HomeGrid Forum G.hn Testing Procedure for Powerline

Achieving meaningful test results in real world, real home environments

As more and more G.hn devices appear on the market, there are also many people who are keen to test how good they are and how they compare to other technologies. HomeGrid Forum is building a robust testing program within its Compliance & Interoperability Work Group and we work closely with our Accredited Test Houses to test under a range of conditions. However, for those organizations, publications and individuals who wish to test G.hn products independently, we have developed guidelines and test plans that can be conducted in the home under true home environment conditions to give effective and meaningful test results.

This document is designed to help anyone wishing to test G.hn products in the field while avoiding pitfalls in choosing the best environment to simulate real world applications that show what can be handled in the home network on a budget that won't require a full test lab.

1 Introduction

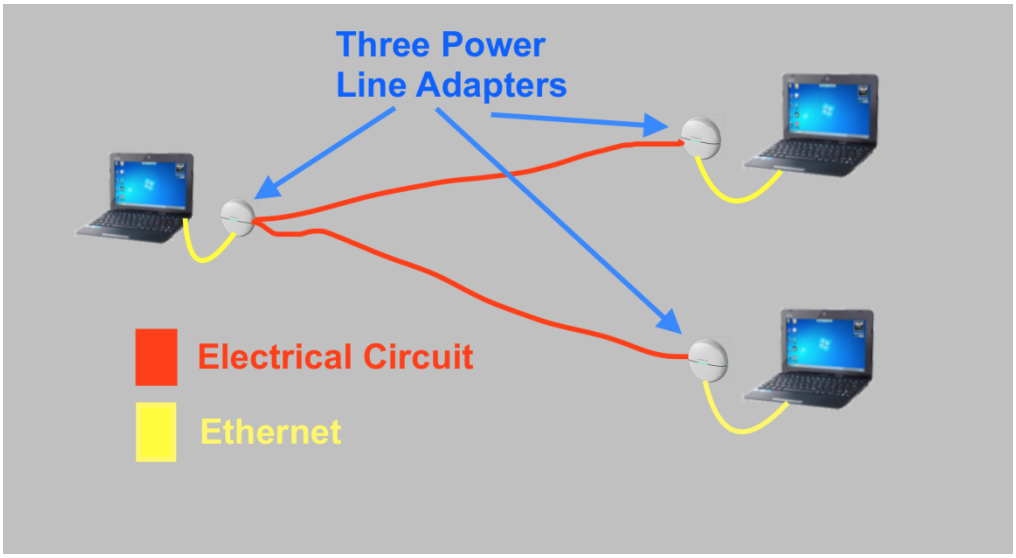
This document describes tests procedures that can be conducted in a typical home environment in order to assess Powerline Home Networking technologies stability & robustness in multi-node use cases. i.e. where more than one connection is being used simultaneously for different data sessions (like watching two different video streams at once).
There are two types of test:

- Test 1 - TCP Rate of Three Devices (One Transmitter, Two Receivers)
- Test 2 - TCP Rate of Three Devices (Two simultaneous Transmitters e.g. Gateway and DVR)

It is important to test more than one link to simulate an actual network where several devices might be competing for bandwidth in order to determine the best solution.

2 Test Equipment

- Laptops will serve as traffic generators for these tests. The number of laptops/PCs should be equal to number of devices tested (one laptop per device). i.e. To run three end-nodes, three adapters and PCs are required.



- The following application is recommended for installation on each laptop:

  iPERF tool (https://iperf.fr/) – command line application that allows running both TCP and UDP traffic. NOTE: Different versions of the tool may provide different behavior. It is thus important to use the same version for comparison tests and HGF recommends using version 2.0.5 for best compatibility with Mac and Linux platforms. NOTE: Scroll down on the iperf web page to find different versions for the different platforms (Mac vs. PC, etc.)

3 General Guidelines

- Plug the devices in at the primary locations where typical services are used, i.e. next to the router, next to the primary TV or the desktop PC.
- It is recommended to connect devices directly to the socket, not to a power strip; but if a power strip is to be used, then assure it is used exactly the same for any adapter tested. Do not test with two adapters in the same power strip as this configuration will never be seen in real-world use cases.
- **DO NOT** disconnect any electrical devices that are currently connected. It is essential that the testing is done in a 'live' environment, for best accuracy of real life results.
- It is STRONGLY recommended that other common electrical appliances in the home should be turned on in order to test performance in the presence of 'noise' loading.
- It is STRONGLY recommended that comparison testing of different products be conducted on the same day for fair comparison since the electrical environment is dynamic.
- It is **crucial** to use same the laptops at the same locations when comparing different products in order to eliminate the impact of the laptop on the results obtained.
- It is also crucial to use the same iperf version for comparison tests and to use the same configuration for each outlet and adapter tested (same cables and positions in the outlets, etc..).
- It is recommended that noise sources should be added in proximity to the devices acting as main receivers, such as set top boxes, desktop PCs, mobile chargers, etc.). Noise sources that can be used are:
  - Fluorescent lamp (PL lamp),
  - USB charger – a Smartphone charger can be used (both iOS or Android) or any other USB charger
  - Laptop power supply – note that it MUST be connected to a laptop and charging the laptop.

