NGN: Next-Generation Public Network Switching

Abstract: Telephone networks will turn into next-generation networks based on Internet Protocols by 2010. Getting there is challenging for vendors and operators of public networks.

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Recommendations

- Vendors of next-generation switches should develop products to support the migration or augmentation of existing networks.
- Service carriers should again consider overhauling their switching topologies to fully migrate to packet-based networks.
- Carriers should ensure that capital expenditure on their infrastructures will be viable in a packet-based future.
Introduction

For the past few years, equipment vendors have promoted next-generation switching as the key to overcoming inefficiencies in public telecommunications networks based on time division multiplexing (TDM).

Vendors could see that carriers were striving to meet demand not only for voice services but also for a mix of voice, data and multimedia services. And vendors argued that all services should be carried in the same way as on the Internet — in packets of digital data.

This would require carriers to replace their circuit-switching equipment with packet routers and additional equipment. But the carriers' cash flows and budgets for capital expenditure have been under pressure, and they have been reluctant to replace local exchanges that are fully depreciated but still functioning.

Meanwhile, vendors themselves are challenged to provide equipment and solutions that allow carriers to upgrade their networks one step at a time using media gateways, softswitches, and application or feature servers, while interfacing with existing technologies (including operation support systems) and complying with appropriate standards.

Evolution Toward Convergence

Service providers are indeed searching for technologies to simplify their networks, to reduce their costs of operations, management and maintenance, and to increase the flexibility of their services. However, rather than distributing network functions and implementing packet-based softswitch architectures, most carriers have been looking to converge network functions case by case. They have been looking for quick returns on investment (ROIs) and checking against benchmarks for costs against performance. This has been particularly true for incumbent carriers with legacy infrastructures and high revenue from voice services.

In 2001 and 2002, carriers thought about implementing networks to deliver Voice over Internet Protocol (VoIP), but because of the economic downturn, they chose not to restructure their networks. Instead, they deployed asynchronous transfer mode (ATM) technologies and IP facilities only at critical pressure points.

As networks are evolving toward softswitches instead of rushing to full-blown packetization, Gartner Dataquest expects that up to 2004, carriers will continue to implement next-generation switching on a small scale.

The ability to converge network elements and layers will play a pivotal role in switch deployments up to mid-2006. In the midterm, incumbents deploying new networks outside their home territories will build end-to-end VoIP networks, using the full range of ATM- and IP-based switching technologies. After 2006, convergence will no longer be a key issue: It will be just another core issue along with others (such as efficiency, service creation and management) in building next-generation switching networks.
From Switches to Routers
Multiservice switch routers are platforms that attempt to marry an IP-based routing scheme with a secure switching model able to deliver services that can be defined by quality of service (QOS). Carriers will deploy such switch routers when they want the option of optimizing their networks, while protecting their investment against the time when they may migrate to full IP networks. With switch routers, carriers will be able to introduce new services with only incremental changes in network configurations, while reducing the costs of service provisioning and collapsing network layers. Multiservice switch routers will be used as stepping-stone solutions rather than as long-term network elements.

Routers for Service Providers
Critical aspects of IP routers and multiservice switch routers are the ways service providers handle issues of QOS and service-level agreements (SLAs). Elements relevant to QOS, such as buffering, shaping, policing and delivery of SLA statistics, are now provided on a per-flow basis. Vendors must incorporate these into hierarchical traffic management in the IP cloud and include congestion management, shaping, scheduling as well as traffic engineering statistics. Reliability and QOS issues remain critical issues in Layer 3 routing and switching.

The Promise of MPLS
One option for handling QOS is to use multiprotocol label switching (MPLS). Attaching labels to IP packets allows seamless interoperability across network elements: Packets are forwarded according to the label instead of the packet header. Because labels can include priority data, QOS guarantees for services can be provided. So far, MPLS has been used for traffic engineering and applications such as virtual private networking (VPN) over IP and ATM networks. With MPLS, which is protocol-agnostic, carriers can packetize their access networks and provide seamless integration with IP networks. Carriers can provide Ethernet services over their ATM or Synchronous Optical Network (SONET)/Synchronous Digital Hierarchy (SDH) network. They can set up point-to-point and point-to-multipoint tunnels for differentiated service offerings to extend their service portfolios with marginal equipment enhancements.

