AUDIO OVER IP NETWORKS

TECHNICAL DOCUMENTATION

Wheatstone Corporation
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Configuring Audio Over IP Networks (ET-2001)

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Introduction

Wheatstone's AoIP technology allows you to transport audio over an Ethernet network. PC audio source signals may be defined and routed to any control surface fader or directly to analog or digital outputs without using sound cards. Audio signals wired to the Bridge or Wheatnet system may also be routed to any PC over Ethernet for monitoring or recording on any PC configured to playback multicast streams. Setting up an AoIP network requires that the different pieces of the puzzle be assembled and configured correctly:

Hardware

- ET-2001 card installed in a Bridge or Satellite cage, IP address defined.
- Ethernet switch selection- Large systems must use a managed switch configured correctly.
- PC's with full duplex 100Mbps NIC.
- USB Security dongle installed on each PC.

Software

- Wheatstone IPAud WDM driver installed and configured on each PC.
- Your audio automation or editing PC configured to use the IPAud driver to play out AoIP streams *onto* the network.
- Your audio automation or editing PC configured to playback AoIP streams *from* the network using any 3rd party plug-in supporting multicast streams.
- Creating AoIP signals in XPoint for routing.

Using this Documentation

While the AoIP system is not complicated to use, several configuration steps must be strictly adhered to in order to get the system working. The following list explains the documentation sections and what they accomplish:

- AoIP Theory - Explains the theory of operation and system requirements.
- HP Procurve Configuration - explains how to configure the HP Procurve 2600 Ethernet switch for AoIP applications.
- IPAud Driver Setup Instructions- how to install IPAud WDM driver on a PC.
- USB Security dongle - how and when to install it.
- Creating AoIP Signals in XPoint - describes by example how to create AoIP signals in XPoint so they are available to any control surface or audio i/o in your system.
- ET-2001 Hardware description for Wheatnet and Bridge systems.
- IP Addressing - details IP addressing schemes and using WsNetServer to configure the ET-2001 card's IP address.
- Troubleshooting AoIP Problems - list common problems and possible solutions.

Section 1 - Theory of Operation

This section documents the theory of operation behind Wheatstone's Audio-over-IP (AoIP) capability, from a networking perspective. It then goes on to describe the supported default configuration of an HP Procurve™ 2600 series Ethernet switch, which is the recommended device to use for anything other than a minimum configuration.

Like many computer network devices, the HP Procurve 2600 series switches are very configurable and very powerful. The features discussed here are the ones required to support Wheatstone AoIP devices. Additional features may be required for a given network configuration. If additional features are required, or if a different type of network switch is to be used at a site, please consult your local IT department, or local IT professional. Many other configurations will work with AoIP; however, this document describes the recommended and supported configuration.

Wheatstone's AoIP capability transports streams of studio quality 24-bit stereo audio at a sampling rate of either 44.1 kHz or 48 kHz across a 100 Mbps full duplex Ethernet interface using multicast UDP packets (see RFC 1112, "Host Extensions for IP Multicasting"). Each stream of stereo data requires approximately 2.5 Mbps of bandwidth, including all network and protocol overhead. Within the Wheatstone Advanced Cross-point Switch (AdvXP), one or more "Ethernet Transport" (ET) cards can receive and send AoIP data seamlessly, completely integrated with the hundreds or thousands of other signals in a typical AdvXP installation. By installing Wheatstone IpAud WDM drivers on a host Windows™ 2000 or XP PC*, any application that makes use of a sound card with a WDM driver may send and receive audio data directly over the AoIP network. The IpAud drivers essentially look like a sound card to Windows, but redirect the normal line-out and line-in sound card interfaces to and from the AoIP network. No digital-to-analog conversion is performed, and the PC needn't even have a sound card installed.

* Note that the PC also requires a NIC with full duplex 100 Mbps Ethernet capabilities. It must also support a multicast table with at least 16 entries. Nearly all NIC cards currently produced have these features; however, we have come across older cards that did not properly support multicast, and one low-end Linksys card that lost data whenever subscribing to or unsubscribing from a multicast group. See the documentation for the IpAud drivers for complete PC system requirements.

The format of the audio data is RTP (see RFC 3550, "A Transport Protocol for Real-Time Applications"), using the 24-bit linear audio payload type (as described in RFC 3190). There are also multicast data channels to support configuration and status of all attached AoIP devices, and to synchronize all devices to the AdvXP system clock ("Metronome" packets). All AoIP devices use Multicast IP addresses in the "Administratively Scoped Multicast Space – Organization Local Scope", per RFC 2365 (these addresses are in the range 239.192.0.0/14). Generally, routers will not forward multicast packets in this range. Therefore, they will not be visible outside the local subnet (and certainly not visible on the Internet).

The multicast groups and ports used by Wheatstone's AoIP devices are as follows:

WORD	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
IP ADDRESS	NETWORK = 239.192.0.0/14														SYS		TYPE		ID (0 - 16383)												

The variable fields in the address are determined as follows:

FIELD	VALUE	NOTES
NETWORK	0xEFCO	Fixed to the 239.192.0.0/14 subnet
SYS	0 - 3	System ID (default: 0)
TYPE	0 - 3	0 = System message (type based on ID) 1 = Reserved 2 = Command (to specified ID) 3 = Audio data (from source ID)
ID	0 - 16383	If Type 0: Message ID 0 = Metronome 1 = Status/Request from IpAud If Type 2: ID of command destination 0 - 8191 = IpAud driver ID 8192 - 16383 modulo 16 = ET card base ID If Type 3: ID of audio source 0 - 8191 = IpAud driver ID 8192 - 16383 = ET card ID

The following table summarizes the IP addresses, the source, and the ports used by the messages:

MESSAGE TYPE	VALUE	NOTES	PORT
AUDIO DATA	IpAud, ET	239.192.192.0 - 239.195.255.255	50100
METRONOME PACKETS	Master ET	239.192.0.0 - 239.195.0.0	51000
SWITCHING COMMANDS	AdvXP	239.192.128.0 - 239.195.191.255	50101
DRIVER STATUS/REQUEST	IpAud	239.192.0.1 - 239.195.0.1	50101

Each ET card may send and receive 16 stereo streams simultaneously. This uses more than 40% of the theoretical bandwidth on the network link. An individual PC may have up to 8 instances of the IpAud drivers installed, which provides 8 simultaneous stereo inputs and outputs, accounting for 20% of the available link bandwidth. Remember, all AoIP devices and network equipment must be at least 100 Mbps, and must operate in full duplex (which eliminates network collisions).

Eliminating collisions means that UDP data can be received without loss, so long as there is enough link bandwidth to transport all the data. As seen above, one ET card communicating with two fully populated PC's will use up nearly half of the available bandwidth, in both directions of the full duplex link. For a simple configuration such as this, a small, unmanaged, network switch may be employed since there is no possibility of overwhelming the network.

But what if there are many PC's, and multiple ET cards? What if it is desirable to connect an office network that adds an unknown overhead of additional data? What if slower devices (e.g. print servers) that cannot tolerate 40 Mbps of data are on the same network?

This is where a managed switch, such as the HP Procurve 2600 series comes into play. These switches make use of IGMP, a protocol that allows users of multicast

data to subscribe (and unsubscribe) to multicast streams. All Wheatstone AoIP devices make use of IGMP protocol. The HP Procurve can be configured to be the "IGMP Requestor" for a given network. In this role, it will query all devices for their current subscriptions, and keep track of which switch ports need which data delivered.

Since no AoIP device will source more data than can be carried by a 100 Mbps link, and no device will subscribe to more data than can be carried on the link, any port can handle either a single ET, or up to two fully populated AoIP-capable PC's, without overflowing the available bandwidth due to AoIP multicast traffic alone.

In addition, ports without devices requesting multicast data will never be sent any. As an added precaution, the default Procurve configuration described below defines certain ports where multicast data is blocked, preventing all possibility of overwhelming slower equipment (or equipment on a hub or other shared network device).

But what happens if other non-AoIP data is on the network? How is the bandwidth required for the AoIP data maintained (guaranteeing the quality of audio data)? The Procurve combined with Wheatstone AoIP technology has this covered as well. The Procurve honors the relatively new 802.1p QoS setting. This "quality of service" indicator is used to prioritize network traffic. The intent of this feature was to deliver real-time streams of data for applications such as Voice-over-IP telephones, which makes it a perfect fit for AoIP technology as well. All the normal traffic in an office environment has a default (low) priority. This data is moved from port-to-port within the Procurve as the bandwidth on each individual port allows. The AoIP data is sent at a higher priority, so it gets first call for available bandwidth. Therefore, even if a large amount of additional data is added to the network, the audio will still get through, without delays and without dropouts.

In summary, when building a network for AoIP, there are several requirements. First, all AoIP-capable devices must be attached to 100 Mbps, full duplex network links to provide sufficient bandwidth and eliminate collisions. Secondly, bandwidth must be managed. In small systems, this may be accomplished by simply keeping the total of all available audio sources below the maximum usable network bandwidth (which we recommend to be less than 50% of total theoretical bandwidth). In large systems, a managed switch with an integral IGMP requestor is required, combined with keeping the total of all available audio sources below the maximum usable network bandwidth *per port* on the switch. We recommend attaching AoIP-capable devices directly to the Procurve (multiple Procurves can be cascaded for very large systems).

Finally, the AoIP data must be protected from other network data, via the QoS prioritization scheme. Note that the AoIP devices make use of the TOS precedence field in the IP header to indicate the relative priority of each IP packet. Normal network traffic has a precedence of 0. The HP Procurve Switch is then configured to use the IP TOS precedence field to map to an 802.1p QoS value, which the switch honors for all forwarded data. If a network switch other than the Procurve is used, it must also support this TOS precedence to QoS priority mapping feature.

