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# Hands-on MESH Network Workshop

## Student Workbook

**Santa Clara County RACES**

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## 1. HANDS ON! Exercise #1: Looking at your Network Configuration

This exercise will help you answer 4 questions:

1. Who am I? (network speaking)
2. What's my name?
3. Is my network working?
4. Who else is out there?

**NOTE!** Before beginning, make sure you are connected to the wireless network named "Mesh\_Workshop"

**NOTE!** For Apple users, differences in commands are listed with a 🍏 in front of the line. Consult any Apple users that are in the room.

### Step 1

#### Run the Program: *cmd*

1. The **cmd** program brings up the Windows Command Line prompt.
2. To run cmd, go to Windows Start. Enter **cmd** in the run field or in the "Search programs or files" field.



3. Windows 10: Right-click on the start icon (lower left in the tool bar), and then select the **Run** menu option. Enter **cmd** in the field presented, and then press Enter to run the program.
4. **Verify** the Command Prompt window opens, and you are presented with a prompt (your login followed by a ">").

```
Microsoft Windows [Version 10.0.10586]
(c) 2015 Microsoft Corporation. All rights reserved.

C:\Users\jimo>
```

🍏 Go to a to **Applications**, and run **Terminal**

---

## Step 2 **WHO AM I?...** Running the Program: *ipconfig*

1. **ipconfig** displays the IP address, subnet mask, and default gateway for all network interfaces you have installed.
2. Run **ipconfig** from the cmd prompt. Try these command strings:
  - a. `ipconfig ?` (shows help for ipconfig)
  - b. `ipconfig` (displays your network Configuration)

```
Microsoft Windows [Version 10.0.10586]
(c) 2015 Microsoft Corporation. All rights reserved.

C:\Users\jimo>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix . . : attlocal.net
    IPv6 Address. . . . . : 2602:306:3970:90d0:d62:5b89:451a:1212
    Temporary IPv6 Address. . . . . : 2602:306:3970:90d0:70f3:c16b:dca7:508d
    Temporary IPv6 Address. . . . . : 2602:306:3970:90d0:e47c:e54a:20ef:f4d2
    Link-local IPv6 Address . . . . . : fe80::d62:5b89:451a:1212%4
    IPv4 Address. . . . . : 192.168.1.82
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : fe80::221:7cff:fea8:13c1%4
                                192.168.1.254
```


(Example; partial listing shown here, your listing will be different)



- 🍏 Run `ifconfig` from the **Terminal**. This displays all your network interfaces.



```
Terminal — tcsh — 113x22
Last login: Mon May 30 17:14:33 on ttys000
judy% ifconfig
lo0: flags=8049<UP,LOOPBACK,RUNNING,MULTICAST> mtu 16384
    options=3<RXCSUM,TXCSUM>
    inet6 ::1 prefixlen 128
    inet 127.0.0.1 netmask 0xff000000
    inet6 fe80::1%lo0 prefixlen 64 scopeid 0x1
    nd6 options=1<PERFORMNUD>
gif0: flags=8010<POINTOPOINT,MULTICAST> mtu 1200
stf0: flags=8<> mtu 1200
en0: flags=8063<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    ether 64:76:ba:a7:cf:24
    inet6 fe80::6676:baff:fea7:cf24%en0 prefixlen 64 scopeid 0x4
    inet 192.168.10.106 netmask 0xfffff000 broadcast 192.168.10.255
    nd6 options=1<PERFORMNUD>
    media: autoselect
    status: active
en1: flags=963<UP,BROADCAST,SMART,RUNNING,PROMISC,SIMPLEX> mtu 1500
    options=60<TS04,TS06>
    ether 32:00:17:d2:80:00
    media: autoselect <full-duplex>
    status: inactive
```

(Example; partial listing shown here, your listing will be different)

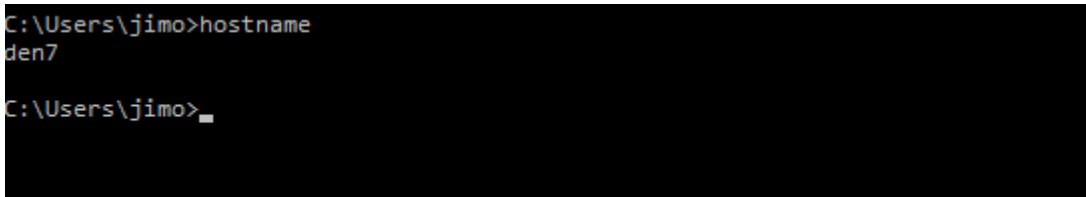
- 
- Step 3**
1. After running `ipconfig`, Review the listing, and...
    - a. find your IP Address (IPv4 version) \_\_\_\_\_
    -  find your IP Address (labeled "inet") \_\_\_\_\_

- 
- Step 4**
1. Run `ipconfig` from the cmd prompt. Try these command strings:
    - a. `ipconfig /all` (displays a lot of network info)
    -  `ifconfig` (same listing as above)
  2. From your listing,
    - a. Find your PC's MAC address (listed as the Physical Address):  
Ethernet Adaptor \_\_\_\_\_  
Wireless LAN Adaptor \_\_\_\_\_
-  Note: The MAC address for each network interface is labelled "**ether**".

