Application Note AN2013-20

Applying the SEL-3031 in Distributed Military Facilities

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INTRODUCTION

Military facilities are upgrading their electrical infrastructure to support the increasing electrical demand of military bases. The size of bases has increased with the addition of more facilities and on-base housing. Military bases are considered a self-contained city needing a complete electrical infrastructure. There are many locations within the base that are considered critical in operation, and they can no longer afford to be out of power for any length of time. These bases are upgrading their substations and electrical infrastructure with microprocessor-based relays, automatic controls, metering, and loop-fed systems.

PROBLEM

Military bases are upgrading their electrical infrastructure, providing a higher quality of electricity service to the base. In order to allow all the relays, reclosers, meters, and substation equipment to operate as a networked system, these bases need cost-effective communications at each equipment location. It is not cost-effective to run fiber to each of these locations for supervisory control and data acquisition (SCADA) polling and high-speed control of the distribution system. The system cannot operate as fast and reliably as needed without a communications system.

SEL SOLUTIONS

The SEL-3031 Serial Radio Transceiver is the perfect solution for connecting all of these locations and providing multiple channels of real-time communication. The SEL-3031 allows high-speed, low-latency communications for implementing loop schemes. The SEL-3031 using MIRRORED BITS® communications can deterministically pass critical information, helping monitor, control, and operate reclosers to quickly isolate the fault and minimize the power outage duration. Because the SEL-3031 comes standard with three serial ports, the substations can poll SCADA information from all of these devices and provide remote engineering access.

Point-to-Point and Point-to-Multipoint Links

Figure 1 shows an example of how the SEL-3031 can be distributed through a military system, providing service for multiple data types. The configuration of the SEL-3031 as a point-to-point (P2P) or point-to-multipoint (P2MP) link depends on the level of service required. The radio operates in either P2P or P2MP mode in addition to using SEL Hop-Sync™ technology for collocated radios.

The SEL-3031 used in P2P mode provides three serial ports between two locations at up to a 20-mile distance. Each of the serial ports supports either MIRRORED BITS communications or any byte-oriented protocol, such as DNP3, Modbus®, or ASCII. The SEL-3031 allows SEL relays or

automation devices to efficiently pass MIRRORED BITS communications data, allowing the system to quickly isolate faults from the grid when the system becomes unstable or to quickly clear a permanent fault on the line. The SEL-3031 provides these low-latency links with less than 6 milliseconds of latency to quickly and reliably operate the circuit breakers.

