Alcatel·Lucent
Enterprise

WHITE PAPER

# The Application Fluent Network

## Delivering a High-Quality User Experience

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# The Growing Crisis in the Enterprise Network

The corporate network is facing an unprecedented set of challenges today—challenges that threaten its ability to meet the rising expectations of its users. At the same time, these challenges create opportunities for businesses that choose to meet them head-on. This paper will show how your organization can respond effectively to a shifting IT climate to create a competitive advantage and drive customer loyalty while minimizing cost.

But first, let's take a look at some trends that are putting pressure on the network today: real-time applications, smart devices, and virtualization.

## Real-time Applications Push Legacy Networks to Their Limit

Delivering real-time applications is a top-of-mind issue today for business managers. Voice over IP (VoIP), video, customer service, and collaboration suites are fast becoming essential tools for corporations to compete effectively and stay engaged with customers, employees, partners, and vendors. These next-generation applications require levels of performance from the corporate network far beyond the needs of the typical enterprise application in terms of throughput and latency.

In response, IT departments must build a network that has sufficient resources to provide a satisfactory experience to users of these applications. Traditionally, the enterprise network has played a limited role in optimizing application delivery: it simply transported raw information from place to place without regard to the application's individual requirements. In this environment, architects designed the network with enough raw bandwidth to meet peak application delivery requirements. This approach—known as over-provisioning—provided an adequate user experience, but is clearly a costly model for network design.

To complicate matters, many enterprise networks are already running close to their practical limits in terms of complexity, performance, and reliability. The reasons are varied. In some cases, networks grew organically over years or even decades with little standardization or central control, resulting in incompatible components, protocols, and management tools. Portions of the network frequently were modified to meet the needs of specific applications, adding complexity and driving up operating costs. Mergers and acquisitions created silos of incompatible technology existing side-by-side within a single network. The business impact of these trends is significant: a rigid infrastructure that will not be able to deliver a good user experience for the new wave of business-critical, real-time applications.

## Smart Devices Increase the Pressure

The stress on the network is only going to increase, thanks to the rapid adoption of always-connected devices by business users. In recent years, IT departments struggled to support a wide range of smart communication devices such as Blackberries, iPhones, and Android-powered phones. The next wave of smart devices—tablet computers—is already well underway, driven by the phenomenal success of the Apple iPad. Apple's competitors are responding by introducing tablets of their own, and businesses are finding new and innovative ways to incorporate tablets into their operations.

These new rich-media devices do more than eat up bandwidth: they make it increasingly difficult for network managers to predict bandwidth consumption. In the absence of a clear picture of network traffic patterns, the traditional practice of setting static priority levels for specific applications no longer works. Network planners need a fresh approach to support the new generation of connected devices.

## Virtualization Squeezes the Network from the Inside

Unlike the previous two trends—real-time applications and smart devices—virtualization is an internally generated pressure. However, its impact on the corporate network can be just as dramatic. To increase agility and reduce costs, corporations are virtualizing servers, storage, and networks in ever-larger numbers. The relentless push to virtualize the data center, including the growing use of cloud-based services, increases baseline network traffic dramatically—and rewrites the rules of network design and operation.

Virtualization is also moving beyond the data center. IT groups are deploying network appliances to deliver specialized services such as intrusion protection and traffic management. Virtualized desktops are gaining in popularity due to their reduced support costs and better security. These and other applications of virtualization will create additional demand for raw bandwidth and require the network to automatically react to the needs of virtualized systems—something legacy networks were never designed to accommodate.

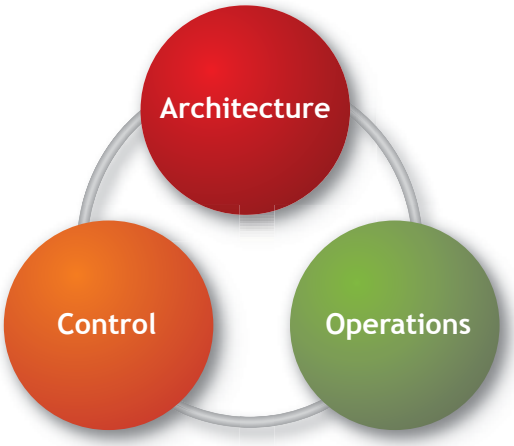
For the first time in history, the demand for bandwidth will exceed the economical capacity of the next generation of network switching equipment. The time-tested solution of adding more and more raw bandwidth will not work. What's needed is a new resilient network architecture that minimizes latency by allocating bandwidth selectively to specific applications, ensuring a high-quality user experience for real-time applications. This network also needs to be far easier to manage and maintain than legacy networks, freeing IT staff from the day-to-day struggle to deliver acceptable levels of application performance to users.

