STAC VIP

Product Manual

COMREX

I. INTRODUCTION

WHAT STAC VIP DOES

STAC VIP is a powerful hardware-based telephony system designed for broadcast on-air telephone management. Unlike legacy systems that interfaced to analog and digital dedicated phone lines, STAC VIP interfaces only to IP-based (VoIP or Voice-over-IP) telephone circuits. By this we mean that all phones lines are delivered virtually over a single Ethernet connection to the mainframe.

The voice telephony industry has been moving toward IP voice service for many years already because it streamlines connections, enhances management, and reduces costs. IP-based voice carries these benefits for the broadcaster, but there is also one very important advantage that broadcasters can leverage:

> ***In a pure IP environment, where a call has run end-to-end over IP networks, it is possible to dramatically increase the voice quality and fidelity of phone calls.***

While this holds promise for significantly better phone calls in general, it has real appeal for the broadcast industry, where so much programming is contributed via telephones every day. Imagine a future where the majority of thin, fatigue-sounding on-air phone calls are banished... It sounds good to us.

As mentioned, STAC VIP (and VoIP in general) brings other advantages to broadcasters:

1. VoIP service is generally much less expensive than dedicated legacy phone lines.
2. STAC VIP implements a codec option (G.729) which allows multiple VoIP lines to be delivered in very little network bandwidth (e.g. 12 lines on a single, low-grade DSL).
3. STAC VIP utilizes a VoIP protocol called SIP, which allows integration with existing and future VoIP gear (e.g. sharing lines and using extensions from PBXs).

Besides the advantages of VoIP leveraged by STAC VIP, the product brings other advantages to broadcasters:

1. STAC VIP mainframe serves a web page that allows for full caller data entry and remote control, as well as a caller ID function.
2. STAC VIP control surfaces (up to four per mainframe) allow screening of up to six phone lines and on-air control of up to twelve phone lines.
3. STAC VIP can be easily interfaced to legacy PSTN, ISDN, T1 and E1 phone lines through the use of external gateway devices.

Figure 1 shows a block diagram of a connected STAC VIP system, with most features fully utilized.

1. A PBX is shown as delivering phone service to the STAC VIP. This is possible only with a PBX that supports the SIP protocol on its extensions. Essentially, the PBX can be programmed to allocate several of its lines to certain extensions. To STAC VIP, these extensions are treated as normal incoming lines.
2. The STAC VIP shown also gets several of its phone lines directly from a SIP telephone service provider, with no PBX in between. There are many of these services available and they can be quite inexpensive when compared to dedicated phone lines.
3. Any SIP-based smartphone app should be able to connect to STAC VIP, and many of them support wideband codecs.
4. Several phone lines are connected to STAC VIP via a VoIP gateway device. This device interfaces with the phones lines via a standard telephone (FXO) port, and delivers these lines to STAC VIP via the SIP protocol.
5. Two computers, a laptop and a desktop, are connected to STAC VIP via the web interface. These computers have opened a web browser and typed the STAC VIP Primary Port IP address. They have the ability to add and view all screening info, and to put lines to air and drop them.
6. Three hardware control surfaces are connected to the LAN network. These units can pick up any phone lines, dial calls, answer incoming calls, and put calls “on hold” and “on-air”. Up to four control surfaces can serve each mainframe.

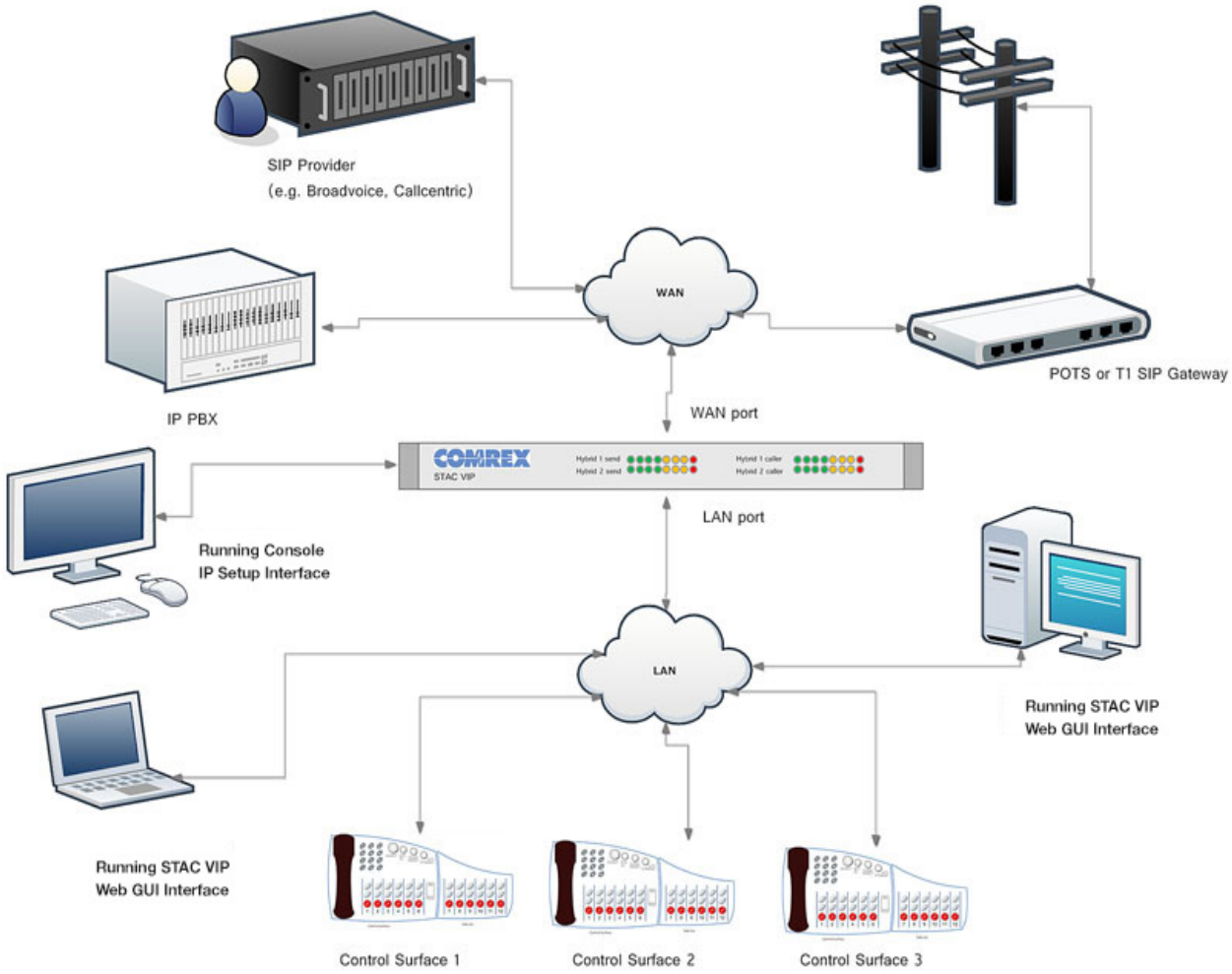


FIGURE 1 **CONNECTED STAC VIP SYSTEM**

ABOUT STAC VIP AUDIO PROCESSING

STAC VIP's main function is to make your on-air phone calls sound great. From an audio perspective, it does this by:

- Making sure the caller you select is presented in the best possible audio quality to your console.
- Making sure that the caller can hear the studio host(s) clearly.
- Making sure if multiple callers are on-air, that they can hear each other clearly.
- Making sure callers with low or high levels are automatically equated (AGC).

A block diagram of STAC VIP audio connections is shown in Figure 2. In this simple configuration, a feed of the station's program audio (pre-delay) is fed to the **HOLD AUDIO 1** port on the mainframe. A studio "mix-minus" feed is attached to the **SEND 1** input, and the caller(s) audio (for delivery to a single console fader) is available on the **CALLER 1** port.

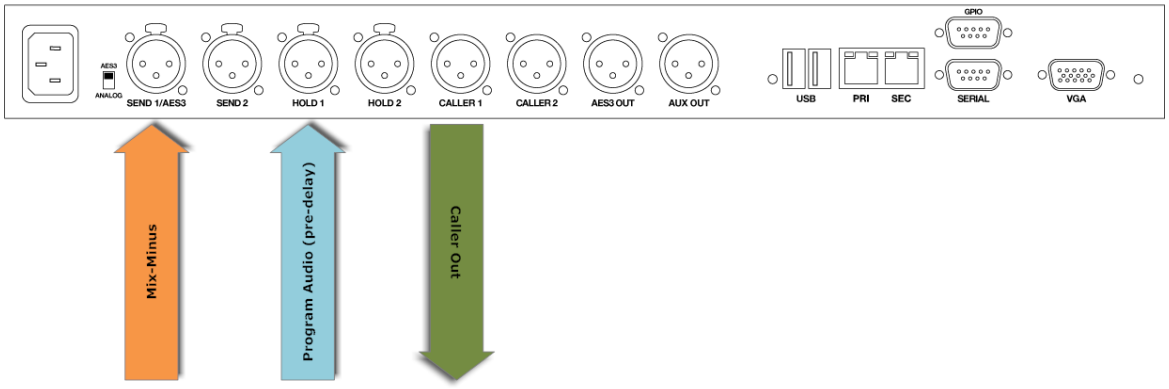


FIGURE 2 **STAC VIP SIMPLE AUDIO CONNECTIONS**

Many applications require that multiple callers be put on-air simultaneously. For this reason, STAC VIP contains two separate hybrids* that allow each caller to be presented on a different output from the mainframe. This allows you to balance each caller on a separate console fader.

Figure 3 shows this arrangement. Here, two caller outputs are used, but only a single mix-minus feed is applied to the **SEND 1** input. This mix-minus must not contain any caller audio from either hybrid. An example of how to create this type of mix-minus is to use an auxiliary bus on your console, deselecting both telephone input ports from that bus.

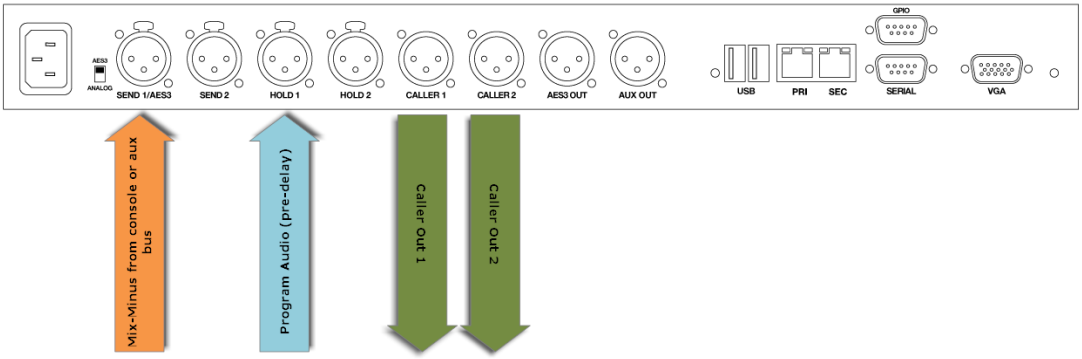


FIGURE 3

** The term Hybrid is a legacy from analog telephony products, which had the task of separating send and receive audio on the phone line. Since VoIP calls don't mix this audio, a Hybrid is technically not employed, but rather a conference is built for each output. For simplicity, we'll continue to use the legacy term for an on-air telephone channel.*

Some consoles have a dedicated "send" output for each fader associated with a caller. Often, the console will define these as "telephone busses" or "channels". In this case (Figure 4), each hybrid gets its own "send" audio from the console, each pre-configured with an appropriate mix-minus feed. These mix-minus feeds will be applied to the **SEND 1** and (optionally) **SEND 2** input ports.

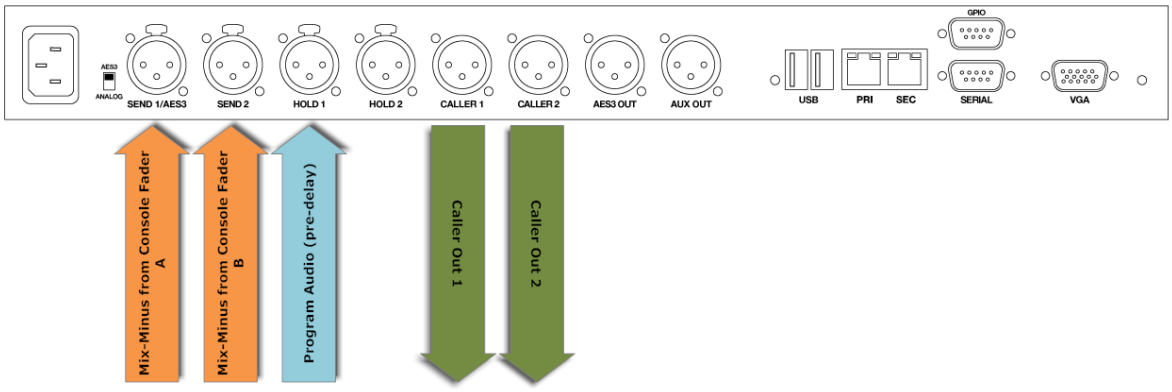


FIGURE 4

Finally, STAC VIP is capable of behaving like two, completely independent products for use in two, unrelated studios. This is called "**Split Studio Mode**" (outlined in **Section XIV**) and is shown in Figure 5.

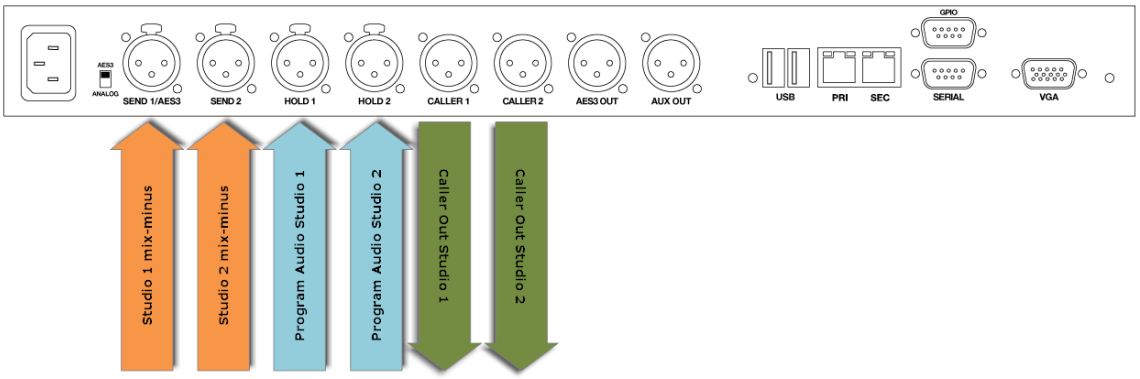


FIGURE 5

ABOUT MIX-MINUS

Comrex support spends a lot of time discussing mix-minus, as it is not an obvious concept. In studio telephony integration, there is a golden rule:

People connecting from outside the studio must never be sent their own audio back to themselves.

If this rule is not followed, the result will be an unpleasant echo in the caller's ear. It is the responsibility of the studio tech to connect a feed to each return channel that is a mix of all important audio sources--in-studio mics, automation, carts, other remote sources, etc., minus the caller. Most modern consoles can do this easily. If not, other options exist and are discussed in the section *"***Why Do I Hear Hear Myself Myself?***"* (**Section XVII**) in this manual.

Finally, when configuring and connecting for using both send inputs, the mix-minus feeds must contain the audio from the opposite send channel (i.e. when two send channels are used there is no internal path for hybrid 1 callers to hear hybrid 2 callers and vice-versa).

II. SETTING UP STAC VIP

HARDWARE ATTACHMENTS

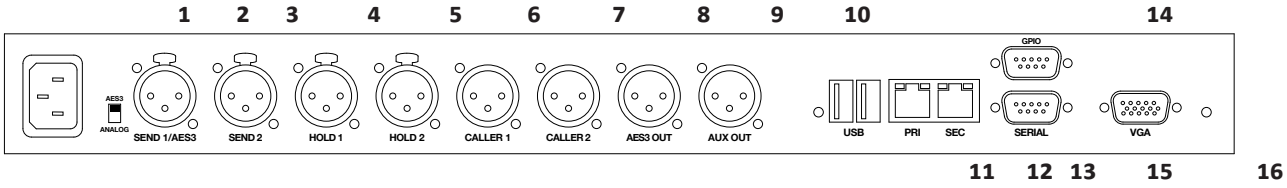


FIGURE 6 **STAC VIP MAINFRAME REAR PANEL**

Figure 6 shows the rear panel of the STAC VIP mainframe:

1 **Mains Power** - Apply universal mains power (110-240VAC) to the IEC connector here.

2 **ANALOG/AES3 Input Switch** - This switch determines whether the leftmost XLR connector is used for analog “send” audio to callers, or is configured as an AES3 digital audio input.

3 **SEND 1 INPUT** - In analog mode, this XLR connector should be sent a balanced, 0dBu signal that is heard by callers when they are “on-air”. This is usually a “mix-minus” feed created on your studio console. In digital AES3 mode, both **SEND 1 INPUT** and **SEND 2 INPUT** are applied here (on left and right channel, respectively).