4 Setting Laptops/PCs

- To install the iPERF tool located at (https://iperf.fr/) on each test laptop, follow these instructions. Although iPERF can be located anywhere on the computer, C:\iperf\ will be the most convenient folder for a Windows PC, and the "Downloads" folder will be most convenient for a Mac.
- Disable all firewalls on the laptops – in Windows, go to **Control Panel > System and Security > Windows Firewall** and select 'Turn Windows Firewall on or off' to completely disable the firewall. On a MacBook, go to system preferences (click the apple icon in the upper left corner) and then click on the "security and privacy" icon in the upper row and highlight the Firewall tab to disable the firewall.
- Set the static IPs per each laptop:
    - Laptop A: 10.10.10.10,
    - Laptop B: 10.10.10.20,
    - Laptop C: 10.10.10.30.
    - *NOTE: See Appendix Afor instructions on setting static IP addresses on MAC or Windows PC.*

- Verify connectivity between all laptops (A->B, B->A, B->C, C->B, etc.) using PING. *See Appendix Bfor instructions on running ping on Mac or Windows.*

5 Testing the power line adapters

5.1 Test 1 - TCP Rate of Three Devices (One Transmitter, Two Receivers)

A. Test purpose

Run the TCP traffic with a window size of 64KBytes from Device A to Device B and to Device C for 40 sec.
IP of device A is **10.10.10.10**
IP of device B is **10.10.10.20**
IP of device C is **10.10.10.30**

B. Test procedure

Type the following command lines on the laptops accordingly:

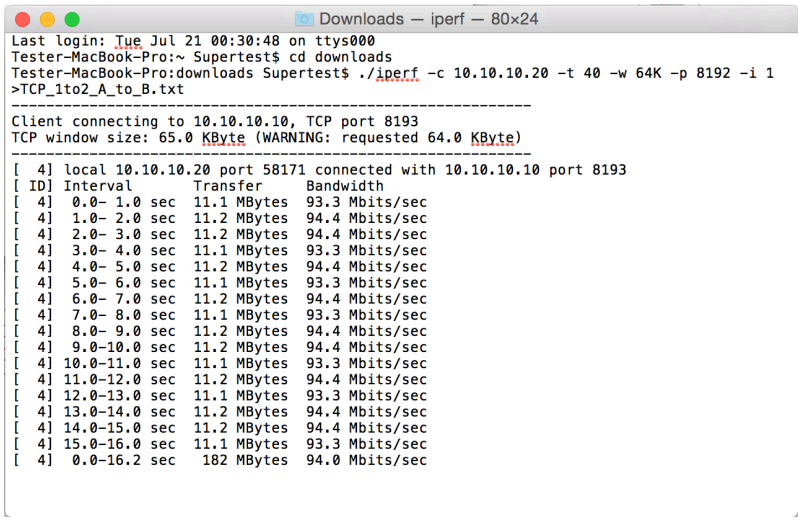
On Laptop A (Client):

Open two command windows <only for a windows PC> and write the following commands (in parallel):

iperf.exe -c 10.10.10.20 -t 40 -w 64K -p 8192 -i 1 > TCP_1to2_A_to_B.txt
iperf.exe -c 10.10.10.30 -t 40 -w 64K -p 8193 -i 1 > TCP_1to2_A_to_C.txt

Open two terminal windows <only for a MacBook laptop> and write the following commands

./downloads/iperf –c 10.10.10.20 –t 40 –w 64K –p 8192 –I 1 > TCP_1to2_A_to_B.txt
./downloads/iperf –c 10.10.10.30 –t 40 –w 64K –p 8193 –I 1 > TCP_1to2_A_to_C.txt



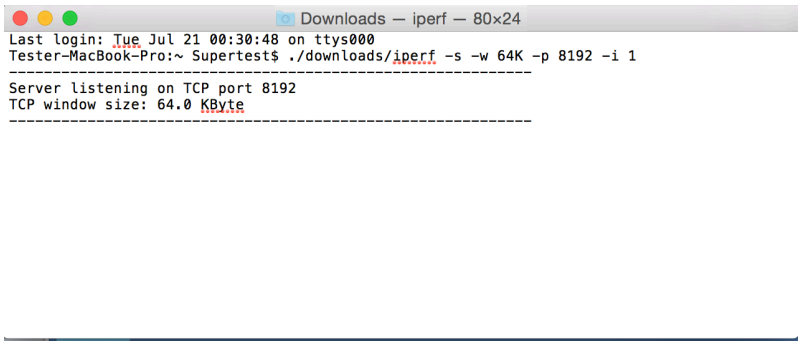
NOTE: This will not actually start to test until the server is also activated as in the following two steps.