## Application Fluency: A New Approach for Enterprise Networks

Application fluency  represents a unique approach to enterprise networking. In Alcatel-Lucent's view, the application fluent network possesses broad knowledge of both network devices and the applications to which they are connecting. Most importantly, the application fluent network understands the context of the conversation between device and application—and makes decisions based on that understanding.

Alcatel-Lucent's application fluent network is based upon a resilient architecture with streamlined operations and automatic control as shown in Figure 1.

**Figure 1. The Application Fluent Network**




**Resilient Architecture:** A simplified, single IP network with built-in security.
**Streamlined Operations:** Reduced complexity through automated provisioning and integrated troubleshooting tools.
**Automatic Control:** High-quality, real-time application delivery with unique dynamic tuning of network performance.

The application fluent network brings significant benefits to the enterprise including a high-quality user experience, lower network administration costs, and a better return on investment (ROI).

### High-Quality User Experience

The application fluent network allows network managers to offer a high-quality user experience with controls that automatically ensure service levels, avoid packet loss, and provide security such as:

- **Dynamic tuning of network performance.** The application fluent network automatically adapts to maintain service levels for individual conversations based upon context and business priorities.
- **Automatic recovery from switch and link faults.** The application fluent network recovers rapidly from single switch fabric and link failures, avoiding any perceptible service interruptions, even for voice and video.
- **Embedded security.** Security features in the application fluent network operate transparently to protect users and their conversations from threats.

### Lower Network Administration Costs

The application fluent network eases the burden on IT staff with built-in features for automated provisioning and integrated management of the network including:

- Low-touch operations. The application fluent network manages provisioning of edge switches, wireless access points, and endpoints with minimal skilled human intervention. The use of network policies ensures consistent configurations across the entire network, reducing time spent tweaking the configuration of individual components.
- Converged management. In the application fluent network, a consolidated management tool provides a single pane of glass for monitoring and managing the network. It also allows administrators to manage the network infrastructure as a single fabric rather than individual components. IT staff spend less time switching between programs and screens, and more time on productive work.

### Better Return on Investment (ROI)

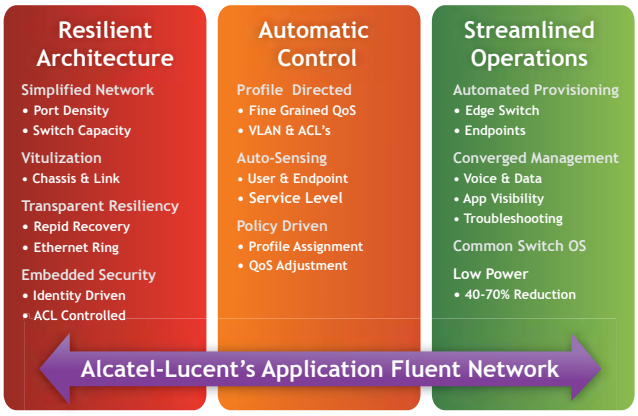
The application fluent network both minimizes the initial capital investment and lowers operational costs, which allows the enterprise to recoup its investment faster through:

- Flatter network architecture. By eliminating an entire network layer, the application fluent network reduces the number of switches, links, and other costly network components.
- Network virtualization. The application fluent network virtualizes both switches and links, resulting in optimized utilization, lower capital requirements, and higher ROI.
- Green design. The new generation of energy-efficient high density switches used in the application fluent network reduces expenses for space, power, and cooling.

