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Thank you for purchasing the Moxa V2201 Series of x86 ready-to-run embedded computers. This manual introduces the software configuration and management of the V2201-LX, which runs the Linux operating system. For hardware installation, connector interfaces, setup, and upgrading the BIOS, please refer to V2201 Series Hardware User’s Manual.

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

The following topics are covered in this chapter:

- Overview
- Software Specifications
- Software Components
Overview

The Moxa V2201 series ultra-compact x86 embedded computer is based on the Intel® Atom™ E3800 series processor, features the most reliable I/O design to maximize connectivity, and supports a wireless module, making it suitable for a diverse range of communication applications. The computer’s meticulous thermal design ensures reliable system operation in temperatures ranging from -40 to 85°C (~40 to 70°C with a special-purpose Moxa wireless module installed).

The V2201 series supports “Moxa Hardware Monitor” for device I/O status monitoring and alerts, system temperature monitoring and alerts, and system power management. Monitoring system status closely makes it easier to recover from errors and provides the most reliable platform for your applications.

Software Specifications

The Linux operating system pre-installed on the V2201 embedded computer is the Debian Jessie 8.1 distribution. The Debian project is a worldwide group of volunteers who endeavor to produce an operating system distribution that 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:

![Software Architecture Diagram]

ATTENTION
For information and documentation on the Debian GNU/Linux and free software concept, refer to the following links:
http://www.debian.org/
http://www.gnu.org/

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 V2201 Linux models are pre-installed with the Debian Jessie 8.1 Linux distribution. For a list of the software components, see “Appendix A.”
In this chapter, we explain how to operate a V2201-LX computer directly from your desktop. There are three ways to connect to the V2201-LX computer: through an HDMI monitor or by using an SSH console from a Windows or Linux machine. This chapter describes basic Linux operating system configurations. The advanced network management and configuration will be described in the next chapter "Managing Communications."

The following topics are covered in this chapter:

- Starting from an HDMI Console
- Connecting from an SSH Console
  - Windows Users
  - Linux Users
- Adjusting the System Time
  - Setting the Time Manually
  - NTP Client
  - Updating the Time Automatically
- Enabling and Disabling Daemons
- Cron—Daemon for Executing Scheduled Commands
- Inserting a USB Storage Device into the Computer
- Checking the Linux Version
- APT—Installing and Removing Packages
Starting from an HDMI Console

Connect the display monitor to the V2201-LX HDMI connector, and then power it up by connecting it to the power adaptor. It takes about 30 to 60 seconds for the system to boot up. Once the system is ready, a login screen will appear on your monitor.

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

Login: moxa
Password: moxa

Moxa login: moxa
Password: moxa

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

moxa@Moxa:~$
Connecting from an SSH Console

The V2201-LX computer supports an SSH Console to offer users with better security over the network compared to Telnet.

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 V2201-LX 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 V2201-LX’s console utility via SSH.

```
# ssh moxa@192.168.3.127
```

Select `yes` to open the connection.

```
[moxa@Moxa:~]$ # ssh moxa@192.168.3.127
The authenticity of host ‘192.168.3.127 (192.168.3.127)’ can’t be established.
Are you sure you want to continue connection (yes/no)? yes
```
Adjusting the System Time

The V2201-LX has two time settings. One is the system time, and the other is provided by an RTC (Real Time Clock) built into the V2201-LX’s hardware.

Setting the Time Manually

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

Use the following command to set the system time.

```
moxa@Moxa:~ # 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.

```
root@Moxa:~ # hwclock
```

NTP Client

The V2201-LX has a built-in NTP (Network Time Protocol) client that is used to initialize a time request to a remote NTP server. Use `ntpdate` to update the system time.

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

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

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

## Updating the Time Automatically

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

### Example shell script for updating the system time periodically

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

Save the shell script using any file name. For example, `fixtime`.

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

Copy the example shell script `fixtime` to directory `/etc/init.d`, and then use `chmod 755 fixtime` to change the shell script mode.

```
```
moxa@Moxa:~# chmod 755 fixtime
```

Next, use `vi` editor to edit the file `/etc/inittab`.

```
moxa@Moxa:~# vi /etc/inittab
```

Add the following line to the bottom of the file:

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

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

```
moxa@Moxa:~# init q
```
Enabling and Disabling Daemons

Only the following daemons are enabled in the V2201 by default:

- **sftpd**: SFTP Server / Client daemon
- **sshd**: Secure Shell Server daemon

You may manage what services to run in the background by the command `inserv`. Below example shows how to add the apache daemon in current runlevel.

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

Apache will not activate in the current boot session, but will be running in the background from the next boot session. To disable the apache daemon, use the following command:

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

Linux daemons can be started or stopped in the current boot session by using of the scripts in `/etc/init.d`. To start the apache daemon, use:

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

To stop the apache daemon, use:

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

---

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 in that minute. 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:

<table>
<thead>
<tr>
<th>mm</th>
<th>h</th>
<th>dom</th>
<th>mon</th>
<th>dow</th>
<th>user</th>
<th>command</th>
</tr>
</thead>
<tbody>
<tr>
<td>minute</td>
<td>hour</td>
<td>date</td>
<td>month</td>
<td>week</td>
<td>user</td>
<td>command</td>
</tr>
<tr>
<td>0-59</td>
<td>0-23</td>
<td>1-31</td>
<td>1-12</td>
<td>0-6 (0 is Sunday)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For example, 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 mode of `fixtime.sh`
   ```
moxa@Moxa:~$ # chmod 755 fixtime.sh
   ```
3. Modify `/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

Since mounting USB storage devices manually can be difficult, a Debian package named `usbmount` to mount the USB drivers automatically. `usbmount` relies on `udev` to mount USB storage devices automatically at certain mount points. The USB storage devices will be mounted on `/media/usb0`, `/media/usb1`, etc.

```
root@Moxa:~# mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
udev on /dev type devtmpfs (rw,relatime,size=10240k, nr_inodes=492181, mode=755)
devpts on /dev/pts type devpts
(rw,nosuid,noexec,relatime,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,nodev,relatime,size=790820k,mode=755)
/dev/sdal on / type ext4 (rw,noatime,errors=remount-ro,data=ordered)
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexec,relatime)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev)
tmpfs on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
sys/fs/cgroup type tmpfs (ro,nosuid,nodev,noexec,mode=755)
cgroup on /sys/fs/cgroup/systemd type cgroup
(rw,nosuid,nodev,noexec,relatime,xattr,release_agent=/lib/systemd/systemd-cgroups
-agents,name=systemd)
pstore on /sys/fs/pstore type pstore (rw,nosuid,nodev,noexec,relatime)
cgroup on /sys/fs/cgroup/cpu,cpuset type cgroup
(rw,nosuid,nodev,noexec,relatime,cpuset)
cgroup on /sys/fs/cgroup/freezer type cgroup
(rw,nosuid,nodev,noexec,relatime,freezer)
cgroup on /sys/fs/cgroup/net_cls,net_prio type cgroup
(rw,nosuid,nodev,noexec,relatime,net_cls,net_prio)
cgroup on /sys/fs/cgroup/blkio type cgroup (rw,nosuid,nodev,noexec,relatime,blkio)
cgroup on /sys/fs/cgroup/perf_event type cgroup
(rw,nosuid,nodev,noexec,relatime,perf_event)
tmpfs on /etc/machine-id type tmpfs (ro,relatime,size=790820k,mode=755)
systemd-1 on /proc/sys/fs/binfmt_misc type autofs
(rw,relatime,fld=21,pgrp=1,timeout=300,minproto=5,maxproto=5,direct)
hugetlbfs on /dev/hugepages type hugetlbfs (rw,relatime)
mqueue on /dev/mqueue type mqueue (rw,relatime)
debugfs on /sys/kernel/debug type debugfs (rw,relatime)
biffmt_misc on /proc/sys/fs/binfmt_misc type bpfint_misc (rw,relatime)
/dev/sdb1 on /media/usb0 type vfat
(rw,nodev,noexec,noatime,nodiratime, sync, fmask=0022, dmask=0022, codepage=437, iocharset=utf8, shortname=mixed, errors=remount-ro)
/dev/sdc1 on /media/usb1 type vfat
(rw,nodev,noexec,noatime,nodiratime, sync, fmask=0022, dmask=0022, codepage=437, iocharset=utf8, shortname=mixed, errors=remount-ro)
```

**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.
ATTENTION

Remember to exit the /media/usb0 or /media/usb1 directory when you disconnect the USB storage device. If you stay in /media/usb0 or /media/usb1, the automatic un-mount process will fail. If that happens, type # umount /media/usb0 to un-mount the USB device manually.

Checking the Linux Version

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

```
root@Moxa:~# uname -a
Linux Moxa 3.16.0-4-amd64 #1 SMP Debian 3.16.7-ckt9-2 (2015-04-13) x86_64 GNU/Linux
root@Moxa:~#
```

APT—Installing and Removing Packages

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

1. Next, configure the /etc/apt/sources.list using vi editor.

```
root@Moxa:~# vi /etc/apt/sources.list
deb http://ftp.us.debian.org/debian/ jessie main contrib non-free
deb-src http://ftp.us.debian.org/debian/ jessie main contrib non-free
deb http://ftp.us.debian.org/debian/ jessie-updates main contrib non-free
deb-src http://ftp.us.debian.org/debian/ jessie-updates main contrib non-free
deb http://security.debian.org/ jessie/updates main contrib non-free
deb-src http://security.debian.org/ jessie/updates main contrib non-free
deb http://ftp.debian.org/debian jessie-backports main contrib non-free
deb-src http://ftp.debian.org/debian jessie-backports main contrib non-free
```

2. Update the source list after you configure it.

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

3. Once you indicate which package you want to install (vim, for example), type:

```
root@Moxa:~# apt-get install vim
root@Moxa:~#
```

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

(a) For a simple package removal:

```
root@Moxa:~# apt-get remove vim
root@Moxa:~#
```

(b) For a complete package removal:

```
root@Moxa:~# apt-get remove vim --purge
root@Moxa:~#
```
ATTENTION
The APT cache space /var/cache/apt is located in tmpfs. If you need to install a huge package, link /var/cache/apt to USB mass storage or mount it to an NFS space to generate more free space. Use df -h to check how much free space is available on tmpfs.

Filesystem  Size  Used  Avail  Use%  Mounted on
/dev/sda1   7.3G  1.2G  6.0G  17%  /
udev        10M   4.0K  10M   1%  /dev
tmpfs       773M  8.6M  764M  2%  /run
tmpfs       1.9G  0  1.9G  0%  /dev/shm
tmpfs       5.0M  0  5.0M  0%  /run/lock
tmpfs       1.9G  0  1.9G  0%  /sys/fs/cgroup

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

root@Moxa:~# apt-get clean
root@Moxa:~#
Managing Communications

The V2201-LX ready-to-run embedded computer is a network-centric platform designed to serve as a front-end for data acquisition and industrial control applications. This chapter describes how to configure the various communication functions supported by the Linux operating system.

