DA-682A-DPP Linux Software User's Manual

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DA-682A-DPP Linux Software User's Manual

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1

Introduction

Thank you for purchasing the Moxa DA-682A-DPP series of x86 ready-to-run embedded computers. This manual introduces the software configuration and management of the DA-682A-DPP-LX, which runs the Linux operating system. For details about hardware setup and installation and BIOS upgrades, please refer to the DA-682A-DPP Hardware Manual.

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

The following topics are covered in this chapter:

❒ **Overview**

❒ **Software Specifications**

Overview

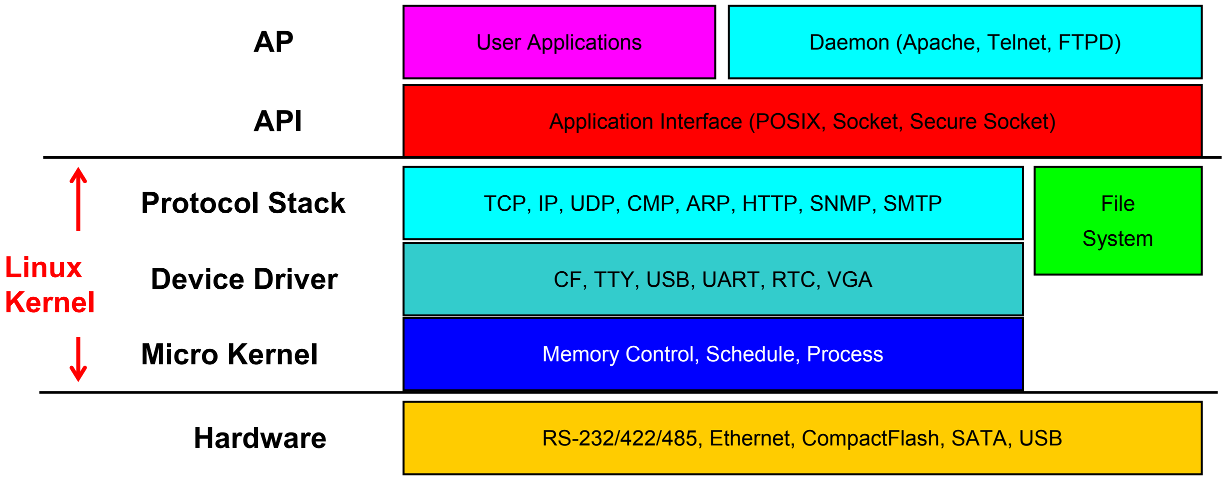
The DA-682A-DPP series of computers have an x86 platform with VGA, 6 gigabit Ethernet ports, CompactFlash, USB, and two PCI ports for DA Series expansion modules. The DA-682A-DPP comes in a standard 19 inch 2U rack-mountable case.

With their robust design, DA-682A-DPP computers are specialized for industrial automation applications: power substations, transportation and shipping, and oil and gas production and supply, and come with either Linux or Windows Embedded Standard 7 operating systems, providing a choice of environments for application development. Moxa's ready-to-run software and readily available after-sale support further make the programmer's job easier, allowing quick, easy development of bug-free code at a low cost.

The DA-682A-DPP comes with 2 PCI ports that accept DA Series expansion modules. Moxa provides a variety of communication modules, including an 8-port RS-232/422/485 module, a 4-port 10/100 Mbps LAN module, and a universal PCI expansion module. The friendly design gives users the advantage of being able to swap out modules quickly and easily. These features make the DA-682A-DPP an ideal solution for use with a wide array of industrial automation applications.

Software Specifications

The Linux operating system pre-installed on DA-682A-DPP-LX embedded computers is the **Debian Wheezy 7.1** distribution. The Debian project involves a worldwide group of volunteers who endeavor to produce an operating system distribution composed entirely of free software. The Debian GNU/Linux follows the standard Linux architecture, making it easy to use programs that meet the POSIX standard. Program porting can be done with the GNU Tool Chain provided by Moxa. In addition to Standard POSIX APIs, device drivers for Moxa UART and other special peripherals are also included. The details of the software packages included in this Debian system are listed in **Appendix A: Linux Software Components**. An example software architecture of a Linux system is shown below:


AP
User Applications
Daemon (Apache, Telnet, FTPD)
API
Application Interface (POSIX, Socket, Secure Socket)
Linux Kernel
Protocol Stack
TCP, IP, UDP, CMP, ARP, HTTP, SNMP, SMTP
File System
Device Driver
CF, TTY, USB, UART, RTC, VGA
Micro Kernel
Memory Control, Schedule, Process
Hardware
RS-232/422/485, Ethernet, CompactFlash, SATA, USB

ATTENTION

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

ATTENTION

The above software architecture is only an example. Different models or different build revisions of the Linux operating system may include components not shown in the figure.

2

Software Configuration

In this chapter, we explain how to operate a DA-682A-DPP-LX computer directly using a desktop interface. This manual describes two ways to connect to the DA-682A-DPP-LX computer: through a VGA monitor or via SSH over a network. Advanced network management and configuration instructions will be described in the next chapter, **Managing Communications**.

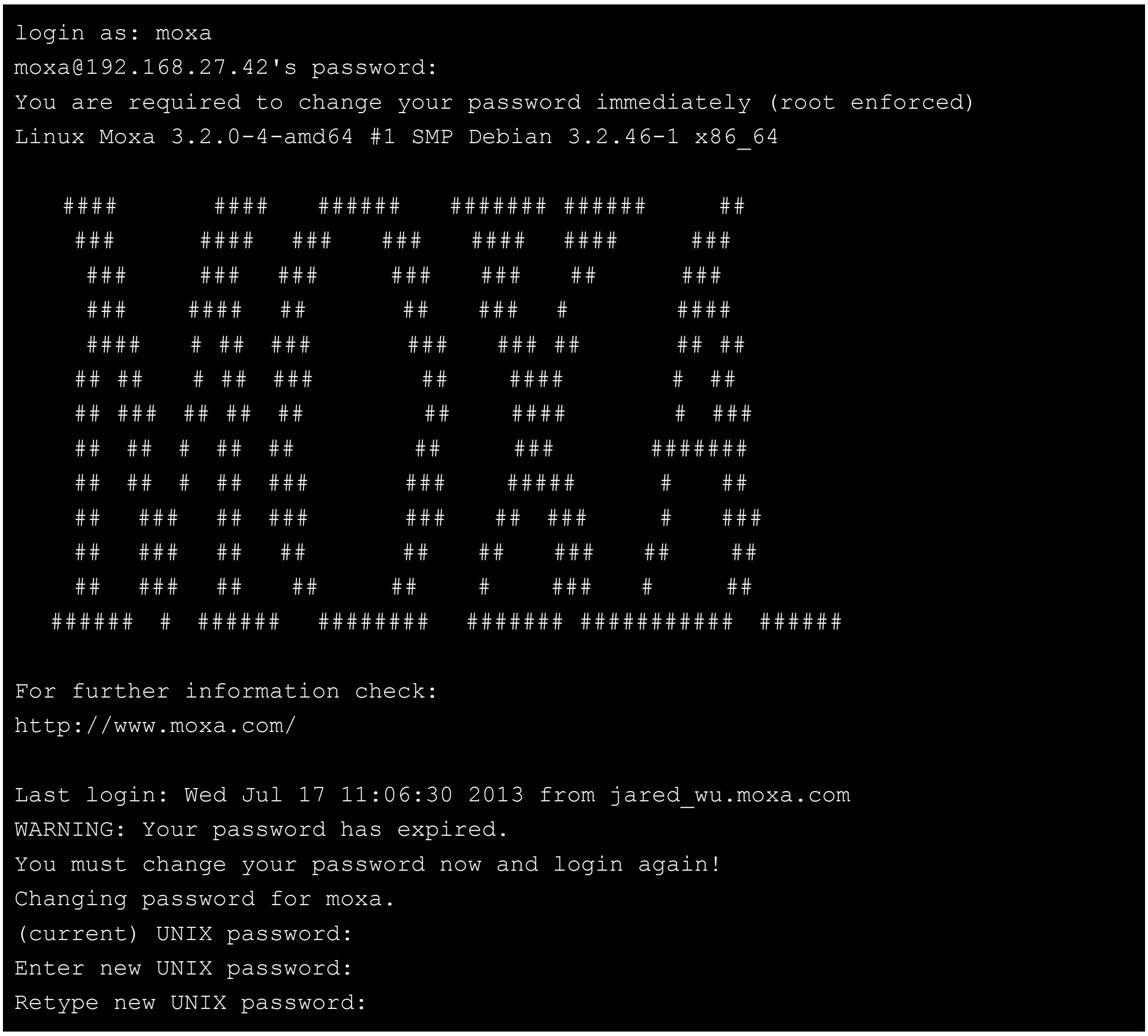
The following topics are covered in this chapter:

Account Management

Connect the DA-682A-DPP to a display and turn on the computer. Use the following default login and password:

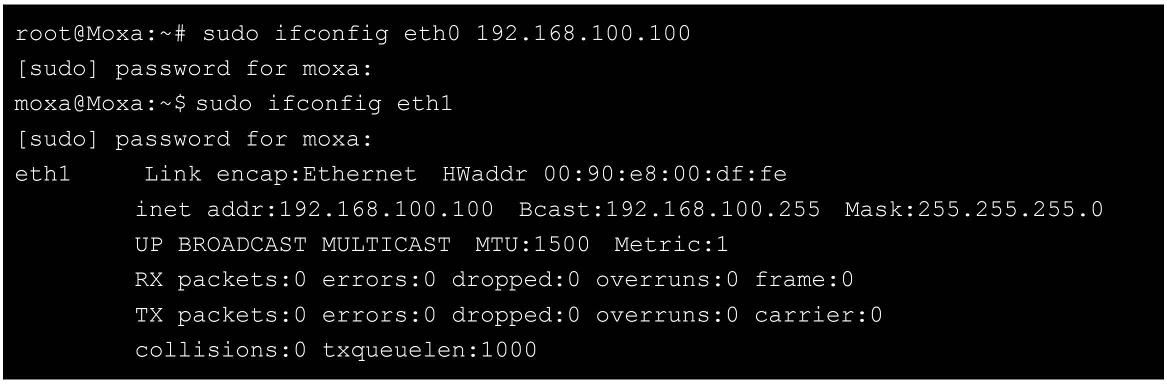
Login: moxa
Password: moxa

For security concerns, we strongly suggest you disable the root account and change the password at the first login. After logging in for the first time, you will be prompted by the system to provide a new password.



```
login as: moxa
moxa@192.168.27.42's password:
You are required to change your password immediately (root enforced)
Linux Moxa 3.2.0-4-amd64 #1 SMP Debian 3.2.46-1 x86_64

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

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

Last login: Wed Jul 17 11:06:30 2013 from jared_wu.moxa.com
WARNING: Your password has expired.
You must change your password now and login again!
Changing password for moxa.
(current) UNIX password:
Enter new UNIX password:
Retype new UNIX password:
```

Because the root account has been disabled, you will need to use **sudo** (the "super-user do" command) when administering commands that require root-level privileges. The sudo command will prompt you for a password before the command will be executed. For example, typing **moxa@Moxa:~# sudo ifconfig eth0 192.168.100.100** will allow you to reset the IP address of the LAN 1 port to 192.168.100.100.



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

```
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
          Interrupt:41 Base address:0xe000
```

If you need to make extensive administrative changes with root privileges, you canuse **sudo –i** to log in as root:

```
moxa@Moxa:~# sudo –i
[sudo] password for moxa:
```

Starting from a VGA Console

Connect the display monitor to the DA-682A-DPP-LX VGA connector, and then power it up by connecting it to the power adaptor. It takes approximately 30 to 60 seconds for the system to boot up. Once the system is ready, a login screen will appear on your monitor.

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

Login: moxa
Password: moxa

```
Moxa login: moxa
Password:
Last login: Thu Sep 15 22:46:00 CST 2011 on tty1
Linux Moxa 2.6.32-5-amd64 #1 SMP Tue Jun 14 09:42:28 UTC 2011 x86_64
The programs included with the Debian GNU/Linux system are free software;
The exact distribution terms for each program are described in the
Individual files in /usr/share/doc/*/copyright.
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
Permitted by applicable law.
root@Moxa:~#
```

Connecting from an SSH Console

The DA-682A-DPP-LX computers come with SSH enabled by default, giving users a strong, secure alternative to Telnet. The default IP addresses and netmasks of the network interfaces are as follows:

	Default IP Address	**Netmask**
LAN 1	192.168.3.127	255.255.255.0
LAN 2	192.168.4.127	255.255.255.0
LAN 3	192.168.5.127	255.255.255.0
LAN 4	192.168.6.127	255.255.255.0
LAN 5	192.168.7.127	255.255.255.0
LAN 6	192.168.8.127	255.255.255.0

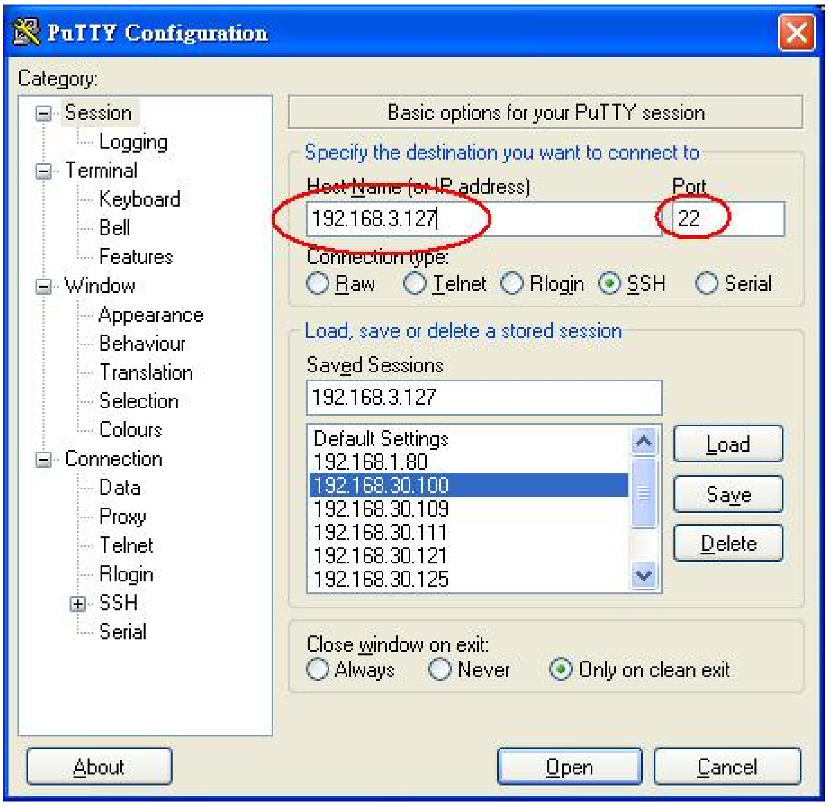
Before using the ssh client, you should change the IP address of your development workstation so that the network ports are on the same subnet as the IP address for the LAN port that you will connect to. For example, if you will connect to LAN1, you could set your PC’s IP address to 192.168.3.126, and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

After a connection has been established, type the login name and password as requested to log on to the computer. The default values are both **moxa**.

Login: moxa
Password: moxa

Windows Users

The most popular SSH client for the Windows platform is the freely available **PuTTY** program. To download PuTTY, visit **`http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html`**. After installing PuTTY, Windows users will be able to access the DA-682A-DPP computer using SSH. The following screen shows the setup of a sample PuTTY session.



Basic options for your PuTTY session

Specify the destination you want to connect to

Host Name (or IP address): 192.168.3.127

Port: 22

Connection type:
○ Raw ○ Telnet ○ Rlogin ● SSH ○ Serial

Load, save or delete a stored session

Saved Sessions: 192.168.3.127

Default Settings
192.168.1.80
192.168.30.100
192.168.30.109
192.168.30.111
192.168.30.121
192.168.30.125

Close window on exit:
○ Always ○ Never ● Only on clean exit

Linux Users

Linux users can run the **ssh** command from the console. The following command logs a user in over LAN1:

```
        moxa@Moxa:~#ssh 192.168.3.127
```

```
user@remoteDebian-moxa@Moxa:~# ssh 192.168.3.127
The authenticity of host ‘192.168.3.127 (192.168.3.127)’ can’t be established.
RSA key fingerprint is 8b:ee:ff:84:41:25:fc:cd:2a:f2:92:8f:cb:1f:6b:2f.
```

When asked if you want to continue connecting over SSH, answer yes by typing **Y**, **y**, or **yes**.

```
Are you sure you want to continue connection (yes/no)? yes_
```

Setting the System Clock and the RTC

The DA-682A-DPP-LX uses two clocks to keep time; one is the system time, and the other is the time provided by the RTC (Real Time Clock) built into the DA-682A-DPP's hardware. The system clock is set using the **date** command, and the RTC is set using the **hwclock** command.

WARNING

The RTC time setting on your computer is not in synch with the current time if the file system check (fsck) utility shows the following error on boot up:
Supberblock last mount time (Tue Dec 15 12:00:00 2015) is in the future. UNEXPECTED INCONSISTENCY; RUN fsck MANUALLY.

To prevent this issue from occuring at the next boot up, synchonize the system BIOS time with the current time.

NTP Client

The DA-682A-DPP-LX comes with a built-in Network Time Protocol (NTP) client that can access remote NTP servers to synchronize your system clock to worldwide reference clocks. To synchronize the system time to a remote reference clock, use the **ntpdate** command:

```
moxa@Moxa:~#sudo ntpdate time.stdtime.gov.tw
```

Next, set the RTC using the **hwclock** command:

```
moxa@Moxa:~#sudo hwclock –w
```

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. For additional information on using NTP (Network Time Protocol), visit the project's homepage at: `http://www.ntp.org`

Using a Shell Script for Automatic Updates

As the RTC gets older, it might run slower and fail to accurately track time. This section provides one example of how a shell script can be used to repeatedly synchronize the RTC to the system clock by using the Linux initialization table (**inittab**). Because the system clock will be automatically synched using NTP, the two clocks will reliably keep time. Other methods are also available, for instance using **cron** (see the section "Cron for Executing Scheduled Commands") or using the **at** command. The example below shows how to write a simple shell script for keeping the two clocks synchronized, and how to set the system to continuously run the script in the background, across sysystem re-boots.

Sample shell script for scheduled clock synchronizations

You can save this shell script using any file name, but it should be saved in the **/etc/init.d** directory. For example: **/etc/init.d/fixtime.sh**

```
#!/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 the RTC less often.
```

How to run a shell script automatically across re-boots

Copy the example above shell script `fixtime.sh` to the directory `/etc/init.d`, and then set its access permissions to **755**.

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

Next, use open the initialization table (**inittab**) for editing in your preferred editor (we use VI as an example):

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

Add the following line to the bottom of the file:

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

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

```
moxa@Moxa:~#  init q
```

NOTE In *nix environments, when inserting a single line at the end of a configuration file it is possible to use a single line command. This allows administrators to save time without opening the configuration file in an editor. To insert a single line at the end of a file, use the **echo** command with **input redirects**:

```
moxa@Moxa:~#  echo “ntp : 2345 : respawn : /etc/init.d/fixtime” >> /etc/inittab
```

Keep in mind, however, that care must be taken to use a **double caret** (>>). Use of a single caret (>) indicates overwriting the entire file with the single line, and will erase the current configuration.

Setting a Time Manually

System Time

When called with unquoted arguments, the date command will reset the system clock. The time and date must be entered in the format of Month-Date-Hour-Minute-Year.

```
moxa@Moxa:~# date [MMDDhhmmYYYY]
```

Month, date, hour, and minute are all entered in a two digit code, with the year entered using the full four digits, as shown below:

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

```
moxa@Moxa:~# date
          Tue Aug 20 11:28:05 CST 2013
moxa@Moxa:~# sudo hwclock
[sudo] password for moxa:
Tue 20 Aug 2013 11:28:47 AM CST  -0.422555 seconds
moxa@Moxa:~# date 121616352009
Wed Dec 16 16:35:00 CST 2009
```

```
moxa@Moxa:~# sudo hwclock -w
moxa@Moxa:~# date ; sudo hwclock
Wed Dec 16 16:36:12 CST 2009
Wed 16 Dec 2009 03:38:13 AM CST -0.016751 seconds
```

Setting the RTC

After setting the system time, use **hwclock** to write the current system time to the RTC, as follows:

```
Moxa~# hwclock -w
```

Enabling and Disabling Daemons

To run a custom daemon (i.e., an automated background process called by the system), you should create an initialization script; this process was briefly described above, in the section **Using a Shell Script for Automatic Updates**. While some people use `rc.local` to enable daemons, this practice is frowned upon and can lead to cases where services or background processes that require a clean exit are broken at shut-down, and will fail to start again at the next reboot. For this reason, best practices dictate that users who wish to set up a scripted process to run in the background should use inittab and an init script to guarantee the process will be cleanly managed, and any errors cleanly handled by the system.

After scripting a background process, for security's sake and convenience of administration, the script should be saved in `/usr/sbin` and then then linked to from `/etc/rc.local`. Then, an initialization script (init script) should be created, saved into `/etc/init.d`, and logged into `/etc/inittab` (for more on this, see above, **How to run a shell script automatically across re-boots**). **A stripped down sample initialization script** is given below, in appendix C, **Sample Scripts**; you canuse the sample script below, or use the script provided with the standard Debian distribution, which is available at `/etc/init.d/skeleton`. (the skeleton script provides a great deal more commentary and features). The complete process is described below.

1. Copy your custom script to `/usr/sbin` using the convention of `rc<scriptname>`:
   ```
   moxa@Moxa:~# cp <full-path-to-your-program> /usr/sbin/rc<scriptname>
   ```
2. Give this script executable permissions:
   ```
   moxa@Moxa:~# chmod 755 /usr/sbin/rc<scriptname>
   ```
3. Make a copy of the sample file at `/etc/init.d/skeleton` (or the one provided in Appendix C of this manual) and edit it to create an initialization script for your program.
   ```
   moxa@Moxa:~# cp /etc/init.d/skeleton /etc/init.d/<scriptname>
   ```
4. Give the initialization script executable permissions.
   ```
   moxa@Moxa:~# chmod 755 /etc/init.d/<scriptname>
   ```
5. Now activate your script so that it can be run when the system boots; use a low startup priority (below we use 97 for starts, 03 for shutdown).
   ```
   moxa@Moxa:~# update-rc.d <scriptname> default 97 03
   ```

ATTENTION

For more details about which systems in a Linux environment should be used for automated scripting and processes, refer to the webpage http://bencane.com/2011/12/30/when-its-ok-and-not-ok-to-use-rc-local/ (Nov, 2013). For more information about creating custom Linux scripts, refer to http://www.linux.com/learn/tutorials/442412-managing-linux-daemons-with-init-scripts

Managing Services Using the insserv Command

Linux services can be started or stopped using of the scripts in `/etc/init.d/`. If you want to start up some service, you can use **insserv** to add or remove the service to a specific run-level. This tutorial shows you how to add or remove a service from a specified run-level.

WARNING

Insserve is a low level tool, and when improperly called can result in an unbootable system. For this reason, current Debian best practices recommends against the use of insserv. If you do not feel comfortable using such a low-level tool, use **update-rc.d** instead. A good summary of how to use update-rc.d is available here: http://www.debuntu.org/how-to-managing-services-with-update-rc-d/ (Nov. 2013)

The example will use a services start-stop utility named **tcps2,** which we shall add to `/etc/init.d/`.

```
# !/bin/sh

### BEGIN INIT INFO
# Provides:           tcps2
# Required-Start:
# Required-Stop:
# Default-Start:       2 3 4 5
# Default-Stop:        0 1 6
# Short-Description:    tcps2
### END INIT INFO

. /lib/lsb/init-functions

export PATH="${PATH:+$PATH:}/usr/sbin:/sbin"

case "$1" in
  start)
        start-stop-daemon --start --quiet --oknodo --pidfile /var/run/tcps2.pid
--exec /usr/sbin/tcps2
        ;;
  stop)
        start-stop-daemon --stop --quiet --oknodo --pidfile /var/run/tcps2.pid
        ;;
esac

exit 0
```

After creating the script, you will now add it as a scheduled service using **insserv**.

To add tcps2 as a service that will start at boot time and run at every run-level, use the following syntax:

```
moxa@Moxa:~#sudo insserv -v -d tcps2
```

Check to see that the script has been added to each run-level:

```
moxa@Moxa:~#ls -l /etc/rc?.d/*tcps*
lrwxrwxrwx 1 root root 15 Jul  6 09:40 /etc/rc2.d/S18tcps2 -> ../init.d/tcps2
lrwxrwxrwx 1 root root 15 Jul  6 09:40 /etc/rc3.d/S18tcps2 -> ../init.d/tcps2
lrwxrwxrwx 1 root root 15 Jul  6 09:40 /etc/rc4.d/S18tcps2 -> ../init.d/tcps2
lrwxrwxrwx 1 root root 15 Jul  6 09:40 /etc/rc5.d/S18tcps2 -> ../init.d/tcps2
```

To remove a service from inittab, use this command:

```
moxa@Moxa:~#insserv -r tcps2
```

Check to make sure the script has been removed.

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

Cron for Executing Scheduled Commands

The **cron** daemon reads `/etc/crontab` to retrieve scripts and other commands to be run at regularly scheduled times.

Cron wakes up every minute and checks each command listed in the crontab file to see if it should be run at that time. Whenever cron executes a command, a report is automatically 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 schedule an application. **Crontab** entries follow the format below:

mm	h	dom	mon	dow	user	command
minute	hour	day of month	month	day of week	user	Command to be run
0-59	0-23	1-31	1-12	0-6 (0 is Sunday)		

For example, to synchronize the RTC at 8 AM every day, use the following cron entry:

```
#minute     hour    dom     date    month   dow     user    command
   00        8       *       *       *       *      root    hwclock -w
```

Every column in a crontab entry must be marked with a character. The asterisk indicates "every possible unit," so that setting an asterisk in the day-of-week column will configure cron to run the command on every day of the week. If you wish to run a command "every X minutes" or "every X hours", then use the format `*/X`.

So, using the example above, the hwclock command will be run under root ownership at the 0 minute (i.e. – top of the hour) of 8 AM on every day of the month, for every date, during every month, and on every day of the week. The following example shows another way of using cron to update the system time and RTC.

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

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

2. Reset the access permissions for `fixtime.sh`**.**

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

3. Modify the **/etc/crontab** file to run `fixtime.sh` every 10 minutes (i.e.: ***/10**) by adding this line:

```
*/10    *   *   *   *   root    /home/fixtime.sh
```

Mounting a USB Storage Device

Since mounting USB storage devices manually can be difficult, a Debian package named **usbmount** is used to mount USB devices automatically. **Usbmount** relies on **udev** to mount USB storage devices automatically under the device nodes `/media/usb0`**,** `/media/usb1`, and so forth. Use the mount command (with no arguments) to verify if the USB device has been successfully mounted.

```
moxa@Moxa:~# mount
...
/dev/sdd1 on /media/usb0 type vfat
(rw,nodev,noexec,noatime,nodiratime,sync,fmask=0022,dmask=0022,codepage=cp437,ioc
harset=utf8,shortname=mixed,errors=remount-ro)
```

Disconnecting a USB Storage Device

Remember to type the command `moxa@Moxa:~# sync` before you disconnect a USB block storage device to prevent data loss.

ATTENTION

Remember to exit the directory you are working in before disconnecting the USB storage device. If you do not first exit the directory, the automated unmount process will fail, possibly corrupting system processes. If you do fail to exit the directory and still disconnect the USB storage device, you can attempt to unmount the device manually by running the following command on the console:

```
root@moxa@Moxa:~#  umount -f /media/usb0
```

Mounting a CF Card

The DA-682A-DPP-LX has an internal CF socket over an IDE interface; it is not hot swappable, so users must power off the system before inserting or removing the CF card. The CF card will be identified as the **/dev/sdb** block device. You must add a line into **/etc/fstab** to mount the CF card automatically while booting.

```
moxa@Moxa:~# sudo vi /etc/fstab
# /etc/fstab: static file system information.
##
# <file system> <mount point>   <type>  <options>       <dump>  <pass>
/dev/sdb1 /media/cf1   ext4    noatime,errors=remount-ro 0     0
```

ATTENTION

The CF socket is not hot swappable; please do not insert the CF card while the system is still powered on: doing so might damage your system.

