The WWLLN Service Unit v4 runs a customized Linux distribution for ARM processors. For additional help contact Michael Hutchins (mlhutch@uw.edu) or Bob Holzworth (bobholz@ess.washington.edu).

WWLLN Service Unit v4 Initial Setup

Software Version 2.0

1   Hardware

The WWLLN Service Unit uses a Gumstix WaterStormCOM mounted on a Tobi breakout board as the on-board computer to run the WWLLN software.

1.1   Hardware Summary

The Gumstix WaterStormCOM is part of the Overo COM series and has the following features:

- 1 GHz ARM Cortex-A8 CPU

- 512 MB RAM

- microSD Card Slot

- OpenGL POWER SGX graphics Aaccelerator

- C64x Fixed Point DSP (Max: 660,800 MHz)

  The Tobi breakout boards adds:

- HDMI video Out

- 1 USB port

- 1 USB console connection

- Stereo in/out

- Ethernet

1.2   Pinouts

The Gumstix COM has direct pinouts to the processor, however as it is not used without the Tobi breakout board, only the Tobi pinout is shown in Figure 1.

In the service unit only pins 1 (GND), 9 (RXD1), 10 (TXD1), 28 (GPIO145), and 40 (V_BATT) are used. RXD1 and TXD1 are used for the serial communication with the GPS. GPIO145 is used to control the pre-amp power supply. V_BATT is the 5 V power for the Gumstix.

SV1

Signal	Pin	Pin	Signal
V_BATT_5	40	39	ADCIN4
ADCIN3	38	37	AGND
ADCIN5	36	35	ADCIN6
ADCIN2	34	33	ADCIN7
PWM1	32	31	PWM0
GPIO144_PWM9	30	29	GPIO147_PWM8
GPIO145_PWM10	28	27	GPIO146_PWM11
VCC_1.8	26	25	GND
GPIO185_SDA3	24	23	GPIO184_SCL3
GPIO166_IR_TXD3	22	21	GPIO165_IR_RXD3
GPIO163_IR_CTS3	20	19	GPIO170_HDQ_1WIRE
GPIO10_TS_IRQ	18	17	GPIO186_GPS_PPS
VCC_1.8	16	15	GND
POWERON	14	13	GPIO31_WAKEUP
VBACKUP	12	11	SYS_EN
GPIO148_TXD1	10	9	GPIO151_RXD1
GPIO175_SPI1_CS1	8	7	GPIO173_SPI1_MISO
GPIO174_SPI1_CS0	6	5	GPIO172_SPI1_MOSI
GPIO114_SPI1_NIRQ	4	3	GPIO171_SPI1_CLK
VCC_3.3	2	1	GND

Figure 1: Pinout of the Gumstix Tobi breakout board.

2 Gumstix Operating System v2.0

2.1 Gumstix-Yocto

The Gumstix used in the service unit is running a custom Linux distribution created using the Yocto Project build system. This OS runs similar to most unix operating systems, with the main difference being the smart package manager instead of yum or apt-get.

A useful resource in setting up and configuring the Gumstix software is the Gumstix developer site (http://gumstix.org) and the mailing list archive forum (http://gumstix.8.x6.nabble.com).

2.2 Distribution Location

The operating system used is the Yocto Project Gumstix Layer v1.5, available on flash5 or in the Git repository:

/home/mlhutch/Git/gumstix.git repository on flash5 in the image folder.

2.3 Building

Building the operating system can be done by following the instructions at:

https://github.com/gumstix/Gumstix-YoctoProject-Repo

With the final configuration in the Git repository on flash5 in image/yocto/local.conf. If rebuilding use the local.conf file in the build/conf folder and run the bitbake target `bitbake gumstix-xfce-image`.

With either a newly made OS image or the one in the gumstix.git repository, follow the install instructions in INSTALL.md for setting up a new microSD card to run with WWLLN.

3 Software

3.1 WWLLN Software

The WWLLN software is provided by James Brundell and compiled specifically for the ARM process. The three programs are **toga**, **ntpcheck**, and **GDspectro**. **toga** is the main WWLLN processing programming that reads in the VLF and GPS signals to produce the UDP packets sent on to the main WWLLN processors. It should be always running on the system with a crontab entry such as:

```
0,5,10,15,20,25,30,35,40,45,50,55 * * * * toga -s 100 -a 3 -j 1 -g -o &
```

This will try to start it every 5 minutes in case it stops for any reason.

