Networking Basics & IT Career Development Tips

Bruce Vaal & Jim Hytken
Trainers, Networking Systems - Both recently retired from Philips Healthcare
Pioneer Biomed
piobio.com

MDEXPO
SoCal • October 11-13, 2022

Agenda

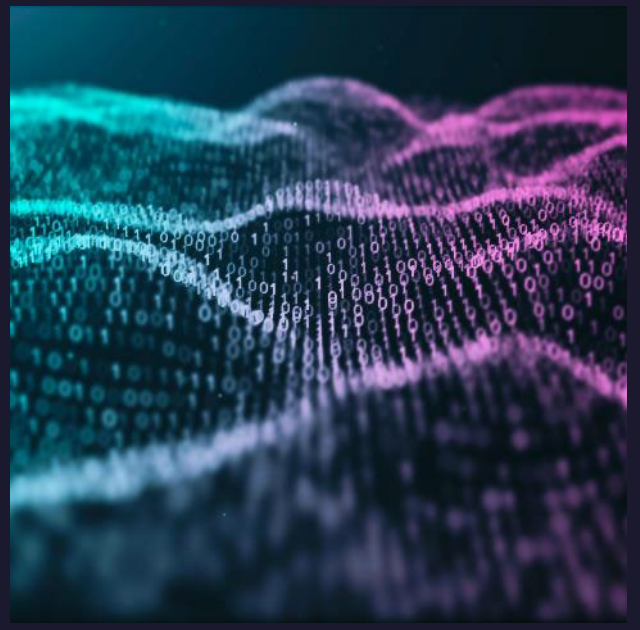
We've been around

How to facilitate inter-departmental communications, teamwork & support

I.T. Basics

Clinical networking

Vendor (Philips) networks






Introduction

- **Summary of Qualifications for Bruce Vaal:**
- Thirty years clinical hospital experience consisting of vendor and in-house employment. Expertise includes Philips patient monitoring and computer networking. Analytical decision maker with excellent problem-solving and technical sales skills. B.S. Degree in Electronics, CompTIA Net+, A+, Cisco Routing & Switching.

- **Summary of Qualifications for Jim Hytken:**
- 20 years with Philips Healthcare. Installed and repair/troubleshoot patient monitoring (bedsides, ECG carts, L&D systems, charting systems, MRI monitors, computer networking. National Support Team. B.S. Degree in Chemistry, CompTIA Net+, A+, Cisco Routing & Switching and Wireless.

We've been around

Yeah, we've seen that. Firsthand experiences.

Lots of them, as a hospital clinical engineer, Field Engineer, National Support member, Sales Support and combined 65 years with HP/Philips in sales and service.

Practical ways to facilitate inter-departmental communication & support within the facility

BIOMEDs

- Biomeds, make friends in the IT dept. Go to lunch with them.
- Learn basic networking skills and get some basic I.T. certifications like A+ and Network+(CompTIA.org)
- Practice using common network commands
- Work with IT to get an assigned IT contact to work with Biomed

IT Folks

- Give Biomeds a chance with IT stuff
- Recognize those in Biomed departments that are interested in learning IT
- Keep Biomed up to date on network changes, especially if late night or weekends. Many problems occur during these times. Why?

Commands that are useful for troubleshooting

- The following are just a partial list of commands that can be used to help troubleshoot a problem with the network. Using these commands will not cause any problems with the system. The output may help you and IT determine the cause, or you may be using these while talking to the vendors help line.
- These won't change your life but may help you fix the system quicker, so no need to take a red or blue pill

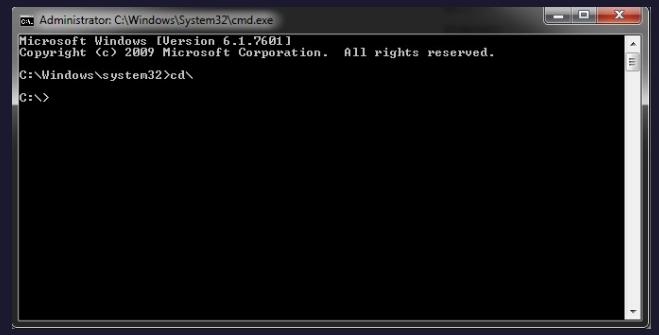
Clinical Networking

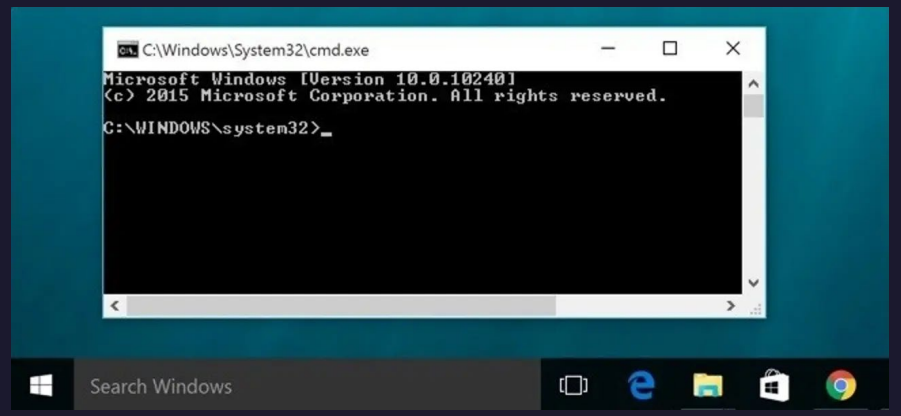
- PING (usually first command used for troubleshooting network)
- IPCONFIG & IPCONFIG/ALL
- DHCP vs Static IP
- Subnet masks and gateways
- DNS and NSLOOKUP

