

IP/MPLS MOBILE BACKHAUL FOR HETEROGENEOUS NETWORKS

ENHANCE QUALITY OF EXPERIENCE AND STREAMLINE OPERATIONS WITH ALCATEL-LUCENT IP/MPLS MACRO AND METRO CELL BACKHAUL

APPLICATION NOTE

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ABSTRACT

The mobile radio access network (RAN) is evolving rapidly, driven by the need to improve capacity and coverage while keeping capital and operating expenses under control. The Alcatel-Lucent IP/MPLS Mobile Backhaul solution has achieved a market-leading position and continues to evolve with groundbreaking innovations in products and professional services. The solution provides the optimal user Quality of Experience (QoE), consistent with the business goals of the service provider, in conjunction with the lowest backhaul Total Cost of Ownership (TCO). This is achieved through unmatched flexibility in deployment models, and massive scale to accommodate growing traffic and base station numbers. The solution also provides advanced network and service management tools to help service providers simplify operations.

UNPRECEDENTED GROWTH IN DEMAND DRIVES NEED FOR INNOVATION

MNOs are facing profound changes in the RAN. Mobile data volume in particular is growing at an unprecedented rate. Alcatel-Lucent Bell Labs predicts that mobile data volumes will increase 25 times by 2016. The need for increased capacity and coverage is driving further innovation in the RAN, including several key developments:

- Long Term Evolution (LTE) radio technology is bringing spectral efficiency improvements, which in turn are leading to higher traffic volumes, a shift in backhaul architectures, and an increasing number of types of data streams to be transported.
- The emergence of public-access small cells (metro cells) complementing 3G and LTE is creating a heterogeneous network of both traditional macro cells and an underlay of metro cells. These metro cells are deployed much more densely and in higher quantities, often in outdoor urban locations with varied access to backhaul transport facilities.
- The practice of RAN and general infrastructure sharing supports the quest for a lower cost per bit. In the backhaul, this brings a need to manage and separate traffic, and to assign network resources appropriately, securely and fairly according to service level agreements (SLAs).

It is important to ensure that the mobile backhaul network is positioned to support and complement these evolutionary trends. The mobile backhaul network must meet a set of challenges (and leverage opportunities for competitive differentiation) in support of the evolving RAN. The principal requirements include:

- **Scalability:** The backhaul network must scale to support increasing numbers of cell sites at higher capacities. High performance IP/MPLS and packet optical transport solutions are needed for extremely scalable and reliable network architectures and topologies. High capacity packet microwave, fixed access and Carrier Ethernet access capabilities must underpin the solution.
- **Flexibility:** Deployment of metro cells in urban and, to some extent, rural settings brings the need to leverage the closest, most cost-effective access media that can meet quality of service (QoS) requirements. This will result in a greater diversity in backhaul access types, driving a requirement for more flexible solutions that can operate consistently whether over microwave, xDSL, Ethernet or GPON. Support for 2G, 3G, LTE and Wi-Fi® services is also needed. Equipment must be optimized for macro and metro sites and for indoor and outdoor locations — all with integrated support for fiber, microwave or copper access.

- **Simplicity:** Simplified operations are required to minimize TCO and permit network deployment without massive cost increases. A standardized approach to cell site backhaul provisioning and turn-up is required, regardless of access type or location. The need for site visits must be minimized. End-to-end visibility and control of elements at every cell site (macro and metro) is needed for streamlined OAM, with surgical, remote troubleshooting. It is crucial that the network actively indicate when key performance indications (KPIs) are out of bounds and SLAs are not being met.
- **Resiliency:** Network resiliency is crucial to supporting the subscriber's QoE. In particular, as more cell sites home in on higher capacity head-end systems, failure recovery mechanisms become more critical to limit the breadth of impact when systems become unavailable.
- **Quality of service:** MNOs must be able to provide appropriate access to network resources, such as link bandwidth, for multiple traffic streams including OAM, telemetry, streaming video, and VoIP, especially when networks are operated at high utilization levels.
- **Synchronization:** Maintaining synchronization has always been a requirement in networks generally and particularly in mobile. This will continue. The mobile backhaul network must provide accurate and resilient frequency and phase where access to external sources is unavailable or prohibitively expensive.

