Strategy White Paper

Optimizing the network architecture for Triple Play

Service providers are racing to take advantage of the rapidly-developing market for Triple-Play services. Their challenge is to find a way to progressively integrate these new services, over both fiber and copper, within a unified Ethernet-based aggregation network that offers scalability at optimal cost.

The goal is to build a service-rich and robust environment that can seamlessly scale to support the flawless delivery of high-definition TV and video applications, in addition to voice and high-speed data services and the solution is the Alcatel's Triple-Play Service Delivery Architecture. Ideally, this delivery package would include non-stop service delivery, service flexibility, cost optimization, reduced risk, and shortened time-to-market for new services.

ALCATEL

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OPTIMIZING THE NETWORK ARCHITECTURE FOR TRIPLE PLAY

Network architectures need to be transformed to deliver Triple Play to the mass market, assuring a flawless user experience in a cost-optimized way.

Service providers are introducing new service delivery architectures that will be the foundation for their service roll-outs to consumers and businesses over the next five to ten years. These architectures therefore need to be highly flexible, service-rich and based on a resource pool that will allow the providers to rapidly develop and roll out innovative services, without requiring the complete re-architecturing of their services or the deployment of new equipment. At the same time, service providers must not be locked into a single operational model, and must be able to scale existing and new services. This includes increased bandwidth, more sophisticated policy enablement, increasing subscriber numbers, added service intelligence, and new networking functions that must be activated without any impact on service levels or changes to network design and operations.

Such an architecture requires rich, dependable service capabilities across all the nodes in the service delivery architecture, so that services and policies are optimally activated across different nodes as service demand, traffic patterns or subscription characteristics change. This allows service providers to cost-optimize their service infrastructures and optimize each service so that it can scale cost-effectively over time. Service providers must also be given the opportunity to "right-size" their infrastructures to optimize Capital Expenditure (CAPEX) as their networks evolve.

A Necessary Transformation

The DSL Forum reported that the number of global Digital Subscriber Line (DSL) subscribers passed the hundred million mark in February 2005, with one new DSL subscriber being added every second. Broadband services are rapidly becoming commodities in some markets, and price erosion is accelerating. Consequently, the battle for the hearts and minds of consumers will rely on leveraging brand equity, creative service bundling and, most importantly, the service provider's ability to rapidly introduce innovative services.

To minimize churn and increase revenues, operators are looking to add a video component to their service packages, as video services are considered essential to generate revenue growth.

Providers must also find ways to optimize their cost structures and streamline their network and business operations.

Business transformation

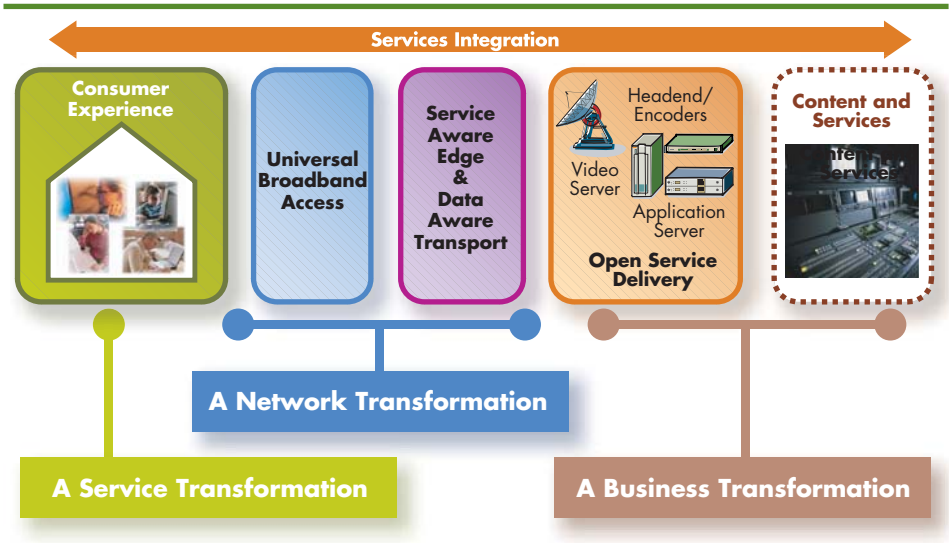
Voice revenues are shrinking in both the business and consumer markets. Moreover, aggressive pricing is luring subscribers towards emerging service and application providers. Operators are reacting with their own innovative voice bundles, often based on Voice over IP (VoIP). Bundling is essential to maintain a high Annual Revenue Per User (ARPU). To minimize churn and increase revenues, operators are looking to add a video component to their service packages, as video services are considered essential to generate revenue growth.

