



Pioneering the Ubiquitous Home Network: New AMD Silicon Solutions for Phone Line Networking



White Paper

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The introduction of AMD's first home networking controller will change the way consumers interact with their personal computers. AMD's new single-chip controller is fully compliant with the Home Phoneline Networking Alliance's (HomePNA) initial specification for 1 Mbps data transfer over standard telephone wiring. Utilizing the widely endorsed HomePNA technology and leveraging significant expertise in enterprise networking allows AMD to produce a highly-integrated device capable of meeting the growing consumer demand for an inexpensive, easy-to-use technology allowing for the sharing of computing resources among many different PCs. The PCnet™-Home single-chip controller marries Ethernet with in-home telephone wiring to deliver on the promises of home networking.

INTRODUCTION

While Local Area Networks (LANs) are a well-accepted part of the communications environment for businesses, LANs are not commonly deployed in the home. This is due to several technical and logistical reasons. Chief among these is the fact that the widely adopted and supported enterprise networking technologies require a technically skilled individual capable of designing and maintaining a complex network architecture. Enterprise networks also require the use of high-grade wiring typically not found in most homes. Also, few home users are willing to master the art of installing and maintaining an Ethernet repeater, learn even the basics about network protocols, or drill holes through their walls to run new network-capable wiring throughout their home.

The driving force behind creating new home connectivity products is the growing number of homes with two or more PCs. With the increased focus on computers in education and the boom in Internet connectivity, a large number of PCs being purchased today are additional PCs as opposed to replacement units. Today, it is estimated that over 15 million of the 100 million homes in the United States have two or more PCs, and 60% of new consumer PC purchases are by families that already have at least one computer. This number is expected to double by the year 2000 according to the research firm Dataquest.

The growth in the number of multiple-PC households leads to a need for connecting these PCs in order to maximize the benefits of peripheral components and to have a convenient method for sharing files and other information between the various computers within the home. In a home with multiple PCs, each computer would ideally have its own printer, scanner or other

required peripheral. With a home network, multiple users can share these expensive peripherals, regardless of their location throughout the home. Without a network, users who want to print a file, but cannot afford to have a printer attached to every PC in the home, must physically move the file from one PC to another via floppy disk. With networked PCs, applications and files can easily be shared by users, saving time and money.

An additional primary requirement for a home network is the ability to provide direct access to the Internet from every PC within the home. Distributing Internet access throughout the home becomes increasingly important as next-generation access technologies such as cable modems and UADSL services deliver increasing amounts of bandwidth to the side of the home. Today, when multiple home users want to access the Internet via separate PCs, they must each use their own telephone line and either share a single Internet account or set-up multiple accounts. Neither of these two solutions are ideal, and the end result is often multiple users who must share Internet access in a serial fashion—one PC at a time. Home networks can deliver huge savings by enabling shared access to a single Internet connection. With integrated silicon and software support, a home network can enable one PC to act as an external gateway, distributing Internet access to every device on the network simultaneously.

Multi-player games will also benefit from the widespread adoption of home networks, enabling gamers to use two PCs located nearly anywhere in the home to compete against one another. A ubiquitous, easy-to-install home network will also foster home automation applications that take advantage of a network environment, such as environmental control and security systems (see Figure 1).

