

# ***LINUX STARTER KIT GETTING STARTED MANUAL***

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## ***Embedded Linux Starter Kit***

Embedded computers are integrated into all sorts of common equipment, from soda machines to incubators. Since these systems require high reliability and low failure rates, more and more companies are loading Linux onto these embedded computers. The Linux Starter Kit (LSK) contains everything you need to get familiar with Embedded Linux Systems. Included with the LSK is a Linux "Getting Started" document takes you through the menu driven configuration program and follows up with exercises using Telnet, FTP, and the Boa Webserver.

The LSK includes a 486DX5-133 headless (no onboard video) Single Board Computer (SBC) that can connect to a PC via Ethernet or via serial port (cable included). The SBC is populated with 16MB RAM and an 8MB flash disk containing EMAC Linux 2.4 distribution ([http://www.emacinc.com/linux2\\_sbc.htm](http://www.emacinc.com/linux2_sbc.htm)), a modified version of the Debian distribution. This is the same build used on EMAC's Server-In-a-Box (SIB) Embedded Web Server. ([http://www.emacinc.com/server\\_in\\_a\\_box.htm](http://www.emacinc.com/server_in_a_box.htm)). The Kit also includes a 25 W power supply, a padded storage case, and a 3.5" floppy disk or CD-ROM containing quick start instructions and additional Linux reference material.

For users that require X Windows, the LSK can be ordered with the optional X Windows Upgrade. This upgrade adds onboard video and increases both the RAM and Flash Disk sizes to 32MB. In addition, X Windows 4.1 and Netscape 4.7 are added to the Linux 2.4 build.

### ***EMAC Linux Starter Kit Features:***

- AMD486DX5-133Mhz based SBC
- 8 Meg. Flash Drive Expandable to 144 Meg.
- 16 Meg RAM Expandable to 32 Meg.
- 1 RS232 & 1 RS232/485 Serial Ports (Serial Cable Included)
- 1Parallel port supports SPP/EPP/ECP
- Keyboard/Mouse port
- 10Base-T Ethernet
- TCP/IP, UDP/IP, PPP, SLIP, and HTTP Protocols
- FTP Module
- Telnet Module
- Boa Web Server
- Extremely Reliable (No Moving Parts)
- Power Supply
- Plastic Carrying case
- Linux 2.4
- Upgradeable with X Windows
- Optional Add-On Linux Module such as SMNP

## ***EMAC Linux 2.4 Features:***

- Custom configuration program
- Boa high-performance web server
- WU-FTPD internet-standard FTP server
- TELNET server
- CRON periodic task scheduler
- DHCP/BOOTP Ethernet configuration
- Dial-in terminal server capability
- PPP server and client capability
- PPP dial-on-demand (modem not included)
- Serial terminal console capability
- Read-only root file system capability for safe, instant shutdown

## ***EMAC Linux 2.4 Specifications:***

- Linux kernel 2.4.9
- 6.2MB Footprint (Standard)
- GPL-compliant modular Disk-On-Chip drivers/Compact Flash/Hard Drive
- Glibc (libc 6) 2.2.4 (Redhat 7.1 binary compatible)
- Based on Debian 2.3 (Woody)

### **Configuration Utility**

Configuring a UNIX-like operating system can be difficult when performed by simple editing of the numerous configuration files. To remedy this, the LSK includes a menu-driven, text-based configuration utility, which is accessible locally via terminal or remotely via telnet. This utility allows the user to configure serial ports, SLIP ports, PPP ports, terminal ports, dial-in ports, and all manner of LAN / Internet networking options.

### **HTTP Server**

The EMAC LSK uses an HTTP server which is quite small in terms of both disk space required and resources required while running. It is also relatively fast even under heavy load (50 hits/second), equaling or beating the industry standard Apache web server. The LSK supports standard HTML1.1 and CGI methods GET and POST. Other HTML features (client-side image maps and Java / Javascript) are implicitly supported by the server, but may or may not be supported by your browser.

### **FTP Server**

The LSK uses a small, stand-alone FTP server which you may use to transfer files to and from the LSK. (The LSK does not have or require an FTP client.) In its default configuration, the FTP server will allow only a single user FTP access (for security reasons). More FTP users may be added later. The server may also be configured to allow anonymous FTP access to the LSK, if desired.