IP/MPLS networking can efficiently support these requirements in RAN backhaul. In fact, a correctly-selected and implemented IP/MPLS mobile backhaul network can be a real strategic business differentiator for MNOs. The Alcatel-Lucent IP/MPLS Mobile Backhaul solution is targeted at meeting these requirements and provides a solid business foundation for efficient growth. The solution is widely and successfully deployed in some of the most extensive mobile network installations globally and in numerous small- and medium-sized networks in all geographies.

ALCATEL-LUCENT IP/MPLS MOBILE BACKHAUL SOLUTION

Solution overview

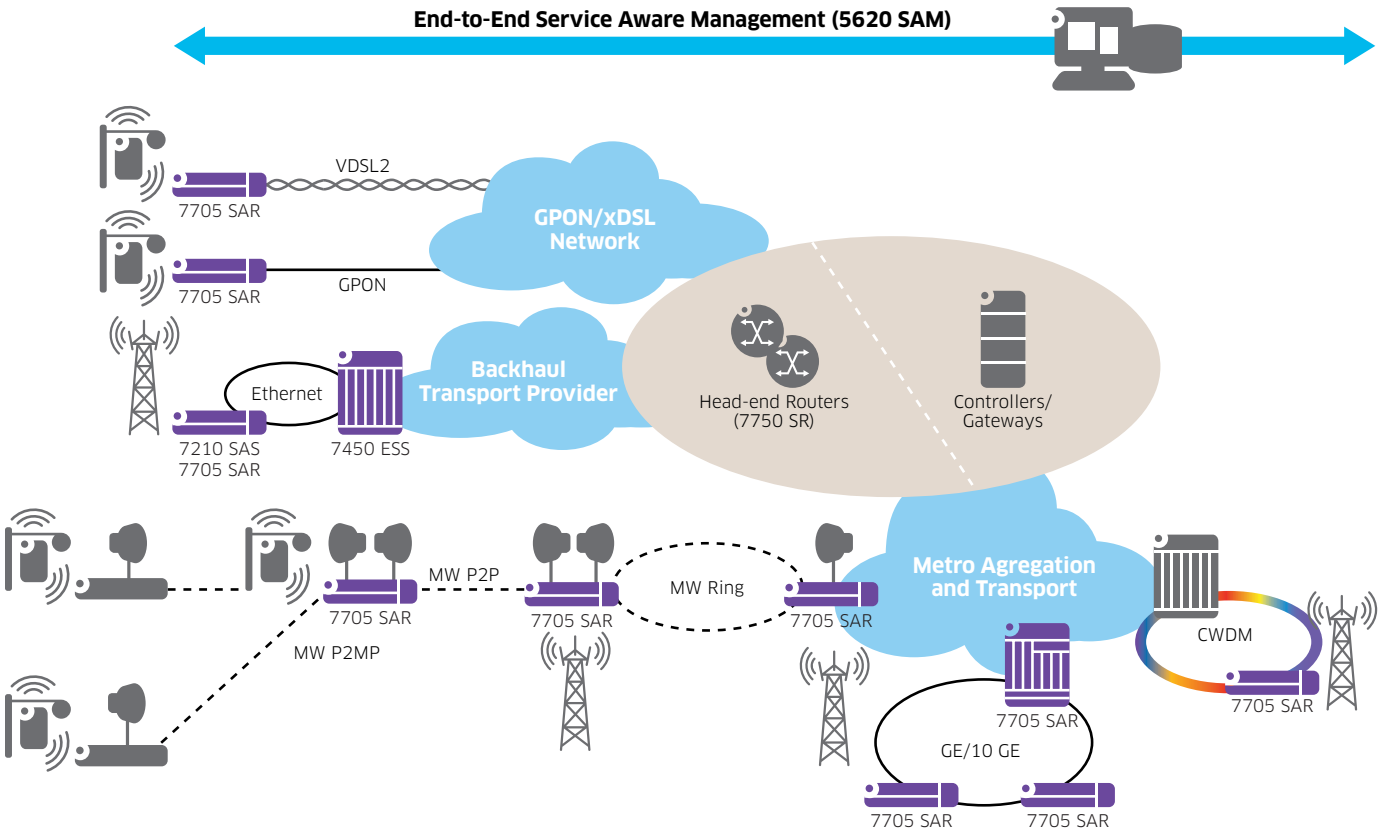
The Alcatel-Lucent IP Mobile Backhaul solution is comprised of a suite of products, and is complemented by Alcatel-Lucent professional services. The principal product elements are the Alcatel-Lucent 7705 Service Aggregation Router (SAR), the 7750 Service Router (SR) and the 5620 Service Aware Manager (SAM).