Checking Versions for your Kernel and OS

The program **uname** 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@Moxa:~# uname -a
Linux Moxa 3.2.0-4-686-pae #1 SMP Debian 3.2.46-1 i686 GNU/Linux
```

If you would like to check Moxa's firmware revision, type:

```
moxa@Moxa:~# kversion -a
```

Using APT to Install and Remove Software

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. Open the **sources.list** file in.the vi editor.

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

2. The configuration file should look something like this:

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

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

3. Update the source list after you configure it.

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

4. Once you indicate which package you want to install (**openswan**, for example), type:

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

5. Use one of the following commands to remove a package.
   a. For a simple package removal:

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

   b. For a complete package removal that removes all related configuration files, including those in individual user directories:

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

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. If you worry about the available space during a package installation, use the command `moxa@Moxa:~# df -h` to check how much free space is available for tmpfs.

Cleaning Out the Package Cache

APT and the Debian system software utilities generally keep software packages stored on the system even after installation. If the disk partition on which `/var` is located runs out of space, you can free up space by using the **clean** tag with **apt-get**.

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

This will delete all software installation packages currently stored in the cache; deleting these packages will not affect the functioning of the system, and will not affect the computer’s current configuration.

Determining Available Drive Space

To have the system return the amount of available drive space remaining, use the **df** command with the **–h** tag. The system will return the amount of drive space broken down by file system, as shown in the example below:

```
moxa@Moxa:~# df -h
Filesystem                    Size  Used Avail Use% Mounted on
rootfs                       7.4G  857M  6.4G  12% /
udev                          10M     0   10M   0% /dev
tmpfs                        202M  288K  202M   1% /run
/dev/disk/by-label/TC6110_MOXA  7.4G  857M  6.4G  12% /
tmpfs                        5.0M     0  5.0M   0% /run/lock
```

```
tmpfs                           403M  4.0K  403M   1% /run/shm
/dev/sdd1                        7.5G  553M  7.0G   8% /media/usb0
```

Checking the File System

The file system check (**`fsck`**) utility will check the boot partition for data consistency errors each time the computer boots up, and helps in recovering the data when an error is encountered. The data consistency check will however fail if the real-time clock (RTC) is not in sync with the current time.

NOTE The RTC time setting on your computer is not in synch with the current time if the file system check (fsck) utility shows the following error on boot up:
Supberblock last mount time (Tue Dec 15 12:00:00 2015) is in the future. UNEXPECTED INCONSISTENCY; RUN fsck MANUALLY.

The data consistency error occurs because the RTC date is earlier than the OS image build date. Synch the BIOS time with the current time to prevent this issue from occurring on the next boot up

3

Managing Communications

The DA-682A-DPP-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:

Configuring Network Interfaces

Configuring a Persistent Network Interface Naming Order

Debian Linux systems use the **udev** daemon to detect and enable new network interfaces and to manage the device files that are created for them. Udev must be configured with rules that enforce a ***persistent interface naming order.*** A persistent network interface naming order allows devices to be consistently named with the same device node every time the machine is rebooted. This is important because settings are configured with reference to a device name (e.g., eth1) associated with a particular device (e.g., your Broadcom gigabit Ethernet card). If every time the system is rebooted the system randomly rearranges the naming of your cards—for instance, assigning your gigabit Ethernet card to eth2 and your 10/100 Ethernet card to eth1—then there will be no way to maintain a consistent configuration across restarts.

The rule for setting up network interfaces with a persistent naming order is found here:

```
        /lib/udev/rules.d/75-persistent-net-generator.rules
```

and it looks like this:

```
# PCI device 0x10ec:/sys/devices/pci0000:00/0000:00:1c.1/0000:02:00.0 (r8169)
SUBSYSTEM=="net", ACTION=="add", DRIVERS=="?*",
ATTR{address}=="00:90:e8:00:de:a9", ATTR{dev_id}=="0x0", ATTR{type}=="1",
KERNEL=="eth*", NAME="eth1"

#PCI device 0x10ec:/sys/devices/pci0000:00/0000:00:1c.0/0000:01:00.0 (r8169)
SUBSYSTEM=="net", ACTION=="add", DRIVERS=="?*",
ATTR{address}=="00:90:e8:00:de:a8", ATTR{dev_id}=="0x0", ATTR{type}=="1",
KERNEL=="eth*", NAME="eth0"
```

The above example indicates that the system has detected two Ethernet interfaces, and assigned them the names eth0 (which is associated with the MAC address `00:90:e8:00:de:a8)` and eth1 (associated with the MAC address `00:90:e8:00:de:a9)`.

ATTENTION

When replacing or connecting a network interface, the system may fail to remove the old record from `/etc/udev/rules.d/70-persistent-net.rules`. This could cause network interfaces to be detected abnormally. To avoid this problem, simply delete the **70-persistent-net.rules** file and reboot the system.

ATTENTION

It may also be necessary to configure a persistent naming order for other system peripherals (e.g., storage drives); to find out more, refer to the: **http://www.reactivated.net/writing_udev_rules.html**
Symantec also offers an effective tutorial, **Setting Persistent SCSI Device Names On Linux Using UDEV**, available at: **http://www.symantec.com/business/support/index?page=content&id=TECH71007**
To get an idea of what Udev can do for you, check out this Linux For You article from 2012, **Some Nifty udev Rules and Examples**:
http://www.linuxforu.com/2012/06/some-nifty-udev-rules-and-examples/

Ethernet Interface Configuration

The DA-682A-DPP-LX computer has two 10/100/1000 Ethernet ports named LAN1 and LAN2. The default IP addresses and netmasks of these network interfaces are:

	Default IP Address	Netmask
LAN1	192.168.3.127	255.255.255.0
LAN2	192.168.4.127	255.255.255.0

These network settings can be modified by changing the **interfaces** (`/etc/networking/interfaces`) configuration file, or they can be adjusted temporarily with the **ifconfig** command.

The file used for configuring network interfaces is the **networking interfaces configuration** file, located in the `/etc/network` directory. The `/etc/network/interfaces` file is where you will configure Ethernet LAN ports for either static or dynamic (DHCP) IP addressing. To edit this file directly, open the network configuration file with your preferred editor (below, we use VI):

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

Static IP Address

The default static IP addresses can be modified. Below, we show the default configuration; changing these values will change the addressing and broadcast parameters used by the associated interface.

```
### 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 receive an IP address through dynamic assignment, replace **static** with **dhcp** and then comment out the rest of the lines. The eth0 interface is shown below, as an example.

```
# The loopback network interface
auto lo
iface lo inet loopback
# The primary network interface
auto eth0
iface eth0 inet dhcp
#       address 192.168.3.127
#       netmask 255.255.255.0
#       broadcast 192.168.3.255
```

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

```
moxa@Moxa:~# sudo service networking restart
```

Adjusting IP Addresses with ifconfig

IP settings can be adjusted during run-time, but the new settings will not be saved to the flash ROM without modifying the file `/etc/network/interfaces`. For example, the following command changes the IP address of **LAN1** to **192.168.1.1**.

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

Point-to-Point Protocol Over Ethernet (PPPoE) Configuration

The Easy Way: pppoeconf

The easiest way to set up a PPPoE connection is to install the Debian package, pppoeconf. This is a script that automates the PPPoE configuration process; it may be used on any connection that is directly linking to an ADSL or other PPPoE modem.

Use **`apt-get`** or Aptitude to install pppoeconf:

```
moxa@Moxa: ~# apt-get pppoeconf
```

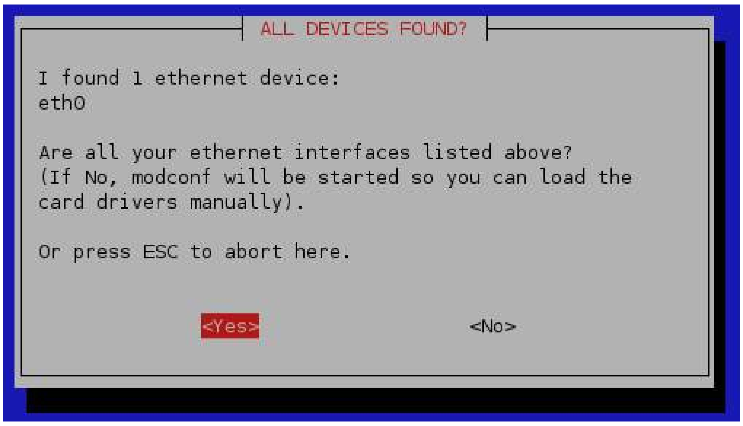
After installing pppoeconf, call it from the command line:

```
moxa@Moxa:~# pppoeconf
```

Next, a dialog will appear telling you pppoeconf is locating your “access concentrator.” If your DSL or ADSL modem is connected to an active LAN interface, pppoeconf will find it.

If there are no available concentrators, pppoeconf will tell you, and exit; if this happens, check to see you’re your modems are connected properly.

If pppoeconf successfully discovers a concentrator on an available interfaces, it will return this screen:

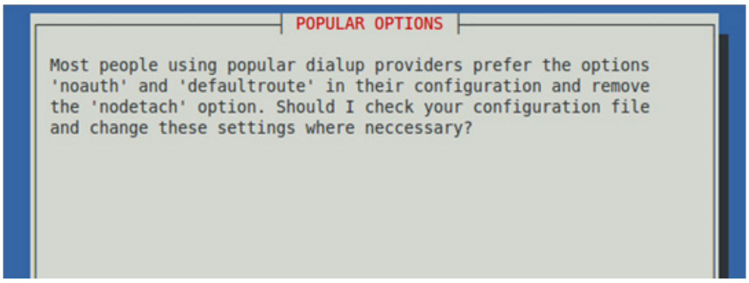

ALL DEVICES FOUND?

I found 1 ethernet device:
eth0

Are all your ethernet interfaces listed above?
(If No, modconf will be started so you can load the
card drivers manually).

Or press ESC to abort here.

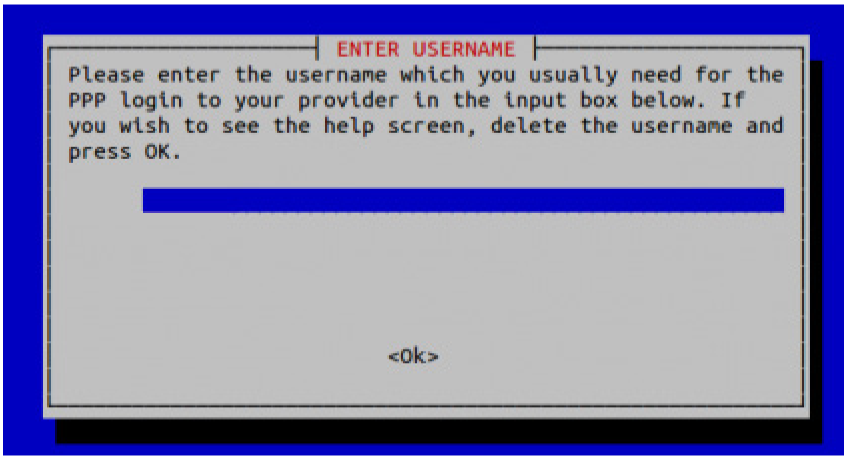
Answer yes. You will then see this screen:


POPULAR OPTIONS

Most people using popular dialup providers prefer the options
'noauth' and 'defaultroute' in their configuration and remove
the 'nodetach' option. Should I check your configuration file
and change these settings where neccessary?

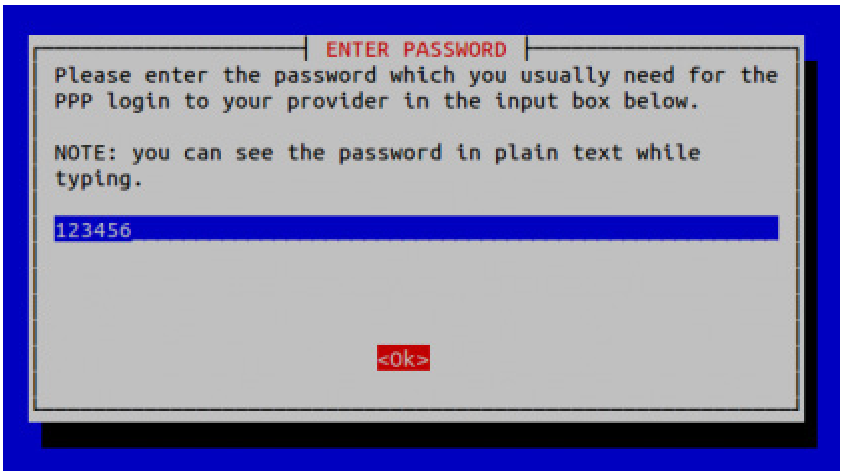
Noauth indicates that the peer does not need to authenticate itself. **Nodetach** indicates that the connection will not detach from the controlling terminal. Without this option, if a serial device other than the terminal on the standard input is specified, pppd will fork to become a background process.

After choosing whether or not to use **noauth** and **nodetach**, the pppoeconf will next ask you for your username and password.



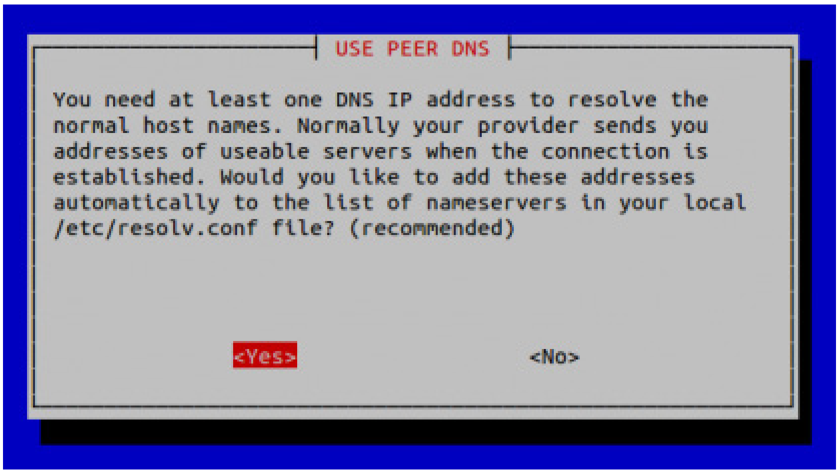
```
ENTER USERNAME
Please enter the username which you usually need for the
PPP login to your provider in the input box below. If
you wish to see the help screen, delete the username and
press OK.
```

Next, enter your password:



```
ENTER PASSWORD
Please enter the password which you usually need for the
PPP login to your provider in the input box below.

NOTE: you can see the password in plain text while
typing.

123456
```

Finally, you will need to choose whether or not your PPPoE provider will supply you with DNS server addresses. These addresses are necessary for DNS resolution (see below, the section Configuring the DNS Resolver). It is generally preferable to click **Yes**, here; however, if your PPPoE provider does not supply these addresses automatically (or if you do not connect to a PPPoE provider directly), click **No** and remember that you will need to enter DNS server addresses into `/etc/resolve.conf` by hand.



```
USE PEER DNS

You need at least one DNS IP address to resolve the
normal host names. Normally your provider sends you
addresses of useable servers when the connection is
established. Would you like to add these addresses
automatically to the list of nameservers in your local
/etc/resolv.conf file? (recommended)
```

The Difficult Way (Manually)

If you want to connect to your PPPoE provider by manually configuring a connection, use the following procedure to configure PPPoE:

1. Connect the DA-682A-DPP-LX's LAN port to an ADSL modem (you may use a cable, HUB, or switch).
2. Log in to the DA-682A-DPP-LX as the root user.
3. Edit the file **/etc/ppp/pap-secrets** and add the following entry in the place indicated below:

   "username@YourProvider.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@YourProvider.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@YourProvider.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/options** and add **plugin rp-pppoe** in the indicated place:

```
# 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>---
```

5. If you connecting over LAN1, use the template below to create a file **/etc/ppp/options.eth0**. LAN2 should be named **/etc/ppp/options.eth1**. All interfaces follow this convention.

```
name username@YourProvider.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.

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

```
nameserver ip_addr_of_first_dns_server
nameserver ip_addr_of_second_dns_server
```

   For example:

```
nameserver 168.95.1.1
nameserver 139.175.10.20
```

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

Now, you should be able to use the following command to establish a **pppoe** connection:

```
moxa@Moxa:~# pppd eth0
```

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

```
moxa@Moxa:~# kill -9 pppd
```

Notes:

1. If the ADSL modem is connected to the **LAN1** port, the connection will be named **eth0**. If the ADSL modem is connected to **LAN2**, it should be named **eth1**, etc.
2. Type `moxa@Moxa: ~# ifconfig ppp0` to check if the connection is OK. If the connection is OK, you should see the IP address of ppp0. You may use the **ping** command to test the IP address.

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

Configuring a Point-to-Point Connection

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 DA-682A-DPP-LX Ethernet port. Since PPP is a peer-to-peer system, the DA-682A-DPP-LX can also use PPP to link two networks (or a local network to the Internet) to create a Wide Area Network (WAN).

ATTENTION

The following links will give you more information about setting up PPP:

http://tldp.org/HOWTO/PPP-HOWTO/index.html
http://axion.physics.ubc.ca/ppp-linux.html

The following is an AT command used to connect to a PPP server by modem. Use this command for old ppp servers that prompt for a login name (replace **username** with the correct name) and password (replace **password** with the correct password). Note that **debug crtscts** and **defaultroute 192.XXX.XX.XXX** are optional.

```
moxa@Moxa:~# pppd connect ‘chat -v “” ATDT5551212 CONNECT “”‘ login: username \
             password: password’ /dev/ttyM0 115200   \
             debug crtscts modem defaultroute 192.1.1.17
```

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

```
moxa@Moxa:~# pppd connect ‘chat -v “” ATDT5551212 CONNECT “”‘ user username
             password password /dev/ttyM0 115200 crtscts modem
```

The pppd options are described below:

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

-v verbose mode; log what we do to syslog

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

ATDT5551212 Dial the modem, and then ...

CONNECT Wait for an answer.

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

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

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

/dev/ Specify the callout serial port.

115200 The baud rate.

debug Log status in syslog.

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

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

defaultroute Once the PPP link is established, make it the default route; if you have a PPP link to the Internet, this is probably what you want.

192.1.1.17 This is a degenerate case of a general option of the form x.x.x.x:y.y.y.y. Here x.x.x.x is the local IP address and y.y.y.y is the IP address of the remote end of the PPP connection. If this option is not specified, or if just one side is specified, then x.x.x.x defaults to the IP address associated with the local machine's hostname (located in /**etc/hosts**), and y.y.y.y is determined by the remote machine.

Connecting to a PPP Server over a Hardwired Link

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

```
moxa@Moxa:~# pppd connect ‘chat –v” “ “ “ ‘ noipdefault /dev/ttyM0 19200 crtscts
```

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

```
moxa@Moxa:~# pppd connect ‘chat –v” “ “ “ ‘ user root password root \
             noipdefault /dev/ttyM0 19200 crtscts
```

Checking the Connection

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

```
moxa@Moxa:~# ifconfig
```

After executing the command, you should be able to see all of the available network interfaces.

ppp0 should be one of the network interfaces. You should recognize the first IP address as the IP address of the computer, and the **P-t-P address** is the address of the server. The output should be similar to this:

```
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:

```
moxa@Moxa:~# ping XXX.XX.XXX.XXX
```

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

```
moxa@Moxa:~# sudo 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@Moxa:~#
```

Try typing:

```
moxa@Moxa:~# netstat -nr
```

You should see three routes similar to the following:

```
Kernel routing table
Destination   Gateway   Genmask         Flags   Metric  Ref Use
iface
129.67.1.165  0.0.0.0   255.255.255.255 UH      0       0   6
ppp0
127.0.0.0     0.0.0.0   255.0.0.0       U       0       0   0 lo
0.0.0.0       129.67.1.165  0.0.0.0     UG      0       0   6298
Ppp0
```

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

Setting up a Machine for Incoming PPP Connections

Method 1: pppd dial-in with pppd commands

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

```
#pppd /dev/ttyM0 115200 crtscts modem 192.168.16.1:192.168.16.2 login auth
```

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

```
*    *    ""    *
```

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

The following example does not check the username and password:

```
moxa@Moxa:~#  pppd/dev/ttyM0 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
crtscts
modem
192.168.16.1:192.168.16.2
debug
```

```
-detach
```

Configure the chat script **/etc/ppp/ppp-ttyM0.chat**

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

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

```
moxa@Moxa:~# sudo pppd call dialin
```

ATTENTION

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

```
moxa@Moxa:~# sudo echo "p0:2345:respawn:pppd call dialin" >> /etc/inittab
```

Telnet/FTP/TFTP Server

For security reasons, the DA-682A-DPP-LX only supports SSH and SFTP. The Telnet, FTP, and TFTP are installed, but have been disabled. Moxa strongly recommends against the use of Telnet or FTP, both of which are considered deprecated, today. However, if you wish to use one of these services, you may follow the directions below to enable or disable these services.

Enabling a Telnet, FTP, or TFTP Server

The following example shows the default content of the file `/etc/inetd.conf`. For security's sake, the Telnet, FTP, and TFTP servers are disabled by default. To enable these services, add the following content to `/etc/inetd.conf`:

```
telnet  stream  tcp nowait  telnetd /usr/sbin/tcpd  /usr/sbin/in.telnetd
ftp     stream  tcp nowait  root    /usr/sbin/tcpd  /usr/sbin/proftpd
…
tftp    dgram   udp wait    nobody  /usr/sbin/tcpd  /usr/sbin/in.tftpd  /srv/tftp
```

Then restart the inetd service:

```
moxa@Moxa:~# sudo service openbsd-inetd restart
```

Disabling a Telnet/FTP/TFTP Server

If, after enabling one of these servers, you wish to disable it again you may do so by commenting out the relevant line inserting a hash (**#**) as the line's first character. Below, the **TFTP** server has been disabled using this method.

```
telnet  stream  tcp nowait  telnetd /usr/sbin/tcpd  /usr/sbin/in.telnetd
ftp     stream  tcp nowait  root    /usr/sbin/tcpd  /usr/sbin/proftpd
…
#tftp   dgram   udp wait    nobody  /usr/sbin/tcpd  /usr/sbin/in.tftpd /srv/tftp
```

As with any other changes to the inet.d configuration, you must restart the inetd service for the changes to take effect.

```
moxa@Moxa:~# sudo service openbsd-inetd restart
```

DNS Utilities

Basic DNS utilities are responsible for managing a system’s hostname, DNS resolver, and the name service switch. The three configuration files associated with these services are `/etc/hostname`, `/etc/resolv.conf`, and `/etc/nsswitch.conf`.

Configuring the OS Hostname

When remotely administrating large networks, it is desirable to provide each computer with a descriptive hostname. This is set by changing the **hostname** file; `/etc/hostname` is a file with a single line that contains the hostname, which can only contain the ascii characters a through z, the numbers 0 through 9, and a hyphen. Hostnames must not include dots (periods), because the hostname is used as part of a fully qualified URL.

1. To change the hostname, use the following command:

```
moxa@Moxa:~# sudo echo ”your-preferred-hostname” > /etc/hostname
```

2. Load the new hostname:

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

3. Check the new hostname.

```
moxa@Moxa:~# hostname
your-preferred-hostname
```

Configuring the DNS Resolver

This is the file most in need of updating when configuring DNS. For example, before using the command

```
moxa@Moxa:~# ntpdate time.stdtime.gov.tw
```

to update the system time, you will need to add a DNS server address to the resolver configuration. Ask your network administrator for addresses to preferred DNS servers. Each server’s address is specified by prefacing the line with **nameserver**. For example, to add a DNS server with IP address is 168.95.1.1 to `/etc/resolv.conf`, you would simply append **nameserver 168.95.1.1** to the end of the file.

```
moxa@Moxa:~#/etc# echo “nameserver 168.95.1.1” >> resolv.conf
moxa@Moxa:~#/etc# cat resolv.conf
# resolv.conf  This file is the resolver configuration file
# See resolver(5).
#
#nameserver 192.168.1.16
nameserver 140.115.1.31
nameserver 140.115.236.10
nameserver 168.95.1.1
```

Configuring the Name Service Switcher

The name service switcher configuration file is **nsswitch.conf**; this file defines in what sequence system databases will be referenced to retrieve name service information when resolving URLs to IP addresses. The file is plain ASCII text, with columns separated by spaces or tab characters. The first column specifies the database name. The remaining columns describe the order of sources to query and a limited set of actions that can be performed by lookup result; the sources will be referenced in the order they appear on the line, from right to left.

Five service specifications may be indicated for any source: **files**, **db**, **nis**, **nisplus**, or **compat**. For the hosts database, you may also specify dns; compatibility mode (**compat**) may only be used with the **passwd**, **group**, and **shadow** databases. Use of the **files** source will have the name service switcher search the /etc directory to find a file that matches the source name (e.g., /etc/hosts, /etc/passwd, /etc/group), and then that file will be used. By omitting dns or files you may effectively disable dns or the local hosts file for URL resolution.

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

passwd:         compat
group:          compat
shadow:         compat

hosts:          files dns
networks:       files

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

netgroup:       nis
```

Apache Web Server

The Apache config directory houses four basic directories: sites-enabled, mods-enabled, sites-available, and mods-available. The **sites-enabled** directory is where active websites are enabled; this is done by creating a symlink into the sites-available directory. **Sites-available** is a repository for all sites, whether inactive or active. The **mods-available** directory houses Apache **software modules**, which allow administrators to adjust the size and features of the Apache webserver to the particular needs of the application. The **mods-enabled** directory enables modules to be loaded by, again, symlinking back to the relevant module located in the mods-available directory.

ATTENTION

There are many Apache modules that may be of use to administrators in need of customizations to their webserver, such as speeding up CGI, or building heightened security. Webserver modules and features are beyond the scope of this manual. If you wish to find a complete list and full documentation for the native modules, please refer to the Apache webserver documentation, found here:

http://httpd.apache.org/modules/

For a more completely list of available modules that includes third-party modules, you may refer to Wikipedia:

http://en.wikipedia.org/wiki/List_of_Apache_modules

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/index.html`**.

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. If the default address hasn’t changed, then when you type http://192.168.3.127/ in the address bar of your web browser you should see Apache’s default web page.

Configuring the Common Gateway Interface (CGI)

Setting Up CGI

CGI comes already enabled. The root CGI directory (where you should put CGI scripts) is `/usr/lib/cgi-bin`. You may change this to `/var/www/cgi-bin`, if you so desire.

ATTENTION

If you have more questions about setting up CGI on Apache 2.2, you may refer to this web page:

http://httpd.apache.org/docs/2.2/howto/cgi.html

Disabling CGI

Support for CGI scripting is enabled by default. To disable it, follow the steps below.

1. Open the configuration file for editing (below, we use VI):
   `moxa@Moxa:~# vi /etc/apache2/sites-enabled/000-default`
   Then, comment out the following lines:

```
moxa@Moxa:~#/etc# vi /etc/apache2/sites-enabled/000-default
#ScriptAlias /cgi-bin/ /usr/lib/w3m/cgi-bin/
#<Directory “/usr/lib/w3m/cgi-bin/”>
#      AllowOverride None
#      Options ExecCGI -MultiViews +SymLinksIFOwnerMatch
#      #Order allow,deny
#      Order deny,allow
#      Allow from all
#</Directory>
```

2. Re-start the apache server.

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

ATTENTION

If you have CGI scripts you wish to transfer to the server, make sure you make the files executable. The command for this is the **change mode** command, **chmod**. To make a file read-only but executable, you may use the numerical combination **555**. To make a file read only but available for editing by root, use the numerical key **755**. The syntax is as follows:

```
moxa@Moxa:~#chmod 555 /usr/lib/cgi-bin/[NAME OF YOUR FILE HERE]
```

Saving Web Pages to a USB Storage Device

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

1. Connect the USB storage device to a USB port, and check where the device is mounted:

```
moxa@Moxa:~# sudo mount
```

2. Prepare the web pages and then save the entire `/var/www` directory to the appropriate USB storage device. Normally, this should be `/media/usb0`.

```
moxa@Moxa:~# sudo cp –a /var/www/ media/usb0/
```

3. Now change the Document Root setting. Open the basic Apache configuration file in an editor:

```
moxa@Moxa:~# /etc# sudo vi /etc/apache2/sites-available/default
```

4. To enable Apache to read your website from the USB device, you must change the **DocumentRoot** entry in the Apache configuration file so that it points to the USB storage device. Navigate to the section beginning with DocumentRoot, and change the directory that immediately follows to **/media/usb0/www**. For a standard, unsecured html page, edit `/etc/apache2/sites-available/default` as below.

