

This document outlines some details to help you better understand the features of your Next Generation IRLP embedded node.

The Next Generation Embedded Node is a compact IRLP node that is optimized for speed, low power consumption, and reliability. The Next Generation nodes are full-load IRLP nodes, so all of the scripts and programs that are made for IRLP nodes will work on the node. This document covers specific features and tips for using the node. It does not replace other documentation for IRLP nodes. Most of the information you will require is available from the following website:

<http://www.irlp.net/new-install/>

Additional information can be found on the IRLP Wiki page at:

<http://wiki.irlp.net>

Please note – The wiki is a collaborative effort, and anyone can edit/add/remove content.

This document will live online as a PDF file. The version of the PDF will be updated as more things are added to the document. Please refer to the ChangeLog on the last page of this document for details on the updates.

David Cameron – VE7LTD
IRLP System Designer

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Each unit is developed using the same series of motherboard, the Intel DN2800MT (or clone) series of mini-itx motherboards. This simplifies the installation, configuration, and support of your system.

The individual case used in your system may differ, but the core system is the same. The specifications of the system are as follows:

- 1.86 GHz clock speed (Intel Atom N2800, dual core)
- 2 Gigabyte DDR3 RAM
- 4 Gigabyte (or larger) Commercial uSATA Solid State Disk
- Version 3.0 IRLP board

Wiring

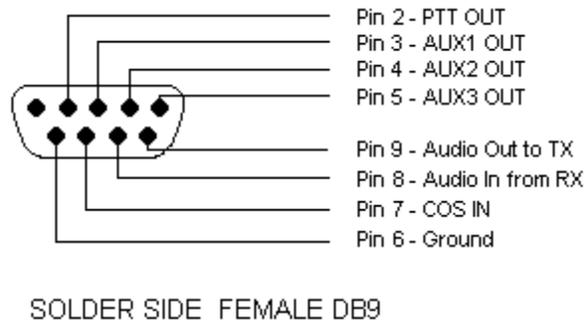
The DB-9 interface between the radio and the IRLP board is directly wired to the audio input and output on the motherboard. This removes the need to use the audio ports of the motherboard for input and output audio, providing a single DB9 connector for all inputs to and outputs from the node.

The wiring of the embedded node DB-9 connector is identical to the IRLP Version 3.0 interface board wiring, except that audio output is available on pin 9 of the DB-9 connector. This means that audio input (and the input to the DTMF decoder) is on pin 8 and the audio output is on pin 9. There is no need to use 1/8" stereo connectors to connect to the audio jacks on the motherboard.

IMPORTANT – Many scripts (including the interval ID) require that the AUX1 and PTT outputs be bridged. This means that you should solder a jumper between pin 2 and pin 3 on the DB-9 cable you build. This is **REQUIRED** for all controller installations and for many scripts developed for the embedded IRLP nodes.

IMPORTANT – Some microphone inputs have a biased voltage applied to them to power the microphone element. **THIS AUDIO OUTPUT IS NOT DC PROTECTED**, and a series capacitor should be added to remove any DC portion on the line. Failure to do so can damage the audio input on the motherboard.

The wiring is as follows:



Embedded DB9 Wiring

Pin 2 – PTT Output

This pin should be connected to the radio PTT. This lead is active LOW only (goes to ground for radio to transmit).

Pin 3 – AUX1 Output

This pin should be connected to any AUX source. For repeater operation and to use some scripts, this must be bridged to PTT (pin 2).

Pin 4 – AUX2 Output

This pin can be connected to any AUX source. This lead is active LOW only.

Pin 5 – AUX3 Output

This pin can be connected to any AUX source. This lead is active LOW only.

Pin 6 – Ground (common to radio and power source)

The ground should be common to the chassis of the radio, audio lines, and common to the power source ground.

Pin 7 – Carrier Operated Squelch (COS) Input from radio

COS is a digital ON/OFF signal from the receiver that changes with the presence of a received signal. The COS can be active high or active low. The COS jumper on the board switches between active HIGH and active LOW. All embedded nodes are shipped with the jumper in the COS active LOW position.

Pin 8 – Audio In (from receiver)

