The Ubuntu for Network Engineers Cookbook

Advance your “Network Engineer of the future” career with the OS of the Cloud

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The following conventions are used in “Ubuntu for Network Engineers”:

Italic

Used for URLs, email addresses, acronyms, filenames, and new terms.

`Constant Width (Consolas Typeface)`

Used for program listings and terminal command output

Constant Width Bold (Consolas Typeface)

Text that should be typed into the terminal

`Constant Width Italic`

Text that should be replaced by user supplied values

Installing Ubuntu 18.04

The first question is should I just spin up a virtual machine or use bare metal. I used Linux for a few years as a VM before I bought dedicated hardware. The advantage of using a VM is that if you damage it or decide for any reason it's not the right distribution you can just delete it and try another one. The drawback to a VM is that the hypervisor hides the hardware so you don't really get the experience of installing, configuring and maintaining Linux.

My suggestion if you have never touched Linux is to install Ubuntu as a VM and get some experience with it. You won't have to spend any money, Ubuntu is free, although I usually donate $10 when I download it to install on a fresh machine, and you can run any of the tools in this book.

I have Kali running on a System 76 Gazelle laptop and Ubuntu on a Dell G5 laptop. I did this because I wanted to get my Linux certifications and I felt that I needed to be running Linux on my daily driver to really learn. The VM can do just about anything the bare metal can do but when I would get stuck on something I would just shut it down and go back to Windows instead of figuring it out.

There are a lot of good tutorials on installing Ubuntu 18.04 available on the Internet so I am not going to cover it here. It is actually very easy, pretty much click, click, next, reboot! The site linuxconfig.org has a lot of great Ubuntu tutorials, here is link to a tutorial on installing 18.04 – How to install Ubuntu 18.04.

Appendix A covers the installation I did on a Dell G5 laptop that wasn't 100% compatible out of the box. It took a lot more time than I expected to get everything working on the Dell and I documented the steps in the Appendix. Dell and System 76 both sell laptops with Ubuntu pre-installed. The System 76 Oryx Pro will definitely be my next machine. It is a beautiful powerhouse with Nvida 2080 graphics, up to 32 GB of RAM and massive storage capacity. Unlike the Dell XPS 13/15 lines it has Ethernet, USB A, and the other ports I find handy.

Even if you buy a System 76 or Dell laptop with Ubuntu preinstalled you may still want to take a look at the Appendix since I documented some things like customizing the Grub boot loader and running nVidia and Intel graphics.

In this book I am going to document the tools that I found useful in the transition to Linux for network engineering tasks.

A note on encryption. Ubuntu supports the Linux LUKS full disk encryption. During setup you can select the encrypt full disk option. This is, of course, a good idea for security but if you encrypt and then decide you don't want it or you want to upgrade to the next release of Ubuntu you will need to decrypt. Use the instructions here to decrypt the LUKS volume:
How to remove LUKS encryption
https://unix.stackexchange.com/questions/60971/how-to-remove-luks-encryption

Using Ubuntu

Switching from Windows to Ubuntu with the Gnome desktop is both easy and hard. How can that be? It's simple, the basic operation of the desktop is similar to Windows. The file manager (Nautilus) is similar to Windows Explorer and of course Chrome or Firefox work just like they do in Windows including syncing, Lastpass, Grammarly, etc. There is a keyboard button called the superkey (on most keyboards it will have the Windows logo) just like the Windows key. You tap it and search for an application or pick from the running applications.

So, what is the hard part? Things like killing a hung application, searching for files from the terminal, checking free disk space are different and will take a little getting used to. Since MACOS is based on Open BSD Unix, once your muscle memory is up to speed you will be able to jump back and forth easily between Windows, Mac and Linux. In a later chapter I will discuss the terminal tools that make Linux so much fun and so powerful for a network engineer.

One of the big advantages for the Linux desktop is that you can customize almost everything since it's free and open source. You can change the terminal you use, the file manager, the way almost anything works and even the desktop itself.

The most popular desktop environments (DE) for Linux are Gnome (Ubuntu's default), and KDE (which is available on Ubuntu) but there are many more. I use the computer for work and just learned to customize Gnome to fit my workflow but I use Terminator for my terminal app and Polo for the file manager.

I listen to a lot of podcasts and KDE Plasma, XFCE and MATE are highly recommended desktop environments (DE) that you may like better than Gnome. If you watched the second episode of Mr. Robot (Season 1 – which I highly recommend) there is a scene were an executive tells Elliot that he runs KDE but understands why Elliott prefers Gnome.

These two short YouTube videos sum it up better than I can:

6 Things to Know When Switching to Linux from Windows
https://www.youtube.com/watch?v=wcdquhB6hT8

10 things you can do with Linux that you can't do with Windows
https://www.youtube.com/watch?v=JOOkfGv58u0

The "Choose Linux" podcast is a show that covers a lot of Linux distributions and has a lot of tips. One episode in particular, *24: What We Wish We'd Known Earlier*, is well worth the time to listen to. The three hosts talk about things they know that would have been very helpful when they first switched to Linux.

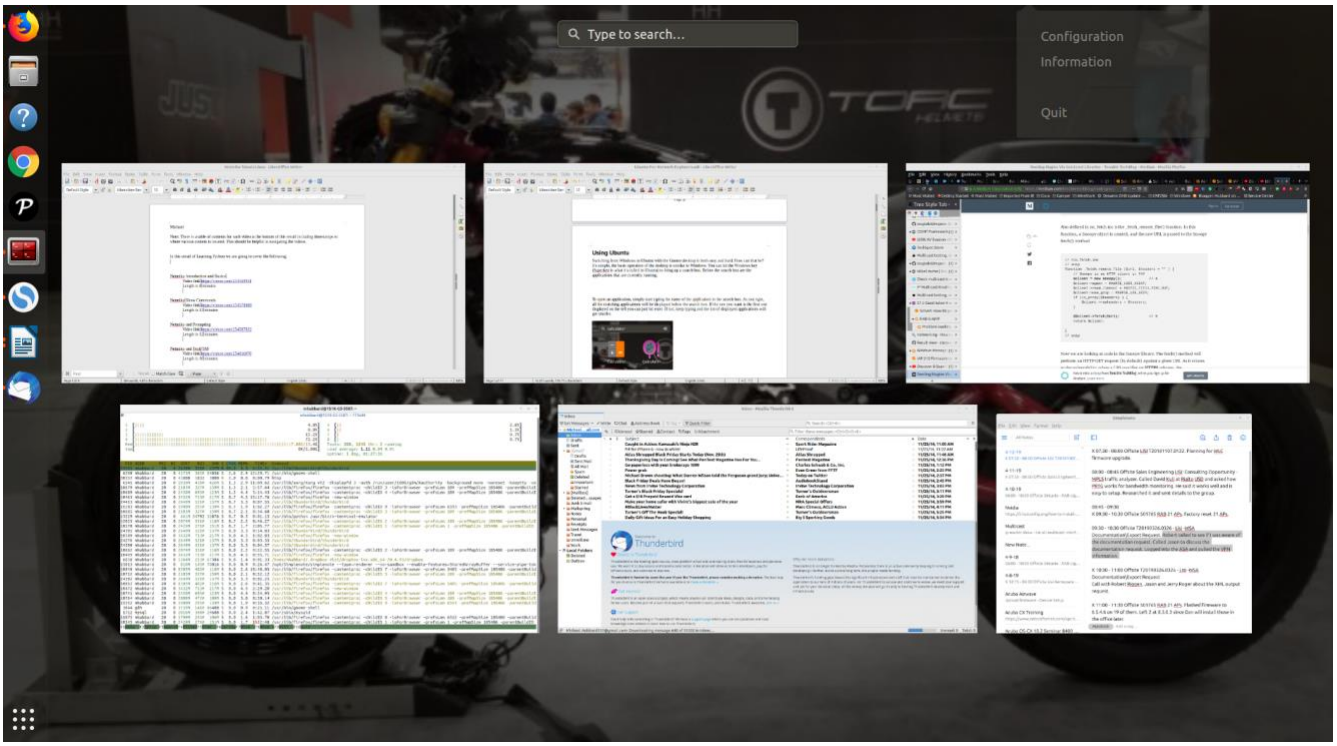
Casting your display

I have a Vizio "Smart" TV with Chromecast built in. Using the Chrome browser I can click the three dot menu on the right and select "Cast..." to send the output to the TV.

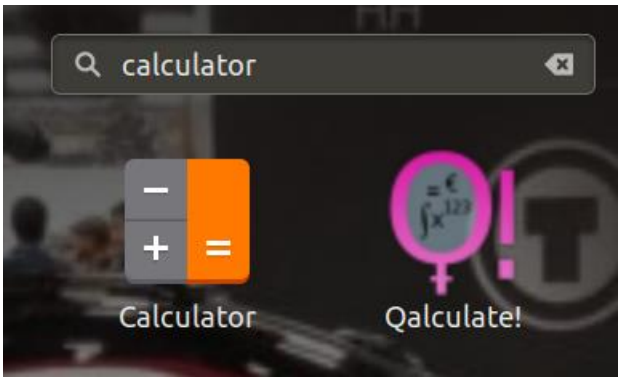
In VLC, select "Playback, Renderer" to send VLC's output to the TV.
I don't have a Chromecast dongle, but I am guessing it would work the same way as the Vizio TV.

Opening Applications

You can hit the Windows key (Superkey is what it's called in Ubuntu) to bring up a search box. Below the search box are the applications that are currently running. You can use the Tab key and enter or use the mouse to select one of the running applications.

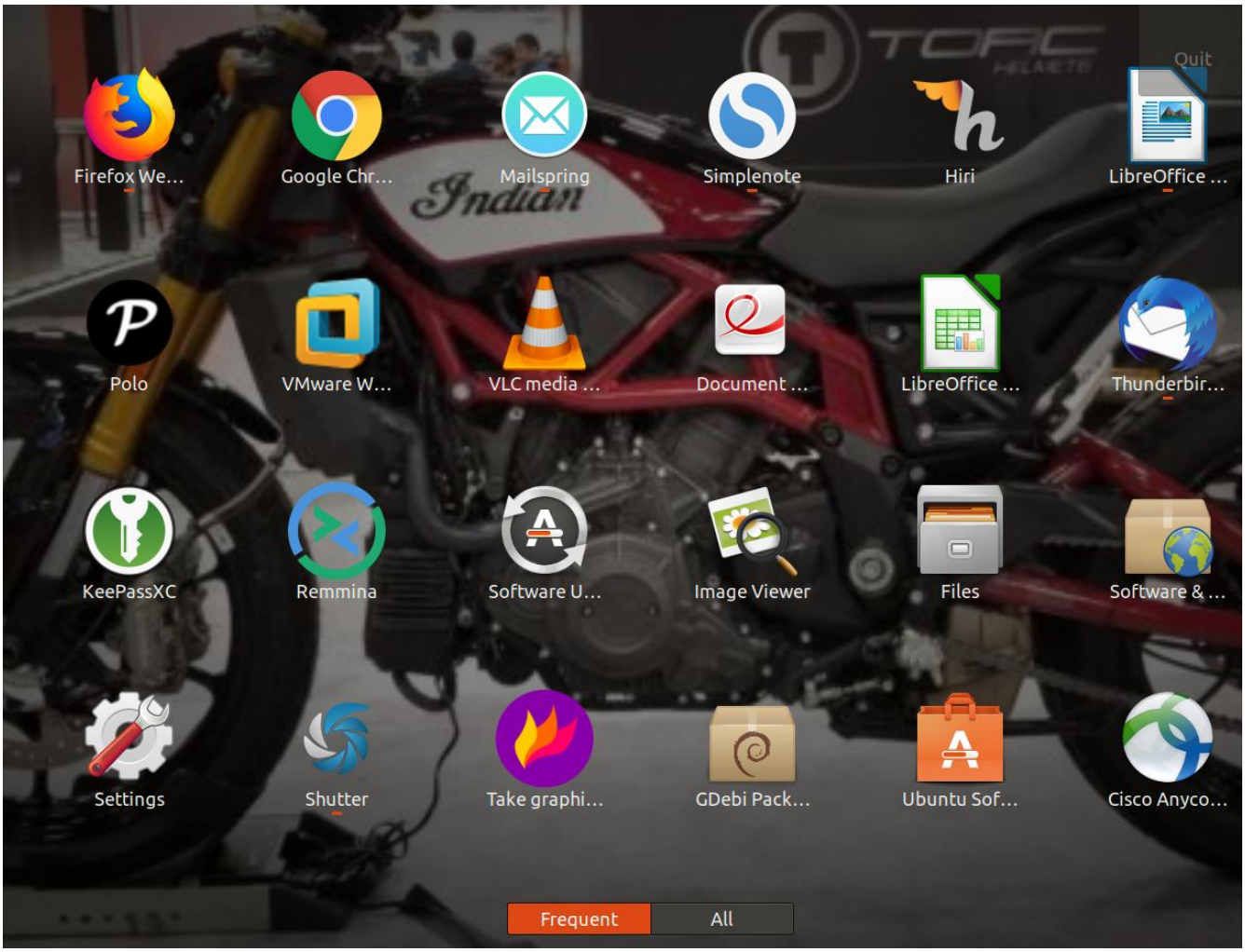


To open an application using search, simply start typing the name of the application in the search box. As you type, all the matching applications will be displayed below the search box. If the one you want is the first one displayed on the left you can just hit enter. If not, keep typing and the list of displayed applications will get smaller. In the screenshot below, hitting enter will open the built in calculator app. Right arrow, Enter will open Qalculate!



You can also use the mouse and click on any application that is displayed to run it.

The dock has a small icon at the bottom, it's three rows of three dots. You can that click that icon to see the installed applications in a window. At the bottom, you can select all or frequent. Below is a screenshot with frequent selected. As you can see, it's very easy to get started.

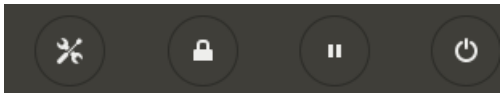


If there are too many to display, a columnmails of circles will appear on the right side of the screen. You can scroll down with the mouse or click on one of the circles to jump to the next page.

If you have several copies of the same application open you can switch between them using the super key and `\~ key (the key to the left of 1 on a US keyboard). You can also bring up the dock, click on the application icon and then select the one you want but the keyboard is much easier and faster.

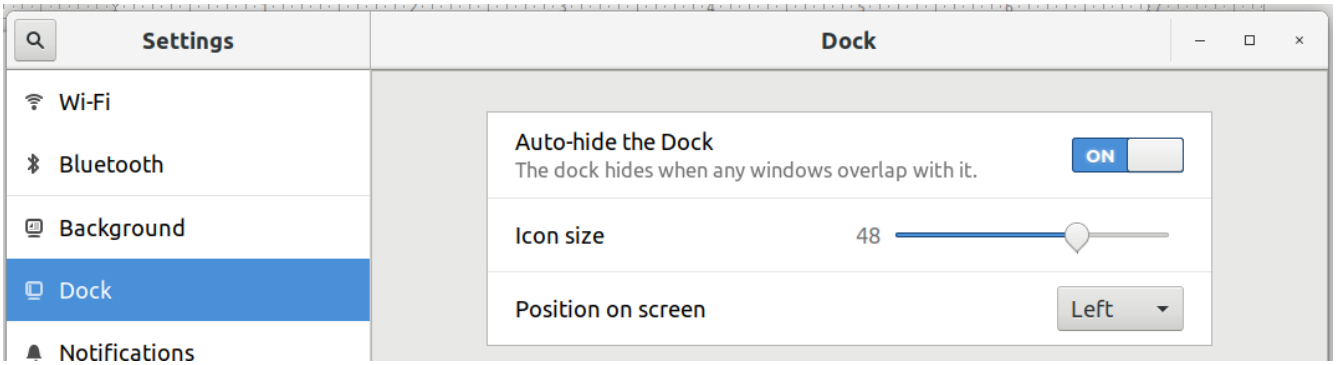
Configuring the Dock

Like Windows and Mac, Ubuntu with the Gnome DE has a dock. You customize the dock using the Gnome Settings app. To open the Gnome Settings application, click the down arrow in the top right corner of the screen, then select the Wrench/Screw drive icon.



When the Settings application opens, click on Dock. One thing I do to help me use all three operating systems is to customize the dock to be similar across all OSes. I set Windows, Mac and Linux to display it on the left because I am almost 100% of the time on a laptop and the screen is wider than it is high. I also set the dock to auto-hide and display a few commonly used apps.

Using the super key and typing the first few letters is now my preferred work flow rather than clicking on an icon in the dock. One thing I like about Ubuntu is that when I'm using multiple monitors it puts the dock on all the monitors.



Customizing Gnome

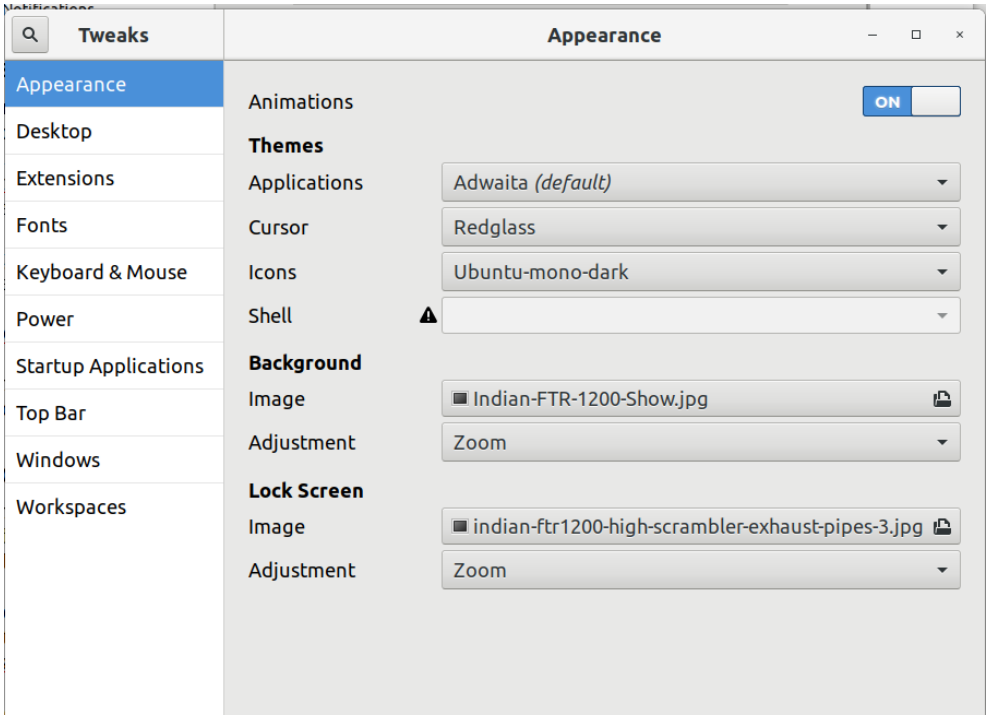
Ubuntu 18.04 ships with Gnome as the desktop environment instead of Unity. I liked Unity better, but with the steps listed below, Gnome is working pretty well for me. Unlike Windows, Linux distributions can use a lot of different desktop environments (DE). Gnome is the default desktop environment for Ubuntu and Redhat (CentOS) so it has a large percentage of the desktop market in Linux. If you want to try others there are several official flavors of Ubuntu that you can download from *Canonical*.

First, install the Gnome Tweak Tool. This tool allows you to change a lot of the Gnome settings to your preference. Open a terminal window, ctrl + alt + t, and type the following:

sudo apt install gnome-tweak-tool

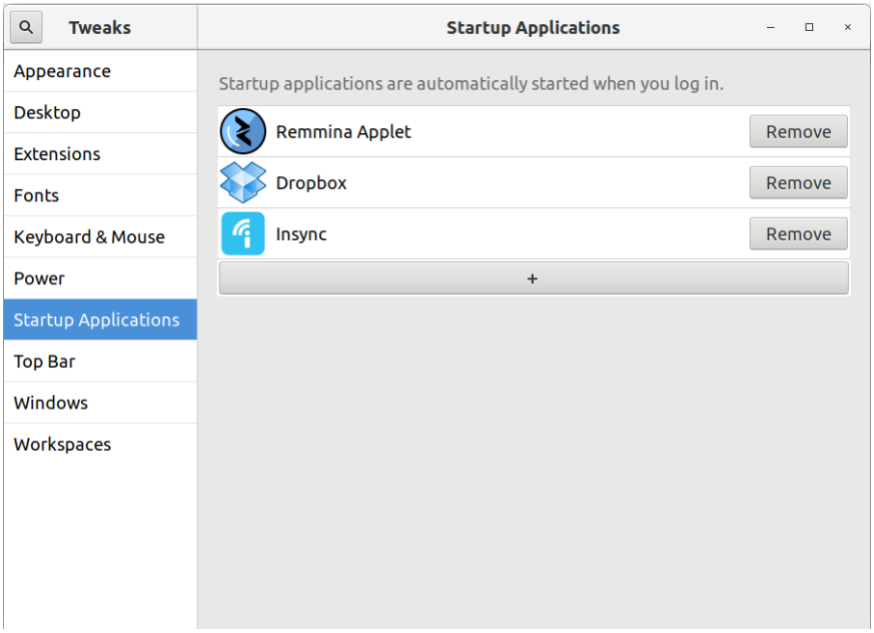
Enter your password and the install will start. When it finishes, hit the super key, type "tweak" and hit enter.

It's very similar to "System Preferences" on the Mac or Control Panel on Windows up to 7.



I won't cover all the categories but you can see that I set a background image, a lock screen image, and a big red cursor.

To set the applications that run on login, use the Startup Applications category.



Gnome extensions

You can also customize Gnome using extensions. To install extensions, open Chrome or Firefox and go to Gnome Extensions. There are hundreds of extensions available. I have heard that you should limit the number of Gnome extensions to 10 or less due to resource usage but I don't know that for sure. I have booted up and started htop, an application that displays system resource usage and I don't see large amounts of memory or processor in use.

Before you can install Gnome extensions, you have to install a browser plugin. The site will prompt you to install it. Here is link to an article on *The 19 best Gnome Extensions*

Here are the extensions that I have installed:
Disconnect Wifi – by kgshank
Refresh Wifi Connections – by kgshank
Extension Update Notifier – by franglais125
notifications alert – by hackedbellini
Places Status Indicator – by fmuellner
Suspend Button – by laser_b

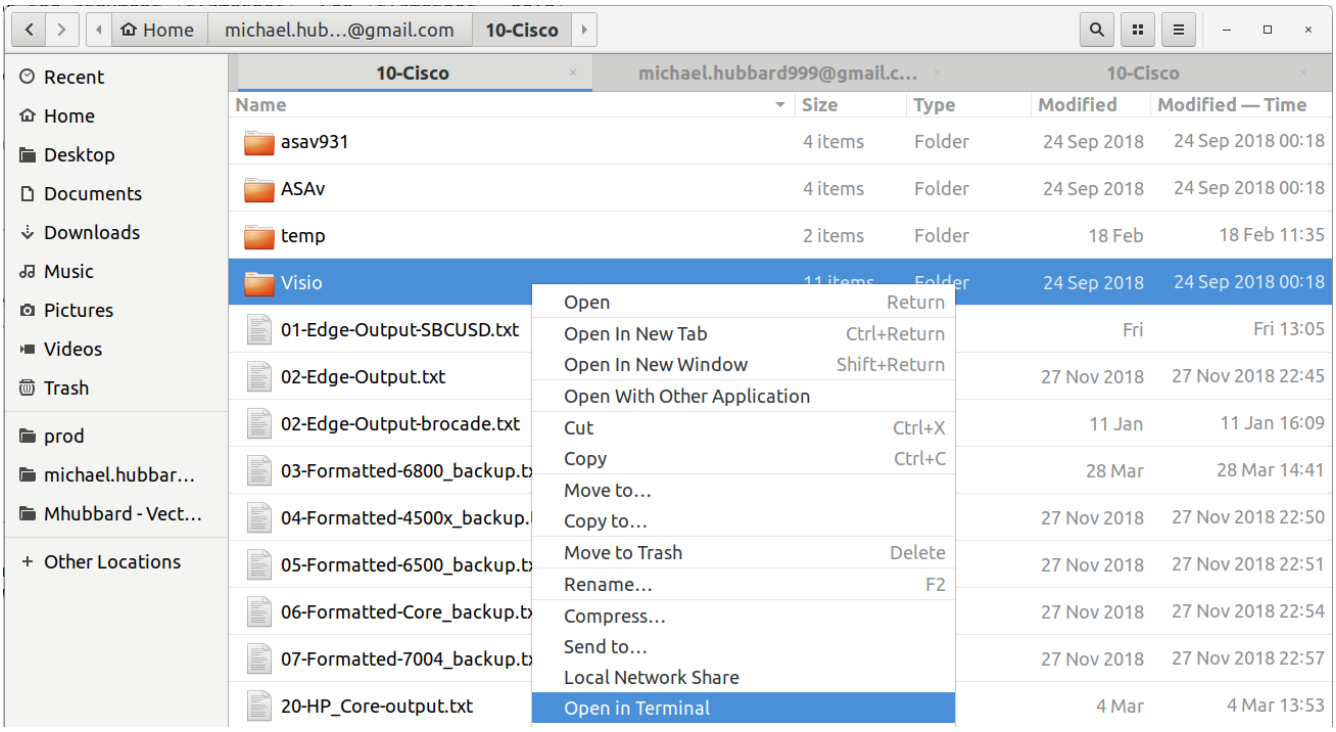
I spoke to the Gnome people at the Southern California Linux Expo 18 (March 2019) and they explained that they don't see the need for any extensions. They prefer to use Gnome work spaces instead of minimizing applications and to use other built in Gnome tools. I tried work spaces and they are very nice.

I had a problem when running VMware workstation in full screen mode. I'm sure there is a work around and I will get back to trying work spaces at some point, but for now I'm using the extensions.

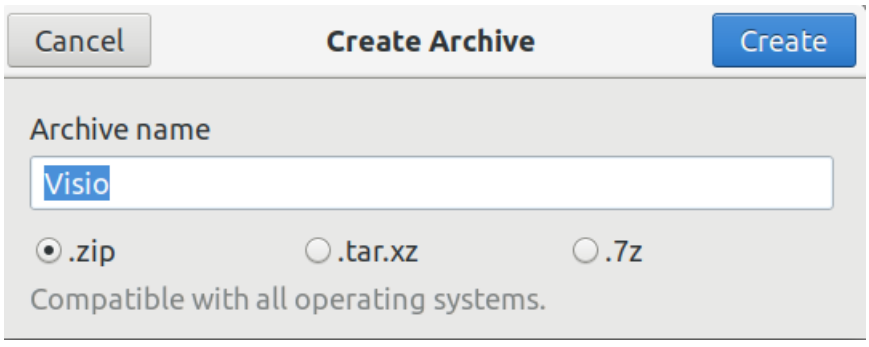
Managing Files

Nautilus is the file manager for Gnome. It works well and has a feature I love – Tabs! Once you get used to having tabs in your file manager it's hard to use Windows Explorer! Here is a screenshot with three tabs open and the right click menu showing "Open in Terminal". You can see how convenient this is. On a Mac, the Finder app has the tabs. I don't know why Windows doesn't.

Nautilus has an extensive right click menu. Here are the options for the folder Visio.

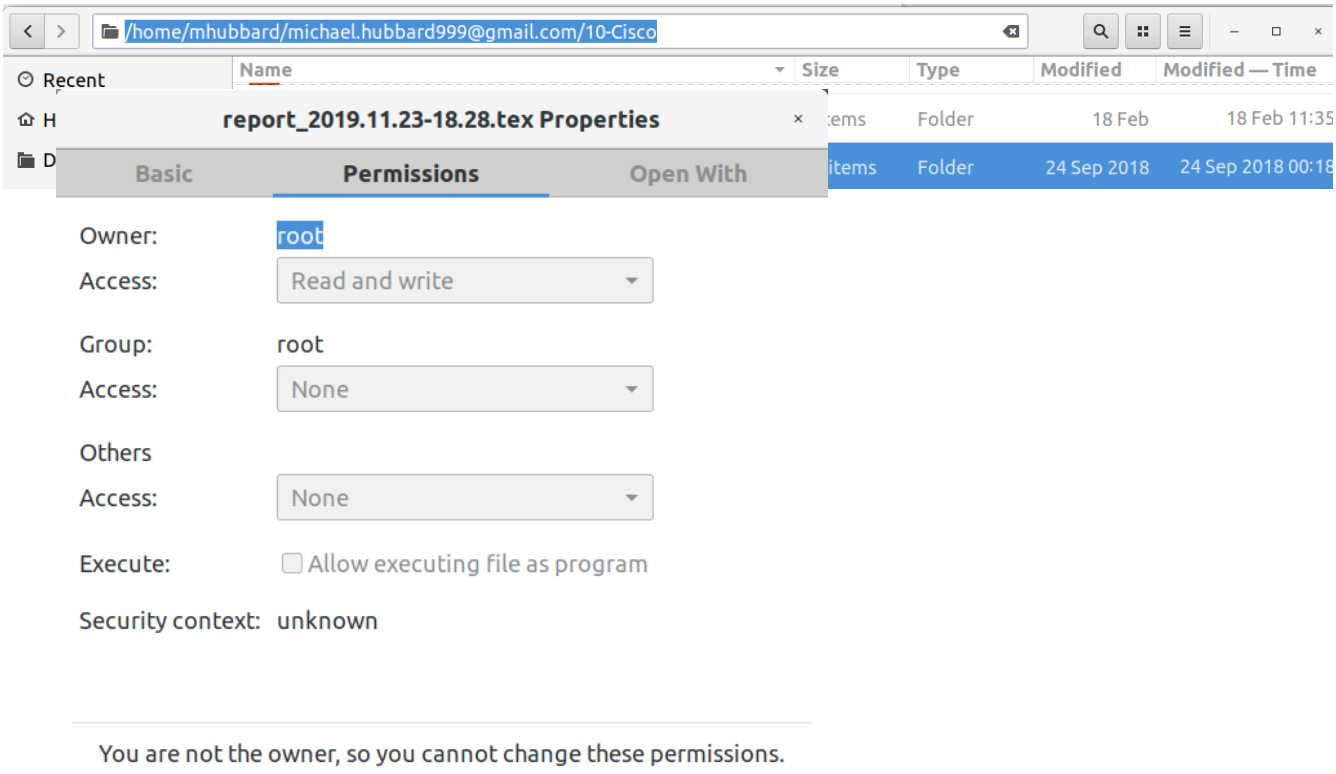


If you click "Compress..." a dialog opens and presents the available applications for compression:



Display the Full path in Nautilus

Sometimes you want to copy the full path to a file when working in the file manager. Hit ctrl+l (lowercase el) and the path will change to a format that you can copy.



Easily preview files in Nautilus

One thing I missed from Windows Explorer was the preview pane. In Ubuntu running the Gnome desktop you can install "Sushi" to preview files.
How to quickly preview a file in Ubuntu's file manager like quick look in MACOS

Then you just hit the spacebar to preview a supported file format.

Why do I have a red X on a file or folder?

Nautilus, like every other GUI file manager, uses icons to represent files and folders. If the icon has a green check mark in it, you have full access to the file or folder. If the icon has a red X in it, you don't have full permissions to the file or folder.

Here is a screenshot of Nautilus showing one file with a green check mark and one with a red x.

The file with the red x is owned by root and no other user has access to it.

To take ownership of the file:

sudo chown mhubbard report_2019.11.23-18.28.tex

Reference
Meaning of files-folders with a red x

Creating a bootable USB stick from an ISO image

There are several ways to accomplish this. If you are creating a live USB to try an Ubuntu distro you can use the built in "Startup disk creator" by tapping the super key (Windows Key) and typing software. You will see the Startup disk icon:

Pick the ISO image from the "Source disc image (.iso)" drop down, then select the USB stick, click "Make Startup Disk". After the image is complete, Ubuntu will use QEMU to test the disc.

You can also use Balena Etcher. The advantage to Etcher is that you can burn any ISO image, not just an Ubuntu based image. To install Etcher, google etcher, from the home page download the .deb file and double click it.

After you burn a disc with Etcher you can use QEMU to test the disc by running:

qemu-system-x86_64 -hda /dev/sdx

Replace x with the letter for your USB stick.

Reference

Using QEMU to test an ISO or Bootable USB

Working with the Linux File System

If you have been a Windows user for a long time the hardest part of switching to Linux is the file system. There is no concept of drive letters in Linux. The Linux file system is based on the "File system Hierarchy Standard" maintained by the Linux Foundation.

The top of the Linux file system is called the root. All files and directories are referenced from the root, even if they are stored on different physical or virtual devices. That is so different from Windows that it will take some time to get comfortable with.

Here is a link to a great tutorial on the Linux file system by Abhishek Prakash - Linux Directory Structure Explained for Beginners. His tutorial will get you up to speed on the Linux file system. Abhishek creates Linux tutorials and I recommend that you sign up for his newsletter. The subscribe button is at the top of the page.

On Windows you have drive letters and the root of the file system is the "\" character – The good old C:\. But Linux/Mac, or any *NIX for that matter, doesn't use drive letters. The file system is usually described as a tree with root at the beginning. Root is shown in the file system as /. Everything is then displayed off the root.

The "/" is another difference that will take a while to get used to. Unix/Linux/Mac use a forward slash instead of the backslash "\" for file system commands. When you use a web browser, you use the forward slash for file commands – *https://github.com/rikosintie* for example.

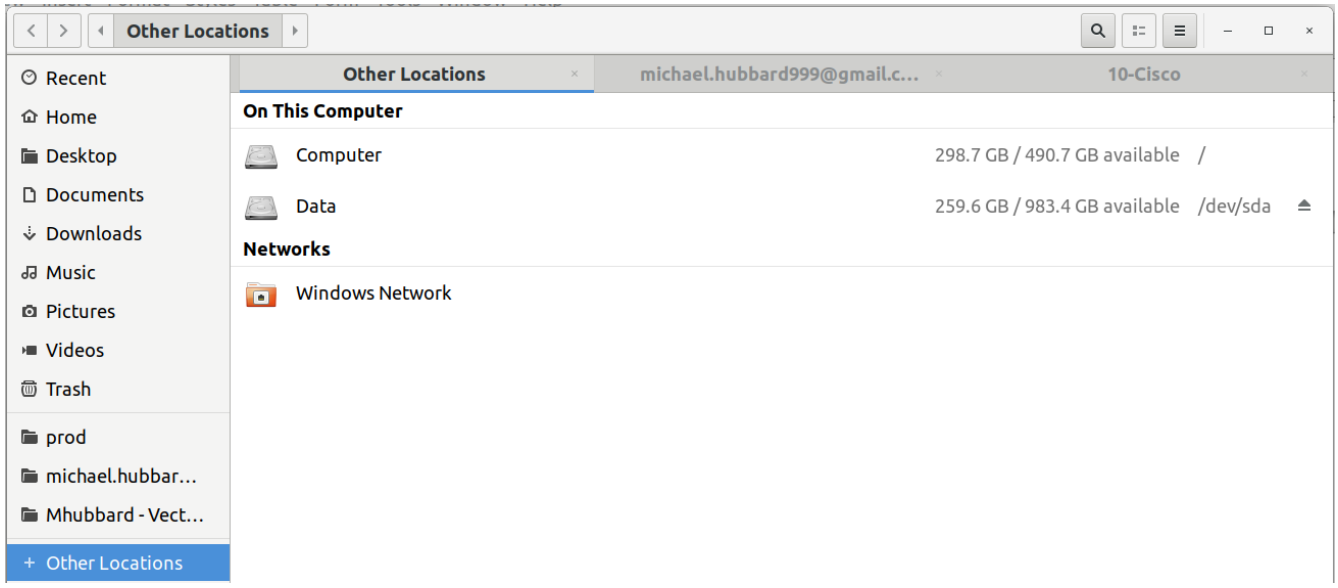
For a quick look at block devices (hard drives, thumb drives, nvme, etc.) on the system, you can use the lsblk command. Here is an lsblk listing on my Dell laptop which has an m.2 NVME drive with the OS on it and 1TB SSD for data.

```
lsblk
NAME          MAJ:MIN       RM      SIZE            RO      TYPE MOUNTPOINT
sda      8:0      0       931.5G 0        disk /media/mhubbard/Data
nvme0n1       259:0    0       465.8G 0        disk
├─nvme0n1p1 259:1             0       513.1M 0        part /boot/efi
└─nvme0n1p2 259:2             0       465.3G          0       part /
```

You can see the nvme drive has two partitions. P1 is the boot partition and p2 has the operating system. Notice that *nvme0n1p2* is type partition and mount is /. That means *nvme0n1p2* is the root of the file system.

The 1 TB SSD is named sda in the operating system and is mounted at /media/mhubbard off of the root. Looking at Nautilus you can see "Computer" which is the OS partition and "Data" which is what I named the SSD.

The display needs a little explanation. For the disk labeled "Computer" it says 298.7 GB / 490.7 GB available. That actually means it's a 490.7GB drive with 298.7GB available.



Once you get used to it, this seems more intuitive and easier to scale than the drive letter model used by Windows. You will also notice in the lsblk output that Linux/Mac, and again all *NIX systems, use the forward slash as a delimiter rather than the backslash.

Linux has many "ls" commands for listing things:

- lsblk – list block level devices like disk drives, thumb drives, etc.
- lspci – list the PCI bus devices on the system
- lsusb – list USB bus devices
- lsof – list open files
- lslogins – list logins
- lsmod – list the status of modules inserted into the kernel

I will cover each of these a later in this section.

lsusb

Linux makes it easy to see what USB devices are connected, who the manufacturer is and what the Product ID (PID) and Vendor ID (VID) are.
In this example, I have a USB to Serial adapter connected. It uses the Future Technology Devices International (FTDI) UART. It's connected to Bus 001 and the Vendor ID is 0403, Product ID is 6001.

lsusb
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 001 Device 002: ID 0c45:6a08 Microdia
Bus 001 Device 003: ID 8087:0aaa Intel Corp.
Bus 001 Device 006: ID 0403:6001 Future Technology Devices International, Ltd FT232 USB-Serial (UART) IC
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub

This is a very useful command once you make it part of your skill set. Anytime you connect a USB device you can quickly see who the manufacturer of the chipset is. Especially useful if the device isn't working correctly and want to Google for some information.

