

HOME NETWORKING BASICS

BASICS OF SETTING UP YOUR MULTIPLE COMPUTER
HOME NETWORK



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COMPONENTS OF A HOME NETWORK

GENERAL TCP/IP NETWORKING BASICS

Most modern networks of today support TCP/IP protocol. The general principal of TCP/IP is that it is routable scheme allowing the user flexibility in defining their network anywhere without the need for the rest of the computer network world knowing the details. In a modern TCP/IP network any given computer on a network has both a TCP/IP address and a MAC address. The TCP/IP address is user configurable and the MAC address is something that is set via the network hardware manufacturers and ideally is unique to the world.

Since a TCP/IP address is routable the networking system (router) only needs to understand that it received a packet from TCP/IP address xxx.xxx.xxx.xxx and has sent a packet to TCP/IP address yyy.yyy.yyy.yyy. A packet is a bundle of digital information. The hardware then waits for a response to anything it sent to a given IP address and remembers where it needs to go once it is received. A

Setting up your own home network is a lot easier than you may think.

packet of information is handed off in this way many times, from point to point, when you are browsing a web site. There is usually a timeout period where the network hardware will wait for a return request and if it does not get anything in that time period it will error out and request a resend. At each handoff of a packet of information from one network component to another the MAC address is used along with the final destination IP address.

No need to be concerned about the details with this since we will only be working with the settings for a TCP/IP address on each of your home computers. Your home computers will learn the whereabouts of each other via various mechanisms of network chatter. A typical IP addresses for your home computers should be similar to 192.168.0.1. This is a standard address for a home network although you could pick about anything. Each grouping of the 4 numbers can range from 0 to 255. The 192.168 portion is fairly standard for home networks and you should maintain that.

THE NETWORK HARDWARE

There are three types of common wired networks that you could implement in your home. The most widely used is Ethernet, which requires you to string CAT5e network cable between all of your locations. This can be a rather painful experience, especially if you have never been in your attic before! The other two options are PhoneLine HomePNA and Powerline Homeplug which both use the wires you already have in your walls. I will briefly describe each below. The basics of the network configuration and setup are similar, therefore, through the rest of this document I will only discuss Ethernet.

ETHERNET

To establish your home Ethernet wired network you will need a minimum of one Ethernet NIC (Network Interface Card) in each computer along with a router and/or a switch/hub to handle the details of routing traffic from one computer to the next.

PHONELINE (HOMEPNA)

This uses the existing phone wiring in your house and will work on active phone lines without interfering with your existing phone system. I used this in my first home network setup and was fairly pleased with its capabilities. Especially since I did not have to pull any wires! For more information see <http://www.homepna.org/>. Again, you will need a PhoneLine NIC in each of your computers. All the computers will be tied together via a common phone line.

POWERLINE (HOMEPLUG)

This network hardware allows the user to make use of the existing power wiring in the house. Your 110V service becomes the conduit for your network traffic. For more information on this see <http://www.homeplug.com/>.

ROUTER

A router is used to translate the information on one network to another. In your home network a packet of information will be translated from your home network IP address to your broadband IP address via a router as it leaves your house. This is called Network Address Translation (NAT) and is a key aspect of a TCP/IP network. A router could either be either a stand alone box or may be a computer configured to perform a router function. This will be described in detail in the "Two Basic Ethernet Configurations" section.

SWITCH/HUB

These devices are used to tie the computers together on the same network. These devices perform the same basic task, the switch is just much more efficient since it remembers which address is on which port and send it directly. A hub does not necessarily know which address is tied to which port so sends information out on all ports.

You will also need connectivity to the world wide network from one of your computers through a DSL or Cable modem. I am going to assume that you would not want to have a home network without the advantages of broadband so I will not discuss the details of a network that assumes a dial up connection. Having an always-on broadband connection is a convenience that once obtained you are not sure how you tolerated the dial-in world. For DSL or Cable home connections please consult the vendors in your area. They will get you up and running to one of the computers in your house. The rest of the networking will be up to you via the help from this document.

THE COMPUTERS

I will not spend a lot of time on the specific computers you have since the networking basics will not change from one system and/or operating system to another. The details of setting network preferences for each computer is Operating System dependent and I will not go into specifics here. Please consult your user documentation to find details. All computers of the last 5 years support TCP/IP networking and have NIC's available for them. The rest of the network is independent of the type of computer. My examples will be specifically tailored for a Windows operating system but for those of you with other operating systems will need to configure the exact same information.

