



Meshdynamics Patented Third Generation Wireless Products

The major problem with preceding generations of wireless technology that used a single backhaul radio is that they could not overcome the key limiting factors in outdoor networking: scarce radio capacity that limits performance; the cost of many wired or fiber connections in the outdoor environment; and the need for easy trouble free deployment.

Meshdynamics' patented and patent-pending solutions begin by providing at least **two active radios to each backhaul**.

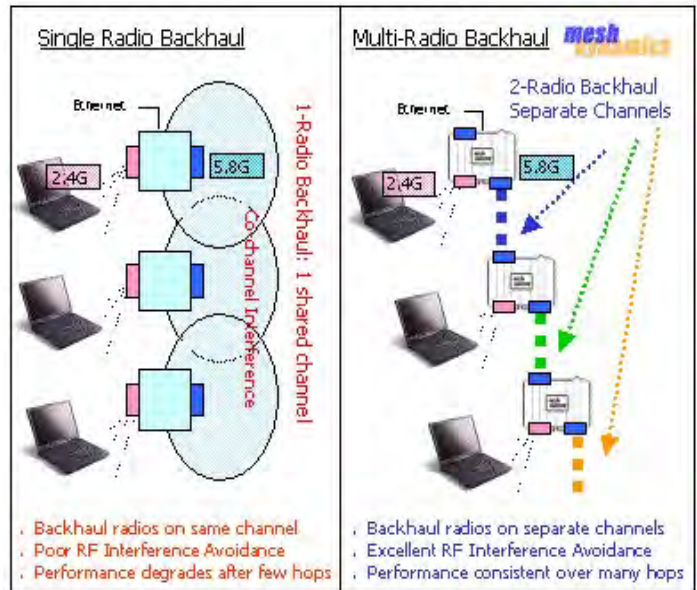
The Power of Third Generation: Two Radios per Backhaul.

To overcome the problems of congestion and contention one radio is used to create a link to its upstream (nearer the wired source or "root") node. Another radio creates a link downstream to the next neighbor node. The radios are on separate (non interfering) channels

This is different from the so-called dual radio solutions, where only one radio serves as the backhaul. The other radio services clients.

Meshdynamics [MD4000](#) products are more powerful because:

1. Each node may be sending and receiving simultaneously to its upstream and downstream neighbors, unlike the backhaul radio of the dual radio, which must continually "turn around" between sending and receiving upstream and downstream.
2. Because each link is managed independently, the available channels can now be re-used across the network. This expands the available spectrum, increasing performance up to 50 times when compared to single backhaul radio products. [\[More\]](#)



Optimized for Latency Sensitive Traffic (e.g. Video, VOIP)

The multi-radio intelligent backhaul pioneered by Meshdynamics vastly increases the performance of the network for demanding data applications. But even more important, Meshdynamics' unique third generation solution **delivers low delay (latency) and minimal variation in delay (jitter)**. Demanding applications like **full-motion surveillance video** and **voice over IP (VOIP)** operate over multiple hops. Military customers have confirmed that other mesh products (using a single backhaul radio) fail. [\[More\]](#)

Automatic Channel Management avoids RF Interference

One factor limiting the spectrum capacity of wireless mesh networks is interference from devices outside the network. Most wireless mesh products operate in the unlicensed 802.11a and 802.11b/g bands. Unfortunately, all devices transmitting in the same area must share the same RF space. Meshdynamics' third-generation Structured Mesh™ **algorithms detect and avoid RF interference** from non-Meshdynamics products. Each node contains the equivalent of a radio spectrum robot, monitoring other radio traffic, tracking its neighbor Meshdynamics mesh nodes, and adjusting channel mapping on the backhauls automatically and without disturbing users' sessions- **automatically**. [\[Short YouTube Videos\]](#)