The **ntpcheck** and **GDspectro** and programs used by **toga** but do not need to be called or run on their own.

3.2 Hardware Controls

Pin GPIO145 is the pin that controls whether the preamp power supply is turned on or off. When the pin is held low (value of 0) the power supply is on, when it is set high (value of 1) it is turned off. The command to change a GPIO pin value is:

```
echo 0 > /sys/class/gpio/gpio145/value
```

The two scripts **preampOn.sh** and **preampOff.sh** can be used to easily toggle the preamp power supply.

The default value for GPIO pins is to hold them high, so during boot the preamp turns off until the **preampOn.sh** script can be called at the end of the boot sequence.

3.3 GPS Interface

The Trimble GPS communicates with the TSIP protocal, compared the NMEA of the previous GPS engine used. The pythons script **readTSIP.py** interprets the TSIP messages and reports the GPS status to the file gps.log and prints them to the console. The console printing can be turned off by changing the variable print_to_console to False.

The program can be started and run in the background to produce a continues record of GPS activity. The default location for the gps.log file is in the public_html folder where it can be remotely checked through the service unit website.

3.4 RAM Disk

The Linux distribution for Gumstix automatically sets up a RAM disk for users. It is created at /var/volatile with half of the available RAM (256 MB). It needs to be used for the running of the WWLLN software as the microSD card is too slow. At start-up the public_html folder (logs and spectrograms) and sferics folder are created in the ram disk and symlinked to the main sferics directory.

For this reason all permanent edits to the Service Unit website should be made in the public_html_static directory.

4 Creating Gumstix microSD Card

There are two methods for configuring a new microSD card for use with the service unit Gumstix computer. Either a card can be formatted and loaded with the latest software following the INSTALL.md instructions, or an existing installation disk image can be copied over (located on flashfile and flash5).

4.1 Card Duplication

Once a new card is created it is advised to make an exact copy of the card to allow for duplication onto new cards. Since the partitioning, and bit location on the card, is critical for the Gumstix the direct copy program **dd** should be used to make the copy. To copy a card to a disk image the command will look like:

```
sudo dd if=/dev/sdb of=/Path/To/Target/gumstix.iso bs=512
```

And the command to copy a microSD image back to a new card in the same slot as the previous card:

```
sudo dd if=/Path/To/Target/gumstix.iso of=/dev/sdb bs=512
```

A word of warning: the **dd** command can overwrite and destroy hard drives if they are incorrectly targeted. Always double check the mount point of the microSD card before running the **dd** command.

5   Gumstix System Setup

Subsection 5.1 gives the setup instructions for a new station, namely setting the IP address so it can be added to the network. A more up to date version is available in the **gumstix.git** repository in the **user_manual** folder. Also included in the station setup instructions are how to setup and customize the service unit webpage, as described in Subsection 5.2.

5.1   Connecting to the Gumstix

Method 1: SSH Setup

The SSH setup method requires:

- Ethernet cable

- SSH capable computer

1. Connect SU to a host computer directly with an ethernet cable

2. Set host computer ethernet network settings to:

   ```
   address: 192.168.10.1
   gateway: 192.168.10.100
   netmask: 255.255.255.0
   ```

3. SSH into the SU from host computer:

   ```
   ssh -p 7777 sferix@192.168.10.2
   password: [ ]
   ```

4. Set desired static ip configuration in file ∼/networkSetup.sh

5. `sudo ./networkSetup.sh`

6. Switch SU to main network ethernet within 1 minute of running networkSetup.sh

7. Test connection by SSH'ing into SU with new IP address

8. (a) If successful: set new IP setting in /etc/network/interfaces

    (b) If unsuccessful: power cycle SU and check settings starting with step 3

9. Reset SU and confirm new settings

Method 2: Workstation Setup

The Workstation setup method requires:

- HDMI Monitor and cable

- **Powered** USB Hub

- USB Keyboard

- USB Mouse

Connect the powered USB hub to the back USB port of the service unit, and attach the keyboard and mouse to the hub. Connect a monitor to the HDMI port, DVI - HDMI adapters work as well. Power on the box, it will take a few minutes for the login screen to show up. Select "Other..." and login with the username **host**. Wait a few more minutes for the graphical display to load.

