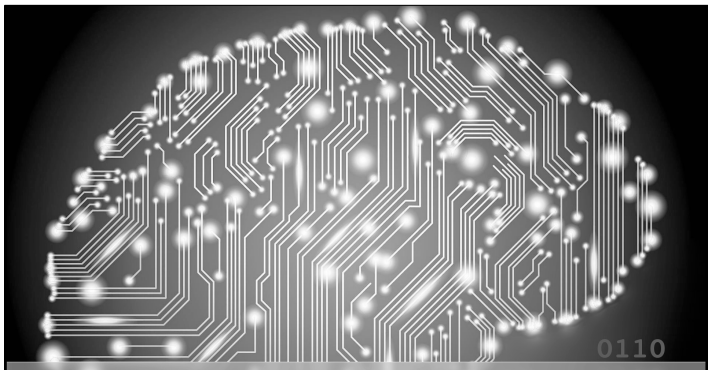

FrugalPi: WLAN Performance Tool

Kevin Capwell – META
Pat Zielke – Viroqua

FrugalPi Monitoring

Disclaimer

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Furthermore, this presentation contains materials that can be potentially damaging or dangerous. If you do not fully understand something in this presentation, then do not attempt to use them! These materials are for educational and research purposes only. The following presentation and its content should not be viewed – by anyone...

FrugalPi Monitoring

School District of Onalaska

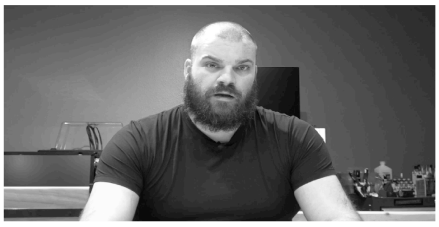
- Kevin Capwell
  fmr → Data Systems Director (24 years)
- Enrollment: 3,166
- Total Staff: 415
- Buildings:
  High School, Middle School, three Elementary Schools, District Office, Pupil Service and School Nutrition (~12 sq. mi.)
- Computers: Desktop 1400, Chrome-books 1400, Other mobile 200.

FrugalPi Monitoring

Viroqua Area Schools

- Pat Zielke
  Technology Coordinator – 19 years
- Enrollment: 1,191
- Total Staff: 184
- Buildings:
  Shared High School/Middle School a separate Elementary all on the same campus.
- Computers: Desktop 400, Chrome-books 200, Other mobile 90.

FrugalPi Monitoring



Pat Zielke

Technology Coordinator Viroqua.

FrugalPi Monitoring

Time to give credit…

Real World Mobile LAN Testing Deep Dive taught by Jerry Olla and Scott McDermott in 2018. The idea for this tool came when Jerry was deploying VoIP over Wi-Fi. He wanted to test the networks to ensure everything was running smoothly.

"I needed to be able to go to different sites and quickly test the throughput as well as the consistency of the network. Measuring things, particularly like jitter, on the network to see if the networking was fluctuating. I needed to not only test the Wi-Fi, but also the the wired network as well."

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What problem are we solving?

I wanted to be as informed as possible about the condition of my network. I insisted on the "hands on" approach wherever possible. I upgraded firmware, installed switches, mounted access points and programed routing tables.

My center of attention shifted to management and troubleshooting. Cacti and SNMP helped me observe my network's throughput. I used Netsight and OneView for centralized control and visibility. However, I still lacked a tool for network performance measurement and tuning…

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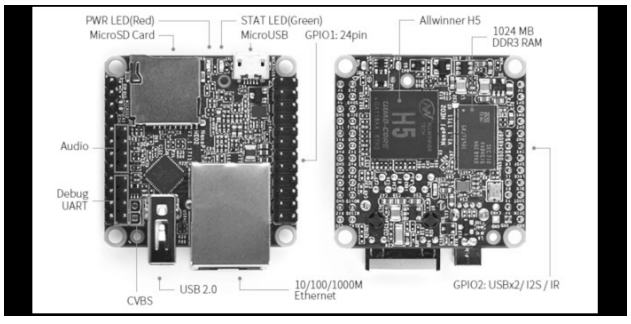
What are the Prerequisites of this Session?

