APPLICATION NOTE

Aggregating DSL Over Ethernet: Preparing for Multiservice Delivery

ALCATEL

Overview

Due to price pressure on commodity services like voice services and high speed Internet access, service providers are focussing on generating more revenues by offering a multitude of today's in-demand services, and reducing customer churn by assuring service quality and offering tailored packages. These new services include voice over IP (VoIP), video on demand (VoD), broadcast television (BTV) and on-line gaming.

Introducing these new services poses a new challenge for service providers due to the sharp increase in bandwidth requirements: for VoD and BTV, several Mb/s are required per video stream. If these services are introduced on a large scale, the existing aggregation network must certainly be extended. Additional capacity has to be added to the aggregation network, and higher speed interfaces have to be introduced. Depending on the type and the scale of the services, it may even be more cost-efficient to introduce a new aggregation technology.

An additional challenge for service providers is the need for more reliability in the network. A network outage in the case of web browsing customers is bad enough, but if those customers subscribe to VoD or BTV services, an outage is disastrous and will quickly lead to dissatisfied customers.

This application note introduces the Alcatel solution for a cost-efficient, service-aware digital subscriber line (DSL) aggregation network

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Building a New DSL Aggregation Network

There are two ingredients for a service-aware digital subscriber line (DSL) aggregation network: a new configuration protocol, and a multiprotocol label switching (MPLS)-enabled Ethernet aggregation network.

Introducing a New Service Configuration Model

Due to the enhanced service offering, service providers' customers — both residential and enterprise — are increasingly using their high speed DSL service for more demanding applications that include voice, video and data. These services require an array of new devices in the network, such as video servers, video head-ends and voice gateways. The current service delivery and configuration model, based on point-to-point protocol (PPP), is optimized for Internet access, but not for the implementation and configuration of these new services.

In the PPP service delivery model, all traffic passes through the broadband remote access server (BRAS). This can result in bottlenecks, and the BRAS is a single point of failure in the network. Especially with new services, like VoD and BTV, service providers need the most reliable solution.

Most of the new end-user devices, such as the session initiation protocol (SIP) phones and the set-top boxes for video services, use the dynamic host configuration protocol (DHCP) for their configuration. These devices are called DHCP clients. DHCP provides an extensive set of IP configuration parameters, allowing full configuration of the IP layer of the user terminal. Additionally, it allows configuration of information related to the services offered over the IP network, such as the addresses of SIP servers or video servers.

The DHCP client tries to contact a DHCP server in the network using a discovery mechanism. The DHCP server returns the configuration parameters and the required addresses. From that moment on, the DHCP server is not needed anymore for that service, and the packets will flow through the network to the appropriate service handling device, be it a SIP server or a video server.

Using Ethernet as the Underlying Technology for DSL Aggregation

Another key business challenge for service providers is to reduce their expenses by simplifying the aggregation architecture and consolidating several services over a single, service-oriented aggregation network, yet maintaining a high level of quality of service (QoS), reliability and maintainability.

To cope with the increased traffic, the most straightforward solution is to extend the existing aggregation network. Possibly links have to be added; other links have to be upgraded to higher speeds. Depending on the amount of additional traffic, it may be more cost-efficient to keep the existing aggregation network for high speed Internet access and to build a complementary aggregation network, based on a different technology, for the new services.

Ethernet is not only a cost-efficient technology but is also a simple technology delivering high speed connectivity. In addition, every end customer and service provider can access it. Furthermore, Ethernet delivers more bandwidth than the traditional transport technology, asynchronous transfer mode (ATM). It is the right technology to build a new aggregation network.

The use of metro Ethernet networks permits accommodating additional reliability features, such as redundant BRASs, which is difficult to implement with the ATM model, since the connections are point-to-point. Some providers have already implemented Ethernet-based networks to deliver business services. Why not use that same Ethernet-based network to aggregate end user DSL traffic?

Although Ethernet is the technology of choice for local area networks (LANs), there are challenges to overcome when using Ethernet in a carrier grade, large scale network:

- **Convergence and traffic restoration after link failure:** In a pure Ethernet network, spanning tree protocol (STP) is used to avoid loops and to restore traffic on link or node failure. Depending on the size and complexity of the network, the convergence and restoration may take several seconds to several minutes. Rapid spanning tree protocol (RSTP)

brings some improvements, but it may still take up to a second to converge and restore traffic. With links that are running at 100 Mb/s or even 1 Gb/s, this results in an unacceptable level of packet loss.

