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

MAJOR CAPABILITIES

- UHF operating band for extended range and coverage
- Scalable point-to-point to wide-area mesh
- Robust suite of physical security and data encryption services
- End-to-end redundancy and fault tolerance configurations
- Up to 30 Mbps full-duplex links
**RAPTOR XR SYSTEM OVERVIEW**

The RAPTOR XR is an industrial-grade wireless networking system designed to meet the rigors and connectivity requirements of critical backhaul and infrastructure operations. RAPTOR XR features a modular hardware and firmware system concept that keeps pace with ever increasing transport and security requirements.

**STANDARD AND OPTIONAL CONFIGURATIONS**

**BROAD SPECTRUM OPERATING SUPPORT**
- Dual UHF operation: 470-602, 620-698 MHz
- Power output:
  - Standard: 2W (33 dBm)
  - Dynamic link performance engine continuously maintains end-to-end signal integrity
  - Spectrum Management System works to avoid interference and sustain connectivity

**NETWORK ARCHITECTURE**
- Pre or field-configurable architectures: point-to-point, broadcast, and ad hoc peer-to-peer mesh topologies
- Compatible with all IP-based routers, hosts, and clients
- Bonded channel aggregation capability increases system reliability, payload capacity, and interference resistance

**ANTENNA OPTIONS**
- Standard: Common (Tx/Rx) antenna (with integrated diplexer)
- Option: Independent Tx/Rx antenna options provide range and coverage flexibility

**SECURITY**
- Robust suite of physical, firmware, and software tools to defend against wireline and wireless threats.

**APPLICATIONS**

**TELECOMMUNICATIONS**
- LTE/4G/GSM Range Extension
- Remote WiFi/WiMax Off-load
- Rural Internet infrastructure
- Superior infrastructure RF penetration and coverage
- Maritime ship-to-shore and ship-to-ship

**NATIONAL INFRASTRUCTURE**
- Border networks to support VoIP, video, data, and ISR systems
- Oil and gas production 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

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

<p>| TABLE 1. RAPTOR RANGE AND COVERAGE ADVANTAGE |</p>
<table>
<thead>
<tr>
<th>FREQUENCY MHz</th>
<th>BAND/ TECHNOLOGY</th>
<th>NOMINAL RANGE (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470–698</td>
<td>UHF</td>
<td>IN-CITY RURAL</td>
</tr>
<tr>
<td>903–928</td>
<td>UHF</td>
<td>7 25</td>
</tr>
<tr>
<td>2400</td>
<td>802.11g/n WiFi</td>
<td>4 10</td>
</tr>
<tr>
<td>5800</td>
<td>802.11a WiFi</td>
<td>2.5 7</td>
</tr>
</tbody>
</table>

Table 1 Analysis Parameters
- Tx and Rx antenna height: 20 meters; Rx sensitivity: -80 dBm at 6 MHz bandwidth
- UHF power out: 27.8 dBm; Single link full-duplex payload rate: 10 Mbps
- 0.9, 2.4, 5.8 GHz systems at 27 dBm output.

Network Advantage
RAPTOR’s embedded physical and network level peer-to-peer and ad hoc unified mesh routing engine supports all network architectures—point-to-point, mesh, star and tree network configurations. With these configurations nearly any real-world connectivity challenge can be solved.

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 critical operations and information from internal and external wireless and network threats.

Application Versatility Advantage
RAPTOR’s network of scalability and versatility allows 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.

Need more information? Email us at raptor@metricsystems.com
RAPTORXR TOPOLOGY EXAMPLES

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

Figure 1. Point-to-point link using a dual VHF or UHF channels.

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 UHF link.

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NETWORK SECURITY AND MAINTENANCE TOOLS

RAPTOR® XR 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® XR will notify and react if non-approved Ethernet/IP pairings occur.

