

# Maintaining Profitable DSL Networks with Tellabs® MPLS Solutions

## Introduction

Rural areas are no longer immune to the network-breaking demand traditionally restricted to metropolitan and suburban areas. To meet these demands, service providers continue to deploy broadband passive optical networks (BPON) and gigabit passive optical networks (GPON). However, their capital costs can be prohibitive, especially in more geographically diverse rural areas.

Digital subscriber loop (DSL) networks deployed in many of these areas represent a healthy opportunity to grow the top-line revenue for rural service providers. In fact, DSL revenues for rural carriers are growing at double-digit rates. End-users fuel this increase with demands for faster Internet downloads and file-sharing activities such as photos, video and music. However, as bandwidth demand continues to increase (exponentially in many areas), carriers must be able to scale their networks cost-effectively to continue to provide profitable services.

## Traditional DSL Architecture

Traditionally, digital loop subscriber access multiplexers (DSLAMs) located at or near customer premises use point-to-point protocol over Ethernet (PPPoE) in conjunction with ATM/SONET transport to deliver traffic to a broadband remote access server (BRAS) in the central office. To maintain separation of traffic, service providers maintain individual asynchronous transfer mode (ATM) permanent virtual circuits (PVCs) per subscriber. Providers then aggregate ATM PVCs and terminate them at an ATM port on a BRAS, as shown in Figure 1.

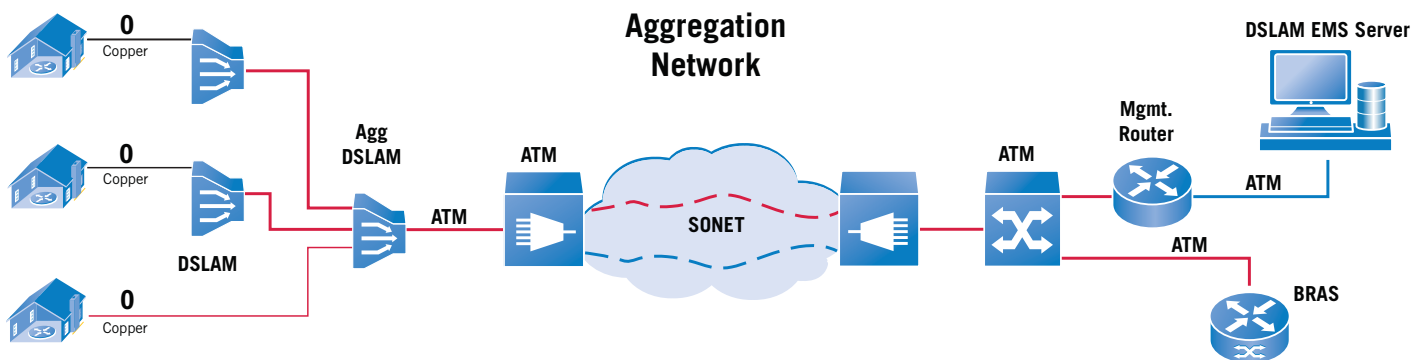


Figure 1. Traditional DLS network architectures

## The Transition of ATM to Ethernet Transport

Network traffic continues to increase dramatically as the number of subscribers grows and the bandwidth per user increases. Service providers must expand their network infrastructure quickly and cost-effectively to handle the demand. This bandwidth demand is driving the migration of the aggregation network from ATM/SONET to Ethernet.

Ethernet transport networks offer a significantly reduced cost-per-bit model vs. ATM. As standardized Carrier Ethernet networks and services become increasingly available, this transition makes logical and financial sense in order to maintain profitable service delivery. Service providers are already beginning to deploy Ethernet and virtual local area network (VLAN) -based transport architectures to support both DSL traffic as well as other business and residential switched Ethernet services.

To accommodate the transition of DSL networks to an Ethernet transport infrastructure, service providers may choose to migrate or upgrade legacy ATM-based DSLAMs and BRAS solutions to IP-based equipment. Figure 2 shows an example of a complete shift to an IP/Ethernet-based architecture.

