Home Network Repair
November 11, 2006 (Original Presentation)
Network and Internet Connection Troubleshooting
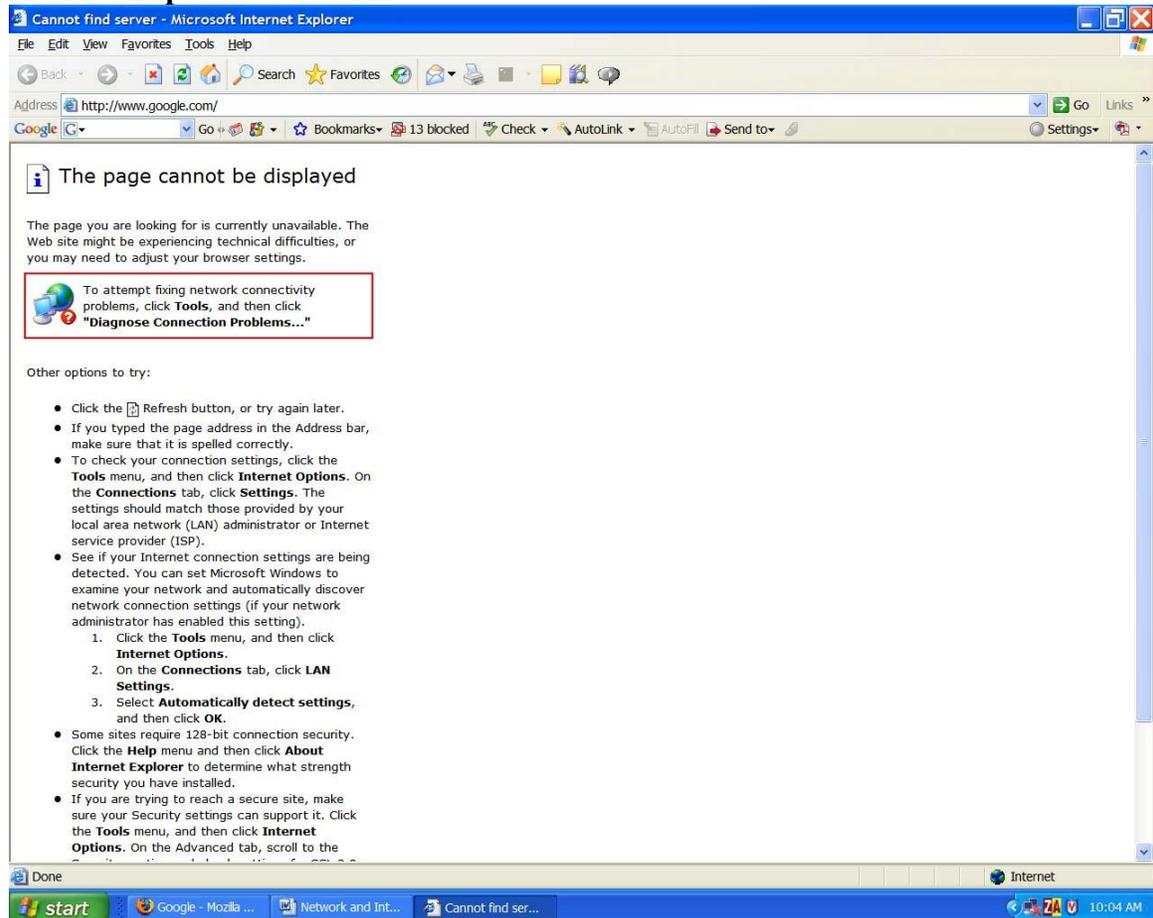Updated: December 7, 2016
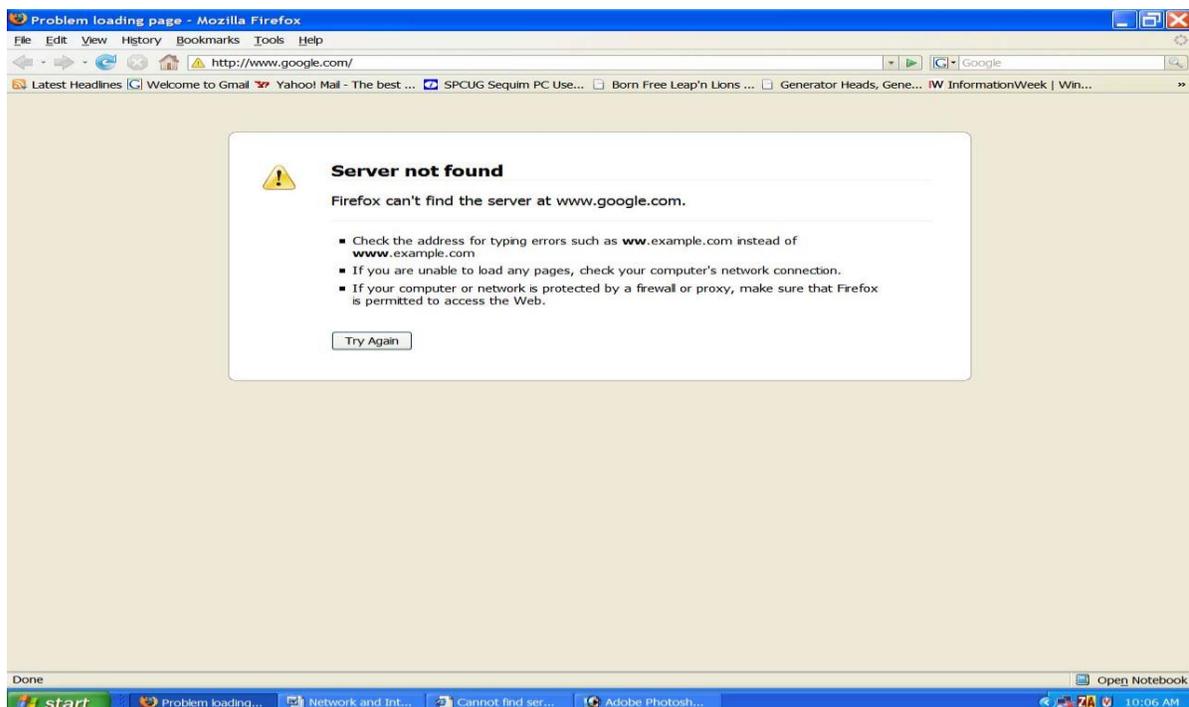Steve Solberg

