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maximising the potential of advanced wireless comm

## MiMOMax Linking Products

### General

The MiMOMax Network Digital Link (NDL) is a software flexible, ultra low latency, digital radio link designed for mission critical data linking and back-haul applications.

The NDL 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 12.8 bits/Hz/s or greater, enabling raw data rates of up to 320kb/s including link overhead.

Utilising licensed spectrum ensures that the link 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).

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

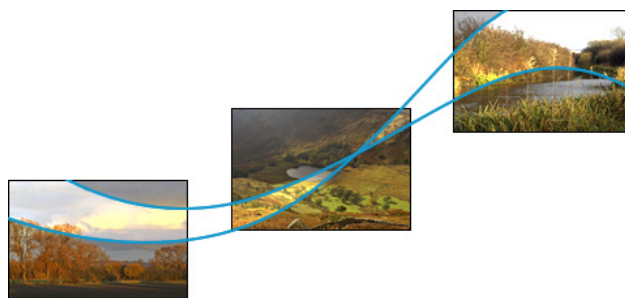
### NDL

The MiMOMax NDL is designed to provide high reliability, fixed linking solutions to a number of mission critical industries. A primary target application is linking together conventional and trunked, digital and analogue radio sites.

A MiMO antenna (or antennas) provides both vertically and horizontally polarized signals at each end of the link, to produce a high performance, pattern diverse MiMO link of over 30km with near-line-of-sight capability, and non-line-of-sight over shorter distances. The addition of a second optional MiMO antenna and receiver operating in a 2x4 configuration can provide further spatial diversity and link robustness.

A number of interfaces are available to support multichannel, conventional, analogue, Simulcast, MPT, P25 or TETRA digital networks, in trunked and simulcast configurations. A separate high quality site interface card with up to 6 x 32k ADPCM audio channels plus a 9k6 RS232 signalling channel, supports analogue networks.

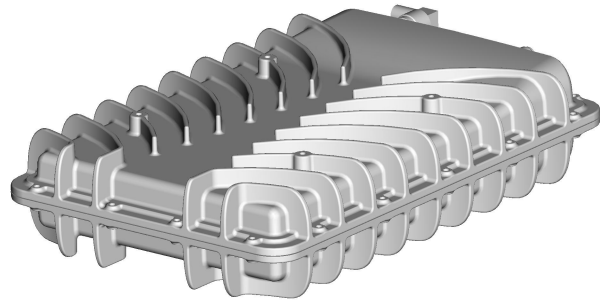
With these applications in mind, the NDL is designed to have ultra low latency and low jitter whilst fitting in the usual channel allocations allocated to fixed radio links. Multiple links can be cascaded to cope with difficult terrains or very long paths.



# 1 PRELIMINARY PRODUCT FEATURES

## 1.1.1 Spectral Efficiency

The NDL utilises 2x2/2x4 MiMO QPSK/16/64/256QAM technologies, to achieve industry-leading spectral efficiency of 80/160/240/320 kb/s raw data rate in a 25kHz channel (40/80/120/160 kb/s in a 12.5kHz channel).



*Network Digital Link (NDL)*

## 1.1.2 Built-in Multiplexer

The NDL has a built-in data multiplexer, supporting a mix of traffic from serial or Ethernet interfaces depending on interface option chosen. An external multiplexer (Rack Mount) supports additional interfaces.

## 1.1.3 Built-in Duplexer

For full duplex multi-antenna operation whilst maintaining a small overall size, the NDL has built-in antenna micro duplexers. External antenna duplexer options are available if required.

## 1.1.4 Form Factor & Installation

The NDL is pole, wall or rack mountable (forced-air cooling when rack mounted). Occupying 2U in a standard 19in rack, it can be installed by installers with normal industry competency. Both the Wall and Pole Mount options include a sun shade.

