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maximising the potential of advanced wireless communications

MiMOMax Linking Products

General

The MiMOMax Network Digital Link (NDL) and Multipoint Digital Link (MDL) is a family of software flexible, low latency, digital radio links designed to provide mission critical linking for data, telemetry, SCADA and back-haul type applications.

The MDL product family utilises licensed narrow band radio channels and MiMO technologies in 2x2 and 2x4 configurations to provide industry leading spectral efficiencies of up to 16 bits/Hz/s or greater, enabling raw data rates (including link overhead) of up to 320kbps.

Utilising licensed spectrum ensures that the equipment operates in an interference-free environment and is capable under the right conditions of providing a reliable low-error data transport service ($<1 \times 10^{-7}$ bit error rate), with coverage diameters of up to 130km dependent on site location and height.

For data and voice linking applications the MDL will provide a number of industry standard data interfaces at link end points.

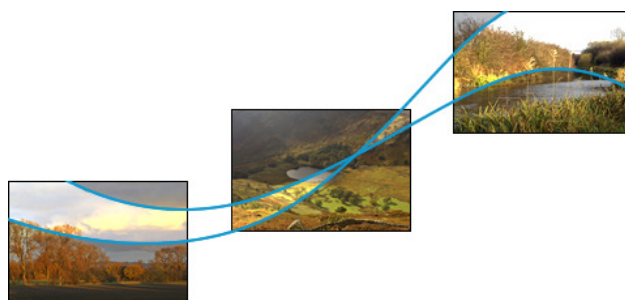
MDL

The MiMOMax MDL solution describes a radio network comprising one or more base stations providing reliable duplex communications with a number of outstations throughout the intended coverage area. A high performance random multi-access protocol allows each outstation rapid access to the system.

Each station uses a MiMO antenna (or antennas) to produce both vertically and horizontally polarized signals, allowing a high performance pattern diverse MiMO link of up to 64km with near-line-of-sight capability and non-line-of-sight over shorter distances. A second optional MiMO antenna and receiver operating in a 2x4 configuration may be used to further enhance link performance by providing spatial diversity and improving link robustness.

A number of interfaces support various applications, and the system can simultaneously support outstations on different modulation schemes to accommodate varying path characteristics.

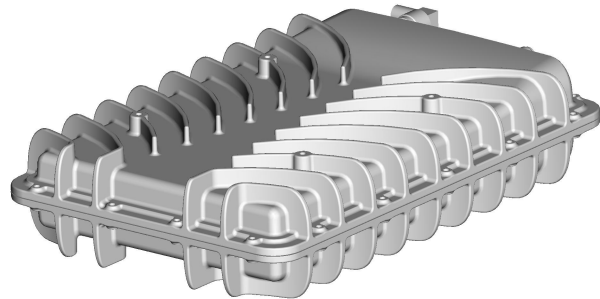
With these applications in mind the MDL is designed to have ultra low latency and low jitter whilst fitting into the usual channel allocations allocated to fixed radio links. Multiple links can be cascaded or combined with NDL's to cope with difficult terrains or very long paths.



1 MULTI-POINT SYSTEM OVERVIEW

The basic Multipoint Digital Link (MDL) system consists of a Base Radio Unit (BRU) communicating with multiple Remote Radio Units (RRU's) on a pair of 12.5 kHz or 25 kHz radio channels f1 and f2, such that f1 is used for RF transmit and f2 for RF receive functionality by the BRU.

Multipoint Digital Link (MDL)



Each RRU conversely uses f2 for transmit and f1 for receive. The BRU connects to the customer's network and the RRU's extend this network to remote outstations. Linking between the BRU and the customer's network is via 10BaseT Ethernet. In cases where wired Ethernet is not available, this network connection can be extended by Link Radio Units (LRU's)¹, using another pair of frequencies f3 and f4. The system currently operates in the UHF band. A basic system level diagram is shown in Figure 1.