Basic Home Network troubleshooting
Have you seen this and what was your response? Did you panic or say the "**Internet is down**"? The screenshot below is from Windows XP but it shows how browsers have evolved over the years to show more information about your internet connection problems.

Internet Explorer 8   WinXP

This is what IE 10 and Windows 8 looks like when there is no connection to the internet.

This newer webpage at least gives you more information on what to check to resolve your problem.

This screenshot is from Windows 10 Home, Microsoft Edge browser. The information is still much the same as IE 10 in Windows 8.

I will show you how you can repair this problem.

Note: Your browser may also "**cache**" or temporarily store webpages that will load even though you have lost your connection. You may also need to **flush your DNS cache**; you can find a URL or link that explains how to do this in the references below.

First some background and then some basics!

TCP/IP

TCP/IP stands for **Transmission Control Protocol / Internet Protocol**. TCP/IP is a set of protocols (rules) by which most of today's computers communicate with one another and the Internet.
Note: This presentation is based on IPv4 addressing currently the most common.

Each computer or other network device has an **address** to differentiate it from the other devices on a network (a network is just a group of interconnected computers and similar devices - this can be a small home network, a larger network at one's workplace, or even the Internet - albeit a very large network). This **address** is called the **IP address**. It's a group of numbers that appear similar to this: 192.168.1.1 - four groups of one to three numbers, separated by periods.

The groups of numbers depict two things - the **network address** the device (computer, Internet gateway, etc.) is connected to, and the **host address** of the device itself. The **subnet mask** is another set of numbers that, while similar in format to an IP address, are not an address unto themselves - rather they define which numbers of an associated IP address are **network** and which are **host**. This can get pretty complicated, but for the most part you will see a subnet mask that looks something like 255.255.255.0.

In conjunction with the address of 192.168.1.1 - this means that the 192.168.1 is the network portion of the address and the ending .1 is the host address or the Gateway.

A **DNS address** is the IP address of a computer or other network device that is helping to find web sites and other devices on the Internet. The **Domain Name Server (DNS)** is basically a computer or device that knows where things are located on the Internet. The DNS server is typically a computer located at the business of the **Internet Service Provider (ISP)**.

How does a computer or device obtain an address, gateway and DNS information?
This happens in usually one of two ways:

- **Statically** - which means somebody goes into the computer or device and types in the address. Referred to as **static addressing**, routers may have a Static IP address.
- **Dynamically** - which means the computer or device **automatically** gets the address and information from another computer or device. The functionality of providing for this automatic process is called **DHCP** (dynamic host configuration protocol - but don't worry about the long name, just call it DHCP). Referred to as **dynamic addressing**. This is most commonly used on home networks. If you have a router, then the router automatically assigns your computer an IP address even though the router may have a Static IP address. **Note** that you probably will want a Static IP address from your ISP if you want to access any device remotely and you may have to turn on Port Forwarding in your router.

