

MPC-2000 Series Linux Software User's Manual

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MPC-2000 Series Linux Software User's Manual

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Introduction

Thank you for purchasing the Moxa MPC-2000 Series x86, ready-to-run embedded computers. This manual introduces the software configuration and management of the MPC-2070/2120-LX and MPC-2101/2121-LX computers (referred to as the “MPC-2000 Series Linux-based computers”), which run the Linux operating system. For hardware installation, connector interfaces, setup, and upgrading the BIOS, please refer to the “Hardware User’s Manual.”

Linux is an open, scalable operating system that allows you to build a wide range of innovative, small footprint devices. Software written for desktop PCs can be easily ported to the embedded computer with a GNU cross compiler and a minimum of source code modifications. A typical Linux-based device is designed for a specific use, and is often not connected to other computers, or a number of such devices connect to a centralized, front-end host. Examples include enterprise tools such as industrial controllers, communications hubs, point-of-sale terminals, and display devices that include HMIs, advertisement appliances, and interactive panels.

The following topics are covered in this chapter:

- **Overview**
- **Software Specifications**
 - Software Components

Overview

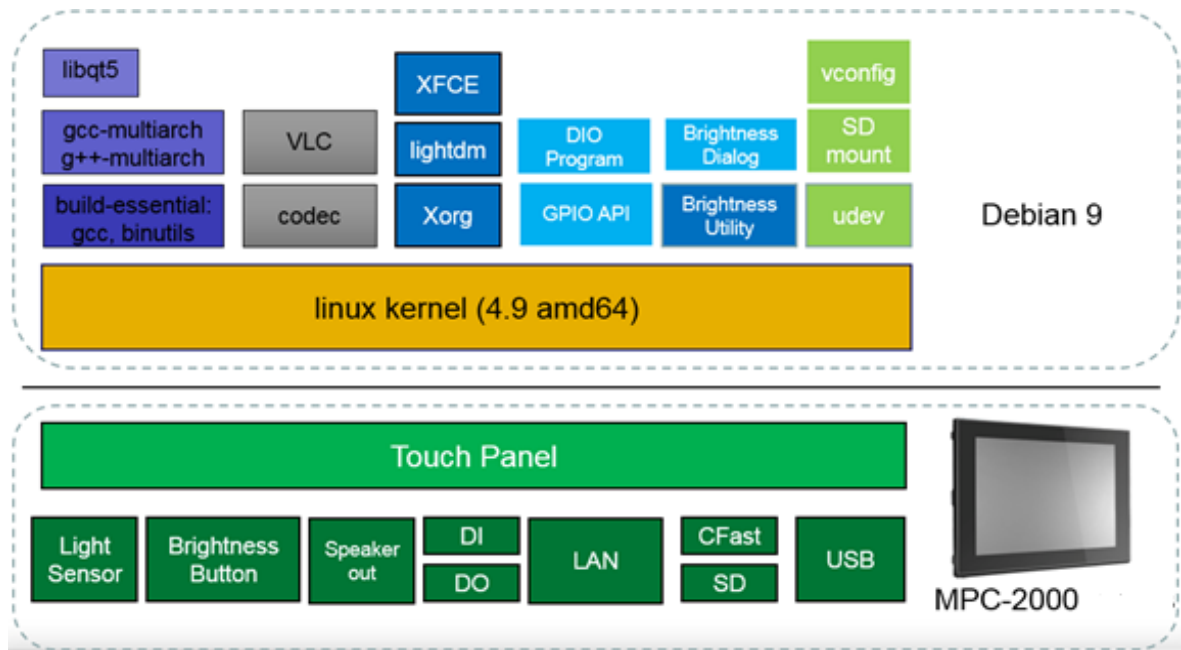
The MPC-2000 Series Linux-based computers are based on the Intel® Atom(TM) CPU and feature RS-232/422/485 serial ports, dual LAN ports, and USB 2.0 hosts. The serial ports make it ideal for connecting a wide range of serial devices to the panel computers, and the dual 10/100 Mbps Ethernet ports offer a reliable solution for network redundancy, which taken together promises continuous data communication and management operations. For added convenience, the panel computers have DI/DO for connecting digital input/output devices. In addition, the SD and USB ports provide the MPC-2000 Series Linux-based computers with data buffering and storage expansion capabilities, which in turn provide the necessary reliability for industrial applications.

Preinstalled with Linux, the MPC-2000 Series Linux-based panel computers provide programmers with a friendly environment for developing sophisticated, bug-free application software at a lower cost.

The MPC-2000 Series Linux-based panel computers support a wide operating temperature range of -40 to 70°C, making them suitable for use in harsh industrial environments.

Software Specifications

The Linux operating system, preinstalled on the MPC-2000 Series Linux-based panel computers, is the Debian Stretch distribution. The Debian project involves a worldwide group of volunteers who endeavor to produce an operating system distribution composed entirely of free software. The Debian GNU/Linux follows the standard Linux architecture, making it easy to use programs that meet the POSIX standard. Program porting can be done with the GNU Tool Chain provided by Moxa. In addition to Standard POSIX APIs, device drivers for the Moxa UART and other special peripherals are also included. An example software architecture is shown below.



The above software architecture is only an example. Different models or different build revisions of the Linux operating system may include components not shown in the above illustration. For information and documentation related to Debian GNU/Linux and the free software concept, refer to <http://www.debian.org/> and <http://www.gnu.org/>

Software Components

The MPC-2000 Series Linux-based panel computers come preinstalled with the Debian Stretch Linux distribution.

System Configuration

In this chapter, we explain how to operate a MPC-2000 Series Linux-based panel computer using your desktop. There are three ways to connect to the panel computer: through a Touch Panel monitor, from a Windows or Linux machine via SSH over the network console. This chapter describes basic Linux operating system configurations. Advanced network management and configuration instructions will be described in the *Chapter 3, Managing Communications*.

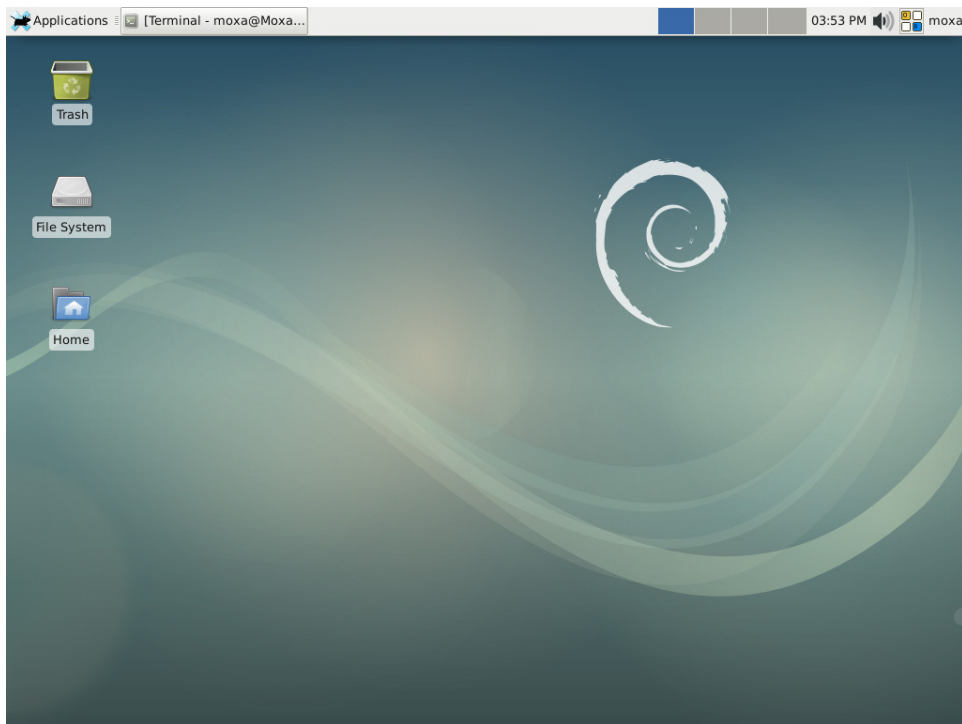
The following topics are covered in this chapter:


- ❑ **Getting Started**
- ❑ **Connecting From an SSH Console**
 - Windows Users
 - Linux Users
- ❑ **Adjusting the System Time**
 - Setting the Time Manually
 - systemd-timesyncd Service
 - NTP Client
 - Manage the Service by systemd script
 - Setting the Time Zone
- ❑ **Cron—Daemon for Executing Scheduled Commands**
- ❑ **The Partition in the System**
- ❑ **Adding Swap Space in the System**
- ❑ **Resizing and Adding a Partition**
- ❑ **Inserting a USB Storage into the Computer**
- ❑ **Inserting a SD Storage into the Computer**
- ❑ **Checking the Linux Version**
- ❑ **Checking Moxa's Control Version**
- ❑ **APT—Installing and Removing Packages**
- ❑ **Audio Player**
- ❑ **Video Player**
- ❑ **Web Browser**
- ❑ **Brightness control**
 - Introduction
 - Auto-brightness control mode
 - Manual brightness control mode

Getting Started

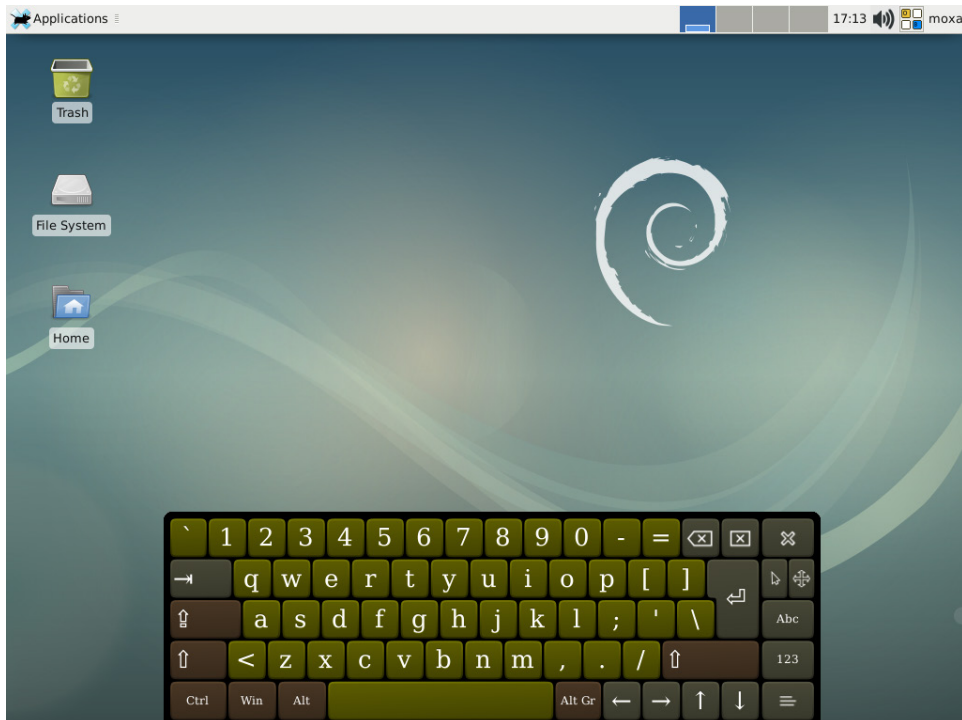
1. Power up the panel computer by connecting it to the power adaptor.

It takes approximately 30 seconds for the system to boot up. Once the system is ready, a XFCE desktop screen will appear on your touch panel.



2. Click the virtual keyboard icon  on the upper corner.

The virtual keyboard will be displayed on the desktop.






ATTENTION

The `lightdm` function is configured in automatic login mode. You can comment out the `autologin-user=moxa` and `autologin-user-timeout=0` in the `/etc/lightdm/lightdm.conf` file to support user authentication before using the device.

```
moxa@Moxa:~# sudo vi /etc/lightdm/lightdm.conf
...
# autologin-user=moxa
# Autologin-user-timeout=0
....
```

3. Right-click to open the desktop menu.

If you are not using a mouse device, the virtual keyboard supports the right-click function as follows:

- a. Press the virtual keyboard icon .
- b. Press the Menu key on the virtual keyboard.

The pop-up menu will be displayed on the desktop.



The XFCE4 and Xorg version:

```
moxa@Moxa:~# sudo xfce4-panel -v
xfce4-panel 4.12.1 (Xfce 4.12)
Copyright (c) 2004-2011
    The Xfce development team. All rights reserved.
Please report bugs to <http://bugzilla.xfce.org/>.
moxa@Moxa:~# sudo Xorg -version
X.Org X Server 1.19.2
Release Date: 2017-03-02
X Protocol Version 11, Revision 0
Build Operating System: Linux 4.9.0-8-amd64 x86_64 Debian
...
xorg-server 2:1.19.2-1+deb9u4 (https://www.debian.org/support)
...
```

Connecting From an SSH Console

The embedded computers support the SSH console to offer users better network security compared to Telnet. The default IP addresses and netmasks of the network interfaces are as follows:

	Default IP Address	Netmask
LAN 1	192.168.3.127	255.255.255.0
LAN 2	192.168.4.127	255.255.255.0

Before using the SSH client, you should change the IP address of your development workstation so that the network ports are on the same subnet as the IP address for the LAN port that you will connect to. For example, if you will connect to LAN1, you could set your PC's IP address to 192.168.3.126, and the netmask to 255.255.255.0. If you will connect to LAN2, you could set your PC's IP address to 192.168.4.126, and the netmask to 255.255.255.0.

Use a cross-over Ethernet cable to connect your development workstation directly to the target computer, or use a straight-through Ethernet cable to connect the computer to a LAN hub or switch. Next, use a SSH client on your development workstation to connect to the target computer. After a connection has been established, type the login name and password as requested to log on to the computer. The default values are both moxa.

Login: moxa

Password: moxa



ATTENTION

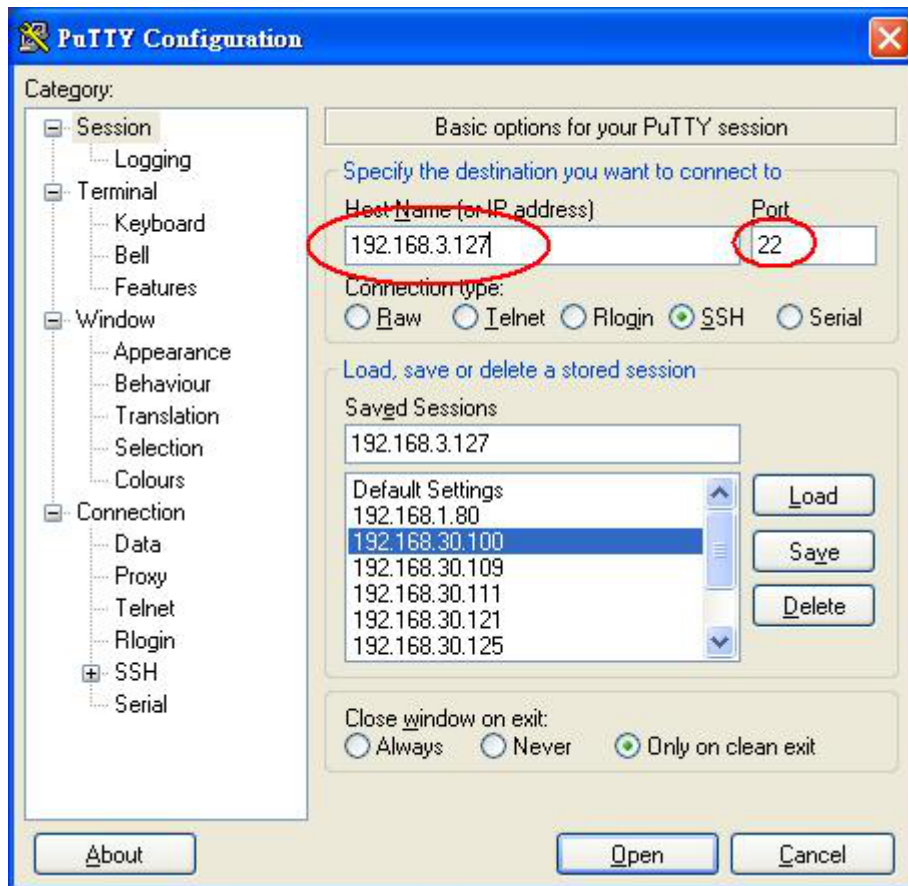
For security concern, the system is set up to log out if the SSH remote console or serial console is inactive for 5 minutes. If you don't need this setting in the development phase, you can comment the configuration.

The sshd automatic logout is configured in **/etc/ssh/sshd_config**

```
...
# Remote session termination
ClientAliveInterval 300
ClientAliveCountMax 0
....
```

Windows Users

Click on the link <http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html> to download PuTTY (free software) to set up an SSH console for the embedded computer in a Windows environment. The following screen shows an example of the configuration that is required.



Linux Users

From a Linux machine, use the `ssh` command to access the embedded computer's console utility via SSH.

```
#ssh moxa@192.168.3.127
```

Select **yes** to open the connection.

```
[root@Jim_notebook root]# ssh moxa@192.168.3.127
The authenticity of host '192.168.3.127 (192.168.3.127)' can't be established.
RSA key fingerprint is 8b:ee:ff:84:41:25:fc:cd:2a:f2:92:8f:cb:1f:6b:2f.
Are you sure you want to continue connection (yes/no)? yes_
```

In addition, use `sudo -i` to login as root to have more privileges.

```
moxa@Moxa:~# sudo -i
[sudo] password for moxa:
root@Moxa:~$
```

**ATTENTION**

To enable sudo on your computer, you must first add a user to the sudo group. To add a user to the sudo group, use the useradd command, as below:

```
useradd [USER-ACCOUNT-NAME-HERE] sudo
```

Using the sudoers file, sudo may be carefully tailored on a user-by-user basis to allow a specific hierarchy of privileges that can be tailored to individual computers within the network. For more information on configuration, usage, and best practices with the sudo command, you may refer to the following websites: Linux.com; introduction to sudo:

<http://www.linux.com/learn/tutorials/306766:linux-101-introduction-to-sudo>

Debian introduction to the sudo command:

<https://wiki.debian.org/sudo>

Ubuntu (a Debian sub-distribution) documentation for the sudoers file:

<https://help.ubuntu.com/community/Sudoers>

A sample sudoers file for an extended network:

<http://www.sudo.ws/sudo/sample.sudoers>.

Adjusting the System Time

The MPC-2070/2120-LX or MPC-2101/2121-LX has two time settings. One is the system time, and the other is provided by an RTC (Real Time Clock) built into the MPC-2000 hardware.

Setting the Time Manually

Use the **date** command to query the current system time or to set a new system time. Use **hwclock** to query the current RTC time or to set a new RTC time.

Use the following command to set the system time.

```
# date MMDDhhmmYYYY
MM: Month
DD: Date
hhmm: Hour and Minute
YYYY: Year
```

Use the following command to write the current system time to the RTC.

```
# hwclock -w
```

```
root@Moxa:~# date
Tue Jul 17 10:59:33 CST 2018
root@Moxa:~# hwclock
2018-07-17 11:01:06.233615+0800
root@Moxa:~# date 071711102018
Tue Jul 17 11:10:00 CST 2018
root@Moxa:~# hwclock -w
root@Moxa:~# date ; hwclock
Tue Jul 17 11:10:12 CST 2018
2018-07-17 11:10:12.233615+0800
root@Moxa:~#
```

systemd-timesyncd Service

The systemd-timesyncd daemon has been added for synchronizing the system clock across the network. This service default is disabled. You can start this service manually by this command.

```
root@Moxa:~# systemctl start systemd-timesyncd
```

You can enable this service and reboot. It would be start after boot.

```
root@Moxa:~# systemctl enable systemd-timesyncd
root@Moxa:~# reboot
```

After reboot, the systemd-timesyncd service should run in background.

```
root@Moxa:~# systemctl status systemd-timesyncd
● systemd-timesyncd.service - Network Time Synchronization
Loaded: loaded (/lib/systemd/system/systemd-timesyncd.service; enabled; vendor
preset: enabled)
Drop-In: /lib/systemd/system/systemd-timesyncd.service.d
└─disable-with-time-daemon.conf
Active: active (running) since Mon 2018-03-12 05:12:47 EDT; 31min ago
Docs: man:systemd-timesyncd.service(8)
Main PID: 297 (systemd-timesyn)
Status: "Idle."
Tasks: 2 (limit: 4915)
CGroup: /system.slice/systemd-timesyncd.service
└─297 /lib/systemd/systemd-timesyncd

Mar 12 05:12:47 Moxa systemd[1]: Starting Network Time Synchronization...
Mar 12 05:12:47 Moxa systemd[1]: Started Network Time Synchronization.
```

When the systemd-timesyncd starting, it reads the configurations from /etc/systemd/timesyncd.conf. Choosing from the [NTP server pool](#) to configure.

```
[Time]
NTP=jp.pool.ntp.org
FallbackNTP=0.debian.pool.ntp.org 1.debian.pool.ntp.org 2.debian.pool.ntp.org
3.debian.pool.ntp.org
```

Restart the systemd-timesyncd service.

```
root@Moxa:~# systemctl restart systemd-timesyncd
```

If NTP is not enabled, you can enable it by this command.

```
root@Moxa:~# timedatectl set-ntp true
```

Once that's done, the time should be kept correctly.

```
root@Moxa:~# timedatectl status
    Local time: Wed 2018-07-04 14:55:00 CST
    Universal time: Wed 2018-07-04 06:55:00 UTC
    RTC time: Wed 2018-07-04 06:55:00
    Time zone: Asia/Taipei (CST, +0800)
Network time on: yes
NTP synchronized: yes
RTC in local TZ: no
```

NTP Client

You can use NTP (Network Time Protocol) client that is used to initialize a time request to a remote NTP server. Use `ntpdate` to update the system time.

```
# ntpdate time.stdtime.gov.tw
# hwclock -w
```

Visit <http://www.ntp.org> for more information about NTP and NTP server addresses.

```
root@Moxa:~# date ; hwclock
root@Moxa Mar 12 05:58:42 EDT 2018
root@Moxa:~# hwclock
2018-03-12 05:59:23.436777-0400
root@Moxa:~# date 031217592018.30
Mon Mar 12 17:59:30 EDT 2018
root@Moxa:~# hwclock -w
root@Moxa:~# date ; hwclock
Mon Mar 12 18:00:42 EDT 2018
2018-03-12 18:00:42.468011-0400
root@Moxa:~#
```



ATTENTION

Before using the NTP client utility, check your IP address and network settings (gateway and DNS) to make sure an Internet connection is available.

The Debian Linux system has a built-in `systemd-timesyncd` that is used for Network Time Synchronization. This service default is disabled.

```
root@Moxa:~# systemctl status systemd-timesyncd
● systemd-timesyncd.service - Network Time Synchronization
Loaded: loaded (/lib/systemd/system/systemd-timesyncd.service; disabled; vendor
preset: enabled)
Drop-In: /lib/systemd/system/systemd-timesyncd.service.d
└─disable-with-time-daemon.conf
Active: inactive (dead)
Docs: man:systemd-timesyncd.service(8)
```

Enable the `systemd-timesyncd` service by the `systemctl enable` command and reboot.

```
root@Moxa:~# systemctl enable systemd-timesyncd
root@Moxa:~# reboot
```



ATTENTION

Before using the time sync utility, check your IP address and network settings (gateway and DNS) to make sure an Internet connection is available.

Manage the Service by systemd script

Linux services can be started or stopped using system script. If you want to start up some service, you can use `systemctl` to enable or disable the service.

You can follow this example to add or remove your service in the system. First, you should write a system service unit. This example creates a systemd service unit at `/etc/systemd/system/networking-check.service`.

```
[Unit]
After=snmpd.service

[Service]
ExecStart=/usr/local/bin/networking-check.sh

[Install]
WantedBy=default.target
```

`After`: Instructs systemd on when the script should be run. In our case the script will run after `snmpd.service` has started.

`ExecStart`: This field provides a full path the actual script to be execute

`WantedBy`: Into what boot target the systemd unit should be installed

This is minimum example of a system script. More information please check `systemd.service`. Next create `/usr/local/bin/networking-check.sh` script to check the network status. This example will ping a global DNS server to check if network is available and write the results in `/var/log/networking-check.log`.

```
moxa@moxa:~# sudo vi /usr/local/bin/networking-check.sh
#!/bin/sh

while [ 1 ]; do
date >> /var/log/networking-check.log
ping -q -w 1 8.8.8.8
if [ $? -eq 0 ]; then
echo "Network is available" >> /var/log/networking-check.log
else
echo "Network is not available" >> /var/log/networking-check.log
fi
sleep 1
done
```

Before we launch this service, we need to make this script executable:

```
root@moxa:~# chmod a+x /usr/local/bin/networking-check.sh
```

Then we can start the `networking-check` service by this command.

```
root@moxa:~# systemctl start networking-check
```

The `networking-check.sh` should run in background.

```
root@moxa:~# ps aux|grep networking-check
root 2260 0.0 0.0 4288 1500 ? Ss 14:49 0:00 /bin/sh /usr/local/bin/networking-check.sh
root 2276 0.0 0.0 12784 980 pts/0 S+ 14:49 0:00 grep networking-check
```

The `/var/log/networking-check.log` should be created.

```
root@moxa:~# cat /var/log/networking-check.log
Wed Mar 14 14:49:09 EDT 2018
Network is available
...
```

Remember use this command to stop this service to prevent the log of this example occupied too much disk space.

```
root@Moxa:~# systemctl stop networking-check
```

Finally, you can enable this service at boot time by this command and reboot the system.

```
root@Moxa:~# systemctl enable networking-check
root@Moxa:~# reboot
```

To disable this service by the systemctl disable command.

```
root@Moxa:~# systemctl disable networking-check
```

Setting the Time Zone

You can choose one of these methods to change the time zone.

- Environment variable - TZ
- dpkg-reconfigure tzdata
- timedatectl
- xfce4-panel clock widget

Using the Environment variable - TZ

You can export the TZ environment variable to change the time zone.

```
root@Moxa:~# export TZ=America/Los_Angeles
root@Moxa:~# date
Tue Jan 29 01:37:22 PST 2019
```

Unset the TZ before using another method to configure the time zone.

```
root@Moxa:~# unset TZ
root@Moxa:~# date
Tue Jan 29 17:39:54 CST 2019
```


Using the dpkg-reconfigure tzdata.

This is the example on how to use dpkg-reconfigure to change the time zone.

```
root@Moxa:~# dpkg-reconfigure tzdata
```

```
Package configuration

|-----| Configuring tzdata |-----|
Please select the geographic area in which you live. Subsequent
configuration questions will narrow this down by presenting a list of
cities, representing the time zones in which they are located.

Geographic area:

Africa
America
Antarctica
Australia
Arctic Ocean
Asia
Atlantic Ocean
Europe
Indian Ocean
Pacific Ocean
System V timezones
US
None of the above

<Ok>                               <Cancel>
```

```
Package configuration

|-----| Configuring tzdata |-----|
Please select the city or region corresponding to your time zone.

Time zone:

Alaska
Aleutian
Arizona
Central
Eastern
Hawaii
Starke County (Indiana)
Michigan
Mountain
Pacific Ocean
Pacific-New
Samoa

<Ok>                               <Cancel>
```

```
Current default time zone: 'US/Central'
Local time is now:      Tue Jan 29 03:44:29 CST 2019.
Universal Time is now: Tue Jan 29 09:44:29 UTC 2019.
```

Using timedatectl

Display the time zone list using the `timedatectl` command.

```
moxa@moxa:~# timedatectl list-timezones
Africa/Abidjan
Africa/Accra
...
UTC
```

Set timezone by timedatectl

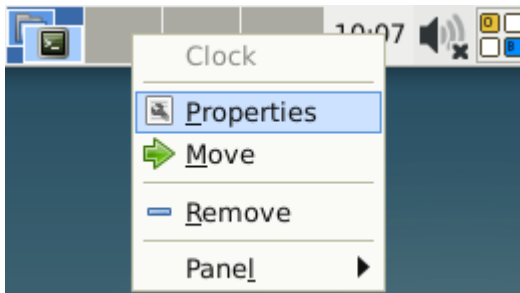
```
moxa@moxa:~# sudo timedatectl set-timezone Asia/Tokyo
```

Show the settings

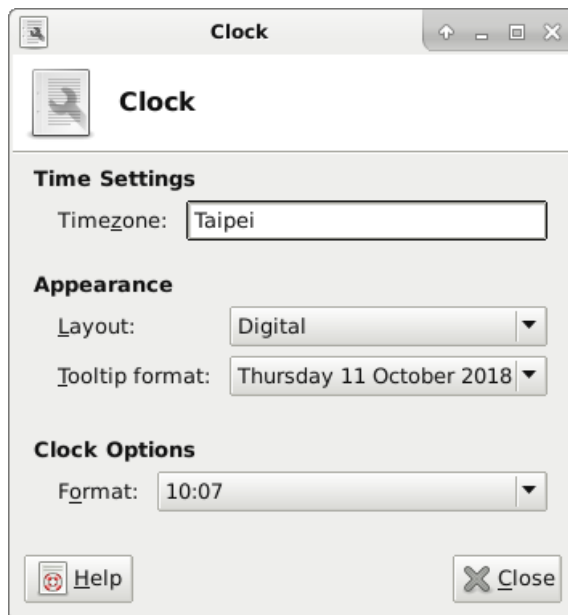
```
moxa@moxa:~# timedatectl
Local time: Tue 2019-01-22 16:05:47 JST
Universal time: Tue 2019-01-22 07:05:47 UTC
RTC time: Tue 2019-01-22 07:05:46
Time zone: Asia/Tokyo (JST, +0900)
Network time on: no
NTP synchronized: no
RTC in local TZ: no
```

Using the xfce4-panel Clock Widget

To set the time zone in the XFCE window, right-click on the Clock on the icon tray at the top right of your computer screen.



This should show the Time Settings, Appearance, and Clock Options. Enter the time zone in the text box and click the Close button to change the time zone in the system.



Cron—Daemon for Executing Scheduled Commands

The Cron daemon will search `/etc/crontab` for crontab files.

Cron wakes up every minute and checks each command to see if it should be run at that time. When executing commands, output is mailed to the owner of the crontab (or to the user named in the MAILTO environment variable in the crontab, if such a user exists).

Modify the file `/etc/crontab` to set up your scheduled applications. Crontab files have the following format:

Mm	H	dom	mon	Dow	user	command
Minute	Hour	date	month	Week	user	command
0-59	0-23	1-31	1-12	0-6 (0 is Sunday)		

For example, issue the following command if you want to launch a program at 8:00 every day:

```
#minute hour date month dow user command
* 8 * * * root /path/to/your/program
```

The following example demonstrates how to use Cron to update the system time and RTC time every day at 8:00.

1. Write a shell script named `fixtime.sh` and save it to `/home/`.


```
#!/bin/sh
ntpdate time.stdtime.gov.tw
hwclock -w
exit 0
```
2. Change the mode of `fixtime.sh`

```
# chmod 755 fixtime.sh
```
3. Modify the `/etc/crontab` file to run `fixtime.sh` at 8:00 every day.
 Add the following line to the end of crontab:

```
* 8 * * * root /home/fixtime.sh
```

The Partition in the System

The storage size installed in the Linux operating system is at least 8 GB. The kernel, grub, /, /etc, /home, and /var are installed in one partition.

The / is mounted by label configured in /etc/fstab.

```
moxa@moxa:~# sudo vi /etc/fstab
...
LABEL=root / ext4 noatime,errors=remount-ro 0 1
#usbfs /proc/bus/usb usbfs defaults 0 0
```

The label naming is checked using the blkid command.

```
moxa@moxa:~# sudo blkid
...
/dev/sda1: LABEL="root" UUID="3a5039b5-4002-4865-9a53-e0eb2326bd84" TYPE="ext4"
PARTUUID="20f4f528-01"
...
```

Adding Swap Space in the System

The memory is large and cheap in the embedded computer system. We don't plan the swap space in the operating system. If your applications need more memory, in addition to add more RAM, setting swap space solve the problem of insufficient memory. You can follow these steps to adding the swap file to support swap in the system.

Create a swap file. This example creates a 4G size swap file located at /var/swapfile.

```
moxa@moxa:~# sudo dd if=/dev/zero of=/var/swapfile bs=512 count=2097156
```

Set up a Linux swap space.

```
moxa@moxa:~# sudo mkswap /var/swapfile
```

Update /etc/fstab to use the swap file in booting.

```
moxa@moxa:~# sudo vi /etc/fstab
/var/swapfile none swap sw 0 0
```

Then reboot the system for the swap space to be active. The swapon -s command shows a summary of the swap space.

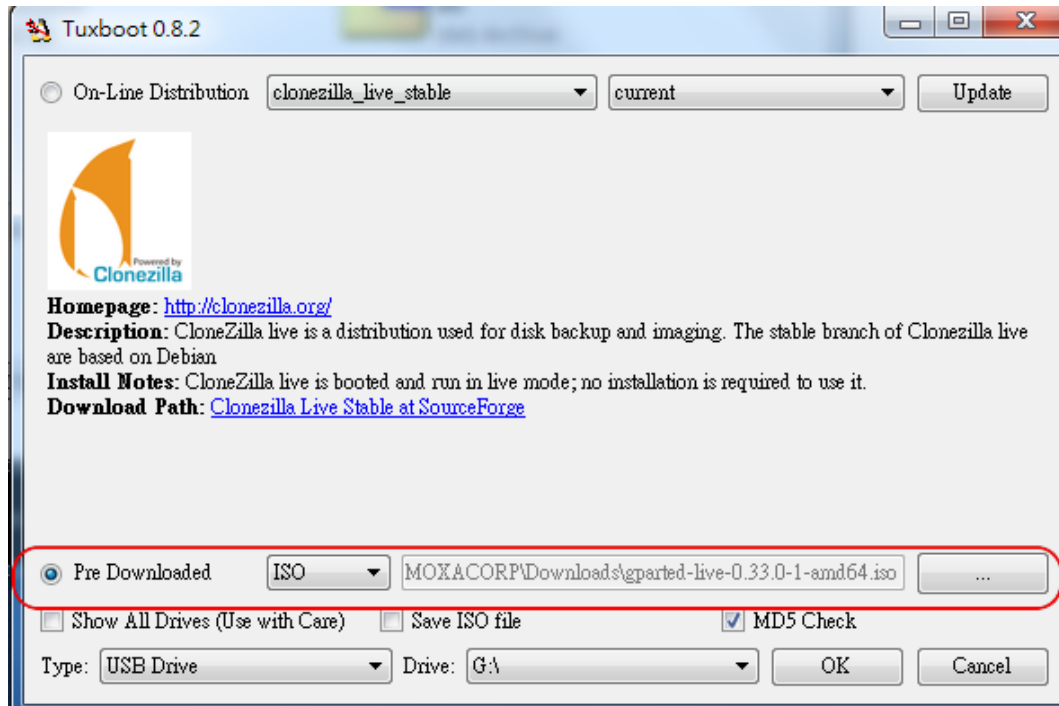
```
Moxa@moxa:~# sudo reboot
<...Wait the system reboot...>
moxa@moxa:~# sudo swapon -s
Filename                Type      Size      Used      Priority
/var/swapfile           file      1048572   0         -1
```

The free shows the free shows the memory and swap usage information.

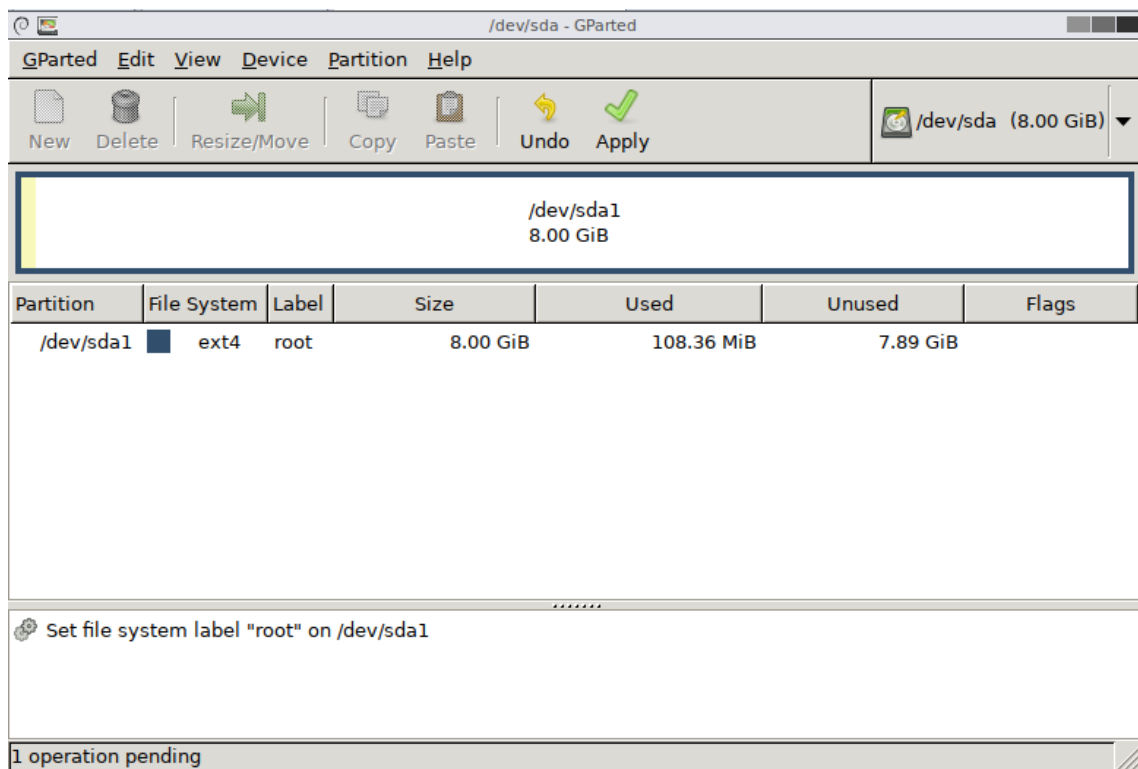
```
moxa@moxa:~# free
              total            used            free      shared  buff/cache   available
Mem:          12191600        1600412        9787112        219100        804076        10112868
Swap:         1048572              0        1048572
```

Resizing and Adding a Partition

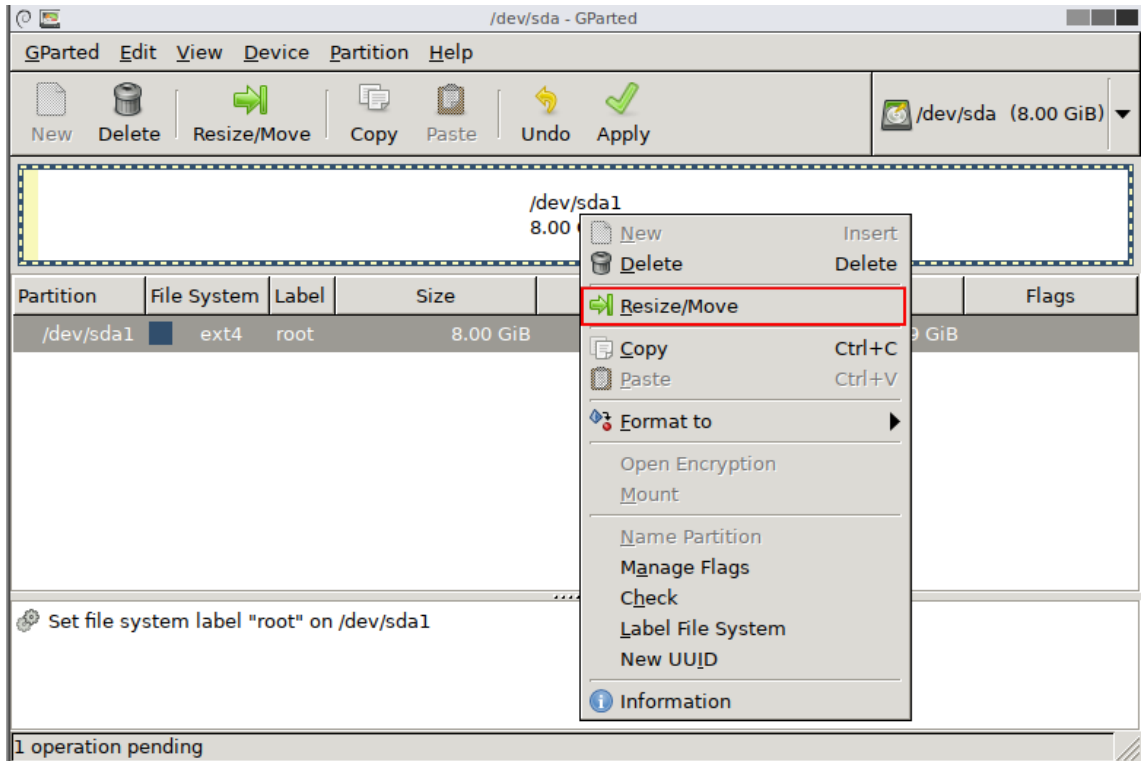
1. Download the GParted Live ISO from the GParted's website.
Then format a FAT16/FAT32 filesystem USB flash driver at least with 300MB size.
2. Use Tuxboot to create the GParted USB driver.
The latest Tuxboot can be downloaded from the Tuxboot's website.



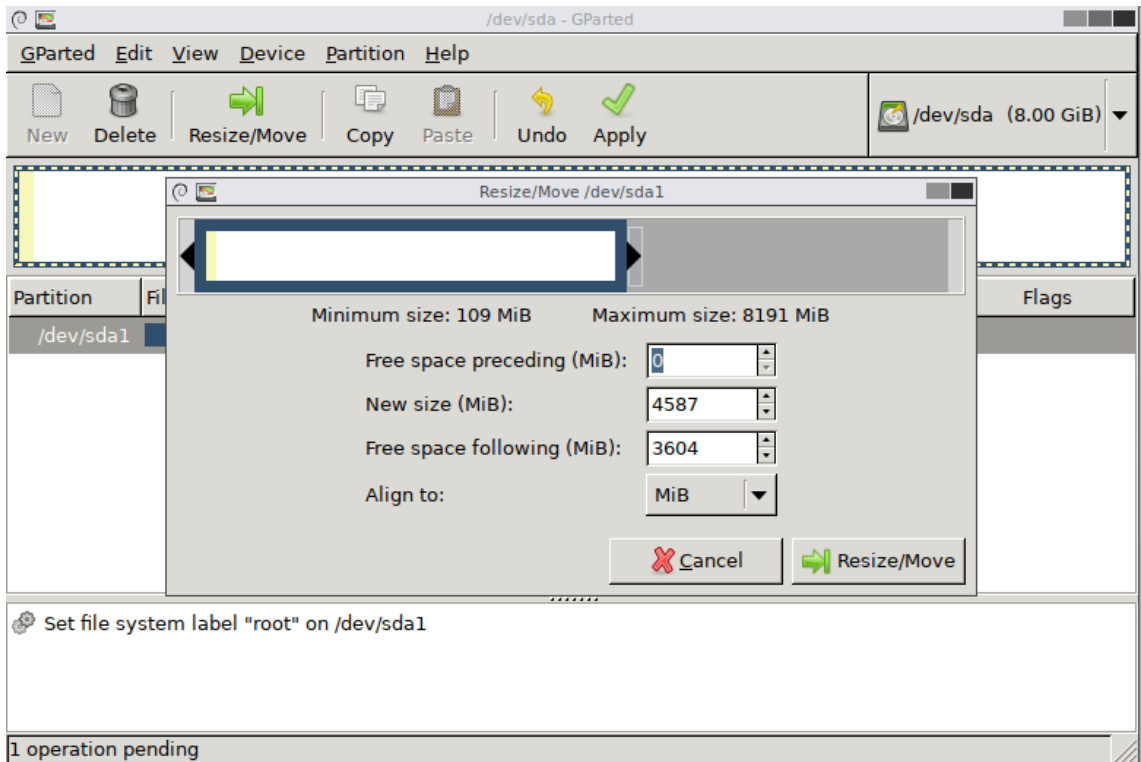
3. Unmount, remove and insert the GParted USB driver to boot in Moxa embedded computer. After boot into GParted USB driver, it shows the disk partition information in a graphic dialog.
This example resizes and creates a new partition labeled as data and mount the new partition at `/media/data`.



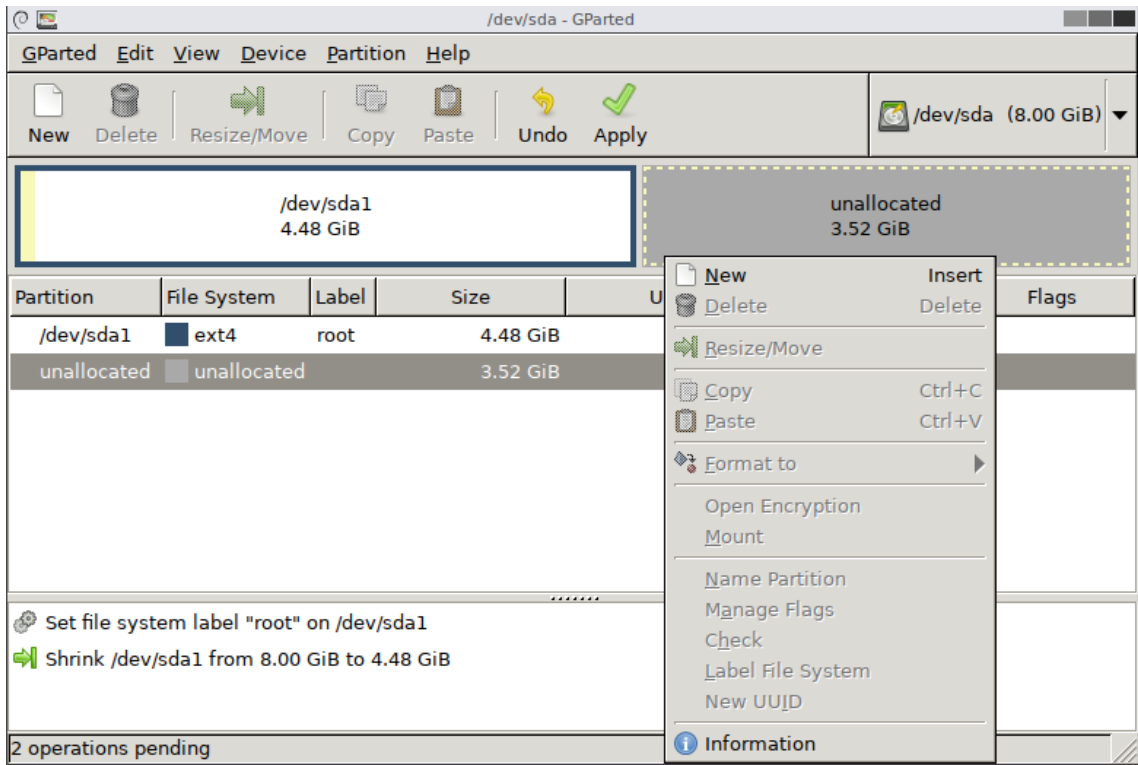
- 4. Right click on partition #1, /dev/sda1 to Resize or Move it.