The 7705 SARs are typically deployed at the cell site, both metro and macro. A range of compact and site-optimized 7705 SARs is available. The 7705 SAR, like all of the networking components of the solution, leverages the Alcatel-Lucent Service Router Operating System (SR OS) software. The 7705 SAR is also deployed for cell site aggregation, with the larger chassis-based variants used at points of concentration leading up to the MTSO/RNC/controller site.

At the head end, the 7750 SR provides the hand-off to the RAN controllers while delivering comprehensive resiliency and massive, proven scaling for any networking paradigm.

The 5620 SAM links the end-to-end solution together, providing unified element, network and service management, which helps MNOs realize visibility and control between the cell site and the controller site. The 5620 SAM, in conjunction with the 7705 SAR as a universal cell site access and routing device, also enables MNOs to more quickly and efficiently roll out new cell sites, and more easily manage the ongoing OAM of the mobile backhaul infrastructure.

Figure 1. Alcatel-Lucent IP/MPLS Mobile Backhaul solution



Key solution attributes

The Alcatel-Lucent IP/MPLS Mobile Backhaul solution leads the industry in its ability to deliver scalable, flexible and simplified backhaul networks while ensuring the resiliency, QoS, and network synchronization required to support the evolution of RAN networks to LTE and metro cells.

Scalability

As mobile networks are extended to include an underlay of metro cells, there will be additional scaling requirements in a number of dimensions. The number of cell sites to be supported in a single backhaul network will expand by an order of magnitude in the coming years. Some of the largest backhaul networks may see expansion from tens of thousands of cell sites to potentially hundreds of thousands of sites. Each one of these sites will also see an increase over time in the amount of bandwidth required, which in turn will drive the requirement for increased bandwidth back into the metro aggregation and transport network.

The 7750 SR provides a highly reliable head-end aggregation and concentration point for thousands of metro cell and/or macro cell sites over any intermediate transport. The 7750 SR with its revolutionary FP3 network processor provides comprehensive resiliency and massive, proven scaling for thousands of cell sites. The 7750 SR supports high-density 10, 40 and 100 Gb/s interfaces, ensuring ample capacity for future growth requirements.

With increasing numbers of cell sites to be connected, and with the potential to enable cell site to cell site connectivity (such as for the LTE X2 interface) in addition to providing connectivity back to the controller site, new topology requirements emerge. Existing networks built on traditional point-to-point and tree architectures become less able to meet the scale and reliability requirements in a cost-effective manner. New architectures including ring and mesh architectures are required, and IP/MPLS networking becomes crucial in order to provide traffic engineering and resiliency mechanisms.

Flexibility

There is a great variety of installation types in metro (and macro) cell sites and a range of uplink media that can be used, depending on availability, suitability and cost. As a result, operational flexibility is a key attribute of any mobile backhaul deployment.

Media flexibility

A powerful aspect of the 7705 SAR family is the ability to provide a consistent networking and operational capability over a wide range of physical media types. Due to the pervasive nature of mobile backhaul networks, varied media types are often encountered, at a range of cost points, throughout the network. The flexibility to select the most cost-effective backhaul media available in a particular site — while meeting service requirements — is a key competitive advantage. Some carriers may choose initially to deploy microwave backhaul to expedite the provision of coverage. This microwave equipment may stay in place, or be enhanced with higher capacity systems as the technology evolves. Alternatively, as fiber is made available at a particular location, this may take the place of microwave, creating an opportunity for re-deployment of the microwave plant. This operation can be carried out with no impact to the networking layer or to ongoing operations. The ability to leverage PDH/SDH and SONET infrastructures also allows maximum depreciation of existing assets while the solution provides a clear, controlled path to a modern packet infrastructure.

The 7705 SAR products can leverage the appropriate transmission media and any underlying network infrastructure for further backhaul deeper into the aggregation network. Wireline access options (such as point-to-point fiber, GPON and bonded xDSL) as well as Line of Sight (LOS) wireless provide the best QoS performance for backhaul. Non Line of Sight (NLOS) wireless options may also be considered where the other access options are not available or where QoS requirements are relaxed. Carrier Ethernet or IP VPN services can be used for backhaul infrastructure, either from a separate backhaul transport provider or from the wireline services arm of a fully converged operator.

