

Agenda

- ◆ Introduction
 - What is Ethernet?
 - Market Analysis Data
- ◆ Technology
 - MAC Types
 - What is CSMA/CD?
 - Variables of CSMA
 - What is OSI Model?
 - What is TCP/IP Model?
 - Ethernet Frames
 - Ethernet PHY Specs
 - Ethernet MAC
 - Ethernet Cabling and Connectors
 - Ethernet Devices
- ◆ Ethernet & Home Networking
 - Motivation for home networking
 - Ethernet in HN
- ◆ Xilinx Solution
- ◆ Alliances
 - Gigabit Ethernet
 - IEEE 802.3
- ◆ Summary

The Push for Home Networking

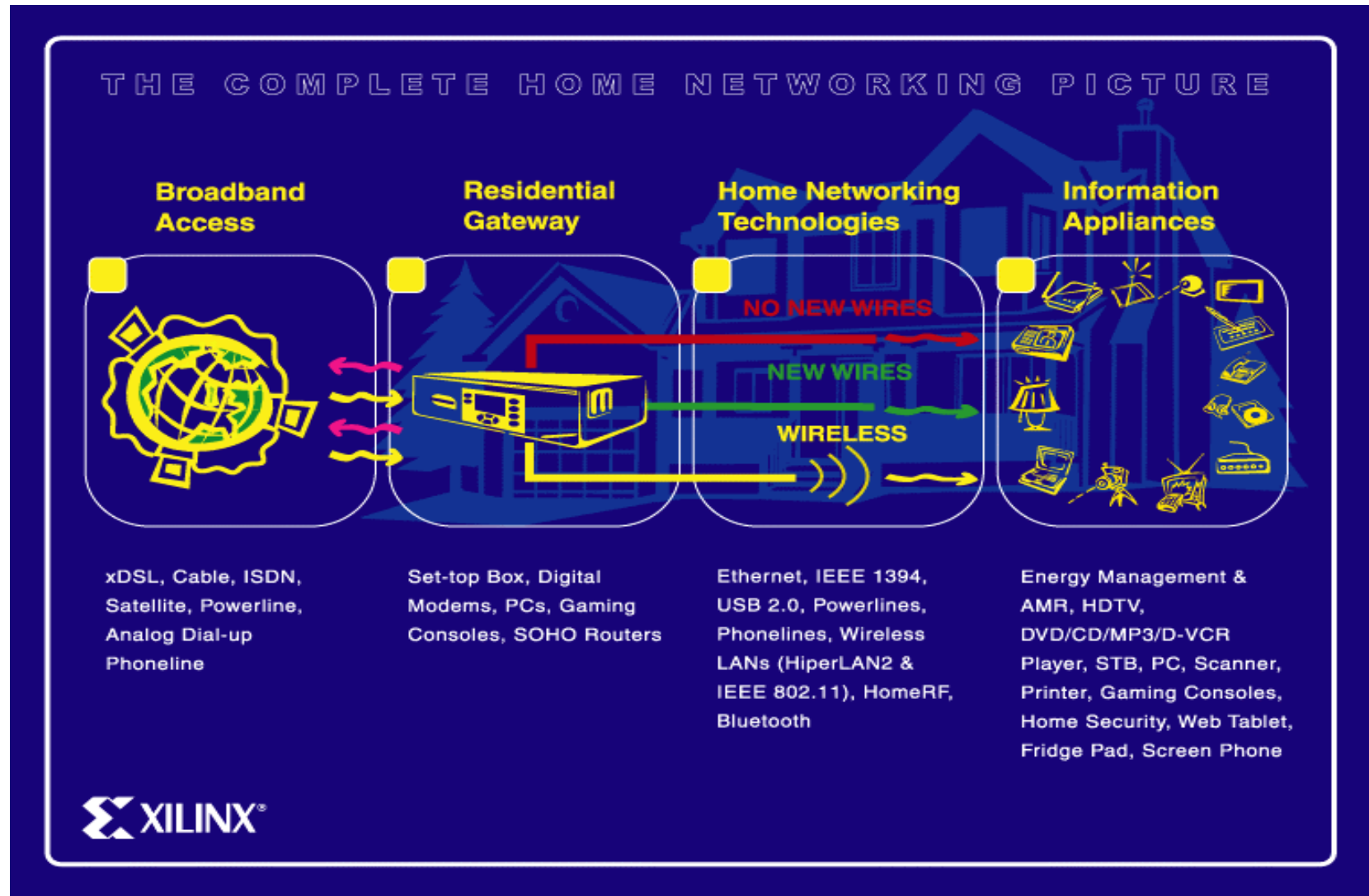
- ◆ Rapid growth in multiple-PC household penetration (Dataquest)
 - PC penetration exceeds 50% in US households
 - Multi-PC households growth: 15M (in 1998) to 26M (in 2003)
- ◆ Increasing Internet usage (Yankee Group)
 - Nearly 90% of PC households will be online by 2001
 - Online households growth: 20% (in 1997) to 47% (in 2001)
- ◆ Broadband Internet access (Forrester Research)
 - Broadband penetration growth: less than 1M (in 1998) to more than 15M (in 2002)
 - % Penetration of online households: increases from 2% (in 1998) to 26% (in 2002)

