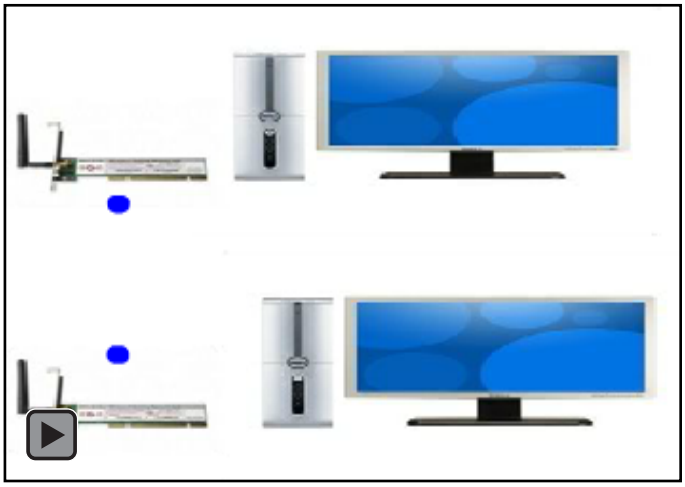
How networks work

ISN'T JUST ONE COMPUTER ENOUGH?

A standalone, desktop computer can adequately support all of your needs. However, at times it is necessary to allow other PC users in your home or at work to share system resources. These resources include files, printers, applications and even your Internet connection.

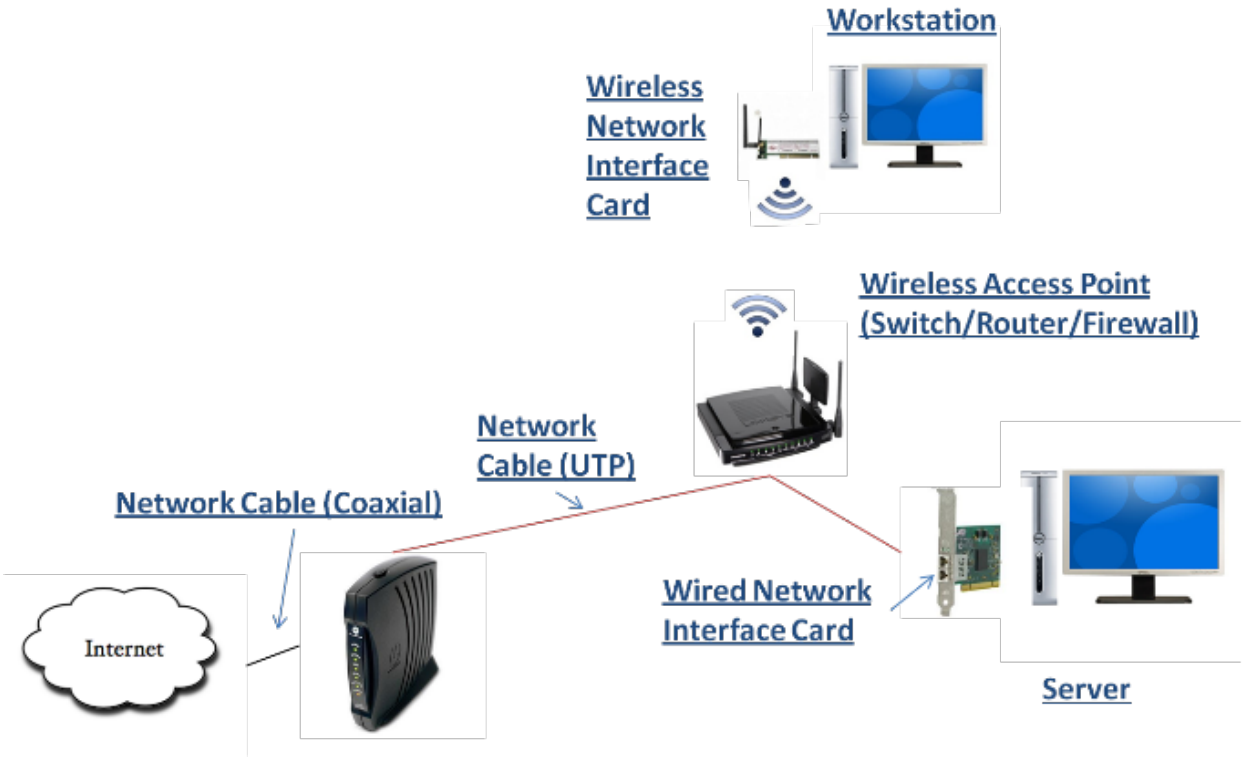
WHEN ONE COMPUTER IS NOT ENOUGH

When two or more computers connect to one another they become "networked" together and the resources that they share essentially become network resources. The connection between the computers can be wired or wireless. In a business environment, high performance computers called servers make network resources more secure and available.



