Telestra Training Manual

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Product Name: Telestra

Telestra Training Manual

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Revision history

Date	Revision	Version	Comments
10/26/2018	G	0	(7.15.0) Converted Telestra Training Manual to XML. Updated screenshots, and edited content for grammar and style. Updated licensing content for USB License Keys.
1/9/2019	G	1	Updated the **Licensing Management** screenshot in "Install a USB License Key."
7/26/2019	H	0	Formatted entire document and edited it for grammar and style. Clarified several unclear sections.
3/8/2023	H	1	Added Red Hat Enterprise Linux subscription and export statement to the front matter.

Contents

1.0 Introduction

ASTi's Telestra suite of products provides comprehensive sound and communication simulation software and equipment. With a wide range of capabilities and scalable solutions, Telestra products meet complex, high-fidelity, network distributed applications in today's training environments. This training course familiarizes you with Target and Studio hardware, the Remote Management System (RMS), and ACE Studio software.

This document discusses how to:

- Hardware overview
- Protocols, services, and networks
- Telestra concepts
- Software
- Model services
- Host Interface
- Remote Management System
- ACE Studio model building
- Advanced topics and examples

2.0 Hardware overview

Figure 1, "Hardware layout" below displays a typical system hardware setup. This system varies in complexity from program to program.

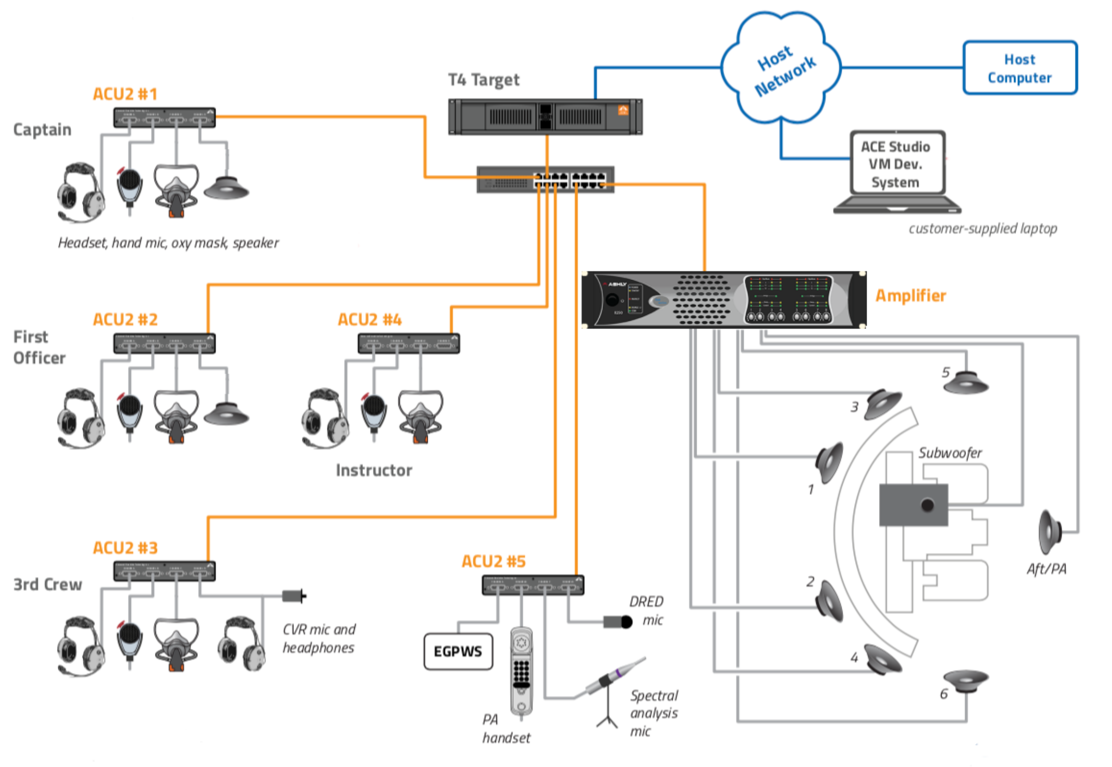


Figure 1: Hardware layout

This chapter discusses the following topics:

- ACE Studio
- Audio distribution devices

2.1 ACE Studio

ACE Studio is available on an ASTi Telestra platform with a removable hard drive or as a software-only application that runs on a virtual machine on a customer-furnished computer. ACE Studio is a suite of software tools that incorporates the following:

- Sound and communication model development
- Project management
- Communications monitoring and fault analysis
- Equipment status and configuration

ACE Studio software provides remote access to all networked simulation models and equipment from a single development workstation. For more information about ACE Studio, go to the *ACE Studio User Guide* (support.asti-usa.com/media/pdf/t4/ace_studio_ug.pdf).

2.2 Audio distribution devices

This section discusses the following topics:

- ACU
- ACU2
- ACE-RIU
- Ashly Power Amplifier
- Peripherals

2.2.1 ACU

The ACU is an audio and input/output (I/O) remote interface for the Telestra suite of products. The ACU provides the Analog-to-Digital/Digital-to-Analog (AD/DA) conversion. All audio and I/O is digitally distributed between ACUs and Targets for maximum noise rejection and reliability. This unit may be connected directly to the Target or more typically through an ASTi-approved ACENet switch.

The Remote Management System (RMS) performs ACU firmware software updates and gain configuration. The hardware is available in a 1U (19-inch) two, four, and six-channel rack-mount configuration. Multiple Targets can share ACU channels when using a four or six-channel ACU; however, the channels are grouped A/B, C/D, and E/F. Different Targets cannot share two channels in a grouping.

The platform components consist of the following:

- Independent, software-configurable audio inputs and outputs (one per channel)
- Control inputs (three per channel)
- Digital outputs (one per channel)
- RS-422 serial ports (one per channel)
- 48 kHz digital audio distribution
- Two, four, or six DB-15 connectors

Figure 2, "ACU front panel" below and Figure 3, "ACU rear panel" below shows ACU rear and front panels:

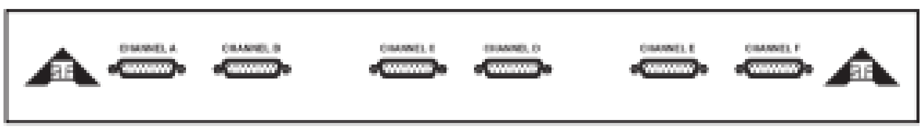


Figure 2: ACU front panel

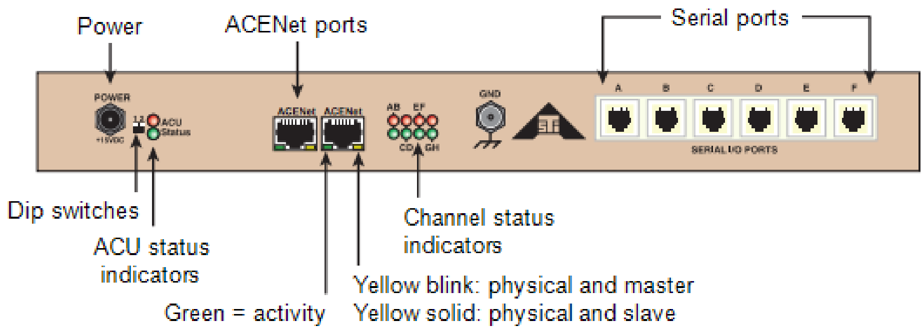


Figure 3: ACU rear panel

For ACU pinout diagrams, go to the *ASTi ACU Technical User Guide* (support.asti-usa.-com/media/pdf/acu_ug.pdf).

2.2.2 ACU2

The ACU2 audio and I/O distribution device features stereo operation for independent left and right output support on a single connector, a reduced footprint that can fit on a desktop. Two units can also fit in a 1U 19" rack space, or it accommodates a convenient power daisy chain connection for two units. The ACU2 has a sample rate of 48 kHz, ensuring high-fidelity audio processing with adjustable amplifier or preamplifier gains and microphone power.

The ACU2 includes the following features:

- Four stereo audio outputs
- Four mono audio inputs
- Independent, software-configurable audio inputs and outputs
- Control inputs (three per channel)
- Digital outputs (one per channel)
- RS-422 serial ports (two per channel)

Figure 4, "ACU2 front panel" below and Figure 5, "ACU2 rear panel" below show the ACU2 front and rear panel:

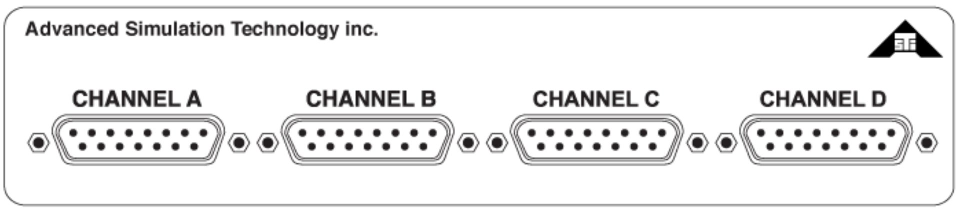


Figure 4: ACU2 front panel

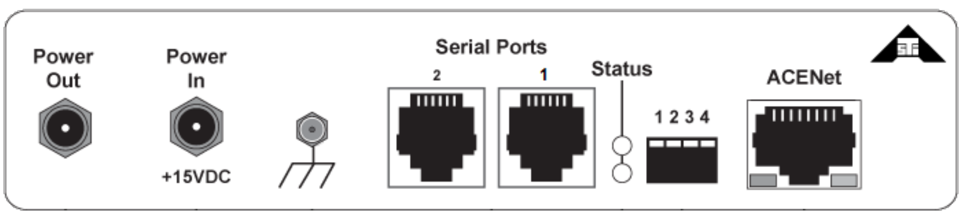


Figure 5: ACU2 rear panel

2.2.3 ACE-RIU

The ACE-RIU is a compact interface module based on digital signal processing (DSP). It connects remote operator headsets, speakers, and control panels to a central Target via ACENet architecture. The ACE-RIU provides low-noise analog-digital conversion and low-latency distribution. The ACE-RIU has a sample rate of 48 kHz, which ensures high-fidelity audio processing. The hardware is available with a 19”, 1U high rackmount kit, and each kit holds three ACE-RIUs.

The platform components consist of the following:

- Digital inputs (one per channel, four channels total)
- Digital outputs (one per channel, four channels total)
- RS-422 serial ports (two per channel)

Figure 6, "ACE-RIU front panel" below and Figure 7, "ACE-RIU rear panel" below show the ACE-RIU's front and rear panels:

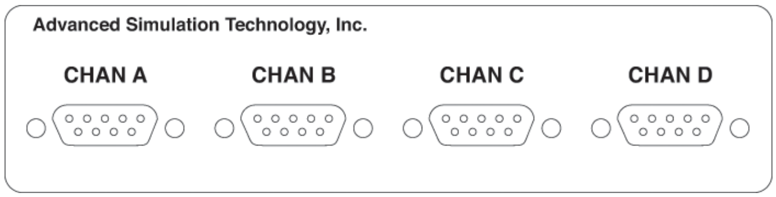


Figure 6: ACE-RIU front panel

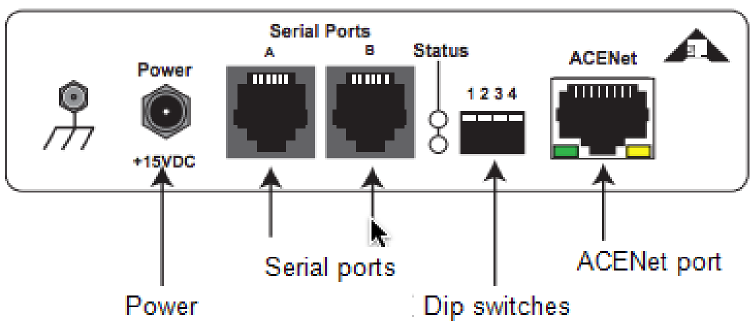


Figure 7: ACE-RIU rear panel

For more information about the ACE-RIU, go to the *ACE-RIU Technical User Guide* (support.asti-usa.com/media/pdf/acenet_ug.pdf).

2.2.4 Ashly Power Amplifier

The Ashly Power Amplifier provides power levels and features that meet the audio requirements for aural cue simulation. Each amplifier is a network component that integrates with ASTi's ACENet architecture. ASTi offers a four-channel amplifier and an eight-channel amplifier, both in a 2U chassis. This platform is for audio output only; customers generally use it for aural cue programs.

The platform components consist of the following:

- Two Ethernet ports to the 1000 Megabits per second (Mbps) network (one used)
- One data port to the 1000 Mbps network
- Four or eight output connectors, depending on the platform
- Mode switches for every two channels
- Channel level controls providing gain control
- Four or eight input connectors, depending on the platform purchased

***Note**: The input connectors are not used in the ASTi system setup.*

Figure 8, "Ashly Power Amplifier front panel" below and Figure 9, "Ashly Power Amplifier rear panel" below show Ashly Power Amplifier rear and front panels:

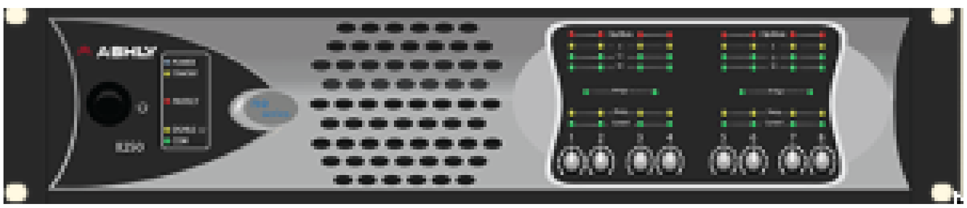


Figure 8: Ashly Power Amplifier front panel

Figure 9: Ashly Power Amplifier rear panel

2.2.5 Peripherals

In addition to Telestra audio hardware, ASTi also offers audio peripherals and user interfaces that connect to the equipment:

- *Headsets, microphones, and speakers*
- *Press-to-talk (PTT) devices*
- *Touchscreen tablets:* the generic solution for a radio control panel. ASTi provides custom software models.
- *Handheld terminals (HHTs):* a highly flexible solution to multioperator simulation requirements.

Figure 10, "Telestra peripherals" below shows Telestra peripheral hardware:

Figure 10: Telestra peripherals

For details about options, pricing, and ordering, go to ASTi Telestra Support (support.asti-usa.com/telestra/index.html).

3.0 Protocols, services, and networks

Models can connect to the protocols in ACE Studio using helpers. Simulated networked radios use standards such as ASTiNet, DIS, or HLA:

- DIS is a simulation standard that uses defined protocol data units (PDUs) to pass data between two sites.
- Simulated radio communications use DIS protocols for transmitter, receiver, and signal PDUs.
- HLA is a flexible simulation architecture managed by a run-time infrastructure.
- ASTiNet is an ASTi-proprietary protocol that provides communication networking for Target-to-Target operation and other ASTi-approved products.

In ACE Studio, **Domain Editor** provides the ability to set parameters for the standards.

Figure 11, "Network overview" below shows a network overview of Target protocols, services, and networks:

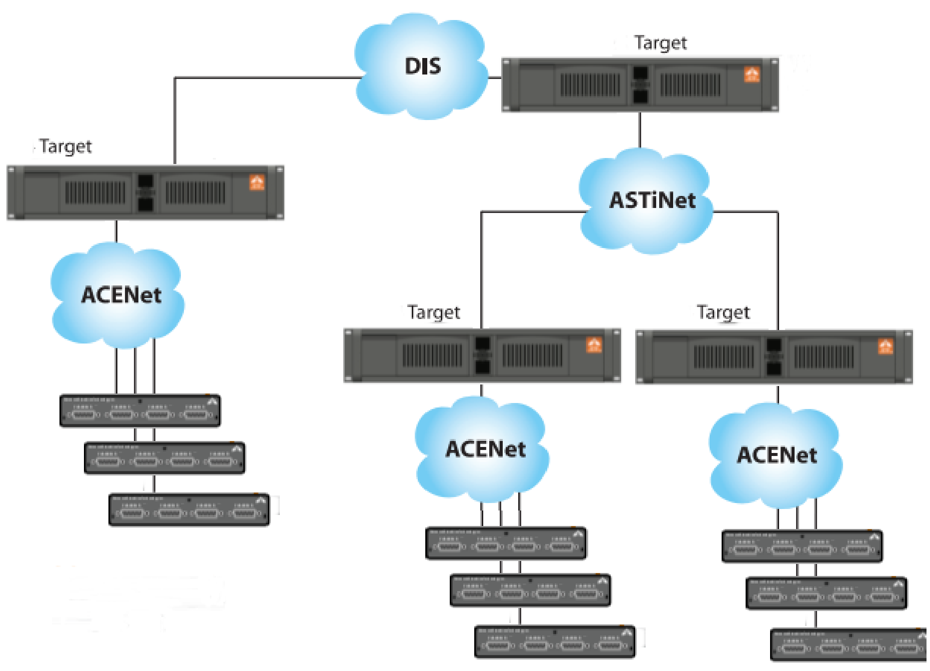


Figure 11: Network overview

This chapter discusses the following topics:

- Abstraction of protocols
- ACENet
- ASTiNet
- DIS
- HLA
- Future protocols

3.1 Abstraction of protocols

ACE Studio develops models independently of network protocols. Set up the network outside of the model. The domain acts as a gateway that maps protocols to the model, making it available to the outside world.