- If you can PING yahoo.com, you're getting out to the internet!
- IPCONFIG can tell you a lot!
- DNS is used by many vendors today
- Are you getting an IP address? If not try Static IP (means to hardcode the IP)

How to bring up a command prompt window

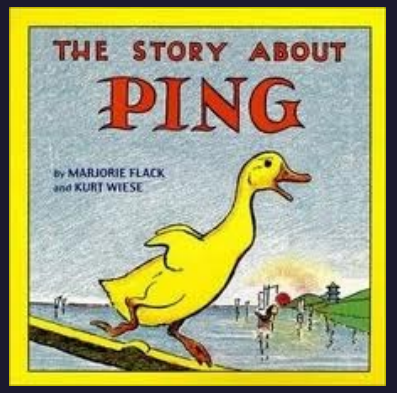
- On a Windows 7 PC you click on the start button and in the search box type ‘cmd’ enter and a new window will open
- On Windows XP Click the Start button then choose ‘Run’ and type ‘cmd’ enter and a new window will open
- On Windows 10 click start (if taskbar is not visible) and type ‘cmd’ and either press enter or choose ‘command prompt’ then the command prompt option should show up





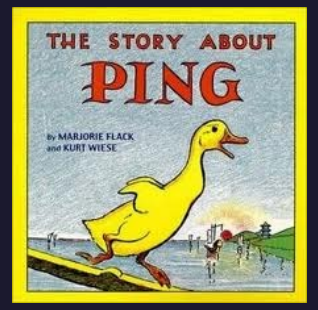
Note: Opening a command prompt in a Central Station may be more difficult as vendors such as Philips and others usually lock out the normal functions or greatly restrict the use of the Start menu. You may need to go into the configuration or service area to find the command prompt. If you need assistance call the vendors Helpdesk.

PING



- Ping stands for Packet INternet Groper.
- The term was first used in 1983 and took the name “ping” because the action of the utility mimicked that of a sonar sending out a signal. The characteristics of the return signal (timing, strength, direction) were useful in determining what lay ahead of the sender.
- An Internet Control Message Protocol (ICMP) echo message and its reply: ping often is used in IP networks to test the reachability of a network device.
- The command takes the form PING *ipaddress*, where *ipaddress* is the numeric IP address of the host you want to contact. It can also take the form PING *hostname*, where hostname is the name of a PC or website, Ex: “PING google.com" or “PING 192.168.2.10”. PING -t 172.31.3.32 or Ping -t hostname will run forever until stopped with CTRL C keypress

PING (Continued)



- Ping -t can be used to troubleshoot intermittent problems when more than 4 replies are needed
- Try pinging a nearby PC to make sure network is operational
- Try pinging the switch connected to PC or the server for the central station
- Perform the following command to ping an IP over and over and do it quietly and have the results go to a text file
- ping -t 8.8.8.8|cmd /q /v /c "(pause&pause)>nul & for /l %a in () do (set /p "data=" && echo(!date! !time! !data!)&ping -n 1 8.8.8.8>nul" >C:\temp\pingtest.txt

PING example of good and bad replies

```
C:\Users\jfh31>ping yahoo.com

Pinging yahoo.com [74.6.231.21] with 32 bytes of data:
Reply from 74.6.231.21: bytes=32 time=38ms TTL=48
Reply from 74.6.231.21: bytes=32 time=38ms TTL=48
Reply from 74.6.231.21: bytes=32 time=37ms TTL=48
Reply from 74.6.231.21: bytes=32 time=38ms TTL=48

Ping statistics for 74.6.231.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 37ms, Maximum = 38ms, Average = 37ms

C:\Users\jfh31>ping 146.2.45.123

Pinging 146.2.45.123 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 146.2.45.123:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

PING -t example

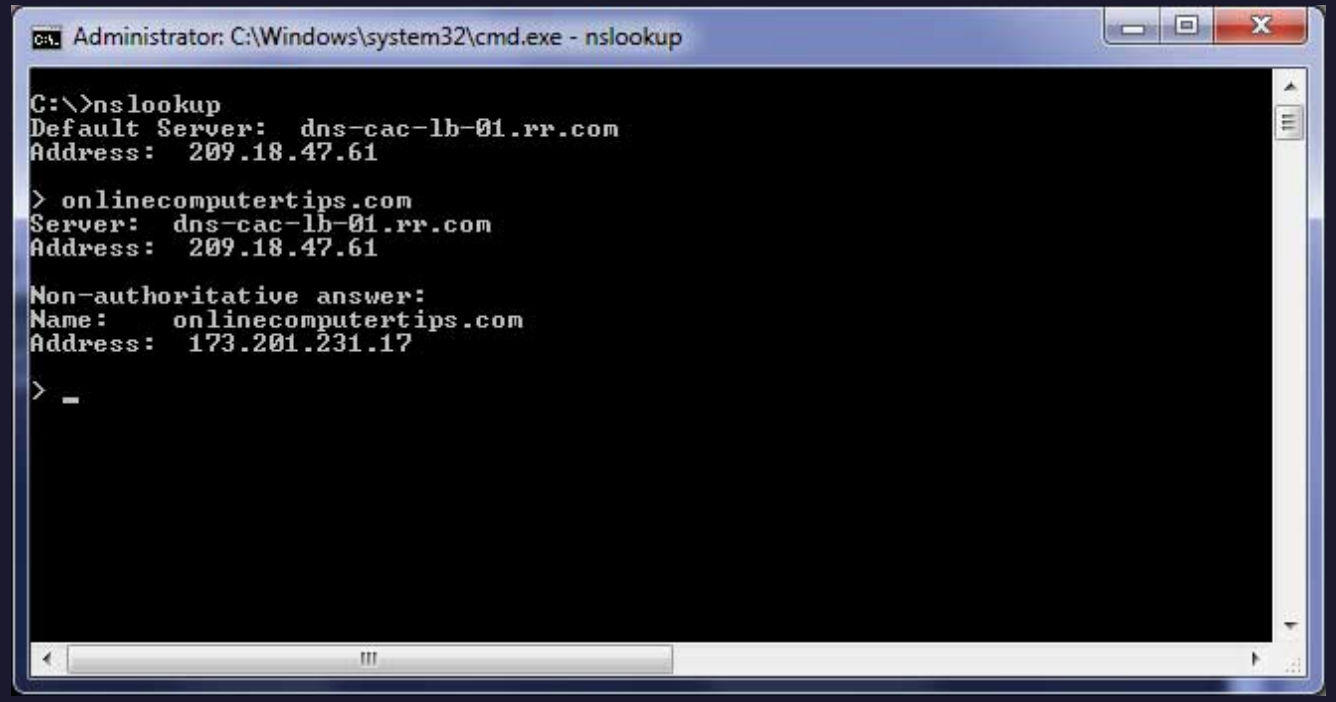
```
C:\Users\jfh31>ping -t finance.yahoo.com

