V2406C Series Linux Software User's Manual

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V2406C Series Linux Software User's Manual

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1

Introduction

Thank you for purchasing a Moxa V2406C Series x86 ready-to-run embedded computer. This manual introduces the software configuration and management of the V2406C Series models, which run the Linux operating system.

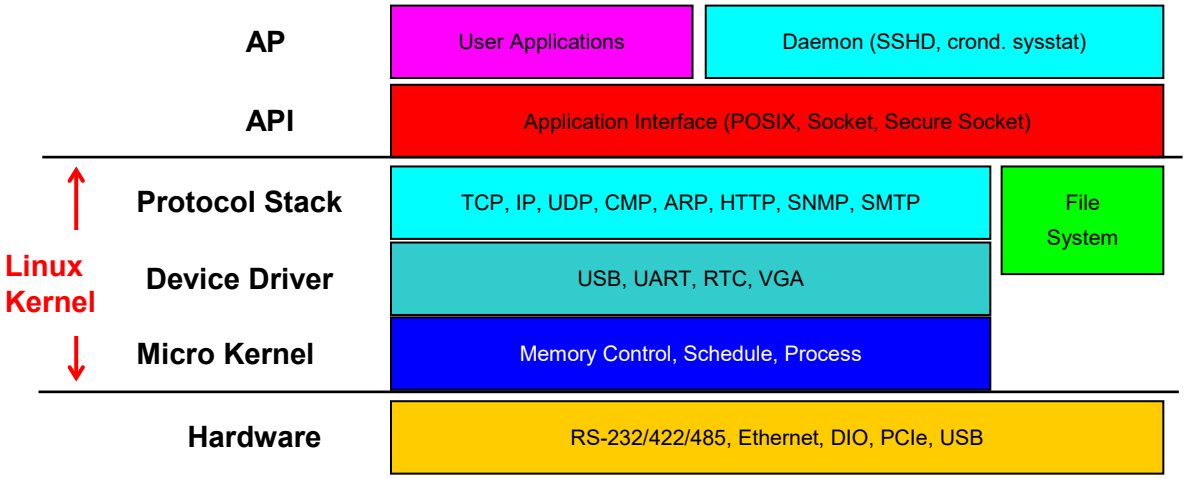
Linux is an open, scalable operating system that allows you to build a wide range of innovative, small footprint devices. Software written for desktop PCs can be easily ported to the embedded computer with a GNU cross compiler and minimum source code modifications. A typical Linux-based device is designed for a specific use, and is often not connected to other computers, or a number of such devices connect to a centralized, front-end host.

The following topics are covered in this chapter:

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

Software Specifications

The Linux operating system preinstalled on the V2406C embedded computer is the **Debian 9 "Stretch"** distribution. The Debian project involves a worldwide group of volunteers who endeavor to produce an operating system distribution composed entirely of free software. The Debian GNU/Linux follows the standard Linux architecture, making it easy to use programs that meet the POSIX standard. Program porting can be done with the GNU Tool Chain provided by Moxa. In addition to Standard POSIX APIs, device drivers for Moxa UART and other special peripherals are also included. An example software architecture is shown below:



ATTENTION

Refer to http://www.debian.org/ and http://www.gnu.org/ for information and documentation related to Debian GNU/Linux and the free software concept.

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 the above graphic.

Software Components

The V2406C Linux models are preinstalled with the Debian 9 Stretch Linux distribution. For a list of the software components, refer to the *Software Components* section.

2

Software Configuration

In this chapter, we explain how to operate a V2406C Linux model computer directly from your desktop. There are three ways to connect to the computer: through a DVI/DP monitor, via with an SSH over the network console from a Windows, or a Linux machine. This chapter describes basic Linux operating system configurations. Advanced network management and configuration instructions will be described in the next chapter, "Managing Communications."

The following topics are covered in this chapter:

- **Account Management**
- **Setting Up a Desktop Environment**
- **Starting From a VGA Console**
- **Connecting From an SSH Console**
  - Windows Users
  - Linux Users
- **Adjusting the System Time**
  - Setting the Time Manually
  - NTP Client or system-timesyncd Service
  - Managing Services Using the systemd Script
- **Cron—Daemon for Executing Scheduled Commands**
- **Inserting a USB Storage Device into the Computer**
- **APT—Installing and Removing Packages**

Account Management

Connect the V2406C to a display and turn on the computer. Enter the following information to log in to the computer.

Login: moxa
Password: moxa

For security reasons, we have disabled the root account. We strongly recommend changing the password at the first login. After successfully logging in, specify a new password.

```
Using username "moxa".
Linux Moxa 4.9.0-6-amd64 #1 SMP Debian 4.9.88-1 (2018-04-29) x86_64

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

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

You have mail.
Last login: Wed Mar  6 00:10:56 2019 from 10.144.54.91
You are using Moxa embedded computer.
Please change the default password in consideration of higher security level or
disable the default user, moxa.
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 enp0s31f6 192.168.100.100** will allow you to configure the IP address of the LAN 1 port.

```
moxa@Moxa:~$ sudo ifconfig enp0s31f6 192.168.100.100
moxa@Moxa:~$ sudo  ifconfig enp0s31f6
enp0s31f6: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
       inet 192.168.100.100  netmask 255.255.255.0  broadcast 192.168.100.255
       ether 00:90:e8:00:d7:38  txqueuelen 1000  (Ethernet)
       RX packets 0  bytes 0 (0.0 B)
       RX errors 0  dropped 0  overruns 0  frame 0
       TX packets 0  bytes 0 (0.0 B)
       TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
       device memory 0xb1300000-b137ffff
```

In addition, use **sudo –i** to login as root to have more privileges.

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

For security reasons, the system has enforced a limitation on the number of consecutive invalid access attempts by a user during a set time period based on applicable organizational policy. The configuration is available at /etc/pam.d/common-auth.

The system default configuration locks out the user in 120 seconds after 3 unsuccessful login attempts. You can unlock the user account using the configuration file located at /etc/pam.d/common-auth.

```
...
auth required pam_tally2.so file=/var/log/tallylog deny=3 even_deny_root
unlock_time=120
```

By default, the password required is a stronger strength with a length of 4-16 characters and a variety of character types as per the libpam-cracklib module. The configuration is available in the **/etc/pam.d/common-password** file.

```
...
password       requisite                    pam_cracklib.so retry=3 difok=3
dcredit=-1 lcredit=-1 minlen=12 ocredit=-1 ucredit=-1
password       [success=1 default=ignore]     pam_unix.so obscure use_authtok
try_first_pass sha512
...
```

Setting Up a Desktop Environment

This section introduces the desktop environment setup. The Linux operating system by default doesn't install a desktop environment. Debian supports all kinds of fully-featured graphical environment, such as, Gnome, KDE, lighter environment like Xfce and LXDE. Users can choose to install one of these desktop systems. You can use these commands to install a desktop environment:

To install Gnome:

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

To install KDE:

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

To install Xfce:

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

To install the minimum LXDE:

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

Starting From a VGA Console

Connect the display monitor to the connector on your computer, and then power it up by connecting it to the power adapter. 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

```
Debian GNU/Linux 9 Moxa tty1

Moxa login: moxa
Password:
Linux Moxa 4.9.0-6-amd64 #1 SMP Debian 4.9.88-1 (2018-04-29) x86_64

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

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

Last login: Wed Mar  6 00:10:56 2019 from 10.144.54.91
You are using Moxa embedded computer.
Please change the default password in consideration of higher security level or
disable the default user, moxa.
moxa@Moxa:~$
```

Connecting From an SSH Console

The V2406C computer supports the SSH console to offer users better network security compared to Telnet. The default IP addresses and netmasks of the network interfaces are as follows:

	Default IP Address	**Netmask**
LAN 1	192.168.3.127	255.255.255.0
LAN 2	192.168.4.127	255.255.255.0
LAN 3	192.168.5.127	255.255.255.0
LAN 4	192.168.6.127	255.255.255.0

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

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

Login: moxa
Password: moxa

ATTENTION

For security reasons, the system will automatically logout if the ssh remote console or serial console is inactive for 5 minutes. If you do not want the system to automatically logout during the development phase, you can comment out the following configuration settings.

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

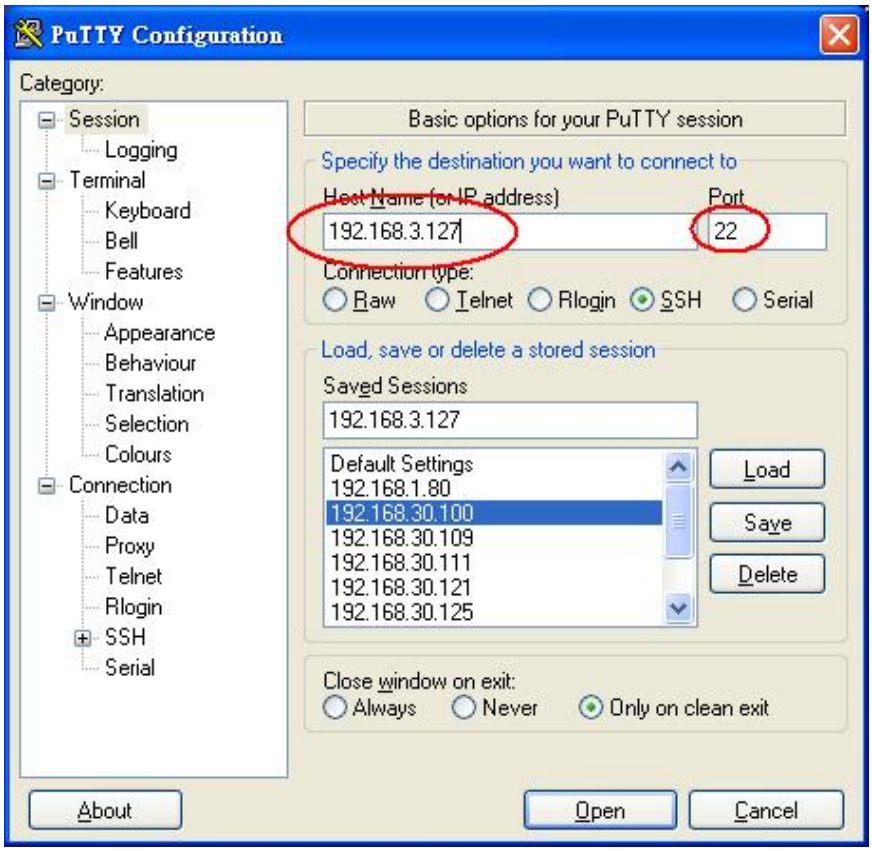
...
LoginGraceTime 120
PermitRootLogin without-password
StrictModes yes

The console automatic logout is configured in /etc/profile.d/moxa.sh

TMOUT=300
Export TMOUT

Windows Users

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



Linux Users

From a Linux machine, use the **ssh** command to access the console utility via SSH.

#ssh moxa@192.168.3.127

Select **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 V2406C has two time settings. One is the system time, and the other is provided by an RTC (Real-time Clock) built into the hardware.

Setting the Time Manually

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

Use the following command to set the system time.

 # date MMDDhhmmYYYY

MM: Month
DD: Date
hhmm: Hour and Minute
YYYY: Year

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

 # hwclock –w

```
root@Moxa:/home/moxa# date
Wed Mar  6 19:33:51 CST 2019
root@Moxa:/home/moxa# hwclock
2019-03-06 19:33:57.482903+0800
root@Moxa:/home/moxa# date 030619352019.30
Wed Mar  6 19:35:30 CST 2019
root@Moxa:/home/moxa# hwclock -w
root@Moxa:/home/moxa# date; hwclock
Wed Mar  6 19:35:34 CST 2019
2019-03-06 19:35:34.061120+0800
```

NTP Client or system-timesyncd Service

The V2406C can use a NTP (Network Time Protocol) client to initialize a time request to a remote NTP server. Use the **ntpdate** command to update the system time. Make sure that the device is connected to an Ethernet network before you run the **ntpdate** command.

 # ntpdate time.stdtime.gov.tw

 # hwclock –w

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

```
root@Moxa:/home/moxa# ntpdate time.stdtime.gov.tw
 6 Mar 19:36:21 ntpdate[1172]: adjust time server 118.163.81.61 offset -0.000877
sec
root@Moxa:/home/moxa# hwclock -w
root@Moxa:/home/moxa# date; hwclock
Wed Mar  6 19:36:50 CST 2019
2019-03-06 19:36:50.154796+0800
```

The V2406C has a built-in system-timesyncd that is used for Network Time Synchronization. This service default is enabled.

```
root@Moxa:/home/moxa# systemctl status systemd-timesyncd
● systemd-timesyncd.service - Network Time Synchronization
   Loaded: loaded (/lib/systemd/system/systemd-timesyncd.service; enabled; vendor
preset: enabled)
  Drop-In: /lib/systemd/system/systemd-timesyncd.service.d
           └─disable-with-time-daemon.conf
   Active: active (running) since Wed 2019-03-06 19:30:32 CST; 7min ago
     Docs: man:systemd-timesyncd.service(8)
 Main PID: 274 (systemd-timesyn)
   Status: "Synchronized to time server 103.18.128.60:123
(2.debian.pool.ntp.org)."
    Tasks: 2 (limit: 4915)
   CGroup: /system.slice/systemd-timesyncd.service
           └─274 /lib/systemd/systemd-timesyncd

Mar 06 19:30:31 Moxa systemd[1]: Starting Network Time Synchronization...
Mar 06 19:30:32 Moxa systemd[1]: Started Network Time Synchronization.
Mar 06 19:31:02 Moxa systemd-timesyncd[274]: Synchronized to time server
103.18.128.60:123 (2.debian.pool.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.

Managing Services Using the systemd Script

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

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

```
[Unit]
After=snmpd.service

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

[Install]
WantedBy=default.target
```

- After: Instructs systemd on when the script should be run. In our case the script will run after snmpd.service has started.
- ExecStart: This field provides a full path the actual script to be execute
- WantedBy: Into what boot target the systemd unit should be installed

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

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

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

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

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

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

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

The networking-check.sh will be launched in the background.

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

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

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

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

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

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

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

To disable this service by the systemctl disable command.

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

Cron—Daemon for Executing Scheduled Commands

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

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

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

Mm	h	Dom	mon	Dow	user	command
minute	hour	Date	month	Week	user	command
0-59	0-23	1-31	1-12	0-6 (0 is Sunday)		

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

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

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

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

   ```
   #!/bin/sh
   ntpdate time.stdtime.gov.tw
   hwclock -w
   exit 0
   ```

2. Change the mode of **fixtime.sh**

   ```
   # chmod 755 fixtime.sh
   ```

3. Modify the **/etc/crontab** file to run fixtime.sh at 8:00 every day.

   Add the following line to the end of crontab:

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

Inserting a USB Storage Device into the Computer

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

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

Alternatively, you can check the **/proc/partitions** file.

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

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

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

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

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

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

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

ATTENTION

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

Example:

```
root@Moxa:/home/moxa# kversion -h
Usage:
       kversion [OPTIONS]
Options:
       -a, --all             show firmware version and build date
       -s, --serial           show PCBA serial number
       -t, --type            show PCBA type number(00-CPU Board, 01-Carrier Board,
02-Riser card)
       -v, --version          show PCBA version
       -h, --help            show this help page
root@Moxa:/home/moxa# kversion -a
DA-820C firmware version v1.0.0 build 201901091804
root@Moxa:/home/moxa# kversion -s
0
root@Moxa:/home/moxa# kversion -t
01
root@Moxa:/home/moxa# kversion -v
0
```

APT—Installing and Removing Packages

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

Use vi editor to configure **/etc/apt/sources.list**.

```
deb mirror://debian.moxa.com/debian/mirrors stretch main contrib non-free

deb  http://deb.debian.org/debian stretch main contrib non-free
#deb-src  http://deb.debian.org/debian stretch main contrib non-free

deb  http://deb.debian.org/debian stretch-updates main contrib non-free
#deb-src  http://deb.debian.org/debian stretch-updates main contrib non-free

deb  http://deb.debian.org/debian stretch-backports main contrib non-free
#deb-src  http://deb.debian.org/debian stretch-backports main contrib non-free

deb  http://security.debian.org/ stretch/updates main contrib non-free
#deb-src  http://security.debian.org/ stretch/updates main contrib non-free
```

1. Update the source list after you configure it.

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

2. Once you indicate which package you want to install (**ipsec-tools**, for example), type:

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

3. Use one of the following commands to remove a package:

   a. For a simple package removal:

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

   b. For a complete package removal:

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

ATTENTION

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

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

3

Managing Communications

The V2406C 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:

- **Changing the Interface Configuration File**
  - Adjusting IP Addresses with "ifconfig"
- **DNS Client**
  - /etc/hostname
  - /etc/resolv.conf
  - /etc/nsswitch.conf
- **Configuring Ethernet Bonding**
- **IPTABLES**
  - IPTABLES Hierarchy
  - IPTABLES Modules
  - Observing and Erasing Chain Rules
  - Defining the Policy for Chain Rules
  - Appending and Deleting Rules
- **Network Address Translation**
  - NAT Example
  - Enabling NAT At Bootup
- **PPP (Point-to-point Protocol)**
  - Connecting to a PPP Server Over a Simple Dial-up
  - Connecting to a PPP Server Over a Hard-wired Link
  - Checking the Connection
  - Setting Up a Machine for Incoming PPP Connections
- **PPPoE**
- **Network File System Client**
- **Simple Network Management Protocol**
- **OpenVPN**
  - Installing OpenVPN
  - Ethernet Bridging for Private Networks on Different Subnets
  - Ethernet Bridging for Private Networks on the Same Subnet
  - Routed IP

Changing the Interface Configuration File

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

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

2. Type **vi interfaces** to edit the network configuration file with **vi** editor. You can configure the V2406C computer Ethernet ports for static or dynamic (DHCP) IP addresses.

```
root@Moxa:~#/etc/network# vi interfaces
```

Static IP Address

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

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

# The primary network interface
auto enp0s31f6
allow-hotplug enp0s31f6
iface enp0s31f6 inet static
       address 192.168.3.127
       netmask 255.255.255.0
       broadcast 192.168.3.255

auto enp9s0
allow-hotplug enp9s0
iface enp9s0 inet static
       address 192.168.4.127
       netmask 255.255.255.0
       broadcast 192.168.4.255

auto enp10s0
allow-hotplug enp10s0
iface enp10s0 inet static
       address 192.168.5.127
       netmask 255.255.255.0
       broadcast 192.168.5.255

auto enp11s0
allow-hotplug enp11s0
iface enp11s0 inet static
       address 192.168.6.127
       netmask 255.255.255.0
       broadcast 192.168.6.255
```

Dynamic IP Address Using DHCP

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

```
# The primary network interface
auto enp0s31f6
iface enp0s31f6 inet dhcp
```

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

 # /etc/init.d/networking restart

```
moxa@Moxa:~# sudo ip addr flush enp0s31f6
moxa@Moxa:~# sudo service 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 flash ROM without modifying the file **/etc/network/interfaces**. For example, type the command **# ifconfig enp0s31f6 192.168.1.1** to change the IP address of LAN1 to 192.168.1.1.

```
moxa@Moxa:~# sudo ifconfig enp0s31f6 192.168.1.1
```

DNS Client

The V2406C computer 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. Rboot the hostname.
   ```
   moxa@Moxa:~# sudo reboot
   ```
3. Check the new hostname.
   ```
   moxa@Moxa:~# sudo hostname
   ```

/etc/resolv.conf

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

```
moxa@Moxa:/etc# cat resolv.conf
#
# resolv.conf  This file is the resolver configuration file
# See resolver(5).
#
#nameserver 192.168.1.16
```

```
nameserver 8.8.8.8
nameserver 8.8.8.4
nameserver 168.95.1.1
```

/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:** information in the **/etc/nsswitch.conf** file means that the **/etc/host** is used first and the DNS service is used to resolve the IP address.

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

passwd:         compat
group:          compat
shadow:         compat

hosts:          files dns
networks:       files

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

netgroup:       nis
```

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 into bond0 interface. Here is the script bonded enp9s0 and enp10s0 together, you can put it in **/etc/init.d/bonding.sh**.

```
#! /bin/bash

NAME=bonding
PATH=/bin:/usr/bin:/sbin:/usr/sbin
BONDING_IP=192.168.3.127

case "$1" in
  start)
    # to set ethX interfaces as slave the bond0 must have an ip
    echo "Starting bonding service: $NAME."
    modprobe bonding mode=1 miimon=100      # load bonding module

    ifdown enp10s0              # putting down LAN3
    ifdown enp9s0               # putting down LAN2

    ifconfig bond0 $BONDING_IP netmask 255.255.255.0 up # set ip address
```

```
    ifenslave bond0 enp10s0         # set LAN3 in slave for bond0
    ifenslave bond0 enp9s0          # set LAN2 in slave for bond0
    ;;

  stop)
    echo "Stopping bonding service: $NAME"
    ifenslave -d bond0 enp10s0          # release LAN3 from bond0
    ifenslave -d bond0 enp9s0           # release LAN2 from bond0

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

    ifup enp10s0
    ifup enp9s0
    ;;

  restart)
    $0 stop
    $0 start $BONDING_IP
    ;;

  *)
    echo "Usage: systemctl {start|stop|restart} $NAME "
    exit 1
    ;;
esac

exit 0
```

Creates a systemd service unit at /etc/systemd/system/bonding.service for bonding the Ethernet service

```
[Unit]
Description=Bonding service

[Service]
Type=oneshot
ExecStart=/sbin/bonding.sh start
ExecStop=/sbin/bonding.sh stop
RemainAfterExit=yes

[Install]
WantedBy=default.target
```

To install it, use the following command.

