

Enabling the Profitable Evolution of Mobile Transport to All-IP

Mobile Evolution Transport Architecture

As demand for mobile multimedia services increases and average revenue per user (ARPU) declines, service providers must transform their networks to profitably support legacy voice and advanced packet-based services. The mobile transport network is one of the key considerations for service providers planning a network transformation. To migrate and scale the backhaul and backbone network to meet market and business objectives, service providers need an end-to-end architecture — from cell site to core — that supports diverse evolution alternatives and provides a clear path to all-IP.

The Alcatel-Lucent Mobile Evolution Transport Architecture (META) delivers an end-to-end network architecture that provides the intelligence, flexibility, simplicity and cost-effectiveness required to support massive growth in the number of mobile subscribers, applications and devices. It allows service providers to make a profitable transition to a more cost-effective mobile transport network infrastructure that supports current services and delivers new multimedia services and applications.

This paper outlines the challenges associated with transforming the mobile transport network and presents the Alcatel-Lucent approach to effective transformation.

Table of contents

1	The Mobile Transport Challenge
2	Mobile Transport Evolution from TDM to all-IP
3	Alcatel-Lucent Mobile Evolution Transport Architecture
5	Customized Mobile Transport Transformation
5	Cell Site Aggregation
5	Service Delivery
6	Integrated Network and Service Management
7	Graceful Introduction of LTE
8	Backed By Professional Services
8	Conclusion
9	Abbreviations

The Mobile Transport Challenge

Today's mobile service providers and backhaul transport providers face unprecedented challenges:

- Need to reduce backhaul transport costs: Driven by bandwidth-rich services (unlimited voice bundles, VPNs, Internet access, mobile TV, etc.) traffic per user is increasing faster than revenue per user, forcing service providers to reduce the cost per bit transported while massively scaling the radio access network (RAN).
- Migration to a packet optimized network: As 2G/3G traffic continues to grow, several transport technologies and new services need to be supported, forcing service providers to focus on packet optimization to reduce costs.
- Retain more value in the network: New players with innovative business models and technologies are appearing, threatening conventional revenues and forcing service providers to respond with differentiated services that leverage the intrinsic value of their physical network.

All these challenges are the result of ever-increasing end user demand.

Attracted by the freedom of mobility that wireless affords and fueled by advances in technology, business and consumer end users are purchasing a variety of mobile devices as fast as manufacturers can deliver them.

In this boom, mobile voice traffic and minutes of use are increasing — and will continue to increase — but average revenue per user (ARPU) is decreasing as mobile service providers continue to differentiate their voice offerings on price.

Meanwhile, broadband wireless technologies have spurred mobile service providers to meet end user demands with new packet-based services, such as:

- Short messaging services
- Web browsing services
- Media streaming services
- Real-time multimedia services

But as end users adopt these services, mobile networks must evolve to deal with the transmission of huge amounts of data alongside legacy voice services.

The challenge for service providers is to deliver all services at attractive rates and at profitable operating margins. At the same time, they must provide the high quality of experience (QoE) end users expect from advanced voice, video, streaming, and presence services. To do so, they must leverage existing network infrastructures where possible and simultaneously transform their networks to support packet-based traffic.

The mobile transport network is one of the key considerations for service providers planning a network transformation that supports legacy voice and advanced packet-based services. To address market challenges, meet business objectives and user demands, the mobile transport network must:

- Support new multimedia services (2G/3G) while preparing for the introduction of LTE
- Enable scalable bandwidth at lower cost (leveraging Ethernet/IP)
- Provide service assurance across all services (via carrier grade Ethernet/MPLS)
- Lower operations costs (via integrated management)

In this environment, service providers are turning to IP/Ethernet technology to offer more valuable, personalized multimedia services and achieve a lower cost base. This is happening just as more spectrally-efficient 3G voice services are generating increasing amounts of packet traffic.

The impact of this shift on mobile transport networks is profound, both in the radio access network (RAN) and in the mobile core.