The Push for Home Networking

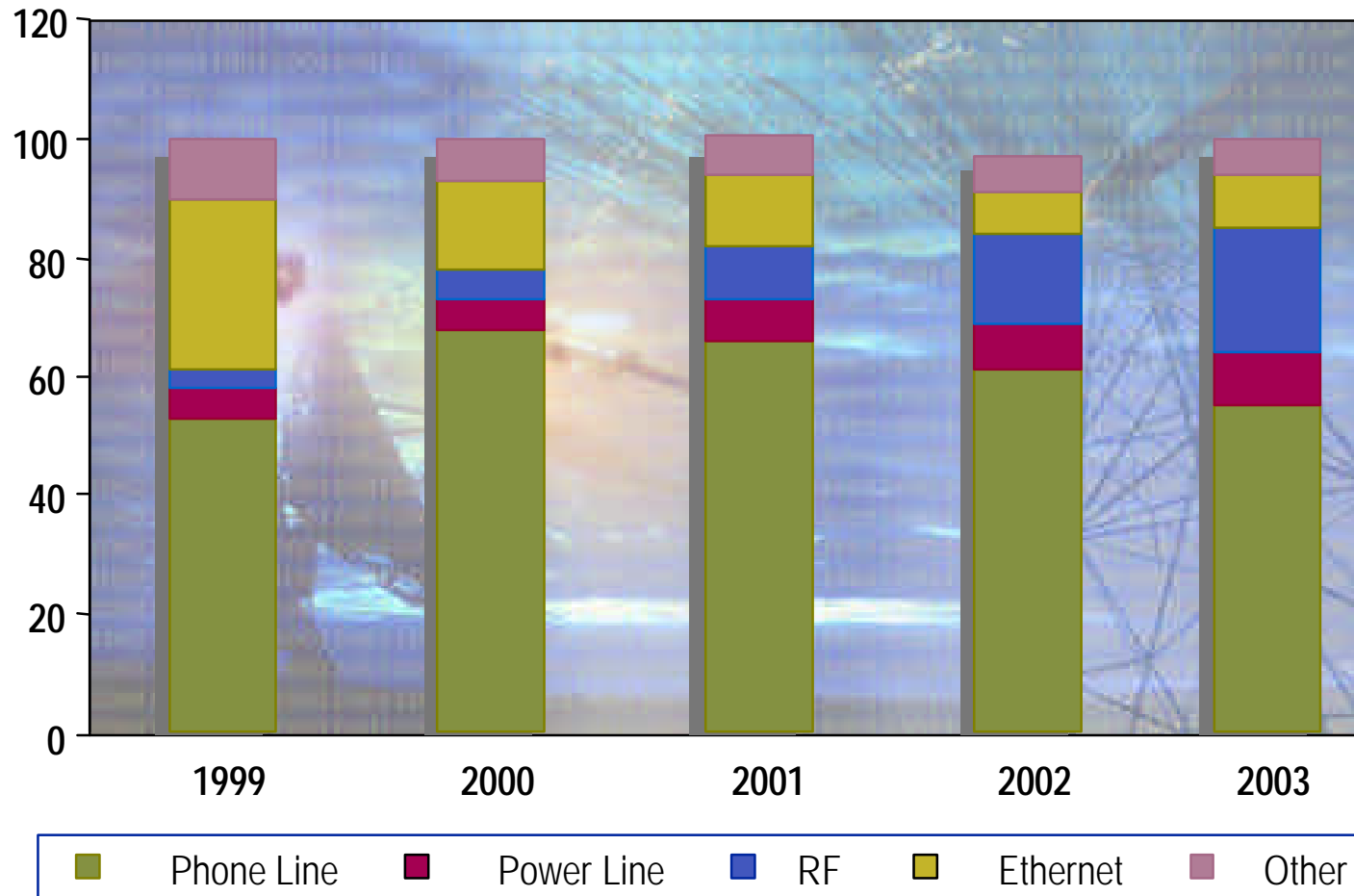
- ◆ More digital appliances are coming into the home
 - DSS, DVD, Digital TV
 - Web-Top boxes, set-top boxes
 - PDAs, mobile (cellular) phones
 - Digital cameras
 - Installed base of internet appliances will exceed 50M by 2001
(by IDC)

- ◆ More digital content entering the home
 - Published Content
 - CD-ROMs, DVDs, DVRs, digital photography
 - Networked Content
 - DTV, DBS, VoIP, MP3, movies-on-demand, streaming media

