

# Use SEL Hop-Sync™ for Redundant Wireless Communications-Assisted Tripping Schemes

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## INTRODUCTION

The SEL-3031 Serial Radio Transceiver is a 915 MHz ISM serial data radio that supports point-to-point (P2P) and point-to-multipoint (P2MP) operational modes. In P2P mode, the SEL-3031 supports three serial data ports in one radio channel. The ports are completely independent and support a mix of protocols, including DNP3, Modbus®, MIRRORRED BITS® communications, SEL Fast Message, plain ASCII, and more. In P2MP mode, a one-channel master radio communicates with multiple remote radios for supervisory control and data acquisition (SCADA) or other data-gathering applications.

Utilities commonly use MIRRORRED BITS communications protocol for communications-assisted tripping schemes, including permissive overreaching transfer trip (POTT) and directional comparison blocking (DCB) schemes. SEL has several application guides available at <http://www.selinc.com> that discuss specific relay settings for these schemes. If the antennas for the communications-assisted tripping schemes are collocated and operate at the same frequency, they can interfere with each other. SEL Hop-Sync™ technology, available in the SEL-3031, solves interference problems with collocated antennas. The SEL-3031 offers an economical and reliable communications solution between local and remote relays.

## APPLICATION

In P2P mode, the SEL-3031 supports up to three independent serial data ports in one radio channel. With this capability, users can configure one radio set to carry MIRRORRED BITS communications data for both the primary and backup relays in a communications-assisted tripping scheme (see Figure 1).

