Configuring the DireWolf Virtual TNC and SignaLink USB Sound Card for Outpost

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Outpost [1] is BBS packet radio client software (s/w) developed by Jim Oberhofer KN6PE and is used by emergency agencies such as Santa Clara County ARES/RACES for Emergency Communications (EmComm). The SCCo ARES/RACES packet training classes (Packet Operations Type II, Type III Part A, and Part B) recommend using Outpost with a dedicated hardware Terminal Node Controller (TNC) such as the Kantronics KPC3+. A typical station configuration is shown below in Figure 1.
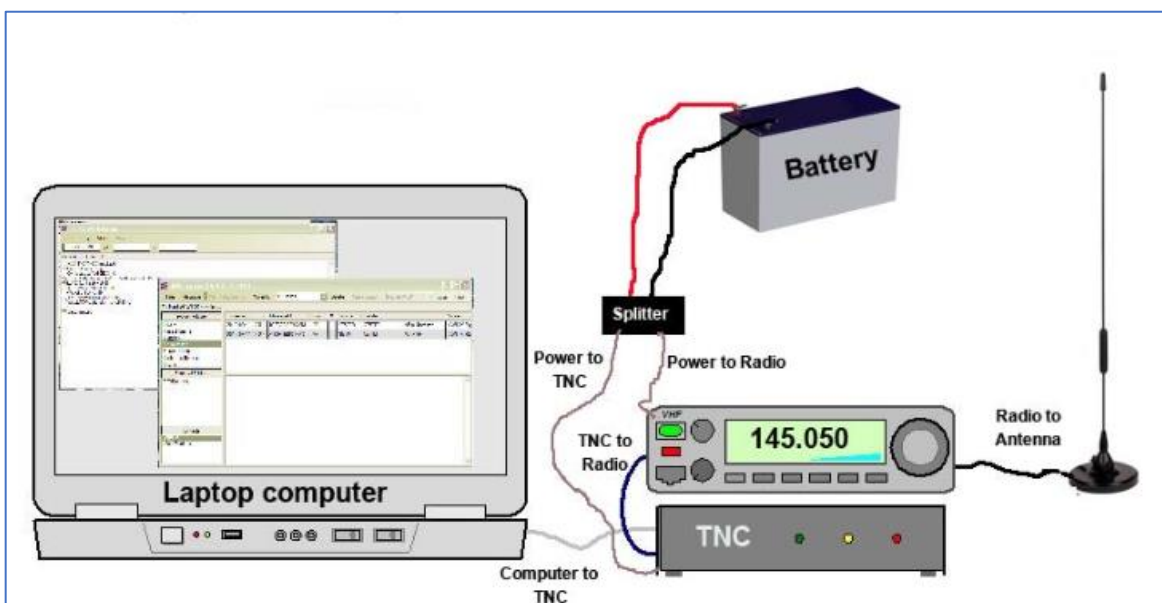

Figure 1. Outpost BBS client using a hardware TNC [2].

In place of the h/w TNC, Outpost also supports a software packet engine called AGWPE using s/w such as the UZ7HO SoundModem and either an internal or external PC sound card. Operators report mixed success when using AGWPE configurations. In some cases, getting the default AGWPE s/w to work properly requires several experimental adjustments and even after these adjustments, sending and receiving packet messages through Outpost using AGWPE may not always be reliable. For the AGWPE approach, detailed troubleshooting procedures are documented, see [3] in the References Section of this document.

An alternative to AGWPE and SoundModem is using only a generic hardware (h/w) sound card such as the SignaLink USB and another s/w modem and packet engine that supports the Outpost AGWPE interface.

At the suggestion of Thomas Leibold KK6FPP, (Santa Clara County ARES/RACES Network Infrastructure Specialist), I explored using DireWolf software [4] which provides an AX.25 packet modem, a *Virtual* TNC, and an AGW API-compliant packet engine. Others have previously described their experiments and attempts to use DireWolf with Outpost [5].

In his document, I outline how to configure and troubleshoot DireWolf to work with Outpost running on a Windows 10 laptop computer with a SignaLink USB Sound Card, and different handheld and base station VHF/UHF radios.

