The Next Generation of Residential Gateways

A Market and Technology Whitepaper

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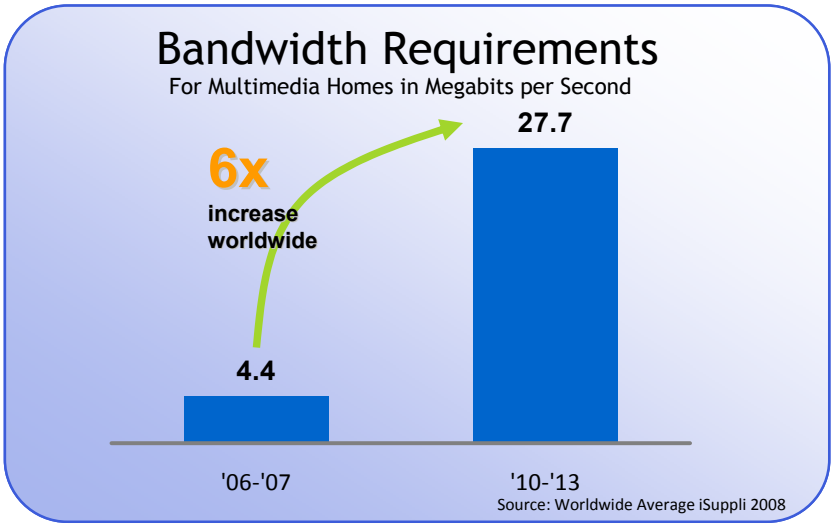
Established telephone companies and competitive access providers worldwide are rushing to offer value-added video, voice and data services to their subscribers. However, before these service providers can deliver new suites of services, they must upgrade their subscriber access loops to VDSL2 or optical transmission. They also will need to redefine the termination of these loops at the subscriber dwelling. This white paper examines the drivers behind the transition of carriers to multimedia service providers and its effect on the residential gateway.

The Drivers

Stagnant revenues and subscriber erosion of an alarming eight percent per year is creating an environment of change for telephone companies and competitive access providers worldwide.

Service providers understand that content, not connectivity, is the key to increasing revenue and reducing subscriber erosion. The vision of many telephone companies is to extend their network into the digital home, using their network to offer innovative, value-added services to the consumer. Telco TV is just the beginning, iSuppli believes. Music, gaming, distance learning, home network maintenance, peer-to-peer content sharing and storage backup are some of the other services telephone companies are investigating.



These new applications are driving a need for increased bandwidth to be

delivered to homes in every region. And this requirement can only be addressed through the implementation of transport technologies like VDSL2 —which is capable of 100 megabits per second (Mbps) symmetrical throughput — and passive optical networks (PON), which provide a path to gigabit per second (Gbps) performance.

Each region, of course, will require its own unique bandwidth levels. However, there is a common denominator for all regions. To accommodate value-added services, network operators need to migrate their access networks to a hybrid architecture in which fiber is deployed to the neighborhood and VDSL2 is used to reach the home or fiber is extended directly to the home (FTTH). These are the only architectures that support both the downstream and upstream bandwidths capable of supporting value-added services.

Becoming a value-added multimedia service provider places telephone companies in direct competition with cable and satellite service providers. Even so, telephone companies have several advantages. First, motivated by survival, they have a will to succeed. Without new revenue streams, they know they will perish. Second, they have a worldwide subscriber base of more than 1 billion consumers —275 million of which use broadband. Third, they have high bandwidth capacity Internet protocol (IP) networks that they can use to deploy video services. Specifically, they can deploy IP television (IPTV) coupled with switched digital video technology, which provides telephone companies with a significant differentiator in enabling innovative services.

One of the primary incentives for telephone companies is an IPTV service revenue stream that is expected to reach $44 billion annually by 2012, as projected by iSuppli. However, telephone companies must still overcome two critical hurdles before IPTV becomes a ubiquitous product offering. The first hurdle is to increase the capacity of the broadband pipe to the consumer. The second is to determine how to terminate the broadband pipe at the consumer's dwelling. To meet the first challenge, telephone companies are upgrading their access networks to VDSL2 or FTTH, creating an infrastructure that enables value-added services. The introduction of a new class of customer premises equipment – the next-generation residential gateway (NGRG) will overcome the second hurdle.