Another command that will help here is dmesg. This displays the system messages that have been logged. With the lsusb command above you can see a Future Technology USB-Serial adapter has been inserted.

If I run:
dmesg | grep FT232
[83003.234941] usb 1-3: Product: FT232R USB UART
[83003.242719] usb 1-3: Detected FT232RL
[106493.653320] usb 1-3: Detected FT232RL

You can see that the system logged the insertion of the UART.

To see what kernel module is loaded for the UART (Note – I am only showing the UART module. Other USB kernel modules were displayed):
lsmod | grep usb
usbserial 49152 3 ftdi_sio

In this example the Future Technology USB-Serial adapter is working correctly but you would do the same things to troubleshoot a device that wasn't working.

The big difference over Windows is that support for a device in Linux is built into the kernel and loads when the device is inserted. There are cases where there is no support in the kernel and you will have to go to the manufacturer's site and download a kernel module (driver in Windows). The steps above will quickly let you know that the device isn't being discovered by Linux.

SSH

*nix systems have SSH installed by default. Newer versions of the OpenSSH client don't allow weak ciphers.

The OpenSSH client allows you to create SSH keys. The current recommended cipher is Bruce Schnierers ED25519. To create a set of keys using ed25519 run the following in the terminal from the ~/.ssh directory:

ssh-keygen -o -a 100 -t ed25519

-o Use the new RFC4716 key format and the use of a modern key derivation function powered by bcrypt.
-a 100 Use 100 rounds of pbkdf2 (password based key derivation 2)

Specify a strong passphrase when prompted. The passphrase is required anytime you use the key. If you don't password protect the key, and an attacker gets access to the keys, they can log into any server you used them on.

Check the existing keys on your system
for keyfile in ~/.ssh/id_*; do ssh-keygen -l -f "${keyfile}"; done | uniq

- DSA or RSA 1024 bits: red flag. Unsafe.

- RSA 2048: yellow recommended to change
- RSA 3072/4096: great, but Ed25519 has some benefits!
- ECDSA: depends. Recommended to change
- Ed25519: wow cool, but are you brute-force safe?

Here is what it looked like on my laptop. Looks Like I have some key generation to do!

```
for keyfile in ~/.ssh/id_*; do ssh-keygen -l -f "${keyfile}"; done | uniq
4096 SHA256:569SKPB/kLsw1DqVlSV4J+bE+NYUDfY/LHNbvjvRs+o mhubbard@vectorusa.com (RSA)
3072 SHA256:6e1qwmoilpbXGQ7hb+GUoPhMxcpeMzTmgg30VOpMDmM mhubbard@HP8600-4.local (RSA)
```

Reference
https://blog.g3rt.nl/upgrade-your-ssh-keys.html

Working with services

Gnome includes a tool like “service.msc” on Windows. You start it by tapping the super key and typing “System.

Ubuntu uses a service called systemd to start and control services. At first it seems confusing and a little difficult compared to just starting “services.msc” on Windows. But like most things, after you do it a few times it’s very logical and easy to use. Here is a cheat sheet for systemd.

Viewing Systemd Information	
systemctl list-dependencies	Show a unit's dependencies)
systemctl list-sockets	List sockets and what activates
systemctl list-jobs	View active systemd jobs
systemctl list-unit-files	See unit files and their states
systemctl list-units	Show if units are loaded/active
systemctl get - default	List default target (like run level)
Working with Services	
systemctl stop service	Stop a running service
systemctl start service	Start a service
systemctl restart service	Restart a running service
systemctl reload service	See if service is running/enabled
systemctl status service	Enable a service to start on boot
systemctl enable service	Disable a service - won't start at boot
systemctl disable service	Show properties of a service (or other unit)
systemctl -H host status network	Run any systemctl command remomtely
Changing System states	
systemctl reboot	Reboot the system (reboot.target)
systemctl poweroff	Power off the system (poweroff.target0
systemctl emergency	Put in emergency mode (emergency.target)
systemctl default	Back to default target (multi-user.target)

Viewing Log Messages	
journalctl	Show all collected log messages
journalctl -u network.services	See network service messages
journalctl -f	Follow messages as they appear
journalctl -k	show only kernel messages
Runlevels to Targets Cheat sheet	
Sysvinit Runlevel	Systemd Target
0	runlevel0.target, poweroff.target
1, s, single	runlevel1.target, rescue.target
2, 4	runlevel2.target, runlevel4.target, multi-user.target
3	runlevel3.target, multi-user.target
5	runlevel5.target, graphical.target
6	runlevel6.target, reboot.target
emergency	emergency.target

Locating files from the terminal

The locate tool allows you to search everywhere on the file system.

sudo apt install mlocate – Install the tool
sudo updatedb - Updates the database, run this periodically especially if you modify the configuration file.

To configure locate:
These two articles have detailed information on customizing locate.

- https://linux.die.net/man/5/updatedb.conf - configure locate
- https://www.tecmint.com/linux-locate-command-practical-examples/

Example:
mhubbard@1S1K-G5-5587:~/Dropbox/Python/Scripts/SIET$
->locate apsum.py
/home/mhubbard/Dropbox/Python/Scripts/prod/apsum.py
/home/mhubbard/Dropbox/Python/Scripts/wlc/apsum.py

Drill - A graphical and CLI tool for searching files

From the website, "Search files without indexing, but clever crawling. It uses a different algorithm than most search tools and doesn't use a database like the the Ubuntu locate utility. It will search every mount point on the computer and is multithreaded so that it can search many at once. It will also use all available RAM to speed up the search."

In the GUI, just enter any part of the filename that you can remember. It's not case sensitive and will find the string anywhere in the name.

From the website, Download Drill, you can download the GUI (.deb) and the cli (CLI .deb). It is also available as an appimage if you don't want to install it.

To use the cli version:

drill-search-cli "filename"

Example
->drill-search-cli hs-hp
/home/mhubbard/Downloads/843dc19f-1d21-461b-b126-b46739e2c4d9_HS-HP2600-8-LA54_20190321_121957.txt
/home/mhubbard/Downloads/a77fc3cc-bbdf-4353-8bdf-c0bcba6f148f_HS-HP2600-8-LA66_20190322_081901.txt
/home/mhubbard/Downloads/f595cff7-45b4-4d80-95bd-d8c8e5d5bf18_HS-HP2600-8-LA50_20191031_153810.txt

Working with the Terminal

Like almost everything else in Linux, you can choose the shell and terminal application you want to use. Ubuntu ships with the Borne Again Shell or BASH, the same as a Mac. When you start the terminal by pressing the super key and typing terminal, you are actually starting the Gnome terminal running BASH as the shell.

I use a terminal emulator called Terminator. It allows you to add new tabs, split screens, log output and do several other useful things. I cover the installation of Terminator in the "Tools Installed from the terminal" section later in the book.

In addition to BASH there are many other shells available – the Fish Shell, Korn Shell, Z Shell, C Shell, etc. I have found BASH to be fine and I like that it is the shell shipped in most distributions so I have stuck with it.

To open a terminal you can press ctrl+alt+t. This will open whatever terminal emulator you have set as the default. See "Enhanced Terminals" late in the book for instructions on setting the default.

Here are some some tips for working in BASH.

Cut/Paste

Cutting and pasting text in BASH is slightly different than in Windows.

To copy press, Ctrl+Shift+C
To paste, press Ctrl+Shift+V

The reason for the shift key is that BASH uses Ctrl+C to terminate running processes.

Manual Pages

Most Linux terminal commands include "Manual Pages" that give details about the command. To access the Man pages you type "man <command name>". This is where the Linux phrase "RTFM" or *Read the fine manual* comes from.

For example,

man pwd

The man page opens in the terminal and you press <enter> to move down the page. You can press "e" to advance one line at a time or "y" to backup one line at a time. You can enter a "\" and a pattern to search the man page. Once you start a search you can press "n" to find the next occurrence or "N" to find the previous occurrence.

If you forget the shortcuts you can type help <enter> and the help menu will be displayed.

Tab Completion

Bash supports tab completion. This is similar to tab completion on a switch or router. Once you have typed enough to be unique you can press tab to complete the line.

explainshell.com

This is a website that has most BASH commands in a much easier format. I recommend trying out explainshell.com when you need to learn how a command works.

Virtual Console

You can also open the shell without a terminal emulator. You would normally do this if something went seriously wrong and you couldn't log in or some other issue occurred.

To open the shell in a *virtual console* enter Ctrl+Alt+F2. There are six virtual consoles – F1, F2, F3, F4, F5, F6. I have found that I usually have to hit Ctrl+Alt+F4 to get a virtual console.
The desktop will disappear and you will be placed into the virtual console with BASH running.

To switch back to the desktop enter Ctrl+Alt+F7. I have found that sometimes I have to hit Ctrl+Alt+F1 and log back into the GUI to return to the desktop. I'm not sure why and I have only used a virtual console once when I broke the login page so I haven't researched it.

Note:
Unlike Windows, Linux/Mac/Unix are case sensitive operating systems. This will take some getting used to because Text.txt is not the same thing as text.txt and the command "cd" will not work if you type Cd or CD!

The Windows PowerShell command line has most of the Linux terminal commands as aliases, if you use it as your Windows command line you can use the same commands on Windows and Linux.

History

BASH keeps a history file of every command you have typed. By default, the file is ~/.bash_history. If the file isn't there you can use "echo $HISTFILE" to locate it. To edit the file use "gedit ~/.bash_history". The file is updated when you close the terminal, so you won't see new entries in the file until you close the terminal.

To view the commands you have typed, enter "history" into the terminal. This prints all the commands in the history file plus the commands in the current shell that haven't been written to the file. There will be a number to the left of the command. For example:

->**history**
```
 1986  sudo linssid
 1987  sipcalc 10.0.246.0/30
 1988  sipcalc 10.0.246.4/30
 1989  sipcalc 10.0.246.7/30
 1990  sipcalc 10.0.246.8/30
 1991  sipcalc 10.0.246.12/30
 1992  sipcalc 10.0.246.16/30
 1993  sipcalc 10.0.246.20/30
```

To reuse the command with 1989 next to it use:

```
->!1989
sipcalc 10.0.246.7/30
-[ipv4 : 10.0.246.7/30] - 0

[CIDR]
```

Host address - 10.0.246.7
Host address (decimal) - 167835143
Host address (hex) - A00F607
Network address - 10.0.246.4
Network mask - 255.255.255.252
Network mask (bits) - 30
Network mask (hex) - FFFFFFFC
Broadcast address - 10.0.246.7
Cisco wildcard - 0.0.0.3
Addresses in network - 4
Network range - 10.0.246.4 - 10.0.246.7
Usable range - 10.0.246.5 - 10.0.246.6

You can use "**history | less**" to page through the history.

Clear the history file
history -c

Where is the history file located?
echo "$HISTFILE"
/home/mhubbard/.bash_history

View history size
echo "$HISTSIZE"
50000

Set history size
export HISTSIZE=50000

Save a record of how you built the system
One use for the history file is to back up a record of the commands used to build the system. To do this, install Ubuntu, install all the applications you need from the terminal, close the terminal and copy

~/.bash_history to a safe location.

The advantage of the history file is that when you open a new terminal you can use the up arrow and replay commands that you have used before. Once you get used to this it's a great feature. In windows you lose the history when you close the command windows.

Reference
https://www.cyberciti.biz/faq/clear-the-shell-history-in-ubuntu-linux/

***Incremental* history searching - An extremely handy tool**

See this page from the "Code in the Hole" blog for more detail: The most important command line tip incremental history searching with inputrc

This is the greatest time saver imaginable! It reads the bash history and lets you search it using the first couple letters of the command and then the up arrow.

To configure it, in terminal enter:
gedit ~/.inputrc

Then copy paste and save:
"\e[A": history-search-backward
"\e[B": history-search-forward
"\e[C": forward-char
"\e[D": backward-char

One extra thing: this functionality can be neatly complimented by some choice history settings in your ~/.bashrc file:

export HISTSIZE=1000000
export HISTFILESIZE=1000000000
shopt -s histappend

The "shopt -s histappend" appends the history rather than having it over.write

From the "code in the hole" website:
All you need to do to find a previous command is to enter say the first two or three letters and upward arrow will take you there quickly:

Say I want:

for f in *.mid ; do timidity "$f"; done

All I need to do is enter:

fo

And hit the upward arrow. The command will soon appear.

If you hit the up arrow again it will find the next occurrence.

On a Raspberry Pi, I had to create the ~/.inputrc file first, then this tip worked just like on Ubuntu.

Reference
Power Shell Usage
https://www.ukuug.org/events/linux2003/papers/bash_tips/

Auto-jump

From the site: A cd command that learns - easily navigate directories from the command line

autojump is a faster way to navigate your filesystem. It works by maintaining a database of the directories you use the most from the command line.

Directories must be visited first before they can be jumped to.

I recently found this project on github.com. It learns the directories you use and allows you to jump to them by typing the first few letters of the directory. For example, I keep my Fortinet vpn scripts in "/home/mhubbard/michael.hubbard999@gmail.com/01_Vector/01_Forticlient-64bit" which is obviously a lot to type when I want to run one of the scripts. But with autojump I just have to enter

j fo

from anywhere and it jumps me to the right folder.

Installation

autojump is in the Ubuntu repository so we can use apt to install it:

sudo apt install autojump

After the install finishes you need to edit ~/.bashrc (gedit ~/.bashrc) and add the following to the end of the file:

#start autojump - /usr/share/autojump/
. /usr/share/autojump/autojump.sh

It will take a while before autojump has a lot of your directories memorized but once it does you will save a lot of time navigating the terminal.

Reference
autojump

Display a new line on the prompt in terminal

https://askubuntu.com/questions/16424/displaying-a-new-line-on-the-prompt

I like to have a new line inserted after the prompt so that my commands are below the prompt. To do that you just need to edit your .bashrc file and add PS1="$PS1\n->" to the bottom of the file:

gedit ~/.bashrc
PS1="$PS1\n->"
save and exit

To reload the file:
exec "$BASH"

Example:
mhubbard@1S1K-G5-5587:/usr/share/nmap/scripts/vulscan/utilities/updater$
->sudo nmap -sV -sC 192.168.10.181

Installing and using zsh instead of bash

Bash is the default shell on Ubuntu. Bash, the Bourne Again Shell, has been around since the 1990s and works great. But there is another shell, zsh, the I have switched to. The big reason is that there is an add on called "Ho My ZSH" which is an unbelievably active community that creates themes and plugins for zsh.

Some zsh Features

- Command-line completion.
- History can be shared among all shells.
- Extended file globbing.
- Better variable and array handling.
- Compatibility with shells like bourne shell.
- Spelling correction and autofill of command names.
- Named directories.

https://www.tecmint.com/install-zsh-in-ubuntu/

sudo apt update
sudo apt upgrade
sudo apt install zsh

Check the version
zsh --version

zsh 5.8 (x86_64-ubuntu-linux-gnu)

This is the current version as of May 2021

You can check your current shell using the echo command:
echo $SHELL
/bin/bash

You can see that the current shell is bash

Run this to make zsh the default
chsh -s $(which zsh)

Verify
grep zsh /etc/passwd
mhubbard:x:1000:1000:Michael Hubbard,,,:/home/mhubbard:/usr/bin/zsh

Log out of the current bash session and restart terminal to use zsh

exit

Reopen a terminal with crtl+alt+t

You will get a message saying zsh needs some configuration:

```
This is the Z Shell configuration function for new users,
zsh-newuser-install.

You are seeing this message because you have no zsh startup files
(the files .zshenv, .zprofile, .zshrc, .zlogin in the directory
~).  This function can help you with a few settings that should
make your use of the shell easier.

You can:

(q)  Quit and do nothing.  The function will be run again next time.
(0)  Exit, creating the file ~/.zshrc containing just a comment.
     That will prevent this function being run again.
(1)  Continue to the main menu.
(2)  Populate your ~/.zshrc with the configuration recommended
     by the system administrator and exit (you will need to edit
     the file by hand, if so desired).

--- Type one of the keys in parentheses --- 0
1S1K-G5-5587%
```

I chose 0 to just create the .zshrc file and exit because I am going to install a tool called "Oh My ZSH" to customize the shell.

Install Oh My zsh

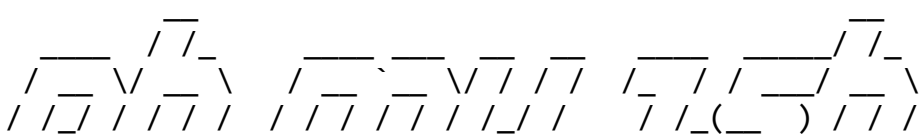
From https://ohmyz.sh/#install

sh -c "$(curl -fsSL https://raw.github.com/ohmyzsh/ohmyzsh/master/tools/install.sh)"

When the install shell starts you will see:

Found ~/.zshrc. Backing up to /home/mhubbard/.zshrc.pre-oh-my-zsh
Using the Oh My Zsh template file and adding it to ~/.zshrc.

Time to change your default shell to zsh:
Do you want to change your default shell to zsh? [Y/n] y
Changing the shell...
Password:
Shell successfully changed to '/usr/bin/zsh'.



```
\____/_/ /_/  /_/ /_/ /_/\__, /    /___/____/_/ /_/
                         /____/                    ....is now installed!
```

Before you scream Oh My Zsh! please look over the ~/.zshrc file to select plugins, themes, and options.

• Follow us on Twitter: https://twitter.com/ohmyzsh
• Join our Discord server: https://discord.gg/ohmyzsh
• Get stickers, shirts, coffee mugs and other swag: https://shop.planetargon.com/collections/oh-my-zsh

Add a theme, some plugins and aliases

Open the .zshrc file
gedit ~/.zshrc
Find the plugin line and change it to
plugins=(
git
zsh-completions
zsh-autosuggestions
zsh-syntax-highlighting
history-substring-search
colored-man-pages
aliases
zsh-docker-aliases
)

Download the plug ins (Autojump should already be installed if you have been following the book. If not follow the instructions in the previous section to install autojump.

git clone https://github.com/zsh-users/zsh-completions ${ZSH_CUSTOM:=~/.oh-my-zsh/custom}/plugins/zsh-completions
git clone https://github.com/zsh-users/zsh-syntax-highlighting.git ${ZSH_CUSTOM:-~/.oh-my-zsh/custom}/plugins/zsh-syntax-highlighting
git clone https://github.com/zsh-users/zsh-autosuggestions ${ZSH_CUSTOM:-~/.oh-my-zsh/custom}/plugins/zsh-autosuggestions

Oh My ZSH offers a lot of themes. I found one that I really like called duellj. To install it change the ZSH-THEME line to:
ZSH_THEME="duellj"

I also like “amuse”. It’s similar to duellj but doesn’t put the username/machine name in the terminal. Since I’m on my personal laptop I don’t need that information. To use “amuse”

ZSH_THEME="amuse"

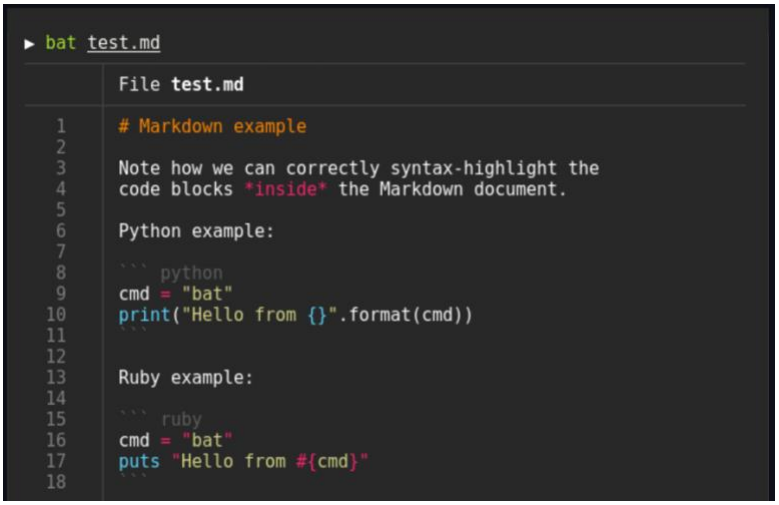
https://github.com/ohmyzsh/ohmyzsh/wiki/Themes

Bat - A cat clone with syntax highlighting and Git integration

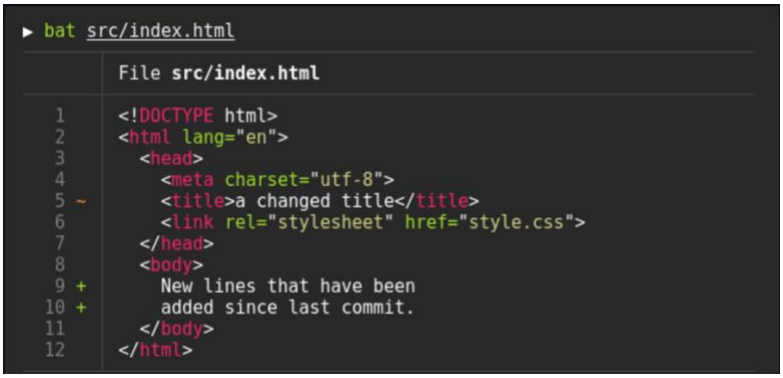
This is a great upgrade to cat. The automatic paging, syntax highlighting, Git integration and the ability to show non-printable characters makes replacing cat with bat a no brainer.

There are a lot of other features to bat. You should review the official Git repository at https://github.com/sharkdp/bat

Syntax highlighting
bat supports syntax highlighting for a large number of programming and markup languages:



Git integration
bat communicates with git to show modifications with respect to the index (see left side bar):



Show non-printable characters
You can use the -A/--show-all option to show and highlight non-printable characters:

Installation

On Ubuntu (using most recent .deb packages)
... and other Debian-based Linux distributions.
Download the latest .deb package from the release page (https://github.com/sharkdp/bat/releases) and install it via:

sudo dpkg -i bat-musl_0.23.0_amd64.deb # adapt version number and architecture

Important: If you install bat this way, please note that the executable may be installed as batcat instead of bat (due to a name clash with another package). You can set up a bat -> batcat symlink or alias to prevent any issues that may come up because of this and to be consistent with other distributions:

mkdir -p ~/.local/bin
ln -s /usr/bin/batcat ~/.local/bin/bat

If you want to use an alias instead of a symlink, add

alias cat='batcat'

to ~/.zshrc

Enhanced Terminals

There are several tiling terminal emulators available for Ubuntu. Tiling means that the terminal can be carved up into several "tiles" each of which can be in a different directory and running different programs. Since a network engineer spends a lot of time in the terminal, a tiling emulator will improve your productivity. I use Terminator, here is a link to an article on four others - https://www.rootusers.com/five-best-terminal-emulators-linux/

Terminator - An enhanced terminal that supports logging, split windows and much more. The logging feature is really nice, as you start a new task in the terminal, just right click and select logging. You are prompted for a filename and everything done in the terminal is logged, not just the keystrokes you type. It's great for capturing nmap scans or other terminal apps.

sudo apt install terminator -y

Detailed description of Terminator
Terminator Linux terminal emulator

Some useful shortcuts in Terminator
ctrl + shift + "+" - increase text size
ctrl + "-" - decrease text size
ctrl + 0 - reset text size to default
Ctrl+Shift+G - reset terminal state and clear window
Ctrl+PageDown - Move to next Tab.
Ctrl+PageUp - Move to previous Tab.
Ctrl+Shift+Right - Move parent dragbar Right.
Ctrl+Shift+Left - Move parent dragbar Left.
Ctrl+Shift+Up - Move parent dragbar Up.
Ctrl+Shift+Down - Move parent dragbar Down.

Pick the default terminal program

sudo update-alternatives --config x-terminal-emulator
Then select your choice from the menu

Example:
sudo update-alternatives --config x-terminal-emulator
[sudo] password for mhubbard:
There are 2 choices for the alternative x-terminal-emulator (providing /usr/bin/x-terminal-emulator).

```
  Selection    Path      Priority   Status
------------------------------------------------------------
* 0   /usr/bin/terminator      50      auto mode
  1   /usr/bin/gnome-terminal.wrapper   40      manual mode
  2   /usr/bin/terminator      50      manual mode
```

Press <enter> to keep the current choice[*], or type selection number: 0

Bash Commands

Press "ctrl+alt+t" to open the terminal. Once the terminal is open, you can use the following commands for common operations.
~ – the tilde represents your home directory in Linux. You can **cd ~** from any level to return to the home directory. For example:

mhubbard@1S1K-G5-5587:~/Dropbox/Python/Scripts/prod$

->**cd ~**

mhubbard@1S1K-G5-5587:~$

Using **pwd** to "print the working directory" you will see that I am now at /*home*/mhubbard

->**pwd**

/home/mhubbard

mhubbard@1S1K-G5-5587:~$

cat – print the contents of text files to the terminal.

From the man page
NAME
cat - concatenate files and print on the standard output

SYNOPSIS
cat [OPTION]... [FILE]...

DESCRIPTION
Concatenate FILE(s) to standard output.

Example 1
Print the contents of a text file.

```
mhubbard@1S1K-G5-5587:~/Dropbox/Python/Scripts/prod$
->cat vlans.txt
 ip address 10.140.1.125 255.255.255.128
 ip address 10.140.0.254 255.255.255.0
 ip address 10.140.39.254 255.255.248.0
 ip address 10.140.47.254 255.255.254.0
 ip address 10.141.15.254 255.255.248.0
 ip address 10.141.7.254 255.255.248.0
 ip address 10.140.45.254 255.255.254.0
 ip address 10.141.23.254 255.255.248.0
 ip address 172.16.1.254 255.255.255.0
 ip address 172.16.202.254 255.255.255.0
 ip address 10.140.1.254 255.255.255.128
# ip address 10.100.15.254 255.255.240.0
```

ip address 10.101.0.254 255.255.255.0

Example 2
combine test1.txt and test2.text into test3.txt

->echo test file 1 > test1.txt
->echo test file 2 > test2.txt
->cat test1.txt test2.txt > test3.txt
->cat test3.txt
test file 1
test file 2

Example 3
Concatenate text into a jpeg file. This is useful if you want to send a short text message in a jpeg file. Great for adding notes to photos.

In this example, I have a jpeg file named airbox.JPG and a text file named steg.txt. I will use cat to combine them into test-steg.jpg.

cat airbox.JPG steg.txt > test-steg.jpg

Now, using cat to display test-steg.jpg (Note: this is the bottom of the file, the beginning will be the gibberish from the jpg)

cat airbox.JPG steg.txt > test-steg.jpg

k3 qZ #%. This is an example of hiding text inside a jpg file.

zcat – Similar to cat but works on gzip archives. The link below has multiple examples of using zcar.

https://www.tecmint.com/linux-zcat-command-examples/

cd – the change directory command, same as windows. Just like in Windows, you can use .. to go back one level. You can also use directory traversal – cd ../../Python/Scripts/prod/. In this example, I went up two levels from the current directory and then to the Python/Scripts/prod folder.

mhubbard@1S1K-G5-5587:~/Dropbox/03_Tools/dnstwist$

->**cd ../../Python/Scripts/prod/**

mhubbard@1S1K-G5-5587:~/Dropbox/Python/Scripts/prod$

Once you get used to directory traversal it is much faster to move around in the terminal.

Note:
Directory Traversal works on Windows also but obviously, you have to use "\" instead of "/".

cp – copy files. Format is cp source destination.

Example of copying a file named test.txt from the current directory to the desktop:

cp test.txt Desktop/
Example of copying a file from a remote directory to the current directory. The "." represents the current working directory.

cp /home/mhubbard/Dropbox/Python/Scripts/prod/apsum.txt .
pwd
/home/mhubbard/tftp-root
ls -l ap*
-rw-rw-r-- 1 mhubbard mhubbard 1641 Jun 7 15:25 apsum.txt

echo – copy text to a file.

Example
Copy the text "test file 1" to a file named test1.txt

echo test file 1 > test1.txt

less – display text files and use cursor keys to navigate. Press Q to quit. For example:

less apsum.txt

ls – list files, similar to dir on windows. You can add -l so show a long format and -la to show the long format and hidden files. The man page (man ls) will list all the options.

mkdir – make directory. Usage is simply mkdir dir-name

mv – move or rename a file or directory. To rename a file you simply "move" it to a new name. The format is mv source-file destination-file

For example:

mv apsum.txt apsum1.txt

mhubbard@1S1K-G5-5587:~/tftp-root$

->ls -l ap*

-rw-rw-r-- 1 mhubbard mhubbard 1641 Jun 7 15:25 apsum1.txt

pwd – print working directory. This prints to the screen the directory you are currently in.

rm – remove. This is different than the windows del command and will take a little getting used to. To remove one file you just use **rm filename**. To remove a directory that has files in it you must add the recursive and force options -rf. To remove the directory ~/Dropbox/Python/Scripts/prod you would enter:

rm -rf ~/Dropbox/Python/Scripts/prod/

Note
There is no confirmation when you hit enter. Make sure that the path you entered is the path you wanted. Once enter is pressed the directory will be deleted immediately.

---

grep

One of the best tools in Linux! You can search a directory or recursively through the file system for a pattern inside a file.

From the man page

NAME
grep - print lines matching a pattern

SYNOPSIS
grep [OPTIONS] PATTERN [FILE...]
grep [OPTIONS] -e PATTERN ... [FILE...]
grep [OPTIONS] -f FILE ... [FILE...]

DESCRIPTION

grep searches for PATTERN in each FILE. A FILE of "-" stands for standard input. If no FILE is given, recursive searches examine the working directory, and nonrecursive searches read standard input. By default, grep prints the matching lines.

Example 1

I have backups of several switches in a directory. I wanted to pull out the management IP address for each switch. I knew they all started with 10.56.246 and had a 255.255.255.0 mask.

I used a regular expression (regex) to look for 10.56.246. and any number from 0-9. I then passed the results of that to grep again using the "|" operator to strip off the "ip addresss", "ntp server" etc.

Regular expressions are beyond the scope of this book but they are very powerful for searching. A Google search for regex will return many articles on how to use them. I like this one Computer Hope Regex Examples

In the gedit text editor built into Ubuntu you can use regex expressions for search/replace. The actual names of the files were real site names that were four characters long. I wanted to change the real name to site. I just hit crtl_h, selected regex and entered:

^…. in the find box and site in the replace box. The ^ means "start of line" and a "." means match one character.

```
mhubbard@1S1K-G5-5587:~/Dropbox/01_test/configs/DataCenter$

->grep -r 10.56.246.[0-9]
site1-6880x.wri: ip address 10.56.246.178 255.255.255.0
site1-6880x.wri: network 10.56.246.178 0.0.0.0
site1-6880x.wri:ntp server 10.56.246.56 prefer
site2-6880x.wri: ip address 10.56.246.58 255.255.255.0
site2-6880x.wri: network 10.56.246.58 0.0.0.0
site2-6880x.wri:ntp server 10.56.246.56 prefer
```

```
site3-6880x.wri: ip address 10.56.246.229 255.255.255.0
site3-6880x.wri: network 10.56.246.229 0.0.0.0
```

Now with the second grep:

mhubbard@1S1K-G5-5587:~/Dropbox/test/configs/DataCenter$

```
->grep -r 10.56.246.[0-9] | grep 255.255.255.0
site1-6880x.wri: ip address 10.56.246.178 255.255.255.0
site2-6880x.wri: ip address 10.56.246.58 255.255.255.0
site3-6880x.wri: ip address 10.56.246.229 255.255.255.0
site4-6880xx.wri: ip address 10.56.246.214 255.255.255.0
site5-6880x.wri: ip address 10.56.246.221 255.255.255.0
site6-6880x.wri: ip address 10.56.246.241 255.255.255.0
site7-6880x.wri: ip address 10.56.246.219 255.255.255.0
site8-6880X.wri: ip address 10.56.246.133 255.255.255.0
site9-6880x.wri: ip address 10.56.246.51 255.255.255.0
site10-6880x.wri: ip address 10.56.246.180 255.255.255.0
site11-6880x.wri: ip address 10.56.246.194 255.255.255.0
```

If I just want the IP address, I can add the "awk" command to print only the 4th item on the line:

```
grep -r 10.56.246.[0-9] | grep 255.255.255.0 | awk '{ print $4 }'
10.56.246.178
10.56.246.58
10.56.246.229
10.56.246.214
10.56.246.221
10.56.246.241
10.56.246.219
10.56.246.133
```

If you have IP addresses are on multiple vlans you can use:

grep -E and the regex '[0-9]{1,3}\.'

That uses a "quantifier" to find 0-9 1, 2 or 3 times and then a ".", the \ is used to tell grep that the "." isn't a regex operator but a real dot. It's called "escaping".

The "-E" is needed and is called extended regex.

Example 2

A while back I needed to find a handful of Dell switches on a large subnet full of Dell computers and other devices. Since almost all of the MAC addresses were Dell just looking for MAC addresses didn't help.

I ran nmap and saved the output to a file.

```
sudo nmap -sS -T4 -sC -p23 -oA powerconnect -n -Pn --open --stylesheet nmap-bootstrap.xsl 10.112.69.1-50
```

Looking at the file it was obvious that the switches returned "Ports: 23/open/tcp//telnet///".

Contents of snippet from powerconnect.gnmap

```
# Ports scanned: TCP(1;23) UDP(0;) SCTP(0;) PROTOCOLS(0;)
Host: 10.112.69.2 ()  Status: Up
Host: 10.112.69.2 ()  Ports: 23/open/tcp//telnet///
Host: 10.112.69.3 ()  Status: Up
Host: 10.112.69.3 ()  Ports: 23/open/tcp//telnet///
Host: 10.112.69.4 ()  Status: Up
Host: 10.112.69.4 ()  Ports: 23/open/tcp//telnet///
```

A quick grep returned just the IP addresses of the switches. The awk command after the pipe just means print the second parameter in the stream. In this example "Host:" is the first parameter.

```
grep telnet/// powerconnect.gnmap | awk '{ print $2 }'
10.112.69.2
10.112.69.3
10.112.69.4
10.112.69.5
10.112.69.6
10.112.69.7
10.112.69.8
10.112.69.9
10.112.69.10
10.112.69.11
10.112.69.14
10.112.69.15
10.112.69.16
10.112.69.17
10.112.69.18
10.112.69.19
10.112.69.21
10.112.69.22
10.112.69.23
10.112.69.44
```

Example 3

In this example, I was looking for a set of switches that had IP addresses in the range of 10.255.255. The syslog was massive so opening it in an editor and use the search feature was impractical. But piping the output of the grep/awk combo to the sort command returned only unique IP addresses almost immediately.

```
grep 10.255.255 SyslogCatchAll.txt.001 | awk '{ print $4 }' | sort -u
```

```
10.255.255.110
10.255.255.111
10.255.255.113
10.255.255.13
10.255.255.14
10.255.255.17
```

Example 4

I had a directory with 8 files in it. They contained Vlan IDs, IP addresses, MAC Addresses, Port Numbers and manufacturer names. I need to pull out just the ports with certain manufacturer names. A little grep with some sort thrown in and the job is done!

Here is a listing of the files in the directory:

ls -l (Some information removed for clarity)
RPU-Springs-ports.txt
RPUVidSec-ports.txt
UOC-BldgB-Water-ports
UOC1stSW1-ports.txt
UOC1stSW2-ports.txt
UOCCore-ports.txt
UOCbldgB-Sw1-ports.txt
UOCbldgB-Sw2-ports.txt

Here is the "grep" command:

```
grep -E
'Uni|Axi|Aru|Chec|Sam|Sony|Hew|Honey|SHA|Pronet|IB|Digibo|Siemens|Tanta|Bosch|
Videx|Industr' *.txt | sort -u -b -k 1 -k 6 -k 5
```

The options:
-E – Interpret PATTERN as an extended regular expression. Without this I would have to use \| instead of just | to get the OR function.
`Uni|AXI… - These are the manufacturers that I wanted to find.
*.txt – Search all files with extension txt
Sort – Pipe the output of the grep to the sort command
-u - Unique
-b - Ignore leading blanks.
-k - sort a table on any column number by using -k option.

The result: (Truncated for space. There were a lot more ports returned)

```
RPU-Springs-ports.txt:  905   10.80.152.168    9c1c.12c4.f84a    Gi0/9       ArubaaHe
RPU-Springs-ports.txt:  905   10.80.153.196    3c52.82bd.14b1    Gi0/2       HewlettP
UOC-BldgB-Water-ports:   64   10.14.64.4       000b.d801.8b94    Gi1/0/20    Industri
UOC-BldgB-Water-ports:  905   10.80.152.63     9c1c.12c4.f846    Gi1/0/24    ArubaaHe
UOC-BldgB-Water-ports:  905   10.80.152.69     0009.9f00.17c4    Gi1/0/13    Videx
UOC-BldgB-Water-ports:  905   10.80.152.80     e4e7.49a3.dde5    Gi1/0/24    HewlettP
UOC1stSW1-ports.txt:     63   10.14.63.212     0004.6368.d0e9    Gi0/44      BoschSec
UOC1stSW1-ports.txt:     65   10.14.65.154     0025.5a22.31e3    Gi0/40      Tantalus
UOC1stSW1-ports.txt:    905   10.195.1.190     fc15.b475.1b69    Gi0/37      HewlettP
UOC1stSW1-ports.txt:    905   10.80.152.189    f09f.fc30.119a    Gi0/39      SHARP
```

```
UOC1stSW1-ports.txt:    905   10.80.152.61     0003.2d2a.764c    Gi0/28      IBASETec
UOC1stSW2-ports.txt:    905   10.80.152.216    00a0.0306.d1fa    Gi0/41      SiemensS
UOCCore-ports.txt:      101   10.253.196.2     001c.7f81.2483    Gi2/23      CheckPoi
UOCCore-ports.txt:      260   10.251.80.10     001c.7f81.2480    Gi2/24      CheckPoi
UOCCore-ports.txt:      905   10.80.152.23     0009.9fff.0aa6    Gi4/10      Videx
UOCbldgB-Sw1-ports.txt: 905   10.80.152.44     0009.9f00.21bf    Gi1/0/16    Videx
UOCbldgB-Sw2-ports.txt: 905   10.80.152.63     9c1c.12c4.f846    Gi1/0/13    ArubaaHe
```

These 8 switches had almost 400 ports (48x8) and this took less than a second to do. Manually, I would have had to open each of the 8 files, look for the manufacturer and then copy the information to a new file. I was migrating 72 sites and had to do this for each site. Some sites had as many as 22 IDFs!

