# Home Networking Technologies

Market Trends

Significant changes are occurring in the way people communicate at home. Internet usage, now at more than 80 million users worldwide, has quadrupled since 1996. Nearly 40% of all US households are "online," and the use of PCs for computing, communicating, and entertaining is now so pervasive that more than 20 million U.S. households have more than one PC.[1] In addition, the mobility of laptop computers gives users an easy way to take work between home and office, and as many as 60% of all laptops routinely travel between these locations.[2] What's more, the role of the traditional office is changing as evidenced by the large and growing number of home-based businesses and home offices. All of these trends are driving the need to share Internet access, PCs, phone lines, peripherals, and information in the home. It is this need that is fostering the tremendous growth in the Home Networking market, and broadband deployments with bundled services should fuel continued growth.

Home networks offer users a way to share information and resources by inter-connecting PCs and other devices within the home. With easy and affordable solutions now available, the home networking market is predicted to reach $1.4 billion by the end of 2003.[3]

Projected Growth of Home Networking in the U.S.

(in '000s)
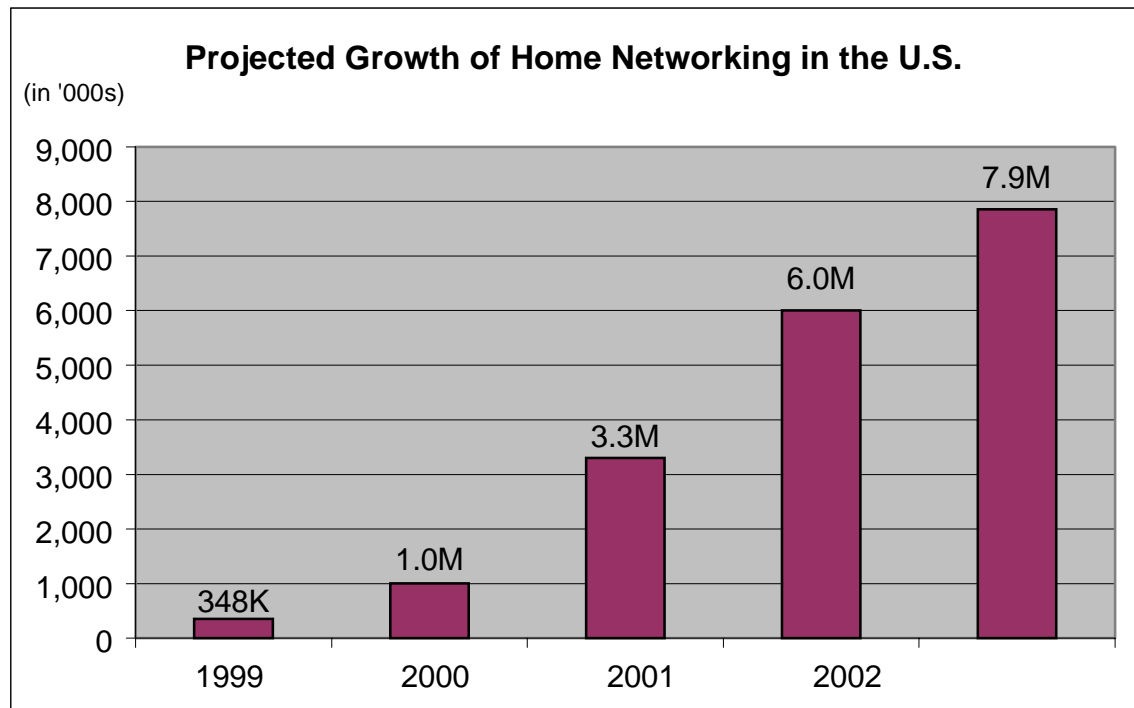
Source: Dataquest (March 2000)

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[1] Parks Associates

[2] Intel Corporation Proprietary Research

[3] Intel Corporation White Paper

Home Networking Applications

Currently, the most compelling reason for having a home network is to give multiple users access to the Internet simultaneously from different PCs. Everyone on the home network can be online, sharing a single modem, phone line and ISP (Internet Service Provider) connection. The rapid growth in subscriptions to cable and DSL (Digital Subscriber Line) service for high-speed Internet access creates an even stronger demand for home networking solutions. With a network, all of the home's computers can take advantage of the greater speeds and bandwidth offered by these more costly services.

The ability to share data drives, files, printers, and other devices benefits many types of home and home office users. With a home network, the user of a PC with a small hard drive can access and store files on a PC with a larger drive. By sharing drives and files among PCs, consumers can avert data loss and access remote files without the inconvenience of carrying them back and forth on floppy disks.

The growth in home networking is spurring the development of new applications that take advantage of connected home PCs. For example, network "jukebox" applications let a user play music at one PC that is stored on another PC's hard drive, eliminating the need to duplicate the music on each PC. Intercom applications let game players talk to each other from separate rooms while they play, or let parents in the kitchen tell the kids in the family room to come to dinner.