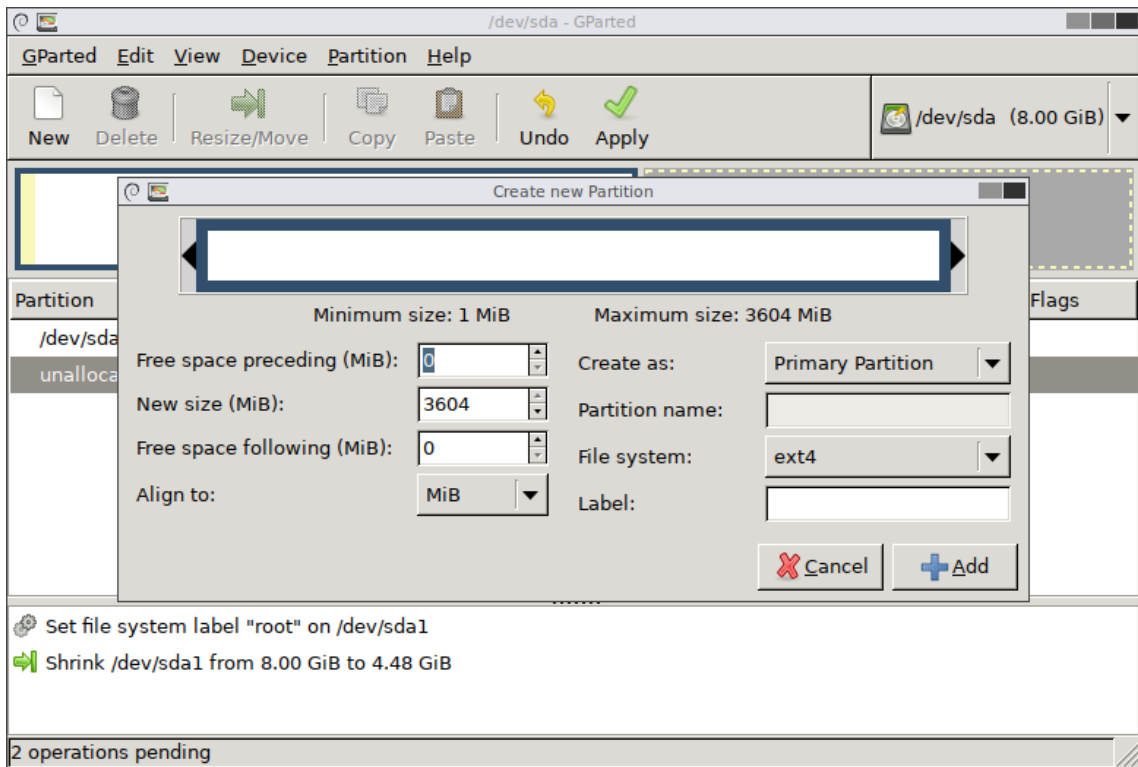
- 5. Use the slider bar to resize partition #1.



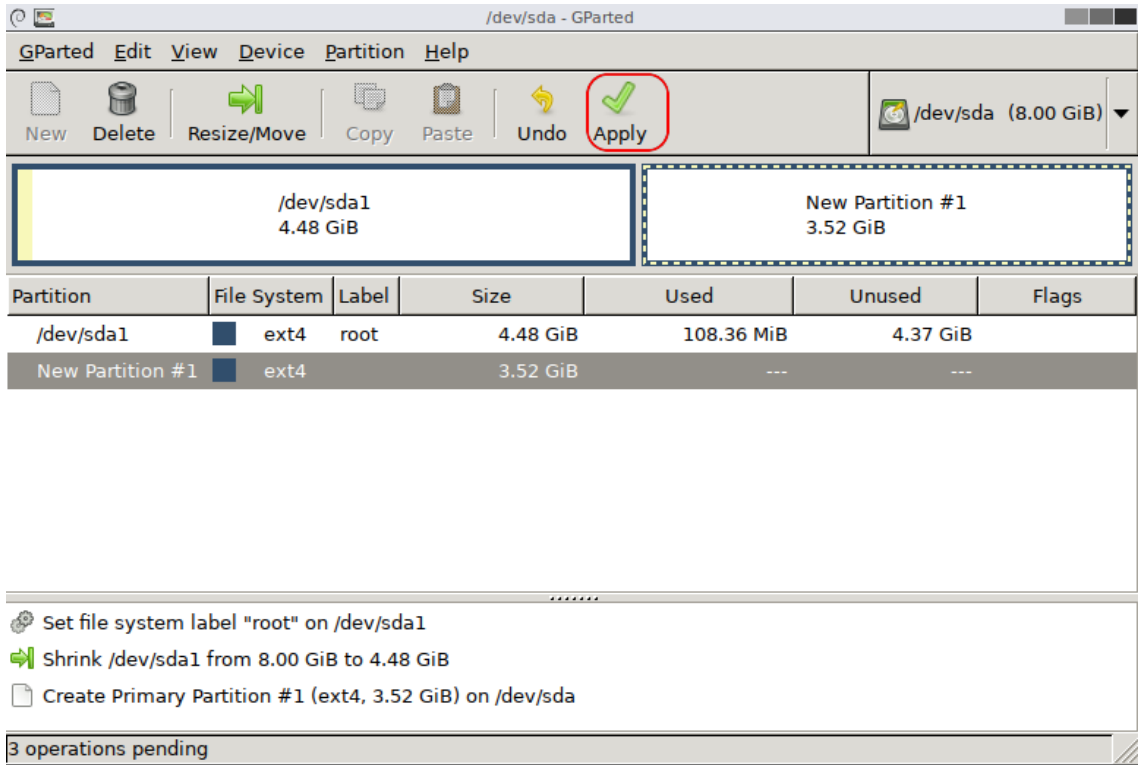
6. Right-click on the unallocated space to New a partition.



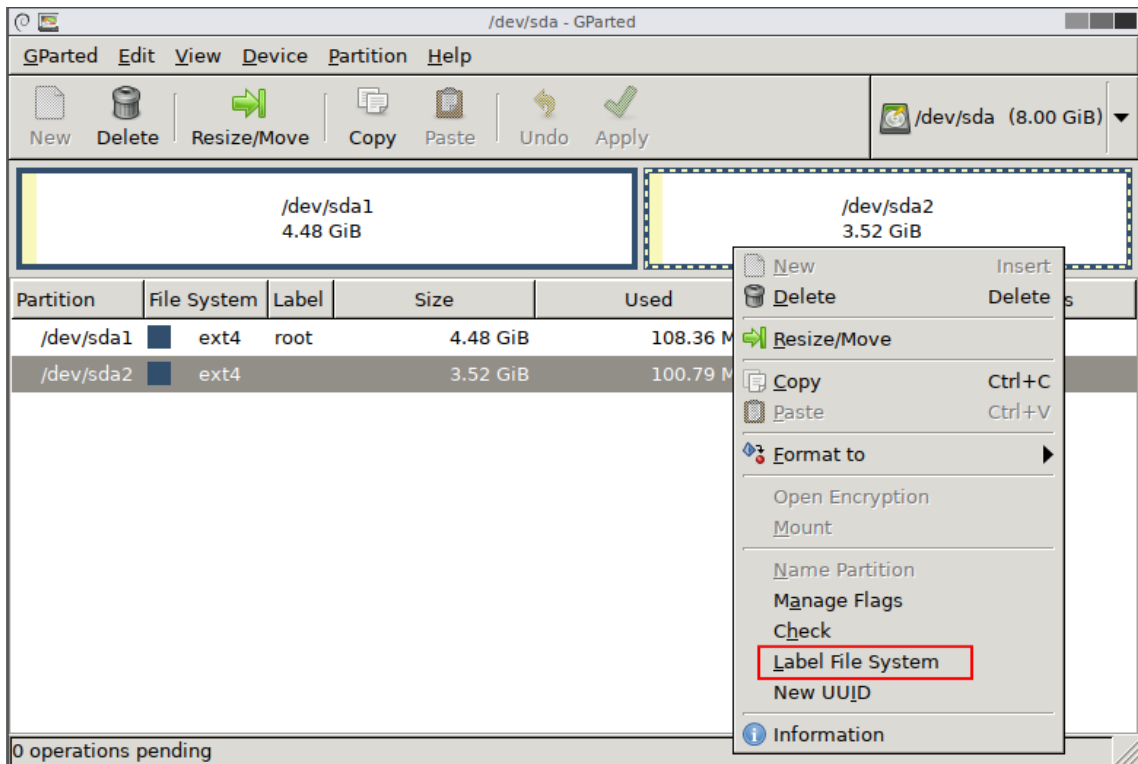
7. Add this partition.



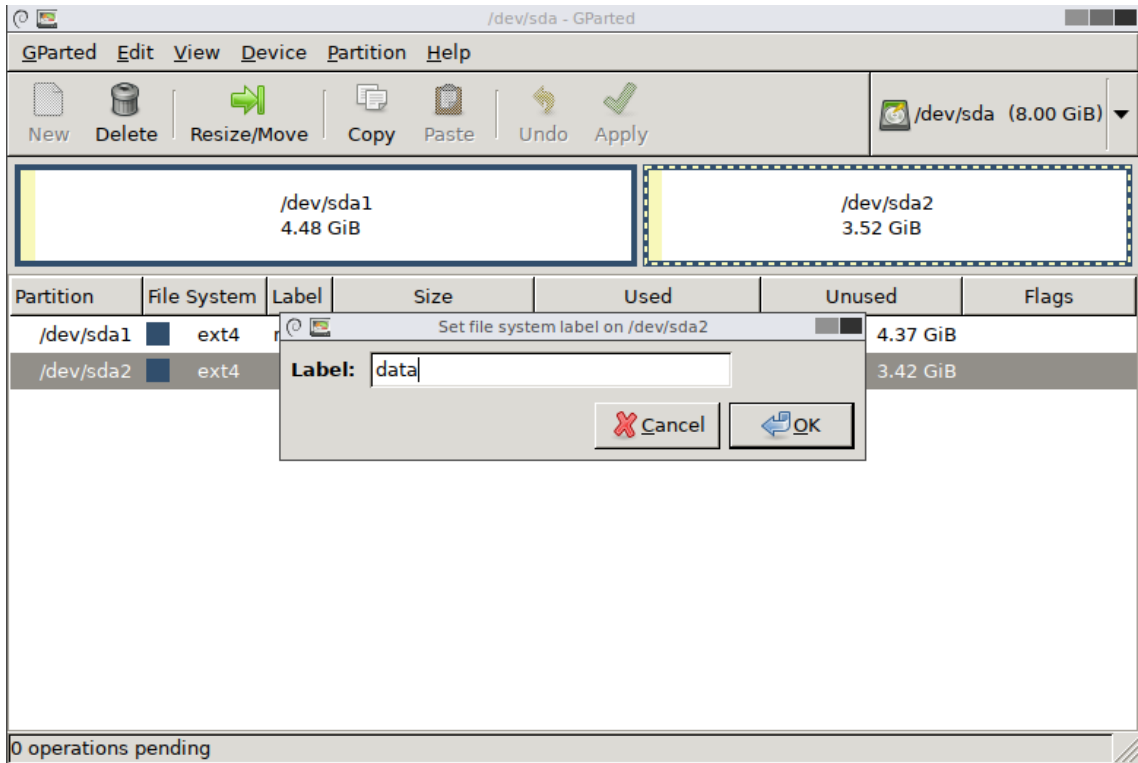
8. Apply the New Partition Creation.



9. Set the label of the partition by right-click on Label File System menu item.

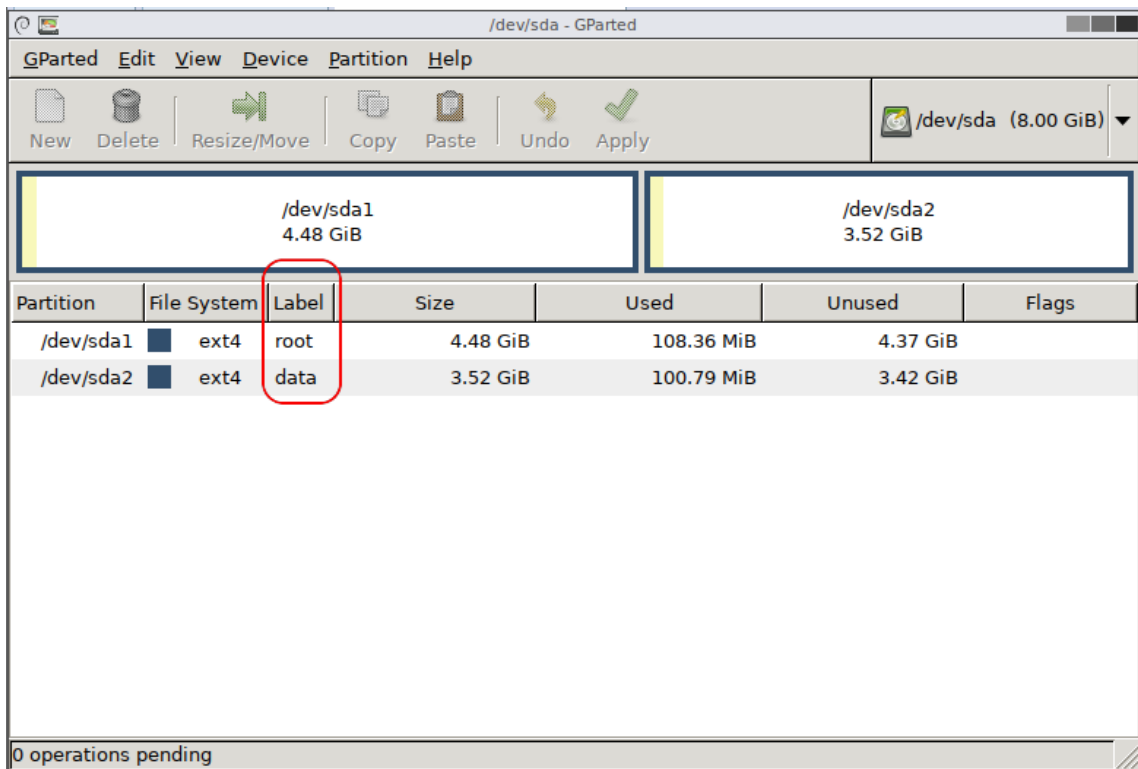


10. The label we set is data.



The OS partition, /dev/sda1, we named it as root. The second partition, /dev/sda2, we called it as data.

NOTE Don't change the /dev/sda1 label name because we mount the root-filesystem by label for mass-production using.



11. Close the GParted dialog.

12. Double-click the Terminal, we need to edit /etc/fstab in the CFast storage, /dev/sda1.

a. Change to root as follows:

```
# sudo -i
```

Then mount /dev/sda1 at a path

```
# mount /dev/sda1 /mnt
```

b. Create /mnt/media/data as the mount point for partition #2, data.

```
# mkdir -p /mnt/media/data
```

c. Edit /mnt/etc/fstab to mount the partition, data, at boot time.

```
# vi /mnt/etc/fstab
```

...

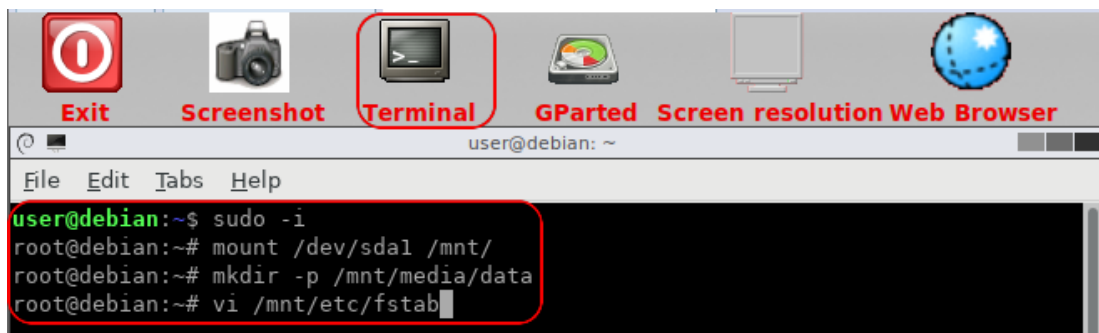
```
LABEL=data      /media/data    ext4    errors=remount-ro 0      1
```

...

d. Reboot the system to boot from CFast card to check these setting.

```
# umount /mnt
```

```
# reboot
```



Inserting a USB Storage into the Computer

This system doesn't support auto mounting USB storage devices automatically. In a Linux system, you should mount the USB devices manually. Before mounting the USB storage, you should check the name of the USB storage using the dmesg command.

```
root@Moxa:~# dmesg
...
[ 564.751226] sd 6:0:0:0: Attached scsi generic sg1 type 0
[ 564.752400] sd 6:0:0:0: [sdb] 3973118 512-byte logical blocks: (2.03 GB/1.89 GiB)
[ 564.753008] sd 6:0:0:0: [sdb] Write Protect is off
[ 564.753013] sd 6:0:0:0: [sdb] Mode Sense: 03 00 00 00
[ 564.753674] sd 6:0:0:0: [sdb] No Caching mode page found
[ 564.753797] sd 6:0:0:0: [sdb] Assuming drive cache: write through
[ 564.759333] sdb: sdb1
[ 564.762273] sd 6:0:0:0: [sdb] Attached SCSI removable disk
```

Or check /proc/partitions

```
root@Moxa:~# cat /proc/partitions
major minor #blocks name
8 0 7824600 sda
8 1 7823576 sda1
8 16 1986559 sdb
8 17 1985535 sdb1
```

Mount the USB storage partition 1, /dev/sdb1, on /mnt.

```
root:~# mount -t vfat /dev/sdb1 /mnt
```

Mount the USB storage partition 1, /dev/sdb1, on /mnt.

```
root:~# mount
...
/dev/sdb1 on /mnt type vfat
(rw,relatime,umask=0022,dmasks=0022,codepage=437,iocharset=ascii,shortname=mixed,utf8,errors=remount-ro)
```

If you want to automatic mount the USB storage at boot time, you can add it in /etc/fstab

```
...
LABEL=root / ext4 noatime,errors=remount-ro 0 1
#usbfs /proc/bus/usb usbfs defaults 0 0
/dev/sdb1 /mnt vfat defaults,nofail 0 0
```



ATTENTION

Remember to type the command `# sync` before you disconnect the USB storage device. If you do not issue the command, you may lose data.

External devices that are to be mounted when present but ignored if absent may require the `nofail` option. This prevents errors being reported at boot.

Inserting a SD Storage into the Computer

The SD slot supports the SD, SDHC, and SDXC formats, and is used as the extend storage in the system. The SD auto-mounting is disabled in the system but we prepared an udev rule to support the auto-mounting feature. You can remove the comment, `#`, which is the first character in `/etc/udev/rules.d/11-media-y-label-auto-mount.rules` to support the SD auto-mounting feature.

```
#KERNEL!="mmcblk[0-9]p[0-9]", GOTO="media_by_label_auto_mount_end"
## Import FS infos
#IMPORT{program}="/sbin/blkid -o udev -p %N"
## Get a label if present, otherwise specify one
#ENV{ID_FS_LABEL}!="", ENV{dir_name}="%E{ID_FS_LABEL}"
#ENV{ID_FS_LABEL}=="", ENV{dir_name}="sd-%k"
## Global mount options
#ACTION=="add", ENV{mount_options}="relatime"
# Filesystem-specific mount options
#ACTION=="add", ENV{ID_FS_TYPE}=="vfat|ntfs",
ENV{mount_options}="$env{mount_options},utf8,gid=100,umask=002"
## Mount the device
#ACTION=="add", RUN+="/bin/mkdir -p /media/%E{dir_name}", RUN+="/bin/mount -o
%E{mount_options} /dev/%k /media/%E{dir_name}"
## Clean up after removal
#ACTION=="remove", ENV{dir_name}!="", RUN+="/bin/umount -l /media/%E{dir_name}",
RUN+="/bin/rmdir /media/%E{dir_name}"
## Exit
#LABEL="media_by_label_auto_mount_end"
```

You can use the `sed` command to remove all beginning `#` matched from lines.

```
moxa@Moxa:~# sudo sed -i s/^#//
/etc/udev/rules.d/11-media-by-label-auto-mount.rules
```

This is the SD auto-mounting rule. It mounts the media by label at first. This means that If the SD card has a label name, it will be auto-mounted at this path, /media/LABEL_NAME. If the SD card doesn't have a label name, it will be auto-mounted to /media/sd-mmcbk0pX, where X is the partition number. Both these cases of mounting the SD card to the system are covered in the examples below:

Case #1, the SD card auto-mounted to /media/LABEL_NAME

Use blkid to read the SD card's label name.

```
root@Moxa:~# blkid /dev/mmcbk0p1
/dev/mmcbk0p1: LABEL="MySD" UUID="70CC-82A8" TYPE="vfat"
```

The inserted SD card will be auto-mounted to /media/MySD

```
root@Moxa:~# mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
...
/dev/mmcbk0p1 on /media/MySD type vfat
(rw,relatime,gid=100,fmask=0002,dmask=0002,allow_utime=0020,codepage=437,ioccharse
t=ascii,shortname=mixed,utf8,errors=remount-ro)
```

Case #2, the SD card auto-mounted to /media/sd-mmcbk0pX

Use blkid to read the SD card's label name.

```
root@Moxa:~# blkid /dev/mmcbk0p1
/dev/mmcbk0p1: UUID="70CC-82A8" TYPE="vfat"
```

Check the mounted storage by mount command.

```
root@Moxa:~# mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
...
/dev/mmcbk0p1 on /media/sd-mmcbk0p1 type vfat
(rw,relatime,gid=100,fmask=0002,dmask=0002,allow_utime=0020,codepage=437,ioccharse
t=ascii,shortname=mixed,utf8,errors=remount-ro)
tmpfs on /run/user/1000 type tmpfs
(rw,nosuid,nodev,relatime,size=807264k,mode=700,uid=1000,gid=1000)
```

Checking the Linux Version

The program **uname**, which stands for "Unix Name" and is part of the UNIX operating system, prints the name, version, and other details about the operating system running on the computer. Use the -a option to generate a response similar to the one shown below:

```
moxa@MOXA:~# uname -a
Linux Moxa 4.9.0-8-amd64 #1 SMP Debian 4.9.130-2 (2018-10-28) x86_64 GNU/Linux
```

Check the distribution specification.

```
moxa@MOXA:~# lsb_release -a
No LSB modules are available.
Distributor ID: Debian
Description:    Debian GNU/Linux 9.8 (stretch)
Release:        9.8
Codename:       stretch
```

Checking Moxa's Control Version

The program `kversion` determines the Linux system released version. Use the `-a` option to check the built date. The built date format is `YYMMDDHH`. You can use `kversion` to check the released image version in troubleshooting. This example shows the built date, `19030611`, which means it was built at 2019/03/06 11:00.

```
moxa@moxa:~# kversion -a
MPC-2121 firmware version 1.0 Build 19030611
moxa@moxa:~#
```

APT—Installing and Removing Packages

APT is the Debian tool used to install and remove packages. Before installing a package, you need to configure the apt source file, `/etc/apt/sources.list`.

Next, use `vi` editor to configure `/etc/apt/sources.list`.

```
root@moxa:~# vi /etc/apt/sources.list

deb http://ftp.us.debian.org/debian/ stretch main
deb-src http://ftp.us.debian.org/debian/ stretch main

deb http://security.debian.org/ stretch/updates main
deb-src http://security.debian.org/ stretch/updates main

# Stretch-updates, previously known as 'volatile'
deb http://ftp.us.debian.org/debian/ stretch-updates main
deb-src http://ftp.us.debian.org/debian/ stretch-updates main

#deb http://ftp.debian.org/debian stretch-backports main
#deb-src http://ftp.debian.org/debian stretch-backports main
```

Update the source list after you configure it.

```
moxa@MOXA:~# sudo apt-get update
moxa@MOXA:~#
```

Once you indicate which package you want to install (`IPsec-tools`, for example), type:

```
moxa@MOXA:~# sudo apt-get install IPsec-tools
moxa@MOXA:~#
```

Use one of the following commands to remove a package:

```
moxa@MOXA:~# sudo apt-get remove IPsec-tools
moxa@MOXA:~#
```

For a complete package removal:

```
moxa@MOXA:~# sudo apt-get remove IPsec-tools --purge
moxa@MOXA:~#
```



ATTENTION

You can free up the cache space with the command `# apt-get clean`.

```
moxa@MOXA:~# sudo apt-get clean
moxa@MOXA:~#
```

The Linux system software is continuously updated and available in the Debian repository. If you want to use the latest released software, you can upgrade it by the apt command. This example holds the Linux kernel package because if the kernel is upgraded, the kernel module might need to be rebuilt and installed again. So we upgrade the whole system except the kernel image package, which was held.

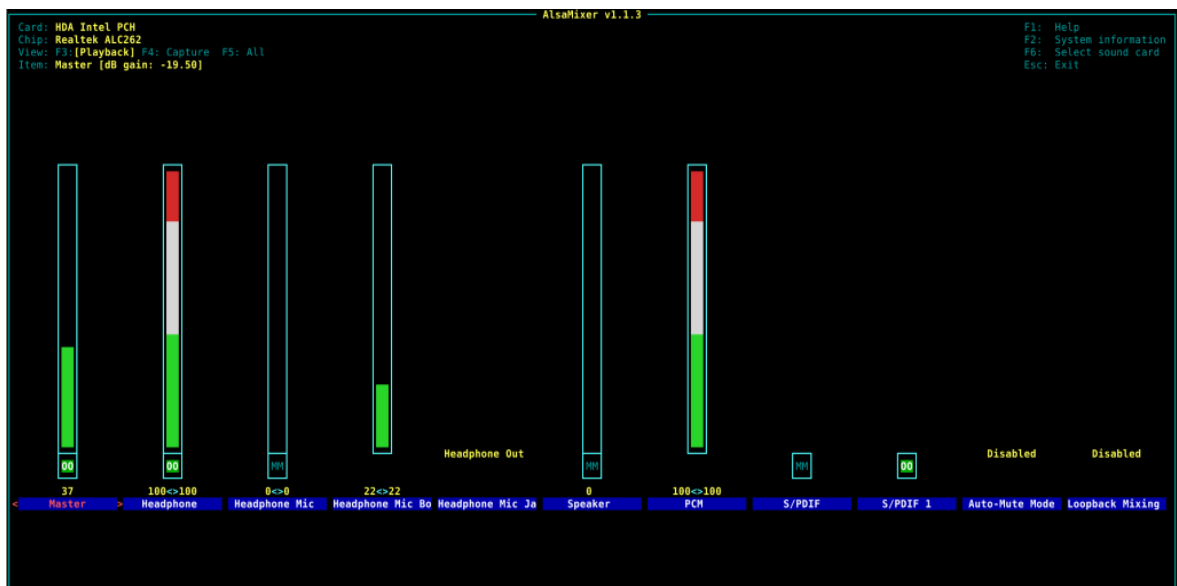
```
moxa@MOXA:~# sudo apt-mark hold linux-image-4.9.0-8-amd64
moxa@MOXA:~# sudo apt-get update
moxa@MOXA:~# sudo apt-get upgrade
```

Audio Player

The MPC-2101/2121-LX has an audio playback interface. The system default installs the command-line playback utility `alsa-utils`. The `alsamixer` is the soundcard mixer for the ALSA soundcard driver. You can use the `alsamixer` to control the audio output or use it to control the volume.

```
moxa@Moxa:~$ sudo alsamixer
```

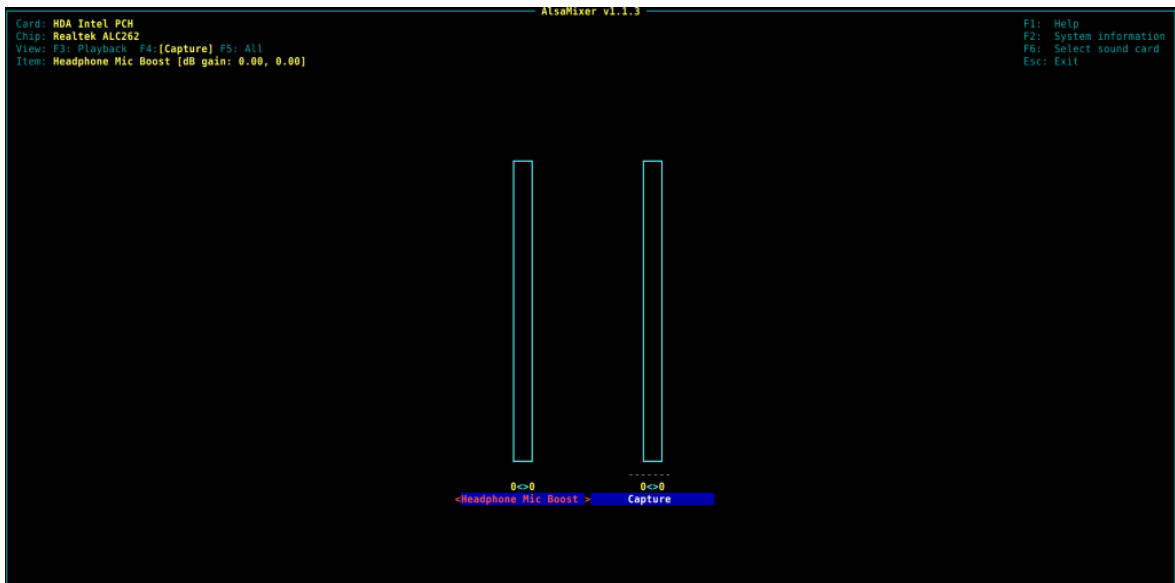
Press F3 or TAB to select the soundcard output interface in the `alsamixer` playback view. In this case, we choose headphones as the soundcard output interface. The volume can be controlled by Master, headphone, or PCM interface.



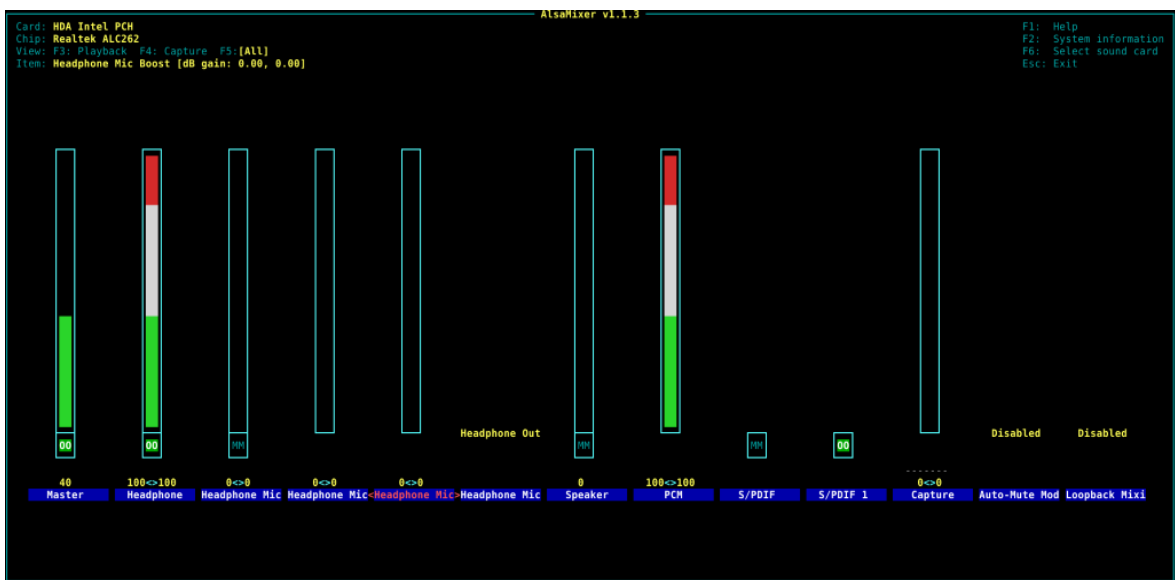
ATTENTION

The audio output sets the headphones as the default playback interface. If you used speakers, you should select the output device as speakers.

Press F4 or TAB to enter the capture view. The MPC-2070/2120-LX or MPC-2101/2121-LX doesn't have the capture feature. You can ignore the capture control in this platform.



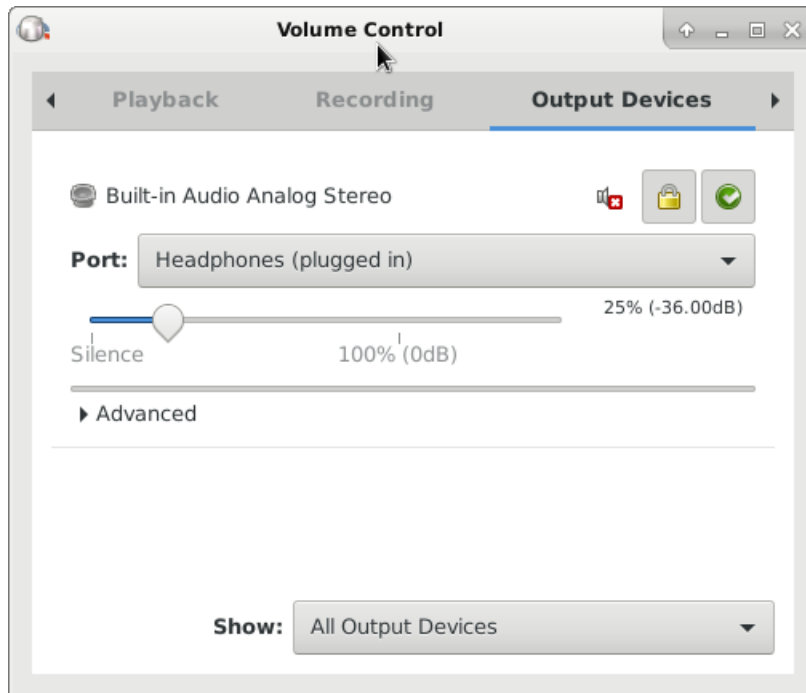
Press F5 or TAB to control all the features in the ALL view.



The alsactl supports aplay for command-line sound player for ALSA soundcard. For supported sound file formats, the sampling rate, bit depth, and so forth can be automatically determined from the sound file header. In this case, we playback the wav file by aplay utility.

```
moxa@moxa:~$ aplay /home/moxa/Download/test.wav
```

The XFCE has the Pulse Audio Volume Control applet to control your pulse audio volume levels using the pulse audio mixer.

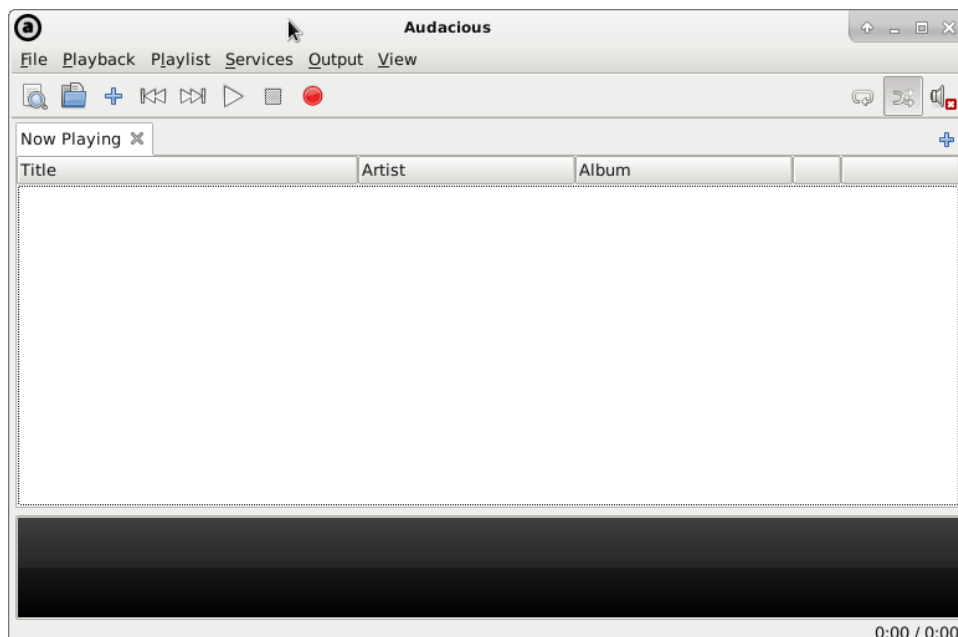


ATTENTION

The audio output sets the headphone as default playback interface. If you used speaker, you should select the output device as speakers.

The XFCE has many popular audio apps. Audacious is an advanced audio player. It is free, lightweight, based on GTK+, is focused on audio quality and supporting a wide range of audio codecs. You can install it from Internet.

```
moxa@Moxa:~$ sudo apt-get install audacious
```



Video Player

The XFCE has many popular video player apps. The VLC Media Player is the famous free and open source cross-platform media player owned by the non-profit organization VideoLAN. It's a simple, fast and powerful media player for playing files, discs, webcams, and for streaming. Plays most codes such as MPEG-2, DivX, H.264, MKV, WebM, WMV, and MP3 with no codec packs needed. You can install it from Internet using the following command:

```
moxa@moxa:~$ sudo apt-get install vlc
```

Or install the browser-plugin-vlc.

```
moxa@moxa:~$ sudo apt-get install browser-plugin-vlc
```

Web Browser

The Linux system by default doesn't install a web browser. To install the chromium browser use the following command.

```
moxa@moxa:~$ sudo apt-get install chromium
```

If you like the Firefox browser, you can install the firefox-esr package.

```
moxa@moxa:~$ sudo apt-get install firefox-esr
```

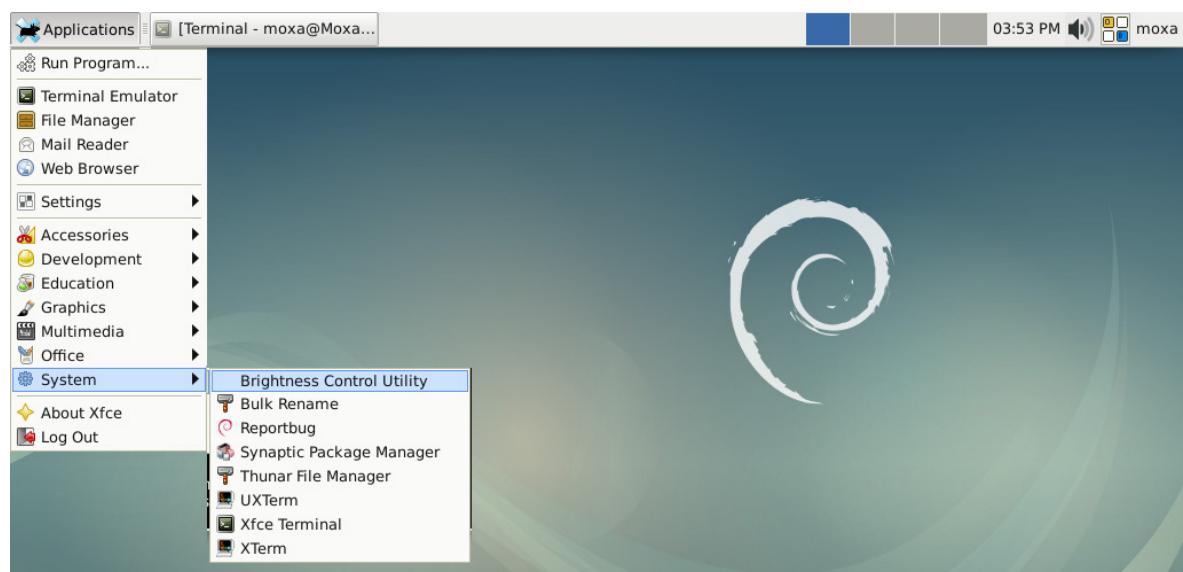
Brightness control

Introduction

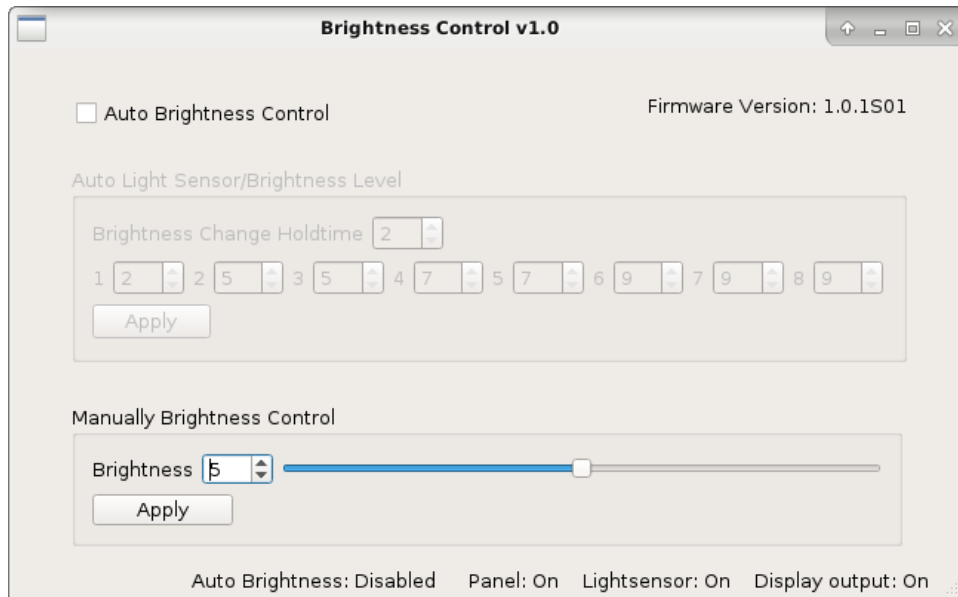
The panel computer embeds with a brightness controller. It supports the auto-brightness control mode and manually brightness control mode. This Linux platform provides a brightness control utility, Brightness Control dialog, for configure the automatically or manually brightness control.

The Brightness Control Dialog can launch from the Application icon.

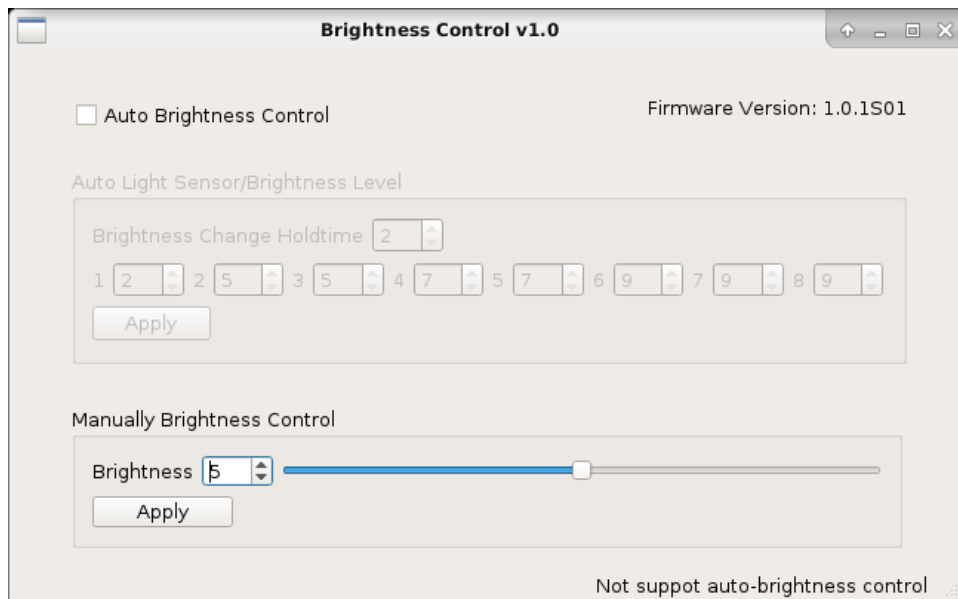
Applications → System → Brightness Control Utility



The Brightness Control Dialog will show in the desktop. The MPC-2101/2121 supports auto-brightness control mode. It shows the Panel, light sensor and display signals at the status bar. If one of these signals is OFF, the hardware might have some issues and the auto-brightness control mode cannot work. The Auto Brightness Control checkbox will be disabled in the Brightness Control Dialog.

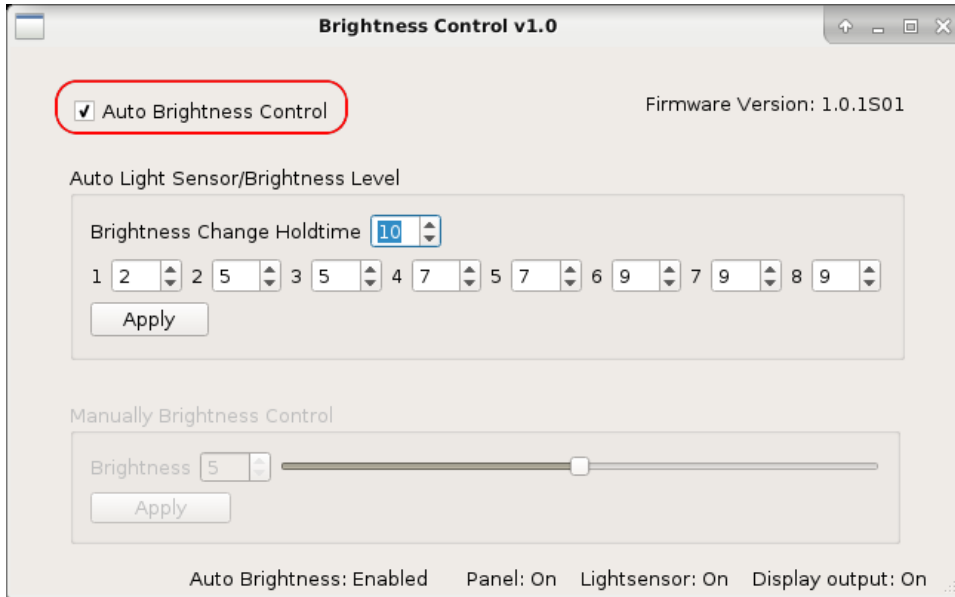


The MPC-2070/2120 does not support auto brightness control mode. The status bar shows it's not supported auto brightness control and the Auto Brightness Control checkbox will be disabled.

