Bandwidth Today, 4G Tomorrow

Is the smartphone explosion giving you bandwidth headaches? Do you need to prepare to better compete in 4G?

See how a large wireless provider:

- Gained instant bandwidth relief with high quality of service
- Bridged the divide between 2G and 3G
- Secured the ability to seamlessly migrate to LTE/4G
- Simplified operations with a single network manager.

Introduction

A Tier 1 mobile operator faced significant challenges:

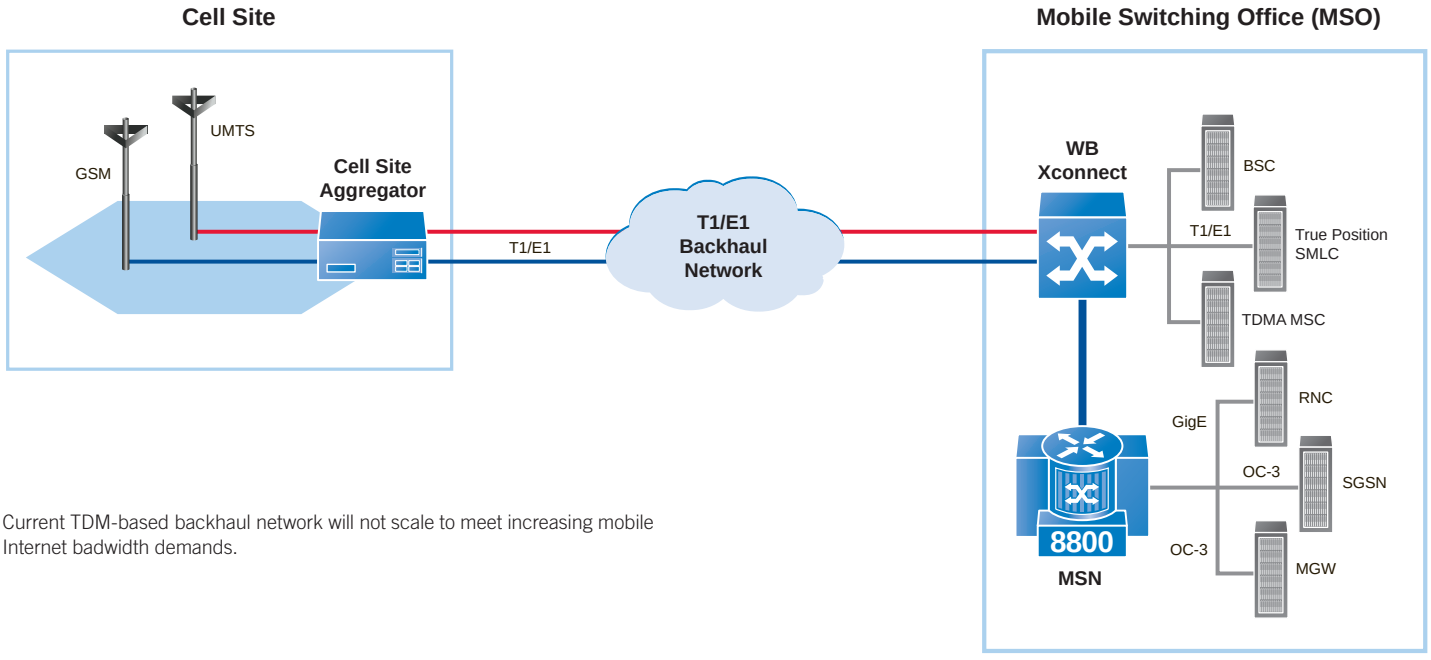
- Increasing bandwidth and adding new services while leveraging a diverse set of embedded services and technologies
- Providing a high-quality user experience
- Applying a path to a packet-oriented mobile network
- Doing it all in parallel.

As with many of its global counterparts, expanding the reach and capacity of its network was crucial to ensuring near- and long-term success. In addition to upgrading its network to deliver advanced 3G mobile-broadband services, the operator is migrating its network from TDM-based equipment to an all-IP infrastructure and preparing to roll out 4G/LTE services.