---

**Step 5**     **WHAT'S MY NAME?...** Running the Program: *hostname*

1. This program displays the name of your computer.
2. Run `hostname` from the cmd prompt.
  - a. `hostname` (returns the computer name)



```
C:\Users\jimo>hostname
den7
C:\Users\jimo>
```

3. After running `hostname`, from your listing,
  - a. find you're your computer name \_\_\_\_\_

---

**Step 6****IS MY NETWORK WORKING?** Running the Program: *ping*

1. This program is used to test the “reachability” of a host on an IP network and to measure the round-trip time for messages sent from the originating host (you) to a destination computer.
2. Run **ping** from the cmd prompt, these 4 options.
  - a. ping (returns help for this command)
  - b. ping 127.0.0.1 (your loopback address)
  - c. ping localhost (another name for your local PC)
  - d. ping <computer name> (using your computer name)

```
C:\Users\jimo>ping 127.0.0.1

Pinging 127.0.0.1 with 32 bytes of data:
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128

Ping statistics for 127.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\jimo>
```

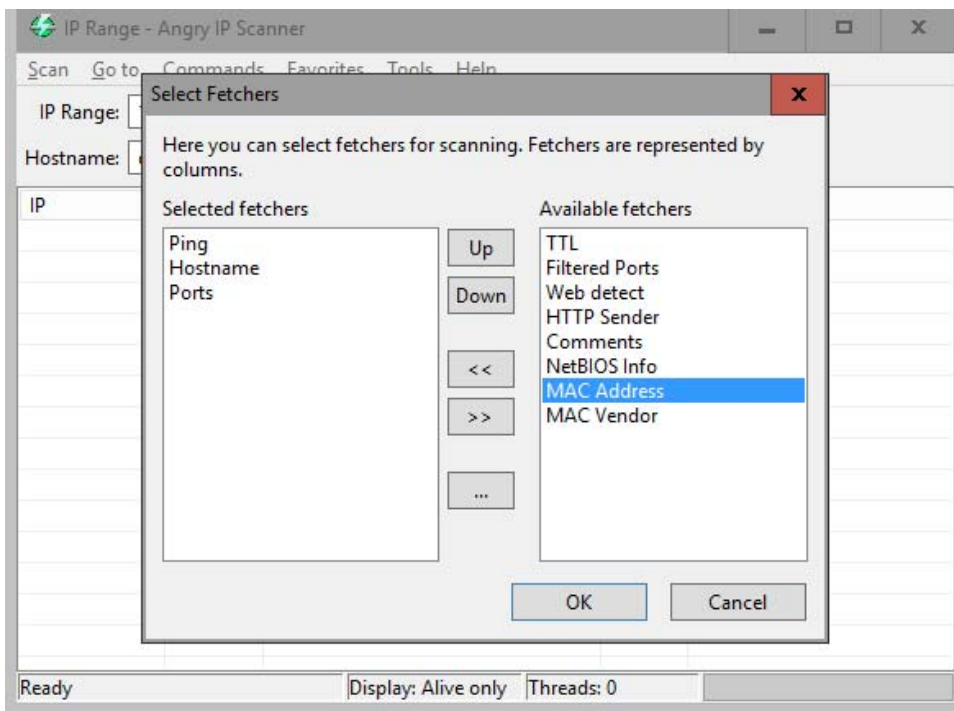
3. What were the results of the 4 ping runs?
  4. How were the results of the other 3 methods for pinging yourself?
-

Angry IP scanner is a very fast IP address and port scanner. It can scan IP addresses in any range as well as any of their ports. The program pings each IP address to check if it's alive, then optionally resolves its hostname, determines the MAC address, scans ports, etc.

**NOTE:** Before beginning, make sure you have installed this program and the associated Java RTE if prompted.

### Configure IP Scanner

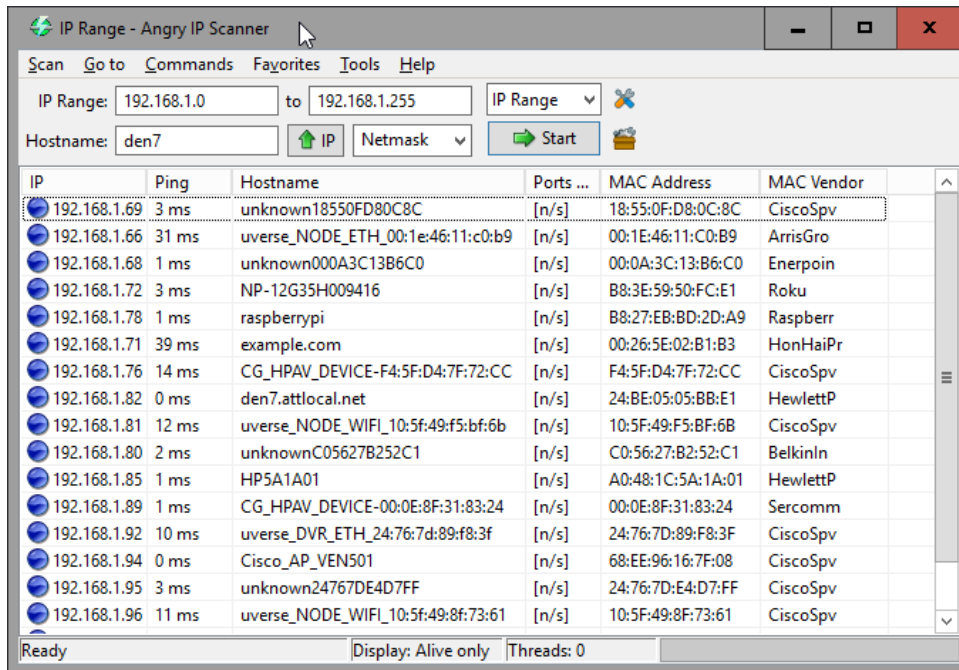
1. Find and run the program.
2. Select additional data to be retrieved. From the program's menu,
  - a. select **Tools > Fetchers**
  - b. Under the right column labeled *Available fetchers*, highlight the entry "MAC Address", and then press the [**<<**] button to add it to the *Selected fetchers* list on the left.
  - c. Next, select "MAC Vendor", and then press the [**<<**] button to add it as well.
  - d. Verify the entries "MAC Address" and "MAC Vendor" are now listed in the left column.
  - e. Press [**OK**] when done.