```
moxa@Moxa:~# sudo systemctl enable bonding
```

To uninstall it, use this command.

```
moxa@Moxa:~# sudo systemctl disable bonding
```

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**.

Linux supports three types of IPTABLES: Filter tables, NAT tables, and Mangle tables.

Filter Table—includes three chains:

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

NAT Table—includes three chains:

- **PREROUTING chain**—transfers the destination IP address (DNAT).
- **POSTROUTING chain**—works after the routing process and before the Ethernet device process to transfer the source IP address (SNAT).
- **OUTPUT chain**—produces local packets.

Sub-tables

- **Source NAT (SNAT)**—changes the first source IP address of the packet.
- **Destination NAT (DNAT)**—changes the first destination IP address of the packet.
- **MASQUERADE**—a special form for SNAT. If one host can connect to the Internet, then the other computers that connect to this host can connect to the Internet when the computer does not have an actual IP address.
- **REDIRECT**—a special form of DNAT that re-sends packets to a local host independent of the destination IP address.

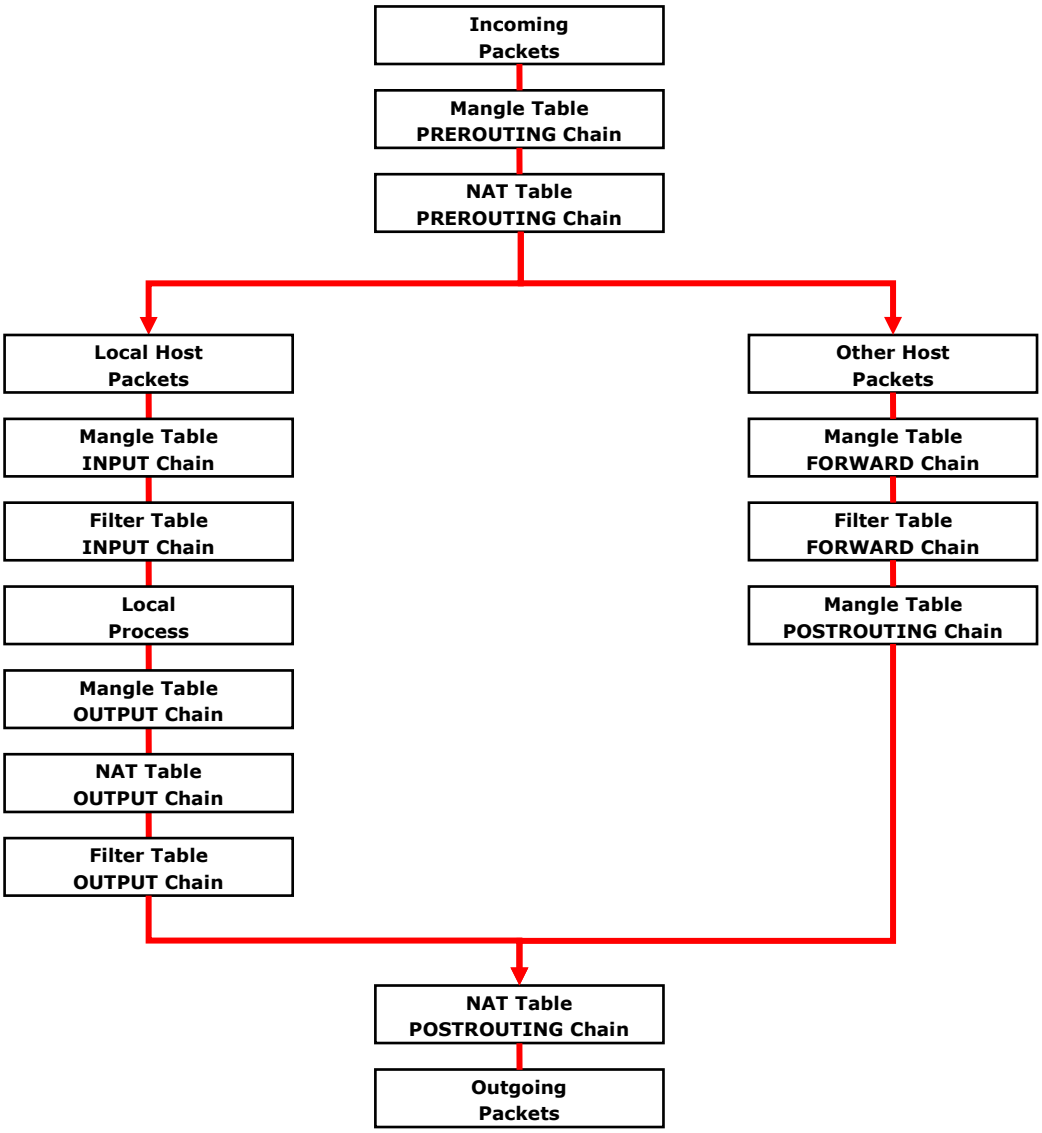
Mangle Table—includes two chains

- **PREROUTING chain**—pre-processes packets before the routing process.
- **OUTPUT chain**—processes packets after the routing process.

Mangle tables can have one of three extensions—TTL, MARK, TOS.

IPTABLES Hierarchy

The following figure shows the IPTABLES hierarchy.



IPTABLES Modules

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

arptable_filter.ko	arp_tables.ko	arpt_mangle.ko	ip_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
iptable_filter.ko	iptable_mangle.ko	iptable_nat.ko	iptable_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 V2406C computer. Use **modprobe** to insert and enable the module.

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

ATTENTION

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

http://www.linuxguruz.com/iptables/
http://www.netfilter.org/documentation/HOWTO//packet-filtering-HOWTO.html

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

Observing and Erasing Chain Rules

Usage:

 # iptables [-t tables] [-L] [-n]

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

 # iptables [-t tables] [-FXZ]

-F: Flush the selected chain (all the chains in the table if none is listed).
-X: Delete the specified user-defined chain.
-Z: Set the packet and byte counters in all chains to zero.

Example:

 # iptables -L -n

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

 # iptables -F
 # iptables -X
 # iptables –Z

Defining the 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 device.

OUTPUT: For locally-generated packets.

FORWARD: For packets routed out through the device.

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.

Appending and Deleting 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 enp0s31f6 -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 enp0s31f6 -p tcp -s 192.168.1.0/24 -j ACCEPT

Example 4: Drop TCP packets from 192.168.1.25.

 # iptables -A INPUT -i enp0s31f6 -p tcp -s 192.168.1.25 -j DROP

Example 5: Drop TCP packets addressed for port 21.

 # iptables -A INPUT -i enp0s31f6 -p tcp --dport 21 -j DROP

Example 6: Accept TCP packets from 192.168.0.24 to the V2406C computer's port 137, 138, 139

 # iptables -A INPUT -i enp0s31f6 -p tcp -s 192.168.0.24 --dport 137:139 -j ACCEPT

Example 7: Log TCP packets that visit the V2406C computer's port 25.

 # iptables -A INPUT -i enp0s31f6 -p tcp --dport 25 -j LOG

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

 # iptables -A INPUT -i enp0s31f6 -p all -m mac --mac-source 01:02:03:04:05:06 -j DROP

ATTENTION

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

Network Address Translation

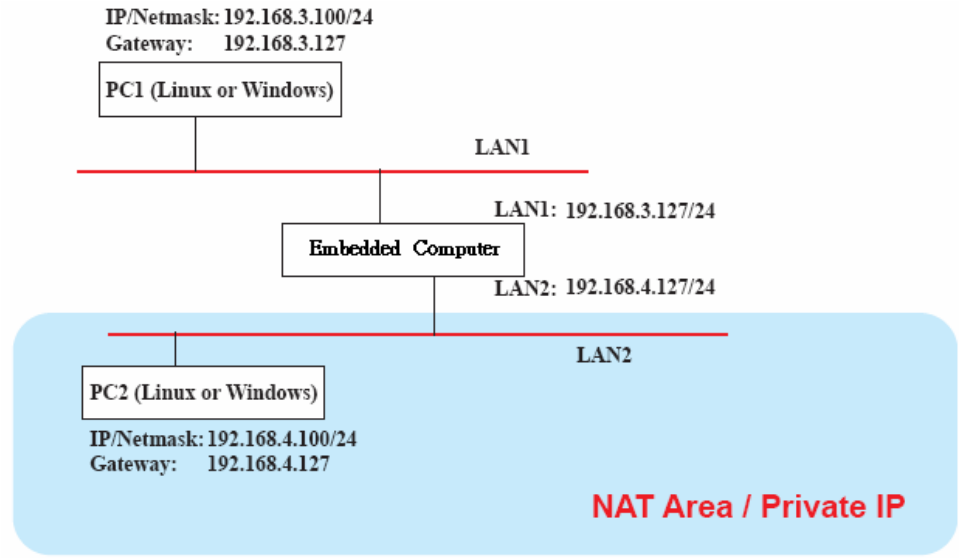
The Network Address Translation (NAT) protocol translates IP addresses used on one network into IP addresses used on a connecting network. One network is designated the inside network and the other is the outside network. Typically, the V2406C computer connects several devices on a network and maps local inside network addresses to one or more global outside IP addresses, and un-maps the global IP addresses on incoming packets back into local IP addresses.

ATTENTION

Click the following link for more information on NAT:
http://www.netfilter.org/documentation/HOWTO//packet-filtering-HOWTO.html

NAT Example

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



Enabling NAT At Bootup

In most real world situations, you will want to use a simple shell script to enable NAT when the V2406C computer 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= "enp0s31f6"  #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 enp0s31f6 -j MASQUERADE
```

PPP (Point-to-point Protocol)

PPP (Point to Point Protocol) 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 PPP 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

The following 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). Note that "debug crtscts" and "defaultroute 192.1.1.17" are optional.

#pppd connect 'chat -v "" ATDT5551212 CONNECT ""' login: username word: password' /dev/ ttyM0 115200 debug crtscts modem defaultroute 192.1.1.17

If the PPP server does not prompt for the username and password, the 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/ ttyM0 115200 crtscts modem

The pppd options are described below:

connect 'chat etc...' This option gives the command to contact the PPP server. The **chat** program is used to dial a remote computer. The entire command is enclosed in single quotes because pppd expects a one-word argument for the **connect** option. The options for **chat** are given below:

-v verbose mode; log what we do to syslog

" " Double quotes—don't wait for a prompt, but instead do ... (note that you must include a space after the second quotation mark)

ATDT5551212 Dial the modem, and then ...

CONNECT Wait for an answer.

" " Send a return (null text followed by the usual return)

ogin: username word: password
Log in with username and password.

Note: Refer to the chat man page, chat.8, for more information about the **chat** utility.

/dev/ Specify the callout serial port.

115200 The baud rate.

debug Log status in syslog.

crtscts Use hardware flow control between the computer and modem (at baudrate of 115200 this is a must).

modem Indicates that this is a modem device; pppd will hang up the phone before and after making the call.

defaultroute 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.

192.1.1.17 This is a degenerate case of a general option of the form x.x.x.x:y.y.y.y. Here x.x.x.x is the local IP address and y.y.y.y 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 x.x.x.x defaults to the IP address associated with the local machine's hostname (located in /**etc/hosts**), and y.y.y.y 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/ttyM0 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/ttyM0 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.

ppp0 should be one of the network interfaces. You should recognize the first IP address as 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, 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/ttyM0 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/ttyM0 115200 crtscts modem 192.168.16.1:192.168.16.2

Method 2: pppd dial-in with pppd script

Configure the 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-ttyMUE0.chat"

# Set up routing to go through this PPP link
defaultroute

# Default modem (you better replace this with /dev/ttySx!)
/dev/ttyM0

# 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-ttyM0.chat**

```
SAY     'Auto Answer ON\n'
''      ATS0=1
```

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

```
# pppd call dialin
```

PPPoE

Use the following procedure to configure PPPoE.

1. Connect the V2406C computer's LAN port to an ADSL modem with a cross-over cable, HUB, or switch.
2. Log in to the V2406C computer as the root user.
3. 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.

4. 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.

5. 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>---
```

6. If you use LAN1 to connect to the ADSL modem, add the file **/etc/ppp/options.enp0s31f6**, if you use LAN2 to connect to the ADSL modem, add **/etc/ppp/options.enp9s0**, etc.

```
name username@hinet.net
mtu 1492
mru 1492
defaultroute
noipdefault
~
~
 "/etc/ppp/options.enp0s31f6" 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.

7. 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 168.95.1.1
   nameserver 139.175.10.20

```
moxa@Moxa:/etc# cat resolv.conf
#
# resolv.conf  This file is the resolver configuration file
# See resolver(5).
#
nameserver 168.95.1.1
nameserver 139.175.10.20
```

Use the following command to create a **pppoe** connection:
#pppd enp0s31f6

8. The ADSL modem is connected to the **LAN1** port, which is named **enp0s31f6**. If the ADSL modem is connected to **LAN2**, use **enp9s0**, etc.
9. 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
```

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

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 users to develop applications for the V2406C computer without worrying about the amount of disk space that will be available. The V2406C computer 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.

1. Scan the NFS Server's shared directory:
   #showmount -e HOST
   showmount: Shows the mount information of an NFS Server
   -e: Shows the NFS Server's export list.
   HOST: IP address or DNS address
2. Establish a mount point on the NFS Client site:
   #mkdir -p /home/nfs/public
3. Mount the remote directory to a local directory:
   # mount -t nfs -o nolock 192.168.3.100:/home/public /home/nfs/public
   (This is where 192.168.3.100 is the example IP address of the NFS server.)

Simple Network Management Protocol

The V2406C computer comes with the simple network management protocol (SNMP) v2c software package preinstalled. The snmpd service is disabled by default. You can enable it using the following command.

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

The snmpd configuration is available in the **/etc/snmp/snmpd.conf** file. If you want to support the SNMP service for all listening interfaces, you should remove the '#' before the **/etc/snmp/snmpd.conf** entry and then restart the snmpd service.

```
/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)
# For security concern, we comment out this line. If you want to support SNMP on
all Ethernet Interfaces, please remove the '#' and restart the snmpd service.
# agentAddress udp:161,udp6:[::1]: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:

```
root@Moxa:/home/moxa# snmpwalk -c public -v2c 127.0.0.1
iso.3.6.1.2.1.1.1.0 = STRING: "Linux Moxa 4.9.0-6-amd64 #1 SMP Debian 4.9.88-1
(2018-04-29) x86_64"
iso.3.6.1.2.1.1.2.0 = OID: iso.3.6.1.4.1.8072.3.2.10
iso.3.6.1.2.1.1.3.0 = Timeticks: (21934) 0:03:39.34
iso.3.6.1.2.1.1.4.0 = STRING: "Me <me@example.org>"
iso.3.6.1.2.1.1.5.0 = STRING: "Moxa"
iso.3.6.1.2.1.1.6.0 = STRING: "Sitting on the Dock of the Bay"
iso.3.6.1.2.1.1.7.0 = INTEGER: 72
iso.3.6.1.2.1.1.8.0 = Timeticks: (1) 0:00:00.01
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.3.6.1.6.3.16.2.2.1
iso.3.6.1.2.1.1.9.1.2.6 = OID: iso.3.6.1.2.1.49
iso.3.6.1.2.1.1.9.1.2.7 = OID: iso.3.6.1.2.1.4
iso.3.6.1.2.1.1.9.1.2.8 = OID: iso.3.6.1.2.1.50
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: "View-based Access Control Model for SNMP."
iso.3.6.1.2.1.1.9.1.3.6 = STRING: "The MIB module for managing TCP
implementations"
iso.3.6.1.2.1.1.9.1.3.7 = STRING: "The MIB module for managing IP and ICMP
implementations"
iso.3.6.1.2.1.1.9.1.3.8 = STRING: "The MIB module for managing UDP
implementations"
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: (0) 0:00:00.00
iso.3.6.1.2.1.1.9.1.4.2 = Timeticks: (0) 0:00:00.00
iso.3.6.1.2.1.1.9.1.4.3 = Timeticks: (0) 0:00:00.00
iso.3.6.1.2.1.1.9.1.4.4 = Timeticks: (0) 0:00:00.00
```

```
iso.3.6.1.2.1.1.9.1.4.5 = Timeticks: (0) 0:00:00.00
iso.3.6.1.2.1.1.9.1.4.6 = Timeticks: (0) 0:00:00.00
iso.3.6.1.2.1.1.9.1.4.7 = Timeticks: (0) 0:00:00.00
iso.3.6.1.2.1.1.9.1.4.8 = Timeticks: (0) 0:00:00.00
iso.3.6.1.2.1.1.9.1.4.9 = Timeticks: (0) 0:00:00.00
iso.3.6.1.2.1.1.9.1.4.10 = Timeticks: (1) 0:00:00.01
iso.3.6.1.2.1.25.1.1.0 = Timeticks: (1105369) 3:04:13.69
iso.3.6.1.2.1.25.1.2.0 = Hex-STRING: 07 E3 03 07 0E 02 10 00 2B 08 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-4.9.0-6-amd64
root=UUID=babacb3b-a96c-449b-89e0-5505c43a1a40 ro quiet
"
iso.3.6.1.2.1.25.1.5.0 = Gauge32: 1
iso.3.6.1.2.1.25.1.6.0 = Gauge32: 102
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)
```

OpenVPN

OpenVPN provides two types of tunnels for users to implement 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.

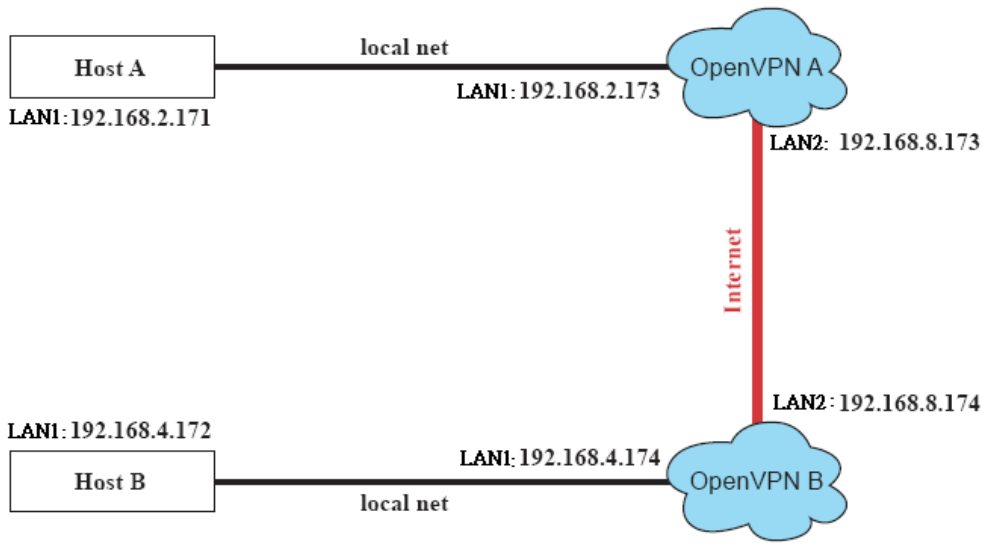
Installing OpenVPN

OpenVPN is an open VPN software. You can install it by this command.