### **TELNET Server**

The LSK includes a standard TELNET server (daemon) which will allow remote TELNET (terminal-style) access over a LAN or the Internet. Once simple network configuration has been performed, you may telnet to your LSK from any computer which has network access to the LSK.

### **Periodic Command Scheduler (CRON)**

The LSK comes with the standard UNIX periodic command scheduler, CRON. This is a program which runs in the background, executing specified commands at specified times. Programs can be executable binaries or shell scripts. CRON is configured from the main system configuration utility.

## Getting Started with the EMAC LSK Server-in-a-Box

The purpose of this document is to allow the user to become familiar with the basic operation of the Single Board Server (SBS) or as it is also known as the Server-in-a-Box (SIB). The SIB comes fully populated with RAM and a DiskOnChip (DOC) flash disk. The flash disk takes the place of a hard drive in most embedded systems as it has no moving parts and therefore is much more rugged. Your Starter Kit should contain the following:

- PCM-4823 or PCM-48E26 single board computer.
- 8 MB DiskOnChip (installed on board).
- 16 MB SIMM memory (installed on board).
- 25 watt power supply.
- Null serial cable for connectivity to host PC.
- Ethernet Crossover Cable

To get started, you will need:

- Host PC with an Ethernet card running MS Windows 9x, NT, XP, 2000, or a Linux distribution.

### ***Initial setup***

1. Connect the null serial cable (included) between the first onboard serial port of the EMAC SIB (tty0) and an unused COM port on your host PC. The serial connector on the SIB is a DB9 male connector, and is located on the left side of the board, towards the front.
2. Connect the four-pin power supply connector to the power connector of the EMAC SIB. The connector is polarized, but care should be taken to assure correct orientation.
3. On the host PC, start the Minicom terminal program (if using Linux) or the HyperTerminal program (if using MS Windows). Set the parameters for 9600 baud, 8 data bits, no parity, and 1 stop bit. Both hardware and software flow control should be disabled. If using HyperTerminal make sure that you select "Direct to COMx" where x is the COM port you are using on your PC. Use the Configure button to set the other parameters.
4. Plug in the power supply. The board should beep and start the boot process. In about 30-45 seconds, the EMAC Linux login screen (similar to the screen shown below) should appear in the host PC's terminal window. If the data on the screen seems scrambled double check the baud rate selection.

```
Terminal
File Edit Settings Help
EMAC Server In a Box 2.4.3
SIBx24.emacinc.com on tty50
SIBx24.emacinc.com login: []

CTRL-A Z for help | 9600 8N1 | NOR | Minicom 1.83.1 | VT102 | Offline
```

## **Logging in**

1. At the `login` prompt, type `root` and press ENTER. When prompted for the password, type `emac_inc`. Do not type the trailing period. Both `root` and `emac_inc` should be typed in all lower case.
2. After a few moments, you will see the EMAC Linux main configuration menu. This menu allows you to control various aspects of the server's configuration.

## **Obtaining a Command Prompt**

In order to use a Bash shell (similar to the DOS commandline), press the "B" key at the main SIB configuration menu.

## **Simple Commands**

Now that you have logged in to the SIB and are at the commandline, you can begin executing simple commands. Try this command at the prompt:

```
cat /proc/cpuinfo
```

This command will show you statistics about the processor in your SIB.

The "df" command will show you percentage of space used and free on the different partitions. Additional commands are referenced in the Linux Primer Document. An excellent reference book detailing Linux commands is "Linux In A Nutshell" published by O'Reilly Books.

When you are finished experimenting with the commands, type "exit" at the command prompt to go back to the main SIB configuration menu.

