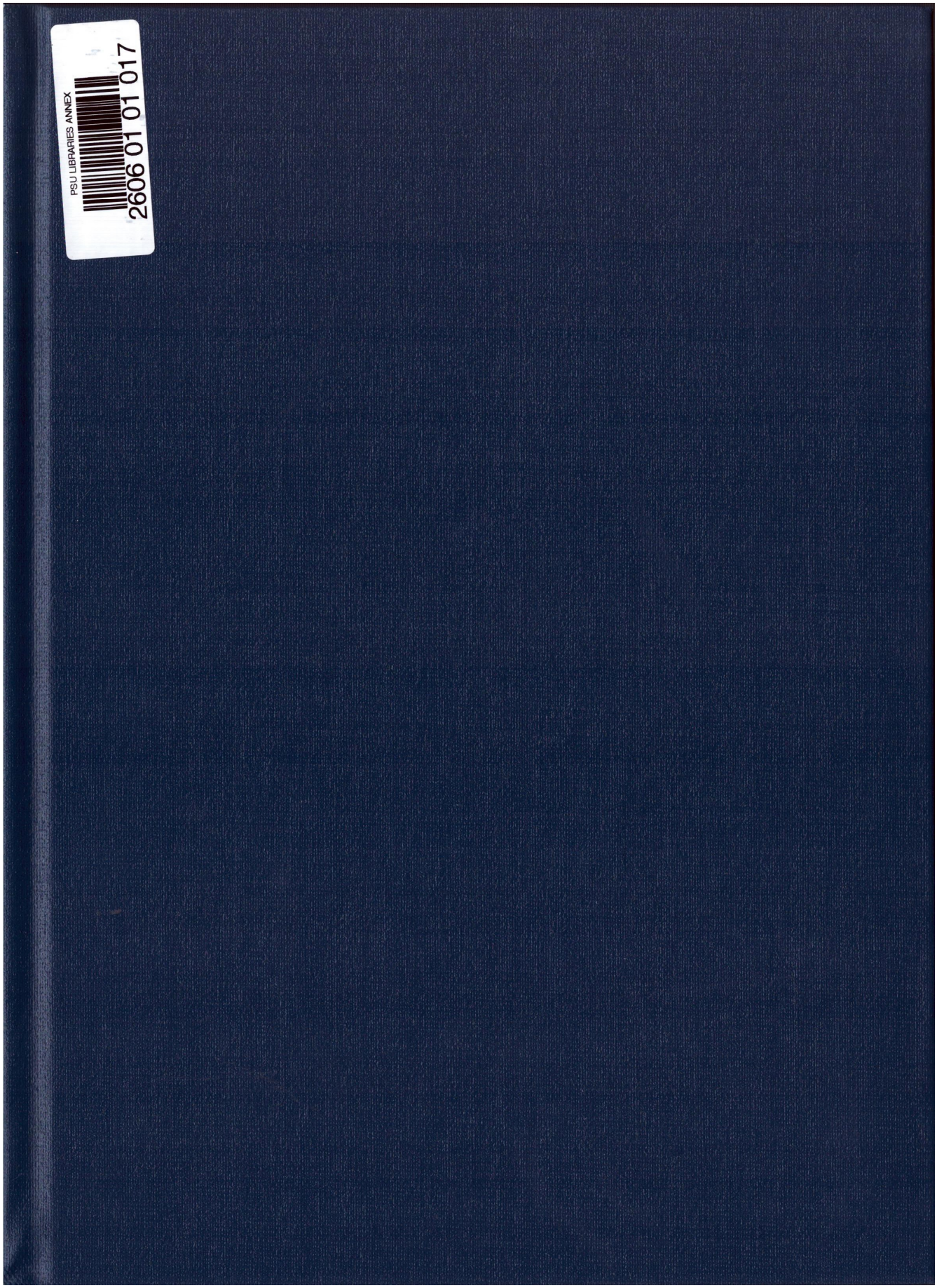

PSU LIBRARIES ANNEX
2606 01 01 017

DISH 1037
Dish Network v. Entropic Commc'ns
IPR2024-00393


COMPUTER
32
JAN-JUNE
1999
ENGIN
QA76
.I56



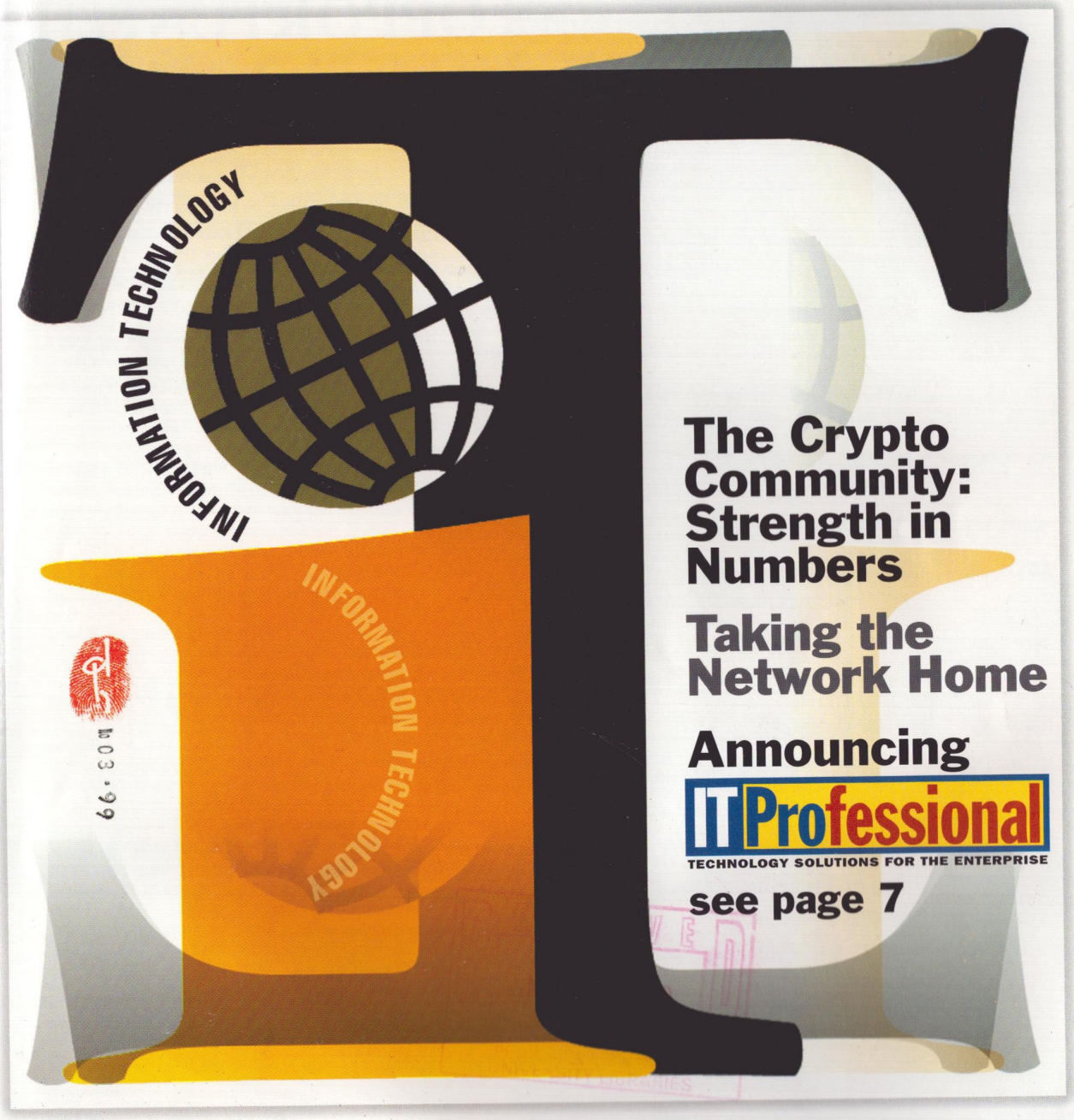
ENGINEERING LIBRARY

SHELVED IN
BOUND
PERIODICAL
COLLECTION

COMPUTER

Innovative Technology for Computer Professionals

March 1999



The Crypto Community: Strength in Numbers

Taking the Network Home

Announcing

IT Professional

TECHNOLOGY SOLUTIONS FOR THE ENTERPRISE

see page 7

********** 5-DIGIT 16802
031999 300 00014
PENN STATE UNIV
PATTEE LIB SER RECORDS
UNIVERSITY PARK PA 16802

IEEE COMPUTER SOCIETY

http://computer.org

You Make the Call: Ethics in the Market, p. 80

March 1999, Volume 32, Number Three

IEEE Computer Society: http://computer.org
Computer: http://computer.org/computer
computer@computer.org

