of VHSIC waveform mode performance.

Table 7-1. Comparison of VHSIC Waveform Mode Performance

Waveform Mode	Bits per Transmission Burst	90% Throughput Anitjam Performance	Single Link Range (Benign)
0	80	---	150 km
1	80	+2 dB	90 km
2	160	+0 dB	60 km
3	240	-2 dB	60 km

7-11. Waveform mode 0 is the standard EPLRS burst transmission waveform using an 800 microsec transmission burst to transmit 80 bits of data. This waveform mode is used to communicate with the nonVHSIC RSs lacking EPLRS VHSIC waveform modes 1, 2, and 3.

7-12. Waveform modes 1, 2, and 3 use transmission burst of about 1000 microseconds and transmit 80, 160, and 240 data bits, respectively. The approximate 1000 microsec transmission burst improves antijam protection or improved throughput over a waveform 0, depending on mode used. The 1000 microsec transmission burst has a shorter single link range than the 800 microsec transmission burst. This is because the extra 200 microsec is taken out of the propagation guard band while maintaining the overall length of the timeslot.

Physical Enhancements

7-13. The high density of VHSIC chips permits these increased capabilities to be realized in less volume than currently required by the SMP module of the non-VHSIC RS. This reduces the number of circuit card assemblies making up the SMP module from four to three.

7-14. In addition, redesign of the SMP for VHSIC insertion has provided an opportunity to reduce the parts count by 30 percent through the application of a signal processing chip, which performs the functions currently being accomplished by multiple logic packages.

Test Benefits

7-15. Improvements in the self-test, fault isolation, and fault tolerance of the RS's signal processing functions are achieved through the insertion of the VHSIC. Each of the VHSIC chips possesses improved BIT capabilities that can be exercised on-line. By capitalizing upon these BIT features and the inherent fault tolerance of the VHSIC chip, the VHSIC SMP module and RS availability are improved.

7-16. The higher operational availability of the units, achievable through an increase in MTBFs, results in lower life-cycle cost and greater system dependability.

EPLRS-SIP

7-17. EPLRS SIP involves upgrading the present RT designs to infuse new technologies and make them more producible. Development and testing of IMA, power amplifier (PA), and pressure transducer (PT) prototypes are in progress. Future EPLRS RSs and spare modules incorporate these design changes.

7-18. The designs developed for the SIP and low rate initial production (LRIP) modules provide mechanical and electrical interchangeability. The PT and radio frequency assembly (RFA) modules are replaced through normal attrition of failed modules. However, the new IMA and PA represent an improvement in RT performance and will be introduced to field units through a retrofit program. The retrofit results in a change of model designation and nomenclature.

SAT SYSTEM

7-19. The SAT utilizes the EPLRS to provide a platform for brigade and below decision makers in the maneuver force. The objective of the SAT employment is to exploit tactical communications for SA, report/overlay processing, and other C4 services that enhance combat fighting capabilities.

HARDWARE CONFIGURATION DESCRIPTION

7-20. The SAT configuration consists of–
- SAT (IP Lite personal computer (PC) or Lightweight Computer Unit [LCU]) with X.25 interface card and interface cable.
- RS with associated ancillary equipment.
- Mouse/trackball or operator I/O.
- Printer (optional).

7-21. The maximum requirement for random access memory (RAM) is 2 Megabytes MB; however, 8 MB is recommended. In addition, a math coprocessor is required to run the software.

IP Lite PC

7-22. The IP Lite PC is a disk operating system (DOS)-based computer with a 25-MHz Intel 80386 processor. The screen consists of a flat liquid crystal display (LCD) with 640 by 480 resolution. The IP Lite PC has a removable keyboard and expansion slots for several interface cards. It operates only from DC power. Therefore, an external 120 Vac to 24 Vdc power converter is required when installing it where AC power is being used. The IP Lite PC is built to commercial standards (not ruggedized or militarized). For additional information on the IP Lite PC operating conditions, refer to Kontron Elektronik IP Lite User's Guide (96-1049-0102-E).

Lightweight Computer Unit

7-23. The LCU is a DOS-based PC with a 25 MHz 80486 processor. The LCU screen consists of an LCD that supports 640 by 480 resolution. The LCU has a detachable keyboard, built-in trackball, and several interface ports for external interfaces; it is built to ruggedized standards.

7-24. The LCU memory is configured IAW the LCU operator's manual to port the SAT software. Once the SAT software is ported to the LCU, the SAT functionality on the LCU is identical to the IP Lite PC, with the exception of minor control key operations. For additional information on the LCU PC operating conditions, refer to SAIC Electronic Systems, Version 2 Lightweight Computer (V2LC) User's Manual.