On Laptop B (Server):

iperf.exe -s -w 64K -p 8192 -i 1

Or for a MacBook – type:

./downloads/iperf –s –w 64K –p 8192 –I 1



On Laptop C (Server):

iperf.exe -s -w 64K -p 8193 -i 1

Notes:

- During the test, one can review the deviation in rates (if any) on laptop A.
- The average rate obtained can be seen at the end of the test on the command window of laptop A.
- The results will be saved into files "**TCP_1to2_A_to_B.txt"** and **" TCP_1to2_A_to_C.txt"**

5.2 Test 2 - TCP Rate of Three Devices (Two simultaneous Transmitters e.g. Gateway and DVR)

A. Test purpose

Run the TCP traffic with a window size of 64Kbytes for 40sec from Device A to Device B and from Device B to C.
IP of device A is **10.10.10.10**
IP of device B is **10.10.10.20**
IP of device C is **10.10.10.30**

B. Test procedure

Type the following command lines on the laptops accordingly:

On Laptop A (Client):

Open a command window and write the following command:

iperf.exe -c 10.10.10.20 -t 40 -w 64K -p 8192 -i 1 > TCP_multiple_transmitters_A_to_B.txt

On Laptop B (Server):

Open a command window and write the following command:

iperf.exe -s -w 64K -p 8192 -i 1

Open another command window on Laptop B (Client) and write the following command:

iperf.exe -c 10.10.10.30 -t 40 -w 64K -p 8193 -i 1 > TCP_multiple_transmitters_B_to_C.txt

On Laptop C (Server):

iperf.exe -s -w 64K -p 8193 -i 1

Notes:

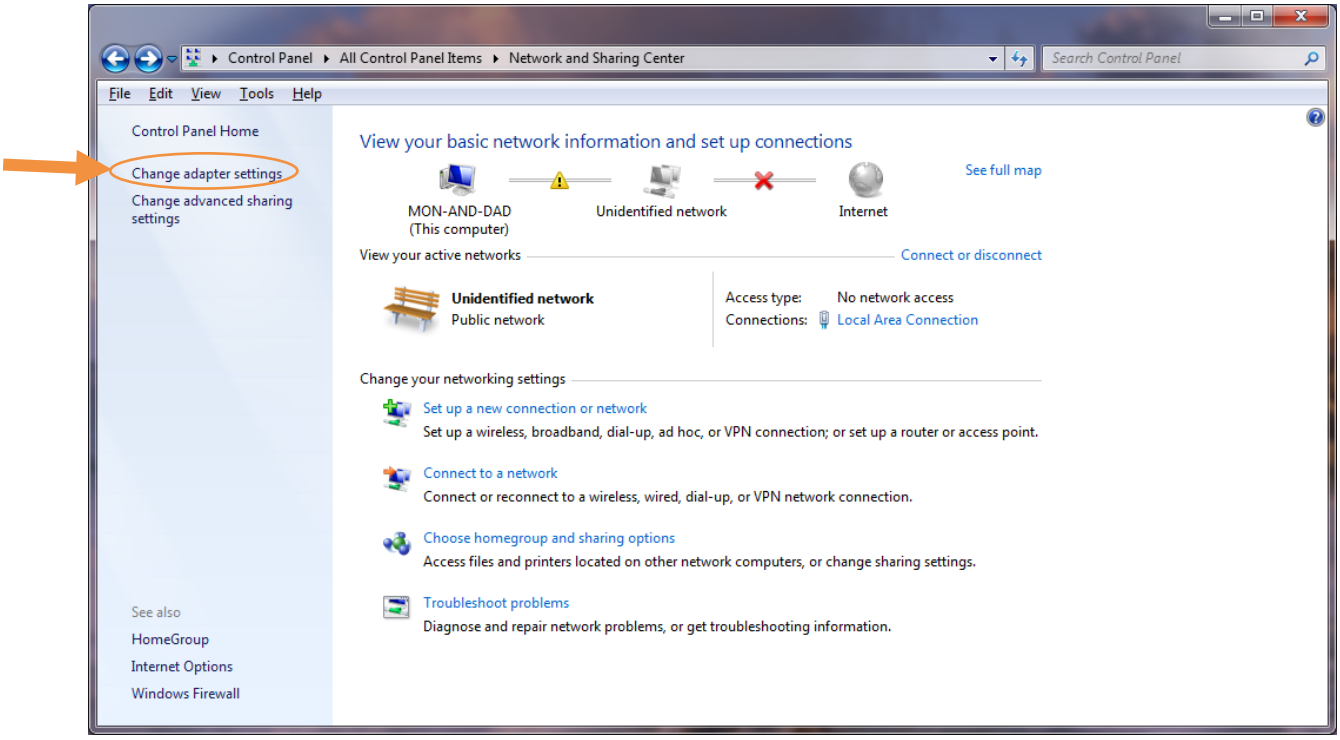
- During the test, one can review the deviation in rates (if any) on laptops A and B.
- The average rate obtained can be seen at the end of the test on the command windows of laptops A and B.
- The results will be saved into files "**TCP_multiple_transmitters_A_to_B.txt"** and **"TCP_multiple_transmitters_B_to_C.txt"**