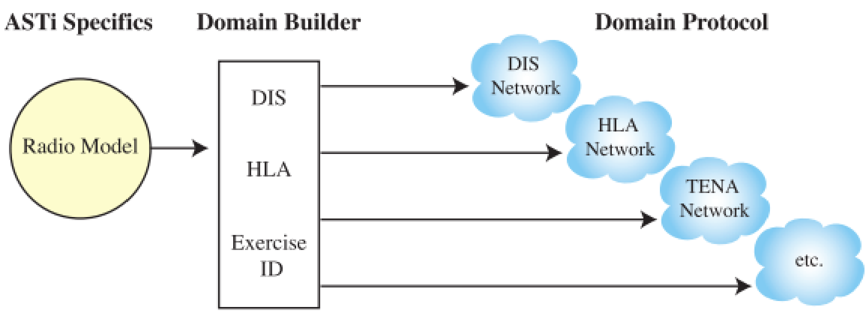


Figure 12: Layers of abstraction

3.2 ACENet

The Audio Communications Environment Network (ACENet) is part of ASTi's latest-generation Telestra product family. It provides a low-latency, network-based audio and I/O distribution architecture for ASTi's ACE communications and sound modeling equipment and software. This flexible architecture provides a highly scalable distribution network of model processing systems and remote audio and I/O interface devices to add multiuser sound and communication applications.

ACENet has a wide array of features:

- *Remote distribution:* network-based, spoke, and hub architecture provides digital audio and I/O distribution across a wide area, hundreds of feet from Target platforms.
- *Ethernet-based:* uses commercial off-the-shelf (COTS) network cabling and ASTi-qualified equipment for easy connection and wide distribution. ACENet always operates on Eth1.

- *Highly scalable:* plugs multiple Target platforms, ACUs, and other ACENet-compatible equipment into a single ACENet network, providing a flexible modeling and distribution capability for applications ranging from a single operator to large, multioperator installations.
- *Flexible audio and I/O:* ACUs provide configurable audio, serial, analog, and discrete I/O interfaces to accommodate a wide range of peripherals, such as military and commercial headsets, audio amplifiers, speakers, microphones, recording equipment, press-to-talk (PTT) devices, simulated communication panels, handheld terminals (HHTs), and other peripheral devices.
- *High-fidelity:* ACENet supports synchronized, 48 kHz digital audio distribution for realistic sound and communication simulation.
- *Low-latency:* closed-network architecture and customized, real-time distribution software means extremely low transport latency, which is essential for realistic simulation and elimination of delay-related audio issues.

Figure 13, "ACENet audio distribution" below shows an example of an ACENet audio distribution:

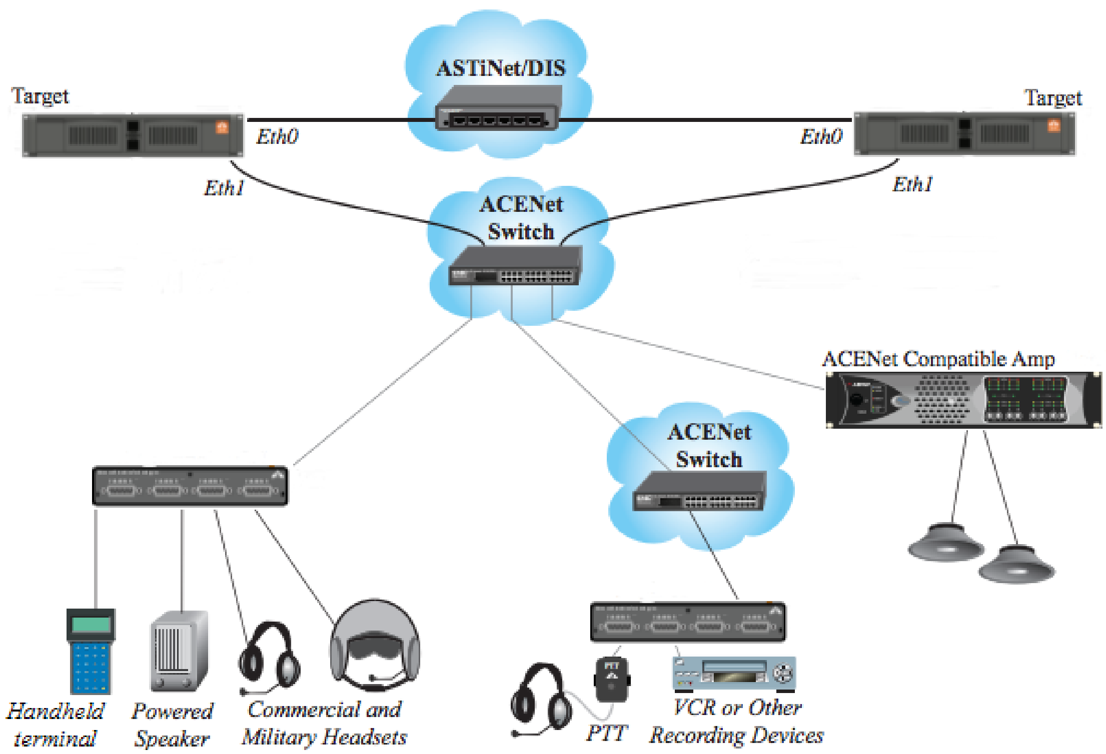


Figure 13: ACENet audio distribution

For a list of ASTi-approved switches and FAQs, go to the *ACENet Technical User Guide* (support.asti-usa.com/media/pdf/acenet_ug.pdf).

3.3 ASTiNet

ASTiNet is an ASTi-proprietary protocol that provides simple and flexible communication networking among Targets and other ASTiNet-enabled products. Some of ASTiNet's features include the following:

- *IPv6-based:* places it in position for use well into the future.
- *Auto configuration:* the IP broadcast and/or multicast addresses do not have to be set, providing a simple, plug-and-play setup.
- *Peer-to-peer:* eliminates the requirement and bottleneck associated with a central server.
- *Voice-over-IP capability:* provides easy setup and use for many-to-many communication mechanisms.
- *Radio simulation:* simple setup for when ease of use is more important than DIS.
- *Flexible message format:* provides extensibility for as-yet unforeseen applications.

ASTiNet is a fundamental networking protocol incorporated in Telestra with device domain configuration, providing support to other protocols, such as DIS and HLA.

3.3.1 Voice over IP (VoIP)

ASTiNet VoIP was designed around the idea of a plug-and-play communication architecture that removes the need for a detailed understanding of the underlying principals of communication. At the heart of ASTi VoIP architecture are the core characteristics that ASTi considered during initial design:

- Easy setup and use
- Point-to-point and conference bridge support
- Based on IPv6, with features such as Quality of Service (QoS) and security
- Minimal configuration requirements for wide area networks (WANs) and firewalls
- Automatic setup when feasible
- Peer-to-peer paradigm (i.e., no single point of failure)
- Features geared toward DoD and the gaming world

3.4 DIS

When the Target is set for Distributed Interactive Simulation (DIS) operation, it connects directly to the DIS network. DIS is a simulation protocol standard developed jointly by industry and the military to enable interoperation of simulation and training devices over local area networks (LANs) and wide area networks (WANs).

One of the more difficult and often underestimated aspects of simulation over LANs and WANs is achieving a realistic radio communication environment. When DIS is active, the Target's local radio and intercom modeling extends over LANs and WANs. Communication simulation between multiple DIS-compatible network devices is invisible with full radio modeling across systems. ASTi supports recent versions of the DIS standard.

During DIS operation, the Target transmits and receives DIS-standard protocol data units (PDUs). Since the Target is involved strictly with communication simulation, it is only concerned with Transmitter, Signal, and Receiver PDUs. The exception to this is Entity State PDUs, which accommodate entity attach features, whereby a radio modeled on the Target is attached to an entity on the network.

3.5 HLA

Unlike many other high-level architecture (HLA) solutions, ASTi implemented HLA from the ground up to fully exploit the flexibility and interoperability of Defense Modeling and Simulation Office's (DMSO's) HLA 1.3 standard. Multiple run-time infrastructure (RTI) support, established and published radio simulation object model (SOM), agile federation object model (FOM) capabilities, back-channel communication options, and debug tools offer a well-supported HLA environment. In addition, ASTi's Target platform takes advantage of high-performance, industrial, off-the-shelf technology to provide increased HLA performance and reliability at a reasonable cost.

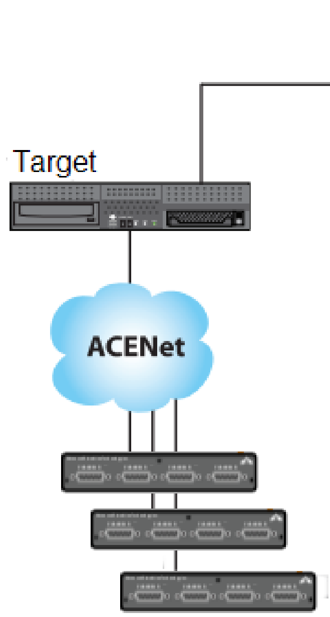


Figure 14: HLA network configuration

3.6 Future protocols

ASTi based its core communication protocol around ASTiNet because it can easily translate to other protocols. Currently, this includes Distributed Interactive Simulation (DIS) and high-level architecture (HLA); however, we are always looking to add new protocols to our product suite based on market demands. So if Session Initiation Protocol (SIP) Voice over IP (VoIP), Test and Training Enabling Architecture (TENA), or others are required for your communication application, contact ASTi.

4.0 Telestra concepts

This chapter discusses the following topics:

- Data flow
- ACE Studio concepts
- System default login credentials
- Cold starts
- System configuration
- System Backup/Restore

4.1 Data flow

Telestra's concepts are very fundamental in understanding how the applications work together. Simply put, the project containing all model data and system configuration resides on the Target, and you can manipulate it using ACE Studio software. The complicated part is understanding the breakdown of information flowing between real-time and non-real-time. Figure 15, "Data flow" below displays the general flow of information from the Studio to the Target over the network.

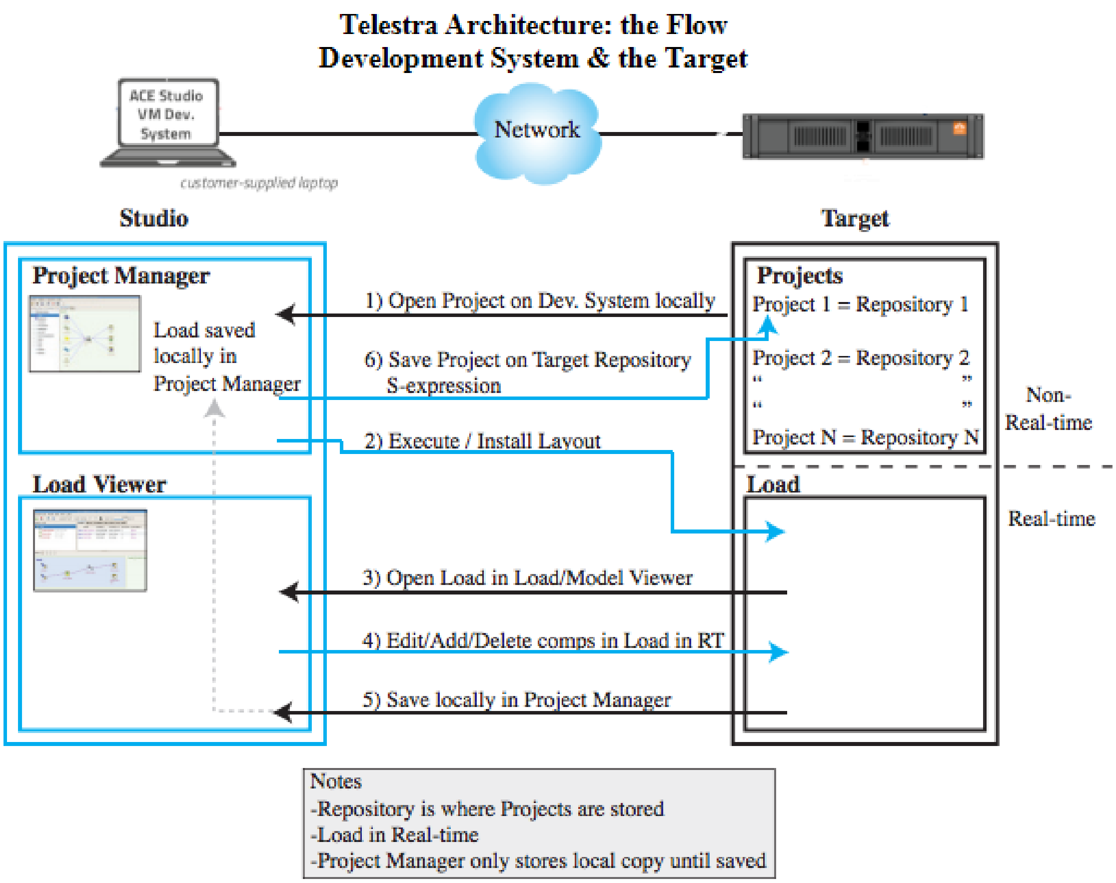


Figure 15: Data flow

4.2 ACE Studio concepts

In ACE Studio, a project consists of several layers of audio system hardware, software models, and network configuration parameters. ASTi created these layers of information to extract all networking configuration and hardware specifics from the model, which lets you change the model without reconfiguring parameters.

ACE Studio projects contain several layers. The first layer in a project is the layout, which contains the project's configuration. Each layout assigns the resources to the load. These resources include domains, comm plans, and sound repositories. The load consists of sets of models created in **ACE Model Builder**. The model layers are similar to past ASTi simulation models with components and primitives to drive the components.

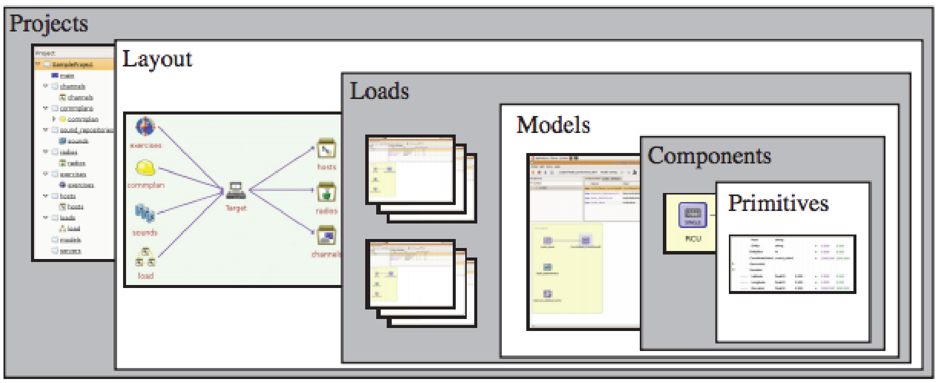


Figure 16: Project layers

4.3 System default login credentials

Every system is set with the following default login username and password. Change system passwords as necessary to meet system administration requirements.

Telestra root login:

Username	Password
root	abcd1234

Studio login:

Username	Password
aceuser	aceuser

Target login:

Username	Password
admin	admin

Remote Management System (RMS) login:

Username	Password
admin	astirules

4.4 Cold starts

The cold-start procedure allows you to build the systems from scratch. You may wish to cold start your system for the following reasons:

1. Install the latest software version
2. Rebuild a damaged hard disk
3. Create spare hard disks

To cold start your system, go to the *ACE Target and Studio Cold Start Guide* (support.asti-usa.com/media/pdf/t4/ace_target_studio_cs.pdf).

4.5 System configuration

The Remote Management System (RMS) provides network configuration for you to specify the network interface for the system, including an Internet Protocol (IP) address, a card mode, and a subnet mask for the Target's three Ethernet interface cards.

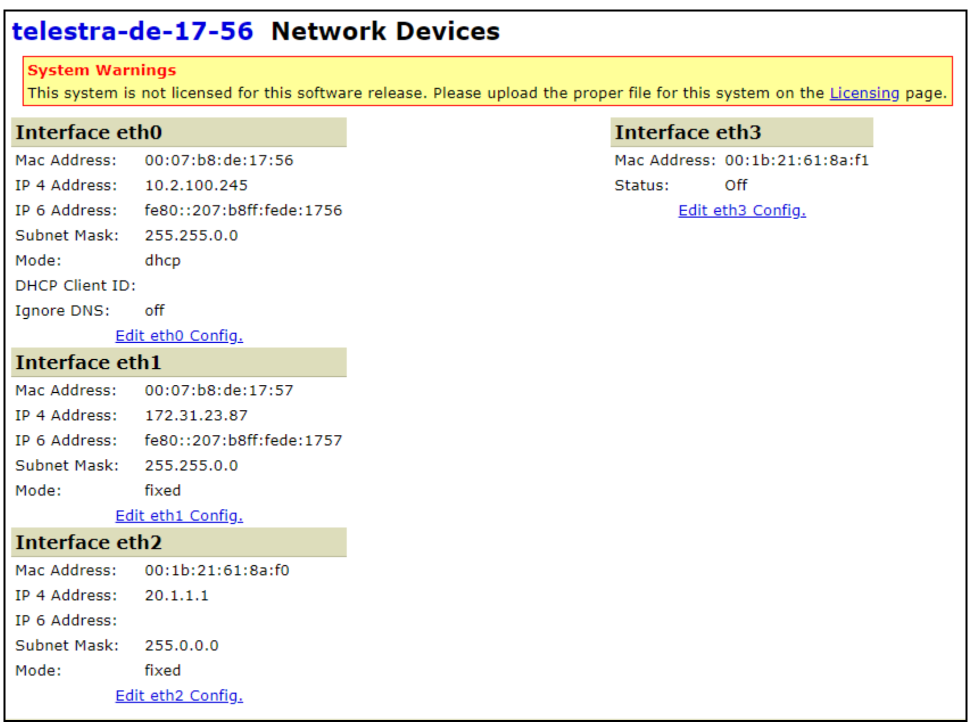


Figure 17: Network Devices

4.6 System Backup/Restore

You can easily manage archiving the system configuration files through the backup and restore options below:

- *Back up:* use **Backup System Configuration** to back up any or all of the individual sections of the overall system configuration or back up the entire system. A **Backup System Configuration as Text Only** option also exists. This setting does not back up any binary information and is useful when exporting a project from a classified area.
- *Restore:* use **Restore System Configuration** to install or restore system configuration files from a previously created backup file. This file can be uploaded to the system if it is not already resident on the Target.
- *Manage:* use **Manage Backup Archives** to inspect, download, and/or delete **System Configuration** backup archives.