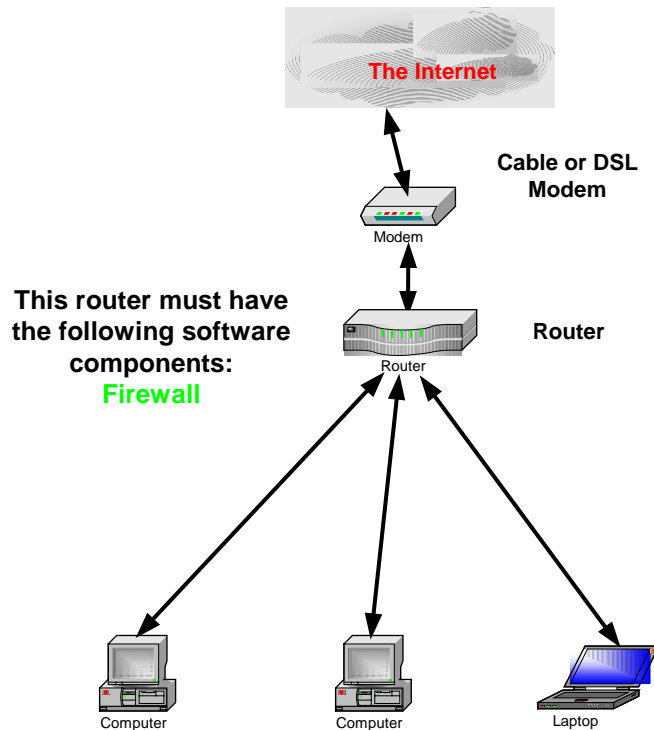
NETWORK CONFIGURATION

TWO BASIC ETHERNET CONFIGURATIONS

There are two basic ways to configure your Ethernet network to allow the sharing of your broadband Internet access with multiple computers. One configuration requires a router (Router Based) that also has a built in firewall and Internet sharing. The other uses one of your computers as the main network server (Server Based) and also handles the firewall and Internet sharing activities.

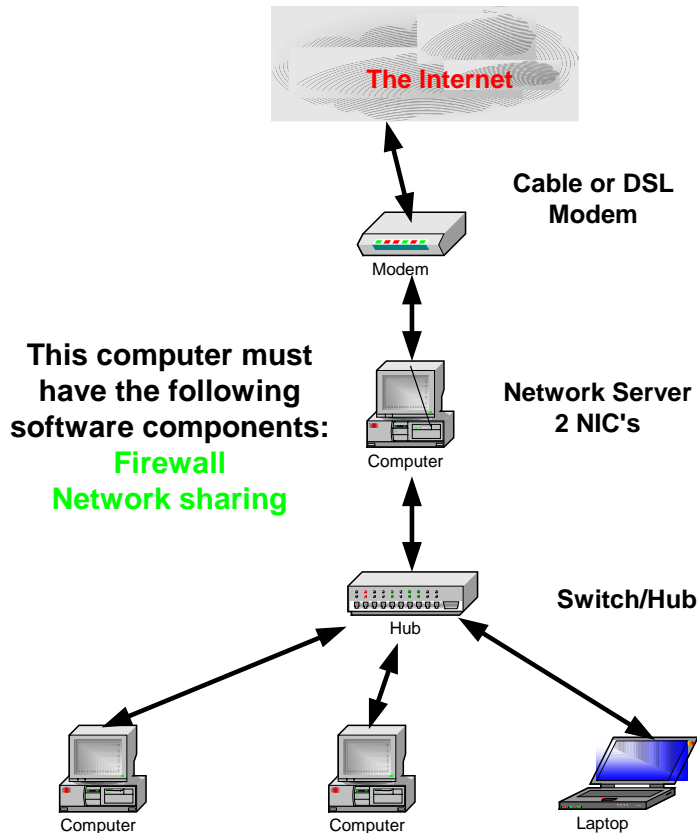
ROUTER BASED

In a router based system the router should contain a basic firewall and also handles the traffic from the Internet to each one of the computers in your house. This is probably the simplest way to get your home network going. The router itself could also contain a wireless interface, which would allow you to setup your other computers without the use of cables. For the beginner I would suggest this type of configuration. For a Powerline or Phoneline network the router will need to be specifically for those types of networks.