169.xxx.xxx.xxx IP address

If the IP address starts with 169, it means the computer has tried but was unable to get an IP address dynamically (from your router). The computer will set itself to a 169.x.x.x address in this instance. Typically, the computer will not be able to communicate properly with such an address as it can only communicate with other computers or devices that also have a 169.x.x.x address. The 169 address allows you to troubleshoot your network problem.

How does a router or home gateway play in with TCP/IP?
It plays a very active and important role. Since it's the network device connecting differing networks together (your home or local network and the Internet) it provides for multiple functions.

- **Provides IP addresses and information** to computers connected to it via the local network. This is usually done via a **built-in DHCP server**.
- Provides for **Network Address Translation (NAT)**. NAT separates the computers on the local network from the computers on the Internet. The local computer's IP addresses will not appear on the Internet. Only one publicly available address is available to the Internet (WAN IP).

  The router / gateway needs a couple of IP addresses itself:
- It **needs an IP address on the Internet**. This address comes from the ISP and can be either statically or dynamically assigned.
- It needs to have an **IP address on the local network** which is usually statically assigned and preconfigured.

NOTE:
LAN: Local Area Network
WAN: Wide Area Network
NAT: Network Address Translation
DHCP: Dynamic Host Control Protocol
DNS: Domain Name Server
PING: Ping operates by sending (ICMP) echo request packets
ICMP: Internet Control Message Protocol
NetBIOS: Network Basic Input/Output System
Ipconfig: Internet Protocol Configuration
PowerShell: is a task automation and configuration management framework

Basics:
Do you have Dial Up, DSL, Cable, Wireless or Satellite?
Are your cables plugged in to the correct ports?
Does your modem or router have power and show connectivity?
If you have wireless; are you connected to your WAP (Wireless Access
Point)? If the above is true, let's find out how to troubleshoot the loss of
connection.

Note: PowerShell will be replacing the Admin Command Prompt in the future but it works very similar. Open PowerShell from Cortana by typing "PowerShell" (without the quotes). You can now copy and paste in this window.

You must **first** open the Command Prompt in **administrator** mode. All testing will be done in the Admin Command Prompt (DOS Mode).

Win Vista & 7
Open>All Programs>Accessories and right click the **command prompt** and left click **run as administrator**

Win 8, 8.1 & 10
Right Click lower left hand corner and select "**Command Prompt (Admin)"**
(It is very **important that you run in administrator mode**). After each of the following commands use the **enter** key.

Do this first! Clear the screen using the following commands: "type" **CD\ (enter)** (This is CD plus Backslash this just moves you back to the "root" directory and is called **Change Directory**) http://en.wikipedia.org/wiki/Root_directory
"Type" **CLS (enter)** (this clears your screen) and will leave you at **C:\>**

Ipconfig is a command line tool used to control the network connections on Windows NT/2000/XP/Vista/7/8/8.1/10 machines.

Ipconfig (IP Configuration) is used from the **Admin Command Prompt**. This will show your Local or Lan IP address from your Router and your Gateway IP address, this is the basic command but if you want more information type **Ipconfig /all** this will also show your connected DNS server.