New transport solutions must support a smooth transformation from 2G/3G to 4G in support of new mobile broadband services. Additionally, new options must allow service providers to reduce operational expenses (OPEX). This has led many service providers to make significant investments in network expansion.

To get there, mobile service providers are following various network evolution strategies depending on their business models, including:

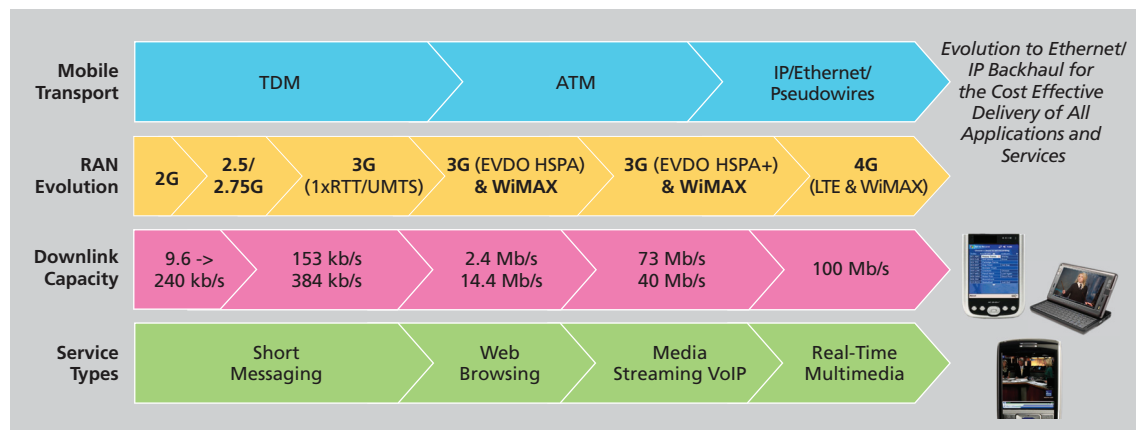
- Optimizing the existing backhaul network to drive out transport costs
- Building new carrier-grade IP backhaul networks that support both circuit and packet traffic
- Implementing a hybrid approach — offloading non-real time data traffic onto an Ethernet backhaul network while keeping voice services on the existing backhaul network

To effectively evolve their network, service providers need a flexible end-to-end architecture — from cell site to core — that supports diverse evolution alternatives and provides a clear path to all-IP networking.