I hope that these examples have shown you how useful the grep command is!

References

Linux sort command
Linux uniq command

touch

Touch is an odd little utility. If you run "touch filename" and filename doesn't exist, touch creates an empty file with the current time as the creation date. If you run "touch filename" and filename does exist it changes the timestamp to the current system time and does not modify the file.

How can I change the date modified of a file

From the man page:

Name

touch - change file timestamps.

SYNOPSIS

touch [OPTION]... FILE…

DESCRIPTION

Update the access and modification times of each FILE to the current time.

A FILE argument that does not exist is created empty.

Uncomplicated firewall

Ubuntu's built-in firewall is called the Uncomplicated Firewall.

To check it's status run the following:

systemctl status ufw (active)

```
● ufw.service - Uncomplicated firewall
     Loaded: loaded (/lib/systemd/system/ufw.service; enabled; vendor preset: enabled)
     Active: active (exited) since Sat 2021-05-01 14:20:29 PDT; 1h 4min ago
       Docs: man:ufw(8)
   Main PID: 371 (code=exited, status=0/SUCCESS)
      Tasks: 0 (limit: 38092)
     Memory: 0B
     CGroup: /system.slice/ufw.service

May 01 14:20:29 1S1K-G5-5587 systemd[1]: Finished Uncomplicated firewall.
Warning: journal has been rotated since unit was started, output may be incomplete.
```

systemctl status ufw (inactive)

```
● ufw.service - Uncomplicated firewall
   Loaded: loaded (/lib/systemd/system/ufw.service; enabled; vendor preset: enabled)
   Active: inactive (dead) since Fri 2019-03-01 22:01:57 PST; 2s ago
   Docs: man:ufw(8)
  Process: 6170 ExecStop=/lib/ufw/ufw-init stop (code=exited, status=0/SUCCESS)
 Main PID: 589 (code=exited, status=0/SUCCESS)

Mar 01 22:01:57 1S1K-G5-5587 systemd[1]: Stopping Uncomplicated firewall...
Mar 01 22:01:57 1S1K-G5-5587 ufw-init[6170]: Skip stopping firewall: ufw (not enabled)
Mar 01 22:01:57 1S1K-G5-5587 systemd[1]: Stopped Uncomplicated firewall.
Warning: Journal has been rotated since unit was started. Log output is incomplete or
unavailable.
```

To stop the firewall, run the following:

sudo systemctl stop ufw

To start the firewall, run the following:

sudo systemctl start ufw

UFW works with IPv6. To verify that IPv6 is open:

sudo nano /etc/default/ufw

And make sure that
IPV6=yes
Display verbose settings:

```
sudo ufw status verbose
Status: active
```

```
Logging: on (low)
Default: reject (incoming), allow (outgoing), deny (routed)
New profiles: skip

To                         Action      From
--                         ------      ----
514/udp                    ALLOW IN    Anywhere
69/udp                     ALLOW IN    Anywhere
514/udp (v6)               ALLOW IN    Anywhere (v6)
69/udp (v6)                ALLOW IN    Anywhere (v6)
```

Display UFW logs

```
tail -f /var/log/ufw.log
May  1 15:14:25 1S1K-G5-5587 kernel: [ 3241.624413] [UFW BLOCK] IN=wlp0s20f3
OUT= MAC=3c:6a:a7:3a:e3:e6:9c:8c:d8:c9:17:ae:08:00 SRC=192.168.10.144
DST=224.0.0.251 LEN=221 TOS=0x00 PREC=0x00 TTL=255 ID=49450 PROTO=UDP
SPT=53535 DPT=53535 LEN=201
```

You can also find UFW's logs in the kernel buffer.

```
sudo dmesg | grep '\[UFW'
```

Allowing inbound connections

```
sudo ufw allow <port#>
```

For example, to allow ssh

```
sudo ufw allow 22
```

Allow a range of ports

You can specify port ranges with UFW. Some applications use multiple ports, instead of a single port.

For example, to allow VoIP connections, which use ports 5060-5061, use these commands:

```
sudo ufw allow 5060:5061/tcp
```

Allowing a specific IP address inbound

```
sudo ufw allow from 203.0.113.4 to any port 22
```

Subnets

If you want to allow a subnet of IP addresses, you can do so using CIDR notation. For example, if you want to allow all of the IP addresses ranging from 10.10.10.1 to 10.10.10.254 you could use this command:

```
sudo ufw allow from 10.10.10.0/24 to any port 22
```

Connections to a Network Interface

Create a firewall rule that only applies to a specific network interface,
Sometimes you have multiple USB adapters connected and my want to allow traffic to a specific interface.

In this example, I want to allow ssh to enp60s0

```
sudo ufw allow in on enp60s0 to any port 22
```

Deleting Rules

Use the UFW status command to display numbers next to each rule:

```
sudo ufw status numbered
```

Status: active

```
     To                         Action      From
     --                         ------      ----
[ 1] 514/udp                    ALLOW IN    Anywhere
[ 2] 69/udp                     ALLOW IN    Anywhere
[ 3] 514/udp (v6)               ALLOW IN    Anywhere (v6)
[ 4] 69/udp (v6)                ALLOW IN    Anywhere (v6)
```

To delete the IPv4 rule for tftp
sudo ufw delete 2

Reset to default

If you have made changes that you don't want any longer:

```
sudo ufw reset
```

This will disable UFW and delete any rules that were previously defined.

Reference

https://serverfault.com/questions/516838/where-are-the-logs-for-ufw-located-on-ubuntu-server
https://www.digitalocean.com/community/tutorials/how-to-set-up-a-firewall-with-ufw-on-ubuntu-20-04

dstat - versatile tool for generating system resource statistics

From the MAN page
NAME
dstat - versatile tool for generating system resource statistics

SYNOPSIS
dstat [-afv] [options..] [delay [count]]

DESCRIPTION
Dstat is a versatile replacement for vmstat, iostat and ifstat. Dstat overcomes some of the limitations and adds some extra features.

Dstat allows you to view all of your system resources instantly, you can eg. compare disk usage in combination with interrupts from your IDE controller, or compare the network bandwidth numbers directly with the disk throughput (in the same interval).

Dstat also cleverly gives you the most detailed information in columns and clearly indicates in what magnitude and unit the output is displayed. Less confusion, less mistakes, more efficient.

Dstat is unique in letting you aggregate block device throughput for a certain diskset or network bandwidth for a group of interfaces, ie. you can see the throughput for all the block devices that make up a single filesystem or storage system.

Dstat allows its data to be directly written to a CSV file to be imported and used by OpenOffice, Gnumeric or Excel to create graphs.

There are a lot more options, just run "man dstat" and you see the entire list. Here are two examples. The first one has cpu (-c), disk (-d), memory (-m), network (-n), and swap file (-s). The second is just the wireless interface.

```
dstat -cdmns
--total-cpu-usage-- -dsk/total- ------memory-usage----- -net/total- ----swap---
usr sys idl wai stl| read  writ| used  free  buff  cach| recv  send| used  free
 14   5  80   0   0| 274k 2121k|9701M  717M  332M 7177M|   0     0 |  13M 2035M
 15   3  80   2   0|   0  8192B|9693M  725M  332M 7172M| 450B    0 |  13M 2035M
 16   3  79   2   0|   0     0 |9704M  714M  332M 7183M| 844B  954B|  13M 2035M
 17   3  78   1   0|   0   220k|9706M  712M  332M 7183M|3183B 2180B|  13M 2035M
 19   5  74   2   0|   0   820k|9701M  716M  332M 7183M| 980B  156B|  13M 2035M
 17   3  78   2   0|   0   240k|9690M  728M  332M 7169M| 768B  370B|  13M 2035M
 18   4  76   1   0|   0     0 |9695M  723M  332M 7174M|1030B  902B|  13M 2035M
 17   4  78   1   0|   0     0 |9685M  733M  332M 7168M|4413B 2006B|  13M 2035M
 21   6  72   1   0|  56k  192k|9692M  726M  332M 7174M|  15k 3991B|  13M 2035M
 16   4  79   1   0|   0     0 |9696M  721M  332M 7174M|4133B  324B|  13M 2035M
 17   4  77   1   0|   0   284k|9693M  725M  332M 7174M|1508B 1472B|  13M 2035M
```

Monitor a network interface
In this example my wireless adapter is wlp0s20f3

```
dstat -n -N wlp0s20f3
```

net/wlp0s20
recv send
0 0
228B 94B
183B 305B
192B 258B
163B 557B
605B 321B

The Ubuntu Software Store

Ubuntu has its own app store. It has a surprisingly large selection of software. To open the store, simply hit the Super Key and type software. You will see icons for software update and Ubuntu Software. Select Ubuntu Software to open the store. From the homepage you can browse or click the magnifying glass and search.

Brasero – ISO, CD, DVD tool

Brasero is a simple application to burn, copy and erase CD and DVD media: audio, video or data. It features among other things:

- On-the-fly burning
- Multisession support
- On-the-fly conversion of music playlists in all formats supported by Gstreamer

Ubuntu stopped including Brasero in 18.04 but if you need to burn CD/DVDs you can install it using the Ubuntu software store.

Cheese webcam

I purchased an endoscope on Endoscope on Ebay for under $20. It's very useful for looking behind racks and any area where you can't get your head. The listing said it only worked with Windows and it came with a driver CD, but when I mounted the iso on Windows, Defender popped up saying there was a trojan on it.

Instead of dealing with the driver, I connected the endoscope to my Ubuntu laptop, the driver was in the kernel, and it works perfect with Cheese.

FBReader - A multi-platform ebook reader

Main features:

- supports several open e-book formats: fb2, html, chm, plucker, palmdoc, ztxt, tcr (psion text),
- rtf, oeb, openreader, non-DRM'ed mobipocket, plain text, epub, eReader
- sreads directly from tar, zip, gzip, bzip2 archives (you can have several books in one archive)
- supports a structured view of your e-book collection
- automatically determines encodings
- automatically generates a table of contents
- keeps the last open book and the last read positions for all open books between runs
- automatic hyphenation (patterns for several languages are included)
- searching and downloading books from www.feedbooks.com and www.litres.ru
- partial CSS support for epub files

Flameshot – Screenshot tool

My favorite screenshot tool, similar to the Windows snipping tool. Powerful and simple to use built-in editor with advanced features. Here is a tutorial for Flameshot:
Flameshot screenshot software for Linux

A nice feature of Flameshot is that you can start it from the terminal with the following:

```
flameshot gui -d 5000
```

And you will have 5 seconds to switch to the screen you want to capture. It allows you to screenshot dropdown menus that would close if you tried opening Flameshot with the mouse.

Glances - An alternative to htop

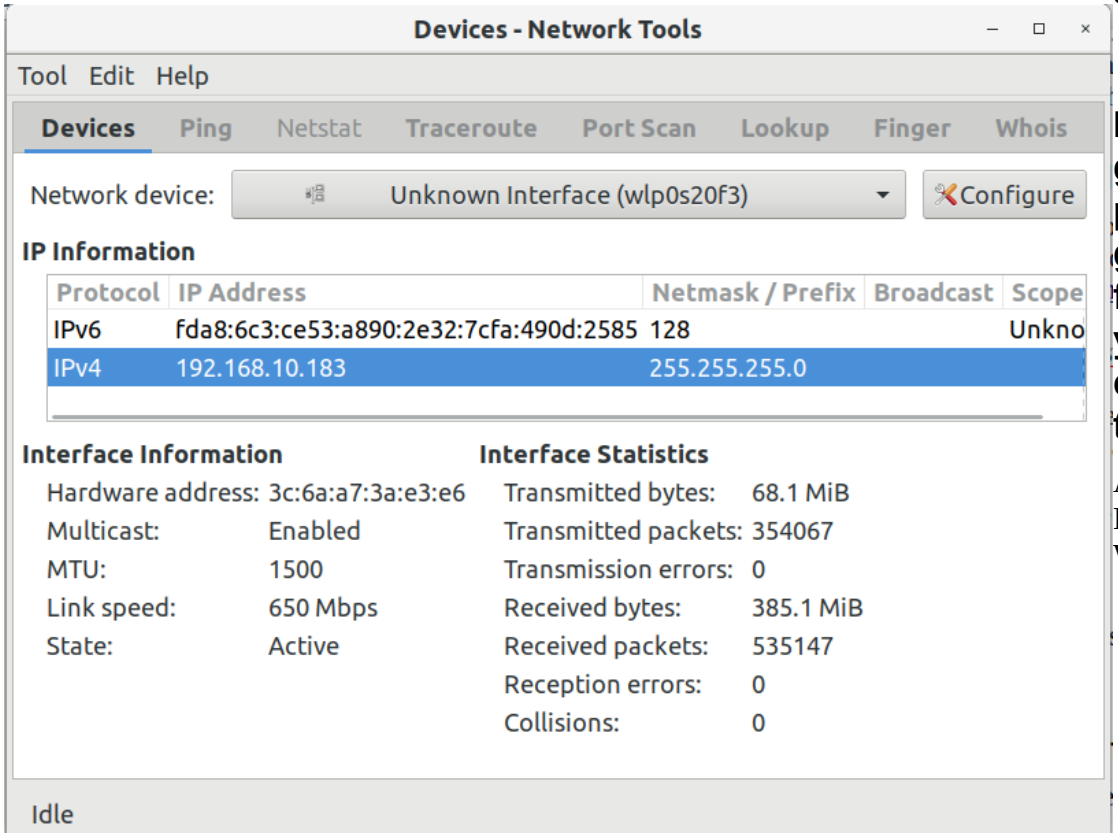
Here is a YouTube tutorial Linux Tools: Monitoring & Troubleshooting Basics with Glances. When you install from the Ubuntu software store you need to click on the permission tab and set what Glances is allowed to do. I selected all.

Gnome Network Tools - A graphical collection of networking tools.

When you first switch to Ubuntu this is a great tool. Don't put off learning the terminal commands though, Linux offers a lot more than windows. Redhat offers a great cheat sheet for the "ip" command - IP command cheat sheet

- Devices - See interface details like IP address, subnet mask, MAC Address, MTU, Link speed for all network devices.
- Ping - Calculates Minimum, Maximum and Average
- Netstat - Routing Table, Open Ports, Multicast addresses
- Traceroute
- Port Scan - A quick port scan for common ports
- Lookup - Basic DNS queries
- Whois - A standard Whois lookup.

See “Networking Cheat Sheet” in the Networking Tools chapter for a tutorial on the most common commands.



Meld - A great cross platform graphical file/directory comparison tool.

Available on Linux, Mac and Windows. The

homepage for the project is Meld. It's much better than the compare plugin for notepad++.

File comparison

Edit files in-place, and your comparison updates on-the-fly
Perform two- and three-way diffs and merges
Easily navigate between differences and conflicts
Visualise global and local differences with insertions, changes and conflicts marked
Use the built-in regex text filtering to ignore uninteresting differences
Syntax highlighting

Directory comparison

Compare two or three directories file-by-file, showing new, missing, and altered files
Directly open file comparisons of any conflicting or differing files
Filter out files or directories to avoid seeing spurious differences
Simple file management is also available

After installation is complete, hit the superkey and type meld to launch it. The initial interface lets you choose between file comparison, directory comparison or Version Control view.

Illustration : Meld initial screen

Openshot - A free, open-source, non-linear video editor

OpenShot Video Editor is a free, open-source, non-linear video editor. It can create and edit videos and movies using many popular video, audio, and image formats. Create videos for YouTube, Flickr, Vimeo, Metacafe, iPod, Xbox, and many more common formats!

Qalculate (gtk+ui) – Calculator with Reverse Polish Notation

An interesting calculator that does almost everything including currency conversions and Reverse Polish Notation. I learned on HP calculators and algebraic calculators drive me crazy. I has happy to find Qalculate.

Qalculate is available as a snap so installation is:

```
sudo snap install qalculate
```

Illustration :

Remmina - The GTK+ Remmina Remote Desktop Client

A remote desktop tool that also does VNC and ssh. Remmina is built into Ubuntu. If you want to run the latest development version you can follow the instructions below. Remmina saves it's connections to ~/.local/share/remmina.

To move connections to another Linux machine just copy all the .remmina files from the old machine to the new machine.
Remmina Usage FAQ

To install the latest development version

```
sudo apt-add-repository ppa:remmina-ppa-team/remmina-next
sudo apt update
sudo apt install remmina remmina-plugin-rdp remmina-plugin-secret
```

If you need to support Microsoft's Remote Desktop Gateway with Remmina please see this blog:
Using Remote Desktop Gateway with Remmina

Foliate - E book reader

This is a very active project with regular updates. Works with most e-book formats. Foliate is now available as a snap so install is just a matter of:

```
sudo snap install foliate
```

From the developer's site:
A simple and modern eBook viewer
Foliate is a simple and modern GTK eBook viewer.

Features include:
Two-page view and scrolled view
Customize font and line-spacing
Light, sepia, dark, and invert mode
Reading progress slider with chapter marks
Bookmarks and annotations
Find in book
Quick dictionary lookup

Foliate can open the following file types:

- .epub
- mobi
- .azw
- .azw3

Chapter 2 Tools installed from the Terminal

Linux has a great terminal compared to the command-line in Windows. As a network engineer you spend a lot of time in the terminal. There are a lot of great tutorials available on the Internet, this one is a good place to start:
37 Important Linux Commands You Should Know
https://www.howtogeek.com/412055/37-important-linux-commands-you-should-know/

The first thing to do is enable HTTPS for the aptitude terminal installation tool since HTTPS have become quite common for Linux repositories:

```
sudo apt update
sudo apt install apt-transport-https
sudo apt install apt-show-versions
```

Next we can start installation of the tools we need. Here we will install tools for general use. There is another section on networking tools.

ClamAV – Open Source Anti-Virus Scanner

https://www.clamav.net/
ClamAV® is an open source antivirus engine for detecting trojans, viruses, malware & other malicious threats. There aren't many viruses that target Ubuntu but I like having ClamAV installed so that I can scan CDs/USB flash drives before I use them on Windows. ClamAV is installed from the terminal, the graphical interface ClamTk is installed from the store.

install clamav

```
sudo apt install clamav
```

update the database

```
sudo freshclam
```

You only need to run freshclam once. If you receive a message "/var/log/clamav/freshclam.log is locked by another process" it's because the log is locked by ClamAV running in the background. This article - https://askubuntu.com/questions/909273/clamav-error-var-log-clamav-freshclam-log-is-locked-by-another-process explains how to troubleshoot this type of error message using the Linux command lsof or List Open Files. The lsof command is useful anytime you need to see what files are open.

Example usage

```
clamscan xmpp-info.nse
```

xmpp-info.nse: OK

---------- SCAN SUMMARY ----------
Known viruses: 6759709
Engine version: 0.100.2
Scanned directories: 0

Scanned files: 1
Infected files: 0
Data scanned: 0.04 MB
Data read: 0.02 MB (ratio 2.50:1)
Time: 10.406 sec (0 m 10 s)

ClamTk - A graphical frontend to ClamAV.

To install – click this link ClamTK and download the .deb file. Select “Open with Software Install” and follow the instructions.

Etcher - Flash OS images to SD cards & USB drives, safely and easily.

This is my favorite tool for creating bootable USB drives. It's cross platform and runs on Windows, Mac and Linux.
Installation is easy:

- Go to Etcher and click on Downloads. At the time of writing the current version was - etcher-electron-1.4.5-linux-x64.zip
- After the download finishes, double click to open the archive manager
- Extract the appimage file.
- Double click to execute it.

C Compiler

A GNU C compiler is needed anytime you are building a tool from source. This is unusual on Windows but pretty common on Linux. It's actually very easy and the site normally has the exact commands needed to build from source.

```
sudo apt install gcc
sudo apt install build-essential
gcc --version
```

More Information
How to install gcc - the c compiler on Ubuntu 18-04

inxi - A full featured terminal system information tool

https://github.com/smxi/inxi

```
sudo apt install inxi
```

Examples
inxi -F -x -c13 -- all output with extra data
inxi -F -xx -c13 -- all output with extra, extra data
inxi -B -- Battery info
inxi -c13 -- use black output
inxi -C -- CPU information
inxi -D -- hard drive info

inxi -f -- all cpu flags
inxi -G -- graphics card info
inxi -i -- network interface info
inxi -I -- processes, uptime, memory, inxi version,
sudo inxi -m -c13 - list memory

unetbootin

A tool for creating live USB drives. Has built in support for many Linux distributions.
sudo add-apt-repository ppa:gezakovacs/ppa
sudo apt update
sudo apt install unetbootin

OpenSSH Server

Ubuntu comes with an SSH client. If you want to be able to ssh back into your laptop or send files to network devices using SCP you need to install and configure the Open-ssh server. Follow these instruction from Enable SSH on Ubuntu 18-04

sudo apt update
sudo apt install ssh

Useful SSH system commands
sudo systemctl start ssh - Start the SSH server
sudo systemctl stop ssh - *Stop the SSH server*
systemctl status ssh - Show server status
sudo systemctl disable ssh – disables SSH server after next reboot
sudo systemctl enable ssh – enables SSH after the next reboot.

I highly recommend SSH Mastery by Michael Lucas. It's available at SSH Mastery or Amzon.com. When I switched to Linux my only experience with SSH was Putty. There is so much more to SSH and Michael explains all of it.

Sublime text

A full featured text editor designed for programmers. There is a trial version and the registered version costs $75 but the license lets you install it on all the computers you own. I purchased the Real Python Sublime text configuration package from https://www.realpython.com and love coding Python in Sublime text. The Realpython package has videos, text and downloads for Linux, Mac and Windows.

To install the latest version of Sublime Text
wget -qO - https://download.sublimetext.com/sublimehq-pub.gpg | sudo apt-key add -
echo "deb https://download.sublimetext.com/ apt/stable/" | sudo tee /etc/apt/sources.list.d/sublime-text.list
sudo apt-get install sublime-text

Solaar

A tool for managing Logitech Unifying dongles under Linux. I use Logitech wireless keyboards on my Odroid, Raspberry Pi and Linux laptop. This tool eliminates the need to configure the dongle on Windows.

sudo apt install solaar

Veracrypt

Open source encryption tool. I love Veracrypt. It's the follow on to the old Truecrypt project. It has had a professional crypto review and passed. I use Veracrypt to do full disk encryption on USB hard drives. If I leave one at a customer or airport, the data is just random noise. You can also create encrypted partitions if you don't need full disk encryption or encrypted flash drives.

Installation
Go to https://www.veracrypt.fr/en/Downloads.html
Download the veracrypt-1.23-setup.tar.bz2 file (or newer)

Run
sha256sum veracrypt-1.23-setup.tar.bz2 to verify the download
sudo ./veracrypt-1.23-setup-gui-x - Follow the prompts

To run Veracypt
Press the Super key (Windows Key) and type Veracypt in the search box.

exa

From the Exa website - A modern replacement for ls written in rust.

https://the.exa.website/
https://www.2daygeek.com/exa-a-modern-replacement-for-ls-command-linux/
download, unzip, copy to /usr/local/bin/exa
https://www.mankier.com/1/exa

Install rust
curl https://sh.rustup.rs -sSf | sh

Install the dependencies
sudo apt install libgit2-24 libgit2-dev cmake git libhttp-parser2.1

After the dependencies are installed, the easiest way to install exa, is to download a binary file and place it under /usr/local/bin.

wget https://the.exa.website/releases/exa-linux-x86_64-0.7.0.zip

unzip exa-linux-x86_64-0.7.0.zip

sudo mv exa-linux-x86_64 /usr/local/bin/exa

Example in a folder controlled by Git
mhubbard@1S1K-G5-5587:~/Dropbox/Python/Scripts/mac-addr-new$
- >exa -l --header --git
Permissions Size User Date Modified Git Name
drwxrwxr-x@   - mhubbard 26 Sep 22:38   -- __pycache__
.rw-rw-r--@ 128 mhubbard 5 Jun 23:59   -N mac-addr-6880.txt
.rw-rw-r--@ 4.4k mhubbard 4 Jun 22:37   -N mac-addr-Nexus-93108.txt
.rw-rw-r--@ 4.4k mhubbard 4 Jun 22:37   -N mac-addr-nexus.txt
.rw-rw-r--@ 19k mhubbard 26 Sep 10:56   -- mac-addr.txt
.rw-rw-r--@ 3.4k mhubbard 6 Jun 0:09   -N mac-addr1.txt
.rw-rw-r--@ 637 mhubbard 12 May 1:00   -N MAC-Test.py
.rw-rw-r--@ 34k mhubbard 26 Sep 10:40   -- Mac2IP.json
.rw-rw-r--@ 24k mhubbard 4 Apr 21:32   -N Mac2IP1.json

Example of Tree View
mhubbard@1S1K-G5-5587:~/Dropbox/Python/Scripts$ exa -x -g -T

```
.
├── 01-Vector
│   ├── core-backup.txt
│   ├── Core Switch Configuration.docx
│   ├── ISHS-6880X-Core Backup.txt
│   ├── sh-vlan-br.txt
│   ├── shvlanbr.txt
│   └── vlan.py
├── 10.52.8.22
├── _ARP-Archive
│   ├── __init__.py
│   ├── __pycache__
│   │   ├── manuf.cpython-34.pyc
│   │   └── manuf.cpython-35.pyc
│   ├── arp.txt
│   ├── arpout.txt
│   ├── manuf
│   ├── manuf.py
│   ├── sbcusd_mo.txt
│   ├── SBCUSDGome.txt
│   ├── test
│   │   ├── __init__.py
│   │   ├── manuf
│   │   └── test_manuf.py
│   └── «VTPDomain».txt
```

Sort by date modified and show directories first.
mhubbard@1S1K-G5-5587:~/Dropbox/Python/Scripts/SIET$

```
->exa -l --sort=modified --group-directories-first
drwxrwxr-x@    - mhubbard 26 Sep  2018 tftp
.rw-rw-r--@  471 mhubbard 24 Apr  2018 vuln_dev_list.txt
.rw-rw-r--@ 2.0k mhubbard 24 Apr  2018 README.md
.rw-rw-r--@ 6.2k mhubbard 24 Apr  2018 sTFTP.py
.rw-rw-r--@ 158k mhubbard 25 Apr  2018 DELR.txt
.rw-rw-r--@  13k mhubbard 27 Apr  2018 siet.py
```

RDFind

Rdfind is a program that finds duplicate files. The name is short for "redundant data find". It uses an algorithm that is lightning fast so you can search large folders quickly.

Installation
sudo apt install rdfind

Show the help for rdfind

```
rdfind --help

usage:
rdfind [options] directory1 directory2 ...
```

Finds duplicate files in directories, and takes appropriate actions
Directories listed first are ranked higher, meaning that if a file is found in several places, the file found in the directory first encountered on the command line is kept, and the others are considered duplicate.
options are (default choice within parentheses)

```
 -makesymlinks true|(false)           replace duplicate files with symbolic links
 -makehardlinks true|(false)          replace duplicate files with hard links
 -deleteduplicates true|(false) delete duplicate files
 -ignoreempty    (true)| false  ignore empty files
 -removeidentinode (true)| false      ignore files with nonunique device and inode
 -makeresultsfile  (true)| false      makes a results file
 -outputname name               sets the results file name to "name" (default
                                results.txt)
 -followsymlinks true|(false)   follow symlinks
 -dryrun|-n true|(false)        print to stdout instead of changing anything
 -checksum (md5)|sha1           checksum type
 -sleep Xms                           sleep for X milliseconds between file reads.
                                Default is 0.Currently, only a few values are
                                supported; 0,1-5,10,25,50,100
```

If properly installed, a man page should be available as man rdfind.

Example

```
rdfind -dryrun true /home/mhubbard/Dropbox/Python/Scripts/nmap3
/home/mhubbard/Dropbox/Python/Scripts/nmap3-1
(DRYRUN MODE) Now scanning "/home/mhubbard/Dropbox/Python/Scripts/nmap3", found 69 files.
(DRYRUN MODE) Now scanning "/home/mhubbard/Dropbox/Python/Scripts/nmap3-1", found 55
files.
```

```
(DRYRUN MODE) Now have 124 files in total.
(DRYRUN MODE) Removed 0 files due to nonunique device and inode.
(DRYRUN MODE) Now removing files with zero size from list...removed 0 files
(DRYRUN MODE) Total size is 904251 bytes or 883 KiB
(DRYRUN MODE) Now sorting on size:removed 24 files due to unique sizes from list.100 files
left.
(DRYRUN MODE) Now eliminating candidates based on first bytes:removed 3 files from list.97
files left.
(DRYRUN MODE) Now eliminating candidates based on last bytes:removed 3 files from list.94
files left.
(DRYRUN MODE) Now eliminating candidates based on md5 checksum:removed 0 files from
list.94 files left.
(DRYRUN MODE) It seems like you have 94 files that are not unique
(DRYRUN MODE) Totally, 332 KiB can be reduced.
(DRYRUN MODE) Now making results file results.txt
```

The results.txt file has all of the non-unique files listed.

More information
https://rdfind.pauldreik.se/

NCDU

An ncurses disk file display tool. Very useful for visualizing disk usage. It depends on the libncurses libraries so you may need to install them first.

sudo apt install libncurses5-dev libncursesw5-dev
sudo apt install ncdu

To use it, change to the directory you are interested in and run ***ncdu:***

Example

```
---/home/mhubbard/Dropbox/Python/Scripts/SIET---------------------
    1.6 MiB [##########] /tftp
  360.0 KiB [##        ] /.git
  160.0 KiB [    ]  DELR.txt
   20.0 KiB [    ]  siet.py
   12.0 KiB [    ]  sTFTP.py
    8.0 KiB [    ]  README.md
8.0 KiB [    ]  vuln_dev_list.txt
```

htop

Top is a tool built into most *nix systems. It displays CPU and memory information very similar to running “show process cpu sorted” on a Cisco device. Since it’s built into most distrobutions it’s worth knowing it’s there. But it is somewhat limited in what you can do.

Htop is a similar tool but adds the ability to use the mouse, sort, kill processes and use colors in the output. To customize htop, press f2. That brings up an ncurses style menu where you can change options.

Installing htop

sudo apt install htop

Running htop

From a terminal,
htop

More information
How to Use htop to Monitor Linux System Processes

iotop

Linux iotop - Check What's Stressing & Increasing Load On Hard Disks

More Information

Linux iotop - simple top like io monitor

iostat

A tool for monitoring disk IO.

Install the sysstat package

```
sudo apt install sysstat
```

In the example below, I was copying a 10GB file from the Samsung EVO 960 NVME drive that Ubuntu is installed on to a Samsung EVO 850 SSD. I am using the Linux "watch" utility to update iostat every 10 second.

Notice that the NVME drive was running 10% utilization and the SSD was 100%! NOTE: Normally you would use a 1 second interval but I couldn't highlight the text and hit ctrl+shift+c fast enough.

```
watch -n 10 iostat -xy --human 1 1

Every 10.0s: iostat -xy --human 1 1


1S1K-G5-5587: Fri Jun 21 22:32:09 2019

Linux 4.15.0-52-generic (1S1K-G5-5587)  06/21/2019      _x86_64_        (8 CPU)

avg-cpu:  %user   %nice %system %iowait  %steal   %idle

           6.1%    0.0%   19.6%   17.8%    0.0%   56.4%
```

```
Device            r/s     w/s     rkB/s     wkB/s   rrqm/s   wrqm/s  %rrqm  %wrqm r_await w_await aqu-sz rareq-sz wareq-sz  svctm  %util
nvme0n1        502.00  147.00    501.1M     12.5M     0.00  3050.00   0.0%  95.4%    0.67    0.08   0.11  1022.2k    87.0k   0.15  10.0%
sda              1.00  759.00      4.0k    474.0M     0.00     0.00   0.0%   0.0%   48.00  182.86 141.13     4.0k   639.5k   1.32 100.0%
```

More Information

Continuously updated iostat

nload

Monitor network traffic from the terminal.

My wireless adapter is named wlp0s20f3. To run nload and display “human readable” output use the following:

nload -u h wlp0s20f3

In this case the human readable switch will output the data in bits/kbits/mbits/gbits depending on how much data is being transmitted.

Python 3 and Python tools

Ubuntu 18.04 comes with Python 3.6.6 so no install is required.

PIP3

The official installer for python tools
sudo apt install python3-pip

XlsxWriter

A Python module for writing files in the Excel 2007+ XLSX file format.
https://pypi.org/project/XlsxWriter/

Tkinter

The Tkinter library for writing graphical python interface.
sudo apt install python3-tk

xsltproc

An xml to html converter. Use it with nmap's -oA option to convert the xml output to html.

sudo apt-get install xsltproc

sudo apt install nload - terminal tool to show network traffic

Speedtest-cli

A simple bandwidth testing tool for the terminal
sudo apt install speedtest-cli

Teamviewer

A proprietary remote access tool. At least they provide a .deb that installs painlessly under Ubuntu. You can use one account for Linux and Windows.

Download Teamviewer for Linux

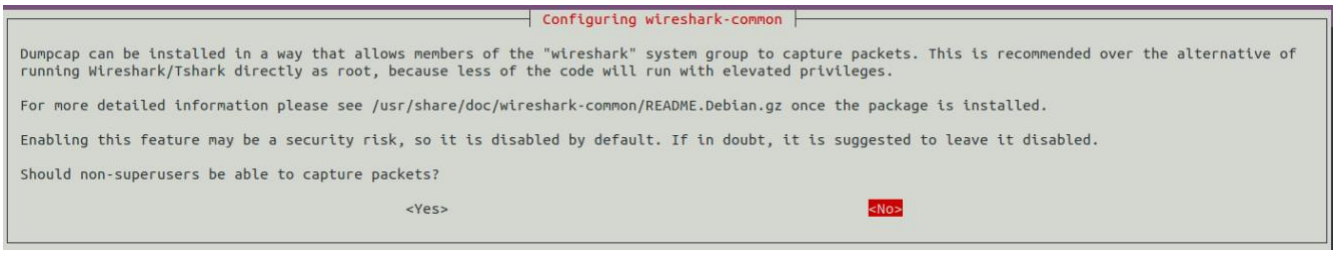
Wireshark

No network engineer's laptop would be complete without Wireshark! The version in the Ubuntu repository is not as current as the version on the wireshark.org website. To remedy that we will add a custom reposistory.

Installation

```
sudo add-apt-repository ppa:wireshark-dev/stable
sudo apt update
sudo apt install wireshark
```

During installation you will see a dialog box asking if you want to setup wireshark for non root users. Click yes.



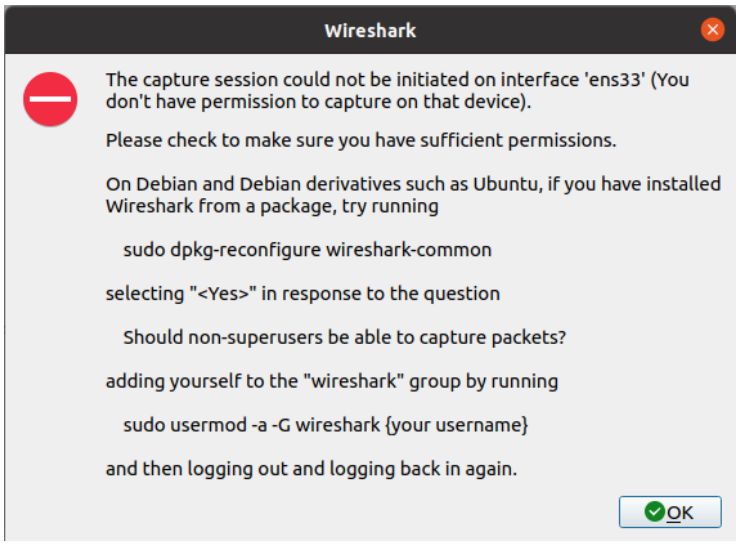
After installation is complete run the following to add your user account to the "wireshark"

sudo usermod -a -G wireshark mhubbard

Change mhubbard to your username.

That's it! Now you will have the latest version of wireshark, you will be notified to update when new versions are available and you can run wireshark without using sudo.

If you didn't select yes during setup you will be presented with the following dialog when you try to



capture packets.

Run the following to restart the setup and display the dialog
```
sudo dpkg-reconfigure wireshark-common
```

CCZE

A robust log colorizer.

Installation

```
sudo apt install ccze
```

Usage

Pipe the output of any tail/head to ccze

```
tail -f /var/log/syslog | ccze -A
```

Here is a screenshot of a tail of syslog with ccze -A, plain tail and lolcat.

Reference

https://www.systutorials.com/docs/linux/man/1-ccze/

Snaps - A new way to install programs on Ubuntu

Installing applications on Linux has been difficult because Arch, Debian and Redhat all use different package managers and some applications are only available in one of the package manager formats.

Snaps are a new way of packaging applications for Linux distributions that eliminates package dependencies so the install is easier and Ubuntu 18.04 ships with support for Snaps. There is an official snap store at - https://snapcraft.io/store The store is a graphical way to find snaps. You can search based on the name of the snap or by category. There is a surprisingly large selection of software available in the store. Once you find an application you want to install, simply click on install, copy the command and paste it into the terminal.

Some Snap terminal commands:
Search the store from the terminal
snap find <app name>

For example:
```
snap find Keepassxc
Name    Version  Publisher     Notes  Summary
keepassxc      2.3.4    keepassxreboot  -    community driven port of the windows
application “Keepass Password Safe”
keepassx-elopio  2.0.2    elopio   -    KeePassX is a cross platform password safe
```

How to install a Snap

Once you find an application, installing easy!
sudo snap install <app name>
Note: Some snaps need the --classic switch. This means the snap isn't sandboxed the way normal snaps are. Be sure you trust the snap before using the --classic switch.

Here is Ubuntu's explanation:
With snapd 2.20, a new confinement policy is introduced: “classic”, designed to cater to all your scripting and tooling needs. Snaps declaring their confinement as “classic”, have access to the rest of the system, as most legacy (debian packages for example) packaged apps do, while still benefiting from the ci-integrated store model, with automated updates, rollbacks to older versions, release channels, etc.

Refreshing Snaps

To refresh (update) all snaps
sudo snap refresh
All snaps up to date.

To refresh a specific snap
sudo snap refresh <app name>

To list all installed Snaps

snap list

To see all Snap commands simply enter snap and press return. All commands will be listed.

