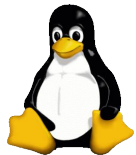# Linux Server Administration

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09th Feb 2019

Agenda

- Exploring Hardware
- Core Kernel & Modules
- Devices and Drivers
- Users and Groups
- Packages
- Services
- Basic troubleshooting

Exploring Hardware

Listing CPUs

- To list CPUs use `lscpu`
- Details like
  - Sockets
  - Cores
  - Threads
  - Cache
  - Flags (CPU features)
  - etc

```
$ lscpu
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Byte Order:            Little Endian
CPU(s):                56
On-line CPU(s) list:   0-55
Thread(s) per core:    2
Core(s) per socket:    14
Socket(s):             2
NUMA node(s):          2
Vendor ID:             GenuineIntel
…
Model name:      Intel(R) Xeon(R) CPU E5-2690 v4 @ 2.60GHz
...
CPU MHz:               1200.000
CPU max MHz:           2600.0000
CPU min MHz:           1200.0000
...
Virtualization:        VT-x
L1d cache:             32K
L1i cache:             32K
L2 cache:              256K
L3 cache:              35840K
NUMA node0 CPU(s):     0-13,28-41
NUMA node1 CPU(s):     14-27,42-55
Flags:            ...
```
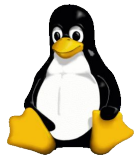
Listing PCI/PCIe devices

- Add-on Networking, Storage, Acceleration devices communicate using Peripheral Component Interconnect [- express] (PCI/PCIe) protocol and bus.
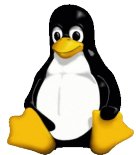- To list all PCI/PCIe devices use `lspci`

```
$ lspci
00:00.0 Host bridge: Intel Corporation Device 5904 (rev 02)
00:02.0 VGA compatible controller: Intel Corporation Device 5916 (rev 02)
00:14.0 USB controller: Intel Corporation Sunrise Point-LP USB 3.0 xHCI Controller (rev 21)
00:14.2 Signal processing controller: Intel Corporation Sunrise Point-LP Thermal subsystem...
00:17.0 SATA controller: Intel Corporation Sunrise Point-LP SATA Controller [AHCI mode]...
00:1c.0 PCI bridge: Intel Corporation Device 9d10 (rev f1)
...
00:1f.0 ISA bridge: Intel Corporation Device 9d58 (rev 21)
00:1f.2 Memory controller: Intel Corporation Sunrise Point-LP PMC (rev 21)
00:1f.3 Audio device: Intel Corporation Device 9d71 (rev 21)
00:1f.6 Ethernet controller: Intel Corporation Ethernet Connection (4) I219-V (rev 21)
05:00.0 Network controller: Intel Corporation Device 24fd (rev 78)
```
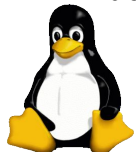
Listing USB devices

- Peripheral devices communicate using Universal Serial Bus (USB) protocol and bus
- To list all USB devices use `lsusb`

```
$ lsusb
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 001 Device 006: ID 138a:0011 Validity Sensors, Inc. VFS5011 Fingerprint Reader
Bus 001 Device 005: ID 04f2:b5c0 Chicony Electronics Co., Ltd
Bus 001 Device 003: ID 046d:c52b Logitech, Inc. Unifying Receiver
Bus 001 Device 002: ID 046d:c52f Logitech, Inc. Unifying Receiver
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
```

Listing SCSI devices

- Storage devices communicate using Small Computer System Interconnect (SCSI) protocol.
- Underlying bus could be
  - Serial ATA (SATA)
  - Serial Attached SCSI (SAS)
  - Peripheral Component Interconnect (PCIe)
  - Non-Volatile Memory express (NVMe)
  - Universal Serial Bus (USB)
- To list all SCSI devices use `lsscsi`
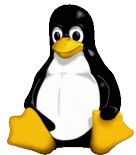
```
$ lsscsi
[0:0:1:0]   cd/dvd   TSSTcorp CDW/DVD SH-M522C TS04   /dev/sr0
[2:0:0:0]   disk     ATA         ST3500418AS      CC38   /dev/sda
[3:0:0:0]   disk     ATA         SEAGATE ST330006 NS00  /dev/sdb
[5:0:0:0]   disk     ATA         HITACHI HUA72202 N100  /dev/sdc
```