3. Select the data to be displayed. From the program's menu,
  - a. Select **Tools > Preferences**
  - b. On the Scanning Tab, check the option:
    - i.  Scan dead hosts, which do not reply to pings (see the notes under Step 8).
  - c. On the Display Tab, click on the option:
    - i.  Alive hosts, (responding to pings) only
  - d. Press [**OK**] when done.

## Performing the Scan

1. Start the Scan.
  - a. Note the default IP range listed in the top.
  - b. Press [ **→ Start** ]



2. Watch the status bar on the bottom of the form. The number of open **Threads** tells you the number of IP address checks that are still pending resolution. Once the Thread count reaches zero, the scan is completed and you can set up for a different scan.

### **NOTE: WHY AREN'T WE USING PING?**

Recent Windows Operating systems do not reply to ping requests by default because **ICMP Echo Requests** had been turned off in the default firewall policy. That means you will be getting 'Request Timed Out' from **Windows 7, 8.1, and 10** PCs even though they are connected and set up properly on the network.

**FYI...** To enable pings on your PC so other people can see you, navigate to your Fire Wall settings, select **Advanced Settings > Inbound Rules**, and look for look for "Echo Request – ICMP4". For **Private** or **Domain**, right-click on the respective entry and check **Enable Rule**.

### When done,

1. **DISCONNECT** from the wireless network "Mesh\_Workshop", and
2. **DISABLE** your wireless adaptor.



**1. HANDS ON! Exercise #2: Cable Inspection**

This exercise gives you a chance to get to know your Ethernet Cable.

**Step 1**

1. Most Category cables provide a variety of information printed right on the cable. There is no standard way the information is presented, but you should see **something** printed on the cable that gives you a hint to some or all of the following. Take a look at your CAT cable. Record your observations here:

- a. Category: \_\_\_\_\_
- b. Wire Gauge (a number followed by AWG): \_\_\_\_\_
- c. Number of Pairs (#P or spelled out): \_\_\_\_\_
- d. Connector Type: \_\_\_\_\_  
Hint: Look for : TIA/EIA 568A  
TIA/EIA 568B.1  
TIA/EIA 568B.2
- e. Other Cable Marking: \_\_\_\_\_

**Step 2**

2. On your cable connector, note the pin-outs:

Pin	Color
1	
2	
3	
4	
5	
6	
7	
8	

Pin	Color
1	
2	
3	
4	
5	
6	
7	
8	

### 3. HANDS ON! Exercise #3: Checking out the Mesh Node configuration

This exercise walks you through an initial inspection of the mesh node using BBHN's user Interface.

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#### Step 1 Your Linksys Router

**NOTE!** All nodes in the workshop are assumed to be already loaded with the MESH firmware V3.0.0 or greater.

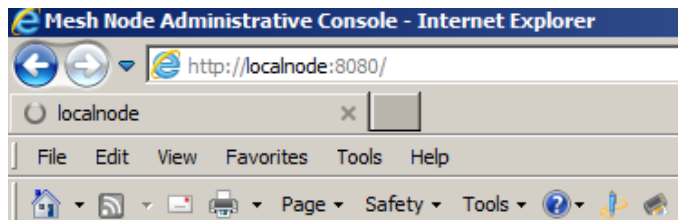
**NOTE! DISABLE** your wireless adaptor before proceeding. Wireless access to the Mesh Node from your PC is not supported.

1. Connect your PC/Laptop to the Linksys WRT54G Mesh Node with your Ethernet cable.
2. Apply Power to the Linksys Router. The boot process should take about 1 minute. Once the DMZ LED goes out, the node is ready for use.
3. On your PC, run the **cmd** Program. Then, run the **ipconfig** program to view your IP address. Record your IP address here.
  - a. Your IP Address \_\_\_\_\_
4. **VERIFY** that an IP address has been assigned AND is in the range **10.###.###.###**. If it is not, **STOP!** Do not proceed. Check your cable or Modem Power. Reboot your PC if necessary. **Turn off your Wi-Fi!**

---

#### Step 2 Accessing the Linksys / Mesh configuration

1. Start up your browser.
2. Enter the following in the URL field: <http://localnode:8080>
3. The first thing you will see is a redirect page:

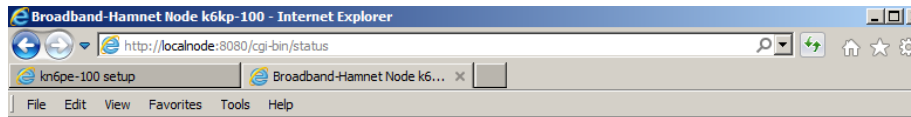


Redirecting to [status page](#)

**Step 2  
(continued)**

**Accessing the Linksys / Mesh configuration**

1. The main mesh node page is presented. The mesh node name to which you are connected is always printed on the top of this page.



