Configuring 1+1 Space Diversity for GigaPro

Overview

This Application Note explains how to setup 1+1 Space Diversity for TrangoLink GigaPro Platform, including specific commands used to configure the system.

Space Diversity is a method of link redundancy used to reduce or eliminate signal loss caused by multipath reflections over highly reflective transmission paths. All types of SD require two antennas separated on a tower by a sufficient amount of distance such that when a fading condition is present on one antenna, there will not simultaneously be a fade occurring on the second antenna.

For more information on Space Diversity, see Tech Brief TB-13-011.

System Configuration

Equipment

A single SD link consists of the following Equipment at each end of the link
- 1 GigaPro IDU
- 1 -48 VDC Power Supply
- 2 Identical ODUs (Same subband and Transmit Frequency)
- 2 Antennas, one mounted vertically above the other.

GigaPro IDUs each have two ODU connectors, one which is used for the main Transmitter and Receiver and the second which is used for the diversity receiver and a Hot Standby Transmitter.

Traffic Interfaces

Usable Traffic Interfaces are all 6 Ethernet ports, or 4 Ethernet Ports and STM-1 A plus the Lower 16 T1/E1 Interfaces. In addition the number of usable interfaces depends on the channel bandwidth and modulation selected. Figure 1 shows a simplified block diagram of the valid interfaces and the datapath.
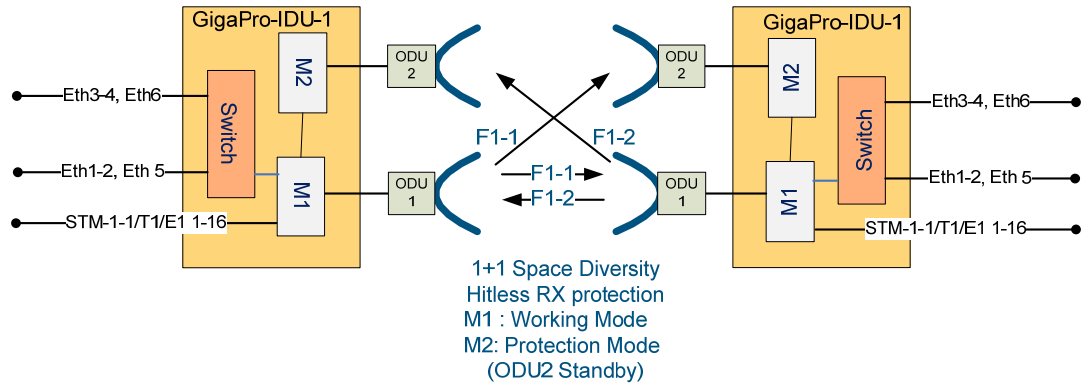
Figure 1 Traffic Interfaces and Datapath

Configuration on the Tower

To achieve space diversity, one antenna must be mounted above the other and a single transmitted signal is received at both the high and low antenna. The best signal is chosen automatically in the IDU using baseband switching and forwarded out the traffic interface towards the user network.

Antenna Spacing

It is very important that the vertical antenna spacing is set to achieve good de-correlation of fading events at each antenna, and there are many ways to fine tune the spacing which are not discussed in this App Note. In general, good de-correlation occurs at the following spacings:

Frequency	Spacing
6 GHz	30 feet
7-8 GHz	25 Feet
10-11 GHz	20 feet

Physical Configuration (Single SD Link)