Platform flexibility

The 7705 SAR product family constitutes a range of SR OS-based platforms. Given the options available, an ideal device can be provided, regardless of the attributes of the cell site. See Table 1 for applicability guidelines.

Table 1. Choosing the best 7705 SAR product for the job

7705 SAR VARIANT	TYPICAL INSTALLATION	PRODUCT ATTRIBUTES
7705 SAR-W	Metro cell	Outdoor ruggedized, very compact
7705 SAR-H	Metro cell	Indoor, compact, firewall
7705 SAR-M/-A/-F	Metro / Macro cell	Indoor, compact, modularity available
7705 SAR-8	Macro cell/Aggregation	Indoor, 2RU, fully modular
7705 SAR-18	Macro cell/ Aggregation/Edge Office	Indoor, 10RU, fully modular

Networking and topology flexibility

The Alcatel-Lucent IP/MPLS Mobile Backhaul solution supports a rich suite of Layer 2, 2.5 and Layer 3 switching and routing capabilities to allow the most appropriate and efficient networking technology to be deployed. From cell site to head end, point-to-point connections such as pseudowires can co-exist with full IP routing including IPv6. VPN options allow OAM traffic to be segregated from user bearer traffic for example. Providing a full routing capability allows the LTE X2 interface to be routed locally if desired for more efficient use of backhauling resources. This can help to contain the need for backhaul bandwidth, which can help lower operating costs. From a topology standpoint, service providers can save bandwidth and boost reliability by aggregating downstream devices in a daisy chain or ring.

Simplicity of operations

Keeping operations costs low has a major impact on the TCO of a network. Leveraging a common SR OS software base and using the embedded OAM capabilities in conjunction with the 5620 SAM enables simple and streamlined operations. With emerging heterogeneous networks, devices will be deployed in huge numbers. It is therefore vitally important that operators be able to achieving remote turn up and troubleshooting with minimal site visits. The 5620 SAM is the overarching management entity for end-to-end wireless domain management. The 5620 SAM provides comprehensive support for Fault, Configuration, Accounting, Performance and Security. The 5620 SAM application suite is a tightly-integrated management system that enables provisioning of an end-to-end service using wizards or point-and-click configuration from a single application (Service Manager) without having to individually configure each device in the connection path.

End-to-end management is a key strength of the Alcatel-Lucent solution. Operators can monitor backhaul KPIs and maintain SLA guarantees with the 5620 SAM, in conjunction with the embedded OAM functionality in the network equipment. At the service layer, Y.1731 provides OAM support for loss, delay and jitter measurements. At the Ethernet layer, 802.3ah EFM support is provided and at both the IP and the MPLS layers, a wide variety of options are available. These functions are all supported throughout the IP/MPLS product portfolio. Furthermore, the Alcatel-Lucent 5620 Service Assurance Agent (SAA) can be used to minimize operator workload by proactively probing the delay, jitter and loss that each service experiences periodically.

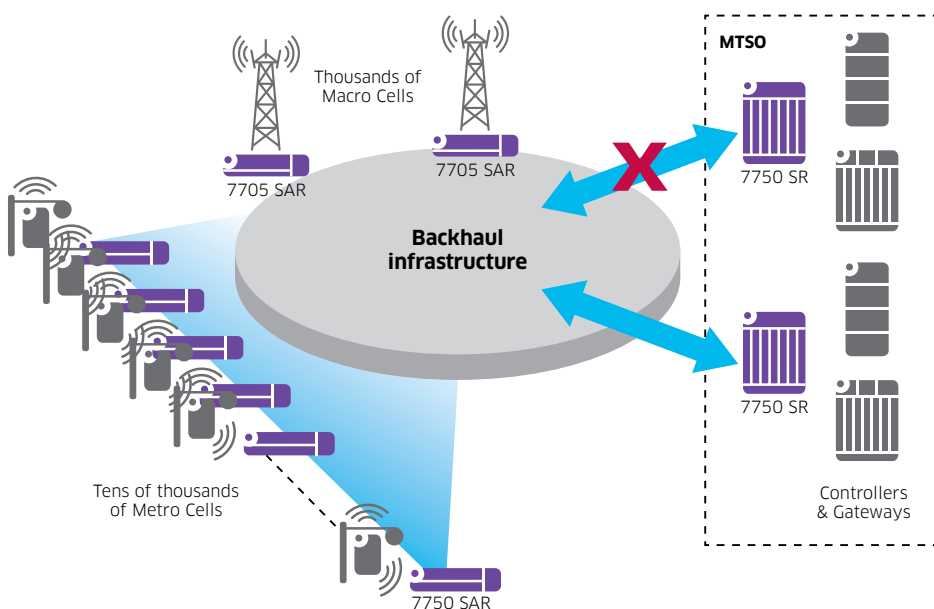
Automatic Discovery and Provisioning features provide automated bring-up and template provisioning capabilities, greatly reducing the workload required to commission new metro cell networks. It also provides a complementary foundation for self-organizing network (SON) -related features.