Overview of DireWolf Components and Interactions

DireWolf software can be found in Github [4]. It provides an AX.25 Modem, a *Virtual* Terminal Node Controller, and a Packet Engine compatible with the AGW Packet Engine API used by Outpost. DireWolf s/w replaces the h/w TNC functions shown in Figure 1. The DireWolf components and functionality provided are shown in Figures 2. and 3 below.
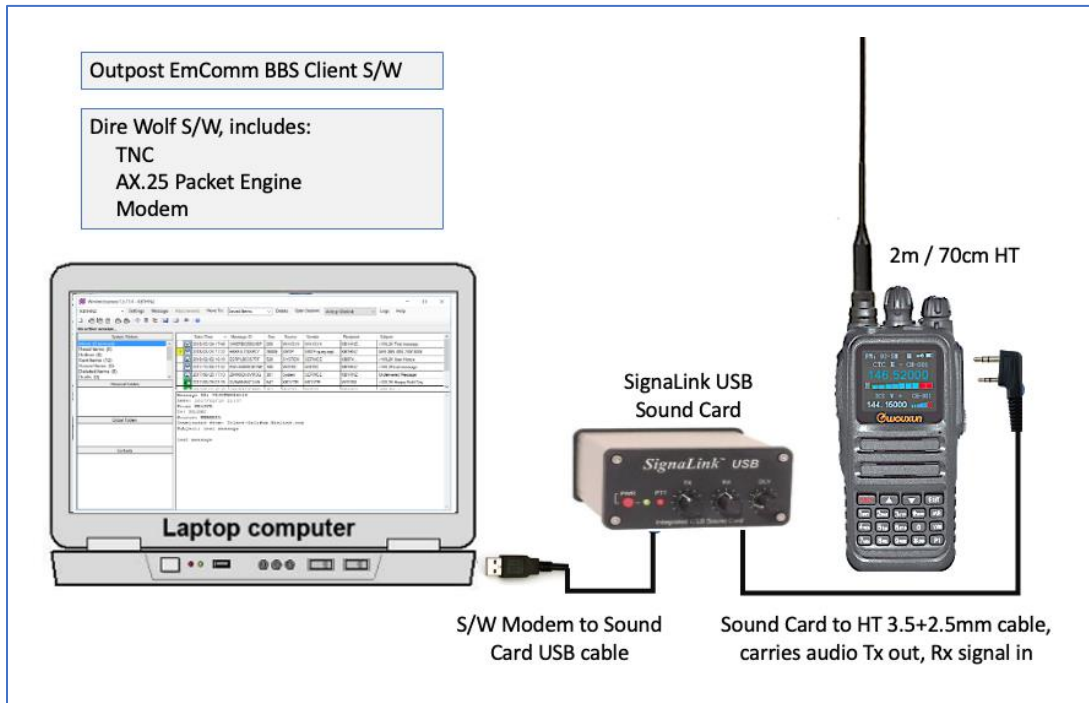

Figure 2. Outpost BBS client using DireWolf s/w and SignaLink Sound Card.
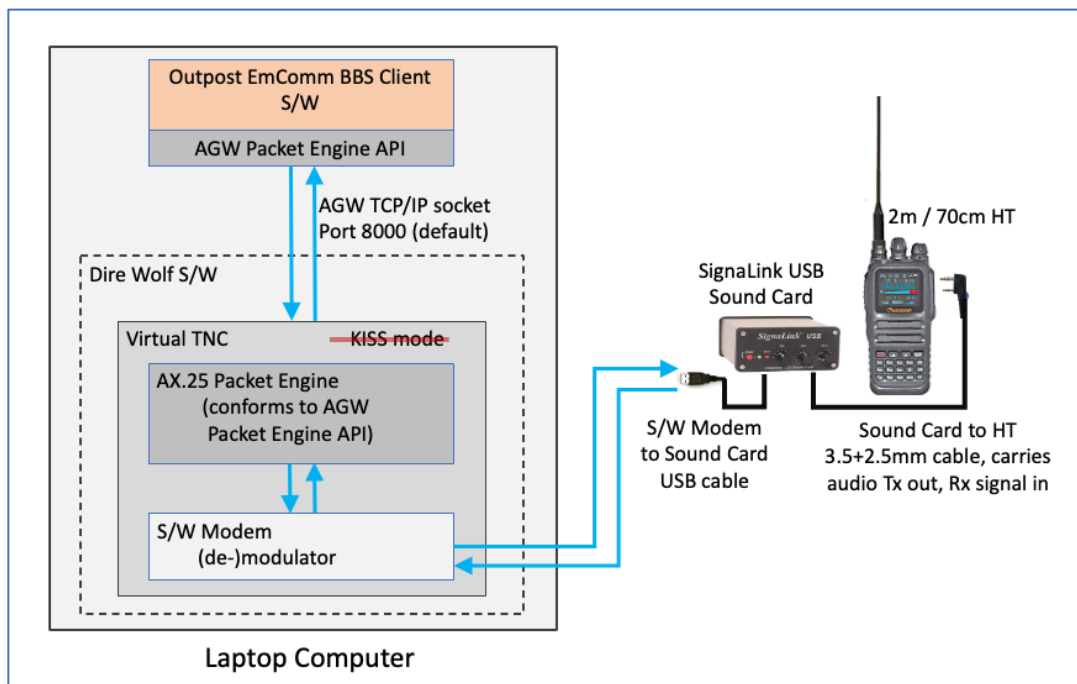

Figure 3. DireWolf provides a s/w modem, virtual TNC, and an AGW API packet engine.

Short Summary:

Configuring DireWolf to work with Outpost and the SignaLink Sound Card is relatively straightforward. The basic steps are summarized below. Each step is described in more detail after the Prerequisites section.

Step 1. Download and Install Outpost – use Outpost download link provided by your EmComm agency.
Step 2. Download and Unzip DireWolf – use DireWolf Github link indicated [4].
Step 3. Verify Audio Devices Available to DireWolf – run direwolf.exe application from command line.
Step 4. Identify which SignaLink input and output audio devices to use for DireWolf – note audio device #s.
Step 5. Configure DireWolf Configuration File Callsign – set MYCALL to your callsign in direwolf.conf.
Step 6. Configure DireWolf Configuration File Audio Devices – set ADEVICE to noted device #s.
Step 7. (Optional) Enable DireWolf KISS for Winlink Express – set KISSPORT to 8100 if you plan to use Winlink.
Step 8. Run the DireWolf Application Again to Confirm Configuration – run direwolf.exe to verify device #s.
Step 9. Create a DireWolf Interface Definition for Outpost – close the default XSC_AGW interface definition.
Step 10. Follow SCCo Packet IIIA Class Instructions to login to W(1-4)XSC – verify round-trip packet communications.