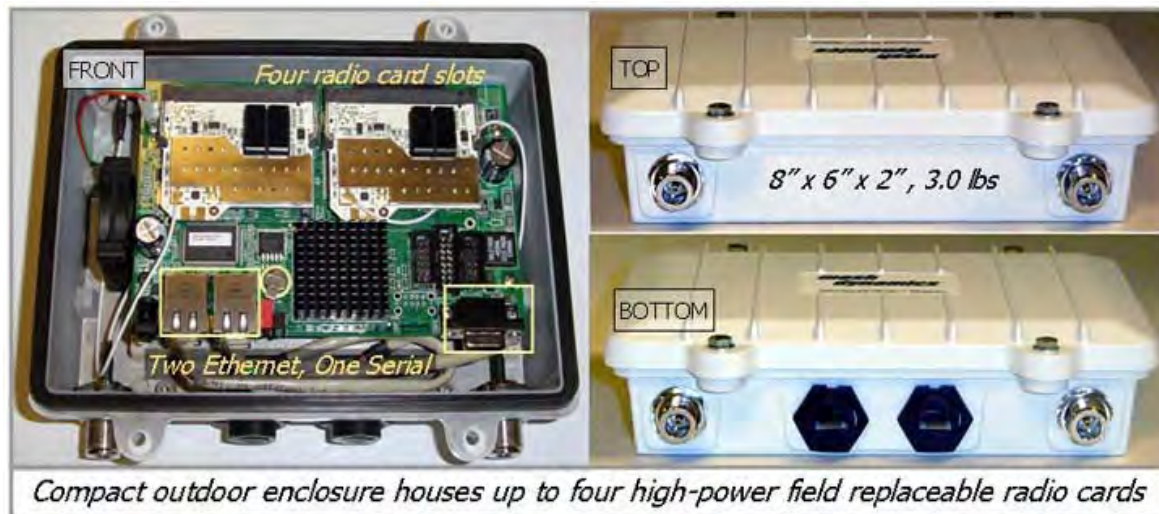
Robust Security , FIPS 140/2, Seamless Interoperability

Our backhaul automatically encrypts all backhaul traffic over the network (128 bit AES-CCM). Multiple encryption options – ranging from **WEP to WPA2 (IEEE 802.11i)** - are also provided for client side encryption. Meshdynamics routing is layer 2 so all our products integrate with and work seamlessly with Layer products. FIPS-140/2 certification supported for US military applications. [\[More\]](#)



MD4000 Structured Mesh™ Modules Feature Set

- Multi-radio backhaul on non-interfering channels
- Supports up to 4 400mw radios in the same enclosure.
- No appreciable bandwidth degradation per hop.
- Deterministic Latency and Jitter at each hop
- WPA/AES Secure backhaul traffic at all times
- Supports WPA/AES and WEP security for clients
- Multiple-SSID with 802.1q VLAN support
- IEEE 802.11e Prioritized traffic control
- Adjustable Power Control and ACK timing
- Remote Management at Network, Node and radio levels
- Operating Range: -40 to +85 Celsius



Compact outdoor enclosure houses up to four high-power field replaceable radio cards

Structured Mesh™ Multi-radio Backhauls. Unlike competing products, Structured Mesh™ multiple radio backhaul bandwidth does not degrade over multiple hops. USAF Tests results confirm this.

Deterministic Latency/Jitter. Uplink and downlink traffic are on separate non-interfering radios. Latency/jitter is thus more deterministic than "dual radio" meshes. Less than 1 ms per hop.

Self-forming, out-of-the-box connectivity. Modules automatically form the network upon powering up. Zero set up or pre-planning.

Self-configuring and self-healing. Network extension achieved by powering up more modules. Automatically switches routes when the RF environment changes.

Integrated 802.11a and 802.11b/g Client Access. Supports both 802.11a and 802.11b/g access. Client access may be restricted to 11a, 11b, 11g, or any combination thereof.

Integrated Ethernet Bridge for Cameras/Sensors. Cameras and other sensors are bridged into the wireless backhaul through one of 2 Ethernet ports provided. Custom serial port support is also available.

Integrated GPS support. Serial connection to a GPS radio supported. GPS radio uses one of the 4 N-Female Connectors on the box.

Backhaul Traffic Encrypted at all times. Backhaul traffic is 128 bit WPA/AES encrypted - regardless of whether clients traffic to the AP is encrypted or not.

Secure Access Point. Support with 128 bit WPA/AES with temporal keys and legacy WEP security supported for client connectivity to the AP. Military FIPS 140/2 certified.

Multiple SSID and VLAN Support. Multiple independent networks serviced simultaneously. Each SSID has configurable security settings. SSIDs may be mapped to 802.1q VLAN tags.

Adjustable ACK Timing and Transmit Power Control. The ACK timing and transmit power control is adjustable for each radio in the module.

