TECHNICAL INFORMATION GUIDE

Alcatel 7670 RSP
Routing Switch Platform

ARCHITECTS OF AN INTERNET WORLD

ALCATEL

Table of Contents

Introduction 1

Product Description 1

Applications and Services 5

Multiservice, Multi-Application, Multiprotocol 5

Multiprotocol Core 5

Managed Data Services 7

g.SHDSL 8

Broadband Access Aggregation 8

Mobile Aggregation and Core Consolidation 9

Gigabit Ethernet 10

Next Generation Voice Infrastructure 13

Optical Core Node 14

Product Benefits 15

Product Architecture 16

Standalone Configurations 16

Multishelf Configuration 20

IP/MPLS on the Alcatel 7670 RSP 27

ATM on the Alcatel 7670 RSP 30

Alcatel 7670 Routing Switch Platform

Introduction

The Alcatel 7670 Routing Switch Platform (RSP) is a next generation system for tomorrow's multiservice, multiprotocol networks. This versatile, highly scalable, highly reliable routing and switching platform offers these capabilities:

- Scales incrementally in multiple dimensions, including protocol, port and fabric capacity
- Supports multiple protocols and services
- Provides the flexibility and investment protection needed in building an edge and core infrastructure

Using industry leading traffic management, the Alcatel 7670 RSP preserves profitable data, video, and voice services from the edge to the core of the network, while providing support for tomorrow's revenue generating services. The network can be scaled in service (2.4 Gb/s at the multiservice edge to 450 Gb/s bidirectional at the multiprotocol core). The multiprotocol to Internet protocol (IP), multiprotocol label switching (MPLS), asynchronous transfer mode (ATM) product architecture enables service providers to migrate to their chosen type of core network at their own pace while preserving revenue. The Alcatel 7670 RSP meets the need for core, core-edge and edge data networking applications, and provides superior availability and reliability with uncompromised performance for both IP packet-based and cell-based services.

In-service scaling provides near limitless flexibility in tailoring systems to meet current and future capacity needs, thereby ensuring optimal use of capital expenditures (CAPEX). Integration of edge and core functions reduces the operational complexities of broadband networking and reduces the amount of critical talent required to operate the network.

With the Alcatel 7670 RSP, Alcatel has leveraged a pedigree in building in-service scalable data networking platforms with carrier class reliability and availability. The Alcatel 7670 RSP is the first hot redundant, multiservice, multiprotocol routing switch platform to implement non-stop routing capability, based on the Alcatel Carrier Environment Internet System (ACEIS) technology breakthrough, which brings 99.999 (five 9s) percent availability to packet networks.

Table 1 on Page 2 shows the business benefit of the Alcatel 7670 RSP.

Product Description

The Alcatel 7670 RSP is a multiservice, multiprotocol routing switch platform that provides carriers with the scalability, reliability and performance to meet their customers' demanding requirements, now and in the future.

The Alcatel 7670's multiprotocol IP/MPLS/ATM integration mitigates the risk associated with any single technology. In addition, the platform enables interworking among protocols to allow migration paths that preserve existing service revenues regardless of core network evolution.

The Alcatel 7670 delivers the flexibility to develop new service offerings, accommodates the migration of voice to packet, and supports the revenue generating services of today and tomorrow in a multiservice, multiprotocol environment. The scalable architecture allows service providers to implement the platform in both single shelf and multishelf configurations, mitigating the cost of future network growth and the risk of technology.

Table 1: Business Benefits of the Alcatel 7670 RSP

Feature	Benefit
Scalability and flexibility	• Reduces CAPEX; minimizes initial system costs with the capability to rapidly expand in response to changing market demands
	• Maximizes asset utilization and defers CAPEX
	• Platform scales from a single shelf to a multishelf, multiservice system, without service disruption
	• Universal card slots enable service providers to install a mix of interfaces or service cards based on business needs
New service capabilities	• Provides a simple evolution to new broadband services
	• Offers advanced IP/MPLS services that take advantage of the proven traffic management capabilities of the Alcatel 7670 RSP
	• Ethernet-frame relay service interworking enables access to switched virtual private networks (VPNs) by either technology, providing a complementary introduction of Ethernet and new revenues from the multiservice WAN
State-of-the-art traffic management	• Provides service differentiation through enhanced QoS capabilities
	• Helps to maintain network performance objectives
	• Reduces operating expenditures (OPEX) by promoting efficient use of network resources
	• Ensures that service level agreements (SLAs) are honored, resulting in greater customer satisfaction and reduced expenses for violations
Carrier class reliability, availability and serviceability	• Improves service availability of the network for greater customer satisfaction and retention
	• Enables a non-stop networking environment for critical traffic, such as voice and financial transactions, over a packet network
	• Increases customer retention with faster problem detection and resolution
	• Improves network reliability by reducing the amount of operator intervention required
Standards compliance and interoperability	• Ensures service transparency in a multivendor network
	• Allows easy integration with existing network and operational systems, due to open solutions
	• Gives freedom to select the best-of-breed products at each functional layer of the network
Network and service management	• Reduces time required to provision new services or expand existing services, thereby improving time to revenue and reducing repair time
	• Provides service providers and their end customers with better control and visibility of their network resources

Significant growth in native IP networks continues, and carriers must be able to seamlessly interconnect native IP and ATM multiservice infrastructures in order to provide end-to-end value-added services while migrating toward the next generation core infrastructure.

As a key technology, MPLS is now being evaluated by leading carriers with a view to deployment in the near future. Therefore, multiservice, multiprotocol switches must be able to interconnect cost effectively at all layers in the network and offer a risk free migration path toward a next generation infrastructure. This requires the support of MPLS functionality and native IP interfaces such as packet over synchronous optical networks/synchronous digital hierarchy (SONET/SDH) (POS) and Gigabit Ethernet (GigE).

Furthermore, carriers recognize that time to market is crucial in a competitive environment. Therefore, automated service provisioning through an industry strength network and service management system is critical.

The Alcatel 7670 RSP addresses these needs by offering unrivaled port density and scalability in a carrier class platform, supporting IP, MPLS and ATM with complete network and service management provided by the Alcatel 5620 Network Manager (NM).

The Alcatel 7670 RSP is designed for the heart of next generation multiservice, multiprotocol networks. By integrating IP/MPLS and ATM into a highly scalable platform, Alcatel has provided carriers with the ability to scale existing multiservice networks to meet the demands placed on the multiprotocol core by the explosion of IP traffic, and to evolve as required, to a next generation core. The Alcatel 7670 RSP offers unparalleled scalability and port density, and leverages Alcatel's extensive experience in delivering reliable, carrier class networking equipment.

The Alcatel 7670 RSP is a highly reliable multiservice, multiprotocol backbone system designed to route IP, to function as a label edge and label switch router (LER and LSR) and to switch ATM cells through the same switching fabric. In addition to supporting MPLS label switched paths (LSPs) over the POS and GigE interfaces, both ATM virtual circuits (VCs) and MPLS LSPs can be configured on the same line cards, providing enormous flexibility to carriers wishing to evolve their core infrastructure to a technology mix that best meets their business objectives.

The Alcatel 7670 RSP supports a single shelf or multishelf architecture, which consists of the following shelves: the peripheral shelf (PS or "50Gig shelf") the switching shelf (SS), the high speed peripheral shelf (HSPS) and the edge services extender shelf (ESE). The function of each of the shelves is as follows:

- **Peripheral Shelf (PS or "50Gig shelf"):** This shelf can be used in standalone applications or as part of a multishelf system. It has 14 slots, and can accommodate up to 224 STM-1/OC-3/DS3 ports, or 56 STM-4/OC-12 ports, or 14 STM-16/OC-48 ports, or 56 GigE ports. Any mixture of interface types can be supported. When expansion is required, the single shelf can become part of a multishelf system. This conversion is achieved without service impact.
- **Edge Services Extender Shelf (ESE):** The ESE supports a wide range of low speed data interface types, including E1/T1/E3/DS3 cell relay, frame relay, circuit emulation and g.SHDSL. Using this shelf, the Alcatel 7670 RSP extends its capabilities to the multiservice edge. The ESE can be deployed as a 2.4 Gb/s standalone node, or subtended from a PS using standard ATM NNI STM-4/OC-12 interfaces.
- **High Speed Peripheral Shelf (HSPS):** This shelf has four subshelves, each of which accommodates two working line cards and two protection line cards. Release 2.0 of the Alcatel 7670 RSP introduced the quad STM-16/OC-48c line card for this shelf. A single port STM-64/OC-192c line card will be available in a future release.
- **Switching Shelf (SS):** This shelf provides the matrix capacity for the multishelf system. The matrix capacity builds according to network requirements. This shelf has 32 slots to hold switching access cards (SACs). Each card provides up to 14 Gb/s of matrix capacity for a total of 450 Gb/s. To provide a fully redundant matrix complex the switching shelf is deployed in pairs, SS-X and SS-Y. Each PS is attached to the switching complex using high speed intershelf links (HISLs)

Figure 1 shows the physical architecture of the Alcatel 7670 RSP.

The Alcatel 7670 RSP is designed to scale from a single shelf standalone configuration of 2.4 Gb/s at the multiservice edge to 450 Gb/s (bidirectional) in a multishelf configuration at the multiprotocol core while in service. This scalability enables a pay-as-you-go approach to network expansion.

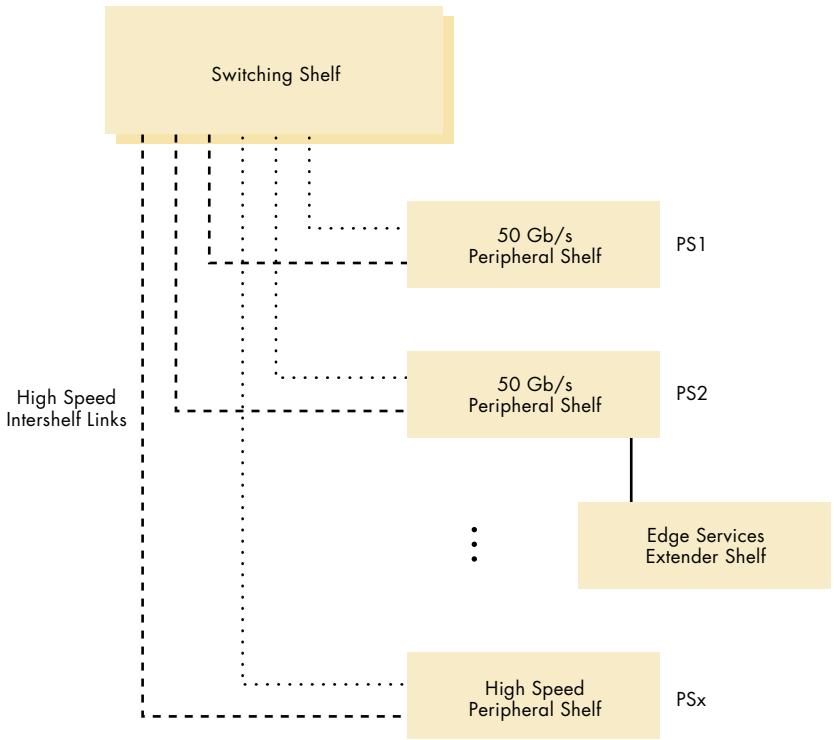
Scalability is complemented by the ability to increase the port density and embedded control infrastructure. Multiple peripheral shelf types allow optimization between high port density and the equipment footprint. The Alcatel 7670 RSP provides 320 Gb/s of bidirectional user input/output (I/O), fully protected by automatic protection switching (APS).

In a multishelf configuration using the PS and HSPS, the Alcatel 7670 RSP provides redundant or nonredundant provisioning using APS of the following channels:

- 1,760 OC-3c/STM-1/DS3
- 440 OC-12c/ STM-4/GigE
- 124 OC-48c/STM-16
- 31 OC-192c/STM-64 channels.

In addition, each ESE can support a wide range of service types and speeds, including frame relay, cell relay, circuit emulation, g.SHDSL and 10/100Base-T Ethernet. The ESE also supports resources cards for IP services.

Figure 1: Alcatel 7670 RSP Physical Architecture



Applications and Services

Multiservice, Multi-Application, Multiprotocol

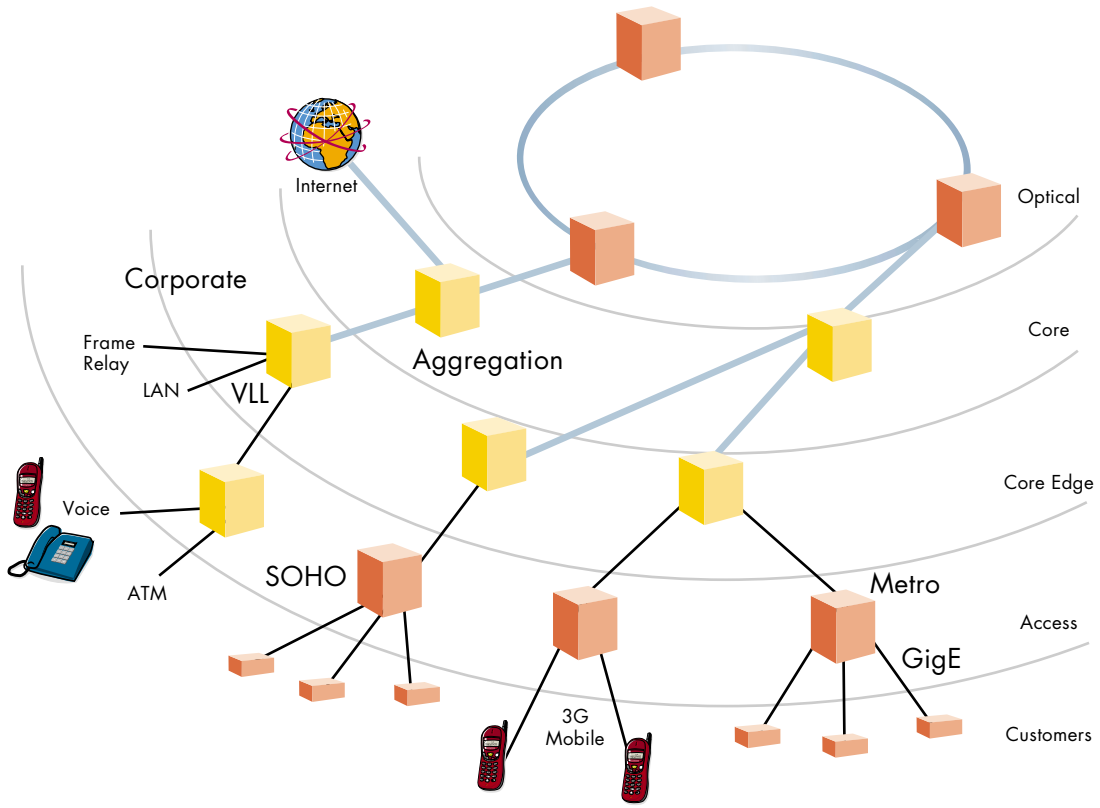
Flexible, and proven in the field, the Alcatel 7670 RSP can be used in a number of edge and core applications:

- Multiprotocol core
- Managed data services
  - private lines, frame relay, ATM,
  - transparent local area network (LAN) services
- Broadband access aggregation
- Mobile aggregation and core consolidation
- GigE applications
- Next generation voice infrastructure
- Optical core node

Multiprotocol Core

Integrating IP, MPLS and ATM on the same platform mitigates risk associated with any one technology. The Alcatel 7670 RSP provides full control and data plane support for private network-to-network interface (PNNI) routing, signaling, hierarchy and QoS routing as well as open shortest path first (OSPF), border gateway protocol 4 (BGP-4), intermediate system-to-intermediate system (IS-IS), cell relay label distribution protocol (CR-LDP) and resource reservation protocol — traffic engineering (RSVP-TE). The integration of ATM, MPLS and IP makes the Alcatel 7670 RSP a strategic investment and creates an extremely versatile product.

