Residential Gateways and Home Networking

Pat Romano, Vice President, Engineering
2Wire, Inc.

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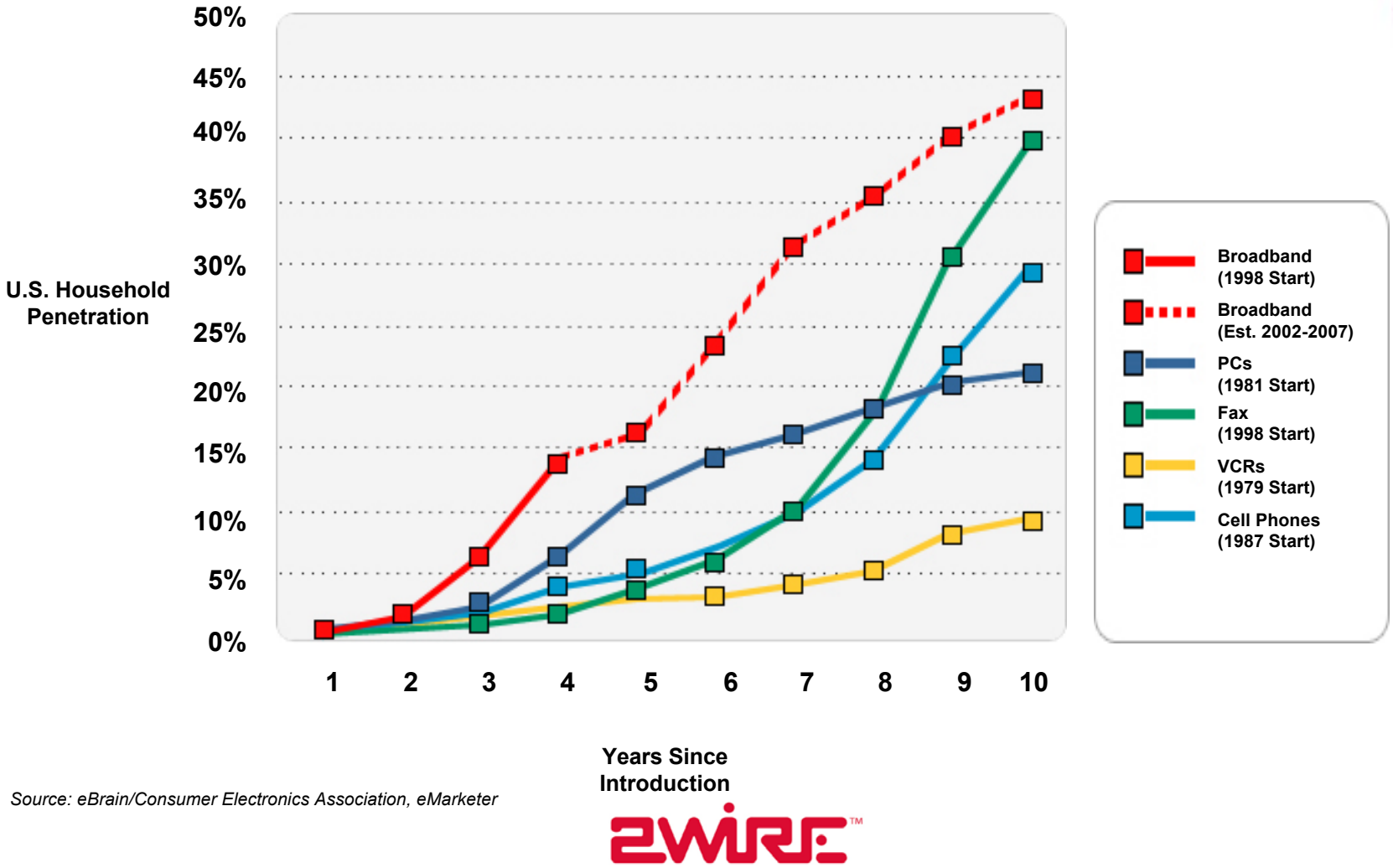
Rapid Consumer Adoption



