

HOME NETWORKING PRIMER

An overview of the different types of home networks

Home Networking F.A.Q. (Frequently Asked Questions)

Q: What is Home Networking?

A: Home networking refers to technology that connects computers and other electronic devices for the purpose of sharing audio, video, peripherals, or a broadband Internet connection.

Q: How much does it cost?

A: Basic networking (linking PCs to share a printer) costs about \$50 for Ethernet cards and cables. More elaborate setups to split a broadband connection cost more. Wireless and Powerline networking products are about two times more expensive but are somewhat easier to set up and more convenient.

Q: Do I really need a home network?

A: For households with more than one PC, a simple home network is worth the expense. Rather than buy a dedicated peripheral for each PC, one can be shared. Even better, but more complicated to set up, is splitting a broadband connection among several PCs.

Q: Can I mix and match networking products from different vendors?

A: Yes, but unless you're technically proficient, this isn't advised, particularly for newer wireless networks. That's because there are competing standards for wireless, and they don't all communicate correctly. Even products that support the same standard, such as 802.11b, don't always work together smoothly.

Q: Who makes networking products?

A: Several companies make wired and wireless network products for the home. Some of the most prominent are:

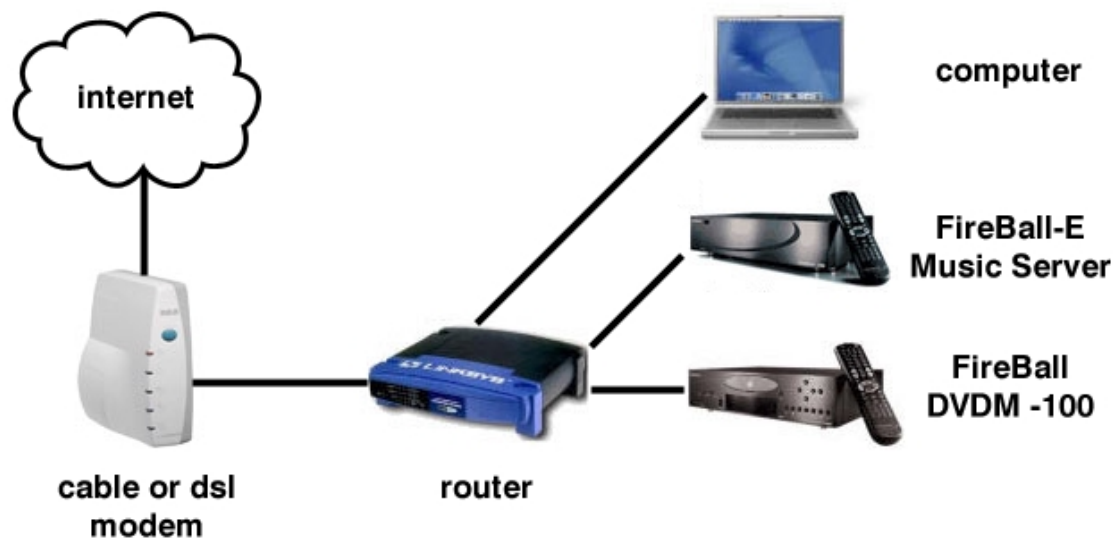
- Linksys
- 3Com
- Intel
- D-Link
- NetGear
- Apple Computer
- Cisco
- Belkin

Types of Networks

Ethernet: 10/100Mbps

The most popular network method because of the low price of the network cards, reliability and speed; but it can be a pain to run the wires through your home. Ethernet networking is built into most modern computers and the current Escient FireBall product line. There are many companies who provide ethernet networking products and they are available at any computer or electronics retailer.

Here is a sample Ethernet Network with a cable or dsl modem connection to the Internet. A "Router" is used to connect multiple Ethernet Devices (including a FireBall-E Music Server and a FireBall DVDM-100) to share a single broadband Internet connection. Each device needs to be connected to the router using an ethernet cable.