4 **SEND 2 INPUT** - Use of **SEND 2 INPUT** is optional. This analog input receives audio to be sent to callers on “hybrid 2” when “on-air”. This input is disabled when in digital mode or when configured for single “send” input.

5 **HOLD 1 INPUT** - Analog only, route audio to this port that will be sent to callers “on-hold”.

6 **HOLD 2 INPUT** - This input is only used when in Split Studio Mode. See the section on **Split Studio Mode (Section XIV)** for more information.

7 **CALLER 1 OUT** - This analog output will deliver the audio from callers who are sent to “hybrid 1” on air. Alternately, the system may be configured to present all caller audio on this single output.

8 **CALLER 2 OUT** - This analog output will deliver the audio from callers who are sent to “hybrid 2” on air.

9 **AES3 Out** - This digital output contains the audio from **CALLER 1 OUT** on the left side, and **CALLER 2 OUT** on the right.

10 **AUX OUT** - This output contains a selectable mix of **CALLER 1 OUT**, **CALLER 2 OUT** and **SEND** audio.

11 **USB (x2)** - Connect a keyboard and mouse to these ports to utilize the **Console IP Setup Interface**.

12 **Primary Ethernet Port** - Connect your network to this gigabit compatible Ethernet port.

13 **Secondary Ethernet Port** - Use allows for “split network” operation, assigning certain services to Primary or Secondary Ethernet port only. Disabled by default.

14 **Contact Closure Connector** - This contains 4 contact closure input and output signals, for various remote control and tally functions as described further on.

15 **Serial Port** - This is an RS-232 connector that presents a serial port for future use.

16 **VGA** - Computer video port. Attach a monitor here for **Console IP Setup Interface**.

AUDIO CONNECTIONS

All analog XLR audio inputs has a nominal level of 0dBu (full scale +20dBu). AES3 inputs support 32, 44.1, and 48KHz sampling rates. If an AES3 input is applied, the AES3 output will rate lock to the input signal. Otherwise, AES3 output is 48KHz.

Analog input and output pinouts:

Pin 1	Ground
Pin 2	Balanced audio +
Pin 3	Balanced audio -

AES3 input and output pinouts:

Pin 1	Ground
Pin 2	Data +
Pin 3	Data -

CONTACT CLOSURES

Contact closure signals are available via the male 9-pin D connector on the back of the STAC VIP. Inputs are triggered by shorting the respective input to Pin 5. Outputs consist of an open collector circuit which, when inactive, will offer a high-impedance path to Pin 5 and, when active, will offer a low-impedance path to Pin 5. These outputs are capable of sinking up to 200mA at a voltage up to 12V. Do not switch AC mains power using these contacts.

Contact Closure Pinouts:

Pin 1	Input #1	Pin 4	Input #4	Pin 7	Output #2
Pin 2	Input #2	Pin 5	Ground	Pin 8	Output #3
Pin 3	Input #3	Pin 6	Output #1	Pin 9	Output #4

MAKING CONNECTIONS

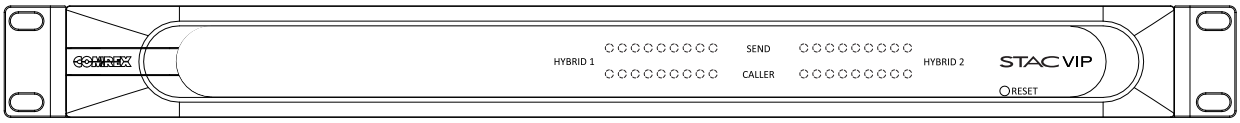


FIGURE 7 **STAC VIP MAINFRAME FRONT PANEL**

At a minimum, STAC VIP will need two audio connections and a network connection. Levels of all analog audio I/O is 0dBu (0.775V) nominal. This level will provide 20dB headroom before the clipping point. Input audio is reflected on the front panel LED based peak meters as indicated in Figure 7. Clipping is indicated by the red LED on these meters.

STAC VIP needs a network connection to be useful. On STAC VIP, network connections are made via a standard 1000Base-T Ethernet connection on an RJ-45 connector.

In most ways, STAC VIP will look like an ordinary computer to this network. In fact, STAC VIP contains an embedded computer with a Linux-based operating system and a full network protocol stack.

STAC VIP is perfectly capable of working over most LANs, but there may be situations where a LAN is heavily firewalled, subject to overloaded traffic conditions, or has security concerns. Better performance is possible if STAC VIP has its own Internet connection.

Since there may be bandwidth, firewall, and security concerns with installing STAC VIP on a managed LAN, it is recommended that your IT manager be consulted in these environments. The details that follow assume a working knowledge of IT topics and network configuration.

On STAC VIP, the single Ethernet port handles connections to your phone lines, your control surfaces, and your web clients. IP addressing in this mode can be DHCP or Static, but if you are using the web interface in your system, you will likely need to assign a Static IP address to the Primary network port in order for the browsers to find the mainframe.

III. CONFIGURING STAC VIP IP INFORMATION

INTRODUCTION

The STAC VIP features two Ethernet interfaces (Primary and Secondary), which provide the following functionality to the system:

1. Voice-over-IP service provider accounts
2. Attachment to PBXs
3. Attachment to gateway devices (bridges to POTS, ISDN, E1/T1 etc)
4. Attachment of control surface(s)
5. Connection to Comrex **Device Manager** software
6. Connection to the STAC VIP Web GUI Interface and Web-based Config Utility pages

Each of the Ethernet ports can be configured for any and all of these functions in the Web-based Config Utility options. But you will need to set up the Ethernet ports initially using either the Console IP Setup Interface (i.e. connecting a keyboard, mouse and video monitor directly to the mainframe) or via the Comrex **Device Manager** software (capable of Primary port configuration only).

Each Ethernet port can be configured with a Static IP address. This is most common, as it allows you to “find” the mainframe on your network and call up the STAC VIP Web GUI Interface at the fixed address. In addition, the Primary port may be configured as a DHCP client, where its address gets assigned by the network. The Secondary port can be disabled completely, set for Static addressing, or act as a DHCP server, by which you can create a “mini” network for control surfaces.

The Primary Ethernet port can not be set as a DHCP Server, and the Secondary can not be set as a DHCP client.

The table below shows the possibilities of the two Ethernet ports.

MODE	PRIMARY	SECONDARY
STATIC	X	X
DHCP CLIENT	X	
DHCP SERVER		X
DISABLED		X

The console interface is shown in Figure 8 You will choose one of the possible configurations for each of the Ethernet ports. In the case of Static addressing, you’ll need to know the following information:

1 The Static IP address you'd like to assign to the STAC VIP Ethernet port

2 The Network Mask used on the network

3 The Gateway address used on the network

4 The DNS address(es) used by your network

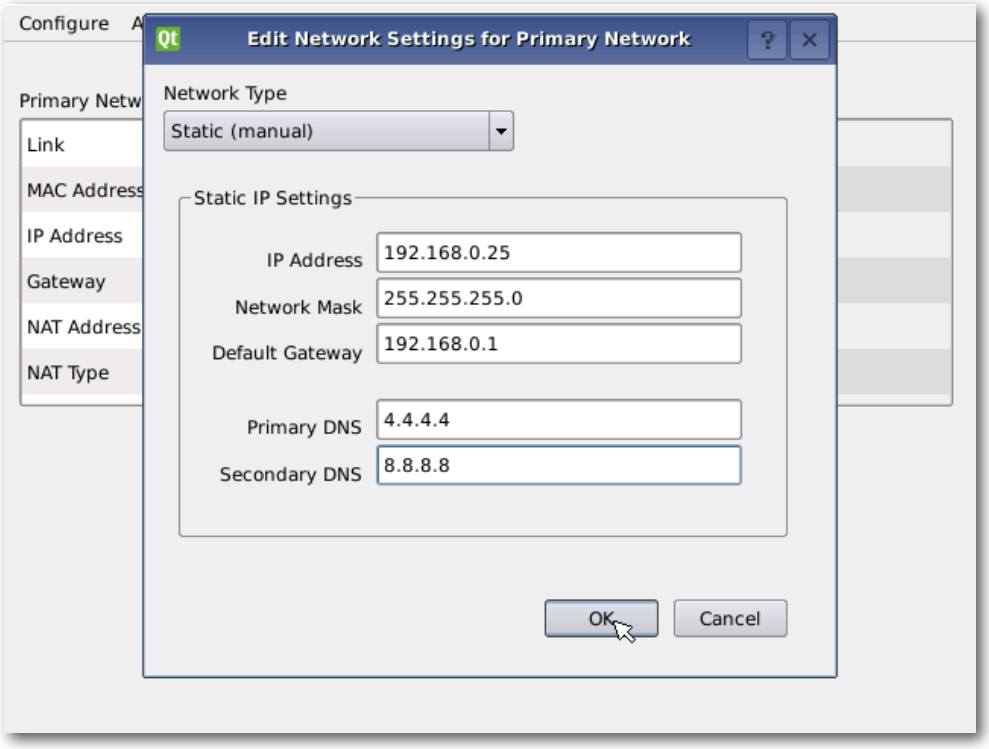


FIGURE 8

This information can be programmed into STAC VIP two ways:

1 You can attach a keyboard and mouse to the USB ports, and a VGA video monitor to the monitor port on the STAC VIP mainframe. [Note: STAC VIP may require a reboot once these are applied.] The **Network Settings Configuration Manager** will appear on the display and allow you to enter the settings information as shown in Figure 8.

2 You can use the Comrex **Device Manager**. STAC VIP ships with the Primary Network port set for DHCP, which means the mainframe will be automatically assigned its IP credentials by the network. Using **Device Manager** on a computer on the same LAN as STAC VIP, you can find the mainframe on the network. This is done by launching the application and choosing **Scan For Devices**. As shown in Figure 9, STAC VIP will appear in the list.

   Device Manager will allow you to set the IP information directly into STAC VIP during the first five minutes that STAC VIP is booted up. When a STAC VIP is located in the left list and selected, you can choose the Web **Configuration** option on the right side to set the IP parameters. But note the countdown clock, which will tell you when those initial five minutes are up.

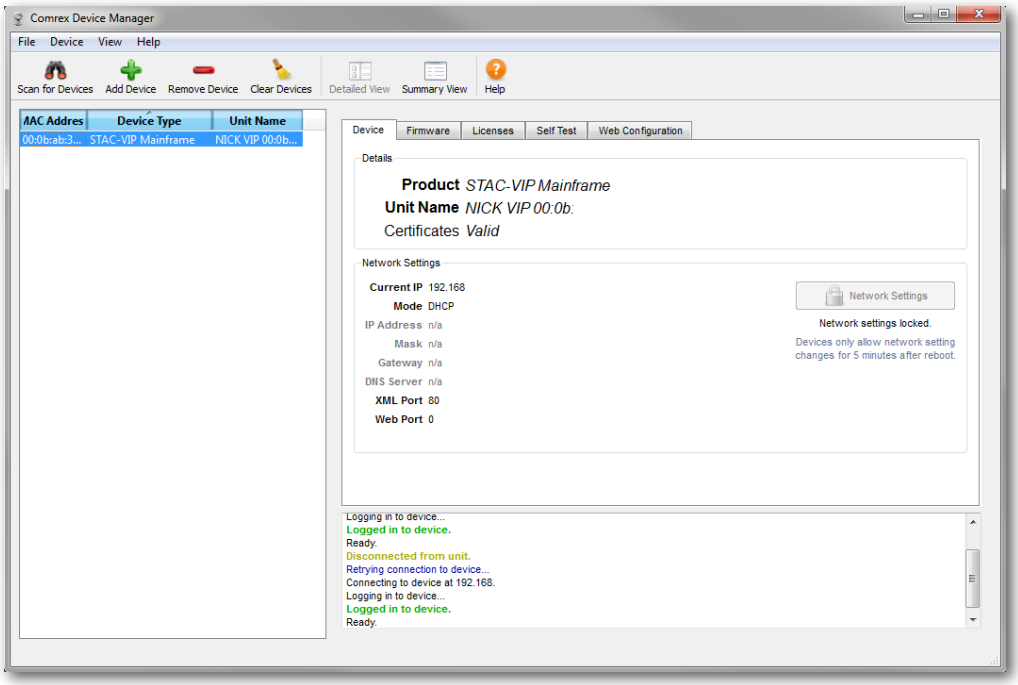


FIGURE 9 **DEVICE MANAGER**

MORE ABOUT DHCP CLIENT AND DHCP SERVER MODES

The Primary Ethernet is capable of being a DHCP client. This means that no IP information is programmed into the mainframe for the Primary port, and the network will assign all the relevant IP information. This mode is not recommended for ports that will need to deliver the Control and Config web Pages. This is because DHCP addresses are subject to change, so your browsers will no longer be able to find the location of the web page.

The Secondary Ethernet is capable of being a DHCP server. This mode is primarily intended to provide a separate LAN for control surfaces. This is shown in Figure 10.

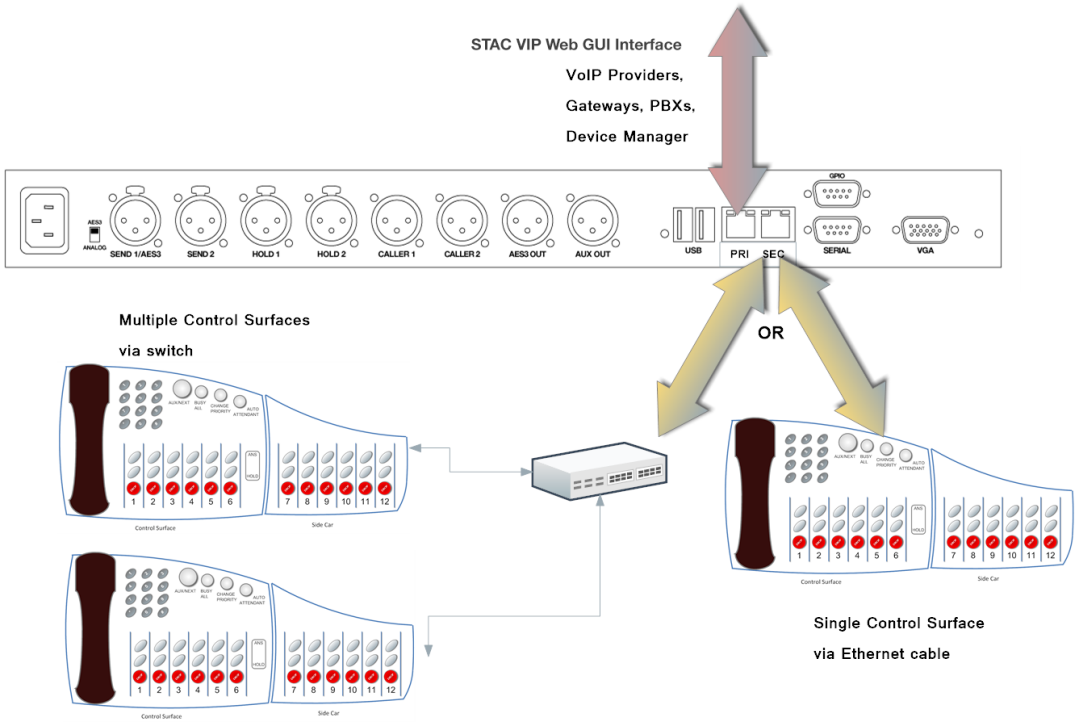


FIGURE 10

In this scenario, the STAC VIP Web GUI Interface page and all Internet-based VoIP services are tied to the Primary port. The Secondary port is reserved for control surfaces. Because control surfaces are set as DHCP clients by default, a single control surface may be attached directly to the Secondary port, and the system will boot and work normally. Alternately, a switch can be attached to the Secondary port and up to four control surfaces can be used there. But no IP configuration is required (other than setting the Secondary port to DHCP server).

Note that these options are required to be set for operation in these modes, but additional options must be configured in the STAC VIP web config page to make the system work the way you want. This is described in the **Network Configuration Page** section (**Section VII**) of the manual.

SECURITY CONCERNS USING DUAL ETHERNET

It might seem like a good idea to set up one of your Ethernet ports to face the open Internet, and the other to your internal LAN. Comrex recommends a security review before this is done, as it has the potential to open some security holes. While the product does not inherently allow cross connection between the Ethernet ports, there is also no actual security firewall in place between them. We do not warrant in any way that this configuration will be immune to hacking attempts.

SETTING IP INFORMATION

Whether you are using the **Device Manager** or the **Console IP Setup Interface**, you will first need to select **Network Type** to choose whether this location will be Static or DHCP (as mentioned, it's easiest to work with STAC VIP using a Static address). If Static, you'll need to enter the appropriate information in the correct fields (IP address, Network Mask, Gateway and DNS server addresses). It's a good idea to give the STAC VIP mainframe a hard reset (pull the power plug and reseat it) after changing IP settings.

IV. TELEPHONE CONNECTIONS

INTRODUCTION TO SIP

SIP (Session Initialization Protocol) is the standard used by STAC VIP to talk to virtual phone lines. These lines must be created in some way externally before they are "applied" to STAC VIP. "Applying" SIP lines to STAC VIP involves configuring the mainframe with certain information about the lines and the location of the server that delivers them. Then the mainframe can be allowed to register with the SIP server and automatically handle all of the interface with the virtual line.

