MRL

Point-to-Point
Wireless Family Product

User Manual and
Installation Guide

Version 1.750

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The information contained in this document is subject to change without notice.
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Information to User

Any changes or modifications of equipment not expressly approved by the manufacturer could void the user's authority to operate the equipment and the warranty for such equipment.

FCC – User Information

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance (MRL) could void the user's authority to operate the equipment.

It is the responsibility of the installer to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), only those antennas certified with the product are used. The use of any antenna other than those certified with the product is expressly forbidden in accordance to FCC rules CFR47 part 15.204.

Outdoor units and antennas should be installed ONLY by experienced installation professionals who are familiar with local building and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities. Failure to do so may void the MRL warranty and may expose the end user or the service provider to legal and financial liabilities. MRL and its resellers or distributors are not liable for injury, damage or violation of regulations associated with the installation of outdoor units or antennas.

FCC Notation for Indoor Units IDU-E and IDU-C

Concerning all models and configurations

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.

(2) This device must accept any interference received, including interference that may cause undesired operation.

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Chapter 1
Introduction

MRL's family of wireless broadband products deliver carrier-class performance at the most competitive price.

MRL products pack legacy TDM and Ethernet services over the 2.3 - 2.7 GHz and 4.9 - 5.95 GHz spectrum bands, and comply with worldwide standards and regulations (including FCC and ETSI).

MRL's carrier-class MRL products meet the stringent performance and quality demands of cellular carriers and service providers. Delivering high capacity connectivity of up to 48 Mbps at distances of up to 80 Km/50 miles, the MRL products offer an unmatched combination of robustness and reliability at an affordable price.

Key Applications

MRL's systems are ideally suited to meet the needs of cellular carriers, service providers and private networks (such as private and public enterprises, government, educational and financial institutions).

The MRL systems power a range of applications, among them:

- Cellular Backhaul
- Broadband Access
- Private Network Connectivity
- Video Surveillance

Cellular Backhaul

MRL products enable cellular carriers to expand their networks in both urban and rural areas quickly and cost-effectively.

MRL systems are ideally suited for a broad range of cellular backhaul deployment scenarios; they empower carriers to expand their presence into remote and low ARPU areas, provide enhanced overlay coverage in urban spots, and can serve as a temporary or backup backhaul solution.

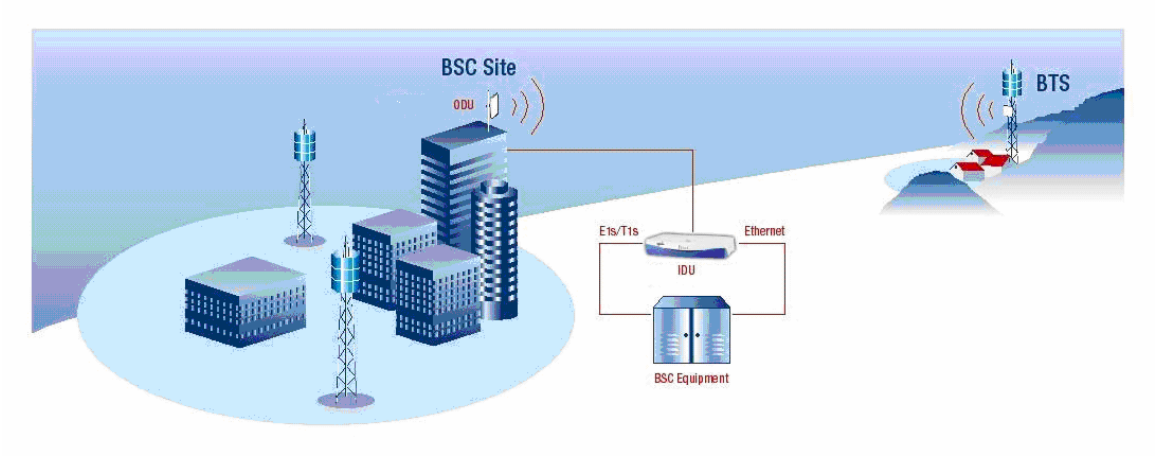


Figure 1-1: Typical Cellular Backhaul Application

Broadband Access

With MRL, service providers can expand their service footprint rapidly and affordably, and provide high-capacity services that match the ever-growing demand for high-quality, high-speed broadband.

MRL is the ideal solution for last mile access, and also powers WiFi backhaul and WMAX backhaul applications.

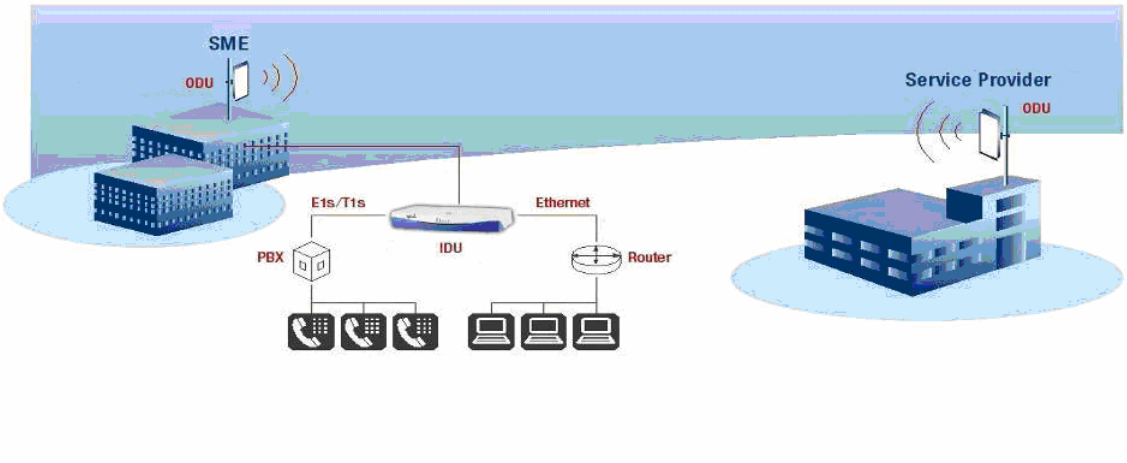


Figure 1-2: Typical Broadband Access Application

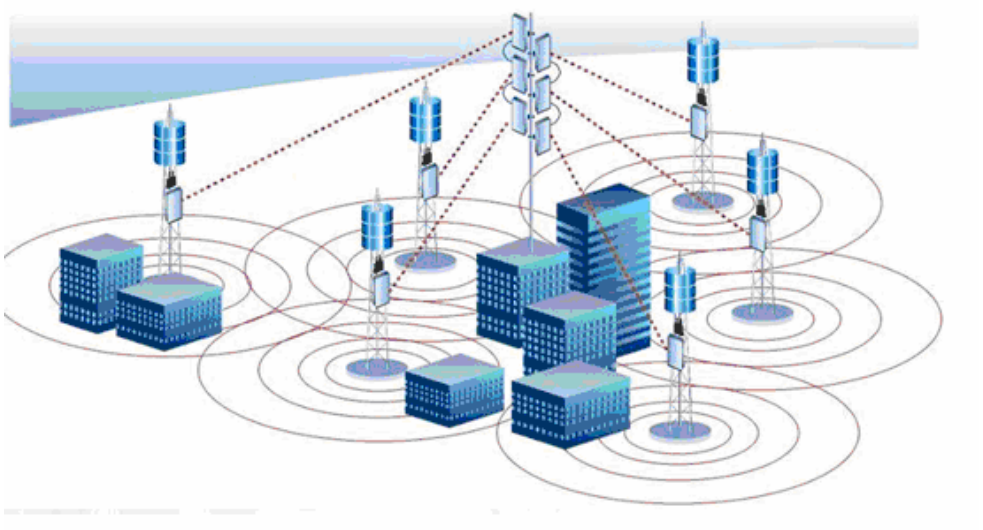


Figure 1-3: Typical WiFi Backhaul Application

Private Networks

MRL is the perfect solution for private networks such as enterprises, education, government and utility organizations that want to own and control their networks and eliminate the high recurring charges for leased lines/cable. MRL's cost-effective solution enables organizations of all types to connect geographically dispersed buildings at ranges of up to 80 Km/50 miles.

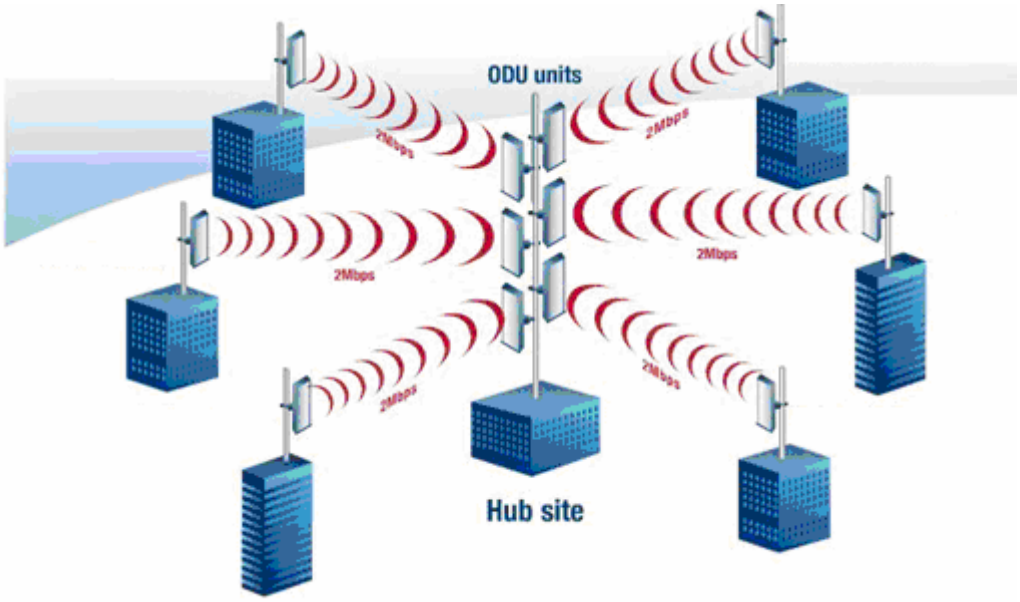


Figure 1-4: Multi Point-to-Point Enterprise Connectivity

Video Surveillance

MRL's wireless broadband systems allow organizations and system integrators to deploy video cameras virtually anywhere while eliminating the costs and installation hassles of wire-based systems. Reliable, robust and affordable, the MRL systems support a variety of transmission topologies such as Ring, Star and Daisy Chain to provide surveillance coverage of the most challenging environments.

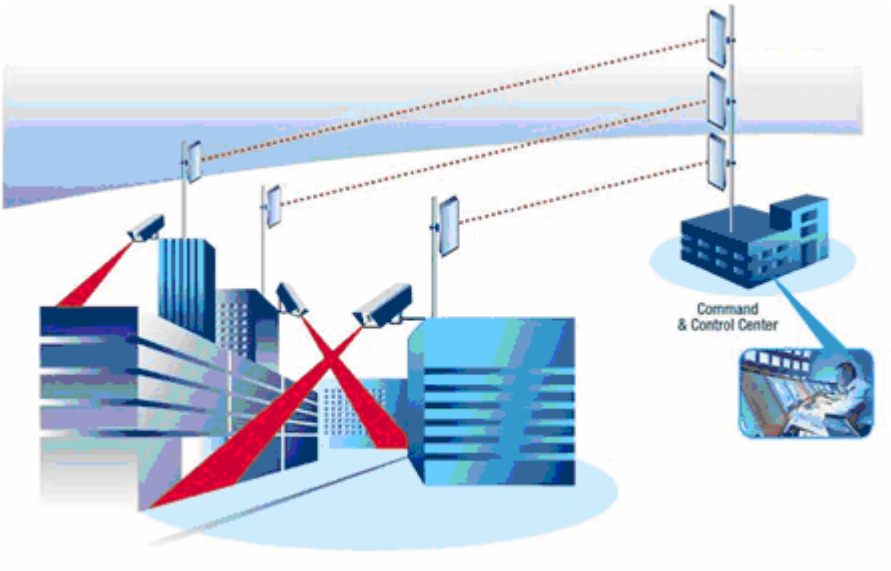


Figure 1-5: Multi Point-to-Point Video Surveillance Deployment

MRL Key Features

The following represents some of the outstanding features that MRL provides:

TDM + Ethernet in one Solution

MRL systems deliver carrier-class TDM + Ethernet over one platform, making them ideal for a range of backhaul and access applications.

Simple Installation

MRL systems are extremely simple to install and maintain, and are typically up and running in less than an hour.

Advanced Air Interface

The MRL system design incorporates an exceptionally robust air interface based on patented technologies. The unique air interface protocol of MRL is designed to ensure non-stop, high quality

transmission, even when encountering interference and harsh conditions.

Automatic Adaptive Rate

Automatic Adaptive Rate is a method of dynamically adapting the transmitted rate by changing both the signal modulation and coding. Automatic Adaptive optimizes the data throughput according to interference conditions, to optimize data throughput while maintaining service quality.

Unique Multi Point-to-Point Deployment

MRL's products can be installed in a unique multi point-to-point architecture. Multiple units are deployed in one hub site location, from where they provide a dedicated, high-capacity connection to each remote site.

This unique concept builds on MRL's Hub Site Synchronization (HSS) feature, which synchronizes the transmission of collocated MRL units, thus virtually reducing mutual interference commonly experienced with collocated TDD radios.

Enhanced Air Interface Security

MRL's AES 128-bit key encryption provides enhanced air interface security.

Advanced Management and Performance Monitoring

The MRL Manager software has full local and remote management capabilities. The user-friendly SNMP-based management tool provides full end-to-end configuration, event log, and performance monitoring capabilities.

How to Use this Manual

This manual (MRL User Manual and Installation Guide version 1.750) contains instructions for both setting up and managing the MRL system. The following topics are covered:

- MRL Hardware Installation
- MRL Manager Software Installation
- Controlling and Monitoring the System Using the MRL Manager
- Troubleshooting

It is recommended that you first read the Overview in the next chapter as this provides an understanding of the various parts of the system and how the system works.

Chapter 2
Overview

MRL System Components

MRL point-to-point solution is made up of a number of key components.

Typically, each side of the link comprises an Indoor Unit (IDU), an Outdoor Unit (ODU) and an antenna. A CAT5e cable from the IDU to the ODU provides both Ethernet and Power. The link is managed via the MRL Manager application.

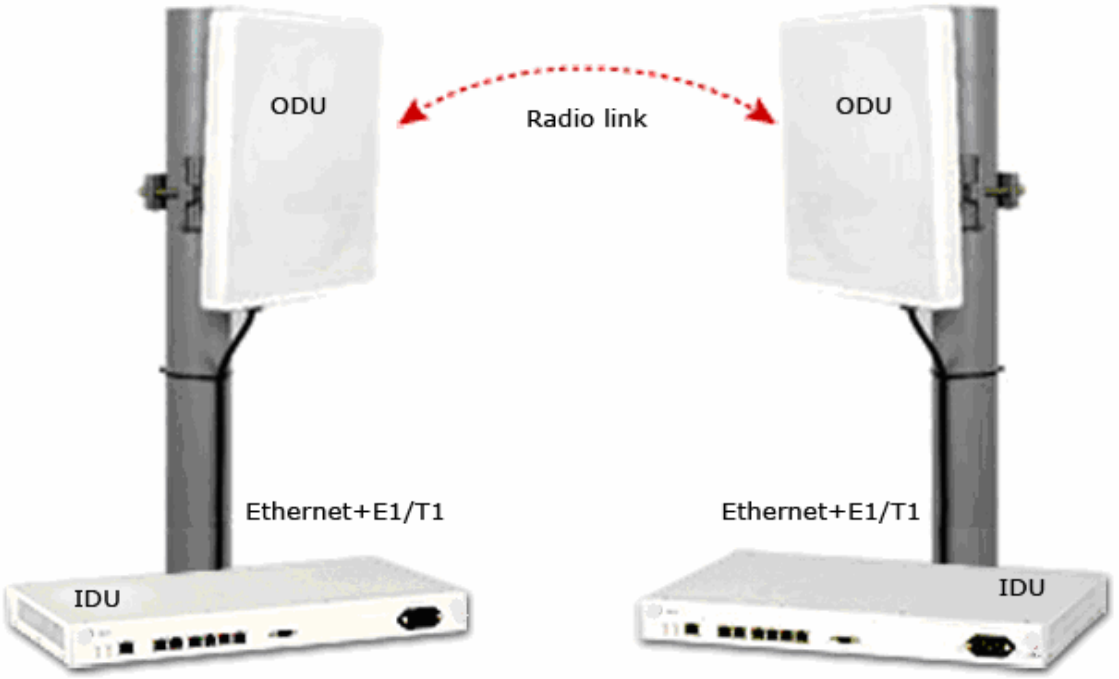


Figure 2-1: Example of Link Architecture

The Indoor Unit (IDU)

The IDU provides TDM and Ethernet ports to connect to the link. It also provides power to the ODU. The IDU is available in four configurations:

IDU-E

A compact, half 19 inch wide, 1U plastic unit, providing up to two Ethernet ports and up to two E1/T1 interfaces.

Figure 2-2: IDU-E Front Panel

Figure 2-3: IDU-E Back Panel

IDU-C

A 19 inch, 1U metal unit, providing two Ethernet ports, 4xE1/T1 interfaces, and dry contact connector alarm.

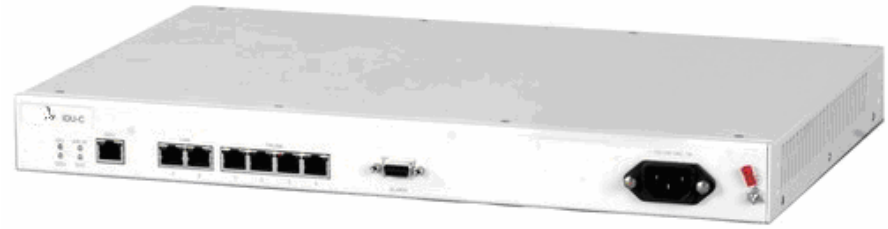


Figure 2-4: IDU-C Front Panel

IDU-R

A compact, half 19 inch, 1U plastic unit for 1 x T1/E1 backup, providing in addition 2 Ethernet ports and an external alarms interface. IDU-R is an indoor unit used for automatic backup of leased lines. IDU-R monitors the status of leased lines, and in the event of a connection failure automatically switches to the radio link. The user configures which of the two links is the main link and which is the backup link.

IDU-R operates with all MRL outdoor units.

Figure 2-5: IDU-R Front Panel

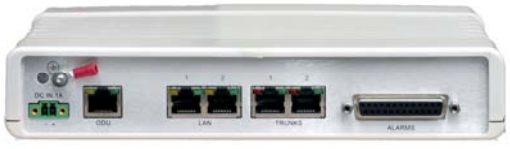


Figure 2-6: IDU-R Back Panel

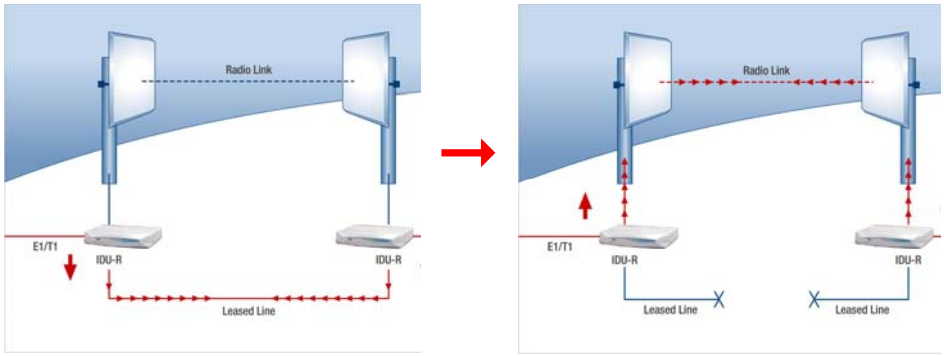


Figure 2-7: Backup link for E1/T1 connections

Power Over Ethernet Units

Power over Ethernet units provide Ethernet services only.

Power over Ethernet (PoE)

An extremely compact device, the Power Over Ethernet (PoE) provides Ethernet only services through one Ethernet port.

Figure 2-8: PoE

Note:

The PoE can only be connected to ODU's that are PoE enabled, or that are High End or Access ODU's.

PoE8

A 19 inch, 1U metal unit providing 8 Ethernet ports enabling connection to collocated Ethernet applications.

Figure 2-9: PoE8

O-PoE

Similar to the PoE, with weatherproof casing and sealed connectors that enables outdoor connectivity (a special mounting kit is supplied for attachment to a mast).

Figure 2-10: O-PoE Unit

The Outdoor Unit (ODU)

The ODU is the radio transceiver of the MRL system and is the main component of the system. The ODU connects to an antenna that enables radio communication and can be mounted on a pole or wall. The ODU connects to the IDU via a CAT5e cable.

ODUs are available in different frequencies and regulations in the ranges: 2.3-2.7GHz, 4.9-5.95GHz.

The ODU comes in two different form factors depending on the type of antenna:

- **ODU with integrated 1ft flat panel antenna**. This unit contains both the ODU and antenna as a single unit housed in a weatherproof casing.
- **ODU with a connector for an external antenna**. The unit is fitted with an N-type connector. An external antenna can extend the range of the link, and in some cases, may help to reduce environmental interferences.

Various external antennas are available for the MRL operating frequencies.

Figure 2-11: ODU with integrated antenna

Figure 2-12: Typically used External Antennas

There are three series of ODU:

- MRL Access
- MRL
- MRL High End

The following table shows the differences between the systems:

Table 2-1: ODU Series Typical Characteristics

	MRL Access	MRL	MRL High End
Max Ethernet Throughput	**2Mbps**	**18Mbps**	**18Mbps**
Max. Range	**20Km**	**80Km**	**80Km**
Supported IDU devices	**PoE**	**PoE and IDU**	**PoE and IDU**
Services	**Ethernet**	**Ethernet and TDM**	**Ethernet and TDM**
HSS	**+**	**-**	**+**
Tx PW	**18 dBm**	**18 dBm**	**23 dBm**

MRL Manager

The MRL Manager is an SNMP based element and link management application which manages a complete link via a single IP address. It identifies the IP Address, Subnet Mask, and Trap Destination for each Site and also monitors the Radio Interface – RSS [dBm] and Ethernet Service – Rx Rate and Tx Rate. The Manager software facilitates the Link installation and Link configuration between the ODU units. The intuitive, easy-to-use Manager has a graphical MS-Windows interface, and can be utilized locally and remotely.

MRL Manager provides:

- Planning tools such as a *Link Budget calculator* for calculating the expected performance of the MRL wireless link and the possible configurations for a specific link range.
- Installation Wizard
- On-line monitoring of air interface quality allowing the administrator to monitor the service and status of each link.
- On-line monitoring of equipment alarms and QoS
- Local and remote loopback testing
- Configuration settings
- On-line user manual and help files
- Over-the-air software upgrades

The MRL Manager can easily be integrated with any NMS system.

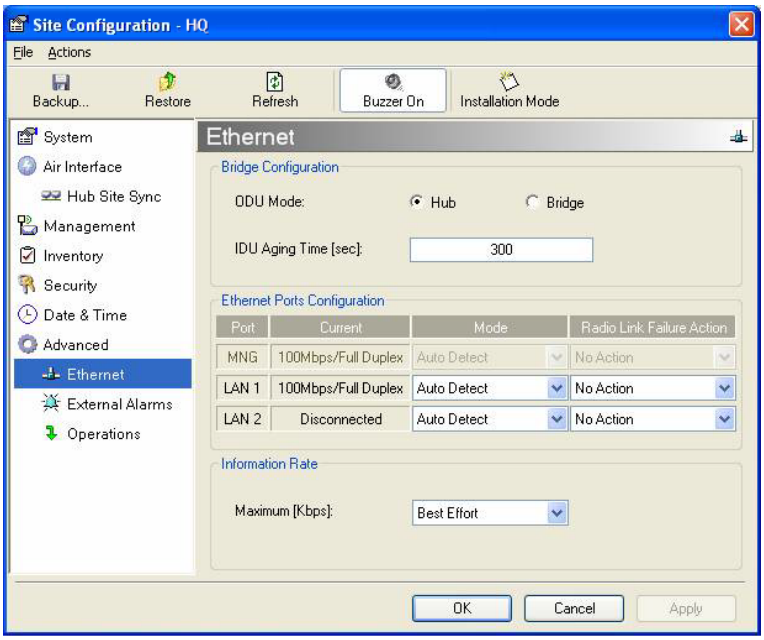


Figure 2-13: MRL Manager screen

(All Indoor Unit) AIND

The AIND - All Indoor unit offers a single enclosure for Radio and Multiplexer modules. It enables outdoor placement of only a passive element.

Figure 2-14: AIND - "All Indoor" unit connected to antenna

Technical Specifications

Air Interface

MRL is available in several different frequency band ranges that comply with ETSI, FCC and IC regulations.

Frequency Bands and Channel Bandwidth

Table 2-2: Configurable Transmission Options

Frequency Bands	**5.850-5.950 GHz**			
	5.725-5.850 GHz			
	5.470-5.725 GHz			
	5.150-5.350 GHz			
	4.940-4.990 GHz			
	2.500-2.700 GHz			
	2.400-2.4835 GHz			
	2.300-2.340 GHz / 2.310-2.485 GHz			
Channel Bandwidth	**5MHz, 10MHz and 20MHz (5MHz Resolution)**			
Transmit Power	**Configurable (max: 23dBm)**			
Duplex Technique	**TDD (Time Division Duplex)**			
Sensitivity (dBm) @BER <10e-11 (20MHz)	**-87 -84 -80 -79 -73 -66 -62**			
Rate (Mbps)	**9**	**12 18**	**24 36**	**48 54**
Modulation@OFDM (Adaptive)	**BPSK**	**QPSK**	**16QAM**	**64QAM**

Rates and Services Supported

MRL systems offer a variety of channel bandwidths, maximum throughput and supported services.

Table 2-3: Rates and Services Supported

Channel Bandwidth	**5 MHz**	**10 MHz**	**20 MHz**
Maximum Throughput	**5.4 Mbps**	**9.9 Mbps**	**18 Mbps**
Supported Services	**1 E1/T1 + Ethernet**	**2E1s or 4T1s + Ethernet**	**4 E1/T1 + Ethernet**
Ethernet Latency	**8 msec**	**6 msec**	**3 msec**

NOTE

Before each installation you must use the Link Budget Calculator (Appendix H: Link Budget Calculator) to locate the supported rates and services for your particular product.

Regulations

MRL operation complies with the radio and environmental regulations listed in the following tables:

Table 2-4: Radio Regulations

FCC 47CFR	**part 15 subparts B&C and E, part 27 and part 90**
IC	**RSS-210**
ETSI	**EN 300 328 and EN 301 893**
UK	**VNS 2107**
Australia	**AS/NZS 4771**
India	**WPC**

Table 2-5: Environmental Regulations

Safety	**EN 60950, IEC 60950, UL 60950, CAN-CSA C22.2 60950**
EMC	**EN 300 386, EN 301 489, EN 55022, EN 61000, EN 55024, AS/NZS CISPR 22, CAN/CSA-CEI/IEC CISPR 22-02, FCC 47CFR class B part 15 sub-part B**
Environmental	**IEC 60721 class 4M5 IP67**

Ethernet Services

The MRL LAN port provides 10/100BaseT interfaces with auto-negotiation and transparent VLAN support. Traffic handling is provided by a MAC level self-learning bridge. Ethernet services include:

- 1 or 2 Ethernet interfaces in the indoor units
- 10/100BaseT with auto-negotiation (IEEE 802.3)
- Layer 2 Ethernet bridge
- Self-learning of up to 2047 MAC addresses (IEEE 802.1Q)
- Support of 1+1 applications (HUB/Bridge selectable mode)
- Up to 18 Mbps symmetrical net throughput
- VLAN transparent

- Latency < 3msec
- Retry mechanism for loss-less connection (Fast ARQ)

TDM (E1/T1) Services

The MRL TDM interface accepts E1 or T1 traffic, supporting unframed operation (E1 and T1) and AMI and B8ZS zero suppression (T1). TDM services include:

- 1 to 4 E1/T1 interfaces in the indoor units
- Standard E1/T1, compliant with ITU-T standards
- Unframed E1/T1
- BER < 1×10^{-11} @ sensitivity threshold
- Accurate clock recovery mechanism (<50 PPB)
- One way delay < 8msec
- Advanced clock configurations

Technical Specification Summary

Table 2-6: Technical Specification Summary

Air Interface	***Technology***	**OFDM**
	Duplexing Method	Time Division Duplex (TDD)
	Capacity	Configurable up to 48 Mbps
	Modulation	OFDM - BPSK, QPSK, 16QAM, 64QAM
	Channel Resolution	5/10/20 MHz (ETSI systems do not support 5/10) (BRS systems Single and Double only)
	Transmitter Power	Specification is different per product, for further details refer to Appendix H: Link Budget Calculator
	Range	Up to 41 km (25.5 miles) Up to 80 km (50 miles) with an external antenna ACCESS versions up to 20 km.
	Frequency Bands [GHz]	2.3-2.7GHz, 4.9-5.95GHz.
Antennas	(See Antenna Characteristics in Appendix D: Antenna)	
LAN Interface	*PHY*	Up to 2 × 10/100BaseT, auto-sensing
	Framing/Coding	IEEE 802.3/U
	Bridging	Self-learning, up to 2048 MAC addresses
	Line Impedance	100Ω
	VLAN Support	Transparent
	Frame Size	1536 bytes max for IDU 1800 bytes max for POE
	Connector	RJ-45
E1 Interface	*Data Rate*	Unframed (transparent) 2.048 Mbps
	Line Code	HDB3
	Connector	RJ-45
	No. of Ports	IDU-E: 1 or 2 IDU-C: 4
T1 Interface	*Data Rate*	Unframed (transparent) 1.544 Mbps
	Line Code	AMI, B8ZS
	Connector	RJ-45
	No. Of Ports	IDU-E: 1 or 2 IDU-C: 4
Indicators	*PWR (green)*	Power status (IDU-E only)

Air Interface	***Technology***	**OFDM**	
	IDU (green)	IDU-C status	
	ODU (green/red)	ODU-to-IDU link status	
	LINK (green/red)	Link status	
	SERVICE (green/red)	E1/T1 signal status	
Power	*Source*	IDU-E: 100–240 VAC via external AC/DC converter IDU-C: 100–240 VAC via AC cable -20 to –60 VDC O-PoE: 100–240 VAC via attached (pigtail) AC cable PoE-8: 100–240 VAC via AC cable -20 to –60 VDC Max **Note**: Both AC and DC power sources can be connected simultaneously but only one source will supply the power	
	Power Received by the ODU	-42 to -60 VDC	
	Power Consumption	ODU plus IDU-E or IDU-E-AL or IDU-R – 10W max ODU plus IDU-C – 14W max AIND – 14 max O-PoE plus ODU – 25W max PoE-8 plus 8 ODU units – 60W max	
	Connector	IDU-E 2-pin IDU-C AC – 3-pin IEC connector DC – 3-pin terminal block	
Alarm Connector	*Connector*	DB-9 female for IDU-C/AIND/PoE-8 DB-25 female for IDU-E-AL/IDU-R	
	Electrical Characteristics	Dry Contact, 30V/2A Max input current, 0.01A at 0.5W (R=5K)	
Sync Connector	*Connector*	RJ-11 for AIND	
Physical	***Outdoor Unit***		ODU with integrated antenna
	Height	24.5 cm / 9.3 in	30.5 cm / 12 in
	Width	13.5 cm / 5.13 in	30.5 cm / 12 in
	Depth	4.0 cm / 1.57 in	5.8 cm / 2.3 in
	Weight	1.0 kg / 2.2 lb	1.5 kg / 3.3 lb
	Indoor Unit	**IDU-E**	**IDU-C/AIND/PoE-8**
	Height	4.5 cm (1.7 in) 1U	4.5 cm (1.7 in) 1U

Air Interface	***Technology***	**OFDM**	
	Width	23.5 cm (9.3 in)	29 cm (11.5 in)
	Depth	16.5 cm (6.7 in)	43 cm (17.7 in)
	Weight	0.5 kg (1.1 lb)	1.5 kg (3.3 lb)
Environment	**Outdoor Unit**		
	Enclosure	All-weather case	
	Temperature	-35 to 60°C/-31 to 140°F	
	Indoor Unit (IDU-E, IDU-E-AL, IDU-R, and IDU-C)		
	Temperature	-0 to 50°C/32 to 122°F	
	Relative Humidity	Up to 90%, non-condensing	
	Indoor Unit (PoE-8)		
	Temperature	-0 to 45°C/32 to 113°F	
	Relative Humidity	Up to 90%, non-condensing	
	All Indoor Unit (AIND)		
	Enclosure	*IDU-C indoor unit*	
	Temperature	*-35 to 60°C/-31 to 140°F*	

Chapter 3

Installation and Setup

This section describes the installation, alignment, and setup procedures for a MRL system.

Site Requirements and Prerequisites

For the IDU units, allow at least 90 cm (36 in) of frontal clearance for operating and maintenance accessibility. Allow at least 10 cm (4 in) clearance at the rear of the unit for signal lines and interface cables.

The ambient operating temperature should be –45 to 60°C/–49 to 140°F (ODU), or –5 to 45°C/23 to 113°F (IDU) at a relative humidity of up to 90%, non-condensing.

Package Contents

The MRL packages include the following items:

ODU package containing:

- ODU
- Mast/Wall mounting kit plus mounting instructions
- CD-ROM [MRL Manager, Installation and Operation Manual, and Link Budget Calculator]
- Self adhesive label showing the MAC address and the alternative community string KEY. Keep this label safe.
- Spare RJ-45 connector

IDU-E or IDU-R package containing:

- IDU-E or IDU-R
- AC/DC Converter
- IDU wall-mounting drilling template
- Self adhesive label showing the IDU LED operation
- Spare RJ-45 connector

IDU-C Package containing:

- IDU-C

- For AC model, 110/240 VAC with IEC 60320 socket cable
- For DC model, 3-prong terminal block connector (green)
- 19" mounting kit
- Spare RJ-45 connector

PoE-8 Package Containing:

- PoE-8
- 110/240 VAC with IEC 60320 socket cable
- 3-prong terminal block connector (green)
- 19" mounting kit
- Spare RJ-45 connector

External antenna (if ordered)

- 1m RF cable
- Mounting kit
- ODU/IDU cable at length ordered (optional)

O-PoE package contains:

- O-PoE
- Mast/Wall mounting kit plus mounting instructions
- Spare RJ-45 connector

Additional Equipment Required

The following is a list of the equipment required for installing the MRL hardware.

- RJ-45 crimp tool (if pre-assembled ODU/IDU cable is not used)
- Drill (for wall mounting only)
- IDU and ODU 10AWG grounding cables
- O-PoE 10AWG grounding cable
- 13 mm (½") spanner/wrench
- ODU to IDU cable if not ordered (outdoor class, CAT-5e, 4 twisted pairs 24AWG)
- ODU to O-PoE both cables (ETH and PoE) if not ordered (outdoor class, CAT-5e, 4 twisted pairs 24AWG)
- Cable ties
- Laptop running Windows 2000 or Windows XP.

Installation Sequence

The following steps are required to install the MRL system:

1. Install the management program on the network management station/laptop. See Installing the MRL Management Software, page 3-33.
2. Mount the ODU at each site (and antenna if external antenna is used). See Mounting the ODU, page 3-34.
3. Connect the ODU to the IDU at both sites. See page 3-35.
4. Connecting the Ground to the IDU, IDU-C, PoE-8, page 3-37.
5. Connect the power. See Connecting Power to an IDU, page 3-37, and Connecting Power to an O-PoE, page 3-38
6. Align the ODU/antennas. See page 3-38.
7. Run the Installation wizard from the management program. See 3-39.
8. Connect user equipment to the local and remote IDUs. See page 3-43.

The following diagram illustrates a typical installation of MRL with an external antenna.

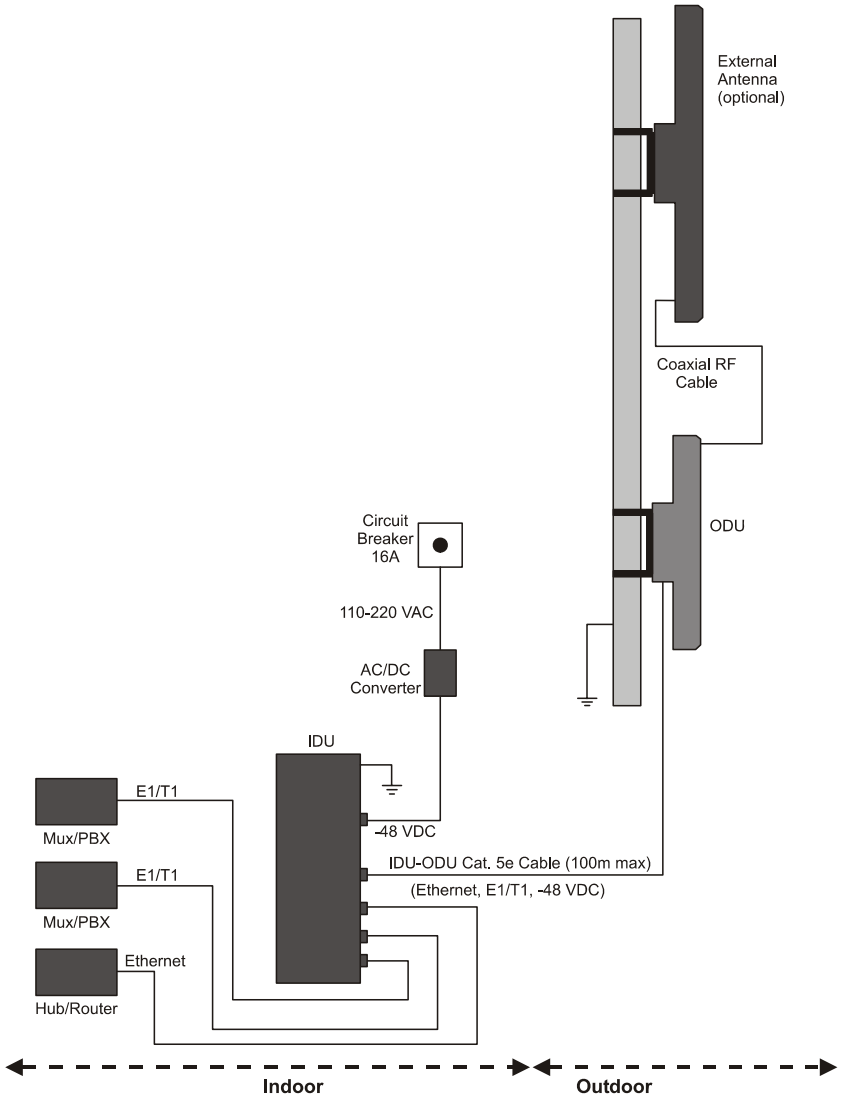


Figure 3-1: Typical Installation Diagram (with external antenna)

The installation steps are detailed in the following sections.