- **Scalability:** Another issue service providers may face in a pure Ethernet environment is the lack of scalability in MAC addresses; in the worst case, every switch must learn every MAC address, including those of the customer switches. The amount of MAC addresses that a Layer 2 switch can handle then becomes a network-wide limit. This could lead to scalability issues. In addition problems can arise if there are duplicate MAC addresses.
- **Service differentiation:** In order to differentiate between services in an Ethernet-based network, virtual LAN (VLAN) tags, as defined in IEEE802.1q, can be used. The maximum number of VLAN tags per interface is 4096, as defined by the standard. With Ethernet bridging in the access network, this number is also the overall maximum. A number of (vendor proprietary) tag-stacking schemes are used to overcome this limitation, increasing the management complexity and hampering interoperability.
- **Troubleshooting:** A basic Ethernet implementation does not allow operators to monitor service connectivity or connection quality. With an "IP ping" an operator can verify the control plane status, but this is not related to services or the data plane behavior.

The Alcatel Solution: MPLS-Enabled Ethernet for the Aggregation of New Services

If a service provider chooses an alternative technology for aggregation, the networking environment must still be carrier grade in order to ensure delivery, provide security and give higher priority to the traffic that requires it. Many of these services require specific treatment in order to deliver the experience the end user expects. Ethernet was not designed to be used in such a demanding large-scale carrier environment.

The Alcatel solution combines Ethernet with MPLS to obtain a simple, cost-effective, yet carrier grade offering. MPLS allows “tunnels” or label switched paths (LSPs) to be set up through the network. These LSPs can then be used to transport Ethernet packets over the aggregation network. The LSPs can be used to build point-to-point connections (virtual leased line (VLL)) and/or point-to-multipoint connections (virtual private LAN service (VPLS)). To segregate services, VLANs can still be used between the digital subscriber line access multiplexer (DSLAM) and the first Ethernet switch, from where the services are further transported in one of the LSPs.

The advantages of using MPLS in an Ethernet environment are:

- **Reliability:** MPLS is self-healing in case of link or node failures.
  - The MPLS fast reroute capability can restore traffic after a link failure in under 50 ms — a vast improvement over the approximately one second restoration with RSTP.
  - MPLS can also be used to support the requirements of resilient packet ring (RPR)
- **Scalability of MAC addresses:** Only MAC addresses visible to locally terminated VLL services need to be learned. As a result, the MAC addresses only need to be unique within the same VLL.
- **Scalability in service differentiation:** Ethernet over MPLS uses MPLS labels for identification purposes. The 20-bit field gives 1 million values, which is sufficient for any network.
- **Manageability:** Alcatel’s implementation of Ethernet over MPLS introduces true service monitoring which is difficult to achieve over legacy Ethernet switch platforms. As an example, the traditional "IP ping" has been extended with:
  - “Service ping” – Is the service reachable end-to-end?
  - “MAC ping” – Can I reach this specific layer 2 destination (e.g., customer router)?
  - “MAC traceroute” – What path do packets follow to this Layer 2 destination?

In addition to the advantages in an Ethernet aggregation network, the same network can be used to offer business customers virtual private network (VPN) services based on VLLs or VPLSs.

The combination of the DHCP model to support new services, Ethernet to provide a cost-efficient aggregation network and MPLS to complement Ethernet with scalability and reliability, results in a service-aware DSL aggregation network.

Application Architecture

Since DSL aggregation over ATM is well known and has been implemented in the majority of DSL aggregation networks, this application note will only expand on the Ethernet-based DSL aggregation.

The Ethernet DSL aggregation solution starts with the residential or business DSL customer, who has a DSL modem and a number of appliances, such as:

- Computer(s) for high speed Internet access, but also for multimedia applications, network-wide gaming, video and audio streaming.
- A television with a set top box and a remote control for VoD and BTV
- A session initiation protocol (SIP) phone or a softphone application on the PC for VoIP

Traffic from multiple end customers is aggregated by a DSLAM, which takes a number of DSL lines and multiplexes them onto a higher speed connection.