A critical component of that multi-faceted transformation strategy is a major upgrade of the backhaul network to provide the bandwidth, quality of service (QoS) and resiliency required by next-generation mobile Internet services and inherent in many time-tested legacy offerings. With Tellabs as a partner, the operator is deploying a high-performance, multi-protocol backhaul segment that scales seamlessly, reliably and cost-effectively across thousands of cell sites and millions of potential users. Anchoring the new backhaul network are the Tellabs® 8800 Multiservice Router (MSR) Series and Tellabs® 8600 Managed Edge System.

In this case study, we look at the Tier 1 operator's ongoing mobile backhaul project, how the operator is addressing its challenges, the Tellabs role in these initiatives, and the resulting benefits to the operator and its users.

Legacy 2G Backhaul



Current TDM-based backhaul network will not scale to meet increasing mobile Internet badwidth demands.

Operator Challenges:

- Increasing bandwidth immediately to meet mobile Internet demands
- Leveraging and interworking embedded technologies such as TDM and ATM
- Ensuring deterministic and scalable QoS for all services
- Supporting the existing legacy network and services in parallel to a smooth migration to future packet network for next generation wireless services.

More Access Speed and Capacity

The operator decided to focus first on increasing access speeds and capacity. Over the last few years, the operator upgraded its 3G base stations to High-Speed Packet Access (HSPA) and, in some markets, converted 850-MHz spectrum from 2G to support 3G services. In addition to adding thousands of new 3G cell sites, the operator increased backhaul bandwidth by replacing or supplementing the 4 to 6 copper-based T1/E1 lines at many cell sites with fiber-based Ethernet links.

The decision to replace or supplement often comes down to the operational model in a specific region of the operator's network; for example, whether the operator owns the backhaul or leases it, or a combination of both. In either case, a flexible solution is needed to adapt strategically to each environment.

These efforts, combined with the HSPA upgrades, increase 3G speeds and capacity and also create a seamless migration path to a 4G/LTE environment, where the required end-user link speeds are expected to exceed 50 Mbps. As the operator rolls out LTE services, users must be able to switch easily among 4G, 3G and 2G services for the fastest and most reliable connection available in a given geographic area.

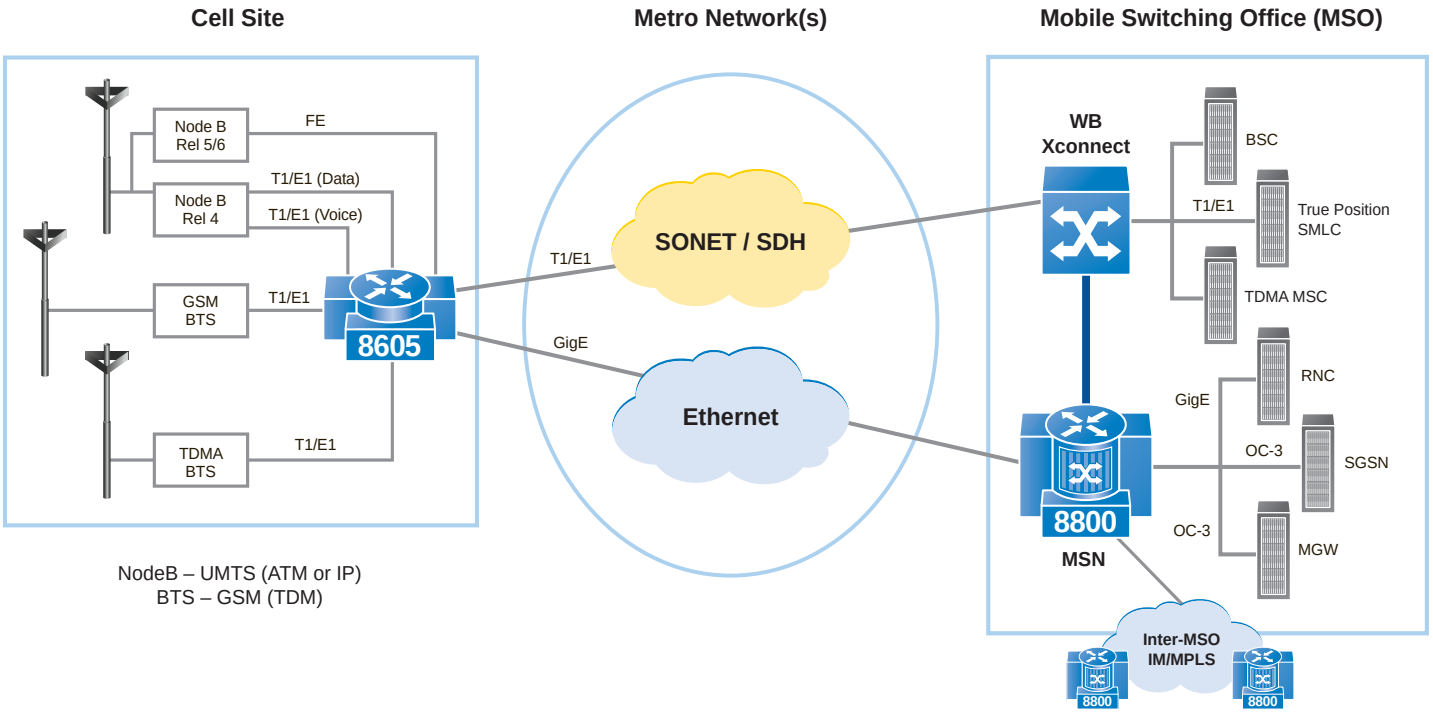
Paving a Migration Path to IP/MPLS and 4G