Ipconfig /all   (this is just a local example with WinXP)
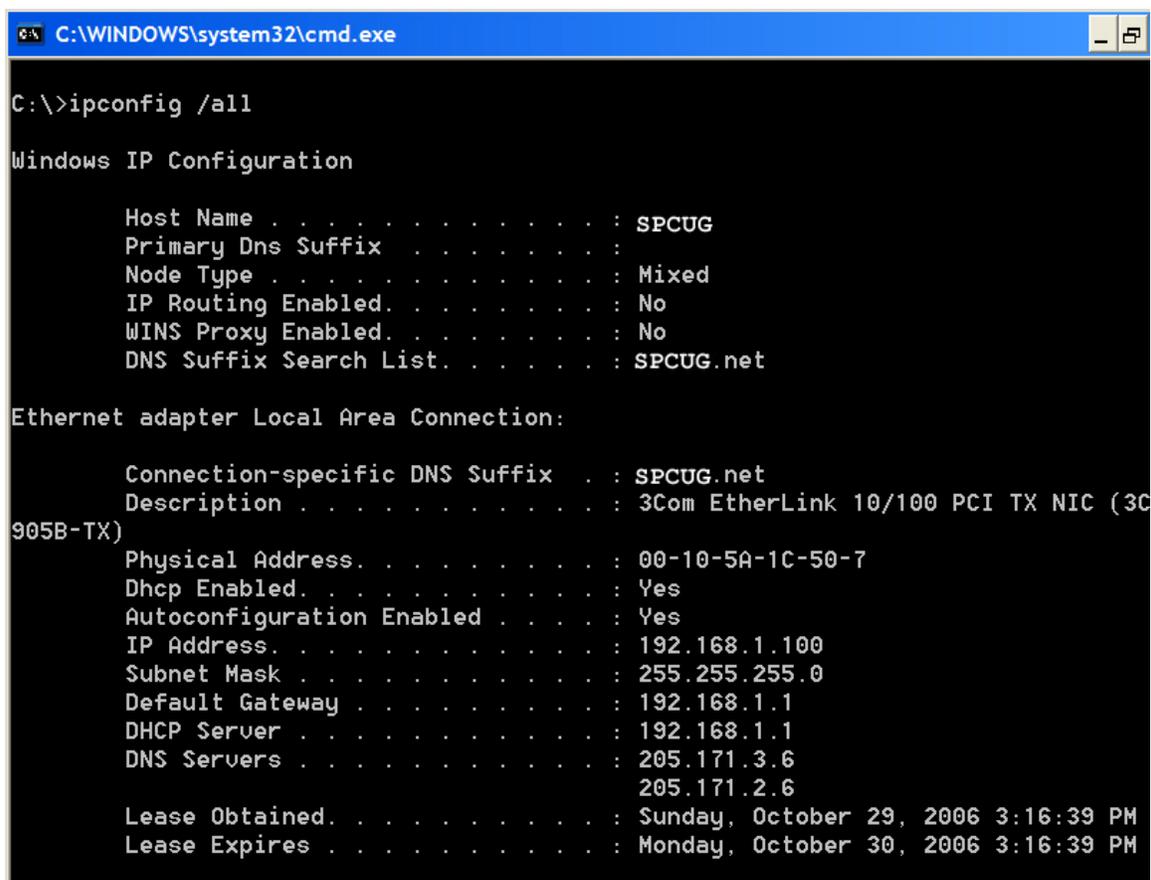

```
C:\WINDOWS\system32\cmd.exe

C:\>ipconfig /all

Windows IP Configuration

        Host Name . . . . . . . . . . . . : SPCUG
        Primary Dns Suffix  . . . . . . . :
        Node Type . . . . . . . . . . . . : Mixed
        IP Routing Enabled. . . . . . . . : No
        WINS Proxy Enabled. . . . . . . . : No
        DNS Suffix Search List. . . . . . : SPCUG.net

Ethernet adapter Local Area Connection:

        Connection-specific DNS Suffix  . : SPCUG.net
        Description . . . . . . . . . . . : 3Com EtherLink 10/100 PCI TX NIC (3C
905B-TX)
        Physical Address. . . . . . . . . : 00-10-5A-1C-50-7
        Dhcp Enabled. . . . . . . . . . . : Yes
        Autoconfiguration Enabled . . . . : Yes
        IP Address. . . . . . . . . . . . : 192.168.1.100
        Subnet Mask . . . . . . . . . . . : 255.255.255.0
        Default Gateway . . . . . . . . . : 192.168.1.1
        DHCP Server . . . . . . . . . . . : 192.168.1.1
        DNS Servers . . . . . . . . . . . : 205.171.3.6
                                            205.171.2.6
        Lease Obtained. . . . . . . . . . : Sunday, October 29, 2006 3:16:39 PM
        Lease Expires . . . . . . . . . . : Monday, October 30, 2006 3:16:39 PM
```

