

RETHINKING THE IP CORE

ACHIEVING SCALE, EFFICIENCY
AND VERSATILITY IN SERVICE
PROVIDER CORE NETWORKS

POSITION PAPER



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INTRODUCTION

The Internet represents the ultimate platform for creativity and communication, and has become central to every aspect of our lives - at work, at home, and everywhere in between. Users expect more of what they assume is an always-on, omnipresent infrastructure, and their experiences are highly personalized, instantaneously shared and virtually stored for access by communities of interest whenever convenient. A proliferation of rich communication devices, combined with the appeal of video services and the power of the cloud to provide virtual storage and feed social networks, further catalyzes the next wave of transformation for the web.

As the commercial web turns 21 years old, the scope of user expectations continues to grow. In turn, the networks that comprise the Internet need to evolve as well, since they play a fundamental role in delivering the experiences that delight users. Service providers find that their core networks are under increasing load from the insatiable thirst for bandwidth from their residential, business and mobile customers. Traffic growth should represent opportunity, as it highlights the desirability of their services. However, as they strive to deliver increasingly compelling offerings, they are challenged to scale their core networks within resource envelopes that can ensure sustainable profitability.

The Internet core and the networks that comprise the cloud must become ever faster and more efficient. At the same time they must become even more nimble in order to anticipate and adapt to new applications and new possibilities, while proving even more cost effective in the face of growth.

The ultimate approach is to provide dramatically higher scale, better efficiency, and more versatility. Alcatel-Lucent delivers on that premise with the 7950 Extensible Routing System (XRS) family of core routers.

CORE ROUTING IN THE 100G ERA

As applications proliferate and the range of user expectations broadens, the network must rise to the challenge.

Scaling the Internet backbone efficiently remains critical and will continue to be a primary focus, which means that Internet backbones and peering points must continue to expand in terms of their capacity requirements. The move to 100G links provides relief and headroom for growth, and they have become the new bandwidth currency in the core.

At the same time, another key change is taking place within the network. To ensure the best customer experience and the most efficient delivery mechanism for the range of multimedia content, including video, proximity to users becomes increasingly important.

THE CORE OPPORTUNITY

- Unabated Internet growth is ushering in the 100G era, an inflection point for core networks.
- The Alcatel-Lucent 7950 XRS is a powerful family of core routers built for the 100G era and beyond.
- Silicon innovation powers system design that yields 50% savings in power and space over five-year horizon of network growth.
- The 7950 XRS, powered by the proven SR OS, handles the full set of IP routing, MPLS switching and infrastructure service capabilities cost effectively in a single platform: scale and efficiency without compromising versatility.

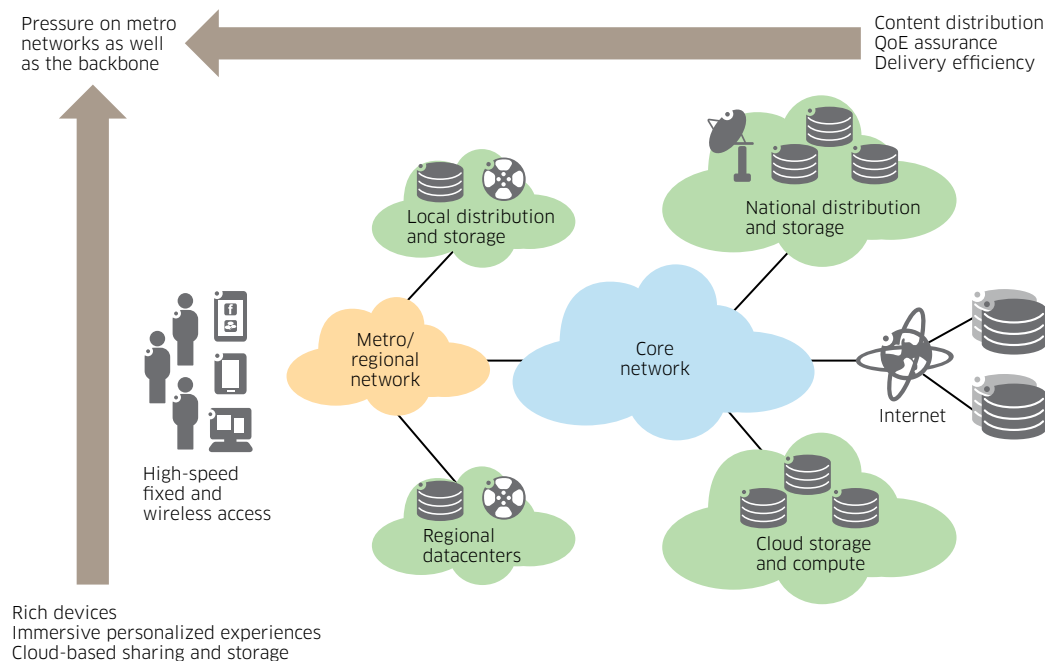
The proliferation of datacenters and distribution of content closer to end users drive increased pressure on metro and regional core networks. As richer multimedia experiences expand, and as users interact with the cloud for network-based compute, storage and sharing, traffic levels in the metro core network will multiply. Consequently, the infrastructure in metros needs scale equal to what we expect in the core, but with the flexibility to support a full array of routing and switching functions, as well as IP and Ethernet infrastructure services.

