

# DA-720 Series Linux Software User's Manual

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**MOXA**®

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# DA-720 Series Linux Software User's Manual

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## Introduction

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Thank you for purchasing a Moxa DA-720 series x86, ready-to-run embedded computer. This manual describes the software configuration and management process for the DA-720 Linux models. For details regarding hardware installation, connector interfaces, setup, and BIOS upgrade, refer to the *DA-720 Series 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 minimum source-code modifications. A typical Linux-based device is designed for a specific use. It is often not connected to other computers. 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, which include HMIs, advertisement appliances, and interactive panels.

The following topics are covered in this chapter:

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

# Overview

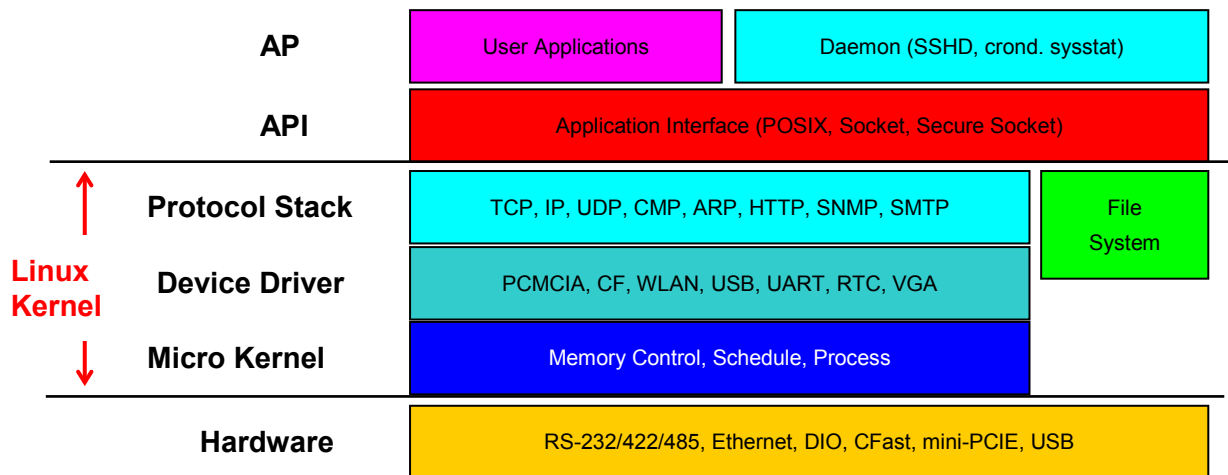
The DA-720 series of computers are x86 platforms with VGA/DVI, mSATA, and SATA interfaces, 14 Gigabit Ethernet ports, 2 USB 2.0 and 2 USB 3.0 hosts, and two PCI-e ports for expansion modules.


The robust design of the DA-720 computers makes them ideal for use in specialized industrial automation applications such as power substations, transportation and shipping, and oil and gas production and supply. The DA-720 computers can run on Linux or Windows, providing a user-friendly environment for developing sophisticated application software. Moxa's ready-to-run software and readily available after-service support makes the programmer's job easier by helping them develop bug-free code quickly and at a lower cost.

The DA-720 comes with 2 PCI-e ports for expansion modules. Moxa provides a variety of communication expansion modules, including an 8-port RS-232/422/485 module, a 4-port 10/100/1000 Mbps LAN module, and an 8-port 10/100/1000 Mbps LAN module. The user-friendly design gives the advantage of quick and easy module swaps. These features make the DA-720 an ideal for use in a wide array of industrial automation applications.

# Software Specifications

The Linux operating system preinstalled on the DA-720 embedded computers is a **Debian Jessie** distribution. The Debian project consists of a group of volunteers located worldwide 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. You can use the GNU Tool Chain provided by Moxa to port programs on to the Debian Linux platform. In addition to standard POSIX APIs, device drivers for Moxa UART and other peripherals such as programmable LEDs and relay are also included along with the Linux operating system. An example that represents the software architecture is shown below:





**ATTENTION**

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 this illustration.

**ATTENTION**

For information and documentation regarding Debian GNU/Linux and the free software concept, refer to the following links:

- <http://www.debian.org/>
- <http://www.gnu.org/>

## Software Components

The DA-720 Linux models are preinstalled with the Debian Jessie Linux distribution. For a complete list of the software components, refer to *Appendix A*.

# Software Configuration

---

There are three ways to connect to the DA-720 Linux model computer from a desktop: through a VGA monitor, and via an SSH over the network console from a Windows or Linux machine. These three methods are explained in this chapter. Only basic Linux operating system configurations on the DA-720 Linux model are covered here. For advanced network configuration and management instructions refer to *Chapter 3, Managing Communications*.

The following topics are covered in this chapter:

- ❑ **Account Management**
- ❑ **Starting from a VGA Console**
- ❑ **Setting up Desktop Environments**
- ❑ **Connecting from an SSH Console**
  - Windows Users
  - Linux Users
- ❑ **Adjusting the System Time**
  - Setting the Time Manually
  - NTP Client
  - Updating the Time Automatically
- ❑ **Enabling and Disabling Daemons**
- ❑ **Executing Scheduled Commands Using the Cron Daemon**
- ❑ **Inserting a USB Storage Device into the Computer**
- ❑ **Checking the Linux Version**
- ❑ **Installing and Removing Packages Using APT**
- ❑ **Setting Up a Desktop Environment**
- ❑ **Power Management—Suspend**
- ❑ **Wake On LAN**



# Account Management

Connect the DA-720 to a display and turn on the computer using the login credentials given below:

**Login: moxa**

**Password: moxa**



## WARNING

**Change the default password after the first login to ensure a higher level of security. The root account on this computer has been disabled by default for security reasons.**

```
login as: moxa
moxa@192.168.27.42's password:

#####
###      ###      #####      #####      #####      ##
###      ###      ###      ###      ###      ###      ###
###      ###      ###      ###      ###      ##      ###
###      ###      ##      ##      ###      #      #####
#####      #      ##      ###      ###      ##      ##      ##
##      ##      #      ##      ###      ##      #####      #      ##
##      ###      ##      ##      ##      ##      #####      #      ##
##      ###      ##      ##      ##      ##      ##      ##      ##      ##
##      ###      ##      ##      ##      #      ##      #      ##
#####      #      #####      #####      #####      #####      #####

For further information check:
http://www.moxa.com/

moxa@Moxa:~#
```

When you finish changing the password, remember to type **sudo** each time you want to run commands with the privilege as the root. For example, typing **sudo ifconfig eth0 192.168.100.100** will allow you to configure the IP address of the LAN 1 port.

```
moxa@Moxa:~# sudo ifconfig eth0 192.168.100.100
[sudo] password for moxa:
moxa@Moxa:~$ sudo ifconfig eth1
[sudo] password for moxa:
eth1      Link encap:Ethernet  HWaddr 00:90:e8:00:df:fe
          inet addr:192.168.100.100  Bcast:192.168.100.255  Mask:255.255.255.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
          Interrupt:41 Base address:0xe000

moxa@Moxa:~$
```

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

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

## Starting from a VGA Console

Connect the display monitor to the DA-720-LX and power it up connecting the power adaptor. It takes approximately 30 to 60 seconds for the system to boot up. Once the system is ready, a login screen will appear on your monitor.

To log in, type the login name and password as requested. The default values are both **moxa**.

**Login:** moxa

**Password:** moxa

```
Moxa login: moxa
Password:

#####          #####          #####          #####          #####          ##
###           #####          ###          ###          #####          ###          ###
###           ###          ###          ###          ###          ##          ###
###           #####          ##          ##          ###          #          #####
#####          #          ##          ###          ###          ##          ##          ##
## ##          #          ##          ###          ##          #####          #          ##
## ##          ##          ##          ##          ##          #####          #          ##
##          #          ##          ##          ##          ##          ##          #####
##          #          ##          ##          ##          ##          ##          ##          ##
##          ##          ##          ##          ##          ##          ##          ##          ##
##          ##          ##          ##          ##          ##          ##          ##          ##
#####          #          #####          #####          #####          #####          #####

For further information check:
http://www.moxa.com/
```

## Setting up Desktop Environments

In this section we discuss how to setup various desktop environments on the DA-720 computer. By default, the DA-720 Linux operating system doesn't install a desktop environment. However, Debian supports various full-fledged graphical environments such as Gnome, KDE as well as lighter environments like Xfce and LXDE. You can install one of these desktop systems on the DA-720.

To install Gnome use the following command:

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

To install KDE use the following commands:

```
moxa@Moxa:~# sudo apt-get install aptitude tasksel
moxa@Moxa:~# sudo aptitude install ~t^desktop$ ~t^kde-desktop$
```

To install Xfce use the following command:

```
moxa@moxa:~# sudo apt-get install xfce4 xfce4-goodies task-xfce-desktop
```

To install the minimum LXDE environment use the following command:

```
moxa@moxa:~# sudo apt-get install lxde-core lxde
```

## Connecting from an SSH Console

You can use an SSH console on your workstation/PC to connect to the DA-720 computers. SSH connections are believed to provide better network security as compared to Telnet connections. The default IP addresses and netmasks of the network interfaces are as follows:

|       | Default IP Address | Netmask       |
|-------|--------------------|---------------|
| LAN1  | 192.168.3.127      | 255.255.255.0 |
| LAN2  | 192.168.4.127      | 255.255.255.0 |
| LAN3  | 192.168.5.127      | 255.255.255.0 |
| LAN4  | 192.168.6.127      | 255.255.255.0 |
| LAN5  | 192.168.7.127      | 255.255.255.0 |
| LAN6  | 192.168.8.127      | 255.255.255.0 |
| LAN7  | 192.168.9.127      | 255.255.255.0 |
| LAN8  | 192.168.10.127     | 255.255.255.0 |
| LAN9  | 192.168.11.127     | 255.255.255.0 |
| LAN10 | 192.168.12.127     | 255.255.255.0 |
| LAN11 | 192.168.13.127     | 255.255.255.0 |
| LAN12 | 192.168.14.127     | 255.255.255.0 |
| LAN13 | 192.168.15.127     | 255.255.255.0 |
| LAN14 | 192.168.16.127     | 255.255.255.0 |

Before using the SSH client, you should change the IP address of your development workstation so that its 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 DA-720, or use a straight-through Ethernet cable to connect the DA-720 to a LAN hub or switch. Use an SSH client installed on your development workstation to connect to the DA-720. After a connection has been established, type the login and password as requested to log on to the DA-720. The default values are both **moxa**.

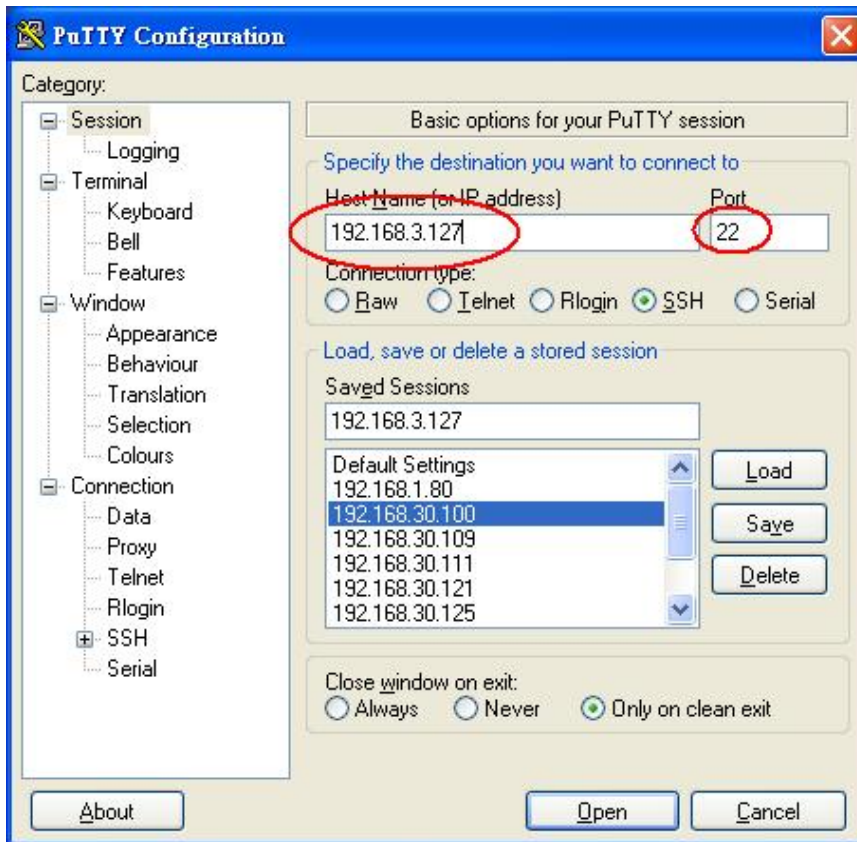
**Login:** **moxa**

**Password:** **moxa**

## Windows Users

To set up an SSH console for the DA-720 in a Windows environment, use the **PuTTY** application available for free at: <http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html>

The following screenshot shows an example of the configuration that is required in **PuTTY**:



## Linux Users

To access the DA-720-LX's console utility via SSH from a Linux machine, use the **ssh** command as follows:

```
#ssh moxa@192.168.3.127
```

Type **yes** to open the connection.

```
[root@Jim_notebook root]# ssh 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_
```

## Adjusting the System Time

The DA-720 has two time settings: The system time, and the time of the RTC (Real Time Clock) built into the DA-720 hardware.

## Setting the Time Manually

Use the `date` command to query the current system time or to set a new system time.

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

Use the `hwclock` command to query the current RTC time or to set a new RTC time.

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

```
# hwclock -w
```

```
root@Moxa:~# date
Wed Dec 16 03:34:46 CST 2016
root@Moxa:~# hwclock
Wed 16 Dec 2016 03:35:16 AM CST  -0.017600 seconds
root@Moxa:~# date 121616352016
Wed Dec 16 16:35:00 CST 2016
root@Moxa:~# hwclock -w
root@Moxa:~# date ; hwclock
Wed Dec 16 16:36:12 CST 2016
Wed 16 Dec 2016 03:38:13 AM CST -0.016751 seconds
root@Moxa:~#
```

## NTP Client

The DA-720 can use a NTP (Network Time Protocol) client to initialize a time request to a remote NTP server, which you can install using the following command:

```
# apt-get install ntpdate
```

Use the `ntpdate` command to update the system time

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

```
root@Moxa:~# date ; hwclock
Wed Dec 16 16:36:12 CST 2016
Wed 16 Dec 2016 03:38:13 AM CST -0.016751 seconds
root@Moxa:~#
root@Moxa:~# ntpdate time.stdtime.gov.tw
 16 Dec 03:49:48 ntpdate[2510]: step time server 220.130.158.52 offset 155905087.9
84256 sec
root@Moxa:~#
root@Moxa:~# hwclock -w
root@Moxa:~# date ; hwclock
Wed Dec 16 03:51:07 CST 2016
Wed 16 Dec 2016 03:51:07 AM CST  -0.016771 seconds
root@Moxa:~#
```

For more information on NTP and NTP server addresses, visit <http://www.ntp.org>.

**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.

## Updating the Time Automatically

This section describes how to use a shell scripts to automatically update the system time.

### Example Shell Script for Periodically Updating the System Time

```
#!/bin/sh
ntpdate time.stdtime.gov.tw
# You can use the time server's ip address or domain
# name directly. If you use domain name, you must
# enable the domain client on the system by updating
# /etc/resolv.conf file.
hwclock -w
sleep 100
# Updates every 100 seconds. The min. time is 100 seconds.
# Change 100 to a larger number to update RTC less often.
```

You can save this shell script using any file name. Let's call it `fixtime`.

### How to run the shell script automatically when the kernel boots up

Copy the example shell script `fixtime` to the directory `/etc/init.d`, and then use the following command to change the shell script mode:

```
# chmod 755 fixtime
```

Use the `vi` editor to edit the `/etc/inittab` file as follows:

```
# vi /etc/inittab
```

At the end of the script add the following line:

```
ntp : 2345 : respawn : /etc/init.d/fixtime
```

Use the `#init q` command to re-initialize the kernel.

```
# init q
```

## Enabling and Disabling Daemons

By default, the following daemons are enabled in the DA-720-LX:

```
sftpd   SFTP Server / Client daemon
sshd   Secure Shell Server daemon
```

You can manage the services that you want to run in the background using the `insserv` command. The following example shows how to add the apache daemon to the current run level:

```
moxa@Moxa:~$ sudo insserv -d apache2
```

The apache daemon will not be activated in current boot session, but will run in the background starting with the next boot session.

To disable the apache daemon, use the following command:

```
moxa@Moxa:~$ sudo insserv -r apache2
```

Linux daemons can be started or stopped in the current boot session by using of the scripts in the `/etc/init.d` file.

To start the apache daemon in the current boot session, use the following command:

```
moxa@Moxa:~$ sudo /etc/init.d/apache2 start
```

To stop the apache daemon, use the following command:

```
moxa@Moxa:~$ sudo /etc/init.d/apache2 stop
```

You can use the management utility called `systemctl` to list all services running at any time as follows:

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

The `apache2` daemon is another service that you can activate in the current boot session.

To enable the `apache2` service, use the following command:

```
moxa@Moxa:~$ sudo systemctl enable apache2
```

To disable the `apache2` service, use the following command:

```
moxa@Moxa:~$ sudo systemctl disable apache2
```

Linux daemons can also be started or stopped using the `systemctl` command.

To start the `apache2` daemon, use the following command:

```
moxa@Moxa:~$ sudo systemctl start apache2
```

To stop the `apache2` service, use the following command:

```
moxa@Moxa:~$ sudo systemctl stop apache2
```

To restart the `apache2` service, use the following command:

```
moxa@Moxa:~$ sudo systemctl restart apache2
```

To show the status of `apache2` service, use the following command:

```
moxa@Moxa:~$ sudo systemctl status apache2
```

To run a private daemon, you can edit the file `rc.local`, as shown below:

1. Type `cd /etc/` to change directory.

```
root@Moxa:~# cd /etc/
```

2. Type `vi rc.local` to edit the configuration file using the `vi` editor.

```
root@Moxa:/etc/# vi rc.local
```

3. Add the application daemon that you want to run to the `rc.local` file.

Here we use the example of the `tcps2-release` program, which you can find on the CD, to illustrate how to configure and run a service as a background process.

```
# !/bin/sh
# Add the daemon that you want to run
/root/tcps2-release &~
```

4. After rebooting the system, you can find the daemon that you enabled by running the `ps` command.

```
root@Moxa:~# ps -ef
  PID  Uid      VmSize  Stat  Command
    1  root      1296  S    init
    2  root          S    [keventd]
    3  root          S    [ksoftirqd_CPU0]
    4  root          S    [kswapd]
    5  root          S    [bdflush]
    6  root          S    [kupdated]
    7  root          S    [mtdblockd]
    8  root          S    [khubd]
   10  root          S    [jffs2_gcd_mtd3]
   32  root          D    [ixp425_csr]
   38  root      1256  S    stdef
   47  root      1368  S    /usr/sbin/apache2
   53  root      4464  S    /usr/sbin/httpd
   63  nobody   4480  S    /usr/sbin/httpd
   64  nobody   4480  S    /usr/sbin/httpd
   65  nobody   4480  S    /usr/sbin/httpd
   66  nobody   4480  S    /usr/sbin/httpd
   67  nobody   4480  S    /usr/sbin/httpd
   92  bin      1460  S    /sbin/portmap
   97  root      1264  S    /root/tcps2-release
  105  root      1556  S    /usr/sbin/rpc.statd
  109  root      4044  S    /usr/sbin/snmpd -s -l /dev/null
  111  root      2832  S    /usr/sbin/snmptrapd -s
  140  root      1364  S    /sbin/cardmgr
  144  root      1756  S    /usr/sbin/rpc.nfsd
  146  root      1780  S    /usr/sbin/rpc.mountd
  153  root      2960  S    /usr/sbin/sshd
  161  root      1272  S    /bin/reportip
  162  root      3464  S    /bin/massupfirm
  163  root      1532  S    /sbin/getty 115200 ttyS0
  164  root      1532  S    /sbin/getty 115200 ttyS1
  166  root      3464  S    /bin/massupfirm
  168  root      3464  S    /bin/massupfirm
  171  root      3652  S    /usr/sbin/sshd
  172  root      2200  S    -bash
  174  root      1592  S    ps -ef
root@Moxa:~#
```

## Executing Scheduled Commands Using the Cron Daemon

The `cron` daemon is used to run scheduled tasks in a Linux environment. When the `cron` daemon is running in the background, it searches the `/etc/crontab` file, **every minute**, to check each command to see if it should be run at that time. The output of the commands that are run is sent to the owner of the `crontab` or to the user named in the `MAILTO` environment variable in the `crontab`, if such a user exists.



To set up your scheduled applications, you must modify the `/etc/crontab` file. The `crontab` entries 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, add an entry to the `crontab` file in the format specified below if you want to launch a program at 8:00 every day:

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

The following example demonstrates how to use the `cron` service to update the system time and RTC time at 8:00 AM every day:

1. Write the following shell script and save it as `fixtime.sh` in the `/home/.` folder:

```
#!/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 by adding the following line to the end of `crontab` content:

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

## Inserting a USB Storage Device into the Computer

By default, the USB storage devices are automatically mounted on to the DA-720. If you want to manually mount a device on to the DA-720, refer to the following instructions:

```
root@Moxa:~# dmesg
...
[ 712.833903] usb 1-1.1: Product: Mass Storage Device
[ 712.833916] usb 1-1.1: Manufacturer: JetFlash
[ 712.833929] usb 1-1.1: SerialNumber: 819KM6NSI94DAIM6
[ 712.859561] usb-storage 1-1.1:1.0: USB Mass Storage device detected
[ 712.861103] scsi2 : usb-storage 1-1.1:1.0
[ 712.861626] usbcore: registered new interface driver usb-storage
[ 714.040211] scsi 2:0:0:0: Direct-Access JetFlash Transcend 8GB 1100 PQ: 0
ANSI: 4
[ 714.041969] sd 2:0:0:0: Attached scsi generic sgl type 0
[ 714.043479] sd 2:0:0:0: [sdb] 15826944 512-byte logical blocks: (8.10 GB/7.54 GiB)
[ 714.044453] sd 2:0:0:0: [sdb] Write Protect is off
[ 714.044476] sd 2:0:0:0: [sdb] Mode Sense: 43 00 00 00
[ 714.045599] sd 2:0:0:0: [sdb] No Caching mode page found
[ 714.045844] sd 2:0:0:0: [sdb] Assuming drive cache: write through
[ 714.053410] sdb: sdb1
[ 714.057663] sd 2:0:0:0: [sdb] Attached SCSI removable disk
```

A USB storage drive is assigned the name `sdb`. The first USB partition can be mounted using `/dev/sdb1` as follows:

```
root@Moxa:~# mount /dev/sdb1 /mnt
```

To check if a USB device is mounted do the following:

```
root@debian:~# mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
udev on /dev type devtmpfs (rw,relatime,size=10240k,nr_inodes=241983,mode=755)
devpts on /dev/pts type devpts
(rw,nosuid,noexec,relatime,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,noexec,relatime,size=195144k,mode=755)
/dev/sda1 on / type ext4 (rw,relatime,errors=remount-ro,data=ordered)
tmpfs on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
tmpfs on /run/shm type tmpfs (rw,nosuid,nodev,noexec,relatime,size=390280k)
/dev/sdb1 on /mnt type vfat
(rw,relatime,mask=0022,dmask=0022,codepage=437,iocharset=utf8,shortname=mixed,
errors=remount-ro)
```

Once it is mounted, you can access the files on the USB storage using the path: `/mnt`

When a USB storage device is not in use, always unmount it before you unplug the device.