```
       DocumentRoot /media/usb0/www
       <Directory />
              Options FollowSymLinks
              AllowOverride None
       </Directory>
```

5. If you have CGI scripts, you must now also change the same file so that the CGI entries point to the files on the USB device. Change your basic Apache configuration file so that it matches the lines shown in red, below:

```
       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>
```

6. For webpages that will be connecting using the secure sockets layer, you will need to edit the SSL configuration file. Open the configuration file using the following command:

```
moxa@Moxa:~#/etc# sudo vi /etc/apache2/sites-available/default-ssl
```

7. Make the changes to your configuration file so that it matches the lines shown in red below:

```
<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>
```

8. Use the following compound command to restart the Apache web server:

```
moxa@Moxa:~# cd /etc/init.d && apache2 restart
```

9. Start your browser and connect to the DA-682A-DPP-LX by typing the current LAN1 IP address in the browser’s address box.

ATTENTION

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

If you would like to check your website for HTML compliance, click on the following link to download the web page test suite from the World Wide Web Consortium:

http://www.w3.org/MarkUp/Test/HTML401.zip

Netfilter/iptables

Netfilter is an administrative tool for setting up, maintaining, and inspecting the Linux kernel's packet filtering rule tables. Netfilter is a **stateful firewall**, which means that it filters packets by tracking connections, rather than each and every individual packet. For more information on connection tracking, see the section **Connection Tracking**, in this same chapter, below.

In Netfilter, a few fundamental **rule tables** are pre-defined, with each table containing built-in chains and user-defined chains. Tables form the highest layer of organization for Netfilter's rule sets, and **rule chains** form the middle layer, by which individual rules are ordered. Each chain is a list of rules that are applied (or not) to a packets as they traverse the chains. 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, or an order to drop a certain type of packet) is also called a **target**.

Netfilter is based around three fundamental tables: **Filter** tables, **NAT** tables, and **Mangle** tables. These tables in turn are structured around a few basic, built-in rule chains. There are five basic rule chains: PREROUTING, INPUT, FORWARDING, OUTPUT, and POSTROUTING. In addition to these five built-in chains, it is possible for users to add user-defined chains of their own devising, and insert them into the filtering and mangling procedures wherever they are needed. Thus, Netfilter may be said to have three layers: the most basic is the rules layer, the next is the chains layer (which order the rules), and the final is the table layer, which orders the rule chains.

Overview of Basic Netfilter Architecture:

Building the Firewall: Writing Filter Rules

Setting Up NAT

ATTENTION

For more information on configuring Netfilter/iptables, you may consult the official project website.

Homepage:	http://www.netfilter.org/
Documentation:	http://www.netfilter.org/documentation/index.html#documentation-howto
Netfilter Extensions:	http://www.netfilter.org/documentation/HOWTO//netfilter-extensions-HOWTO.html

IP Tables and IP Chains

The highest layer of organization in Netfilter is the **table layer**. This is where all of the **rule chains** are organized. Rule chains are ordered lists of packet filtering and packet mangling rules; each chain represents a basic flow of operations to be performed on a packet at that stage. Where chains are prioritized lists of rules, tables are prioritized lists of chains. Additionally, each of Netfilter's built-in tables comes with a set of built-in chains that are associated with it; these chains set the basic path packets will traverse as they are processed by Netfilter. To view and manipulate (delete, flush, and add) rule tables, rulechains, and individual rules, refer to the section below, **Manipulating Rulesets**.

The NAT Table

The NAT table is the first table that all packets will encounter; no filtering takes place in this table. The only packet alterations enforced by the NAT table are changes to the **source** and **destination** addresses; moreover, only the first packet of a new connection will traverse this table: after the first packet in a **connection** has been processed, the result will be automatically applied to all future packets in the same connection (for more information on connections, see the section **Connection Tracking**, in this same chapter, below).

When the NAT table alters the destination address (on inbound packets, in the PREROUTING chain), it is called **Destination Network Address Translation** (**DNAT)**, or **Port Forwarding**. When the NAT table alters the source address (on outbound packets, in the POSTROUTING chain), it is called **Source Network Address Translation** (**SNAT**), or **IP Masquerading**. Netfilter conventions distinguish Masquerading from SNAT in the following way:

- **Masquerading** is a form of SNAT where you let your firewall automatically detect the external interface address
- **SNAT** refers a situation where you explicitly specify what source address will be used when re-writing the outbound source address field.

The NAT table does not filter packets. Packet filtering is reserved for the **Filter Table**.

The NAT table utilizes the built-in PREROUTING, OUTPUT, and POSTROUTING rule chains.

The Filter Table

The Filter table is the only table that is responsible for filtering packets; it should never alter them in the ways that the Mangle and NAT tables do, e.g., it should not alter the information in individual packets. The only work done by the Filter table consists of executing the targets ACCEPT, DROP, QUEUE, or RETURN.

ACCEPT means the packet continues traversing the chain.
DROP quietly drops the packet, without notifying the sender.
QUEUE passes the packet to userspace, where it may be picked up by the Mangle table, or may be passed along to other userspace utilities or modules.
RETURN sends the packet back to the rule following the last rule it passed in the **previous** rule chain; that is, when a rule is forwarded from one rule chain to another, the RETURN target will send a packet back to the next in the rule chain from which it was forwarded.
In addition, there one target extension may also be used with the Filter table:
Reject will drop the packet, but send an ICMP notification to the sending machine that the packet has been dropped.

The Filter table uses the built-in INPUT, OUTPUT, and FORWARD rule chains

The Mangle Table

The Mangle table is primarily used to prioritize certain connections for quality of service optimizations; it is used for general packet header modification, such as setting the Time-to-Live (TTL) or Type-of-Service (TOS) fields, or to set an internal mark (called **nfmark**, and set with the MARK target) to identify the packet for later processing.

The Five Built-In Rule Chains

The tables handle five built-in chains:

1. All inbound packets hit the **PREROUTING** chain, with no exceptions. Any changes performed on the packets here are done before the routing decision and filtering is done. When connections are bound for machines located on the local subnet this chain will alter the destination IP address for **destination network address translation** (DNAT). By the time a packet reaches the PREROUTING chain, all checks on the IP headers have been completed, but the packet has not yet been routed.
2. The **INPUT** chain receives all **inbound** packets which are addressed to the local intranet served by this firewall. All packets which are addressed to the local intranet will be filtered here, before they continue onwards.
3. The **FORWARD** chain receives and filters all packets which are addressed to computers which are not located on the local intranet located behind the firewall, i.e., it redirects packets which are intended to be forwarded to other parts of the network which are not located on the subnet administered by the firewall, or which have arrived from sections of the network (not located behind the administered subnet) and are destined for the open Internet.
4. The **OUTPUT** chain receives all **outbound** packets which are addressed to computers outside the local intranet. All packets which are addressed to the local intranet served by the firewall will be filtered here, before they continue outwards, onto the Internet.
5. The **POSTROUTING** chain is the very last chain that is applied; all outbound packets which are leaving the local machine (or subnet) will pass through this chain. Packets which are processed by the POSTROUTING chain have already been routed, but have not been sent over the Ethernet. This is where Netfilter performs **source network address translation** (SNAT), altering the source address from the IP address that is used on the local intranet to the one which identifies the firewall on the open Internet.

User-Defined Chains

User-defined chains are used to create customized filters for a wide variety of needs; however, there are some commonly used chains which most administrators call when building a firewall. One example follows:

```
moxa@Moxa:~# iptables –N TCP && iptables –N UDP
```

This creates a user-defined chain called TCP and another called UDP, which you may use to manage protocols later on. To see how to implement these chains in the INPUT chain, see below, **Rule Examples: Applying User-Defined Chains**.

ATTENTION

To find out what rules are currently written into each table and chain, use the commands described below, in the section **Viewing and Manipulating Rulesets**.

Understanding Basic Traffic Flows

Users should recognize that these five chains may be used to build three fundamental traffic flows. Additionally, certain chains are only associated with certain tables. For more information on which tables use which chains, see the next section,

A) **Forwarded** packets will traverse this set of chains in the following order:

PREROUTING	➔	**FORWARD**	➔	**POSTROUTING**
(in the NAT table)		(in the Filter table)		(in the NAT table)

B) **Inbound** traffic that is destined for the local subnet will traverse this set of chains:

PREROUTING	➔	**INPUT**	➔	**INPUT**
(in the NAT table)		(in the Mangle table)		(in the Filter table)

C) **Outbound** traffic that is leaving the firewall will traverse this set of chains:

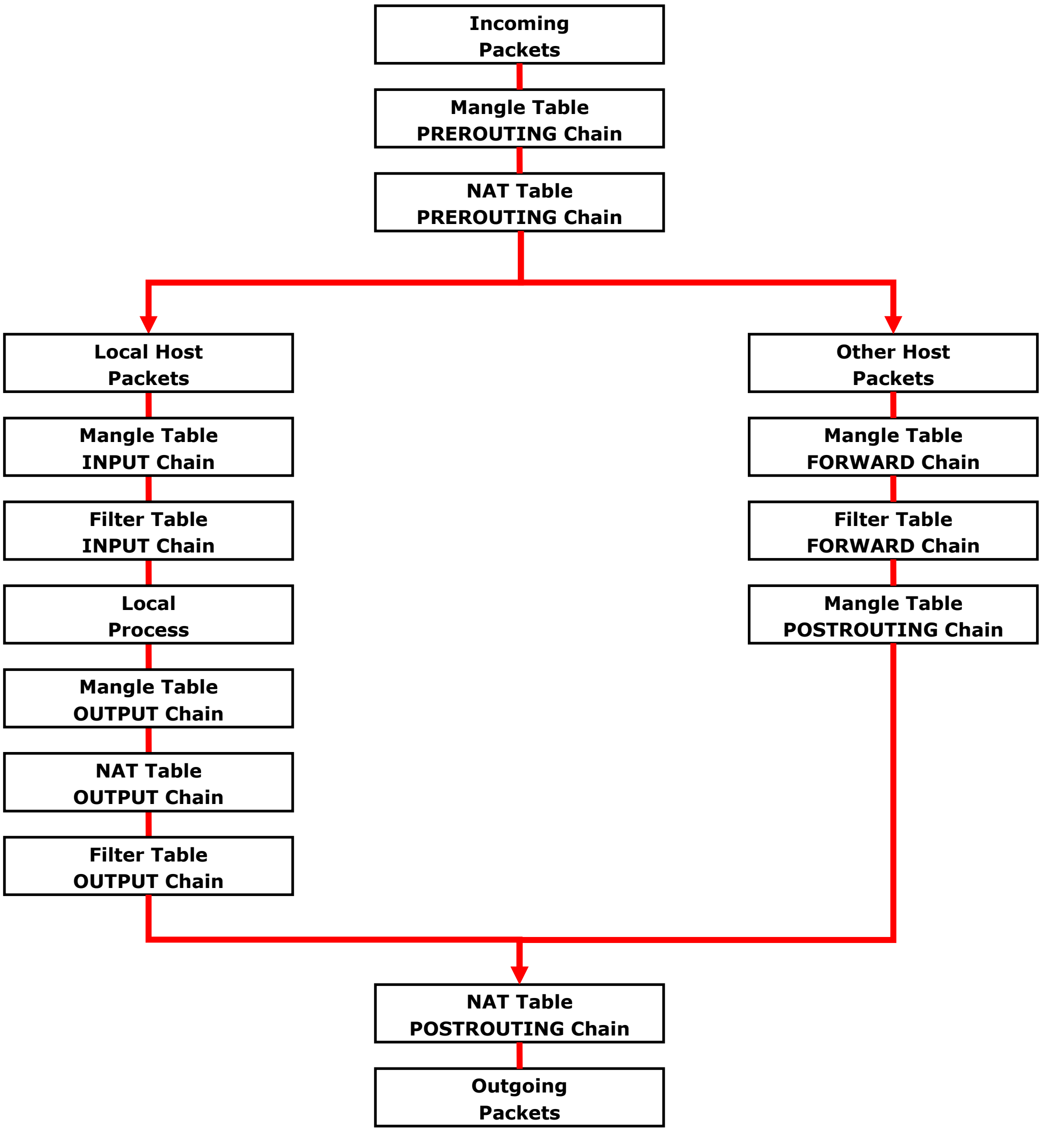
OUTPUT	➔	**OUTPUT**	➔	**POSTROUTING**
(in the NAT table)		(in the Mangle table)		(in the Filter table)

ATTENTION

Building complex firewalls using the Netfilter rules and interface can become overwhelming, even for experienced administrators. If you require advanced firewall capabilities, Moxa recommends using a Netfilter configuration interface. One of the easiest to learn and most powerful is the Shoreline Firewall, commonly known as Shorewall. Shorewall is available as a standard Debian package, and may be downloaded using apt-get. Shorewall documentation is available at the Shorewall website, found at **http://www.shorewall.net**.

Netfilter Hierarchy for Incoming Packets

This figure shows how packets traverse the table hierarchy. Outbound packets originating on the local network start at the box labeled **Local Process**. Inbound packets start at the top box labeled **Incoming Packets**.


Incoming Packets
Mangle Table PREROUTING Chain
NAT Table PREROUTING Chain
Local Host Packets
Mangle Table INPUT Chain
Filter Table INPUT Chain
Local Process
Mangle Table OUTPUT Chain
NAT Table OUTPUT Chain
Filter Table OUTPUT Chain
Other Host Packets
Mangle Table FORWARD Chain
Filter Table FORWARD Chain
Mangle Table POSTROUTING Chain
NAT Table POSTROUTING Chain
Outgoing Packets

ATTENTION
Be careful when setting up iptables rules. Incorrectly configured rules can very easily break connectivity with a remote host. For simple setups requiring minimal configuration (five rules or less), Moxa recommends directly configuring iptables using the console and a standard editor. For more complicated setups, users may use Arno's iptables firewall script, or for very large, extremely complicated setups Moxa recommends the Shoreline Firewall. The following links will take you to further information about iptables setups and the various software packages mentioned in this chapter:

- The netfilter/iptables Project Homepage: http://www.netfilter.org/index.html
- The Official netfilter/iptables packet-filtering HOWTO: Go to the homepage mentioned above and select **Documentation** > **HOWTOs** on the left panel of the page.
- Arno's iptables Firewall (click on IPtables firewall link on the left panel): http://rocky.eld.leidenuniv.nl/html/
- The Shoreline Firewall Homepage: http://www.shorewall.net/Documentation_Index.html
- Public iptables/netfilter Forum: http://www.linuxguruz.com/iptables/

Connection Tracking

A connection tracking system does not filter packets. The Netfilter connection tracking system monitors kernel memory structures to keep track of the state of each connection; this means that it logs the protocol types, port number pairs, and source and destination IP addresses, and associates that with various connection states and timeout values. By being able to track connection states, it is possible to build much more powerful and secure filtering rules.

There are four states that may be defined for a connection:

- NEW
  This is the state when a connection is just initiating: the firewall has only seen traffic in one direction (either inbound or outbound) and if the packet is a valid one for initiating a connection (i.e., a SYN packet for a TCP request).
- ESTABLISHED
  This is used to describe a connection that has been successfully negotiated, and packets are being exchanged in both directions.
- RELATED
  At the application layer there are some protocols—like FTP passive mode, for instance—which are difficult to track. FTP passive mode uses a wide range of ports, from 1024 to 65535, rather than just one; tracking in this connections is much more difficult than simply tracking a connection across a single port (typically port 20, in FTP). The connection tracking system defines an expectation, which is a connection that is expected to happen in a set period of time, but that has a limited lifetime. Using helpers and expectations, the Netfilter connection tracking system is able to track connections according to patterns by defining **master** connections, and **related** connections.
- INVALID
  This is used to identify packets that do not follow the expected behavior of a connection. Systems administrators can set filters to drop them.

Policies: Setting Default Firewall Behavior

Netfilter **policies** set the default behavior for its built-in tables, and policies may only be set for Netfilter's built-in tables. This means that policies set the default behavior for all packets handled by the firewall: if a packet arrives which no rule can process, Netfilter will default to the root policy set for that connection. Policies may be set for every table and chain, which means that default policies may be independently set for inbound, outbound, and forwarded packets.

The default policy for most firewalls should be an across-the-board **drop** all connections; after setting the policies to drop all connections, administrators may then add exceptions to allow connections through on a case-by-case basis. This section will only show you how to set the policies; to see how to write rules, look at the section, **Writing Rulechains**.

WARNING

Firewall rules are only valid for the time the computer is on. If the system is rebooted, the rules will be automatically flushed. To save a ruleset so that it loads on the next reboot, use the following command:

```
moxa@Moxa:~# /sbin/service iptables save
```

Setting Firewall Policies

```
moxa@Moxa:~# iptables [-t tables] [-P, --policy chain target] [Policy: ACCEPT, DROP,
ETC]
```

Command Arguments:

-P, --policy: This sets a default policy the firewall will enforce on a particular chain for a particular table. Only built-in chains (i.e.: not user-defined) can have policies. Possible targets for policy enforcement are INPUT, OUTPUT, FORWARD, PREROUTING, OUTPUT, and POSTROUTING. Possible policies that may be enforced on these chains are ACCEPT, DROP, QUEUE, and RETURN (see below for explanation).

INPUT: Targets packets coming into the DA-682A-DPP-LX over the **filter**, **mangle**, or **security** tables.

OUTPUT: Targets locally-generated packets leaving the DA-682A-DPP-LX. All tables have an output chain.

FORWARD: Targets packets routed through the machine, on the **filter**, **mangle**, or **security** tables.

PREROUTING: Targets packets for alteration before they have traversed the firewall; used on the **NAT**, **mangle**, and **raw** tables.

POSTROUTING: Targets packets as they are about to be sent out over the **NAT** and **mangle** tables.

Policy Arguments:

ACCEPT: By default, all packets are let through the chain.

DROP: Packets are dropped, with no notification or response sent back to the originating computer.

QUEUE: Passes the packet to userspace; see **NFQUEUE** in Netfilter/iptables documentation for more information about how these targets are used.

RETURN: Stop traversing this chain and resume at the next rule in the previous (calling) chain.

REJECT: Equivalent to DROP, but it returns a message to the packet's origin.

LOG: Turns on kernel logging for matching packets, printing information on all matching packets on the kernel log where it may be read using *dmesg* or *syslogd*.

Netfilter Policy Examples:

```
moxa@Moxa:~# iptables –P INPUT DROP
```

This changes the default policy so that ***all incoming packets*** on ***all chains*** are ***dropped***, with no notification. This is Moxa's recommended setting for the input interface.

```
moxa@Moxa:~# iptables –P OUTPUT ACCEPT
```

This rule accepts ***all outgoing packets*** that originate on the local network, and is acceptable for a strictly secure internal network. If you change this policy to DROP it will considerably increase the complexity of the firewall. However, you may wish to consider this for computers that will be serving as a firewall to untrusted customers. For instance, to guarantee security on a train computer that will be serving wireless connections from outside the train to local passengers, the default rule always is **DROP**, with only specific, secure protocols and services allowed through on a rule-by-rule basis.

To help with the construction of advanced firewalls, Moxa recommends use of the Shoreline Firewall; advanced firewalls are beyond the scope of this manual, but you can find a link **to the Shoreline site, linked to above**.

```
moxa@Moxa:~# iptables –P FORWARD DROP
```

This sets the FORWARD chain in the filter table to **DROP** all packets. ***This is the recommended policy for all firewalls***, and may be safely used on devices occupying a terminal segment in the network topology, this is the appropriate rule.

```
moxa@Moxa:~# iptables –t nat –P PREROUTING ACCEPT
```

The nat tables are for address translation, not for filtering. The **PREROUTING** chain for the **NAT** should be set to **ACCEPT**, otherwise connection initialization packets will not be able to get through the firewall.

```
moxa@Moxa:~# iptables –t nat –P OUTPUT ACCEPT
```

The nat tables are for address translation, not for filtering. The **OUTPUT** chain for the NAT should be set to **ACCEPT**, otherwise connection initialization packets will not be able to get through the firewall.

```
moxa@Moxa:~# iptables -t nat –P POSTROUTING ACCEPT
```

The nat tables are for address translation, not for filtering. The **POSTROUTING** chain for the NAT should be set to **ACCEPT**, otherwise connection initialization packets will not be able to get through the firewall.

Viewing and Manipulating Rulesets

Beginning with this section you will be provided some examples of rules commonly used to manipulate, view, and configure simple firewalls for industrial environments. For simple setups, typically only three or four rules are needed to give a device strong protection against unauthorized network intrusions.

List current rule chains for a target table, or for all tables

The full command for **listing** rule chains is as follows:

```
Moxa:~# iptables [-t table, or multiple, tables,…] [-L chain] [-n]
```

Command Arguments:

-t: Table to manipulate (default: 'filter'); available args are **filter**, **nat**, **mangle**, **raw**, and **security**

-L: Indicates a chain to be listed. If no chain is selected, all chains are listed.

-n: Returns the numeric output of addresses and ports: e.g. TCP and UDP ports are printed as numbers, rather than names. This also saves execution time by preventing iptables from looking up DNS requests.

WARNING

Simple commands listing iptable NAT or filter rules will autoload selected kernel modules, including the connection tracking (conntrack) and filter (iptable_filter) modules. On high-capacity production servers, these modules easily overload and bring the networking system down. Whenever a list command is issued, check the message buffer (**dmesg**) to see if drivers have been auto-loaded, and what they are. For more information, see http://backstage.soundcloud.com/2012/08/shoot-yourself-in-the-foot-with-iptables-and-kmod-auto-loading/.

Flush a current rule chain, or delete a user-specified chain

The full command to **flush** rule chains is as follows:

```
Moxa:~# iptables [-t table, or tables] [-FXZ]
```

Command Arguments:

-t: Table to manipulate; choices are **filter**, **nat**, **mangle**, **raw**, and **security**. Defaults to **filter**.

-F: Flush the selected chain (if no chains are specified, this flushes all the chains in the table)

-X: Delete the specified user-defined chain (chain must be empty and all references to the chain must be deleted first); if no argument is given, all non-built-in chains will be deleted

WARNING

The command `moxa@Moxa:~# iptables -F` will flush all iptables rulechains from the kernel, permanently deleting the firewall and fully exposing the computer to the open Internet.

You should save any firewall rules you configure in a file that you can use to convenient re-load them, in the event that they are flushed. Before flushing any rule chains, first make sure you have saved your configuration in an independent file that may be conveniently uploaded to Netfilter. The following command will save all of the current iptables rules to `/etc/sysconfig/iptables.save`:

```
root@Moxa:~# iptables-save > /etc/sysconfig/iptables.save
```

Zero-out the packet and byte counters for a rule chain

Zeroing the counters is sometimes useful when monitoring firewall activity for analysis. When used in combination with the list argument, the zero argument will give a precise measurement of the number of packets that have been processed since the last measurement, for all chains, a given chain, or even a given rule within a chain. The full command to **flush** rule chains is as follows:

```
Moxa:~# iptables -L -Z -n [chain [rulenum]]
```

Command Arguments:

-Z: Set the packet and byte counters to zero in all chains, for only a given chain, or only a rule in a chain

Delete a User-Generated Chain

This command deletes a specified user-defined chain.

```
Moxa:~# iptables -X [chain]
```

There must be no references to the chain in other chains or tables, and the chain must be empty, i.e. not contain any rules. You must delete or replace any remaining referring rules before the chain can be deleted. *If no argument is given, this will attempt to delete every user defined chain in the table.*

Writing Rulechains

In this section we show you how to write rules for a simple industrial network firewall. More complicated firewalls—such as those serving public networks, or untrusted customers—are beyond the scope of this manual. For advanced firewall needs, Moxa recommends the use of the Shoreline Firewall, **mentioned above**.

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

-A: Append one or more rules to the end of the selected chain
-I: Insert one or more rules in the selected chain as the given rule number
-i: Identifies an **interface** which will **received** a packet
-o: Identifies an **interface** over which a packet will be **sent**
-p: Identifies the **protocol** to be filtered
-s: Identifies a **source address** (network name, host name, network IP address, or plain IP address)
--sport: Identifies the **source port**, or the port where the packet originated
-d: Identifies the **destination address** (network name, host name, NAT or IP address)
--dport: Identifies the **destination port**, or the port where the packet will terminate
-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.

WARNING

For all firewalls using a strict DROP policy on incoming packets, be sure to include a rule that accepts packets on the loopback interface:

```
moxa@Moxa:~# iptables -A INPUT -i lo -j ACCEPT
```

Examples:

REQUIRED RULE for all firewalls:

Accept all packets from the loopback interface:

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

RECOMMENDED RULE from the **sample firewall** provided in **Appendix C: Sample Scripts**:

Allow all traffic from that belongs to established connections, or new, related traffic:

```
# iptables -A INPUT -m conntrack --ctstate RELATED,ESTABLISHED -j ACCEPT
```

RECOMMENDED RULE from the **sample firewall** provided in **Appendix C: Sample Scripts:**

Drops all traffic with an invalid state, e.g. "Port Unreachable" when nothing was sent to the host, invalid headers or checksums, and out-of-sequence packets:

```
# iptables -A INPUT -m conntrack --ctstate INVALID -j DROP
```

Basic Filter Rules show examples of how you can open commonly opened ports:

Web server / HTTP:

```
# iptables -A INPUT -p tcp --dport 80 -j ACCEPT
```

Secure-sockets web server / HTTPS:

```
# iptables -A INPUT -p tcp --dport 443 -j ACCEPT
```

Remote SSH Connections **(*REQUIRED RULE*):**

```
# iptables -A INPUT -p tcp --dport 22 -j ACCEPT
```

Incoming UDP Streams:

```
# iptables -A INPUT -p udp --dport 53 -j ACCEPT
```

ATTENTION

ICMPv6 Neighbor Discovery packets will always be classified INVALID (if you don't know what this means, you can probably ignore it). You may accept them with this rule:

```
# iptables -A INPUT -p 41 -j ACCEPT
```

Example 1: Accept TCP packets from 192.168.0.1.

```
# iptables -A INPUT -i eth0 -p tcp -s 192.168.0.1 -j ACCEPT
```

Example 2: 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 3: Drop TCP packets from 192.168.1.25 (this rule is only necessary on firewalls where you have set the INPUT policy to ACCEPT; ***this is not recommended***).

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

Example 4: ACCEPT all TCP packets addressed for port 21.

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

Example 5: Accept TCP packets from 192.168.0.24 to DA-682A-DPP-LX's port 137, 138, 139

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

Example 7: Log TCP packets that visit DA-682A-DPP-LX's port 25.

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

ATTENTION

To use the rule in Examples 8 and 9, below, remember to first, to load the module ipt_mac:

```
moxa@Moxa:~# modprobe ipt_mac.
```

To make a module load across reboots, you may add it to the /etc/modprobe.conf file using this command:

```
moxa@Moxa:~# echo "ipt_mac" >> /etc/modprobe.conf
```

Don't forget to backup your modprobe.conf file before altering it, and take care to use the double pointer (>>)—which is **append**—rather the single pointer (>) which is **overwrite**.

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
```

Example 9: Accept all packets from MAC address 02:03:04:05:06:07.

```
# iptables –A INPUT –i eth0 –p all –m mac --mac-source 02:03:04:05:06:07 –j ACCEPT
```

Rule Examples: Applying User-Defined Chains

Some network administrators may find it useful to define their own rule chains. Here, we show how to implement them in the INPUT chain, and use the chains defined above, in the section **User-Defined Chains**.

```
# iptables -A INPUT -p udp -m conntrack --ctstate NEW -j UDP
# iptables -A INPUT -p tcp --syn -m conntrack --ctstate NEW -j TCP
```

The TCP and UDP chains are now attached to the INPUT chain; by adding in the above connection rule, once a connection is accepted by either chain, it will be handled by the RELATED/ESTABLISHED rule. You may now add rules to these chains as if you were adding rules to the INPUT chain. Using some of the INPUT rules defined above as examples:

```
# iptables -A TCP -p tcp --dport 80 -j ACCEPT
# iptables -A TCP -p tcp --dport 443 -j ACCEPT
# iptables -A TCP -p tcp --dport 22 -j ACCEPT
# iptables -A UDP -p udp --dport 53 -j ACCEPT
```

ATTENTION

A sample firewall is provided in **Appendix C, Sample Scripts**. If you have further questions, please refer to those.

Saving the Firewall

You must save your firewall so that it will reload on the next reboot; otherwise, the firewall rules and settings will be permanently deleted. After configuring iptables, the following command will save the ruleset to /etc/sysconfig/iptables:

```
moxa@Moxa:~# /sbin/service iptables-save
```

NAT (Network Address Translation)

The NAT (Network Address Translation) protocol translates IP addresses used on a local network into IP addresses used on a connecting network. One network is designated the inside network and the other is the outside network. Typically, the DA-682A-DPP-LX connects several devices on a network and maps local inside network addresses to one or more global outside IP addresses, and translates the global IP address used on by packets coming in from the WAN back into local IP addresses.

IP Tables NAT Policies

IP tables policies for the NAT table should all be ACCEPT (see the section above, **Netfilter Policy Examples,** for more information):

```
# iptables -t nat -P PREROUTING ACCEPT
# iptables -t nat -P POSTROUTING ACCEPT
# iptables -t nat -P OUTPUT ACCEPT
```

Source NAT (SNAT) and Destination NAT (DNAT)

Source NAT (SNAT) is when the source address is altered on the first packet of an outbound connection. That is, it changes the originating address (which is usually a LAN address that looks like 192.168.xxx.xxx) for outbound packets so that they show the IP address with which the connection to the open internet is associated.

Destination NAT (DNAT) is when the destination address is altered on the first packet of an outbound connection. That is, it changes the originating address (which is usually a LAN address that looks like 192.168.xxx.xxx) for outbound packets so that they show the IP address with which the connection to the open internet is associated.