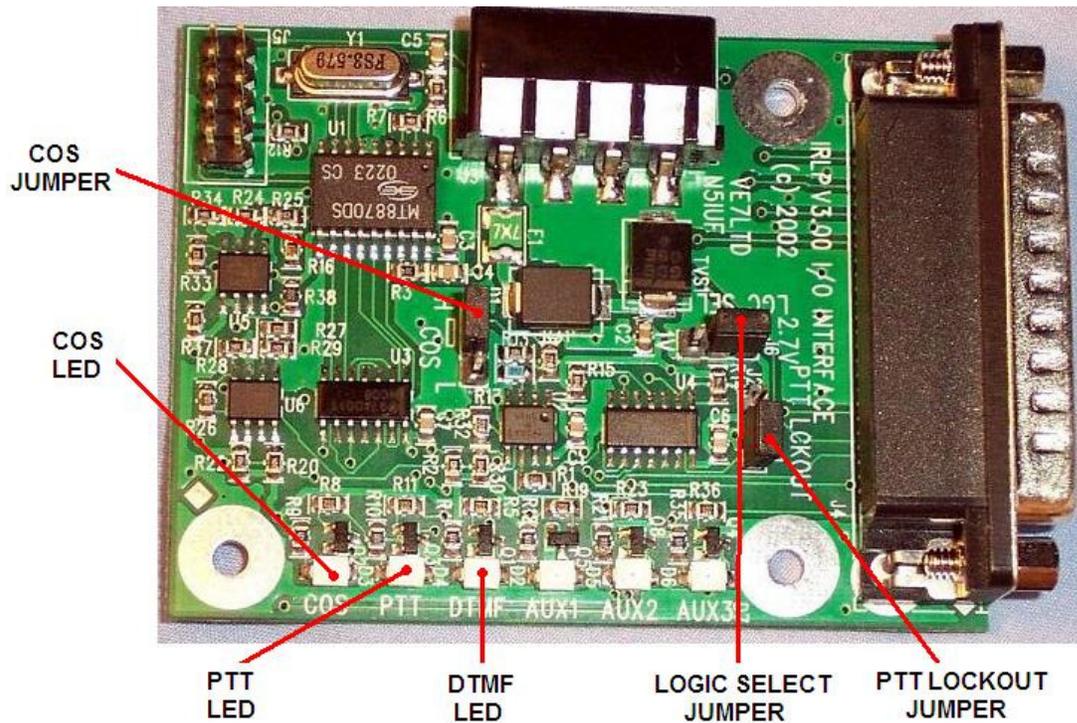
This pin should have the squelched audio from the receiver. This is the audio input to both the node and the DTMF decoder on the IRLP board. The input impedance is about 50Kohms, expecting between 0.1V to 1.0V P-t-P audio.

Pin 9 – Audio Out (to transmitter)

This is the audio source for the transmitter. It should be tied to the audio input of the transmitter. The output impedance is 300 ohms, and produces a 1V P-t-P signal.

IRLP Board Jumper Adjustments

The IRLP interface board is located inside the embedded node. The board has three jumpers which can be adjusted to suit the needs of the connected radio. The jumpers are the COS HIGH/LOW jumper, the LOGIC SELECT jumper, and the PTT LOCKOUT jumper.



The COS HIGH/LOW jumper changes the logic required for the COS signal. If the COS signal is drawn to ground when the receiver is active, the jumper should be in the L (LOW) position (default when shipped). If the COS signal applies a positive voltage when the receiver is active, the jumper should be in the H (HIGH) position.

The LOGIC SELECT jumper changes the voltage threshold for the COS signal. It can be switched between 2.7V (default when shipped) and 1.0V. This is the threshold voltage that the COS must swing past to indicate a change in state. If you are having problems making the COS work, you should try changing this value.

The PTT LOCKOUT jumper is used to inhibit a COS signal when the radio PTT is being applied. By default the PTT LOCKOUT jumper is in the disabled position. If you have your node connected directly to a repeater or full duplex radio, this jumper must be in the disabled position. The jumper can operate with simplex radios in either position.

USATA Solid State File System

The disk is a 4 gigabyte (or larger, depending on stock availability) solid state disk, which operates as a standard SATA device. It is fast and reliable system, which will provide many years of trouble-free operation.

There is approximately 1 gigabyte used by default for the Linux file system and the IRLP files. This leaves plenty of space free for log files and customization.

The file system is optimized to minimize the number of write cycles to extend the life of the disk. The disk is designed for several million read and write cycles, but in the design of the system, the disk will outlive the useful life of the node (estimated for 15 years). This system should also never require a reboot.

The First Login and the ROOT Password

For the first login, you will require a VGA or HDMI monitor and USB style keyboard. Once the embedded computer has finished booting, you will be presented with a login prompt. The user you will log into your embedded node with is:

```
root
```

The default root password on every shipped embedded IRLP node is:

```
rootirlp
```

The system will force you to change this on first login. **DO NOT forget your password, as we cannot recover it for you.** Your whole system will have to be reflashed and reconfigured from scratch. This is because it is very difficult to modify files (including the password file) on the flash drive, as it is only used read-only. Once the initial passwords are set, the changes are automatically synced to the flash device for the next boot.

The repeater user password and IRLP Web Admin and IRLPvCON user (username=admin) passwords are also set on the first boot.

NOTE: All usernames, password, filenames, commands are CASE SENSITIVE. Be sure to look carefully at the directions when executing setting passwords and issuing commands.

IRLP Board Function Tests

Once the wiring is complete, and the jumpers are set in the correct position, you should perform a few tests. This is best done with the IRLP interface board in view, but can also be performed on the computer console. To monitor on the console, log into the node, and switch to the repeater user, and use the readinput program:

```
su - repeater (su SPACE MINUS SPACE repeater)
readinput
```

To exit the readinput program, press CTRL+C.