Figure 2: Multiservice Networks



Alcatel 7670 Routing Switch Platform

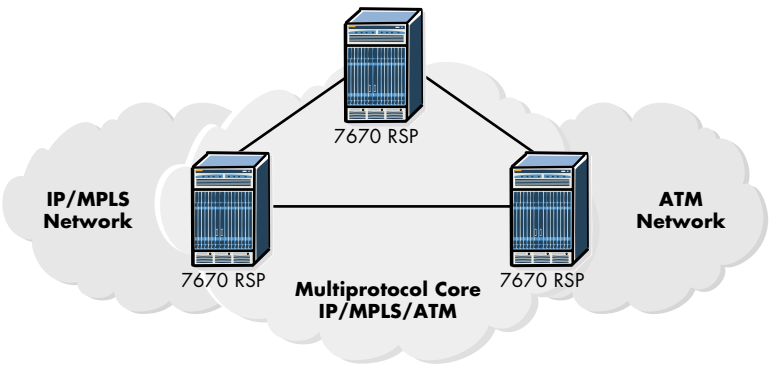
The Alcatel 7670 RSP acts as an ATM multiservice switch, including frame relay (one of the most profitable service offerings), voice over packet trunking and media gateway, and 3/1/0 circuit grooming for private line and digital cross-connect system (DCS) applications. It also performs concurrently as an MPLS LER, LSR and IP router, allowing an operator to migrate at their pace to these evolving services. Combined, these attributes define the next generation of scalable, multiprotocol core and multiservice routing switch platforms. It's all about aggregating and mediating all services for transport across the intelligent optical core.

MPLS brings much needed network and traffic engineering capabilities to the pure hop-by-hop routing approach used in large scale IP networks. These traffic engineering capabilities allow service providers to meet the growing demand for business class IP services.

Key Benefits

- Investment protection with multiprotocol integration that enables core convergence at the carrier's own pace
- Ability to offer existing services seamlessly with new MPLS-based services
- Deployment of carrier class IP/MPLS networks (five 9s availability) with the unique non-stop routing feature
- Deployment of trusted service level agreements (SLAs) while enabling new Layer 3 IP base services

Figure 3: Multiprotocol Core



- Transparent LAN
- Layer 3 IP aggregation
- GigE LAN extension over MPLS
- BGP/MPLS Layer 3 VPN
- Internet transit service with QoS
- Layer 3 VPN (RFC2547bis)

- NGN voice network
- Private line
- Frame relay
- ATM
- Layer 2 VPN
- Broadband aggregation
- Mobile aggregation

Managed Data Services

The Alcatel 7670 RSP helps service providers generate revenue today with ATM, frame relay, private lines, and transparent LAN services.

The private line capability of the platform means service providers can deliver leased-line services directly to customers. DCS functionality is integrated to seamlessly interwork private line networks with the broadband backbone.

The Alcatel 7670 RSP is a flexible, multiservice, multiprotocol platform that accommodates frame relay growth without affecting current services. Award-winning frame relay performance addresses the demand for this service, which continues to grow, particularly among small- to medium-sized enterprise customers. Also, support for seamless interworking with ATM addresses increasing bandwidth demand, especially from large enterprise customers.

The introduction of Ethernet-frame relay service interworking allows any mix of Ethernet, frame relay and cell relay access connections to a Layer 2 VPN service. This enables enterprises to upgrade specific sites to Ethernet in a multisite VPN without having to upgrade sites where existing frame relay CPE and access continues to provide the desired level of service.

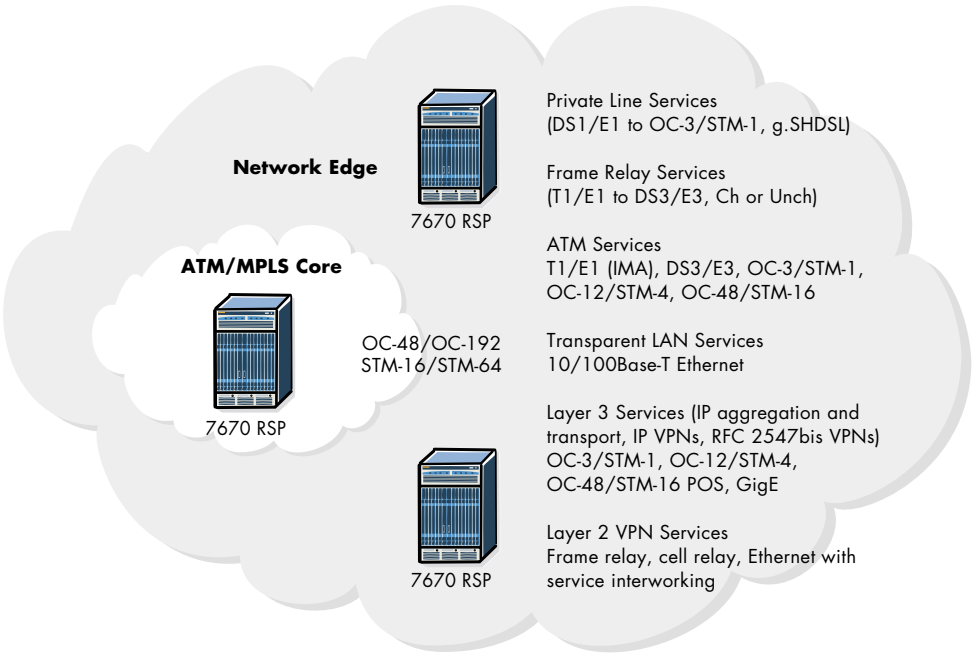
It all adds up to developing your network capabilities from single to multiservice over a common infrastructure.

Figure 4 shows the Alcatel 7670 RSP as part of a broadband network that delivers multiple services.

Key Benefits

- Wide range of interface speeds, from DS0 to OC-192/STM-64
- Superior end-to-end monitoring and diagnostic capabilities
- Advanced traffic management capabilities that support a flexible pricing structure
- Broad range of Layer 2 and Layer 3 VPN services, accessed over multiple technologies

Figure 4: Multiservice Delivery



g.SHDSL

Figure 5 shows the Alcatel 7670 RSP as part of a Managed Data Services solution, using the 48-port g.SHDSL card on the ESE shelf, and CPE modems that also support a g.SHDSL physical uplink. This solution provides a more cost-effective and flexible alternative to traditional TDM-based leased line services and extends the carrier's broadband capabilities to the customer premises.

Key Benefits:

- Provide SLAs based on advanced traffic management capabilities
- Proven carrier class reliability with full redundancy and non-stop networking
- Profitable service delivery by utilizing the high margin service possibilities available on a multiservice platform

Broadband Access Aggregation

Deployment of wireline and wireless last-mile access solutions are growing in response to increasing demand for high speed Internet access and services.

The Alcatel 7670 RSP platform complements broadband access solutions by concentrating the traffic coming from the access network. This aggregation enables the efficient digital loop carriers (DLCs) or wireless digital base stations (DBSs) over a high speed link to the network core.

While aggregating last-mile traffic, the Alcatel 7670 RSP can also deliver classic data, advanced IP and voice services. In addition, this versatile platform can aggregate traffic from mobile networks. The bottom line: increased revenues, service margins and profitability.

Figure 5: Alcatel 7670 RSP in a Managed Data Services Solution

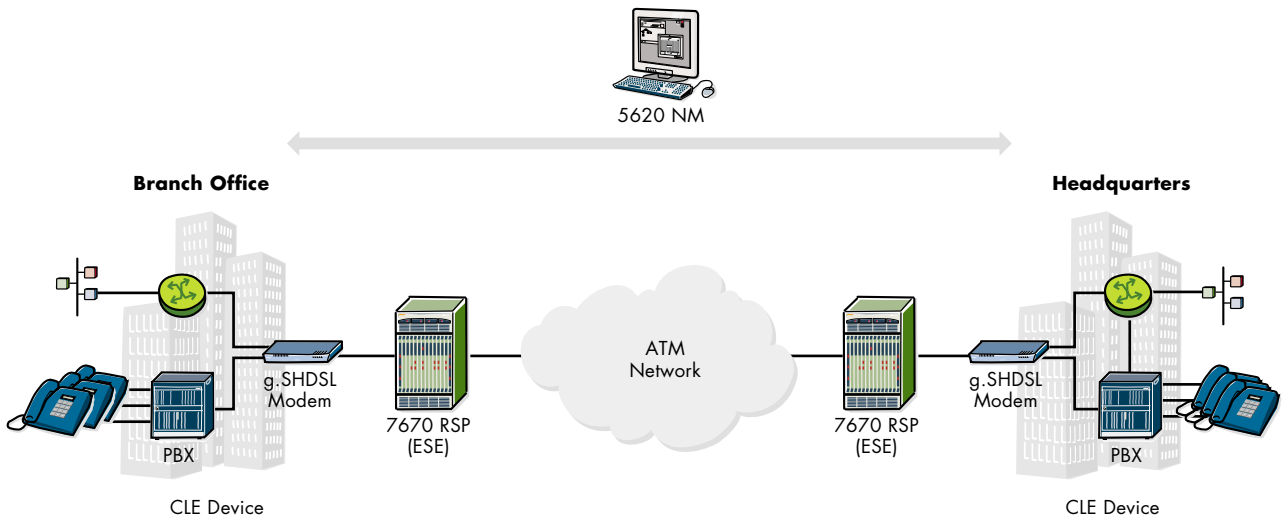


Figure 6 illustrates the use of the Alcatel 7670 RSP in the edge to aggregate traffic from DSLAMs and DLCs to an Alcatel 7670 RSP in the core. Aggregation provides a significant cost benefit by maximizing the efficiency of the links to the core.

Key Benefits

- Highest available number of virtual connections
- High port density
- Elimination of incremental equipment purchases
- End-to-end service provisioning
- Capability to deliver new services, including multimedia and voice over DSL

Mobile Aggregation and Core Consolidation

As mobile networks grow and evolve, consolidation will be required to realize economies of scale and simplify service delivery.

Mobile operators are seeking competitive, future-proof solutions that will support all types of mobile voice and data traffic over 2G, 2.5G and 3G networks. Operators want platforms that can accommodate current services while supporting an evolution to 3G networks.

The Alcatel 7670 RSP supports the current time division multiplexing (TDM)-based mobile network, and can also add higher speed data capabilities to the network as it evolves. Circuit emulation supports 2G traffic while frame relay offers the additional capabilities required for 2.5G services. ATM and MPLS provide the broadband aggregation and core consolidation capabilities required to support all generations of mobile networks including 3G.

Figure 6: Broadband Access Aggregation

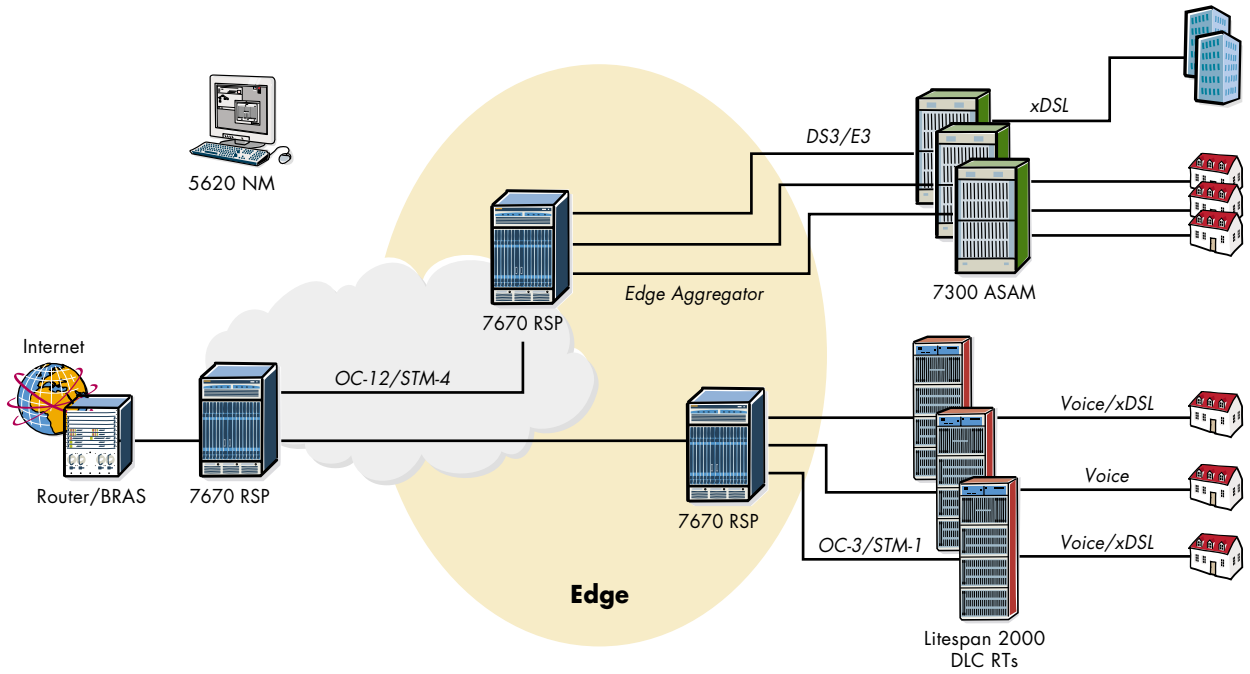


Figure 7 illustrates the use of the Alcatel 7670 RSP to aggregate traffic from the base transceiver station (BTS) to connect via ATM to the base station controller (BSC). ATM transports voice traffic between the BSC and the mobile switching center (MSC). The connection between the BSC and the data network is based on ATM, or MPLS for the IP traffic. The Alcatel 7670 RSP forms the backbone of the network.