Pinging edge.gycpi.b.yahoodns.net [209.73.179.253] with 32 bytes of data:
Reply from 209.73.179.253: bytes=32 time=11ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=13ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=11ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=11ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=11ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53
Reply from 209.73.179.253: bytes=32 time=12ms TTL=53

Ping statistics for 209.73.179.253:
    Packets: Sent = 18, Received = 18, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 11ms, Maximum = 13ms, Average = 11ms
Control-C
^C
```

DNS and using NSLOOKUP

- DNS is an acronym for Domain Name System
- IP addresses for Internet and Intranet works on numbers, not names
- If a valid DNS server is not available then there is no access to websites
- Think of DNS as a phonebook; Type in a site (yahoo.com for example) and DNS directories sync'ed across the internet work together to translate the name to an IP address such as 74.6.231.21 which is what networks use. This number is then used by programs and Browsers to bring up the site requested
- You still let your fingers do the walking but now it is on a keyboard instead of a book
- Older legacy systems used WINS (Windows Internet Naming Service) that mapped computer names to IP addresses
- Many Nextgen central stations (such as Philips PIICiX) rely on DNS. If a problem exists communicating with a server or central it could be DNS related

Using NSLOOKUP to find an IP or verify that the DNS entry is correct

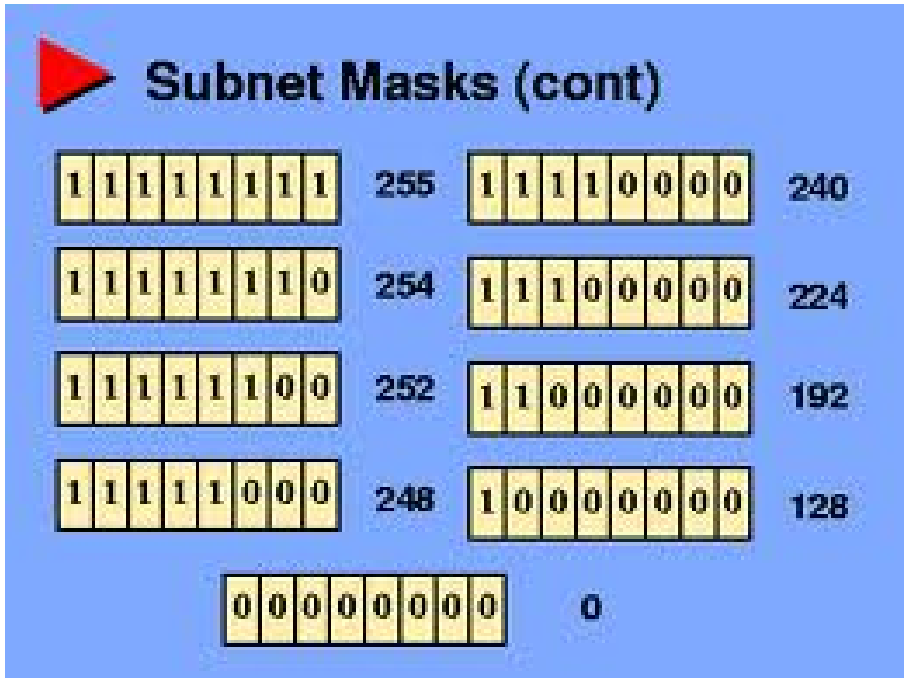
- Type NSLOOKUP and the hostname of the PC or the website to obtain the IP address. It can be used interactively or as a command
- In the example typing onlinecomputertips.com brings up 2 IPs
- The first is the DNS server that was used to look up the hostname
- Below that is the hostname (onlinecomputertips.com) and the IP address.
- "Non-authoritative answer" means that this result came from a cache and not an actual query of the DNS server



This command can be helpful to determine that the hostname and IP are correct for your central or server

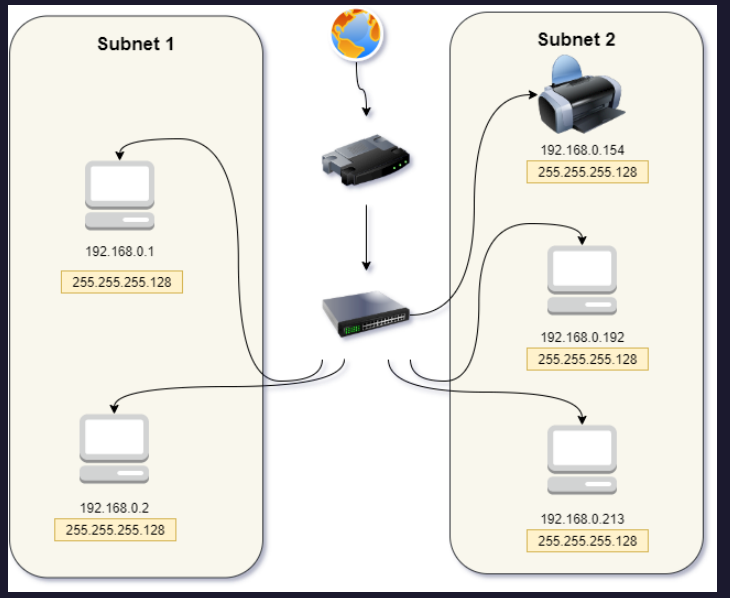
Different ways of displaying the Subnet mask

- 192.168.3.2/255.255.255.0 – shows Subnet as 4 bytes
- 192.168.3.2/24 – shorthand that shows 24 bits are set to 1 and the remaining 8 are set to 0 (max =32)
- 192.168.3.2/11111111.11111111.11111111.00000000 – shows each of the 32 bits of a subnet in binary form



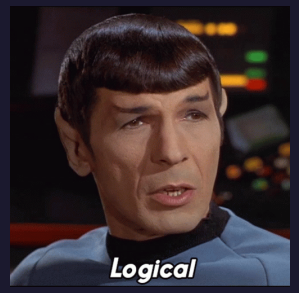
Subnets

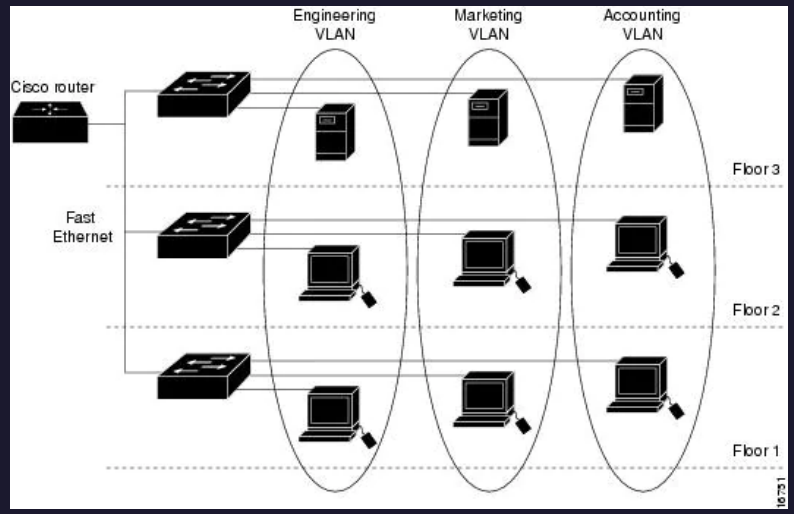
No, not this kind of sub net



- Servers may be on a different subnet than central stations, bedsides, telemetry devices, printers, etc.
- This makes it easier to keep track of devices on the network