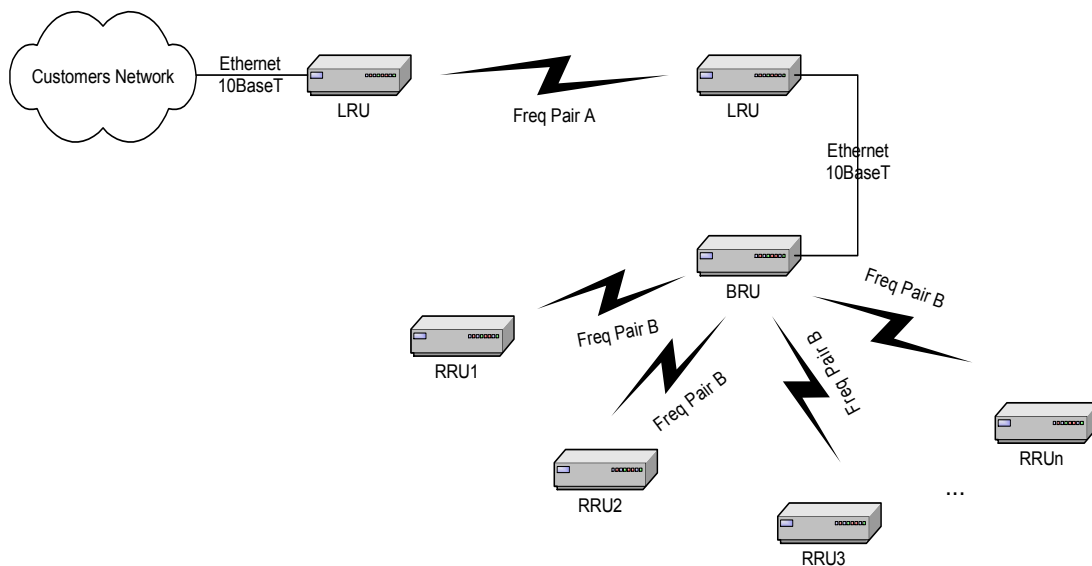


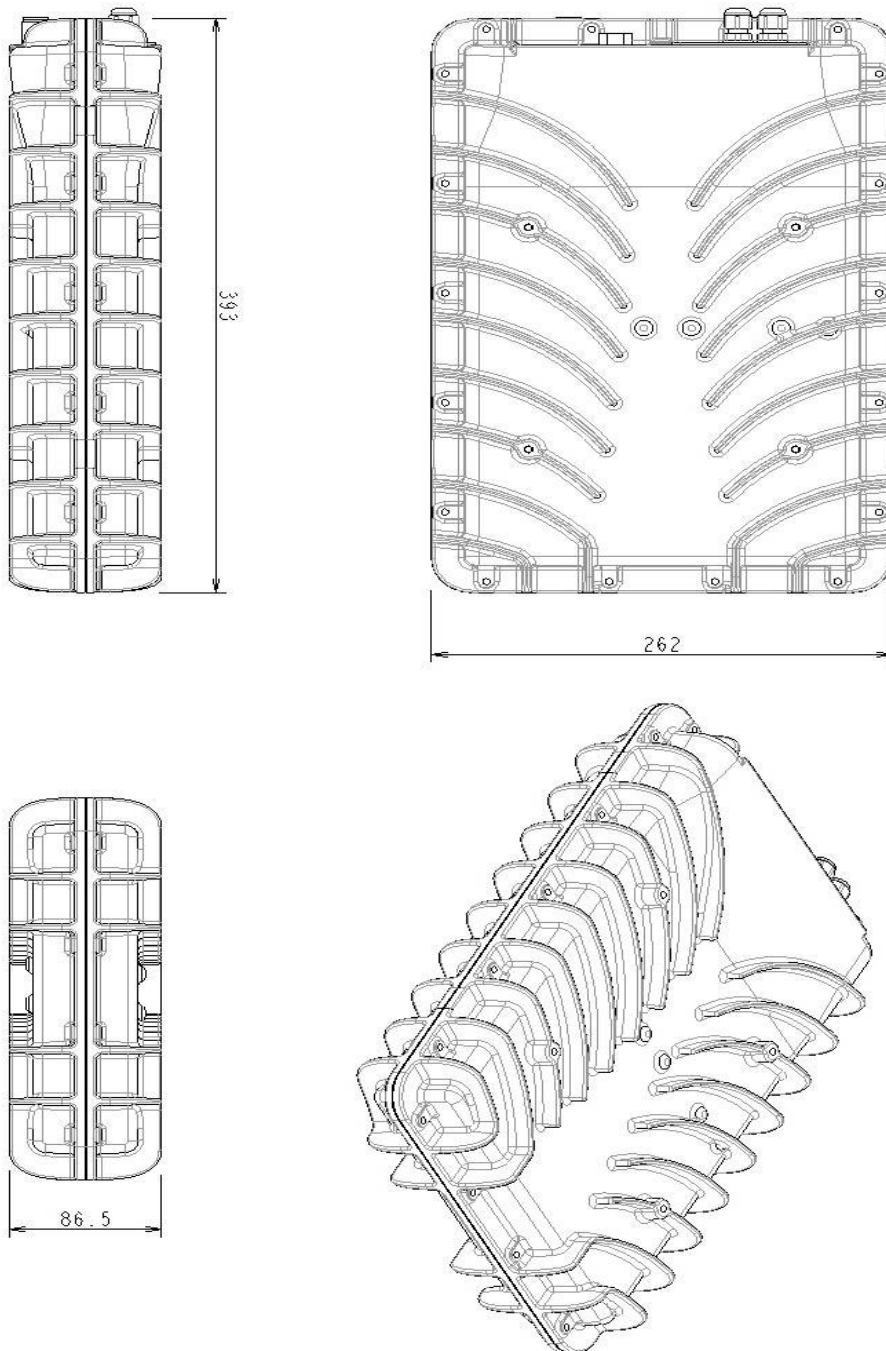
Figure 1 - System Diagram MDL Linking Network