Mobile Transport Evolution from TDM to all-IP

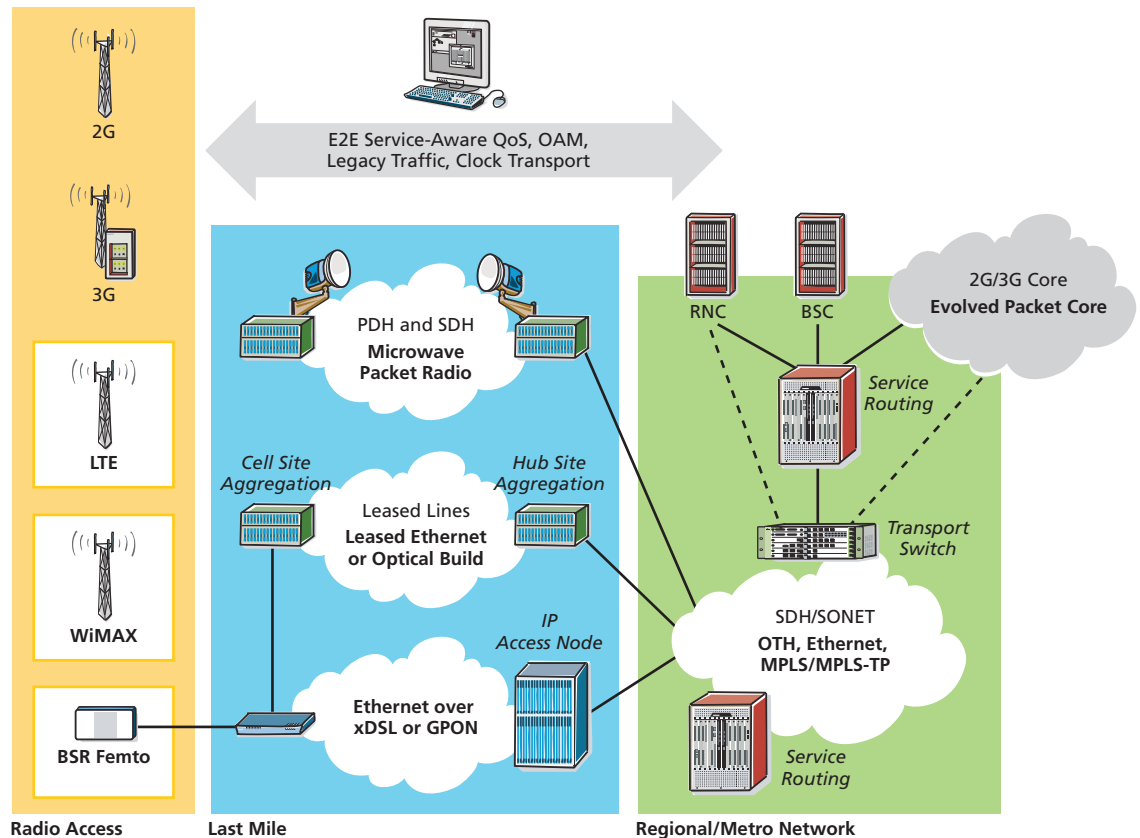
As part of a mobile network transformation, service providers must evolve the transport network to accommodate new packet-based services while simultaneously supporting existing 2G services (Figure 1).

Figure 1. Evolution of the Radio Access Network (RAN) and Mobile Transport Network



The Alcatel-Lucent vision for mobile transport addresses these fundamental requirements through a comprehensive IP transformation architecture, which provides service providers with an evolution path to all-IP, regardless of the type of network they want to deploy (Figure 2). This solution is based on building blocks that can meet a variety of operator strategies. It is designed to help them reduce total cost of ownership (TCO) and simplify their network as much as possible, while at the same time preparing for the evolution towards broadband wireless services.