Four Aspects to Home Networking



Applications Driving Home Networking



Courtesy: Dataquest



www.xilinx.com



Different Strokes for Different Folks

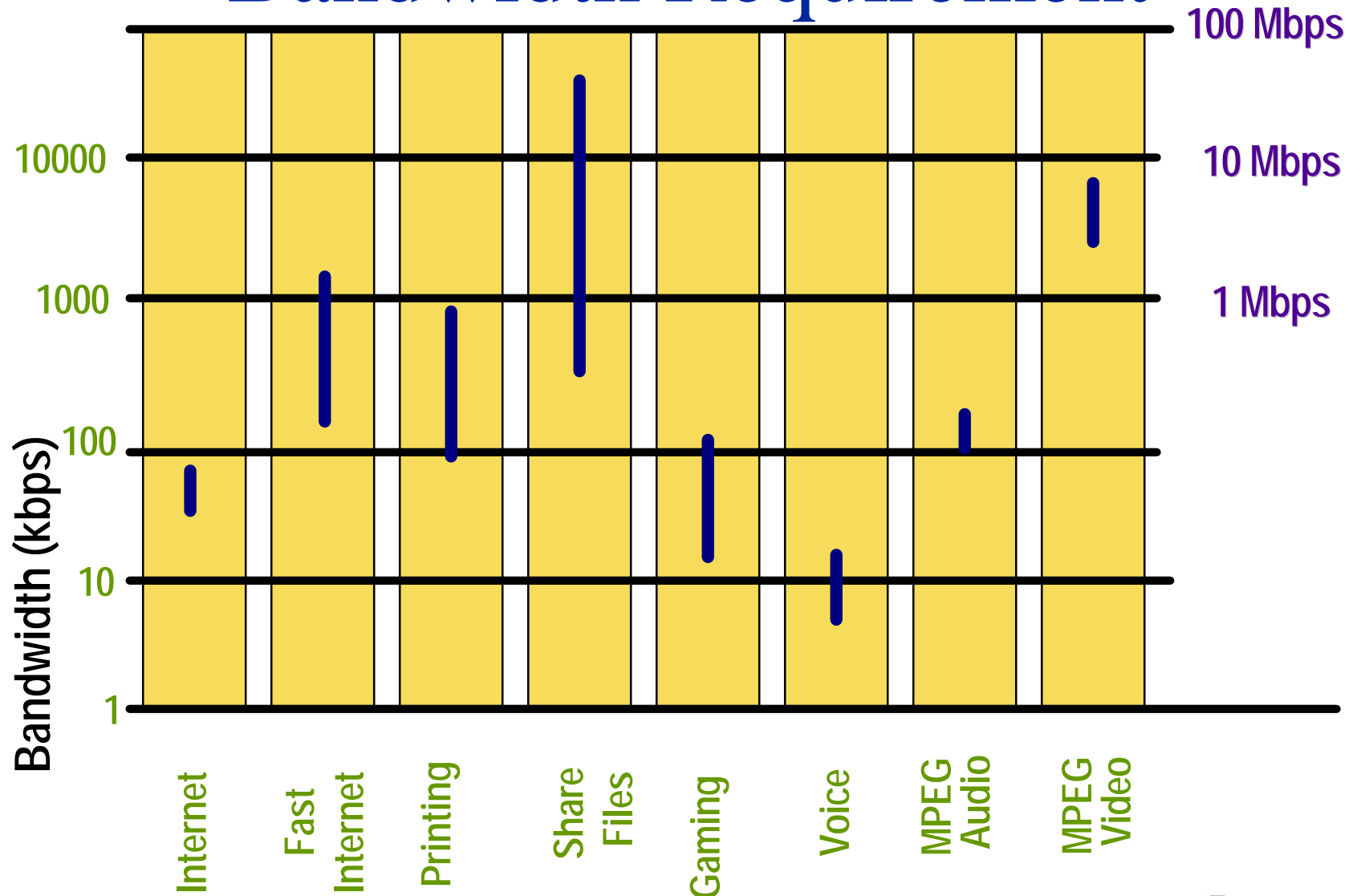
	Home Automation	Entertainment	Information	Personal Communications	Communication
Devices	<ul style="list-style-type: none"> - Home appliances - Security/safety systems - Utility meters 	<ul style="list-style-type: none"> - TV sets - Set-top boxes - DVD Players - Game consoles - VCRs - MP3 Players 	<ul style="list-style-type: none"> - PCs - Screen phones - Printers - Modems - Routers - Hubs - Scanners 	<ul style="list-style-type: none"> - Mobile phones - Smart phones - Handheld - Laptop - Pagers 	<ul style="list-style-type: none"> - Corded/Cordless telephones - Fax machines
Content	Information on home processes, house environment, remote diagnostics and technical support	Rich multimedia content, electronic programming guides, impulse purchases	Discrete information on external world, shopping for household goods	Information used on the move or requiring instant action: travel, weather, local services, stock market	Information on how to reach people in time and space
Usage Pattern	Communal	Communal	Individual Shared	Individual Personal	Communal or Individual Shared
Connection to Outside World	<ul style="list-style-type: none"> - Power line - POTS 	<ul style="list-style-type: none"> - Cable - DBS 	<ul style="list-style-type: none"> - Cable modem - ADSL - POTS, ISDN 	<ul style="list-style-type: none"> - GSM - Infrared 	<ul style="list-style-type: none"> - POTS
Practical Networking Technology	<ul style="list-style-type: none"> - CEBus - X-10 - LONWorks 	<ul style="list-style-type: none"> - IEEE 1394 (Fire Wire) 	<ul style="list-style-type: none"> - HomeRF - HomePNA - Ethernet 	<ul style="list-style-type: none"> - Infrared - Bluetooth 	<ul style="list-style-type: none"> - POTS - DECT - 900MHz, 2.4GHz

Home appliances have different content, functionality, application, and use different interconnection technologies

Multimedia Bandwidth Requirements

- ◆ High Quality Video
 - Digital Data = (30 frames / second) (640 x 480 Pixels) (24-bit color / pixel) = 221 Mbps
- ◆ Reduced Quality Video
 - Digital Data = (15 frames / second) (320 x 240 Pixels) (16-bit color / pixels) = 18 Mbps
- ◆ High Quality Audio
 - Digital Data = (44,100 audio samples / sec) (16-bit audio samples) (2 audio channels for stereo) = 1.4 Mbps
- ◆ Reduced Quality Audio
 - Digital Data = (11,050 audio samples / sec) (8-bit audio samples) (1 audio channel for monaural) = 0.1 Mbps

Bandwidth Requirement



Home Appliances Bandwidths

	Application	Technique	Data Rate	Compression
Video	Video Conference Quality	H.261	0.1 Mbps	Yes
	Streaming Video	MPEG-4	5 Kbps ~10 Mbps	Yes
	VCR Quality	MPEG-1	1.2 Mbps	Yes
	Broadcast Quality	MPEG-2	2 ~ 4 Mbps	Yes
	Studio Quality Digital TV	ITU-R 601	166 Mbps	No
	DVD/ Studio Quality DTV	MPEG -2	3 ~6 Mbps	Yes
	HDTV	CD-DA	2000 Mbps	No
	HDTV	MPEG-2	25 ~ 34 Mbps	Yes
Audio	Streaming Audio	MPEG L3(MP3)	32~ 320 Kbps	
	Consumer CD-Audio	CD-DA	1441 Kbps	No
	Consumer CD-Audio	MPEG with FFT	192 ~256 Kbps	Yes
	Sound Studio Quality	MPEG with FFT	384 Kbps	Yes
	Dolby AC-3	5.1 Channels	640 Kbps	Yes
Telephone	Standard	G.711 PCM	64 Kbps	No
	Standard	G.721 ADPCM	32 Kbps	Yes
	Lower	GSM	13 Kbps	Yes
	Lower	CELP	5 ~7 Kbps	Yes
Broadband Internet Access	DSL	ADSL	1.5 ~9 Mbps	N/A
	Cable Modem	DOCSIS	2 Mbps	N/A

Ethernet & Home Networking

- ◆ For the home networking purists, Ethernet equipment offers cheap and proven products
- ◆ The Ethernet market is second behind the phonline technology
- ◆ Cahners In-Stat Group expects that Ethernet networking will be 30% of total home networking units shipped

Ethernet & Home Networking

- ◆ Distribution of Video for the entertainment applications requires larger bandwidth
 - MPEG 2 (used in HDTV) requires between 24 to 35Mbps
 - Fast Ethernet delivers video data at 100 Mbps
- ◆ Fast Ethernet is capable of delivering video data at high speed
 - Fast Ethernet is a mature, proven, and Inexpensive solution
 - Fast Ethernet has been successfully used in enterprise networking

