Cable's Connected Future: Modems Morph Into Home Gateways

Abstract: Cable modems are evolving into higher-functionality home gateway and networking devices that will support a range of emerging managed home network data and entertainment services.

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Strategic Market Statements

Shipments of cable modems — embedded and stand-alone — are expected to reach approximately 20 million units annually by 2006.

There were more than 6.2 million multi-PC households with home networks as of June 2002, and the number has significant potential to increase as wired and wireless technology standards emerge and service providers start to offer managed home network services.

Broadband subscribers via cable modems reached more than 13.3 million in North America at the end of 2002 and are expected to approach 30 million subscribers by the end of 2007.
Introduction

The vision of the future connected home conjures up a scenario where, through the power of a seamlessly integrated, centralized network, all members of a household have convenient, secure, high bandwidth and always-on access to all entertainment, communications, and personal content. This content is also highly customizable to their preferences, seamlessly transferable to all or many different voice, video and data-centric devices and platforms — wired and wireless.

The reality is disparate devices and technologies for digital audio and video entertainment, mobile and fixed communications, and data services. Some of these devices or platforms, such as PCs and printers, are connected with each other, but most are not. The challenge for vendors and broadband service providers is how to reach this nirvana of seamless connectivity among and between devices and platforms expeditiously and economically. And, perhaps just as importantly, who will offer these services?

Some of the most complete and visionary thinking on the future of "connected" homes has been enunciated by consumer electronics and software companies, particularly Sony and Microsoft. However, cable broadband service providers are expected to play a role in providing some of the answers to the challenge of seamless broadband connectivity in the home.

While the larger issues spelled out in the vision are left for a separate discussion, the fundamental building blocks of seamless interoperability between communications, entertainment and information services delivered over broadband starts with the penetration of broadband access services and associated enabling technologies. This Perspective looks at the transformation of the cable modem into a higher-functionality device, and the cable home initiative that is expected to lead the way to better manageability and security of networking services to the residential consumer market.

State of the Market

Gartner Dataquest's consumer research for 2002 indicated that there were approximately 68 million PC households in the United States, more than 95 percent of which were connected to the Internet by some access technology. Among access modalities, broadband online households used cable modems by a margin of 3-to-2.

The number of U.S. households with multiple PCs is projected to grow at an 8 percent compound annual growth rate (CAGR) from 2001 through 2006. Gartner Dataquest estimates that 28 million, or one in four households, will have more than one PC in the home by the end of 2006.
Moreover, Gartner Dataquest’s U.S. June 2002 consumer survey results indicated that more than 6.2 million households said they had a home PC network. Further granularity on the type of networks installed in these 6.2 million, multi-PC networked households indicated that:

- Fifty-eight percent had a wired home networking through a hub or router.
- Thirteen percent had wireless home networking.
- Eleven percent had a network using existing telephone wiring.
- Eighteen percent didn't know what type of home network was installed.

**Cable’s Role in the Networked Digital Home**

The cable industry is pushing hard to move into a new realm of more pervasive managed home broadband services. While the sale of value-added home networking services is just starting to show on the radar screen for many cable operators, the technological foundations for more extensive services and applications are being built at CableLabs.

The CableLabs standard that made cable broadband modems possible — the Data over Cable Service Interface Specification (DOCSIS) — is now in its third generation, and the success of a standards-based approach is everywhere. Market demand for cable modems grew to more than 11 million units annually in 2002, and shipments are projected to reach more than 20 million units annually by 2006. Since Gartner Dataquest began tracking cable access devices in 1997, cumulative global shipments are estimated at almost 35 million units.

Cable’s most recent standards initiative is CableHome, which extends DOCSIS further into the residential environment. It is designed to develop an infrastructure for managed broadband home services that can support any available home network media and deliver services and applications in the most convenient manner possible. It defines how applications will be offered, including home networking, home automation and control, security, energy management, digital audio and video content delivery, and a host of other home-based services.