Key Benefits

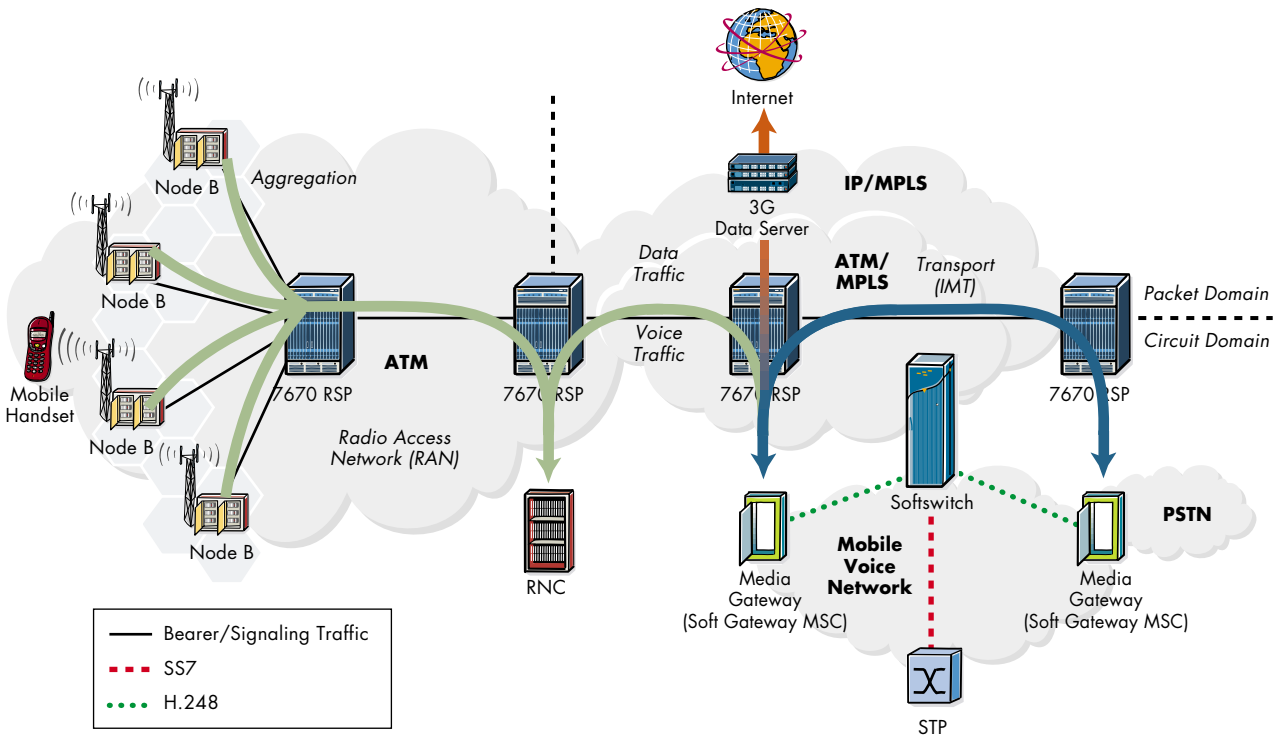
- Port and service scalability enables rapid network buildout
- Support for 2G, 2.5G, and 3G services over a common network
- Seamless infrastructure evolution from ATM to IP/MPLS
- Elimination of the requirement for an overlay network

Gigabit Ethernet

The Gigabit Ethernet line card is a packet-based interface that processes Ethernet encapsulated packets. The physical interface conforms to the GigE physical layer standards as described in IEEE 802.3.

Carriers can use the GigE interface on the Alcatel 7670 RSP to provide Layer 3 IP aggregation and to support MPLS (LER and LSR functionality).

Figure 7: 3G Mobile Network

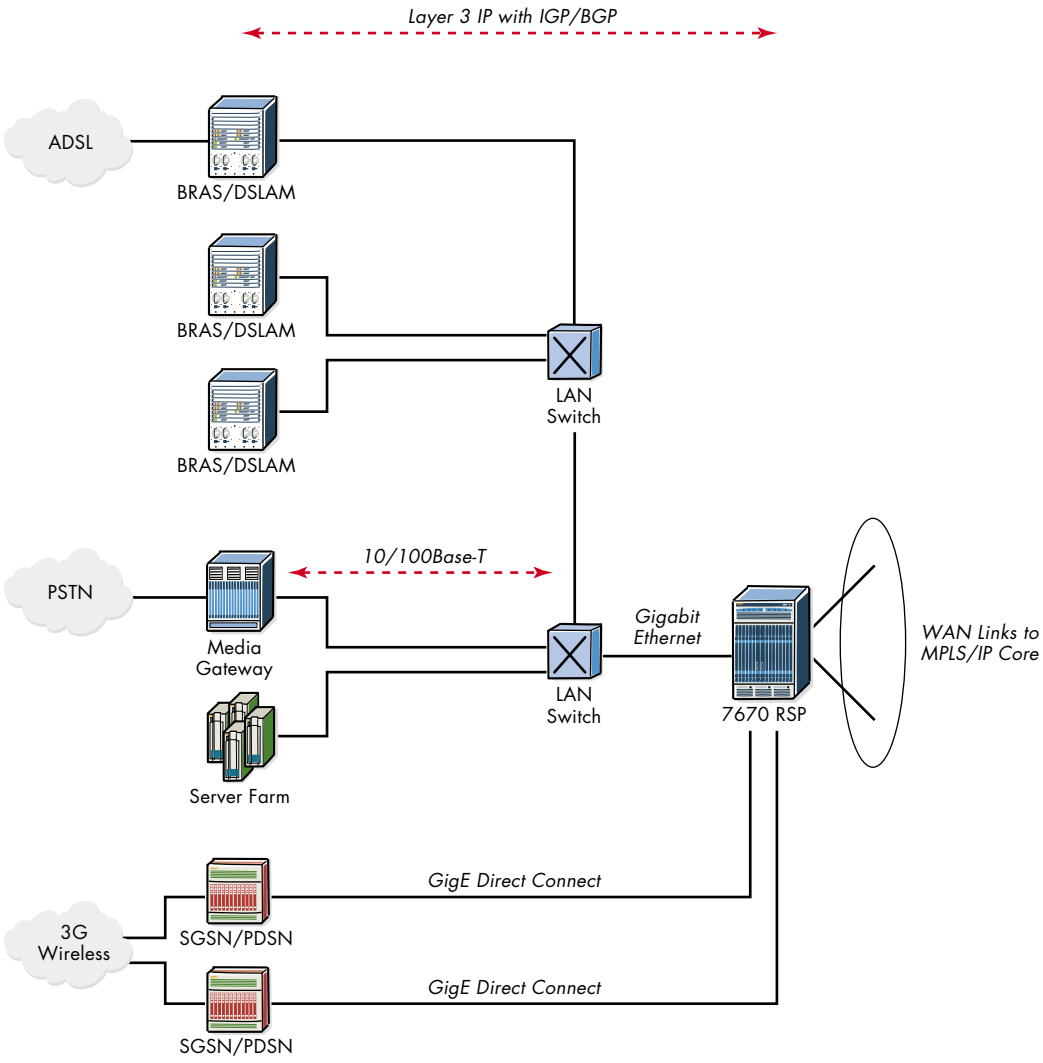


Layer 3 IP Aggregation

The GigE interface enables various IP applications including voice over IP (VoIP), video distribution, xDSL Layer 3 aggregation and 3G wireless data applications.

The Alcatel 7670 RSP can be used to aggregate all traffic from strategic components in applications such as media gateway, video server, to broadband remote access server (BRAS) and 3G to data services serving GPRS support node/packet data serving node (SGSN/PDSN). (See Figure 8.)

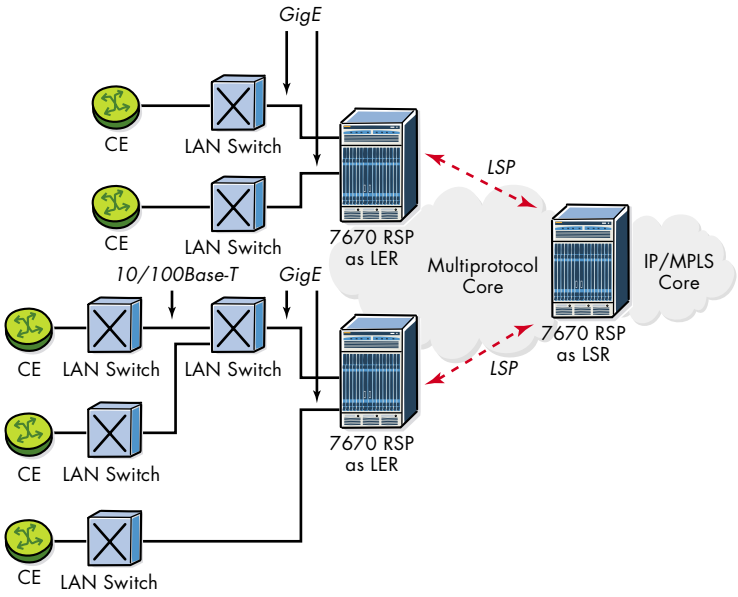
Figure 8: Layer 3 IP Aggregation



MPLS Aggregation

An Alcatel 7670 RSP with GigE interface can serve as an aggregator (LER and LSR) of Ethernet-based IP traffic. (See Figure 9.)

Figure 9: MPLS Aggregation



Ethernet Distance Extension

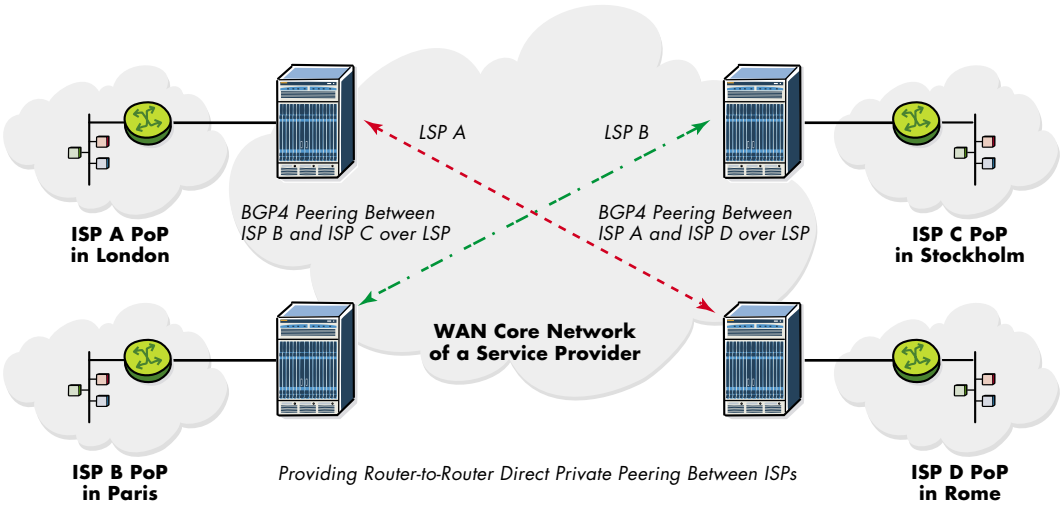
GigE distance extension is a feature that allows Layer 2 Ethernet packets to traverse an MPLS cloud connecting two Ethernet LANs together. Packets ingress on a GigE interface on the Alcatel 7670 RSP node and egress the originating node via an LSP using an MPLS capable interface. The Layer 2 packets travel through an LSP tunnel over an MPLS network and terminate on an Alcatel 7670 RSP node on an MPLS capable interface. The packets then egress out a GigE interface onto the destination Ethernet LAN.

Ethernet distance extension enables bandwidth efficient transport of Ethernet traffic over an MPLS core network. This capability can be used to enable:

- Remote BGP4 private peering
- Access to IP to virtual private network/virtual private LAN service (VPN/VPLS)
- Access to the Internet
- Point-to-point private line service
- Inter-metro Ethernet connectivity service

Figure 10 shows an example of GigE used on a private line service application.

Figure 10: Ethernet Distance Extension



Next Generation Voice Infrastructure

Although IP traffic is growing exponentially, voice services still represent the lion's share of a service provider's revenues. The challenge today is to converge lucrative voice services onto a broadband network that supports emerging IP revenue opportunities. This is the converged voice and data network.

Deploying a multiservice platform enables you to effectively deliver integrated voice services. A proven carrier class platform, the Alcatel 7670 RSP is a key component of Alcatel's voice strategy.

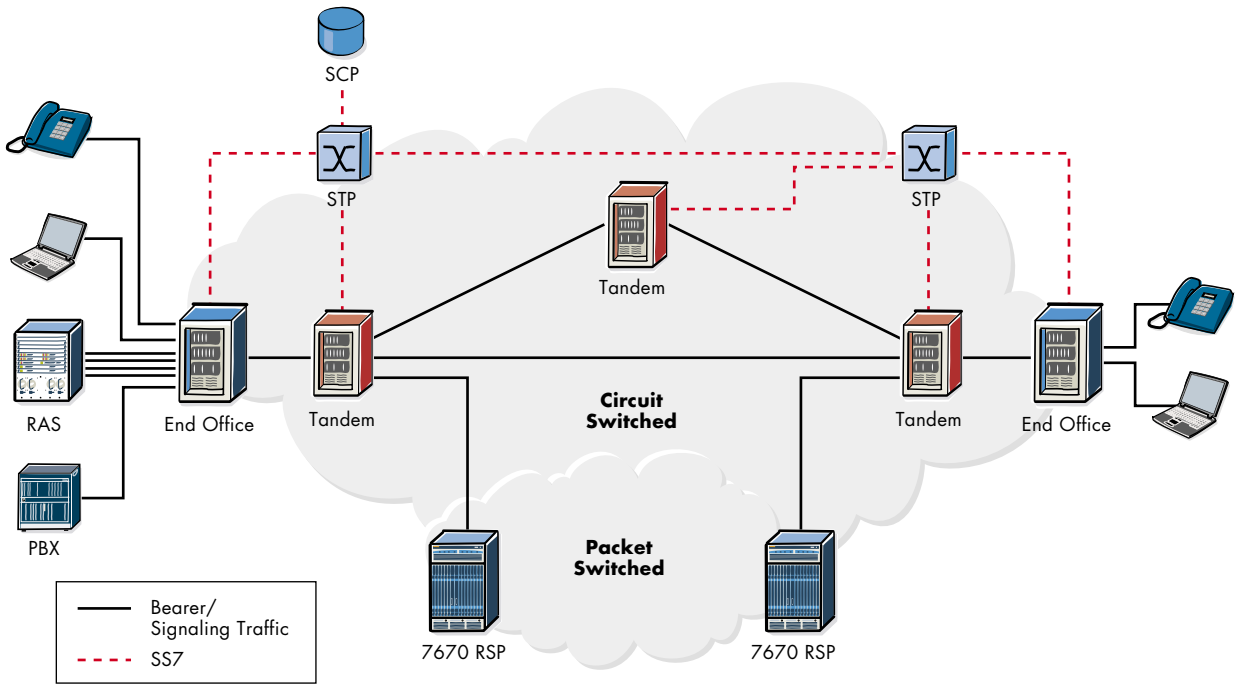
The Alcatel 7670 RSP provides a reliable and cost-effective aggregation and transport technology for delay and jitter-sensitive voice traffic. PSTN and mobile operators can immediately begin to realize the benefits of aggregating their voice traffic for provisioned trunking over a packet network today as a first step toward an NGN. The strength of beginning with the Alcatel 7670 RSP for point-to-point VoATM transport is that it can provide immediate cost savings while enabling a migration toward a softswitch-controlled network at a pace and timeframe established by the operator. The benefit of additional bandwidth savings in the provisioned network can also be achieved with voice compression over ATM adaptation layer 2 (AAL2) and voice activity detection (VAD).