SERVER BASED

In a server based network system the server computer takes care of routing the traffic between the cable modem/DSL and the internal network. The server must stay powered on in order for the other computers to be able to communicate with the Internet and will need to have 2 NICs installed. This type of network will most likely be much more configurable in terms of the details of which computer can access the network at what times and which sites can be visited. This network configuration is ideal for a home with children where you may want to exercise control of computer browsing times and sites. This type of network configuration using Phonerline or Powerline networking will not need the router indicated. The router is only necessary for Ethernet networks.



SELECTION OF NETWORK COMPONENTS

THE EXAMPLE NETWORK

For this section we will assume that our network is an Ethernet wired network and has the following minimum requirements:

- 2 desktop computers which are hard wired to the network

- 1 laptop that needs a cable for networking. i.e. not a wireless setup.
- A router based network configuration

YOUR SHOPPING LIST

NIC CARDS FOR DESKTOP MACHINES

For the desktop machines you will need 1 NIC for each. Your system may already have an Ethernet NIC installed so check out the back and see if you have a jack that looks like a phone jack, only wider. If you have one then your system already has an NIC installed.

If you don't have a NIC factory installed they can be purchased for about \$10-\$20 each. The selection is pretty simple; any PCI Network card will most likely work just fine. After making the purchase install them and the drivers as instructed. The network card should be one that offers data rates of at least 100MBps.

NIC CARD FOR THE LAPTOP

Your laptop may already have a network card built into it. If you have a network jack on it you are most likely ready to go. If not there is a possibility of a network card that goes into a PCMCIA slot in the side. They are about the size of a credit card only about 3 times thicker. You could also get a USB port adapter that is an external arrangement.

NETWORK CABLE

You will need a network cable from the cable or DSL modem to your router and then 2 cables from the router to each of the 2 desktop computers. The cable should be of type CAT-5e at a minimum.

THE ROUTER

I would suggest you purchase a router that also has wireless capabilities and a firewall built in. Web based configuration of the router is also a feature that you may want to look for so you can configure the router wherever it resides on your network. Some of the routers require a USB connection for configuration, which is fine if it's always positioned next to your computer. Having DHCP capabilities in the router is also a plus so you won't have to setup each computer's network information manually. With DHCP all information is sent to each computer so there is no need to manually configure each computer on your network.

The wireless part of the router system is **optional** and should support 802.11b (11MBps), which is a good starter for most systems. We will not be making use of the wireless at this time but if you need a router/firewall you might as well add in the wireless, especially if you will have, or will be getting a laptop. An alternative wireless addition to your router is the higher speed 802.11g (54MBps) network but it's probably not worth the added cost for the average home user.

CONNECTION OF COMPONENTS

The connection process is pretty simple. As in the diagram above you plug your cable or DSL model into the router uplink port and then plug your computers into the remaining ports on the router. That's it! You have the hardware for your new network all done.

SETTING UP OF THE COMPUTERS ON YOUR NETWORK

ROUTER

For your router, I would suggest following the instructions supplied with your unit. It will probably default to have your home network set to an IP address of 192.168.0.x, where X is any number between 1 and 255. If that is not the case I would suggest that as a good starting point. Setup your LAN address to be 192.168.0.1. This will be the main gateway where internal network traffic will route if it's not on the local house network. Also, you should set the network mask to 255.255.255.0 and the DNS servers to the addresses provided by your broadband service provider. You will also need to setup WAN side (connection to the DSL or cable modem) address as per your broadband providers instructions.

If you enable DHCP in the router, the IP addresses and other IP information for each one of your networked computers will be assigned by the router. If you do not have DHCP enabled in your router you will need to pick the unique address for each computer yourself and manually set it up. For example it would be necessary to setup the IP address, the net mask, the gateway and the DNS servers manually on each computer.

I would also suggest that you enable the firewall within the router. This will prevent unauthorized Internet traffic from coming into your network. When this is enabled it will block traffic based on the type of traffic (TCP or UDP) and the specific port number (between 1 and 32768). Each one of your applications will use a specific port, which will need to be opened in your firewall to allow it to successfully communicate outside your house.

TYPICAL PORTS TO LEAVE OPEN IN YOUR FIREWALL

- 20 & 21 if you will be using ftp
- 80 & 443 for web browsing
- 110 & 25 for email
- 123 for network time syncing

YOUR COMPUTERS

ENSURE BASE NETWORK SOFTWARE IS INSTALLED

Go into the properties of your network card. On a windows based machine this is accomplished by right clicking on Network Neighborhood and then right clicking on your network card. You should have the following components installed as a minimum:

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- Client for Microsoft Networks
- File and Print Sharing for Microsoft Networks
- Internet Protocol (TCP/IP)

If any of these are missing go ahead and click the install button to load them. If they are not already loaded you should be able to add them from the list. You need your Windows install disks so have them handy.