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

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 preshared key is located at **/etc/openvpn/secrouter.key**. You can use it for testing purposes. We suggest creating a new key for non-testing 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
```

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---------------------------
```

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

```
#!/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="enp9s0"
eth_ip="192.168.8.173"
eth_netmask="255.255.255.0"
eth_broadcast="192.168.8.255"
#gw="192.168.8.174"
...
```

Start the bridge script file to configure the bridge interface:
 # /etc/openvpn/bridge restart

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
```

5. 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 -----------------------------
```

6. 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="enp9s0"
eth_ip="192.168.8.174"
eth_netmask="255.255.255.0"
eth_broadcast="192.168.8.255"
#gw="192.168.8.173"
...
```

7. 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

8. 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

9. On each OpenVPN machine, check the routing table by typing the command **# route**

```
Destination     Gateway Genmsk          Flags   Metric  Ref Use Iface
192.168.5.0     0.0.0.0 255.255.255.0   U       0       0   0   enp10s0
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   enp0s31f6
192.168.30.0    0.0.0.0 255.255.255.0   U       0       0   0   enp11s0
192.168.8.0     0.0.0.0 255.255.255.0   U       0       0   0   br0
```

   Interface **enp9s0** 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 enp9s0 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.

10. 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 enp0s31f6

    To create an indirect connection from Host B to Host A, you need to add the following routing item:
    # route add –net 192.168.2.0 netmask 255.255.255.0 dev enp0s31f6

    Now ping Host B from Host A by typing:
    # ping 192.168.4.174

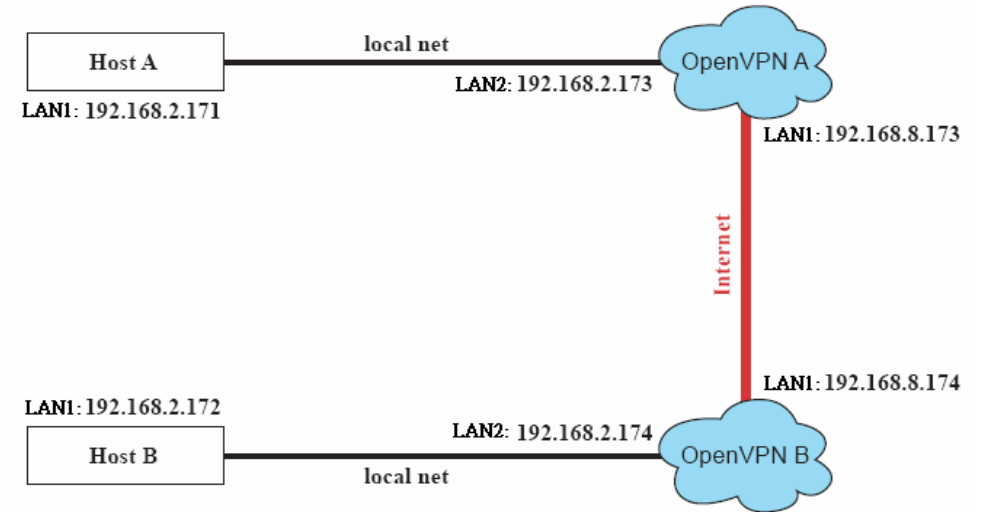
    A successful ping indicates that you have created a VPN system that only allows authorized users from one internal network to access users at the remote site. For this system, all data is transmitted by UDP packets on port 5000 between OpenVPN peers.

11. 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.

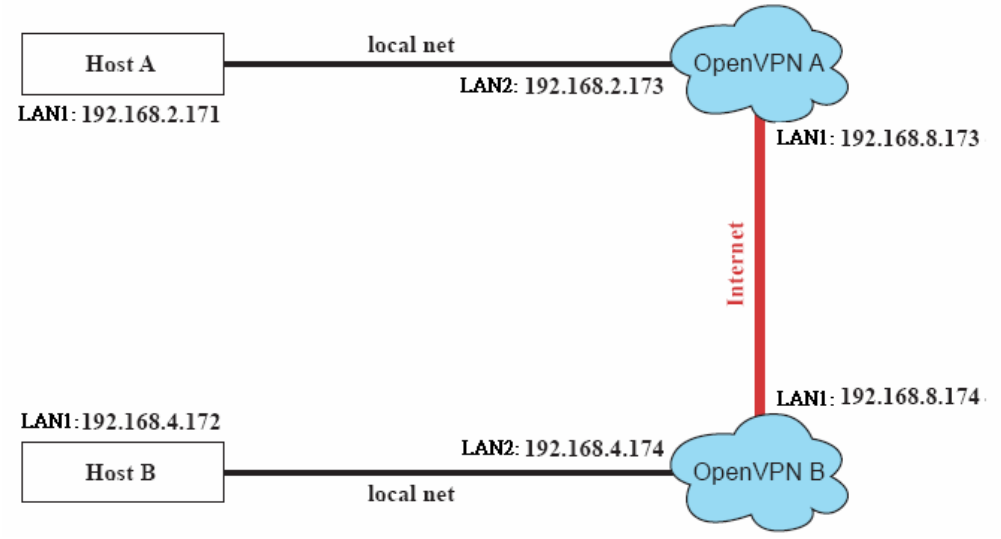


2. The configuration procedure is almost the same as for the previous example. The only difference is that you will need to comment out the parameter **up** in **/etc/openvpn/tap0-br.conf** of OpenVPN A and **/etc/openvpn/tap0-br.conf** of OpenVPN B.

```
# 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 command **# route**.

```
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   enp9s0
192.168.8.0     *               255.255.255.0   U       0       0   0
    enp0s31f6
```

4

System Restore and Backup

The V2406C computer is installed with the Embedded Linux operating system, which is located in the mSATA shipped with the V2406C computer. Although it rarely happens, you may find on occasion that operating system files and/or the disk file system have been damaged. In this chapter we describe how to restore the Linux operating system.

The following topics are covered in this chapter:

- **Restore Environment**
- **Restore the System from the USB Drive**
- **Backup the System to the USB Drive**

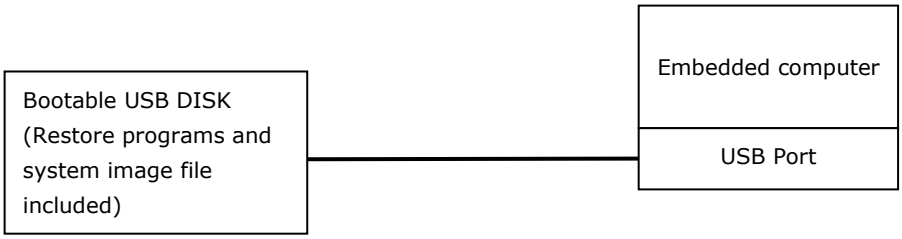
Restore Environment

The restore environment includes the V2406C embedded computer and a bootable USB disk with the restore programs and system image file.

Hardware

The hardware used includes a PC, a V2406C computer, and a USB disk with the restore programs.

NOTE The USB disk should be at least 2GB.



Restore the System from the USB Drive

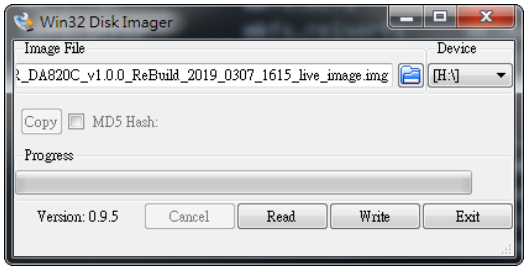
Step 1: Prepare your USB drive

For Windows user:

Execute **Win32DiskImager installer** from the **utility_tools/** folder on the Software CD. Or you can download it from https://sourceforge.net/projects/win32diskimager/

After install processes, execute **Win32DiskImager,** and select the Moxa Live USB image file in the directory of
Restore\moxa_live_image\FWR_<product>_<version>_ReBuild_<date>_live_image.img

The Moxa Live USB image file **contains corresponding firmware image**.



For Debian Linux user:

Copy the ISO file in the directory of

Restore\moxa_live_image\FWR_<product>_<version>_ReBuild_<date>_live_image.img

For example: (/dev/sde is USB storage device node)

```
root@Moxa:/home/moxa# dd if=FWR_DA820C_<version>_ReBuild_<date>_live_image.img
of=/dev/sde conv=noerror,sync status=progress bs=4096
262144+0 records in
262144+0 records out
1073741824 bytes (1.1 GB, 1.0 GiB) copied, 403.449 s, 2.7 MB/s
root@Moxa:/home/moxa# parted /dev/sde print Fix
Warning: Not all of the space available to /dev/sde appears to be used, you can
fix the GPT to use all of the space (an extra 13126656 blocks) or continue with
the
current setting?
```

```
Model: SanDisk Cruzer Blade (scsi)
Disk /dev/sde: 7795MB
Sector size (logical/physical): 512B/512B
Partition Table: gpt
Disk Flags:

Number  Start   End     Size    File system  Name   Flags
 1      1049kB  10.5MB  9437kB  fat16        EFI    boot, esp
 2      10.5MB  268MB   258MB   ext4         ROOT
 3      268MB   1073MB  804MB   ext4         IMAGE
root@Moxa:/home/moxa# parted -s /dev/sde resizepart 3 100%
root@Moxa:/home/moxa# sync
root@Moxa:/home/moxa# e2fsck -fy /dev/sde3
e2fsck 1.43.4 (31-Jan-2017)
Pass 1: Checking inodes, blocks, and sizes
Pass 2: Checking directory structure
Pass 3: Checking directory connectivity
Pass 4: Checking reference counts
Pass 5: Checking group summary information
/dev/sde3: 23/49152 files (0.0% non-contiguous), 136129/196352 blocks
root@Moxa:/home/moxa# resize2fs /dev/sde3
resize2fs 1.43.4 (31-Jan-2017)
Resizing the filesystem on /dev/sde3 to 1837435 (4k) blocks.
The filesystem on /dev/sde3 is now 1837435 (4k) blocks long.
```

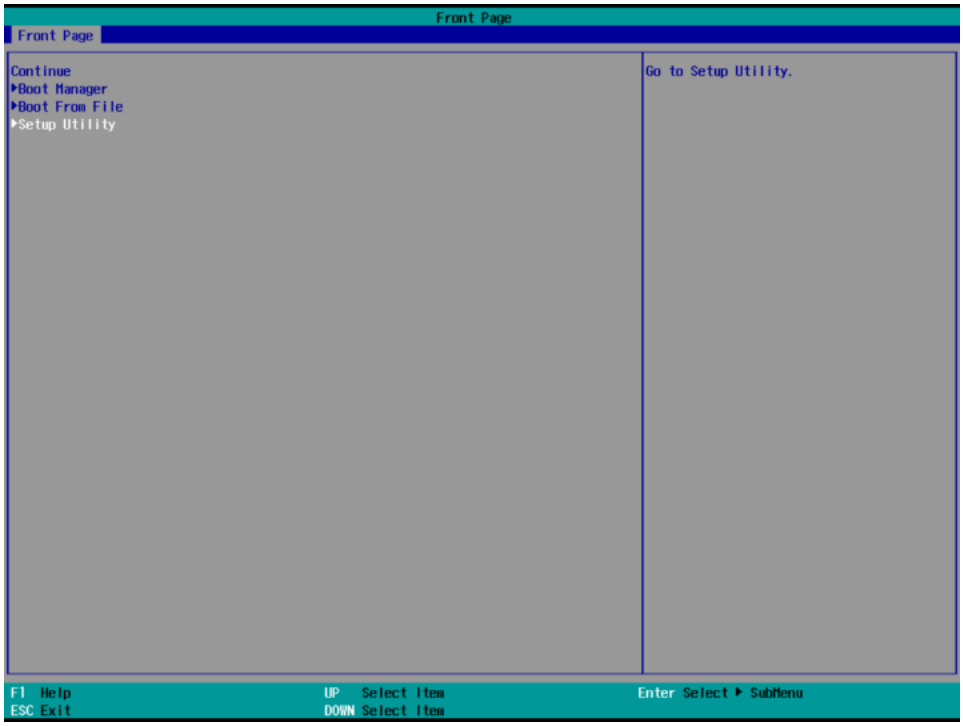
Standalone Debian firmware image file:
Restore\firmware\FWR_<product>_<version>_ReBuild_<date>.img

Compressed firmware image:
Restore\firmware\FWR_<product>_<version>_ReBuild_<date>.img.gz

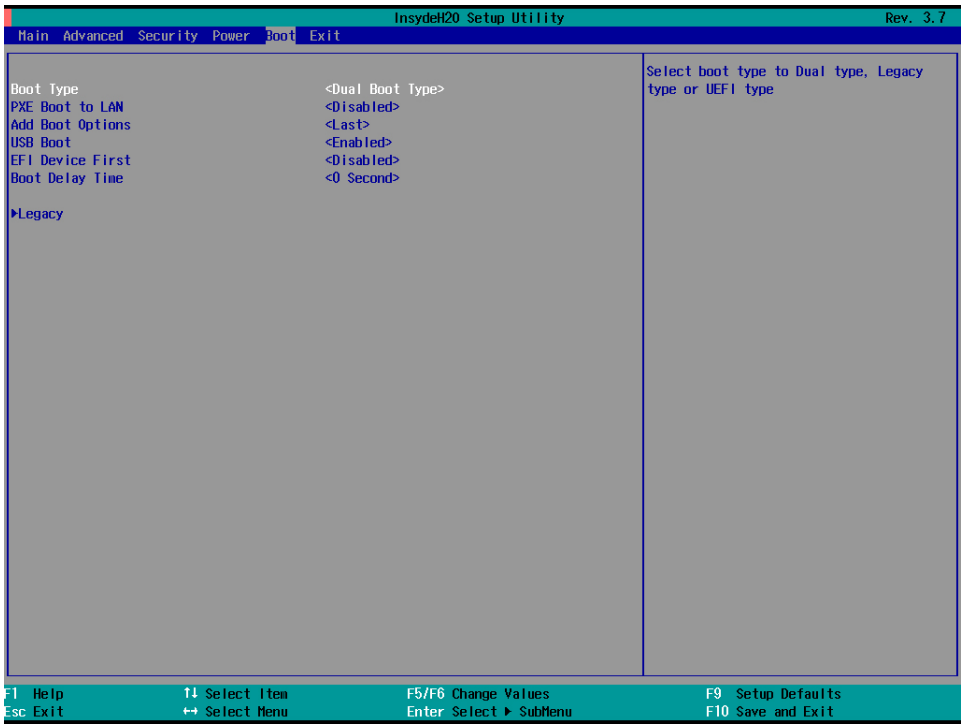
Step 2: Change the BIOS Settings

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

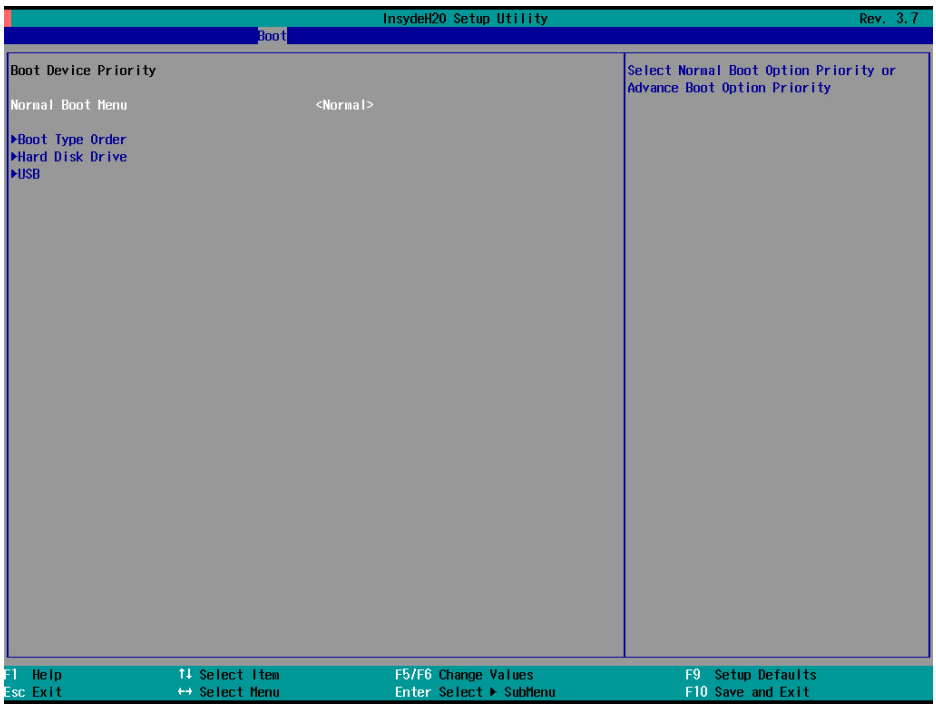
1. Turn on the computer and press **F2.** Select **Setup Utility** in the following screen.



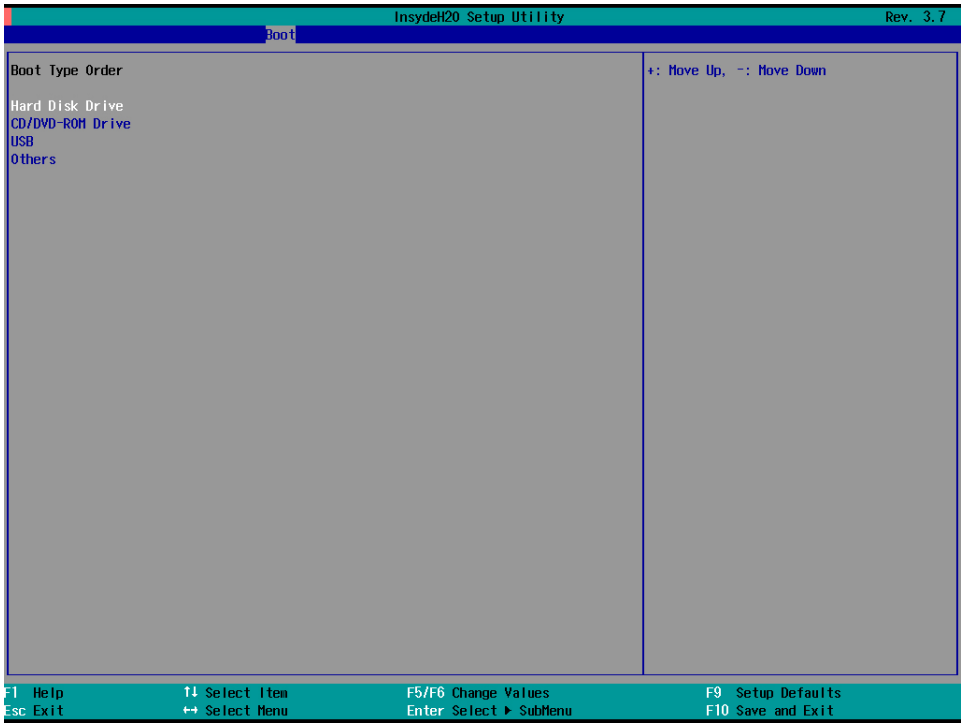
2. Select **Boot** and then select UEFI **Boot Type**. Press **Enter** to continue.



3. Select **Boot order**.



4. Select USB disk and then press "+" to move it to the first boot device position.
   Warning: An incorrect boot priority will lead to restore or boot failure.



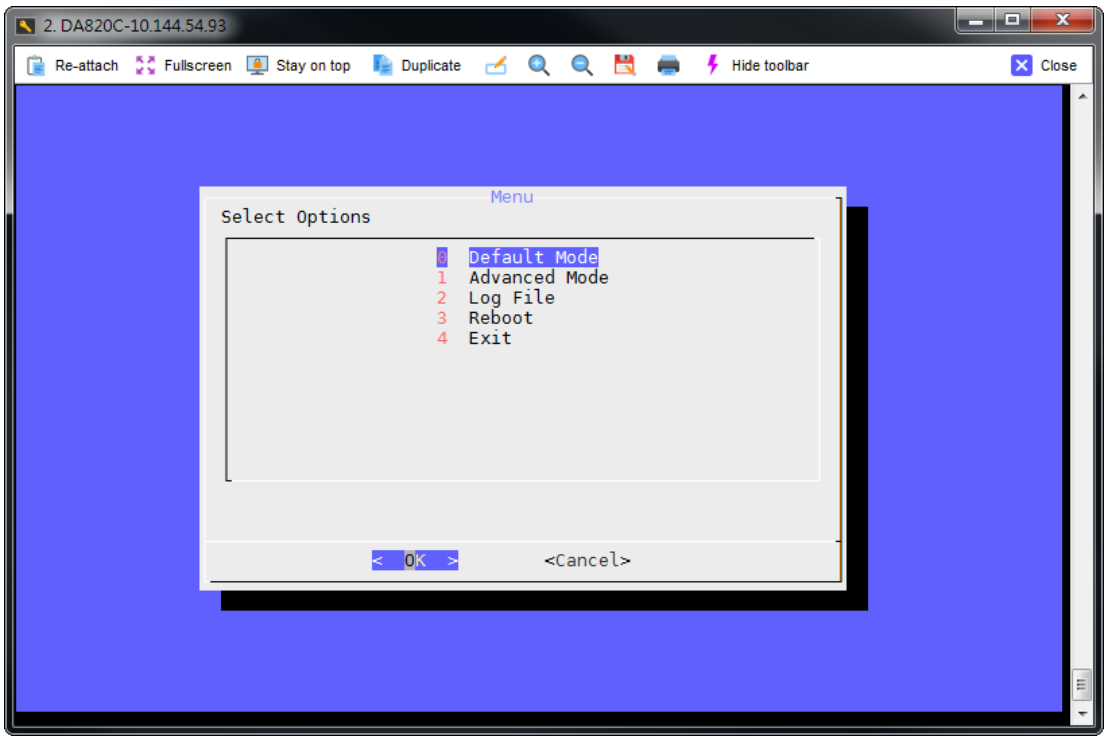
5. Press **F10** and then press **Enter** to save and exit BIOS setup.
6. Insert the USB disk and then reboot the computer.
7. Press F2 to enter the BIOS setting.
8. Select the **Boot Manager**.
9. Select EFI **USB device.**
   The system will boot from the restore utility.