Here are link to ac couple tutorial on snaps
https://tutorials.ubuntu.com/tutorial/basic-snap-usage#0
https://blog.ubuntu.com/2017/01/09/how-to-snap-introducing-classic-confinement

Snaps I have installed:
asciinema - A tool to capture terminal output and save it to asciinema.org. Useful for sharing terminal application demos. Here is an example of the python tool pingsvi in asciinema - https://asciinema.org/a/p9ICnD759vWOzvhJLPDxGMphY

Brave - Much more than a browser, Brave is a new way of thinking about how the web works.

Cheat - Cheat allows you to create and view interactive cheat-sheets on the command-line. It was designed to help remind *nix system administrators of options for commands that they use frequently, but not frequently enough to remember.

The site is https://github.com/chrisallenlane/cheat. I use it to save SCP commands, shortcut keys for Terminator and other things that I don't use all the time.

emu2 - MS Dos emulator. I haven't actually used this yet but it's pretty cool if you have some old DOS programs and would like to run them on Linux. Here's the home page https://github.com/dmsc/emu2

fkill - A better way to kill a process than the built in kill command. A command-line tool for easily and quickly killing processes.
Once installed, this snap needs to be manually connected to some plugins:-
sudo snap connect fkill:process-control :process-control
sudo snap connect fkill:system-observe :system-observe

NOTE: This snap is maintained by the Snapcrafters community, and is not necessarily endorsed or officially maintained by the upstream developers.

Ghex - A graphical hex editor from Canonical

Hiri - A mail client that supports Microsoft Office 365/Exchange. Hiri is not free, there is an annual subscription cost of $39 or a lifetime for $119.

htop - htop as a snap. Htop is a terminal tool to visualize CPU/Memory/Processes etc.

hw-probe - A tool to probe for hardware and upload result to the Linux Hardware Database at the Linux Hardware Project https://github.com/linuxhw/hw-probe.
To run a probe:
sudo hw-probe -all -upload -ID “Description.”

A URL will be onscreen when it finishes. Just paste into a browser and see all of the hardware on your laptop.
See https://linux-hardware.org/index.php?view=howto for more information.

KeepassXC - A community fork of KeePassX, the cross-platform port of KeePass for Windows.

Lolcat – A Command Line Tool to Output Rainbow Of Colors in the Linux Terminal

Mailspring - Boost your productivity and send better email with Mailspring, the best mail client for Mac, Linux, and Windows.

Mumble - Mumble is an open source, low-latency, high quality voice chat software. Popular in many Linux podcast communities.

NCDU - An Ncurses implementation of the Linux DU command. Displays disk usage for every folder and file.

Notepadqq - A notepad++ like editor. Has a lot of features and is open source.
https://notepadqq.com/wp/news/

Pac-vs - SecureCRT replacement. If you had been using PAC-vs on another machine it's easy to move the config over. Follow these steps:
Close Pac-vs
Copy ~/snap/pac-vs/common/.config/pac/pac.yml from the existing machine to the same folder on the new machine. Note that .config is a hidden folder. Press ctrl+h to view hidden folders.
Delete pac.nfreeze using rm pac.nfreeze
Restart Pac-vs

Powershell - Microsoft open sourced Powershell. This snap installs Powershell core on Linux. Note that PowerShell requires the --classic switch. This removes the strict confinement model from the snap.

rem - A small tool for remembering things on the command line.
https://github.com/mborho/rem

Simplenote - A great cross platform note taking tool. It syncs in the cloud between all you your devices.

Skype - Microsoft's communicator application

Slack - Official Slack client

Supercalc - A multi-function calculator that can do conversions, scientific, dates.

Telegram - Official desktop client for Telegram

Termius - A nice crossplatform SSH client. It has an annual subscription fee. I use it on my iPhone/iPad/Mac and Linux laptop.

Tusk - An Evernote client for Linux.

Visual Studio Code - Microsoft's Open source code editor. I use it for Python but it has support for almost every programming language.

VLC - VLC is a Video playback application.

Here is how to install the "Snaps" mentioned above

```
sudo snap install asciinema --classic
sudo snap install axeman
sudo snap install brave
sudo snap install cheat
sudo snap install emu2
sudo snap install fkill
sudo snap install ghex-udt
sudo snap install glances
sudo snamp install hiri
sudo snap install htop
sudo snap install hw-probe
sudo snap install keepassxc
sudo snap install lolcat
sudo snap install mailspring
sudo snap install mumble
sudo snap install ncdu-kz6fittycent
sudo snap install notepadqq
sudo snap install pac-vs
sudo snap install powershell --classic
sudo snap install rem --classic
sudo snap install simplenote
sudo snap install skype --classic
sudo snap install slack --classic
sudo snap install supercalc-snap
sudo snap install telegram-desktop
sudo snap install termius-app
sudo snap install tusk
sudo snap install vscode --classic
sudo snap install vlc
```

Flatpak

Like snap, flatpak is a new containerized method for distributing Linux applications. I haven’t installed too many Flatpak applications yet but it looks like it is rapidly gaining popularity so you should know it exists.

To install flatpak:
sudo add-apt-repository ppa:alexlarsson/flatpak
sudo apt update
sudo apt install flatpak
sudo apt install gnome-software-plugin-flatpak
flatpak remote-add --if-not-exists flathub https://flathub.org/repo/flathub.flatpakrepo

Flatpak requires a restart after installation. Once the reboot is complete you can go to https://flathub.org and search for applications.

I have installed the following flatpaks:
Arduino IDE - not necassarily a network engineering tool but Arduinos are fun to play with!
Marker - A simple, clean markdown editor.

Using Google Drive with Linux
Unbelievably, even though Google's cloud is built on Linux, they do not have a native client for Linux. I have found that Insync works great and has all the features of the Windows or Mac client. It's not free, when I purchased it there was a one time charge of $25.00.

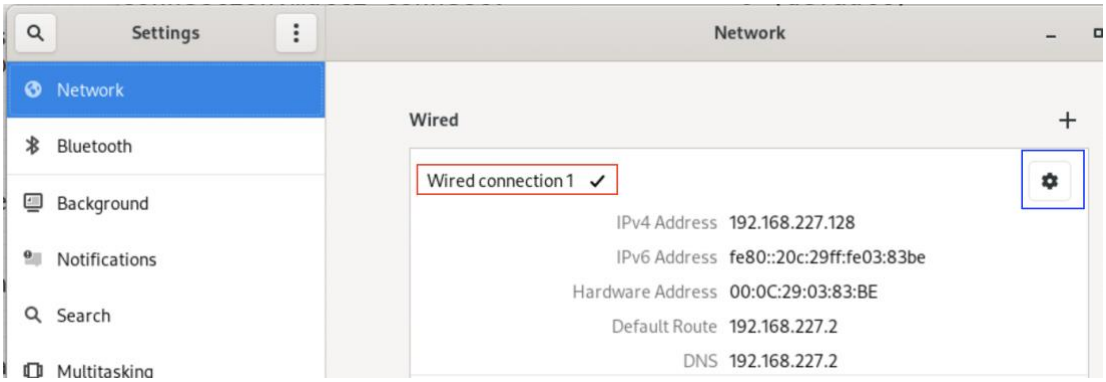
Insync for Google Drive.

Managing Network Devices

Ubuntu provides Graphical and terminal based tools for managing network devices and connection.

Using the GUI to Configure network Connection Profiles

Most modern Linux distributions include Network Manager for managing network settings. On Ubuntu desktop installations you can use Settings, Network to modify connection profiles. You will a see default connection profile named "Wired Connection 1" on a new install.



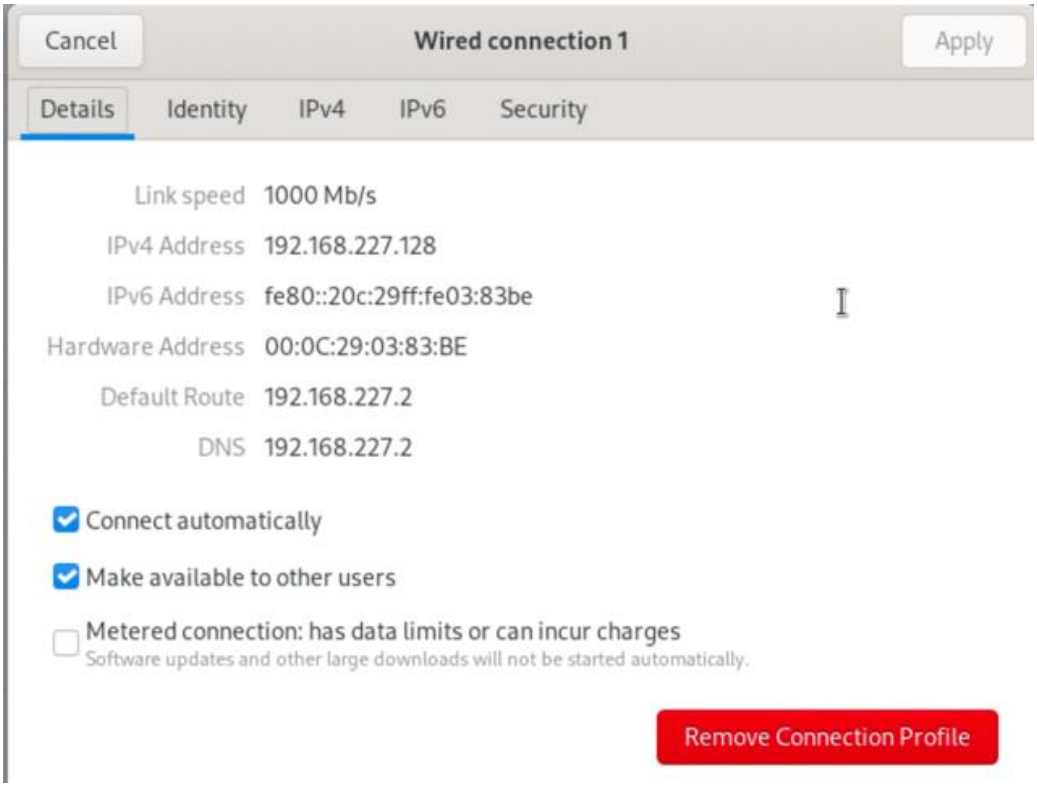
In the box below the name are the IPV4/IPV6 addresses, Hardware (MAC) address, default IPv4 route and DNS server for that connection.

Click on the "Gear" icon to make changes. There are five tabs as described below.

Details

This tab lists the following information about the connection profile
Link Speed
IP Addresses (IPv4/IPv6)
Hardware (MAC) Address
Default Route
DNS Servers

A checkbox for "Connect Automatically"
A checkbox for "Make available to others"
A checkbox for "Metered Connection: Has data limits or can incur charges. Software updates and other large downloads will not be started automatically"


Cancel
Wired connection 1
Apply
Details
Identity
IPv4
IPv6
Security
Link speed 1000 Mb/s
IPv4 Address 192.168.227.128
IPv6 Address fe80::20c:29ff:fe03:83be
Hardware Address 00:0C:29:03:83:BE
Default Route 192.168.227.2
DNS 192.168.227.2
Connect automatically
Make available to other users
Metered connection: has data limits or can incur charges
Software updates and other large downloads will not be started automatically.
Remove Connection Profile

Identity

Name – You can click into this field and change the connection profile name.
Note: If I am creating several connections while working on a customer network, I use the IP address or Vlan id as the connection name. I find it easier to remember what the connection is used for rather than "Wired Connection 2" or something similar.

View the MAC address
Clone a new mac address
Change the MTU

IPv4

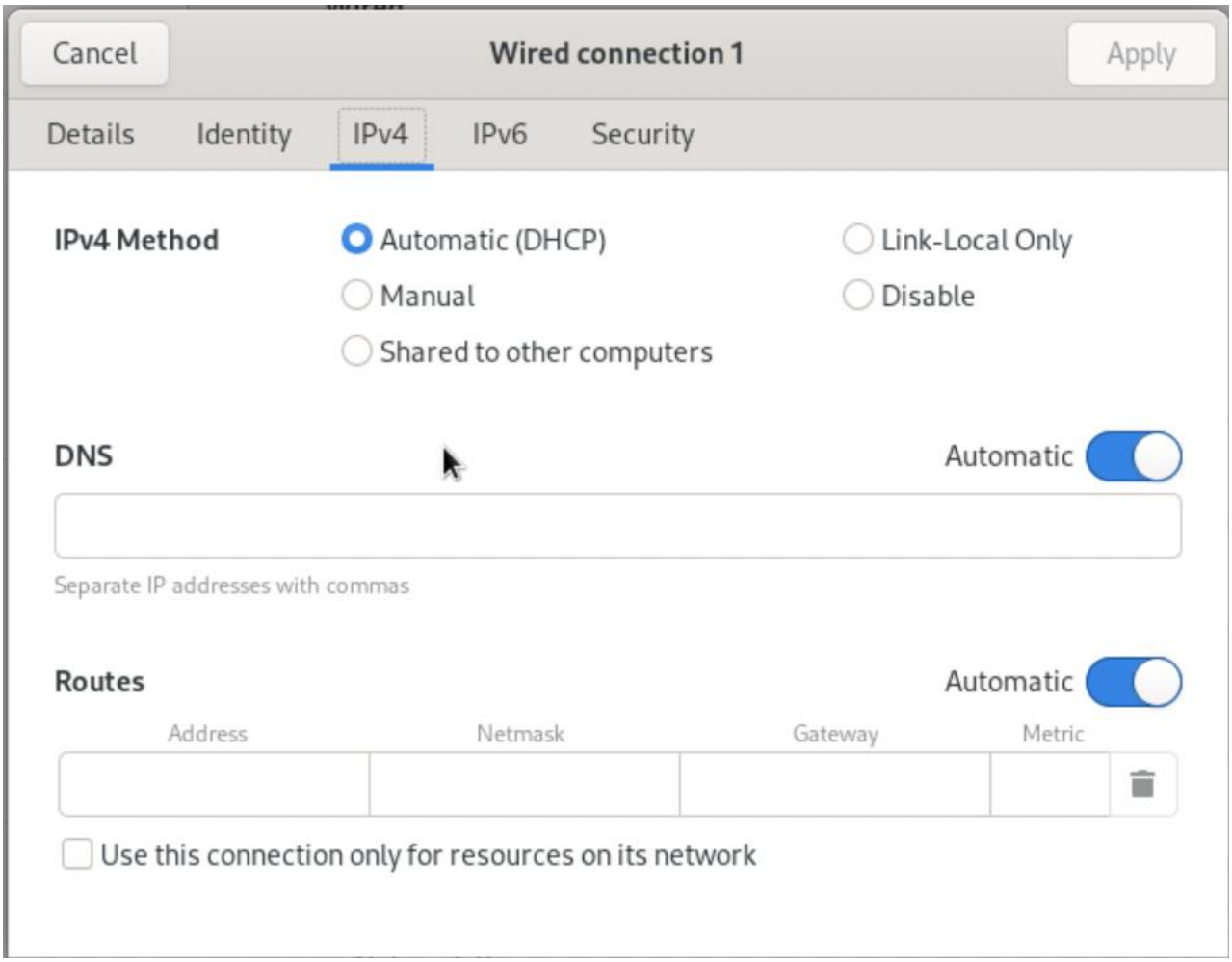
This tab allows you to configure IPv4 settings

IPv4 Method (How an address is assigned)

- Automatic (DHCP)
- Manual - If you need to add multiple static addresses, additional boxes will appear after you enter the first address.
- Shared to other Computers
- Link-Local Only Note: MS calls this Automatic Private Internet Protocol Addressing (APIPA)
- Disable

DNS
set to automatic or manual
If you choose manual mode separate servers with a ","

Routes
You can leave it on automatic or turn off automatic and enter your own routes as required



IPv6

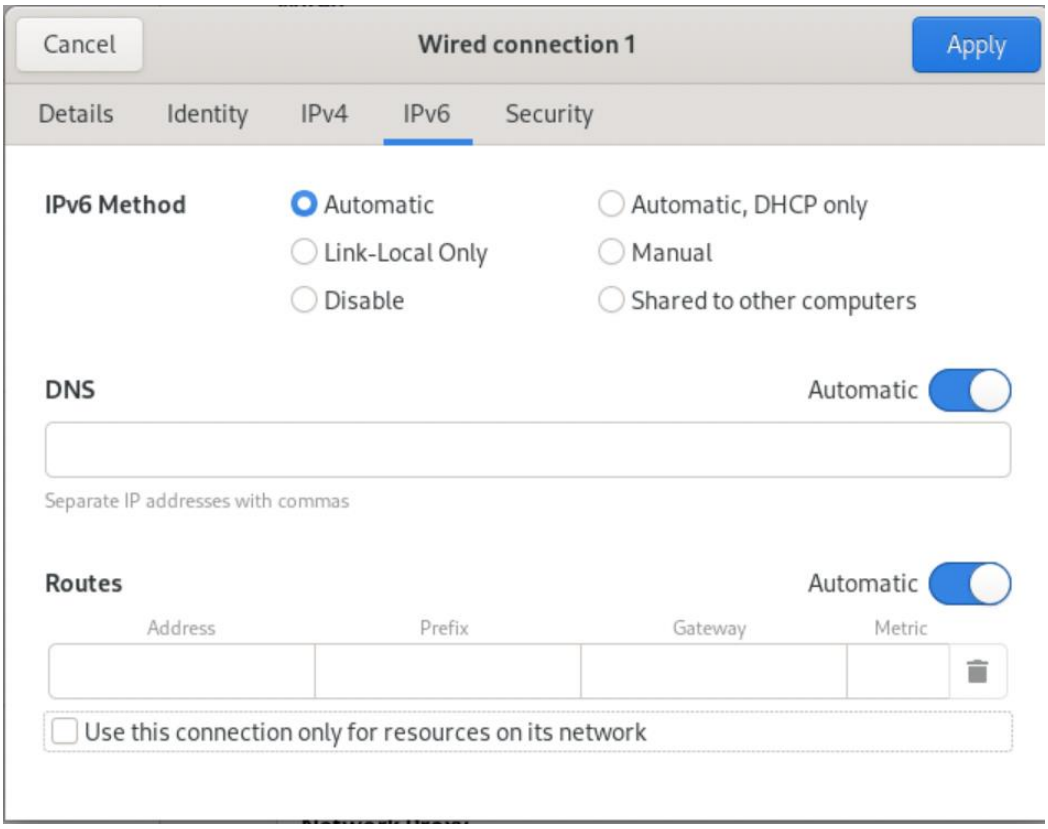
IPv6 Method (How an address is assigned)

- Automatic (DHCP)
- Automatic, DHCP only
- Manual - If you need to add multiple static addresses, additional boxes will appear after you enter the first address.
- Shared to other Computers
- Link-Local Only Note: MS calls this Automatic Private Internet Protocol Addressing (APIPA)
- Disable

DNS
set to automatic or manual
If you choose manual mode separate servers with a ","

Routes
You can leave it on automatic or turn off automatic and enter your own routes as required

A checkbox
Use this connection only for resources on its network

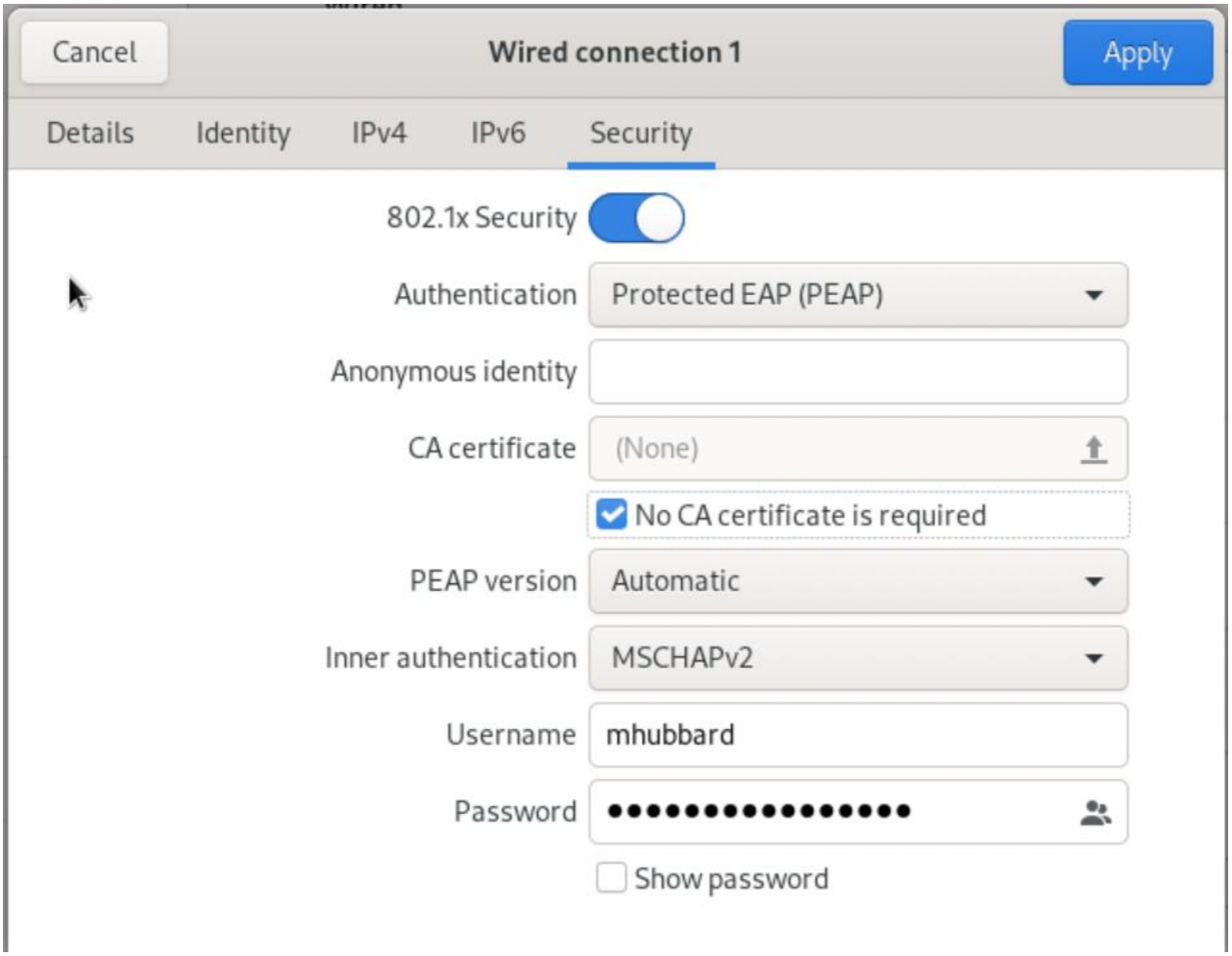


Security

Here is where you configure the 802.1x supplicant.

For authentication, the following methods are supported:

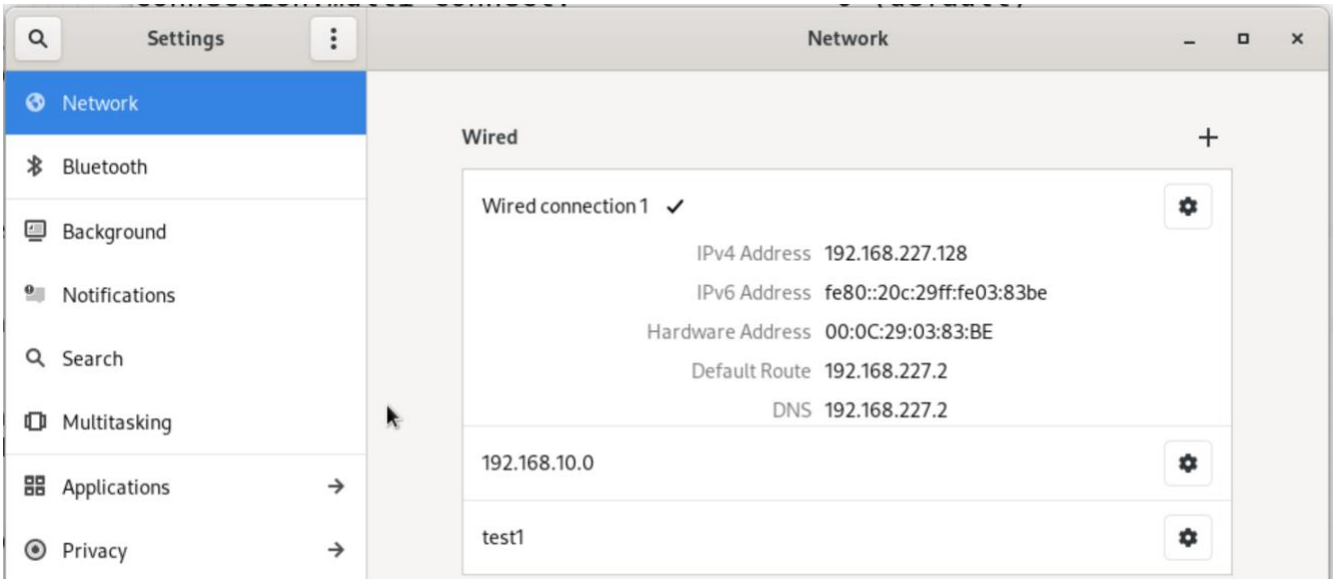
- MD5
- TLS
- PWD
- FAST
- Tunneled TLS
- Protected EAP (PEAP)



You can also create a new connection profile by clicking the "+" sign. Ubuntu (Debian) really shines with this feature because you can create many different profiles then select which one you need. This is great when testing new networks that have many vlans or anytime you are switching networks and need custom settings.

Each profile will be listed on the Network page in settings. The active connection profile will be expanded to show basic information about the connection. Any other connection profiles will be listed by name but none of the details will be visible. To change to a different profile simply click on it.

In the figure below I have created profiles
192.168.10.0
test1



Network Manager CLI

nmcli is a command line tool that you can use to query or set adapter information. There is even an interactive shell mode and a terse mode for scripting.

Here is a nmcli tutorial - https://www.techrepublic.com/article/how-to-use-the-nmcli-command-to-gather-network-device-information-on-linux/

As always on *nix systems, you can use the man page to look up commands and options – man nmcli and man nmcli-examples.

Just like on a Cisco or Aruba device you can abbreviate commands as soon as they are unique and use tab completion. You can use the -a switch and nmcli will stop and ask for any missing required arguments.

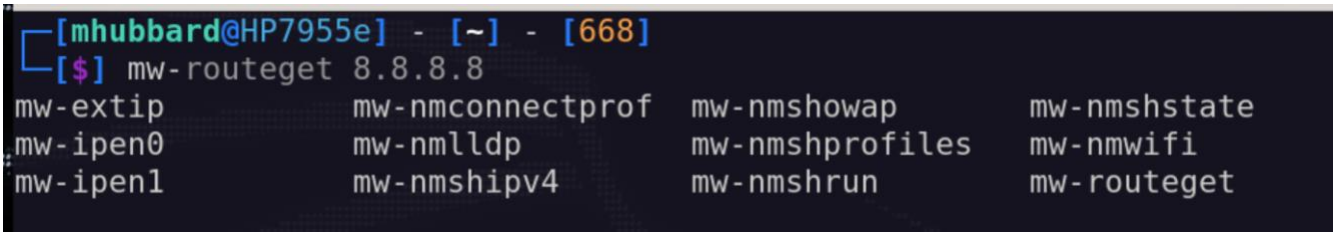
Aliases

Before I show examples of nmcli commands I am going to show the aliases I have created. The reason is that I have noticed most users don't create aliases. I have found aliases to be a great time saver and they are very easy to create.

If you are using BASH for your shell, just use
nano ~/bashrc
to open the file

If you are using ZSH, just use
nano ~/zshrc
to open the file.

Then add the following lines at the bottom. I started all my network manager aliases with "mw". That allows me to type “mw [tab]” and see all of my aliases:



#show status of network manager
alias mw-nmshrun="nmcli -t -f RUNNING general"

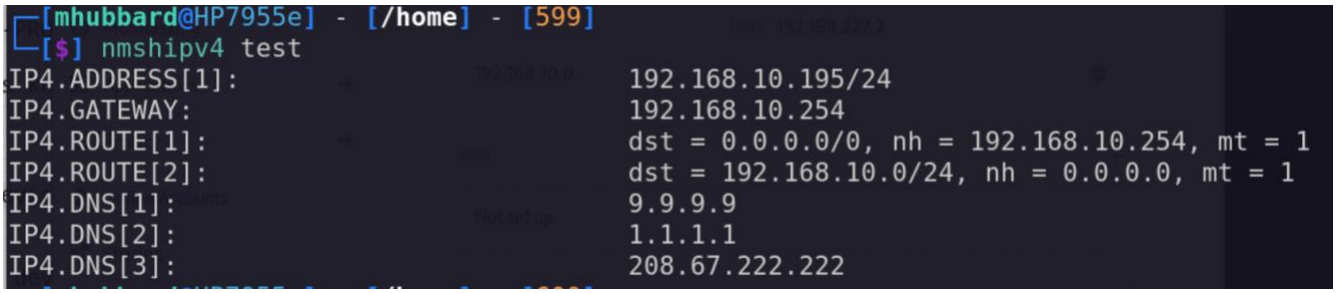
#show network manager state
alias mw-nmshstate="nmcli -t -f STATE general"

#show network connection profiles. $1 is interface name
alias mw-nmshprofiles='(){nmcli -a -f CONNECTIONS device show $1}'

```
#connect to an existing profile. $1 is the profile name
alias mw-nmconnectprof='(){nmcli -p connection up "$1" ifname eth0}'

#show profile IPv4 settings. Profile must be active. $1 is profile name I.E. "Wired connection 1"
alias mw-nmshipv4='(){nmcli -a -f IP4 connection show $1}'

#Show wifi properties
alias mw-nmwifi='nmcli -f GENERAL,WIFI-PROPERTIES dev show $1'

#list available Wi-Fi access points known to Network Manager
alias mw-nmshap='nmcli dev wifi'

#Use mw-nmcli to list lldp neighbors
alias mw-nmlldp='(){sudo nmcli -a -p device lldp list ifname $1}'

#show wifi passwords
alias mw-nmshwifi='(){sudo nmcli -a -p device wifi show-password ifname $1}'
```

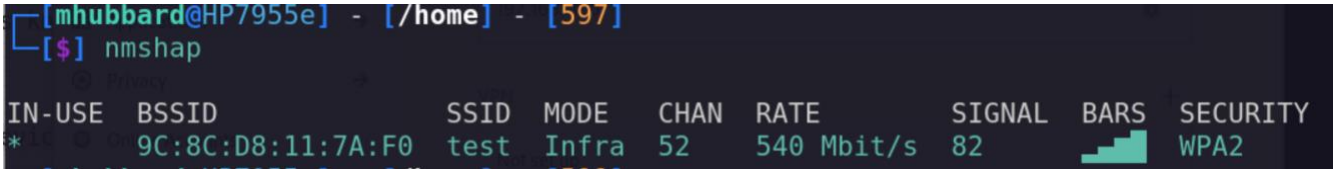
Then exit nano using ctrl+w, y, [enter]

Here is a screenshot of the nmshipv4 alias for the “test” ssid.



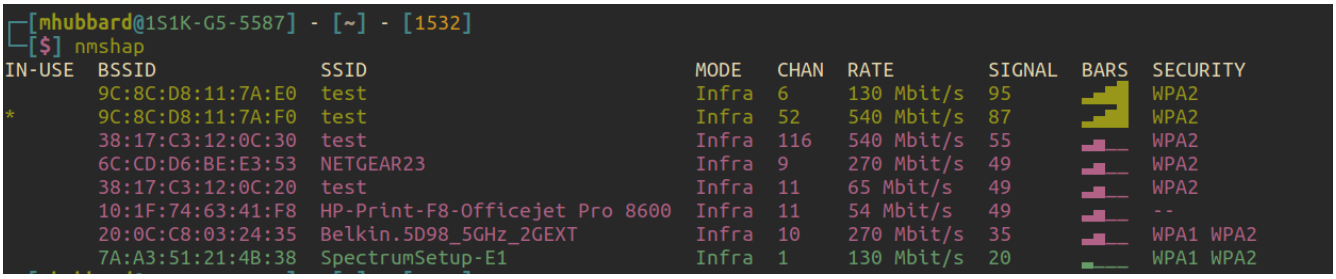
Here is a screenshot of the nmwifi alias

Here is a screenshot of the nmshap alias. Very useful information indeed.



Here is a screenshot of the nmshwifi alias. If you use your camera on the QR code it will offer to connect you to the SSID - test.

Here is a screenshot of nmshap. This one is very useful when you are new to an environment and want to see the wireless environment.



Examples:

All these examples are from the man pages. I used "man nmcli" to display it. I modified some of the descriptions to be more consistent with this tutorial, but all of the information is from the man pages. I used "man nmcli-examples" to get additional examples.

Display NetworkManager status
nmcli -t -f RUNNING general
running

Display the general status of Network Manager
nmcli -t -f STATE general
connected

To shut down or bring up an interface:

nmcli connection down wlp0s20f3
nmcli connection up wlp0s20f3

Turn Wi-Fi radio off
nmcli radio wifi off

Activate the connection profile "Wired connection 1" on interface enp60s0
The -p option makes nmcli show progress of the activation.
nmcli -p connection up "Wired connection 1" ifname enp60s0

This is a great command if you use a few different USB Ethernet adapters. You can quickly activate a connection profile on a different device.

Note: This connection profile has spaces in the name. You must enclose it in double quotes or escape the spaces. I recommend not using spaces in connection profile names.

nmcli -p connection show Wired connection 1
Error: Wired - no such connection profile.

If you want to escape the spaces instead of double quotes use
nmcli -p connection show Wired\ connection\ 1

List all connection profiles.
nmcli connection show

List all configured connections in multi-line mode
nmcli -p -m multiline -f all connection show

Show the status for all devices
nmcli device status

To list all devices (physical interfaces) enter "nmcli -p dev sho" which is device show with the “pretty” flag. It lists all the devices on your system and their current settings in a "pretty" table. Notice that wireless interfaces are listed as wifi and wired as ethernet.

nmcli -p device show

```
===============================================================================
        Device details (wlp0s20f3)
===============================================================================
GENERAL.DEVICE:           wlp0s20f3
-------------------------------------------------------------------------------
GENERAL.TYPE:             wifi
-------------------------------------------------------------------------------
GENERAL.HWADDR:           3C:6A:A7:3A:E3:E6
-------------------------------------------------------------------------------
GENERAL.MTU:              1500
-------------------------------------------------------------------------------
GENERAL.STATE:            100 (connected)
-------------------------------------------------------------------------------
GENERAL.CONNECTION:       test
-------------------------------------------------------------------------------
GENERAL.CON-PATH:         /org/freedesktop/NetworkManager/ActiveConnection/1
-------------------------------------------------------------------------------
IP4.ADDRESS[1]:  192.168.10.183/24
IP4.GATEWAY:     192.168.10.254
IP4.ROUTE[1]:    dst = 0.0.0.0/0, nh = 192.168.10.254, mt = 600
IP4.ROUTE[2]:    dst = 192.168.10.0/24, nh = 0.0.0.0, mt = 600
IP4.ROUTE[3]:    dst = 169.254.0.0/16, nh = 0.0.0.0, mt = 1000
IP4.DNS[1]:      192.168.10.221
-------------------------------------------------------------------------------
IP6.ADDRESS[1]:       fe80::b05c:adfa:b145:a837/64
IP6.GATEWAY:     --
IP6.ROUTE[1]:    dst = ff00::/8, nh = ::, mt = 256, table=255
IP6.ROUTE[2]:    dst = fe80::/64, nh = ::, mt = 256
IP6.ROUTE[3]:    dst = fe80::/64, nh = ::, mt = 600



===============================================================================
    Device details (enp60s0)
===============================================================================
GENERAL.DEVICE:       enp60s0
-------------------------------------------------------------------------------
GENERAL.TYPE:             ethernet
-------------------------------------------------------------------------------
GENERAL.HWADDR:           54:BF:64:3B:9C:68
-------------------------------------------------------------------------------
GENERAL.MTU:              1500
-------------------------------------------------------------------------------
GENERAL.STATE:            100 (connected)
-------------------------------------------------------------------------------
GENERAL.CONNECTION:       Static
-------------------------------------------------------------------------------
```

```
GENERAL.CON-PATH:         /org/freedesktop/NetworkManager/ActiveConnection/9
------------------------------------------------------------------------------
WIRED-PROPERTIES.CARRIER: on
------------------------------------------------------------------------------
IP4.ADDRESS[1]:           204.100.254.205/29
IP4.GATEWAY:              --
IP4.ROUTE[1]:             dst = 204.100.254.200/29,       nh = 0.0.0.0, mt = 100
IP4.ROUTE[2]:             dst = 169.254.0.0/16,           nh = 0.0.0.0, mt = 1000
------------------------------------------------------------------------------
IP6.ADDRESS[1]:       fe80::e1db:4855:2a9b:e590/64
IP6.GATEWAY:      --
IP6.ROUTE[1]:     dst = ff00::/8,       nh = ::, mt = 256, table=255
IP6.ROUTE[2]:     dst = fe80::/64,      nh = ::, mt = 256
IP6.ROUTE[3]:     dst = fe80::/64,      nh = ::, mt = 100
------------------------------------------------------------------------------
```

List WiFi details

This command will list the connected wireless interface's SSID, Mode, Channel, Rate, Signal Strength and security.

nmcli dev wifi

```
IN-USE       SSID   MODE   CHAN   RATE         SIGNAL       BARS   SECURITY
*            test   Infra  100    405 Mbit/s   76           ▂▄▆_   WPA2
```

List all devices on the system

nmcli device

```
DEVICE     TYPE        STATE      CONNECTION
wlp0s20f3  wifi        connected    test
docker0    bridge      connected    docker0
enp60s0    ethernet    unavailable  --
vmnet1     ethernet    unmanaged    --
vmnet8     ethernet    unmanaged    --
lo         loopback    unmanaged    --
```

List details for one Interface

Now that you have the interface names, you can list all the details for one interface:

nmcli dev sho wlp0s20f3

```
GENERAL.DEVICE:    wlp0s20f3
GENERAL.TYPE:      wifi
GENERAL.HWADDR:    3C:6A:A7:3A:E3:E6
GENERAL.MTU:       1500
GENERAL.STATE:     100 (connected)
GENERAL.CONNECTION:test
GENERAL.CON-PATH:  /org/freedesktop/NetworkManager/ActiveCo
IP4.ADDRESS[1]:    192.168.10.183/24
IP4.GATEWAY:       192.168.10.254
```

```
IP4.ROUTE[1]:      dst = 0.0.0.0/0, nh = 192.168.10.254, mt
IP4.ROUTE[2]:      dst = 192.168.10.0/24, nh = 0.0.0.0, mt
IP4.ROUTE[3]:      dst = 169.254.0.0/16, nh = 0.0.0.0, mt =
IP4.DNS[1]:        1.1.1.1
IP4.DNS[2]:        208.67.222.222
IP6.ADDRESS[1]:    fda8:6c3:ce53:a890:2e32:7cfa:490d:2585/1
IP6.ADDRESS[2]:    fe80::b05c:adfa:b145:a837/64
IP6.GATEWAY:     --
IP6.ROUTE[1]:      dst = ff00::/8, nh = ::, mt = 256, table
IP6.ROUTE[2]:      dst = fe80::/64, nh = ::, mt = 256
IP6.ROUTE[3]:      dst = fda8:6c3:ce53:a890:2e32:7cfa:490d:
IP6.ROUTE[4]:      dst = fe80::/64, nh = ::, mt = 600
```

If you are looking for specific items, you can use grep and the "or" operator. Remember that Linux is case sensitive. To list just ipv4 details use "IP4" instead of "DNS|GA".