7-25. The RS associated with each SAT is connected via an interface cable from the SAT to the EPLRS data port hi-hat connector. The X.25 interface provides the appropriate transport layer protocol for communication services. The SAT software automatically activates needlines that the DSO establishes IAW the current software library update.

Mouse/Trackball

> 7-26. The SAT uses any standard PC-based mouse or trackball for normal user I/O. If the mouse/trackball is inoperable, the arrow keys and HOME key can be used to move the cursor.

Printers

> 7-27. The SAT uses one of two standard parallel printers (Alps and EPSON FX+ series printers).

SCREEN DISPLAY AREAS

> 7-28. Figure 7-2 shows the screen display areas. The actual display configuration depends on the mode (SA, mail, overlay, NAVAIDS, task organization element [TOE] file, communication [COMM] file, or exit). The operator selects this mode by clicking entries in the lower right-hand mode control area with the mouse/trackball.
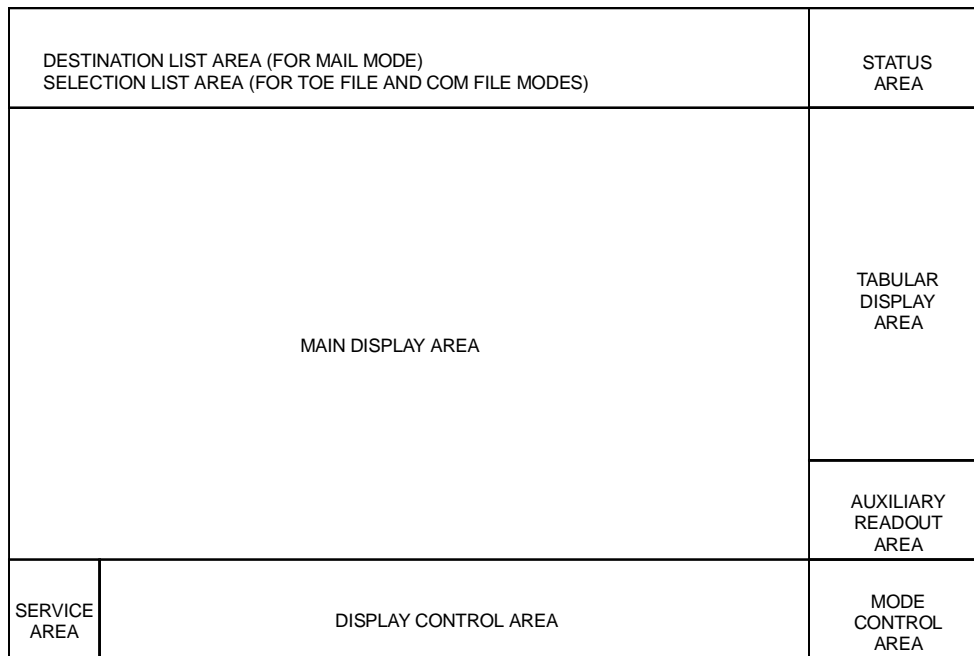
DESTINATION LIST AREA (FOR MAIL MODE) SELECTION LIST AREA (FOR TOE FILE AND COM FILE MODES)	STATUS AREA
MAIN DISPLAY AREA	TABULAR DISPLAY AREA
	AUXILIARY READOUT AREA
SERVICE AREA / DISPLAY CONTROL AREA	MODE CONTROL AREA

Figure 7-2. Screen Display Areas

Main Display Area

> 7-29. The main display area displays the background map, map overlays, mail messages, NAVAIDS, TOE file, or COMM file. When the SA, overlay, or NAVAIDS mode is chosen, the main display area includes all of the area not used by the status, tabular display, auxiliary readout, mode control, display control, and service areas.