Installing the MRL Management Software

Minimum Requirements

The MRL management application is distributed on CD-ROM as an executable file. The application has the following PC requirements:

- Memory: 128 MB RAM
- Disk: 1 GB free hard disk space
- Processor: Pentium 3 or higher
- Network: 10/100BaseT NIC
- Graphics: Card and monitor that support 1024×768 screen resolution with 16 bit color
- Operating system: Windows 2000/XP
- Microsoft Explorer 5.01 or later.

Installing the Software

To install the MRL management program:

1. Insert the CD-ROM into your CD-ROM drive.

   The MRL Installation starts automatically.

2. Follow the on-screen instructions of the installation wizard to complete setup of the MRL Management program in the desired location.

Any PC running the MRL management application can be used to configure MRL units.

Mounting the ODU

The ODU is the transceiver element of the MRL system. The ODU can be mounted on a mast or a wall. In both installations, the supplied mounting kit is used to secure the ODU. Appendix B: Mast and Wall Installation describes the mast/wall installation instructions.

A MRL link operates in pairs of two ODUs with the same configuration. Both ODUs must be installed, and the antennas aligned for maximum throughput.

Warning

Prior to connecting cables to the ODU, the protective earth terminal (screw) of the ODU must be connected to an external protective ground conductor or to a grounded mast. For grounding the O-PoE, connect the grounding cable from the dedicated earth terminal (screw at the side of the enclosure) to an external protective ground conductor or to a grounded mast.

Only a qualified person using the proper safety equipment should climb the antenna mast. Only trained professional installers should be used when installing or dismantling ODUs and masts.

To mount the ODU:

1. Verify that the ODU mounting brackets are properly grounded.
2. Mount the ODU onto the mast or wall. Refer to Appendix B: Mast and Wall Installation for the ODU or O-PoE mounting instructions.
3. Connect the ground cable to the chassis point on the ODU.
4. Attach the ODU-IDU cable to the ODU RJ-45 connector. If making own ODU-IDU cable, refer to Appendix A: Wiring Specifications for the connector pin-out.
5. Screw in the cable glands to ensure hermetic sealing of the ODU.

6. Secure the cable to the mast or brackets using UV-rated cable ties.
7. Repeat the procedure at the remote site.

Note:

Do not tightly secure the ODU to its mounting brackets until the alignment process of the antenna is complete.

When installing the ODU, check that there are no direct obstructions in front of the ODU or interference from man-made obstacles.

Caution For O-PoE UL Listed parts and components must be used for installation. Use UL listed devices having an environmental rating equal to or better than the enclosure rating to close all unfilled openings.

Connecting the ODU to the IDU

The ODU-IDU cable conducts all the user traffic between the IDU and the ODU. The ODU-IDU cable also provides -48 VDC supply and Ethernet to the ODU. The maximum length for one leg of the ODU-IDU cable is 100m (328 ft) in accordance with 10/100BaseT standards. When using an O-PoE or PoE-8, the maximum length for two legs of the O-PoE or PoE-8 cable is 100m (328 ft) in accordance with 10/100BaseT standards.

The ODU-IDU cable is supplied pre-assembled with RJ-45 connectors, at the length specified when ordering. If the ODU-IDU cable was not ordered, use Cat. 5e 24AWG shielded cable. Wiring specifications are given in Appendix A: Wiring Specifications.

To connect the ODU to the IDU

1. Route the cable from the ODU to the IDU.
2. Secure the cable along its path.
3. Connect the ODU-IDU cable to the RJ-45 connector on the IDU.

   The figures below illustrate typical IDU panels. You may have differences in your panels depending on the hardware ordered.

Figure 3-2: Typical IDU-E Rear Panel

Figure 3-3: IDU-R Rear Panel

Figure 3-4: Typical IDU-C Front Panel

Figure 3-5: AIND All Indoor Radio Unit

Figure 3-6: PoE-8 Unit

Figure 3-7: O-PoE Unit

Note:

Panels may be fitted with different connector combinations than shown, depending on the model ordered.

Connecting the Ground to the IDU

Connect an 18AWG grounding cable to the grounding terminal of the device. The device should be permanently connected to the ground.

Connecting Power to an IDU

AC power is supplied to the MRL IDU through a standard IEC 60320 connector.

AC power should be supplied via a 1.5m (5 ft) standard power cable terminated by a IEC 60320 socket. A cable is provided with the unit.

To connect AC power to an IDU:

Connect the power cable socket to the power connector on the MRL front panel.

- Connect the power cable plug to the mains outlet.

  The unit turns on automatically upon connection to the mains.

To connect DC power to an IDU

A special 3-prong socket for DC power connection is supplied with the unit.

Connecting Power to an O-PoE

AC power is supplied to the O-PoE via a 3m (10 ft) 3 wire AC cable attached to the unit (pigtail). The AC cable is provided with no termination.

To connect AC power to an O-PoE:

Connect the power cable to a protected/shielded AC mains outlet.

The AC mains outlet should be provided with circuit breaker rated 5A according to the local national electrical code.

The unit will be turned on automatically upon connection to the mains.

Warning

To maintain Overvoltage (Installation) Category II, install a suitable surge suppressor device in the branch circuit to limit expected transients to Overvoltage Category II values.
The limits are based on IEC60664 and are also located in Table 2H of UL60950 (for mains ≤ 150V, the transient rating is 1500V;
for 150V < mains ≤ 300V, the transient rating is 2500V;
for 300V < mains ≤ 600V, the transient rating is 4000V).

Aligning Antennas with the Beeper

Perform the antenna alignment using the ODU's audible tone. The tone is not suitable for aligning the All Indoor Units (AIND). To align an AIND system, see Appendix C: AIND Alignment.

Warning

To speed up the installation time, alignment of a MRL system should be performed by two teams simultaneously, at site A and at site B.

❋ **To align the ODUs using the alignment tone:**

1. Verify that power is connected to the IDUs at both sites.

Do not stand in front of a live ODU.

Provided that Site A detects the signal from Site B, the ODU starts beeping 20 seconds after power up, and continues beeping until the ODUs are aligned, and the installation is complete.

2. Verify normal operation of the IDU by the LED indications on the front panel. See IDU Front Panel Indicators.

3. Direct the antenna of site B in the direction of the site A. This is simplified if a previous site survey has been completed and azimuths are known.
4. Make an azimuth sweep of 180 degrees with the site A ODU so that the strongest signal from site B can be detected.
5. Slowly turning the site A ODU back towards the position of Site B, listen to the tone until the best signal is reached. See the following figure for audible signal variations.

Figure 3-8: Beeper Sequence for ODU Alignment

Note:

Three beeps and a pause is the best signal

Two beeps and a pause, signal quality increased

One beep and pause is no signal change

Any other signal detects no signal between ODUs.

6. Secure the site A ODU to the mast/wall.
7. At site B, adjust the ODU slowly whilst listening to the beeper sequence until the best signal is attained.
8. Secure the site B ODU to the mast/wall.
9. Monitor the link quality for about 15 minutes to verify stability.

Installing the Link

During the installation procedure, the definition of all parameters is automatically applied to both sides of the link.

Note:

For HSS screens see Appendix E: Hub Site Synchronization..

❋ To install the link:

1. Verify that there is IP connectivity between the management station/laptop and the IDU, and that the MRL Manager application is running.
2. With BRS systems you need to activate the link at both sites, see Appendix F: BRS Installation Procedure for method. Once the link is activated, continue installation from this point.
3. In the toolbar, click the Link Installation button. The Link Installation button is only accessible if antennas are aligned. Align antennas if this box is "grayed out".

   The Installation wizard opens:

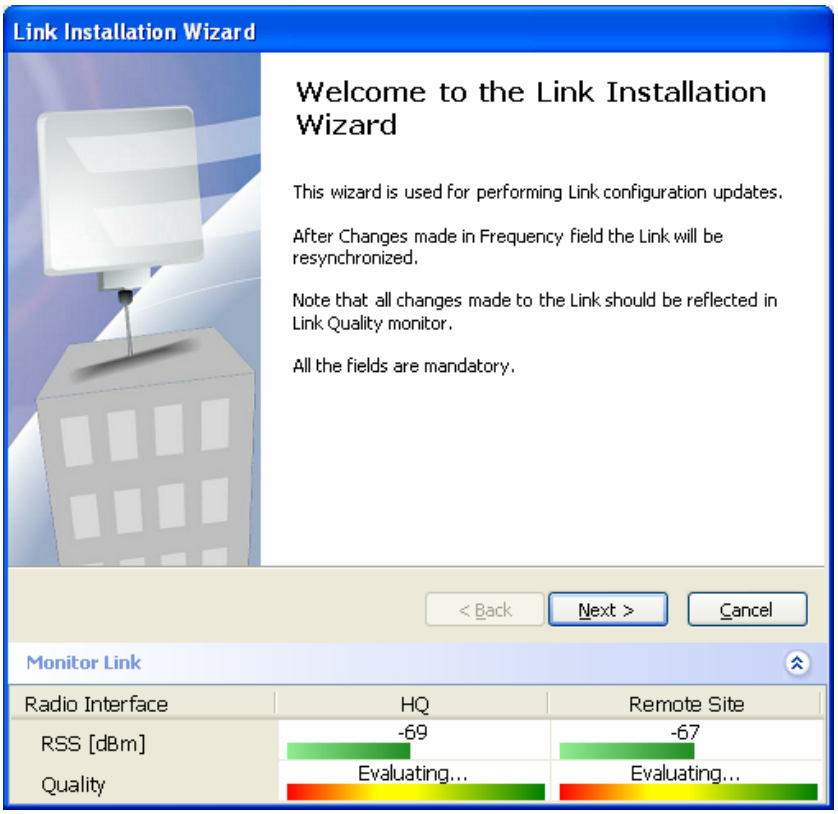


Figure 3-9: Link Installation Wizard

4. Click Next to proceed with the installation procedure.

   The system dialog box opens:

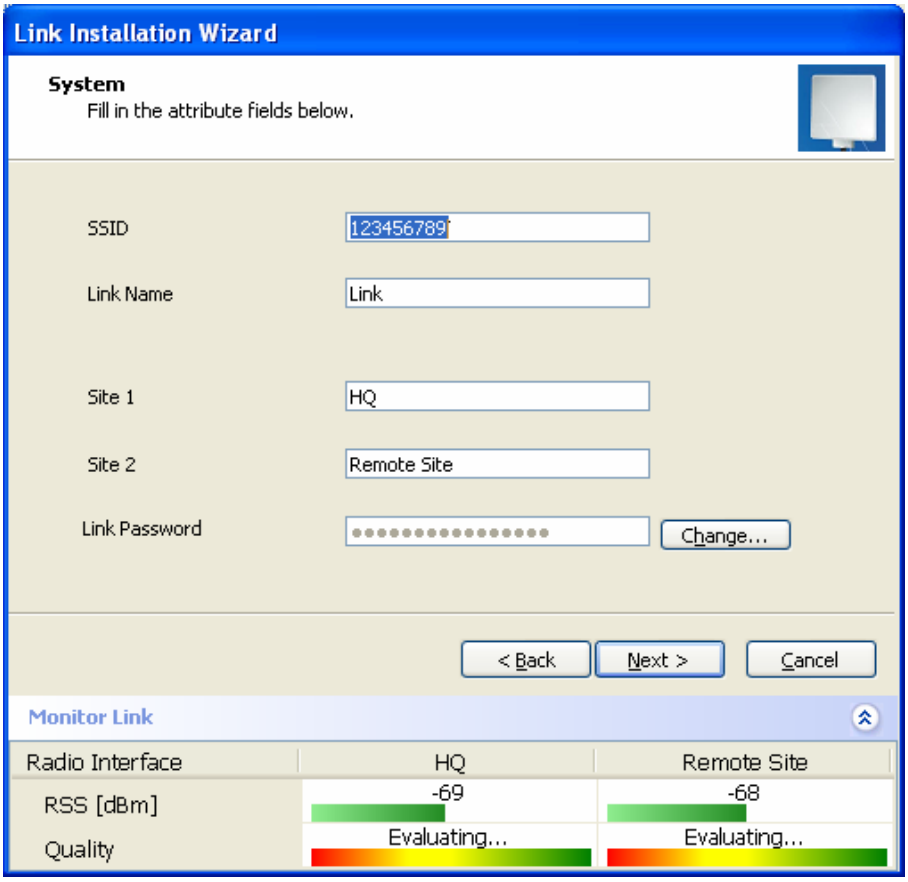


Figure 3-10: Installation Wizard, System dialog box

5. Enter a SSID (System ID – must unique for each link in the area). The SSID must include at least eight alphanumeric characters. Up to 24 characters are allowed.

Note:

Both sides of a link must have the same SSID number for data transmission to take place.

---

6. Enter a Link Name for the link identification.
7. Enter a name for site 1 (the site to which your laptop is connected).
8. Enter a name for site 2 (remote site).
9. Optionally enter a new Link Password (version 1.400 and after). See Changing the Link Password, page 120 for details on the Link Password.

Note:

If the Link Password is incorrect a link is established but configuration cannot be performed and no services are available. A new link password may be obtained from Technical Support or use the alternative password supplied with the product. See Changing the Link Password for more details.

10. Click Next.

    The default link with a rate of 9 Mbps is evaluated.

    The *Channel Setting* dialog box appears. This dialog box may be different according to the version that you have purchased.

Changing the Link Password

The default password is Wireless-Bridge. Optionally, you can change the link password as explained here.

✱ **To change the Link password:**

1. Click the Change button in the System dialog box.

   The Change Link Password dialog box opens.

Note:

Use the Hide Characters check box for maximum security.

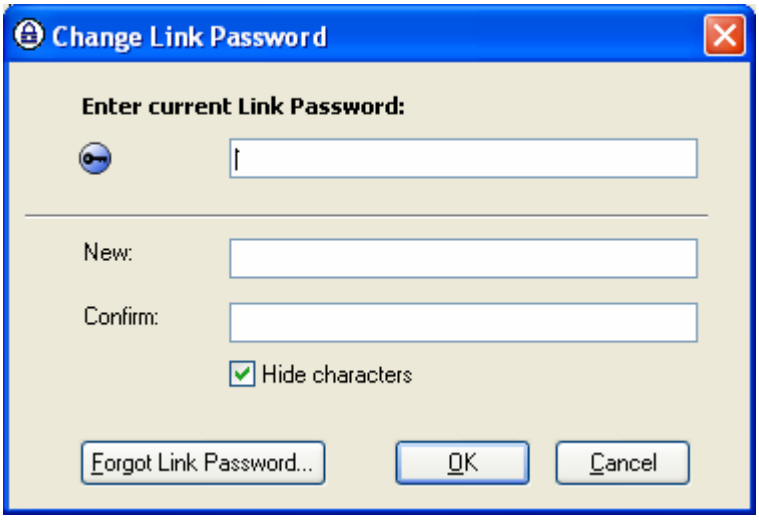


Figure 3-11: Change Link Password dialog box

2. Enter the default link password wireless-bridge.
3. Enter a new password.
4. Retype the new password in the confirm field.
5. Click OK.
6. Click Yes when asked if you want to change the link password.
7. Click OK at the successful message.

Note:

Restoring Factory Defaults returns the Link Password to wireless-bridge.

Connecting the User Equipment

The IDU is a standalone desktop, wall-mounted, or rack-installed unit. The following figure illustrates a typical front panel of the IDU:

Figure 3-12: Typical Front Panel of IDU-C

❋ **To connect user equipment to the IDU:**

1. Connect user E1/T1 traffic to the IDU panel RJ-45 port designated **TRUNK**. There may be multiple Trunk ports available depending on unit ordered.
   Refer to Appendix A: Wiring Specifications, for the connector pinout.
2. Connect user hub/router or any other compatible device to the IDU panel RJ-45 port designated **LAN**. There may be multiple LAN ports available for connecting to different LANs depending on the IDU unit ordered.
   Refer to Appendix A: Wiring Specifications for the connector pinout.

Note:

Use a straight cable for router connection.

Do not connect two LAN ports to the same LAN, or flooding may occur.

Selecting Channels

MRL systems later than version 1.300 have a feature called Automatic Channel Select, which allows you to define several alternative frequency channels if interference is detected on the channel in use.

Note: For the ETSI version, skip to page 3-45; for the BRS version, skip to page 3-46.

MRL with Automatic Channel Select

Automatic Channel Select (ACS) gives MRL the ability to change frequency channels automatically if interference is detected on the current operating channel.

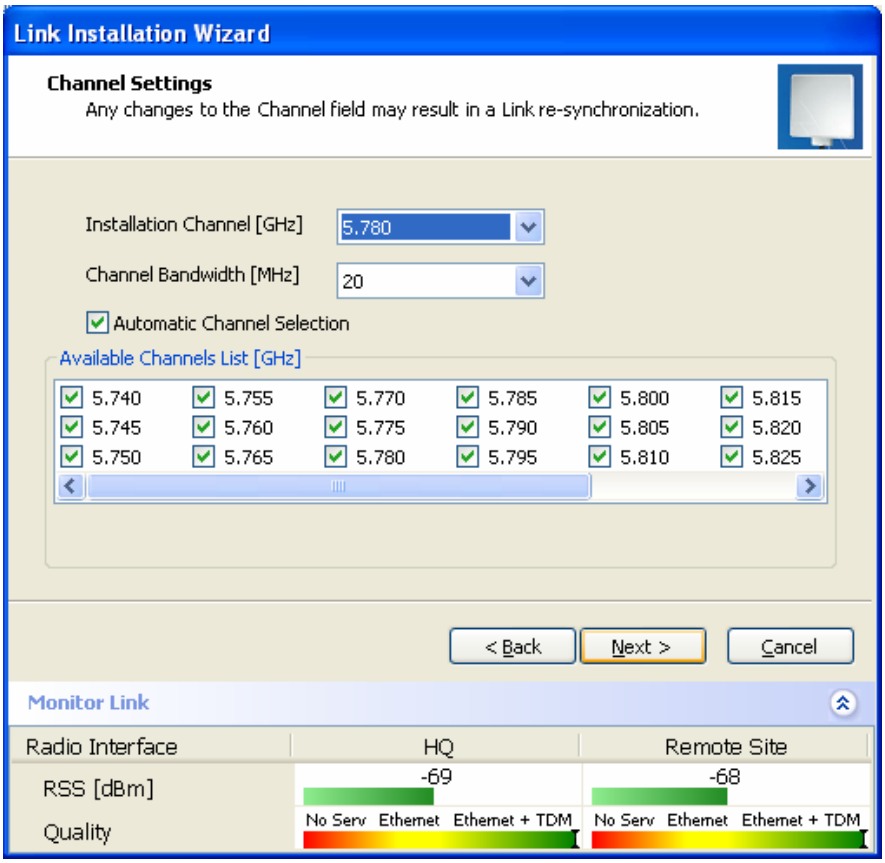


Figure 3-13: Channel Select dialog box - Automatic Channel Select

1. Select the main frequency from the Installation Channel menu.
2. Select the required Channel Bandwidth 5, 10, or 20 MHz. Default is 20 MHz.

   When changing the channel bandwidth, the MRL Manager repeats evaluation of the link.

3. Click the check box if Automatic Channel Selection is required.
4. Click the check boxes in the Available Channels List of all the allowable channels that can be automatically selected.

   Selecting a new channel causes the system quality to change. The quality bar shows the adjustment until the system finds the best quality link.

	Quality	Service
0.1% – 0.4%	80-99%	TDM + Ethernet
0.4% – 2.0%	77- 56%	Ethernet
2.0% – 50.0%	44 - 2%	Antenna Alignment or replace Channel

5. If you are not satisfied with the channel that is selected automatically, click Reselect Channel.

   A new channel is selected from one of the Available Channels that has been defined.

6. Click Next.

   The Evaluating Rate box appears. When the optimum rate for the link is selected the Service Parameters dialog box opens. Skip to page 3-48 to set the Service parameters.

Note:

Any changes to the frequency settings cause the link to re-synchronize. A short loss of service will occur during re-synchronization.

MRL 5.4 GHz ETSI Version

In accordance with ETSI, if MRL detects Radar interference it changes the frequency channel automatically. This feature is termed Dynamic Frequency Selection (DFS). In this version, the Automatic Channel Selection is selected by default and a minimum of two channels must be defined as available.

1. Select the main frequency from the Operating Channel menu.
2. Select the Bandwidth required.

Note:

Automatic Channel Selection is selected by default.

3. Click at least two check boxes in the Available Channels List of all the allowable channels that can be automatically selected.

Note:

Installation will not continue until at least two channels are defined.

Selecting a new channel causes the system quality to change. The quality bar shows the adjustment until the system finds the best quality link.

Any channel selected is evaluated for 60 seconds; therefore this selection process may take a few minutes.

4. If you are not satisfied with the channel that is selected automatically, click Reselect Channel.

A new channel will be selected from one of the Available Channels that has been defined.

5. Click Next.

The Evaluating Rate box appears. The optimum rate for the link is selected.

The Service Parameters dialog box opens. Proceed to page 3-48.

MRL BRS Version

Note:

Both sites in a BRS Link must be configured identically.

❋ To Configure BRS Channel Settings

1. Set the Band Plan.
2. Select the Bandwidth required,
   Single Band (5 MHz)
   Double Band (10 MHz)
   Quad Band (20MHz)
3. Select the Frequency from the pull-down menu.
4. Click Next. The system is re-synchronized to the changes.

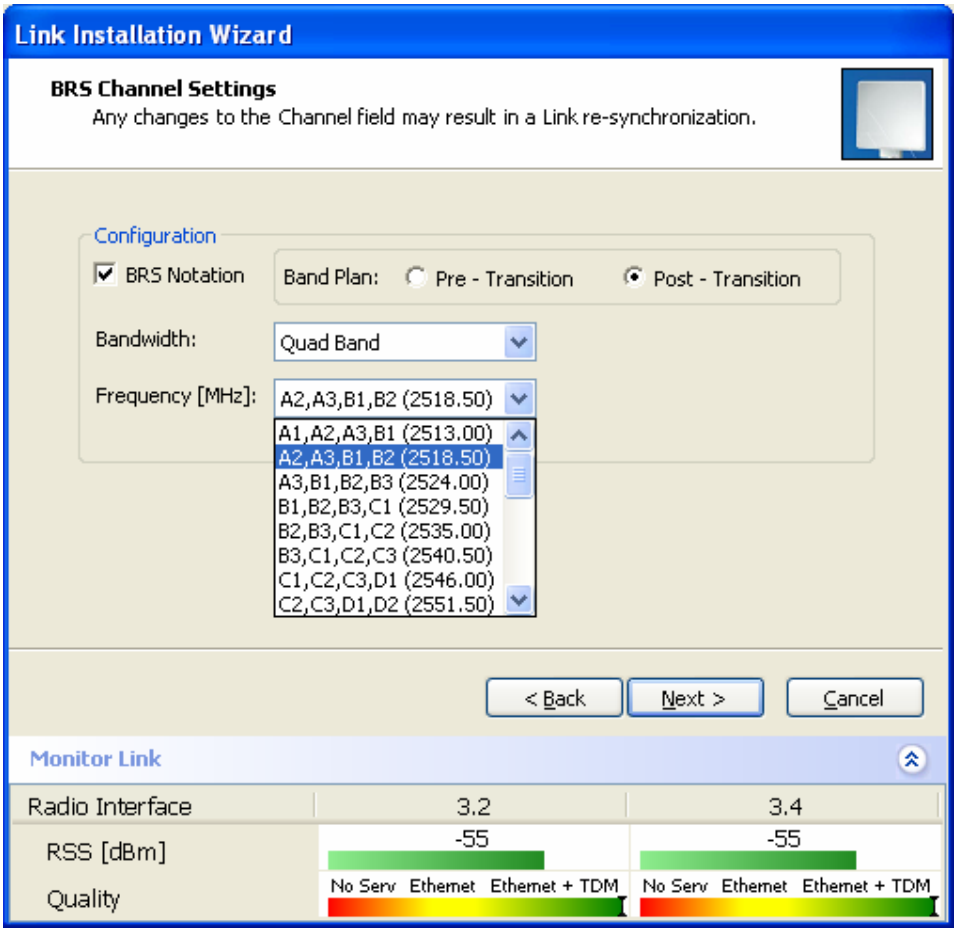


Figure 3-14: BRS Channel Settings Post-Transition

Selecting the Service Parameters

You define the type of service required, Ethernet Only or Ethernet with TDM in the Services screen as shown below. Notice that the Distance between the sites automatically appears in the Distance box (from Version 1.600).

Note:

MRL ACCESS versions are Ethernet Only.

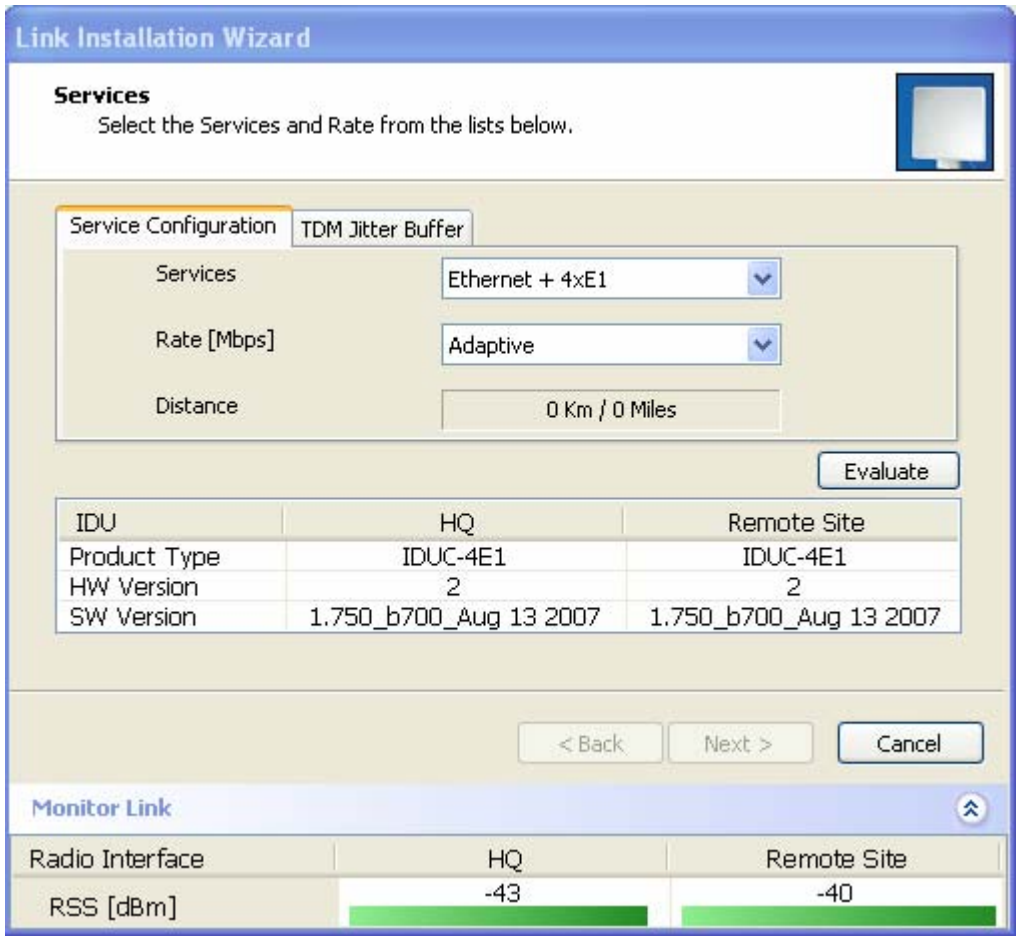


Figure 3-15: Installation Wizard, Service dialog box

❋ **To select the services and rates:**

1. In the Services box, select a service:
   - Ethernet Only
   - Ethernet + E1/T1.

   The available bandwidth depends on the number of E1/T1 ports selected.

2. In the Rate box, select the required transmission rate.
   If Adaptive is selected (refer to page 1-15 for information about Automatic Adaptive Rate), MRL constantly monitors and adjusts the transmission rate to ensure maximum throughput for the link at the highest quality. ACCESS versions are preset to adaptive and the rate selection is disabled.
3. Click the Evaluate button. The optimum transmission rate for the selected services is evaluated. Table 3-1: Rates per Bandwidth shows the rates used by MRL.
4. Click **Next**.

   If TDM services were selected, then the TDM parameters dialog box appears, (see *Figure 3-16: TDM Parameters dialog box*).

Note:

ACCESS versions do not have TDM services. Instead, ACCESS versions operate at a default rate of 2 Mbps.

If Ethernet Only was selected, then the Finish screen appears (see *Figure 3-19: Installation Wizard, Finish Screen*) showing a summary of the link configuration, the alignment is complete.

Table 3-1: Rates per Bandwidth

Modulation/FEC	5 MHz	10 MHz	20 MHz
BPSK / ¾	2.25 Mbps	4.5 Mbps	9 Mbps
QPSK / ½	3 Mbps	6 Mbps	12 Mbps
QPSK / ¾	4.5 Mbps	9 Mbps	18 Mbps
16QAM / ½	6 Mbps	12 Mbps	24 Mbps
16QAM / ¾	9 Mbps	18 Mbps	36 Mbps
64QAM / $^{2}/_{3}$	12 Mbps	24 Mbps	48 Mbps
64QAM / ¾	13.5 Mbps	27 Mbps	

Setting the Clock Configuration

If TDM services are selected then the TDM parameters dialog box appears. (TDM is not relevant in MRL ACCESS versions.)

The TDM Parameters dialog box contains five working modes; select the appropriate clock mode according to your application. Choosing one of these modes sets the TDM clock behavior on both sides of the

link. The user equipment must be configured as described in the following table.

Table 3-2: TDM Clock Modes

	Unit Clock Mode		User Equipment Side	
	Local Unit	**Remote Unit**	**HQ side**	**Branch side**
1	Transparent	Transparent	Internal/Recover	Internal/Recover
2	Loop Time	Recover	Internal	Recover
3	Recover	Loop Time	Recover	Internal
4	Internal	Recover	Recover	Recover
5	Recover	Internal	Recover	Recover

Transparent/Transparent

MRL transparently regenerates the clock from line clock side to Tx clock on the opposite side of the link.

Loop time/Recover

The local unit receive clock is the transmit clock on both sides of the link.

Recover/Loop time

The remote unit receive clock is the transmit clock on both sides.

Internal/Recover

The local unit internal oscillator generates the clock while the remote unit recovers this clock.

Recover/Internal

The remote unit internal oscillator generates the clock while the local unit recovers this clock.

Note:

The Line code option is used with T1 Systems.

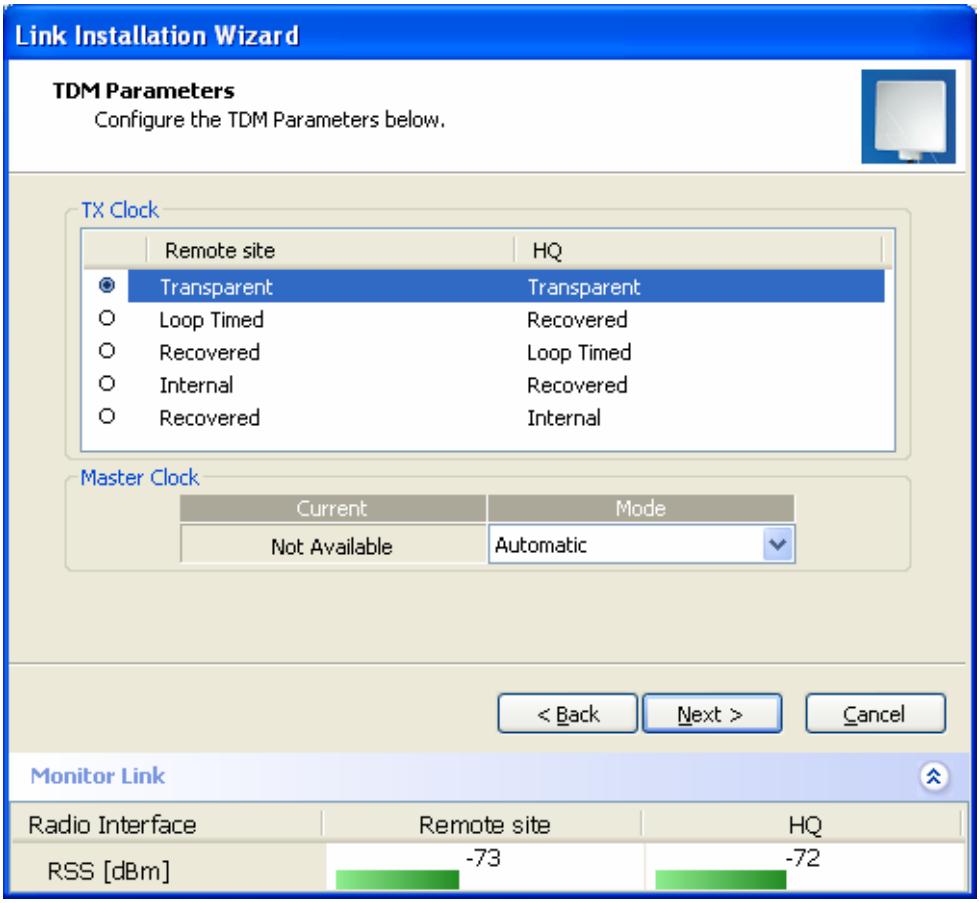


Figure 3-16: TDM Parameters dialog box

Note:

This dialog box is available with IDU-E and IDU-C units; it is activated after TDM service is chosen in the previous Service dialog box. In Ethernet only services, the TDM dialog box does not appear.

Setting the T1 Line Code

The T1 line code can be set as B8Zs or AMI in the TDM Parameters dialog box.

The default is B8ZS.

✱ To change the line code

- In the TDM Parameters dialog box, set the line code to B8ZS or AMI.

Setting the TDM Backup (for IDU-R only)

IDU-R units have two E1 trunk lines, one for MRL air interface via the ODU, and the second external equipment such as a PBX. The TDM backup screen is displayed in IDU-R systems only.

The external equipment status is displayed on the Main screen of the Manager in IDU-R systems.

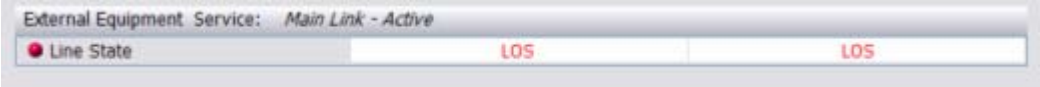


Figure 3-17: External Equipment Status

To use the Backup Mode

1. Click Enabled Backup Mode.
2. Set which link is backup link; either MRL or the external equipment.

   The second link becomes the main link.

To disable the Backup mode

1. Click Disable Backup Link
2. Set which link is the Main Link; either MRL or the external equipment.

Figure 3-18 shows the TDM Backup Service screen.