```
root@Moxa:~# umount /mnt
```

## Checking the Linux Version

The `uname` command, short for UNIX name, prints the name, version, and other details of the operating system running on the current computer. Use the `-a` option to see the information in the following format:

```
moxa@Moxa:~# uname -a
Linux Moxa 4.6.0-0.bpo.1-amd64 #1 SMP Debian 4.6.4-1~bpo8+1 (2016-08-11) x86_64
GNU/Linux
```

## Installing and Removing Packages Using APT

The advance package tool (APT) is a Debian tool used to install and remove packages. Before you use this tool to install a package, you need to configure the apt source file.

1. Use the `vi` editor to configure the apt source file `/etc/apt/sources.list` as follows:

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

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

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

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

deb http://ftp.debian.org/debian jessie-backports main
```

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

# Moxa's update
deb http://debian.moxa.com/debian jessie main
#deb http://220.135.161.42/debian jessie main
```

2. Add Moxa's **apt** repository to **/etc/apt/sources.list**

To enable you to add or update the drivers, libraries, and utility packages provided by Moxa, we have already included the "**deb http://debian.moxa.com/debian jessie main**" in the **source list** by default. If it is deleted or not available for some reason, you should add these to the source list before you add Moxa's **apt** repository.

```
root@Moxa:~# sudo vi /etc/apt/sources.list
deb http://debian.moxa.com/debian jessie main
```



### ATTENTION!

Moxa has encrypted its packages with a GPG key, which allows you to check if a package is verified by us. Hence, you must first upload the GPG key to the Moxa's embedded computer and add it to the GPG key list before installing the packages. You can find the GPG key in the CD/DVD or on the Moxa website.

You can check if the GPG key is already uploaded to your computer by checking the key list as follows:

```
root@Moxa:~# apt-key list
/etc/apt/trusted.gpg
-----
pub 2048R/62B24532 2014-05-28 [expires: 2024-05-25]
uid MOXA SYS <sys.support@moxa.com>
sub 2048R/F7F3CD9E 2014-05-28 [expires: 2024-05-25]
```

The GPG key will be displayed using **MOXA SYS**. If you do not find the GPG key, you can add it to the GPG key list as follows:

```
root@Moxa:~# apt-key add NEW-MOXA-SYS-DEBIAN-KEY
```

You must then update the package list as follows:

```
root@Moxa:~# apt-get update
Ign http://debian.moxa.com jessie Release.gpg
Ign http://debian.moxa.com/debian/ jessie/main Translation-en
Ign http://debian.moxa.com/debian/ jessie/main Translation-en_HK
Get:1 http://debian.moxa.com jessie Release [1,633 B]
Ign http://debian.moxa.com jessie/main i386 Packages
Get:2 http://debian.moxa.com jessie/main i386 Packages [1,585 B]
Fetched 3,218 B in 0s (47.2 kB/s)
Reading package lists... Done
```

3. After updating the package list, you can use the **apt-get** command to install or upgrade the packages from Moxa's **apt** repository as follows:

a) Update the source list after you configure it.

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

b) 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:

- a. For a simple package removal:

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

- b. 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 # `apt-get clean` command.

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

## Setting Up a Desktop Environment

The DA-720 Linux operating system by default doesn't install a desktop environment. Debian supports multiple fully-featured graphical environments, such as Gnome, KDE, and lighter environment like Xfce and LXDE. You can choose to install one of these desktop systems on your DA-720.

To install the Gnome environment, run the following command:

```
moxa@moxa:~# sudo apt-get install gnome
```

To install the KDE environment, run the following command:

```
moxa@moxa:~# sudo apt-get install kde-standard
```

To install the Xfce environment, run the following command:

```
moxa@moxa:~# apt-get install xfce4 xfce4-goodies thunar-archive-plugin
```

To install the minimum LXDE environment, run the following command:

```
moxa@moxa:~# sudo apt-get install lxde-core lxde
```



### ATTENTION

You must remove the package after the GUI installation is complete using the # `apt-get remove xserver-xorg-video-intel` command.

# Power Management—Suspend

The DA-720 supports the power management function ACPI S3 (suspend to RAM). To enable this support, you must first enable the S3 option in the BIOS and then use the following command:

```
Moxa:~# pm-suspend --quirk-s3-bios
```

Once the **suspend** command is in effect, you can use the power button to wake up the computer.

In X Windows, an administrator (root) user can use the **System** → **Shutdown** → **Suspend** function to suspend a device. This function is not available to non-root users.

When Moxa's embedded computers come out of a suspended state, some application components may need to be reset. You can write a simple script in the **/usr/lib/pm-utils/sleep.d/** folder to perform this procedure as demonstrated in the following example, **script 99serial**:

```
#!/bin/sh

case "$1" in
    hibernate|suspend)
        echo "close AP and tty ports which are opened"
        echo "operations before serial ports suspend"
        ;;
    thaw|resume)
        echo "restart AP"
        echo "operations after serial ports resume"
        ;;
    *) exit $NA
    ;;
esac
```

**NOTE** To run this script, start **rsyslogd** using the command **/etc/init.d/rsyslogd start** and then view the file **/var/log/pm-suspend.log** to see the event log

## Wake On LAN

The DA-720 supports wake on LAN (WOL), a feature used to wake up a device for suspend (S3) and shutdown (S5) states.

To check the WOL support on Ethernet port *x*, type **ethtool ethx**, where "x" is the port number.

```
Moxa:/# ethtool eth0
Settings for eth0:
    Supported ports: [ TP ]
    Supported link modes:   10baseT/Half 10baseT/Full
                           100baseT/Half 100baseT/Full
                           1000baseT/Full
    Supports auto-negotiation: Yes
    Advertised link modes:  10baseT/Half 10baseT/Full
                           100baseT/Half 100baseT/Full
                           1000baseT/Full
    Advertised auto-negotiation: Yes
    Speed: 100Mb/s
    Duplex: Full
    Port: Twisted Pair
```

```
PHYAD: 0
Transceiver: internal
Auto-negotiation: on
Supports Wake-on: pumbg
Wake-on: g
Current message level: 0x00000033 (51)
Link detected: yes
Moxa:/#
```

The default WOL support parameter is “g” (wake on Magic packet).

If the WOL setting is not **g**, we suggest that you modify the setting using the `ethtool -s ethx wol g` command.

The following example illustrates how to suspend (S3) your computer and how to wake it up using another computer:

1. On Moxa’s embedded computer:
  - i. Enable the **S3** options in the BIOS
  - ii. Get the MAC address using the `ifconfig ethx` (x is the port number) command
  - iii. Suspend to RAM using the `pm-suspend --quirk-s3-bios` command
2. On a remote computer:

Run the `etherwake -b mac_of_the_Moxa_computer` command to wake Moxa’s embedded computer.  
For example:

```
etherwake -b 00:90:e8:00:d7:07
```

The following example illustrates how to shutdown (S5) your computer and how to wake it up using another computer:

1. On Moxa’s embedded computer:

Shut down your computer using the `shutdown -h now` command
2. On a remote computer:

Run the `etherwake -b mac_of_the_Moxa_computer` command to wake Moxa’s embedded computer.  
For example:

```
etherwake -b 00:90:e8:00:d7:07
```

# Managing Communications

---

The DA-720-LX ready-to-run embedded computer is a network-centric platform designed to serve as a front-end for data acquisition 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:

- ❑ **Renaming the Network Interfaces**
- ❑ **Changing the Network Settings**
  - Editing the Interfaces Configuration File
  - Adjusting IP Addresses with "ifconfig"
- ❑ **DNS Client**
  - /etc/hostname
  - /etc/resolv.conf
  - /etc/nsswitch.conf
- ❑ **Configuring Ethernet Bonding**
- ❑ **Apache Web Server**
  - Install the apache web server
  - Default Homepage
- ❑ **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
- ❑ **PPP (Point-to-Point Protocol)**
  - Connecting to a PPP Server over a Simple Dial-up Connection
  - Connecting to a PPP Server over a Hard-wired Link
  - Checking the Connection
  - Setting up a Machine for Incoming PPP Connections
- ❑ **PPPoE**
- ❑ **NFS (Network File System) Client**
- ❑ **SNMP (Simple Network Management Protocol)**
- ❑ **OpenVPN**
  - Install the openvpn
  - Ethernet Bridging for Private Networks on Different Subnets
  - Ethernet Bridging for Private Networks on the Same Subnet
- **Routed IP**

## Renaming the Network Interfaces

You can use the `udev` command on Linux-based systems to detect new network interfaces, including Ethernet and wireless interfaces. The default order of the network interfaces is not the same as the order of the interfaces as labelled on the product. The udev rule, `/etc/udev/rules.d/01-rename_net_interface.rules`, can be used to reorder the network interface. The content of the file is similar to the following example:

```
KERNEL=="eth*", KERNELS=="0000:01:00.0", NAME="eth0"
KERNEL=="eth*", KERNELS=="0000:02:00.0", NAME="eth1"
KERNEL=="eth*", KERNELS=="0000:06:00.0", NAME="eth2"
KERNEL=="eth*", KERNELS=="0000:07:00.0", NAME="eth3"
```

## Changing the Network Settings

The DA-720-LX computer has four 10/100/1000 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 |
| LAN3  | 192.168.5.127      | 255.255.255.0 |
| LAN4  | 192.168.6.127      | 255.255.255.0 |
| LAN5  | 192.168.7.127      | 255.255.255.0 |
| LAN6  | 192.168.8.127      | 255.255.255.0 |
| LAN7  | 192.168.9.127      | 255.255.255.0 |
| LAN8  | 192.168.10.127     | 255.255.255.0 |
| LAN9  | 192.168.11.127     | 255.255.255.0 |
| LAN10 | 192.168.12.127     | 255.255.255.0 |
| LAN11 | 192.168.13.127     | 255.255.255.0 |
| LAN12 | 192.168.14.127     | 255.255.255.0 |
| LAN13 | 192.168.15.127     | 255.255.255.0 |
| LAN14 | 192.168.16.127     | 255.255.255.0 |

These network settings can be modified by editing the parameters in the **interfaces** configuration file. You can also temporarily adjust these setting using the `ifconfig` command.

## Editing the Interfaces Configuration File

1. Type `cd /etc/network` to change the path to **network** folder.

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

2. Type `vi interfaces` to edit the network configuration file using the **vi** editor.

You can then modify the network parameter in the **interfaces** file.

```
Moxa:/etc/network# vi interfaces
```

For example, you can configure the DA-720-LX's Ethernet ports for static or dynamic (DHCP) IP addresses.



## Configuring a Static IP Address

The default static IP addresses can be modified as shown in the following example:

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

# The primary network interface
auto eth0
iface eth0 inet static
    address 192.168.3.127
    netmask 255.255.255.0
    broadcast 192.168.3.255

auto eth1
iface eth1 inet static
    address 192.168.4.127
    netmask 255.255.255.0
    broadcast 192.168.4.255

auto eth2
iface eth2 inet static
    address 192.168.5.127
    netmask 255.255.255.0
    broadcast 192.168.5.255

auto eth3
iface eth3 inet static
    address 192.168.6.127
    netmask 255.255.255.0
    broadcast 192.168.6.255

auto eth4
iface eth4 inet static
    address 192.168.7.127
    netmask 255.255.255.0
    broadcast 192.168.7.255

auto eth5
iface eth5 inet static
    address 192.168.8.127
    netmask 255.255.255.0
    broadcast 192.168.8.255

auto eth6
iface eth6 inet static
    address 192.168.9.127
    netmask 255.255.255.0
    broadcast 192.168.9.255

auto eth7
iface eth7 inet static
    address 192.168.10.127
```

```
netmask 255.255.255.0
broadcast 192.168.10.255

auto eth8
iface eth8 inet static
address 192.168.11.127
netmask 255.255.255.0
broadcast 192.168.11.255

auto eth9
iface eth9 inet static
address 192.168.12.127
netmask 255.255.255.0
broadcast 192.168.12.255

auto eth10
iface eth10 inet static
address 192.168.13.127
netmask 255.255.255.0
broadcast 192.168.13.255

auto eth11
iface eth11 inet static
address 192.168.14.127
netmask 255.255.255.0
broadcast 192.168.14.255

auto eth12
iface eth12 inet static
address 192.168.15.127
netmask 255.255.255.0
broadcast 192.168.15.255

auto eth13
iface eth13 inet static
address 192.168.16.127
netmask 255.255.255.0
broadcast 192.168.16.255
```

## Configuring 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 eth0
iface eth0 inet dhcp
```

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

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

## 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 `# ifconfig eth0 192.168.1.1` command to change the IP address of LAN1 to 192.168.1.1.

```
Moxa:~# ifconfig eth0 192.168.1.1
Moxa:~#
```

## DNS Client

The DA-720-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`

1. Edit `/etc/hostname`:

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

2. Re-configure the hostname.

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

3. 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 using the `nameserver` command. For example, add the line `nameserver 8.8.8.8` to the `/etc/resolv.conf` file (assuming the DNS server's IP address is 8.8.8.8) as shown below:

```
Moxa:/etc# cat resolv.conf
#
# resolv.conf This file is the resolver configuration file
# See resolver(5).
#
#nameserver 192.168.1.16
nameserver 8.8.8.8
nameserver 8.8.4.4
nameserver 8.8.8.8
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` file here specifies that the `/etc/host` file and the DNS service should be used first 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
```

## Configuring Ethernet Bonding

The Linux bonding driver provides a method for aggregating multiple network interfaces into a single logical "bonded" interface. To use the bonding feature, you have to load the bonding driver with mode setting. Then use the `ifenslave` command to add the Ethernet interface to the `bond0` interface. A script that bonds `eth1` and `eth2` is given below. You can include this in the `/etc/init.d/bonding.sh` file.

```
#!/bin/bash

#### BEGIN INIT INFO
# Provides:          bonding
# Short-Description: Start the bonding service, bond eth1 and eth2.
# Required-Start:    $all
# Required-Stop:     $all
# Should-Start:
# Should-Stop:
# Default-Start:     2 3 4 5
# Default-Stop:      0 1 6
#### END INIT INFO

NAME=bonding
PATH=/bin:/usr/bin:/sbin:/usr/sbin

case "$1" in
  start)
    # to set ethX interfaces as slave the bond0 must have an ip
    if [ "$2" == "" ]; then
```

```

    $0
    exit 1
fi
echo "Starting bonding service: $NAME."
modprobe bonding mode=1 miimon=100      # load bonding module

ifdown eth2          # putting down eth2
ifdown eth1          # putting down eth1

ifconfig bond0 hw ether 00:90:E8:00:00:60 # change mac address
ifconfig bond0 $2 netmask 255.255.255.0 up # set ip address

ifenslave bond0 eth2      # set eth2 in slave for bond0
ifenslave bond0 eth1      # set eth1 in slave for bond0
;;

stop)
echo "Stopping bonding service: $NAME"
ifenslave -d bond0 eth2    # release eth2 from bond0
ifenslave -d bond0 eth1    # release eth1 from bond0

ifconfig bond0 down        # putting down bond0
modprobe -r bonding        # unload bonding module

ifup eth2
ifup eth1
;;

restart)
$0 stop
$0 start $2
;;

*)
echo "Usage: /etc/init.d/$NAME {start|stop|restart} [ip address]"
exit 1
;;
esac

exit 0

```

You can add this script to the run level as follows:

```
moxa@Moxa:~# sudo inserv -v -d bonding.sh
```

To remove it from the run level, use the following command:

```
moxa@Moxa:~# sudo inserv -r bonding.sh
```

# Apache Web Server

## Install the apache web server

The Apache web server is one of the famous web server. It's has installed in this system but not enabled. You can enable it using the `systemctl` command.

```
Moxa:~# sudo systemctl enable apache2
```

Manually start the apache2 server.

```
Moxa:~# sudo systemctl start 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`**

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/w3mail.cgi`**

## 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 DA-720-LX supports three types of IPTABLES: Filter tables, NAT tables, and Mangle tables.

### Filter Table

Includes the following chains:

- **INPUT chain**
- **OUTPUT chain**
- **FORWARD chain**

## NAT Table

Includes the following 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.

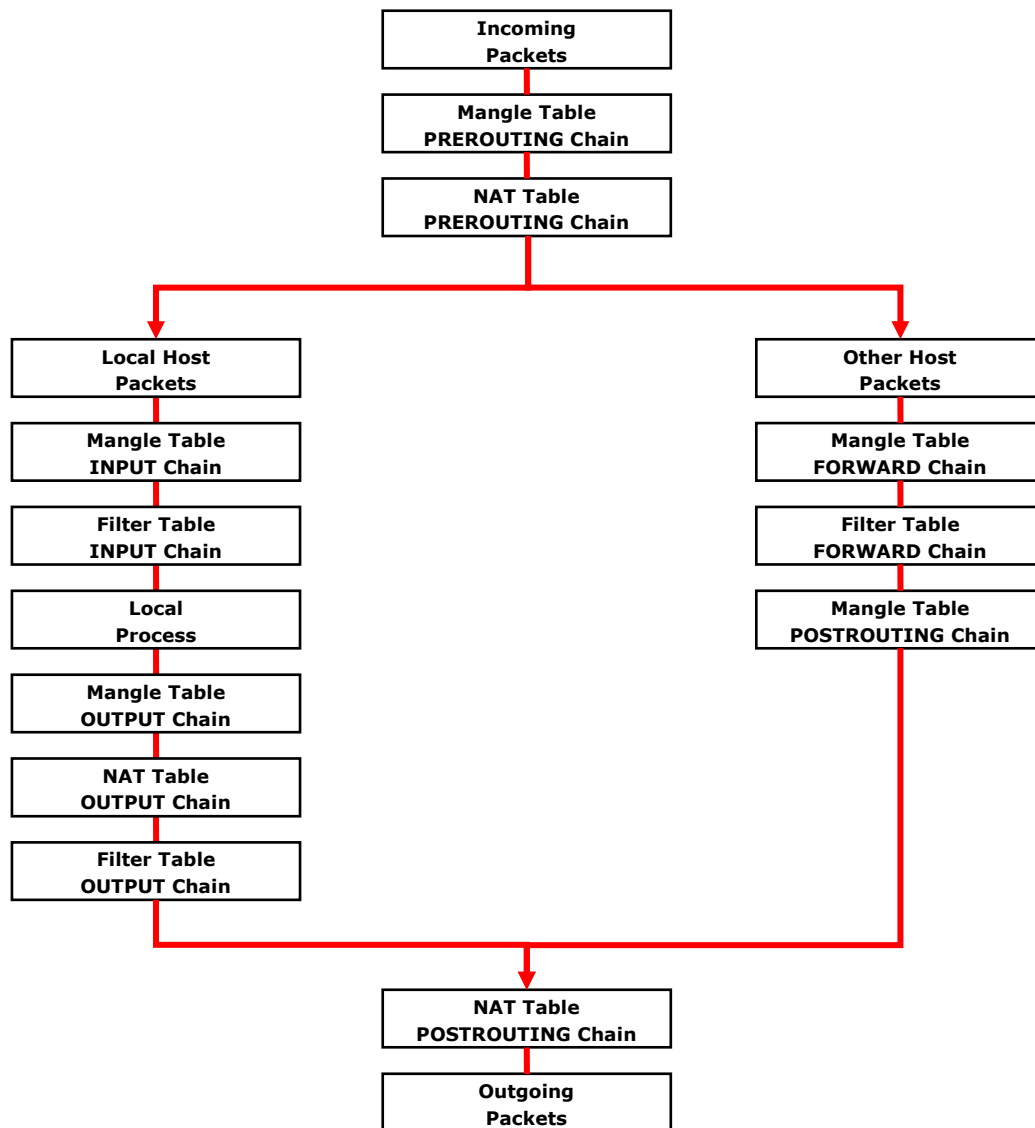
## Mangle Table

- **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.

|                            |                         |                      |                            |
|----------------------------|-------------------------|----------------------|----------------------------|
| arpfilter.ko               | arp_tables.ko           | arp_mangle.ko        | ip_conntrack_amanda.ko     |
| ip_conntrack_ftp.ko        | ip_conntrack_h323.ko    | ip_conntrack_irc.ko  | ip_conntrack.ko            |
| ip_conntrack_netbios_ns.ko | ip_conntrack_netlink.ko | ip_conntrack_pptp.ko | ip_conntrack_proto_sctp.ko |
| ip_conntrack_sip.ko        | ip_conntrack_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 DA-720-LX. Use `modprobe` to insert and enable the module.

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



### ATTENTION

The `iptables` module can be used in packet filtering or network address translation. Be careful when setting up the `iptables` rules. If the rules are incorrect, remote hosts that connect via a LAN or PPP may be denied access. We recommend using the VGA console to set up the `iptables` module. Click on the following links for more information:

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

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

Since the `iptables` command are complex, 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 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 DA-720-LX.

OUTPUT: For locally-generated packets.

FORWARD: For packets routed out through the DA-720-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 eth0 -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 eth0 -p tcp -s 192.168.1.0/24 -j ACCEPT
```

Example 4: Drop TCP packets from 192.168.1.25.

```
# iptables -A INPUT -i eth0 -p tcp -s 192.168.1.25 -j DROP
```

Example 5: Drop TCP packets addressed for port 21.

```
# iptables -A INPUT -i eth0 -p tcp --dport 21 -j DROP
```

Example 6: Accept TCP packets from 192.168.0.24 to DA-720-LX's port 137, 138, 139

```
# iptables -A INPUT -i eth0 -p tcp -s 192.168.0.24 --dport 137:139 -j ACCEPT
```

Example 7: Log TCP packets that visit DA-720-LX's port 25.