Ipconfig /all   Win 8 using Administrator Command Prompt

```
Windows 8        Administrator: Command Prompt        _ □ ×

C:\>ipconfig /all

Windows IP Configuration

    Host Name . . . . . . . . . . . . : ASUS_Laptop
    Primary Dns Suffix  . . . . . . . :
    Node Type . . . . . . . . . . . . : Hybrid
    IP Routing Enabled. . . . . . . . : No
    WINS Proxy Enabled. . . . . . . . : No

Ethernet adapter Ethernet:

    Connection-specific DNS Suffix  . :
    Description . . . . . . . . . . . : Atheros AR8121/AR8113/AR8114 PCI-E Ethern
et Controller
    Physical Address. . . . . . . . . : 90-E6-BA-4D-9F-A1
    DHCP Enabled. . . . . . . . . . . : Yes
    Autoconfiguration Enabled . . . . : Yes
    Link-local IPv6 Address . . . . . : fe80::36:7052:cd20:a170%11(Preferred)
    IPv4 Address. . . . . . . . . . . : 192.168.0.2(Preferred)
    Subnet Mask . . . . . . . . . . . : 255.255.255.0
    Lease Obtained. . . . . . . . . . : Friday, January 31, 2014 4:17:46 PM
    Lease Expires . . . . . . . . . . : Sunday, February 2, 2014 2:52:52 PM
    Default Gateway . . . . . . . . . : 192.168.0.1
    DHCP Server . . . . . . . . . . . : 192.168.0.1
    DHCPv6 IAID . . . . . . . . . . . : 261154490
    DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-19-99-93-30-71-E6-BA-4D-9F-C1

    DNS Servers . . . . . . . . . . . : 208.67.222.222
    NetBIOS over Tcpip. . . . . . . . : Enabled

Tunnel adapter Teredo Tunneling Pseudo-Interface:

    Connection-specific DNS Suffix  . :
    Description . . . . . . . . . . . : Teredo Tunneling Pseudo-Interface
    Physical Address. . . . . . . . . : 00-00-00-00-00-00-00-E0
    DHCP Enabled. . . . . . . . . . . : No
    Autoconfiguration Enabled . . . . : Yes
    IPv6 Address. . . . . . . . . . . : 2001:0:5ef5:79fb:4066:58f:3f57:fffd(Prefe
rred)
    Link-local IPv6 Address . . . . . : fe80::2066:58f:3f77:fffd%15(Preferred)
    Default Gateway . . . . . . . . . : ::
    NetBIOS over Tcpip. . . . . . . . : Disabled

Tunnel adapter isatap.{C4FCE279-AD3E-4D42-AF69-EAF88F58C1A3}:

    Media State . . . . . . . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :
    Description . . . . . . . . . . . : Microsoft ISATAP Adapter #5
    Physical Address. . . . . . . . . : 00-00-00-00-00-00-00-E0
    DHCP Enabled. . . . . . . . . . . : No
    Autoconfiguration Enabled . . . . : Yes

C:\>_
```

You will notice Windows 8 gives you much more information than Win XP, this example is a laptop and has both an Ethernet and Wi-Fi connection. Win 10 has even more information, very useful when you know what to look for.

Ipconfig /release   this releases the network adapter.
Ipconfig /renew   this renews the IP address to the adapter.

Ipconfig /flushdns   this flushes the DNS cache.
Ipconfig /help   A help and command line reference.

Note 1: This works in WinXP, Vista, 7, 8, 8.1 and 10
Note 2: This was formerly called **WINIPCFG** in Win95/98/ME

Loop Back Address for testing.
However, there is one address that cannot be used by any computer in the world, and that
address is **127.0.0.1**. The reason is that this address has been reserved for what is known
as the **loopback address**. A loopback address is an address that tells the computer not to
test its connections to another computer, but to test its **own basic network setup**.

Note: Older Apple (MAC) does **not** have a loopback address but you can create one
here: http://extjs.eu/how-to-add-an-ip-address-to-loopback-interface-on-mac/
Note: MAC OS X10.10 Yosemite and OS X10.11 El Capitan does have the loopback
address built in now but this can only be run from the terminal utility. It is located in the
Utilities folder within the Applications folder   more info here:
http://guides.macrumors.com/Terminal
OS X: Network Utility https://support.apple.com/en-us/HT202790
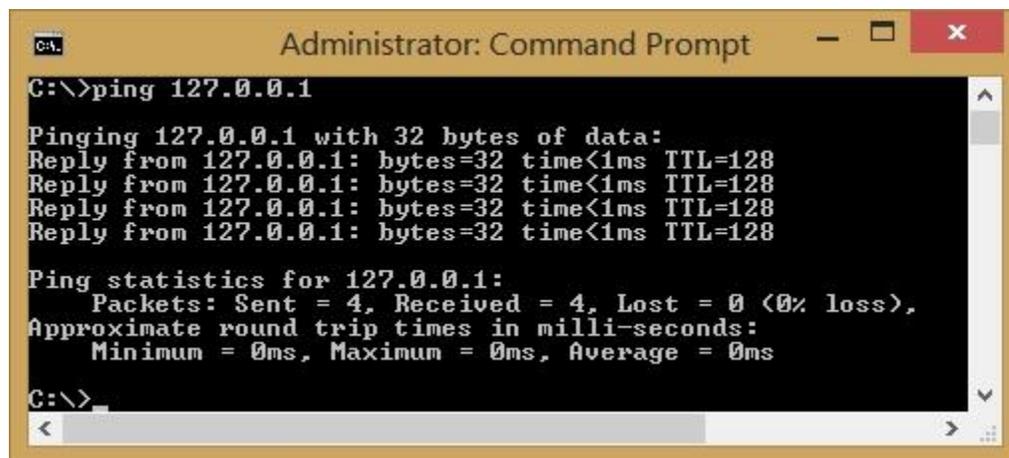
What is Ping?
PING is a command that is used on computer networks to verify connections to
other computers. This program has been bundled with Windows since Win 95 to
present. The name comes from active sonar terminology which sends a pulse of
sound and listens for the echo to detect objects underwater.
Note: On an Apple you can find Ping in the network utility folder or use the
Terminal program command line interface.