# k6kp-100

[Help](#)       Night Mode

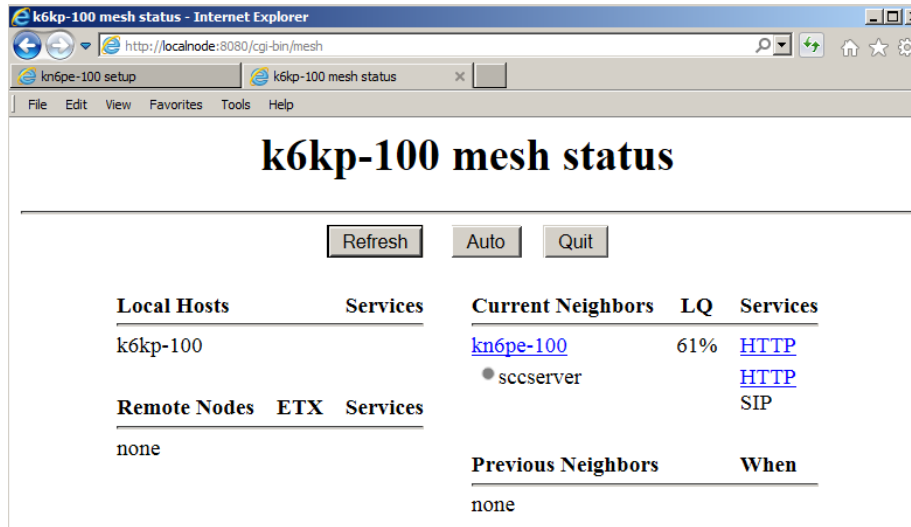
<b>WiFi address</b>	10.9.49.226 / 8 fe80::212:17ff:fe09:31e2 Link	<b>Signal/Noise/Ratio</b>	-61 / -91 / 30 dB	<input type="button" value="Auto"/>
<b>LAN address</b>	10.73.143.17 / 29 fe80::212:17ff:fe09:31e0 Link	<b>firmware version</b>	3.0.0	
<b>WAN address</b>	192.168.1.79 / 24 fe80::212:17ff:fe09:31e0 Link	<b>configuration</b>	mesh	
<b>default gateway</b>	192.168.1.254	<b>system time</b>	Wed Mar 18 2015 03:57:58 UTC	
<b>your address</b>	10.73.143.18	<b>uptime</b>	10 min	
		<b>load average</b>	0.35, 0.16, 0.10	
		<b>free space</b>	flash = 560 KB /tmp = 7060 KB memory = 2660 KB	

2. What is the name of this Mesh node? \_\_\_\_\_
3. What is the firmware version? \_\_\_\_\_
4. Notice the different IP addresses listed at this node. They are:
  - a. Wi-Fi address: this is the address of the Wi-Fi Port for this MESH node that talks to other MESH nodes.
  - b. LAN address: this is the address of the Switch for the PCs plugged in to it.
  - c. WAN address: this is the address of the Port if your node is connected to the internet

### Step 3

### Looking at the Mesh Status

1. Press the **Mesh Status** button. This form reports the local Host name (your Mesh Node name) and the list of Mesh Node neighbors that you can hear.



2. Other controls on this page are:
  - a. Refresh: one-time refresh of the results on this page.
  - b. Auto: automatically refreshes the results of this page about every 10 seconds.
  - c. Quit: Exits this page and returns to the main status page.
3. Note the list of neighbors and any services they offer. In the above example, you see the following:

- a. Neighbor: **kn6pe-100**. Alias: **sccserver**
- b. Services: HTTP: This neighbor offers HTTP web services  
SIP: This neighbor offers SIP (PBX Phone ) services

4. List a few of your **Current Neighbors** and their services that you see:

1. Neighbor: \_\_\_\_\_, Services: \_\_\_\_\_
2. Neighbor: \_\_\_\_\_, Services: \_\_\_\_\_
3. Neighbor: \_\_\_\_\_, Services: \_\_\_\_\_

5. Click on any one of your **Current Neighbors** links. What happens?

- a. Note the Web address in your browser address line.

6. Press the Browser Back button to your own node (Hint: or re-enter "<http://localnode:8080>" if you are not sure where you are).

7. When done, press **Quit**.

---

**STEP 4****Other Mesh Page tabs**

1. From your node's home page,
  - a. Press **WiFi Scan**. This displays the list of all the Wi-Fi nodes that are within range of your node. Note the Signal Level in Column 1.

## k6kp-100 WiFi scan

---

Sig	Chan	Enc	SSID	MAC	Vendor
-52	8	*	2WIRE310	00217C:A813C1	2Wire
-64	3	*	cyclones	4C5E0C:67CCFB	
-65	1		BroadbandHamnet-20-v3	422AAF:B7F37A	Ad-Hoc
-79	3	*	LCARS	E4F4C6:149FFB	
-82	6	*	Sweet_Home	6C709F:EF3EF2	
-82	8	*	JodrellBank	881FA1:3873CA	
-83	11	*	Bletchley Park	000A95:F48DD1	Apple
-83	6	*	Welcome_Guest	7E709F:EF3EF2	
-85	3	*	freddythepup	14358B:113F24	
-85	9	*	ATTXxBX222	3C36E4:76BB50	
-88	11	*	ATT2G8x6c6	145BD1:E57ED0	

- b. Notice all the entries that are standard Wi-Fi routers that you might hear.
  - c. Note the entry with the SSID that says BroadbandHamnet-20-v3. These are other BBHN Mesh Nodes that you can hear.
  - d. What is the Channel Assignment for the BBHN nodes? \_\_\_\_\_
  - e. If there is a "\*" in the **Enc** column, this means that the channel is encrypted. Note that the Broadband Hamnet nodes are not encrypted per Part 97 rules.
  - f. Also, note the different MAC address representation: #####:#####. This is the same MAX number but in a different format.
-

## Step 5 Setup/Basic Setup

- To access the Setup menu, you need to enter the mesh node logon and password:
  - Logon: root
  - Password: mesh (or contact the node owner for the password)

**NOTE:** if you manage your own Mesh node, **DO NOT FORGET** your password. The method for resetting the password is non-trivial ☹.

- After the logon form, the Basic Setup page shows the basic information for your node. Confirm these settings:

- Node Type: Set to Mesh Node.
- LAN Mode: Set to 5 Host Direct.
- WAN Protocol: Set to DHCP.