- Familiarity with the basics of Linux.
- Being comfortable with the CLI.
- Basic concept of networking terminology.
- Familiarity with wireless access points.
- Understanding of Wi-Fi terminology.
- Need to observe your network's performance.
- Proactively monitor your network's health.

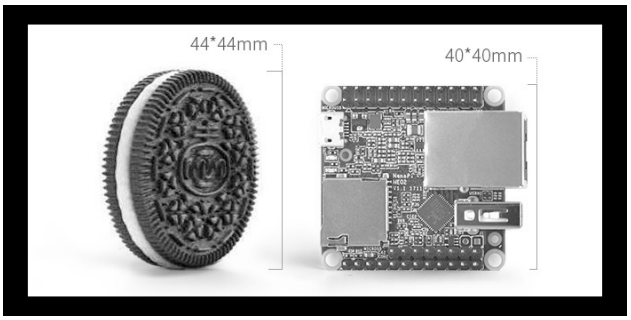
FrugalPi Monitoring

Overview of the NanoPi NEO2



FrugalPi Monitoring

Let's show this at scale…



FrugalPi Monitoring

Mind blown!

FrugalPi Monitoring

Pat Zielke

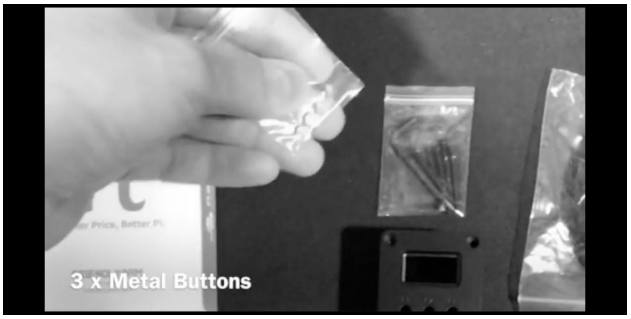
Technology Coordinator
Viroqua.