```
# iptables -A INPUT -i eth0 -p tcp --dport 25 -j LOG
```

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

```
# iptables -A INPUT -i eth0 -p all -m mac --mac-source 01:02:03:04:05:06 -j DROP
```



#### ATTENTION

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

## 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 DA-720-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:

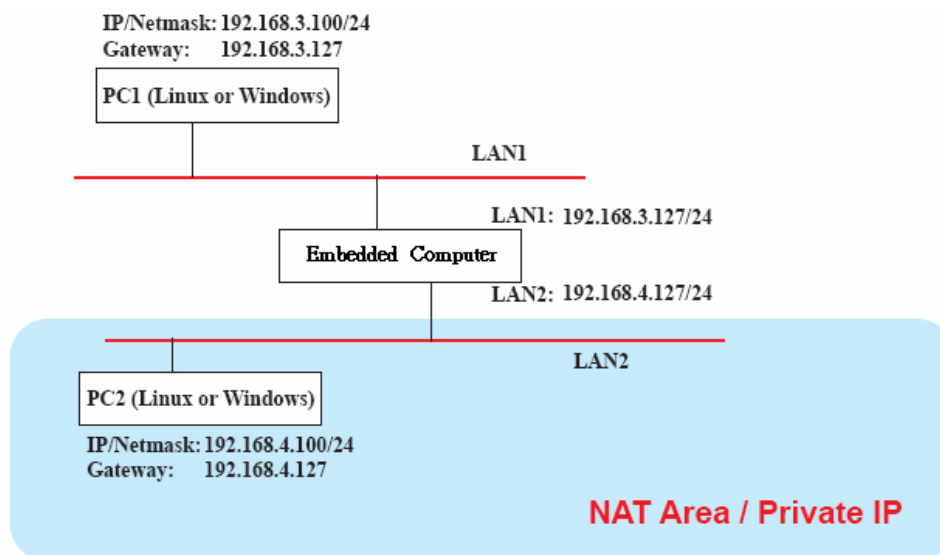
<http://www.netfilter.org/documentation/HOWTO//packet-filtering-HOWTO.html>

## NAT Example

The IP address of all packets leaving LAN1 are changed to **192.168.3.127**

**NOTE** The `ipt_MASQUERADE` module is required for the NAT function.

():



## Enabling NAT at Bootup

In most real world situations, you will want to use a simple shell script to enable NAT when the DA-720-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="eth0" #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.
```

```
#ehco 1 > /proc/sys/net/ipv4/ip_forward#modprobe ipt_MASQUERADE#iptables -t nat -  
A POSTROUTING -o eth0 -j MASQUERADE
```

## PPP (Point-to-Point Protocol)

PPP is used to run IP (Internet Protocol) and other network protocols over a serial link. PPP can be used for direct serial connections (using a null-modem cable) over a Telnet link, and links established using a modem over a telephone line.

Modem/PPP access is almost identical to connecting directly to a network through the embedded computer Ethernet port. Since PPP is a peer-to-peer system, the Linux operating system can use it to link two networks (or a local network to the Internet) to create a Wide Area Network (WAN).



### ATTENTION

Click on the following links for more information about PPP:

<http://tldp.org/HOWTO/PPP-HOWTO/index.html>

<http://axion.physics.ubc.ca/ppp-linux.html>

## Connecting to a PPP Server over a Simple Dial-up Connection

The `pppd` command is used to connect to a PPP server by modem. Use this command for old PPP servers that prompt for a login name (replace "username" with the correct name) and password (replace "password" with the correct password). The `debug` `crtsets` and `defaultroute 192.1.1.17` parameters are optional.

```
#pppd connect `chat -v "" ATDT5551212 CONNECT ""login: username password: password`  
/dev/ ttyS0 115200 debug crtsets modem defaultroute 192.1.1.17
```

If the PPP server does not prompt for the username and password, the `pppd` command should be entered as follows (replace "username" with the correct username and replace "password" with the correct password):

```
#pppd connect `chat -v "" ATDT5551212 CONNECT "" ` user username password password /dev/  
ttyS0 115200 crtsets modem
```

The `pppd` command options are described below:

| Option   | Description  |
|--|--|
| <code>connect 'chat etc...'</code>   | This option gives the command to contact the PPP server. The <code>chat</code> program is used to dial a remote computer. The entire command is enclosed in single quotes because <code>pppd</code> expects a one-word argument for the <code>connect</code> option. The options for <code>chat</code> are given below:  |
| <code>-v</code>  | verbose mode; log what we do to syslog   |
| <code>" "</code>   | Double quotes—don't wait for a prompt, but instead do ... (note that you must include a space after the second quotation mark)   |
| <code>ADDT5551212</code>   | Dial the modem, and then ...   |
| <code>CONNECT</code>   | Wait for an answer.  |
| <code>" "</code>   | Send a return (null text followed by the usual return)   |
| <code>Login: username; password: password</code>   | Log in with username and password.   |
| Note: For more information about the <code>chat</code> utility, refer to the <code>chat</code> man page. |  |
| <code>/dev/</code>   | Specify the callout serial port.   |
| <code>115200</code>  | The baud rate.   |
| <code>debug</code>   | Log status in syslog.  |
| <code>crtscts</code>   | Use hardware flow control between the computer and modem (mandatory at baudrates of 115200 and above).   |
| <code>modem</code>   | Indicates that this is a modem device; <code>pppd</code> will hang up the phone before and after making the call.  |
| <code>defaultroute</code>  | Once the PPP link is established, make it the default route; if you have a PPP link to the Internet, this is probably what you want.   |
| <code>192.1.1.17</code>  | This is a degenerate case of a general option of the form <code>x.x.x.x:y.y.y.y</code> . Here <code>x.x.x.x</code> is the local IP address and <code>y.y.y.y</code> is the IP address of the remote end of the PPP connection. If this option is not specified, or if just one side is specified, then <code>x.x.x.x</code> defaults to the IP address associated with the local machine's hostname (located in <code>/etc/hosts</code> ), and <code>y.y.y.y</code> is determined by the remote machine. |

## Connecting to a PPP Server over a Hard-wired Link

If a username and password are not required, use the following command (note that `noipdefault` is optional):

```
#pppd connect 'chat -v' " " " \ noipdefault /dev/ttyS0 19200 crtscts
```

If a username and password is required, use the following command (note that `noipdefault` is optional, and the username and password are both "root"):

```
#pppd connect 'chat -v' " " " \ user root password root noipdefault /dev/ttyS0 19200 crtscts
```

## Checking the Connection

Once you have set up a PPP connection, there are some steps you can take to test the connection. First, type:

```
# /sbin/ifconfig
```

Depending on your distribution, the command might be located elsewhere. After executing the command, you should be able to see all of the network interfaces that are up. The `ppp0` interface is one of the network interfaces that is displayed. The first IP address shown is the IP address of the computer, and **P-t-P address** is the IP address of the server. The output should be similar to the following:

```
lo          Link encap Local Loopback
           inet addr 127.0.0.1  Bcast 127.255.255.255 Mask 255.0.0.0
           UP LOOPBACK RUNNING  MTU 2000  Metric 1
           RX packets 0 errors 0 dropped 0 overrun 0

ppp0       Link encap Point-to-Point Protocol
           inet addr 192.76.32.3  P-t-P 129.67.1.165 Mask 255.255.255.0
           UP POINTOPOINT RUNNING  MTU 1500  Metric 1
           RX packets 33 errors 0 dropped 0 overrun 0
           TX packets 42 errors 0 dropped 0 overrun 0
```

Now, type:

```
# ping z.z.z.z
```

Where z.z.z.z is the address of your name server. The output should be similar to the following:

```
Moxa:~# ping 129.67.1.165
PING 129.67.1.165 (129.67.1.165): 56 data bytes
64 bytes from 129.67.1.165: icmp_seq=0 ttl=225 time=268 ms
64 bytes from 129.67.1.165: icmp_seq=1 ttl=225 time=247 ms
64 bytes from 129.67.1.165: icmp_seq=2 ttl=225 time=266 ms
^C
--- 129.67.1.165 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 247/260/268 ms
Moxa:~#
```

Try typing:

```
# netstat -nr
```

You should see three routes similar to the following:

```
Kernel routing table
Destination Gateway Genmask Flags Metric Ref Use
iface
129.67.1.165 0.0.0.0 255.255.255.255 UH 0 0 6
ppp0
127.0.0.0 0.0.0.0 255.0.0.0 U 0 0 0 lo
0.0.0.0 129.67.1.165 0.0.0.0 UG 0 0 6298
ppp0
```

If your output looks similar but does not have the "destination 0.0.0.0" line (which refers to the default route used for connections), you may have run `pppd` without the **defaultroute** option. At this point, you can try using Telnet, FTP, or Finger services, bearing in mind that you will have to use numeric IP addresses unless you have configured `/etc/resolv.conf` correctly.

## Setting up a Machine for Incoming PPP Connections

### Method 1: pppd dial-in with pppd commands

This first example applies to using a modem, and requiring authorization with a username and password.

```
#pppd /dev/ttyS0 115200 crtscts modem 192.168.16.1:192.168.16.2 login auth
```

You should also add the following line to the file `/etc/ppp/pap-secrets`:

```
* * "" *
```

The first star (\*) lets everyone login. The second star (\*) lets every host connect. The pair of double quotation marks ("" ) indicates that the file `/etc/passwd` can be used to check the password. The last star (\*) is to let any IP connect.

The following example does not check the username and password:

```
# pppd/dev/ttyS0 115200 crtscts modem 192.168.16.1:192.168.16.2
```

### Method 2: pppd dial-in with pppd script

Configure a dial-in script `/etc/ppp/peer/dialin`

```
# You usually need this if there is no PAP authentication
noauth
#auth
#login

# The chat script (be sure to edit that file, too!)
init "/usr/sbin/chat -v -f /etc/ppp/ppp-ttyS0.chat"

# Set up routing to go through this PPP link
defaultroute

# Default modem (you better replace this with /dev/ttySx!)
/dev/ttyS0

# Speed
115200

# Keep modem up even if connection fails
persist
crtscts
modem
192.168.16.1:192.168.16.2
debug
-detach
```

Configure the chat script `/etc/ppp/ppp-ttyS0.chat`

```
SAY 'Auto Answer ON\n'
`` ATSO=1
```

Start the **pppd** dial-in service.

```
# pppd call dialin
```



**ATTENTION**

If you would like to have auto dial-in service, you can launch the dial-in service in **/etc/inittab** with the **respawn** command.

```
Moxa:~# mount -o remount,rw /dev/sda1 /
Moxa:~# echo "p0:2345:respawn:pppd call dialin" >> /etc/inittab
Moxa:~# umount /
```

## PPPoE

Use the following procedure to configure PPPoE:

1. Connect the DA-720-LX's LAN port to an ADSL modem with a cross-over cable, HUB, or switch.
2. Log in to the DA-720-LX as the root user.

Edit the file **/etc/ppp/chap-secrets** and add the following:

```
"username@hinet.net" * "password" *
```

```
# Secrets for authentication using CHAP
# client      server secret          IP addresses

# PPPoE example, if you want to use it, you need to unmark it and modify it
"username@hinet.net" * "password" *
```

**username@hinet.net** is the username obtained from the ISP to log in to the ISP account. **password** is the corresponding password for the account.

Edit the file **/etc/ppp/pap-secrets** and add the following:

```
"username@hinet.net" * "password" *
```

```
# ATTENTION: The definitions here can allow users to login without a
# password if you don't use the login option of pppd! The mgetty Debian
# package already provides this option; make sure you don't change that.

# INBOUND connections

# Every regular user can use PPP and has to use passwords from /etc/passwd
*      hostname      ""      *
"username@hinet.net" * "password" *

# UserIDs that cannot use PPP at all. Check your /etc/passwd and add any
# other accounts that should not be able to use pppd!
guest  hostname      "*"     -
master hostname      "*"     -
root   hostname      "*"     -
support hostname     "*"     -
stats  hostname      "*"     -

# OUTBOUND connections
```

**username@hinet.net** is the username obtained from the ISP to log in to the ISP account; **password** is the corresponding password for the account.

Edit the file **/etc/ppp/options** and add the following line:

```
plugin rp-pppoe
```

```
# received. Note: it is not advisable to use this option with the persist
# option without the demand option. If the active-filter option is given,
# data packets which are rejected by the specified activity filter also
# count as the link being idle.
#idle <n>

# Specifies how many seconds to wait before re-initiating the link after
# it terminates. This option only has any effect if the persist or demand
# option is used. The holdoff period is not applied if the link was
# terminated because it was idle.
#holdoff <n>

# Wait for up n milliseconds after the connect script finishes for a valid
# PPP packet from the peer. At the end of this time, or when a valid PPP
# packet is received from the peer, pppd will commence negotiation by
# sending its first LCP packet. The default value is 1000 (1 second).
# This wait period only applies if the connect or pty option is used.
#connect-delay <n>

# Load the pppoe plugin
plugin rp-pppoe.so

# ---<End of File>---
```

3. If you use LAN1 to connect to the ADSL modem, add the file `/etc/ppp/options.eth0`, if you use LAN2 to connect to the ADSL modem, add `/etc/ppp/options.eth1`, etc.

```
name username@hinet.net
mtu 1492
mru 1492
defaultroute
noipdefault
~
~
"/etc/ppp/options.eth0" 5 lines, 67 characters
```

Type your username (the one you set in the `/etc/ppp/pap-secrets` and `/etc/ppp/chap-secrets` files) after the **name** option. You may add other options as needed.

4. Set up DNS.

If you are using DNS servers supplied by your ISP, edit the file `/etc/resolv.conf` by adding the following lines of code:

```
nameserver ip_addr_of_first_dns_server
nameserver ip_addr_of_second_dns_server
```

For example:

```
nameserver 8.8.8.8
nameserver 8.8.4.4
```

```
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:/etc#
```

Use the following command to create a **PPoE** connection:

```
#pppd eth0
```

- The ADSL modem is connected to the **LAN1** port, which is named **eth0**. If the ADSL modem is connected to **LAN2**, use **eth1**, etc.
- Type **#ifconfig ppp0** to check if the connection is OK. If the connection is OK, you should see the IP address of ppp0. Use **#ping** to test the IP address.

```
ppp0      Link encap Point-to-Point Protocol
          inet addr 192.76.32.3  P-t-P 129.67.1.165 Mask 255.255.255.0
          UP POINTOPOINT RUNNING  MTU 1500  Metric 1
          RX packets 33 errors 0 dropped 0 overrun 0
          TX packets 42 errors 0 dropped 0 overrun 0
```

- If you want to disconnect the connection, use the **kill** command to stop the **pppd** process.

## 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, and seamless sharing of files across a network. NFS allows you to develop applications for the DA-720-LX without worrying about the amount of disk space that will be available. The DA-720-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 procedures illustrate how to mount a remote NFS Server:

- 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
- Establish a mount point on the NFS Client site:
 

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

# SNMP (Simple Network Management Protocol)

The DA-720-LX comes with the SNMP v2c (Simple Network Management Protocol) software package. The `snmpd` service is disabled by default. You can use the following command to enable it:

```
moxa@moxa:~# sudo systemctl enable snmpd
```

The `snmpd` configuration is at `/etc/snmp/snmpd.conf`. You can configure the `snmpd` listening address and port only from the local system to all interfaces.

```
# /etc/snmp/snmpd.conf
# ...
# Listen for connections from the local system only
#agentAddress udp:127.0.0.1:161
# Listen for connections on all interfaces (both IPv4 *and* IPv6)
agentAddress udp:161,udp6:[::]:161
```

Then restart the `snmpd` service.

```
moxa@moxa:~# sudo systemctl restart snmpd
```

The following example shows an SNMP agent responding to a query from the SNMP browser on the host site:

```
iso.3.6.1.2.1.1.1.0 = STRING: "Linux Moxa 4.6.0-0.bpo.1-amd64 #1 SMP Debian
4.6.4-1~bpo8+1 (2016-08-11) x86_64"
iso.3.6.1.2.1.1.2.0 = OID: iso.3.6.1.4.1.8691.12.720
iso.3.6.1.2.1.1.3.0 = Timeticks: (163) 0:00:01.63
iso.3.6.1.2.1.1.4.0 = STRING: "Moxa Inc., Embedded Computing Business.
<www.moxa.com>"
iso.3.6.1.2.1.1.5.0 = STRING: "Moxa"
iso.3.6.1.2.1.1.6.0 = STRING: "F1.4, No.135, Lane 235, Baoquao Rd., Xindian Dist.,
New Taipei City, Taiwan, R.O.C."
iso.3.6.1.2.1.1.7.0 = INTEGER: 72
iso.3.6.1.2.1.1.8.0 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.1.9.1.2.1 = OID: iso.3.6.1.6.3.11.3.1.1
iso.3.6.1.2.1.1.9.1.2.2 = OID: iso.3.6.1.6.3.15.2.1.1
iso.3.6.1.2.1.1.9.1.2.3 = OID: iso.3.6.1.6.3.10.3.1.1
iso.3.6.1.2.1.1.9.1.2.4 = OID: iso.3.6.1.6.3.1
iso.3.6.1.2.1.1.9.1.2.5 = OID: iso.3.6.1.2.1.49
iso.3.6.1.2.1.1.9.1.2.6 = OID: iso.3.6.1.2.1.4
iso.3.6.1.2.1.1.9.1.2.7 = OID: iso.3.6.1.2.1.50
iso.3.6.1.2.1.1.9.1.2.8 = OID: iso.3.6.1.6.3.16.2.2.1
iso.3.6.1.2.1.1.9.1.2.9 = OID: iso.3.6.1.6.3.13.3.1.3
iso.3.6.1.2.1.1.9.1.2.10 = OID: iso.3.6.1.2.1.92
iso.3.6.1.2.1.1.9.1.3.1 = STRING: "The MIB for Message Processing and Dispatching."
iso.3.6.1.2.1.1.9.1.3.2 = STRING: "The management information definitions for the
SNMP User-based Security Model."
iso.3.6.1.2.1.1.9.1.3.3 = STRING: "The SNMP Management Architecture MIB."
iso.3.6.1.2.1.1.9.1.3.4 = STRING: "The MIB module for SNMPv2 entities"
iso.3.6.1.2.1.1.9.1.3.5 = STRING: "The MIB module for managing TCP implementations"
iso.3.6.1.2.1.1.9.1.3.6 = STRING: "The MIB module for managing IP and ICMP
implementations"
iso.3.6.1.2.1.1.9.1.3.7 = STRING: "The MIB module for managing UDP implementations"
iso.3.6.1.2.1.1.9.1.3.8 = STRING: "View-based Access Control Model for SNMP."
iso.3.6.1.2.1.1.9.1.3.9 = STRING: "The MIB modules for managing SNMP Notification,
```

```

plus filtering."
iso.3.6.1.2.1.1.9.1.3.10 = STRING: "The MIB module for logging SNMP Notifications."
iso.3.6.1.2.1.1.9.1.4.1 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.1.9.1.4.2 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.1.9.1.4.3 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.1.9.1.4.4 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.1.9.1.4.5 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.1.9.1.4.6 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.1.9.1.4.7 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.1.9.1.4.8 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.1.9.1.4.9 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.1.9.1.4.10 = Timeticks: (4) 0:00:00.04
iso.3.6.1.2.1.25.1.1.0 = Timeticks: (55237) 0:09:12.37
iso.3.6.1.2.1.25.1.2.0 = Hex-STRING: 07 E0 09 13 03 0B 2F 00 2D 04 00
iso.3.6.1.2.1.25.1.3.0 = INTEGER: 393216
iso.3.6.1.2.1.25.1.4.0 = STRING: "BOOT_IMAGE=/boot/vmlinuz-4.6.0-0.bpo.1-amd64
root=LABEL=root ro initrd=/install/initrd.gz quiet 8250.nr_ufacts=2
"
iso.3.6.1.2.1.25.1.5.0 = Gauge32: 2
iso.3.6.1.2.1.25.1.6.0 = Gauge32: 24
iso.3.6.1.2.1.25.1.7.0 = INTEGER: 0
iso.3.6.1.2.1.25.1.7.0 = No more variables left in this MIB View (It is past the
end of the MIB tree)
...

```

To remove the `moxa-snmpp-da-720` package, use the following command:

```

moxa@moxa:~$ sudo dpkg -r moxa-snmpp-da-682a
(Reading database ... 31739 files and directories currently installed.)
Removing moxa-snmpp-da-682a ...
Stopping Moxa SNMP ...
Stopping Moxa SNMP OK
update-rc.d: using dependency based boot sequencing

```

## OpenVPN

### Install the `openvpn`

OpenVPN is a community VPN software. You can install it by this command.

```

moxa@moxa:~$ sudo apt-get install openvpn

```

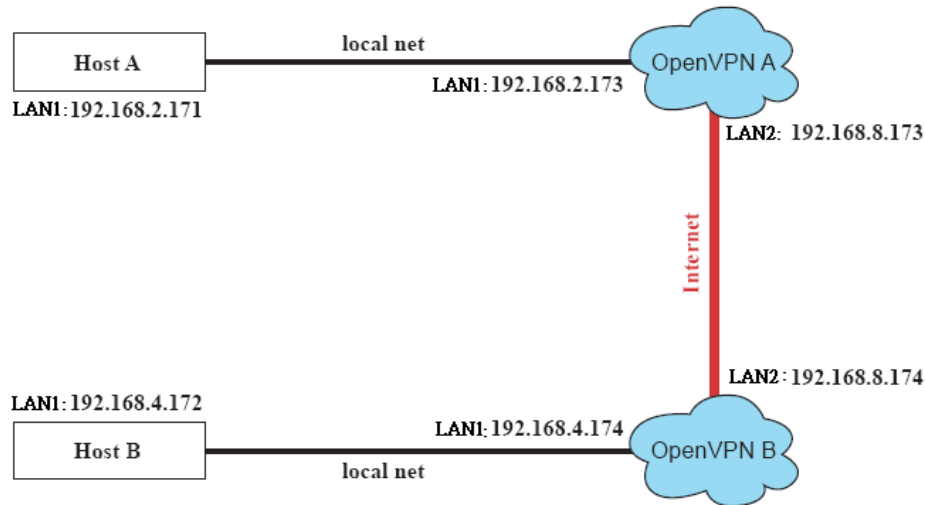
OpenVPN provides two types of tunnels for implementing VPNs: **Routed IP Tunnels** and **Bridged Ethernet Tunnels**.

An Ethernet bridge is used to connect different Ethernet networks together. The Ethernets are bundled into one bigger, "logical" Ethernet. Each Ethernet corresponds to one physical interface (or port) that is connected to the bridge.

On each OpenVPN machine, you should carry out configurations in the `/etc/openvpn` directory, where script files and key files reside. Once established, all operations will be performed in that directory.

## Ethernet Bridging for Private Networks on Different Subnets

1. Set up four machines, as shown in the following diagram:



Host A represents the machine that belongs to OpenVPN A, and Host B represents the machine that belongs to OpenVPN B. The two remote subnets are configured for a different range of IP addresses. When this configuration is moved to a public network, the external interfaces of the OpenVPN machines should be configured for static IPs, or connected to another device (such as a firewall or DSL box) first.

2. Generate a preset shared key by typing the following command:
 

```
# openvpn --genkey --secret secrouter.key
```
3. Copy the file that is generated to the OpenVPN machine:
 

```
# scp /etc/openvpn/secrouter.key 192.168.8.174:/etc/openvpn
```



### ATTENTION

A pre-shared key is located in `/etc/openvpn/secrouter.key`. You can use it for testing purposes. We suggest creating a new key for commercial purposes.