1) COS Function Test

Transmit a signal into the radio connected to the node. The green COS LED should illuminate with a signal, and turn off with no signal. If monitoring on the console, the words "COS ACTIVE" should show on the screen with a signal and "COS INACTIVE" without. If the signals are opposite, change the position of the COS HIGH/LOW jumper. If no change is observed, check your wiring to pin 7 of the IRLP DB-9, and ensure the radio and node share a common ground.

2) DTMF Function Test

Transmit a signal with some DTMF tones. The green COS LED should illuminate with the signal, and the yellow DTMF LED should illuminate with each DTMF tone. If monitoring on the console, the words "COS ACTIVE" should show on the screen followed by DTMF X for each tone pressed, followed by "COS INACTIVE". If this is not observed, check your wiring to pin 8 of the IRLP DB-9, and ensure the radio and node share a common ground.

3) PTT Function Test

Note: If you are running the readinput program, press CTRL+C to exit.

Using the computer console, type the commands:

```
key
unkey
```

The radio should key and unkey, and the red PTT LED should illuminate and go out. If this is not observed, check your wiring to pin 2 of the IRLP DB-9, and ensure the radio and node share a common ground.

Editing Configuration Files with nano or pico

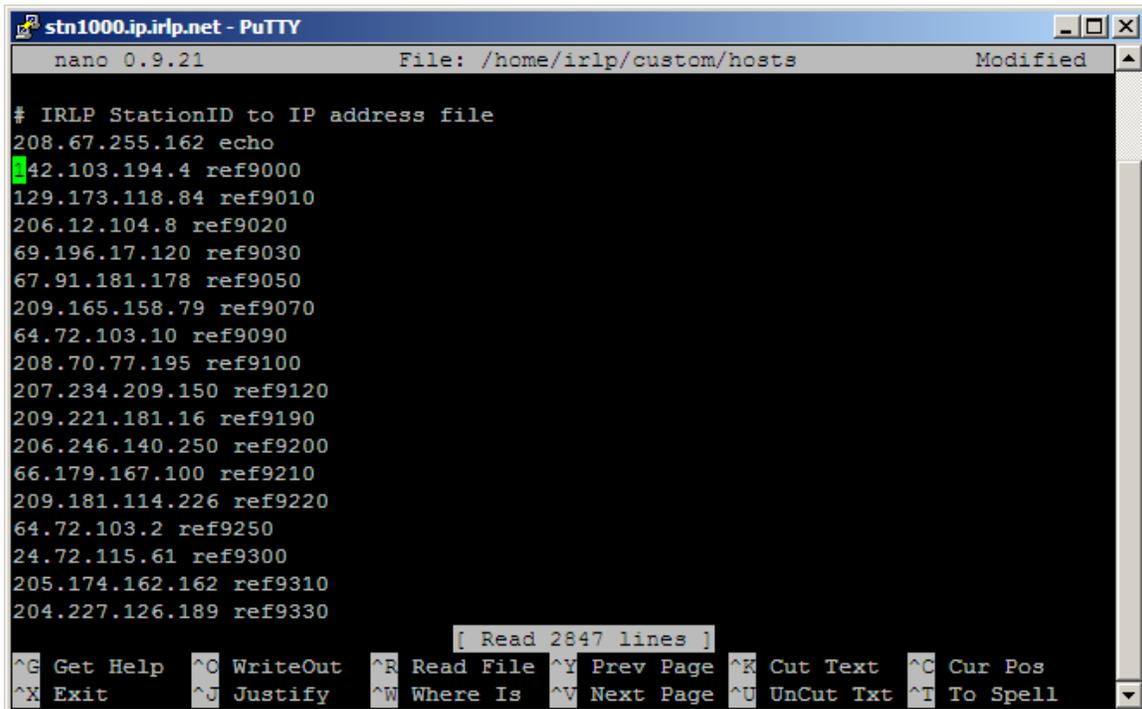
During the configuration of your embedded node, you may have to change some of the configuration files. The programs nano or pico are used to edit text configuration files on the embedded node. nano is actually a recent clone of pico, but since much of the documentation from the history of IRLP uses pico, the two programs can be used interchangeably. The correct syntax is

```
nano filename
```

Once you are complete with editing a file, you press CTRL-X to exit. If changes have been made, it will ask to press “Y” if you want to save those changes, and then prompt you for a filename to save it under.