## 1.1.5 Configuration, Monitoring & Alarms

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

## 1.1.6 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 traverses from QPSK through to the maximum modulation scheme available and vice versa, depending on the RF channel conditions.

This feature can be disabled if required, and the modulation fixed in a specified state independent of signal quality. 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 (e.g. synchronous data, where fixed latency is required).

## 1.1.7 M-DAP- MiMOMax Data Acceleration Protocols

MiMOMax Wireless Ltd has released an optional suite of Data Acceleration Protocols (M-DAP). M-DAP is a suite of up to four individual protocols which accelerate the transfer of data across all MiMOMax linking products. In addition to accelerated data transfer, M-DAP also offers a QoS solution that fragments low priority data traffic to enable low jitter and ultra low latency for high priority traffic (for example VoIP). It compresses Ethernet, IP, UDP and RTP headers to allow additional bytes for the voice payload. This is particularly useful when protocol headers of VoIP streams occupy more bytes than the voice payload. For example, the headers on a VoIP packet might ordinarily occupy up to 60 bytes, but, M-DAP can compress this down to an ultra efficient 3 bytes.

### 1.1.7 M-RAP – Routing Adaptation Protocols

M-RAP is a suite of protocols that provide dynamic re-routing in the event of a path failure, where multiple paths are available. M-RAP is able to learn the topology of the network and therefore reroute paths as the topology changes (links lost or added). The OSPF (Open Shortest Path First) routing protocol is used to determine which path to take to achieve this re-routing functionality in a MiMOMax system. Where networking equipment is set to use a radio as the “default gateway”, there is a risk that the entire subnet could become unreachable in the event of the gateway going offline. MiMOMax uses VRRP (Virtual Router Redundancy Protocol) to dynamically assign a virtual IP address, so that any MiMOMax radio in the subnet can perform the role of 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

### 1.2.2 Operating Temperature Range

Maximum ambient temperature range -25°C to +60°C

(Where the radio unit is exposed to direct sunlight a suitable solar shield is required to prevent solar temperature gain)

### 1.2.3 Humidity

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

### 1.2.4 Environmental Protection

IP67 for outdoor wall or pole mount. IP20 for indoor rack-mount unit

### 1.2.5 Operating Altitude

Up to 3000m

## 1.3 EXTERNAL COMPLIANCES

The product is designed to comply with the following standards:

#### **Radio Performance:**

- AS/NZS 4768
- EN 302 217
- FCC 47CFR part 90
- RSS-Gen, RSS-119

#### **EMC:**

- AS/NZS/CISPR22
- EN 301 489
- FCC 47CFR part 15
- ICES-003

#### **Environmental:**

- EN 300 019 sections 3.3 and 4.2H

#### **Safety:**

- EN 60950



MiMO Multi Port Nib

## 1.4 INTERFACES

### 1.4.1 Ethernet Interface

For linking digital networks, Ethernet connectivity is presented via an RJ45 socket and is configurable to provide connectivity to other IP enabled networked devices. The network connectivity provided by the NDL is at layer 2 (IP). Layer 3 is also optionally available. Bandwidth not used by this connection is available for other optional interfaces. User data rates of up to 256kbps can be supported in the appropriate configuration.

### 1.4.2 Analogue and Serial Interface and Connection

An optional external audio interface card provides up to 6 high quality 32k ADPCM audio channels plus an asynchronous 9600bd RS232 serial data interface. This enables the direct support of up to 6 analogue VF channels with site signalling over one MiMOMax NDL link, for example supporting a 6 channel MPT site over one NDL 25 kHz link. Other codecs may be supported on request.

### 1.4.3 Power Interface

The NDL operates on an external DC supply over a range of 10.5V to 32V. Optional external AC or DC power supplies (230/110V AC or 48V DC) are available for mains or higher voltage operation.