The following topics are covered in this chapter:

- **Detecting Network Interfaces**
- **Changing the Network Settings**
  - Changing the "interfaces" Configuration File
  - Adjusting IP Addresses with "ifconfig"
- **Serial Port Operation Mode**
- **DNS Client**
  - /etc/hostname
  - /etc/resolv.conf
  - /etc/nsswitch.conf
- **Configuring Ethernet Bonding**
- **Apache Web Server**
  - Default Homepage
  - Disabling the CGI Function
  - Saving Web Pages to a USB Storage Device
- **IPTABLES**
  - IPTABLES Hierarchy
  - IPTABLES Modules
  - Observe and Erase Chain Rules
  - Define Policy for Chain Rules
  - Append or Delete Rules
- **NAT (Network Address Translation)**
  - NAT Example
  - Enabling NAT at Bootup
- **PPP (Point to Point Protocol)**
  - Connecting to a PPP Server over a Simple Dial-up Connection
  - Connecting to a PPP Server over a Hard-wired Link
  - Checking the Connection
  - Setting up a Machine for Incoming PPP Connections
- **PPPoE**
- **NFS (Network File System) Client**
- **SNMP**
- **OpenVPN**
  - Ethernet Bridging for Private Networks on Different Subnets
  - Ethernet Bridging for Private Networks on the Same Subnet
  - Routed IP
  - Cellular Module
  - Wi-Fi Module
Detecting Network Interfaces

Debian Linux systems use udevd to detect new network interfaces, including Ethernet interfaces and wireless interfaces. One of the rules is /lib/udev/rules.d/75-persistent-net-generator.rules for creating a persistent network interface naming order. The content in /etc/udev/rules.d/70-persistent-net.rules is similar to the following:

```
# PCI device 0x10ec:0x8168 (r8168)
SUBSYSTEM=="net", ACTION=="add", DRIVERS=="?"*, ATTR{address}=="00:90:e8:00:00:20",
ATTR{dev_id}=="0x0", ATTR{type}=="1", KERNEL=="eth*", NAME="eth0"

# PCI device 0x10ec:0x8168 (r8168)
SUBSYSTEM=="net", ACTION=="add", DRIVERS=="?"*, ATTR{address}=="00:90:e8:00:00:21",
ATTR{dev_id}=="0x0", ATTR{type}=="1", KERNEL=="eth*", NAME="eth1"
```

The above example indicates that the system has detected two Ethernet interfaces.

ATTENTION
When replacing or connecting a network interface, the system may keep the old record in /etc/udev/rules.d/70-persistent-net.rules, which could cause network interfaces to be detected abnormally. To avoid this problem, delete the content of the file /etc/udev/rules.d/70-persistent-net.rules and reboot the system.

Changing the Network Settings

The V2201 computer has two 10/100 or 10/100/1000 Ethernet ports named LAN1 and LAN2. The default IP addresses and netmasks of these network interfaces are:

<table>
<thead>
<tr>
<th>Default IP Address</th>
<th>Netmask</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAN1 192.168.3.127</td>
<td>255.255.255.0</td>
</tr>
<tr>
<td>LAN2 192.168.4.127</td>
<td>255.255.255.0</td>
</tr>
</tbody>
</table>

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

Changing the “interfaces” Configuration File

1. Type `cd /etc/network` to change directories.
   ```bash
   moxa@Moxa:~# cd /etc/network
   ``
2. Type `vi interfaces` to edit the network configuration file with vi editor. You can configure the V2201’s Ethernet ports for static or dynamic (DHCP) IP addresses.
   ```bash
   moxa@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 eth0
```
iface eth0 inet static
    address 192.168.3.127
    netmask 255.255.255.0
    broadcast 192.168.3.255

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

Dynamic IP Address using DHCP

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

# The primary network interface
auto eth0
iface eth0 inet dhcp

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

# /etc/init.d/networking restart

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

Adjusting IP Addresses with “ifconfig”

IP settings can be adjusted during run-time, but the new settings will not be saved to the flash ROM without modifying the file /etc/network/interfaces. For example, type the command # ifconfig eth0 192.168.1.1 to change the IP address of LAN1 to 192.168.1.1.

moxa@Moxa:~# ifconfig eth0 192.168.1.1
moxa@Moxa:~#

Serial Port Operation Mode

The V2201-LX computer has 2 serial ports named COM1 and COM2. The ports support RS-232, RS-422, 2-wire RS-485, and 4-wire RS-485 operation modes with baudrate settings up to 115200 bps.

By default, the serial interface is set to RS-232. You can use the setinterface command to change the serial port operation mode, as indicated below:

setinterface device-node [interface-no]

device-node /dev/ttyS0 to /dev/ttyS1
interface-no
    0 set to RS232 interface
    1 set to RS485-2WIRES interface
    2 set to RS422 interface
    3 set to RS485-4WIRES interface

For example, use the following commands to set /dev/ttyS0 to RS-422:

root@Moxa:/home/moxa# setinterface /dev/ttyS0 2
root@Moxa:/home/moxa# setinterface /dev/ttyS0
DNS Client

The V2201-LX supports DNS client (but not DNS server). To set up DNS client, you need to edit three configuration files: `/etc/hostname`, `/etc/resolv.conf`, and `/etc/nsswitch.conf`.

/etc/hostname

1. Edit `/etc/hostname`:
   ```
   moxa@Moxa:~# sudo vi /etc/hostname
   Moxa
   ```
2. Re-configure the hostname.
   ```
   root@Moxa:~# /etc/init.d/hostname.sh start
   ```
3. Check the new hostname.
   ```
   root@Moxa:~# hostname
   ```

/etc/resolv.conf

This is the most important file that you need to edit when using DNS. For example, before using `# ntpdate time.stdtime.gov.tw` to update the system time, you will need to add the DNS server address to the file. Ask your network administrator which DNS server address you should use. The DNS server’s IP address is specified with the `nameserver` command. For example, add the following line to `/etc/resolv.conf` (assuming the DNS server’s IP address is 168.95.1.1):

`nameserver 168.95.1.1`

```
root@Moxa:/etc# cat resolv.conf
#
# resolv.conf This file is the resolver configuration file
# See resolver(5).
#
#nameserver 192.168.1.16
#nameserver 168.95.1.1
nameserver 140.115.1.31
nameserver 140.115.236.10
Moxa:/etc#
```

/etc/nsswitch.conf

This file defines the sequence of files, `/etc/hosts` or `/etc/resolv.conf`, to be read to resolve the IP address. The `hosts` line in `/etc/nsswitch.conf` means use `/etc/host` first and DNS service to resolve the 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
```
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, load the bonding driver. Then use ifenslave to add the Ethernet interface into the bond0 interface. The following script bonds eth1 and eth2 together; you can place the script in `/etc/init.d/bonding.sh`.

```bash
#!/bin/bash

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

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

case "$1" in
  start)
    # to set ethX interfaces as slave the bond0 must have an ip
    if [ "$2" == "" ]; then
      $0
      exit 1
    fi
    echo "Starting bonding service: $NAME."
    modprobe bonding mode=1 miimon=100    # load bonding module
    ifdown eth2                       # putting down eth2
    ifdown eth1                       # putting down eth1
    ifconfig bond0 hw ether 00:90:E8:00:00:60 # change mac address
    ifconfig bond0 $2 netmask 255.255.255.0 up # set ip address
    ifenslave bond0 eth2       # set eth2 in slave for bond0
    ifenslave bond0 eth1       # set eth1 in slave for bond0
  *")

done
```

shadow: compat
hosts: files dns
networks: files
protocols: db files
services: db files
ethers: db files
rpc: db files
netgroup: nis
stop)
  echo "Stopping bonding service: $NAME"
  ifenslave -d bond0 eth2 # release eth2 from bond0
  ifenslave -d bond0 eth1 # release eth1 from bond0
  ifconfig bond0 down   # putting down bond0
  modprobe -r bonding   # unload bonding module
  ifup eth2
  ifup eth1

restart)
  $0 stop
  $0 start $2

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

esac

exit 0

You can use insserv to add this to run level.

moxa@Moxa:-# sudo insserv -v -d bonding.sh

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

moxa@Moxa:-# sudo insserv -r bonding.sh

**Apache Web Server**

**Default Homepage**

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

Save your own homepage to the following directory:

`/var/www/apache2-default`

Save your CGI page to the following directory:

`/var/www/apache2-default/cgi-bin/`

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

`http://192.168.3.127/`

To test the default CGI page, type:

`http://192.168.3.127/cgi-bin/w3mmail.cgi`
Disabling the CGI Function

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

1. Type 
   `# vi /etc/apache2/sites-enabled/000-default` to edit the configuration file. Comment out 
   the following lines:
   ```
   #ScriptAlias /cgi-bin/ /var/www/apache2-default/cgi-bin/
   #<Directory "/var/www/apache2 default/cgi-bin/">
   # AllowOverride None
   # Options ExecCGI -MultiViews +SymLinksIfOwnerMatch
   # #Order allow,deny
   # Order deny,allow
   # Allow from all
   #</Directory>
   ```

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

2. Re-start the apache server.
   ```
   root@Moxa:~# /etc/init.d/apache2 restart
   ```

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

Saving Web Pages to a USB Storage Device

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

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

2. Uncompress the zip file to your desktop PC, and then use FTP to transfer it to the V2201-LX’s 
   /media/usb0 directory.

3. Type 
   `# vi /etc/apache2/sites-available/default` and 
   `# vi /etc/apache2/sites-available/default-ssl` to edit the configuration file.

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

4. Change the DocumentRoot directory to the USB storage directory /media/usb0/www.
   ```
   ...
   <VirtualHost *:80>
   ...
   ...
   DocumentRoot /media/usb0/www
   ```
<Directory />  
  Options FollowSymLinks  
  AllowOverride None  
</Directory>
...
...
ScriptAlias /cgi-bin/ /media/usb0/www/cgi-bin/  
<Directory "/media/usb0/www/cgi-bin/"/
  AllowOverride None  
  Options ExecCGI -MultiViews +SymLinksIfOwnerMatch  
  Order allow,deny  
  Allow from all
</Directory>
...
</VirtualHost>
...
<VirtualHost *:443>
...
...
DocumentRoot /media/usb0/www  
<Directory />  
  Options FollowSymLinks  
  AllowOverride None  
</Directory>
...
...
ScriptAlias /cgi-bin/ /media/usb0/www/cgi-bin/  
<Directory "/media/usb0/www/cgi-bin/"/
  AllowOverride None  
  Options ExecCGI -MultiViews +SymLinksIfOwnerMatch  
  Order allow,deny  
  Allow from all
</Directory>
...
</VirtualHost>

5. Use the following commands to restart the Apache web server:
   
   # cd /etc/init.d  
   #./apache2 restart

6. Start your browser and connect to the V2201-LX by typing the current LAN1 IP address in the browser’s address box.

7. Re-start the apache server.

   root@Moxa:~# /etc/init.d/apache2 restart

---

**ATTENTION**

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

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

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

The V2201-LX supports three types of IPTABLES: Filter tables, NAT tables, and Mangle tables.