## Building the Application Fluent Network

The application fluent network is identified by a number of key properties that are required to deliver the desired user experience: architecture, adaptability, and management; this is shown in Figure 2 and described in more detail below.

**Figure 2. Key properties of the application fluent network**



The architecture of an application fluent network can reduce complexity, cut costs, and provide users with a better experience. These benefits are enabled by:

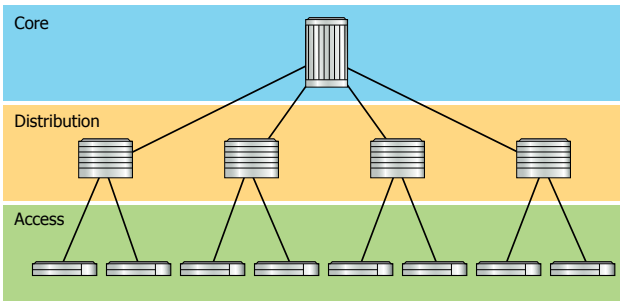
- A low-latency network delivered via a simplified architecture
- An optimized utilization of switch and links achieved by virtualization
- A resilient network enabled by minimized re-convergence times
- The removal of security complexity

In the remainder of this section we will explore each of these aspects of an application fluent network in more detail.

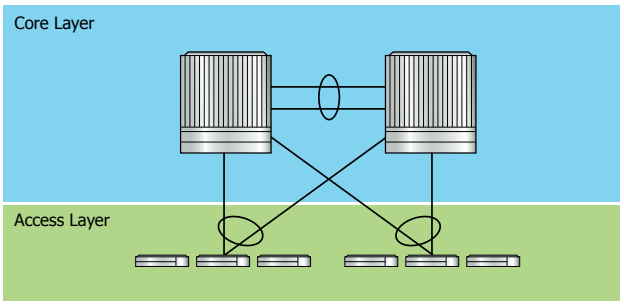
## Simplified Network

The application fluent network eliminates the aggregation layer, resulting in a two-tiered network that supports voice, video, data, and storage on a single network (see Figure 3). The switches used in the application fluent network permit the removal of the aggregation layer because they feature wire-rate and non-blocking capacity as well as a high port density, along with the ability to provide Layer 3 switching functionality in a Layer 2 network. The removal of the aggregation layer is also key to achieving a lower latency network.

**Figure 3. Flattening the enterprise network**




Traditional Three-Tiered Network

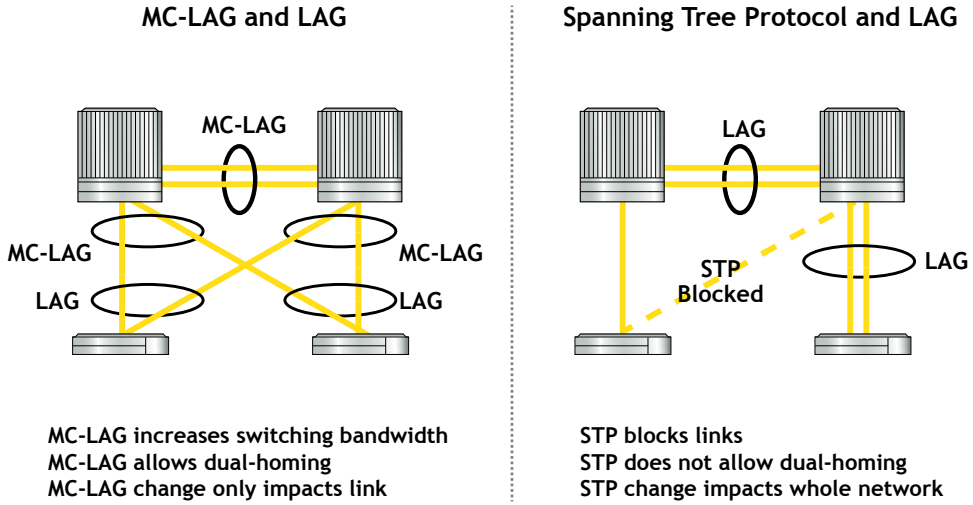



Simplified Two-Tiered Network

## Virtualization

By virtualizing switch management and network links, the application fluent network optimizes resource utilization, reduces operational complexity, and increases scalability. The virtualization of both switch management and network links, referred to as multi-chassis link aggregation (MC-LAG), is central to allowing the new two-layer architecture of an application fluent network to operate as a Layer 3 network without requiring the use of the spanning tree protocol (see Figure 4).

