Introduction:

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Matrix 510/520 are ARM9-based Linux ready industrial computer. The key features are as follow:

1. ARM920T ARM Thumb Processor with 200MIPS at 180MHz, Memory Management Unit
2. 16-KByte Data Cache and 16-KByte Instruction Cache
3. 64MB SDRAM, 16MB Flash on board
4. Two 10/100 Mbps Ethernet
5. Two USB 2.0 full speed (12 Mbps) Host Ports
6. Multimedia Card Interface for SD memory card
7. Five 3-in-1 RS-232/422/485 ports and three RS-232 ports
8. 21 programmable Digital I/O port
9. LCM Display (2x18 character mode) with backlight (Matrix 520 only)
10. Audio Output
11. 9 to 40VDC power input
12. Pre-installed Standard Linux 2.6 OS
13. GNU tool chain available in Artila CD
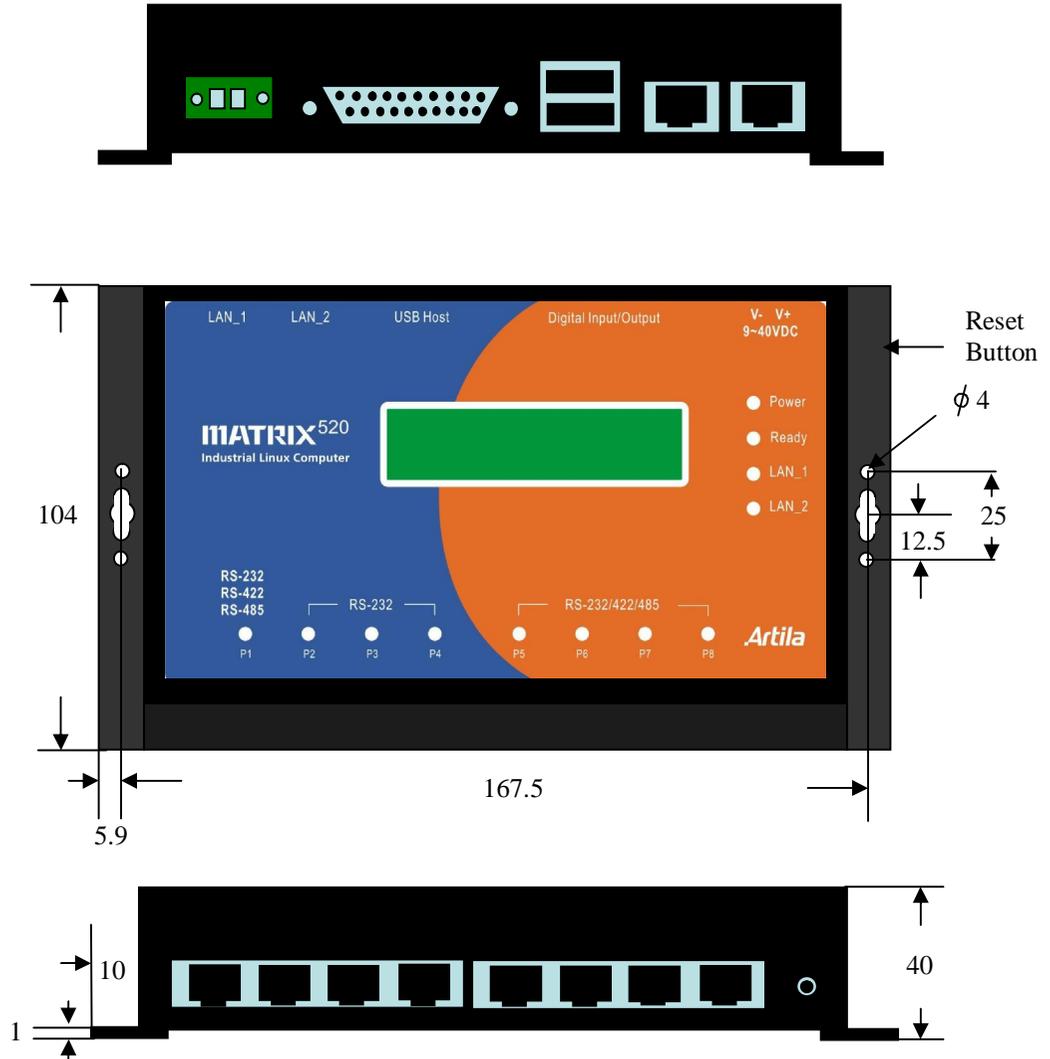14. Optional DIN RAIL mounting adaptor