Figure 18, "System Backup/Restore" below shows **System Backup/Restore**:

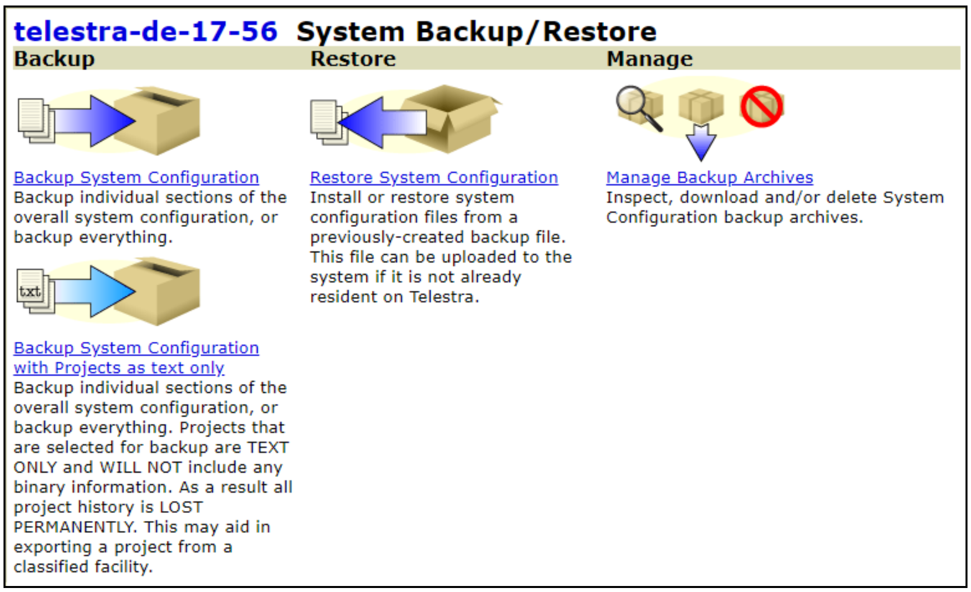


Figure 18: System Backup/Restore

This section discusses the following topics:

- Backup System Configuration
- Restore System Configuration

4.6.1 Backup System Configuration

Backup System Configuration archives projects, sound libraries, and system configuration information on a local workstation.

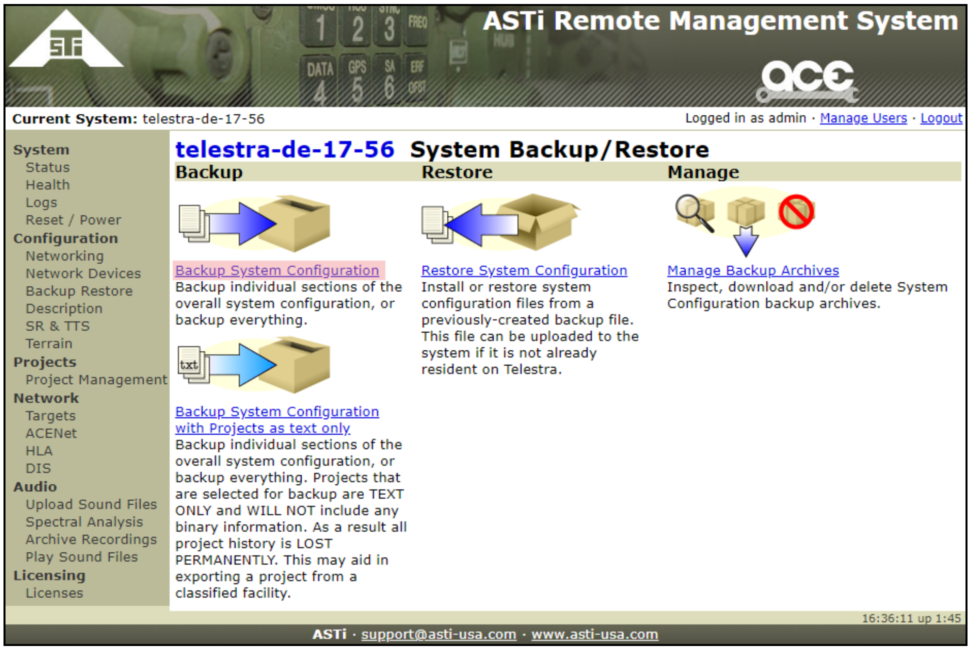


Figure 19: Backup System Configuration

Figure 19, "Backup System Configuration" above shows a variety of check boxes that back up projects, sound files, or system configuration sections:

- ***CrownAmpMapping***: when renaming a Crown Power Amplifier or Ashly Power Amplifier in the RMS, the amplifier does not allow you to store a name internally. The new name is mapped to the amplifier's media access control (MAC) address(es) in a file in the Telestra. This setting saves that mapping information.
- ***DefaultLoadandLayout***: saves the default load and layout information on **System Status**, which allows the Telestra run the required layout after perhaps a power interruption.
- ***ProjectsArchive***: saves any projects stored on the Telestra and lists all projects.

> ***Note***: *This check box does not select the sound files associated with the project; you must select them under* ***SoundLibrary***.

- ***RMSUsersandConfig***: saves information for all RMS users and their passwords on the Telestra as well as any user lockout settings.
- ***RecordReplay***: saves any audio files recorded with **RecordReplay**.

- ***SoundLibrary***: saves any **Sound Libraries** stored on the Telestra. Alternatively, select **SoundLibrary** to list all libraries on the Telestra.
- ***SpeakerEQConfig***: backs up **SpeakerEQ** configurations, which automatically equalize a speaker by comparing referenced and measured sound responses.
- ***SpeechRecognitionConfig***: backs up speech recognition license files and configuration.
- ***TelestraConfig***: backs up the Telestra configuration, which includes the host name and network settings.
- ***TextToSpeechConfig***: backs up basic text-to-speech (TTS) configuration and file locations. It does not back up the TTS license or the TTS installed voices.
- ***Backup filename prefix***: by default, the backup file name is **telestraConfig**, with the date and time appended to the file name. This box replaces **telestraConfig** with something more related to the information or project you are backing up.

Figure 20, "Backup System Configuration options" below shows **Backup System Configuration** options:

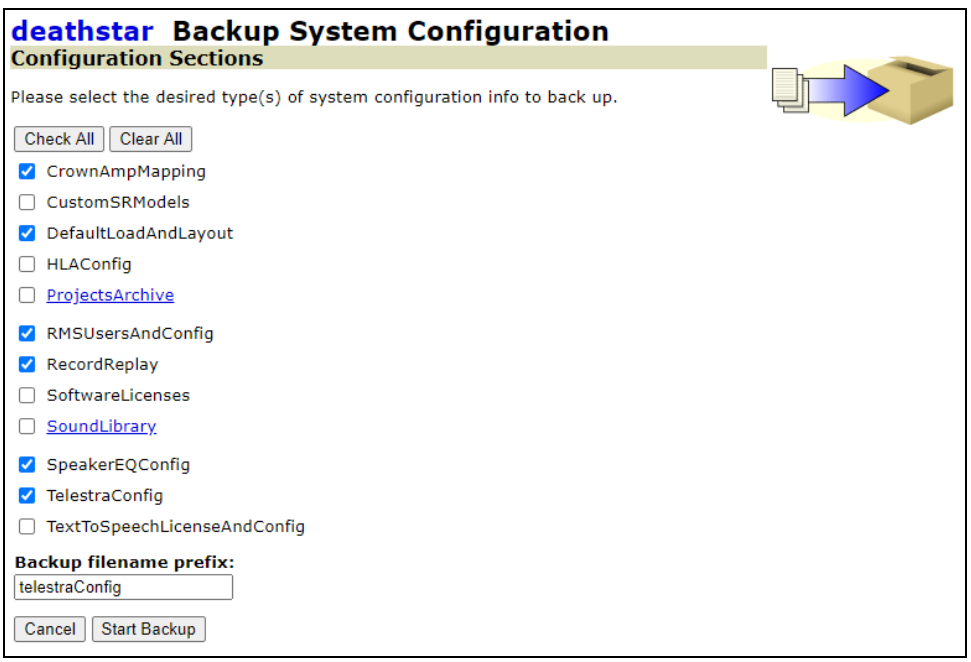


Figure 20: Backup System Configuration options

Select **Start Backup**, and a status page shows a message asking you to wait.

Figure 21: Start Backup

This page shows the categories selected for backup. At this time, the archive file has generated on the hard drive in the Telestra but has not transferred to the local computer.

To transfer the archive to your local computer, select the archive name.

Some browsers may ask where you would like to store the archive. The browser may also store the archive in a preset location.

The archive is now stored safely on your local computer.

4.6.2 Restore System Configuration

Restore System Backup restores a model archive on the Telestra server or uploads and restores a backup file from your local computer. Figure 22, "Restore System Backup" below shows **Restore System Configuration**:

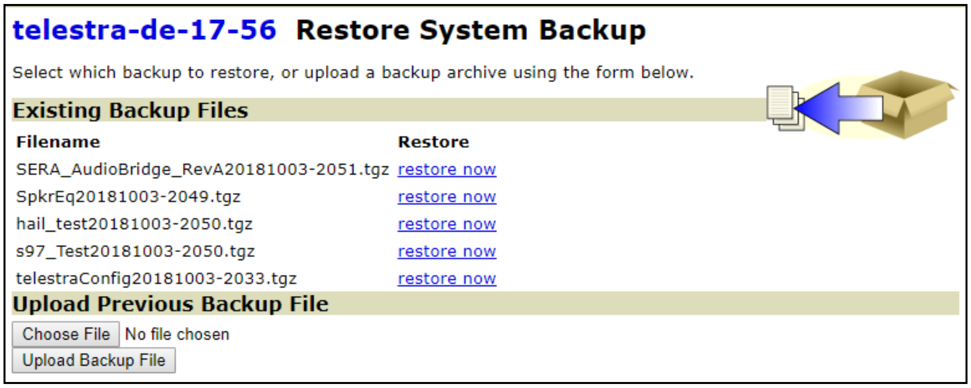


Figure 22: Restore System Backup

To restore an archive, follow these steps:

You can restore a file (e.g., **ASTi-20151214-1603.tgz**) from the Telestra itself. Alternatively, select **Choose File** and **Upload Backup File** to upload an archive on your local computer.

Select **Choose File**, and find the backup archive on your local computer.

To transfer the archive to the Telestra, select **Upload Backup File**, and it displays under **Existing Backup Files**.

Under **Configuration Sections**, choose configuration(s) to restore, and select **Start Restoration**.

Each check box allows you to restore a specific project, sound file, or section of system configuration:

- ***CrownAmpMapping****:* when renaming a Crown Power Amplifier or Ashly Power Amplifier in the RMS, the amplifier does not allow you to store a name internally. The new name maps to the amplifier's MAC address(es) in a Telestra file. Selecting this box restores that mapping information.
- ***DefaultLoadandLayout****:* restores the default load and layout on **System Status**.
- ***ProjectsArchive****:* restores any projects in the archive. Alternatively, selecting **ProjectArchive** lists projects in the archive so you can individually select them.
- ***RMSUsersandConfig****:* restores all information for the RMS users and their passwords in the archive as well as any user lockout settings.
- ***RecordReplay****:* restores any archived audio files recorded using **RecordReplay**.

- ***SoundLibrary***: restores archived sound libraries. Alternatively, selecting **SoundLibrary** lists all sound libraries in the archive so you can individually restore them.
- ***SpeechRecognitionConfig***: restores the speech recognition license file and configuration from the archive.
- ***TelestraConfig***: restores the Telestra configuration, which includes the host name and network settings.

> ***Caution***: *If you created a backup on a different Telestra, the configuration settings might not be applicable to this Telestra.*

- ***TextToSpeechConfig***: restores basic text-to-speech (TTS) configuration and file locations. It does not back up the TTS license or the TTS installed voices.
- ***Start Restoration***: brings up a window showing that the restoration is in progress.

> ***Note***: *A warning message may indicate if a project already exists on the Target.*

Figure 23, "Select Sections to Restore" below shows **Select Sections to Restore**:

Figure 23: Select Sections to Restore

Once the restoration is complete, a page similar to Figure 24, "Restoration Complete" below appears:

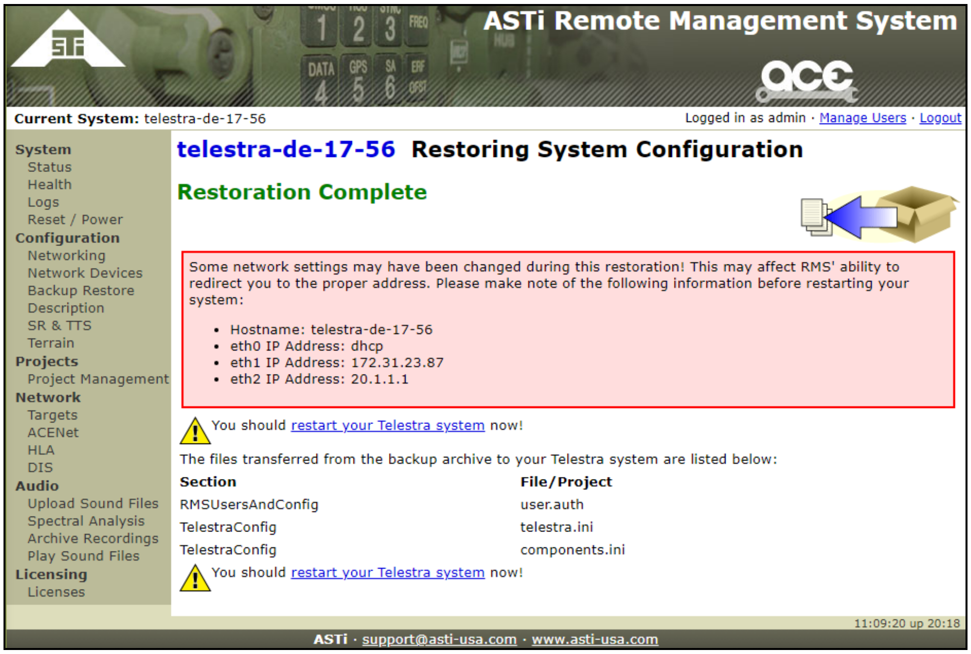


Figure 24: Restoration Complete

TelestraConfig replaced the Telestra's settings with the archive's network configuration. To use the newly restored files, select **restart your Telestra system**. In the confirmation message, select **Reboot Telestra System Now**.

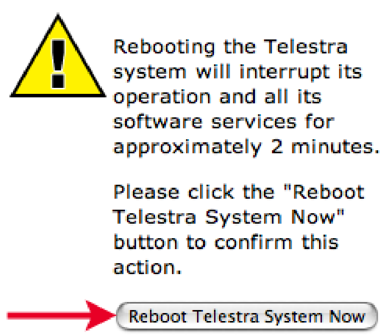


Figure 25: Reboot Telestra System Now

5.0 Software

Three main system software areas exist:

- *Project Manager:*
    - Manages the entire program or system
    - Acts as a configuration tool
    - Builds and installs layout
- *Load Viewer:*
    - Loads the configuration
    - Develops, builds, and debugs models
- *RMS:*
    - Provides hardware configuration
    - Configures the network
    - Manages USB License Key(s)
    - Manages ACENet device (e.g., gain settings and firmware updates)
    - Manages system health and debug settings

This chapter discusses the following topics:

- Project Manager
- Load Viewer

5.1 Project Manager

Many of today's simulation and training applications have transitioned from beyond simple, stand-alone training devices to multiplatform, complex, networked simulation applications. **ACE STUDIO Project Manager** provides the ability to develop, set up, and manage sound and communications models, simulation applications, and other related elements across a set of platforms and applications. Projects can manage greater simulation complexities and allow successful interoperation.

A project is a sound and communications simulation scenario that consists of hardware (e.g., modeling platforms, audio and I/O distribution, simulation servers), simulation software (e.g., sound and communication models, satellite communications (SATCOM), terrain, data link), and configuration elements (e.g., communication plans, entity assignments, exercise parameters).

A project can represent the sound and communication hardware, software, and models for a simple, standalone desktop simulator. On the opposite end of the spectrum, a project can encompass many training devices and applications participating in a WAN-based simulation architecture or exercise.