ATTENTION

Click on the following link for more information about NAT:

http://www.netfilter.org/documentation/HOWTO/NAT-HOWTO.html

Enabling NAT Masquerading

NAT masquerading allows you to create a subnet of devices mapped to a single IP address. When used with port forwarding and static IP addressing, it can allow you to expand a single public IP address to a very large LAN.

To enable NAT in your device, first load the NAT module:

```
moxa@Moxa:~# modprobe ipt_MASQUERADE
```

ATTENTION

To make a module load across reboots, you may add it to the /etc/modprobe.conf file using this command:

```
moxa@Moxa:~# echo "ipt_MASQUERADE" >> /etc/modprobe.conf
```

Don't forget to backup your modprobe.conf file before altering it, and take care to use the double pointer (>>)—which is **append**—rather the single pointer (>) which is **overwrite**.

In the NAT table (-t nat), Append a rule (-A) after routing (POSTROUTING) for all packets going out ppp0 (-o ppp0) which says to MASQUERADE the connection (-j MASQUERADE).

```
# iptables -t nat -A POSTROUTING -o eth0 -s 555.666.777.888/24 -j MASQUERADE
```

Then turn on IP forwarding:

```
# echo 1 > /proc/sys/net/ipv4/ip_forward
```

Using these rules and DHCP, it will now be possible to allow local devices to communicate with devices outside the subnet; however, communications will only be able to be initiated from the local network. To allow full address translation both ways, you will need to set up static IP addresses for your devices, and port forwarding rules.

Setting up a Networked File System: NFS

The Network File System (NFS) is used by client computers to mount a remote disk partition as if it were part of their local hardware. NFS is a distributed file system that allows fast, seamless sharing of files across a network. NFS allows users to develop applications for the DA-682A-DPP-LX without worrying about the amount of disk space that will be available. By default, the DA-682A-DPP-LX only natively supports the NFS client protocol. Mounting an NFS on a local machine is very simple.

The following procedures illustrate how to mount a remote NFS Server. In the example below, **192.168.3.5**—shown in step 3—is the IP address of the NFS server.

1. Scan the NFS Server's shared directory:

```
moxa@Moxa:~# showmount  -e  HOST
```

showmount:	Shows the mount information of an NFS Server
-e:	Shows the NFS Server's export list.
HOST:	IP address or DNS address

2. Create a mount point on the machine which will be an NFS client:

```
moxa@Moxa:~# mkdir -p /home/nfs/public
```

3. Mount the remote directory to a local directory:

```
moxa@Moxa:~# mount -t nfs -o nolock 192.168.3.5:/home/public /home/nfs/public
```

(192.168.3.5 is the example IP address of the NFS server.)

ATTENTION

To set up a mount process to mount at boot-time, copy the mount command into the `/etc/fstab` file. For more information on NFS and its configuration options, you may refer to the NFS homepage, at: **http://nfs.sourceforge.net/** (Dec. 2013).

Setting Up a VPN

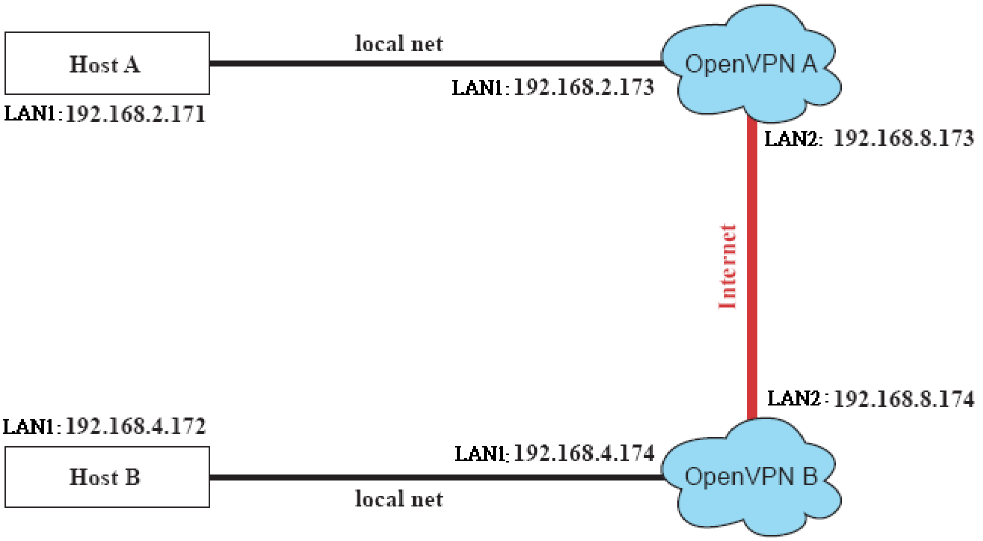
This platform uses the OpenVPN package to provide VPN capability. OpenVPN provides two basic types of tunnels for users to implement VPNS: **Routed IP Tunnels** and **Bridged Ethernet Tunnels**.

An Ethernet bridge is used to connect different Ethernet networks together. The Ethernets are bundled into one bigger, logical network that can communicate securely across the open Internet. 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 Bridges Linking Independent Subnets Over the Internet

This setup will link at two independent subnets over the Internet. It will use at least four machines, as shown in the following diagram. **OpenVPN** designates a dedicated VPN server (perhaps also a firewall), while **Host** designates a client computer located behind the VPN server.



Host A represents the machine that belongs to the subnet served by the VPN server, **OpenVPN A**, and **Host B** represents a machine that belongs to the subnet served by the VPN server, **OpenVPN B**. The two remote subnets are configured for **distinct ranges of IP addresses** on **separate subnets**. When this configuration is moved to a public network, the external interfaces of the OpenVPN machines must be configured for static IPs, or connected to another device (such as a firewall or DSL box) that uses a static address. To set up a bridged Ethernet tunnel following this basic architecture, follow the instructions below:

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

```
moxa@Moxa:~# openvpn --genkey --secret secrouter.key
```

2. Copy the keyfile that you have just generated to the OpenVPN machines:

```
moxa@Moxa:~# scp /etc/openvpn/secrouter.key XXX.XXX.X.XXX:/etc/openvpn
```

ATTENTION

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

```
moxa@Moxa:~# openvpn --show-ciphers
moxa@Moxa:~# openvpn --show-auths
```

For testing purposes, a pre-shared key is provided at **/etc/openvpn/secrouter.key**. This is adequate for testing, but users must create a new key when going live or their network will be insecure..

Configuring OpenVPN A

1. Modify the remote address in the configuration file `/etc/openvpn/tap0-br.conf` by adding the IP address for the remote server (in this case, OpenVPN B).

```
# 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
```

2. Next, modify the routing table in `/etc/openvpn/tap0-br.sh script`.so that it maps the internal subnet VPN server A will be serving.

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

3. 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”
...
```

4. Start the VPN link by calling the bridge script:

```
moxa@Moxa:~# /etc/openvpn/bridge restart
```

Configuring OpenVPN B,

5. Modify the **remote address** entry in the VPN 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 the `/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 -----------------------------
```

7. And then configure the bridge interface script in `/etc/openvpn/bridge`.

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

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

```
moxa@Moxa:~# /etc/openvpn/bridge restart
```

9. Start the OpenVPN peers that are on machine OpenVPN A and OpenVPN B with the following command:

```
moxa@Moxa:~# openvpn --config /etc/openvpn/tap0-br.conf&
```

If you see a line that looks like **Peer Connection Initiated with 192.168.8.173:5000**on each machine, then the connection the Ethernet bridge has been successfully established over UDP port 5000.

10. Check the routing table on each VPN server by typing the command below:

```
moxa@Moxa:~# route

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

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

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

```
moxa@Moxa:~# 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:

```
moxa@Moxa:~# route add -net 192.168.2.0 netmask 255.255.255.0 dev eth0
```

Now ping Host B from Host A by typing:

```
moxa@Moxa:~# ping 192.168.4.174
```

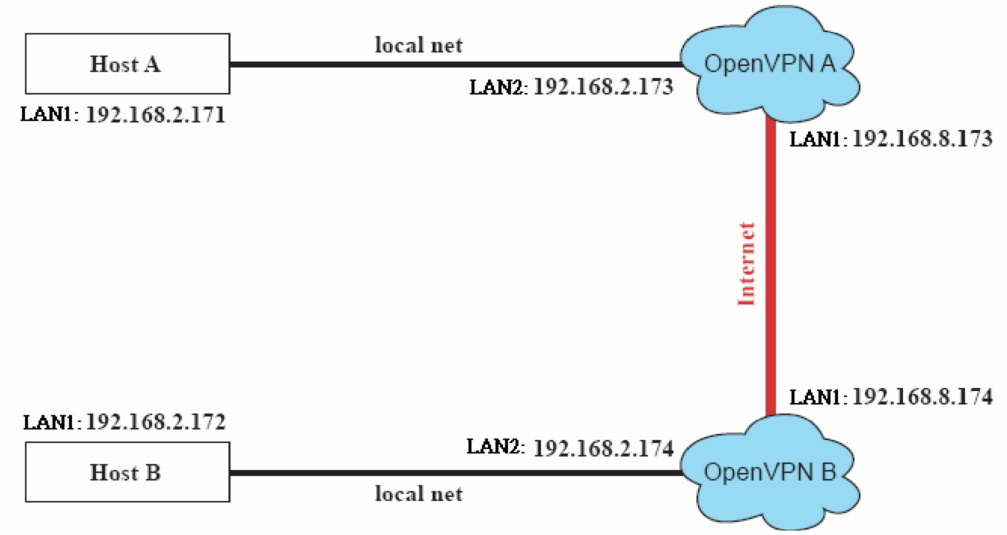
A successful ping indicates that you have created a VPN system that only allows authorized users from one internal network to access users at the remote site. For this system, all data is transmitted by UDP packets on port 5000 between OpenVPN peers.

12. To shut down the VPN servers, use the **killall** command:

```
moxa@Moxa:~# killall -TERM openvpn
```

Ethernet Bridging for Private Networks on the Same Subnet

Like the last example, this setup will link two subnets across the open Ethernet; however, these two subnets will share addressing as if they were located on the same local subnet.



All of the clients on the two remote subnets are configured for a range of IP addresses that spans **the same subnet**. When this configuration is moved to a public network, the external interfaces of the OpenVPN machines must be configured for static IPs or connected to another device (such as a firewall or DSL box) that uses a static address.

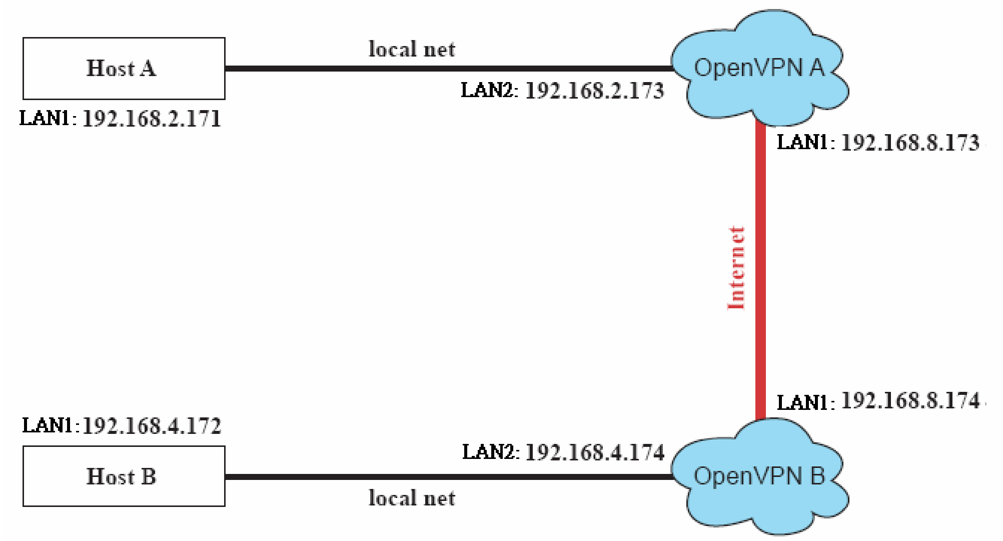
The configuration procedure for this setup is almost the same as for the previous example. The only difference is that you will need to comment out the parameter **up** in the `/etc/openvpn/tap0-br.conf` on each of the gateways, OpenVPN A and OpenVPN B.

```
# 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 Tunnels

Routed IP tunnels are used to route point-to-point IP traffic without broadcasts; the advantage of routed IP tunnels is that they are slightly more efficient than bridged ethernet tunnels and easier to configure.

1. **Host A** represents the machine that belongs to the subnet served by the VPN server, **OpenVPN A**, and **Host B** represents a machine that belongs to the subnet served by the VPN server, **OpenVPN B**. The two remote subnets are configured for **distinct ranges** of private IP addresses on **separate subnets**.



2. On VPN server A (**OpenVPN A**), modify the **remote address** entry in the configuration file `/etc/openvpn/tun.conf` by adding the address of OpenVPN B. Also, you must add an **ifconfig** entry which indicates the local (1st) and remote (2nd) VPN gateway addresses, separated by a space.

```
# 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, change OpenVPN A's `/etc/openvpn/tun.sh` so that the routing table matches the local subnet the VPN gateway is serving. Notice the **gw $5** appended to the end of this line: the **$5** is a variable argument that OpenVPN passes to the startup script. Its value is the second argument of **ifconfig** in the `/etc/openvpn/tun.conf` 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 gw $5
#----------------------------end-----------------------------
```

4. On VPN server B (**OpenVPN B**), change the **remote address** in configuration file `/etc/openvpn/tun.conf` by adding the address of OpenVPN A. Also, you must add an **ifconfig** entry which indicates the local (1st) and remote (2nd) VPN gateway addresses, each separated by a space.

```
# 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
```

5. Next, change OpenVPN B's routing table in the file `/etc/openvpn/tun.sh` so that it matches the local subnet the VPN gateway is serving. Notice the **gw $5** appended to the end of this line: the **$5** is a variable argument that OpenVPN passes to the script file. Its value is the second argument of **ifconfig** in the **/etc/openvpn/tun.conf** 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 gw $5
#---------------------------end----------------------------
```

6. Check the routing table after you run OpenVPN. You will see an established route running between your two VPN gateways. The command to view the routing table is:

```
          moxa@Moxa:~# route.
```

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

Setting Up Hot Swap for Block Storage

The DA-682A-DPP-LX computers come with two removable trays for additional block storage devices like hard disks or SSD drives. It also supports hot swapping capability along with user-defined programmable LEDs and a related API for convenient storage management.

File Overview

- **mxhtspd:** a daemon for monitoring hot-swap events
- **mxhtspd-setled:** a command to set up LED signals
- **/etc/mxhtspd/scripts:** scripts executed when an event occurs; the following files are included:
  - ➢ action-btn -pressed
  - ➢ action-disk-plugged
  - ➢ action-disk-unplugged
  - ➢ action-part-over-usage
- **/etc/mxhtspd/mxhtspd.conf:** configuration file for the mxhtspd daemon
- **libmxhtsp.so:** library

4

Programming Guide

The following topics are covered in this chapter:

Desktop Management Interface (DMI)

Product information may be read using Debian Linux's Desktop Management Interface (DMI), **dmidecode**, as with the following commands:

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

Other keywords to retrieve DMI information are listed below:

```
 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-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 for the RTC is located at **/dev/rtc**. The DA-682A-DPP-LX supports standard Linux simple RTC control. You must include **<linux/rtc.h>**.

1. The line below may be named Function: RTC_RD_TIME; it will read time information from the RTC. It will return the value on argument 3.

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

2. Function: RTC_SET_TIME will set the RTC time. Argument 3 will be passed to RTC.

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

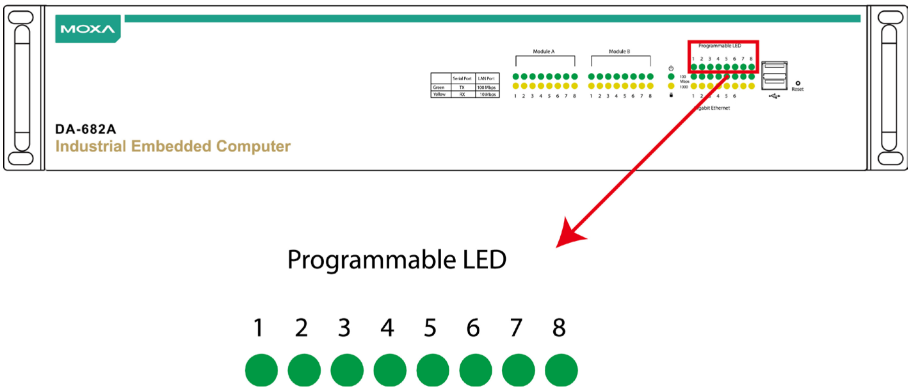
UART

The normal tty device nodes are **/dev/ttyS0**. The DA-682A-DPP-LX supports standard Linux **termios** control with RS-232 **serial** ports.

Programmable LEDs

There are four programmable LEDs in the front of DA-682A-DPP. The LED device node is located at **/dev/pled**, and may be manipulated directly. Each LED can be accessed using the **/dev/pled** device node, and similarly the SATA LEDs may be accessed directly using the **/dev/sata_pledX** device node. The examples below show you how.

There are eight programmable LED indicators on the front panel of the DA-682A-DPP. Refer to the following figure for the specific location of these LED indicators.



Turning On or Off the LEDs

To turn on the first LED and turn off the second, third and fourth LED. You should.

```
moxa@Moxa:~# echo 10000000 > /dev/pled
```

To turn off all the LED you should.

```
moxa@Moxa:~# echo 00000000 > /dev/pled
```

To turn on the second LED and turn off the others. You should

```
moxa@Moxa:~# echo 01000000 > /dev/pled
```

Relay Output

You can enable or disable the relay output after you have installed Proactive Monitoring using the following commands:

Syntax::

To enable the relay output

```
# /sbin/mx_perform_alarm
```

To disable the relay output

```
# /sbin/mx_stop_alarm
```

Watch Dog Timer (WDT)

Introduction

The WDT can be enabled or disabled directly, using a shell script (if you wish to use the Synmap software package for this control, see the Synmap section above, **Enabling the Watchdog**). When the WDT is enabled and fails to receive a reset signal in the configured amount of time (1 to 255 seconds), the system will automatically reboot.

How the WDT Works

If you need the watchdog to run at boot time, use **`moxa@MoxaL~# update-rc.d`** to add it.

```
root@moxa@Moxa:~# update-rc.d watchdog defaults
update-rc.d: using dependency based boot sequencing
root@moxa@Moxa:~# ls -al /etc/rc?.d/*watchdog*
lrwxrwxrwx 1 root root 18 Jul 16 11:23 /etc/rc0.d/K01watchdog -> ../init.d/watchdog
lrwxrwxrwx 1 root root 18 Jul 16 11:23 /etc/rc1.d/K01watchdog -> ../init.d/watchdog
lrwxrwxrwx 1 root root 18 Jul 16 11:23 /etc/rc2.d/S21watchdog -> ../init.d/watchdog
lrwxrwxrwx 1 root root 18 Jul 16 11:23 /etc/rc3.d/S21watchdog -> ../init.d/watchdog
lrwxrwxrwx 1 root root 18 Jul 16 11:23 /etc/rc4.d/S21watchdog -> ../init.d/watchdog
lrwxrwxrwx 1 root root 18 Jul 16 11:23 /etc/rc5.d/S21watchdog -> ../init.d/watchdog
lrwxrwxrwx 1 root root 18 Jul 16 11:23 /etc/rc6.d/K01watchdog -> ../init.d/watchdog
```

The watchdog configuration file is **`/etc/watchdog.conf`**. By default, the watchdog daemon is configured to signal the watchdog every 60 seconds.

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

The watchdog device IOCTL commands

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

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

IOCTL	**WDIOC_GETBOOTSTATUS**
Description	This returns the status of the card that was reported at bootup.
Input	None
Output	(int *)arg)
Return	On success, return 0. Otherwise, return < 0 value.

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

IOCTL	WDIOC_KEEPALIVE
Description	This pings the card to tell it not to reset your computer.
Input	None
Output	None
Return	On success, return 0. Otherwise, return < 0 value.

IOCTL	WDIOC_SETTIMEOUT
Description	Sets the watchdog timeout
Input	arg: 1 ~ 255 seconds
Output	None
Return	On success, return 0. Otherwise, return < 0 value.

IOCTL	WDIOC_GETTIMEOUT
Description	Gets the current watchdog timeout.
Input	None
Output	arg: 1 ~ 255 seconds
Return	On success, return 0. Otherwise, return < 0 value.

Examples

This sample watchdog script, **watchdog-simple.c**, checks the watchdog every in 10 seconds.

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

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

Hot-Swapping Block Drives

A development library is provided to help you develop your applications. All of the code can be found at **`/example/hotswap`** on the software CD

Documentation Format

#define mxhtsp_close(fd) close(fd)	
Description	Closes the hotswap devices.
Parameters	*fd*: the open port
Returns	None

Function Documentation

int mxhtsp_check_partition_usage (const char * partition_name)	
Description	Gets what percentage of a partition is in use.
Parameters	*partition_name*: the name of the partition being checked. In linux, it should be /media/diskxpx
Returns	None

int mxhtsp_is_button_pressed (int fd, int btn_num)	
Description	Checks if a button is pressed.
Parameters	*fd*: the open port *btn_num*: the button number
Returns	1: pressed 0: not pressed -1: fail

int mxhtsp_is_disk_busy (int fd, int disk_num)	
Description	Checks if a disk is busy.
Parameters	*fd*: the open port *disk_num*: the disk number
Returns	1: busy 0: idle -1: fail

int mxhtsp_is_disk_plugged (int fd, int disk_num)	
Description	Checks if a disk is plugged in.
Parameters	*fd*: the open port *disk_num*: the disk number
Returns	1: plugged 0: unplugged -1: fail

Open the hotswap devices.	
Description	Checks if a disk is plugged in.
Returns	*fd* if successful -1: fail

int mxhtsp_set_led (int fd, int led_num, int on)	
Description	Sets the led to on/off.
Parameters	*fd*: the open port *led_num*: the led number 1 on 0 off
Returns	0: success -1: fail

Moxa SafeGuard

A development library is provided to help you develop your applications.

ATTENTION

There are two accelerometers in DA-682A-DPP-LX. The i2c address for accelerometer #1 is 0x1D, and 0x53 for accelerometer #2.

Function Documentation

int mx_accelerometer_read (GSENSOR_DATA *axis, unsigned char sensor_address)	
Description	Reads G sensor data from accelerometer
Parameters	axis: the 3-axis data structure sensor_address: the accelerometer i2c address
Returns	0: success -1: fail

int mx_accelerometer_get_state(unsigned char sensor_addr, unsigned char reg_addr)	
Description	Gets register value from specific accelerometer
Parameters	sensor_address: the i2c address of accelerometer reg_addr: the register in accelerometer
Returns	0: success -1: fail

int mx_accelerometer_set_state(unsigned char sensor_addr, unsigned char reg_addr, unsigned char value)	
Description	Sets register value to specific accelerometer
Parameters	sensor_address: the i2c address of accelerometer reg_addr: the register in accelerometer value: assigned value
Returns	0: success -1: fail

int mx_accelerometer_calibrate(unsigned char sensor_addr)	
Description	Sets calibration in specific accelerometer
Parameters	sensor_address: the i2c address of accelerometer
Returns	0: success -1: fail

int mx_accelerometer_clear_offset (unsigned char sensor_addr)	
Description	Clears calibration offset
Parameters	sensor_address: the i2c address of accelerometer
Returns	0: success -1: fail

Examples

The example file can power on accelerometer and calibrate it before reading data.

Library path: /lib/libmxdev.so

Header file path: /usr/include/mxdev.h

```
#include <stdio.h>
#include <stdlib.h>
#include <mxdev.h>

#define I2C_GSENSOR1_ADDR   0x1D
#define I2C_GSENSOR2_ADDR   0x53
#define DATA_RATE_REG      0x2C
#define POWER_CTL         0x2D
#define DATA_FORMAT_REG    0x31
#define MEASURE_BIT        0x08
#define DATA_RATE         0x0a
#define DATA_FORMAT        0x0b

int main(void)
{
   GSENSOR_DATA axis;
   int ret;
   mx_accelerometer_set_state(I2C_GSENSOR1_ADDR, POWER_CTL, MEASURE_BIT);
   mx_accelerometer_set_state(I2C_GSENSOR2_ADDR, POWER_CTL, MEASURE_BIT);

   mx_accelerometer_set_state(I2C_GSENSOR1_ADDR, DATA_RATE_REG, DATA_RATE);
   mx_accelerometer_set_state(I2C_GSENSOR2_ADDR, DATA_RATE_REG, DATA_RATE);

   //full resolution
   mx_accelerometer_set_state(I2C_GSENSOR1_ADDR, DATA_FORMAT_REG, DATA_FORMAT);
   mx_accelerometer_set_state(I2C_GSENSOR2_ADDR, DATA_FORMAT_REG, DATA_FORMAT);

   mx_accelerometer_calibrate(I2C_GSENSOR1_ADDR);
   sleep (1);
   mx_accelerometer_calibrate(I2C_GSENSOR2_ADDR);

   if (mx_accelerometer_read(&axis, I2C_GSENSOR1_ADDR) == 0) {
      printf("Disk1: x %f y %f z %f\n", axis.x_axis, axis.y_axis, axis.z_axis);
   }

   if (mx_accelerometer_read(&axis, I2C_GSENSOR2_ADDR) == 0) {
         printf("Disk2: x %f y %f z %f\n", axis.x_axis, axis.y_axis, axis.z_axis);
   }
   return 0;
}
```

5

Programming Optional Modules

The DA-682A-DPP comes with 2 slots that allow users to install various expansion modules. This chapter describes how to program these modules with different communication interfaces.

The following topics are covered in this chapter:

- **Programming Serial Modules**
  - Configuring Serial Port Mode
  - Loading the Defaults
- **Programming the LAN Module**
- **Programming the Switch Module**
- **Programming the Fiber Module**
- **Programming the PCI Module**

Loading the Defaults

To reset the ports to their defaults:

Edit **/etc/udev/rules.d/96-moxa.rules.**

```
moxa@Moxa:~# vi /etc/udev/rules.d/96-moxa.rules
…
# Example to set the device, DA-SP08-I-DB, 0x1393:0x1180 default as 485-2W mode
interface
KERNEL=="ttyM0", RUN+="/bin/setinterface /dev/ttyM%n 1"
```

Edit the command line **RUN+="/bin/setinterface /dev/ttyM%n 0**″.

If you want to change the serial mode as RS-232, use the following parameter.
RUN+="/bin/setinterface /dev/ttyM%n 0"

If you want to change the serial mode as RS-485 2-wire, use the following parameter.
RUN+="/bin/setinterface /dev/ttyM%n 1"

If you want to change the serial mode as RS-422, use the following parameter.
RUN+="/bin/setinterface /dev/ttyM%n 2"

If you want to change the serial mode as RS-485 4-wire, use the following parameter.
RUN+="/bin/setinterface /dev/ttyM%n 3"

Reboot your computer.

```
moxa@Moxa:~# reboot
```

When the computer has been restarted, check if the setting has been loaded as the default value.

```
moxa@Moxa:~# setinterface /dev/ttyM0
Now setting is RS485-2WIRES interface.
moxa@Moxa:~#
```

ATTENTION

As the DA-SP38 and DA-SP08 use the same driver, mxser.ko, the /dev/ttyM* probing order is hard coded in the driver. This means the card probing order is fixed. You have to install them in this order and the /dev/ttyM* order will not be reverse.
1) Insert module DA-SP08 into "Module A" of DA-682A-DPP.
2) Insert module DA-SP38 into "Module B" of DA-682A-DPP.

Programming the LAN Module

The DA-682A-DPP can be inserted with the DA-LAN04-RJ LAN module, which uses the r8169 Ethernet driver. When the system boots up, you can see the Ethernet interface in the ifconfig command.

