Technologic SYSTEMS

OVERVIEW

The **TS-WIFIBOX** Application Kit includes a complete solution for 802.11g WiFi applications. The one-piece setup includes a TS-7400 200Mhz ARM9 SoM engine, a Hammond aluminum enclosure, two aluminum end-plates and an internal 802.11g WiFi card integrated with external antenna. In addition, Linux drivers and software packages are installed to provide an out-of-the-box WiFi solution.

On the software side, the TS-WIFIBOX is powered with the Linux OS pre-installed with busybox and all the tools and drivers to make the WiFi module work out-of-the-box.

Additional TS-WIFIBOX features include:

✔ Internal TS-7400 SoM engine
✔ Ultra-Fast Bootup Firmware
✔ 200 MHz ARM9 processor with MMU
✔ Internal 802.11g WiFi with external antenna
✔ Industrial quality design, Rugged aluminum enclosure, No moving parts, Industrial power connector will not loosen, Low power, low heat, long life, All components soldered-on
✔ SD Card clamped in socket
✔ 32 MB SDRAM (up to 128 MB optional)
✔ 32 MB NAND Flash
✔ 1 10/100 Ethernet port
✔ 1 USB 2.0 Compatible OHCI ports (12 Mbit/s Max)
✔ Up to 4GB flash via SD Card
✔ WiFi drivers and packages for Linux
✔ Optional On-Board Temperature Sensor
✔ Optional Battery-Backed RTC

> **Notes**
>
> The TS-WIFIBOX makes use of a TS-7400 computer module. Please, refer to the TS-7400 documentation for further information.

POWER ON AND CONNECTION TO THE BOARD

The TS-WIFIBOX can be powered either by a 5VDC power supply through a connector in the front panel (LEDs, Ethernet and USB connectors), or by a 8-30VDC power supply through a screw terminal connector in the rear panel (WIFI antenna). The 5VDV is the standard option, while the switching power regulator is optional.

Before power on your TS-WIFIBOX, make sure to connect a valid network cable on the Ethernet connector. After power on, the board will boot Linux and after about 8 seconds it will be possible to use the telnet, ftp and http services through the default IP 192.168.0.50. Telnet to the board (**telnet 192.168.0.50**) using user root - no password is required.

> **Notes**
>
> There is no serial console on the TS-WIFIBOX. The TS-9441 peripheral board provides a serial console. However, it is possible to login to Linux through Telnet.

The following are the possible connections by default:

✔ Using telnet client: telnet 192.168.0.50, user root, no password

- ✔ Using ftp client: ftp 192.168.0.50, user root, no password
- ✔ Using web browser: **http://192.168.0.50/**

SD CARD with Debian Linux

The TS-WIFIBOX will boot TS-Linux from the on-board NAND flash by default. If your TS-WIFIBOX is equipped with an optional SD Card shipped by Technologic Systems, it is also possible to use Debian Linux. In order to use the SD Card, telnet to the board (telnet 192.168.0.50, login as root, no password) and issue the mount command:

```
# insmod /initrd/sdcard.o
# mkdir /mnt/sd
# mount /dev/sdcard0/disc0/part3 /mnt/sd
```

To use Debian Linux, after mounting the SD Card:

```
# cd /mnt/sd
# chroot .
```

> ↗ **Notes**
>
> It is also possible to boot to Debian Linux, Fastboot Linux or a NFS root. Read the TS-7400 manual for further info. However, is is not recommended trying to do that without a TS-9441 console/recovery peripheral board.

The TS-Linux distribution is pre-configured for the TS-WIFIBOX. The Debian Linux is not, in spite of wireless networks can also be configured and used with Debian in the same way. Therefore, the use of the TS-Linux is recommend with TS-WIFIBOX. Debian Linux is recommended if embedded application development with GNU C/C++ is needed.

THE WIFI INTERFACE

The Linux driver for the WiFi interface is included in the Linux distribution and is loaded during boot-up. Also, the Wireless Tools for Linux (iwtools) come installed by default with the TS-WIFIBOX. iwtools commands include: **iwconfig, iwlist, iwevent, iwgetif, iwspy, iwpriv.** Help information is available by supplying '--help' for any of these commands in the Linux prompt (login using telnet). For example: 'iwconfig --help'.