In addition to the conveniences offered by home networking solutions, they also reduce costs. Sharing Internet access, peripherals, and other devices via a home network offers a cheaper alternative to equipping each PC with its own modem, phone line, ISP account, and printer. The cost of each additional phone line and ISP account required for Internet access can easily exceed $400 per PC for the year. The cost of a home networking solution is significantly less (about that of a moderately priced home printer) and offers greater convenience.

Approaches to Home Networking

There are several approaches to home networking, which can be grouped into three classifications: networking solutions that require new wires, those that use existing wires, and those that are wireless, requiring no wires.

New Wires

Ethernet solutions provide the highest data rates and are reasonably priced, but require the installation of special wiring, which can be expensive and inconvenient to install, if even possible or allowed (rentals may not allow this). Additionally, future changes to room layouts or use can require additional rewiring and cost.

Options for new wiring include Ethernet based Category 5 Unshielded Twisted Pair (UTP), Coaxial cable, fiber, or structured wiring that includes a combination of these cable types. To help solve the problems associated with installing new wires in homes, such integrated cabling systems can now be installed when constructing new homes if requested by the homebuyer. These systems can handle various telephony, data, video, and home control technologies.

No New Wires

Solutions that use a home's existing wires, whether phone lines or power lines, provide more convenient and affordable alternatives for home users. Based on a specification developed by the HomePNA (Home Phone-line Networking Association), phone-line networking uses the same basic transmission technology as traditional Ethernet. A recent increase in speed from 1 Mbps to 10 Mbps has created additional momentum for this technology. A drawback of using phone lines is that users are restricted to the locations of the phone jacks.

Equipment that uses AC power lines to network PCs offers more flexibility, since power outlets are found in almost every room of the house. While the data transmission using power lines has traditionally been slow and unreliable, industry standards are being created to solve these problems. As a result, power line networking may become a more attractive approach to networking the home.

No Wires (Wireless)

While existing wire-based networks offer no-new-wires installation, wireless takes this one step further to enable "no wires" mobility and convenience. A wireless home network uses radio frequency (RF) instead of wires or cables to transmit information. A network unrestricted by wires is the most suitable solution for the home. Most homeowners do not want to incur the expense and inconvenience of running special cables throughout their homes, nor do they have a dedicated IT staff to assist with network installation. Wireless helps simplify home networking.

Of the home networks available, wireless networks offer the most flexibility. They allow users to share peripherals and Internet access while also giving them mobility. For example, a wireless home network allows a laptop user to download a file from the World Wide Web and print it on a printer connected to a networked PC in the family room – all from the comfort of his sofa, kitchen table or back patio. The most useful wireless home networks support the household's needs for voice and entertainment as well as data. These networks allow users to talk, surf, compute and communicate from anywhere in or around the home without being tied to telephone jacks or power outlets.

Solutions are being developed that will enable multiple network environments to work together easily. For example, wireless networks can be made to communicate seamlessly with phone line or Ethernet networks. This will soon enable wireless home networks to serve as a backbone for interconnecting PCs, information appliances, home security systems, and digital entertainment centers.

Current Wireless Home Networking Technologies

Several radio technologies are contending for acceptance in the home wireless networking space. The two primary contenders are IEEE 802.11b sponsored by the Wireless Ethernet Compatibility Alliance (WECA) and HomeRF sponsored by the HomeRF Working Group.

IEEE 802.11b

The 802.11b wireless Ethernet specification was designed to support roaming in a large office or business campus environment that is supported by IT professionals that can tune the network for maximum throughput and provide for security. Supporting 10 to 100 access points, the primary application of 802.11b is high performance data networking such as file or Internet sharing. While 802.11b offers high-speed data transfer, it is more expensive than other technologies. Additionally, the use of Direct Sequence Spread Spectrum (DSSS) technology inhibits its performance in high-density situations where there is no centralized IT support. This results in interference in smaller businesses, apartment buildings, or similar environments unless 802.11b base stations are very strategically placed.

The ability of 802.11b technology to support voice is limited. Although it can support digitized voice-over-Internet Protocol (VoIP), it is currently of poor quality, and the phone handsets are expensive. Furthermore, the 802.11b specification does not address support of key telephony features such as Caller ID. For these reasons, 802.11b does not offer a complete solution for service providers or homeowners wishing to employ a single wireless network for all of their networking needs.

> ### Bluetooth and Infrared Technologies
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> *While often assumed to be a wireless networking specification, Bluetooth actually defines a Personal Area Network (PAN), enabling short-range, point-to-point connectivity. Like Infrared, Bluetooth is designed for cable replacement applications, not for home networking. While these technologies do not offer such capabilities as file and device sharing like LAN solutions, they enable quick-file copy and data synchro-nization functions, allowing application data to be exchanged wirelessly between mobile PCs, mobile phones and other portable devices such as PDAs. One drawback of Infrared is that it requires line-of-sight connectivity. Bluetooth, on the other hand, uses radio frequency (RF) to link devices up to thirty feet apart without requiring line of sight.*

HomeRF

While 802.11b was designed for the corporate environment, HomeRF was developed from the start to meet the unique needs of the consumer in home networking applications. In addition to offering solid technical features, simplicity, security, and ease of use, HomeRF networks are designed to be more affordable to home users than other wireless technologies.