Many advanced network configurations can be realized while still providing a reliable interface for AoIP data as long as the requirements above are maintained. For most configurations, the basic HP Procurve configuration described below will be quite sufficient. If not, please consult your local IT department, or local IT professional to design a network infrastructure that meets your needs while supporting the AoIP requirements.

Section 2 - Choosing an Ethernet Switch

As described in the previous section, AoIP will work with a minimum number of AoIP devices on a small dedicated LAN using an unmanaged switch. If you plan on connecting the AoIP LAN to more than just a couple of PC's, or perhaps AoIP data will reside on a LAN with office network traffic, than a managed IGMP compliant switch is required. Wheatstone recommends and supports configurations that use the HP Procurve 2600 switch. You may choose another vendor's Ethernet switch; however, Wheatstone may be unable to support that 3rd party switch should problems arise.

Supported Configuration

This section documents the basic HP Procurve™ 2600 series network switch configuration that is recommended and supported for most AoIP installations. The following steps start from a factory default configuration, and assume a PC with an RS-232 serial connection to the Procurve is being used to configure the switch.

First, if you are unsure whether or not the switch is set to factory defaults execute the factory default reset:

1. Using pointed objects, simultaneously press both the Reset and Clear buttons on the front of the switch.

2. Continue to press the Clear button while releasing the Reset button.

3. When the Self Test LED begins to flash, release the Clear button.

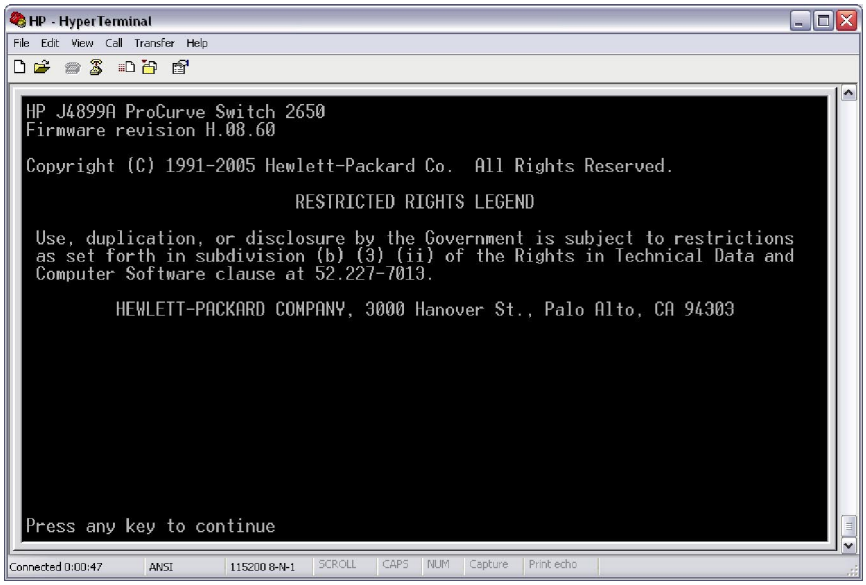
The switch will then complete its self-test and begin operating with the configuration restored to the factory default settings.

The rest of this procedure assumes you are using HyperTerminal as your terminal emulator. If you use a different terminal emulator, you may need to adapt this procedure to the operation of your particular emulator.

1. Start the terminal emulator program.

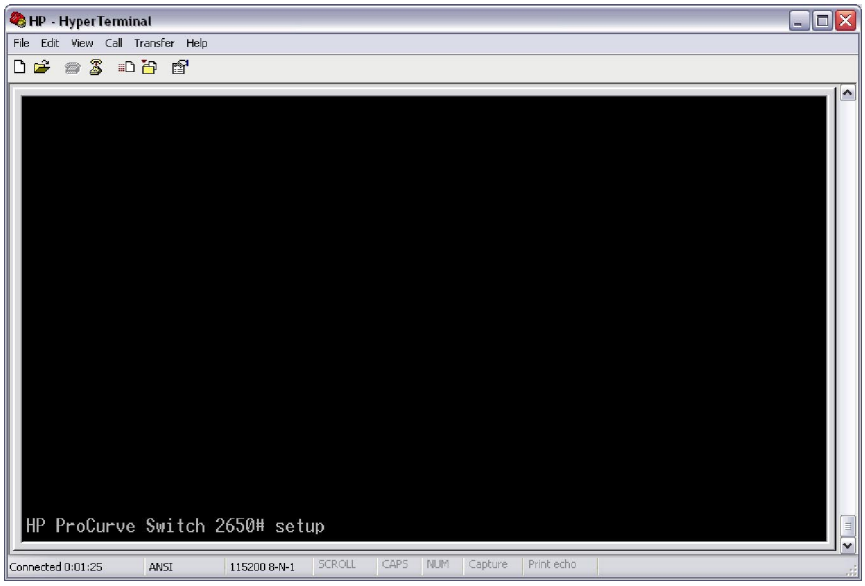
2. Ensure that the terminal program is configured as follows:
   - Baud rate: 115200
   - No parity
   - 8 Bits
   - 1 stop bit
   - No flow control
   - Terminal emulation set to ANSI

3. Use the Reset button to reset the switch. Wait for the switch's self-test to complete, press <RETURN> several times, and the following prompt should then appear in the terminal emulator:



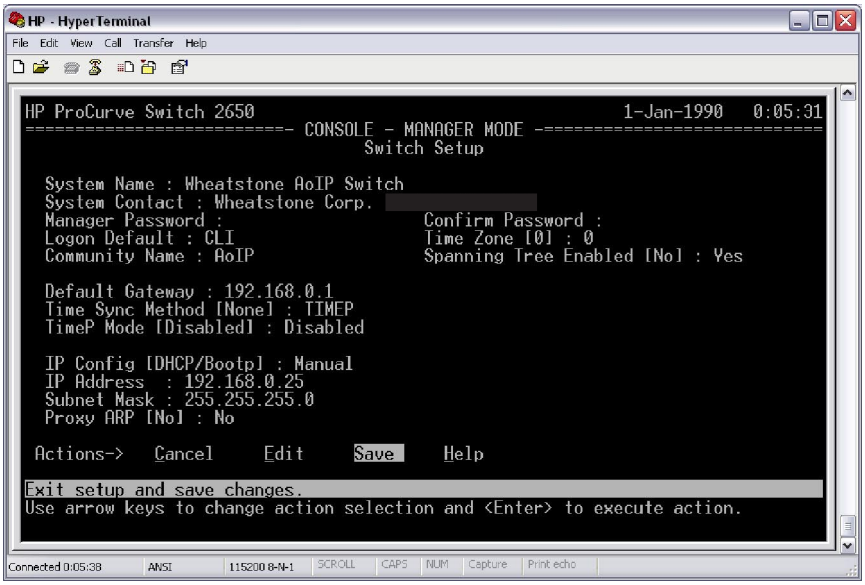
Note that the firmware revision shown in the preceding screen must be H.08.60 or greater… if not, follow instructions in the Procurve 2600 series manual to update the software.

Next, press <RETURN> and respond to the prompt as follows:



This will display the following menu to perform most of the basic switch configuration:

Fill in the fields on this screen as follows:

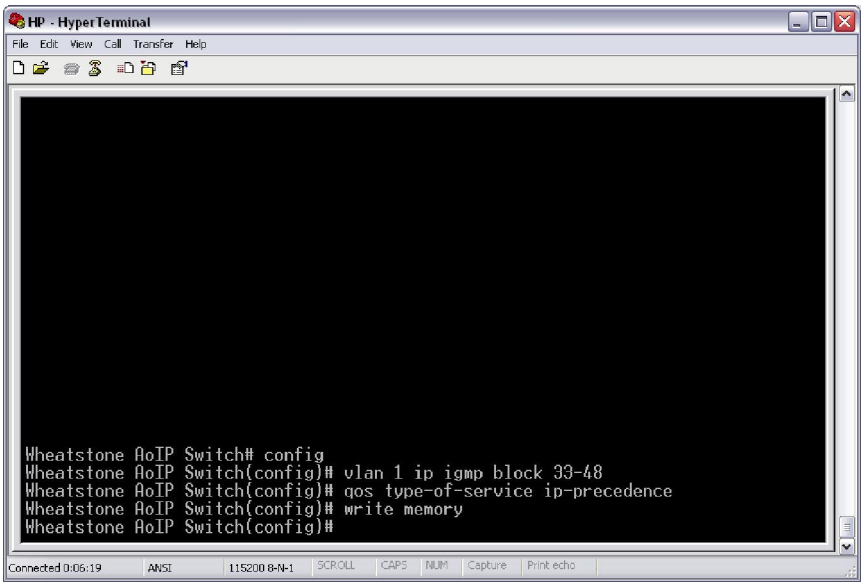


- System Name / System Contact: These fields are free text and can be filled in as desired.
- Manager Password / Confirm Password: Set these fields if a password is desired to protect the switch configuration.
- Logon Default: Leave at CLI (Command Line Interface).
- Time Zone: Can be left at zero.
- Community Name: The name of the SNMP community to which this switch will belong. Can be set to “AoIP” or any other community desired.
- Spanning Tree Enabled: Recommended to be enabled. Allows the switch to communicate with other network devices to support redundant links and prevent network loops.
- Default Gateway: Set to the IP address of the gateway on the local network to which the Procurve will be attached.
- Time Sync Method / TIMEP Mode: May leave the method as TIMEP and mode as disabled. Nothing in AoIP requires an accurate time-of-day clock in the Procurve. If accurate time-of-day is desired (perhaps for use in interpreting Procurve log files), set the fields to appropriate values for your network.
- IP Config: The Procurve must be allocated an IP address since it will be an IGMP requestor for its subnet. We recommend a fixed, manual IP address selection (“Manual”) although BOOTP or DHCP may also be employed.
- IP Address / Subnet Mask: Set to an available permanent address on your network.
- Proxy ARP: Leave set to “No”.