The sequence of commands that can be used to connect to an ESSID network follows:

```
ifconfig wlan0 down
iwconfig wlan0 essid 'NAME'
iwconfig wlan0 commit
ifconfig wlan0 up
```

Use the following commands to scan for available WiFi networks:

```
iwlist wlan0 scan
```

Use the following command to configure the client interface using DHCP:

```
udhcpc -n -i wlan0
```

EASY WIFI CONFIGURATION TOOLS

The **'wlscan'** utility is installed in Linux to help you configure the wireless interface. Just type 'wlscan' after logged in as root via telnet. Type 'help' for help information then.

Furthermore, there is a simple web interface to play around with the wireless tools for Linux. Try it clicking by entering **http://192.168.0.50/** on your favorite web browser.

ADVANCED WIFI CONFIGURATION OPTIONS: CLIENT MODE

The Wireless Tools for Linux and the Linux WPA Supplicant tools are installed in the TS-Linux distribution for the TS-WIFIBOX. It is possible to use either options to configure a WiFi connection. Also, one can configure the Linux system to restore a desired connection after a reset, during system initialization.

WEP vs WPA

From Wikipedia:

"Wired Equivalent Privacy (WEP) is a scheme that is part of the IEEE 802.11 wireless networking standard to secure IEEE 802.11 wireless networks (also known as Wi-Fi networks). Because a wireless network broadcasts messages using radio, it is particularly susceptible to eavesdropping. WEP was intended to provide comparable confidentiality to a traditional wired network (in particular it does not protect users of the network from each other), hence the name. Several serious weaknesses were identified by cryptanalysts — any WEP key can be cracked with readily available software in two minutes or less — and WEP was superseded by Wi-Fi Protected Access (WPA) in 2003, and then by the full IEEE 802.11i standard (also known as WPA2) in 2004. Despite the weaknesses, WEP provides a level of security that can deter casual snooping."

✔ **http://en.wikipedia.org/wiki/Wired_Equivalent_Privacy**
✔ **http://en.wikipedia.org/wiki/Wi-Fi_Protected_Access**

WEP and Wireless Tools for Linux

Using these tools is the simplest way to get a wireless network connection up after system power on. The wanted configuration parameters are stored in the file '**/etc/sysconfig/ifcfg-wlan0**'. You will want to ensure ESSID, CHANNEL, and KEY are set to the proper values for your ESSID. MODE should be set to Managed. For example, if you would like to connect to a WEP with an ESSID of 'my_essid' and a key of '0xdeadbeef', use:

```
#more /etc/sysconfig/ifcfg-wlan0

DEVICE=wlan0
IPADDR=192.168.1.100
NETMASK=255.255.255.0
NETWORK=192.168.1.0
BROADCAST=192.168.1.255
BOOTPROTO=static
#BOOTPROTO=dhcp
ENABLE=yes

#iwconfig $DEVICE $IWCONFIG_ARGS
ESSID=my_essid
MODE=Managed
CHANNEL=6
KEY=off
#KEY=0xdeadbeef

IWCONFIG_ARGS="essid ${ESSID} mode ${MODE} key ${KEY}"
```

During Linux boot time, the script located at '**/etc/init.d/network**' will read this file and configure the network automatically. This script also provides the functions start, stop and restart for the wireless network service.

See the 'Further Reference' section for more information about the Wireless Tools for Linux.

WPA and Linux WPA Supplicant

WPA Supplicant for Linux includes support for WPA and WPA2 (IEEE 802.11i / RSN). It implements key negotiation with a WPA Authenticator and it controls the roaming and IEEE 802.11 authentication/association of the wlan driver.

