

## Microwave Radio Rapid Ring Protection in Public Safety P-25 Land Mobile Radio Systems

Achieving Mission Critical Reliability



## Overview

New data, video and IP voice services are transforming private communications networks in public safety. Consequently, these new IP services affect microwave backhaul network design and implementation.

As IP network technology evolves in public safety communications, Ethernet is gaining widespread popularity and use. However, the growing dominance of Ethernet poses a new set of challenges in ring networks that support public safety P-25 land mobile radio systems.

This white paper discusses the advantages of hardware Rapid Ring Protection (RRP) switching compared to software switching such as Rapid Spanning Tree (RSTP) in a P-25 backhaul network to ensure reliable and secure communications.

## Trends in Public Safety Communications

Several trends shape new public safety communications networks and the way network planners design and implement the networks.

The trends include:

- » Implementation of P-25 LMR systems
- » FFC Narrowband Phase 1 & 2 mandates
- » FirstNet and statewide LTE networks
- » Evolution of TDM to IP technology
- » Evolving Ethernet standards

In fact, IP and Ethernet affect the design of ring topology in microwave backhaul networks that support P-25 LMR systems.

## Mission Critical Reliability and Ring Protection

Public safety communications is uncompromising. Network outage is not an option when lives and property are at stake. First-responders need continuous availability of their land mobile radio networks.

To ensure communications are up and operating under all conditions, extreme reliability in mission critical networks demands for five-nines availability. Network designers have traditionally planned high reliability networks using one of two schemes. They use redundant transmission equipment to protect against hardware failures. Or when possible, they provide more than one path among the sites by configuring the network in a ring.

Ring topology ensures availability by providing more than one connection path between any two points in a network. Data is able to travel both clockwise and counter-clockwise around the ring. The ring network not only provides duplication of equipment to protect against hardware failure, but ensures network availability even if one segment of the network becomes disabled. In some networks ultimate reliability is achieved using redundant equipment in a ring networks, but in most cases ring networks are implemented with non-redundant transmission gear.

Ring configured networks have long been used in T1 based backhaul networks to ensure availability by providing more than one connection path between any two points in the network. Before the widespread use of Ethernet protocol, DS1 based networks served most P-25 systems and their Simulcast predecessors. In a DS1

Ring topology improves network availability and reliability.

In ring networks, each site includes a DS1 Loop Protection Switch for each DS1 which originates or terminates at that site. In the transmit direction, the Loop Protection Switch sends incoming DS1 data in both directions around the loop. In the receive direction, the switch monitors the incoming DS1 signal arriving from both the clockwise and counter-clockwise direction and selects the better of the two signals to output. A hardware based solution, DS1 loop switching provides alternate routing of data.

## Software Switching Issues

In Ethernet microwave backhaul, software switching is available. However, traditional software switching can be slow...too slow for P-25 systems. For example, Layer 2 Rapid Spanning Tree Protocol (RSTP) or Layer 3 Open Shortest Path First (OSPF) or Interior Gateway Protocol (IGP) switching times can range from a couple hundred milliseconds to several seconds. These traditional software switching methods cannot guarantee fast enough switching time to avoid temporarily disrupting a P-25 system.

P-25 LMR systems cannot tolerate more than 800 milliseconds of outage, otherwise data frames are lost and communications availability becomes compromised. Outages can endanger first-responders. Prolonged network outage is simply unacceptable.

Fortunately there is a solution.

## Successful Rapid Ring Protection and P-25 LMR Systems

Rapid Ring Protection is a hardware based Ethernet switching mechanism built into the transport medium.

Rapid Ring Protection works similarly to RSTP (in detecting loops) and to the order-wire loop switch. Management packets are periodically sent out into the network to

detect network topology changes.

In RRP, one node of the ring is designated as the Switch Node. It periodically sends polling packets to determine whether the ring is intact and to convey to the other nodes in the ring whether a topology change has occurred. The other nodes are Pass-Through Nodes. They participate in the ring, but for the most part are passive except when there is a topology change detected by the switch node. After a topology change, every pass-through node will clear its MAC Address Tables to account for the new topology.

With RRP, network engineers can configure several RRP parameters including the RRP behavior mode, poll timing intervals, broken ring timing thresholds, port forward delay timing, and ring identification. As an integral part of the hardware, RRP achieves switching times typically under 200 milliseconds, and well under the P-25 threshold of 800 milliseconds.