Bundling video with voice and broadband data subscriptions can create a compelling Triple Play offer, with bundles varying from basic to user-centric:

- basic Triple Play offers bundle broadcast TV services with High Speed Internet (HSI) and voice services. This tactical and incremental offer will help operators to reduce churn in the short term;

IP Television
(IPTV) is a term used to describe a number of service offerings for the delivery of packetized video services over a broadband network. These video services can range from a multi-channel video service (switched digital video) that mimics traditional broadcast TV, to true video-on-demand, and fully interactive and/or enhanced video services. Typical service enhancements include robust program information, selection and navigation, as well as multiple camera angles, integrated digital video recording functionality, and the integration of data and telephony services into the video experience.

Figure 1: Video changes everything



- user-centric Triple Play, centered around "better TV" (Internet Protocol Television; IPTV), provides the user with a flawless user experience of any content, anytime and anywhere. Added benefits include interactivity, high-definition content, fast zapping time, picture-in-picture, video-on-demand and personalized video recording, providing a much more personal experience. This offer will enable operators to differentiate themselves from their competitors and increase the ARPU of their broadband subscribers.

The introduction of IPTV represents a real business transformation for the telecommunication operators (see *Figure 1*) for the following reasons:

- obtaining rights to content is a critical and time-consuming activity. Delays in acquiring these rights can cause corresponding delays in the deployment of products and services, thereby negatively affecting the entire project;
- when implementing a new video service, substantial effort must go into developing custom middleware interfaces for back-end systems integration, such as customer order entry and customer care. This stage also includes the creation of custom applications to meet the service provider's marketing requirements.

Most service providers need an integration partner who understands content acquisition and is familiar with the steps needed to license content, thereby ensuring the successful and timely acquisition of premium content. This integration partner can also provide expertise in building and integrating custom applications, and can work with the provider's marketing teams to develop a premium image and brand.

Network transformation

Along with the business transformation, the introduction of Triple Play has a major impact on the network, imposing new requirements and new constraints, thereby requiring operators to upgrade their existing infrastructures. Bandwidth-intensive video services create a massive demand for increased throughput and a heightened requirement for Quality of Service (QoS), as well as service and policy scale and performance.

To be strategically engaged in the Triple Play transformation process, and to benefit from its opportunities, operators must ensure that their networks can accommodate new demands for content-rich applications and bandwidth-intensive services over the next five to ten years. Operators are in agreement about the ultimate end-to-end networking model to be used for the delivery of services. Evolution to Ethernet in the access and aggregation networks has already started because of its cost-effectiveness and bandwidth efficiency.

The evolution to Triple Play services has also highlighted the significant limitations of deployment models that offered incremental improvements on best-effort HSI service delivery, such as the DSL Forum's TR-59. This standard defined one session between Internet Customer Premises Equipment (CPE) modems and the Broadband Remote Access Server (BRAS) for all services. This model and the platforms that were optimized for its implementation suffer from a lack of scalability and flexibility for new media-rich Triple Play deployments, which require plug-and-play devices such as IP set-top boxes and IP phones.

The process of transformation that service providers must engage in is summarized in *Figure 2*.

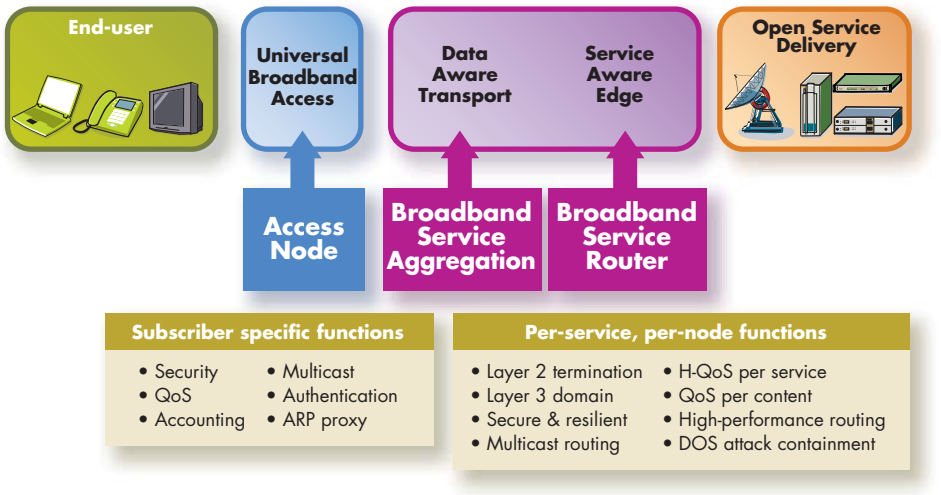
Figure 2: Network transformation process for triple play