As with DOCSIS, CableHome seeks to reduce costs, time to market and system complexity for managed residential broadband services, and to allow cable network service providers to offer various tiers of services and support a baseline number of devices within those particular service tiers. CableLabs issued the first CableHome 1.0 specification in 2001 and started certification testing of products against that standard in October 2002. The International Telecommunications Union (ITU) approved CableHome 1.0 as an international standard in 2002 via document J.191.
Network Architecture

The CableHome standard is designed to enable higher levels of quality of service (QOS) and security, as well as troubleshooting and management of residential gateways for home networking applications. As a complete toolset, the CableHome standard allows cable broadband service providers to resolve the customer issue (for instance, the case of configuring the residential gateway to work properly for a particular network game) remotely.

In addition, CableHome has built-in tools that allow configuration of the residential gateway so that devices, which are not a known part of the customer’s environment, are hindered from gaining access to a consumer's Wireless Fidelity (Wi-Fi) network. The design protects against unauthorized snooping on Wi-Fi-based home networks. Figure 1 shows the CableHome network architecture.

Figure 1
CableHome Network Architecture

CMTS = Cable modem termination system
CPE = Customer premises equipment
HVAC = Heating, ventilation and air conditioning
CM = Cable modem
MPEG = Motion Picture Experts Group
Source: CableLabs
Future Service Opportunities

More than $70 billion has been spent to upgrade and rebuild North American cable networks since 1997. Naturally, multiple systems operators (MSOs) are eager to develop value-added services that leverage the power of these networks and sustainable business models that create incremental revenue streams, either directly or in revenue-sharing agreements with branded partners. Many operators, especially in the United States and Canada, are conducting trials or have already rolled out services to support networking multiple PCs. While increasing numbers of residential consumer teleworkers and small office/home office (SOHO) businesses are starting to see value in networking their home offices and possibly extending the broadband connection from their PC to their audio or video equipment, the challenge for the cable industry lies in how to get revenue beyond the monthly connection fee. Many are just going out to buy a Linksys router, for instance, and setting up the networks themselves. Cable is counting on the fact that, except for the technically savvy early adopter, home networking is too complicated a task that will require professional installation, support and maintenance.

What's envisioned is a host of other services (for example, home security and managed home network services, among others, with some offered in conjunction with partners such as Brinks or ADT for home security). Trials of more future-oriented services — medical monitoring, energy management and home automation — are increasingly finding their way into more cable MSOs, but business models are, as yet, undefined.

It is important to distinguish among regions, however, as the opportunity for cable is not equal everywhere around the world. Overall, DSL is more penetrated than cable globally, and in many instances, is offering higher data-throughput rates than cable to residential users. Japan already has 8-Mbps DSL services, and China, South Korea and Japan are deploying very-high-bit-rate DSL (VDSL)-based services. As a result of shorter loop lengths, most of Europe could already have 3.5 Mbps based on asymmetric DSL (ADSL), and higher data rates may be enabled with future ADSL standards. This eclipses cable's 1-Mbps to 3-Mbps throughput rates, even in the North American market.

Residential Gateway Technology

Residential home gateways are being designed as the key access platform through which cable broadband service providers will deploy a range of services, extending broadband connectivity deeper into the household. Devices now available reside between the cable broadband access network and the in-house network. A residential home gateway serves as the primary platform and point of convergence for different networking approaches — wired (home phone network alliance [HPNA] and home radio frequency [RF]) and wireless (wireless LANs, Institute of Electrical and Electronics Engineers [IEEE] 1394, 802.11g and so on).
The fundamental building blocks of a residential home gateway include processors, memory (volatile [RAM] and nonvolatile [flash]), a digital cable modem, home networking chipsets and associated software.

Clearly, equipment vendors and service providers are looking to move the market forward. Cable modems are morphing into any number of other devices, extending the DOCSIS-based technology into residential gateways for home networking, multimedia terminal adapters for Internet Protocol (IP)-based data and voice services, as well as digital set-top boxes (STBs)/home media gateways for networked home video, and video game consoles for live, online interactive multiplayer game playing. Futurists even envision smart domestic appliances (the broadband refrigerator) with embedded cable modems, as well as TV sets, DVD players, digital cameras and home security systems.