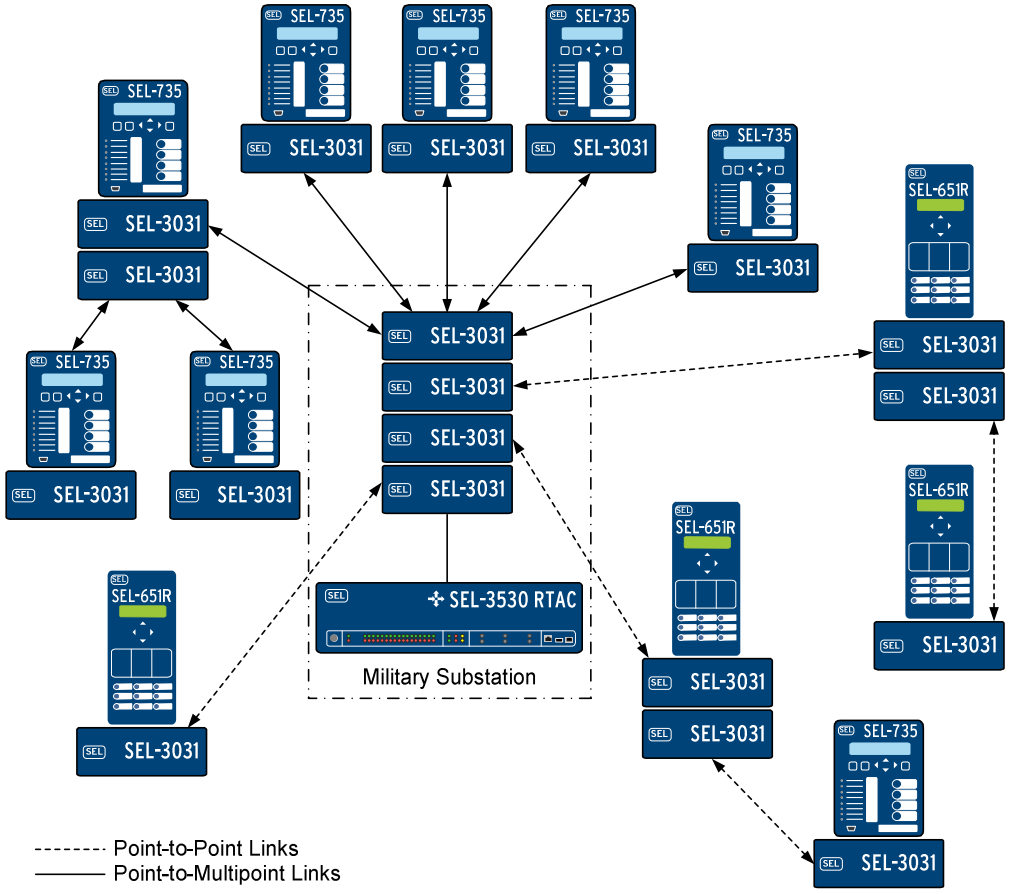

Figure 1 Military Layout for Complete Metering and Control

In a P2MP system, one master communicates with multiple remote or outstation radios. The master establishes contact with one remote radio, exchanges data, and then moves on to communicate with the next radio. P2MP operation is well suited for applications such as SCADA data gathering, where it is acceptable for seconds to elapse between polls. In this mode, only Port 1 is active and polling is accomplished by using multidrop protocols with addressing.

The optional encryption card works in P2P and P2MP modes. The additional settings are simple to use, hiding the amount of behind-the-scenes work required to implement secure encryption. The encryption card provides FIPS 140-2-level certification, securing all wireless data and preventing eavesdropping, man-in-the-middle, and replay attacks.

Using Collocated Radios

Generally, when there are multiple radios at the same site (collocated), the transmission from one radio can easily overpower the weaker signals (from up to 20 miles away) that a nearby radio is trying to receive. This may degrade the availability of the radio link, resulting in poor radio link performance.

By synchronizing collocated radios so that they all hop, transmit, and receive at the same times, no local radios will be transmitting while receiving signals. This allows dependable data

communications for back-to-back radios used as repeaters and for multiple P2P links from the same station.

High-Speed Loop Scheme

For fast isolation and restoration schemes, a fast P2P link is needed between the substation and each of several remote recloser controls. Each of these links requires a radio at the substation. The radios are classified as collocated because the antennas are installed at the same site and on the same pole or tower. SEL Hop-Sync technology synchronizes these collocated master radios so that none are transmitting when any are receiving data; therefore, the strong local transmissions cannot override the weaker remote signals that must be received. Figure 2 shows an additional capability of SEL Hop-Sync technology using collocated radios and P2P radio frequency chain links with drops. This topology allows the maximum reach between radios using Yagi antennas and removes the need for extra repeaters for remote tie locations.

