EPLRS—more than just data

EPLRS provides secure, jam -resistant data communications in a robust, self healing network.

by Rick Makowski

In scanning through the numerous communications and electronics trade journals, you find mentioned or advertised a multitude of radios. There are so many different radios for so many varied purposes, that it is often difficult to get excited when you hear of a new one coming along. After all, the purpose of a radio is basically just to serve as the vehicle in the transfer of information from one place to another.

With so many choices displaying the latest high technology communications capabilities, it seems as if one radio will work as well as another. To a large degree that is true. But there is now one radio system that breaks out of the traditional mold as just a vehicle to transfer information. This system is the Enhanced Position Location Reporting System or EPLRS which provides secure, jam-resistant data communications in a robust, self-healing network.

Like most radios capable of transferring data, EPLRS provides user-to-user data communications. Aside from the differences in communications capabilities such as network management, communications architecture, high-tech communications techniques and anti-jam capabilities, EPLRS has significant capabilities that are not found in other radios. EPLRS provides automatic position location and identification as well as a variety of navigational services. These additional capabilities, which are referred to as EPLRS services, can be used by individual users, command and control centers, or a combination of different functional areas to effect battlefield synchronization.

EPLRS evolved from the Position Location and Reporting System (PLRS), which was developed for the U.S. Marine Corps under a joint program with the U.S. Army and fielded in 1987. The two primary equipment components comprising the line-of-sight Enhanced Position Location Reporting System are the Enhanced PLRS radio set and the net control station (NCS). The radio set is a small, lightweight and man-portable unit that gives the user the ability to access EPLRS services and transfer data when hooked to a data terminal. The radio set can be carried on soldiers' backs, mounted in vehicles and shelters, such as trucks or tanks, or installed in fixed and rotary winged aircraft (Figure 1).

The net control station serves as the focal point for automated technical control and dynamic network management of the EPLRS community. It is currently configured in an S280 shelter and is installed, operated, and maintained by the Signal organization. The net control station also provides automatic processing of position location, navigation and identification requests and exchanges data with other net control stations to ensure continuity of operations.

The term TRIAD of Army Battlefield Communications Systems is a common term to the Signal community. It refers to the foundation by which the Signal Corps supports the current and evolving Army command, control and communications requirements. EPLRS is a key system helping to form the TRIAD of Battlefield Communications Systems.

EPLRS fits into the familiar three ring configuration as part of the Army Data Distribution System (ADDS) which is interlocked with the Area Common User System (ACUS) and Combat Net Radio (CNR). EPLRS serves to interconnect users within a Battlefield Functional Area (BFA) across each of the echelons as well as providing interconnects between the five points of the Sigma Star.

EPLRS serves as the foundation for data distribution in the Army division, brigade, and lower echelons and services a large portion of corps data distribution requirements. EPLRS supports the emerging tactical Battlefield Automated Systems, which include several key command and control systems, and supports all five Army mission areas on the tactical battlefield. These mission areas include maneuver control (infantry, armor, aviation,