FrugalPi Monitoring

Let's review the parts…

FrugalPi Monitoring

Let's review the parts…

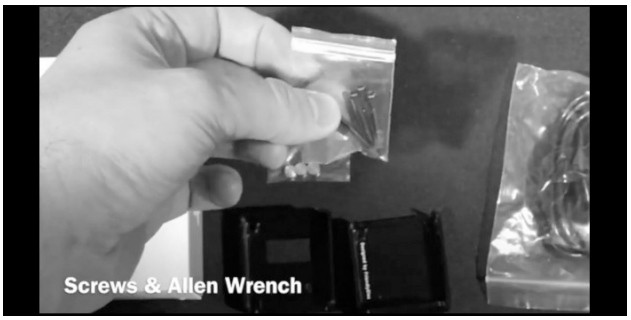


FrugalPi Monitoring

Let's review the parts…

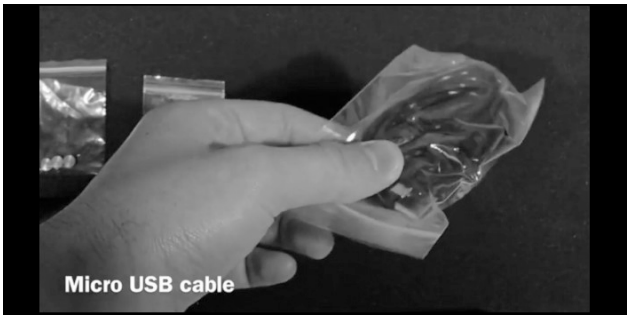
FrugalPi Monitoring

Let's review the parts…



FrugalPi Monitoring

Let's review the parts…

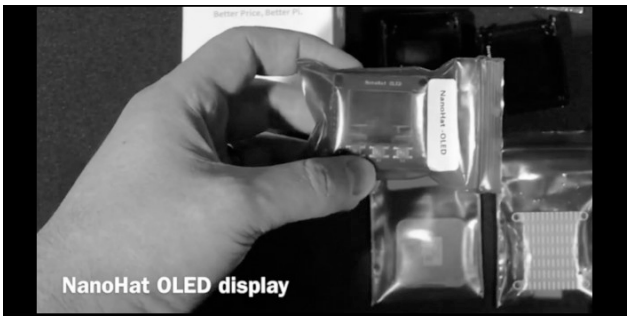


FrugalPi Monitoring

Let's review the parts…

FrugalPi Monitoring

Let's review the parts…



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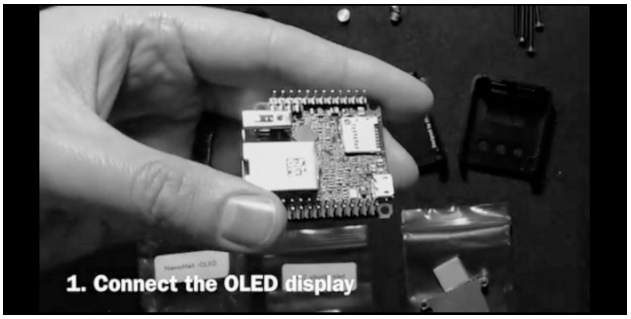
Can we build it?

FrugalPi Monitoring

Open the NEO2, note the pins…



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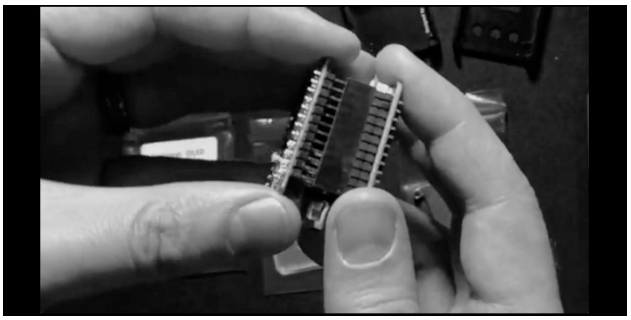
Align the pins on the OLED hat



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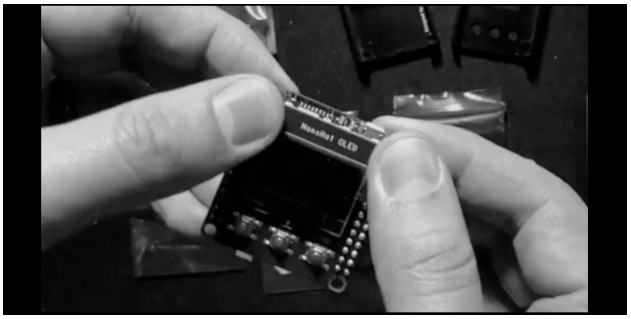
Do *not* press on the screen!



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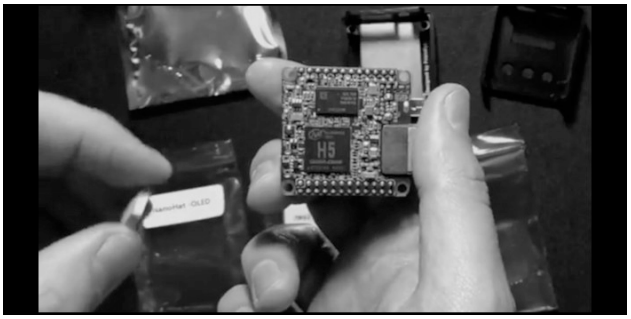
Install thermal pad on H5 SoC



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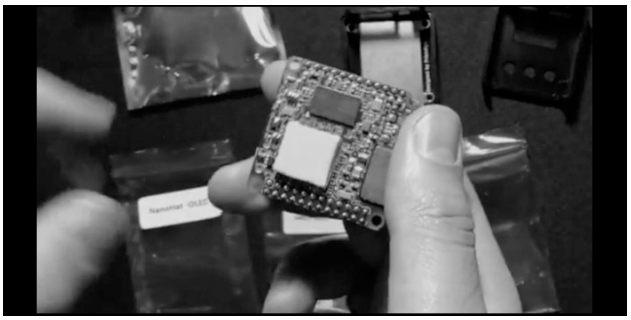
Now, remove the second film