Resiliency

Networking resiliency is built into the Alcatel-Lucent IP/MPLS product portfolio: it is part of the foundational architecture of the SR OS software. The solution brings a strong suite of traffic engineering and resiliency capabilities via functions such as control and switch fabric redundancy, Fast Reroute and redundant pseudowires that can ensure end-to-end reliability across both leased and self-built mobile backhaul environments.

The 7705 SAR operates in conjunction with 7750 SRs at the head end — in a central office or MTSO — as shown in Figure 2. If an event occurs to compromise access to one of the 7750 SRs, the 7705 SARs will rapidly re-converge traffic on the remaining device. These kinds of advanced features have been verified at high scale in independent test labs and in large deployments in real networks. Without these kinds of sophisticated mechanisms, it could be possible to lose traffic from tens of thousands of metro sites for an extended period of time following a maliciously triggered or accidental failure.

Figure 2. Providing resiliency for cell site backhaul



End-to-end QoS

It is critical to be able to control and maintain QoS for packet traffic. Not all types of traffic have the same set of requirements. Voice traffic in particular requires low latency and jitter (latency variation) as well as low loss. Data traffic often has less stringent delay requirements but may be very sensitive to loss, as packet loss can seriously constrain application throughput. To offer the required treatment throughout the network, traffic flows with different requirements are identified at the access point and marked in-line with the appropriate QoS metrics.

Products in the Alcatel-Lucent IP/MPLS Mobile Backhaul solution use extensive traffic management policies to ensure fairness. Detailed classification and hierarchical scheduling options include: queue type-based, weighted round robin or strict priority and profiled scheduling. Multi-tier policing is also available to differentiate and prioritize individual services and flows. With the solution, operators can differentiate multiple traffic streams, which enables them to meet the different QoS needs of various traffic types including OAM, synchronization, site telemetry, streaming video, VoIP and bulk data. The 7705 SAR in particular has the ability to buffer and shape traffic in order to absorb bursts and improve effective application throughput. This helps operators deliver an optimal QoE for mobile subscribers.

While QoS must be properly applied at both the metro and macro network separately, the network must also ensure that when traffic flows from the metro to the macro network or vice-versa, a consistent QoE is maintained. Operators need to deliver a high QoE for subscribers regardless of the access location in the heterogeneous network.

Maintaining synchronization

Cell sites may rely on the mobile backhaul network to deliver a stable reference from which to derive radio frequencies and to ensure reliable subscriber handover between cells. Other mobile applications such as evolved Multimedia Broadcast Multicast Service (eMBMS) are emerging which tend to increase the importance of synchronization, including frequency, phase and time of day (ToD). The Alcatel-Lucent IP/MPLS Mobile Backhaul solution supports line timing, adaptive clock recovery (ACR), differential clock recovery, synchronous Ethernet and also timing distribution using 1588v2. 1588v2 Master Clock, Boundary Clock, Transparent Clock, and Ordinary Clock are all supported for frequency, phase and ToD.

Accuracy and high performance timing for packet solutions, such as ACR and 1588v2, are accomplished by a combination of built-in architectural features, efficiently tuned algorithms, and powerful QoS mechanisms to minimize the delay experienced by synchronization traffic. Management of the synchronization distribution infrastructure is a key differentiating capability. The 5620 SAM provides tools for managing synchronization, providing centralized synchronization path visualization, proactive monitoring and alarm correlation to allow rapid discovery, and correction of, synchronization impairments.

