A COMPLETE BROADBAND MULTIPOINT NETWORKING BACKHAUL AND MESH INFRASTRUCTURE SOLUTION PROVIDING SUPERIOR RANGE AND COVERAGE FOR WILDERNESS, RURAL, AND URBAN OPERATIONS

MAJOR BENEFITS
- Support new services and revenue opportunities
- Reliable unlicensed broadband reach in wilderness, rural and urban areas
- Reduce or eliminate VSAT and microwave reliance
- Reduce in-field telecommunications CAPEX and OPEX
- Strengthen enterprise OPSEC and in-field security

MAJOR CAPABILITIES
- VHF/UHF spectrum enables you to reach further and deeper into rugged terrain
- Scalable and expandable to meet the growing needs of the network and infrastructure requirements; extends reach of all Internet-based services
- Integrated support for point-to-point, multipoint, and mesh architectures
- Robust suite of physical security and data encryption services
- Network and equipment redundancy and fault tolerance configurations
RAPTOR® SYSTEM OVERVIEW

The RAPTOR® is a rugged industrial-grade wireless networking system designed to meet the rigors and field connectivity requirements to support critical broadband backhaul and infrastructure connectivity. The RAPTOR® features a modular hardware and firmware system concept to keep pace with ever increasing transport and security requirements.

RAPTOR® STANDARD CONFIGURATIONS AND APPLICATIONS

STANDARD AND OPTIONAL CONFIGURATIONS

BROAD SPECTRUM OPERATING SUPPORT
- Dual Hi-Band VHF and UHF operation: 174-216, 470-602, 620-698 MHz
- Optional bands:
  - Military: 225–400 MHz
- Power output:
  - Standard: 2 Watts (33 dBm)
  - Link performance algorithm maintains end-to-end signal integrity control
  - Spectrum Management System automatically avoids interference to sustain connectivity

NETWORK ARCHITECTURE
- Configurable architectures: point-to-point, point-to-multipoint, and ad hoc mesh topologies
  - Compatible with all IP-based routers, hosts, and clients
- Multiple RF channel bonding capability increases
- System reliability, payload capacity, and interference resistance

ANTENNA
- Single and dual antenna options support frequency and space diversity operations

SECURITY
- Robust support of physical, firmware, and software tools secure and defend against communications denial, field intrusions, and data theft.

APPLICATIONS

TELECOMMUNICATIONS SUPPORT
- LTE/4G/GSM Range Extension
- Remote WiFi/WiMax Off-load
- Superior in-structure penetration and coverage
- Ship-to-shore and ship-to-ship

NATIONAL INFRASTRUCTURE
- Border and customs networks to support VoIP, video and data requirements
- Oil and gas refineries and distribution
- Water and waste water infrastructure
- Electric power transmission and distribution grid
- Chemical and pharmaceutical processing facilities

TRANSPORTATION SYSTEMS
- Public and Safety backhaul
- Highway infrastructure networks
- Rail monitoring and control systems
- Harbor and waterways network

OPTIONS
- Mobile and explosion resistant packaging
- Interfaces for legacy (non-IP) devices
- DC input support from 12 to –48 VDC
RAPTOR® WIRELESS NETWORK TECHNOLOGY OFFERS THE NETWORK DESIGNER, OPERATOR AND SERVICE PROVIDER MAJOR PERFORMANCE ADVANTAGES OVER CONVENTIONAL LTE/4G, MICROWAVE, AND SATELLITE SYSTEMS.

Raptor®’s Spectrum Advantage
- Up to 5 times the range and coverage of WiMax and WiFi in urban and rural settings (see Table 1)
- Superior RF reach and coverage within structures, canopied, and vegetative spaces
- Spectrum Agility and Frequency Diversity to increase throughput, and avoid or by-pass on-air interference

Network Advantage
Raptor®’s embedded physical and network level multi-point and Peer-to-Peer ad hoc unified mesh routing engine supports all network architectures—point-to-point, multi-point, mesh, star and tree network configurations. These configurations support nearly any real-world connectivity challenge.

Network Management Advantage
SafariView, RAPTOR®’s embedded Operations, Administration and Maintenance (OAM) tool provides total secure administration and control of each RAPTOR® node and the network.

Cyber Advantage
RAPTOR®’s suite of security-focused hardware, firmware, and software assists in defending your critical operations and information from internal and external wireless and network threats.

Application Versatility Advantage
RAPTOR®’s network scalability and versatility enables system planners to meet specific range, coverage, security, and mission requirements at minimum life cycle cost and system interruption.

Capital Advantage
RAPTOR® is the economic solution of choice. Its broad operating spectrum capability and longer reach mean quicker deployment with less equipment and required infrastructure. Raptor® offers a real alternative to VSAT and microwave in challenging environments.

Table 1 Analysis Parameters
- Tx and Rx antenna height: 20 meters; Rx sensitivity: -85 dBm at 6 MHz bandwidth
- VHF/UHF power out: 10 Watts (40 dBm); Single link payload rate: 5 Mbps
- 0.9, 2.4, 5.8 GHz systems 1 Watt output.