Listing all hardware

- To list all hardware devices in tree structure use `lshw`
    - Details like Vendor, Product, Serial numbers, etc
- To get many more details about hardware `dmidecode`

```
# lshw
cycle.cse.iith.ac.in
    description: Rack Mount Chassis
    product: ProLiant DL380 Gen9 (719064-B21)
    vendor: HP
    serial: AFT315RDG
            ...
    *-core
        *-cpu
                ...
        *-memory
                ...
        *-firmware
                ...
        *-pci
            ...
            *-usb
                    ...
            *-pci:3
                *-network
                    ...
                *-scsi
                    *-disk
                        ...
```

Core Kernel and Modules

Core Kernel

- The Core kernel is kernel code packaged into the vmliuz file in /boot.
- Each kernel has a version.
- List all kernels using `ls /boot/vmlinuz*`

```
$ ls -l /boot/vmlinuz*
-rw-r--r-- 1 root root 7710912 May 21  2018 /boot/vmlinuz-4.13.0-36-generic
-rw-r--r-- 1 root root 7712824 Mar  1  2018 /boot/vmlinuz-4.13.0-36-generic.efi.signed
-rw------- 1 root root 7711664 May  3  2018 /boot/vmlinuz-4.13.0-41-generic
-rw------- 1 root root 7713592 May 22  2018 /boot/vmlinuz-4.13.0-41-generic.efi.signed
-rw------- 1 root root 7713296 May 17  2018 /boot/vmlinuz-4.13.0-43-generic
-rw------- 1 root root 7715224 May 26  2018 /boot/vmlinuz-4.13.0-43-generic.efi.signed
-rw------- 1 root root 7712560 May 30  2018 /boot/vmlinuz-4.13.0-45-generic
-rw------- 1 root root 7714488 Jun 14 06:17 /boot/vmlinuz-4.13.0-45-generic.efi.signed
```
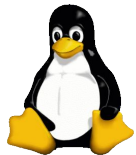
Kernel Modules

- A kernel module is kernel code packaged into a .ko file.
- Module could be statically linked into vmlinuz or a loadable kernel module.
- List all kernel modules using `lsmod`

```
$ lsmod
Module                    Size  Used by
...
xfs                     970752  0
nvidia_uvm              647168  0
...
kvm_intel               172032  0
kvm                     540672  1    kvm_intel
...
btrfs                   987136  0
...
drm                     364544  3    drm_kms_helper,nvidia_drm
...
```
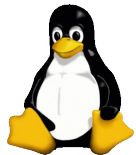
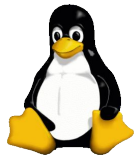# Loading Kernel Modules

- To load a kernel module and its dependencies from standard path, use `modprobe -v <name>`
- To load a kernel module from any path, use `insmod <path_to_ko>`

```
# modprobe -v kvm_intel
insmod /lib/modules/4.15.0-42-generic/kernel/virt/lib/irqbypass.ko
insmod /lib/modules/4.15.0-42-generic/kernel/arch/x86/kvm/kvm.ko
insmod /lib/modules/4.15.0-42-generic/kernel/arch/x86/kvm/kvm-intel.ko

# insmod ~/AllCode/Maruthi/lkd/01.modules/01.mykmod/kernel/mykmod.ko

# lsmod | grep kvm
Module                Size  Used by
...
kvm_intel            217088  0
kvm                  598016  1 kvm_intel
irqbypass             16384  1 kvm
...
mykmod                16384  0
...
```
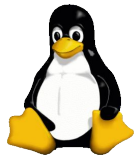
Unloading Kernel Modules

- To unload a kernel module and its dependencies, use `modprobe -vr <name>`
- To unload a kernel module, use `rmmod <name>`

```
# modprobe -vr kvm_intel
rmmod kvm_intel
rmmod kvm
rmmod irqbypass

# rmmod mykmod
```

Drivers and Devices

Drivers

- Driver is a kernel module that manages devices (aka Device driver).
- Two types : "Character device drivers" or "Block device drivers".
- List all drivers using `cat /proc/devices`

```
$ cat /proc/devices
Character devices:
  4 tty
...
 81 video4linux
...
136 pts
...
Block devices:
...
  7 loop
  8 sd
 11 sr
...
253 device-mapper
```
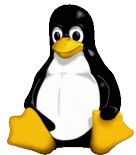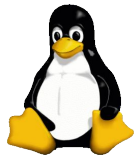
Character devices

- Driver creates a character device special file for each character device instance
  - Eg. keyboard, mouse, many pseudo devices.
- Accessible in unit of 1B
- List all character devices using `ls -l /dev/ | grep ^c`

```
$ ls -l /dev/ | grep ^c
crw-rw-rw-  1 root root        1,   3 Dec  7 05:53 null
...
crw--w----  1  maruthisi tty  136,  0 Dec  8 06:56 pts/0
...
crw--w----  1 root tty         4,   0 Dec  7 05:53 tty0
...
crw-rw----+ 1 root video      81,   0 Dec  7 05:53 video0
crw-rw-rw-  1 root root        1,   5 Dec  7 05:53 zero
```
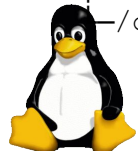
Block devices