Figure 11 depicts the Alcatel 7670 RSP providing aggregation and transport within a PSTN network. Tandem switch interconnection is indicated, though the application is equally applicable to an end office switch.

Key Benefits

- Density scaling to 24,000 DS0s per shelf
- Per channel configuration AAL1, AAL2, voice detection (VAD), G.711, G.726 and echo cancellation
- Carrier class end-to-end QoS
- Multivendor interoperability
- Converged voice and data network enables new revenue-generating services

Figure 11: Aggregation and Transport in a Typical PSTN Network



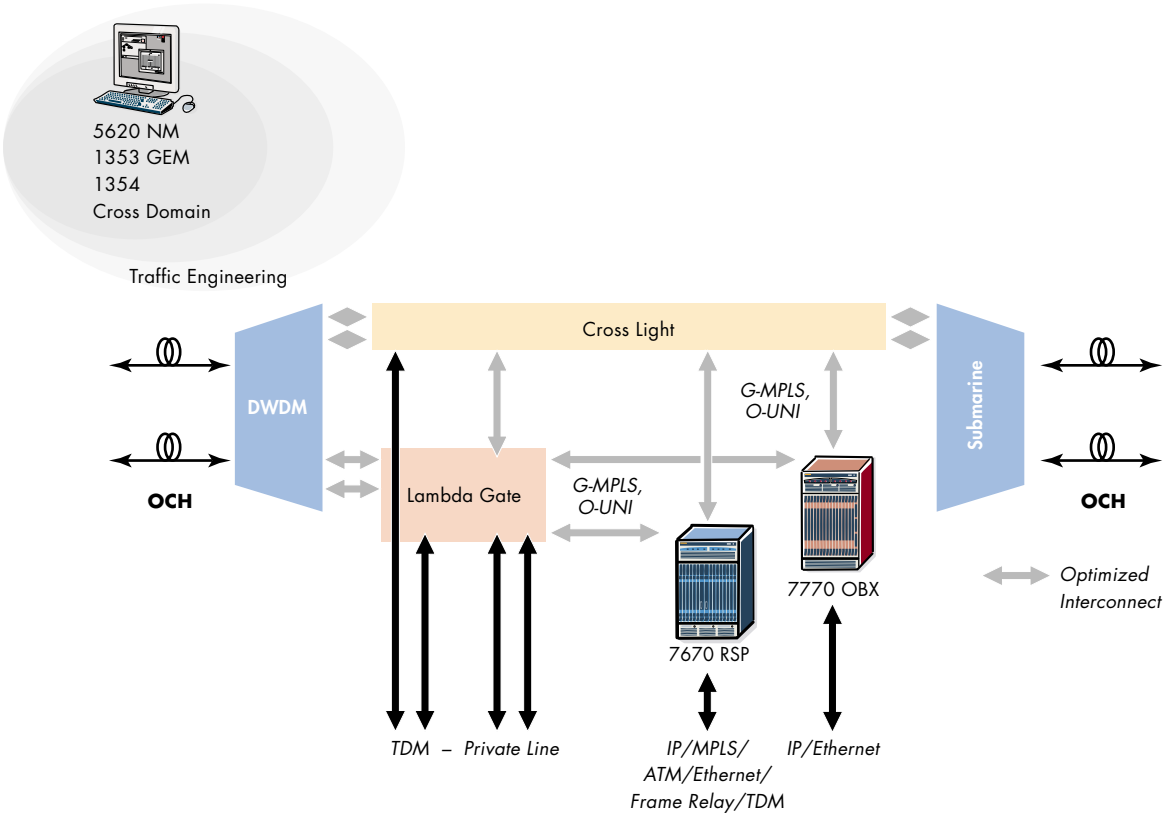
Optical Core Node

Intelligence in the network is now expanding into the optical domain where the transport layer can be dynamically controlled and operated in conjunction with the data layer. This is accomplished by equipping the optical network with a common control plane, generalized MPLS (G-MPLS), and an optical user-to-network interface (O-UNI). The Alcatel 7670 RSP is a key data networking element (DNE) that will serve as client of the intelligent optical network.

The end result is a network that is now capable of rapid service provisioning and streamlined protection.

Alcatel has created the Core Node, a modular, scalable solution that combines the assets of Alcatel's core products into a unified solution. It comprises the Alcatel 7770 Routing Core Platform (RCP) core IP router, the Alcatel 7670 RSP switch router, the Cross Light and the Lambda Gate. These products are coupled using G-MPLS and O-UNI for optical channel or SONET/SDH switching over DWDM or dedicated fiber. The management platform consists of the Alcatel 5620 Network Manager (NM) for ATM and IP management and the Alcatel 1354 for optical network management. Cross-layer traffic engineering is added using the Alcatel ALMA Vision Traffic Engineering tool.

Figure 12: The Optical Core Node



Product Benefits

The Alcatel 7670 RSP addresses the key market requirements of today's service providers:

- **Multidimensional scaling**: The Alcatel 7670 RSP has the highest fabric capacity available today. Furthermore, through leveraging of the multishelf capability and multi-dimensional scaling of the system, fabric capacity is available in increments, allowing equipment to scale to meet actual demands over the life of the network. The Alcatel 7670 RSP also provides high density interfaces to reduce price per port through the use of multiport cards or high-order, channelized cards.

- **IP/MPLS/ATM integration:** The Alcatel 7670 RSP's multiprotocol IP/MPLS/ATM integration mitigates the risks associated with adopting any single technology. In addition, the platform enables interworking among protocols to allow migration paths that preserve existing service revenues irrespective of how the core network evolves.

- **Managed multiservice capability**: The Alcatel 7670 RSP multiservice capability enables service providers to collapse physically separate networks onto one broadband network. Having fewer network elements means having less equipment to maintain and operate as well as requiring less talent to operate the network. The Alcatel 7670 RSP is fully managed by the Alcatel portfolio of network and service management systems and provides open interfaces to fully interwork within other OSS environments.

- **Non-stop routing:** Alcatel has a long history in carrier grade networking and has turned this experience into a unique non-stop networking approach applied throughout its solution portfolio. With the necessary redundancy already in place at every level, Alcatel ensures five 9s resiliency by providing the Alcatel Carrier Environment Internet System. ACEIS is a combination of hardware and software features that enables the delivery of true carrier class IP and MPLS solutions. Alcatel is first to prove a hitless routing protocol failover between redundant route processors.

  The Alcatel 7670 RSP supports non-stop BGP, OSPF and IS-IS routing protocols, a key requirement for carrier class IP and MPLS networks. Traditionally, core routers lacked the redundancy, scalability and robustness that have been the tradition of carrier class voice and multiservice data switches. The Alcatel 7670 RSP is the first non-stop routing switch platform to provide 99.999 percent availability for packet networks.

- **QoS-based services for two worlds:** IP/MPLS and ATM The Alcatel 7670 RSP addresses the critical need to generate profitable services revenue. Alcatel understands the art and science of delivering predictable QoS. In addition, carrier grade resiliency ensures high levels of availability. Traffic management and engineering tools facilitate the buildout of carrier scale, QoS-based network services.

- **Wide selection of interfaces:** New interfaces in Release 2.0 included a channelized, multiservice STM-1/OC-3 interface that supports up to 2000 DS0 (equivalent to 84 DS1 or 63 E1) logical interfaces in a single card slot. Other interfaces include a four-port OC-48/STM-16 ATM interface as well as IP interfaces, OC-48/STM-16 POS, and a four-port GigE interface.

- **Low speed multiservice data interfaces:** The introduction of low speed multiservice interface support through the simple addition of the ESE shelf dramatically enhances the Alcatel 7670 RSP's flexibility, allowing carriers to deliver a wider range of revenue generating services on one compact platform. The resulting savings in networking costs further contribute to the carrier's profitability. These interfaces

cover a wide range of physical interfaces, T1/E1, DS3/E3, OC-3/STM-1, g.SHDSL, 10/100Base-T Ethernet, and a wide range of services support including lease lines, frame relay, cell relay, DSL and Ethernet.

- **Automated service provisioning:** Integration with Alcatel's carrier strength Alcatel 5620 NM provides rapid, end-to-end provisioning of services to minimize time to revenue. Simple configuration of service category and QoS/class of service (CoS) coupled with statistics collection and billing, enables monitoring of SLAs to ensure customer satisfaction and retention as well as accurate invoicing for revenue collection.

The Alcatel 7670 RSP is now deployed by many of the world's leading carriers. The enhancements introduced in Release 2.0 further improve the platform's price performance and, through support of multiservice interfaces, widen the range of deployment options, leading to further cost savings through network consolidation.

Product Architecture

The Alcatel 7670 RSP is available in a number of configurations, with the principal variants being:

- Single shelf standalone:
  - PS or
  - ESE
- Multishelf configuration:
  - SS
  - PS
  - ESE
  - HSPS

Migration from a standalone configuration to a multishelf system can occur without service interruption.

Standalone Configurations

The Alcatel 7670 RSP has two options for standalone configuration:

- PS or
- ESE

Peripheral shelf (PS)

The peripheral shelf has a midplane design. The basic system consists of the following hardware:

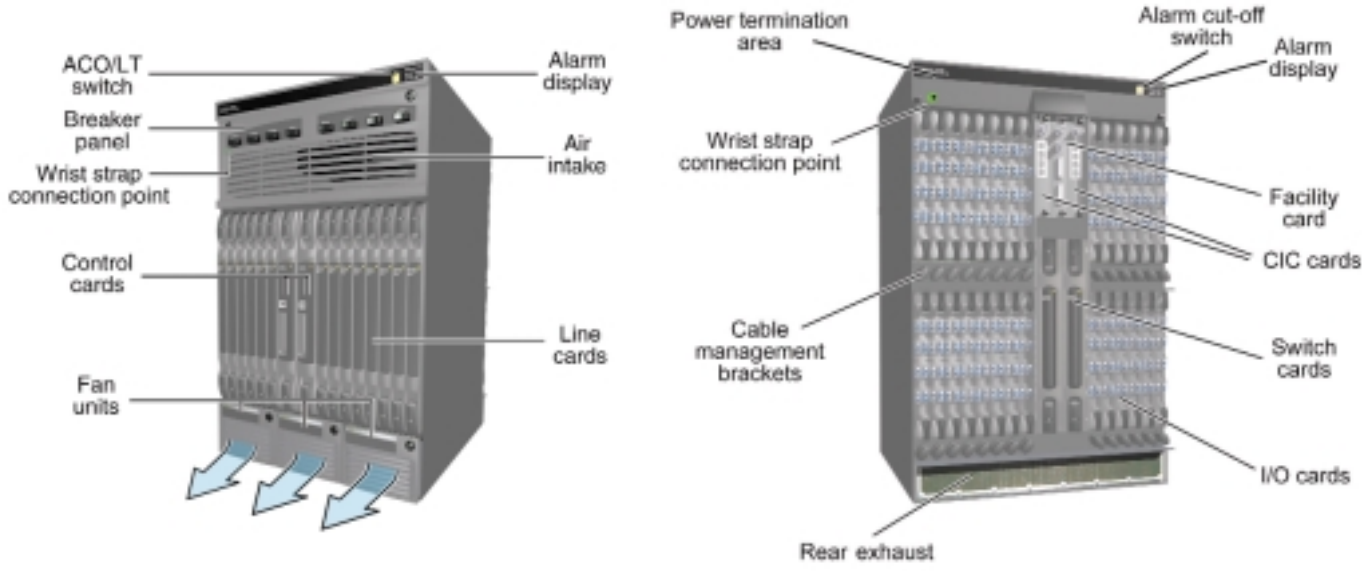
- The chassis
- A redundant pair of control cards that perform system control, call processing and routing functions
- A redundant pair of control interconnect cards (CICs), which are located on the rear of the midplane and are used to provide external connection to the control fabric
- The Facilities card (FAC), which acts as an interface to the Control cards. The FAC is used by the active control card and is installed on the back of the Alcatel 7670 RSP. The FAC comes in two variants: international and North American. The international variant has two BNC connectors for clock inputs of 2 Mb/s. The North American variant has two sets of three wire-wrap posts for BITS clock inputs.
- The switching fabric is formed by a pair of redundant 56 Gb/s switching cards installed on the rear of the midplane

Up to 14 line processing cards can be installed in the front of the shelf. These can optionally be arranged as either standalone or 1+1 protected pairs using APS.

External connection to the line processing cards is achieved through I/O cards, which are installed as required on the rear of the midplane. A wide range of I/O cards is available, offering a variety of connectivity options.

Table 2 on Page 17 shows the line cards and type of I/O that the PS supports. The number inside the table indicates the amount of I/Os that can be install for each specific card.

Figure 13: Card Distribution on the Standalone PS



Edge services extender (ESE) shelf

The ESE is a 19-inch, single shelf system. A standalone unit can be mounted in a standard 19-inch shelf or a standard Telcordia-compliant, 23-inch shelf, using adapter brackets. The unit can be front- or mid-mounted.

The shelf encloses the interface cards and the backplane. The shelf provides 2.4 Gb/s switching matrix, 14 slots—two for redundant to ESE control complex cards (ECCs) with optional OC-12/STM-4 line modules and 12 for interface cards and any applicable adapter cards. The backplane provides the connectors for the interface and adapter cards when required.