- As an example for a subnet mask that is 255.255.248.0 central stations might be in a range from 172.31.3.32 to 172.31.3.94 while bedsides might use 172.31.7.1 to 172.31.7.254 and wireless might use 172.31.6.1 to 172.31.6.255
- If a device needs to be added then it is a simple matter to determine the right range based on the type of device and it can be added either via a static IP or DHCP
- Troubleshooting is easier when having like devices grouped within an IP range

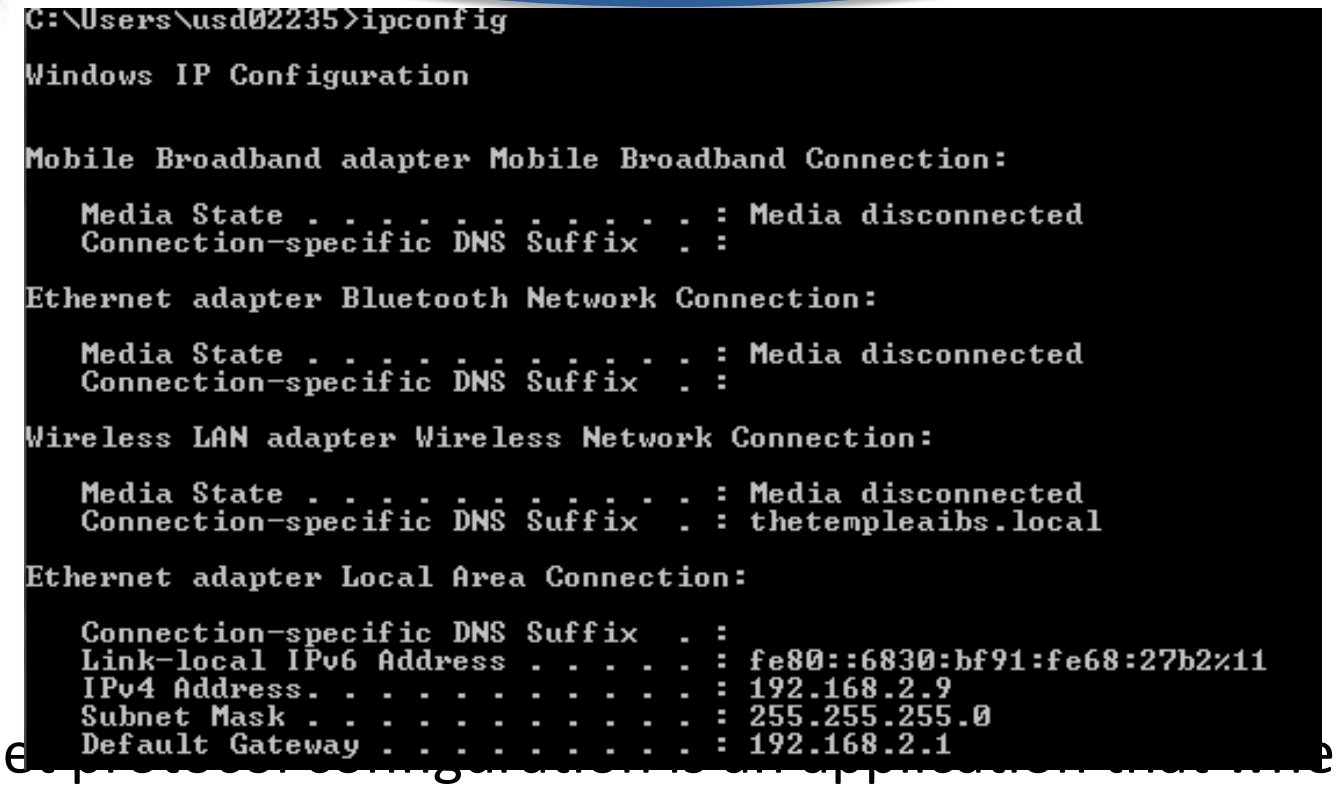
VLANs





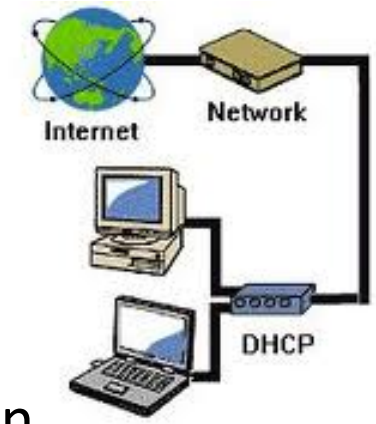
- A VLAN is a logical collection of network devices that can communicate with each other as though they were on a single private LAN. A hospital can have hundreds of VLANs on a single wire or wireless infrastructure. Each VLAN is programmed into routers and/or switches. A device on one VLAN is not able to contact a device on a different VLAN (unless the router or firewall permits it).
- VLANs (Virtual LANs) can be used to isolate the network into several unique logical networks (requires a router or layer 3 switch)
- This allows for multiple networks on one physical switch or physical network
- Why do hospitals use them? VLANs are cost effective and everything within one VLAN can communicate with all others in the same network without needing a router. Less switches are needed since individual ports can be assigned to a specific VLAN. Less administrative work is needed to manage the network since there are less devices.
- As an example many hospitals use VLANs on the hospital network to connect central stations to each other and to servers.