Filter Table—includes three chains:
- INPUT chain
- OUTPUT chain
- FORWARD chain

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

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

Mangle Table—includes two chains
- PREROUTING chain—pre-processes packets before the routing process.
- OUTPUT chain—processes packets after the routing process.

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

The following figure shows the IPTABLES hierarchy.

IPTABLES Modules

The V2201-LX supports the following sub-modules. Use the module that matches your application.

<table>
<thead>
<tr>
<th>Module</th>
<th>Module</th>
<th>Module</th>
<th>Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>arptable_filter.ko</td>
<td>arp_tables.ko</td>
<td>arpt_mangle.ko</td>
<td>ip_conntrack_amanda.ko</td>
</tr>
<tr>
<td>ip_conntrack_ftp.ko</td>
<td>ip_conntrack_h323.ko</td>
<td>ip_conntrack_irc.ko</td>
<td>ip_conntrack.ko</td>
</tr>
<tr>
<td>ip_conntrack_netbios_ns.ko</td>
<td>ip_conntrack_netlink.ko</td>
<td>ip_conntrack_pptp.ko</td>
<td>ip_conntrack_proto_sctp.ko</td>
</tr>
<tr>
<td>ip_conntrack_sip.ko</td>
<td>ip_conntrack_tftp.ko</td>
<td>ip_nat_amanda.ko</td>
<td>ip_nat_ftp.ko</td>
</tr>
<tr>
<td>ip_nat_h323.ko</td>
<td>ip_nat_irc.ko</td>
<td>ip_nat.ko</td>
<td>ip_nat_pptp.ko</td>
</tr>
<tr>
<td>ip_nat_sip.ko</td>
<td>ip_nat_snmp_basic.ko</td>
<td>ip_nat_tftp.ko</td>
<td>ip_queue.ko</td>
</tr>
<tr>
<td>iptable_filter.ko</td>
<td>iptable_mangle.ko</td>
<td>iptable_nat.ko</td>
<td>iptable_raw.ko</td>
</tr>
<tr>
<td>ip_tables.ko</td>
<td>ipt_addrtype.ko</td>
<td>ipt_AH.ko</td>
<td>ipt_CLUSTERIP.ko</td>
</tr>
<tr>
<td>ipt_dscp.ko</td>
<td>ipt_DSCP.ko</td>
<td>ipt_ecn.ko</td>
<td>ipt_ECN.ko</td>
</tr>
<tr>
<td>ipt_hashlimit.ko</td>
<td>ipt_iprange.ko</td>
<td>ipt_LOG.ko</td>
<td>ipt_MASQUERADE.ko</td>
</tr>
<tr>
<td>ipt_NETMAP.ko</td>
<td>ipt_owner.ko</td>
<td>ipt_recent.ko</td>
<td>ipt_REDIRECT.ko</td>
</tr>
<tr>
<td>ipt_REJECT.ko</td>
<td>ipt_SAME.ko</td>
<td>ipt_TCPMSS.ko</td>
<td>ipt/tos.ko</td>
</tr>
<tr>
<td>ipt_TOS.ko</td>
<td>ipt_ttl.ko</td>
<td>ipt_TTL.ko</td>
<td>ipt_ULOG.ko</td>
</tr>
</tbody>
</table>
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 V2201-LX. Use `modprobe` to insert and enable the module.

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

**ATTENTION**

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

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

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

**Observe and Erase Chain Rules**

**Usage:**

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

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

**Example:**

# iptables -L -n

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

# iptables -F
# iptables -X
# iptables -Z
Define Policy for Chain Rules

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

- `-P`: Set the policy for the chain to the given target.
- `INPUT`: For packets coming into the V2201-LX.
- `OUTPUT`: For locally-generated packets.
- `FORWARD`: For packets routed out through the V2201-LX.
- `PREROUTING`: To alter packets as soon as they come in.
- `POSTROUTING`: To alter packets as they are about to be sent out.

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

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

Append or Delete Rules

Usage:
```
```

- `-A`: Append one or more rules to the end of the selected chain.
- `-I`: Insert one or more rules in the selected chain as the given rule number.
- `-i`: Name of an interface via which a packet is going to be received.
- `-o`: Name of an interface via which a packet is going to be sent.
- `-p`: The protocol of the rule or of the packet to check.
- `-s`: Source address (network name, host name, network IP address, or plain IP address).
- `--sport`: Source port number.
- `-d`: Destination address.
- `--dport`: Destination port number.
- `-j`: Jump target. Specifies the target of the rules; i.e., how to handle matched packets.

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

Examples:
Example 1: Accept all packets from the lo interface.
```
# iptables -A INPUT -i lo -j ACCEPT
```

Example 2: Accept TCP packets from 192.168.0.1.
```
# iptables -A INPUT -i eth0 -p tcp -s 192.168.0.1 -j ACCEPT
```

Example 3: Accept TCP packets from Class C network 192.168.1.0/24.
```
# iptables -A INPUT -i eth0 -p tcp -s 192.168.1.0/24 -j ACCEPT
```

Example 4: Drop TCP packets from 192.168.1.25.
```
# iptables -A INPUT -i eth0 -p tcp -s 192.168.1.25 -j DROP
```

Example 5: Drop TCP packets addressed for port 21.
```
# iptables -A INPUT -i eth0 -p tcp --dport 21 -j DROP
```

Example 6: Accept TCP packets from 192.168.0.24 to V2201-LX’s port 137, 138, 139
```
# iptables -A INPUT -i eth0 -p tcp -s 192.168.0.24 --dport 137:139 -j ACCEPT
```
Example 7: Log TCP packets that visit V2201-LX’s port 25.

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

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

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

ATTENTION

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

---

**NAT (Network Address Translation)**

The NAT (Network Address Translation) protocol translates IP addresses used on one network into IP addresses used on a connecting network. One network is designated the inside network and the other is the outside network. Typically, the V2201-LX connects several devices on a network and maps local inside network addresses to one or more global outside IP addresses, and un-maps the global IP addresses on incoming packets back into local IP addresses.

ATTENTION

Click on the following link for more information about NAT:


---

**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 V2201-LX boots up. The following script is an example.

```bash
#!/bin/bash
# If you put this shell script in the /home/nat.sh
# Remember to chmod 744 /home/nat.sh
# Edit the rc.local file to make this shell startup automatically.
# vi /etc/rc.local
# Add a line in the end of rc.local /home/nat.sh
EXIF= "eth0"  #This is an external interface for setting up a valid IP address.
EXNET= "192.168.4.0/24"  #This is an internal network address.
# Step 1. Insert modules.
# Here 2> /dev/null means the standard error messages will be dump to null device.
modprobe ip_tables  2> /dev/null
modprobe ip_nat_ftp  2> /dev/null
modprobe ip_nat irc  2> /dev/null
modprobe ip_conntrack  2> /dev/null
modprobe ip_conntrack_ftp  2> /dev/null
modprobe ip_conntrack_irc  2> /dev/null
# Step 2. Define variables, enable routing and erase default rules.
PATH=/bin:/sbin:/usr/bin:/usr/sbin:/usr/local/bin:/usr/local/sbin
export PATH
echo "1" > /proc/sys/net/ipv4/ip_forward
/sbin/iptables -F
/sbin/iptables -X
/sbin/iptables -Z
/sbin/iptables -F -t nat
/sbin/iptables -X -t nat
/sbin/iptables -Z -t nat
/sbin/iptables -P INPUT ACCEPT
/sbin/iptables -P OUTPUT ACCEPT
/sbin/iptables -P FORWARD ACCEPT
/sbin/iptables -t nat -P PREROUTING ACCEPT
/sbin/iptables -t nat -P POSTROUTING ACCEPT
/sbin/iptables -t nat -P OUTPUT ACCEPT
# Step 3. Enable IP masquerade.
#ehco 1 > /proc/sys/net/ipv4/ip_forward#modprobe ipt_MASQUERADE#iptables –t nat –A
PPPoE (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 V2201-LX Ethernet port. Since PPP is a peer-to-peer system, the V2201-LX can also use PPP to link two networks (or a local network to the Internet) to create a Wide Area Network (WAN).
Connecting to a PPP Server over a Simple Dial-up Connection

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 "default route 192.1.1.17" are optional.

```
# pppd connect 'chat -v "" ATDT5551212 CONNECT "" login: username word: password' /dev/ttyS0 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/ttyUSBx 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)

`Login: username; Password: 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.

`crlscts` 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/tty 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/ttyUSBx 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:

```
root@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:

```markdown
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/ttyUSBx 115200 crtscts modem 192.168.16.1:192.168.16.2 login auth
```

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

```
*   *    ""    *
```

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

The following example does not check the username and password:

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

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

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

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

# The chat script (be sure to edit that file, too!)
init "/usr/sbin/chat -v -f /etc/ppp/ppp-ttyM0.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
crlctcs
modem
192.168.16.1:192.168.16.2
debug
-detach

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

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

Start the `pppd` dial-in service.

```
# pppd call dialin
```

**ATTENTION**

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

```
root@Moxa:~# mount -o remount,rw /dev/hda1 /
root@Moxa:~# echo "p0:2345:respawn:pppd call dialin" >> /etc/inittab
root@Moxa:~# umount /
```

**PPPoE**

Use the following procedure to configure PPPoE:

1. Connect the V2201-LX's LAN port to an ADSL modem with a cross-over cable, HUB, or switch.
2. Log in to the V2201-LX 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.eth0, if you use LAN2 to
connect to the ADSL modem, add /etc/ppp/options.eth1, etc.

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

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

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

   Use the following command to create a `pppoe` connection:
   ```
   # pppd eth0
   ```

   8. The ADSL modem is connected to the LAN1 port, which is named `eth0`. If the ADSL modem is connected to LAN2, use `eth1`, 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-to-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.

---

**NFS (Network File System) Client**

The Network File System (NFS) is used to mount a disk partition on a remote machine (as if it were on a local hard drive), allowing fast, seamless sharing of files across a network. NFS allows users to develop applications for the V2201-LX without worrying about the amount of disk space that will be available. The V2201-LX only supports NFS client protocol.

**ATTENTION**

Click on the following links for more information about NFS.


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

1. Scan the NFS Server's shared directory:
   ```
   # showmount -e HOST
   ```
   
   - `-e`: Shows the mount information of an NFS Server
   - `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.)

### SNMP

The V2201-LX comes with the SNMP V1 (Simple Network Management Protocol) agent software pre-installed. It supports **RFC 1213 MIB-II**. The following example shows an SNMP agent responding to a query from the SNMP browser on the host site:

```
***** SNMP QUERY STARTED *****
[root@jaredRH90 root]# snmpwalk -v 1 -c public 192.168.30.128 | more
RFC1213-MIB::sysDescr.0 = STRING: "Linux Moxa 2.6.30-bpo.2-686 #1 SMP Fri Dec 11 18:12:58 UTC 2009 i686"
RFC1213-MIB::sysObjectID.0 = OID: RFC1155-SMI::enterprises.8691.12.2420
DISMAN-EVENT-MIB::sysUpTimeInstance = Timeticks: (126176) 0:21:01.76
RFC1213-MIB::sysContact.0 = STRING: "\"Jared\""
RFC1213-MIB::sysName.0 = STRING: "Moxa"
RFC1213-MIB::sysLocation.0 = STRING: "\"Fl.8 No.6, Alley 6, Lane 235, Pao-Chiao Rd., Shing Tien City, Taipei, Taiwan, R.O.C.\""
SNMPv2-MIB::sysORLastChange.0 = Timeticks: (4) 0:00:00.04
SNMPv2-MIB::sysORID.1 = OID: SNMP-FRAMEWORK-MIB::snmpFrameworkMIBCompliance
SNMPv2-MIB::sysORID.2 = OID: SNMP-MPD-MIB::snmpMPDCompliance
SNMPv2-MIB::sysORID.3 = OID: SNMP-USER-BASED-SM-MIB::usmMIBCompliance
SNMPv2-MIB::sysORID.4 = OID: SNMPv2-MIB::snmpMIB
SNMPv2-MIB::sysORID.5 = OID: TCP-MIB::tcpMIB
SNMPv2-MIB::sysORID.6 = OID: RFC1213-MIB::ip
SNMPv2-MIB::sysORID.7 = OID: UDP-MIB::udpMIB
SNMPv2-MIB::sysORID.8 = OID: SNMP-VIEW-BASED-ACM-MIB::vacmBasicGroup
...
```

**ATTENTION**

Click on the following links for more information about RFC1317 RS-232 like groups and RFC 1213 MIB-II:


### 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.
Ethernet Bridging for Private Networks on Different Subnets

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

   ![Diagram showing four machines and their subnets](image)

   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:
   
   ```bash
   # openvpn --genkey --secret secrouter.key
   ```

3. Copy the file that is generated to the OpenVPN machine:
   
   ```bash
   # 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`.
   
   ```bash
   # point to the peer
   remote 192.168.8.174
   dev tap0
   port 1194
   secret /etc/openvpn/secrouter.key
   cipher DES-EDE3-CBC
   auth MD5
   tun-mtu 1500
   tun-mtu-extra 64
   ping 40
   up /etc/openvpn/tap0-br.sh
   #comp-lzo
   ```

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

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

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

6. 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---------------------------------------

And then configure the bridge interface in /etc/openvpn/bridge.
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:

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

7. Start both OpenVPN peers on machine OpenVPN A and OpenVPN B.
   
   ```bash
   # 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:

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

To stop the service, you should create these links:

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

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

<table>
<thead>
<tr>
<th>Destination</th>
<th>Gateway</th>
<th>Genmask</th>
<th>Flags</th>
<th>Metric</th>
<th>Ref</th>
<th>Use</th>
<th>Iface</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.168.5.0</td>
<td>0.0.0.0</td>
<td>255.255.255.0</td>
<td>U</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>eth2</td>
</tr>
<tr>
<td>192.168.4.0</td>
<td>0.0.0.0</td>
<td>255.255.255.0</td>
<td>U</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>br0</td>
</tr>
<tr>
<td>192.168.3.0</td>
<td>0.0.0.0</td>
<td>255.255.255.0</td>
<td>U</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>eth0</td>
</tr>
<tr>
<td>192.168.30.0</td>
<td>0.0.0.0</td>
<td>255.255.255.0</td>
<td>U</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>eth3</td>
</tr>
<tr>
<td>192.168.8.0</td>
<td>0.0.0.0</td>
<td>255.255.255.0</td>
<td>U</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>br0</td>
</tr>
</tbody>
</table>

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

9. To create an indirect connection to Host B from Host A, you need to add the following routing item:
   ```bash
   # route add -net 192.168.4.0 netmask 255.255.255.0 dev eth0
   ```
   
   To create an indirect connection to Host A from Host B, you need to add the following routing item:
   ```bash
   # route add -net 192.168.2.0 netmask 255.255.255.0 dev eth0
   ```
   
   Now ping Host B from Host A by typing:
   ```bash
   # 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.

10. To shut down OpenVPN programs, type the command:
    ```bash
    # 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`.

```bash
# 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`.

```bash
#!/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
```

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

```bash
# 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`.

```bash
#!/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
```

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`.

<table>
<thead>
<tr>
<th>Destination</th>
<th>Gateway</th>
<th>Genmsk</th>
<th>Flags</th>
<th>Metric</th>
<th>Ref</th>
<th>Use</th>
<th>Iface</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.168.4.174</td>
<td>*</td>
<td>255.255.255.255</td>
<td>UH</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>tun0</td>
</tr>
<tr>
<td>192.168.4.0</td>
<td>192.168.4.174</td>
<td>255.255.255.0</td>
<td>UG</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>tun0</td>
</tr>
<tr>
<td>192.168.2.0</td>
<td>*</td>
<td>255.255.255.0</td>
<td>U</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>eth1</td>
</tr>
<tr>
<td>192.168.8.0</td>
<td>*</td>
<td>255.255.255.0</td>
<td>U</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>eth0</td>
</tr>
</tbody>
</table>
ATTENTION

For more information about wpa_supplicant.conf, go to the following websites:
http://www.daemon-systems.org/man/wpa_supplicant.conf.5.html
http://linux.die.net/man/5/wpa_supplicant.conf

Cellular Module

Read below on to find out how to understand cellular signal strength from signal indicators, how to dial up on V2201, and several advanced setting in cellular module.

The MC7304, MC7354 and MC9090 cellular modules can be used with the V2201 series. Specifications can be found in the product’s datasheet. You may use the V2201 cellular connection utility cell_mgmt to establish a cellular connection.

IMPORTANT!

Check the version of the cellular management utility using the cell_mgmt version command to ensure that it is v1.7.4 or higher and upgrade to the latest version available on Moxa’s website. The carrier switch function on the cellular module might not work if the correct version of cellular management utility is not installed.

Cellular Signal Strength

<table>
<thead>
<tr>
<th>Value</th>
<th>RSSI dbm</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 to 30</td>
<td>-73 to -53</td>
<td>Excellent</td>
</tr>
<tr>
<td>10 to 19</td>
<td>-93 to -74</td>
<td>Good</td>
</tr>
<tr>
<td>2 to 9</td>
<td>-109 to -94</td>
<td>Marginal</td>
</tr>
<tr>
<td>Else</td>
<td>Else</td>
<td>No signal</td>
</tr>
</tbody>
</table>

Cellular Dial-Up mode

For the 2 modules provided, it is suggested to dial up from QMI interface with QMI commands instead of using AT commands from the AT ports.

<table>
<thead>
<tr>
<th>Dial Up mode</th>
<th>QMI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/dev/cdc-wdm0</td>
</tr>
<tr>
<td>AT Port</td>
<td>/dev/ttyUSB2</td>
</tr>
<tr>
<td>GPS port</td>
<td>/dev/ttyUSB0</td>
</tr>
</tbody>
</table>

cell_mgmt Usage

Manual page

"cell_mgmt" is a utility to handle cellular module-related behavior.

moxa@Moxa:~$ sudo cell_mgmt help
[sudo] password for moxa:
Usage:
  ./cell_mgmt [OPTIONS]

OPTIONS
  start [APN=[APN],Username=[user],Password=[pass],PIN=[pin_code]]
  Start network.

example:
Automatic dial up

It will set DNS and default gateway automatically.

Please clean up your computer’s default gateway first, if you want to use cellular interface’s gateway.

```
cell_mgmt start APN=[APN] Username=[user] Password=[pass] PIN=[pin_code]
```

```
moxa@moxa:/home/moxa# cell_mgmt start APN="internet"
warning: file /etc/qmi-network.conf does not exist.
Loading profile...
APN: internet
Starting network with 'qmicli -d /dev/cdc-wdm1 --wds-start-network=internet'
```
--client-no-release-cid --device-open-net=net-802-3|net-no-qos-header'...
Saving state... (CID: 8)
Saving state... (PDH: 1205656072)
Network started successfully
There is no PIN code

APN, Username, Password, PIN will be written in config file: /etc/qmi-network.conf when use "cell_mgmt start".
Next time you can use "cell_mgmt start" without OPTIONs if OPTIONs are the same as last time set.

cell_mgmt stop
Stop network.
moxa@Moxa:/home/moxa# cell_mgmt stop
Loading profile...
  APN: internet
Loading previous state...
  Previous CID: 8
  Previous PDH: 1205656072
Stopping network with 'qmicli -d /dev/cdc-wdm1 --wds-stop-network=1205656072 --client-cid=8'...
Network stopped successfully
Clearing state...

cell_mgmt restart
Restart network.
moxa@Moxa:/home/moxa# cell_mgmt restart
Loading profile...
  APN: internet
Loading previous state...
  Previous CID: 8
  Previous PDH: 1205716376
Stopping network with 'qmicli -d /dev/cdc-wdm1 --wds-stop-network=1205716376 --client-cid=8'...
Network stopped successfully
Clearing state...
Loading profile...
  APN: internet
Starting network with 'qmicli -d /dev/cdc-wdm1 --wds-start-network=internet --client-no-release-cid --device-open-net=net-802-3|net-no-qos-header'...
Saving state... (CID: 8)
Saving state... (PDH: 1205652720)
Network started successfully
There is no PIN code

Cellular module

cell_mgmt reset
Reset cellular module.
moxa@Moxa:/home/moxa# cell_mgmt restart
Loading profile...
  APN: internet
Loading previous state...
  Previous CID: 8
  Previous PDH: 1205716376
Stopping network with 'qmicli -d /dev/cdc-wdm1 --wds-stop-network=1205716376
Network stopped successfully
Clearing state...
Loading profile...
  APN: internet
Starting network with 'qmicli -d /dev/cdc-wdm1 --wds-start-network=internet
--client-no-release-cid --device-open-net=net-802-3|net-no-qos-header'...
Saving state... (CID: 8)
Saving state... (PDH: 1205652720)
Network started successfully
There is no PIN code

**cell_mgmt power_on**
Turn on cellular module power.

```
moxa@Moxa:/home/moxa# cell_mgmt power_on
```

**cell_mgmt power_off**
Turn off cellular module power.

```
moxa@Moxa:/home/moxa# cell_mgmt power_off
```

**cell_mgmt gps_on**
Turn on gps power.

```
moxa@Moxa:/home/moxa# cell_mgmt gps_on
GPS function is *ENABLE*
```

**cell_mgmt gps_off**
Turn off gps power.

```
moxa@Moxa:/home/moxa# cell_mgmt gps_off
GPS function is *DISABLE*
```

**cell_mgmt status**
Query network connection status.

```
moxa@Moxa:/home/moxa# cell_mgmt status
Status: disconnected
```

**cell_mgmt signal**
Get signal strength.

```
moxa@Moxa:/home/moxa# cell_mgmt signal
-86 dbm
```

**cell_mgmt at ['AT_COMMAND']**
Input AT Command.

Must use SINGLE QUOTATION to enclose AT Command.