Sample Ethernet Network

Powerline Networking

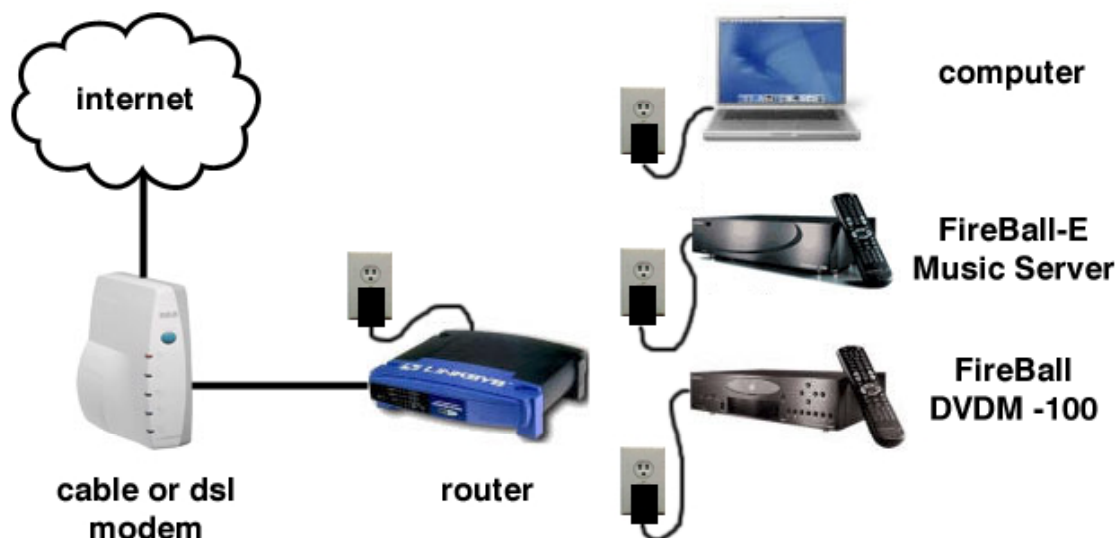
Powerline Networking (also called HomePlug Networking) allows easy network setup across existing 110V electrical outlets. It works with 2 & 3 prong standard 110 volt electrical outlets, transfers data at speeds up to 14 mbps (faster than 802.11b wireless) and it is compatible with 10Mbps or 10/100 Mbps ethernet products.

Powerline adapters are available from the following companies:

- Asoka Powerline
- Belkin
- Corinex Powernet
- DLink

- Gigafast Ethernet
- IOGear
- Linksys
- Netgear
- Phonex Broadband
- Siemens
- ST&T Corporation
- Telkonet

Here is a sample Powerline Network with a cable or dsl modem connection to the Internet. Again, a "Router" is used to connect multiple Powerline Devices to share a single broadband Internet connection. Ethernet cables are used to connect the network devices to the Powerline adapters. You will also need a Powerline adapter at the Router location so that the Powerline signals can be connected to the rest of the network and access Internet connection.



Sample Powerline Network

Wireless 802.11b: 11 Mbps

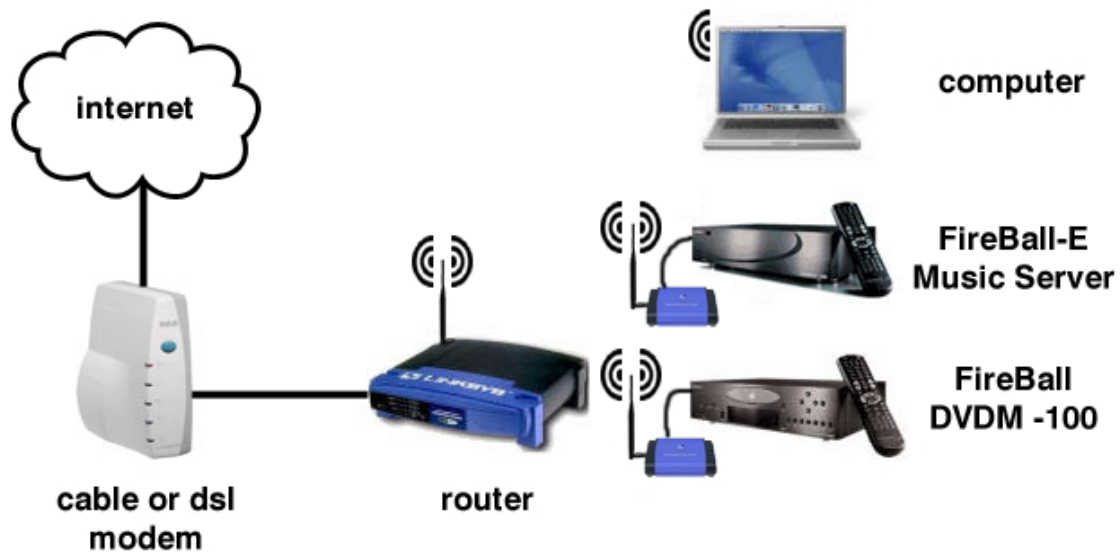
802.11b is now the standard for wireless networking in both the home and business. It has become inexpensive, has good speed but may not be appropriate for some secure communications.