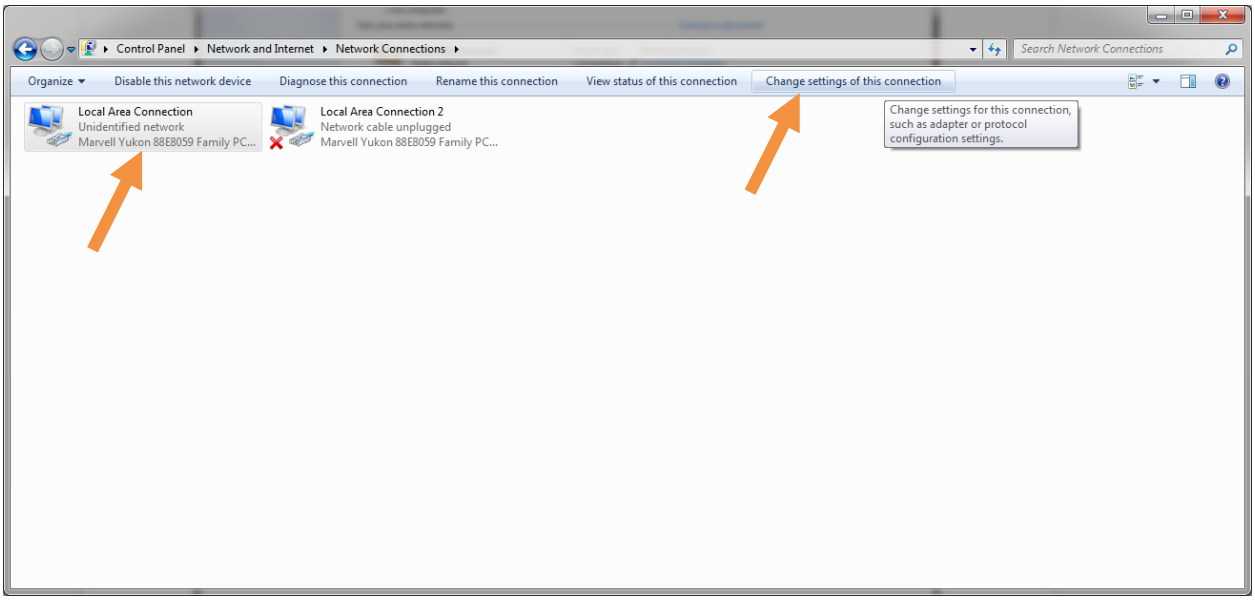
Conclusion

We believe that G.hn products deliver the reliability, ease of use and quality of service that is a necessity in today's home network and that the test conditions we have set out are designed to show the technology in imperfect conditions. We believe that any powerline testing should always take the real world, true home networking environment and real usage into consideration to achieve meaningful results.

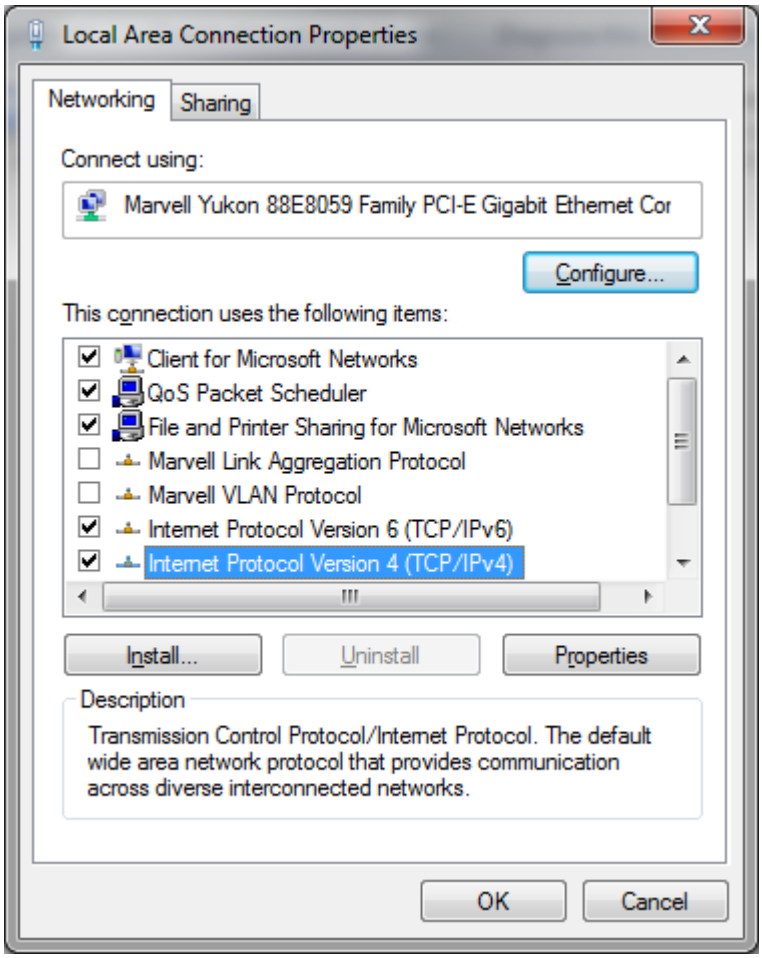
Setting up static IP addresses (APPENDIX A)