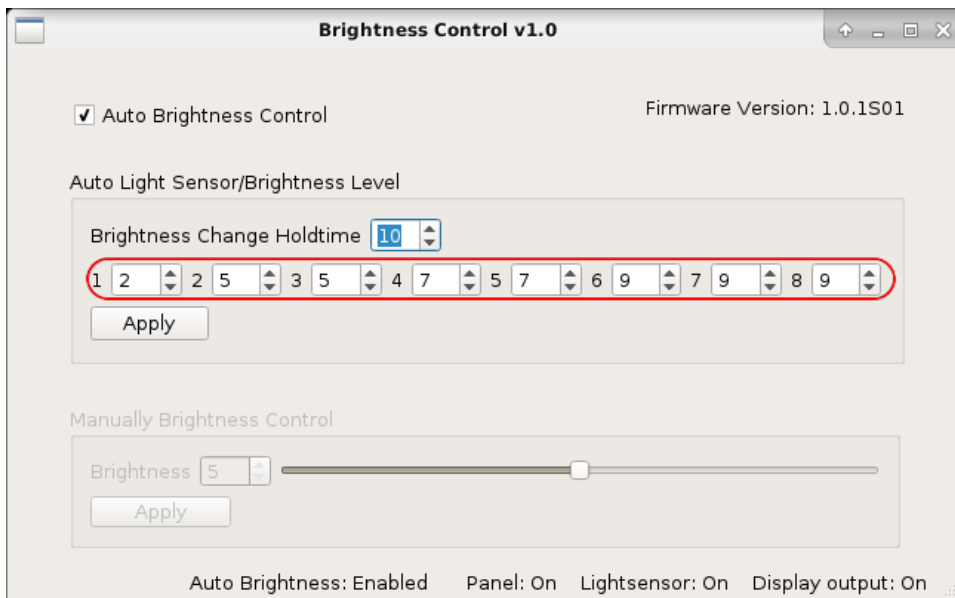


Auto-brightness control mode

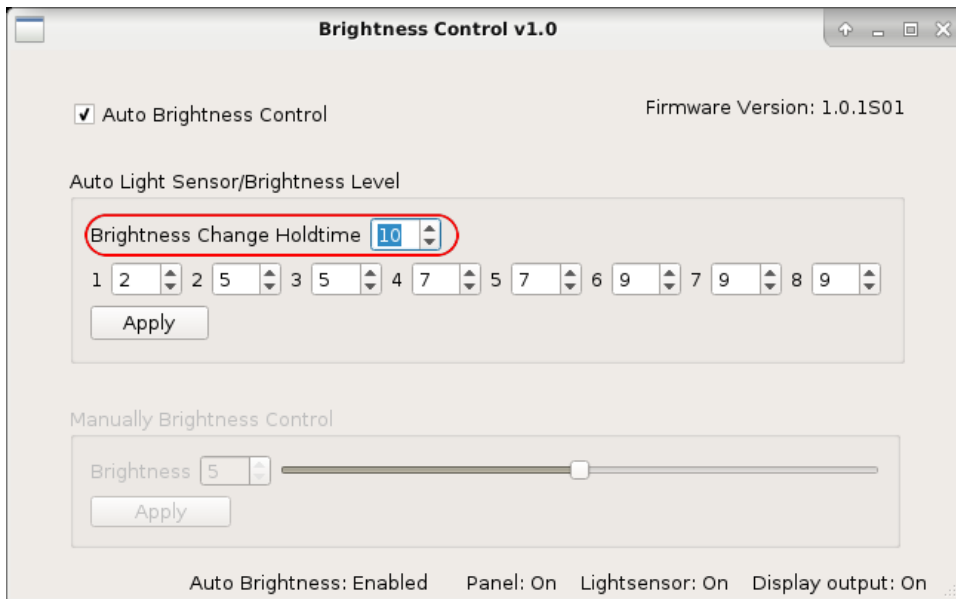
Use can click the Auto Brightness Control checkbox to enable the Auto Brightness Control mode or enable Manually Brightness Control mode in MPC-2101/2121-LX.



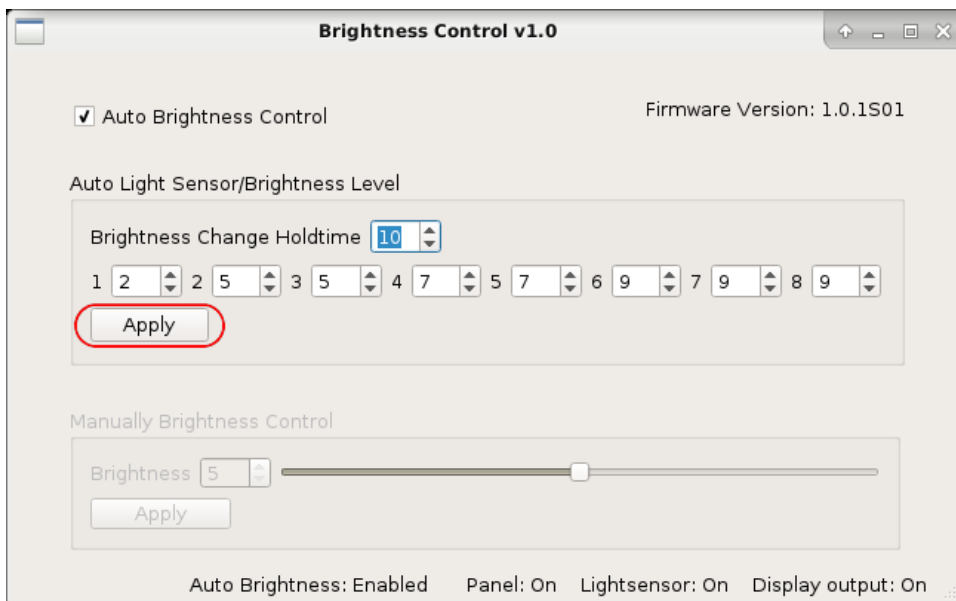
The ambient brightness will be divided into 1 to 8 levels in auto-brightness control mode. The lower numbers indicate that the environment brightness is darker. The light sensor automatically measures the ambient lightness and then automatically adjusts the display brightness according to the ambient brightness level. Meanwhile, users can manually configure the settings of the display brightness in correspondence with the ambient brightness levels.



The Brightness Change Holdtime is the brightness level change interval. The minimum value is 1 and the maximum is 30. Default value is 10. One unit of the hold time is 800 ms; the maximum is 30 is 24 seconds.

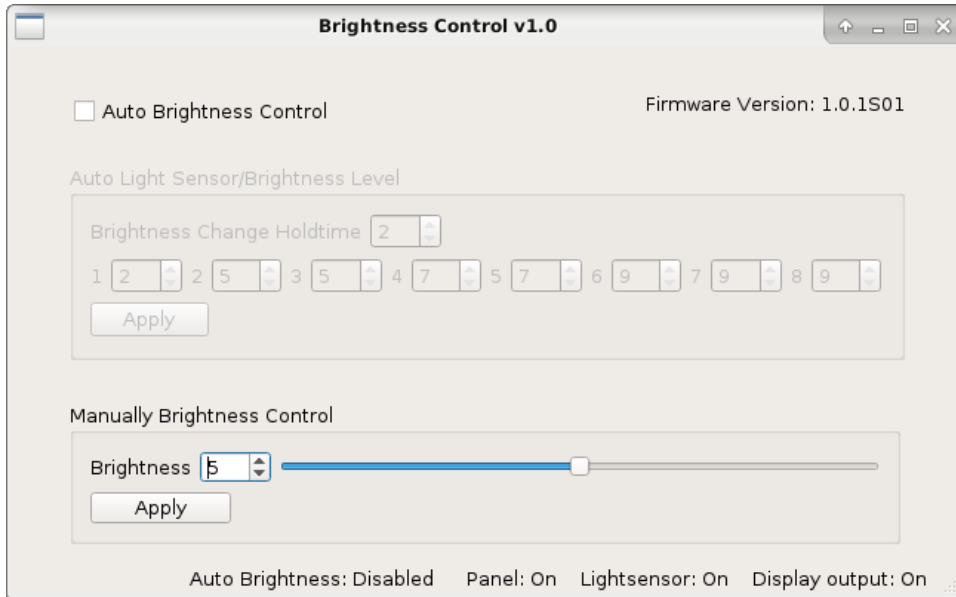


Then click the Apply button to apply the setting. The applied value will be saved in the brightness controller. The saved values will be used in next boot.

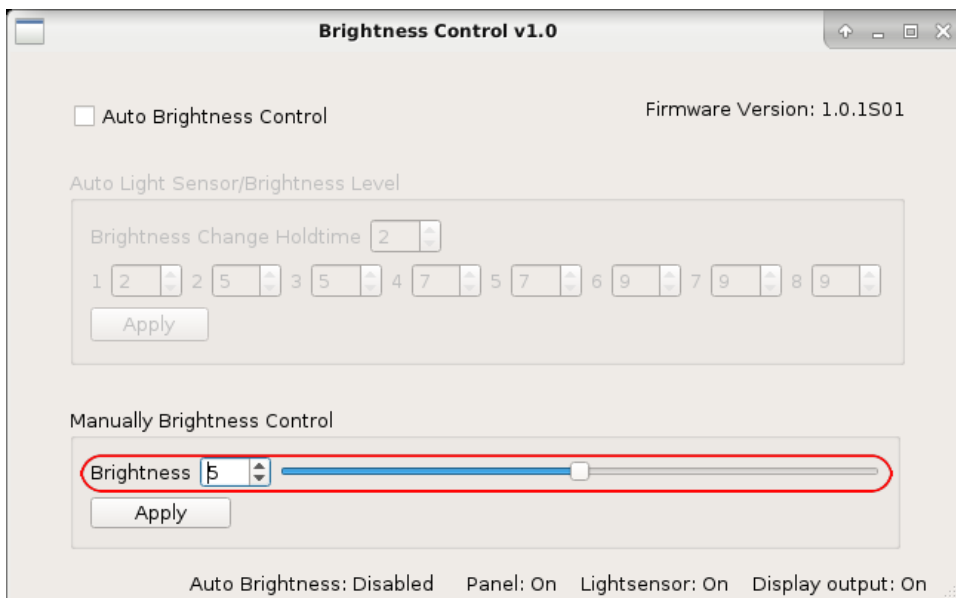


Manual brightness control mode

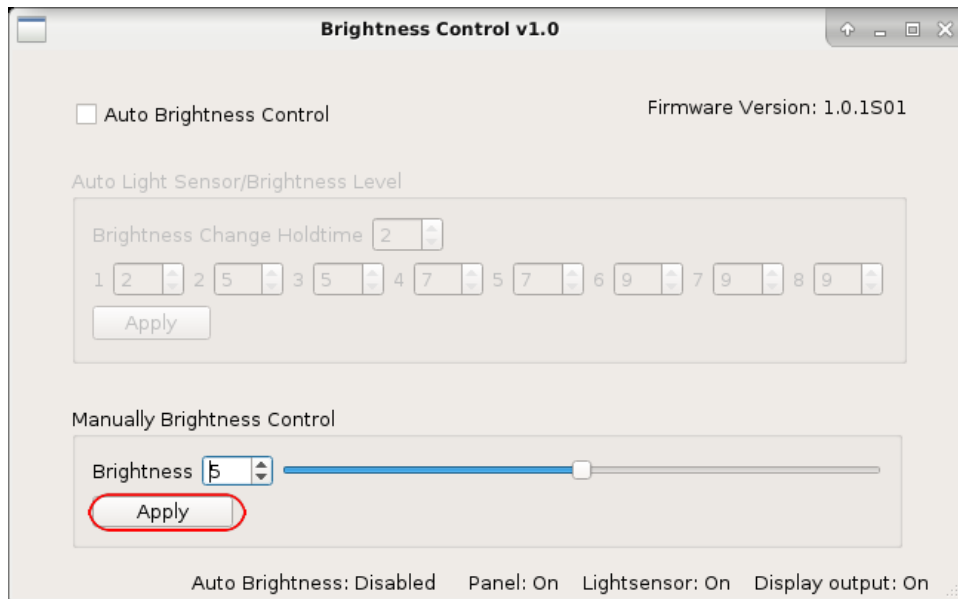
User can click to uncheck the Auto Brightness Control checkbox. It enables the manually brightness control mode in MPC-2101/2121-LX.



User can specify a brightness value or drag the slider to set a value.



Then click the Apply button to apply the brightness value. The brightness value would be kept in Brightness Controller and load in next boot.



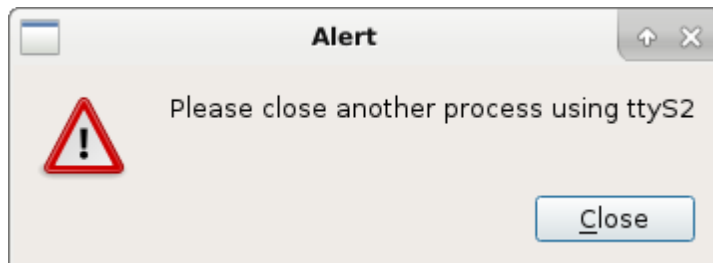
ATTENTION

Apply the display brightness as 0 in manually brightness control mode would turn off the backlight and nothing displayed in the panel. The computer is not power off. You can click the brightness key to turn on the display backlight.



ATTENTION

The Brightness Control Dialog and upgrade_mcfwr.sh cannot run at the same time. If the upgrade_mcfwr.sh is running, the Brightness Control Dialog cannot run and pop up the alert dialog to exit the program.



Managing Communications

The MPC-2070/2120-LX or MPC-2101/2121-LX ready-to-run embedded computer is a network-based platform designed to serve as a front-end for data acquisition, panel display and industrial control applications. This chapter describes how to configure the various communication functions supported by the Linux operating system.

The following topics are covered in this chapter:

❑ **Changing the Network Settings**

- Changing the "interfaces" Configuration File
- Configure the VLAN tag in "interfaces"
- Adjusting IP Addresses with "ifconfig"

❑ **DNS Client**

- /etc/hostname
- /etc/resolv.conf
- /etc/nsswitch.conf

❑ **Apache Web Server**

- Install the apache web server
- Default Homepage
- Disabling the CGI Function
- Saving Web Pages to a USB Storage Device

❑ **IPTABLES**

- IPTABLES Hierarchy
- IPTABLES Modules
- Observe and Erase Chain Rules
- Define Policy for Chain Rules
- Append or Delete Rules

❑ **NAT (Network Address Translation)**

- NAT Example
- Enabling NAT at Bootup

❑ **NFS (Network File System) Client**

❑ **Wireless Management**

- Device Driver for WPEA-172GN – rt5572sta.ko
- Device Driver for WPEA-172GN - rt2800usb.ko
- iw
- wpasupplicant

❑ **Cellular Management – cell_mgnt**

Changing the Network Settings

The MPC-2070/2120-LX or MPC-2101/2121-LX computer has two 10/100 Ethernet ports. The default IP addresses and netmasks of these network interfaces are:

	Default IP Address	Netmask
LAN1	192.168.3.127	255.255.255.0
LAN2	192.168.4.127	255.255.255.0

These network settings can be modified by changing the interfaces configuration file, or they can be adjusted temporarily with the ifconfig command.

Changing the “interfaces” Configuration File

Type `cd /etc/network` to change directories.

```
moxa@Moxa:~# cd /etc/network
```

Type `vi interfaces` to edit the network configuration file with vi editor. You can configure the MPC-2070/2120-LX or MPC-2101/2121-LX's Ethernet ports for static or dynamic (DHCP) IP addresses.

```
moxa@Moxa:/etc/network# sudo vi interfaces
```

Static IP Address

As shown in the following example, the default static IP addresses can be modified.

```
# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
auto enp1s0
iface enp1s0 inet static
address 192.168.3.127
netmask 255.255.255.0
broadcast 192.168.3.255

auto enp2s0
iface enp2s0 inet static
address 192.168.4.127
netmask 255.255.255.0
broadcast 192.168.4.255
```

Dynamic IP Address using DHCP

To configure one or both LAN ports to request an IP address dynamically, replace static with DHCP and then delete the rest of the lines.

```
# The primary network interface
auto enp1s0
iface enp1s0 inet dhcp
```

After modifying the boot settings of the LAN interface, issue the following command to activate the LAN settings immediately.

```
root@Moxa:~# /etc/init.d/networking restart
```


Configure the VLAN tag in “interfaces”

This example shows how to tag the LAN1 with VLAN ID, 10, of the raw interface enp1s0. The tag will be active after reboot or networking restarted.

```
# The loopback network interface
...
# Tag the VLAN ID, 10, of the Ethernet interface, enp1s0.
auto enp1s0.10
iface enp1s0.10 inet static
address 192.168.5.127
netmask 255.255.255.0
Vlan-raw-device enp1s0
...
```

You can use the vconfig command to manually tag the VLAN ID.

```
root@Moxa:~# vconfig add enp1s0 10
```

Configure the network setting for the VLAN interface.

```
root@Moxa:~# ip addr add 192.168.10.127/24 dev enp1s0.10
```

Configure the network setting for the VLAN interface.

```
root@Moxa:~# ip link set enp1s0.10 up
```

If you subsequently need to delete the interface, use this command to bring down and delete it.

```
root@Moxa:~# ip link set enp1s0.10 down
root@Moxa:~# vconfig rem enp1s0.10
```

Adjusting IP Addresses with “ifconfig”

IP settings can be adjusted during run-time, but the new settings will not be saved to the disk without modifying the file **/etc/network/interfaces**. For example, type the command `# ifconfig enp1s0 192.168.1.1` to change the IP address of LAN1 to 192.168.1.1.

```
root@Moxa:~# ifconfig enp1s0 192.168.1.1
root@Moxa:~#
```

NOTE Predictable Network Interface Names

Starting with v197 systemd/udev will automatically assign predictable, stable network interface names for all local Ethernet, WLAN and WWAN interfaces. This is a departure from the traditional interface naming scheme ("eth0", "eth1", "wlan0", ...), but should fix real problems.

The classic naming scheme for network interfaces applied by the kernel is to simply assign names beginning with "eth0", "eth1", ... to all interfaces as they are probed by the drivers. As the driver probing is generally not predictable for modern technology this means that as soon as multiple network interfaces are available the assignment of the names "eth0", "eth1" and so on is generally not fixed anymore and it might very well happen that "eth0" on one boot ends up being "eth1" on the next. This can have serious security implications, for example in firewall rules which are coded for certain naming schemes, and which are hence very sensitive to unpredictable changing names.

The Predictable Network Interface Name is assigned fixed names based on firmware/topology/location information has the big advantage that the names are fully automatic, fully predictable, that they stay fixed even if hardware is added or removed (i.e. no re-enumeration takes place) and that broken hardware can be replaced seamlessly. That said, they admittedly are sometimes harder to read than the "eth0" or "wlan0" everybody is used to. Example: "enp5s0"

DNS Client

The MPC-2070/2120-LX or MPC-2101/2121-LX supports DNS client (but not DNS server). To set up DNS client, you need to edit three configuration files: /etc/hostname, /etc/resolv.conf, and /etc/nsswitch.conf.

/etc/hostname

Edit /etc/hostname:

```
moxa@Moxa:~# sudo vi /etc/hostname
MOXA
```

Re-configure the hostname.

```
moxa@Moxa:~# sudo /etc/init.d/hostname.sh start
```

Check the new hostname.

```
moxa@Moxa:~# hostname
```

/etc/resolv.conf

This is the most important file that you need to edit when using DNS. For example, before using # ntpdate time.stdtime.gov.tw to update the system time, you will need to add the DNS server address to the file. Ask your network administrator which DNS server address you should use. The DNS server's IP address is specified with the nameserver command. For example, add the following line to /etc/resolv.conf (assuming the DNS server's IP address is 8.8.8.8): nameserver 8.8.8.8

```
moxa@MOXA:/etc# cat resolv.conf
#
# resolv.conf This file is the resolver configuration file
# See resolver(5).
#
nameserver 8.8.8.8
nameserver 8.8.4.4
moxa@MOXA:/etc#
```

/etc/nsswitch.conf

This file defines the sequence of files, `/etc/hosts` or `/etc/resolv.conf`, to be read to resolve the IP address. The `hosts` line in `/etc/nsswitch.conf` means that the `/etc/hosts` first and DNS service should be used to resolve the IP address

```
# /etc/nsswitch.conf
#
# Example configuration of GNU Name Service Switch functionality.
# If you have the `glibc-doc-reference' and `info' packages installed, try:
# `info libc "Name Service Switch"' for information about this file.

passwd: compat
group: compat
shadow: compat

hosts: files dns
networks: files

protocols: db files
services: db files
ethers: db files
rpc: db files

netgroup: nis
```

Apache Web Server

Install the apache web server

The Apache web server is one of the famous web server. You can install it by the `apt` command.

```
moxa@Moxa:~# sudo apt-get install apache2
```

Manually uninstall the `apache2` server.

```
moxa@Moxa:~# sudo apt-get remove apache2
```

Default Homepage

The Apache web server's main configuration file is `/etc/apache2/sites-enabled/000-default.conf`, with the default homepage located at `/var/www/html/index.html`.

Save your own homepage to the following directory:

`/var/www`

Save your CGI page to the following directory:

`/var/www/cgi-bin`

Before you modify the homepage, use a browser (such as Microsoft Internet Explorer or Mozilla Firefox) from your PC to test if the Apache web server is working. Type the LAN1 IP address in the browser's address box to open the homepage. For example, if the default IP address 192.168.3.127 is still active, type:

`http://192.168.3.127/`

To test the default CGI page, type:

`http://192.168.3.127/cgi-bin/w3mmail.cgi`

Disabling the CGI Function

The CGI function is enabled by default. If you want to disable the function, modify the file **/etc/apache2/sites-enabled/000-default**.

Type **# vi /etc/apache2/sites-enabled/000-default** to edit the configuration file. Comment out the following lines:

```
#ScriptAlias /cgi-bin/ /var/www/cgi-bin/
#<Directory "/var/www/cgi-bin/">
# AllowOverride None
# Options ExecCGI -MultiViews +SymLinksIfOwnerMatch
# #Order allow,deny
# Order deny,allow
# Allow from all
#</Directory>
```

```
root@Moxa:/etc# vi /etc/apache2/sites-available/default
#ScriptAlias /cgi-bin/ /var/www/cgi-bin/
#<Directory "/var/www/cgi-bin/">
# AllowOverride None
# Options ExecCGI -MultiViews +SymLinksIfOwnerMatch
# #Order allow,deny
# Order deny,allow
# Allow from all
#</Directory>
```

Restart the apache server.

```
moxa@MOXA:~# sudo service apache2 restart
```



ATTENTION

When you develop your own CGI application, make sure your CGI file is executable.

Saving Web Pages to a USB Storage Device

Some applications may have web pages that take up a lot of storage space. This section describes how to save web pages to the USB mass storage device, and then configure the Apache web server's DocumentRoot to open these pages. The files used in this example can be downloaded from Moxa's website.

Prepare the web pages and then save the pages to the USB storage device. Click on the following link to download the web page test suite: <http://www.w3.org/MarkUp/Test/HTML401.zip>.

Uncompress the zip file to your desktop PC, and then use FTP to transfer it to the embedded computer's USB mount directory, EX: /media/usb0.

```
# vi /etc/apache2/sites-available/default
```

and

```
# vi /etc/apache2/sites-available/default-ssl
```

to edit the configuration file.

```
root@Moxa:/etc# vi /etc/apache2/sites-available/default
root@Moxa:/etc# vi /etc/apache2/sites-available/default-ssl
```

Change the DocumentRoot directory to the USB storage directory **/media/usb0/www**.

```

...
<VirtualHost *:80>
...
...
DocumentRoot /media/usb0/www
<Directory />
Options FollowSymLinks
AllowOverride None
</Directory>
...
...
ScriptAlias /cgi-bin/ /media/usb0/www/cgi-bin/
<Directory "/media/usb0/www/cgi-bin/">
AllowOverride None
Options ExecCGI -MultiViews +SymLinksIfOwnerMatch
Order allow,deny
Allow from all
</Directory>
...
</VirtualHost>
/etc/apache2/sites-available/default"
<VirtualHost *:443>
...
...
DocumentRoot /media/usb0/www
<Directory />
Options FollowSymLinks
AllowOverride None
</Directory>
...
...
ScriptAlias /cgi-bin/ /media/usb0/www/cgi-bin/
<Directory "/media/usb0/www/cgi-bin/">
AllowOverride None
Options ExecCGI -MultiViews +SymLinksIfOwnerMatch
Order allow,deny
Allow from all
</Directory>
...
</VirtualHost>
/etc/apache2/sites-available/default-ssl"

```

Use the following commands to restart the Apache web server:

```
# service restart apache2
```

Start your browser and connect to the embedded computer by typing the current LAN1 IP address in the browser's address box.

Restart the apache server.

```
moxa@moxa:~# sudo service restart apache2
```

**ATTENTION**

Visit the Apache website at <http://httpd.apache.org/docs/> for more information about setting up Apache servers.

IPTABLES

IPTABLES is an administrative tool for setting up, maintaining, and inspecting the Linux kernel's IP packet filter rule tables. Several different tables are defined, with each table containing built-in chains and user-defined chains.

Each chain is a list of rules that apply to a certain type of packet. Each rule specifies what to do with a matching packet. A rule (such as a jump to a user-defined chain in the same table) is called a target.

The MPC-2070/2120-LX OR MPC-2101/2121-LX supports three types of IPTABLES: Filter tables, NAT tables, and Mangle tables.

Filter Table—includes three chains:

- INPUT chain
- OUTPUT chain
- FORWARD chain

NAT Table—includes three chains:

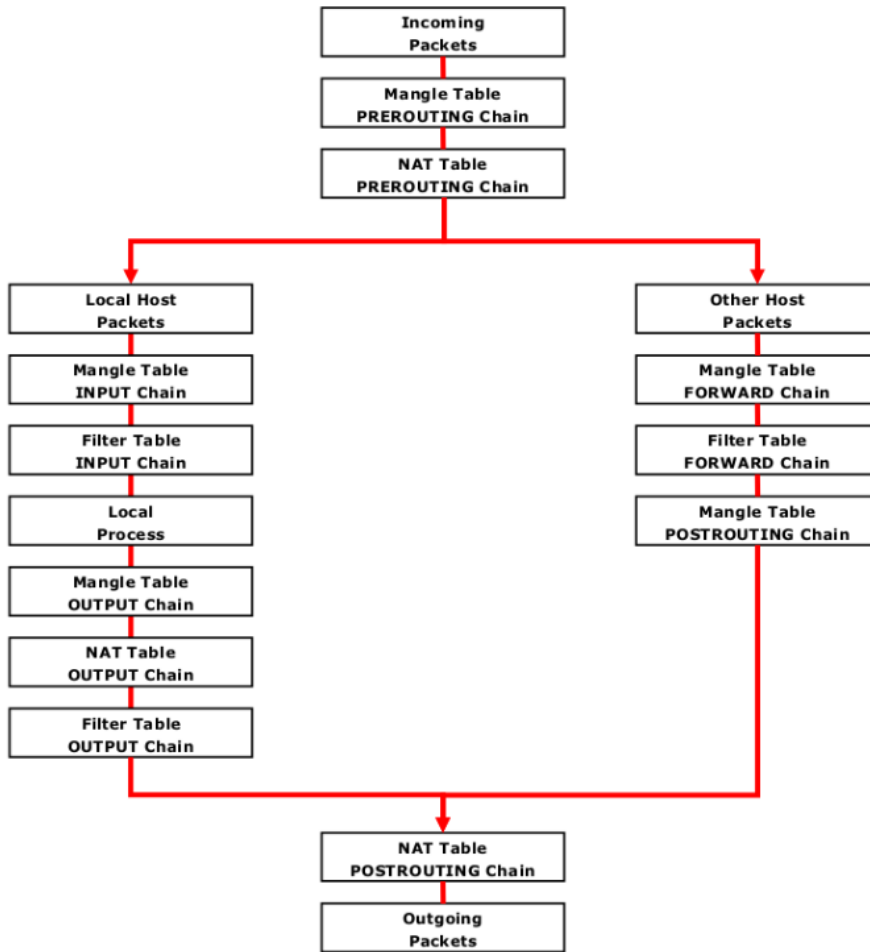
- PREROUTING chain—transfers the destination IP address (DNAT).
- POSTROUTING chain—works after the routing process and before the Ethernet device process to transfer the source IP address (SNAT).
- OUTPUT chain—produces local packets.
- Sub-tables
- Source NAT (SNAT)—changes the first source IP address of the packet.
- Destination NAT (DNAT)—changes the first destination IP address of the packet.
- MASQUERADE—a special form for SNAT. If one host can connect to the Internet, then the other computers that connect to this host can connect to the Internet when the computer does not have an actual IP address.
- REDIRECT—a special form of DNAT that re-sends packets to a local host independent of the destination IP address.

Mangle Table—includes two chains

- PREROUTING chain—pre-processes packets before the routing process.
- OUTPUT chain—processes packets after the routing process.
- Mangle tables can have one of three extensions—TTL, MARK, TOS.

IPTABLES Hierarchy

The following figure shows the IPTABLES hierarchy.



IPTABLES Modules

The iptables supports the following sub-modules. Be sure to use the module that matches your application.

arptable_filter.ko	arp_tables.ko	arpt_mangle.ko	ip_contrack_amanda.ko
ip_contrack_ftp.ko	ip_contrack_h323.ko	ip_contrack_irc.ko	ip_contrack.ko
ip_contrack_netbios_ns.ko	ip_contrack_netlink.ko	ip_contrack_pptp.ko	ip_contrack_proto_sctp.ko
ip_contrack_sip.ko	ip_contrack_tftp.ko	ip_nat_amanda.ko	ip_nat_ftp.ko
ip_nat_h323.ko	ip_nat_irc.ko	ip_nat.ko	ip_nat_pptp.ko
ip_nat_sip.ko	ip_nat_snmp_basic.ko	ip_nat_tftp.ko	ip_queue.ko
iptables_filter.ko	iptables_mangle.ko	iptables_nat.ko	iptables_raw.ko
ip_tables.ko	ipt_addrtype.ko	ipt_ah.ko	ipt_CLUSTERIP.ko
ipt_dscp.ko	ipt_DSCP.ko	ipt_ecn.ko	ipt_ECN.ko
ipt_hashlimit.ko	ipt_iprange.ko	ipt_LOG.ko	ipt_MASQUERADE.ko
ipt_NETMAP.ko	ipt_owner.ko	ipt_recent.ko	ipt_REDIRECT.ko
ipt_REJECT.ko	ipt_SAME.ko	ipt_TCPMSS.ko	ipt_tos.ko
ipt_TOS.ko	ipt_ttl.ko	ipt_TTL.ko	ipt_ULOG.ko

The basic syntax to enable and load an IPTABLES module is as follows:

```
# lsmod
# modprobe ip_tables
# modprobe iptable_filter
# modprobe iptable_mangle
# modprobe iptable_nat
```

Use lsmod to check if the ip_tables module has already been loaded in the MPC-2070/2120-LX or MPC-2101/2121-LX. Use modprobe to insert and enable the module.

Use iptables, iptables-restore, and iptables-save to maintain the database.



ATTENTION

IPTABLES plays the role of packet filtering or NAT. Be careful when setting up the IPTABLES rules. If the rules are not correct, remote hosts that connect via a LAN or PPP may be denied. We recommend using the VGA console to set up the IPTABLES. Click on the following links for more information about IPTABLES.

<http://www.linuxguruz.com/iptables/>

<http://www.netfilter.org/documentation/HOWTO//packet-filtering-HOWTO.html>

Since the IPTABLES command is very complex, to illustrate the IPTABLES syntax we have divided our discussion of the various rules into three categories: **Observe and erase chain rules**, **Define policy rules**, and **Append or Delete rules**.

Observe and Erase Chain Rules

Usage:

```
# iptables [-t tables] [-L] [-n]
-t tables: Table to manipulate (default: 'filter'); example: NAT or filter.
-L [chain]: List all rules in selected chains. If no chain is selected, all chains are listed.
-n: Numeric output of addresses and ports.

# iptables [-t tables] [-FXZ]
-F: Flush the selected chain (all the chains in the table if none is listed).
-X: Delete the specified user-defined chain.
-Z: Set the packet and byte counters in all chains to zero.
```

Example:

```
# iptables -L -n
```

In this example, since we do not use the -t parameter, the system uses the default "filter" table. Three chains are included: INPUT, OUTPUT, and FORWARD. INPUT chains are accepted automatically, and all connections are accepted without being filtered.

```
# iptables -F
# iptables -X
# iptables -Z
```


Define Policy for Chain Rules

Usage:

```
# iptables [-t tables] [-P] [INPUT, OUTPUT, FORWARD, PREROUTING, OUTPUT, POSTROUTING] [ACCEPT, DROP]
```

-P: Set the policy for the chain to the given target.

INPUT: For packets coming into the MPC-2070/2120-LX or MPC-2101/2121-LX.

OUTPUT: For locally-generated packets.

FORWARD: For packets routed out through the MPC-2070/2120-LX or MPC-2101/2121-LX.

PREROUTING: To alter packets as soon as they come in.

POSTROUTING: To alter packets as they are about to be sent out.

Example:

```
#iptables -P INPUT DROP
#iptables -P OUTPUT ACCEPT
#iptables -P FORWARD ACCEPT
#iptables -t nat -P PREROUTING ACCEPT
#iptables -t nat -P OUTPUT ACCEPT
#iptables -t nat -P POSTROUTING ACCEPT
```

In this example, the policy accepts outgoing packets and denies incoming packets.

Append or Delete Rules

Usage

```
# iptables [-t table] [-AI] [INPUT, OUTPUT, FORWARD] [-io interface] [-p tcp, udp, icmp, all] [-s IP/network] [--sport ports] [-d IP/network] [--dport ports] -j [ACCEPT. DROP]
```

-A: Append one or more rules to the end of the selected chain.

-I: Insert one or more rules in the selected chain as the given rule number.

-i: Name of an interface via which a packet is going to be received.

-o: Name of an interface via which a packet is going to be sent.

-p: The protocol of the rule or of the packet to check.

-s: Source address (network name, host name, network IP address, or plain IP address).

--sport: Source port number.

-d: Destination address.

--dport: Destination port number.

-j: Jump target. Specifies the target of the rules; i.e., how to handle matched packets.

For example, ACCEPT the packet, DROP the packet, or LOG the packet.

Examples:

Example 1: Accept all packets from the lo interface.

```
# iptables -A INPUT -i lo -j ACCEPT
```

Example 2: Accept TCP packets from 192.168.0.1.

```
# iptables -A INPUT -i enp1s0 -p tcp -s 192.168.0.1 -j ACCEPT
```

Example 3: Accept TCP packets from Class C network 192.168.1.0/24.

```
# iptables -A INPUT -i enp1s0 -p tcp -s 192.168.1.0/24 -j ACCEPT
```

Example 4: Drop TCP packets from 192.168.1.25.

```
# iptables -A INPUT -i enp1s0 -p tcp -s 192.168.1.25 -j DROP
```

Example 5: Drop TCP packets addressed for port 21.

```
# iptables -A INPUT -i enp1s0 -p tcp --dport 21 -j DROP
```

Example 6: Accept TCP packets from 192.168.0.24 to MPC-2070/2120-LX OR MPC-2101/2121-LX's port 137, 138, 139

```
# iptables -A INPUT -i enp1s0 -p tcp -s 192.168.0.24 --dport 137:139 -j ACCEPT
```

Example 7: Log TCP packets that visit MPC-2070/2120-LX or MPC-2101/2121-LX's port 25.

```
# iptables -A INPUT -i enp1s0 -p tcp --dport 25 -j LOG
```

Example 8: Drop all packets from MAC address 01:02:03:04:05:06.

```
# iptables -A INPUT -i enp1s0 -p all -m mac --mac-source 01:02:03:04:05:06 -j DROP
```



ATTENTION

In Example 8, remember to issue the command `# modprobe ipt_mac` first to load the module `ipt_mac`.

NAT (Network Address Translation)

The NAT (Network Address Translation) protocol translates IP addresses used on one network into IP addresses used on a connecting network. One network is designated the inside network and the other is the outside network. Typically, the MPC-2070/2120-LX or MPC-2101/2121-LX connects several devices on a network and maps local inside network addresses to one or more global outside IP addresses, and un-maps the global IP addresses on incoming packets back into local IP addresses.



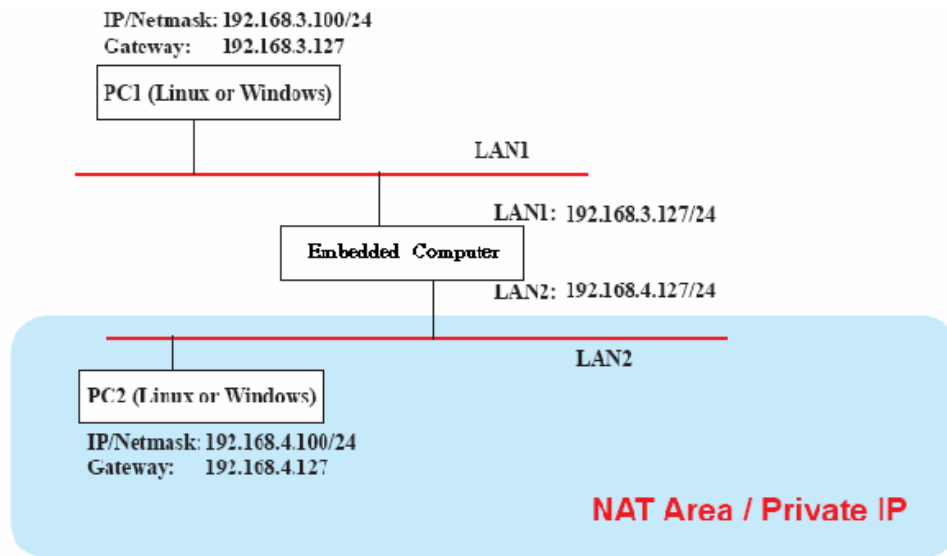
ATTENTION

Click the following link for more information on NAT:

<http://www.netfilter.org/documentation/HOWTO//packet-filtering-HOWTO.html>

NAT Example

The IP address of all packets leaving LAN1 are changed to 192.168.3.127 (you will need to load the module `ipt_MASQUERADE`):



Enabling NAT at Bootup

In most real world situations, you will want to use a simple shell script to enable NAT when the MPC-2070/2120-LX or MPC-2101/2121-LX boots up. The following script is an example.

```
#!/bin/bash
# If you put this shell script in the /home/nat.sh
# Remember to chmod 744 /home/nat.sh
# Edit the rc.local file to make this shell startup automatically.
# vi /etc/rc.local
# Add a line in the end of rc.local /home/nat.sh
EXIF= "enpl0" #This is an external interface for setting up a valid IP address.
EXNET= "192.168.4.0/24" #This is an internal network address.

# Step 1. Insert modules.
# Here 2> /dev/null means the standard error messages will be dump to null device.
modprobe ip_tables 2> /dev/null
modprobe ip_nat_ftp 2> /dev/null
modprobe ip_nat_irc 2> /dev/null
modprobe ip_conntrack 2> /dev/null
modprobe ip_conntrack_ftp 2> /dev/null
modprobe ip_conntrack_irc 2> /dev/null

# Step 2. Define variables, enable routing and erase default rules.
PATH=/bin:/sbin:/usr/bin:/usr/sbin:/usr/local/bin:/usr/local/sbin
export PATH
echo "1" > /proc/sys/net/ipv4/ip_forward
/sbin/iptables -F
/sbin/iptables -X
/sbin/iptables -Z
/sbin/iptables -F -t nat
/sbin/iptables -X -t nat
/sbin/iptables -Z -t nat
/sbin/iptables -P INPUT ACCEPT
```

```

/sbin/iptables -P OUTPUT ACCEPT
/sbin/iptables -P FORWARD ACCEPT
/sbin/iptables -t nat -P PREROUTING ACCEPT
/sbin/iptables -t nat -P POSTROUTING ACCEPT
/sbin/iptables -t nat -P OUTPUT ACCEPT

# Step 3. Enable IP masquerade.
#echo 1 > /proc/sys/net/ipv4/ip_forward
#modprobe ipt_MASQUERADE
#iptables -t nat -A POSTROUTING -o enp1s0 -j MASQUERADE

```

NFS (Network File System) Client

The Network File System (NFS) is used to mount a disk partition on a remote machine (as if it were on a local hard drive), allowing fast, seamless sharing of files across a network. NFS allows users to develop applications for the MPC-2070/2120-LX or MPC-2101/2121-LX without worrying about the amount of disk space that will be available. The MPC-2070/2120-LX or MPC-2101/2121-LX only supports NFS client protocol.



ATTENTION

Click on the following links for more information about NFS.

<http://www.ietf.org/rfc/rfc1213.txt>

<http://www.faqs.org/rfcs/rfc1317.html>

The following procedure illustrate how to mount a remote NFS Server.

1. Scan the NFS Server's shared directory:

```
# showmount -e HOST
```

showmount: Shows the mount information of an NFS Server

-e: Shows the NFS Server's export list.

HOST: IP address or DNS address

2. Establish a mount point on the NFS Client site:

```
# mkdir -p /home/nfs/public
```

3. Mount the remote directory to a local directory:

```
# mount -t nfs -o nolock 192.168.3.100:/home/public /home/nfs/public
```

(This is where 192.168.3.100 is the example IP address of the NFS server.)

Wireless Management

MPC-2101/2121 differs from MPC-2070/2120 had a mini-PCIE slot for wireless module installation. Currently it supports the WPER-172GN Wi-Fi module and UBlox L280 cellular module in the Linux system. The Wi-Fi module is manageable by iw, wpa_supplicant or hostapd software package in the system. The cellular module is manageable by cell_mgmt utility.

Device Driver for WPEA-172GN – rt5572sta.ko

There are two choices of device driver for WPER-172GN. One is the rt5572sta.ko. The source is opened at, <https://github.com/cristiklein/ralink>. We have built and install it in the released Linux image. It's located at /lib/modules/4.9.0-8-amd64/kernel/drivers/net/wireless/rt5572sta.ko. You can follow these steps to put another driver in blacklist. The system will load the rt5572sta.ko during boot up.

```

moxa@moxa:~$ sudo vi /etc/modprobe.d/rt2800usb.conf
Blacklist rt2800usb

```

Configure the ra0 interface in /etc/network/interfaces

```
moxa@moxa:~$ sudo vi /etc/network/interfaces
...
auto ra0
iface ra0 inet static
    address 192.168.5.127
    network 192.168.5.0
    netmask 255.255.255.0
...
```

Then reboot the system. The ra0 interface should be up if the WPER-172GN module installed in the mini-PCIE slot. Type ifconfig or ip command can check the network interface up and down status.

You can use iwlist to manually scan the wireless network.

```
moxa@moxa:~# sudo ifconfig ra0 up
moxa@moxa:~# sudo iwlist ra0 scanning
...
    Cell 16 - Address: 70:62:B8:64:21:10
        Protocol:802.11b/g/n
        ESSID:"dlink_24GHz_luke"
        Mode:Managed
        Frequency:2.412 GHz (Channel 1)
        Quality=73/100 Signal level=-61 dBm Noise level=-92 dBm
        Encryption key:on
        Bit Rates:54 Mb/s
        IE: WPA Version 1
            Group Cipher : TKIP
            Pairwise Ciphers (2) : CCMP TKIP
            Authentication Suites (1) : PSK
        IE: IEEE 802.11i/WPA2 Version 1
            Group Cipher : TKIP
            Pairwise Ciphers (2) : CCMP TKIP
            Authentication Suites (1) : PSK
        IE: Unknown:
        DD1D0050F204104A0001101044000102103C0001031049000600372A000120
```

In the above scan result, we want to associate with "dlink_24GHz_luke" access point. Configure wpa_supplicant to associate with the access point.

```
root@moxa:~# vi /etc/wpa_supplicant/wpa2.conf
network={
    ssid="dlink_24GHz_luke"
    psk=12345678
}

root@moxa:~# wpa_supplicant -D wext -i ra0 -c /etc/wpa_supplicant/wpa2.conf -B
root@moxa:~#
```

-B means run wpa_supplicant in the background.

-D specifies the wireless driver. wext is the generic driver.

-c specifies the path for the configuration file.

NOTE You can use -d to replace the -B in debugging purpose.

Use the iwconfig command to verify that you are indeed connected to the SSID.

```
root@Moxa:~# iwconfig ra0
    ra0      Ralink STA  ESSID:"dlink_24GHz_luke"  Nickname:"RT2870STA"
            Mode:Managed  Frequency=2.412 GHz  Access Point: 70:62:B8:64:21:10
            Bit Rate=54 Mb/s
            RTS thr:off   Fragment thr:off
            Encryption key:A5C4-EB2D-CC06-07AF-461C-4F2B-05F4-C3C3 [2]  Security
mode:restricted  Security mode:open
            Link Quality=83/100  Signal level:-63 dBm  Noise level:-84 dBm
            Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
            Tx excessive retries:0  Invalid misc:0  Missed beacon:0
```

Obtain IP address by DHCP

```
root@Moxa:~# sudo dhclient ra0
    Use the ip command to verify the IP address assigned by DHCP. The IP address is
192.168.3.90 from below.

root@Moxa:~# ip addr show ra0
    4: ra0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group
default qlen 1000
    link/ether 00:0e:8e:6e:f9:63 brd ff:ff:ff:ff:ff:ff
    inet 192.168.5.127/24 brd 192.168.5.255 scope global ra0
        valid_lft forever preferred_lft forever
    inet 192.168.3.90/24 brd 192.168.3.255 scope global ra0
        valid_lft forever preferred_lft forever
    inet6 fe80::20e:8eff:fe6e:f963/64 scope link
        valid_lft forever preferred_lft forever
root@Moxa:~#
```

Ping the global IP address to test connectivity.

```
root@Moxa:~# ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=119 time=12.6 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=119 time=3.57 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=119 time=4.22 ms
^C
--- 8.8.8.8 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 3.571/6.809/12.633/4.127 ms
```

Device Driver for WPEA-172GN - rt2800usb.ko

To support the rt2800usb.ko, you should add a non-free component, firmware-misc-nonfree, in the system. First of all, configure /etc/apt/sources.list to install the non-free components.

```
# Debian 9 "Stretch"
deb http://http.debian.net/debian/ stretch main contrib non-free
```

Update the list of available packages

```
root@Moxa:~# apt-get update
```

In Debian Stretch: Install the firmware-misc-nonfree package

```
root@Moxa:~# apt-get install firmware-misc-nonfree
```

Connect the device to your system. The `rt2800usb` kernel module is automatically loaded for supported devices. Configure your wireless interface by `iw` or `wpa_supplicant` as appropriate.

iw

`iw` is a new `nl80211` based CLI configuration utility for wireless devices. It replaces the old tool `iwconfig`, which uses Wireless Extensions interface, is deprecated and recommended to switch to `iw` and `nl80211`.