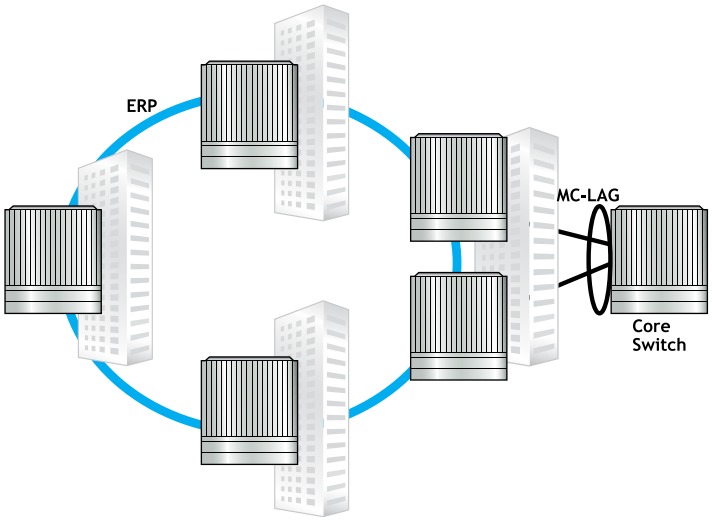
Figure 4. MC-LAG verus spanning tree protocol




## Transparent Resiliency

Real-time applications require low latency and high availability, which can be compromised by hardware problems. The application fluent network recovers rapidly from component failure—without impacting application traffic. Of course, all network switches have redundant power supplies, fans, management, and fabric. Ethernet Ring Protection (ERP) also ensures quick re-convergence time in case of switch or link failure (see Figure 5) for geographically distributed networks.

Figure 5. Ethernet Ring Protection (ERP)




## Embedded Security

Because every enterprise has unique security requirements, the application fluent network includes a robust set of embedded security features. Built-in network access control (NAC) and intrusion detection and prevention (IDP) offer additional layers of protection that supplement existing endpoint and server security solutions. LAN security is based on MAC address, not switch port, providing specific endpoint and user policy enforcement. Post admission control is based upon Access Control Lists not simply VLAN assignment, providing fine-grained controls. Network switches feature overload protection to prevent failure due to Denial of Service (DOS) attacks. Intrusion prevention for the WLAN guards against rogue access points and hacker attacks.

- To relieve the burden on IT staffs and reduce operational costs, the application fluent network focuses on several essential needs: Providing automation wherever possible, such as with provisioning
- Consolidating management tools
- Ensuring operational consistency between switch features
- Designing equipment to minimize power consumption

In the remainder of this section we explore each of these needs in more detail.

### Automatic Provisioning

The application fluent network includes automatic setup capabilities for switches, wireless access points, and endpoints. When an access layer switch is added to the application fluent network, it downloads the right configuration through the network. The switch becomes a functioning member of the network with minimal human intervention. In a similar way, WLAN controllers automatically download configuration information to newly connected wireless access points, integrating them into the existing wireless network infrastructure. Specialized devices such as VoIP handsets are automatically recognized and configured as well.

### Converged Management

A common complaint by IT administrators is the proliferation of tools for monitoring and managing the network infrastructure. The application fluent network helps relieve this problem by:

- Consolidating many network management functions into a single management tool. IT staff can access this system remotely, allowing them to monitor and control the network from any location, at any time.
- Enabling management of the network infrastructure as virtualized segments, (for example, all switches on one floor of a building would be treated as one virtualized complex) , rather than as individual network elements. Including application traffic monitoring tools allowing network operators to collect statistics such as loss, jitter, latency, response time, and packet loss.
- Offering the capability of integrating third-party tools.

### Common Operating System

Multiple operating systems in a network can lead to spiraling training costs and operational inefficiencies. In the application fluent network, a single operating system powers all switches and routers, which allows administrators to manage the network using common tools. Technicians no longer need to refer to a complex matrix to determine hardware and software compatibility when installing patches and upgrades to network components.