The Device Landscape

A number of vendors already released residential cable home gateway products into the market or are preparing a device for shipment in 2003. Here’s a quick rundown on the direction of product categories that use cable modem technology.

**Cable Modem Gateway-Based Devices**

Vendors in the data networking and cable equipment space are attacking this market with integrated solutions that marry cable modems with routers, and combinations of wired and wireless networking technologies, data-centric, and entertainment-centric devices. Typical solutions contain an integrated DOCSIS 1.1 cable modem-router combined with multiport Ethernet routers and switches, 802.11a or 802.11b wireless access points or base stations, advanced firewalls, and print servers. The move to incorporate 802.11g into their devices is also anticipated once the standard is finalized this year.

Many solutions are starting to incorporate the CableHome 1.0 standard. Some also support the Home PNA 2.0 standard. Encryption techniques usually include 40/128-bit Wired Equivalent Privacy (WEP) and triple Data Encryption Standard (DES) encryption as the standard approach.

Motorola Broadband, the top global supplier of cable modems (3.5 million units in 2002), has put forward a comprehensive and aggressive strategy to attack the "digital home" consumer market and drive broadband connectivity and usage beyond PCs.

Other top cable modem vendors include Scientific-Atlanta, Thomson Multimedia, Toshiba America and Terayon. While Thomson expects to transition into the cable home networking market, its devices are not yet fully developed. Thomson says it will take a decidedly "consumer friendly approach" and will incorporate the CableHome initiative to develop a "one box" solution to "lower the barriers to entry" for people not familiar with complicated technologies. Pioneer Electronics debuted its cable modem-based residential gateway late last year, as have Toshiba and Arris.
Whole-House Media Gateways
These products look to extend broadband beyond data-centric applications and services into residential living spaces for digital entertainment and communications services. Many of these devices are expected to be located at or near the main household TV set. This is an area that is not yet fully defined, but which holds the most promise for the vision of an integrated seamless solution among and between devices and platforms.

Voice/Telephony MTAs
Multimedia terminal adapters (MTAs) incorporate a DOCSIS 1.1 cable modem and IP voice-signaling capabilities to enable voice and data services over the cable IP network.

Companies such as Arris, which supplies cable telephony solutions for circuit-switched and cable IP voice services to the cable industry, also offer devices with embedded cable modems and a two-line MTA with bridged Ethernet and Universal Serial Bus (USB) connections. These can also be called cable telephony modems. They are intended for use inside the residence. Motorola Broadband Communications, Scientific-Atlanta, Toshiba America, Terayon Communications and Com21 are also among a growing list of vendors anticipating the emergence of the cable IP voice market with their MTA solutions.

Another device in this category is the outdoor unit (ODU) that adheres more closely to the traditional telephony service model — a network interface unit that attaches to the side of the premises and that acts as a service point of demarcation outside the premises. These ODUs traditionally have a cable modem, and a two- or four-line MTA with Ethernet and Home PNA 2.0. Arris' device, for example, is also CableHome-ready. Many ODU devices also incorporate Home PNA 2.0 to enable distribution of high-speed data connections throughout the home using traditional telephone wiring.

Wireless Home Monitoring Devices
These devices are envisioned for residential automation and control services. The entire system is expected to include a residential gateway (with cable modem), cameras, sensors and motion detectors, using wireless and wired broadband technologies. They will enable remote viewing of a residence or business by a home or small-business owner using the broadband cable network.

STB-Based Devices
In the video and home entertainment space, a number of vendors are combining cable modems with digital STBs that support standard and high-definition TV signals, and personal/digital video recorder capability. Vendors such as Motorola Broadband Communications, Scientific-Atlanta, Pioneer Digital, Pace MicroTechnology, Sony and Digeo are incorporating cable modem technology into their digital home gateways or home media centers. Many have digital video recorders that will support standard and high-definition digital TV. All aim to enable high performance, run
advanced interactive services and support future IP and MPEG video-based applications at the TV such as streaming media, file transfer capability and session-oriented gaming.