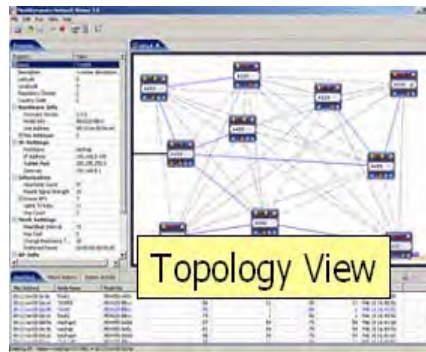
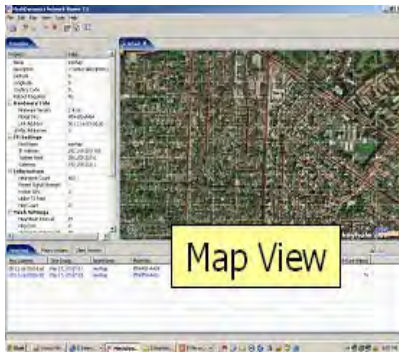
IEEE 802.11e Class of Service (CoS) Support. 4 IEEE 802.11e compliant classes of service are supported.

Adjustable Channel Width and Center Frequency. Supported for Non FCC customers (e.g. Military).

Outdoor Use enclosure. Die cast aluminum enclosure is weather tight. Operating range is -40 to + 85 Celsius.



MD4000 Network Management System (NMS)



RF Activity Map

BSSID	SSID	Signal	Tx %	Retx %
00:00:00:00:00:00		-90 dBm	0.56%	0.00%
00:00:00:00:00:00	adwinet	-85 dBm	0.30%	0.00%
00:1124:67:49:09	Turn_Alyshani	-87 dBm	3.26%	1.68%
00:14bf:0e:3f:cf	lincast	-87 dBm	2.30%	1.52%
00:12:0e:00:00:70	StructuredMesh	-88 dBm	2.77%	0.56%
00:12:0e:00:00:0c	StructuredMesh	-87 dBm	2.43%	0.88%
00:12:0e:00:00:04	StructuredMesh	-87 dBm	0.73%	0.01%
00:7451:78:03:f9	SK Wireless	-83 dBm	0.21%	0.00%
00:14:6c:8b:02:18	RTL8	-88 dBm	2.56%	0.29%
00:1b:09:06:04:73	YYY	-82 dBm	1.39%	0.07%

Comprehensive Network Management System (NMS). The MD4000 Network Management System (NMS) provides the ability to configure, monitor and analyze the MD4000 family of products. Based on Java technology, the NMS runs on any PC with the Java runtime environment. MD4000 nodes appear as graphical widgets with multiple LED status indicators, allowing point-and-click management of the units. The status window on the bottom window reports the current state of all nodes based on their recently received heartbeat. Heartbeat data includes transmit rate, signal strength, board temperature, packets moved etc. The left hand side properties window provides detailed information for a selected node including AP client activity. [\[More\]](#)

Per radio Security settings, ACK timing, transmit power control, SSID (including hidden SSIDs), VLAN settings

Per radio QoS settings include IEEE 802.11e support and specialized support for Voice and Video at the packet level.

Remote upgrades and Data logging: Software upgrades may be installed on the mesh nodes, through a secure interface between the mesh nodes and the NMS. Heart beat information may be saved to log files in CSV (comma separated values) format for further analysis using standard spreadsheet tools.

GPS Location Tracking. If the GPS sensor is installed on the mesh node, then GPS location information is transmitted periodically with the mesh node heart beat. Node locations are automatically updated in the NMS view. The NMS dynamically manages the background image movement to ensure that the current location of all nodes is correctly depicted. [\[More\]](#)

Application Integration Support. The NMS at its core is a headless Java Engine and the API supports both JavaScript and Java for automation scripts, packet analysis and third party application integration. For example, custom application software on mesh nodes polls sensors via the serial line interface on the node. The sensor data is processed in the node and then routed across the mesh. The processed data is recorded in a remote database. [\[Videos\]](#)

Other distinctive features of the Meshdynamics NMS include:

- No central management. The NMS is not needed for the mesh to run. No single point of failure.
- LED Status lights on node icons provide a succinct view of state of the network e.g. transmit rate, temperature etc.
- Macro Actions: Multi-selection (even across multiple networks) automates tedious tasks.
- RF Channel Activity map for both service and backhaul radios shows interfering radios in vicinity..
- Mesh Performance Logs: Heart beat data may be saved to log files for further analysis or charting in EXCEL.
- Client Activity Logs: Client data including signal strength, bandwidth used etc may also be logged in EXCEL.
- Configuration of VLAN, Security, SSID settings is simplified by group selection of mesh nodes
- Ability to set IEEE 802.11E support for Differentiated classes of service (CoS) supported on a per radio basis.
- Configuration of Radio Transmit Power Control and ACK timing on a per radio basis.
- Ability to define custom channel number center frequencies channel width.
- Ability to run throughput tests on the network via NMS diagnostic tools included with the NMS
- Remote Software Upgrades: All nodes may be remotely upgrades through a secure interface from the NMS.
- Remote command line interface: for advanced diagnostics and trouble shooting via a remote link.
- Remote Node recovery: All nodes may be set to factory default settings, through a laptop and wi-fi card.
- Web browser interface. All nodes have a web browser interface for advanced diagnostics and configuration.

Note: A detailed list of all NMS features and OEM customization options is available in the [NMS Configuration Guide](#). [\[Videos\]](#)

Four Radio Mesh Node Configuration Options

MD4000 Modular Mesh™ support up to 4 400mw radio cards in a single enclosure. Slots 0, 1 are generally used for the backhaul uplink and downlink radios respectively operating on non-interfering channels. Backhaul radios may be 2.4GHz, 5.8GHz or 4.9GHz. Slot 2 may be used for a 2.4GHz or 4.9GHz client access AP radio or an additional downlink. Slot 3 may be used for a downlink, 2nd AP radio or scanner (for mobility).

2.4 GHz Backhaul Products (operating in 2.412GHz – 2.482GHz)

MD4220-IIxx	2-Radio module with 2.4GHz uplink and downlink Backhaul (BH) in slots 0,1 Downlink also acts as AP.
MD4320-IIIx	3-Radio module 2.4GHz sectored BH and 2.4GHz AP radio in slot 2. AP client connectivity settable to b, g, b and g.
MD4325-IIxI	3-Radio mobile mesh module 2.4GHz BH, slots 0,1. Downlink also acts as AP. 2.4G Mobility Scanner radio in slot 3
MD4424-IIII	4-Radio mobile mesh module 2.4GHz Service Radios in all 4 slots. Use with 4 sectored antennas as 4 radio root AP.



5GHz Backhaul Products (operating in 5.250GHz- 5.350 GHz, 5.4000GHz- 5.700GHz, 5.725GHz – 5.845GHz)

MD4250-AAxx	2-Radio module 5GHz BH uplink and downlink Structured Mesh Backhaul (BH), slots 0, 1.
MD4350-AAIx	3-Radio module 5GHz BH in slots 0,1. 2.4GHz AP radio in slot 2. AP client connectivity settable to b, g, b and g.
MD4354-AAxA	3-Radio module 5GHZ Downlink radios. Three Downlinks, no uplinks. Must be used as a root node.
MD4455-AAIA	4-Radio mobile mesh module 5GHz BH in slots 0,1. 2.4G AP radio in slot 2. 5GHz Mobility Scanner radio in slot 3.
MD4452-AAIA	4-Radio module 5GHz BH in slots 0,1. 2.4GHz AP radio in slot 2. Second 5GHz Backhaul downlink in slot 3.
MD4454-AAAA	4-Radio module with 4 radios all 5GHz downlinks. Intended as a root node with four 90 degree panel antennas
MD4458-AAII	4-Radio module 5GHz BH in slots 0,1. Two 2.4GHz AP radios in slots 2, 3. AP connectivity settable to b, g, b and g.