Source: eBrain/Consumer Electronics Association, eMarketer

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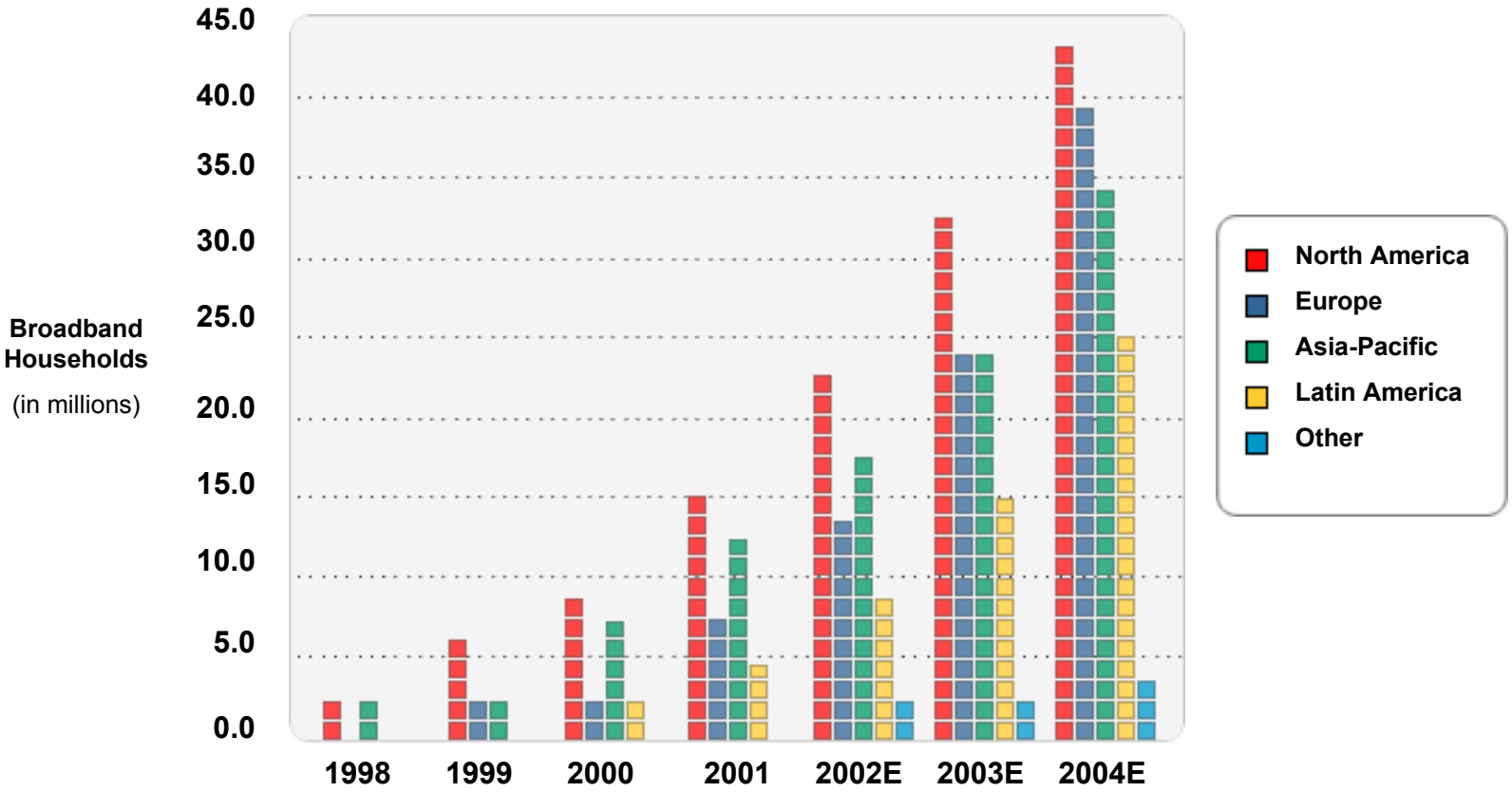
A Worldwide Opportunity