Today's core router platforms struggle to deliver a palatable solution for this network evolution. Optimized for the 10GE era, they struggle to scale in the 100GE currency. In some cases, they have managed to scale efficiently but at the expense of significant functionality, reverting to single-function switching platforms.

Alcatel-Lucent believes that core routing platforms must scale in multiple dimensions to match evolving capacity demands. And they must do so without compromising performance or functionality.

- In the IP core they must offer scalable IP routing and Internet peering, optimized for 100G, with full resiliency and the ability to switch at the MPLS layer when network design and traffic mix show it is more efficient to do so.
- Within rapidly expanding metro cores they must handle modes of operation that span traditional IP core routing and MPLS switching, and offer Layer 2 and 3 VPN infrastructure service capabilities.
- Within the cloud infrastructure they must offer high-speed and low-latency datacenter interconnection for efficient content distribution and disaster recovery.

Figure 1. New reality of core networks



The ideal core routing platform possesses the flexibility to adapt and deliver this new range of capabilities on a single platform, with appropriate economics and consistent operations and management. It can scale to levels that let it thrive in the network for the next decade, while minimizing the space and power costs of operations. This is the vision that has shaped Alcatel-Lucent's view for rethinking core networks.

THE ALCATEL-LUCENT 7950 XRS: REVOLUTIONIZING THE ECONOMICS OF DELIVERING THE INTERNET

The Alcatel-Lucent 7950 Extensible Routing System (XRS) is purpose-built to provide scalable routing capacity in a dramatically smaller space and power footprint, while maintaining maximum versatility to accommodate the current and future core network needs of service providers.

The 7950 XRS family addresses the full spectrum of networking needs for the Internet core, expanding metro core, and cloud infrastructure. This will enable service providers to deliver the Internet experiences we see today and expect tomorrow. It offers an immediate solution to cost-effectively accelerating 100 Gb/s deployments, as well as a graceful evolution to 400 Gb/s and 1 Tb/s links in the future.

The 7950 XRS leverages the proven and highly reliable Service Router Operating System (SR OS), which delivers a rich and mature feature set operationalized in more than 450 network deployments. Service providers benefit from flexible pay-as-you-grow options to tailor the 7950 XRS feature set to their evolving core routing needs, with software licenses that expand the range of functionality as required.

The 7950 XRS family consists of three products, each addressing the broad range of core routing needs (Table 1):

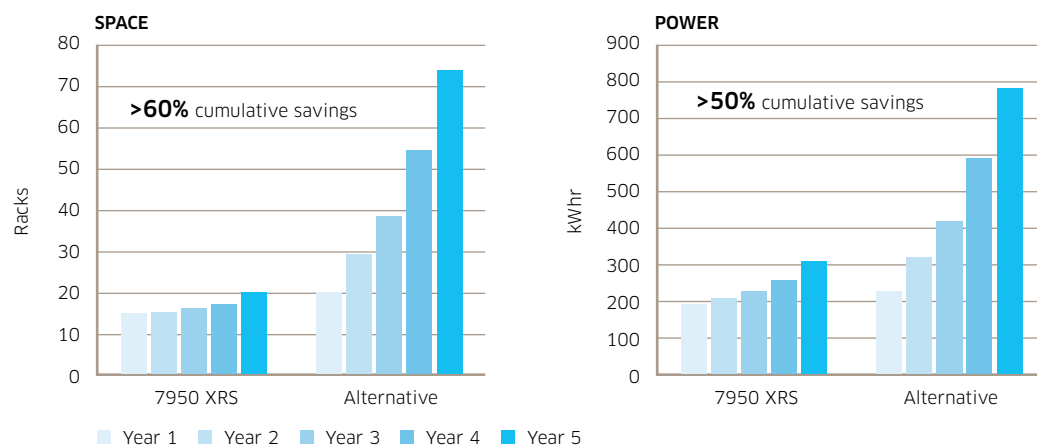
1. The 7950 XRS-40 is a 32 Tb/s core router capable of supporting up to 160 100GE interfaces in a single system, delivering unparalleled capacity for in-place growth with multi-chassis expansion to ensure continued scaling.
2. The 7950 XRS-20 is a 16 Tb/s routing system supporting up to 80 100GE ports in a single 19" rack, representing unmatched port density for the new core network currency. It can be upgraded to the 7950 XRS-40 and/or multi-chassis configurations as traffic demands warrant.
3. The 7950 XRS-16c is a standalone 6.4 Tb/s system that is designed to cost effectively meet the needs of smaller networks.