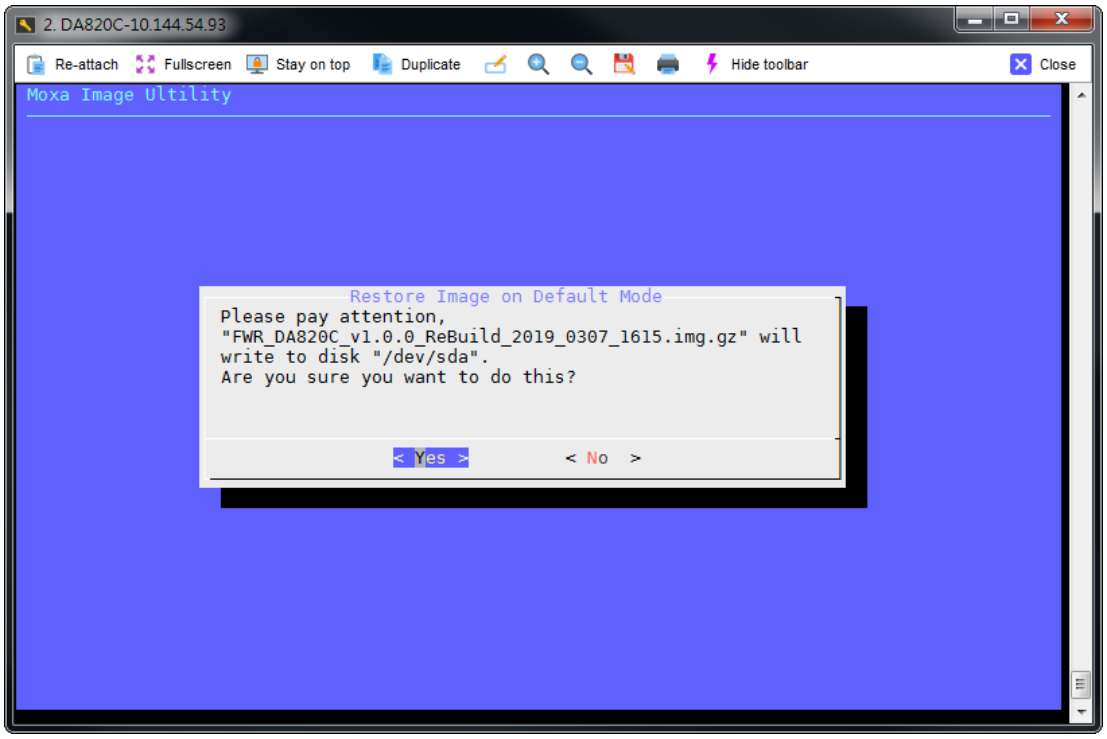
Step 3: Restore the system from the USB drive

Connect the USB disk to any of the V2406C computer's USB ports and then reboot the computer. The system will boot from the USB disk and the Pre-installation Environment and the restore utility will appear.

[Default Mode]

Selecting the "Default Mode" option will write the default image to the default mSATA disk. **If you have multiple images or storage disks, we strongly suggest that you select the "Advanced mode" option.**

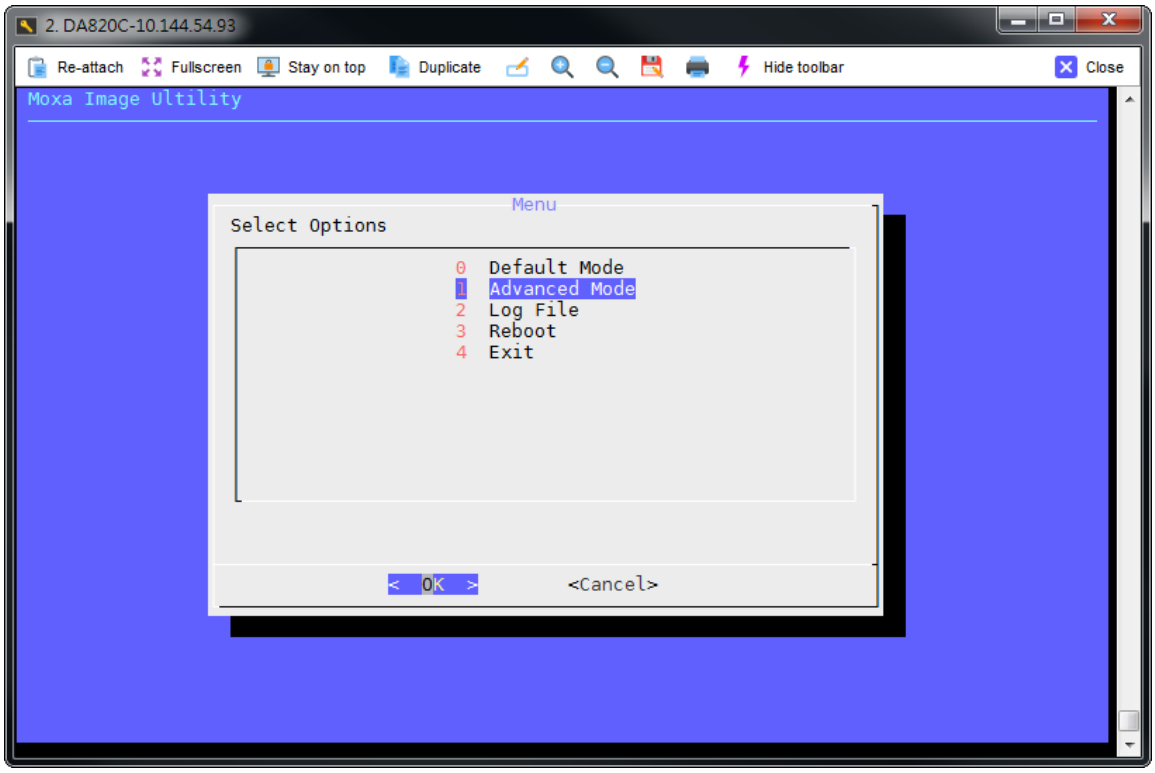




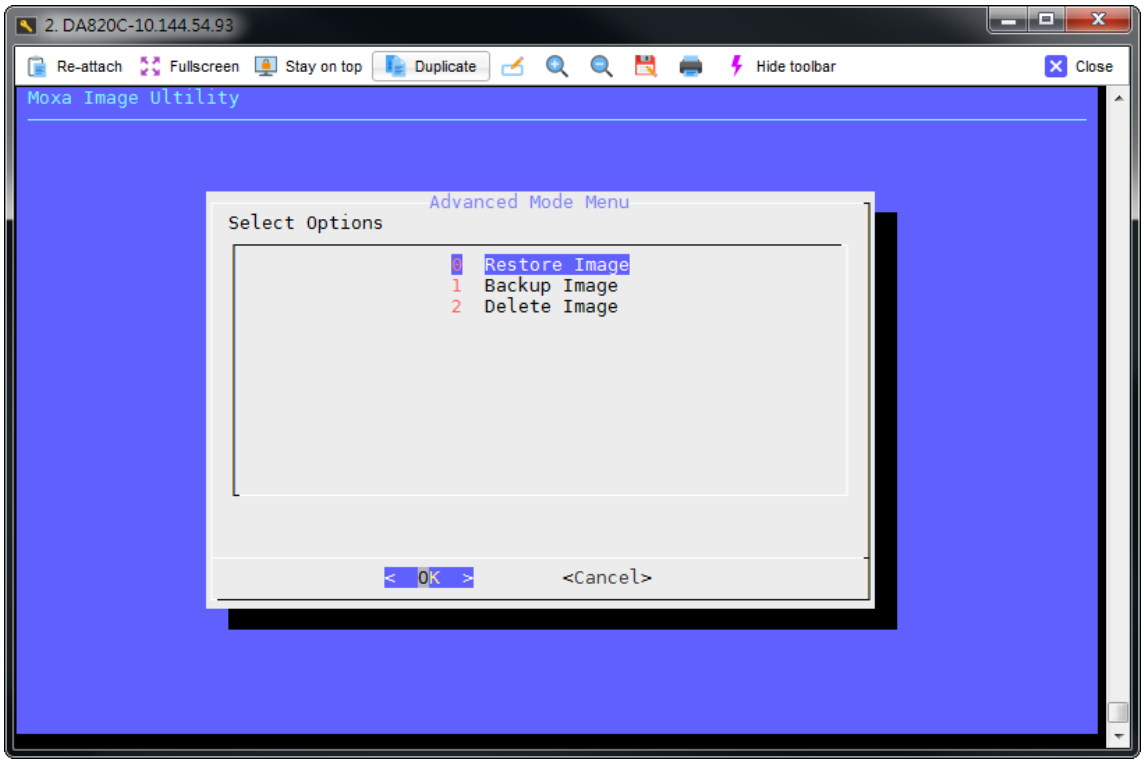
Press OK and wait for restore image process. If the process was finished, you can select to reboot, and remove the USB drive after the computer has been powered off, and jump to Step4.

[Advanced Mode]

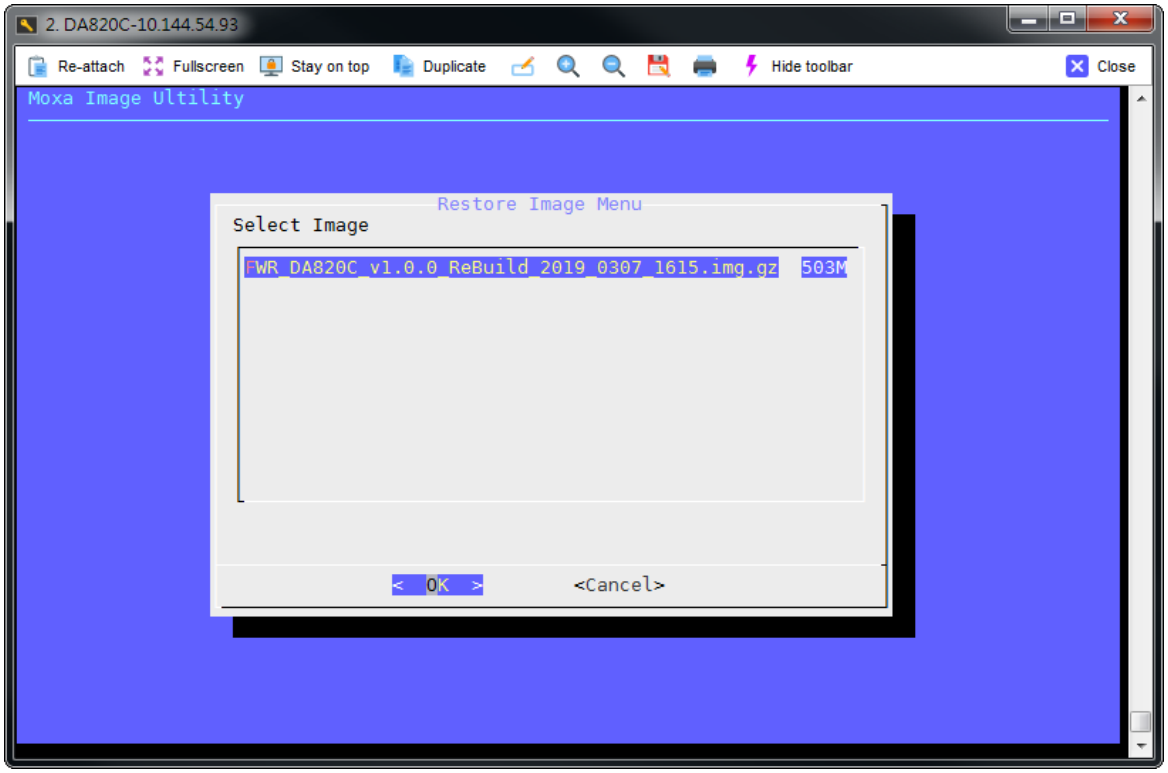
1. Select the **Advanced Mode** option in the utility window and select **OK**.



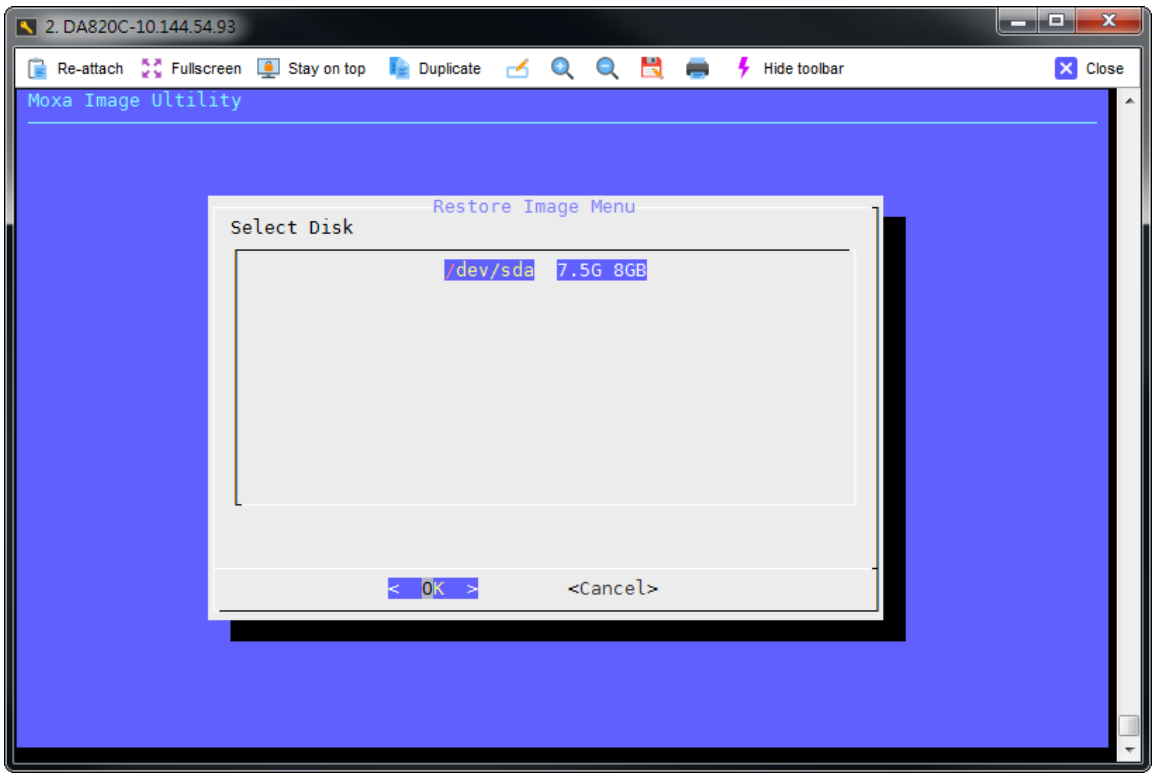
2. Select the **Restore Image** and then select **OK**.



3. Select the target image.



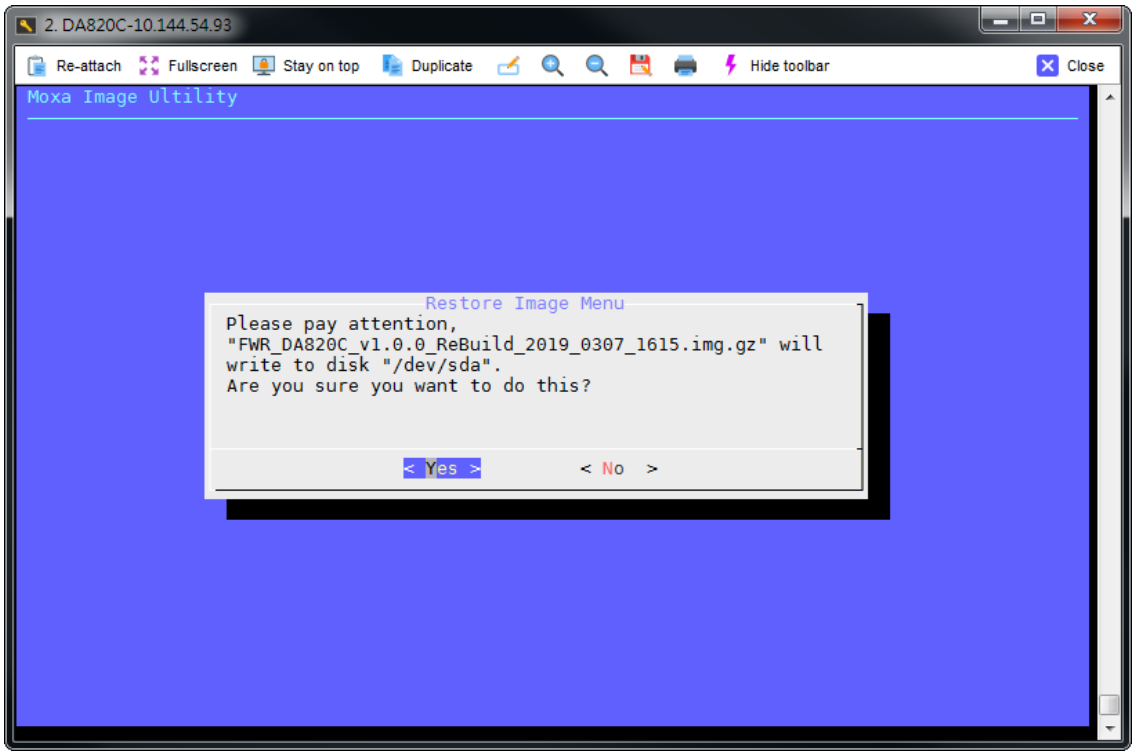
4. Select the target storage disk.



5. Reconfim the operation by selecting **OK**.

IMPORTANT!

This step will erase all partitions on the disk.

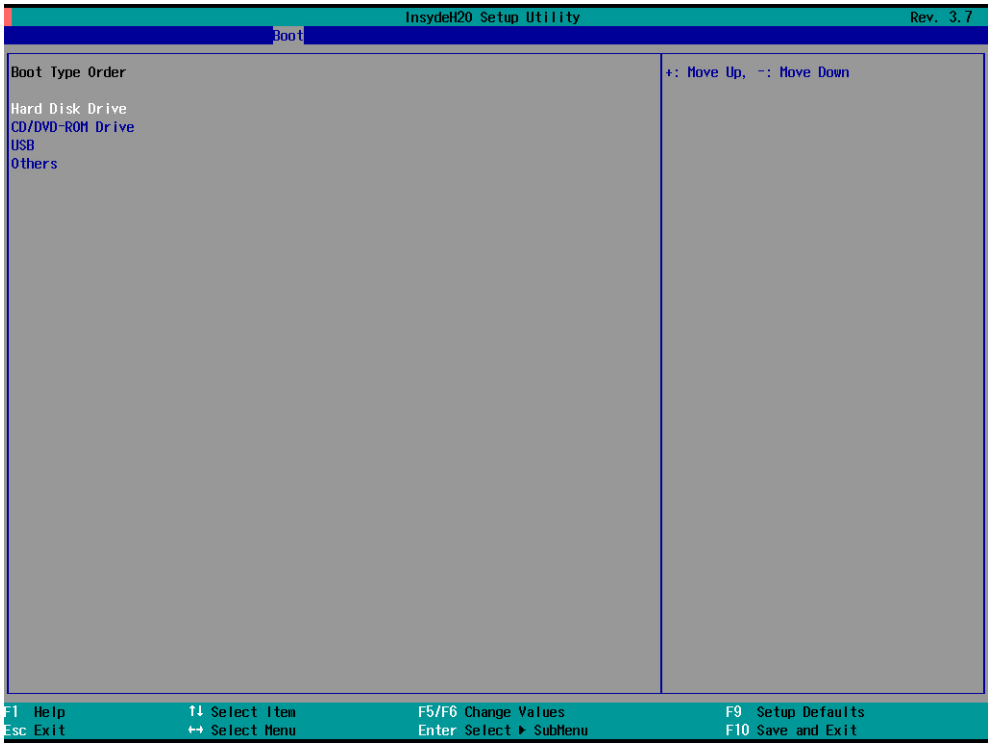


Wait for the restore image process to complete. After the process is completed, you can select the reboot, option, remove the USB drive after the computer has been powered off, and go to Step 4.

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

You will need to change the boot priority so that the system can boot from the original disk. As the system reboots, press **F2** to enter the BIOS setup menu.

1. Select **Hard Disk Drive,** press + to move to the first boot device position, and then press **Enter.** Confirm that the hard disk has first boot priority.