```
moxa@Moxa:~# ifconfig
…
eth6      Link encap:Ethernet  HWaddr 00:90:e8:00:e0:02
         inet addr:192.168.9.127  Bcast:192.168.9.255  Mask:255.255.255.0
         UP BROADCAST MULTICAST  MTU:1500  Metric:1
         RX packets:0 errors:0 dropped:0 overruns:0 frame:0
         TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:0  (0.0 B)  TX bytes:0  (0.0 B)
         Interrupt:45 Base address:0x8000
```

```
eth7      Link encap:Ethernet  HWaddr 00:90:e8:00:e0:03
         inet addr:192.168.10.127  Bcast:192.168.10.255  Mask:255.255.255.0
         UP BROADCAST MULTICAST  MTU:1500  Metric:1
         RX packets:0 errors:0 dropped:0 overruns:0 frame:0
         TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
         Interrupt:45 Base address:0x8000

eth9      Link encap:Ethernet  HWaddr 00:90:e8:00:e0:04
         inet addr:192.168.11.127  Bcast:192.168.11.255  Mask:255.255.255.0
         UP BROADCAST MULTICAST  MTU:1500  Metric:1
         RX packets:0 errors:0 dropped:0 overruns:0 frame:0
         TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
         Interrupt:45 Base address:0x8000

eth10      Link encap:Ethernet  HWaddr 00:90:e8:00:e0:05
         inet addr:192.168.11.127  Bcast:192.168.11.255  Mask:255.255.255.0
         UP BROADCAST MULTICAST  MTU:1500  Metric:1
         RX packets:0 errors:0 dropped:0 overruns:0 frame:0
         TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
         Interrupt:45 Base address:0x8000
```

Programming the Switch Module

The DA-682A-DPP can be inserted with DA-SW08-RJ switch module. When the module has been installed, you can use the switch without any driver installed for this module. There is an Ethernet MAC connect to DA-SW08-RJ internally. You can use ifconfig to configure this Ethernet interface

```
moxa@Moxa:~# ifconfig
…
eth6      Link encap:Ethernet  HWaddr 00:90:e8:00:e0:06
         inet addr:192.168.9.127  Bcast:192.168.9.255  Mask:255.255.255.0
         UP BROADCAST MULTICAST  MTU:1500  Metric:1
         RX packets:0 errors:0 dropped:0 overruns:0 frame:0
         TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
         Interrupt:45 Base address:0x8000
```

Programming the Fiber Module

The DA-682A-DPP can be inserted with the DA-FX04-MM-ST-T fiber module. The driver is supported on the official DA-682A-DPP-LX firmware. You can use ifconfig to configure this Ethernet interface

```
moxa@Moxa:~# ifconfig
…
eth6      Link encap:Ethernet  HWaddr 00:90:e8:00:e0:07
```

```
        inet addr:192.168.9.127  Bcast:192.168.9.255  Mask:255.255.255.0
        UP BROADCAST MULTICAST  MTU:1500  Metric:1
        RX packets:0 errors:0 dropped:0 overruns:0 frame:0
        TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
        Interrupt:45 Base address:0x8000

eth7     Link encap:Ethernet  HWaddr 00:90:e8:00:e0:08
        inet addr:192.168.10.127  Bcast:192.168.10.255  Mask:255.255.255.0
        UP BROADCAST MULTICAST  MTU:1500  Metric:1
        RX packets:0 errors:0 dropped:0 overruns:0 frame:0
        TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
        Interrupt:45 Base address:0x8000

eth8     Link encap:Ethernet  HWaddr 00:90:e8:00:e0:09
        inet addr:192.168.11.127  Bcast:192.168.11.255  Mask:255.255.255.0
        UP BROADCAST MULTICAST  MTU:1500  Metric:1
        RX packets:0 errors:0 dropped:0 overruns:0 frame:0
        TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
        Interrupt:45 Base address:0x8000

eth9     Link encap:Ethernet  HWaddr 00:90:e8:00:e0:0a
        inet addr:192.168.12.127  Bcast:192.168.12.255  Mask:255.255.255.0
        UP BROADCAST MULTICAST  MTU:1500  Metric:1
        RX packets:0 errors:0 dropped:0 overruns:0 frame:0
        TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
        Interrupt:45 Base address:0x8000
```

Programming the PCI Module

The DA-682A-DPP can be inserted with the DA-UPCI-DK PCI development module. If the default root file system doesn’t have the driver, you have to compile the driver for the extension card.

6

System Recovery

The DA-682A-DPP-LX ready-to-run embedded computers are an embedded Linux platform. This chapter describes the recovery process in the event of system instability.

The following topics are covered in this chapter:

- ❒ **Overview: Setting Up the Recovery Environment**
- ❒ **Step 1: Preparing the USB Drive**
  - ➢ Two Types of Recovery: Base Install and Fully Configured
- ❒ **Step 2 (optional): Recovering to a Stock OS**
- ❒ **Step 3: Setting the BIOS to Boot via USB**
- ❒ **Step 4 (optional): Create a Custom System Image**
- ❒ **Step 5: Performing a System Recovery**
- ❒ **Step 6: Resetting the BIOS to its Original State**

Overview: Setting Up the Recovery Environment

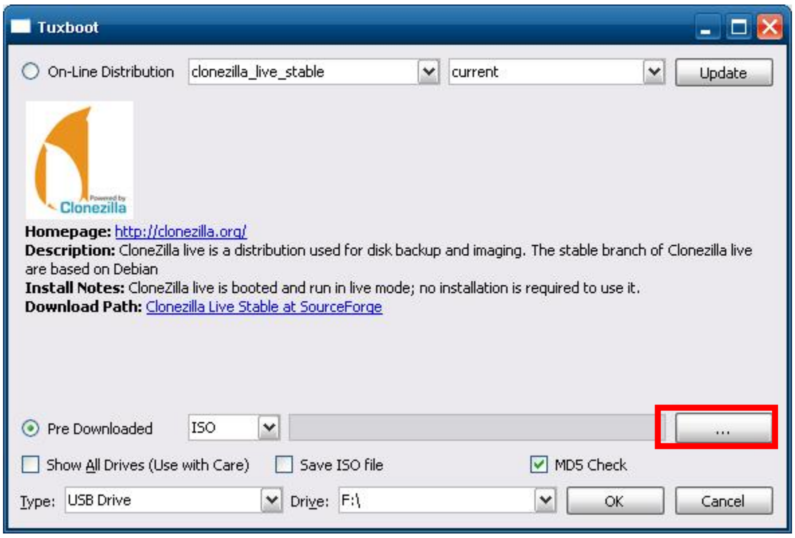
A DA-682A-DPP computer, a 4 GB (min.) USB drive, and a copy of the recovery suite are all required to set up the DA-682A-DPP's system recovery environment.
The recovery procedure itself requires only a DA-682A-DPP computer and a bootable USB drive.

The following steps describe the basic process of setting up the system recovery environment:

1. First, prepare the USB drive by copying over to it a bootable recovery environment; this comes in the form of an ISO image, and can be found on your software CD.
2. Here, you may choose to create a bare-bones stock OS recovery image; if you choose this option as your recovery method, keep in mind that any applications or scripts you install later will be lost if a recovery is required.
3. Here, you will reset the BIOS so the USB port is the first boot priority. **If you are initiating a recovery from a key you have already configured, this will be your starting point.** The system will re-booted into the CloneZilla recovery environment found on the USB
4. This step describes how to create an exact copy of a fully configured system on the USB drive. This is the alternative to the stock OS recovery offered in Step 2.
5. This step describes how to perform a recovery; you may use it to run a trial recovery and test your setup.
6. This step explains how and why to return the BIOS to its original state.

Step 1: Preparing the USB Drive

1. From the software DVD that came with your computer **start the Clonezilla imaging program** (within the current OS) by starting `tuxboot-windows-23.exe`, which is found in the `\recovery\DA-682A-DPP-LX_Recovery\clonezilla` directory.
2. At the right, select **Pre-Downloaded** and set the dropdown to **ISO**.
3. **Browse the CD to locate the Clonezilla ISO image** by clicking the button with an ellipsis (**...**).



○ On-Line Distribution: clonezilla_live_stable, current

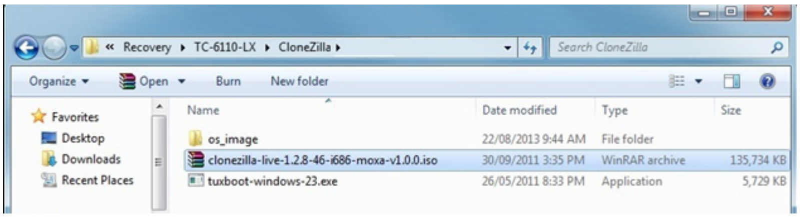
Homepage: http://clonezilla.org/
Description: CloneZilla live is a distribution used for disk backup and imaging. The stable branch of Clonezilla live are based on Debian
Install Notes: CloneZilla live is booted and run in live mode; no installation is required to use it.
Download Path: Clonezilla Live Stable at SourceForge

● Pre Downloaded: ISO

□ Show All Drives (Use with Care) □ Save ISO file ☑ MD5 Check

Type: USB Drive Drive: F:\

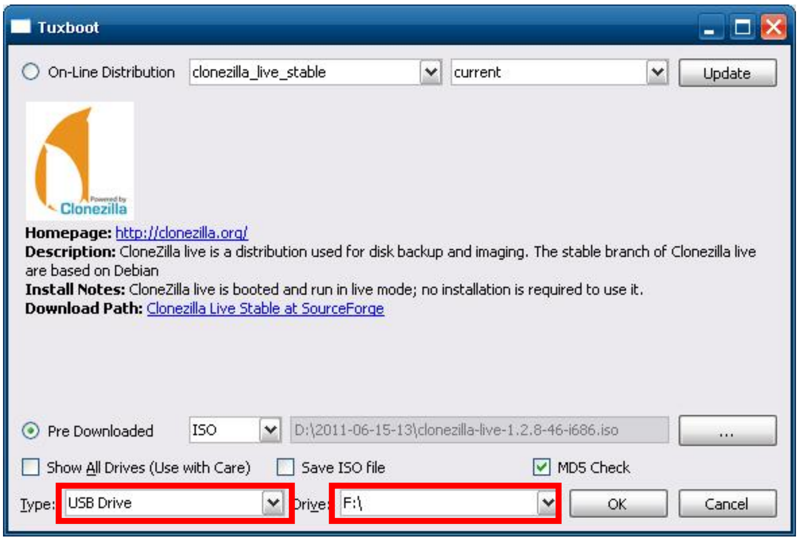
4. Navigate the file manager to `\Recovery\DA-682A-DPP-LX_Recovery\clonezilla` directory on the software DVD and select the CloneZilla recovery environment's ISO image.



« Recovery › TC-6110-LX › CloneZilla ›

Name	Date modified	Type	Size
os_image	22/08/2013 9:44 AM	File folder	
clonezilla-live-1.2.8-46-i686-moxa-v1.0.0.iso	30/09/2011 3:35 PM	WinRAR archive	135,734 KB
tuxboot-windows-23.exe	26/05/2011 8:33 PM	Application	5,729 KB

5. Set the **Device Type** (lower left-hand corner) as **USB Drive**, then set the **Drive** dialog to the letter under which the USB is currently mounted.



Tuxboot

○ On-Line Distribution clonezilla_live_stable current Update

Homepage: http://clonezilla.org/
Description: CloneZilla live is a distribution used for disk backup and imaging. The stable branch of Clonezilla live are based on Debian
Install Notes: CloneZilla live is booted and run in live mode; no installation is required to use it.
Download Path: Clonezilla Live Stable at SourceForge

● Pre Downloaded ISO D:\2011-06-15-13\clonezilla-live-1.2.8-46-i686.iso ...

□ Show All Drives (Use with Care) □ Save ISO file ☑ MD5 Check

Type: USB Drive Drive: F:\ OK Cancel

6. Click **OK**, and the CloneZilla recovery environment (plus bootloader) will be copied to your USB drive.

Two Types of Recovery: Base Install and Fully Configured

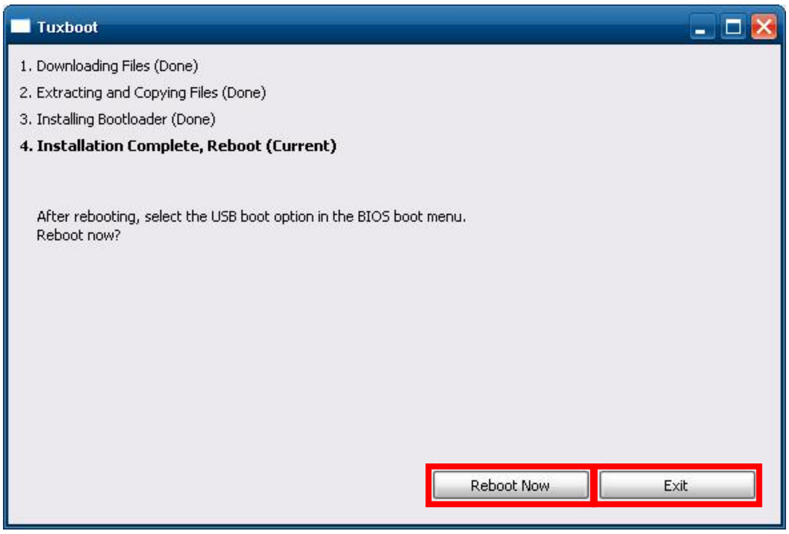
Because of the naming conventions used, for any given computer only a single system image may be stored on any given USB drive. Consequently, at this point, users need to make a decision about which sort of system recovery is preferred:

A. A recovery image of **a fully configured OS**, with user-installed software applications and scripts, or

B. A recovery image of only the **basic, newly-installed root OS.**

A: To configure the recovery environment to copy over a fully configured system, users should click **Reboot Now** to close the installation environment and restart the computer. They should then proceed to the next section, **Step 3: Setting the BIOS to Boot via USB** and continue the installation of the recovery environment by continuing to **Step 4 (optional): Create a Custom System Image**.

B: Users who want to restore the system to a clean OS image with no installed applications, scripting, or alterations of any kind, should complete this portion of the process by clicking **Exit** here and returning to the original OS. At this point, **Step 1** has been completed, and you should proceed to **Step 3: Setting the BIOS to Boot via USB**, and then go directly to **Step 4: Restoring to a Stock OS**.



Tuxboot

1. Downloading Files (Done)
2. Extracting and Copying Files (Done)
3. Installing Bootloader (Done)
4. **Installation Complete, Reboot (Current)**

After rebooting, select the USB boot option in the BIOS boot menu.
Reboot now?

Reboot Now Exit

ATTENTION

You must manually delete the **EFI** directory on the USB.

Step 2 (optional): Recovering to a Stock OS

The instructions which follow describe how to set up the recovery environment that will ***restore the operating system to a pristine post-install state***. If you have installed any software on your system, then following these directions will result in ***all custom applications and code being wiped from the operating system***. If the computer has already been heavily customized with user applications and local scripts, then skip this section and instead go to the next section, **Step 3: Setting the BIOS to Boot via USB**. There, you will begin the process of copying over a full system image.

Creating a post-install rescue drive involves just two steps: preparing the USB drive, and then copying the rescue image (found on your Moxa software CD) to it.

1. First, if you haven't already, complete step 1 **by preparing the USB drive.**
2. Next, copy the stock OS image (found on the software CD that shipped with your computer) over to the USB drive; the image will be found in the **recovery** directory, /media/cd0/recovery/**os_image**, and will be copied to the USB file tree at /media/usb0/home/partimag. Depending on how the USB and CD have been mounted on the computer, you can use a command similar to the one below to copy the image file:

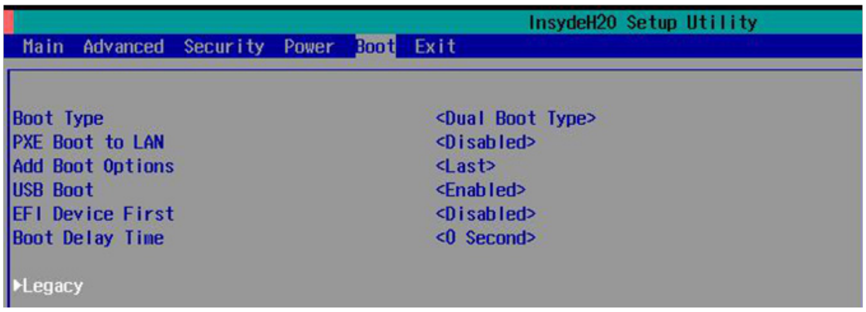
```
moxa@Moxa:~# cp /media/cd0/recovery/os_image  /media/usb0/home/partimag/
```

That's it. You have now configured a USB recovery key that will recover your computer to the stock operating system it shipped with. If you wish, you may now undertake a trial recovery To do this, continue on to **step 3, setting the BIOS to boot over USB**, skip step 4, and then go on to **step 5, performing a system recovery**.

Step 3: Setting the BIOS to Boot via USB

At this stage, users will reset the BIOS so that the system boots directly from the USB. This must be done before the rest of the system recovery environment may be configured.

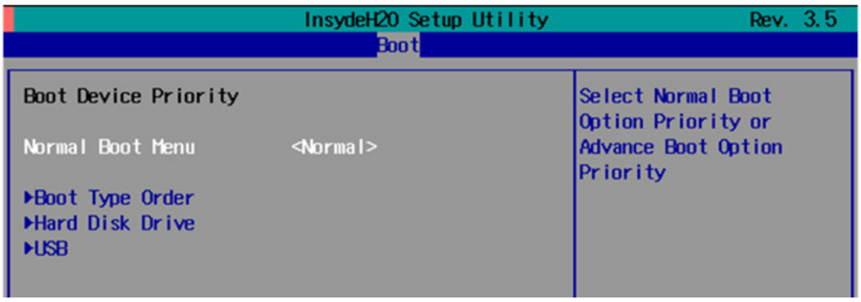
1. Turn on the computer and, during the POST process, press F2 until you hear a long beep. You should then enter the BIOS setup menu.
2. Use the arrow keys to navigate to the **Boot** tab, and then press **Enter**.
3. Use the up/down arrows to highlight **Legacy** in the boot tab's menu, and press **Enter**.



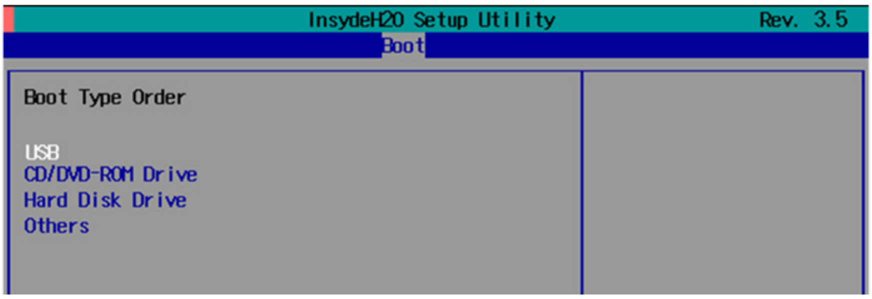
Boot Type <Dual Boot Type>
PXE Boot to LAN <Disabled>
Add Boot Options <Last>
USB Boot <Enabled>
EFI Device First <Disabled>
Boot Delay Time <0 Second>

▸Legacy

4. Use the up/down arrow keys to navigate to the **Boot Type Order** link, and then press **Enter**.



5. Use the arrows to highlight USB and then use the plus/minus signs (**+ -**) to move it to the first boot priority position. **Warning: Incorrectly configuring the boot priority will lead to recovery failure.**



6. Press F10 and then press **Enter** to save and exit the BIOS configuration interface. This should initiate the next reboot, and your system should now boot from the USB drive.

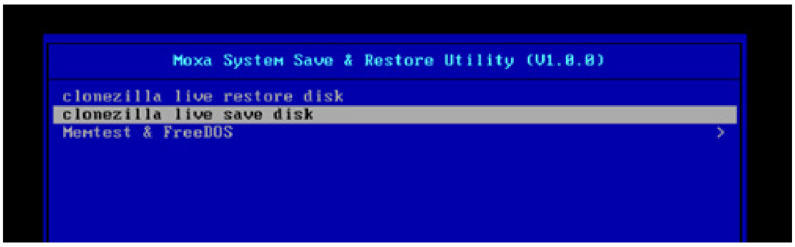
Step 4 (optional): Create a Custom System Image

The instructions which follow are only to be used if you decided in **Step 1** of this process ***to create a full copy of an already-configured system***. If you have not yet installed any software on your system and are configuring this recovery utility to restore a bare-bones stock OS, then skip this section and instead go to **Step 4: Recovering to a Stock OS** to see how to prepare your USB with a clean OS image.

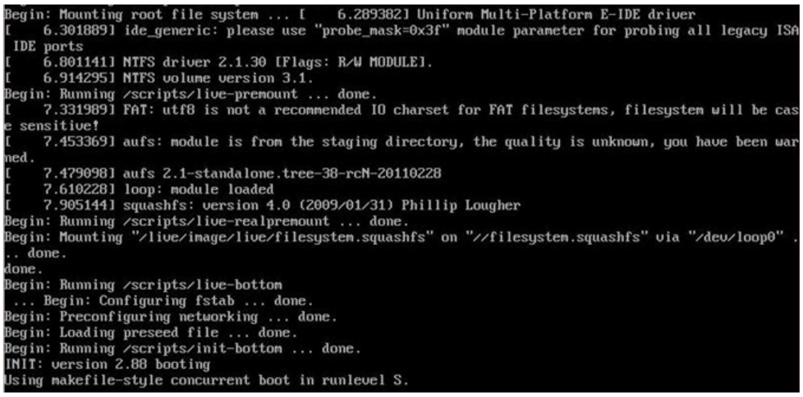
The procedure below describes a configuration for restoring a complete system that has been customized with user applications and scripts. Here, you will save to the USB drive a copy of the entire system as it is currently configured to be used as a full system recovery image should the system crash. During this process, ***all files on your USB that are mounted under*** *F:\home\partimag\* ***will be overwritten***.

You should have already changed the BIOS settings to set the USB drive as the first boot priority. If you have not yet reset the boot priority, first return to **Step 3: Setting the BIOS to Boot via USB** and follow the directions there.

1. Once the system has launched and the DA-682A-DPP has booted the recovery environment from the USB drive, navigate to the entry **Clonezilla Live Save Disk**, and select it by pressing **Enter**. This will take you into the **recovery image creation environment**, allowing you to copy your full system setup to the USB drive.

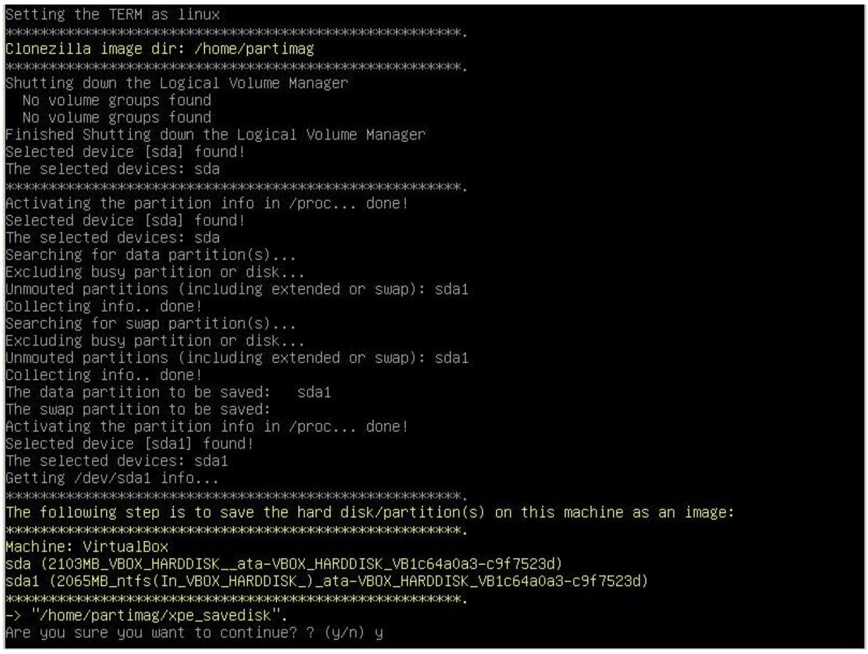

Moxa System Save & Restore Utility (V1.0.0)
clonezilla live restore disk
clonezilla live save disk
Memtest & FreeDOS
>

2. The DA-682A-DPP will now boot into the image creation environment. Wait for the boot process to finish.



```
Begin: Mounting root file system ... [    6.289382] Uniform Multi-Platform E-IDE driver
[    6.301889] ide_generic: please use "probe_mask=0x3f" module parameter for probing all legacy ISA
 IDE ports
[    6.801141] NTFS driver 2.1.30 [Flags: R/W MODULE].
[    6.914295] NTFS volume version 3.1.
Begin: Running /scripts/live-premount ... done.
[    7.331989] FAT: utf8 is not a recommended IO charset for FAT filesystems, filesystem will be cas
e sensitive!
[    7.453369] aufs: module is from the staging directory, the quality is unknown, you have been war
ned.
[    7.479098] aufs 2.1-standalone.tree-38-rcN-20110228
[    7.610228] loop: module loaded
[    7.905144] squashfs: version 4.0 (2009/01/31) Phillip Lougher
Begin: Running /scripts/live-realpremount ... done.
Begin: Mounting "/live/image/live/filesystem.squashfs" on "//filesystem.squashfs" via "/dev/loop0" .
.. done.
done.
Begin: Running /scripts/live-bottom
 ... Begin: Configuring fstab ... done.
Begin: Preconfiguring networking ... done.
Begin: Loading preseed file ... done.
Begin: Running /scripts/init-bottom ... done.
INIT: version 2.88 booting
Using makefile-style concurrent boot in runlevel S.
```

3. Once the image creation environment has completed booting up, you will be given a warning and asked if you wish to continue. Please keep in mind that if you create the recovery image, then ***any residual files currently copied to the*** `/home/partimag` ***directory will be deleted***. If there are any files remaining in the USB **partition image** directory and you wish to save them, you must exit the recovery environment and copy these files to another disk. If you wish to continue with the image creation, press **Y** (case insensitive) to continue (screenshot on the next page).

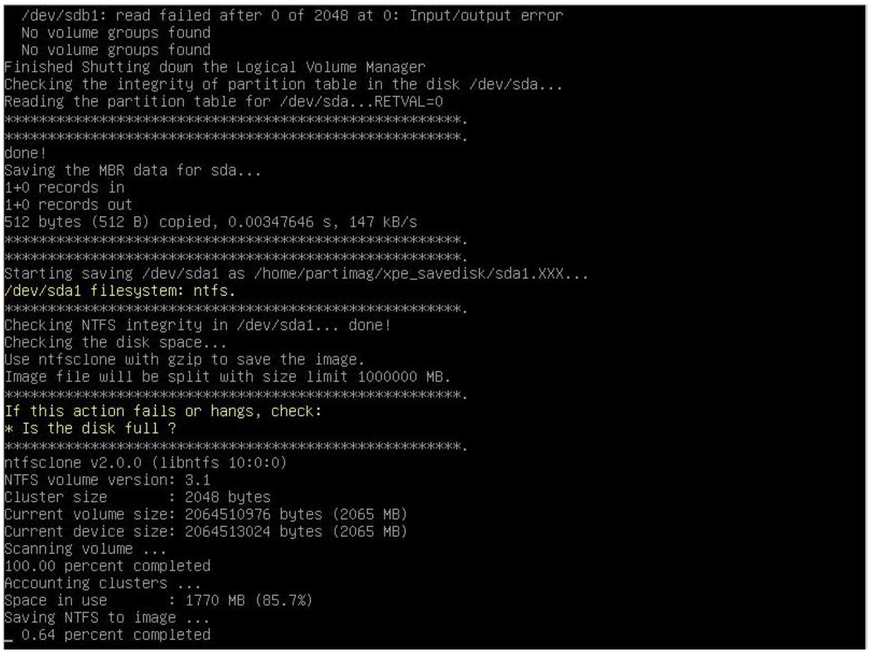


```
Setting the TERM as linux
*****************************************************.
Clonezilla image dir: /home/partimag
*****************************************************.
Shutting down the Logical Volume Manager
  No volume groups found
  No volume groups found
Finished Shutting down the Logical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

WARNING

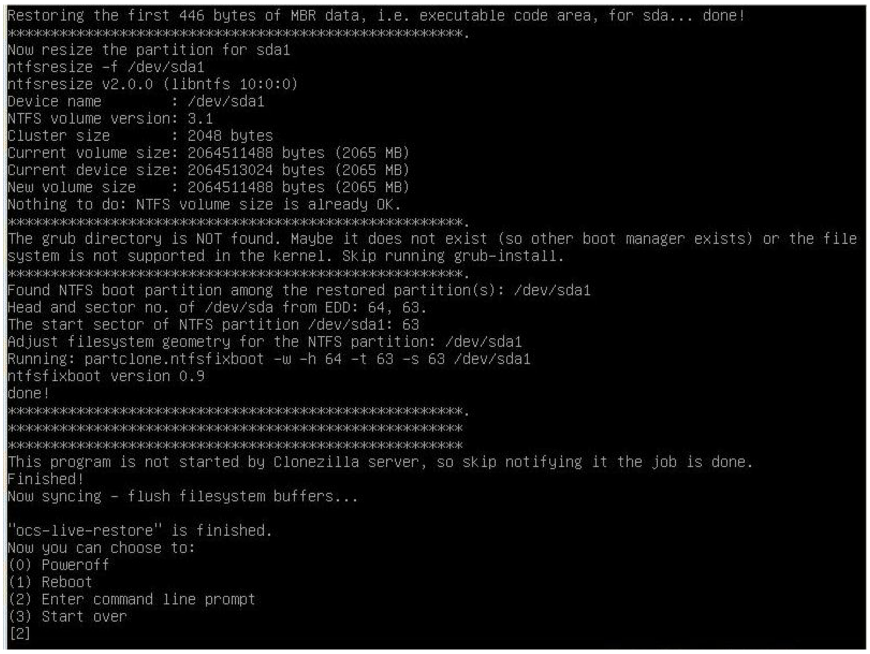
The same filename is used for all recovery images, whether for the full system backup or for the clean OS image installation. This means that currently, it is impossible to have more than one system image per USB drive.