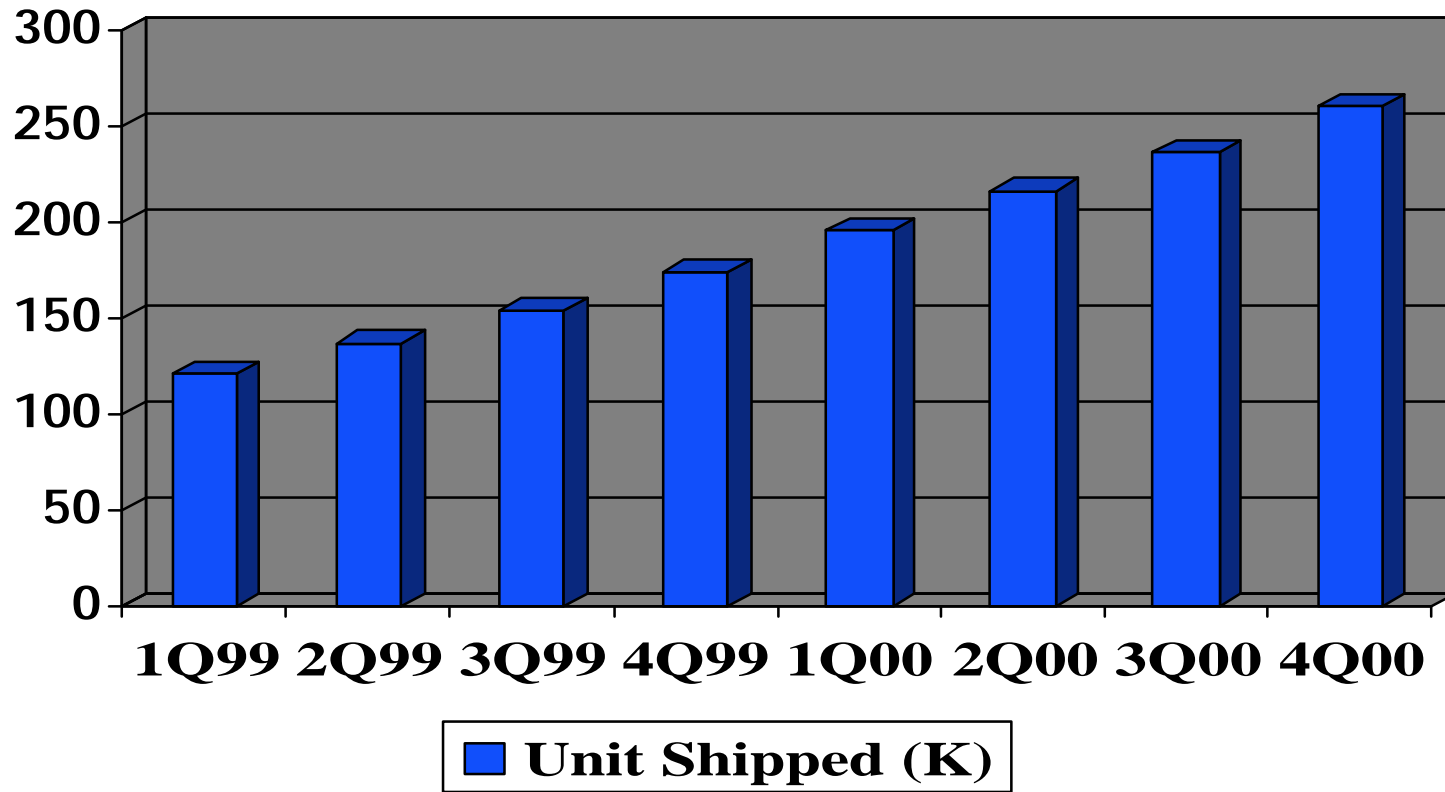
Home Networking Applications

- ◆ Fast Ethernet is an enabling technology for connecting devices such as:
 - Digital Camcorders and VCRs
 - Direct-to-Home (DTH) satellite audio/video
 - Cable TV and MMDS (microwave) set-top boxes
 - DVD Players
 - Video Games
 - Home Theater
 - Musical synthesizers/samplers with MIDI and digital audio capabilities
 - Digital audio tape (DAT) recorders, mixers, hard-disk recorders, video editors, etc.

Home Networking Applications

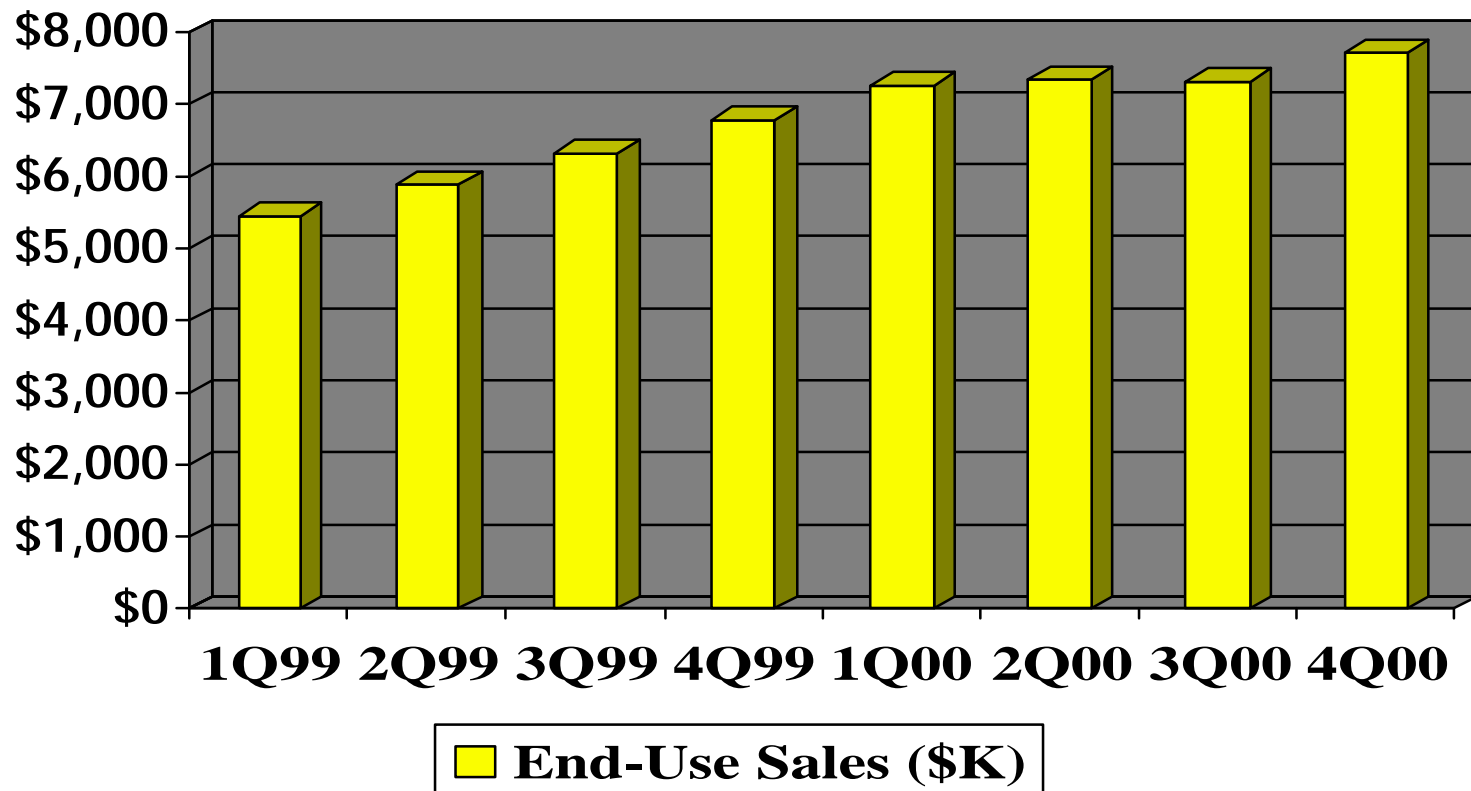
- Digital Video (DV) applications (including security cameras)
- Fixed and removable PC disk drives
- PC-to-PC networking and PC peripheral component sharing
- Printers for video and computer data
- Scanners