COMPUTER

innovative technology for computer professionals

NEWS

11 Industry Trends
New Technologies Take the Network Home
George Lawton

15 Technology News
Will 1999 Be the Year of IP Telephony?
Neal Leavitt

18 News Briefs
Groups Duel over New I/O Standards ❖ Oracle, Sun Team Up to Dump the OS ❖ Bringing the Net to Mobile Appliances



A growing number of vendors are selling a variety of home-networking products.

Y2K REPORT

21 Y2K in Brief
US Corporations' Y2K Efforts Go Global

22 Rubin's Y2K Diary
Doing the Y2K Spin: Is Image Everything?

DEPARTMENTS

4 Letters

103 New Books

104 New Tools



Has R&D's dependence on deep-pocket funding sacrificed innovation for quick payoffs?

COLUMNS

108 Internet Watch
Cryptography: The Importance of Not Being Different
Bruce Schneier

110 Standards
Defining Stakeholder Relationships
Harold W. Lawson

113 Management
Making RAD Work for Your Project
Barry Boehm

115 Component and Object Technology
Scientific Components Are Coming
Paul F. Dubois

120 Binary Critic
Innovation in the Small
Ted Lewis

MEMBERSHIP NEWS

76 Computer Society Connection
Society Activities Attract New Members ❖ Two Presented Technical Achievement Awards ❖ Michael C. Mulder Tribute

80 Your Call
When a Product Doesn't Measure Up to Its Claims

83 Call and Calendar

Computer's NEW TOOLS

http://computer.org/computer/tools

IEEE CS Membership Application, 8
Advertiser/Product Index, 101
Career Opportunities, 92

24 Article Summaries

CYBERSQUARE



27 Have We Witnessed a Real-Life Turing Test?

Marina Krol

COMPUTING PRACTICES

31 Beyond Spreadsheets: Tools for Building Decision Support Systems

Hemant K. Bhargava, Suresh Sridhar, and Craig Herrick

COVER FEATURES



40 Transforming Business Through Information Technology

Girish Pathak and Shri K. Goyal

42 The Changing Role of Information Technology in Manufacturing

Krishnamurthy Srinivasan and Sundaresan Jayaraman

50 Reinventing GTE with Information Technology

Richard Brandau, Tony Confrey, Alin D'Silva, Christopher Matheus, and Robert Weihmayer

59 The BT Intranet: Information by Design

Mark Norris, Paul Muschamp, and Steve Sim

67 Making Business Sense of Electronic Commerce

Dawn Jutla, Peter Bodorik, Catherine Hajnal, and Charles Davis

COPYRIGHT © 1999 BY THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS INC. ALL RIGHTS RESERVED. ABSTRACTING IS PERMITTED WITH CREDIT TO THE SOURCE. LIBRARIES ARE PERMITTED TO PHOTOCOPY BEYOND THE LIMITS OF US COPYRIGHT LAW FOR PRIVATE USE OF PATRONS: (1) THOSE POST-1977 ARTICLES THAT CARRY A CODE AT THE BOTTOM OF THE FIRST PAGE, PROVIDED THE PER-COPY FEE INDICATED IN THE CODE IS PAID THROUGH THE COPYRIGHT CLEARANCE CENTER, 222 ROSEWOOD DR., DANVERS, MA 01923; (2) PRE-1978 ARTICLES WITHOUT FEE. FOR OTHER COPYING, REPRINT, OR REPUBLICATION PERMISSION, WRITE TO COPYRIGHTS AND PERMISSIONS DEPARTMENT, IEEE PUBLICATIONS ADMINISTRATION, 445 HOES LANE, P.O. BOX 1331, PISCATAWAY, NJ 08855-1331.