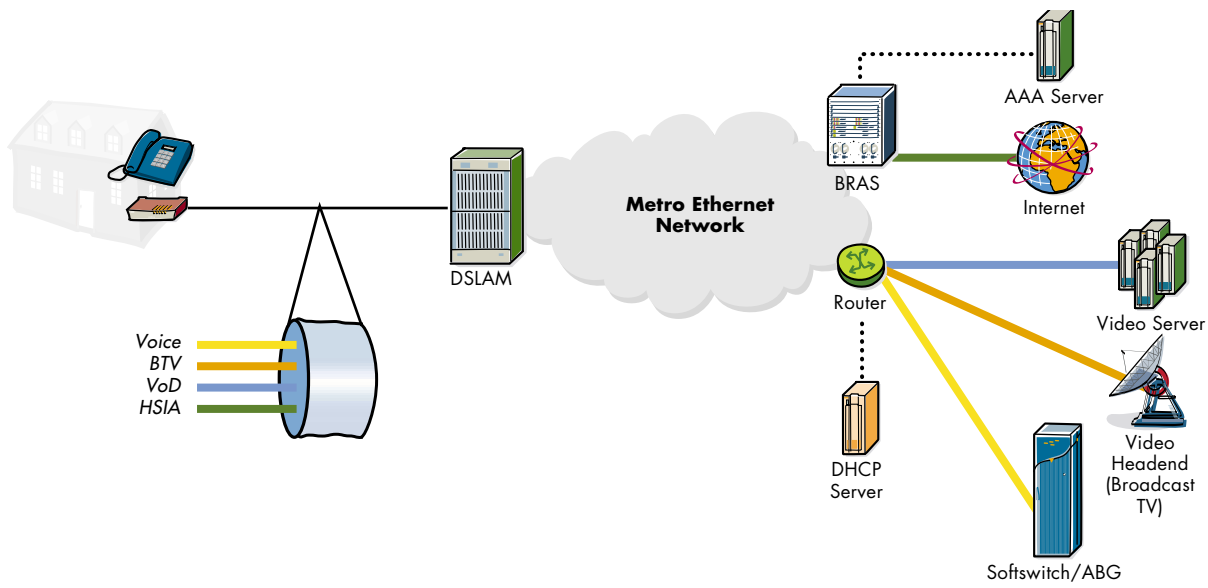
State-of-the-art DSLAMs, like the Alcatel 7300 series, offer additional capabilities. For BTV users, for example, the built-in multicasting functionality, combined with Internet gateway message protocol (IGMP) snooping, results in “real time zapping”.

The DSLAM is then connected to the Alcatel Ethernet DSL aggregation network. These networks aggregate the traffic further and carry it to the next point in the network. Table 1 explains what the next point in the network will be, based on the service. Figure 1 shows this equipment in the network.

Table 1 - Service-Supporting Equipment in the Ethernet Network

Equipment	Supported Service
BRAS	High speed Internet access
AAA server	Server to provide the required information for the authentication and authorization of subscribers. It is also involved with the accounting.
Softswitch/ Access border gate (ABG)	VoIP from IP phone or PC
Video servers	Storage of the video films or programs for VoD
Video head-ends	Encoding of video signals for BTV
DHCP server	Allocation of an IP address to the user when switching on equipment. Also provides the address of the other server (softswitch, video server, etc.) if applicable.
Alcatel 7750 Service Router (SR)	Internet access (IP connectivity)/ Service-aware IP services

Figure 1 - Service Delivery in the Metro Ethernet Network



Connecting all the equipment from Table 1 is the Ethernet DSL aggregation network, indicated as the metro Ethernet network (MEN) in Figure 1. Strictly speaking, the term "metro" is not an ideal description of the network because it usually refers to metropolitan networks, which are typically applicable in large countries with big cities (e.g., China, United States). In reality, an entire country could be considered to be a single MEN, based on a fiber ring.