## **Determining the SIB's IP Address**

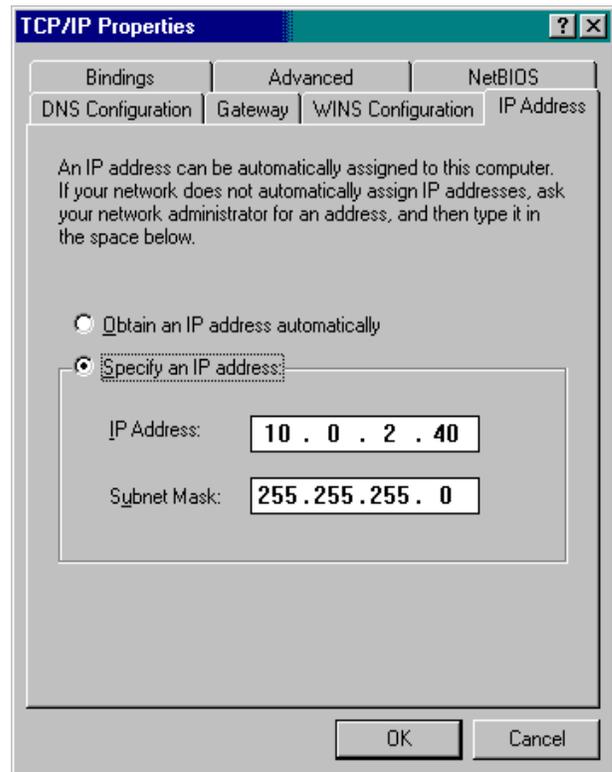
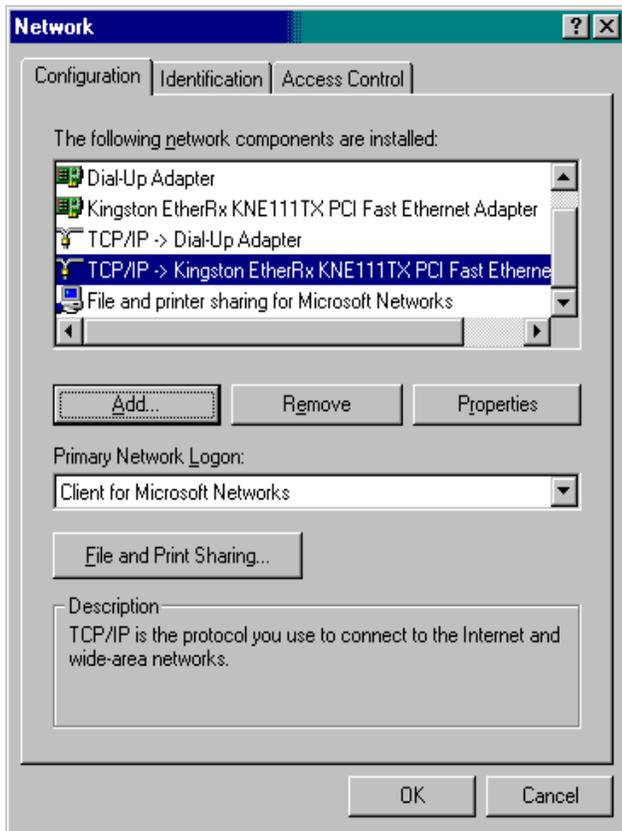
For the FTP and telnet exercises, you will need to connect the SIB to a local area network. If you already have access to one, you will need to determine if this network has a DHCP server. If so, then your host machine will have already taken an IP address from it, and the SIB will also automatically take one from it when it boots. Hence, you will not need to do any additional configuration, since both your host machine and the SIB will be automatically configured to be on the same network.

If you do not have a DHCP server on your network, or if you are connecting the SIB and your host computer via a crossover ethernet cable, you may need to do some additional configuration. By default, in the absence of a DHCP server, the SIB will assume the IP address `10.0.2.41`. You will need to

- a) Set your host machine to an IP address of `10.0.2.x` (where X is a number from 1 to 254, not including 41),  
or
- b) Reconfigure the SIB to an IP address that is compatible with your existing network.

