



MICROWAVE FOR THE BROADBAND ERA

9500 MICROWAVE PACKET RADIO –
TRANSCENDING OBSTACLES TO IP

LEVERAGING MICROWAVE TO ADDRESS DEMAND

In today's dynamic market, operators must be able to respond quickly to the relentless demand for bandwidth and services. Microwave wireless transmission solutions can help. Microwave solutions can be deployed quickly in scenarios where wireline alternatives such as fiber optic cable are not feasible or would be too costly to deploy. Microwave is ideally suited, for example, to small cell and macro cell mobile backhaul and long-haul transport/trunking. There can, however, be no compromise in quality and microwave solutions must meet high availability standards. This is especially important for mission-critical networks such as those supporting energy, transportation and public sector communications.

Alcatel-Lucent's flexible wireless transmission solutions enable operators to meet the demands of an Ultra-Broadband world, both in terms of capacity and reliability. And they do this while holding the line on operating and capital expenditures.



THE EVOLVING NATURE OF NETWORK TRAFFIC

Microwave network operators are under constant pressure to support new Ultra-Broadband technologies such as LTE. These new technologies deliver more bandwidth to end users, and that in turn fosters the growing adoption of IP-based applications and services. Demand for traditional voice services is decreasing as more people opt for IP voice, along with other IP data services. Mobile subscribers want everything available on their tablets and smartphones: high-speed Internet, applications, and mobile video. Many will be moving to voice over LTE (VoLTE). Industry and enterprise services and applications are also evolving to IP, with rich media content and applications. Mission-critical networks are being stressed by the need to reliably support higher-bandwidth applications, including video. All of this IP traffic demand is making it harder for traditional wireless transmission solutions to keep up.

Network capacity, quality of service (QoS) and availability demands are pushing networks to their limits and have, in many cases, created network bottlenecks. Although demand is coming from many sources, there is one constant. Networks must be designed for the optimal transport of IP traffic, or they run the risk of quickly becoming obsolete.

At the same time, new IP networks must continue to support traditional traffic types. This so-called legacy traffic is embedded in many networks, and requires a long replacement cycle. If their new IP networks cannot effectively support the small but critical amount of traditional traffic, operators will have to operate parallel networks. Alternatively, they could be forced into a hybrid network structure that might address the needs of traditional traffic but is ineffective at supporting the future growth of IP, leading to prohibitive operating costs and poor service quality.

Alcatel-Lucent has developed microwave solutions that are specifically designed to meet the needs of an IP future, while enabling ongoing effective support of traditional technologies.

For the foreseeable future all communications traffic will be based on IP.



MICROWAVE SOLUTIONS FROM ALCATEL-LUCENT

Alcatel-Lucent's packet-based microwave solutions set the standard for delivering faster, longer, more reliable and efficient wireless transmission links and networks. Proven in more than 250 networks worldwide, the portfolio has been deployed in a wide range of applications including 2G, 3G and 4G/LTE mobile backhaul, high-capacity long-haul trunking/transport, and mission-critical networks. Alcatel-Lucent's packet microwave solutions also support a smooth transition from traditional or legacy traffic to all-IP for increased network capacity at a lower total cost of ownership (TCO).

It is clear today that IP data services are the way of the future. And yet few microwave vendors have moved as quickly as Alcatel-Lucent to make the strategic investments necessary to evolve their microwave systems to fully support IP data. As services continue to transition to data, an architecture focused on supporting IP packet traffic makes natural sense. However, any new technology should also support the traditional services that are already in place. Alcatel-Lucent's packet-based architecture is built with the understanding that TDM and ATM services must be supported along with IP. Only a common network that efficiently supports both IP and traditional services will enable a smooth evolution to all IP services and minimize network TCO. Alcatel-Lucent's microwave offering packetizes traditional services, but does so in a unique way that has no impact on the SLAs for the traditional services.

Alcatel-Lucent's microwave solutions are based on the Alcatel-Lucent 9500 Microwave Packet Radio (MPR) portfolio. Details on this solution portfolio are provided later in this brochure. The following describes how these solutions can be deployed in real-world networks today.



Alcatel-Lucent packetizes traditional services in a unique way that has no impact on SLAs.