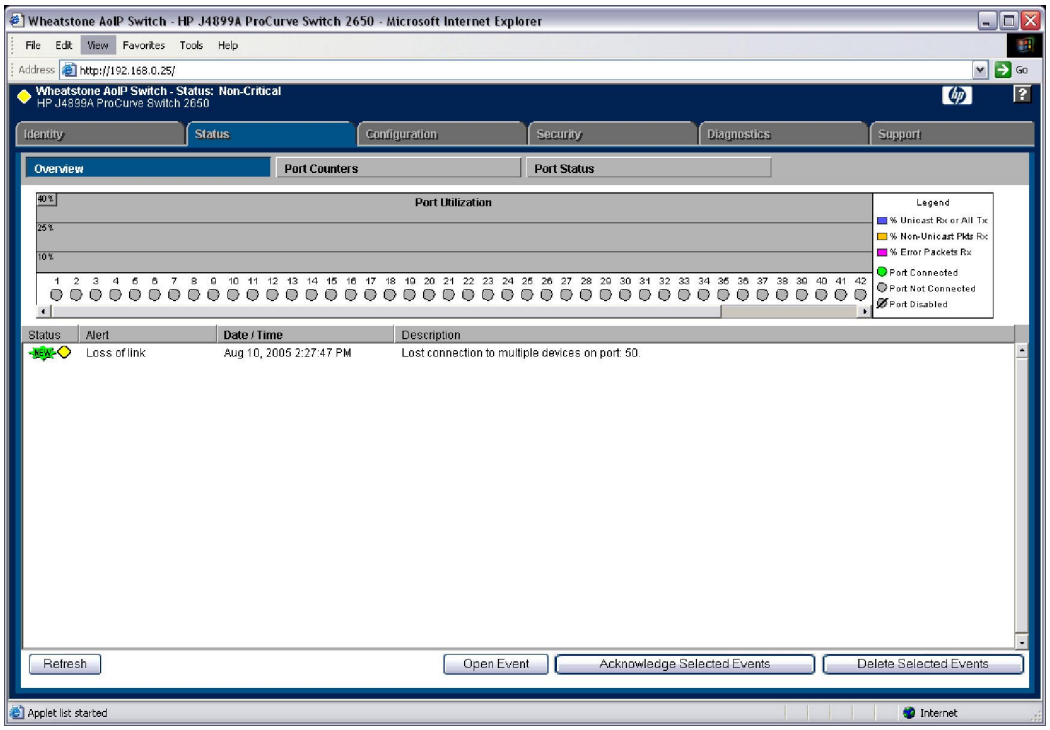
Once these changes are complete, select the “Save” option to commit them to the switch’s memory.

Finally, two additional configurations are made. First, choose to set aside as many ports as required for non-AoIP devices. By default, we reserve the last 1/3 of the 10/100 switch ports for non-AoIP devices. These will be blocked from receiving multicast packets from the other ports on the switch. Secondly, the Procurve must be configured to map IP precedence to QoS values.

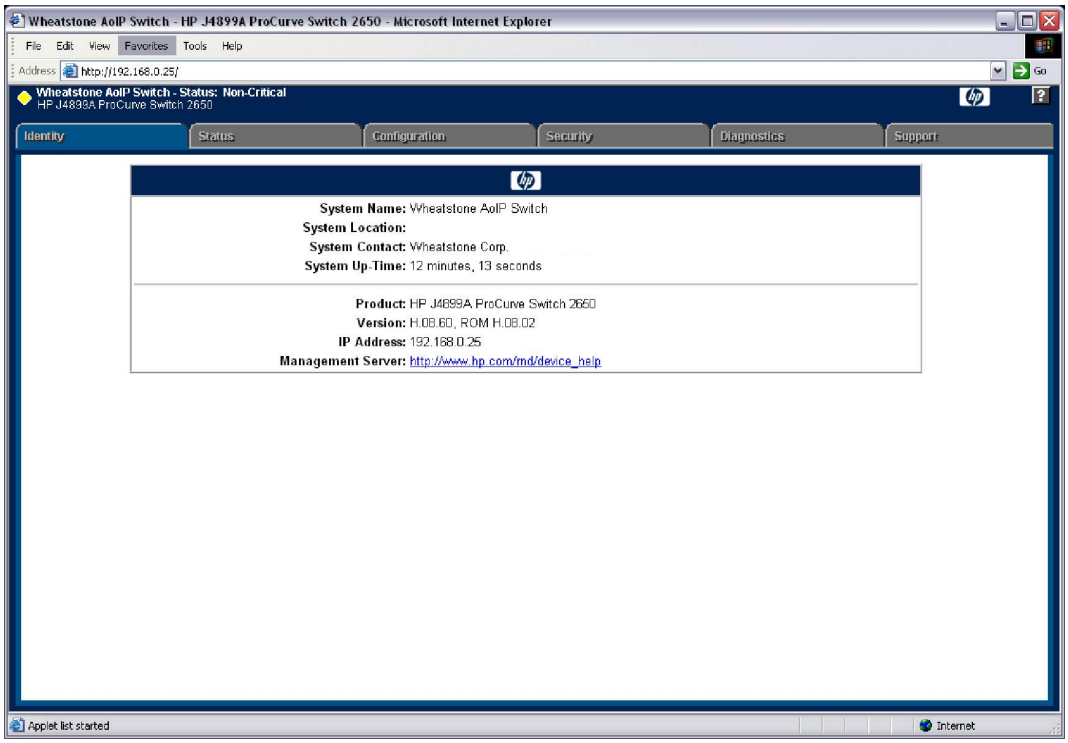
The following screen shows these two actions, followed by a command to commit all changes to the switch’s FLASH memory. Note that the number of ports where multicast data is blocked may vary in the “vlan 1 ip igmp block” command depending on the size of the switch and local requirements.



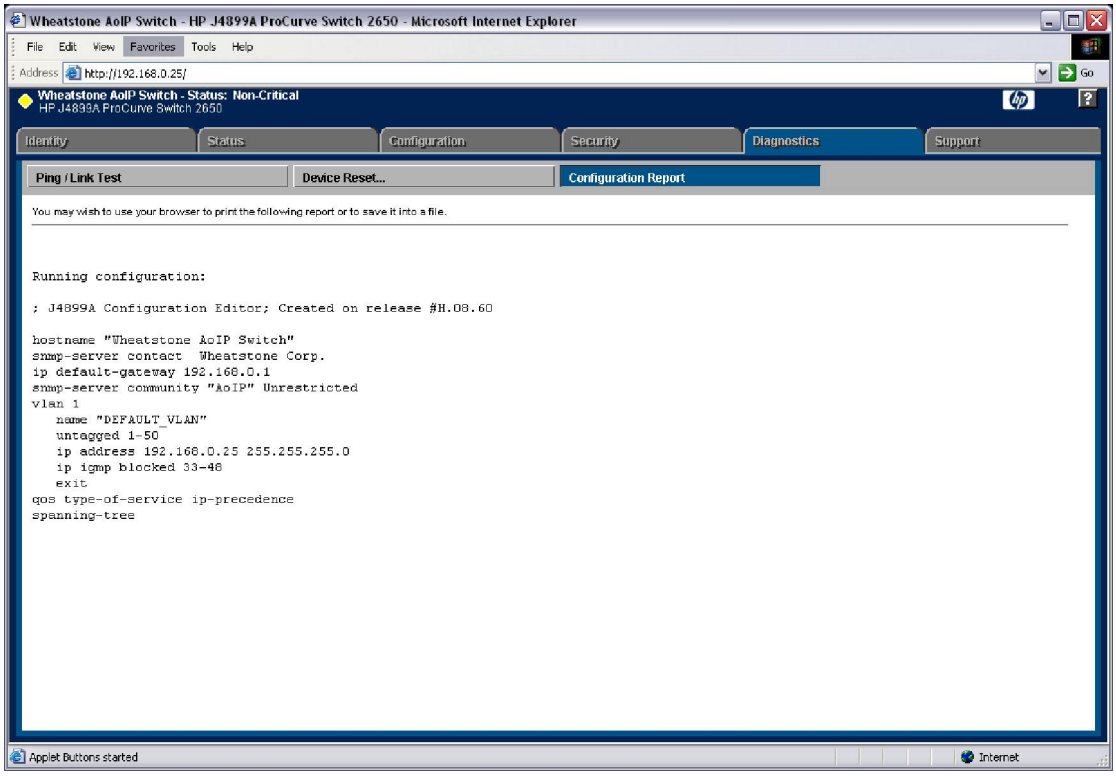
Once these steps are complete, verify the changes by using a web browser (on a machine connected to the Procurve). Enter http://xx.xx.xx.xx, where the x’s correspond to the IP address assigned to the Procurve during configuration. The screen in the following figure should appear. If not, check connectivity to the switch, verify that the PC is configured on the same subnet as the Procurve (or has a gateway specified that can reach the Procurve), and go back to the configuration screens to verify the information entered.



The preceding is the default screen displayed when you first connect to the Procurve via its web interface. Select the “Identity” tab, and a screen similar to the following should appear. Verify that all fields displayed are consistent with those entered during configuration:



Finally, select the "Diagnostics" tab and press the "Configuration Report" button. This will display a screen showing all switch configuration items that were changed from their factory default values. Following the recommended entries listed previously, this screen should look like the following figure.