The next step in upgrading the base station-to-RNC backhaul network centered on two requirements: high-density inverse-multiplexing-over-ATM (IMA) transport and aggregation, and a migration path to IP/MPLS. The operator's network is largely a centralized one, with thousands of base stations connected through hundreds of mobile switching offices (MSOs) to multiple radio network controllers (RNCs).

The sheer physical scale of the network, along with potential growth in traffic volumes, required the aggregation of at least 400 IMA bundles per MSO group. For illustrative purposes, if 200 base stations, each with 10 IMA links, connect to a single RNC, that translates into 2,000 T1s/E1s or about 25 OC-3/STS-3 [assuming 80 T1s per OC-3] or over 30 STM-1s [assuming 60 E1s per STM-1].

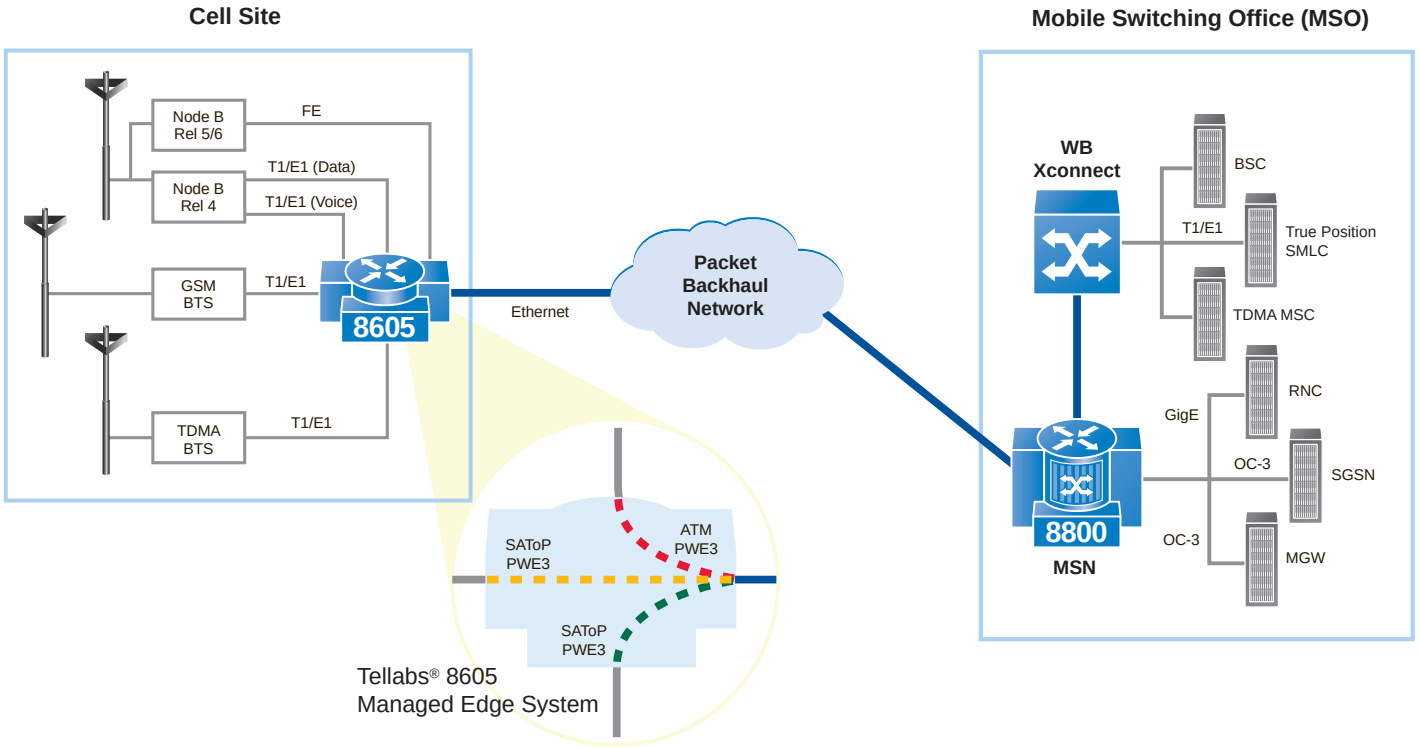
Like many mobile providers around the world, the operator had substantial investments in two platforms--one designed for 3G (ATM-based) backhaul and another that supports 2G (TDM-based) backhaul. To accommodate its growing data demands and