Microwave deployment applications

MOBILE BACKHAUL

Microwave access to cell sites is an important building block for the delivery of mobile services. Today, more than 50% of the world's cell sites are connected to the network over microwave access. As both macro and small cell sites transition to packet-optimized, higher-speed 4G/LTE services, scalable cost-effective solutions to support this evolution are required.

Several types of wireless cell site connection options are required to support mobile network capacity and coverage expansions. Alcatel-Lucent's 9500 MPR solutions support a full suite of wireless frequency options including 5.8 - 42 GHz solutions for macro cell backhaul, 80 GHz millimeter wave solutions that are typically used for macro cell backhaul, unlicensed 60 GHz millimeter wave and sub-6 GHz solutions that are typically used to support the backhaul of small cells.

These flexible deployment options allow mobile operators and backhaul transport providers to rapidly deliver high capacity connectivity to cell sites wherever they are needed. Alcatel-Lucent mobile backhaul solutions offer:

- High capacity, small cell and macro cell backhaul options
- Full-indoor and full-outdoor deployment options
- Seamless evolution to IP networks
- Support for any network topology
- End-to-end connectivity: from small cell to macro cell and long-haul

LONG-HAUL TRANSPORT

Long-haul microwave systems are typically used to aggregate multiple services in a wider transport network and provide connectivity on long distance transport spans (e.g. 20 to 250 km) when fiber is not a cost-effective option. This configuration can be used to support fixed/wireline communications together with mobile communications.

Alcatel-Lucent long-haul transport capabilities include:

- Efficient waveguide, couplers, and transceiver components to maximize long-haul link distance while delivering optimal network TCO
- 1024 QAM modulation support with superior transmit power
- High performance equalizers to minimize the need for the deployment of costly 2 antenna space diversity systems.
- Integrated digital combiners to reliably extend the reach of long-haul links over the most challenging terrain.
- Proven interworking with traditional SDH/SONET wireline and microwave systems
- Standards-based interworking with modern packet optical systems using ITU-T G.8032v2 Carrier Ethernet networking
- Seamless evolution to IP networks
- Flexible configurations to address all network site constraints and save on space and/or power:
 - Various sized long-haul indoor footprints
 - Transceiver packaging options that leverage common technology, and offer protection flexibility with integrated XPIC and antenna diversity ports
 - Industry-leading 20 direction density/rack for terminal or repeater site applications
- An evolution path to 10G long-haul packet microwave

When network failure is not an option.

MISSION-CRITICAL NETWORKS

Mission-critical networks are deployed by many industries including utilities and transportation authorities, public safety organizations, governments and defense organizations. These are referred to as “mission-critical” networks because they are used to monitor and protect critical infrastructure that provides life-saving assistance in the event of emergencies. Mission-critical networks must support safe and continuous 24 x 7 operations. These networks often need to reach remote areas over difficult terrain. Alcatel-Lucent’s low-risk, high-availability microwave solutions can readily support these mission-critical requirements. They also provide full support for IP transformation and can be delivered as part of an end-to-end approach that spans fixed and wireless networking.

When network failure is not an option, operators need solutions that offer:

- High availability and capacity over long distances
- Full-indoor and full-outdoor deployment options
- Seamless evolution to IP networks
- Support for any network topology



ALCATEL-LUCENT 9500 MICROWAVE PACKET RADIO

Since our ground-breaking initial packet microwave product introduction in 2008, we've grown the Alcatel-Lucent 9500 MPR portfolio to be the most complete end-to-end packet wireless transmission offer in the industry. Our portfolio includes standalone microwave and integrated microwave solutions with in-house packet optical and IP/MPLS switching and routing offers. The entire portfolio is managed by the Alcatel-Lucent 5620 Service Aware Manager (SAM) network and service management suite to simplify end-to-end operations.

Build faster, longer, more efficient and reliable microwave links

The unique features of the Alcatel-Lucent 9500 MPR portfolio let operators deliver more data with superior performance and availability while using less spectrum and equipment. These features include:

- Advanced packet compression techniques that increase channel spectrum capacity
- Scalable multichannel microwave links that support increased capacity and reliability
- High order adaptive modulation that extends across multiple channels to sustain maximum performance in all environments
- Support for maximum system gain using high performance equalizers and integrated digital combiners to reliably extend the reach of links over the most challenging terrain.