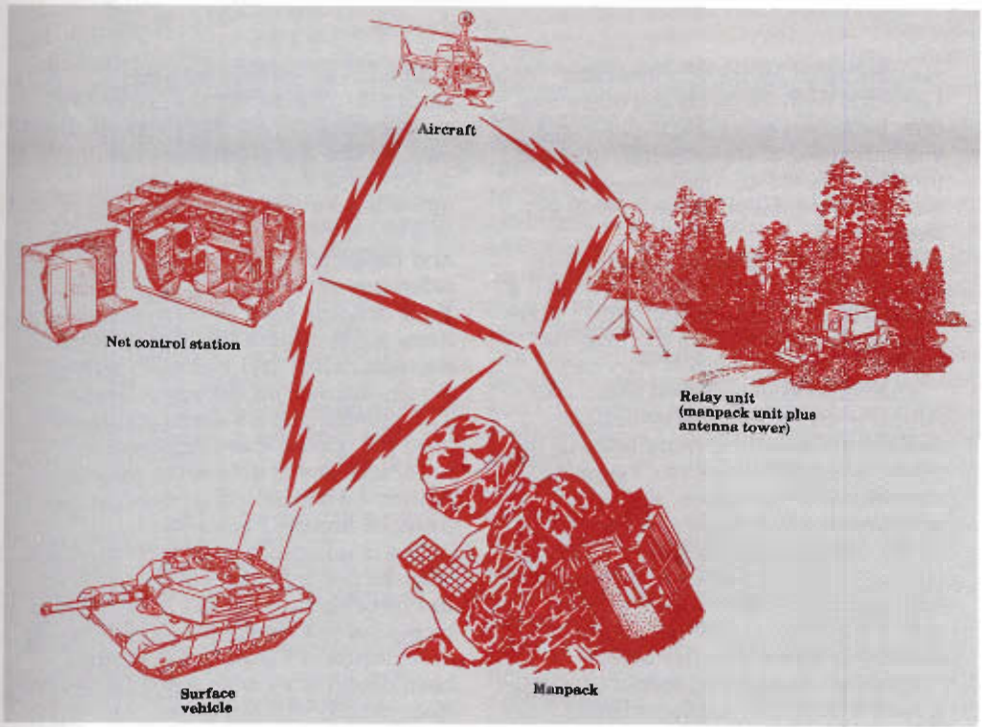

Illustration by Willie Smith

etc.), air defense, fire support, intelligence/electronic warfare and combat service support.

The Army's deployment concept for EPLRS is up to four single net control station communities supporting a division area of operations. Each single net control station community would consist of 100 to 200 EPLRS radio sets.

A net control station would normally be deployed with each of the brigade areas and one to service the division rear area. Each division and the Corps would deploy in separate multiple net control station communities, each with its own set of cryptovariables. Communications between users in both a single and multiple net control station communities are established directly through any required relay paths. Users in different multiple NCS communities, such as between divisions, can communicate by a gateway station established by the supporting Signal unit (Figure 2).

Let's imagine a soldier carrying this radio into battle. What can an EPLRS radio do for him? Is it worth carrying on his back, taking up space in his HMMWV, M1A1, Bradley, shelter, or Tactical Operations Center? Can it ensure the basics: survivability, reliability, flexibility, speed, security and synchronization?

When the soldier turns on the EPLRS radio, he is automatically entered into the network within minutes. Now, the soldier can transmit or receive data communications via a tactical computer such as a handheld terminal unit connected to the EPLRS radio set. He also has access to numerous EPLRS services through the user read-out device.

Now that the soldier's EPLRS radio set is operating and entered in the network, what can the radio do and what needs can it meet?

The Army requires battlefield command and control as well as synchronization of the force. The unique features of EPLRS services achieves these objectives with a single radio system.

Battlefield command and control synchronization is enhanced with the ability to transfer and receive information automatically from the different battlefield automated systems of the different battlefield functional areas. EPLRS services the data communications needs of multiple users of different battlefield functional areas and echelons, all at the same time. This wide use of EPLRS in servicing both intra- and inter-battlefield functional area data communications allows a consolidation of many time consuming command and control functions.

At a maneuver brigade tactical operations center, the computer hardware and software can be configured to receive a wide range of information including: the friendly deployment from the EPLRS net control station and overlay it on a map background, maneuver control system data, forward area air defense

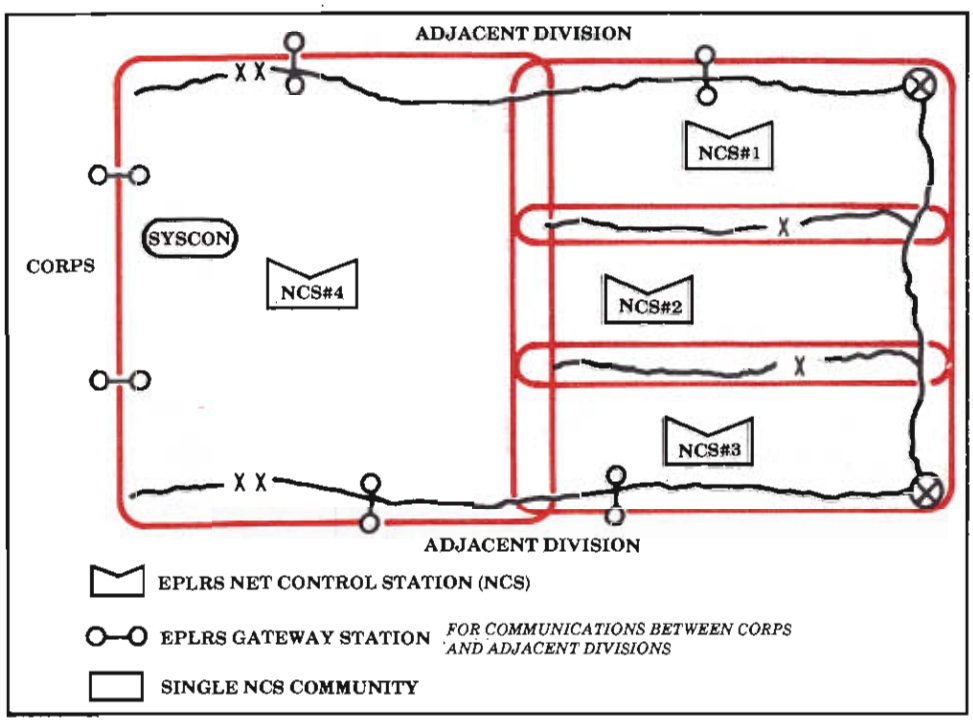

Figure 2. The Army's deployment concept for EPLRS. In support of a division, up to four single NCS communities form a multiple NCS community.