Ethernet Home Networking NIC Forecast



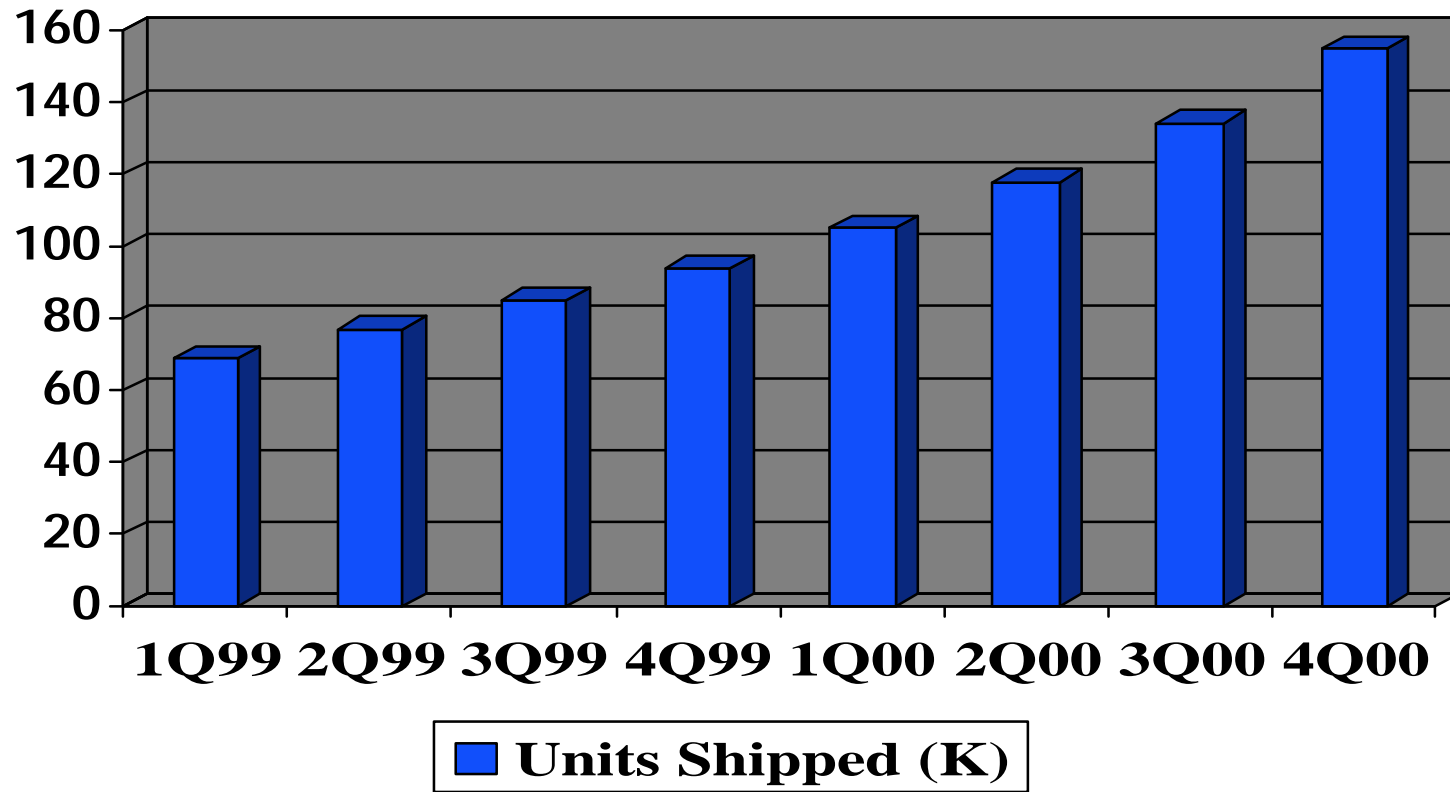
Source: In-stat Group

Ethernet Home Networking NIC Forecast



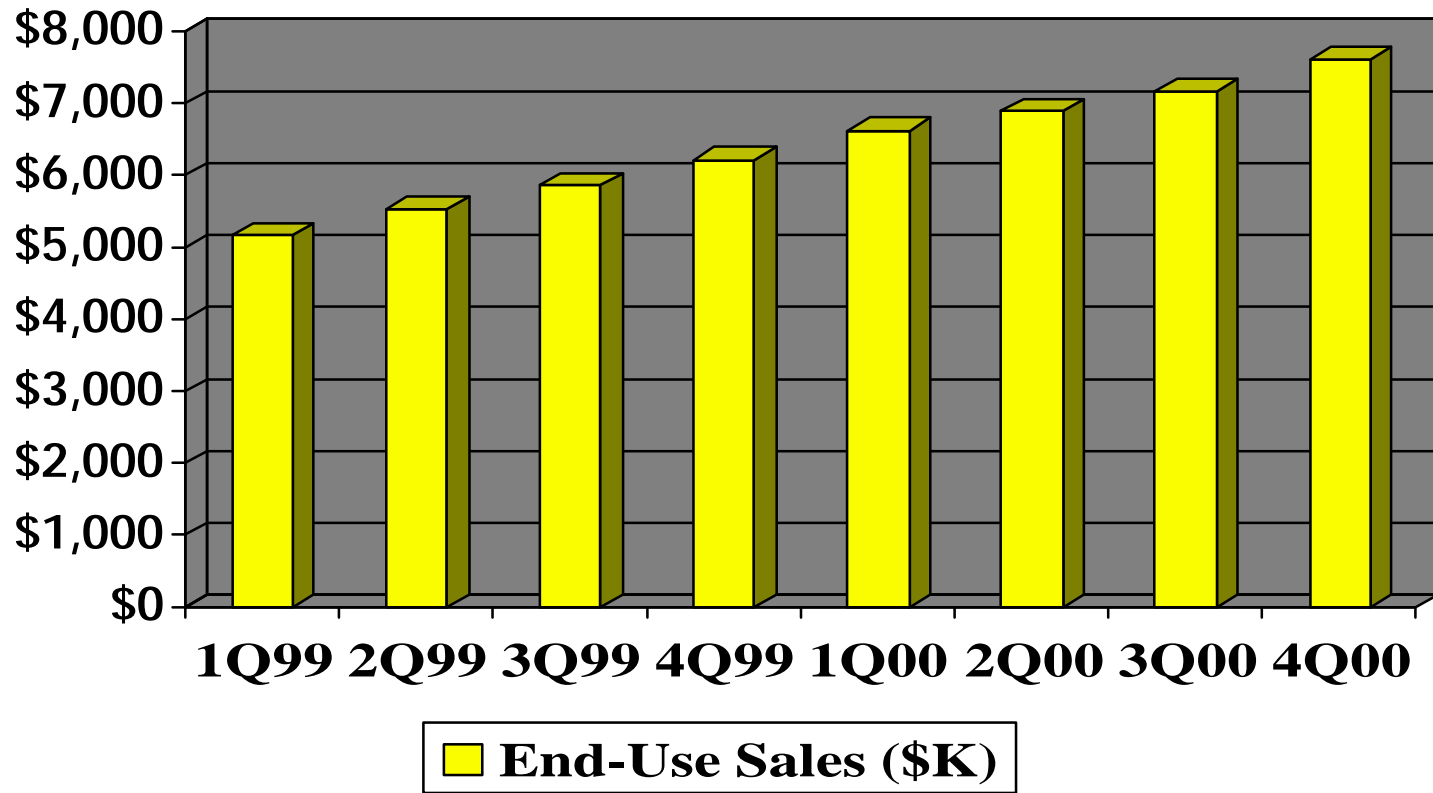