That's all there is to it. The HP Procurve switch requires no further ongoing administration to perform all AoIP operations.

The switch does have many powerful network diagnostic features built-in, including alerts for various error conditions, and a full set of statistics for each port. These are very useful if network errors are ever encountered. See your Procurve manual for more information on using these features.

Section 3 - Wheatstone IPAud Driver Installation

These Instructions are for version 1.1.0 of the Wheatstone IPAud driver for Windows™ installer.

Hardware Requirements:

Standard PC (Intel or AMD x 86 based computer) with the following:

- 100 base T network interface configured to run in full duplex mode.
- USB Security Dongle (see Section below) required for driver operation - but DO NOT install it until after the driver has been installed.

Software Requirements:

The IpAud driver has been designed to run under the Windows™ operating system. The following are minimum requirements:

- Windows 2000 with Service Pack 4.

OR

- Windows XP with Service Pack 2.

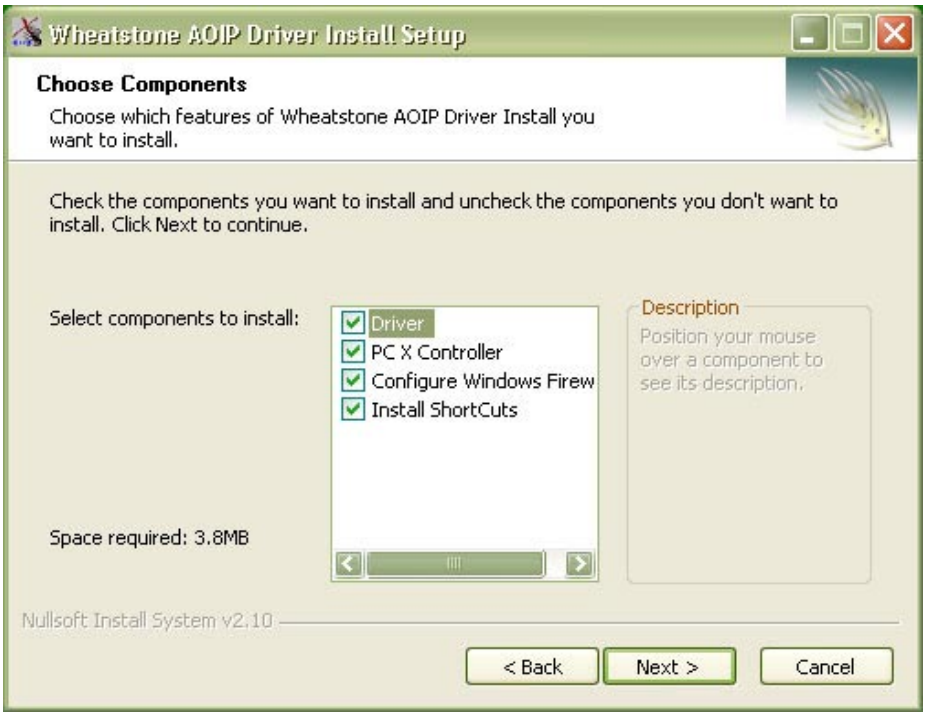
Installation

To install the driver, run the setup application. Make sure any previously installed version of the AOIP driver or Audsnd (winamp plugin) software has been removed.

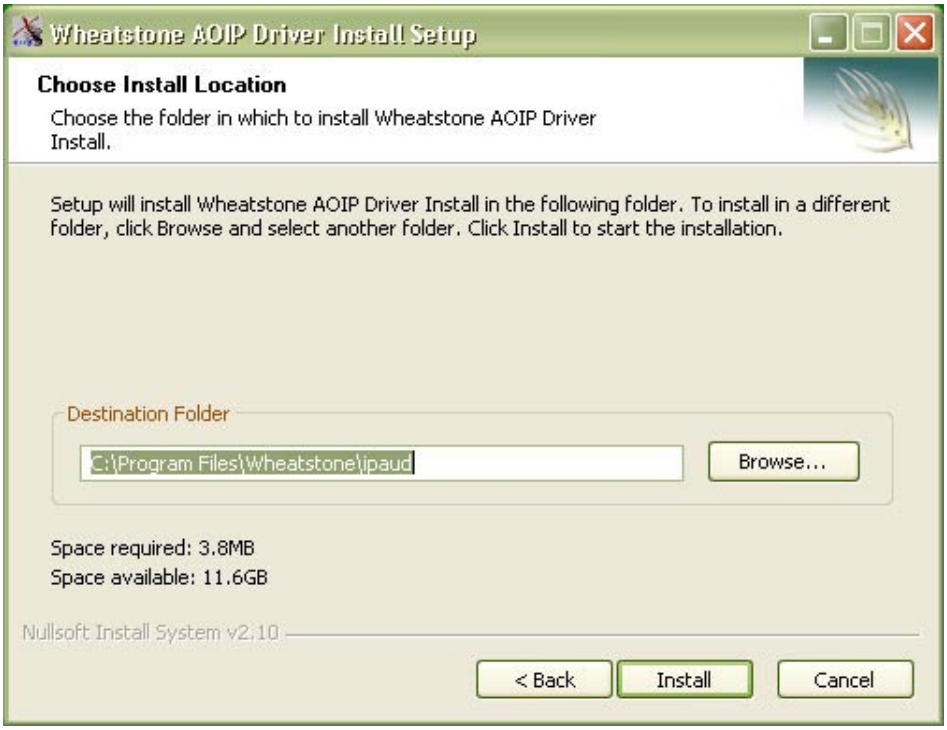
NOTE: DO NOT install the USB Security Dongle (as described in Section 4) until AFTER you have installed the driver.

1. Read the license and release notes before proceeding! Then click “I Agree”.

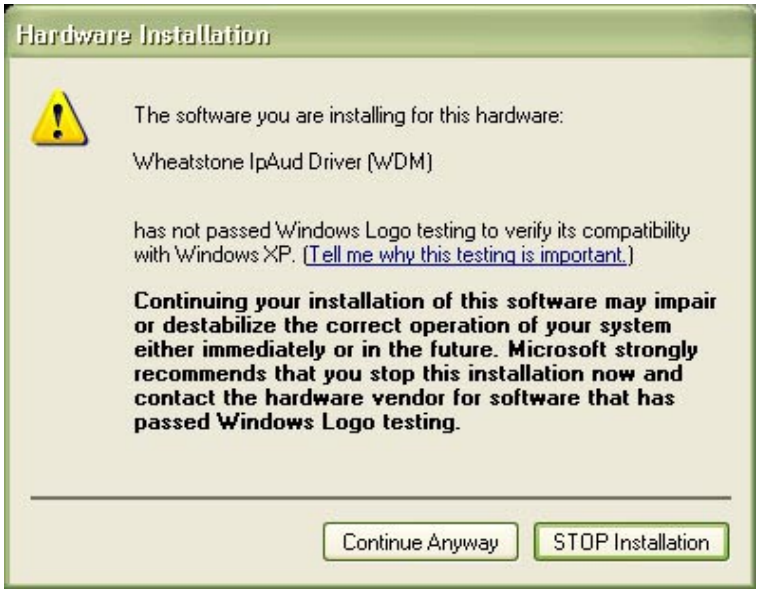
2. Select the components you want to install (default selection should be correct) and click "Next" to install the drivers. You will want to make sure that no audio applications are running at this time.



3. If you need to install the applications in a site-specific location, change the install directory on the next screen. Click "Install" to proceed.

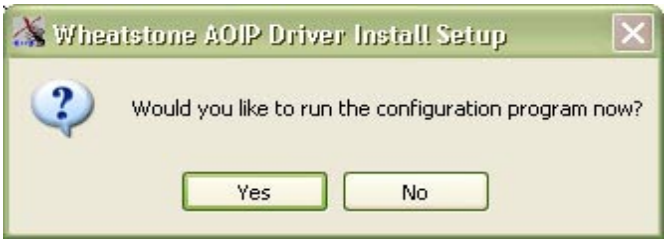


4. Windows may warn you that the driver is not signed. If it does, click the option to “Continue Anyway”.



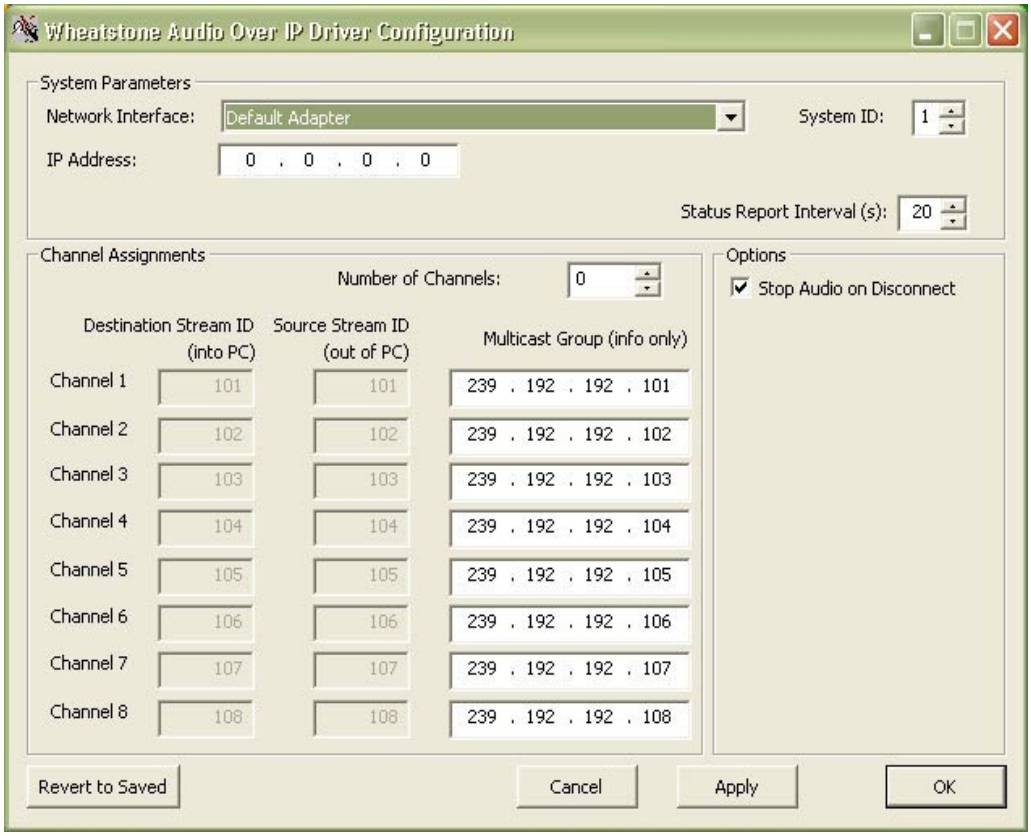
5. After the driver installs (you should see a successful install dialog)

and you click “Close” on the installer dialog, you will be prompted to run the configuration program to setup the channel assignments and system parameters. Select “Yes” to configure the system.