IF YOUR ROUTER HAS DHCP ENABLED

This makes setup pretty simple and so I would suggest having it enabled in your router. Go back to the properties for your network card as you did above and now single click on "Internet Protocol (TCP/IP)" and then click on the properties button. Make sure the "Obtain an IP Address Automatically" and "Obtain DNS server address automatically" are checked. This will indicate that your router, if configured for DHCP, will provide this information to each computers on the network.

IF YOUR ROUTER DOES NOT HAVE DHCP ENABLED

Go back to the properties of your network card and then properties on "internet Protocol (TCP/IP)" and then click on properties. In this case make sure the "Obtain an IP Address Automatically" and "Obtain DNS server address automatically" items are not checked and you have the "Use the following..." checked. The field will now be available to add in your own address information. For all the computers on your network set the following the same:

- Subnet Mask: 255.255.255.0
- Default Gateway: 192.168.0.1 (This must match the LAN address you set in your router)
- Preferred and Alternate DNS Servers: DNS server address provided by your broadband provider.

For the "IP Address" field this will need to be unique for each computer but the first 3 fields of the address must be the same. i.e 192.168.0. Since your router is already using 192.168.0.1 that can't be used for any of the computers on your network. For simplicity, increment the last field by one for each of your computers for the "IP address". The address 192.168.0.2, 192.168.0.3 & 192.168.0.4 should work fine for you for each of the 3 computers on your network.

SHARING A HIGH SPEED NETWORK CONNECTION

With a router based network you are all set to share your broadband network connection with each of the computers on your new network. Enjoy!

In a "Sever Based" network you need to go the properties for the broadband network of your main server and enable "Enable Internet Connection Sharing for this Connection". There are also 3rd party software solutions for Internet sharing which are more configurable, and more complicated so I would not suggest these for the beginner. Again, as a beginner, I would suggest that you go with a router based network configuration.

GLOSSARY OF TERMS

Term	Full Name	Description
802.11b	-	Wireless TCP/IP network with a 11Mb/s data rate
802.11g	-	Wireless TCP/IP network with a 54Mb/s data rate
ACLs	Access Control Lists	Who can get to which system(s)
API	Application Programming Interface	Software application calls for communication with the network.
DHCP	Dynamic Hosts Configuration Protocol	A server that allows clients to request IP configuration automatically
DNS	Domain Name Server – TCP/IP Server	A server that maps network names to IP addresses so they can be accessed.
Ethernet	-	A wired network that has 4 pairs of wires in CAT5e or CAT6 cable
FTP	File Transfer Protocol	A program that allows transfer of files from one computer to another over the network.
HUB		Links multiple computers together on a network.
IS	Information Services	An organization that is responsible for the overall maintenance of an individual's computer.
ISP	Internet Service Provider	Organizations that provide full service access to the internet via dial-in, Cable modem or DSL.
IT	Information Technology	An organization that is responsible for the definition, implementation and security of networks
LAN	Local Area Network	Your internal house network.
NAT	Network Address Translation	Translate an IP address from one network to another. This function is performed by a router.
NetBIOS	Network Basic Input Output System	The basics of windows file sharing on a network
NIC	Network Interface Card	PCI Bus card that plugs into your computer to allow communications on a network
PCI		
POP3	Post Office Protocol version 3	This is used for communication of email tools such as Netscape, Outlook etc with the email server.

Term	Full Name	Description
Port	-	In the TCP/IP world a port is a number between 1 and 32768 which your software components will use for both sending and listening for information
Router		Functionally similar to a hub but in a more efficient manner
SAM	Security Accounts Manager	Who can get to what file
SMTP	Simple Mail Transport Protocol	This is what receives email that you send and then forwards it to the correct email server host.
TCP/IP	Transmission Control Protocol/ Internet Protocol	The basics of modern networks.
UDP	User Datagram Protocol	Transaction based protocol with less overhead than TCP. There is also no acknowledgement back to the sender like with TCP.
UPS	Uninterruptible Power Supply	This is a battery backup system which will keep a computer running in the event of a power failure
VPN	Virtual Private Network	Allows secure communications between computers and/or networks over the public internet networks.
WAN	Wide Area Network	The network world outside of your house.
WINS	Windows Internet Names Service	How windows machines discover each others computer names.

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