Source: In-stat Group

Ethernet Home Networking Hub Forecast



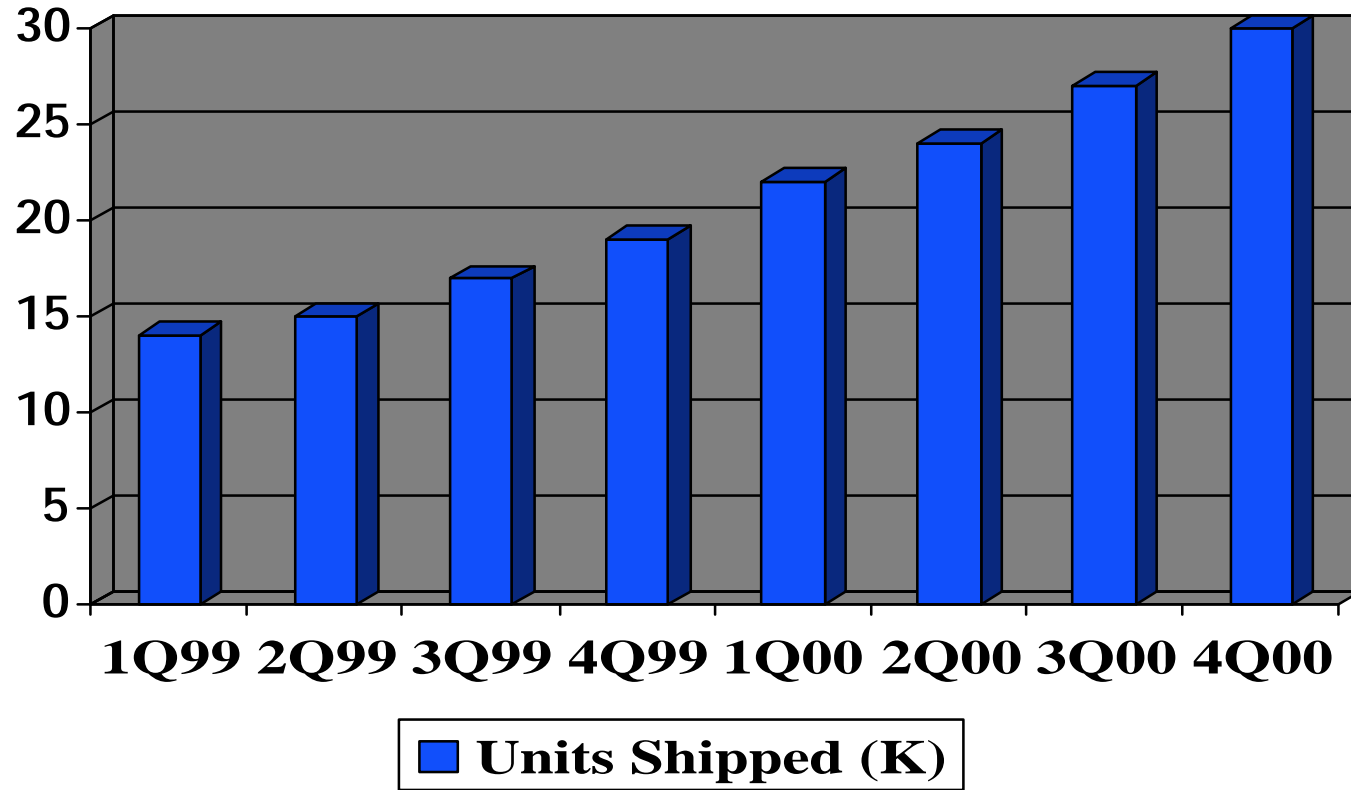
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Ethernet Home Networking Hub Forecast