- Driver creates a block device special file for each block device instance
  - Eg. Disk, Tape, CD/DVD, many pseudo devices.
- Accessible in units of 512B, 1KiB, 4KiB.
- List all character devices using `ls -l /dev/ | grep ^b` or `lsblk -pa`

```
$ lsblk -pa
NAME          MAJ:MIN RM    SIZE RO TYPE MOUNTPOINT
/dev/loop1    7:1     0          0 loop
...
/dev/sda      8:0     0 931.5G  0 disk
├─/dev/sda4   8:4     0  46.6G  0 part /
├─/dev/sda2   8:2     0  14.9G  0 part [SWAP]
...
├─/dev/sda7   8:7     0 186.3G  0 part /home
...
├─/dev/sda1   8:1     0   512M  0 part /boot/efi
─/dev/sda6    8:6     0  46.6G  0 part

NOTE: device names sda, sdb are volatile. May change across reboots.
```
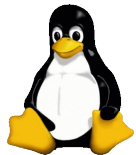
Users and Groups

Users (Recap)

- User is an account for
  - A super user (root)
  - A person
  - A service

- An integer number (UID) is assigned to each user account (/etc/passwd file)

- root has UID = 0

Creating User Account

- To create an user account and home directory, use `useradd -m`

```
# useradd -s /bin/bash -m maruthisi
# useradd -s /bin/sh -m jyothin

# cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
...
amits:x:10001:10001::/home/amits:/usr/bin/nologin
sohailm:x:11001:11001::/home/sohailm:/bin/sh
davidk:x:20001:20001::/home/davidk:/bin/bash
maruthisi:x:20201:20201::/home/maruthisi:/bin/bash
jyothin:x:20202:20202::/home/jyothin:/bin/sh

# id maruthisi
uid=20201(maruthisi) gid=20201(maruthisi) groups=20201(maruthisi)
```

Passwords

- Passwords are stored in encrypted form in /etc/shadow
- Change password using `passwd` command. Root can change anyone's password.
- An `!` or `*` at the begin of second field, locks the account.

```
# passwd maruthisi

# cat /etc/shadow
root:!:17119:0:99999:7:::
daemon:*:17001:0:99999:7:::
...
amits:$6$IRU45oem$RcHnDVg459/1GXNwRJmz7wqsyyfzb95k.6WEMV2Du04yf/lz0:17564:0:99999:7:::
sohailm:$6$FKFYEysx$xvwpzSRJPq1hLtlH577YQZJKLHX9.RCp01KKry6A2guclV0:17564:0:99999:7:::
jyothin:$6$NU9mvrF4$bgHrQxIV24lMlHynK2Mxefbo1UC9gMpcKNzCVaK/8mA9IS.:17564:0:99999:7:::
maruthisi:$6$WT483SxE$bzsX290lzla/nb8NZ6X2c3u0OFdhpcv.BynwFqP5.UPr1:17564:0:99999:7:::
```
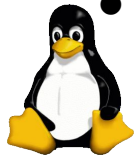
Groups (1/2) (Recap)

Group is
- A logical collection of user accounts
- An integer number (GID) is assigned to each group (/etc/group file)
- Each user
    - Must belong to one primary group (preferably solo group)
    - May belong to many supplementary groups

Eg:
- All students belonging to CANDLE Research lab
  `candle`
- All sudo users
- A solo group
  `maruthisi`

Groups (2/2) (Recap)

```
# cat /etc/group
root:x:0:
daemon:x:1:
sudo:x:27:owner
...
maruthisi:x:20201:
jyothin:x:20202:


# id maruthisi
uid=20201(maruthisi) gid=20201(maruthisi) groups=20201(maruthisi)
```
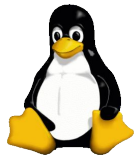
Supplementary Group Administration

- To create a supplementary group, use `groupadd`
- To add membership of user to a supplementary group, use `usermod -aG`

```
# groupadd candle

# cat /etc/group
..
sudo:x:27:owner
...
candle:x:2081:
```

```
# usermod -aG sudo maruthisi
# usermod -aG candle maruthisi
# usermod -aG candle jyothin

# cat /etc/group
...
sudo:x:27:owner,maruthisi
...
candle:x:2081:maruthisi,jyothin

# id maruthisi
uid=20201(maruthisi) gid=20201(maruthisi)
groups=20201(maruthisi),27(sudo),2081(candle)
```
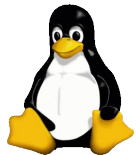
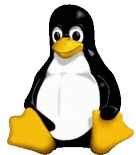# Locking/Unlocking/Deleting User Account