`nmcli device show eth0 | grep -E "DNS|GA"`

```
IP4.GATEWAY:                    192.168.227.2
IP4.DNS[1]:                     192.168.227.2
IP6.GATEWAY:                    --
```

List all currently active connections

`nmcli connection show --active`

```
NAME                  UUID                                  TYPE      DEVICE
Wired connection 1    9654ef4c-2494-4e7b-9e58-6d58dec3e964  ethernet   eth0
```

List all connection profile names and their auto-connect property

`nmcli -f name,autoconnect c s` (connection show)

```
NAME                AUTOCONNECT
Wired connection 1  yes
192.168.10.0        yes
test                yes
```

Lists all details for the "Wired connection 1" connection profile

`nmcli -p connection show "Wired connection 1"`

Note: shows all properties even if the connection profile isn't applied to an interface

List details for the "Wired connection 1" active connection, like IP, DHCP information, etc.

`nmcli -f active connection show "Wired connection 1"`

Note: This will only return data for active connections. DHCP options from the server are listed. For example:

DHCP4.OPTION[3]: dhcp_server_identifier = 192.168.227.254

-f means "field". Valid fields are 6lowpan,802-11-olpc-mesh,802-11-wireless,802-11-wireless-security,802-1x,802-3-ethernet,adsl,bluetooth,bond,bond-port,bridge,bridge-port,cdma,connection,dcb,dummy,ethtool,generic,gsm,hostname,infiniband,ip-tunnel,ipv4,ipv6,macsec,macvlan,match,ovs-bridge,ovs-dpdk,ovs-external-ids,ovs-interface,ovs-

patch,ovs-port,ppp,pppoe,proxy,serial,sriov,tc,team,team-port,tun,user,veth,vlan,vpn,vrf,vxlan,wifi-p2p,wimax,wireguard,wpan and GENERAL,IP4,DHCP4,IP6,DHCP6,VPN, or profile,active.

List static configuration details of the connection profile "Wired connection 1"
`nmcli -f profile connection show "Wired connection 1"`
Note: -f profile returned 96 rows on my laptop.

List All Connection Profiles

To see all connections, use the connection option. Notice it returns all the wifi SSIDs that my laptop has connected to over time. There is a bash shell script that can use that information to fingerprint your laptop. You can find it here: Show me your SSID's, I'll Tell Who You Are!

`nmcli connection`

```
NAME                UUID                                  TYPE          DEVICE
docker0             224e7634-38ef-4ad9-8a4d-273baab05f65  bridge        docker0
test                f9620460-92c5-4dfb-9b01-efa8c0372df1  wifi          wlp0s20f3
1S1K-phone          d259ea15-0549-44a2-b818-d0b5b0916ed6  wifi          --
AirConsole          7f103423-e068-476f-895e-9aef413818fd  wifi          --
BGHS                914e7da0-3b24-4a93-b4af-e3d8efa37e80  ethernet      --
BGHS                aece44c6-55e8-4f18-af43-e90c8bd089cc  ethernet      --
DHCP                76ee6a5c-9581-4b29-997e-8b2ffd941c8e  ethernet      --
MOTOTRBO            42da0d72-2ec9-4cdc-b7b4-7dd9001ecca0  wifi          --
RoTW                7175654c-a88e-4c8e-b18d-d390b741af6d  vpn           --
SBCUSD_ATV          f42c9d3a-7749-4639-9ea1-420d665d5ab2  wifi          --
Static              67eb952f-350a-4f55-8141-57c564795a0b  ethernet      --
Wired connection 1  eabb14c6-a3b7-3e25-ade4-098691196efa  ethernet      --
hhonors_Hampton     9520e0b4-343c-48ef-8bac-6b76dad2c9d2  wifi          --
```

As always, you can pipe the output to grep.
`nmcli connection | grep eth`

To see only connection profiles for ethernet interfaces.

Show details for the "test" connection profile with all passwords.
Note: without --show-secrets option, secrets would not be displayed.
`nmcli --show-secrets connection show "test"`

If you are looking for a PSK password, you can add a grep to the end
`nmcli --show-secrets connection show test | grep security.psk`
802-11-wireless-security.psk: SuperSecretPasswd

List all available connection profiles for your Wi-Fi interface wlp0s20f3.
`nmcli -f CONNECTIONS device show wlp3s0`

List only GENERAL and WIFI-PROPERTIES sections for wlp0s20f3
`nmcli -f GENERAL,WIFI-PROPERTIES dev show wlan0`

Using Vlan tags

One big advantage to Ubuntu for network engineers is that it can tag traffic using standard IEEE 801.q tags.

Note
you must install the vlan package using “sudo apt install vlan”.

There are a couple ways to do this, but nmcli is easy and straight forward. The example below creates the following:
Connection name - vl56
Vlan Tag - 56
Interface - enp60s0

`nmcli con add type vlan con-name vl56 dev enp60s0 id 56 ip4 10.112.56.2/23 gw4 10.112.57.254`

ip addr will show the interface and IP addresses

```
enp60s0.56@enp60s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP
group default qlen 1000
    link/ether 54:bf:64:3b:9c:68 brd ff:ff:ff:ff:ff:ff
    inet 10.112.56.2/23 brd 10.112.57.255 scope global noprefixroute enp60s0.56
     valid_lft forever preferred_lft forever
    inet6 fe80::32ee:1b10:8dcf:ed52/64 scope link noprefixroute
     valid_lft forever preferred_lft forever
```

Notice that it’s UP, UP.

`nmcli connection`

```
NAME       UUID          TYPE    DEVICE
BGHS       aece44c6-55e8-4f18-af43-e90c8bd089cc  ethernet  enp60s0
docker0    704dbd24-5290-411a-a7f8-606534961bbf  bridge    docker0
vl56       79f677e0-0529-474b-ab00-313c9d111cbe  vlan    enp60s0.56
```

The switchport configuration it’s plugged into is:

```
interface GigabitEthernet1/0/12
 description < vlan 56 test >
 switchport trunk encapsulation dot1q
 switchport mode trunk
 spanning-tree portfast
end
```

and the vlan configuration is:

```
interface Vlan56
 description < Test Network >
 ip address 10.112.57.254 255.255.254.0
 ip helper-address 192.168.10.221
end
```

Testing the Interface

ping 10.112.57.254

```
PING 10.112.57.254 (10.112.57.254) 56(84) bytes of data.
64 bytes from 10.112.57.254: icmp_seq=1 ttl=255 time=2.68 ms
64 bytes from 10.112.57.254: icmp_seq=2 ttl=255 time=1.23 ms
^C
```

ip route get 10.112.57.254

```
10.112.57.254 dev enp60s0.56 src 10.112.56.2 uid 1000 cache
```

As you can see, the ping succeeded and the ip route get shows that it is using our vlan 56 interface.

When you are done with the interface use:

nmcli connection

to identify the UUID then:

nmcli connection delete <uuid>

to delete it.

For example, to delete the vl10 connection:

nmcli connection

```
NAME       UUID         TYPE    DEVICE
docker0    704dbd24-5290-411a-a7f8-606534961bbf  bridge    docker0
test       f9620460-92c5-4dfb-9b01-efa8c0372df1  wifi    wlp0s20f3
1S1K-phone   d259ea15-0549-44a2-b818-d0b5b0916ed6  wifi    --
Wired connection 1  eabb14c6-a3b7-3e25-ade4-098691196efa  ethernet  --
hhonors_Hampton   9520e0b4-343c-48ef-8bac-6b76dad2c9d2  wifi    --
vl10       cd99c9bf-4100-40be-acf8-2ed0c43bd125  vlan    --
vl56       9cb5c90c-7e8b-4f54-ac95-5236bee668da  vlan    --
```

nmcli connection delete cd99c9bf-4100-40be-acf8-2ed0c43bd125

Connection 'vl10' (cd99c9bf-4100-40be-acf8-2ed0c43bd125) successfully deleted.

Monitoring interface status while a switch reboots

Linux has a great little utility called “watch”. You can use it with any other Linux utility that returns text to the screen. In this example I was connected to a switch that I needed to reboot. I wanted to monitor the Ethernet interface and know when it was back up. The default time for watch is 2 seconds but you can override that with the -n (interval) switch. In this case 2 seconds was fine.

watch nmcli dev sho enp60s0

```
Every 2.0s: nmcli dev sho enp60s0
1S1K-G5-5587: Tue Jun 18 15:31:03 2019

GENERAL.DEVICE:                         enp60s0
GENERAL.TYPE:                           ethernet
GENERAL.HWADDR:                         54:BF:64:3B:9C:68
GENERAL.MTU:                            1500
GENERAL.STATE:                          20 (unavailable)
GENERAL.CONNECTION:                     --
GENERAL.CON-PATH:                       --
WIRED-PROPERTIES.CARRIER:               off
```

Once the switch rebooted:

```
Every 2.0s: nmcli dev sho enp60s0             1S1K-G5-5587: Tue Jun 18 15:47:36 2019

GENERAL.DEVICE:                         enp60s0
GENERAL.TYPE:                           ethernet
GENERAL.HWADDR:                         54:BF:64:3B:9C:68
GENERAL.MTU:                            1500
GENERAL.STATE:                          100 (connected)
GENERAL.CONNECTION:                     DHCP
GENERAL.CON-PATH:
/org/freedesktop/NetworkManager/ActiveConnection/13
WIRED-PROPERTIES.CARRIER:               on
IP4.ADDRESS[1]:                         10.140.55.169/24
IP4.GATEWAY:                            10.140.55.254
IP4.ROUTE[1]:                           dst = 0.0.0.0/0, nh = 10.140.55.254, mt = 100
IP4.ROUTE[2]:                           dst = 10.140.55.0/24, nh = 0.0.0.0, mt = 100
IP4.ROUTE[3]:                           dst = 169.254.0.0/16, nh = 0.0.0.0, mt = 1000
IP4.DNS[1]:                             10.140.46.67
IP4.DNS[2]:                             10.140.7.85
IP4.DNS[3]:                             10.140.46.64
IP6.ADDRESS[1]:                         fe80::5024:a81a:866c:c798/64
IP6.GATEWAY:                            --
IP6.ROUTE[1]:                           dst = ff00::/8, nh = ::, mt = 256, table=255
IP6.ROUTE[2]:                           dst = fe80::/64, nh = ::, mt = 256
IP6.ROUTE[3]:                           dst = fe80::/64, nh = ::, mt = 100
```

NMCLI Cheat Sheets

https://www.cheatography.com/nielzzz/cheat-sheets/ububtu-server/
https://learncodethehardway.org/unix/bash_cheat_sheet.pdf
https://www.linuxtrainingacademy.com/linux-commands-cheat-sheet/

Wireless Terminal commands

Linux has many built-in or freely available terminal based tools for viewing information the wireless Interface.

iwconfig

This is an oldie but goodie in Linux! From the MAN pages:
Iwconfig is similar to ifconfig(8), but is dedicated to the wireless interfaces. It is used to set the parameters of the network interface which are specific to the wireless operation (for example: the frequency). Iwconfig may also be used to display those parameters, and the wireless statistics (extracted from /proc/net/wireless).

That last line means that we can display wireless interface statistics using the Linux watch command. Watch is a tool that runs a command at a regular interval and displays the output to the screen. The default is 2 seconds, -n1 sets it to 1 second.

```
watch -n1 iwconfig
wlp0s20f3  IEEE 802.11  ESSID:"test"
   Mode:Managed  Frequency:5.26 GHz  Access Point: 9C:1C:12:96:1D:F0
   Bit Rate=780 Mb/s   Tx-Power=22 dBm
   Retry short limit:7   RTS thr:off   Fragment thr:off
   Power Management:on
   Link Quality=70/70  Signal level=-37 dBm
   Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
   Tx excessive retries:9  Invalid misc:10   Missed beacon:0
```

You can set all parameters for the interface using iwconfig. I am not going to cover configuring an interface using iwconfig because the GUI is easily accessible from the menu at the top of the screen. From the Debian Wiki:

“iwconfig is part of the wireless-tools for Linux package maintained by Jean Tourrilhes. Due to the relative complexity of requiring two separate commands to find and sync with a wireless access point, some recommend using frontends provided by GNOME and KDE, or an application called NetGo, to manipulate these settings.”

iwgetid

The iwgetid command is designed to be used with shell or Perl scripts. You get the same output as iwconfig but in a format that makes it easy to save in a variable. You can tell the command is old because the scheme switch outputs in a format for PCMCIA cards!

```
iwgetid -h
```

Usage iwgetid [OPTIONS] [ifname]
  Options are:
    -a,--ap   Print the access point address
    -c,--channel Print the current channel
    -f,--freq   Print the current frequency
    -m,--mode   Print the current mode
    -p,--protocol Print the protocol name
    -r,--raw   Format the output as raw value for shell scripts
    -s,--scheme   Format the output as a PCMCIA scheme identifier
    -h,--help   Print this message

Examples

```
iwgetid -a
wlp0s20f3  Access Point/Cell: 9C:1C:12:96:1D:F0

iwgetid -a -r
9C:1C:12:96:1D:F0

iwgetid -f
wlp0s20f3  Frequency:5.745 GHz

iwgetid -f -r
5.745e+09

iwgetid -m
wlp0s20f3  Mode:Managed

iwgetid -m -r
2
```

iwlist

From the man page:

Name “iwlist - Get more detailed wireless information from a wireless interface”.

Description
Iwlist is used to display some additional information from a wireless-network interface that is not displayed by iwconfig(8). The main argument is used to select a category of information, iwlist displays in detailed form all information related to this category, including information already shown by iwconfig(8).

SYNOPSIS
iwlist [interface] scanning
iwlist [interface] frequency
iwlist [interface] rate
iwlist [interface] keys
iwlist [interface] power
iwlist [interface] txpower
iwlist [interface] retry
iwlist [interface] event
iwlist [interface] auth
iwlist [interface] wpakeys
iwlist [interface] genie
iwlist [interface] modulation
iwlist --help
iwlist –version

It is amazing the amount of information you can get from this command.

With this one iwlist command you will get detailed information about all the APs your card can see:

```
iwlist wlp0s20f3 scanning
wlp0s20f3  Scan completed :
          Cell 01 - Address: 9C:1C:12:96:1D:F0
                    Channel:149
                    Frequency:5.745 GHz
                    Quality=64/70  Signal level=-46 dBm
                    Encryption key:on
                    ESSID:"test"
                    Bit Rates:12 Mb/s; 18 Mb/s; 24 Mb/s; 36 Mb/s; 48 Mb/s
                              54 Mb/s
                    Mode:Master
                    Extra:tsf=00000068fa9f2032
                    Extra: Last beacon: 1902640ms ago
                    IE: Unknown: 000474657374
                    IE: Unknown: 01069824B048606C
                    IE: Unknown: 030195
                    IE: Unknown: 050400010000
```

```
IE: Unknown: 071255532024041734041E640524840424950524
IE: Unknown: 200100
IE: Unknown: 23021600
IE: IEEE 802.11i/WPA2 Version 1
    Group Cipher : CCMP
    Pairwise Ciphers (1) : CCMP
    Authentication Suites (1) : PSK
IE: Unknown: 0B05070005D978
IE: Unknown: 2D1AEF0117FFFFFF0000000000000000000000000000000000000000
IE: Unknown: 3D16950D040000000000000000000000000000000000000000
IE: Unknown: 7F080400080000000040
IE: Unknown: BF0CB059820FEAFF0000EAFF0000
IE: Unknown: C005019B000000
IE: Unknown: C30402242424
IE: Unknown: DD07000B8601040816
IE: Unknown: DD180050F2020101840003A4000027A4000042435E0062322F00
```

In this example:
`Cell – Address: 9C:1C:12:96:1D:F0 is the radio MAC of the AP`
`IE stands for Generic Information Events. I do not know how to decode them!`

Transmit Power
Note that the power switch requires sudo.

sudo iwlist wlp0s20f3 txpower
wlp0s20f3 unknown transmit-power information.

Current Tx-Power=22 dBm (158 mW)

Bit Rate
```
iwlist wlp0s20f3 rate
wlp0s20f3  unknown bit-rate information.
          Current Bit Rate:866.7 Mb/s
```

More Information
Get more detailed wireless information from a wireless interface

Display Saved SSIDs

When you connect to a wireless network, the settings, including the username/password, are saved. To view them, open a terminal and enter:

nm-connection-editor
A GUI will open and you can select a saved SSID:

Wavemon

Illustration : nm-connection-editor

Another wireless monitoring tool for Ubuntu. You install it with:

```
sudo apt install wavemon
```

From the MAN pages -

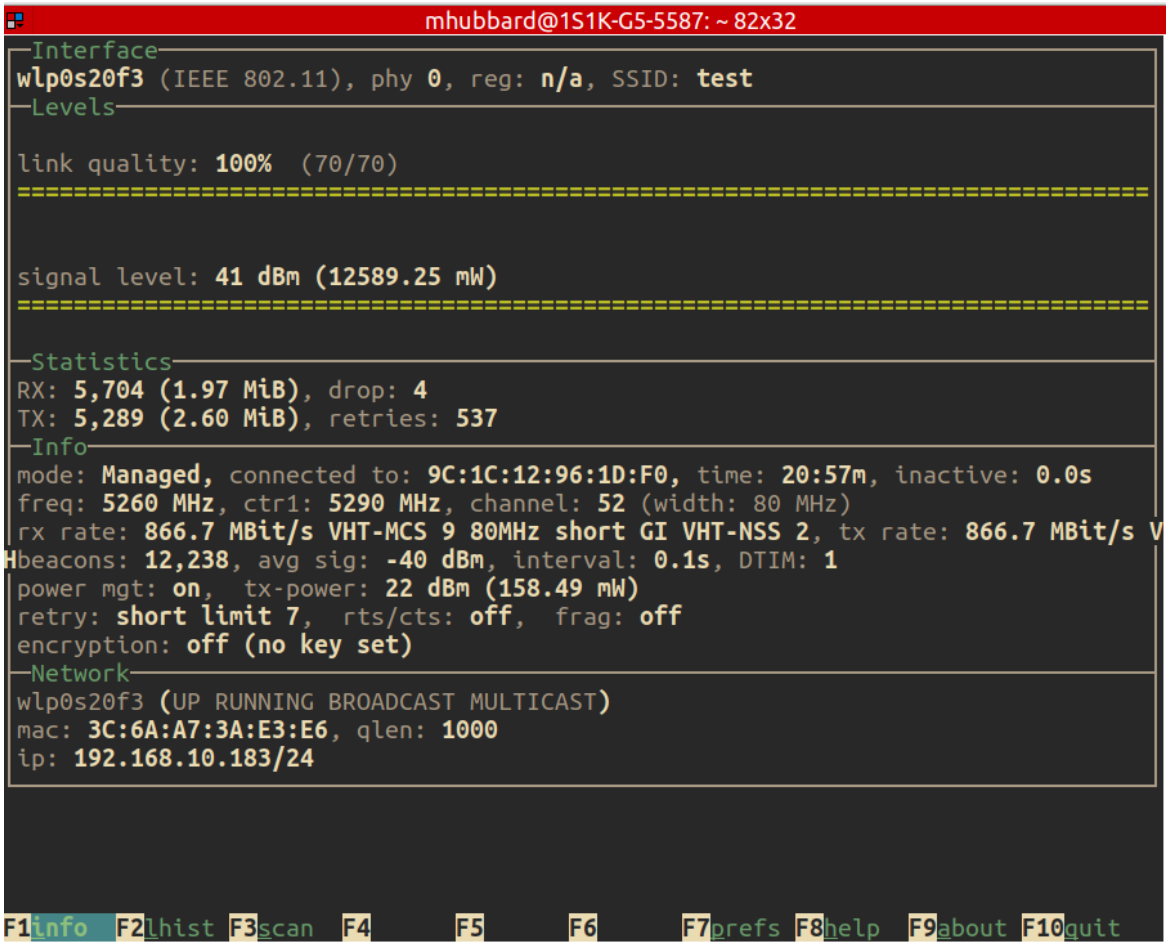
Wavemon is an ncurses-based monitoring application for wireless network devices. It plots levels in real-time as well as showing wireless and network related device information.

The wavemon interface splits into different "screens". Each screen presents information in a specific manner. For example, the "info" screen shows current levels as bargraphs, whereas the "level" screen represents the same levels as a moving histogram.

Run wavemon with sudo to get the most information.

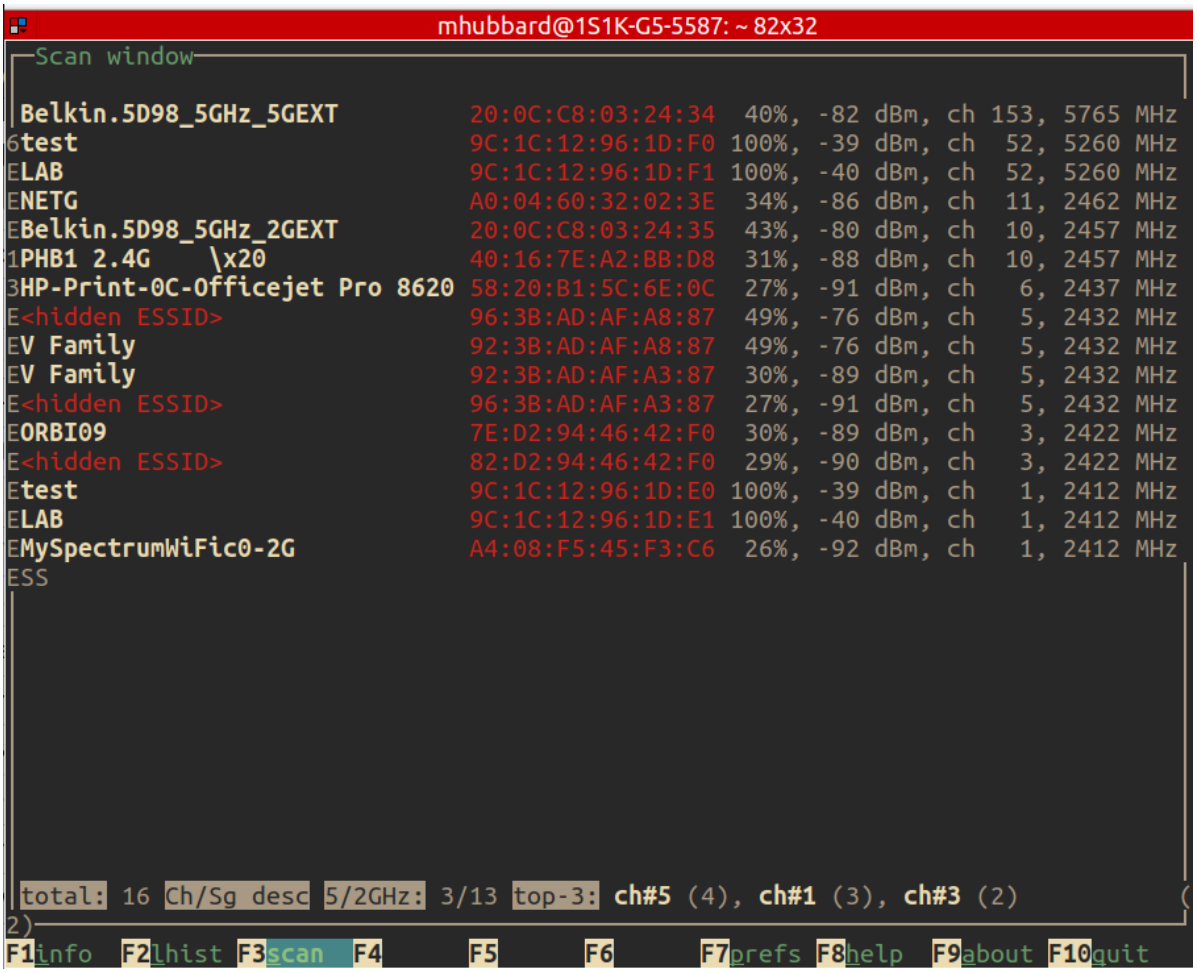
```
sudo wavemon
```

By default, it opens on the information screen.



You can press “s” to bring up the scanning screen. This is useful to see all of the SSIDs your laptop can see along with AP MAC, signal quality, power, channel and frequency.

Note that you can see “hidden” SSIDs also.


mhubbard@1S1K-G5-5587: ~ 82x32
Scan window
Belkin.5D98_5GHz_5GEXT 20:0C:C8:03:24:34 40%, -82 dBm, ch 153, 5765 MHz
6test 9C:1C:12:96:1D:F0 100%, -39 dBm, ch 52, 5260 MHz
ELAB 9C:1C:12:96:1D:F1 100%, -40 dBm, ch 52, 5260 MHz
ENETG A0:04:60:32:02:3E 34%, -86 dBm, ch 11, 2462 MHz
EBelkin.5D98_5GHz_2GEXT 20:0C:C8:03:24:35 43%, -80 dBm, ch 10, 2457 MHz
1PHB1 2.4G \x20 40:16:7E:A2:BB:D8 31%, -88 dBm, ch 10, 2457 MHz
3HP-Print-0C-Officejet Pro 8620 58:20:B1:5C:6E:0C 27%, -91 dBm, ch 6, 2437 MHz
E<hidden ESSID> 96:3B:AD:AF:A8:87 49%, -76 dBm, ch 5, 2432 MHz
EV Family 92:3B:AD:AF:A8:87 49%, -76 dBm, ch 5, 2432 MHz
EV Family 92:3B:AD:AF:A3:87 30%, -89 dBm, ch 5, 2432 MHz
E<hidden ESSID> 96:3B:AD:AF:A3:87 27%, -91 dBm, ch 5, 2432 MHz
EORBI09 7E:D2:94:46:42:F0 30%, -89 dBm, ch 3, 2422 MHz
E<hidden ESSID> 82:D2:94:46:42:F0 29%, -90 dBm, ch 3, 2422 MHz
Etest 9C:1C:12:96:1D:E0 100%, -39 dBm, ch 1, 2412 MHz
ELAB 9C:1C:12:96:1D:E1 100%, -40 dBm, ch 1, 2412 MHz
EMySpectrumWiFic0-2G A4:08:F5:45:F3:C6 26%, -92 dBm, ch 1, 2412 MHz
ESS
total: 16 Ch/Sg desc 5/2GHz: 3/13 top-3: ch#5 (4), ch#1 (3), ch#3 (2)
2)
F1info F2lhist F3scan F4 F5 F6 F7prefs F8help F9about F10quit

Ethtool

Ethtool allows you to view and change the settings of your network interface

Set speed/duplex to 100 full

```
sudo ip link set enp60s0 down
sudo ethtool -s enp60s0 autoneg off speed 100 duplex full
sudo ip link set enp60s0 up
```

Auto-negotiation of speed and duplex is part of the 1000BASE-T specification, that is gigabit ethernet over unshielded twisted pair copper cables.

You can set speed and duplex for 10Mbps and 100Mbps, because autoneg was not required for those versions of Ethernet.

If you like, you can disable the various speeds and duplexes which a NIC advertises, so it only ever advertises 1000/full, but auto-negotiation is still required.

Advertising speed and duplex

advertise - Sets the speed and duplex advertised by autonegotiation.
Example - set advertised speed to 100baseT Full

```
sudo ethtool -s enp60s0 advertise 0x008
```

To set multiple advertisements add the hex values.
Example - set 100baseT Full and 1000baseT Full

```
sudo ethtool -s enp60s0 advertise 0x028
```

The argument is a hexadecimal value using one or a combination of the following values:

```
0x001    10baseT Half
0x002    10baseT Full
0x004    100baseT Half
0x008    100baseT Full
0x010    1000baseT Half    (not supported by IEEE standards)
0x020    1000baseT Full
0x20000    1000baseKX Full
0x20000000000   1000baseX Full
0x800000000000    2500baseT Full
0x8000   2500baseX Full    (not supported by IEEE standards)
0x1000000000000   5000baseT Full
0x1000   10000baseT Full
0x40000    10000baseKX4 Full
0x80000    10000baseKR Full
0x40000000000   10000baseCR  Full
0x80000000000   10000baseSR  Full
0x100000000000    10000baseLR  Full
0x200000000000    10000baseLRM Full
0x400000000000    10000baseER  Full
0x200000   20000baseMLD2 Full     (not supported by IEEE standards)
```

```
0x400000   20000baseKR2 Full      (not supported by IEEE standards)
0x80000000      25000baseCR Full
0x100000000     25000baseKR Full
0x200000000     25000baseSR Full
0x800000   40000baseKR4 Full
0x1000000  40000baseCR4 Full
0x2000000  40000baseSR4 Full
0x4000000  40000baseLR4 Full
0x400000000     50000baseCR2 Full
0x800000000     50000baseKR2 Full
0x10000000000   50000baseSR2 Full
0x8000000  56000baseKR4 Full
0x10000000      56000baseCR4 Full
0x20000000      56000baseSR4 Full
0x40000000      56000baseLR4 Full
0x1000000000    100000baseKR4 Full
0x2000000000    100000baseSR4 Full
0x4000000000    100000baseCR4 Full
0x8000000000    100000baseLR4_ER4 Full
```

Display autonegotiation

ethtool -a enp60s0

Pause parameters for enp60s0:
Autonegotiate: off
RX: on
TX: on

Display statistics

sudo ethtool -S enp60s0

Display only Errors

sudo ethtool -S enp60s0 | grep er

rx_fcs_errors: 0
rx_length_errors: 0
rx_oversize_packets: 0
rx_align_errors: 45
rx_address_errors: 3554
tx_exc_defer_packets: 0
tx_defer_packets: 31
tx_underrun: 0
tx_length_errors: 0

Display only Collisions

sudo ethtool -S enp60s0 | grep co

tx_single_collision: 8
tx_multiple_collisions: 9
tx_late_collision: 1
tx_abort_collision: 0

Show Features

sudo ethtool -k enp60s0

Features for enp60s0:
rx-checksumming: off
tx-checksumming: off
	tx-checksum-ipv4: off [fixed]
	tx-checksum-ip-generic: off
	tx-checksum-ipv6: off [fixed]
	tx-checksum-fcoe-crc: off [fixed]
	tx-checksum-sctp: off [fixed]
scatter-gather: off
	tx-scatter-gather: off
	tx-scatter-gather-fraglist: off [fixed]
tcp-segmentation-offload: off
	tx-tcp-segmentation: off
	tx-tcp-ecn-segmentation: off [fixed]
	tx-tcp-mangleid-segmentation: off
	tx-tcp6-segmentation: off
udp-fragmentation-offload: off
generic-segmentation-offload: off [requested on]
generic-receive-offload: on
large-receive-offload: off [fixed]
rx-vlan-offload: off [fixed]
tx-vlan-offload: off [fixed]
ntuple-filters: off [fixed]
receive-hashing: off [fixed]
highdma: off [fixed]
rx-vlan-filter: off [fixed]
vlan-challenged: off [fixed]
tx-lockless: off [fixed]
netns-local: off [fixed]
tx-gso-robust: off [fixed]
tx-fcoe-segmentation: off [fixed]
tx-gre-segmentation: off [fixed]
tx-gre-csum-segmentation: off [fixed]
tx-ipxip4-segmentation: off [fixed]
tx-ipxip6-segmentation: off [fixed]
tx-udp_tnl-segmentation: off [fixed]
tx-udp_tnl-csum-segmentation: off [fixed]
tx-gso-partial: off [fixed]
tx-sctp-segmentation: off [fixed]

tx-esp-segmentation: off [fixed]
fcoe-mtu: off [fixed]
tx-nocache-copy: off
loopback: off [fixed]
rx-fcs: off [fixed]
rx-all: off [fixed]
tx-vlan-stag-hw-insert: off [fixed]
rx-vlan-stag-hw-parse: off [fixed]
rx-vlan-stag-filter: off [fixed]
l2-fwd-offload: off [fixed]
hw-tc-offload: off [fixed]
esp-hw-offload: off [fixed]
esp-tx-csum-hw-offload: off [fixed]
rx-udp_tunnel-port-offload: off [fixed]

Display permanent address

ethtool -P wlp0s20f3
Permanent address: 3c:6a:a7:3a:e3:e6

Flash the NIC LED

To blink the LED of Ethernet device enp60s0 for 10 seconds:

sudo ethtool -p enp60s0 10

The LED will begin blinking, so you know which card you're dealing with. NOTE: the card must support this feature.

Testing a NIC

sudo ethtool -t enp60s0 online
Cannot test: Operation not supported

Testing is not supported on all NICs. For example, my Dell laptop has a Qualcomm Atheros Killer E2400 Gigabit Ethernet chip and testing isn’t supported.

Show Driver Information

ethtool -i enp60s0
driver: alx
version:
firmware-version:
expansion-rom-version:
bus-info: 0000:3c:00.0
supports-statistics: yes
supports-test: no

supports-eeprom-access: no
supports-register-dump: no
supports-priv-flags: no

Make Changes Permanent After Reboot

If you've changed any ethernet device parameters using the ethtool, it will all disappear after the next reboot, unless you do the following.

On ubuntu, you have to modify /etc/network/interfaces file and add all your changes as shown below.

sudo gedit /etc/network/interfaces
post-up ethtool -s eth2 speed 100 ***duplex*** full autoneg off

The above line should be the last line of the file. This will change speed, duplex and autoneg of eth2 device permanently.

More Information
https://www.garron.me/en/linux/ubuntu-network-speed-duplex-lan.html
https://www.techrepublic.com/article/how-to-troubleshoot-an-ethernet-interface-ubuntu-server-with-ethtool/
https://etherealmind.com/ethernet-autonegotiation-works-why-how-standard-should-be-set/
http://www.cisco.com/en/US/tech/tk389/tk214/technologies_tech_note09186a0080094781.shtml
https://www.thegeekstuff.com/2010/10/ethtool-command/

LLDP client for Linux

Having an LLDP client on your laptop is very useful when you are working with non-Cisco switches, VoIP phones and any other devices that support LLDP. There are LLDP programs for Windows but most are shareware that time out and then have to be purchased.
https://fnord.no/2016/04/28/lldp-on-linux/

Installation

sudo apt install lldpd
sudo service lldpd restart

LLDP client Usage

lldpcli show neighbors
lldpcli show interfaces
lldpcli show chassis [summary|details]
lldpcli show configuration
lldpcli show statistics
lldpcli update - Make lldpd update its information and send new LLDP PDU on all interfaces.
For detailed help type "man lldpd"

Running interactively

You can also run it interactively by runninng lldpcli without any options:

```
mhubbard@1S1K-G5-5587:~/Dropbox/Python/Scripts/SIET$
->lldpcli
[lldpcli] $
[lldpcli] $ sh neighbors
-------------------------------------------------------------------------------
LLDP neighbors:
-------------------------------------------------------------------------------
Interface:    enp60s0, via: LLDP, RID: 5, Time: 0 day, 00:04:01
  Chassis:
    ChassisID:    mac 10:1f:74:a4:01:20
    SysName:    PROCURVE J9450A
    SysDescr:    HP ProCurve 1810G - 24 GE, P.1.17, eCos-2.0
    MgmtIP:     192.168.10.10
    Capability:   Bridge, on
  Port:
    PortID:     local 3
    PortDescr:    Port #3
    TTL:   120
-------------------------------------------------------------------------------
(Note - this is a Windows 7 virtual machine with a hostname of FFKN25S)
Interface:    vmnet8, via: LLDP, RID: 4, Time: 0 day, 00:44:06
  Chassis:
    ChassisID:    local EPCEheha
    SysName:    FFKN25S
    SysDescr:   Intel64 Family 6 Model 158 Stepping 10, GenuineIntel - Windows 6.1 (Build 7601)
Service Pack 1
    MgmtIP:     172.16.209.128
    Capability:   Station, on
  Port:
    PortID:     mac 00:0c:29:f5:02:cc
    PortDescr:    Intel(R) PRO/1000 MT Network Connection
    TTL:   120
-------------------------------------------------------------------------------
[lldpcli] $ sh interfaces
-------------------------------------------------------------------------------
LLDP interfaces:
-------------------------------------------------------------------------------
Interface:    enp60s0, via: LLDP, Time: 0 day, 03:28:15
  Chassis:
    ChassisID:    mac 54:bf:64:3b:9c:68
    SysName:    1S1K-G5-5587
```

```
    SysDescr:   Ubuntu 18.04.1 LTS Linux 4.15.0-36-generic #39-Ubuntu SMP Mon Sep 24 16:19:09
UTC 2018 x86_64
    MgmtIP:     192.168.10.183
    MgmtIP:     fe80::b05c:adfa:b145:a837
    Capability:   Bridge, off
    Capability:   Router, off
    Capability:   Wlan, on
    Capability:   Station, off
  Port:
    PortID:     mac 54:bf:64:3b:9c:68
    PortDescr:    enp60s0
  TTL:   120
-------------------------------------------------------------------------------
Interface:    wlp0s20f3, via: unknown, Time: 0 day, 03:46:10
  Chassis:
    ChassisID:    mac 54:bf:64:3b:9c:68
    SysName:    1S1K-G5-5587
    SysDescr:   Ubuntu 18.04.1 LTS Linux 4.15.0-36-generic #39-Ubuntu SMP Mon Sep 24 16:19:09
UTC 2018 x86_64
    MgmtIP:     192.168.10.183
    MgmtIP:     fe80::b05c:adfa:b145:a837
    Capability:   Bridge, off
    Capability:   Router, off
    Capability:   Wlan, on
    Capability:   Station, off
  Port:
    PortID:     mac 3c:6a:a7:3a:e3:e6
    PortDescr:    wlp0s20f3
  TTL:   120
-------------------------------------------------------------------------------
Interface:    vmnet1, via: unknown, Time: 0 day, 03:46:36
  Chassis:
    ChassisID:    mac 54:bf:64:3b:9c:68
    SysName:    1S1K-G5-5587
    SysDescr:   Ubuntu 18.04.1 LTS Linux 4.15.0-36-generic #39-Ubuntu SMP Mon Sep 24 16:19:09
UTC 2018 x86_64
    MgmtIP:     192.168.10.183
    MgmtIP:     fe80::b05c:adfa:b145:a837
    Capability:   Bridge, off
    Capability:   Router, off
    Capability:   Wlan, on
    Capability:   Station, off
  Port:
    PortID:     mac 00:50:56:c0:00:01
    PortDescr:    vmnet1
  TTL:   120
-------------------------------------------------------------------------------
```

```
Interface:    vmnet8, via: LLDP, Time: 0 day, 03:46:36
  Chassis:
    ChassisID:    mac 54:bf:64:3b:9c:68
    SysName:    1S1K-G5-5587
    SysDescr:   Ubuntu 18.04.1 LTS Linux 4.15.0-36-generic #39-Ubuntu SMP Mon Sep 24 16:19:09
UTC 2018 x86_64
    MgmtIP:     192.168.10.183
    MgmtIP:     fe80::b05c:adfa:b145:a837
    Capability:   Bridge, off
    Capability:   Router, off
    Capability:   Wlan, on
    Capability:   Station, off
  Port:
    PortID:     mac 00:50:56:c0:00:08
    PortDescr:    vmnet8
  TTL:   120
-------------------------------------------------------------------------------
[lldpcli] $ sh chassis
-------------------------------------------------------------------------------
Local chassis:
-------------------------------------------------------------------------------
Chassis:
  ChassisID:    mac 54:bf:64:3b:9c:68
  SysName:    1S1K-G5-5587
  SysDescr:   Ubuntu 18.04.1 LTS Linux 4.15.0-36-generic #39-Ubuntu SMP Mon Sep 24 16:19:09
UTC 2018 x86_64
  MgmtIP:     192.168.10.183
  MgmtIP:     fe80::b05c:adfa:b145:a837
  Capability:   Bridge, off
  Capability:   Router, off
  Capability:   Wlan, on
  Capability:   Station, off
-------------------------------------------------------------------------------
[lldpcli] $ sh configuration
-------------------------------------------------------------------------------
Global configuration:
-------------------------------------------------------------------------------
Configuration:
  Transmit delay: 30
  Transmit hold: 4
  Receive mode: no
  Pattern for management addresses: (none)
  Interface pattern: (none)
  Interface pattern for chassis ID: (none)
  Override description with: (none)
  Override platform with: Linux
  Override system name with: (none)
```

```
Advertise version: yes
Update interface descriptions: no
Promiscuous mode on managed interfaces: no
Disable LLDP-MED inventory: yes
LLDP-MED fast start mechanism: yes
LLDP-MED fast start interval: 1
Source MAC for LLDP frames on bond slaves: local
Port ID TLV subtype for LLDP frames: unknown
Agent type:   unknown
```

Reference

Vincent Bernat's LLDPD usage instructions

Networking Tools

One of the greatest things about Linux is the vast number of free tools for network engineers. Here are the ones I have found. I'm sure this is just a small percentage of all the tools available.