The prerequisites and step details are presented in the next sections.

Prerequisites:

Step 1. Have working knowledge of how to edit files on Windows. You will be making minor modifications to the DireWolf configuration file. Be able to open a Windows command line and cd to different directories to run the DireWolf .exe application. If you are not familiar with how to use "cd" or type "command" into the Windows Task Bar to run a Command Prompt, review this.

Step 2. Verify that your SignaLink USB Sound Card is properly working.

Check that the SignaLink has the correct jumper module installed, or the proper jumpers are set for your radio. Verify that the SignaLink is connected to your radio (usually to a dual 3.5 and 2.5mm jack for HTs). Also verify that the SignaLink is also connected to your computer through the provided USB cable.

As a starting point, set the controls on the SignaLink as follows:

```
Tx  = 2.0        # controls the audio drive level from the DireWolf s/w modem.
Rx  = 2.0        # controls the audio receive level from your radio the modem.
DLY = 0.0        # sets how fast the SignaLink switches to receive after transmit (this is the Auto-PTT
                   Delay or Transmit "Hang-Time", between 30ms to 3 sec., usually set as low as possible.)
```

On your radio, check that the frequency is correct, (e.g., 145.750 MHz for W1XSC) and that the SQUELCH is off (i.e., receive is wide open.) Set the volume control low, this may need to be adjusted later.

Step 3. (Optional) Download and install the Soundcard Oscilloscope. This is a s/w oscilloscope utility that will allow you to check and adjust audio levels if necessary, from your radio to the SignaLink Sound Card and to the DireWolf s/w modem. If you are already comfortable setting SignaLink and radio Rx levels, you can skip this step. The sound card oscilloscope can be found at:

https://www.zeitnitz.eu/scope_en

Use the provided download link:

https://www.zeitnitz.eu/getfile?issrc&name=scope/scope_147.exe

Install and Configure Outpost and DireWolf Software

Here are the detailed steps for installing and configuring and using DireWolf to work with Outpost.

Step 1. Download and Install Outpost.

If you haven't done so already, follow EmComm class instructions to download and install Outpost. Outpost release information can be found on:

https://www.scc-ares-races.org/data/packet/client-software.html

Download Outpost and the SCCo Packet Installer from:

https://www.scc-ares-races.org/data/packet/installer/sccsetup161Gpub.exe

Run the .exe and follow any additional instructions to install it.

Step 2. Download and Unzip DireWolf.

Download and install the DireWolf release from github.com, for release information see:

https://github.com/wb2osz/direwolf/releases

If possible, use the 64bit release which is significantly faster than the 32bit version. The 64bit version of DireWolf can be found at:

https://github.com/wb2osz/direwolf/releases/download/1.6/direwolf-1.6.0-413855e_x86_64.zip

Step 3. Verify Audio Devices Available to DireWolf.

Before configuring DireWolf, determine which audio devices are available for it to use. To accomplish this, run the direwolf.exe application on the command line which will show what devices are available.

Open a command prompt by typing "command" (no quotes) into the Windows Task Bar search field (usually a field on the lower left of the screen that says "Type here to search". Once you open the command line and get a prompt, "cd" to the DireWolf install directory named "direwolf-1.6.0-413855e_x86_64" and then type "direwolf.exe".

       C:\(Your DireWolf Install Path)> direwolf.exe

You should get output from DireWolf that looks like below.

Step 4. Identify which SignaLink input and output audio devices to use for DireWolf.

For the SignaLink USB external Sound Card, the devices of interest will appear like the below, possibly with different device numbers. E.g., on my computer values were:

> 1: Line (USB AUDIO CODEC)
> 1: Speakers (USB AUDIO CODEC)

Record the device numbers corresponding to your SignaLink CODECs from the above. (E.g., my SignaLink provides USB AUDIO CODECs for 1: Line (Tx) and 2: Speaker (Rx), I selected audio input device #1 and output device #1. Yours may differ.)

Step 5. Configure DireWolf Configuration File Callsign.

Go to the DireWolf directory (folder) that was created after you unzipped DireWolf during your installation. Locate the default direwolf.conf file. Make a backup copy of this file. OPEN your direwolf.conf file with your file editor and locate the MYCALL NOCALL directive. First change NOCALL to your callsign, with no parenthesis:

> MYCALL (Your-Callsign)

Step 6. Configure DireWolf Configuration File Audio Devices.