- To lock a user account from login, use `usermod -L`
- To unlock a user account from login, use `usermod -U`
- To delete a user account, use `userdel`
- To delete a user account and home directory [irrecoverable], use `userdel -r`

```
# usermod -L jyothin

# usermod -U jyothin


# userdel maruthisi

# userdel -r jyothin
```

Removing Supplementary Groups & Deleting Group

- To remove membership from supplementary groups, use `usermod`
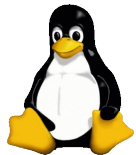- To delete a group [after removing all memberships]

```
# usermod -G candle maruthisi
# usermod -G candle jyothin


# groupdel candle
```
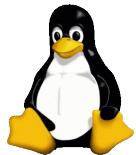
Home Directories (Recap)

- A directory in /home created one for each user
- Starting directory after login.
- Special character is ~

- Permissions play a key role for securing files from other users, other groups, others in the world.
- UMASK in `/etc/login.defs` should be set to 077.

- Per user limits on storage space usage can be enforced using quotas.

Home Directories (Recap)

```
# ls -l /home/
total 36
drwx------  2 amits      amits      4096 Feb  2 10:50 amits
drwx------  2 davidk     davidk     4096 Feb  2 10:51 davidk
drwx------  2 jyothin    jyothin    4096 Feb  2 10:59 jyothin
drwx------  2 maruthisi  maruthisi  4096 Feb  2 10:52 maruthisi
drwx------ 17 owner      owner      4096 Feb  2 11:19 owner
...
```

Change user ownership

- To change user ownership of a file,
  use `chown <uid/name> <file>` command
    - -R : recursively change ownership of a directory and its contents

```
# ls -l /home
...
drwxr-xr-x   3 root        root        22 Aug 31 21:01 candle
...

# chown maruthisi /home/candle/

# ls -l /home/
...
drwxr-xr-x   3 maruthisi root        22 Aug 31 21:01 candle
...
```
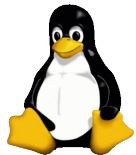
Change group ownership

- To change group ownership of a file, use `chgrp` command
  - -R : recursively change ownership of a directory and its contents

```
# ls -l /home/
...
drwxr-xr-x   3 maruthisi root       22 Aug 31 21:01 candle
...

# chgrp candle /home/candle/

# ls -l /home/
...
drwxr-xr-x   3 maruthisi candle        22 Aug 31 21:01 candle
...
```
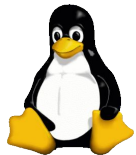
Change user/group ownership

- To change user and/or group ownership of a file,
  use `chown <uid/name>[:<gid/name>] <file>` command
  - -R : recursively change ownership of a directory and its contents

```
# ls -l /home
...
drwxr-xr-x   3 root      root       22 Aug 31 21:01 candle
...

# chown maruthisi:candle /home/candle/

# ls -l /home/
...
drwxr-xr-x   3 maruthisi candle        22 Aug 31 21:01 candle
...
```

Process User/Group ownerships - Real, Effective, Saved

- Every process has four uids
  - Real user : uid of the logged-in user. (ruid)
  - Effective user : uid the process. (euid)
  - Saved/Set user : uid of the program file. (suid)
  - Filesystem user : Effective uid the process, used for NFS access (fsuid)
- Similarly every process has four gids
  - Real, Effective, Saved, Filesystem group : rgid, sgid, egid, fsgid

```
$ cat /proc/self/status
Name:    cat
...
Uid:    1001    1001    1001    1001
Gid:    1001    1001    1001    1001
...
```
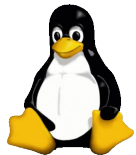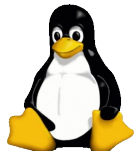Real   Effective   Saved Filesystem

Set user-id/group-id bit

- In addition to read(r), write(w), execute(x), there is one more bit in permissions.
  - Saved/Set bit (s) : set user or group ID on execution for files with x
  - Saved/Set bit (S) : set user or group ID on execution for files without x

```
$ ls -l /usr/bin/passwd
-rwsr-xr-x 1 root root 54256 May 17  2017 /usr/bin/passwd

$ ls -l /etc/passwd
-rw-r--r-- 1 root root 2582 Dec 18 14:10 /etc/passwd

$ ls -l /usr/bin/sudo
-rwsr-xr-x 1 root root 136808 Jul  4  2017 /usr/bin/sudo
```