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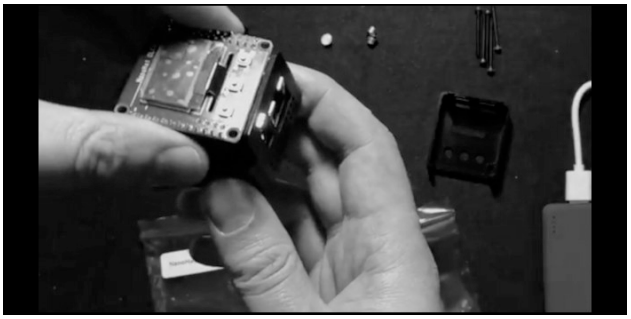
Slide the NEO2 into the bottom case



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Buttons should be flush with the top

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Secure all four screws

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All done! No display – yet…

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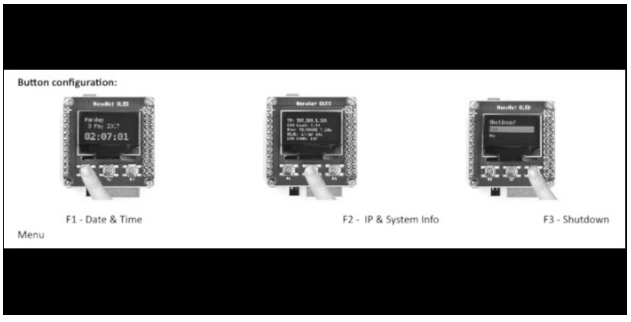
Button functions…



FrugalPi Monitoring

About Debian 9.0 (Stretch)

- Source model: Open-source
- One of the earliest operating systems based on Linux
- First stable version was released on June 17, 1996
- Debian 9.0 (Stretch) was released in June 2017
- Requirements: No GUI desktop → RAM min: 128 megabytes RAM rec: 512+ megabytes Storage: 2 gigabytes.

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The supporting cast…

- Iperf3 server 3.1.3
- Iperf2 server 2.0.9
- SpeedFlex / ZAPd (Ruckus) 1.83.18
- Speed Tests (HTML5)
- Kismet 2019-01-BETA2
- HORST version-5.0-106
- WiFi Explorer Pro Sensor

- Etcher version 1.5.0
- VirtualBox version 6.0.6
- Elementary OS (v 5.0 Juno)

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Important items to remember!

- SSID of test network: BrainStorm
- Password for Wi-Fi: BrainStorm2019

- Password for ByteSpeed PC running Windows 10 Pro is: brainstorm
- Password for bstorm account on the VM running Elementary OS is: bstorm2019

- NEO2: SSH user: wlanpi pass: wlanpi
- NEO2: KISMET user: kismet pass: wlanpi

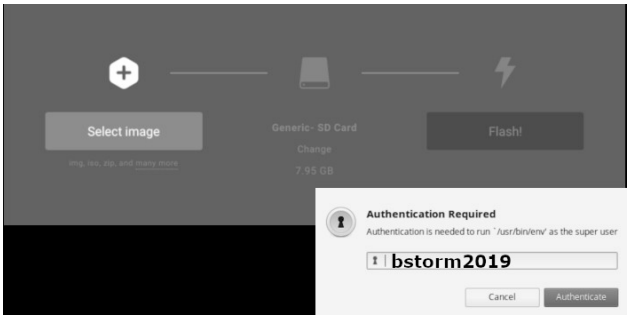
FrugalPi Monitoring

"Burning" Debian to your microSD

- Insert the microSD into USB reader
- Place the reader into the USB 3.0 port
- Start VirtualBox, run eOS
- WAIT! Etcher will begin automatically
- Select the .img file (in Downloads)
- Click Flash (password is bstorm2019)
- When the copy has completed successfully (~4-6 min), quit Etcher
- Click on the Files icon on the dock at the bottom of the screen

FrugalPi Monitoring

Using Etcher to create the boot drive



FrugalPi Monitoring

Why are we jumping though hoops?