Battle for the Digital Home

Telephone companies expect the NGRG to be the home router and potentially the home media server. Over time, the NGRG could control IP-set top boxes (STB), offer personal video recorder (PVR) capabilities and integrate home automation services, such as security, heating and air conditioning control, power management and other new services for the digital home. For telephone companies, the NGRG is strategic to their pursuit of being the multimedia service provider of choice for the consumer. Telephone companies plan to offer bundles of services from voice and data to video and home network management, as they try to obtain a disproportionate amount of consumers' multimedia spend. The telephone companies are not alone in the quest for the digital home spend.

The NGRG is necessary for this strategy to succeed. Therefore, it is important that the NGRG not only be capable of supporting video service today, but that it also offers the performance to support new services the telephone company may offer in the future.

Because the NGRG is strategic to the success of the telephone company, iSuppli expects each of the major telephone companies to define their own set of requirements for NGRGs.

The table below lists the key functions for the NGRG.

Key Functions of the Next-Generation Residential Gateway

Function	Summary
Voice Control Center	▪ 2 to 4 VoIP channels ▪ Fixed mobile convergence (cellular and 802.11) ▪ Supports: SIP, MGCP, IOS, H.323 ▪ Supports vocoders: G.711, G.726, G.729ab and programmable ▪ Standard interface for TDM/PCM30
Access Technologies	▪ Supports all broadband technologies (via SKUs): ADSL2+, VDSL2, FTTP (EPON, GPON), WiMAX
OAM	▪ Servers with locally attached or network attached storage (optional)
QoS	▪ Include intrahome flows as part of the quality of service (QoS) scheme ▪ Supports downstream QoS, upstream QoS, and prioritizing intrahome traffic with respect to access network traffic; ▪ Supports QoS remarking of LAN-side traffic. Unique QoS per flow, minimum of four levels of priority and 12 to 20 unidirectional flows; ▪ Bridge between WAN QoS scheme and LAN QoS schemes (i.e.: 802.11e, 802.1p/Q).
Performance	▪ Routes content at wire speeds (down stream 100 Mbps, upstream 100 Mbps and home network 150 Mbps)
IGMP Support	▪ IGMP-multicast group, (upstream multicast supported), IGMP Proxy-Multicast
Home Networking	▪ Interfaces to home networking devices: HomePNA, HomePlug, MOCA, DS2, 802.11 a,b,g,n; future G.hn
I/O	▪ I/O: USB 2, PCI, PCI v2.3 host interface, Ethernet 10/100 and Gig. E [MII, GMII, integrated Phy(s)], integrated Ethernet switch
Encryption and Security	▪ Supports encryption: DES, 3 DES, AES; Management system and HG both need to be authenticated ▪ Supports specified (and updatable) list of application layer gateways (ALGs) ▪ Provides a firewall (home network security: firewall, ALGs, DoS protection) ▪ Access control per service, per user and per device ▪ Unique (gateway) hardware ID ▪ Secure remote (WAN-side) access to appropriate devices (e.g. a security camera) ▪ Different classes of user with regard to management access rights

NGRG Performance

Several, but not all, of the key functions mentioned in the preceding chart exist in today's broadband routers. Performance in terms of packet throughput and remote diagnostics are the major differentiators between NGRG and the current family of CPE.

Not all functions above will necessarily be provisioned for a given household at the same time and if provisioned, not all will be operational at the same time. However, for the worst-case analysis, iSuppli has assumed that they are all provisioned and operating concurrently.

The difference in bandwidth demand by region varies not only by applications and need, but also culture. In Japan and Korea, subscribers demand the highest bandwidth available, even if it cannot be utilized in a meaningful way. In these regions, the provider that has the fastest pipe is the winner. Subscribers are willing to pay for the right to receive higher bandwidths. These differences are reflected in the bandwidth assumptions.