The ESE may be deployed as a single shelf, 2.4 Gb/s edge switch providing multiservice adaptation, aggregation, switching and service definition over an OC-12/STM-4 line

Table 2: Line Cards and I/Os Supported by the PS

I/O Type	Card Type	Multi-Rate 8	Multi-Rate 16	OC-48c/STM-16	OC-48/STM-16	GigE
		IP/ATM	ATM	ATM	POS	
Optical	4-port OC-3c/STM-1	2	-	-	-	-
	8-port OC-3c/STM-1	-	2	-	-	-
	1-port OC-12c/STM-4	1	-	-	-	-
	2-port OC-12c/STM-4	-	2	-	-	-
	1-port OC-48c/STM-16	-	-	1	1	-
	2-port GigE	-	-	-	-	2
Electrical	4-port STM-1	2	-	-	-	-
	8-port STM-1	-	2	-	-	-
	8-port DS3	-	2	-	-	-

module or OC-3/STM-1 line cards. This allows service providers, where appropriate, to begin an Alcatel 7670 RSP deployment at the network edge, then expand to an integrated core/edge routing switch platform as traffic capacity increases and/or existing core elements are capped/replaced due to end-of-life management initiatives.

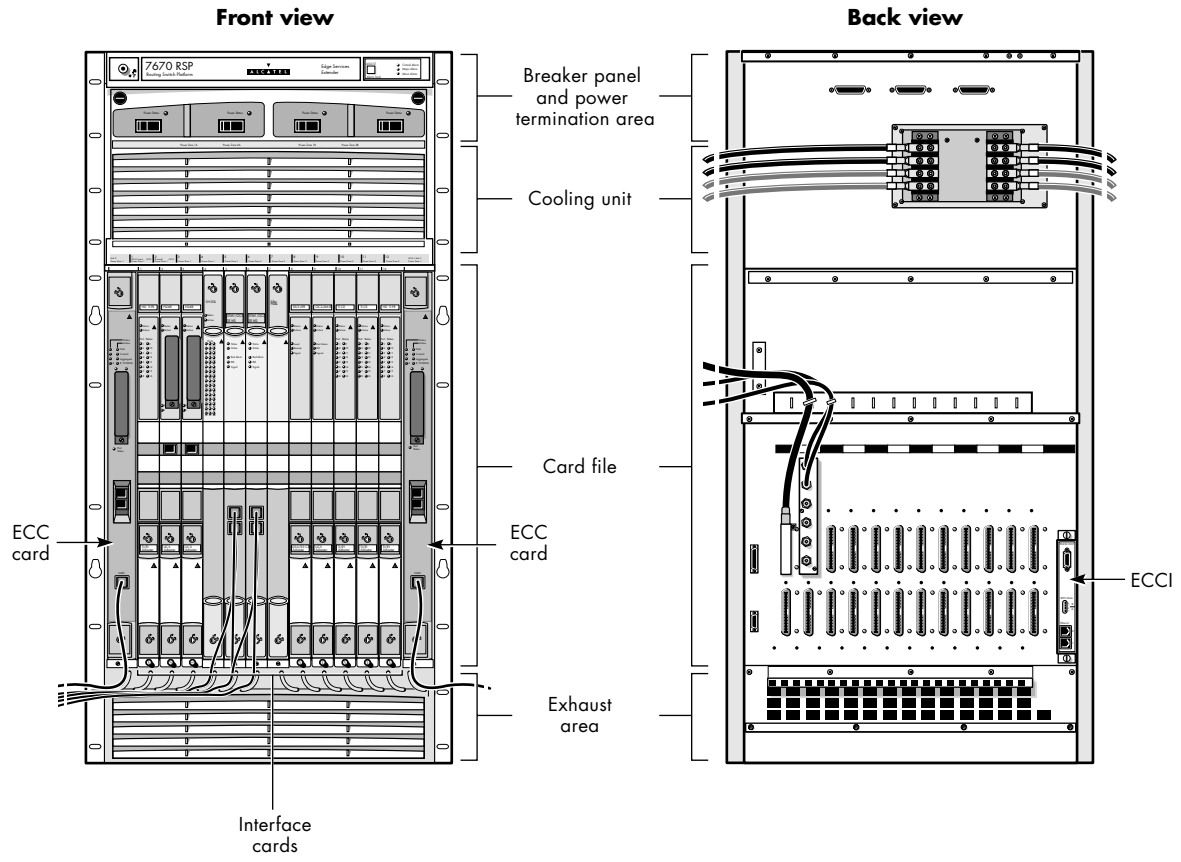
The ESE could be subtended from the Alcatel 7670 RSP PS using the ESE integrated OC-12/STM-4 interface and a multiport OC-12/STM-4 interface card in the PS. This open interface allows high levels of deployment flexibility. For example, the ESE can be physically colocated in the same rack as the PS, at the opposite end of the central office or in an entirely different central office using interoffice facilities for interconnection.

The design of an ESE allows service providers to quickly deploy the system in the configurations and environments that best meet their service deployment requirements. The main components of the system are:

- ESE
- ECC card
- Interface cards and modules:
  - High speed ATM aggregate line module for ECC cards
  - ATM, frame relay, circuit emulation (CE)/voice, IP/Ethernet, DSL
  - Public switched telephone network (PSTN) trunk interfaces
- Resource cards:
  - IP services card

Figure 14 shows the front and back of an ESE.

Figure 14: Alcatel 7670 RSP with ESE Shelf



Edge services extender control complex (ECC) card

The ECC card depicted in Figure 15 integrates system control, switching fabric, call control, call processing, PNNI, data spooling (for billing data or endpoint statistics), and OC-12/STM-4 line module functions on one full-height card. The line module interface is provided through an optional hardware module. The data spooling function is also available as an upgrade kit for an ECC purchased without integrated data spooling.

The node control portion of the ECC provides local and remote control of the system. This function controls all the cards in the system, maintains the configuration and connection database for the node, and collects and reports statistics. It also provides the following management functions:

- Node management terminal support
- Network management system support
- Configuration and connection management
- Network synchronization
- Alarm consolidation
- Statistics collection and reporting
- Nonvolatile configuration database
- Maintenance and diagnostic support

The switching fabric of the ECC provides multiplexing and switching functions for the node with a total switching capacity of 2.4 Gb/s in the current release.

ECC modules

As shown in Figure 15, optional OC-12/STM-4 cell relay modules are available for the ECC card. The aggregate module supports a transmission rate of 622.08 Mb/s, can be configured for SONET or SDH, and supported 1+1 APS.

These modules are single port user network interface/network node interface (UNI/NNI) with each port supporting up to 64,000 connections. Because they are installed on the ECC cards, they do not consume a universal card slot (UCS).

Three types of modules are supported:

- Short reach – multimode fiber (MMF)
- Intermediate reach – single mode fiber (SMF)
- Long reach – SMF

All modules use optical snap connection (SC) connectors.

Figure 15: Edge Services Extender Control Complex Card

Control card interconnect panel (CCIP)

The ESE platform integrates the CCIP function into the shelf. This assembly is called the ESE control complex interconnect (ECCI). The ECCI supports the following connection to the control cards:

- External timing inputs
  - input ports allow the SSU-2 to synchronize the node
- External timing outputs (European variant only)
  - output ports can be connected to the input ports on the ECCI of a second node, enabling both nodes to synchronize to the same clock
- Ethernet (10Base-T) interfaces to the active and inactive ECC cards
- A TIA/EIA-232 node management interface to the active ECC card

ESE interfaces

Multiservice (MS) interfaces:

- STM-1/OC-3 multiservice (CE) card
- STM-1/OC-3 multiservice (cell relay – CR) card
  - CR/IMA module – optional module enabling T1/E1 CR service delivery

ATM – Cell Relay interfaces:

- OC-12/STM-4 CR module
- OC-3-2M and STM-1-2M CR cards and optional eTM module
- 8-port DS3 card and optional eTM module
- 3-port DS3 and E3 CR cards and optional eTM module
- 8-port T1 and E1 CR cards and optional IMA module
- 4-port OC-3/STM-1 cards

Frame relay interfaces:

- 16-port T1 and E1 FR cards
- 1-port DS3 CFR cards
- 1-port DS3 and E3 UFR cards

Circuit emulation interfaces and voice services:

- STM-1/OC-3 multiservice (CE) card
- A2G (AAL2) cards
- 8-port T1 and E1 CE cards and optional echo cancellation modules
- 3-port DS3 and E3 channelized CE cards

DSL interfaces:

- 48-port g.SHDSL card

IP and Ethernet services:

- 4-port 10/100Base-T Ethernet card

Multishelf Configuration

The single shelf configuration of the Alcatel 7670 RSP can be migrated, while in service, to a multishelf configuration, thereby providing unrivalled scalability without loss of investment.

The Alcatel 7670 RSP multishelf system consists of:

- Two switching shelves (1+1 redundant mode)
- A control complex located in the peripheral shelf 1 (PS1), and up to 15 peripheral shelves
- HSPSs
- ESE shelves, which are subtended from the PSs

Switching shelf (SS)

The switching shelf, illustrated in Figure 16 on Page 21, is a self-contained 450 Gb/s (bidirectional) switching fabric. To eliminate failures due to single faults, the switching shelf is duplicated in a 1+1 redundant manner.

The switching shelf provides up to 450 Gb/s of switching capacity or 320 Gb/s user bandwidth of nonblocking cell-based switching fabric capacity. Switching shelves are deployed in pairs to provide a 1+1 fabric redundancy model. The redundant switching shelves are referred to as Switching Shelf X and Switching Shelf Y.

Nonredundant fabric configuration is not supported. All single fault conditions are covered and protected with this model. The fabric redundancy scheme also allows for future in-service fabric upgrades.

The switching shelves provide the cell switching capacity for the system. Each switching shelf contains a switching fabric core and 32 switching access cards (SACs).

SACs provide bidirectional switch access at approximately 14.4 Gb/s (25M cell per second) or 10Gb/s user bandwidth. Up to 32 SACs are provisioned per shelf, depending on the number of peripheral shelves, PSs or HSPSs, in place.

Each switching shelf houses six switching matrix cards (SMX). This set of six SMX cards constitutes the nonblocking 32 x 32 HISL core of the switching fabric.

The switching scheduler card (SCH) provides the overall centralized arbitration functions for the entire switching shelf.

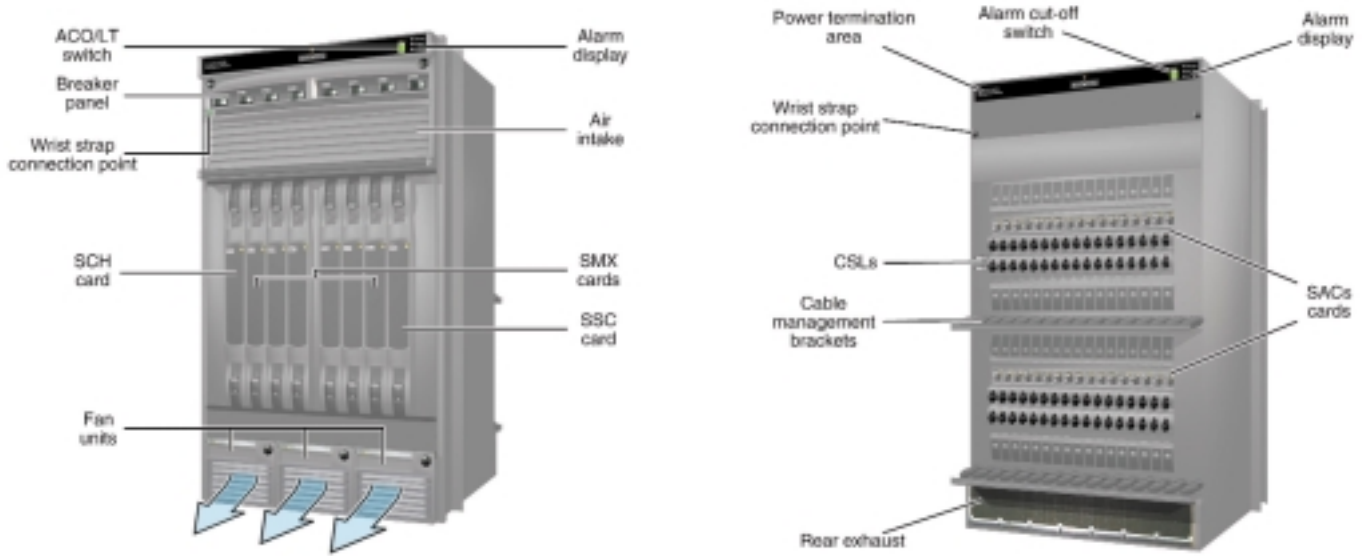
The switching shelf controller (SSC) card provides the housekeeping functions for the entire switching shelf. The SSC is a centralized entity and is responsible for configuring, monitoring, and maintaining all elements within the switching shelf.

The redundant switching shelves connect to all PS and HSPS, in the system via the fabric interface cards (FICs), to provide cell switching to the line cards.

In the case of the HSPS, each line card communicates with the fabric over two high speed fabric interface cards (HFICs). In the PS, each line card communicates with the fabric over two peripheral fabric interface cards (PFICs). In both shelves types, one of the two FICs connects to a SAC card in Switching Shelf X and the other FIC connects to a SAC card in Switching Shelf Y.

The link between a FIC card (HFIC or PFIC) and a SAC card is called a high speed intershelf link (HISL) and carries 14.4 Gb/s of cell switched data path traffic per HISL. The SMXs, the SACs, the HISLs, and the FICs create the switching fabric

Figure 16: Alcatel 7670 RSP Switching Shelf



or data plane. Figure 17 shows the full data plane through the switching fabric, as well as the protection mechanism.