## 1.5 PERFORMANCE

### 1.5.1 Raw Link Data Rate

MiMO NDL operates with QPSK or 16/64/256QAM at a symbol rate of 20(10) kilosymbols/second, resulting in raw data rates of 80/160/240/320 kb/s in a 25 kHz channel (40/80/120/160 kb/s in a 12.5 kHz channel). MiMOMax Cognizant Adaptive Modulation (M-CAM) is available as an option to enhance link reliability and throughput.

### 1.5.2 Transmission Frequency Band & Bandwidth

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

### 1.5.3 Transmission Power

The NDL transmits a maximum power of 1W average per transmitter (total 2W average for 2x2 and 2x4 MIMO).

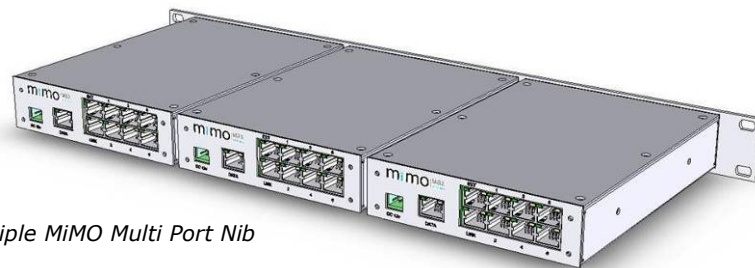
### 1.5.4 Ethernet Interface Performance

#### 1.5.4.1 Ethernet Physical Layer

The physical layer of the Ethernet interface is 10BaseT.

#### 1.5.4.2 Bit Error Rate

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



Multiple MiMO Multi Port Nib

## NDL SPECIFICATIONS (PRELIMINARY)

### 1.6 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		
Ambient Temperature Range	-25°C to +60°C		
Mounting	2U high rack mount Also available as pole/wall mount unit		
Dimensions (W x H x D), Rack mount option	440 x 84.5 x 382 mm (box size) 481 x 86 x 392 mm (including protrusions)		
Dimensions (W x H x D), Wall/pole mount option	262 x 393 x 86.5 mm (radio unit only, excluding mounting)		
Weight	6.8kg (radio unit only, excluding mounting)		
Gross Data Rate	25 kHz	80/160/240/320kb/s	320 kb/s
	12.5 kHz	40/80/120/160kb/s	160kb/s

### 1.7 TRANSMITTER

Number of MIMO transmitters	2
Modulation	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	See section 1.3

### 1.8 RECEIVER / DIVERSITY RECEIVER

Number of MIMO receivers	2		4
Modulation	QPSK, 16/64/256QAM		256QAM
Typical RF Sensitivity for 10 <sup>-4</sup> BER	25 kHz	<-102/-99/-94/-87dBm	<-87dBm
	12.5 kHz	<-106/-102/-97/-90dBm	<-90dBm
Typical RF Sensitivity for 10 <sup>-7</sup> BER	25 kHz	<-101/-98/-92/-85dBm	<-85dBm
	12.5 kHz	<-105/-101/-95/-88dBm	<-88dBm
Frequency Step Size	6.25 kHz		
Frequency Accuracy and Stability	≤2ppm		
Nominal Channel Bandwidth	12.5 kHz or 25 kHz		
RF & EMC Standards Compliance	See section 1.3		

## 1.9 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

## 1.10 ANALOGUE AND DATA INTERFACE

<b>Ethernet</b>	
Format	10BaseT
Connector	RJ45
Supported Bit Rates	Up to 280 kb/s *
<b>Serial (optional)</b>	
Format	RS232
Connector	DB9 female
Rate	9600 baud
<b>Audio (optional)</b>	
Format	6 x 4 wire 600Ω ports
Coding	32kbps ADPCM **
Connector	6 x RJ45
Signalling	Via RS232 serial port

\* The total aggregate data rate is 70, 140, 210 or 280 kbps dependent on configuration and signal path. Use of M-DAP further improves throughput.