Packing List

1. Matrix 520 Box Computer
2. Wall mount bracket
3. Artila CD

Optional Accessory:

1. CB-RJ45F9-150: RJ45 to DB9 Female Cable
2. CB-RJ2CON-100: Serial Console Cable
3. DK-35A: DIN RAIL Mounting Kit

Matrix 520 Layout

Reset Button
Press the "Reset" button to activate the hardware reset. You should only use this function if the software does not function properly.

Power LED
The Power LED will show solid green if power is properly applied

Ready LED
The Ready LED will show solid green if Matrix 520 complete system boot up.   If Ready LED is off during system boot up, please check if power input is correct. Turn off the power and restart Matrix 520 again. If Ready LED is still off, please contact the manufacture for technical support.

Link/Act LED
When Ethernet port are connected to the network, Link/ Act will show solid green and if there is traffic is the Ethernet, this LED will flash

Serial Port LED
These eight dual color LEDs indicate the data traffic at the serial ports. When RXD line is high then Green light is ON and when TXD line is high, Yellow light is ON.

Ethernet Port

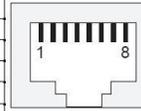| Pin	Signal
1	ETx+
2	ETx-
3	ERx+
6	ERx-
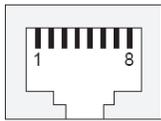
Serial Ports:
Port 1,5,6,7 and 8: 3-in-1 RS-232/422/485
Port 2: RS-232 with full modem control
Port 3, 4: RS-232 with hardware flow control
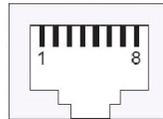
Note: RS-232/422/485 is software selection

Pin	RS-232	RS-422	RS-485
1	DSR	---	---
2	RTS	TXD+	Data+
3	GND	GND	GND
4	TXD	TXD-	Data-
5	RXD	RXD+	---
6	DCD	RXD-	---
7	CTS	---	---
8	DTR	---	---

Serial Console Port:
Serial console port share the connector with Serial port 3 but the pin definition as shown as follow:

P3

Pin	RS-232
1	
2	TXD
3	GND
4	
5	
6	
7	RXD
8	

The serial console port is disabled as factory default setting. To enable the serial console, you need to use the serial console cable and connect it to port 3.   Use any terminal software such as hyper terminal and setting as follow:
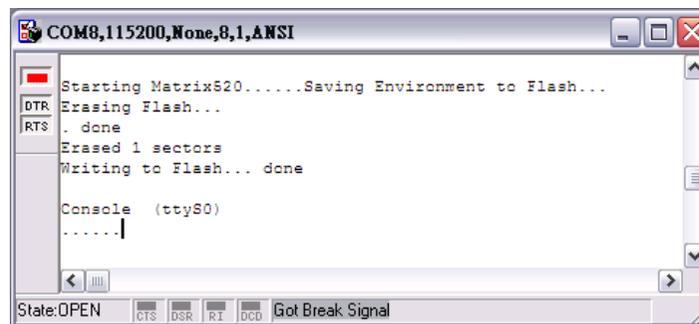
Baud Rate: 115200
Data bits: 8
Parity: N
Stop bit: 1
Terminal type: ANSI

Right after powering on the system, keep typing $ continuously until you see the message as shown in the figure followed. Console (ttyS0) stands for console port ttyS0 is enabled. Repeat this procedure will disable the serial console and Screen will show "Console (null)"

Digital I/O Port (DB25 Female)
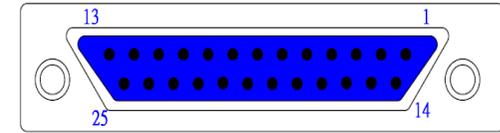
Pin No.	Function	Pin No.	Function
1	DIO0	14	DIO13
2	DIO1	15	DIO14
3	DIO2	16	DIO15
4	DIO3	17	DIO16
5	DIO4	18	DIO17
6	DIO5	19	DIO18
7	DIO6	20	DIO19
8	DIO7	21	DIO20
9	DIO8	22	GND
10	DIO9	23	GND
11	DIO10	24	VCC3
12	DIO11	25	VCC5
13	DIO12		