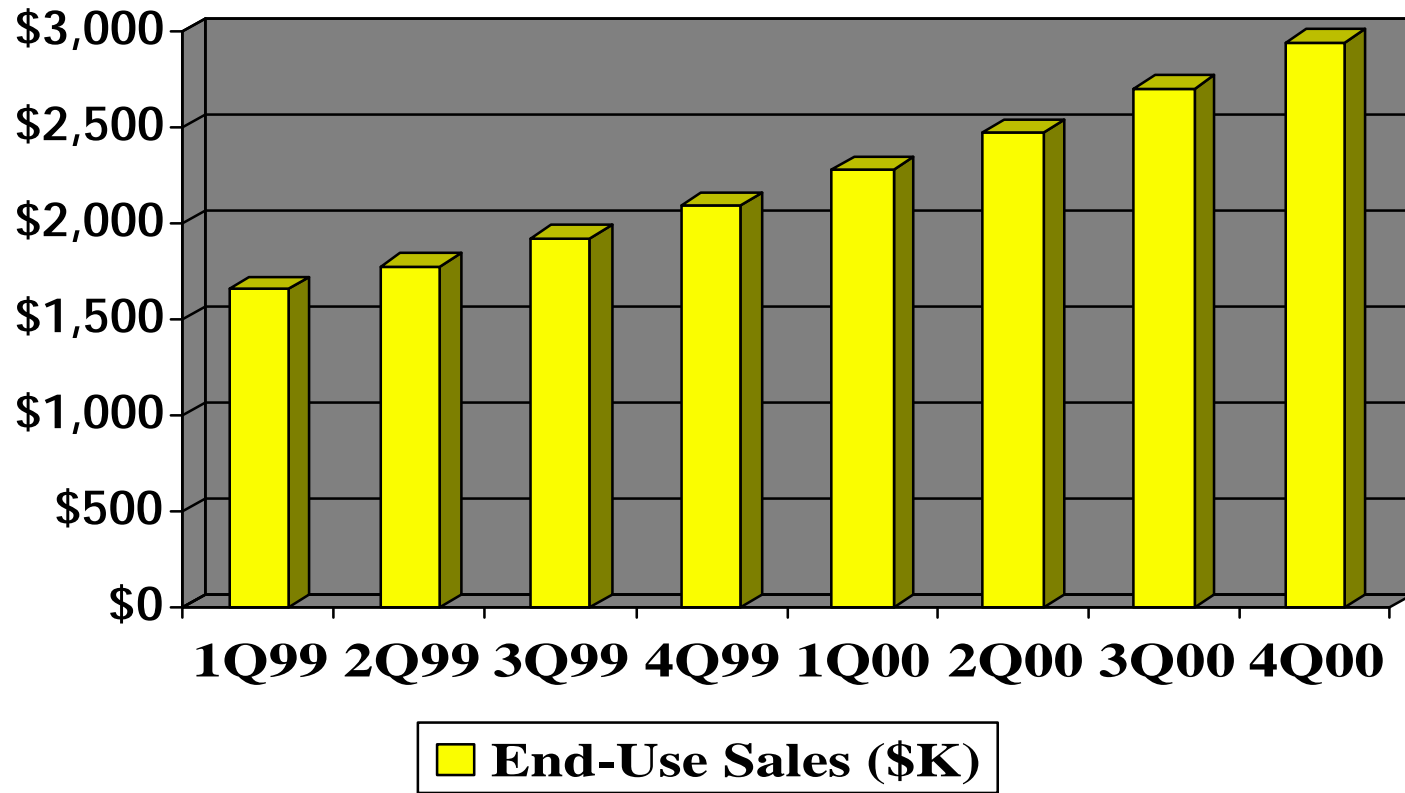
Source: In-stat Group

Ethernet Home Networking Switch Forecast



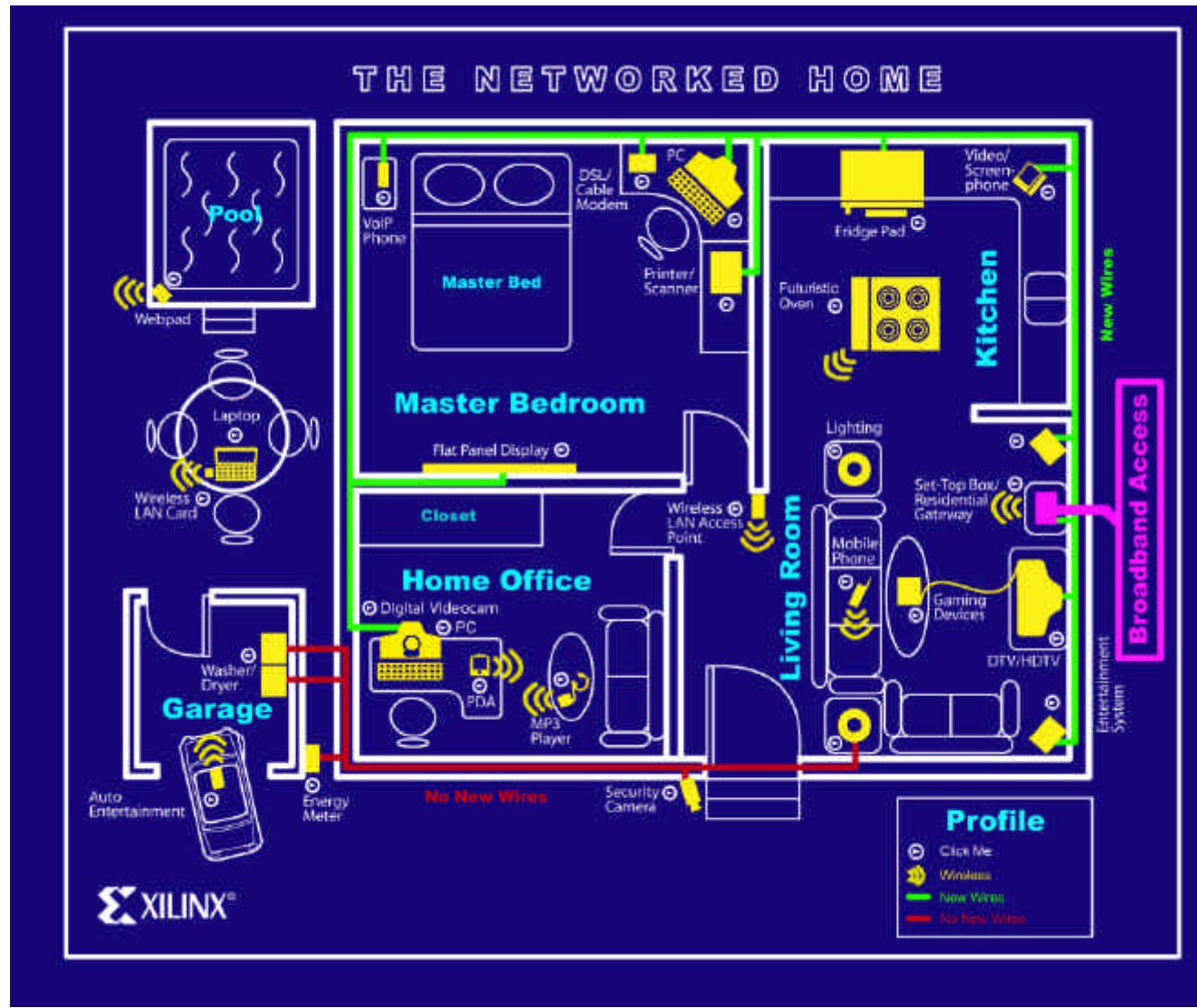
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Ethernet Home Networking Switch Forecast