### Energy Efficient

More and more enterprises are moving to green networks as a cost-saving measure as well as a corporate responsibility mandate. The application fluent network minimizes power consumption through the selection of network components designed for energy efficiency. As a major contributor to network power consumption, all switches in the application fluent network have market-leading low power consumption characteristics.

## Automatic Control: The Intelligent Network

Ensuring a high-quality user experience requires the ability to adjust key network parameters in real time. This ability to make dynamic adjustments requires the following:

- Knowledge about endpoints and users declared in profiles
- The ability to monitor actual service levels provided
- Policies to determine when and how to adjust network parameters

The application fluent network recognizes endpoints automatically and assigns profiles that regulate access and bandwidth usage. The network is then continuously monitored, with policies informing the update of key network parameters that affect the user experience when needed. Each requirement is explored in more detail below.

### Profile Directed

Profiles embedded within the network contain information about the requirements for QoS and security for conversations that will be carried by the network. In the application fluent network, profiles for users, endpoints, and applications are globally defined and embedded in the network switches. These profiles specify QoS and security requirements. The profile also indicates appropriate VLAN assignment.

### Autosensing

Autosensing allows the application fluent network to treat individual conversations within the network as follows:

- Assign initial allocation of network resources based upon priority. As each user and endpoint accesses the application fluent network, it is automatically recognized—regardless of location—and assigned the right profile.
- Dynamically adjust treatment of traffic for a particular conversation when the required service level is not being met. By monitoring network status events the application fluent network can determine the service level and take corrective action.

### Policy Driven

A policy engine and rule set embedded in the application fluent network determines which actions to take for network events such as:

- An endpoint, user, or application requesting access to the network
- A conversation that is not experiencing an appropriate level of service
- A move request for a virtual machine in the data center

## Solutions Enabled by the Application Fluent Network

The application fluent network is suitable for the most demanding deployments in the enterprise and service provider networks. Typical target deployments for the application fluent network include:

- Converged IP networks
- The data center
- Service-aware networks
- Managed access services

Each of these examples is described in more detail below.

## Converged IP Network

As discussed earlier, enterprises today must deliver real-time applications with guaranteed quality and reliability. The emergence of new rich-media devices challenges the business to keep up with the demands of their customers. When coupled with the shift to cloud computing and virtualization, these new pressures force the enterprise to view the infrastructure as a set of utility-based services that must work in harmony with their applications. Important requirements for these enterprises include:

- Integrated wired and wireless capabilities
- Mobility within the campus and remote locations/workers
- A network that adapts and recognizes new applications such as video conferencing suites, online collaboration, and new devices such as the iPad
- Integrated security and consolidated management capabilities