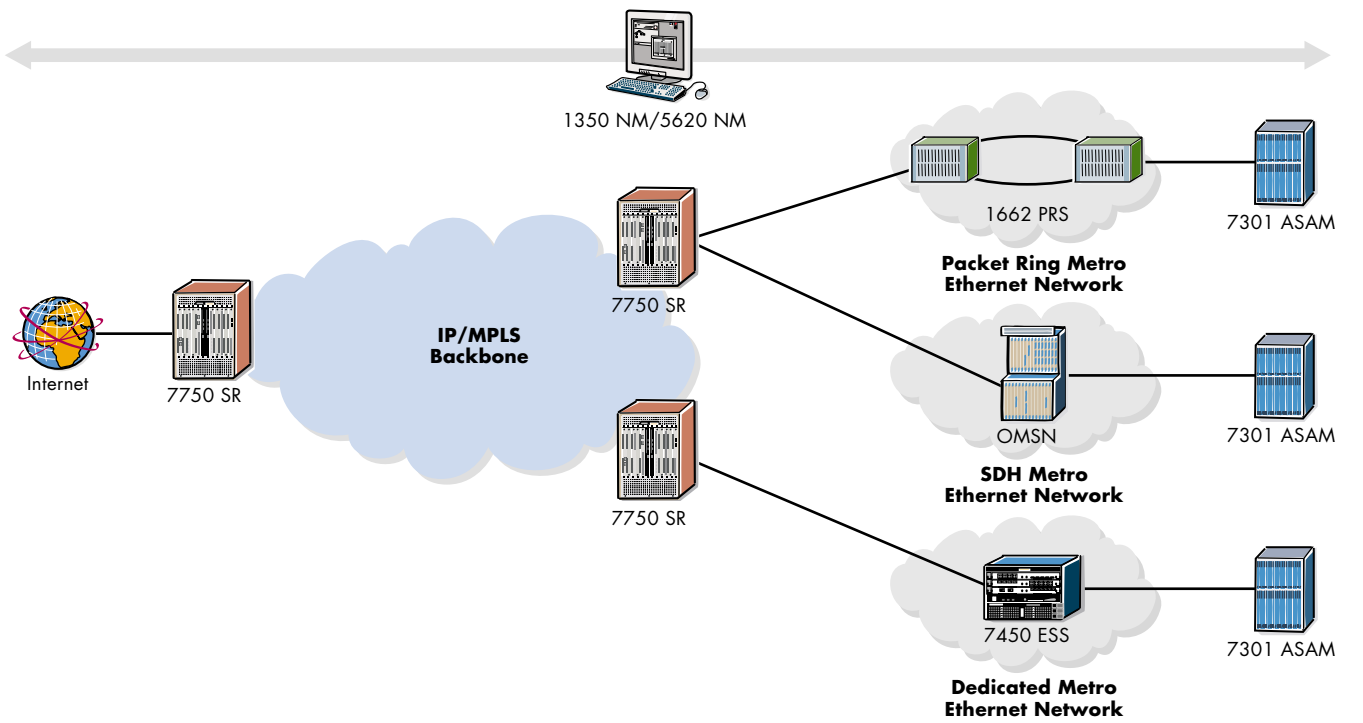
In the ATM model, the DSLAM is connected to a BRAS over a virtual pipe. The Alcatel Ethernet DSL aggregation solution does the same thing using a VLL or VPLS to couple the DSLAM to the BRAS, or any of the other devices mentioned in Table 1. When using one VLL/VPLS per service (VoIP, BTV, VoD, etc.) from the DSLAM, the service providers can segregate these services. As MPLS is the underlying technology used for VLLs and VPLSs, service providers immediately benefit from the advantages of MPLS, including reliability, scalability of MAC addresses, scalability in service differentiation and manageability.

The Alcatel solution for metro Ethernet networks relies on the following products:

- Alcatel 7450 Edge Services Switch (ESS): For service providers with no existing Alcatel aggregation infrastructure; designed for high performance and/or large scale VPN implementations. The network is called a metro Ethernet service network.
- Alcatel Optical Multi-Service Nodes (OMSN) family and Alcatel 1662 Packet Ring Switch (PRS): For service providers who can leverage an existing synchronous digital hierarchy (SDH) network. The network is called a metro SDH access ring.
- In a service-oriented network, the Alcatel network and services management applications provide cutting edge capabilities in provisioning and troubleshooting the most complex services. These applications are implemented in the Alcatel 5620 management suite and the Alcatel 1350 management suite.

Figure 2 illustrates these products and shows how several MENs can be interconnected with an IP/MPLS backbone using the Alcatel 7750 SR.

Figure 2 - Alcatel Solution for Ethernet DSL Aggregation



The optimal solution, both in terms of capabilities and cost-efficiency, can be selected by following these guidelines:

1. If the service provider is building a new Ethernet network from the ground up or cannot leverage on an Alcatel SDH installed base, the Alcatel 7450 ESS is the ideal platform for accommodating a high density subscriber base and delivering all the services end users are looking for in a carrier grade fashion.
2. If the service provider has an existing SDH network based on the Alcatel OMSN family of products, all that is required is the addition of integrated service adaptor (ISA) cards to enable Ethernet DSL aggregation. This approach protects investments in the SDH network.
3. If the service provider needs a low capacity, low port density metro access network, the Alcatel 1662 PRS provides the most cost-efficient solution. The 1662 PRS also supports the resilient packet ring (RPR) functions, based on MPLS.

Most service providers use fibre rings in their access networks. The OMSN or the Alcatel 1662 PRS can be used here for efficient aggregation.