Configuration

The Wheatstone Audio Over IP Driver Control application will allow you to setup the required parameters for the driver.



Each control is described below:

System Parameters

- **Network Interface** – This control is used to select a specific network interface card to use to connect to the AOIP network. If you only have 1 network connection, then leave "Default Adaptor" selected. The IP Address of the selected interface card is displayed in the **IP Address** field below the selection box.
- **System ID** – This control is used to form logical groups of equipment on a single AOIP network. It is primarily used for engineering testing and should be left at "1".
- **Status Report Interval (s)** – This controls how often the driver sends status back to the AdvXP switch. The default value is 20 seconds

Channel Assignments

The AOIP driver supports 8192 distinct channels. Channel 0 is reserved for local PC listening (allows a PC with the AOIP driver installed to monitor an AOIP stream without interacting with the AdvXP). Channels 1-8191 are available for assignment to the driver. The input and output channels must be uniquely assigned and coordinated with the settings in the AdvXP configuration. The input and output stream Ids for a channel can be the same, as long as no other driver in the system is assigned that stream Id.

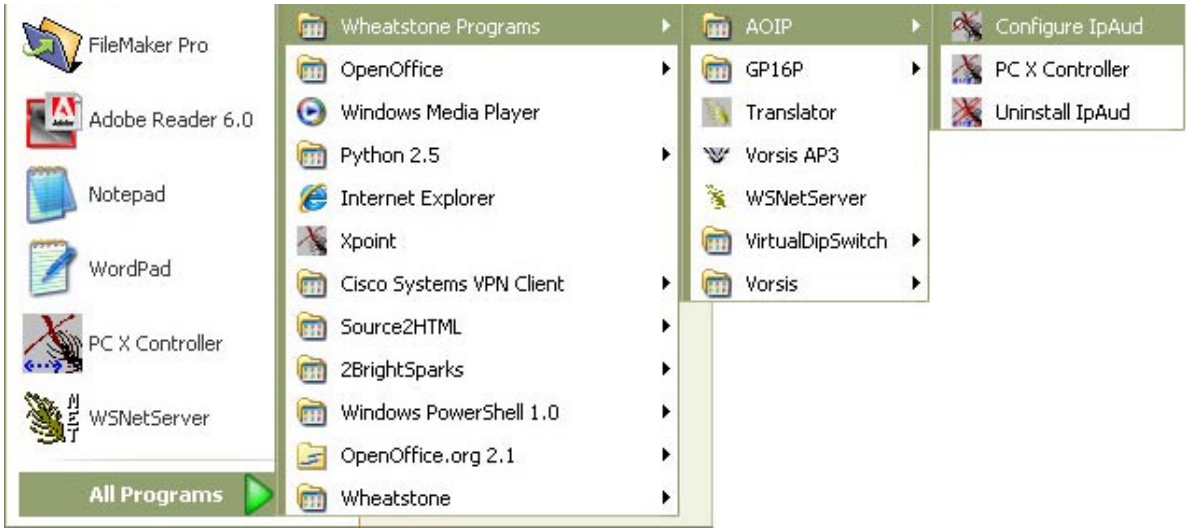
- **Number of Channels** – This control is used to select the number of (full duplex) stereo channels supported by this driver. Although the driver is capable of supporting up to 8 input and output channels, configuring drivers that will not be used places additional burdens on the system.
- **Destination Stream ID** – Enter the stream Id(s) assigned to this device. These stream Ids must correspond to those entered in the AdvXP configuration GUI as *Destinations*.
- **Source Stream ID** – Enter the stream Id(s) assigned to this device. These stream Ids must correspond to those entered in the AdvXP configuration GUI as *Sources*.
- **Multicast Group** – The network multicast group derived from the output stream Id (and system Id) is displayed here (read-only value). This field is only updated after you apply the changes or read the values from the registry.
- **Stop Audio on Disconnect** - if this box is not checked and the audio stream ends, audio remaining in the buffer will continue to play as a loop - it is recommended to check this box.

Other Controls

- **Revert to Saved** – This button causes the application to reread configuration values from the registry, discarding any changes you have made.
- **Cancel** – Closes the application without updating the parameters.
- **Apply** – Applies the changes made to the driver parameters.
- **OK** – Applies the parameter changes and exits the application.

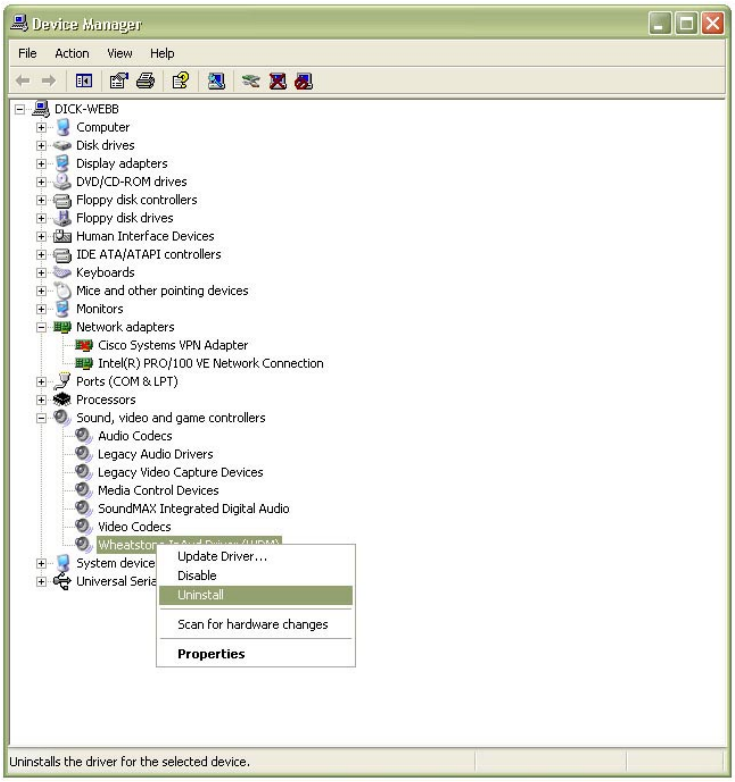
Note that both the Apply and OK controls will need to re-start the driver for the changes to take effect. The application will attempt to restart the driver for you. If the system is unable to restart the driver, you will be prompted to reboot the computer.

The configuration application and PC X Controller utility (it installed) are available under the start menu. All of the AoIP driver related programs are grouped under **start>All Programs>Wheatstone Programs>AOIP.**



Uninstalling the Drivers

To uninstall the AOIP drivers, open the device manager by selecting **start>Control Panel>System**, select the **Hardware** tab, and click on the **Device Manager** button. In the Device Manager, expand the **Sound, Video and game controllers** item (by clicking on the + sign next to it). Right click over the **Wheatstone IpAud (WDM)** item and select Uninstall.



Windows will ask you to confirm uninstalling the driver.

Verify that you are indeed uninstalling the Wheatstone AoIP drivers and press "OK". You can then run the applications uninstaller from **start>All Programs>Wheatstone Programs>AOIP>Uninstall IpAud.**

NOTE: Make sure you uninstall the driver before installing it again. If you install it twice you will get multiple devices showing up, none of which will work!

Section 4 - USB Security Dongle

You will have received one or more USB Security Dongles with your order, depending on how many computers you planned on using in the system as AoIP sources and/or destinations. One dongle is required per computer. Each dongle has been programmed, as indicated on the order sheet that accompanies the shipment, to enable a number of AoIP channels (from 1 to 8, with 8 being typical).

The dongle can be plugged into any USB port on the computer, and its presence is required for the AoIP driver to work.

As indicated earlier, do NOT install the dongle until after the driver has been installed. If you inadvertently installed the driver while the dongle was installed, you may need to uninstall the driver and then re-install it with the dongle disconnected.

Section 5 - Creating AoIP Signals in XPoint

In order to access AoIP signals in the Bridge or Wheatnet router you must first create some AoIP Source and Destination signals using XPoint software. Basically you are mapping the AoIP *Stream ID #'s* you specified when you configured the AoIP drivers on a PC to Source and Destination signals in the router. This section explains how to do this.