for example input the at command AT+GMR

```
moxa@Moxa:/home/moxa# cell_mgmt at 'AT+GMR'
please wait...

--- AT COMMAND: AT+GMR ---

OK
```
Sim card

**cell_mgmt sim_status**
Query sim card status.

sim card had been locked or failed.

```
moxa@Moxa:/home/moxa# cell_mgmt sim_status
[/dev/cdc-wdm1] UIM state retrieved:
  State: 'locked-or-failed'
```

sim card initialization-completed.

```
moxa@Moxa:/home/moxa# cell_mgmt sim_status
[/dev/cdc-wdm1] UIM state retrieved:
  State: 'initialization-completed'
```

**cell_mgmt set_pin [PIN]**
Set PIN code to configuration file and verify.

```
moxa@Moxa:/home/moxa# cell_mgmt set_pin 0000
old PIN=, new PIN=0000
[/dev/cdc-wdm1] PIN verified successfully
```

**cell_mgmt pin_protection [PIN|PIN2] [enable|disable] [current_PIN]**
Set PIN protection in the UIM.

enable PIN protection

```
moxa@Moxa:/home/moxa# cell_mgmt pin_protection PIN enable 0000
[/dev/cdc-wdm1] PIN protection updated
```

disable PIN protection

```
moxa@Moxa:/home/moxa# cell_mgmt pin_protection PIN disable 0000
[/dev/cdc-wdm1] PIN protection updated
```

Set interface

**cell_mgmt interface [num]**
Set the interface wwan[num] for cell_mgmt.

Check the interface current using.

```
moxa@Moxa:/home/moxa# cell_mgmt interface
[0] wwan0  <Current>
[1] wwan1
```

Set interface to wwan[num]

```
moxa@Moxa:/home/moxa# cell_mgmt interface 1
set interface=1
moxa@Moxa:/home/moxa# cell_mgmt interface
```
cellular management

cell_mgmt version
Cellular management version.

moxa@Moxa:/home/moxa# cell_mgmt version
cell_mgmt
version:1.7.0

Wi-Fi Module

In this section we show you how to connect to an 802.11 access point. The connection program we will use is `wpa_supplicant`.

There are two ways to use `wpa_supplicant`. You can use `wifi_mgmt`, which is offered by Moxa or use the use `wpa_supplicant` command.

Install wifi_mgmt

Upload the v2200-wifimgmt_1.0.0_amd64.deb file to target machine and use dpkg installer to install the package.

Moxa:/home# dpkg -i v2200-wifimgmt_1.0.0_amd64.deb

wifi_mgmt Usage

Manual page

`wifi_mgmt help`
`wifi_mgmt` is a utility for handling wifi module-related behavior.

moxa@Moxa:~$ sudo wifi_mgmt help
[sudo] password for moxa:
Usage:
/sbin/wifi_mgmt [OPTIONS]

OPTIONS
start Type=[type] SSID=[ssid] Password=[password]
Insert an AP information to the managed AP list and then connect to the AP.

[type] open/wep/wpa/wpa2
[ssid] access point's SSID
[password] access point's password

example:
wifi_mgmt start Type=wpa SSID=moxa_ap Password=moxa
wifi_mgmt start Type=open SSID=moxa_ap
start [num]
Connect to AP by the managed AP list number.
start
Connect to the last time AP that was used.
scan -d
Scan all the access points information and show the detail message.
scan
Scan all the access points information.
signal
Show the AP's signal.
list
Show the managed AP list.
insert Type=\[type\] SSID=\[ssid\] Password=\[password\]
Insert a new AP information to the managed AP list.

\[type\]        open/wep/wpa/wpa2
\[ssid\]        access point's SSID
\[password\]    access point's password

example:
    wifi_mgmt insert Type=wpa SSID=moxa_ap Password=moxa

select \[num\]
Select an AP num to connect which is in the managed AP list.
stop
Stop network.
status
Query network connection status.
interface \[num\]
Switch to another wlan\[num\] interface.

\[num\]    interface number
example:
    wifi_mgmt interface 0
interface
Get the current setting interface.
reconnect
Reconnect to the access point.
restart
Stop wpa_supplicant then start it again.
version
Wifi management version.

Connect to an AP

There are three ways to connect to an AP. The DNS and default gateway will be configured automatically. If you want to use the wireless interface's gateway, be sure to clean up your computer's default gateway first.

wifi_mgmt start Type=\[type\] SSID=\[ssid\] Password=\[password\]
Insert the AP information in the managed AP list and then connect to an AP.

root@Moxa:~# wifi_mgmt start Type=wpa SSID=moxa_ap Password=moxa
wpa_state=COMPLETED
*** Get DHCP IP address from AP ***
*** Get DHCP IP from AP! ***

wifi_mgmt start \[num\]
Connect to the AP using the managed AP list number. If you have inserted AP information before, some AP information will still be in the managed AP list. Check the managed AP list with the wifi_mgmt list command.

root@Moxa:~# wifi_mgmt list
network id / ssid / bssid / flags
Choose an AP number to start.

```
root@Moxa:~# wifi_mgmt start 1
wpa_state=COMPLETED
*** Get DHCP IP address from AP ***
*** Get DHCP IP from AP! ***
```

**wifi_mgmt start**

Connect to the previous AP that was used.

```
root@Moxa:~# wifi_mgmt list
network id / ssid / bssid / flags
0   MOXA_AP1  any     [LAST USED]
1   MOXA_AP2  any     [DISABLED]
2   MOXA_AP3  any     [DISABLED]
```

Use the command wifi_mgmt to connect to the AP "MOXA_AP1" that was used the previous time.

```
root@Moxa:~# wifi_mgmt start
wpa_state=COMPLETED
*** Get DHCP IP address from AP ***
*** Get DHCP IP from AP! ***
```

**Stop or restart network**

**wifi_mgmt stop**

```
root@Moxa:~# wifi_mgmt stop
wpa_supplicant is closed!!
```

**wifi_mgmt restart**

```
root@Moxa:~# wifi_mgmt restart
wpa_supplicant is closed!!
wpa_state=COMPLETED
*** Get DHCP IP address from AP ***
*** Get DHCP IP from AP! ***
```

**Insert an AP or choose another AP to connect.**

If you want to use another AP to connect, use the wifi_mgmt select command to switch to another AP.

```
root@Moxa:~# wifi_mgmt insert Type=wpa2 SSID=MOXA_AP3 Password=moxa
root@Moxa:~# wifi_mgmt list
network id / ssid / bssid / flags
0   MOXA_AP1  any     [CURRENT]
1   MOXA_AP2  any     [DISABLED]
2   MOXA_AP3  any     [DISABLED]
```

If you want to use another AP to connect, use the wifi_mgmt select command to switch to another AP.

```
root@Moxa:~# wifi_mgmt list
network id / ssid / bssid / flags
0   MOXA_AP1  any     [DISABLED]
1   MOXA_AP2  any     [CURRENT]
2   MOXA_AP3  any     [DISABLED]
```
**Other functions**

**wifi_mgmt scan**

Scan all of the access point information.

```bashoot@Moxa:~# wifi_mgmt scan
bssid / frequency / signal level / flags / ssid
2c:54:cf:fd:5ac:cf      2437    -83     [WPA-PSK-TKIP][ESS]     5566fans
fe:f0:28:cb:5da8        2462    -87     [WPA2-EAP-CCMP-preauth][ESS] MHQ-Mobile
02:1a:11:f1:dca1        2462    -91     [WPA2-PSK-CCMP][ESS]     M9 Davidoff
```

**wifi_mgmt scan -d**

Scan all of the access point information and show a detailed message.

```bashoot@Moxa:~# wifi_mgmt scan -d
wlan0  Scan completed :
  Cell 01 - Address: FC:F5:28:CB:8C:23
    Channel:1
    Frequency: 2.412 GHz (Channel 1)
    Quality=51/70 Signal level=-59 dBm
    Encryption key:on
    ESSID:"MHQ-NB"
    9 Mb/s; 12 Mb/s; 18 Mb/s
    Mode:Master
    Group Cipher : CCMP
    Pairwise Ciphers (1) : CCMP
    Authentication Suites (1) : 802.1x
    Preauthentication Supported
  Cell 02 - Address: FE:F0:28:CB:5D:A8
    Channel:11
    Frequency: 2.462 GHz (Channel 11)
    Quality=25/70 Signal level=-85 dBm
    Encryption key:on
    ESSID:"MHQ-Mobile"
    9 Mb/s; 12 Mb/s; 18 Mb/s
```
Mode: Master
  Group Cipher : CCMP
  Pairwise Ciphers (1) : CCMP
  Authentication Suites (1) : 802.1x
  Preauthentication Supported

More... ...

wifi_mgmt signal
Show the AP’s signal.

root@Moxa:~# wifi_mgmt signal
level=-59 dBm

wifi_mgmt delete

root@Moxa:~# wifi_mgmt list
network id / ssid / bssid / flags
0     MOXA_AP1  any     [CURRENT]
1     MOXA_AP1  any     [DISABLED]
2     MOXA_AP3  any     [DISABLED]

root@Moxa:~# wifi_mgmt delete 2
***** WARNING *****
Are you sure that you want to delete network id 2 (y/n)?

network id / ssid / bssid / flags
0     MOXA_AP1  any
1     MOXA_AP2  any     [DISABLED]

wifi_mgmt status

root@Moxa:~# wifi_mgmt status
bssid=b0:b2:dc:dd:c9:e4
ssid=MOXA_AP1
id=0
mode=station
pairwise_cipher=TKIP
group_cipher=TKIP
key_mgmt=WPA-PSK
wpa_state=COMPLETED
ip_address=192.168.1.36
address=00:0e:8e:4c:13:5e

wifi_mgmt interface [num]
If there is more than one wifi interface, you can change the interface.

root@Moxa:~# wifi_mgmt interface
There is(are) 2 interface(s):
wlan0    [Current]
wlan1

root@Moxa:~# wifi_mgmt interface 1
Now is setting the interface as wlan1.

wifi_mgmt reconnect

root@Moxa:~# wifi_mgmt reconnect
wpa_state=SCANNING
wpa_state=SCANNING
wpa_state=COMPLETED
*** Get DHCP IP address from AP ***
*** Get DHCP IP from AP! ***
wifi_mgmt version

```
root@Moxa:~# wifi_mgmt version
wifi_mgmt version 1.0 Build 15050223
```

### Configuring the Wireless LAN by wpa_supplicant.conf

**WARNING**

You might encounter **compatibility issues** if you configure Wi-Fi settings using `wifi_mgmt` instead of using `wpa_supplicant.conf`. Because `wifi_mgmt` edits `wpa_supplicant.conf` dynamically, use `wifi_mgmt` instead of editing `wpa_supplicant.conf` by yourself.

**Moxa strongly advises against using the WEP and WPA encryption standards.** Both are now officially deprecated by the Wi-Fi Alliance, and are considered insecure. To guarantee proper Wi-Fi encryption and security, please use WPA2 with the AES encryption algorithm.

