

# Matrix 514 User Guide

## Matrix 514 Layout

### Introduction:

Matrix 514 is an ARM9-based Linux ready industrial computer. The key features are as follow:

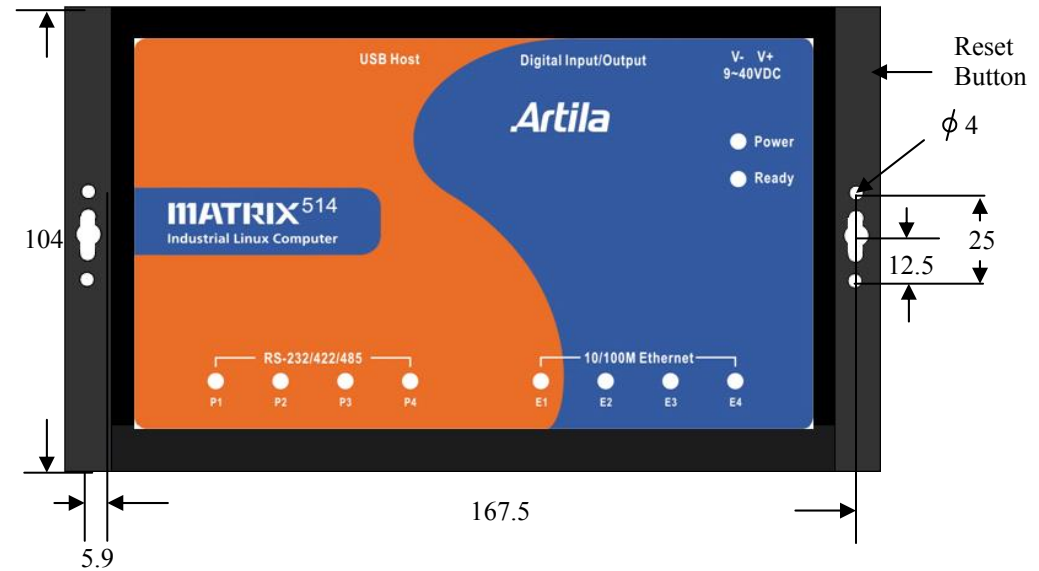
1. ARM920T ARM Thumb Processor with 200MIPS at 180MHz, Memory Management Unit
2. 16-KByte Data Cache and 16-KByte Instruction Cache
3. 64MB SDRAM, 16MB Flash on board
4. Four independent 10/100 Mbps Ethernet
5. Two USB 2.0 full speed (12 Mbps) Host Ports
6. Multimedia Card Interface for SD memory card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

### Packing List

1. Matrix 514 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



## Pin Assignment and Definition

### 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 514 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 514 again. If Ready LED is still off, please contact the manufacture for technical support.

### Link/Act

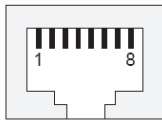
When Ethernet ports are connected to the network, Link/Act will show solid green and if there is traffic is the Ethernet, this LED will flash

### Serial Port LED

These four 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-



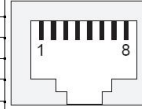
### Serial Ports:

The four serial ports are 3-in-1 RS-232/422/485 ports.

Note:

1. RS-232/422/485 is software selection
2. Only port2 support modem control signals

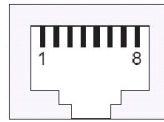
Pin	RS-232	RS-422	RS-485
1	DSR	---	---
2	RTS	TXD+	Data+
3	GND	GND	GND
4	TXD	TXD-	Data-
5	RXD	RXD+	---
6	DCD	RXD-	---
7	CTS	---	---
8	DTR	---	---