This section discusses the following topics:

- Project elements
- ACE STUDIO Project Manager
- Layout

Figure 26, "ACE STUDIO Project Manager" below shows the **ACE STUDIO Project Manager**:

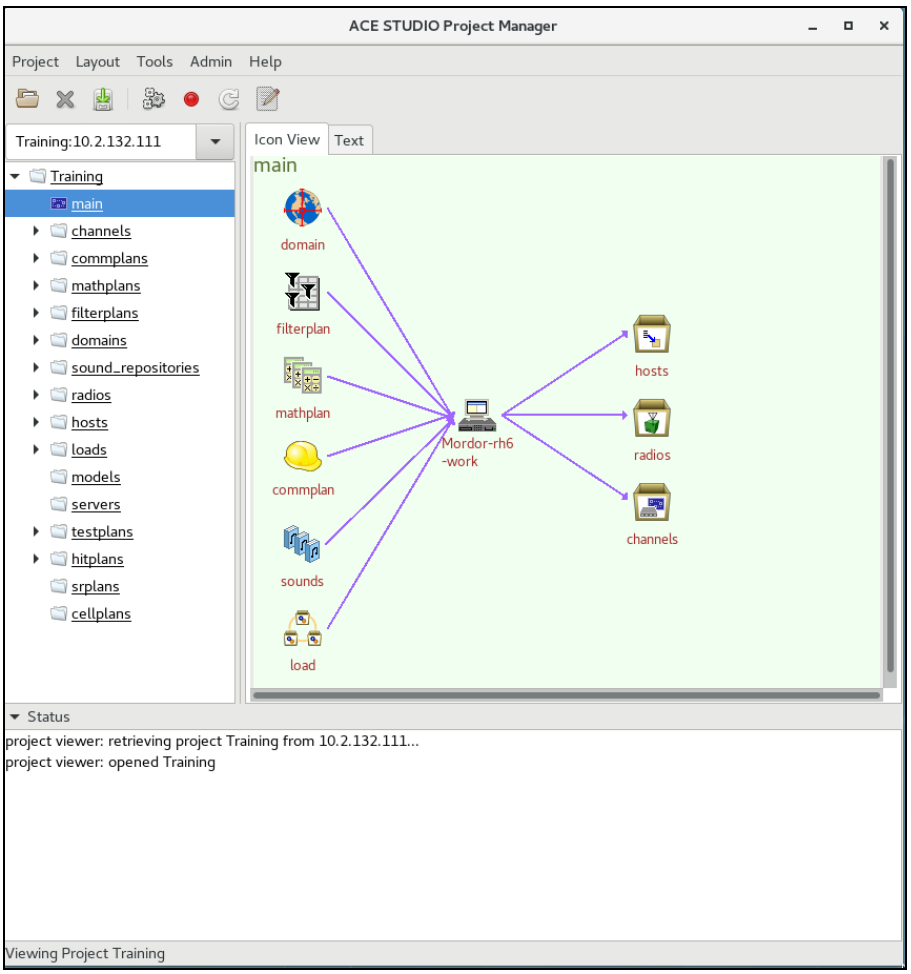


Figure 26: ACE STUDIO Project Manager

5.1.1 Project elements

Projects contain elements that develop, set up, and manage a complex sound and communication simulation scenario across network-based ASTi hardware and simulation applications. Projects elements include the following:

- *Targets:* embedded modeling platforms that run sound and communication models and other ASTi simulation applications that you can develop and set up.
- *Audio and I/O distribution devices:* include ASTi's ACUs, ACU2s, ACE-RIUs, and ACENet-compatible audio amplifiers.
    - *ACUs and ACU2s:* provide remote digital audio and I/O distribution between Targets and audio peripherals (e.g., military and commercial headsets, powered speakers, tape units, DVRs, real-world communication equipment). Distribution is via ASTi's ACENet protocol over dedicated Ethernet-based networks.
    - *ACE-RIUs:* remote audio interface devices that connect remote operator headsets, speakers, and control panels to a central Target via ACENet.
    - *ACENet:* compatible audio amplifiers that reinforce sounds in environmental cue applications. These amplifiers connect to ACENet, eliminating the need for an individual ACU and audio amplifier in environmental cue applications.
- *Simulation servers:* Telestra simulation server software runs server-based simulation applications and services, such as satellite communications (SATCOM), terrain, high-fidelity (HF) propagation environments, high-level architecture (HLA), data link, and Network Time Protocol (NTP).
- *Communication and sound models:* distribute, link, and manage communication and sound model elements as part of the project. Develop models with ACE Studio's model generation tools.
- *Sound repositories:* develop and manage recorded sound libraries from sound and communication models.
- *Host interface configuration:* set up host interfaces to sound and communication models as part of project development. Develop model elements that are reusable across platforms and are agnostic to any particular host simulation software's structure.
- *Comm plans:* with ACE Studio's communications planning tool, radio, intercom, and other communication assets, set up and manage across a set of models and applications to help ensure interoperability. Comm plans change, store, and reuse communication parameters for different exercises.
- *Domain:* the project manages domain-related parameters, such as entity assignments, DIS, and HLA parameters.

- *Loads:* the project configures models, simulation applications, host interfaces, and other elements for each Target.

5.1.2 ACE STUDIO Project Manager

ACE STUDIO Project Manager develops and manages projects. This tool is part of ASTi's ACE Studio software suite. When launched, the **ACE STUDIO Project Manager** searches the network for available Targets. It then queries found Targets and generates a list of existing projects on them. You can then choose to work with any project from the available list. Alternatively, build a new project, and develop on any available Target. Install, develop, and manage all projects on that Target.

In **ACE STUDIO Project Manager**, perform typical file operations on a project, such as **Save**, **Save As**, **Open**, **Close**, and **New**. To push model changes back to the Target, save in **ACE STUDIO Project Manager**.

A built-in control management system also tracks changes to the Target. As a result, you can manage projects much like software source code. Features such as change tracking, change descriptions, release management, and the ability to return work with earlier release instances provide powerful configuration management capabilities.

Some project management features are also available through the Remote Management System (RMS). Pointing a network browser at a Target from any convenient computer connected to the same network accesses the RMS application on that Target.

Within the RMS, select **ACE STUDIO Project Management**. From the pages under this tab, view local and global projects.

- *Local projects (i.e., projects on the Target):*
  - Display list of projects on the current Target
  - Back up projects from the Target
  - Delete projects from the Target
  - View **Change Logs** of each project
- *Global projects (projects on other machines visible to Targets over the network):*
  - Display list of projects on other Targets
  - View change logs of each project on other Targets

5.1.3 Layout

A layout is a graphical and textual representation of your project with configuration parameters. The layout collects user and tool-generated elements:

- Hardware
- Models
- Interfaces
- Communications assets
- Exercise and communication-planning parameters

In **ACE STUDIO Project Manager**, select links and set these elements from the current project libraries to create an executable layout. You can also add and generate new project elements.

Links between icons show dependencies and associations of the individual project elements. For example, a link from a load element to a Target element indicates the load will be installed and run on that particular Target. Link a communication plan element to several Targets, indicating that each Target will use the communication plan after executing the layout.

5.2 Load Viewer

A load is a collection of models linked to form a communication and sound model to run on a selected Target. A load is a model set for a specific Target, whereas a project is a complete configuration of loads, comm plans, and servers across one or more Targets, servers, and simulation applications. Generate models via ACE Studio's model development tools, through the various helpers, or a combination of both.

To generate an empty load in **ACE STUDIO Project Manager**, right-click **Loads**, and select **Add**.

The ACE Studio model builder generates the models in the load. Create a load from scratch. To add the current load to the project, select **Save**.

To apply a load to a Target, double-click the Target in **Layout**. The Target configuration window appears with a load list. Choose a load to run on a Target.

Figure 27, "Text view of a load" below shows the text view of a load in **ACE STUDIO Project Manager**:

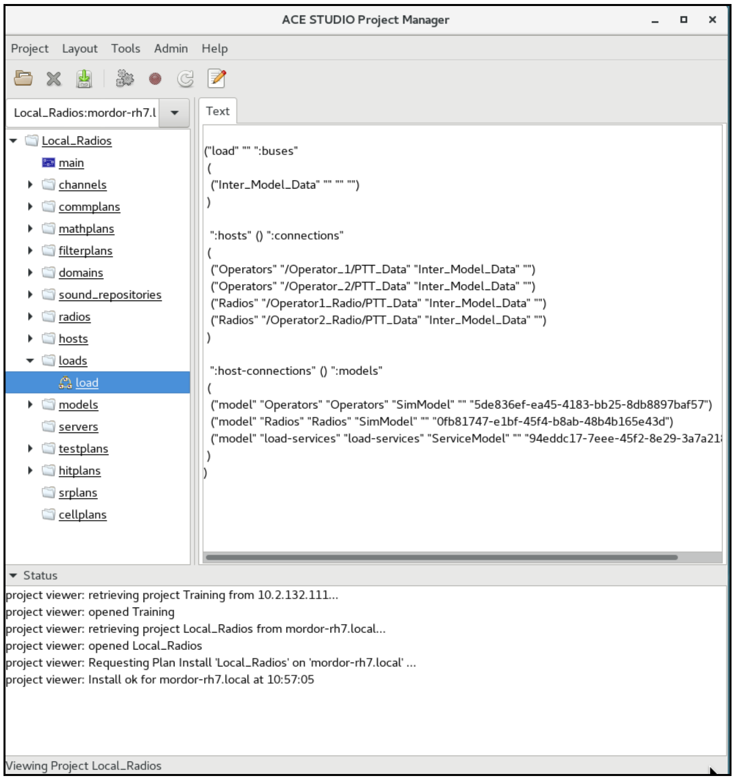


Figure 27: Text view of a load

This section discusses the following topics:

- Models
- Servers

5.2.1 Models

Models are the individual modeling elements generated by either helpers and/or ACE Studio’s modeling environment. A model can be small and simple (e.g., a set of components that model an engine sound, a shipboard binaural operator, or an F-16 Caution Warning system). A model can also be large and complex, such as the entire communication system for an F-18 platform.

Models are self-contained and can link together; therefore, you can create a library of reusable model components to build larger, more complex models.

Add models that the project helpers or that ACE Studio's model development tools build to a project. The model folder shows all models that Targets in the project use. Additionally, add models to the project to create a library of reusable components, regardless of whether the current layout uses them.

Figure 28, "Models view" below shows models in **ACE STUDIO Project Manager**:

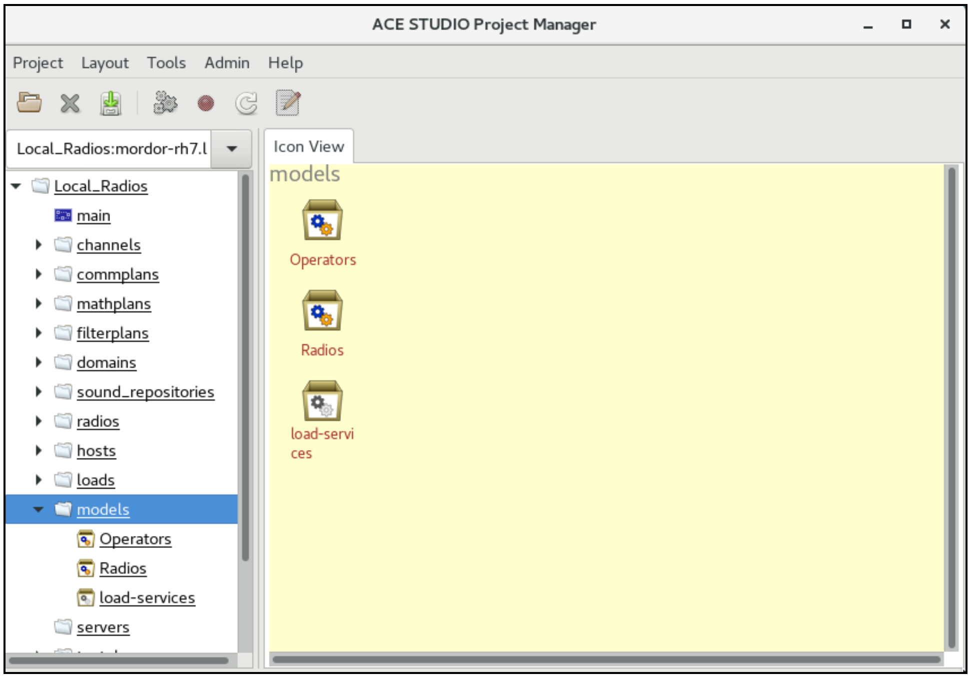


Figure 28: Models view

5.2.2 Servers

In addition to Targets, you can add server platforms to a project. From a hardware standpoint, server platforms are additional Target platforms connected to a set of Target systems over a network. The servers run ASTi's server-based simulation applications:

- High-level architecture
- Satellite communications (SATCOM)
- High frequency (HF)
- Automatic link establishment (ALE)
- Terrain

Server platforms can also provide traditional, server-based services, such as Network Time Protocol (NTP).

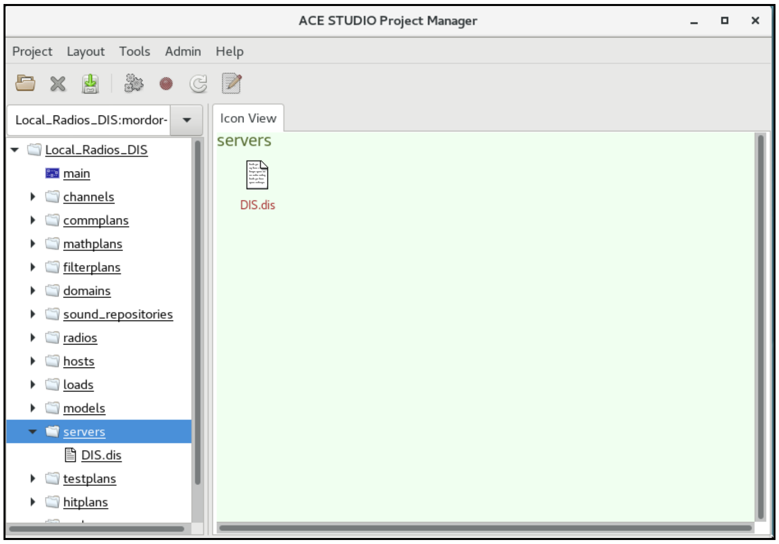


Figure 29: Servers

As the name implies, these simulation applications provide simulation capabilities and features to a collection of Targets. To add servers to the project, right-click the **Layout** canvas and add **Server**. Double-click **Server** to open up the configuration tool, and choose the simulation services that support the application.

The most commonly used feature is **DIS Gateway**, which provides the interface to the DIS network:

a. Set DIS **version** to 4, 5, or 6.

b. Set the **DIS interface** to eth0, 2, 3, or 4.

c. Set the DIS RX/TX **port** (e.g., 53000).

d. In **main**, set the outgoing destination address for DIS packets (e.g., 255.255.255.255). Choose **broadcast** or **multicast**.

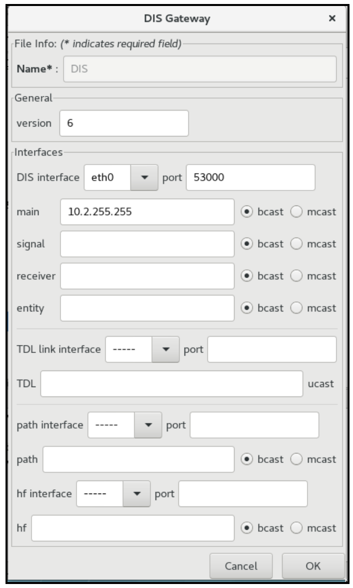


Figure 30: DIS Gateway

6.0 Model services

This chapter discusses the following topics:

- Intercoms
- Sound repositories
- Math Plan
- Radios
- Commplan Editor
- Radio Monitor
- Domain Editor
- Helpers

6.1 Intercoms

Intercom components relate to internal communication paths within the model. This group includes the communication panel and local **Intercom** buses. Audio on **Intercom** buses never transmits to the voice network. These buses internally pass audio around.

Intercoms provide an **Intercom** audio bus structure that other components can use to distribute audio throughout a model and to simulate **Intercom** bus structures in simulation applications. A network version allows an extension of **Intercom** buses between systems using simulation industry standard Distributed Interactive Simulation (DIS) or high-level architecture (HLA) protocols.

Figure 31, "Intercom example" below demonstrates how **Intercom** works:

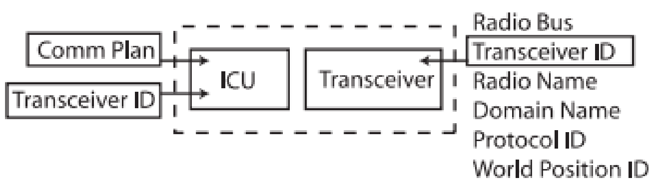


Figure 31: Intercom example

6.2 Sound repositories

Sound repositories are the sound file libraries that support sound and communication models. For example, an AH-64D Apache model may use a library of recorded sounds (e.g., weapon launches, engine ignitions, touch-down thump, caution/ warning voice alerts, threat alerts, crypto tones, FH equipment beeps and squawks) .

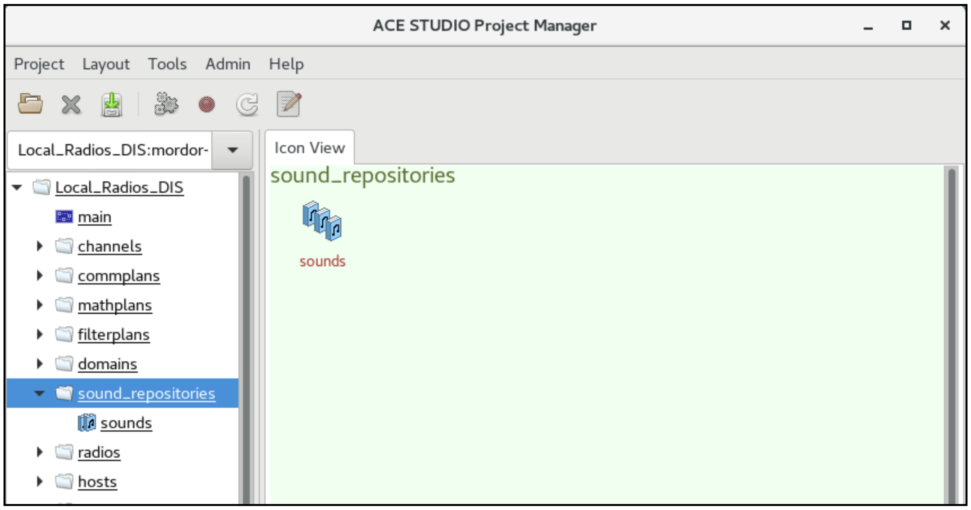


Figure 32: ACE STUDIO Project Manager

Sound Library Editor creates, reuses, and manages these libraries. The editor also structures these sounds, allowing you to build sound groups in an individual sound library. For example, you might create an F18 communications sound library with around 20 sound files. You can then group these sounds inside the library by function (e.g., ARC-182, caution, weapons). Reuse the sound repository apply it to multiple F18 platforms.