Source: eMarketer, FCC, Ovum, Pioneering Consulting

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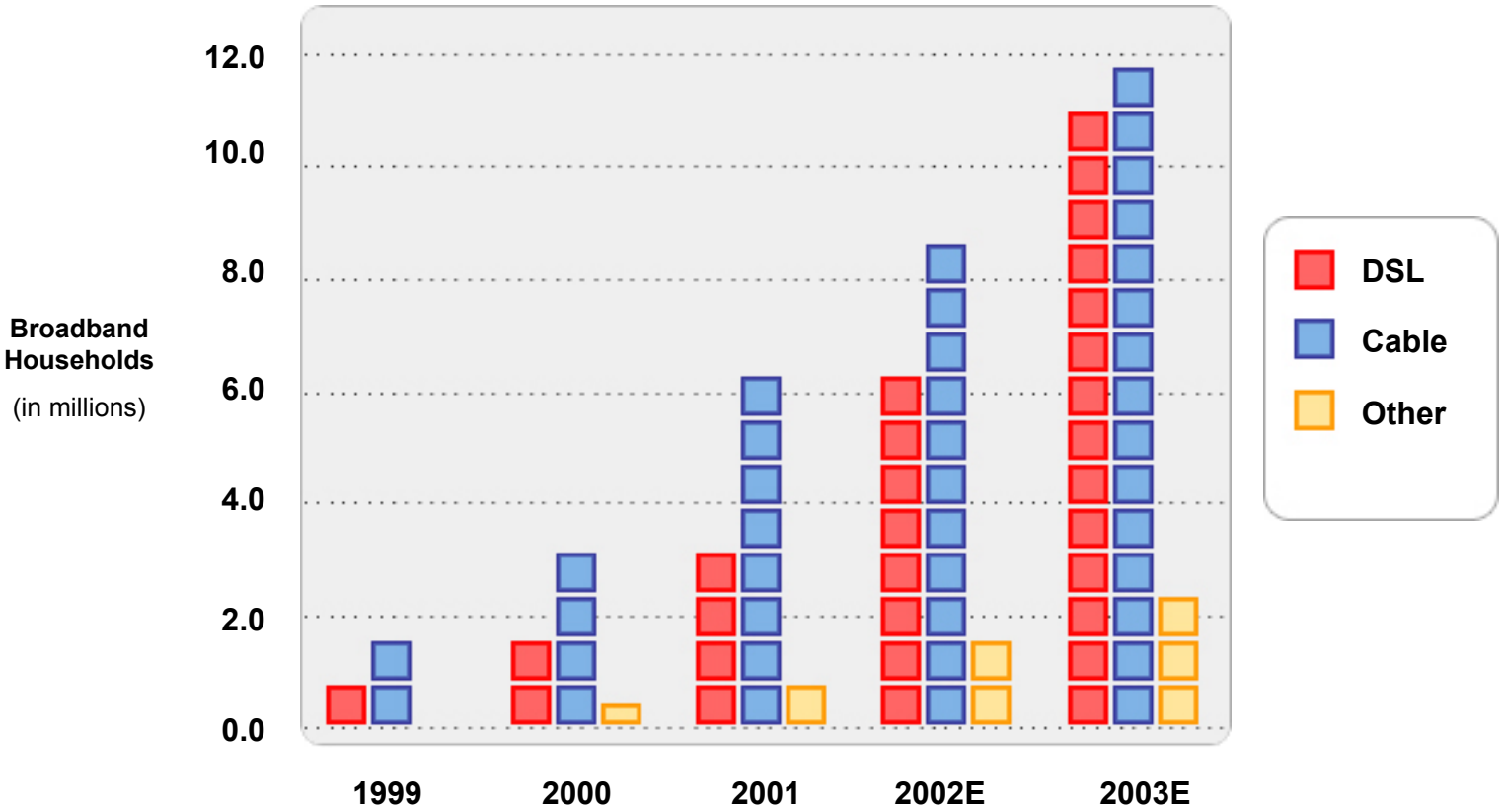
DSL and Cable Dominate Connectivity



Source: eMarketer, Ovum

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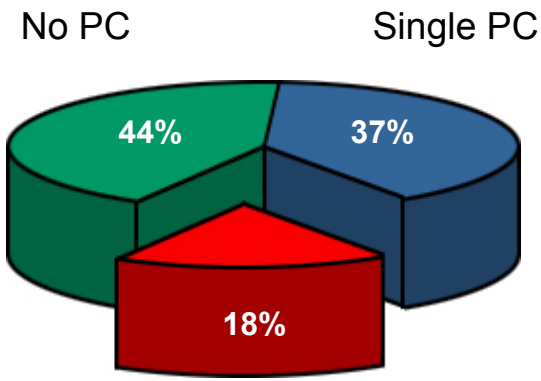
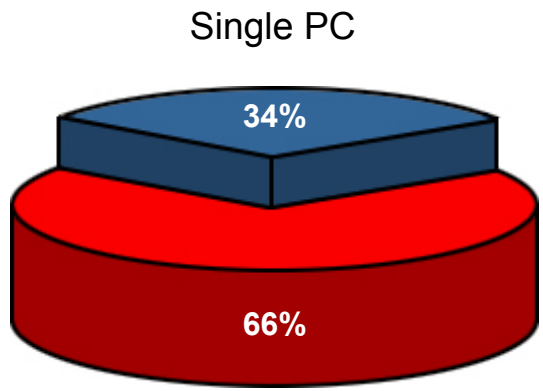
Immediate Market Opportunity