EDITOR-IN-CHIEF:
JAMES H. AYLOR, UNIV. OF VIRGINIA,
JHA@VIRGINIA.EDU (804) 924-6100

ASSOCIATE EDITOR-IN-CHIEF:
DORIS CARVER, LOUISIANA STATE UNIV.,
CARVER@BIT.CSC.LSU.EDU

COMPUTING PRACTICES:
THOMAS CAIN, UNIV. OF PITTSBURGH;
T.CAIN@COMPUTER.ORG

CYBERSQUARE:
RONALD HOELZEMAN, UNIV. OF PITTSBURGH,
R.HOELZEMAN@ COMPUTER.ORG

SPECIAL ISSUES:
KATHLEEN SWIGGER, UNIV. OF NORTH TEXAS,
KATHY@CS.UNT.EDU

1999 PRESIDENT:
LEONARD TRIPP

EDITORIAL STAFF

ANGELA BURGESS
EXECUTIVE EDITOR
A.BURGESS@COMPUTER.ORG

SCOTT HAMILTON
SENIOR ACQUISITIONS EDITOR
S.HAMILTON@COMPUTER.ORG

JANET WILSON
SENIOR ACQUISITIONS EDITOR
J.WILSON@COMPUTER.ORG

LEE GARBER
NEWS EDITOR
L.GARBER@COMPUTER.ORG

CHRISTINE MILLER
PRODUCTION EDITOR
C.MILLER@COMPUTER.ORG

JAMES SANDERS
ASSOCIATE EDITOR

KIRK L. KROEKER
STAFF EDITOR

MARY-LOUISE G. PINER
STAFF EDITOR, MEMBERSHIP NEWS

GREG GOTH
STAFF EDITOR, NEWS

JASON SEABORN
EDITORIAL ASSISTANT

MICHELLE J. SAEWERT
ELECTRONIC MEDIA ASSISTANT

SHANNON BUCKELS
PRODUCTION ASSISTANT

HEATHER SEMON
MAGAZINE ASSISTANT

EXECUTIVE DIRECTOR & CHIEF EXECUTIVE OFFICER
T. MICHAEL ELLIOTT

PUBLISHER
MATT LOEB
M.LOEB@COMPUTER.ORG

MEMBERSHIP & CIRCULATION MARKETING MANAGER
GEORGANN CARTER

ADVERTISING MANAGER
PATRICIA GARVEY

ADVERTISING SUPERVISOR
MARIAN ANDERSON

DESIGN
DIRK HAGNER

PRODUCTION
CHRISTOPHER A. PATTERSON
LARRY BAUER
KEN DUCKWORTH

NEXT MONTH: Active Networks

MEMBERSHIP MAGAZINE OF THE IEEE COMPUTER SOCIETY

Cover design and artwork by Dirk Hagner

BPA INTERNATIONAL

New Technologies Take the Network Home

George Lawton

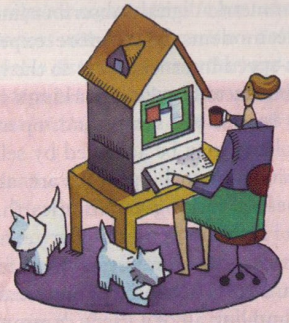
Home networks, once the realm of the rich and technically gifted, are now considered to be one of the computer industry's hottest markets. Although home networking is still in its early stages, a number of trends have made this technology important.

During the past couple of years, an increasing number of households have acquired more than one PC. To permit the users of different computers in a home to access the same files, play video games against each other, and share Internet access and peripherals, a growing number of consumers are networking their homes.

And the increasing use of embedded chips in domestic appliances (as well as in security, temperature control, and other household systems) that can connect to a home network has accelerated this process.

In response to this trend and the availability of a potentially lucrative untapped market, companies have developed technologies for low-cost, easy-to-use home networks.

Until recently, home networking was restricted to low-speed technologies or traditional LANs, which are too difficult for most consumers to install and maintain. However, this is changing because of new, faster, easier-to-use home-networking approaches, enabled in part by more powerful and less expensive processor technology.



A growing number of vendors are selling a variety of home-networking products.

Major vendors in the computer and consumer-electronics industries are selling home-networking products, including chips (such as stand-alone and Ethernet chips) and networking cards (such as PCI cards), that use phone, wireless, coaxial cable, and power-line technology.

Meanwhile, consortiums and companies like Microsoft and Sun Microsystems are creating architectures that will let PCs and appliances on different platforms communicate with each other over home networks.