Get device capabilities:

```
moxa@Moxa:~$ sudo iw list
```

Scanning

```
moxa@Moxa:~$ sudo iw dev wlan0 scan
```

Listening to events

```
moxa@Moxa:~$ sudo iw event
```

Establishing a basic connection to an AP that has encryption disabled.

```
moxa@Moxa:~$ sudo iw dev wlan0 connect TARGET_AP_SSID
```

To connect to an AP that use WEP, you can use:

```
moxa@Moxa:~$ sudo iw dev wlan0 connect TARGET_AP_SSID key 0:abcde d:1:6061626364
```

Disconnect from the current network.

```
moxa@Moxa:~$ sudo iw dev wlan0 disconnect
```

Get the usage information of the `iw` utility.

```
moxa@Moxa:~$ sudo iw -help
```

wpa_supplicant

Create `/etc/wpa_supplicant/wpa_supplicant.conf` for connecting to an AP that has encryption disabled.

```
moxa@Moxa:~$ sudo vi /etc/wpa_supplicant/wpa_supplicant.conf
network={
ssid="MYAPSSID"
key_mgmt=NONE
}
```

To connect to an AP that uses WEP, the configuration is as follows:

```
moxa@Moxa:~$ sudo vi /etc/wpa_supplicant/wpa_supplicant.conf
network={
ssid="MYAPSSID"
key_mgmt=NONE
wep_key0=1234567890
wep_key1="abcde"
wep_key2="1234567890123"
wep_tx_keyidx=0
priority=5
}
```

To connect to an AP that use WPA, the configuration is as follows:

```
moxa@Moxa:~$ sudo vi /etc/wpa_supplicant/wpa_supplicant.conf
network={
ssid="MYAPSSID"
```

```
psk="1234567890"  
}
```

Manually run the `wpa_supplicant` in daemon mode with the above configures.

```
moxa@moxa:~$ sudo wpa_supplicant -Dnl80211 -iwlan0 -c  
/etc/wpa_supplicant/wpa_supplicant.conf -B
```

Then you can check the connection using the `iw` command.

```
moxa@moxa:~$ sudo iw dev wlan0 link
```

After `/etc/wpa_supplicant/wpa_supplicant.conf` has confirmed, edit `/etc/network/interfaces` to use `wpa_supplicant`.

```
moxa@moxa:~$ sudo vi /etc/network/interfaces  
...  
auto wlan0  
iface wlan0 inet dhcp  
wpa-driver nl80211  
wpa-conf /etc/wpa_supplicant/wpa_supplicant.conf
```

Then you can "ifdown wlan0" and "ifup wlan0" to check the `wpa_supplicant` configure.

Cellular Management – cell_mgmt

The MPC-2101/2121 has a mini-PCIE slot. You can install a LTE mini-PCIE module on this slot. Most popular mini-PCIE module supports AT command or QMI interface. We provide a cellular management utility, `cell_mgmt`, for cellular module management. You can check the help information from the cellular management.

```
moxa@moxa:~# sudo cell_mgmt help
```

Following are the example used the cellular management utility managed the cellular module, Ublox L280.

Get the signal strength.

```
moxa@moxa:~# sudo cell_mgmt signal  
lte -68 dbm
```

Get the SIM card status.

```
moxa@moxa:~# sudo cell_mgmt sim_status  
+CPIN: READY
```

Check module information.

```
Module=u-blox TOBY-L2 series  
WWAN_node=enp0s29u1u4  
AT_port=/dev/ttyACM0  
GPS_port=NotSupport  
LAC=  
CellID=  
ICC-ID=89886920042526767236  
IMEI=358503060403350  
QMI_port=NotSupport  
LCID=
```

Check operator information.

```
moxa@moxa:~# sudo cell_mgmt operator  
Chunghwa Telecom
```


Power on/off the cellular module.

```
moxa@moxa:~# sudo cell_mgmt power_off
Network already stopped
Clearing state...
root@moxa:~# ls -al /dev/ttyACM0
ls: cannot access /dev/ttyACM0: No such file or directory
moxa@moxa:~# sudo cell_mgmt power_on
```

Check at command.

```
moxa@moxa:~# sudo cell_mgmt at "+csq"
+CSQ: 23,99 OK
```

Reset the cellular module and check the cellular module connect and disconnect information.

```
moxa@moxa:~# sudo cell_mgmt reset
root@moxa:~# dmesg
...
[ 1740.205317] usb 1-1.3.1: USB disconnect, device number 8
[ 1740.206225] option1 ttyUSB0: GSM modem (1-port) converter now disconnected from
ttyUSB0
[ 1740.206303] option 1-1.3.1:1.0: device disconnected
[ 1740.206930] qmi_wwan 1-1.3.1:1.2 wwan0: unregister 'qmi_wwan'
usb-0000:00:1d.0-1.3.1, WWAN/QMI device
[ 1740.233955] option1 ttyUSB1: GSM modem (1-port) converter now disconnected from
ttyUSB1
[ 1740.233993] option 1-1.3.1:1.3: device disconnected
[ 1740.235131] option1 ttyUSB2: GSM modem (1-port) converter now disconnected from
ttyUSB2
[ 1740.235167] option 1-1.3.1:1.4: device disconnected
[ 1740.237083] option1 ttyUSB3: GSM modem (1-port) converter now disconnected from
ttyUSB3
[ 1740.237122] option 1-1.3.1:1.5: device disconnected
[ 1740.238483] option1 ttyUSB4: GSM modem (1-port) converter now disconnected from
ttyUSB4
[ 1740.238520] option 1-1.3.1:1.6: device disconnected
[ 1752.436526] usb 1-1.3.1: new high-speed USB device number 9 using ehci-pci
[ 1752.536781] usb 1-1.3.1: New USB device found, idVendor=1bc7, idProduct=1201
[ 1752.536803] usb 1-1.3.1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 1752.536817] usb 1-1.3.1: Product: Android
[ 1752.536829] usb 1-1.3.1: Manufacturer: Android
[ 1752.536841] usb 1-1.3.1: SerialNumber: 0123456789ABCDEF
[ 1752.556214] option 1-1.3.1:1.0: GSM modem (1-port) converter detected
[ 1752.557043] usb 1-1.3.1: GSM modem (1-port) converter now attached to ttyUSB0
[ 1752.561008] qmi_wwan 1-1.3.1:1.2: cdc-wdm0: USB WDM device
[ 1752.561956] qmi_wwan 1-1.3.1:1.2 wwan0: register 'qmi_wwan' at
usb-0000:00:1d.0-1.3.1, WWAN/QMI device, 02:29:d8:91:80:f5
[ 1752.562375] option 1-1.3.1:1.3: GSM modem (1-port) converter detected
[ 1752.562909] usb 1-1.3.1: GSM modem (1-port) converter now attached to ttyUSB1
[ 1752.563628] option 1-1.3.1:1.4: GSM modem (1-port) converter detected
[ 1752.564122] usb 1-1.3.1: GSM modem (1-port) converter now attached to ttyUSB2
[ 1752.569265] option 1-1.3.1:1.5: GSM modem (1-port) converter detected
[ 1752.569558] usb 1-1.3.1: GSM modem (1-port) converter now attached to ttyUSB3
[ 1752.569960] option 1-1.3.1:1.6: GSM modem (1-port) converter detected
[ 1752.570227] usb 1-1.3.1: GSM modem (1-port) converter now attached to ttyUSB4
[ 1752.570857] usb-storage 1-1.3.1:1.7: USB Mass Storage device detected
```

```
[ 1752.571702] scsi host2: usb-storage 1-1.3.1:1.7
[ 1753.571280] scsi 2:0:0:0: Direct-Access Linux File-CD Gadget 0000 PQ: 0 ANSI: 2
```

GPS on/off.

```
root@Moxa:~# cell_mgmt gps_on
GPS function is *ENABLE*

root@Moxa:~# cat /dev/ttyUSB1

root@Moxa:~# cell_mgmt gps_on
GPS function is *ENABLE*
```

Connect/disconnect to/from the operator.

```
root@Moxa:~# cell_mgmt start APN="Internet"
PIN code: Disabled or verified
Clearing state...
root@Moxa:~# ifconfig
enp0s29u1u4: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet6 fe80::6855:faff:fef0:2c19 prefixlen 64 scopeid 0x20<link>
ether 6a:55:fa:f0:2c:19 txqueuelen 1000 (Ethernet)
RX packets 2 bytes 132 (132.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 12 bytes 2064 (2.0 KiB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
root@Moxa:~# dhclient enp0s29u1u4
root@Moxa:~# ifconfig enp0s29u1u4
enp0s29u1u4: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet 192.168.1.100 netmask 255.255.255.0 broadcast 192.168.1.255
inet6 fe80::6855:faff:fef0:2c19 prefixlen 64 scopeid 0x20<link>
ether 6a:55:fa:f0:2c:19 txqueuelen 1000 (Ethernet)
RX packets 9 bytes 948 (948.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 30 bytes 5870 (5.7 KiB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
root@Moxa:~# ping -I enp0s29u1u4 8.8.8.8
PING 8.8.8.8 (8.8.8.8) from 10.166.110.17 wwan0: 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=46 time=284 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=46 time=94.8 ms

root@Moxa:~# cell_mgmt stop
Killed old client process
Stopping network with '_qmicli --wds-stop-network=1138741424 --client-cid=10'...
Network stopped successfully
Clearing state...

root@Moxa:~# ifconfig enp0s29u1u4
enp0s29u1u4: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet6 fe80::6855:faff:fef0:2c19 prefixlen 64 scopeid 0x20<link>
ether 6a:55:fa:f0:2c:19 txqueuelen 1000 (Ethernet)
RX packets 12 bytes 1144 (1.1 KiB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 36 bytes 6822 (6.6 KiB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@Moxa:~# ping -I enp0s29u1u4 8.8.8.8
```

```
ping: Warning: source address might be selected on device other than enp0s29u1u4.  
PING 8.8.8.8 (8.8.8.8) from 192.168.3.127 enp0s29u1u4: 56(84) bytes of data.
```

**ATTENTION**

The MPC-2000 serial has two models, only the MPC-2101/2121 supports the mini-PCIe slot. The cell_mgnt is only for miniPCIe LTE module.

Programming Guide

The following topics are covered in this chapter:

- ❑ **The Device Driver Source**
- ❑ **Multi-arch Development Tools**
- ❑ **Year 2038 Problem – Recompile the Program with 64-bits glibc**
- ❑ **Device IOCTL**
- ❑ **RTC (Real Time Clock)**
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- ❑ **Digital I/O**
- ❑ **WDT (Watch Dog Timer)**
 - Introduction
 - Watchdog Usage
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- ❑ **Brightness Control Programming**
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- ❑ **Qt Programming**
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 - Qt5 Tutorial Using Qt Creator
 - Qt Programming Reference
- ❑ **mtdev (multitouch protocol translation library)**
 - Introduction
 - The multitouch and evdev
 - Examples

The Device Driver Source

The device driver sources are available at:

<https://github.com/Moxa-Linux>

Getting Product Serial Number

The product information can read by dmidecode. You can use following commands to get the information.

```
moxa@Moxa:~$ sudo dmidecode -s "baseboard-manufacturer"
MOXA
moxa@Moxa:~$ sudo dmidecode -s "baseboard-serial-number"
TACCA1000000
```

Refer to the following keywords for getting other product information.

```
bios-vendor
bios-version
bios-release-date
system-manufacturer
system-product-name
system-version
system-serial-number
system-uuid
baseboard-manufacturer
baseboard-product-name
baseboard-version
baseboard-serial-number
baseboard-asset-tag
chassis-manufacturer
chassis-type
chassis-version
chassis-serial-number
chassis-asset-tag
processor-family
processor-manufacturer
processor-version
processor-frequency
```

Multi-arch Development Tools

The MPC-2070/2120-LX OR MPC-2101/2121-LX is a native 64-bits Linux operating system. The system installs multi-arch development tools to support 32-bits programs in the 64-bits operating system. You can compile your program with `-m32 CFLAGS` to output the 32 bits program. For example, add `-m32` in `CFLAGS` in the `selftests` program.

```
moxa@Moxa:~$ vi selftests/Makefile
...
CFLAGS += -O3 -Wl,-no-as-needed -Wall -m32
```

Build the program and check the file type.

```
moxa@Moxa:~$ make
moxa@Moxa:~$ file set-2038
set-2038: ELF 32-bit LSB shared object, Intel 80386, version 1 (SYSV), dynamically
```

```
linked, interpreter /lib/ld-linux.so.2, for GNU/Linux 2.6.32,
BuildID[sha1]=662623acbf53f7b9db464b88d9e20cf1611e3458, not stripped
Run the test program - The test result are all OK.
```

Run this program in a 64-bits environment.

```
moxa@moxa:~$ ./set-2038
```

Year 2038 Problem – Recompile the Program with 64-bits glibc

In a 32-bits operating system, C the standard 4-byte format assumes the beginning of time is January 1, 1970, at 12:00:00 a.m. It rolls over to a negative (and invalid) value is 2,147,483,647, which translates into January 19, 2038. On this date, any 32-bits C programs that use the standard time library will start to have problems with date calculations. To correct it simply recompile the programs with the 64-bits library that uses 8-byte values for the storage format.

Device IOCTL

The MPC-2070/2120-LX or MPC-2101/2121-LX is a Linux operating system. Most device supports the ioctl system call to control the device. The ioctl system call is shown below:

```
int ioctl(int d, int request,...);

Input:
<d> open device node return file handle
<request> argument in or out
```

Refer the Linux's man page for detailed documentation:

```
# man ioctl
```

RTC (Real Time Clock)

The device node is located at /dev/rtc. It supports the standard Linux simple RTC control. You must include <Linux/rtc.h>.

Function: RTC_RD_TIME

```
int ioctl(fd, RTC_RD_TIME, struct rtc_time *time);
```

```
Description: read time information from the RTC. It will return the value on argument 3.
```

Function: RTC_SET_TIME

```
int ioctl(fd, RTC_SET_TIME, struct rtc_time *time);
```

```
Description: set RTC time. Argument 3 will be passed to RTC.
```

UART

The normal tty device nodes are **/dev/ttyS0**, **/dev/ttyS1**, ... in Linux. The UART port supports standard Linux termios control. The serial interface default operation mode is set to RS-232, you can use this command to change the operation mode.

setinterface device-node [interface-no]

device-node: /dev/ttySn; n = 0,1,2,...

interface-no: [see following table]:

Interface-no	Operation Mode
None	Display current setting
0	RS-232
1	RS-485 2-wires
2	RS-422 or RS-485 4-wires

Digital I/O

Digital Output channels can be set to high or low. The channels are controlled by /sys file. Following is the DI/DO number mapping table.

Function	Sysfs file
DI1	/sys/class/gpio/di1/value
DI2	/sys/class/gpio/di2/value
DI3	/sys/class/gpio/di3/value
DI4	/sys/class/gpio/di4/value
DO1	/sys/class/gpio/do1/value
DO2	/sys/class/gpio/do2/value

The DI/DO can be accessed via **/sys/class/gpio/diN/value** or **/sys/class/gpio/doN/value**. All the GPIO sysfs files have been exported by

/etc/systemd/system/multi-user.target.wants/mx_gpio_export.service at boot. You don't need to export the GPIO entry. You can use cat or echo to access the GPIO directly in a shell program.

To set DO1 to status as low in shell script:

```
moxa@Moxa:~# sudo echo 0 > /sys/class/gpio/do1/value
```

To set DO1 to status as high in shell script:

```
moxa@Moxa:~# sudo echo 1 > /sys/class/gpio/do1/value
```

To read the DI1 status in shell script:

```
moxa@Moxa:~# sudo cat /sys/class/gpio/di1/value
```

In case of setting the value of DO1 in C:

```

sprintf(buf, "/sys/class/gpio/do%d/value", gpio);

fd = open(buf, O_WRONLY);

// Set GPIO high status
write(fd, "1", 1);
// Set GPIO low status
write(fd, "0", 1);

close(fd);

```

In case of getting the value of DI1 in C:

```
sprintf(buf, "/sys/class/gpio/di%d/value", gpio);

fd = open(buf, O_RDONLY);

read(fd, &value, 1);

if(value == '0')
{
// Current GPIO status low
}
else
{
// Current GPIO status high
}
close(fd);
```

WDT (Watch Dog Timer)

Introduction

The WDT works like a watchdog function, and can be enabled or disabled. When the WDT function is enabled and the application does not acknowledge it, the system will reboot.

Watchdog Usage

User can set the ack time from a minimum of 1 sec to a maximum of 1days.The default timer is 60. So, if the watchdog daemon crashes, the system will reboot after the timeout has passed.

WDT IOCTL Commands

The Linux Watchdog Device IOCTL Commands can found in `/usr/include/Linux/watchdog.h`.

How the WDT Works

Debian project supports a watchdog daemon. The watchdog daemon checks if your system is still working. If programs are no longer executed it will perform the hard reset of the system. The standard watchdog driver and package have been installed in the system. If you need to run the watchdog once the system boots up, you can use the **systemctl** to enable the watchdog function.

```
moxa@Moxa:~# sudo systemctl enable watchdog
moxa@Moxa:~$
```

The watchdog configure file is located in `/etc/watchdog.conf`. The acknowledgement interval can be set to any number between 2 seconds and 58 seconds. Currently we configure the watchdog daemon to acknowledge in 29 seconds because the watchdog daemon suggests to acknowledge twice before the watchdog timer timeout and the daemon might sleep. The realtime is to lock itself into memory, so it is never swapped out to prevent the delay of watchdog acknowledge. The priority set the schedule priority for realtime mode.

```
...
watchdog-device = /dev/watchdog
...
interval = 29
```



```
realtime = yes
priority = 1
...
```

If you want to monitor the execution of some daemon, eg: crond, you can configure the pidfile to monitor the daemon.

```
pidfile=/var/run/crond.pid
```

If you want to monitor network is alive, you can configure the ping and interface to check the gateway in the local area network. Eg. The system will reset if ping the gateway 10.144.7.254 from eth0 over 5 times.

```
ping=10.144.7.254
interface=eth0
```

If you want to remove it from systemd, you can use this command.

```
moxa@moxa:~# sudo systemctl disable watchdog
```

To check if the watchdog daemon is enabled or disabled. You can use this command.

```
moxa@moxa:~# sudo systemctl status watchdog
```

Brightness Control Programming

Introduction

The panel computer embeds with a micro-controller (uC) which controls the display brightness. User can read or write the control commands to /dev/ttyS2 with 9600 baud rate, 8 data bits, no flow control to control the display brightness.

Example: Scenario of Get Brightness value command

```

X86          /dev/ttyS2 (9600 N 8 1)      uC
0xF0 0x01 0xC0 0xC0  --->
                                     <---  0xF0 0x02 0xC0 0x01
```

Example: Scenario of Set Brightness value command

```

X86          /dev/ttyS2 (9600 N 8 1)      uC
0xF0 0x02 0xC1 0x01 0xC2  --->
                                     <---  0xF0 0x01 0xC1 0x01
```

Programming the Brightness

The brightness control command is serial protocol. We have prepared an example code for brightness programming. You can check the example code, br-util. The API is in br.h.

```

/*
 * Open the brightness control device, /dev/ttyS2, in 9600n81.
 * return: the device descriptor
 */
int open_brightness_control(void);
/*
 * Close the brightness control device, /dev/ttyS2.
 */
void close_brightness_control(int fd);
/*
 *      X86                                uC
```

```

* Get auto brightness control status
*   0xF0 0x01 0xC2 0xC2 --->
*           <--- 0xF0 0x02 0xC2 0x01 0xC3
*
* int fd: the device descriptor
* return:
*   0: Auto brightness control is disabled
*   1: Auto brightness control is enabled
*  -4: write brightness command fail
*  -5: read the response of brightness command fail
*  -6: The response is not the expected value
*/
int get_auto_brightness_control_status(int fd);
/*
*   X86                               uC
* Enable auto brightness control
*   0xF0 0x02 0xC3 0x01 0xC4 --->
*           <--- 0xF0 0x01 0xC3 0xC3
*
* Disable auto brightness control
*   0xF0 0x02 0xC3 0x00 0xC3 --->
*           <--- 0xF0 0x00 0xC3 0xC3
*           <--- 0xF0 0x01 0xC3 0xC3
* int fd: the device descriptor
* int on_off:
*   0: disable the auto brightness control
*   1: enable the auto brightness control
*   2: enable the auto-sent brightness control (debugging purpose)
* return:
*   0: success
*  -2: on_off is not 0 or 1
*  -4: write brightness command fail
*  -5: read the response of brightness command fail
*  -6: The response is not the expected value
*/
int set_auto_brightness_control(int fd, int on_off);
/*
* Set the brightness level
*
*   X86                               uC
*   0xF0 0x02 0xC1 0x01 0xC2 --->
*           <--- 0xF0 0x01 0xC1 0x01
* int fd: the device descriptor
* int br_value: The brightness level is in 0, 1, ..., 10.
* return:
*   0: Success
*  -3: br_value is not in 1 ~ 10
*  -4: Write brightness command fail
*  -5: Read the response of set brightness command fail
*  -6: Set brightness fail
*/
int set_brightness(int fd, int br_value);
/*
* Get the brightness level
*

```

```

*      X86                                uC
*      0xF0 0x01 0xC0 0xC0  --->
*
*      <--- 0xF0 0x02 0xC0 0x01
* int fd: the device descriptor
* int value: The brightness level is in 0, 1, ..., 10.
* return:
*      0: Success
*     -4: Write the GET BRIGHTNESS command fail
*     -5: Read the response of set brightness command fail
*/
int get_brightness(int fd, int *br_value);
/*
* Set the hold time in auto brightness control mode.
*
*      X86                                uC
*      0xF0 0x02 0xE9 0x0A 0xF3  --->
*
*      <--- 0xF0 0x01 0xE9 0xE9
* int fd: the device descriptor
* int holdtime: The holdtime is the time interval to poll the brightness of the light source.
* return:
*      0: Success
*     -3: holdtime is not in 1 ~ 10
*     -4: Write brightness command fail
*     -5: Read the response of set brightness command fail
*     -6: Set brightness fail
*/
int set_auto_brightness_control_holdtime(int fd, int holdtime);
/*
* Get the hold time in auto brightness control mode.
*
*      X86                                uC
*      0xF0 0x01 0xE9 0xE9  --->
*
*      <--- 0xF0 0x02 0xE9 0x02 0xEB
* int fd: the device descriptor
* int *holdtime: The holdtime is the time interval to poll the brightness of the light source.
* return:
*      0: Success
*     -4: Write the GET BRIGHTNESS command fail
*     -5: Read the response of set brightness command fail
*/
int get_auto_brightness_control_holdtime(int fd, int *holdtime);
/*
* Set the light sensor and brightness mapping for auto brightness control
*
*      X86                                uC
*      0xF0 0x02 0xE1 0x02 0xE3  --->
*
*      <--- 0xF0 0x01 0xE1 0xE1
* int fd: the device descriptor
* int lightsensor_level: It's in 0xE1 (Level 1), 0xE2, ..., 0xE8 (Level 8).
* int br_value: It's in 1, 2, ..., 10.
* return:
*      0: Success
*     -2: lightsensor_level is not in 1 ~ 8
*     -3: br_value is not in 1 ~ 10
*     -4: Set light sensor and brightness mapping fail

```

```

*   -5: Read the response of set brightness command fail
*   -6: Set brightness mapping response fail
*/
int set_auto_brightness_level(int fd, int lightsensor_level, int br_value);
/*
* Get the light sensor and brightness mapping for auto brightness control
*
*   X86                                uC
*   0xF0 0x01 0xE1 0xE1 --->
*                               <--- 0xF0 0x02 0xE1 0x02 0xE3
* int fd: the device descriptor
* int lightsensor_level: It's in 0xE1 (Level 1), 0xE2 (Level 2), ..., 0xE8 (Level 8).
* int br_level: It's in 1, 2, ..., 10.
* return:
*   0: Success
*  -2: lightsensor_level is not in 1 ~ 8
*  -4: Set light sensor and brightness mapping fail
*  -5: Read the response of set brightness command fail
*  -6: Get light sensor/brightness mapping fail
*/
int get_auto_brightness_level(int fd, int lightsensor_level, int *br_level);
/*
* Get the firmware version
*
*   X86                                uC
*   0xF0 0x01 0xC7 0xC7 --->
*                               <--- 0xF0 0x02 0xC7 0x12 0xD9
*   0xF0 0x01 0xCA 0xCA --->
*                               <--- 0xF0 0x02 0xCA 0x22 0xEC
*
*   The firmware version is: 0x1222, V1.2.2 S02
*
* int fd: the device descriptor
* int *frm_ver: The firmware version.
* return:
*   0: Success
*  -4: Write the GET FIRMWARE VERSION command fail
*  -5: Read the response of command fail
*  -6: Set brightness fail
*/
int get_firmware_version(int fd, int *frm_ver);
/*
*   X86                                uC
* Get brightness system status
*   0xF0 0x01 0xCE 0xCE --->
*                               <--- 0xF0 0x02 0xCE 0x03 0xE1
*
* int fd: the device descriptor
* int *value: The brightness system status.
* return:
*   0: Success
*  -4: Write the get brightness system status command fail
*  -5: Read the response command fail
*  -6: Response command incorrect
*/

```

```
int get_brightness_system_status(int fd, int *value);
```

A user program should include the br.h to include these API. To control the brightness, you should open the brightness controller and close it finally. The program would like this:

```
#include "br.h"
...
int mc_fd;
...
/* open the brightness controller */
mc_fd = open_brightness_control();
...
/* get/set/... the information from the brightness controller */
set_brightness(mc_fd, 5);
...
/* close the brightness controller */
close_brightness_control(mc_fd);
```

Programming Example - br-setbrightness-example.c

The br-setbrightness-example.c is an example of the set brightness programming. You can download this example code from Moxa's web site.

```
#include <stdio.h>
#include <unistd.h>
#include <fcntl.h>
#include <string.h>
#include <stdlib.h>
#include <sys/select.h>
#include <sys/time.h>
#include <sys/types.h>
#include <unistd.h>
#include "br.h"

#define VERSION "1.0"

int main(int argc, char *argv[]) {
    int i, mc_fd;

    mc_fd = open_brightness_control();
    if( mc_fd < 0 ) {
        if ( mc_fd == -1 )
            printf("%s opened fail.\n", BRIGHTNESS_DEVICE);
        else if( mc_fd == -2)
            printf("Please close another process using %s.\n", BRIGHTNESS_DEVICE);
        goto __exit2;
    }

    /* Set brightness manually in Auto Brightness Mode disabled. */
    for ( i=MIN_BRIGHTNESS_VALUE; i<= MAX_BRIGHTNESS_VALUE; i++) {
        if ( i == 0 )
            printf("Turn off the backlight at level %d.\n", i);
        else
            printf("Set brightness: %d.\n", i);
    }
}
```

```

        sleep(1);
        set_brightness(mc_fd, i);
    }

__exit1:
    close_brightness_control(mc_fd);
__exit2:
    return 0;
}

```

The Makefile:

```

CC=${CROSS_COMPILE}gcc
STRIP=${CROSS_COMPILE}strip

CFLAGS+= -fPIC -DBUILDDATE="$(shell date +%y%m%d%H)"

# The source of brightness control utility
TARGET1=br-util
# The set brightness programming example code
TARGET2=br-setbrightness-example

all: ${TARGET1} ${TARGET1}-debug ${TARGET2} ${TARGET2}-debug

libbr.a: br.o
    ar r libbr.a br.o

libbr.so: br.o
    $(CC) br.o -shared -o libbr.so

${TARGET1}: ${TARGET1}.c libbr.a
    $(CC) $(CFLAGS) ${TARGET1}.c -o ${TARGET1} -L. -lbr
    $(STRIP) -s ${TARGET1}

${TARGET1}-debug: ${TARGET1}.c libbr.a
    # Define -DDEBUG for debugging purpose
    $(CC) $(CFLAGS) -DDEBUG br.c ${TARGET1}.c -o ${TARGET1}-debug

${TARGET2}: ${TARGET2}.c libbr.a
    $(CC) $(CFLAGS) ${TARGET2}.c -o ${TARGET2} -L. -lbr
    $(STRIP) -s ${TARGET2}

${TARGET2}-debug: ${TARGET2}.c libbr.a
    # Define -DDEBUG for debugging purpose
    $(CC) $(CFLAGS) -DDEBUG br.c ${TARGET2}.c -o ${TARGET2}-debug

install: all
    mkdir -p $(DESTDIR)/usr/local/bin
    install -m uog+rx ${TARGET1} $(DESTDIR)/usr/local/bin
    chmod a+s $(DESTDIR)/usr/local/bin/${TARGET1}

clean:
    /bin/rm -rf *.o *.a *.so ${TARGET1} ${TARGET1}-debug ${TARGET2} ${TARGET2}-debug

```

Type make to compile the executable.

```
moxa@moxa:~/br-util/# sudo make
gcc -fPIC -DBUILDDATE="19020111" -c -o br.o br.c
ar r libbr.a br.o
ar: creating libbr.a
gcc -fPIC -DBUILDDATE="19020111" br-util.c -o br-util -L. -lbr
strip -s br-util
# Define -DDEBUG for debugging purpose
gcc -fPIC -DBUILDDATE="19020111" -DDEBUG br.c br-util.c -o br-util-debug
gcc -fPIC -DBUILDDATE="19020111" br-setbrightness-example.c -o
br-setbrightness-example -L. -lbr
strip -s br-setbrightness-example
# Define -DDEBUG for debugging purpose
gcc -fPIC -DBUILDDATE="19020111" -DDEBUG br.c br-setbrightness-example.c -o
br-setbrightness-example-debug
```

Launch the executable. The display brightness will be changed.

```
moxa@moxa:~/br-util/# sudo ./br-setbrightness-example
```

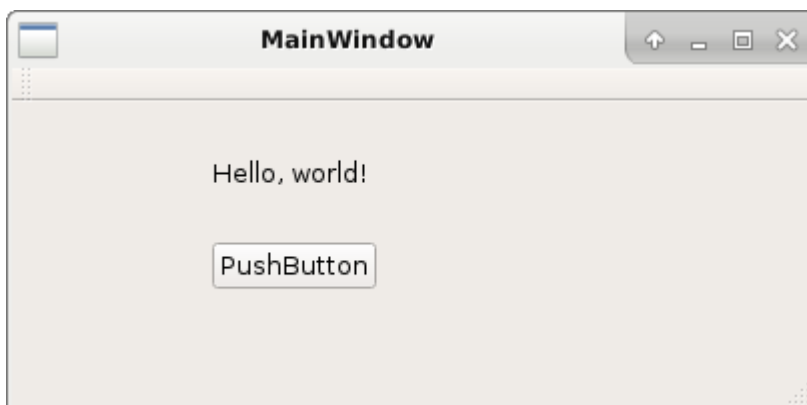
Qt Programming

Introduction

Qt (pronounced as "cute", not "cu-tee") is a cross-platform framework that is usually used as a graphical toolkit, although it is also very helpful in creating CLI applications.

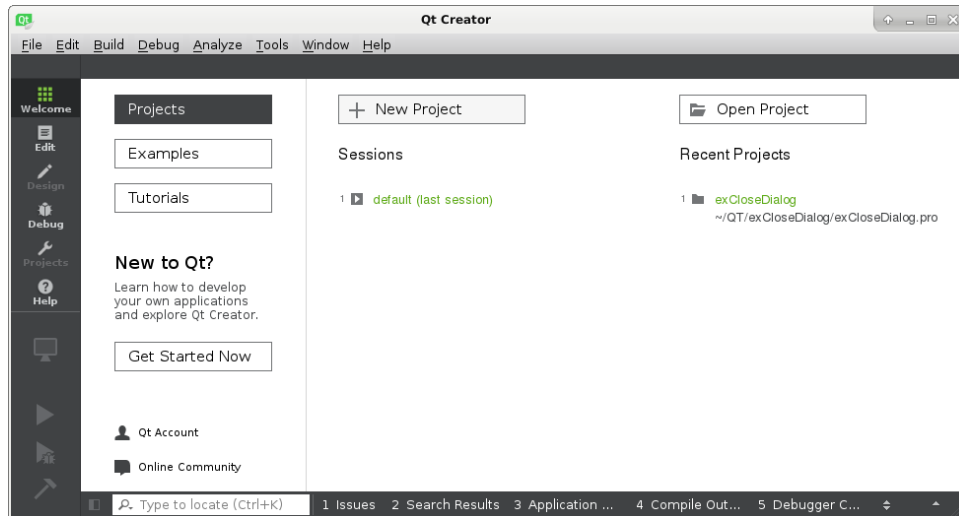
Qt5 Tutorial Using Qt Creator

This Tutorial demonstrates using Qt Creator to make a GUI application. The image bellow shows this Qt application.

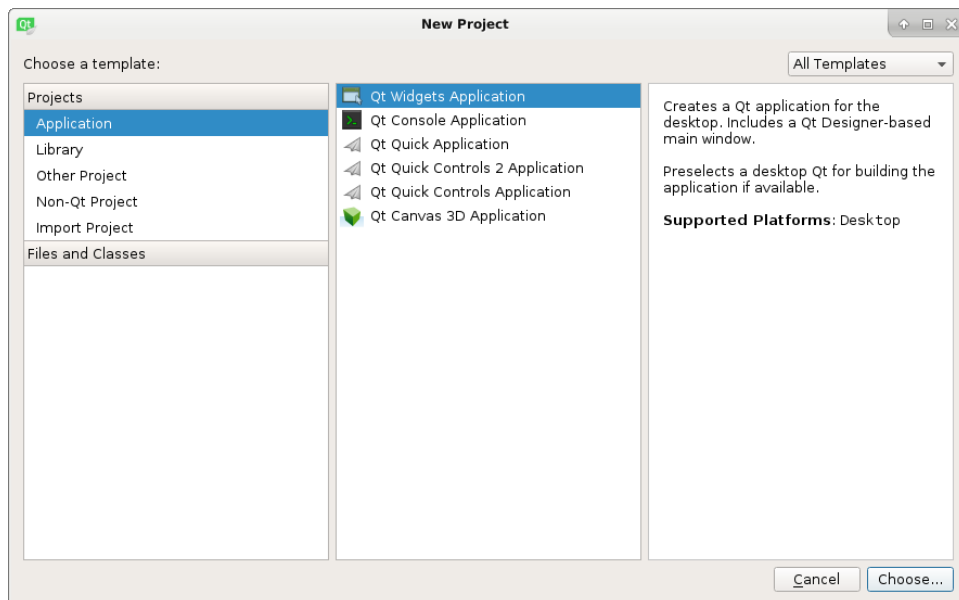


The Steps to Make a Qt Application Using Qt Creator

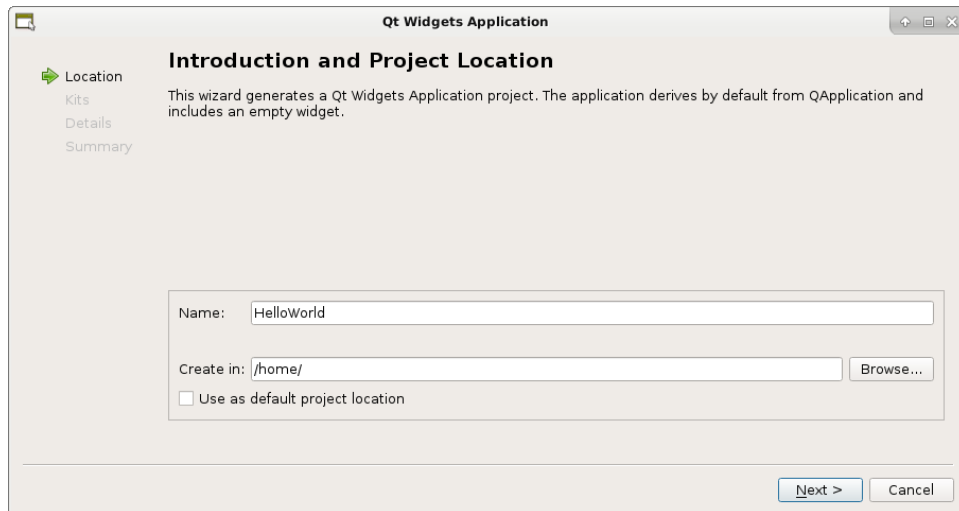
1. Start a New Qt Creator Project from **Application** → **Development** → **Qt Creator**.
2. Open the Qt Creator application and click the **New Project** button, or **File** → **New File or Project ...** from the top menu.



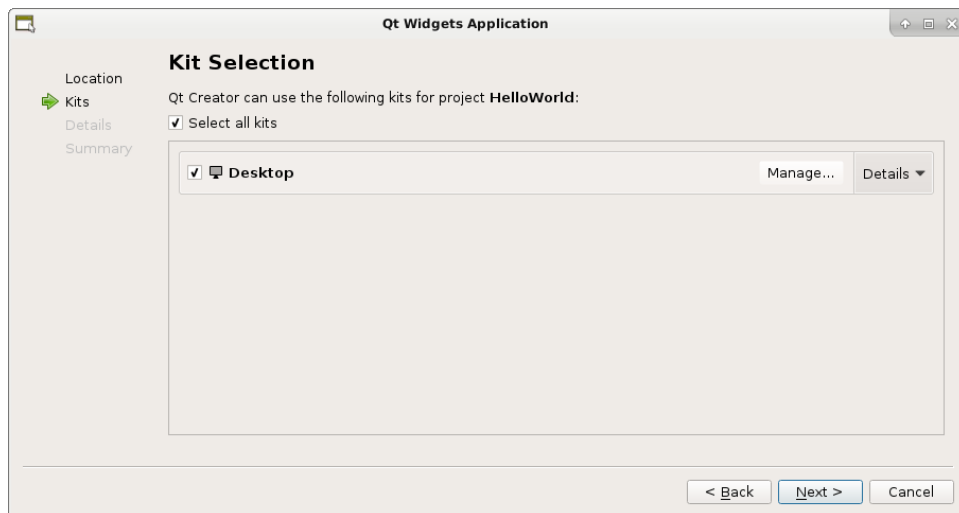
3. In the **New Project** dialog box choose **Qt Widgets Application** and then click the **Choose...** button.



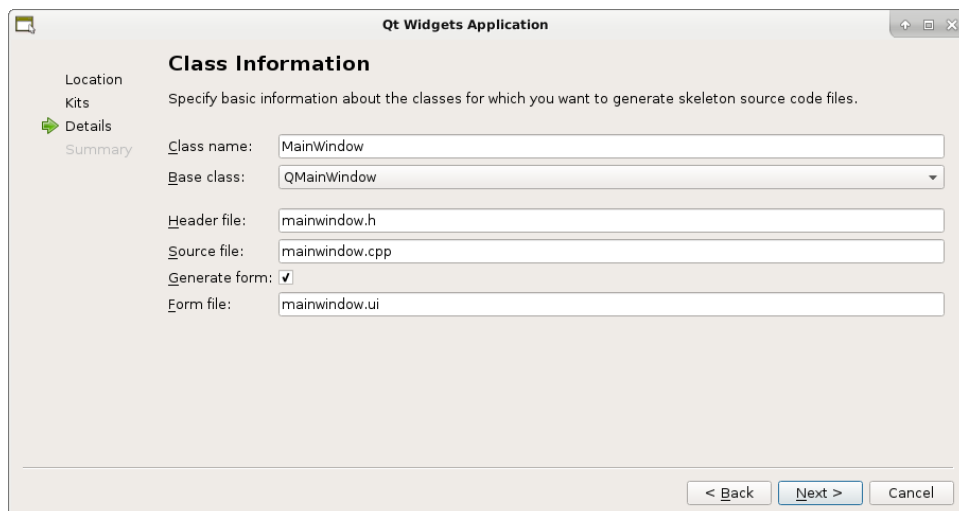
4. In the next dialog box enter the name of the project and choose the location to create the project in. Click the **Next >** button when done.



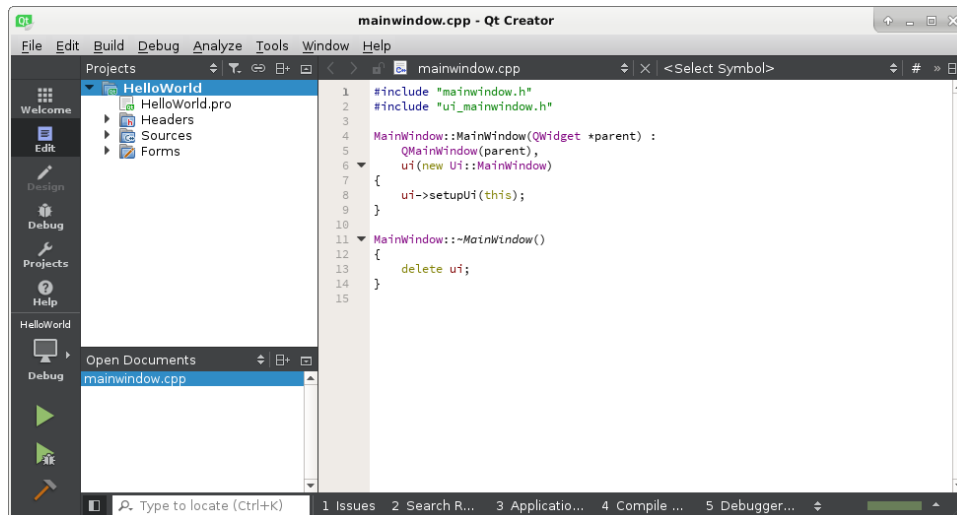
5. The Qt Kit can now be selected. It can be modified by clicking the **Manage...** or **Details...** button.



6. Click the **Next >** button and leave the class information at the default values.



7. At this stage the Run button can be clicked to build and run the new Qt Creator application (or use **Ctrl + R** on the keyboard to run). When the application runs, a window will appear that can be resized and closed.



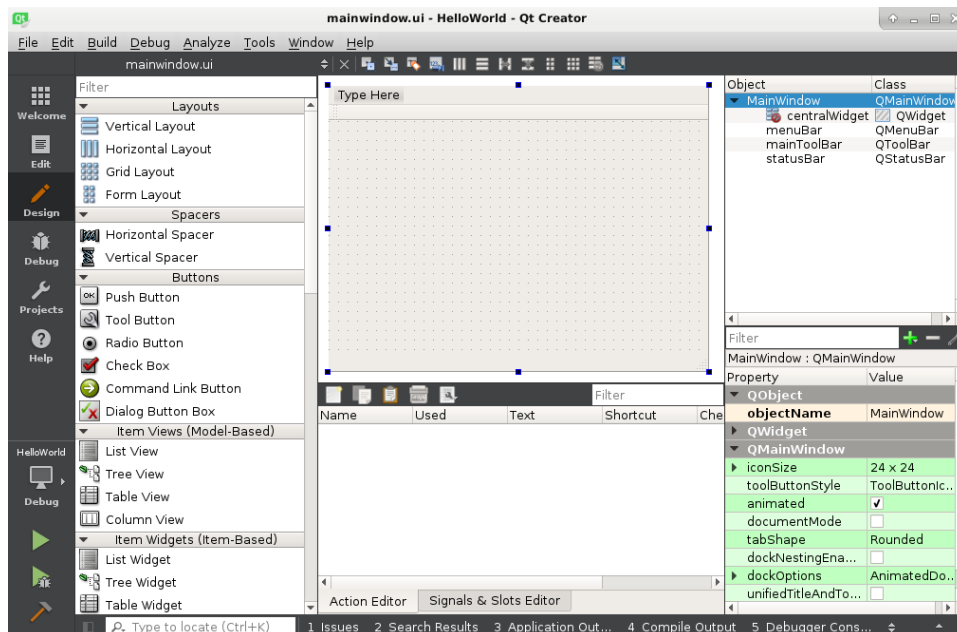
8. Edit the Application Window Graphically

To start editing the new application window in Qt Creator:

1. Expand the Forms folder at the top left of Qt Creator and double-click the mainwindow.ui file that appears. Qt Creator will now change to Design mode allowing the hello application window to be edited.

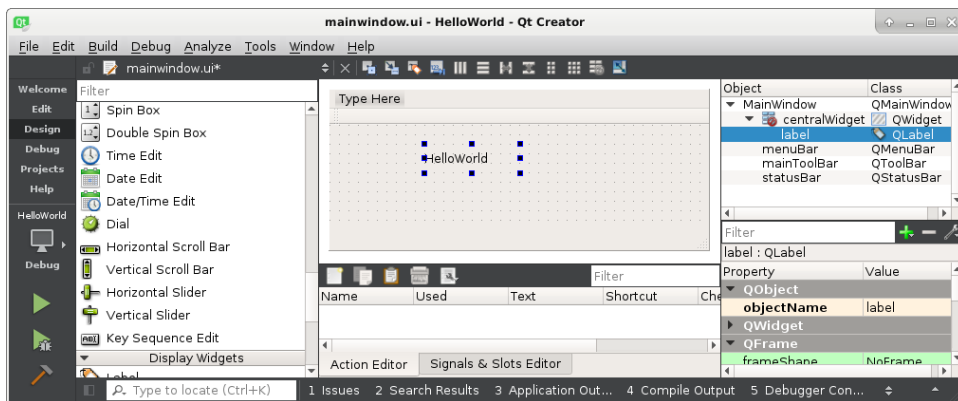


The widgets is in the right side. The widget attribute is in the left side. The Application form is in the center. You can drag-and-drop the widgets on the form.