\*\* Other CODECS also available on request

## 2 ANTENNAS

### 2.1 DUAL-POLARISED COMPACT YAGI

Polarisation	Horizontal and vertical with separate feeds
Antenna Gain	>10dBi across the band
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	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)

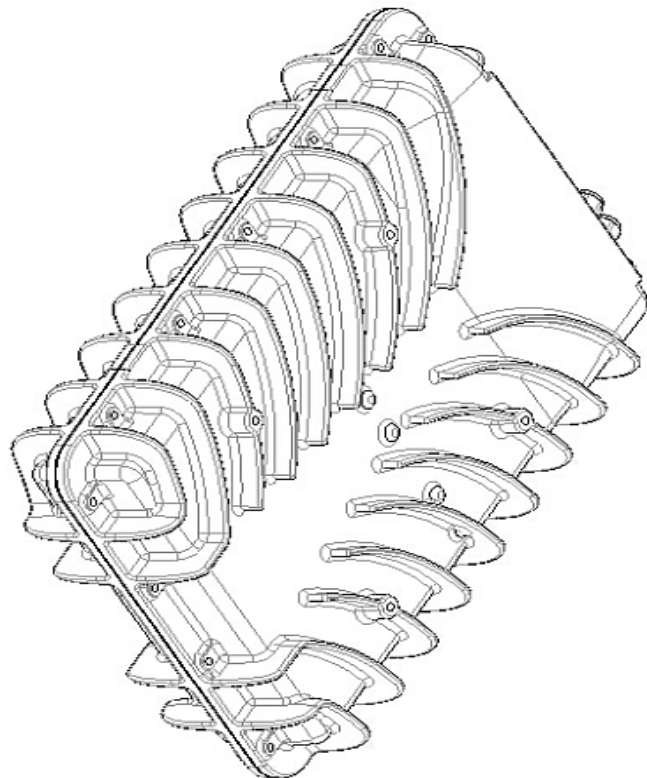
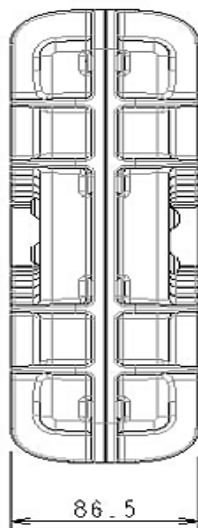
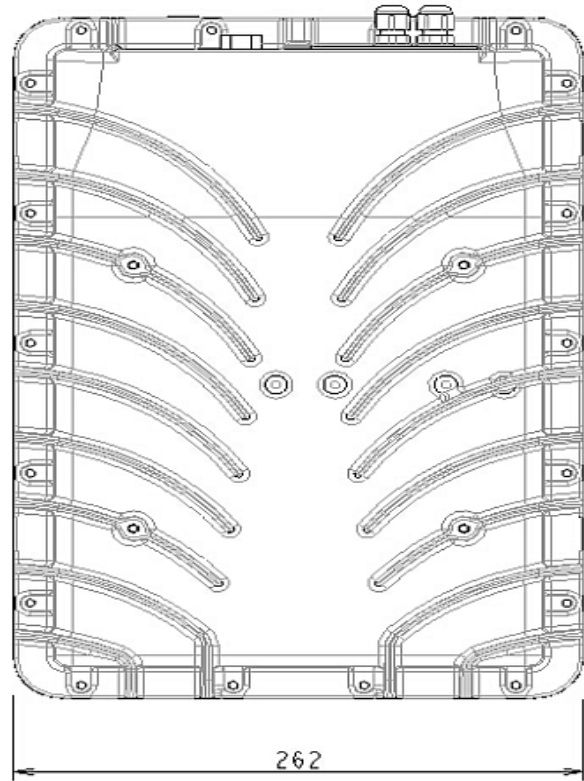
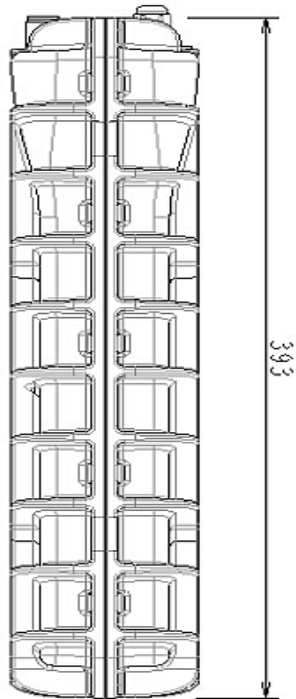
Polarisation	Horizontal and vertical with separate feeds
Antenna gain	>10dBi
Beam width (horizontal, vertical)	75° nominal, 32° nominal
Front-to-back ratio	>20dB
Frequency bandwidth (15dB return loss)	80 MHz
Connector arrangement	2 x female 7/16 connectors
Maximum Gust Withstand Speed	250 kph
Wind loading	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)