Figure 2. Mobile Transport Evolution



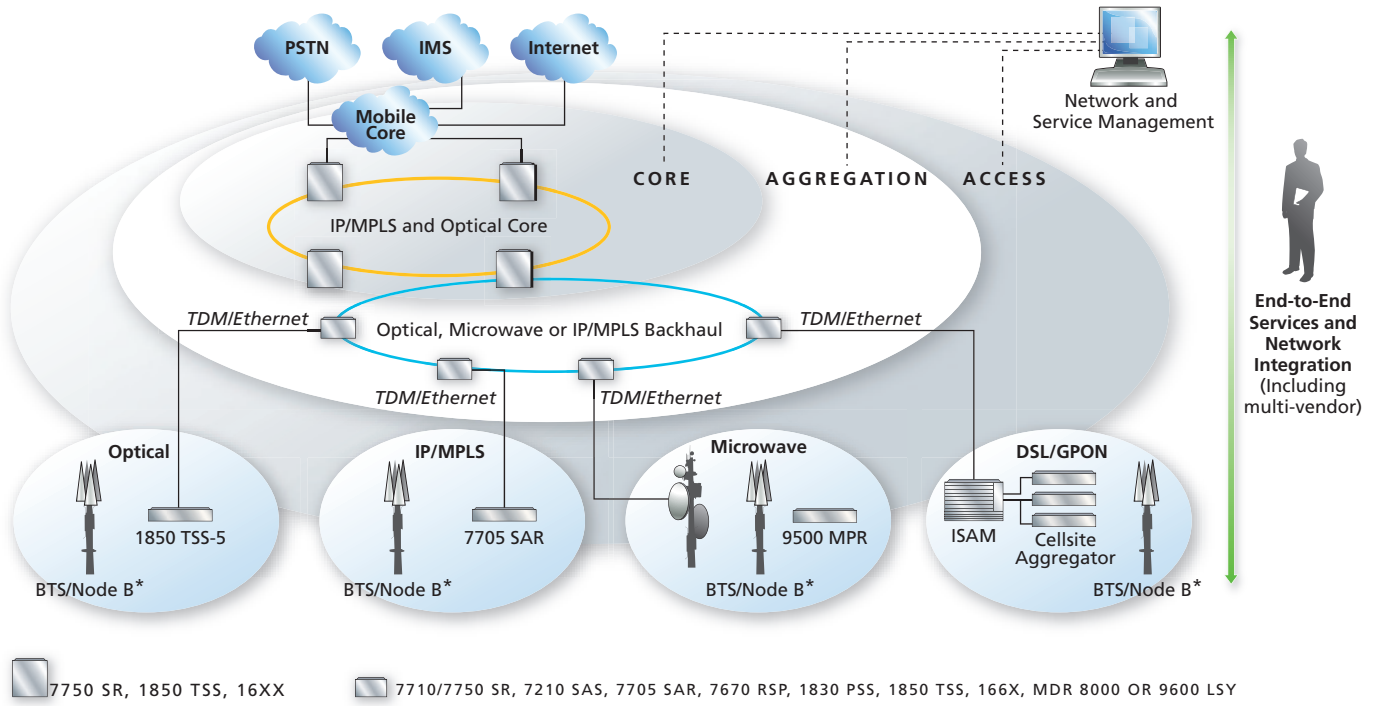
Alcatel-Lucent Mobile Evolution Transport Architecture

The Alcatel-Lucent Mobile Evolution Transport Architecture (META) provides an end-to-end network architecture that supports Alcatel-Lucent's Mobile Transformation Strategy and enables network operators to migrate and scale their network profitably (Figure 3). This architecture offers more service intelligence, flexibility, simplicity and cost-effectiveness to allow mobile service providers and backhaul transport providers to successfully serve the massive growth in 2G and 3G mobile broadband service demand.

Using the optimal cost points of Ethernet, coupled with the proven scalability, availability and service aware capabilities of multiprotocol label switching (MPLS), META enables service providers to leverage existing infrastructure investments and evolve to all-IP networking at the pace of customer demand, and with the QoE that customers have come to expect from traditional wireline services.

META is a highly integrated solution based on Alcatel-Lucent's fixed and wireless leadership. It greatly reduces OPEX, and it increases scalability and availability to enable broadband service delivery over any media — fiber, copper, wireless.

Figure 3. Mobile Evolution Transport Architecture



*SUPPORT OF MULTI-GENERATIONAL WIRELESS NETWORKS USING ANY BTS/NODE B (CDMA, GSM/W-CDMA, WiMAX, LTE)

This comprehensive solution for mobile transport evolution offers service providers the flexibility, reliability, and scalability they need to profitably migrate from time division multiplexing/ plesiochronous digital hierarchy (TDM/PDH) backhaul to all-IP supported by Ethernet and MPLS.

In addition, META provides service providers with unprecedented flexibility. The architecture lets operators evolve at their own pace because it supports multiple backhaul alternatives, including:

- Packet Optical backhaul (SDH/SONET/WDM)
- Asynchronous transfer mode (ATM)
- Digital subscriber line (DSL)
- Gigabit passive optical network (GPON)
- IP/MPLS
- Packet-optimized microwave

This comprehensive approach allows service providers to cost-effectively transform their mobile transport infrastructure from TDM/PDH to packet whether following a hybrid data offload approach or converging all services onto an IP-RAN.