The SIP line can be delivered from several sources:

1. A commercial telephony provider that delivers SIP-based lines over a public or private IP network.
2. A PBX that delivers telephony to extensions via SIP (in this case the STAC VIP mainframe is treated like a PBX extension).
3. A hardware gateway device designed to bridge legacy telephone services to SIP. These devices interface to the outside worlds via analog POTS/PSTN cables, T1/E1 circuits, or ISDN. They interface to STAC VIP via IP over Ethernet.

The setup and interface are identical for options 1 & 2 and similar for option 3.

The first step in setting up a SIP-based phone line is establishing an account with some kind of SIP based provider or PBX. This process can't be described here, but the result of this process is that you will have access to certain credentials for that account. These typically consist of:

Server Domain - The IP address or URL of the server to which you are being registered.

Username - The name that STAC VIP will use when logging into the service.

Password - The password associated with your account for security purposes.

In addition, several SIP providers require an **Authorization Username**, which is often defaulted to be the same as the username but sometimes is required to be different.

SIP is a complex protocol, and is based on Internet standards documents called RFCs. These documents are often subject to interpretation, and some PBXs, Gateways, or telephony providers may have some obscure SIP settings requirements to work best with STAC VIP. But most should work with just the credentials noted above.

Once STAC VIP is set up to work with a PBX or Internet Telephony Provider, it will automatically register with the correct server and maintain a connection to the server indefinitely. This way, the provider or PBX can notify STAC VIP of incoming calls to its phone number, as well as route outgoing calls correctly.

With hardware gateways, the process is reversed. STAC VIP will actually emulate a SIP server to the gateway device. The credentials will be entered into the gateway device. STAC VIP will only need to know the address of the gateway device.

SETTING UP A SIP PROVIDER OR PBX

SIP provider's info is entered using the Web-based Config Utility. Note that this process is entirely different than choosing which physical buttons on the control surfaces (or the lines as displayed on STAC VIP Web GUI Interface) are assigned to these channels. That will happen later. To state this another way, setting up SIP info is entirely removed from the choice of which provider is assigned to line 1, 2 etc.

In most arrangements, a SIP provider can deliver several telephone channels to you over a single account. When you subscribe to a SIP provider, make sure you understand how many simultaneous channels are provided with that account. These channels will act like a traditional telephone hunt group, so in the case of channel one being busy, calls will be routed to channel two etc. You are only required to put in your credentials once for each account even if you have multiple channels.

Along with account credentials, you'll need a Direct Inward Dial (DID) number associated with your account. This is the "old fashioned" phone number users will dial to reach you. STAC VIP does not need to know this number—translation to the proper SIP channel happens behind the scenes at the SIP provider (although often the DID and SIP account name are the same).

GAINING ACCESS TO THE WEB INTERFACE

To input SIP provider data, you will need to access the STAC VIP Web GUI Interface. We'll cover more about web accounts later, but for now, you will need to access the admin account on STAC VIP. It is assumed you now have the mainframe set for a Static IP address (or at least know what the address is). You'll need to key this into the address bar on a browser that supports **Adobe Flash**, as shown in Figure 11.

FIGURE 11 **STAC VIP LOGIN**

You'll be prompted for login credentials here. Enter the user name "**admin**" and the password "**comrex**". Note that a warning will appear to notify that the default password has not yet been changed. It's highly recommended that the admin password be changed. That process is covered further on.

But for now, click the "**Configure**" option as shown in Figure 12 to gain access to the Web-based Config Utility. You will need to enter the admin user name and password again to access this page.

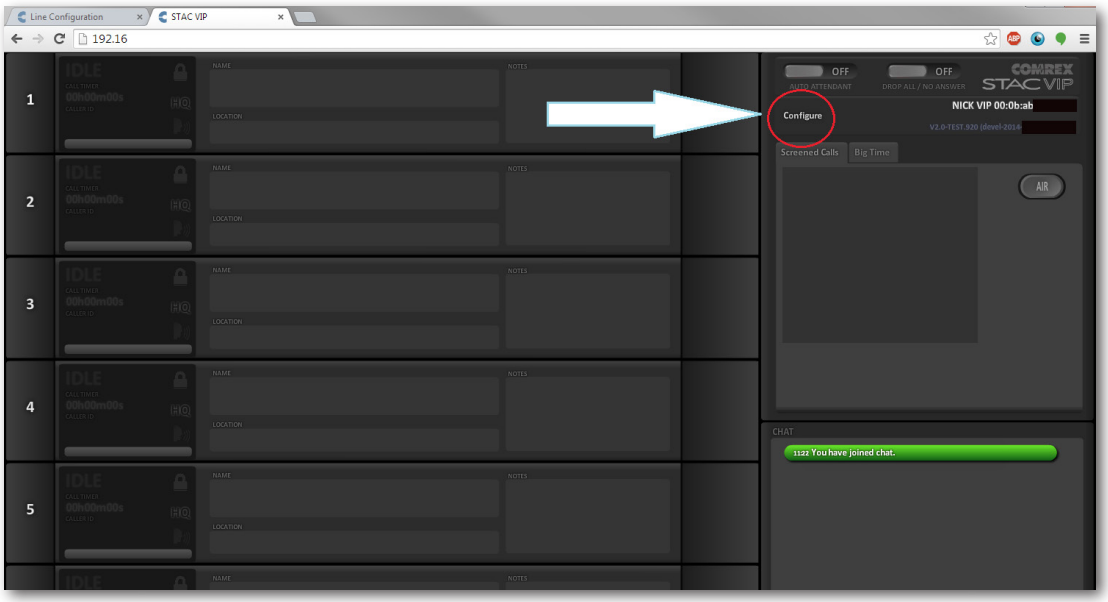


FIGURE 12 **CONFIGURE OPTION**

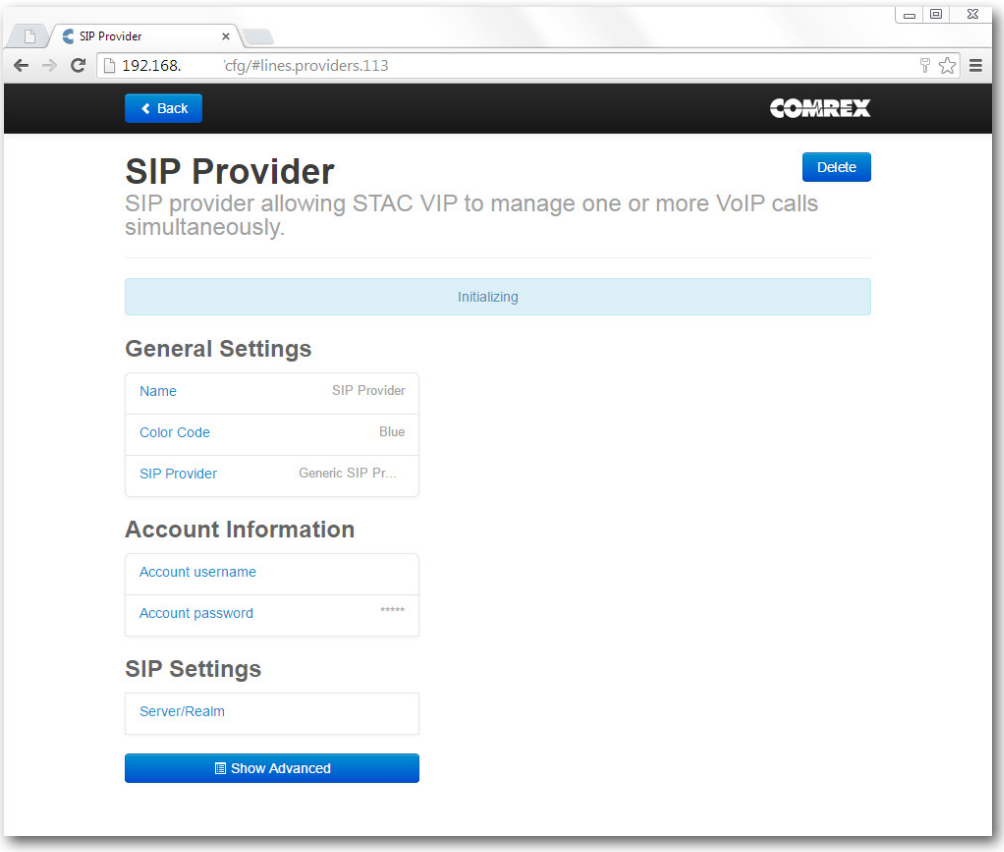


FIGURE 13 **NEW SIP PROVIDER**

SIP providers are entered using **Line Configuration -> VoIP Providers -> Add provider -> SIP Provider**.
The basic settings for a SIP provider are shown in Figure 13. First, you should give your provider a unique name. On the Web-based Config Utility, this name will be displayed in a small colored banner next to any lines that have been assigned to it. The next entry, **Color Code**, determines the color of the banner used.

Under the **SIP Provider** entry, we've provided a list of commonly used providers. Using one of these profiles helps set up some of the more obscure settings that we've found necessary for these providers to work correctly. If your provider isn't on the list (or if you're setting up a SIP extension from a PBX) leave this set to **Generic**.

The next three fields are where you should enter your account credentials: **Account Username**, **Account Password**, and **Server/Realm**. These should have been provided to you by the SIP provider. **Account Username** is usually the name at the start of any SIP URI assigned. (more on that later) E.g., **username@sip_provider**. Make sure to enter only the username part.

The **Server/Realm** is the address of a registration server maintained by the provider. No web prefixes are needed here, just the address e.g. **sip.comrex.com** or **iptel.org**. If you are programming a PBX extension here, this will be the IP address (or URL) of the PBX.

Under most circumstances this is all you should need, setting these parameters, clicking **Back** then clicking **Restart** should start the process of VIP registering with the provider or PBX. However, SIP registration can be tricky in some systems, and if registration fails you should check the required SIP settings carefully and use the **Advanced SIP** settings.

ADVANCED SIP SETTINGS

By clicking **Show Advanced** in the **SIP Setup** menu, the list expands to include less used options:

- *UNDER* GENERAL -

Network Port Binding - Chooses whether this provider is connected over the network attached to the Primary or Secondary Ethernet port. If you have not enabled the Secondary port, (or if you're using it exclusively for control surfaces) then this should always be Primary. It's possible, for example, to connect to a SIP provider on a WAN connection on the Primary port, while connecting to a PBX on a LAN connection on the Secondary port.

- *UNDER* ACCOUNT INFORMATION -

Auth Username - By default, this field is set internally to the same as the **user. Name Entry** - Occasionally, SIP providers require this field be something different, and will outline that in their setup instructions.

- *NEW SECTION* - CODEC SETTINGS -

These settings will generally not interfere with registration. Codecs are a complex subject and are treated separately in the next section.

- *UNDER* SIP SETTINGS -

Outgoing Caller ID Name, Number - If your provider or PBX allows changing the default name and number sent with outgoing calls, you can set these values in these two fields. Many providers will ignore this.

Provider Binding Port - This port is assigned by STAC VIP based on the number of providers you have assigned. Unless required, you should leave the default setting as is.

Proxy Address - Most providers use the same server address for incoming call registration and proxying SIP traffic. If your provider shows a different address for proxy, enter it here.

Register Proxy Address - Some providers require REGISTER messages be sent to a different server. If your provider has specifically required this, enter the address here.

From Username - SIP providers will usually automatically fill in the "**From**" field on an outgoing SIP call. If allowed, you can change the name used in this field by changing this entry.

From Domain - Likewise, the **From Domain** field is set automatically by the SIP provider for outgoing calls. If changeable, enter a desired name here.

Expire Time, Retry Time - These values determine how long to wait (without any communication) before the SIP provider will consider the registration connection lost, and once lost, how often to attempt to re-establish. The default values are usually best, unless strictly required to be changed by your provider.

Register - If you would like to save SIP provider entries for occasional use, you can set them to be disabled here by setting this value to **No**. No registration will be attempted until this setting is changed from no back to **Yes**.

Register Transport - Leave set to UDP in all but very unusual circumstances.

INVITE Contact Compatibility - Optionally force extension to be sent in **Contact** field of **SIP INVITE**. This setting is required by **3Com NBX**.

INVITE SDP Compatibility - Optionally enable compatibility mode for **SIP INVITE lacking SDP**. This setting is required by **Cisco CUCM** and **3Com NBX**.

Server/Realm - Address of the SIP server/authorization realm.

- *NEW SECTION* - EXTRA SETTINGS -

Outgoing Enabled - Controls whether or not the line can make outgoing calls.

Transfer Enabled, Transfer Domain - See section on **Call Transfers.**

Destination Match- This field is normally left blank. If an expression is entered here, the system will attempt to match the text in this field with the incoming calls **"Destination"** field. Calls that don't match will be rejected. This is required when working with some PBXs. This field can also be set as a "regular expression" for a dial plan, which is a more complex topic and can be handled by Comrex support.

As an example, entering the following value in the field:

^(1\d{3}555210\d)$

Would match the sequence **"1xxx555210x"** where **"x"** is any digit.

CODECS

Codecs refer to the voice coding protocol used to communicate between the provider and the STAC VIP.

Here is a list of the supported SIP codecs in STAC VIP:

G.711 - This is the same codec used in everyday normal telephone calls, and is the most common codec used in VoIP. When your SIP provider (or PBX) bridges incoming or outgoing calls to the legacy phone network, it will use this codec. So if you are using this mode primarily (e.g not taking or making any wideband calls on this provider) this is often the best codec to use, so no transcoding needs to occur. The downside is that by modern standards, G.711 uses a lot of network data bandwidth (64kb/s). There are actually two flavors of G.711 (u-law and a-law) but STAC VIP automatically adapts between these.

G.729 - The function of this codec is to provide nearly the same (narrowband) voice quality as G.711 using a much lower network data bandwidth. This is a good choice for users on constrained bandwidth connections like DSL lines, since the codec only requires 8kb/s per channel (plus overhead) and can cram many telephone channels into a moderate Internet connection. It's also a good choice for any network that's subject to congestion. Your SIP provider must support G.729 (or G.729a) for this codec to work. Not all do.

G.722 - This codec is the most common used in the "**HD Voice**" world to deliver wideband phone calls. It uses the same network bandwidth as G.711 (64kb/s), but delivers much higher fidelity (7KHz vs. 3KHz) sound.

iSAC - This is another wideband codec that delivers "**HD Voice**" sound similar to G.722 (7KHz) but uses a lower network bandwidth (24 kb/s).

Opus - A newer entry in the "**HD Voice**" world that has higher quality at lower bit rates than previous choices. Opus is used primarily to be compatible with VoIP apps that support it. In addition, Opus allows integration with WebRTC, a codec engine that's contained in many web browsers. See "**Technotes**" on the Comrex website for more information on integrating with apps and WebRTC. (**www.comrex.com/support**)

CODEC CHOICE ON STAC VIP

On SIP calls, codecs are negotiated at the beginning of each call. The codec selected between the STAC VIP and SIP provider (or PBX) will be displayed on the STAC VIP Web GUI Interface.

Within the SIP provider settings, you can determine how STAC VIP prioritizes the codec choices in the negotiation. The settings are made once for each SIP provider and all calls using that provider will be negotiated with the same settings.

The default setting is called **Normal**, and uses the Opus codec codec as top priority, followed by the iSAC, G.722, G.711 and G.729 codec. In this mode, you can expect the system to attempt to negotiate an HQ Wideband call first, and fall back to normal narrowband G.711 audio if not possible, and as a last resort, G.729. This will work well for most installations, but there are exceptions.

If your SIP provider supports HQ Wideband calls (often referred to as HD Voice), but you don't intend to take any wideband calls, it is possible that the negotiation will end with G.722, and the provider will transcode incoming narrowband G.711 calls to wideband G.722 for connection to STAC VIP. If this happens, there will be no increase in voice quality, but the STAC VIP Web GUI Interface will signify an HQ call. In fact, due to the transcoding, you may experience audio artifacts and extra delay on these calls. To avoid this, you can set the codec priority to **Telco** and have the system negotiate a G.711 call from the start (with fallback to G.729).

You may also be in a situation where your network bandwidth is constrained (e.g. DSL) and want to make sure that all calls are negotiated with the low network bandwidth G.729 codec. In this case set the codec priority to **Low Bitrate Only** to be sure G.729 is the only choice. Other choices here include **HQ Only** (Opus, iSAC and G.722), and a setting where iSAC and Opus are not offered, but all others are.

CODEC FAIRNESS

The **Codec Fairness** setting determines who has priority in the negotiation between STAC VIP and the provider. The default setting of **Fair** actually gives a slight edge to STAC VIP and is best for most users. You can also force absolute control to STAC VIP by changing this setting to **Favor STAC VIP**, or relinquish control with the **Favor Remote** setting.

CONFIGURING FOR A PBX

In the case where you wish to set up incoming lines as extensions of an upstream PBX, the instructions are very similar. Your PBX will deliver channels to STAC VIP in the same way a SIP provider does, and you will need to set up the PBX and retrieve the proper credentials to program into the SIP Provider fields in STAC VIP. IP PBX programming is usually very complex and is usually handled by the PBX vendor. Inform the vendor that you wish to set up an extension with “x” number of simultaneous channels and without additional features like conferencing, transfer, etc. (since STAC VIP doesn’t support these functions).