There are a number of arguments you can use with nano, the most commonly used one is “-w”, which prevents the wrapping of long lines, which is the number one cause of corrupted configuration files in IRLP. More information on the nano editor can be found by reading the nano manual page at:

<http://linux.die.net/man/1/nano>



```
stn1000.ip.irlp.net - PuTTY
nano 0.9.21 File: /home/irlp/custom/hosts Modified
# IRLP StationID to IP address file
208.67.255.162 echo
42.103.194.4 ref9000
129.173.118.84 ref9010
206.12.104.8 ref9020
69.196.17.120 ref9030
67.91.181.178 ref9050
209.165.158.79 ref9070
64.72.103.10 ref9090
208.70.77.195 ref9100
207.234.209.150 ref9120
209.221.181.16 ref9190
206.246.140.250 ref9200
66.179.167.100 ref9210
209.181.114.226 ref9220
64.72.103.2 ref9250
24.72.115.61 ref9300
205.174.162.162 ref9310
204.227.126.189 ref9330
[ Read 2847 lines ]
^G Get Help ^C WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Txt ^T To Spell
```

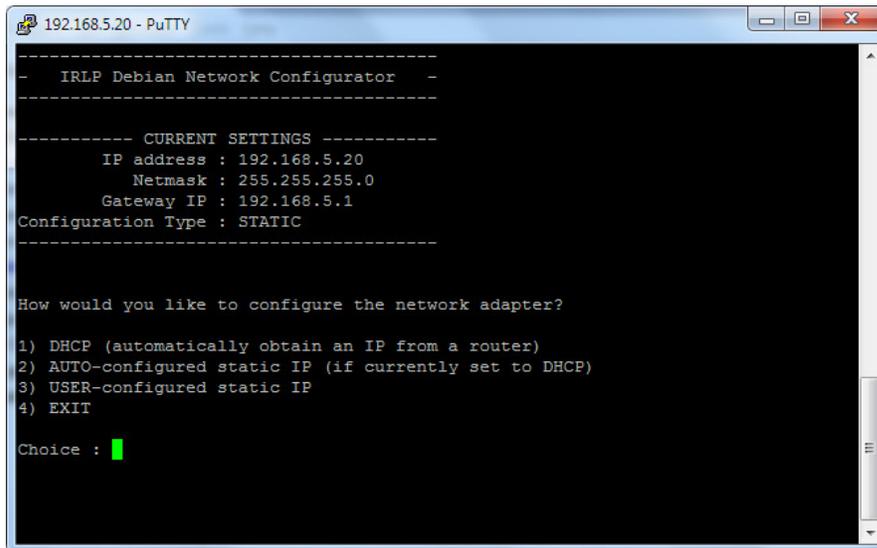
Sample screenshot of nano

Configuring the Network Adaptor

The network adapter driver is already preloaded into the system. The network adapter is initially set to automatically obtain an IP address using DHCP. The IRLP nodes can be run directly connected to the internet, or behind a router or firewall. However, if you are operating your node behind a router, you will want to set your IP address statically. The script:

```
netconfig
```

is used to help you configure your IP address.



netconfig program

Forwarding IRLP Ports through a Router

As with any other IRLP node, if your embedded node is behind a router, you have to forward some TCP and UDP ports to the node, or put the node into the DMZ of the router.

The IP address of your node should have automatically been set static by the scripts in the section "Configuring the Network Adapter". You will need to forward the following ports through your router to the IRLP node:

```
15425 TCP (for IRLP calls)
2074 through 2093 UDP (for IRLP audio)
```

If you want to be able to access the IRLP Remote Admin or IRLPvCON from the outside, you will also need to forward:

```
80 TCP
```

If you are using Echolink (EchoIRLP) on the embedded node, you will also need to forward:

5198 and 5199 UDP

If you want to access your console remotely (through SSH), or would like help from the support crew remotely, you will have to forward:

22 TCP
or
15426 TCP

Alternately, if your router has a "DMZ" feature, you can put the IP address of the node into the DMZ, and all ports will be forwarded to the IRLP node.

More information of ways to perform the port forwarding or DMZ setting is available in the "**IRLP behind a Router or Firewall**" section at:

<http://www.irlp.net/new-install/>

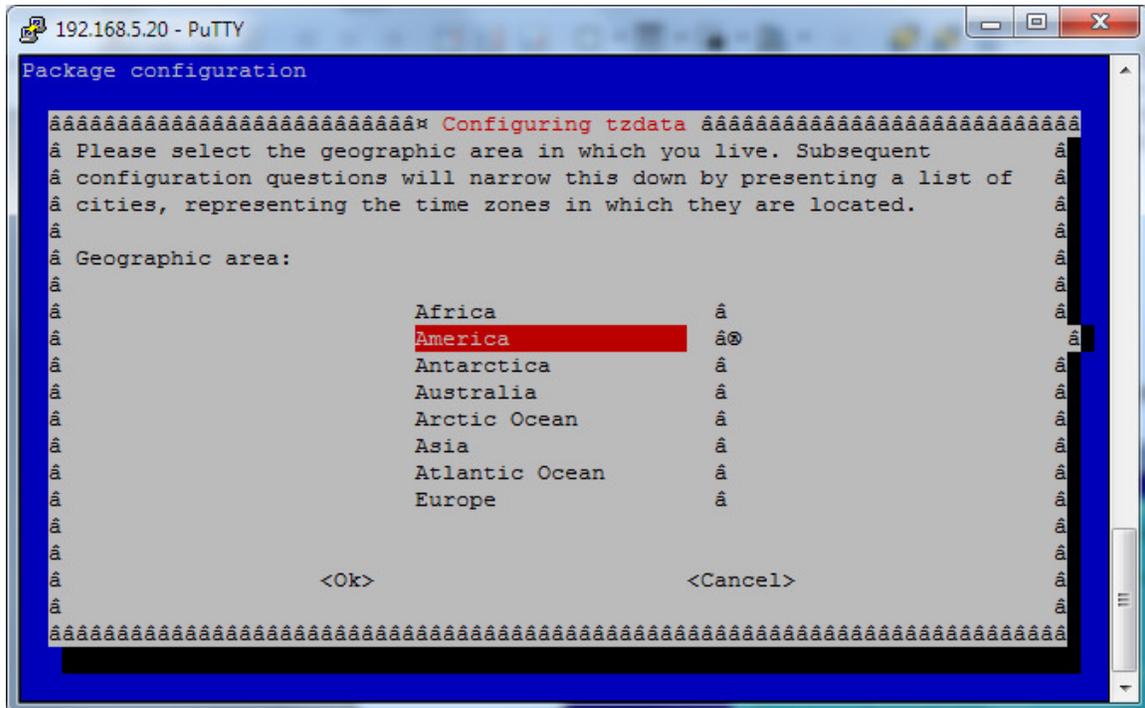
Timezone Configuration and Time Setting

The timezone is configured using the program:

timeconfig

Choose your location from the list.

This node uses ntp (network time protocol) to synchronize the time automatically.



timeconfig configuration screen

The IRLP Troubleshooting Script

The software on the embedded node contains a script that will help you determine if there are any problems with your node. The script tests a number of conditions, and is used as the basis of diagnosis by the IRLP support team.

To run the troubleshooting script, log in and type:

```
su - repeater      (su SPACE MINUS SPACE repeater)
troubleshoot-irlp
```

Details on each step of the script and possible causes and solutions can be found on the following webpage:

<http://www.irlp.net/ts.html>

IMPORTANT – As your embedded node contains entries to allow EchoIRLP to work, it will fail Test 10 – Environment File Corruption Test. THIS CAN SAFELY BE IGNORED.

Remote Access Using Secure Shell (SSH)

SSH is a secure and encrypted protocol used to remotely communicate with your embedded node. If you are using Windows as your primary computer, you should download and install puTTY and WinSCP as two tools to assist you with controlling your node.

The SSH port defaults to TCP 15426. This is made to prevent standard hacking scripts that hunt SSH servers have a harder time finding your node. This means you have to program port 15426 into any SSH or SCP program (such as PuTTY or WinSCP) you may use. Also, if you wish to have remote access to your IRLP node, you will need to forward port 15426/TCP as well.

In winSCP and puTTY you can set the port to 15426 where you set the IP.

In linux, you can use the format `ssh -p15426 IP_address`.

If you wish to change the SSH port to another port, you can edit the Port option in the `/etc/ssh/sshd_config` file.

NOTE: On the embedded nodes, IRLP has installed a "public key" on your node which will allow the support team to login to the nodes with root or repeater user access without a password. You can remove this feature by removing the file:

```
rm /root/.ssh/authorized_keys2
rm /home/irlp/.ssh/authorized_keys2
```

Adjusting Audio Levels

The audio levels (both receive and transmit) are adjusted using the mixer program (as user root) :