<a href="#">Node Status</a>	<b>Basic Setup</b>	<a href="#">Port Forwarding, DHCP, and Services</a>	<a href="#">Administration</a>		
<a href="#">Help</a>	Save Changes	Reset Values	Default Values	Reboot	
Node Name	<input type="text" value="k6kp-100"/>	Password	<input type="text"/>		
Node Type	<input type="text" value="Mesh Node"/>	Verify Password	<input type="text"/>		
<b>WiFi</b>		<b>LAN</b>		<b>WAN</b>	
Protocol	<input type="text" value="Static"/>	LAN Mode	<input type="text" value="5 host Direct"/>	Protocol	<input type="text" value="DHCP"/>
IP Address	<input type="text" value="10.9.49.226"/>	IP Address	<input type="text" value="10.73.143.17"/>	DNS 1	<input type="text" value="8.8.8.8"/>
Netmask	<input type="text" value="255.0.0.0"/>	Netmask	<input type="text" value="255.255.255.248"/>	DNS 2	<input type="text" value="8.8.4.4"/>
SSID	<input type="text" value="BroadbandHamne-20-v3"/>	DHCP Server	<input checked="" type="checkbox"/>	Mesh Gateway	<input type="checkbox"/>
Mode	<input type="text" value="Ad-Hoc"/>	DHCP Start	<input type="text" value="18"/>		
Channel	<input type="text" value="1"/>	DHCP End	<input type="text" value="22"/>		
Active Settings					
Rx Antenna	<input type="text" value="Diversity"/>				
Tx Antenna	<input type="text" value="Diversity"/>				
Tx Power	<input type="text" value="19 dBm"/>				
Distance	<input type="text" value="0"/>				
	Apply				

- Under the LAN column, note that DHCP Server is checked and the Starting and Ending DHCP Addresses. In the above example, the IP Address range is: 10.73.143.18 to 10.73.143.22; your listing will be different. Who on your node has these IP Addresses?

- IP addr \_\_\_\_\_ Owner: \_\_\_\_\_
- IP addr \_\_\_\_\_ Owner: \_\_\_\_\_
- IP addr \_\_\_\_\_ Owner: \_\_\_\_\_
- IP addr \_\_\_\_\_ Owner: \_\_\_\_\_
- IP addr \_\_\_\_\_ Owner: \_\_\_\_\_

4. Change LAN Mode from 5 host Direct to another option like 13 Host Direct. What happens to the available IP address range? Change it back when done.
5. On your PC, run the **Angry IP Scanner** Program.
  - a. Note the IP Range: \_\_\_\_\_
  - b. Do you recognize any other devices connected to your local node?

**STEP 6 Setup/Port Forwarding, DHCP, and Services**

6. Click on the **Port Forwarding, DHCP, and Services** link.
7. This page shows the following:
  - a. DHCP Reservations. Sometimes, it is important that a device's IP address does not change, such as a VoIP server (the phones need to know where it is all the time). This is the way to "lock in" an IP Address regardless of when and where it is plugged into this Mesh Node.
  - b. Current DHCP Leases. This shows what devices have been assigned an IP address by this node. Note the associated MAC address. Hover over the **Add** button; this creates a DHCP reservation for the associated device
  - c. Advertised Services. This lets you set up a device and have it advertise an available network service to the rest of the network.
  - d. Port Forwarding. If we are connected to the internet, this can add a port forwarding rule to the router portion of the node.

<a href="#">Node Status</a>	<a href="#">Basic Setup</a>	<b>Port Forwarding, DHCP, and Services</b>	<a href="#">Administration</a>
<a href="#">Help</a> <input type="button" value="Save Changes"/> <input type="button" value="Reset Values"/> <input type="button" value="Refresh"/>			
<b>DHCP Address Reservations</b>		<b>Advertised Services</b>	
Hostname	IP Address	MAC Address	Name   Link   URL
<input type="text"/>	- IP Address - <input type="button" value="Add"/>	<input type="text"/>	<input type="text"/> <input type="checkbox"/> <input type="text"/> ://k6kp-100 <input type="button" value="Add"/>
<b>Current DHCP Leases</b>			
den7	10.73.143.18	24:be:05:05:bb:e1	<input type="button" value="Add"/>
<b>Port Forwarding</b>			
Interface	Type	Outside Port	LAN IP   LAN Port
WAN <input type="button" value="v"/>	TCP <input type="button" value="v"/>	<input type="text"/>	- IP Address - <input type="button" value="Add"/>

---

**Step 7 NICE TO KNOW: Looking at Advertised Services**

1. Let's take a closer look at a node with Advertised Services. Back on Step 3, you saw what neighbors you have and the services they offer. Here is how the services were set up on the **kn6pe-100** Mesh Node.

The screenshot shows the 'kn6pe-100 setup' web interface in Internet Explorer. The browser address bar shows 'http://kn6pe-100:8080/cgi-bin/ports'. The page has a navigation menu with 'Node Status', 'Basic Setup', 'Port Forwarding, DHCP, and Services' (highlighted), and 'Administration'. Below the menu are buttons for 'Help', 'Save Changes', 'Reset Values', and 'Refresh'. The main content area is divided into three sections:

- DHCP Address Reservations:** A table with columns 'Hostname', 'IP Address', and 'MAC Address'. One entry is 'sccserver' with IP '10.29.34.5' and MAC '00:24:e8:b3:42:6e'. There is a 'Del' button and an 'Add' button.
- Current DHCP Leases:** A table with columns 'Hostname', 'IP Address', and 'MAC Address'. Two entries are shown: 'sccserver' with IP '10.29.34.5' and MAC '00:24:e8:b3:42:6e', and '\*' with IP '10.29.34.4' and MAC '00:01:e1:09:de:71'. Each has an 'Add' button.
- Advertised Services:** A table with columns 'Name', 'Link', and 'URL'. Two entries are shown: 'SIP' with a checked 'Link' box and URL 'sip://sccserver:5060/' and 'HTTP' with a checked 'Link' box and URL 'http://sccserver:80/'. Each has a 'Del' button. There is also an 'Add' button at the bottom.