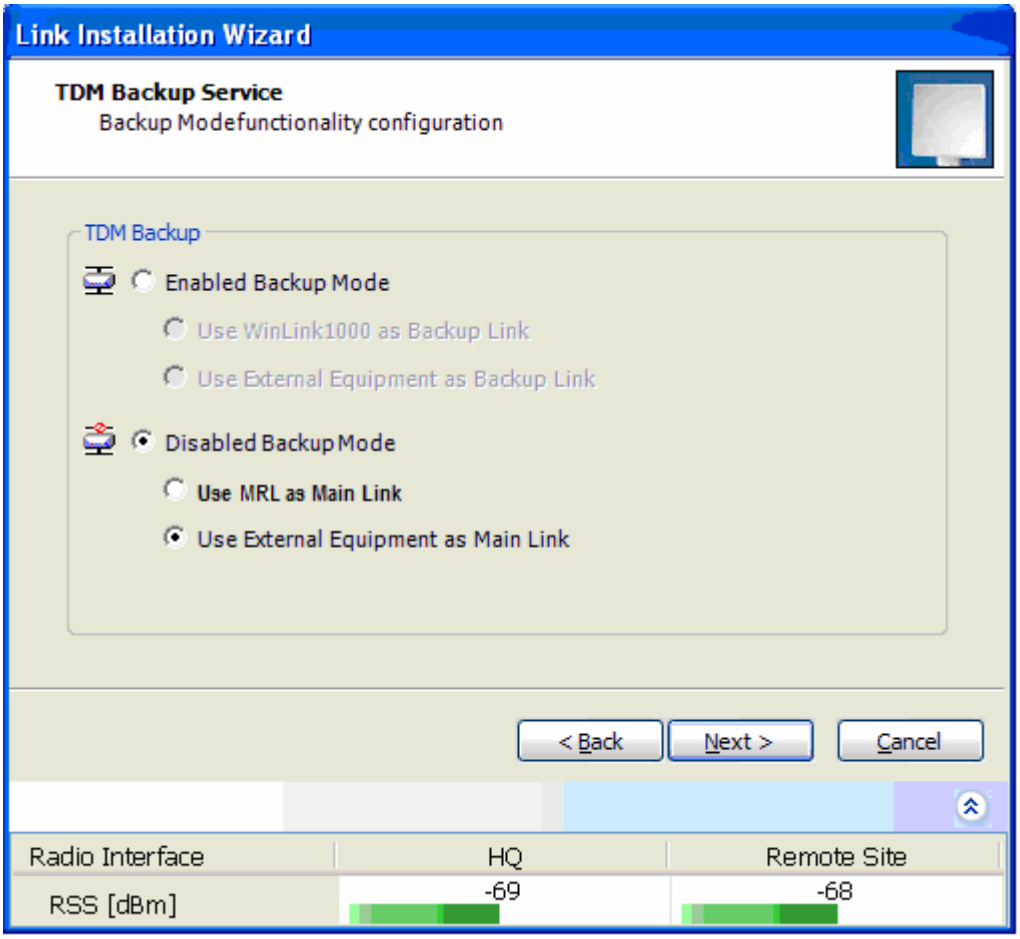


Figure 3-18: TDM Backup Service, IDU-R units only

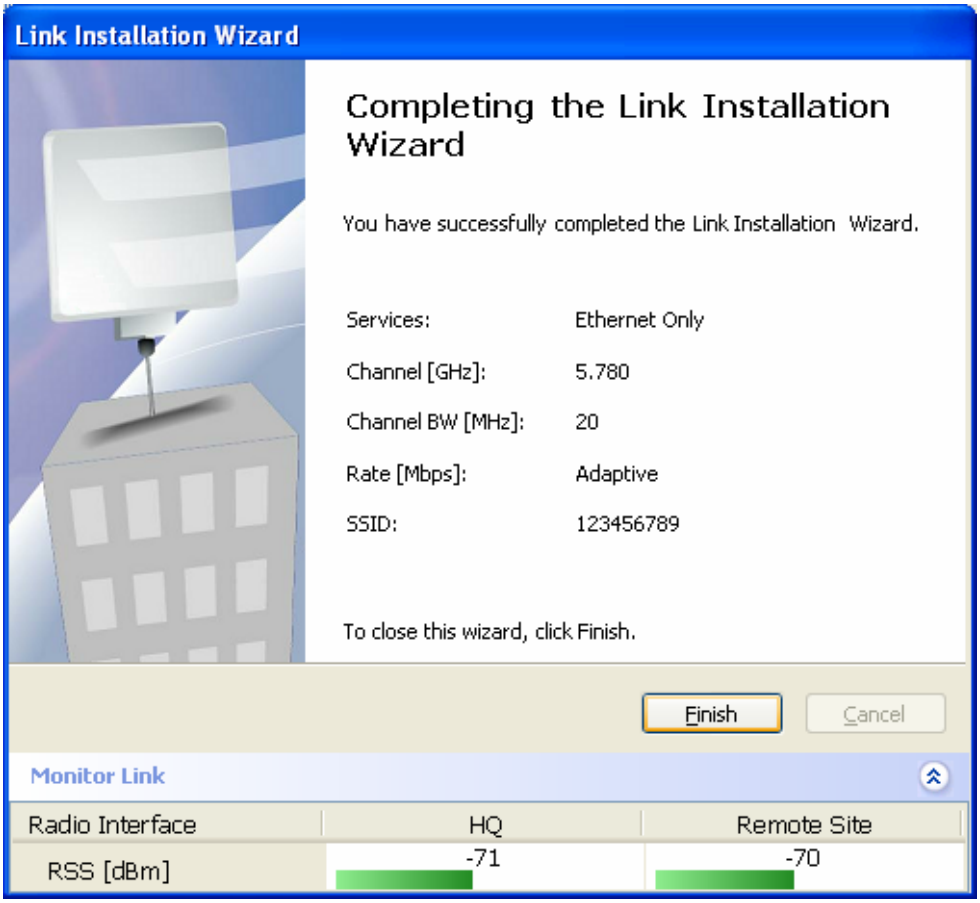


Figure 3-19: Installation Wizard, Finish Screen

3. Click **Finish** to complete the installation wizard.

   Verify that the Radio Signal Strength (RSS) is according to expected results as determined by the Link Budget Calculator.

   Verify that the Radio Signal Strength (RSS) numerical value is relative to the expected results that were determined by the Link Budget Calculator.

Chapter 4

Getting Started

This section provides the following information for MRL:

- Turning the system on and off
- Starting the MRL Manager software
- Controls and indicators
- Normal Indications
- Default settings
- Technical Specifications

Turning On MRL

❋ **To turn on MRL:**

- Connect the AC/DC converter to the IDU power connector and to the mains. See Connecting Power to an IDU for full instructions on connecting the power.

  The PWR indicator lights up (IDU-E only) and remains lit as long as the IDU is receiving power.

Controls and Indicators

MRL requires no operator attention once installed, with the exception of occasional monitoring of front panel indicators and statistics data. Intervention is only required when MRL must be configured to its operational requirements, or diagnostic tests are performed.

IDU Front Panel Indicators

The front panel of the IDU-C and IDU-E includes a series of LED indicators that show the operating status of the unit.

The following figure shows the IDU-E front panel:

Figure 4-1: IDU-E Front Panel

The following table describes the indicators:

Table 4-1: Front Panel LEDs

Name	Color	Function
PWR	Green	ON –Power supply is ON (IDU-E only)
IDU	Green	ON – IDU operational
With Ethernet only	Green	ON – During power-up only
With TDM	Orange	ON - During power-up only
	Red	ON – Failure
ODU	Green	ON – ODU-to-IDU communication link is operating
	Red	ON – ODU-to-IDU communication link is disrupted
LINK	Green	ON – Wireless link is synchronized
	Orange	ON – During installation mode only
	Red	ON – Wireless link lost synchronization
SERVICE	Green	ON – E1 or T1 line is synchronized
	Orange	ON – Alarm detected at the remote interface ON – Local or Remote loopback
	Red	ON – Alarm detected at the local interface

ODU/LAN Indicators

The ODU/LAN and TDM connectors (IDU-E rear panel, IDU-C front panel) have LED indicators that show the operating status. The following tables describe the indicators.

Table 4-2: ODU/LAN LEDs

Name	Color	Function	Location
LINK	Green	On – Good Ethernet link integrity	ODU/LAN connectors
ACT	Orange	Blinks according to the Ethernet traffic	ODU/LAN connectors

IDU Back Panel Indicators

Table 4-3: TDM Traffic Indicators

Function	Green LED	Red LED
OK	On	Off
AIS	Off	On
LOS	On	On
Loopback	On	Blinking

Upon turning on MRL, the PWR LED in the IDU-E front panel lights to indicate that MRL is on. *Table 4-4* shows the correct status of the indicators at power-up.

Table 4-4: MRL Indicators at Startup

Indicator	Color	Status
PWR	Green	ON (IDU-E only)
IDU		
With Ethernet only	Green	ON for short duration during startup
With TDM only	Orange	ON for short duration during startup
	Green	For normal operation after successfully connecting the ODU to the IDU.
ODU	Green	ON shows normal operation
LINK	Orange	ON for short duration during startup
	Green	ON shows normal operation
SERVICE	Green	ON shows normal operation OFF when Service is configured for Ethernet only

If the above LED indications do not appear following initial power turn-on, refer to *Chapter 5* for the diagnostic test instructions.

ODU Indicators

Color	Function	Location
Green	Blinking – Good Ethernet link integrity	IDU/LAN connectors
Orange	On - during power on self test	IDU/LAN connectors

Default Settings

Table 4-5 lists the default settings of the MRL configuration parameters.

Table 4-5: Default Settings

Parameter	Default Value
ODU IP Address	10.0.0.120
Subnet Mask	255.0.0.0
Manager Login password	Admin
SSID	–
Link Password	Wireless-bridge
Rate	Adaptive
Services	Ethernet
Ethernet Configuration	Auto Detect
Radio Link Failure Actions	No action
Bridge	Non PoE systems: Hub Mode, Aging time = 300 sec PoE systems: Bridge Mode
Community values	Read-write – netman Read-only – public

Starting the MRL Manager Software

❋ **To start the MRL Manager:**

1. Connect the management station to the LAN.
2. Double-click the MRL Manager icon on the desktop, or click Start > Programs > MRL Manager.

   The Login dialog box appears.

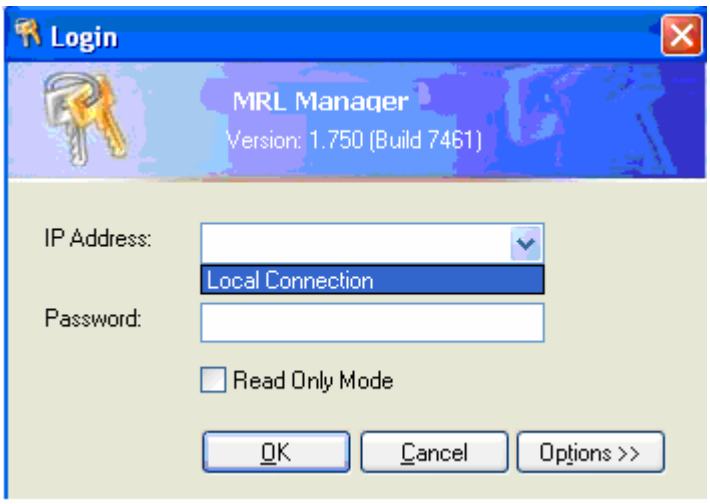


Figure 4-2: Login Screen

3. For IP Address do one of the following:
   - Type an IP address for the ODU (for Network mode), OR
   - Click Local Connection (if you are connected directly to the IDU LAN port).

   The default IP address for the ODU is 10.0.0.120. The Subnet mask is 255.0.0.0. For Versions 1.700 and greater, any valid subnet mask may be used.
4. Enter the password

Note:

The actual IP address is defined during link configuration (see Defining the Management Addresses).

   Default password – ***admin*** (see the section on Changing the Management Password)
5. If you are a user with Read-Write permission, click Options to enter the community options.

   MRL is protected with Community passwords. A user may be defined with read-only permission or with read-write permission. See the section Changing Community Values for more detail.

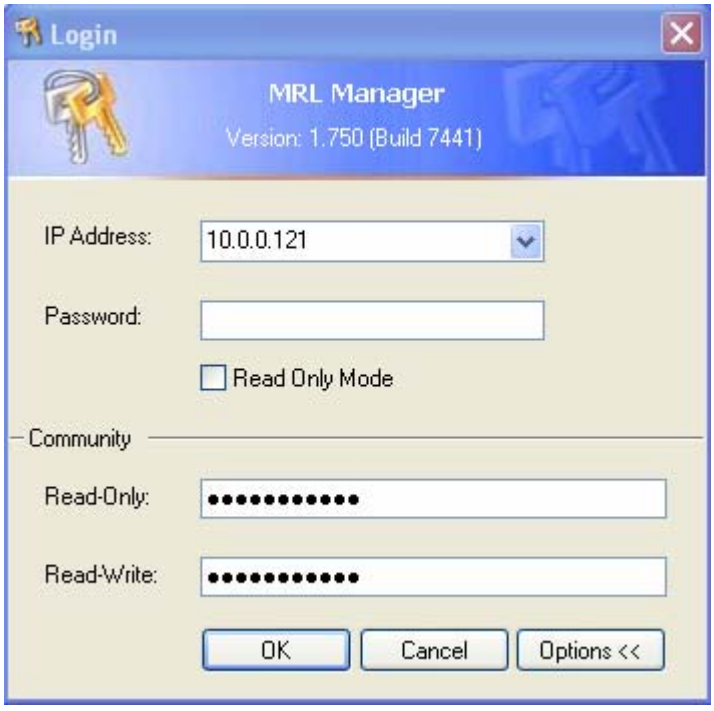


Figure 4-3: Login Screen with Community Options Visible

- If using the system for the first time, leave the default community passwords, **netman** for read-write, and **public** for read-only.
- If community values were previously defined, enter them under Community in the Read-Only or Read-Write boxes.
- If you are a user with read-only permission, click the Read Only Mode check box.

The MRL Manager main screen is displayed (see *Figure 4-4).*

Note:

With BRS systems the link must be activated at both sites when installing for the first time. A red Inactive Link box appears in the center of the Manager screen. Activation is performed later.

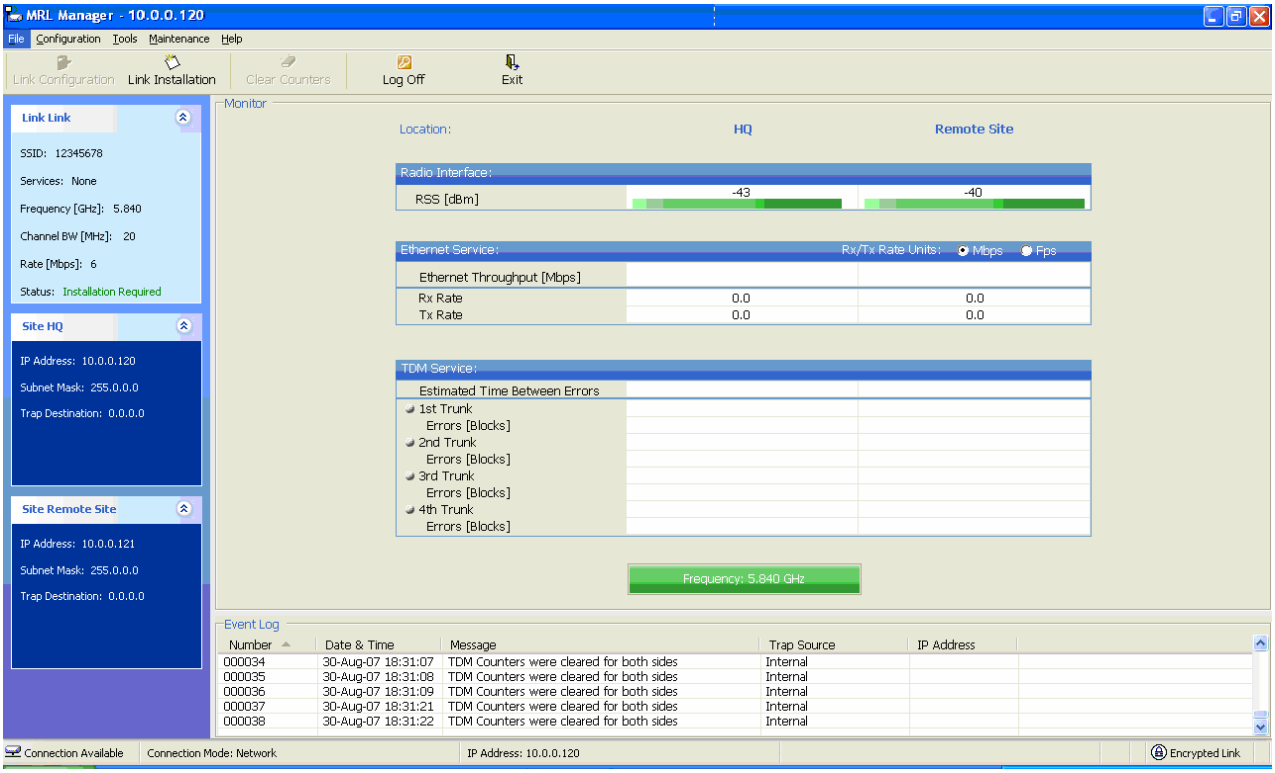


Figure 4-4: MRL Manager Main Screen

Over the Air Connection indication

During the login the Manager reports on over the air connection.

Note:

Over the Air connection to remote unit is not recommended

- Select the relevant option for your login requirements.

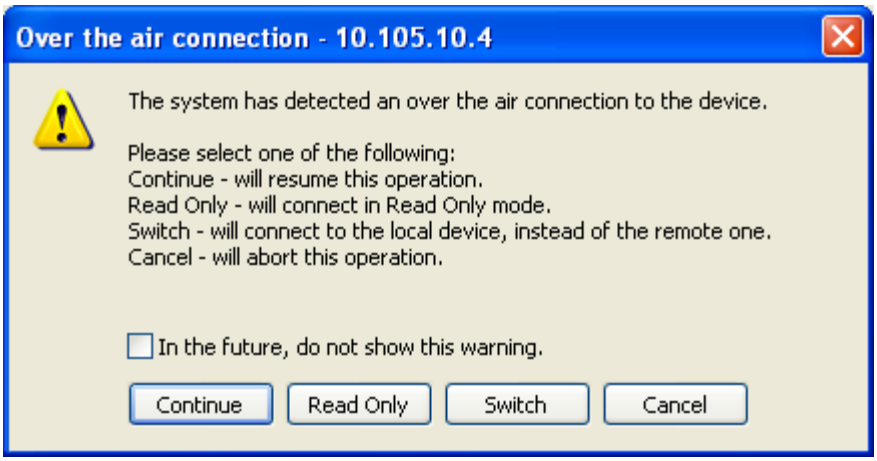


Figure 4-5: Over the Air Connection

Managing MRL

Before starting a management session, make sure that a communication link between local and remote units exists. The Link Status indication bar in the middle of the Main menu must be green and the *Radio Link - Sync* message must appear in the event log (see *Figure 4-6*).

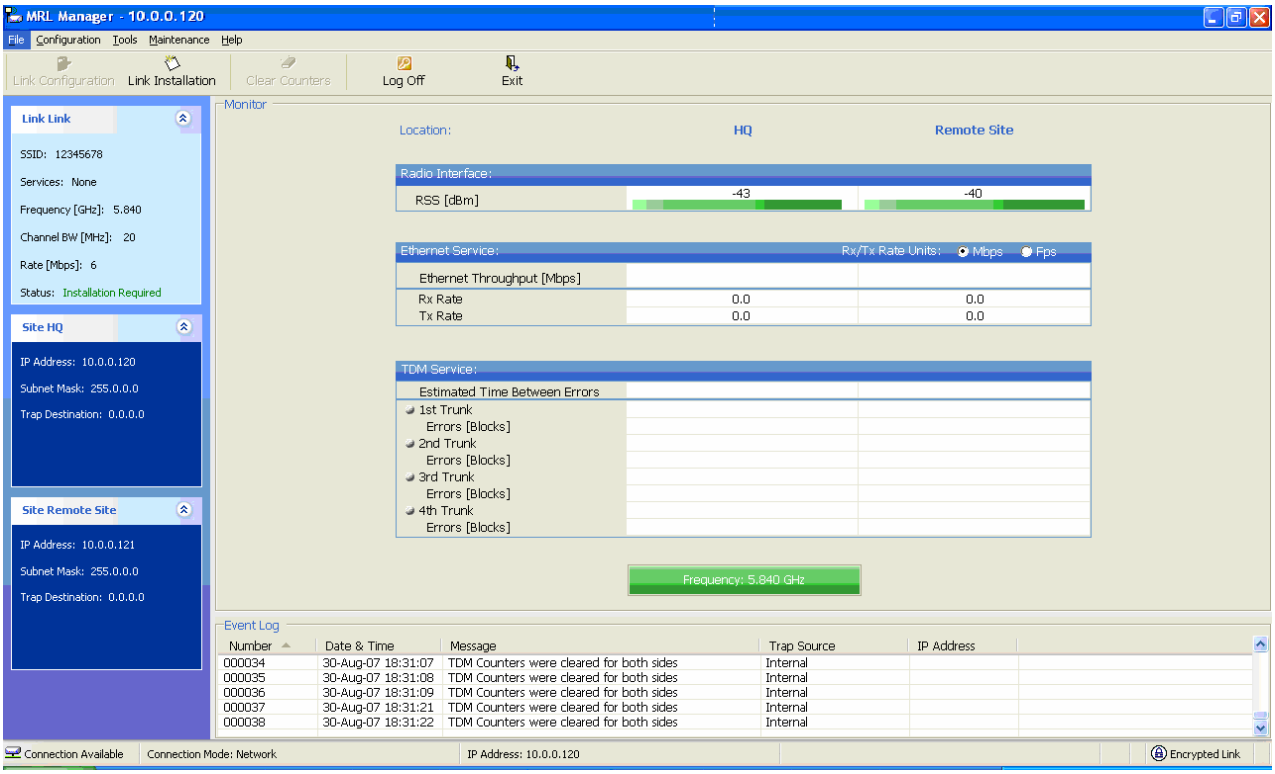


Figure 4-6: Main Screen, Wireless Link is Active

The MRL Manager Main screen consists of the following elements:

Toolbar buttons

Link Configuration	Changes configuration parameters of operating wireless link; assigns text files for storing alarms, statistics and configuration data
Link Installation	Performs preliminary configuration of the system This button is disabled once a link is defined.
Clear Counters	Clears error counters (available with TDM only)
Log off	Logs off MRL Manager
Exit	Exits MRL Manager

Menu bar

File	Log off, and exit
Configuration	Use for link configuration, individual site configuration or link installation
Tools	Acesses Performance Monitoring Report, Active Alarms, Change password, Event log handling, Set Preferences
Maintenance	Provides the following functions: Clear counters, Loopbacks, System Reset.
Help	Provides MRL Manager Help, Link Budget Calculator, Get Link Information About MRL

Link details pane

- Summarizes information on the radio frequency, IP address, type of TDM service, number of assigned E1 or T1 timeslots, and IP details of the local and remote MRL units.

Monitor pane

- Displays the link quality between local and remote devices and the following statistics:
- Radio signal strength (RSS) in dBm
- Current Ethernet bandwidth in Mbps. This is not the actual traffic rate, but the maximum capacity (Net symmetrical Throughput "Full-Duplex") that can be supported currently, (see *Figure 4-7*).
  The scale on the bar varies depending on the link distance and air interface quality.
- Local/remote receive and transmit traffic rate, in Mbps or Fps (frames per second).
- TDM status
  The Estimated Time Between Errors bar gives an indication of

the TDM quality. The ETBE constantly calculates the expected TDM ratio according to the current air interface conditions.

- Link Status: Shows the channel frequency. The color of the box indicates the status.
  Green is an active link
  Red is an inactive link
  Magenta shows an authentication or compatibility problem
  Brown shows severe compatibility problem.
- Event log – stores alarms generated by local and remote units.

Status Bar

Displays the following icons:

- Connectivity icon showing how the device is connected to the Ethernet.
- Network connection to the local unit – using IP of the local unit

  Over the Air connection - using IP address of the remote for over the air connection

  Local mode using broadcast - direct connection to IDU LAN port without IP address. This mode is only recommended when the managed PC is connected directly to the IDU (no network involved) the managed PC must have a static IP configured. (No DHCP)
- Encryption icon showing if the link is encrypted

   encrypted link

   Link Password Validation failed. The link is encrypted with default keys. Service and configuration is unavailable. Need to change the link password in either site

   No Encryption – an older release is used. No encryption is available

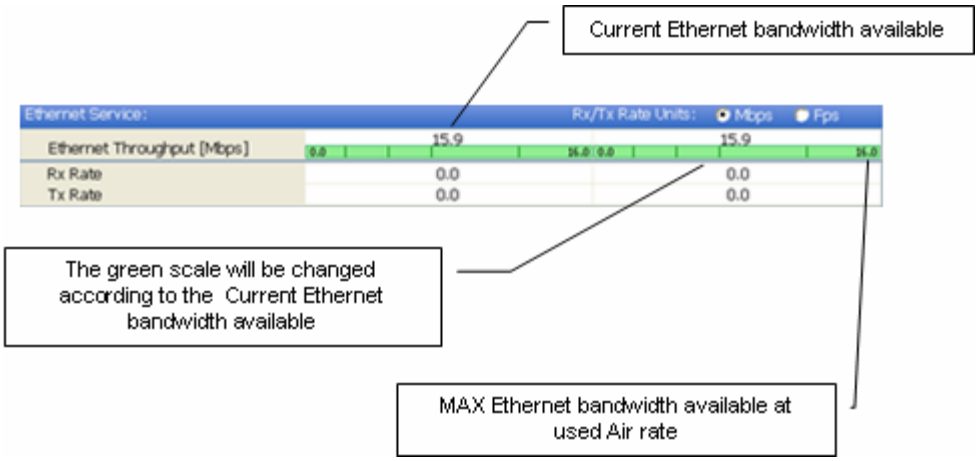


Figure 4-7: Ethernet Bandwidth Indication

❋ **To change link configuration parameters:**

1. In the Main menu, click Configure Link.

   The Configure Link wizard appears. See Link Configuration Wizard for configuration details.

2. Click Next.
3. Continue through the configuration wizard and define the Link name and ID, Channel, Rate and Services.
4. Once you finish changing configuration parameters, click Finish.

   The system takes a few seconds to activate the link with the new configuration.

Turning Off MRL

❋ **To turn off MRL:**

1. Exit the management application.
2. Remove the AC/DC converter power cord from the mains.

Chapter 5
Configuring the Link

This chapter describes configuration procedures, which are performed after the physical installation of the local and remote MRL units and after the Installation Link wizard has been run. A Link Configuration wizard is used to redefine the configuration parameters if necessary. Both the HQ and sites in the link are defined simultaneously (both sides of the link are defined simultaneously).

The following parameters are configured via the Site Configuration Wizard:

- System parameters
- Frequency channel
- Air interface rate
- Service parameters
- TDM
- Hub Site Synchronization Settings.

The following parameters are configured via the Configuration dialog box.

- Transmit power
- Management and trap addresses
- Bridge mode
- Ethernet mode
- Community values.

For HSS screens see Appendix E: Hub Site Synchronization.

After installing the link, the system configuration can be modified.

Link Configuration Wizard

Configuring System Parameters

❋ **To change general parameters:**

1. In the Main menu, click the **Link Configuration** button.

   The Configuration wizard opens:

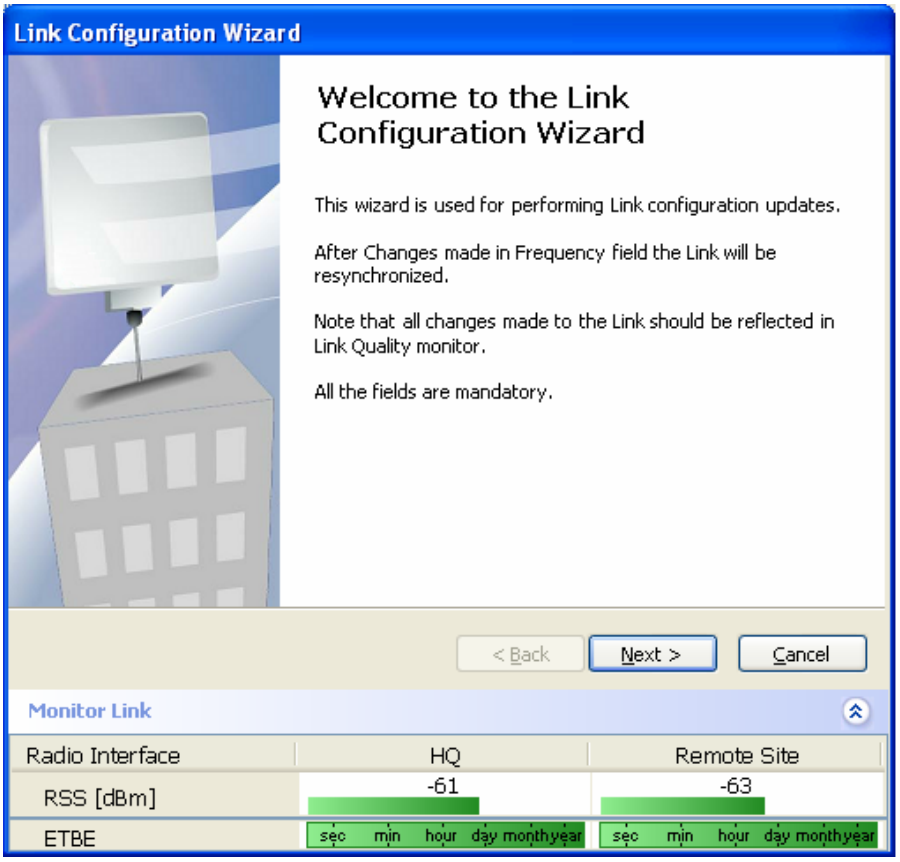


Figure 5-1: Configuration Link Wizard

2. Click **Next**.

   The Link Configuration dialog box appears:

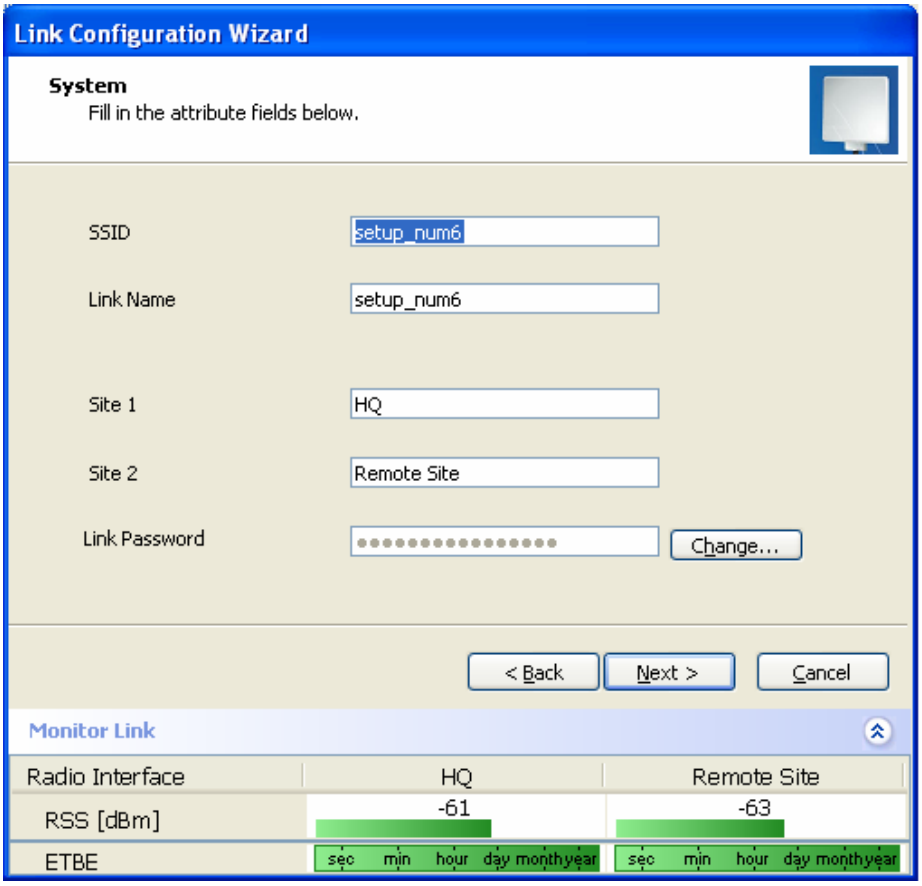


Figure 5-2: Link Configuration, System dialog box

3. In the System dialog box, enter the new data for the link. All fields with a white background can be edited.
4. Click Next.

   The Channel Settings dialog box appears.

Selecting Channels: Automatic Channel Select

You are required to define the operating frequency channel. Newer versions have a feature called Automatic Channel Select (ACS). This allows you to define several allowable frequency channels to which you can change if interference is detected on the channel in use. ACS performs channel monitoring and selects the channel with the lowest interference for the transmission.

Automatic Channel Select enables coexistence with any radar system that may be active in the area.

Note: For the ETSI version, skip to page 5-70; for the BRS version, skip to page 5-72.

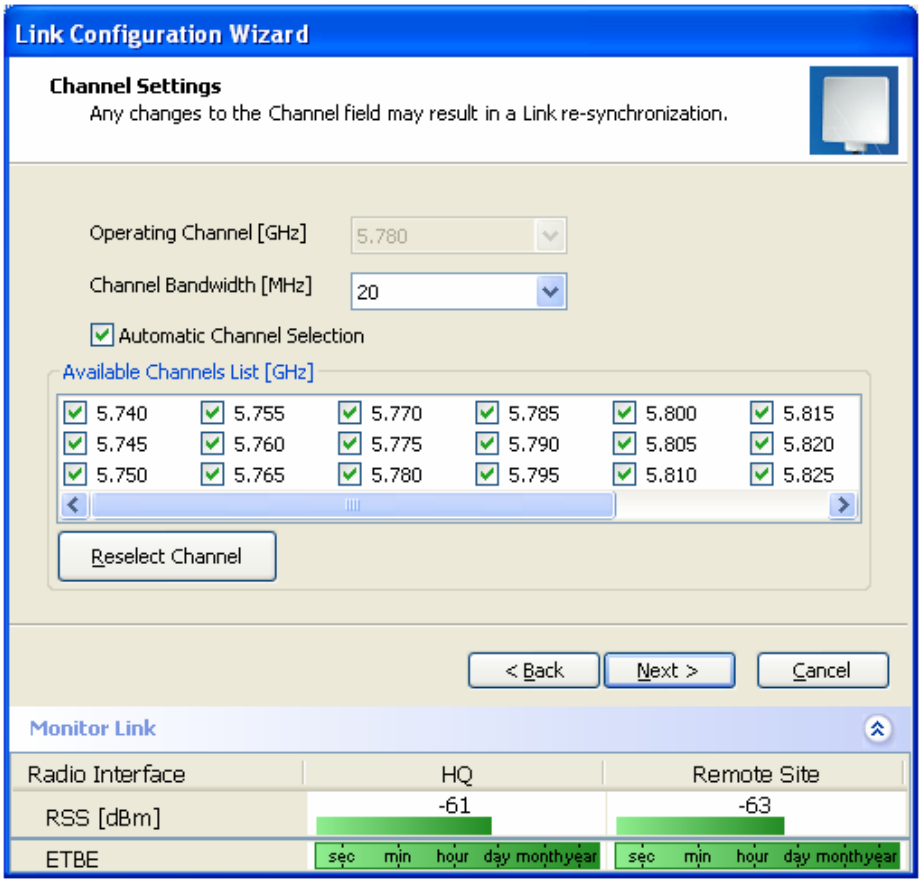


Figure 5-3: Channel Select dialog box - Automatic Channel Select

✱ **To define automatic channel selection:**

1. Select the main frequency from the Operating Channel menu.
2. Select the required Bandwidth 5, 10, or 20 MHz.
3. Click the check box if Automatic Channel Selection is required.
4. Click the check boxes in the Available Channels List of all the allowable channels that can be automatically selected.
5. If you are not satisfied with the channel that is selected automatically, click **Reselect Channel**.

   A new channel will be selected from one of the Available Channels that have been defined.

Note:

By clicking Reselect Channel, the ODU scans the selected channels looking for radio frequency activity. Once it determines which of the channels is free of RF signal activity, it locks onto it. If you require a different channel than the one selected, you must first remove the

operating channel that the ODU finds most free of RF signal activity from the available channel list.

6. Click **Next**.

   The Rate Select box appears.

Note: If you have the standard version, proceed to Configuring Service Parameters, page 5-73. For the ETSI version, proceed to the next section; for the BRS version, skip to page 5-72.

The 5.4 GHz ETSI Version

In accordance with ETSI, unlicensed wireless data equipment is not allowed to interrupt radar services. Therefore, if the ETSI Version detects Radar activity, it automatically changes the frequency channel. This feature is termed Dynamic Frequency Selection (DFS). According to the standard, a channel with active Radar is prohibited from use for 30 minutes. Before any transmission, MRL probes a channel for Radar signals for a period of 60 seconds.

In the 5.4 GHz ETSI version, the Automatic Channel Selection is selected by default and a minimum of two channels must be defined as available.

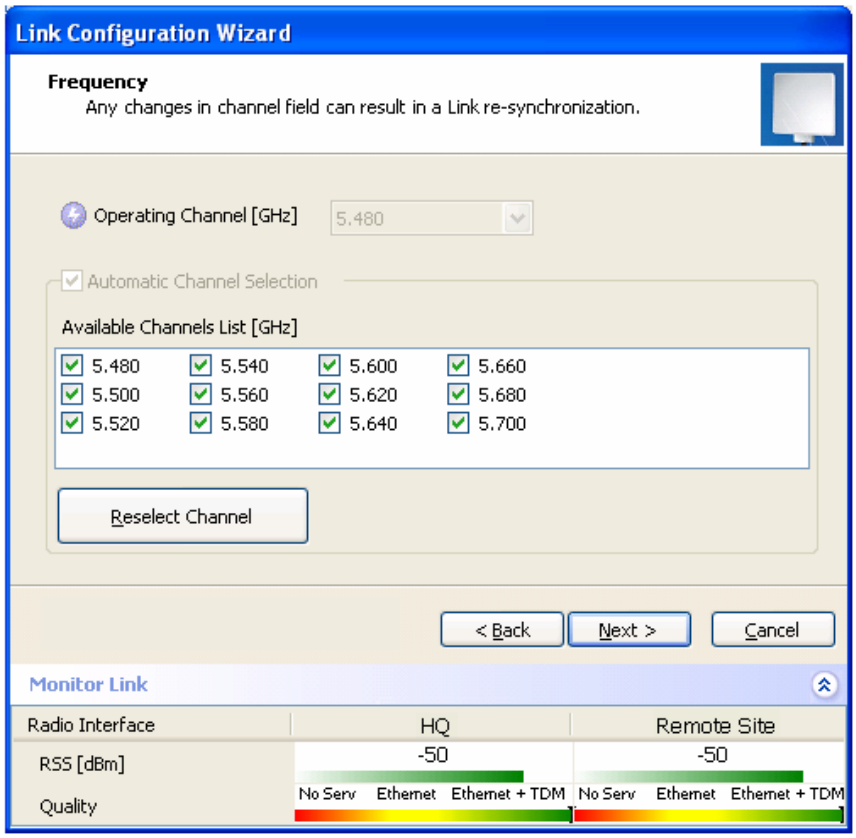


Figure 5-4: Channel Select dialog box (DFS, ETSI requirement)

The  sign on the configuration Wizard and Status bar indicates that the radar detection is on.

❋ To define automatic channel selection in the 5.4 ETSI version

1. Select the main frequency from the Operating Channel menu.

Note:

Automatic Channel Selection is selected by default.

2. Click at least two check boxes in the Available Channels List of all the allowable channels that can be automatically selected.

Note:

Installation will not continue until at least two channels are defined.

Selecting a new channel causes the system quality to change. The quality bar shows the adjustment until the system finds the best quality link.

Any channel selected is evaluated for 60 seconds; therefore this selection process may take a few minutes.

3. If you are not satisfied with the channel that is selected automatically, click **Reselect Channel**.

A new channel will be selected from one of the Available Channels that have been defined.

Note:

The reselection process may take a few minutes.

4. Click **Next.**

The maximum rate is selected according to the link conditions

The quality bar may fluctuate until the system finds the best quality link.

5. Click **Next**.

The Service Parameters dialog box appears. Proceed to page 5-73.