A.1 Set static IP addresses for a Windows PC

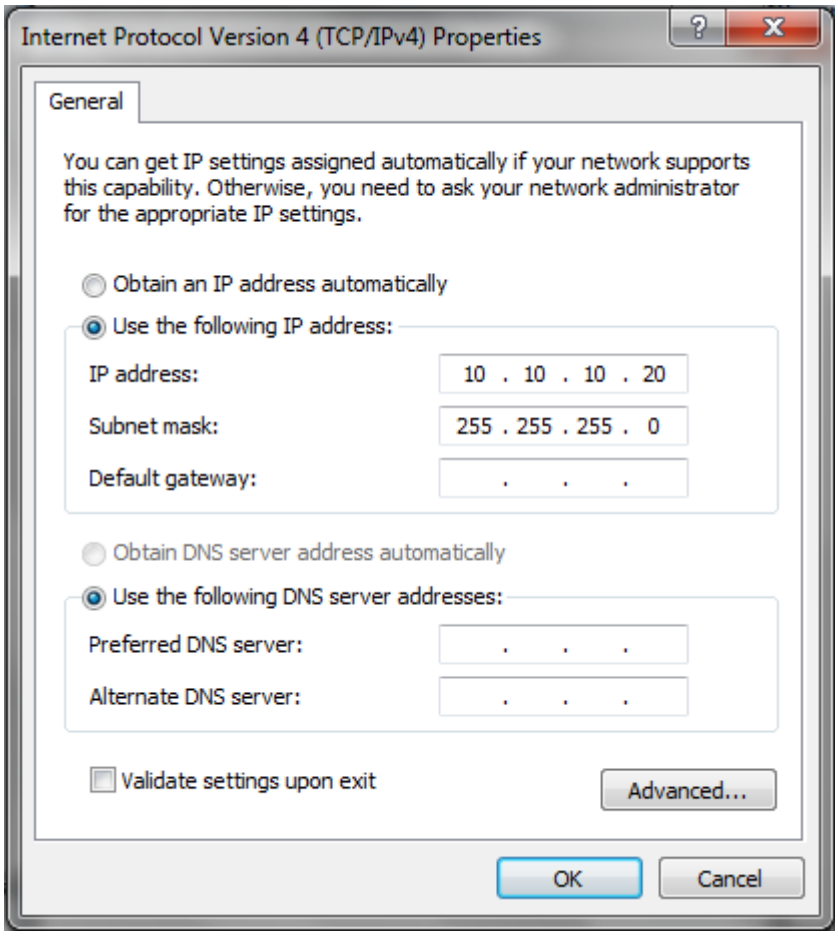




Select the Local Area Connection attached to the Unidentified Network and select Change settings of the connection" (or right click and select "Properties").



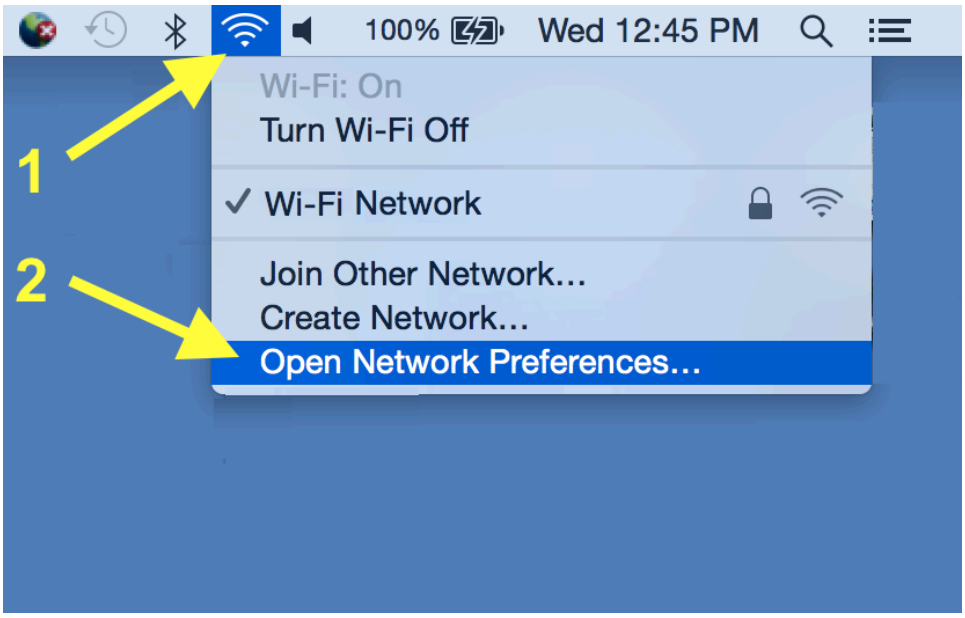
Select Properties of Internet Protocol Version 4