At the bottom, there is a 'Port Forwarding' section with a table:

Interface	Type	Outside Port	LAN IP	LAN Port
WAN	TCP		- IP Address -	

An 'Add' button is next to the table.

2. **Current DHCP Leases.** There are 2 devices connected to this mesh node:
  - a. sccserver IP=10.29.34.5. This is a HTTP and SIP server.
  - b. \* IP=10.29.34.4. This is a Zulus ZIP2 VoIP Phone (no name)
3. **DHCP Address Reservations.** There is one device connected to this mesh node that is guaranteed a specific IP Address:
  - a. sccserver IP=10.29.34.5. This is a Linux server.
4. **Advertised Services.** There are 2 services set up that reside on the **sccserver**:
  - a. SIP: Tells other mesh node users that they can find the PBX VoIP phone server here.
  - b. HTTP: Tells other mesh node users that they can find the website on this server. Note the  Link is checked indicating that this entry can be clicked on from this node's Mesh Status page.



## 1. HANDS ON! Exercise #4: VoIP Phone configuration

This exercise walks you through the setup of your VoIP phone.

---

### Step 1 Getting started

**NOTE:** These instructions assume a Zultys ZIP2 VoIP phone. If you have some version of the ZIP phone brand (such as ZIP2+ or ZIP2x2), or some other vendor all together, the forms and screens will look different.

**NOTE:** the phone must be set for DHCP before starting this installation.

1. Before plugging in the phone, turn it over and record the MAC Address. It will be a mix of HEX characters, 12 digits long.

MAC Address : \_\_\_\_\_

---

### Step 2 Reset to Factory Defaults

This step should be done whenever you are connecting your phone to a new network for the first time or if you are unsure of the phone settings last made. Check with the MESH network administrator for assistance.

1. Perform a **Reset to Factory Defaults** for your Zultys ZIP2 phone:
  - a. Remove power (if applied) from your ZIP2 phone (unplug the power adapter).
  - b. Pick up the handset.
  - c. While pressing the '1' button, connect power to the phone. Do not release the '1' button until both the red and yellow LEDs stop flashing; this usually takes about 10 seconds.
  - d. Disconnect power from the ZIP2 by removing the power adapter.

---

### Step 3 Normal Phone Power up procedure

1. If a phone has been configured into the network, the following is the normal Phone power up procedure.
  - a. Connect the Phone to the Mesh router using an Ethernet cable.
  - b. Connect power to the ZIP2.
  - c. The phone quickly flashes the red LED above the keypad and the yellow LED below the keypad two times. Both LEDs turn off a few seconds after the power stabilizes.
2. Within a minute, check for a dial tone. If you hear one, this means:
  - a. the phone has power, and
  - b. the phone has been assigned an IP address by the Router.
3. If you did not hear a dial-tone,
  - a. check the network cable between the phone and the router and power cycle the phone again.
  - b. Perform a **Reset to Factory Defaults** to ensure the phone is configured for DHCP.

**NOTE:** If you do not have a Dial Tone at this point, do not proceed!

---

**Step 4 Determine the Phone's IP Address**

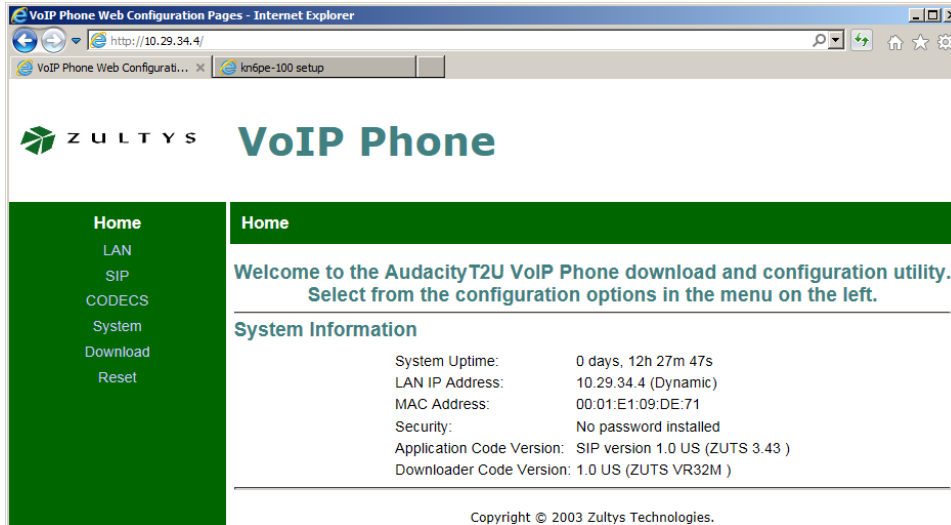
1. Before we can configure it, we need to find its IP Address. Open your browser and connect to your router <http://localnode:8080>
  - b. Select the **Setup** link. Enter the router's logon and password.
  - c. Select the **Port Forwarding, DHCP, and Services** link.
  - d. Look under the **Current DHCP Leases** section.
  - e. Find the entry that matches the phones' MAC address that you identified from Step 1 above. Zulty's phones have an asterisk "\*" in the first **Current DHCP Leases** column. Record the corresponding IP Address below.
2. Write down the IP Address for this phone:

\_\_\_\_\_

---

## Step 5 Accessing the Phone's Interface

1. There are typically 2 ways to configure this phone:
  - a. Download a configuration file from a central server
  - b. Manually enter the configuration from the phone's web interface.
2. We will be using the **manual method** since this is more likely to be the method used in the field.
3. Open your browser and enter the phone's IP address in the URL address line. You are presented with the following form.



4. From the left menu, select **LAN**. Note the various network settings that the phone discovered. Note that "Dynamic IP Assignment" (DHCP) is set to YES.