4. On machine OpenVPN A, modify the remote address in configuration file `/etc/openvpn/tap0-br.conf`.

```
# point to the peer
remote 192.168.8.174
dev tap0
port 1194
secret /etc/openvpn/secrouter.key
cipher DES-EDE3-CBC
auth MD5
tun-mtu 1500
tun-mtu-extra 64
ping 40
up /etc/openvpn/tap0-br.sh
#comp-lzo
```

5. Next, modify the routing table in `/etc/openvpn/tap0-br.sh` script.

```
#-----Start-----
#!/bin/sh
# value after "-net" is the subnet behind the remote peer
route add -net 192.168.4.0 netmask 255.255.255.0 dev br0
#-----end-----
```

6. And then configure the bridge interface in **/etc/openvpn/bridge**.

```
#!/bin/bash
# Create global variables
# Define Bridge Interface
br="br0"
# Define list of TAP interfaces to be bridged,
# for example tap="tap0 tap1 tap2".
tap="tap0"
# Define physical ethernet interface to be bridged
# with TAP interface(s) above.
eth="eth1"
eth_ip="192.168.8.173"
eth_netmask="255.255.255.0"
eth_broadcast="192.168.8.255"
#gw="192.168.8.174"
...
```

7. Start the bridge script file to configure the bridge interface:  
**# /etc/openvpn/bridge restart**
8. On machine OpenVPN B, modify the remote address in configuration file  
**/etc/openvpn/tap0-br.conf**.

```
# point to the peer
remote 192.168.8.173
dev tap0
secret /etc/openvpn/secrouter.key
cipher DES-EDE3-CBC
auth MD5
tun-mtu 1500
tun-mtu-extra 64
ping 40
up /etc/openvpn/tap0-br.sh
#comp-lzo
```

9. Next modify the routing table in **/etc/openvpn/tap0-br.sh** script file.

```
#-----Start-----
#!/bin/sh
# value after "-net" is the subnet behind the remote peer
route add -net 192.168.2.0 netmask 255.255.255.0 dev br0
#----- end -----
```

10. Then configure the bridge interface in **/etc/openvpn/bridge**.

```
#!/bin/bash
# Create global variables
# Define Bridge Interface
br="br0"
# Define list of TAP interfaces to be bridged,
# for example tap="tap0 tap1 tap2".
tap="tap0"
# Define physical ethernet interface to be bridged
# with TAP interface(s) above.
eth="eth1"
eth_ip="192.168.8.174"
eth_netmask="255.255.255.0"
```

```
eth_broadcast="192.168.8.255"
#gw="192.168.8.173"
...
```

11. Start the bridge script file to configure the bridge interface.
 

```
# /etc/openvpn/bridge restart
```



### ATTENTION

Select cipher and authentication algorithms by specifying cipher and auth. To see which algorithms are available, type:

```
# openvpn --show-ciphers
# openvpn --show-auths
```

12. Start both OpenVPN peers on machine OpenVPN A and OpenVPN B.
 

```
# openvpn --config /etc/openvpn/tap0-br.conf&
```

If you see the line **Peer Connection Initiated with 192.168.8.173:5000** on each machine, the connection between OpenVPN machines has been established successfully on UDP port 5000.



### ATTENTION

You can create link symbols to start the OpenVPN service at boot time:

```
# ln -sf /etc/init.d/openvpn /etc/rc2.d/S16openvpn
```

To stop the service, you should create these links:

```
# ln -sf /etc/init.d/openvpn /etc/rc0.d/K80openvpn
# ln -sf /etc/init.d/openvpn /etc/rc6.d/K80openvpn
```

13. On each OpenVPN machine, check the routing table by typing the `# route` command

| Destination  | Gateway | Genmsk        | Flags | Metric | Ref | Use | Iface |
|--------------|---------|---------------|-------|--------|-----|-----|-------|
| 192.168.5.0  | 0.0.0.0 | 255.255.255.0 | U     | 0      | 0   | 0   | eth2  |
| 192.168.4.0  | 0.0.0.0 | 255.255.255.0 | U     | 0      | 0   | 0   | br0   |
| 192.168.3.0  | 0.0.0.0 | 255.255.255.0 | U     | 0      | 0   | 0   | eth0  |
| 192.168.30.0 | 0.0.0.0 | 255.255.255.0 | U     | 0      | 0   | 0   | eth3  |
| 192.168.8.0  | 0.0.0.0 | 255.255.255.0 | U     | 0      | 0   | 0   | br0   |

Interface **eth1** and device **tap0** both connect to the bridging interface, and the virtual device **tun** sits on top of **tap0**. This ensures that all traffic coming to this bridge from internal networks connected to interface **eth1** write to the TAP/TUN device that the OpenVPN program monitors. Once the OpenVPN program detects traffic on the virtual device, it sends the traffic to its peer.

14. To create an indirect connection to Host B from Host A, you need to add the following routing item:
 

```
# route add -net 192.168.4.0 netmask 255.255.255.0 dev eth0
```

To create an indirect connection to Host A from Host B, you need to add the following routing item:

```
# route add -net 192.168.2.0 netmask 255.255.255.0 dev eth0
```

Now ping Host B from Host A by typing:

```
# ping 192.168.4.174
```

A successful **ping** command indicates that you have created a VPN system that only allows authorized users from one internal network to access users at the remote site. For this system, all data is transmitted by UDP packets on port 5000 between OpenVPN peers.

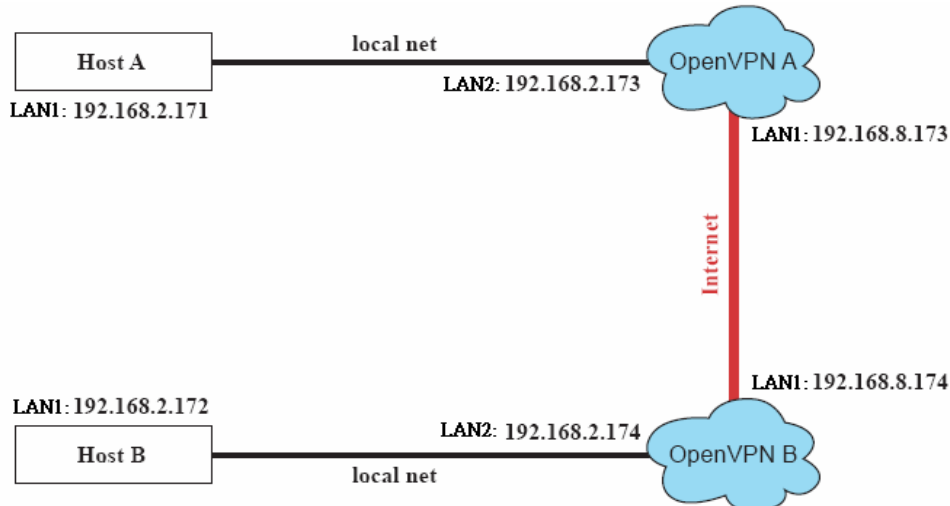


15. To shut down OpenVPN programs, type the command:

```
# killall -TERM openvpn
```

## Ethernet Bridging for Private Networks on the Same Subnet

1. Set up four machines, as shown in the following diagram:

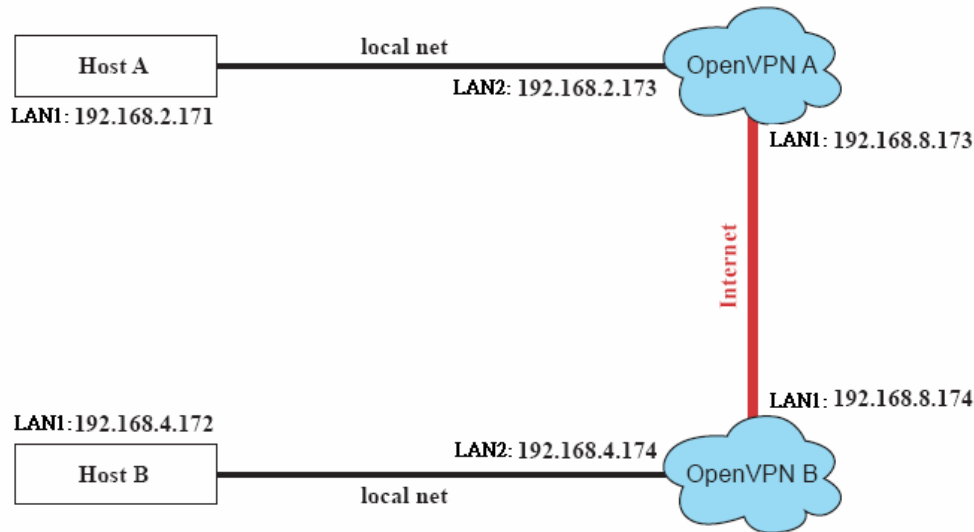


2. The configuration procedure is almost the same as for the previous example. The only difference is that you will need to comment out the parameter **up** in **/etc/openvpn/tap0-br.conf** of OpenVPN A and **/etc/openvpn/tap0-br.conf** of OpenVPN B.

```
# point to the peer
remote 192.168.8.174
dev tap0
secret /etc/openvpn/secrouter.key
cipher DES-EDE3-CBC
auth MD5
tun-mtu 1500
tun-mtu-extra 64
ping 40
#up /etc/openvpn/tap0-br.sh
#comp-lzo
```

## Routed IP

1. Set up four machines, as shown in the following diagram:



2. On machine OpenVPN A, modify the remote address in configuration file `/etc/openvpn/tun.conf`.

```
# point to the peer
remote 192.168.8.174
dev tun
secret /etc/openvpn/secrouter.key
cipher DES-EDE3-CBC
auth MD5
tun-mtu 1500
tun-mtu-extra 64
ping 40
ifconfig 192.168.2.173 192.168.4.174
up /etc/openvpn/tun.sh
-----
```

3. Next, modify the routing table in script file `/etc/openvpn/tun.sh`.

```
#-----Start-----
#!/bin/sh
# value after "-net" is the subnet behind the remote peer
route add -net 192.168.2.0 netmask 255.255.255.0 gw $5
#-----end-----
```

4. On machine OpenVPN B, modify the remote address in configuration file `/etc/openvpn/tun.conf`.

```
# point to the peer
remote 192.168.8.173
dev tun
secret /etc/openvpn/secrouter.key
cipher DES-EDE3-CBC
auth MD5
tun-mtu 1500
tun-mtu-extra 64
ping 40
ifconfig 192.168.4.174 192.168.2.173
up /etc/openvpn/tun.sh
```

And then modify the routing table in script file `/etc/openvpn/tun.sh`.

```
#-----Start-----
#!/bin/sh
# value after "-net" is the subnet behind the remote peer
route add -net 192.168.2.0 netmask 255.255.255.0 gw $5
#-----end-----
```

The first argument of parameter **ifconfig** is the local internal interface and the second argument is the internal interface at the remote peer.

**\$5** is the argument that the OpenVPN program passes to the script file. Its value is the second argument of **ifconfig** in the configuration file.

5. Check the routing table after you run the OpenVPN programs, by typing the **# route** command.

| Destination   | Gateway       | Genmsk          | Flags | Metric | Ref | Use | Iface |
|---------------|---------------|-----------------|-------|--------|-----|-----|-------|
| 192.168.4.174 | *             | 255.255.255.255 | UH    | 0      | 0   | 0   | tun0  |
| 192.168.4.0   | 192.168.4.174 | 255.255.255.0   | UG    | 0      | 0   | 0   | tun0  |
| 192.168.2.0   | *             | 255.255.255.0   | U     | 0      | 0   | 0   | eth1  |
| 192.168.8.0   | *             | 255.255.255.0   | U     | 0      | 0   | 0   | eth0  |

# Programming Guide

---

The following topics are covered in this chapter:

- ❑ **Device API**
- ❑ **RTC (Real Time Clock)**
- ❑ **UART**
- ❑ **Programmable LED, Power Indicator, and Relay control**
- ❑ **WDT (Watch Dog Timer)**
  - Introduction
  - Watchdog Usage
  - How the WDT Works
  - The Watchdog Device IOCTL Commands
  - Examples

## Device API

The DA-720 supports control devices with the **ioctl** system API. The interface is shown below:

```
int ioctl(int d, int request,...);
Input:
  <d> open device node return file handle
  <request> argument in or out
```

Refer to desktop Linux's man page for detailed documentation:

```
#man ioctl
```

## RTC (Real Time Clock)

The device node is located at **/dev/rtc**. The DA-720-LX supports standard Linux simple RTC control. You must include **<linux/rtc.h>**.

1. 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.
```

2. 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** and **/dev/ttyS1**. The DA-720 supports standard Linux terminal I/Os (termios) control functions for serial ports. The **setinterface** utility can be used to configure the RS-232/422/485 mode. By default, the serial interface is set to RS-232.

### setinterface device-node [interface-no]

device-node: /dev/ttySn; n = 0,1,2,...  
interface-no: (See the table below for details.)

| interface-no | Operation Mode          |
|--------------|-------------------------|
| None         | Display current setting |
| 0            | RS-232                  |
| 1            | 2-wire RS-485           |
| 2            | RS-422                  |
| 3            | 4-wire RS-485           |

For example, use the following commands to set **/dev/ttyM0** to **RS-422**:

```
Moxa:~# setinterface /dev/ttyS0 2
Moxa:~# setinterface /dev/ttyS0
Now setting is RS422 interface.
Moxa:~#
```

# Programmable LED, Power Indicator, and Relay control

Digital Output channels can be set to high or low. The channels are controlled by /sys file. The mapping table for programmable LEDs and relay is given below:

| Function | GPIO number | Sysfs file                   |
|----------|-------------|------------------------------|
| pled1    | 355         | /sys/class/gpio/pled1/value  |
| pled2    | 356         | /sys/class/gpio/pled2/value  |
| pled3    | 357         | /sys/class/gpio/pled3/value  |
| pled4    | 358         | /sys/class/gpio/pled4/value  |
| pwrin1   | 353         | /sys/class/gpio/pwrin1/value |
| pwrin2   | 354         | /sys/class/gpio/pwrin2/value |
| relay1   | 359         | /sys/class/gpio/relay1/value |

The Programmable LED, Power Indicator, and Relay can be accessed via /sys/class/gpio/gpioN/value. All the GPIO sysfs files have been exported by /etc/systemd/system/multi-user.target.wants/mx\_gpio\_export.service at boot sequence. You don't need to export the GPIO entry. You can use the `echo` command to control the GPIO directly in a shell program.

To set pled1 to status low:

```
moxa@moxa:~# sudo echo 0 > /sys/class/gpio/pled1/value
```

To set pled1 to status high:

```
moxa@moxa:~# sudo echo 1 > /sys/class/gpio/pled1/value
```

To read the pled1 status:

```
moxa@moxa:~# sudo cat /sys/class/gpio/pled1/value
```

To control the relay:

```
moxa@moxa:~# sudo echo "0" > /sys/class/gpio/relay1/value
```

```
<...Wait relay activated ... >
```

```
moxa@moxa:~# sudo echo "1" > /sys/class/gpio/relay1/value
```

To set the pled1 value in C:

```
sprintf(buf, "/sys/class/gpio/pled%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);
```

To get the value of pwrind1 in C:

```
Sprintf(buf, "/sys/class/gpio/pwrind%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

You can set the acknowledge time from a minimum of 1 sec to a maximum of 1day. The default is 60 seconds. So, if the watchdog daemon crashes, the system will reboot after the timeout period has passed.

### 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 **insserv** command to enable the watchdog function.

```
moxa@moxa:~# sudo insserv -v -d wd_keepalive
insserv: enable service ../init.d/wd_keepalive ->
/etc/init.d/./rc2.d/S01wd_keepalive
insserv: enable service ../init.d/wd_keepalive ->
/etc/init.d/./rc3.d/S01wd_keepalive
insserv: enable service ../init.d/wd_keepalive ->
/etc/init.d/./rc4.d/S01wd_keepalive
insserv: enable service ../init.d/wd_keepalive ->
/etc/init.d/./rc5.d/S01wd_keepalive
insserv: creating .depend.boot
insserv: creating .depend.start
insserv: creating .depend.stop
moxa@moxa:~$ sudo insserv -v -d watchdog
[sudo] password for moxa:
insserv: enable service ../init.d/watchdog -> /etc/init.d/./rc0.d/K01watchdog
```

```

insserv: enable service ../init.d/watchdog -> /etc/init.d/./rc1.d/K01watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/./rc2.d/S23watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/./rc3.d/S23watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/./rc4.d/S23watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/./rc5.d/S23watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/./rc6.d/K01watchdog
insserv: creating .depend.boot
insserv: creating .depend.start
insserv: creating .depend.stop
moxa@Moxa:~$

```

The watchdog configuration file is **/etc/watchdog.conf**. Currently we configure the watchdog daemon to acknowledge the watchdog device in 60 seconds. The **realtime** parameter in the configuration file is used to specify if the watchdog is locked in memory (**yes=lock**) so as to prevent a delay in watchdog acknowledge. You can configure the **watchdog.conf** file to enable the watchdog as per the system requirement.

```

...
watchdog-device = /dev/watchdog
...
interval          = 60
realtime          = yes
priority          = -10
...

```

If you want to remove it from run-level, you can use this command:

```

moxa@Moxa:~# sudo insserv -v -r watchdog
insserv: remove service /etc/init.d/./rc0.d/K01watchdog
insserv: remove service /etc/init.d/./rc1.d/K01watchdog
insserv: remove service /etc/init.d/./rc2.d/S05watchdog
insserv: remove service /etc/init.d/./rc3.d/S05watchdog
insserv: remove service /etc/init.d/./rc4.d/S05watchdog
insserv: remove service /etc/init.d/./rc5.d/S05watchdog
insserv: remove service /etc/init.d/./rc6.d/K01watchdog
insserv: creating .depend.boot
insserv: creating .depend.start
insserv: creating .depend.stop
moxa@Moxa:~# sudo insserv -v -r wd_keepalive
insserv: remove service /etc/init.d/./rc2.d/S01wd_keepalive
insserv: remove service /etc/init.d/./rc3.d/S01wd_keepalive
insserv: remove service /etc/init.d/./rc4.d/S01wd_keepalive
insserv: remove service /etc/init.d/./rc5.d/S01wd_keepalive
insserv: creating .depend.boot
insserv: creating .depend.start
insserv: creating .depend.stop

```



## The Watchdog Device IOCTL Commands

| <b>IOCTL</b> | <b>WDIOC_GETSUPPORT</b>                            |
|--------------|--|
| Description  | This returns the support of the card itself        |
| Input        | None   |
| Output       | (struct watchdog_info *) arg                       |
| Return       | On success, return 0. Otherwise, return < 0 value. |

| <b>IOCTL</b> | <b>WDIOC_GETSTATUS</b>                             |
|--------------|--|
| Description  | This returns the status of the card                |
| Input        | None   |
| Output       | (int *)arg   |
| Return       | On success, return 0. Otherwise, return < 0 value. |

| <b>IOCTL</b> | <b>WDIOC_GETBOOTSTATUS</b>  |
|--------------|---|
| Description  | This returns the status of the card that was reported at boot-up. |
| Input        | None  |
| Output       | (int *)arg)   |
| Return       | On success, return 0. Otherwise, return < 0 value.                |

| <b>IOCTL</b> | <b>WDIOC_SETOPTIONS</b>  |
|--------------|--|
| Description  | This lets you set the options of the card. You can either enable or disable the card this way. |
| Input        | None   |
| Output       | (int *)arg)  |
| Return       | On success, return 0. Otherwise, return < 0 value.   |

| <b>IOCTL</b> | <b>WDIOC_KEEPLIVE</b>                                      |
|--------------|--|
| Description  | This pings the card to tell it not to reset your computer. |
| Input        | None   |
| Output       | None   |
| Return       | On success, return 0. Otherwise, return < 0 value.         |

| <b>IOCTL</b> | <b>WDIOC_SETTIMEOUT</b>                            |
|--------------|--|
| Description  | Set the watchdog timeout                           |
| Input        | arg: 1 ~ 255 seconds                               |
| Output       | None   |
| Return       | On success, return 0. Otherwise, return < 0 value. |

| <b>IOCTL</b> | <b>WDIOC_GETTIMEOUT</b>                            |
|--------------|--|
| Description  | Get the current watchdog timeout.                  |
| Input        | None   |
| Output       | arg: 1 ~ 255 seconds                               |
| Return       | On success, return 0. Otherwise, return < 0 value. |

## Examples

The example file **watchdog-simple.c** acks the watchdog every 10 seconds.

```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <fcntl.h>

int main(void)
{
    int fd = open("/dev/watchdog", O_WRONLY);
    int ret = 0;
    if (fd == -1) {
        perror("watchdog");
        exit(EXIT_FAILURE);
    }
    while (1) {
        ret = write(fd, "\0", 1);
        if (ret != 1) {
            ret = -1;
            break;
        }
        sleep(10);
    }
    close(fd);
    return ret;
}
```

## System Recovery

---

The DA-720 are installed with the Embedded Linux operating system, which is located in the Flash DOM (CompactFlash card) shipped with the DA-720-LX 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 recover the Linux operating system.

The following topics are covered in this chapter:

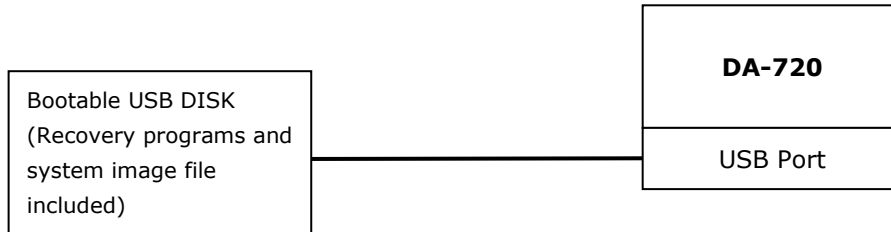
- **Recovery Environment**
- **Recovery Procedure**

# Recovery Environment

The recovery environment includes the DA-720 embedded computer and a bootable USB disk with the recovery programs and system image file.