Below is a Block Diagram showing the typical physical configuration for Space Diversity. The diagram shows one ODU per antenna with two of the ODUs transmitting and receiving while the other ODUs are receiving only.
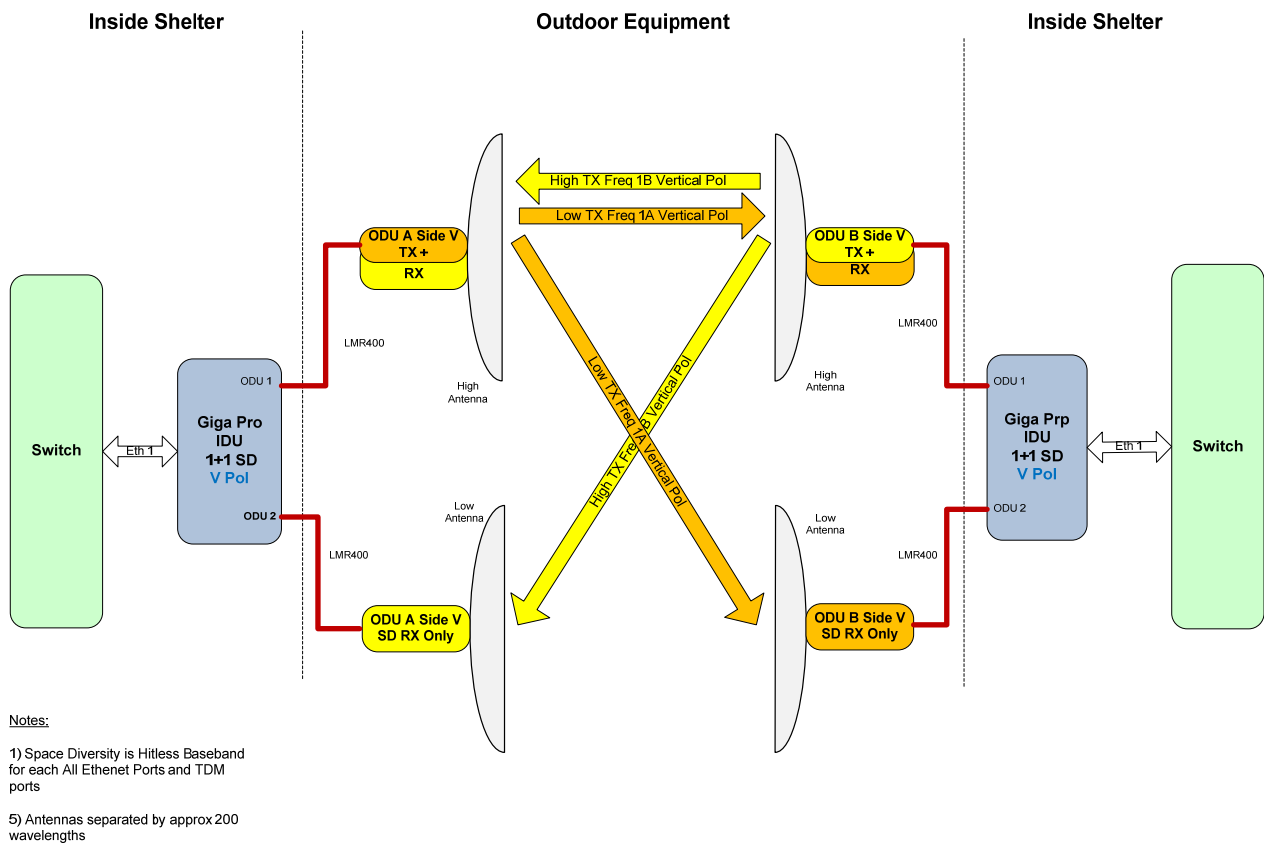
Space Diversity System using Trango GigaPro

Inside Shelter   Outdoor Equipment   Inside Shelter

High TX Freq 1B Vertical Pol

Low TX Freq 1A Vertical Pol

ODU A Side V
TX +
RX

ODU B Side V
TX +
RX

Low TX Freq 1A Vertical Pol

High TX Freq 1A Vertical Pol

Switch

Eth 1

Giga Pro
IDU
1+1 SD
V Pol

ODU 1

ODU 2

LMR400

LMR400

High
Antenna

Low
Antenna

High
Antenna

Low
Antenna

LMR400

LMR400

ODU 1

ODU 2

Giga Prp
IDU
1+1 SD
V Pol

Eth 1

Switch

ODU A Side V
SD RX Only

ODU B Side V
SD RX Only

Notes:

1) Space Diversity is Hitless Baseband for each All Ethenet Ports and TDM ports

5) Antennas separated by approx 200 wavelengths

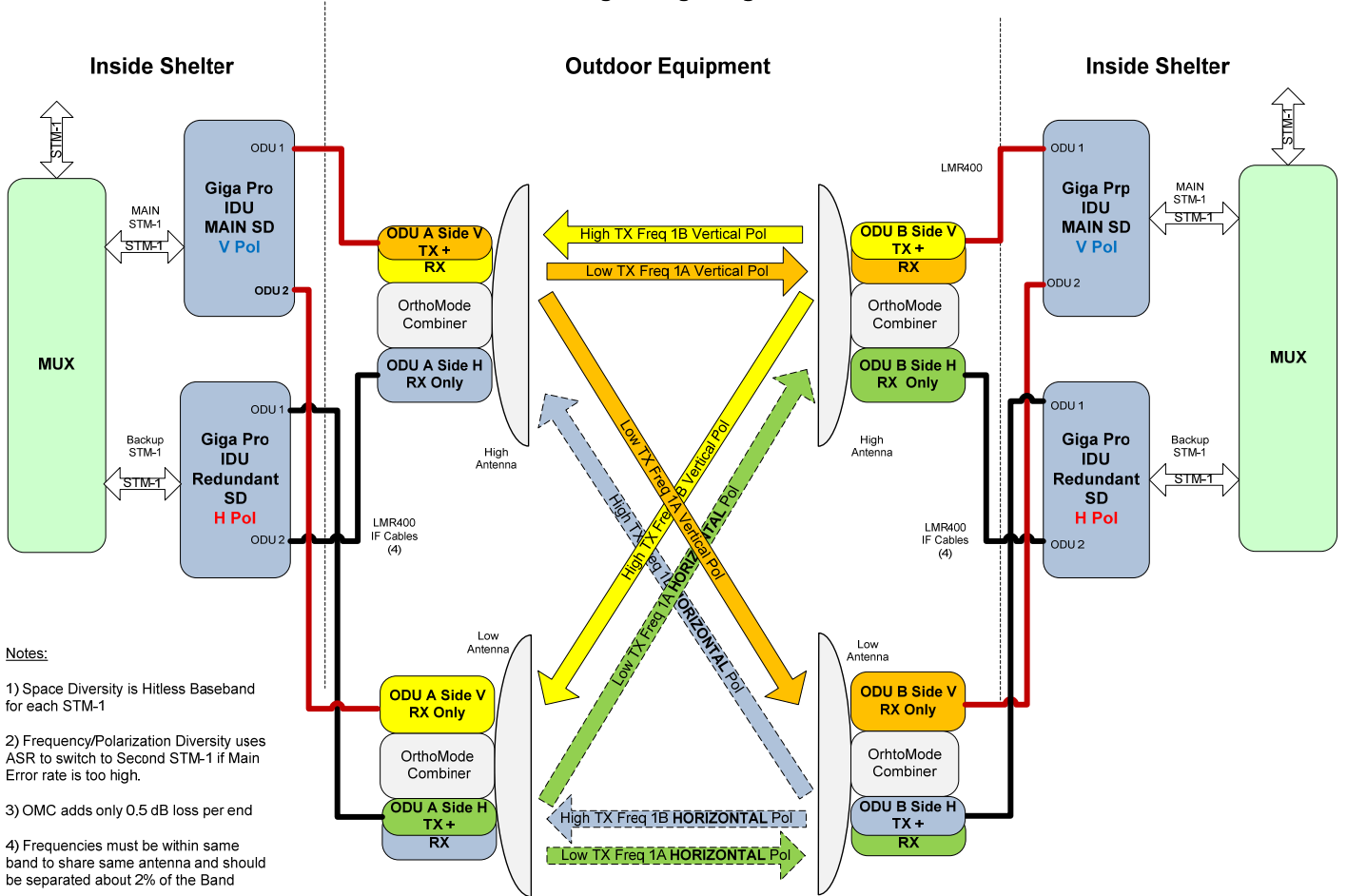Figure 2 : 1+1 Space Diversity Basic Setup

Physical Configuration (Dual SD Link)

A second configuration that can add redundancy is a dual space diversity setup with **frequency** and antenna **polarization** diversity added. An external multiplexer is used to switch from the main to the redundant paths in the event that fading on the main link is so severe that errors occur on both the main and diversity paths.

The configuration is basically another space diversity link added to the single space diversity link using the same antennas. An Ortho-mode combiner is used to add the second link to the opposite polarization of the first link, and the second link is chosen to be at a frequency 2 % or more away from the main link. In this configuration the same RF band must be used to allow sharing of antennas.

A second frequency band may be used but two more antennas would be required on each tower site.