Next locate the section that shows the following:

```
###############################################################
#                                                             #
#              FIRST AUDIO DEVICE PROPERTIES                  #
#              (Channel 0 + 1 if in stereo)                   #
#                                                             #
###############################################################

#
# Many people will simply use the default sound device.
# Some might want to use an alternative device by choosing it here.
#
# When the Windows version starts up, it displays something like
# this with the available sound devices and capabilities:
#
#       Available audio input devices for receive (*=selected):
#         *  0: Microphone (C-Media USB Headpho    (channel 2)
#            1: Microphone (Bluetooth SCO Audio
#            2: Microphone (Bluetooth AV Audio)
#         *    3: Microphone (Realtek High Defini   (channels 0 & 1)
#       Available audio output devices for transmit (*=selected):
#         *  0: Speakers (C-Media USB Headphone    (channel 2)
#            1: Speakers (Bluetooth SCO Audio)
#            2: Realtek Digital Output(Optical)
#            3: Speakers (Bluetooth AV Audio)
#         *    4: Speakers (Realtek High Definiti   (channels 0 & 1)
#            5: Realtek Digital Output (Realtek
#
# Example: To use the microphone and speaker connections on the
# system board, either of these forms can be used:

# ADEVICE High
# ADEVICE  3 4
```

Change the ADEVICE 3 4 default setting in your conf file to use the device #s that you noted when you ran the direwolf.exe. E.g., for my laptop, I used:

    ADEVICE 1 1

Ensure there is only one uncommented ADEVICE declaration (i.e., no preceding #). Any entries that are commented out using # ADEVICE can be left alone. After making the change, SAVE the direwolf.config file and EXIT your editor.

> **Note 1:** You can alternatively use the direwolf.conf directives ADEVICE USB and ACHANNELS 1 instead of ADEVICE X Y where X = your audio input device and Y = audio output device, respectively in the example above). I used the former (ADEVICE X Y) method because it clearly shows the DireWolf device bindings to the SignaLink audio channels.

> **Note 2:** While we're changing the DireWolf config file, you can make one additional change that allows DireWolf to support the "Packet Winlink" mode for Winlink Express. This is described below in Step 7. If you are not planning to use Winlink, you can skip this next step or come back to it later.

Step 7. (Optional) Enable DireWolf KISS for Winlink Express.

To enable DireWolf for the Winlink client, EDIT the direwolf.conf file to set the KISSPORT to 8100, this is the default used by Winlink. Find the section in direwolf.conf that appears as follows.

```
#################################################################
#                                                               #
#               VIRTUAL TNC SERVER PROPERTIES                   #
#                                                               #
#################################################################
#
# Dire Wolf acts as a virtual TNC and can communicate with
# client applications by different protocols:
#
#       - the "AGW TCPIP Socket Interface" - default port 8000
#       - KISS protocol over TCP socket - default port 8001
#       - KISS TNC via serial port
#

AGWPORT 8000
KISSPORT 8001
```

In the KISSPORT declaration, change this to the following:

    KISSPORT 8100

SAVE your DireWolf configuration file and EXIT.

> **Note:** Outpost does not require a KISSPORT value. Setting a default KISSPORT for Winlink should not break anything and will allow you to use your DireWolf configuration for both Outpost and Winlink.

Step 8. Run the DireWolf Application Again to Confirm Configuration.

From the command line run direwolf.exe again to confirm that the proper audio devices are being used. You should see an asterisk before each selected audio device. Your output should appear like the following:

```
Command Prompt - direwolf

C:\Users\wachang\sandbox\direwolf-1.6.0-413855e_x86_64>direwolf
Dire Wolf version 1.6

Reading config file direwolf.conf
Available audio input devices for receive (*=selected):
    0: Microphone (High Definition Aud
 *  1: Line (USB AUDIO  CODEC)   (channel 0)
Available audio output devices for transmit (*=selected):
    0: Speakers (High Definition Audio
 *  1: Speakers (USB AUDIO  CODEC)   (channel 0)
Channel 0: 1200 baud, AFSK 1200 & 2200 Hz, E+, 44100 sample rate.
Note: PTT not configured for channel 0. (Ignore this if using VOX.)
Ready to accept AGW client application 0 on port 8000 ...
Ready to accept KISS TCP client application 0 on port 8001 ...
```

Note: For most handheld transceivers, the 3.5mm + 2.5mm dual jack adapter will provide all necessary audio and Rx/Tx switching signals. For some HTs (e.g., Baofeng), VOX may need to be enabled.

At this point DireWolf has been configured to work with your SignaLink Sound Card. Next create an Outpost Interface.

Step 9. Create a DireWolf Interface Definition for Outpost.

To use the DireWolf and SignaLink configuration set up in the last steps, you will need to create a Station ID profile, select or create a BBS profile, and create an Outpost Interface. Since DireWolf is compatible with the same API exposed by AGWPE, an Outpost Interface can be created by cloning and modifying the provided XSC_AGW template provided.