4. At this point, the recovery environment will copy of the entire hard drive to your USB drive. This will likely take several minutes, and perhaps as long as half an hour. Do not remove the USB drive during this time; wait patiently for the process to finish. Depending on the speed of your USB drive, this may be a good time to get a cup of coffee, or take a nap.



```
  /dev/sdb1: read failed after 0 of 2048 at 0: Input/output error
  No volume groups found
  No volume groups found
Finished Shutting down the Logical Volume Manager
Checking the integrity of partition table in the disk /dev/sda...
Reading the partition table for /dev/sda...RETVAL=0
*****************************************************.
*****************************************************.
done!
Saving the MBR data for sda...
1+0 records in
1+0 records out
512 bytes (512 B) copied, 0.00347646 s, 147 kB/s
*****************************************************.
*****************************************************.
Starting saving /dev/sda1 as /home/partimag/xpe_savedisk/sda1.XXX...
/dev/sda1 filesystem: ntfs.
*****************************************************.
Checking NTFS integrity in /dev/sda1... done!
Checking the disk space...
Use ntfsclone with gzip to save the image.
Image file will be split with size limit 1000000 MB.
*****************************************************.
If this action fails or hangs, check:
* Is the disk full ?
*****************************************************.
ntfsclone v2.0.0 (libntfs 10:0:0)
NTFS volume version: 3.1
Cluster size       : 2048 bytes
Current volume size: 2064510976 bytes (2065 MB)
Current device size: 2064513024 bytes (2065 MB)
Scanning volume ...
100.00 percent completed
Accounting clusters ...
Space in use       : 1770 MB (85.7%)
Saving NTFS to image ...
_ 0.64 percent completed
```

5. At this point you may choose to power down the computer (press **0**), reboot (press **1**), enter a console terminal (access a console TTY -- press **2**), or re-initiate the entire procedure (press **3**). ***Do not remove the USB drive until you have rebooted or powered down the system.***



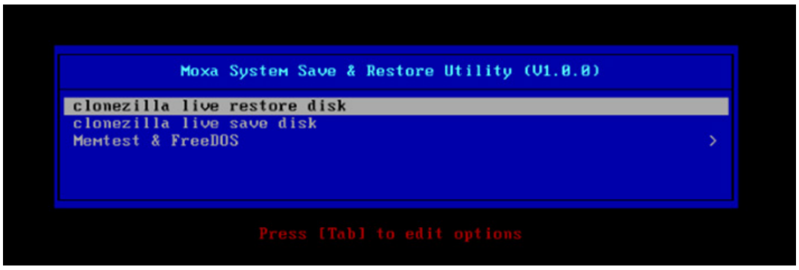
```
Restoring the first 446 bytes of MBR data, i.e. executable code area, for sda... done!
*****************************************************.
Now resize the partition for sda1
ntfsresize -f /dev/sda1
ntfsresize v2.0.0 (libntfs 10:0:0)
Device name        : /dev/sda1
NTFS volume version: 3.1
Cluster size       : 2048 bytes
Current volume size: 2064511488 bytes (2065 MB)
Current device size: 2064513024 bytes (2065 MB)
New volume size    : 2064511488 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. of /dev/sda from EDD: 64, 63.
The start sector of NTFS partition /dev/sda1: 63
Adjust filesystem geometry for the NTFS partition: /dev/sda1
Running: partclone.ntfsfixboot -w -h 64 -t 63 -s 63 /dev/sda1
ntfsfixboot version 0.9
done!
*****************************************************.
*****************************************************
*****************************************************
This program is not started by Clonezilla server, so skip notifying it the job is done.
Finished!
Now syncing - flush filesystem buffers...

"ocs-live-restore" is finished.
Now you can choose to:
(0) Poweroff
(1) Reboot
(2) Enter command line prompt
(3) Start over
[2]
```

6. Once you have powered down the system and removed the USB drive, you have finished configuring the recovery environment. The USB drive should be clearly labeled and stored in a safe place. You may now continue to **Step 6, where you will reset the BIOS to its original state**, or you may go to and test the recovery procedure for successful configuration (Step 5).

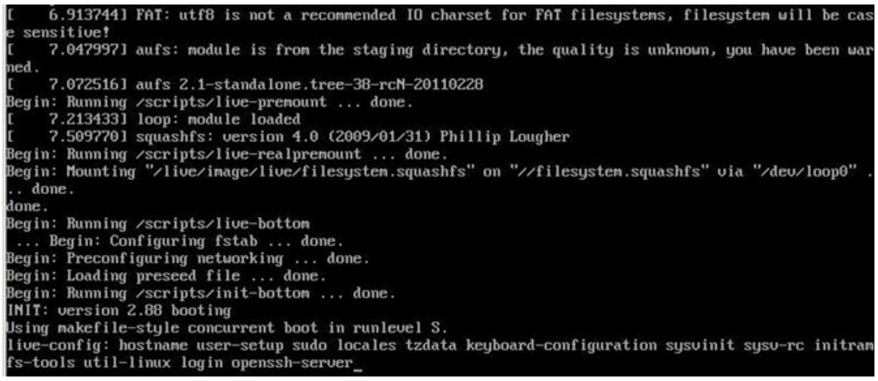
Step 5: Performing a System Recovery

Connect the USB drive to any of the DA-682A-DPP's USB ports and then reboot the computer. The system will boot from the USB into the Clonezilla boot loader.

1. Select **Clonezilla Live Restore Disk** to boot into the system restoration environment.

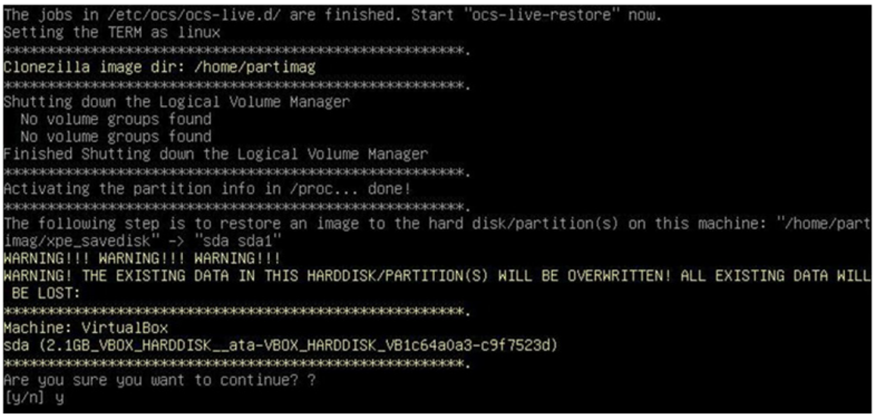

Moxa System Save & Restore Utility (V1.0.0)
clonezilla live restore disk
clonezilla live save disk
Memtest & FreeDOS
>
Press [Tab] to edit options

2. Wait for the boot process to finish.



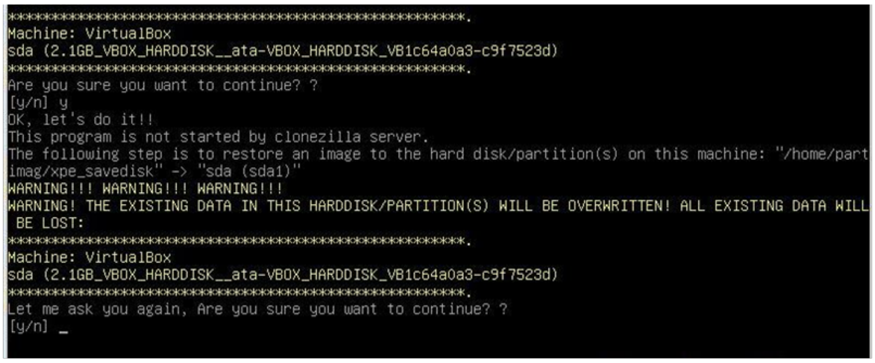
```
[    6.913744] FAT: utf8 is not a recommended IO charset for FAT filesystems, filesystem will be cas
e sensitive!
[    7.047997] aufs: module is from the staging directory, the quality is unknown, you have been war
ned.
[    7.072516] aufs 2.1-standalone.tree-38-rcN-20110228
Begin: Running /scripts/live-premount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

3. At this point, the system will remind you that you are about to overwrite your entire operating system with a new drive image, and ask you if you want to continue. When prompted, enter **Y** (case insensitive) from the keyboard to start the system restoration process. Any other letter or **Ctrl-C** will cancel it and exit Clonezilla.



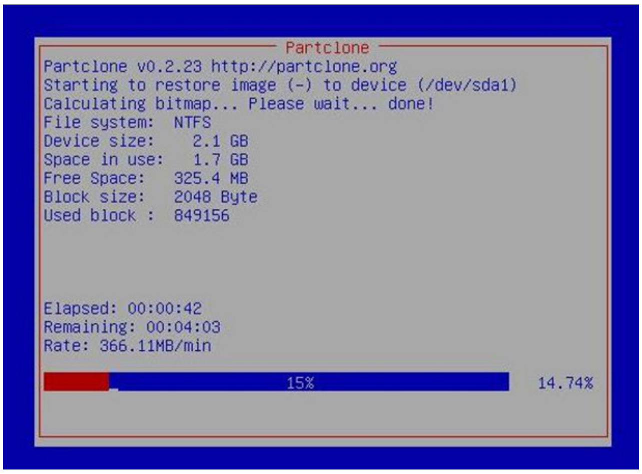
```
The jobs in /etc/ocs/ocs-live.d/ are finished. Start "ocs-live-restore" now.
Setting the TERM as linux
*******************************************************.
Clonezilla image dir: /home/partimag
*******************************************************.
Shutting down the Logical Volume Manager
  No volume groups found
  No volume groups found
Finished Shutting down the Logical Volume Manager
*******************************************************.
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/part
imag/xpe_savedisk" -> "sda sda1"
WARNING!!! WARNING!!! WARNING!!!
WARNING! THE EXISTING DATA IN THIS HARDDISK/PARTITION(S) WILL BE OVERWRITTEN! ALL EXISTING DATA WILL
 BE LOST:
*******************************************************.
Machine: VirtualBox
sda (2.1GB_VBOX_HARDDISK__ata-VBOX_HARDDISK_VB1c64a0a3-c9f7523d)
*******************************************************.
Are you sure you want to continue? ?
[y/n] y
```

4. The system will give you another warning that you are about to overwrite your hard drive, and erase all data on the partition listed (**sda1**, in the example below). If you wish to continue, enter **Y** (case insensitive).



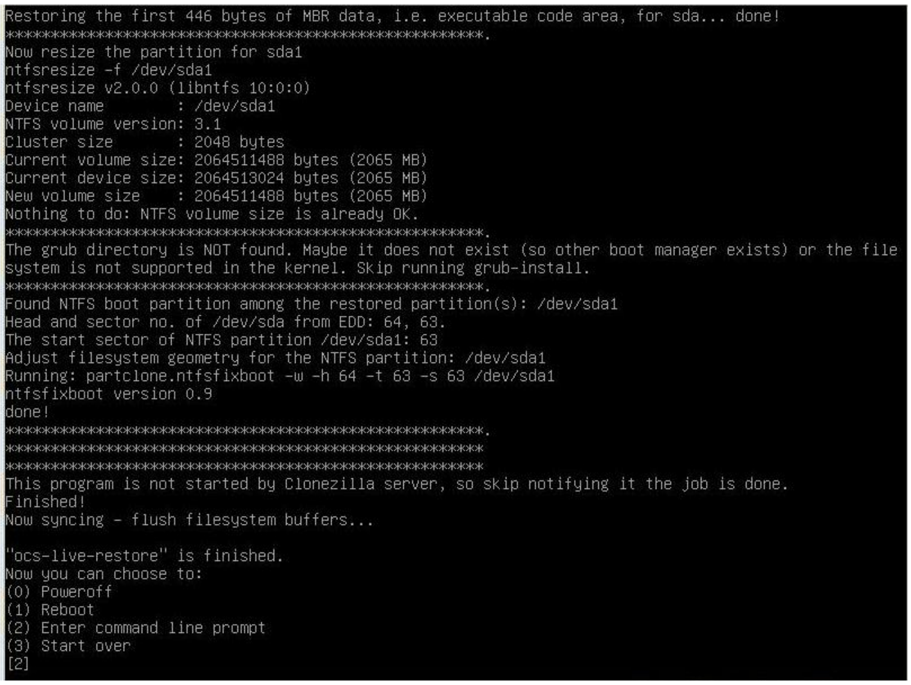
```
*****************************************************.
Machine: VirtualBox
sda (2.1GB_VBOX_HARDDISK__ata-VBOX_HARDDISK_VB1c64a0a3-c9f7523d)
*****************************************************.
Are you sure you want to continue? ?
[y/n] y
OK, let's do it!!
This program is not started by clonezilla server.
The following step is to restore an image to the hard disk/partition(s) on this machine: "/home/part
imag/xpe_savedisk" -> "sda (sda1)"
WARNING!!! WARNING!!! WARNING!!!
WARNING! THE EXISTING DATA IN THIS HARDDISK/PARTITION(S) WILL BE OVERWRITTEN! ALL EXISTING DATA WILL
 BE LOST:
*****************************************************.
Machine: VirtualBox
sda (2.1GB_VBOX_HARDDISK__ata-VBOX_HARDDISK_VB1c64a0a3-c9f7523d)
*****************************************************.
Let me ask you again, Are you sure you want to continue? ?
[y/n] _
```

5. Now, Clonezilla will copy the system image you have configured on to your primary system drive. Your original system (and any stored data or configurations that were made after the recovery disk was created) will be entirely wiped clean. Wait for the process to finish; depending on the system, this should take about 10 minutes.



```
Partclone
Partclone v0.2.23 http://partclone.org
Starting to restore image (-) to device (/dev/sda1)
Calculating bitmap... Please wait... done!
File system:  NTFS
Device size:    2.1 GB
Space in use:   1.7 GB
Free Space:   325.4 MB
Block size:   2048 Byte
Used block :  849156



Elapsed: 00:00:42
Remaining: 00:04:03
Rate: 366.11MB/min

                     15%                    14.74%
```

6. At this point, complete the restoration by selecting (**0**) **Poweroff**. This will shut down the computer; however, if the **Power Switch** remains inserted in the front panel of the computer and is left in the **ON** position, then the system will immediately initiate a soft reboot. To avoid this, users may use the switch to cut power to the computer immediately following the shutdown, or may simply remove the power switch from the front panel and then use the console to shut down the computer by pressing **0**.



```
Restoring the first 446 bytes of MBR data, i.e. executable code area, for sda... done!
*****************************************************.
Now resize the partition for sda1
ntfsresize -f /dev/sda1
ntfsresize v2.0.0 (libntfs 10:0:0)
Device name        : /dev/sda1
NTFS volume version: 3.1
Cluster size       : 2048 bytes
Current volume size: 2064511488 bytes (2065 MB)
Current device size: 2064513024 bytes (2065 MB)
New volume size    : 2064511488 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. of /dev/sda from EDD: 64, 63.
The start sector of NTFS partition /dev/sda1: 63
Adjust filesystem geometry for the NTFS partition: /dev/sda1
Running: partclone.ntfsfixboot -w -h 64 -t 63 -s 63 /dev/sda1
ntfsfixboot version 0.9
done!
*****************************************************.
*****************************************************
*****************************************************
This program is not started by Clonezilla server, so skip notifying it the job is done.
Finished!
Now syncing - flush filesystem buffers...

"ocs-live-restore" is finished.
Now you can choose to:
(0) Poweroff
(1) Reboot
(2) Enter command line prompt
(3) Start over
[2]
```

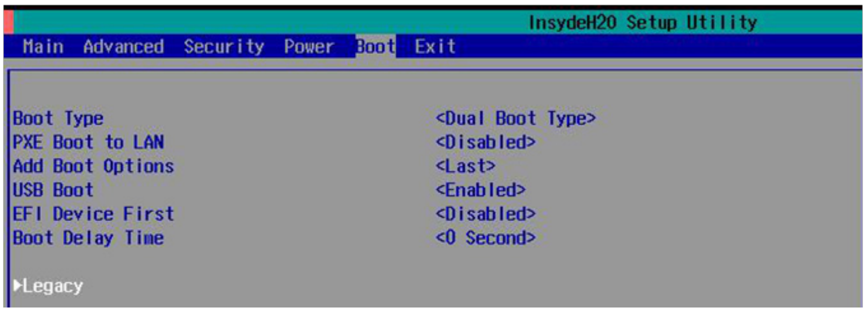
7. After the computer has powered down, remove the USB drive and store it in a safe place.

Step 6: Resetting the BIOS to its Original State

Now you will need to return the boot priority to its original configuration so that the system will boot from the original disk. This is done for two reasons; the first is security, so that the machine may not be rebooted from unauthorized USB drives

The second reason, however, is functional: currently, if the DA-682A-DPP is set to boot from the USB drive, then ***the DA-682A-DPP will hang any time a USB data drive (i.e.: non-bootable image) is inserted in the machine at boot time***. The DA-682A-DPP does not currently have the capacity to distinguish between simple USB data drives and boot-capable OS drives.

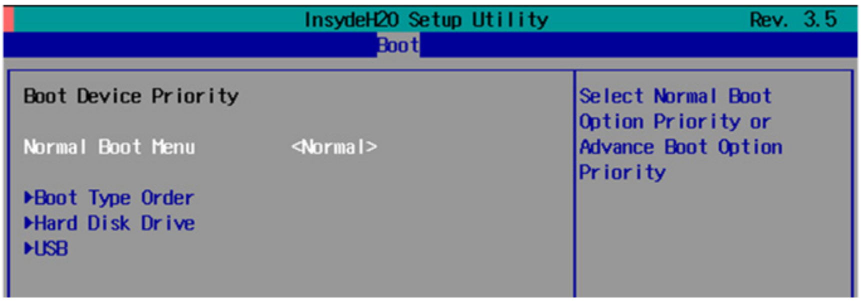
1. Reboot the computer and, during the POST process, press F2 until you hear a long beep. You should then enter the BIOS setup menu.
2. Use the left/right arrow keys to navigate to the **Boot** tab, and then press **Enter**.
3. Use the up/down arrows to highlight **Legacy** in the boot tab’s menu, and press **Enter**.



Boot Type <Dual Boot Type>
PXE Boot to LAN <Disabled>
Add Boot Options <Last>
USB Boot <Enabled>
EFI Device First <Disabled>
Boot Delay Time <0 Second>

▸Legacy

4. Use the up/down arrow keys to navigate to the **Boot Type Order** link, and then press **Enter**.



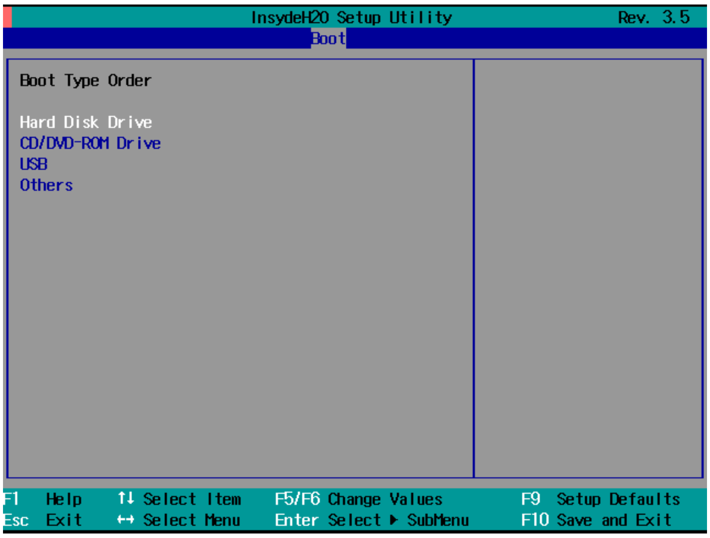
Boot Device Priority

Normal Boot Menu <Normal>

▸Boot Type Order
▸Hard Disk Drive
▸USB

Select Normal Boot Option Priority or Advance Boot Option Priority

5. Use the up/down arrows to highlight **Hard Disk Drive** and then use the plus/minus signs (**+ -**) to move it to the first boot priority position



```
                    InsydeH20 Setup Utility                  Rev. 3.5
                                Boot
 Boot Type Order