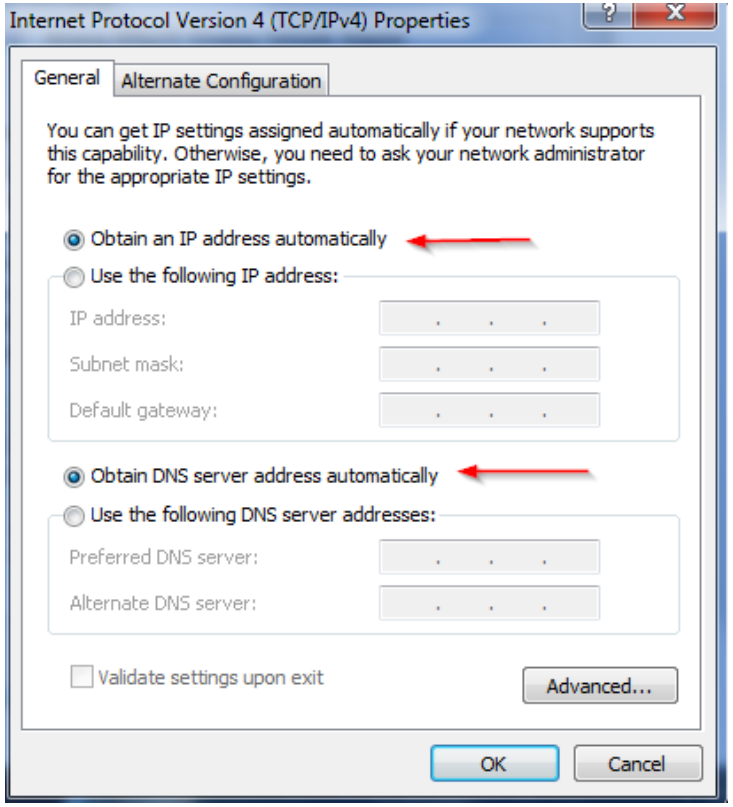
Using IPConfig



- Ipconfig (internet protocol configuration is an application that when executed from a command prompt displays the current TCP/IP network values- It also refreshes DHCP and DNS settings
- Ipconfig/all-also shows the Host name of your device, among other things

Configure a network card (NIC) for DHCP

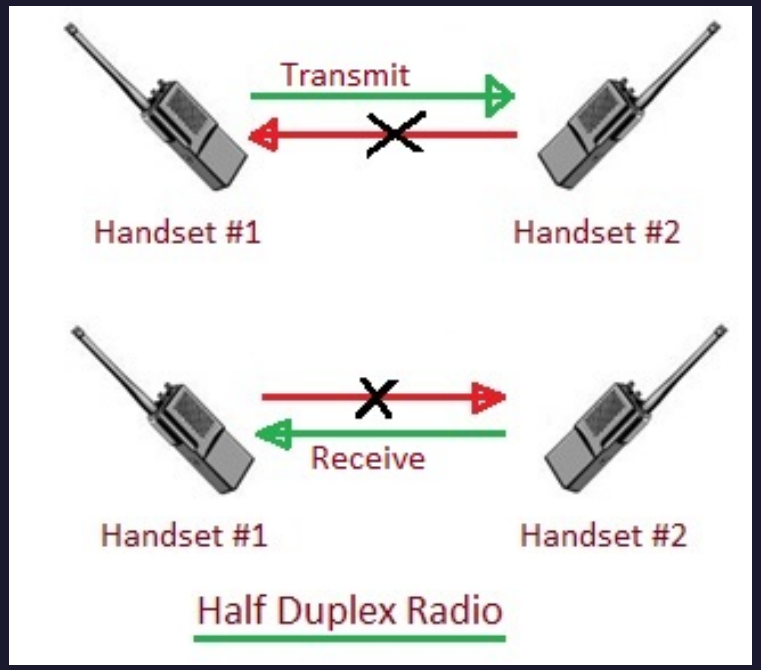


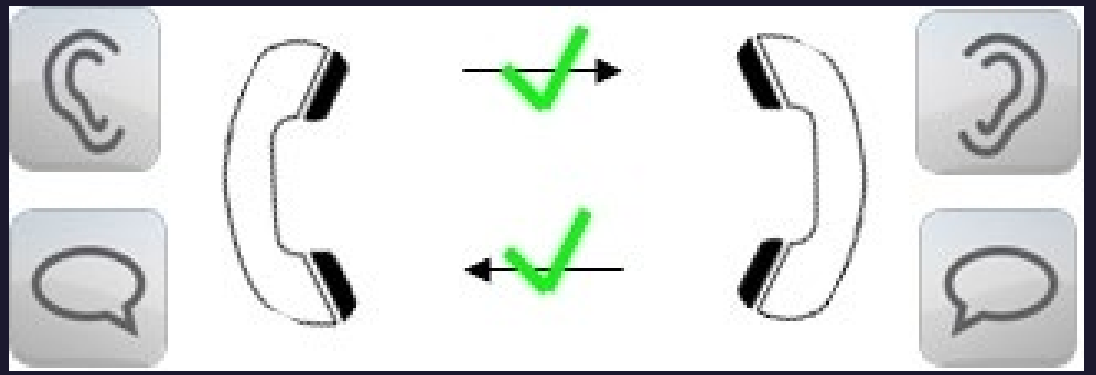


- DHCP – Dynamic Host Configuration Protocol
- Computers must have an address before they can communicate on a network with other hosts.
- Hospital supplied networks have assigned DHCP servers
- Vendor networks may use hospital DHCP servers or use their own DHCP server
- DHCP addressing prevents duplicate IP addresses which can cause connectivity issues

Why is duplex important?

Make sure that the data switch setting and PC are at the same speed and duplex. If a Cisco switch is set to AUTO and the PC is set to 100Mb/Full duplex then the actual speed will be 100/Half duplex (Half duplex is like a walkie-talkie whereas Full duplex is like a phone). If not set correctly this can cause errors and slow the communications down greatly. May be indicated as waveform gaps on a central station or the system seems very slow to respond.



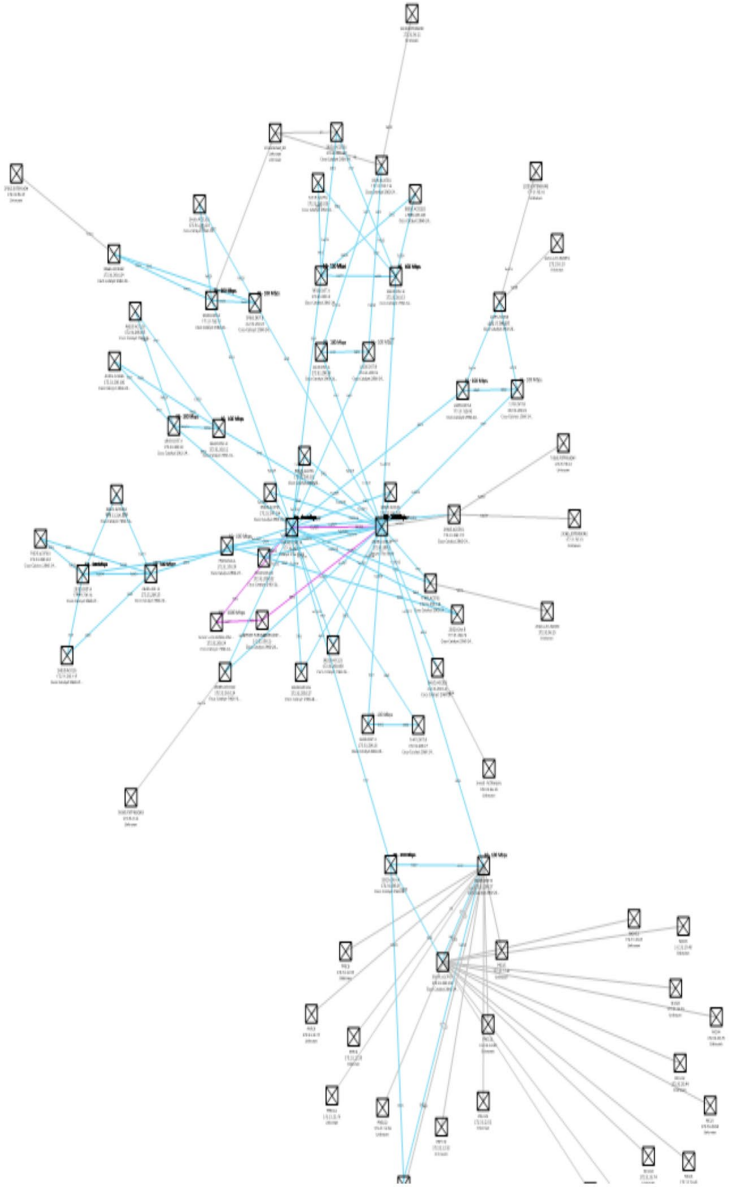


Full Duplex

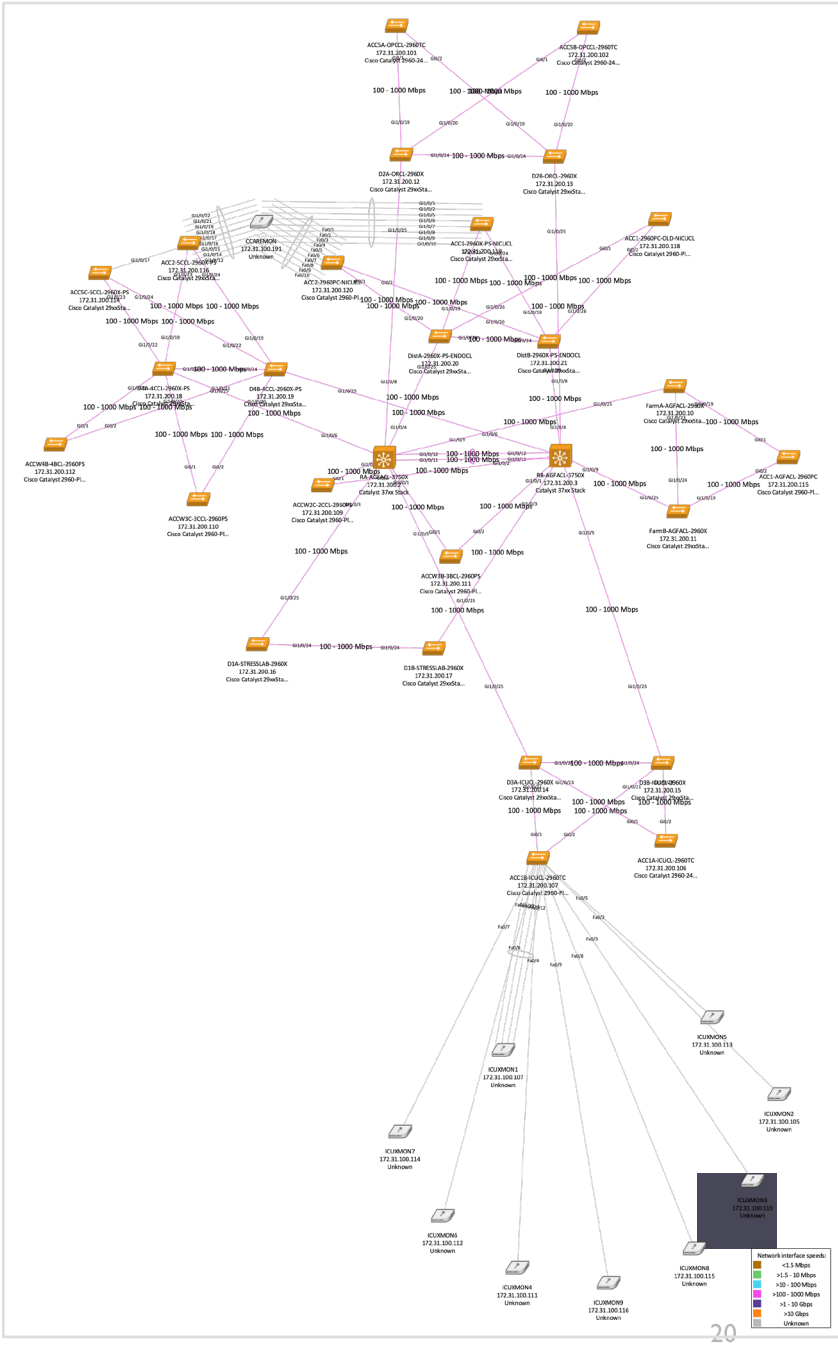