Wireless 802.11g: 22/54 Mbps

An upgrade to 802.11b, the 802.11g standard doubles the speed of 802.11b while retaining compatibility.

Here is a sample wireless network where the FireBall-E Music Server and FireBall DVDM-100 are each connected to an Ethernet to Wireless adapter. The computer has built-in wireless connectivity and the router is a hybrid router/wireless access point. The wireless devices are

able to access the shared broadband Internet connection because the router/access point provides the “bridge” between the wireless and wired networks.



Sample 802.11 Wireless Network

HomePNA 2.0 (Phone Line): 10Mbps

HPNA, PhoneLine or HomePNA networking works over the existing copper telephone wires in your home without interfering with voice or DSL communications. HomePNA 3.0 will push the speed up to 100Mbps when it comes out.

Escient FireBall-H products use HomePNA networking.

Alternative Networking Technologies

Alternative networking technologies are often used to supplement a primary network. They are not as popular as the aforementioned networks, but are still available. They can be 'bridged' to other networks to create a single integrated network. You can buy different network adapters to 'bridge' or connect one type of network to another.

Ethernet: Gigabit - 1000TX

The fastest network technology available to the home or small business, gigabit ethernet comes built in to most Mac systems now. As the name suggests, gigabit ethernet runs at 1000Mbps

Wireless 802.11a: 54 Mbps

A new standard for wireless ethernet, 802.11a is incompatible with 802.11b and g. It does however offer amazing speeds for a wireless network, but is not as popular as 802.11g

Firewire Networking - 400Mbps

Modern operating systems now support networking over firewire cables. Most appropriate for short distances, firewire is FAST and inexpensive to install. Great for transferring huge video files between computers! 800Mbps firewire is also available on new Mac systems.

Bluetooth

A new 'personal' wireless networking technology, Bluetooth has recently made an appearance. It is easy to implement and will be VERY inexpensive soon. Because of its low speed (1.5Mbps) it is not appropriate as a replacement for other networks but IS valuable for connecting peripherals.

Wireless HomeRF 2.0: 10Mbps

Developed to compete with 802.11b, HomeRF made a brief appearance and died off. Siemens and Proxim were the main supporters.

Ethernet Networking

Ethernet is the most popular and considered the networking topology standard for most computer connections. There have been many kinds of Ethernet, but the most popular is 10/100Mbps running over copper twisted pair wires. 100Mbps Ethernet is also called 100baseT and Fast Ethernet.

All current Escent products support built-in Ethernet networking.

Note: Older Ethernet standards ran on COAX cable and were referred to as 10base2 Thin Ethernet and 10base5 Thick Ethernet. Some hubs still have a coax connector to bridge together twisted pair and Thin Ethernet networks.

A newer Ethernet standard called Gigabit Ethernet or 1000baseT also can run over copper wire but hubs and switches are VERY expensive.

10/100 Ethernet

Connections:

Connections between 10/100 Ethernet adapters are made using cables that run to an Ethernet HUB or Switch. Hubs electrically connect your computers together and switches act like traffic cops making your network more efficient.

When only two computers are present. A special kind of Ethernet cable can be used called a "CROSSOVER cable.

Cables:

10/100 Ethernet cables have 8 wires, of which 4 are used for data. The other wires are twisted around the data lines for electrical stability and resistance to electrical interference. The cables end in RJ-45 connectors that resemble large telephone line connectors.

Two kinds of wiring schemes are available for Ethernet cables. Patch cables and Crossover cables. Crossover cables are special because with a single cable, two computers can be directly connected together without a hub or switch. If a cable does not say crossover, it is a standard patch cable. If you are connecting computers to a hub or switch, you need patch cables.

There are also different grades of cable quality. The most common are CAT5, CAT5e and CAT6. CAT5 is good for most purposes and can transfer data at 100Mbps. CAT5e is rated for 200Mbps and CAT6 is rated for gigabit Ethernet. Run CAT5e whenever possible because there is usually not a cost difference from CAT5 if you look hard enough.

Maximum distances:

For all twisted pair Ethernet, 100Meters is your maximum distance.

Ethernet to Fiber

Ethernet to Fiber media converters are starting to come down in price - they can be found for under \$150. When 100Meters is not enough distance, an Ethernet to fiber media converter can

be placed on each end making the maximum distance something like 40Km. Another use for fiber is electrical insulation. Some people like to run cables underground between homes. If you run CAT5 cable, the homes have different 'ground potentials' and you will burn out network card during any electrical storm. The solution is fiber! Run fiber between the homes or run a pair of fiber converters on one end of the cable with a short fiber run. This will electrically separate the two homes.