BRS Version: Configuring BRS Channel Settings

Note:

Both sites in a BRS Link must be configured identically.

✱ To Configure BRS Channel Settings

1. Select the Band Plan: Pre-Transition or Post-Transition.
2. Select the Bandwidth required.
   - Single Band (5MHz)
   - Double Band (10MHz)
   - Quad Band (20MHz)
3. Select the Frequency.
4. Click Next. The system is re-synchronized to the changes.

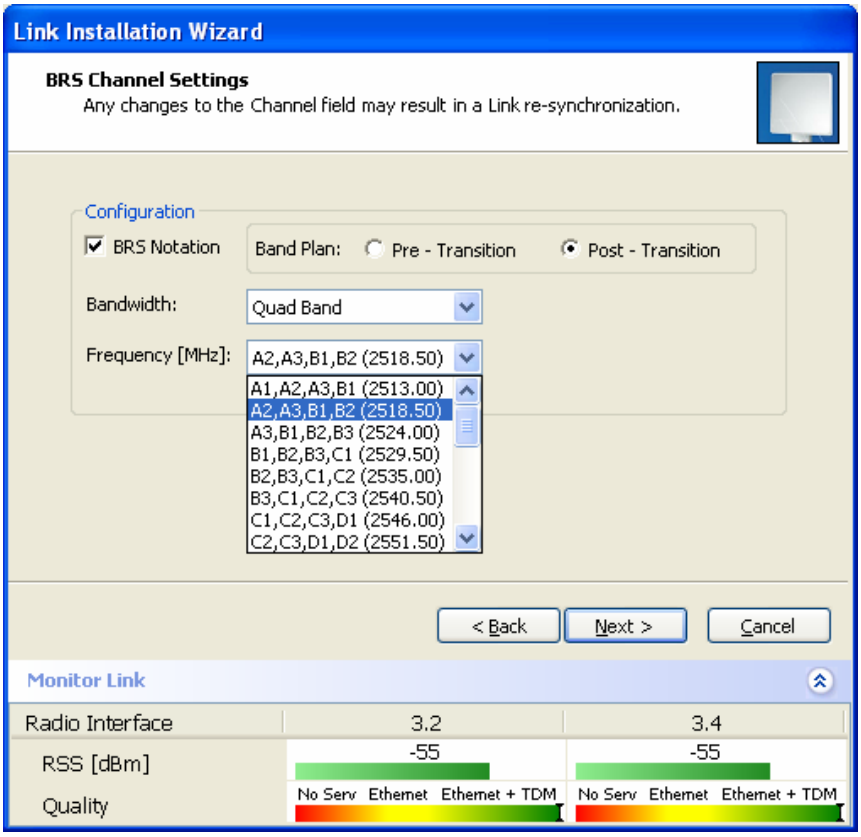


Figure 5-5: BRS Channel Settings Post-Transition

Configuring Service Parameters

You define the type of service required, Ethernet Only or Ethernet with TDM. The bandwidth remaining available for Ethernet if TDM services are required is shown in the dialog box.

Note:

ACCESS versions are Ethernet Only.

In the Service Parameters dialog box select the number of E1 connections (x1 or x2 for IDU-E, or x4 for IDU-C). Define the required transmission rate, and the distance between the sites.

✱ **To configure E1/T1 and Ethernet services:**

1. In the Service dialog box, select one of the following:
   - Ethernet plus a number of E1/T1 channels (see *Figure 5-6*).
   - Ethernet data only.
2. Select the transmission rate required.
   - Adaptive
   - 9 Mbps
   - 12 Mbps
   - 18 Mps
   - 24 Mbps
   - 36 Mbps
   - 48 Mbps

   The default rate is Adaptive. ACCESS versions only operate in Adaptive mode.

   Adaptive Modulation - The system changes modulation automatically depending on channel characteristics in order to guarantee continuation of service. The adaptive modulation enables the user to maximize Ethernet throughput without degradation of the TDM service quality. When Ethernet only service is used, the adaptive modulation enables improving the Ethernet performance in case of air performance degradation (periodical interference or RSS changes).

   In event of interference at one site, there is no need to use a lower modulation at the other site (as in previous versions). In such a case the actual rate changes automatically only at the problematic

site, while the second side of the link maintains the highest rate possible (Asymmetric).

Adaptive modulation can be changed in both Installation and Configuration wizards.

For versions 1.6 and greater, distance between the sites is automatically measured.

If TDM services are selected, then the Evaluate icon shows on the screen while the maximum rate is evaluated.
When evaluation is complete the icon changes and the following message is shown:

Service has been evaluated, click **Next** to continue.

3. Click **Next**.

   The TDM Parameters dialog box or the Finish screen appears depending on which services were selected.

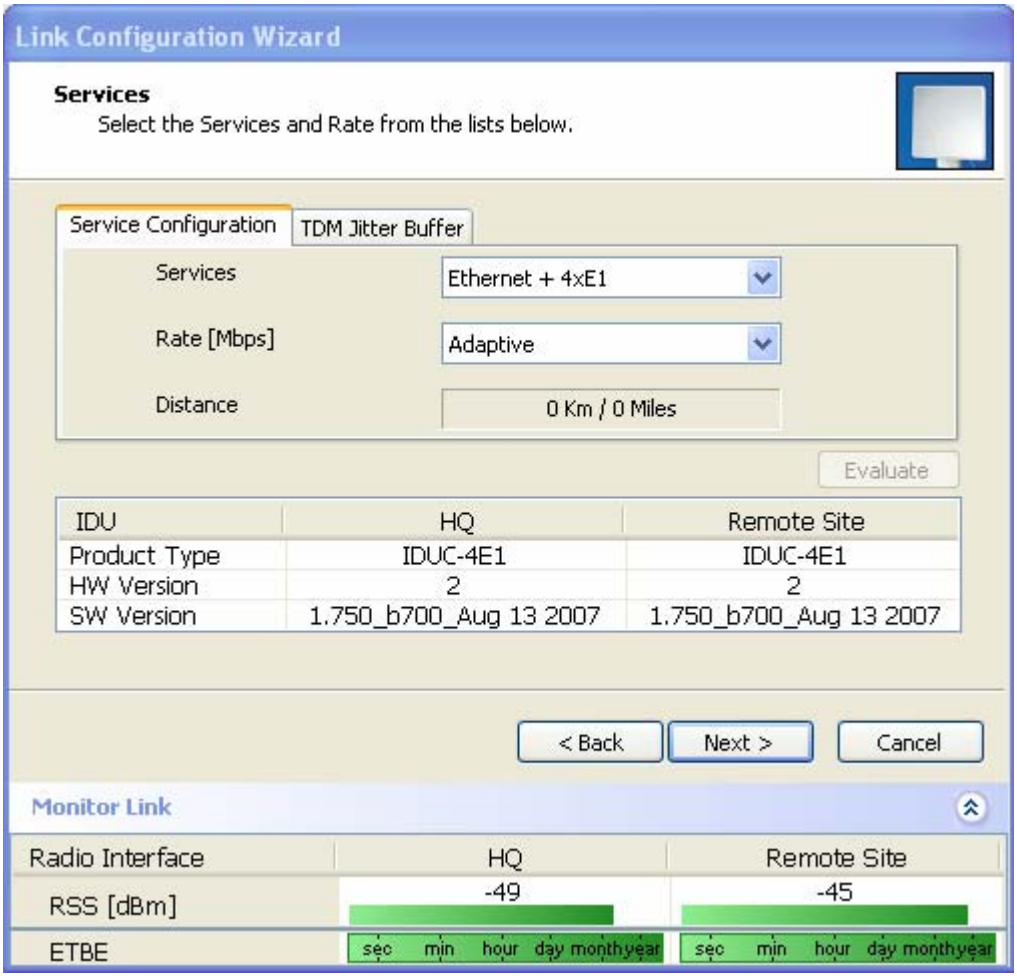


Figure 5-6: Services Dialog Box, E1/T1 Interface

Configuring TDM Operation

Setting the Clock Configuration

The TDM clock feature is enabled for carrier class IDU-C in addition to the hardware version 2 and greater IDU-E with TDM. A TDM dialog box will appear where IDU supports the clocking configuration feature (see *Figure 5-7* and *Figure 5-8*).

A new master clock configuration option is available in the Link Configuration Wizard. The automatic mode selects the clock from the first trunk that is working in normal mode (or is configured to loop-back maintenance). If a specific trunk is selected, this trunk shall be used as the system master regardless of the trunks state. The current master clock trunk is also displayed.

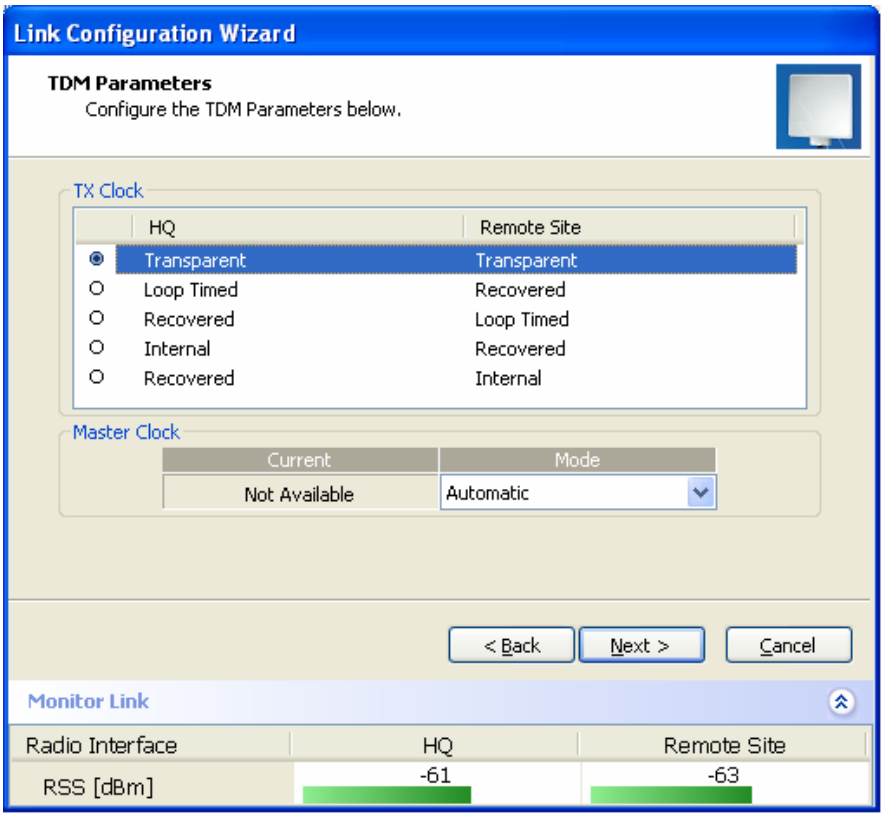


Figure 5-7: TDM clock dialog box for T1 IDU

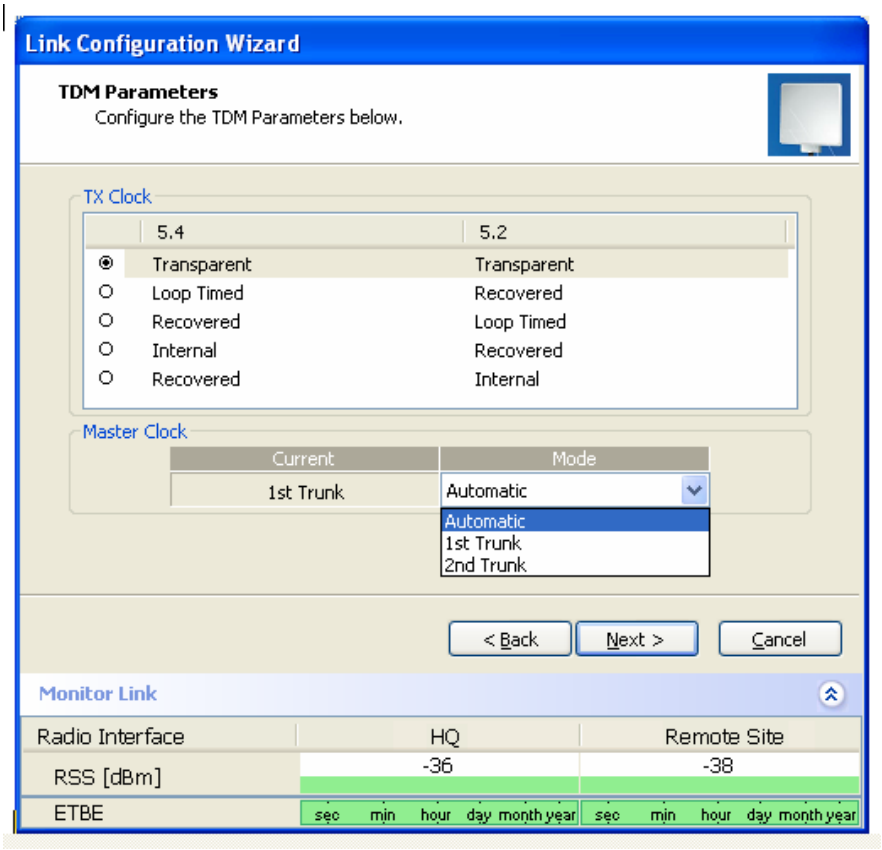


Figure 5-8: TDM clock dialog box for E1 IDU

If TDM services are selected then the TDM parameters dialog box appears.

The TDM Parameters dialog box contains five working modes; select the appropriate clock mode according to your application. Choosing one of these modes sets the TDM clock behavior on both sides of the link. The user equipment must be configured as described in *Chapter 3*.

Transparent/Transparent

MRL regenerates the clock from line clock side to Tx clock on the opposite side of the link.

Loop time/Recover

The local unit receive clock is the transmit clock on both sides of the link.

Recover/Loop time

The remote unit receive clock is the transmit clock on both sides.

Internal/Recover

The local unit internal oscillator generates the clock while the remote unit recovers this clock.

Recover/Internal

The remote unit internal oscillator generates the clock while the local unit recovers this clock.

Note:

The Line code option is used with T1 Systems.

Table 5-1: TDM Clock Modes

	Unit Clock Mode		User Equipment Side	
	Local Unit	**Remote Unit**	**HQ side**	**Branch side**
1	Transparent	Transparent	Internal/Recover	Internal/Recover
2	Loop Time	Recover	Internal	Recover
3	Recover	Loop Time	Recover	Internal
4	Internal	Recover	Recover	Recover
5	Recover	Internal	Recover	Recover

Setting the T1 Line Code

The T1 line code can be set as B8Zs or AMI in the TDM Parameters dialog box.

The default is B8ZS.

Note:

This dialog box is available only when TDM service was selected in the previous Services dialog box.

❋ **To change the line code**

1. Run the Configuration wizard until you reach the Services dialog box.
2. Verify that T1 services have been selected.
3. Click Next to open the TDM Parameters dialog box.
4. Set the line code to B8ZS or AMI as required.
5. Click **Next**.

Setting the TDM Backup (IDU-R only)

The IDU-R units have two E1/T1 trunk lines, one for MRL air interface via the ODU, and the second external is for peripheral equipment- I.E. PBX. The external equipment status is displayed on the Main screen of the Manager in IDU-R systems.

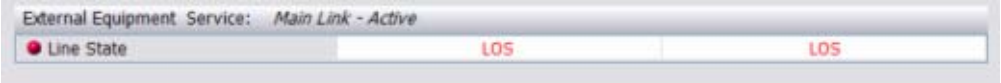


Figure 5-9: IDU-R - External Equipment Status

❋ **To use the Backup Mode**

1. Click Enabled Backup Mode.
2. Set which link is backup link; either the link or the external equipment.

   The second link becomes the main link.
3. Click **Next** to continue.

❋ **To disable the Backup mode**

1. Click Disable Backup Link
2. Set which link is the Main Link; either the link or the external equipment.
3. Click **Next** to continue.

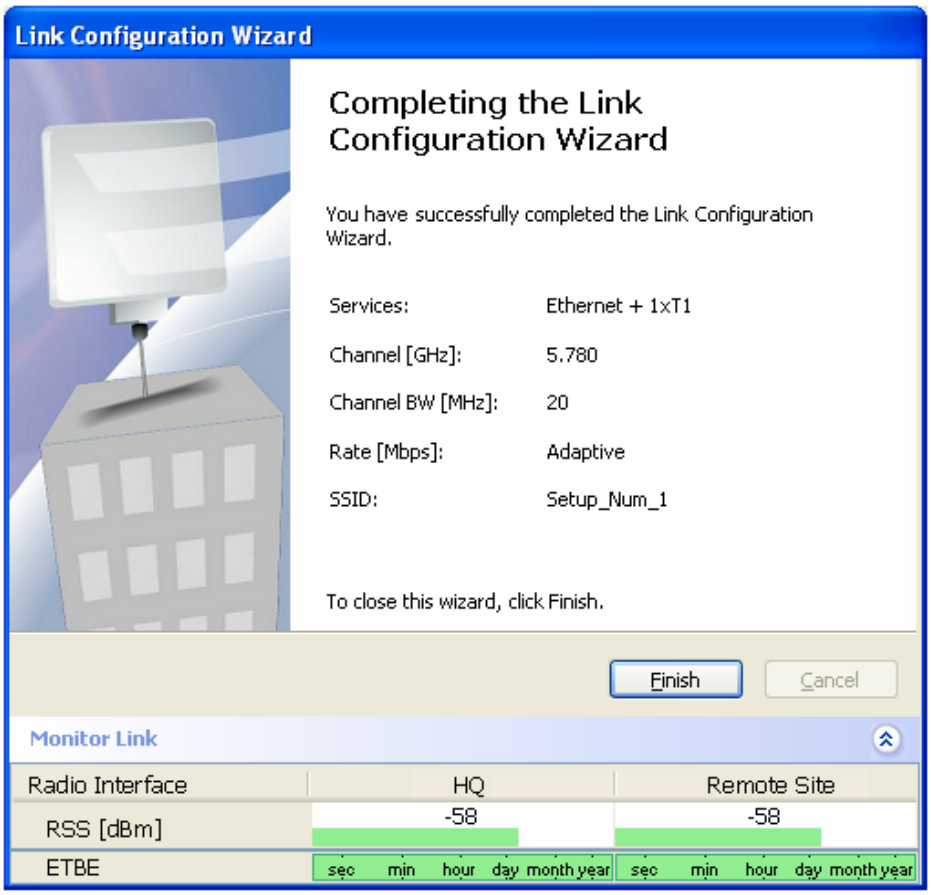


Figure 5-10: Configuration Link, Finish screen

The Finish screen appears, showing a summary of the link configuration (see *Figure 5-10*) above.

4. Click **Finish** to complete the configuration wizard.

   The Main screen is displayed.

Configuring the Site

Editing the Configuration Parameters by Site

You can edit the configuration parameters for each site individually. The following functions are available from either the left side of the dialog box, or the buttons on the top of the dialog box (see *Figure 5-11*).

Functions on the left of the dialog box:

System	Edit the contact person and location details. View the system details
Air Interface	Change the transmit power

Inventory	View the hardware and software inventory.
Management	Configure the IP address, Subnet Mask, Default Gateway, and the Trap Destination.
Security	Change the Community Values and the Link Password
Date and Time	Set the date and time of the server and of the System.
Advanced	Configure the Bridge, define the LAN connection and set the external alarm inputs.

Functions at the top of the dialog box:

Backup	Save a backup.ini file with the current configuration.
Restore	Load the backup.ini file created by the backup.
Installation Mode	Return to Installation Mode for the entire link. Selecting the Mute check box before clicking the Install Mode button mutes the Beeper.
Mute	Mutes the alignment tone at startup. Reactivate the beeper during alignment.

❋ **To edit the Configuration Parameters:**

1. Click **Configuration** from the main menu.
2. Select which site to configure.

   The Configuration dialog box opens. (See *Figure 5-11*)

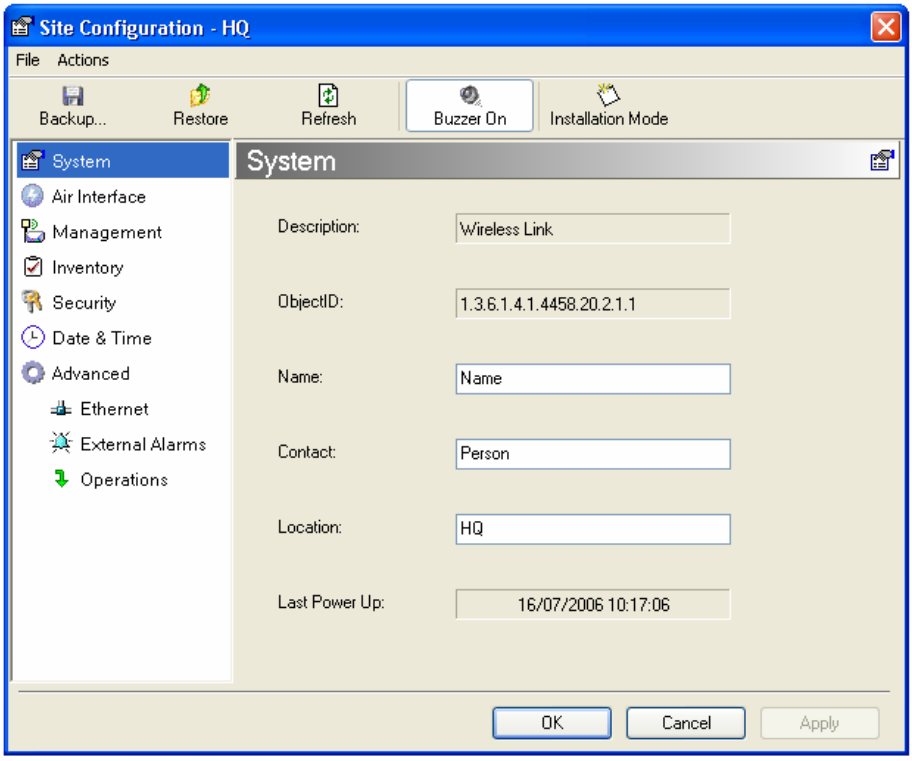


Figure 5-11: Configuration Dialog Box

3. Select the appropriate item in the left hand list to open a dialog box.
4. Click **Apply** to save changes.

Changing the Transmit Power

Each site can have a different transmit power level.

✱ **To change the Transmit Power:**

1. Click **Configuration** from the main menu.
2. Select which site to configure.

   The Configuration dialog box opens.
3. Select Air Interface. (See *Figure 5-12*)
4. Select the required Transmit Power Level.
5. Click Apply to save the changes.

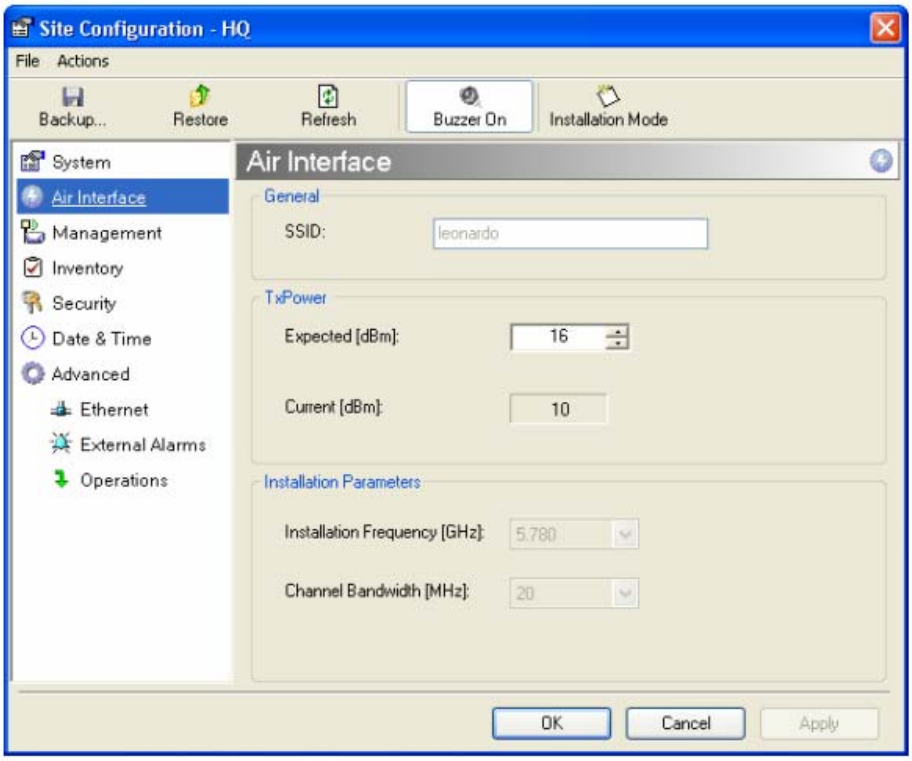


Figure 5-12: Changing the Transmit Power

Defining the Management Addresses

Each site must be configured separately, first site A then site B.

✱ **To define the Management Addresses:**

1. Click **Configuration** from the main menu.
2. Select which site to configure.

   The Configuration dialog box opens:

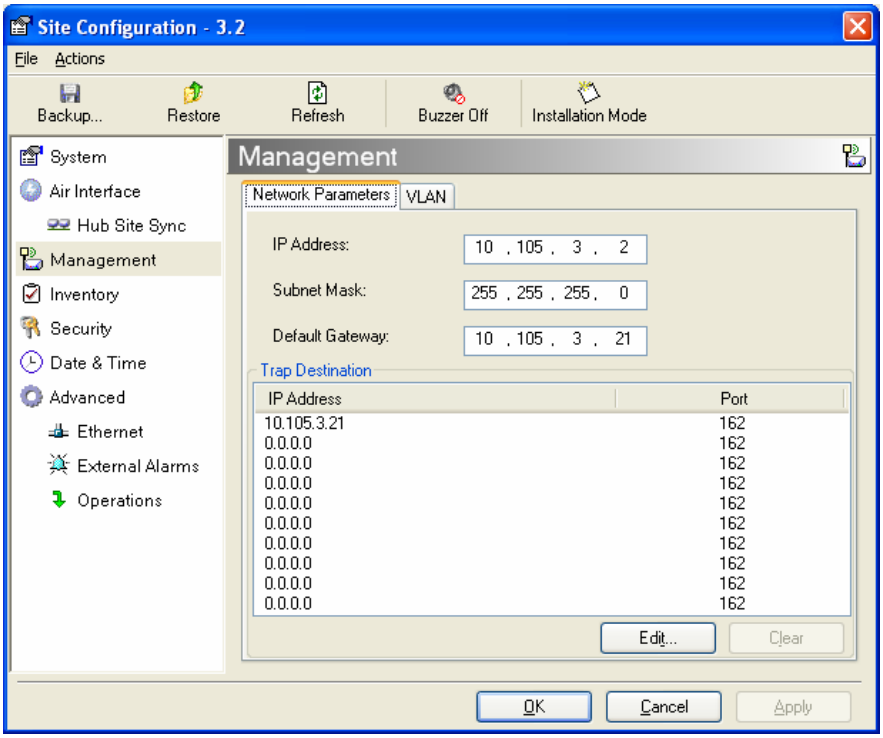


Figure 5-13: Management Addresses - Site Configuration dialog box

3. Select **Management**.
4. Enter the IP address of the ODU in the IP address field.

Note:

If performing configuration from the MRL Manager, the IP address is entered in the login screen.

5. Enter the Subnet Mask.
6. Enter the Default Gateway.
7. Enter the Trap Destination. This is the IP address of the PC running the management application. The event log will be stored at this address.
8. Click **Apply** to save the changes.

Configuring VLAN Settings

VLAN Management enables separation of user traffic from NMS Traffic. The user decides if such a separation is required. Both the HQ and Remote site are configured with VLAN Management.

❋ **To enable VLAN management:**

1. Click **Configuration** from the main menu.
2. Select which site to configure (HQ or Remote site).
3. Select Management.
4. Open the VLAN tab.
5. Check The Enabled box.
6. Enter a VLAN ID.

   After entering the VLAN ID, only packets with the specified VLAN ID are processed by the ODU. This includes all the protocols supported by the ODU (ICMP, SNMP, TELNET and NTP). The VLAN priority is used for the traffic sent from the ODU to the management workstation. VLAN management affects all types of management connections (local, network and over the air).
7. Enter a Priority number.

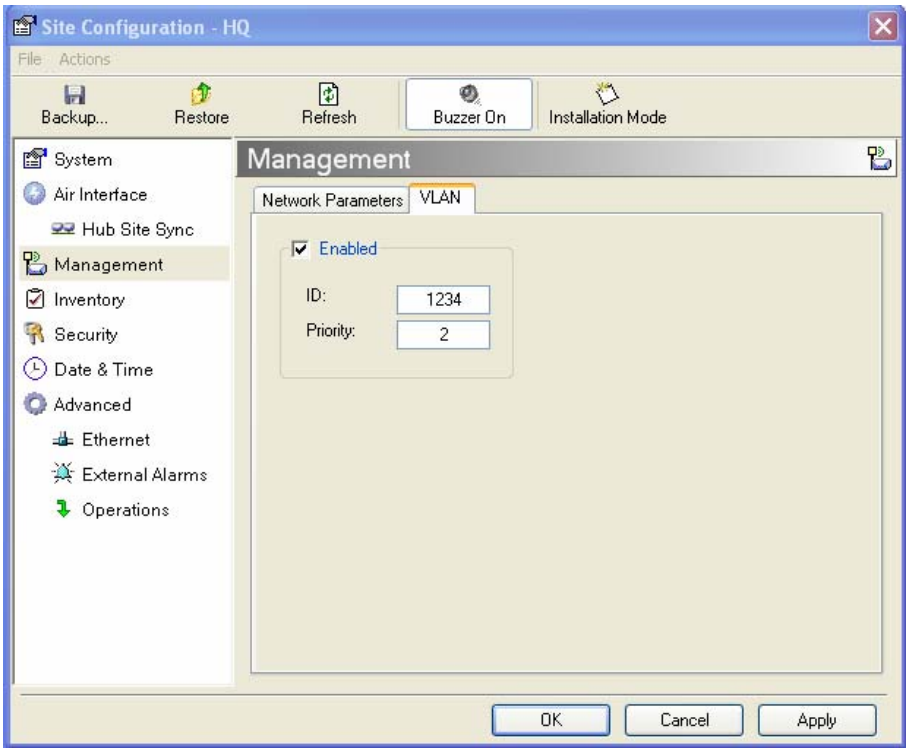


Figure 5-14: Configuring VLAN Settings

Warning

Changing this parameter causes the management application to immediately disconnect. In order to avoid problems, it is recommended to verify the change by setting the VLAN only to one ODU, and only after verifying the VLAN network operation, change the other VLAN setting can be changed.

Troubleshooting:

If the VLAN ID is forgotten or there is no VLAN network connected to the ODU:

- Reset the device.

  In the first two minutes both VLAN and no VLAN connections are available.

Setting the Date and Time

The ODU maintains a date and time value. The date and time value should be synchronized with any Network Time Protocol (NTP) version 3 compatible server[1]. On power-up the ODU configures the initial date and time using an NTP server. If the server IP is not configured or is not reachable, a default time is set. When configuring the NTP server IP, you should also configure the offset from the Universal Coordinated Time (UTC). If there is no server available, you can either set the date and time, or you can set the manager workstation time. Note that manual setting is not recommended since reset, power up, or synchronization with an NTP server will override the setting.

Note:

The NTP uses UDP port 123. If a firewall is configured between the ODU and the NTP server this port must be opened[2].

It can take up to 8 minutes for the NTP to synchronize the ODU date and time.

❋ **To set Date and time**

1. Click **Configuration** from the main menu.
2. Select which site to configure.

   The Configuration dialog box opens.
3. Select Date & Time:

[1]Windows XP is configured by default as a server.

[2] Windows XP command w32tm /stripchart /computer:<server IP> can be use to check the NTP server connectivity

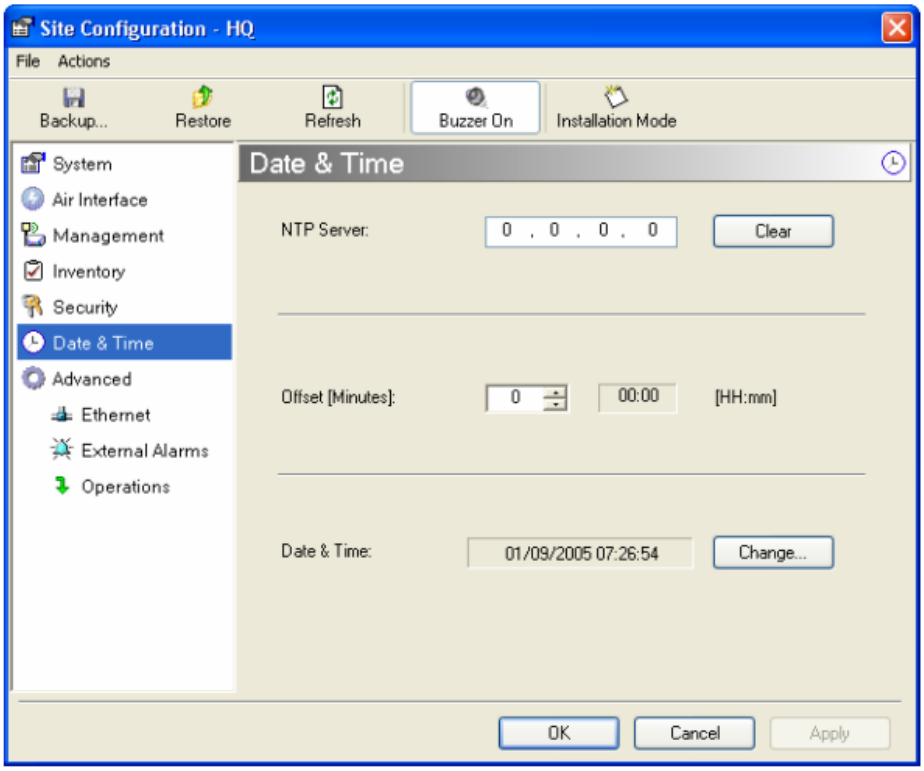


Figure 5-15: NTP Server Address - Site Configuration dialog box

4. If entering an address for the NTP Server, click **Clear**, and then enter the new address.
5. Set the Offset value.
6. To manually set the date and time, click **Change** and edit the new values.

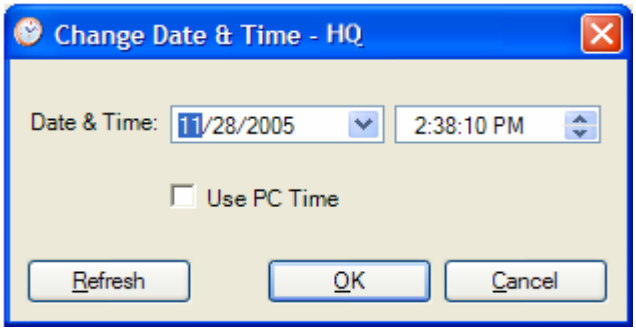


Figure 5-16: Change Date and Time - HQ dialog box

Configuring the Bridge

Bridge configuration is required in various network topologies, such as protection (1+1) and ring application. The bridge configuration

parameters are located under the Advanced tab of the Configuration dialog box:

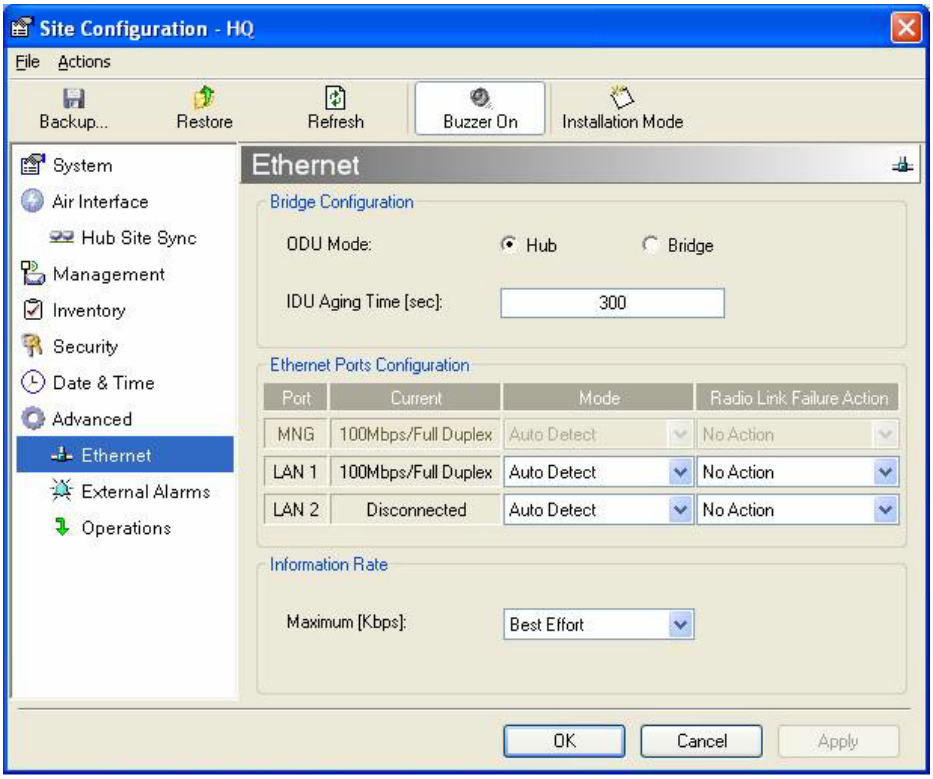


Figure 5-17: Bridge Configuration - Site Configuration dialog box

ODU Bridge Mode

This parameter controls the ODU mode with two optional values,

- Hub Mode – in Hub mode the ODU transparently forwards the all the packets over the wireless link.
- Bridge Mode – In Bridge mode the ODU performs both learning and aging, the aging time of the ODU is fixed at 300 seconds.

Note:

Changing these modes requires system reset.

IDU Aging time

This parameter controls the IDU aging time.

The IDU has a 2047 MAC address-learning table. The aging time parameter controls the time each MAC address is dropped from the table. Default value is 300 seconds.

Note:

Any change to these parameters is effective immediately.

Each side of the link can be configured separately.