**Figure 6. Converged IP Network**

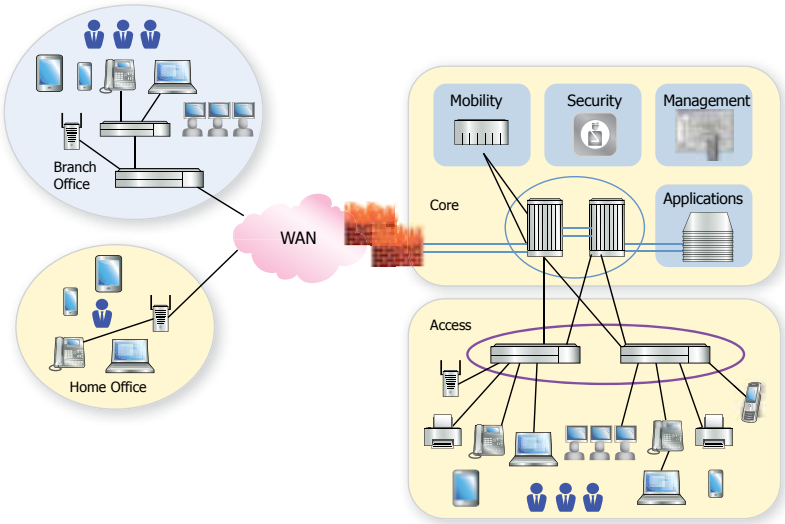


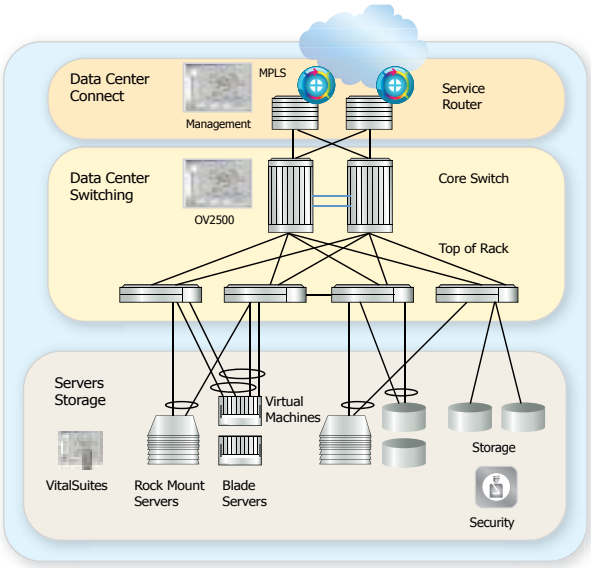

Figure 6 shows a typical converged IP network based on the application fluent network. It includes a simplified two-tier LAN architecture with integrated mobility and security. Integrated monitoring and troubleshooting tools provide end-to-end monitoring of applications. The network can adapt service levels automatically, easing the burden on IT staff to ensure the user application experience is within acceptable limits. All users, whether located at corporate headquarters, a branch or home office, or on the road have secure access to a common set of business applications and network services.

## The Data Center

The data center is undergoing transformation driven by the need to reduce costs and improve agility. At the core of this transformation is the consolidation of servers in the data center to reduce equipment, space, cooling, and energy costs—all made possible by server virtualization technology. Continued transformation in the data center is expected with the eventual convergence of data and storage networks. This consolidation is driving a refresh of the switching fabric in the data center with the following requirements:

- Simplified network delivering resilient, low latency, and low power switching
- Efficient delivery of intra-server traffic as well as client-server traffic
- Network support for automatic movement of virtual applications between servers
- The ability to carry both data and storage information over Ethernet networks
- Disaster recovery between data center sites

**Figure 7. The Data Center**



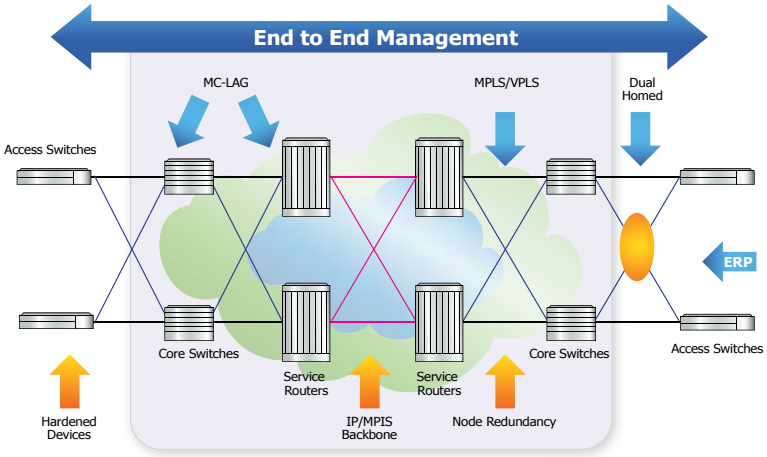

Within the data center, as shown in Figure 7, an application fluent network provides a two-tier resilient and low latency network architecture that supports server virtualization with automated virtual machine migration. It also provides for convergence of data and storage networks onto a single lossless Ethernet network. Integrating the application virtualization management with the network enables the ability to move virtual machines across the WAN, providing for disaster recovery and load balancing between data center sites.