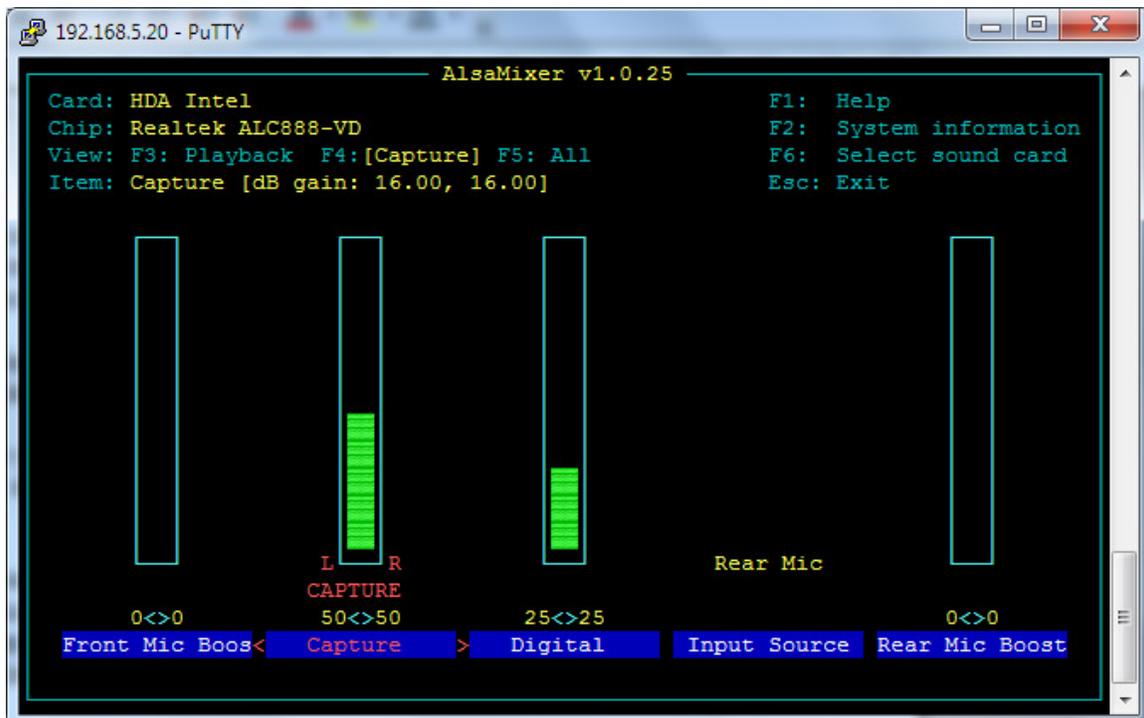
```
alsamixer
```

You choose the view you want with the “TAB” key. It is best to show ALL by default (press TAB twice), as there are only a limited number of controls available. Alternately, you can view the Capture and Playback separately.

The motherboard has an extensive number of sliders to control. It can be very confusing, so please carefully read this section before using the mixer.

You choose the device you want to edit with the right/left arrow keys, and the level with the up/down arrows. Selections can my muted/unmuted with the “M” key.

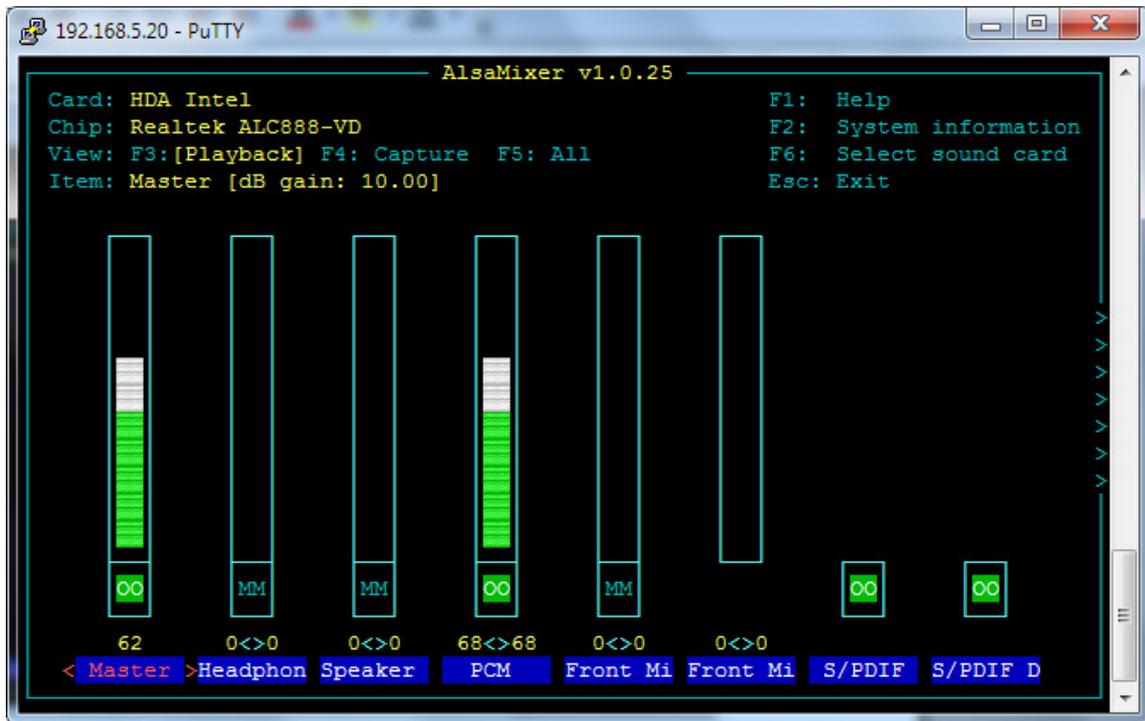
The level of audio passed from INPUT to the IRLP encoder (IRLP input level) is adjusted with the Capture slider. It is shown as a level from 0 to 100. The word “CAPTURE” should appear in red beneath the level slider. If it does not, press the SPACE bar to enable the capture.



Input and Capture Controls

Note: The Digital slider should be kept around 25.

The level of audio passed from the IRLP decoder to the OUTPUT (IRLP output level) is adjusted with the PCM slider. The overall output audio gain is adjusted with the Master slider.



Output Level Control

To quit alsamixer, use the “ESC” key.

After exiting, to save, run (as user root) :

alsactl store

Setting your Local Transmit Audio

Every IRLP system is preloaded with an audio test script that is designed to help you adjust the level of audio from the IRLP node to your transmitter. The audio test consists of a 1000Hz tone that is set at the maximum usable threshold of your sound card, combined with some voice (of IRLP creator David Cameron – VE7LTD).