Note:
1. VCC3: 3.3 VDC output
2. VCC5: 5 VDC output
3. GND: Digital Ground

Factory Default Settings

LAN 1 IP Address: 192.168.2.127
LAN 2 IP Address: DHCP
Login: guest
Password: guest
Supervisor: root (ssh supported)
Password: root

Network Settings

```
# cat /etc/rc
hostname Matrix520
hwclock -s
mount -t proc proc /proc
mount -o remount,rw /dev/root /
mount /sys
ifconfig lo 127.0.0.1
ifconfig eth0 192.168.2.127 netmask 255.255.255.0
route add default gw 192.168.2.254
route add -net 127.0.0.0 netmask 255.255.255.0 lo
ifconfig eth1 up
dhcpcd eth1 &
lcdctl --lcdon --ip
cat /etc/motd

#
```

To configure the IP address, Netmask and Gateway setting, please modify /disk/etc/rc as following:
ifconfig eth0 192.168.2.127 netmask 255.255.255.0
For DHCP setting:
dhcpcd eth1 &

Wireless LAN Configuration

Matrix 520 supports wireless LAN by using USB WLAN adaptor which uses Ralink RT2570 (rt2570) /2571 (rt73)controller. Please refer to the website http://ralink.rapla.net for the supporting list of the USB WLAN adaptor.
To configure the wireless LAN setting, please use command:
modprobe rt73 or *modprobe rt2570*
ifconfig wlan0 up
iwconfig wlan0 essid XXXX key YYYYYYYY mode MMMM
For infrastructure mode XXXX is the access point name and YYYYYYYY is the encryption key and MMMM should be *managed*
For Ad-Hoc mode mode XXXX is the Matrix 500 device name and YYYYYYYY is the encryption key MMMM should be *ad-hoc*.
To configure the IP address use command
dhcpcd wlan0 & or *ifconfig wlan0 192.168.2.127 netmask 255.255.255.0*

File System

```
Telnet 192.168.2.127

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

guest@Matrix520 ~>mount
/dev/ram0 on / type ext2 (rw,nogrpid)
/dev/mtdblock4 on /mnt/disk type jffs2 (rw,noatime)
/proc on /proc type proc (rw,nodiratime)
/dev/sys on /sys type sysfs (rw)
guest@Matrix520 ~>df
Filesystem       1k-blocks     Used Available Use% Mounted on
/dev/ram0             8059     6777       873  89% /
/dev/mtdblock4       11648      532     11116   5% /mnt/disk
guest@Matrix520 ~>
```

Matrix 520 configures the root file system as RAMDISK and the user disk (/disk) which includes /home and /etc directory are configured as Flash Disk. To find out the file system information, please use command /mount as show as above. In addition, use command /df to find out the disk space of the disk. The RAMDISK uses 8MB memory space to store the root file system and the user disk is about 11MB for user's program storage.
Therefore, user's program and utility software must be saved in the user disk space (/disk). Files saved to other directory will be loss after power off !!!

```
Telnet 192.168.2.127

guest@Matrix520 />ls
bin         disk        lib         proc        tmp
default     etc         lost+found  sbin        usr
dev         home        mnt         sys         var
guest@Matrix520 />
```

Devices list

The supported devices are shown at /dev directory. Following list are most popular ones:
1. ttyS0: serial console port
2. ttyS1 to ttyS8: serial port 1 to port 8
3. mmc to mmc2: SD memory card
4. sda to sde: USB flash disk
5. ttyUSB0 to ttyUSB1: USB RS-232 adaptor (fdti_sio.ko)
6. rtc: Real Time Clock
7. gpio: General Purpose digital I/O
8. ttyACM0 and ttyACM1: USB Modem (CDC compliant)

```
Telnet 192.168.2.127

guest@Matrix520 /dev>ls
console  mem       mtdblock4  ptyp8   sde        ttyACM0
cua0     midi00    mtdr0      ptyp9   sequencer  ttyACM1
cua1     mixer     mtdr1      ram0    sndstat    ttyS0
dsp      mmc       mtdr2      ram1    spi0       ttyS1
flash    mmc0      mtdr3      ram2    spi1       ttyS2
gpio     mmc1      mtdr4      ram3    tty        ttyS3
hda      mmc2      null       random  tty0       ttyS4
hda1     mtd0      ppp        rtc     tty1       ttyS5
hda2     mtd1      ptyp0      sda     tty2       ttyS6
hda3     mtd2      ptyp1      sda1    tty3       ttyS7
hda4     mtd3      ptyp2      sda2    tty4       ttyS8
ipsec    mtd4      ptyp3      sda3    tty5       ttyUSB0
kmem     mtdblock0 ptyp4      sda4    tty6       ttyUSB1
lcd      mtdblock1 ptyp5      sdb     tty7       ttyp0
ledman   mtdblock2 ptyp6      sdc     tty8       ttyp1
log      mtdblock3 ptyp7      sdd     tty9       ttyp2
guest@Matrix520 /dev>
```