Sticky bit

- In addition to read(r), write(w), execute(x), set-user/group-id (s), there is one more bit in permissions.
  - Sticky bit (t) : restricted deletion flag or sticky bit for files with x
  - Sticky bit (T) : restricted deletion flag or sticky bit for files without x

```
$ ls -ld /tmp/
drwxrwxrwt 14 root root 4096 Feb  9 07:05 /tmp/

$ ls -la /home/candle/datasets/
drwxrwxr-x 7 candle    candle     75 Feb  9 18:32 .
drwxr-xr-x 2 jyothin   candle    128 Aug 31 19:53 MNIST
drwxr-xr-x 4 maruthisi candle     32 Oct 29 14:13 YOLO
...

$ chmod +t /home/candle/datasets/

$ ls -ld /home/candle/datasets/
drwxrwxr-t 7 candle    candle     75 Feb  9 18:32 .
...
```
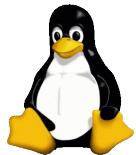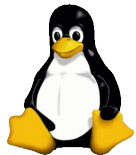
Packages

Online package management

- Packages are available online in repositories

- Repository is like warehouse of packages.
- Maintained by distribution vendors and other third parties

- Repository management tool
  - apt for Ubuntu/Debian
  - yum or dnf for CentOS/Fedora/RHEL/SuSE
- Repo tools automatically download and install prerequisite packages.

Setting up download package sources

- List of download sources could be setup in `/etc/apt/sources.list`
  - deb clause specifies binary packages
  - deb-src clause specifies source code corresponding to the binary packages.
- List of additional download sources could be setup in `/etc/apt/sources.list.d/`
- CAUTION: never setup untrusted packages sources.
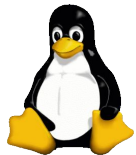
```
$ cat /etc/apt/sources.list
# deb cdrom:[Ubuntu 16.04.4 LTS _Xenial Xerus_ - Release amd64 (20180228)]/ xenial main
restricted

deb http://in.archive.ubuntu.com/ubuntu/ xenial main restricted
# deb-src http://in.archive.ubuntu.com/ubuntu/ xenial main restricted

$ ls -l /etc/apt/sources.list.d/
-rw-r--r-- 1 root root  38 Nov 20  2017 cuda-9-0-local.list
-rw-r--r-- 1 root root  66 Dec 21 07:32 dropbox.list
-rw-r--r-- 1 root root 189 Jul 18  2018 google-chrome.list
-rw-r--r-- 1 root root  51 Jun 20  2018 ros-latest.list
-rw-r--r-- 1 root root  56 Jan 31 10:45 skype-stable.list
...
```

Setting up mirror for the package sources

- Find and replace `in.archive.ubuntu.com` with `mirror.iith.ac.in` in the `/etc/apt/sources.list` file
- Update the package source information using `apt-get update`
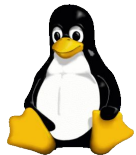
```
$ cat /etc/apt/sources.list
# deb cdrom:[Ubuntu 16.04.4 LTS _Xenial Xerus_ - Release amd64 (20180228)]/ xenial main
restricted

deb http://mirror.iith.ac.in/ubuntu/ xenial main restricted
# deb-src http://mirror.iith.ac.in/ubuntu/ xenial main restricted

...
...
```
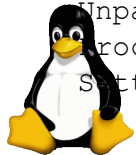
Installation using apt

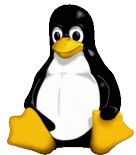- Install a package using `apt install <package_name>`

```
$ sudo apt install lsscsi
[sudo] password for owner:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following NEW packages will be installed:
  lsscsi
0 upgraded, 1 newly installed, 0 to remove and 320 not upgraded.
Need to get 31.9 kB of archives.
After this operation, 110 kB of additional disk space will be used.
Get:1 http://in.archive.ubuntu.com/ubuntu xenial/main amd64 lsscsi amd64 0.27-3 [31.9 kB]
Fetched 31.9 kB in 0s (42.0 kB/s)
Selecting previously unselected package lsscsi.
(Reading database ... 210867 files and directories currently installed.)
Preparing to unpack .../lsscsi_0.27-3_amd64.deb ...
Unpacking lsscsi (0.27-3) ...
Processing triggers for man-db (2.7.5-1) ...
Setting up lsscsi (0.27-3) ...
```

Querying using apt

- List a single package using `apt list --installed <package_name>`
- List all packages using `apt list --installed`

```
$ sudo apt list --installed lsscsi
Listing... Done
lsscsi/xenial,now 0.27-3 amd64 [installed]
```
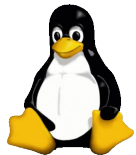
Uninstallation using apt