GATEWAYS

Gateways allow you to use STAC VIP with traditional analog phone lines, as well as T1, BRI and PRI ISDN, and other legacy telephone trunks. Gateways will convert these telephone channels to SIP-style virtual phone lines. You will need to find Gateways that deliver FXO style channels on their telco side - the ports on the Gateway are designed to point toward the telephone service (and not interface with telephones and PBXs, like an FXS port does).

Setup of gateway devices can be quite complex. Comrex maintains some basic instructions on how to set the most popular gateway devices for use with STAC VIP on our website.

Gateways deliver their virtual SIP lines differently than SIP providers. With Gateways, STAC VIP becomes the “provider” and the Gateways register with it. This means the credentials you set up on STAC VIP will be generated by you, and they will need to be mirrored into the Gateway. To use a Gateway, both the Gateway and the STAC VIP must have Static IP addresses so they can find each other.

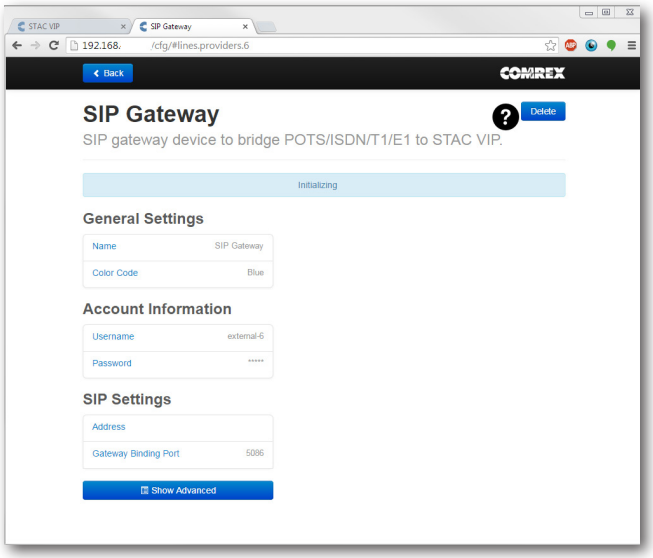


FIGURE 14 **NEW SIP GATEWAY**

Figure 14 shows the settings for Gateways (**Line Configuration > VoIP Providers > Add Providers > SIP Gateway Device**). Many of the settings are populated automatically by STAC VIP, but can be changed to any value you wish.

- GENERAL SETTINGS -

Name - On the STAC VIP Web GUI Interface, this name will be displayed in a small colored banner next to any lines that have been assigned to it. The next entry, **Color Code** - determines the color of the banner used.

- ACCOUNT INFORMATION -

Username and Password - Locally generated values that the Gateway will use to register to STAC VIP

- SIP SETTINGS -

Address - The IP address of the Gateway.

Gateway Binding Port - Automatically populated with an unused port. Must be mirrored into the Gateway settings.

ADVANCED GATEWAY SETTINGS

NETWORK PORT BINDING

Chooses whether this Gateway is connected over the network attached to the Primary or Secondary Ethernet port. If you have not enabled the Secondary port, (or if you're using it exclusively for control surfaces) then this should always be Primary. It's possible, for example, to connect to a SIP provider on a WAN connection on the Primary port, while connecting to a Gateway on a LAN connection on the Secondary port.

DIAL PREFIX

Some Gateways require a certain prefix be dialed in order to select a particular legacy port for outgoing calls. If this is required for your Gateway (e.g. **991**) enter it here.

OUTGOING ENABLED

Allow outgoing calls on channels using this Gateway

TRANSFER ENABLED, TRANSFER DOMAIN

See Section on **Call Transfers**

SIP TRUNKS

With regard to STAC VIP, we refer to SIP Trunks as provider accounts that don't require registration with a provider's server. These types of services are also referred to as using "IP Authorization" because call authorization is accomplished by sending calls to a specific, fixed IP address at the customer's site. Likewise, outgoing calls are authorized if they come from the customer's static IP address.

In this way, SIP Trunks are simpler on the provider side because there is no username or password associated with the account, and no login procedure. Trunks can be more complex on the STAC VIP side, because STAC VIP must have a way to filter incoming calls as being from your provider, and not some random call on your network. If setting up a SIP trunk behind a router or firewall, special port forwarding rules will need to be applied to your network. Your trunking provider often has guides for this process.

You may also come across certain PBXs that must deliver their extensions in this way. In order for STAC VIP to receive these extensions, a SIP trunk must be created instead of a provider account.

SIP Trunks also differ from normal SIP providers in several ways. Rather than having STAC VIP "pull" the SIP channel from a provider, a SIP trunking provider will "push" the channel to a specific IP address of the user. This means in order to support SIP trunking you need a public, static IP address, and no other devices can be utilizing the SIP ports at that address.

Unlike normal SIP providers, **only a single SIP Trunk is supported on each STAC VIP mainframe**.

The option to add a new SIP Trunk is located in **Line Configuration-> VoIP providers-> Add Provider -> SIP Trunk**. Once a new Trunk is created, there will be no option to create another.

Although the settings menu for SIP trunking appears the same as for a normal provider, only a few of them are meaningful. You should put your trunking provider's name into the "**name**" field, choose your codec options (see normal provider settings) and set the correct SIP port value (usually **5060**). **Username** and **Password** fields can be ignored.

You'll also need to populate the **Server/Realm** field in the trunk settings menu. This will be the IP address (e.g. **74.94.151.151**) of the Trunking provider. Unlike with registered providers, this field should not be populated with a domain name (e.g. **myprovider.com**) but needs the actual IP address of the provider's server. This is required for matching as explained below. This is also the destination to which outgoing call requests will be sent.

If you are connecting the network with the trunk to the secondary Ethernet port, you should set this via **Show Advanced->Network Port Binding->Secondary**.

Finally, a SIP trunk needs to determine which calls are from your provider, in order to process them to the correct incoming phone line. This is done via a process called "matching". The simplest form of matching is the default, where the source address of incoming calls will be matched to the value in the **Server/Realm** field, and if correct, the incoming call will be routed to the proper line.

In some circumstances, this setting isn't correct and needs to be adjusted. You can access the matching settings by clicking **Show Advanced** and looking under the **Extra Settings** section.

The two options of interest for trunks are:

1. **Trunk Incoming Match Parameter** - Selects which field within the incoming call parameters (sent at call setup time by the provider) is used for the match. This can be the **Network Address** (default) or the **Destination Number** field.
2. **Trunk Incoming Match** - This is the field where you enter the text that will be matched by the system to the incoming call.

If the **Network Address** option is chosen, It's OK to leave the **Trunk Incoming Match** field blank - this is the default configuration, and the system will use the **Server/Realm** field entry for the match.

Alternately, you can input a different IP address to be matched, in the case where the source IP of the call is different than the **Server/Realm** entry.

Alternately, if the **Destination Number** selection is chosen, the **Trunk Incoming Match** field must be populated. The system will look at the **Destination Number** field of incoming calls and accept only calls with literal matching text.

This field can also be set as a “regular expression” for a dial plan, which is a more complex topic and can be handled by Comrex support. As an example, entering the following value in the field:

^(1\d{3}555210\d)$

Would match the sequence “**1xxx555210x**” where “**x**” is any digit.

Note the “Destination Match” field is not used for SIP Trunks. This is used for registered providers only. Putting information in this field for SIP Trunks may result in call failure.

Once created, the status of your SIP trunks will always show as “**registered**”. In the case of SIP trunks, this status is meaningless, since no actual data has been received from the provider until a call is established.

LINE ASSIGNMENTS

Once you have configured your SIP Providers, Gateway and PBX extensions, you’ll need to map these services to STAC VIP Lines. In STAC VIP, the concept of a Line is simply where that channel appears in the STAC VIP Web GUI Interface and on any attached control surfaces. Go to the **Line Assignment** menu by accessing the Web-based Config Utility through the STAC VIP Web GUI Interface in a browser (**Line Configuration -> Line Assignments**).

Line assignments are simple. As shown in Figure 15 each line has a pull down menu allowing you to assign it to any Provider, Gateway, or PBX extension.

Once a line is assigned, the STAC VIP Web GUI Interface will reflect it with a colored banner, and registration status will be reflected there as well.

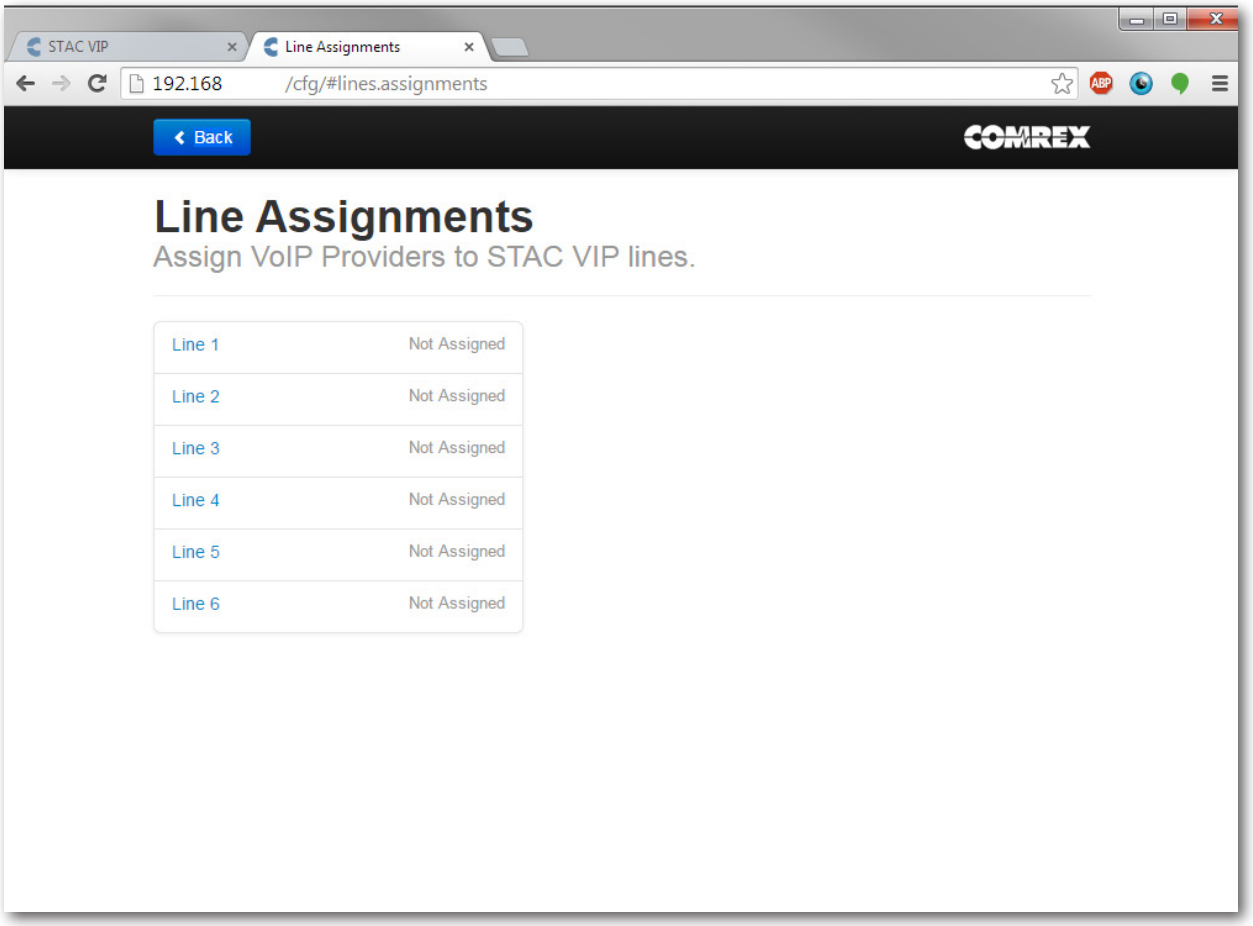


FIGURE 15 **LINE ASSIGNMENTS**

v. CONTROL SURFACES

All hardware control surfaces must exist on either the Primary or Secondary Ethernet port on the STAC VIP Mainframe. They can not be split between both ports. As shipped from the factory, the Secondary Ethernet port is disabled and the Primary port assumes all network functions, including control surface connection.

In order to use control surfaces on the Secondary port, the port must first be enabled using the Web-based Config Utility (see **Section III**) and the Secondary Ethernet should be selected as the control surface port in the config page's **Network Settings** menu (see **Network Settings Menu** section).

Control surfaces must be attached to the same physical LAN as the mainframe. They must share an IP Subnet. Routers between mainframe and control surfaces will cause malfunction.

STAC VIP allows up to four hardware control surfaces to work in conjunction with the mainframe. Control surfaces provide all the major functions of the Web Control Page minus the screening information. Details of control surface operation are contained in the **Control Surface Manual**.

Using the handset on a control surface is the only way to screen a call before it enters "on-air" state.

Control surface association is simple and automatic - when the option is selected on the mainframe, the local LAN is scanned for the existence of control surfaces. By selecting one of the unused entries, a list of detected control surfaces is presented by Ethernet MAC Address (The MAC address is printed on a label on the bottom of the control surface). Select up to four surfaces for each mainframe, one for each of the unused entries. All other configuration happens automatically.

VI. SYSTEM BEHAVIOR

INTRODUCTION

The **System Behavior** settings in STAC VIP determine several important options of how the system performs in your studio:

- AUTO-ATTENDANT -

Greeting - When enabled on a control surface, **Auto-Attendant** will automatically answer incoming calls, play out a pre-recorded greeting, and put the call in the hold queue. **Auto-Attendant** outgoing messages are recorded and managed by control surface functions (see **Control Surface Manual** for more).

There are two separate outgoing messages available for record and playback. This setting allows you to quickly choose the preferred message, or to disable the outgoing message completely and put incoming calls directly to the hold queue.

Also in **Auto Attendant** settings, the **Mode** option exists to change the default behavior after a message has been played out. During non-broadcast times, it might be better for calls to be dropped after the message is played out rather than put “on-hold”.

- AUDIO -

Studio Audio I/O - This setting determines how many “**SEND**” audio inputs are used and how many “**CALLER**” audio outputs are used. This setting is only relevant for usage cases where more than one call will be taken at a time. The choices are:

1. **Single in/Single Out** - Only **SEND 1** and **CALLER 1** ports will be used for all calls. Multiple calls will be conferenced on to the **CALLER 1** output.
2. **Single in/Dual Out** - Only **SEND 1** port will be used for audio to callers. Incoming caller audio will be routed to **CALLER 1** and **CALLER 2** output ports based on the setting of **Air Channel Order** below.
3. **Dual in/Dual Out** - Both **SEND** and **CALLER** ports are active, and which call is active on which port is based on the setting of **Air Channel Order** below.

Aux Audio Output - STAC VIP features an additional output labeled **AUX**. This output is available in analog format only, and is designed to be routed to a recorder or other device that requires a mix of studio and caller audio.

The **AUX** audio output always contains the output of both “caller” channels. In addition, the audio from each (or both) of the “**SEND**” ports may be added into this mix.

Air Channel Order - This entry is dependent on the **Studio Audio I/O** entry above. If **Single in/Single Out** is chosen in the **Studio Audio I/O** entry, no options appear here, since all calls

will be routed to the **CALLER 1** output. Otherwise, you can choose the sequence of how multiple calls are assigned to the different outputs here. Note that these settings only affect simultaneous calls (i.e. at least one call has been "locked' on-air and a second call is put to "air"). The choices are:

1. **Single** - Despite the fact that both outputs are active, all calls will be routed to the **CALLER 1** output port and will hear the audio present on the **SEND 1** input. This is equivalent to setting **Single in/Single Out** on the previous page.
2. **Classic** - This mode attempts to "balance" the calls between the output channels. If no calls are "on-air", the first call will always default to the **CALLER 1** output. The second will go to **CALLER 2**. The third will also go to **CALLER 2**, and the fourth will go back to **CALLER 1** Additional calls will repeat this 1-2-2-1 sequence.
3. **VIP -** This scenario assumes there is one call present that should have special treatment. This is assumed to be the first call put "on-air" and it will default to **CALLER 1** output. All other subsequent calls will be applied to the **CALLER 2** output.

AGC (Automatic Gain Control) - STAC VIP has the ability to automatically adjust caller levels so soft callers and loud callers are equated in level.

This setting has the following choices:

1. **Off -** No AGC is applied at all.
2. **On -** The level of all caller audio will be automatically raised or lowered by the system to make them approximately the same.

Caller Ducking - Sometimes, there's an advantage to having caller audio automatically reduced when the studio host speaks. This function is called "ducking" and can allow a host to dominate a conversation.

This setting has the following choices:

1. **Off** - No ducking will be employed.
2. **Mild (6dB)** - Caller audio will be reduced slightly when host audio is detected.
3. **Medium (12dB)** - Caller audio will be reduced a substantial amount when host audio is detected.
4. **High (18dB)** - Caller audio will be reduced a dramatic amount when host audio is detected.