¹ A LRU is an NDLink point to point Linking Radio Unit used to provide point to point linking. LRU's can be used to extend the customer's network to a BRU or beyond the RRU's.

1.1 MDL CUSTOMER APPLICATION REQUIREMENTS

The MDL is capable of carrying IP data including DNP3 (TCIP encapsulated SCADA) information across all elements of the network. MDL's may be used to configure and download data from a variety of customer equipment types e.g. protection equipment, SCADA RTU's and security equipment. The latency of SCADA response time, including multi-access protocol, is typically less than 1 second.

1.1.1 Mechanical Dimensions of Radio Modem



19In Rack Mount Options



2 PRELIMINARY PRODUCT FEATURES

1.1.2 Spectral Efficiency

The MDL utilises 2x2 or 2x4 MiMO QPSK/16/64/256QAM technologies, to achieve industry-leading spectral efficiency of up to 320kbps raw data rate in a 25 kHz radio channel and 160kbps raw data rate in a 12.5 kHz channel.

1.1.3 Form Factor & Installation

The MDL is optionally wall, pole or rack mountable (with forced-air cooling for rack mount), occupying just 2U in a standard 19in rack, and can be installed by installers with the usual competency and industry skills. In outdoor configuration, the MDL is designed to meet IP67 waterproofing.

1.1.4 Configuration, Monitoring & Alarms

The MDL offers a range of comprehensive configuration and monitoring packages which enables both local and optional remote configuration and monitoring of the system. The configuration tool can be accessed locally or over the air or remotely via an internet/intranet connection. SNMP is also optionally available. A range of alarms can be configured in a number of ways depending on the application.

1.1.5 M-CAM – MiMOMax Cognizant Adaptive Modulation

M-CAM is MiMOMax's proprietary smart adaptive modulation scheme, designed to optimise the data throughput while simultaneously maintaining the radio link in adverse conditions. It achieves this by adapting the RF modulation scheme depending on the measured "quality" of the received signal. It transverses from QPSK through to the maximum modulation scheme available (256 QAM) and visa versa, depending on the RF channel conditions.

M-CAM typically allows for better utilisation of the channel, as the modulation order is adapted as channel conditions change. In some circumstances, this may not be desirable (eg. Synchronous data, where fixed latency is required).

1.1.6 M-RAP – MiMOMax Routing Adaptation Protocols

M-RAP is an optional suite of protocols that provide dynamic re-routing in the event of a path failure where multiple paths are available. M-RAP would be able to learn the topology of the network and therefore reroute paths as the topology changes (links lost or added). OSPF routing protocol is used to determine which path to take, to achieve this re-routing functionality in a MiMOMax system. When a radio is “hard coded”, as “the default gateway” into an area, then the area loses communications, even when other radios could potentially act as default gateways. In the event of a communications failure VRRP is used in the MiMOMax radios to dynamically assign a virtual IP address so that the selected radio becomes the default gateway.

OSPF routers only communicate their state with the other routers in that “area”. GRE (Generic Routing Encapsulation) protocol may be used to pipe this monitoring information from the “areas” to a monitoring system in the core of the customer’s network.

1.2 ENVIRONMENTAL SPECIFICATIONS

1.2.1 Operating Temperature Range

Ambient maximum temperature range -25°C to +60°C

1.2.2 Humidity

4% to 100% (per EN 300 019 sec. 3.3 & 4.2H)

1.2.3 Environmental Protection

Designed to meet IP67 for outdoor mounting and IP20 for indoor rack-mount unit.