Creating AoIP Source Signals - Sending PC Audio to the Router

Creating AoIP signals in XPoint is easy; you just need to know what the *Destination* and *Source Stream ID* numbers are for each PC using IPAud drivers. For this example let's assume we have 2 PC's. PC1 has a single stereo channel in and out. PC2 has 3 stereo channels in and out. We will also assume that the IPAud driver on each PC is configured as follows:

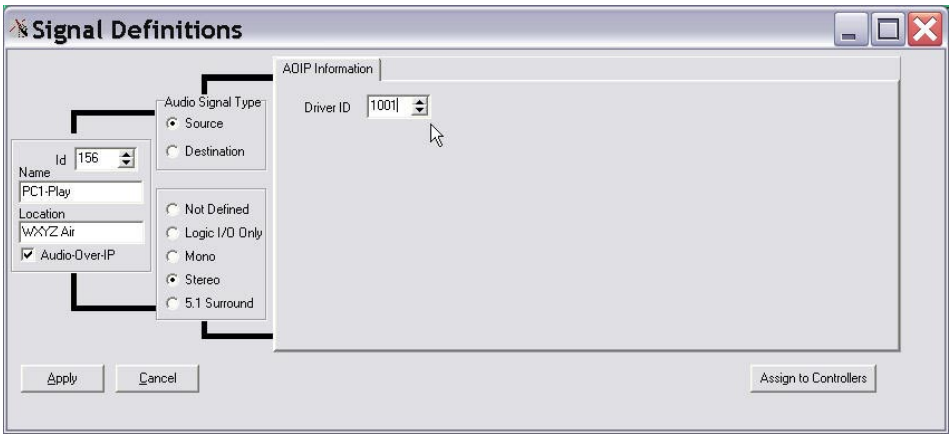
IPaud Driver Stream Setup

PC	CHANNELS	PC DESTINATION STREAM ID	PC SOURCE STREAM ID
1	1	101	1001
2	3	201, 202, 203	2001, 2002, 2003

The terms *Destination Stream* and *Source Stream* are named relative to the Bridge - Destination Stream is the "Line In" input to the PC, and Source Stream is the "Line Out" (playback) from the PC. Note that the stream ID's chosen are arbitrary. By carefully choosing ID #'s, though, you can tell which stream belongs to which PC, and this numbering scheme may prove useful should stream troubleshooting be required. Each stream may be thought of as a simple pair of audio channels.

Ok, by the stream ID numbers we now know where each PC will be sending and receiving audio over the network. Now we need to map these stream ID's to specific audio signals in XPoint so PC audio can be routed to faders and router sources can be fed to a PC for recording or monitoring.

To create signals in XPoint you use the Modify Signal Definitions form. Let's create the PC source signals first - remember that the PC audio *outputs* or playback signals are *input sources to the router*. On the main crosspoint grid in XPoint, simply pick a blank *Source* signal ID location along the top of the grid where the PC audio will be placed and right click on it. The following Signal Definitions form appears:



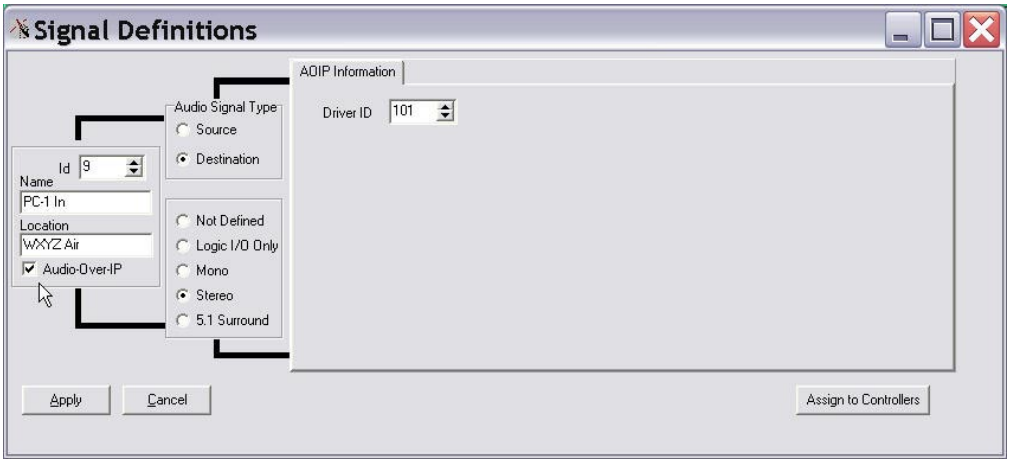
Check the Audio-Over IP check box. Type a Source Signal Name - "PC1-Play" for this example. The Stereo radio button is automatically chosen and cannot be changed. On the AOIP Information tab, enter the Driver ID number. The Driver ID number must match the Source Stream ID chosen for the PC channel you are mapping. For this example, the XPoint *Source* signal we are creating is "PC1-Play" so enter PC1's *Source Stream ID* - 1001.

Next we'll create the three Source signals for PC2. Create a new source signal using the Signal Definitions form as you did for PC1. Enter Source Stream ID number 2001 for "PC2 -1", 2002 for "PC2 -2", and 2003 for "PC2- 3".

Once you press the Apply button on the Signal Definitions form, the source signals are immediately added to the router and available for use. You can now route PC1 and PC2 sources anywhere in the system. Note that you will need to setup your 3rd party audio software so that software uses the IPAud driver as the playback device (instead of a sound card). Every software application sets up the audio I/O differently so refer to the documentation that came with your software.

Creating AoIP Destination Signals - Sending Audio to the PC

Let's create the PC destination signals next - remember that the PC audio *"Line In* "signals are output destinations *from the router*. On the main crosspoint grid in XPoint, simply pick a blank Destination Signal location (from the vertical Destination column on the left) and right click on it. The following Signal Definitions form appears:



Check the Audio-Over IP check box. Type a Destination Signal Name - "PC-1 In" for this example. The Stereo radio button is automatically chosen and cannot be changed. On the AOIP Information tab, enter the Driver ID number. The Driver ID number must match the Destination Stream ID chosen for the PC channel you are mapping. For this example, the XPoint *Destination* signal we are creating is "PC-1 In", so enter PC1's *Destination Stream ID* - 101.

Next we'll create the three Destination signals for PC2. Create a new destination signal using the Signal Definitions form as you did for PC1. Enter *Destination Stream ID* number 201 for "PC2 REC1", 2002 for "PC2 REC2", and 2003 for "PC2 REC3".

Once you press the Apply button on the Signal Definitions form, the destination signals are immediately added to the router and available for use. You can now route any Bridge or Wheatnet source to PC1 and/or PC2. Note that you will need to configure your 3rd party audio software so that software uses the IPAud driver as the record device (instead of a sound card). Every software application sets up the audio I/O differently so refer to the documentation that came with your software.

Section 6 - IP Addressing for AoIP Networks

The AoIP network uses a static IP addressing scheme and all devices must reside on the same subnet. This means that every PC, ET-2001 card, and other devices installed in the system must be given a unique IP address and the same subnet mask. The following device list will includes typical hardware and default IP addresses:

Device	Default Address	Subnet Mask
Bridge/Wheatnet Primary CPU	192.168.1.160	255.255.255.0
Bridge/Wheatnet Failover CPU's	192.168.1.161, .162, etc.	
ET-2001 cards	192.168.1.141, .142, etc.	
PC's with IPAud Drivers	192.168.1.212 , .213, etc.	
Managed Ethernet switch (Procurve)	192.168.1.2	
Surfaces	192.168.1.11, .12, etc.	
XYE Controllers	192.168.1.171, .172, etc.	

Large systems may use close to 100 IP addresses; therefore careful planning and mapping of the address space is imperative. Plan on room for future growth and changes to hardware that might occur.

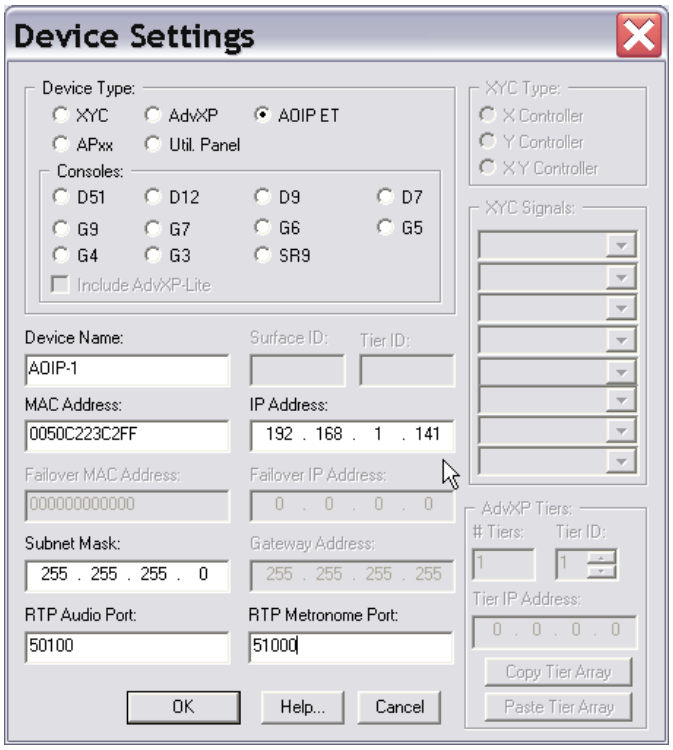
The IP address and subnet mask are stored in EEPROM memory on the ET-2001 card. The default IP address is 192.168.1.141, and the subnet mask is 255.255.255.0. IP address changes are made using the provided PC application, WsNetServer.

Using WsNetServer to Change IP Addresses

WsNetServer is a utility Windows application that may be used to discover and change IP addresses on most Wheatstone devices connected to your network.