Because of these factors, said analyst Kurt Scherf with Parks Associates, a market research firm, revenues from the sale of home-networking products could grow from $10 million in 1998 to almost $200 million in 2001 to about $375 million in 2004, as Figure 1 shows.

Home networks currently reach speeds of up to 10 megabits per second (Mbps) and thus are slower than corporate networks. This is the case primarily because home networks are built over phone lines and other media that are easier to maintain but of lower quality than those used in traditional LANs. However, home-networking vendors say they are working on products that will transmit at rates of up to 100 Mbps.

Meanwhile, home-networking technologies should be able to link devices in all but the largest homes, since even the technology with the shortest range still works at distances of 150 feet.

Home-networking analyst Karuna Uppal with the Yankee Group, a market research firm, said users will begin to adopt the technology in earnest this year.

Parks Associates estimates the total number of households with LANs will grow from 2.5 million in 1998 to 4.3 million next year to 11.9 million by 2004.

Meanwhile, the technology will also be attractive to smaller businesses, particularly those without IT departments and those in older buildings without fiber or other high-quality wiring.

BACKGROUND

People have been talking about home networking for more than a decade. Initially, home networking was a slow technology used just for turning on and off lights and household appliances, as well as other home automation tasks.

However, lack of enthusiasm by consumers inhibited the technology, limited product development, and left home networking primarily to users with a lot of money or technical talent.

Now, however, less expensive and more powerful CPUs are permitting PCs to act like servers for home networks and like gateways for distributing Internet access. This is the primary reason that the

Editor: Lee Garber, *Computer*, 10662 Los Vaqueros Circle, PO Box 3014, Los Alamitos, CA 90720-1314; l.garber@computer.org

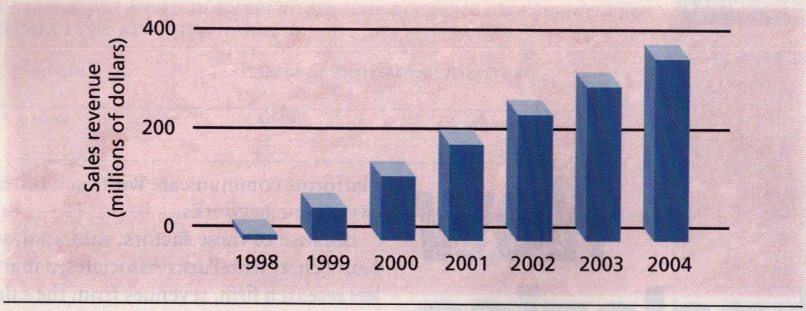


Figure 1. Many market analysts predict the home-networking market will take off in 1999. Parks Associates estimates revenue from the sale of home-networking products will soar from about $10 million last year to about $75 million this year to about $200 million in 2001.

home networking industry is growing now, noted Craig Stouffer, vice president of marketing at networking vendor Tut Systems.

GROWING DEMAND

The demand for home networking is being driven by the growth of multicomputer homes, which is being driven by the growing number of computer users and low-cost computers.

Dataquest, a market research firm, said the number of US homes with multiple PCs will grow from 12.3 million in 1997 to 20.1 million in 2001, as Figure 2 shows. However, noted analyst Bruce Ryan with Media Metrix, a computer-industry market-measurement firm, some multicomputer households don't use more than one of their PCs.

The Yankee Group's Uppal said

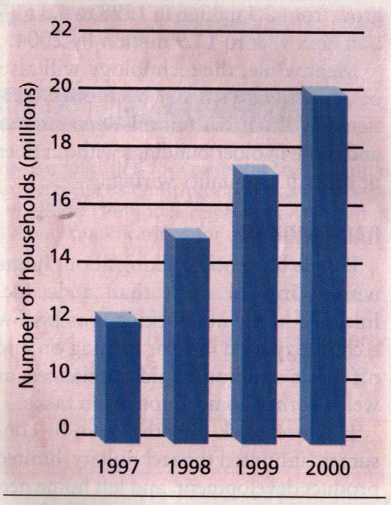


Figure 2. Statistics and estimates from Dataquest say the number of US homes with more than one PC has increased steadily during the past couple of years and will continue to do so. Many industry observers say that the growing number of multi-PC homes is driving the demand for home-networking products.