Boost capacity and reliability with advanced networking

With Alcatel-Lucent 9500 MPR solutions, you get advanced Carrier Ethernet networking capabilities and high availability. These capabilities include:

- Unique ring and mesh topology configurations that can double network capacity, improve reliability and reduce network costs
- Integrated IP-microwave solutions that reduce space and power consumption
- The ability to support TDM, ATM, Ethernet and IP services on a single packet-based network

Simplify operations with an end-to-end approach

The 9500 MPR portfolio encompasses the needs of a wireless transmission network end to end. It includes a complete family of solutions that addresses all network sizes and locations including tail, hub and backbone sites. With an approach that uses common equipment and software across all sites, Alcatel-Lucent helps operators streamline management processes and reduce TCO. The solution portfolio offers:

- Common radio transceivers that reduce the need for spares across all applications
- A flexible range of right-sized Indoor Units optimized to reduce space and power consumption
- Common software and network management that simplify operations across the network

Innovative, end-to-end product family efficiently addresses all sites and applications.



9500 MPR SOLUTION COMPONENTS

Microwave Packet Terminal

The 9500 MPR Microwave Packet Terminal (MPT) transceivers all leverage the same software and technologies whether they are deployed in a split-mount, full-indoor, or full-outdoor configuration. This offers operators more deployment flexibility, minimizes spares inventory, and results in lower network TCO (see Figure 1). The MPTs support:

- Advanced packet compression
- Hitless, high order adaptive modulation
- IP along with legacy technologies
- Integrated cross-polarization to double capacity
- N+N hot standby with spatial diversity options

Both short-haul (less than 20 km) and long-haul (greater than 20 km) MPTs are available to address distance and availability needs.

Microwave Service Switch indoor units

Full-outdoor MPTs can be deployed independently (for example, connecting directly to an LTE eNode B mobile base station) or together with a 9500 MPR Microwave Service Switch (MSS) indoor unit to offer additional networking flexibility. The MSS comes in various sizes to suit different requirements, as shown in Table 1.


The complete range of right-sized indoor microwave units addresses any site footprint requirement. The units are energy-efficient, extremely scalable and offer deployment

flexibility. All indoor units support traditional services such as TDM and ATM, and newer Ethernet and IP services over a converged, packet-based, operationally efficient network. To minimize operational complexity, the various MPTs and MSSs share common technology, software, and network and service management. They can be combined to support any wireless transmission application.

9500 MPR solution portfolio

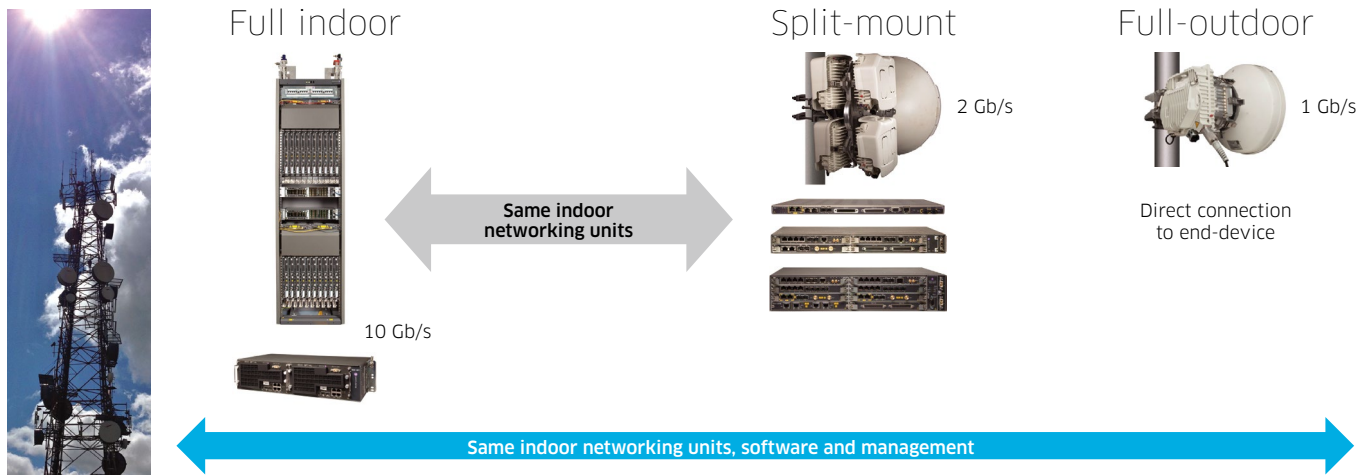
An Alcatel-Lucent 9500 MPR solution consists of a combination of full-indoor and split-mount MPT and MSS components. Depending on the options chosen, the solution can be used in tail, hub, and long-haul packet microwave applications and supports frequencies