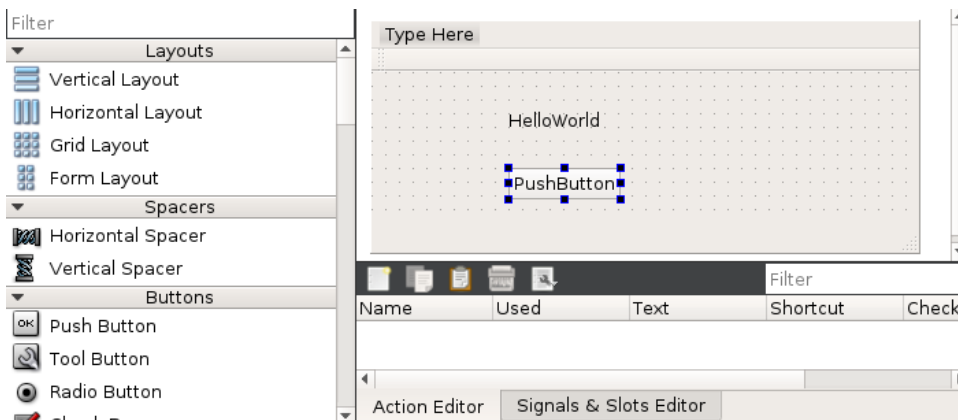


2. Add Text label

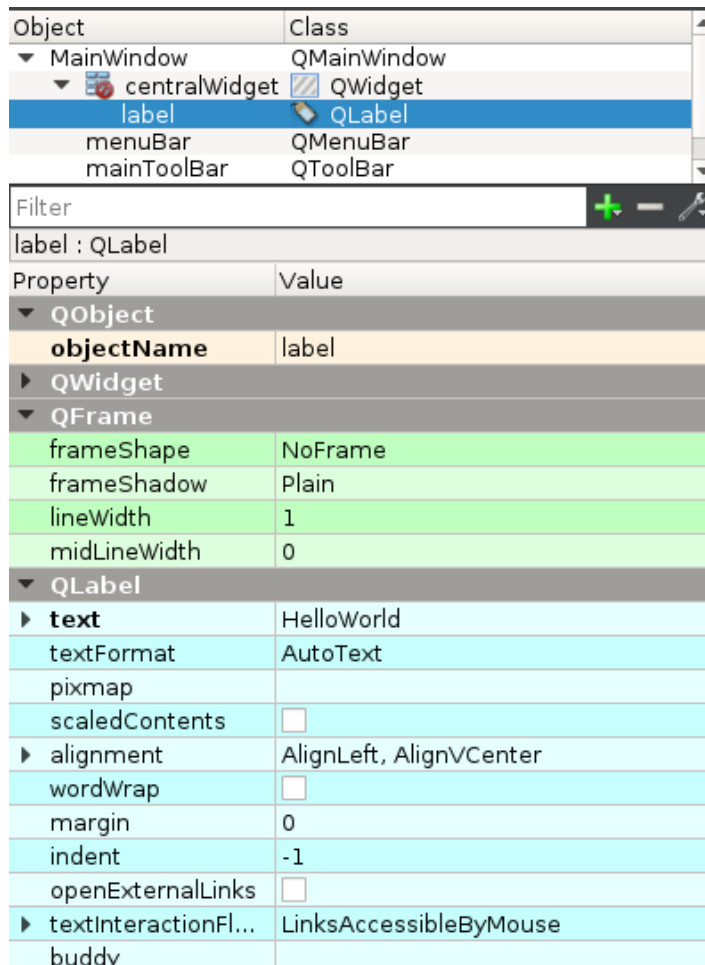
3. Drag and drop two **Label** widgets from the pane at the left of the window form, under **Display Widgets**. Drop the labels onto the form.



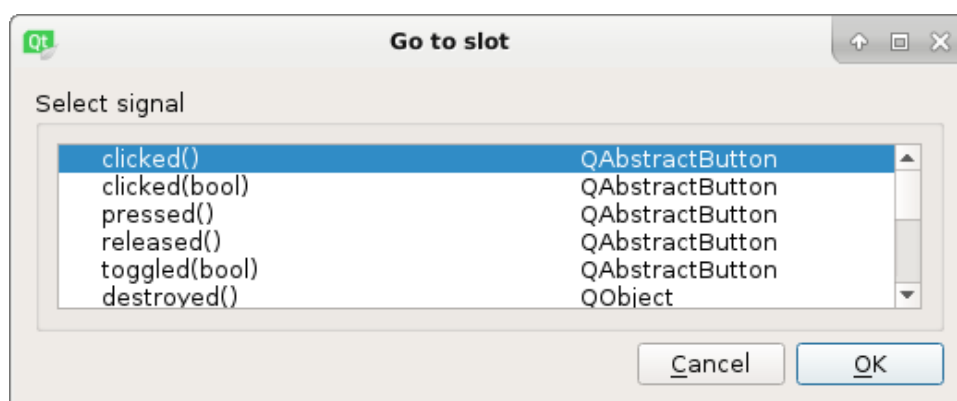
4. Add and Edit a Button Widget.
5. Add a **Push Button** to the window form by dragging and dropping it from the left widget pane under **Buttons**.



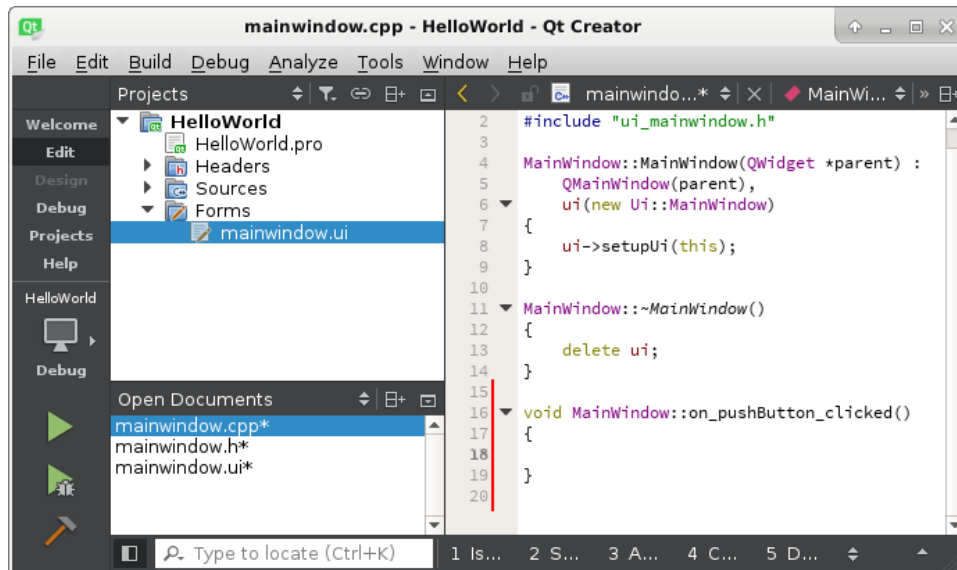
The Object names, Attributes, Alignment, ... are configurable in the right side.



6. Connecting the Button to Code.
7. We now want to connect the button to the code that will run when it is clicked. Right-click the button on the form and select **Go to slot...** on the menu that pops up. Choose **clicked()** in the dialog box that pops up and then click the **OK** button.



8. Application Operational Code.



The application code can now be written. The code writes "Hello, world!" to the first text label in the window and increments a count in the second text label every time that the button is clicked.

The code listing below shows the code added to the button click handler in the mainwindow.cpp file.

```

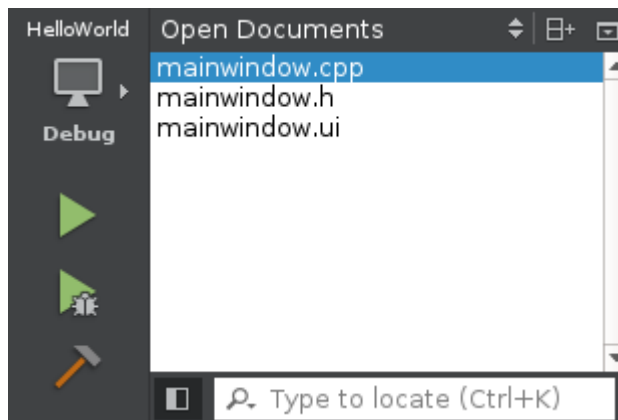
#include "mainwindow.h"
#include "ui_mainwindow.h"
MainWindow::MainWindow(QWidget *parent) :
    QMainWindow(parent),    ui(new Ui::MainWindow)
{
    ui->setupUi(this);
}
MainWindow::~MainWindow()
{
    delete ui;
}
void MainWindow::on_pushButton_clicked()
{
    // display text message in first label
    ui->label->setText("Hello, world!");
}

```

9. Build and Run the Application

Save changes to the project. This can be done using **File → Save All** from the top menu or **Ctrl + Shift + S** on the keyboard.

The Qt 5 Hello World Tutorial project can be built by clicking the hammer icon on the left toolbar of Qt Creator. The application can be run by clicking the green triangle icon on the left toolbar.



Qt Programming Reference

The Qt programming has many documentations in the Qt official web site.

You can check the Qt Reference Pages for more detail information.

<http://doc.qt.io/qt-5/reference-overview.html>

mtdev (multitouch protocol translation library)

Introduction

The mtdev is the multitouch protocol library which transforms all variants of kernel MT events to the slotted type B protocol. This platform has installed the multitouch protocol translation library. The developer can include `/usr/include/mtdev.h` which supports the API for multitouch programming. `mtview` is the multitouch example.

The multitouch and evdev

The mtdev is the multitouch protocol library which transforms all variants of kernel MT events to the slotted type B protocol. This platform has installed the multitouch protocol translation library. The developer can include `/usr/include/mtdev.h` and `/usr/include/libevdev-1.0/libevdev/libevdev.h` headers to support the multitouch programming. Parts of the functions sorted out from the header files are given below:

	WDIOC_GETSUPPORT
Function	<code>int mtdev_open(struct mtdev *dev, int fd)</code>
Description	Initialize the mtdev structure and configure it by reading the protocol capabilities through the file descriptor.
Argument	<code>struct mtdev *dev</code> : the mtdev to open
Argument	<code>int fd</code> : file descriptor of the kernel device
Return	Returns zero on success, negative error number otherwise.
Function	<code>void mtdev_close(struct mtdev *dev)</code>
Description	Deallocates all memory associated with mtdev, and clears the mtdev structure.
Argument	<code>Struct mtdev *dev</code> : the mtdev to close
Return	None
Function	<code>struct mtdev *mtdev_new_open(int fd)</code>
Description	Close conversion and delete mtdev
Argument	<code>dev</code> : the mtdev in use
Return	None
Function	<code>int mtdev_idle(struct mtdev *dev, int fd, int ms)</code>
Description	Check state of kernel device
Argument	<code>struct mtdev *dev</code> : the mtdev in use
Argument	<code>int fd</code> : file descriptor of the kernel device
Argument	<code>int ms</code> : number of milliseconds to wait for activity
Return	Returns true if the device is idle, i.e., there are no fetched events in the pipe and there is nothing to fetch from the device.
Function	<code>int mtdev_get(struct mtdev *dev, int fd, struct input_event* ev, int ev_max)</code>
Description	Get processed events from mtdev.
Argument	<code>struct mtdev *dev</code> : the mtdev in use
Argument	<code>int fd</code> : file descriptor of the kernel device
Argument	<code>struct input_event *ev</code> : array of input events to fill
Argument	<code>int ev_max</code> : maximum number of events to read
Return	On success, return 0. Otherwise, return < 0 value.
IOCTL command	<code>EVIIOCGRAB</code>
Description	Grab or ungrab the device through a kernel <code>EVIIOCGRAB</code> . This prevents other clients (including kernel-internal ones such as <code>rkill</code>) from receiving events from this device.
Function	<code>int libevdev_new_from_fd(int fd, struct libevdev **dev)</code>
Description	Get the current watchdog timeout.
Argument	<code>int fd</code> : A file descriptor to the device in <code>O_RDWR</code> or <code>O_RDONLY</code> mode.
Argument	<code>Struct libevdev **dev</code> : The newly initialized evdev device.
Return	On success, 0 is returned and <code>dev</code> is set to the newly allocated struct. On failure, a negative <code>errno</code> is returned and the value of <code>dev</code> is undefined.
Function	<code>void libevdev_free(struct libevdev *dev)</code>
Description	Clean up and free the libevdev struct. After completion, the struct <code>*libevdev</code> is invalid and must not be used. Note: This function may be called before <code>libevdev_set_fd()</code> .
Argument	<code>Struct libevdev *dev</code> : The evdev device
Return	None

Function	int libevdev_has_event_code(const struct libevdev *dev, unsigned int type, unsigned int code)
Description	Check the device supports this event type and code.
Argument	struct libevdev *dev: The evdev device, already initialized with libevdev_set_fd()
Argument	unsigned int type: the event type for the code to query (EV_SYN, EV_REL, etc.)
Argument	unsigned int code: The event code to query for, one of ABS_X, REL_X, etc.
Return	return 1 if the device supports this event type and code, or 0 otherwise.
Function	int libevdev_get_abs_minimum(const struct libevdev *dev, unsigned int code);
Description	Get the minimum axis value for the given axis, as advertised by the kernel.
Argument	struct libevdev *dev: The evdev device, already initialized with libevdev_set_fd()
Argument	unsigned int code The EV_ABS event code to query for, one of ABS_X, ABS_Y, etc.
Return	return axis minimum for the given axis or 0 if the axis is invalid
Function	int libevdev_get_abs_maximum(const struct libevdev *dev, unsigned int code);
Description	Get the maximum axis value for the given axis, as advertised by the kernel.
Argument	struct libevdev *dev: The evdev device, already initialized with libevdev_set_fd()
Argument	unsigned int code The EV_ABS event code to query for, one of ABS_X, ABS_Y, etc.
Return	return axis minimum for the given axis or 0 if the axis is invalid

Examples

The mtview is the multitouch example. You can compile and reference this example to support multitouch input feature in your application. (Note: The system has multiple input devices, you should select the touch device for mtview using.)

```
moxa@moxa:~/mtview$ make
make all-recursive
make[1]: Entering directory '/home/moxa/mtview'
Making all in tools
make[2]: Entering directory '/home/moxa/mtview/tools'
gcc -DHAVE_CONFIG_H -I. -I.. -I/usr/include/libevdev-1.0/ -I/usr/include/cairo
-I/usr/include/glib-2.0 -I/usr/lib/x86_64-linux-gnu/glib-2.0/include
-I/usr/include/pixman-1 -I/usr/include/freetype2 -I/usr/include/libpng16 -g -O2
-MT mtview.o -MD -MP -MF .deps/mtview.Tpo -c -o mtview.o mtview.c
mv -f .deps/mtview.Tpo .deps/mtview.Po
/bin/bash ../libtool --tag=CC --mode=link gcc -g -O2 -lmtdev -levdev -lX11 -lXi
-lm -lcairo -o mtview mtview.o
libtool: link: gcc -g -O2 -o mtview mtview.o -lmtdev -levdev -lX11 -lXi -lm -lcairo
make[2]: Leaving directory '/home/moxa/mtview/tools'
Making all in man
make[2]: Entering directory '/home/moxa/mtview/man'
make[2]: Nothing to be done for 'all'.
make[2]: Leaving directory '/home/moxa/mtview/man'
make[2]: Entering directory '/home/moxa/mtview'
make[2]: Leaving directory '/home/moxa/mtview'
make[1]: Leaving directory '/home/moxa/mtview'

moxa@moxa:~/mtview# sudo ./tools/mtview
Available devices:
/dev/input/event0: CHICONY HP Basic USB Keyboard
/dev/input/event1: Power Button
/dev/input/event2: Sleep Button
/dev/input/event3: Power Button
/dev/input/event4: PC Speaker
/dev/input/event5: eGalax Inc. eGalaxTouch EXC3146-3899-09.00.00
```



```
/dev/input/event6: Video Bus
/dev/input/event7: Logitech USB Optical Mouse
Select the device event number [0-7]: 5
XIO: fatal IO error 11 (Resource temporarily unavailable) on X server ":0.0"
after 4793 requests (48 known processed) with 0 events remaining.
moxa@moxa:~/mtview$
```



System Restore

The MPC-2000-LX is installed with a Linux operating system, which is located in the CFast card shipped with the MPC-2000 panel computer. Although it rarely happens, you may find on occasion that operating system files and/or the disk file system have been damaged. In this chapter we describe how to restore the Linux operating system.

The following topics are covered in this chapter:

- ❑ **Embedded Computer Restore Environment 1**
 - Embedded Computer Restore Environment
 - Embedded Computer Restore Procedure
- ❑ **Saving the System to the USB Drive**
- ❑ **Brightness Controller Firmware Upgrade**

Embedded Computer Restore Environment 1

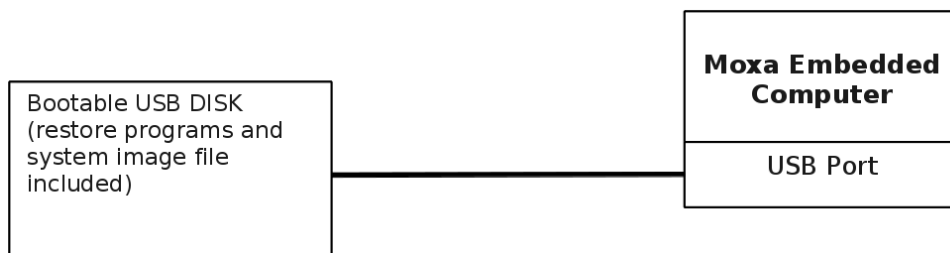
Embedded Computer Restore Environment

The restore environment includes the MPC-2070/2120-LX or MPC-2101/2121 embedded computer and a bootable USB disk with the restore programs and system image file.

Hardware

The hardware used includes a PC, a MPC-2070/2120-LX or MPC-2101/2121-LX computer and a USB disk with the restore programs.

NOTE The USB disk should be at least 4 GB

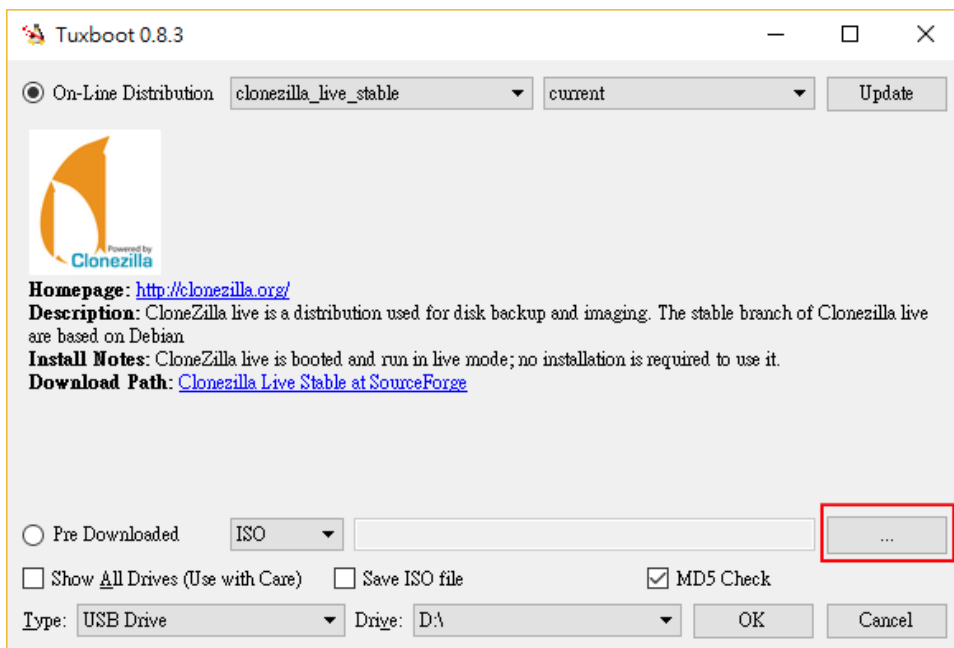


Embedded Computer Restore Procedure

Step 1: Prepare Your USB drive

For Windows Users:

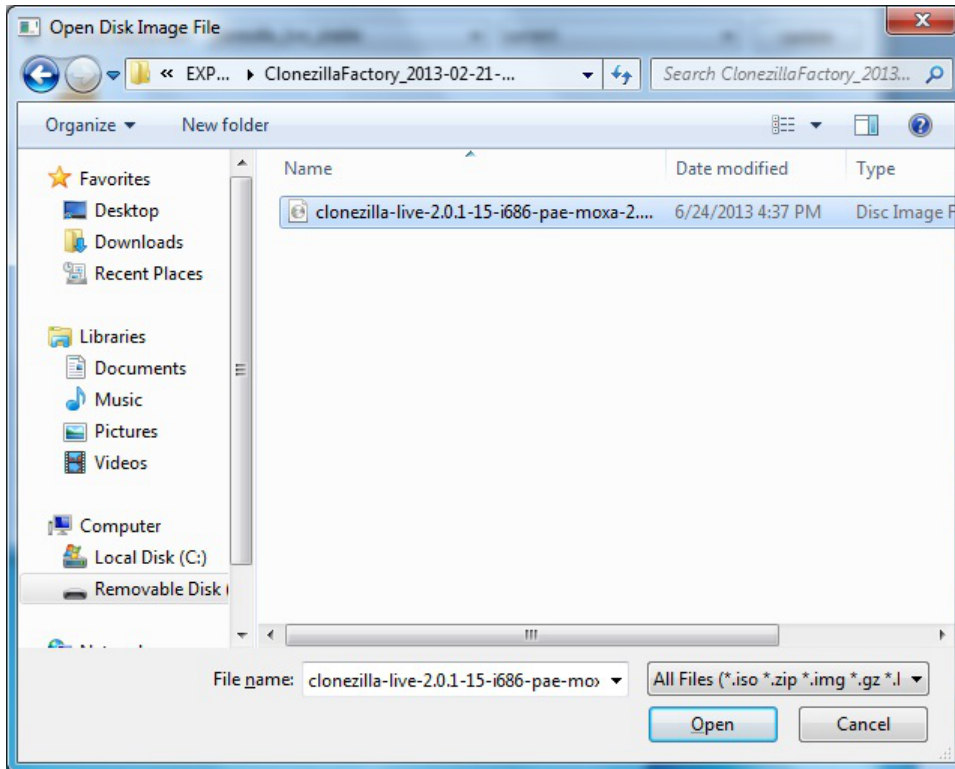
1. Execute tuxboot from the Clonezilla/tuxboot/Windows folder on the Software CD, select Pre Download, and then click "...".



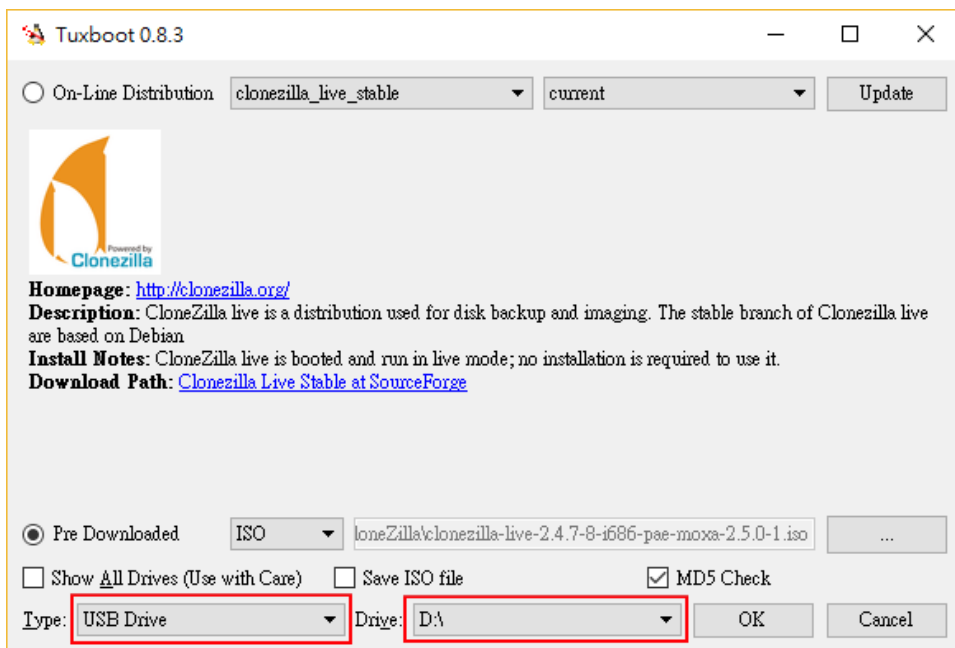
Linux users can get the Linux version of tuxboot from sourceforge to make the Clonezilla USB stick.

<https://sourceforge.net/projects/tuxboot/files/0.8/Linux/>

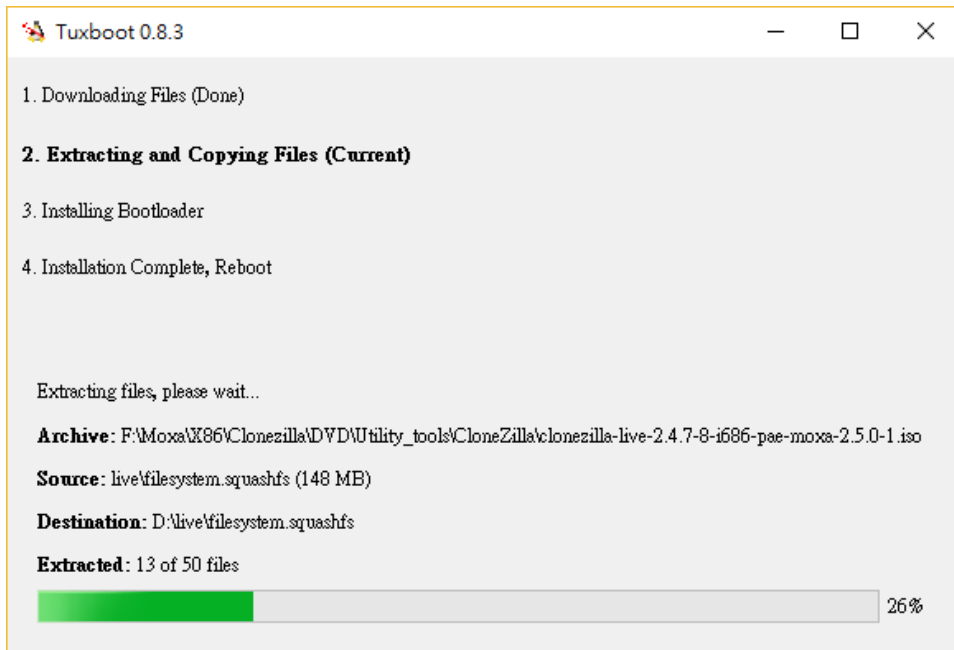
2. Select the ISO file in the directory of <Software DVD> \Restore\Clonezilla_Image\



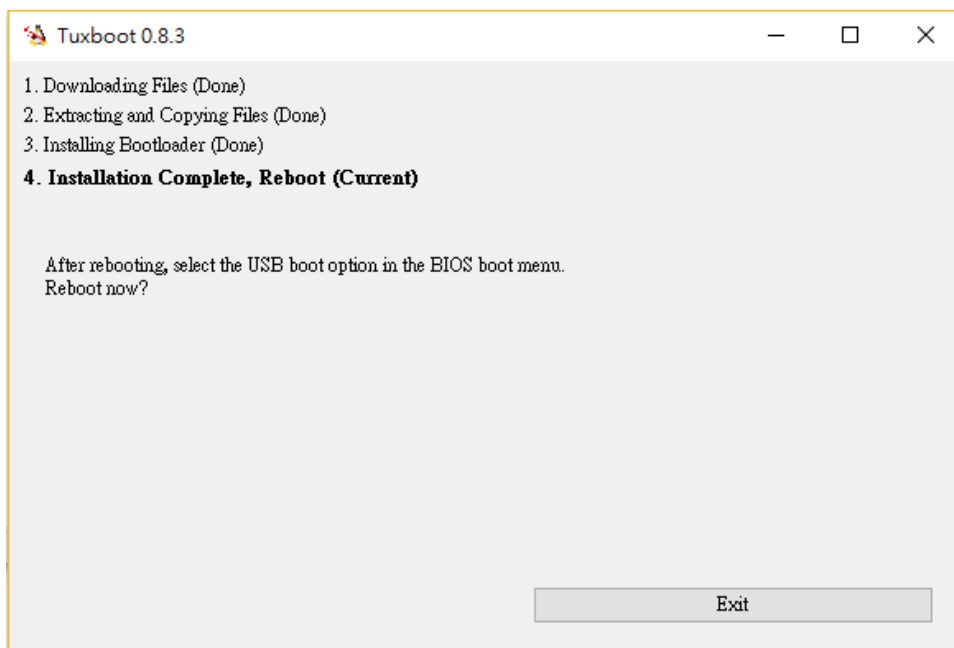
3. Select **USB Drive** type, select a **Drive**, and then click **OK** to continue.



The boot files will be copied to your USB drive.



4. When finished, click **Exit** to stop the program.

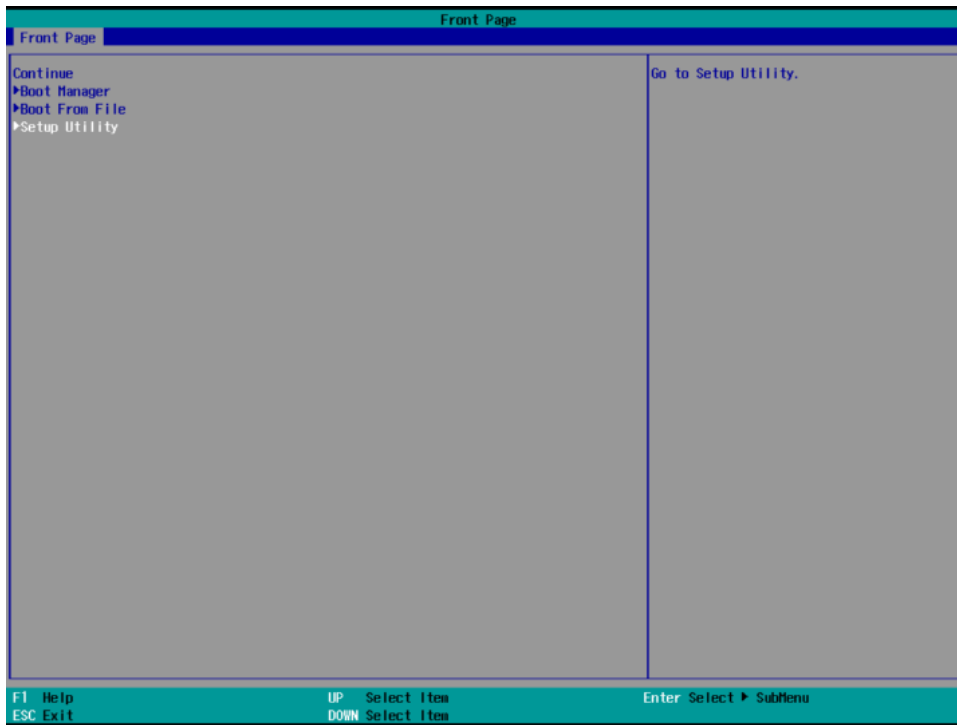


Manually extract the **os_image.zip** from the path **\Restore\CloneZilla_Image\VX.Y.Z_Build_YYMMDDHH** folder to **\home\partimag** on the USB drive.

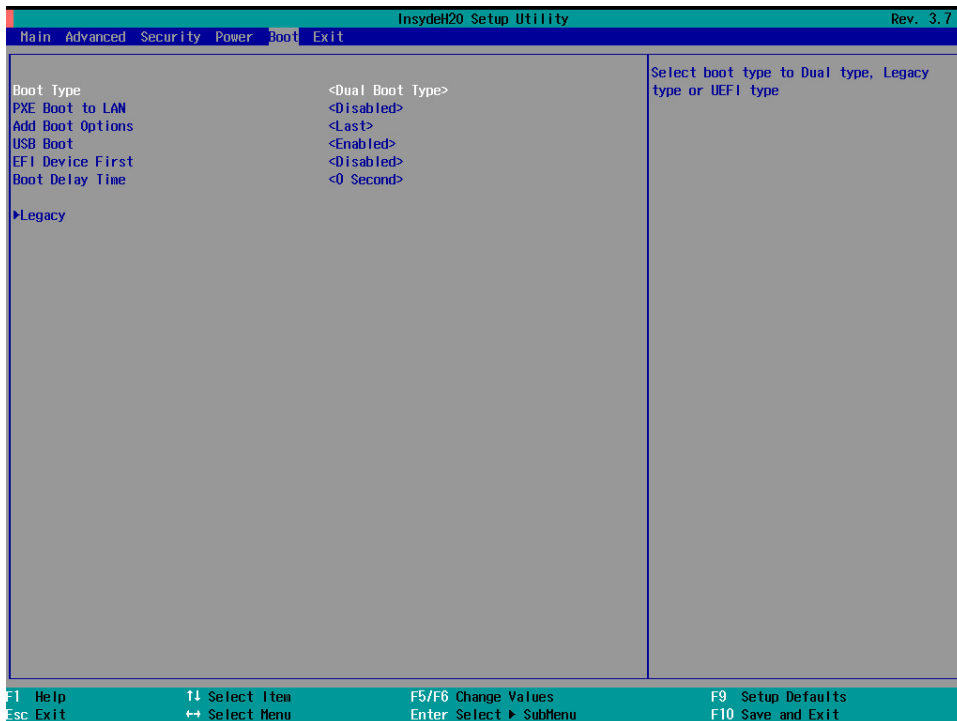
Step 2: Change the BIOS Settings

You will need to change the BIOS settings to boot from the USB disk.

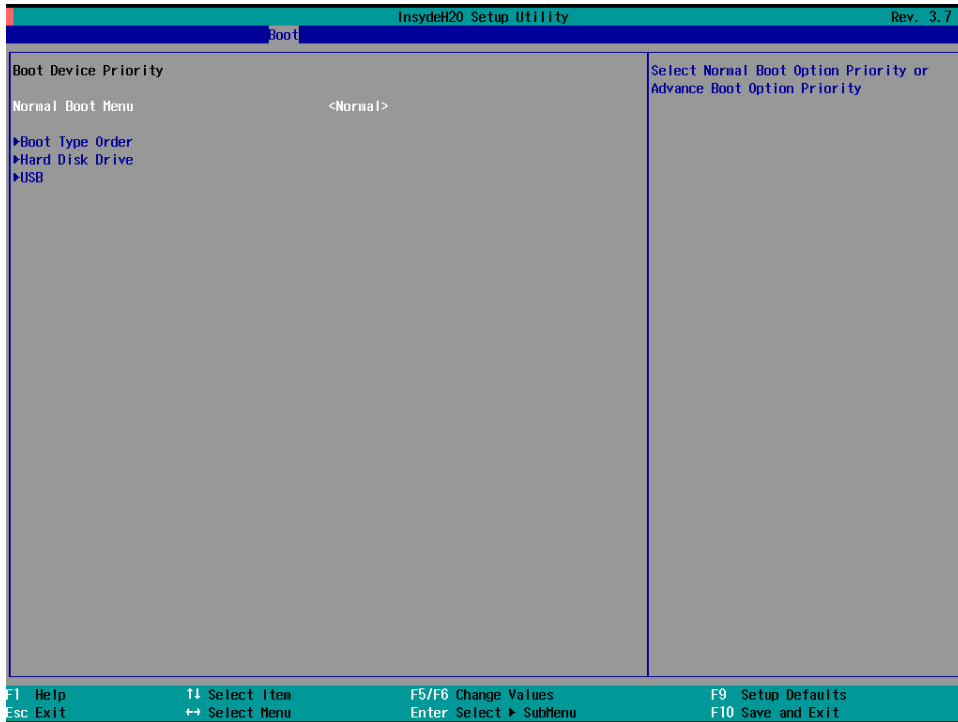
1. Turn on the computer and press F2. Select Setup Utility in the following screen.



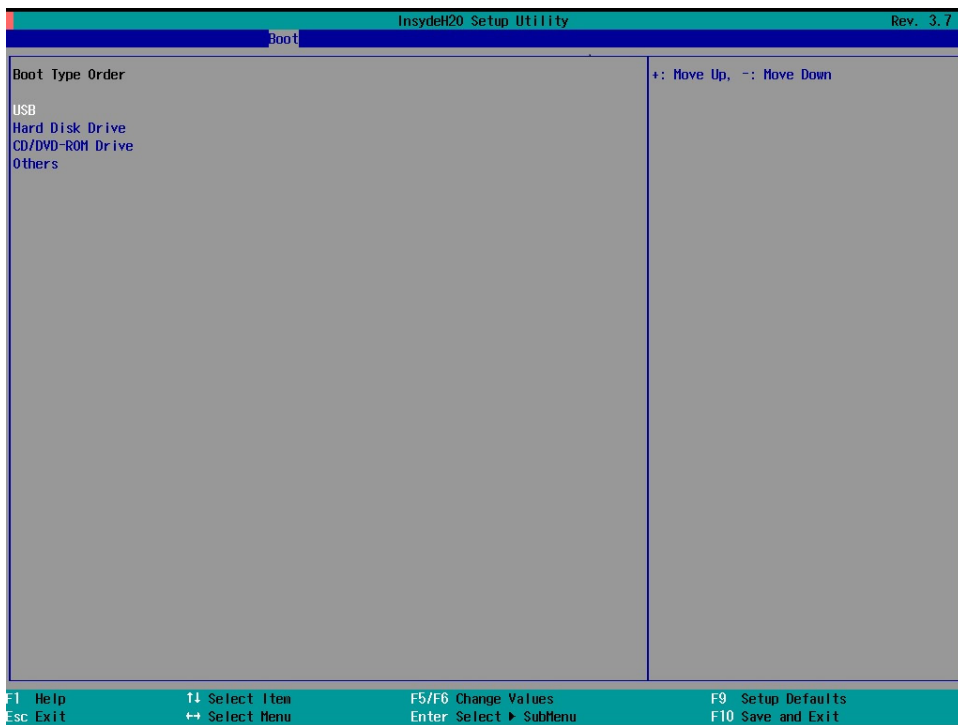
2. Select **Boot** and then select **Legacy**. Press **Enter** to continue.



3. Select **Boot order**.



4. Select USB disk and then press "+" to move it to the first boot device position.



WARNING

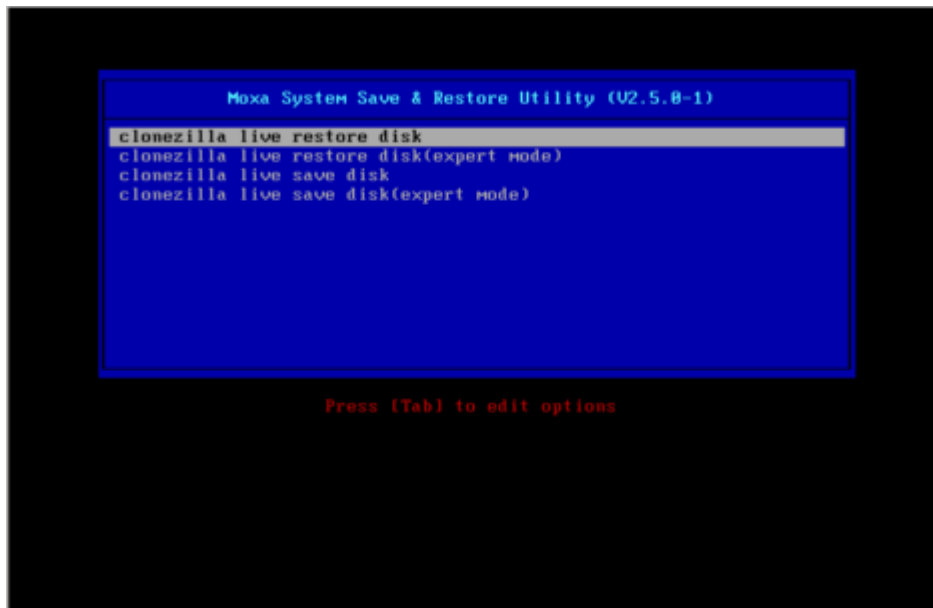
An incorrect boot priority will lead to restore or boot failure.

5. Press **F10** and then press **Enter** to save and exit BIOS setup.

Step 3: Restore the system from USB drive

Connect the USB disk to any of the computer's USB ports and then reboot the computer. The system will boot from the USB disk and the Pre-installation Environment and the restore utility will appear.

1. Select clonezilla live restore disk.



2. Wait for the USB drive boot process to finish.

```

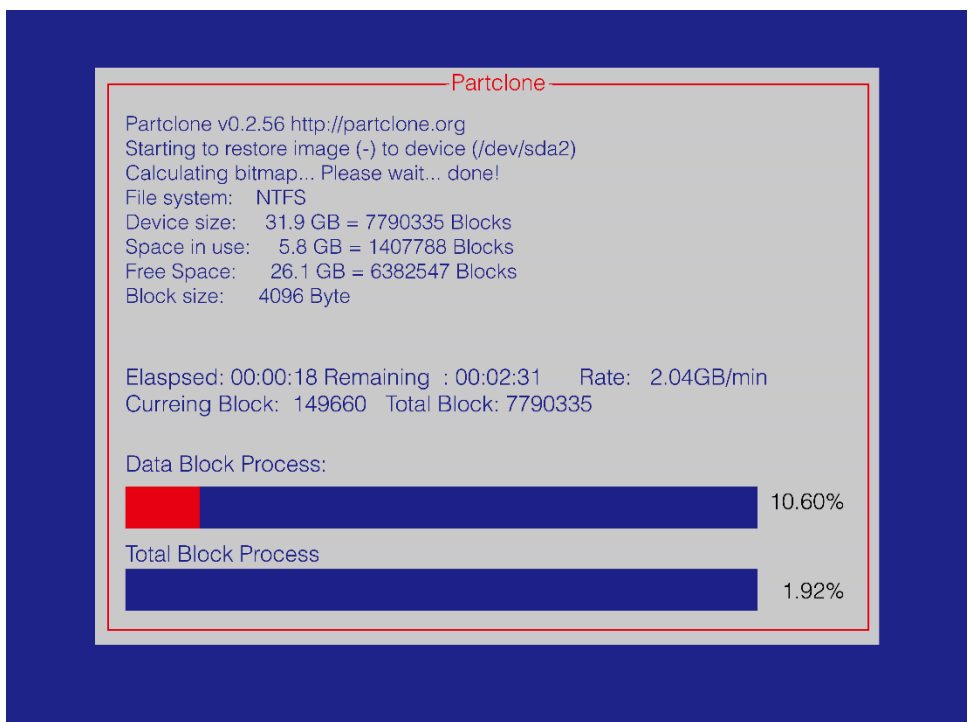
[ 6.913744] FAT: utf8 is not a recommended IO charset for FAT filesystems, filesystem will be case sensitive!
[ 7.047997] aufs: module is from the staging directory, the quality is unknown, you have been warned.
[ 7.072516] aufs 2.1-standalone.tree-38-rcN-20110228
Begin: Running /scripts/live-premount ... done.
[ 7.213433] loop: module loaded
[ 7.509770] squashfs: version 4.0 (2009/01/31) Phillip Lougher
Begin: Running /scripts/live-realpremount ... done.
Begin: Mounting "/live/image/live/filesystem.squashfs" on "//filesystem.squashfs" via "/dev/loop0" ... done.
done.
Begin: Running /scripts/live-bottom
... Begin: Configuring fstab ... done.
Begin: Preconfiguring networking ... done.
Begin: Loading preseed file ... done.
Begin: Running /scripts/init-bottom ... done.
INIT: version 2.88 booting
Using makefile-style concurrent boot in runlevel S.
live-config: hostname user-setup sudo locales tzdata keyboard-configuration sysvinit sysv-rc initramfs-tools util-linux login openssh-server_
  
```


3. Enter **y** to continue the restore process.

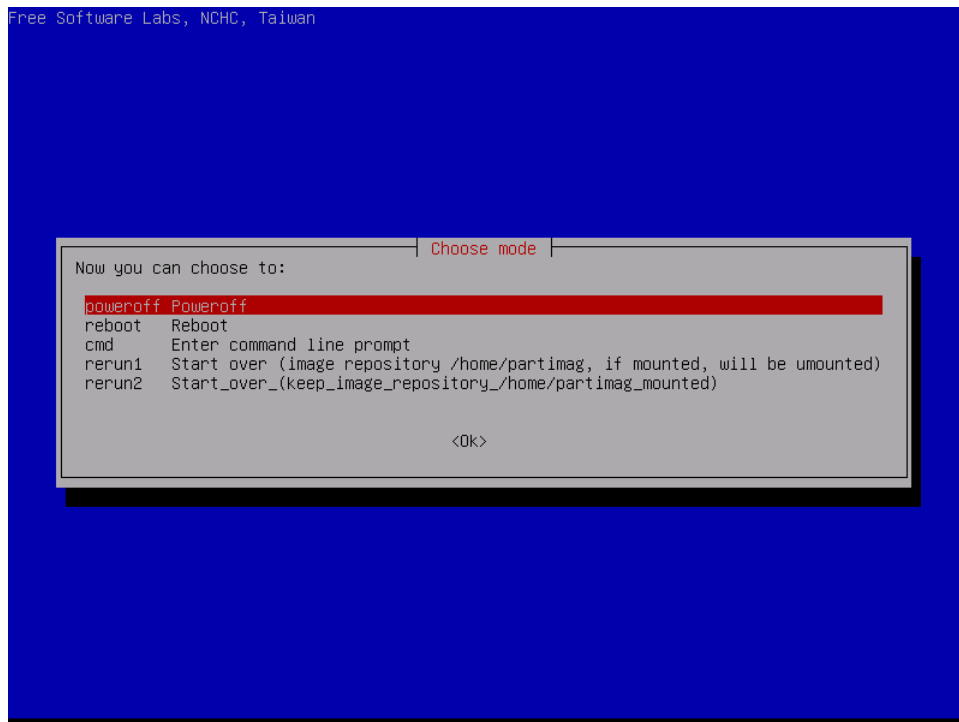
```

Checked successfully.
The image of this partition is restorable: sda2
*****
All the images of partition or LV devices in this image were checked and they are restorable: os_image
Summary of image checking:
=====
Partition table file for disk was found: sda
MBR file for this disk was found: sda
The image of this partition is restorable: sda1
The image of this partition is restorable: sda2
All the images of partition or LV devices in this image were checked and they are restorable: os_image
=====
Activating the partition info in /proc... done!
Getting /dev/sda1 info...
Getting /dev/sda2 info...
*****
The following step is to restore an image to the hard disk/partition(s) on this machine: "/home/part
imag/os_image" -> "sda sda1 sda2"
The image was created at: 2016-1214-1923
WARNING!!! WARNING!!! WARNING!!!
WARNING. THE EXISTING DATA IN THIS HARDDISK/PARTITION(S) WILL BE OVERWRITTEN! ALL EXISTING DATA WILL
BE LOST:
*****
Machine: VMware Virtual Platform
sda (21.5GB_VMWare_Virtual_S_No_disk_serial_no)
sda1 (128M_ext4(In_VMWare_Virtual_S_No_disk_serial_no)
sda2 (19.9G(In_VMWare_Virtual_S_No_disk_serial_no)
*****
Are you sure you want to continue? (y/n) _
    
```

4. Wait for the process to finish.



5. Select **Poweroff** to power off the computer.

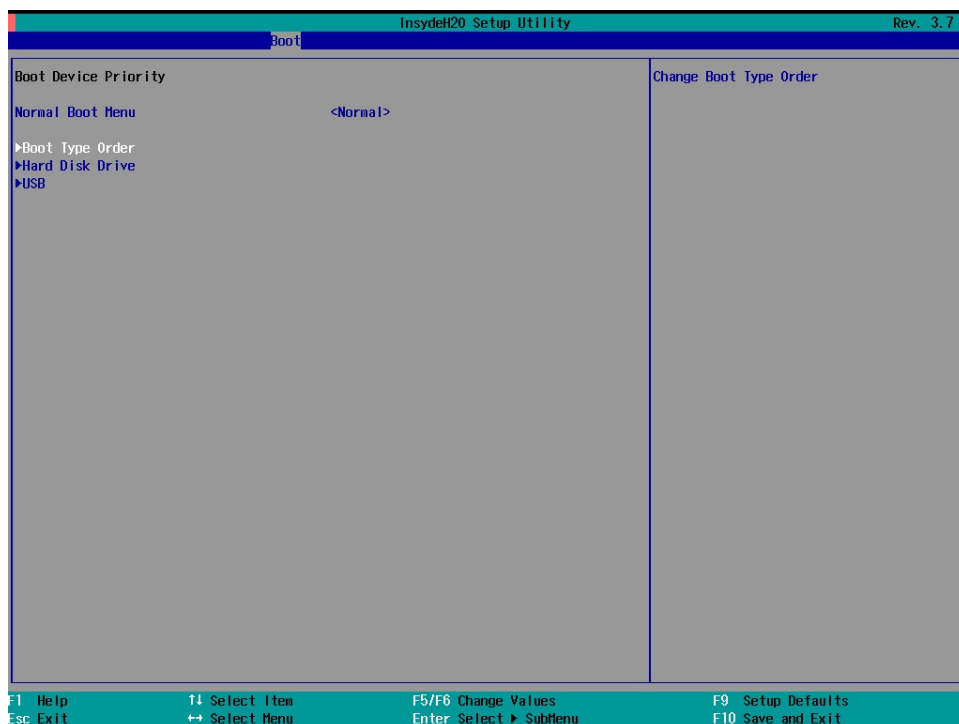


6. Remove the USB drive after the computer has been powered off.

Step 4: Change the BIOS Settings to Boot from the Original Disk

Now you will need to change the boot priority so that it can boot from the original disk.