Internet access has been the primary source of interest in home networks. Home networks can transmit Internet-based video, audio, and other multimedia presentations from a gateway computer to other PCs, TVs, and entertainment centers. It is less expensive for users to let these devices share a single Internet account than to set up multiple accounts.

These trends will increase as ADSL (asymmetric digital subscriber line) and cable modems bring more expensive, high-speed Internet access to the home.

The key to home networking's success will be simple setup and operation. Simplicity may be achieved by self-configuring networking software and by home-networking capabilities that are built into computers. For example, Compaq sells computers with its Net Wizard software that can automatically find and link all of a user's computers.

HOME-NETWORKING TECHNOLOGIES

Many industry observers predict that most home-networking technologies will operate over phone lines. However, vendors are also working with wireless, cable, and power-line technologies.

Home-networking technologies work with architectures that let applications find and configure devices automatically, which eliminates the setup and configuration necessary with corporate networks.

Phone lines

Phone-line networks appear particularly promising because telephone service is so widespread and because data transmissions over phone wiring experience relatively little interference from analog voice transmissions. Frequency-division multiplexing divides a phone line into separate communications channels, each with a different frequency. This permits data, Internet, and voice communications to use the same line simultaneously. With power-line or wireless technologies, on the other hand, there can be considerable interference.

Meanwhile, phone-line networking is less expensive than other home-networking technologies. In addition, said Uppal, phone-line networking promises higher speeds in the near future.

No hubs. Unlike traditional corporate LANs that operate over telephone wiring, home phone-line networks do not have to be set up in a star topology, as Figure 3 shows, because participating PCs and other devices can recognize each other without a hub. Rather, users can set up networks by simply plugging devices with network cards into telephone outlets. Thus, phone-line networking saves consumers from having to buy hubs or configure their networks.

HomePNA. The Home Phoneline Networking Association (http://www.homepna.org) includes such companies as Compaq, Intel, and Rockwell. The HomePNA is working on standards to ensure compatibility between home-networking products and has developed a Home Phoneline Network seal of approval for companies that comply, said Jeff Thermond, CEO of Epigram, a home-networking company that is a HomePNA member.

The consortium is focusing on similar technologies developed by Epigram and Tut Systems. The HomePNA has released its first specification based on Tut's 1-Mbps Ethernet-based HomeRun technology. Such companies as AMD, Intel, Lucent Technologies, National Semiconductor, and Rockwell are manufacturing HomeRun-based chips to be used in modems and networking cards.

The HomePNA is working with Epigram to develop a 10-Mbps specification. Epigram already has its iLine10 10-Mbps Ethernet LAN chipset technology, which is backward compatible with the 1-Mbps technology used in the current HomePNA specification. 3Com and Nortel Networks' Netgear subsidiary have already released iLine10-based products, including network cards.

Meanwhile, Avio Digital is working on an 88-Mbps technology, while Epigram is working on a 100-Mbps technology.

Limitations. One potential limitation of

phone-line-based home networks is that they can support a networked device only where there is a phone jack. This is not necessarily a critical limitation in the US, where, according to Intel consumer research, the average home has 4.5 phone jacks. However, homes in most other countries do not have as many jacks.

Wireless

A number of companies—such as Diamond Multimedia Systems, Proxim, Sharewave, and Web Gear—are selling wireless home-networking products. Wireless home networks provide users with convenience by opening up communications capabilities to mobile devices.

Wireless networks use receivers and transmitters that operate over radio or infrared waves. The networks transmit at rates from 1 to 4 Mbps. Infrared-based products work over several dozen feet, while radio-based products work over distances up to several hundred feet.

Most wireless systems tend to be more expensive than other home-networking systems because they must be engineered with relatively powerful radio transmitters and receivers, as well as sophisticated digital signal processors. DSPs filter out some of the interference that comes from other devices, such as phones, and that can slow or even shut down a network.

Convergence. Some companies are looking to wireless networking to promote the convergence of home computing and home entertainment. For example, Philips Electronics' Philips Peripherals Group is developing Ambi. Ambi will use Sharewave's wireless-networking technology in set-top boxes that will let consumers access computer functionality from their televisions, using a kind of TV browser.

Interoperability. A current limitation of wireless networking is that different vendors' products are not interoperable. Proxim has launched the Wireless LAN Interoperability Forum (http://www.wlif.org) and is working with 25 other companies, including IBM and Motorola, to set standards for this technology. The standards would be based on Proxim's radio-frequency (RF) LAN technology, which permits transmission speeds of up to 1.6 Mbps.