## Hardware

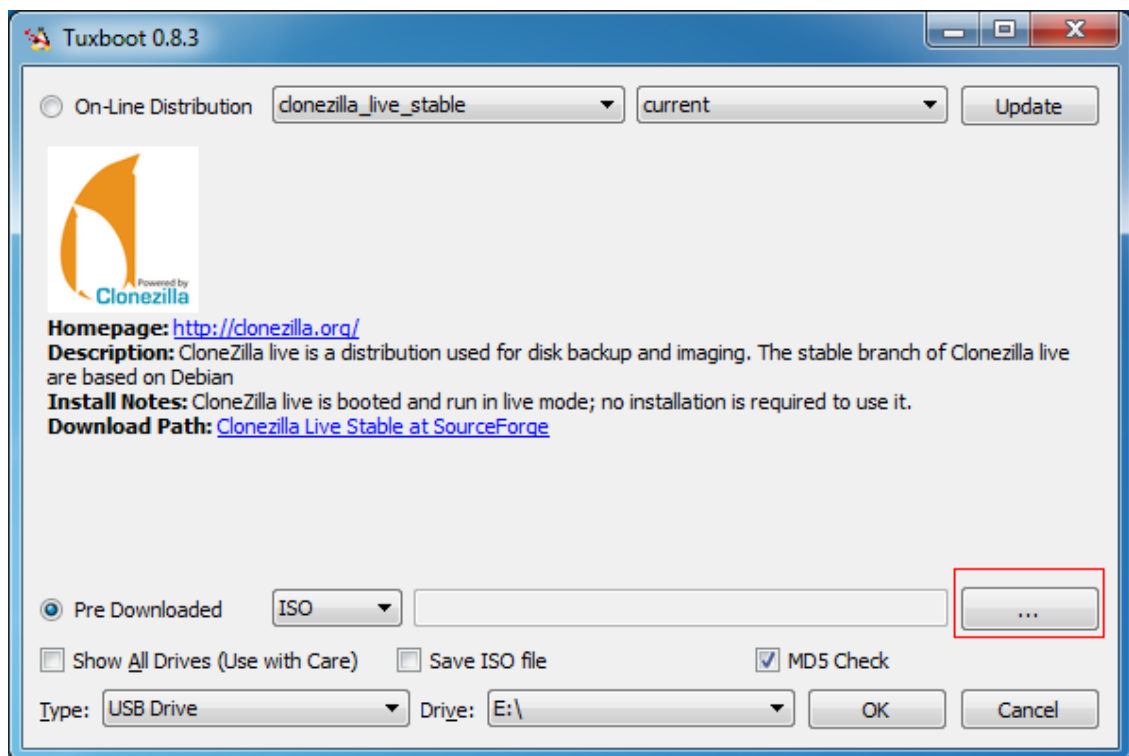
The hardware used includes a PC, a DA-720 computer and a USB disk with the recovery programs. **(Note: The USB disk should be at least 2GB.)**



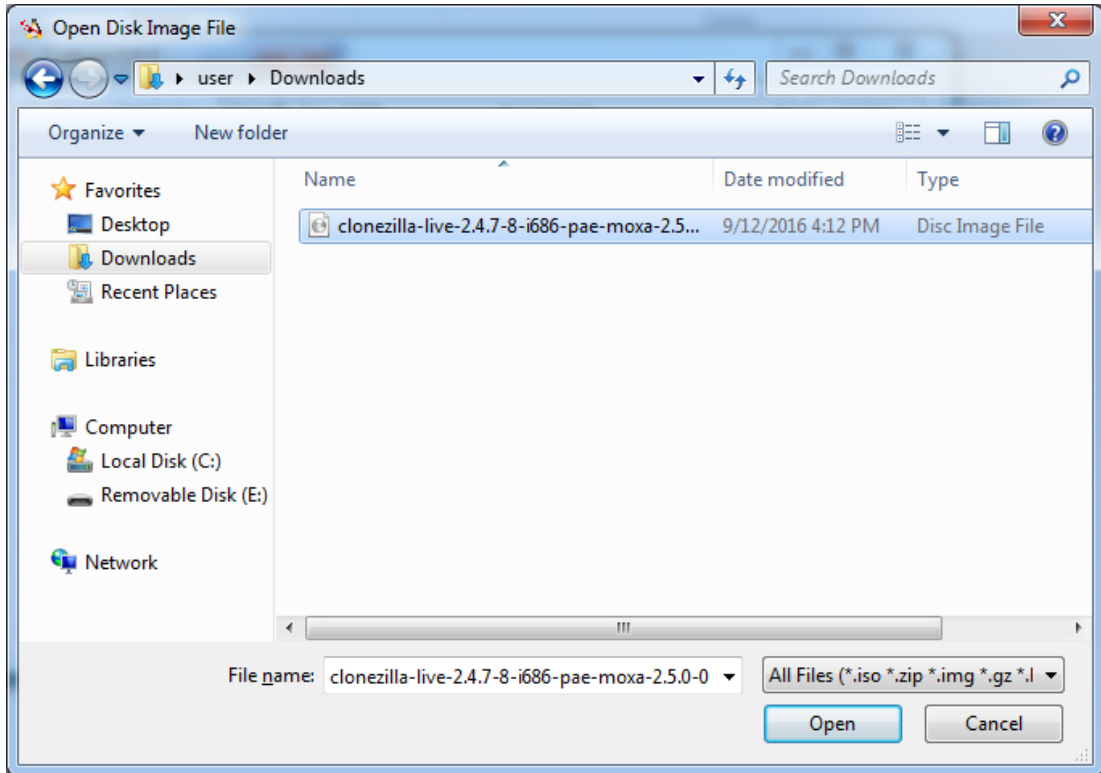
# Recovery Procedure

## Step 1: Prepare your USB drive

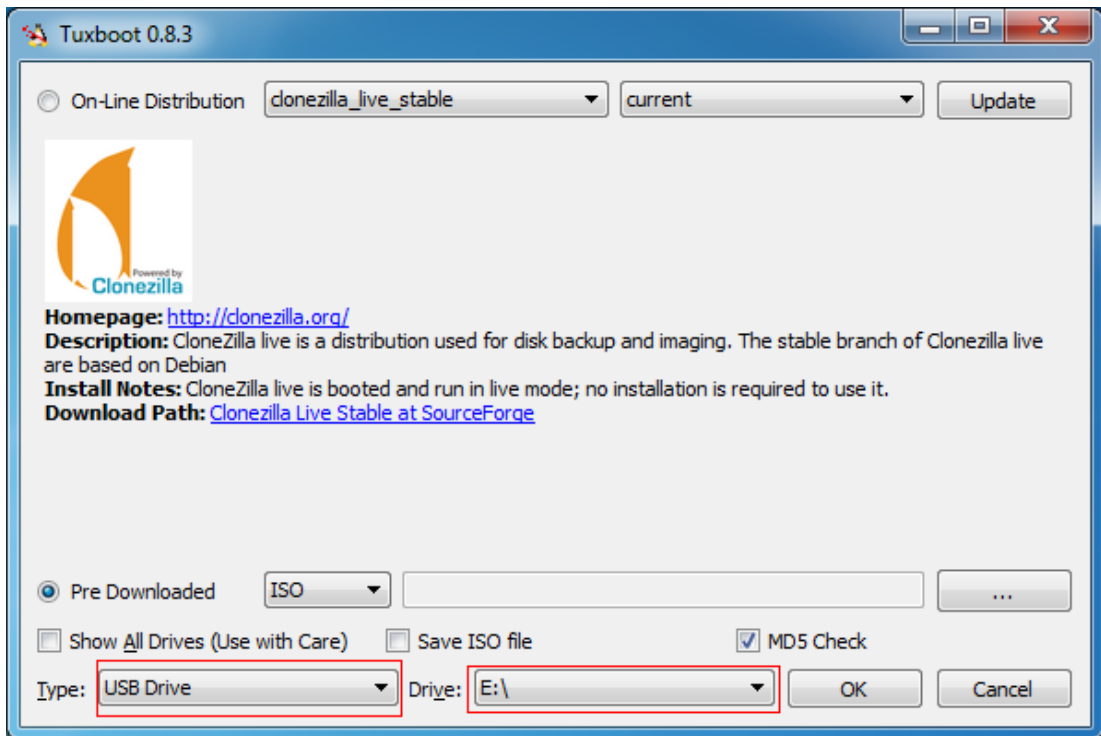
1. Execute **tuxboot-0.8.3.exe** from the **utility\_tools/CloneZilla** folder on the Software CD, select **Pre Download**, and then click "..."



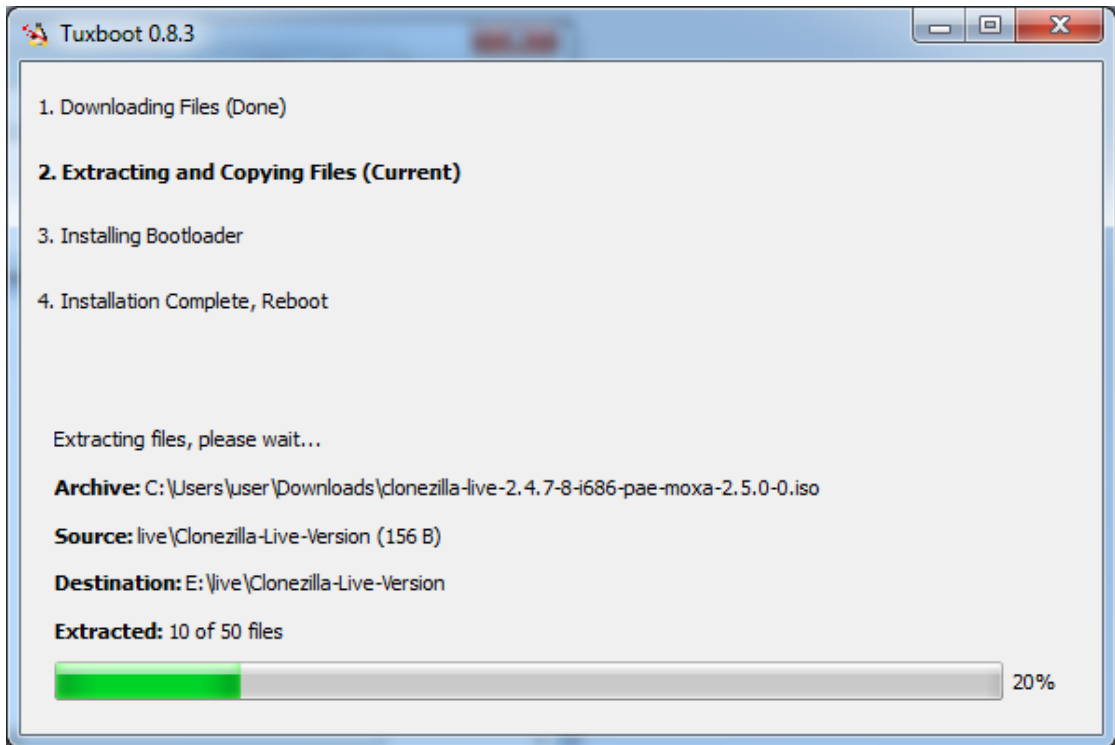
- 2. Select the ISO file in the directory of <Software DVD> \Recovery\DA-720-LX\_Recovery\CloneZilla\



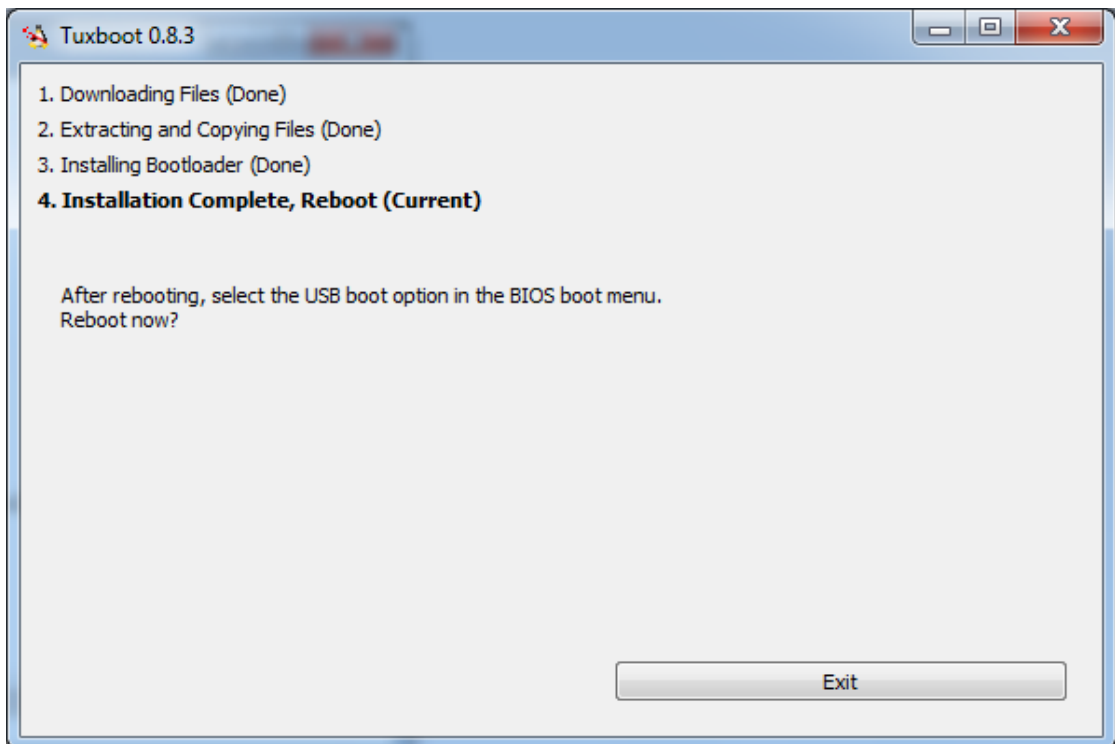
- 3. Select **USB Drive** type, select a **Drive**, and then click **OK** to continue.



- The boot files will be copied to your USB drive.



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

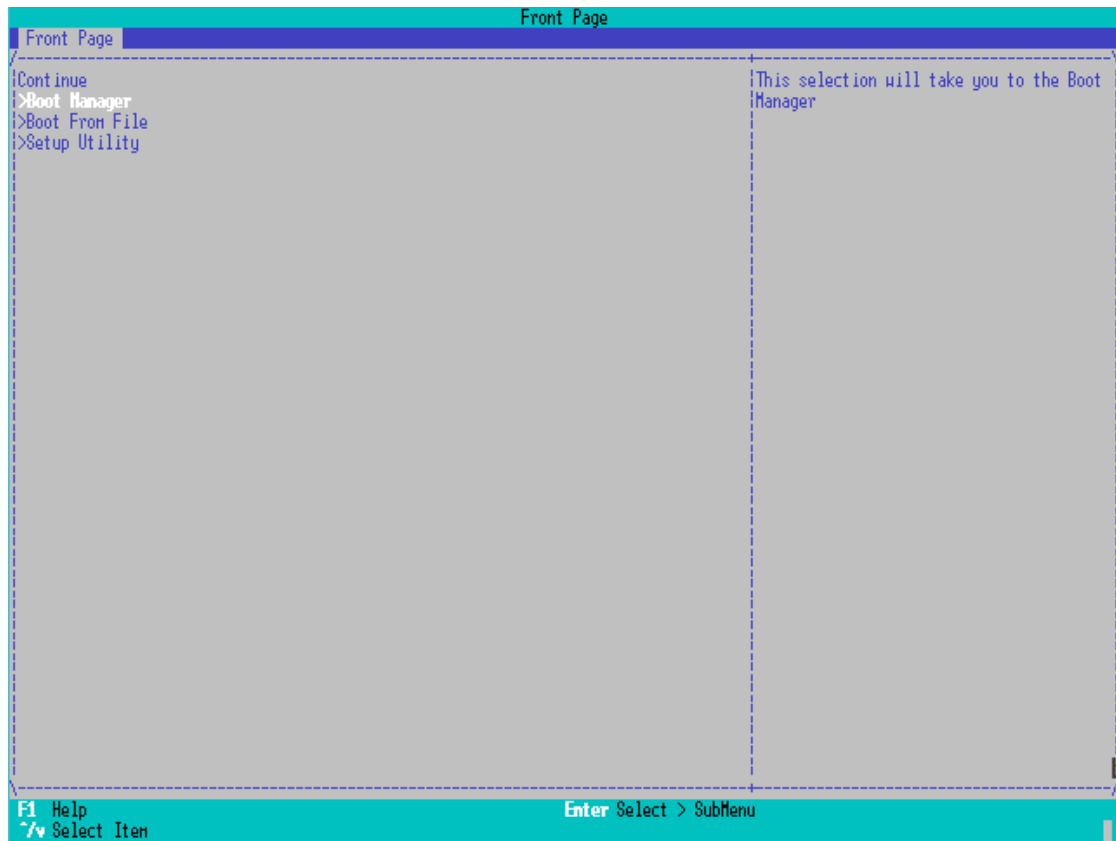


- Manually copy the **os\_image** directory from the <Software DVD> \Recovery\DA-720-LX\_Recovery\CloneZilla\ folder on the Software DVD to **\home\partimag\** on the USB drive.

## Step 2: Boot from USB Disk

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

1. Turn on the computer and press **F2**. Select **Boot Manager** in the following screen:

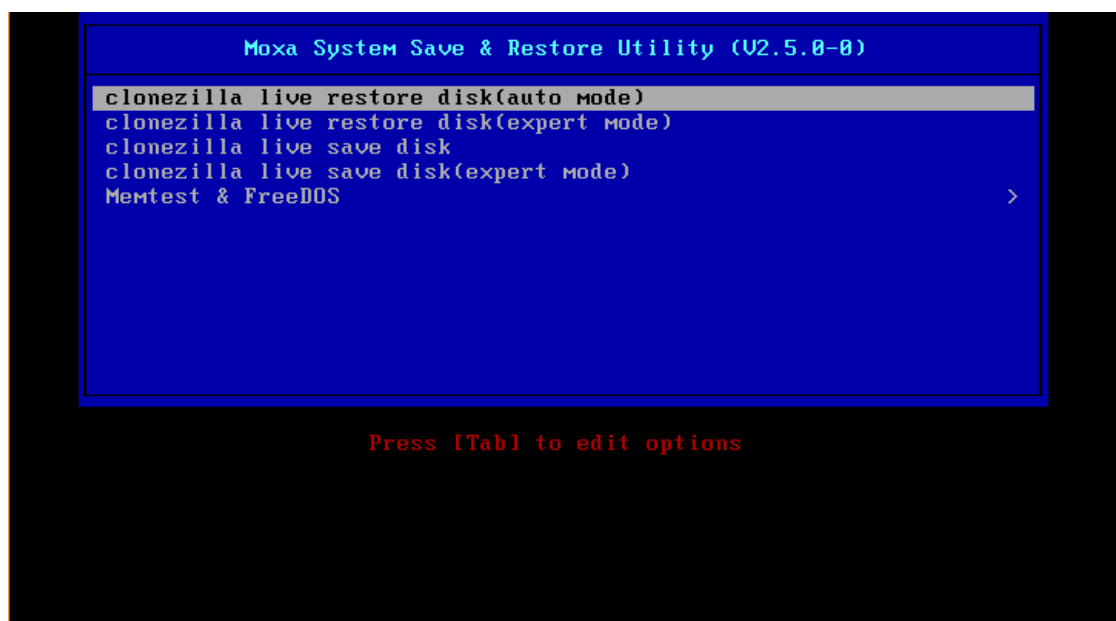


2. Select **Target USB Disk**. Press **Enter** to continue.

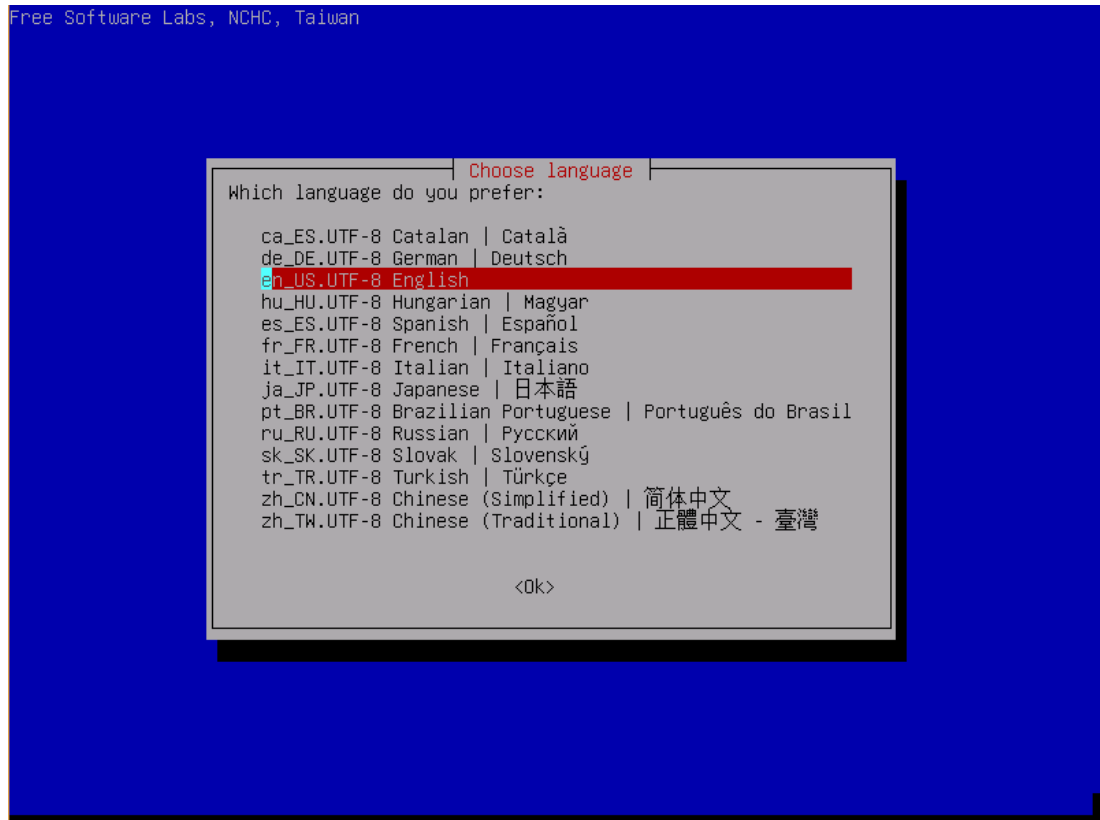
## Step 3: Restore the system from USB drive

Connect the USB disk to any of the DA-720's USB ports and then reboot the computer. The system will boot from the USB disk and the **Moxa System Save and Restore Utility** window is displayed.

