WHITE PAPER

Texas Instruments

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Next-Generation Residential Gateways:

Flexibility and High-Performance will be Critical

Introduction

Increasingly, homes are being populated with a divergent array of digital devices, multimedia applications, networked appliances, voice and data communications platforms, entertainment systems and much more. All the while consumers are acquiring more and more digital content, which often enters the home through broadband access to the Internet, is subsequently moved and shared among the devices in the home, and eventually may be transferred outside the home via the Internet or by loading it onto a portable consumer device.

The need to make sense of this situation and maintain some semblance of order has given rise to home networks, both wired and wireless. But centering a home network on a DSL or cable modem even if they have an integrated wireless networking router, or, for that matter, a personal computer, is not the answer. The complexity caused by the presence of more and more digital devices and the sheer quantity of multimedia content requires a managed approach. Such a solution would be more capable of supporting the ever increasing need for higher data throughput rates, signaling range that covers the whole house and robustness capable of mitigating the sources of interference found in the home.

The next-generation residential gateway (RG) will serve these needs. More importantly for the service providers that deploy them, advanced RGs are critical for coping with the uncertainties of the marketplace while reducing operational costs and providing an effective platform for launching a host of new revenue-generating services. And for the equipment manufacturers who will provide them, next-generation RGs must have a reconfigurable and flexible architecture that can adapt to the requirements of telecommunications service providers and cable companies in every region of the world.

What Consumers Want

Consumers can be greedy. As more homes have installed broadband access to the Internet in recent years, consumers have found that they enjoy the faster speeds considerably and that they want to do more. Unfortunately, the higher bandwidth was typically connected directly to the home's primary personal computer, limiting residents' access to the higher bandwidth.

To distribute the broadband bandwidth more effectively, home networks, and specifically wireless home networks, increased in popularity. Eventually, standalone wireless local area networking (WLAN) routers and access points gave way to DSL and cable modems with integrated WLAN connectivity. The first glimmer of an RG emerged.

At the same time, consumers were putting their newfound bandwidth to good use. Laptop computers could easily connect to the home network. Voice over IP (VoIP) phone systems, interactive video gaming consoles, printers and other devices could access the Internet directly by way of the home's WLAN. Other types of digital devices like portable MP3 and DVD players/recorders were relegated to ad hoc connections to the home network by way of an intermediary device such as a PC.

Over time and as more digital devices with their multimedia content enter the home, the unmanaged and ad hoc connections throughout the residence could show signs of strain under the sheer weight of the applications and data flow. As this happens, consumer frustrations and dissatisfaction could rise as well.

Enter the Next-Generation RG

Some of the critical characteristics of the next-generation RG will be:

- Significant processing power to handle multiple, voice and high-throughput data streams, many of which may have their own distinct requirements for quality-of-service (QoS), security and other parameters.
- Flexible architecture and adaptable configuration options to tailor the RG to the particular needs of a home, various segments of consumers, each service provider's unique requirements, and the restrictions of regions and countries throughout the world.
- An open platform architecture for supporting any of a myriad of wide-area-networking (WAN) technologies outside the home as well as the many local area network (LAN) technologies that could be deployed inside the home, ultimately enabling maximum system reuse on a market-by-market basis.
- Expandability with advanced capabilities and additional resources for integration of various value-adds such as a hard disk drive (HDD) for high-end functionality.
- A software framework that ensures cost-effective code re-use across various RG platforms.
- Embedded management capabilities for ensuring QoS over internet protocol (IP) networks.

In addition to being the centerpiece of a home's network, next-generation RGs will be the lynchpin in the digital home's voice communications capabilities as well. An advanced gateway with voice channels gives telecom service providers the ability to migrate their customer base from analog plain old telephone service (POTS) to digital VoIP, which brings lower operating costs and a more effective means for rolling out new revenue-generating services, such as second and third phone lines.

In some cases, the RG will support standard POTS replacement VoIP, but in others the RG will function as a platform for fixed-mobile convergence (FMC). For example, the homeowner carries a Wi-Fi®-enabled mobile phone with him. When he returns from work at the end of the day, the mobile phone senses the WLAN that's controlled by the home's RG. The mobile phone associates itself with the home WLAN and functions as a cordless VoIP phone until it leaves the range of the network the next morning. At that time, it functions as a typical wireless mobile phone would, handling calls and Internet access over the cellular network. The importance of FMC will accelerate significantly throughout the rest of the decade. The market research firm iSuppli found that 22 million mobile phones featured Wi-Fi connectivity in 2006, and that by the end of the decade that figure would grow to an astounding 285 million.