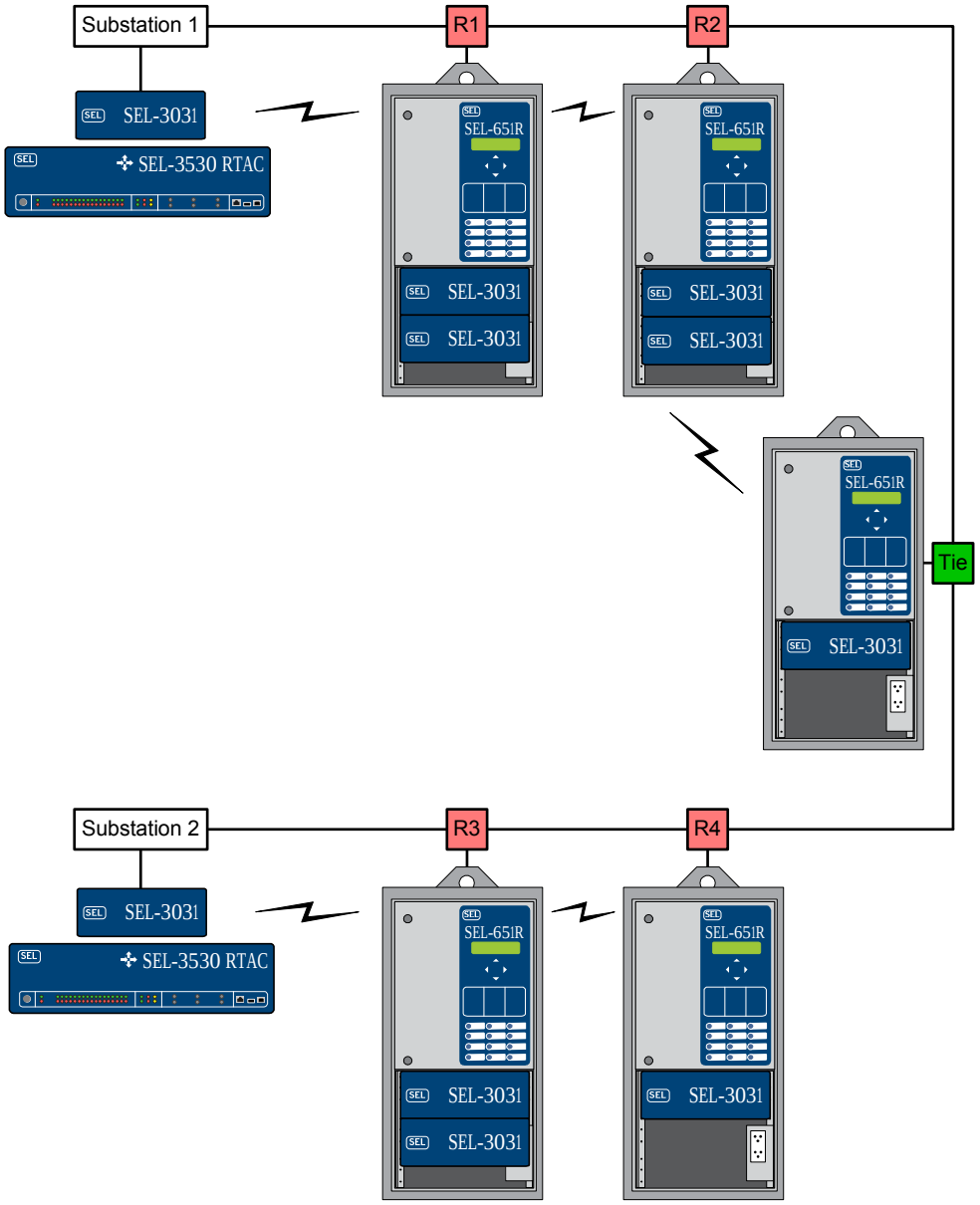

Figure 2 High-Speed Loop Scheme

Figure 3 provides a closer view of Figure 2 and shows how the data channels are propagated from Substation 1 through the tie breaker. The P2P links provide the capability to send any three types of serial protocols between the two points. At each repeater location, the user has the ability to terminate the port to the recloser, passing the channel through the next radio link or creating a multidrop network, extending the complete length of the network.

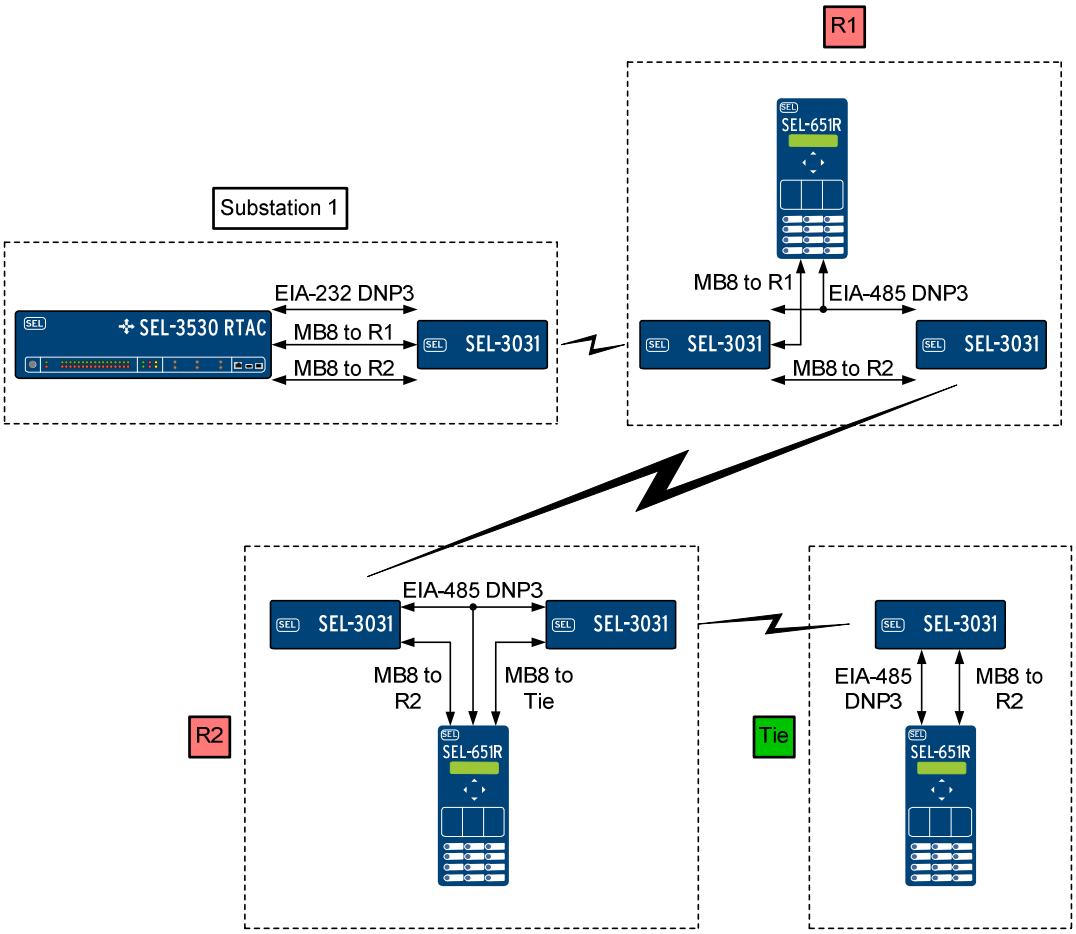

Figure 3 Moving Data Through the SEL-3031 Network

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