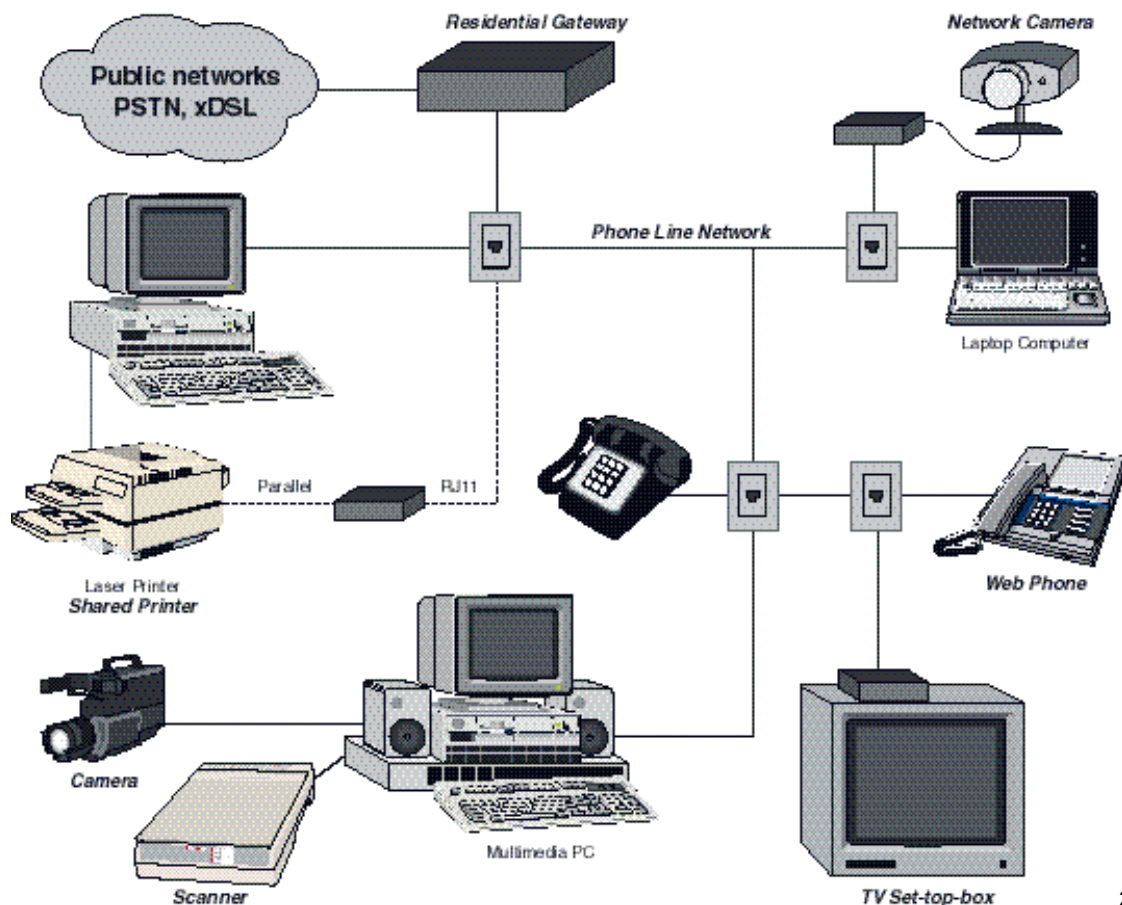
AMD, a leader in highly-integrated Ethernet networking silicon, has founded an alliance with 10 other companies to designate, promote and support a home networking technology that uses existing in-home telephone wiring to connect PCs and peripherals. The HomePNA technical specification currently supports the transmission of data at up to 1 Mbps across existing phone wiring, without interfering with standard voice transmissions. AMD's new home networking silicon device enables the creation of low-cost Network Interface Cards (NICs) and adapters that seamlessly connect PCs, printers, remote access routers, scanners, or any other peripherals to the home network.

INTRODUCING PCnet-HOME

To be successful in the consumer market, a home networking technology must be inexpensive, easy-to-install and truly easy-to-use—while requiring the installation of no new wires. AMD's PCnet-Home controller supports a truly Plug-and-Play networking envi-

ronment designed to meet all of these requirements. First and foremost, the AMD home networking solution uses existing in-home telephone wiring and does not require the installation of any additional wiring. With the PCnet-Home controller, every RJ-11 modular phone jack in the home can become a port on the LAN. Up to 25 PCs, peripherals, or network devices can be installed on a single network that can span up to 500 feet between the two farthest points.

The PCnet-Home controller uses a Frequency Division Multiplexing approach that enables standard telephone wiring to simultaneously carry voice, Universal ADSL and home networking signals without any of the services impacting each other. Signals from the AMD home networking device are centered at 7.5Mhz, with the signal ranging between 5.5Mhz and 9.5Mhz. As shown in the figure below, this range is well above the frequencies used by voice services (POTS) and Universal Asynchronous Digital Subscriber Line (UADSL) services (see Figure 2).



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AMD's Home Networking Vision. AMD is pioneering home networking by building LAN silicon solutions that provide PC and peripheral manufacturers with complete, easy-to-use, inexpensive home networking silicon. A PCnet-Home NIC plugged into a PC allows the computer to communicate with other HomePNA-capable PCs and peripheral devices in the home. In addition, a single Internet line can be shared by all of the PCs on the network. Regular phone service is not compromised by the HomePNA networking solution, allowing both voice and data services to occur simultaneously over the same wiring. Plug-and-play network drivers for Windows 95 and Windows 98 ease the installation process.

Figure 1. Home Networking: What does it look like?