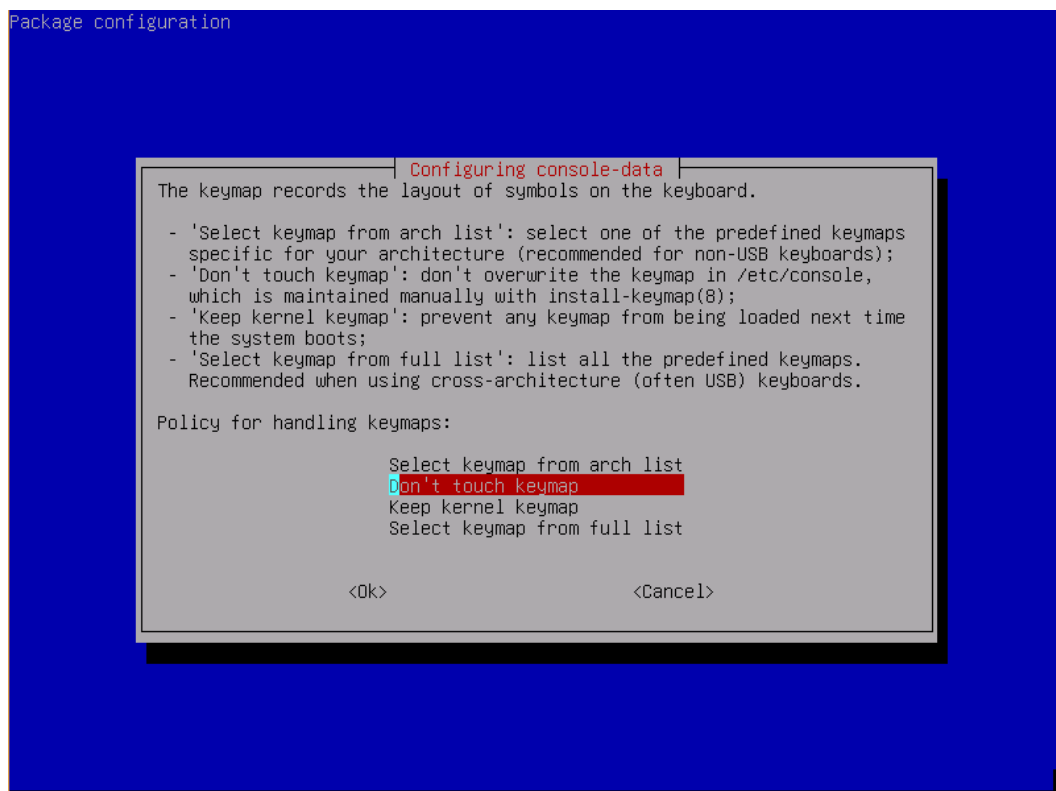
1. Select **clonezilla live restore disk**.



## 2. Select a language



## 3. Select a policy for handling keymaps.











## DA-720 Expansion Module

---

The following topics are covered in this chapter:

- ❑ **Installing the HSR/PRP Module Utility**

- ❑ **Linux Platform**

- Online installation

- Offline Installation

- ❑ **The HSR/PRP Module Utility**

- ❑ **Linux Platform**

# Installing the HSR/PRP Module Utility

## Linux Platform

1. Install the HSR/PRP module on Moxa's embedded computer.

There are two ways to install the HSR/PRP utility and status daemon on Moxa's embedded computers. One way is to install it from Moxa's APT server. Another is off-line installation. You can choose one of these methods to install the HSR/PRP packages on Moxa's embedded computers.

2. Add `acpi_enforce_resources=lax` in the `grub` option

```
root@Moxa:~# sudo vi /etc/default/grub
...
# add acpi_enforce_resources=lax to GRUB_CMDLINE_LINUX_DEFAULT line
GRUB_CMDLINE_LINUX_DEFAULT="quiet 8250.nr_uarts=2 video=DP-1:1024x768
acpi_enforce_resources=lax"
root@Moxa:~# sudo update-grub
root@Moxa:~# sudo reboot
```

3. Install the packages required for the HSR/PRP module utility.

## Online installation

- a. Update `/etc/apt/sources.list` with Moxa's apt server

```
root@Moxa:~# sudo vi /etc/apt/sources.list
...
# Moxa debian package server
deb http://debian.moxa.com/debian jessie main
```

- b. Install the HSR/PRP package from Moxa' apt server
- c. Update the package list

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

- d. Check the `mxhsrprp` package

```
root@Moxa:~# sudo apt-cache search mxhsrprp
mxhsrprp-da720 - Moxa HSR/PRP Card Utility for DA-720, DA-682B
```

- e. Install the HSR/PRP utility and status daemon

```
root@Moxa:~# sudo apt-get install mxhsrprp-da720
```

- f. After that, the HSR/PRP utility and status daemon should be installed. The status daemon should be running with default configure.

```
root@Moxa:~# ps -aux | grep mxhsrprpd
root      2000  1.2  0.0 88332  96 ?        S1   Oct30 17:46
/usr/local/bin/mxhsrprpd -b /dev/i2c-0 -t 2 -B
```

## Offline Installation

- a. Upload or copy the private key and packages to target da720-mxhsrprp\_1.0.0\_amd64.deb
- b. Install the HSR/PRP utility and status daemon

```
root@Moxa:/home/moxa/DebianServer# dpkg -i da720-mxhsrprp_1.0.0_amd64.deb
```

- c. After that, the HSR/PRP utility and status daemon should be installed. The status daemon should be running with default configure.

```
root@Moxa:~# ps -aux | grep mxhsrprpd
root      2000  1.2  0.0  88332   96 ?        Sl    Oct30  17:46
/usr/local/bin/mxhsrprpd -b /dev/i2c-0 -t 2 -B
```

## The HSR/PRP Module Utility

### Linux Platform

The HSR/PRP module utility is locate at /usr/local/bin.

| Program                | Usage  |
|------------------------|--|
| <b>mxhsrprpd</b>       | Used to set the HSR or PRP mode and correct the HSR/PRP protocol statistics.   |
| <b>mxprpinfo</b>       | Depending on the setting in the mxhsrprpd, this program is used to either get HSR/PRP protocol statistics or set the HSR/PRP mode. |
| <b>chk-mx-prp-card</b> | Reports on the current HSR/PRP module name on the Ethernet   |
| <b>mxprpsuper</b>      | Sends the HSR/PRP supervision frame Moxa HSR/PRP module.   |
| <b>mxprpalarm</b>      | This program is called by mxhsrprpd when the Link status has changed. The action should be modified by user.                       |

### mxhsrprpd

This HSR/PRP module status daemon is used to set the HSR or PRP mode and correct the HSR/PRP protocol statistics.

```
root@Moxa:~# mxhsrprpd -h
Usage:
  -h: Show this information.
  -B: Run daemon in the background
  -b: SMBUS device, default is /dev/i2c-0
  -t: HSR/PRP Status update period. Default is 2 second.
  -m: configure to prp or hsr mode, default is prp mode.
      The argurement is [index]:[mode]
      index range from 0~7, mode 0 is prp, mode 1 is hsr.
  Ex: Set card 0 to hsr mode, card 1 to prp mode.
```

Usage example: Set status update interval to 2 seconds and set Card 0 to HSR mode and Card 1 to PRP mode.

```
root@Moxa:~# mxhsrprpd -t 2 -m 0:1,1:0
```

### Configuring the HSR/PRP Status Daemon

The HSR/PRP status daemon is managed by the `/etc/init.d/mx_prp.sh` script. The default configuration, `MX_PRP_OPTS` is available at `/etc/init.d/mx_prp.sh`.

```
root@Moxa:~# sudo vi /etc/init.d/mx_prp.sh
...
MX_PRP_OPTS="-t 2 -B"
...
```

After you configure it, restart the daemon as follows:

```
root@Moxa:~# sudo /etc/init.d/mx_prp.sh restart
```

## mxprpinfo

This program is used to get the HSR/PRP protocol statistics or set the HSR/PRP mode.

```
root@Moxa:~# mxprpinfo -h
Usage:
  -h: Show this information.
  -l: Show link status.
  -s: Show link speed.
  -c: Show counter.
  -m: Show current mode. 0 is PRP, 1 is HSR.
  -p: Set current mode. 0 is PRP, 1 is HSR.
  -i: Specify card index, the range is 0~7
```

Usage example: Get the mode, counters, and link status of the HSR/PRP module.

```
root@Moxa:/home/moxa# mxprpinfo -l -c -m
Mode:
index:1
mode:0

Link Status:
index:1
link_status_i:1
link_status_a:1
link_status_b:1

Counters:
index:1

port: interlink
rx_good_octets:192
...

port: lana
rx_good_octets:2516630
...

port: lanb
rx_good_octets:2516630
...
```

Usage example: Set the PRP mode on card index 1

```
root@moxa:/home/moxa# mxprpinfo -i 1 -p 0
Set HSR/PRP mode:
index:1, curr: 0, new:0
```

## chk-mx-prp-card

This program is used to get the Ethernet interface name of the Moxa HSR/PRP module.

```
root@moxa:/home/moxa# chk-mx-prp-card
Searching Moxa HSR/PRP card...
eth14 - pcibus id is 0000:13:00.0
```

## mxprpsuper

This program is used to send the HSR/PRP supervision frame. You can get the interface name using the chk-mx-prp-card program.

```
root@moxa:/home/moxa# mxprpsuper
This program use to send supervision frame to Moxa HSR/PRP Card.

Usage:
  -h: Show this information.
  -t: send HSR/PRP supervision frame period.
      Default is 2 second.
  -m: send HSR or PRP supervision frame mode.
      0 is PRP; 1 is HSR. Default is 0.
  -i: interface name, Ex.: eth0.
      Execute chk-mx-prp-card to list supported interface.
  -a: Destination MAC address last byte.
      The range is 00~FF. Default is 00
```

Usage example: Send the PRP supervision frame to eth14 in the time period of 2 seconds. The program should run in the background.

```
root@moxa:/home/moxa# mxprpsuper -t 2 -m 0 -i eth14 &
```

## mxprpalarm

This script is called by the mxhsrprpd program when the HSR/PRP link status changes. The script can be modified as necessary.

```
root@moxa:/home/moxa# vi /usr/local/bin/mxprpalarm
#!/bin/bash
#
# This shell script will call by mxhsrprpd.
# You can design custom action in this script. Please search 'TODO'
#
# $1 - Card index, 0~7.
# $2 - Event name
#      li: inter link status
#      la: lan A link status
```



```
#         lb: lab B link status
# $3 - Event argument
#

function run_alarm_link_down()
{
    echo "Card $1 $2 Link down"
    ...
}

function run_alarm_link_up()
{
    echo "Card $1 $2 Link up"
    ...
}

#
# Process inter link status event
#
if [ x"$2" = x"li" ]; then
    #TODO: do something when event occur
    if [ x"$3" = x"0" ]; then
        run_alarm_link_down $1 "Interlink"
    elif [ x"$3" = x"1" ]; then
        run_alarm_link_up $1 "Interlink"
    fi
elif [ x"$2" = x"la" ]; then
#
# Process Lan A link status event
#
    #TODO: do something when event occur
    if [ x"$3" = x"0" ]; then
        run_alarm_link_down $1 "LAN A"
    elif [ x"$3" = x"1" ]; then
        run_alarm_link_up $1 "LAN A"
    fi
elif [ x"$2" = x"lb" ]; then
#
# Process Lan B link status event
#
    #TODO: do something when event occur
    if [ x"$3" = x"0" ]; then
        run_alarm_link_down $1 "LAN B"
    elif [ x"$3" = x"1" ]; then
        run_alarm_link_up $1 "LAN B"
    fi
fi
```

# A

## Software Components

---

| Name              | Version               | Description   |
|-------------------|-----------------------|---|
| acl               | 2.2.52-2              | Access control list utilities                                   |
| acpi              | 1.7-1                 | displays information on ACPI devices                            |
| acpi-support-base | 0.142-6               | scripts for handling base ACPI events such as the power button  |
| acpid             | 1:2.0.23-2            | Advanced Configuration and Power Interface event daemon         |
| adduser           | 3.113+nmu3            | add and remove users and groups                                 |
| anacron           | 2.3-23                | cron-like program that doesn't go by time                       |
| apache2           | 2.4.10-10+deb8u5      | Apache HTTP Server  |
| apache2-bin       | 2.4.10-10+deb8u5      | Apache HTTP Server (modules and other binary files)             |
| apache2-data      | 2.4.10-10+deb8u5      | Apache HTTP Server (common files)                               |
| apache2-utils     | 2.4.10-10+deb8u5      | Apache HTTP Server (utility programs for web servers)           |
| apt               | 1.0.9.8.3             | Command-line package manager                                    |
| apt-listchanges   | 2.85.13+nmu1          | package change history notification tool                        |
| apt-utils         | 1.0.9.8.3             | package management related utility programs                     |
| aptitude          | 0.6.11-1+b1           | terminal-based package manager                                  |
| aptitude-common   | 0.6.11-1              | architecture independent files for the aptitude package manager |
| aptitude-doc-en   | 0.6.11-1              | English manual for aptitude, a terminal-based package manager   |
| at                | 3.1.16-1              | Delayed job execution and batch processing                      |
| avahi-autoipd     | 0.6.31-5              | Avahi IPv4LL network address configuration daemon               |
| base-files        | 8+deb8u5              | Debian base system miscellaneous files                          |
| base-passwd       | 3.5.37                | Debian base system master password and group files              |
| bash              | 4.3-11+b1             | GNU Bourne Again SHell  |
| bash-completion   | 1:2.1-4               | programmable completion for the bash shell                      |
| bc                | 1.06.95-9             | GNU bc arbitrary precision calculator language                  |
| bind9-host        | 1:9.9.5.dfsg-9+deb8u6 | Version of 'host' bundled with BIND 9.X                         |
| binutils          | 2.25-5                | GNU assembler, linker and binary utilities                      |
| bluetooth         | 5.23-2                | Bluetooth support   |
| bluez             | 5.23-2+b1             | Bluetooth tools and daemons                                     |
| bridge-utils      | 1.5-9                 | Utilities for configuring the Linux Ethernet bridge             |
| bsd-mailx         | 8.1.2-0.20141216cvs-2 | simple mail user agent  |
| bsdmainutils      | 9.0.6                 | collection of more utilities from FreeBSD                       |
| bsdutils          | 1:2.25.2-6            | basic utilities from 4.4BSD-Lite                                |
| build-essential   | 11.7                  | Informational list of build-essential packages                  |
| busybox           | 1:1.22.0-9+deb8u1     | Tiny utilities for small and embedded systems                   |
| bzip2             | 1.0.6-7+b3            | high-quality block-sorting file compressor - utilities          |

| Name                   | Version               | Description  |
|------------------------|-----------------------|--|
| ca-certificates        | 20141019+deb8u1       | Common CA certificates                                       |
| console-setup          | 1.123                 | console font and keymap setup program                        |
| console-setup-linux    | 1.123                 | Linux specific part of console-setup                         |
| coreutils              | 8.23-4                | GNU core utilities   |
| cpio                   | 2.11+dfsg-4.1+deb8u1  | GNU cpio -- a program to manage archives of files            |
| cpp                    | 4:4.9.2-2             | GNU C preprocessor (cpp)                                     |
| cpp-4.9                | 4.9.2-10              | GNU C preprocessor   |
| crda                   | 3.13-1                | wireless Central Regulatory Domain Agent                     |
| cron                   | 3.0pl1-127+deb8u1     | process scheduling daemon                                    |
| da720-misc             | 1.0.0                 | Moxa da720 Led/Relay/On Board Serial Interface device driver |
| da720-mxser            | 1.0.0                 | mxser driver for DA-720 series                               |
| da720-setinterface     | 1.0.0                 | utility for mxser  |
| da720-watchdog         | 1.0.0                 | Moxa da720 watchdog device driver                            |
| dash                   | 0.5.7-4+b1            | POSIX-compliant shell  |
| dbus                   | 1.8.20-0+deb8u1       | simple inter process messaging system (daemon and utilities) |
| dc                     | 1.06.95-9             | GNU dc arbitrary precision reverse-polish calculator         |
| debconf                | 1.5.56                | Debian configuration management system                       |
| debconf-i18n           | 1.5.56                | full internationalization support for debconf                |
| debian-archive-keyring | 2014.3                | GnuPG archive keys of the Debian archive                     |
| debian-faq             | 5.0.3                 | Debian Frequently Asked Questions                            |
| debiannutils           | 4.4+b1                | Miscellaneous utilities specific to Debian                   |
| dictionaries-common    | 1.23.17               | spelling dictionaries - common utilities                     |
| diffutils              | 1:3.3-1+b1            | File comparison utilities                                    |
| discover               | 2.1.2-7               | hardware identification system                               |
| discover-data          | 2.2013.01.11          | Data lists for Discover hardware detection system            |
| dmidecode              | 2.12-3                | SMBIOS/DMI table decoder                                     |
| dmsetup                | 2:1.02.90-2.2+deb8u1  | Linux Kernel Device Mapper userspace library                 |
| dnsutils               | 1:9.9.5.dfsg-9+deb8u6 | Clients provided with BIND                                   |
| doc-debian             | 6.2                   | Debian Project documentation and other documents             |
| docutils-common        | 0.12+dfsg-1           | text processing system for reStructuredText - common data    |
| docutils-doc           | 0.12+dfsg-1           | text processing system for reStructuredText - documentation  |
| dpkg                   | 1.17.27               | Debian package management system                             |
| dpkg-dev               | 1.17.27               | Debian package development tools                             |
| e2fslibs:amd64         | 1.42.12-1.1           | ext2/ext3/ext4 file system libraries                         |
| e2fsprogs              | 1.42.12-1.1           | ext2/ext3/ext4 file system utilities                         |
| easy-rsa               | 2.2.2-1               | Simple shell based CA utility                                |
| emacsen-common         | 2.0.8                 | Common facilities for all emacsen                            |
| ethtool                | 1:3.16-1              | display or change Ethernet device settings                   |
| fakeroot               | 1.20.2-1              | tool for simulating superuser privileges                     |
| file                   | 1:5.22+15-2+deb8u1    | Determines file type using "magic" numbers                   |
| findutils              | 4.4.2-9+b1            | utilities for finding files--find, xargs                     |
| firmware-linux-free    | 3.3                   | Binary firmware for various drivers in the Linux kernel      |
| firmware-misc-nonfree  | 20160110-1~bpo8+1     | Binary firmware for various drivers in the Linux kernel      |
| fontconfig             | 2.11.0-6.3            | generic font configuration library - support binaries        |

| Name                | Version               | Description  |
|---------------------|-----------------------|--|
| fontconfig-config   | 2.11.0-6.3            | generic font configuration library - configuration                         |
| fonts-dejavu-core   | 2.34-1                | Vera font family derivate with additional characters                       |
| g++                 | 4:4.9.2-2             | GNU C++ compiler   |
| g++-4.9             | 4.9.2-10              | GNU C++ compiler   |
| gcc                 | 4:4.9.2-2             | GNU C compiler   |
| gcc-4.8-base:amd64  | 4.8.4-1               | GCC, the GNU Compiler Collection (base package)                            |
| gcc-4.9             | 4.9.2-10              | GNU C compiler   |
| gcc-4.9-base:amd64  | 4.9.2-10              | GCC, the GNU Compiler Collection (base package)                            |
| geoip-database      | 20150317-1            | IP lookup command line tools that use the GeoIP library (country database) |
| gettext-base        | 0.19.3-2              | GNU Internationalization utilities for the base system                     |
| gnupg               | 1.4.18-7+deb8u1       | GNU privacy guard - a free PGP replacement                                 |
| gnupg-agent         | 2.0.26-6              | GNU privacy guard - password agent   |
| gnupg2              | 2.0.26-6              | GNU privacy guard - a free PGP replacement (new v2.x)                      |
| gpgv                | 1.4.18-7+deb8u1       | GNU privacy guard - signature verification tool                            |
| grep                | 2.20-4.1              | GNU grep, egrep and fgrep  |
| groff-base          | 1.22.2-8              | GNU troff text-formatting system (base system components)                  |
| grub-common         | 2.02~beta2-22+deb8u1  | GRand Unified Bootloader (common files)                                    |
| grub-pc             | 2.02~beta2-22+deb8u1  | GRand Unified Bootloader, version 2 (PC/BIOS version)                      |
| grub-pc-bin         | 2.02~beta2-22+deb8u1  | GRand Unified Bootloader, version 2 (PC/BIOS binaries)                     |
| grub2-common        | 2.02~beta2-22+deb8u1  | GRand Unified Bootloader (common files for version 2)                      |
| gzip                | 1.6-4                 | GNU compression utilities  |
| hdparm              | 9.43-2                | tune hard disk parameters for high performance                             |
| hicolor-icon-theme  | 0.13-1                | default fallback theme for FreeDesktop.org icon themes                     |
| host                | 1:9.9.5.dfsg-9+deb8u6 | Transitional package   |
| hostname            | 3.15                  | utility to set/show the host name or domain name                           |
| iamerican           | 3.3.02-6              | American English dictionary for ispell (standard version)                  |
| ibritish            | 3.3.02-6              | British English dictionary for ispell (standard version)                   |
| ienglish-common     | 3.3.02-6              | Common files for British and American ispell dictionaries                  |
| ifenslave           | 2.6                   | configure network interfaces for parallel routing (bonding)                |
| ifstat              | 1.1-8+b1              | InterFace STATistics Monitoring  |
| ifupdown            | 0.7.53.1              | high level tools to configure network interfaces                           |
| info                | 5.2.0.dfsg.1-6        | Standalone GNU Info documentation browser                                  |
| init                | 1.22                  | System-V-like init utilities - metapackage                                 |
| init-system-helpers | 1.22                  | helper tools for all init systems  |
| initramfs-tools     | 0.120+deb8u2          | generic modular initramfs generator  |
| initscripts         | 2.88dsf-59            | scripts for initializing and shutting down the system                      |
| insserv             | 1.14.0-5              | boot sequence organizer using LSB init.d script dependency information     |
| install-info        | 5.2.0.dfsg.1-6        | Manage installed documentation in info format                              |