Sipcalc

A great terminal subnet calculator.

Installation
sudo apt install sipcalc

The simplest use is just sipcalc and a network address:

```
sipcalc 10.56.0.0/21
-[ipv4 : 10.56.0.0/21] - 0

[CIDR]
Host address            - 10.56.0.0
Host address (decimal)  - 171442176
Host address (hex)      - A380000
Network address      - 10.56.0.0
Network mask            - 255.255.248.0
Network mask (bits)     - 21
Network mask (hex)      - FFFFF800
Broadcast address       - 10.56.7.255
Cisco wildcard          - 0.0.7.255
Addresses in network  - 2048
Network range           - 10.56.0.0 - 10.56.7.255
Usable range            - 10.56.0.1 - 10.56.7.254
```

In this example, sipcalc returned IPv4 information including the results in dotted quad notation, hex and the Cisco wildcard mask along with the number of hosts in the network!

But, sipcalc supports a lot of options. The -a switch is useful if you are helping someone learn subnetting and they need the masks in bit form:

```
[Classful bitmaps]
Network address         - 00001010.00000000.00000000.00000000
Network mask       - 11111111.00000000.00000000.00000000

[CIDR bitmaps]
Host address       - 00001010.00111000.00000000.00000000
Network address         - 00001010.00111000.00000000.00000000
Network mask       - 11111111.11111111.11111110.00000000
Broadcast address       - 00001010.00111000.00000001.11111111
Cisco wildcard          - 00000000.00000000.00000001.11111111
Network range           - 00001010.00111000.00000000.00000000 -
```

```
                          00001010.00111000.00000001.11111111
Usable range       - 00001010.00111000.00000000.00000001 -
                          00001010.00111000.00000001.11111110
```

Sipcalc using an Interface

Another userful switch is the -I or Interface switch. It returns the information for the specified interface.

sipcalc -I vmnet8

```
-[int-ipv4 : vmnet8] - 0

[CIDR]
Host address       - 172.16.209.1
Host address (decimal)    - 2886783233
Host address (hex)  - AC10D101
Network address           - 172.16.209.0
Network mask       - 255.255.255.0
Network mask (bits)- 24
Network mask (hex)  - FFFFFF00
Broadcast address         - 172.16.209.255
Cisco wildcard            - 0.0.0.255
Addresses in network      - 256
Network range             - 172.16.209.0 - 172.16.209.255
Usable range       - 172.16.209.1 - 172.16.209.254
```

You can see all of the options with:

sipcalc -h

sipcalc 1.1.6

Usage: sipcalc [OPTIONS]... <[ADDRESS]... [INTERFACE]... | [-]>

Global options:

-a, --all	All possible information.
-d, --resolve	Enable name resolution.
-h, --help	Display this help.
-I, --addr-int=INT	Added an interface.
-n, --subnets=NUM	Display NUM extra subnets (starting from the current subnet). Will display all subnets in the current /24 if NUM is 0.
-u, --split-verbose	Verbose split.
-v, --version	Version information.
-4, --addr-ipv4=ADDR	Add an ipv4 address.
-6, --addr-ipv6=ADDR	Add an ipv6 address.

IPv4 options:

-b, --cidr-bitmap	CIDR bitmap.
-c, --classful-addr	Classful address information.

```
  -i, --cidr-addr           CIDR address information. (default)
  -s, --v4split=MASK        Split the current network into subnets
                            of MASK size.
  -w, --wildcard            Display information for a wildcard
                            (inverse mask).
  -x, --classful-bitmap Classful bitmap.

IPv6 options:
  -e, --v4inv6              IPv4 compatible IPv6 information.
  -r, --v6rev               IPv6 reverse DNS output.
  -S, --v6split=MASK        Split the current network into subnets
                            of MASK size.
  -t, --v6-standard         Standard IPv6. (default)

Address must be in the "standard" dotted quad format.
Netmask can be given in three different ways:
 - Number of bits    [/nn]
 - Dotted quad       [nnn.nnn.nnn.nnn]
 - Hex               [0xnnnnnnnn | nnnnnnnn]

Interface must be a valid network interface on the system.
If this options is used an attempt will be made to gain the address
and netmask from the specified interface.
```

Ipcalc

Another subnet mask tool. Ipcalc outputs the information in decimal and binary.

Installation
sudo apt install ipcalc

Example:
ipcalc 10.56.0.0/21

```
Address:   10.56.0.0   00001010.00111000.00000 000.00000000
Netmask:   255.255.248.0 = 21   11111111.11111111.11111 000.00000000
Wildcard:  0.0.7.255   00000000.00000000.00000 111.11111111
=>
Network:   10.56.0.0/21  00001010.00111000.00000 000.00000000
HostMin:   10.56.0.1   00001010.00111000.00000 000.00000001
HostMax:   10.56.7.254   00001010.00111000.00000 111.11111110
Broadcast: 10.56.7.255   00001010.00111000.00000 111.11111111
Hosts/Net: 2046    Class A, Private Internet
```

Like sipcalc, ipcalc has a lot of options. Like most Linux terminal apps the -h switch lists them.

ipcalc -h

Usage: ipcalc [options] <ADDRESS>[[/]<NETMASK>] [NETMASK]

ipcalc takes an IP address and netmask and calculates the resulting
broadcast, network, Cisco wildcard mask, and host range. By giving a
second netmask, you can design sub- and supernetworks. It is also
intended to be a teaching tool and presents the results as
easy-to-understand binary values.

```
 -n --nocolor  Don't display ANSI color codes.
 -c --color    Display ANSI color codes (default).
 -b --nobinary Suppress the bitwise output.
 -c --class    Just print bit-count-mask of given address.
 -h --html     Display results as HTML (not finished in this version).
 -v --version  Print Version.
 -s --split n1 n2 n3
            Split into networks of size n1, n2, n3.
 -r --range    Deaggregate address range.
   --help     Longer help text.
```

Examples:

ipcalc 192.168.0.1/24
ipcalc 192.168.0.1/255.255.128.0
ipcalc 192.168.0.1 255.255.128.0 255.255.192.0

ipcalc 192.168.0.1 0.0.63.255

ipcalc <ADDRESS1> - <ADDRESS2> deaggregate address range
ipcalc <ADDRESS>/<NETMASK> --s a b c
split network to subnets where a b c fits in.

Notice that you can enter two subnet masks and ipcalc with display both ranges:

ipcalc 192.168.0.1 255.255.128.0 255.255.192.0
Address: 192.168.0.1 11000000.10101000.0 0000000.00000001
Netmask: 255.255.128.0 = 17 11111111.11111111.1 0000000.00000000
Wildcard: 0.0.127.255 00000000.00000000.0 1111111.11111111
=>
Network: 192.168.0.0/17 11000000.10101000.0 0000000.00000000
HostMin: 192.168.0.1 11000000.10101000.0 0000000.00000001
HostMax: 192.168.127.254 11000000.10101000.0 1111111.11111110
Broadcast: 192.168.127.255 11000000.10101000.0 1111111.11111111
Hosts/Net: 32766 Class C, Private Internet

Subnets after transition from /17 to /18

Netmask: 255.255.192.0 = 18 11111111.11111111.11 000000.00000000
Wildcard: 0.0.63.255 00000000.00000000.00 111111.11111111

1.
Network: 192.168.0.0/18 11000000.10101000.00 000000.00000000
HostMin: 192.168.0.1 11000000.10101000.00 000000.00000001
HostMax: 192.168.63.254 11000000.10101000.00 111111.11111110
Broadcast: 192.168.63.255 11000000.10101000.00 111111.11111111
Hosts/Net: 16382 Class C, Private Internet

2.
Network: 192.168.64.0/18 11000000.10101000.01 000000.00000000
HostMin: 192.168.64.1 11000000.10101000.01 000000.00000001
HostMax: 192.168.127.254 11000000.10101000.01 111111.11111110
Broadcast: 192.168.127.255 11000000.10101000.01 111111.11111111
Hosts/Net: 16382 Class C, Private Internet

Subnets: 2
Hosts: 32764

Arpscan

One of the best features of Linux is that you have much more flexibility with the network stack than you have with Windows. The arp-scan tool by Roy Hill allows you to use arp instead of ICMP to locate devices on the network.

Why is this important? Today, many devices have a firewall turned on by default. A ping scan won't locate these devices but an arp scan will. If you need to connect to a network that doesn't have DHCP, you must make sure that the address you select isn't in use. Ping can't guarantee that because of firewalls but arp-scan can find devices that don't respond to ping.

Installation
sudo apt install arp-scan

Examples
In this example, my Macbook Air has the firewall turned on and an IP address of 192.168.10.175. A ping fails to locate it but arp-scan returns the mac address and manufacture.

```
ping 192.168.10.175
PING 192.168.10.175 (192.168.10.175) 56(84) bytes of data.
^C
--- 192.168.10.175 ping statistics ---
8 packets transmitted, 0 received, 100% packet loss, time 7175ms

mhubbard@1S1K-G5-5587:~$
sudo arp-scan -I wlp0s20f3 192.168.10.175
Interface: wlp0s20f3, datalink type: EN10MB (Ethernet)
Starting arp-scan 1.9 with 1 hosts (http://www.nta-monitor.com/tools/arp-scan/)
192.168.10.175     b8:8d:12:08:65:aa   Apple, Inc.

1 packets received by filter, 0 packets dropped by kernel
Ending arp-scan 1.9: 1 hosts scanned in 1.008 seconds (0.99 hosts/sec). 1 responded
```

Scan using the adapter's settings

In this example we scan the entire subnet based off of the adapter's settings. This example assumes we already have an IP address and mask assigned and are just looking for devices that don't respond to ping.

Note: If you don't know anything about the network you can use wireshark and arp-scan in combination. See my blog for a detailed example - https://mwhubbard.blogspot.com/2017/04/using-arp-scan-to-find-free-ip-address.html

```
sudo arp-scan -I wlp0s20f3 --localnet
Interface: wlp0s20f3, datalink type: EN10MB (Ethernet)
Starting arp-scan 1.9 with 256 hosts (http://www.nta-monitor.com/tools/arp-scan/)
192.168.10.13   64:52:99:69:fd:20     The Chamberlain Group, Inc
192.168.10.20   c0:3f:d5:68:0c:cc     (Unknown)
```

```
192.168.10.50   fc:ec:da:c4:6e:55    (Unknown)
192.168.10.51   fc:ec:da:c4:77:0b    (Unknown)
192.168.10.154  ac:bc:32:7c:97:85    (Unknown)
192.168.10.163  dc:56:e7:49:61:d3    (Unknown)
192.168.10.156  70:81:eb:55:2a:a8    (Unknown)
192.168.10.179  9c:1c:12:c1:61:de    Aruba Networks
192.168.10.201  00:04:7d:0e:24:e5    Pelco
192.168.10.175  b8:8d:12:08:65:aa    Apple, Inc.
192.168.10.174  f0:76:6f:71:4b:10    (Unknown)
192.168.10.221  00:0c:29:4c:aa:4e    VMware, Inc.
192.168.10.239  10:1f:74:63:41:f8    Hewlett-Packard Company
192.168.10.254  08:5b:0e:d4:54:b2    Fortinet, Inc.
192.168.10.160  fc:e9:98:57:e9:ea    (Unknown)
192.168.10.162  ac:3c:0b:7a:13:e9    Apple

17 packets received by filter, 0 packets dropped by kernel
Ending arp-scan 1.9: 256 hosts scanned in 2.634 seconds (97.19 hosts/sec).
17 responded
```

Notice that we received serveral mac addresses that arp-scan listed as unknown. To update the oui.txt file that arp-scan uses run the following:

get-oui -v

```
Fetching OUI data from file://var/lib/ieee-data/oui.txt
Fetched 3823600 bytes
Opening output file ieee-oui.txt
Wide character in print at /usr/sbin/get-oui line 136.
24485 OUI entries written to file ieee-oui.txt
```

Now run the arp-scan again. Now we have a manufacture for all the device on my home network.

sudo arp-scan -I wlp0s20f3 --localnet

```
Interface: wlp0s20f3, datalink type: EN10MB (Ethernet)
Starting arp-scan 1.9 with 256 hosts (http://www.nta-monitor.com/tools/arp-scan/)
192.168.10.13      64:52:99:69:fd:20  The Chamberlain Group, Inc
192.168.10.20      c0:3f:d5:68:0c:cc  Elitegroup Computer Systems Co.,Ltd.
192.168.10.50      fc:ec:da:c4:6e:55  Ubiquiti Networks Inc.
192.168.10.51      fc:ec:da:c4:77:0b  Ubiquiti Networks Inc.
192.168.10.163     dc:56:e7:49:61:d3  Apple, Inc.
192.168.10.154     ac:bc:32:7c:97:85  Apple, Inc.
192.168.10.160     fc:e9:98:57:e9:ea  Apple, Inc.
192.168.10.162     ac:3c:0b:7a:13:e9  Apple, Inc.
192.168.10.156     70:81:eb:55:2a:a8  Apple, Inc.
192.168.10.179     9c:1c:12:c1:61:de  Aruba Networks
192.168.10.201     00:04:7d:0e:24:e5  Pelco
192.168.10.221     00:0c:29:4c:aa:4e  VMware, Inc.
192.168.10.175     b8:8d:12:08:65:aa  Apple, Inc.
```

```
192.168.10.239     10:1f:74:63:41:f8   Hewlett Packard
192.168.10.254     08:5b:0e:d4:54:b2   Fortinet, Inc.
192.168.10.151     08:66:98:45:7f:86   Apple, Inc.
192.168.10.174     f0:76:6f:71:4b:10   Apple, Inc.
192.168.10.158     04:db:56:ed:ad:58   Apple, Inc.

18 packets received by filter, 0 packets dropped by kernel
Ending arp-scan 1.9: 256 hosts scanned in 2.630 seconds (97.34 hosts/sec). 18 responded
```

Additional information
Project website - https://github.com/royhills/arp-scan
Project Wiki - http://www.nta-monitor.com/wiki/
arp-scan(1) - Linux man page - https://linux.die.net/man/1/arp-scan
Arp-Scan Command Tutorial With Examples - https://www.poftut.com/arp-scan-command-tutorial-examples/
My python wrapper for arp-scan - https://github.com/rikosintie/arp-scan
My blog on arp-scan - https://mwhubbard.blogspot.com/2017/04/using-arp-scan-to-find-free-ip-address.html

grepcidr

http://www.pc-tools.net/unix/grepcidr/
This is a great little utility! It's like grep but for CIDR addresses.

Below is a fictitious example from a cutover. I intentionally removed four lines from the "show ip arp" file (arp-b4Cut.txt) to simulate some devices not being up afterward (arp-AfterCut.txt). The output is just the four lines I removed on purpose. NOTE: I did have to search/replace the "Internet " at the beginning of each line since the -f option expects a list of IP addresses.

You can do a lot more, the man page (man grepcidr) has several examples and Google will find more.

grepcidr -vf arp-AfterCut.txt arp-b4Cut.txt

```
10.100.0.1      0   0015.5d0d.1d38  ARPA   Vlan700
10.100.0.11    214   d02b.20e1.b6bb  ARPA   Vlan700
10.100.0.12     0   Incomplete    ARPA
10.100.0.17    20   88b4.a677.fb6b  ARPA   Vlan700
```

EXAMPLES from the MAN Page

grepcidr -f ournetworks blacklist > abuse.log
Find customers (CIDR ranges in file) that appear in blacklist

grepcidr 2001:db8::/32 log.1 log.2
Search for this IPv6 network inside two files

grepcidr 127.0.0.0/8 iplog
Searches for any localnet IP addresses inside the iplog file

grepcidr "192.168.0.1-192.168.10.13" iplog
Searches for IPs matching indicated range in the iplog file

script | grepcidr -vf whitelist > blacklist
Create a blacklist, with whitelisted networks removed (inverse)

grepcidr -f list1 list2
Cross-reference two lists, outputs IPs common to both lists

Here is an example run against a file from a core switch with a few thousand ARP records. I wanted just addresses in the 10.140.0.0/23 subnet. Notice that I didn't have to remove the "Internet " from the beginning of each line.

```
grepcidr 10.140.0.0/23 arp-test.txt
Internet  10.140.0.241   196   24e9.b33e.f080  ARPA   TenGigabitEthernet2/16
Internet  10.140.0.242    35   24e9.b33f.3d40  ARPA   TenGigabitEthernet2/16
Internet  10.140.0.244   137   24e9.b33f.3cc0  ARPA   TenGigabitEthernet2/16
Internet  10.140.0.245    51   24e9.b33f.3d80  ARPA   TenGigabitEthernet2/16
Internet  10.140.0.246   148   24e9.b33f.3dc0  ARPA   TenGigabitEthernet2/16
Internet  10.140.0.247   226   24e9.b33f.3c80  ARPA   TenGigabitEthernet2/16
Internet  10.140.0.248    25   24e9.b33e.f4c0  ARPA   TenGigabitEthernet2/16
Internet  10.140.0.249    40   24e9.b33e.f240  ARPA   TenGigabitEthernet2/16
Internet  10.140.0.250   230   24e9.b33e.f0c0  ARPA   TenGigabitEthernet2/16
Internet  10.140.0.254   -   3c08.f6ff.2640  ARPA   TenGigabitEthernet2/16
Internet  10.140.1.125   -   3c08.f6ff.2640  ARPA   TenGigabitEthernet2/15
Internet  10.140.1.126   0   906c.ac6d.6a73  ARPA   TenGigabitEthernet2/15
Internet  10.140.1.240    80   0011.212d.6701  ARPA   Vlan556
Internet  10.140.1.243   102   58f3.9cf5.0661  ARPA   Vlan556
Internet  10.140.1.251   113   24e9.b33f.3d00  ARPA   Vlan556
Internet  10.140.1.252   9   24e9.b33e.f200  ARPA   Vlan556
Internet  10.140.1.254   -   3c08.f6ff.2640  ARPA   Vlan556
```

nmap

From the introduction at nmap.org
Nmap ("Network Mapper") is a free and open source utility for network discovery and security auditing. Many systems and network administrators also find it useful for tasks such as network inventory, managing service upgrade schedules, and monitoring host or service uptime.

In addition to the classic command-line Nmap executable, the Nmap suite includes an advanced GUI and results viewer (Zenmap), a flexible data transfer, redirection, and debugging tool (Ncat), a utility for comparing scan results (Ndiff), and a packet generation and response analysis tool (Nping).

In my opinion, you need to be very proficient with nmap to be a good network engineer. If you aren’t comfortable, there are a lot of websites with nmap tutorials and udemy.com has several inexpensive videos. The trick to udemy is to sign up for an account and then look for the courses you want. They

will be pretty expensive. Just add them to your cart but don't check out. Within a couple weeks you will get an email saying they are on sale for $9.99 each.

Installation
nmap is in Ubuntu's repository but it is usually quite old. For our purposes we will download the source and build the latest version.

Download from https://nmap.org/download.html to ~/Downloads
The filename will be nmap-<version>.tar.bz2

Decompress the tarball
```
tar xvjf nmap-<version>.tar.bz2
cd nmap-<version>.tar.bz2
./configure
```

If the configuration succeeds, an ASCII art dragon appears to congratulate you on successful configuration and warn you to be careful.

Build nmap
make

The next step is a little different on Ubuntu because the root account is disabled by default. So, we have to enable root first:
sudo -i passwd root

You will be prompted to enter your password.

Now we can do the installation
Become a privileged user for system-wide install: su root
make install

Congratulations! Nmap is now installed as `/usr/local/bin/nmap`! Run it with no arguments for a quick help screen.

Now we need to disable the root account
sudo passwd -l root

On Linux the default installation puts the files in the following locations:
```
/usr/share/nmap
/usr/share/nmap/nselib – The LUA scripts used by nmap
/usr/share/nmap/nselib/data – Data files needed for scripts
/usr/share/nmap/scripts – The location of the NSE scripts
```

Example 1
In the arp-scan example above we used my Macbook Air at 192.168.10.175 and Ping failed but arp-scan succeeded. With nmap, if you run it without sudo it uses ICMP for Host Discovery.

```
nmap -sn 192.168.10.175
```

Starting Nmap 7.60 (https://nmap.org) at 2019-02-10 20:20 PST
Note: Host seems down. If it is really up, but blocking our ping probes, try -Pn
Nmap done: 1 IP address (0 hosts up) scanned in 3.00 seconds

Now we run nmap with sudo which uses arp if the host is on the same subnet:

sudo nmap -sn 192.168.10.175

Starting Nmap 7.60 (https://nmap.org) at 2019-02-10 20:20 PST
Nmap scan report for 192.168.10.175
Host is up (0.012s latency).
MAC Address: B8:8D:12:08:65:AA (Apple)
Nmap done: 1 IP address (1 host up) scanned in 0.30 seconds

Notice that the host responded and nmap recorded the MAC Address. Keep this in mind when you use nmap on a LAN.

Example 2
The beauty of nmap is that it has a scripting language and an active community. Here is a script for pulling information out of Ubiquiti devices. In this case I have two Ubiquiti Nano Loco access points in my home lab:

sudo nmap -sU -p 10001 --script ubiquiti-discovery.nse 192.168.10.50-51

```
Starting Nmap 7.60 ( https://nmap.org ) at 2019-02-10 21:51 PST
Nmap scan report for 192.168.10.50
Host is up (0.0042s latency).

PORT    STATE SERVICE
10001/udp open  ubiquiti-discovery
| ubiquiti-discovery:
|   protocol: v1
|   firmware: WA.ar934x.v8.5.11.39842.190109.1449
|   version: v8.5.11
|   uptime_seconds: 194815
|   uptime: 2 days 06:06:55
|   hostname: Office
|   product: N5L
|   essid: death2all
|   model: NanoStation 5AC loco
|   interface_to_ip:
|   fc:ec:da:c4:6e:55:
|     169.254.110.85
|     192.168.10.50
|   mac_addresses:
|_    fc:ec:da:c4:6e:55
MAC Address: FC:EC:DA:C4:6E:55 (Ubiquiti Networks)
Service Info: OS: Linux
```

To compare the firmware versions of multiple devices:

```
sudo nmap -sU -p 10001 --script ubiquiti-discovery.nse -oG ubnt 192.168.10.50-51 |
grep firmware
|   firmware: WA.ar934x.v8.5.11.39842.190109.1449
|   firmware: WA.ar934x.v8.5.11.39842.190109.1449
```

Reporting

Here are a few of the reporting tools I use for nmap
CSV output
https://github.com/maaaaz/nmaptocsv

It can take the normal or XML output from nmap as input.

XML output
https://github.com/honze-net/nmap-bootstrap-xsl/

This is one of my favorites. You add --stylesheet nmap-bootstrap.xsl when you run the scan and then it creates a beautiful report that you can send in email.

Text output
http://blog.techorganic.com/2012/09/15/parsing-nmaps-output/

A bit awkward to run but a nice output

https://github.com/actuated/nmap-grep
Comprehensive parsing script for grepable Nmap output files. Provides a summary table, split hosts files, and URLs for web and SMB hosts.

More Information

https://nmap.org/book/inst-source.html
https://www.tecmint.com/enable-and-disable-root-login-in-ubuntu/
https://www.udemy.com - The complete nmap ethical hacking course
www.packtpub.com - Nmap: Network Exploration and Security Auditing Cookbook Paulino Calderon
www.packtpub.com - Mastering the Nmap Scripting Engine Paulino Calderon

nping

This utility is included with nmap. It allows you to ping devices using tcp or udp on any port. It's great when you have a firewall between you and the device that blocks ICMP.

Examples
Ping using the HTTPS port tcp 443

sudo nping -tcp -p443 www.cisco.com

```
Starting Nping 0.7.60 ( https://nmap.org/nping ) at 2019-03-01 21:47 PST
SENT (0.1008s) TCP 192.168.10.225:25337 > 96.7.79.147:443 S ttl=64 id=32736 iplen=40
seq=3093962918 win=1480
RCVD (0.2788s) TCP 96.7.79.147:443 > 192.168.10.225:25337 SA ttl=56 id=0 iplen=44
seq=881035284 win=29200 <mss 1460>
SENT (1.1011s) TCP 192.168.10.225:25337 > 96.7.79.147:443 S ttl=64 id=32736 iplen=40
seq=3093962918 win=1480
RCVD (1.2988s) TCP 96.7.79.147:443 > 192.168.10.225:25337 SA ttl=56 id=0 iplen=44
seq=896669537 win=29200 <mss 1460>
SENT (2.1018s) TCP 192.168.10.225:25337 > 96.7.79.147:443 S ttl=64 id=32736 iplen=40
seq=3093962918 win=1480
RCVD (2.1187s) TCP 96.7.79.147:443 > 192.168.10.225:25337 SA ttl=56 id=0 iplen=44
seq=878740795 win=29200 <mss 1460>
SENT (3.1039s) TCP 192.168.10.225:25337 > 96.7.79.147:443 S ttl=64 id=32736 iplen=40
seq=3093962918 win=1480
RCVD (3.1388s) TCP 96.7.79.147:443 > 192.168.10.225:25337 SA ttl=56 id=0 iplen=44
seq=894586121 win=29200 <mss 1460>
SENT (4.1059s) TCP 192.168.10.225:25337 > 96.7.79.147:443 S ttl=64 id=32736 iplen=40
seq=3093962918 win=1480
RCVD (4.1588s) TCP 96.7.79.147:443 > 192.168.10.225:25337 SA ttl=56 id=0 iplen=44
seq=876671119 win=29200 <mss 1460>

Max rtt: 197.631ms | Min rtt: 16.872ms | Avg rtt: 95.972ms
Raw packets sent: 5 (200B) | Rcvd: 5 (230B) | Lost: 0 (0.00%)
Nping done: 1 IP address pinged in 4.20 seconds
```

Traceroute for IPv4

Ubuntu dropped traceroute for IPv4 from the default installation so you need to install it before running an IPv4 traceroute.

From the man page
traceroute tracks the route packets taken from an IP network on their way to a given host. It utilizes the IP protocol's time to live (TTL) field and attempts to elicit an ICMP TIME_EXCEEDED response from each gateway along the path to the host.

The only required parameter is the name or IP address of the destination host . The optional packet_len'gth is the total size of the probing packet (default 60 bytes for IPv4 and 80 for IPv6). The specified size can be ignored in some situations or increased up to a minimal value.

Installation
sudo apt install traceroute

Example
traceroute 107.170.203.230

```
traceroute to 107.170.203.230 (107.170.203.230), 30 hops max, 60 byte packets
 1  _gateway (192.168.10.254)  4.411 ms  3.997 ms  3.864 ms
```

```
 2  * * *
 3  acr02vntrca-gbe-1-1.vntr.ca.charter.com (96.34.97.109)  12.484 ms  13.003 ms  13.883 ms
 4  24-180-19-29.static.lsan.ca.charter.com (24.180.19.29)  13.779 ms  13.827 ms  14.075 ms
 5  bbr01olvemo-tge-0-1-0-11.olve.mo.charter.com (96.34.2.88)  21.333 ms  20.389 ms  24.041 ms
 6  las-b21-link.telia.net (213.248.94.182)  21.259 ms  17.020 ms  23.072 ms
 7  sjo-b21-link.telia.net (62.115.116.40)  32.029 ms las-b24-link.telia.net (62.115.136.47)  16.329
ms  15.544 ms
 8  palo-b22-link.telia.net (62.115.125.0)  24.806 ms  24.414 ms  24.713 ms
 9  * * *
10  * * *
11  * * *
12  107.170.203.230 (107.170.203.230)  23.746 ms !X  23.372 ms !X  23.595 ms !X
```

More information
traceroute(8) - Linux man page - https://linux.die.net/man/8/traceroute
A Practical Guide to (Correctly) Troubleshooting with TracerouteTroubleshootingwithTraceroute
https://www.nanog.org/meetings/nanog47/presentations/Sunday/RAS_Traceroute_N47_Sun.pdf

Tracepath

From the man page
It traces path to destination discovering MTU along this path. It uses UDP port port or some random port. It is similar to traceroute, only does not not require superuser privileges and has no fancy options.

Options
-n
   Do not look up host names. Only print IP addresses numerically.
-l (lowercase elle)
   Sets the initial packet length to pktlen instead of 65536 for tracepath or 128000 for tracepath6.

Installation
sudo apt install iputils-tracepath

Examples
Trace a path to my Digital Ocean CentOS VPS
tracepath 107.170.203.230

```
 1?: [LOCALHOST]      pmtu 1500
 1:  _gateway       3.682ms
 1:  _gateway       1.472ms
 2:  no reply
 3:  acr02vntrca-gbe-1-1.vntr.ca.charter.com     12.945ms
 4:  24-180-19-29.static.lsan.ca.charter.com     12.282ms
 5:  bbr01olvemo-tge-0-1-0-11.olve.mo.charter.com  17.153ms asymm  6
 6:  las-b21-link.telia.net      14.142ms
 7:  las-b24-link.telia.net      55.495ms asymm  8
 8:  palo-b22-link.telia.net       47.295ms
 9:  no reply
10:  no reply
11:  no reply
12:  107.170.203.230      35.467ms !H
   Resume: pmtu 1500
```

Trace the same path without DNS resolution. This is probably more useful on your internal network than the public Internet.

```
tracepath -n 107.170.203.230
 1?: [LOCALHOST]      pmtu 1500
 1:  192.168.10.254        1.657ms
 1:  192.168.10.254        1.467ms
 2:  no reply
 3:  96.34.97.109         13.074ms
 4:  24.180.19.29         12.283ms
 5:  96.34.2.88          11.745ms asymm  6
 6:  213.248.94.182       16.195ms
 7:  62.115.116.40        20.683ms
 8:  62.115.125.0         22.429ms
 9:  no reply
10:  no reply
11:  no reply
12:  107.170.203.230      26.307ms !H
   Resume: pmtu 1500
```

Additional Information

tracepath(8) - Linux man page

A Practical Guide to (Correctly) Troubleshooting with Traceroute

Socket Status (ss)

Similar to netstat, from the man page - another utility to investigate sockets. There are a myriad of options, as always, you can use the man pages to see all of them - man ss.

Here are some common options from the man page:
When no option is used ss displays a list of open non-listening sockets (e.g. TCP/UNIX/UDP) that have established connection.

-h, --help
Show summary of options.

-n, --numeric
Do not try to resolve service names.

-r, --resolve
Try to resolve numeric address/ports.

-a, --all
Display both listening and non-listening (for TCP this means established connections) sockets.

-l, --listening
Display only listening sockets (these are omitted by default).

-p, --processes
Show process using socket.

-t, --tcp
Display TCP sockets.

-u, --udp
Display UDP sockets.

-w, --raw
Display RAW sockets.

-x, --unix
Display Unix domain sockets (alias for -f unix).

-S, --sctp
Display SCTP sockets.

STATE-FILTER
STATE-FILTER allows to construct arbitrary set of states to match. Its syntax is sequence of keywords state and exclude followed by identifier of state.

Available identifiers are:

All standard TCP states: established, syn-sent, syn-recv, fin-wait-1, fin-wait-2, time-wait, closed, close-wait, last-ack, listening and closing.

all - for all the states
connected - all the states except for listening and closed
synchronized - all the connected states except for syn-sent
bucket - states, which are maintained as minisockets, i.e. time-wait and syn-recv
big - opposite to bucket

Usage Examples

`ss -t -a`
Display all TCP sockets.

`ss -t -a -Z`
Display all TCP sockets with process SELinux security contexts.

`ss -u -a`
Display all UDP sockets.

`ss -o state established '( dport = :ssh or sport = :ssh )'`
Display all established ssh connections.

`ss -x src /tmp/.X11-unix/*`
Find all local processes connected to X server.

An example looking for established tcp sockets

->ss -t -p state established

```
Recv-Q  Send-Q  Local Address:Port      Peer Address:Port
0       0       192.168.10.183:52772    74.125.197.189:https    users:(("firefox",pid=5498,fd=108))
0       0       192.168.10.183:42748    162.125.34.129:https    users:(("dropbox",pid=4558,fd=69))
0       0       192.168.10.183:35626        52.96.31.2:https    users:(("hirimain",pid=23454,fd=16))
0       0       192.168.10.183:35620        52.96.31.2:https    users:(("hirimain",pid=23437,fd=21))
0       0       192.168.10.183:34802     52.42.195.146:https    users:(("firefox",pid=5498,fd=98))
0       0       192.168.10.183:49238   192.241.168.185:https    users:(("firefox",pid=5498,fd=115))
0       0       192.168.10.183:55360        52.96.31.2:https    users:(("hirimain",pid=23437,fd=91))
0       0       192.168.10.183:58596      192.0.84.247:https    users:(("simplenote",pid=23091,fd=92))
0       0       192.168.10.183:49780     172.217.14.78:https    users:(("firefox",pid=5498,fd=120))
0       0       192.168.10.183:49824       52.96.3.130:https    users:(("hirimain",pid=23437,fd=85))
0       0       192.168.10.183:47182      35.170.0.145:https    users:(("firefox",pid=5498,fd=114))
0       0       192.168.10.183:60332     172.217.4.142:https    users:(("firefox",pid=5498,fd=107))
0       0       192.168.10.183:42054    162.125.34.129:https    users:(("dropbox",pid=4558,fd=162))
0       0       192.168.10.183:48602    54.152.127.232:http     users:(("firefox",pid=5498,fd=103))
```

If any process, like SSH, is running as root, you will need to use sudo to see the Process ID and File Descriptor.