In short, the Alcatel-Lucent META end-to-end architecture, spanning from cell site to core, enables service providers to simplify operations via integrated network and service management. In this way it:

- Provides flexibility and scalability to support new, profitable 3G and 4G mobile services
- Provides QoS support for all mobile services, efficiently allocating scarce backhaul network resources in real time
- Increases network optimization and capacity, improving cost per bit transported
- Addresses infrastructure diversity via flexible backhaul alternatives, each providing an evolution to all-IP

Customized Mobile Transport Transformation

To make the backhaul transformation efficient, Alcatel-Lucent has designed META to give service providers complete control over the network transformation process. It can be tailored to meet diverse backhaul network evolution requirements, including hybrid data offload approaches, over any media (copper, fiber, or microwave).

In addition, META leverages IP/MPLS and optical backbones to meet the reliability and service scaling requirements of next generation networks, IP multi-media subsystems (IMS) and IP-based services. By using a service router or transport service switch in the MTSO to interconnect mobile elements, META allows service providers to optimize resources and networking flexibility of inter-element connections to drive costs out of the RAN.

Additional flexibility is provided by allowing service providers to take the capabilities of service routing and Carrier Ethernet transport to intermediate hub locations in the RAN. This allows a common, shared infrastructure to be used for all aggregated traffic between the hub and the MTSO. It also delivers significant leased line savings because Carrier Ethernet or optical connections can be used for backhaul.

Finally, META can also support multi-generational access via simultaneous support for TDM/PDH, SDH/SONET, optical transport hierarchy (OTH), multilink point-to-point protocol (MLPPP), ATM with inverse multiplexing over ATM (IMA), Ethernet and IP as the access network evolves.

Cell Site Aggregation

Alcatel-Lucent META provides additional benefits by extending IP/MPLS, MPLS-TP and Ethernet aggregation towards the cell site.

In the cell site there are opportunities for aggregation solutions that converge multi-generational traffic streams and/or adapt legacy base station interfaces onto packet transport infrastructures.

This is accomplished through the deployment of cell site aggregators either co-located with a mobile base station or at intermediate aggregation (hub) sites. This enables a dedicated, fully-managed, end-to-end backhaul solution capable of supporting any combination of wireless access technologies and vendors.

These cell site aggregation solutions can also help service providers by linking small clusters of base stations and grooming the traffic to reduce backhaul costs. Through the implementation of Carrier Ethernet between the cell site and the MTSO, traffic can be aggregated efficiently and end-to-end service delivery upheld.

For service providers evolving to IP backhaul, the combination of both Ethernet for reduced costs and MPLS for enhanced services delivery with reliability and QoS are essential to support all mobile services.

Service Delivery

The goal of mobile transport network modernization is to enable new service delivery while lowering the cost of transport. Alcatel-Lucent META leverages the optimal cost points of newer transport technologies such as Carrier Ethernet and MPLS/MPLS-TP helping service providers prepare for the profound changes that long term evolution (LTE) will bring.

A key component of the architecture is an IP-optimized, data-aware transport infrastructure suitable for the full range of legacy and new services. This infrastructure supports different QoS requirements (i.e., delay), depending on the application.

To meet the stringent QoS requirements of real-time traffic, the IP backhaul network must integrate many of the qualities and attributes of switched networks: predictability, reliability and manageability.

The implementation of MPLS/MPLS-TP within the Alcatel-Lucent META provides the QoS, traffic engineering and management capabilities necessary to support all mobile services as well as business applications and consumer Internet services over an IP network.