- Wlanpi uses DHCP for IP distribution, you need to access *your* NEO2.
- Win/Mac doesn't natively support ext4
- In Files, click on 3.5 GB volume (left)
- At the top, right click on the last entry after /media/bstorm
- From the menu: Open with → Terminal
- In the Terminal type: sudo -s
- Enter the password: bstorm2019
- Type: nano etc/network/interfaces

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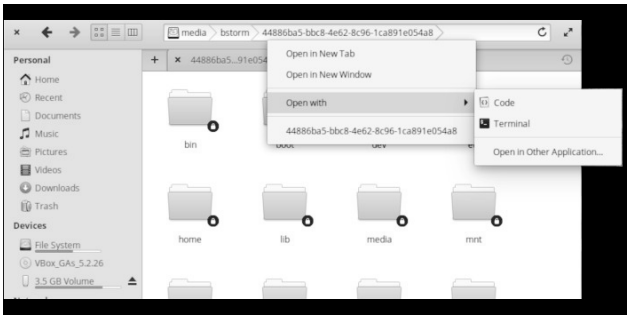
Modifying the boot microSD



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Editing etc/network/interfaces

- At the top look for Wired Adaptor #1
- On the line with "iface eth0" change the last word from dhcp to static
- Remove the # from address line and *carefully* type in your assigned IP
- Remove the # from netmask
- Remove the # from gateway and type in: 192.168.136.1
- Remove the # from dns
- Type: Cont+X to save – answer Y

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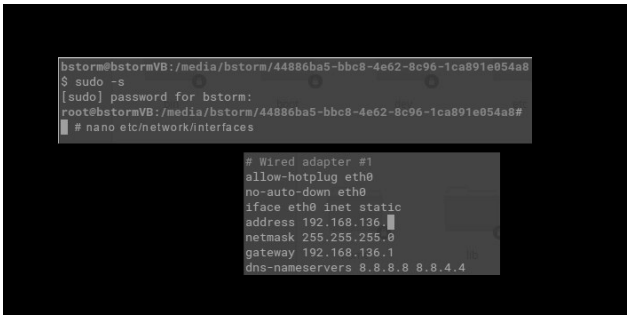
Editing the files in Elementary OS



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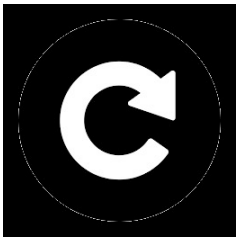
Editing etc/network/interfaces



- In the Elementary OS Terminal press Cont+D (then repeat two more times)
- In the upper right corner of the Elementary OS VM and select Shutdown
- Quit VirtualBox
- Remove the USB card reader
- Remove your microSD card
- Give the USB card reader to the person next to you (if needed).

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Ready?

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Let's Go!

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Putting it all together

- Insert the microSD card into the NEO2
- Warning: a gap exists between the top of the case and the card slot.
- Connect the usb Wi-Fi dongle.
- Connect the NEO2 via Ethernet.
- Finally, connect the USB power cable to the NEO2.
- The NEO2 can take between 20-40 seconds for the OLED to activate.