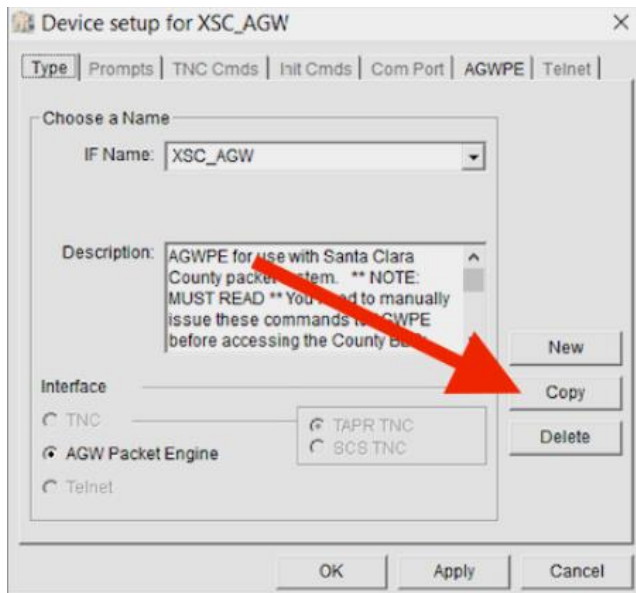Step 9a. Go to the Outpost Menu bar and select Setup -> Interface.
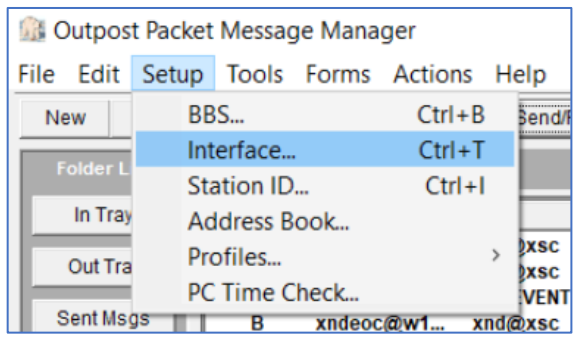
Step 9b. Under the IF Name dropdown menu, select the XSC_AGW template.
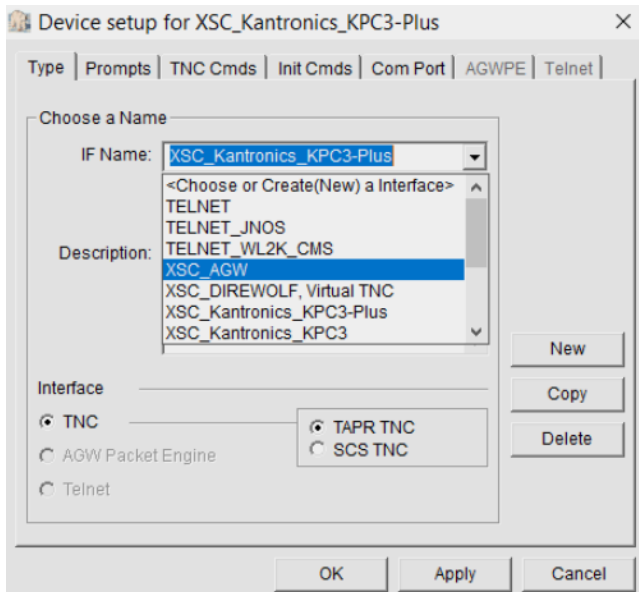
**Step 9c.** To create a functional clone of this device interface using the AGWPE API, select Copy.

Step 9d. In the IF Name: field, type in a name for your new DireWolf Device Interface. E.g., Use "XSC_DIREWOLF, Virtual TNC" to indicate what device the interface is for. I omitted "SignaLink" from the interface name since other sound cards such as the DRA-45 from Masters Communications might be used.
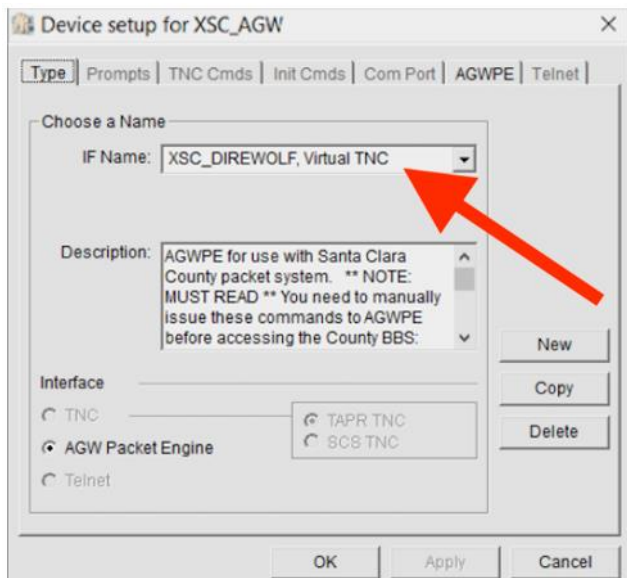
Step 9e. Press OK to save, and then select this Interface when you want to use the DireWolf Virtual TNC instead of a hardware TNC.

Step 10. Follow SCCo Packet IIIA Class Instructions to Login to W(1-4)XSC.

Ensure that your new DireWolf interface is selected in Outpost and follow the instructions provided by your packet class to create a Station ID profile, select or create a W(1-4)XSC BBS profile, verify that your radio is set to the frequency of the appropriate BBS, verify other radio connections and settings are correct, then click Send/Receive to log in.

Congratulations - You have successfully configured Outpost to use DireWolf!

Troubleshooting Tips

If after attempting to log into your selected BBS you receive no packet response, the following may be useful.

If Outpost is unable to connect to the selected BBS, verify the following:

1. SignaLink DLY is set to the minimum "0" value or fully counterclockwise (unless instructed otherwise).
2. Radio audio output is not overdriving your SignaLink (see Audio Level Adjustment Procedure).
3. SignaLink Rx setting is not overdriving the DireWolf s/w modem (see Audio Level Adjustment Procedure).
4. There are no other issues with your SignaLink USB Sound Card. Consult their troubleshooting document [6].
5. A round-trip RF path is possible between your packet station and the target ARES/RACES BBS station. See the Packet Round-Trip verification Procedure below.