7-1. When the mail mode is chosen, the main display area is reduced with the mail mode destination list areas taking up the top portion of the main display area screen. When the TOE file or COMM file mode is chosen, the main display area is reduced with the TOE or COMM file mode selection list taking up the top portion of the main display area screen. Figure 7-3 shows the main display area for SA, overlay, and NAVAIDS mode.
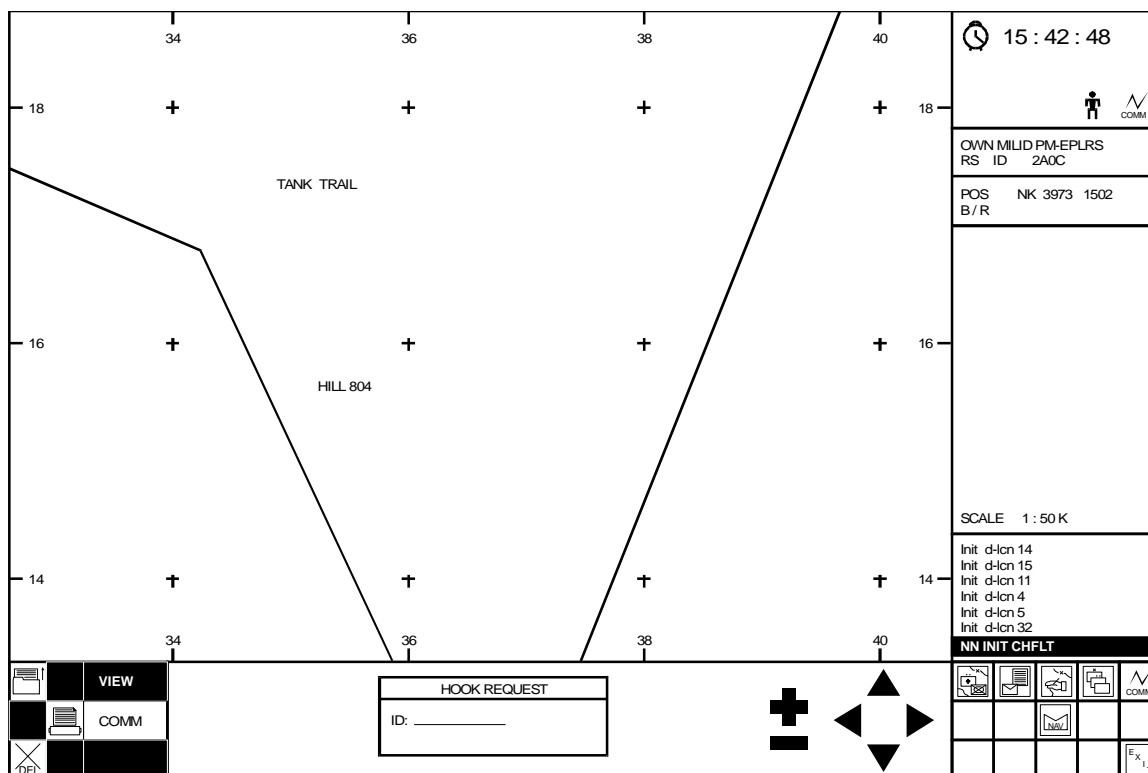

Figure 7-3. Main Display Area

Status Area

7-30. Upon system startup, all of the status area icons are displayed. These include the alert, mail, playback, hard disk lock, communications, and time icons. Once startup procedures are complete (typically in a few seconds following initial display of the status icons), all status area icons disappear from the screen with the hard disk lock icon changing from a running soldier to a standing soldier. The communications icon stays on the screen indicating that the user's communications link to his EPLRS RS is working.

Tabular Display Area

7-31. This area shows the–
- MILID.
- RS ID.
- Cursor position.
- B/R from a hooked unit to the cursor position.

- Current scale being viewed on the map.
- Specific unit information for hooked units.
- Specific overlay information for hooked overlay objects.
- Message status (inbound/outbound).

7-32. The displayed information in the tabular display area varies based on the mode selected by the user.

Auxiliary Readout Area (ARO)

7-33. This area automatically displays all traffic messages exchanged between the EPLRS NCS and the SAT. This readout enables the user to review the status of the SAT interface over the EPLRS system. All URO device messages sent from the SAT and those received in response to a URO request will be displayed in the ARO. The ARO queue holds the most recent 100 ARO messages. The SAT software also generates messages to provide the user with additional information and error conditions detected.

Mode Control Area

7-34. The SAT has seven mode control functions: SA, mail, overlay, TOE file, COMM file, NAVAIDS, and exit.

Display Control Area

7-35. This area includes the spatial controls (scale/scroll buttons) and other unique controls related to the particular mode of operation the operator is currently in, such as:
- Hook request box for the SA mode.
- INBOX.
- EDIT.
- OUTBOX buttons for the mail mode.
- Drawing tools for the overlay mode.

Service Area

7-36. This area is highlighted or unhighlighted depending on the user selected mode of control. Within a selected mode, such as the mail mode, the service area icons will be selectively highlighted to correspond to various display control settings (mail, INBOX mode, mail OUTBOX mode, or mail EDIT mode).

REPORTS

7-37. The SAT software comes with a variety of preformatted reports. These reports are discussed below.