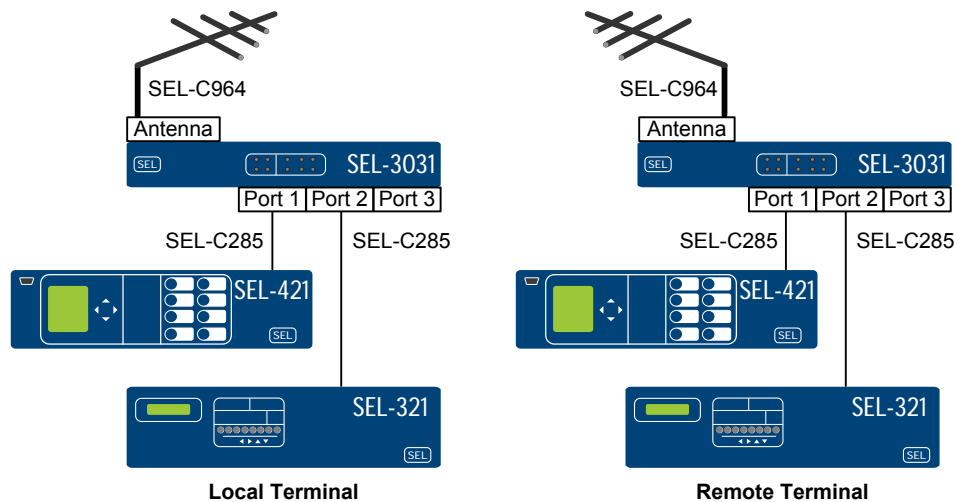


Figure 1 Dual MIRRORRED BITS Communications Channels Over Single Radio Set

Once the system is configured, users can monitor and evaluate the communications system performance. SEL recommends a receive signal strength indication (RSSI) of  $-77$  dBm or greater (see the SEL-3031 Instruction Manual, available at <http://www.selinc.com>). Users can review the RAD command response from the SEL-3031 to obtain the RSSI value and overall availability (see the following screen capture).

```

=>rad
SEL-3031                               Date: 06/07/2010 Time: 08:48:59
POTT MB 321 / 311                       Time Source: Internal

RSSI
-69 dBm

AVAILABILITY:                            From 05/14/2010 13:16:49

Overall
99.72 %

Zone 1      Zone 2      Zone 3      Zone 4      Zone 5
99.71 %    99.62 %    99.63 %    99.73 %    99.75 %

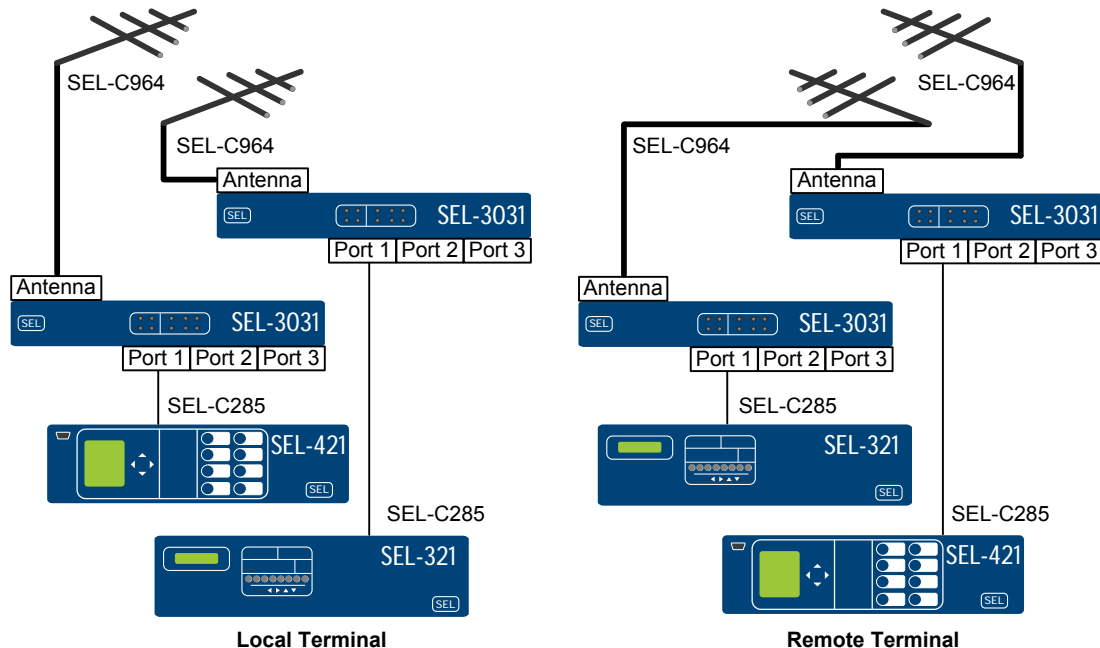
Zone 6      Zone 7      Zone 8      Zone 9      Zone 10
99.94 %    99.71 %    99.75 %    99.67 %    99.71 %

=>

```

In addition, users can review the MIRRORED BITS communications reports from the protective relays to verify a low unavailability rate and view further information on the radio system and MIRRORED BITS communications protocol performance.

Users sometimes require redundant communications networks—one for the communication of a primary relay and a second for the communication of the backup relay (see Figure 2).



**Figure 2 Redundant Communications Links**

Using multiple antennas at one location that operate at the same frequency band causes interference issues with adjacent (collocated) antennas. With the configuration shown in Figure 2, users notice very poor overall availability, yet strong signal strength. The RAD command

response with collocated antennas and without Hop-Sync technology is shown in the following screen capture.

```

=>rad
SEL-3031                               Date: 04/12/2010 Time: 09:42:34
POTT MB 321 / 311                       Time Source: Internal

RSSI
-71 dBm

AVAILABILITY:                            From 03/10/2010 15:56:41

Overall
55.37 %

Zone 1      Zone 2      Zone 3      Zone 4      Zone 5
89.19 %    86.31 %    88.63 %    88.46 %    83.42 %

Zone 6      Zone 7      Zone 8      Zone 9      Zone 10
85.40 %    78.87 %    83.55 %    81.82 %    13.40 %

=>

```

## SEL SOLUTION

To improve the dependability when using collocated antennas, the SEL-3031 radios include Hop-Sync technology. Hop-Sync technology allows two or more collocated radios to synchronize the transmit and receive time slots and hop frequencies at exactly the same time. This prevents interference from the adjacent antenna, and the collocated antennas can be placed within 8 to 10 feet of each other.