### TABLE 1. RAPTOR® RANGE AND COVERAGE ADVANTAGE

<table>
<thead>
<tr>
<th>FREQUENCY MHz</th>
<th>BAND/TECHNOLOGY</th>
<th>NOMINAL RANGE (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>IN-CITY</td>
</tr>
<tr>
<td>174–216</td>
<td>High-Band VHF</td>
<td>10</td>
</tr>
<tr>
<td>470–698</td>
<td>UHF</td>
<td>7</td>
</tr>
<tr>
<td>903–928</td>
<td>UHF</td>
<td>4</td>
</tr>
<tr>
<td>2400</td>
<td>802.11g/n WiFi</td>
<td>2.5</td>
</tr>
<tr>
<td>5800</td>
<td>802.11a WiFi</td>
<td>1</td>
</tr>
</tbody>
</table>

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RAPTOR® TOPOLOGY EXAMPLES

Flexibility and scalability are essential elements in successfully meeting today’s backhaul infrastructure requirements. The figures below illustrate Raptor®’s ability to meet virtually any topology challenge.

**Figure 1.** Point-to-point link using a single VHF or UHF channel.

**Figure 2.** Aggregating multiple channels increases throughput by doubling RF bandwidth and enhancing system reliability through spare diversity (antenna separation) and frequency diversity via a secondary VHF/UHF link.

**Figure 3.** Raptor® makes implementing VHF/UHF multi-point infrastructure links on VHF/UHF bands easy.

**Figure 4.** Dual multipoint network link segments provide increased payload rates and enhance system reliability.

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NETWORK SECURITY AND MAINTENANCE TOOLS

RAPTOR® DUAL CPU CORE, CRYPTO-ACCELERATED
NETWORK PROCESSOR SUPPORTS DEPLOYMENT IN NEARLY
ANY CRITICAL INFRASTRUCTURE APPLICATION.

Standard network architecture and security capabilities include:

**FIREWALL/DMZ**
- Robust firewall rule construction
- Secure download of firewall rule sets

**AUTHENTICATION**
- Multi-factor authentication
- Remote access token-based authentication

**MALICIOUS CODE DETECTION**
- Deep packet inspection

**EVENT/STATUS MONITORING AND LOGGING**
- SNMPV3 enhanced security and remote configuration
- Maintenance logs
- Authentication
- Traffic monitoring and analysis
- Intrusion detection

**WIRELESS MAINTENANCE SUPPORT**
- Secure password support for remote management and configuration of wireless and network elements

**FAULT TOLERANT AND REDUNDANCY SUPPORT**
- Power Shelf provides 100% backup for all RF functions
- Dual channel operation supports frequency and space diversity providing high reliability data transfer over long and NLOS paths

**VLAN SUPPORT**
- Multiple independent VLANs
- VLAN trunking

**CYBER DEFENSE TOOLS:**
- Static Coding of ARP Tables
- Embedded encryption along with strong authentication provides resilience to Man-in-the-Middle attacks
- Embedded ARPWatch tool monitors and logs Ethernet traffic activity e.g. changing IP and MAC addresses. Raptor® will notify and react if non-approved Ethernet/IP pairings occur.

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SafariView Network Graph UI provides a visual monitor of all levels of connectivity and key statistics

**INTERFACING WITH RAPTOR®**

Raptor® Network Radio Shelves are bundled with SafariView, an embedded web-based UI that performs standard Operations, Administration, and Maintenance (OA&M) activities.

**SafariView | Raptor® Operations, Administration, and Maintenance (OAM) Tool**

Embedded in each Raptor® is a robust suite of network tools and applications to configure, monitor, administer, and control each Raptor® within the network. Capabilities under password and secure control include:

- Ability to locally or remotely configure any Raptor® within a network
- Robust firewall defense at each Raptor® WAN and LAN gateway
- Support for multiple secure VPN circuits
- Redundant and alternative fault-tolerant network scenario support
- Manual or automatic control of radio link services for each Raptor® site
- Embedded wireless controller support for secure WiFi and third party wireless systems
- Factory support for non-IP devices and wireless voice and data systems
- Deployment Aids:
  - Over-the-air antenna aiming tools
  - Link quality measurement system
TYPICAL NETWORK AND RF SITE CONFIGURATIONS

**Basic Network Configuration**

- **LED Status Field**
- **System Status and Control**
- **WAN1**
- **LAN**
- **WAN2**
- **USB and Console**
- **Router (optional)**
- **Public/Private Internet**
- **Intranet**
  - Local LAN
  - Middle mile and edge devices

**Single Link Half-Duplex/Single Antenna Configuration**

Use this configuration for point-to-point and multi-point applications. (See Topologies Example page)

Choose antenna to meet footprint requirements:
- Omni (360°)
- Directional (60°–90°)
- Sector (90°–180°)

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OPERATING AND TECHNICAL SPECIFICATIONS

POWER
- AC Input: 110/240 VAC, 50/60 Hz
- Power consumption:
  - Single link: 70 Watts
  - Dual link: 130 Watts
- RF channel output (standard): 2 Watt average power over 6 MHz bandwidth