U.S. Homes with Multiple PCs



U.S. Broadband Homes with Multiple PCs



Source: Yankee Group

Emerging Market Opportunities

PC Networking

- Shared high-speed Internet access
- Shared peripherals
- Application rentals

Telephony

- Multiple phone lines
- PBX functionality
- Unified messaging

Entertainment

- Audio-on-demand
- Video-on-demand
- Gaming

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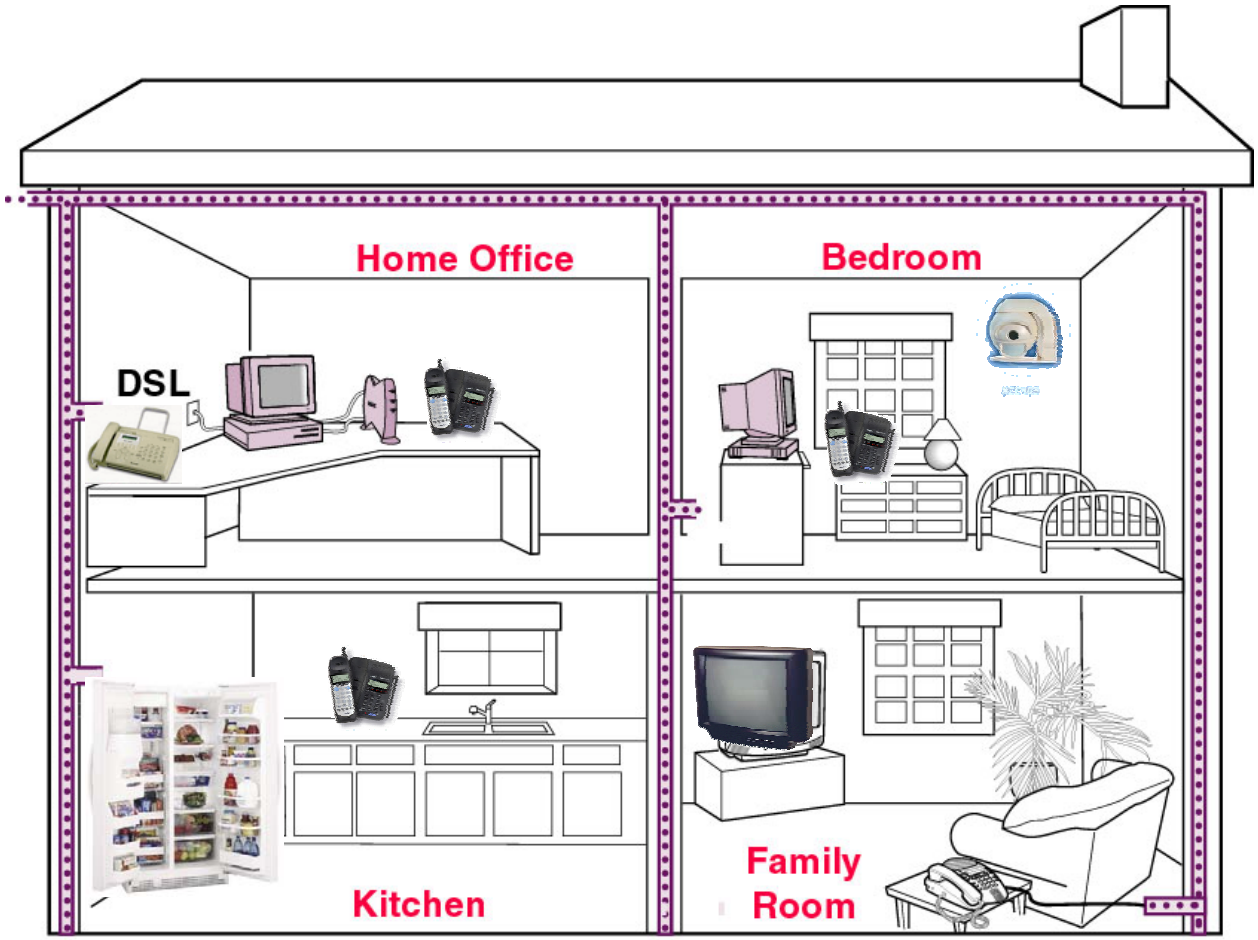
The Home Networking Factor – Get it All Connected



Home networks extend the reach of broadband services to devices that are more naturally suited for service delivery

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Structured Wiring is a Barrier

- Current home networking technologies such as home phone-line networking and 802.11b allow the “structured wiring” problem to be overcome without a truck roll
- When a users are faced with a significant infrastructure upgrade requirement they will either delay or re-evaluate their service options
- Ethernet is fine for legacy connectivity within a single room but is a significant barrier for “whole house” broadband service deployment
- Structured wiring requirements become an even larger barrier for broadband services beyond basic Internet access