### 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**

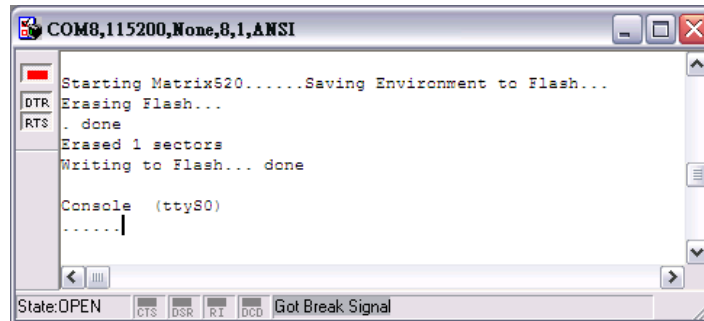
**Data bits: 8**

**Parity: N**

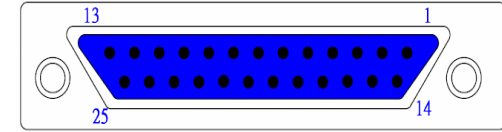
**Stop bit: 1**

**Terminal type: ANSI**

Once system is power on, you will see “Starting Matrix520...”, Keep typing \$\$\$\$ to turn on the serial console function. If the serial console is enabled, you will see “Console (ttyS0)” as follow. 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  
LAN 3 IP Address: 192.168.3.127  
LAN 4 IP Address: 192.168.4.127  
Login: guest  
Password: guest  
Supervisor: root (ssh supported)  
Password: root

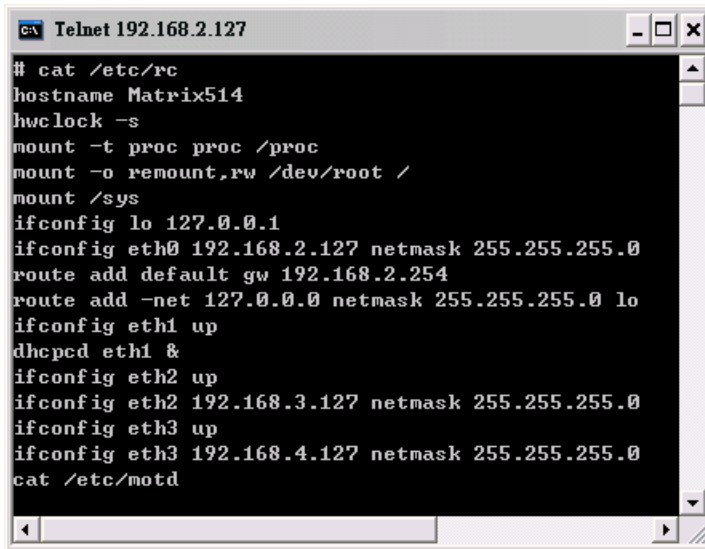
## Network Settings

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 &
```



```
ca Telnet 192.168.2.127
# cat /etc/rc
hostname Matrix514
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 &
ifconfig eth2 up
ifconfig eth2 192.168.3.127 netmask 255.255.255.0
ifconfig eth3 up
ifconfig eth3 192.168.4.127 netmask 255.255.255.0
cat /etc/motd
```

## Wireless LAN Configuration

Matrix 514 supports wireless LAN by using USB WLAN adaptor which uses Ralink 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:

```
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*.

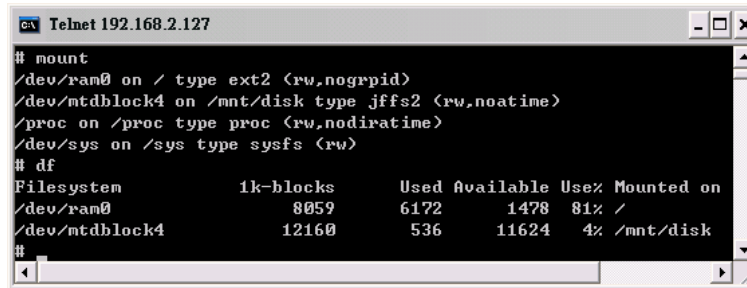
To configure the IP address use command

```
dhcpcd wlan0 &
```

or

```
ifconfig wlan0 192.168.2.127 netmask 255.255.255.0
```

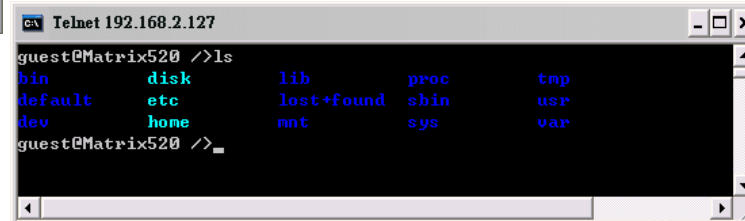
## File System



```
ca Telnet 192.168.2.127
# mount
/dev/ram0 on / type ext2 (rw,nogrpuid)
/dev/mtdblock4 on /mnt/disk type jffs2 (rw,noatime)
/proc on /proc type proc (rw,nodiratime)
/dev/sys on /sys type sysfs (rw)
# df
Filesystem          1k-blocks      Used Available Use% Mounted on
/dev/ram0             8059          6172      1478    81% /
/dev/mtdblock4       12160          536      11624     4% /mnt/disk
#
```