command control and intelligence air picture/support overlays, and field artillery support overlays. As an objective, this can give a commander and staff "one-stop shopping" to help plan, coordinate, direct and control the force. It avoids the "swivel-chair operation" at command and control centers.

The EPLRS services are the commander's tools to help implement his plan. The services can be used as control measures to ensure a wide range of needs, from safe passage to battlefield synchronization. The real advantages of using these tools is the ability to rapidly change control measures and the immediate updates available to the force. The integration of the battlefield functional area communications data, combined with the EPLRS services, adds a dimension to the battlefield that is not available in any other single communications system.

The radio on the soldier's back, in his vehicle and in his aircraft maintain the same time as all other EPLRS radio sets in the division. This can ensure precise timing so that aviation assets and field artillery fire support can be closely synchronized with ground maneuver forces. You no longer have to reset your watch before an operation to ensure that you have the same time standard.

The EPLRS radio set can tell you where your sister company is located with an eight-digit military grid reference. Or the radio set can tell you the bearing and range to get to that unit. If you see some activity on your right flank and you are unsure if it is another sister company, an anti-armor platoon or possibly the enemy moving into position, your radio set can tell you if there is a friendly EPLRS radio set-equipped unit in that area.

For a hasty emplacement of your mortars or a field artillery firing battery, your own position, accurate to within 15 meters, is displayed automatically at the user read-out on demand. You can establish your limits of fire by receiving bearing and range information on selected map points defining your limits.

You can request navigation assistance to any point on the map or EPLRS-equipped unit, day or night, in any type of weather, and receive automatic updates. A Medevac helicopter can receive automatic updates of your location, even as you are moving so you can affect a rendezvous in a safer area, versus remaining at an unsafe location. Link-ups with units on the move can now be achieved as the radio keeps you informed of its location, the link-up unit's location, and provides navigation assistance on how to get there.

An alert on the radio informs you that you have inadvertently entered a restricted area, Zone Alpha, and then automatically displays the bearing and range of the nearest way out.

The radio also tells you that Zone Alpha is an anti-armor minefield. Aside from marking minefields in the above example, zones can be used for marking free fire zones, and field artillery or air defense artillery zones of fire. Since zones include an altitude parameter, your Medevac helicopter will also be alerted if the pilot flies into a zone designated as an air defense artillery free fire area.

Another application would be using a zone to mark Phase Line Blue for an assault on Objective Tango, Hill #322. Your brigade established Zone Bravo as Phase Line Blue to ensure synchronization before the final assault. Rain is expected throughout the night, making it difficult to navigate; however, you will know when you have reached Phase Line Blue as you will get a zone alert from the EPLRS radio set.

From the minefield example, you could have avoided entering Zone Alpha by requesting guidance to Lane Alpha, which your brigade established to help guide you between the two minefields. Once in the lane, you will automatically receive guidance to keep you on course through the lane. If you stray out of the lane, the EPLRS radio set will alert you and guide you back to the proper course. This lane, with the zones, helps to ensure safe passage of friendly units. Lanes can also be used for passage of lines, designating the line of attack, or aircraft low level transit routes.

Equipped with the same type of radios, scout and attack helicopters in transit for a combined arms operation can receive air corridor guidance and alerts to ensure safe passage to the battle area. Aviation elements with EPLRS radio sets also have the same capability as ground users, which allows for a high degree of synchronization with the ground forces.

EPLRS service called pre-designated items are user reference points whose applications are limited only by the imagination. These reference points can be placed anywhere in the area of operations and units either request the bearing and range to or the military grid reference of the pre-designated item. Your brigade used predesignated items to designate the Start Point, Release Point, and Point of Departure for the assault on Objective Tango. The pre-designated items can also be used for rendezvous and checkpoints, to form a line of attack for navigation, or may be connected to show phase lines, or limits of advance.

