1 Linux commandline basics

Even if an onboard autopilot hardware platform is capable of graphics rendering, complex rendering operations are normally avoided in the software stack used in an autopilot to focus the processing on performing flight critical tasks well. Similarly, sending graphics over a command and control link is not usually the best use of the limited link bandwidth. Because of this, you will often interact with a remote computer onboard your airframe using the command line. Linux is the most often used operating system. Taking a few minutes to become comfortable working in the command line will open up many options later.

1.1 Navigating and working with files

ls Lists files in current directory. Use ls-l to see more detail.

cd Changes directories

cp Copies files and folders. Note to copy a folder and its subfolders you must request recursive

rm Deletes files and folders. You may need to specify force.

mv Moves files and folders

grep filters an output for a pattern (e.g., a string)

1.2 Running and stopping programs

./executible Runs the file "executible" located in the current directory.

Ctrl C Stops the progam executing. (SIGINT)

!! redo last command

!top do last command starting with top

$ sudo Elevates your permissions to run files requiring higher access (similar to "run as administrator" on Windows). Requires your account to have superuser privileges.

1.3 Working with console input/output, shortcuts, and convenience features

cat Displays contents of the argument. (e.g., cat file.txt shows the contents of file.txt)

less, d,b,q For long console outputs, you want a "pager" that lets you scroll through the output. Use less, then use d to scroll down, b to scroll back, and q to quit

clear

$ nano A lightweight text editor. Competitor to vi and emacs. Exit the program via Ctrl X

Ctrl Z, then fg Puts the current program to the background. To bring it back to the foreground, use fg.

Ctrl R, Ctrl G Ctrl R to search backward through command line history, ctrl G to stop

tab Autocomplete or show options to autocomplete

Ctr alt T to launch

Ctrl T to transpose letters, esc T to transpose words

xclip -o to copy, then shift ins to paste

ctrl s to pause, ctrl q to unpause

man bash get a manual for these commands, then q to exit

1.4 Networking

ifconfig Show networking configuration (networking adapters, ip addresses, etc)

ping Bounces packets off an ip address. For example, ping google.com looks up the IP address associated with google.com and bounces packets off this server. This is a good way to make sure your network is working. Typically we start with close computers (127.0.0.1 is the local computer) and working farther outwards. By pinging the local computer, the default gateway, and servers progressively farther out on the internet, you can isolate if your networking issue is with your network adapter, on your local LAN, or somewhere farther upstream. Note it is generally not a good idea to ping military or other high security servers as some nefarious actors do this when they are looking for ways to break in; avoid doing this to be confused with one of them.

wpa_passphrase Generate a WPA PSK from an ASCII passphrase for a SSID

iwconfig Configure a wireless network card

hostname Returns the hostname. Most useful when called with the -A option, which is an overload for –all-fqdns

1.5 Configuration and updates

ps Show currently running processes

dmesg This is log file that has many of the events you may be interested in. For example, connecting a USB device will generate an entry. I don't recommend reading this file unless it is bedtime, instead, use grep to search through it for the items of most relevance. Example: suppose I am connecting a communications device that shows up as serial port. I might look for this via

```
pi@raspberrypi:~ $ dmesg | grep tty
[    0.000000] Kernel command line: 8250.nr_uarts=0 bcm2708_fb.fbwidth=480 bcm2708_fb.f
[    0.000818] console [tty1] enabled
[    1.356019] 3f201000.serial: ttyAMA0 at MMIO 0x3f201000 (irq = 87, base_baud = 0) is
[   32.886968] input: iClever IC-BK08 Keyboard as /devices/platform/soc/3f201000.serial
[  841.043054] input: iClever IC-BK08 Keyboard as /devices/platform/soc/3f201000.serial
```

shows that the comm device is not yet conected, but that a wireless keyboard (that connects through a virtual serial port) has been connected and disconnected.

watch Watch repeatedly calls a command and displays the output to screen. This is useful to monitor for a specific event. Use the -n parameter to say how often the command is called, in seconds. For example, if you wanted to confirm a device was correctly detected, you could pass watch a grep and dmesg call for the USB device to appear in dmesg. For example, if we wanted to monitor the signal strength of my connected wireless LAN, we could call

```
watch -n 1  iwconfig wlan0
```

which returns

```
Every 1.0s: iwconfig wlan0

wlan0     IEEE 802.11  ESSID:"OSUSTAFF"
          Mode:Managed  Frequency:5.5 GHz  Access Point: 50:2F:A8:D4:BF:2F
          Bit Rate=325 Mb/s   Tx-Power=31 dBm
          Retry short limit:7   RTS thr:off   Fragment thr:off
          Power Management:on
          Link Quality=43/70  Signal level=-67 dBm
          Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
          Tx excessive retries:24  Invalid misc:0   Missed beacon:0
```

The -n parameter means this command calls iwconfig wlan0 every 1 second, and allows us to monitor how the signal strength changes.

bluetoothctl Bluetooth configuration options

apt -get Debian's tool for installing programs

shutdown Exactly what it sounds like. Usually called with the option -now and normally requires super user privilege.