- The following list details common configurations; both sides are must be configured with the same parameter.
- Standard (Default) Configuration for Ethernet Applications
- Set IDU aging to 300 seconds, ODU set to Bridge mode
- Fast aging mode – for rapid network topology changes
- Set IDU aging to one second, ODU set to Hub mode.
- Hub Mode
- The ODU is set to HUB mode. IDU aging is not applicable.
- Ethernet Bridge

The ODU is set to Bridge mode. The IDU aging is not applicable.

Configuring Ethernet Mode

The Ethernet mode is configurable for line speed (10/100BaseT) and duplex mode (half or full duplex). This mode provides an Auto detect feature where the line speed and duplex mode are detected automatically using auto negotiation. Use the manual configuration when external equipment does not support auto negotiation. The default setting is Auto Detect.

The maximum Ethernet Information Rate can be limited via the pull down menu. The default setting is Best Effort.

Note:

It is not recommended to configure the port that is used for the management connection, since a wrong configuration can cause management disconnection or Ethernet services interruption.

❋ **To configure the Ethernet Mode:**

1. From the **Configuration** menu, select the site to reconfigure.

   The Site Configuration dialog box opens.

2. Click **Advanced > Ethernet**.
3. In the Ethernet Ports Configuration pane, use the drop-down menu to select the LAN configuration.

4. Click **Apply** to save the changes.

Note:

It is possible to close the Ethernet service by disconnecting the Ethernet port. The user should be aware that it is possible to close the port and not have any access to the device. If this should occur the workaround is as follows:

- Connect the system from the remote site
- Connect via other Ethernet port (IDU-C)
- Power down the equipment and connect immediately after the power up (the fastest way is to enter install mode).

Setting the Maximum Information Rate

The maximum Ethernet throughput of the link can be limited. The default setting is Best Effort, where the highest information rate available for the link conditions and settings is used.

❋ **To set the Ethernet information rate:**

1. From the **Configuration** menu, select the site to reconfigure.
2. Click Advanced > Ethernet

   The Configuration dialog box opens.
3. In the Information Rate pane, use the drop-down menu to select the maximum Information Rate.
4. Select **Other** to define the throughput with 8 Kbps resolution
5. Select **Best Effort** for the highest information rate possible for the link conditions and settings
6. Click **Apply** to save the changes.

Note:

ACCESS systems have a maximum rate of 2048 kbps.

Configuring the Jitter Buffer

By configuring the Jitter Buffer, the receiver jitter buffer for each site can be enlarged, thereby increasing system resistance to interference (the larger the jitter buffer, the longer the interference period that the system will overcome without TDM BER). You can also decrease the jitter buffer to decrease the system delay.

The jitter buffer can be configured between 2.1 and 16.0 milliseconds.

❋ **To configure the Jitter Buffer:**

1. In the Main menu click the **Link Configuration** button.
2. Run the Configuration wizard (see *Figure 5-1*).
3. On the Services screen, select the TDM Jitter Buffer tab:

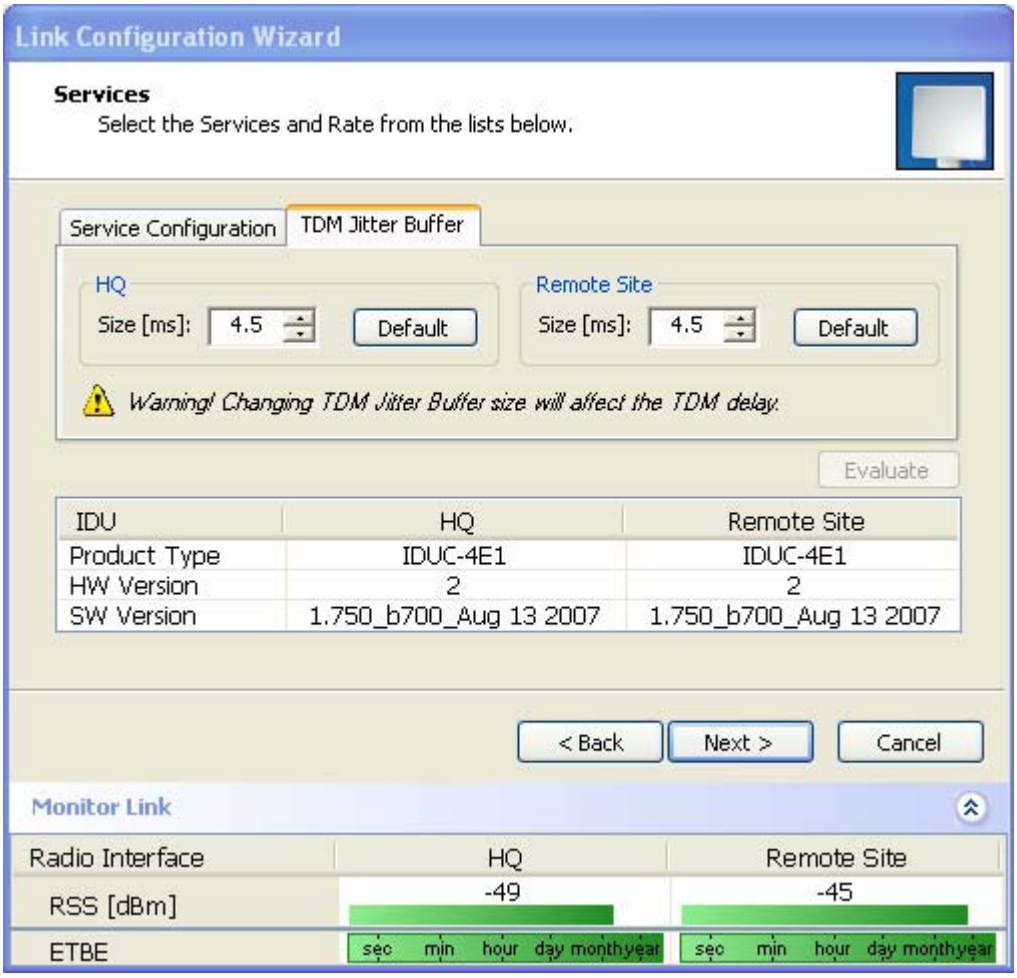


Figure 5-18: Jitter Buffer Configuration

4. Choose the desired values for HQ and Remote Site.

   After setting the new value, the user must evaluate the expected quality. During the evaluation the ETBE bar is displayed.

5. Click **Next >** to perform the change or **< Back** to cancel the change.

Caution Extra caution should be use when decreasing the value, since the service quality might be affected in the case of interference. In cases of asymmetric interference, the jitter buffer can be set to different values per site. In such cases the latency will also be asymmetric.

Changing Community Values

The ODU communicates with the management application using SNMPv1 protocol. The protocol defines three types of communities:

- Read-Only for retrieving information from the ODU
- Read-Write to configure and control the ODU
- Trap used by the ODU to issue traps.

The community string must be entered at login. The user must know the password and the correct community string in order to gain access to the system. A user may have read-only privileges.

It is not possible to manage the ODU if the read-write or the read community values are forgotten. A new community value may be obtained from technical support for the purpose of setting new community; the serial number or the MAC address of the ODU must be supplied.

Note:

*The manager application and the ODU use the community strings **public-bru1** for the local unit and **public-bru4097** for the remote unit. These are the factory defaults, but can only be used one time on the first installation.*

A new community string must be set when entering the system for the first time. The read-write community and read-only community have a minimum of five alphanumeric characters. (Bru1 and bru4097 are not permitted). Changing the trap community is optional by clicking the check box.

Editing Community Strings

The community change dialog box is available from the **Configuration > Security** tab. Both read-write and read-only communities must be defined.

On entering for the first time, use the following as the current community:

- For Read/Write community, use **netman**.
- For Read Only community, use **public**.
- For Trap community, use **public-bru1**.

❋ **To change a community:**

1. From the Configuration dialog box, select the **Security** tab
2. Type the current read-write community (default is **netman**).

3. Select the communities to be changed by clicking the check box.
4. Type the new community and re-type to confirm.
5. Click **OK** to save.

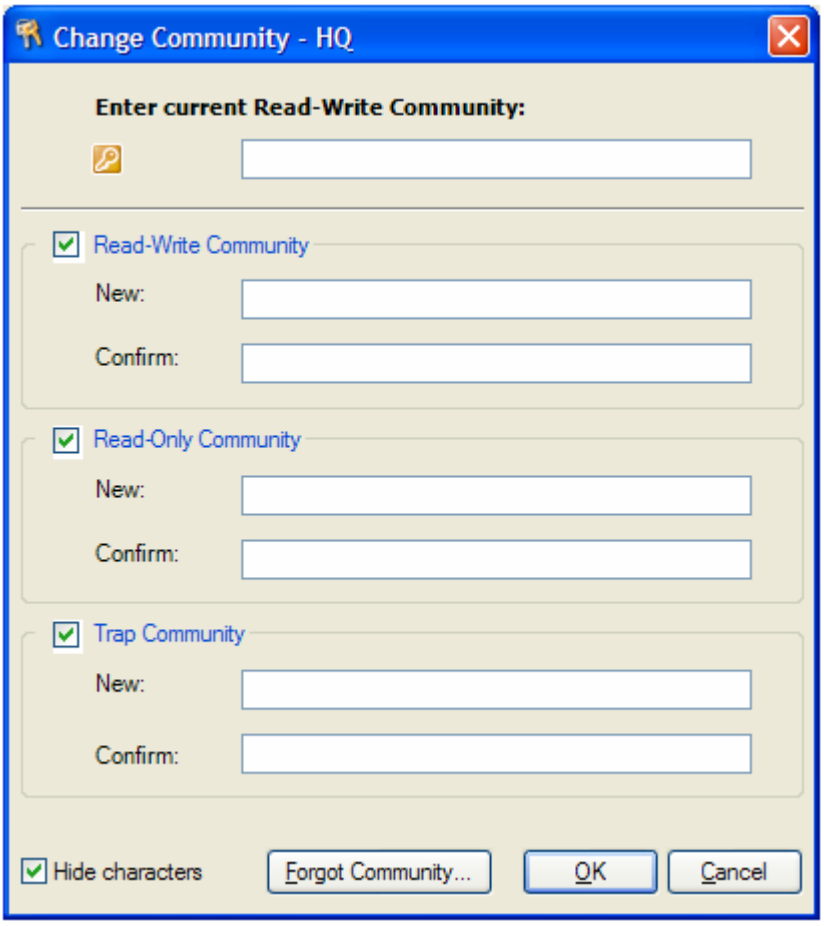


Figure 5-19: Changing the Community String

Forgotten Community string

If the read-write community string is unknown, an alternative community key can be used. The alternative community key is unique per ODU and can be used only in order to change the community strings. The alternative community key is supplied with the product, and it is recommended to keep it safe.

If both the read-write community and the alternative community key are unavailable, then an alternative community key can be obtained from customer support using the ODU serial number or MAC address. The serial number is located on the product, and the MAC address is displayed in the manager inventory tab.

When you have the alternative community key, click the **Forgot Community** button and enter the Alternative Community (*Figure 5-20*). Then reconfigure the read-write community string.

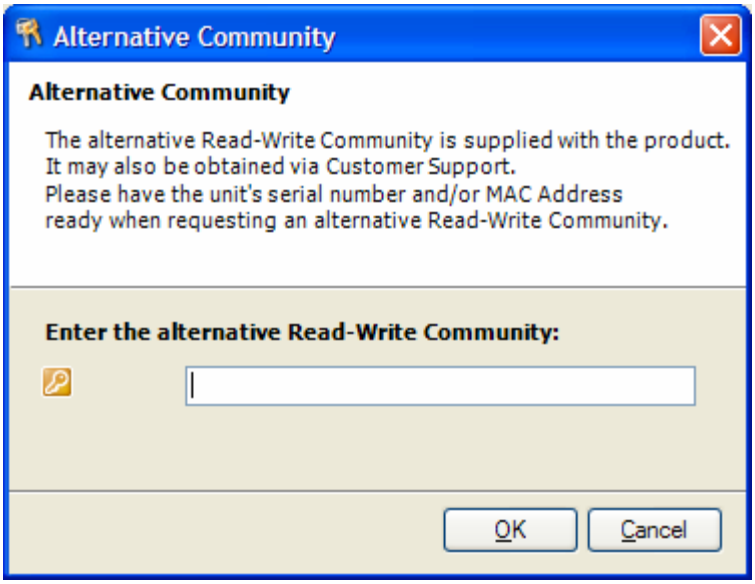


Figure 5-20: Alternative Community Dialog box

Muting the alignment tone

The ODU alignment tone becomes audible as soon as power is supplied, and continues until the ODUs are aligned and the link established.

It is possible to mute the tone until the alignment procedure is to be performed.

✱ **To mute the alignment tone:**

1. Click on **Configuration** in the Menu bar and select the relevant site.
2. The Configuration dialog box opens.
3. In the Configuration dialog box, click the Buzzer button. The button toggles between on and off.

   The tone stops.

✱ **To restore the alignment tone:**

1. Click **Configuration** in the Menu bar and select the relevant site.

   The Configuration dialog box opens.
2. In the Configuration dialog box, click the Buzzer button. The button toggles between on and off. The tone starts.

Setting External Alarm Inputs

The IDU-C has two external alarm inputs in the form of dry-contact relays. The Alarm interface is located on the front panel of the IDU-C and is a 9-pin D-type female connector, see IDU-C Alarm Connector, Appendix A: Wiring Specifications for the pinout. The user enables or disables each of the alarms and can configure the text that appears in the alarm trap. The ODU sends the alarm within less than a second from actual alarm trigger.

✱ **To set the external alarm inputs:**

1. Open the Site Configuration Alarms configuration by clicking **Configuration > Advanced.**

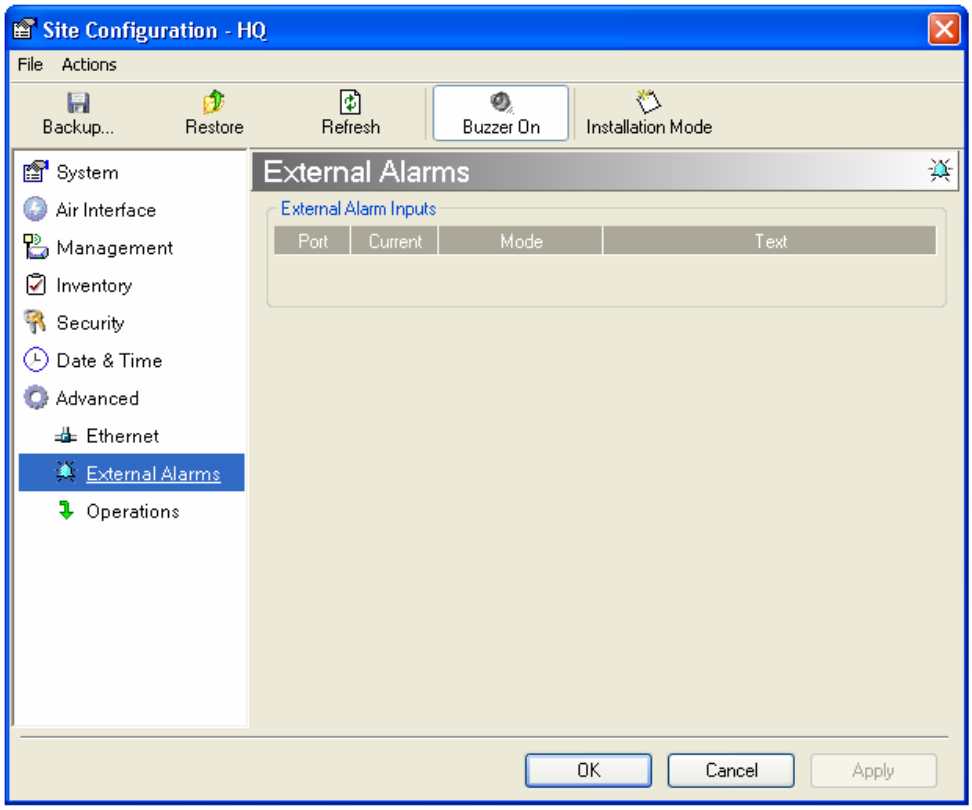


Figure 5-21: External Alarm Configuration

2. Enter a description of the alarms in the fields.
3. Click **Apply** to save.

Managing Configuration Files

Saving Configuration in a File

The management software allows you to save configuration parameters of the local and remote units on the management station as an INI file. Each site is saved in a separate INI file.

❋ **To save the configuration in a file:**

1. Click **Configuration** from the main menu.
2. Select which site to backup.

   The configuration dialog box opens.
3. Click **Backup**.
4. In the Save As dialog box, indicate in which folder and under what name configuration file is to be saved, and click **Save**.

Restoring a Configuration File

Configuration files (***.ini**) can be uploaded from the management station. Verified configuration files can be distributed to other units that use the same configuration.

❋ **To restore a configuration file:**

1. From the **Configuration** menu, select the site to reconfigure.

   The Configuration dialog box opens.
2. Click **Restore**.
3. From the Open dialog box select *.**ini** file to upload and click **OK**.

Resetting

Note:

Resetting the link causes service disconnection.

*In order to maintain the link configuration, reset the remote site first***.**

❋ **To reset the unit:**

1. From **Maintenance,** reset the remote unit.
2. From **Maintenance,** reset the local unit.

❋ **To reset to Factory Defaults**

1. Click Configuration in the Menu bar and select any one of the sites.

   The Configuration dialog box opens.

2. Select Operations in the Configuration dialog box.
3. Click the **Restore Defaults** button.

   A message box asking if you want to restore factory default appears.

4. Click the check box if you want to keep the current IP settings.
5. Click **Yes** to continue.

Displaying the Inventory

❋ **To view the inventory data**

1. Click Configuration from the main menu.
2. Select which site to configure.

   The configuration dialog box opens.

3. Select Inventory (*Figure 5-22*).

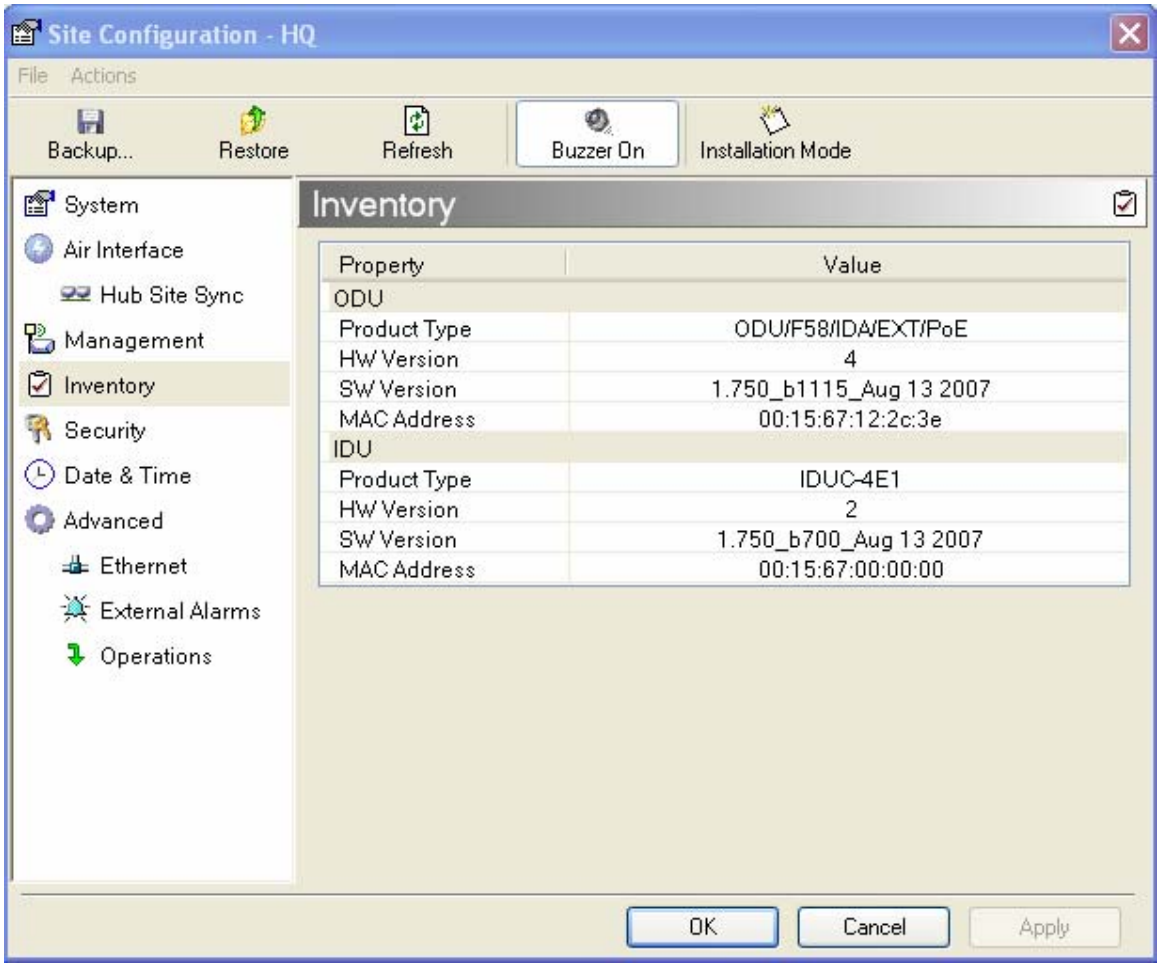


Figure 5-22: Inventory Screen

Configuration via Telnet

A Telnet terminal can be used to configure and monitor the ODU on site. Remote configuration cannot be performed via Telnet.

The login username/password is identical to the communities' strings; Read allows display only, Read/Write allows display and set commands.

Table 5-2 depicts the Telnet commands that are supported:

Table 5-2: Telnet Commands

Command	Explanation
display inventory	Displays ODU product name, Name, Location, hardware and software revisions, uptime, MAC address, IDU product name, IDU software and hardware revisions
Display management	Displays IP, Subnet, Gateway, Traps table
display link	Displays State, SSID, Channel BW, RSS, TSL, Frequency/ACS, DFS, Rate/ARA, Distance
display Ethernet	Displays Bridge Mode, Aging time, Port table (State, Status and action)
display tdm	Displays Clock Mode, Master Clock Mode, Current Clock, Quality[1], TDM table (Line status, Error Blocks)
display ntp	Displays Time, Server and Offset
set ip <ipaddr> <subnetMask> <gateway>	Set the ODU IP address, subnet mask and gateway The user must reset the ODU after the command completion
set trap <index:1-10> <ipaddr> <port:0-65535>	Set a specific trap from the traps table (set trap 3 10.0.0.133 162)
set readpw <oldpasswd> <passwd>	Set the read access password (read community)
set writepw <oldpasswd> <passwd>	Set the read-write access password (read-write community)
set trappw <oldpasswd> <passwd>	Set the trap community string
set buzzer <mode:0=OFF,1 =ON>	Toggle the buzzer mode (0 – off, 1 – on)
set tpc<power:Value between minimal TX power, and maximal TX power>	Set the ODU transmit power. If a wrong value is entered, both min and max values shall be displayed in the error reply
set bridge <mode:0=Bridging OFF,1= Bridging ON >	Set the ODU bridge mode (0 – off, 1 – on)
reboot	Reset both the IDU and the ODU. The user shall be prompt that the command will reset the card and that he has to reconnect the telnet session after TBD seconds.
help	Displays the available commands

Figure 5-23, below, shows the available Telnet commands via the Help command.

```
Hello admin, welcome to ODU Management CLI!
+------------------------------------------------------------+
     Software Revision      1.750  Build 1115_August 13 2007
+------------------------------------------------------------+



admin@10.103.6.1-> help
    display inventory
    display management
    display link
    display ethernet
    display tdm
    display ntp
    set ip <ipaddr> <subnetMask> <gateway>
    set trap <index:1-10> <ipaddr> <port:0-65535>
    set readpw <oldpasswd> <passwd>
    set writepw <oldpasswd> <passwd>
    set trappw <oldpasswd> <passwd>
    set buzzer <mode:0=OFF,1 =ON>
    set tpc <power:Value between minimal TX power, and maximal TX power>
    set bridge <mode:0=Bridging OFF,1= Bridging ON >
    reboot
    help
Command "help" finished OK.
```

Figure 5-23: Telnet Management Screen

Chapter 6

Monitoring and Testing the Link

The MRL Manager software enables you to monitor the link, as well as perform Loopback tests. It also provides a handy Link calculator utility for calculating the expected performance of the wireless link and the possible RF and antenna configurations for a specific link range.

Retrieving Link Information (Get Link Information)

The Get Link Information feature collects and writes all link and Manager information (from both sides) into a comprehensive file. The file can be used for diagnostics and should be sent to technical support to speed up assistance.

The following table lists link and system information that can be monitored.

Table 6-1: Get Link Information Data and Description

Data	**Description**
System Data	General information about the system
Link Information	Information about the link properties
Event Log	List of recent system events
Site Configuration	Data about the site parameters
Active Alarms	List of active alarms
Performance Monitor	Network performance data over defined time
Monitor	Detailed event data record

❋ **To get link information**

1. On the **Help** menu, choose **Link Information**.

The Get Link Information dialog box appears:

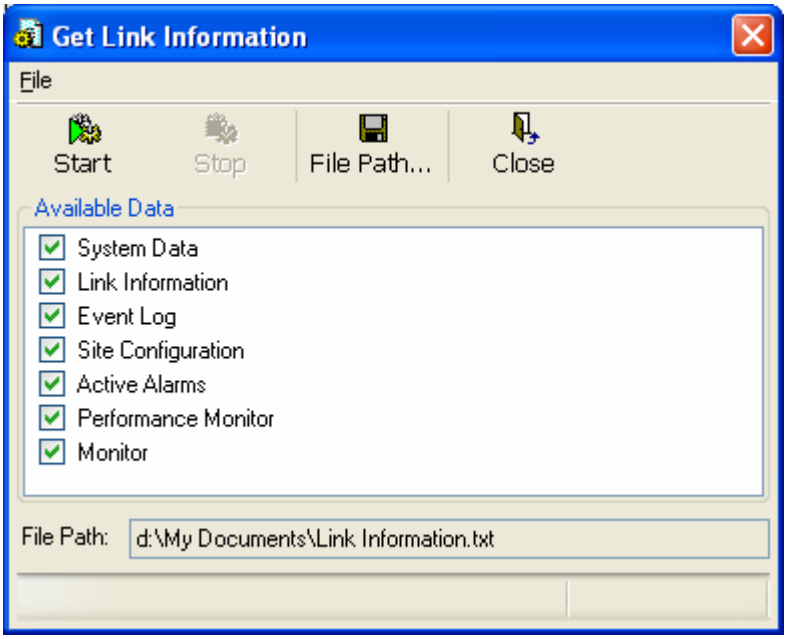


Figure 6-1: Get Link Information Dialog Box

2. Select or deselect the data options. If the file is to be sent to Technical Support leave all options checked.
3. Click **File Path** to specify the folder in which you want to save the file and then click **Start** to save the information.

   The file is saved in the specified folder as Link Information.txt

Link Compatibility

Link Compatibility indicates the version compatibility via software traps. As new hardware is added to existing networks compatibility issues may arise. An incompatibility issue is indicated to the user via a change of color of the Link Status box on the Main Menu screen. Trap messages in the Event Log indicate the problems or limitations and suggest upgrades when appropriate.

The following Link Status messages are given:

fullCompatibility - different software versions were detected that are fully compatible. Message indicates that upgrade is available.

restrictedCompatibility - different software versions were detected that operate correctly. However, new features are not supported

softwareUpgradeRequired - different software versions were detected with limited operation. The link will operate as Ethernet only; a full service will not be available. The message is software upgrade required.

versionsIncompatibility - different software versions were detected that are not compatible. User needs to perform local upgrades.

Table 6-2: Link Compatibility Trap Messages

Link State	Link	Link Status	Site Description	Site	Link Status
	State text	Color		Desc. Color	Color
fullCompatibility	Active	Green	SW Upgrade Available	Yellow	Green
restrictedCompatibility	Active - SW Version mismatch	Magenta (Same as authentication error)	SW Upgrade Recommended	Yellow	Magenta (Same as authentication error)
softwareUpgradeRequired	Active – SW Upgrade Required	Brown (Major)	SW Upgrade Required	Yellow	Brown (Major)
versionsIncompatibility	Not Active - SW Upgrade Required	Red	Local SW Upgrade Required	Yellow	Red

Testing the Connection

Testing the connection supports activation of the internal and external loopbacks on the local and remote units.

✱ **To activate a loopback:**

1. From the Maintenance menu, choose **Set Loopbacks**.

   The Loopbacks dialog box appears:

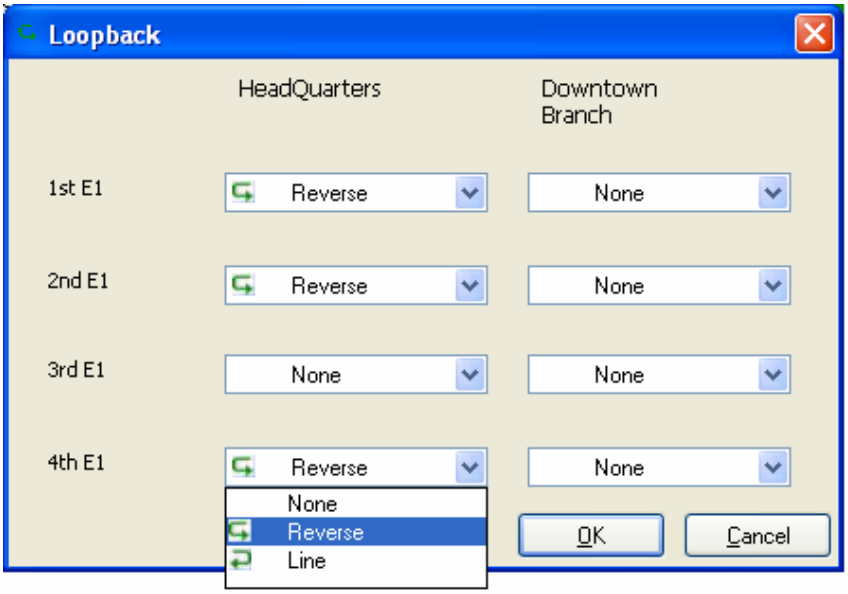


Figure 6-2: Loopback dialog box

2. From the Local or Remote drop-down box, select a loopback that you intend to run, and click **OK**.

   A confirmation message appears.

3. Click **OK** to activate a loopback.

   This activates selected loopback. A loopback status arrow in the Main menu turns green to indicate an active loopback.

❋ **To deactivate a loopback:**

- From the From the Local or Remote drop-down box of the Loopbacks dialog box, select **None** and click **OK**.

  A loopback is deactivated and the corresponding status arrow in the Main menu becomes dimmed.

Local External Loopback

Local external loopback can be set to an external loopback to test the local E1/T1 port and its connection to the local side user equipment. In this mode, data coming from the local user equipment is looped back to it. This loopback is initiated from a management station connected to the local unit.

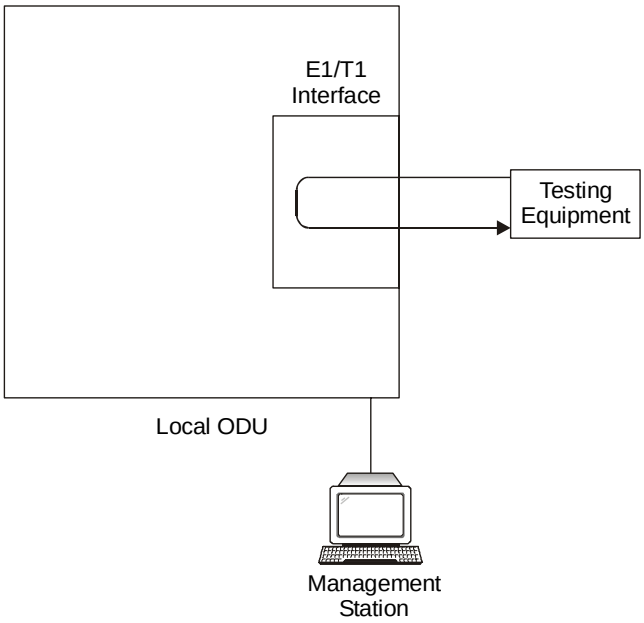


Figure 6-3: Local External Loopback

Remote Internal Loopback

Remote internal loopback can be set to an internal loopback to test connection between the local and remote units, the local E1/T1 port and its connection to the local side user equipment. In this mode, data coming from the local unit is looped back to it. This loopback is initiated in band from a management station connected to the local unit.

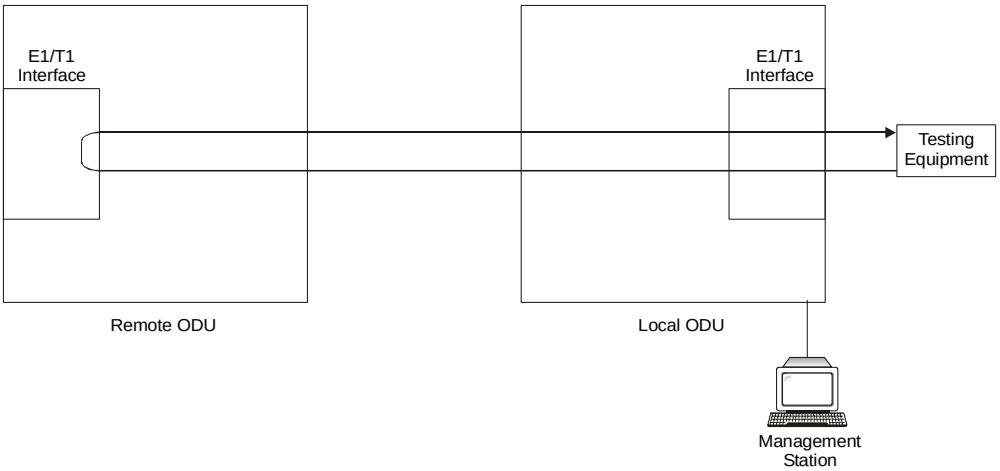


Figure 6-4: Remote Internal Loopback

Remote External Loopback

The remote unit can be set to an external loopback to test the remote E1/T1 port and its connection to the remote side user equipment. In this mode, data coming from the remote user equipment is looped back to it. This loopback is initiated by an in band command sent from a management station connected to the local unit.

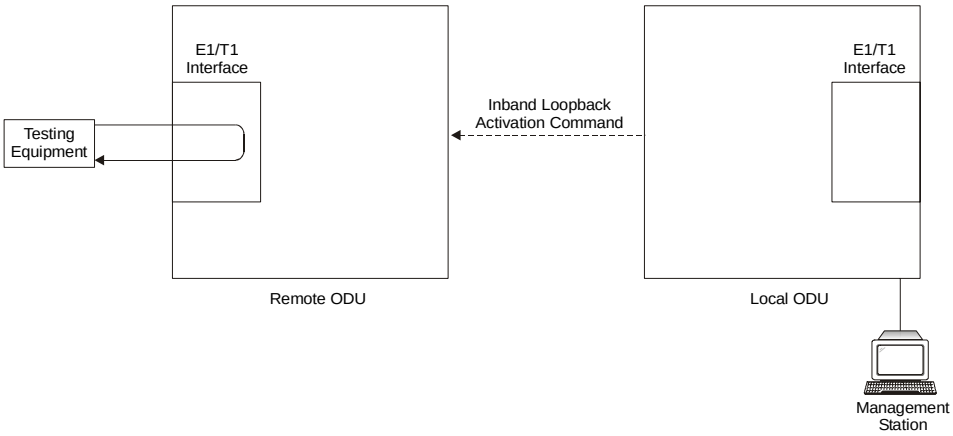


Figure 6-5: Remote External Loopback

Local Internal Loopback

The local unit can be set to close an internal loopback to test connection between the local and remote units, remote E1/T1 port and its connection to the remote side user equipment. In this mode, data coming from the remote user equipment is looped back to it. This loopback is initiated by an in band command sent from a management station connected to the local unit.

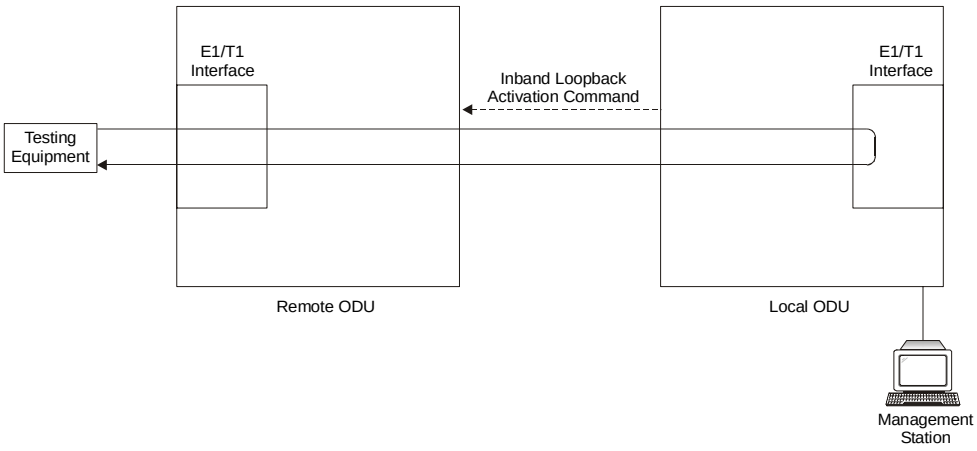


Figure 6-6: Local Internal Loopback

Reinstalling/Realigning the Link

It may be necessary to reinstall the link if the ODUs need to be realigned.

Note:

Activating Install Mode causes both sites to go into install mode, causing disruption in service for approximately fifteen seconds.

❋ **To reinstall the link:**

1. From the **Configuration** menu, choose a site.

   The Configuration dialog box opens.

2. In the Configuration dialog box, click the **Install Mode** button.

   A message box asking if you want to enter install mode appears.

3. Click **Yes** to continue.

   The system enters Install mode and the alignment tone becomes audible.

4. Realign the ODUs and start the Installation wizard (see Chapter *3*).

The Link Budget Calculator

The Link Budget Calculator is part of the MRL Manager software and is found in the Help menu. This useful utility enables you to calculate the expected performance of the wireless link and the possible configurations for a specific link range including antenna size, cable loss and climate conditions.