To run the script, log in as user root, and execute the following commands:

```
su - repeater    (su SPACE MINUS SPACE repeater)
audiotest
```

You can adjust the mixer levels live while the test is playing by opening up an additional SSH console session, or by opening up an additional virtual console if you are connected via keyboard directly to the node (ALT + F2). Then you can run the audiotest script with one console, and adjust the levels on the other.

You want to adjust the levels up right until the point of distortion, and then reduce them. You can also turn it up until it does not get any louder when the node is being received by another radio, and then back it off a bit.

Make sure that you save the modified audio level using the command:

```
alsactl store
```

This level can be fine tuned later, as ultimately this needs to be adjusted so remote users sound the same as local users.

Setting the Node Input Audio

A special script has been designed to assist with the initial setting of input audio levels. The script can be invoked using the "repeater" user from the console with the following commands:

```
su - repeater      (su SPACE MINUS SPACE repeater)
audio_level_test
```

It can also be invoked from the radio using the DTMF code:

AA33BB

The script will key up and prompt you "Audio level test ready". You must now send at least 10 seconds of audio, either voice audio or continuous tone audio. If using DTMF, use the "D" key. Once you unkey, it will process the audio file and report back:

"Clipping 4 percent" (percentage of clipped samples is 4 – GOOD)
"Audio Level 66 percent" (median level is 66 out of 100 - GOOD)

You want to adjust the input audio level so it is right on the brink of clipping with voice audio.

You would then adjust the Capture slider in the alsamixer program to raise or lower the input level. An audio level between 70-80 with 0 clipping on a continuous DTMF tone "D" is good. On a voice signal, an audio level greater than 50, with a clipping less than 5% is good.

If you are unable to get the audio high enough by adjusting the Capture slider to pass the test, increase the Rear Mic Boost slider first, and then the Digital slider if required.

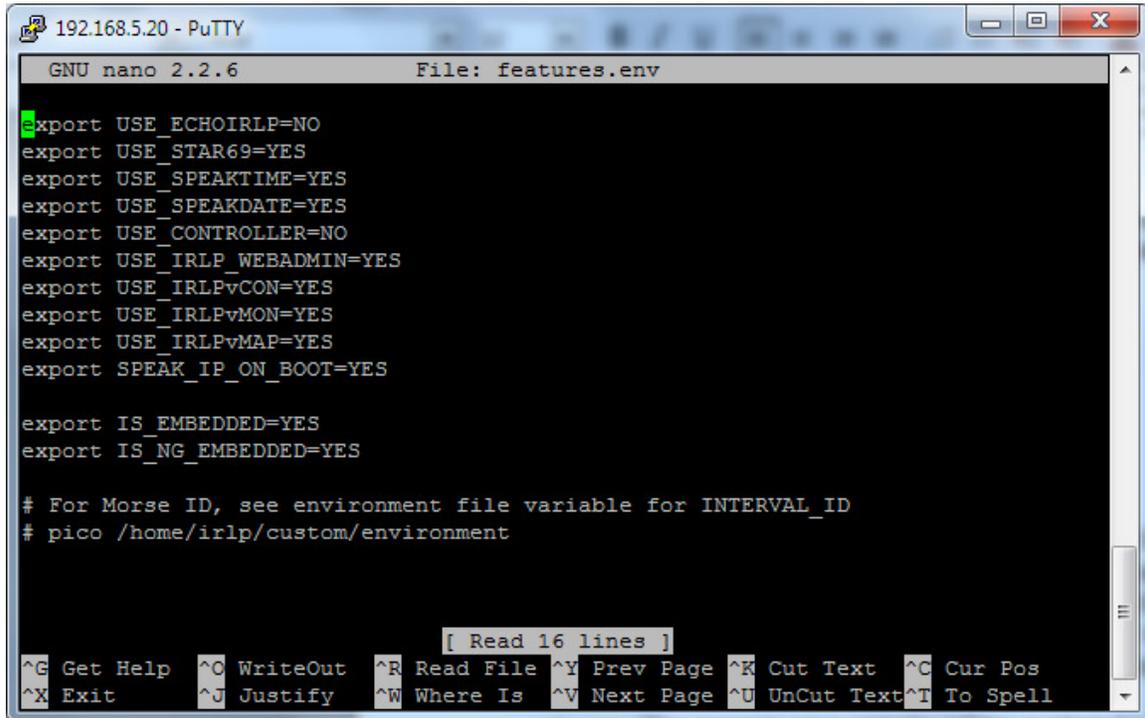
If you are unable to get the audio LOW enough to pass the test, decrease the Rear Mic Boost slider first, and then the Digital slider if required.

The numbers will vary between voices and tones, but as long as the clipping is not too high, and the level is not too low, you will be sending good audio.