Utility Software:

Matrix 520 includes busybox utility collection and Artila utility software as follow:

```
Telnet 192.168.2.127

guest@Matrix520 /bin>ls
addgroup    echo           ln              setuart
adduser     egrep          login           sh
amgrd       false          ls              sleep
bash        fgrep          mkdir           sshd
boa         ftpd           mke2fs          stty
busybox     gpioctl        mkfs.jffs2      su
cat         grep           mknod           sync
chat        gunzip         mktemp          tar
chgrp       gzip           more            telnetd
chmod       hostname       mount           tip
chown       inetd          mp3play         tone
cp          init           mv              touch
cpu         iptables       netstat         true
date        iptables-restore pidof         umount
delgroup    iptables-save  ping            update
deluser     iwconfig       pppd            usleep
df          iwlist         ps              version
dhcpcd      iwpriv         pwd             vi
discard     kill           rm              vplay
dmesg       lcdctl         rmdir           zcat
guest@Matrix520 /bin>
```

Image/diagram (Flash/SDRAM memory layout):

FLASH 16MB — 4MB: Image of Loader, Linux Kernel and Root file system; 12MB: User disk (/disk) Note: user programs, HTML files, and data should be stored in this space

de-compress

SDRAM 64MB — Uboot loader | Linux Kernel 2.6.14 | Root file system (/bin, /lib, /proc, /tmp, /usr, /dev, /mnt, /sys, /var etc.,) | Free memory space

16MB   48MB

Artila Utility Software:

The introduction of Artila utility software as follow:

1. *update* : update loader, kernel or root file system image. Also use *update —FORMAT* to format user disk. Type *update—help* to find the command usage
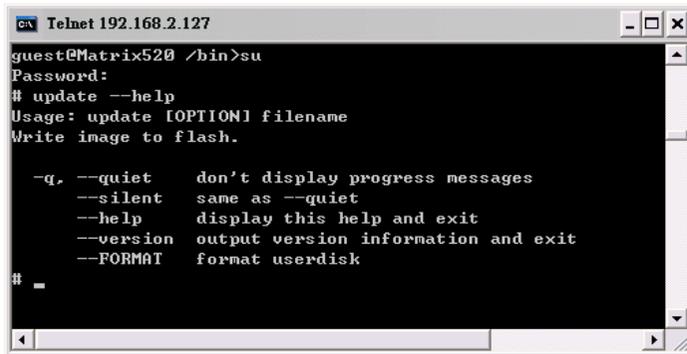
```
Telnet 192.168.2.127                              _ □ ×
guest@Matrix520 /bin>su
Password:
# update --help
Usage: update [OPTION] filename
Write image to flash.

  -q, --quiet      don't display progress messages
      --silent     same as --quiet
      --help       display this help and exit
      --version    output version information and exit
      --FORMAT     format userdisk

# _
```

Update can only operated under supervisor mode (password : root)