The SEL-3031 radios are synchronized with one setting in each collocated radio and an external cable between the radios. The radios use Pins 7 and 8 on Port 3 for synchronization. If the user only has two collocated radios and Port 3 is unused, an SEL-C273A cable is used. Along with the normal EIA-232 data lines, the SEL-C273A cable also has Pins 7 and 8 wired. For a specific wiring diagram of the SEL-C273A cable, users can download the SEL-5801 Cable Selector program from <http://www.selinc.com>. In addition, users can consult the SEL-3031 Instruction Manual if the application requires more than two collocated radios or if Port 3 is in use. See Figure 3 for an example of a Hop-Sync system.

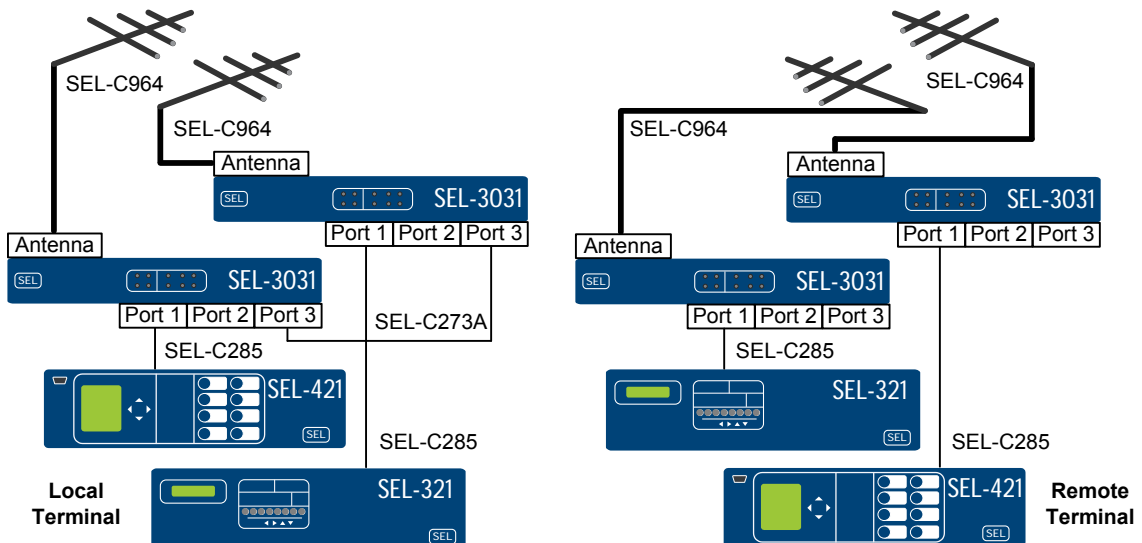


Figure 3 Collocated Radios With Hop-Sync Technology

Note that in the application shown in Figure 3, the radios only need to be synchronized at one terminal. Synchronizing the transmit timing between collocated radios at one terminal results in synchronized receive and transmit data at the remote terminal.

Once the system is configured to synchronize transmit timing at one collocated antenna location, reset the radio communications statistics and relay communications report. Re-run the RAD command on the SEL-3031 radio, and verify a strong RSSI and near 100 percent overall availability. The communications statistics of the SEL-3031 radios and the MIRRORED BITS communications report performance of the relay should be similar to the performance of the single radio set link shown in Figure 2.

When using the radios in collocated applications with MIRRORED BITS communications or other critical communications, additional setup is needed to validate that if the radios become unsynchronized, the radio links will still operate as expected with an acceptable level of dependability. Refer to the SEL-3031 Instruction Manual for a five-step procedure to identify how far apart the antennas need to be to provide adequate link availability if synchronization is ever lost.