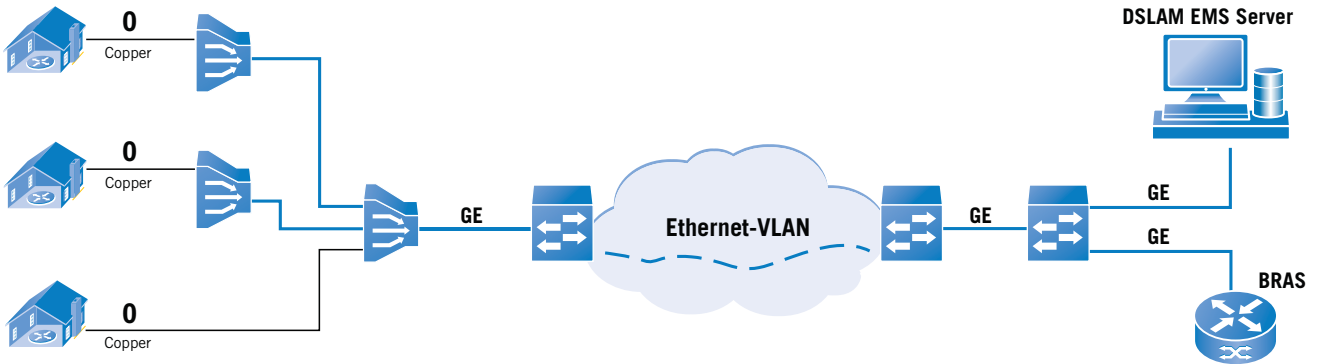


Figure 2. IP/Ethernet network architectures

### Tellabs® 8600 Managed Edge System and Tellabs® 8800 Multiservice Router Series (MSR) DSLAM aggregation and transport solution

The cost savings of Ethernet often leads to extremely attractive transport savings. However, up-front expenses of upgrading existing DSLAMs and BRAS equipment to IP can be prohibitive, given the already razor-thin margins on DSL services and the breadth of ATM DSLAM deployments. As an alternative, service providers can maintain current DSLAM/BRAS devices and use multiprotocol label switching (MPLS) to provide a seamless and more cost-effective way to facilitate the transition to an Ethernet transport architecture.

### Converged solution to gracefully transition existing ATM-based DSLAM networks

Service providers use pseudowire emulation (PWE) to encapsulate service-specific bitstreams — whether they are ATM, Ethernet, TDM, or other — over an Ethernet transport network. The Tellabs 8600 system combined with the Tellabs 8800 MSR series uses MPLS-based PWEs to cost-effectively emulate ATM, Ethernet, TDM and

other services over an Ethernet infrastructure, as illustrated in Figure 3. This creates a converged architecture in which service providers can manage both ATM and Ethernet services over a ubiquitous Ethernet transport network.

The Tellabs 8600 system and the Tellabs 8800 MSR series converged DSLAM aggregation solution enables service providers to seamlessly evolve to next-generation IP/Ethernet architectures, without an immediate forklift upgrade to their infrastructure. The DSLAM aggregation solution reduces capital expenses (CapEx) and operating expenses (OpEx) associated with costly upgrades and enables flexible, cost-effective Ethernet transport.

Service providers can co-locate the Tellabs® 8605 Access Switch with DSLAMs at multiple points in the DSLAM aggregation network. Co-location minimizes or eliminates the need to upgrade legacy DSLAMs already deployed and operational to IP. At the other side of the Ethernet transport network, the Tellabs 8800 MSR series aggregates and terminates the multiple PWEs transported over Ethernet.

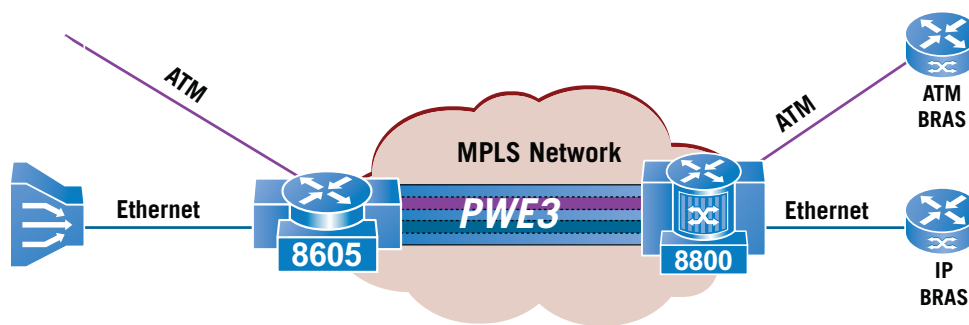


Figure 3. ATM and Ethernet Pseudowires

It also forwards the native ATM or Ethernet traffic to the appropriate BRAS, whether it is an ATM-based or IP-based BRAS. Figure 4 shows an example of this converged architecture. By deploying the Tellabs 8605 switch and Tellabs 8800 MSR series to support converged transport over Ethernet, service providers can drive higher DSL revenues at higher margins. The key is leveraging existing network elements as long as possible while taking advantage of lower-cost Ethernet transport.