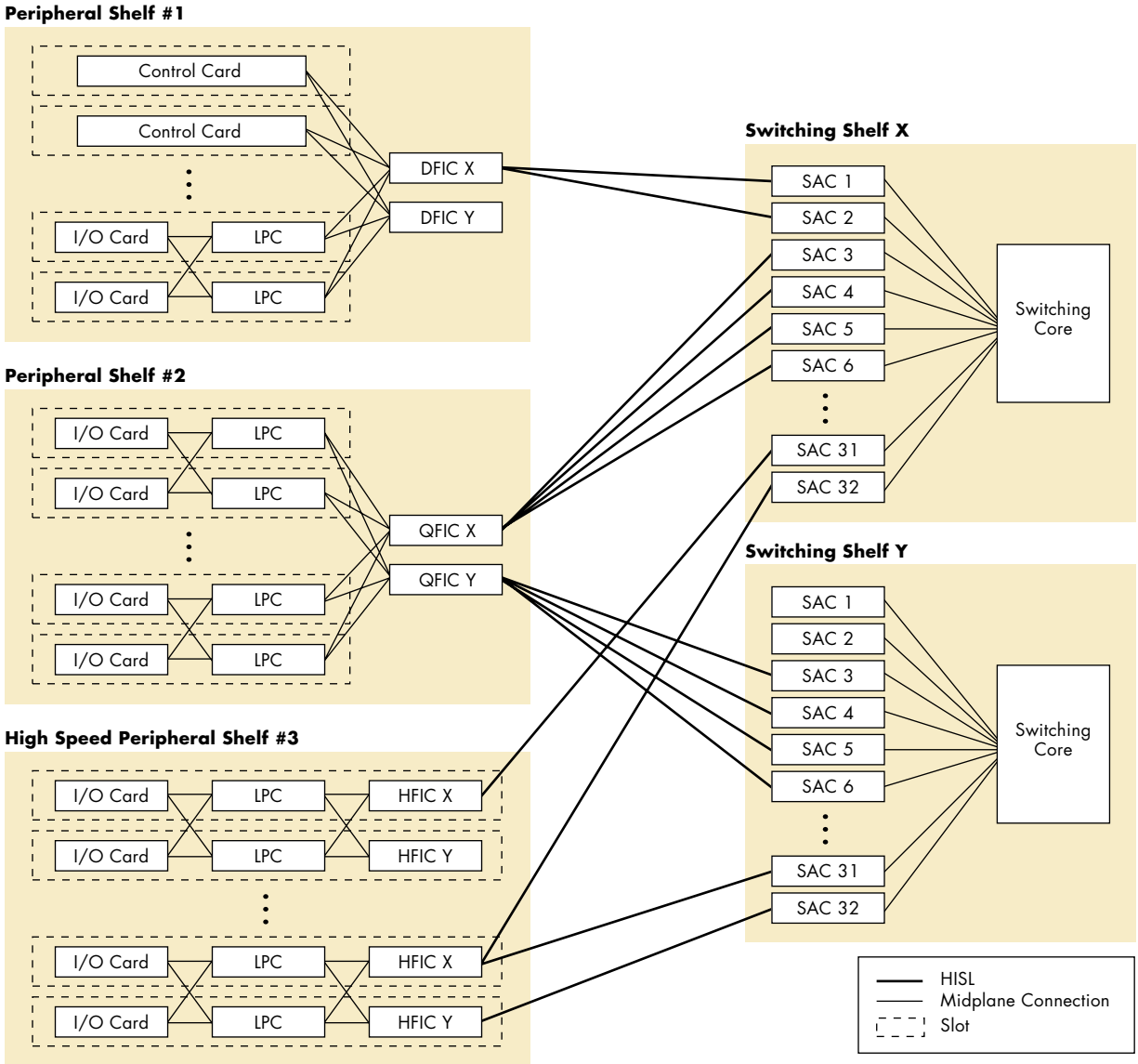
Peripheral shelf (PSn, 1<n<15)

The PS is the same shelf as used in the standalone configuration and supports the same types of line processing cards.

The first PS (PS1) includes a control complex, which uses the same control card, CICs and FAC, as the Alcatel 7670 RSP standalone system.

The control complex is a logical grouping of cards that provides the central management for the switch. The control

Figure 17: Alcatel 7670 Datapath Components



complex comprises the control card, the intershelf connection (ICON) card, the ICON I/O card, the CIC card and the FAC. Figure 18 illustrates the PS1 and the distribution of its elements.

The control complex is interconnected with all shelves in the system through the ICON infrastructure. This infrastructure provides an out-of-band network that allows the system to transfer control traffic without utilizing any bandwidth on the data path.

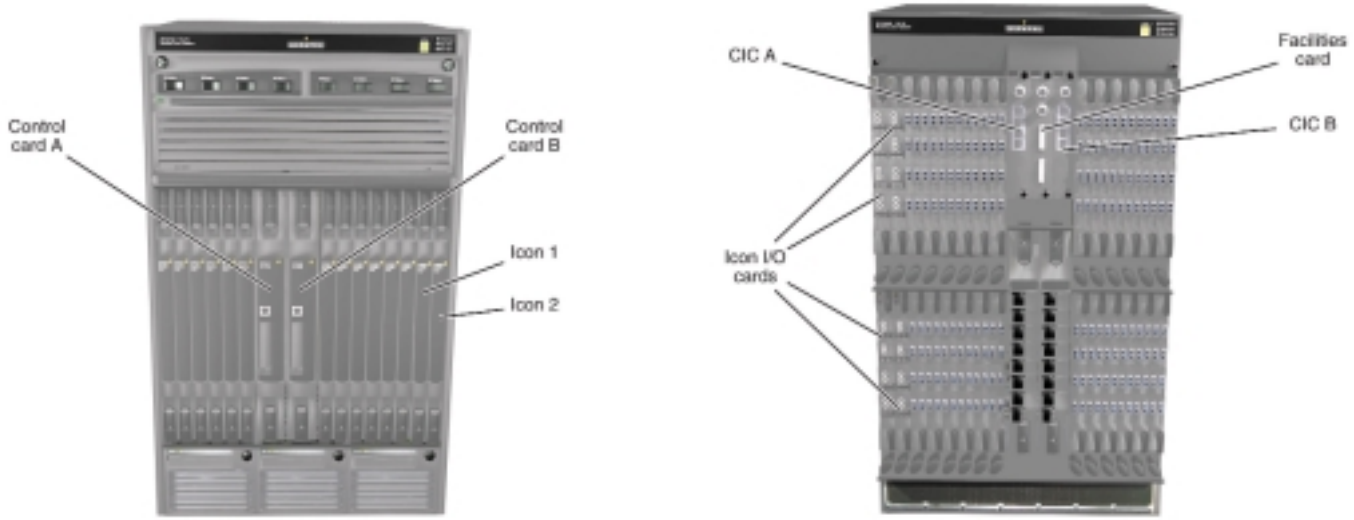
In PS1, the intershelf connection (ICON) cards are installed in Slots 13 and 14. These operate in a redundant manner and provide termination and switching of the control services link (CSL) infrastructure for all shelves in the multishelf system. Essentially, the CSL provides the communications link between the control complex in PS1 and the shelf controllers in the other system shelves, PSs or HSPSs, building in this way the control plane of the system. Physical connectivity between the ICON and CSL is through ICON I/O cards on the rear of the midplane. Figure 19 on Page 24 shows the control plane that interconnects the control complex and all other shelves, as well as the protection mechanism.

In the PS1 of a multishelf system, the slots that are normally occupied by the switching cards (SICs) in a standalone system are occupied by fabric interface cards (FICs). These provide the connectivity between the line interface cards and the switching fabric in the switching shelves over the high speed intershelf links. Two types of FICs are supported: dual (DFIC), which supports two HISLs, and quad (QFIC), which supports four.

The type of FIC deployed depends on the level of redundancy provisioned on the line processing cards (LPCs). Dual FICs carry two 14 Gb/s HISLs, and therefore carry 28 Gb/s of traffic. A dual FIC can be used if the peripheral shelf has no more than seven working line processing cards thus intended for applications where line card APS protection and redundancy are used; otherwise, the quad FIC must be used for a total of 56 Gb/s.

Peripheral shelves other than PS1 do not have a control complex. Instead, the control card is substituted by a peripheral shelf controller (PSC), and the CIC is substituted by a peripheral interconnect card (PIC), as illustrated below. The PIC provides CSL connectivity to PS1. Figure 20 on Page 25 shows PSs 2 to 15.

Figure 18: Alcatel 7670 RSP Peripheral Shelf 1



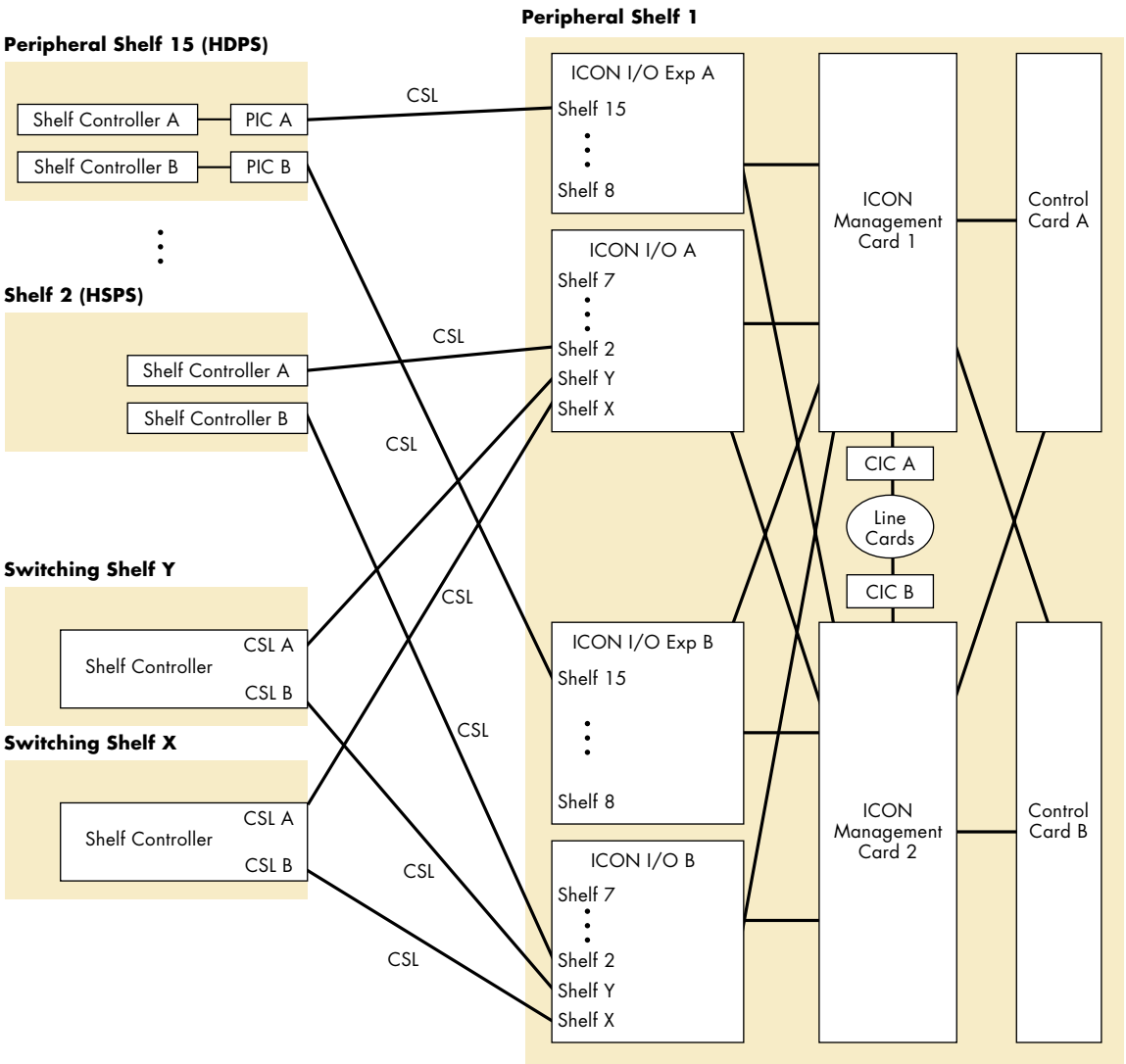
ICON cards are not used in these peripheral shelves, therefore slots 13 and 14 are free to be used by line cards. FAC cards are still required to provide alarm output signals, but the FAC TIA/EIA-232 port and external sync inputs are not used on these shelves. They are only used on the PS1 FAC.

ESE shelf

The ESE may be subtended from the Alcatel 7670 RSP PS via the ESE's integrated OC-12/STM-4 interface and connected to a multiport OC-12/STM-4 interface card on the PS. This open interface allows high levels of deployment flexibility. For example, the ESE can be physically colocated in the same rack as the peripheral shelf, at a central office or in an entirely different central office using interoffice facilities for interconnection between the shelves.

This allows service providers, where appropriate, to begin an Alcatel 7670 RSP deployment at the network edge then

Figure 19: Alcatel 7670 RSP Central Plane Components



expand to an integrated core/edge routing switch platform as traffic capacity increases and/or existing core elements are capped/replaced due to end-of-life management initiatives.

For more details on the ESE please refer to Standalone Configurations in this document.

High speed peripheral shelf (HSPS)

The HSPS introduced in Release 2.0 supports quad OC-48c/STM-16 ATM line interface card types. The HSPS, illustrated in Figure 21, is built around the concept of multiple field replaceable subshelves, for greater reliability, availability and serviceability (RAS) capabilities.