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

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

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

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

- Ability to configure any Raptor® XR within a network locally or remotely
- Robust firewall defense at each Raptor® XR 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® XR 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

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TYPICAL NETWORK AND RF SITE CONFIGURATIONS

**Basic Site Configuration**

![Basic Site Configuration Diagram]

**Single Link Full-Duplex/Common Tx/Rx Antenna Configuration**

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

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

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OPERATING AND TECHNICAL SPECIFICATIONS

POWER
- AC Input: 110/240 VAC 50/60 Hz
- Power consumption: 70 Watts

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 Information Assurance tools

NETWORK ARCHITECTURE
- VLAN: Supports multiple laws; static and dynamic
- System integrity logs
- Firewall: 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 (with diplexer)
- Optional: Separate Tx and Rx antennas

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

SUPPORT ACCESSORIES
- Antennas: Directional, omni or sector
- External GPS Geo Location module: Provides NEMA 0183 format latitude and longitude output
- Precision Frequency Synchronization Module: GPS time-base precision frequency source (<±1 ppm), ±1 Hz

GENERAL
- Standard Frequency Range
- UHF Low-Band: 470–602 MHz
- UHF High-Band: 620–698 MHz
- Dynamic Frequency Agility (DFA) option: Provides active broad spectrum operation to avoid fading and interference
- Frequency tuning steps: 1 kHz

Weight
- Primary link: 9.5 lbs (4.31 kg)
- Power supply: 9.4 lbs (4.26 kg)

Dimensions
- Primary link: 14 in. D x 19 in. W x 1.75 in. H (355.6 mm x 482.6 mm x 44.45 mm)
- Power supply: 14 in. D x 19 in. W x 1.75 in. H (355.6 mm x 482.6 mm x 44.45 mm)
- Operating temperature: Standard: -10° to +65°C Optional: -35° to +65°C

RECEIVER/TRANSMITTER MINIMUM SPECIFICATIONS
- Modulation Mode
  - QPSK (4 QAM): Minimum Signal Level -85 dBm, Minimum Required SNR 8 dB, Full-Duplex Link Rate 8.28 Mbps
  - 16 QAM - OFDM: Minimum Signal Level -80 dBm, Minimum Required SNR 12 dB, Full-Duplex Link Rate 12.4 Mbps
  - 64 QAM - OFDM: Minimum Signal Level -75 dBm, Minimum Required SNR 18 dB, Full-Duplex Link Rate 18.66 Mbps
- Adjacent channel rejection (6 MHz channel VHF/UHF): > 70 dB (100 kHz off-channel)
- Image rejection: > 70 dB
- Average conductive RF power output per VHF/UHF 6 MHz channel: 27.8 dBm

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**CHANNEL SELECTION**

**How do I choose what channel to use?**
Operating channels should match your application. For example, in long range and wide 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 LOS applications, both VHF and UHF bands offer comparable service, although when possible, the lower frequency provides additional margin. For outside to inside operation, UHF is recommended. In high vegetative and beyond-line-of-sight applications, VHF is superior. In all cases, Raptor XR’s spectrum evaluation tool will assist in this process. Whenever possible, over-the-air (OTA) evaluation should be performed in both VHF and UHF bands if channels are available.

**INTERFERENCE**

**What happens if there is interference on a channel I am using?**
When communication is degraded by interference, the Raptor XR can be configured to manually, or automatically do the following:

a) Switch to an alternate authorized clear channel using Raptor XR’s embedded SafariView Spectrum Management tools.
b) Automatically or manually change modulation format to maintain data flow.
c) Increase power to legal maximum to overcome the interference.
d) Automatically switch to a pre-programmed channel to continue operation.

**SPECIALIZED SOLUTIONS**

**Can Metric Systems provide specialized Raptor XR solutions to fit ship-to-shore, ship-to-ship, ground-to-ground, or ground-to-air requirements?**
Yes, Metric Systems sales representatives welcome the opportunity to work with your organization to deliver application-specific solutions to meet your specific needs.

**NETWORK CAPABILITIES**

**Can I use 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.

**Can I change channels remotely?**
Yes. Raptor XR network access is fully controlled by a secure pre-configuration, or over-the-air via an encrypted channel.

**Can a Raptor XR network integrate into an existing RF data network or microwave infrastructure network?**
Yes. The Raptor XR is an Internet Protocol (IP) device using Ethernet interconnect technology which is compatible with all other network devices including WiFi and LTE/4G systems. Raptor XR’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. Raptor XR 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 provide defined geographical coverage.

**LICENSING**

**Is an export license required?**
An export license for the Raptor XR is only required if it is used for military applications or optimized to operate in the 225 to 400 MHz band.

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Raptor X and XR are covered under one or more of the following U.S. patents: 6952563, 7013345, 7089014, and Canadian patents 2417031, 2444805, and 2444643. Specifications subject to change without notice.