Table 1. 9500 MPR Microwave Service Switch



FEATURES	MSS-1	MSS-4	MSS-8
Chassis	<ul style="list-style-type: none"> • Fixed • No slots • 16 Gb/s • Operating temp: -40 C to +65 C 	<ul style="list-style-type: none"> • Modular: 2 core slots (1+1), 2 interface slots • 16 Gb/s • Operating temp: -40 C to +65 C 	<ul style="list-style-type: none"> • Modular: 8 slots • 2 core slots (1+1), 6 interface slots • 16 Gb/s • Operating temp: -40 C to +65 C
Interfaces	<ul style="list-style-type: none"> • 16 E1/DS1, 4x10/100/1000 RJ-45, 2x SFP • Console, sync-in and sync-out, management, alarm 	<ul style="list-style-type: none"> • Up to 64 E1/DS1, 4 DS3, 4 STM1/OC3, 2 E3, 22 GE • Console, sync-in and sync-out, management, alarm 	<ul style="list-style-type: none"> • Up to 192 E1/DS1, 12 DS3, 2 E3, 12 STM1/OC3, 54 GE • Console, sync-in and sync-out, management, alarm
Services	<ul style="list-style-type: none"> • TDM/PDH, SONET/SDH • MEF compliant E-Line, E-Tree, E-LAN 	<ul style="list-style-type: none"> • TDM/PDH, SONET/SDH • MEF compliant E-Line, E-Tree, E-LAN 	<ul style="list-style-type: none"> • TDM/PDH, SONET/SDH • MEF compliant E-Line, E-Tree, E-LAN
Networking	<ul style="list-style-type: none"> • ITU-T G.8032 • Multichannel Ethernet LAG • SONET/SDH 	<ul style="list-style-type: none"> • ITU-T G.8032 • Multichannel Ethernet LAG • SONET/SDH 	<ul style="list-style-type: none"> • ITU-T G.8032 • Multichannel Ethernet LAG • SONET/SDH
Power	<ul style="list-style-type: none"> • Dual feeds: +/-24V DC to +/- 48V 	<ul style="list-style-type: none"> • Single feed: -48 DC, or optional integrated +24V DC 	<ul style="list-style-type: none"> • Dual feeds: -48 DC, or optional integrated +24V DC

Figure 1. Flexible deployment options



from 5.8-42 GHz and 80 GHz. Figure 2 illustrates the 9500 MPR wireless transmission solution portfolio.

9500 MPR-e

The 9500 MPR-e is a full outdoor MPT solution set optimized for Ethernet-oriented all-outdoor deployments. The 9500 MPR-e is fully integrated with the Alcatel-Lucent 7705 Service Aggregation Router (SAR) IP/MPLS portfolio, including support for the 9500 MPR-e as a native 7705 SAR microwave interface. Microwave-specific cards have been added to the 7705 SAR to support microwave protection and powering.