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

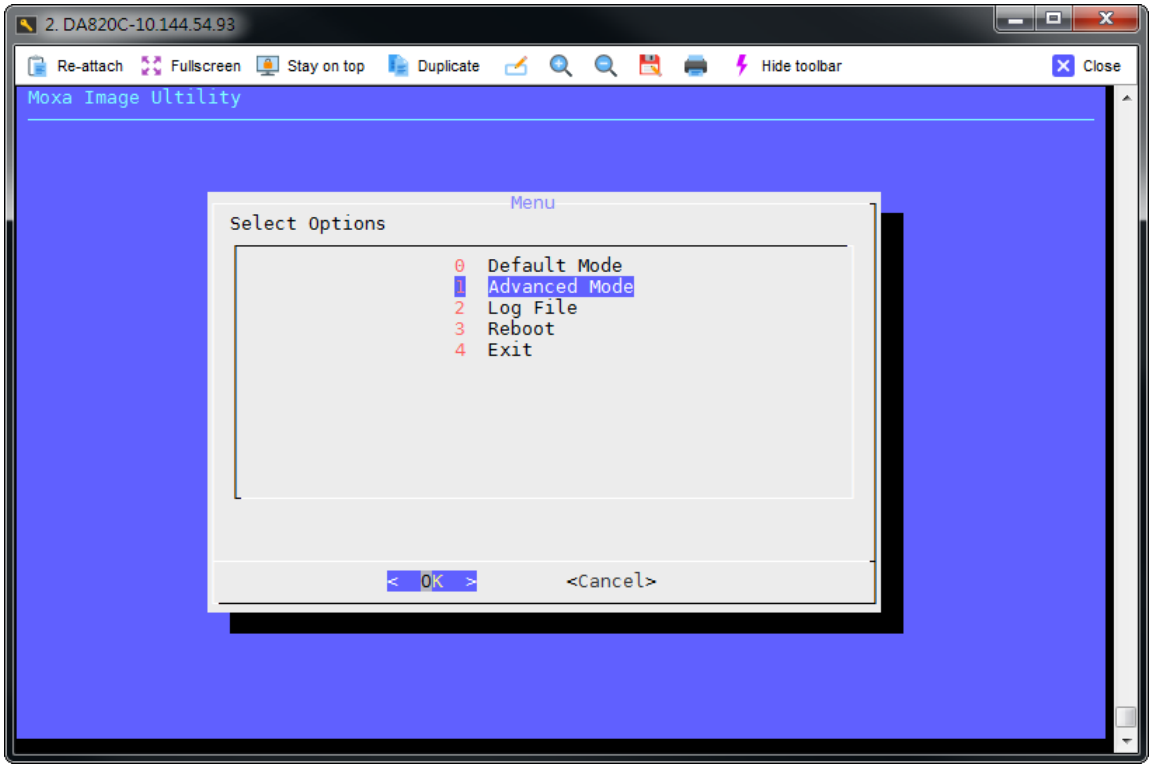
Step 5: Reboot the Computer

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

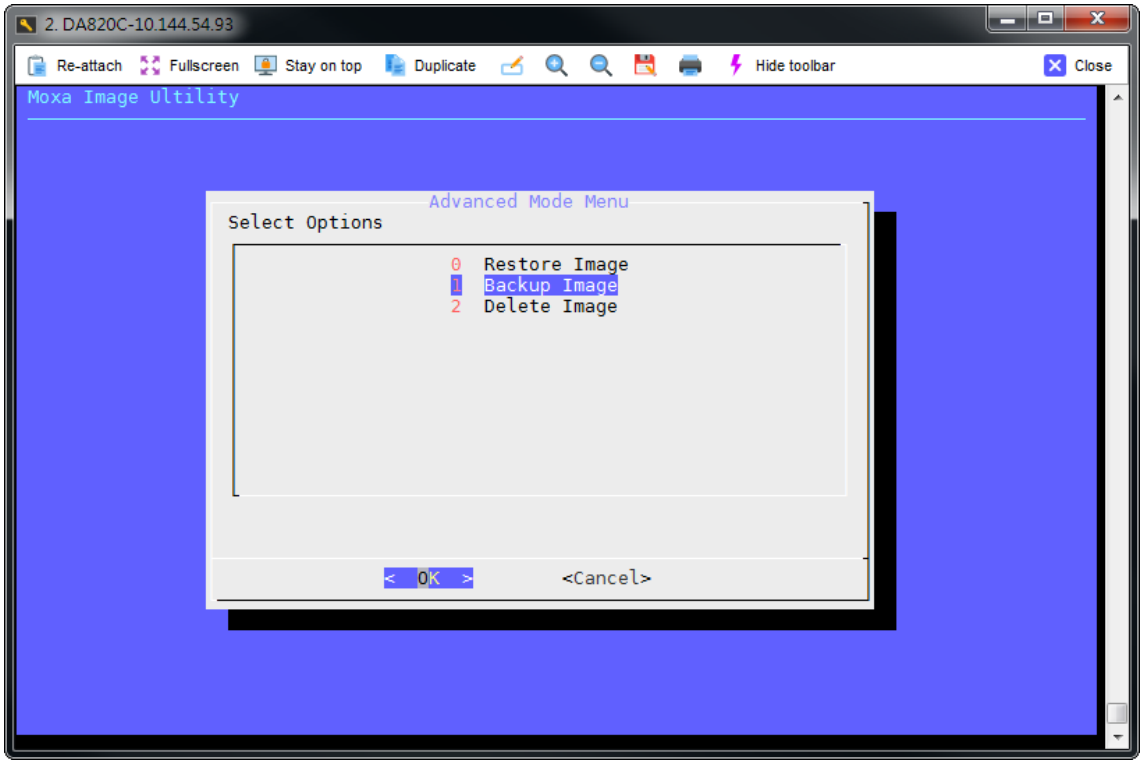
Backup the System to the USB Drive

You may also backup the current system to the USB drive for system restore in case the system crashes. Change the BIOS settings to make the USB drive the first boot priority. When the system has been launched, take the following steps.

To select "Advanced Mode":



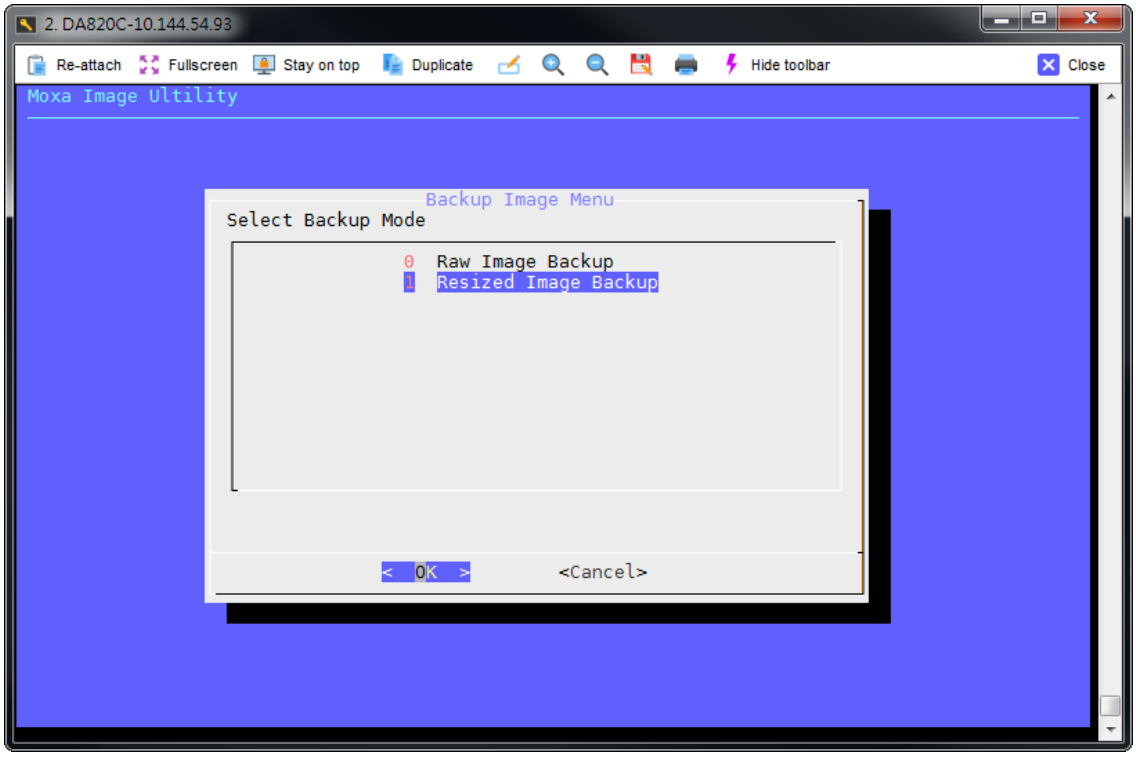
To select "Backup Image":



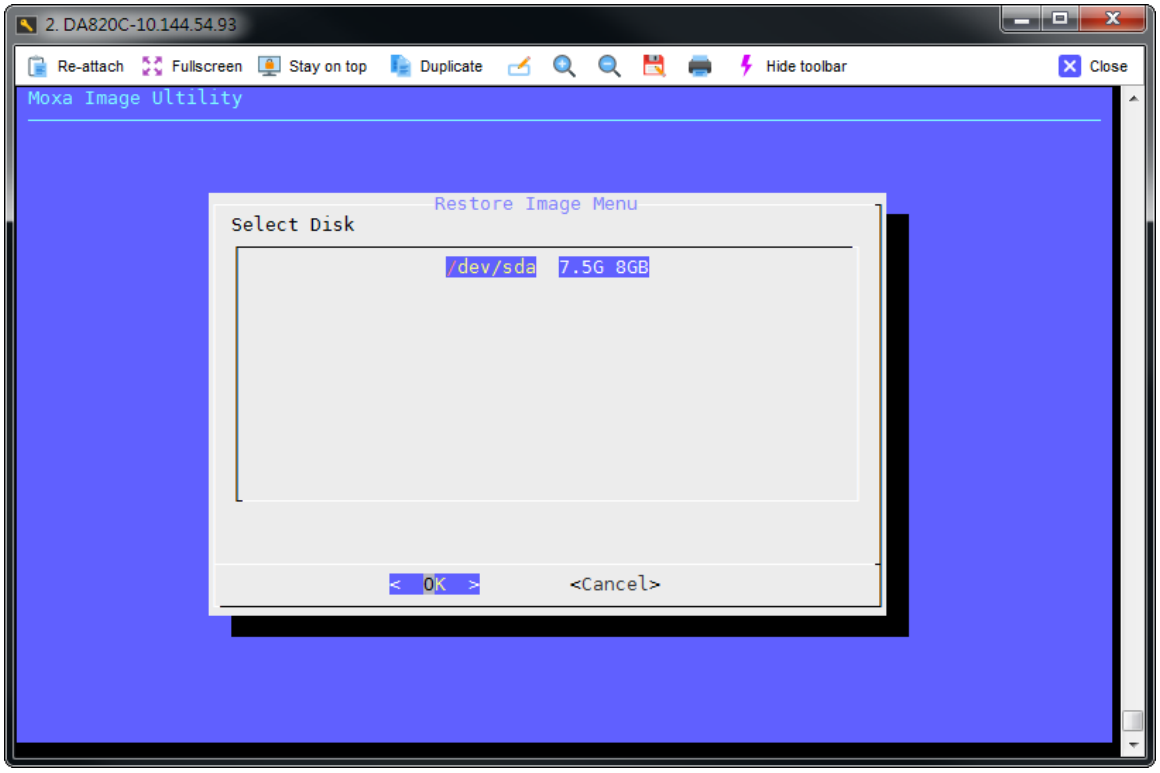
If you want to backup raw image, please select "Raw Image Backup".

If you want to backup image and resize disk size, please select "Resized Image Backup".

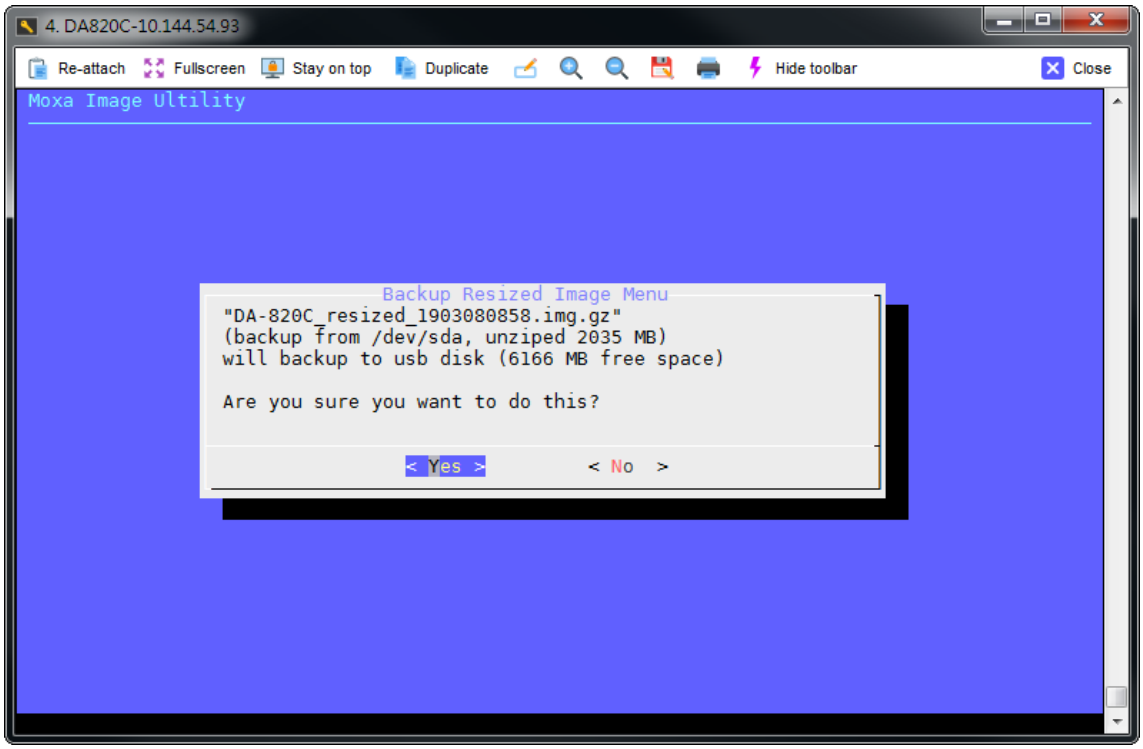
For example, to select "Resized Image Backup".



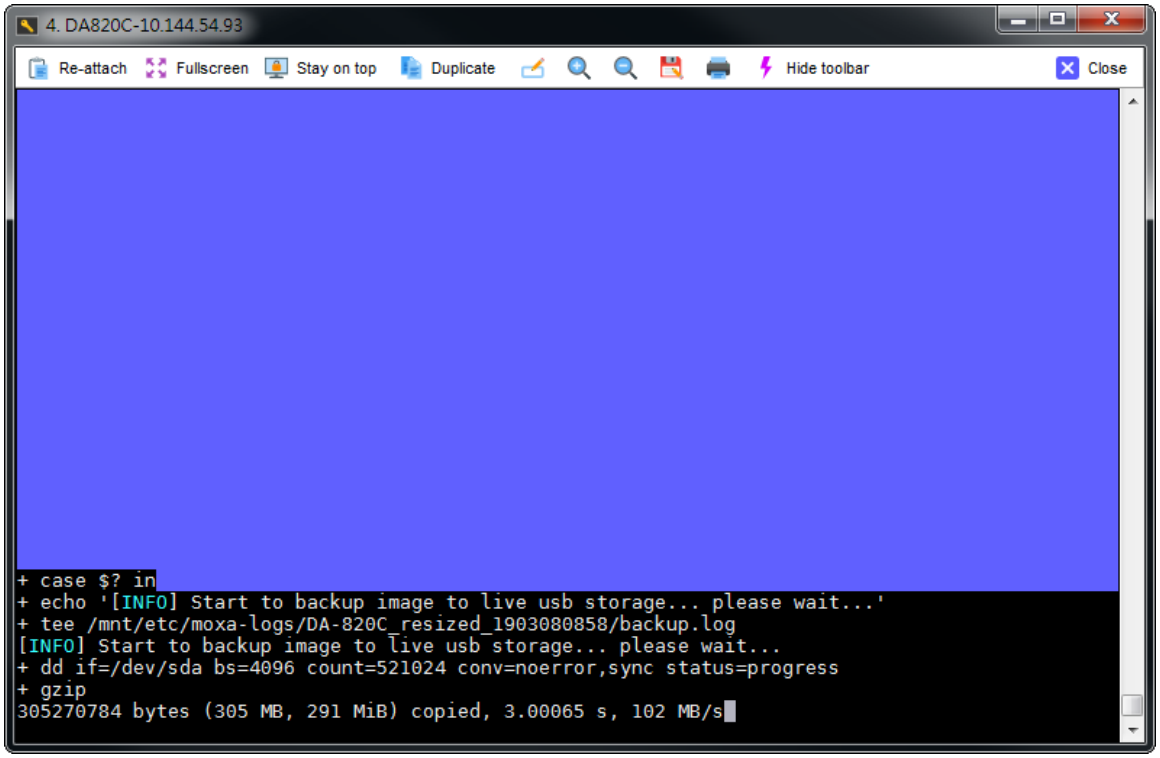
To select the target storage disk to backup:



The check box will show the backup information, including image size and the rest free space of USB live disk.

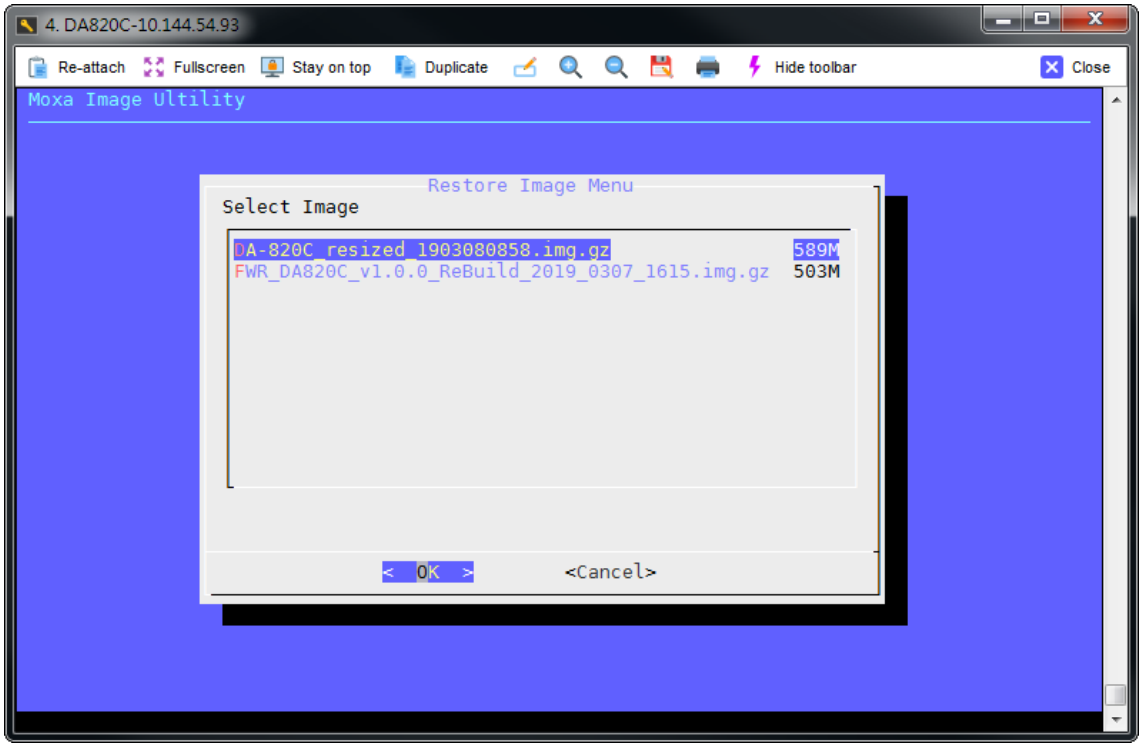


Select "Yes" button and start to backup disk.