1.2.4 Operating Altitude

Up to 3000m

1.2.5 External Compliances

The product is designed to comply with:

EMC:

- AS/NZS/CISPR22
- EN 301 489 parts 1 and 4
- FCC 47CFR part 15
- ICES-003

Radio Performance:

- AS/NZ 4768
- EN 302 326
- FCC 47CFR part 90
- RSS-Gen, RSS-119

Environmental:

- EN 300 019 parts 3.3 and 4.2H

Safety:

- EN 60950



MiMO Multi Port Nib

1.3 INTERFACES

1.3.1 Ethernet Interface

Ethernet connectivity is presented via an RJ45 socket and is also configurable to provide connectivity to other IP enabled networked devices. The network connectivity provided by the MDL is at layer 2 or 3 (IP). In the layer 3 mode the MDL will function as a router as opposed to an Ethernet bridge or switch. Data rates of up to 256kbps can be achieved in the appropriate configuration and conditions.

1.3.2 Power Interface

The MDL operates on an external DC supply over a range of 10.5V to 32V. Optional external AC or DC power supplies are available for mains or higher voltage operation.

1.4 PERFORMANCE

1.4.1 Raw Link Data Rate

MiMO MDL operates with QPSK or 16/64/256 QAM, at a symbol rate of 20 kilosymbols/second, resulting in raw data rates of 80/160/240/320 kbps in a 25 kHz channel and 40/80/120/160 kbps in a 12.5 kHz channel (Under MiMOMax M-CAM).

1.4.2 Transmission Frequency

The MDL operates on 12.5 kHz and 25 kHz PMR paired channels within the 420-470 MHz band.

1.4.3 Transmission Power

The MDL transmits a maximum power of 1 Watt average per transmitter (total 2 Watts average for 2x2 MIMO).

1.4.5 Ethernet Interface Performance

1.4.5.1 Ethernet Physical Layer

The physical layer of the Ethernet interface is 10BaseT.

1.4.5.2 Bit Error Rate

The bit error rate provided by the IP transport (via Ethernet) service under appropriate link conditions is typically less than 1×10^{-7} .

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MDL SPECIFICATIONS (PRELIMINARY)

1.5 GENERAL

Configuration	2 x 2 MIMO		2 x 4 MIMO
Supply Voltage	10.5V DC to 32V DC		
Maximum Power Consumption	92W at 13.8V		
Supported Outstations (RRU's)	Typically 250 (Up to 1000 RRU's can be supported depending on individual requirements. Please contact MiMOMax Wireless Ltd for further details)		
Ambient Temperature Range	-25°C to +60°C		
Mounting	2U high rack mount Also available as wall mount unit		
Dimensions (W x H x D)	440 x 84.5 x 382 mm (box size) 481 x 86 x 392 mm (including protrusions)		
Weight	6.8kg (radio only excluding mounting bracket)		
Raw Data Rate	25 kHz	80/160/240/320kbps	80/160/240/320kbps
	12.5 kHz	40/80/120/160kbps	40/80/120/160kbps

1.6 TRANSMITTER

Number of MIMO transmitters	2	
Modulation	QPSK, 16/64/256QAM	QPSK, 16/64/256QAM
RF Power Output	2 x +30dBm (1 Watt) average	
RF Power Control Range	10dB	
RF Power Tolerance	+/- 1dB	
Frequency Range	420 to 470 MHz	
Frequency Step Size	6.25 kHz	
Frequency Accuracy and Stability	≤2ppm	
Nominal Channel Bandwidth	12.5 kHz or 25 kHz	
RF & EMC Standards Compliance	Refer to Section 1.3 External Compliances	

1.7 RECEIVER / DIVERSITY RECEIVER

Number of MIMO receivers	2		4
Modulation	QPSK, 16/64/256QAM		QPSK, 16/64/256QAM
RF typ Sensitivity for 10 ⁻⁴ BER	25 kHz	<-102/-99/-94/-87dBm	<-102/-99/-94/-87dBm
	12.5 kHz	<-106/-102/-97/-90dBm	<-106/-102/-97/-90dBm
RF typ Sensitivity for 10 ⁻⁷ BER	25 kHz	<-101/-98/-92/-85dBm	<-101/-98/-92/-85dBm
	12.5 kHz	<-105/-101/-95/-88dBm	<-105/-101/-95/-88dBm
Frequency Range	420 to 470 MHz		
Frequency Step Size	6.25 kHz		
Frequency Accuracy and Stability	≤2ppm		
Nominal Channel Bandwidth	12.5 kHz or 25 kHz		
RF & EMC Standards Compliance	Refer to Section 1.3 External Compliances		