KEY PRODUCTS IN THE IP/MPLS MOBILE BACKHAUL SOLUTION

Alcatel-Lucent 7705 SAR

The 7705 SAR portfolio is optimized for multiservice adaptation, aggregation and routing, especially onto a modern Ethernet and IP/MPLS infrastructure. At metro cell sites, compact and rugged 7705 SAR variants such as the 7705 SAR-W and 7705 SAR-H are typically deployed, adapting traffic to the available uplink media. However, at larger clustered metro sites such as a rail station or sports arena, variants such as a 7705 SAR-M or 7705 SAR-8 could be used.

At macro cell sites, 7705 SAR variants are deployed for many of the pragmatic reasons encountered at the metro site. However, at macro sites, multiple access technologies and instances are often encountered in interfacing to various types and generations of radio

base stations. Scaling requirements are higher and modularity is increasingly of value at macro locations. For this reason, products such as the 7705 SAR-M and 7705 SAR-8 have often been deployed, leveraging their modular and scalable architectures. The 7705 SAR-8 provides excellent modularity with six chassis slots available for interface cards. The 7705 SAR-8 also brings redundancy of control plane and switch fabric, an important consideration when supporting multiple macro and metro sites on one platform.

At higher points of concentration, the larger form factor 7705 SAR-18 can provide increased levels of traffic aggregation plus support for multiple macro sites. The 7705 SAR-18 supports 16 slots for user interface cards plus redundancy of control plane and switch fabric.

The business case for a metro cell router

While the business case for packetized mobile backhaul is well understood and has been proven in many successful deployments, the newer case of metro cells warrants a fresh examination from a CAPEX/OPEX perspective. Alcatel-Lucent's business case analysis shows that the deployment of the 7705 SAR-W, as a metro cell router, can reduce capital expenses at metro sites by 15 – 20 % when compared with the cost of providing all or some of the following site-required capabilities to a basic backhaul capability. Note that all of these are available as standard in the 7705 SAR-W:

- Enhanced OAM capability (Y.1731, TWAMP, uSec accuracy)
- Layer 2 services (for example, E-Line, E-LAN)
- Layer 3 services (for example, routing, VPRN)
- QoS traffic conditioning (queuing and shaping capability)
- Synchronization capability
- PoE+ function, for microwave power injector, for example

The potential savings extend beyond capital outlay to encompass operating expenses because metro cell deployment is vastly simplified. Different site requirements can be accommodated in a single integrated process with the 7705 SAR-W. For a demonstration of the compelling business case for metro cell router deployment, contact your Alcatel-Lucent sales team.

Alcatel-Lucent 7750 SR

7750 SR multiservice edge routers have been designed from inception to deliver differentiated, high-performance, high availability services. The 7750 SR offers platform capacities ranging from 90 Gb/s to 4.8 Tb/s and beyond, specialized service-aware application processing, advanced quality of service (QoS), and a comprehensive range of Ethernet and multiservice interfaces and protocols. It provides the kind of scale and intelligence operators need to deliver residential, business, and wireless broadband IP services on a converged edge routing platform.

The 7750 SR integrates the scalability, resiliency and predictability of MPLS along with the bandwidth and economics of Ethernet and a broad selection of legacy interfaces. These features enable a converged network infrastructure for the delivery of next-generation services. With its advanced and comprehensive feature set, the 7750 SR can be deployed as a:

- Broadband Network Gateway for residential services
- Multiservice Edge for Carrier Ethernet and IP VPN business services
- Mobile packet core for 2G, 3G and LTE wireless networks
- High-capacity aggregation router in mobile backhaul applications.

Alcatel-Lucent 5620 SAM

The 5620 SAM takes service providers well beyond the traditional boundaries of element, network and service management. The 5620 SAM enables end-to-end management of the all-IP network to help service providers quickly gain the efficiencies they need to beat the competition.

From access to core, fast and easy provisioning reduces time to market and increases flexibility when launching new services. Proactive troubleshooting helps resolve problems before they affect customers, and ease of integration within the existing operational environment helps service providers get the most from their investments.