NETWORK DEVICES

The hardware devices shown in the image below are devices required to construct a network in a small business/home network. Notice that both wired and wireless connections are used. This configuration is an example of both a wireless local area network (WLAN) and a local area network (LAN).



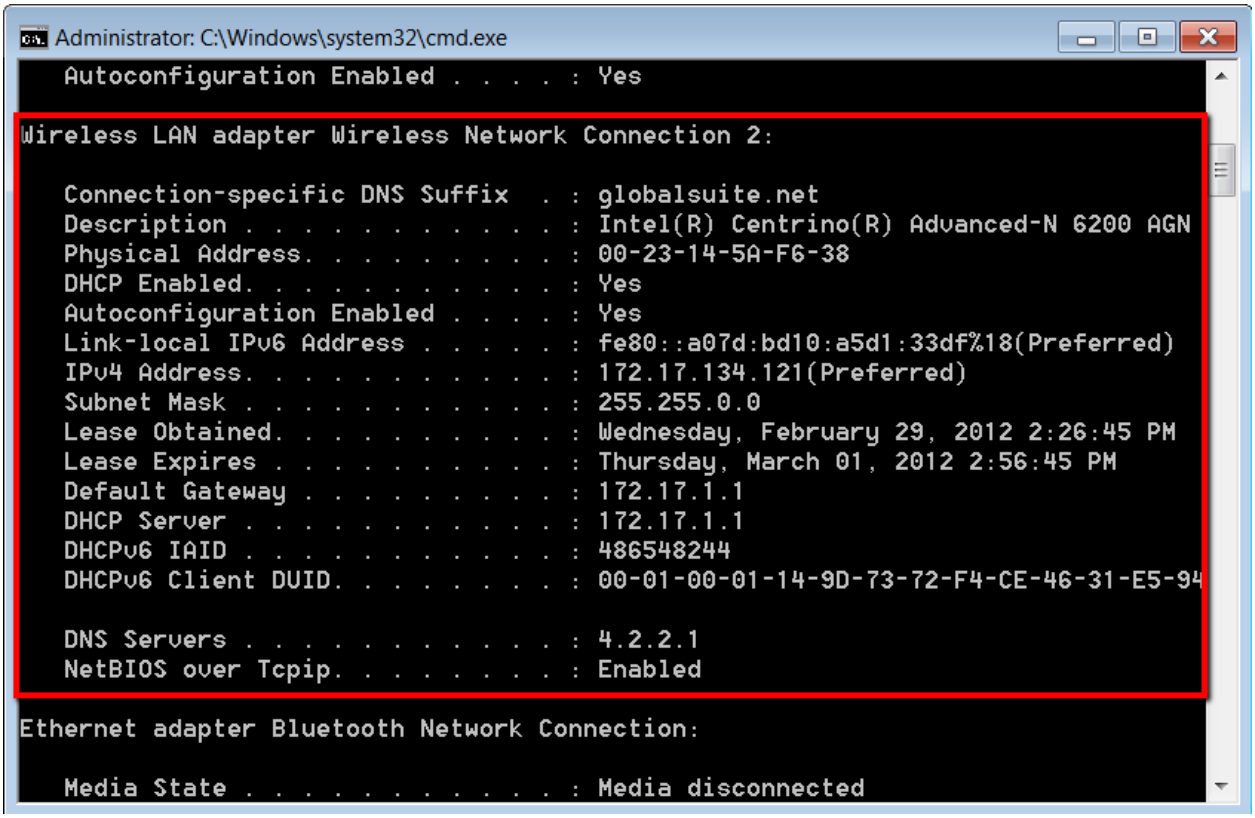
NETWORK COMMUNICATION

The devices in the sample network represented in the above image have to communicate with one another to make a network functional. They do this by sending and receiving network packets. For this to happen, each network device has to connect to one another through a network interface adapter, wired or wireless. To further support network functionality, each device has to share a common communication protocol and have unique addresses.

COMMUNICATION PROTOCOLS

TCP/IP is the Internet protocol of choice, it is also the protocol of choice for local area networks (LANs) and wide area networks (WANs). In a LAN, the computers communicate at high-speeds and are usually in one building. In a WAN, computers communicate more slowly because they connect over long distances, between buildings, cities or even countries.

To view your computer's current network connection settings first open your command line interface (CLI) by clicking **Start**, type **cmd** in the search box and press **<Enter>**. Once at the command line type **ipconfig / all** and take note of your local connection settings. An example of a wireless connection is shown in the image below.