 Hard Disk Drive
 CD/DVD-ROM Drive
 USB
 Others

F1   Help   ↑↓ Select Item   F5/F6 Change Values       F9  Setup Defaults
Esc  Exit   ↔ Select Menu    Enter Select ▶ SubMenu    F10 Save and Exit
```

6. Press F10 and then press **Enter** to save and exit the BIOS configuration interface. This should initiate the next reboot, and your system should now boot from the USB drive.

A

Linux Software Components

acpi	1.6-1	amd64 displays information on ACPI devices
acpi-support-base	0.140-5	all scripts for handling base ACPI events such as the power button
acpid	1:2.0.16-1+deb7u1	amd64 Advanced Configuration and Power Interface event daemon
adduser	3.113+nmu3	all add and remove users and groups
apache2	2.2.22-13	amd64 Apache HTTP Server metapackage
apache2-mpm-prefork	2.2.22-13	amd64 Apache HTTP Server - traditional non-threaded model
apache2-utils	2.2.22-13	amd64 utility programs for webservers
apache2.2-bin	2.2.22-13	amd64 Apache HTTP Server common binary files
apache2.2-common	2.2.22-13	amd64 Apache HTTP Server common files
apt	0.9.7.9	amd64 commandline package manager
apt-listchanges	2.85.11	all package change history notification tool
apt-utils	0.9.7.9	amd64 package management related utility programs
aptitude	0.6.8.2-1	amd64 terminal-based package manager
aptitude-common	0.6.8.2-1	all architecture independent files for the aptitude package manager
at	3.1.13-2	amd64 Delayed job execution and batch processing
base-files	7.1wheezy1	amd64 Debian base system miscellaneous files
base-passwd	3.5.26	amd64 Debian base system master password and group files
bash	4.2+dfsg-0.1	amd64 GNU Bourne Again SHell
bash-completion	1:2.0-1	all programmable completion for the bash shell
bc	1.06.95-2+b1	amd64 The GNU bc arbitrary precision calculator language
bind9-host	1:9.8.4.dfsg.P1-6+nmu2	amd64 Version of 'host' bundled with BIND 9.X
binutils	2.22-8	amd64 GNU assembler, linker and binary utilities
bridge-utils	1.5-6	amd64 Utilities for configuring the Linux Ethernet bridge
bsdmainutils	9.0.3	amd64 collection of more utilities from FreeBSD
bsdutils	1:2.20.1-5.3	amd64 Basic utilities from 4.4BSD-Lite
build-essential	11.5	amd64 Informational list of build-essential packages
busybox	1:1.20.0-7	amd64 Tiny utilities for small and embedded systems
bzip2	1.0.6-4	amd64 high-quality block-sorting file compressor - utilities
ca-certificates	20130119	all Common CA certificates
console-setup	1.88	all console font and keymap setup program
console-setup-linux	1.88	all Linux specific part of console-setup
coreutils	8.13-3.5	amd64 GNU core utilities
cpio	2.11+dfsg-0.1	amd64 GNU cpio -- a program to manage archives of files
cpp	4:4.7.2-1	amd64 GNU C preprocessor (cpp)
cpp-4.7	4.7.2-5	amd64 GNU C preprocessor

cron	3.0pl1-124	amd64 process scheduling daemon
dash	0.5.7-3	amd64 POSIX-compliant shell
db5.1-util	5.1.29-5	amd64 Berkeley v5.1 Database Utilities
dc	1.06.95-2+b1	amd64 The GNU dc arbitrary precision reverse-polish calculator
debconf	1.5.49	all Debian configuration management system
debconf-i18n	1.5.49	all full internationalization support for debconf
debian-archive-keyring	2012.4	all GnuPG archive keys of the Debian archive
debian-faq	5.0.1	all Debian FAQ
debianutils	4.3.2	amd64 Miscellaneous utilities specific to Debian
dialog	1.1-20120215-2	amd64 Displays user-friendly dialog boxes from shell scripts
dictionaries-common	1.12.11	all Common utilities for spelling dictionary tools
diffutils	1:3.2-6	amd64 File comparison utilities
discover	2.1.2-5.2	amd64 hardware identification system
discover-data	2.2010.10.18	all Data lists for Discover hardware detection system
dmidecode	2.11-9	amd64 SMBIOS/DMI table decoder
dmsetup	2:1.02.74-7	amd64 Linux Kernel Device Mapper userspace library
dnsutils	1:9.8.4.dfsg.P1-6+nmu2	amd64 Clients provided with BIND
dpkg	1.16.10	amd64 Debian package management system
dpkg-dev	1.16.10	all Debian package development tools
e2fslibs:amd64	1.42.5-1.1	amd64 ext2/ext3/ext4 file system libraries
e2fsprogs	1.42.5-1.1	amd64 ext2/ext3/ext4 file system utilities
ethtool	1:3.4.2-1	amd64 display or change Ethernet device settings
fakeroot	1.18.4-2	amd64 tool for simulating superuser privileges
file	5.11-2	amd64 Determines file type using "magic" numbers
findutils	4.4.2-4	amd64 utilities for finding files--find, xargs
firmware-realtek	0.36+wheezy.1	all Binary firmware for Realtek wired and wireless network adapters
ftp	0.17-27	amd64 classical file transfer client
g++	4:4.7.2-1	amd64 GNU C++ compiler
g++-4.7	4.7.2-5	amd64 GNU C++ compiler
gcc	4:4.7.2-1	amd64 GNU C compiler
gcc-4.7	4.7.2-5	amd64 GNU C compiler
gcc-4.7-base:amd64	4.7.2-5	amd64 GCC, the GNU Compiler Collection (base package)
gdb	7.4.1+dfsg-0.1	amd64 The GNU Debugger
gdbserver	7.4.1+dfsg-0.1	amd64 The GNU Debugger (remote server)
geoip-database	20130213-1	all IP lookup command line tools that use the GeoIP library (country database)
gettext-base	0.18.1.1-9	amd64 GNU Internationalization utilities for the base system
gnupg	1.4.12-7	amd64 GNU privacy guard - a free PGP replacement
gpgv	1.4.12-7	amd64 GNU privacy guard - signature verification tool
grep	2.12-2	amd64 GNU grep, egrep and fgrep
groff-base	1.21-9	amd64 GNU troff text-formatting system (base system components)
grub-common	1.99-27+deb7u1	amd64 GRand Unified Bootloader (common files)
grub-pc	1.99-27+deb7u1	amd64 GRand Unified Bootloader, version 2 (PC/BIOS version)
grub-pc-bin	1.99-27+deb7u1	amd64 GRand Unified Bootloader, version 2 (PC/BIOS binaries)
grub2-common	1.99-27+deb7u1	amd64 GRand Unified Bootloader (common files for

		version 2)
gzip	1.5-1.1	amd64 GNU compression utilities
hdparm	9.39-1+b1	amd64 tune hard disk parameters for high performance
host	1:9.8.4.dfsg.P1-6+nmu2	all Transitional package
hostname	3.11	amd64 utility to set/show the host name or domain name
iamerican	3.3.02-6	all American English dictionary for ispell (standard version)
ibritish	3.3.02-6	all British English dictionary for ispell (standard version)
ienglish-common	3.3.02-6	all Common files for British and American ispell dictionaries
ifrename	30~pre9-8	amd64 Rename network interfaces based on various static criteria
ifupdown	0.7.8	amd64 high level tools to configure network interfaces
initramfs-tools	0.109.1	all generic modular initramfs generator
initscripts	2.88dsf-41	amd64 scripts for initializing and shutting down the system
insserv	1.14.0-5	amd64 boot sequence organizer using LSB init.d script dependency information
install-info	4.13a.dfsg.1-10	amd64 Manage installed documentation in info format
iproute	20120521-3+b3	amd64 networking and traffic control tools
iptables	1.4.14-3.1	amd64 administration tools for packet filtering and NAT
iputils-ping	3:20101006-1+b1	amd64 Tools to test the reachability of network hosts
isc-dhcp-client	4.2.2.dfsg.1-5+deb70u6	amd64 ISC DHCP client
isc-dhcp-common	4.2.2.dfsg.1-5+deb70u6	amd64 common files used by all the isc-dhcp* packages
iso-codes	3.41-1	all ISO language, territory, currency, script codes and their translations
ispell	3.3.02-6	amd64 International Ispell (an interactive spelling corrector)
kbd	1.15.3-9	amd64 Linux console font and keytable utilities
keyboard-configuration	1.88	all system-wide keyboard preferences
klibc-utils	2.0.1-3.1	amd64 small utilities built with klibc for early boot
kmod	9-3	amd64 tools for managing Linux kernel modules
krb5-locales	1.10.1+dfsg-5+deb7u1	all Internationalization support for MIT Kerberos
laptop-detect	0.13.7	amd64 attempt to detect a laptop
less	444-4	amd64 pager program similar to more
libacl1:amd64	2.2.51-8	amd64 Access control list shared library
libalgorithm-diff-perl	1.19.02-2	all module to find differences between files
libalgorithm-diff-xs-perl	0.04-2+b1	amd64 module to find differences between files (XS accelerated)
libalgorithm-merge-perl	0.08-2	all Perl module for three-way merge of textual data
libapache2-mod-php5	5.4.4-14+deb7u3	amd64 server-side, HTML-embedded scripting language (Apache 2 module)
libapr1	1.4.6-3	amd64 Apache Portable Runtime Library
libaprutil1	1.4.1-3	amd64 Apache Portable Runtime Utility Library
libaprutil1-dbd-sqlite3	1.4.1-3	amd64 Apache Portable Runtime Utility Library - SQLite3 Driver
libaprutil1-ldap	1.4.1-3	amd64 Apache Portable Runtime Utility Library - LDAP Driver
libapt-inst1.5:amd64	0.9.7.9	amd64 deb package format runtime library
libapt-pkg4.12:amd64	0.9.7.9	amd64 package managment runtime library
libasprintf0c2:amd64	0.18.1.1-9	amd64 GNU library to use fprintf and friends in C++
libattr1:amd64	1:2.4.46-8	amd64 Extended attribute shared library

libbind9-80	1:9.8.4.dfsg.P1-6+nmu2	amd64 BIND9 Shared Library used by BIND
libblkid1:amd64	2.20.1-5.3	amd64 block device id library
libboost-iostreams1.49.0	1.49.0-3.2	amd64 Boost.Iostreams Library
libbsd0:amd64	0.4.2-1	amd64 utility functions from BSD systems - shared library
libbz2-1.0:amd64	1.0.6-4	amd64 high-quality block-sorting file compressor library - runtime
libc-bin	2.13-38	amd64 Embedded GNU C Library: Binaries
libc-dev-bin	2.13-38	amd64 Embedded GNU C Library: Development binaries
libc6:amd64	2.13-38	amd64 Embedded GNU C Library: Shared libraries
libc6-dev:amd64	2.13-38	amd64 Embedded GNU C Library: Development Libraries and Header Files
libcap2:amd64	1:2.22-1.2	amd64 support for getting/setting POSIX.1e capabilities
libclass-isa-perl	0.36-3	all report the search path for a class's ISA tree
libcomerr2:amd64	1.42.5-1.1	amd64 common error description library
libcwidget3	0.5.16-3.4	amd64 high-level terminal interface library for C++ (runtime files)
libdb5.1:amd64	5.1.29-5	amd64 Berkeley v5.1 Database Libraries [runtime]
libdevmapper1.02.1:amd64	2:1.02.74-7	amd64 Linux Kernel Device Mapper userspace library
libdiscover2	2.1.2-5.2	amd64 hardware identification library
libdns88	1:9.8.4.dfsg.P1-6+nmu2	amd64 DNS Shared Library used by BIND
libdpkg-perl	1.16.10	all Dpkg perl modules
libedit2:amd64	2.11-20080614-5	amd64 BSD editline and history libraries
libept1.4.12	1.0.9	amd64 High-level library for managing Debian package information
libevent-2.0-5:amd64	2.0.19-stable-3	amd64 Asynchronous event notification library
libexpat1:amd64	2.1.0-1	amd64 XML parsing C library - runtime library
libfile-copy-recursive-perl	0.38-1	all Perl extension for recursively copying files and directories
libfile-fcntllock-perl	0.14-2	amd64 Perl module for file locking with fcntl(2)
libfreetype6:amd64	2.4.9-1.1	amd64 FreeType 2 font engine, shared library files
libfuse2:amd64	2.9.0-2+deb7u1	amd64 Filesystem in Userspace (library)
libgc1c2	1:7.1-9.1	amd64 conservative garbage collector for C and C++
libgcc1:amd64	1:4.7.2-5	amd64 GCC support library
libgcrypt11:amd64	1.5.0-5	amd64 LGPL Crypto library - runtime library
libgdbm3:amd64	1.8.3-11	amd64 GNU dbm database routines (runtime version)
libgeoip1	1.4.8+dfsg-3	amd64 non-DNS IP-to-country resolver library
libgmp10:amd64	2:5.0.5+dfsg-2	amd64 Multiprecision arithmetic library
libgnutls26:amd64	2.12.20-7	amd64 GNU TLS library - runtime library
libgomp1:amd64	4.7.2-5	amd64 GCC OpenMP (GOMP) support library
libgpg-error0:amd64	1.10-3.1	amd64 library for common error values and messages in GnuPG components
libgpgme11	1.2.0-1.4	amd64 GPGME - GnuPG Made Easy
libgpm2:amd64	1.20.4-6	amd64 General Purpose Mouse - shared library
libgssapi-krb5-2:amd64	1.10.1+dfsg-5+deb7u1	amd64 MIT Kerberos runtime libraries - krb5 GSS-API Mechanism
libgssglue1:amd64	0.4-2	amd64 mechanism-switch gssapi library
libidn11:amd64	1.25-2	amd64 GNU Libidn library, implementation of IETF IDN specifications
libisc84	1:9.8.4.dfsg.P1-6+nmu2	amd64 ISC Shared Library used by BIND
libisccc80	1:9.8.4.dfsg.P1-6+nmu2	amd64 Command Channel Library used by BIND
libisccfg82	1:9.8.4.dfsg.P1-6+nmu2	amd64 Configuration file Handling Library used by BIND

libitm1:amd64	4.7.2-5	amd64 GNU Transactional Memory Library
libiw30:amd64	30~pre9-8	amd64 Wireless tools - library
libk5crypto3:amd64	1.10.1+dfsg-5+deb7u1	amd64 MIT Kerberos runtime libraries - Crypto Library
libkeyutils1:amd64	1.5.5-3	amd64 Linux Key Management Utilities (library)
libklibc	2.0.1-3.1	amd64 minimal libc subset for use with initramfs
libkmod2:amd64	9-3	amd64 libkmod shared library
libkrb5-3:amd64	1.10.1+dfsg-5+deb7u1	amd64 MIT Kerberos runtime libraries
libkrb5support0:amd64	1.10.1+dfsg-5+deb7u1	amd64 MIT Kerberos runtime libraries - Support library
libldap-2.4-2:amd64	2.4.31-1+nmu2	amd64 OpenLDAP libraries
liblocale-gettext-perl	1.05-7+b1	amd64 module using libc functions for internationalization in Perl
liblockfile-bin	1.09-5	amd64 support binaries for and cli utilities based on liblockfile
liblockfile1:amd64	1.09-5	amd64 NFS-safe locking library
liblwres80	1:9.8.4.dfsg.P1-6+nmu2	amd64 Lightweight Resolver Library used by BIND
liblzma5:amd64	5.1.1alpha+20120614-2	amd64 XZ-format compression library
liblzo2-2:amd64	2.06-1	amd64 data compression library
libmagic1:amd64	5.11-2	amd64 File type determination library using "magic" numbers
libmount1	2.20.1-5.3	amd64 block device id library
libmpc2:amd64	0.9-4	amd64 multiple precision complex floating-point library
libmpfr4:amd64	3.1.0-5	amd64 multiple precision floating-point computation
libncurses5:amd64	5.9-10	amd64 shared libraries for terminal handling
libncurses5-dev	5.9-10	amd64 developer's libraries for ncurses
libncursesw5:amd64	5.9-10	amd64 shared libraries for terminal handling (wide character support)
libnet-telnet-perl	3.03-3	all Script telnetable connections
libnewt0.52	0.52.14-11.1	amd64 Not Erik's Windowing Toolkit - text mode windowing with slang
libnfnetlink0	1.0.0-1.1	amd64 Netfilter netlink library
libnfsidmap2:amd64	0.25-4	amd64 NFS idmapping library
libonig2	5.9.1-1	amd64 Oniguruma regular expressions library
libp11-kit0:amd64	0.12-3	amd64 Library for loading and coordinating access to PKCS#11 modules - runtime
libpam-modules:amd64	1.1.3-7.1	amd64 Pluggable Authentication Modules for PAM
libpam-modules-bin	1.1.3-7.1	amd64 Pluggable Authentication Modules for PAM - helper binaries
libpam-runtime	1.1.3-7.1	all Runtime support for the PAM library
libpam0g:amd64	1.1.3-7.1	amd64 Pluggable Authentication Modules library
libpcap0.8:amd64	1.3.0-1	amd64 system interface for user-level packet capture
libpci3:amd64	1:3.1.9-6	amd64 Linux PCI Utilities (shared library)
libpcre3:amd64	1:8.30-5	amd64 Perl 5 Compatible Regular Expression Library - runtime files
libperl-dev	5.14.2-21	amd64 Perl library: development files
libperl5.14	5.14.2-21	amd64 shared Perl library
libpipeline1:amd64	1.2.1-1	amd64 pipeline manipulation library
libpkcs11-helper1:amd64	1.09-1	amd64 library that simplifies the interaction with PKCS#11
libpopt0:amd64	1.16-7	amd64 lib for parsing cmdline parameters
libprocps0:amd64	1:3.3.3-3	amd64 library for accessing process information from /proc
libpth20	2.0.7-16	amd64 The GNU Portable Threads
libpython2.7	2.7.3-6	amd64 Shared Python runtime library (version 2.7)

libqdbm14	1.8.78-2	amd64 QDBM Database Libraries without GDBM wrapper[runtime]
libquadmath0:amd64	4.7.2-5	amd64 GCC Quad-Precision Math Library
libreadline6:amd64	6.2+dfsg-0.1	amd64 GNU readline and history libraries, run-time libraries
libsasl2-2:amd64	2.1.25.dfsg1-6+deb7u1	amd64 Cyrus SASL - authentication abstraction library
libsasl2-modules:amd64	2.1.25.dfsg1-6+deb7u1	amd64 Cyrus SASL - pluggable authentication modules
libselinux1:amd64	2.1.9-5	amd64 SELinux runtime shared libraries
libsemanage-common	2.1.6-6	all Common files for SELinux policy management libraries
libsemanage1:amd64	2.1.6-6	amd64 SELinux policy management library
libsensors4:amd64	1:3.3.2-2	amd64 library to read temperature/voltage/fan sensors
libsepol1:amd64	2.1.4-3	amd64 SELinux library for manipulating binary security policies
libsigc++-2.0-0c2a:amd64	2.2.10-0.2	amd64 type-safe Signal Framework for C++ - runtime
libslang2:amd64	2.2.4-15	amd64 S-Lang programming library - runtime version
libsqlite3-0:amd64	3.7.13-1+deb7u1	amd64 SQLite 3 shared library
libsqlite3-dev	3.7.13-1+deb7u1	amd64 SQLite 3 development files
libss2:amd64	1.42.5-1.1	amd64 command-line interface parsing library
libssl1.0.0:amd64	1.0.1e-2	amd64 SSL shared libraries
libstdc++6:amd64	4.7.2-5	amd64 GNU Standard C++ Library v3
libstdc++6-4.7-dev	4.7.2-5	amd64 GNU Standard C++ Library v3 (development files)
libswitch-perl	2.16-2	all switch statement for Perl
libtasn1-3:amd64	2.13-2	amd64 Manage ASN.1 structures (runtime)
libtext-charwidth-perl	0.04-7+b1	amd64 get display widths of characters on the terminal
libtext-iconv-perl	1.7-5	amd64 converts between character sets in Perl
libtext-wrapi18n-perl	0.06-7	all internationalized substitute of Text::Wrap
libtimedate-perl	1.2000-1	all collection of modules to manipulate date/time information
libtinfo-dev:amd64	5.9-10	amd64 developer's library for the low-level terminfo library
libtinfo5:amd64	5.9-10	amd64 shared low-level terminfo library for terminal handling
libtirpc1:amd64	0.2.2-5	amd64 transport-independent RPC library
libtokyocabinet9:amd64	1.4.47-2	amd64 Tokyo Cabinet Database Libraries [runtime]
libudev0:amd64	175-7.2	amd64 libudev shared library
libusb-0.1-4:amd64	2:0.1.12-20+nmu1	amd64 userspace USB programming library
libusb-1.0-0:amd64	2:1.0.11-1	amd64 userspace USB programming library
libustr-1.0-1:amd64	1.0.4-3	amd64 Micro string library: shared library
libuuid-perl	0.02-5	amd64 Perl extension for using UUID interfaces as defined in e2fsprogs
libuuid1:amd64	2.20.1-5.3	amd64 Universally Unique ID library
libwrap0:amd64	7.6.q-24	amd64 Wietse Venema's TCP wrappers library
libx11-6:amd64	2:1.5.0-1+deb7u1	amd64 X11 client-side library
libx11-data	2:1.5.0-1+deb7u1	all X11 client-side library
libx86-1:amd64	1.1+ds1-10	amd64 x86 real-mode library
libxapian22	1.2.12-2	amd64 Search engine library
libxau6:amd64	1:1.0.7-1	amd64 X11 authorization library
libxcb1:amd64	1.8.1-2+deb7u1	amd64 X C Binding
libxdmcp6:amd64	1:1.1.1-1	amd64 X11 Display Manager Control Protocol library
libxext6:amd64	2:1.3.1-2+deb7u1	amd64 X11 miscellaneous extension library

libxml2:amd64	2.8.0+dfsg1-7+nmu1	amd64 GNOME XML library
libxmuu1:amd64	2:1.1.1-1	amd64 X11 miscellaneous micro-utility library
linux-base	3.5	all Linux image base package
linux-image-3.2.0-4-amd64	3.2.46-1	amd64 Linux 3.2 for 64-bit PCs
linux-image-amd64	3.2+46	amd64 Linux for 64-bit PCs (meta-package)
linux-libc-dev:amd64	3.2.46-1	amd64 Linux support headers for userspace development
locales	2.13-38	all Embedded GNU C Library: National Language (locale) data [support]
lockfile-progs	0.1.17	amd64 Programs for locking and unlocking files and mailboxes
login	1:4.1.5.1-1	amd64 system login tools
logrotate	3.8.1-4	amd64 Log rotation utility
lsb-base	4.1+Debian8+deb7u1	all Linux Standard Base 4.1 init script functionality
lsb-release	4.1+Debian8+deb7u1	all Linux Standard Base version reporting utility
lsof	4.86+dfsg-1	amd64 Utility to list open files
m4	1.4.16-3	amd64 a macro processing language
make	3.81-8.2	amd64 An utility for Directing compilation.
man-db	2.6.2-1	amd64 on-line manual pager
manpages	3.44-1	all Manual pages about using a GNU/Linux system
manpages-dev	3.44-1	all Manual pages about using GNU/Linux for development
mawk	1.3.3-17	amd64 a pattern scanning and text processing language
mime-support	3.52-1	all MIME files 'mime.types' & 'mailcap', and support programs
mlocate	0.23.1-1	amd64 quickly find files on the filesystem based on their name
module-init-tools	9-3	all transitional dummy package (module-init-tools to kmod)
mount	2.20.1-5.3	amd64 Tools for mounting and manipulating filesystems
moxa-snmp-DA-682A-DPP	1.0	amd64 The Simple Network Management Protocol (SNMP) provides a framework for the exchange of management information between agents (servers) and clients.
multiarch-support	2.13-38	amd64 Transitional package to ensure multiarch compatibility
mutt	1.5.21-6.2	amd64 text-based mailreader supporting MIME, GPG, PGP and threading
mx-snmp-DA-682A-DPP	1.0	amd64 The Simple Network Management Protocol (SNMP) provides a framework for the exchange of management information between agents (servers) and clients.
ncurses-base	5.9-10	all basic terminal type definitions
ncurses-bin	5.9-10	amd64 terminal-related programs and man pages
ncurses-term	5.9-10	all additional terminal type definitions
net-tools	1.60-24.2	amd64 The NET-3 networking toolkit
netbase	5.0	all Basic TCP/IP networking system
netcat-traditional	1.10-40	amd64 TCP/IP swiss army knife
netsnmp	1.0	amd64 The Simple Network Management Protocol (SNMP) provides a framework for the exchange of management information between agents (servers) and clients.

nfs-common	1:1.2.6-4	amd64 NFS support files common to client and server
ntpdate	1:4.2.6.p5+dfsg-2	amd64 client for setting system time from NTP servers
openbsd-inetd	0.20091229-2	amd64 OpenBSD Internet Superserver
openssh-blacklist	0.4.1+nmu1	all list of default blacklisted OpenSSH RSA and DSA keys
openssh-blacklist-extra	0.4.1+nmu1	all list of non-default blacklisted OpenSSH RSA and DSA keys
openssh-client	1:6.0p1-4	amd64 secure shell (SSH) client, for secure access to remote machines
openssh-server	1:6.0p1-4	amd64 secure shell (SSH) server, for secure access from remote machines
openssl	1.0.1e-2	amd64 Secure Socket Layer (SSL) binary and related cryptographic tools
openvpn	2.2.1-8+deb7u2	amd64 virtual private network daemon
os-prober	1.58	amd64 utility to detect other OSes on a set of drives
passwd	1:4.1.5.1-1	amd64 change and administer password and group data
patch	2.6.1-3	amd64 Apply a diff file to an original
pciutils	1:3.1.9-6	amd64 Linux PCI Utilities
perl	5.14.2-21	amd64 Larry Wall's Practical Extraction and Report Language
perl-base	5.14.2-21	amd64 minimal Perl system
perl-modules	5.14.2-21	all Core Perl modules
php5	5.4.4-14+deb7u3	all server-side, HTML-embedded scripting language (metapackage)
php5-cli	5.4.4-14+deb7u3	amd64 command-line interpreter for the php5 scripting language
php5-common	5.4.4-14+deb7u3	amd64 Common files for packages built from the php5 source
pm-utils	1.4.1-9	all utilities and scripts for power management
pmount	0.9.23-2	amd64 mount removable devices as normal user
powermgmt-base	1.31	amd64 Common utils and configs for power management
ppp	2.4.5-5.1+b1	amd64 Point-to-Point Protocol (PPP) - daemon
pppconfig	2.3.18+nmu4	all A text menu based utility for configuring ppp
pppoe	3.8-3	amd64 PPP over Ethernet driver
pppoeconf	1.20	all configures PPPoE/ADSL connections
procps	1:3.3.3-3	amd64 /proc file system utilities
proftpd-basic	1.3.4a-4+nmu1	amd64 Versatile, virtual-hosting FTP daemon - binaries
proftpd-mod-vroot	0.9.2-2+b2	amd64 ProFTPD module mod_vroot
psmisc	22.19-1+deb7u1	amd64 utilities that use the proc file system
python	2.7.3-4	all interactive high-level object-oriented language (default version)
python-apt	0.8.8.2	amd64 Python interface to libapt-pkg
python-apt-common	0.8.8.2	all Python interface to libapt-pkg (locales)
python-chardet	2.0.1-2	all universal character encoding detector
python-debian	0.1.21	all Python modules to work with Debian-related data formats
python-debianbts	1.11	all Python interface to Debian's Bug Tracking System
python-fpconst	0.7.2-5	all Utilities for handling IEEE 754 floating point special values
python-minimal	2.7.3-4	all minimal subset of the Python language (default version)
python-reportbug	6.4.4	all Python modules for interacting with bug tracking systems

python-soappy	0.12.0-4	all SOAP Support for Python
python-support	1.0.15	all automated rebuilding support for Python modules
python2.7	2.7.3-6	amd64 Interactive high-level object-oriented language (version 2.7)
python2.7-minimal	2.7.3-6	amd64 Minimal subset of the Python language (version 2.7)
readline-common	6.2+dfsg-0.1	all GNU readline and history libraries, common files
rpcbind	0.2.0-8	amd64 converts RPC program numbers into universal addresses
rsyslog	5.8.11-3	amd64 reliable system and kernel logging daemon
sed	4.2.1-10	amd64 The GNU sed stream editor
sensible-utils	0.0.7	all Utilities for sensible alternative selection
sgml-base	1.26+nmu4	all SGML infrastructure and SGML catalog file support
sqlite3	3.7.13-1+deb7u1	amd64 Command line interface for SQLite 3
ssh	1:6.0p1-4	all secure shell client and server (metapackage)
ssl-cert	1.0.32	all simple debconf wrapper for OpenSSL
strace	4.5.20-2.3	amd64 A system call tracer
sudo	1.8.5p2-1+nmu1	amd64 Provide limited super user privileges to specific users
sysstat	10.0.5-1	amd64 system performance tools for Linux
sysv-rc	2.88dsf-41	all System-V-like runlevel change mechanism
sysvinit	2.88dsf-41	amd64 System-V-like init utilities
sysvinit-utils	2.88dsf-41	amd64 System-V-like utilities
tar	1.26+dfsg-0.1	amd64 GNU version of the tar archiving utility
task-english	3.14.1	all General English environment
task-ssh-server	3.14.1	all SSH server
tasksel	3.14.1	all Tool for selecting tasks for installation on Debian systems
tasksel-data	3.14.1	all Official tasks used for installation of Debian systems
tcpd	7.6.q-24	amd64 Wietse Venema's TCP wrapper utilities
tcpdump	4.3.0-1	amd64 command-line network traffic analyzer
telnet	0.17-36	amd64 The telnet client
telnetd	0.17-36	amd64 The telnet server
tftpd	0.17-18	amd64 Trivial file transfer protocol server
time	1.7-24	amd64 GNU time program for measuring CPU resource usage
traceroute	1:2.0.18-3	amd64 Traces the route taken by packets over an IPv4/IPv6 network
tzdata	2013c-0wheezy1	all time zone and daylight-saving time data
ucf	3.0025+nmu3	all Update Configuration File: preserve user changes to configuration files.
udev	175-7.2	amd64 /dev/ and hotplug management daemon
update-inetd	4.43	all inetd configuration file updater
usbmount	0.0.22	all automatically mount and unmount USB mass storage devices
usbutils	1:005-3	amd64 Linux USB utilities
util-linux	2.20.1-5.3	amd64 Miscellaneous system utilities
util-linux-locales	2.20.1-5.3	all Locales files for util-linux
vbetool	1.1-2	amd64 run real-mode video BIOS code to alter hardware state
vim	2:7.3.547-7	amd64 Vi IMproved - enhanced vi editor
vim-common	2:7.3.547-7	amd64 Vi IMproved - Common files
vim-runtime	2:7.3.547-7	all Vi IMproved - Runtime files

vim-tiny	2:7.3.547-7	amd64 Vi IMproved - enhanced vi editor - compact version
w3m	0.5.3-8	amd64 WWW browsable pager with excellent tables/frames support
wamerican	7.1-1	all American English dictionary words for /usr/share/dict
watchdog	5.12-1	amd64 system health checker and software/hardware watchdog handler
wget	1.13.4-3	amd64 retrieves files from the web
whiptail	0.52.14-11.1	amd64 Displays user-friendly dialog boxes from shell scripts
whois	5.0.23	amd64 intelligent WHOIS client
xauth	1:1.0.7-1	amd64 X authentication utility
xkb-data	2.5.1-3	all X Keyboard Extension (XKB) configuration data
xml-core	0.13+nmu2	all XML infrastructure and XML catalog file support
xz-utils	5.1.1alpha+20120614-2	amd64 XZ-format compression utilities
zlib1g:amd64	1:1.2.7.dfsg-13	amd64 compression library - runtime

B

The Moxa Custom MIB File

```
--
-- MOXA-SYS-MIB.txt
--

    MOXA-SYS-MIB DEFINITIONS ::= BEGIN

        IMPORTS
            enterprises, IpAddress, Integer32, OBJECT-TYPE, MODULE-IDENTITY,
            NOTIFICATION-TYPE
                FROM SNMPv2-SMI
            DisplayString
                FROM SNMPv2-TC;

        -- 1.3.6.1.4.1.8691.17.1
        moxaSystem MODULE-IDENTITY
            LAST-UPDATED "201301031111Z"       -- January 03, 2013 at 11:11 GMT
            ORGANIZATION
                "Moxa Techonology , Software Research Department"
            CONTACT-INFO
                "This mib is being maintained by the Moxa System Software R&D who handle
product line.

                postal:   Taiwan,Taipei,ShienTien
                        P.O. Box 222
                        Phone:(02)8919-1230

                email:   technical_support@moxa.com"
            DESCRIPTION
                "MIB script for all serial product of Embedded Communication &
Computing .Dep."
            REVISION "201301031111Z"       -- January 03, 2013 at 11:11 GMT
            DESCRIPTION
                "Added LED, Power policy, Accelerometer Objects
                Modify Sensor value SYNTAX ( Gauge32 -> Integer32)"
            REVISION "201212221327Z"       -- December 22, 2012 at 13:27 GMT
            DESCRIPTION
                "Added SystemInfoMgmt"
            REVISION "201203211854Z"       -- March 21, 2012 at 18:54 GMT
            DESCRIPTION
                "This file defines the private Moxa product MIB."
            ::= { embeddedComputer 1 }
```

```
--
-- Type definitions
--

        Minutes ::= Integer32
        KBytes ::= INTEGER
        Second ::= Integer32

--
-- Node definitions
--

        -- 1.3.6.1.4.1.8691
        moxa OBJECT IDENTIFIER ::= { enterprises 8691 }

        -- 1.3.6.1.4.1.8691.17
        embeddedComputer OBJECT IDENTIFIER ::= { moxa 17 }

        -- 1.3.6.1.4.1.8691.17.1.1
        productInfoMgmt OBJECT IDENTIFIER ::= { moxaSystem 1 }

        -- 1.3.6.1.4.1.8691.17.1.1.1
        productName OBJECT-TYPE
            SYNTAX DisplayString
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "Showing product name, eg. UC7110-LX/IA240-LX/DA683-LX/DA683-XPE."
            ::= { productInfoMgmt 1 }

        -- 1.3.6.1.4.1.8691.17.1.1.2
        productDesc OBJECT-TYPE
            SYNTAX DisplayString
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "Showing product short description.(if one exists)."
            ::= { productInfoMgmt 2 }

        -- 1.3.6.1.4.1.8691.17.1.1.3
        productVersion OBJECT-TYPE
            SYNTAX DisplayString
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "Showing product version eg. 1.0/1.0.1"
            ::= { productInfoMgmt 3 }

        -- 1.3.6.1.4.1.8691.17.1.1.4
        productBuildDate OBJECT-TYPE
            SYNTAX DisplayString
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "Showing product last build date, the format is YYMMDDHH.
                eg. 2012/01/23 19:22 -> 12012319."
            ::= { productInfoMgmt 4 }

        -- 1.3.6.1.4.1.8691.17.1.2
        systemInfoMgmt OBJECT IDENTIFIER ::= { moxaSystem 2 }

        -- 1.3.6.1.4.1.8691.17.1.2.1
        systemObject OBJECT IDENTIFIER ::= { systemInfoMgmt 1 }

        -- 1.3.6.1.4.1.8691.17.1.2.1.1
        systemCpuUsage OBJECT-TYPE
            SYNTAX Integer32
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "Show CPU usage rate (0-100 %). Eg. 38"
            ::= { systemObject 1 }

        -- 1.3.6.1.4.1.8691.17.1.2.1.3
        systemMemUsage OBJECT-TYPE
            SYNTAX Integer32
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "Show memory usage rate (0-100 %). Eg. 57"
            ::= { systemObject 3 }

        -- 1.3.6.1.4.1.8691.17.1.2.1.5
        systemUptime OBJECT-TYPE
            SYNTAX Minutes
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "The amount of time since this host was last initialized."
            ::= { systemObject 5 }

        -- 1.3.6.1.4.1.8691.17.1.2.1.6
        systemTotalUptime OBJECT-TYPE
            SYNTAX Minutes
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "The amount of time from total boot up time."
            ::= { systemObject 6 }

        -- 1.3.6.1.4.1.8691.17.1.2.3
        systemStorageObject OBJECT IDENTIFIER ::= { systemInfoMgmt 3 }

        -- 1.3.6.1.4.1.8691.17.1.2.3.1
        systemMemorySize OBJECT-TYPE
            SYNTAX KBytes
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "The amount of physical main memory contained by the host. Eg. 524288
                Note that this is same as hrMemorySize in HOST-RESOURCE."
            ::= { systemStorageObject 1 }

        -- 1.3.6.1.4.1.8691.17.1.2.3.2
        systemVolumeCount OBJECT-TYPE
            SYNTAX Integer32
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "Show total volume count."
            ::= { systemStorageObject 2 }

        -- 1.3.6.1.4.1.8691.17.1.2.3.3
        systemVolumeTable OBJECT-TYPE
            SYNTAX SEQUENCE OF SystemVolumeEntry
            MAX-ACCESS not-accessible
            STATUS current
            DESCRIPTION
                "Table of File System Volume and their values."
            ::= { systemStorageObject 3 }