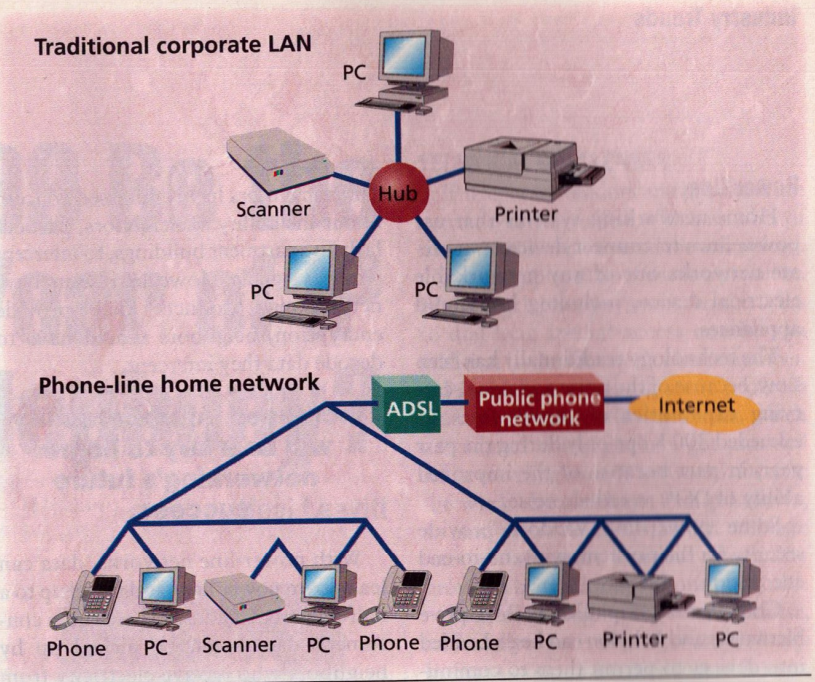


Figure 3. In a traditional corporate star-topology LAN, each device is linked to a port on a hub. This requires organizations to buy hubs and configure networks. In a phone-line home network, all devices with network cards are linked via phone lines (as long as they are within a maximum allowable distance of each other) and automatically recognize each other. This eliminates the need for a hub and makes network operation simpler and less expensive. Home networks can connect via high-speed ADSL modems to the Internet via the public phone network.

Meanwhile, such companies as Compaq, Hewlett-Packard, Intel, Microsoft, and Sony are working with the HomeRF Working Group (http://www.homerf.org) to develop the Shared Wireless Access Protocol (SWAP) for radio-based home networks. The specification allows data rates up to 2 Mbps, lets home networks accommodate up to 127 nodes, and transmits up to 150 feet through walls.

HomeRF Working Group Chair Ben Manny said the first SWAP-based products to emerge later this year will probably permit the operation of networks that let laptops share resources and Internet connectivity with other computers.

He said the working group has also been looking at a lower strength SWAP Lite that could be used for lower cost connectivity applications.

Cable

The coaxial cable installed in many homes for use with TVs can also carry data signals and, in fact, can carry a signal of more bandwidth over a longer distance with less attenuation than other home-networking media.

However, said Hongjun Li, Parks Associates' director of research, only 67 percent of US households have cable TV service, while 96 percent have telephone service. In addition, consumers have little experience and expertise adding new cable for purposes other than receiving TV signals. Therefore, relatively few companies are pursuing cable-based home networking.

In most cable-based home networks, set-top boxes serve as gateways for connecting devices to each other or to the Internet. The boxes would connect to other devices via, for example, infrared transmissions or the IEEE 1394 high-performance serial bus.

Consumers could use the boxes to tune in video and audio channels on the cable TV network or the Internet. The hubs would translate the signals into a form that could be distributed over the home network to the various receiving devices. Cable modems could be used for high-speed Internet access.

Cable TV set-top-box vendor General Instrument is working with Sony's Aperios networking software to deliver home-networking services. Another vendor, Scientific Atlanta, is working to integrate Avio Digital's proposed 88-Mbps MediaWire home-networking technology into its Explorer 2000 set-top box.