1.8 DUPLEXER (INTERNAL)

Frequency	420 to 470 MHz (in three frequency splits)
Tx / Rx split	5 MHz Minimum
Stop Band Attenuation	>70dB
Stop Band Bandwidth	>500kHz
Insertion Loss	<2dB

1.9 ANALOGUE AND DATA INTERFACE

Ethernet	
Format	10BaseT
Connector	RJ45
Supported Bit Rates	Up to 250 kbps *
Serial (optional)	This can be configured, to suit individual requirements. For further information, please contact MiMOMax Wireless Ltd directly.
Audio (optional)	This can be configured, to suit individual requirements. For further information, please contact MiMOMax Wireless Ltd directly.

* The total aggregate data rate is 80, 160, or 320 kbps dependent on configuration and signal path.

2 ANTENNAS

2.1 DUAL - POLARISED COMPACT LOOP YAGI

Polarisation	Horizontal and vertical with separate feeds
Antenna Gain	>10dBi
Beam width, -3dB (parallel to polarisation plane) (perpendicular to polarisation plane)	48° nominal 52° nominal
Front-to-back ratio	>15dB
Frequency bandwidth (15dB return loss)	20 MHz
Connector arrangement	2 x Male Type N connectors on 1.5m tails of RG214 coaxial cable.
Mounting (Pole)	Twin vertically spaced clamps for attachment to 25 - 55 mm mounting pipe.
Number required per link end	1 for 2 receiver MIMO, 2 for 4 receiver MIMO
Dimensions W x H x L (direction of propagation)	250 x 250 x 850 mm
Weight	2.5 kg including coax tails and mounting brackets

2.2 QUAD ARRAY DUAL POLARISED LOOP YAGI

Polarisation	Horizontal and Vertical with separate feeds
Antenna Gain	> 16dBi
Beam width, -3dB (parallel to polarisation plane) (perpendicular to polarisation plane)	24 degrees (nominal) 24 degrees (nominal)
Front-to-back ratio	>20 dB
Frequency bandwidth (15dB return loss)	20 MHz
Connector arrangement	2 x Female type n connectors on combining Harness (Optional 1.5m tails of RG213 terminated in 2 x Male type n connectors)
Mounting	4 vertically spaced clamps for attachment to 25 to 55 mm mounting pipe. >= 50mm pipe recommended
Number required per link end	1 for 2 receiver MIMO, 2 for 4 Receiver MIMO
Dimensions W x H x L (direction of propagation)	910 x 910 x 860 mm
Weight	13kg including coax tails and mounting brackets

2.3 PANEL MIMO ANTENNA (HIGH WIND AND ICE TOLERANT)

Polarisation	Horizontal and vertical with separate feeds
Antenna gain	>10dBi (Typically 11.5 dBi)
Beam width (horizontal, vertical)	75° nominal, 32° nominal
Front-to-back ratio	>20dB
Frequency bandwidth (15dB return loss)	80 MHz
Connector arrangement	2 x female 7/16 connectors
Maximum gust wind speed	250 kph
Wind loading	660N (at 150kph)
Mounting	Twin vertically spaced clamps for attachment to 48 - 114 mm mounting pipe. Provision for additional stabilising struts (up to 4)
Number required per link end	1 for 2-receiver MIMO, 2 for 4-receiver MIMO
Dimensions W x H x T (direction of propagation)	500 x 1100 x 120 mm (+ mounting bracket)

ANTENNAS

Dual- Polarised Compact Yagi



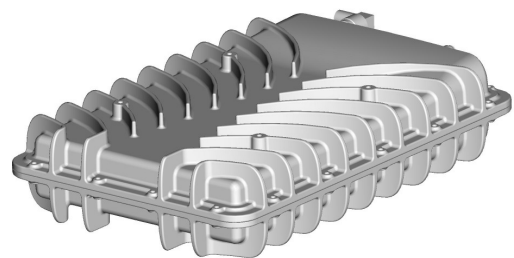
Panel MiMO Antenna



Quad- Array Dual Polarised Compact Yagi



NOTES



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DISCLAIMER:

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