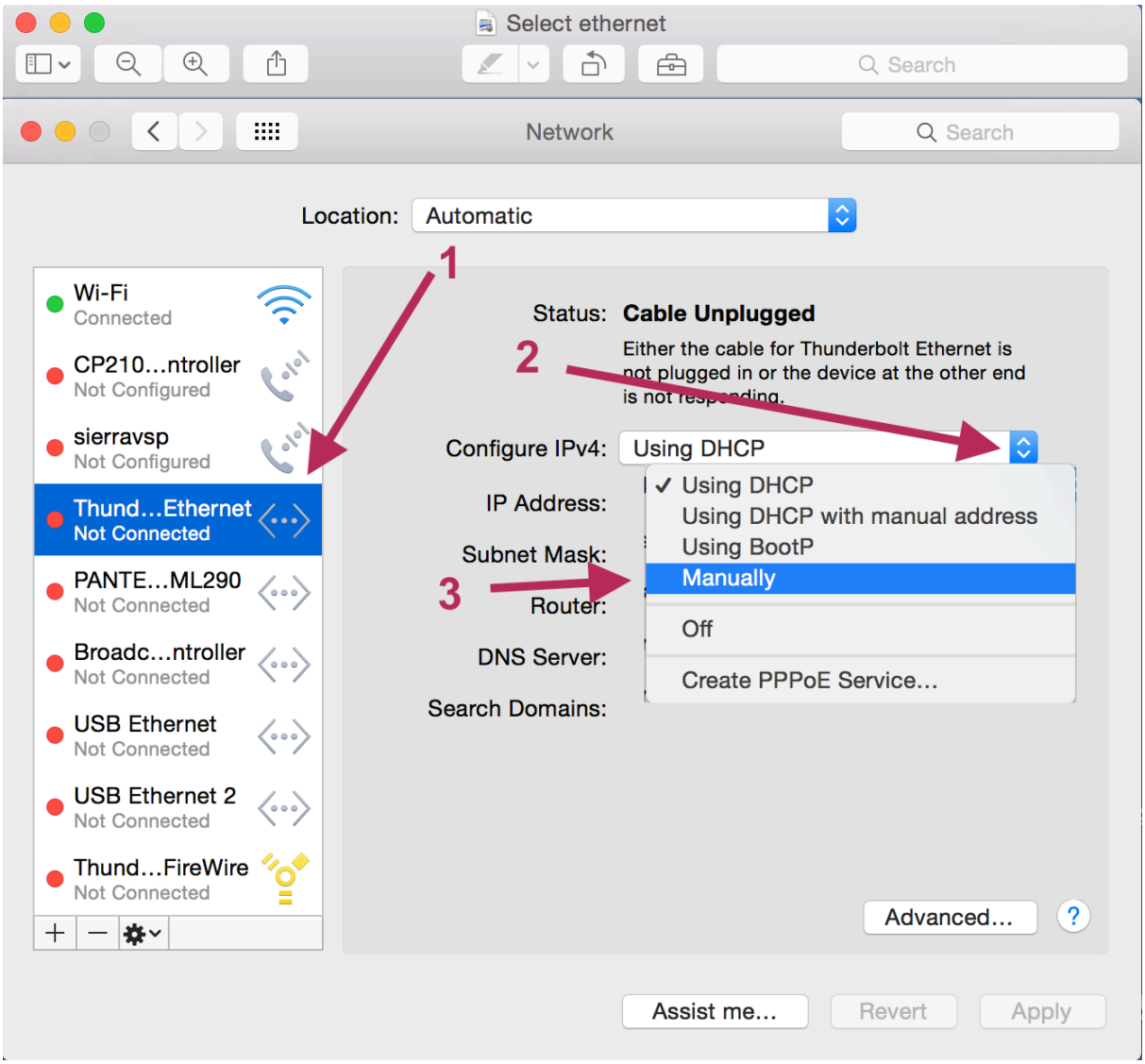
Enter the IP address for this PC/laptop.

A.2 Set static IP addresses for a Mac computer

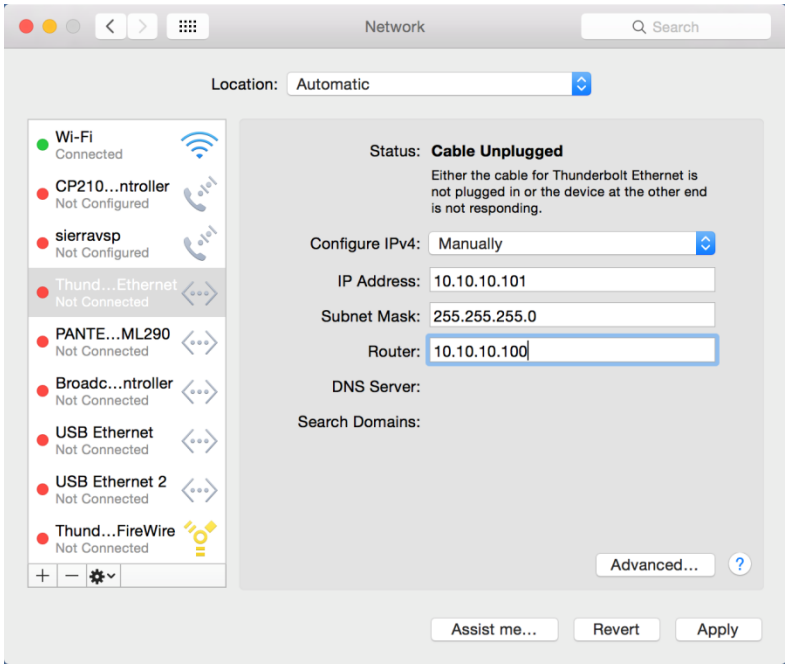
In the upper right hand corner of your desktop; click on the network icon (1 in yellow) and then click on the “Open Network Preferences” (2 in yellow) and the networking window will appear.



When the networking window opens as shown below; highlight the “Ethernet” device (1 in red) and then click the options arrows (2 in red) to open the drop down and select “manually” (3 in red) to allow setting the IP address you prefer.