Key 5620 SAM features include:

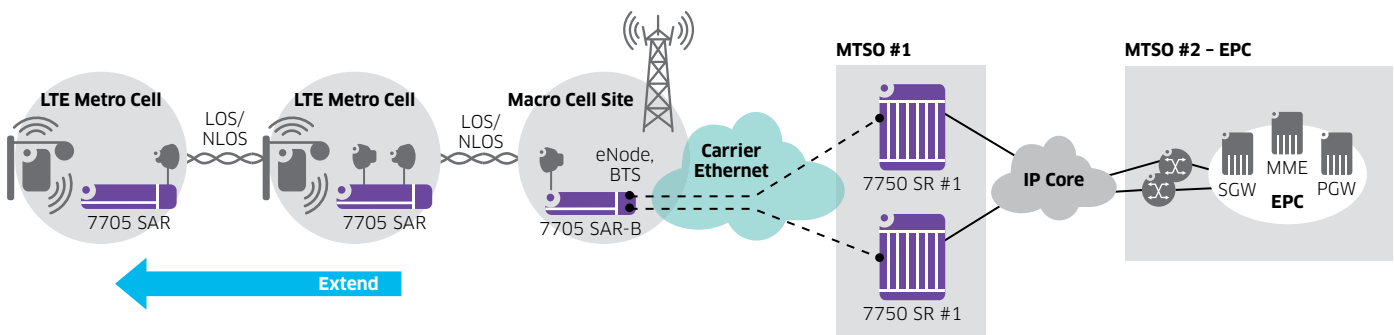
- Easy-to-use GUI that accelerates configuration and provisioning tasks. Automation further accelerates tasks and minimizes the time and costs associated with the errors that commonly occur when a command-line interface is used.
- Common provisioning for Layer 2 and Layer 3 services to reduce the cost of delivering different service types
- Extensive service assurance capabilities that allow proactive identification of problems before they affect customers
- Powerful troubleshooting tools that help to quickly pinpoint the root cause of problems to speed resolution
- Templates that allow simplified integration with existing processes and workflows
- Open interfaces that enable integration with custom web portals, Operations Support Systems, and Business Support Systems.

DEPLOYMENT SCENARIOS

Extending a macro cell mobile backhaul deployment

A number of large tier 1 operators, particularly in the Americas region, are planning to build a metro backhaul capability from an existing macro cell backhaul base.

Figure 3. Extending a macro cell mobile backhaul deployment



Where a macro backhaul deployment based on the Alcatel-Lucent product family exists, deployment of metro cell backhaul is easily facilitated. For example, a 7705 SAR-8 or 7705 SAR-M at the macro site can be used to concentrate daisy-chained metro sites. The established backhaul solution is extended using LOS, NLOS or near line of sight (nLOS) microwave solutions available from the Alcatel-Lucent product portfolio or from pre-tested and integrated specialist partners.

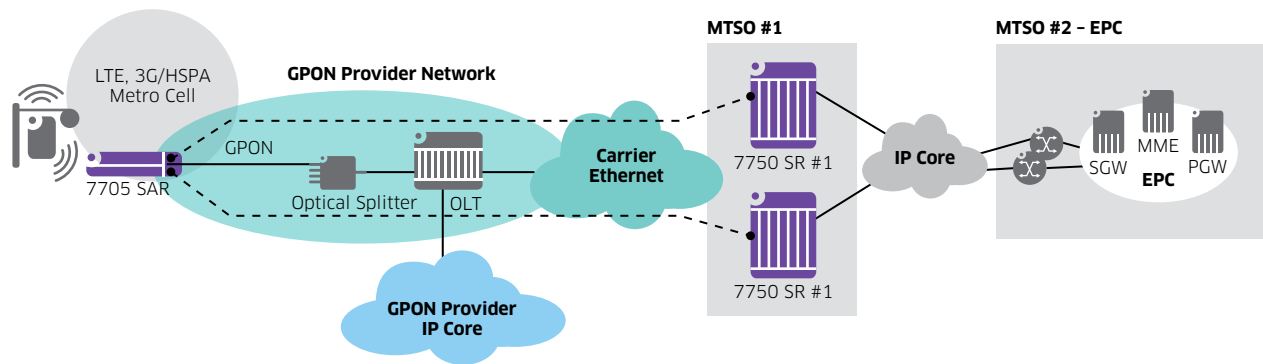
The 7705 SAR-8 at the macro site aggregates multiple metro cells and also the macro cell, leveraging existing Layer 2 Carrier Ethernet service to the MTSO. The 7705 SAR-8 provides Layer 3 routing at the macro site to reduce X2 latency and backhaul bandwidth for local metro-to-metro and metro-to-macro cell handovers. For example, a 7705 SAR-W can be deployed at the metro cell site to enable consistent end-to-end operations and the delivery of resilient Layer 2 and/or Layer 3 services.