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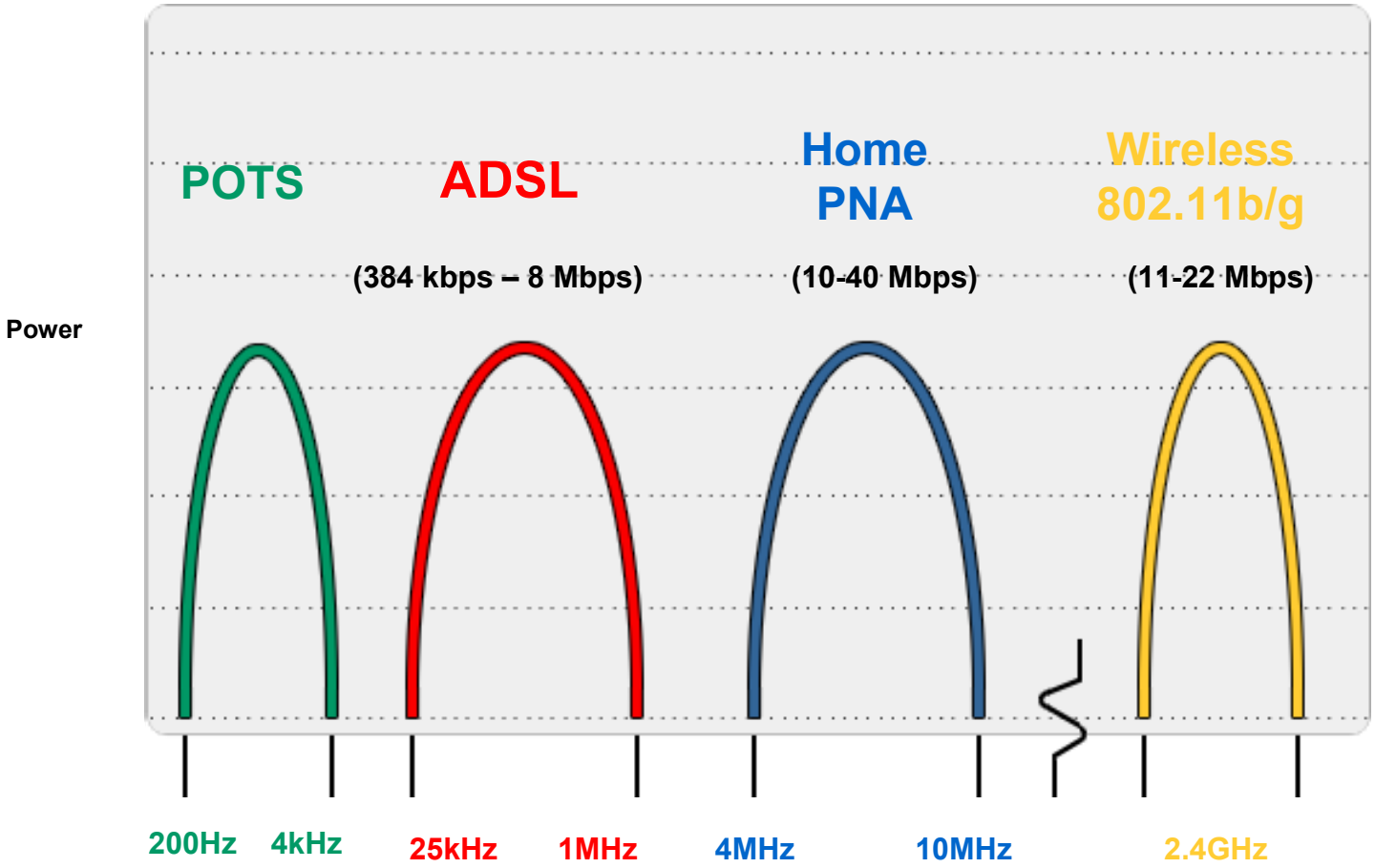
No New Wires Connectivity



USB UNIVERSAL SERIAL BUS

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Home Phone Line Networking

- Standard for networking a home using the existing phone wiring
- Tolerant of differing wiring topologies
- HPNA 1.0 specification defines a standard for 1Mbps home phoneline networking using pulse position modulation (no penetration)
- HPNA 2.0 Standard ratified by the Home Phoneline Network Alliance in December 1999 (www.homepna.org) employing QAM modulation to achieve 10-16Mbps and higher
- Spectrally compatible with POTS telephony and ADSL signaling on the same wire
- HPNA 2.0 standard has mandatory provisions for fair weighted priority queuing to enable QOS for applications requiring it