By 2009, residential gateways supporting multimedia services in many regions of the world will require peak throughputs of 150 Mbps or more. For original equipment manufacturers (OEMs) and silicon suppliers, building products that can accommodate traffic up to 300 Mbps would appear to offer adequate headroom and therefore be a reasonable objective. However, many telephone service providers are requiring much higher performance from their NGRGs. OEMs need to realize that the NGRG is strategic to each telephone company's objective of being the preferred multimedia content provider for the digital home. Several telephone companies are specifying performance not based upon today's envisioned application, but rather on total possible throughput based upon wire speeds. For VDSL2, this would imply that the NGRG would, at a minimum, handle 200 Mbps of traffic between the WAN and the home network and up to 150 Mbps for home networking traffic over wire (MOCA, HPNA 3.0, HomePlug AV etc.) and another 50 to 100 Mbps of traffic over the 802.11n network. Therefore, OEMs and silicon suppliers' target needs to be in the 450 Mbps or greater range. When the NGRG is terminated to the WAN via a fiber connection, the performance of the router could be specified up to one gigabit in performance.

Silicon providers are faced with the challenge of providing the required performance from the telephone companies' perspective while holding the average selling price (ASP) at a level telephone companies find acceptable.

Provisioning and Monitoring

To provide video services, telephone companies need complete remote management capability for the residential gateway, the home network and the STBs. Having this remote management capability will enable telephone companies to service customers without having to roll a truck, in most cases. Establishing viable video services with remote management control provides telephone companies with a beachhead within the home from which they can launch additional suites of services.

NGRGs will provide provisioning and monitoring capabilities in addition to those specified via the DSL Forum's TR-069 CPE WAN Management Protocol.

NGRGs also will be compatible with the Device Discovery, Control and Media Management protocol as recommended by the UPnP forum (http://www.upnp.org/) and several other recommendations, such as the Digital Media Renderer (DMR) devices and Digital Media Server (DMS) classes established by the DLNA (http://www.dlna.org/en/consumer/home).

For more detailed information on the technical reports issued by the DSL Forum, please visit http://www.dslforum.org/techwork/treports.shtml.

Quality of Service

The NGRG will handle QoS on traffic from the home to the WAN and within the home. Today's gateways can handle downstream traffic quite efficiently. The network knows the nature of the session and can use virtual local area network (VLAN) tags to designate the QoS profile for a given data stream. In addition, the destination port within the home can be used to define the QoS profile for any given session. Via remote provisioning, the service provider will be capable of setting the IP-STB port to a specific QoS profile to provide very high queuing priority, zero packet

loss (forward error correction) and the use of latency channels. Traffic directed to the voice port could be assigned the highest queuing priority and the use of the fastest path channel. iSuppli expects that between four and eight such profiles for downstream data will be sufficient for several years.

The upstream data path is more challenging. This capability differentiates the NGRG from previous gateways. Knowing the source address of the packet may not be sufficient in all cases. It will be necessary in certain instances to examine the packet to recognize the application, such as a change of video channels, and to provide the corresponding QoS profile for the packet. This packet examination will need to be performed at line rates. Additionally, this same requirement will be required for traffic routed within the digital home. The advanced ability to route traffic at line rates and to provide the required QoS profile for each data stream is a major feature of the NGRG.

Media Servers with Network-Based Storage

NGRG's also offer the potential to evolve into the media server for the digital home of the future. Several telephone companies are studying the possibility of adding disk storage into the NGRG for this application. The difficulty in using this approach is that consumer storage requirements vary widely and will increase substantially over time.

For the NGRG supplier, the ability to provide upgradeability to a network attached storage device via a USB port is sufficient, if not superior, iSuppli believes. The IP-STB, which also is defined by the telephone company, will be the telephone companies' choice to take on the role of the media access server over the next few years, iSuppli believes.

At least one version of an IP-STB will have an integrated disk. The IP-STB will be able to share content over the home network with other IP-STBs and perhaps other digital living network alliance (DLNA)-enabled consumer networked appliances. The question of digital rights management (DRM) must be solved before all content can be shared, but open or personal content does not require DRM.

For OEMs, the only sure path is to continue to work very closely with the telephone companies and be in a position to integrate the media server application into the NGRG when required.