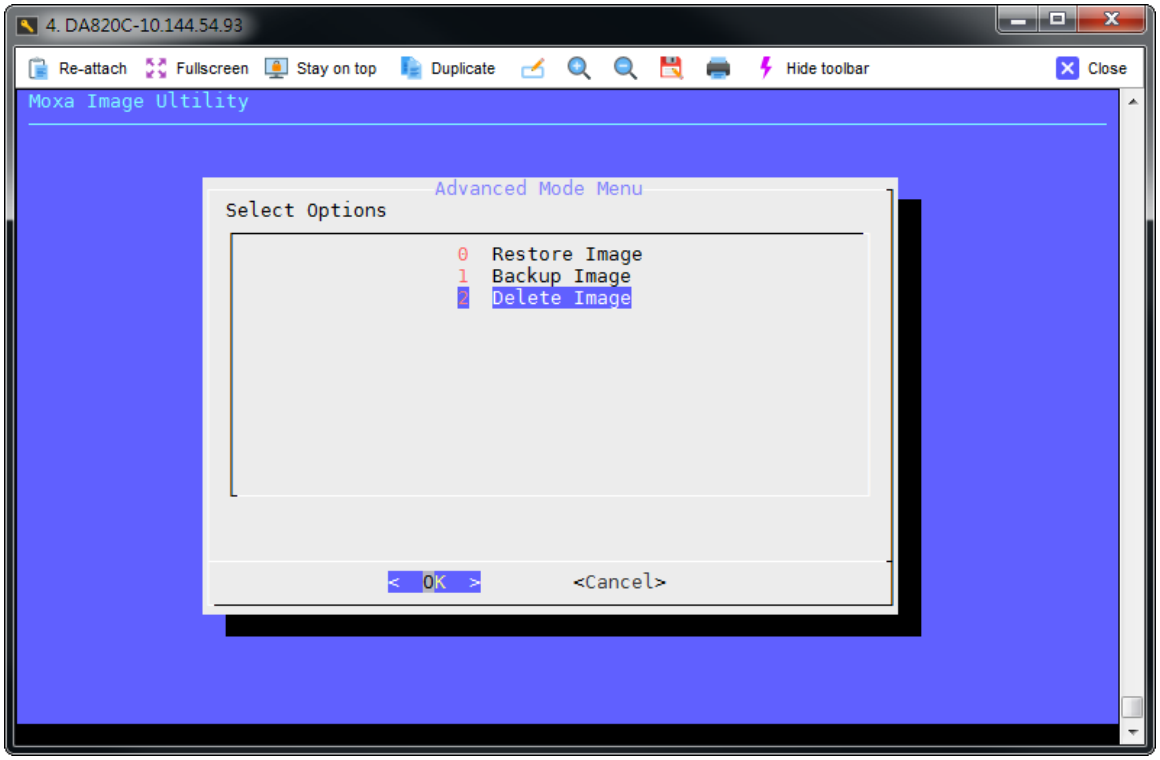


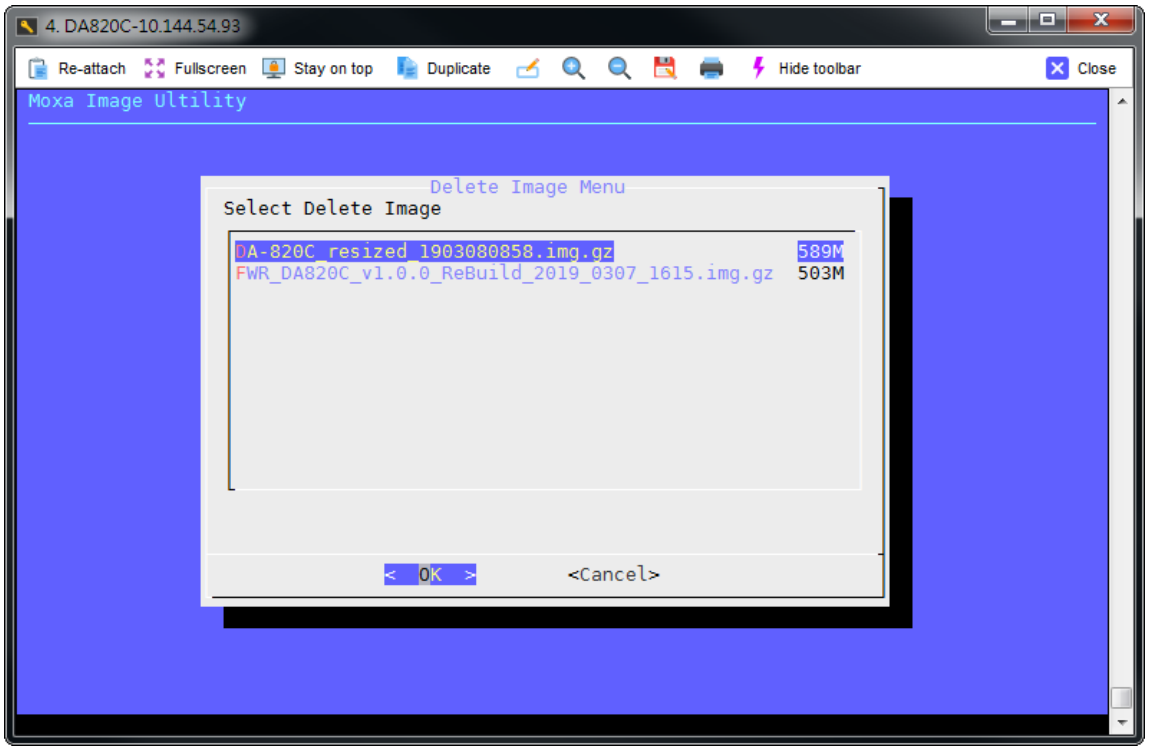
After backup process, the backup image was stored at live USB storage.

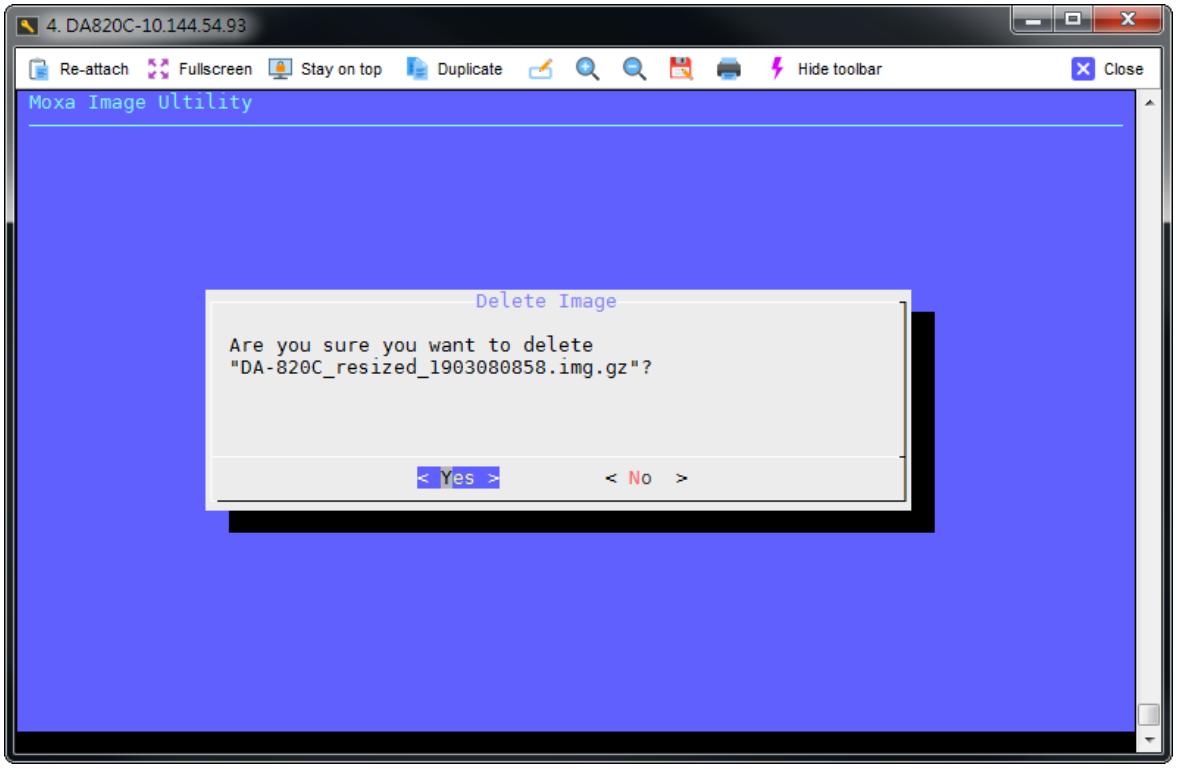
To select restore page, you can find out the backup image is located on USB storage.

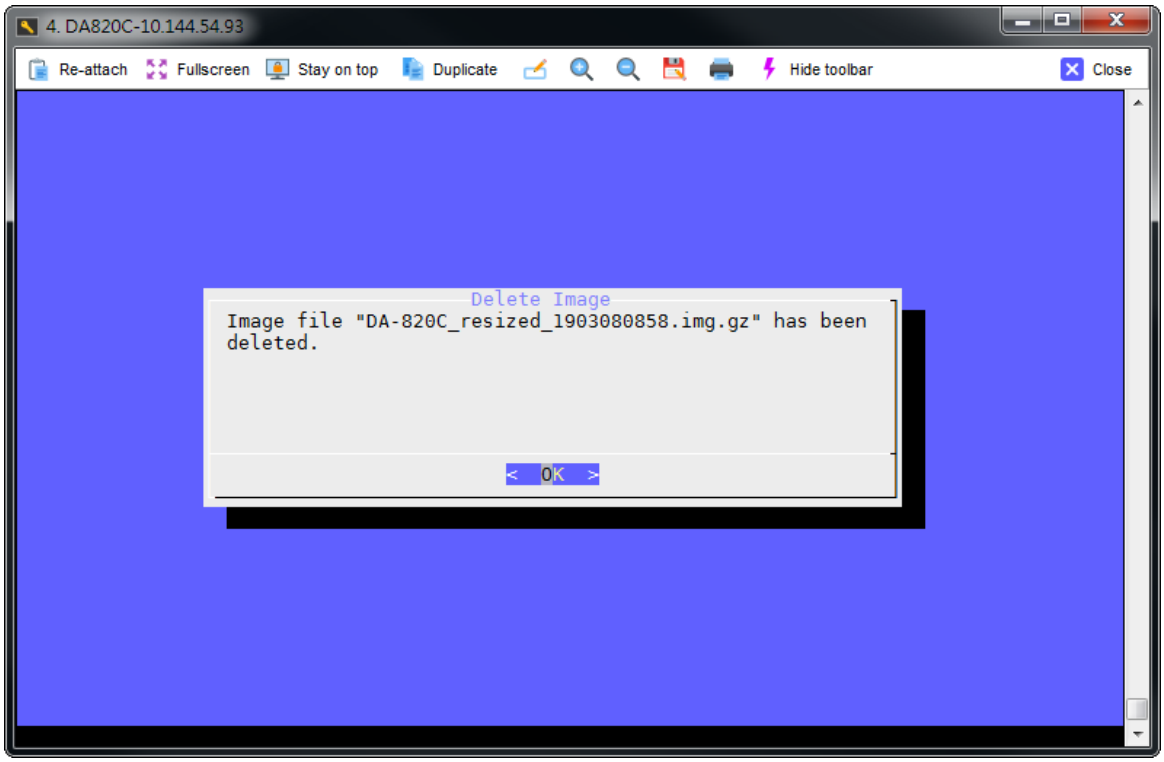


If you need to delete backup images in live USB storage, to select "Delete image" in advanced mode to delete image.




4. DA820C-10.144.54.93
Re-attach
Fullscreen
Stay on top
Duplicate
Hide toolbar
Close
Moxa Image Ultility
Delete Image Menu
Select Delete Image
DA-820C_resized_1903080858.img.gz 589M
FWR_DA820C_v1.0.0_ReBuild_2019_0307_1615.img.gz 503M
< OK >
<Cancel>


4. DA820C-10.144.54.93
Re-attach
Fullscreen
Stay on top
Duplicate
Hide toolbar
Close
Moxa Image Ultility
Delete Image
Are you sure you want to delete
"DA-820C_resized_1903080858.img.gz"?
< Yes >
< No >


4. DA820C-10.144.54.93
Re-attach
Fullscreen
Stay on top
Duplicate
Hide toolbar
Close
Delete Image
Image file "DA-820C_resized_1903080858.img.gz" has been deleted.
< OK >

5

Advanced Configuration

The following topics are covered in this chapter:

- **Checking the Linux Version**
- **Checking Moxa's Control Version**
- **Device Suspend**
- **Wake on LAN**
- **Default Network Interface Name**
- **Renaming the Network Interfaces**
- **Getting Product Serial Number**
- **RTC (Real-time Clock)**
- **UART**
- **HDD/SSD Disk Hotswap**
- **Audio Jack Retasking**
- **DIP Switch**
- **SIM Card Select Switch**
- **miniPCIe Card Power Switch**
- **Digital I/O**
- **WDT (Watch Dog Timer)**
  - Introduction
  - How the WDT Works
- **Software Components**

Checking the Linux Version

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

```
moxa@Moxa:~$ uname -a
Linux Moxa 4.9.0-9-amd64 #1 SMP Debian 4.9.168-1+deb9u3 (2019-06-16) x86_64
GNU/Linux
```

Checking the Version

Querying the Firmware Version

The **kversion** program prints version information on the Linux system release, which is controlled by Moxa. Use the -**a** option to check the build date. The build date format is *YYYYMMDDHHmm*. You can use this program to check the version of the released image for troubleshooting issues. For example the build date, 19080617 means it was built on 2019/08/06 at 17:00 hrs.

According to EPPROM information on IO board, use the -s option to show the PCBA serial number, -t option to show PCBA type number (00-CPU Board, 01-Carrier Board, 02-Riser card), -p option to show PCBA version, and -v option to show verbose information.

```
root@Moxa:/home/moxa# kversion
V2406C-KL5-T version 1.0
root@Moxa:/home/moxa# kversion -a
V2406C-KL5-T version 1.0 Build 19120515
```

Querying the Hardware Version

Use the **dmidecode** program to show the PCBA serial number based on the EPPROM information on your computer's IO board. The PCBA board information is mapped to the DMI table 12 and option 2. For example, the hardware version **V2406C001091** is displayed, if you run the command: **dmidecode -t 12 | grep "Option 2:**

Hardware Information Range:

Definition	Value	Remark
PCBA Name (Characters, English)	V	
PCBA Name (Number)	2406C	
Serial	0	PCBA serial number
Type	01	00-CPU Board, 01-Carrier Board, 02- Riser card
PCBA Version	091	PCBA version number

```
root@Moxa:/home/moxa# dmidecode -t 12 | grep "Option 2:"
      Option 2:    V2406C001091
```

Device Suspend

The V2406C supports ACPI S3 (suspend to RAM) function. You should enable option S3 in the BIOS and then use the **pm-suspend --qurik-s3-bios** command as follows:

```
root@Moxa:/home/moxa# pm-suspend --quirk-s3-bios
```

When the device suspend function is in effect, press the power button to wake up the computer.

If you login in as administrator (root) in X windows, you can use **System → Shutdown → Suspend** to suspend your device. Note that this option is not available to non-root users.

Some components on Moxa's embedded computers may need to be reset after resuming. You can write a simple script and save it in the **/usr/lib/pm-utils/sleep.d/** directory to complete this procedure. For example, you could create a script for your application.

```
#!/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 If you want to see how to execute the script, start rsyslogd with the **/etc/init.d/rsyslogd start** command and then view the file **/var/log/pm-suspend.log**.

Wake on LAN

The V2406C supports wake on LAN (WoL), a feature used to wake up a device from suspend (S3) and shutdown (S5). To check the WOL support on an Ethernet port x, run the **ethtool enp***x* command, where **enp***x* is the network interface name.

```
root@Moxa:/home/moxa# apt update && apt install ethtool
root@Moxa:/home/moxa# ethtool enp0s31f6
Settings for enp0s31f6:
      Supported ports: [ TP ]
      Supported link modes:   10baseT/Half 10baseT/Full
                              100baseT/Half 100baseT/Full
                              1000baseT/Full
      Supported pause frame use: No
      Supports auto-negotiation: Yes
      Advertised link modes:  10baseT/Half 10baseT/Full
                              100baseT/Half 100baseT/Full
                              1000baseT/Full
      Advertised pause frame use: No
      Advertised auto-negotiation: Yes
      Speed: 1000Mb/s
      Duplex: Full
```

```
        Port: Twisted Pair
        PHYAD: 1
        Transceiver: internal
        Auto-negotiation: on
        MDI-X: on (auto)
        Supports Wake-on: pumbg
        Wake-on: g
        Current message level: 0x00000007 (7)
                               drv probe link
        Link detected: yes
```

The default WoL option is **g** (wake on magic packet). If the WoL setting is not g, we suggest that you modify the setting with the **ethtool -s enpx wol g** command.

The following example illustrates how to wake up a computer from suspend (S3):

1. On Moxa's embedded computer:
   - Enable the S3 option in the BIOS.
   - Get the MAC address by issuing the **ifconfig eth*x*** command (***x*** is the port number).
   - Suspend to RAM using the **pm-suspend --quirk-s3-bios** command.
2. A remote computer:
   Issue the **etherwake -b *<mac-address-of-the-embedded-computer>*** command to wake up the computer as per the following example:

```
etherwake -b 00:90:e8:00:d7:38
```

The following example illustrates how to wake up a computer from shutdown (S5):

1. Moxa's embedded computer:
   - Shut down the computer using the **shutdown -h now** command.
2. A remote computer:
   Issue the **etherwake -b *<mac-address-of-the-embedded-computer>*** command to wake up the computer as per the following example:

```
etherwake -b 00:90:e8:00:d7:38
```

Default Network Interface Name

Debian 9 Stretch adopts the systemd predictable network interface naming convention by default. The network interface name is no longer just based on eth*X*. The interface names depend on the hardware design and physical connections. You may see different types of interface names, for example:

1. Names incorporating Firmware/BIOS-provided index numbers for onboard devices (example: eno1)
2. Names incorporating Firmware/BIOS-provided PCI Express hotplug slot index numbers (example: ens1)
3. Names incorporating physical/geographical location of the connector of the hardware (example: enp2s0)
4. Names incorporating the interfaces' MAC address (example: enx78e7d1ea46da)
5. Classic, unpredictable kernel-native ethX naming (example: eth0)

For more details, refer to:
https://www.freedesktop.org/wiki/Software/systemd/PredictableNetworkInterfaceNames/

The V2406C default LAN port and network interface name mapping is as given below:

LAN port	Network Interface Name
LAN1	enp0s31f6
LAN2	enp2s0

Renaming the Network Interfaces

You can use the udev rule to rename the network interfaces. For example, if you would like to rename them to the classic "ethX" naming, you can create a rules file named **/etc/udev/rules.d/70-persistent-net.rules**, and edit the content of the file as given below:.

Renaming the interfaces using the MAC address (example)

```
SUBSYSTEM=="net", ACTION=="add", ATTR{address}=="00:90:e8:00:d7:38", NAME="eth0"
SUBSYSTEM=="net", ACTION=="add", ATTR{address}=="00:90:e8:00:d7:58", NAME="eth1"
```

Viewing the Product Serial Number

The product information can be obtained using the **dmidecode** command as shown in the following example.

```
moxa@Moxa:~$ sudo dmidecode -t 1
# dmidecode 3.0
Getting SMBIOS data from sysfs.
SMBIOS 3.0.0 present.

Handle 0x0001, DMI type 1, 27 bytes
System Information
       Manufacturer: Moxa
       Product Name: V2406C
       Version:
       Serial Number: 123456789
       UUID: 12345678-1234-5678-90AB-CDDEEFAABBCC
       Wake-up Type: Power Switch
       SKU Number:
       Family:
```

Real-time Clock (RTC)

The V2406C supports standard Linux simple RTC control. The device node is located at **/dev/rtc**. You must include the file **<linux/rtc.h>**.

1. Function RTC_RD_TIME

   Reads time information from the RTC and returns the value to the third argument (**struct rtc_time *time**).

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

2. Function RTC_SET_TIME

   Sets the RTC time. Argument 3 will be passed to RTC.

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

Serial Ports

The serial ports support RS-232, RS-422, and RS-485 2-wire operation modes with flexible baudrate settings. The default operation mode is RS-422. Use the **mx-uart-ctl** command to change the operation mode.

mx-uart-ctl -p <*port_number*> **-m** <*uart_mode*>

port_number: 0,1,2,...
uart_ mode: As in the following table

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

For example, use the following commands to set port 0 to RS-485 4-wire mode:

```
root@Moxa:/home/moxa# mx-uart-ctl -p 0
Current uart mode is RS232 interface.
root@Moxa:/home/moxa# mx-uart-ctl -p 0 -m 2
Set OK.
```

Changing the Terminal Settings

The **stty** command is used to view and modify the serial terminal settings.

Displaying All Settings

The following example shows the **stty** command options used to display all the serial terminal settings.

```
root@Moxa:/home/moxa# sudo stty -a -F /dev/ttyM0
speed 9600 baud; rows 0; columns 0; line = 0;
intr = ^C; quit = ^\; erase = ^?; kill = ^U; eof = ^D; eol = <undef>; eol2 = <undef>;
swtch = <undef>; start = ^Q; stop = ^S; susp = ^Z; rprnt = ^R; werase = ^W;
lnext = ^V; discard = ^O; min = 1; time = 0;
-parenb -parodd -cmspar cs8 hupcl -cstopb cread clocal -crtscts
-ignbrk -brkint -ignpar -parmrk -inpck -istrip -inlcr -igncr icrnl ixon -ixoff -iuclc
-ixany -imaxbel -iutf8
opost -olcuc -ocrnl onlcr -onocr -onlret -ofill -ofdel nl0 cr0 tab0 bs0 vt0 ff0
isig icanon iexten echo echoe echok -echonl -noflsh -xcase -tostop -echoprt echoctl
echoke -flusho -extproc
```

Configuring the Serial Settings

The following example changes the baudrate to 115200.

```
root@Moxa:/home/moxa#  sudo stty 115200 -F /dev/ttyM0
```

```
root@Moxa:/home/moxa# sudo stty -a -F /dev/ttyM0
speed 115200 baud; rows 0; columns 0; line = 0;
intr = ^C; quit = ^\; erase = ^?; kill = ^U; eof = ^D; eol = <undef>; eol2 =
<undef>; swtch = <undef>; start = ^Q; stop = ^S; susp = ^Z; rprnt = ^R; werase = ^W;
lnext = ^V; discard = ^O; min = 1; time = 0;
-parenb -parodd -cmspar cs8 hupcl -cstopb cread clocal -crtscts
-ignbrk -brkint -ignpar -parmrk -inpck -istrip -inlcr -igncr icrnl ixon -ixoff -
iuclc -ixany -imaxbel -iutf8
opost -olcuc -ocrnl onlcr -onocr -onlret -ofill -ofdel nl0 cr0 tab0 bs0 vt0 ff0
isig icanon iexten echo echoe echok -echonl -noflsh -xcase -tostop -echoprt echoctl
echoke -flusho -extproc
```

Note Detailed information on the stty utility is available at:
http://www.gnu.org/software/coreutils/manual/coreutils.html

HDD/SSD Disk Hot Swap

Hot-swappable SSD/HDD slots help to easily expand the storage capacity of your computer. The V2406C has two hot-swappable 2.5” SSD/HDD slots and two buttons to control the hot-swap function (use **`mx_hotswapd.service`**) and to display the SATA status.