1. As the system reboots, press F2 to enter the BIOS setup menu.
2. Select **Hard Disk Drive** and then press **+** to move to the first boot device position, and then press **Enter**. Make sure the hard disk has **first boot priority**.



3. Press **F10** and then press Enter to **save and exit BIOS** settings.

Step 5: Reboot the Computer

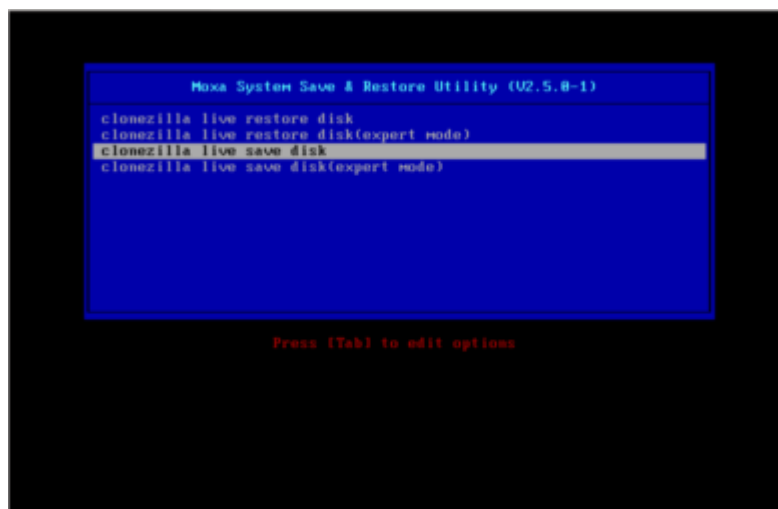
You need to wait about 10 to 15 minutes for the system to restart, since the system configuration files will be initiated while booting up for the first time. **Do not turn off the computer or shut down the computer** while the system is restarting; otherwise, the IIS service will be terminated. When the operating system has successfully launched, you will need to restart your computer so that the new settings can be activated.

Saving the System to the USB Drive

You may also save the current system to the USB drive for system restore in case the system crashes. Before saving the system to the USB drive, we suggest you remove all files under `\home\partimag` on the USB drive. In addition, change the BIOS settings to **make the USB drive the first boot priority**.

When the system has been launched, do the following:

1. Select clonezilla live save disk.



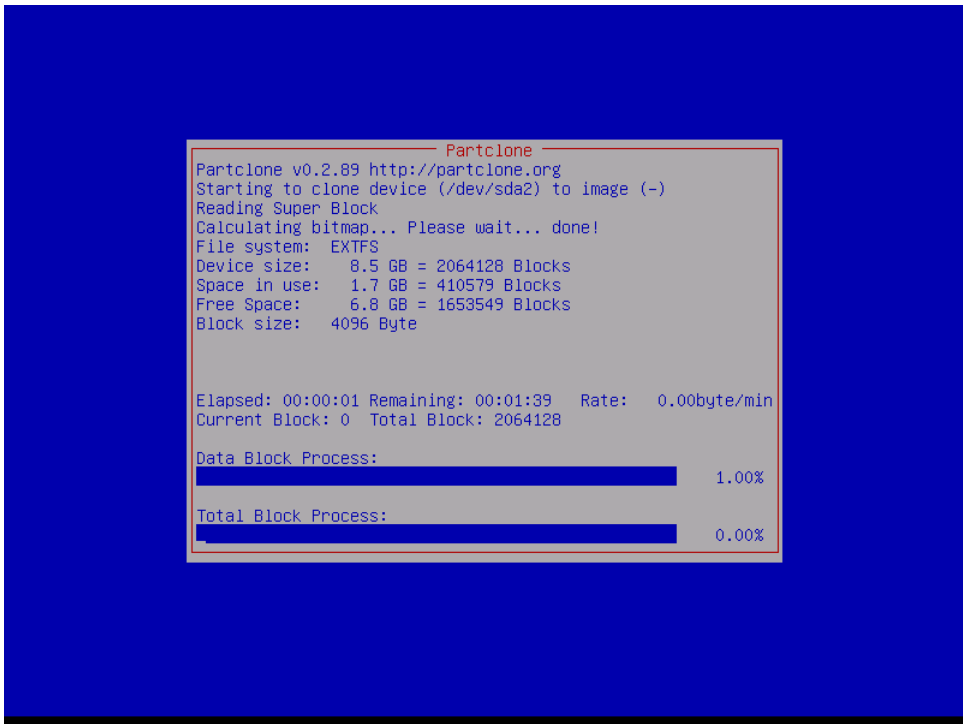
2. Wait for the USB drive boot process to finish.

```
[ 6.913744] FAT: utf8 is not a recommended IO charset for FAT filesystems, filesystem will be case sensitive!
[ 7.047997] aufs: module is from the staging directory, the quality is unknown, you have been warned.
[ 7.072516] aufs 2.1-standalone.tree-38-rcN-20110228
Begin: Running /scripts/live-premount ... done.
[ 7.213433] loop: module loaded
[ 7.509770] squashfs: version 4.0 (2009/01/31) Phillip Lougher
Begin: Running /scripts/live-realpremount ... done.
Begin: Mounting "/live/image/live/filesystem.squashfs" on "//filesystem.squashfs" via "/dev/loop0" ... done.
done.
Begin: Running /scripts/live-bottom
... Begin: Configuring fstab ... done.
Begin: Preconfiguring networking ... done.
Begin: Loading preseeds file ... done.
Begin: Running /scripts/init-bottom ... done.
INIT: version 2.88 booting
Using makefile-style concurrent boot in runlevel S.
live-config: hostname user-setup sudo locales tzdata keyboard-configuration sysvinit sysv-rc initscripts
fs-tools util-linux login openssh-server_
```

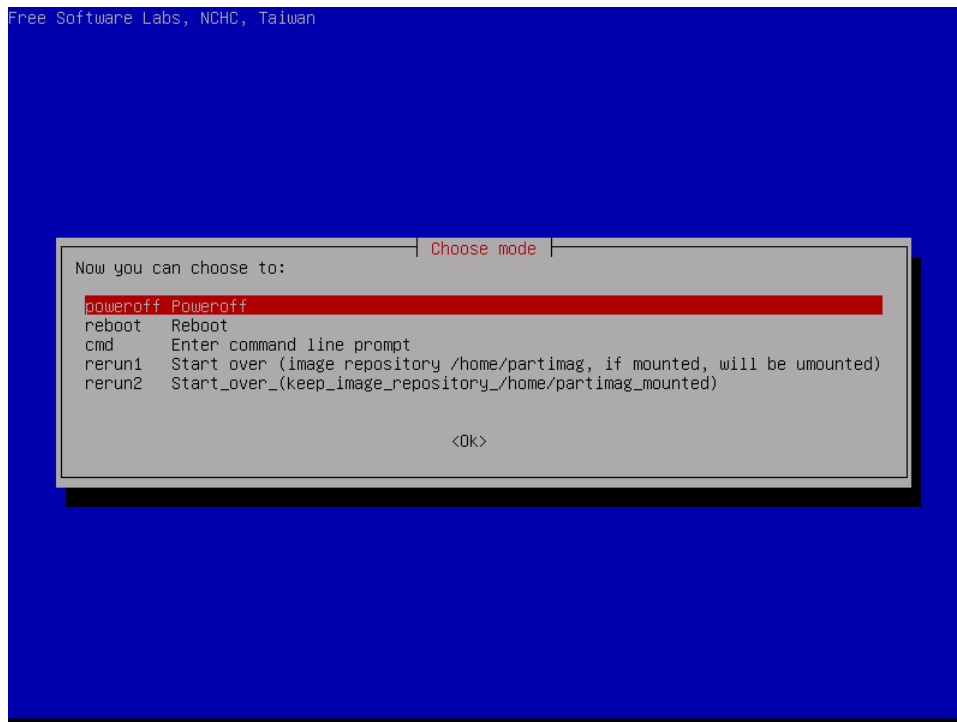
3. Enter **y** to continue.

```
Setting the TERM as linux
*****
Clonezilla image dir: /home/partimag
*****
Shutting down the Logical Volume Manager
  No volume groups found
  No volume groups found
Finished Shutting down the Logical Volume Manager
Selected device [sda] found!
The selected devices: sda
*****
Activating the partition info in /proc... done!
Selected device [sda] found!
The selected devices: sda
Searching for data partition(s)...
Excluding busy partition or disk...
Unmouted partitions (including extended or swap): sda1
Collecting info.. done!
Searching for swap partition(s)...
Excluding busy partition or disk...
Unmouted partitions (including extended or swap): sda1
Collecting info.. done!
The data partition to be saved: sda1
The swap partition to be saved:
Activating the partition info in /proc... done!
Selected device [sda1] found!
The selected devices: sda1
Getting /dev/sda1 info...
*****
The following step is to save the hard disk/partition(s) on this machine as an image:
*****
Machine: VirtualBox
sda (2103MB_VBOX_HARDDISK__ata-VBOX_HARDDISK_VB1c64a0a3-c9f7523d)
sda1 (2065MB_ntfs(In_VBOX_HARDDISK_)_ata-VBOX_HARDDISK_VB1c64a0a3-c9f7523d)
*****
-> "/home/partimag/xpe_savedisk".
Are you sure you want to continue? ? (y/n) y
```

4. Wait for the process to finish.



5. Select **Poweroff** so that the computer will power off when the process is finished.



Brightness Controller Firmware Upgrade

The brightness can be controlled by the Brightness Controller, which works with a preinstalled firmware. The firmware is embedded in the Brightness Controller and it can be upgraded by the `upgrade_mcfwr.sh` utility.

This is the usage information of this utility.

```
root@moxa:~/# upgrade_mcfwr.sh
Please input the micro-controller firmware in the argument
EX: upgrade_mcfwr.sh /home/moxa/MPC-2121_V100.S02.hex
```

This is an example to upgrade the firmware, `FWR_MCU_MPC-2121_V1.20S00`.

```
root@moxa:~/# upgrade_mcfwr.sh /home/moxa/MPC-2121_V100.S02.hex
1
*** Erasing flash from 0x1000 ***
*** Flash erase code area finished ***
Enter a command >

MOXA MCU Firmware Version V1.20S00
-----
1. Erase the firmware flash block
2. Receive HEX file
?. Print command List
Enter a command > 2
Ready to receive Hex file...

!!!Please don't power-off or stop the upgrade before it finished!!!

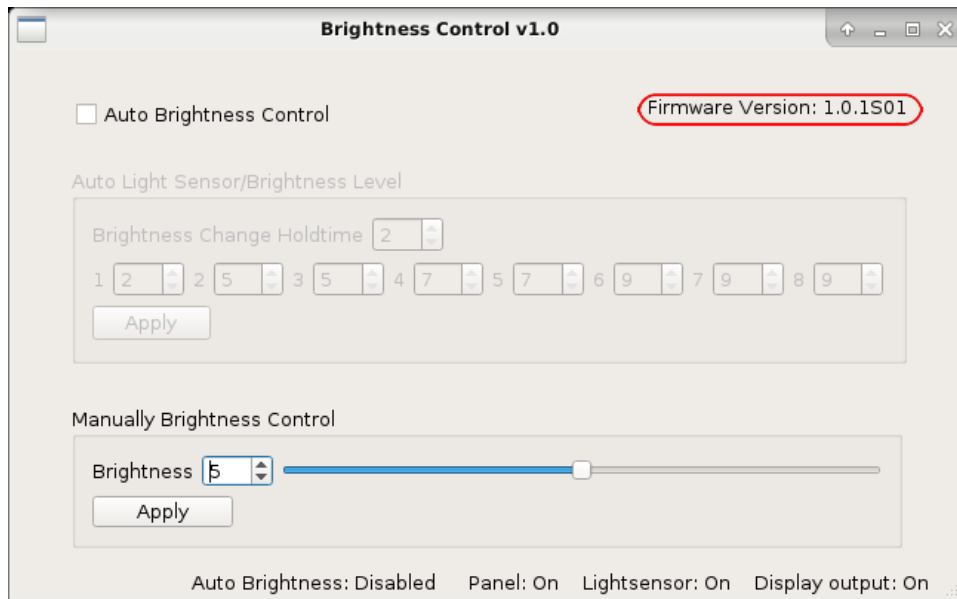
Start the ASCII transfer and firmware upgrade
ASCII upload of "./MPC-2121_V100.S02.hex"
```

```
6.4 Kbytes transferred at 929 CPS... Done.  
  
Firmware upgrade finished.  
You can check the firmware version by br-util -f.  
root@Moxa:~/
```

After the firmware upgraded finished, you can check the firmware version by `br-util -f` command.

```
root@Moxa:~/# br-util -f  
The firmware version: 1.0.0S02 (1002)
```

Or check the firmware version in Brightness Control Dialog.



ATTENTION

The Brightness Control Dialog and upgrade_mcfwr.sh cannot run at the same time. You should close the Brightness Control Dialog . Then the upgrade_mcfwr.sh can run.

A

Software Components

Name	Version	Description
accountsservice	0.6.43-1	query and manipulate user account information
acl	2.2.52-3+b1	Access control list utilities
adduser	3.115	all add and remove users and groups
adwaita-icon-theme	3.22.0-1+deb9u1	all default icon theme of GNOME
alsa-utils	1.1.3-1	Utilities for configuring and using ALSA
anacron	2.3-24	cron-like program that doesn't go by time
apg	2.2.3.dfsg.1-4+b1	Automated Password Generator - Standalone version
apt	1.4.9	commandline package manager
apt-listchanges	3.10	all package change history notification tool
apt-utils	1.4.9	package management related utility programs
aspell	0.60.7~20110707-3+b2	GNU Aspell spell-checker
aspell-en	2016.11.20-0-0.1	all English dictionary for GNU Aspell
at-spi2-core	2.22.0-6+deb9u1	Assistive Technology Service Provider Interface (dbus core)
avahi-autoipd	0.6.32-2	Avahi IPv4LL network address configuration daemon
avahi-daemon	0.6.32-2	Avahi mDNS/DNS-SD daemon
base-files	9.9+deb9u8	Debian base system miscellaneous files
base-passwd	3.5.43	Debian base system master password and group files
bash	4.4-5	GNU Bourne Again SHell
bash-completion	1:2.1-4.3	all programmable completion for the bash shell
bind9-host	1:9.10.3.dfsg.P4-12.3+deb9u4	Version of 'host' bundled with BIND 9.X
binfmt-support	2.1.6-2	Support for extra binary formats
binutils	2.28-5	GNU assembler, linker and binary utilities
binutils-multiarch	2.28-5	Binary utilities that support multi-arch targets
bluetooth	5.43-2+deb9u1	all Bluetooth support
bluez	5.43-2+deb9u1	Bluetooth tools and daemons
bluez-obexd	5.43-2+deb9u1	bluez obex daemon
bridge-utils	1.5-13+deb9u1	Utilities for configuring the Linux Ethernet bridge
bsdmainutils	9.0.12+nmu1	collection of more utilities from FreeBSD
bsdutils	1:2.29.2-1+deb9u1	basic utilities from 4.BSD-Lite
build-essential	12.3	Informational list of build-essential packages
busybox	1:1.22.0-19+b3	Tiny utilities for small and embedded systems
bzip2	1.0.6-8.1	high-quality block-sorting file compressor - utilities
ca-certificates	20170717	all Common CA certificates
ca-certificates-java	20170531+nmu1	all Common CA certificates (JKS keystore)
clang	1:3.8-36	C, C++ and Objective-C compiler (LLVM based)
clang-3.8	1:3.8.1-24	C, C++ and Objective-C compiler (LLVM based)
coinor-libcgl1	0.58.9-1+b1	COIN-OR Cut Generation Library
coinor-libcoinmp1v5:amd64	1.7.6+dfsg1-2	Simple C API for COIN-OR Solvers Clp and Cbc -- library
coinor-libosi1v5	0.106.9-2+b1	COIN-OR Open Solver Interface
colord	1.3.3-2	system service to manage device colour profiles -- system daemon

Name	Version	Description
colord-data	1.3.3-2	all system service to manage device colour profiles -- data files
console-setup	1.164	all console font and keymap setup program
console-setup-Linux	1.164	all Linux specific part of console-setup
coreutils	8.26-3	GNU core utilities
cpio	2.11+dfsg-6	GNU cpio -- a program to manage archives of files
cpp	4:6.3.0-4	GNU C preprocessor (cpp)
cpp-6	6.3.0-18+deb9u1	GNU C preprocessor
cracklib-runtime	2.9.2-5	runtime support for password checker library cracklib2
crda	3.18-1	wireless Central Regulatory Domain Agent
cron	3.0pl1-128+deb9u1	process scheduling daemon
cups-common	2.2.1-8+deb9u3	all Common UNIX Printing System(tm) - common files
cups-pk-helper	0.2.6-1+b1	PolicyKit helper to configure cups with fine-grained privileges
dash	0.5.8-2.4	POSIX-compliant shell
dbus	1.10.26-0+deb9u1	simple interprocess messaging system (daemon and utilities)
dbus-user-session	1.10.26-0+deb9u1	all simple interprocess messaging system (systemd --user integration)
dbus-x11	1.10.26-0+deb9u1	simple interprocess messaging system (X11 deps)
dconf-gsettings-backe nd:amd64	0.26.0-2+b1	simple configuration storage system - GSettings back-end
dconf-service	0.26.0-2+b1	simple configuration storage system - D-Bus service
debconf	1.5.61	all Debian configuration management system
debconf-i18n	1.5.61	all full internationalization support for debconf
debian-archive-keyring	2017.5	all GnuPG archive keys of the Debian archive
debian-faq	8.1	all Debian Frequently Asked Questions
debiutils	4.8.1.1	Miscellaneous utilities specific to Debian
desktop-base	9.0.2+deb9u1	all common files for the Debian Desktop
desktop-file-utils	0.23-1	Utilities for .desktop files
dh-python	2.20170125	all Debian helper tools for packaging Python libraries and applications
dialog	1.3-20160828-2	Displays user-friendly dialog boxes from shell scripts
dictionaries-common	1.27.2	all spelling dictionaries - common utilities
diffutils	1:3.5-3	File comparison utilities
discover	2.1.2-7.1+deb9u1	hardware identification system
discover-data	2.2013.01.11	all Data lists for Discover hardware detection system
distro-info-data	0.36	all information about the distributions' releases (data files)
dleyna-server	0.4.0-1.1	DBus service to interact with DLNA Digital Media Servers
dmidecode	3.0-4	SMBIOS/DMI table decoder
dmsetup	2:1.02.137-2	Linux Kernel Device Mapper userspace library
dnsmasq-base	2.76-5+deb9u1	Small caching DNS proxy and DHCP/TFTP server
doc-debian	6.4	all Debian Project documentation and other documents
docbook-xml	4.5-8	all standard XML documentation system for software and systems
dosfstools	4.1-1	utilities for making and checking MS-DOS FAT filesystems
dpkg	1.18.25	Debian package management system
dpkg-dev	1.18.25	all Debian package development tools
e2fslibs:amd64	1.43.4-2	ext2/ext3/ext4 file system libraries
e2fsprogs	1.43.4-2	ext2/ext3/ext4 file system utilities
emacsen-common	2.0.8	all Common facilities for all emacsen
enchant	1.6.0-11+b1	Wrapper for various spell checker engines (binary programs)
etherwake	1.09-4+b1	tool to send magic Wake-on-LAN packets
ethtool	1:4.8-1+b1	display or change Ethernet device settings
evince	3.22.1-3+deb9u1	Document (PostScript, PDF) viewer
evince-common	3.22.1-3+deb9u1	all Document (PostScript, PDF) viewer - common files

Name	Version	Description
evolution-data-server	3.22.7-1	evolution database backend server
evolution-data-server-common	3.22.7-1	all architecture independent files for Evolution Data Server
exfat-fuse	1.2.5-2	read and write exFAT driver for FUSE
exfat-utils	1.2.5-2	utilities to create, check, label and dump exFAT filesystem
exo-utils	0.10.7-1	Utility files for libexo
expect	5.45-7+deb9u1	Automates interactive applications
fakeroot	1.21-3.1	tool for simulating superuser privileges
file	1:5.30-1+deb9u2	Recognize the type of data in a file using "magic" numbers
findutils	4.6.0+git+20161106-2	utilities for finding files--find, xargs
firmware-Linux-free	3.4	all Binary firmware for various drivers in the Linux kernel
fontconfig	2.11.0-6.7+b1	generic font configuration library - support binaries
fontconfig-config	2.11.0-6.7	all generic font configuration library - configuration
fonts-crosextra-caladea	20130214-1	all Sans-serif font metric-compatible with Cambria font
fonts-crosextra-carlito	20130920-1	all Sans-serif font metric-compatible with Calibri font
fonts-dejavu	2.37-1	all metapackage to pull in fonts-dejavu-core and fonts-dejavu-extra
fonts-dejavu-core	2.37-1	all Vera font family derivate with additional characters
fonts-dejavu-extra	2.37-1	all Vera font family derivate with additional characters (extra variants)
fonts-droid-fallback	1:6.0.1r16-1.1	all handheld device font with extensive style and language support (fallback)
fonts-liberation	1:1.07.4-2	all Fonts with the same metrics as Times, Arial and Courier
fonts-linuxlibertine	5.3.0-2	all Linux Libertine family of fonts
fonts-noto-mono	20161116-1	all "No Tofu" monospaced font family with large Unicode coverage
freepats	20060219-1	all Free patch set for MIDI audio synthesis
fuse	2.9.7-1+deb9u2	Filesystem in Userspace
g++	4:6.3.0-4	GNU C++ compiler
g++-6	6.3.0-18+deb9u1	GNU C++ compiler
g++-6-multilib	6.3.0-18+deb9u1	GNU C++ compiler (multilib support)
g++-multilib	4:6.3.0-4	GNU C++ compiler (multilib files)
gawk	1:4.1.4+dfsg-1	GNU awk, a pattern scanning and processing language
gcc	4:6.3.0-4	GNU C compiler
gcc-6	6.3.0-18+deb9u1	GNU C compiler
gcc-6-base:amd64	6.3.0-18+deb9u1	GCC, the GNU Compiler Collection (base package)
gcc-6-multilib	6.3.0-18+deb9u1	GNU C compiler (multilib support)
gcc-multilib	4:6.3.0-4	GNU C compiler (multilib files)
gconf-service	3.2.6-4+b1	GNOME configuration database system (D-Bus service)
gconf2-common	3.2.6-4	all GNOME configuration database system (common files)
gcr	3.20.0-5.1	GNOME crypto services (daemon and tools)
gdb	7.12-6	GNU Debugger
gdisk	1.0.1-1	GPT fdisk text-mode partitioning tool
geoip-database	20170512-1	all IP lookup command line tools that use the GeoIP library (country database)
gettext-base	0.19.8.1-2	GNU Internationalization utilities for the base system
ghostscript	9.26a~dfsg-0+deb9u1	interpreter for the PostScript language and for PDF
gimp	2.8.18-1+deb9u1	GNU Image Manipulation Program
gimp-data	2.8.18-1+deb9u1	all Data files for GIMP
gir1.2-accountsservice-1.0	0.6.43-1	GObject introspection data for AccountService

Name	Version	Description
gir1.2-appindicator3-0.1:amd64	0.4.92-4	Typelib files for libappindicator3-1
gir1.2-atk-1.0:amd64	2.22.0-1	ATK accessibility toolkit (GObject introspection)
gir1.2-atspi-2.0:amd64	2.22.0-6+deb9u1	Assistive Technology Service Provider (GObject introspection)
gir1.2-caribou-1.0	0.4.21-1+b1	GObject introspection for the Caribou library
gir1.2-clutter-1.0:amd64	1.26.0+dfsg-3	GObject introspection data for the Clutter 1.0 library
gir1.2-clutter-gst-3.0:amd64	3.0.24-1	Gobject introspection data for Clutter GStreamer elements
gir1.2-cogl-1.0:amd64	1.22.2-2	GObject introspection data for the Cogl 1.0 library
gir1.2-coglpango-1.0:amd64	1.22.2-2	GObject introspection data for the CoglPango 1.0 library
gir1.2-evince-3.0:amd64	3.22.1-3+deb9u1	GObject introspection data for the evince libraries
gir1.2-freedesktop:amd64	1.50.0-1+b1	Introspection data for some FreeDesktop components
gir1.2-gck-1:amd64	3.20.0-5.1	GObject introspection data for the GCK library
gir1.2-gconf-2.0	3.2.6-4+b1	GNOME configuration database system (GObject-Introspection)
gir1.2-gcr-3:amd64	3.20.0-5.1	GObject introspection data for the GCR library
gir1.2-gdesktopenums-3.0	3.22.0-1	GObject introspection for GSettings desktop-wide schemas
gir1.2-gdkpixbuf-2.0:amd64	2.36.5-2+deb9u2	GDK Pixbuf library - GObject-Introspection
gir1.2-gdm-1.0	3.22.3-3+deb9u2	GObject introspection data for the GNOME Display Manager
gir1.2-glib-2.0:amd64	1.50.0-1+b1	Introspection data for GLib, GObject, Gio and GModule
gir1.2-gnomebluetooth-1.0:amd64	3.20.1-1	Introspection data for GnomeBluetooth
gir1.2-gnomedesktop-3.0:amd64	3.22.2-1	Introspection data for GnomeDesktop
gir1.2-gst-plugins-base-1.0	1.10.4-1	GObject introspection data for the GStreamer Plugins Base library
gir1.2-gstreamer-1.0	1.10.4-1	GObject introspection data for the GStreamer library
gir1.2-gtk-3.0:amd64	3.22.11-1	GTK+ graphical user interface library -- gir bindings
gir1.2-gtkclutter-1.0:amd64	1.8.2-2	GObject introspection data for the GTK+ Clutter library
gir1.2-gtksource-3.0:amd64	3.22.2-1	gir files for the GTK+ syntax highlighting widget
gir1.2-gweather-3.0:amd64	3.20.4-1	GObject introspection data for the GWeather library
gir1.2-ibus-1.0:amd64	1.5.14-3+deb9u1	Intelligent Input Bus - introspection data
gir1.2-javascriptcoregtk-4.0:amd64	2.18.6-1~deb9u1	JavaScript engine library from WebKitGTK+ - GObject introspection data
gir1.2-json-1.0:amd64	1.2.6-1	GLib JSON manipulation library (introspection data)
gir1.2-mutter-3.0:amd64	3.22.3-2	GObject introspection data for Mutter
gir1.2-networkmanager-1.0:amd64	1.6.2-3+deb9u2	GObject introspection data for NetworkManager
gir1.2-nmgtk-1.0:amd64	1.4.4-1+deb9u1	GObject introspection data for libnm-gtk
gir1.2-pango-1.0:amd64	1.40.5-1	Layout and rendering of internationalized text - gir bindings

Name	Version	Description
gir1.2-polkit-1.0	0.105-18+deb9u1	GObject introspection data for PolicyKit
gir1.2-rsvg-2.0:amd64	2.40.16-1+b1	gir files for renderer library for SVG files
gir1.2-soup-2.4:amd64	2.56.0-2+deb9u2	GObject introspection data for the libsoup HTTP library
gir1.2-sugarext-1.0	0.110.0-4	Sugar Learning Platform - toolkit GObject introspection
gir1.2-telepathyglib-0.12	0.24.1-1.1	GLib Telepathy connection manager library (GObject-Introspection)
gir1.2-telepathylogger-0.2	0.8.2-2	Telepathy logger service - introspection
gir1.2-upowerglib-1.0:amd64	0.99.4-4+b1	GObject introspection data for upower
gir1.2-webkit2-4.0:amd64	2.18.6-1~deb9u1	Web content engine library for GTK+ - GObject introspection data
gjs	1.46.0-1+b2	Mozilla-based javascript bindings for the GNOME platform
gkbd-capplet	3.22.0.1-1+b1	GNOME control center tools for libgnomekbd
glib-networking:amd64	2.50.0-1+b1	network-related giommodules for GLib
glib-networking-common	2.50.0-1	all network-related giommodules for GLib - data files
glib-networking-services	2.50.0-1+b1	network-related giommodules for GLib - D-Bus services
gnome-accessibility-themes	3.22.2-2	all Accessibility themes for the GNOME desktop
gnome-backgrounds	3.22.1-1	all Set of backgrounds packaged with the GNOME desktop
gnome-control-center-data	1:3.22.2-3	all configuration applets for GNOME - data files
gnome-desktop3-data	3.22.2-1	all Common files for GNOME desktop apps
gnome-icon-theme	3.12.0-2	all GNOME Desktop icon theme
gnome-keyring	3.20.0-3	GNOME keyring services (daemon and tools)
gnome-settings-daemon	3.22.2-2+deb9u2	daemon handling the GNOME session settings
gnome-shell	3.22.3-3	graphical shell for the GNOME desktop
gnome-shell-common	3.22.3-3	all common files for the GNOME graphical shell
gnome-sushi	3.21.91-2	sushi is a quick previewer for nautilus
gnome-themes-standard:amd64	3.22.2-2	Adwaita GTK+ 2 theme — engine
gnome-themes-standard-data	3.22.2-2	all Adwaita GTK+ 2 theme — common files
gnome-user-guide	3.22.0-1	all GNOME user's guide
gnupg	2.1.18-8~deb9u4	GNU privacy guard - a free PGP replacement
gnupg-agent	2.1.18-8~deb9u4	GNU privacy guard - cryptographic agent
gpgv	2.1.18-8~deb9u4	GNU privacy guard - signature verification tool
grep	2.27-2	GNU grep, egrep and fgrep
groff-base	1.22.3-9	GNU troff text-formatting system (base system components)
grub-common	2.02~beta3-5+deb9u1	GRand Unified Bootloader (common files)
grub-pc	2.02~beta3-5+deb9u1	GRand Unified Bootloader, version 2 (PC/BIOS version)
grub-pc-bin	2.02~beta3-5+deb9u1	GRand Unified Bootloader, version 2 (PC/BIOS binaries)
grub2-common	2.02~beta3-5+deb9u1	GRand Unified Bootloader (common files for version 2)
gsettings-desktop-schemas	3.22.0-1	all GSettings desktop-wide schemas
gsfonts	1:8.11+urwcyr1.0.7~pre44-4.3	all Fonts for the Ghostscript interpreter(s)

Name	Version	Description
gstreamer1.0-alsa:amd64	1.10.4-1	GStreamer plugin for ALSA
gstreamer1.0-plugins-base:amd64	1.10.4-1	GStreamer plugins from the "base" set
gstreamer1.0-plugins-good:amd64	1.10.4-1	GStreamer plugins from the "good" set
gstreamer1.0-pulseaudio:amd64	1.10.4-1	GStreamer plugin for PulseAudio
gstreamer1.0-x:amd64	1.10.4-1	GStreamer plugins for X11 and Pango
gtk-update-icon-cache	3.22.11-1	icon theme caching utility
gtk2-engines-pixbuf:amd64	2.24.31-2	pixbuf-based theme for GTK+ 2.x
gtk2-engines-xfce	3.2.0-2	GTK+-2.0 theme engine for Xfce
gvfs:amd64	1.30.4-1	userspace virtual filesystem - GIO module
gvfs-backends	1.30.4-1	userspace virtual filesystem - backends
gvfs-common	1.30.4-1	all userspace virtual filesystem - common data files
gvfs-daemons	1.30.4-1	userspace virtual filesystem - servers
gvfs-libs:amd64	1.30.4-1	userspace virtual filesystem - private libraries
gzip	1.6-5+b1	GNU compression utilities
hddtemp	0.3-beta15-52+b1	hard drive temperature monitoring utility
hdparm	9.51+ds-1+deb9u1	tune hard disk parameters for high performance
hicolor-icon-theme	0.15-1	all default fallback theme for FreeDesktop.org icon themes
hostname	3.18+b1	utility to set/show the host name or domain name
hunspell-en-us	20070829-7	all English_american dictionary for hunspell
i965-va-driver:amd64	1.7.3-1	VAAPI driver for Intel G45 & HD Graphics family
iamerican	3.4.00-5	all American English dictionary for ispell (standard version)
ibritish	3.4.00-5	all British English dictionary for ispell (standard version)
icedtea-netx-common	1.6.2-3.1	all NetX - implementation of the Java Network Launching Protocol (JNLP)
ienglish-common	3.4.00-5	all Common files for British and American ispell dictionaries
ifenslave	2.9	all configure network interfaces for parallel routing (bonding)
ifenslave-2.6	2.9	all transitional package, use "ifenslave"
ifupdown	0.8.19	high level tools to configure network interfaces
iio-sensor-proxy	2.0-4	IIO sensors to D-Bus proxy
init	1.48	metapackage ensuring an init system is installed
init-system-helpers	1.48	all helper tools for all init systems
initramfs-tools	0.130	all generic modular initramfs generator (automation)
initramfs-tools-core	0.130	all generic modular initramfs generator (core tools)
installation-report	2.62	all system installation report
iproute	1:4.9.0-1+deb9u1	all transitional dummy package for iproute2
iproute2	4.9.0-1+deb9u1	networking and traffic control tools
iptables	1.6.0+snapshot20161117-6	administration tools for packet filtering and NAT
iputils-ping	3:20161105-1	Tools to test the reachability of network hosts
irqbalance	1.1.0-2.3	Daemon to balance interrupts for SMP systems
isc-dhcp-client	4.3.5-3+deb9u1	DHCP client for automatically obtaining an IP address
isc-dhcp-common	4.3.5-3+deb9u1	common manpages relevant to all of the isc-dhcp packages
iso-codes	3.75-1	all ISO language, territory, currency, script codes and their translations
ispell	3.4.00-5	International Ispell (an interactive spelling corrector)
iw	4.9-0.1	tool for configuring Linux wireless devices

Name	Version	Description
java-common	0.58	all Base package for Java runtimes
javascript-common	11	all Base support for JavaScript library packages
kbd	2.0.3-2+b1	Linux console font and keytable utilities
keyboard-configuration	1.164	all system-wide keyboard preferences
keyutils	1.5.9-9	Linux Key Management Utilities
klibc-utils	2.0.4-9	small utilities built with klibc for early boot
kmod	23-2	tools for managing Linux kernel modules
krb5-locales	1.15-1+deb9u1	all internationalization support for MIT Kerberos
laptop-detect	0.13.8	system chassis type checker
less	481-2.1	pager program similar to more
lib32asan3	6.3.0-18+deb9u1	AddressSanitizer -- a fast memory error detector (32bit)
lib32atomic1	6.3.0-18+deb9u1	support library providing __atomic built-in functions (32bit)
lib32cilkrt5	6.3.0-18+deb9u1	Intel Cilk Plus language extensions (32bit)
lib32gcc-6-dev	6.3.0-18+deb9u1	GCC support library (32 bit development files)
lib32gcc1	1:6.3.0-18+deb9u1	GCC support library (32 bit Version)
lib32gomp1	6.3.0-18+deb9u1	GCC OpenMP (GOMP) support library (32bit)
lib32itm1	6.3.0-18+deb9u1	GNU Transactional Memory Library (32bit)
lib32mpx2	6.3.0-18+deb9u1	Intel memory protection extensions (32bit)
lib32quadmath0	6.3.0-18+deb9u1	GCC Quad-Precision Math Library (32bit)
lib32stdc++-6-dev	6.3.0-18+deb9u1	GNU Standard C++ Library v3 (development files)
lib32stdc++6	6.3.0-18+deb9u1	GNU Standard C++ Library v3 (32 bit Version)
lib32ubsan0	6.3.0-18+deb9u1	UBSan -- undefined behaviour sanitizer (32bit)
libaa1:amd64	1.4p5-44+b1	ASCII art library
libaacs0:amd64	0.8.1-2	free-and-libre implementation of AACs
libaccountsservice0:amd64	0.6.43-1	query and manipulate user account information - shared libraries
libacl1:amd64	2.2.52-3+b1	Access control list shared library
libalgorithm-diff-perl	1.19.03-1	all module to find differences between files
libalgorithm-diff-xs-perl	0.04-4+b2	module to find differences between files (XS accelerated)
libalgorithm-merge-perl	0.08-3	all Perl module for three-way merge of textual data
libao-common	1.2.2-1	Cross Platform Audio Output Library (Common files)
libapache2-mod-dnssd	0.6-3.1	Zeroconf support for Apache 2 via avahi
libapparmor1:amd64	2.11.0-3+deb9u2	changehat AppArmor library
libappindicator3-1:amd64	0.4.92-4	allow applications to export a menu into the panel -- GTK3 version
libapt-inst2.0:amd64	1.4.9	deb package format runtime library
libapt-pkg5.0:amd64	1.4.9	package management runtime library
libarchive13:amd64	3.2.2-2+deb9u1	Multi-format archive and compression library (shared library)
libasan3:amd64	6.3.0-18+deb9u1	AddressSanitizer -- a fast memory error detector
libasound2:amd64	1.1.3-5	shared library for ALSA applications
libasound2-data	1.1.3-5	all Configuration files and profiles for ALSA drivers
libasound2-plugins:amd64	1.1.1-1	ALSA library additional plugins
libaspell15:amd64	0.60.7~20110707-3+b2	GNU Aspell spell-checker runtime library
libassuan0:amd64	2.4.3-2	IPC library for the GnuPG components
libasyncns0:amd64	0.8-6	Asynchronous name service query library
libatasmart4:amd64	0.19-4+b1	ATA S.M.A.R.T. reading and parsing library
libatk-adaptor:amd64	2.22.0-2	AT-SPI 2 toolkit bridge
libatk-bridge2.0-0:amd64	2.22.0-2	AT-SPI 2 toolkit bridge - shared library

Name	Version	Description
libatk1.0-0:amd64	2.22.0-1	ATK accessibility toolkit
libatk1.0-data	2.22.0-1	all Common files for the ATK accessibility toolkit
libatkmm-1.6-1v5:amd64	2.24.2-2	C++ wrappers for ATK accessibility toolkit (shared libraries)
libatomic1:amd64	6.3.0-18+deb9u1	support library providing __atomic built-in functions
libatspi2.0-0:amd64	2.22.0-6+deb9u1	Assistive Technology Service Provider Interface - shared library
libattr1:amd64	1:2.4.47-2+b2	Extended attribute shared library
libaudit-common	1:2.6.7-2	all Dynamic library for security auditing - common files
libaudit1:amd64	1:2.6.7-2	Dynamic library for security auditing
libauthen-sasl-perl	2.1600-1	all Authen::SASL - SASL Authentication framework
libavahi-client3:amd64	0.6.32-2	Avahi client library
libavahi-common-data:amd64	0.6.32-2	Avahi common data files
libavahi-common3:amd64	0.6.32-2	Avahi common library
libavahi-core7:amd64	0.6.32-2	Avahi's embeddable mDNS/DNS-SD library
libavahi-glib1:amd64	0.6.32-2	Avahi GLib integration library
libavahi-gobject0:amd64	0.6.32-2	Avahi GObject library
libavc1394-0:amd64	0.5.4-4+b1	control IEEE 1394 audio/video devices
libavcodec57:amd64	7:3.2.12-1~deb9u1	FFmpeg library with de/encoders for audio/video codecs - runtime files
libavresample3:amd64	7:3.2.12-1~deb9u1	FFmpeg compatibility library for resampling - runtime files
libavutil55:amd64	7:3.2.12-1~deb9u1	FFmpeg library with functions for simplifying programming - runtime files
libbabeltrace-ctf1:amd64	1.5.1-1	Common Trace Format (CTF) library
libbabeltrace1:amd64	1.5.1-1	Babeltrace conversion libraries
libbcprov-java	1.56-1+deb9u1	all Bouncy Castle Java Cryptographic Service Provider
libbdplus0:amd64	0.1.2-2	implementation of BD+ for reading Blu-ray Discs
libbind9-140:amd64	1:9.10.3.dfsg.P4-12.3+deb9u4	BIND9 Shared Library used by BIND
libblkid1:amd64	2.29.2-1+deb9u1	block device ID library
libbluray1:amd64	1:0.9.3-3	Blu-ray disc playback support library (shared library)
libboost-date-time1.62.0:amd64	1.62.0+dfsg-4	set of date-time libraries based on generic programming concepts
libboost-filesystem1.62.0:amd64	1.62.0+dfsg-4	filesystem operations (portable paths, iteration over directories, etc) in C++
libboost-system1.62.0:amd64	1.62.0+dfsg-4	Operating system (e.g. diagnostics support) library
libboost-thread1.62.0:amd64	1.62.0+dfsg-4	portable C++ multi-threading
libbotan-1.10-1	1.10.16-1	multiplatform crypto library
libbsd0:amd64	0.8.3-1	utility functions from BSD systems - shared library
libbz2-1.0:amd64	1.0.6-8.1	high-quality block-sorting file compressor library - runtime
libc-bin	2.24-11+deb9u4	GNU C Library: Binaries
libc-dev-bin	2.24-11+deb9u4	GNU C Library: Development binaries
libc-l10n	2.24-11+deb9u4	all GNU C Library: localization files
libc6:amd64	2.24-11+deb9u4	GNU C Library: Shared libraries
libc6-dbg:amd64	2.24-11+deb9u4	GNU C Library: detached debugging symbols
libc6-dev:amd64	2.24-11+deb9u4	GNU C Library: Development Libraries and Header Files
libc6-dev-i386	2.24-11+deb9u4	GNU C Library: 32-bit development libraries for AMD64

Name	Version	Description
libc6-dev-x32	2.24-11+deb9u4	GNU C Library: X32 ABI Development Libraries for AMD64
libc6-i386	2.24-11+deb9u4	GNU C Library: 32-bit shared libraries for AMD64
libc6-x32	2.24-11+deb9u4	GNU C Library: X32 ABI Shared libraries for AMD64
libcaca0:amd64	0.99.beta19-2+b2	colour ASCII art library
libcairo-gobject2:amd64	1.14.8-1	Cairo 2D vector graphics library (GObject library)
libcairo-perl	1.106-1+b2	Perl interface to the Cairo graphics library
libcairo-script-interpreter2:amd64	1.14.8-1	Cairo 2D vector graphics library (script interpreter)
libcairo2:amd64	1.14.8-1	Cairo 2D vector graphics library
libcairo2-dev	1.14.8-1	Development files for the Cairo 2D graphics library
libcaiomm-1.0-1v5:amd64	1.12.0-1+b1	C++ wrappers for Cairo (shared libraries)
libcamel-1.2-59:amd64	3.22.7-1	Evolution MIME message handling library
libcanberra-gtk3-0:amd64	0.30-3	GTK+ 3.0 helper for playing widget event sounds with libcanberra
libcanberra-gtk3-module:amd64	0.30-3	translates GTK3 widgets signals to event sounds
libcanberra0:amd64	0.30-3	simple abstract interface for playing event sounds
libcap-ng0:amd64	0.7.7-3+b1	An alternate POSIX capabilities library
libcap2:amd64	1:2.25-1	POSIX 1003.1e capabilities (library)
libcap2-bin	1:2.25-1	POSIX 1003.1e capabilities (utilities)
libcaribou-common	0.4.21-1	all Configurable on screen keyboard with scanning mode - common files
libcaribou0:amd64	0.4.21-1+b1	Configurable on screen keyboard with scanning mode - library
libcc1-0:amd64	6.3.0-18+deb9u1	GCC cc1 plugin for GDB
libcddb2	1.3.2-5	library to access CDDb data - runtime files
libcdio-cdda1:amd64	0.83-4.3+b1	library to read and control digital audio CDs
libcdio-paranoia1:amd64	0.83-4.3+b1	library to read digital audio CDs with error correction
libcdio13:amd64	0.83-4.3+b1	library to read and control CD-ROM
libcdparanoia0:amd64	3.10.2+debian-11	audio extraction tool for sampling CDs (library)
libcilkrts5:amd64	6.3.0-18+deb9u1	Intel Cilk Plus language extensions (runtime)
libclang-common-3.8-dev	1:3.8.1-24	clang library - Common development package
libclang1-3.8:amd64	1:3.8.1-24	C interface to the clang library
libclang1-3.9:amd64	1:3.9.1-9	C interface to the clang library
libclass-isa-perl	0.36-5	all report the search path for a class's ISA tree
libclutter-1.0-0:amd64	1.26.0+dfsg-3	Open GL based interactive canvas library
libclutter-1.0-common	1.26.0+dfsg-3	all Open GL based interactive canvas library (common files)
libclutter-gst-3.0-0:amd64	3.0.24-1	Open GL based interactive canvas library GStreamer elements
libclutter-gtk-1.0-0:amd64	1.8.2-2	Open GL based interactive canvas library GTK+ widget
libcogl-common	1.22.2-2	all Object oriented GL/GLES Abstraction/Utility Layer (common files)
libcogl-pango20:amd64	1.22.2-2	Object oriented GL/GLES Abstraction/Utility Layer
libcogl-path20:amd64	1.22.2-2	Object oriented GL/GLES Abstraction/Utility Layer
libcogl20:amd64	1.22.2-2	Object oriented GL/GLES Abstraction/Utility Layer
libcolor2:amd64	1.3.3-2	system service to manage device colour profiles -- runtime