| Name                          | Version               | Description  |
|-------------------------------|-----------------------|--|
| installation-report           | 2.58                  | system installation report   |
| iproute                       | 1:3.16.0-2            | transitional dummy package for iproute2                                |
| iproute2                      | 3.16.0-2              | networking and traffic control tools                                   |
| ipsec-tools                   | 1:0.8.2+20140711-2+de | IPsec utilities  |
| iptables                      | 1.4.21-2+b1           | administration tools for packet filtering and NAT                      |
| iputils-ping                  | 3:20121221-5+b2       | Tools to test the reachability of network hosts                        |
| irqbalance                    | 1.1.0-2~bpo8+1        | Daemon to balance interrupts for SMP systems                           |
| isc-dhcp-client               | 4.3.1-6+deb8u2        | DHCP client for automatically obtaining an IP address                  |
| isc-dhcp-common               | 4.3.1-6+deb8u2        | common files used by all of the isc-dhcp packages                      |
| isc-dhcp-server               | 4.3.1-6+deb8u2        | ISC DHCP server for automatic IP address assignment                    |
| iso-codes                     | 3.57-1                | ISO language, territory, currency, script codes and their translations |
| ispell                        | 3.3.02-6              | International Ispell (an interactive spelling corrector)               |
| iw                            | 3.17-1                | tool for configuring Linux wireless devices                            |
| kbd                           | 1.15.5-2              | Linux console font and keytable utilities                              |
| keyboard-configuration        | 1.123                 | system-wide keyboard preferences                                       |
| klibc-utils                   | 2.0.4-2               | small utilities built with klibc for early boot                        |
| kmod                          | 18-3                  | tools for managing Linux kernel modules                                |
| krb5-locales                  | 1.12.1+dfsg-19+deb8u2 | Internationalization support for MIT Kerberos                          |
| laptop-detect                 | 0.13.7                | attempt to detect a laptop   |
| less                          | 458-3                 | pager program similar to more  |
| libacl1:amd64                 | 2.2.52-2              | Access control list shared library                                     |
| libalgorithm-c3-perl          | 0.09-1                | Perl module for merging hierarchies using the C3 algorithm             |
| libalgorithm-diff-perl        | 1.19.02-3             | module to find differences between files                               |
| libalgorithm-diff-xs-perl     | 0.04-3+b1             | module to find differences between files (XS accelerated)              |
| libalgorithm-merge-perl       | 0.08-2                | Perl module for three-way merge of textual data                        |
| libapache2-mod-php5           | 5.6.24+dfsg-0+deb8u1  | server-side, HTML-embedded scripting language (Apache 2 module)        |
| libapr1:amd64                 | 1.5.1-3               | Apache Portable Runtime Library  |
| libaprutil1:amd64             | 1.5.4-1               | Apache Portable Runtime Utility Library                                |
| libaprutil1-dbd-sqlite3:amd64 | 1.5.4-1               | Apache Portable Runtime Utility Library - SQLite3 Driver               |
| libaprutil1-ldap:amd64        | 1.5.4-1               | Apache Portable Runtime Utility Library - LDAP Driver                  |
| libapt-inst1.5:amd64          | 1.0.9.8.3             | deb package format runtime library                                     |
| libapt-pkg4.12:amd64          | 1.0.9.8.3             | package management runtime library                                     |
| libarchive-extract-perl       | 0.72-1                | generic archive extracting module                                      |
| libasan1:amd64                | 4.9.2-10              | AddressSanitizer -- a fast memory error detector                       |
| libasprintf0c2:amd64          | 0.19.3-2              | GNU library to use fprintf and friends in C++                          |
| libassuan0:amd64              | 2.1.2-2               | IPC library for the GnuPG components                                   |
| libatk1.0-0:amd64             | 2.14.0-1              | ATK accessibility toolkit  |
| libatk1.0-data                | 2.14.0-1              | Common files for the ATK accessibility toolkit                         |
| libatomic1:amd64              | 4.9.2-10              | support library providing __atomic built-in functions                  |
| libattr1:amd64                | 1:2.4.47-2            | Extended attribute shared library                                      |
| libaudit-common               | 1:2.4-1               | Dynamic library for security auditing - common                         |

| Name                           | Version               | Description   |
|--------------------------------|-----------------------|---|
|                                |                       | files   |
| libaudit1:amd64                | 1:2.4-1+b1            | Dynamic library for security auditing                             |
| libauthen-sasl-perl            | 2.1600-1              | Authen::SASL - SASL Authentication framework                      |
| libavahi-client3:amd64         | 0.6.31-5              | Avahi client library  |
| libavahi-common-data:amd64     | 0.6.31-5              | Avahi common data files   |
| libavahi-common3:amd64         | 0.6.31-5              | Avahi common library  |
| libbind9-90                    | 1:9.9.5.dfsg-9+deb8u6 | BIND9 Shared Library used by BIND                                 |
| libblkid1:amd64                | 2.25.2-6              | block device id library   |
| libboost-iostreams1.55.0:amd64 | 1.55.0+dfsg-3         | Boost.Iostreams Library   |
| libbsd0:amd64                  | 0.7.0-2               | utility functions from BSD systems - shared library               |
| libbz2-1.0:amd64               | 1.0.6-7+b3            | high-quality block-sorting file compressor library - runtime      |
| libc-bin                       | 2.19-18+deb8u4        | GNU C Library: Binaries   |
| libc-dev-bin                   | 2.19-18+deb8u4        | GNU C Library: Development binaries                               |
| libc6:amd64                    | 2.19-18+deb8u4        | GNU C Library: Shared libraries                                   |
| libc6-dev:amd64                | 2.19-18+deb8u4        | GNU C Library: Development Libraries and Header Files             |
| libcairo2:amd64                | 1.14.0-2.1+deb8u1     | Cairo 2D vector graphics library                                  |
| libcap-ng0:amd64               | 0.7.4-2               | An alternate POSIX capabilities library                           |
| libcap2:amd64                  | 1:2.24-8              | POSIX 1003.1e capabilities (library)                              |
| libcap2-bin                    | 1:2.24-8              | POSIX 1003.1e capabilities (utilities)                            |
| libcgi-fast-perl               | 1:2.04-1              | CGI subclass for work with FCGI                                   |
| libcgi-pm-perl                 | 4.09-1                | module for Common Gateway Interface applications                  |
| libcilkrts5:amd64              | 4.9.2-10              | Intel Cilk Plus language extensions (runtime)                     |
| libclass-accessor-perl         | 0.34-1                | Perl module that automatically generates accessors                |
| libclass-c3-perl               | 0.26-1                | pragma for using the C3 method resolution order                   |
| libclass-c3-xs-perl            | 0.13-2+b1             | Perl module to accelerate Class::C3                               |
| libclass-isa-perl              | 0.36-5                | report the search path for a class's ISA tree                     |
| libcloog-isl4:amd64            | 0.18.2-1+b2           | Chunky Loop Generator (runtime library)                           |
| libcomerr2:amd64               | 1.42.12-1.1           | common error description library                                  |
| libcpan-meta-perl              | 2.142690-1            | Perl module to access CPAN distributions metadata                 |
| libcryptsetup4:amd64           | 2:1.6.6-5             | disk encryption support - shared library                          |
| libcups2:amd64                 | 1.7.5-11+deb8u1       | Common UNIX Printing System(tm) - Core library                    |
| libcurl3-gnutls:amd64          | 7.38.0-4+deb8u3       | easy-to-use client-side URL transfer library (GnuTLS flavour)     |
| libcwidget3:amd64              | 0.5.17-2              | high-level terminal interface library for C++ (runtime files)     |
| libdaemon0:amd64               | 0.14-6                | lightweight C library for daemons - runtime library               |
| libdata-optlist-perl           | 0.109-1               | module to parse and validate simple name/value option pairs       |
| libdata-section-perl           | 0.200006-1            | module to read chunks of data from a module's DATA section        |
| libdatrie1:amd64               | 0.2.8-1               | Double-array trie library   |
| libdb5.3:amd64                 | 5.3.28-9              | Berkeley v5.3 Database Libraries [runtime]                        |
| libdbus-1-3:amd64              | 1.8.20-0+deb8u1       | simple interprocess messaging system (library)                    |
| libdebconfclient0:amd64        | 0.192                 | Debian Configuration Management System (C-implementation library) |
| libdevmapper1.02.1:amd64       | 2:1.02.90-2.2+deb8u1  | Linux Kernel Device Mapper userspace library                      |
| libdiscover2                   | 2.1.2-7               | hardware identification library                                   |

| Name                      | Version               | Description  |
|---------------------------|-----------------------|--|
| libdns-export100          | 1:9.9.5.dfsg-9+deb8u6 | Exported DNS Shared Library                                      |
| libdns100                 | 1:9.9.5.dfsg-9+deb8u6 | DNS Shared Library used by BIND                                  |
| libdpkg-perl              | 1.17.27               | Dpkg perl modules  |
| libedit2:amd64            | 3.1-20140620-2        | BSD editline and history libraries                               |
| libencode-locale-perl     | 1.03-1                | utility to determine the locale encoding                         |
| libestr0                  | 0.1.9-1.1             | Helper functions for handling strings (lib)                      |
| libevent-2.0-5:amd64      | 2.0.21-stable-2       | Asynchronous event notification library                          |
| libexpat1:amd64           | 2.1.0-6+deb8u2        | XML parsing C library - runtime library                          |
| libfakeroot:amd64         | 1.20.2-1              | tool for simulating superuser privileges - shared libraries      |
| libfcgi-perl              | 0.77-1+b1             | helper module for FastCGI  |
| libffi6:amd64             | 3.1-2+b2              | Foreign Function Interface library runtime                       |
| libfile-fcntllock-perl    | 0.22-1+b1             | Perl module for file locking with fcntl(2)                       |
| libfile-listing-perl      | 6.04-1                | module to parse directory listings                               |
| libfont-afm-perl          | 1.20-1                | Font::AFM - Interface to Adobe Font Metrics files                |
| libfontconfig1:amd64      | 2.11.0-6.3            | generic font configuration library - runtime                     |
| libfreetype6:amd64        | 2.5.2-3+deb8u1        | FreeType 2 font engine, shared library files                     |
| libfuse2:amd64            | 2.9.3-15+deb8u2       | Filesystem in Userspace (library)                                |
| libgc1c2:amd64            | 1:7.2d-6.4            | conservative garbage collector for C and C++                     |
| libgcc-4.9-dev:amd64      | 4.9.2-10              | GCC support library (development files)                          |
| libgcc1:amd64             | 1:4.9.2-10            | GCC support library  |
| libgcrypt20:amd64         | 1.6.3-2+deb8u1        | LGPL Crypto library - runtime library                            |
| libgdbm3:amd64            | 1.8.3-13.1            | GNU dbm database routines (runtime version)                      |
| libgdk-pixbuf2.0-0:amd64  | 2.31.1-2+deb8u4       | GDK Pixbuf library   |
| libgdk-pixbuf2.0-common   | 2.31.1-2+deb8u4       | GDK Pixbuf library - data files                                  |
| libgeoip1:amd64           | 1.6.2-4               | non-DNS IP-to-country resolver library                           |
| libglib2.0-0:amd64        | 2.42.1-1+b1           | GLib library of C routines                                       |
| libglib2.0-data           | 2.42.1-1              | Common files for GLib library                                    |
| libgmp10:amd64            | 2:6.0.0+dfsg-6        | Multiprecision arithmetic library                                |
| libgnutls-deb0-28:amd64   | 3.3.8-6+deb8u3        | GNU TLS library - main runtime library                           |
| libgnutls-openssl27:amd64 | 3.3.8-6+deb8u3        | GNU TLS library - OpenSSL wrapper                                |
| libgomp1:amd64            | 4.9.2-10              | GCC OpenMP (GOMP) support library                                |
| libgpg-error0:amd64       | 1.17-3                | library for common error values and messages in GnuPG components |
| libgpgme11:amd64          | 1.5.1-6               | GPGME - GnuPG Made Easy (library)                                |
| libgpm2:amd64             | 1.20.4-6.1+b2         | General Purpose Mouse - shared library                           |
| libgraphite2-3:amd64      | 1.3.6-1~deb8u1        | Font rendering engine for Complex Scripts -- library             |
| libgssapi-krb5-2:amd64    | 1.12.1+dfsg-19+deb8u2 | MIT Kerberos runtime libraries - krb5 GSS-API Mechanism          |
| libgtk2.0-0:amd64         | 2.24.25-3+deb8u1      | GTK+ graphical user interface library                            |
| libgtk2.0-bin             | 2.24.25-3+deb8u1      | programs for the GTK+ graphical user interface library           |
| libgtk2.0-common          | 2.24.25-3+deb8u1      | common files for the GTK+ graphical user interface library       |
| libharfbuzz0b:amd64       | 0.9.35-2              | OpenType text shaping engine (shared library)                    |
| libhogweed2:amd64         | 2.7.1-5+deb8u1        | low level cryptographic library (public-key cryptos)             |
| libhtml-form-perl         | 6.03-1                | module that represents an HTML form element                      |
| libhtml-format-perl       | 2.11-1                | module for transforming HTML into various formats                |
| libhtml-parser-perl       | 3.71-1+b3             | collection of modules that parse HTML text documents             |
| libhtml-tagset-perl       | 3.20-2                | Data tables pertaining to HTML                                   |

| Name                       | Version               | Description  |
|----------------------------|-----------------------|--|
| libhtml-tree-perl          | 5.03-1                | Perl module to represent and create HTML syntax trees                    |
| libhttp-cookies-perl       | 6.01-1                | HTTP cookie jars   |
| libhttp-daemon-perl        | 6.01-1                | simple http server class   |
| libhttp-date-perl          | 6.02-1                | module of date conversion routines                                       |
| libhttp-message-perl       | 6.06-1                | perl interface to HTTP style messages                                    |
| libhttp-negotiate-perl     | 6.00-2                | implementation of content negotiation                                    |
| libc52:amd64               | 52.1-8+deb8u3         | International Components for Unicode                                     |
| libidn11:amd64             | 1.29-1+deb8u1         | GNU Libidn library, implementation of IETF IDN specifications            |
| libintl-perl               | 1.23-1                | Uniform message translations system compatible i18n library              |
| libio-html-perl            | 1.001-1               | open an HTML file with automatic charset detection                       |
| libio-socket-ip-perl       | 0.32-1                | module for using IPv4 and IPv6 sockets in a protocol-independent way     |
| libio-socket-ssl-perl      | 2.002-2+deb8u1        | Perl module implementing object oriented interface to SSL sockets        |
| libio-string-perl          | 1.08-3                | Emulate IO::File interface for in-core strings                           |
| libirs-export91            | 1:9.9.5.dfsg-9+deb8u6 | Exported IRS Shared Library  |
| libisc-export95            | 1:9.9.5.dfsg-9+deb8u6 | Exported ISC Shared Library  |
| libisc95                   | 1:9.9.5.dfsg-9+deb8u6 | ISC Shared Library used by BIND  |
| libisccc90                 | 1:9.9.5.dfsg-9+deb8u6 | Command Channel Library used by BIND                                     |
| libiscfg-export90          | 1:9.9.5.dfsg-9+deb8u6 | Exported ISC CFG Shared Library  |
| libiscfg90                 | 1:9.9.5.dfsg-9+deb8u6 | Config File Handling Library used by BIND                                |
| libisl10:amd64             | 0.12.2-2              | manipulating sets and relations of integer points bounded by linear cons |
| libitm1:amd64              | 4.9.2-10              | GNU Transactional Memory Library   |
| libiw30:amd64              | 30~pre9-8             | Wireless tools - library   |
| libjasper1:amd64           | 1.900.1-debian1-2.4+d | JasPer JPEG-2000 runtime library   |
| libjbig0:amd64             | 2.1-3.1               | JBIGkit libraries  |
| libjpeg62-turbo:amd64      | 1:1.3.1-12            | libjpeg-turbo JPEG runtime library                                       |
| libjson-c2:amd64           | 0.11-4                | JSON manipulation library - shared library                               |
| libk5crypto3:amd64         | 1.12.1+dfsg-19+deb8u2 | MIT Kerberos runtime libraries - Crypto Library                          |
| libkeyutils1:amd64         | 1.5.9-5+b1            | Linux Key Management Utilities (library)                                 |
| libklibc                   | 2.0.4-2               | minimal libc subset for use with initramfs                               |
| libkmod2:amd64             | 18-3                  | libkmod shared library   |
| libkrb5-3:amd64            | 1.12.1+dfsg-19+deb8u2 | MIT Kerberos runtime libraries   |
| libkrb5support0:amd64      | 1.12.1+dfsg-19+deb8u2 | MIT Kerberos runtime libraries - Support library                         |
| libksba8:amd64             | 1.3.2-1+deb8u1        | X.509 and CMS support library  |
| liblcms2-2:amd64           | 2.6-3+b3              | Little CMS 2 color management library                                    |
| libldap-2.4-2:amd64        | 2.4.40+dfsg-1+deb8u2  | OpenLDAP libraries   |
| liblocale-gettext-perl     | 1.05-8+b1             | module using libc functions for internationalization in Perl             |
| liblockfile-bin            | 1.09-6                | support binaries for and cli utilities based on liblockfile              |
| liblockfile1:amd64         | 1.09-6                | NFS-safe locking library   |
| liblog-message-perl        | 0.8-1                 | powerful and flexible message logging mechanism                          |
| liblog-message-simple-perl | 0.10-2                | simplified interface to Log::Message                                     |
| liblogging-stdlog0:amd64   | 1.0.4-1               | easy to use and lightweight logging library                              |
| liblognorm1:amd64          | 1.0.1-3               | Log normalizing library  |
| liblsan0:amd64             | 4.9.2-10              | LeakSanitizer -- a memory leak detector (runtime)                        |
| liblua5.1-0:amd64          | 5.1.5-7.1             | Shared library for the Lua interpreter version 5.1                       |



| Name                       | Version               | Description  |
|----------------------------|-----------------------|--|
| liblwp-mediatypes-perl     | 6.02-1                | module to guess media type for a file or a URL                           |
| liblwp-protocol-https-perl | 6.06-2                | HTTPS driver for LWP::UserAgent  |
| liblwres90                 | 1:9.9.5.dfsg-9+deb8u6 | Lightweight Resolver Library used by BIND                                |
| liblzma5:amd64             | 5.1.1alpha+20120614-2 | XZ-format compression library  |
| liblzo2-2:amd64            | 2.08-1.2              | data compression library   |
| libmagic1:amd64            | 1:5.22+15-2+deb8u1    | File type determination library using "magic" numbers                    |
| libmailtools-perl          | 2.13-1                | Manipulate email in perl programs  |
| libmnl0:amd64              | 1.0.3-5               | minimalistic Netlink communication library                               |
| libmodule-build-perl       | 0.421000-2            | framework for building and installing Perl modules                       |
| libmodule-pluggable-perl   | 5.1-1                 | module for giving modules the ability to have plugins                    |
| libmodule-signature-perl   | 0.73-1+deb8u2         | module to manipulate CPAN SIGNATURE files                                |
| libmount1:amd64            | 2.25.2-6              | device mounting library  |
| libmpc3:amd64              | 1.0.2-1               | multiple precision complex floating-point library                        |
| libmpfr4:amd64             | 3.1.2-2               | multiple precision floating-point computation                            |
| libmro-compat-perl         | 0.12-1                | mro::* interface compatibility for Perls < 5.9.5                         |
| libncurses5:amd64          | 5.9+20140913-1+b1     | shared libraries for terminal handling                                   |
| libncurses5-dev:amd64      | 5.9+20140913-1+b1     | developer's libraries for ncurses  |
| libncursesw5:amd64         | 5.9+20140913-1+b1     | shared libraries for terminal handling (wide character support)          |
| libnet-http-perl           | 6.07-1                | module providing low-level HTTP connection client                        |
| libnet-smtp-ssl-perl       | 1.01-3                | Perl module providing SSL support to Net::SMTP                           |
| libnet-ssleay-perl         | 1.65-1+b1             | Perl module for Secure Sockets Layer (SSL)                               |
| libnetfilter-acct1:amd64   | 1.0.2-1.1             | Netfilter acct library   |
| libnettle4:amd64           | 2.7.1-5+deb8u1        | low level cryptographic library (symmetric and one-way cryptos)          |
| libnewt0.52:amd64          | 0.52.17-1+b1          | Not Erik's Windowing Toolkit - text mode windowing with slang            |
| libnfnlink0:amd64          | 1.0.1-3               | Netfilter netlink library  |
| libnfsidmap2:amd64         | 0.25-5                | NFS idmapping library  |
| libnl-3-200:amd64          | 3.2.24-2              | library for dealing with netlink sockets                                 |
| libnl-genl-3-200:amd64     | 3.2.24-2              | library for dealing with netlink sockets - generic netlink               |
| libnuma1:amd64             | 2.0.10-1              | Libraries for controlling NUMA policy                                    |
| libonig2:amd64             | 5.9.5-3.2             | Oniguruma regular expressions library                                    |
| libopts25:amd64            | 1:5.18.4-3            | automated option processing library based on autogen                     |
| libp11-kit0:amd64          | 0.20.7-1              | Library for loading and coordinating access to PKCS#11 modules - runtime |
| libpackage-constants-perl  | 0.04-1                | List constants defined in a package                                      |
| libpam-modules:amd64       | 1.1.8-3.1+deb8u1+b1   | Pluggable Authentication Modules for PAM                                 |
| libpam-modules-bin         | 1.1.8-3.1+deb8u1+b1   | Pluggable Authentication Modules for PAM - helper binaries               |
| libpam-runtime             | 1.1.8-3.1+deb8u1      | Runtime support for the PAM library                                      |
| libpam0g:amd64             | 1.1.8-3.1+deb8u1+b1   | Pluggable Authentication Modules library                                 |
| libpango-1.0-0:amd64       | 1.36.8-3              | Layout and rendering of internationalized text                           |
| libpangocairo-1.0-0:amd64  | 1.36.8-3              | Layout and rendering of internationalized text                           |
| libpangoft2-1.0-0:amd64    | 1.36.8-3              | Layout and rendering of internationalized text                           |
| libpaper-utils             | 1.1.24+nmu4           | library for handling paper characteristics (utilities)                   |
| libpaper1:amd64            | 1.1.24+nmu4           | library for handling paper characteristics                               |
| libparams-util-perl        | 1.07-2+b1             | Perl extension for simple stand-alone param                              |

| Name                          | Version               | Description  |
|-------------------------------|-----------------------|--|
|                               |                       | checking functions   |
| libparse-debianchangelog-perl | 1.2.0-1.1             | parse Debian changelogs and output them in other formats                 |
| libpci3:amd64                 | 1:3.2.1-3             | Linux PCI Utilities (shared library)                                     |
| libpcre3:amd64                | 2:8.35-3.3+deb8u4     | Perl 5 Compatible Regular Expression Library - runtime files             |
| libpcsclite1:amd64            | 1.8.13-1              | Middleware to access a smart card using PC/SC (library)                  |
| libperl-dev                   | 5.20.2-3+deb8u6       | Perl library: development files  |
| libperl4-corelibs-perl        | 0.003-1               | libraries historically supplied with Perl 4                              |
| libperl5.20                   | 5.20.2-3+deb8u6       | shared Perl library  |
| libpipeline1:amd64            | 1.4.0-1               | pipeline manipulation library  |
| libpixmap-1-0:amd64           | 0.32.6-3              | pixel-manipulation library for X and cairo                               |
| libpkcs11-helper1:amd64       | 1.11-2                | library that simplifies the interaction with PKCS#11                     |
| libpng12-0:amd64              | 1.2.50-2+deb8u2       | PNG library - runtime  |
| libpod-latex-perl             | 0.61-1                | module to convert Pod data to formatted LaTeX                            |
| libpod-README-perl            | 0.11-1                | Perl module to convert POD to README file                                |
| libpopt0:amd64                | 1.16-10               | lib for parsing cmdline parameters                                       |
| libprocps3:amd64              | 2:3.3.9-9             | library for accessing process information from /proc                     |
| libpsl0:amd64                 | 0.5.1-1               | Library for Public Suffix List (shared libraries)                        |
| libpth20:amd64                | 2.0.7-20              | GNU Portable Threads   |
| libpython-stdlib:amd64        | 2.7.9-1               | interactive high-level object-oriented language (default python version) |
| libpython2.7-minimal:amd64    | 2.7.9-2               | Minimal subset of the Python language (version 2.7)                      |
| libpython2.7-stdlib:amd64     | 2.7.9-2               | Interactive high-level object-oriented language (standard library, versi |
| libqdbm14                     | 1.8.78-5+b1           | QDBM Database Libraries without GDBM wrapper[runtime]                    |
| libquadmath0:amd64            | 4.9.2-10              | GCC Quad-Precision Math Library  |
| libreadline6:amd64            | 6.3-8+b3              | GNU readline and history libraries, run-time libraries                   |
| libregex-common-perl          | 2013031301-1          | module with common regular expressions                                   |
| librtmp1:amd64                | 2.4+20150115.gita107c | toolkit for RTMP streams (shared library)                                |
| libsasl2-2:amd64              | 2.1.26.dfsg1-13+deb8u | Cyrus SASL - authentication abstraction library                          |
| libsasl2-modules:amd64        | 2.1.26.dfsg1-13+deb8u | Cyrus SASL - pluggable authentication modules                            |
| libsasl2-modules-db:amd64     | 2.1.26.dfsg1-13+deb8u | Cyrus SASL - pluggable authentication modules (DB)                       |
| libselinux1:amd64             | 2.3-2                 | SELinux runtime shared libraries   |
| libsemanage-common            | 2.3-1                 | Common files for SELinux policy management libraries                     |
| libsemanage1:amd64            | 2.3-1+b1              | SELinux policy management library  |
| libsensors4:amd64             | 1:3.3.5-2             | library to read temperature/voltage/fan sensors                          |
| libsepol1:amd64               | 2.3-2                 | SELinux library for manipulating binary security policies                |
| libsigc++-2.0-0c2a:amd64      | 2.4.0-1               | type-safe Signal Framework for C++ - runtime                             |
| libsigsegv2:amd64             | 2.10-4+b1             | Library for handling page faults in a portable way                       |
| libslang2:amd64               | 2.3.0-2               | S-Lang programming library - runtime version                             |
| libsmartcols1:amd64           | 2.25.2-6              | smart column output alignment library                                    |
| libsnmp-base                  | 5.7.2.1+dfsg-1        | SNMP configuration script, MIBs and documentation                        |