Power line

Home-networking systems that use power lines to connect devices can create networks out of any networkable electrical device, including household appliances.

The technology traditionally has been slow, because of the noise and signal-carrying capabilities of power lines. It exceeded 300 Kbps only during the past year, in part because of the improved ability of DSPs to reduce noise.

Some power-line vendors provide security for their systems with end-to-end encryption.

Chips from companies like Adaptive Networks and Echelon can be embedded into devices to permit them to communicate directly over power lines at lower speeds.

Intelogis recently released the Passport Plug-In Network. The system uses adapters, which are external networking modules that plug into electrical outlets and then connect to networked devices via parallel cables. The product currently supports a 350-Kbps network that links devices up to a quarter-mile apart. Intelogis plans to have a 2-Mbps version available by the end of this year.

Todd Green, Intelogis' director of marketing, said power-line networking's main advantages are that homes generally have more electrical outlets than phone outlets and that, unlike wireless systems, power lines allow transmission through concrete or metal floors.

However, power-line technology has been limited by such technical issues as potentially high interference levels from electrical transmissions. In addition, homes can have various configurations of splitters and/or outlets, which means their electrical properties can differ.

OBSTACLES, CHALLENGES, AND PROBLEMS

Although apparently a rising star in the computer industry, home networking still faces its share of challenges to widespread adoption.

Security

Park Associates' Li said users appear to have confidence in the security of wired home-networking technology. Li said some users have expressed concern about the ability of neighbors, particularly in apartment buildings, to intercept wireless signals. However, if users have networking products that provide encryption, neighbors would have to decode data they intercept.

Increased interoperability will be a key to home networking's future success.

With power-line networks, data can leak down power lines and travel up to a half-mile from a house. Therefore, a consumer's data could be picked up by neighbors who receive electricity from the same power line and use the same networking equipment. Again, though, neighbors would have to decode data that has been encrypted.

Interoperability

Several efforts are under way to tie home-networking applications together across platforms and media.

HomeAPI. The HomeAPI Working Group is developing an open industry specification that defines a standard set of software services and application programming interfaces that let applications discover, monitor, and control networked devices and systems.

The working group expects to release the first HomeAPI developers kit for Windows this year and to support other operating systems later.

HAVi. Eight Japanese and European consumer-electronics vendors—including Germany's Grundig, France's Thomson Multimedia, and Japan's Toshiba—have developed the HAVi (home audio/video interoperability) specification primarily for connecting digital home-entertainment devices, although it can also be used with PCs.

The specification lets devices communicate via their IEEE-1394-compatible high-performance serial buses. A number of industry observers have expressed interest in the standard but say it should work with all devices, not just those with IEEE 1394 buses.

Avio Digital CEO Eugene Van Bergen said, "I think it is always undesirable to link an architectural standard like that to a particular media."

Universal Plug-and-Play. Microsoft's Universal Plug-and-Play initiative is designed to let users connect PCs, networked appliances, networks, services, and so on without complicated setup or configuration. In addition, a PC would not be needed for other devices to connect.

Universal Plug-and-Play would define a set of common interfaces that describe devices and services, and permit automatic discovery when a device connects to a network. It would not be restricted to the Windows platform, said Alec Saunders, a Microsoft group planning manager.

Jini. Sun's Jini technology would run a set of Java class libraries on top of various enabled devices' Java virtual machines (JVMs) and would also specify APIs for various hardware infrastructures and operating systems. This would permit enabled devices using various platforms to form a federation of JVMs that could communicate with each other.

Parks Associates' Scherf said household LAN products will begin to proliferate this year and will then rapidly begin to reach a mass market.

A key factor will be the success of the interoperability initiatives. When home-networking products are interoperable, consumers can buy the networking components that suit their needs and pocketbooks. This, in turn, will increase competition, which could lead to a bigger variety of better, less expensive products.

Meanwhile, said Bob Dillon, Enikia's vice president of marketing, the next generation of broadband network services may encourage even more users to buy home-networking systems.

Said Scherf, "The rapid growth of multi-PC households, the proliferation of the Internet, and the complications of traditional computer networking solutions have set the perfect stage for the birth of the home-networking industry." ❖

George Lawton is a freelance technology writer based in Brisbane, California. Contact him at glawton@best.com.

ENGINEERING LIBRARY