You can configure the Wi-Fi connection using a configuration file or the `wpa_supplicant` command.

The following example is for OPEN/WEP/WPA/WPA2 AP.

```
ctrl_interface=/var/run/wpa_supplicant
ctrl_interface_group=wheel
update_config=1

### Open system ###
#network=
#       ssid="Open"
#       key_mgmt=NONE
#

### WEP ###
#network=
#       ssid="WEP-ssid"
#       bssid=XX:XX:XX:XX:XX:XX
#       key_mgmt=NONE
#       wep_key0=KEY
#

### WPA/WPA2 PSK ###
#network=
#       ssid="WPA-ssid"
#       proto=WPA WPA2 RSN
#       key_mgmt=WPA-PSK
#       pairwise=TKIP CCMP
#       group=TKIP CCMP
#       psk="KEY"
#
```

The basic command to connect for WPA-supplicant is:

```
root@Moxa:~# wpa_supplicant -i <interface> -c <configuration file> -B
```

The `-B` option should be included because it forces the supplicant to run in the background.

1. Connect with the following command after editing `wpa_supplicant.conf`:
2. Use `iwconfig` to check the connection status. The response you receive should be similar to the following:

```
root@Moxa:~# wpa_supplicant -i wlan0 -c /etc/wpa_supplicant.conf -B

wlan0       IEEE 802.11abgn  ESSID:"MOXA_AP"
Mode:Managed  Frequency:2.462 GHz  Access Point: 00:1F:1F:8C:0F:64
Bit Rate=36 Mb/s  Tx-Power=27 dBm
Retry min limit:7   RTS thr:off   Fragment thr:off
Encryption key:1234-5678-90   Security mode:open
Power Management:off
Link Quality=37/70  Signal level=-73 dBm
Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
Tx excessive retries:0  Invalid misc:0   Missed beacon:0
```

**ATTENTION**

For more information about `wpa_supplicant.conf`, go to the following websites:

- [http://www.daemon-systems.org/man/wpa_supplicant.conf.5.html](http://www.daemon-systems.org/man/wpa_supplicant.conf.5.html)
- [http://linux.die.net/man/5/wpa_supplicant.conf](http://linux.die.net/man/5/wpa_supplicant.conf)
The following topics are covered in this chapter:

- **Device API**
- **Getting the Product Serial Number**
- **RTC (Real-Time Clock)**
- **UART**
- **Digital I/O**
  - Special Note
  - Examples
- **WDT (Watch Dog Timer)**
  - Introduction
  - Watchdog Usage
  - How the WDT Works
  - Watchdog Device IOCTL Commands
  - Examples
Device API

The V2201 supports control devices with the `ioctl` system API. The interface is shown below:

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

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

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

```
#man ioctl
```

Getting the Product Serial Number

Use `dmidecode` command to read the product information.

```bash
moxa@Moxa:~$ sudo dmidecode -s "baseboard-manufacturer"
```

```
Moxa
```

Refer to the following keywords to get other product information.

```bash
bios-vendor
bios-version
bios-release-date
system-manufacturer
system-product-name
system-version
system-serial-number
system-uuid
baseboard-manufacturer
baseboard-product-name
baseboard-version
baseboard-serial-number
baseboard-asset-tag
chassis-manufacturer
chassis-type
chassis-version
chassis-serial-number
chassis-asset-tag
processor-family
processor-manufacturer
processor-version
processor-frequency
```
RTC (Real-Time Clock)

The device node is located at /dev/rtc. The V2201 supports standard Linux simple RTC control. You must include <linux/rtc.h>.

1. Function: RTC_RD_TIME
   ```c
   int ioctl(fd, RTC_RD_TIME, struct rtc_time *time);
   ```
   Description: read time information from the RTC. It will return the value on argument 3.

2. Function: RTC_SET_TIME
   ```c
   int ioctl(fd, RTC_SET_TIME, struct rtc_time *time);
   ```
   Description: set RTC time. Argument 3 will be passed to RTC.

UART

The normal tty device nodes are /dev/ttyS0 to /dev/ttyS1. The V2201 supports standard Linux termios control with RS-232/422/485 serial ports.

Usage: setinterface <device node> <interface-no>
Device: The uart device node
Operation: 0 set to RS232 interface
          1 set to RS485-2WIRES interface
          2 set to RS422 interface
          3 set to RS485-4WIRES interface

Example:
To set the MUE interface, use:
# setinterface /dev/ttyS0 2

Digital I/O

Digital Output channels can be set to high or low. The channels are controlled by the function call set_dout_state(). Use the digital input channels to detect the state change of the digital input signal. The DI channels can also be used to detect whether or not the state of a digital signal changes during a fixed period of time. This can be done with the function call set_din_event().

Return error code definitions:

```c
#define DIO_ERROR_PORT -1 // no such port
#define DIO_ERROR_MODE -2 // no such mode or state
#define DIO_ERROR_CONTROL -3 // open or ioctl fail
#define DIO_ERROR_DURATION -4 // The value of duration is not 0 or not in the range, 40 <= duration <= 3600000 milliseconds (1 hour)
#define DIO_ERROR_DURATION_20MS -5 // The value of duration must be a multiple of 20 ms
#define DIO_OK 0
```

DIN and DOUT definitions:

```c
#define DIO_HIGH 1
#define DIO_LOW 0
```
### Moxa functions for DI/DO

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Input</th>
<th>Output</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>set_dout_state</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Set the DOUT port to high or low state.</td>
<td><code>&lt;doport&gt;</code>: The DOUT port you want to set. Port starts from 0 to 1. <code>&lt;state&gt;</code>: Set high or low state; DIO_HIGH (1) for high, DIO_LOW (0) for low.</td>
<td>None</td>
<td>Refer to the error code</td>
</tr>
</tbody>
</table>

**Function** | **get_din_state**<sup>2</sup> | **get_dout_state**<sup>3</sup> | **set_din_event**<sup>4</sup> |
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Get the DIN port state</td>
<td>Get the DOUT port state</td>
<td>Set the DIN event when the state is changed from high to low or from low to high</td>
</tr>
<tr>
<td><strong>Input</strong></td>
<td><code>&lt;diport&gt;</code>: The DIN port to get the state of. Port numbering is from 0 to 5. <code>&lt;state&gt;</code>: Save the current state.</td>
<td><code>&lt;doport&gt;</code>: The DOUT port to get the state of. <code>&lt;state&gt;</code>: Save the current state.</td>
<td><code>&lt;diport&gt;</code>: The port that will be used to detect the DIN event. Port numbering is from 0 to 5. This value depends on your device. <code>&lt;(*func) (int diport)&gt;</code>: Not NULL: Returns the call back function. When the event occurs, the call back function will be invoked. NULL: Clear this event. <code>&lt;mode&gt;</code>: DIN_EVENT_HIGH_TO_LOW (1): From high to low. DIN_EVENT_LOW_TO_HIGH (0): From low to high. DIN_EVENT_CLEAR (-1): Clear this event. <code>&lt;duration&gt;</code>: 0: Detect the din event DIN_EVENT_HIGH_TO_LOW or DIN_EVENT_LOW_TO_HIGH without duration. Not 0: Detect the din event DIN_EVENT_HIGH_TO_LOW or DIN_EVENT_LOW_TO_HIGH with duration.</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td><code>&lt;state&gt;</code>: DIO_HIGH (1) for high, DIO_LOW (0) for low</td>
<td><code>&lt;state&gt;</code>: DIO_HIGH (1) for high, DIO_LOW (0) for low</td>
<td>Output None</td>
</tr>
</tbody>
</table>

---

<sup>1</sup> The error of the measurement is 24 ms. For example, if the DIN duration is 200 ms, this event will be generated when the DIN pin stays in the same state for a time between 176 ms and 200 ms.

---

<sup>2</sup> The value of "duration" must be a multiple of 20 milliseconds. The range of "duration" is 0, or 40 <= duration <= 3600000 milliseconds.

<sup>3</sup> The range of "duration" is 0, or 40 <= duration <= 3600000 milliseconds.

<sup>4</sup> The range of "duration" is 0, or 40 <= duration <= 3600000 milliseconds.
Function: `int get_din_event(int diport, int *mode, long int *duration)`

Description: To retrieve the DIN event configuration, including mode (DIN_EVENT_HIGH_TO_LOW or DIN_EVENT_LOW_TO_HIGH), and the value of "duration."

Input:
- `<diport>` Which DIN port you want to retrieve
- `<mode>` Save the set event.
- `<duration>` The duration the DIN port is kept in high or low state. - return to the current duration value of diport

Output:
- `<mode>`
  - DIN_EVENT_HIGH_TO_LOW (1): From high to low
  - DIN_EVENT_LOW_TO_HIGH(0): From low to high
  - DIN_EVENT_CLEAR(-1): Clear this event
- `<duration>`
  - The value of duration should be 0 or 40 <= duration <= 3600000 milliseconds.

Return: Refer to the error code

Special Note

1. You need to build the moxalib in advance for DI/DO. The moxalib is included in the folder `\example\` on the CD.
2. Make sure to link the library `libmoxalib` for DI/DO programming, and include the header file `moxadevice.h`. Only one program at a time can use the DI/DO library.
3. Due to hardware limitations, you need to modify MIN_DURATION as 60 for V2201 computers.

Examples

Example files `tdio.c` and `Makefile` are located in the folder `\example\` on the CD.

WDT (Watch Dog Timer)

Introduction

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

Watchdog Usage

Users can set the ack time from a minimum of 1 sec to a maximum of 1 day. The default timer is 60 seconds and NO WAY OUT is enabled by default; there is no way of disabling the watchdog once it has been started, so if the watchdog daemon crashes, the system will reboot after the timeout has passed. If the NO WAY OUT is disabled, the user can stop the timer.

Example of setting the default timer

Edit the `/etc/modprobe.d/watchdog.conf` file to set the default timer. The following commands set the default timer to 60 seconds:

```
moxa@Moxa:$ vi /etc/modprobe.d/watchdog.conf
options moxa_v2100_wdt timer_margin=60
moxa@Moxa:$
```
Enable or disable NO WAY OUT

Edit the /etc/modprobe.d/watchdog.conf file to enable or disable NO WAY OUT.