Caller On-Air Tone - This setting (off by default) provides for a short "blip" sound to be heard by the caller when he is placed "**On-Air**" in any way. It serves as a notification that the caller has moved from the "handset", "hold" or "screened hold" state and is currently "On-Air". The setting is universal--it cannot be disabled only for certain calls or certain studios.

- OTHER -

Caller ID to Name - On the STAC VIP Web GUI Interface, caller ID info received on incoming calls is always displayed in the **Line Status** box. This is a simple on/off option that determines whether the caller ID info is also automatically put into the **Name** field of the screener entry section.

Drop All Drops Locked Air - Both the STAC VIP Web GUI Interface and the control surfaces have a function labeled **Drop All**. This is designed to clear all lines and reject calls for a time when preparing for a contest or other event where a specific start time is required. This option controls the behavior of this mode. Specifically, it determines whether calls that have been “locked” on-air are dropped when the function is activated.

Contact Closures - The STAC VIP mainframe has four input and four output contact closures available. This entry determines the function of the four outputs. The choices are:

1. **No Function**
2. **Call On Air** - A call has been put “on-air” on any line.
3. **Call On Air 1 & 2** - A call has been placed “on-air” and is active on either the **CALLER 1** or **CALLER 2** output specifically.
4. **Call Ringing** - An incoming call is ringing on any configured line.

Test Modes - These options are used for diagnostics or demo purposes only and will interfere with normal operation when enabled.

- **Call Simulator -** When enabled, this will allow creation of a “fake” provider that will initiate “fake” incoming calls for product demo purposes.
- **Call Simulator Interval -** Adjusts how often the “fake” incoming calls are generated in the simulator.
- **Audio Test -** These options provide for specific audio paths to be enabled (e.g., **SEND IN** to **CALLER OUT**). These are used in unit production tests and can also be used to troubleshoot general hookup issues. Modes are also offered that generate a tone from the caller out ports.
- **Contact Closure Test -** Likewise, enabling this option puts the contact closure feature in “loopback” mode with inputs directly driving outputs (e.g., input 1-> output 1 etc).

VII. NETWORK CONFIGURATION PAGE

The **Network Configuration** page is shown in Figure 16. The settings in this section determine which of the enabled Ethernet ports are allowed to carry certain services like control surfaces, delivery of the STAC VIP Web GUI Interface and Web-based Config Utility, and connection to the **Device Manager**, among other administrative functions.

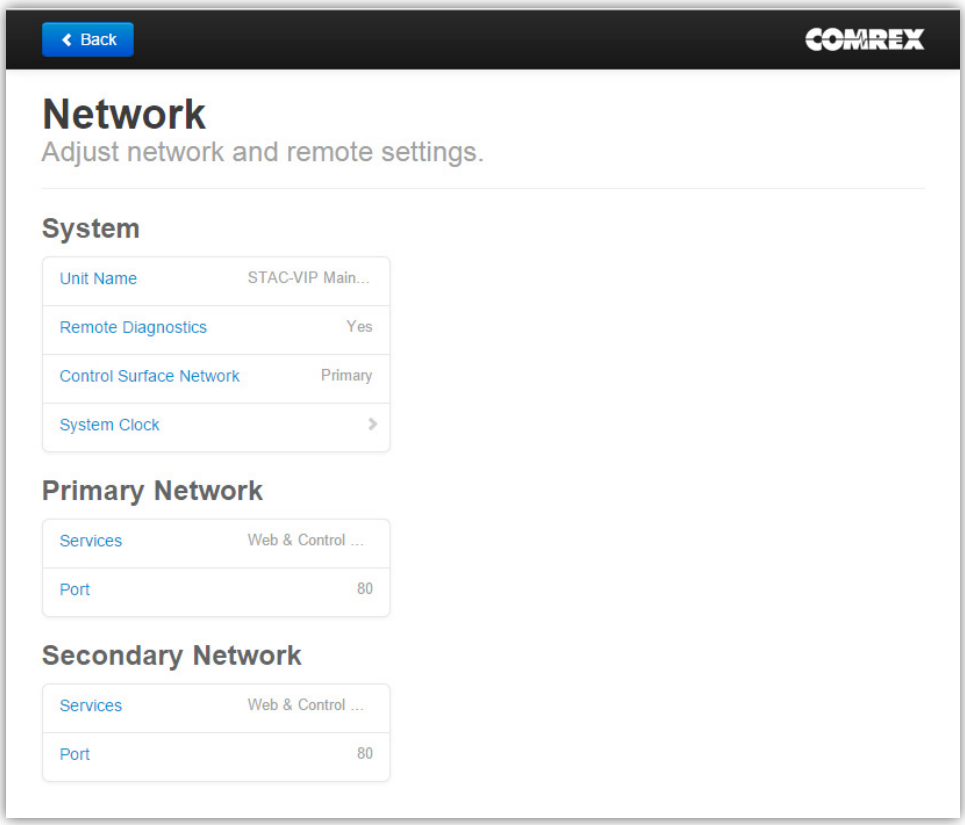


FIGURE 16

- SYSTEM -

Giving your STAC VIP system a unique name will help you identify it on the network, especially if more than one mainframe is used.

Remote Diagnostics - Comrex support has the ability to connect to your STAC VIP via the SSH protocol to troubleshoot issues. This requires a private keypair that we don't provide. If you have security concerns about SSH, you can disable it by setting this option to "**No**".

Control Surface Network - Choose whether hardware control surfaces will be attached to the Primary or Secondary Ethernet port here. Note Secondary Ethernet must be enabled as in Section III before making any change here. You must choose only one (default is Primary) to run all your control surfaces (even, for example, in Split Studio mode). See the **Control Surface** section for more.

System Clock - STAC VIP maintains a network connection to an NTP server that delivers the time-of-day information required to show the clock on the STAC VIP Web GUI Interface page. The specifics of that function can be changed here. The default settings allow for a pool of public servers to be used.

- PRIMARY/SECONDARY NETWORK SETTINGS -

This section is different and independent from the console-based Ethernet setup function described in **Section III**. In order to select an Ethernet port to provide any service, it must first be enabled and configured via the process in **Section III**.

When shipped from the factory, the Secondary Ethernet port is disabled, so all services are enabled to run on the Primary port.

As shown in Figure 17, each port has a pull-down option to enable or disable certain services:

1. **Web and Control Servers** - This Ethernet port will deliver the STAC VIP Web GUI Interface and Web-based Config Utility, will allow **Device Manager** to connect to it and allow control surfaces to connect.
2. **Control Server Only** - No web page will be served from this port, but **Device Manager** and control surfaces can connect.
3. **None** - No web page will be served and **Device Manager** and control surfaces can not connect.

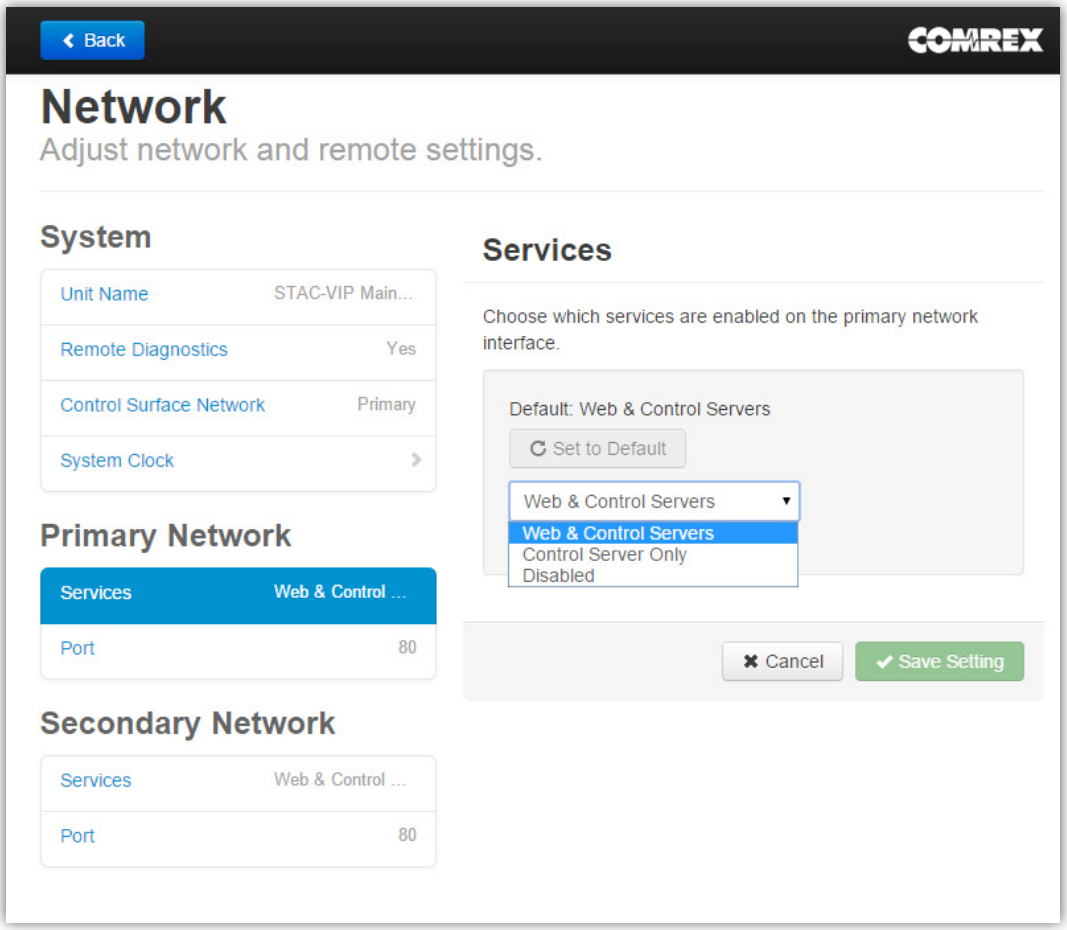


FIGURE 17

Note that none of these options limit the ability of either port to support telephone, PBX, or gateway services. Those options are chosen in the **Line Settings Configuration** section.

The default IP port for all these services is port **80**. This can be changed, however it must also be set properly in any browser, **Device Manger**, or control surface attached to these ports.

VIII. SECURITY AND USER ACCOUNTS

Security settings are accessed through the Web-based Config Utility. Log in to the admin account (default password = **comrex**) and select the "**Configure**" option. You will be prompted to log in again with your admin credentials.

Choose "**Security**" to open these options.

- SECURITY -

See the next section to detail user accounts.

ADMIN SETTINGS

Unit name - The name of this unit. To appear to the **Device Manager**.

Web Server Port - By default, the control and configuration web pages are delivered from the well-known server port **80**. To enable web control and configuration outside a LAN, this port should be forwarded to the STAC VIP mainframe in your Gateway router. In the case where you have already have a web server running on **TCP 80**, and it's already forwarded, you can change the default setting here. Once this setting is changed, you'll need to address it with your browser using the new port number (e.g. **74.94.151.151:81** for port **81**).

ADVANCED OPTIONS

Click "**Show Advanced**" to see the following options

DIAGNOSTICS

Enable remote diagnostics (SSH). Enable this to allow Comrex support to access the device during troubleshooting sessions.

SURFACE SIP PASSWORD

Control surfaces communicate with the STAC VIP mainframe via the SIP protocol. Under most circumstances this is handled automatically, and only a quick selection in the mainframe menu is necessary. In some unusual circumstances you may need to change the SIP password from the default. This can be done here. Note that if this password is changed, it must also changed in the configuration of each control surface.

IX. CREATING AND USING WEB ACCOUNTS

When we refer to accounts, we mean the username/password combination used to access the STAC VIP Web GUI Interface and Web-based Config Utility,.

So far, we've only addressed the STAC VIP mainframe via the admin account, and in some situations (e.g. use only over a LAN, with no web page directed to the Internet) this account will suffice. But the admin account user has the ability to make configuration changes to the system, and this isn't always desirable. STAC VIP allows you to generate user accounts without configuration capability.

The main admin account is listed here and can not be deleted. It is highly recommended that this account password be changed from the default, especially if the STAC VIP Web GUI Interface is visible to the Internet.

Accounts can be created here also. The default password is always **comrex**, and again, it's important to change as soon as possible. When you create a new account you have three choices in privilege level. These are selectable under the option labeled "**Role**":

1. **User** - STAC VIP Web GUI Interface is visible only, no configuration is possible.
2. **Power user** - Access to Web-based Config Utility , but this account will not allow for firmware updates to be applied (e.g. with the **Device Manager**).
3. **Admin** - Full access to control, configuration, and firmware update features.

x. MORE ABOUT SIP

Before we get into a conversation about routers and SIP issues, it's important to understand the basics of how SIP works.

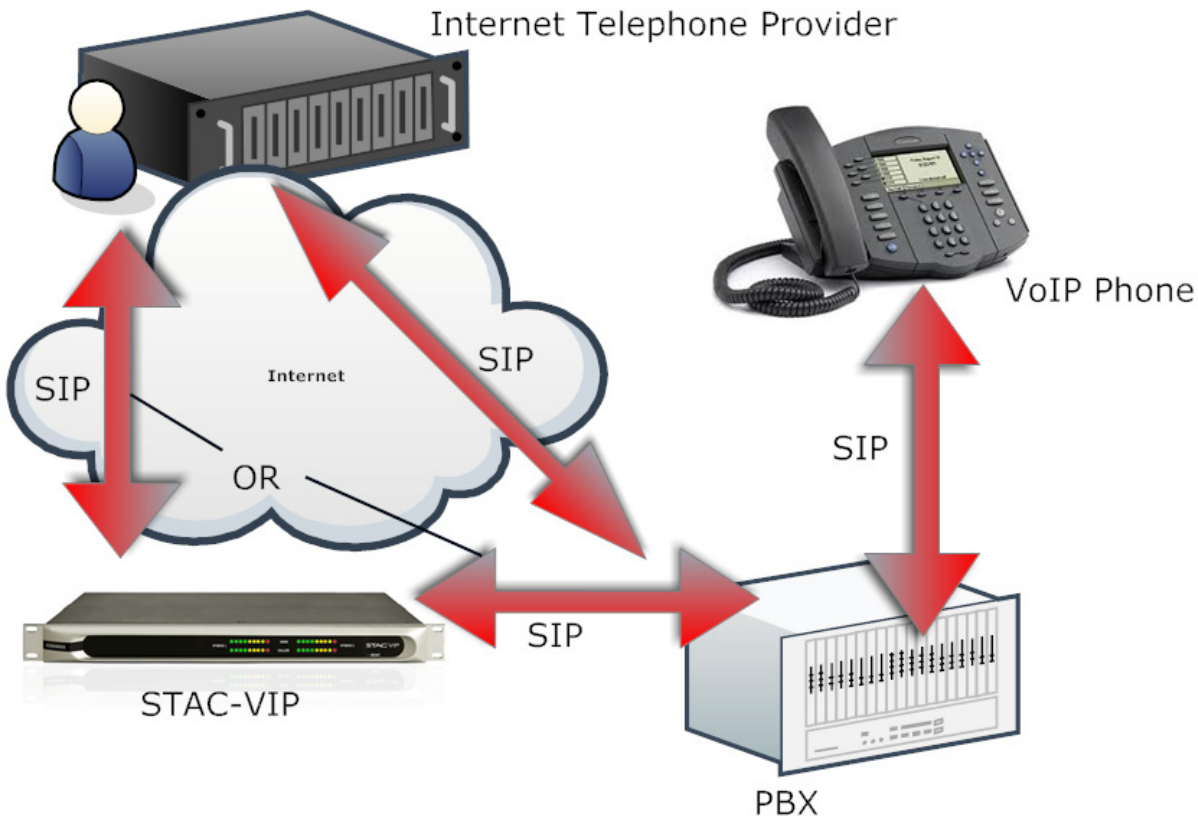


FIGURE 18 **SIP CHAIN**

The great thing about SIP is that the same protocol is used between devices along the chain. In our example shown in Figure 18, a SIP PBX uses the protocol to register and place and receive calls with a SIP service provider on the Internet. In this scenario, the provider is acting like a SIP host and the PBX is acting like a client.

Further down the chain, the PBX has a similar but inverse relation with its extensions - the PBX in this link is the host and the extensions are the clients.

But in both links, the protocol is the same - the client is registering with the SIP host, the host is notifying the client of incoming calls and handling outbound call routing. The way the clients and hosts are set up is identical.

If in this scenario, you replace the phone extension with a STAC VIP system, you can see how lines can now be shared between a PBX and your studio telephone system. The VIP acts like a SIP extension to the PBX. This requires some PBX programming to keep straight, but offers the ultimate in flexibility and utility. Of course, since the protocol is the same, the VIP can register with the SIP provider directly, bypassing the PBX entirely.