Table 1. 7950 XRS family overview

SYSTEM MODEL	SYSTEM CAPACITY	INTERFACE SLOTS	100GE CAPACITY	EXPANSION OPTIONS	RACK SPACE (STANDARD 19")
XRS-40	32 Tb/s	40	160	Multi-Chassis	2 racks
XRS-20	16 Tb/s	20	80	XRS-40 or Multi-Chassis	1 rack
XRS-16c	6.4 Tb/s	16	32	Standalone	1 rack

Inefficiencies in the core drain service provider profits. The 7950 XRS delivers equivalent core capacity in 1/5 the space using 1/3 the power, which translates into substantial operational cost savings relative to the status quo. As service provider networks grow, their buildings and power budgets do not. Service providers must limit use of these valuable assets; indeed, in some cases it may simply not be possible to feed more power to a central office building, or to find more space for additional racks. The 7950 XRS was built to expand network capacity without multiplying space, power or cooling costs. At network scale, the 7950 XRS system benefits translate into significant savings on Total Cost of Ownership (TCO). Network modeling by Bell Labs shows that a 16-node core network serving 30 million subscribers over a five-year period yields service providers a recurring savings of more than 50 percent on space and power – which amounts to millions of dollars in operational expenses (Figure 1). These savings enable service providers to grow capacity within their existing space and power footprint and budget for years to come.

Figure 2. Reducing operational expenses in the core



Source: Bell Labs Analysis

Lacking the most powerful silicon and system design, existing core routers are often prematurely forced into expensive and cumbersome multi-chassis implementations in order to deliver the required capacity. In addition to capital costs, these systems use disproportionately more power and space to deliver the necessary bandwidth. Traditional core routing solutions also struggle to balance cost-effective scaling with the expanding range of functionality required to meet the various needs of backbone and metro core networks. Some are proposing single-purpose platforms with stripped down functionality to achieve scale and efficiency, while others maintain richer functionality at the expense of unwieldy systems that consume multiples of space and power.

That leads to a fundamental dilemma: Achieve necessary scale but sacrifice key capabilities to do so, or preserve functionality but sacrifice scale and efficiency?

Retreating to single-purpose “LSR-only” core platforms, which increase capacity and power efficiency at the expense of stripping router functionality, is viable in certain situations. However, this approach introduces fundamental constraints at a time when networks require more flexibility to meet evolving demands. Alcatel-Lucent believes that the economic benefits of MPLS switching can be maintained wherever appropriate without sacrificing the ability of core platforms to deliver routing and services whenever needed. The flexibility to offer MPLS LSR switching alongside IP routing and services will prove fundamentally important as service providers gauge the overall cost of scaling and operating their core networks.

The 7950 XRS outperforms single-purpose MPLS switching platforms in terms of capacity and efficiency, and does so without making concessions on features or flexibility. Trade-offs on scale, efficiency and flexibility needlessly hold back the potential of the network. The Alcatel-Lucent 7950 XRS shatters this tradeoff, delivering unparalleled scale and efficiency while meeting the IP routing, MPLS switching and infrastructure needs of service provider core networks.

Groundbreaking 400G FP3 network processor

The Alcatel-Lucent 7950 XRS is based on the industry's first and only 400G network processing silicon. Through three successive generations of network processor design leadership, Alcatel-Lucent has been committed to driving flexibility in system design through powerful programmable silicon. As the fundamental building block for the 7950 XRS family of core routers, innovative silicon enables scale and efficiency across a broad range of core networking applications. Many new features that typically require hardware upgrades in traditional routers are introduced through software-only upgrades in the SR OS.

The 400G FP3 chipset provides the perfect geometry to address the range of interfaces required by the IP core. It allows full utilization of slot capacity for 10, 40 and 100 Gb/s line card configurations, as well as evolution to 400 Gb/s interfaces using existing silicon and system infrastructure. The combination of groundbreaking silicon, perfectly devised slot and system geometry, and enhancements in power and cooling efficiency result in a core routing platform that efficiently delivers five times the capacity in the footprint required by today's core routers, while using only a fraction of the power.