Matrix 514 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 !!!**

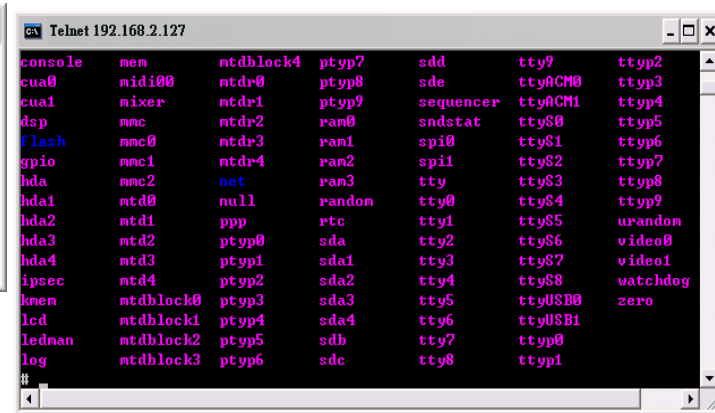


```
ca Telnet 192.168.2.127
guest@Matrix520 >>ls
bin      disk      lib        proc       tmp
default  etc       lost+found sbin       usr
dev      home     mnt        sys        var
guest@Matrix520 >>
```

## Devices list

The supported devices are shown at /dev directory. Following list are most popular ones:

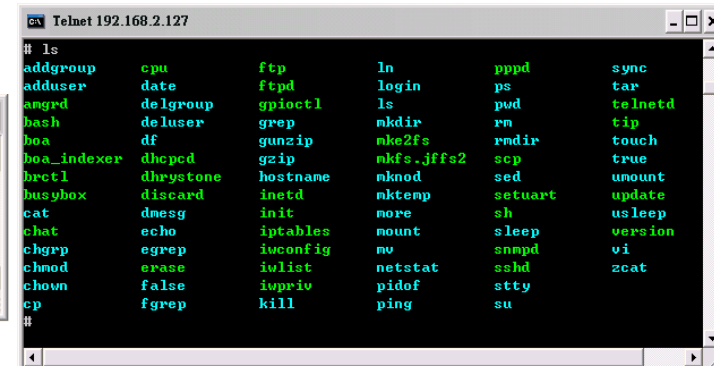
1. ttyS0: serial console port
2. ttyS1 to ttyS4: serial port 1 to port 4
3. mmc to mmc2: SD memory card
4. sda to sde: USB flash disk
5. ttyUSB0 to ttyUSB1: USB RS-232 adaptor (fdti\_sio.ko)
6. rtc: Real Time Clock
7. gpio: General Purpose digital I/O
8. ttyACM0 and ttyACM1: USB Modem (CDC compliant)



```
ca Telnet 192.168.2.127
console  mem      mtdblock4  ptyp7     sdd       tty9      tty2
cua0     midi0    ntdb0      ptyp8     sde       ttyACM0   tty3
cua1     mixer    ntdb1      ptyp9     sequencer ttyACM1   tty4
dsp      mmc      ntdb2      ram0      sndstat   ttyS0     tty5
Flash    mmc0     ntdb3      ram1      spi0      ttyS1     tty6
gpio     mmc1     ntdb4      ram2      spi1      ttyS2     tty7
hda      mmc2     net        ram3      tty       ttyS3     tty8
hda1     ntd0     null       random    tty0      ttyS4     tty9
hda2     ntd1     ppp        rtc       tty1      ttyS5     urandom
hda3     ntd2     ptyp0      sda       tty2      ttyS6     video0
hda4     ntd3     ptyp1      sda1      tty3      ttyS7     video1
ipsec    ntd4     ptyp2      sda2      tty4      ttyS8     watchdog
kmem     ntdblock0 ptp3      sda3      tty5      ttyUSB0   zero
lcd      ntdblock1 ptp4      sda4      tty6      ttyUSB1
ledman   ntdblock2 ptp5      sdb       tty7      tty0
log      ntdblock3 ptp6      sdc       tty8      tty1
#
```

## Utility Software:

Matrix 514 includes busybox utility collection and Artila utility software as follow:



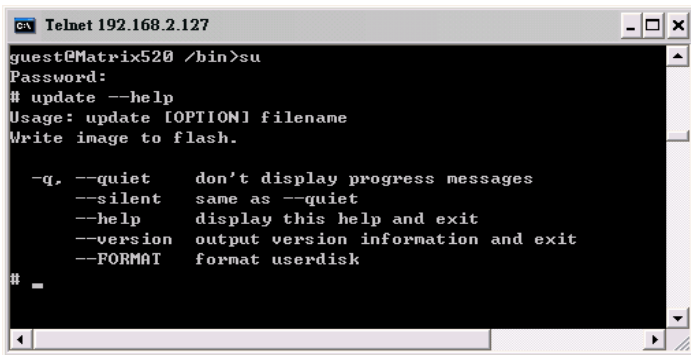
```
ca Telnet 192.168.2.127
# ls
addgroup  cpu      ftp      ln      pppd     sync
adduser  date     ftpd     login   ps       tar
anrpd    delgroup gpioctl  ls      psd      telnetd
bash     deluser  grep     mkdir   rm       tip
boa      df       gunzip   nke2fs  rmdir   touch
boa_indexer dhcpcd  gzip     mkfs.jffs2 scp      true
brctl    dhrystone hostname mknod   sed      umount
busybox  discard  inetd    mktemp  setuart  update
cat      dmesg   init     more    sh       usleep
chat     echo    iptables mount    sleep   version
chgrp    egrep   iuconfig mv       snmpd   vi
chmod    erase   iwlist  netstat sshd     zcat
chown    false  ioprio  pidof   stty
cp       fgrep   kill    ping    su
```

### 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



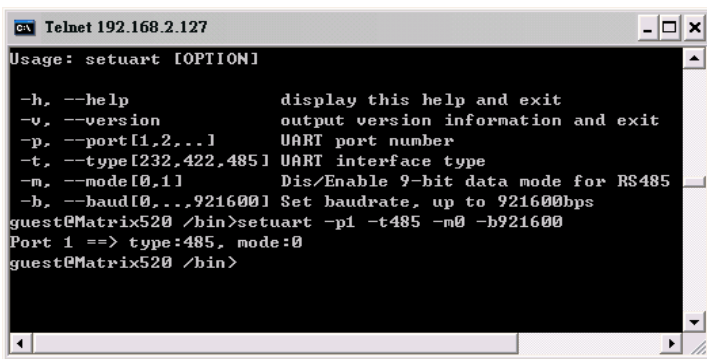
```
ca Telnet 192.168.2.127
guest@Matrix520 /bin>su
Password:
# update --help
Usage: update [OPTION] filename
Write image to flash.

-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

#
```

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

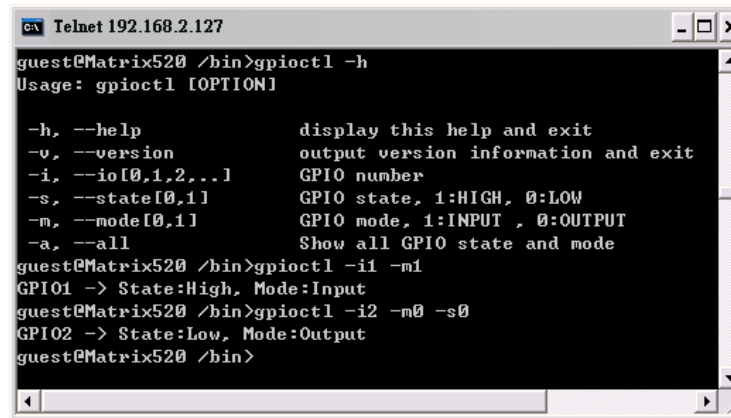
2. *setuart*: configure serial port setting. An example show as followed to configure port 1 as RS-485 interface with baud rate 921600. Please note only port 1 support 9-bit data at RS-485



```
ca 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. *gpiocctl*: gpiocctl 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.