So the best way to troubleshoot is to ping the following.
To Ping, type on the same line as the command prompt the following and then enter.

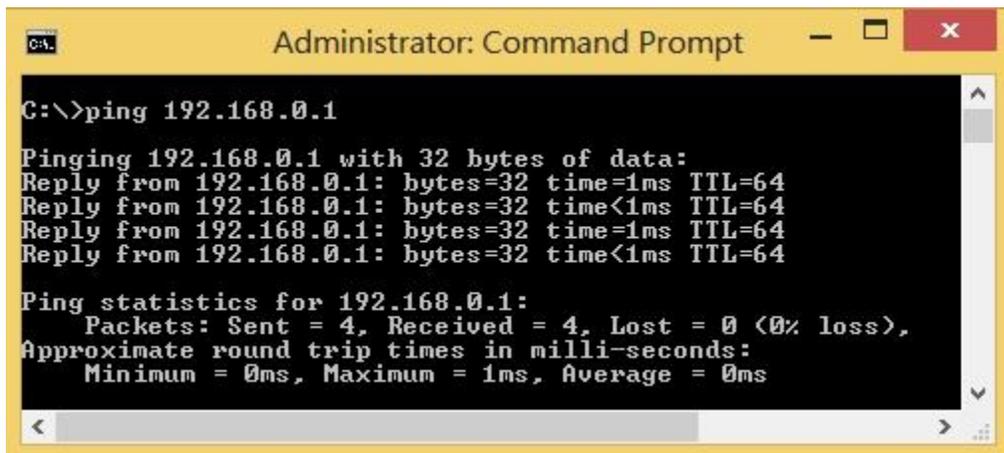**Ping 127.0.0.1 (**Loopback address) pings 4 times and you should receive 4 replies'.

Ping your default gateway (usually your home router) (192.168.0.1 or 192.168.1.1)
(For example: ping 192.168.0.1)

```
Administrator: Command Prompt                          –  □  ×

C:\>ping 192.168.0.1

Pinging 192.168.0.1 with 32 bytes of data:
Reply from 192.168.0.1: bytes=32 time=1ms TTL=64
Reply from 192.168.0.1: bytes=32 time<1ms TTL=64
Reply from 192.168.0.1: bytes=32 time=1ms TTL=64
Reply from 192.168.0.1: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```
:

Ping your ISP's Primary DNS server (Domain Name Server) to see if the name
"resolves", you need to check this before your service is down.
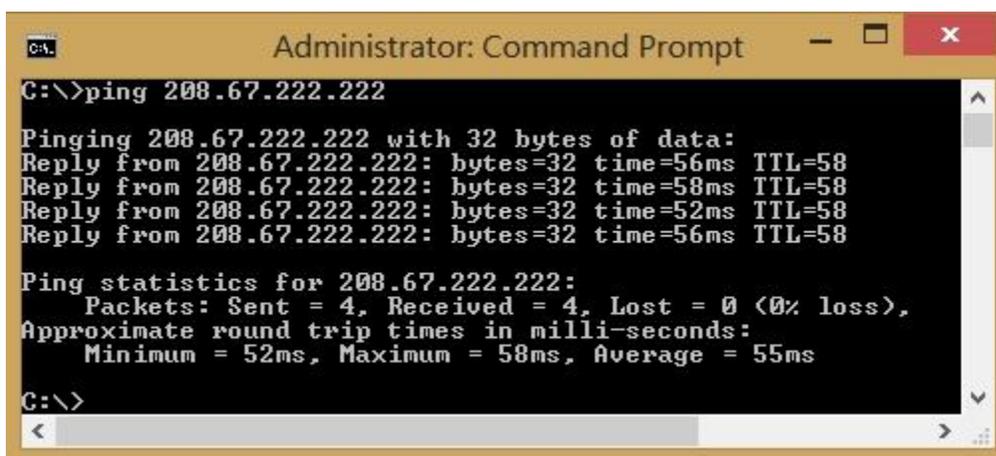
```
Administrator: Command Prompt                          –  □  ×