2G/3G Backhaul with Separate Packet and SONET/SDH Networks



NodeB – UMTS (ATM or IP)
BTS – GSM (TDM)

From T1/E1 to Ethernet Packet Backhaul



subsequent IMA aggregation requirements across a huge network, the operator faced the prospect of continuing to invest in multiple ATM network elements, each of which in this case could only support 8 IMA groups, and aggregating those to its existing routing/switch platform.

At the same time, to protect its 2G service revenues, the operator would have to maintain its existing investment in TDM platforms where necessary. More investment in ATM and TDM-only elements proved inefficient and only hindered the need to lay out a clean migration path to a packet network. In addition, traditional ATM switches did not offer the flexible Gigabit and multi-Gigabit interfaces needed for both network scaling needs and Ethernet interconnect with newer, Ethernet-oriented backhaul networks.

The operator found a cost-effective, end-to-end solution to all three issues in the Tellabs® 8800 Multiservice Router (MSR) Series. The first IP/MPLS router to support native ATM switching and TDM circuit emulation over packet (SAToP), the Tellabs 8800 series also supports classic IP and MPLS protocols — such as RSVP, LDP, BGP, OSPF, etc. — as well as the faster Ethernet interfaces needed for 4G/LTE services. In parallel, with an IMA density 8 times greater than alternative solutions, the Tellabs 8800 series protects the operator's existing 2G/3G investments and revenues and paves a seamless migration to an IP/MPLS-enabled network.

One Platform = Mobile Aggregation + Core Interconnection

In some areas of the network, the operator is deploying the Tellabs 8800 series to function as an IMA aggregation or Ethernet interconnect point in front of the RNC and also as an IP/MPLS core edge router. As a result, the operator does not have to invest in two separate platforms and the associated rack space, power and cooling requirements.

The Tellabs 8800 series supports the Iub (Node B to RNC), IuR (RNC to RNC)and also IuCS/ IuPS (mobile core) interfaces in the carrier network. Effectively serving as single-platform RNC "cloud," the Tellabs 8800 series surrounds the RNC and connects it, via Ethernet or point-to-point protocol (PPP), over channelized OC-3, 12- and 48 links, to the appropriate network elements in the mobile core.