A waveset is necessary to uploading sound files, because it creates a folder location where all sound files are stored. To upload sound files, go to the *Remote Management System User Guide* (support.asti-usa.com/media/pdf/t4/rms4_ug.pdf)

All files must be 48 kHz, mono, 16-bit windows pulse-code modulation (PCM). All sound files are uploaded to the following file location on the Target: **var/local/asti/soundfiles/***waveset*, where *waveset* is the waveset's name. To load sound files at model load, set the buffer to **True**.

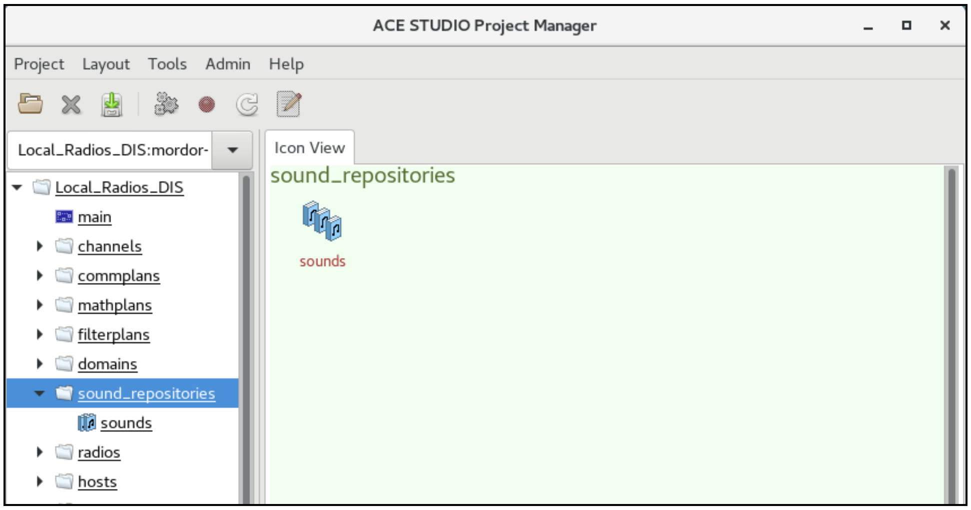


Figure 33: Sound Library Editor

6.3 Math Plan

Math Plan provides access to various mathematical functions that you may apply to the layout. These functions permit local data manipulation in the models. This tutorial demonstrates how to use the **Math Plan** in **MathFunction**.

When you create a new project, ACE Studio automatically creates a default **Math Plan** called "mathplan." To rename the **Math Plan**, follow these steps:

1. On the canvas, right-click **Math Plan** ( ).
2. Select **Clone and Replace**.
3. Enter a name for the **Math Plan**.
4. Right-click the server icon ( ), and select **edit**. On **core**, you can now view the **Math Plan's** new name in **select**.

To set up a **Math Plan**, follow these steps:

1. Add a new project, or open an existing project.
2. In the layout, double-click **mathplan**.

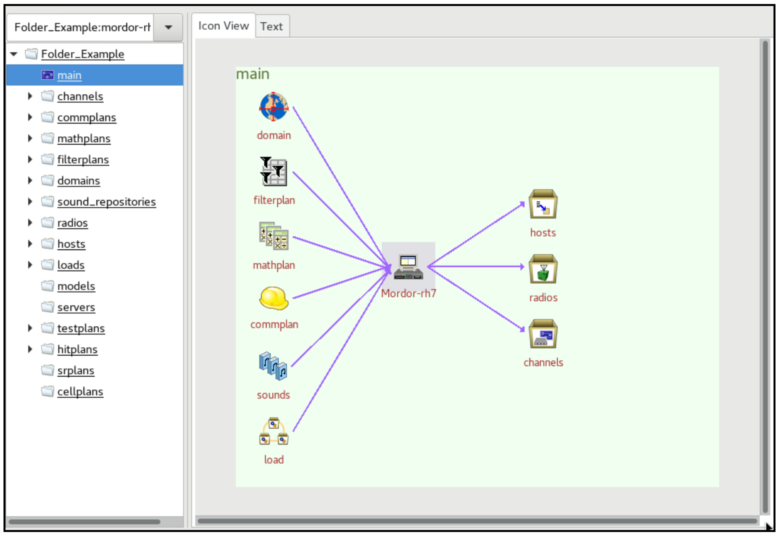


Figure 34: Icon for mathplan

3. Select **Add Group**, and name it **New_Group**.

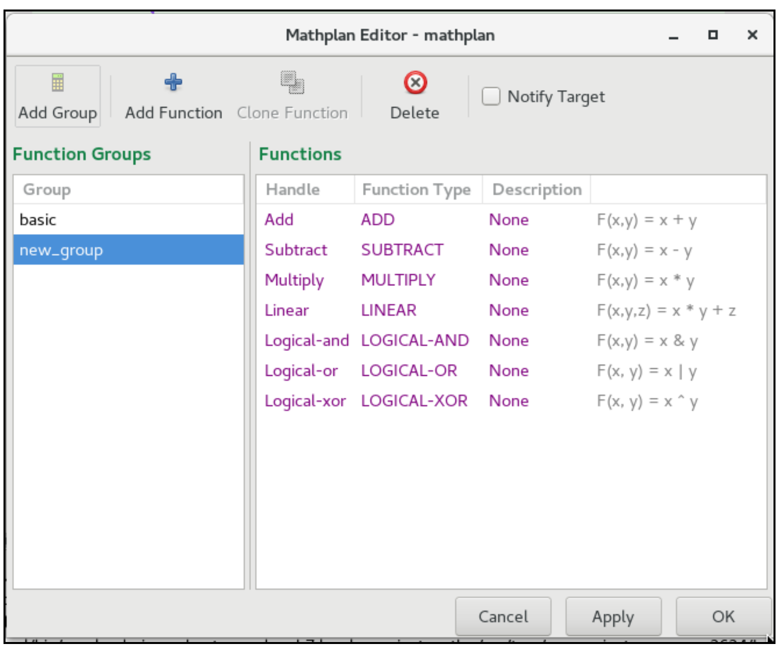


Figure 35: Mathplan Editor

4. Select **Add Function**, and name it **Table_Function**.

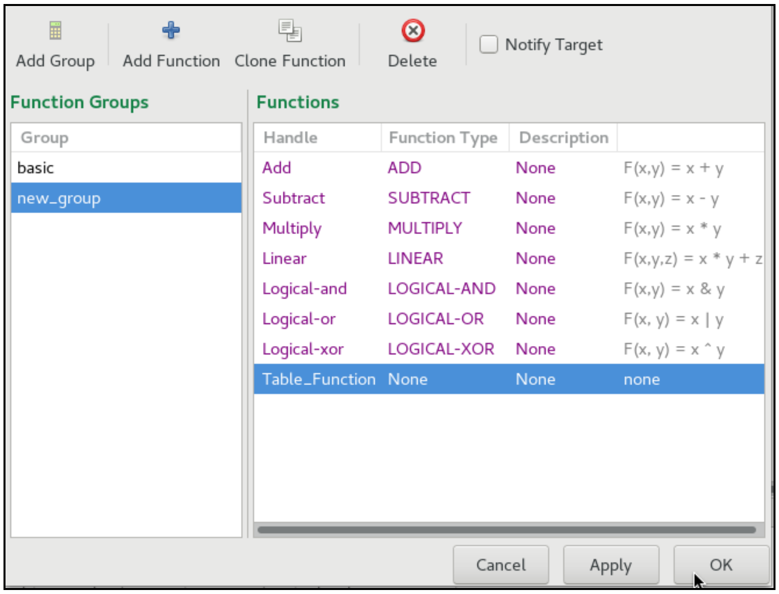


Figure 36: Math Plan function

5. Select **Function Type**, and then select **TABLE**.

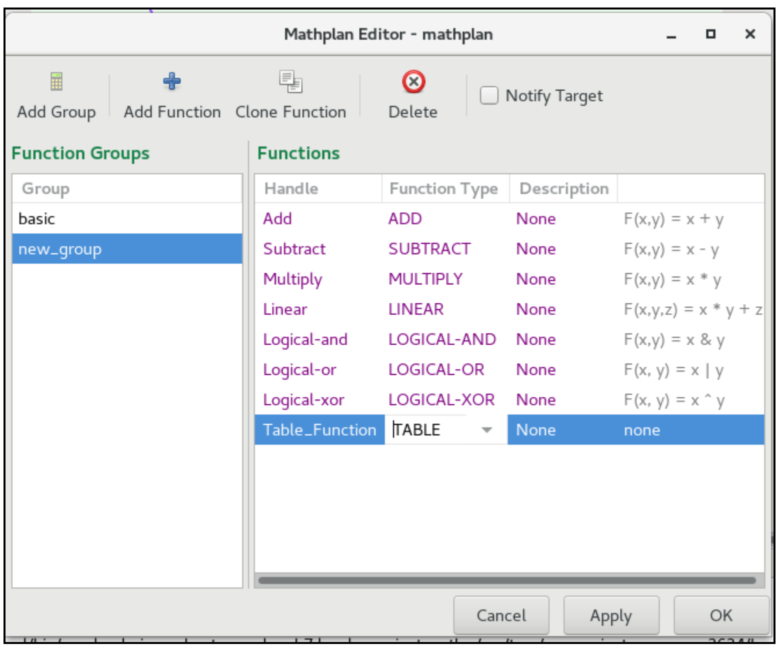


Figure 37: New Table Function

6. To the right of **Description**, double-click **edit**.

7. Fill in the table values:

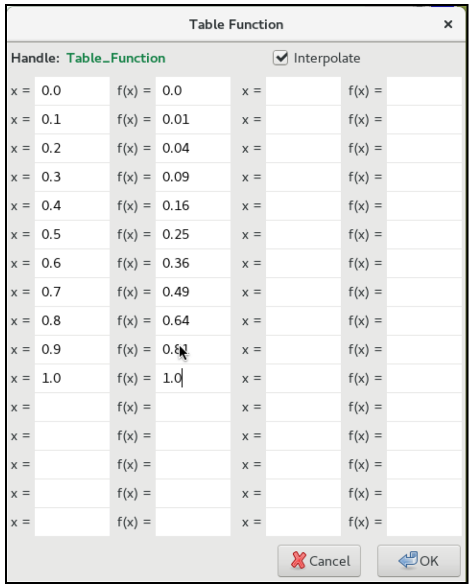
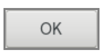


Figure 38: Table Function

8. To close **Table Function**, select  and .

9. Select  to close **Math Plan Editor**.

10. Save and install the project.

11. Double-click the server icon () to open **Model Viewer**.

12. To add a simulation model, right-click the canvas.

13. To open the model, double-click the **Model** icon.

14. Add a **MathFunction** component.

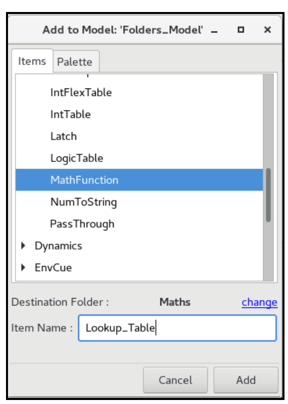


Figure 39: Add Table Function

15. To open the **Ace Data Viewer**, double-click **MathFunction**.

16. Double-click **select** in **Value** for the *Function* variable.
17. In the new group, select the **Table_Function** that you created in Step 5.
18. Select 

.
19. In the **Ace Data Viewer**, double-click **Modifier** for *Input_X*, and enter **0.6**.

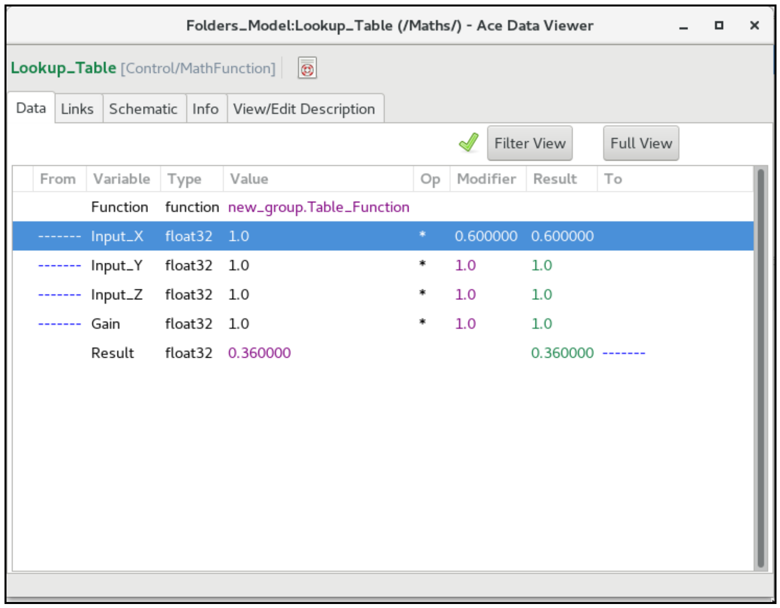


Figure 40: MathFunction

The *Result* is now 0.36, which matches the table's output for an input of 0.6.

6.4 Radios

Radios are the largest, most complex, and most used components in ACE Studio. The following is a summary list of radio features for all simulated radios:

- ***World Position**:* defines the X, Y, Z coordinates of the radio's location.
- ***Frequency**:* defines the center of the radio tune frequency for transmit and receive. Optionally, it can define separate transmit and receive frequencies.
- ***Antenna Gain**:* simulates the size and radiative efficiency of the antenna. All modeled antennae are isotropic.
- ***Squelch**:* a noise gate that only allows signals exceeding a specified strength to filter through and play.
- ***Background Noise**:* the general noise created when using radios.

- ***Fill***: allows you to choose one of a set of *N* predefined radio fills, as defined in a global comm plan.
- ***Multiple Net Support***: provides the radio with the ability to support multiple nets per a specific fill. Nets define the following core radio characteristics:
    - ***Multiple Modulation Type***: describes the modulation parameters of the radio, such as AM, FM, SATCOM, HQ, Intercom, etc.
    - ***Amplitude Modulation (AM) and Frequency Modulation (FM)***: two primary modulations for radio operation.
    - ***Modulation Discrimination***: occurs when radios can only receive signals from radios with the same modulation type.
    - ***AM Mixing***: when multiple AM signals broadcast on the same channel frequency, the AM receiver will receive all signals and mix them according to signal strength.
    - ***FM Capture Effect***: when several FM radios are transmitting on the same frequency, an FM receiver will only be able to receive the strongest signal.
    - ***Sensitivity***: receiver sensitivity in dB.
    - ***Bandwidth and Bandwidth Overlap***: determines the amount of audio noise mixed into the received audio, based on the simulated bandwidth of the radio band. This parameter does not affect the in-tune calculation.
    - ***Encoding Type and Rate***: defines the audio encoding type, including muLaw, continuously variable slope delta (CVSD), pulse-code modulation (PCM), and the sample rate.
    - ***Transmit Power***: indicates the transmission power of the radio in Watts/dBm
    - ***Automatic Gain Control (AGC)***: adjusts the gain to appropriate levels for a range of input signal levels.
    - ***SATCOM Parameters***: defines satellite mode parameters, if applicable.
    - ***Frequency Hopping***: a method of rapidly switching frequencies while a receiver and transmitter communicate. The receiver and transmitter have to jump between the same frequencies, at the same speed, and at the same time.
    - ***Crypto Parameters***: radios that scramble the signals before they are transmitted so that only receivers who know the special key will have the ability to decode them, producing a secure voice transmission across any frequency.
- ***Half Duplex and Full Duplex***: half-duplex mode is when the radio is able to transmit and receive signals but cannot do both at the same time. Full-duplex mode allows radios to transmit and receive signals at the same time. Typically, full-duplex mode is only used for intercom systems but never for real radios.

- ***Propagation**:* the movement of the radio waves as they move away from the transmitting antenna.
    - ***Ranging**:* an effect that occurs as a result of the distance between two radios. The greater the distance between the radios, the weaker the signal due to the dissipating power of the signal as it traverses a large area.
    - ***Occulting**:* the loss of radio signal due to the curvature of the earth's horizon.
    - ***Ionosphere Effects**:* the loss of signal due to the changes in the earth's atmosphere such as time of day or different seasons. The ionosphere effects only occur with high-frequency (HF) radios.
    - ***Line of Sight (LOS)**:* when radio waves traveling in a straight line are dispersed due to obstacles or obstructions.
    - ***Fresnel Diffraction**:* loss of signal due to the reflection of off obstacles in the path of the radio waves from transmitter to receiver.
    - ***Terrain Effects**:* the loss of signal due to land obstruction, such as a mountain.

This section discusses the following topics:

- Local radios
- Comm Plan
- Add a model

6.5 Commplan Editor

Commplan Editor creates a library of radio “fills” consisting of crypto, frequency hop, waveform types, nets, and other necessary parameters for the simulated radios in the project. You can create multiple comm plans and store them as part of the project.