Spot Report

7-38. This report follows the military size, activity, location, unit, time of observation, and equipment type (SALUTE) format. The spot report has a title block (20 characters maximum text length) and one line for each SALUTE entry (34 characters maximum text length).

URO Message

7-39. This message is an on-screen duplication of the standard URO message display each EPLRS URO device operator uses in the field. It provides the SAT user with NCS services typically provided to URO device users in the field. Likewise, the SAT operator can enter/transmit URO messages (from the SAT) to any URO device user. The SAT beeps once (provided the beeper is enabled) when a URO message is received.

Dispatch

7-40. This form provides the user with a one-line, 60-character maximum form to send a message to the EPLRS NCS. The EPLRS NCS can reformat the message and broadcast it to selected elements in the force. Dispatch messages received at SATs are displayed in the ARO.

7-41. The SAT beeps twice (provided the beeper is enabled) when a dispatch message is received. Dispatch messages are typically used to exchange administrative data or request assistance on EPLRS issues.

Warning Order

7-42. This form is a two-page report consisting of 11 line items (each with one line text entries). Lines 1-4, 6-7, and 10-11 are 75 text characters maximum in length. Other lines provide for a maximum of 10-15 character text entries.

Commander's Situation Report (SITREP)

7-43. This is a 16-page report consisting of the items required to support a battalion's combat situation. Line items in the report have single or multiple line entries, depending on the line item selected.

Personnel Daily Status Report

7-44. This report is presented to the user as a matrix. It provides 14 lines for specified unit names/statuses and five blank lines for user-selected unit status entries. The report is designed to allow a breakdown of information by subordinate units.

Collection Plan

7-45. This is an intelligence gathering report that specifies collection tasks for elements in the force. The collection plan is organized as a matrix with 10 lines provided for individual entries.

Personnel Spot Report

7-46. This is a one-page report with three parts: losses, remarks, and summary. The loss section provides 20 characters maximum length for each line of information entered. The remarks and summary sections of the report each provide multiple lines of 60 characters maximum length.

Orange Report

7-47. This is an 11-page personnel and logistics report with line items presented on the display in chronological order, providing comprehensive data on the status of the reporting unit. Line items in the report have single or multiple line entries, depending on the line item selected.

Blank Form

7-48. This is a general-purpose report that allows the user to generate unique matrix report(s) for a variety of functional areas. This report is organized into a matrix with 19 lines provided for individual entries (not counting the header line).

Send File Message

7-49. This message provides the user with 13 lines, each with a 49-character maximum length. It allows the operator to load selected DOS files and to transmit them to other SAT users. The DOS file must be in the working directory (the directory in which the SA program resides).

Materiel Condition Status Report

7-50. This is a nine-page equipment status report with line items presented on the display in chronological order. These line items have single or multiple line entries, depending on the line item selected. This report follows the standard format of a Department of the Army (DA) Form 2406, front and backsides.

Serious Incident Report

7-51. This is a status report for reporting serious incidents. It is formatted to show important data on the person(s) involved, incident description, and actions taken.

Closing Report

7-52. This is a status report that indicates important unit information for point of debarkation and closure time at a particular location. This report is formatted to show unit name/size, closure time, number of personnel, point of debarkation, mode of travel, purpose of deployment, and equipment types and quantities.

Sensitive Items Report

7-53. This is an accountability report that indicates the status of sensitive items for a particular element or unit. This report is formatted to show time/date for missing sensitive item(s) and probable location of loss and actions taken. The free text format also allows the user to send a report of no missing sensitive items for a particular time.

Free Text Form

7-54. This form is a general-purpose report that allows the user to send a free text message. It provides the user with 17 text lines on the first page and 19 text lines on pages two through five. Each line of free text is 55 characters in length.

Intelligence Annex Reconnaissance and Surveillance (R&S) Plan

7-55. This plan is an intelligence gathering report that specifies reconnaissance and surveillance tasks for elements in the force. This plan is organized as a matrix with six entries provided for each individual line. The report provides for 17 individual lines.

Counter Reconnaissance Plan

7-56. This plan is an intelligence-gathering report that specifies counter reconnaissance tasks for elements in the force. It is organized as a matrix with six entries provided for each individual line. The report provides for 17 individual lines.

Overlay Free Text Message

7-57. This message is available to the user in the mail OUTBOX mode when the user generates and saves an overlay for transmission. It is available to the user in the mail INBOX mode when the user receives an overlay from another SAT user. However, it is not a standard formatted message provided in the mail EDIT mode. This message allows the user to enter a short text message to be accompanied with an overlay being transmitted to other SAT users.

NOTE: The user should make sure that the overlay free text message title is exactly the same as the overlay title prior to overlay transmission.