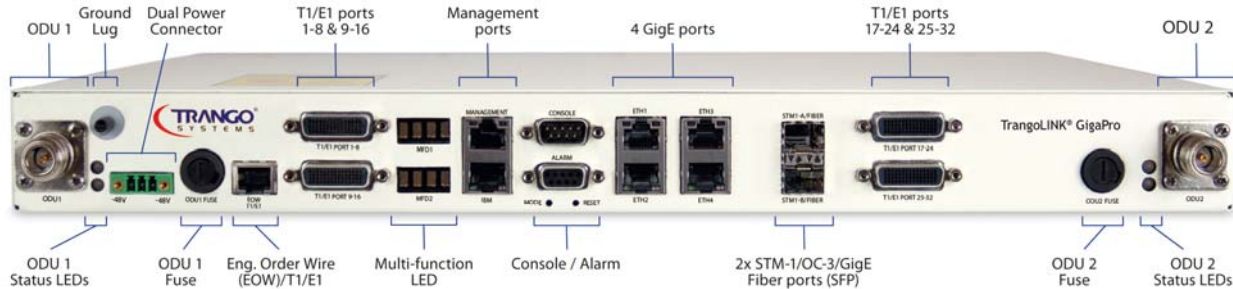**Space, Frequency and Polarization Diversity System using Trango GigaPro**

Figure 3 Dual Space Diversity

Equipment Setup

The Front Panel of the GigaPro IDU is shown below for reference.

After Connecting the IDUs and ODUs per Figure 2, the equipment may be set up using the following steps:

Basic 1+1 Space Diversity Setup Steps:

1) Log into the IDU using Telnet or SSH.

2) Enter the licenses for System, Speed, TDM, and STM-1 if not already done by the factory. Use the *license_speed , license_stm1, license_system, and license_tdm* commands if needed.

3) Set the desired datapath using the *datapath* command. This must be selected based on the traffic interfaces that are to be used in the final 1+1 Space Diversity configuration.

4) Set the system up using a **1+0 sysconfig (Default)** with ODUs connected only to ODU 1 Port. Do not connect ODUs to ODU Port 2 yet.
   a. Turn ODU power on using the *odupower on* command.
   b. Set TX frequency using the *freq* command.
   c. Set TX Power using the *power* command. Use the highest power possible based on the ODU model used.
   d. Set Speed using the *speed* command. Use the narrowest channel bandwidth and the lowest modulation for best performance in high multipath conditions.
   e. Enable ACM if desired using the *ACM enable on* command.
   f. Turn Opmode on.
   g. Set the default opmode to on using the *default opmode* command
   h. Repeat for the opposite end of the link.

5) Align the main antennas only to achieve the expected RSSI. Use the BNC connector at the ODU to achieve real time feedback of the RSL.

6) Verify the link is running as expected and Save the configuration using the *config save* command.

7) Change the sysconfig from 1+0 to 1+1 SD using the *sysconfig 1* or *sysconfig 3* command. *sysconfig 1* will be SD with no protection for Transmitter failure and *sysconfig 3* will be 1+1 Hot Standby with protection for a TX failure and SD.

8) Save the configuration using the *config save* command.

9) Immediately physically turn the power off on both ends and connect the second ODU to the second antenna (typically the lower antenna) using the IF cable.

10) Repeat for the other end.

11) Repower both ends.

12) The link should power up in a 1+1 SD configuration and information for both radios will be shown independently.

13) Configure Radio 2 to match radio 1 speed, TX power, ACM, and other items from step 4 above. Log into the radio2 prompt by running the *radio2* command. Exit the radio2 prompt by running the *exit* command.

14) Align the second antennas until the RSSI is the same as the main antenna (assuming non faded path conditions).

15) The system is now running in SD Configuration.

16) Run the *config save* command to save all settings.

Verifying and Monitoring Performance

RSSI

Monitoring RSSI of all Radios over time using SNMP will allow verification of the decorrelated nature of the two paths. If the RSSI values fade the same for both the main and the diversity path, realignment may be necessary, or the antennas may not be far enough apart.

MSE

Some multipath interference will not show up as a reduction of RSSI, but the MSE will increase (NOTE: -20 is a higher (worse) MSE than -35) since the modem decoder has to work much harder to correct signal distortion.. Monitoring the MSE on both radios will allow verification of the decorrelation between the main and SD path just like the RSSI.

BER

The Bit Error Rate will show the actual Bit Errors of the combined main and diversity paths and there will be a significant improvement in this metric over a non protected link.

Summary

Space Diversity can dramatically improve reliability of microwave links in high multipath/reflective environments and is recommended for links over water and long links over flat terrain. In addition to GigaPro, Trango has other products that can be used in challenging multipath environments.

For more information contact Trango Systems or visit our web site at www.trangosys.com.

About Trango Systems, Inc.

Trango Systems, Inc., was founded in 1996 and is headquartered in San Diego County, California. The company designs and manufactures innovative licensed and unlicensed microwave backhaul equipment for customers in over 70 countries and is ISO 9001:2008 certified.