        -- 1.3.6.1.4.1.8691.17.1.2.3.3.1
        systemVolumeEntry OBJECT-TYPE
            SYNTAX SystemVolumeEntry
            MAX-ACCESS not-accessible
            STATUS current
            DESCRIPTION
                "An entry containing a device and its statistics."
            INDEX { systemVolumeIndex }
            ::= { systemVolumeTable 1 }

        SystemVolumeEntry ::=
            SEQUENCE {
                systemVolumeIndex
                    Integer32,
                systemVolumeName
                    OCTET STRING,
                systemVolumeLabel
                    OCTET STRING,
                systemVolumeSize
                    OCTET STRING,
                systemVolumeAvail
                    OCTET STRING
             }

        -- 1.3.6.1.4.1.8691.17.1.2.3.3.1.1
        systemVolumeIndex OBJECT-TYPE
            SYNTAX Integer32
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "Reference index for each observed device."
            ::= { systemVolumeEntry 1 }

        -- 1.3.6.1.4.1.8691.17.1.2.3.3.1.2
```

```
systemVolumeName OBJECT-TYPE
    SYNTAX OCTET STRING
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The name of the volume.
            Eg. /dev/sda1
            Eg. C:"
    ::= { systemVolumeEntry 2 }

-- 1.3.6.1.4.1.8691.17.1.2.3.3.1.3
systemVolumeLabel OBJECT-TYPE
    SYNTAX OCTET STRING
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The label of the volume.
            Eg. System
            Eg. Data"
    ::= { systemVolumeEntry 3 }

-- 1.3.6.1.4.1.8691.17.1.2.3.3.1.4
systemVolumeSize OBJECT-TYPE
    SYNTAX OCTET STRING
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The total size of the volume.
            Eg. 100.9 MB
            Eg. 3.6 GB"
    ::= { systemVolumeEntry 4 }

-- 1.3.6.1.4.1.8691.17.1.2.3.3.1.5
systemVolumeAvail OBJECT-TYPE
    SYNTAX OCTET STRING
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The available size of the volume.
            Eg. 965 KB
            Eg. 844.8 MB"
    ::= { systemVolumeEntry 5 }

-- 1.3.6.1.4.1.8691.17.1.4
biosMgmt OBJECT IDENTIFIER ::= { moxaSystem 4 }

-- 1.3.6.1.4.1.8691.17.1.4.1
biosVersion OBJECT-TYPE
    SYNTAX DisplayString
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Showing the BIOS version. eg. V1.00S01"
    ::= { biosMgmt 1 }
```

```
-- 1.3.6.1.4.1.8691.17.1.4.2
biosSaveSetting OBJECT-TYPE
    SYNTAX INTEGER
        {
        none(0),
        apply(1),
        discard(2)
        }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Write 1 to save bios setting, and read 0 mean setting had been applied."
    ::= { biosMgmt 2 }

-- 1.3.6.1.4.1.8691.17.1.4.3
biosSettingStatus OBJECT-TYPE
    SYNTAX INTEGER
        {
        same(0),
        modified(1)
        }
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Showing compare of bios CMOS setting and bios new setting."
    ::= { biosMgmt 3 }

-- 1.3.6.1.4.1.8691.17.1.4.4
bootSequence OBJECT IDENTIFIER ::= { biosMgmt 4 }

-- 1.3.6.1.4.1.8691.17.1.4.4.1
bootDeviceStatus OBJECT-TYPE
    SYNTAX DisplayString
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Showing the current support boot device."
    ::= { bootSequence 1 }

-- 1.3.6.1.4.1.8691.17.1.4.4.2
firstBootDevice OBJECT-TYPE
    SYNTAX Integer32 (1..99)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "read show current first boot device, write set boot device."
    ::= { bootSequence 2 }

-- 1.3.6.1.4.1.8691.17.1.4.8
powerFeature OBJECT IDENTIFIER ::= { biosMgmt 8 }

-- 1.3.6.1.4.1.8691.17.1.4.8.1
pwrOnAfterPwrFail OBJECT-TYPE
    SYNTAX INTEGER
        {
```

```
        off(0),
        on(1),
        former(2)
        }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Select power on after power fail behavior."
    ::= { powerFeature 1 }

-- 1.3.6.1.4.1.8691.17.1.4.8.3
pwrLanWakeUp OBJECT-TYPE
    SYNTAX INTEGER
        {
        disbale(0),
        enable(1)
        }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Enable/Disable wake on LAN functionality."
    ::= { powerFeature 3 }

-- 1.3.6.1.4.1.8691.17.1.5
sensorMgmt OBJECT IDENTIFIER ::= { moxaSystem 5 }

-- 1.3.6.1.4.1.8691.17.1.5.1
sensorObject OBJECT IDENTIFIER ::= { sensorMgmt 1 }

-- 1.3.6.1.4.1.8691.17.1.5.1.1
tempSensorsTable OBJECT-TYPE
    SYNTAX SEQUENCE OF TempSensorsEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Table of temperature sensors and their values."
    ::= { sensorObject 1 }

-- 1.3.6.1.4.1.8691.17.1.5.1.1.1
tempSensorsEntry OBJECT-TYPE
    SYNTAX TempSensorsEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An entry containing a device and its statistics."
    INDEX { tempSensorsIndex }
    ::= { tempSensorsTable 1 }

TempSensorsEntry ::=
    SEQUENCE {
        tempSensorsIndex
            Integer32,
        tempSensorsDevice
            DisplayString,
        tempSensorsValue
```

```
            Integer32
     }

-- 1.3.6.1.4.1.8691.17.1.5.1.1.1.1
tempSensorsIndex OBJECT-TYPE
    SYNTAX Integer32 (1..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Reference index for each observed device."
    ::= { tempSensorsEntry 1 }

-- 1.3.6.1.4.1.8691.17.1.5.1.1.1.2
tempSensorsDevice OBJECT-TYPE
    SYNTAX DisplayString
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The name of the temperature sensor we are reading."
    ::= { tempSensorsEntry 2 }

-- 1.3.6.1.4.1.8691.17.1.5.1.1.1.3
tempSensorsValue OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The temperature of this sensor in mC."
    ::= { tempSensorsEntry 3 }

-- 1.3.6.1.4.1.8691.17.1.5.1.2
voltSensorsTable OBJECT-TYPE
    SYNTAX SEQUENCE OF VoltSensorsEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Table of voltage sensors and their values."
    ::= { sensorObject 2 }

-- 1.3.6.1.4.1.8691.17.1.5.1.2.1
voltSensorsEntry OBJECT-TYPE
    SYNTAX VoltSensorsEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An entry containing a device and its statistics."
    INDEX { voltSensorsIndex }
    ::= { voltSensorsTable 1 }

VoltSensorsEntry ::=
    SEQUENCE {
        voltSensorsIndex
            Integer32,
        voltSensorsDevice
            DisplayString,
        voltSensorsValue
            Integer32
     }

-- 1.3.6.1.4.1.8691.17.1.5.1.2.1.1
voltSensorsIndex OBJECT-TYPE
    SYNTAX Integer32 (1..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Reference index for each observed device."
    ::= { voltSensorsEntry 1 }

-- 1.3.6.1.4.1.8691.17.1.5.1.2.1.2
voltSensorsDevice OBJECT-TYPE
    SYNTAX DisplayString
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The name of the device we are reading."
    ::= { voltSensorsEntry 2 }

-- 1.3.6.1.4.1.8691.17.1.5.1.2.1.3
voltSensorsValue OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The voltage in mV."
    ::= { voltSensorsEntry 3 }

-- 1.3.6.1.4.1.8691.17.1.5.1.3
accelerometerTable OBJECT-TYPE
    SYNTAX SEQUENCE OF AccelerometerEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Table of accelerometer and their values."
    ::= { sensorObject 3 }

-- 1.3.6.1.4.1.8691.17.1.5.1.3.1
accelerometerEntry OBJECT-TYPE
    SYNTAX AccelerometerEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An entry containing a device and its statistics."
    INDEX { accelerometerIndex }
    ::= { accelerometerTable 1 }

AccelerometerEntry ::=
    SEQUENCE {
        accelerometerIndex
            Integer32,
        accelerometerAxis
```

```
            DisplayString,
        accelerometerValue
            DisplayString,
        accelerometerTimestamp
            DisplayString
     }

-- 1.3.6.1.4.1.8691.17.1.5.1.3.1.1
accelerometerIndex OBJECT-TYPE
    SYNTAX Integer32 (1..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Reference index for each observed device."
    ::= { accelerometerEntry 1 }

-- 1.3.6.1.4.1.8691.17.1.5.1.3.1.2
accelerometerAxis OBJECT-TYPE
    SYNTAX DisplayString
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The name of the accelerometer axis we are reading."
    ::= { accelerometerEntry 2 }

-- 1.3.6.1.4.1.8691.17.1.5.1.3.1.3
accelerometerValue OBJECT-TYPE
    SYNTAX DisplayString
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The accelerometer value in mG."
    ::= { accelerometerEntry 3 }

-- 1.3.6.1.4.1.8691.17.1.5.1.3.1.4
accelerometerTimestamp OBJECT-TYPE
    SYNTAX DisplayString
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The timestamp when accelerometer measured."
    ::= { accelerometerEntry 4 }

-- 1.3.6.1.4.1.8691.17.1.6
peripheralMgmt OBJECT IDENTIFIER ::= { moxaSystem 6 }

-- 1.3.6.1.4.1.8691.17.1.6.1
perIoMgmt OBJECT IDENTIFIER ::= { peripheralMgmt 1 }

-- 1.3.6.1.4.1.8691.17.1.6.1.1
ioObject OBJECT IDENTIFIER ::= { perIoMgmt 1 }

-- 1.3.6.1.4.1.8691.17.1.6.1.1.1
ioDiNumber OBJECT-TYPE
    SYNTAX Integer32 (0..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Number of digital input pin in current system."
    ::= { ioObject 1 }

-- 1.3.6.1.4.1.8691.17.1.6.1.1.2
ioDiTable OBJECT-TYPE
    SYNTAX SEQUENCE OF IoDiEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Table of digital input and their values."
    ::= { ioObject 2 }

-- 1.3.6.1.4.1.8691.17.1.6.1.1.2.1
ioDiEntry OBJECT-TYPE
    SYNTAX IoDiEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An entry containing a digital input pin and its statistics."
    INDEX { diIndex }
    ::= { ioDiTable 1 }

IoDiEntry ::=
    SEQUENCE {
        diIndex
            Integer32,
        diPort
            Integer32,
        diValue
            INTEGER,
        diTrapEnable
            INTEGER
     }

-- 1.3.6.1.4.1.8691.17.1.6.1.1.2.1.1
diIndex OBJECT-TYPE
    SYNTAX Integer32 (1..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Reference index for each digital input pin."
    ::= { ioDiEntry 1 }

-- 1.3.6.1.4.1.8691.17.1.6.1.1.2.1.2
diPort OBJECT-TYPE
    SYNTAX Integer32 (0..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The port number of digital input pin."
    ::= { ioDiEntry 2 }
```

```
        -- 1.3.6.1.4.1.8691.17.1.6.1.1.2.1.3
        diValue OBJECT-TYPE
            SYNTAX INTEGER
                {
                low(0),
                high(1)
                }
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "The digital input status, 0 is low, 1 is high."
            ::= { ioDiEntry 3 }

        -- 1.3.6.1.4.1.8691.17.1.6.1.1.2.1.4
        diTrapEnable OBJECT-TYPE
            SYNTAX INTEGER
                {
                disable(0),
                enable(1)
                }
            MAX-ACCESS read-write
            STATUS current
            DESCRIPTION
                "Agent will send trap message when digital input pin status changed
and this object enabled."
            ::= { ioDiEntry 4 }

        -- 1.3.6.1.4.1.8691.17.1.6.1.1.3
        ioDoNumber OBJECT-TYPE
            SYNTAX Integer32 (0..65535)
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "Number of digital output pin in current system."
            ::= { ioObject 3 }

        -- 1.3.6.1.4.1.8691.17.1.6.1.1.4
        ioDoTable OBJECT-TYPE
            SYNTAX SEQUENCE OF IoDoEntry
            MAX-ACCESS not-accessible
            STATUS current
            DESCRIPTION
                "Table of digital output and their values."
            ::= { ioObject 4 }

        -- 1.3.6.1.4.1.8691.17.1.6.1.1.4.1
        ioDoEntry OBJECT-TYPE
            SYNTAX IoDoEntry
            MAX-ACCESS not-accessible
            STATUS current
            DESCRIPTION
                "An entry containing a digital output pin and its statistics."
            INDEX { doIndex }
            ::= { ioDoTable 1 }
```

```
IoDoEntry ::=
    SEQUENCE {
        doIndex
            Integer32,
        doPort
            Integer32,
        doValue
            INTEGER
     }

-- 1.3.6.1.4.1.8691.17.1.6.1.1.4.1.1
doIndex OBJECT-TYPE
    SYNTAX Integer32 (1..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Reference index for each digital output pin."
    ::= { ioDoEntry 1 }

-- 1.3.6.1.4.1.8691.17.1.6.1.1.4.1.2
doPort OBJECT-TYPE
    SYNTAX Integer32 (0..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The port number of digital output pin."
    ::= { ioDoEntry 2 }

-- 1.3.6.1.4.1.8691.17.1.6.1.1.4.1.3
doValue OBJECT-TYPE
    SYNTAX INTEGER
        {
        low(0),
        high(1)
        }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "The digital output status, 0 is low, 1 is high."
    ::= { ioDoEntry 3 }

-- 1.3.6.1.4.1.8691.17.1.6.1.2
ioNotification OBJECT IDENTIFIER ::= { perIoMgmt 2 }

-- 1.3.6.1.4.1.8691.17.1.6.1.2.1
ioDiChange NOTIFICATION-TYPE
    STATUS current
    DESCRIPTION
        "This trap is sent when digital input pin status changed."
    ::= { ioNotification 1 }

-- 1.3.6.1.4.1.8691.17.1.6.2
perLedMgmt OBJECT IDENTIFIER ::= { peripheralMgmt 2 }

-- 1.3.6.1.4.1.8691.17.1.6.2.1
```

```
ledNumber OBJECT-TYPE
    SYNTAX Integer32 (0..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Description."
    ::= { perLedMgmt 1 }

-- 1.3.6.1.4.1.8691.17.1.6.2.2
ledTable OBJECT-TYPE
    SYNTAX SEQUENCE OF LedEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Description."
    ::= { perLedMgmt 2 }

-- 1.3.6.1.4.1.8691.17.1.6.2.2.1
ledEntry OBJECT-TYPE
    SYNTAX LedEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Description."
    INDEX { ledIndex }
    ::= { ledTable 1 }

LedEntry ::=
    SEQUENCE {
        ledIndex
            Integer32,
        ledPort
            Integer32,
        ledValue
            INTEGER
     }

-- 1.3.6.1.4.1.8691.17.1.6.2.2.1.1
ledIndex OBJECT-TYPE
    SYNTAX Integer32 (1..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Description."
    ::= { ledEntry 1 }

-- 1.3.6.1.4.1.8691.17.1.6.2.2.1.2
ledPort OBJECT-TYPE
    SYNTAX Integer32 (0..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Description."
    ::= { ledEntry 2 }
```

```
-- 1.3.6.1.4.1.8691.17.1.6.2.2.1.3
ledValue OBJECT-TYPE
    SYNTAX INTEGER
        {
        off(0),
        on(1)
        }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Description."
    ::= { ledEntry 3 }

-- 1.3.6.1.4.1.8691.17.1.6.3
perSerialMgmt OBJECT IDENTIFIER ::= { peripheralMgmt 3 }

-- 1.3.6.1.4.1.8691.17.1.6.3.1
uartNumber OBJECT-TYPE
    SYNTAX Integer32 (0..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Number of internal UART in current system."
    ::= { perSerialMgmt 1 }

-- 1.3.6.1.4.1.8691.17.1.6.3.2
uartConfigTable OBJECT-TYPE
    SYNTAX SEQUENCE OF UartConfigEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Table of internal UART and their values."
    ::= { perSerialMgmt 2 }

-- 1.3.6.1.4.1.8691.17.1.6.3.2.1
uartConfigEntry OBJECT-TYPE
    SYNTAX UartConfigEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An entry containing a UART port and its statistics."
    INDEX { uartIndex }
    ::= { uartConfigTable 1 }

UartConfigEntry ::=
    SEQUENCE {
        uartIndex
            Integer32,
        uartType
            INTEGER
     }

-- 1.3.6.1.4.1.8691.17.1.6.3.2.1.1
uartIndex OBJECT-TYPE
    SYNTAX Integer32 (1..65535)
```

```
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "Reference index for each UART port."
            ::= { uartConfigEntry 1 }

        -- 1.3.6.1.4.1.8691.17.1.6.3.2.1.2
        uartType OBJECT-TYPE
            SYNTAX INTEGER
                {
                rs232(0),
                rs485w2(1),
                rs422(2),
                rs485w4(3)
                }
            MAX-ACCESS read-write
            STATUS current
            DESCRIPTION
                "The UART mode, 0 is RS232, 1 is RS485 2 wires, 2 is RS422, 3 is RS485
4 wires."
            ::= { uartConfigEntry 2 }

        -- 1.3.6.1.4.1.8691.17.1.6.4
        perUsbMgmt OBJECT IDENTIFIER ::= { peripheralMgmt 4 }

        -- 1.3.6.1.4.1.8691.17.1.6.4.1
        usbObject OBJECT IDENTIFIER ::= { perUsbMgmt 1 }

        -- 1.3.6.1.4.1.8691.17.1.6.4.1.1
        usbNumber OBJECT-TYPE
            SYNTAX Integer32 (0..65535)
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                "The number of ports regardless of their current state
                in the usb general port table"
            ::= { usbObject 1 }

        -- 1.3.6.1.4.1.8691.17.1.6.4.1.3
        usbDeviceTable OBJECT-TYPE
            SYNTAX SEQUENCE OF UsbDeviceEntry
            MAX-ACCESS not-accessible
            STATUS current
            DESCRIPTION
                "A list of USB device ports. Usually the device has
                only one USB device port"
            ::= { usbObject 3 }

        -- 1.3.6.1.4.1.8691.17.1.6.4.1.3.1
        usbDeviceEntry OBJECT-TYPE
            SYNTAX UsbDeviceEntry
            MAX-ACCESS not-accessible
            STATUS current
            DESCRIPTION
                "Status and parameter values for the USB device port."
```

```
    INDEX { usbDeviceIndex }
    ::= { usbDeviceTable 1 }

UsbDeviceEntry ::=
    SEQUENCE {
        usbDeviceIndex
            Integer32,
        usbDeviceVendorID
            OCTET STRING,
        usbDeviceProductID
            OCTET STRING,
        usbDeviceActiveClass
            INTEGER
     }

-- 1.3.6.1.4.1.8691.17.1.6.4.1.3.1.1
usbDeviceIndex OBJECT-TYPE
    SYNTAX Integer32 (1..65535)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The index is identical to usbPortIndex for the
        correspondent USB port"
    ::= { usbDeviceEntry 1 }

-- 1.3.6.1.4.1.8691.17.1.6.4.1.3.1.2
usbDeviceVendorID OBJECT-TYPE
    SYNTAX OCTET STRING
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The USB device port vendor HEX-formatted string as it
        is provided to the USB host by the USB device"
    ::= { usbDeviceEntry 2 }

-- 1.3.6.1.4.1.8691.17.1.6.4.1.3.1.3
usbDeviceProductID OBJECT-TYPE
    SYNTAX OCTET STRING
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The product ID HEX-formatted string as it is provided
        to the USB host by the USB device"
    ::= { usbDeviceEntry 3 }

-- 1.3.6.1.4.1.8691.17.1.6.4.1.3.1.4
usbDeviceActiveClass OBJECT-TYPE
    SYNTAX INTEGER
        {
        other(1),
        hid(2),
        mass(3)
        }
    MAX-ACCESS read-only
    STATUS current
```

```
            DESCRIPTION
                "This object returns USB Device Class type of the
                active configuration"
            ::= { usbDeviceEntry 4 }

        -- 1.3.6.1.4.1.8691.17.1.6.4.1.4
        usbPlugTrapEnable OBJECT-TYPE
            SYNTAX INTEGER
                {
                disable(0),
                enable(1)
                }
            MAX-ACCESS read-write
            STATUS current
            DESCRIPTION
                "Agent will send trap message when USB device inserted or removed and
this object enabled."
            ::= { usbObject 4 }

        -- 1.3.6.1.4.1.8691.17.1.6.4.2
        usbNotification OBJECT IDENTIFIER ::= { perUsbMgmt 2 }

        -- 1.3.6.1.4.1.8691.17.1.6.4.2.1
        usbPlugEvent NOTIFICATION-TYPE
            STATUS current
            DESCRIPTION
                "This trap is sent when USB device inserted or removed."
            ::= { usbNotification 1 }

        -- 1.3.6.1.4.1.8691.17.1.6.6
        perSystemMgmt OBJECT IDENTIFIER ::= { peripheralMgmt 6 }

        -- 1.3.6.1.4.1.8691.17.1.6.6.2
        systemWatchdog OBJECT IDENTIFIER ::= { perSystemMgmt 2 }

        -- 1.3.6.1.4.1.8691.17.1.6.6.2.1
        watchdogPeriod OBJECT-TYPE
            SYNTAX Second (0..255)
            MAX-ACCESS read-write
            STATUS current
            DESCRIPTION
                "Watchdog period, 0 means disable watchdog monitor program; otherwise
enable watchdog monitor program and configure the expired time."
            ::= { systemWatchdog 1 }

        -- 1.3.6.1.4.1.8691.17.1.6.6.2.2
        watchdogStatus OBJECT-TYPE
            SYNTAX INTEGER
                {
                running(1),
                stopped(2)
                }
            MAX-ACCESS read-write
            STATUS current
            DESCRIPTION
```

```
                "To show the watchdog monitor program status."
            ::= { systemWatchdog 2 }

        -- 1.3.6.1.4.1.8691.17.1.7
        powerMgmt OBJECT IDENTIFIER ::= { moxaSystem 7 }

        -- 1.3.6.1.4.1.8691.17.1.7.2
        powerPolicy OBJECT-TYPE
            SYNTAX INTEGER
                {
                balanced(1),
                power_saver(2),
                high_performance(3)
                }
            MAX-ACCESS read-write
            STATUS current
            DESCRIPTION
                "Current system power policy."
            ::= { powerMgmt 2 }

        -- 1.3.6.1.4.1.8691.17.1.9
        notificationMgmt OBJECT IDENTIFIER ::= { moxaSystem 9 }

        -- 1.3.6.1.4.1.8691.17.1.9.1
        moxaSystemTrapIP OBJECT-TYPE
            SYNTAX IpAddress
            MAX-ACCESS read-write
            STATUS current
            DESCRIPTION
                "Set Trap IP address. eg. 192.168.1.100"
            ::= { notificationMgmt 1 }

        -- 1.3.6.1.4.1.8691.17.1.9.2
        moxaSystemTrapCommunity OBJECT-TYPE
            SYNTAX OCTET STRING (SIZE (0..127))
            MAX-ACCESS read-write
            STATUS current
            DESCRIPTION
                "Trap community. eg. public"
            ::= { notificationMgmt 2 }

    END
--
-- MOXA-SYS-MIB.txt
--
```

C

Sample Scripts and Firewall Rules

Here are the sample scripts referenced in this manual that were too long to include in the text.

The following topics are covered in this appendix:

❒ **A Sample Initialization Script**

❒ **A Sample Firewall**

A Sample Initialization Script

```
#! /bin/sh
# Copyright (c) XXXX <<Your Name Here>>
# All rights reserved.
#
#
# /etc/init.d/<<name of your script here>>
#   and its symbolic link
# /usr/sbin/rc<<name of your script here>>

### BEGIN INIT INFO
# Provides:          <<name of your script here>>
# Required-Start:    $network
# Required-Stop:
# Default-Start:     3 5
# Default-Stop:      0 1 2 6
# Short-Description: The <<name of your script here>> daemon provides....
# Description:       The <<name of your script here>> daemon is ...
#    that is active in runlevels 3 and 5.
#
### END INIT INFO

# Check for missing binaries
<<NAME OF YOUR SCRIPT HERE>>_BIN=/usr/bin/<<name of your script here>>
test -x $<<NAME OF YOUR SCRIPT HERE>>_BIN || { echo "$<<NAME OF YOUR SCRIPT
HERE>>_BIN not installed";
        if [ "$1" = "stop" ]; then exit 0;
        else exit 5; fi; }

# Check for existence of needed configuration file and read it
<<NAME OF YOUR SCRIPT HERE>>_CONFIG=/etc/<<name of your script here>>.cfg
test -r $<<NAME OF YOUR SCRIPT HERE>>_CONFIG || { echo "$<<NAME OF YOUR SCRIPT
HERE>>_CONFIG not existing";
        if [ "$1" = "stop" ]; then exit 0;
        else exit 6; fi; }

# Read config
. $<<NAME OF YOUR SCRIPT HERE>>_CONFIG

# Load the rc.status script for this service.
. /etc/rc.status

# Reset status of this service
rc_reset

case "$1" in
    start)
        echo -n "Starting <<name of your script here>> "
        ## Start daemon with startproc(8). If this fails
        ## the return value is set appropriately by startproc.
        startproc $<<NAME OF YOUR SCRIPT HERE>>_BIN

        # Remember status and be verbose
        rc_status -v
        ;;
    stop)
        echo -n "Shutting down <<name of your script here>> "
        ## Stop daemon with killproc(8) and if this fails
        ## killproc sets the return value according to LSB.

        killproc -TERM $<<NAME OF YOUR SCRIPT HERE>>_BIN

        # Remember status and be verbose
        rc_status -v
        ;;
    restart)
        ## Stop the service and regardless of whether it was
        ## running or not, start it again.
        $0 stop
        $0 start

        # Remember status and be quiet
        rc_status
        ;;
    reload)
        # If it supports signaling:
        echo -n "Reload service bar "
        killproc -HUP $BAR_BIN
        #touch /var/run/<<NAME OF YOUR SCRIPT HERE>>.pid
        rc_status -v

        ## Otherwise if it does not support reload:
        #rc_failed 3
        #rc_status -v
        ;;
    status)
        echo -n "Checking for service <<name of your script here>> "
        ## Check status with checkproc(8), if process is running
        ## checkproc will return with exit status 0.

        # Return value is slightly different for the status command:
        # 0 - service up and running
        # 1 - service dead, but /var/run/  pid  file exists
        # 2 - service dead, but /var/lock/ lock file exists
        # 3 - service not running (unused)
        # 4 - service status unknown :-(
        # 5--199 reserved (5--99 LSB, 100--149 distro, 150--199 appl.)

        # NOTE: checkproc returns LSB compliant status values.
        checkproc $<<NAME OF YOUR SCRIPT HERE>>_BIN
        # NOTE: rc_status knows that we called this init script with
        # "status" option and adapts its messages accordingly.
        rc_status -v
        ;;
    *)
        ## If no parameters are given, print which are avaiable.
        echo "Usage: $0 {start|stop|status|restart|reload}"
```

```
       exit 1
       ;;
esac
rc_exit
```

A Sample Firewall

```
 #!/bin/bash
 # If you put this shell script in the /home/nat.sh
 # Remember to chmod 744 /home/nat.sh
 # Edit the rc.local file to make this shell startup automatically.
 # vi /etc/rc.local
 # Add a line in the end of rc.local /home/nat.sh
 EXIF= “eth0”  #This is an external interface for setting up a valid IP address.
 EXNET= “192.168.4.0/24”  #This is an internal network address.
 # Step 1. Insert modules.
 # Here 2> /dev/null means the standard error messages will be dump to null device.
 modprobe ip_tables  2> /dev/null
 modprobe ip_nat_ftp  2> /dev/null
 modprobe ip_nat_irc  2> /dev/null
 modprobe ip_conntrack  2> /dev/null
 modprobe ip_conntrack_ftp  2> /dev/null
 modprobe ip_conntrack_irc  2> /dev/null
 # Step 2. Define variables, enable routing and erase default rules.
 PATH=/bin:/sbin:/usr/bin:/usr/sbin:/usr/local/bin:/usr/local/sbin
 export PATH
 echo “1” > /proc/sys/net/ipv4/ip_forward
 /sbin/iptables -F
 /sbin/iptables -X
 /sbin/iptables -Z
 /sbin/iptables -F -t nat
 /sbin/iptables -X -t nat
 /sbin/iptables -Z -t nat
 /sbin/iptables -P INPUT ACCEPT
 /sbin/iptables -P OUTPUT ACCEPT
 /sbin/iptables -P FORWARD ACCEPT
 /sbin/iptables -t nat -P PREROUTING ACCEPT
 /sbin/iptables -t nat -P POSTROUTING ACCEPT
 /sbin/iptables -t nat -P OUTPUT ACCEPT
 # Step 3. Enable IP masquerade.
 #ehco 1 > /proc/sys/net/ipv4/ip_forward
 #modprobe ipt_MASQUERADE
#iptables –t nat –A POSTROUTING –o eth0 –j MASQUERADE
```