In this way, you can apply and install different plans with relative ease to support changing operational or exercise requirements. For example, the day-to-day operations of an F-16 simulator may use one plan that provides the trainer communication simulation as tested and signed off with the device. However, other plans may be applied when the F-16 device is used in network-wide exercises.

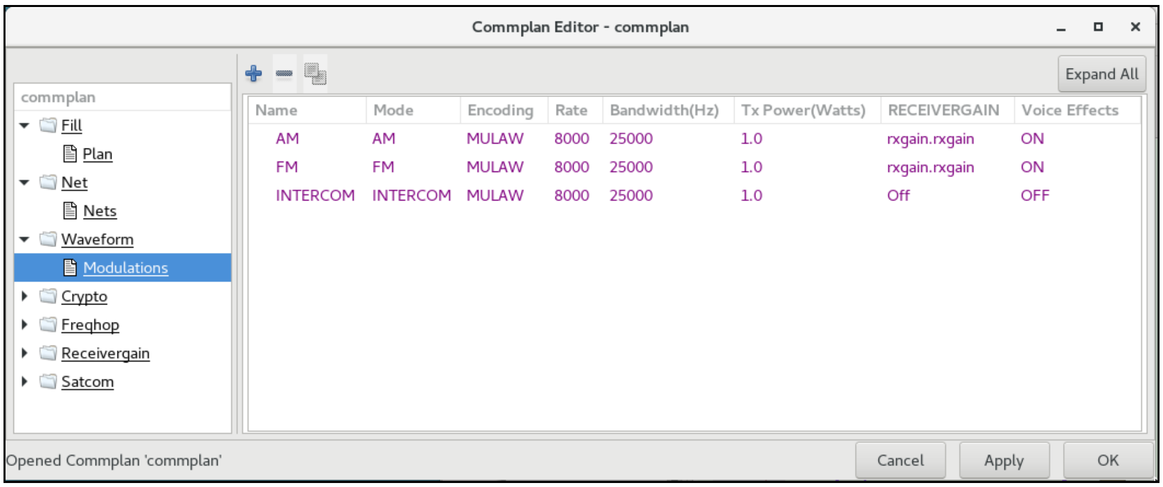


Figure 41: Commplan Editor

6.6 Radio Monitor

Radio Monitor is a network-debugging tool that examines radios in the local radio environment and other servers. Updating in real time, **Radio Monitor** views the radios on the network. Radio details include the following:

- Source or domain
- Ether
- Frequency
- Mode
- Target IP address
- Name
- Protocol ID

Under **Name**, view the DIS ID. The DIS ID is defined in the following order:

- Exercise ID
- Site and application IDs from the IP address of the local Target
- Entity
- Radio ID

The **Radio Monitor** view tabs:

- ***Radios****:* shows receivers and transmitters on the network.
- ***DIS Maps****:* displays the DIS gateway mapping to DIS identifiers to Universally Unique Identifiers (UUIDs). ACE radios are identified via UUIDs.
- ***Statistics****:* provides diagnostics information.

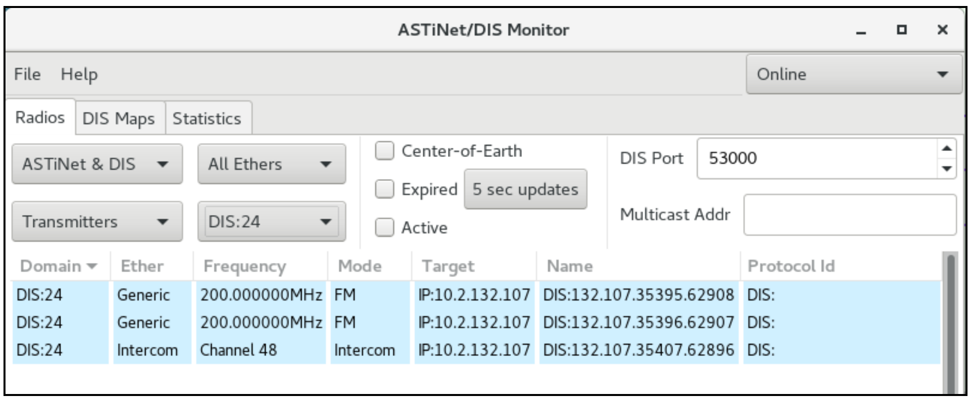


Figure 42: Radio Monitor

In the radio list, all transmitting or receiving radios are green. Double-click any radio available on the network to view the details. The radios time out after 12.5 seconds and turn white in the list. The radio disappears from the list after 25 seconds if it receives no further updates.

Online displays all Targets available on the network and allows selection of a specific Target to view traffic visible only to that Target.

To view the general radio details, open a radio in the radio list. The radio general information includes the following:

- **Radio Name**
- **Model Name**
- **Target Name**
- **IP Address**
- **Protocol ID**
- Universally unique identifier (**UUID**)
- **Domain**

At the bottom of the window, view in-tune radios, and select each name to view their details. **Out-Of-Tune** is blank if all radios are in tune. Factors include occulting, ranging, terrain, and squelch.

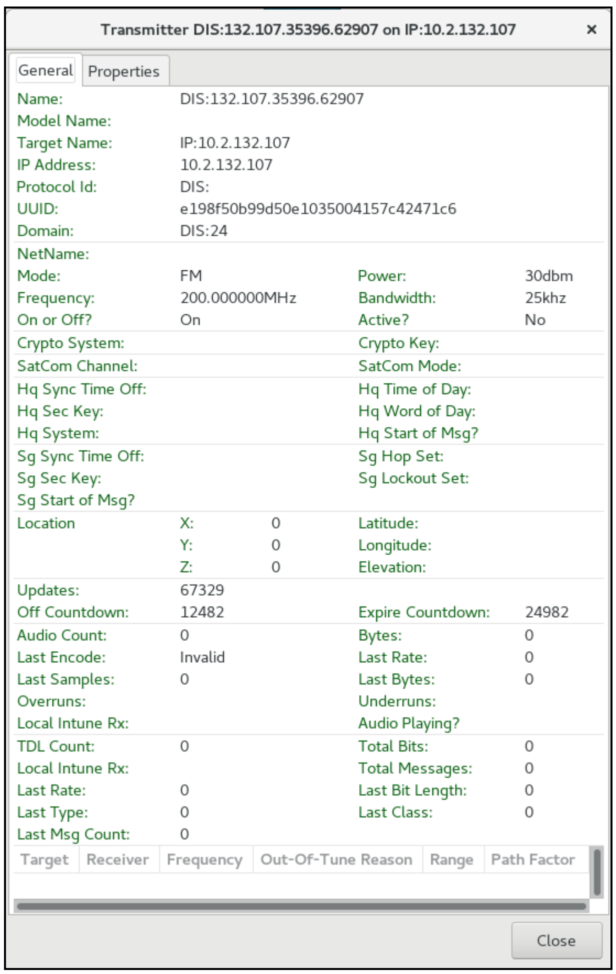


Figure 43: Radio Monitor detail

6.6.1 Radio filters

Radio Monitor displays radios available on the ASTiNet, Distributed Interactive Simulation (DIS), or both networks. Filter out a network, or view both simultaneously. Filter the radios as transmitters or receivers or by assigned domain name. Alternatively, you can view all domains.

Ethers identify groups of radio types that interoperate with each other. For example, AM and FM radios operate in the same generic ether, so when an AM and FM radio have the same frequency, they interfere with each other. On the other hand, Intercom radios and Voice-over-IP (VoIP) radios do not interact with AM or FM radios or with each other. Intercom radios and VoIP radios exist in separate ether groups.

Filter radios by the following:

- ***All Ethers****:* view all radio types.
- ***Generic****:* view AM, FM, continuous waveform (CW), upper sideband (USB), lower sideband (LSB), single sideband filter (SSBF), jammer, pulse, and satellite communications (SATCOM). Generic radios tune via frequency.
- ***Intercom****:* view only intercoms. Intercom radios tune via channel number.
- ***VoIP****:* view only VoIP radios, which tune via net name.
- ***HaveQuick****:* view only HaveQuick radios, which tune via spread spectrum net ID.
- ***SINCGARS****:* view only SINCGARS radios.

Other filters include the following:

- ***Center of the Earth****:* radios located at the center of the earth (i.e., 0,0,0).
- ***Expired****:* radios that are timed out.
- ***Active****:* active radios on the network.

6.6.2 Statistics

In the **Radio Monitor**, **Statistics** displays the radio details for diagnostic purposes:

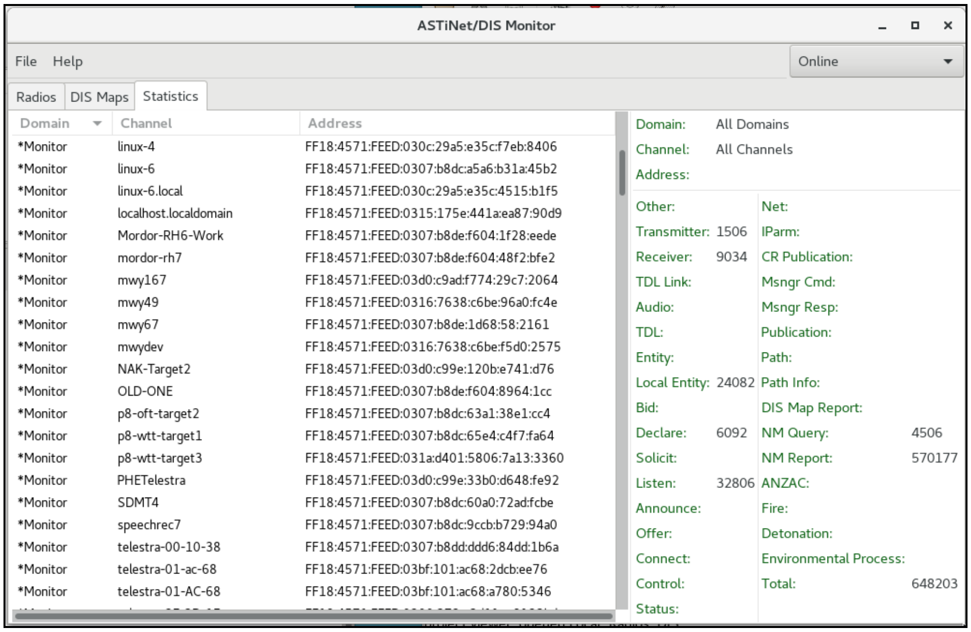


Figure 44: Radio Monitor Statistics

6.7 Domain Editor

Domain Editor sets standard DIS or HLA parameters to a specific exercise in the project. In a DIS exercise, **Exercise ID**, **Site ID**, **App ID**, **Entity ID**, and **Radio ID** must uniquely identify each simulated radio. Simulated radios must operate on the same exercise ID and frequency to communicate with each other.

First, add a domain, and enter an exercise ID. Select the **Site ID** and **App ID**, which default to the last two IP octets:

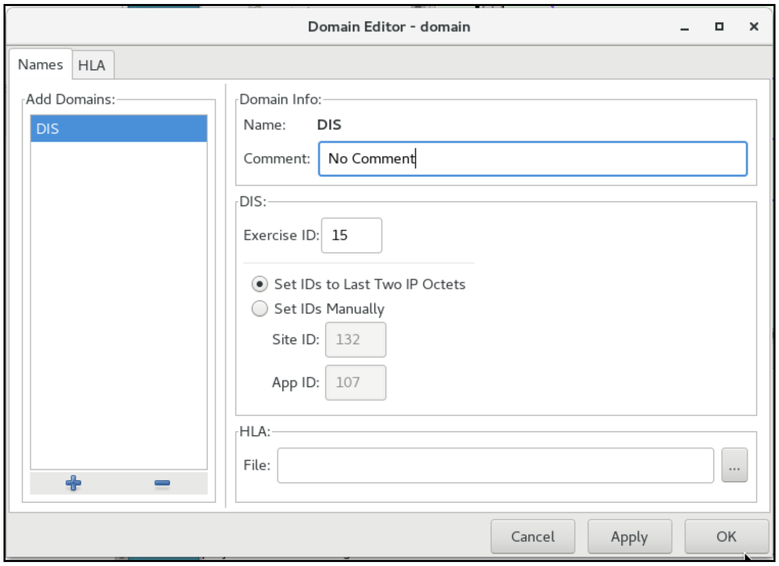


Figure 45: Domain Editor

6.8 Helpers

Helpers are specialized tools in **Project Manager** that build various types of project elements. Helpers include the following:

- **Channel Helper**
- **Communication Planner**
- **Math Plan**
- **Domain Editor**
- **Sound Library Editor**
- **Radio Helper**
- **Host Interface Helper**
- **Loads**
- **Models**
- **Server Configuration Helper**
- **Test Plan**
- **HIT Plan**

- **Speech Recognition (SR) Plan**
- **Cell Plan**

Each helper produces project elements for the project tree. Elements live in their own respective folders for easy visibility and access. In this fashion, libraries of reusable elements are created for future use.

Helpers allow you to quickly build and manage complex simulation models by creating reusable elements, which ensures consistency and interoperability within the simulation application.

6.8.1 Channels

At their basic level, channels are audio connection points in the sound and communication model. A simple example is a mix of environmental cue sounds that must route to a particular speaker location. Another, more complex example is an operator with a microphone input and headset output and a communication panel structure and communication asset links (e.g., radios, intercoms).

While you can generate these structures using ACE Studio, **Channel Helper** is a useful alternative, because it can automatically generate some of these more complex, audio-related modeling structures. **Channel Helper** creates modeling elements that you can reuse in a sound or communication model.

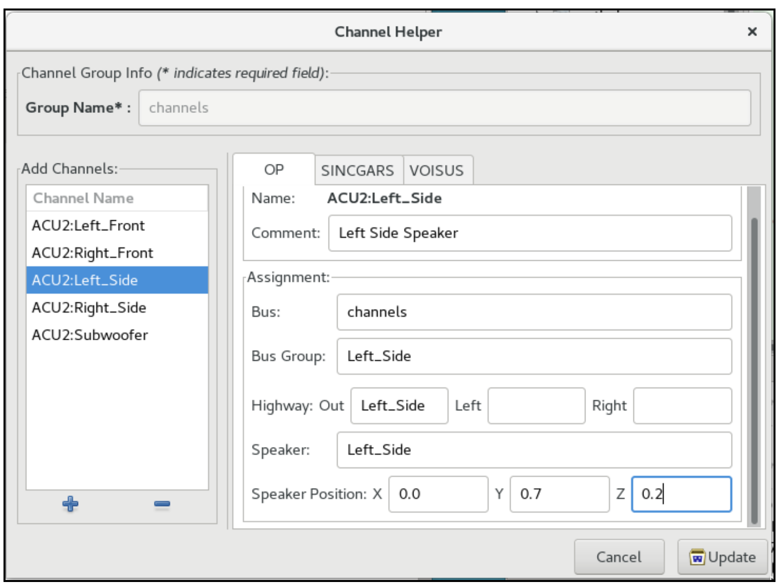


Figure 46: Channel Helper

For example, it is much easier and more consistent to use **Channel Helper** to generate three generic IOS operator positions than to manually generate them in the modeling environment. To avoid losing work, do not edit objects that you created with **Channel Helper** in **Model Viewer** or helper-generated submodels that you generated in ACE Studio.

Channel Helper has the ability to create Audio I/O channels for ACUs, ACU2s, ACE-RIUs, and amplifiers. It can also create radio operator stations. Set up the operator stations with up to 16 radios for each operator. Set up SINCGARS for use with ASTi's simulated SINCGARS panels.

7.0 Host Interface

Hosts are representations of packet interfaces that link state data from your host application software to user-developed sound and communication models in a project. Each packet interface structure built into a model has a corresponding host at the project level. You can input or output hosts, since state information can flow between models and host applications in either direction.

The ACE Studio host interface consists of two parts:

- Host containers and their corresponding sockets at the project level
- Host I/O packets at the model level

Each host container icon on the canvas sets the packet interface with the appropriate User Datagram Protocol (UDP) port and physical Ethernet port (i.e., Eth0, Eth2) on a Target.

In the host model, each host I/O packet defines the information in the host UDP packet. The host I/O packet is commonly called the Interface Control Document (ICD). The ICD defines and controls input offsets, data types, and the UDP port number.

This approach removes the reference link to the models because they carry no specific network configuration information, making them reusable across platforms without configuration changes.

Socket refers to a network endpoint. This is where the IP address, Ethernet port number, and UDP port number are specified for input packets. Additionally, the destination IP address and UDP port number, payload size in bytes, and iteration rate for output packets are specified. **Host Packet Editor** points to these sockets.

This chapter discusses the following:

- Host control at the project level
- Host control at the load and model level
- Host interface exercise

7.1 Host control at the project level

In **Project** > **Host**, the host containers and sockets are created in each host container. Each socket is defined as *HostIn* or *HostOut*. Figure 47, "Host In" below shows *HostIn* in the **Host Interface Helper**:

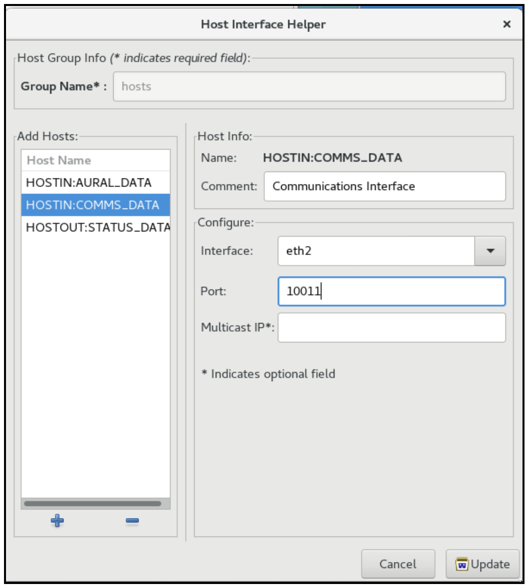


Figure 47: Host In

For each *HostIn* socket, define the interface and port number. The port number selects the default network receive port for the packet data if it is an input packet or the transmit network port if it is an output packet.