```
# when SSD/HDDs are inserted to two slots (Disk 1 and Disk 2), the hot-swap
buttons will light up.
root@Moxa:/home/moxa# mount | grep "/media"
/dev/sdb1 on /media/disk1p1 type ext4 (rw,relatime,data=ordered)
/dev/sdc1 on /media/disk2p1 type ext4 (rw,relatime,data=ordered)

# press Disk 1/2 button over 3 seconds
# the LED indicator was twinkling three times, and then light off.
root@Moxa:/home/moxa# mount | grep "/media"
(show nothing)

# then re-insert SSD/HDD to slots, the Disk 1 and Disk 2 buttons will light on
# the udev rules auto-mounts SSD/HDD as /media/disk1p* and /media/disk1p*
root@Moxa:/home/moxa# mount | grep "/media"
/dev/sdb1 on /media/disk1p1 type ext4 (rw,relatime,data=ordered)
/dev/sdc1 on /media/disk2p1 type ext4 (rw,relatime,data=ordered)
```

DIP Switch

There are two DIP switches inside the V2406C computer. They are controlled to switch between cellular and Wi-Fi mode. In the cellular mode, user can control the form factor power on/off. In the Wi-Fi mode, user cannot control the power on/off. 0/LOW (ON) for the Wi-Fi module, 1/HIGH (OFF) for the cellular module.

The DIP switches device file is located at Linux file system path:

DIP slot 1: /sys/class/gpio/gpio455/value

DIP slot 2: /sys/class/gpio/gpio487/value

DIP switches status can be accessed via device node. These are the examples to show the DIP switches status.

Example to show the DIP switches status:

```
root@Moxa:/home/moxa# cat /sys/class/gpio/gpio455/value
0
root@Moxa:/home/moxa# cat /sys/class/gpio/gpio487/value
0
```

Moxa HDA Audio Retasking Control

There are two audio jack slots (line out and line in) on the front panel of the V2406C computer. Realtek ALC262 chip provides re-tasking function to change audio function by Intel HDA driver, e.g. Line out/Headphone/Line in/Microphone/etc. The HD-audio component consists of two parts: the controller chip and the codec chips on the HD-audio bus. Linux provides a single driver for all controllers, snd-hda-intel.

The following table shows the support modes of the retasking control:

	LINE_OUT	SPEAKER	HEADPHONE	LINE_IN	MICROPHONE
Line out (port 1)	✓	✓	✓	✓	*
Line in (port 2)	✓	✓	✓	✓	✓

* The performance of the Line-out port (port 1) in the MICROPHONE mode is not very good. We recommend using Line-in port (port 2) to record the MICROPHONE data.

Moxa Audio Retasking Utility

```
Usage:
       mx-audio-retask [Options]

Operations:
       -v,--version
              Show utility version
       -p,--port <port_index>
              Select Jack Index (e.g. 1, 2, ...)
       -m,--mode <mode_name>
              Switch Jack Mode

Mode List:
       LINE_OUT
       SPEAKER
       HEADPHONE
       LINE_IN
       MICROPHONE

Example:
       Get audio jack 1 mode
       # mx-audio-retask -p 1
       Switch audio jack 2 to HEADPHONE mode
       # mx-audio-retask -p 2 -m HEADPHONE
```

The following is an example for **mx-audio-retask:**

```
$ mx-audio-retask -p 1 -m HEADPHONE
Set 'Port 1' as Mode 'HEADPHONE' is succeeded.
Write audio fw file is succeeded.
Please reboot to finish audio retask setup

# after reboot
$ mx-audio-retask -p 1
Pin 0x14 (Black Headphone, Front side): present = No

$ mx-audio-retask -p 2 -m LINE_IN
Set 'Port 2' as Mode 'LINE_IN' is succeeded.
Write audio fw file is succeeded.
Please reboot to finish audio retask setup

# after reboot
$ mx-audio-retask -p 2
Pin 0x18 (Black Line In, Front side): present = No

# if port is not specific, default port is 1
$ mx-audio-retask -m LINE_OUT
Set 'Port 1' as Mode 'LINE_OUT' is succeeded.
Write audio fw file is succeeded.
Please reboot to finish audio retask setup
```

hda-jack-retask Utility

hda-jack-retask is a user-friendly GUI program to manipulate the HD-audio pin control for jack retasking. If you have a problem about the jack assignment, try this program and check whether you can get useful results.

```
# install KDE
apt install aptitude tasksel
aptitude install ~t^desktop$ ~t^kde-desktop$

# install alsa-tools-gui package
root@Moxa:/home/moxa# apt install alsa-tools-gui

# execute hdajackretask GUI interface
root@Moxa:/home/moxa# hdajackretask
```

Moxa Module Control

moxa-module-control is a utility for controlling modules on platform. Including power control, module detection, initialize setting, and SIM slot switching (for Cellular modules) features.

```
Moxa module control utility
Version: 1.3.1
---------------------------
Usage:
       mx-module-ctl [Options]

Operations:
       -v,--version
              Show utility version
       -l,--list
              List module slots
       -s,--slot <module_slot_id>
              Select slot
       -p,--power on|off
              Power on/off module
       -r,--reset on|off
              Reset module
       -i,--sim 1|2
              Select sim card slot

Example:
       Power on module 1
       # mx-module-ctl -s 1 -p on

       Reset module 2
       # mx-module-ctl -s 2 -r on

       Select SIM 2 for module 1
       # mx-module-ctl -s 1 -i 2
```

Switching the SIM Card

The following is an example for switching SIM card by **mx-module-ctl.** Please notice that the 'SIM card select' only for switching SIM card slot, for some celluar modules, they need to do power cycle to re-attach SIM card.

```
# Example for module slot 1 SIM card switch
## Switch to SIM card slot 1 (upper side)
root@Moxa:/home/moxa# mx-module-ctl -s 1 -i 1

## Switch to SIM card slot 2 (lower side)
root@Moxa:/home/moxa# mx-module-ctl -s 1 -i 2
```

Powering On/Off the Cellular Module

Example to control cellular module power by **mx-module-ctl**

```
# Power on cellular module slot 1
root@Moxa:/home/moxa# mx-module-ctl -s 1 -p on
# Power off cellular module slot 1
root@Moxa:/home/moxa# mx-module-ctl -s 1 -p off

# Power on cellular module slot 2
root@Moxa:/home/moxa# mx-module-ctl -s 2 -p on
# Power off cellular module slot 2
root@Moxa:/home/moxa# mx-module-ctl -s 2 -p off
```

Moxa Digital I/O Control

Digital Output channels can be set to high or low. The channels are controlled by **moxa-dio-control**. Following is the DI/DO number mapping table. **moxa-dio-control** is a C library for getting and setting the state of the digital input/output ports.

Return all the GPIO sysfs files have been exported by /etc/systemd/system/multi-user.target.wants/v2406c_platform_init.service at boot sequence. You don't need to export the GPIO entry. The default digital inputs status is high.

```
root@Moxa:/home/moxa# mx-dio-ctl
action type is unset
Usage:
      mx-dio-ctl <-i|-o <#port number> [-s <#state>]>

OPTIONS:
      -i <#DIN port number>
      -o <#DOUT port number>
      -s <#state>
            Set state for target DOUT port
            0 --> LOW
            1 --> HIGH

Example:
      Get value from DIN port 0
      # mx-dio-ctl -i 0
```

```
Get value from DOUT port 0
# mx-dio-ctl -o 0

Set DOUT port 0 value to LOW
# mx-dio-ctl -o 0 -s 0
Set DOUT port 0 value to HIGH
# mx-dio-ctl -o 0 -s 1
```

To set DO-0 to status **high,** do the following:

```
root@Moxa:/home/moxa# mx-dio-ctl -o 0 -s 1
DOUT port 0 state: 1
```

Connect DO-0 to DI-0 to read the DI-0 status as follows:

```
root@Moxa:/home/moxa# mx-dio-ctl -i 0
DIN port 0 state: 1
```

To set DO-0 to status **low,** do the following:

```
root@Moxa:/home/moxa# mx-dio-ctl -o 0 -s 0
DOUT port 0 state: 0
```

Connect DO-0 to DI-0 to read the DI-0 status as follows:

```
root@Moxa:/home/moxa# mx-dio-ctl -i 0
DIN port 0 state: 0
```

Moxa Cellular Utility

The **cell_mgmt** utility is used to manage the cellular module in the computer. You must use sudo or run with root permission for the cell_mgmt command. This **cell_mgmt** is based on version 2.0.5.

Manual Page

```
Usage:
      /usr/sbin/cell_mgmt [-i <module id>] [-s <slot id>] <OPTIONS>

OPTIONS
      -i <module id>
            Module identifier, start from 0 and default to 0.
      -s <slot id>
            Slot identifier, start from 1 and default value depends
            on module interface.
            example: module 0 may in slot 2
      modules
            Shows module numbers supported.
      slot
            Shows module slot id
      interface [interface id]
            Switching and checking module interface(s)
      start [OPTIONS]
            Start network.

            OPTIONS:
            Phone - Phone number (especially for AT based modules)
            Auth - Authentication type(CHAP|PAP|BOTH), default=NONE.
            Username
            Password

            example:
                  cell_mgmt start
                  cell_mgmt start Phone=*99#
      stop
            Stop network.
      power_on
            Power ON.
      power_off
            Power OFF.
      power_cycle
            Power cycle the module slot.
      switch_sim <1|2>
            Switch SIM slot.
      gps_on
            GPS ON.
      gps_off
            GPS OFF.
      attach_status
            Query network registration status.
      status
            Query network connection status.
      signal
            Get signal strength.
      at <'AT_COMMAND'>
            Input AT Command.
            Must use SINGLE QUOTATION to enclose AT Command.
      sim_status
```

```
            Query sim card status.
      unlock_pin <PIN>
            Unlock PIN code and save to configuration file.
      pin_retries
            Get PIN code retry remain times.
      pin_protection <enable|disable> <current PIN>
            Set PIN protection in the UIM.
      set_flight_mode [0|1]
            Set module into flight mode (1) or online mode (0), Default=1.
      set_apn <APN>
            Set APN to configuration file and PDP profile.
            And use this APN as the default one.
      check_carrier
            Check current carrier.
      switch_carrier <Verizon|ATT|Sprint|Generic>
            Switching between carrier profiles.
      m_info (deprecated)
            Module/SIM information.
      module_info
            Module information.
      module_ids
            Get device IDs (ex: IMEI and/or ESN).
      iccid
            Get SIM card ID
      imsi
            Get IMSI (International Mobile Subscriber Identity).
      location_info
            Get cell location information.
      operator
            Telecommunication operator.
      vzwauto
            Verizon Private Network auto dialup.
      version
            Cellular management version.
```

Dial-up Step-by-Step

Before dialing, APN (Access Point Name) should be set correctly and the module should attach with the base station.

1. Unlock the PIN code if SIM locked by a PIN code

Use cell_mgmt sim_status to check SIM card status and use cell_mgmt unlock_pin <PIN> to unlock SIM card if "SIM-PIN"

```
root@Moxa:/home/moxa# cell_mgmt sim_status
+CPIN: READY
```

2. Set the APN with cell_mgmt set_apn <APN>, this command will update the APN in profile ID 1

```
root@Moxa:/home/moxa# cell_mgmt set_apn internet
old APN=, new APN=internet
```

3. Check if the service attached with correct APN

PS (packet-switched) should be attached for network connection.

```
root@Moxa:/home/moxa# cell_mgmt attach_status
CS: attached
PS: attached
```

4. Check cellular signal strength is good or not

```
root@Moxa:/home/moxa# cell_mgmt signal
4G Level 4 (Good)
```

5. Dial up with **cell_mgmt start** and check connection status with **cell_mgmt status**

```
root@Moxa:/home/moxa# cell_mgmt start
PIN code: Disabled or verified
Saving state... (PPP_ISP_NAME: wvdial-2)

root@Moxa:/home/moxa# cell_mgmt status
Status: connected
PPPIFName: ppp0
IFName: ppp0
IP: 100.72.98.84
IPRemote: 10.64.64.64
DNS: 61.31.233.1 8.8.8.8
```

The **cell_mgmt dial-up** function will automatically set the DNS and default gateway of the computer.

Cellular Management

cell_mgmt start

To start a network connection, use the default cellular module of the computer (using **cell_mgmt interface** to verify which module is selected by default if the computer supports multiple modules).

If you run the cell_mgmt start command with the APN, Username, Password, and PIN, all the configurations will be written into the configuration file /etc/moxa-cellular-utils/moxa-cellular-utils.conf.

This information is then used when you run the command without specifying the options.

Usage: **cell_mgmt start**

cell_mgmt stop

Stops/disables the network connection on the cellular module of the computer by **cell_mgmt stop** and check current status with **cell_mgmt status .**

```
root@Moxa:/home/moxa# cell_mgmt stop
Clearing state...
root@Moxa:/home/moxa# cell_mgmt status
Status: disconnected
```

cell_mgmt restart

Restarts the network connection on the cellular module of the computer.

```
root@Moxa:/home/moxa# cell_mgmt restart
Clearing state...
PIN code: Disabled or verified
Saving state... (PPP_ISP_NAME: wvdial-2)
root@Moxa:/home/moxa# cell_mgmt status
Status: connected
PPPIFName: ppp0
IFName: ppp0
IP: 100.72.98.84
IPRemote: 10.64.64.64
DNS: 61.31.233.1 8.8.8.8
```

cell_mgmt status

Provides information on the status of the network connection.

```
root@Moxa:/home/moxa# cell_mgmt status
Status: connected
PPPIFName: ppp0
IFName: ppp0
IP: 100.72.98.84
IPRemote: 10.64.64.64
DNS: 61.31.233.1 8.8.8.8
```

cell_mgmt sim_status

Query sim card status.

```
root@Moxa:/home/moxa# cell_mgmt sim_status
+CPIN: READY
```

cell_mgmt signal

Provides the cellular signal strength.

```
root@Moxa:/home/moxa# cell_mgmt signal
4G Level 4 (Good)
```

cell_mgmt operator

Provides information on the cellular service provider.

```
root@Moxa:/home/moxa# cell_mgmt operator
TW Mobile
```

Cellular Module

cell_mgmt -s <slot>

Slot identifier, start from 1 and default value depends on module interface.

```
root@Moxa:/home/moxa# cell_mgmt -s 1 module_info
SLOT: 1
Module: Sierra Wireless WP7607
WWAN_node: wwan0
AT_port: /dev/ttyUSB2
GPS_port: /dev/ttyUSB1
QMI_port: /dev/cdc-wdm0
Modem_port: NotSupport
AT_port (resvered): NotSupport

root@Moxa:/home/moxa# cell_mgmt -s 2 module_info
SLOT: 2
Module: Huawei ME909s-821
WWAN_node: enp0s20f0u7c2
AT_port: /dev/ttyUSB3
GPS_port: NotSupport
QMI_port: NotSupport
Modem_port: /dev/ttyUSB0
AT_port (resvered): NotSupport
```

cell_mgmt module_info

Provides information of the cellular module (AT port, GPS port, QMI port, and module name, etc.).

```
root@Moxa:/home/moxa# cell_mgmt module_info
SLOT: 2
Module: Huawei ME909s-821
WWAN_node: enp0s20f0u7c2
AT_port: /dev/ttyUSB2
GPS_port: NotSupport
QMI_port: NotSupport
Modem_port: /dev/ttyUSB0
AT_port (resvered): NotSupport
```

cell_mgmt interface [id]

Used to view the supported modules and default module on the computer with their IDs. Change the default module by specified the ID.

```
root@Moxa:/home/moxa# cell_mgmt interface
[0] enp0s20f0u7c2   <Current>
```

cell_mgmt power_cycle

Power cycle the cellular module in the computer. Some kernel message for module reloaded may be popped out.

```
root@Moxa:/home/moxa# cell_mgmt power_cycle
Clearing state...

[kernel message]
[ 3347.762575] usb 1-7: USB disconnect, device number 5
[ 3347.762799] cdc_ether 1-7:2.0 enp0s20f0u7c2: unregister 'cdc_ether' usb-
0000:00:14.0-7, CDC Ethernet Device
[ 3347.795175] option1 ttyUSB0: GSM modem (1-port) converter now disconnected
from ttyUSB0
[ 3347.795184] option 1-7:2.2: device disconnected
[ 3347.795273] option1 ttyUSB1: GSM modem (1-port) converter now disconnected
from ttyUSB1
[ 3347.795281] option 1-7:2.3: device disconnected
[ 3347.795374] option1 ttyUSB2: GSM modem (1-port) converter now disconnected
from ttyUSB2
[ 3347.795384] option 1-7:2.4: device disconnected
[ 3347.795514] option1 ttyUSB3: GSM modem (1-port) converter now disconnected
from ttyUSB3
[ 3347.795523] option 1-7:2.5: device disconnected
[ 3347.795645] option1 ttyUSB4: GSM modem (1-port) converter now disconnected
from ttyUSB4
[ 3347.795656] option 1-7:2.6: device disconnected
[ 3355.207128] usb 1-7: new high-speed USB device number 6 using xhci_hcd
[ 3355.348597] usb 1-7: New USB device found, idVendor=12d1, idProduct=15c1
[ 3355.348605] usb 1-7: New USB device strings: Mfr=1, Product=2,
SerialNumber=3
[ 3355.348610] usb 1-7: Product: HUAWEI Mobile V7R11
[ 3355.348615] usb 1-7: Manufacturer: Huawei Technologies Co., Ltd.
[ 3355.348619] usb 1-7: SerialNumber: 0123456789ABCDEF
[ 3355.353522] cdc_ether 1-7:2.0 usb0: register 'cdc_ether' at usb-
0000:00:14.0-7, CDC Ethernet Device, 02:1e:10:1f:00:00
[ 3355.354373] option 1-7:2.2: GSM modem (1-port) converter detected
[ 3355.354669] usb 1-7: GSM modem (1-port) converter now attached to ttyUSB0
[ 3355.355526] option 1-7:2.3: GSM modem (1-port) converter detected
[ 3355.355805] usb 1-7: GSM modem (1-port) converter now attached to ttyUSB1
[ 3355.356298] option 1-7:2.4: GSM modem (1-port) converter detected
[ 3355.356557] usb 1-7: GSM modem (1-port) converter now attached to ttyUSB2
[ 3355.356888] option 1-7:2.5: GSM modem (1-port) converter detected
[ 3355.356944] usb 1-7: GSM modem (1-port) converter now attached to ttyUSB3
[ 3355.357104] option 1-7:2.6: GSM modem (1-port) converter detected
[ 3355.357156] usb 1-7: GSM modem (1-port) converter now attached to ttyUSB4
[ 3355.368589] cdc_ether 1-7:2.0 enp0s20f0u7c2: renamed from usb0
[ 3355.403015] IPv6: ADDRCONF(NETDEV_UP): enp0s20f0u7c2: link is not ready
```

cell_mgmt check_carrier

This command helps to check if current carrier matched with the service (SIM card) provider.

```
root@Moxa:/home/moxa# cell_mgmt check_carrier
----------Carrier Info----------
preferred firmware=02.22.00.00
preferred carrier name=GENERIC
preferred carrier config=GENERIC_002.048_000
firmware=02.22.00.00
carrier name=GENERIC
carrier config=GENERIC_002.048_000
available carriers=ATT GENERIC VERIZON
--------------------------------
```

cell_mgmt switch_carrier <carrier>

Some module provides multiple carrier supports, using this command to switch between provided carriers. It may take some time (depends on module's mechanism) to switch between carriers.

```
root@Moxa:/home/moxa#  cell_mgmt switch_carrier
----------switch_carrier------------
Usage:
      switch_carrier <Verizon|ATT|Generic>

root@Moxa:/home/moxa# cell_mgmt switch_carrier ATT
----------switch_carrier------------
cmd=AT!IMPREF="ATT"

OK

OK

OK
wait for module reset ...

OK

root@Moxa:/home/moxa# cell_mgmt check_carrier
----------Carrier Info----------
preferred firmware=02.22.00.00
preferred carrier name=ATT
preferred carrier config=ATT_002.051_000
firmware=02.22.00.00
carrier name=ATT
carrier config=ATT_002.051_000
available carriers=ATT GENERIC VERIZON
--------------------------------
```

cell_mgmt at <'AT_COMMAND'>

Used to input an AT command. For example, use AT commands like ATI or AT+CSQ:

```
root@Moxa:/home/moxa# cell_mgmt at 'ATI'
ATI
Manufacturer: Sierra Wireless, Incorporated
Model: WP7607
Revision: SWI9X07Y_02.28.03.03 000000 jenkins 2019/05/21 03:33:04
IMEI: 359779080114230
IMEI SV:  6
FSN: VN829285061610
+GCAP: +CGSM

OK
root@Moxa:/home/moxa# cell_mgmt at 'AT+CSQ'
AT+CSQ
+CSQ: 99,99

OK
```

Watchdog Timer

Introduction

The watchdog timer (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. The watchdog driver is load with default timeout 60 seconds. The watchdog application should acknowledge in 60 seconds.

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 on the V2406C computer.

To enable it, first modify the **/etc/watchdog.conf** to remove the '**#**' in front of the "**watchdog-device**" setting

```
…
watchdog-device = /dev/watchdog
…
```

Then enable the **watchdog** service via **systemctl**

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

The watchdog configuration is located in the **/etc/watchdog.conf** file.
The acknowledge interval can be set to any number between 2 seconds and 58 seconds. Currently, we configure the watchdog daemon to acknowledge in 29 seconds because the watchdog daemon suggests to acknowledge twice before the watchdog timer timeout and the daemon might go to sleep. The **realtime** option is to store the setting in memory so it is never swapped out, to prevent a delay in the watchdog acknowledge. You can modify the **/etc/watchdog.conf** file to enable the watchdog settings as per your system requirement. This priority also sets the schedule priority for the real-time mode.