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Wireless Home Networking Options

802.11b/g
802.11a
HomeRF
Bluetooth

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802.11b/g Wireless Networking

- Direct Sequence Spread Spectrum and Frequency Hoping modes in 2.4 Ghz ISM band (slight variations by country)
- Base standard includes data rates of 1 and 2 Mbps (no significant penetration)
- Achieves data rates of up to 11Mbps
- Supports optional encryption modes for security although current shortcomings here are a significant issue
- Proposals being considered for QOS, priority management and improved security in future versions of the standard
- Significant penetration of 802.11B seen in the business environment

802.11a Wireless Networking

- OFDM modulation in the 5 Ghz band
- Achieves data rates up to 54Mbps
- Shares protocols for security and QoS with 802.11B
- Limited penetration given the maturity of the technology

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HomeRF Wireless Networking

- 2.4 Ghz ISM band
- 1 or 2 Mbps via FSK modulation (frequency hoping)
- 50 meter range
- 2 coexisting node types (Isocronous “I” or Asynchronous “A”)
- Includes support for up to 6 TDMA voice channels derived from DECT (Digitally Enhanced Cordless Phone) technology using I mode
- Includes support for data encryption

Bluetooth Wireless Networking

- Targeted at personal area networks (PDAs, mobile phones, etc.)
- Normal range to 10 meters
- Optional extension to 100 meters
- Operates in the 2.4 Ghz band
- 1Mbps data rate (720k data + voice)
- Intended for cost sensitive applications
- Includes support for data encryption
- Bridges likely to exist to allow Bluetooth enabled devices to be bridged onto alternative wired and wireless home network technologies

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Which Wireless Standard Where?

- 802.11B/G will likely dominate. Workers returning home with their business laptops will most likely require 802.11B networking at home for convenience
- 802.11A will require co-implementation with 802.11B/G. No network technology in history has succeeded in supplanting its predecessor without being backward compatible
- Bluetooth may be available in some personal convenience devices in the quest to eliminate cables. It has no cost or performance advantages as a networking solution and will therefore not be important for those applications
- HomeRF is dead. It has no advantage over 802.11 and will lose on cost due to sheer economies of scale. Wireless LANs address portable technology applications which demand seamless compatibility between work and home

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Powerline Home Networking

- Consortium settled on an OFDM approach
- Achieves data rates up to 11Mbps
- Current building code places power outlets every 10 feet so access is convenient
- The question here is can the technology mature fast enough to beat the combination of HPNA and wireless for cost and performance

1394 Home Networking

- Not a viable “whole home” networking technology
- Supported rates include 100, 200 and 400 Mbps on same bus
- Limited cable lengths
- Targeted primarily at the entertainment cluster and associated devices such as camcorders and digital still cameras
- HAVI technology layered on 1394 for AV control and streaming
- Defined mechanism for running IP on 1394
- Expected to be very successful in its core market and will drive the creation of bridges between 1394 and other home networking technologies