For each *HostOut* socket, define the following:

- Destination IP address
- Port
- Packet length in bytes
- Send rate in Hertz (Hz)

***Note**: The send rate limit is approximately 20 Hz.*

Figure 48, "Host Out" below shows the **Host Out** in the interface helper:

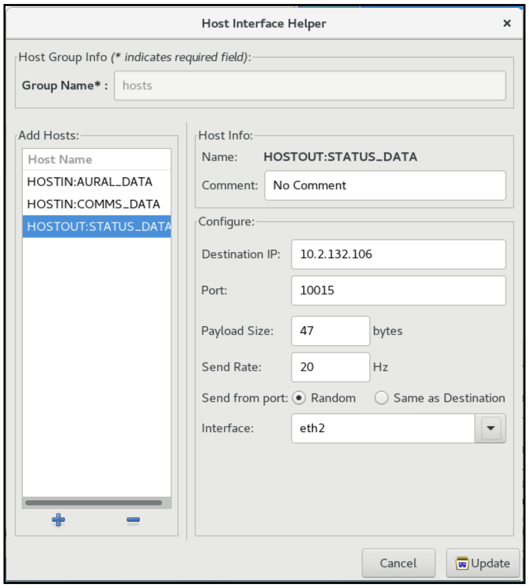


Figure 48: Host Out

7.2 Host control at the load and model level

In the load, add a host model. Create the host I/O packets in a readily locatable block. Inside the host model, add either a *HostIn* or *HostOut* variable when creating a host I/O packet component:

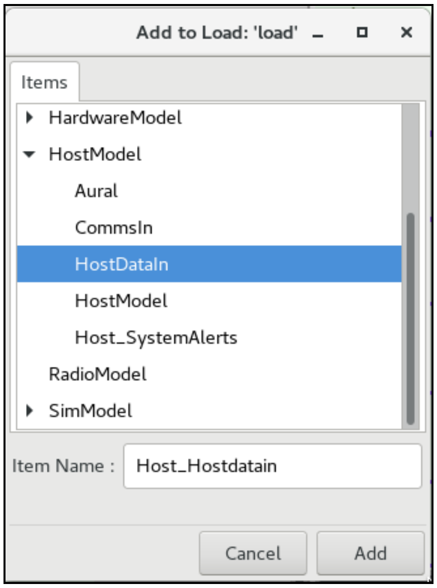


Figure 49: Add a host simulation model

Before getting into the details of *HostIn* and *HostOut*, there are a few general things to note about creating packets. You must assign each packet to a socket, and only one host I/O packet can link to a single socket at a time. Select **change** to assign the packet to a socket.

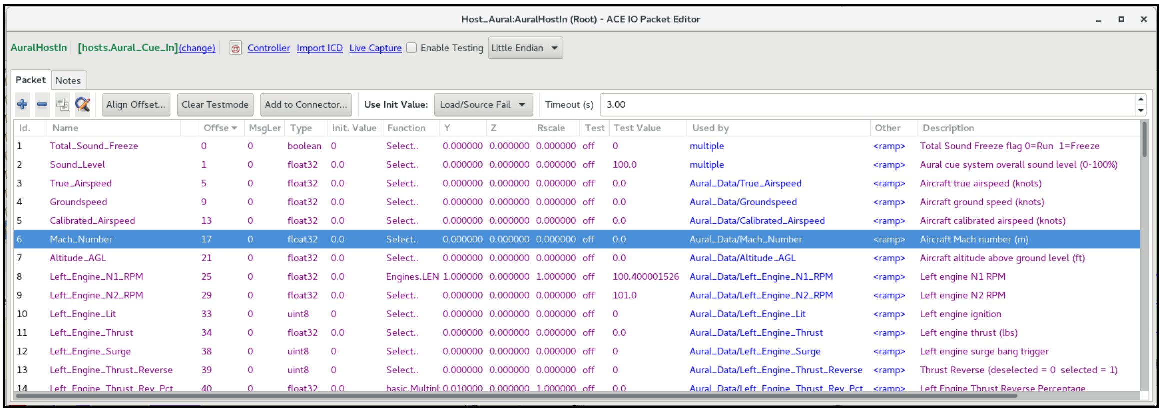


Figure 50: Add a host simulation model

Select **Controller** to view the socket and packet statistics. For *HostIn*, a column exists for the **Fail Threshold** time. If a packet has not arrived within the set amount of time, then ACE Studio assumes a communication failure. For *HostOut* variables, a column exists for **Rate (Hz)**; this is the rate for variables coming in.

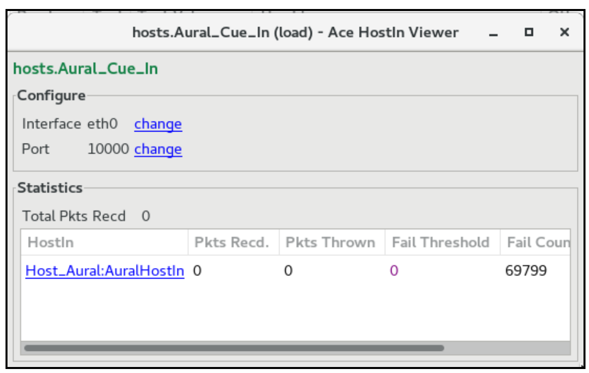


Figure 51: Controller

Host Packet Editor includes the following settings:

- ***Enable Testing***: allows operation of the **Test Mode**, **Test Values**, and other columns to be used for local testing. When deselected, these columns are disregarded.
- ***Live Capture***: opens a window showing the current values for each entry in the ICD in real time if packets are being received. The display may also be captured and saved as a comma-separated value (.csv) file.
- ***Endianness***: set to big or little endianness to match the endianness of the UDP data packet's source.

- ***Align Offset**:* correctly byte-aligns the entries in the ICD. Alignment commences at the location of the highlighted entry in the ICD.

  ***Note**: **Align Offset** does not work for packed bytes.*

- ***Clear Testmode**:* turns off entities in **Test Mode**.
- ***Add to Connector…**:* links entries that you selected in the ICD to a specified connector.
- ***Use Init Value**:*
  - ***Never**:* if the UDP data stops, **HostIn** component outputs equal zero.
  - ***Load**:* when the project loads, **HostIn** outputs **Init Values** until it receives UDP packets and needs to use **Init Values**.
  - ***Load/Source Fail**:* when this setting does not receive UDP packets for a period exceeding the value in the **Timeout (s)**, **HostIn** outputs **Init Value** until **Load/Source Fail** receives UDP packets again.
- ***Timeout (s)**:* sets the threshold for assumed communication failure when a packet has not arrived within the set amount of time in seconds.

For *HostIn*, the host I/O packet defines values for information entering the port:

- ***Name**:* defines the *HostIn* variable name.
- ***Offset**:* sets the offset location in the Ethernet packet in bytes for the variable's data.
- ***Type**:* sets the data type for the variable.
- ***Init. Value**:* sets the initial value for the variable. Options include **never**, **load**, and **load/source fail**.
- ***Function**:* adds a **MathFunction** to apply to the variable.
- ***Scaler**:* applies a scale factor to the **MathFunction** output as a gain entry.
- ***Test Mode**:* toggles between using the host value or the value set in **Test Value**.
- ***Test Value**:* sets the value used for overriding the host value when in **Test Mode**.
- ***Used by**:* sets the variable's destination (e.g., a connector).
- ***Other**:* uses a linear ramp as a test value that cycles between minimum and maximum; toggles Boolean values on and off at a set rate.
- ***Description**:* adds variable details (i.e., maximum and minimum value range).

For *HostOut*, the host I/O packet defines the values for the information going out on the port. The I/O packet values include the following:

- *Name:* defines the *HostOut* name.
- *Offset:* sets the offset location in the Ethernet packet in bytes for the data associated with the variable.
- *Type:* sets the data type for the variable.
- *Used by:* sets where the variable is coming from (e.g., a connector).
- *Description:* adds details about the variable.

7.3 Host interface exercise

This exercise assumes you are familiar with the ACE modeling environment. Figure 52, "Host interface" below shows how to set up the host interface:

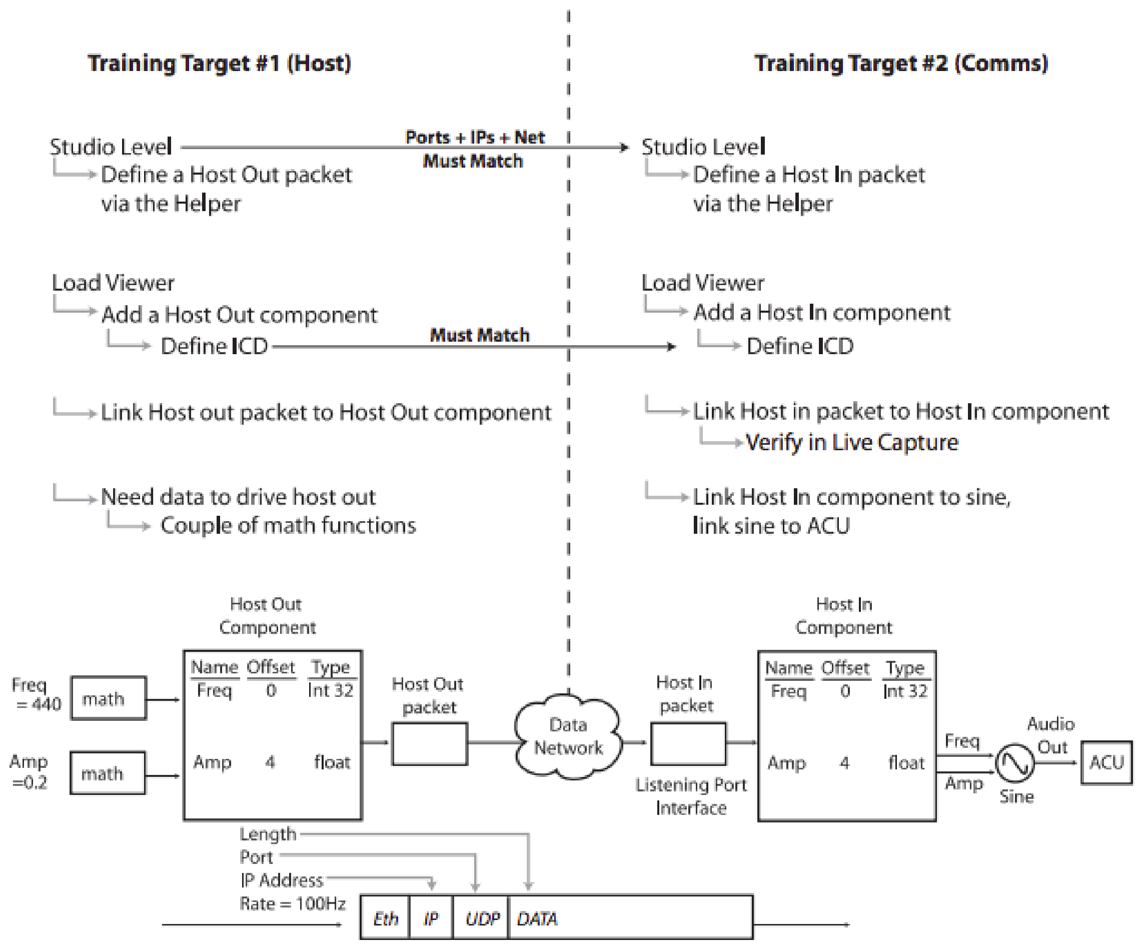


Figure 52: Host interface

8.0 Remote Management System

The Remote Management System (RMS) is a specialized web server that provides complete sight and control of all ASTi devices on the simulation network, ranging from standalone to multisite, exercise-wide network configurations. The RMS provides an easy-to-navigate, user-friendly interface. Using a standard web browser from anywhere on the network, you can accomplish the following tasks:

- View system status and health
- Edit network configurations and upload licenses
- Perform project management
- Set up audio distribution devices and hosts

This chapter discusses the following topics:

- Getting started
- Add a user account
- System
- Licensing
- Audio devices in the RMS

For additional information, go to the *Remote Management System User Guide* (support.asti-usa.com/media/pdf/t4/rms4_ug.pdf).

8.1 Getting started

To log into the Remote Management System (RMS), follow these steps:

1. Open a web browser on a computer sharing a network with the Telestra server.
2. To access the RMS, in the address bar, enter the Telestra server's IP address.
3. In the top-right corner, select **Login**.
4. Log into the system using the following default credentials:

Username	Password
admin	astirules

To set up the Target’s network, go to the *Telestra Quick Start Guide* (support.asti-usa.com/media/pdf/t4/ace_t4_qsg.pdf).

8.2 Add a user account

Before adding a new user account, log in using the default username and password:

Username	Password
admin	astirules

Figure 53, "RMS login screen" below shows the RMS login screen:

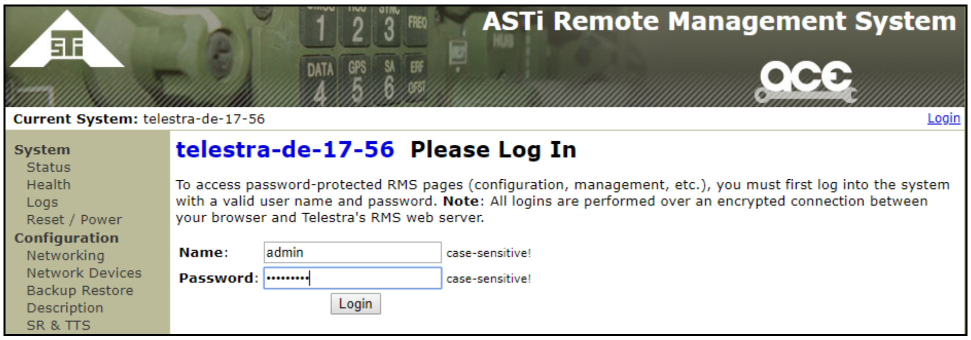


Figure 53: RMS login screen

After logging into the RMS, select **Manage Users** in the top right. On **RMS User Management**, add or edit new user accounts with administrator privileges.

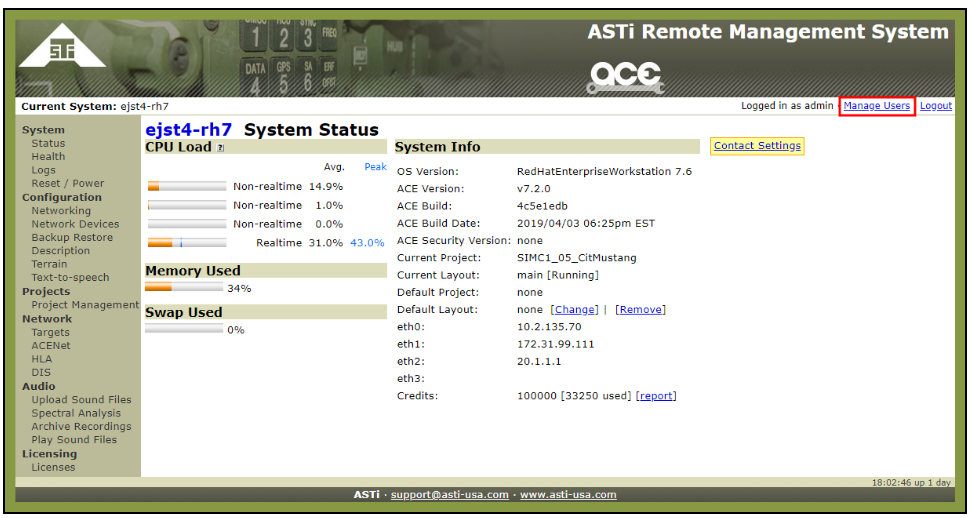


Figure 54: RMS User Management

8.3 System

This section discusses the following topics:

- Status
- Health
- Logs

8.3.1 Status

Go to **System** > **Status** to view the system and installation information. Select **Contact Settings** to enter installation and contact information for the system. This page also displays the Target software version:

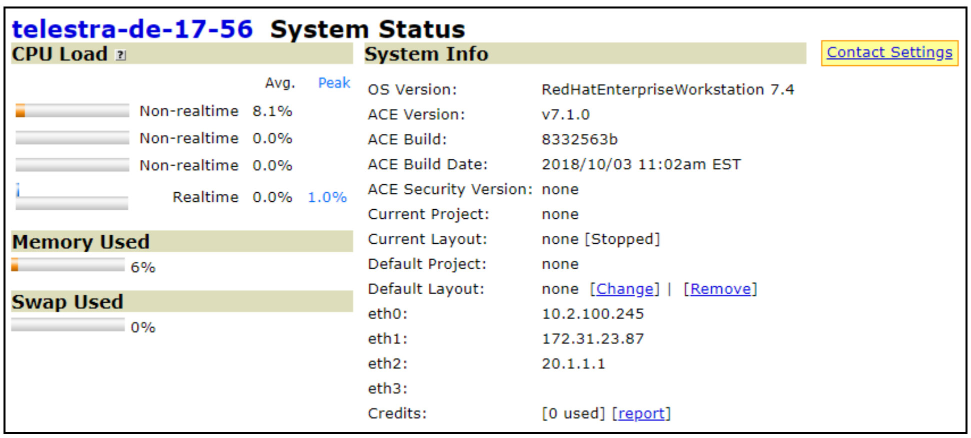


Figure 55: System Status

8.3.2 Health

System > **Health** verifies that the software is running properly. **ACE System Health** allows system debugging by providing low-level, raw information. Most of this information provides ASTi with informative, accurate debugging details. The health system is made of a tree-like structure. Each section includes subsections, and those subsections include additional sub-sections.