2. *setuart:* configure serial port setting. An example show as followed to configure port 1 as RS-485 interface with baud rate 921600. Please note only port 1 support 9-bit data at RS-485
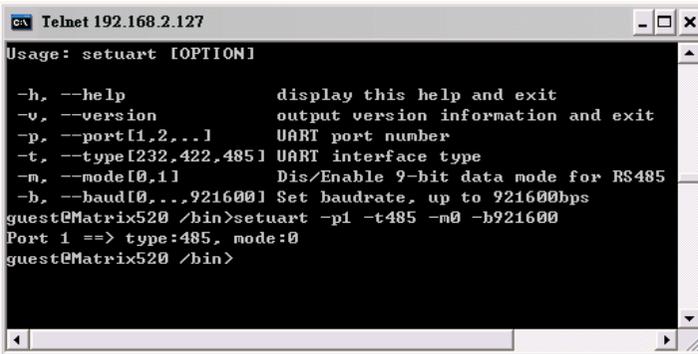
```
Telnet 192.168.2.127                              _ □ ×
Usage: setuart [OPTION]

  -h, --help             display this help and exit
  -v, --version          output version information and exit
  -p, --port[1,2,..]     UART port number
  -t, --type[232,422,485] UART interface type
  -m, --mode[0,1]        Dis/Enable 9-bit data mode for RS485
  -b, --baud[0,...,921600] Set baudrate, up to 921600bps
guest@Matrix520 /bin>setuart -p1 -t485 -m0 -b921600
Port 1 ==> type:485, mode:0
guest@Matrix520 /bin>
```

3. *lcdctl*: lcdctl is used to control the LCD display. Use lcdctl to display user message, please prepare 2x18 text message and save it as a file. Then use lcdctl filename to display the message on the LCD screen. Use *lcdctl —ip 0* to display the ip address of the network setting on the LCD screen. The parameter *time* is the refresh rate in second and use *lcdctl —cpu 0* to display the system loading information
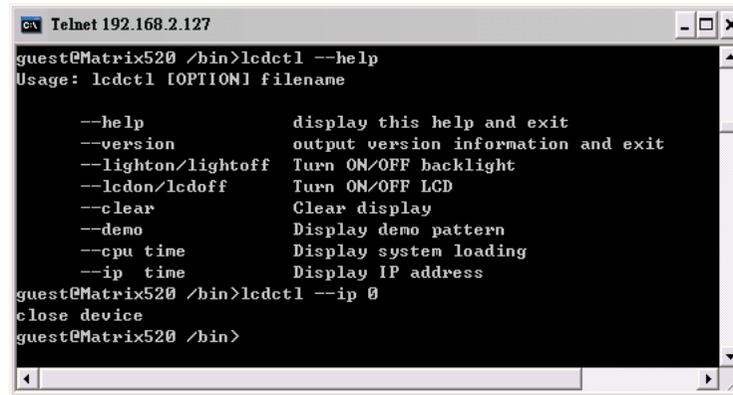
```
Telnet 192.168.2.127                              _ □ ×
guest@Matrix520 /bin>lcdctl --help
Usage: lcdctl [OPTION] filename

  --help              display this help and exit
  --version           output version information and exit
  --lighton/lightoff  Turn ON/OFF backlight
  --lcdon/lcdoff      Turn ON/OFF LCD
  --clear             Clear display
  --demo              Display demo pattern
  --cpu time          Display system loading
  --ip  time          Display IP address
guest@Matrix520 /bin>lcdctl --ip 0
close device
guest@Matrix520 /bin>
```

4. *gpioctl*: gpioctl is used to control the programmable digital I/O port located on the DB25 connector. Following example is to configure DIO1 as digital input and DIO2 as digital output with low output state.
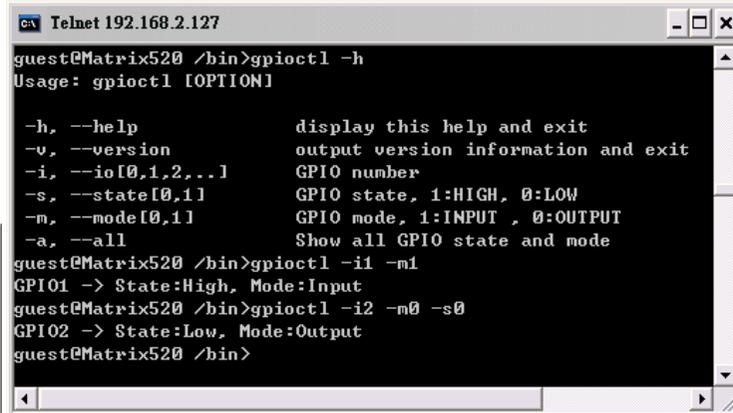
```
Telnet 192.168.2.127                              _ □ ×
guest@Matrix520 /bin>gpioctl -h
Usage: gpioctl [OPTION]

  -h, --help             display this help and exit
  -v, --version          output version information and exit
  -i, --io[0,1,2,...]    GPIO number
  -s, --state[0,1]       GPIO state, 1:HIGH, 0:LOW
  -m, --mode[0,1]        GPIO mode, 1:INPUT , 0:OUTPUT
  -a, --all              Show all GPIO state and mode
guest@Matrix520 /bin>gpioctl -i1 -m1
GPIO1 -> State:High, Mode:Input
guest@Matrix520 /bin>gpioctl -i2 -m0 -s0
GPIO2 -> State:Low, Mode:Output
guest@Matrix520 /bin>
```