Enable NO WAY OUT:

moxa@Moxa:~$ vi /etc/modprobe.d/watchdog.conf
options moxa_v2100_wdt nowayout=1
moxa@Moxa:~$

Disable NO WAY OUT:

moxa@Moxa:~$ vi /etc/modprobe.d/watchdog.conf
options moxa_v2100_wdt nowayout=0
moxa@Moxa:~$

Magic close

If NO WAY OUT is disabled, you can stop the timer using magic close. Use the following commands to do this:

root@Moxa:~$ echo V > /dev/watchdog
root@Moxa:~$

How the WDT Works

The Debian project supports a watchdog daemon. The watchdog daemon checks if your system is still working. If programs are no longer executing, it will perform a hard reset of the system. The standard watchdog driver and package have been installed in the V2201. If you need to run the watchdog once the system boots up, you can use `insserv` to enable the watchdog function.

moxa@Moxa:~$ sudo insserv -v -d watchdog
[sudo] password for moxa:
insserv: enable service ../init.d/watchdog -> /etc/init.d/../rc0.d/K01watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/../rc1.d/K01watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/../rc2.d/S23watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/../rc3.d/S23watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/../rc4.d/S23watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/../rc5.d/S23watchdog
insserv: enable service ../init.d/watchdog -> /etc/init.d/../rc6.d/K01watchdog
insserv: creating .depend.boot
insserv: creating .depend.start
insserv: creating .depend.stop
moxa@Moxa:~$

Check the run level:

moxa@Moxa:~$ ls -l /etc/rc?.d/*watchdog*
1rwxrwxrwx 1 root root 18 Nov  8 15:48 /etc/rc0.d/K01watchdog -> ../init.d/watchdog
1rwxrwxrwx 1 root root 18 Nov  8 15:48 /etc/rc1.d/K01watchdog -> ../init.d/watchdog
1rwxrwxrwx 1 root root 18 Nov  8 15:48 /etc/rc2.d/S23watchdog -> ../init.d/watchdog
1rwxrwxrwx 1 root root 18 Nov  8 15:48 /etc/rc3.d/S23watchdog -> ../init.d/watchdog
1rwxrwxrwx 1 root root 18 Nov  8 15:48 /etc/rc4.d/S23watchdog -> ../init.d/watchdog
1rwxrwxrwx 1 root root 18 Nov  8 15:48 /etc/rc5.d/S23watchdog -> ../init.d/watchdog
1rwxrwxrwx 1 root root 18 Nov  8 15:48 /etc/rc6.d/K01watchdog -> ../init.d/watchdog
moxa@Moxa:~$
The watchdog configuration file is located in `/etc/watchdog.conf`. Currently, we configure the watchdog daemon to acknowledge the watchdog device in 60 seconds. The real-time parameter is to lock it into memory so that it is never swapped out to prevent the delay of watchdog acknowledge. You can configure this file to enable the watchdog as needed by your application.

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

Use the following command to remove it from run-level:

```
moxa@Moxa:~# sudo insserv -r watchdog
```

Confirm that the watchdog is removed for the run level as follows:

```
moxa@Moxa:~# ls -l /etc/rc?.d/*watchdog*
ls: cannot access /etc/rc?.d/*watchdog*: No such file or directory
```

### Watchdog Device IOCTL Commands

<table>
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<tr>
<th>IOCTL</th>
<th>WDIOC_GETSUPPORT</th>
<th>WDIOC_GETSTATUS</th>
<th>WDIOC_GETBOOTSTATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Returns the support of the card itself</td>
<td>Returns the status of the card</td>
<td>Returns the status of the card that was reported at bootup.</td>
</tr>
<tr>
<td>Input</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Output</td>
<td>(struct watchdog_info *) arg</td>
<td>(int *)arg</td>
<td>(int *)arg</td>
</tr>
<tr>
<td>Return</td>
<td>On success, returns 0. Otherwise, returns a value &lt; 0.</td>
<td>On success, returns 0. Otherwise, returns a value &lt; 0.</td>
<td>On success, returns 0. Otherwise, returns a value &lt; 0.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IOCTL</th>
<th>WDIOC_SETOPTIONS</th>
<th>WDIOC_KEEPALIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Lets you set the options of the card. You can either enable or disable the card.</td>
<td>Pings the card to tell it not to reset your computer.</td>
</tr>
<tr>
<td>Input</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Output</td>
<td>(int *)arg</td>
<td>None</td>
</tr>
<tr>
<td>Return</td>
<td>On success, returns 0. Otherwise, returns a value &lt; 0.</td>
<td>On success, returns 0. Otherwise, returns a value &lt; 0.</td>
</tr>
</tbody>
</table>
### IOCTL WDIOC_SETTIMEOUT

**Description**
Sets the watchdog timeout.

**Input**
arg: 1 to 255 seconds

**Output**
None

**Return**
On success, returns 0. Otherwise, returns a value < 0.

---

### IOCTL WDIOC_GETTIMEOUT

**Description**
Gets the current watchdog timeout.

**Input**
None

**Output**
arg: 1 to 255 seconds

**Return**
On success, returns 0. Otherwise, returns a value < 0.

---

### Examples

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

```c
#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;
}
```
The V2201-LX is installed with the Embedded Linux operating system, which is located in the mSATA shipped with the V2201-LX computer. Although it rarely happens, you may find on occasion that operating system files and/or the disk file system are damaged. This chapter describes how to recover the Linux operating system.

The following topics are covered in this chapter:

- Recovery Environment
- Recovery Procedure
- Saving the System to the USB Drive
Recovery Environment

The recovery environment includes the V2201 embedded computer and a bootable USB disk with the recovery programs and system image file.

Hardware

The hardware used includes a PC, a V2201 computer and a USB disk with the recovery programs. (Note: The USB disk should be at least 2 GB.).

Recovery Procedure

Step 1: Prepare your USB drive

1. Execute `tuxboot-windows-23.exe` from the Recovery`\` folder on the Software CD, select Pre Download, and then click "..."
V2201 Series Linux Software System Recovery

2. Select the ISO file in the directory `<Software DVD> \Recovery`.

3. Select **USB Drive** type, select a **Drive**, and then click **OK** to continue.
4. The boot files will be copied to your USB drive.

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

6. Manually copy the `os_image` directory from the `<Software DVD>` \\Recovery\\V2201-LX_V1.1_FW\\Clonezilla\\FWR_V2201-LX_V1.1_Build_15103018 on the Software DVD to \\home\\partimag on the USB drive.
Step 2: Change the BIOS Settings
You will need to change the BIOS settings to boot from the USB disk.

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

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

![In BIOS Setup Utility](image)

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

![In BIOS Setup Utility](image)

5. Press **F10** and then press **Enter** to save and exit the BIOS setup.
Step 3: Restore the system from the USB drive

Connect the USB disk to any of the V2201’s USB ports and then reboot the computer. The system will boot from the USB disk and the Pre-installation Environment and the recovery utility will appear.

There are 2 kinds of recovery process in Clonezilla: auto mode and expert mode:

- Select auto mode to complete the recovery task if you want Clonezilla to help you recover the MBR and expand the image automatically.
- Select expert mode to see a list of selectable options for completing the recovery task.

Auto mode:

1. Select clonezilla live restore disk.

2. Wait for the USB drive boot process to finish.
3. Enter `y` to continue the restore process.

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

The jobs in /etc/ocs/ocs-live.d/ are finished. Start "ocs-live-restore" now.
Setting the TERM as linux
***************************************************************
clonezilla Image disk /home/partimag
***************************************************************
Shutting down the Logical Volume Manager
No volume groups found
No volume groups found
Finished Shutting down the Logical Volume Manager
***************************************************************
Activating the partition info in /proc... done!
***************************************************************
The following step is to restore an image to the hard disk/partition(s) on this machine: "/home/partimag" 
WARNING!!! WARNING!!! WARNING!!!
WARNING! THE EXISTING DATA IN THIS HARDISK/PARTITION(S) WILL BE OVERWRITTEN! ALL EXISTING DATA WILL BE LOST.
***************************************************************
Machine: VirtualBox
sda [2.10.81_VBOX-HARDISK_ata-VBOX_HARDISK_VBe664bd90-c9f73523d]
***************************************************************
Are you sure you want to continue? y
[y/n] y
```

4. Enter `y` to confirm again.

```
4. Enter y to confirm again.

The jobs in /etc/ocs/ocs-live.d/ are finished. Start "ocs-live-restore" now.
Setting the TERM as linux
***************************************************************
clonezilla Image disk /home/partimag
***************************************************************
Shutting down the Logical Volume Manager
No volume groups found
No volume groups found
Finished Shutting down the Logical Volume Manager
***************************************************************
Activating the partition info in /proc... done!
***************************************************************
The following step is to restore an image to the hard disk/partition(s) on this machine: "/home/partimag" 
WARNING!!! WARNING!!! WARNING!!!
WARNING! THE EXISTING DATA IN THIS HARDISK/PARTITION(S) WILL BE OVERWRITTEN! ALL EXISTING DATA WILL BE LOST.
***************************************************************
Machine: VirtualBox
sda [2.10.81_VBOX-HARDISK_ata-VBOX_HARDISK_VBe664bd90-c9f73523d]
***************************************************************
Are you sure you want to continue? y
[y/n] y
```

This program is not started by clonezilla server.
```
This program is not started by clonezilla server.
```

Let me ask you again. Are you sure you want to continue? y
```
5. Wait for the process to finish.

**NOTE** You can press any key or use **CTRL+C** to cancel the recovery process and exit Clonezilla.

6. Select **(0) Poweroff** to power off the computer.

```
Restoring the first 446 bytes of HBR data, i.e. executable code area, for sda... done!
You resize the partition for sda1
NTFSresize -f /dev/sda1
NTFSresize v2.0.0 (Unofficial 10/02/02)
Device name : /dev/sda1
NTFS volume version: 3.1
Cluster size : 2048 bytes
Current volume size: 206431388 bytes (2065 MB)
Current device size: 206483824 bytes (2065 MB)
New volume size : 206451936 bytes (2065 MB)
Nothing to do. NTFS volume size is already OK.
*****************************************************************************
The grub directory IS NOT found. Maybe it does not exist (so other boot manager exists) or the file
system is not supported in the kernel. Skip running grub-install.
*****************************************************************************
Found NTFS boot partition among the restored partition(s): /dev/sda1
Head and Sector no. 0 of /dev/sda1 from EOD: 64, 63.
The start sector of NTFS partition /dev/sda1: 63
Adjust filesystem geometry for the NTFS partition: /dev/sda1
Running: partclone.ntfs1-boot -w -h 64 -t 63 -s 63 /dev/sda1
NTFSboot version 0.3
done!
*****************************************************************************
This program is not started by Clonezilla server, so skip notifying it the job is done.
Finished.
Now syncing - flush filesystem buffers...
```

7. Remove the USB drive after the computer has been powered off.
Step 4: Change the BIOS Settings to Boot from the Original Disk

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

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

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

**Expert mode:**

1. Select clonezilla live restore disk(expert mode).

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

A number of storage areas will be shown for you to confirm; press Enter to continue the restore process.
3. Choose which storage area you want to restore.