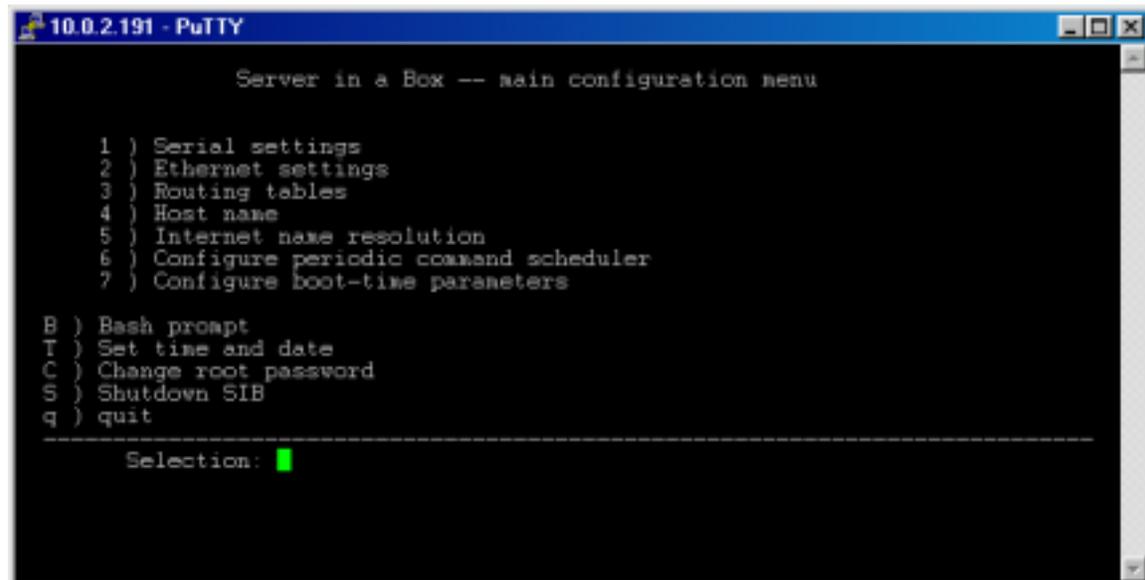
In order to change the IP address of a Windows host machine:

1. Open the network applet in the Control Panel.
2. Double-click on the TCP/IP properties entry which corresponds to your current network adapter (figure 1).
3. On the IP Address tab, choose "Specify an IP Address" and enter an IP address which is suitable for your network (figure 2).



In order to change the IP address of the SIB:

- Using the console or a serial terminal, log in as root, and choose the "Ethernet Settings" option (number 2) from the main SIB configuration menu.
- Choose option #1 from the Ethernet menu, and enter a suitable IP address, network address, subnet mask, and broadcast address for ethernet interface eth0.



If your SIB and host computer are connected via a crossover ethernet cable, it is most advisable to change the IP address of your host machine. If the host computer and SIB are connected to an existing LAN, it is easiest to reconfigure the SIB to match the addresses of the existing machines.

### ***Connecting the SIB to the host computer using an ethernet cable***

This will largely depend upon your existing network. If you already have a small network consisting of at least two machines connected with a hub, you can simply connect the SIB to the hub using a **straight-through** 10/100 Base-T patch cable (do not use the cross over cable). If you are connecting the SIB to a host computer directly (no hub), you will need to use the included **crossover** 10/100 Base-T Ethernet cable.

### ***Testing the network connection***

Once you have determined and correctly set the IP addresses of the SIB and host machines, test connectivity by using the **ping** utility. From the commandline (DOS commandline for a Windows machine) interface on the host computer, issue:

```
ping x.x.x.x
```

Where x.x.x.x is the SIB's IP address. You should see a series of replies. Press CTRL+BREAK to stop the utility if it does not stop after three or four pings. If you can ping the SIB from the host computer, you are ready to start the telnet session and try some simple commands.

## **Using Telnet**

Telnet is a facility that allows a user to connect to a remote machine and use that machine as if he or she was sitting at the physical console. Since some embedded systems do not have video or keyboard facilities (headless systems), one must administer them using the serial console or telnet. This exercise will demonstrate some basic Linux commands and the telnet interface.

Before undertaking this Exercise make sure you have established a network connection from your PC to your EMAC Single Board Computer as outlined above.

For this example, the telnet client included with Windows can be used, but it has problems with cursor and extended keys when connecting with Linux hosts. A better alternative to the Windows telnet client is called Putty, and can be downloaded free of charge from <http://chiark.greenend.org.uk/~sgtatham/putty>

Once you obtain the Putty program and install it, you are ready to connect to your Linux Single Board Server. Start Putty by double-clicking on the icon.