```
…
interval              = 29
realtime              = yes
priority              = 1
…
```

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

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

Check the watchdog daemon status.

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

Watchdog Device IOCTL Commands

IOCTL	**WDIOC_GETSUPPORT**
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.
IOCTL	**WDIOC_GETSTATUS**
Description	This returns the status of the card
Input	None
Output	(int *)arg
Return	On success, return 0. Otherwise, return < 0 value.
IOCTL	**WDIOC_GETBOOTSTATUS**
Description	This returns the status of the card that was reported at bootup.
Input	None
Output	(int *)arg)
Return	On success, return 0. Otherwise, return < 0 value.
IOCTL	**WDIOC_SETOPTIONS**
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.
IOCTL	**WDIOC_KEEPALIVE**
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.
IOCTL	WDIOC_SETTIMEOUT
Description	Set the watchdog timeout
Input	arg: 2 ~ 255 seconds
Output	None
Return	On success, return 0. Otherwise, return < 0 value.
IOCTL	WDIOC_GETTIMEOUT
Description	Get the current watchdog timeout.
Input	None
Output	arg: 2 ~ 255 seconds
Return	On success, return 0. Otherwise, return < 0 value.

Example

Using the settings in the example file **watchdog-simple.c,** the watchdog can be acknowledged 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;
}
```

A

Software Components

This packages table is based on firmware v1.0 with build number 19120515.

```
$ apt list --installed
adduser, 3.115, all
alsa-tools, 1.1.3-1, amd64
apt, 1.4.9, amd64
apt-utils, 1.4.9, amd64
base-files, 9.9+deb9u11, amd64
base-passwd, 3.5.43, amd64
bash, 4.4-5, amd64
bc, 1.06.95-9+b3, amd64
bsdmainutils, 9.0.12+nmu1, amd64
bsdutils, 1:2.29.2-1+deb9u1, amd64
busybox, 1:1.22.0-19+b3, amd64
ca-certificates, 20170717, all
coreutils, 8.26-3, amd64
cpio, 2.11+dfsg-6, amd64
cracklib-runtime, 2.9.2-5, amd64
crda, 3.18-1, amd64
cron, 3.0pl1-128+deb9u1, amd64
curl, 7.52.1-5+deb9u9, amd64
dash, 0.5.8-2.4, amd64
dbus, 1.10.28-0+deb9u1, amd64
dconf-gsettings-backend:amd64, 0.26.0-2+b1, amd64
dconf-service, 0.26.0-2+b1, amd64
debconf, 1.5.61, all
debconf-i18n, 1.5.61, all
debian-archive-keyring, 2017.5+deb9u1, all
debianutils, 4.8.1.1, amd64
diffutils, 1:3.5-3, amd64
dmidecode, 3.0-4, amd64
dmsetup, 2:1.02.137-2, amd64
dpkg, 1.18.25, amd64
e2fslibs:amd64, 1.43.4-2, amd64
e2fsprogs, 1.43.4-2, amd64
efibootmgr, 14-2, amd64
ethtool, 1:4.8-1+b1, amd64
file, 1:5.30-1+deb9u2, amd64
findutils, 4.6.0+git+20161106-2, amd64
firmware-atheros, 20161130-5, all
firmware-misc-nonfree, 20161130-5, all
gawk, 1:4.1.4+dfsg-1, amd64
gcc-6-base:amd64, 6.3.0-18+deb9u1, amd64
gettext-base, 0.19.8.1-2+deb9u1, amd64
glib-networking:amd64, 2.50.0-1+b1, amd64
```

glib-networking-common, 2.50.0-1, all
glib-networking-services, 2.50.0-1+b1, amd64
gnupg, 2.1.18-8~deb9u4, amd64
gnupg-agent, 2.1.18-8~deb9u4, amd64
gnupg1, 1.4.21-4+deb9u1, amd64
gpgv, 2.1.18-8~deb9u4, amd64
gpgv1, 1.4.21-4+deb9u1, amd64
grep, 2.27-2, amd64
grub-common, 2.02~beta3-5+deb9u2, amd64
grub-efi-amd64, 2.02~beta3-5+deb9u2, amd64
grub-efi-amd64-bin, 2.02~beta3-5+deb9u2, amd64
grub2-common, 2.02~beta3-5+deb9u2, amd64
gsettings-desktop-schemas, 3.22.0-1, all
gzip, 1.6-5+b1, amd64
hostname, 3.18+b1, amd64
i2c-tools, 3.1.2-3, amd64
ifenslave, 2.9, all
ifupdown, 0.8.19, amd64
init, 1.48, amd64
init-system-helpers, 1.48, all
initramfs-tools, 0.130, all
initramfs-tools-core, 0.130, all
iperf3, 3.1.3-1, amd64
iproute2, 4.9.0-1+deb9u1, amd64
iptables, 1.6.0+snapshot20161117-6, amd64
iputils-ping, 3:20161105-1, amd64
isc-dhcp-client, 4.3.5-3+deb9u1, amd64
isc-dhcp-common, 4.3.5-3+deb9u1, amd64
iw, 4.9-0.1, amd64
jq, 1.5+dfsg-1.3, amd64
keyutils, 1.5.9-9, amd64
klibc-utils, 2.0.4-9, amd64
kmod, 23-2, amd64
libacl1:amd64, 2.2.52-3+b1, amd64
libapparmor1:amd64, 2.11.0-3+deb9u2, amd64
libapt-inst2.0:amd64, 1.4.9, amd64
libapt-pkg5.0:amd64, 1.4.9, amd64
libasound2:amd64, 1.1.3-5, amd64
libasound2-data, 1.1.3-5, all
libassuan0:amd64, 2.4.3-2, amd64
libattr1:amd64, 1:2.4.47-2+b2, amd64
libaudit-common, 1:2.6.7-2, all
libaudit1:amd64, 1:2.6.7-2, amd64
libblkid1:amd64, 2.29.2-1+deb9u1, amd64
libbluetooth3:amd64, 5.43-2+deb9u1, amd64
libbsd0:amd64, 0.8.3-1, amd64
libbz2-1.0:amd64, 1.0.6-8.1, amd64
libc-bin, 2.24-11+deb9u4, amd64
libc-l10n, 2.24-11+deb9u4, all
libc6:amd64, 2.24-11+deb9u4, amd64
libcap-ng0:amd64, 0.7.7-3+b1, amd64
libcap2:amd64, 1:2.25-1, amd64
libcomerr2:amd64, 1.43.4-2, amd64
libcrack2:amd64, 2.9.2-5, amd64
libcryptsetup4:amd64, 2:1.7.3-4, amd64

libcurl3:amd64, 7.52.1-5+deb9u9, amd64
libdb5.3:amd64, 5.3.28-12+deb9u1, amd64
libdbus-1-3:amd64, 1.10.28-0+deb9u1, amd64
libdconf1:amd64, 0.26.0-2+b1, amd64
libdebconfclient0:amd64, 0.227, amd64
libdevmapper1.02.1:amd64, 2:1.02.137-2, amd64
libdns-export162, 1:9.10.3.dfsg.P4-12.3+deb9u5, amd64
libedit2:amd64, 3.1-20160903-3, amd64
libefiboot1:amd64, 30-2, amd64
libefivar1:amd64, 30-2, amd64
libelf1:amd64, 0.168-1, amd64
libestr0, 0.1.10-2, amd64
libevent-2.0-5:amd64, 2.0.21-stable-3, amd64
libexpat1:amd64, 2.2.0-2+deb9u2, amd64
libfastjson4:amd64, 0.99.4-1, amd64
libfdisk1:amd64, 2.29.2-1+deb9u1, amd64
libffi6:amd64, 3.2.1-6, amd64
libfreetype6:amd64, 2.6.3-3.2, amd64
libfuse2:amd64, 2.9.7-1+deb9u2, amd64
libgcc1:amd64, 1:6.3.0-18+deb9u1, amd64
libgcrypt20:amd64, 1.7.6-2+deb9u3, amd64
libgdbm3:amd64, 1.8.3-14, amd64
libglib2.0-0:amd64, 2.50.3-2+deb9u1, amd64
libgmp10:amd64, 2:6.1.2+dfsg-1, amd64
libgnutls30:amd64, 3.5.8-5+deb9u4, amd64
libgpg-error0:amd64, 1.26-2, amd64
libgpm2:amd64, 1.20.4-6.2+b1, amd64
libgssapi-krb5-2:amd64, 1.15-1+deb9u1, amd64
libgudev-1.0-0:amd64, 230-3, amd64
libhogweed4:amd64, 3.3-1+b2, amd64
libicu57:amd64, 57.1-6+deb9u3, amd64
libidn11:amd64, 1.33-1, amd64
libidn2-0:amd64, 0.16-1+deb9u1, amd64
libip4tc0:amd64, 1.6.0+snapshot20161117-6, amd64
libip6tc0:amd64, 1.6.0+snapshot20161117-6, amd64
libiperf0:amd64, 3.1.3-1, amd64
libiptc0:amd64, 1.6.0+snapshot20161117-6, amd64
libisc-export160, 1:9.10.3.dfsg.P4-12.3+deb9u5, amd64
libiw30:amd64, 30~pre9-12+b1, amd64
libjansson4:amd64, 2.9-1, amd64
libjq1:amd64, 1.5+dfsg-1.3, amd64
libjson-c3:amd64, 0.12.1-1.1, amd64
libk5crypto3:amd64, 1.15-1+deb9u1, amd64
libkeyutils1:amd64, 1.5.9-9, amd64
libklibc, 2.0.4-9, amd64
libkmod2:amd64, 23-2, amd64
libkrb5-3:amd64, 1.15-1+deb9u1, amd64
libkrb5support0:amd64, 1.15-1+deb9u1, amd64
libksba8:amd64, 1.3.5-2, amd64
libldap-2.4-2:amd64, 2.4.44+dfsg-5+deb9u3, amd64
libldap-common, 2.4.44+dfsg-5+deb9u3, all
liblocale-gettext-perl, 1.07-3+b1, amd64
liblogging-stdlog0:amd64, 1.0.5-2+b2, amd64
liblognorm5:amd64, 2.0.1-1.1+b1, amd64
liblz4-1:amd64, 0.0~r131-2+b1, amd64

liblzma5:amd64, 5.2.2-1.2+b1, amd64
libmagic-mgc, 1:5.30-1+deb9u2, amd64
libmagic1:amd64, 1:5.30-1+deb9u2, amd64
libmbim-glib4:amd64, 1.18.0-1, amd64
libmbim-proxy, 1.18.0-1, amd64
libmm-glib0:amd64, 1.10.0-moxa1, amd64
libmnl0:amd64, 1.0.4-2, amd64
libmount1:amd64, 2.29.2-1+deb9u1, amd64
libmoxa-dio-control1:amd64, 1.2.0+deb9, amd64
libmoxa-gpio-control1:amd64, 1.0.2+deb9, amd64
libmoxa-uart-control1:amd64, 1.1.6+deb9, amd64
libmpfr4:amd64, 3.1.5-1, amd64
libncurses5:amd64, 6.0+20161126-1+deb9u2, amd64
libncursesw5:amd64, 6.0+20161126-1+deb9u2, amd64
libndp0:amd64, 1.6-1+b1, amd64
libnetfilter-conntrack3:amd64, 1.0.6-2, amd64
libnettle6:amd64, 3.3-1+b2, amd64
libnewt0.52:amd64, 0.52.19-1+b1, amd64
libnfnetlink0:amd64, 1.0.1-3, amd64
libnfsidmap2:amd64, 0.25-5.1, amd64
libnghttp2-14:amd64, 1.18.1-1+deb9u1, amd64
libnl-3-200:amd64, 3.2.27-2, amd64
libnl-genl-3-200:amd64, 3.2.27-2, amd64
libnm0:amd64, 1.6.2-3+deb9u2, amd64
libnpth0:amd64, 1.3-1, amd64
libonig4:amd64, 6.1.3-2, amd64
libp11-kit0:amd64, 0.23.3-2, amd64
libpam-cracklib:amd64, 1.1.8-3.6, amd64
libpam-modules:amd64, 1.1.8-3.6, amd64
libpam-modules-bin, 1.1.8-3.6, amd64
libpam-runtime, 1.1.8-3.6, all
libpam-systemd:amd64, 232-25+deb9u12, amd64
libpam0g:amd64, 1.1.8-3.6, amd64
libpcap0.8:amd64, 1.8.1-3, amd64
libpcre3:amd64, 2:8.39-3, amd64
libpcsclite1:amd64, 1.8.20-1, amd64
libperl5.24:amd64, 5.24.1-3+deb9u5, amd64
libpipeline1:amd64, 1.4.1-2, amd64
libpng16-16:amd64, 1.6.28-1+deb9u1, amd64
libpolkit-agent-1-0:amd64, 0.105-18+deb9u1, amd64
libpolkit-backend-1-0:amd64, 0.105-18+deb9u1, amd64
libpolkit-gobject-1-0:amd64, 0.105-18+deb9u1, amd64
libpopt0:amd64, 1.16-10+b2, amd64
libprocps6:amd64, 2:3.3.12-3+deb9u1, amd64
libproxy1v5:amd64, 0.4.14-2, amd64
libpsl5:amd64, 0.17.0-3, amd64
libqmi-glib5:amd64, 1.22.0-1.2, amd64
libqmi-proxy, 1.22.0-1.2, amd64
libqmi-utils, 1.22.0-1.2, amd64
libreadline7:amd64, 7.0-3, amd64
librtmp1:amd64, 2.4+20151223.gitfa8646d.1-1+b1, amd64
libsasl2-2:amd64, 2.1.27~101-g0780600+dfsg-3, amd64
libsasl2-modules-db:amd64, 2.1.27~101-g0780600+dfsg-3, amd64
libseccomp2:amd64, 2.3.1-2.1+deb9u1, amd64
libselinux1:amd64, 2.6-3+b3, amd64

libsemanage-common, 2.6-2, all
libsemanage1:amd64, 2.6-2, amd64
libsensors4:amd64, 1:3.4.0-4, amd64
libsepol1:amd64, 2.6-2, amd64
libsigsegv2:amd64, 2.10-5, amd64
libslang2:amd64, 2.3.1-5, amd64
libsmartcols1:amd64, 2.29.2-1+deb9u1, amd64
libsoup2.4-1:amd64, 2.56.0-2+deb9u2, amd64
libsqlite3-0:amd64, 3.16.2-5+deb9u1, amd64
libss2:amd64, 1.43.4-2, amd64
libssh2-1:amd64, 1.7.0-1+deb9u1, amd64
libssl1.0.2:amd64, 1.0.2s-1~deb9u1, amd64
libssl1.1:amd64, 1.1.0k-1~deb9u1, amd64
libstdc++6:amd64, 6.3.0-18+deb9u1, amd64
libsystemd0:amd64, 232-25+deb9u12, amd64
libtasn1-6:amd64, 4.10-1.1+deb9u1, amd64
libteamdctl0:amd64, 1.26-1+b1, amd64
libtext-charwidth-perl, 0.04-7+b5, amd64
libtext-iconv-perl, 1.7-5+b4, amd64
libtext-wrapi18n-perl, 0.06-7.1, all
libtinfo5:amd64, 6.0+20161126-1+deb9u2, amd64
libtirpc1:amd64, 0.2.5-1.2+deb9u1, amd64
libudev1:amd64, 232-25+deb9u12, amd64
libuniconf4.6, 4.6.1-12~deb9u1, amd64
libunistring0:amd64, 0.9.6+really0.9.3-0.1, amd64
libustr-1.0-1:amd64, 1.0.4-6, amd64
libuuid1:amd64, 2.29.2-1+deb9u1, amd64
libwrap0:amd64, 7.6.q-26, amd64
libwvstreams4.6-base, 4.6.1-12~deb9u1, amd64
libwvstreams4.6-extras, 4.6.1-12~deb9u1, amd64
libxapian30:amd64, 1.4.3-2+deb9u3, amd64
libxml2:amd64, 2.9.4+dfsg1-2.2+deb9u2, amd64
libxtables12:amd64, 1.6.0+snapshot20161117-6, amd64
linux-base, 4.5, all
linux-image-4.9.0-11-amd64, 4.9.189-3, amd64
linux-image-amd64, 4.9+80+deb9u9, amd64
lm-sensors, 1:3.4.0-4, amd64
locales, 2.24-11+deb9u4, all
login, 1:4.4-4.1, amd64
logrotate, 3.11.0-0.1, amd64
lsb-base, 9.20161125, all
mawk, 1.3.3-17+b3, amd64
mount, 2.29.2-1+deb9u1, amd64
moxa-archive-keyring, 2019.4.26+deb9, all
moxa-at-cmd, 0.9.2-1, amd64
moxa-atheros-ath10k-driver-amd64, 4.9.198+1.0.0, amd64
moxa-cellular-utils, 2.0.5, all
moxa-dio-control, 1.2.0+deb9, amd64
moxa-hotswap-driver-amd64, 1.0.1, amd64
moxa-hwmon-ina2xx-driver-amd64, 4.9.168+1.0.0, amd64
moxa-it87-gpio-driver-amd64, 5.2+1.0.0, amd64
moxa-it87-serial-driver-amd64, 1.0.0, amd64
moxa-it87-wdt-driver-amd64, 5.2+1.0.0, amd64
moxa-module-control, 1.3.1+deb9, all
moxa-uart-control, 1.1.6+deb9, amd64

moxa-v2406c-hotswapd, 1.0.1+deb9, amd64
moxa-version, 1.1.0+deb9, amd64
multiarch-support, 2.24-11+deb9u4, amd64
nano, 2.7.4-1, amd64
ncurses-base, 6.0+20161126-1+deb9u2, all
ncurses-bin, 6.0+20161126-1+deb9u2, amd64
net-tools, 1.60+git20161116.90da8a0-1, amd64
netbase, 5.4, all
network-manager, 1.6.2-3+deb9u2, amd64
nfs-common, 1:1.3.4-2.1, amd64
ntpdate, 1:4.2.8p10+dfsg-3+deb9u2, amd64
openssh-client, 1:7.4p1-10+deb9u7, amd64
openssh-server, 1:7.4p1-10+deb9u7, amd64
openssh-sftp-server, 1:7.4p1-10+deb9u7, amd64
openssl, 1.1.0k-1~deb9u1, amd64
passwd, 1:4.4-4.1, amd64
perl, 5.24.1-3+deb9u5, amd64
perl-base, 5.24.1-3+deb9u5, amd64
perl-modules-5.24, 5.24.1-3+deb9u5, all
pinentry-curses, 1.0.0-2, amd64
pm-utils, 1.4.1-17, all
policykit-1, 0.105-18+deb9u1, amd64
powermgmt-base, 1.31+nmu1, all
ppp, 2.4.7-1+4, amd64
procps, 2:3.3.12-3+deb9u1, amd64
readline-common, 7.0-3, all
rpcbind, 0.2.3-0.6, amd64
rsyslog, 8.24.0-1, amd64
sed, 4.4-1, amd64
sensible-utils, 0.0.9+deb9u1, all
sudo, 1.8.19p1-2.1, amd64
systemd, 232-25+deb9u12, amd64
systemd-sysv, 232-25+deb9u12, amd64
sysvinit-utils, 2.88dsf-59.9, amd64
tar, 1.29b-1.1, amd64
tasksel, 3.39, all
tasksel-data, 3.39, all
tzdata, 2019b-0+deb9u1, all
ucf, 3.0036, all
udev, 232-25+deb9u12, amd64
udhcpc, 1:1.22.0-19+b3, amd64
util-linux, 2.29.2-1+deb9u1, amd64
v2406c-base-system, 1.1.2, amd64
v2406c-moxa-configs, 1.1.2, all
vim, 2:8.0.0197-4+deb9u3, amd64
vim-common, 2:8.0.0197-4+deb9u3, all
vim-runtime, 2:8.0.0197-4+deb9u3, all
vim-tiny, 2:8.0.0197-4+deb9u3, amd64
wamerican, 7.1-1, all
wget, 1.18-5+deb9u3, amd64
whiptail, 0.52.19-1+b1, amd64
wireless-regdb, 2016.06.10-1, all
wireless-tools, 30~pre9-12+b1, amd64
wpasupplicant, 2:2.4-1+deb9u4, amd64
wvdial, 1.61-4.1, amd64

xxd, 2:8.0.0197-4+deb9u3, amd64
zlib1g:amd64, 1:1.2.8.dfsg-5, amd64