At present, no standard exists for MPLS: Implementations are proprietary and mostly not interoperable with other implementations. Gartner Dataquest expects that with standardization, MPLS will become a major support for making IP traffic acceptable for SLAs. This is important when carriers must guarantee IP services. End-to-end MPLS will become a major selection criterion.
**Working at the Edge**

Edge routers or edge devices that incorporate MPLS can determine a packet's destination and any special treatment required. Thus, edge routers can act as either the media gateway or the packet backbone switch-router in the overall architecture.

With excess capacity in the core of the network, the edge of the network is becoming the bottleneck for delivering high-bandwidth services. Edge service provider routers, gateways and central office switching offerings are all concerned with delivering more bandwidth to subscribers, while streamlining network operations for the carrier. Today, carriers are looking to run QOS-based IP services over their networks although IP traffic lacks the features to be managed effectively. On the edge of the network, edge routers integrate functions such as VPN over IP, aggregation of broadband and leased lines, and the delivery of advanced IP services. But edge routers are challenged to provide IP services at line rate speeds, supporting reliability 99.999 percent of the time.

Gartner Dataquest believes that carriers will prioritize edge switching and routing because those products will directly influence their ability to deliver existing and new IP-based services to provision those services effectively and bill for differentiated service bundles.

Similar roles are played by access or residential gateways and integrated access devices (IADs), or advanced access multiservice platforms (AMSPs) with gateway functionality in the softswitch architecture. With such devices at the edge of the network, carriers can bring service provisioning, subscriber management, troubleshooting, self-provisioning and billing closer to the subscriber. They can also use the information for calls or events from a softswitch closer to the subscriber. This avoids deploying a full-fledged infrastructure with large network elements but, instead, supports selective deployment of intelligent edge devices that extend the switching network.

**New Approaches to Next-Generation Switching**

At present, the industry is changing its approach to deploying softswitches and media gateways. Industry players and organizations such as the International Softswitch Consortium (ISC) accept that a distributed switching architecture must be standardized. Vendors have implemented many standards covering communications between the softswitch or media gateway controllers and the access network. However, no industry consensus has been reached on the pace at which standards should be incorporated or the prioritization of those standards in product road maps. Many products use standard protocols yet are unable to support other vendors’ offerings.
Benefits to Subscribers
One caveat remains: Packet networks will deliver on their full potential only if they are delivering packet services to subscriber terminals. This will require a broad distribution of appropriately equipped residential phones or PBXs based on IP. Subscribers are less likely to replace their communications devices in times of economic downturn. If they cannot see a substantial value in changing terminals, they will not do so. Carriers that are replacing central office, or Class 5, switches must not only maintain traditional services such as voice mail and call forwarding but also provide new IP services such as follow-me services, call prioritization and others.

Gartner Dataquest Perspective
In the short term, carriers’ cash flow concerns and economic conservatism, together with their understanding that the technology is still immature, will cause carriers to limit deployments of next-generation switches to selected network extensions, capacity expansions or new builds.

By 2006, next-generation switching will be widely adopted for building new networks and extending old networks. After 2006, comprehensive conversions of networks from TDM to packet technologies will occur to facilitate end-to-end flows of IP traffic.

Core routers will be accompanied by edge routers and multiservice switch routers that bring intelligent service provisioning and monitoring closer to the subscriber. Softswitch architectures will see their roles as replacements for tandem switches and primary rate interfaces (PRI) being complemented by a variety of VoIP deployments in local networks.

Vendors of next-generation switches wishing to stay in the market should develop products that will support the migration or augmentation of existing switching networks. They should have modules to ease capacity constraints and make it possible to offer new services.

They should accept that incumbent carriers have limited funds for capital expenditure and will prefer to invest to meet practical problems in their switching architectures rather than save future operating expenses. Saving operating expenses will contribute to, but not dominate, decisions by carriers. However, already new networks will mostly employ ATM or IP architectures.

In the midterm to long term, carriers will again consider overhauling their switching topologies. Carriers with business customers will be the first to replace existing infrastructure, as they will gain faster ROIs from businesses than from residential customers. Offering VoIP services to residential customers with broadband access will be accelerated after 2005.

Key Issue
How will developments in switch technology affect network evolution?
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