- Uninstall a package using `apt remove <package_name>`
- Uninstall a package and purge all configuration files using `apt purge <package_name>`

```
$ sudo apt remove lsscsi
(Reading database ... 210874 files and directories currently installed.)
Removing lsscsi (0.27-3) ...
Processing triggers for man-db (2.7.5-1) ...

$ sudo apt list
Listing... Done

$ sudo apt purge lsscsi
...
```
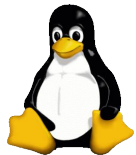
Offline package management

- Package management tool
  - dpkg for Ubuntu/Debian
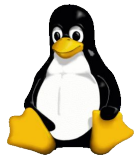 - rpm for Fedora/CentOS/RHEL/SuSE

Installation using dpkg

- Download a package from Internet or Copy from CD/DVD
- Install the package using `dpkg`

```
$ ls -l lsscsi_0.27-3_amd64.deb
-rw-r--r-- 1 owner owner 31884 Oct 25  2014 lsscsi_0.27-3_amd64.deb

$ sudo dpkg -i lsscsi_0.27-3_amd64.deb
[sudo] password for owner:
Selecting previously unselected package lsscsi.
(Reading database ... 210867 files and directories currently installed.)
Preparing to unpack lsscsi_0.27-3_amd64.deb ...
Unpacking lsscsi (0.27-3) ...
Setting up lsscsi (0.27-3) ...
Processing triggers for man-db (2.7.5-1) ...
```

Querying using dpkg

- List a single package using `dpkg -l <package_name>`
- List all packages using `dpkg -l`

```
$ dpkg -l lsscsi
Desired=Unknown/Install/Remove/Purge/Hold
| Status=Not/Inst/Conf-files/Unpacked/halF-conf/Half-inst/trig-aWait/Trig-pend
|/ Err?=(none)/Reinst-required (Status,Err: uppercase=bad)
||/ Name            Version        Architecture Description
+++-===============-=============-============-=================================
ii  lsscsi          0.27-3         amd64        list all SCSI devices (or hosts)

$ sudo dpkg -l
||/ Name            Version        Architecture Description
+++-===============-=============-============-=================================
ii  python3         3.5.1-3        amd64        interactive high-level object-oriented language
                                                (default python3 version)
...
i   lsscsi          0.27-3         amd64        list all SCSI devices (or hosts)
```
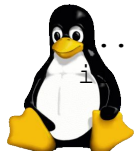
Information about a package

- To see description, and other detailed information about a package, use
  `dpkg -s <package_name>`

```
$ dpkg -s lsscsi
Package: lsscsi
Status: install ok installed
Priority: optional
Section: admin
Installed-Size: 107
Maintainer: Ubuntu Developers <ubuntu-devel-discuss@lists.ubuntu.com>
Architecture: amd64
Version: 0.27-3
Depends: libc6 (>= 2.14)
Description: list all SCSI devices (or hosts) currently on system
 Uses information in sysfs (Linux kernels 2.6.0 and later) to list all
 scsi devices (or hosts) currently attached to the system. Options can
 be used to control the amount and form of information provided for each
 device.
Original-Maintainer: Matt Taggart <taggart@debian.org>
Homepage: http://sg.danny.cz/scsi/lsscsi.html
```
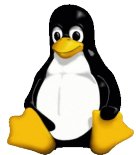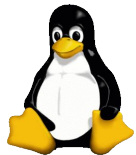
Listing files in package

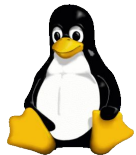- List files in a package using `dpkg -L <package_name>`

```
$ dpkg -L lsscsi
/.
/usr
/usr/share
/usr/share/man
/usr/share/man/man8
/usr/share/man/man8/lsscsi.8.gz
/usr/share/doc
/usr/share/doc/lsscsi
/usr/share/doc/lsscsi/CREDITS
/usr/share/doc/lsscsi/AUTHORS
/usr/share/doc/lsscsi/README
/usr/share/doc/lsscsi/changelog.Debian.gz
/usr/share/doc/lsscsi/copyright
/usr/bin
/usr/bin/lsscsi
```

Finding package that installed a file

- To find a package that installed a file,
  use d_{pkg -S <absolute_path_to_file>}

```
$ dpkg -S /usr/bin/lsscsi
lsscsi: /usr/bin/lsscsi
```