Early and Present Day ATM-Based Broadband Aggregation	Next-Generation Ethernet and IP-Based Broadband Aggregation
ATM DSLAMs	**IP DSLAMs**
• Unintelligent Layer 1 aggregation • Low-speed ATM uplinks • Mostly Central Office - based	• Intelligent aggregation with support for multicast • Gigabit Ethernet Uplinks • Increasingly RT-based
Complex, fixed connections	**Simple, flexible connections**
• PPP-based • Bound to DSL CPE in the home • Provisioning cost high	• DHCP-based • Independent of device • User-based • Provisioning cost low
Centralized B-RAS	**Distributed broadband aggregation routers**
• Optimized for best-effort internet access • Lack of scalable routing and QoS • Typical OC-12 handoff to IP core	• Optimized for video and other QoS-sensitive services • Highly scalable • 10 GbE handoff to IP/MPLS core
Lack of network resiliency	**Highly available network**
• Outages tolerated • Minimal financial repercussions	• Little to no tolerance of service interruptions • Risk of churn if reliability metrics aren't met

Source: Yankee Group "Inside the trends and Numbers of the Broadband Aggregation Market", June 2005

HSI-optimized platforms (BRAS) were not designed or optimized for the required bandwidth capacity, Ethernet density, service richness, performance and high-availability characteristics that are essential for always-on, always-available Triple Play services. Neither can they handle the high rate of change associated with new dynamic volatile services that are highly unpredictable in nature (large subscriber bases, volatile channel changes, varying demographics, numerous types of show, live events, breaking news, etc). Service providers that try to modify BRAS-based implementations to meet Triple Play service requirements face costly platform proliferation, exorbitant cost structures, increased risk to brand equity, and increased financial, technological and architectural lock-in risk.

Figure 3: Distributed intelligence



Distributed intelligence

Alcatel's acclaimed Triple Play Service Delivery Architecture (TPSDA) (see sidebar) advocates the optimal distribution of service intelligence over the entire access, aggregation and edge network, rather than concentrating on centralized BRAS models. This allows a more flexible and optimized deployment of services in a network, guaranteeing high quality and reliable delivery of all services to the user.

TPSDA
Alcatel's Triple Play Service Delivery Architecture is a service implementation blueprint that represents the ultimate step in the network transformation process, allowing service providers to implement viable Triple Play service offerings over both copper and fiber infrastructures.

For example, multicasting from an upstream, central point in the network (subscriber termination point) would result in every packet, for every channel being watched, being sent as a separate unicast stream to each subscriber across the network, even if thousands of customers on the same Digital Subscriber Line Access Multiplexer (DSLAM) were watching the same channel. This approach contrasts with the Alcatel implementation, which intelligently pushes content and its replication (multicasting functions) to the access or aggregation network, depending on actual traffic patterns and channel audience, to achieve minimum-cost video distribution.

The required distribution of service intelligence focuses on functionality that was typically centralized in the BRAS for HSI, but translated and upgraded to address the stringent QoS, security, accounting, authentication, scalability and service availability demands of Triple Play rollouts.

Alcatel's TPSDA also provides the pre-integration of element, service and subscriber management required for the fast and efficient configuration and "single click" activation of Triple Play services with minimum risk and short time-to-market.

Optimizing the Triple Play Service Delivery Architecture

The goal of the Triple Play service infrastructure is to accommodate high-performance broadcast TV and video-on-demand services, real-time voice/multimedia, and high-bandwidth Internet access services. The fundamental challenge is that these two dimensions of scalability work against each other. In order to be scalable, it is necessary to distribute functionality in the network. However, if unnecessary functionality is too widely distributed, inefficiencies drive up costs.