## Service Aware Networks

Service-aware networks extend the corporate LAN across a private WAN and are typically deployed by organizations that have specific requirements for reliable, high-quality service delivery in rugged environments where security cannot be compromise—for example, in utilities, transportation, and public safety organizations. These organizations are under pressure to deliver additional services while reducing costs, which often requires significant modernization of the existing infrastructure. Important requirements for these organizations include:

- A highly scalable and reliable network – including the ability to operate in harsh environments
- Integrated security that protects the network from attack and prevents unauthorized access
- Guaranteed service levels for specific traffic based upon business priorities
- End-to end management and visibility on the service levels actually delivered

**Figure 8. Service Aware Network**



The end-to-end application delivery requirements of service aware networks demand an MPLS backbone as shown in Figure 8. Application fluency is achieved in this network with the implementation of Virtual Output Queuing (VOQ) to ensure high-quality application delivery by adding carrier-class QoS to the MPLS backbone. Additional important elements include carrier-class reliability features such as multi-chassis link aggregation, Ethernet ring protection and dual-homed link aggregation. For harsh environments, devices that can operate at high temperatures without requiring a fan for cooling are a must. Management is provided end-to-end across all devices deployed in the solution with a common management platform for visibility and troubleshooting.

## Managed Access Services

Enterprises that rely on a service-provider WAN to deliver high-quality applications are no longer satisfied with simple packet delivery: they are demanding that providers commit to a level of service for these critical applications. To meet this need, service providers need to extend the QoS control from their core network all the way to the enterprise edge. They must also manage QoS to the demarcation point at the customer premises.

**Figure 9. Managed Access Service Networks**

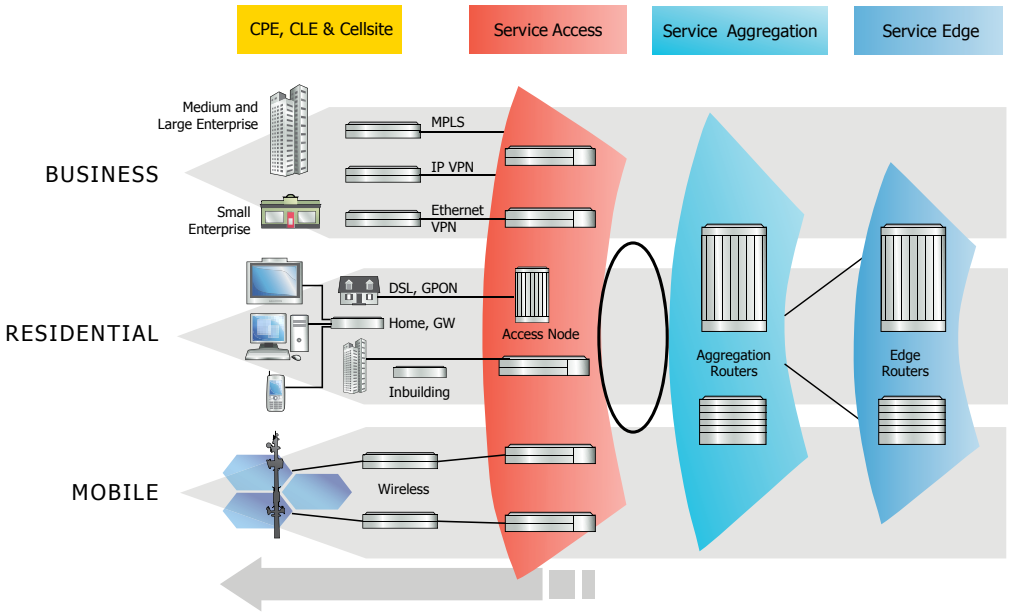
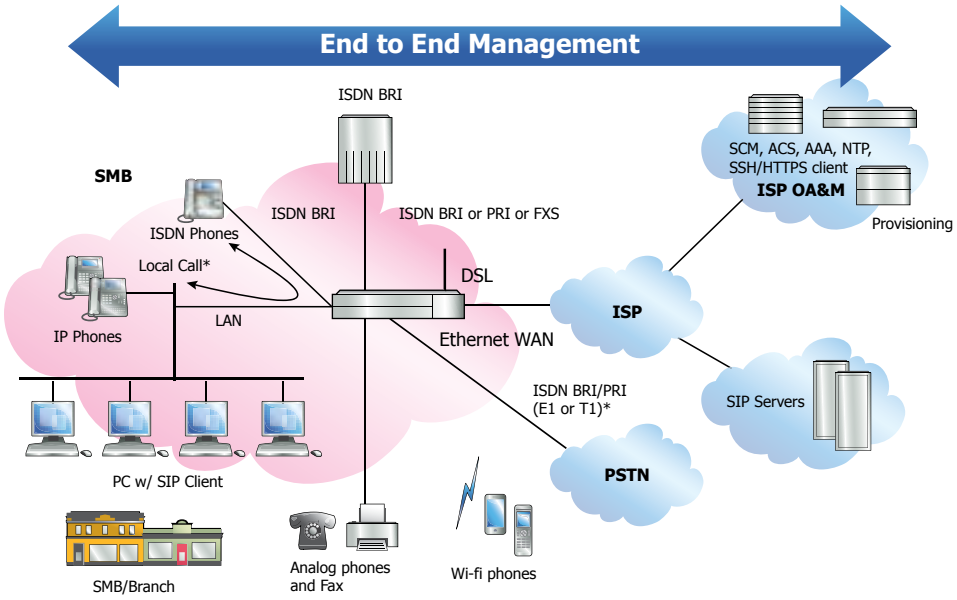