SECURITY
- Authorization and Accounting: Protects against unauthorized administration/maintenance and over-the-air access
- System access/authentication capabilities: Multi-factor authentication. Remote access token-based authentication
- System access/authentication capabilities: Integrated firewall and suite of information assurance tools

NETWORK ARCHITECTURE
- VLAN: Supports multiple laws; static and dynamic
- System integrity logs
- Firewalls: Robust rule support and encrypted download
- Dynamic ad hoc network: Adaptive, self-forming, self-healing network
- Network size: Limited only by available RF channels
- Network capabilities/single channel: Point-to-point, point-to-multipoint, and mesh
- Network capabilities/dual channel: Point-to-point, multipoint, and mesh
- Maintenance/diagnostics: Over-the-air programming, integrated web-based administration, monitoring, and reconfiguration
- System logs: System security, authentication, information flow, traffic monitoring, and intrusion detection
- Network timing: Multiple network timing protocol options (NTP)

STANDARD ANTENNA INTERFACES
- Standard: Common Tx/Rx antenna
- Optional: Separate Tx and Rx antennas

FREQUENCY STABILITY
- Internal (standard): ±2.5 ppm, ±25 Hz
- External (optional): High stability reference, ±0.25 Hz

SUPPORT ACCESSORIES
- Antennas: High and low gain directional, omni, or sector
- External GPS Geo location Reference module: Provides NEMA 0183 format latitude/longitude output
- Precision frequency synchronization module: GPS time-base precision frequency source: (<± 0.1 ppm) ±1 Hz

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SPECTRUM BENEFITS
What channels are best for non-line-of-sight and beyond horizon communications?

Non-Line-of-Sight (NLOS) paths are obscured by trees, buildings, and hills, etc. where signals arrive from and return to the sender via totally reflective paths. In general, VHF signals in the 174 to 216 MHz band outperform UHF channels. With the Raptor X propagation at all available bands is automatically evaluated to determine appropriate operating channels.

CHANNEL SELECTION
How do I choose what channel to use?

Operating channels should match your application. For example, in long range and wide-area coverage scenarios, a lower operating frequency or channel should be used. Operating over a relatively flat 20 km range, a UHF channel will perform well with adequate signal margin to survive 10 to 20 dB fades. Over the same range in a forested area, high-band VHF 170 to 216 MHz provides a higher Rx signal and increased fade tolerance.

How do I determine what channels are available?

In straight LOS applications, both VHF and UHF bands offer comparable service, although when possible, the lower frequency provides additional margin. In high vegetative and beyond-line-of-sight applications, VHF is superior. In all cases, Raptor X’s spectrum evaluation tool will assist in this process. Evaluation should be performed in both VHF and UHF bands.

INTERFERENCE
What happens if there is interference on a channel I am using?

When communication is degraded by interference, the Raptor X can be directed to manually, or automatically do the following:

a) Switch to an alternate authorized clear channel using Raptor X’s embedded SafariView Spectrum Management tools.
b) Change modulation format to lower Bit Error Rate (BER) and maintain data flow.
c) Increase power to overcome the interference.
d) Automatically search for and switch to a usable channel to continue operation.

Can output power be increased?

Yes, the Raptor X High Power 10 Watt Power Amplifier provides the added punch needed in long-range and difficult terrain scenarios. See the Raptor X High Power datasheet for additional information.

NETWORK CAPABILITIES
Can I aggregate multiple VHF/UHF channels to increase transport speed and reliability?

Yes. Independent adjacent or non-adjacent channels in the same or different VHF/UHF bands can be bonded to increase data speeds and to provide frequency and spatial diversity to increase system reliability in the event of channel degradation by noise or fading.

Note: Channel bonding requires at least one Raptor X Channel Expansion Shelf per link.

Can I change channels remotely?

Yes. Raptor X network access is fully controlled by a secure SSL pre-configuration, or over-the-air via an encrypted channel.

Can a Raptor X network be integrated into an existing RF data network or microwave infrastructure network?

Yes. The Raptor X is an Internet Protocol (IP) device using Ethernet interconnect technology that is compatible with all other network devices including WiFi and LTE/4G systems. Raptor X’s internal routing engine allows you to integrate with any network based communication system.

ANTENNAS
How do I determine what antenna to use?

Antenna choice is based primarily on two factors:

a) In a point-to-point application, directional gain antennas are recommended. In addition, Raptor X offers an independent receive antenna option that allows the use of high-gain Rx antennas to increase Rx signal level for extended reach applications.
b) For point-to-multipoint operations, recommended antennas range from 360° omnidirectional coverage to 90 to 180° sector antennas that provide defined geographical coverage.

LICENSING
Is an export license required?

Yes, for military applications or when operated in the 225 to 400 MHz band, the U.S. Department of State requires an export license.

SPECIALIZED SOLUTIONS
Can Metric Systems provide specialized engineered solutions to fit ship-to-shore, ship-to-ship, ground-to-ground, or ground-to-air requirements?

Yes, Metric Systems Corporation welcomes the opportunity to work with your organization to deliver focused end-to-end solutions to meet your specific needs.