This level of integration offers unique capabilities for deploying IP/MPLS networking over microwave links:

- The solution offer is managed as a single network element, under common network management. This unique capability brings a number of OPEX advantages. For example, regardless of how many radio instances exist, network element maintenance procedures, such as software upgrades and configuration backups, are done only once to all components.
- Microwave radios can be directly powered by IP/MPLS cell site devices which provide lightning protection and voltage surge suppression. This

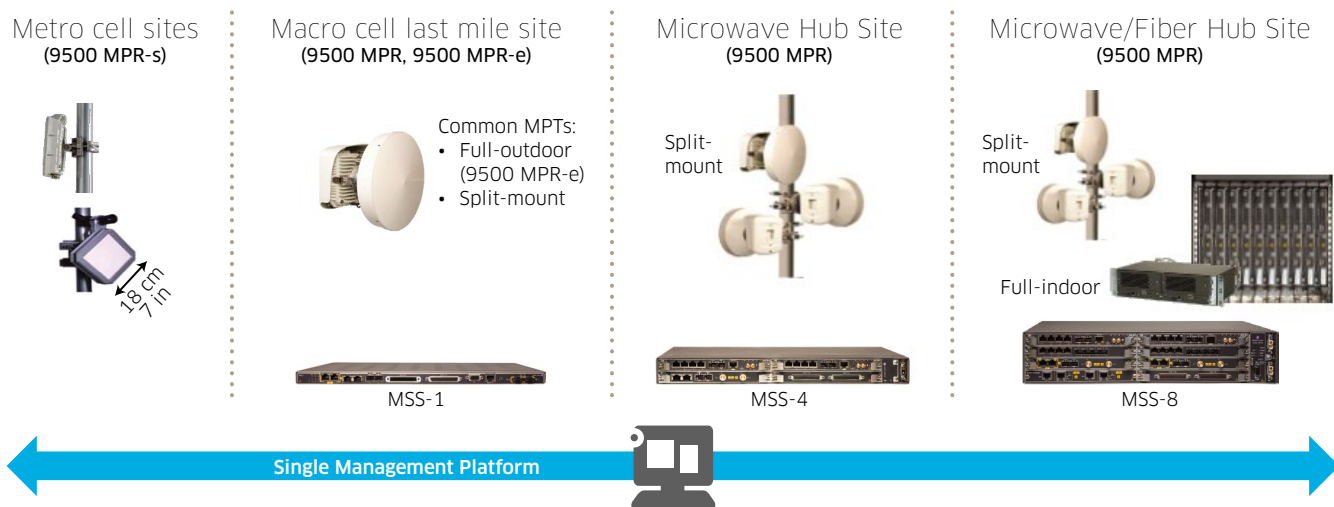
simplifies and optimizes cell site battery feed planning and installation.

- Collapsing two platforms into a single compact and very flexible platform reduces real estate requirements, operations complexity and energy costs.

9500 MPR-s

The 9500 MPR-s is a solution set optimized for small cell site deployments leveraging sub-6 GHz and 60 GHz radio frequencies. These products can also be used in other segments and can extend access to Carrier Ethernet business services the last mile to the customer.

Figure 2. 9500 MPR solution portfolio



9500 MPR SOLUTION FEATURES

Common software and management

Components of the 9500 MPR portfolio leverage the same technologies, software, network and service management. Deployment flexibility and streamlined management processes reduce network TCO.

Advanced networking to support any network topology

To reliably network microwave and fiber sites MSS indoor units support both traditional SDH/SONET networking, and advanced standards ITU-T G.8032v2-based Ethernet networking. This ITU-T G.8032v2 support allows networks to benefit from the inherent strengths of ring architectures:

- Network capacity can be doubled by sending traffic in both directions around the ring when failures aren't present.
- Ethernet loops can be easily contained by blocking traffic on selected ring spans, avoiding the need for complex, spanning tree-based network protection mechanisms, which are slow to react to failure (such as Rapid Spanning Tree Protocol).
- 50 ms protection can be easily implemented by turning traffic away from failed ring spans.

With the option to packetize traditional services, all services can take advantage of the reliability and scale that ITU-T G.8032v2 provides. This introduces further operational simplification when compared to hybrid microwave systems, which require the use of both packet and TDM networking technology to create microwave networks.

Multichannel

Scaling capacity on traditional microwave links has typically relied on 1:N-based protection algorithms. These algorithms require extra capacity for the protection channel – capacity that is not optimally used when protection events are not present. Packet microwave solutions can leverage more efficient protection mechanisms based on Ethernet link aggregation (LAG) algorithms. LAG implementations bond channels together to create a larger virtual link without the need to dedicate protection capacity.