You can also use modifiers with ss. In this example I have two connections to a Cisco switch:

3750x#who

```
    Line       User       Host(s)              Idle       Location
   1 vty 0     mhubbard   idle                 00:06:36 192.168.10.183
```

```
*  2 vty 1     mhubbard   idle                 00:00:00 192.168.10.183
```

```
->ss -at '( dport = :ssh or sport = :ssh )'
State      Recv-Q  Send-Q  Local Address:Port      Peer Address:Port
LISTEN     0       128      0.0.0.0:ssh            0.0.0.0:*
ESTAB      0       0        192.168.10.183:52968   192.168.10.52:ssh
ESTAB      0       0        192.168.10.183:52970   192.168.10.52:ssh
LISTEN     0       128      [::]:ssh               [::]:*
```

In this example I had been connected to a Microsoft server:

```
->ss -at '( dport = :445 or sport = :445 )'
State       Recv-Q  Send-Q   Local Address:Port   Peer Address:Port
CLOSE-WAIT  1       0        10.67.2.12:42318     10.67.2.224:microsoft-ds
CLOSE-WAIT  1       0        10.67.2.12:42266     10.67.2.224:microsoft-ds
CLOSE-WAIT  1       0        10.67.2.12:42324     10.67.2.224:microsoft-ds
CLOSE-WAIT  1       0        10.67.2.12:42312     10.67.2.224:microsoft-ds
CLOSE-WAIT  1       0        10.67.2.12:42274     10.67.2.224:microsoft-ds
```

You can also use operators like GT and LT

```
->ss -t sport gt :5000
State        Recv-Q Send-Q Local Address:Port  Peer Address:Port
CLOSE-WAIT   32           0            192.168.10.183:46760      162.125.2.3:https
ESTAB        0            0            192.168.10.183:54650      1.1.1.1:https
ESTAB        0            0            192.168.10.183:33432      192.241.168.185:https
CLOSE-WAIT   32           0            192.168.10.183:42588      162.125.34.6:https
ESTAB        0            0            192.168.10.183:42712      140.82.113.25:https
CLOSE-WAIT   32           0            192.168.10.183:54128      162.125.2.4:https
CLOSE-WAIT   32           0            192.168.10.183:40688      8.43.85.14:https

Notice that I am using Cloud


->ss -t dport lt :5000
State        Recv-Q Send-Q Local Address:Port  Peer Address:Port
CLOSE-WAIT   32           0            192.168.10.183:46760      162.125.2.3:https
ESTAB        0            0            192.168.10.183:54650      1.1.1.1:https
ESTAB        0            0            192.168.10.183:33432      192.241.168.185:https
CLOSE-WAIT   32           0            192.168.10.183:36956      162.125.33.7:https
ESTAB        0            0            192.168.10.183:42712      140.82.113.25:https
CLOSE-WAIT   32           0            192.168.10.183:54128      162.125.2.4:https
CLOSE-WAIT   32           0            192.168.10.183:40688      8.43.85.14:https
```

Additional Information

Linux for Network Engineers blog

How to get Socket Status Information (ss)

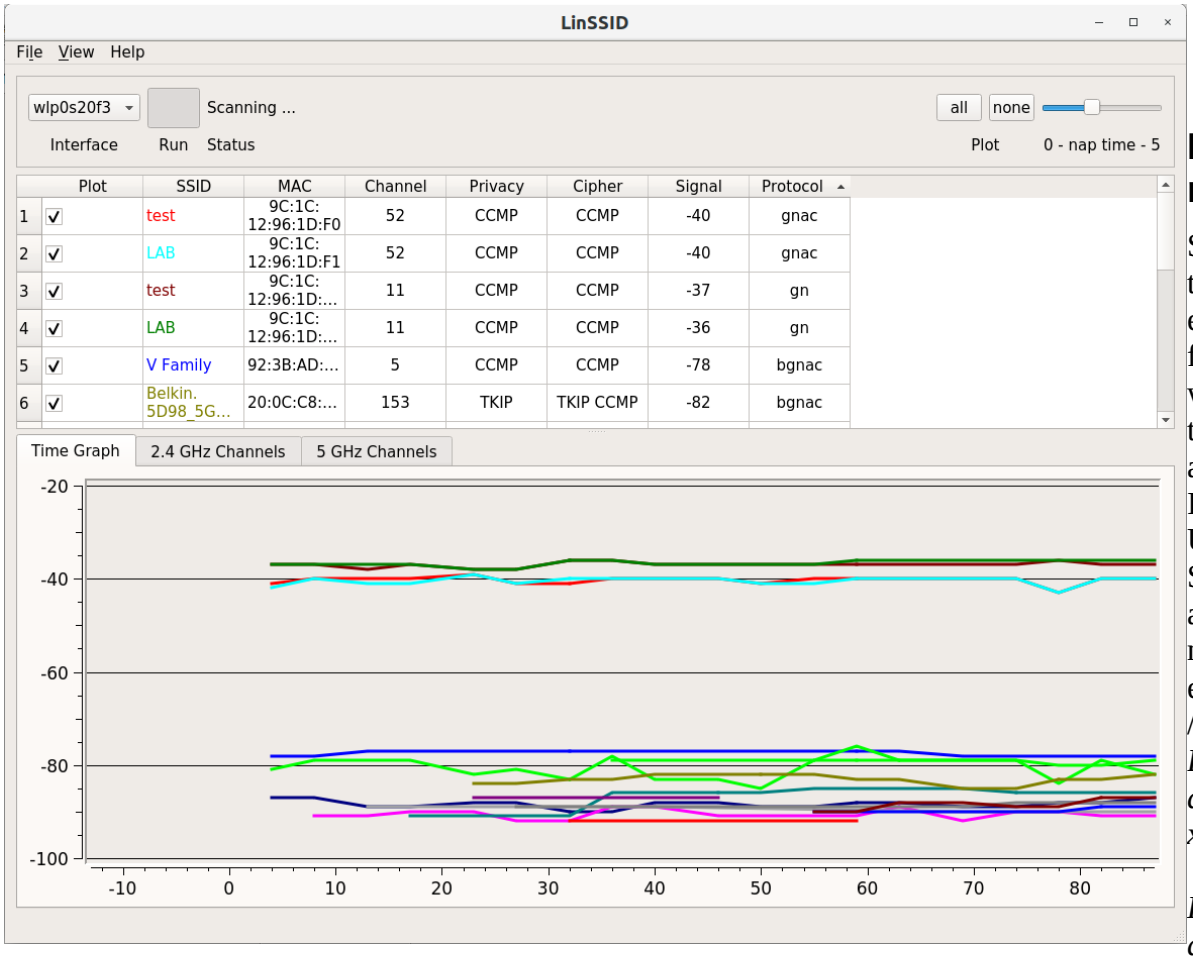
LinSSID

A tool similar to Metageek's inSSIDer. It scans for SSIDs and displays them graphically.

sudo apt install linssid

To run it:
sudo linssid

A GUI will open but it's paused by default. Click the button next to "paused" and the tool will start scanning. Here is screenshot:



Minicom

Serial terminal emulator for use with USB to Serial adapters. In Linux USB to Serial adapters mount as either */dev/ttyUSBx or devttyACMx.*

Example of a connecting to the USB mini port on a Cisco switch

```
ls -l /dev/tty*
crw-rw---- 1 root     dialout 166,  0 Sep 30 13:52 /dev/ttyACM0
```

Installation

sudo apt install minicom

Setup mode

sudo minicom -s

scroll down to "Serial Port Setup"

Press "E", "C" to select 9600, N81.
Hit enter a couple times to exit setup and then select "Exit from Minicom"

Now you can run Minicom with:
minicom
and have it set to 9600, n81.
If you include a -C and a filename it will log all output.
minicom -C test.txt

Press ctrl+a, z to open the minicom menu.
Press ctrl+a, z, x to exit minicom.

Q: Why is error message "Device /dev/ttyUSB0 is locked." shown when executed 'minicom'?
A: It usually occurred by last abnormal close of minicom.
You can fix it by:
rm /var/lock/LCK..ttyUSB0

https://spremi.wordpress.com/2012/01/10/minicom-enable-access-to-normal-users/

https://openmaniak.com/minicom.php

sudo usermod -a -G dialout mhubbard
sudo usermod -a -G dialout $USER

ls -l /dev/ttyUSB0

cat /etc/group | grep dialout
dialout:x:20:mhubbard

chown root /dev/tty8
chgrp dialout /dev/tty8
chmod 660 /dev/tty8

Additional Information
http://manpages.ubuntu.com/manpages/trusty/man1/minicom.1.html - Manual web page
http://processors.wiki.ti.com/index.php/Setting_up_Minicom_in_Ubuntu

IPMI Tools

Ubuntu has a package called ipmitool in it's repository. Using ipmitool you can list the users and add a new Administrative user even if you don't have valid credentials. For HP iLo this works on firmware up to v1.6 on iLo3 and up to v1.3 on iLo4. For iLo firmware greater than this for for IPMI in general, you will need to have valid administrator credentials to make changes.

Installation

sudo apt-get install ipmitool

Examples
Use the list command to see the current users. In this example, iLo version was vulnerable to the "Null Password" exploit so I used FluffyWabbit as the passord.

```
ipmitool -I lanplus -C 0 -H 10.0.0.99 -U Administrator -P FluffyWabbit user list
```

Once you run the list command look for an ID that shows (Empty User).

SNMP

An oldie but goodie! SNMP is a valuable tool for a network engineer.

Installation

```
sudo apt install snmp
```

Due to license issues Canonical disables MIBs by default. To enable them simply comment out the MIBS line in /etc/snmp/snmp.conf

```
sudo gedit /etc/snmp/snmp.conf
```

As the snmp packages come without MIB files due to license reasons, loading
of MIBs is disabled by default. If you added the MIBs you can reenable
loading them by commenting out the following line.
#mibs :

save and exit

Cisco devices

Get the v2 mibs from Cisco's FTP site (ftp://ftp.cisco.com/pub/mibs/v2/v2.tar.gz)
To install the MIBs:

```
sudo mkdir /usr/share/snmp/mibs/cisco
cd /usr/share/snmp/mibs/cisco
```

Copy v2.tar.gz that you just downloaded to /usr/share/snmp/mibs/cisco/v2.tar.gz

```
sudo tar xvfz v2.tar.gz
sudo gedit /etc/snmp/snmp.conf
```

add this as the first line in the file:
mibdirs +/usr/share/snmp/mibs/cisco/auto/mibs/v2

Examples
To display the arp table on a Cisco switch

```
snmpbulkwalk -v 2c -c Sup3rS3cr3t -OXsq  10.243.1.1 \.1.3.6.1.2.1.3.1.1.2
iso.3.6.1.2.1.3.1.1.2.82.1.10.243.1.1 "00 2A 10 77 8B 80 "
iso.3.6.1.2.1.3.1.1.2.94.1.192.168.1.1 "00 2A 10 77 8B 80 "
iso.3.6.1.2.1.3.1.1.2.96.1.10.243.2.1 "00 2A 10 77 8B 80 "
iso.3.6.1.2.1.3.1.1.2.96.1.10.243.2.2 "38 0E 4D F9 82 F0 "
iso.3.6.1.2.1.3.1.1.2.96.1.10.243.2.3 "38 0E 4D 6F 94 9C "
iso.3.6.1.2.1.3.1.1.2.96.1.10.243.2.4 "6C B2 AE 09 F8 C4 "
iso.3.6.1.2.1.3.1.1.2.96.1.10.243.2.5 "7C AD 74 50 10 42 "
iso.3.6.1.2.1.3.1.1.2.96.1.10.243.2.6 "38 0E 4D F9 86 8C "
iso.3.6.1.2.1.3.1.1.2.96.1.10.243.2.7 "6C B2 AE 09 F5 48 "
```

To display a switch serial number

```
snmpget -v 2c -c Sup3rS3cr3t -O s 10.207.1.26 .1.3.6.1.2.1.47.1.1.1.1.11.1001
```

iso.3.6.1.2.1.47.1.1.1.1.11.1001 = STRING: "FDO1320X0XP"

To display the system information

```
snmpbulkwalk -v2c -Os -c Sup3rS3cr3t 10.243.1.1 system
```

sysDescr.0 = STRING: Cisco IOS Software, c6880x Software (c6880x-ADVENTERPRISEK9-M), Version 15.2(1)SY7, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2018 by Cisco Systems, Inc.
Compiled Thu 05-Jul-18 04:32 by prod_rel_team
sysObjectID.0 = OID: enterprises.9.1.1934
sysUpTimeInstance = Timeticks: (416930035) 48 days, 6:08:20.35
sysContact.0 = STRING:
sysName.0 = STRING: TEST-6880x.home.local
sysLocation.0 = STRING: <Home Lab>
sysServices.0 = INTEGER: 78
sysORLastChange.0 = Timeticks: (0) 0:00:00.00

More information

https://sourceforge.net/p/net-snmp/mailman/message/26565635/
https://networkengineering.stackexchange.com/questions/2900/using-snmp-to-retrieve-the-arp-and-mac-address-tables-from-a-switch
https://networkengineering.stackexchange.com/questions/2990/translating-snmpwalk-output-into-human-readable-format/775/
Cisco MIB Locator - https://mibs.cloudapps.cisco.com/ITDIT/MIBS/MainServlet
https://serverfault.com/questions/440319/did-not-find-zerodotzero-in-module-snmpv2-smi

Remove EXIF data from photos

While not specifically network related I wanted to include this tool. When you take a photo with a smart phone it saves a lot of metadata that isn't visible in the photo. This data includes the GPS coordinates where the photo was taken. Ask John McAfee about what can happen when you put a photo on the Internet with GPS data in it!

I subscribe to ***Linux Pro Magazine*** and I found this article on using exiftool to remove all metadata.

To clear the metadata of all files that start with airbox in a folder use the following:

```
for i in airbox*.jpg; do echo "Processing $i"; exiftool -all= "$i"; done
```

The article has more detail and examples to just remove geotags.

Viewing EXIF data

exiftool can display all exif data using the following:

exiftool -a -u -g1 airbox.JPG

If you want to view the GPS data before removing it you can use:

```
exiftool IMG_4276.JPG | grep GPS
GPS Version ID                  : 2.2.0.0
GPS Latitude Ref                : North
GPS Longitude Ref               : West
GPS Altitude Ref                : Above Sea Level
GPS Time Stamp                  : 20:53:29.99
GPS Speed Ref                   : km/h
GPS Speed                       : 0
GPS Img Direction Ref           : True North
GPS Img Direction               : 270.8547973
GPS Dest Bearing Ref            : True North
GPS Dest Bearing                : 270.8547973
GPS Date Stamp                  : 2019:06:25
GPS Horizontal Positioning Error: 10 m
GPS Altitude                    : 361.7 m Above Sea Level
GPS Date/Time                   : 2019:06:25 20:53:29.99Z
GPS Latitude                    : 34 deg 7' 22.67" N
GPS Longitude                   : 117 deg 19' 22.66" W
GPS Position                    : 34 deg 7' 22.67" N, 117 deg 19' 22.66" W
```

There is also a built in tool called ImageMagick that can disp EXIF data. It's actually a suite of tools and the "identify" tool will dump all EXIF data including all GPS data. The tool is designed for photographers and dumps a huge amount of metadata about the camera's settings. You can use grep to see just the EXIF data

```
identify -verbose IMG_4276.JPG | grep "exif:"
```

Here is the output with just the GPS data:

```
    exif:GPSAltitude: 1537038/4249
    exif:GPSAltitudeRef: 0
    exif:GPSDateStamp: 2019:06:25
    exif:GPSDestBearing: 527896/1949
    exif:GPSDestBearingRef: T
    exif:GPSImgDirection: 527896/1949
    exif:GPSImgDirectionRef: T
    exif:GPSInfo: 1884
    exif:GPSLatitude: 34/1, 7/1, 2267/100
    exif:GPSLatitudeRef: N
    exif:GPSLongitude: 117/1, 19/1, 2266/100
    exif:GPSLongitudeRef: W
    exif:GPSSpeed: 0/1
    exif:GPSSpeedRef: K
    exif:GPSTimeStamp: 20/1, 53/1, 2999/100
    exif:GPSVersionID: 2, 2, 0, 0
```

More Information

How to View EXIF data of a Photo from Terminal in Linux

DNS Enumeration Tools

Whether you are checking the security of your public facing servers, preparing to do a pentest or you are an attacker looking for a way in, DNS Enumeration is a good place to start. In this blog I am going to list my favorite enumeration tools.

Several of them are Linux only but will run under Windows using the Windows Subsystem for Linux. If you are running Windows 10 version 1809 you can go to the HyperV Gallery and install Ubuntu 1804. If you don't have Windows 10 you can also use Virtualbox for free to run Ubuntu as a VM.

DNS Brute Force Wordlists

https://packetstormsecurity.com/Crackers/wordlists/dictionaries/
https://github.com/TheRook/subbrute/blob/master/names.txt
https://github.com/danielmiessler/SecLists/tree/master/Discovery/DNS

DNSENUM

https://github.com/fwaeytens/dnsenum
https://www.youtube.com/watch?v=raGRvfpsaLw

multithreaded perl script to enumerate DNS information of a domain and to discover non-contiguous ip blocks.

Think of dnsenum as a supercharged version of a whois query. It not only discovers all of the dns records but it goes a step further and attempts to use google to discover subdomains, discovers BIND versions and more.

dnsenum --dnsserver 9.9.9.9 --enum --noreverse -f /usr/share/dnsenum/dns.txt -f --subfile ~/Desktop/DNS/dnsresults.txt vectorusa.com

dnsmap

Dnsmap is a passive dns mapper that is used for subdomain bruteforce discovery.
https://github.com/makefu/dnsmap

dnsrecon

DNS enumeration script written in python for performing TLD expansion, SRV record enumeration, host and subdomain brute force, zone transfer, reverse lookup and general record identification.

Github site
https://github.com/darkoperator/dnsrecon

Tutorial
http://www.rwbnetsec.com/dnsrecon/

Installation

Clone the project
git clone https://github.com/darkoperator/dnsrecon.git
cd dnsrecon
pip(3) install -r requirements.txt --user

Basic Usage
python3 dnsrecon -d <domainname>

Example 1
I ran this against the Win2008 DC in my home lab. You can see that it returned all the srv records, Name Server and DNS Server version in just a couple seconds.

```
python3 dnsrecon.py -d pu.pri
[*] Performing General Enumeration of Domain: pu.pri
[-] All nameservers failed to answer the DNSSEC query for pu.pri
[-] Could not Resolve SOA Record for pu.pri
[*]     NS win-l6hbt78g89g.pu.pri 192.168.10.221
[-]     Recursion enabled on NS Server 192.168.10.221
[*]     Bind Version for 192.168.10.221 b'Microsoft DNS 6.1.7601 (1DB15EC5)'
[-] Could not Resolve MX Records for pu.pri
[*]     A pu.pri 192.168.10.221
[*] Enumerating SRV Records
[*]     SRV _kerberos._tcp.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 88 100
[*]     SRV _kerberos._udp.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 88 100
[*]     SRV _gc._tcp.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 3268 100
[*]     SRV _ldap._tcp.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 389 100
[*]     SRV _ldap._tcp.ForestDNSZones.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 389 100
[*]     SRV _ldap._tcp.pdc._msdcs.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 389 100
[*]     SRV _kpasswd._udp.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 464 100
[*]     SRV _kerberos._tcp.dc._msdcs.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 88 100
[*]     SRV _kpasswd._tcp.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 464 100
[*]     SRV _ldap._tcp.gc._msdcs.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 3268 100
[*]     SRV _ldap._tcp.dc._msdcs.pu.pri win-l6hbt78g89g.pu.pri 192.168.10.221 389 100
[+] 11 Records Found
```

Example 2
Google seems to have a much larger DNS infrastructure than I do!

```
python3 dnsrecon.py -d google.com
[*] Performing General Enumeration of Domain: google.com
[-] All nameservers failed to answer the DNSSEC query for google.com
[-] Could not Resolve SOA Record for google.com
[*]     NS ns4.google.com 216.239.38.10
[*]     NS ns4.google.com 2001:4860:4802:38::a
[*]     NS ns1.google.com 216.239.32.10
```

[*] NS ns1.google.com 2001:4860:4802:32::a
[*] NS ns3.google.com 216.239.36.10
[*] NS ns3.google.com 2001:4860:4802:36::a
[*] NS ns2.google.com 216.239.34.10
[*] NS ns2.google.com 2001:4860:4802:34::a
[*] MX alt4.aspmx.l.google.com 74.125.31.27
[*] MX alt2.aspmx.l.google.com 173.194.219.27
[*] MX alt1.aspmx.l.google.com 74.125.129.26
[*] MX aspmx.l.google.com 74.125.197.26
[*] MX alt3.aspmx.l.google.com 173.194.205.26
[*] MX alt4.aspmx.l.google.com 2607:f8b0:400c:c02::1b
[*] MX alt2.aspmx.l.google.com 2607:f8b0:4002:c03::1b
[*] MX alt1.aspmx.l.google.com 2607:f8b0:4001:c15::1a
[*] MX aspmx.l.google.com 2607:f8b0:400e:c08::1a
[*] MX alt3.aspmx.l.google.com 2607:f8b0:400d:c02::1a
[*] A google.com 216.58.219.14
[*] AAAA google.com 2607:f8b0:4007:806::200e
[*] Enumerating SRV Records
[*] SRV _ldap._tcp.google.com ldap.google.com 216.239.32.58 389 0
[*] SRV _carddavs._tcp.google.com google.com 216.58.219.14 443 0
[*] SRV _carddavs._tcp.google.com google.com 2607:f8b0:4007:806::200e 443 0
[*] SRV _caldav._tcp.google.com calendar.google.com 216.58.219.14 80 0
[*] SRV _caldav._tcp.google.com calendar.google.com 2607:f8b0:4007:806::200e 80 0
[*] SRV _jabber._tcp.google.com alt3.xmpp-server.l.google.com 173.194.205.125 5269 0
[*] SRV _jabber._tcp.google.com alt1.xmpp-server.l.google.com 74.125.129.125 5269 0
[*] SRV _jabber._tcp.google.com alt2.xmpp-server.l.google.com 173.194.219.125 5269 0
[*] SRV _jabber._tcp.google.com alt4.xmpp-server.l.google.com 74.125.31.125 5269 0
[*] SRV _jabber._tcp.google.com xmpp-server.l.google.com 74.125.142.125 5269 0
[*] SRV _xmpp-server._tcp.google.com alt4.xmpp-server.l.google.com 74.125.31.125 5269 0
[*] SRV _xmpp-server._tcp.google.com alt2.xmpp-server.l.google.com 173.194.219.125 5269 0
[*] SRV _xmpp-server._tcp.google.com alt1.xmpp-server.l.google.com 74.125.129.125 5269 0
[*] SRV _xmpp-server._tcp.google.com alt3.xmpp-server.l.google.com 173.194.205.125 5269 0
[*] SRV _xmpp-server._tcp.google.com xmpp-server.l.google.com 74.125.142.125 5269 0
[*] SRV _jabber-client._tcp.google.com alt3.xmpp.l.google.com 173.194.205.125 5222 0
[*] SRV _jabber-client._tcp.google.com alt3.xmpp.l.google.com 2607:f8b0:400d:c02::7d 5222 0
[*] SRV _jabber-client._tcp.google.com xmpp.l.google.com 74.125.142.125 5222 0
[*] SRV _jabber-client._tcp.google.com xmpp.l.google.com 2607:f8b0:400e:c08::7d 5222 0
[*] SRV _jabber-client._tcp.google.com alt1.xmpp.l.google.com 74.125.129.125 5222 0
[*] SRV _jabber-client._tcp.google.com alt1.xmpp.l.google.com 2607:f8b0:4001:c15::7d 5222 0
[*] SRV _jabber-client._tcp.google.com alt2.xmpp.l.google.com 173.194.219.125 5222 0
[*] SRV _jabber-client._tcp.google.com alt2.xmpp.l.google.com 2607:f8b0:4002:c03::7d 5222 0
[*] SRV _jabber-client._tcp.google.com alt4.xmpp.l.google.com 74.125.31.125 5222 0
[*] SRV _jabber-client._tcp.google.com alt4.xmpp.l.google.com 2607:f8b0:400c:c02::7d 5222 0
[*] SRV _caldavs._tcp.google.com calendar.google.com 216.58.219.14 443 0
[*] SRV _caldavs._tcp.google.com calendar.google.com 2607:f8b0:4007:806::200e 443 0
[*] SRV _xmpp-client._tcp.google.com alt4.xmpp.l.google.com 74.125.31.125 5222 0
[*] SRV _xmpp-client._tcp.google.com alt4.xmpp.l.google.com 2607:f8b0:400c:c02::7d 5222 0

[*] SRV _xmpp-client._tcp.google.com alt3.xmpp.l.google.com 173.194.205.125 5222 0
[*] SRV _xmpp-client._tcp.google.com alt3.xmpp.l.google.com 2607:f8b0:400d:c02::7d 5222 0
[*] SRV _xmpp-client._tcp.google.com alt1.xmpp.l.google.com 74.125.129.125 5222 0
[*] SRV _xmpp-client._tcp.google.com alt1.xmpp.l.google.com 2607:f8b0:4001:c15::7d 5222 0
[*] SRV _xmpp-client._tcp.google.com alt2.xmpp.l.google.com 173.194.219.125 5222 0
[*] SRV _xmpp-client._tcp.google.com alt2.xmpp.l.google.com 2607:f8b0:4002:c03::7d 5222 0
[*] SRV _xmpp-client._tcp.google.com xmpp.l.google.com 74.125.142.125 5222 0
[*] SRV _xmpp-client._tcp.google.com xmpp.l.google.com 2607:f8b0:400e:c08::7d 5222 0
[+] 37 Records Found

In order to run the Domain Name Brute-Force we need to type:
python3 dnsrecon.py -d <domain> -D <namelist> -t brtd

dnswalk

Dnswalk is a DNS debugger. It performs zone transfers of specified domains, and checks the database in numerous ways for internal consistency, as well as accuracy.

dnscan

https://github.com/rbsec/dnscan

Anubis

https://www.kitploit.com/2018/01/anubis-subdomain-enumeration-and.html
https://github.com/jonluca/Anubis

```
anubis -h
Usage:
  anubis -t TARGET [-o FILENAME] [-noipbarv] [-w SCAN] [-q NUM]
  anubis -h
  anubis --version

Options:
  -h –help         show this help message and exit
  -t –target set target (comma separated, no spaces, if multiple)
  -n –with-nmap    perform an nmap service/script scan
  -o –output       save to filename
  -i –additional-info     show additional information about the host from Shodan (requires
API key)
  -p –ip                  outputs the resolved IPs for each subdomain, and a full list of
unique ips
  -a –send-to-anubis-db   send results to Anubis-DB
  -r –recursive           recursively search over all subdomains
  -w --overwrite-nmap-scan SCAN overwrite default nmap scan (default -nPn -sV -sC)
  -v –verbose print debug info and full request output
  -q --queue-workers NUM override number of queue workers (default: 10, max: 100)
  --version               show version and exit
```

Example
anubis -t vectorusa.com -ipv -o temp.txt

-t - The target domain
-i - Show additional information from Shodan. If you don't have a Shodan.io API key you can register and get one for free at shodan.io
-p - outputs the resolved IPs for each subdomain, and a full list of unique ips
-v - Verbose mode

anubis -t vectorusa.com -ip -o temp.txt

```
   d8888   888    d8b
  d88888   888    Y8P
      d88P888   888
     d88P 888 88888b.  888  888 88888b.  888 .d8888b
    d88P  888 888 "88b 888  888 888 "88b 888 88K
   d88P   888 888  888 888  888 888  888 888 "Y8888b.
    d8888888888 888  888 Y88b 888 888 d88P 888    X88
   d88P   888 888  888  "Y88888 88888P"  888  88888P'

Searching for subdomains for 104.196.200.136 (vectorusa.com)
Testing for zone transfers
Searching HackerTarget
Searching VirusTotal
Searching NetCraft.com
Searching crt.sh
Searching DNSDumpster
Searching Anubis-DB
Searching Shodan.io for additional information
Server Location: Houston, US - 77002
ISP  or Hosting Company: Google Cloud
Found 46 subdomains
----------------
rdp.vectorusa.com: 40.135.170.153
quarantine.vectorusa.com:
vectorresources.vectorusa.com:
tor-conf.vectorusa.com: 40.135.170.143
phpmyadmin.vectorusa.com:
vlamailfrontend.vectorusa.com:
mailgw02.vectorusa.com:
vpn.vectorusa.com: 40.135.168.156
demo-expe.vectorusa.com:
mail.vectorusa.com: 40.135.170.129
link.vectorusa.com: 34.229.2.237
collab.vectorusa.com:
mailgw01.vectorusa.com: 40.135.170.158
dev.vectorusa.com: 40.135.170.151
vectorresourcesinc.vectorusa.com: 40.135.170.151
casht03.corp.vectorusa.com:
tor-av.vectorusa.com: 40.135.170.144
cppm.corp.vectorusa.com:
autodiscover.vectorusa.com: 52.96.26.168
```

```
webmail2k3.vectorusa.com:
connect.vectorusa.com: 40.135.170.131
sts.vectorusa.com: 40.135.170.154
sip.vectorusa.com: 40.135.170.130
casht01.corp.vectorusa.com:
torexpe01.vectorusa.com:
www.vectorusa.com: 104.196.200.136
crm.vectorusa.com: 40.135.170.151
tor-access.vectorusa.com: 40.135.170.142
vlacrm01.vectorusa.com:
my.vectorusa.com: 40.135.170.148
lyncwebext.vectorusa.com:
toraccess.vectorusa.com:
tor-expe01.collab.vectorusa.com: 40.135.170.131
tor-expe01.vectorusa.com: 40.135.170.131
casht02.corp.vectorusa.com:
*.vectorusa.com:
vlasharepoint.vectorusa.com:
da.vectorusa.com:
casht04.corp.vectorusa.com:
sw.vectorusa.com:
insight.vectorusa.com:
vectorusa.com: 104.196.200.136
archiver.vectorusa.com: 40.135.170.157
lyncweb-ext.vectorusa.com: 40.135.170.149
owa.vectorusa.com: 40.135.170.150
mypassword.vectorusa.com: 40.135.170.133
Found 19 unique IPs
40.135.170.153
34.229.2.237
40.135.170.144
104.196.200.136
40.135.170.143
40.135.170.154
40.135.170.142
40.135.170.151
40.135.170.149
40.135.170.133
40.135.170.148
40.135.170.131
40.135.170.157
52.96.26.168
40.135.170.130
40.135.170.129
40.135.170.150
40.135.170.158
40.135.168.156
Subdomain search took 0:00:01.778’
```

DNSTracer

dnstracer determines where a given Domain Name Server (DNS) gets its information from, and follows the chain of DNS servers back to the servers which know the data.
http://www.mavetju.org/unix/dnstracer.php

sudo apt install dnstracer

Example

```
dnstracer -s 1.1.1.1 -v vectorusa.com
Tracing to vectorusa.com[a] via 1.1.1.1, maximum of 3 retries
1.1.1.1 (1.1.1.1) IP HEADER
- Destination address:  1.1.1.1
DNS HEADER (send)
- Identifier:    0x260F
- Flags:       0x00 (Q )
- Opcode:      0 (Standard query)
- Return code:   0 (No error)
- Number questions:   1
- Number answer RR:   0
- Number authority RR:  0
- Number additional RR: 0
QUESTIONS (send)
- Queryname:   (9)vectorusa(3)com
- Type:      1 (A)
- Class:       1 (Internet)
DNS HEADER (recv)
- Identifier:    0x260F
- Flags:       0x8080 (R RA )
- Opcode:      0 (Standard query)
- Return code:   0 (No error)
- Number questions:   1
- Number answer RR:   1
- Number authority RR:  0
- Number additional RR: 0
QUESTIONS (recv)
- Queryname:   (9)vectorusa(3)com
- Type:      1 (A)
- Class:       1 (Internet)
ANSWER RR
- Domainname:    (9)vectorusa(3)com
- Type:      1 (A)
- Class:       1 (Internet)
- TTL:    867 (14m27s)
- Resource length:    4
- Resource data:      104.196.200.136
Got answer
```

subbrute

A DNS meta-query spider that enumerates DNS records, and subdomains.

Subbrute is also a python library so you can use it in your own tools.
Written in python, it should work on any OS and the github readme has detailed instructions on how to install it.
https://github.com/TheRook/subbrute

To install on Linux just clone the repository
git clone https://github.com/TheRook/subbrute.git

The only requirement is python-dns.
Under Ubuntu/Debian all you need is:
sudo apt install python-dnspython

Examples
Minimum usage to return all subdomains
./subbrute.py google.com

Tests multiple domains:
./subbrute.py google.com gmail.com blogger.com

or a newline delimited list of domains:
./subbrute.py -t list.txt

Also keep in mind that subdomains can have subdomains (example: _xmpp-server._tcp.gmail.com):
./subbrute.py gmail.com > gmail.out
./subbrute.py -t gmail.out

The subdomains enumerated from previous scans can now be used as input to enumerate other DNS records. The following commands demonstrate this new functionality:

./subbrute.py google.com -o google.names
...162 subdomains found...

./subbrute.py -s google.names google.com --type TXT
google.com,"v=spf1 include:_spf.google.com ip4:216.73.93.70/31 ip4:216.73.93.72/31 ~all"
adwords.google.com,"v=spf1 redirect=google.com"
...

./subbrute.py -s google.names google.com --type CNAME
blog.google.com,www.blogger.com,blogger.l.google.com
groups.google.com,groups.l.google.com
...

DNSDIAG

https://www.kitploit.com/2018/10/dnsdiag-dns-diagnostics-and-performance.html
https://github.com/farrokhi/dnsdiag
https://dnsdiag.org/

From dnsdiag.org

Ever been wondering if your ISP is hijacking your DNS traffic (https://decentralize.today/is-your-isp-hijacking-your-dns-traffic-f3eb7ccb0ee7#.fevks5wyc)? Ever observed any misbehavior with your DNS responses? Ever been redirected to wrong address and suspected something is wrong with your DNS? Here we have a set of tools to perform basic audits on your DNS requests and responses to make sure your DNS is working as you expect.

Installation

git clone https://github.com/farrokhi/dnsdiag.git
cd dnsdiag
pip3 install -r requirements.txt

dnsping

This is ping for DNS servers.
The common switches are:
-4 or -6 - Choose IPv4 or IPv6
-C 3 - Number of tries.
-s - DNS Server to use
-t - Record type. A is default. Others are MX, AAAA, NS, PTR,
-v - Verbose

Examples
A Record
python3 dnsping.py -4 -c 3 -v -s 9.9.9.9 -t A google.com
dnsping.py DNS: 9.9.9.9:53, hostname: google.com, rdatatype: A
34 bytes from 9.9.9.9: seq=0 time=15.305 ms
google.com. 243 IN A 172.217.4.142
flags: QR RD RA

AAAA Record
python3 dnsping.py -4 -c 3 -v -s 9.9.9.9 -t AAAA google.com
dnsping.py DNS: 9.9.9.9:53, hostname: google.com, rdatatype: AAAA
48 bytes from 9.9.9.9: seq=0 time=14.287 ms
google.com. 252 IN AAAA 2607:f8b0:4007:801::200e
flags: QR RD RA

NS Record
python3 dnsping.py -4 -c 3 -v -s 9.9.9.9 -t NS google.com
dnsping.py DNS: 9.9.9.9:53, hostname: google.com, rdatatype: NS
163 bytes from 9.9.9.9: seq=0 time=18.206 ms
google.com. 300887 IN NS ns3.google.com.
google.com. 300887 IN NS ns4.google.com.
google.com. 300887 IN NS ns1.google.com.
google.com. 300887 IN NS ns2.google.com.
flags: QR RD RA

dnstraceroute

Like Traceroute but for DNS!
The common switches are:
-a --asn   Turn on AS# lookups for each hop encountered
-c --count   Maximum number of hops (default: 30)
-C --color   Print colorful output
-s --server   DNS server to use (default: first system resolver)
-x --expert   Print expert hints if available

Example using Google DNS server.
sudo python3 dnstraceroute.py --expert -C -t A -s 8.8.4.4 facebook.com
dnstraceroute.py DNS: 8.8.4.4:53, hostname: facebook.com, rdatatype: A
1 _gateway (192.168.10.254) 2.959 ms
2 *
3 acr02vntrca-gbe-1-1.vntr.ca.charter.com (96.34.97.109) 11.931 ms
4 24-180-19-29.static.lsan.ca.charter.com (24.180.19.29) 14.211 ms
5 bbr01olvemo-tge-0-1-0-11.olve.mo.charter.com (96.34.2.88) 17.241 ms
6 bbr02chcgil-tge-0-2-0-1.chcg.il.charter.com (96.34.3.129) 14.121 ms
7 74.125.51.245 (74.125.51.245) 15.059 ms
8 108.170.247.129 (108.170.247.129) 15.077 ms
9 216.239.41.89 (216.239.41.89) 16.861 ms
10 google-public-dns-b.google.com (8.8.4.4) 14.975 ms

=== Expert Hints ===
[*] No expert hint available for this trace

Example using OpenDNS DNS server. Note that OpenDNS was two hops closer than Google.
sudo python3 dnstraceroute.py --expert -C -t A -s 208.67.220.220 facebook.com
dnstraceroute.py DNS: 208.67.220.220:53, hostname: facebook.com, rdatatype: A
1 _gateway (192.168.10.254) 3.214 ms
2 *
3 acr02vntrca-gbe-1-1.vntr.ca.charter.com (96.34.97.109) 16.945 ms
4 24-180-19-29.static.lsan.ca.charter.com (24.180.19.29) 11.714 ms
5 bbr01olvemo-tge-0-1-0-11.olve.mo.charter.com (96.34.2.88) 17.250 ms
6 bbr02chcgil-tge-0-2-0-1.chcg.il.charter.com (96.34.3.129) 14.635 ms
7 peer1.rtr1.lax.opendns.com (206.223.123.85) 14.647 ms
8 resolver2.opendns.com (208.67.220.220) 16.493 ms

=== Expert Hints ===
[*] No expert hint available for this trace

Example using Quad9 DNS server
sudo python3 dnstraceroute.py -a --expert -C -t A -s 9.9.9.9 facebook.com
dnstraceroute.py DNS: 9.9.9.9:53, hostname: facebook.com, rdatatype: A
1 _gateway (192.168.10.254) 2.008 ms
2 *

3 acr02vntrca-gbe-1-1.vntr.ca.charter.com (96.34.97.109) 13.022 ms
4 24-180-19-29.static.lsan.ca.charter.com (24.180.19.29) [AS20115 CHARTER-NET-HKY-NC - Charter Communications, US] 72.408 ms
5 bbr01olvemo-tge-0-1-0-11.olve.mo.charter.com (96.34.2.88) 17.735 ms
6 bbr02chcgil-tge-0-2-0-1.chcg.il.charter.com (96.34.3.129) 16.433 ms
7 equinix-la.woodynet.net (206.223.123.110) 14.467 ms
8 dns.quad9.net (9.9.9.9) [AS19281 QUAD9-AS-1 - Quad9, US] 16.221 ms

=== Expert Hints ===
[*] No expert hint available for this trace

dnseval

dnseval is a bulk ping utility that sends an arbitrary DNS query to a give list of DNS servers. This script is meant for comparing response time of multiple DNS servers at once.