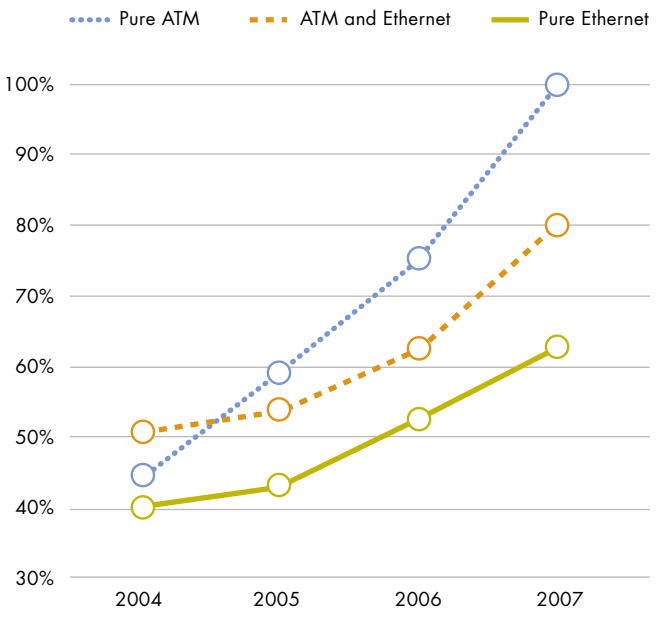
In addition to Ethernet DSL aggregation, all platforms support business Ethernet services: where point-to-point connections are required, a VLL service is a good choice, whereas point-to-multipoint connections are supported with VPLS. This capability allows the provider to service business customers with Ethernet requirements, on top of the DSL customers (either for residential or business applications). This maximizes the use of the aggregation network and relieves the service provider from having to build a separate network for business Ethernet services such as VLL and VPLS.

Addressing the Business Challenge

Based on a study conducted for an incumbent European operator, substantial cost benefits can be observed when comparing an ATM-based DSL aggregation network, with a network based on ATM and Ethernet or a pure Ethernet network.

The services that were taken into account are high speed Internet access, VoIP and VoD. The cost calculations consider the cost of the DSLAM, the aggregation network(s) (including the SDH portion) and the BRASs. Figure 3 shows the result, taking the final value of the pure ATM based aggregation network in 2007 as the relative reference (100 percent). The "ATM and Ethernet" case assumes that ATM is used for high speed Internet access, while the other services are aggregated over the Ethernet network.

Figure 3 - CAPEX Comparison for DSL Aggregation Networks

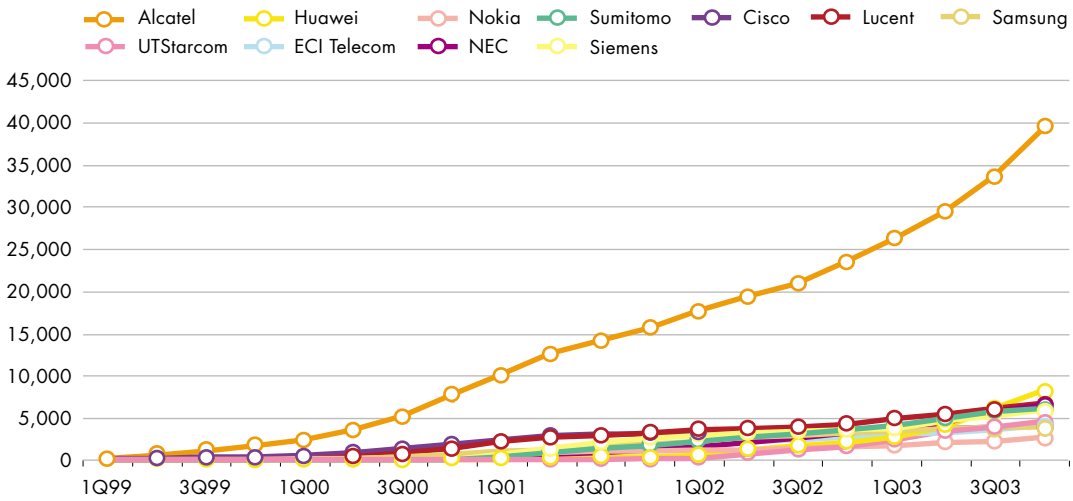


For this particular business case, the calculations took into account the initial installed base of ATM switches with the existing (low speed) interfaces. The calculations for another service provider may provide a different figure, but the benefits of using Ethernet as a cost-efficient and high speed technology are evident. The point in time at which introduce a new aggregation network depends, among other factors, on the traffic increase and the need for high speed interfaces.