The TCP/IP protocol is actually part of a suite of protocols. The IP protocol within this suite controls the logical addressing of computers by using a unique, Internet Protocol (IP) address that consists of four sets of digits (octets) separated by periods. An example of an IP address can found in the image above next to the **IPv4 Address** caption.

WHERE DOES YOUR ADDRESS COME FROM?

You will likely notice that the IP address identifying your computer was obtained dynamically through a DHCP (Dynamic Host Configuration Protocol) server. Computers that obtain IP addresses from DHCP servers "lease" the IP Address. As you can see by the image above, the DHCP server that leased an IP address to the wireless connection was **172.17.1.1**.

WHAT ARE ALL THOSE OTHER IP ADDRESSES?

You will also notice other IP addresses that identify how network packets are to be "routed" out to the Internet (Default Gateway) and which network server/device will resolve domain names (URLs) into IP addresses (DNS Servers). In the image above you can see that the default gateway address is also **172.17.1.1** whereby the DNS server is **4.2.2.1**.

GATEWAYS AND SUBNETS

The IP address of your default gateway is the IP address of the router port that network traffic has to go through to get into a different network, such as the Internet or another defined network (subnet) in the same building. Networks are classified based on the value of the IP address and the subnet mask (i.e. 255.255.255.0). My address is a private, class C address that my DHCP server assigned dynamically.

DYNAMIC VERSUS STATIC ADDRESSES

The IP address of your default gateway is an example of a static (unchanging) IP address. It is set by the administrator at the time the router was configured. It should be static because there are other devices that have to reference this address (as my computer does). Printers, routers and servers are network devices that are configured with static addresses.

DOMAIN NAMING SERVICE (DNS)

Fortunately, we do not always have to remember IP addresses to communicate with other network devices such as servers or routers. In TCP/IP network installations we only need to remember names thanks to domain name resolution (DNS). The purpose of DNS is to resolve names into IP addresses. To see this work type **nslookup www.ntc.edu** at the command prompt and you will see the IP address that is resolved from the fully qualified domain name (FQDN) www.ntc.edu. See image below.

```
C:\Users\husband>nslookup www.ntc.edu
Server:  vnsc-pri.sys.gtei.net
Address:  4.2.2.1

Non-authoritative answer:
DNS request timed out.
    timeout was 2 seconds.
Name:    www.ntc.edu
Address:  198.150.172.8


C:\Users\husband>
```

WHAT IS IN A DOMAIN NAME?

So far you have learned that there are fully qualified domain names (FQDN) such as **www.ntc.edu** and a corresponding IP address for that domain name. Within the FQDN there is a host name (www) and a registered domain name (ntc.edu). The prefix of a FQDN is always the host name, everything after that represents a domain name.

YET ANOTHER ADDRESS

Communication between computers does not end with names and IP addresses. Before network devices can actually send and receive network packets between each other, they have to get to know each other by physical address. Another name for this physical address is Media Access Control (MAC) address and is unique for each network device on the network and throughout the world. This address becomes known on your network through another TCP/IP protocol called Address Resolution Protocol (ARP). See image below.

```
Wireless LAN adapter Wireless Network Connection 2:

   Connection-specific DNS Suffix  . : globalsuite.net
   Description . . . . . . . . . . . : Intel(R) Centrino(R) Advanced-N 6200 AGN
   Physical Address. . . . . . . . . : 00-23-14-5A-F6-38
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::a07d:bd10:a5d1:33df%18(Preferred)
   IPv4 Address. . . . . . . . . . . : 172.17.134.121(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.0.0
   Lease Obtained. . . . . . . . . . : Wednesday, February 29, 2012 2:26:45 PM
   Lease Expires . . . . . . . . . . : Thursday, March 01, 2012 2:56:45 PM
   Default Gateway . . . . . . . . . : 172.17.1.1
   DHCP Server . . . . . . . . . . . : 172.17.1.1
   DHCPv6 IAID . . . . . . . . . . . : 486548244
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-14-9D-73-72-F4-CE-46-31-E5-94

   DNS Servers . . . . . . . . . . . : 4.2.2.1
   NetBIOS over Tcpip. . . . . . . . : Enabled
```

ADDRESS RESOLUTION PROTOCOL (ARP).

When a local IP address is used from your computer, the MAC address of this IP address will have to be obtained. ARP will obtain this MAC address by doing a network broadcast (a special network packet that is sent to all computers in the immediate local area network segment) asking who belongs to the given IP address. Once ARP gets a response, it will remember the returned MAC address for a given amount of time to minimize the network broadcasts that are sent. To see this at work, ping an address in your LAN such as your gateway and then type **arp –a**. See image below.