**Consumer Electronics Manufacturers**

Consumer electronics manufacturers are not content to leave the growing home networking market to either the PC/networking gear vendors or cable TV-equipment suppliers. Suppliers such as Sony, Pioneer, Samsung, Thomson Multimedia/RCA (which also happen to be set-top manufacturers and modem suppliers) are using DOCSIS-certified modems in a range of PC and home entertainment networking devices in an attempt to catch the wave of demand for home networking-based services. Many are starting with a digital audio-video-centric focus.

Sony has been a modest supplier of digital cable STBs with embedded cable modems to top U.S. cable systems operators. Sony's corporate vision, however, has outlined a higher calling, seeking to be a potent force in the formation of "ubiquitous value networks." Sony's vision of the connected home is ambitious and is expected to leverage all its core competencies in audio/video, photography consumer electronics, PCs and game consoles as a fully integrated entertainment company.

Sony has also hooked up with Digeo to manufacture an all-in-one STB to enable Moxi Media Center Services. Digeo's Moxi provides access to media from multiple televisions in a single home, a multituner personal video recording, high-definition TV (HDTV), music, games, photos and an optional DVD, and uses Sony's Passage technology.

**Other Technology Platforms: Game Consoles**

Microsoft's X-Box has interfaces to cable modems and routers, but its evolutionary path is to incorporate an embedded cable modem directly into the gaming platform. The service allows X-Box owners to play against each other and download new content for live-enabled games. X-Box Live recently passed the 350,000-subscriber mark, and the service hosts more than 3 million game sessions per week. Sony's PlayStation 2 and Nintendo GameCube are geared toward the growing base of broadband-enabled homes and are moving in a similar direction.

**Gartner Dataquest Perspective**

The success of the DOCSIS standard for cable modem technology is expected to combine with the CableHome platform to enable broad proliferation of broadband-enabled devices and services. Meanwhile, competing visions are emerging on the consumer electronics front to make inroads into cable's broadband-enabled home, especially for networked entertainment services.
In the short to midterm, service provider challenges will be multifold: continued monetization of the value of broadband network, defusing the consumer confusion, and offering simple, yet compelling, services either alone or in conjunction with strong and identifiable brand partners. Cable MSOs must move rapidly to counter the erosion of their customer base to digital satellite TV competitors, starting with advanced service bundles, including networking services that can appeal to the whole spectrum of users.

Technology vendors will be challenged to extend their competencies into higher-functionality devices and to extract increasing revenue from their investment in DOCSIS-based and other technology solutions at good margins. Broadband service providers will be challenged to find appropriate business models that target real consumer wants and needs, and provide maximum utility for residential and SOHO users for managed home networked services, be they entertainment-focused, data-centric or some other version.

Gartner Dataquest believes that a number of key factors must converge to pave the way for a revenue-generating business model for seamless, managed home network services. These will include emergence of less-expensive, more-integrated systems-on-a-chip solutions; better and less-expensive storage technologies; agreement on key standards for wired and wireless networking technologies; and development of more-advanced intelligent software and toolkits.

Cable broadband service providers are determined to layer more and more services and applications into their multiservice bundles. The whole concept of managed home networking may, in fact, become the ribbon that ties the bundle together. As technologies and players sort themselves out, it may be too soon to gauge the uptake or the consumer experience. If, however, new technologies and services can enable seamless broadband networks operating ubiquitously across many devices and platforms, cable may have the power to reduce customer churn and bring heightened technology cachet and increased consumer confidence back to its industry. Cable’s train might then become hard for anyone to overtake.

**Key Issues**

What revenue-generating applications will be enabled or supported by next-generation technology?

How will developments in access technology affect network evolution?
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