Why Alcatel?

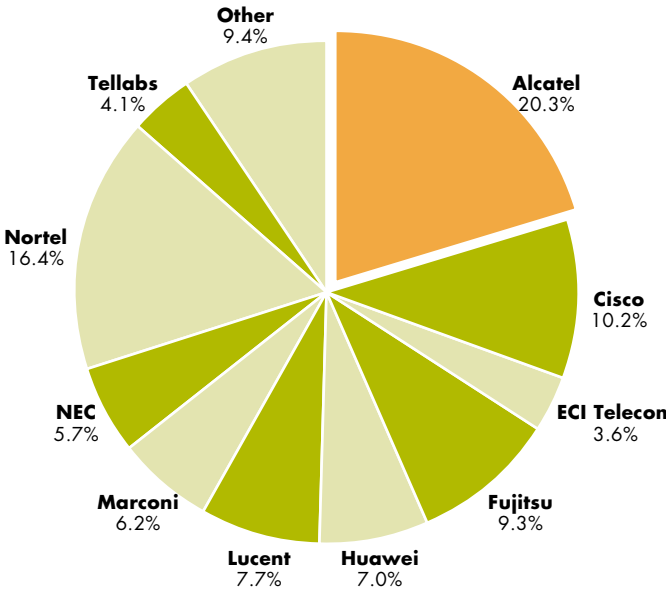
Service providers looking for an experienced partner to deliver Ethernet DSL aggregation need look no further than Alcatel. Alcatel is not only the market leader in DSL and next generation SDH equipment, but provides cutting-edge products to build an end-to-end solution.

Figure 4 - DSL Cumulative Shipments (ports) Worldwide



Source: Dell'Oro, February 2004

Figure 5 - Global Market Share for Next Generation SDH/SONET (Ethernet-Enabled MSPP)



Source: RHK, November 2003

Market Leadership

We hold a leadership position in DSL. At the end of 2003, we had shipped 39.3 million DSL lines worldwide — almost five times the number of our nearest competitor (see Figure 4). We have helped many service providers resolve the challenges of DSL over ATM, and we are extending those capabilities to support the Ethernet environment.

Alcatel is also a market leader in next-generation SDH (see Figure 5) with over 20 percent market share.

Setting the Standards

Alcatel plays an active role in industry organizations responsible for setting the standards that govern applications like Ethernet DSL aggregation. The Internet Engineering Task Force (IETF), Metro Ethernet Forum, ITU and DSL Forum are all heavily involved in defining the technologies and capabilities that relate to this application. Some of the relevant standards include:

- **802.1:** A comprehensive set of Ethernet standards
- **MPLS:** Based on a collection of standards, led by IETF
- **Layer 2 VPN standards:** VLL, VPLS standards being developed by the IETF. Alcatel is playing a leading role in the standardization of these features: Alcatel's Vach Kompella is one of the co-authors of the VPLS draft.

Investment Protection and Cost Reduction

Our solution complements the service provider's existing network; in an SDH environment, all that is required is the addition of ISA cards to enable Ethernet DSL aggregation, while in an ATM environment, service providers can continue to deliver high speed Internet as they always have and add the Alcatel 7450 ESS to build an Ethernet aggregation network for the new services. The Alcatel 7300 series DSLAM has both an ATM interface towards the ATM aggregation network and a GE interface towards the Ethernet aggregation network. Figure 6 illustrates this network.

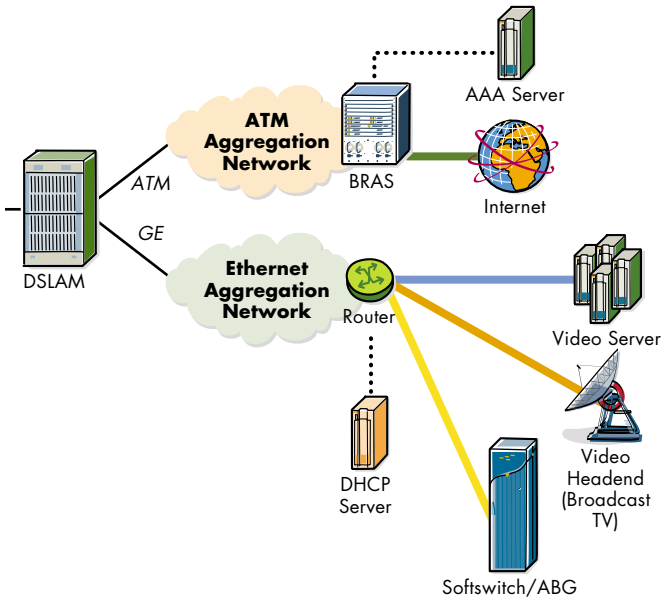
Cutting Edge Products

We can present service providers with an end-to-end solution, from the DSL modem right up to the BRAS. This one-stop shopping simplifies the purchasing decision and has the potential to reduce capital expenditures (CAPEX).