The 7705 SAR-W scalability at the metro cell site accommodates future growth. New frequency bands or services (for example, WiFi) can be easily added. Expansion to include additional metro cell sites is also straightforward.

Adding a metro broadband backhaul deployment

In many parts of the world and particularly in Western Europe and Asia, operators want to leverage fiber assets for mobile backhaul.

Figure 4. Adding a metro broadband backhaul deployment



Many operators use GPON technology to allow for improved scale for broadband backhaul over fiber. GPON termination as an ONT is available on the 7705 SAR. This can supply line synchronization and provide line reach up to 20 km. The 7705 SAR-W at a metro site enables end-to-end operations in Layer 2 or Layer 3 services, resiliency and OAM. Note that it is possible to deploy 7705 SAR-8s at macro sites to allow microwave backhaul (LOS/NLOS/nLOS) for those areas that are not served with fiber.

Integrated PON uplinks are available on all 7705 SAR access platforms including the 7705 SAR-W, 7705 SAR-M, 7705 SAR-A and 7705 SAR-8. Macro and metro cell backhaul via SHDSL, 8-pair bonded ADSL2+ and 8-pair bonded VDSL2 is also available as an integrated option within the 7705 SAR portfolio. These additional options make it possible for operators to leverage existing wireline assets for backhaul.

CONCLUSION

IP/MPLS has become the foundation for many fixed, mobile and converged networks. Its acceptance has been equally driven by the cost-effectiveness of fiber access and Ethernet, as well as by its ability to act as a uniform and unifying layer for many underlying technologies.

The Alcatel-Lucent IP/MPLS Mobile Backhaul solution delivers a strong set of features and capabilities to support the evolution to 4G / LTE wireless broadband. During the transition, the solution efficiently supports 2G and 3G (plus HSPA). Newer trends, such as metro cell deployment and network infrastructure sharing, are well supported. Fixed Mobile Convergence and IP transformation are enabled and augmented by the solution.

The Alcatel-Lucent IP/MPLS Mobile Backhaul solution, and the products that comprise it, support high-capacity, reliable, scalable, cost-efficient and fully managed mobile packet transport. The solution allows MNOs and backhaul transport providers to take full control of their networks and quickly deliver advanced, revenue-generating services.

ACRONYMS

5620 SAM	Alcatel-Lucent 5620 Service Aware Manager	nLOS	Near line of sight
7705 SAR	Alcatel-Lucent 7705 Service Aggregation Router	OAM	operations, administration and management
7750 SR	Alcatel-Lucent 7750 Service Router	OPEX	operating expenditures
BTS	base transceiver station	P2MP	point-to-multipoint
CAPEX	capital expenditures	P2P	point-to-point
CWDM	Coarse Wavelength Division Multiplexing	PDH	Plesiochronous Digital Hierarchy
DSL	Digital Subscriber Line	PGW	Packet Data Network Gateway
EFM	Ethernet in the first mile	PoE	Power over Ethernet
eMBMS	Evolved Multimedia Broadcast Multicast Service	QoE	quality of experience
EPC	Evolved Packet Core	QoS	quality of service
GPON	Gigabit-capable Passive Optical Network	RAN	radio access network
GUI	graphical user interface	RNC	radio network controller
HSPA	High Speed Packet Access	RU	rack unit
KPI	key performance indicators	SDH	Synchronous Digital Hierarchy
LOS	line of sight	SGW	serving gateway
LTE	Long Term Evolution	SLA	service level agreement
MME	mobile management entity	SON	self-organizing network
MNO	mobile network operator	SR OS	Alcatel-Lucent Service Router Operating System
MTSO	Mobile Telephone Switching Office	TCO	total cost of ownership
MW	microwave	ToD	time of day
NLOS	Non line of sight	VoIP	Voice over IP
		VPN	virtual private network
		VPRN	virtual private routed network