Figure 20: Alcatel 7670 RSP Peripheral Shelves 2-15

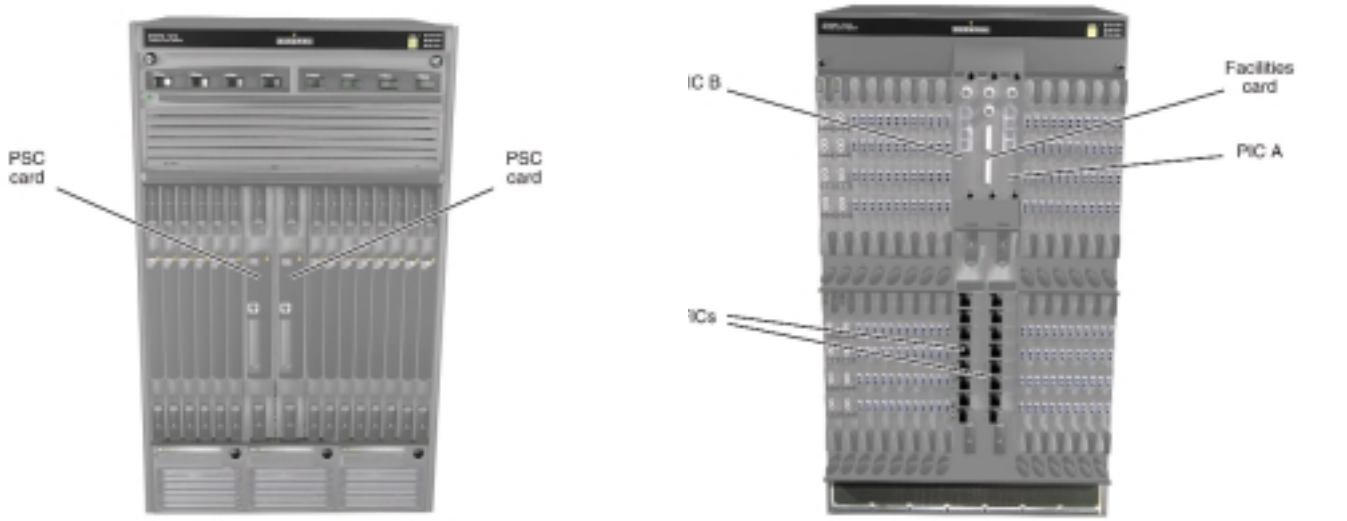
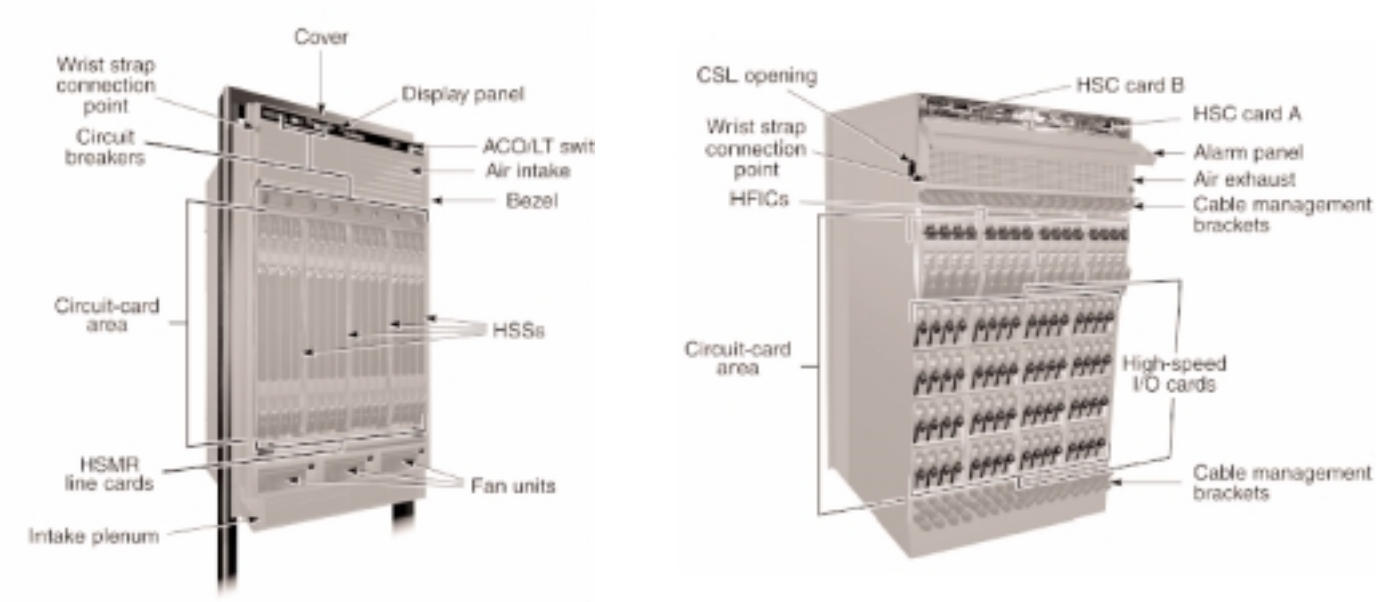


Figure 21: Front Layout of the HSPS



Each HSPS can house up to four high speed subshelves (HSS), resulting in a maximum of 16 line card slots per HSPS. In conjunction with the HSS, the HSPS serves as the housing for the high speed line cards.

Connection to the switching shelf takes place via the HISLs, which are terminated on the HFIC. The CSLs from the PS1 control complex are terminated on the high speed control card (HSC).

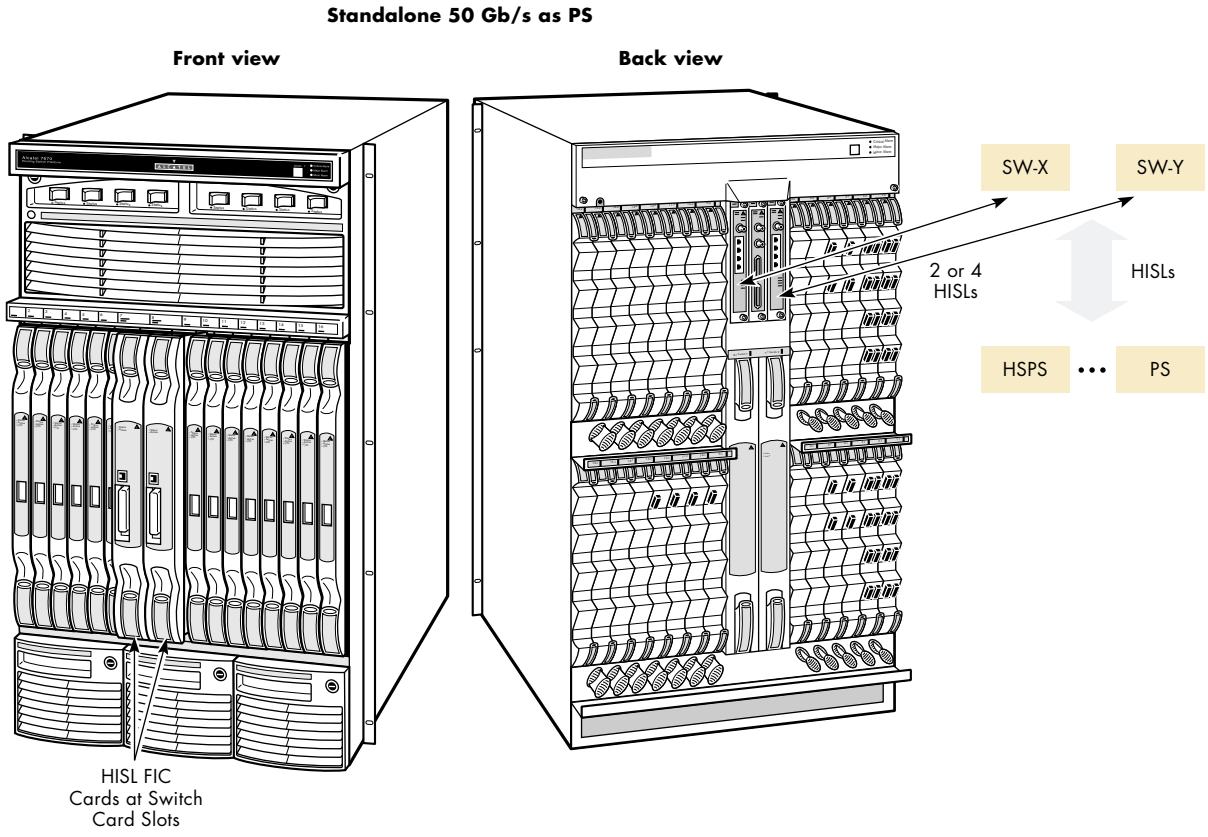
Upgrading from single shelf to multishelf configuration

An Alcatel 7670 RSP single shelf configuration can be upgraded to a multishelf configuration while in service. Essentially, the upgrade is performed by replacing the redundant switching card with a FIC, connecting this to the SS, performing a fabric switchover, then replacing the now-redundant switching card with a FIC that is connected to the redundant SS. The single shelf now becomes PS1 of a multishelf system. This is depicted in Figure 22.

Quad or dual FICs are used depending on the number of protection and working line processing cards present in Peripheral Shelf 1. Dual FICs carry two 14 Gb/s HISLs, and therefore carry 28 Gb/s of traffic. A dual FIC can be used if the PS has no more than seven working line processing cards; otherwise, the quad FIC must be used.

From this point, further PSs and/or HSPSs can be added.

Figure 22: Upgrade of Single Shelf System to Multishelf System



IP/MPLS on the Alcatel 7670 RSP

The Alcatel 7670 RSP supports both MPLS and native IP forwarding. With the Alcatel 7670 RSP, Alcatel combines its expertise in carrier grade switching with state-of-the-art IP routing technologies to create the ultimate IP/MPLS solution for next generation networks.

The Alcatel 7670 RSP leverages its separate data plane and control plane architecture by separating routing and forwarding functions. This separation provides more robust forwarding. The control card maintains routing adjacencies, calculates the IP forwarding table, and downloads the IP forwarding table to the line cards that support forwarding directly. The line cards use information from the IP forwarding table to select traffic for forwarding. In addition to supporting both IP and non-IP forwarding line cards, the Alcatel 7670 RSP supports MPLS LERs and LSPs on all line cards. In doing so, the Alcatel 7670 RSP supports LSR functions at OC-3/STM-1, OC-12/STM-4, and OC-48/STM-16 line rates. The Alcatel 7670 RSP can route IP packets over:

- MPLS LSPs through a traffic filter
- Native IP traffic through hop-by-hop routing

Native IP interfaces can be configured on line cards that support IP forwarding (MR-8, GigE and POS).

The Alcatel 7670 RSP can be configured as an LER or LSR. The Alcatel 7670 RSP supports LER functionality on all IP forwarding-capable line cards. Both label switching controlled interfaces (LC-ATM) and generic labels are supported. For a list of the line card that support native IP/MPLS traffic see the Architecture section in this document.

The Alcatel 7670 RSP leverages the similarities between ATM and MPLS through the network core to function as a high performance LER and LSR with QoS, across both ATM and IP interfaces.

As a core LSR, the Alcatel 7670 RSP participates in the IP routing control plane and becomes a true IP routing peer, transforming the IP network from a transparent overlay into a converged Layer 2 and 3 network. The Alcatel 7670 RSP supports core LSR functionality on all line cards.

MPLS data and signaling planes

On the Alcatel 7670 RSP, LSPs carrying labeled packets from the MPLS data plane. Each LSP has an associated IP destination prefix, which defines the subset of IP packets to be put on the LSP. The Alcatel 7670 RSP supports two types of LSPs:

- **Permanent LSP (P-LSP):** static LSP established by cross-connections at each node in the path.
- **Switched LSP (S-LSP):** dynamic LSP established by a signaling protocol such as label distribution protocol (LDP), RSVP-TE or CR-LDP

The MPLS signaling plane is used by the LDP to establish an LSP in the data plane. The Alcatel 7670 RSP supports the following signaling protocols:

- LDP
- RSVP-TE
- CR-LDP

RSVP-TE enables RSVP to be used in MPLS to create LSPs. RSVP-TE is an alternative to CR-LDP in an MPLS network.

CR-LDP is based on LDP, the original label distribution protocol used to create an LSP on a hop-by-hop basis with best effort service. A best effort LSP that is routed hop-by-hop is called a generic LSP.

CR-LDP extends LDP to provide constraint-based routing. Constraint-based routing extends the LSP setup information to explicit route and QoS constraints. CR-LDP enables IP traffic engineering and QoS services in the network. It includes support for OSPF-TE, IS-IS-TE and BGP.

The Alcatel 7670 RSP also supports RSVP-TE and CR-LDP with resource reservation. Support of these protocols allows network operators to create LSPs with guaranteed resources through the network to meet QoS requirements.

IP data plane and routing support

The Alcatel 7670 RSP IP data plane supports IP forwarding, to Internet control message protocol (ICMP), IP CoS, differentiated services (DiffServ) and IP fragmentation.

With IP forwarding, IP packets received at one interface are forwarded to another interface based on the packet's destination IP address and the IP forwarding table created through routing protocols. The Alcatel 7670 RSP supports IP forwarding on the Multi-Rate 8 (OC-3/ STM-1, OC-12/STM-4) ATM/IP, Multi-Rate 16 POS (OC-48/STM-16), and Quad GigE cards.

ICMP provides a mechanism that IP routers and hosts can use to communicate any control or error information. The Alcatel 7670 RSP uses ICMP extensively to report problems and test destination reachability.

With IP CoS, service providers can offer differentiated services to their customers. IP packets arriving from an interface are classified according to the DSCP field in the header and are mapped to one of the classes according to a user-configurable DiffServ profile. The Alcatel 7670 RSP supports eight configurable IP CoS.

DiffServ defines an architecture for implementing scalable service differentiation in the Internet. DiffServ gives service providers the ability to mark individual packets and act on them according to their marking. DiffServ can be used to aggregate the QoS properties of a large number of individual microflows into a conceptual macroflow or per-hop behavior.

When an IP packet traverses a link that has a maximum transfer unit (MTU) smaller than the size of the packet, the packet must be fragmented. The Alcatel 7670 RSP fragments IP packets when it forwards packets that are larger than the MTU configured on the egress interface.

IP routing support underpins the MPLS capability of the Alcatel 7670 RSP. The following is an abstract of the routing implementation on the Alcatel 7670 RSP:

- **Static routing:** Allows the Alcatel 7670 RSP to reach networks that were not discovered from dynamic routing protocols. The Alcatel 7670 RSP can also use static routes to override routes learned through dynamic routing protocols. The Alcatel 7670 RSP supports static routes with configurable administrative distances and weights.
- **Default routing:** Allows the Alcatel 7670 RSP to reduce the number of routes that need to be advertised in a network. Packets are only forwarded along a default route when a more specific route is not available in the forwarding table.
- **BGP-4:** By supporting BGP-4, the Alcatel 7670 RSP can be deployed as an autonomous system border router in the public Internet. The Alcatel 7670 RSP can run BGP-4 as either the interior border gateway protocol (IBGP) or exterior border gateway protocol (EBGP), depending on whether or not the peering router is in the same autonomous system.
- **OSPFv2:** Dynamic interior gateway protocol (IGP) deployed within an autonomous system. By supporting OSPFv2, the Alcatel 7670 RSP can be deployed inside an autonomous system as one of the following, an internal router, an area border router on an autonomous system border router, a backbone router.
- **IS-IS**: Integrated IS-IS is used to exchange IP routing information between the Alcatel 7670 RSP and other IP routers within an autonomous system.

Non-stop routing

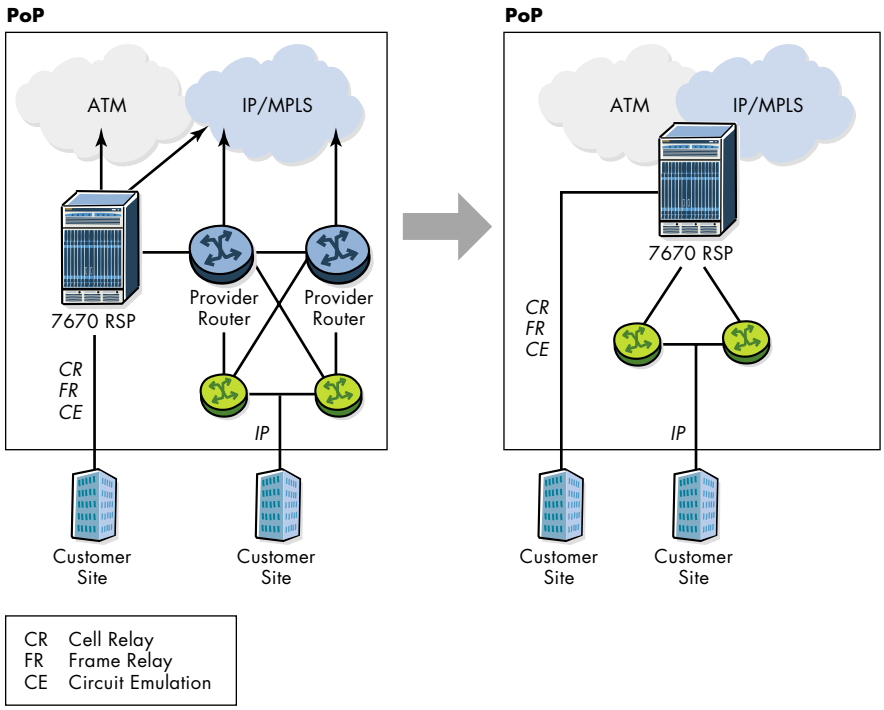
The Alcatel 7670 RSP non-stop routing capability supports hot redundant BGP, OSPF and IS-IS routing protocols, based on the high availability Alcatel Carrier Environment Internet System (ACEIS) breakthrough technology. These hot redundancy capabilities are key requirements for carrier class IP networks.