5. *vplay*: vplay is used to play audio file in wave format.
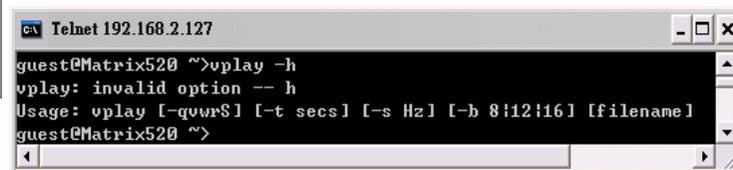
```
Telnet 192.168.2.127                              _ □ ×
guest@Matrix520 ~>vplay -h
vplay: invalid option -- h
Usage: vplay [-qvwrS] [-t secs] [-s Hz] [-b 8¦12¦16] [filename]
guest@Matrix520 ~>
```
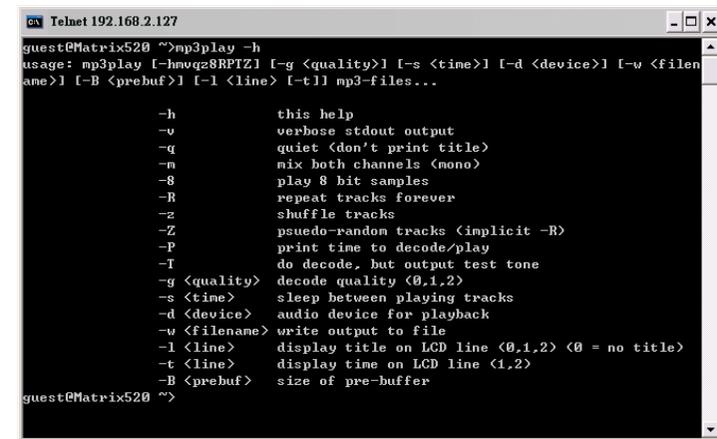
6. *Tone:* Audio output test program
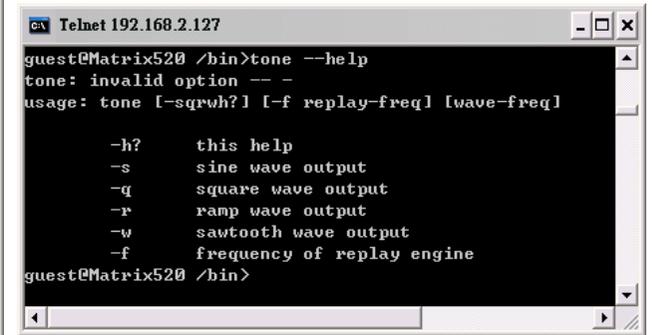
```
Telnet 192.168.2.127                              _ □ ×
guest@Matrix520 /bin>tone --help
tone: invalid option -- -
usage: tone [-sqrwh?] [-f replay-freq] [wave-freq]

  -h?    this help
  -s     sine wave output
  -q     square wave output
  -r     ramp wave output
  -w     sawtooth wave output
  -f     frequency of replay engine
guest@Matrix520 /bin>
```

7. *mp3play*: mp3play is used to play MP3 format audio files

```
Telnet 192.168.2.127                              _ □ ×
guest@Matrix520 ~>mp3play -h
usage: mp3play [-hmvqz8RPTZ] [-g <quality>] [-s <time>] [-d <device>] [-w <filename>] [-B <prebuf>] [-l <line>] [-t]] mp3-files...
  -h            this help
  -v            verbose stdout output
  -q            quiet (don't print title)
  -m            mix both channels (mono)
  -8            play 8 bit samples
  -R            repeat tracks forever
  -z            shuffle tracks
  -Z            psuedo-random tracks (implicit -R)
  -P            print time to decode/play
  -T            do decode, but output test tone
  -g <quality>  decode quality (0,1,2)
  -s <time>     sleep between playing tracks
  -d <device>   audio device for playback
  -w <filename> write output to file
  -l <line>     display title on LCD line (0,1,2) (0 = no title)
  -t <line>     display time on LCD line (1,2)
  -B <prebuf>   size of pre-buffer
guest@Matrix520 ~>
```

How to make more utility software

You might also find utility software available on Artila CD under /Matrix 520/utility such as *ntpclient, ssh, scp, bluez* and *ssh-keygen*. If you want, you can ftp or copy the utility software to Matrix 520 user disk (/disk). Also you can use find the source code and use the GNU Tool Chain to make the utility by yourself.