Select ethernet
Search
Network
Search
Location: Automatic
Wi-Fi
Connected
CP210...ntroller
Not Configured
sierravsp
Not Configured
Thund...Ethernet
Not Connected
PANTE...ML290
Not Connected
Broadc...ntroller
Not Connected
USB Ethernet
Not Connected
USB Ethernet 2
Not Connected
Thund...FireWire
Not Connected
1
2
3
Status: Cable Unplugged
Either the cable for Thunderbolt Ethernet is not plugged in or the device at the other end is not responding.
Configure IPv4: Using DHCP
IP Address:
Subnet Mask:
Router:
DNS Server:
Search Domains:
Using DHCP
Using DHCP with manual address
Using BootP
Manually
Off
Create PPPoE Service...
Advanced...
Assist me...
Revert
Apply

Within the manual entry box, enter the IP address and subnet followed by clicking “apply”.

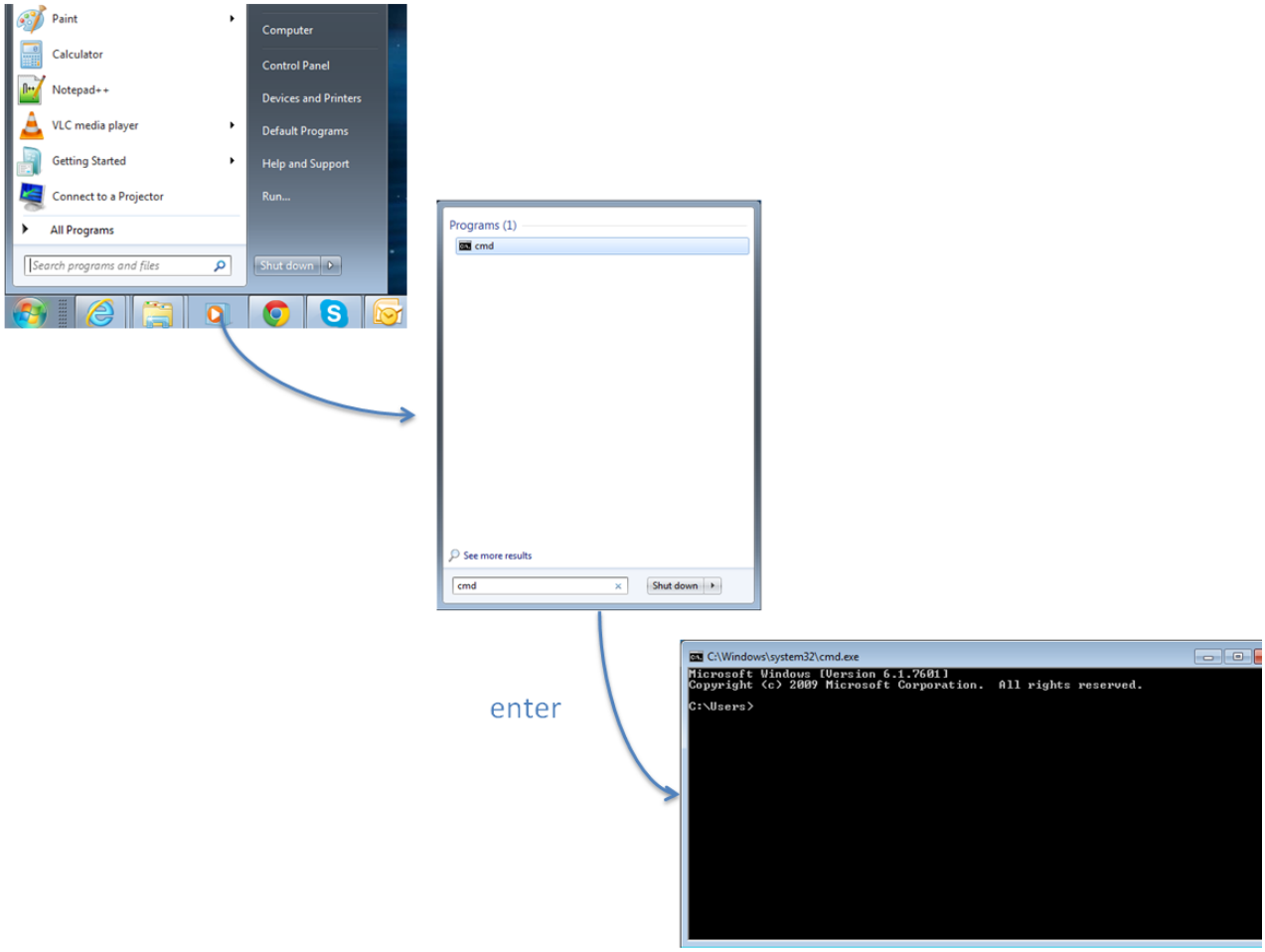


After the other test laptops are configured in the same subnet (10.10.10.x) and the power line adapters are installed and connected with Ethernet cables, a ping test can be run to assure connection.