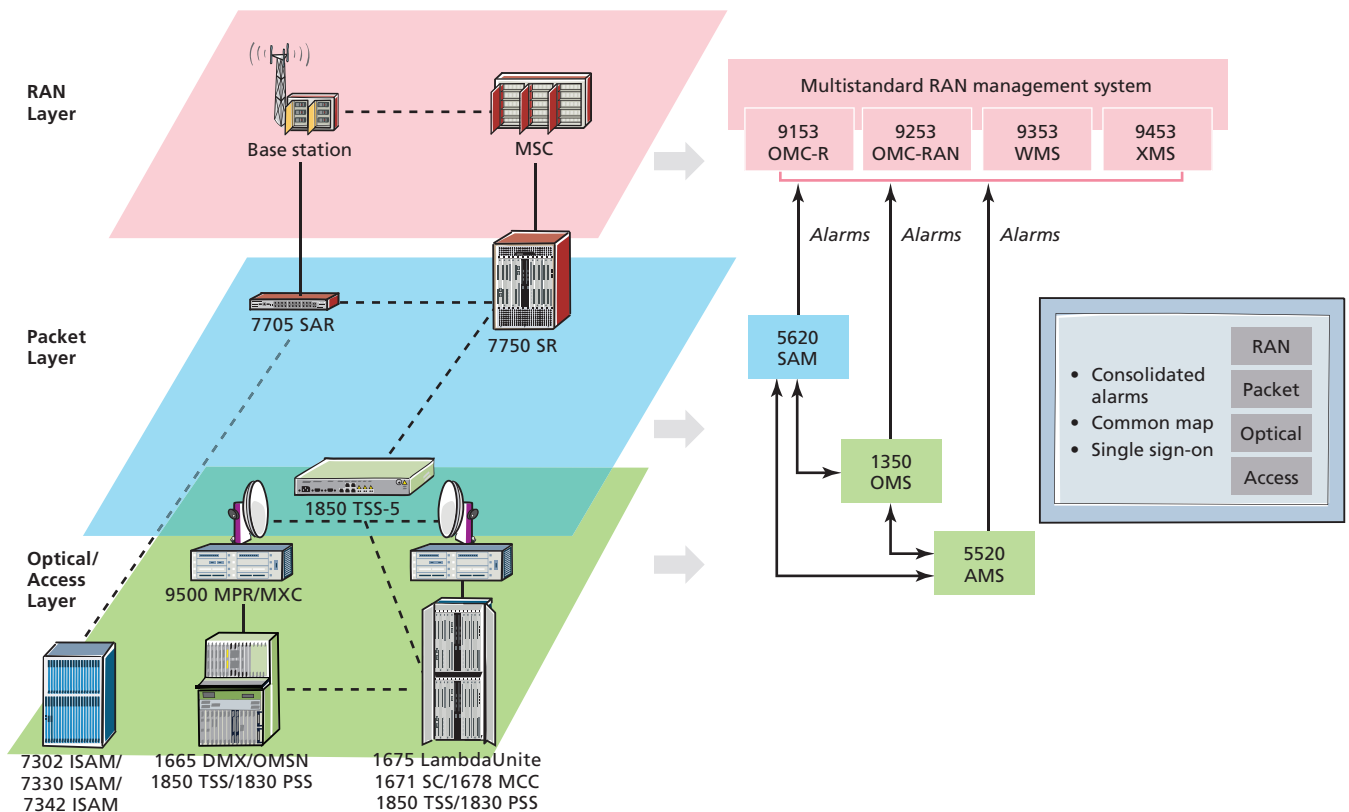
Rather than using multiple overlay backhaul networks, Alcatel-Lucent META can accommodate legacy access needs and be optimized for next generation broadband services using Ethernet and MPLS, based on multi-service routing and switching platforms. The use of IP/MPLS-based pseudo-wires brings mature and efficient functionality to the RAN and enables transition of the legacy RAN to packet. In addition, the incorporation of Circuit Emulated Service (CES) capabilities onto transport service switches lets operators leverage existing TDM investments by enabling the transport of TDM traffic over Ethernet.

Integrated Network and Service Management

The mobile RAN is characterized by rapid growth and a high churn rate as well as a diversity of access types. As mobile networks grow, a continuous rebalancing of the RAN can have a major impact on the cost of network ownership, as new cells are added or existing cells modified to accommodate changes in capacity requirements. To support this critical business activity, strong network management tools and processes are needed to control operating expenses.