In addition, some areas within the operator's IP/MPLS core network have a decentralized RNCs which are remotely located from core functions such as the Gateway GPRS Support Node (GGSN) and Serving GPRS Support Node (SGSN). In these instances, the operator uses the Tellabs 8800 series to create an IP/MPLS transmission path for traffic between the RNC and the mobile core to address the lack of co-location and to ensure redundancy and reliability. If a failure occurs, the operator is protected by technologies such as Fast Re-Route to divert traffic to another destination point, ensuring a given RNC has multiple interconnection

points to the mobile core, providing redundancy and reliability.

Further, the capacity of the Tellabs 8800 series, in terms of slots and switching needed to handle Iub and core-facing traffic, is more than enough to handle current traffic volumes arriving at the RNC, as well as expected growth in that traffic. Tellabs has made recent capacity enhancements to meet current and future network demands for both bandwidth and control plane protocols (BFD, OSPF, LDP, etc).

Tellabs 8800 MSR series benefits:

- Supports and scales existing ATM and TDM services
- Offers routing as well as circuit packet interconnect
- Provides multiservice interworking between technologies.

Migrating Legacy Traffic to Ethernet Backhaul Transport

Like wireless providers everywhere, the operator struggled with the prospect of continuing to add or lease copper-based T1/E1 lines to accomodate its growing user and cell-site traffic. Backhaul often accounts for the biggest part of wireless providers' radio access network (RAN) operating expenses and average Revenue Per User (ARPU), even with the rapid uptake of mobile-broadband data services, wasn't growing fast enough to offset those costs.

To strengthen and sustain its profit margins, the operator needed a solution to significantly reduce its cost per bit transported while at the same time increasing overall backhaul bandwidth.

Although the wireless industry's long-term goal is an all-IP infrastructure, no carrier can afford to replace all existing TDM assets with packet-based equipment at once. The operator needed a backhaul-transport solution that met multiple criteria:

- Ensure continued quality of service (QoS) for existing 2G voice services
- Accommodate a mix of legacy TDM and ATM technologies
- Scale to keep pace with the rising number of subscribers and their mobile Internet needs
- Leverage existing investments in TDM equipment and T1/E1 leases.

The operator chose to migrate to a leased, fiber-based metro Ethernet backhaul infrastructure. While that decision resolved the bandwidth and cost-per-bit issues in the backhaul, it presented another challenge: how to ensure resiliency and reliability in a third-party leased Ethernet network. With thousands of logical connections in the network, the operator needed a solution to support:

- Multiple routing and signaling protocols, for example, OPSF, LDP, and MPLS
- Operations Administration Maintenance (OAM) and network resiliency protocols including (BFD), VRRP, and APS/MSPTDM and ATM pseudowires
- Timing synchronization for various services
- Robust traffic-management capabilities.