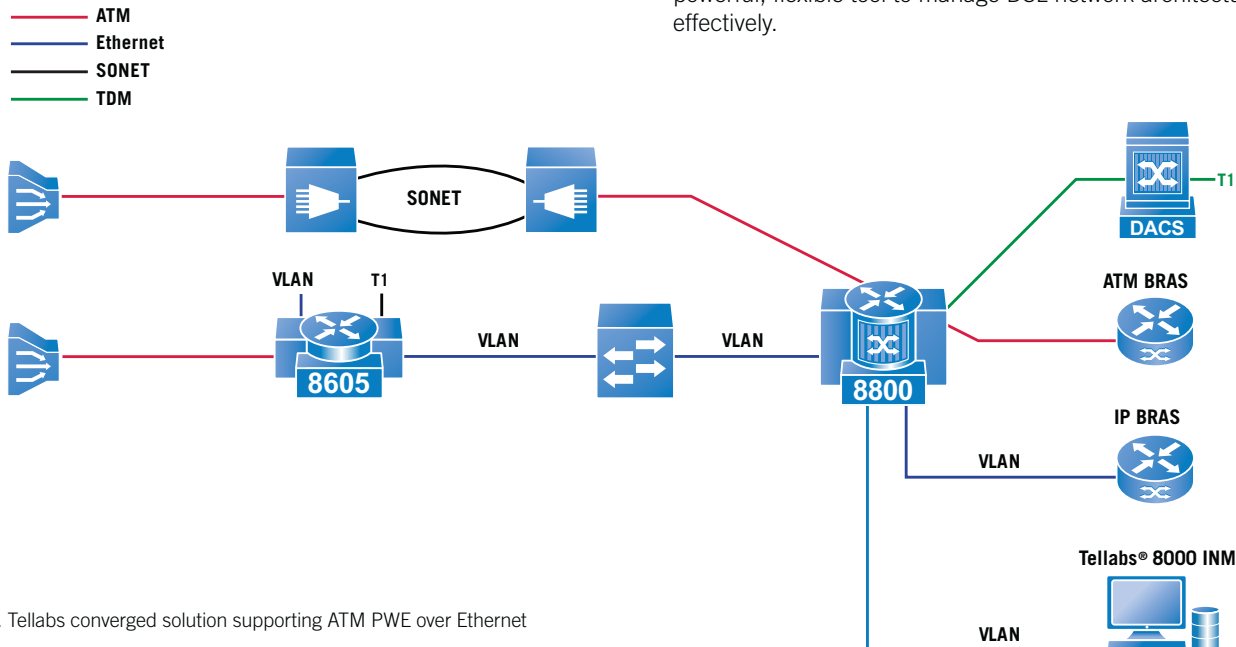


Figure 4. Tellabs converged solution supporting ATM PWE over Ethernet

The Tellabs converged solution provides the service provider with numerous benefits:

- Provides a converged solution and evolution path that enables legacy ATM DSL architectures to gracefully evolve and take advantage of Ethernet transport;
- Optimizes and scales the delivery of Ethernet to more locations as Ethernet becomes more widely available;
- Enables the delivery of IP/Ethernet, ATM, Frame Relay, TDM and wholesale mobile backhaul business services through the same Tellabs converged solution architecture.

In addition, the Tellabs® 8000 Intelligent Network Manager (INM), enables point-and-click provisioning of services between the Tellabs 8600 system and Tellabs 8800 MSR series providing comprehensive fault management, troubleshooting and maintenance tools, combined with flexible and robust performance reporting capabilities.

### Maximum Flexibility with a Single Platform

Although Ethernet services are increasingly pervasive, service providers may continue to leverage SONET transport networks in some areas. To accommodate these scenarios, the Tellabs 8800 MSR series offers the capability to natively aggregate and switch

ATM traffic over legacy ATM transport networks, thereby eliminating the need for a dedicated ATM switch. Additionally, the Tellabs 8800 MSR series also supports Ethernet to ATM service interworking which enables an IP/VLAN-based BRAS in the central office to interoperate seamlessly with ATM-based DSLAMs over ATM transport networks. This unique service-interworking capability, combined with ATM/ATM PWE support and the scalability to match any deployment, makes the Tellabs 8800 MSR series a very powerful, flexible tool to manage DSL network architectures more effectively.