C:\>ping 208.67.222.222

Pinging 208.67.222.222 with 32 bytes of data:
Reply from 208.67.222.222: bytes=32 time=56ms TTL=58
Reply from 208.67.222.222: bytes=32 time=58ms TTL=58
Reply from 208.67.222.222: bytes=32 time=52ms TTL=58
Reply from 208.67.222.222: bytes=32 time=56ms TTL=58

Ping statistics for 208.67.222.222:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 52ms, Maximum = 58ms, Average = 55ms

C:\>
```

You should be able to ping the IP and URL's below.

ISP Primary DNS Servers
CenturyLink DNS: 207.14.235.234
Wbhsi.net (Orbitel) DNS: 216.207.208.71
OpenDNS: 208.67.222.222
Google DNS: 8.8.8.8

Ping 207.14.235.234 (your ISP's DNS in this case CenturyLink)
Ping CenturyLink.net (this shows the name is being resolved to an IP address)
Ping 206.190.36.45 (this is www.yahoo.com)
Ping yahoo.com (this proves you can get beyond your ISP and onto the WWW.
Ping 66.96.149.32 this is the same as pinging: Saddlebrookecc.org

Note 3: if you can ping an IP address but NOT an IP Name then you likely have a problem with your DNS server, try a different DNS server (e.g. OpenDNS:208.67.222.222)
 Note 4: you may not be able to ping your ISP's DNS if your login and password are not authenticated by your ISP's radius server.

Remote Authentication Dial-In User Service (**RADIUS**) is a networking protocol that provides centralized Authentication, Authorization, and Accounting (AAA or Triple A) management for users who connect and use a network service.
https://en.wikipedia.org/wiki/RADIUS

Note 5: CenturyLink uses a RADIUS server when using DSL or VDSL.

Tracert (trace route) this is a useful troubleshooting tool
The tracert command is used to visually see a network packet being sent and received and the amount of hops required for that packet to get to its destination.
Tracert **206.190.36.45** this is the www.yahoo.com website, see how many "hops" it takes to get to its destination.

Is a **"hop"** an ingredient of beer? No, "hops" are actually servers/routers that the packet/email data stops at on the way to its destination.

Traceroute utilities work by sending packets with low time-to-live (TTL) fields. The TTL value specifies how many hops the packet is allowed before it is returned. When a packet can't reach its destination because the TTL value is too low, the last host returns the packet and identifies itself. By sending a series of packets and incrementing the TTL value with each successive packet, traceroute finds out who all the intermediary hosts are.

Local Area Connection Status (Win Vista, 7, 8 and 10)
Start>Control Panel>Network & Sharing Center>Internet (Ethernet or Wi-Fi)>Ethernet Status>Details button gives you Network Connection details.
Local Area Connection Status (WinXP)
Start>Control Panel>Network and Internet Connections>Network Connections>Local area connections then the General Tab gives you connection status and packets sent and received. Support Tab gives you a detailed connection status.

Whois
WHOIS (pronounced as the phrase who is) is a query and
response protocol that is widely used for querying databases that
store the registered users or assignees of an Internet resource,
such as a domain name, an IP address block
http://www.internic.net/whois.html

How to properly configure a wired or wireless network printer.

Note 6: *if you use **DHCP** at some point in time you will **lose your IP address** and **NOT** be able to connect and print from any computer in your home, you will end up reloading your software, talking to tech support and getting frustrated when they can't help you.*