*Left: Panel MIMO Antenna*

*Right: Quad-Array Compact Yagi*

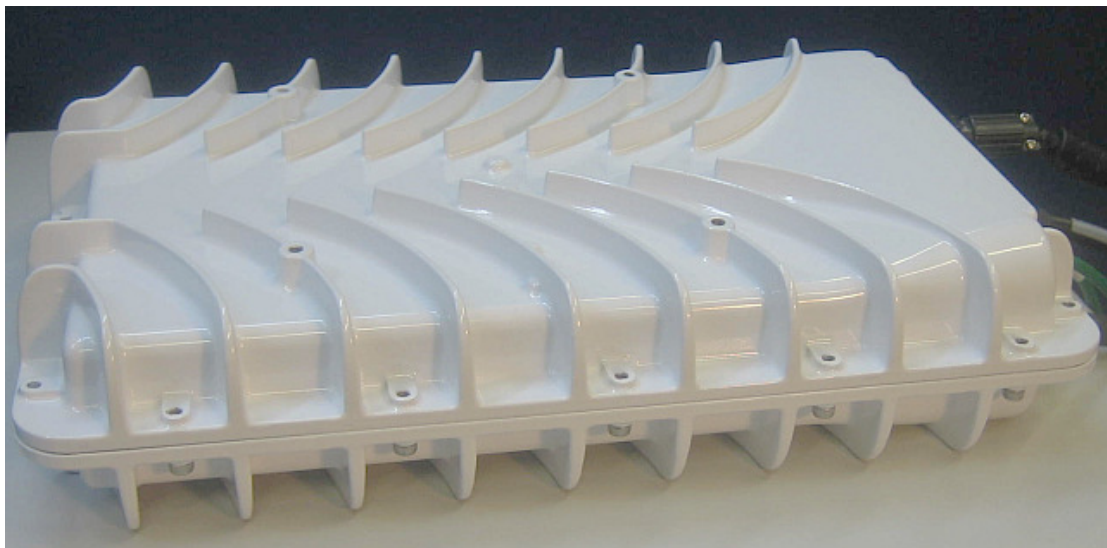
### 3 MECHANICAL DIMENSIONS



**RACK MOUNT MIMOMAX OPTIMISED PROTECTION VARIANT (OPV)**

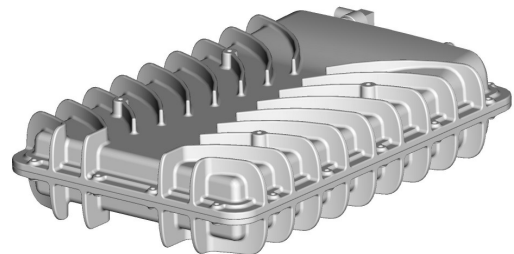


**POLE OR WALL MOUNT OPTIMISED PROTECTION VARIANT**





**4 NOTES:**



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**DISCLAIMER:**

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