Installed Features

The embedded nodes are pre-loaded with a series of commonly used add-on features. These feature can be enabled or disabled by adjusting flags in the file:

`/home/irlp/features/features.env`



```
GNU nano 2.2.6 File: features.env
export USE_ECHOIRLP=NO
export USE_STAR69=YES
export USE_SPEAKTIME=YES
export USE_SPEAKDATE=YES
export USE_CONTROLLER=NO
export USE_IRLP_WEBADMIN=YES
export USE_IRLPvCON=YES
export USE_IRLPvMON=YES
export USE_IRLPvMAP=YES
export SPEAK_IP_ON_BOOT=YES

export IS_EMBEDDED=YES
export IS_NG_EMBEDDED=YES

# For Morse ID, see environment file variable for INTERVAL_ID
# pico /home/irlp/custom/environment

[ Read 16 lines ]
^G Get Help  ^O WriteOut  ^R Read File  ^Y Prev Page  ^K Cut Text   ^C Cur Pos
^X Exit      ^J Justify   ^W Where Is  ^V Next Page  ^U UnCut Text ^T To Spell
```

features.env file

REMOTE WEB ADMIN

The IRLP Remote Web Admin is installed by default on all embedded IRLP nodes. This allows you to perform some simple control features from any web enabled computer. You can send DTMF to the decode script, enable/disable the node, drop the current connection, edit several files, view the messages file, and see the status of your node.

You access your remote admin system by entering the URL

<http://stnxxxx.ip.irlp.net/control/>
(replace xxx with your node number)

NOTE: You must forward port 80/TCP through your router for this to work from outside your network. Some ISPs will block incoming data on port 80.

The default username and password are: admin/admin. These will be changed on the first login. The same username and password are used for both the remote web admin and irlpvcon suite.

If you lose the admin user password for the remote web administrator or irlpvcon, it can be removed by entering the command as the root user:

```
/var/www/irlpvutil/remove_pwd
```

IRLPvCON, IRLPvMAP, IRLPvMON

The IRLPvCON suite of control software is installed by default. More information about the software can be found at

<http://k6ib.com/irlpvcon/>

You access the system using one of the following three links:

<http://stnxxxx.ip.irlp.net/irlpvcon/>
<http://stnxxxx.ip.irlp.net/irlpvmon/>
<http://stnxxxx.ip.irlp.net/irlpvmap/>

CONTROLLER

The IRLP controller program is a simple controller that provides hangtime, DTMF muting, activity controller ID, and programmable courtesy tones.

The IRLP controller requires a pair of courtesy tone files to be setup. The controller requires files to be made that are RAW (no header), 8 bit, with a sample rate of 8000hz. The names are `ct1.raw` and `ct2.raw`.

`ct1.raw` is played for local traffic, and `ct2.raw` is played for remote (IRLP and controller generated traffic). These can be made to whatever you like, using a program like CoolEdit. You can then use a program like WinSCP to transfer the files from a windows machine onto the embedded node. After the files have been sent, the `flash_sync` script must be run to save the changes.

The controller has an environment file at:

```
/home/irlp/features/controller/controller.env
```

which can adjust many of the features of the controller. You can adjust:

- The hangtime in milliseconds.
- The shortcut timer in milliseconds (COS time required for hangtime activation).
- The alligator timer in seconds (COS timeout).
- The ID interval in seconds (time between IDs).
- The courtesy tone frequency.

After making any changes to the environment file, the controller must be restarted by running:

```
/home/irlp/custom/rc.irlp
```

SPEAKTIME

The speaktime script is already pre-installed on the system. The DTMF code “C” is used to invoke the speaktime script.

STAR69

The star69 script is already pre-installed on the system. The DTMF code “*69” is used to invoke the star69 script.

EchoIRLP

EchoIRLP allows you to run both an Echolink and an IRLP node from the same computer and radio hardware. The EchoIRLP system is installed on each embedded system, but disabled by default. You must configure your own EchoIRLP system, by editing a series of configuration files.

If provided at the time of order, the node will be preconfigured with your EchoIRLP settings. The configuration files for EchoIRLP are located in:

```
/home/irlp/features/EchoIRLP/custom/
```

The files you will need to customize are:

```
userdata.txt  
tbd.conf  
echo_environment
```

Next Steps

Once the router has been configured, your node passed the troubleshooting script, and the audio levels have been set, you are ready to start enjoying your new embedded node. There are few more steps you should perform in order to advertise your node, and become more informed about the IRLP network.

Please review the “What to do After the Install” document at:

<http://www.irlp.net/new-install/afterinstallv2.pdf>

Using this document, you can complete the following steps:

- 1) Publish your node on the IRLP Status Page (<http://status.irlp.net>)
- 2) Join the IRLP and Embedded-IRLP Yahoo Groups
- 3) Record and upload your connect/disconnect audio files
- 4) Test your node for a PULSEBACK and adjust the timing file
- 5) Learn a few operating guidelines.

Change Log

Date	By	Rev	Change
12/05/14	VE7LTD	2a	Initial release