The Link Budget Calculator enables you to calculate the expected RSS of the link, and determine the stability of services and their effective throughput as a function of the link range and deployment conditions.

The Link Budget Calculator is found on the Installation CD and from tech support so it can be used prior to installation to define and verify link parameters such as expected RSS, maximum range, and number of E1s/T1s that a link is capable of providing. It enables verification of installation quality and provides calculations that consider "real world" factors such as climate.

The Link Budget Calculator screen appears in the following figure.

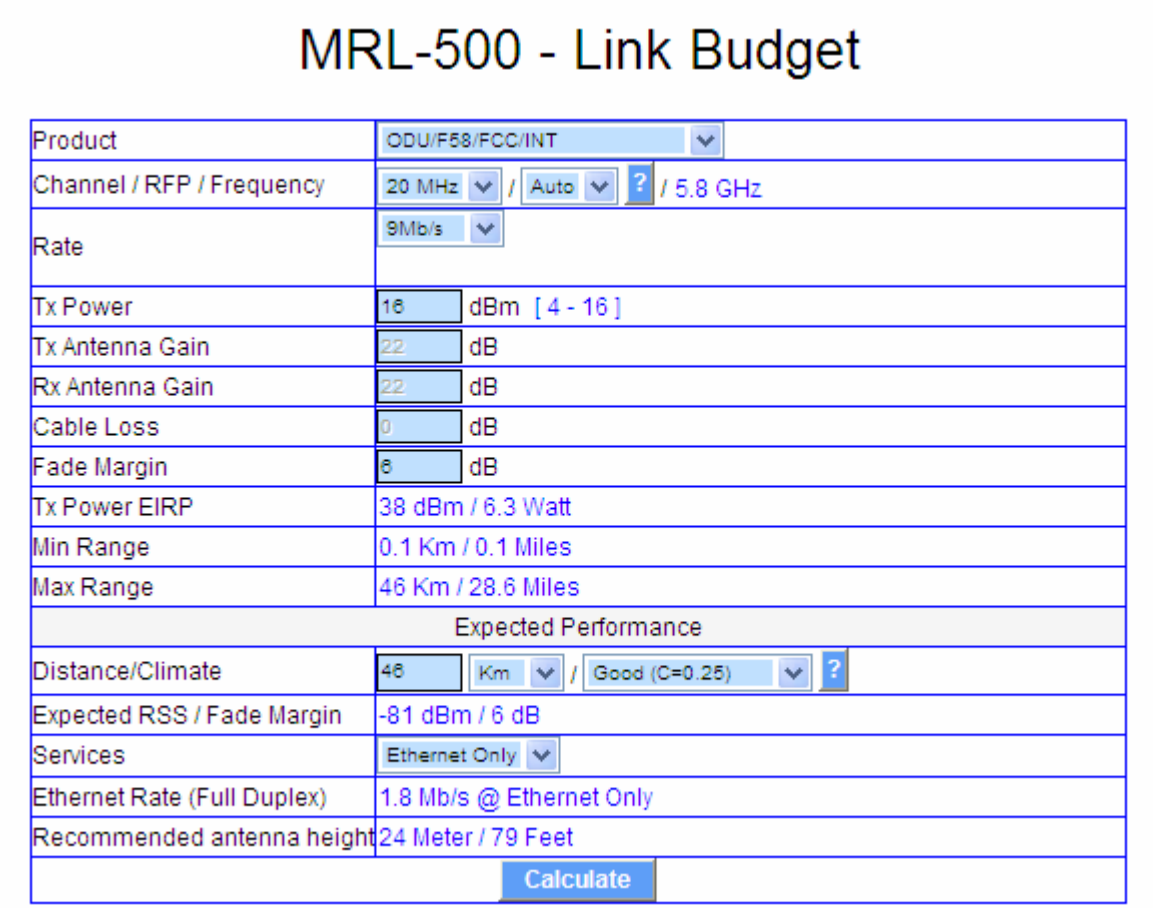


Figure 6-7: MRL - Link Budget Calculator

Performance Monitoring

Performance Monitoring constantly monitors traffic over the radio link and collects the following statistics data:

- Site 1/Site 2 received traffic rate (in Mbps)
- Site 1/Site 2 received frames rate (in Mbps)
- Radio signal strength (in dBm)
- Error (Blocks).

MRL monitors the Air interface, ETH ports, and TDM trunks. It does so continuously, even when the MRL Manager is not connected.

Two types of logs are recorded:

- **Monitor log** that records statistics on traffic rate and radio signal strength.

- **Events log** that records when the rates fall above or below a predefined threshold.

Both the statistics (monitor) log and event log can be saved as TXT files.

The Monitor Log

The Monitor log records performance statistics for predefined intervals. You can save the monitor log to a text file, as well as display the information in an on-screen report.

Saving the Monitor Log

You can save the recorded Monitor log statistics to a text file.

✱ **To save the monitor log:**

1. From the **Tools** menu, choose **Preferences**.

   The Preferences dialog box appears:

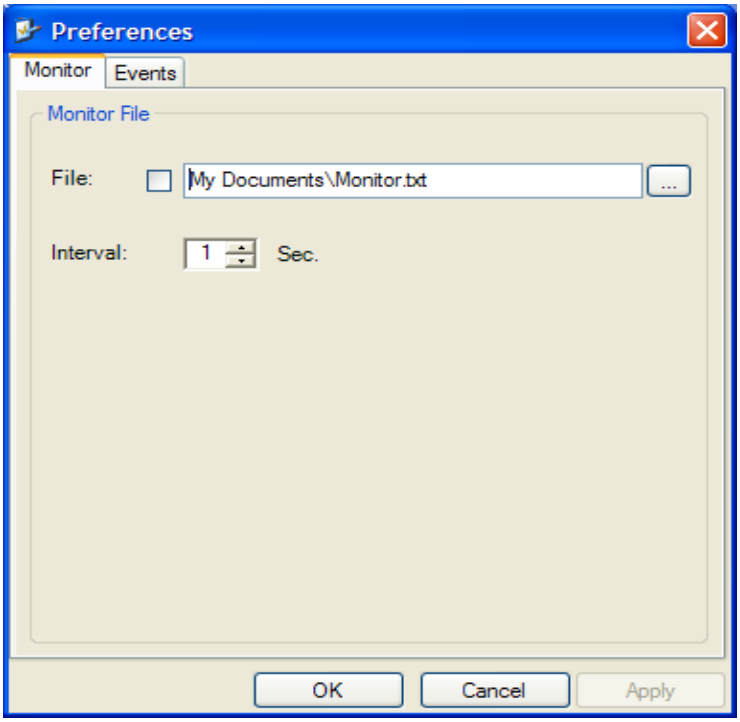


Figure 6-8: Preferences dialog box

2. Click the **Monitor** Tab.
3. Select the file to save.
4. Click the check box to open the file for saving.

5. Click the ... button and in the Select File dialog box indicate in which folder and under what name the monitor log file is to be saved.
6. Set the time interval for adding data to the file.
7. Click **OK** to save the file.

Viewing Performance Reports

The Performance Monitor Report displays performance views of each of the interfaces[3]:

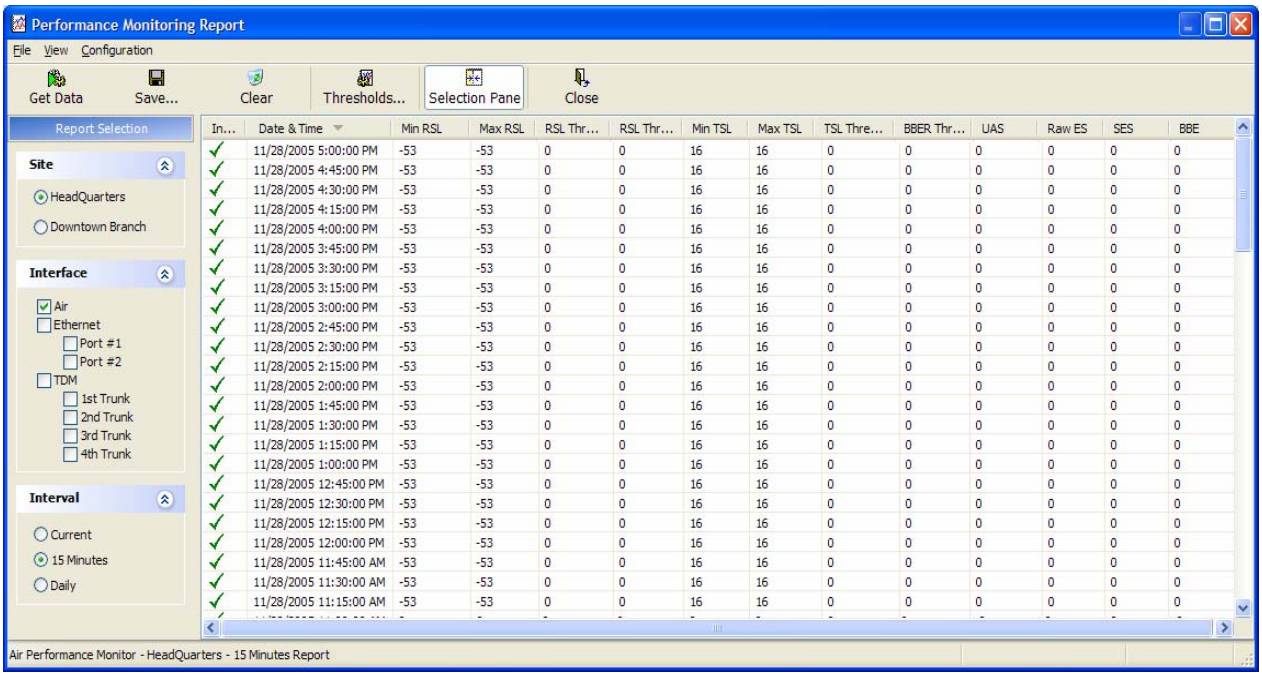


Figure 6-9: Performance Monitoring Report window

Several performance data occurrences are collected for each of the interfaces (ES, SES, and UAS), as well as Specific data per Interface type (e.g., TX and RX bytes for Ethernet). For the Air Interface, user defined thresholds data are collected. Refer to *Table 6-3* and *Table 6-4, Performance Monitoring Report Toolbar.*

Data is collected and selectively displayed based on three time intervals as selected by the **Interval** radio buttons:

- Current (t=0)

[3] Ethernet performance is not collected in PoE systems.

- 15 minutes Intervals
- Daily.

UAS – This parameter counts the time the air link was not providing any service. There are several potential reasons for this situation; one of the sites has a power failure, high interference, maintenance operation, etc.

Radio **BBER** Threshold – This parameter counts the seconds in which the radio performance is below a user specified threshold. The threshold is measured in percent. The threshold can be set from 0.1% up to 50%.

For links with E1/T1 service the recommended value is 1% (system default). Excellent TDM service is expected below the 1% threshold, meaning that for 1% threshold, the expected BBER value should be 0 if there are no problems during the 15 min interval. If the BBER threshold increases a degraded service might be noticed.

For links with Ethernet only service, 8% threshold is recommended and not 1% meaning that for 8% threshold, the recommended BBER value should be 0 if there are no problems during the 15 min interval. Since the system provides a loss less Ethernet service, there is throughput degradation in case of interference. The degradation is proportional to the BBER.

Radio RSS Threshold - Radio RSS Threshold can also be used to indicate problems in the radio channel. You can verify the RSS according to the link budget calculator during the installation. A value of -5dB from the current RSS is recommended as a threshold.

Table 6-3: Explanation of performance data

Data type	Reported Value	Explanation
Generic PM Data	UAS – Unavailable Seconds	Seconds in which the interface was out of service.

Data type	Reported Value	Explanation
	ES – Error Second	The number of seconds in which there was at least an error block. Note that notation of an error block is different per interface.
	SES – Severe Error Second	The number of seconds in which the service quality is low (the actual BBER ratio varies per interface).
	BBE – Background Block Error	The number of error block in an interval.
	Integrity	A flag indicating that the data is valid. Note that the PM data is not valid if not all the values were stored[4].
Air Interface PM Data	Max RSL	The maximum of the receive signal level (measured in dBm).
	Min RSL	The minimum of the receive signal level (measured in dBm).
	Max TSL	The maximum of the transmit signal level (measured in dBm)[5].
	Min TSL	The minimum of the transmit signal level (measured in dBm).
	RSL Threshold 1	This parameter counts the number of seconds in which the RSL is below the specified threshold.
	RSL Threshold 2	This parameter counts the number of seconds in which the RSL is below the specified threshold.
	TSL Threshold 1	This parameter counts the number of seconds in which the RSL is above the specified threshold.

[4] Possible reasons are: Clock changes within the interval and Power up reset

[5] The transmit power is fixed. The value can be changed only by user configuration

Data type	Reported Value	Explanation
	BBER Threshold	The BBER Threshold value counts the number of seconds in which the Background Block Error Ratio (BBER) exceeds the specified threshold. Note, that the system is design for excellent quality of service with BBER of less then 1%. (at 1% BBER expected TDM BER is less than 1E-6.
Ethernet Interface PM Data	Received Bytes	The number of Mega bytes received in the specified port within the interval
	Transmitted Bytes	The number of Mega bytes transmitted in the specified port within the interval.

Performance Monitoring Report Toolbar

You can use the toolbar to perform the actions described in the following table:

Table 6-4: Action of the toolbar buttons

Command Button	Action
Save	Saves the alarms in CSV or text format for further analysis.
Refresh	Reads the alarms from the ODU, and displays the alarms.
Site	Selects site for the active alarms.
Close	Closes the active alarm window.

Setting Air Interface Thresholds

You use the Thresholds button on the Monitoring Performance Report toolbar to set the Air Interface Thresholds:

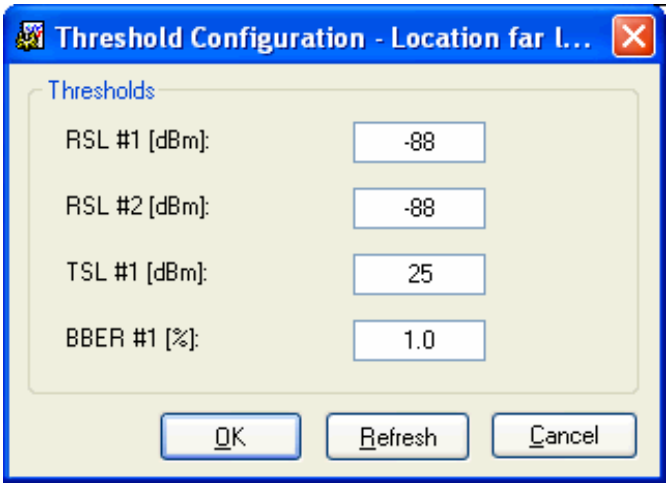


Figure 6-10: Threshold configuration dialog box

The Events Log

The Events log records system failures, loss of synchronization, loss of signal, and other events as described in the following table:

Table 6-5: Alarms and Information Messages

Message	Description
Radio Link – Sync	Radio link is synchronized
Radio Link – Out Of Sync	Radio link lost synchronization
Link Has Been Reset	ODU was reset due to internal problem
TDM Interface – Normal	TDM interface is operating properly
TDM Interface – LOS	Loss of Signal is reported by TDM interface
TDM Interface – AIS	Alarm Indication Signal is reported by TDM interface
TDM Interface – Loopback	A loopback is active on TDM interface
Link Resetting	Wireless link reset from the management station. This alarm is caused by automatic reset after link configuration.
Local ODU Resetting	The local ODU reset from the management station.
Monitor was stopped since no connection to the link	No ODU-to-IDU traffic was detected during the last 20 minutes.
TDM Service – Normal	TDM service is operating properly
TDM Service – Alarm	Error has been detected on a TDM line
Configuration problem detected	The link needs to be reinstalled
Channel Scanning in progress	The ODU is scanning the channels for the remote ODU
Transmitting on <frequency> GHz	The ODU is transmitting on the frequency channel listed
Radar activity was detected in <site>, on channel <frequency> GHz	For DFS versions only. Radar is detected; the channel is prohibited for 30 minutes.
Monitoring fo Radar activity on channel <frequency> GHz	For DFS versions only. ODU is looking for Radar activity.
Bit Failed indication	Indicates ODU hardware problem. Send error code to Technical Support.
Link Status	Indicates incorrect connection or incompatibility between versions. Available in 1.620 versions and above.
Site Status	Indicates incorrect connection or operation at the site. Available in 1.620 versions and above.

The events are displayed in the Events log in the lower part of the MRL Manager Main menu:

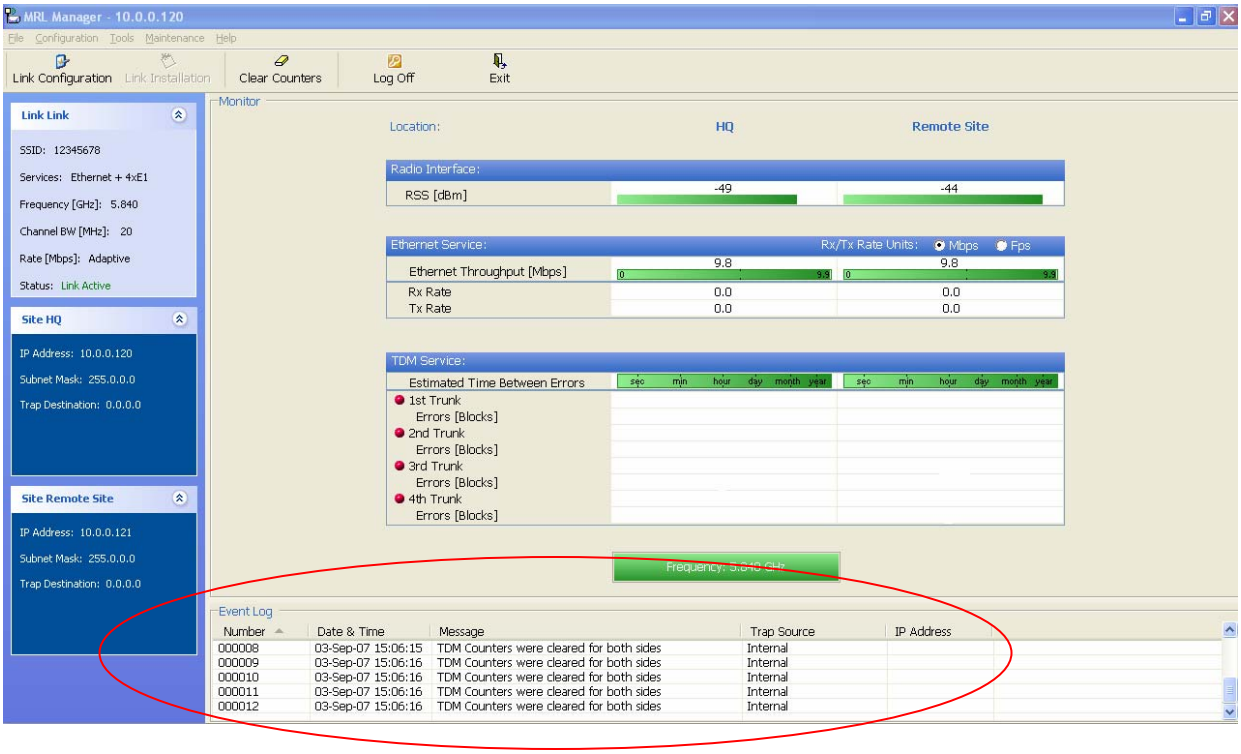


Figure 6-11: Events Log Display

Setting the Events Preferences

You can define a color for the traps to be displayed in the Active Alarms screen, according to the severity of the event. The severity is predefined.

To set the trap color:

1. From the **Tools** menu, choose **Preferences**.

   The Preferences dialog box appears.

2. Click the **Events** Tab:

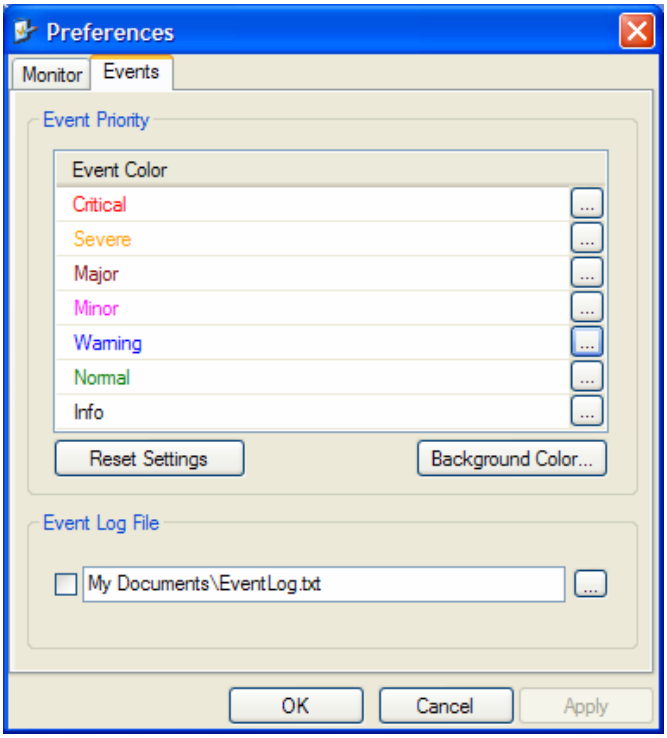


Figure 6-12: Preferences dialog box

3. Select the Event priority type and click on the ... button.

   A color chart opens.

4. Select the desired color.
5. Repeat for all the trap types.

✱ **To set the trap background color:**

- Click **Background Color** to change the text background.

✱ **To reset the trap colors:**

- Click **Reset Settings** to return to the default color settings.

Saving the Events Log

You can save recorded events in an Events log text file. New alarms are automatically added to the text file, as they enter the event log.

✱ **To save the event log:**

1. From the **Tools** menu, choose **Preferences**.

   The Preferences dialog box appears

2. Click the **Events** Tab.
3. Select the file to save.

4. Click the check box to open the file for saving.
5. Click the  button and in the Select File dialog box indicate in which folder and under what name the alarm log file is to be saved, and click **OK**.

Error Detection and Alarms

MRL Error detection and Alarms detect compatibility problems, fault conditions of the radio or user links, and subsequently initiates alarms to alert the user.

Note:

To store the Event Log, first define the IP address, subnet mask, default gateway and trap address of the management PC, (see *Defining the Management Addresses, page 5-82 for details).*

Alarms (traps) are displayed in the Event Log in the lower panel of the Main Menu screen. The event log may be saved as a TXT file.

The event log includes the following fields:

- Sequential number (ID)
- Date and time stamp
- Message
- Trap source
- IP address of the ODU that initiated alarm.

❋ To view summary of saved alarms

- From the Tools menu, choose **Active Alarm Summary**.

  The Active Alarms Summary window opens:

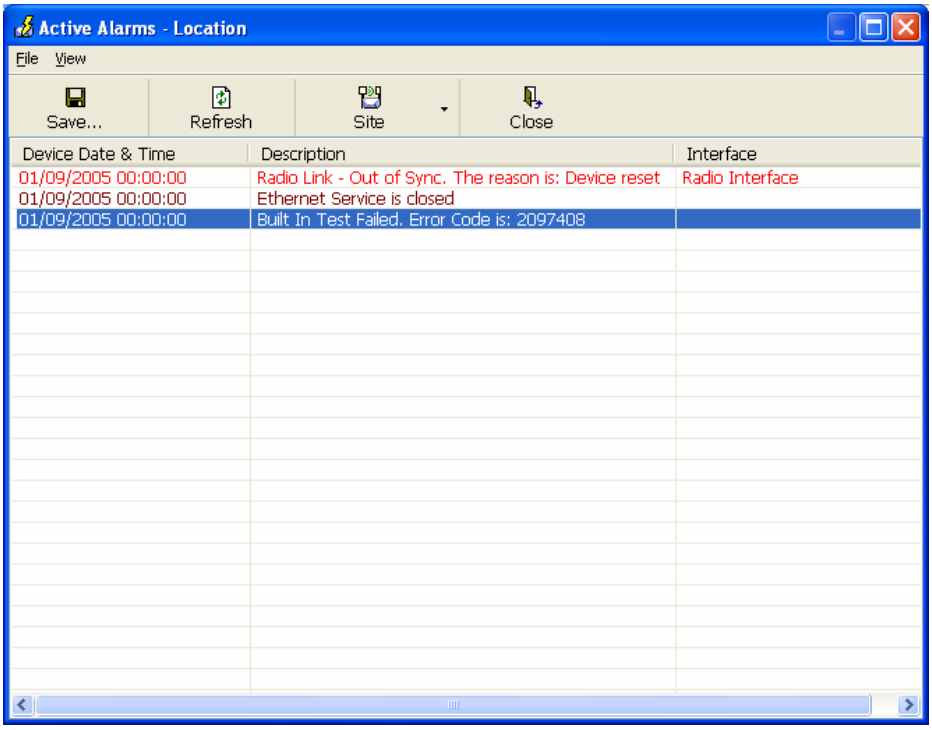


Figure 6-13: Active Alarms Summary

The following table provides an explanation of the command buttons.

Table 6-6: Active Alarms command buttons

	Action
Save	Saves the alarms in CSV or text format for further analysis.
Refresh	Reads the alarms from the ODU, and displays the alarms.
Site	Selects site for the active alarms.
Close	Closes the active alarm window.

Remote Power Fail Indication

Remote power fail indication indicates to one side that the other side has had a power failure. The failed site sends a final trap indication about the power loss just before powering off.

A Dying-Gasp circuit identifies the power failure at a minimum interval of 20 milliseconds before the IDU crash, during that interval a message notifying the power failure is sent to the remote end.

Alarm output number 4 indicates link loss due to power failure at the remote end.

Chapter 7
Security

MRL's integrated advanced encryption support provides enhanced air interface security for carriers and private networks by ensuring user data protection with one of the most sophisticated commercially available combined encryption and authentication techniques, CCM/AES. This technique combines message authentication (preventing anti-spoofing and replay protection) with commercial encryption, and complies with the IEEE 802.11i (phase iii) security recommendations.

CCM/AES uses a symmetric 128-bit encryption key (EK), and a nonce, and provides both message encryption and authenticating signature. The nonce mechanism enables the receiver to remember already received genuine messages and reject all replayed messages.

Initial encryption and authentication is based on a user-defined master key (Link Password). While standard Wireless LAN encrypts only the Ethernet Payload, the AES encrypts both the source and destination MAC addresses.

Entering and Changing Passwords

There are two passwords necessary to use the MRL system:

- Management Password required for running the Management software
- Link Password used for encryption purposes. This link password is entered when installing or configuring the link.

Changing the Management Password

❋ **To change the management password**

1. From the Tools menu, select Change Password.

   The Change Password dialog box appears.

2. Enter the current password, and the new password.
3. Click **OK** to confirm.

Changing the Link Password

The Radio Link is encrypted using the Advanced Encryption System (AES) using a 128 bit dynamic key. During the installation process, you must enter a Link Password. An Initial encryption key is then generated. Each time a link is established, the system validates the Encryption key. If the validation fails, the link is established but no service or configuration is allowed. In this state, you can change the link password for each of the sites.

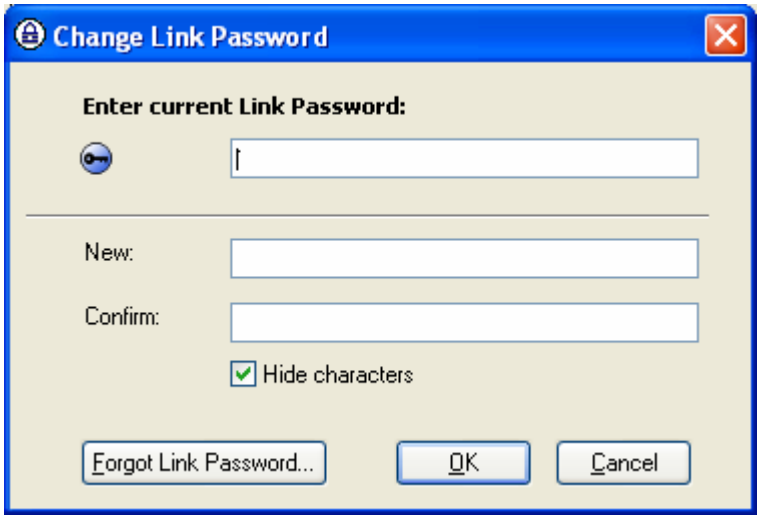
Note:

Returning to factory defaults returns the Link Password to the default password ***wireless-bridge****.*

✱ **To change the Link Password:**

1. From the Configuration dialog box, select the **Security** tab.
2. Click **Change** next to the Link Password field box.

   The Change Link Password dialog box appears:



3. Enter the current link password.
4. Enter the new password.
5. Enter the new password again in the Confirm box.

Forgotten Link Password

In case of a forgotten link password, you may enter the key password supplied with the product. The key password may be obtained from customer support after validation of the device serial number or MAC address. You may change the link password of both sides of the link at any time using the Link Configuration Wizard.

❋ **To enter the key password:**

1. From the Configuration dialog box, select the **Security** tab.
2. Click **Change** next to the Link Password field box.
3. The Change Link Password dialog box appears.
4. Click the Forgot Link Password button.
   The Key Link Password dialog box appears.
5. Type the key link password.
6. A new link password may now be set.

Chapter 8
Diagnostics and Troubleshooting

Use the following tables to diagnose any faults in the system.

Table 8-1: Troubleshooting

Symptom	Remedy
No power	Verify that AC power is connected to the IDU.
	Verify that the ODU cable is properly wired and connected.
No signal	Complete the installation procedure from the management software.
	Verify the ODU alignment. Check that the radio configuration of both site A and site B units are the same (channel and SSID).
Weak signal	Verify the ODU alignment, reconfigure the link.
	Verify the alignment tone sounds the Best Signal sequence.

The LEDs show faults in the system or the link.

Table 8-2: Troubleshooting with LEDs

LED	Status	Remedy
PWR	Off	Check that AC adapter is connected to the IDU-E and the AC power outlet.
IDU	Orange	Check that the IDU/ODU cable is properly wired and connected.
ODU	Red	Check that the IDU/ODU cable is properly wired and connected.
AIR I/F	Orange	Complete the installation procedure from the management software.
	Red	Check the ODU Antenna alignment. Check that the radio configuration of both site A and site B units are the same (channel and SSID).
SERVICE	Off	Check the TDM service configuration in the NMS.

LED	Status	Remedy
	Orange	Check that the system is not in loopback mode. Check the site B IDU ports and cables and site B external equipment.
	Red	Check the site A IDU ports, cables and external equipment.

Replacing an ODU

Prior to any action verify that both ODUs have the same software version (Configuration > Configure site xxxxxx>Inventory). If one ODU has an old software version, perform a software upgrade. It is important to configure the new ODU exactly the same as the old ODU to avoid configuration mismatches, which will disrupt the link.

An ODU may be replaced in several ways.

- **Use the backup**
  If a backup of the configuration is available, restore that configuration using Configuration > Configure site > Restore.
- **Manual Configuration**
  The new ODU can be configured manually according to the link configuration. Remember to use the same settings for SSID, channels, link password, IP addresses, and names.

Restore Factory Setup

The Restore Factory Setup feature is available from version 1.6xx forward. To use this feature, we recommend performing the following sequence:

1. Set the remaining ODUs back to the factory setup by using the Configuration>Configure site>Advance option.
2. Activate the second ODU and reconfigure the link from scratch.

Frequently Asked Questions

Q: What performance issues will arise due to environmental conditions?

A: The system is not sensitive to environmental conditions. However if heavy rain or snowfall is expected ensure the performance by allowing a higher fade margin in the link budget planning calculations. This can be accomplished by using higher gain antennas.

Q: When using the MRL, what is the potential for interference between our system and other cellular or wireless Networks devices?

A: The MRL is a robust system. However since it operates in unlicensed ban, interference can occur. Nevertheless, the fact that we can manually set the frequency to one of 5 (6) non-overlapping channels gives you the flexibility to find a clean channel. In addition, each MRL link incorporates Forward Error Correction and adaptive modulation to mitigate interference.

Q: What protocol does the MRL use, i.e. 802.11?

A: **MRL** uses a proprietary protocol; this protocol contains improved options that more efficiently support the clock reconstruction from the TDM services.

Q: What type of security is offered on MRL?

A: MRL has three levels of security:

1. AES hardware mechanism
2. Each unit uses a unique SSID link-specific code (up to 24 alphanumeric characters)
3. Proprietary protocol protects from eavesdropping from other systems.

Q: Can we use horizontal and vertical polarization on the same frequency to double the number of wireless links?

A: Installing two MRL systems in the same band with cross polarization provides 20–25 dB separations. However, spatial separation is a superior method and is recommended.

Q: Could you add the frequency of 5.735 to the manual selection in order to increase the number of 20 MHz channels to six?

A: Currently the system provides fixed channels, with one manual frequency setting. The manual setting provides flexibility of spectrum selection, including 5.735 MHz.

Q: Can we mange MRL using SNMPc other than the supplied management software that comes with the units?

A: Yes. The MRL is SNMP-based. The MRL can be managed when using other SNMP software after implementing MRL MIB's.

Q: Can I use the MRL with any vendor's external antenna?

A: MRL supplies the MRL external ODU with an N-type typical connector. Any vendor's external antenna that is of the same type and of equal or less directional gain as an antenna that MRL authorized with its specific external ODU product, can be used. This is provided that it can be cascaded to our external unit. Please note that db losses in the cascading table between the external ODU and the antenna should be taken into consideration. (In the supplied cascading cable of one meter we have 1 dB loss).

Q: Do we need to add external arrestors on MRL cables?

A: Although the MRL ODU includes arrestors and lightening protection, it is suggested to implement external lightning/grounding suppression. See Appendix J – Lightning & Grounding Guidelines.

Q: What is the actual Ethernet data rate and maximum throughput?

A: The maximum net throughput of the MRL is full duplex 18 Mbps.

Note:

The MRL is a symmetrical system meaning that 18Mbps is provided in both directions.

Q: What is the sensitivity for each rate of the MRL?

A: The rate sensitivities for a 20MHz channel are:

Rate [Mbps]	**Sensitivity** [dB]
12	-84
18	-81
36	-74
48	-68

Q: Does MRL withhold any MAC Addresses?

A: The MRL is a layer 2 Bridge (VLAN transparent). The built-in switch contains a MAC Address table up to 2047.

Q: Can I use any category 5e cable in order to connect the IDU and ODU?

A: The cable should be suitable for outdoor use, and shielded Category 5e.

Q: What are the BER values expected in the MRL link?

A: 10-11 (according to BER sensitivity threshold)

Q: Does MRL use DSSS technique?

A: No, **MRL** uses the advanced OFDM technique.

Q: What are the advantages of the MRL solution over other possible alternatives (e.g., wireline, wireless, etc.)?

A: Advantages include the following:

- Easy and intuitive installation using audio indication.
- Easy configuration using the management software of overall link site-to-site, there is no need to travel between the two sites in order to change the configuration.
- Easy migration between transmission channels.
- Backup option – backup and restore using .ini files.
- Very light ODU (1.5 kg). Low wind-loading
- No RF loss between IDU and ODU. Smaller antennas can be used
- Robust Air Interface Layer 2 ARQ insures "error-free" Ethernet service even in harsh conditions. Retransmit mechanism for TDM ensures low BER.
- Integrated E1/T1 and Ethernet radio over one single product.
- Supports simultaneous Voice and Data applications with a single radio – no need for external mediation device.
- Smooth migration to VoIP applications.
- Carrier class compliant with ITU standards for E1 and T1.
- Low and constant TDM latency (8 msec).
- Extremely accurate recovered clock low cost replacement to PDH radios.

Online Help

Online help can be accessed from the Help menu on the main screen of the MRL Manager.

Figure 8-1: Online Help for MRL

Technical Support

Technical support for this product can be obtained from the local VAR, Integrator or distributor from whom it was purchased.

For further information, please contact the MRL distributor nearest you.

Chapter 9

Appendix A: Wiring Specifications

The ODU-IDU cable is shielded/outdoor CAT-5, 4 twisted-pair 24 AWG FTP, terminated with RJ-45 connectors on both ends. It is covered by a cable gland on the ODU side for hermetic sealing.

The following table shows the connector pinout:

Table 9-1: ODU-IDU Connector Pinout

IDU RJ-45		Color	Function	ODU RJ-45
1	twisted	White/Green	Ethernet (RxN)	1
2	pair	Green	Ethernet (RxT)	2
3	twisted	White/Orange	Ethernet (TxT)	3
6	pair	Orange	Ethernet (TxN)	6
4	twisted	Blue	Power (+)	4
5	pair	White/Blue	Power (+)	5
7	twisted	White/Brown	Power (–)	7
8	pair	Brown	Power (–)	8

User Port Connectors

The IDU includes ports for connecting E1/T1 and 10/100BaseT Ethernet user devices.

Trunk Port

The Trunk (E1/T1) interface terminates in an 8-pin RJ-45 balanced connector, wired in accordance to *Table 9-2*.

Table 9-2: E1/T1 Connector Pinout

Pin	Function
4,5	Receive (input)
1,2	Transmit (output)

LAN Port

The LAN 10/100BaseT interface terminates in an 8-pin RJ-45 connector, wired in accordance to *Table 9-3*.

Table 9-3: Fast Ethernet Connector Pinout

Pin	Signal	Function
1	TD (+)	Transmit Data (positive)
2	TD (–)	Transmit Data (negative)
3	RD (+)	Receive Data (positive)
6	RD (–)	Receive Data (negative)

LAN Port for PoE-8

When connecting the PoE-8 LAN port cable directly to PC, a crossed LAN cable, terminated with RJ-45 connectors on both ends must be used, wired according to the following table:

Table 9-4: Fast Ethernet Connector Pinout

Pin		Wire Color	Function	PC
1	wisted	White/Green	Ethernet (RxN)	3
2	pair	Green	Ethernet (RxT)	6
3	twisted	White/Orange	Ethernet (TxT)	1
6	pair	Orange	Ethernet (TxN)	2
4	twisted	Blue	NA	4
5	pair	White/Blue	NA	5
7	twisted	White/Brown	NA	7
8	pair	Brown	NA	8

IDU-C Connectors

IDU-C DC Power Terminal

Table 9-5: Terminal Block 3-pin -48VDC

Pin	Function
Right	**+**
Center	**Chassis**
Left	**–**

IDU-C Alarm Connector

Table 9-6 lists the IDU-C Alarm connector pinout.