Nurses Central station Networking Yesterday vs Today

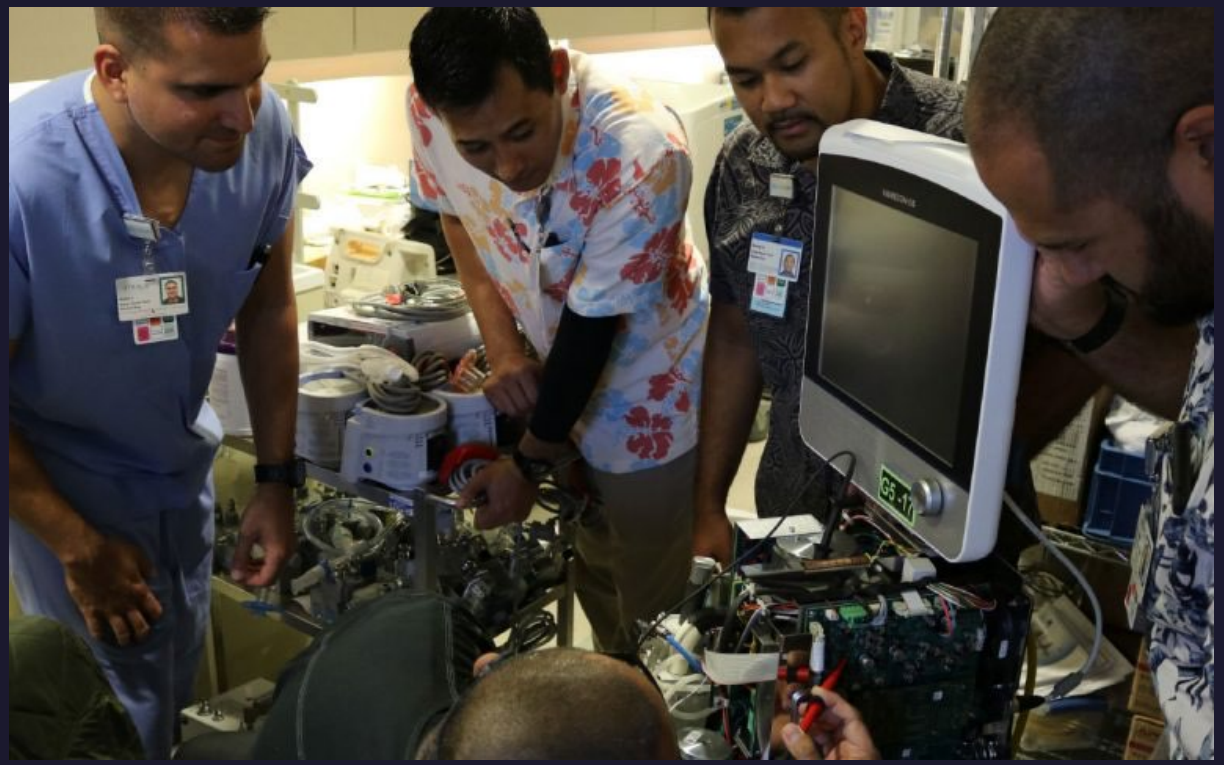
rday the data traversing the nurses station network was within the capability mb devices

- Today the amount of data flowing through a central station network is much higher given the additional bedside and central options, requiring Gigabit infrastructure
- Think of this change as a small town with just a few buildings and streets and maybe 2 stop lights (and nobody was in a hurry and was in a can).
- Today this small town has grown into a megapolis. Many more people with more cars requires added streets and hundreds of stop lights, parking lots, buildings and electricity increases (everybody is in a rush and now spam is rampant (You might still be able to find it in grocery stores though)
- Next page is an example showing two vendor (Philips) supplied networks. Left side is an older system used when 100Mb bandwidth was sufficient. Right side is a current Gigabit bandwidth system needed for todays higher demand of data traversing the network.



SolarWinds network example
Left side is mostly 100Mb network
(indicated by Blue lines)
Right side is all Gigabit network
(indicated by Pink lines) for newer devices
For legacy systems
Left Side is sufficient
But today we
need faster networks to handle the increased data traversing the network





Biomed

I.T.

Let’s work together to reduce those long sleepless nights and unexpected weekend problems. Work with a contact in IT to help isolate problems and improve uptime. While there are systems on isolated vendor networks there are others that are integrated into the hospital infrastructure. Close cooperation will be needed.

Summary

Clinical Engineering and I.T. working together=SUCCESS!

Learn more about Networking

- If you are interested in becoming more proficient with networking consider taking a course and obtain a certification. There are many out there.
- CompTia has a networking course called Network+ and this would be a good place to start. Go to https://www.comptia.org/certifications/network to learn more. Study on your own and pay to take a test.
- Cisco also has several certifications and many vendors require their service personnel to become proficient and pass tests in one or more Cisco and/or CompTia certs
- If you want to learn more but do not want to obtain any specific certifications try ITPRO.TV for video training. https://www.itpro.tv/courses/comptia/comptia-network-n10008/
- This is a virtual class you view at your leisure. While it is not free it is a great way to learn about networking. ITPRO has a large list of IT related courses if there are other courses that interest you. With some of their subscription plans they also have made available virtual practice machines

Thank You for attending. Questions?

Jim Hytken(Retired from Philips July 2021)

jim@PioBio.com

Bruce Vaal(Retired from Philips July 2022)

bruce@PioBio.com