This section is a quick guide to using WsNetServer for changing the IP address on the ET-2001 card installed in a Bridge rack. A Reset of the ET-2001 card will be required to activate the changes (using the reset switch on the card). Please refer to WsNetServer documentation for details. A full version of the WsNetServer manual is available from Wheatstone Technical Support, and can also be found on your AoIP Driver CDROM.

You will need to know the MAC address of the ET-2001 card. This is displayed on the label attached to the card.



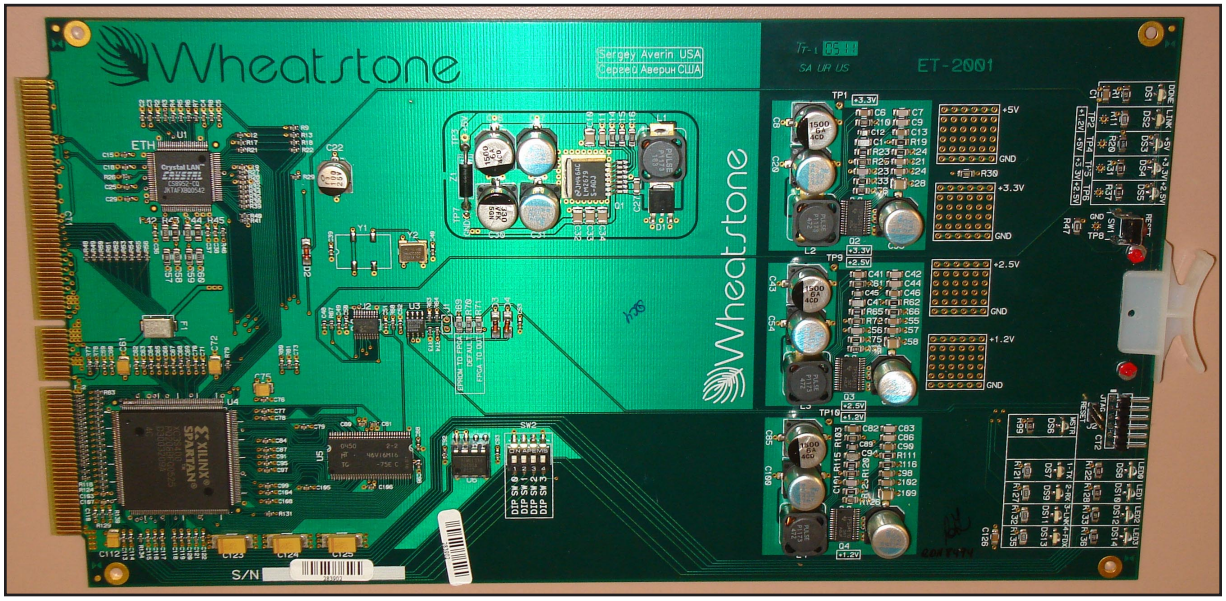
- Start the WsNetServer program. Then press F4 to manually "Add Device".
- In the Device Settings form select the following:
  - Device Type = AOIP ET
  - Device Name - Any 8-character Name
  - MAC Address - Enter your ET-2001 card's MAC address as shown on the label
  - IP Address - Enter new IP Address
  - Subnet Mask - Enter new subnet mask
  - RTP Audio Port = 50100
  - RTP Metronome Port = 51000

Once the Device Settings are entered correctly, click "OK".

Your new AOIP ET type device is now shown on the WsNetServer screen.

Open the Activity log to capture the IP Address requests from the ET-2001 card. The Activity log will show communication between WsNetServer and the ET-2001 card. Now Reboot the ET-2001 card by pressing and holding the Reset switch, located near the card's handle, for about 2 seconds. The IP Address settings should now be updated.

Section 7 - ET-2001 Hardware



Internal Programming Options

All internal programming is done via PCB mounted switches and jumper.

SW1 - ET Reset Switch

Momentarily pressing and holding this switch resets the ET-2001 card and reloads its software.

DIPSW2

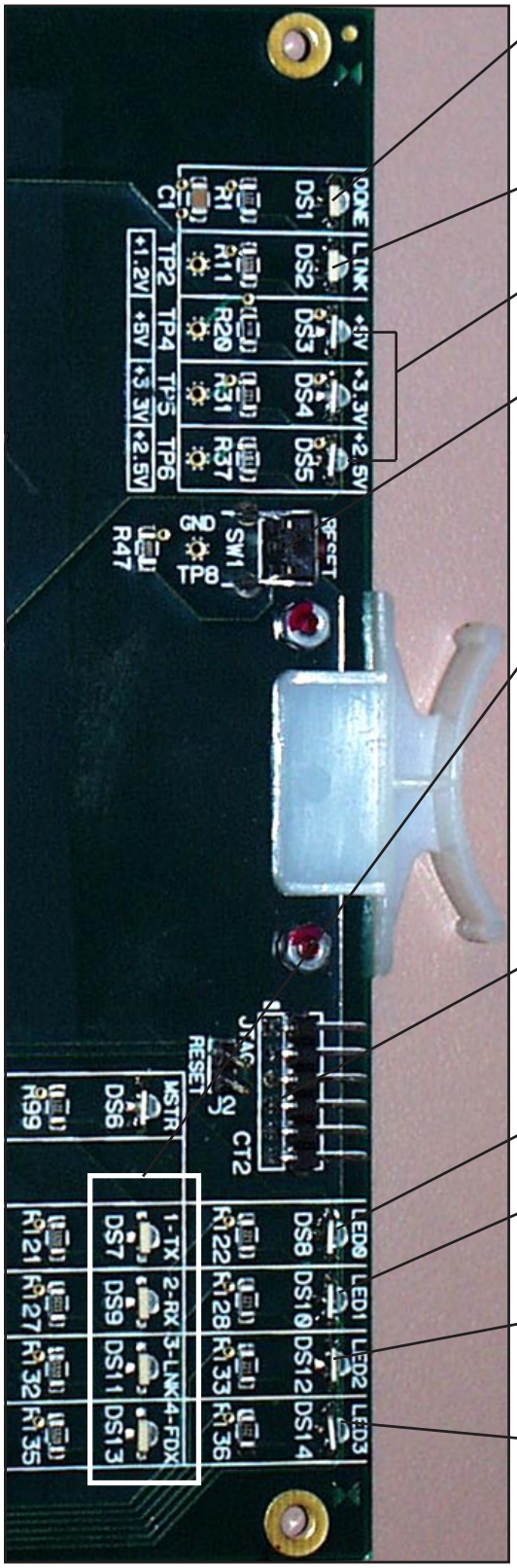
Pos.1 - On
Pos.2 - On
Pos.3 - On
} Factory Defaults
Pos.4 - Off - Not Used

J1 - Not Used

J2 - Factory Use Only - Watchdog Reset

Momentary shorting does a complete reset.

ET Card Status LED's



DONE LED (DS1) - Normally OFF;
ON when programming the FPGA,
Flashes when system clock is missing.

LINK LED (DS2) - lights when Ethernet connected.

POWER SUPPLY STATUS (DS3-DS5) -
ON indicates power supply is OK.

RESET SWITCH (SW1) - momentary pushbutton.
Resets the ET card.

<u>LINK STATUS LED's</u>

TX STATUS (DS7) - ON indicates that the data transmission link is OK.

RX STATUS (DS9) - ON indicates that the data receive link is OK.

LINK STATUS (DS11) - ON indicates that a hardware link is established.

FULL DUPLEX (DS13) - ON indicates that the link is in full duplex mode.

JTAG HEADER - FPGA programming - factory use only.

<u>AUXILIARY STATUS LED's</u>

ACTIVITY LED (DS8) - flashes on messages.

CLOCK MASTER (DS10) - ON indicates that this ET card supplies the backplane clock.

COMM ERROR (DS12) - Normally OFF.
ON for errors.

CFG/BUFFER ERROR (DS14) - Normally OFF.
Flashes when the card is not configured.
Once configured, the LED indicates buffer errors.

Hook-Ups

All user wiring to and from the ET-2001 Card takes place at the rear I/O connector module (ETRJ-2001). CAT5 connections to the network are made via the RJ-45 connector. The pinout drawing on page 28 shows all wiring connections at a glance.

RJ-45—CAT5 Network Connector

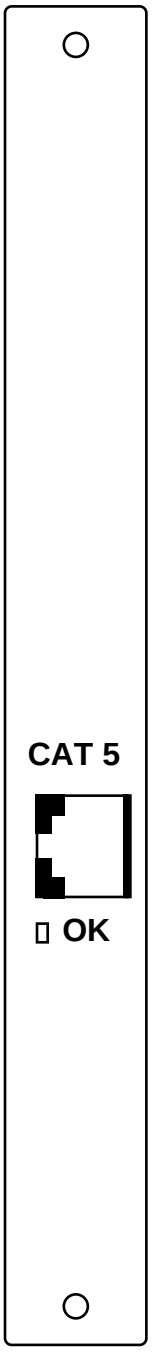
Pin 1 – TXD +
Pin 2 – TXD -
Pin 3 – RXD +
Pin 4 – N/C
Pin 5 – N/C
Pin 6 – RXD -
Pin 7 – N/C
Pin 8 – N/C

CAT5 Ethernet Cable for ET to Network Connections

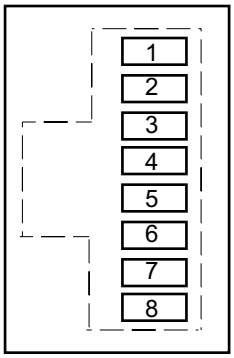
	PIN		PIN	
White/Orange	1	TXD +	1	White/Orange
Orange	2	TXD -	2	Orange
White/Green	3	RXD +	3	White/Green
Blue	4	N/C	4	Blue
White/Blue	5	N/C	5	White/Blue
Green	6	RXD -	6	Green
White/Brown	7	N/C	7	White/Brown
Brown	8	N/C	8	Brown

RJ-45 Plug *RJ-45 Plug*

ET-RJ Panel
I/O Connections



Connector
RJ-45



TXD +
TXD -
RXD +
N/C
N/C
RXD -
N/C
N/C

Section 8 - Troubleshooting

If the AUDIO-OverIP checkbox is missing, AOIP is not enabled in the XP.ini file. To correct this, exit from Xpoint. Navigate to the c:\program files\wheatstone\xpoint folder. Double click on the xp.ini file and change the entry AOIPEnabled=0 to AOIPEnabled=1. Save the file and start XPoint.