Of course, many telco service providers are eyeing IP television (IPTV) service as a prime function for the next-generation gateway. Since cable companies are now offering voice services, it is perfectly logical for telco companies to defend their turf by offering as many services as possible, including TV programming. Indeed, next-generation RGs will give service providers the ability to supplant their competition by meeting all of a home's entertainment, communication and networking needs.

Routing, managing and guaranteeing the bandwidth for multiple IPTV feeds directed to the several television sets that are typically found in today's homes will test the performance capabilities of the home's RG. Instead of the managing the QoS for VoIP channels running at a rather mundane 64 kbps, the gateway could be asked to control multiple HDTV-H.264/V1 streams each operating at eight Mbps or more. High-performance video processors or cores will be essential to the sophisticated next-generation RG.

In addition, broadcast-quality video will require the presence of wired interfaces on the RG for the foreseeable future. Until the throughput rates, security features and QoS capabilities of WLAN technology has progressed sufficiently, RGs will need to support both WLAN and wired technologies. Under some conditions, WLAN may be appropriate, but in others, such as high-definition video with stringent QoS requirements, wired interfaces will be better suited over the short-term. Besides standard wired Ethernet or some sort of proprietary solution, the wired technologies that are currently being examined include those championed by Multimedia over Coax Alliance (MOCA), Home Phoneline Networking Alliance (HPNA), HomePlug Powerline Alliance (HPPA) and the Universal Powerline Association (UPA).

The wide variety of high-bandwidth applications that will be managed by a next-generation RG argues for a high-performance device embedded in the home and capable of handling just about anything that's thrown at it. But, of course, not all consumers will want everything that's offered to them. That means that the RG of tomorrow must have a flexible architecture capable of adapting both its hardware and software to meet a narrowly defined set of requirements without burdening segments of the marketplace with costly yet untapped capabilities. Gateways with this sort of flexibility will complement nicely the marketing and deployment strategies of service providers.

Coping with Uncertainties

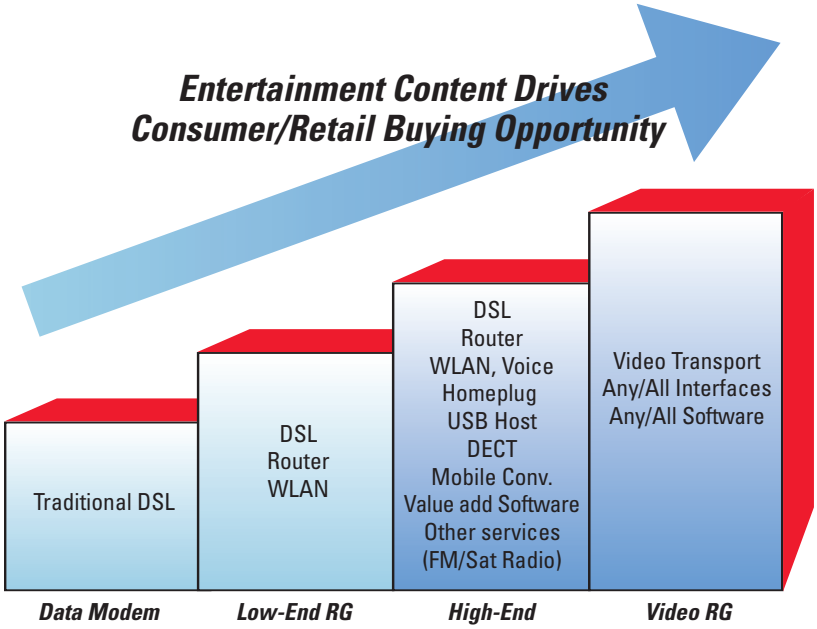
In horse racing and technology, picking winners is too often a losing proposition. For digital service operators, the stakes are too high and the risks too great to commit to one or a few technologies that may or may not find acceptance with consumers. Consequently, the architecture of next-generation gateways must be open and adaptable. Indeed, this architecture must have three-dimensional flexibility.

First, its internal hardware and software design structure must provide a base upon which resources and applications can be easily and cost-effectively added, subtracted and modified. Second, its outward-facing interfaces to the WAN must be adaptable in the event new technologies—like WiMax, a variation on optical networking or any other emerging technology—are deployed in the public network. And third, its inward-facing interfaces to the home LAN must be reconfigurable to give consumers different alternatives at various price-points and to ensure that the operator is not limited to a LAN technology that may not be accepted by home owners. This high degree of flexibility is also imperative for future-proofing the service operator's deployment investment.

