DEMYSTIFYING JOINT RANGE EXTENSION APPLICATION PROTOCOL (JREAP)

Technical Article

Introduction

Tactical Data Link (TDL) development has always been driven by the need to enhance the capabilities of military communication systems.

Military communications need to be reliable, unambiguous, timely and accurate. They need to be secure, both in terms of message encryption, and in terms of resistance to jamming. They need to be high bandwidth, delivering large quantities of data quickly across complex decentralised networks. They need to be able to support a wide range of functions, suiting the needs of different forces, operations and theatres. They also need to be interoperable; all the systems on the network must comply with common standards, to enable all units needing access to the network to exchange tactical data.

No TDL has yet been developed which can meet all these requirements in all circumstances. While all standards and systems can provide a great deal of capability to the units they were primarily designed for, the choice of TDL for a given unit or in a given situation is often much more driven by the constraints of a particular system or message set; what it can't do, rather than what it can. Link 11, for example, is not resistant to jamming, and has a limited message set. Link 22 has a relatively low bandwidth, is only Electronic Counter Measures (ECM) resistant over a short range, and has some capability constraints in terms of digital aircraft control, imagery and voice.

Link 16, and its Multifunctional Information Distribution System (MIDS) bearer, is in many respects the least constrained TDL in widespread use. It is nodeless, which means networks can be created across multiple platforms without a single point of failure. It provides a high level of security, supporting both message encryption and, through frequency hopping, ECM resistance. It has a very high capacity and data rate (1.38 Mega Bytes per second), orders of magnitude beyond the Link 11 and Link 22 specifications, as well as typical Variable Message Format (VMF) radios. It also has an extremely extensive message set, supporting the exchange of data concerning air, land, surface, subsurface and space environments.

For this reason, Link 16 is in very widespread use and continues to be equipped in more and more platforms. However, the use of conventional Link 16 networks comes with a major trade-off, in that it is limited to Ultra-High Frequency (UHF) transmission, which means it can't transmit Beyond-Line-Of-Sight (BLOS). Link 16 networks, therefore, have a limited range; as little as 25 nautical miles in ground-to-ground applications, rising to 200 in air-to-ground and 300-500 in air-to-air.

Using Link 16 over a wide area has therefore typically relied on being able to support the network with airborne assets capable of relaying data beyond the range of a particular unit. This comes with many disadvantages, not least being the reliance on such assets being available, but also in terms of the capacity demands of retransmitting information across the extended network. Link 16, in common with many TDLs, is also limited to transmitting over specialised hardware – 'bearer systems' – and cannot interface with units without that kind of equipment available.

The Joint Range Extension Application Protocol (JREAP) is designed to supplement Link 16 networks by mitigating these disadvantages.

What is JREAP?

JREAP provides a foundation to overcome the Line-Of-Sight (LOS) limitations of terminals such as MIDS and extends coverage of these data links through the use of long-haul media. Although in principle JREAP supports message sets other than Link 16, the governing standard (MIL-STD-3011 and ATDLP-5.18) does not yet define support for others. In practice, because of Link 16's specific constraints, JREAP has been shown to add the greatest value when used in conjunction with these systems.

JREAP provides a foundation for Joint Range Extension of Link 16 to overcome the Line-Of-Sight (LOS) limitations of terminals such as MIDS, and extends coverage of these data links through the use of long-haul media. Specifically, JREAP allows TDL messages to be formatted for and transmitted securely across, internet protocol communications, by secure telephone and both military and commercial satellite communications networks. This not only dramatically extends the potential range of a network, it reduces the dependency on relay platforms and so the load on stressed capacity. It can also provide backup communications if a normal link is lost and can provide connections to platforms that may not have specific communications equipment for that TDL.

Unlike TDLs, which rely on specialised bearer systems to interface with the network, JREAP can transmit TDL data to any system which has the correct software and is designed to be as platform-agnostic as possible. A JREAP network can be connected into a Link 16 network by means of a JREAP processor attached to a conventional MIDS terminal. The JREAP processor receives information from the Link 16 network, converts it into a JREAP format, and then forwards it to 'clients' – the systems with JREAP processor software used by individual units – on independently governed schedules and protocols to the Link 16 network, and likewise converts and transmits any data provided by clients back to Link 16 units. The JREAP processor also supports multiple servers – and indeed connections across and between multiple Link 16 networks – serving as a gateway as well as a node with respect to these conventional networks.

In other words, JREAP can keep units in the loop about what is going on in the Link 16 network, and even allow them to feed information into it, without them actually participating in the Link 16 network themselves. This means they do not have to be constrained by the range, capacity, timing and bearer system requirements of actually being on the network properly. Consequently, data can be shared over whatever medium and on whatever schedule that works for the unit, even over long ranges with large latency.

This allows Link 16 data to be sent and transmitted globally without a Link 16 terminal, and across distances BLOS without the asset and network capacity demands of a traditional Link 16 relay. Essentially, bolting a JREAP network onto a Link 16 network allows units which can't meet the speed or equipment demands of Link 16 – either because they are out of range, or because they don't have a Link 16 terminal – to still have access to and contribute to shared situational awareness; they can still share in the same single source of truth provided by the Link 16 network.

JREAP operates over different media to conventional Link 16. The main trade-off is latency, but in many other respects equivalent standards can be achieved, albeit in different ways. For example, the means of achieving message accuracy and security will largely depend on the medium of transmission – such as Transport Control Protocol/Internet Protocol (TCP/IP) and Advanced Encryption Standards (AES) if the internet is being used as the bearer system – but can be made equivalent to the expectations of a Link 16 network.

Of course, even if transmission over JREAP takes no more than seconds, some information (especially the position of a moving track) will be out of date by the time it arrives. To mitigate this, JREAP includes the ability to extrapolate such changes in the data, to ensure it is as accurate as possible when it arrives.

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When JREAP Should be Used

JREAP is not a substitute for standard Link 16 or any other data link, it allows some capabilities like latency to be traded off for some others like range, while maintaining interoperability with the conventional systems. If units are within a close enough range to use an established Link 16 network, and have the appropriate equipment, that should of course still be preferred.

But where Link 16 equipment is not available, or when a unit has no LOS visibility of a Link 16 network, JREAP means they can still share in complete situational awareness.

For example, JREAP can provide a shared source of truth to navies and ground forces when they lack air support. It can also provide the picture to an aircraft travelling to join a mission for which it is presently out of range, or when it is transporting personnel or supplies; the aircraft can have situational awareness from the moment they take off, rather than only receiving it shortly before arrival.

Additionally, of course, it allows the common operational picture to be provided to headquarters in real-time, allowing Command and Control (C2), tactical situation monitoring and interaction through text messages, from thousands of miles away.