Uninstallation using dpkg

- Uninstall a package using `dpkg -r`
- Uninstall a package and purge all its configuration files using `dpkg -P`

```
$ sudo dpkg -r lsscsi
(Reading database ... 210874 files and directories currently installed.)
Removing lsscsi (0.27-3) ...
Processing triggers for man-db (2.7.5-1) ...

$ sudo dpkg -l lsscsi
dpkg-query: no packages found matching lsscsi

$ sudo dpkg -P lsscsi
(Reading database ... 210874 files and directories currently installed.)
Removing lsscsi (0.27-3) ...
Processing triggers for man-db (2.7.5-1) ...
```
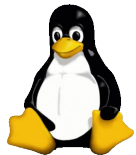
Building from sources ~~and installing~~

- Sometimes packages are not available, only source code is available in github or some other open source.
- Usually there are instructions "make", "make install".
- CAUTION: never run "sudo make install".
  - There is no way to uninstall
  - There may be spyware/malware/virus in the source which can compromise your server, and spread around in datacenter.

```
$ make
$ make install
```
Set PATH, LD_LIBRARY_PATH appropriately in your .bashrc

```
$ make
$ sudo make install
```

Background Services

List all background services

- To list all background services, use systemctl

```
$ systemctl
  UNIT                            LOAD   ACTIVE SUB         DESCRIPTION
  proc-sys-fs-binfmt_misc.automount loaded active running   Arbitrary Executable
  ...
  ...
  ureadahead-stop.timer           loaded active elapsed    Stop ureadahead data collec

LOAD   = Reflects whether the unit definition was properly loaded.
ACTIVE = The high-level unit activation state, i.e. generalization of SUB.
SUB  = The low-level unit activation state, values depend on unit type.

206 loaded units listed. Pass --all to see loaded but inactive units, too.
To show all installed unit files use 'systemctl list-unit-files'.
```
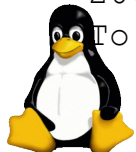
Status of a background service

- To know status of a background service, use `systemctl status <svc_name>`

```
$ systemctl status NetworkManager.service
● NetworkManager.service - Network Manager
   Loaded: loaded (/lib/systemd/system/NetworkManager.service; enabled; vendor
p
   Active: active (running) since Sat 2019-02-09 03:20:17 IST; 7h ago
     Docs: man:NetworkManager(8)
 Main PID: 1274 (NetworkManager)
    Tasks: 5
   Memory: 15.8M
      CPU: 14.449s
   CGroup: /system.slice/NetworkManager.service
           ├─ 1274 /usr/sbin/NetworkManager --no-daemon
           ├─ 2458 /usr/sbin/dnsmasq --no-resolv --keep-in-foreground --no-hosts
           └─11013 /sbin/dhclient -d -q -sf /usr/lib/NetworkManager/nm-dhcp-help
```
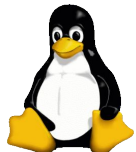
Start/Stop a background service

- To start a background service, use `systemctl start <svc_name>`
- To stop a background service, use `systemctl stop <svc_name>`

```
# systemctl stop NetworkManager.service

# systemctl status NetworkManager.service
● NetworkManager.service - Network Manager
   Loaded: loaded (/lib/systemd/system/NetworkManager.service; enabled; vendor p
   Active: inactive (dead) since Sat 2019-02-09 10:46:09 IST; 4s ago
   ...

# systemctl start NetworkManager.service

# systemctl status NetworkManager.service
● NetworkManager.service - Network Manager
   Loaded: loaded (/lib/systemd/system/NetworkManager.service; enabled; vendor p
   Active: active (running) since Sat 2019-02-09 10:46:36 IST; 1min 18s ago
   ...
```
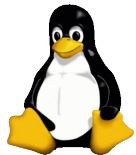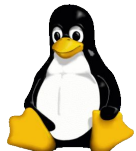
Restart a background service

- To restart a background service, use `systemctl restart <svc_name>`

```
# systemctl restart NetworkManager.service

# systemctl status NetworkManager.service
● NetworkManager.service - Network Manager
   Loaded: loaded (/lib/systemd/system/NetworkManager.service; enabled; vendor p
   Active: active (running) since Sat 2019-02-09 10:49:56 IST; 1min 28s ago
   ...
```

Enable/Disable a background service

- To enable a background service, use `systemctl enable <svc_name>`
- To disable a background service, use `systemctl disable <svc_name>`

```
# systemctl enable NetworkManager.service
Created symlink from
/etc/systemd/system/multi-user.target.wants/NetworkManager.service to
/lib/systemd/system/NetworkManager.service.
Created symlink from
/etc/systemd/system/dbus-org.freedesktop.nm-dispatcher.service to
/lib/systemd/system/NetworkManager-dispatcher.service.

# systemctl disable NetworkManager.service
Removed symlink
/etc/systemd/system/multi-user.target.wants/NetworkManager.service.
Removed symlink
/etc/systemd/system/dbus-org.freedesktop.nm-dispatcher.service.
```
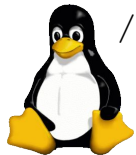
Change default boot from GUI to CLI