The TS-WIFIBOX includes the following WPA Supplicant tools in the '/usr/sbin' directory of the filesystem: **wpa_supplicant**, **wpa_cli** and **wpa_passphrase**. One can use these tools to setup a WAP connection with Linux. Also, some scripts are provided to configure the system during booting time. In order to achieve that, change the WPA configuration file at **'/etc/wpa_supplicant.conf'** to meet your configuration requirements. The default file shipped with TS-WIFIBOX is shown below:

```
#more /etc/wpa_supplicant.conf
eapol_version=1
fast_reauth=1
ap_scan=1
network={
        ssid="toto"
        scan_ssid=1
        #psk="BodoR3716"
         psk=e82d61a503251a3601bdc4a92035fbc509c77fc168465dadd7d1323e
9639e25c
        pairwise=TKIP
        group=TKIP
        key_mgmt=WPA-PSK
        proto=WPA
}
```

The wpa_passphrase utility can be used to generate the ssid and psk strings to be pasted into /etc/wpa_supplicant.conf. For example:

```
$ wpa_passphrase my_essid my_passphrase

network={
     ssid="my_essid"
     #psk="my_passphrase"
      psk=c287a1721c84e7fe5d9bdcf0c251ab5f78ff1988734682a56b89e51788
51f341
}
```

After power on, the wpa_supplicant service script located at '/etc/init.d/' will read the configuration parameters during the boot time in order to auto configure the wireless network. Make sure to set 'ENABLED=1' in the script file. This script also provides the start, stop and restart service functions. The variables this script make use of are listed below:

```
#more /etc/init.d/wpa_supplicant

#!/bin/sh
ENABLED=0
INTERFACE="wlan0"
CONFIG="/etc/wpa_supplicant.conf"
OPTIONS="-Dwext -i$INTERFACE -c$CONFIG -Bw"
...
```

See the 'Further Reference' section for more information about the Linux WPA Supplicant.

CONFIGURATION FOR MASTER MODE (WIRELESS ACCESS POINT)

Master mode allows a wifi device to act as a WAP. In order to configure the TS-WIFIBOX as a WAP with an essid of 'my_essid' with no encryption one would use the following sample '/etc/sysconfig/ifcfg-wlan0' configuration file.

```
$ more /etc/sysconfig/ifcfg-wlan0

DEVICE=wlan0
IPADDR=192.168.1.100
NETMASK=255.255.255.0
NETWORK=192.168.1.0
BROADCAST=192.168.1.255
BOOTPROTO=static
#BOOTPROTO=dhcp
ENABLE=yes



#iwconfig $DEVICE $IWCONFIG_ARGS
ESSID=my_essid
MODE=Master
CHANNEL=6
KEY=off
#KEY=0xdeadbeef

IWCONFIG_ARGS="essid ${ESSID} mode ${MODE} key ${KEY}"
```

To setup a TS-WIFIBOX as a WAP with WEP encryption, the KEY must be prefixed with "s:". The following '/etc/sysconfig/ifcfg-wlan0' configuration file demonstrates how to configure a TS-WIFIBOX as a WAP with an essid of 'my_essid' using WEP encryption with a KEY of 'mykey':

```
$ more /etc/sysconfig/ifcfg-wlan0

DEVICE=wlan0
IPADDR=192.168.1.100
NETMASK=255.255.255.0
NETWORK=192.168.1.0
BROADCAST=192.168.1.255
BOOTPROTO=static
#BOOTPROTO=dhcp
ENABLE=yes

#iwconfig $DEVICE $IWCONFIG_ARGS
ESSID=my_essid
MODE=Master
CHANNEL=6
#KEY=off
KEY=s:mykey

IWCONFIG_ARGS="essid ${ESSID} mode ${MODE} key ${KEY}"
```

The TS-WIFIBOX does not currently support WPA encryption when configured in master mode.

FURTHER REFERENCE

To take full advantage of the TS-WIFIBOX, it is highly recommended the reading of the TS-7400 documentation and the Linux Manuals provided by Technologic Systems as well.

- ✔ TS-WIFIBOX web page (**http://www.embeddedarm.com/epc/wifi-h.htm**)
- ✔ TS-7400 web page (**http://www.embeddedarm.com/epc/ts7400-spec-h.htm**)
- ✔ Wireless Tools for Linux
  (**http://www.hpl.hp.com/personal/Jean_Tourrilhes/Linux/Tools.html**)
- ✔ Linux WPA Supplicant (**http://hostap.epitest.fi/wpa_supplicant/**)
- ✔ Linux for ARM on TS-7000 (**http://www.embeddedarm.com/linux/ARM.htm**)

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