The Alcatel-Lucent packet microwave implementation, which bonds microwave channels together to create larger virtual links, is referred to as multichannel. Although it is based on LAG, it has been uniquely adapted to the microwave environment to carry traffic under the most severe environmental conditions (that is, it is “adaptive modulation aware”). The use of a multichannel reduces the number of channels required to reliably scale a microwave link. It also optimally distributes traffic between channels, and understands the microwave environment. This leads to more reliable, efficient, and operationally effective microwave links.

Advanced packet compression

Packet compression is another mechanism that can be used to scale packet microwave link capacity. Alcatel-Lucent has implemented advanced packet compression capabilities in its “Packet Booster” feature. Packet Booster can increase microwave link efficiency by as much as 300%.

Feature flexibility

Packet Booster, multichannel, and the evolution of traditional services to all-IP with ITU-T G.8032v2 networking: these are all powerful and unique Alcatel-Lucent features. These features can be deployed independently or together. However, it is when they are used together that the advantages over traditional microwave systems are most convincing and provide the foundation for:

- Faster, longer, more efficient links for all services
- Advanced 50 ms failover protection for all services

5620 SAM INTEGRATION

The 9500 MPR portfolio is integrated with the industry-leading Alcatel-Lucent 5620 SAM software suite. This allows the 9500 MPR portfolio to take advantage of a network and services investment that spans Alcatel-Lucent's IP/MPLS, packet optical, and RAN portfolios. It provides a single end-to-end management solution for all networking and service deployments and operational needs.

As microwave transport becomes integrated with IP packet networks, operators are faced with the challenge of adjusting network management systems, workflows and processes to efficiently manage the converged IP microwave packet network. There are many inter-dependencies that can be better managed when an integrated management approach is possible. An integrated approach will also reduce the number of touch-points across the multi-technology network.

To optimize operations, service providers need a unified, end-to-end view across multi-technology layers for effective service provisioning and assurance. They need the flexibility to logically divide and control workflows between IP and microwave transport network domains, and to be able to manage and monitor both technologies together from a service perspective. The 5620 SAM provides converged, cross-domain management that transcends the traditional product and technology boundaries and spans element, network and service management. It enables operators to manage transport services end-to-end with cross-layer visibility.

Transcend
traditional product
and technology
boundaries.



For IP and microwave solutions, the 5620 SAM offers:

- Complete coverage of both IP and microwave equipment management (fault, configuration, alarm, performance and system/security)
- Automated configuration and flexible connectivity and bandwidth provisioning for the end-to-end IP network
- Integrated IP and microwave topology visualization and proactive monitoring
- Advanced real-time troubleshooting capabilities that isolate emerging issues down to the IP or microwave domain, pin-pointing the root cause of the problem within the domain before it impacts services
- Flexible, open architectures for fast, cost-effective integration with existing operational processes and systems

With the 5620 SAM, operators can proactively identify and resolve potential problems in the network before they impact customers. Service testing, for example, gives detailed information on service performance to determine where increased latency, jitter or packet loss could diminish the user's quality of experience (QoE).

Integrated graphical views of the physical and logical topology depict all resources traversed by a service, including both microwave transport and IP data service links. Integrated fault management isolates microwave transport versus IP data services problems. Enhanced multi-layer alarm correlation reduces the number of alerts and identifies the root cause of the problem. Operators can drill down into affected resources and services.



SUMMARY

Alcatel-Lucent 9500 MPR wireless transmission solutions offer outstanding performance, along with networking and operational simplicity. They enable operators to address the growing wave of IP services and to benefit from:

- Faster, longer, more efficient and reliable radio links with support for a range of advanced and innovative features. These features increase link capacity, so operators can deliver more services and a higher QoE for their customers.
- Support for advanced packet networking, which increases microwave network reliability and scale.
- Operational simplification with a unique streamlined end-to-end portfolio approach that can help operators reduce the TCO for their networks.

Through its 9500 MPR portfolio, Alcatel-Lucent ensures that wireless transmission is not a barrier to building modern IP networks. Instead, microwave deployments can be used to support and expedite the evolution to IP that will enable operators to keep up with the relentless demand for more bandwidth and services.

Support and expedite the evolution to IP.