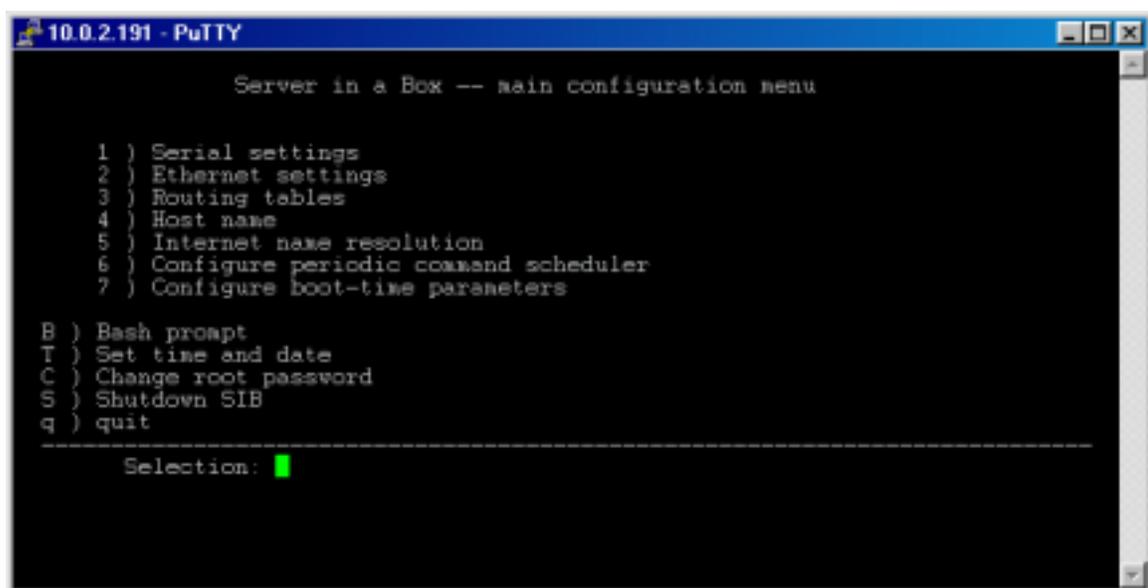
Enter the EMAC Server's IP address in the Host box and click the Open button to connect (all other settings are correct by default). The telnet server in this case is your EMAC Single Board Computer (SBC) or commonly called Single Board Server (SBS) or Server In a Box (SIB). The client is the telnet program you are running on your PC. You should have determined your IP address or Host Name in the "Getting Started" Section of the Manual. Enter the IP address or Host Name in the "Host Name" Text Box and use the default Port Number.



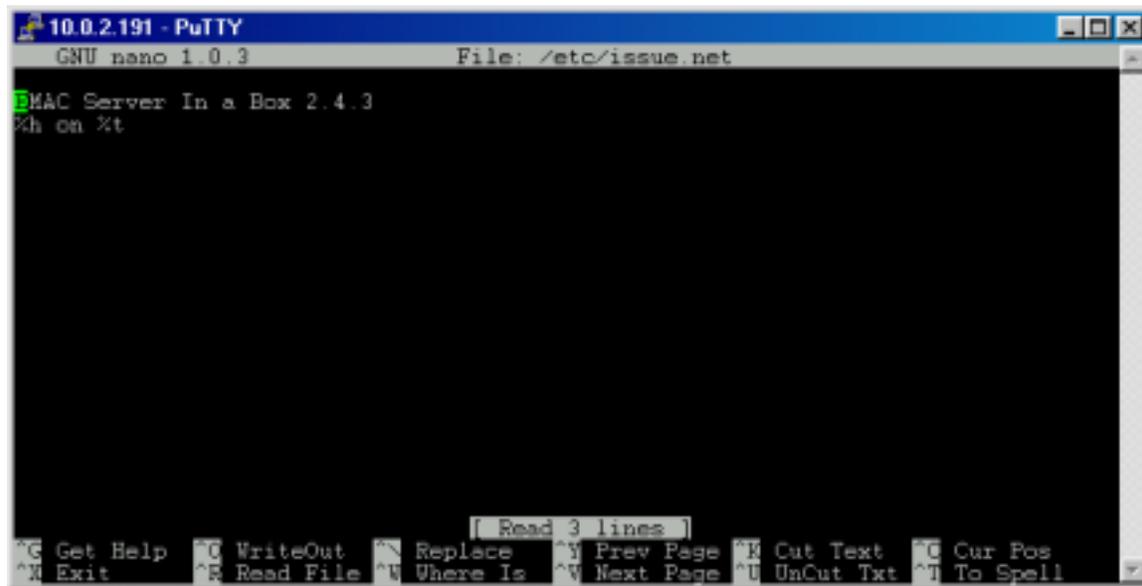
Enter `root` for the login and `emac_inc` for the password.