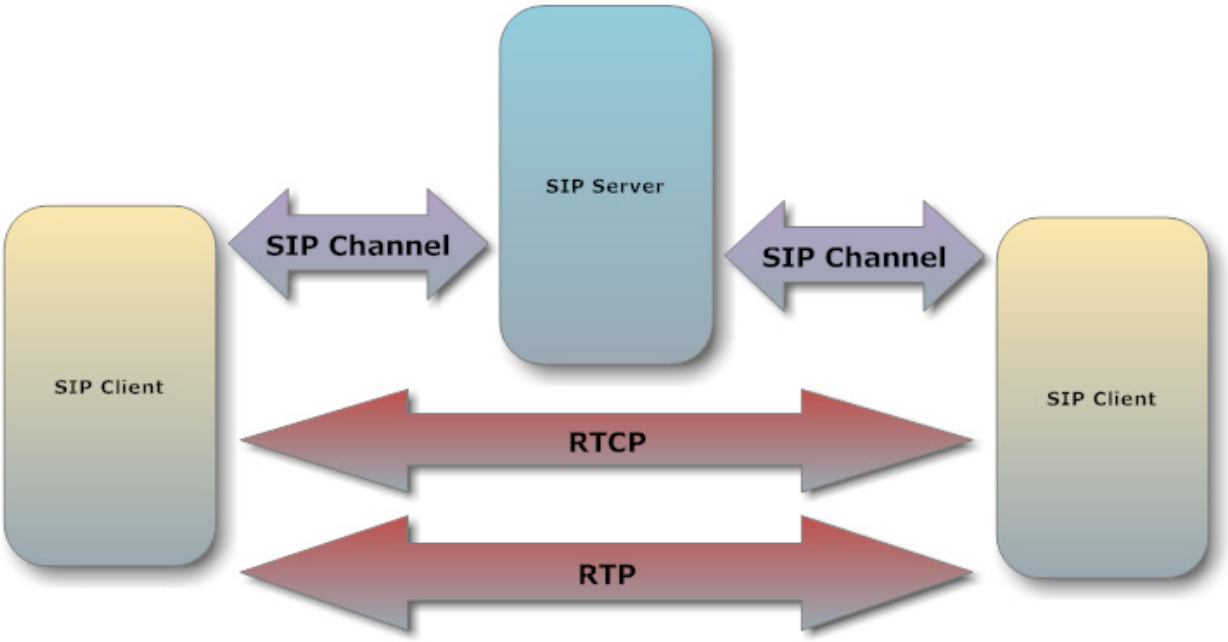


FIGURE 19 **SIP CHANNELS**

Technically, as shown in , a SIP client opens one channel to its host when it registers. This channel is kept open indefinitely, and uses the TCP transport layer for reliability.

This channel is used by the SIP client to request an outgoing call, as well as by the SIP host to notify the client of incoming calls. The channel is initiated from the client and kept open with keep-alive data so it doesn't have any issue when running through routers that incorporate Network Address Translation (NAT).

This signalling channel doesn't actually carry any voice data, the voice data channel is created separately over distinctly different "ports" on the client, using a protocol called RTP.

NAT ROUTER ISSUES WITH SIP

The issues with a SIP client (like STAC VIP) behind a NAT router are twofold:

1. When SIP clients (like STAC VIP) are behind NAT routers, they don't know their public IP address. The client only knows the private LAN (e.g. 192.168.x.x) address, but not the public IP used by the NAT router on the Internet. During the negotiation process, the client provides information on how other devices can reach it directly. But this information is flawed, since the LAN address is useless to devices outside the LAN.
2. **NAT routers don't know what to do with unsolicited incoming RTP streams.** The RTP and RTCP channels that are created as a result of the negotiation over the registration channel for incoming calls are aimed at the router's public IP address and are targeted to temporary or "ephemeral" ports that are chosen during that negotiation.

Issue #1 is usually resolved when using a reputable SIP provider, as they will have the smarts to substitute your public IP address for your private one during the negotiation process.

Note that even when this issue is resolved, the second issue remains - the streams created to the proper address will "bounce" off the router, because the router has no idea where to send them.

Issue #2 is more complex, but there are some workarounds:

1. The simplest way of avoiding NAT issues is not to use NAT at all. If your router supports a DMZ function, this will have the effect of putting your client (STAC VIP) open to all incoming traffic on the Internet. Alternately, STAC VIP can be located directly on an open Internet connection with a fixed, public IP programmed into it.
2. Many modern routers and firewalls have a feature called **SIP ALG** that may be either on or off by default. If **SIP ALG** is designed correctly (and not all implementations are), your router will be smart enough to "sniff" the command SIP channel, predict where incoming RTP streams are expected, and route them to the proper ports on your SIP device. The one magic rule of **SIP ALG** use is to avoid the use of other workarounds simultaneously - **SIP ALG** assumes it's the only one tasked with NAT traversal and will malfunction if other workarounds are employed.
3. Use a SIP provider that has implemented their own complete NAT solution. Several providers have systems that have been finely tuned to resolve the NAT issue for RTP streams. They can detect the difference between public and private addressing, and proxy all the media data between the clients if necessary, making NAT traversal much simpler. You can inquire whether your SIP provider implements a "NAT solution" and in particular whether they employ a "media relay", which means the provider can act as a proxy for your calls.

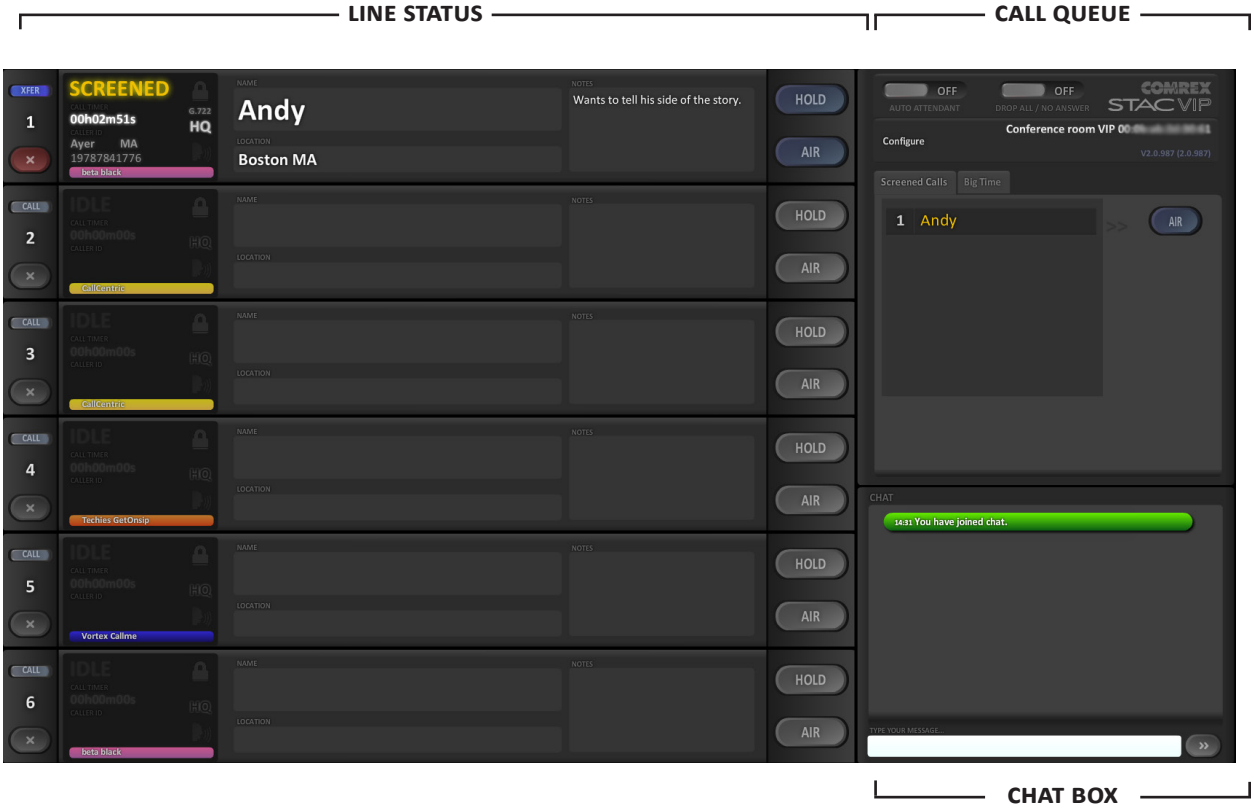


FIGURE 20 **WEB CONTROL INTERFACE**

The heart of the control system for STAC VIP is the STAC VIP Web GUI Interface served by the mainframe. This web page is delivered to browsers when they key in the IP address of the STAC VIP mainframe. The STAC VIP Web GUI Interface is rich and animated, and requires the user install a recent version of **Adobe Flash Player** into their Internet browser.

The control page (Figure 20) is divided into three distinct sections; the largest is **Line Status**, where each of the available phone lines is given several status fields. The field in the upper right is the screened **Call Queue**, indicating the calls that in the screened state and the order they will be put on-air with the master **AIR** button. On the lower right is the **Chat Box**, allowing anyone logged into the STAC VIP Web GUI Interface to chat between themselves.

LINE SECTION

The line section consists of a status bar for each line supported by STAC VIP.

The leftmost section of the lines (with the line number) has two controls:

1. The call button allows you to initiate an outgoing call on that line (if enabled in the Web-based Config Utility).
2. The drop call button (**X**) ends any activity on that line and sets the line back to idle mode.

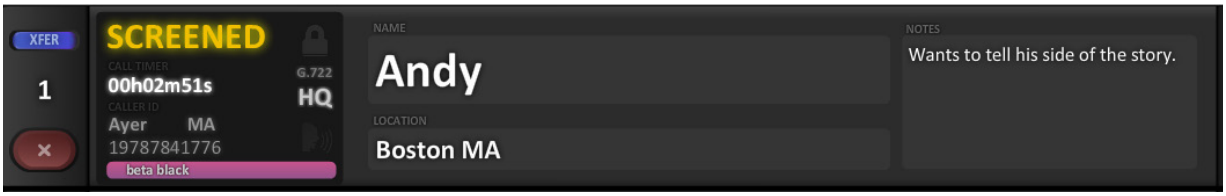


FIGURE 21 **LINE STATUS DETAILS**

The next box to the right (Figure 21) shows detailed status of each line. There are several fields:

1. **STATUS** - Calls on STAC VIP are treated as being in six different states that are reflected in the line status field:
    a. **IDLE** - No active incoming or outgoing call on this line.
    b. **RINGING** - A caller is trying to ring in but the call is not yet answered.
    c. **DIALING** - A call has been placed from the system but not yet answered.
    d. **ON-HOLD** - The call has been placed on hold, and the caller can hear hold audio, but has not yet been screened.
    e. **SCREENED** - The caller has been screened via a control surface and is waiting to be put on-air.
    f. **ON-AIR** - The call is currently routed to one of the hybrids and audio is routed to the send and caller ports.
2. **CALL TIMER** - This timer starts when an incoming line starts ringing, and continues to count up whether on-hold, screened, or on-air until the call is ended. It helps you manually determine which calls should be given priority (this is done automatically by the Hold Queue).
3. **CALLER ID** - This field displays whatever is in the incoming calls Caller ID field. In the **Config** section, you can set STAC VIP to populate the screener name filed with this value also.
4. **Lock Icon** - If lit, this signifies that the line has been “locked” on-air, and subsequent calls will be conferenced with this call.
5. **HQ Icon** - If lit, this call is being presented in fidelity better than normal telephone sound. G.722 and iSAC calls qualify as HQ. Above this icon, a technical description of the codec used will appear during a call.

6 **Speaker Activity Icon** - When lit, this signifies that this caller is currently generating audio.

7 **Provider Status Bar** - This colored bar indicates which provider a line is currently assigned to, and the status of registration to that provider.

8 **Screener Entry Fields** - The three fields to the right of the status info box allow text input from a screener once a call has been answered. Caller ID can be configured to populate the name filed automatically. The screener can edit that name (if present) and can add info in the location and notes fields, to be visible by all viewing the page.

OTHER SECTIONS

Besides the **Line** sections, there are five other sections of the control page:

1 **AUTO ATTENDANT ON/OFF** - This controls whether incoming ringing lines are answered automatically, and (optionally) an outgoing greeting is played out to the caller before placing them on-hold.

2 **DROP ALL/NO ANSWER** - This control will put all lines in a state where they will not reflect incoming calls. Any calls on-hold or on-air will be disconnected (the behavior of on-air calls is adjustable). When the function is disengaged, all ringing lines will be rejected and new calls can be taken.

3 **SCREENED CALLS** - When a call enters screened state, the call will appear in this queue, ordered with the call with the longest timer value at the top. The call will be identified by the screener name field. This allows the top call to be put on-air via the master on-air button to the right. You can reprioritize calls in this queue by dragging the top calls to a lower position.

4 **Big Time** (This tab can be selected to replace screened calls) - This section provides a handy network-synched clock readout. There's also a count-up timer that can be shared with anyone else logged in to the STAC VIP Web GUI Interface.

5 **Chat Window** - To facilitate chat between users of the interface, a chat box is provided. Everyone viewing the page can see all chat. Chatters are identified by their login names.

XII. GENERAL OPERATIONAL NOTES

OUTGOING CALLS

It is assumed that outgoing calls placed via the STAC VIP Web GUI Interface need a way for the callers to communicate, so these calls are routed directly to on-air state once the call is established. This way the called party can be spoken to through the send and heard through the caller ports on the mainframe.

Outgoing calls can be made to phone numbers or SIP URIs (e.g. **quarterback@football.net**). Usually, SIP URLs are the only way to place outgoing wideband calls. Note that since the control surfaces have no text input, the STAC VIP Web GUI Interface is the only way to make outgoing calls to non-numeric places. Some SIP providers require a leading "**1**" ahead of the outgoing numeric number in this field, some don't. You'll need to experiment or contact your provider for this information.

HOLD VS. SCREENED

On control surfaces, there is a straightforward difference between calls that have been put on-hold and calls that have been screened (the screener has had a pre-chat with the caller). Since the STAC VIP Web GUI Interface has no handset, calls must be screened in the on-air state, (e.g. while the mainframe outputs are in a CUE position on the studio console). But the control surface function of the distinction is maintained—putting a call on-hold once places it in on-hold state, and placing it on-hold again (or clicking on-hold a second time) places it into screened state and into the screened queue.

ON-AIR LOCKED VS. UNLOCKED

Calls that have been put "**On-Air**" via the STAC VIP Web GUI Interface have two states, "**Locked**" and "**Unlocked**". An unlocked call will be dropped when the next line is selected. This is typical of a call-in show with only one caller at a time. Locking calls is the only way to conference more than one caller at a time - by clicking the "**Air**" button for that line a second time, a "**Lock**" icon will appear in the call status box to the left. Locked lines will remain on-air until intentionally disconnected via the "**Drop**" button (**X** on the control page).

XIII. TRANSFERRING CALLS WITH STAC VIP

STAC VIP has the capability of transferring calls to other phone numbers, SIP addresses, and PBX extensions. This can be accomplished through the STAC VIP Web GUI Interface or through the Control Surface.

As shown in Figure 22, the outgoing “call” button on each line becomes a different function when a call is active (whether “on-hold” or “on-air”). The “**XFER**” button enables a slide-out field that allows the user to input a transfer destination.

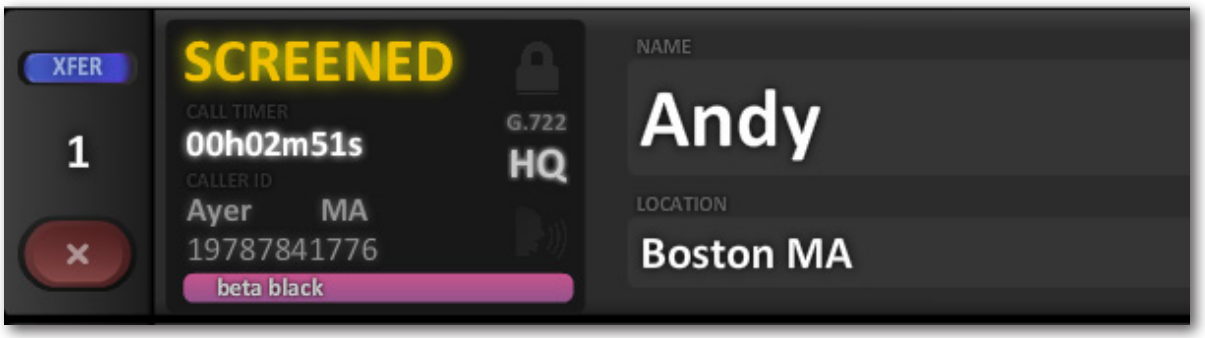


FIGURE 22

The destination field requires the full SIP address of the transfer destination. This means the full SIP URI in the form of **<user@domain>** (e.g. **techies@comrex.com**). It is possible to “pre-program” the domain field within the configuration settings so the domain portion is always assumed, and it need not be included in the transfer address.

The configuration settings that affect how transfers work are tied to the provider/Gateway/PBX settings in the **Config** menus. This means any settings made will be global to all lines assigned to that provider.

Figure 23 shows the settings available in the **Provider Settings** menu. Note these are located under "**Extra Settings**" and are only visible when "**Show Advanced**" is selected.