Other Supported Options (4.9G, Single Radio Mesh)

1. The MD4000 Family also supports [4.9GHz radios](#) in both backhaul and service radio configurations. [Contact us](#) for details.
2. MD4000 nodes support [GPS based location](#) as an option. The GPS radio is housed in the same enclosure. [\[More\]](#)
3. Versions of our product are available for [explosion proof environments](#) (e.g. mining, military, refineries). [\[More\]](#)
4. 24VDC 2A Power over Ethernet (POE) adaptor is available for 120/22VAC VAC to 12VDC conversion [\[More\]](#)
5. OEM software licenses available for low cost 1-radio edge nodes and 1- radio mesh enabled nodes [\[More\]](#)
6. MeshDynamics supports custom mesh node configurations for OEM customers [\[More\]](#)

Additional Technical Information

www.meshdynamics.com/MDwebcasts.html Short Illustrative YouTube© Videos on our product, NMS, configuration etc.
www.meshdynamics.com/Multiple-Radio-Mesh-Nodes.html Overview on node configuration options for 2.4GHz and 5.8GHz models
www.meshdynamics.com/tech-presentations.html Technical support page, containing Installation and configuration guides, [FAQ](#).



MD4000 Specifications/Certifications

<p>System Operating Temperature Range Dimensions, Weight, Weather Rating System Power Consumption Supply Voltage Range Supported Ethernet Ports Serial Ports</p>	<p>- 40 to + 85 degrees Celsius. 8" (length) 6" (width) 2" (height), 3.0 lbs. NEMA 67 weather tight. 5-16 W depending on number of radios (up to 4 in one enclosure) 12 VDC - 48 VDC. 24VDC, 2A POE available from Meshdynamics. Two. Power over Ethernet (POE) supported on Eth Port 1. One. May be exposed through second Ethernet Port.</p>
<p>Number of Radio card slots in Enclosure Radio Frequency Bands Supported. Radio Output Power Supported Radio Transmit Power range (dBm, typical) Radio Receive Sensitivity range (dBm, typical)</p>	<p>Up to four field upgradeable radios cards per enclosure. 2.4GHz, 5.8GHz and 4.9GHz Atheros based radios. Depends on Radio Card selection. Wistron Complex Depends on Radio Card selection. Depends on Radio Card Selection.</p>
<p>Backhaul Capacity (raw) Backhaul Capacity TCP/IP Bandwidth Degradation Latency between hops Maximum number of Hops (field tested)</p>	<p>Depends on Radio card 22-300 Mbps TCP/IP Validated by US Government Labs. No degradation over multiple hops. Validated by US Government Labs. Less than 2 milliseconds per hop. Validated by US Government Labs. 64 hops, 300 node network, underground mine [communications network]</p>
<p>128 Bit Security/Encryption? Secure Backhaul Traffic? Priority Traffic and IEEE 802.11e? Multiple VLANs and multiple SSIDs?</p>	<p>Yes. Support both WEP and WPA/AES (e.g. with temporal keys). Yes. 128-256 Bit WPA/AES encryption (e.g. with temporal keys). Yes. Up to 4 IEEE 802.11e compliant categories supported. Yes. 16 standard. Hidden SSID with muted beacons also supported</p>
<p>RF Bandwidth control? RF Transmit Power Control? RF Adjustable ACK timing for long range? RF Auto Channel Management? GPS radio support in enclosure?</p>	<p>Yes. Selectable based on settings available for all radios. Yes. Slider scale user settable for all radios (0 –100%) Yes. Range: 50 us - 500 us, for all radios. Yes. Manual overrides/channel exclusions also possible. Yes. Uses serial line connection.</p>
<p>Ability to Change Channel Width? Ability to set custom channel frequencies? Multi-country support? Module is FCC/CE Compliant? FIPS 140/2 security certification?</p>	<p>Yes. For Non FCC applications channel width settable to 5, 10,20, 40 MHz Yes. Center Frequency of Channel settable via NMS utility. Yes. Country and channel selection. NMS settable. Yes. FCC ID: UZU-MD5, UZU-MD2, Can: IC-6935A-MD5, IC-6935A-MD2 Yes. [Certificate]</p>

About Meshdynamics

Meshdynamics' [third generation](#) wireless mesh technology is [patented](#) and patent-pending, developed by engineering teams in USA and India. Development began in 2001, with production shipments in late 2005. Core patents are awarded, others in process.

The Meshdynamics design is uniquely radio-manufacturer independent, allowing the rapid addition of new radio frequencies, radio system suppliers, and new technologies. Since late 2005, our mesh nodes have been installed in demanding applications requiring performance over multiple hops, rapid mesh formation and support for high speed mobility nodes. Applications include: municipal networking, underground mining and industrial, video surveillance, homeland security, transportation and public safety. [\[More\]](#)