### Optimize and scale the delivery of Ethernet transport

to support DSLAM network infrastructures

As service providers choose to migrate legacy DSLAMs to become Ethernet-capable, they must decide how to best support these new Ethernet devices. Enabling a large Ethernet network infrastructure requires the support structure to scale and support media access control (MAC) learning for these devices, along with the requisite VLAN support. DSLAM implementations often must identify each customer by a separate MAC address or VLAN, which can cause significant scaling issues. Service providers must support and manage these issues within the transport network.

Ethernet switches have limited MAC table sizes. Supporting DSLAM traffic over Ethernet can potentially exceed or overwhelm the MAC switching capacity for these switches. Additionally, service providers face the challenges of managing VLAN assignments with a 4,096 VLAN tag limitation and often tedious coordination across multiple organizations. These challenges can make even small- and medium-sized network implementations complex, cumbersome and costly.

By using Ethernet and VLAN PWEs the Tellabs 8600 system and Tellabs 8800 MSR series solution effectively “hides” MAC addresses from the Ethernet transport network while simultaneously preserving the entire Ethernet payload, header information and L2 attributes of the service. As illustrated in Figure 5, this capability enables service

providers to scale their Ethernet infrastructures effectively by limiting the number of MAC addresses to learn and maintain. Additionally, service providers can manipulate VLAN tags in the central office to assure that VLAN assignments are locally significant. This helps different departments plan for improvements independently and without the need to consider the Metro Ethernet network in their design.

Instead of deploying and managing their own Ethernet infrastructure, service providers may choose to procure wholesale Ethernet services from another party. Pricing for these services often depends upon the number of MAC addresses that they must support across the transport network. In these cases, service providers can leverage the Tellabs solution by employing Ethernet/

VLAN PWEs on both sides of the network to minimize the number of MAC addresses that require support across the Ethernet network infrastructure.

So, whether DSL providers maintain their own Ethernet infrastructures or outsource this to third parties, they can realize significant OpEx savings by limiting the number of MAC addresses to be transported over the Ethernet transport infrastructure.

Figure 6 shows a fully converged solution capable of supporting Ethernet DSLAMs in addition to ATM DSLAMs using ATM PWEs, Ethernet/VLAN PWEs and ATM to Ethernet service interworking.