Name	Version	Description
libcolorhug2:amd64	1.3.3-2	library to access the ColorHug colourimeter -- runtime
libcomerr2:amd64	1.43.4-2	common error description library
libcroco3:amd64	0.6.11-3	Cascading Style Sheet (CSS) parsing and manipulation toolkit
libcryptsetup4:amd64	2:1.7.3-4	disk encryption support - shared library
libcrystalhd3:amd64	1:0.0~git20110715.fdd2f19-12	Crystal HD Video Decoder (shared library)
libcue1	1.4.0-1	CUE Sheet Parser Library
libcups2:amd64	2.2.1-8+deb9u3	Common UNIX Printing System(tm) - Core library
libcupsfilters1:amd64	1.11.6-3	OpenPrinting CUPS Filters - Shared library
libcupsimage2:amd64	2.2.1-8+deb9u3	Common UNIX Printing System(tm) - Raster image library
libcurl3-gnutls:amd64	7.52.1-5+deb9u9	easy-to-use client-side URL transfer library (GnuTLS flavour)
libdaemon0:amd64	0.14-6	lightweight C library for daemons - runtime library
libdatrie1:amd64	0.2.10-4+b1	Double-array trie library
libdb5.3:amd64	5.3.28-12+deb9u1	Berkeley v5.3 Database Libraries [runtime]
libdbus-1-3:amd64	1.10.26-0+deb9u1	simple interprocess messaging system (library)
libdbus-glib-1-2:amd64	0.108-2	simple interprocess messaging system (GLib-based shared library)
libdbusmenu-glib4:amd64	12.10.2-2	library for passing menus over DBus
libdbusmenu-gtk3-4:amd64	12.10.2-2	library for passing menus over DBus - GTK+ version
libdconf1:amd64	0.26.0-2+b1	simple configuration storage system - runtime library
libdebconfclient0:amd64	0.227	Debian Configuration Management System (C-implementation library)
libdevmapper1.02.1:amd64	2:1.02.137-2	Linux Kernel Device Mapper userspace library
libdiscover2	2.1.2-7.1+deb9u1	hardware identification library
libdjvulibre-text	3.5.27.1-7	all Linguistic support files for libdjvulibre
libdjvulibre21:amd64	3.5.27.1-7	Runtime support for the DjVu image format
libdleyna-core-1.0-3:amd64	0.4.0-1	Utility functions for higher level dLeyna components
libdns-export162	1:9.10.3.dfsg.P4-12.3+deb9u4	Exported DNS Shared Library
libdns162:amd64	1:9.10.3.dfsg.P4-12.3+deb9u4	DNS Shared Library used by BIND
libdotconf0:amd64	1.3-0.2	Configuration file parser library - runtime files
libdouble-conversion1:amd64	2.0.1-4	routines to convert IEEE floats to and from strings
libdpkg-perl	1.18.25	all Dpkg perl modules
libdrm-amdgpu1:amd64	2.4.74-1	Userspace interface to amdgpu-specific kernel DRM services -- runtime
libdrm-dev:amd64	2.4.74-1	Userspace interface to kernel DRM services -- development files
libdrm-intel1:amd64	2.4.74-1	Userspace interface to intel-specific kernel DRM services -- runtime
libdrm-nouveau2:amd64	2.4.74-1	Userspace interface to nouveau-specific kernel DRM services -- runtime
libdrm-radeon1:amd64	2.4.74-1	Userspace interface to radeon-specific kernel DRM services -- runtime
libdrm2:amd64	2.4.74-1	Userspace interface to kernel DRM services -- runtime
libdv4:amd64	1.0.0-11	software library for DV format digital video (runtime lib)
libdw1:amd64	0.168-1	library that provides access to the DWARF debug information
libbackend-1.2-10:amd64	3.22.7-1	Utility library for evolution data servers

Name	Version	Description
libebook-1.2-16:amd64	3.22.7-1	Client library for evolution address books
libebook-contacts-1.2-2:amd64	3.22.7-1	Client library for evolution contacts books
libecal-1.2-19:amd64	3.22.7-1	Client library for evolution calendars
libedata-book-1.2-25:amd64	3.22.7-1	Backend library for evolution address books
libedata-cal-1.2-28:amd64	3.22.7-1	Backend library for evolution calendars
libedataserver-1.2-22:amd64	3.22.7-1	Utility library for evolution data servers
libedit2:amd64	3.1-20160903-3	BSD editline and history libraries
libegl1-mesa:amd64	13.0.6-1+b2	free implementation of the EGL API -- runtime
libelf1:amd64	0.168-1	library to read and write ELF files
libenca0:amd64	1.19-1+b1	Extremely Naive Charset Analyser - shared library files
libenchant1c2a:amd64	1.6.0-11+b1	Wrapper library for various spell checker engines (runtime libs)
libencode-locale-perl	1.05-1	all utility to determine the locale encoding
libepoxy0:amd64	1.3.1-2	OpenGL function pointer management library
libept1.5.0:amd64	1.1+nmu3+b1	High-level library for managing Debian package information
libestr0	0.1.10-2	Helper functions for handling strings (lib)
libevdev-dev	1.5.6+dfsg-1	wrapper library for evdev devices - development files
libevdev2:amd64	1.5.6+dfsg-1	wrapper library for evdev devices
libevdocument3-4:amd64	3.22.1-3+deb9u1	Document (PostScript, PDF) rendering library
libevent-2.0-5:amd64	2.0.21-stable-3	Asynchronous event notification library
libevview3-3:amd64	3.22.1-3+deb9u1	Document (PostScript, PDF) rendering library - Gtk+ widgets
libexempi3:amd64	2.4.1-1	library to parse XMP metadata (Library)
libexif12:amd64	0.6.21-2+b2	library to parse EXIF files
libexo-1-0:amd64	0.10.7-1	Library with extensions for Xfce
libexo-common	0.10.7-1	all libexo common files
libexo-helpers	0.10.7-1	helpers for the exo library
libexpat1:amd64	2.2.0-2+deb9u1	XML parsing C library - runtime library
libexpat1-dev:amd64	2.2.0-2+deb9u1	XML parsing C library - development kit
libfakeroot:amd64	1.21-3.1	tool for simulating superuser privileges - shared libraries
libfastjson4:amd64	0.99.4-1	fast json library for C
libfdisk1:amd64	2.29.2-1+deb9u1	fdisk partitioning library
libffi-dev:amd64	3.2.1-6	Foreign Function Interface library (development files)
libffi6:amd64	3.2.1-6	Foreign Function Interface library runtime
libfftw3-single3:amd64	3.3.5-3	Library for computing Fast Fourier Transforms - Single precision
libfile-basedir-perl	0.07-1	all Perl module to use the freedesktop basedir specification
libfile-copy-recursive-perl	0.38-1	all Perl extension for recursively copying files and directories
libfile-desktopentry-perl	0.22-1	all Perl module to handle freedesktop .desktop files
libfile-fcntllock-perl	0.22-3+b2	Perl module for file locking with fcntl(2)
libfile-listing-perl	6.04-1	all module to parse directory listings
libfile-mimeinfo-perl	0.27-1	all Perl module to determine file types
libflac8:amd64	1.3.2-1	Free Lossless Audio Codec - runtime C library
libfont-afm-perl	1.20-2	all Font::AFM - Interface to Adobe Font Metrics files
libfontconfig1:amd64	2.11.0-6.7+b1	generic font configuration library - runtime
libfontconfig1-dev:amd64	2.11.0-6.7+b1	generic font configuration library - development

Name	Version	Description
libfontenc1:amd64	1:1.1.3-1+b2	X11 font encoding library
libfreetype6:amd64	2.6.3-3.2	FreeType 2 font engine, shared library files
libfreetype6-dev	2.6.3-3.2	FreeType 2 font engine, development files
libfribidi0:amd64	0.19.7-1+b1	Free Implementation of the Unicode BiDi algorithm
libfuse2:amd64	2.9.7-1+deb9u2	Filesystem in Userspace (library)
libgail-3-0:amd64	3.22.11-1	GNOME Accessibility Implementation Library -- shared libraries
libgail-common:amd64	2.24.31-2	GNOME Accessibility Implementation Library -- common modules
libgail18:amd64	2.24.31-2	GNOME Accessibility Implementation Library -- shared libraries
libgarcon-1-0	0.4.0-2	freedesktop.org compliant menu implementation for Xfce
libgarcon-common	0.4.0-2	all common files for libgarcon menu implementation
libgbm1:amd64	13.0.6-1+b2	generic buffer management API -- runtime
libgcc1c2:amd64	1:7.4.2-8	conservative garbage collector for C and C++
libgcc-6-dev:amd64	6.3.0-18+deb9u1	GCC support library (development files)
libgcc1:amd64	1:6.3.0-18+deb9u1	GCC support library
libgcj-common	1:6.3-4	all Java runtime library (common files)
libgcj17:amd64	6.3.0-18+deb9u1	Java runtime library for use with gcj
libgck-1-0:amd64	3.20.0-5.1	Glib wrapper library for PKCS#11 - runtime
libgconf-2-4:amd64	3.2.6-4+b1	GNOME configuration database system (shared libraries)
libgcr-3-common	3.20.0-5.1	all Library for Crypto UI related tasks - common files
libgcr-base-3-1:amd64	3.20.0-5.1	Library for Crypto related tasks
libgcr-ui-3-1:amd64	3.20.0-5.1	Library for Crypto UI related tasks
libgcrypt20:amd64	1.7.6-2+deb9u3	LGPL Crypto library - runtime library
libgd3:amd64	2.2.4-2+deb9u4	GD Graphics Library
libgdata-common	0.17.6-2	all Library for accessing GData webservices - common data files
libgdata22:amd64	0.17.6-2	Library for accessing GData webservices - shared libraries
libgdbm3:amd64	1.8.3-14	GNU dbm database routines (runtime version)
libgdk-pixbuf2.0-0:amd64	2.36.5-2+deb9u2	GDK Pixbuf library
libgdk-pixbuf2.0-common	2.36.5-2+deb9u2	all GDK Pixbuf library - data files
libgdm1	3.22.3-3+deb9u2	GNOME Display Manager (shared library)
libgee-0.8-2:amd64	0.18.1-1	GObject based collection and utility library
libgeoclue-2-0:amd64	2.4.5-1	convenience library to interact with geoinformation service
libgeocode-glib0:amd64	3.20.1-2	geocoding and reverse geocoding GLib library using Nominatim
libgeoip1:amd64	1.6.9-4	non-DNS IP-to-country resolver library
libgirepository-1.0-1:amd64	1.50.0-1+b1	Library for handling GObject introspection data (runtime library)
libgjs0e	1.46.0-1+b2	Mozilla-based javascript bindings for the GNOME platform
libgl1-mesa-dev:amd64	13.0.6-1+b2	free implementation of the OpenGL API -- GLX development files
libgl1-mesa-dri:amd64	13.0.6-1+b2	free implementation of the OpenGL API -- DRI modules
libgl1-mesa-glx:amd64	13.0.6-1+b2	free implementation of the OpenGL API -- GLX runtime
libglapi-mesa:amd64	13.0.6-1+b2	free implementation of the GL API -- shared library
libgles2-mesa:amd64	13.0.6-1+b2	free implementation of the OpenGL ES 2.x API -- runtime
libglew2.0:amd64	2.0.0-3+b1	OpenGL Extension Wrangler - runtime environment
libglib-perl	3:1.324-1	interface to the GLib and GObject libraries
libglib2.0-0:amd64	2.50.3-2	GLib library of C routines
libglib2.0-bin	2.50.3-2	Programs for the GLib library
libglib2.0-data	2.50.3-2	all Common files for GLib library
libglib2.0-dev	2.50.3-2	Development files for the GLib library

Name	Version	Description
libglibmm-2.4-1v5:amd64	2.50.0-1	C++ wrapper for the GLib toolkit (shared libraries)
libglu1-mesa:amd64	9.0.0-2.1	Mesa OpenGL utility library (GLU)
libglu1-mesa-dev:amd64	9.0.0-2.1	Mesa OpenGL utility library -- development files
libgmp10:amd64	2:6.1.2+dfsg-1	Multiprecision arithmetic library
libgnome-autoar-0-0:amd64	0.1.1-4+b1	Archives integration support for GNOME
libgnome-autoar-common	0.1.1-4	all Archives integration support for GNOME - common files
libgnome-bluetooth13:amd64	3.20.1-1	GNOME Bluetooth tools - support library
libgnome-desktop-3-12:amd64	3.22.2-1	Utility library for loading .desktop files - runtime files
libgnomekbd-common	3.22.0.1-1	all GNOME library to manage keyboard configuration - common files
libgnomekbd8:amd64	3.22.0.1-1+b1	GNOME library to manage keyboard configuration - shared library
libgnutls30:amd64	3.5.8-5+deb9u4	GNU TLS library - main runtime library
libgoa-1.0-0b:amd64	3.22.5-1	library for GNOME Online Accounts
libgoa-1.0-common	3.22.5-1	all library for GNOME Online Accounts - common files
libgomp1:amd64	6.3.0-18+deb9u1	GCC OpenMP (GOMP) support library
libgpg-error0:amd64	1.26-2	library for common error values and messages in GnuPG components
libgphoto2-6:amd64	2.5.12-1	gphoto2 digital camera library
libgphoto2-l10n	2.5.12-1	all gphoto2 digital camera library - localized messages
libgphoto2-port12:amd64	2.5.12-1	gphoto2 digital camera port library
libgpm2:amd64	1.20.4-6.2+b1	General Purpose Mouse - shared library
libgraphite2-3:amd64	1.3.10-1	Font rendering engine for Complex Scripts -- library
libgs9:amd64	9.26a~dfsg-0+deb9u1	interpreter for the PostScript language and for PDF - Library
libgs9-common	9.26a~dfsg-0+deb9u1	all interpreter for the PostScript language and for PDF - common files
libgsm1:amd64	1.0.13-4+b2	Shared libraries for GSM speech compressor
libgssapi-krb5-2:amd64	1.15-1+deb9u1	MIT Kerberos runtime libraries - krb5 GSS-API Mechanism
libgstreamer-plugins-bad1.0-0:amd64	1.10.4-1	GStreamer development files for libraries from the "bad" set
libgstreamer-plugins-base1.0-0:amd64	1.10.4-1	GStreamer libraries from the "base" set
libgstreamer1.0-0:amd64	1.10.4-1	Core GStreamer libraries and elements
libgtk-3-0:amd64	3.22.11-1	GTK+ graphical user interface library
libgtk-3-bin	3.22.11-1	programs for the GTK+ graphical user interface library
libgtk-3-common	3.22.11-1	all common files for the GTK+ graphical user interface library
libgtk2-perl	2:1.2499-1	Perl interface to the 2.x series of the Gimp Toolkit library
libgtk2.0-0:amd64	2.24.31-2	GTK+ graphical user interface library
libgtk2.0-bin	2.24.31-2	programs for the GTK+ graphical user interface library
libgtk2.0-common	2.24.31-2	all common files for the GTK+ graphical user interface library
libgtkmm-3.0-1v5:amd64	3.22.0-1	C++ wrappers for GTK+ (shared libraries)
libgtksourcesview-3.0-1:amd64	3.22.2-1	shared libraries for the GTK+ syntax highlighting widget

Name	Version	Description
libgtksourceview-3.0-common	3.22.2-1	all common files for the GTK+ syntax highlighting widget
libgtksourceview2.0-0:amd64	2.10.5-3	shared libraries for the GTK+ syntax highlighting widget
libgtksourceview2.0-common	2.10.5-3	all common files for the GTK+ syntax highlighting widget
libgudev-1.0-0:amd64	230-3	GObject-based wrapper library for libudev
libgusb2:amd64	0.2.9-1+b1	GLib wrapper around libusb1
libgweather-3-6:amd64	3.20.4-1	GWeather shared library
libgweather-common	3.20.4-1	all GWeather common files
libgxps2:amd64	0.2.4-1+b1	handling and rendering XPS documents (library)
libharfbuzz-icu0:amd64	1.4.2-1	OpenType text shaping engine ICU backend
libharfbuzz0b:amd64	1.4.2-1	OpenType text shaping engine (shared library)
libhogweed4:amd64	3.3-1+b2	low level cryptographic library (public-key cryptos)
libhtml-form-perl	6.03-1	all module that represents an HTML form element
libhtml-format-perl	2.12-1	all module for transforming HTML into various formats
libhtml-parser-perl	3.72-3	collection of modules that parse HTML text documents
libhtml-tagset-perl	3.20-3	all Data tables pertaining to HTML
libhtml-tree-perl	5.03-2	all Perl module to represent and create HTML syntax trees
libhttp-cookies-perl	6.01-1	all HTTP cookie jars
libhttp-daemon-perl	6.01-1	all simple http server class
libhttp-date-perl	6.02-1	all module of date conversion routines
libhttp-message-perl	6.11-1	all perl interface to HTTP style messages
libhttp-negotiate-perl	6.00-2	all implementation of content negotiation
libhunspell-1.4-0:amd64	1.4.1-2+b2	spell checker and morphological analyzer (shared library)
libhyphen0:amd64	2.8.8-5	ALTLinux hyphenation library - shared library
libibus-1.0-5:amd64	1.5.14-3+deb9u1	Intelligent Input Bus - shared library
libical2:amd64	2.0.0-0.5+b1	iCalendar library implementation in C (runtime)
libice-dev:amd64	2:1.0.9-2	X11 Inter-Client Exchange library (development headers)
libice6:amd64	2:1.0.9-2	X11 Inter-Client Exchange library
libicu57:amd64	57.1-6+deb9u2	International Components for Unicode
libidn11:amd64	1.33-1	GNU Libidn library, implementation of IETF IDN specifications
libidn2-0:amd64	0.16-1+deb9u1	Internationalized domain names (IDNA2008) library
libiec61883-0:amd64	1.2.0-2	partial implementation of IEC 61883 (shared lib)
libieee1284-3:amd64	0.2.11-13	cross-platform library for parallel port access
libijs-0.35:amd64	0.35-12	IJS raster image transport protocol: shared library
libimobiledevice6:amd64	1.2.0+dfsg-3.1	Library for communicating with the iPhone and iPod Touch
libindicator3-7:amd64	0.5.0-3+b1	panel indicator applet - shared library
libinput-bin	1.6.3-1	input device management and event handling library - udev quirks
libinput10:amd64	1.6.3-1	input device management and event handling library - shared library
libio-html-perl	1.001-1	all open an HTML file with automatic charset detection
libio-socket-ssl-perl	2.044-1	all Perl module implementing object oriented interface to SSL sockets
libip4tc0:amd64	1.6.0+snapshot20161117-6	netfilter libip4tc library
libip6tc0:amd64	1.6.0+snapshot20161117-6	netfilter libip6tc library

Name	Version	Description
libipc-system-simple-perl	1.25-3	all Perl module to run commands simply, with detailed diagnostics
libiptc0:amd64	1.6.0+snapshot20161117-6	netfilter libiptc library
libiptcdata0	1.0.4-6+b1	Library to parse IPTC metadata
libisc-export160	1:9.10.3.dfsg.P4-12.3+deb9u4	Exported ISC Shared Library
libisc160:amd64	1:9.10.3.dfsg.P4-12.3+deb9u4	ISC Shared Library used by BIND
libisccc140:amd64	1:9.10.3.dfsg.P4-12.3+deb9u4	Command Channel Library used by BIND
libiscfg140:amd64	1:9.10.3.dfsg.P4-12.3+deb9u4	Config File Handling Library used by BIND
libisl15:amd64	0.18-1	manipulating sets and relations of integer points bounded by linear constraints
libitm1:amd64	6.3.0-18+deb9u1	GNU Transactional Memory Library
libiw30:amd64	30~pre9-12+b1	Wireless tools - library
libjack-jackd2-0:amd64	1.9.10+20150825git1ed50c92~dfsg-5	JACK Audio Connection Kit (libraries)
libjansson4:amd64	2.9-1	C library for encoding, decoding and manipulating JSON data
libjavascriptcoregtk-4.0-18:amd64	2.18.6-1~deb9u1	JavaScript engine library from WebKitGTK+
libjbig0:amd64	2.1-3.1+b2	JBIGkit libraries
libjbig2dec0:amd64	0.13-4.1	JBIG2 decoder library - shared libraries
libjpeg62-turbo:amd64	1:1.5.1-2	libjpeg-turbo JPEG runtime library
libjs-jquery	3.1.1-2	all JavaScript library for dynamic web applications
libjson-glib-1.0-0:amd64	1.2.6-1	GLib JSON manipulation library
libjson-glib-1.0-common	1.2.6-1	all GLib JSON manipulation library (common files)
libjsoncpp1:amd64	1.7.4-3	library for reading and writing JSON for C++
libk5crypto3:amd64	1.15-1+deb9u1	MIT Kerberos runtime libraries - Crypto Library
libkeybinder-3.0-0:amd64	0.3.1-1	registers global key bindings for applications - Gtk+3
libkeyutils1:amd64	1.5.9-9	Linux Key Management Utilities (library)
libklibc	2.0.4-9	minimal libc subset for use with initramfs
libkmod2:amd64	23-2	libkmod shared library
libkpathsea6:amd64	2016.20160513.41080.dfsg-2+deb9u1	TeX Live: path search library for TeX (runtime part)
libkrb5-3:amd64	1.15-1+deb9u1	MIT Kerberos runtime libraries
libkrb5support0:amd64	1.15-1+deb9u1	MIT Kerberos runtime libraries - Support library
libksba8:amd64	1.3.5-2	X.509 and CMS support library
liblcms2-2:amd64	2.8-4+deb9u1	Little CMS 2 color management library
libldap-2.4-2:amd64	2.4.44+dfsg-5+deb9u2	OpenLDAP libraries
libldap-common	2.4.44+dfsg-5+deb9u2	all OpenLDAP common files for libraries
libldb1:amd64	2:1.1.27-1+deb9u1	LDAP-like embedded database - shared library
liblightdm-gobject-1-0	1.18.3-1	simple display manager (gobject library)
libllvm3.8:amd64	1:3.8.1-24	Modular compiler and toolchain technologies, runtime library
libllvm3.9:amd64	1:3.9.1-9	Modular compiler and toolchain technologies, runtime library
liblocale-gettext-perl	1.07-3+b1	module using libc functions for internationalization in Perl
liblockfile-bin	1.14-1+b1	support binaries for and cli utilities based on liblockfile

Name	Version	Description
liblogging-stdlog0:amd64	1.0.5-2+b2	easy to use and lightweight logging library
liblognorm5:amd64	2.0.1-1.1+b1	log normalizing library
liblsan0:amd64	6.3.0-18+deb9u1	LeakSanitizer -- a memory leak detector (runtime)
libltdl7:amd64	2.4.6-2	System independent dlopen wrapper for GNU libtool
liblwp-mediatypes-perl	6.02-1	all module to guess media type for a file or a URL
liblwp-protocol-https-perl	6.06-2	all HTTPS driver for LWP::UserAgent
liblwres141:amd64	1:9.10.3.dfsg.P4-12.3+deb9u4	Lightweight Resolver Library used by BIND
liblz4-1:amd64	0.0~r131-2+b1	Fast LZ compression algorithm library - runtime
liblzma5:amd64	5.2.2-1.2+b1	XZ-format compression library
liblzo2-2:amd64	2.08-1.2+b2	data compression library
libmagic-mgc	1:5.30-1+deb9u2	File type determination library using "magic" numbers (compiled magic file)
libmagic1:amd64	1:5.30-1+deb9u2	Recognize the type of data in a file using "magic" numbers - library
libmailtools-perl	2.18-1	all Manipulate email in perl programs
libmbim-glib4:amd64	1.14.0-1+b1	Support library to use the MBIM protocol
libmbim-proxy	1.14.0-1+b1	Proxy to communicate with MBIM ports
libmediaart-2.0-0:amd64	1.9.0-2	media art extraction and cache management library
libmhash2:amd64	0.9.9.9-7	Library for cryptographic hashing and message authentication
libmission-control-plugins0	1:5.16.3-2.1	management daemon for Telepathy (library for plugins)
libmn10:amd64	1.0.4-2	minimalistic Netlink communication library
libmount1:amd64	2.29.2-1+deb9u1	device mounting library
libmozjs-24-0:amd64	24.2.0-5.1+b2	Spidermonkey JavaScript engine
libmp3lame0:amd64	3.99.5+repack1-9+b2	MP3 encoding library
libmpc3:amd64	1.0.3-1+b2	multiple precision complex floating-point library
libmpdec2:amd64	2.4.2-1	library for decimal floating point arithmetic (runtime library)
libmpfr4:amd64	3.1.5-1	multiple precision floating-point computation
libmpx2:amd64	6.3.0-18+deb9u1	Intel memory protection extensions (runtime)
libmtdev-dev	1.1.5-1+b1	Multitouch Protocol Translation Library - dev files
libmtdev1:amd64	1.1.5-1+b1	Multitouch Protocol Translation Library - shared library
libmtp-common	1.1.13-1	all Media Transfer Protocol (MTP) common files
libmtp-runtime	1.1.13-1	Media Transfer Protocol (MTP) runtime tools
libmtp9:amd64	1.1.13-1	Media Transfer Protocol (MTP) library
libmusicbrainz5-2:amd64	5.1.0+git20150707-6	Library to access the MusicBrainz.org database (C wrapper functions)
libmusicbrainz5cc2v5:amd64	5.1.0+git20150707-6	Library to access the MusicBrainz.org database
libmutter0i:amd64	3.22.3-2	window manager library from the Mutter window manager
libnautilus-extension1a:amd64	3.22.3-1+deb9u1	libraries for nautilus components - runtime version
libncurses5:amd64	6.0+20161126-1+deb9u2	shared libraries for terminal handling
libncurses5-dev:amd64	6.0+20161126-1+deb9u2	developer's libraries for ncurses
libncursesw5:amd64	6.0+20161126-1+deb9u2	shared libraries for terminal handling (wide character support)
libneon27-gnutls:amd64	0.30.2-2	HTTP and WebDAV client library (GnuTLS enabled)
libnet-dbus-perl	1.1.0-4+b1	Perl extension for the Dbus bindings
libnet-http-perl	6.12-1	all module providing low-level HTTP connection client

Name	Version	Description
libnet-smtp-ssl-perl	1.04-1	all Perl module providing SSL support to Net::SMTP
libnet-ssleay-perl	1.80-1	Perl module for Secure Sockets Layer (SSL)
libnetfilter-contrack3:amd64	1.0.6-2	Netfilter netlink-contrack library
libnettle6:amd64	3.3-1+b2	low level cryptographic library (symmetric and one-way cryptos)
libnewt0.52:amd64	0.52.19-1+b1	Not Erik's Windowing Toolkit - text mode windowing with slang
libnfnetlink0:amd64	1.0.1-3	Netfilter netlink library
libnfs8:amd64	1.11.0-2	NFS client library (shared library)
libnfsidmap2:amd64	0.25-5.1	NFS idmapping library
libnghttp2-14:amd64	1.18.1-1	library implementing HTTP/2 protocol (shared library)
libnl-3-200:amd64	3.2.27-2	library for dealing with netlink sockets
libnl-genl-3-200:amd64	3.2.27-2	library for dealing with netlink sockets - generic netlink
libnm-glib4:amd64	1.6.2-3+deb9u2	network management framework (GLib shared library)
libnm-gtk0:amd64	1.4.4-1+deb9u1	library for wireless and mobile dialogs (libnm-glib version)
libnm-util2:amd64	1.6.2-3+deb9u2	network management framework (shared library)
libnm0:amd64	1.6.2-3+deb9u2	GObject-based client library for NetworkManager
libnotify-bin	0.7.7-2	sends desktop notifications to a notification daemon (Utilities)
libnotify4:amd64	0.7.7-2	sends desktop notifications to a notification daemon
libnpt0:amd64	1.3-1	replacement for GNU Pth using system threads
libnspr4:amd64	2:4.12-6	NetScape Portable Runtime Library
libnss-mdns:amd64	0.10-8	NSS module for Multicast DNS name resolution
libnss-myhostname:amd64	232-25+deb9u4	nss module providing fallback resolution for the current hostname
libnss3:amd64	2:3.26.2-1.1+deb9u1	Network Security Service libraries
libntfs-3g871	1:2016.2.22AR.1+dfsg-1	read/write NTFS driver for FUSE (runtime library)
libnuma1:amd64	2.0.11-2.1	Libraries for controlling NUMA policy
liboauth0:amd64	1.0.1-1	C library for implementing OAuth 1.0
libobjc-6-dev:amd64	6.3.0-18+deb9u1	Runtime library for GNU Objective-C applications (development files)
libobjc4:amd64	6.3.0-18+deb9u1	Runtime library for GNU Objective-C applications
libogg0:amd64	1.3.2-1	Ogg bitstream library
libopenal-data	1:1.17.2-4	all Software implementation of the OpenAL audio API (data files)
libopenjp2-7:amd64	2.1.2-1.1+deb9u2	JPEG 2000 image compression/decompression library
libopus0:amd64	1.2~alpha2-1	Opus codec runtime library
liborc-0.4-0:amd64	1:0.4.26-2	Library of Optimized Inner Loops Runtime Compiler
libp11-kit0:amd64	0.23.3-2	library for loading and coordinating access to PKCS#11 modules - runtime
libpam-cap:amd64	1:2.25-1	POSIX 1003.1e capabilities (PAM module)
libpam-gnome-keyring:amd64	3.20.0-3	PAM module to unlock the GNOME keyring upon login
libpam-modules:amd64	1.1.8-3.6	Pluggable Authentication Modules for PAM
libpam-modules-bin	1.1.8-3.6	Pluggable Authentication Modules for PAM - helper binaries
libpam-runtime	1.1.8-3.6	all Runtime support for the PAM library
libpam-systemd:amd64	232-25+deb9u9	system and service manager - PAM module
libpam0g:amd64	1.1.8-3.6	Pluggable Authentication Modules library
libpango-1.0-0:amd64	1.40.5-1	Layout and rendering of internationalized text
libpango-perl	1.227-1+b1	Perl module to layout and render international text
libpangocairo-1.0-0:amd64	1.40.5-1	Layout and rendering of internationalized text

Name	Version	Description
libpangoft2-1.0-0:amd64	1.40.5-1	Layout and rendering of internationalized text
libpangomm-1.4-1v5:amd64	2.40.1-3	C++ Wrapper for pango (shared libraries)
libpangoft-1.0-0:amd64	1.40.5-1	Layout and rendering of internationalized text
libpaper-utils	1.1.24+nmu5	library for handling paper characteristics (utilities)
libpaper1:amd64	1.1.24+nmu5	library for handling paper characteristics
libparted2:amd64	3.2-17	disk partition manipulator - shared library
libpcap0.8:amd64	1.8.1-3	system interface for user-level packet capture
libpci3:amd64	1:3.5.2-1	Linux PCI Utilities (shared library)
libpciaccess0:amd64	0.13.4-1+b2	Generic PCI access library for X
libpcre16-3:amd64	2:8.39-3	Old Perl 5 Compatible Regular Expression Library - 16 bit runtime files
libpcre2-8-0:amd64	10.22-3	New Perl Compatible Regular Expression Library- 8 bit runtime files
libpcre3:amd64	2:8.39-3	Old Perl 5 Compatible Regular Expression Library - runtime files
libpcre3-dev:amd64	2:8.39-3	Old Perl 5 Compatible Regular Expression Library - development files
libpcre32-3:amd64	2:8.39-3	Old Perl 5 Compatible Regular Expression Library - 32 bit runtime files
libpcrecpp0v5:amd64	2:8.39-3	Old Perl 5 Compatible Regular Expression Library - C++ runtime files
libpcsclite1:amd64	1.8.20-1	Middleware to access a smart card using PC/SC (library)
libperl-dev	5.24.1-3+deb9u5	Perl library: development files
libperl5.24:amd64	5.24.1-3+deb9u5	shared Perl library
libphonenumber7:amd64	7.1.0-5+b1	parsing/formatting/validating phone numbers
libpipeline1:amd64	1.4.1-2	pipeline manipulation library
libpixman-1-0:amd64	0.34.0-1	pixel-manipulation library for X and cairo
libpixman-1-dev	0.34.0-1	pixel-manipulation library for X and cairo (development files)
libplist3:amd64	1.12+git+1+e37ca00-0.3	Library for handling Apple binary and XML property lists
libpng-dev:amd64	1.6.28-1	PNG library - development (version 1.6)
libpng-tools	1.6.28-1	PNG library - tools (version 1.6)
libpng16-16:amd64	1.6.28-1	PNG library - runtime (version 1.6)
libpolkit-agent-1-0:amd64	0.105-18+deb9u1	PolicyKit Authentication Agent API
libpolkit-backend-1-0:amd64	0.105-18+deb9u1	PolicyKit backend API
libpolkit-gobject-1-0:amd64	0.105-18+deb9u1	PolicyKit Authorization API
libpoppler-glib8:amd64	0.48.0-2+deb9u2	PDF rendering library (GLib-based shared library)
libpoppler64:amd64	0.48.0-2+deb9u2	PDF rendering library
libpopt0:amd64	1.16-10+b2	lib for parsing cmdline parameters
libprocps6:amd64	2:3.3.12-3+deb9u1	library for accessing process information from /proc
libprotobuf10:amd64	3.0.0-9	protocol buffers C++ library
libproxy1v5:amd64	0.4.14-2	automatic proxy configuration management library (shared)
libpsl5:amd64	0.17.0-3	Library for Public Suffix List (shared libraries)
libpthread-stubs0-dev:amd64	0.3-4	pthread stubs not provided by native libc, development files
libpulse-mainloop-glib0:amd64	10.0-1+deb9u1	PulseAudio client libraries (glib support)

Name	Version	Description
libpulse0:amd64	10.0-1+deb9u1	PulseAudio client libraries
libpulsedsp:amd64	10.0-1+deb9u1	PulseAudio OSS pre-load library
libpwquality-common	1.3.0-1	all library for password quality checking and generation (data files)
libpython-stdlib:amd64	2.7.13-2	interactive high-level object-oriented language (default python version)
libpython2.7:amd64	2.7.13-2+deb9u3	Shared Python runtime library (version 2.7)
libpython2.7-minimal:amd64	2.7.13-2+deb9u3	Minimal subset of the Python language (version 2.7)
libpython2.7-stdlib:amd64	2.7.13-2+deb9u3	Interactive high-level object-oriented language (standard library, version 2.7)
libpython3-stdlib:amd64	3.5.3-1	interactive high-level object-oriented language (default python3 version)
libpython3.5:amd64	3.5.3-1+deb9u1	Shared Python runtime library (version 3.5)
libpython3.5-minimal:amd64	3.5.3-1+deb9u1	Minimal subset of the Python language (version 3.5)
libpython3.5-stdlib:amd64	3.5.3-1+deb9u1	Interactive high-level object-oriented language (standard library, version 3.5)
libqbscore1.7	1.7.0+dfsg-4	Qbs core library
libqbsqtprofilessetup1.7	1.7.0+dfsg-4	Qbs profile setup library
libqmi-glib5:amd64	1.16.2-1	Support library to use the Qualcomm MSM Interface (QMI) protocol
libqmi-proxy	1.16.2-1	Proxy to communicate with QMI ports
libqmi-utils	1.16.2-1	Utilities to use the QMI protocol from the command line
libqt5clucene5:amd64	5.7.1-1	Qt 5 CLucene module
libqt5concurrent5:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 concurrent module
libqt5core5a:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 core module
libqt5dbus5:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 D-Bus module
libqt5designer5:amd64	5.7.1-1	Qt 5 designer module
libqt5designercomponents5:amd64	5.7.1-1	Qt 5 Designer components module
libqt5gui5:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 GUI module
libqt5help5:amd64	5.7.1-1	Qt 5 help module
libqt5network5:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 network module
libqt5opengl5:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 OpenGL module
libqt5opengl5-dev:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 OpenGL library development files
libqt5printsupport5:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 print support module
libqt5qml5:amd64	5.7.1-2+b2	Qt 5 QML module
libqt5quick5:amd64	5.7.1-2+b2	Qt 5 Quick library
libqt5quickparticles5:amd64	5.7.1-2+b2	Qt 5 Quick particles module
libqt5quicktest5:amd64	5.7.1-2+b2	Qt 5 Quick Test library
libqt5quickwidgets5:amd64	5.7.1-2+b2	Qt 5 Quick Widgets library
libqt5script5:amd64	5.7.1~20161021+dfsg-2	Qt 5 script module
libqt5sql5:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 SQL module
libqt5sql5-sqlite:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 SQLite 3 database driver
libqt5svg5:amd64	5.7.1~20161021-2+b2	Qt 5 SVG module
libqt5test5:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 test module

Name	Version	Description
libqt5webkit5:amd64	5.7.1+dfsg-1	Web content engine library for Qt
libqt5widgets5:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 widgets module
libqt5xml5:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 XML module
libqt5xmlpatterns5:amd64	5.7.1~20161021-3	Qt 5 XML patterns module
libquadmath0:amd64	6.3.0-18+deb9u1	GCC Quad-Precision Math Library
librarian0	0.8.1-6+b1	Documentation meta-data library (library package)
libraw1394-11:amd64	2.1.2-1+b1	library for direct access to IEEE 1394 bus (aka FireWire)
libreadline7:amd64	7.0-3	GNU readline and history libraries, run-time libraries
libreoffice-avmedia-backend-gstreamer	1:5.2.7-1+deb9u4	GStreamer backend for LibreOffice
libreoffice-base	1:5.2.7-1+deb9u4	office productivity suite -- database
libreoffice-base-core	1:5.2.7-1+deb9u4	office productivity suite -- shared library
libreoffice-base-drivers	1:5.2.7-1+deb9u4	Database connectivity drivers for LibreOffice
libreoffice-calc	1:5.2.7-1+deb9u4	office productivity suite -- spreadsheet
libreoffice-common	1:5.2.7-1+deb9u4	all office productivity suite -- arch-independent files
libreoffice-core	1:5.2.7-1+deb9u4	office productivity suite -- arch-dependent files
libreoffice-draw	1:5.2.7-1+deb9u4	office productivity suite -- drawing
libreoffice-help-en-us	1:5.2.7-1+deb9u4	all office productivity suite -- English_american help
libreoffice-impress	1:5.2.7-1+deb9u4	office productivity suite -- presentation
libreoffice-java-common	1:5.2.7-1+deb9u4	all office productivity suite -- arch-independent Java support files
libreoffice-math	1:5.2.7-1+deb9u4	office productivity suite -- equation editor
libreoffice-ogltrans	1:5.2.7-1+deb9u4	LibreOffice Impress extension for slide transitions using OpenGL
libreoffice-pdfimport	1:5.2.7-1+deb9u4	PDF Import component for LibreOffice
libreoffice-report-builder	1:5.2.7-1+deb9u4	all LibreOffice component for building database reports
libreoffice-report-builder-bin	1:5.2.7-1+deb9u4	LibreOffice component for building database reports -- libraries
libreoffice-script-provider-bsh	1:5.2.7-1+deb9u4	all BeanShell script support provider for LibreOffice scripting framework
libreoffice-script-provider-js	1:5.2.7-1+deb9u4	all JavaScript script support provider for LibreOffice scripting framework
libreoffice-script-provider-python	1:5.2.7-1+deb9u4	all Python script support provider for LibreOffice scripting framework
libreoffice-sdbc-hsqldb	1:5.2.7-1+deb9u4	HSQLDB SDBC driver for LibreOffice
libreoffice-sdbc-postgresql	1:5.2.7-1+deb9u4	PostgreSQL SDBC driver for LibreOffice
libreoffice-style-galaxy	1:5.2.7-1+deb9u4	all office productivity suite -- Galaxy (Default) symbol style
libreoffice-style-tango	1:5.2.7-1+deb9u4	all office productivity suite -- Tango symbol style
libreoffice-writer	1:5.2.7-1+deb9u4	office productivity suite -- word processor
librest-0.7-0:amd64	0.8.0-2	REST service access library
librsvg2-2:amd64	2.40.16-1+b1	SAX-based renderer library for SVG files (runtime)
librsvg2-common:amd64	2.40.16-1+b1	SAX-based renderer library for SVG files (extra runtime)
librtmp1:amd64	2.4+20151223.gitfa8646d.1-1+b1	toolkit for RTMP streams (shared library)
libsac-java-gcj	1.3+dfsg-2	Simple API for CSS Java library (native code)
libsamplerate0:amd64	0.1.8-8+b2	Audio sample rate conversion library
libsane:amd64	1.0.25-4.1	API library for scanners
libsane-common	1.0.25-4.1	all API library for scanners -- documentation and support files
libsane-extras:amd64	1.0.22.4	API library for scanners -- extra backends

Name	Version	Description
libsane-extras-common	1.0.22.4	API library for scanners -- documentation and support files
libsasl2-2:amd64	2.1.27~101-g0780600+dfsg-3	Cyrus SASL - authentication abstraction library
libsasl2-modules:amd64	2.1.27~101-g0780600+dfsg-3	Cyrus SASL - pluggable authentication modules
libsasl2-modules-db:amd64	2.1.27~101-g0780600+dfsg-3	Cyrus SASL - pluggable authentication modules (DB)
libseccomp2:amd64	2.3.1-2.1+deb9u1	high level interface to Linux seccomp filter
libsecret-1-0:amd64	0.18.5-3.1	Secret store
libsecret-common	0.18.5-3.1	all Secret store (common files)
libselinux1:amd64	2.6-3+b3	SELinux runtime shared libraries
libsemanage-common	2.6-2	all Common files for SELinux policy management libraries
libsemanage1:amd64	2.6-2	SELinux policy management library
libsensors4:amd64	1:3.4.0-4	library to read temperature/voltage/fan sensors
libsepol1:amd64	2.6-2	SELinux library for manipulating binary security policies
libshine3:amd64	3.1.0-5	Fixed-point MP3 encoding library - runtime files
libshout3:amd64	2.3.1-3	MP3/Ogg Vorbis broadcast streaming library
libsigc++-2.0-0v5:amd64	2.10.0-1	type-safe Signal Framework for C++ - runtime
libsigsegv2:amd64	2.10-5	Library for handling page faults in a portable way
libslang2:amd64	2.3.1-5	S-Lang programming library - runtime version
libsm-dev:amd64	2:1.2.2-1+b3	X11 Session Management library (development headers)
libsm6:amd64	2:1.2.2-1+b3	X11 Session Management library
libsmartcols1:amd64	2.29.2-1+deb9u1	smart column output alignment library
libsmbcclient:amd64	2:4.5.16+dfsg-1	shared library for communication with SMB/CIFS servers
libsnappy1v5:amd64	1.1.3-3	fast compression/decompression library
libsndfile1:amd64	1.0.27-3	Library for reading/writing audio files
libsnmp-base	5.7.3+dfsg-1.7+deb9u1	all SNMP configuration script, MIBs and documentation
libsnmp30:amd64	5.7.3+dfsg-1.7+deb9u1	SNMP (Simple Network Management Protocol) library
libsoup-gnome2.4-1:amd64	2.56.0-2+deb9u2	HTTP library implementation in C -- GNOME support library
libsoup2.4-1:amd64	2.56.0-2+deb9u2	HTTP library implementation in C -- Shared library
libsoxr0:amd64	0.1.2-2	High quality 1D sample-rate conversion library
libspectre1:amd64	0.2.8-1	Library for rendering PostScript documents
libspeex1:amd64	1.2~rc1.2-1+b2	The Speex codec runtime library
libspeexdsp1:amd64	1.2~rc1.2-1+b2	The Speex extended runtime library
libsqlite3-0:amd64	3.16.2-5+deb9u1	SQLite 3 shared library
libss2:amd64	1.43.4-2	command-line interface parsing library
libssh2-1:amd64	1.7.0-1	SSH2 client-side library
libssl1.0.2:amd64	1.0.2r-1~deb9u1	Secure Sockets Layer toolkit - shared libraries
libssl1.1:amd64	1.1.0j-1~deb9u1	Secure Sockets Layer toolkit - shared libraries
libstartup-notification0:amd64	0.12-4+b2	library for program launch feedback (shared library)
libstdc++-6-dev:amd64	6.3.0-18+deb9u1	GNU Standard C++ Library v3 (development files)
libstdc++6:amd64	6.3.0-18+deb9u1	GNU Standard C++ Library v3
libstemmer0d:amd64	0+svn585-1+b2	Snowball stemming algorithms for use in Information Retrieval
libsugarext-data	0.110.0-4	all Sugar Learning Platform - toolkit common files
libsugarext0:amd64	0.110.0-4	Sugar Learning Platform - toolkit runtime library
libswitch-perl	2.17-2	all switch statement for Perl