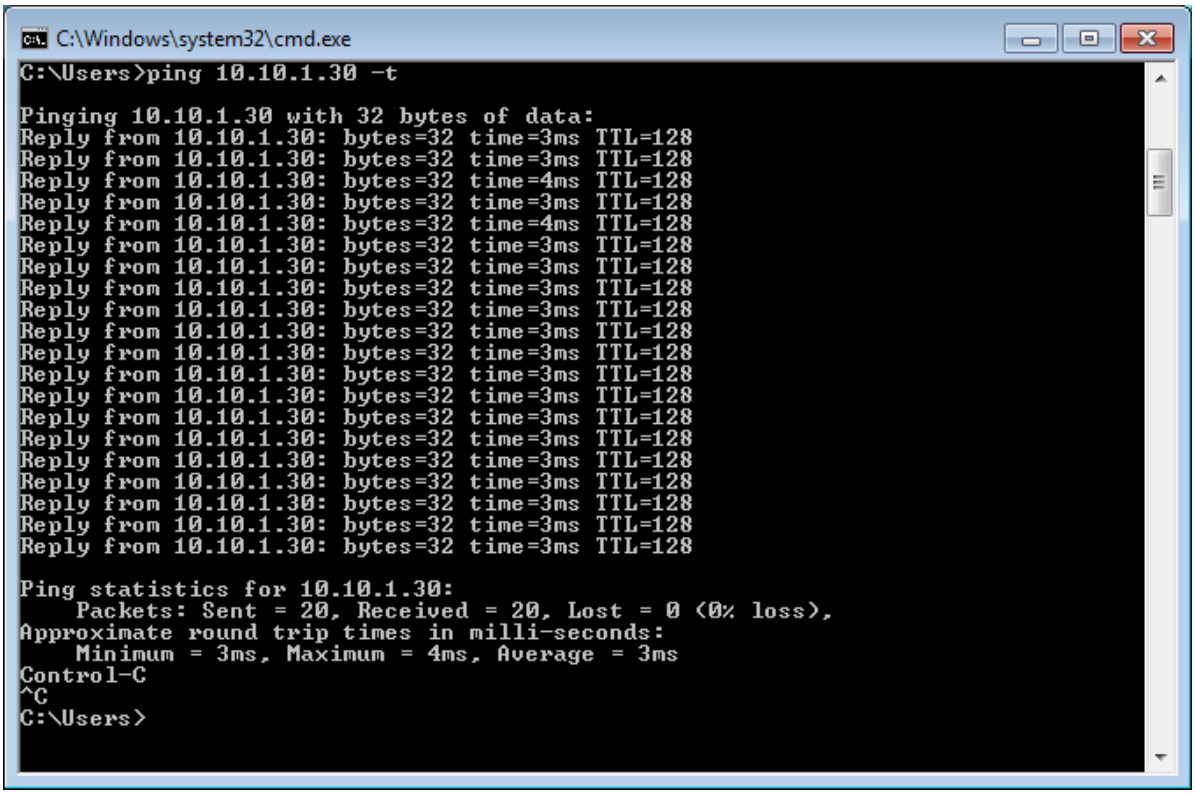
Note: If your Mac does not have an Ethernet port (after 2012) you can connect using your thunderbolt port with an Ethernet adapter from your nearby Apple store or other retailer.

Running Ping tests (APPENDIX B)

B.1 Running Ping tests on a Windows PC



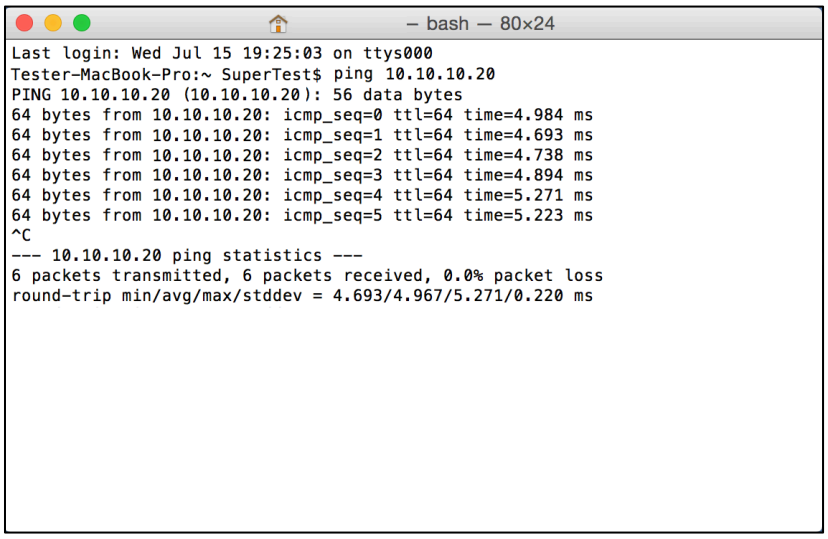
When command line is activated, enter ping “10.10.1.X” corresponding to the address of the other PC. When you wish to stop the ping test, you enter “Control C”.



B.2 Running Ping tests on a Mac PC

Find the Launchpad (usually at the bottom of your screen) and open your applications. In Applications, click the group called “other” and then click to open the terminal (some call this the command line interface).

When activated, the terminal will open a command line window like the one below. From the command line, enter “ping 10.10.10.x” for the address of the other machine you’d like to verify communications. Enter “control C” to stop the ping test.



Once communications are verified, testing of the adapters can proceed using iperf from the same command line.