- To find current boot mode, use `systemctl get-default`
- To change default boot mode from GUI to CLI, use
  - `systemctl set-default multi-user.target`
- To change default boot mode from CLI to GUI, use
  - `systemctl set-default graphical.target`

```
# systemctl get-default
graphical.target

# systemctl set-default multi-user.target
Created symlink from /etc/systemd/system/default.target to
/lib/systemd/system/multi-user.target

# systemctl get-default
Multi-user.target

# reboot
```

Troubleshooting

Utilization of CPU

- To see utilization of CPU, use `top`

```
$ top
top - 10:55:21 up  7:35,  1 user,  load average: 1.35, 1.28, 1.26
Tasks: 244 total,   1 running, 163 sleeping,   0 stopped,   0 zombie
%Cpu(s):  6.3 us,  1.5 sy,  0.0 ni, 92.1 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem : 12175876 total,  6080796 free,  3820940 used,  2274140 buff/cache
KiB Swap: 15625212 total, 15625212 free,        0 used.  7530808 avail Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
 4524 maruthi+  20   0 2795680 760016 125664 S  15.6  6.2  30:04.53 Web Content
 4013 maruthi+  20   0 2762640 563160 192060 S   8.3  4.6  45:07.60 firefox
 4208 maruthi+  20   0 3063968 888956 140660 S   6.0  7.3  63:50.87 Web Content
```
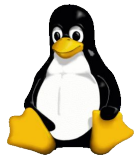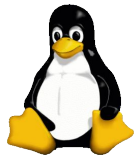
Utilization of memory, swap space

- To see utilization of free/used memory and swap, use free -lm

```
$ free -lmh
                total      used        free      shared   buff/cache     available
Mem:              11G      3.6G        5.8G        376M         2.2G          7.2G
Low:              11G      5.8G        5.8G
High:             0B         0B          0B
Swap:             14G        0B         14G
```

Kernel logs

- To see prints done by core kernel at early boot or by the kernel modules, use `dmesg`
- To clear the logs, use `sudo dmesg -c`

- NOTE: By default the kernel logs are not persisted in Ubuntu in `/var/log/dmesg`

```
$ dmesg
[    0.000000] microcode: microcode updated early to revision 0x8e, date = 2018-03-24
[    0.000000] Linux version 4.15.0-42-generic (buildd@lgw01-amd64-023) (gcc version 5.4.0
20160609 (Ubuntu 5.4.0-6ubuntu1~16.04.10)) #45~16.04.1-Ubuntu SMP Mon Nov 19 13:02:27 UTC 2018
(Ubuntu 4.15.0-42.45~16.04.1-generic 4.15.18)
[    0.000000] Command line: BOOT_IMAGE=/vmlinuz-4.15.0-42-generic
root=UUID=4e6dbcf8-4a6b-4311-b394-05fc013262b3 ro quiet splash vt.handoff=7
...

$ sudo dmesg -c
...
```
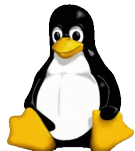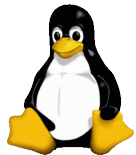
Package installation/uninstallation logs

- To see prints done by installation/uninstallation, see `/var/log/dpkg.log`
- Few older files are also available as `/var/log/dpkg.log.*`

```
$ dmesg
$ ls -l /var/log/dpkg.log*
-rw-r--r-- 1 root root      0 Feb  1 04:16 /var/log/dpkg.log
-rw-r--r-- 1 root root 373174 Jan 31 10:45 /var/log/dpkg.log.1
-rw-r--r-- 1 root root  33701 Dec 31 19:08 /var/log/dpkg.log.2.gz
...
```

Background service logs

- To see prints done by systemd based background services, use
  `journalctl -ae`

```
$ journalctl -ae
-- Logs begin at Sat 2019-02-09 03:19:52 IST, end at Sat 2019-02-09 10:20:55 IST. --
Feb 09 03:20:15 playpen kernel: Bluetooth: BNEP socket layer initialized
Feb 09 03:20:15 playpen bluetoothd[1132]: Bluetooth management interface 1.14 initialized
...
...
...
Feb 09 10:20:55 playpen sudo[10768]: pam_unix(sudo:session): session opened for user root by
(uid=0)
```
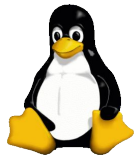
References

References

- Linux manual pages
- www.kernel.org

Q & A