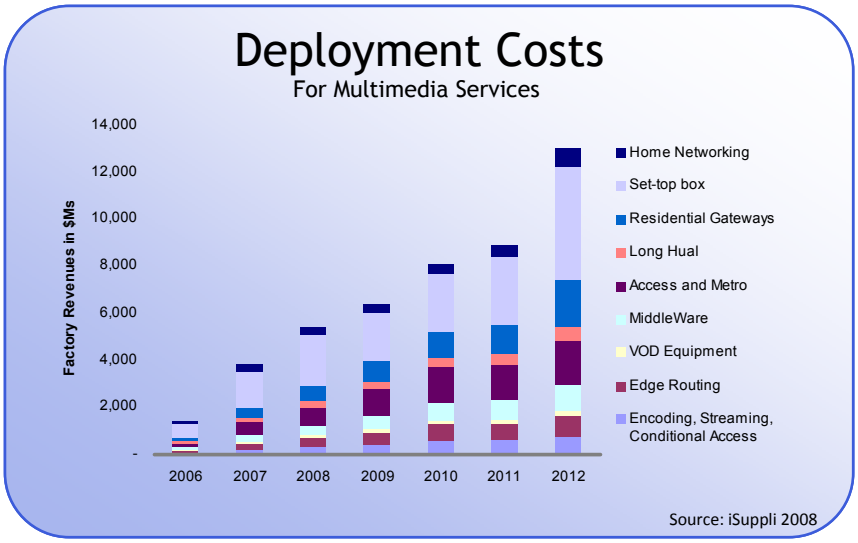
Integration of Home Networking

Networking over the home's wired infrastructure will continue to be defined by the service provider. Many service providers will require multiple solutions, and as a result, a single ubiquitous technology will not emerge. Rather than a single “killer” technology, several adequate technologies will be deployed. The determining factor will be the region in which it is deployed and the applications that require the interconnection. For instance, in North America—where coaxial cable is plentiful—telephone companies may settle on HomePNA (as AT&T has chosen), while cable operators and Verizon may settle on MoCA because of its ability coexist with cable traffic already on the coax. In Europe and parts of Asia, where coaxial cable is not available and Wi-Fi has challenges, power line could become the pervasive choice. However, it is still too early to determine if power line will be dominated by HomePlug or UPA technology or a new technology that ultimately prevail. Global standards issued by the leading standards bodies, including IEEE or ITU, are a necessary, but insufficient, condition for the growth of multimedia home networking. There must be multiple silicon providers offering interoperable standards-based solutions before the market can reach its growth potential, iSuppli believes.

For OEMs the message is clear: Only integrate the home networking function (other than 802.11x) if it is a requirement of the telephone company. For generic products, provide at least one Ethernet and one USB connection to enable attachment with almost any home networking device.

Cost to Deploy

The transition from voice and data to multimedia service provider will not come cheap for the telephone company. iSuppli projects that the worldwide equipment and software investment required to provide multimedia services will reach $5.4 billion by the end of 2008 and will grow to $13 billion by 2012.



The residential gateway (modem and router) will account for 15 percent of the total equipment and software capex by 2012, making it the second most expensive item in the delivery of multimedia services to the IP-STB. Further integration of additional capabilities into the residential gateway will be required to reduce deployment costs and provide a platform for the delivery of the new revenue-generating services, iSuppli believes.

Last Words

The market for next-generation residential gateways depends on two major factors: first, telephone companies must successfully transition from voice and data providers to multimedia suppliers; second, consumer must accept NGRGs as the primary hub for the digital home.

The principal differentiator between today's gateways and the next generation of gateways will be performance of the processing capability. The NGRG must not only be able to meet the needs of value-added services envisioned by telephone companies today, but they will need the added head room to accommodate services that may be introduce during the next several years.

iSuppli forecasts that both telephone companies will evolve to multimedia companies and consumers will adopt NGRGs in the home. The NGRG is an integral part of service providers IPTV network strategy. Cost performance will be a critical issue for service providers, with NGRG comprising 15 percent of the IPTV equipment capital outlay for service providers. As an integral component of the service providers' broadband network, the NGRG will need to be managed by the service provider as another network element.

The IPTV market directly affects the NGRG market. As IPTV homes grow, so will the demand for NGRGs. iSuppli is forecasting IPTV households worldwide will grow from 10 million at the end of 2007 to 91 million by 2012.

By 2012, the demand for NGRG will reach 35 million per year. These 35 million NGRGs will be highly integrated devices that enable the lowest cost home router while providing extraordinary performance for the service provider.

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