Routers used in a typical IP network today do not have the ability to continue updating the routing database and forwarding packets when a route-processing engine experiences a failure. For this reason, most current network implementations rely on a dual node architecture to provide the required redundancy and network reliability.

Non-stop routing builds on the Alcatel 7670 RSP's system architecture, which separates routing and forwarding functions, and improves the reliability of the IP network. Separating the forwarding engine from the routing engine dramatically improves the robustness of the router architecture. A hot redundant routing plane eliminates the need for routing reconvergence, since the routing database is not affected in a failure condition. The recovery time from a failure of the route-processing engine is improved from minutes to milliseconds thus ensuring that no data session interruptions occur and that TCP session state and routing update messages are maintained.

Using the Alcatel 7670 RSP with non-stop routing offers CAPEX and OPEX advantages over that of a dual node architecture. The new model requires fewer routers, interfaces and IP addresses and, therefore, has fewer points of failure.

Figure 23: Alcatel 7670 RSP Non-Stop Routing



Class of service (CoS)

The Alcatel 7670 RSP classifies IP packets into a CoS when received by the ingress line card. Up to eight CoSs can be supported and configured. These are identified as “CoS 1” to “CoS 8”. The Alcatel 7670 RSP allows users to configure the relative priorities in queue scheduling between CoS 1 and CoS 8 when forwarding IP packets.

Differentiated services (DiffServ)

The Alcatel 7670 can be deployed as a DiffServ intermediate node inside a DiffServ domain where all IP packets have been marked by a DiffServ border node. The following DiffServ components are supported:

- Classifier/per-hop behavior
- Traffic metering
- Shaper

ATM on the Alcatel 7670 RSP

The Alcatel RSP uses its switching architecture for routing and switching. The switching architecture uses ATM virtual connections, including LSPs and Layer 3 interfaces. The Alcatel 7670 RSP uses system cards to switch traffic.

The control card passes information needed for cross-connections to the line cards. After the Alcatel 7670 RSP starts receiving ATM cells or IP-over-ATM cells, the I/O cards send the cells to the ingress line cards. The line cards add a temporary header with cross-connection information to each cell and send the cells to the switch cards.

The egress line cards examine the header of each cell at the egress point of the switching fabric, select cells based on the cross-connection information in the header, remove the header, and send the cells to their I/O cards. The I/O cards transmit the cells over the appropriate interface to the network.

Cross-connections

An ATM VC provides the information needed for the Alcatel 7670 RSP to establish a cross-connection between an ingress point and an egress point of the node. There are three types of VCs, each set up differently:

- Switched VCs (SVC)
- Switched permanent VCs (SPVC)
- Permanent VCs (PVC)

SVCs

An SVC is an ATM virtual connection set up automatically by the switch in response to information sent by the originating device over an SVC infrastructure that exists between all the devices. The SVC infrastructure includes path determination and signaling to establish the connection. Path determination may be configured manually as static or as dynamic using PNNI.

The Alcatel 7670 RSP supports static and PNNI routing, to integrated local management interface (ILMI) links, signaling links, call processing, SVC accounting, and usage records for point-to-point and point-to-multipoint SVCs at the VP and VC levels. The following signaling protocols are supported:

- ATM Forum UNI 3.1 and 4.0
- ATM Forum IISP 1.0
- ATM Forum PNNI 1.0
- ITU-T Q.2931
- AINI*
- AINI
- ILMI 4.0

The Alcatel 7670 RSP supports native ATM addresses and International E.164 and X.121 addresses encoded in an ATM end system address (AESA).

SPVCs

An SPVC is an ATM virtual connection that combines the path endpoint characteristics of PVCs with network path characteristics of SVCs. The path endpoints are configured by an operator. The path through the network is set up automatically by the switches in response to information sent over an SVC infrastructure that exists between the supporting devices. The Alcatel 7670 RSP supports static routing, PNNI routing, and signaling links for point-to-point SPVCs at the virtual path (VP) and VC levels.

SPVCs benefit network operators by providing easily provisioned, scalable, standards-compliant permanent virtual circuits in ATM networks. Because the control plane manages the node-by-node establishment and re-establishment of the connection through the network, interoperability between nodes from different vendors is easier to achieve. Because connection management is performed by the nodes, SPVCs make it is easier to initiate reroute and recovery actions in the event of a network failure.

PVCs

PVC is an ATM virtual connection set up by an operator. The operator sets up the PVC through a network management system or through a CLI session at each device along the PVC. The Alcatel 7670 RSP supports point-to-point and point-to-multipoint PVCs at the VP and VC levels.

PNNI hierarchy

The PNNI routing protocol can organize and distribute network topology information hierarchically. PNNI hierarchy is vital for network operators who are considering deploying PNNI in their networks. From the hierarchical topology information, network nodes create routing tables that switch SVC calls using PNNI signaling. PNNI hierarchy enables the Alcatel 7670 RSP and the rest of the 7_70 portfolio to inter-operate in mixed-vendor networks that use PNNI hierarchy.

The Alcatel 7670 RSP supports three levels of hierarchy and up to 66 nodes per level. The Alcatel 7670 RSP conforms to ATM Forum PNNI version 1.0.

Standardized AINI support

The Alcatel 7670 RSP is fully compliant with the ATM Forum Advanced Intelligent Network Interface (AINI) standard, as specified in af-cs-0125.000. This feature makes the Alcatel 7670 RSP interoperable with AINI-based networks and environments of other vendors.

Path and connection trace

The Alcatel 7670 RSP supports standards-based path trace and connection trace to:

- Determine the network path taken by SPVCs and SVCs
- Diagnose problems with SPVCs and SVCs

Path trace diagnoses problems with call set-up and examines the routing paths of calls that are in the process of being established. Connection trace determines the current path of an existing call in the network. Connection trace allows network operators to determine suboptimal paths that should be rerouted. PNNI signaling messages use path trace and connection trace to record PNNI logical nodes, PNNI logical ports, and other requested information. The Alcatel 7670 RSP uses path trace and connection trace across multiple-vendor networks that support standards-based tracing.

Traffic management capabilities

The Alcatel 7670 RSP uses industry-leading traffic management processes to ensure maximum efficiency and bandwidth use. The advanced traffic management of the Alcatel 7670 RSP provides absolute guaranteed QoS for all service categories.

Traffic management is part of the traffic flow architecture of the Alcatel 7670 RSP. The ingress line cards use traffic management before passing traffic to the switching fabric. The egress line cards use traffic management after receiving traffic from the switching fabric. The ingress line cards effectively manage traffic by using back-pressure information from the fabric and egress line cards. Figure 24 shows the traffic flow architecture.

With virtual queuing, the Alcatel 7670 RSP can resolve traffic congestion at isolated points within the switch while continuing to process traffic from uncongested points.

The major components of traffic management are:

- Network congestion management
- Service categories
- QoS parameters
- Connection admission control (CAC)
- Traffic policing and shaping
- Congestion control
- VP aggregation shaping

Network congestion management

Traffic management processes prevent network congestion on shared network devices and transmission links. Network congestion created by some traffic can cause other traffic to experience unacceptable loss or delays. Traffic management guarantees a QoS level and fairness for all connections. The Alcatel 7670 RSP uses ATM traffic management for IP over ATM virtual connections and ATM virtual connections at the ingress and egress points of the node.

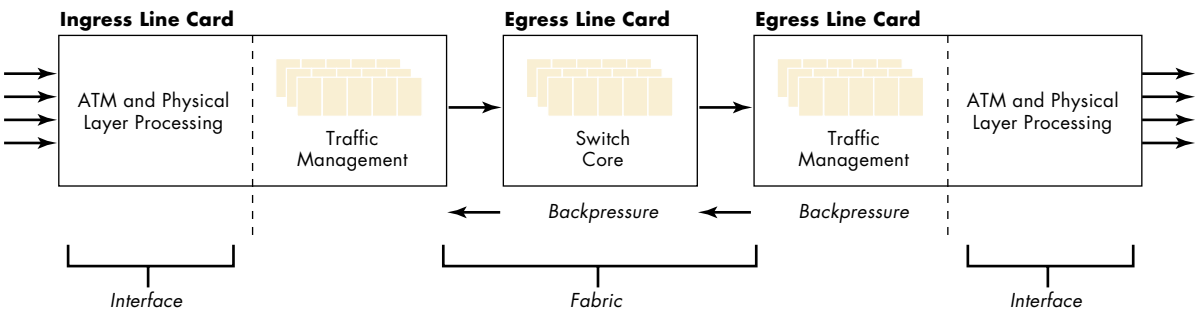
ATM traffic management of virtual connections:

- Monitors and controls traffic flow
- Ensures an appropriate and fair allocation of resources
- Handles traffic that exceeds the configured limits

Service categories

Service categories ensure an appropriate and fair allocation of resources by providing the means to determine the priority that a connection receives when requesting network bandwidth. The Alcatel 7670 RSP supports the TM4.1 standard, which identifies five service categories, each optimized for a different type of traffic. The Alcatel 7670 RSP uses the service category assigned to the connection when it sets up the connection. This process ensures that each connection receives the resources appropriate for its traffic. Table 3 lists the service categories and their characteristics.

Figure 24: Traffic Flow Architecture



QoS parameters

QoS is a set of parameters and their values that determine the performance of a connection. QoS parameters allow service differentiation in each service category. The QoS parameters supported by the Alcatel 7670 RSP are:

- Cell loss ratio (CLR)
- Cell delay variation (CDV)
- Cell transfer delay (CTD)

The Alcatel 7670 RSP provides traffic descriptors that allow configuration of the peak information rate (PIR), sustained information rate (SIR) and minimum information rate (MIR).

The Alcatel 7670 RSP supports a configurable maximum burst rate (MBS). The larger the MBS value, the less concentrated the SIR traffic policing. MBS is used for CAC and traffic policing functions.

CAC

CAC is an algorithm that evaluates whether the Alcatel 7670 RSP can accept a new connection without affecting the service objectives of existing connections.

CAC examines the shared resources of the Alcatel 7670 RSP, such as the number of existing virtual connections, available bandwidth, and available buffers. CAC also examines the resource requirements of the proposed connection. The proposed connection is accepted by CAC if the Alcatel 7670 RSP has the resources to accommodate it and its projected requirements without hindering QoS guarantees for existing connections.

Disabling capacity checking or increasing the booking factor allows CAC to be configured to accept proposed connections that would otherwise not be admitted. The booking factor is a value that determines the degree to which CAC accepts or rejects proposed connections.

Table 3: Service Categories and their Characteristics

Service category	Cell switching priority	Bit rate	Typical traffic type	Delay sensitivity	Cell loss sensitivity
Constant bit rate (CBR)	High	Constant	Mission-critical data	Yes	High
			Interactive multimedia		
Real time variable bit rate (rt-VBR)	High	Bursty	Mission-critical data	Yes	High
			Interactive video		
Non real-time variable bit rate (nrt-VBR)	Medium	Bursty	Mission-critical data	No	Medium
			LAN interconnect		
			Interworking		
Available bit rate (ABR)	Low	Bursty	LAN interconnect	No	Low to medium
			Interworking		
			IP services		
Unspecified bit rate (UBR)	Low	Bursty	IP services	No	Low
			LAN interconnect		

Traffic policing and shaping

Traffic policing ensures that the traffic on a virtual connection conforms to its traffic contract. The Alcatel 7670 RSP accepts conforming cells and discards or tags nonconforming cells. Tagged cells have a lower priority than accepted cells and may be discarded in the event of congestion.

Traffic shaping ensures that traffic exceeding the configured traffic policing rates is shaped so that it conforms to the traffic policing parameters for that connection. Traffic shaping is performed according to the traffic descriptors. At ingress points, shaping can allow the Alcatel 7670 RSP to accept nearly compliant traffic as compliant instead of discarding it. At egress points, shaping allows strict control of cell delay variation (CDV).

Congestion control

Congestion control in the Alcatel 7670 RSP reduces inefficient throughput caused by traffic congestion. The payload in an IP packet is often encapsulated into many ATM cells. During periods of congestion, some cells can be discarded, resulting in an incomplete IP packet at the destination and causing the destination to request the source to resend the entire packet.

The Alcatel 7670 RSP uses partial packet discard (PPD) or early packet discard (EPD) to reduce congestion throughput inefficiency.

VP aggregation shaping for CBR VPs

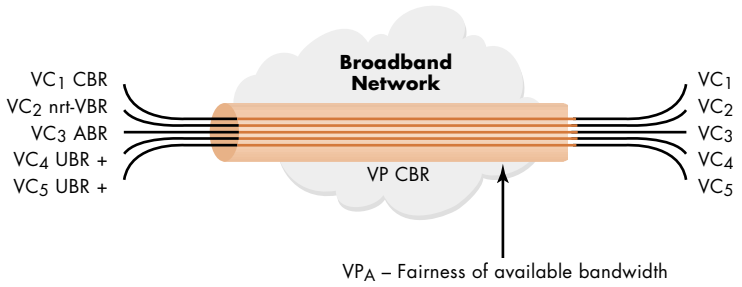
VP aggregation shaping is a commissioning capability that aggregates the traffic of multiple VCs onto the same VP and shapes the aggregated traffic on the egress port of a line card to a particular VP traffic descriptor.

With VP aggregation shaping, service providers can aggregate multiple VCs with different QoS onto the same VP while maintaining the QoS requirements for individual VCs. By shaping a single VP rather than many VCs, VP aggregation:

- Simplifies cross-connections through the network core
- Allows scaling of a network
- Increases network rerouting
- Allows more stringent SLAs to be offered

The Alcatel 7670 RSP supports VP aggregation shaping on PVCs, SVCs, and SPVCs. VP aggregation shaping supports point-to-point and point-to-multipoint connections.

Figure 25: VP Aggregation Shaping



www.alcatel.com

3CL 00469 0271 TQZZA Ed.02 17033

ARCHITECTS OF AN INTERNET WORLD