Figure 9 shows a typical managed access service network based on the application fluent network. The key architectural features include:

- IP/MPLS infrastructure for a metro network
- Support for business, residential, and mobile users
- An Ethernet access layer in addition to Ethernet VPN, xDSL, and GPON
- Visibility, monitoring, and troubleshooting capabilities with one management platform
- Seamless integration with the carrier infrastructure to provide end-to-end visibility of application delivery
- Ability to troubleshoot available circuits with carrier-based tools that monitor the availability, reliability, and end-user experience
- Plug-and-play capabilities to reduce complexity and deployment time

**Figure 10. Managed Communication Service Networks**




### Managed Communication Services Networks

More and more small enterprises are looking to service providers for a complete all-in-one communications solution that includes voice, data (wired and wireless), collaboration tools, and video. To meet these customer expectations, service providers must ensure end-to-end QoS from the hosted application platforms to the endpoints at the customer's site.

Figure 10 shows a typical managed communication services network based on the application fluent network. The key architectural features include:

- An all-in-one converged business access gateway that enables migration from legacy voice telephony to SIP, and includes redundancy by connecting to an all-IP network while failing back to the PSTN network.
- QoS that extends to small businesses with carrier-class visibility and monitoring.
- Managed service readiness and integration that allows the solution to be deployed anywhere and anytime as a plug-and-play solution.

## Application Fluency: The Next Generation of the Enterprise Network

The demanding requirements of rich media applications and virtualization within the enterprise combined with the limitations of legacy networks are forcing enterprises to look for innovative ways to improve application performance while minimizing operating costs and capital investment. The application fluent network as defined by Alcatel-Lucent promises to transform the way enterprises deliver applications throughout an organization's global operations. It features a resilient architecture, streamlined operations, and automatic control, which together meet the challenges facing enterprise IT groups today. With tangible benefits such as a high-quality user experience, reduced demands on IT staff, and a faster time to ROI, the application fluent network represents market leading innovation in network design and operation—one that Alcatel-Lucent is uniquely qualified to lead.

## Why Alcatel-Lucent?

Alcatel-Lucent is taking the lead in the industry's migration to the application fluent network. Why is Alcatel-Lucent the best choice for building the application fluent network?

- Unlike competitors, we offer disaggregated solutions that provide choice and allow the enterprise to tailor its network architecture to individual business requirements.
- Our commitment to an open network infrastructure enables a multivendor strategy by:
  - o Providing rich interfaces into the switching infrastructure
  - o Supporting industry standards
  - o Accommodating third-party management tools
- Our professional services are available to assist our business partners with specialized knowledge when needed. Our consultants are trained in a wide range of technologies and platforms, allowing them to support effectively complex, multivendor network installations.
- Alcatel-Lucent's systematic multivendor approach maximizes existing investments.
- Our expanding ecosystem augments the value delivered to the customer.



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