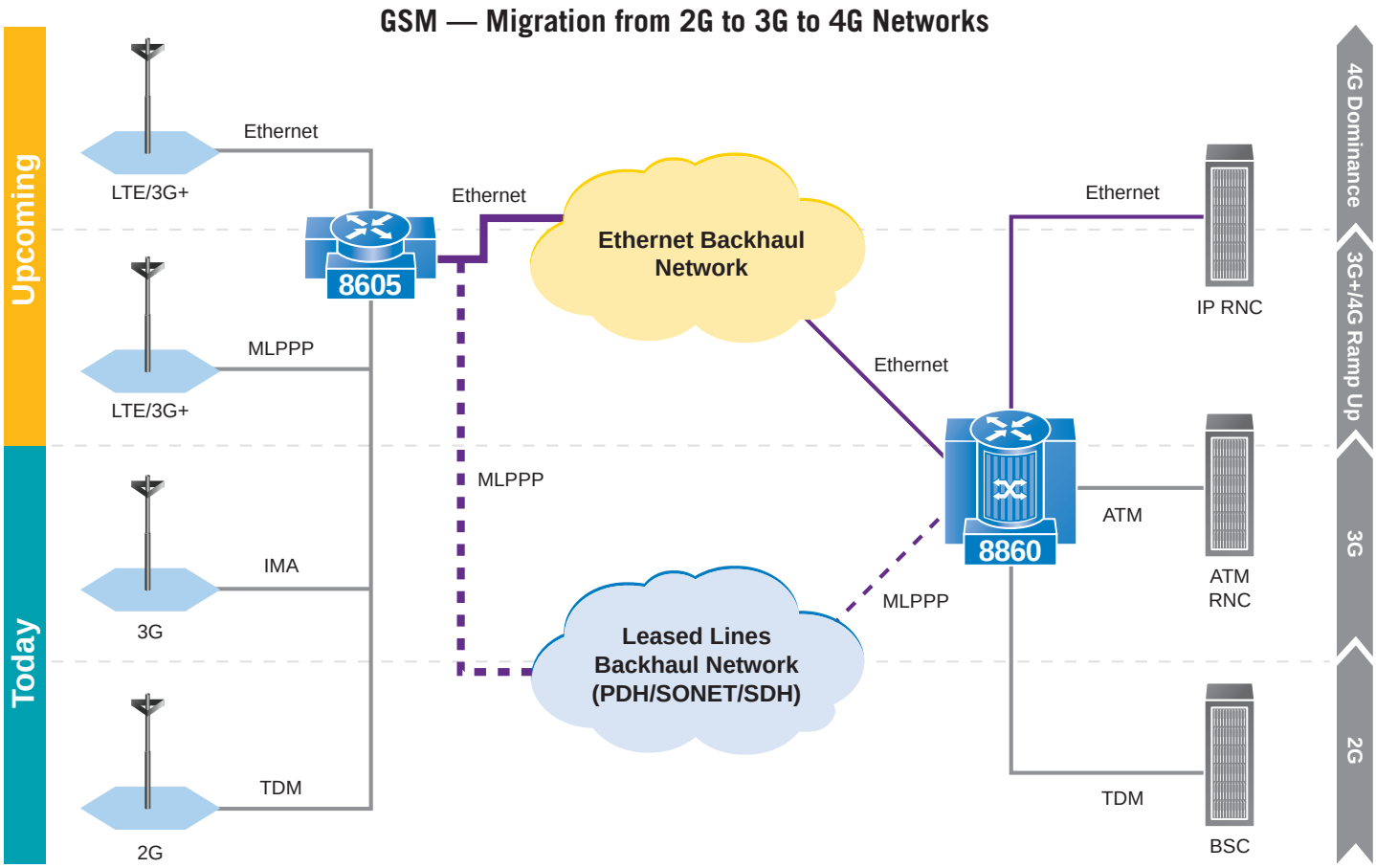
In short, the operator needed a solution that can accommodate several functions, all connected via multiple protocols on a huge scale over a third-party network.

The final missing piece was a reliable, field-tested cell-site solution that could support all of the above requirements better than the operator's existing cell-site devices. The operator chose the Tellabs 8600 Managed Edge System, the first solution to support Ethernet interfaces, along with all of the common TDM (PDH, SDH, SONET) interfaces, thus giving service providers the flexibility to select the optimal network transport technology.

Effectively converging voice and data services in a common network, the Tellabs 8600 system is based on packet-switched technology and incorporates guaranteed QoS and a unique Packet Loop Test feature for delay, jitter, packet loss and bandwidth. Real-world deployments enabled Tellabs to create an ultra-robust synchronization algorithm that supports both line-timing and packet-based mechanisms.

Tellabs 8605 system benefits:

- Offers scalable solutions from cell-site to aggregation
- Provides interface and transport diversity from TDM and Ethernet to MPLS pseudowires
- Guaranteed QoS with performance monitoring through the unique packet loop test capability



Deployed at the base stations/cell sites, the Tellabs 8600 system serves two roles in the operator's network.

First, it terminates T1 IMA bundles and uses TDM and ATM pseudowires to migrate legacy 2G and 3G traffic over the Ethernet backhaul network for termination on the Tellabs 8800 series at the RNC. Because the backhaul is still based on TDM and ATM, the Tellabs 8600 system enables the operator to preserve revenues derived from legacy traffic, while reducing transport costs for new services.

Second, the Tellabs 8600 system transports IP traffic from the operator's HSPA-enabled 3G base stations for termination at the Tellabs 8800 series to lay the foundation for LTE traffic backhaul.