The intelligence staff section, or S-2, can use pre-designated items to keep the force updated of key enemy locations or targets of opportunity. As an example, Objective Tango has been designated with a pre-designated item, which will be the reference for field artillery prep fires and a target reference for a combined arms assault with attack helicopters.

Through a capability referred to as notices, you can receive common information such as the current challenge and password, what the current edition of the signal operating instructions is, operation movement times or weather data. The most current information is available from the EPLRS radio set on demand.

Via the EPLRS radio set's user read-out device, you can manually send 10-character messages separate from the communications capability that your computer is using. Using brevity codes, you can send a variety of reports and messages to include closing, spot, nuclear/biological/chemical, supply request, Medevac request, and movement orders ("GO TO CP3").

The EPLRS radio set also has the capability to store up to 10 messages. This can be used to keep a critical message for later reference, versus writing it down, or to minimize reentering a recurring message item.

A report comprising several messages can be stored, then rapidly transmitted in succession by recalling the stored message. This capability complements the position location information and will significantly reduce the traffic on our VHF-FM radio nets. This allows less contention on combat net radio nets for the transmission of critical voice traffic.

You need good connectivity for network and communications survivability. The key to a good communications system is its ability to maintain required contact despite the dynamics of the AirLand battlefield.

Suppose you are in the forward area of the brigade with difficult terrain that strains your ability to communicate with other elements. The network will ensure that you remain in contact by automatically selecting the best path for connectivity. Other EPLRS radio sets may be automatically assigned to serve as your relay path on what is referred to as the control network, providing the best connectivity path within the net control station community. Your EPLRS radio set may also be a relay for other users as well. This is part of the control network function that occurs without you ever having to worry about how you are connected into the system.

If you are mobile and displacing to a new location, the network will automatically adapt to your movement so that you remain in the network. You may have lost connectivity from one EPLRS radio set acting as your relay, but the net control station ensured that your radio's control information was routed through another EPLRS radio set newly assigned as your relay. This occurs so fast and automatically that you never even know a new path was established. It is transparent to the user.

This automatic relaying capability, which extends your range and allows you to have the best path irrespective of your location or movement, is performed by the EPLRS radio set and the net control station.

A similar type of automatic relaying capability occurs for a communications needline. A needline is defined as a requirement to establish a communications path from one user to another. All you need to do is transmit data to another user and the EPLRS radio set and net control station automatically activates that communications needline. The two-way needline will be routed directly from you to a sister company on a single link or up to four relays to ensure optimum connectivity. You are unaware how many relays are required, if any at all.

As a user, you are concerned with the successful transfer of information and not the details of how it was accomplished. The EPLRS radio set takes care of that for you so you can be left to fight the battle and not the communications system. These communications needlines are established as needed and assigned to support your throughput and speed of service requirements. The EPLRS radio set can support multiple needlines at one time. The self-healing occurs at the system level as needlines from multiple users throughout the division are serviced simultaneously.

Aided by the automatic relay capability and a self-healing network, the message you send or need can get through. Your communications requirements are serviced without contention for access. For instance, in combat radio nets, you must wait for the net to be clear before you send your message. If the net is used for both voice and data, the wait may be a long time. This contention delay may be unacceptable if the information needed is a target handover request or a position report of a fast moving aircraft where a 10-second delay would make the report obsolete. The EPLRS radio in your vehicle has a reserved time to send or receive, depending on your needs, to avoid any contention delays. Depending on the size of your message traffic and how fast it needs to get there, EPLRS assigns the appropriate number of "time slots" to ensure that your message gets through in the required time.

Your communications requirements can be serviced with two-way (duplex) acknowledged needlines for command and control data or with broadcast (group-addressed) needlines for transmissions of sensor data and other information to multiple destinations. Error detection and correction is applied to all communications to ensure quality in the message transmission.

The EPLRS radio set in your vehicle employs safeguards for security of the transmission (TRANSEC) and security of the communications information (COMSEC). TRANSEC protects the anti-jam hopping pattern, whereas COMSEC protects the information passing through the radio. Cryptovariables are issued for TRANSEC at the Confidential level and COMSEC for either Secret or Confidential users. A unique set of cryptovariables for each needline are assigned to both your EPLRS radio set and that of the destination. These cryptovariables are assigned for communications security (COMSEC), and since they are different for each needline, you also have privacy of your message traffic. The EPLRS radio set maintains the next day's variables and it can also be rekeyed over the air (OTAR), allowing you to maintain the proper level of security without a large COMSEC overhead.