| Name                     | Version           | Description  |
|--------------------------|-------------------|--|
| libsnmp30:amd64          | 5.7.2.1+dfsg-1    | SNMP (Simple Network Management Protocol) library                    |
| libsoftware-license-perl | 0.103010-3        | module providing templated software licenses                         |
| libsqlite3-0:amd64       | 3.8.7.1-1+deb8u1  | SQLite 3 shared library  |
| libsqlite3-dev:amd64     | 3.8.7.1-1+deb8u1  | SQLite 3 development files   |
| libss2:amd64             | 1.42.12-1.1       | command-line interface parsing library                               |
| libssh2-1:amd64          | 1.4.3-4.1+deb8u1  | SSH2 client-side library   |
| libssl1.0.0:amd64        | 1.0.1t-1+deb8u2   | Secure Sockets Layer toolkit - shared libraries                      |
| libstdc++-4.9-dev:amd64  | 4.9.2-10          | GNU Standard C++ Library v3 (development files)                      |
| libstdc++6:amd64         | 4.9.2-10          | GNU Standard C++ Library v3  |
| libsub-exporter-perl     | 0.986-1           | sophisticated exporter for custom-built routines                     |
| libsub-install-perl      | 0.928-1           | module for installing subroutines into packages easily               |
| libsub-name-perl         | 0.12-1            | module for assigning a new name to referenced sub                    |
| libswitch-perl           | 2.17-2            | switch statement for Perl  |
| libsystemd0:amd64        | 215-17+deb8u4     | systemd utility library  |
| libtasn1-6:amd64         | 4.2-3+deb8u2      | Manage ASN.1 structures (runtime)                                    |
| libterm-ui-perl          | 0.42-1            | Term::ReadLine UI made easy  |
| libtext-charwidth-perl   | 0.04-7+b3         | get display widths of characters on the terminal                     |
| libtext-iconv-perl       | 1.7-5+b2          | converts between character sets in Perl                              |
| libtext-soundex-perl     | 3.4-1+b2          | implementation of the soundex algorithm                              |
| libtext-template-perl    | 1.46-1            | perl module to process text templates                                |
| libtext-unidecode-perl   | 1.22-1            | Text::Unidecode -- US-ASCII transliterations of Unicode text         |
| libtext-wrapi18n-perl    | 0.06-7            | internationalized substitute of Text::Wrap                           |
| libthai-data             | 0.1.21-1          | Data files for Thai language support library                         |
| libthai0:amd64           | 0.1.21-1          | Thai language support library  |
| libtiff5:amd64           | 4.0.3-12.3+deb8u1 | Tag Image File Format (TIFF) library                                 |
| libtimedate-perl         | 2.3000-2          | collection of modules to manipulate date/time information            |
| libtinfo-dev:amd64       | 5.9+20140913-1+b1 | developer's library for the low-level terminfo library               |
| libtinfo5:amd64          | 5.9+20140913-1+b1 | shared low-level terminfo library for terminal handling              |
| libtirpc1:amd64          | 0.2.5-1           | transport-independent RPC library                                    |
| libtokyocabinet9:amd64   | 1.4.48-3          | Tokyo Cabinet Database Libraries [runtime]                           |
| libtsan0:amd64           | 4.9.2-10          | ThreadSanitizer -- a Valgrind-based detector of data races (runtime) |
| libubsan0:amd64          | 4.9.2-10          | UBSan -- undefined behaviour sanitizer (runtime)                     |
| libudev1:amd64           | 215-17+deb8u4     | libudev shared library   |
| liburi-perl              | 1.64-1            | module to manipulate and access URI strings                          |
| libusb-0.1-4:amd64       | 2:0.1.12-25       | userspace USB programming library                                    |
| libusb-1.0-0:amd64       | 2:1.0.19-1        | userspace USB programming library                                    |
| libustr-1.0-1:amd64      | 1.0.4-3+b2        | Micro string library: shared library                                 |
| libuuid1:amd64           | 2.25.2-6          | Universally Unique ID library  |
| libwebp5:amd64           | 0.4.1-1.2+b2      | Lossy compression of digital photographic images.                    |
| libwebpdemux1:amd64      | 0.4.1-1.2+b2      | Lossy compression of digital photographic images.                    |
| libwebpmux1:amd64        | 0.4.1-1.2+b2      | Lossy compression of digital photographic images.                    |
| libwrap0:amd64           | 7.6.q-25          | Wietse Venema's TCP wrappers library                                 |
| libwww-perl              | 6.08-1            | simple and consistent interface to the world-wide web                |

| Name                               | Version              | Description   |
|------------------------------------|----------------------|---|
| libwww-robotrules-perl             | 6.01-1               | database of robots.txt-derived permissions                  |
| libx11-6:amd64                     | 2:1.6.2-3            | X11 client-side library                                     |
| libx11-data                        | 2:1.6.2-3            | X11 client-side library                                     |
| libx86-1:amd64                     | 1.1+ds1-10           | x86 real-mode library                                       |
| libxapian22                        | 1.2.19-1+deb8u1      | Search engine library                                       |
| libxau6:amd64                      | 1:1.0.8-1            | X11 authorisation library                                   |
| libxcb-render0:amd64               | 1.10-3+b1            | X C Binding, render extension                               |
| libxcb-shm0:amd64                  | 1.10-3+b1            | X C Binding, shm extension                                  |
| libxcb1:amd64                      | 1.10-3+b1            | X C Binding   |
| libxcomposite1:amd64               | 1:0.4.4-1            | X11 Composite extension library                             |
| libxcursor1:amd64                  | 1:1.1.14-1+b1        | X cursor management library                                 |
| libxdamage1:amd64                  | 1:1.1.4-2+b1         | X11 damaged region extension library                        |
| libxdmcp6:amd64                    | 1:1.1.1-1+b1         | X11 Display Manager Control Protocol library                |
| libxext6:amd64                     | 2:1.3.3-1            | X11 miscellaneous extension library                         |
| libxfixed3:amd64                   | 1:5.0.1-2+b2         | X11 miscellaneous 'fixes' extension library                 |
| libxi6:amd64                       | 2:1.7.4-1+b2         | X11 Input extension library                                 |
| libxinerama1:amd64                 | 2:1.1.3-1+b1         | X11 Xinerama extension library                              |
| libxml-libxml-perl                 | 2.0116+dfsg-1+deb8u1 | Perl interface to the libxml2 library                       |
| libxml-namespacesupport-perl       | 1.11-1               | Perl module for supporting simple generic namespaces        |
| libxml-parser-perl                 | 2.41-3               | Perl module for parsing XML files                           |
| libxml-sax-base-perl               | 1.07-1               | base class for SAX drivers and filters                      |
| libxml-sax-expat-perl              | 0.40-2               | Perl module for a SAX2 driver for Expat (XML::Parser)       |
| libxml-sax-perl                    | 0.99+dfsg-2          | Perl module for using and building Perl SAX2 XML processors |
| libxml2:amd64                      | 2.9.1+dfsg1-5+deb8u1 | GNOME XML library   |
| libxmuu1:amd64                     | 2:1.1.2-1            | X11 miscellaneous micro-utility library                     |
| libxrandr2:amd64                   | 2:1.4.2-1+b1         | X11 RandR extension library                                 |
| libxrender1:amd64                  | 1:0.9.8-1+b1         | X Rendering Extension client library                        |
| libxtables10                       | 1.4.21-2+b1          | netfilter xtables library                                   |
| linux-base                         | 4.3~bpo8+1           | Linux image base package                                    |
| linux-compiler-gcc-4.9-x86         | 4.6.4-1~bpo8+1       | Compiler for Linux on x86 (meta-package)                    |
| linux-headers-4.6.0-0.bpo.1-amd64  | 4.6.4-1~bpo8+1       | Header files for Linux 4.6.0-0.bpo.1-amd64                  |
| linux-headers-4.6.0-0.bpo.1-common | 4.6.4-1~bpo8+1       | Common header files for Linux 4.6.0-0.bpo.1                 |
| linux-image-4.6.0-0.bpo.1-amd64    | 4.6.4-1~bpo8+1       | Linux 4.6 for 64-bit PCs                                    |
| linux-kbuild-4.6                   | 4.6.4-1~bpo8+1       | Kbuild infrastructure for Linux 4.6                         |
| linux-libc-dev:amd64               | 4.6.4-1~bpo8+1       | Linux support headers for userspace development             |
| lm-sensors                         | 1:3.3.5-2            | utilities to read temperature/voltage/fan sensors           |
| locales                            | 2.19-18+deb8u4       | GNU C Library: National Language (locale) data [support]    |
| lockfile-progs                     | 0.1.17               | Programs for locking and unlocking files and mailboxes      |
| login                              | 1:4.2-3+deb8u1       | system login tools  |
| logrotate                          | 3.8.7-1+b1           | Log rotation utility  |
| lsb-base                           | 4.1+Debian13+nmu1    | Linux Standard Base 4.1 init script functionality           |
| lsb-release                        | 4.1+Debian13+nmu1    | Linux Standard Base version reporting utility               |
| lshw                               | 02.17-1.1            | information about hardware configuration                    |
| lsuf                               | 4.86+dfsg-1          | Utility to list open files                                  |

| Name                | Version               | Description   |
|---------------------|-----------------------|---|
| m4                  | 1.4.17-4              | macro processing language   |
| make                | 4.0-8.1               | utility for directing compilation   |
| man-db              | 2.7.0.2-5             | on-line manual pager  |
| manpages            | 3.74-1                | Manual pages about using a GNU/Linux system                                 |
| manpages-dev        | 3.74-1                | Manual pages about using GNU/Linux for development                          |
| mawk                | 1.3.3-17              | a pattern scanning and text processing language                             |
| mime-support        | 3.58                  | MIME files 'mime.types' & 'mailcap', and support programs                   |
| mlocate             | 0.26-1                | quickly find files on the filesystem based on their name                    |
| mount               | 2.25.2-6              | Tools for mounting and manipulating filesystems                             |
| multiarch-support   | 2.19-18+deb8u4        | Transitional package to ensure multiarch compatibility                      |
| mutt                | 1.5.23-3              | text-based mail reader supporting MIME, GPG, PGP and threading              |
| nano                | 2.2.6-3               | small, friendly text editor inspired by Pico                                |
| ncurses-base        | 5.9+20140913-1        | basic terminal type definitions   |
| ncurses-bin         | 5.9+20140913-1+b1     | terminal-related programs and man pages                                     |
| ncurses-term        | 5.9+20140913-1        | additional terminal type definitions  |
| net-tools           | 1.60-26+b1            | NET-3 networking toolkit  |
| netbase             | 5.3                   | Basic TCP/IP networking system  |
| netcat-traditional  | 1.10-41               | TCP/IP swiss army knife   |
| nfacct              | 1.0.1-1.1             | netfilter accounting object tool  |
| nfs-common          | 1:1.2.8-9             | NFS support files common to client and server                               |
| ntp                 | 1:4.2.6.p5+dfsg-7+deb | Network Time Protocol daemon and utility programs                           |
| ntpdate             | 1:4.2.6.p5+dfsg-7+deb | client for setting system time from NTP servers                             |
| opensc              | 0.14.0-2              | Smart card utilities with support for PKCS#15 compatible cards              |
| opensc-pkcs11:amd64 | 0.14.0-2              | Smart card utilities with support for PKCS#15 compatible cards              |
| openssh-client      | 1:6.7p1-5+deb8u3      | secure shell (SSH) client, for secure access to remote machines             |
| openssh-server      | 1:6.7p1-5+deb8u3      | secure shell (SSH) server, for secure access from remote machines           |
| openssh-sftp-server | 1:6.7p1-5+deb8u3      | secure shell (SSH) sftp server module, for SFTP access from remote machines |
| openssl             | 1.0.1t-1+deb8u2       | Secure Sockets Layer toolkit - cryptographic utility                        |
| openvpn             | 2.3.4-5+deb8u1        | virtual private network daemon  |
| os-prober           | 1.65                  | utility to detect other OSes on a set of drives                             |
| passwd              | 1:4.2-3+deb8u1        | change and administer password and group data                               |
| patch               | 2.7.5-1               | Apply a diff file to an original  |
| pciutils            | 1:3.2.1-3             | Linux PCI Utilities   |
| perl                | 5.20.2-3+deb8u6       | Larry Wall's Practical Extraction and Report Language                       |
| perl-base           | 5.20.2-3+deb8u6       | minimal Perl system   |
| perl-modules        | 5.20.2-3+deb8u6       | Core Perl modules   |
| php5                | 5.6.24+dfsg-0+deb8u1  | server-side, HTML-embedded scripting language (metapackage)                 |
| php5-cli            | 5.6.24+dfsg-0+deb8u1  | command-line interpreter for the php5 scripting language                    |

| Name                 | Version               | Description   |
|----------------------|-----------------------|---|
| php5-common          | 5.6.24+dfsg-0+deb8u1  | Common files for packages built from the php5 source                  |
| php5-json            | 1.3.6-1               | JSON module for php5  |
| php5-readline        | 5.6.24+dfsg-0+deb8u1  | Readline module for php5  |
| pinentry-gtk2        | 0.8.3-2               | GTK+-2-based PIN or pass-phrase entry dialog for GnuPG                |
| pm-utils             | 1.4.1-15              | utilities and scripts for power management                            |
| pmount               | 0.9.23-3+b1           | mount removable devices as normal user                                |
| powermgmt-base       | 1.31+nmu1             | Common utils and configs for power management                         |
| powertop             | 2.6.1-1               | diagnose issues with power consumption and management                 |
| procmail             | 3.22-24               | Versatile e-mail processor  |
| procps               | 2:3.3.9-9             | /proc file system utilities   |
| psmisc               | 22.21-2               | utilities that use the proc file system                               |
| python               | 2.7.9-1               | interactive high-level object-oriented language (default version)     |
| python-apt           | 0.9.3.12              | Python interface to libapt-pkg  |
| python-apt-common    | 0.9.3.12              | Python interface to libapt-pkg (locales)                              |
| python-chardet       | 2.3.0-1               | universal character encoding detector for Python2                     |
| python-debian        | 0.1.27                | Python modules to work with Debian-related data formats               |
| python-debianbts     | 1.12                  | Python interface to Debian's Bug Tracking System                      |
| python-defusedxml    | 0.4.1-2               | XML bomb protection for Python stdlib modules (for Python 2)          |
| python-docutils      | 0.12+dfsg-1           | text processing system for reStructuredText (implemented in Python 2) |
| python-minimal       | 2.7.9-1               | minimal subset of the Python language (default version)               |
| python-pil:amd64     | 2.6.1-2+deb8u2        | Python Imaging Library (Pillow fork)                                  |
| python-pkg-resources | 5.5.1-1               | Package Discovery and Resource Access using pkg_resources             |
| python-pygments      | 2.0.1+dfsg-1.1+deb8u1 | syntax highlighting package written in Python                         |
| python-reportbug     | 6.6.3                 | Python modules for interacting with bug tracking systems              |
| python-roman         | 2.0.0-1               | module for generating/analyzing Roman numerals for Python 2           |
| python-six           | 1.8.0-1               | Python 2 and 3 compatibility library (Python 2 interface)             |
| python-soappy        | 0.12.22-1             | SOAP Support for Python   |
| python-support       | 1.0.15                | automated rebuilding support for Python modules                       |
| python-wstools       | 0.4.3-2               | WSDL parsing tools Python module                                      |
| python2.7            | 2.7.9-2               | Interactive high-level object-oriented language (version 2.7)         |
| python2.7-minimal    | 2.7.9-2               | Minimal subset of the Python language (version 2.7)                   |
| racoon               | 1:0.8.2+20140711-2+de | IPsec Internet Key Exchange daemon                                    |
| read-edid            | 3.0.1-2               | hardware information-gathering tool for VESA PnP monitors             |
| readline-common      | 6.3-8                 | GNU readline and history libraries, common files                      |
| rename               | 0.20-3                | Perl extension for renaming multiple files                            |
| reportbug            | 6.6.3                 | reports bugs in the Debian distribution                               |

| Name               | Version           | Description   |
|--------------------|-------------------|---|
| rpcbind            | 0.2.1-6+deb8u1    | converts RPC program numbers into universal addresses               |
| rsync              | 3.1.1-3           | fast, versatile, remote (and local) file-copying tool               |
| rsyslog            | 8.4.2-1+deb8u2    | reliable system and kernel logging daemon                           |
| sed                | 4.2.2-4+b1        | The GNU sed stream editor   |
| sensible-utils     | 0.0.9             | Utilities for sensible alternative selection                        |
| sgml-base          | 1.26+nmu4         | SGML infrastructure and SGML catalog file support                   |
| shared-mime-info   | 1.3-1             | FreeDesktop.org shared MIME database and spec                       |
| snmp               | 5.7.2.1+dfsg-1    | SNMP (Simple Network Management Protocol) applications              |
| snmpd              | 5.7.2.1+dfsg-1    | SNMP (Simple Network Management Protocol) agents                    |
| sqlite3            | 3.8.7.1-1+deb8u1  | Command line interface for SQLite 3                                 |
| ssh                | 1:6.7p1-5+deb8u3  | secure shell client and server (metapackage)                        |
| ssl-cert           | 1.0.35            | simple debconf wrapper for OpenSSL                                  |
| startpar           | 0.59-3            | run processes in parallel and multiplex their output                |
| sudo               | 1.8.10p3-1+deb8u3 | Provide limited super user privileges to specific users             |
| sysstat            | 11.0.1-1          | system performance tools for Linux                                  |
| systemd            | 215-17+deb8u4     | system and service manager  |
| systemd-sysv       | 215-17+deb8u4     | system and service manager - SysV links                             |
| sysv-rc            | 2.88dsf-59        | System-V-like run level change mechanism                            |
| sysvinit-utils     | 2.88dsf-59        | System-V-like utilities   |
| tar                | 1.27.1-2+b1       | GNU version of the tar archiving utility                            |
| task-english       | 3.31+deb8u1       | General English environment   |
| task-laptop        | 3.31+deb8u1       | laptop  |
| task-ssh-server    | 3.31+deb8u1       | SSH server  |
| tasksel            | 3.31+deb8u1       | tool for selecting tasks for installation on Debian systems         |
| tasksel-data       | 3.31+deb8u1       | official tasks used for installation of Debian systems              |
| tcpd               | 7.6.q-25          | Wietse Venema's TCP wrapper utilities                               |
| texinfo            | 5.2.0.dfsg.1-6    | Documentation system for on-line information and printed output     |
| time               | 1.7-25            | GNU time program for measuring CPU resource usage                   |
| traceroute         | 1:2.0.20-2+b1     | Traces the route taken by packets over an IPv4/IPv6 network         |
| tzdata             | 2016d-0+deb8u1    | time zone and daylight-saving time data                             |
| ucf                | 3.0030            | Update Configuration File(s): preserve user changes to config files |
| udev               | 215-17+deb8u4     | /dev/ and hotplug management daemon                                 |
| usbmount           | 0.0.22            | automatically mount and unmount USB mass storage devices            |
| usbutils           | 1:007-2           | Linux USB utilities   |
| util-linux         | 2.25.2-6          | Miscellaneous system utilities                                      |
| util-linux-locales | 2.25.2-6          | Locales files for util-linux  |
| vbetool            | 1.1-3             | run real-mode video BIOS code to alter hardware state               |
| vim                | 2:7.4.488-7       | Vi IMproved - enhanced vi editor                                    |
| vim-common         | 2:7.4.488-7       | Vi IMproved - Common files  |
| vim-runtime        | 2:7.4.488-7       | Vi IMproved - Runtime files   |

| Name           | Version               | Description  |
|----------------|-----------------------|--|
| vim-tiny       | 2:7.4.488-7           | Vi IMproved - enhanced vi editor - compact version           |
| w3m            | 0.5.3-19              | WWW browsable pager with excellent tables/frames support     |
| wamerican      | 7.1-1                 | American English dictionary words for /usr/share/dict        |
| watchdog       | 5.14-3                | system health checker and software/hardware watchdog handler |
| wget           | 1.16-1                | retrieves files from the web                                 |
| whiptail       | 0.52.17-1+b1          | Displays user-friendly dialog boxes from shell scripts       |
| whois          | 5.2.7                 | intelligent WHOIS client                                     |
| wireless-regdb | 2014.11.18-1          | wireless regulatory database                                 |
| wireless-tools | 30~pre9-8             | Tools for manipulating Linux Wireless Extensions             |
| wpa_supplicant | 2.3-1+deb8u3          | client support for WPA and WPA2 (IEEE 802.11i)               |
| xauth          | 1:1.0.9-1             | X authentication utility                                     |
| xdg-user-dirs  | 0.15-2                | tool to manage well known user directories                   |
| xkb-data       | 2.12-1                | X Keyboard Extension (XKB) configuration data                |
| xml-core       | 0.13+nmu2             | XML infrastructure and XML catalog file support              |
| xz-utils       | 5.1.1alpha+20120614-2 | XZ-format compression utilities                              |
| zlib1g:amd64   | 1:1.2.8.dfsg-2+b1     | compression library - runtime                                |