Service providers can choose to manage the RAN, packet and optical domains separately or in a more integrated fashion. Alcatel-Lucent's integrated management suite provides a flexible management solution that enables both approaches. Supporting unified backhaul, the solution provides integrated management across technology layers using alarms from each layer that are fed to the top layer's management system for consolidated alarm view. This lets mobile operators see the full maintenance status of the backhaul network whereby transport related alarms are fed to either Alcatel-Lucent RAN management systems (i.e. 9153 OMC-R, 9253 OMC-RAN, 9353 WMS, 9453 XMS) or other 3rd party RAN management systems). And to further simplify operations and maintenance, a common network tree / map, with secure operator navigation is provided (Figure 4).

Figure 4. Alcatel-Lucent Integrated Management Suite



As part of the Alcatel-Lucent management suite, the 5620 Service Aware Manager (SAM) facilitates delivery of advanced network services based on Alcatel-Lucent's converged IP, Ethernet and MPLS portfolio. And it enables management of cell sites that provide microwave access via the Alcatel-Lucent 9500 Microwave Packet Radio (MPR).

The 5620 SAM enables provisioning of an end-to-end service using wizards or point and-click configuration from a single application without having to individually configure each device in the service path. It greatly reduces the complexity and risk associated with provisioning complex services, and provides comprehensive support for fault, configuration, accounting, performance and security.

The management system of a transformed mobile backhaul network must have the capability to understand the hierarchy of end-to-end service construction. With this service awareness the management system can react to individual nodal and composite service events and present correlated, relational information to the operator. This enables faster service provisioning, verification and restoration.

Management of the optical and microwave transport systems in the Alcatel-Lucent META is provided by the Alcatel-Lucent 1350 Optical Management System (OMS), a comprehensive set of applications, bundled according to the transport network solutions managed (e.g., connectivity services based on Ethernet, MPLS, SDH/SONET, and WDM technologies). This complete solution, allows service providers to manage multi-technology, multi-service networks that integrate current and next-generation transport technologies with emerging data traffic like metro Ethernet.

In addition, the Alcatel-Lucent 5520 Access Management System (AMS) supports the ISAM family of Alcatel-Lucent access nodes. It provides all management requirements for provisioning, maintaining and troubleshooting access networks with all the necessary means for enabling smooth integration into a service provider's operations support system (OSS). And it provides a set of productivity tools that drastically increase operator efficiency.

Graceful Introduction of LTE

With mobile traffic evolving to become fully IP-based, the mobile transport network needs to address key new requirements for guaranteed enhanced QoS and low latency. At the same time, the mobile transport network needs to provide required scalability while ensuring service reliability and flexibility. Service providers who are employing mobile packet transport based on META can leverage the same packet transport network architecture for LTE. This gives operators a future-safe evolution path to LTE, and allows co-existence with previous generations of mobile technologies through cost-effective, converged transport. META provides a comprehensive solution addressing the introduction of LTE by supporting:

- Precise alignment of mobile and transport network layers to ensure end-to-end QoS
- Scalability to match LTE bandwidth requirements
- Ability to converge backhaul and backbone transport for maximum flexibility in LTE roll-out and growth
- Integration of mobility OAM&P functions with the transport layer to reduce network complexity and streamline operations

Delivering a multi-technology solution, META enables the reliable transport of all-IP traffic over Optical, Microwave, IP/MPLS, or DSL/GPON packet networks. To ensure the continuity of services based on existing mobile technologies while introducing LTE, META allows advanced traffic management and processing, and full separation and prioritization of different service traffic, in order to deliver guaranteed end-to-end, managed QoS. Through the implementation of META, service providers can consolidate Capex and Opex through a more scalable, flexible, resilient and secure transport network.