The EPLRS radio on your back, provides position location information to you and not the enemy via radio direction finding techniques. The EPLRS radio set is considered to be a "constant emitter" by some users, but you are in little danger of being detected or your position fixed by enemy direction finding equipment.

First, the radio is not a "constant emitter" as the transmissions are burst at less than one-1000th of a second and are normally separated by one or more seconds.

Secondly, the radio signal is spread across a wide spectrum prior to transmission. This means that the signal containing your information looks more like background noise instead of an intentional signal, especially with many radios operating in the same area. If your EPLRS radio signals cannot be separated from other radio signals, you cannot be found. This is true even if you operate the radio at high power. Combined with other anti-jamming techniques such as frequency hopping, pseudo noise coding, and interleaving, the enemy would have a very difficult time exploiting your transmissions or pinpointing your locations.

These same techniques ensure resiliency from jamming. A frequency hopping signal with short bursts requires highly sophisticated jamming techniques. The spread spectrum signal and the signal coding/interleaving significantly improve your ability to operate in a jamming environment.

The EPLRS services are shared by all who have EPLRS radio sets or the PLRS equivalent. This means that if you were in a joint operation with the Navy and/or Marines, you could exchange position location/identification information, and navigational aids, and communicate using the free text 10-character message capability. Your unit could conduct a passage of lines safely through a Marine area of operation.

Can Operational Security (OPSEC) be provided for in a radio? Controls that limit the access to information or authorization to change EPLRS services, such as a pre-designated item or lane, are programmed into the system during the planning phase. In this way, your scout section sergeant on the front line cannot receive position information on the brigade or battalion commanders.

Normally, the scout section sergeant would not need that information (need to know), and if his radio was captured before it could be zeroized, the OPSEC impact would be minimal. You can be given the authorization, at your radio, to allow you to change a pre-designated item, zone, or lane. This authorization can be a one-time request, be indefinite, or set up in the OPORD for a period of time. For OPSEC reasons, the authorization to change EPLRS services or accessibility to other users' position location information should be limited to only what you need to do your job.

If, by chance, one of the EPLRS radio sets in your unit was captured by the enemy, you could inform the net control station operator to cut off all communications and EPLRS services to that radio. If you were unaware that the radio was captured, the net control station operator, who also tracks unit movement, would be alerted by any unauthorized requests for information from that radio. The combination of tracking and monitoring the unauthorized requests prompts further investigation. If the enemy attempts to disassemble the radio, tamper protection automatically renders it useless to them.

Interoperability in terms of inter-battlefield area communications is also achieved. In an M1A1 tank, Bradley Fighting Vehicle or tactical operations center, you can receive air threat warnings from the Forward Area Air Defense C^2I air picture, initiate a field artillery fire mission, and display maneuver and intelligence data pertinent to your mission. The exchange of battlefield information, in near real time shared between the battlefield functional areas, allows a degree of interoperability that is currently not possible with other systems.

You are not limited to fighting only in a conventional war in central Europe to achieve full use of the radio. You can be deployed anywhere in the world in high-, mid-, or low-intensity conflicts, and EPLRS is flexible enough to support both heavy and light forces. The use of additional assets and thorough planning by the Signal organization can supplement areas of the network that may require greater connectivity or location reference due to terrain or the deployment. These assets and planning also ensures continuity of operations for displacement of net control stations or battle losses.

The EPLRS radio set is flexible enough to allow communications across divisions and corps boundaries, and provide EPLRS services as our moving unit transitions across boundaries.

EPLRS services enhance and automate many of the current cumbersome, manual battlefield functions. This information is displayed in the net control station to allow effective technical control of the network and is sent and displayed at battlefield tactical operation centers to enhance the commander's control of forces and situation awareness.

These new capabilities mean that our soldiers no longer have to rely solely upon maps and landmarks to know their true location on the battlefield. Locations accurate to within 15 meters are automatically displayed on the EPLRS radio set user read-out device.

This high technology information system is designed to provide users with a multitude of C^3I tools as simply as possible. Considering the magnitude of all of those tasks, available in each user's radio, the system is actually very complex, yet this complexity remains transparent to the user. The system supports data distribution and command and control in one package. What other joint system available can accomplish all of the above battlefield tasks at one radio? The Enhanced Position Location Reporting System is more than just data. And the radio is definitely more than just another radio.

Mr. Makowski is a Signal Corps Captain in the U.S. Army Reserves and is currently working as an engineer for Hughes. He spent nine years on active duty in a variety of tactical Signal and combat developments positions. *The author acknowledges the excellent input received from numerous Army and Hughes sources in the development of this article.*