Once you are logged in, you should see the main configuration menu for the SIB:

To drop to a commandline, press the B ("Bash prompt") selection. For this exercise, we're going to edit the `/etc/issue.net` file so that a different login prompt is displayed.



1. Start by opening the text editor. Type `nano /etc/issue.net` and press ENTER at the command line. Nano is the name of the editor included with the EMAC SIB. You should see a screen similar to the one below.
2. The contents of the file `/etc/issue.net` should be displayed. Take notice of the special keystroke combinations that access the various functions of nano. The ^ character means to hold down the CTRL key while you press the second key indicated. For example, to save (Writeout) the current file, hold down CTRL and press w.



```
10.0.2.191 - PuTTY
GNU nano 1.0.3 File: /etc/issue.net
EMAC Server In a Box 2.4.3
%h on %t

^G Get Help ^O WriteOut ^R Replace ^Y Prev Page ^K Cut Text ^C Cur Pos
^M Exit ^F Read File ^W Where Is ^V Next Page ^U UnCut Txt ^T To Spell
```

The text displayed should be somewhat familiar, since this is the file that's displayed at the login prompt of a telnet session. The %h is replaced with the machine's current hostname (by default, this is sibx24.emacinc.com), and %t is replaced with the name of the current terminal (should be tty1) to which you're connected. Other symbols and their functions are as follows:

- %d current time and date
- %s show the name of the operating system
- %m machine (hardware) type
- %r operating system release number
- %v operating system version number
- %% single percent character

Experiment by changing the file to show time and date (Hint: add a %d to the last line of the file).

3. Save your changes, and exit nano by using the Writeout command (CTRL + W), then the exit command (CTRL + X). Proceed back to the main SIB menu by typing `exit`. Exit the SIB menu by pressing q. Then log out by typing `logout` or `exit`. This command has the effect of disconnecting you from the system. Reconnect to the SBC and notice that the text displayed with the login prompt has changed. This is the result of your editing the `/etc/issue` file.

## **Summary**

Telnet is a feature used to communicate with Linux and other computer systems remotely. It allows a user or administrator to run programs and change settings on the machine as if the user were sitting at the physical console.

Telnet allows you to communicate with your EMAC SIB from any PC that provides a telnet client. Both Linux and Windows provide telnet clients. You can even communicate with your SIB over the Internet provided you have access through the firewall if one is present.

## **Connecting to the Webserver**

Your EMAC SIB is equipped with webserver software that allows it to server webpages over an Internet or intranet connection. In many embedded applications the web browser is used as the user interface to the system. To see this functionality, open a web browser window and enter the following address in the browser location bar.

x.x.x.x/index.html            (where x.x.x.x is your IP address)

Then press ENTER. After a few seconds, the SIB's default homepage should appear provided your network connection is working correctly.

## **Getting Linux Command Help from the Webserver**

The core functionality of EMAC Linux is provided by a multi-call binary called busybox. Usage information about the commands provided by Busybox are available in HTML format. Just point a web browser to:

x.x.x.x/busybox.html            (where x.x.x.x is your IP address)

Once this page is loaded you can use search/find function of your Browser to locate most commands. This is the busybox equivalent of Man pages. Man pages are the Linux default help system. The Man pages on your LSK have been deleted as is typical on an Embedded System where Flash disk space is at a premium.

## **Using FTP**

FTP is a facility that allows a user to transfer files and programs from one machine to another. A good example of FTP is transferring web pages from your PC to a server for viewing. An FTP server is included with the EMAC SIB. This exercise will demonstrate simple FTP operation to upload and download files.

For this exercise, a graphical FTP client will be used. On Linux hosts, it is recommended to obtain the gftp application. This application is part of the GNOME window manager suite. The method for obtaining this application will vary depending upon your Linux distribution. On Windows, the WS\_FTP LE application can be downloaded free of charge from the Download section of [www.ipswitch.com](http://www.ipswitch.com).