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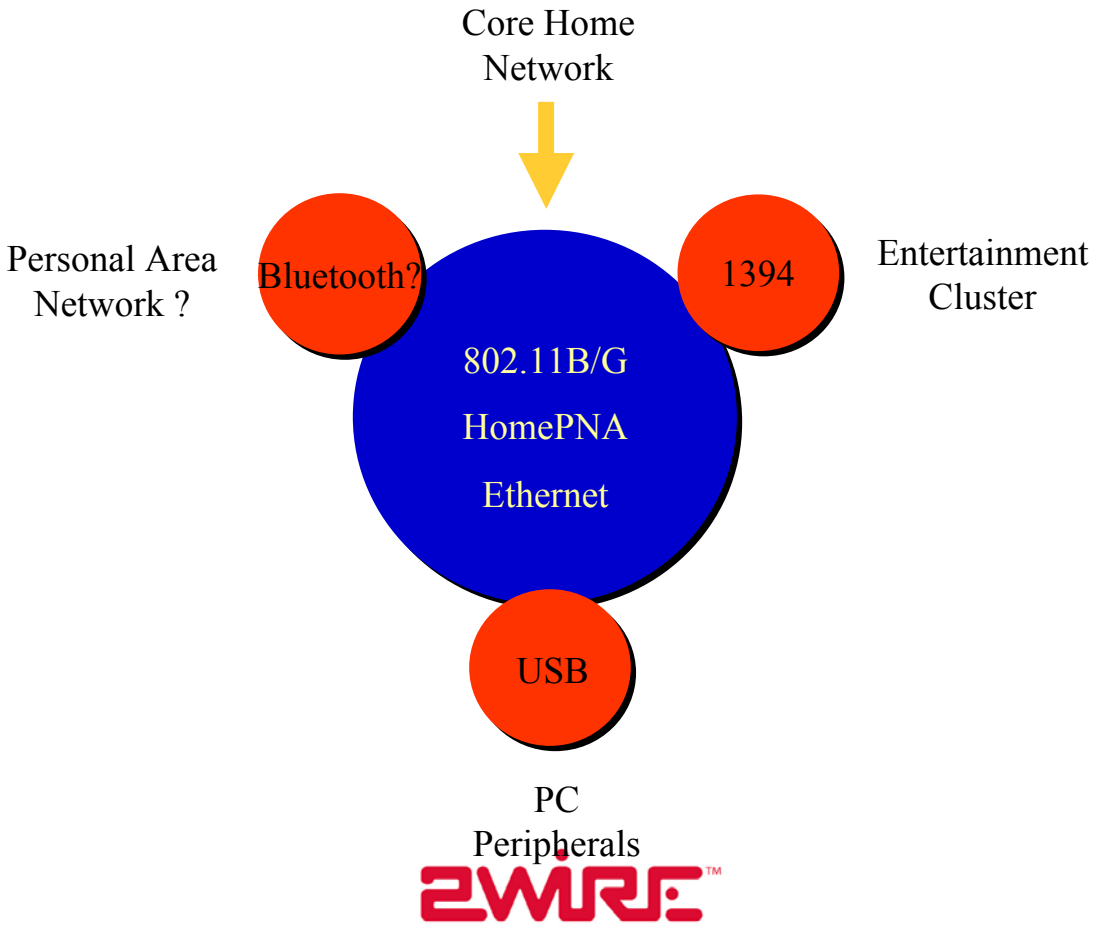
Likely Combination of Network Technology



Residential Gateway Solution

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Attributes of a Residential Gateway

- Consumer installable
- Standards based broadband connection (either G.DMT for ADSL and DOCSIS for cable)
- Router for broadband Internet traffic
- Bridge for several home networking mediums (HomePNA, Ethernet, USB, 802.11B/G)
- Consumer friendly firewall for security
- Seamless interworking with VPN technology
- Broadband link and home networking architecture scalable to services such as voice and entertainment
- Network manageable and provisionable

Service Provider Benefits

- Residential gateways enable additional revenue generating services that leverage the existing ADSL infrastructure
- Residential gateways provide the missing link between both PC and non-PC devices in the home and their associated service in the network
- New services and options can be marketed incrementally without the need to replace CPE or roll a truck
- Customers entering the broadband market are self-selected for a high propensity to “take” additional services and options

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Home Network Security Issues

- Broadband home networks are vulnerable to security breaches from hackers due to the always-on nature of the connection
- Firewall technology must be employed to prevent external access to in home resources
- The firewall must be intelligent enough to not protect users from themselves (traditional NAT and firewall technologies break many applications)
- Denial of service attack vulnerability also needs to be addressed
- Inbound access to home networks from members of the family need to be accommodated
- Connecting the home network to the corporate network via a secure VPN tunnel is problematic at home. Opt for a VPN pass through approach

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Voice in the Networked Home

- “Virtual” structured wiring via the home network
- Consumer oriented PBX features
- New VoIP voice services provide inexpensive and simple incremental lines
- Residential Gateway to manage it all and insulate the residence from changes in the network

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Voice Services

- Three primary approaches:
  - Carrier Class VoIP - MGCP
  - Additional Use Line VoIP - SIP
  - VoATM (dead)
- The residential gateway is the bridge between diverse and dynamic technologies in the network and stable and familiar devices in the home

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Voice Services

Voice over home phone-line networking

- Solves structured wiring problem
- Eliminates truck roll
- Enables consumers to use existing handsets via convenient adapter
- Increases flexibility of existing handsets (not physically tied to a specific line)
- Inexpensive
- Standard in process
- Establish consumer phone vendors will build the technology into readily available handsets
- Residential gateway becomes the centerpiece for voice control in the home