## Packet Round-Trip Verification Procedure:

1. Set a second radio to receive on your packet station's transmit frequency. An inexpensive HT such as a Baofeng UV-5R with rubber duck antenna works well for this purpose.
2. Click on Send/Receive in Outpost. Listen for your radio's packet output signal on your second radio (a set of buzzing tones). If nothing heard, check your radio settings, cable wiring, antenna, and power output.
3. Listen for a packet response on your packet station from the BBS station. The Monitor or Speaker audio output of the SignaLink can be used for this purpose. If there's no response, adjust your SignaLink Tx levels following the Tigertronics documentation, check your cable wiring, increase radio output RF power if possible.
    a. Tx and Rx settings of "2" or 9 o-clock usually work for HTs, the SignaLink is relatively forgiving. Proceed to the next step when you hear a response on your packet station radio from the remote BBS station.
    b. If you are still unable to receive a response, you may need to select a different W(1-4)XSC BBS station.
4. Verify that audio levels from your packet station radio and SignaLink are not overdriving or under driving the DireWolf s/w modem. Use any audio level adjustment procedure you are familiar with or use the Audio Level Receive Adjustment Procedure described below.
5. In rare cases, it may be necessary to calibrate the transmit level using the Audio Level Transmit Adjustment Procedure described below. For this procedure, you will need a separate SDR receiver with a spectrum display.

Audio Level Receive Adjustment Procedure:

1. Verify that your computer laptop is using the correct SignaLink devices for input (Line - USB AUDIO CODEC) and output (Speaker – USB AUDIO CODEC). See Steps 7 and 8.
2. Verify that on the laptop computer that the SignaLink audio levels are set to 100% and that the level units are "percentage" and not "decibels" unless indicated by other documentation. These settings can be inspected or set from the Windows Sound Control Panel. This is shown below.
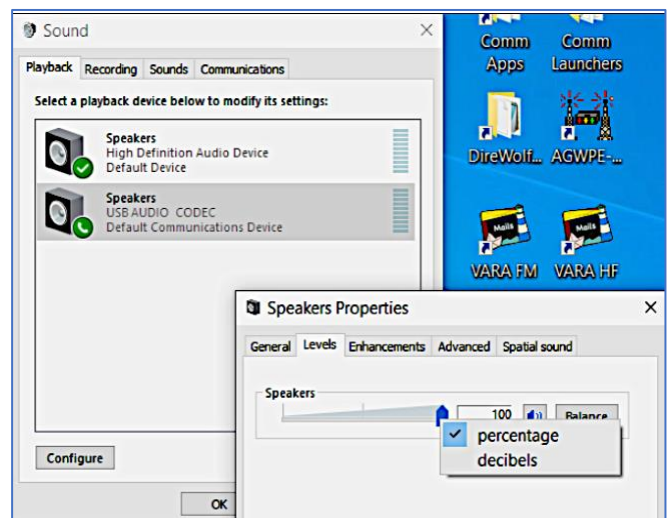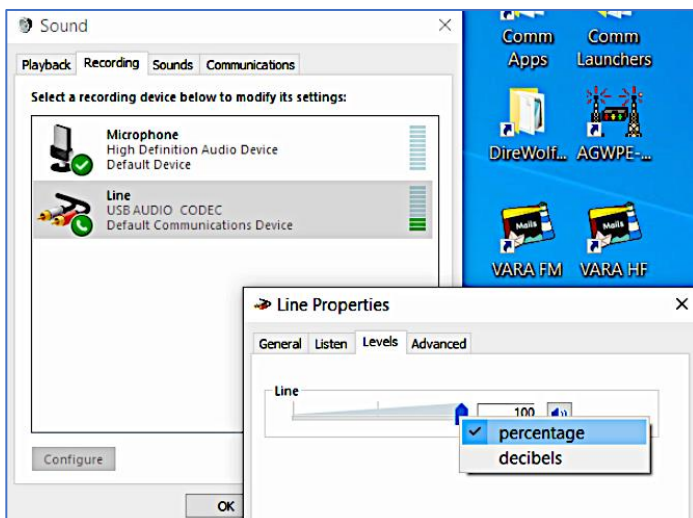
3. Start the Sound Card Oscilloscope s/w that was installed from Step 3. under the Prerequisites section.
4. Verify that the oscilloscope is using the same input and output audio devices specified in your DireWolf configuration file. Under the settings tab, it should look something like the following. If the correct audio devices are not already selected, use the Output and Input dropdown menu shown below (indicated by the upside-down triangle) to select the correct devices.
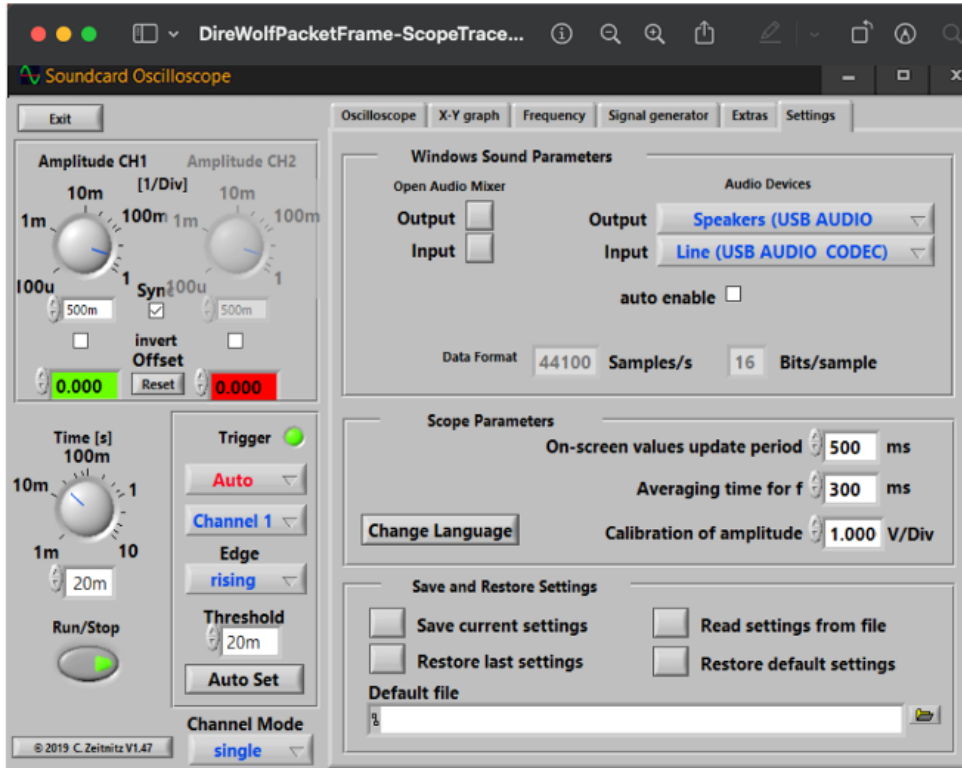
5. Initially set the radio audio level to low, leave the SignaLink Rx setting at the "2" or 9 o'clock position. Set the oscilloscope log Time (s) scale to approximately 20ms and adjust the Amplitude CH1 scale to approximately 200 units. Initiate a Send/Receive command from the Outpost GUI. Once you are receiving packet frames from the remote BBS station, select the Oscilloscope tab and view the signal waveform. It should appear as follows.