## Step 6

### Get your unique configuration

**STOP!** Go to the Mesh network administrator and request the following:

Server Address: \_\_\_\_\_  
Port Number: \_\_\_\_\_  
Domain Name: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
User Name: \_\_\_\_\_  
Password: \_\_\_\_\_

## Step 7

### Configuring the Phone

**Definition: VoIP**, Voice Over Internet Protocol, a technology that delivers voice communication and multimedia sessions (such as video) over Internet Protocol (IP) networks.

**Definition: SIP**, Session Initiation Protocol, internet standard for real time voice and video communication. Asterisk is the application we use for all phone management.

**Definition: PBX**, Private Branch Exchange, a telephone system within an enterprise that switches calls between enterprise users on local lines while allowing all users to share a certain number of external phone lines. Most of the phone's general settings can be defaulted. However, we do need to ensure this phone is unique to the SIP (PBX) server.

1. From the left menu, select **SIP**.

The screenshot shows the Zultys VoIP Phone web configuration interface. The browser title is "VoIP Phone Web Configuration Pages - Internet Explorer" and the address bar shows "http://10.29.34.4/". The page has a green header with the Zultys logo and "VoIP Phone". A left sidebar contains a menu with options: Home, LAN, SIP, CODECS, System, Download, and Reset. The main content area is titled "SIP Configuration" and includes the following sections:

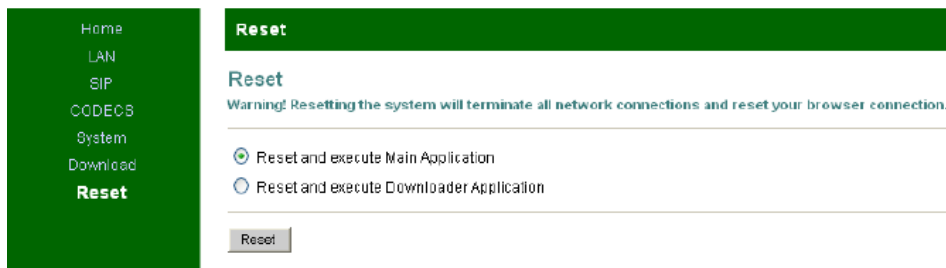
- SIP Server Settings** (Current Server: sccserver : 5060 ; Domain: sccserver)
  - \* Server Address:  (IP or FQDN)
  - \* Port:
  - \* Domain Name:
  - Send Registration Request
  - Backup Server Address:  (IP or FQDN)
  - Backup Server Port:
  - Send Registration to Backup Server
- Gateway Settings**
  - Dial Plan:
  - Transport:
- Line Settings Table**

	Phone Number	CallerID Name	Port	AEC On	User Name	Password
Line1:	<input type="text" value="7001"/>	<input type="text" value="7001"/>	<input type="text" value="5060"/>	<input type="text" value="ON"/>	<input type="text" value="7001"/>	<input type="text" value="*****"/>

\* Leaving a setting blank will force the unit to use the information obtained via DHCP and/or DNS

2. The following needs to be confirmed or entered for the phone to work.
  - a. **SIP Server Settings:** This section identifies the location of the SIP server that manages all telephone call processing. The 3 three fields that **MUST** be filled in are:
    - i. Server Address: \_\_\_\_\_ (from **Step 6**)
    - ii. Port Number: 5060\_\_\_\_\_ (from **Step 6**)
    - iii. Domain Name: \_\_\_\_\_ (from **Step 6**)
  - b. **Gateway Settings.** This section uniquely identifies the phone to the SIP Server. On boot up, the phone connects to the SIP Server (above) and registers using the phone’s user name and password that you will enter here. Once registered, you can then make and receive phone calls. The fields are:
    - i. Phone Number: \_\_\_\_\_ (OK to leave blank)
    - ii. Caller ID Name: \_\_\_\_\_ (OK to leave blank)
    - iii. Port: 5060\_\_\_\_\_ (from **Step 6**)
    - iv. AEC ON: **[ON]**\_\_\_\_\_ (must be **ON**)
    - v. User Name: \_\_\_\_\_ (from **Step 6**)
    - vi. Password: \_\_\_\_\_ (from **Step 6**)
  - c. Press **Save SIP Settings**.
3. **Reset the phone.** All changed settings made to the phone do not take effect until you power cycle or reset the phone. Do either one of the following:
  - a. To power cycle the phone, remove power from the phone for a few seconds and then reapply power.
  - b. To reset the phone,
    - i. select **Reset** from the Left menu
    - ii. select the  “Reset and execute Main Application” option, and then
    - iii. press the **Reset** button at the bottom of the phone.

 **VoIP Phone**



4. The phone will restart as described in Step 3 of this exercise.

---

## Step 8 Test your telephone setup

1. Along with having several user phone numbers configured, this SIP server has a few additional numbers set up for testing your phone's configuration.
  - a. Dial "100" This is a very basic phone-to-SIP Server test.
  - b. Dial "200" play backs your extension number.
  - c. Dial "5000" This is an echo test. Listen to the description and follow the prompts.
2. If you hear the messages, your setup is correct!

**NOTE:** While the ZOLTYs ZIP2 phone has a *Speaker* button, it does have an external microphone. In short, this phone **IS NOT** a true speaker phone.