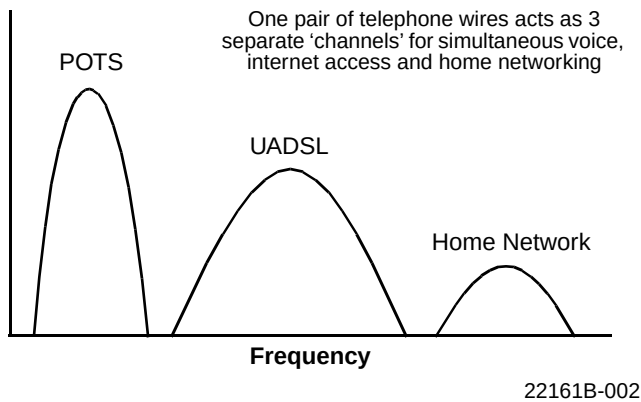


Figure 2. Compatible with Voice and UADSL

Enabling A Low-Cost Solution

In order to offer a cost-effective home networking solution, the PCnet-Home device leverages existing Ethernet protocols and operations from the Media Access Controller (MAC) layer up. The only addition required to interface an 802.3-compliant Ethernet controller with a telephone network is a new PHY implementing the HomePNA specification. This provides a convenient and economical solution using the existing TCP/IP based networking software stacks used in the Windows 95, 98, and NT operating systems. AMD's PCnet-Home integrates all of these components into a single, inexpensive device bundled with additional hardware and software support enabling a complete home networking solution.

The PCnet-Home device (see Figure 3) combines a standard Ethernet controller with two PHY devices, one supporting the 802.3 Ethernet standard for 10Base-T,