To achieve both scalability and cost-effectiveness, the right functionality must be optimally distributed to meet the service requirements, managing per-user QoS, security and billing scales by pushing queuing, scheduling, accounting and filtering closer to the subscriber (see *Figure 3*). Bandwidth scaling, especially for the second mile, is optimized by performing multicast packet replication throughout the network (access, aggregation and edge nodes). Growth in unicast video-on-demand services is achieved by ensuring that the aggregation node capacity can be scaled to hundreds of gigabit Ethernet ports.

Alcatel has capitalized on its operational experience and expertise as a service and solution integrator to develop a new type of Triple Play service infrastructure. Triple Play service delivery architectures must be based on a comprehensive, purpose-built product portfolio that helps operators to flexibly distribute the required intelligence throughout the network. The required intelligence can be activated in each part of the network (access, aggregation or edge) according to the optimal cost and function set required by any given operator.

Service Reach
The capability for a service provider to deliver services to more customers because of flexible equipment practices, products designed with the right modularity, and optimized cost structures.

The TPSDA offers the following key benefits:

- service flexibility;
- non-stop service delivery;
- service reach.

Service flexibility

Operators are working on new service delivery architectures that will be the foundations for their service roll-outs for both the consumer and business markets over the next five to ten years. Therefore these architectures need to be highly flexible, service-rich and dependable resource pools, which will allow service providers to engage in rapid innovation and deployment without requiring the complete re-architecturing of their services or the installation of new equipment.

Operators must not be locked in to any specific operational model, and must be able to scale existing and new services to adapt to demands for increased bandwidth and subscriber numbers, improved QoS, and new types of networking functions, without affecting performance or service levels or requiring a network/service re-architecture.

This allows operators to cost-optimize their service infrastructures and optimize each policy to determine where it can scale cost-effectively. Service providers must also be given the opportunity to "right-size" their infrastructures over time to optimize their CAPEX.

Non-stop service delivery

Video and audio services are always-on services that cannot accept unpredictable network recovery timeouts and best-effort QoS implementations. Unpredictable behavior can result in a user perception of poor video quality, and eventually increase customer churn.

Operators require a highly-available infrastructure foundation that will enable them to build their brand equity through the flawless achievement of the required service level guarantees. Such a foundation should be based on products designed to exceed the most stringent reliability demands of service providers, with hardware and software architectures designed for maximum uptime. It should provide millisecond-level service recovery or restoration mechanisms at the path, link, node and network levels, for the infrastructure control, forwarding and management planes.

Security is a further key element in ensuring service continuity or non-stop services. Security enablement across the access, aggregation and edge networks provides the operator with mechanisms that guarantee an assured user experience while containing denial of service and theft of service attacks.

Service reach

The success of Triple Play and rich media services depends on the ability to provide more interactivity than traditional broadcast video networks offering user-centric broadband services – that is, any content, to any user at any time. This flexibility results in a diversity of access technologies. Consequently, the broadband network must operate with multiple access types in order to reach all subscribers, in both the fixed and mobile environments. This results in a mix of technologies, including central office based DSL (multi-ADSL); Fiber To The Node (FTTN), that is, ADSL2+, Very high speed DSL (VDSL) and VDSL2; Fiber To The User (FTTU) based on a passive optical network; 3G mobile; WiFi; and Worldwide interoperability for Microwave Access (WiMAX).

The key challenge for operators when introducing these technologies is to minimize their operational impact, that is, to maintain a unified access network. Ideally, therefore, access nodes should share the same equipment practice, provide interchangeable blades, typically run the same software, and present a unified interface towards the aggregation network. This allows operators to rationalize their networks and to simplify their operations in the aggregation and edge networks.