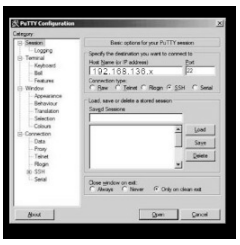
FrugalPi Monitoring

Before we begin some Linux basics

- Get help: man <cmd> or <cmd> -h
- Linux Info: Prompts are important - # vs $
- Type: cat /etc/*release*
- The tab key is your friend
- The up and down arrows are your friend
- Capitalization counts
- Run process in background add & at the end
- Tail <filename> will give you the last 10 lines

FrugalPi Monitoring

Connecting to the NEO2



- On the PC open the command line.
- Type: ping 192.168.136.x
- yourIP... ttl=64 time=4.792 ms
- On your PC open PuTTY
- Connect to the NEO2 using your IP.
- User: wlanpi Pass: wlanpi
- $ passwd
- $ sudo apt update
- $ sudo apt upgrade
- $ sudo apt dist-upgrade

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Updating the wlanpi…

A

```
Get:114 http://cdn-fastly.deb.debian.org/debian stretch-backports/non-free armhf
 Packages 2019-02-24-0811.12.pdiff [2,874 B]
Get:115 http://cdn-fastly.deb.debian.org/debian stretch-backports/non-free armhf
 Contents (deb) 2019-02-24-0811.12.pdiff [974 B]
Get:115 http://cdn-fastly.deb.debian.org/debian stretch-backports/non-free armhf
 Contents (deb) 2019-02-24-0811.12.pdiff [974 B]
Get:116 http://cdn-fastly.deb.debian.org/debian stretch-backports/non-free arm64
 Contents (deb) 2019-02-24-0811.12.pdiff [974 B]
Get:116 http://cdn-fastly.deb.debian.org/debian stretch-backports/non-free arm64
 Contents (deb) 2019-02-24-0811.12.pdiff [974 B]
100% [108 Contents-armhf rred 10.5 MB] [57 Packages store 0 B]
```

B

```
(Reading database ... 40354 files and directories currently installed.)
Preparing to unpack .../libnss-myhostname_232-25+deb9u9_arm64.deb ...
Unpacking libnss-myhostname:arm64 (232-25+deb9u9) over (232-25+deb9u8) ...
Preparing to unpack .../libpam-systemd_232-25+deb9u9_arm64.deb ...
Unpacking libpam-systemd:arm64 (232-25+deb9u9) over (232-25+deb9u8) ...
Preparing to unpack .../systemd_232-25+deb9u9_arm64.deb ...
Unpacking systemd (232-25+deb9u9) over (232-25+deb9u8) ...

Progress: [ 14%] [########.....................................................]
```

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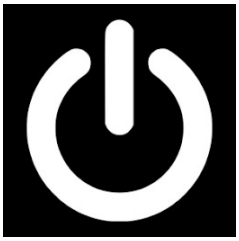
Rebooting the NEO2



- $ cat /etc/*release*
- $ lsb_release -a
- $ crontab -e (start on boot)
- $ nano /etc/rc.local (...see also)
- $ sudo apt install [name of package]

- $ sudo shutdown -r now
- $ sudo shutdown -h now

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Connecting to the web interface

- After the reboot is complete open the browser of your choice on the PC
- In the URL bar type:
- http://192.168.136.<yourIP>
- You will be presented with the following web page

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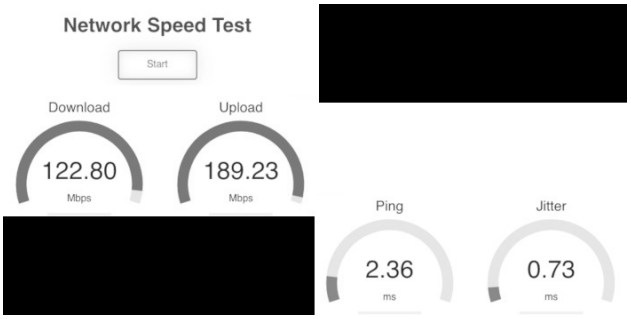
WLAN Pi v1.6.1 website

FrugalPi Monitoring

Network Speed Test



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Regarding ping and jitter…

- LAN pings should be below 10ms, unless high CPU / high traffic.
- Jitter is the variation in the latency on a packet flow between two points.
- Jitter results from network congestion, timing drift and route changes.
- Jitter should be below 30 ms.
- Packet loss shouldn't be > 1%.
- Network latency shouldn't be > 150 ms (in one direction) or 300 ms round trip.