Example using public-servers.txt as the list of servers. I added 8.8.8.8/8.8.4.4 to the file.
python3 dnseval.py -t AAAA -f public-servers.txt -c10 yahoo.com

```
server   avg(ms)   min(ms)   max(ms)   stddev(ms)  lost(%)  ttl      flags
-------------------------------------------------------------------------------------------------------------
8.8.8.8    14.408    12.907    15.592    0.880     %0     1467     QR -- -- RD RA -- --
8.8.4.4    15.667    13.452    27.905    4.350     %0     1053     QR -- -- RD RA -- --
1.0.0.1    22.177    13.704    92.637    24.760    %0     1313     QR -- -- RD RA -- --
1.1.1.1    14.178    13.112    15.532    0.967     %10    1311     QR -- -- RD RA -- --
2606:4700:4700::1001   0.000     0.000     0.000     0.000     %100   N/A      -- -- -- -- -- -- --
2606:4700:4700::1111   0.000     0.000     0.000     0.000     %100   N/A      -- -- -- -- -- -- --
195.46.39.39    14.293    13.218    15.388    0.840     %0     1736     QR -- -- RD RA -- --
195.46.39.40    14.572    13.018    16.015    0.890     %0     1735     QR -- -- RD RA -- --
208.67.220.220    14.539    12.623    17.116    1.336     %0     947      QR -- -- RD RA -- --
208.67.222.222    15.125    11.527    26.396    4.073     %0     947      QR -- -- RD RA -- --
2620:0:ccc::2   0.000     0.000     0.000     0.000     %100   N/A      -- -- -- -- -- -- --
2620:0:ccd::2   0.000     0.000     0.000     0.000     %100   N/A      -- -- -- -- -- -- --
216.146.35.35   77.689    76.192    78.979    0.787     %0     457      QR -- -- RD RA -- --
216.146.36.36   79.335    76.648    90.497    4.212     %0     1278     QR -- -- RD RA -- --
209.244.0.3     14.708    13.208    17.192    1.232     %0     1405     QR -- -- RD RA -- --
209.244.0.4     15.709    12.883    25.111    3.418     %0     709      QR -- -- RD RA -- --
4.2.2.1    14.092    12.942    16.463    0.945     %0     1667     QR -- -- RD RA -- --
4.2.2.2    13.648    12.941    14.500    0.547     %0     709      QR -- -- RD RA -- --
4.2.2.3    14.383    12.609    16.922    1.168     %0     783      QR -- -- RD RA -- --
4.2.2.4    14.176    13.088    15.746    0.746     %0     1404     QR -- -- RD RA -- --
4.2.2.5    14.485    12.798    16.889    1.157     %0     783      QR -- -- RD RA -- --
80.80.80.80     86.292    75.268    166.986   28.457    %0     1799     QR -- -- RD RA -- --
80.80.81.81     77.751    73.909    89.048    4.314     %0     1799     QR -- -- RD RA -- --
8.8.4.4    14.048    12.663    15.477    0.835     %0     965      QR -- -- RD RA -- --
8.8.8.8    14.350    13.417    15.257    0.597     %0     801      QR -- -- RD RA -- --
2001:4860:4860::8844   0.000     0.000     0.000     0.000     %100   N/A      -- -- -- -- -- -- --
2001:4860:4860::8888   0.000     0.000     0.000     0.000     %100   N/A      -- -- -- -- -- -- --
9.9.9.9    14.137    13.236    16.648    1.138     %0     393      QR -- -- RD RA -- --
2620:fe::fe     0.000     0.000     0.000     0.000     %100   N/A      -- -- -- -- -- -- --
149.112.112.112   14.097    12.741    15.663    0.833     %0     1225     QR -- -- RD RA -- --
```

CTFR

Abusing Certificate Transparency logs for getting HTTPS websites subdomains.

https://github.com/UnaPibaGeek/ctfr

~/tools/ctfr
python3 ctfr.py --help
python3 ctfr.py -d vvc.edu -o /home/ctfr/subdomains_vvc.txt

References
DNS Enumeration Techniques in Linux
https://resources.infosecinstitute.com/dns-enumeration-techniques-in-linux/

Is your ISP hijacking your DNS traffic?Is your ISP hijacking your DNS traffic?
https://decentralize.today/is-your-isp-hijacking-your-dns-traffic-f3eb7ccb0ee7#.fevks5wyc

Wikipedia - Domain Name System
https://en.wikipedia.org/wiki/Domain_Name_System

What is DNS
http://www.howtogeek.com/122845/htg-explains-what-is-dns/

Fortinet SSL VPN client
You need to get the VPN client tar ball from someone with a Fortinet contract and then follow the instructions here:
http://kb.fortinet.com/kb/documentLink.do?externalID=FD39996

I found this site that has the client available without a Fortinet account. I didn't use it so I can't vouch for it but it looks like he put a lot of effor into it.
https://hadler.me/2018/05/openfortigui-0-6-1/

After the client is installed, I create a bash script for each customer. The contents look like this:
cat company1.sh
./forticlientsslvpn_cli --server vpn.somecompany.com:443 --vpnuser michaelhubbard

Create the file in gedit, save and then run "chmod +x company1.sh" to make the script executable.

****
Horst - wifi tool github.com/br101/horst
git clone --recursive https://github.com/br101/horst

****
HPE iLo Java Remote Console
HP gen8 ilo4 remote console problem

Download Oracle Java JDK from
https://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html
I used Java SE Development Kit 8u192 jdk-8u192-linux-x64.tar.gz

Extract the file
tar zxvf jdk-8u192-linux-x64.tar.gz

From iLo, click on Remote Console, under Java Integrated Remote Console (Java IRC), click on Web Start and save the file to the downloads folder.
cd to jdk1.8.0_192/bin and execute:
jdk1.8.0_192/bin$ ./javaws ~/Downloads/iLO-jirc.jnlp

You will have to accept the security warnings (An scream that HP hasn't written an HTML5 interface like Dell and IBM) and then an interface just like the .net interface will open.

MySQL

https://dev.mysql.com/doc/mysql-apt-repo-quick-guide/en/

Go to
https://dev.mysql.com/downloads/repo/apt/

and download the mysql-apt-confi_0x.x.x.x_all.deb file

sudo dpkg -i mysql-apt-config_0.8.10-1_all.deb

All components are selected. Hit OK

sudo apt-get update
sudo apt install mysql-server

sudo service mysql status
sudo service mysql stop
sudo service mysql start

sudo apt-get install mysql-workbench-community

TFTP

Installing a tftp server.
Set-Up tftp Client Server

sudo apt install -y tftpd-hpa
sudo systemctl enable tftpd-hpa
sudo systemctl restart tftpd-hpa

Modify /etc/default/tftp-hpa as follows
sudo nano /etc/default/tftpd-hpa

TFTP_USERNAME="tftp"
TFTP_DIRECTORY="/home/mhubbard/tftp-root"
TFTP_ADDRESS="0.0.0.0:69"
TFTP_OPTIONS="--secure --create"

Note: the "--create" in TFTP_OPTIONS allows new files to be created in the "TFTP_DIRECTORY".

TFTP Client

To download a file from a tftp server
tftp 10.56.239.150
tftp> get
(files) BRAD-6880x.wri
tftp> ?
tftp-hpa 5.2

To upload a file to a tftp server
put somefile.txt

NOTE: to copy a file to the server you must create an empty file in the "TFTP_Directory" and set the file to be publicly writable. The easiest way to create the file is with "touch somefile.txt" and then "chmod 666 somefile.txt" to make it writable by anyone. Doing exa -l will list the permissions after the chmod:

.rw-rw-rw- 2.2k mhubbard 13 Dec 2018 somefile.txt

Commands may be abbreviated.
Commands are:

```
connect      connect to remote tftp
mode         set file transfer mode
put    send file
get    receive file
quit         exit tftp
verbose      toggle verbose mode
trace        toggle packet tracing
literal      toggle literal mode, ignore ':' in file name
status       show current status
binary       set mode to octet
ascii        set mode to netascii
rexmt        set per-packet transmission timeout
timeout      set total retransmission timeout
?      print help information
help         print help information
tftp>
```

****

VMware Workstation Linux
allow promiscuous mode
If you want all users to be able to set the virtual network adapter (/dev/vmnet0 in our example) to promiscuous mode, you can simply run the following command on the host operating system as root:

chmod a+rw /dev/vmnet0

Secure boot
Could not open /dev/vmmon: No such file or directory.
https://kb.vmware.com/s/article/2146460

sudo openssl req -new -x509 -newkey rsa:2048 -keyout vmmon.priv -outform DER -out vmmon.der -nodes -days 36500 -subj "/CN=VMware/"

sudo /usr/src/linux-headers-`uname -r`/scripts/sign-file sha256 ./vmmon.priv ./vmmon.der $(modinfo -n vmmon)

sudo /usr/src/linux-headers-`uname -r`/scripts/sign-file sha256 ./vmmon.priv ./vmmon.der $(modinfo -n vmnet)

sudo mokutil --import vmmon.der

****
openSSH Server
With openSSH server you will be able to use your laptop as an SCP server.
https://www.maketecheasier.com/setup-enable-ssh-ubuntu/

Install the package
sudo apt install openssh-server

Configure
Make a backup copy of the config
sudo cp /etc/ssh/sshd_config /etc/ssh/sshd_config.factory-defaults

scp from laptop to switch
Add ip ssh logging events so that failed attempts show why
sudo service ssh start
sudo service ssh restart

On router
copy scp://mhubbard@192.168.10.100/tftp-root/YB_16_03_0007.swi YB_16_03_0007.swi

copy scp://mhubbard@10.42.52.172/tftp-root/cat3k_caa-universalk9.16.03.07.SPA.bin

Troubleshooting
Cisco switch doesn't have ip ssh version 2 enabled
%Error opening scp://*@10.42.52.172/cat3k_caa-universalk9.16.03.07.SPA.bin (Undefined error)

systemctl status sshd
ssh.service - OpenBSD Secure Shell server
   Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset: enabled)
   Active: active (running) since Wed 2018-12-12 21:31:56 PST; 21h ago
  Process: 19309 ExecReload=/bin/kill -HUP $MAINPID (code=exited, status=0/SUCCESS)
  Process: 19305 ExecReload=/usr/sbin/sshd -t (code=exited, status=0/SUCCESS)
 Main PID: 2184 (sshd)
    Tasks: 1 (limit: 4915)
   CGroup: /system.slice/ssh.service
     └─2184 /usr/sbin/sshd -D

Dec 13 18:46:11 1S1K-G5-5587 sshd[19813]: Protocol major versions differ for 10.40.250.40 port 23825: SSH-2.0-OpenSSH_7.6p1 Ubuntu-4ubuntu0.1 vs. SSH-

****

Unicode characters
https://help.ubuntu.com/community/ComposeKey

https://unicode-table.com/en/#control-character

Unicode composition
Another means to enter non-keycap characters is to enter them as Unicode character number.

Press Shift+Ctrl+U, release U, enter the hexadecimal (0123456789abcdef) Unicode character code point, then release Shift+Ctrl. An underlined u followed by the number will be displayed as you type.

Alternatively, press (and release) Shift+Ctrl+U, then, while underlined u is displayed, enter the hexadecimal Unicode character code point followed dvd0brx1
by <Return>.

° = 00b0

****
Docker
https://docs.docker.com/install/linux/docker-ce/ubuntu/

****
Webmap
https://github.com/Rev3rseSecurity/WebMap
 mkdir /tmp/webmap
docker run -d --name webmap -h webmap -p 8000:8000 -v /tmp/webmap:/opt/xml rev3rse/webmap

****
HP Scanner/printer

https://developers.hp.com/hp-linux-imaging-and-printing/install/install/index

****
git-cola - GUI for Git
https://github.com/git-cola/git-cola

Installation
sudo add-apt-repository ppa:pavreh/git-cola
sudo apt update
sudo apt install git-cola

****
****
Startech USB Crash Cart NOTECONS01
This is a cool little device that connects to your laptop using a USB 3 port and a server's VGA port/usb port. It then displays the server on your laptop eliminating the need for a keyboard/mouse and monitor.

Startech provides drivers for Debian and CentOS distros
https://www.startech.com/Server-Management/KVM-Switches/Portable-USB-PS-2-KVM-Console-Adapter-for-Notebook-PCs~NOTECONS01#dnlds

On 18.04 I had to follow the instructions here to make it work.
https://ubuntuforums.org/showthread.php?t=2375927
I solved the problem in this way:
moving the libz.so.1 from the folder and creating a link for libz.so.1 in lib/x86_64-linux-gnu/libz.so.1.
In particular the commands are:
cd /opt/usb-crash-cart-adapter/20180327/guts/ (the directory in which is present libz.so.1)
sudo mv libz.so.1 libz.so.1.old
sudo ln -s /lib/x86_64-linux-gnu/libz.so.1

****
DNSTwist
https://github.com/elceef/dnstwist

Domain name permutation engine for detecting typo squatting, phishing and corporate espionage.

sudo apt-get install python-dnspython python-geoip python-whois python-requests python-ssdeep python-cffi

Docker
If you use Docker, you can pull official image from Docker Hub and run it:

docker pull elceef/dnstwist
docker run elceef/dnstwist example.com

How to use
To start, it's a good idea to enter only the domain name as an argument. The tool will run it through its fuzzing algorithms and generate a list of potential phishing domains with the following DNS records: A, AAAA, NS and MX.

Next run it with the --registered switch to get just the domains that are registered.

docker run elceef/dnstwist vectorusa.com –registered

```
     _     _   _  _
  __| |_ __  ___| |___     _(_)___| |_
 / _` | '_ \/ __| __\ \ /\ / / / __| __|
| (_| | | | \__ \ |_ \ V  V /| \__ \ |_
 \__,_|_| |_|___/\__| \_/\_/ |_|___/\__| {1.04b}
```

Processing 325 domain variants ..70% 12 hits (3%)

Original* vectorusa.com 104.196.200.136 NS:ns1-09.azure-dns.com MX:vectorusa-com.mail.protection.outlook.com
Bitsquatting vektorusa.com 72.52.178.23 NS:ns1.parklogic.com
Hyphenation vector-usa.com 74.208.236.99 2607:f1c0:100f:f000::248 NS:ns1018.ui-dns.com MX:mx00.1and1.com
Insertion vectoreusa.com 184.168.221.48 NS:ns27.domaincontrol.com MX:mailstore1.secureserver.net
Omission vectorus.com 50.63.202.49 NS:ns53.domaincontrol.com MX:mailstore1.secureserver.net
Omission vectorsa.com 141.8.230.20
Subdomain vec.torusa.com 18.211.9.206 NS:ns1.namebrightdns.com
Subdomain vect.orusa.com 72.52.4.119 NS:ns1.sedoparking.com MX:localhost
Subdomain vector.usa.com 69.10.42.209
Subdomain vectoru.sa.com 141.8.226.34 MX:sa-com-wildcard-null-mx.centralnic.net
Transposition vectoruas.com NS:ns1.moneytones.com
Vowel-swap victorusa.com 208.91.197.194 NS:dns01.gpn.register.com

****
ngrok
ngrok.com

Download the binary and unzip it where you want to run it from.

On the dashboard, under connect your account, grab the auth token and run:
./ngrok authtoken 6itiYzJXwW4pAyRjKH7sq_4YDwSMfSsvFDCARqaoGpk

Result:
Authtoken saved to configuration file: /home/mhubbard/.ngrok2/ngrok.yml

---

Ookla Speedtest
sudo apt install speedtest-cli

From a terminal
speedtest-cli
Retrieving speedtest.net configuration...
Testing from Spectrum (71.93.137.125)...
Retrieving speedtest.net server list...
Selecting best server based on ping...
Hosted by Sprint (Anaheim, CA) [44.29 km]: 25.211 ms
Testing download speed.....
Download: 110.82 Mbit/s
Testing upload speed.....
Upload: 11.75 Mbit/s

HPE MyRoom
https://www.myroom.hpe.com/Download

Allows HPE support staff remote access.
Select the .deb file, once downloaded double click and install.

To execute, super key then type myhproom
Select "login with key"

Useful Linux commands
Display a binary's dependencies. In Linux a binary executable is called an ELF. In Windows it's called an EXE.

In this example, exa is the ELF file, grep is used to display just the needed dependencies.

readelf -d /usr/local/bin/exa | grep NEEDED
0x0000000000000001 (NEEDED) Shared library: [libz.so.1]
0x0000000000000001 (NEEDED) Shared library: [libdl.so.2]
0x0000000000000001 (NEEDED) Shared library: [librt.so.1]
0x0000000000000001 (NEEDED) Shared library: [libpthread.so.0]
0x0000000000000001 (NEEDED) Shared library: [libgcc_s.so.1]
0x0000000000000001 (NEEDED) Shared library: [libc.so.6]
0x0000000000000001 (NEEDED) Shared library: [ld-linux-x86-64.so.2]

ldd recurses through all dependencies so the output can be different than readelf. It is not safe to use ldd on an untrusted binary. It can result in the execution of untrusted code!

ldd /usr/local/bin/exa

```
linux-vdso.so.1 (0x00007ffd5537b000)
libz.so.1 => /lib/x86_64-linux-gnu/libz.so.1 (0x00007fa2a6e33000)
libdl.so.2 => /lib/x86_64-linux-gnu/libdl.so.2 (0x00007fa2a6c2f000)
librt.so.1 => /lib/x86_64-linux-gnu/librt.so.1 (0x00007fa2a6a27000)
libpthread.so.0 => /lib/x86_64-linux-gnu/libpthread.so.0 (0x00007fa2a6808000)
libgcc_s.so.1 => /lib/x86_64-linux-gnu/libgcc_s.so.1 (0x00007fa2a65f0000)
libc.so.6 => /lib/x86_64-linux-gnu/libc.so.6 (0x00007fa2a61ff000)
/lib64/ld-linux-x86-64.so.2 (0x00007fa2a73a7000)
```

man ldd(1) says that:
In the usual case, ldd invokes the standard dynamic linker (see ld.so(8)) with the LD_TRACE_LOADED_OBJECTS environment variable set to 1, which causes the linker to display the library dependencies. Be aware, however, that in some circumstances, some versions of ldd may attempt to obtain the dependency information by directly executing the program. Thus, you should never employ ldd on an untrusted executable, since this may result in the execution of arbitrary code.

objdump -p /usr/local/bin/exa | grep NEEDED

```
  NEEDED      libz.so.1
  NEEDED      libdl.so.2
  NEEDED      librt.so.1
  NEEDED      libpthread.so.0
  NEEDED      libgcc_s.so.1
  NEEDED      libc.so.6
  NEEDED      ld-linux-x86-64.so.2
```

Check the status of outbound ports
Black Hills Information Security maintains a service on the public Intenret called Allports.Exposed that has all ports open. https://www.blackhillsinfosec.com/poking-holes-in-the-firewall-egress-testing-with-allports-exposed/.

You should block all outbound ports that are not required for your company at the firewall. All firewalls should be configured to block TCP ports 135/137.139 and 445 outbound. These are the Microsoft SMB ports. If left open, malware can trick a Microsoft OS to send it's NTLM has and username to a malicious server on the public Internet. Rob Vandenbrink of SANS has a good blog on determining what ports you can block at https://isc.sans.edu/forums/diary/Egress+Filtering+What+do+we+have+a+bird+problem/18379/.

Here is a short PowerShell port scanning script they provide that you can use to test ports 1-1024 against allports.exposed.

1. Open up a command terminal.
2. Type 'powershell.exe -exec bypass' and hit enter.

1..1024 | % {$test= new-object system.Net.Sockets.TcpClient; $wait = $test.beginConnect("allports.exposed",$_,$null,$null); ($wait.asyncwaithandle.waitone(250,$false)); if($test.Connected){echo "$_ open"}else{echo "$_ closed"}} | select-string " "

Alternatively, if you would like to just check for certain ports you can comma-separate each port you would like to scan at the beginning of the script in place of "1..1024". For example, the following script will only scan ports 21, 22, 23, 25, 80, 443, and 1337.

21,22,23,25,80,443,1337 | % {$test= new-object system.Net.Sockets.TcpClient; $wait =$test.beginConnect("allports.exposed",$_,$null,$null); ($wait.asyncwaithandle.waitone(250,$false)); if($test.Connected){echo "$_ open"}else{echo "$_ closed"}} | select-string " "

Here is the same script, but this time we are testing the top 128 ports in use on the Internet as defined by the Nmap project.

80,23,443,21,22,25,3389,110,445,139,143,53,135,3306,8080,1723,111,995,993,5900,1025,587,8888,199,1720,465,548,113,81,6001,10000,514,5060,179,1026,2000,8443,8000,32768,554,26,1433,49152,2001,515,8008,49154,1027,5666,646,5000,5631,631,49153,8081,2049,88,79,5800,106,2121,1110,49155,6000,513,990,5357,427,49156,543,544,5101,144,7,389,8009,3128,444,9999,5009,7070,5190,3000,5432,3986,13,1029,9,6646,49157,1028,873,1755,2717,4899,9100,119,37,1000,3001,5001,82,10010,1030,9090,2107,1024,2103,6004,1801,19,8031,1041,255,3703,17,808,3689,1031,1071,5901,9102,9000,2105,636,1038,2601,7000 | % {$test= new-object system.Net.Sockets.TcpClient; $wait =$test.beginConnect("allports.exposed",$_,$null,$null); ($wait.asyncwaithandle.waitone(250,$false)); if($test.Connected){echo "$_ open"}else{echo "$_ closed"}} | select-string " ""

Cisco Anyconnect client
https://www.cocheno.com/2016/08/anyconnect-package-on-the-secure-gateway-could-not-be-located/

Download the client from the cisco site. It will be similar to this AnyConnect Pre-Deployment Package (Linux 64-bit) anyconnect-linux64-4.6.04056-predeploy-k9.tar.gz.

Unpack it into a folder. Set the shell script as executable.
chmod +x vpn_install.sh

Run the shell script as root
sudo ./vpn_install.sh

When the script finishes you can use ./vpn to start the client from the terminal or hit the windows key and type "anyconnect" to start the GUI.

NOTE: you must install the Linux packages on the ASA or you will get a message "AnyConnect Package on the secure gateway could not be located".

AnyConnect Headend Deployment Package (Linux 64-bit)
anyconnect-linux64-4.6.04056-webdeploy-k9.pkg

Security
Ubuntu is reasonably secure out of the box, but there are things you can do to tighten it up based on your threat environment. Below are some tools that will let you tune the security to your needs.

Setting up a secure Linux server – This blog is on a Debian server but most of it applies to Ubuntu on a laptop.
http://www.linux-magazine.com/Issues/2016/183/Securing-Linux

Lynis
Lynis is an open source security tool. It helps with auditing systems running UNIX-alike systems (Linux, macOS, BSD), and providing guidance for system hardening and compliance testing. Here are the basics steps to use the Lynis.

Installation
git clone https://github.com/CISOfy/lynis
cd lynis

Lynis commands
audit system Perform a system audit
show commands Show available Lynis commands
show help Provide a help screen
show profiles Display discovered profiles
show settings List all active settings from profiles
show version Display current Lynis version

Example,
./lynis audit system –quick --reverse-colors --auditor "Michael Hubbard"

Audit the system, don't pause between tests and list Michael Hubbard as the auditor in the report.

The report is long! If it finds something that doesn't fit best practices it will include a link explaining what it found and how to change it.

Tips
- If Lynis is not installed as package (with included man page), use --man or nroff -man ./lynis.8
- For systems where the shell background is light, use --nocolors or –reverse-colors
- Use lynis show options to see all available parameters of Lynis

Getting started guide - https://cisofy.com/documentation/lynis/get-started/

Debian Security Analyzer
sudo apt install debsecan
http://manpages.ubuntu.com/manpages/bionic/man1/debsecan.1.html
http://www.enyo.de/fw/software/debsecan/

To use debsecan we need the version of Debian that Ubuntu is based on.
cat /etc/debian_version

buster/sid

Now run debsecan with these switches to see packages with missing security updates. You can drop the --only-fixed to see all installed Debian packages.
debsecan --suite buster --format packages --only-fixed

To get details about security vulnerabilities use the –format detail switch.
debsecan --suite sid --format detail

Check the MD5 hashes of installed packages
sudo apt install debsums
https://www.tecmint.com/check-verify-md5sum-packages-files-in-linux/

sudo debsums | grep FAILED

This will show any files that fail the md5 check. If you think malicious activity has occurred you can quickly verify that all of your system files are valid and haven't been changed.

Tripwire
https://computingforgeeks.com/how-to-install-and-configure-tripwire-on-ubuntu-18-04/
https://www.tecmint.com/install-tripwire-ids-intrusion-detection-system-on-linux/
https://github.com/Tripwire/tripwire-open-source

Open Source Tripwire® is a security and data integrity tool for monitoring and alerting on file & directory changes. This project is based on code originally contributed by Tripwire, Inc. in 2000.

It is still maintained but if you want the lasted and greatest you can purchase a copy from https://www.tripwire.com/. Configuration and usage is beyond the scope of this book. The Github site has installation and configuration information.

Samhain
sudo apt install samhain
http://manpages.ubuntu.com/manpages/bionic/man8/samhain.8.htmlhttps://www.linuxquestions.org/questions/linux-security-4/anyone-familiar-with-samhain-on-debian-ubuntu-893234/
https://www.la-samhna.de/samhain/

From the project site:
The Samhain host-based intrusion detection system (HIDS) provides file integrity checking and log file monitoring/analysis, as well as rootkit detection, port monitoring, detection of rogue SUID executables, and hidden processes.

Check if a restart is needed to refresh any packages
There are two different tools for this task. Lynis checks to see if they are installed.

sudo apt install needrestart
http://manpages.ubuntu.com/manpages/xenial/man1/needrestart.1.html

needrestart

sudo apt install debian-goodies
sudo checkrestart

apt-listchanges - Show new changelog entries from Debian package archives. Lynis checks to see if this tool is installed.
sudo apt install apt-listchanges
http://manpages.ubuntu.com/manpages/bionic/man1/apt-listchanges.1.html

Fail2Ban
sudo apt install fail2ban
https://www.techrepublic.com/article/how-to-install-fail2ban-on-ubuntu-server-18-04/

kolourpaint
Start up applications in tweak tool
Joe Editor

Debugging
tail -f /var/log/syslog

using Remote Desktop Gateway with Remmina
https://blog.gpunktschmitz.com/1076-using-remote-desktop-gateway-with-remmina

Appendix A – A Dell Laptop running Linux

I did an impulse purchase of a Dell G5 15" gaming laptop from Walmart in September 2018. It has 16GB of RAM and an Nvidia GTX1060ti video card for hash cracking. Walmart had it on sale for $879 with free "to Store" shipping.

It came with a 256GB m.2 SATA drive for the OS and a 1TB 2.5" spinning HD. I removed both and replaced them with a 500GB Samsung Evo 960 m.2 PCIe drive for the OS and a Samsung Evo 850 1TB SATA SSD for storage. Fry's had the 1TB SSD on sale for $197.00.

This model is available from Dell with Ubuntu but Walmart only had the Windows version. Since it is available with Ubuntu I took the gamble that Ubuntu 18.04 would install and run without a lot of hassle. So far that has been pretty much the case.

Update the BiOS
The first thing I did was check for a BiOS update. Dell has an exe file that gets executed by the UEFI so you don't have to boot into Windows! If you are a Windows user that doesn't seem like a big deal but if you don't dual boot and only have Linux installed it is a big step forward.

Here are some reference articles from Dell:
What is BIOS and How to Update the BIOS on Your Dell System
https://www.dell.com/support/article/us/en/19/sln284433/what-is-bios-and-how-to-update-the-bios-on-your-dell-system?lang=en#How_to_linux

Updating the Dell BIOS in Linux and Ubuntu Environments
https://www.dell.com/support/article/us/en/19/sln171755/updating-the-dell-bios-in-linux-and-ubuntu-environments?lang=en

Download the BiOS
https://www.dell.com/support/home/us/en/19?app=drivers
You need to select BiOS from the drop down. Once the page refreshes you have to click on the link for the BiOS. Once that page refreshes you have to click on the “View full driver details” link to see the hashes for the file. Pretty pathetic that the hashes are listed with the file but I guess they are Windows centric and most Windows users don't check the hashes of the files they download.

Manual “nomodeset” Kernel Boot Line Option for Linux Booting
https://www.dell.com/support/article/uk/en/ukbsdt1/sln306327/manual-nomodeset-kernel-boot-line-option-for-linux-booting?lang=en
I didn’t have any issues with the installer but if you just get a black screen with a cursor you can use this link to work around it.

On the Dell G5 I purchased I did run into a couple problems installing Ubuntu 18.04. The first issue I ran into was that the BiOS didn't recognize the m.2 NVME drive I had installed. A quick google found this Dell KB - https://www.dell.com/support/article/us/en/04/sln299303/loading-ubuntu-on-systems-using-pcie-m2-drives?lang=en which resolved that issue.

After that it was just a matter of following the prompts on the installer. I didn't do full disk encryption on this laptop. I use Veracrypt to encrypt external USB drives where I store critical data so I didn't feel that I needed full disk encryption.

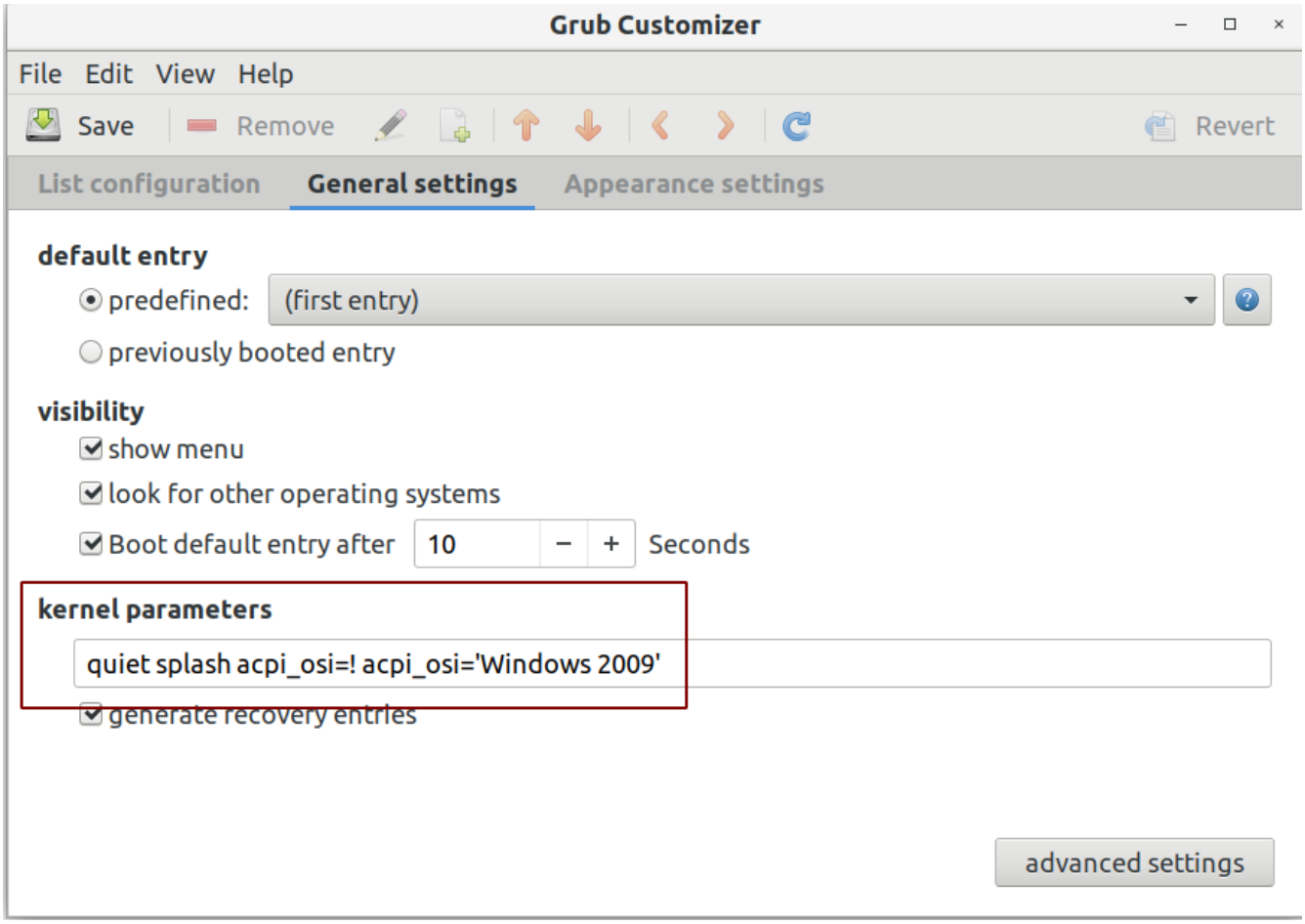
If you do want full disk encryption just select it during the installation. Ubuntu uses the Linux Unified Key Setup (LUKS) encryption specification. The advantage of LUKS is that it's used on Ubuntu and Red Hat so it's very well supported and there are a lot of technical articles available on the Internet.

Now it locks up after a few hours.
After I started using it on a daily basis it would lock up. Doing some Googling I found this article that resolved the problem. Turns out that the ACPI in the BiOS expected Windows and I needed to have Linux report an invalid version.

https://askubuntu.com/questions/19486/how-do-i-add-a-kernel-boot-parameter#19487
acpi_osi=! acpi_osi='Windows 2009'
https://ubuntuforums.org/showthread.php?t=2396250

Grub customizer
This great little utility makes it easy to experiment with kernel options.
http://tipsonubuntu.com/2018/03/11/install-grub-customizer-ubuntu-18-04-lts/
To install it do the following:
sudo add-apt-repository ppa:danielrichter2007/grub-customizer
sudo apt update
sudo apt install grub-customizer

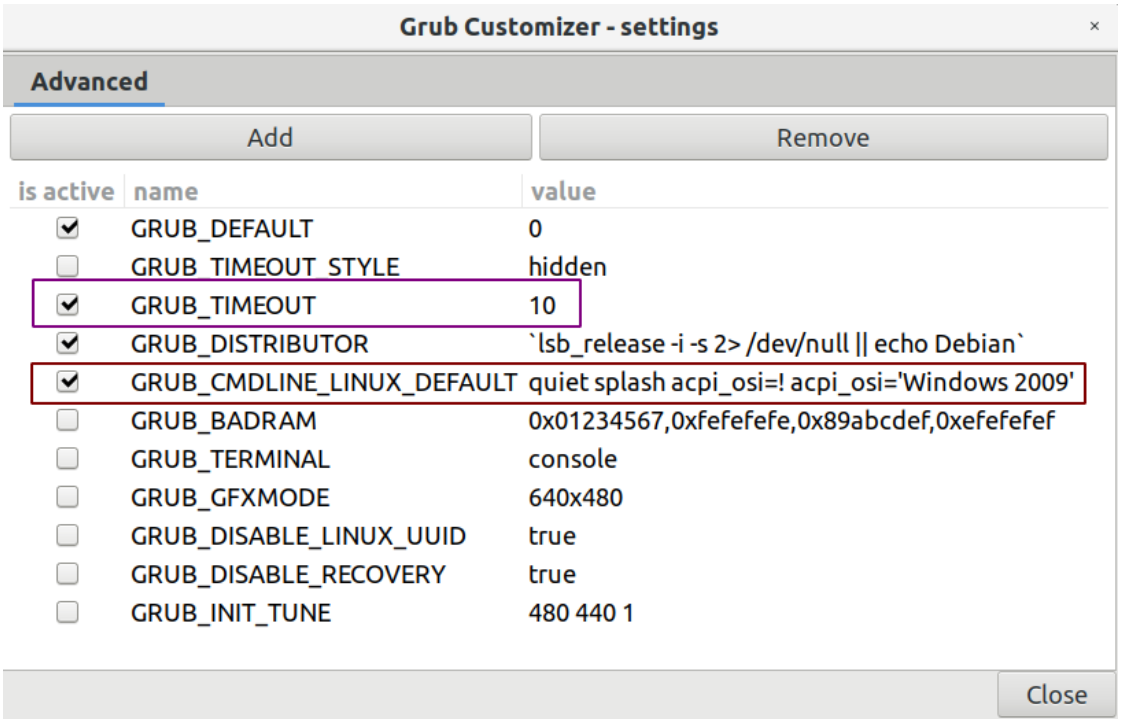
Here is the interface for the grub customizer



You can see the kernel parameters I needed to add in the screenshot.

Showing the Grub menu
Normally, during install, if there are no other operating systems, the installer sets the boot variable to GRUB_HIDDEN_TIMEOUT=0 . I needed to see the menu for troubleshooting so I changed it to GRUB_HIDDEN_TIMEOUT=10 per the instructions in this article.
https://ubuntuforums.org/showthread.php?t=2398935

Click the advanced settings button and you will see several options that you can change using the check boxes.



Identifying if Ubuntu has been installed in UEFI mode
https://help.ubuntu.com/community/UEFI
Ubuntu installed in UEFI mode can be detected the following way:

if the /etc/fstab file contains an UEFI partition (mount point: /boot/efi) it uses the grub-efi bootloader (not grub-pc)

cat /etc/fstab | grep efi
# /boot/efi was on /dev/nvme0n1p1 during installation
UUID=CA3C-BE2C /boot/efi vfat umask=0077 0 1

from the installed Ubuntu, open a terminal (Ctrl+Alt+T) then type the following command:

[-d /sys/firmware/efi] && echo "Installed in UEFI mode" || echo "Installed in Legacy mode"
Installed in UEFI mode

Nvidia and Intel built in graphics
Getting both the Intel and Nvidia graphic cards working isn't a easy as it is on Windows but Dell has a KB to help with that.
https://www.dell.com/support/article/us/en/04/sln298475/a-guide-to-hybrid-video-on-dell-pcs-with-an-ubuntu-operating-system?lang=en

Now that Ubuntu is working correctly, what's next?
Tweak your touchpad to taste in Linux
https://www.techrepublic.com/article/tweak-your-touchpad-to-taste-in-linux/

Display Brightness
I had problems getting the Dell work with the built in gnome brightness settings. I found this little app the did the trick.

https://www.debugpoint.com/2016/10/2-ways-fix-laptop-brightness-problem-ubuntu-linux/
sudo add-apt-repository ppa:apandada1/brightness-controller
sudo apt update
sudo apt install brightness-controller

Maximum Battery Life
https://www.linuxuprising.com/2019/03/linux-battery-optimization-tool-tlp-12.html