Adjust the network settings by the steps listed in Method 1 or 3.

1. Connect an HDMI display, keyboard and mouse

2. Follow Method 1 or Method 3

Method 3: Manual microSD Editing

The files that need to be edited on the rootfs partition are:

```
/etc/network/interfaces
/etc/resolv.conf
/etc/systemd/system/sshd.socket
```

The interfaces file lists the IP information of the machine whole the resolv.conf file is for the DNS information. The sshd.socket file sets the port with which SSH is allowed.

The last step, if a non-standard port is being used, is to also alter the built in firewall of iptables and netfilter. The firewall settings are stored in:

```
/etc/iptable.rules
```

and can be edited as a standard iptables configuration file.

5.2   Website Setup

Starting apache2

To get apache2 running only one change needs to be made in the /etc/apache2/httpd.conf file.

```
#ServerName www.example.com:80
```

Needs to be uncommented and changed to the hostname of the computer, e.g.:

```
ServerName gumstix.ess.washington.edu:80
```

Then httpd needs to be restarted:

```
sudo httpd -k restart
```

Setting up the website

All changes to the website need to be made in the /home/sferix/public_html_static folder, this folder is copied to /home/sferix/public_html during start up. Changes to public_html are not saves as the folder is located in system RAM due to SD card read/write limitations. A restart in not necessary if the public_html_static contents are copied to public_html.

5.3 Sound Settings

The Gumstix a myriad of analog inputs that are all controlled with **alsamixer**. For the WWLLN service unit the stereo input is controlled by the <Analog> input as shown highlighted in Figure 2, and a digital gain through <TX1 Digital>. Included in the installation files is the default alsa profile **asound.state**.
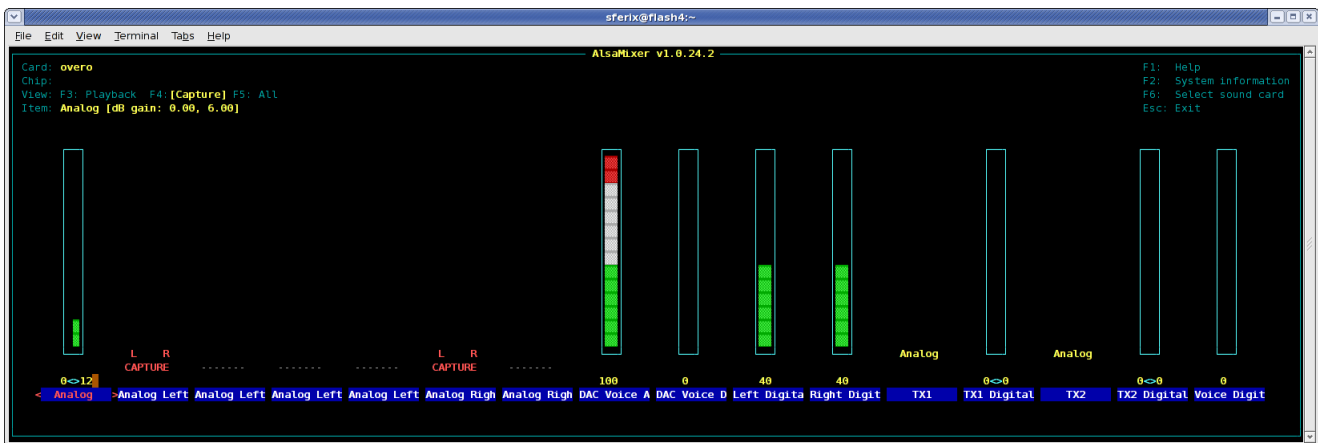

Figure 2: Alsamixer settings for Gumstix stereo input, <Analog> controls the stereo gain.

6 Common Problems

- The network icon in the top menu bar says the network connections are disabled.

  The GUI network manager is disabled, but the network settings set as above still work.

- The GPS pulse per second is not working with the TOGA program, it lists "PPS bad" for most lines.

  Adjust the gain on the pulse per second with Alsamixer ¡TX1 Digital¿ right channel, usually lowering it will resolve the problem.