Proven Operating System

The 7950 XRS runs the SR OS, which has been deployed in the IP/MPLS networks of more than 450 service providers over the past decade, including 28 of the top 30 service providers worldwide. The SR OS is a modular operating system with full separation of the control and forwarding planes, as well as a comprehensive suite of resiliency, high-availability and in-service software upgrade (ISSU) capabilities. It utilizes a distributed processing architecture that splits features and functionality across multi-core processors within the system to achieve maximum protocol and service scalability.

Optical Integration

As service providers optimize their core network architectures, they are interested in closer integration between the IP and optical layers. In addition to transponder integration, which incorporates tunable DWDM interfaces directly on the 7950 XRS, the platform design includes Optical Extension Shelf (OES) ports within the system control module. The OES ports facilitate further capabilities for management integration with the Alcatel-Lucent 1830 PSS. Today the Alcatel-Lucent 5620 SAM provides common management tools across both the IP and optical domains to enhance cross-layer visibility and facilitate troubleshooting. With industry leading silicon innovation in IP (400G FP3 silicon) as well as optics (400G Photonic Services Engine), Alcatel-Lucent is committed to delivering best-of-breed IP and optical portfolios, along with meaningful IP/optical integration that will optimize the efficiency of the core network.

Comprehensive network management with the 5620 SAM

The 5620 Service Aware Manager (SAM) optimizes overall operation of the core network, and provides a unified, end-to-end view across IP core and service edge domains as well as IP and optical transport domains. The system provides converged, cross-domain management that transcends the traditional product and technology boundaries, spanning equipment-, network- and service-level management across the metro aggregation, service edge and core network domains.

The 5620 SAM is designed to manage transport and infrastructure services and provides service-level visibility into the network as needed across the range of IP core routing, MPLS switching, and infrastructure service deployments.

As service providers move to streamline operations between the IP and optical transport domains of their network, the 5620 SAM provides common management of the Alcatel-Lucent 7950 XRS core router family as well as the 1830 Photonic Service Switch (PSS) DWDM and OTN transport portfolio. This adds a level of cross-layer visibility that will prove highly beneficial to optimizing overall network turn-up, troubleshooting and operations.

The Alcatel-Lucent 5650 Control Plane Assurance Manager (CPAM) complements the 5620 SAM with real-time control plane visualization, surveillance, and problem diagnosis, giving unprecedented visibility into the network's underlying IP routing layer.

CONCLUSION

Core networks have reached an inflection point. The Internet is growing unabated, spurred on by the proliferation of rich communication devices, combined with the appeal of video and the power of the cloud. This increases the pressure on Internet backbones to scale efficiently. At the same time, video and cloud-based services change the dynamics of user interaction with applications and content. As this traffic is pushed ever closer to users, it is driving increased pressure on metro and regional cores and vastly expanding the requirements of routing platforms in these domains.

Consequently, we have entered an era where 100G links are the new network currency, and 10G-optimized platforms struggle to balance cost-effective scaling with the expanding range of functionality required to meet the various needs of backbone and metro core networks.

Service providers can elect to prolong the status quo with its implicit compromises. Or, they have an opportunity to rethink the core network and opt for a core routing platform that scales in multiple dimensions to keep up with evolving capacity demands without compromising performance or functionality.

The 7950 XRS offers the flexibility to adapt and deliver the full range of required capabilities in a single platform. It meets the IP routing, MPLS switching and infrastructure service needs of core networks in a single platform, with appropriate economics. Designed for today's 100G reality, the 7950 XRS is ready to gracefully embrace the logical next steps to 400 Gb/s and 1 Tb/s interfaces. Options for optical integration further enable service providers to streamline their core networks and increase cross-layer visibility between their IP and optical networks. At the system level, the 7950 XRS also rethinks operational economics by delivering unparalleled scale and efficiency that reduce space requirements by 80 percent and cut power consumption by up to two-thirds.

Driven by innovative 400G silicon, the proven SR OS, and comprehensive network management, the Alcatel-Lucent 7950 XRS represents a fresh and technologically advanced alternative on the core routing landscape. With the 7950 XRS, service providers can build a core network for the next decade – one that is faster, more efficient and more nimble to support evolving requirements, while proving even more cost effective in the face of growth.

ACRONYMS

DWDM	Dense wavelength-division multiplexing
ISSU	In-service Software Upgrade
LSR	Label Switch Router
MPLS	Multi-protocol Label Switching
OTN	Optical Transport Network
PSS	Photonic Service Switch
SR OS	Service Router Operating System
TCO	Total Cost of Ownership
VPN	Virtual Private Network
XRS	Extensible Routing System

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