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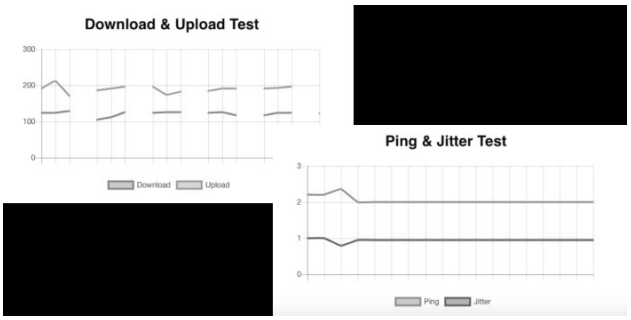
Speed Graph



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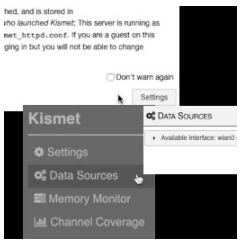
Kismet Wi-Fi utility



- Is a detector, sniffer, and intrusion detection system for wireless LANs.
- At the error dialog box click Settings.
- KISMET user: kismet pass: wlanpi.
- Select Save Changes (close window).
- Select Data Source (left) to use wlan0.
- Enable Source to scan, pause to stop.
- Data is stored in browser memory.
- Logs files can eat free space – quickly.
- $ sudo service kismet stop
- $ sudo service kismet start

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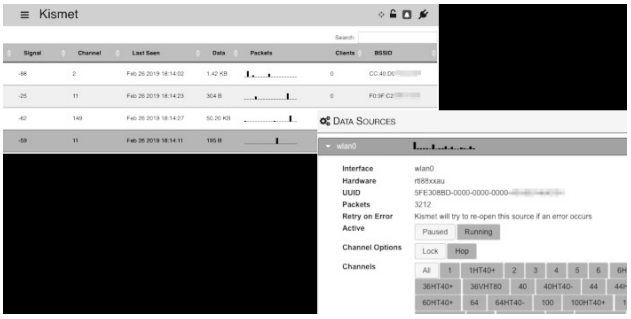
Kismet data and data sources dialog



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SpeedFlex [optional]

- SpeedFlex is a wireless performance tool, it tests network throughput. Capture packet loss and test data throughput going from or to the server.
- [Optional] iOS or Android required.
- Go to configuration.
- Enter <yourIP> as the Destination.
- Select link up / down / both.
- Select protocol TCP or UDP.
- Select duration.

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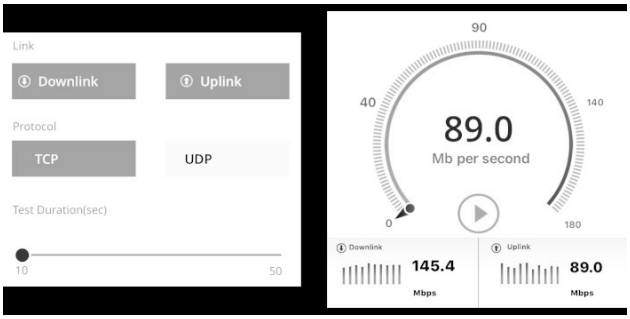
SpeedFlex config and results!



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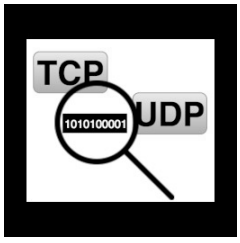
TCP vs UDP



- The Transport Control Protocol (TCP) and User Datagram Protocol (UDP).
- TCP will receive the packets in order. The recipient acknowledges the receipt of the packets. If the sender does not get a correct response, it will resend.
- The UDP protocol throws all the error-checking stuff out the window.
- UDP is used for streaming and VoIP.