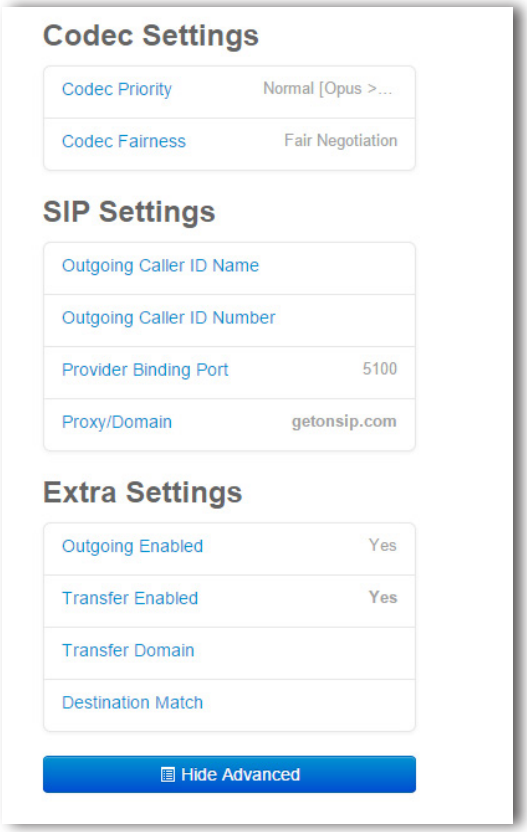


FIGURE 23

First, you must have outgoing capability enabled on any provider from which you wish to transfer. Second, "**Transfer Enabled**" should be set to "**Yes**" (default is **No**). Finally, if your call transfers will usually go to the same domain (e.g. a PBX) you can set the domain in the "**Transfer Domain**" field. If no domain is used in the Control page "**XFER**" field, this domain will be used.

As an example, if STAC VIP is configured as a PBX extension (e.g. ext 5000), with the PBX domain as **<192.168.1.200>**, you could put that domain into the **Transfer Domain** field. During operation, if the STAC VIP Web GUI Interface user "**XFER**"s a call to **5001**, the transfer will happen to **<5001@192.168.1.200>**.

If the **Transfer Domain** field is populated, and a domain is used in the "**XFER**" address (i.e. if an @ sign is used in the "**XFER**" destination), the **Transfer Domain** config field is ignored.

It is also possible to transfer calls from the Control Surface when transfer mode is enabled. Calls can only be transferred from the control surface when they are active on that surface's handset (green light active for the channel).

As described above, you must have a transfer domain set in the system in order to transfer via handset (because the handset has only numeric keys). Once the call is active on the handset, pressing "**CHANGE PRIORITY**" will put that line in "transfer" mode and deliver a special dial tone. Key in the numeric extension number on the Control Surface keypad, followed by "**SEND**" (#) to transfer the call. Pressing the "**CHANGE PRIORITY**" button anytime before "**SEND**", or dropping the handset will end "transfer mode" and the call will be dropped.

XIV. SPLIT STUDIO MODE

INTRODUCTION

Split Studio mode is a special mode of STAC VIP, allowing it to serve two separate studios with very little interaction between them with regard to configuration and use. As shown in Figure 24, each studio uses its own audio port for **SEND IN**, **HOLD AUDIO IN**, and **CALLER OUT**.

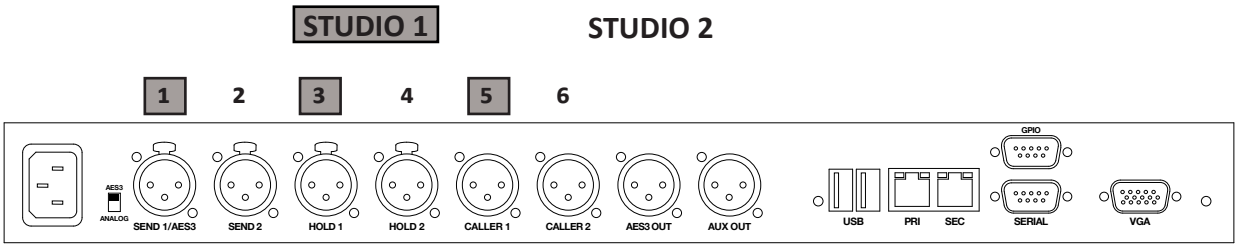


FIGURE 24

It is important not to confuse the functions of Primary and Secondary Ethernet in this mode. When Split Studio mode is engaged, the STAC VIP mainframe shares both the Primary and Secondary Ethernet port with both studios, and each of the services enabled on each port is enabled for both studios.

As an example, if the secondary Ethernet port is configured as the port on which to attach control surfaces, all control surfaces for both studios must be attached to Secondary.

In Split Studio mode, two separate STAC VIP Web GUI Interface pages are presented. Within each control page, the "**Config**" link opens a global configuration page that affects the settings for both studios. New options appear on the **Config** page to direct specific configurations to Studio 1 or 2. This is outlined in Figure 25.

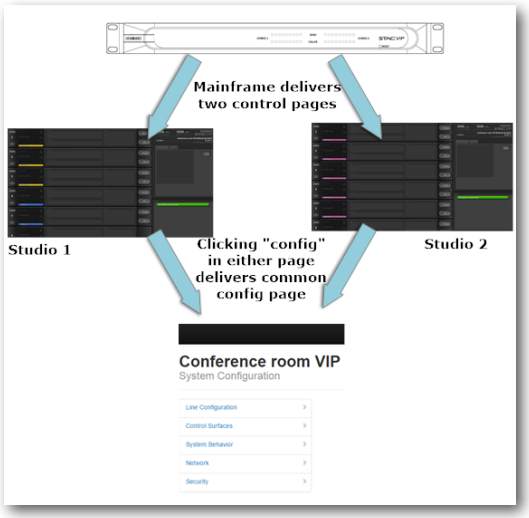


FIGURE 25

Within the **Global Config** page, you will set up Providers, Gateways, and PBXs the same way as described in **Section IV**. These providers will be available for line assignments in either studio.

ACTIVATING SPLIT STUDIO

Split Studio mode is a licensed feature. The license is applied to your STAC VIP mainframe via the Windows or MAC-based **Device Manager**. The license will automatically allow for usage of twelve phone lines, six on each studio. Single studio operation can only be restored by removing the Split Studio license via **Device Manager**. Single Studio twelve line licenses should be removed before applying Split Studio.

More information on using **Device Manager** can be found on the Comrex website, as well as in the **Device Manager Help** menu.

CHANGES TO CONFIG OPTIONS IN SPLIT STUDIO MODE

USER ACCOUNTS

User accounts, as described in **Section VIII**, are now assignable exclusively to each studio, or can be made global as shown in Figure 26.

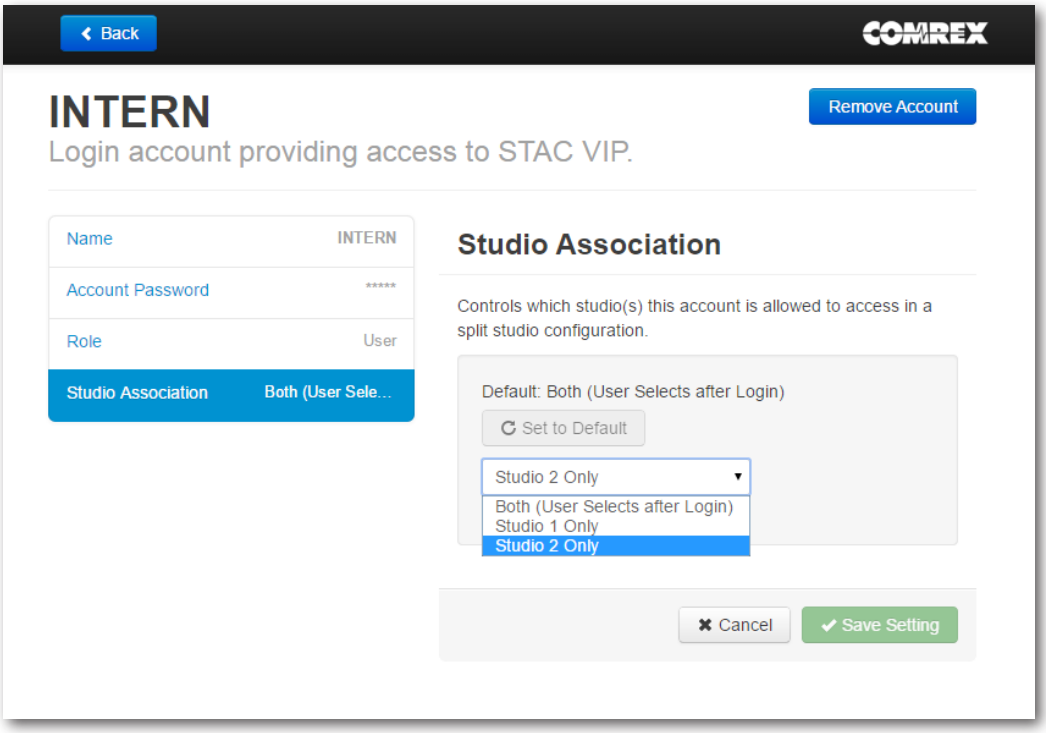


FIGURE 26

If the user account is global, the user will be prompted at login time which studio he wishes to access.

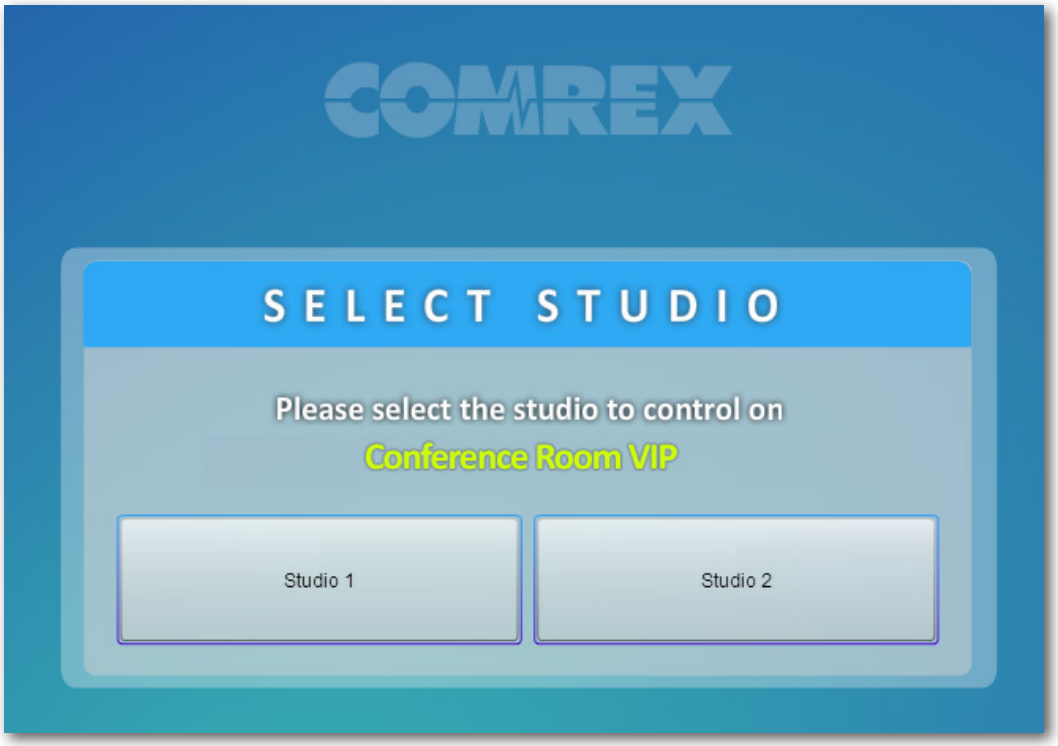


FIGURE 27

LINE SELECTION

As shown in Figure 28, there are now two categories of line selection in the **Config** menu, allowing accounts to be selected between the two studios.

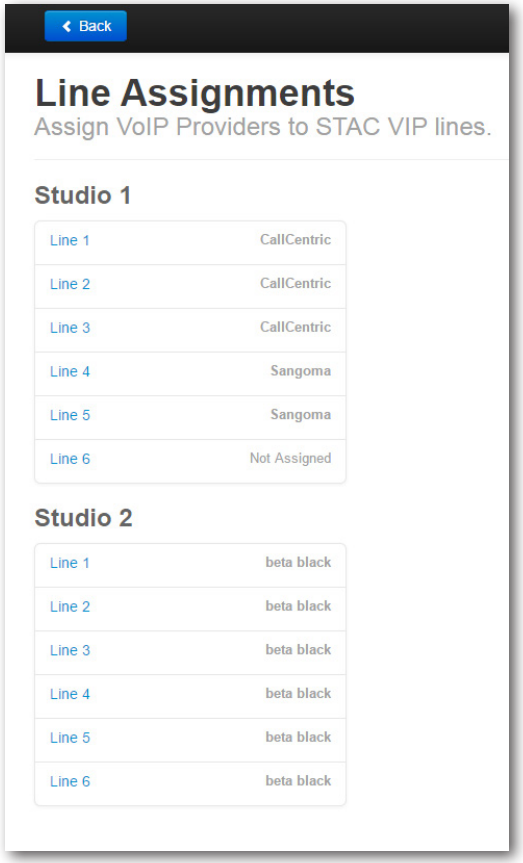


FIGURE 28

CONTROL SURFACES

As shown in Figure 29, a new entry appears in the **Control Surface** setup menu, allowing each surface to be selected for a specific studio.

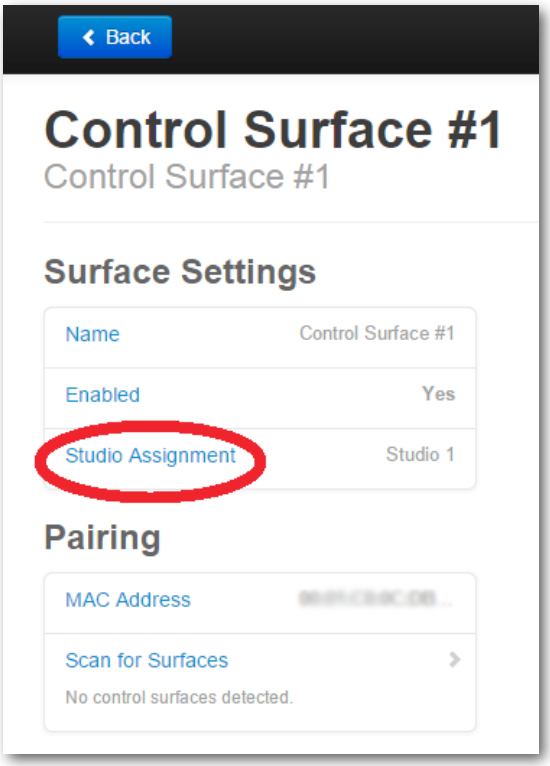

Back
Control Surface #1
Control Surface #1
Surface Settings
Name
Control Surface #1
Enabled
Yes
Studio Assignment
Studio 1
Pairing
MAC Address
Scan for Surfaces
No control surfaces detected.

FIGURE 29

AUTO ATTENDANT

Auto Attendant for each studio is handled independently, and each studio has its own settings in the **System Behavior** menu.

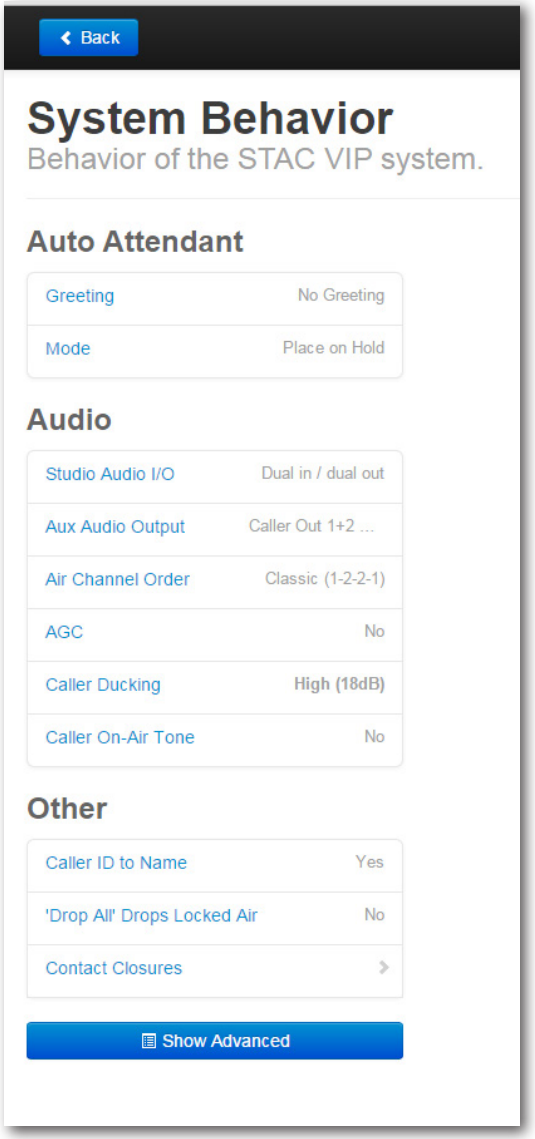


FIGURE 30

OTHER CHANGES

As shown in Figure 30, several options available under the **System Behavior** menu change with Split Studio activated.