As proof of RRP success, U.S. public safety and government organizations currently use RRP in Ethernet microwave networks that backhaul and transport P-25 traffic. As TDM networks migrate to Internet Protocol in P-25 mission critical networks, microwave backhaul with RRP will continue to grow in popularity.

## Deploying Rapid Ring Protection with Microwave Radios

When implementing microwave radio networks with Rapid Ring Protection, government organizations typically use turnkey LMR suppliers supported by experienced mission critical microwave radio suppliers.

Microwave radio product engineering and network design and optimization are a specialized science and art that demands special skills and expert know-how. Obtaining microwave radios from mission critical microwave communications experts assigns full accountability ensuring networks

perform with mission critical reliability. Successful design and deployment of microwave radio networks with Rapid Ring Protection begins with selecting mission critical microwave radios.

## What to Look For In a Microwave Communications Solution

Implementing public safety communications systems is accomplished with the right microwave radio selection. In addition to RRP compatibility, mission critical microwave communications radios should include,

- » P-25 Compatibility
- » Built-in Gigabit Ethernet
- » Hybrid native TDM and native IP technologies
- » Automatic Switchover
- » 6 to 38 GHz bands – Licensed
- » 1+1 protected Hot Standby Radios
- » 100% redundancy of active circuits
- » Port-based and tag-based VLAN for traffic class
- » Up to 12 x RJ-45 ports for external connections
- » Adaptive Code Modulation
- » MPLS and LTE compatibility
- » All Indoor, Split Mount, and All Outdoor configurations
- » SNMPv3 Network Management Interface
- » Chart Recorder Diagnostic Tools
- » MicroBus™ - a single cable cross connect to multiple collocated radios or devices

Furthermore, public safety organizations and turnkey suppliers should consider microwave suppliers that have designed and implemented Rapid Ring Protection in Ethernet microwave networks as well as well DS1 loop protection switching in

TDM networks, because many public safety organizations continue to operate hybrid IP and TDM networks. Microwave project engineering and maintenance services are important in the successful deployment and operations of ring protected networks.

### Project Engineering Services:

- » Path Profiles
- » RF and Transmission engineering
- » Design
- » Staging and Integration
- » Factory and Field Acceptance Testing
- » Installation
- » Optimization

### Maintenance Support Services:

- » 2-year, 3-year, 5-year, and lifetime Warranty Options
- » Continuing 24 x 7 or 8 x 5 Remote Technical Support
- » On-Site Technical Support – preventive and corrective maintenance
- » 24-hour Advance Replacement
- » 7-day and 14-day Repair Options
- » Operations, Maintenance, and Installation Training and Certification
- » Firmware Upgrades
- » Remote NOC Troubleshooting and Alerts
- » Full Turnkey Maintenance Services
- » Network Health Mobile Application for Smartphones & Tablets
- » Detailed Weekly and Monthly Reporting about the network
- » A vendor with years of public safety mission critical microwave experience

In summary, Rapid Ring Protection in Ethernet IP microwave networks fully supports public safety P-25 LMR systems.

Networks perform at peak availability, providing reliable service to first-responders when they need to communicate. Mission critical communications is achieved.

## About Microwave Networks

Microwave Networks has designed and implemented Rapid Ring Protected microwave networks for public safety and government.

Microwave Networks is a trusted global provider of microwave communications products and services. We design, provide, install, and service licensed and unlicensed, point-to-point and point-to-multipoint microwave systems.

For over 40 years, Microwave Networks has provided reliable microwave communications products and services to public safety, government, utilities, mobile network operators, and industrial customers. Our commitment to mission critical microwave communications is proven in radios that operate with unmatched performance, hot-standby redundancy, low latency, and excellent system-gain. As TDM transitions to IP networks, Microwave Networks leads in developing IP microwave communications convergence and evolution. Microwave Networks is at the forefront of continuous innovation, development, and integration of its microwave radios with evolving Ethernet and IP technology.

Microwave Networks has a qualified team of trained and experienced microwave engineers, technicians, trainers, program managers, and administrators, who know how to build, design, integrate, implement, and support reliable microwave networks.

Please contact a Microwave Networks Regional Sales Director to learn more about Rapid Ring Protection.



4000 Greenbriar Dr., Stafford, TX 77477

1-281-263-6500

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[www.microwavenetworks.com](http://www.microwavenetworks.com)