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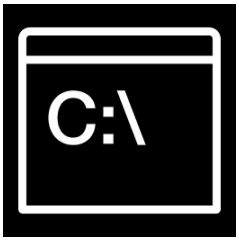
Using iperf3 in DOS



- On the PC open the command line.
- Type: %userprofile%"\Downloads\Win install\iperf-3.1.3-win64"
- iperf3 -c 192.168.136.<yourIP>
- iperf3 --client 192.168.136.<yourIP> --bandwidth 100M --length 512 --udp
- iperf3 --client 192.168.136.<yourIP> --reverse --bandwidth 100M --length 512 --udp
- iperf is also supported, but is older.

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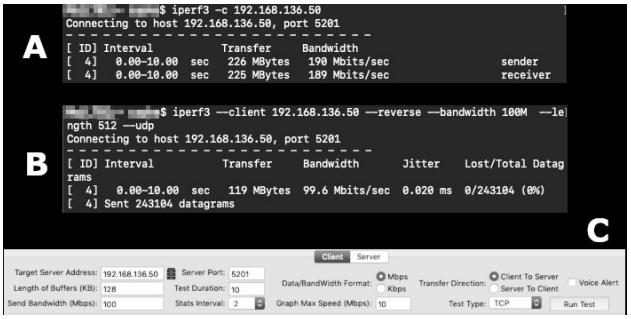
iperf3 results and [optional] GUI



FrugalPi Monitoring

H.O.R.S.T radio scanning tool

- On your PC open PuTTY.
- Connect to the NEO2 using your IP.
- User: wlanpi Pass: ???
- $ sudo horst
- Enter your new password
- a to bring up the statistics screen
- e for the ESSID screen (q to quit)
- H.O.R.S.T = (HIGHLY OPTIMIZED RADIO SCANNING TOOL)
- Cont+D to exit

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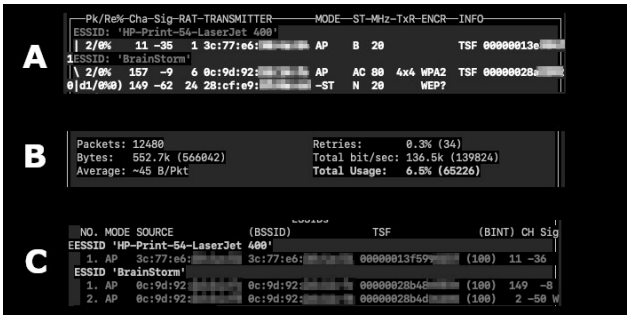
A visual guide to HORST



FrugalPi Monitoring

WiFi Explorer Sensor

- Requires WiFi Explorer - Pro
- Single user – academic ~ $50.00.
- OS: macOS

- Connect to a remote platform and perform a passive Wi-Fi scan using a capable Wi-Fi adapter. When a remote sensor is used, the scan results are sent back to WiFi Explorer Pro for its visualization.

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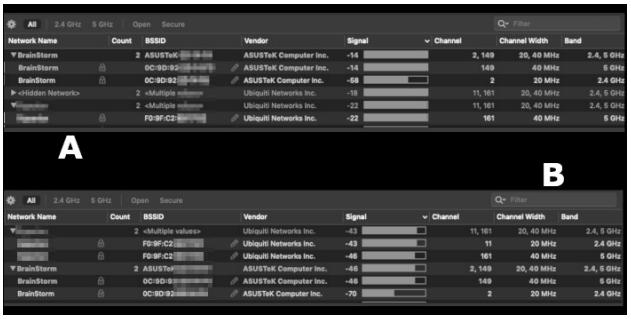
Acquiring Wi-Fi from remote sites



FrugalPi Monitoring

Pat Zielke

Technology Coordinator Viroqua.

FrugalPi Monitoring

More info… Suggested links!

- http://www.wlanpi.com
- https://www.wlanpros.com/resources/wlan-pi-resources
- https://www.smallnetbuilder.com/wireless/wireless-howto/33187-build-a-wi-fi-performance-analyzer-for-75-part-1
- https://www.smallnetbuilder.com/wireless/wireless-howto/33189-build-a-wi-fi-performance-analyzer-for-75-part-2

FrugalPi Monitoring

Did Someone Mention a Surprise?!?

FrugalPi Monitoring

Questions?

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