Connect to the SIB using the IP address you determined in the Getting Started section. If you have connected to FTP sites in the past, you are familiar with the anonymous login that most FTP sites support. This feature exists so that anyone can retrieve files, without using a password. However, for this exercise, you will need to login as user "www" so that you gain the ability to place files onto the SIB. Use the password "emac\_inc" when you log in as this user. The settings on the other tabs of the connect box do not need to be changed.



```
</FONT><P ALIGN="CENTER"><A  
  HREF="http://www.emacinc.com/"><FONT  
  SIZE=5>www.emacinc.com</FONT></A><FONT SIZE=6> </P>  
</FONT><FONT SIZE=2><P  
  ALIGN="CENTER">&nbsp;   </P></FONT></BODY>  
</HTML>
```

Edit the line “Welcome to EMAC’s” (bold text) line to read “Welcome to <your name>’s”. Re-save the file with the name `home.html`. Upload this newly saved file to the SIB using the FTP client. Now, point your browser to the IP address of the SIB as follows.

`x.x.x.x/home.html` (where `x.x.x.x` is your IP address)

Your newly modified page should appear.

## Using X Windows

If you have an SIB with the Xwindows option, you can connect a monitor, keyboard, and mouse, and use the SIB as if you were using a normal computer workstation. You can then access the FTP and web servers that are built into the SIB by using the SIB's IP address.

Logging in at the console is identical to logging in using the telnet server or serial console. After you log in as root, you need to issue the `startx` command at the commandline to start XWindows. After XWindows is finished loading, you will be presented with a screen similar to Microsoft Windows.

You can have access to both a textual login prompt and the XWindows screen by pressing <CTRL+ALT+F1>, <CTRL+ALT+F2>, or <CTRL+ALT+F3> to select one of the three textual login terminals, and <ALT+F4> to select the XWindows terminal.

The Xwindows installation on the SIB includes a small calculator, the Netscape Navigator web browser, and a small graphical FTP client. You can launch an xterminal (a graphical representation of the Linux command prompt), the calculator, or Netscape Navigator by clicking one of the buttons near the bottom left corner of the screen. The default web address should be `127.0.0.1/index.html`. This is the server loopback address and will operate regardless of what IP address the SIB is set to.

You can also launch programs using the menu on the bottom left side of the screen, similar to Microsoft Windows's taskbar. On this menu, you will see icons for Netscape Navigator, and xterminal.

To begin this exercise, open Netscape Navigator by using one of the methods outlined above. The SIB's default homepage should appear. For this exercise, we will customize this page to show your name instead of "EMAC" on the homepage.

1. Open the Xenon editor by clicking Linux->Editors->Xenon on the "Start Menu."
2. In the Xenon editor, open the file `/home/www/index.html`.
3. Find the line which ends with "Welcome to EMAC's"
4. Change "EMAC's" to "<Your name>'s"
5. Resave the file and exit Xenon.
6. In Netscape Navigator, click "Reload."

The default homepage should now reflect your name in place of EMAC's.

## ***Displaying Xwindow Applications On A Remote PC***

The Xwindows system allows connections over a local area network so that applications may be executed on a central server, and displayed on remote X terminals, similar to the way PC Anywhere functions. In this case the SIB acts as the Xwindow Server and the host PC as the Xwindow client. This exercise will allow you to execute applications on the SIB, and display them on another PC running Xwindows.

This exercise can be performed using any recent distribution of Xwindows, however a recent Redhat release is preferred. Other Linux distributions may require that the Xwindow Client have "Listen on TCP" enabled to use this exercise. You will need to have the SIB and host PC connected via Ethernet for this exercise.

1. On the host PC, from an Xterminal, issue:

```
xhost +x.x.x.x
```

where x.x.x.x is the IP address of the SIB. This sets up the host PC so that it will allow connections from the SIB.

2. Telnet into the SIB. Login as root.
3. Issue this command at the telnet prompt:

```
export DISPLAY=x.x.x.x:0
```

This tells the SIB to output display information to the Xserver at the specified IP address.

4. Start the xenon editor by typing `xe` at the SIB's telnet prompt. You should see the editor appear after a few moments. You can then edit any file located on the SIB. Try editing the default web page on the SIB.

Notes: You may need to edit the `/etc/hosts` file on the SIB, and enter a dummy hostname for your host PC. Just add a line like:

```
x.x.x.x    host.pc.net    host
```

to the bottom of the file. This is necessary because the SIB checks all IP addresses connecting to it, to be sure that they have a corresponding hostname. This is for network security.

Using the Xwindow Server is a very convenient way of running Xwindow applications on a headless SIB.