Mounting External Storage Memory

To find out the device name of the external memory device which plug into Matrix 520, you can use the command
/dmesg | grep sd
or
/dmesg | grep mmc
Type
mount /dev/sda1 to mount the USB disk and
mount /dev/mmc0 to mount SD card
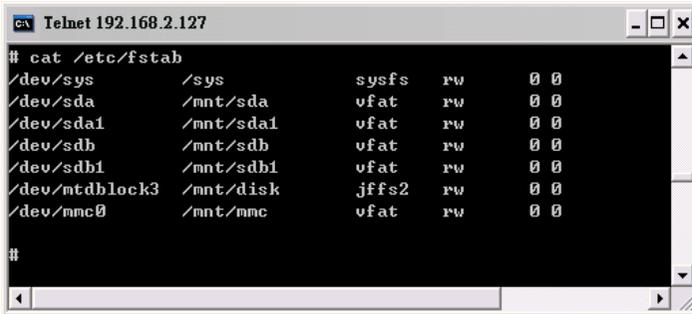
Welcome Message

To modify the welcome message, user can use text edit to modify the /etc/motd.

Web Page Directory

The web pages are placed at /home/httpd and the boa.conf contains the boa web server settings. The home page name should be *index.html*

Adjust the system time

To adjust the RTC time, you can follow the command
/date MMDDhhmmYYYY
where
MM=Month (01~12)
DD=Date (01~31)
hh=Hour
mm=minutes
YYYY= Year
/hwclock –w
To write the date information to RTC
User can also use NTP client utility in Artila CD to adjust the RTC time.
/ntpclient [time server ip]

SSH Console

Matrix 520 support SSH. If you use Linux computer, you can use SSH command to login Matrix 520. The configuration of SSH and key are located at
/etc/config/ssh
The key generation program is available at Artila CD
/matrix 520/utility/ssh_keygen
User can copy this program to Matrix 520 to generate the key

Install GNU Tool Chain

Find a PC with Linux 2.6.X Kernel installed and login as a **root** user then copy the arm-linux-3.3.2.tar.gz to root directory of PC. Under root directory, type following command to install the Matrix 520 Tool Chain
#tar zxvf arm-linux-3.3.2.tar.gz

Getting started with the Hello program

There are many example programs in Artila CD. To compile the sample you can use the Make file to and type
make
To compile and link the library. Once done, use ftp command
ftp 192.168.2.127
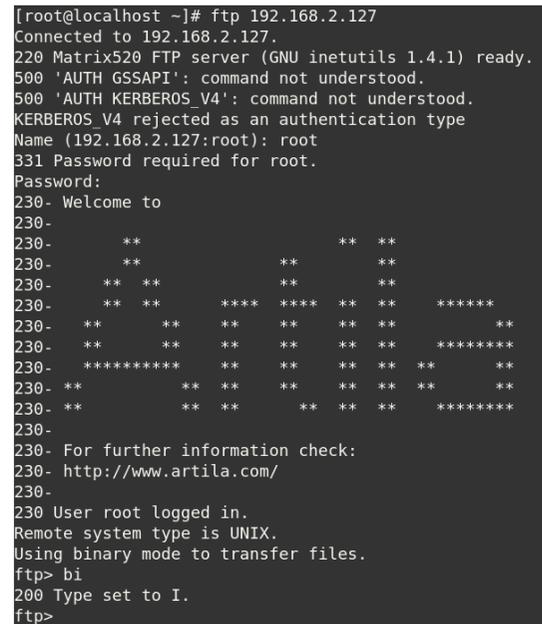And bin command to set transfer mode to binary
ftp>bin
to transfer the execution file to Matrix 520 user disk (/disk) and use
chmod +x file.o
Change it to execution mode and
./file.o
to run the file