Name	Version	Description
libswresample2:amd64	7:3.2.12-1~deb9u1	FFmpeg library for audio resampling, rematrixing etc. - runtime files
libsystemd0:amd64	232-25+deb9u9	systemd utility library
libtag1v5:amd64	1.11.1+dfsg.1-0.1	audio meta-data library
libtag1v5-vanilla:amd64	1.11.1+dfsg.1-0.1	audio meta-data library - vanilla flavour
libtagc0:amd64	1.11.1+dfsg.1-0.1	audio meta-data library - C bindings
libtalloc2:amd64	2.1.8-1	hierarchical pool based memory allocator
libtasn1-6:amd64	4.10-1.1+deb9u1	Manage ASN.1 structures (runtime)
libtcl8.6:amd64	8.6.6+dfsg-1+b1	Tcl (the Tool Command Language) v8.6 - run-time library files
libtdb1:amd64	1.3.11-2	Trivial Database - shared library
libtelepathy-glib0:amd64	0.24.1-1.1	Telepathy framework - GLib library
libtelepathy-logger3:amd64	0.8.2-2	Telepathy logger service - utility library
libtevent0:amd64	0.9.31-1	talloc-based event loop library - shared library
libtext-charwidth-perl	0.04-7+b5	get display widths of characters on the terminal
libtext-iconv-perl	1.7-5+b4	converts between character sets in Perl
libtext-wrapi18n-perl	0.06-7.1	all internationalized substitute of Text::Wrap
libthai-data	0.1.26-1	all Data files for Thai language support library
libthai0:amd64	0.1.26-1	Thai language support library
libtheora0:amd64	1.1.1+dfsg.1-14+b1	Theora Video Compression Codec
libthunarx-2-0	1.6.11-1	extension library for thunar
libtie-ixhash-perl	1.23-2	all Perl module to order associative arrays
libtiff5:amd64	4.0.8-2+deb9u4	Tag Image File Format (TIFF) library
libtimedate-perl	2.3000-2	all collection of modules to manipulate date/time information
libtinfo-dev:amd64	6.0+20161126-1+deb9u2	developer's library for the low-level terminfo library
libtinfo5:amd64	6.0+20161126-1+deb9u2	shared low-level terminfo library for terminal handling
libtirpc1:amd64	0.2.5-1.2+deb9u1	transport-independent RPC library
libtk8.6:amd64	8.6.6-1+b1	Tk toolkit for Tcl and X11 v8.6 - run-time files
libtracker-sparql-1.0-0:amd64	1.10.5-1	metadata database, indexer and search tool - library
libtsan0:amd64	6.3.0-18+deb9u1	ThreadSanitizer -- a Valgrind-based detector of data races (runtime)
libtumbler-1-0	0.1.31-2+b3	library for tumbler, a D-Bus thumbnailing service
libtwolame0:amd64	0.3.13-2	MPEG Audio Layer 2 encoding library
libtxc-dxtn-s2tc:amd64	1.0+git20151227-2	Texture compression library for Mesa
libubsan0:amd64	6.3.0-18+deb9u1	UBSan -- undefined behaviour sanitizer (runtime)
libudev1:amd64	232-25+deb9u9	libudev shared library
libudisks2-0:amd64	2.1.8-1	GObject based library to access udisks2
libuniconf4.6	4.6.1-12~deb9u1	C++ network libraries for rapid application development
libunique-1.0-0	1.1.6-5	Library for writing single instance applications - shared libraries
libunistring0:amd64	0.9.6+really0.9.3-0.1	Unicode string library for C
libupower-glib3:amd64	0.99.4-4+b1	abstraction for power management - shared library
liburi-perl	1.71-1	all module to manipulate and access URI strings
libusb-0.1-4:amd64	2:0.1.12-30	userspace USB programming library
libusb-1.0-0:amd64	2:1.0.21-1	userspace USB programming library
libusbmuxd4:amd64	1.0.10-3+b1	USB multiplexor daemon for iPhone and iPod Touch devices - library
libustr-1.0-1:amd64	1.0.4-6	Micro string library: shared library
libutempter0:amd64	1.1.6-3	privileged helper for utmp/wtmp updates (runtime)
libuuid1:amd64	2.29.2-1+deb9u1	Universally Unique ID library

Name	Version	Description
libv4l-0:amd64	1.12.3-1	Collection of video4linux support libraries
libv4lconvert0:amd64	1.12.3-1	Video4linux frame format conversion library
libva-drm1:amd64	1.7.3-2	Video Acceleration (VA) API for Linux -- DRM runtime
libva-x11-1:amd64	1.7.3-2	Video Acceleration (VA) API for Linux -- X11 runtime
libva1:amd64	1.7.3-2	Video Acceleration (VA) API for Linux -- runtime
libvdpau-va-gli:amd64	0.4.2-1	VDPAAU driver with OpenGL/VA-API backend
libvdpau1:amd64	1.1.1-6	Video Decode and Presentation API for Unix (libraries)
libvisual-0.4-0:amd64	0.4.0-10	audio visualization framework
libvlc5:amd64	3.0.2-0+deb9u1	multimedia player and streamer library
libvo-aacenc0:amd64	0.1.3-1	VisualOn AAC encoder library
libvo-amrwbenc0:amd64	0.1.3-1	VisualOn AMR-WB encoder library
libvorbis0a:amd64	1.3.5-4+deb9u2	decoder library for Vorbis General Audio Compression Codec
libvorbisenc2:amd64	1.3.5-4+deb9u2	encoder library for Vorbis General Audio Compression Codec
libvorbisfile3:amd64	1.3.5-4+deb9u2	high-level API for Vorbis General Audio Compression Codec
libvpx4:amd64	1.6.1-3+deb9u1	VP8 and VP9 video codec (shared library)
libvte-2.91-0:amd64	0.46.1-1	Terminal emulator widget for GTK+ 3.0 - runtime files
libvte-2.91-common	0.46.1-1	all Terminal emulator widget for GTK+ 3.0 - common files
libwacom-bin	0.22-1+b1	Wacom model feature query library -- binaries
libwacom-common	0.22-1	all Wacom model feature query library (common files)
libwacom2:amd64	0.22-1+b1	Wacom model feature query library
libwavpack1:amd64	5.0.0-2+deb9u2	audio codec (lossy and lossless) - library
libwayland-client0:amd64	1.12.0-1+deb9u1	wayland compositor infrastructure - client library
libwayland-cursor0:amd64	1.12.0-1+deb9u1	wayland compositor infrastructure - cursor library
libwayland-egl1-mesa:amd64	13.0.6-1+b2	implementation of the Wayland EGL platform -- runtime
libwayland-server0:amd64	1.12.0-1+deb9u1	wayland compositor infrastructure - server library
libwbclient0:amd64	2:4.5.16+dfsg-1	Samba winbind client library
libwebkit2gtk-4.0-37:amd64	2.18.6-1~deb9u1	Web content engine library for GTK+
libwebp6:amd64	0.5.2-1	Lossy compression of digital photographic images.
libwebpmux2:amd64	0.5.2-1	Lossy compression of digital photographic images.
libwebrtc-audio-processing1:amd64	0.3-1	AudioProcessing module from the WebRTC project.
libwildmidi-config	0.4.0-2	all software MIDI player configuration
libwnck-common	2.30.7-5.1	all Window Navigator Construction Kit - common files
libwnck22:amd64	2.30.7-5.1	Window Navigator Construction Kit - runtime files
libwrap0:amd64	7.6.q-26	Wietse Venema's TCP wrappers library
libwvstreams4.6-base	4.6.1-12~deb9u1	C++ network libraries for rapid application development
libwvstreams4.6-extras	4.6.1-12~deb9u1	C++ network libraries for rapid application development
libwww-perl	6.15-1	all simple and consistent interface to the world-wide web
libwww-robotrules-perl	6.01-1	all database of robots.txt-derived permissions
libx11-6:amd64	2:1.6.4-3+deb9u1	X11 client-side library
libx11-data	2:1.6.4-3+deb9u1	all X11 client-side library
libx11-dev:amd64	2:1.6.4-3+deb9u1	X11 client-side library (development headers)
libx11-doc	2:1.6.4-3+deb9u1	all X11 client-side library (development documentation)
libx11-protocol-perl	0.56-7	all Perl module for the X Window System Protocol, version 11

Name	Version	Description
libx11-xcb-dev:amd64	2:1.6.4-3+deb9u1	Xlib/XCB interface library (development headers)
libx11-xcb1:amd64	2:1.6.4-3+deb9u1	Xlib/XCB interface library
libx264-148:amd64	2:0.148.2748+git97eaef2-1	x264 video coding library
libx265-95:amd64	2.1-2+b2	H.265/HEVC video stream encoder (shared library)
libx32asan3	6.3.0-18+deb9u1	AddressSanitizer -- a fast memory error detector (x32)
libx32atomic1	6.3.0-18+deb9u1	support library providing __atomic built-in functions (x32)
libx32cilkrts5	6.3.0-18+deb9u1	Intel Cilk Plus language extensions (x32)
libx32gcc-6-dev	6.3.0-18+deb9u1	GCC support library (x32 development files)
libx32gcc1	1:6.3.0-18+deb9u1	GCC support library (x32)
libx32gomp1	6.3.0-18+deb9u1	GCC OpenMP (GOMP) support library (x32)
libx32itm1	6.3.0-18+deb9u1	GNU Transactional Memory Library (x32)
libx32quadmath0	6.3.0-18+deb9u1	GCC Quad-Precision Math Library (x32)
libx32stdc++-6-dev	6.3.0-18+deb9u1	GNU Standard C++ Library v3 (development files)
libx32stdc++6	6.3.0-18+deb9u1	GNU Standard C++ Library v3 (x32)
libx32ubsan0	6.3.0-18+deb9u1	UBSan -- undefined behaviour sanitizer (x32)
libx86-1:amd64	1.1+ds1-10.2	x86 real-mode library
libxapian30:amd64	1.4.3-2+deb9u3	Search engine library
libxatracker2:amd64	13.0.6-1+b2	X acceleration library -- runtime
libxau-dev:amd64	1:1.0.8-1	X11 authorisation library (development headers)
libxau6:amd64	1:1.0.8-1	X11 authorisation library
libxaw7:amd64	2:1.0.13-1+b2	X11 Athena Widget library
libxcb-dri2-0:amd64	1.12-1	X C Binding, dri2 extension
libxcb-dri2-0-dev:amd64	1.12-1	X C Binding, dri2 extension, development files
libxcb-dri3-0:amd64	1.12-1	X C Binding, dri3 extension
libxcb-dri3-dev:amd64	1.12-1	X C Binding, dri3 extension, development files
libxcb-glx0:amd64	1.12-1	X C Binding, glx extension
libxcb-glx0-dev:amd64	1.12-1	X C Binding, glx extension, development files
libxcb-icccm4:amd64	0.4.1-1	utility libraries for X C Binding -- icccm
libxcb-image0:amd64	0.4.0-1+b2	utility libraries for X C Binding -- image
libxcb-keysyms1:amd64	0.4.0-1+b2	utility libraries for X C Binding -- keysyms
libxcb-present-dev:amd64	1.12-1	X C Binding, present extension, development files
libxcb-present0:amd64	1.12-1	X C Binding, present extension
libxcb-randr0:amd64	1.12-1	X C Binding, randr extension
libxcb-randr0-dev:amd64	1.12-1	X C Binding, randr extension, development files
libxcb-render-util0:amd64	0.3.9-1	utility libraries for X C Binding -- render-util
libxcb-render0:amd64	1.12-1	X C Binding, render extension
libxcb-render0-dev:amd64	1.12-1	X C Binding, render extension, development files
libxcb-res0:amd64	1.12-1	X C Binding, res extension
libxcb-shape0:amd64	1.12-1	X C Binding, shape extension
libxcb-shape0-dev:amd64	1.12-1	X C Binding, shape extension, development files
libxcb-shm0:amd64	1.12-1	X C Binding, shm extension
libxcb-shm0-dev:amd64	1.12-1	X C Binding, shm extension, development files

Name	Version	Description
libxcb-sync-dev:amd64	1.12-1	X C Binding, sync extension, development files
libxcb-sync1:amd64	1.12-1	X C Binding, sync extension
libxcb-util0:amd64	0.3.8-3+b2	utility libraries for X C Binding -- atom, aux and event
libxcb-xf86dri0:amd64	1.12-1	X C Binding, xf86dri extension
libxcb-xfixes0:amd64	1.12-1	X C Binding, xfixes extension
libxcb-xfixes0-dev:amd64	1.12-1	X C Binding, xfixes extension, development files
libxcb-xinerama0:amd64	1.12-1	X C Binding, xinerama extension
libxcb-xkb1:amd64	1.12-1	X C Binding, XKEYBOARD extension
libxcb-xv0:amd64	1.12-1	X C Binding, xv extension
libxcb1:amd64	1.12-1	X C Binding
libxcb1-dev:amd64	1.12-1	X C Binding, development files
libxcomposite1:amd64	1:0.4.4-2	X11 Composite extension library
libxcursor1:amd64	1:1.1.14-1+deb9u2	X cursor management library
libxdamage-dev:amd64	1:1.1.4-2+b3	X11 damaged region extension library (development headers)
libxdamage1:amd64	1:1.1.4-2+b3	X11 damaged region extension library
libxdmcp-dev:amd64	1:1.1.2-3	X11 authorisation library (development headers)
libxdmcp6:amd64	1:1.1.2-3	X11 Display Manager Control Protocol library
libxext-dev:amd64	2:1.3.3-1+b2	X11 miscellaneous extensions library (development headers)
libxext6:amd64	2:1.3.3-1+b2	X11 miscellaneous extension library
libxfce4panel-2.0-4	4.12.1-2	Xfce4 panel libraries (GTK3 variant)
libxfce4ui-1-0	4.12.1-2	widget library for Xfce - Gtk+2 variant
libxfce4ui-2-0	4.12.1-2	widget library for Xfce - Gtk+3 variant
libxfce4ui-common	4.12.1-2	all common files for libxfce4ui
libxfce4ui-utils	4.12.1-2	Utility files for libxfce4ui
libxfce4util-bin	4.12.1-3	tools for libxfce4util
libxfce4util-common	4.12.1-3	all common files for libxfce4util
libxfce4util7:amd64	4.12.1-3	Utility functions library for Xfce4
libxfconf-0-2	4.12.1-1	Client library for Xfce4 configure interface
libxfxes-dev:amd64	1:5.0.3-1	X11 miscellaneous 'fixes' extension library (development headers)
libxfxes3:amd64	1:5.0.3-1	X11 miscellaneous 'fixes' extension library
libxfont1:amd64	1:1.5.2-4	X11 font rasterisation library
libxfont2:amd64	1:2.0.1-3+deb9u1	X11 font rasterisation library
libxft2:amd64	2.3.2-1+b2	FreeType-based font drawing library for X
libxi-dev:amd64	2:1.7.9-1	X11 Input extension library (development headers)
libxi6:amd64	2:1.7.9-1	X11 Input extension library
libxinerama1:amd64	2:1.1.3-1+b3	X11 Xinerama extension library
libxkbcommon-x11-0:amd64	0.7.1-2~deb9u1	library to create keymaps with the XKB X11 protocol
libxkbcommon0:amd64	0.7.1-2~deb9u1	library interface to the XKB compiler - shared library
libxkbfile1:amd64	1:1.0.9-2	X11 keyboard file manipulation library
libxklavier16:amd64	5.4-2	X Keyboard Extension high-level API
libxml-commons-resolver1.1-java	1.2-7	all XML entity and URI resolver library
libxml-parser-perl	2.44-2+b1	Perl module for parsing XML files
libxml-twig-perl	1:3.50-1	all Perl module for processing huge XML documents in tree mode
libxml-xpathengine-perl	0.13-1	all re-usable XPath engine for DOM-like trees

Name	Version	Description
libxml2:amd64	2.9.4+dfsg1-2.2+deb9u2	GNOME XML library
libxmu6:amd64	2:1.1.2-2	X11 miscellaneous utility library
libxmuu1:amd64	2:1.1.2-2	X11 miscellaneous micro-utility library
libxpm4:amd64	1:3.5.12-1	X11 pixmap library
libxrandr2:amd64	2:1.5.1-1	X11 RandR extension library
libxrender-dev:amd64	1:0.9.10-1	X Rendering Extension client library (development files)
libxrender1:amd64	1:0.9.10-1	X Rendering Extension client library
libxres1:amd64	2:1.0.7-1+b3	X11 Resource extension library
libxshmfence-dev:amd64	1.2-1+b2	X shared memory fences - development files
libxshmfence1:amd64	1.2-1+b2	X shared memory fences - shared library
libxslt1.1:amd64	1.1.29-2.1	XSLT 1.0 processing library - runtime library
libxss1:amd64	1:1.2.2-1	X11 Screen Saver extension library
libxt6:amd64	1:1.1.5-1	X11 toolkit intrinsics library
libxtables12:amd64	1.6.0+snapshot20161117-6	netfilter xtables library
libxtst6:amd64	2:1.2.3-1	X11 Testing -- Record extension library
libxv1:amd64	2:1.0.11-1	X11 Video extension library
libxvidcore4:amd64	2:1.3.4-1+b2	Open source MPEG-4 video codec (library)
libxvmc1:amd64	2:1.0.10-1	X11 Video extension library
libxxf86dga1:amd64	2:1.1.4-1+b3	X11 Direct Graphics Access extension library
libxxf86vm-dev:amd64	1:1.1.4-1+b2	X11 XFree86 video mode extension library (development headers)
libxxf86vm1:amd64	1:1.1.4-1+b2	X11 XFree86 video mode extension library
libyelp0:amd64	3.22.0-1	Library for the GNOME help browser
libzvb1-common	0.2.35-13	all Vertical Blanking Interval decoder (VBI) - common files
libzvb1:amd64	0.2.35-13	Vertical Blanking Interval decoder (VBI) - runtime files
lightdm	1.18.3-1	simple display manager
lightdm-gtk-greeter	2.0.2-1	simple display manager (GTK+ greeter)
linux-base	4.5	all Linux image base package
linux-compiler-gcc-6-x86	4.9.144-3.1	Compiler for Linux on x86 (meta-package)
linux-headers-4.9.0-8-amd64	4.9.144-3.1	Header files for Linux 4.9.0-8-amd64
linux-headers-4.9.0-8-common	4.9.144-3.1	all Common header files for Linux 4.9.0-8
linux-image-4.9.0-8-amd64	4.9.144-3.1	Linux 4.9 for 64-bit PCs
linux-image-amd64	4.9+80+deb9u6	Linux for 64-bit PCs (meta-package)
linux-kbuild-4.9	4.9.144-3.1	Kbuild infrastructure for Linux 4.9
linux-libc-dev:amd64	4.9.144-3.1	Linux support headers for userspace development
linux-manual-4.9	4.9.144-3.1	all Linux kernel API manual pages for version 4.9
llvm-3.8	1:3.8.1-24	Modular compiler and toolchain technologies
llvm-3.8-dev	1:3.8.1-24	Modular compiler and toolchain technologies, libraries and headers
llvm-3.8-runtime	1:3.8.1-24	Modular compiler and toolchain technologies, IR interpreter
lm-sensors	1:3.4.0-4	utilities to read temperature/voltage/fan sensors
locales	2.24-11+deb9u4	all GNU C Library: National Language (locale) data [support]
login	1:4.4-4.1	system login tools
logrotate	3.11.0-0.1	Log rotation utility
lrzsz	0.12.21-8	Tools for zmodem/xmodem/ymodem file transfer
lsb-base	9.20161125	all Linux Standard Base init script functionality
lsb-release	9.20161125	all Linux Standard Base version reporting utility

Name	Version	Description
lsuf	4.89+dfsg-0.1	Utility to list open files
make	4.1-9.1	utility for directing compilation
man-db	2.7.6.1-2	on-line manual pager
manpages	4.10-2	all Manual pages about using a GNU/Linux system
manpages-dev	4.10-2	all Manual pages about using GNU/Linux for development
mawk	1.3.3-17+b3	a pattern scanning and text processing language
mesa-common-dev:amd64	13.0.6-1+b2	Developer documentation for Mesa
mesa-utils	8.3.0-3	Miscellaneous Mesa GL utilities
mesa-va-drivers:amd64	13.0.6-1+b2	Mesa VA-API video acceleration drivers
mesa-va-drivers:amd64	13.0.6-1+b2	Mesa VDPAAU video acceleration drivers
mime-support	3.60	all MIME files 'mime.types' & 'mailcap', and support programs
minicom	2.7-1.1	friendly menu driven serial communication program
mount	2.29.2-1+deb9u1	tools for mounting and manipulating filesystems
mousepad	0.4.0-4	simple Xfce oriented text editor
mousetweaks	3.12.0-1+b1	mouse accessibility enhancements for the GNOME desktop
moxa-archive-keyring	2018.4.11	all GnuPG archive keys of the Moxa archive
moxa-at-cmd	0.9.2-1	Utility to execute AT command.
moxa-cellular-utils	1.50.1	all Cellular modem utility on Moxa computer.
mpc2000-br-util	1.2	Moxa brightness control utility for panel computer brightness control.
mtdev-tools	1.1.5-1+b1	Multitouch Protocol Translation Library - test tools
multiarch-support	2.24-11+deb9u4	Transitional package to ensure multiarch compatibility
mutter	3.22.3-2	lightweight GTK+ window manager
mutter-common	3.22.3-2	all shared files for the Mutter window manager
mysql-common	5.8+1.0.2	all MySQL database common files, e.g. /etc/mysql/my.cnf
nano	2.7.4-1	small, friendly text editor inspired by Pico
nautilus	3.22.3-1+deb9u1	file manager and graphical shell for GNOME
nautilus-data	3.22.3-1+deb9u1	all data files for nautilus
ncurses-base	6.0+20161126-1+deb9u2	all basic terminal type definitions
ncurses-bin	6.0+20161126-1+deb9u2	terminal-related programs and man pages
ncurses-term	6.0+20161126-1+deb9u2	all additional terminal type definitions
net-tools	1.60+git20161116.90da8a0-1	NET-3 networking toolkit
netbase	5.4	all Basic TCP/IP networking system
netcat-traditional	1.10-41+b1	TCP/IP swiss army knife
network-manager	1.6.2-3	network management framework (daemon and userspace tools)
network-manager-gnome	1.4.4-1	network management framework (GNOME frontend)
nfs-common	1:1.3.4-2.1	NFS support files common to client and server
notification-daemon	3.20.0-1+b1	daemon for displaying passive pop-up notifications
ntfs-3g	1:2016.2.22AR.1+dfsg-1	read/write NTFS driver for FUSE
ntpdate	1:4.2.8p10+dfsg-3+deb9u2	client for setting system time from NTP servers
numlockx	1.2-7+b2	enable NumLock in X11 sessions
onboard	1.3.0-1	Simple On-screen Keyboard
onboard-common	1.3.0-1	all Simple On-screen Keyboard (common files)
onboard-data	1.3.0-1	all Language model files for the word suggestion feature of Onboard
openjdk-8-jre-headless:amd64	8u171-b11-1~deb9u1	OpenJDK Java runtime, using Hotspot JIT (headless)

Name	Version	Description
openssh-client	1:7.4p1-10+deb9u6	secure shell (SSH) client, for secure access to remote machines
openssh-server	1:7.4p1-10+deb9u6	secure shell (SSH) server, for secure access from remote machines
openssh-sftp-server	1:7.4p1-10+deb9u6	secure shell (SSH) sftp server module, for SFTP access from remote machines
openssl	1.1.0j-1~deb9u1	Secure Sockets Layer toolkit - cryptographic utility
orage	4.12.1-3	Calendar for Xfce Desktop Environment
os-prober	1.76~deb9u1	utility to detect other OSes on a set of drives
p11-kit	0.23.3-2	p11-glue utilities
p11-kit-modules:amd64	0.23.3-2	p11-glue proxy and trust modules
p7zip	16.02+dfsg-3+deb9u1	7zr file archiver with high compression ratio
p7zip-full	16.02+dfsg-3+deb9u1	7z and 7za file archivers with high compression ratio
packagekit	1.1.5-2	Provides a package management service
parted	3.2-17	disk partition manipulator
passwd	1:4.4-4.1	change and administer password and group data
patch	2.7.5-1+deb9u1	Apply a diff file to an original
pavucontrol	3.0-3.1	PulseAudio Volume Control
pciutils	1:3.5.2-1	Linux PCI Utilities
perl	5.24.1-3+deb9u5	Larry Wall's Practical Extraction and Report Language
perl-base	5.24.1-3+deb9u5	minimal Perl system
perl-modules-5.24	5.24.1-3+deb9u5	all Core Perl modules
perl-openssl-defaults:amd64	3	version compatibility baseline for Perl OpenSSL packages
pinentry-curses	1.0.0-2	curses-based PIN or pass-phrase entry dialog for GnuPG
pinentry-gnome3	1.0.0-2	GNOME 3 PIN or pass-phrase entry dialog for GnuPG
pkg-config	0.29-4+b1	manage compile and link flags for libraries
pm-utils	1.4.1-17	all utilities and scripts for power management
policykit-1	0.105-18+deb9u1	framework for managing administrative policies and privileges
policykit-1-gnome	0.105-6	authentication agent for PolicyKit
poppler-data	0.4.7-8	all encoding data for the poppler PDF rendering library
powermgmt-base	1.31+nmu1	all Common utils and configs for power management
powertop	2.8-1+b1	diagnose issues with power consumption and management
ppp	2.4.7-1+4	Point-to-Point Protocol (PPP) - daemon
procps	2:3.3.12-3+deb9u1	/proc file system utilities
psmisc	22.21-2.1+b2	utilities that use the proc file system
pulseaudio	10.0-1+deb9u1	PulseAudio sound server
pulseaudio-utils	10.0-1+deb9u1	Command line tools for the PulseAudio sound server
python	2.7.13-2	interactive high-level object-oriented language (default version)
python-apt-common	1.4.0~beta3	all Python interface to libapt-pkg (locales)
python-cairo	1.8.8-2.2	Python bindings for the Cairo vector graphics library
python-dateutil	2.5.3-2	all powerful extensions to the standard datetime module
python-dbus	1.2.4-1+b1	simple interprocess messaging system (Python interface)
python-decorator	4.0.11-1	all simplify usage of Python decorators by programmers
python-gi	3.22.0-2	Python 2.x bindings for GObject-introspection libraries
python-gi-cairo	3.22.0-2	Python Cairo bindings for the GObject library
python-minimal	2.7.13-2	minimal subset of the Python language (default version)
python-six	1.10.0-3	all Python 2 and 3 compatibility library (Python 2 interface)
python-sugar3	0.110.0-4	all Sugar Learning Platform - toolkit Python bindings
python-talloc	2.1.8-1	hierarchical pool based memory allocator - Python bindings
python-telepathy	0.15.19-3	all Python language bindings for telepathy
python2.7	2.7.13-2+deb9u3	Interactive high-level object-oriented language (version 2.7)
python2.7-minimal	2.7.13-2+deb9u3	Minimal subset of the Python language (version 2.7)

Name	Version	Description
python3	3.5.3-1	interactive high-level object-oriented language (default python3 version)
python3-apt	1.4.0~beta3	Python 3 interface to libapt-pkg
python3-cairo	1.10.0+dfsg-5+b1	Python 3 bindings for the Cairo vector graphics library
python3-charadet	2.3.0-2	all universal character encoding detector for Python3
python3-cupshelpers	1.5.7-3	all Python utility modules around the CUPS printing system
python3-dbus	1.2.4-1+b1	simple interprocess messaging system (Python 3 interface)
python3-debian	0.1.30	all Python 3 modules to work with Debian-related data formats
python3-debianbts	2.6.1	all Python interface to Debian's Bug Tracking System
python3-gi	3.22.0-2	Python 3 bindings for GObject-introspection libraries
python3-gi-cairo	3.22.0-2	Python 3 Cairo bindings for the GObject library
python3-httpplib2	0.9.2+dfsg-1	all comprehensive HTTP client library written for Python3
python3-minimal	3.5.3-1	minimal subset of the Python language (default python3 version)
python3-pkg-resources	33.1.1-1	all Package Discovery and Resource Access using pkg_resources
python3-pycurl	7.43.0-2	Python bindings to libcurl (Python 3)
python3-pysimplesoap	1.16-2	all simple and lightweight SOAP Library (Python 3)
python3-reportbug	7.1.7+deb9u2	all Python modules for interacting with bug tracking systems
python3-requests	2.12.4-1	all elegant and simple HTTP library for Python3, built for human beings
python3-six	1.10.0-3	all Python 2 and 3 compatibility library (Python 3 interface)
python3-urllib3	1.19.1-1	all HTTP library with thread-safe connection pooling for Python3
python3.5	3.5.3-1+deb9u1	Interactive high-level object-oriented language (version 3.5)
python3.5-minimal	3.5.3-1+deb9u1	Minimal subset of the Python language (version 3.5)
qml-module-qtgraphicaleffects:amd64	5.7.1~20161021-3	Qt 5 Graphical Effects module
qml-module-qtqml-models2:amd64	5.7.1-2+b2	Qt 5 Models2 QML module
qml-module-qtquick-controls:amd64	5.7.1~20161021-2	Qt 5 Quick Controls QML module
qml-module-qtquick-layouts:amd64	5.7.1-2+b2	Qt 5 Quick Layouts QML module
qml-module-qtquick-window2:amd64	5.7.1-2+b2	Qt 5 window 2 QML module
qml-module-qtquick2:amd64	5.7.1-2+b2	Qt 5 Qt Quick 2 QML module
qmlscene	5.7.1-2+b2	Qt 5 QML scene viewer
qt3d5-doc	5.7.1+dfsg-2	all Qt 3D documentation
qt5-default	5.7.1+dfsg-3+deb9u1	Qt 5 development defaults package
qt5-doc	5.7.1-2	all Qt 5 API Documentation
qt5-gtk-platformtheme:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 GTK+ 3 platform theme
qt5-qmake:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 qmake Makefile generator tool
qt5-qmltooling-plugins:amd64	5.7.1-2+b2	Qt 5 qmltooling plugins
qtbase5-dev:amd64	5.7.1+dfsg-3+deb9u1	Qt 5 base development files
qtbase5-dev-tools	5.7.1+dfsg-3+deb9u1	Qt 5 base development programs
qtbase5-doc	5.7.1+dfsg-3+deb9u1	all Qt 5 base documentation
qtchooser	63-g13a3d08-1	Wrapper to select between Qt development binary versions
qtconnectivity5-doc	5.7.1~20161021-2	all Qt 5 Sensors documentation
qtcreator	4.2.0-1+b1	integrated development environment (IDE) for Qt
qtcreator-data	4.2.0-1	all application data for Qt Creator IDE
qtcreator-doc	4.2.0-1	all documentation for Qt Creator IDE

Name	Version	Description
qtdeclarative5-dev:amd64	5.7.1-2+b2	Qt 5 declarative development files
qtdeclarative5-dev-tools	5.7.1-2+b2	Qt 5 declarative development programs
qtdeclarative5-doc	5.7.1-2	all Qt 5 declarative documentation
qtgraphicaleffects5-doc	5.7.1~20161021-3	all Qt 5 graphical effects documentation
qtlocation5-doc	5.7.1-1	all Qt 5 Positioning documentation
qtmultimedia5-doc	5.7.1~20161021-2	all Qt 5 multimedia documentation
qtquickcontrols2-5-doc	5.7.1-1	all Qt 5 Quick Controls 2 documentation
qtquickcontrols5-doc	5.7.1~20161021-2	all Qt 5 Quick Controls documentation
qtscript5-doc	5.7.1~20161021+dfsg-2	all Qt 5 script documentation
qtsensors5-doc	5.7.1~20161021-2	all Qt 5 Sensors documentation
qtserialport5-doc	5.7.1~20161021-2	all Qt 5 serial port documentation
qtsvg5-doc	5.7.1~20161021-2	all Qt 5 SVG documentation
qttools5-dev-tools:amd64	5.7.1-1	Qt 5 development tools
qttools5-doc	5.7.1-1	all Qt 5 tools documentation
qttranslations5-l10n	5.7.1~20161021-1	all translations for Qt 5
qtwayland5-doc	5.7.1~20161021-2	all Qt 5 Wayland Compositor documentation
qtwebchannel5-doc	5.7.1-2	all Web communication library for Qt - Documentation
qtwebengine5-doc	5.7.1+dfsg-6.1	all Qt 5 webengine documentation
qtwebkit5-doc	5.7.1+dfsg-1	all Qt 5 webkit documentation
qtwebkit5-examples-doc	5.7.1+dfsg-1	all Qt 5 webkit examples documentation
qtwebsockets5-doc	5.7.1~20161021-4	all Qt 5 Web Sockets documentation
qtx11extras5-doc	5.7.1~20161021-2	all Qt 5 X11 extras documentation
qtxmlpatterns5-dev-tools	5.7.1~20161021-3	Qt 5 XML patterns development programs
qtxmlpatterns5-doc	5.7.1~20161021-3	all Qt 5 XML patterns documentation
rarian-compat	0.8.1-6+b1	Documentation meta-data library (compatibility tools)
readline-common	7.0-3	all GNU readline and history libraries, common files
realmd	0.16.3-1	DBus service for configuring kerberos and other online identities
rename	0.20-4	all Perl extension for renaming multiple files
reportbug	7.1.7+deb9u2	all reports bugs in the Debian distribution
rpcbind	0.2.3-0.6	converts RPC program numbers into universal addresses
rsyslog	8.24.0-1	reliable system and kernel logging daemon
rtkit	0.11-4+deb9u1	Realtime Policy and Watchdog Daemon
rygel	0.32.1-3	GNOME UPnP/DLNA services
samba-ls:amd64	2:4.5.16+dfsg-1	Samba core libraries
sane-utils	1.0.25-4.1	API library for scanners -- utilities
screen	4.5.0-6	terminal multiplexer with VT100/ANSI terminal emulation
sed	4.4-1	GNU stream editor for filtering/transforming text
sensible-utils	0.0.9+deb9u1	all Utilities for sensible alternative selection
sgml-base	1.29	all SGML infrastructure and SGML catalog file support
sgml-data	2.0.10	all common SGML and XML data
shared-mime-info	1.8-1+deb9u1	FreeDesktop.org shared MIME database and spec
snmp	5.7.3+dfsg-1.7+deb9u1	SNMP (Simple Network Management Protocol) applications
snmpd	5.7.3+dfsg-1.7+deb9u1	SNMP (Simple Network Management Protocol) agents
ssh	1:7.4p1-10+deb9u6	all secure shell client and server (metapackage)
ssl-cert	1.0.39	all simple debconf wrapper for OpenSSL
strace	4.15-2	System call tracer

Name	Version	Description
sudo	1.8.19p1-2.1	Provide limited super user privileges to specific users
sugar-browse-activity	200+20170502-1	all Sugar Learning Platform - web browsing activity
synaptic	0.84.2	Graphical package manager
sysstat	11.4.3-2	system performance tools for Linux
system-config-printer	1.5.7-3	all graphical interface to configure the printing system
system-config-printer-common	1.5.7-3	all backend and the translation files for system-config-printer
systemd	232-25+deb9u9	system and service manager
systemd-sysv	232-25+deb9u9	system and service manager - SysV links
sysvinit-utils	2.88dsf-59.9	System-V-like utilities
tango-icon-theme	0.8.90-6	all Tango icon theme
tar	1.29b-1.1	GNU version of the tar archiving utility
task-desktop	3.39	all Debian desktop environment
task-english	3.39	all General English environment
task-laptop	3.39	all laptop
task-ssh-server	3.39	all SSH server
tasksel	3.39	all tool for selecting tasks for installation on Debian systems
tasksel-data	3.39	all official tasks used for installation of Debian systems
tcl-expect:amd64	5.45-7+deb9u1	Automates interactive applications (Tcl package)
tcl8.6	8.6.6+dfsg-1+b1	Tcl (the Tool Command Language) v8.6 - shell
tcpd	7.6.q-26	Wietse Venema's TCP wrapper utilities
tcpdump	4.9.2-1~deb9u1	command-line network traffic analyzer
telepathy-mission-control-5	1:5.16.3-2.1	management daemon for Telepathy real-time communication framework
telepathy-salut	0.8.1-5.1	Link-local XMPP connection manager for the Telepathy framework
telnet	0.17-41	basic telnet client
thunar	1.6.11-1	File Manager for Xfce
thunar-archive-plugin	0.3.1-4	Archive plugin for Thunar file manager
thunar-data	1.6.11-1	all Provides thunar documentation, icons and translations
thunar-media-tags-plugin	0.2.1-1+b2	Media tags plugin for Thunar file manager
thunar-volman	0.8.1-2	Thunar extension for volumes management
tk8.6	8.6.6-1+b1	Tk toolkit for Tcl and X11 v8.6 - windowing shell
traceroute	1:2.1.0-2	Traces the route taken by packets over an IPv4/IPv6 network
tumbler	0.1.31-2+b3	D-Bus thumbnailing service
tumbler-common	0.1.31-2	all D-Bus thumbnailing service (common files)
tzdata	2018i-0+deb9u1	all time zone and daylight-saving time data
ucf	3.0036	all Update Configuration File(s): preserve user changes to config files
udev	232-25+deb9u9	/dev/ and hotplug management daemon
udhcpc	1:1.22.0-19+b3	Provides the busybox DHCP client implementation
udisks2	2.1.8-1	D-Bus service to access and manipulate storage devices
unzip	6.0-21	De-archiver for .zip files
update-inetd	4.44	all inetd configuration file updater
upower	0.99.4-4+b1	abstraction for power management
usb-modeswitch	2.5.0+repack0-1	mode switching tool for controlling "flip flop" USB devices
usb-modeswitch-data	20170120-1	all mode switching data for usb-modeswitch
usbmuxd	1.1.0-2+b2	USB multiplexor daemon for iPhone and iPod Touch devices
usbutils	1:007-4+b1	Linux USB utilities
util-linux	2.29.2-1+deb9u1	miscellaneous system utilities
util-linux-locales	2.29.2-1+deb9u1	all locales files for util-linux
va-driver-all:amd64	1.7.3-2	Video Acceleration (VA) API -- driver metapackage

Name	Version	Description
vbetool	1.1-4	run real-mode video BIOS code to alter hardware state
vdpa-driver-all:amd64	1.1.1-6	Video Decode and Presentation API for Unix (driver metapackage)
vim	2:8.0.0197-4+deb9u1	Vi IMproved - enhanced vi editor
vim-common	2:8.0.0197-4+deb9u1	all Vi IMproved - Common files
vim-runtime	2:8.0.0197-4+deb9u1	all Vi IMproved - Runtime files
vim-tiny	2:8.0.0197-4+deb9u1	Vi IMproved - enhanced vi editor - compact version
vlan	1.9-3.2+b1	user mode programs to enable VLANs on your ethernet devices
vlc-plugin-base:amd64	3.0.2-0+deb9u1	multimedia player and streamer (base plugins)
vlc-plugin-notify:amd64	3.0.2-0+deb9u1	LibNotify plugin for VLC
vlc-plugin-samba:amd64	3.0.2-0+deb9u1	Samba plugin for VLC
vlc-plugin-skins2:amd64	3.0.2-0+deb9u1	multimedia player and streamer (Skins2 plugin)
vlc-plugin-video-output:amd64	3.0.2-0+deb9u1	multimedia player and streamer (video output plugins)
vlc-plugin-video-splitter:amd64	3.0.2-0+deb9u1	multimedia player and streamer (video splitter plugins)
vlc-plugin-visualization:amd64	3.0.2-0+deb9u1	multimedia player and streamer (visualization plugins)
wakeonlan	0.41-11	all Sends 'magic packets' to wake-on-LAN enabled ethernet adapters
watchdog	5.15-2	system health checker and software/hardware watchdog handler
wget	1.18-5+deb9u2	retrieves files from the web
whiptail	0.52.19-1+b1	Displays user-friendly dialog boxes from shell scripts
wireless-regdb	2016.06.10-1	all wireless regulatory database
wireless-tools	30~pre9-12+b1	Tools for manipulating Linux Wireless Extensions
wpa_supplicant	2:2.4-1+deb9u2	client support for WPA and WPA2 (IEEE 802.11i)
wvdial	1.61-4.1	intelligent Point-to-Point Protocol dialer
x11-apps	7.7+6+b1	X applications
x11-common	1:7.7+19	all X Window System (X.Org) infrastructure
x11-session-utils	7.7+2+b1	X session utilities
x11-utils	7.7+3+b1	X11 utilities
x11-xkb-utils	7.7+3+b1	X11 XKB utilities
x11-xserver-utils	7.7+7+b1	X server utilities
x11proto-core-dev	7.0.31-1	all X11 core wire protocol and auxiliary headers
x11proto-damage-dev	1:1.2.1-2	all X11 Damage extension wire protocol
x11proto-dri2-dev	2.8-2	all X11 DRI2 extension wire protocol
x11proto-fixes-dev	1:5.0-2	all X11 Fixes extension wire protocol
x11proto-glx-dev	1.4.17-1	all X11 OpenGL extension wire protocol
x11proto-input-dev	2.3.2-1	all X11 Input extension wire protocol
x11proto-kb-dev	1.0.7-1	all X11 XKB extension wire protocol
x11proto-render-dev	2:0.11.1-2	all X11 Render extension wire protocol
x11proto-xext-dev	7.3.0-1	all X11 various extension wire protocol
x11proto-xf86vidmode-dev	2.3.1-2	all X11 Video Mode extension wire protocol
xarchiver	1:0.5.4-7	GTK+ frontend for most used compression formats
xauth	1:1.0.9-1+b2	X authentication utility
xbitmaps	1.1.1-2	all Base X bitmaps
xbrlapi	5.4-7	Access software for a blind person using a braille display - xbrlapi
xdg-user-dirs	0.15-2+b1	tool to manage well known user directories

Name	Version	Description
xdg-utils	1.1.1-1+deb9u1	all desktop integration utilities from freedesktop.org
xfce4	4.12.3	all Meta-package for the Xfce Lightweight Desktop Environment
xfce4-appfinder	4.12.0-2	Application finder for the Xfce4 Desktop Environment
xfce4-clipman	2:1.4.1-1	clipboard history utility
xfce4-notifyd	0.3.4-1	simple, visually-appealing notification daemon for Xfce
xfce4-panel	4.12.1-2	panel for Xfce4 desktop environment
xfce4-power-manager	1.4.4-4	power manager for Xfce desktop
xfce4-power-manager-data	1.4.4-4	all power manager for Xfce desktop, arch-indep files
xfce4-power-manager-plugins	1.4.4-4	power manager plugins for Xfce panel
xfce4-pulseaudio-plugin:amd64	0.2.4-1	Xfce4 panel plugin to control pulseaudio
xfce4-screenshooter	1.8.2-2	screenshots utility for Xfce
xfce4-screenshooter-plugin	1.8.2-2	all transitional dummy package for xfce4-screenshooter
xfce4-session	4.12.1-5	Xfce4 Session Manager
xfce4-settings	4.12.1-1	graphical application for managing Xfce settings
xfce4-terminal	0.8.3-1	Xfce terminal emulator
xfconf	4.12.1-1	utilities for managing settings in Xfce
xfdesktop4	4.12.3-3	xfce desktop background, icons and root menu manager
xfdesktop4-data	4.12.3-3	all xfce desktop background, icons and root menu (common files)
xfonts-100dpi	1:1.0.4+nmu1	all 100 dpi fonts for X
xfonts-75dpi	1:1.0.4+nmu1	all 75 dpi fonts for X
xfonts-base	1:1.0.4+nmu1	all standard fonts for X
xfonts-encodings	1:1.0.4-2	all Encodings for X.Org fonts
xfonts-scalable	1:1.0.3-1.1	all scalable fonts for X
xfonts-utils	1:7.7+4	X Window System font utility programs
xfwm4	4.12.4-1	window manager of the Xfce project
xinit	1.3.4-3+b1	X server initialisation tool
xkb-data	2.19-1+deb9u1	all X Keyboard Extension (XKB) configuration data
xml-core	0.17	all XML infrastructure and XML catalog file support
xorg	1:7.7+19	X.Org X Window System
xorg-docs-core	1:1.7.1-1	all Core documentation for the X.org X Window System
xorg-sgml-doctools	1:1.11-1	all Common tools for building X.Org SGML documentation
xserver-common	2:1.19.2-1+deb9u5	all common files used by various X servers
xserver-xephyr	2:1.19.2-1+deb9u5	nested X server
xserver-xorg	1:7.7+19	X.Org X server
xserver-xorg-core	2:1.19.2-1+deb9u5	Xorg X server - core server
xserver-xorg-input-all	1:7.7+19	X.Org X server -- input driver metapackage
xserver-xorg-input-evdev	1:2.10.5-1	X.Org X server -- evdev input driver
xserver-xorg-input-libinput	0.23.0-2	X.Org X server -- libinput input driver
xserver-xorg-input-multitouch	1.0~rc2+git20110312-2+b6	Multitouch X input driver
xserver-xorg-legacy	2:1.19.2-1+deb9u5	setuid root Xorg server wrapper
xserver-xorg-video-all	1:7.7+19	X.Org X server -- output driver metapackage
xserver-xorg-video-amdgpu	1.2.0-1+b1	X.Org X server -- AMDGPU display driver
xserver-xorg-video-ati	1:7.8.0-1+b1	X.Org X server -- AMD/ATI display driver wrapper

Name	Version	Description
xserver-xorg-video-fbdev	1:0.4.4-1+b5	X.Org X server -- fbdev display driver
xserver-xorg-video-intel	2:2.99.917+git20161206-1	X.Org X server -- Intel i8xx, i9xx display driver
xserver-xorg-video-nouveau	1:1.0.13-3	X.Org X server -- Nouveau display driver
xserver-xorg-video-qxl	0.1.4+20161126git4d7160c-1	X.Org X server -- QXL display driver
xserver-xorg-video-radeon	1:7.8.0-1+b1	X.Org X server -- AMD/ATI Radeon display driver
xserver-xorg-video-vesa	1:2.3.4-1+b2	X.Org X server -- VESA display driver
xserver-xorg-video-vmware	1:13.2.1-1+b1	X.Org X server -- VMware display driver
xterm	327-2	X terminal emulator
xtrans-dev	1.3.5-1	all X transport library (development files)
xxd	2:8.0.0197-4+deb9u1	tool to make (or reverse) a hex dump
xz-utils	5.2.2-1.2+b1	XZ-format compression utilities
yelp	3.22.0-1	Help browser for GNOME
yelp-xsl	3.20.1-2	all XSL stylesheets for the yelp help browser
zeitgeist-core	0.9.16-0.2+b1	event logging framework - engine
zenity	3.22.0-1+b1	Display graphical dialog boxes from shell scripts
zenity-common	3.22.0-1	all Display graphical dialog boxes from shell scripts (common files)
zlib1g:amd64	1:1.2.8.dfsg-5	compression library - runtime
zlib1g-dev:amd64	1:1.2.8.dfsg-5	compression library - development