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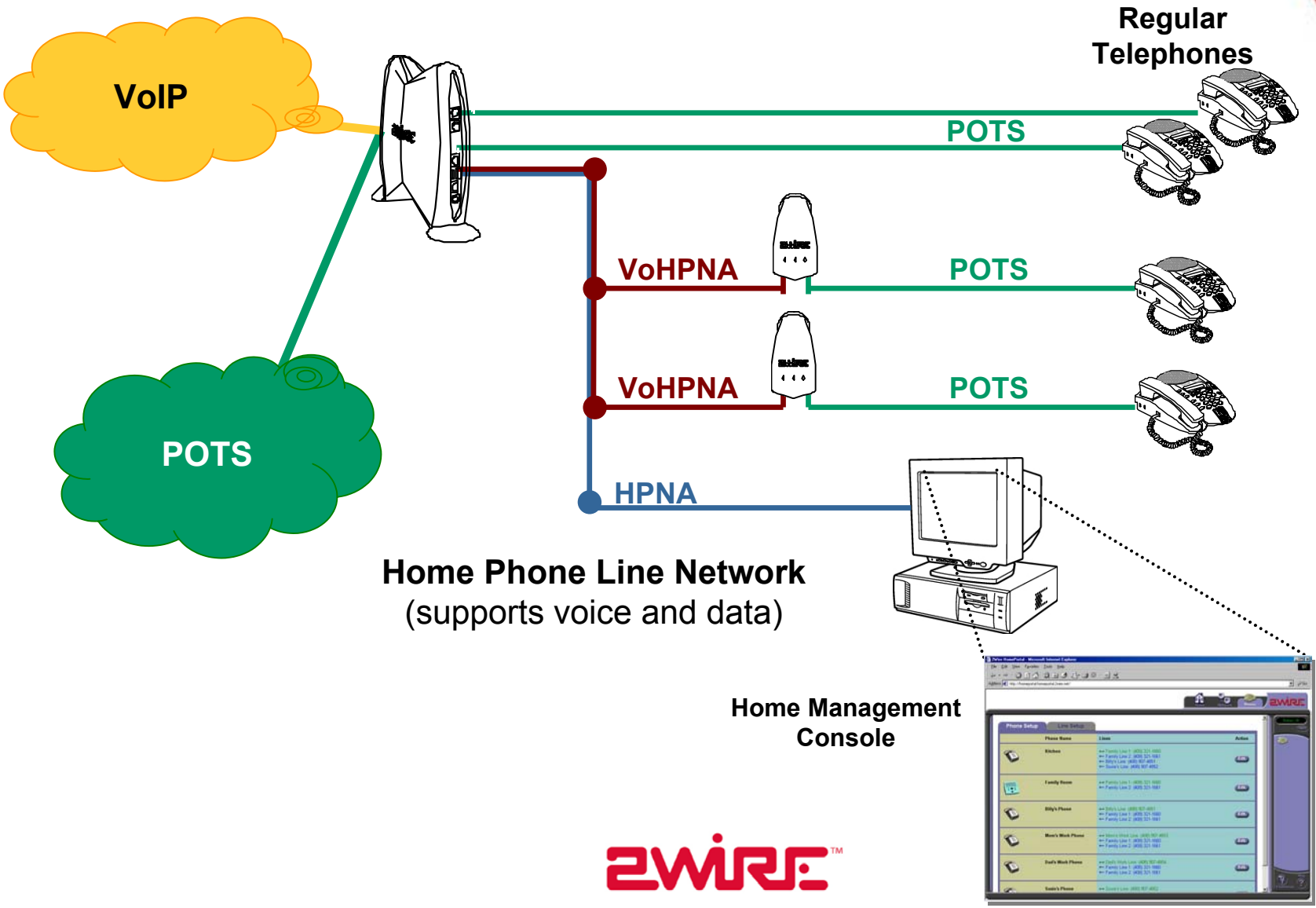
Residential Telephony Network



Appliances in the Networked Home

- Network enabled versions of existing consumer products will likely be the first to get traction (tv, radio, CD player, security system, etc.)
- Service providers are developing network models to deal with the authentication and traffic management issues surrounding appliance connectivity to their associated services

Gaming Services

- Subscription service opportunity for access to engineered gaming networks
- Latency must be kept to an absolute minimum
- Firewall capabilities of residential gateway needs to support secure hosting of game servers
- PC games are nice but support for networked versions of traditional game consoles is essential to mass market adoption
- Residential gateway is key to QoS enforcement and console to service routing

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Video and Music Services

- Bandwidth limits make full cable replacement a future proposition but video and audio on demand services can be a reality now
- New fiber plant and advanced copper loop conditioning technologies will push average bit rates significantly higher
- Home networks with good QoS are essential for the distribution of content to convenient and familiar outlets
- Auto-provisioning systems are essential for consumer installation of both residential gateways and video and audio appliances
- Strict digital rights management is essential to catalyze content providers to endorse services. Keeping content off the PC is a plus here

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Conclusions

- Heterogeneous home networks are here to stay
- Achieving the full potential of broadband requires the deployment of services beyond browser based Internet Access
- It has to be simple and easy for both the user and the service provider