Tested and Proven Scalability

To demonstrate the solution's ability to accommodate the sheer scale of the network, the operator and Tellabs put the Tellabs 8600/8800 systems through a rigorous series of performance validation tests. From the cell site to the MSN, with a target of 500-1,000 cell-site devices per Tellabs 8800 series, the solution easily handled thousands of BFD, LDP and OSPF sessions per node, along with thousands of SAToP PWE3 and ATM PWE3 circuits.

The tests also demonstrated the combined solution's ability to support:

- VoIP via bridging interfaces
- MSO-to-RNC links, via
  - ATM interfaces with 1+1 automatic protection switching (APS)
  - ATM local circuits (IuCS) between RNCs and the 3G media gateway (uMGW), with 1+1 protection for the MGW
  - ATM local circuits (IuPS) between RNCs and the SGSN
- Traffic between/among the Tellabs 8800 series routers, via
  - VPLS bridging of VoIP traffic
  - ATM PWE3 circuits between RNCs (IuR).

End-to-End Management

As part of the overall Tellabs solution, the Tellabs® 8000 Intelligent Network Manager enables the operator to centrally manage its evolving and growing network. The benefits of this centralized management tool include reduced operating expenses and enhanced revenues thanks to advanced SLA support and tailored per-customer reporting.

The Tellabs 8000 intelligent manager's flexible design enables the operator's OSS architects to choose from Telecommunications Management Network (TMN)-based element, network and service level functions. Where those functions are already present, open interfaces provide seamless integration. Running on industry-standard platforms and supporting redundancy and distributed deployment configurations, the Tellabs 8000 system's scalable, client-server system features reliable Fault, Configuration, Accounting, Performance, Security (FCAPS) functionality at the element, network and service management layers.

Whether functioning as an out-of-the-box OSS solution or as a complementary piece of the operator's larger OSS vision, the Tellabs 8000 intelligent manager delivers multiple benefits, including:

- Fast, easy network configuration, central monitoring/diagnostics and point-and-click service provisioning
- End-to-end provisioning of Layers 1, 2 and 3 services
- Simplified set-up of services via client-user interfaces that ensure interworking mechanisms are defined with the appropriate QoS for a given service
- Automated network operations through OSS integration interfaces
- A comprehensive inventory, capacity and use reporting system which enables on-demand and scheduled report generation.

Tellabs Global Services

The operator enlisted Tellabs® Global Services to help them achieve the aggressive schedule for the network-upgrade and rollout of 4G/LTE services and to facilitate the integration of Tellabs products with equipment from other vendors in the network. To help the operator maximize return from its investment in the Tellabs 8800 /8600 solution, Tellabs Global Services has a dedicated team of network consultants, engineers and program management staff devoted to the operator's network-transformation project. This team works in partnership with the operator's architecture and design group, collaborating in the development of network architecture, detailed network design and the creation of engineering documents to support the overall network transformation. Additional teams are embedded with the operator's program management, deployment and operations staff to deliver end-to-end project support.

Results:

- Converged 2G, 3G, 4G network with single end-to-end solution
- Unparalleled scalability of cell-site devices and resiliency (i.e. BFD)
- Full protocol interworking to meet varying architectures
- Solution that supports existing and future network needs.

The End Product

With a full suite of products and services, Tellabs enabled this mobile operator to take advantage of its myriad networking challenges, from technology interworking to successful backhaul over legacy technology as well as new Ethernet offerings. As a result, the operator can migrate to an IP backhaul network as its customers dictate, and can do so in parallel with new services revenue generation. The ability to provide this diverse, scalable high-reliability network has enabled the operator to offer new high-bandwidth mobile services on a network with a future path to IP centrism. Tellabs' experience in providing an end-to-end mobile backhaul migration solution to operators worldwide enables its customers to benefit from today's revenues and plan for tomorrow's growth.

About Tellabs

Tellabs innovates to deliver the mobile Internet and help our customers succeed. That's why 43 of the top 50 global communications service providers choose our mobile, optical, business and services solutions. We help them get ahead by adding revenue, reducing expenses and optimizing networks.

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