Wireless Networking with 802.11b

In 2000, 802.11b became the standard wireless networking technology for both business and home. The WiFi organization was created to ensure interoperability between 802.11b products. With a realistic throughput of 2.5-4Mbps, it is fast enough for most network applications and tolerable for file transfers.

Wireless to Ethernet Bridges can be used to connect Ecient products to your Ethernet network when you can't run ethernet cables to your equipment.

Access Points

An 802.11b wireless network adapter can operate in two modes, Ad-Hoc and Infrastructure. In infrastructure mode, all your traffic passes through a wireless 'access point'. In Ad-hoc mode your computers talk directly to each other and do not need an access point at all.

Access point varieties

Access points come in three varieties -- bridge, NAT router and NAT router+bridge. A bridge connects a wireless network to a wired network transparently.

Communication is possible between both networks in both directions. A NAT router type routes traffic from your wireless network to an Ethernet wired network, but it will not route traffic back. This type can be used to share an Internet connection. Lastly, there are hybrid NAT router + Bridge devices that bridge your wired and wireless networks, then route them both to the internet using a single IP address. This is good for sharing an Internet connection when you have both wired and wireless computers in your home. These are often called Cable or DSL routers with wireless access points built-in.

Security

Any network adapter coming within range of another 802.11b network adapter or access point can instantly connect and join the network unless WEP – Wireless Encryption Protocol – is enabled. WEP is secure enough for most homes and business, but don't think it can't be hacked. There are several flaws in WEP making it unusable for high security applications. At this point, it takes some serious hacking abilities to bust into a WEP enabled network so home users should not worry.

WEP and Speed

WEP 'WILL' slow down your wireless network. Expect a 20-50% reduction in speed depending on the products you are using. The speed issue is often the result of an access point without enough processing power.

Encryption

Encryption comes in 64bit and 128bit key varieties. All your nodes must be at the same encryption level with the same key to operate. 40bit and 64bit encryption is the same. it's just a matter of how the manufacturer decided to label the product. Often 128bit cards can often be placed in 40/64bit mode.

Form Factors

802.11b adapters come in two major form factors. PC Cards for laptops and USB for desktops. In addition, there are PCI adapters that let you plug a PC Card into a PCI Slot.

Speed

A full strength 802.11b signal will get you about 3.5-4.5 Mbps without WEP enabled. With WEP enabled, expect 2.5-3.5 Mbps. As you put walls and distance between your wireless adapter and your access point, your speed will drop. Don't expect to put more than a few walls between you and your access point.

Technical Specs

802.11b is a half duplex protocol – it can send OR receive, but not both at the same time. In addition it uses the same 2.4 GHz range as many cordless phones so plenty of opportunity exists for interference. Use 900Mhz cordless phones if using 802.11b in the same area.

Distance

Distance will very widely depending on which wireless networking device you are using, what kind of antenna it uses, the construction materials in your home, electrical interference, and capabilities of the wireless receiver. Some people have used directional antennas to get some serious range out of their 802.11b products – miles!

Faster Wireless 802.11g

The 802.11g spec was drafted in Nov of 2001. 802.11g operates on the same frequency as 802.11b and is backwards compatible. The planned common implementation of consumer 802.11g devices operate at a maximum of 22Mbps but can communicate at up to 54Mbps. 802.11g is sometimes called 'Turbo Mode' on some 802.11b cards.

Like 802.11b, 802.11g is subject to the same interference and security issues. It operates at 2.4Ghz and may cause problems with 2.4Ghz cordless telephones.

When a 802.11g product communicates with an 11Mbps 802.11b product, it drops down to 11Mbps or less depending on signal strength. In other words, if you purchase an 802.11g product for use with an 802.11b access point, expect only 11Mbps.

Powerline Networking

Powerline networking has existed in a few forms in the past, the latest specification is called HomePlug and runs at 14Mbps. HomePlug uses your existing home electrical wiring to transfer data.

HomePlug does not interfere with your existing electrical equipment or home automation devices like X-10, CEBus, and LONworks. HomePlug also encrypts all data with 56bit DES encryption to ensure that your neighbors can not eavesdrop on your network traffic. Note: encryption is usually not enabled by default and must be 'turned on' using software provided by the devices manufacturer.

The HomePlug specification incorporates a technology called PowerPacket. This new technology is what makes HomePlug different from the old Powerline networks. PowerPacket eliminates noise from electrical appliances like hair driers and televisions plus it offers security.

Powerline network adapters come in PCI and USB versions but are fairly expensive right now - about \$50 to \$100 per computer. There are also Powerline to Ethernet bridges and Powerline broadband routers with ethernet bridges built-in, in the same price range.