If your device only has one storage area, this step will be skipped.

```bash
The jobs in /etc/ocs/ocs-live.d/ are finished. Start 'ocs-live-restore' now. Found ocs_presume parameter in boot parameters...
The order to run: ocs_presume ocs_presume2
Now run 'ocs_presume1': mount --bind /lib/live/mount/medium/home/partima /home/partima/
Now run 'ocs_presume2': sude /lib/live/mount/medium/live/restore_presume.sh y n...
COUNT=2 [0] /dev/sda `Vware3.9G
[1] /dev/sdb `Vware3.4G
Please enter the target device number: 0
```

4. If you want to restore MBR (Master Boot Record), press y to continue the restore process.

```bash
If ocs_live_extra_parm is used only when ocs_live_run=ocs_live-restore (not for ocs-live-gen
This line is actually those of ocs-sr).
# ocs_live_extra_parm="-b -c restoredisk sarge-r3 hda"
# ocs_live_extra_parm="-s auto -o1 auto -o2 -t c -i sda -j2 -k 0 true restoredisk os_image sda"
# ocs_live_keymap is for keymap used in Clonezilla live. Man install-keymap for more details. Exit:
# ocs_live_keymap="NONE" (won’t change the default layout)
# ocs_live_keymap="/usr/share/keymaps/1356/azerty-fr-latin9.keymap.gz" (French keyboard)
# /lib/live/sbin/oclive_reboot is deprecated. It’s better to use the parameters live-config/keyboard-layouts to configure the keyboard layout. Refer: http://live.debian.co
ocs_live_keymap="NONE"
# batch mode or not (yes/no). If no, will run interactively.
ocs_live_batch="yes"
# ocs_lang is the language used in Clonezilla live. Available value: en_US.UTF-8, zh_TW.UTF-8...
# (PREPARE_SCRIPT/PATH/eng/bash)
ocs_lang="" # the tty for the ocs_live_run. Default it will be "/dev/tty1"
ocs_live_run_tty=""
ocs_cryptfs_cipher="aes"
ocs_cryptfs_key_bytes="16"
PRESS any key to restore MBR... (y/n)?y
```

5. If you want to expand the file system (modify the partition table), press y to continue the restore process.

```bash
Disk /dev/sda: 9 GIB, 9663567544 bytes, 18874068 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/ optimum): 512 bytes / 512 bytes
```

---

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6. After confirming the storage information, press **Enter** to continue the restore process.

```
# ocs_live_run_tty is the tty for the ocs_live_run. Default it will be "/dev/tty1"
ocs_live_run_tty=""
ocs_cryptfs_cipher="ocs"
ocs_cryptfs_key_bytes="192"

Press any key to restore MBR... (yn)?y
1+0 records in
1+0 records out
512 bytes (512-B) copied, 0.0230981 s, 22.2 kB/s
Warning: Unable to open /dev/sr0 read-write (read-only file system). /dev/sr0 has been opened read-only.
Warning: Unable to open /dev/sr0 read-write (read-only file system). /dev/sr0 has been opened read-only.
Disk /dev/sda: 9 GIB, 9663676416 bytes, 18374688 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimum): 512 bytes / 512 bytes
disk identifier: 0x0000000d

Device Boot Start End Sectors Size Id Type
/dev/sda1  2048 1024047 1024000 500M 83 Linux
/dev/sda2  1024048 18374687 18372720 180k Linux LVM
To you want to expand file system[yn]?

```

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

```
The following step is to restore an image to the hard disk/partition(s) on this machine: '/home/par

```

8. Enter **y** to confirm again.

```
```

WARNING!!! WARNING!!! WARNING!!!
WARNING, THE EXISTING DATA IN THIS HARDISK/PARTITION(S) WILL BE OVERWRITTEN! ALL EXISTING DATA WILL

```

WARNING!!! WARNING!!! WARNING!!!
WARNING, THE EXISTING DATA IN THIS HARDISK/PARTITION(S) WILL BE OVERWRITTEN! ALL EXISTING DATA WILL

```

```
```

```
9. Wait for the process to finish.

10. Choose which storage in the file system you want to resize.

```
Ending /usr/sbin/pes-sr at 2015-10-23 03:37:38 UTC...
"pcs-live-restore" finished.
Check /var/log/clonezilla.log for more details.
The order to run: pcs_postrun1

Now run "pcs_postrun1": sudo /lib/live/mount/medium/live/restore_postrun.sh y n...
TARGET_DEVICE=/dev/sda
device_count=2
[0] /dev/sda_VmwareS_3G
[1] /dev/sdb_VmwareS_4G
Please Enter the target device number:0
```

11. If you want to resize the file system, press y to continue the restore process.

```
Now run "pcs_postrun1": sudo /lib/live/mount/medium/live/restore_postrun.sh y n...
TARGET_DEVICE=/dev/sda
device_count=2
[0] /dev/sda_VmwareS_3G
[1] /dev/sdb_VmwareS_4G
Please Enter the target device number:0
Do you want to resize filesystem(y/n)?y
```

12. Select `reboot` to reboot the computer.

```
Now you can choose to:
     poweroff  poweroff
     reboot    reboot
     cmd        Enter command line prompt
     runv1      Start over (image repository /home/partimag, if mounted, will be unmounted)
     runv2      Start over (image repository /home/partimag, if mounted, will be unmounted)

<OK>
```

13. Remove the USB drive after the computer has been rebooted.
Saving the System to the USB Drive

You may also save the current system to the USB drive for system recovery in case the system crashes. Before saving the system to the USB drive, we suggest removing all files under `\home\partimag\` on the USB drive.

In addition, change the BIOS settings to make the USB drive the first boot priority.

When the system has been launched, take the following steps.

**Auto mode:**

1. Select **clonezilla live save disk**. (If you want to configure more parameters, refer to the next section on "Expert mode.")

![Image of Moxa System Save & Restore Utility](image)

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

```bash
[ 5.441941] sd 0:0:0:0: [sdb] Attached SCSI disk
[ 5.256271] sd 0:0:0:0: Attached scsi generic sg0 type 0
[ 5.256611] sd 0:0:0:0: Attached scsi generic sg0 type 0
[ 5.256661] sr 1:0:0:0: Attached scsi generic sg0 type 5
[ 5.772651] ath88: (0) L2 Ethernet Driver - version 2.2.3
[ 5.772651] Copyright (c) 2007 Atheros Corporation.
[ 5.863156] Broadcom NetXtreme II 57xx 10 Gigabit Ethernet Driver bus0x 1.62.00-6 (2011-01-30)
[ 6.065952] Blifs loaded
[ 7.331968] MNT: utmp is not a recommended 10 charset for FVFS filesystems, filesystem will be case

2.493391] autofs: module is from the staging directory, the quality is unknown, you have been warned.
[ 7.610120] loop: module loaded
[ 7.905141] squashfs: version 4.0 (2009-03-31) Phillip Loonger
[ 7.941201] squashfs: loading squashfs file system 4.0
[ 7.941201] squashfs: loading squashfs file system 4.0
[ 7.941201] squashfs: loading squashfs file system 4.0
[ 7.941201] squashfs: loading squashfs file system 4.0
```

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3. Enter `y` to continue.

4. Wait for the process to finish.
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5. Select (0) Poweroff so that the computer will power off when the process is finished.

Expert mode:
1. Select clonezilla live save disk(expert mode).

2. Wait for the USB drive boot process to finish.
   Choose which storage area you want to save.
   If your device only has one storage area, this step will be skipped.

The jobs in /etc/ocs/ocs-live.d/ are finished. Start "ocs-live-restore" now.
Found ocs_premun parameter in boot parameters...
The order to run: ocs_premun1 ocs_premun2 ocs_premun3
*************************************************************************************
Now run "ocs_premun1": mount -o remount,ro /lib/live/mount/medium/...
*************************************************************************************
Now run "ocs_premun2": mount --bind /lib/live/mount/medium/home/partimag /home/partimag/...
*************************************************************************************
Now run "ocs_premun3": sudo /lib/live/mount/medium/save_premun.sh...
[0] /dev/sda_VMware_06
[1] /dev/sdb_VMware_06
Please Enter the target device number:
3. If you want to resize the file system, press y to continue the restore process.

```
# batch mode or not (yes/no), if no, will run interactively.
ocs_live_batch="yes"
# ocs_lang is the language used in Clonezilla live. Available values: en_US.UTF-8, zh_TW.UTF-8... (see /usr/share/locale/lang/locales)/
ocs_lang="en"
# ocs_live_run.tty is the tty for the ocs_live_run. Default it will be "/dev/tty1"
ocs_live_run.tty="
ocs_encrypt_cipher="aes"
ocs_encrypt_key_bits="128"
do you want to resize filesystem(y/n)? y
```

4. Enter y to continue the restore process.

```
********************************************
The following step is to save the hard disk/partition(s) on this machine as an image:
********************************************
Machines VMware Virtual Platform
sda (5664MB VMware_Virtual_S_No_disk_serial_no)
sda1 [5664MB Ext4 VMware_Virtual_S_No_disk_serial_no]
sda2 [761MB member VMware_Virtual_S_No_disk_serial_no]
------------------------------------------
-> /home/partimag/bis_image"
Are you sure you want to continue? (y/n) y
```

5. Wait for the process to finish.

```
Partclone
Partclone v0.2.78 http://partclone.org
Starting to clone device (/dev/vg1Group/lv_root) to image (-)
Reading Super Block
Calculating bitmap... Please wait... done!
File System: EXTFS
Device size: 60.7 GB = 1631232 Blocks
Space in use: 875.5 MB = 213763 Blocks
Free Space: 52.8 GB = 1417499 Blocks
Block size: 4096 Byte

Elapsed: 00:00:01 Remaining: 00:01:39 Rate: 0.00byte/min
Current Block: 0 Total Block: 1631232

Data Block Process: 1.00%
Total Block Process: 0.00%
```

6. Select reboot to reboot the computer.

```
<table>
<thead>
<tr>
<th>Choose mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>poweroff</td>
</tr>
<tr>
<td>poweroff</td>
</tr>
<tr>
<td>reboot</td>
</tr>
<tr>
<td>reboot</td>
</tr>
</tbody>
</table>
| cmd         | Enter command line prompt
| renuc       | start over image repository /home/partimag, if mounted, will be unmounted
| renuc2      | Start_over (keep_image_directory /home/partimag_mounted)
|             |
```

7. Remove the USB drive after the computer has been rebooted.
The V2201 series supports the Moxa Proactive Monitoring utility. See the Moxa Proactive Monitoring Linux Software User's Manual for details. The manual can be found on the product CD/DVD or downloaded from Moxa’s website. Note that the V2201 does not support hardware relay.
## Software Components

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<th>Component</th>
<th>Version</th>
<th>Description</th>
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</thead>
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<td>2.2.52-2</td>
<td>Access control list utilities</td>
</tr>
<tr>
<td>acpi</td>
<td>1.7-1</td>
<td>displays information on ACPI devices</td>
</tr>
<tr>
<td>adduser</td>
<td>3.113+nmu3</td>
<td>add and remove users and groups</td>
</tr>
<tr>
<td>anacron</td>
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<td>cron-like program that doesn’t go by time</td>
</tr>
<tr>
<td>apache2</td>
<td>2.4.10-10</td>
<td>Apache HTTP Server</td>
</tr>
<tr>
<td>apache2-bin</td>
<td>2.4.10-10</td>
<td>Apache HTTP Server (modules and other binary files)</td>
</tr>
<tr>
<td>apache2-data</td>
<td>2.4.10-10</td>
<td>Apache HTTP Server (common files)</td>
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