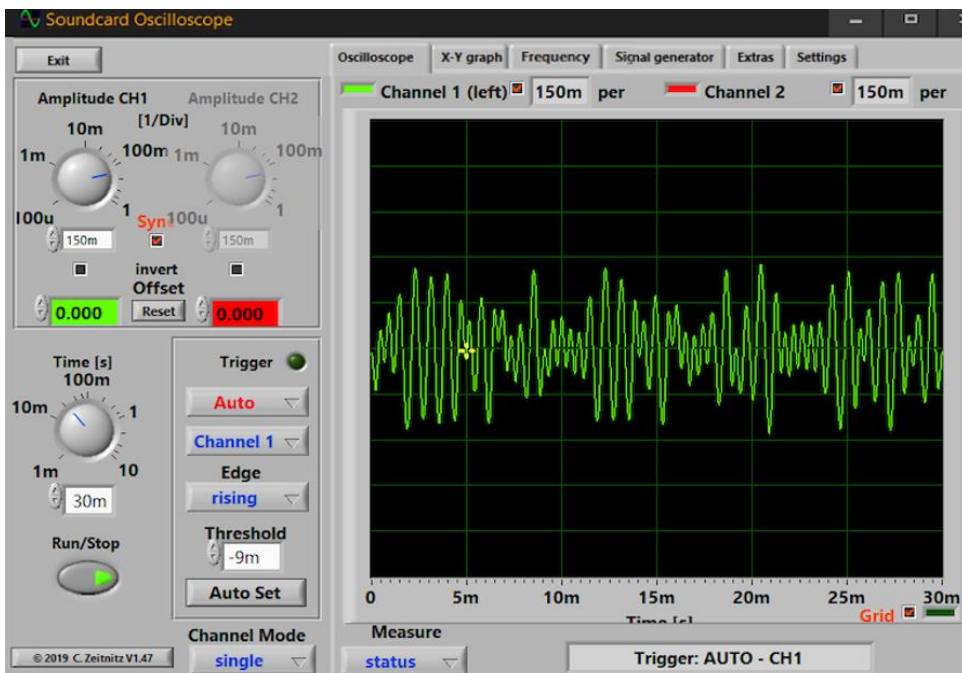
6. If the peaks of your received signal waveform are mostly flat, your radio may be overdriving the SignaLink or the SignaLink Rx setting is overdriving the DireWolf AX.25 modem. Adjust each control until received packet waveforms appear like the previous example above. Examples of overdriving or under driving the h/w and s/w components of your station are shown below and should be avoided. Additionally, the DireWolf command application itself may warn you if it senses that the audio input level is too high and instruct you to reduce Rx audio levels.
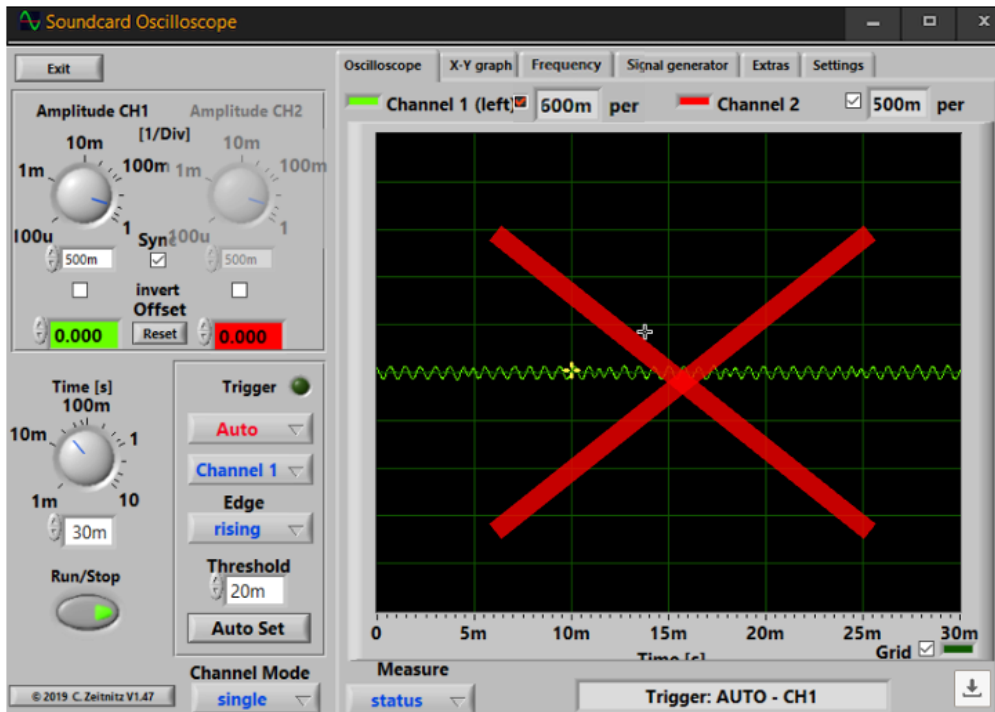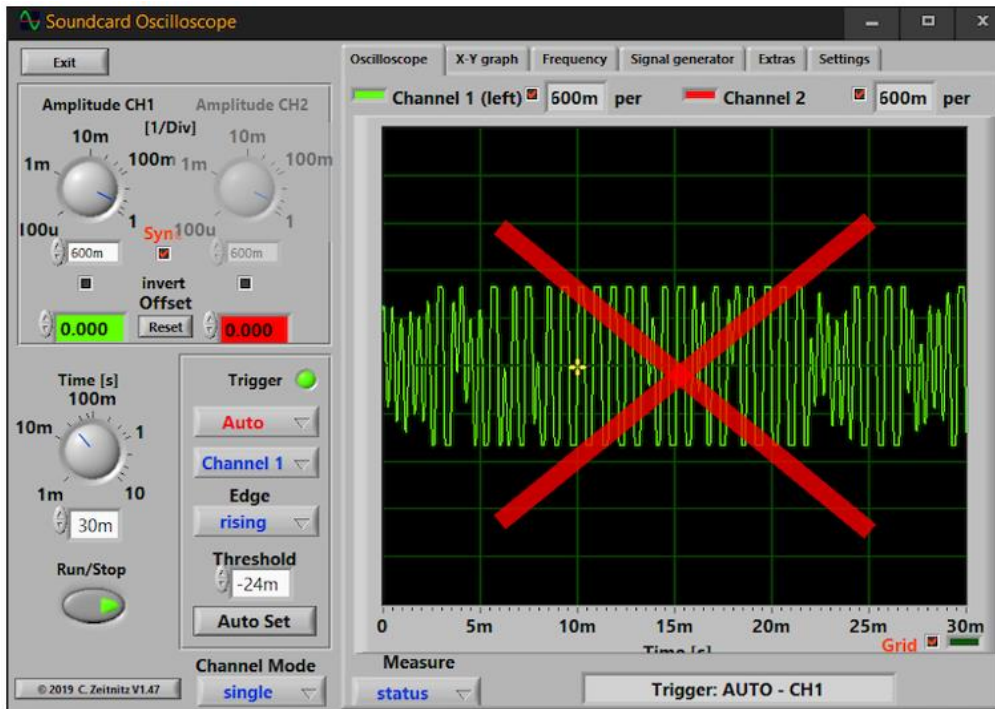
If after trying all the troubleshooting procedures above you are still unable to complete a round-trip packet exchange with your BBS, contact your local ARES/RACES communications specialist for assistance.

Acknowledgements

References

[1] https://www.cupertinoares.org/docs/040401-OutpostTnT110.pdf
[2] http://sacvalleyares.org/contents/ARES Documents/Training/Sending messages digitally/Packet/Outpost Packet Station Quick Start Guide 100613b.pdf
[3] https://www.soundcardpacket.org/4probtx.aspx
[4] https://raw.githubusercontent.com/wb2osz/direwolf/master/doc/User-Guide.pdf
[5] https://www.outpostpm.org/howto/howto_Dire-Wolf.pdf
[6] https://www.tigertronics.com/slusbts.htm

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