Service providers have stringent requirements for an Ethernet DSL aggregation application, such as:

- High density solution to support existing and future DSL customers
- Switching capacity to accommodate tens of thousands of users with multimedia and business services.

Figure 6 - Existing ATM-Based DSL Aggregation Network Plus Ethernet-Based High Speed Network for New Services



- Network and port resilience to guarantee an always-on solution
- QoS to differentiate among services
- Accounting capabilities to enhance billing options

The Alcatel solution addresses each of these requirements.

Alcatel 7300 series DSLAM

In addition to DSL line multiplexing, the Alcatel 7300 series DSLAMs offer advanced capabilities, such as:

- Prevention of user-to-user communication in the Ethernet network: End users connected to the same DSLAM cannot communicate directly with one another. They must first go through a service point. This capability, called intelligent bridging, mimics the security of ATM, in which peer-to-peer communication is impossible because each user has a separate connection. In addition to the increased security, this feature also protects the service provider's revenues in case of a usage-based billing model.
- IGMP snooping for video applications: In a classical IP multicast environment, users of a BTV service must wait up to three seconds after pressing a button on their remote control before they see the results of their action on-screen. This delay is due to the fact that their action is transmitted through the IP network. With IGMP snooping, the user's action is interpreted in the DSLAM, which is closer to the end user. This results in a capability called "real time zapping".
- Built-in multicasting functionality: This eliminates replicated traffic in the network, significantly reducing transport costs. Services can be delivered closer to end users with optimal network performance ensured, and users can selectively join or leave real-time audio or video multicasts. The back-plane architecture is specifically designed to offer broadcast services. The broadcast video bus of 622 Mb/s can simultaneously deliver up to 250 video channels to 10,000 users.
- DHCP relay functionality for non-PPP environments

Alcatel 7450 ESS

The Alcatel 7450 ESS provides key features that make it an ideal platform for the Ethernet DSL aggregation application:

- **Application-based QoS:** Service providers can differentiate among the services delivered over each virtual leased line on an application-by-application basis to deliver the right guarantees to end users and increase revenue with tiered service levels.
- **Daisy-chained implementation of VPLS:** This provides an innovative approach to BTV by avoiding any traffic replication in the aggregation network while still offering the fast restoration mechanisms of MPLS.
- **Density:** The Alcatel 7450 ESS provides 120 Fast Ethernet ports per slot, which is sufficient to aggregate the traffic of several tens of thousands of DSL users. The Alcatel 7450 ESS also supports Gigabit Ethernet and 10 Gigabit Ethernet interfaces.
- **Network and port resilience:** Our solution supports rerouting in milliseconds in the event of a failure in the network. For port resilience, we support link aggregation between the Alcatel 7450 ESS and the DSLAM, which enables traffic to be switched from one link to another for the same connection.
- **QoS:** The Alcatel 7450 ESS supports both per-service QoS and hierarchical QoS. Hierarchical QoS enables service providers to allocate an overall quality to a customer's traffic and then further differentiate among the services provided to that customer
- **Accounting:** The accounting has a granularity down to the service-level, simplifying billing for the service provider.

Alcatel OMSN products

The Alcatel OMSN product portfolio provides next-generation SDH optical transport function with integrated data-aware features that cost-effectively enable new competitive data services — Ethernet, Gigabit Ethernet, MPLS, ATM — by adding specific ISA plug-in modules. OMSN integrated Layer 2 switching capabilities allow carriers to deliver advanced metro Ethernet and ATM packet-based services over standard SDH infrastructure at only incremental cost. The OMSN family was designed to address metropolitan transport and optical access networks.

The Alcatel 1640 FOX, available in desktop as well as wall-mount configuration, offers STM-1/4 ADM for SDH optical access extension to customer premises as well as PDH, Ethernet and Gigabit Ethernet interfaces. The Alcatel 1650 SMC is a very compact STM-1/4 ADM and mini cross connect node for metro access applications. The Alcatel 1660 SM is a 2.5 Gb/s multi-service node with PDH, Ethernet 10/100/1000, STM-1, STM-4 and STM-16 interfaces. The Alcatel 1670 SM is a 10 Gb/s multi-service node for metro-core applications with STM-64 ports and full STM-1/4/16 drop capability and Gigabit Ethernet interfaces.