```
ca Telnet 192.168.2.127
guest@Matrix520 /bin>gpiocctl -h
Usage: gpiocctl [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>gpiocctl -i1 -m1
GPIO1 -> State:High, Mode:Input
guest@Matrix520 /bin>gpiocctl -i2 -m0 -s0
GPIO2 -> State:Low, Mode:Output
guest@Matrix520 /bin>
```

### How to make more utility software

You might also find utility software available on Artila CD under /Matrix & iPAC/utility such as *ntpclient*, *ssh*, *scp*, *bluez* and *ssh-keygen*. If you want, you can ftp or copy the utility software to Matrix 514 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 514, 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

```
ca Telnet 192.168.2.127
# cat /etc/fstab
/dev/sys      /sys      sysfs     rw      0 0
/dev/sda      /mnt/sda  vfat      rw      0 0
/dev/sda1     /mnt/sda1 vfat      rw      0 0
/dev/sdb      /mnt/sdb  vfat      rw      0 0
/dev/sdb1     /mnt/sdb1 vfat      rw      0 0
/dev/mtdblock3 /mnt/disk jffs2     rw      0 0
/dev/mmc0     /mnt/mmc  vfat      rw      0 0
#
```

## 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 Artilla CD to adjust the RTC time.

`/ntpclient [time server ip]`

## SSH Console

Matrix 514 support SSH. If you use Linux computer, you can use SSH command to login Matrix 514. The configuration of SSH and key are located at  
`/etc/config/ssh`

The key generation program is available at Artilla CD

`/matrix & iPAC/utility/ssh_keygen`

User can copy this program to Matrix 514 to generate the key

```
root@localhost:/artila/linux-2.6.x
[root@localhost ~]# ssh 192.168.2.127
The authenticity of host '192.168.2.127 (192.168.2.127)' can't be established.
RSA key fingerprint is ba:4b:2d:ae:04:07:bd:c6:5c:4f:8a:43:4b:24:ee:9f.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.2.127' (RSA) to the list of known hosts.
root@192.168.2.127's password:
Welcome to

**          ** **
**          ** **
** **      ** **
** **      **** ** ** *****
** **      ** ** ** ** **
** **      ** ** ** ** ** *****
***** ** ** ** ** ** **
** **      ** ** ** ** **
** **      ** ** ** ** ** *****

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

root@Matrix520 />
```

## 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 the Hello program

There are many example programs in Artilla 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

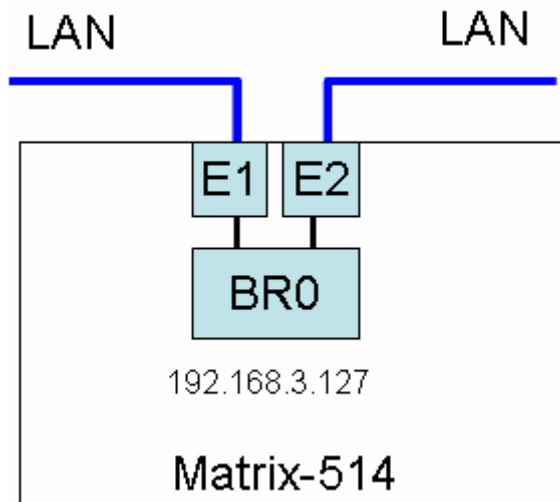
`./file.o`

to run the file

```
[root@localhost ~]# ftp 192.168.2.127
Connected to 192.168.2.127.
220 Matrix520 FTP server (GNU inetutils 1.4.1) ready.
500 'AUTH GSSAPI': command not understood.
500 'AUTH KERBEROS_V4': command not understood.
KERBEROS_V4 rejected as an authentication type
Name (192.168.2.127:root): root
331 Password required for root.
Password:
230- Welcome to
230-
230-          **          ** **
230-          **          ** **
230-          ** **      ** **
230-          ** **      **** ** ** *****
230-          ** **      ** ** ** ** **
230-          ** **      ** ** **~**
230-          ***** ** ** **~**
230-          ** **      ** ** **~**
230-          ** **      ** ** **~** *****
230-
230- For further information check:
230- http://www.artila.com/
230-
230- User root logged in.
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> bi
200 Type set to I.
ftp>
```

## Daisy Chain connection

All the Ethernet ports of Matrix-514 can be configured as a Bridge. The Bridge combines one or more Ethernet interface and bridging them under a single bridge interface. Therefore Matrix-514 can use two Ethernet ports as a bridge and make a daisy chain connection in the network.



To configure bridge function, please use command **brctl** as follow:

```
/brctl addbr br0  
/ifconfig eth1 0.0.0.0  
/ifconfig eth2 0.0.0.0  
/brctl addif br0 eth1  
/brctl addif br0 eth2  
/ifconfig br0 192.168.3.127 up
```

Using Daisy Chain connection, user can extend the network without using switch as follow