Backed By Professional Services

Beyond technology and products successful transformation must be supported by end-to-end service delivery. This requires a services integrator who understands the requirements of the new RAN and backhaul network and can effectively integrate all components. Alcatel-Lucent backs the Mobile Evolution Transport Architecture with extensive experience and comprehensive professional services. As a leader in developing and delivering 2G/3G and WiMAX networks, broadband wireless access, and carrier-grade IP/MPLS networks, Alcatel-Lucent is the ideal mobile transport network transformation partner.

Today, Alcatel-Lucent is setting the standard for IP network transformation based on a vision, portfolio and commitment to deliver next-generation, user-centric solutions.

As the world leader in IP network transformation, Alcatel-Lucent provides mobile service providers and backhaul transport providers with a wealth of industry thought leadership and services integration experience for:

- Consultation on service transformation
- Integration of carrier-grade solutions across multiple vendors and telecom domains
- Operations support system/business support system (OSS/BSS) and security integration
- Support for policy-driven security, QoS, blending and personalization approaches
- Skills and resources for rapid development and deployment of high-value technologies and services.
- Extensive operations and maintenance services

This complete and integrated approach allows mobile operators to ensure their networks are ready to address the needs of their customers. It enables them to launch a broad variety of profitable new, IP-based services and blend them with already available services.

Conclusion

To meet the ever-increasing end user demand for more personalized multimedia services and address competitive pressures, service providers must find a way to deliver all services at attractive rates and at profitable operating margins. At the same time, they must provide the high QoE end users expect from advanced voice, video, streaming, and presence services. These objectives can only be met by leveraging existing network infrastructures where possible and simultaneously transforming networks to support packet-based traffic.

The mobile backhaul transport network is one of the key considerations for mobile service and backhaul transport providers planning a network transformation that supports legacy voice and advanced packet-based services. To migrate and scale the network to meet market and business objectives, service providers need an end-to-end architecture — from cell site to core — that supports diverse evolution alternatives and provides a clear path to all-IP.

The Alcatel-Lucent Mobile Evolution Transport Architecture (META) is designed to help service providers make a profitable transition to a more cost-effective mobile transport network infrastructure. It supports the delivery of new multimedia services and applications with stringent QoS requirements, reduces costs in the mobile transport network, and provides an evolution path to all-IP.

This complete solution provides:

- A comprehensive integrated solution, unmatched in the industry, for evolving CDMA and GSM/W-CDMA mobile transport networks to all-IP
- Flexible backhaul evolution by supporting any access: TDM/PDH, ATM, DSL/GPON, IP/MPLS, microwave, and SDH/SONET/WDM migrating to all IP/Ethernet
- QoS support for all mobile services, efficiently allocating scarce backhaul network resources in real time

- Increased network optimization and capacity, improving cost per bit transported
- Diverse base station transport options for optimized backhaul of all mobile services
- Comprehensive portfolio of professional services in support of mobile transport network transformation

For mobile service providers and backhaul transport providers embarking on a network transformation, the Alcatel-Lucent META presents the best option for today and tomorrow.

Abbreviations

ARPU	average revenue per user
ATM	asynchronous transfer mode
BSS	business support system
BTS	base transceiver station
CDMA	code division multiple access
DSL	digital subscriber line
GPON	gigabit passive optical network
IMA	inverse multiplexing over ATM
IMS	IP multi-media subsystems
IP/MPLS	Internet protocol/multi-protocol label switching
LTE	Long Term Evolution
META	mobile evolution transport architecture
MLPPP	multilink point-to-point protocol
MPLS	multiprotocol label switching
MPLS-TP	multiprotocol label switching transport profile
MTSO	mobile telephone switching office
OAM&P	operations, administration, maintenance and provisioning
OPEX	operational expenditure
OSS	operations support system
OSS/BSS	operations support system/business support system
OTH	optical transport hierarchy
PDH	plesiochronous digital hierarchy
QoE	quality of experience
QoS	quality of service
RAN	radio access network
SDH	synchronous digital hierarchy
SONET	synchronous optical network
TCO	total cost of ownership
TDM	time division multiplexing
WDM	wavelength division multiplexing

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