All OMSN products feature integrated Layer 2 Ethernet, MPLS and ATM switching capabilities. They also provide QoS to differentiate between premium real-time, premium non-real-time and best effort services. For BTV, the OMSN products use the "drop-and-continue" feature, where the video stream is not only dropped to a node (connecting to the DSLAMs), but is also forwarded to the next node in the ring, without traffic replication.

Alcatel 1662 PRS

The Alcatel 1662 PRS represents a new concept for the delivery of reliable metro Ethernet services over the optical transport architecture. Specifically designed for packet-centric networks, the Alcatel 1662 PRS complements Alcatel's OMSN product family by offering service providers with a full packet based, cost-effective platform that is interoperable with any existing SDH transport network. The Alcatel 1662 PRS supports VLL, VPLS and Ethernet aggregation services.

The Alcatel 1662 PRS leverages the MPLS RPR technology already available on the OMSN products.

Network management

Operational support systems (OSS) and network management is a top priority at Alcatel, where we understand the impact that a well-designed management solution can have on operational expenditures (OPEX). Our management platforms combined with our management solutions for broadband access focus on operational excellence and offer capabilities that others do not, such as:

- Self-activation, self-care
- Streamlining and automation of the entire service delivery process (from order entry to billing)
- Service views showing immediate service impact
- Monitoring of customer experience in real time
- Collecting information for service billing purposes
- Automating analysis, activation and quality assurance for voice, data and video "triple play" services

This leads to faster problem resolution, associated cost reduction and ultimately reduced customer churn.

Building on Customer References

The following is a subset of customers who have installed our metro Ethernet solutions with a network based on the Alcatel 7450 ESS or the Alcatel 7750 SR

- Allstream (Canada)
- Masergy (U.S.)
- Telenet (Belgium)
- Iberdrola (Spain)
- Shandong Netcom (China)

These customers have built networks based on the Alcatel OMSN family:

- Belgacom (Belgium)
- SingTel (Singapore)
- T-Com (DTAG) (Germany)
- Fastweb (Italy)
- CNC Beijing Communication Corporation (China)

Industry Impact

Our in-depth involvement with standards bodies gives service providers the assurance that our solutions are architected with today's leading standards in mind. We are driving the development of new standards, not simply following them.

Leading industry analysts recognize the strength and validity of our development strategies: several analysts now assess platforms under the new category of "service switches" based on the introduction of the Alcatel 7450 ESS.

Consultative Marketing Programs

Alcatel has developed consultative marketing programs to help service providers deliver the services that customers demand today. We help service providers make a business case for new services in terms of their potential for revenue generation. This program can also be to help service providers optimize their network and reduce CAPEX and OPEX.

In addition, Alcatel works with service providers to help them resolve issues directly related to the delivery of DSL services. To date, more than 30 DSL operators have experienced the competencies and knowledge of these consultants and have boosted their DSL business as a result.

Through these consultative marketing programs, Alcatel becomes the service provider's partner in enhancing their service portfolio, controlling costs and improving the bottom line.

More Information

For more information on Alcatel platforms and solutions for DSL access applications, refer to http://www.alcatel.com/dsl. Specific information on Alcatel products for Ethernet DSL Aggregation can be found as follows:

Alcatel 7750 SR
http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/a7750sr.jhtml

Alcatel 7450 ESS
http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/a7450ess.jhtml

Alcatel 1640 FOX
http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/Alcatel_1640_FOX.jhtml

Alcatel 1650 SMC
http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/Alcatel_1650_SMC.jhtml

Alcatel 1660 SM
http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/Alcatel_1660_SM.jhtml

Alcatel 1670 SM
http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/Alcatel_1670_SM.jhtml

Alcatel 1662 PRS
http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/a1662prs.jhtml

Alcatel 5620 NM
http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/Alcatel_5620.jhtml

Alcatel 1350 Management Suite
http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/a1350_ms.jhtml

Alcatel 7300 ASAM
ANSI: http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/Alcatel_7300_ASAM.jhtml
ETSI: http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/a7300asamETSI.jhtml

Alcatel 7301 ASAM
ANSI: http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/a7301ansi.jhtml
ETSI: http://www.alcatel.com/products/productsummary.jhtml?relativePath=/x/opgproduct/a7301etsi.jhtml

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