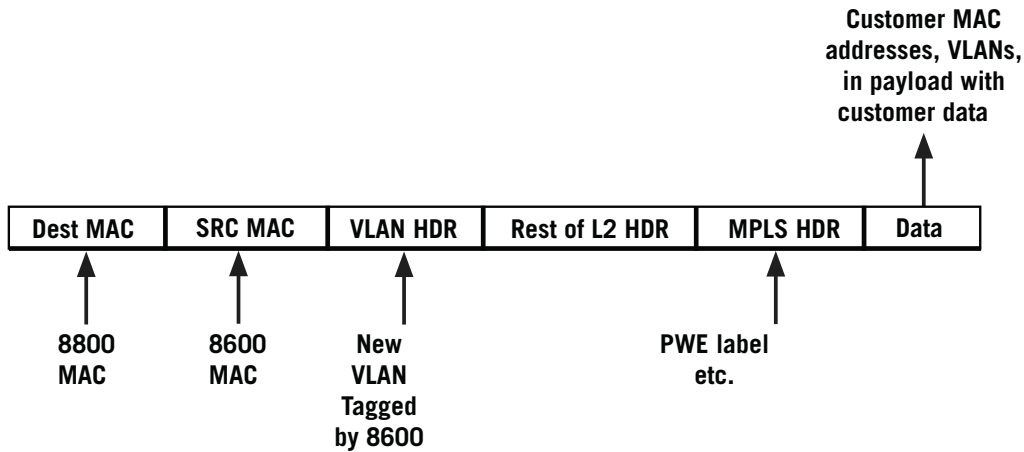


Figure 5. MAC hiding and VLAN tagging with the Tellabs solution

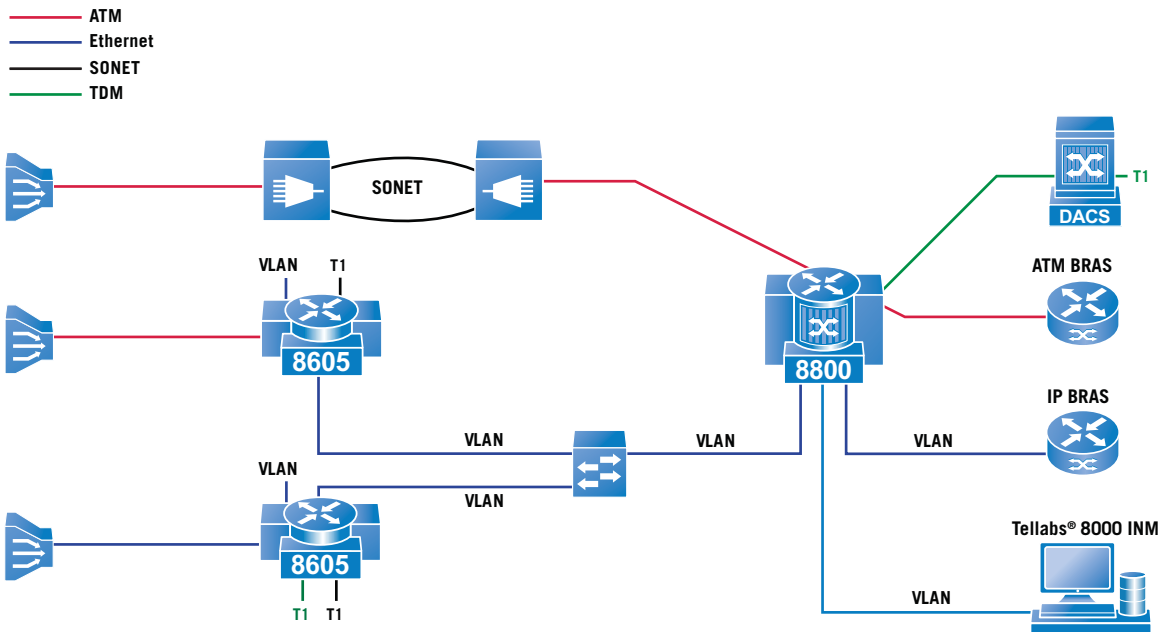


Figure 6. Tellabs converged architecture



## Benefits of migrating to a Tellabs converged solution

The cost benefits associated with migrating to an Ethernet infrastructure are clear. In fact, migrating from an ATM-based DSLAM/BRAS infrastructure over SONET (Figure 1 above) to an IP-based infrastructure with Ethernet transport supported by Tellabs converged solution (Figure 6 above) can save carriers up to 90% in CapEx on incremental capacity additions. In addition, using the Tellabs converged solution for Ethernet transport in DSL networks offers these key benefits:

- The GigE/MPLS port on the Tellabs 8800 at the central office can terminate more than one remote DSLAM when Metro Ethernet transport is used. Often six or more DSLAM NEs are terminated onto a single GigE transport port making DSLAM additions and network expansions extremely cost-effective.
- The GigE transport links from the Tellabs® 8605 and the Tellabs 8800 MSR series that connect to the Metro Ethernet network are shared by multiple DSLAM NEs. This enables statistical multiplexing gains on these links that are not possible with the ATM OC3 channel.
- With the flexibility to support ATM PWEs, the Tellabs solution enables support for ATM DSLAMs and Ethernet DSLAMs on the same Ethernet infrastructure.

## Leveraging converged infrastructure for additional business services

In addition to providing flexible options for DSL network expansions, service providers can leverage the Tellabs converged transport solution to support new or complementary business services such as frame relay, ATM, TDM, enhanced IP VPN and Carrier Ethernet services. For example, mobile carriers can deploy the Tellabs 8600 system at cell sites to provide comprehensive T1 or Ethernet access options for wholesale mobile backhaul services. Multiple Tier 1 operators deploy the Tellabs 8600 system because it is perfectly suited for mobile backhaul applications.

Service providers can leverage the Tellabs 8800 MSR series as an edge device in business services delivery, as it supports a variety of Carrier Ethernet services including VPLS services, Ethernet services over SONET (EoS) and Ethernet over TDM access aggregation. It can also function as an IP/IP VPN provider edge (PE) router.

The Tellabs 8000 INM, when combined with the Tellabs 8600 system and Tellabs 8800 MSR series, provides advanced end-to-end management capabilities which can significantly reduce OpEx and provide sophisticated SLA measurement tools to ensure the best services possible.

## The Tellabs difference

Tellabs is unique in its ability to provide an end-to-end managed solution to address dynamic DSLAM aggregation needs. The Tellabs converged transport solution enables service providers to leverage existing network assets while taking advantage of the significant cost-savings associated with Ethernet transport. Providers can apply this flexible, scalable solution to other parts of their networks to offer additional service and value to customers and simplify existing network operations.

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