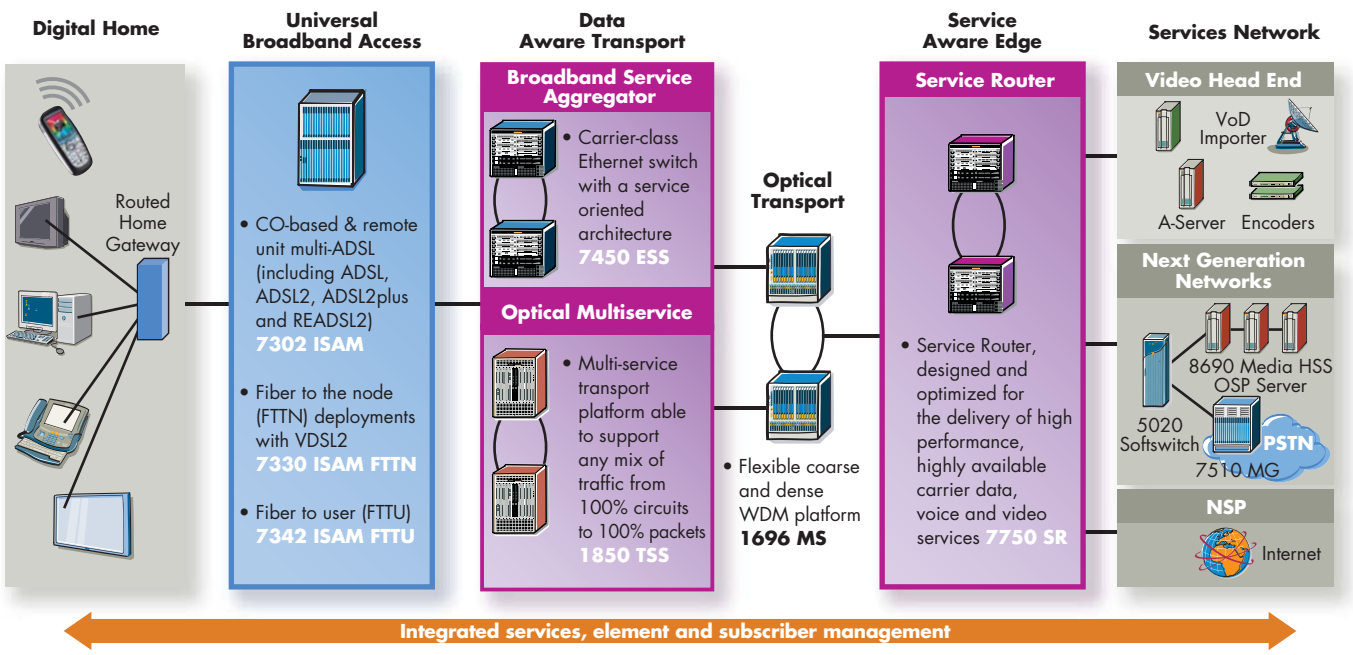
Thanks to the availability of carrier-grade, multi-purpose Ethernet service switches and optical platforms, the aggregation network can also deliver business services on top of the residential services infrastructure, maximizing the return on investment for Triple Play networks. A single infrastructure can, for instance, deliver residential Triple Play services, next generation network multimedia/voice over IP applications, Layer 2 / Layer 3 managed enterprise services, such as the Virtual Private LAN Service (VPLS), and IP Virtual Private Networks (VPN), as well as storage services and legacy Time Division Multiplex (TDM) services.

Making it Happen

To make the TPSDA a reality, operators require a set of purpose-built products designed for multiple services delivery from day one:

- In the access area, operators will have to mix access technologies and form factors to cost-effectively provide Triple Play services to the majority of their customers. The access network should also be non-blocking to guarantee the delivery of user-centric Triple Play services to all subscribers. With IP underpinning Triple Play, it is increasingly important for the access node to be a native IP platform that is aware of the IP services, as the access node has an integral role in guaranteeing end-to-end service quality and enforces strict priority QoS for voice and video services. As the network element closest to the subscriber, an IP-aware access node also helps increase overall security by preventing spoofing as well as denial of service and other malicious attacks from propagating in the network in conjunction with the broadband service aggregator.
- The aggregation network must not be a bottleneck between the access and the edge. It has to rely on robust carrier-grade equipment with enough capacity and rich service capabilities to handle the stringent requirements imposed by Triple Play service roll-outs at hundreds of gigabits per second. Whether it is based on Ethernet service switches to deliver the broadband service aggregator function (hierarchical QoS, multicasting, anti-spoofing / theft of service, security, accounting etc), or combined with multi-service optical platforms, it has to provide the service and bandwidth scalability (up to hundreds of Gbit/s) and millisecond service recovery capabilities required by always-on services. In addition to rich per-subscriber capabilities, the aggregation network should also provide per-service QoS enforcement to prioritize traffic and optimize bandwidth usage, whilst assuring optimal service delivery upstream through hierarchical scheduling. For instance, a best-effort service level agreement can be defined for HSI, while latency-sensitive applications, such as voice, and jitter-sensitive applications, such as video, can be supported by a built-in QoS mechanism that can respond intelligently to changes in actual traffic patterns. This mechanism can also enforce the relative traffic priority based on configured committed information rates and peak information rates within and across various types of service.