OVERLAY MODE

7-58. This mode is activated when the user selects the overlay mode icon in the mode control area of the display. In this mode, the situation background display map and grid reference markers are displayed for reference (the operator will not be able to edit any of these features as part of the overlay editing process).

7-59. Overlay mode is similar to the SA mode, but there are no unit positions displayed. All of the scrolling and zooming buttons in the SA mode affect the situation background display map and grid reference markers in overlay mode, and vice-versa. Therefore, if the user scrolls to a selected area at a given scale in the SA mode or overlay mode, then each mode comes up at the last map location/scale set by the user. This allows the user to move to and from the overlay and SA modes to check overlay information against the map background and unit positions.

7-60. In overlay mode, the user can load existing overlay files, create new overlay objects (points, lines, areas, or text), edit existing overlay objects, and save overlay objects to a new file. Overlay information may be printed either in map format (a screen dump of the current portion of the map displayed) or in tabular format.

TOE FILE MODE

7-61. This mode is activated when a user selects the TOE file in the mode control area of the display. The version, name, and number of the last TOE file read-in (currently being used) are displayed at the top of the main display area. Directly below the version is a line that indicates the host unit status. This status may be SYSCON or NOT SYSCON.

7-62. The SYSCON status enables the host unit to send out TOE updates and to increment the current TOE version number. In the TOE file mode, the edit version of the TOE is displayed. This edit TOE file display is a copy of the current TOE database actually being used (the last one read in from the hard disk). This edit display may differ from the TOE database actually being used. The NOT SYSCON status does not allow the user to send out TOE updates.

COMM FILE MODE

7-63. This mode is activated when the user selects the COMM mode in the mode control area of the display. The version, name, and number of the last COMM file read-in (currently being used) are displayed at the top of the main display area. Directly below this is a line that indicates the host unit status. This status may be SYSCON or NOT SYSCON.

7-64. The status of SYSCON enables the host unit to send out COMM file updates and to increment the current COMM file version number. In the COMM file mode, the edit version of the COMM file is displayed. The edit COMM file display is a copy of the current COMM file database actually being used (the last one read in from the hard disk). This edit display may differ from the COMM file database actually being used.

NAVAIDS MODE

7-65. This mode is activated when the user selects the NAVAIDS mode icon in the mode control area of the display. In the NAVAIDS mode, the situation map background and grid reference markers are displayed along with any units being tracked and any overlays that have been previously loaded. In this mode, the user enters new EPLRS NAVAIDS; reviews, modifies, or deletes any existing NAVAIDS; or sends an existing NAVAIDS to the EPLRS NCS. NAVAIDS can be received from the EPLRS NCS over a group needline whenever the NCS operator enters a new one.

7-66. Changes from the EPLRS NCS are automatically incorporated into the sent/received NAVAIDS databases, and the user is notified of the change via message(s) in the auxiliary readout area. All existing NAVAIDS are displayed in both NAVAIDS and SA modes.

SADL SYSTEM

7-67. The SADL utilizes the EPLRS to provide an all-weather, low-cost data-link for fighter-to-fighter, fighter-to-ground, and ground-to-fighter information transfer. SADL takes advantage of EPLRS being a secure, jam resistant communications system with low probability of intercept qualities to provide a low cost, near-term data link capability for older United States Air Force (USAF) aircraft.

7-68. The SADL enhances a pilot's SA of friendly ground troop concentrations and position to prevent fratricide when operating in the air-to-ground role. It capitalizes on the developing Army and Marine corps digitized battlefield architectures. The SADL has growth capability to ensure compatibility with future digital battlefield upgrades.

SOFTWARE CONFIGURATION

7-69. The SADL uses tactical data information link (TADIL) -J message sets in the fighter-to-fighter mode. It uses EPLRS message sets (see Appendix B) between the fighter and ground units to ensure interoperability with the current Army ground EPLRS networks. The SADL will be reprogrammed to a variable message format (VMF) as the Army ground EPLRS moves to the VMF.

EMPLOYMENT

7-70. SADL is flown in F-16, Block 25, and A-10 Aircraft. Fighter parameters, radar targets, ground targets, and friendly positions are passed on the net. EPLRS and SINCGARS-SIP (in the Tactical Internet- (TI) equipped ground positions) are displayed in the F-16 Heads Up and Heads Down weapon displays to allow timely fratricide prevention.

7-71. SADL-equipped ground forward air controllers (GFACs) can digitally transmit target coordinates and attack control information and clearance to SADL-equipped fighters. GFACs monitor attacks in progress to ensure the aircraft are attacking the correct target.