HomeRF networks provide a range of up to 150-feet, sufficient to cover the typical home, garage, and yard. A recent ruling by the FCC allowed increased data rates for HomeRF networks, and products based on the second-generation HomeRF 2.0 specification will take advantage of this ruling. HomeRF 2.0 enables the introduction of new types of devices, applications, and services including high-speed applications such as whole house CD quality audio distribution to wireless speakers and streaming video. At the same time, backward compatibility ensures that all current HomeRF products will operate with future products.

A HomeRF Advantage: Integrated Voice & Data

In addition to the expected benefits of home networking, such as shared Internet access, PCs, data files, and printers, HomeRF also opens up a new world of applications by supporting high-quality voice and data. Consumers can look forward to innovative new services from telephone companies, cable companies and others. New information appliances" and other devices "will emerge that take advantage of the integrated voice and data capabilities. As services and devices evolve, HomeRF networks will support home entertainment, home automation, and even telemedicine applications.

An integrated network offers a simple, low cost solution and makes it easy to add voice or data devices to the network whenever needed. Additionally, it improves access to and utilization of both traditional telephone lines and high-speed Internet connections.

HomeRF Voice Applications

The HomeRF specification incorporates the DECT (Digital Enhanced Cordless Telephony) standard. This standard supports all the telephony features consumers expect plus a full range of enhanced features useful in both home and small business applications. Cordless handsets using HomeRF will offer even more convenience than traditional cordless telephones, including more flexible phone placement. Today, cordless phones must be connected to telephone jacks in locations that may not be ideal to the end user. And since many homes include only two or three phone jacks, traditional cordless phones are confined to certain rooms.

With HomeRF there is no need for multiple base units to be tied to individual phone jacks. Only one connection to a single telephone jack is required, and additional cordless handsets can be purchased and placed wherever convenient. The ability to expand the voice network by simply adding handsets offers savings over purchasing multiple cordless phones.

Users also benefit from the convenience of sharing the same, rich set of telephone features. Multiple handsets can also be used to enable users to place both external and intercom calls at the same time.

HomeRF technology also provides superior voice quality and security. Using 2.4GHz technology, the HomeRF avoids interference from other cordless phones, remote controls, and baby monitors. Using Frequency Hopping Spread Spectrum (FHSS) technology, the voice channel changes fifty times every second, ensuring conversations are not overheard.

Emerging HomeRF Applications

While today's home networks typically connect multiple PCs to enable Internet and printer sharing, home networks of tomorrow will enable sharing of unified voice, data and video services. Users will realize new benefits and conveniences by including everything from new digital entertainment devices to traditional household appliances in the home network. As services and devices evolve, HomeRF networks will support a variety of home entertainment, home automation, and even telemedicine applications. Further, HomeRF support of both voice and data will allow speech-enabled applications for increased user convenience.

Some examples of what users will be able to do with the availability of products that adhere to the HomeRF specification include:

- Set up a wireless home network to share voice and data between PCs, peripherals, PC-enhanced cordless phones, and new devices such as portable, remote displays or "Web" pads

- Access the Internet from anywhere in and around the home from portable display devices

- Share a single ISP connection between PC's and other new devices

- Intelligently forward incoming telephone calls to multiple cordless handsets, FAX machines and voice mailboxes

- Review incoming voice, FAX and e-mail messages from a small PC-enhanced cordless telephone handset

- Activate other home electronic systems by simply speaking a command into a PC-enhanced cordless handset

- Play multi-player games, toys and gaming consoles based on PC or Internet resources

- Download MP3 and other audio files using audio streaming

- Enjoy streaming audio and video from networked devices anywhere in the home

Comparison of HomeRF and 802.11b

	HomeRF	802.11b
Speed	10 Mbps*	11 Mbps
High Security	Y	N
User Installable	Y	Y[#]
Products Available at Consumer Price Points	Y	Y[##]
Recommended for Uncoordinated Networks	Y	N
Voice Support	Y	N
Enhanced Telephone Features	Y	N
Low Power Consumption	Y	N

* HomeRF 2.0 operates at 10 Mbps and is compatible with HomeRF 1.0 operating at 1.6 Mbps
\# Normally installed by professionals but becoming easier
\## Starting to reach consumer price points

Concluding Remarks

The HomeRF Working Group (HomeRF WG), which includes the leading companies from the personal computer, consumer electronics, peripherals, software communications, and semiconductor industries, developed HomeRF as a specification for wireless home communications. The HomeRF specification provides the flexibility and mobility of a wireless solution, which is important to creating compelling, complete, and successful home network solutions. In addition, the HomeRF specification defines a common interface that supports wireless voice and data networking in the home.

To date, the high cost and impracticality of installing new wires have inhibited the wide spread adoption of home networking technologies, and wired technologies inhibit the mobility of networked portable devices. HomeRF changes that.