Figure 4: Enabling products for Triple Play Service Delivery Architecture



- At the service edge, operators need a Broadband Service Router (BSR) designed and optimized for the delivery of high-performance data, voice and video services. This flexible service delivery platform should provide purpose-built, highly available software and hardware architectures that allow network operators to right-size their service infrastructure build-out, yet provide the necessary service, packet processing and bandwidth headroom that allows them to scale service and policy instances, subscriber count and bandwidth without compromise. The BSR is the IP edge optimized for always-on Triple Play service delivery. It terminates the Layer 2 access and routes over IP with support for a full set of Multi Protocol Label Switching (MPLS) and IP routing protocols, including multicast routing, Protocol Independent Multicast – Sparse Mode (PIM-SM), Internet Group Management Protocol (IGMP), non-stop routing, non-stop services, VPLS, Control Processor Module Queuing (CPMQ) (for denial of service containment), per-service hierarchical QoS and much more. The BSR is a high-capacity service router supporting hundreds of Gigabit Ethernet ports and sophisticated QoS mechanisms for per-service and per-content/source differentiation.

Alcatel can deploy an end-to-end solution that offers the flexibility and cost-effectiveness operators want, while delivering services with superior quality and reliability

With its Intelligent Services Access Manager (ISAM) family, optical transport platforms (Optical Multi-Service Nodes, 1850 Transport Service Switch and MetroSpan), 7450 Ethernet Service Switch (BSA function), and 7750 Service Router (BSR function), Alcatel can deploy an end-to-end solution that offers the flexibility and cost-effectiveness operators want, while delivering services with superior quality and reliability (see *Figure 4*). Alcatel also provides pre-integrated element, service and subscriber management solutions within its comprehensive management portfolio.

All Alcatel platforms in the Triple Play service delivery architecture were designed to exceed the stringent demands of new types of service infrastructure roll-out. The Alcatel portfolio has been proven and hardened in the largest production networks worldwide.

Conclusion

While service providers are diving into Triple Play to protect their customer bases and increase revenues, they face a transformation not only in their businesses in terms of the new types of service they are offering, but also in their networks. The access and aggregation networks are moving from the Asynchronous Transfer Mode (ATM) to Ethernet to support increased bandwidth requirements in a cost-effective way. Alcatel recommends that the functions that were traditionally implemented in a central BRAS should be optimally distributed across the service delivery architecture. This model, known as the Triple Play Service Delivery Architecture (TPSDA), has been implemented in the world's largest Triple Play deployments. Alcatel has implemented over 20 IPTV projects around the world with leading fixed service providers in every region, including SBC's Lightspeed project.

The key differentiators of TPSDA are:

- Non-stop service delivery: TPSDA guarantees the experience expected by users, who demand service continuity, image quality, etc. as a matter of course;
- Service flexibility: TPSDA enables right-sized deployments that can grow cost-effectively to support mass market service roll-outs. It also provides the key service capabilities across the network so that policies can be optimally activated across different nodes as traffic patterns and services evolve. This allows service providers to cost-optimize their service infrastructures and optimize each service so that it can scale cost-effectively

over time. TPSDA also provides the service, packet processing and bandwidth headroom that will allow service providers to add innovative new services without requiring a complete re-architecture of services or the deployment of new equipment;

- Service reach: TPSDA enables services to be delivered to more customers over any access method with the same, predictable, rich capabilities. Moreover, it can support both mass-market consumer services and demanding enterprise applications.

Future new services, bandwidth demands and an ever-increasing customer base can all be catered for within the Alcatel architecture, whilst QoS and cost optimization can be simultaneously maintained. TPSDA therefore allows operators to concentrate on attracting and retaining customers through their service offerings, and by leveraging the brand equity generated by their ability to deliver services flawlessly.

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Glossary

BRAS Broadband remote access server
HSI High speed internet
VoD Video on demand
VoIP Voice over IP
ATM Asynchronous transfer mode
BTV Broadcast TV
ARPU Average revenue per user
TPSDA Triple-Play Service Delivery Architecture
FTTN Fiber to the node
FTTU Fiber to the user
PON Passive optical network
POTS Plain Old Telephone Service
TDM Time division multiplexing
E-Line Ethernet line
E-LAN Ethernet local access network
VPLS Virtual private LAN services
SAN Storage area network
DSL Digital subscriber line
CPE Customer premises equipment
PPP Point-to-Point Protocol
QoS Quality of services
SLA Service level agreement
CAPEX Capital expenditure