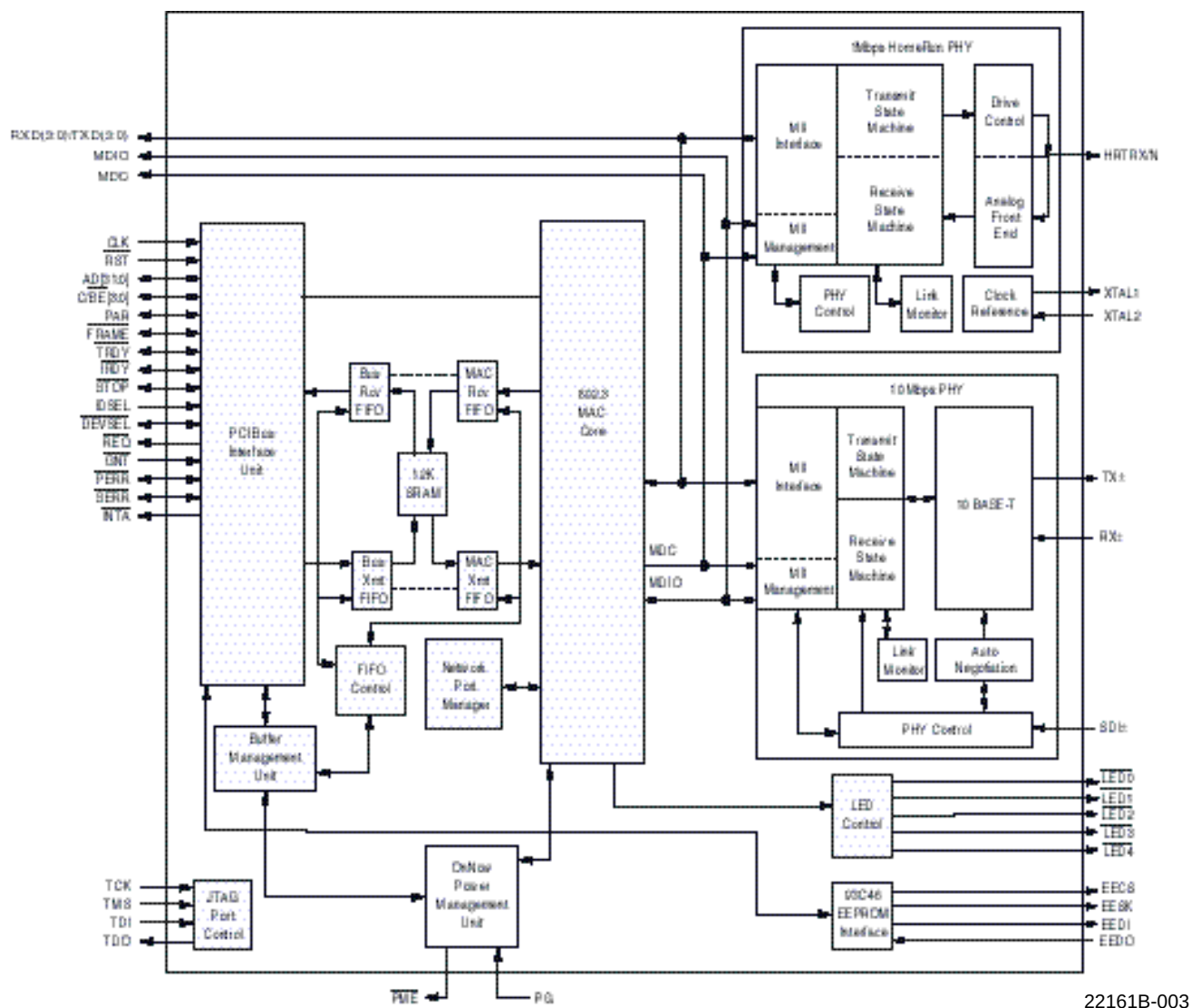


Figure 3. The AMD PCnet-Home controller is a highly integrated single-chip device incorporating the silicon necessary for both a HomePNA and Ethernet NIC.

and another supporting the HomePNA 1 Mbps specification. This dual functionality allows a single controller to support both standard Ethernet networking as well as the HomePNA network standard, creating a NIC that is a complete Ethernet or home network node integrated into a single device. A NIC based on this single-chip controller approach uses the Windows 95/98 or NT Network Driver Interface Specifications (NDIS) stacks, and does not require any additional software drivers to enable a home network. This significantly decreases time to market issues and also ensures home networking support is native to the operating system.

Additional silicon functionality is enabled through the integration of a PCI bus interface unit, a Direct Memory Access (DMA) Buffer Management Unit, an ISO/IEC 88023 (IEEE 802.3) compliant MAC, and a Transmit FIFO and a large Receive FIFO. This additional on-chip functionality serves as the foundation for creating a compelling, easy-to-use home networking solution. The Media Independent Interface (MII) allows for direct connection to an additional external PHY, such as a 100 Mbps PHY to enable Fast Ethernet support. This high level of integration at the silicon level enables a compelling and inexpensive HomePNA NIC to be built that meets the consumer price/performance requirements for a successful home networking solution.

AMD enables additional ease-of-use features at the silicon level as well. For instance, AMD's innovative any1Home™ technology simplifies network management by indicating when a valid node has been detected. The any1Home packet uses minimal network resources to detect a network failure, allowing upper layer protocols to take action and correct potential conflicts that may compromise network performance. This feature is key if one PC is acting as a file or print server, requiring the node to maintain a constant network link.

AMD HOME NETWORKING SOLUTIONS

Home networking devices built around the AMD home networking controller provide a low-cost consumer networking solution (see Figure 4). NICs using the AMD home networking controller can be manufactured to sell below \$50, or simply be integrated onto a PC or printer motherboard. An integrated, PCI-based HomePNA and Ethernet controller is a flexible bus-mastering device that can be used in a variety of applications, including network ready PCs, home bridges, and routers. Direct interface to the PCI local bus simplifies overall

node design complexity, providing a direct link between the network and a local bus. Expanded PCI bus support also allows for increased levels of connectivity, including support for a V.90 modem. Combining home networking capabilities and V.90 support onto a single NIC reduces costs, provides a multi-use card simplifying system integration, and allows a consumer to use a single RJ-11 jack to access multiple LAN and WAN networking capabilities.

Silicon support integrated into the controller enables the NIC to comply fully with the Network Device Class Power Management requirements under the OnNow Architecture for the PC98 and PC99 specifications. Support for the D0 through D3 state operation defined in the Advanced Configuration and Power Interface (ACPI) specification and compliance with the Power Management Interface Specification Revision 1.0 are also supported at the silicon level. All of these features enable greater management functionality to be integrated into the home network, providing end-users with an easily configured and managed network.

THE FUTURE

The achievable throughput capacity capable in most existing in-home phone wiring can extend far beyond 1 Mbps. AMD's PCnet-Home controller is designed to allow for the development of higher-speed generations of the technology to be implemented that are both backwards compatible and fully interoperable with the first version of the technology. Next-generation devices will offer similar functionality to the current AMD home networking controllers, only they will provide for a home network running at speeds of 10 Mbps and beyond. Similar to how Fast Ethernet and Ethernet devices work together in today's corporate environment, multiple generations of networking devices will also be used within the home network without conflict or interoperability issues. The applications and protocol stacks present in the PCnet-Home NIC will remain unchanged, and all that is needed would be the addition of the next-generation PHY block. This provides a very clean and simple migration path to 10 Mbps and higher home networking solutions.

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