Table 9-6: IDU-C Alarm Connector (Dry-Contact)

Pin	I/O	Description
1	Input 1	Positive
2	Input 2	Positive
3	Output 1	Normally Closed
4	Output 1	Normally Open
5	Output 2	Normally Open
6	Input 1	Negative
7	Input 2	Negative
8	Output 1	Common
9	Output 2	Common

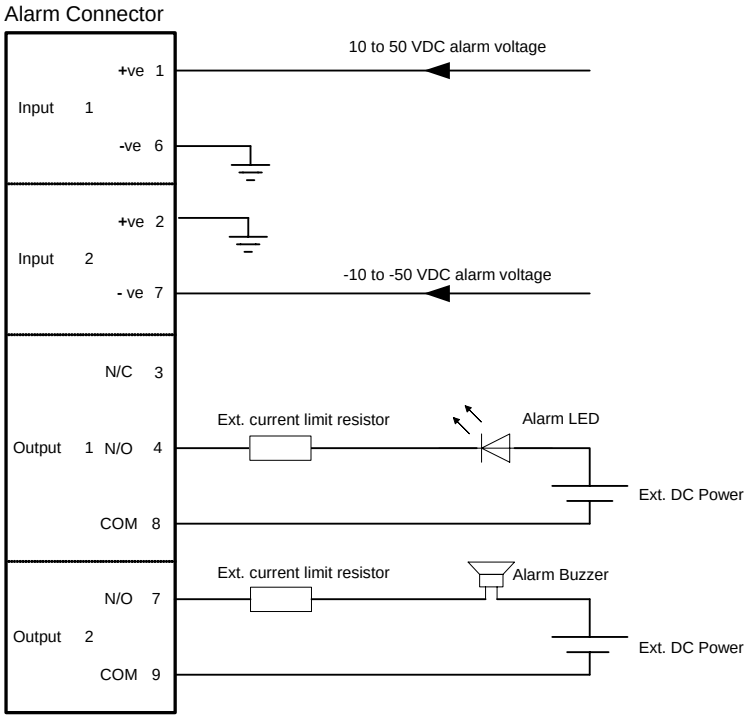


Figure 9-1: Example for connecting the alarm connector

PoE Alarm Connector

The following table lists the PoE Alarm connector pinout.

Table 9-7: PoE Alarm Connector (Dry-Contact)

Pin	I/O	Description
1	NA	NA
2	NA	NA
3	Output 1	Normally Closed
4	Output 1	Normally Open
5	Output 2	Normally Open
6	NA	NA
7	Output 2	Normally Closed
8	Output 1	Common
9	Output 2	Common

IDU-R and IDU-AL Alarm Connectors

The following table shows the pinout for the IDU-R and IDU-AL Alarm Connectors.

Table 9-8: Alarm Connector (Dry-Contact)

PIN #	I/O	Description
1	Output 1	Normally Open
2	Output 1	Common
3	Ouput 1	Normally Common
4	Output 2	Normally Open
5	Output 2	Common
6	Output 2	Normally Common
7	Output 3	Normally Open
8	Output 3	Common

PIN #	I/O	Description
9	Output 3	Normally Common
10	Output 4	Normally Open
11	Output 4	Common
12	Output 4	Normally Common
14	Input 1	Positive
15	Input 1	Negative
16	Input 2	Positive
17	Input 2	Negative
18	Input 3	Positive
19	Input 3	Negative
20	Input 4	Positive
21	Input 4	Negative
22-25	Ground	

O-PoE to PC LAN Cable

When connecting the O-PoE ETH port cable directly to PC, a crossed LAN CAT-5, 4 twisted-pair 24 AWG FTP, terminated with RJ-45 connectors on both ends must be used.

The following table shows the connector pinout:

Table 9-9: O-POE to PC Cable Connector Pinout

O-PoE (ETH) RJ-45	Wire Color	Function	PC
1 wisted	White/Green	Ethernet (RxN)	3
2 pair	Green	Ethernet (RxT)	6
3 twisted	White/Orange	Ethernet (TxT)	1
6 pair	Orange	Ethernet (TxN)	2
4 twisted	Blue	NA	4
5 pair	White/Blue	NA	5
7 twisted	White/Brown	NA	7
8 pair	Brown	NA	8

Chapter 10

Appendix B: Mast and Wall Installation

The ODU or O-PoE can be mounted on a mast or a wall.

ODU or O-PoE Mounting Kit Contents

The ODU or O-PoE mounting kit includes the following items:

- One Large Clamp (see Figure 10-1)
- One Small Clamp (see Figure 10-2)
- One Arm (see Figure 10-3)
- Four Screw hex head M8x40
- Two Screw hex head M8x70
- Four Washer flat M8
- Three Washer spring M8
- Two M8 Nuts

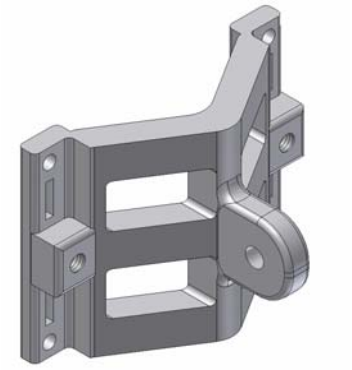


Figure 10-1: Large Clamp

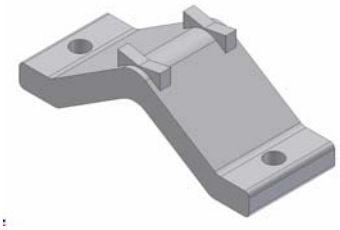


Figure 10-2: Small Clamp

Figure 10-3: Arm

Mounting MRL on a Mast

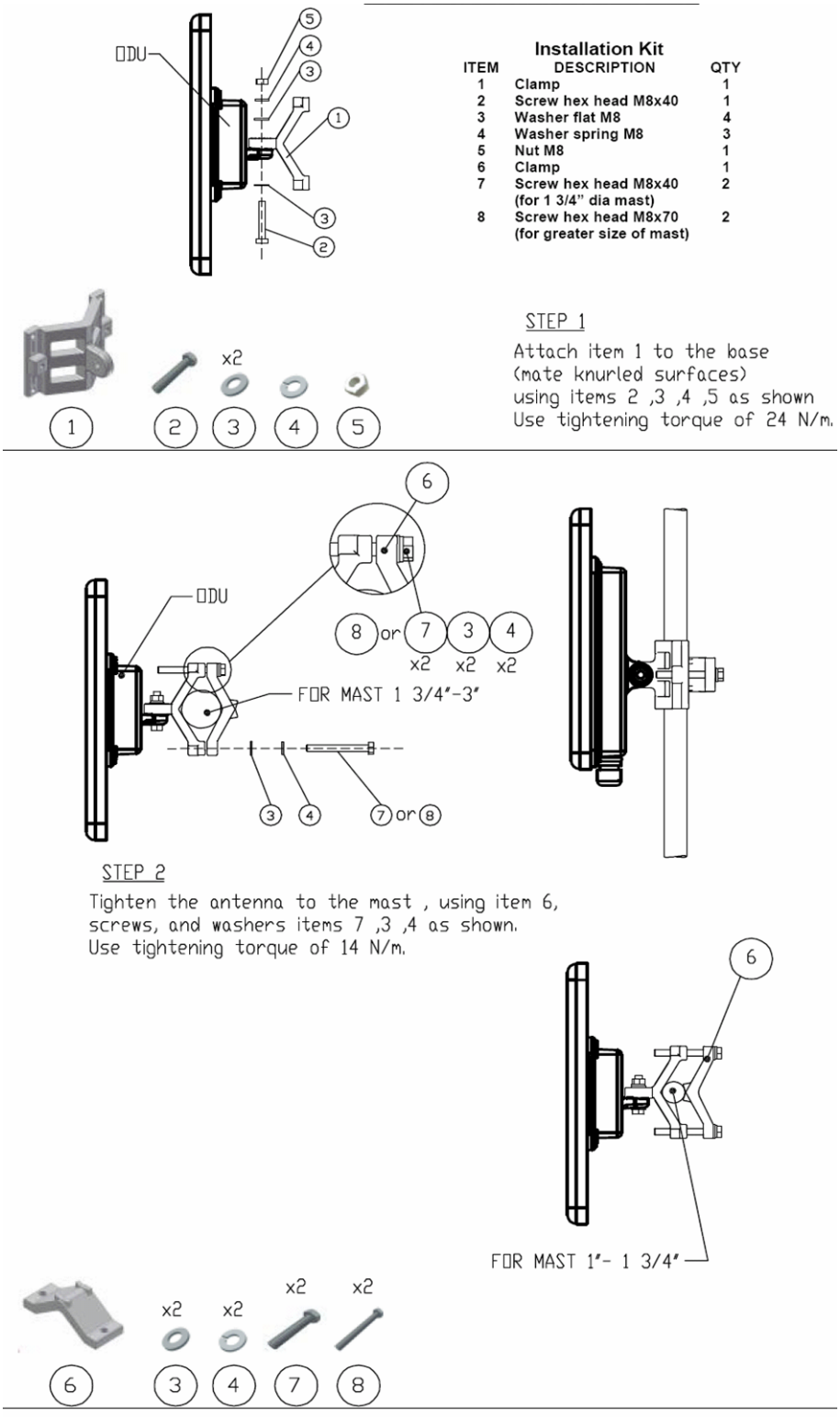


Figure 10-4: Mounting on a Mast

Mounting MRL on a Wall

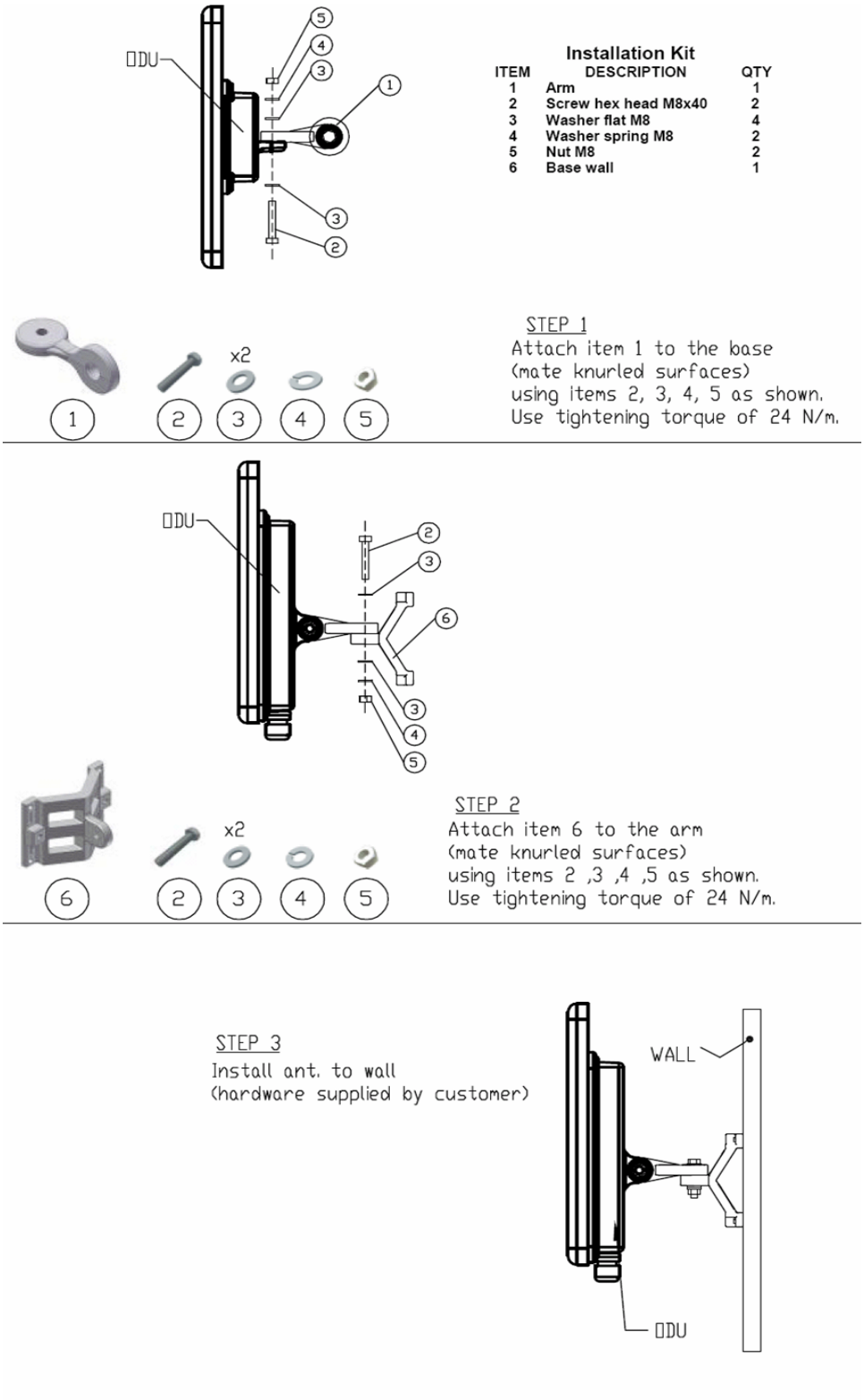


Figure 10-5: Mounti ng on a Wall

Mounting an External Antenna

The optional external antenna can be mounted on a mast.

External Antenna Mounting Kit Contents

The external antenna mounting kit includes the following items:

- Twelve flat washers
- Eight spring washers
- Eight hex nuts
- Four bolts
- One U-bracket
- One pivoting bracket
- Two metal strap clamps.

❋ To install external antenna on the mast:

1. Attach the U-bracket to the back of the antenna using four flat washers, four spring washers and four hex nuts.
2. Attach the pivoting bracket to the U-bracket using eight flat washers, four spring washers, four hex nuts and four bolts.
3. Pass both strap clamps through the vertical slots in the pivoting bracket.
4. Attach the antenna to the mast using the two strap clamps.
5. Adjust the required tilt using the angular scale and tighten all bolts and nuts at the required position.

Chapter 11

Appendix C: AIND Alignment

Use this procedure when using the all indoor system MRL-ANID or manually aligning two MRL units.

To achieve the best benefit and link budget from the MRL installation, the link antennas must be aligned; the two antennas should exactly face each other.

In order to achieve the best performance, the line of sight must be as clear as possible with no obstructions between the two sites.

Prior to attempting alignment, install the hardware and software in accordance with the MRL Installation and Operation Manual. The figure below shows the link setup. At least two people are needed to perform the alignment procedures.

Once the alignment is complete, you are able to evaluate the quality of the link.

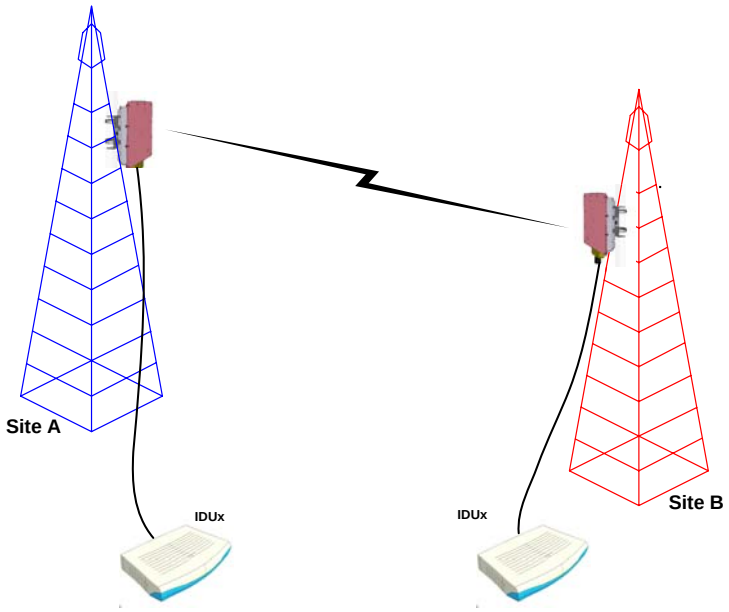


Figure 11-1: MRL Link Setup

Expected Signal Level for AIND radios

Use the Link Budget Calculator utility supplied on the MRL Manager Software CD-ROM to calculate the expected performance of the MRL wireless link. The utility allows you to determine the RSS of the link and number of E1/T1 services available at a specified distance. In all-indoor type installations, a long transmission line (RF cable) between the radio and antenna will be used;

oftentimes over 100'. In this case the attenuation (RF loss) of the cable must be determined (for both sides) and entered as a dB loss in the Link Budget calculator. In many cases, a larger antenna is necessary to compensate for this transmission line loss.

Andrew LDF and AVA cables are good for minimizing loss.

Performing MRL AIND Alignment

The supervisor of the antenna alignment is situated at the receive site with the Spectrum Analyzer.

Equipment Setup

❋ **To set up the antenna alignment equipment:**

1. Coarsely align the two antennas. Use the compass readings taken during the Site Survey to point the antennas in the correct direction.
2. Connect the equipment as shown in Figure 11-1 but connect a spectrum analyzer in place of the remote MRL-AIND.
3. Turn on the CW transmit signal from site A (from the MRL NMS).
4. At site B, tune the SA to the frequency transmitted.
5. Increase the SA sensitivity according to the expected receive signal.

Aligning the antennas

Note

When one antenna is moved, the opposite site is passive. Move the antennas very slowly.

❋ **To align the antennas:**

1. Slowly move the site B antenna azimuth axis (the elevation axis should be locked) until you see the best signal on the SA Lock the azimuth axis.
2. Slowly move the site A antenna azimuth axis (the elevation axis should be locked) until you see the best signal on the SA.
3. Lock the azimuth axis.
4. Slowly move the site B antenna elevation axis (the azimuth axis should be locked) until you see the best signal on the SA.
   Lock the elevation axis.
5. Slowly move the site A antenna elevation axis (the azimuth axis should be locked) until you see the best signal on the SA.
   Lock the elevation axis.
6. Repeat steps 1 to 4 until the reading on the SA is equal or as close as possible to the calculated receive signal (for Rx Power Level, see Expected Signal Level for AIND radios).

7. When the SA reads the expected receive signal, the antennas are aligned and there is an indication of a good link between the sites.
8. Tighten the antenna azimuth axis and elevation axis.
9. Stop the CW function. The NMS will restart the system.
10. Connect MRL-AIND unit to the external antenna. See MRL Installation and Operation Manual for details. The operational link is shown in Figure 2-1.
11. Configure MRL NMS at both sites to operate at the pure channel frequency found in the RF survey. MRL is now ready for operation.

Configuring the Link

1. Run the Installation Wizard in the MRL Manager Software to set the configuration of the link. Configure the link in accordance with the parameters calculated in the Link Budget Calculator.
2. MRL has a unique identification number, the SSID. Each side of the link looks for its partner with the same SSID. Therefore both sides of the link must be configured with the same SSID.
3. The MRL link is now ready for operation.

Evaluating the Link

With the link operating at a pure channel as determined by the RF survey procedure, the recommended performance threshold of an MRL link is the following:

RSS: –84 dBm minimum

There are cases when there is no line of sight, but still the link is of an acceptable quality.

If the link is not within the acceptable limit, see Troubleshooting.

Troubleshooting

If the link is not within the acceptable limit as defined in Evaluating the Link, check the following:

- Verify that both antennas have the same polarization (horizontal/vertical).
- Check all the MRL-AIND cable connectors for faulty connections.
- Verify that there are no obstacles in the Fresnel zone of the antenna path such as large buildings, trees, etc.
- Use a spectrum analyzer with suitable sensitivity to measure the signal at the distance between the sites.
- If nothing improves the receive power level, check the overall link.
- Reduce the distance of the link–move the equipment from one site closer to the other site–where it is possible to actually see the antennas with the naked eye.

- If you now get the expected receive signal level, you can assume that the equipment is operational, and the problem arises from interference between the sites.

Chapter 12

Appendix D: Antenna

An antenna is the radiating and receiving element from which the radio signal, in the form of RF power, is radiated to its surroundings and vice versa. The transmission range is a function of the antenna gain and transmitting power. These factors are limited by country regulations.

The MRL may be operated with an integrated antenna attached to the ODU unit, or with an external antenna wired to the ODU via an N-type connector. All cables and connections must be connected correctly to reduce losses. The required antenna impedance is 50Ω.

Table 12-1: Antenna Characteristics

Type		Gain [dBi]	Max Range		Beam width	Dimensions		Weight		Connector	Lightening Protection
			[km]	[miles]	[degrees]	mm	in	Kg	lb		
5.8, 5.4, 5.3 GHz											
Integrated	Flat panel	22	40	25	9.0	305×305×15	12×12×0.6	1.2	2.6	NR	Yes
External	Flat panel	28	80	50	4.5	600×600×51	23.6×23.6×2	5.0	11.0	N-type	No
5.8 GHz only											
External	Dish	32.5	80	50	4.5	Dia 900	Dia 35.4	10	22	N-type	No
4.9 GHz											
External	Flat panel	21	24	15	9.0	305×305×15	12×12×0.6	1.2	2.6	N-type	Yes
External	Dish	27	80	50	5	Dia 600	Dia 23.6	5.0	11.0	N-type	Yes
2.4 GHz											
Integrated	Flat panel	16	40	25	20	305×305×25	12×12×1	1.2	2.6	NR	Yes
External	Grid	24	80	50	H:10 V:14	600×997×380	23.5×39.2×15	2.0	4.6	N-type	No
2.5 GHz											
Integrated	Flat panel	17.5	40	25	25	305×305×25	12×12×1	1.2	2.6	NR	Yes
External	Grid	24	80	50	H:9 V:13	600x900	23.6x35.4	2.5	5.5	N-type	No

Parabolic Dish Antenna

The Parabolic dish antenna is a high-gain, reflector antenna used for radio, television, and data communications. The relatively short wavelength of electromagnetic (radio) energy at these frequencies allows reasonably sized reflectors to exhibit the very desirable highly directional response for both receiving and transmitting.

Grid Antenna

Used for 2.4 GHz applications. Due to the large size, the grid design minimizes weight and windloading.

Chapter 13

Appendix E: Hub Site Synchronization

When several units are collocated at a common hub site, interference may occur from one unit to another. ODU units are supplied with special hardware for the collocation of up to eight units from a central site.

Using a method called Hub Site Synchronization (HSS) an external cable is connected from the master to all collocated ODUs; this cable carries pulses sent to each ODU, which synchronize their transmission with each other. The pulse synchronization ensures that the transmission of packets occurs at the same time for all collocated units. This also results in all of the hub units receiving data at the same time, eliminating the possibility of interference that could result if some units transmit while other units at the same location receive.

Figure 13-1 shows interference caused by non-synchronized collocated units.

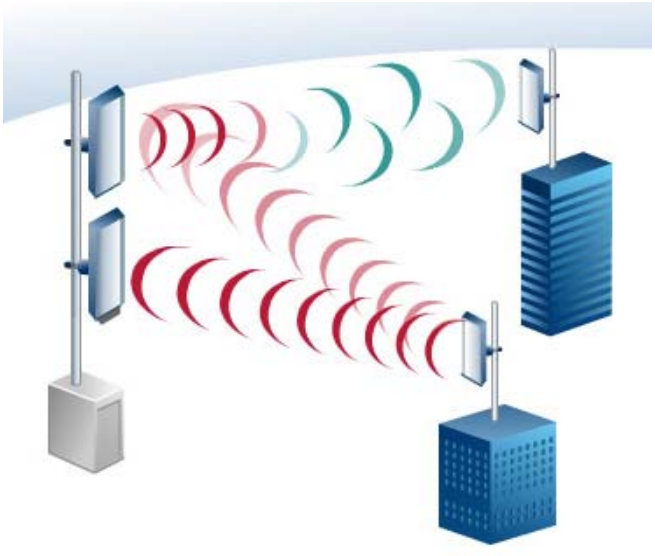


Figure 13-1: Interference caused by collocated units

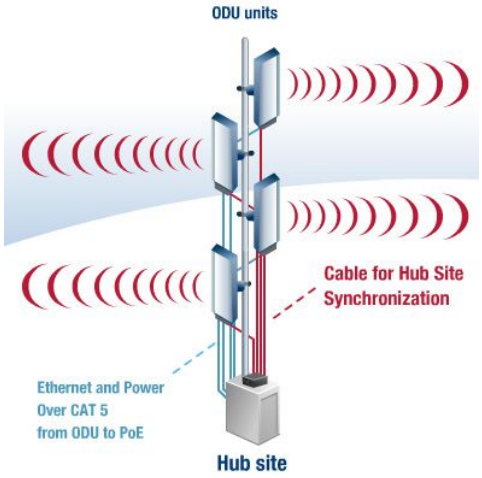


Figure 13-2: Collocated units using Hub Site Synchronization

Collocation Planning

MRL provides a collocation planning tool and calculator for planning the placement of multiple units at the same site. It provides physical guidelines for each specific installation scenario. The tool can be used prior to installation to define and verify the distance between the collocated units and their direction, polarization and TPC adjustment.

Frequency Band (GHz): 2.4 | Channel Bandwidth: 20 | Clear All

Desired link	Height HS (m)	Antenna Type @ HS	Azimuth (degrees) @ HS	Range (Km)	Desired Air Rate (Mbps)	Height RS (m)	Antenna Type @ RS	Tx Power @ RS (dBm)	Forbidden Chanel Differences: Link A	Link B	Link C					
Link A	15	5.XG 28dbi ant MTI	110	5	18	15	.X 22dbi (integrated	16	-47dBm OK	Co,	Co,	N.A	N.A	N.A	N.A	N.A
Link B	16	24dbi ant Kenbonton	120	10	24	15	4dbi ant Kenbonton	16	Co,F1,	-56dBm OK	Co,	N.A	N.A	N.A	N.A	N.A
Link C	17	2.4 16dbi (integrated	90	2	48	10	2.4 16dbi (integrated	16	Co,	Co,	-56dBm OK	N.A	N.A	N.A	N.A	N.A
Fill Link Name...	0		0	0		0		16	N.A	N.A	N.A		N.A	N.A	N.A	N.A
Fill Link Name...	0		0	0		0		16	N.A	N.A	N.A	N.A		N.A	N.A	N.A
Fill Link Name...	0		0	0		0		16	N.A	N.A	N.A	N.A	N.A		N.A	N.A
Fill Link Name...	0		0	0		0		16	N.A	N.A	N.A	N.A	N.A	N.A		N.A
Fill Link Name...	0		0	0		0		16	N.A	N.A	N.A	N.A	N.A	N.A	N.A	

Figure 13-3: Collocation Site Calculator

Hardware Installation

HSS supports installation of up to sixteen collocated units. In addition to each unit being connected to its IDU or PoE device, the collocated unit has an additional cable that is connected to the HSS Unit. The HSS Unit is a compact, weatherproof (IP67) connector box that is installed on the same mast as the ODUs. All collocated units connect to this box via CAT 5e cable. Prepared lengths are available for purchase.

The HSS is supplied with ten protective covers; any port not in use must be closed with a protective cover.

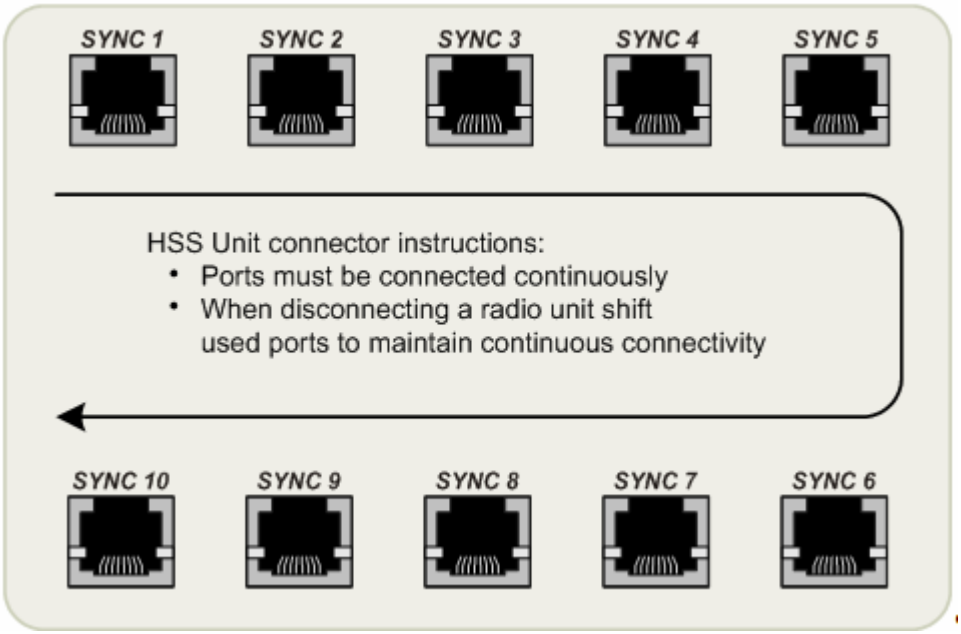


Figure 13-4: HSS Interconnection Unit

Note *Ensure that the collocated units are connected in sequence from SYNC 1. If an ODU is removed form the hub site, then all remaining ODUs must be reconnected to maintain the connectivity.*

To connect an ODU to the HSS

1. Unscrew the protective cover from the port marked SYNC 1.
2. Connect the RJ-45 connector from one end of the prepared CAT 5e cable to SYNC 1.
3. Connect the other end of the CAT 5e cable to the ODU connector labeled SYNC.
4. Tighten the protective seal that is on the prepared cable over the RJ-45 connector.

5. Repeat for all ODUs that are to be collocated at the hub site. The next ODU to be connected is inserted to SYNC 2, followed by SYNC 3 and so on.

ODU/HSS Connection Pinout

ODU RJ-45		Color	HSS HUB RJ-45	Notes
1	twisted	White/Green	1	
2	pair	Green	2	Not Applicable
3	twisted	White/Orange	3	
6	pair	Orange	6	
4	twisted	Blue	4	
5	pair	White/Blue	5	
7	twisted	White/Brown	7	
8	pair	Brown	8	

Architecture

One of the collocated ODUs at the hub site acts as the **Hub Sync Master (HSM)**; all the other collocated units are Hub Sync Clients. The Hub Sync Master generates the pulses that synchronize the timing of the Hub Sync Clients.

A Hub Sync Client can be configured to be two different types:

Hub Sync Client–Continue Transmission (HSC-CT): In the event that the unit loses synchronization with the Hub Sync Master, the link remains active. However, without synchronization pulses, it is possible that this unit will cause interference.

Hub Sync Client–Disable Transmission (HSC-DT): In the event that the unit loses synchronization with the Hub Sync Master, the link is dropped until the synchronization pulses resume. This setting prevents the unit from causing interference.

The remote ODUs that are not located at the hub site, are called Independent Units and do not require HSS hardware.

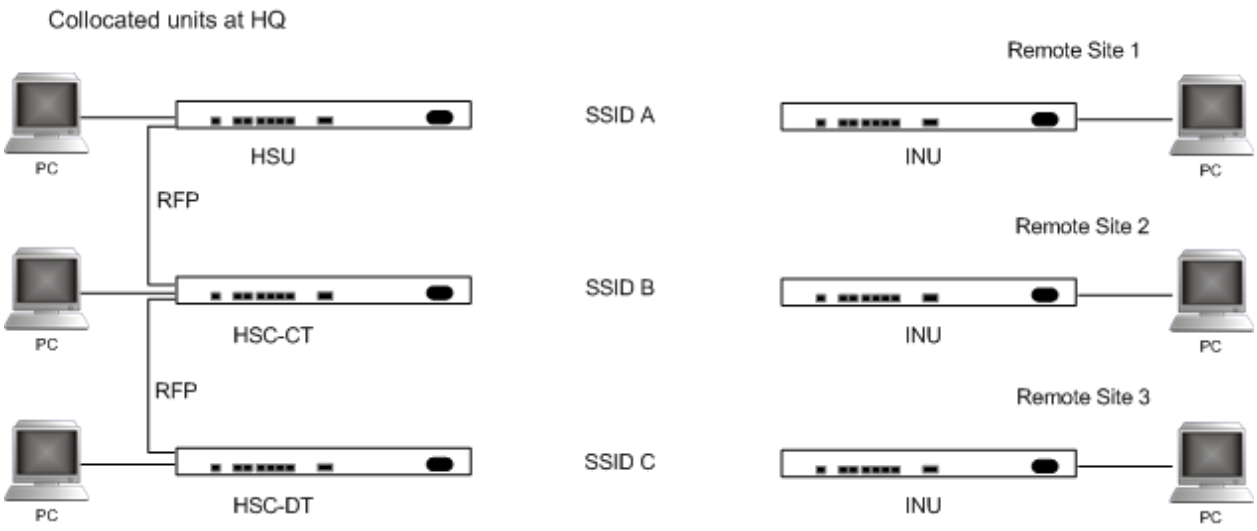


Figure 13-5: HSS Typical Application

Radio Frame Pattern Table

The synchronization pulse is termed Radio Frame Pattern (RFP). Four RFP pulses are available. The RFP is selected depending on the type of services that the complete system is to provide - see the table below. Select the RFP that gives you the Best Fit for the system services and select the Channel Bandwidth accordingly.

Note *The RFP must be the same for each link within the collocated system.*

Table 13-1: Radio Frame Pattern Table

	Channel Bandwidth				
	20 MHz	**10 MHz**		**5 MHz**	
RFP	TDM & EDO	TDM	EDO	TDM	EDO
A	**Best**	**Fit**		--	
B	--	**Best**	**Fit**	**Best**	**Fit**
C	--	--	**Best**	--	**Fit**
D	--	--		--	**Best**

HSS Link Configuration

For HSS-enabled units, the Hub Site Synchronization Settings dialog box appears in the Link Configuration Wizard.

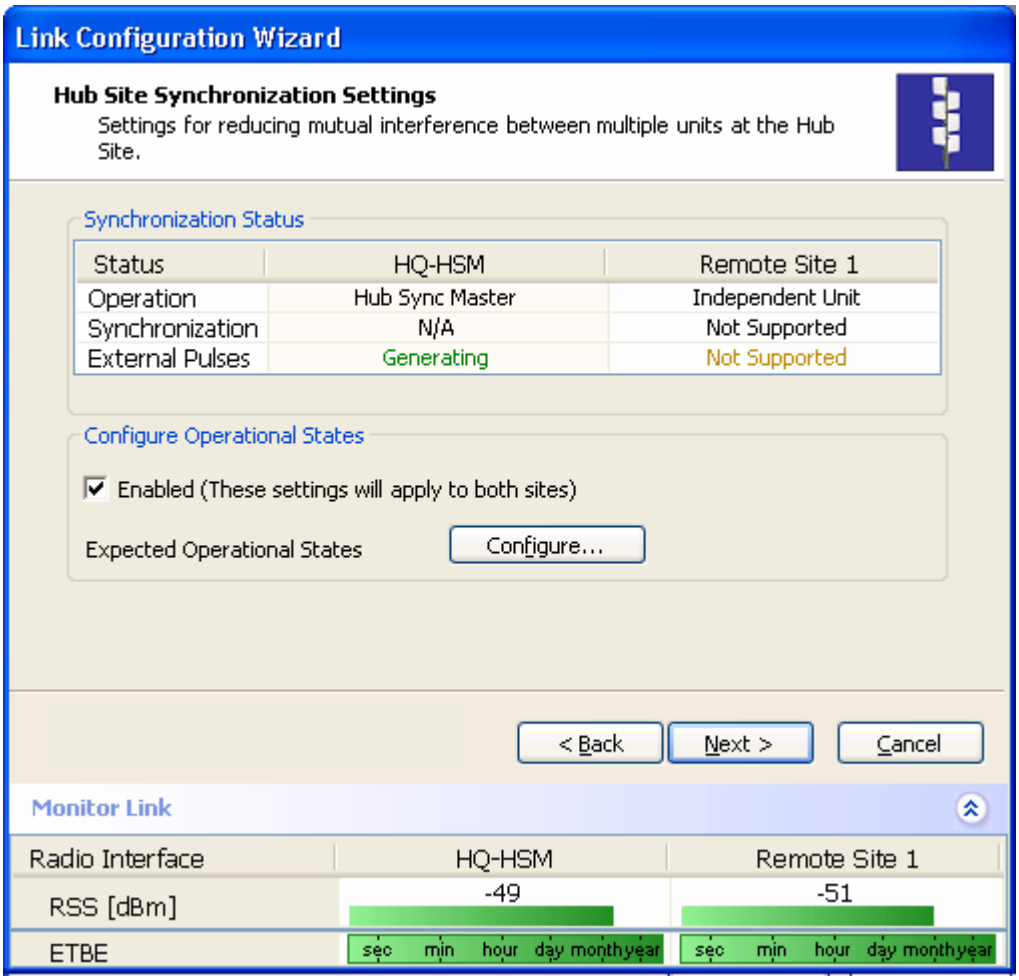


Figure 13-6: Hub Site Synchronization Settings dialog box

The Synchronization Status dialog box displays the current status of each side of the link.

- Operation: Type of unit
  Hub Sync Master (HSM)
    Hub Sync Client – Disable Transmission (HSC-DT)
    Hub Sync Client – Continue Transmission (HSC-CT)
  Independent Unit
- Synchronization:
    N/A- for Master or Independent Units
    Synchronized – for Hub Site Clients
    Not Synchronized – for Hub Site Clients
- External Pulses: The status of the pulses running through the HSS cable. The Master generates such pulses. The severity of each of these states is indicated by green, yellow or red text color. Possible states are described in the following table:

Table 13-2: External Pulse Status

Status	Description	Text Color
Not Detected	**Sync pulses not detected**	**Green**
Generating	**Unit is HSM and is generating RFP pulses**	**Green**
Generating and Detected	**Unit is HSM and generating RFP pulses and is also receiving pulses from another unit. Incorrect configuration.**	**Red**
Generating and Improper Detected	**Unit is HSM and generating RFP pulses and is also receiving incorrect pulses from another unit. Incorrect configuration.**	**Red**
Detected	**HSC detecting pulses**	**Green**
Improper Detected	**Incorrect RFP and BW configuration**	**Red**
Multiple Sources Detected	**More than one HSM generating pulses. Incorrect configuration.**	**Red**

❋ To configure the Operational States of the hub site unit

1. Click the **Enabled** check box
2. Click the **Configure** button

   The Hub Site Configuration dialog box with the current status of the ODUs is displayed.
3. Select the type of unit configuration from the drop-down list. Because only the relevant options are displayed according to the hardware configuration of each unit, usually the remote site will have only the Independent Unit option available.
4. Select the appropriate RFP radio button. Some RFP options may be disabled depending on the BW previously selected.