Possible Interfaces on Next-Generation Residential Gateway

LAN Interfaces	WAN Interfaces
• Wi-Fi/WLAN • Wired Ethernet • Power Line • Coaxial Cable • Phone line • USB	• Phone Line (ADSL, VDSL2, etc.) • Coaxial Cable (DOCSIS) • Wireless (WiMAX, Broadband Wireless, etc.) • FTTx (GPON, EPON, etc.) • Power Line (UPA, etc.)

An adaptable, reconfigurable gateway platform will also complement service operators' segmentation strategies. Consumers have diverse tastes and preferences. One size RG will not fit all consumer needs. Some may only be interested in VoIP replacement for analog phone service. Other consumers will want a basic home network, and still others will need a gateway with local storage where movies, music and other content can be accessed anywhere in the home through the local network or anywhere in the world by way of an Internet connection.



Always a critical consideration for any consumer marketplace, ease-of-use will have a decided influence on the architecture of next-generation RGs. By and large, consumers will want to hand over day-to-day responsibilities for their home networks to digital service providers. The working of the gateway must be relatively transparent to consumers or it will not be acceptable. Studies have shown that a set-up and configuration time of longer than 30 minutes will cause many consumers to give up and return the electronic device to the retail outlet where it was purchased.

To facilitate cost-effective installation, support and maintenance by service providers, next-generation gateways will be equipped with software subsystems that allow remote management and provisioning. Of course, this process will be complicated by the fact that many devices connected to the home's network will not fall under the purview of a service provider, yet consumers will likely request support from the service provider when these devices do not function properly. Consequently, the support and management mechanisms built into the gateway must include visibility beyond the gateway box itself and, where possible, into the attached devices and applications. Then, at the very least, service providers can direct consumers seeking support to the appropriate parties.

Flexibility Rules

Many of the considerations that are driving service providers toward gateway platforms with a high degree of flexibility are having similar effects on equipment manufacturers. Manufacturers also strive to minimize risks and maximize opportunities. That means investing development dollars into a next-generation gateway with the largest possible marketplace potential.

Most manufacturers serving consumer markets out of necessity adopt segmentation strategies to ensure they provide products that meet the narrowly defined needs of distinct consumer groups. To do otherwise would be to court failure. However, gateway manufacturers can adopt a flexible base architecture that can be cost-effectively reconfigured across all consumer segments from low-end data-only platforms to high-end advanced multimedia gateways with local storage facilities. By doing so, the return on investment in a base gateway architecture can be recouped much faster since it is spread across a much larger marketplace. A next-generation RG with such a base architecture gives equipment manufacturers the agility they need to not only attack all segments of consumers but also enter regions or countries that have unique restrictions or requirements.

Software re-use is another way to ensure gateway manufacturers will achieve a rapid return on their development investment. A complete software framework that comprehends all variations of the base hardware architecture is a necessity for executing a segmented and global marketing strategy. An open operating system familiar to developers worldwide as well as software tools like application programming interfaces (API) and code-generating tools are also needed. The availability of portable digital media modules like coders/decoders (codecs), video processing modules and others that can be readily dropped into any of many hardware designs will significantly reduce a gateway manufacturer's time-to-market as well. More importantly, with capabilities finely tuned to each segment or region, a gateway will be primed for success in the competitive marketplace.

TI's UR8 Architecture for Nex-Generation Residential Gateways

Texas Instruments' (TI) UR8 architecture serves as the foundation for an entire family of next-generation RG solutions that fulfill the expectations of consumers, service providers and equipment manufacturers. With its many years of experience in broadband communications, home networking, multimedia processing, VoIP systems and software, digital signal processing, media software development and other pertinent technologies, TI is certainly the only technology supplier capable of bringing all of these disciplines to bear on RGs. The result is the UR8 architecture, an open platform with exceptional voice capabilities, high-performance data communications, and advanced multimedia and video processing.

With its easily interchangeable hardware and software configuration options, the UR8 slashes development time for equipment manufacturers and gives service providers a cost-efficient yet powerful platform for new revenue-generating services, as well as advanced maintenance and support programs. With the programmable voice subsystem of the UR8, manufacturers can leverage TI's extensive voice codec library and Telogy Software™ for VoIP. Included in the codec library are wideband, wireline and wireless codecs, as well as advanced features such as fax and modem relay, packet-loss minimization and noise-reducing algorithms.

For More Information

For more information on TI's residential gateway solutions, please visit **www.ti.com/broadband**

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