Using WinAmp to Test Audio Streams

WinAmp is a free software application used by millions to playback MP3 files and internet content. This application may be setup to playback streams from the network and also play streams into the network. There are just a few setup issues to deal with.

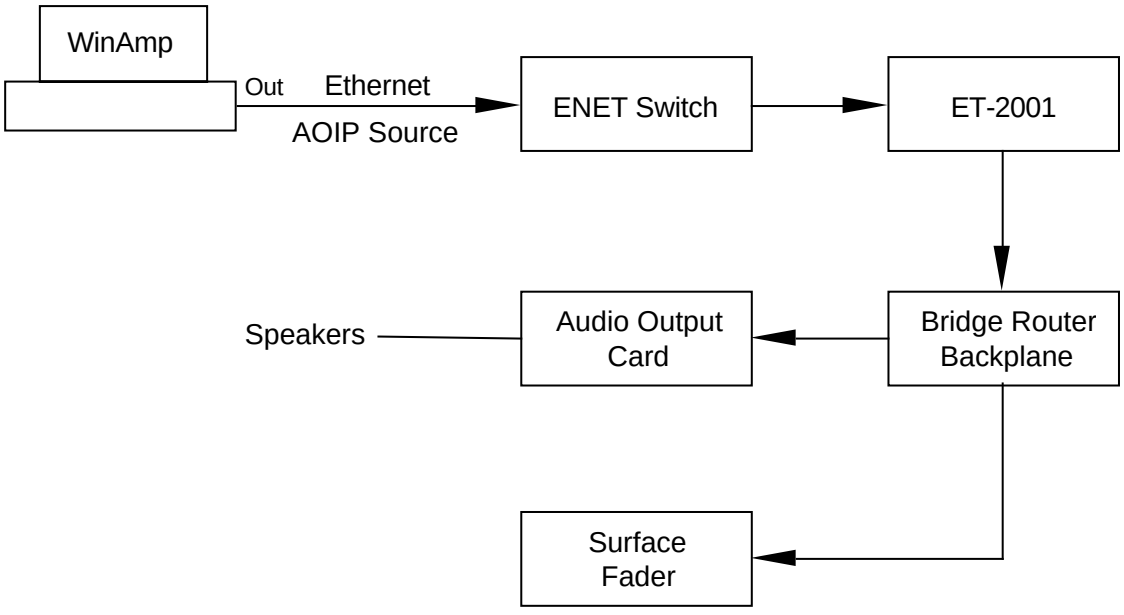
Play Back AOIP Streams:

- Install the Line In plug in for WinAmp.
- Choose Play URL.
- Enter line://dev = n - where "n" = an integer from 1 to 8. The integer corresponds to one of the 8 available AOIP input streams on the PC.
- Cross connect any audio source in XPoint to the AOIP destination signal corresponding to the PC's AOIP channel ID number.

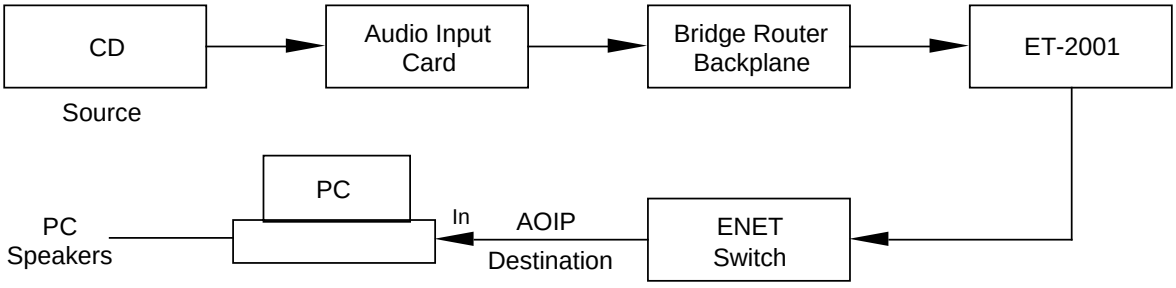
To Play Audio Out onto the Network:

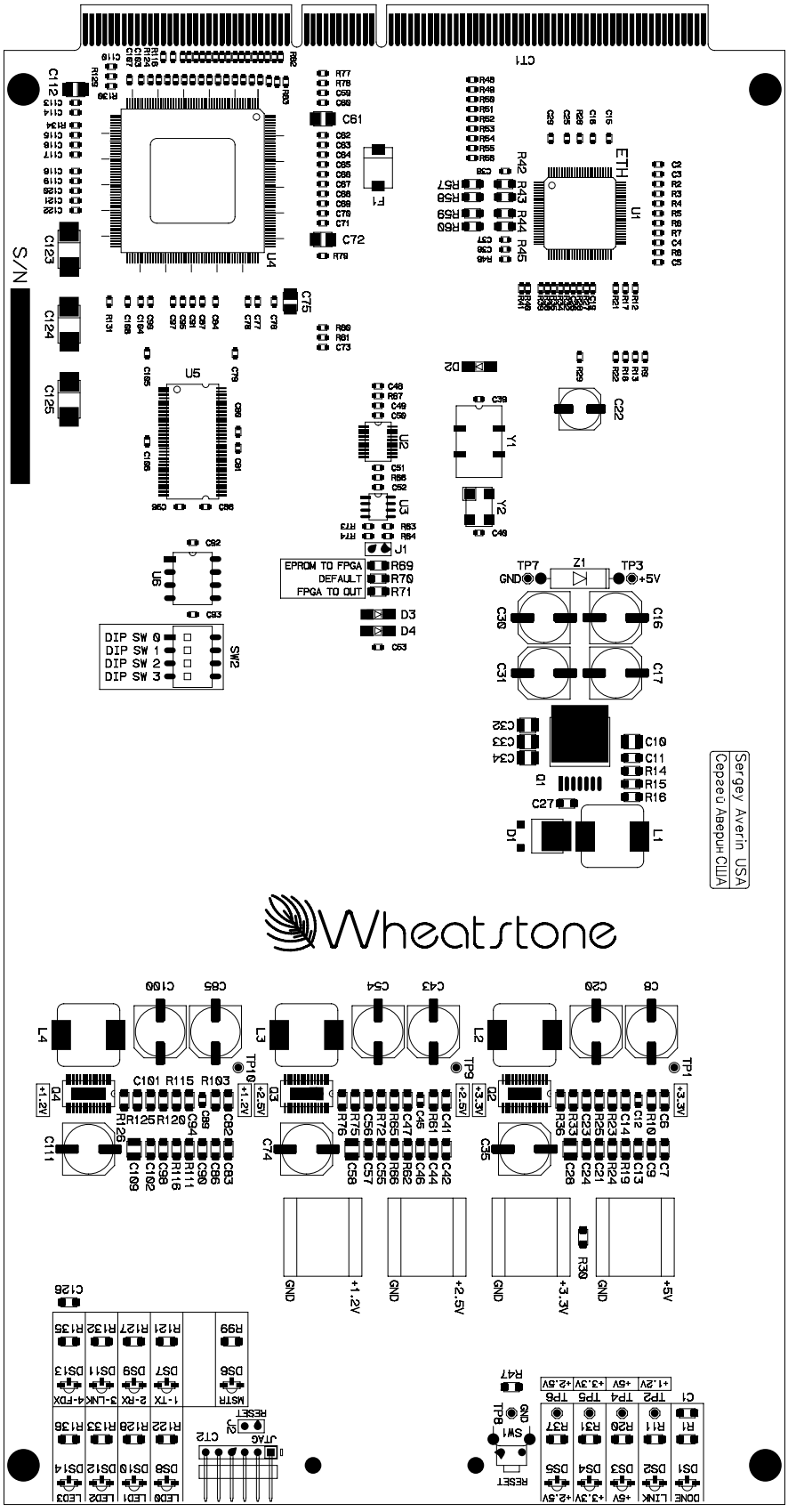
- Choose WinAmp *Preferences-Output* and select the Wheatstone AOIP Driver as the output device.
- Play any MP3 or other media file normally with WinAmp.
- Cross connect the PC's AOIP source signal to any surface fader or audio output in the Bridge router.

Play Back from PC - AOIP Source Diagram



AOIP Destination Diagram





ET-2001 Audio Over IP Card Load Sheet

REPLACEMENT PARTS — AoIP

COMPONENT	DESCRIPTION	*WS P/N*
ET-2001	AUDIO OVER IP CARD	***"008656"***
ETRJ-2001	COMPLETE REAR MODULE WITH RJ CONNECTOR	***"008662"***
SOFTWARE	AoIP SOFTWARE PLUG IN	***"071782"***
USB DONGLE	USB SECURITY DONGLE	***"940035"***
TECHNICAL DOCUMENTATION	AUDIO OVER IP TECHNICAL DOCUMENTATION	***"008395"***