Rather than using the **DHCP** setup that is normally done with the software that comes with your printer you will want to use a **Static IP** and this will require a manual or advanced setup. Wired is best and simpler to setup, if you use an Ethernet cable then be sure and disable the wireless radio (option) or the wired portion will **NOT** work. If you decide to use wireless, then enter the manual settings. This will be MUCH easier if you have a flat panel LCD display and keypad otherwise you will need a USB cable to configure the advanced settings the first time. You will need to know the "**gateway**" address of your router and can find that by using the Ipconfig command (above), then you will want to set your Static IP to a high number that will not be normally used by other devices. Here is an example: **192.168.1.200** (the 200 is for the printer) assuming the gateway address of your AP (access point) is 192.168.1.1 Your Subnet Mask will be: 255.255.255.0
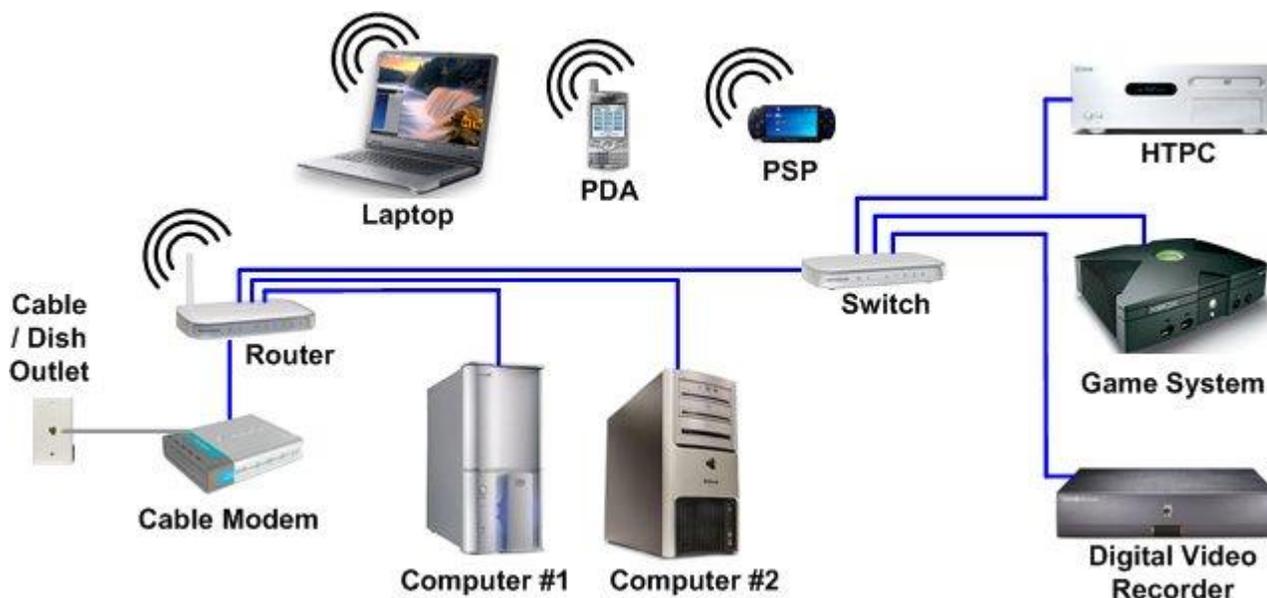
Now if your software has already been loaded then you may be able to open **Control Panel>Devices and Printers and "add a network printer"**. Find your printer on the list, make sure you see your Static IP address and when you name your printer put the IP address in the name to make it easy to find.
There is a (possible) alternate method to configure your printer if it is already installed (and working), you will need to know the DHCP IP address of the printer so you can put the IP address in your browser address bar and (maybe) access and change your settings. This works on newer network printers since they have embedded web servers.
Note 7: You can print out your network settings on most printers or you can access your router and find the IP address there.
Note 8: When shopping for a new printer pick one that has both wired and wireless.

Typical Home Network

References:

http://www.howtogeek.com/134132/how-to-use-traceroute-to-identify-network-problems/

http://4sysops.com/archives/how-to-share-wi-fi-in-windows-8-with-internet-connection-sharing-ics/   How to setup internet connection sharing

https://en.wikipedia.org/wiki/Whois

http://www.internic.net/whois.html

http://en.wikipedia.org/wiki/RADIUS

http://www.whatismyip.com   (find WAN or outside IP address)

http://www.webopedia.com/TERM/L/loopback_address.html

https://www.whatsmydns.net/flush-dns.html   How to flush the DNS cache for various OS's

http://support.apple.com/kb/PH13739?viewlocale=en_US   How to Ping OS X Mavericks

http://www.printertechs.com/other-instructions/network-printing-tutorial/321-network-printing-tutorial-part-1

Here is a Brother HL-2270-DW network install guide in PDF format:
http://www.brother-usa.com/VirData/Content/en-US%5CPrinters%5CConsumer%5CNetworkUsersManual%5CNUM_HL_2270DW_EN_2639.PDF

http://ip-check.info/?lang=en (check for WAN IP address)

https://www.dnsleaktest.com/ DNS Server Test 1
https://ipleak.net/   DNS Server Test 2

HomeGroup (Networking) from start to finish: http://windows.microsoft.com/en-US/windows/homegroup-help#homegroup-start-to-finish=windows-7&v1h=win81tab1&v2h=win7tab1

How to install a **network printer** in Windows: http://windows.microsoft.com/en-us/windows/install-printer#install-printer=windows-7

http://www.advanced-ip-scanner.com/   for scanning your home network to find your printer.

https://support.opendns.com/entries/26336865-Clearing-the-DNS-Cache-on-Computers-and-Web-Browsers

https://technet.microsoft.com/en-us/library/mt427362.aspx PowerShell Features

https://spcugpcoutlaws.wordpress.com/ Lots of good information on this website