Note *Take care to avoid incorrect configuration of bandwidth, RFP or to set multiple Hub Sync Masters, as system interference can occur. MRL*

gives error messages and tool tips if the system is configured with mismatches.

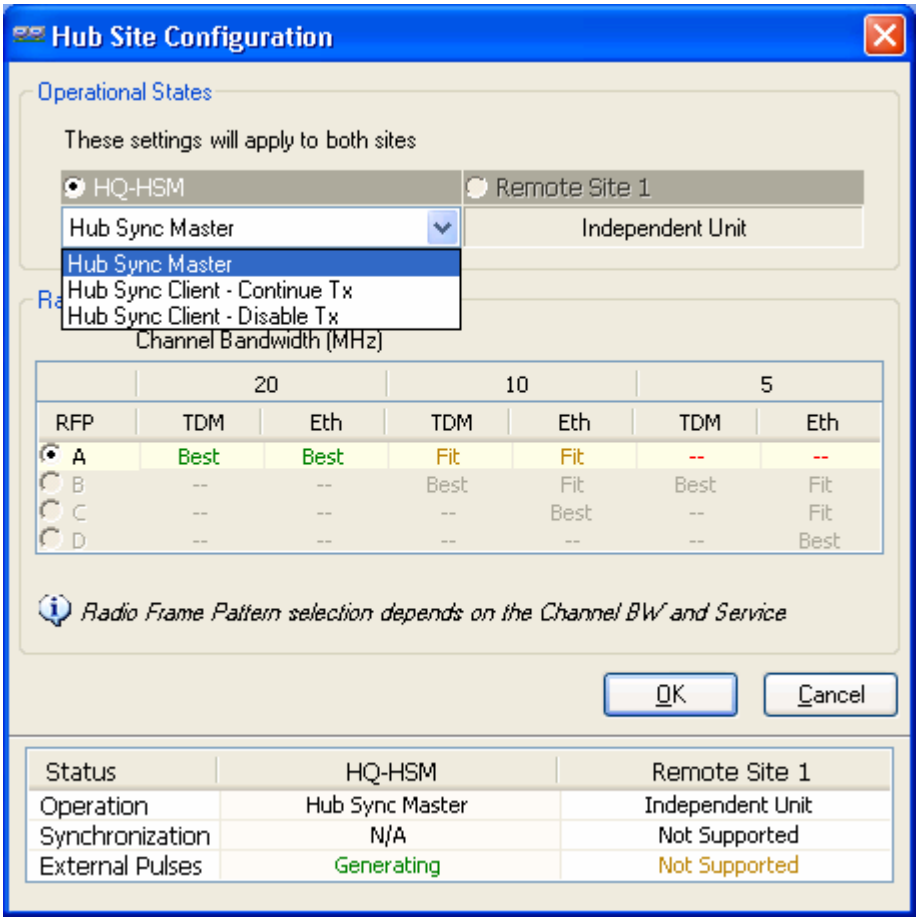


Figure 13-7: Hub Site Configuration dialog box

Site Configuration

For units that support HSS, the Hub Site Sync option appears in the Air Interface section and displays the current HSS of the unit. Configure the unit from the Link Configuration Wizard according to the procedure described above.

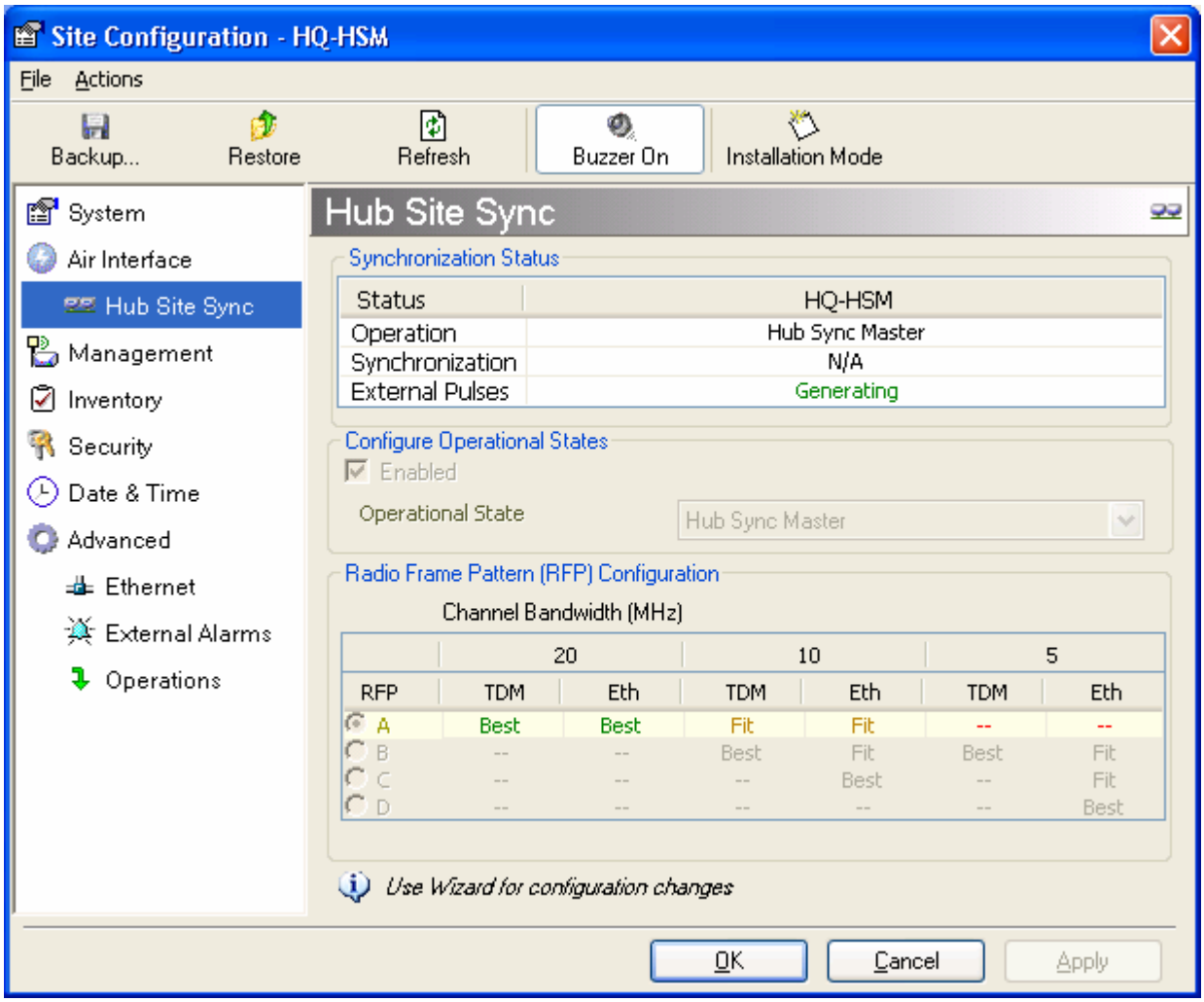


Figure 13-8: Site Configuration – Hub Site Sync dialog box

The following figure is displayed when the hardware does not support HSS. These units may be used as independent remote units.

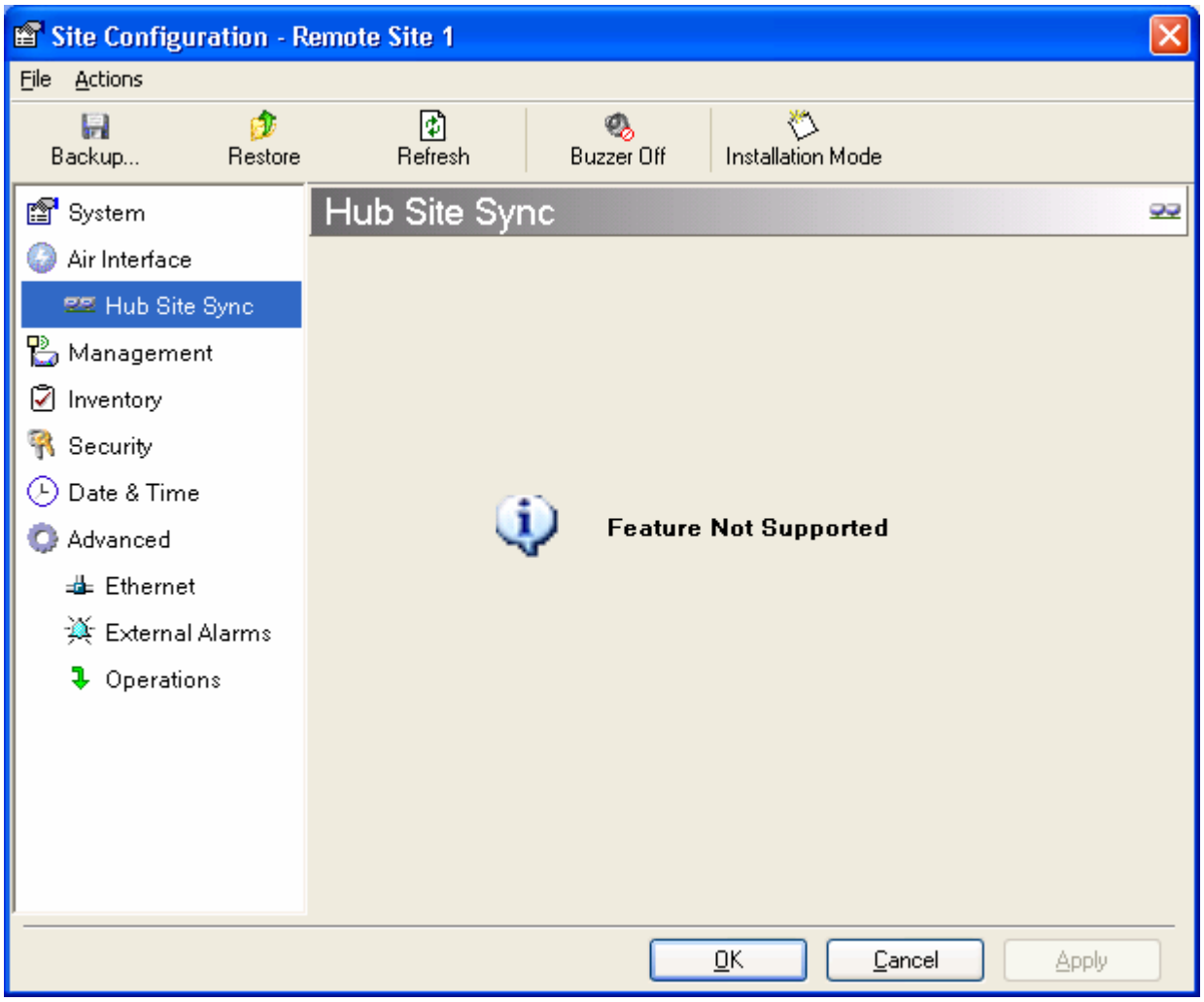


Figure 13-9: HSS Not Supported

Chapter 14

Appendix F: BRS Installation Procedure

BRS Link Activation

In accordance with 2.5 GHz standard, MRL-BRS systems links must be activated before use. This is done at both ODUs independently before installation on site. Both ODUs must be configured the same.

To Activate a BRS Link

1. Install MRL Manager software as usual.
2. When the Manager Main Screen is displayed it appears with the Link Status label red and showing Inactive. The Link Configuration and Link installation buttons are disabled.

Figure 14-1: Inactive Manager Screen

3. Click **Configuration>Configure Location**
   The Air Interface dialog box opens:

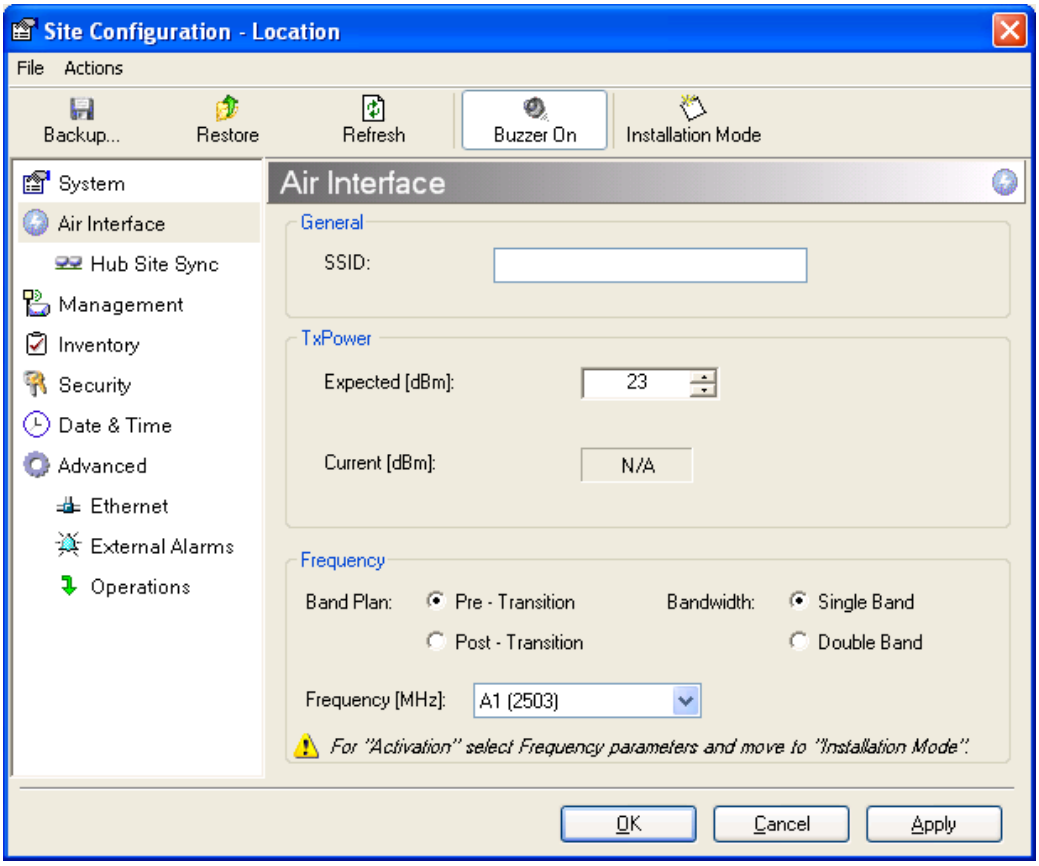


Figure 14-2: BRS Air Interface dialog box

4. Set the appropriate Frequency Band Plan and Bandwidth.
5. Select the required frequency band, and click **Apply**.
6. Click **Installation Mode**
7. Repeat for the remote ODU.

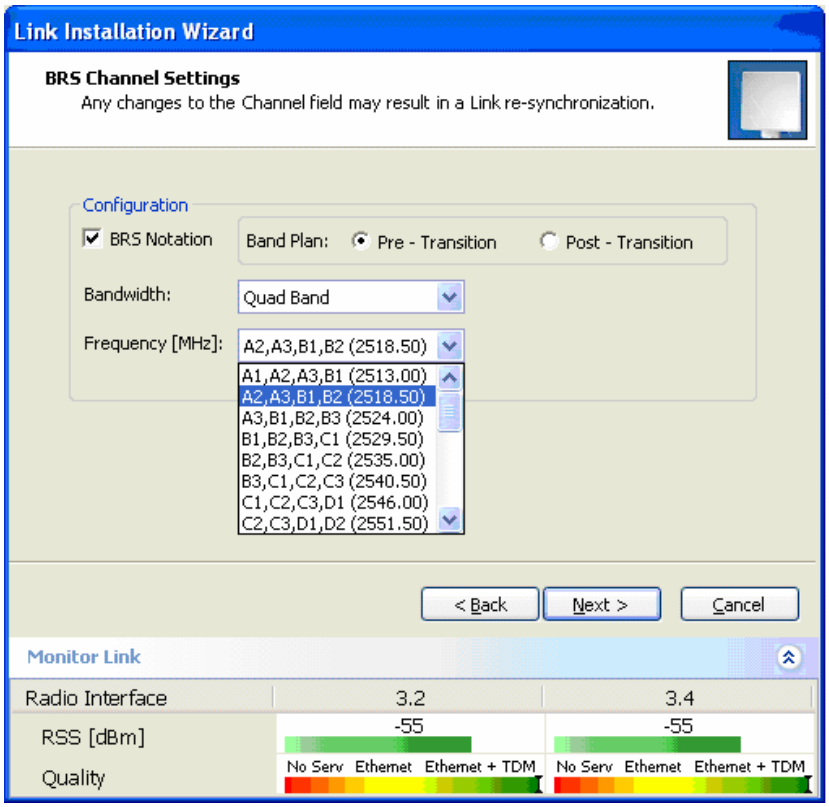


Figure 14-3: BRS Channel Settings Pre-Transition

8. Perform the remainder of the Installation procedure as defined in the Installation section.

BRS Link Configuration

The BRS link is reconfigured during the Link Installation or the Link Configuration wizards, or from the Air Interface screen.

Note

Both sites in a BRS Link must be configured identically.

Any changes to the frequency settings cause the link to re-synchronize. A short loss of service will occur during re-synchronization.

To Configure BRS Channel Settings

1. Set the Band Plan.
2. Select the Bandwidth required,
   Single Band
   Double Band
3. Select the Frequency from the pull-down menu.
4. Click Next. The system is re-synchronized to the changes.

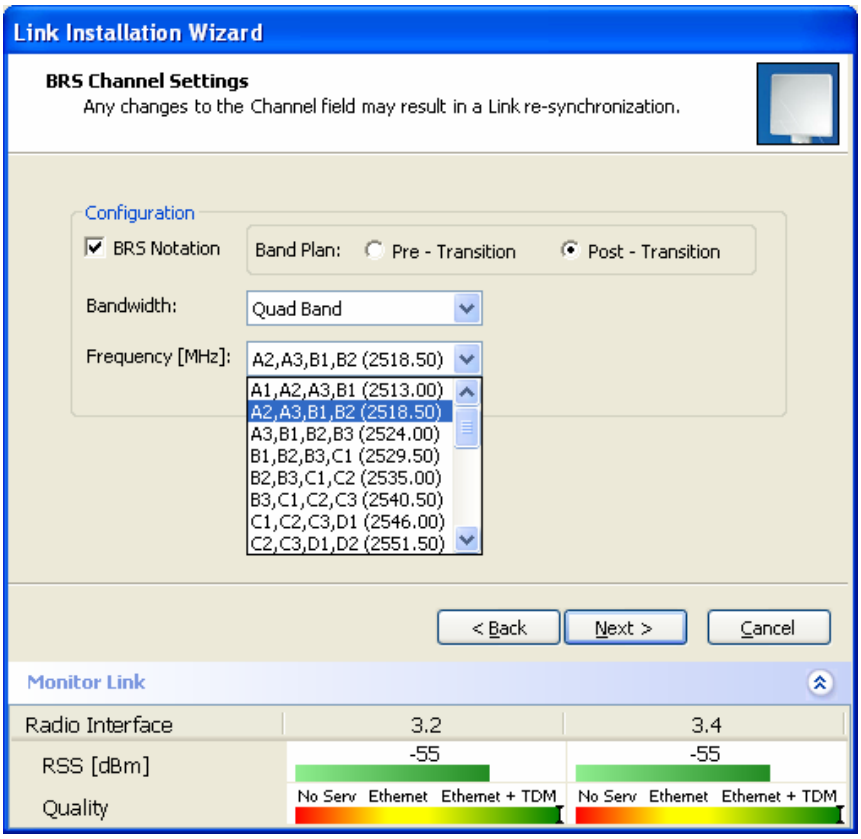


Figure 14-4: BRS Channel Settings Post-Transition

Chapter 15

Appendix G: RF Exposure

The antennas used for the following transmitters must be installed to provide a separation distance as specified. They must not be co-located or operated in conjunction with any other antenna or transmitter.

Product	FCC ID	Antenna gain [dBi]	Min. Safety Distance [cm]
F58A/HE/FCC	Q3KAMWL1580	22	109
F58A/HE/FCC	Q3KAMWL1580	28	217
F58A/HE/FCC F58A/FCC/AIND	Q3KAMWL1580	32.5	364
F24/FCC	Q3KAMWL1240	16	16
F24/FCC	Q3KAMWL1240	24	40
F24A/HE/FCC	Q3KAMWL1240H	24	71
F24A/HE/FCC	Q3KAMWL1240H	15.2	37
F25/HE/BRS	Q3KAMWL1250	17	200
F25/HE/BRS	Q3KAMWL1250	24	200
F25/HE/BRS/AIND	Q3KAMWL1250	24	200

Chapter 16

Appendix H: Link Budget Calculator

Overview

The Link Budget Calculator is a utility for calculating the expected performance of the MRL wireless link and the possible configurations for a specific link range.

The utility allows you to calculate the expected RSS of the link, and find the type of services and their effective throughput as a function of the link range and deployment conditions.

The Link Budget Calculator is supplied on the MRL Manager CD. After installation, it may also be accessed from the menu bar of the MRL Manager as shown in the following figure:

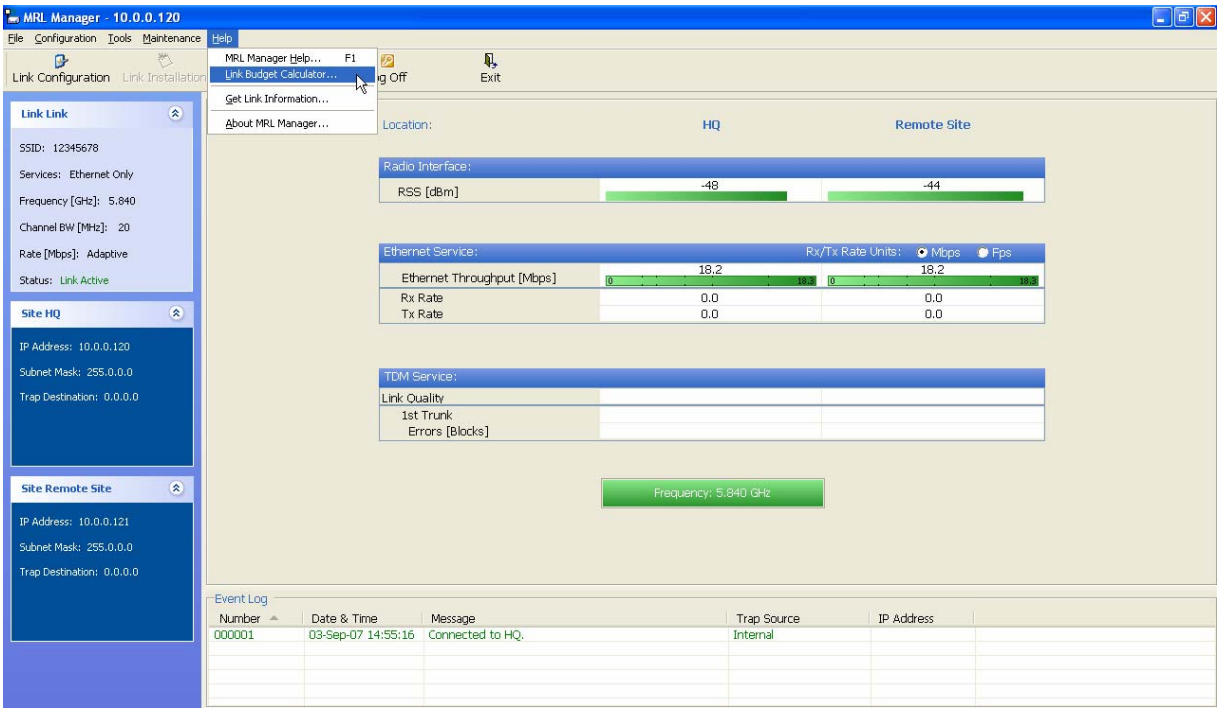


Figure 16-1: Accessing the Link Budget Manager Calculator

Description of Parameters

The parameters described in this section are indicated in Figure 16-2.

Fade Margin (FM) the margin taken in consideration as part of the parameters needed as spare for high availability. Min level accepted by the LBC is 6dB.

EIRP Tx Power + Antenna Gain (*) – in some products they are limited to a max value due to local regulation and type approval.

Example 1

10 x Log (Value in mW) = (Value in dBm)

1W is the maximum EIRP (Tx Power + Antenna Gain (*)) that is allowed in 5.4 GHz ETSI products by ETSI regulation, (*) considering cable loss.

Note: 3 dB = 2 x Power

1W = 1000 mW → 10 x Log (1000) = 30 dBm

2W = 2000 mW → 10 x Log (2000) =33 dBm

Max/ Min range (distance) MRL sensitivity threshold in -60dB range

-30 dBm < RSS (sensitivity) <-90 dBm, in addition Propagation Delay is also considered 3.3uS / 1 km (refer to Throughput vs Distance guideline)

Example 2

RSS = Tx(power) + Ant(Tx) + Ant(Rx) – loss

loss = 32.5 + 20 Log (D) + 20 Log (f);

D – Distance in km, f – Center Frequency

Climate/Terrain Factor, see Figure 16-3 and Figure 16-4.

Expected FM and RSS, refer to A and B

Required Antenna Height, this is the required antenna height considering the Fresnel Zone. Refer to MRL site-survey guideline.

based on antenna beam

Considering LOS (clear *Line of Site*)

Channel Bandwidth is required with the available Radio Frame Pattern (RFP) for collocated HSS systems.

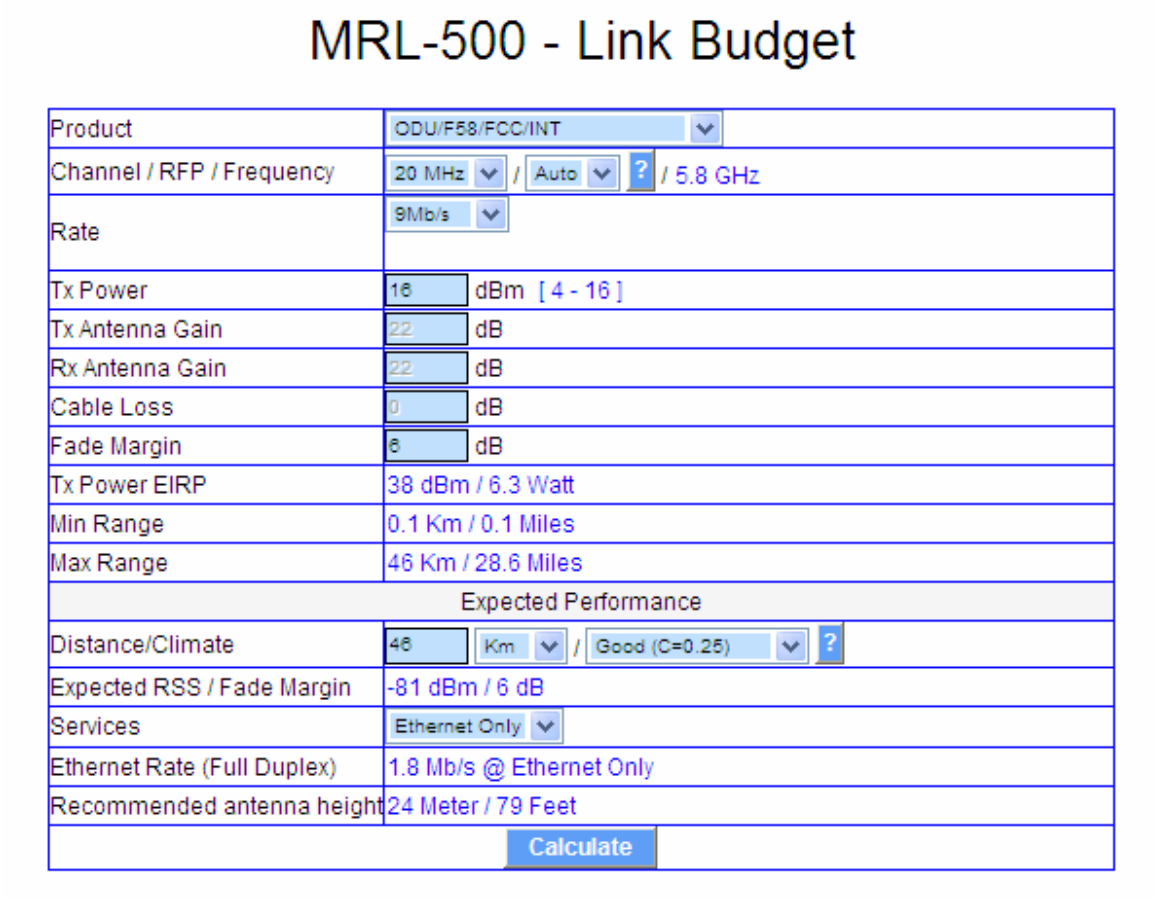


Figure 16-2: Link Budget Screen

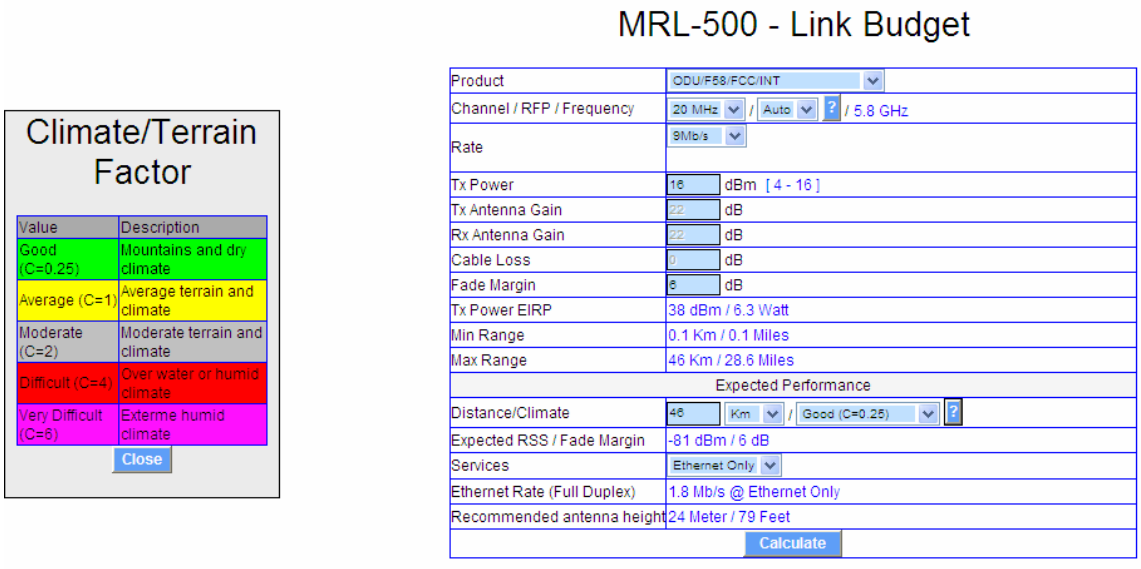


Figure 16-3: Climate and Terrain Factor

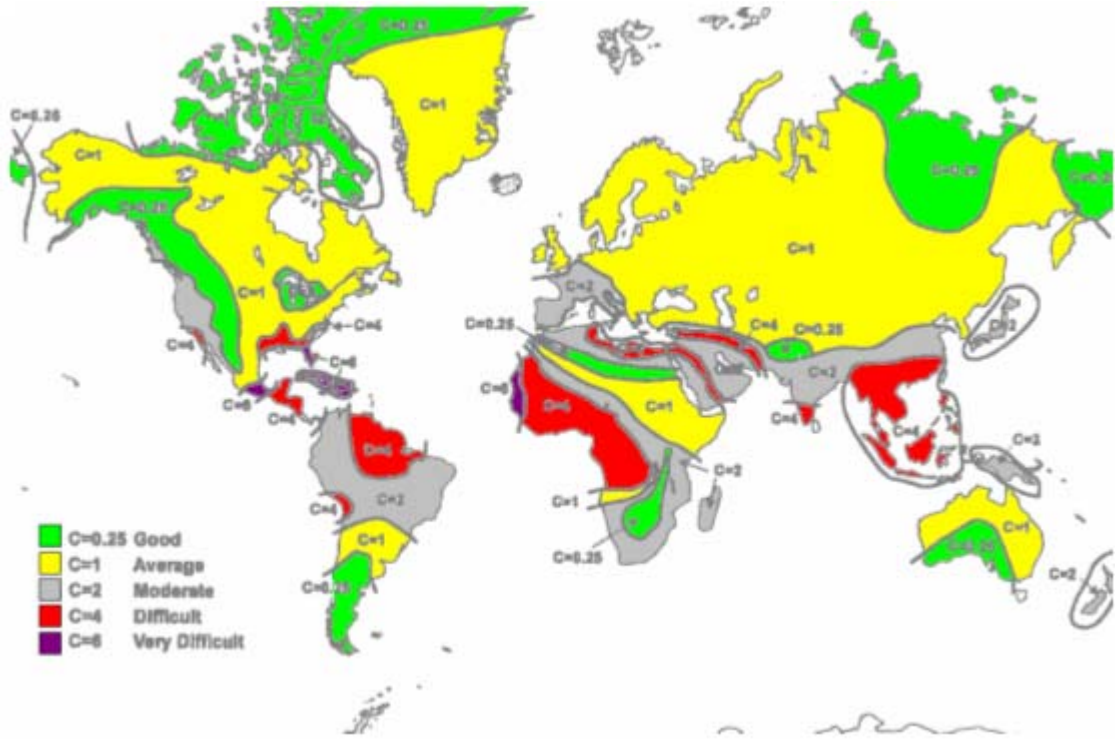


Figure 16-4: Geographical Conditions

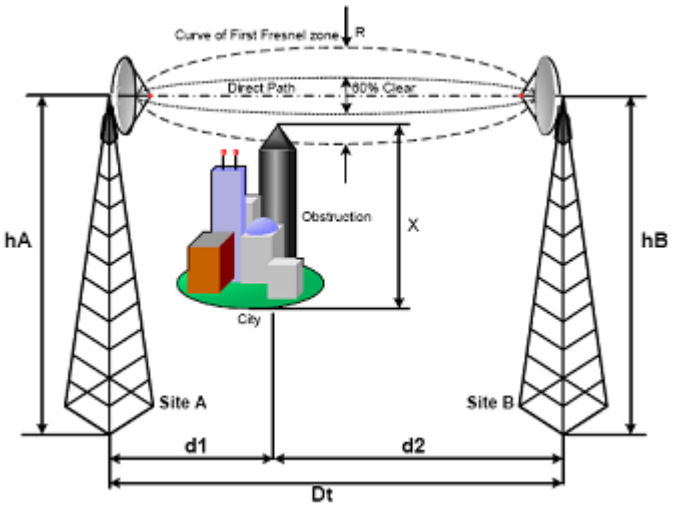


Figure 16-5: Fresnel Zone

Using the Link Budget Calculator

The Link Budget Calculator is composed of one table where all the link parameters are defined.

❋ To calculate the link budget

1. Select your system product from the dropdown list of products.

2. Select the rate from the dropdown list. The rate defines the air-interface rate in Mbps. The system operates in TDD mode and has overhead of the air-interface protocol and therefore the accurate actual throughput is provided in the 'Service' Row and the effective Ethernet throughput is provided in the 'Ethernet Rate'.

Note *Throughput can be decreased as a function of range due to propagation delay.*

The remaining fields are completed automatically depending on the product selected in the product field. Standard MRL system parameters are entered as default. Fields in blue boxes may be edited if non-standard antennas and cables are used.

The Fade margin is the minimum margin that is required for LOS conditions. For degraded link conditions, a larger fade margin should be taken into account.

The Tx power EIRP for the system is given in dBm and Watts.

3. Type the required link distance and select units of distance, kilometers or miles.
4. Select the general conditions
5. Select the services required
6. Click **Calculate**

The Expected Performance parameters are calculated and displayed in the lower part of the table.

- Expected RSS – this is the number that the MRL Manager software shows when the MRL ODUs are best aligned.
- Ethernet Rate – Maximum throughput available with the chosen system.

If the expected performance is not suitable for your application, select a different data rate and re-calculate.

Chapter 17

Appendix J – Lightning & Grounding Guidelines

The MRL Lightning protection system consists of the following components, as described below:

- Individual Grounding for each Indoor/Outdoor unit
- External Primary Surge Suppressor unit for the CAT-5 Outdoor cable
- Internal ESD protection circuits over the Power/Telecom lines

Grounding for Indoor/Outdoor Units

ODU (Out Door Unit) Grounding

MRL uses a Shielded CAT-5 cable to interconnect the Outdoor (ODU) and Indoor (IDU) units.

However, this shielding does not provide a good Lightning Discharge path, since it can not tolerate the high Lightning Current surges.

In order to provide an alternate Lightning Discharge path, the ODU/Antenna Grounding posts should be connected to Ground point by a 10 AWG short Copper wire, as per NEC 810-21.

IDU (Indoor Unit) Grounding

The IDU's grounding post should be connected to the internal Ground point, merely for Safety and ESD protection reasons.

External Lightning Surge Suppressors

To minimize direct Lightning damages, an external well grounded CAT-5 Lightning Protector should be mounted outside the building, located as near as possible to the entrance of the CAT-5 ODU-IDU interconnection cable. 3rd pary protectors may be used such as Motorola's 300SS, Hyperlink's HGLN-CAT5, or Sixnet's SP-ETH-2

Internal ESD Protection circuits

MRL is designed to meet the ETSI/FCC/Aus/NZ/CSA EMC and Safety requirements. To fulfill these requirements, the system's Telecom lines at the ODU/IDU are Transformer-isolated and include internal ESD (Electro-Static-Discharge) Protection circuits.

Chapter 18
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