### It works 😊... Now what?

3. Set up your phone number with the on-line Telephone Directory.
  - a. From your Browser, go to <http://sccserver>
  - b. On the web page, select the **User Sign In** menu option on the left:
    - i. If you already have an account, then sign in.
    - ii. If you do not have an account, then click the **Sign Up** link (you will be prompted for your call sign and a password).
  - c. Once signed in, select the **My Account** menu option on the left.
  - d. Under the Account Settings, find the Phone Book entry, and click on **Add**.
  - e. Enter the following:
    - i. your phone number as assigned: \_\_\_\_\_
    - ii. Other Notes (*optional*; could be your ICS Position, Location, or "cell phone"): \_\_\_\_\_
  - f. Press **Add to Phone Book** when done. Verify your phone number was correctly added to the phonebook.
4. If there is more than one user associated with this phone number, that user should also log in as well and set up the same number.
5. Once all users are entered in the phone book, make your first phone call. Call Extension 7020, and report the following:
  - a. Your first name, Call sign
  - b. Names and Call signs of people at this extension
  - c. Assigned Phone Number

---

## It doesn't work ☹... Now what?

6. If you hear a rapid busy signal, your phone did not register with the SIP Server. Try the following:
    - a. Check for a Dial Tone
    - b. Check the LAN connection between the Phone and Mesh Router
    - c. Check the power connection
    - d. Check your settings: confirm ...
      - i. Server Name
      - ii. Port Number
      - iii. User Name
      - iv. Password
    - e. Power cycle or reset the phone
    - f. Go back to Step 7.1 above and try again
-

## 2. HANDS ON! Exercise #5: iPhone, Android and media5-fone (OPTIONAL)

Yes, it is possible to connect a smartphone to the Mesh Network and make phone calls within the mesh network, PROVIDED

- i. there is a Wireless Access Point (WAP) available (and, for this exercise, there is one), and
- ii. there is a VoIP app running on your smartphone.

### Using the Media5-fone app

**Media5-fone** is a SIP Client that lets users to make and receive VoIP calls over Wi-Fi, 3G, 4G, and LTE networks. It is interoperable with most IP-PBX systems and transforms your smartphone into IP-PBX phone extension. Do an internet search for “media5-fone”

And, it works with our Mesh Network.

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### Step 1 Load your smartphone app

1. Before beginning, go you your smartphone’s app store, find, and download the free version of media5-fone.
  - a. The paid version enables a few features that we won’t need for this exercise, but you may want to spend the a few bucks for this later on.

---

### Step 2 Get your unique configuration

**STOP!** Go to the **MESH network administrator** and request the following:

Server Address: \_\_\_\_\_  
Port Number: \_\_\_\_\_  
Domain Name: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
User Name: \_\_\_\_\_  
Password: \_\_\_\_\_

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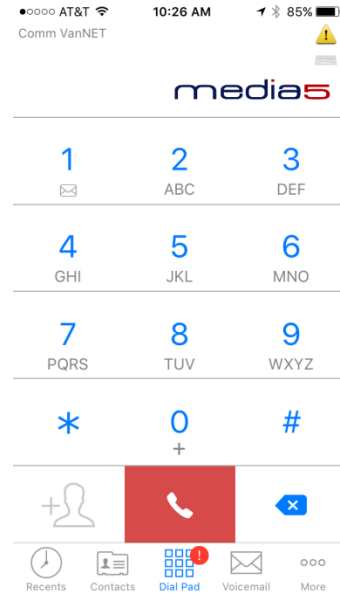
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**Step 2****Configuring media5-fone**

1. From your smartphone's Wi-Fi selection, find and connect to the Wi-Fi hot spot named **SCCMeshNode**.

**Note:** these instructions are specific for the iPhone. The Android app should be similar.

2. Run the program. Find the media5-fone icon on your smartphone and double-click on it. It will look something like the picture on the right.
3. On menu bar, click on the **More** button to open the **More** menu.
4. On the **More** menu, click on **Settings**.
5. On the **Settings** menu, click on **Configure SIP Accounts**.
6. On the **Accounts** menu, add a new account by clicking the **+** on the page.
7. On the **New Sip Accounts** menu, click on **Define Manually**.
8. On the **New Accounts** menu, Enter the following:
  - a. Title: <Give it some name>
  - b. Username: \_\_\_\_\_ (from **Step 2**)
  - c. Password: \_\_\_\_\_ (from **Step 2**)
9. Press the **Servers** button. On the Servers page, enter the following:
  - d. Address: \_\_\_\_\_ (from **Step 2**)
  - e. Port: \_\_\_\_\_ (from **Step 2**)
10. When done, press **Done**, and then press the **Dial Pad** button on the menu bar.



---

**Step 8****Test your telephone setup**

1. Along with having several user phone numbers configured, this SIP server has a few additional numbers set up for testing your phone's configuration.
  - a. Dial "100" This is a very basic phone-to-SIP Server test.
  - b. Dial "200" play backs your extension number.
  - c. Dial "5000" This is an echo test. Listen to the description and follow the prompts.
2. If you hear the messages, your setup is correct!

---

## It works 😊... Now what?

3. Register your phone number with the on-line Telephone Directory.
  - a. From your Browser, go to <http://sccserver>
  - b. Select the **User Sign In** menu option on the left:  
**NOTE:** FIRST TIME USERS OF THIS SITE WILL HAVE TO CREATE AN ACCOUNT.
    - i. If you already have an account, then sign in.
    - ii. If you forgot your password, call **Mesh Net Support** for a password reset (see the phone book for the extension).
  - c. Once signed in, select the **My Account** menu option on the left.
  - d. Under the Account Settings, find the Phone Book entry, and click on **Add**.
  - e. Enter the following:
    - i. your phone number as assigned: \_\_\_\_\_
    - ii. Other Notes: iPhone
  - f. Press **Add to Phone Book** when done. Verify your phone number was correctly entered in the phonebook.
4. Make your first phone call. Call Extension 7020, and report the following:
  - a. Your first name, Call sign
  - b. Identify this as a smartphone call
  - c. Assigned Phone Number

## It doesn't work ☹... Now what?

5. If you hear a rapid busy signal, your phone did not register with the SIP Server. Try the following:
    - a. Check that your smartphone is connected to the Wi-Fi hot spot named **SCCMeshNode**.
    - b. Check that your smartphone is registered with the server.
    - c. Check your settings: confirm ...
      - i. Server Name
      - ii. Port Number
      - iii. User Name
      - iv. Password
-