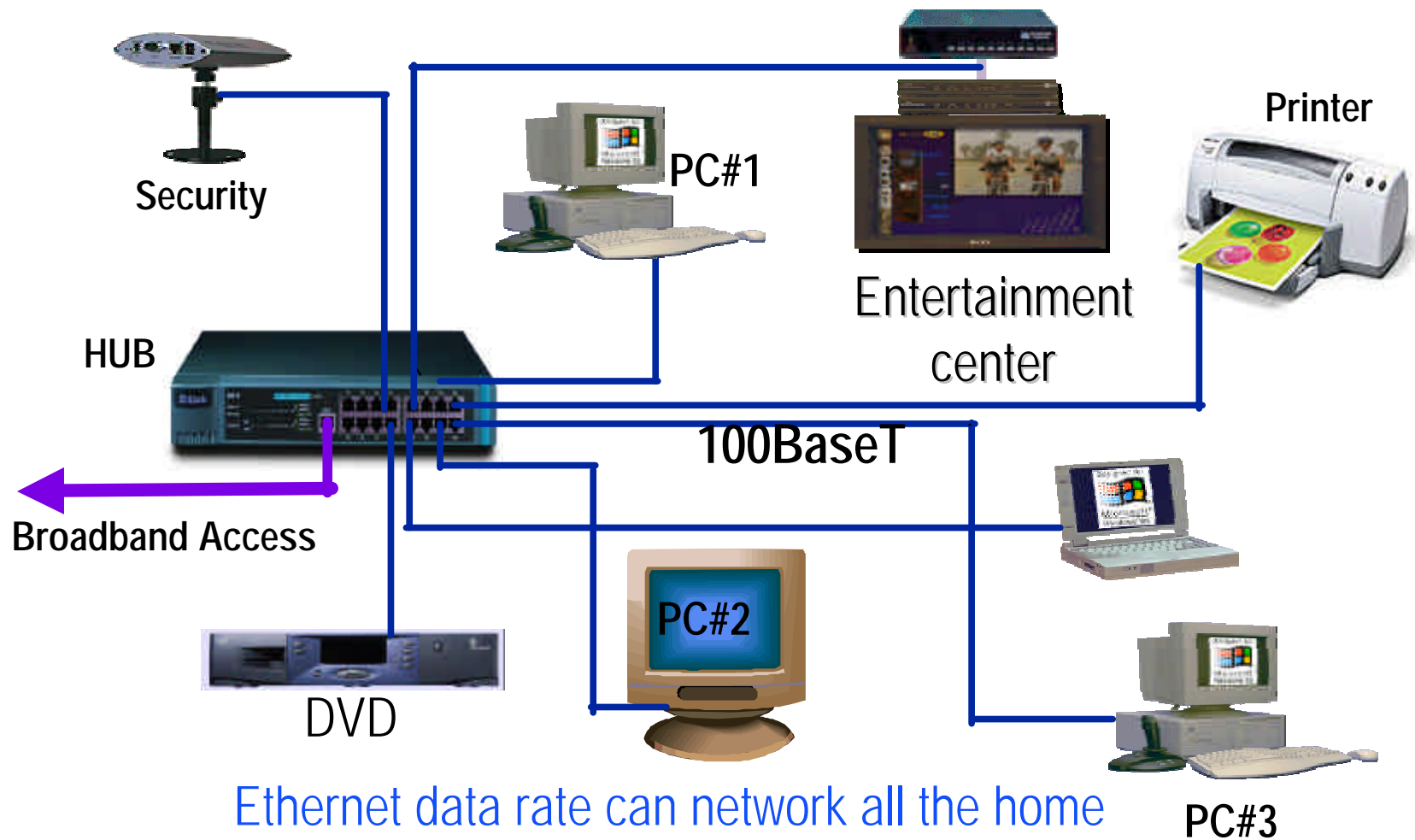


Source: In-stat Group

Problem: Islands of Technology



Fast Ethernet Home Network



Ethernet data rate can network all the home appliances efficiently