1. **Studio Audio I/O** (options to use more than one input/output) is disabled, because each studio now has only a single audio I/O port.
2. **Air Channel Order** (options to assign calls to hybrids in a specific order) is disabled, because each studio now has only a single hybrid.
3. An entry appears to give each studio a unique name, that will appear in the **Studio Select** page and elsewhere.
4. New options appear in the **Contact Closure** menus to select closures to activate on activities of a specific studio. (Figure 31)

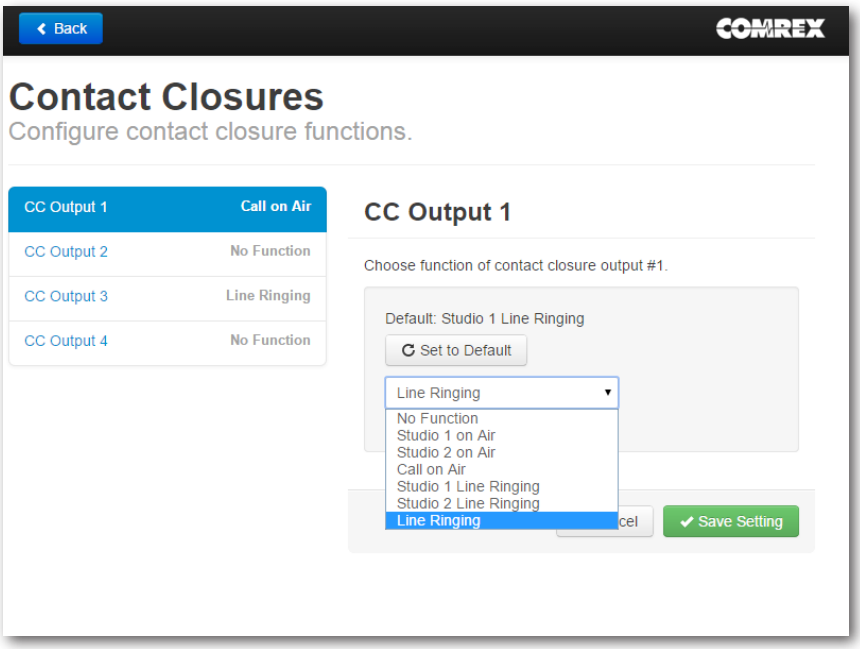


FIGURE 31

All other entries in the **System Behavior** menu are global. It is not possible to set independent AGC, Caller Ducking, "**Caller ID to Name**" or "**Drop All**" settings for each studio.

XV. INFORMATION FOR IT MANAGERS ABOUT STAC VIP

MAINFRAME

STAC VIP mainframe is an embedded Linux-based device with dual 10/100/1000Base-T Ethernet ports.
The device contains an optimized version of the Linux kernel (at this writing, 3.12). The IP parameters are set using a GUI that requires attachment of a keyboard and VGA monitor to the device.

Alternately, during the first five minutes of power up, the IP parameters may be set by a PC on the local LAN using a proprietary broadcast UDP protocol. Comrex provides the **Device Manager** software to perform this function on the local PC. After five minutes of operation, this function is disabled.

The device runs several services on different ports, outlined here:

INCOMING SERVICES

The device hosts a combined HTTP/XML service on **TCP 80**. If this service is needed outside the firewall, the port will need to be routed to the mainframe.

Firmware updates to the device are installed using the **Device Manager**. This update process is password protected and done via XML over **TCP port 80**. In addition to the password protection, the update data itself must have a valid cryptographic signature from Comrex, or else it is rejected. In order for the unit to be remotely updated, **TCP port 80** must be forwarded to the device. Alternately, updates can be initiated from any local PC using the **Device Manager** software.

The device can support connection to a SIP trunking service, which would require incoming service on a single UDP SIP port (usually **5060**) and two UDP RTP ports in the range of **16384-16432**.

The device can support connection to a registered SIP service. In this case, the UDP SIP connection will be outgoing and the two UDP RTP ports will be incoming in the range of **16384-16482.**

Typically, SIP services rely on the presence of a SIP ALG within the firewall to open RTP ports.

The device will host a SIP connection to its control surface accessories over **UDP 5070** and RTP streams in the range of **UDP 16384-16482**. Connection to control surfaces outside the LAN subnet is not currently supported.

If Comrex support is required, we may ask for access to the SSH host on the mainframe on **TCP 22**. SSH service is protected by a private keypair which is not delivered to customers. SSH service can be disabled in the setup menu.

OUTGOING SERVICES

As described above, the mainframe will make outgoing connections to register with SIP providers (usually to port **UDP 5060**) combined with incoming and outgoing RTP in the range of **UDP 16384-16432**.

An NTP client is implemented by default to **UDP 123**.

The mainframe syncs by default to a Comrex cloud server at **TCP 8090**. This is currently not required for normal operation.

SIP connection attempts will sometimes make external STUN connections to **UDP 3478**.

Ports TCP and UDP 53 are utilized for DNS lookup.

CONTROL SURFACES

STAC VIP Control Surface is an embedded Linux-based device with a 10/100Base-T Ethernet port.
The device contains an optimized version of the Linux kernel. It generally works in DHCP mode.

If static IP addressing is required, during the first five minutes of power up the IP parameters may be set by a PC on the local LAN using a proprietary broadcast UDP protocol. The broadcast protocol is also utilized by the mainframe to locate the control surfaces at configuration time. Comrex provides the **Device Manager** software to perform this function on the local PC. After five minutes of operation, this function is disabled.

The device runs a SIP client that makes outgoing connections to its mainframe **UDP 5070**. It also establishes incoming and outgoing RTP connections to the range of **UDP 16384-16484**.

XVI. CONTACT AND SUPPORT

Comrex Corporation
19 Pine Road
Devens, MA 01434
USA

Technical Support is available Monday-Friday 8:30AM-5PM EST.
1-800-237-1776 (North America)
1-978-784-1776 (International)
1-978-784-1717 (FAX)

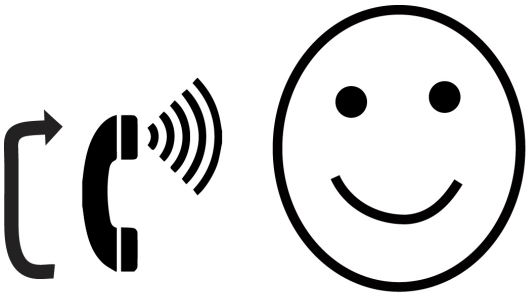
email techies@comrex.com

Product manuals and firmware updates available on the web at:
http://www.comrex.com

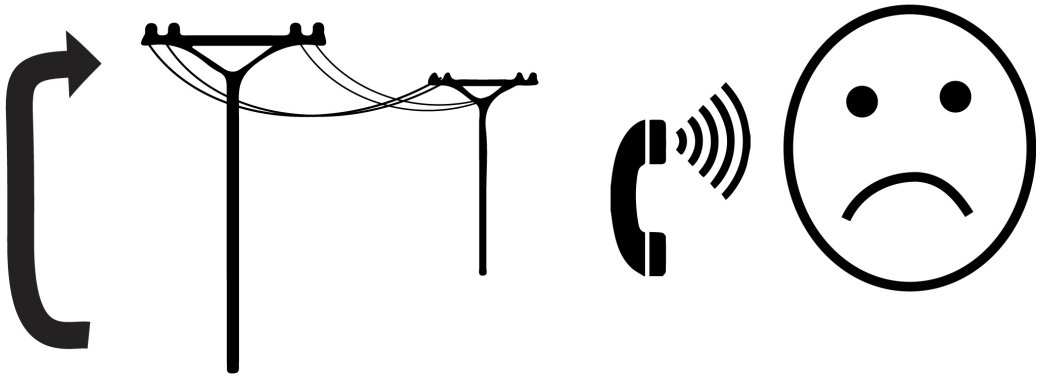
XVII. WHY DO I HEAR HEAR MYSELF MYSELF?

MIX-MINUS AND ELIMINATING ECHO

Studio telephone integration is a two-way process. The caller must send his audio to the studio, but also receive a return feed that allows him to interact with other sources, like a host. An important element of voice telephony involves allowing a speaking party to hear his own voice in his own earpiece. This sidetone provides a speaker the comfort of knowing his voice is getting through, and makes two-way communication flow more easily.



Sidetone created within a telephone has no delay
and makes conversation easier



Sidetone created on the far end of a call has delay
and makes conversation difficult

But for several reasons, telephone sidetone is always generated locally within the speaker's equipment, rather than on the far end of the call. This is because humans have a very hard time handling even the smallest delay in this sidetone signal. In testing, we find that any delay over around 10mS starts to have an effect called "slapback" where the speaker is unable to maintain conversation and begins to halt and stutter.

Even in “old-fashioned” analog telephone circuits, it’s possible to create a 10mS round-trip delay on a long distance call. Now add in the requirement that modern VoIP-based systems have inherent windowing and buffer delays, and its easy to pile up over 100mS round-trip on a call. A delay of this length will typically not impede interactive conversation, but will certainly create an intolerable “slapback” environment if the caller hears his own voice delayed.

The telephone network employs digital echo cancellers at various nodes along the path of a phone call to avoid this scenario. And when they malfunction or are “untrained” at the start of a call, the effect is a dramatic echo in the caller’s ear.

Many users installing a studio-based phone system for the first time make the mistake of applying audio to the outgoing “send’ port that contains the main program feed - the same audio used to feed the transmitter or webstream. Since this mix contains the caller’s own audio, and there’s an inherent delay in modern digital systems, the “slapback” effect is immediate.

The solution here is mix-minus-- a term used for a special mix of audio that explicitly excludes one source--the audio coming from the place the mix-minus is being sent. To put it another way, mix-minus is the entire studio mix minus one audio source.

So how do we create this special audio mix? On modern studio systems, this is usually well defined and easy to do. Many consoles feature channels dedicated to telephone interface, and part of the channel is an automatically-created mix-minus output.

In less full-featured consoles, a mix-minus can often be created with an auxiliary or “audition” bus function. By selecting all relevant incoming sources on the bus except for the telephone fader, you can do this easily. Figure 32 shows the block diagram of a single mix-minus feed being generated on a mixing console.

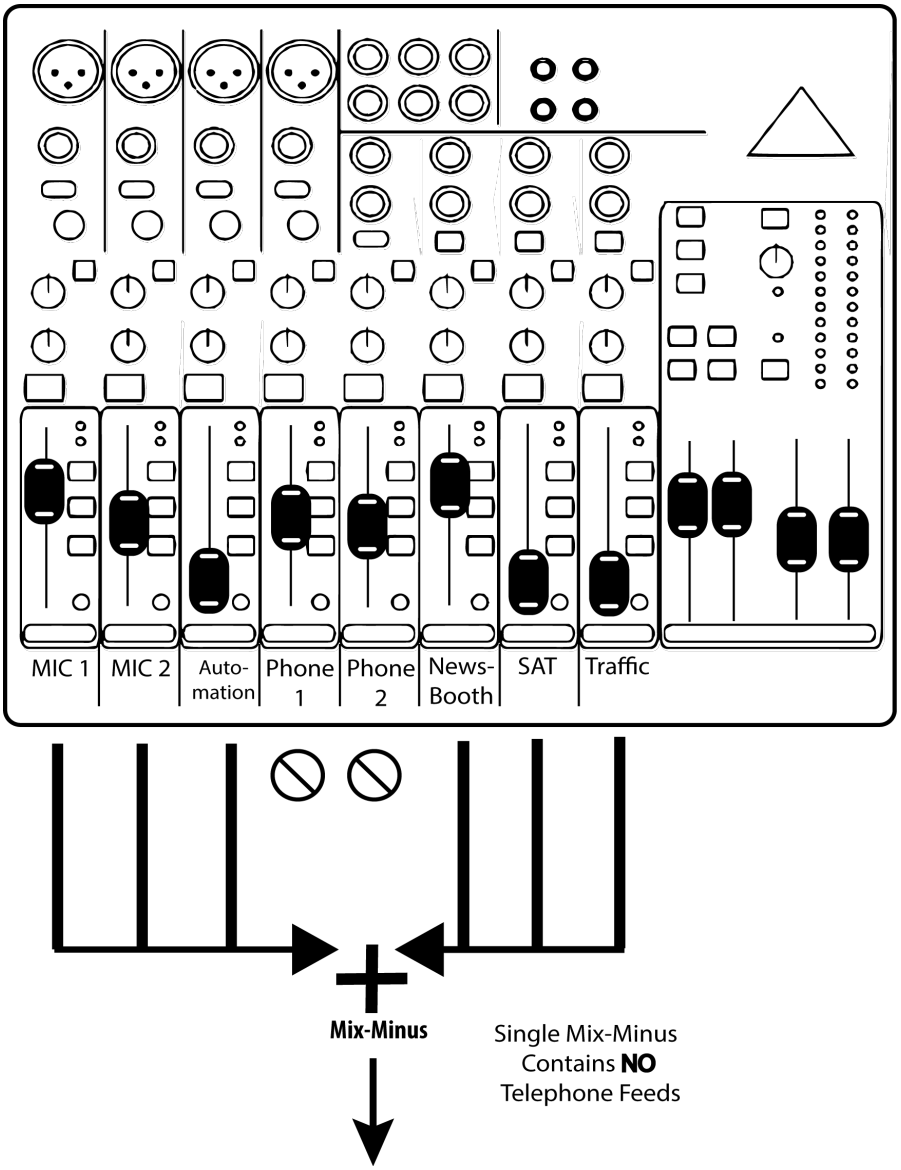


FIGURE 32 **SINGLE MIX-MINUS NO TELEPHONE FEEDS**

In some environments, it's only important that the caller hear the in-studio host, and less urgent that the on-air caller be able to hear automation, news reports, codecs etc. It's possible that simply routing an amplified version of the studio microphone signal to the "send" input will meet those needs.

Some studio telephone systems, like Comrex STAC VIP, allow telephone callers to appear on one of two outputs (and therefore on two, separate console faders). In this circumstance, you often have a choice of delivering a single mix-minus with neither of the telephone audio sources present, or two distinct mix-minus feeds. In the case of two feeds, it's important to note that mix-minus A must include the caller audio B and vice-versa. Figure 33 illustrates this concept. Many consoles with dual telephone channels are designed to work this way, and should deliver the correct set of mixes automatically.

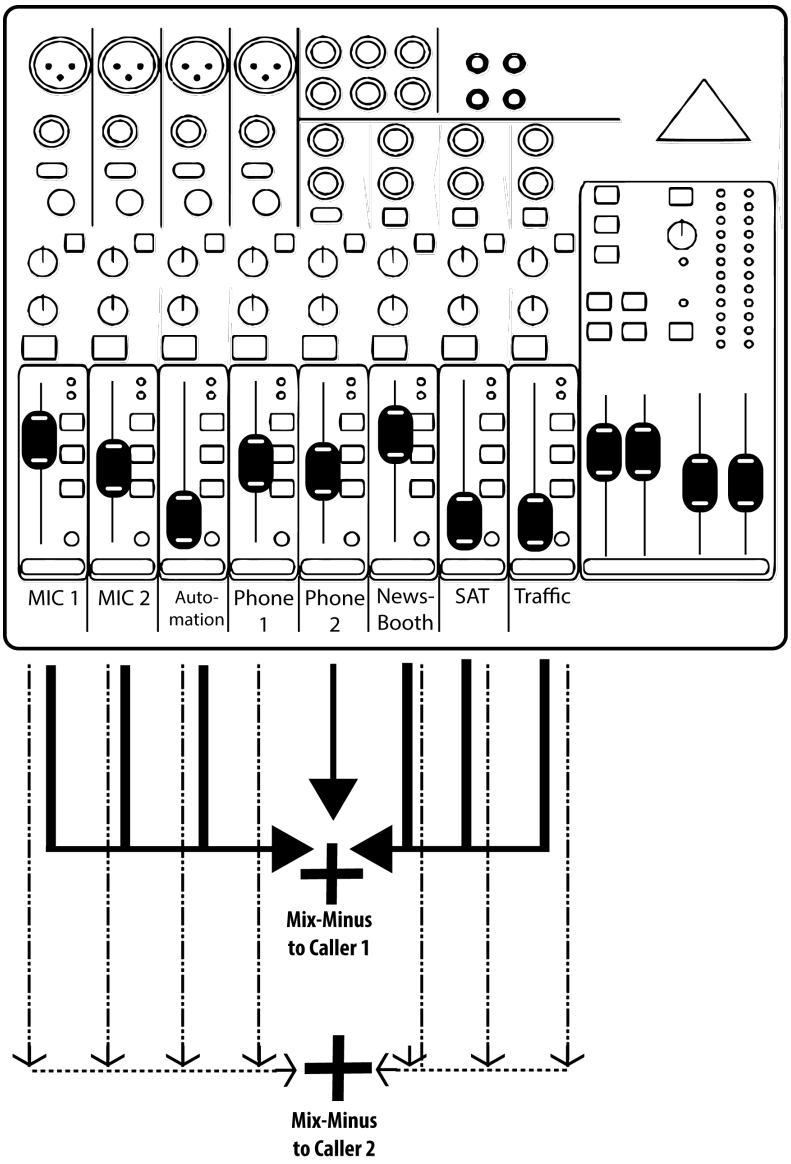


FIGURE 33 **TWO MIX-MINUS FEEDS**

XVIII. SOFTWARE LICENSES

STAC VIP contains both proprietary and open source software. All proprietary portions are **Copyright © 2012 Comrex Corporation, all rights reserved**.

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