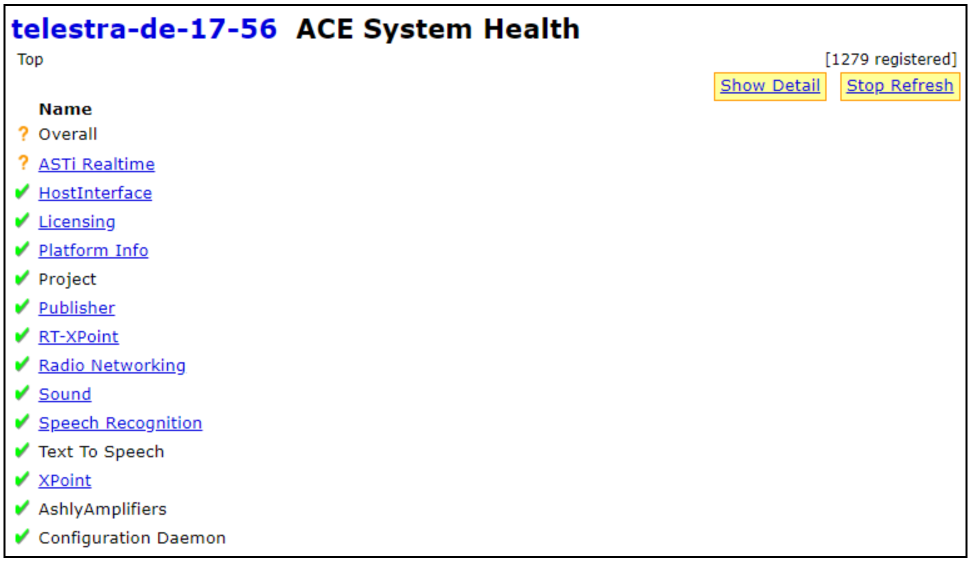


Figure 56: ACE System Health

8.3.3 Logs

System > **Log** displays 100 of the most recent log entries. Download the log files to the local system to view the log details. Filter capabilities provide quick search capabilities for debug, information, warnings, and errors.

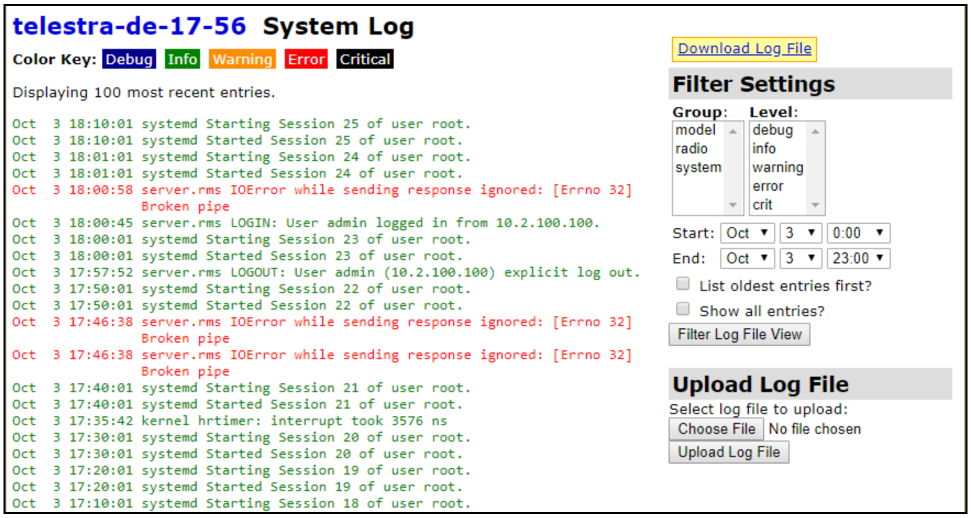


Figure 57: System Log

8.4 Licensing

ASTi's licenses are tied to USB License Keys, which are DoD-approved devices covered under ASTi's Authority to Operate (ATO) and Risk Management Framework (RMF) accreditation. Upon delivery, each USB License Key activates a predefined set of software functionality for any system running Telestra software. This includes ASTi-provided hardware, customer-furnished equipment (CFE), government-furnished equipment (GFE), and virtual machines (VMs). USB License Keys also give you the ability to transfer functionality among systems and receive loaner and trial licenses. To learn more about USB License Key benefits and FAQs, go to USB License Keys and your ASTi System (#123).

This section discusses how to:

- View licensing information
- Install a USB License Key
- Update a USB License Key

8.4.1 View licensing information

On **Licensing Management**, under **Available Options**, view the total credits and options available to your system:

Available Options		
Credits	100000	
Data Link Interface	✓	
HLA	✓	
IA	✓	
Level D Spectral Analysis	✓	
Propagation Loss Interface	✓	
Speech Recognition	✓	2 streams
Telestra Runtime	✓	
Terrain Database Server	✓	
Text-to-Speech	✓	2 streams
Vibration Analysis	✓	

Figure 58: License Available Options

Licenses shows a list of installed USB License Keys:

- License ID
- License type (i.e., hardware or software)
- Model
- Version
- The date the license was generated
- Error message, if applicable

Green licenses are active with no errors, while yellow licenses will expire in the next 90 days or sooner. Red licenses have already expired. If a system is unlicensed, a warning displays at the top of the page. Minimum functionality may still be available on unlicensed systems. However, if you would like to use the application's full feature set, contact ASTi to update your USB License Key.

Figure 59, "Installed licenses" below shows an example of installed licenses:

Licenses

ID	Type	Model	Version	Date	Error	Details	
88275080	Hardware	Max	4.27	[illegible]		Show	Download
102768155	Hardware	Max	4.27	[illegible]		Show	Download
1830087180	Hardware	Max	4.27				Download

Figure 59: Installed licenses

Under **Details**, select **Show** to view the license's individual credits, options, and expiration dates:

Licenses

ID	Type	Model	Version	Date	Error	Details	
88275080	Hardware	Max	4.27	[illegible]		Hide	Download

Name	Qty.	Expired?	Exp. Date
Credits	250000	No	
Data Link Interface	1	No	
HLA	1	No	
IA	1	No	
Level D Spectral Analysis	1	No	
Propagation Loss Interface	1	No	
Speech Recognition	4 streams	No	
Telestra Runtime	1	No	
Terrain Database Server	1	No	
Text-to-Speech	4 streams	No	
Vibration Analysis	1	No	

Figure 60: Individual license details

8.4.2 Install a USB License Key

When you first receive one or more ASTi USB License Key(s) with a shipment, you must insert your licenses into the applicable Telestra server(s).

To install your USB License Key(s), follow these steps:

1. Insert the USB License Key(s) into the applicable servers.
2. Open a web browser on a computer sharing a network with the Telestra server.
3. To access the RMS, in the address bar, enter the Telestra server's IP address.
4. In the top-right corner, select **Login**.
5. Log into the system using the following default credentials:

Username	Password
admin	astirules

6. On the left, go to **Licenses**.

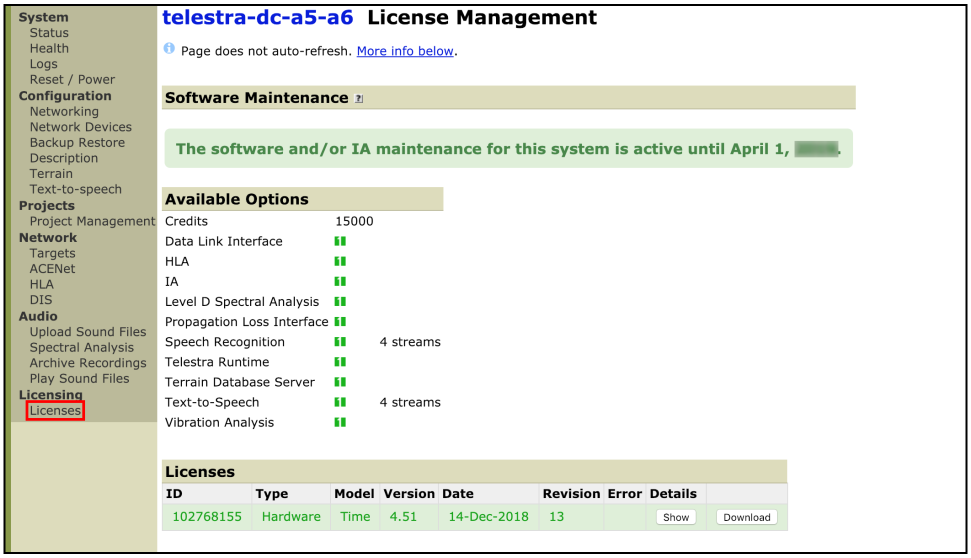


Figure 61: Licenses navigation

7. Under **Licenses**, find your license's ID to confirm that it is active. This ID is printed on the tag attached to your USB License Key.

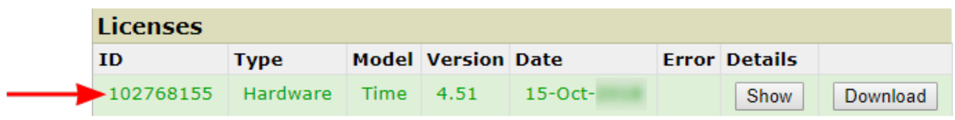


Figure 62: Active license ID

8.4.3 Update a USB License Key

You may need to update ASTi USB License Key(s) to expand or alter system functionality (e.g., receive a software trial, add more clients). ASTi provides a License Key Update (.lku) file that you can upload to the Telestra server. Updating a USB License Key or changing its license terms does not require returning it to ASTi. A single file can also update multiple keys.

To update USB License Key(s), follow these steps:

1. Insert the USB License Key(s) into a Telestra server.
2. Open a web browser on a computer sharing a network with the Telestra server.
3. To access the RMS, in the address bar, enter the Telestra server's IP address.
4. In the top-right corner, select **Login**.
5. Log into the system using the following default credentials:

Username	Password
admin	astirules

6. On **Licensing Management**, under **Update/Install a License**, select **Choose File**, and find the License Key Update (.lku) file on your local system.

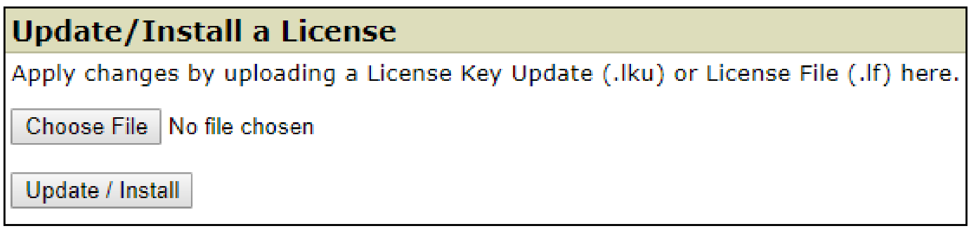


Figure 63: Update/Install a License

The new license displays under **Licenses**:

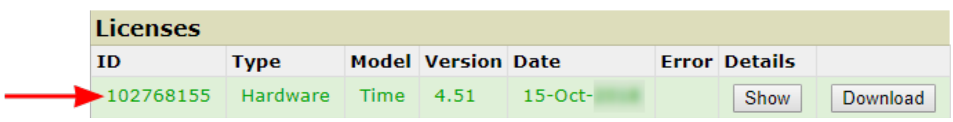


Figure 64: Active license

8.5 Audio devices in the RMS

Network > **ACENet** displays all the devices available on the ACENet network. Select the device to rename it, or set the input and output gains for each device channel.

__Note__: You can only set or change the gains if the device is part of the model currently running on the system.

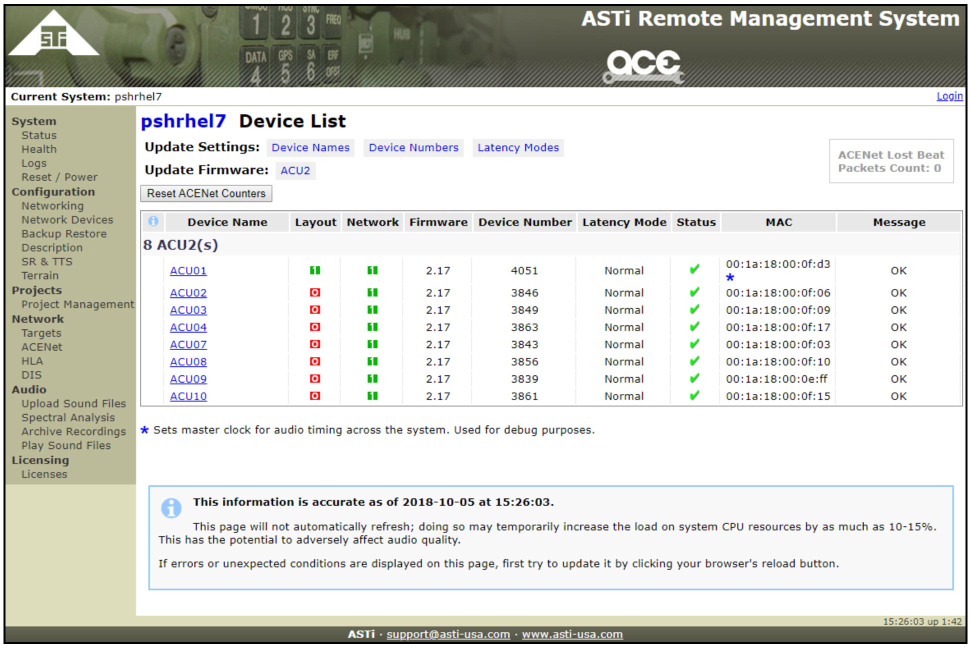


Figure 65: Device List

The Remote Management System provides a wide variety of functions beyond the scope of this document. For additional information, go to the *Remote Management System User Guide* (support.asti-usa.com/media/pdf/t4/rms4_ug.pdf).

9.0 ACE Studio model building

This section discusses ACE Studio model building from simple sine waves to creating radio models. The hands-on exercises build on each other because it assumes a certain level of knowledge as you work your way through the exercises.

This document does not take the place of an ASTi training course. ASTi recommends a three-day training course, which includes intensive hardware and software familiarization and model building assistance oriented to your application.

This chapter discusses the following topics:

- Sine wave
- Mixer
- Vox folder organization
- Math Plan
- Playsound
- Intercoms
- Radios
- Add a communication model with helpers

9.1 Sine wave

Figure 66, "Sine wave exercise" below shows an example of a sine wave exercise:

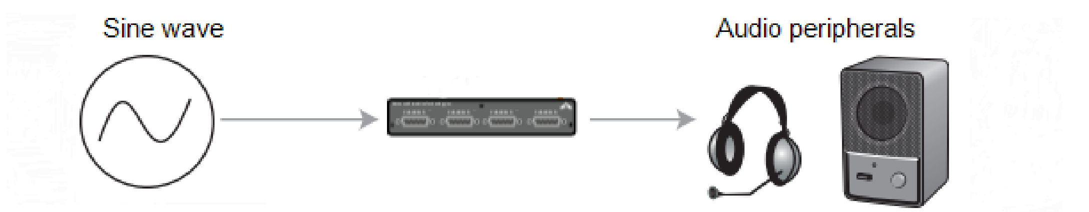


Figure 66: Sine wave exercise

This section discusses how to do the following:

- Build a model
- Connect an ACU2 to the model

9.1.1 Build a model

To build a model, follow these steps:

1. From the desktop, open ACE Studio.
2. To open a project, select **Project**. A screen opens, showing all the Targets on the network.
3. To view the projects located on each Target, expand each Target in the list.
4. Choose an existing project, or create a new one. To create a new project, choose a Target, and select the plus sign ().
5. Enter a name for the new project.
6. To view the layout, under **Projects**, select **main**. Main is the default layout icon view of the project. You can also add a new layout, starting with a blank canvas. Add each item one by one.
7. To install the contents of the project on the designated Target, select **Install Layout**. The project continues to run as you build models.
8. In the layout, right-click the server icon ().
9. To open **Model Viewer**, double-click the server icon ().
10. Right-click the **Load** canvas, and select **Add**.
11. To create the model canvas, select **Sim Model**, and name it **Audio_Out_Example**.

> ***Note**: When naming files, use an underscore (_) instead of a space.*

12. To open the model, double-click the **Audio_Out_Example** model icon.
13. To add an item, right-click the canvas. Expand the **Audio** tab, and select **Wave**.
14. Name the component **Sine_Wave1**.

15. Select **Add**.

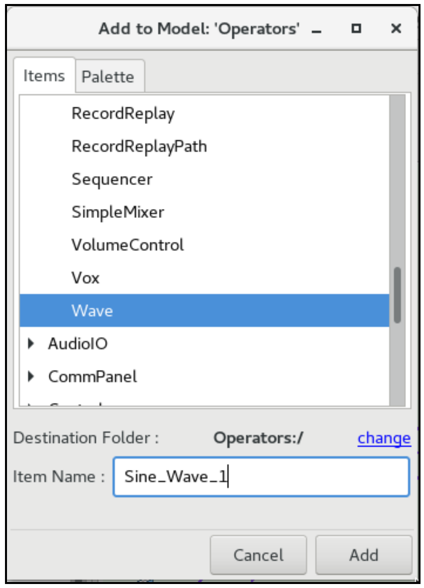


Figure 67: Add sine wave

16. To open **ACE Data Viewer**, double-click **Sine_Wave1**.

17. Set **Frequency** to **440**.

18. Set **Gain** to 0.20.

19. Expand **OutSignal**, and select **view scope**. This action creates a sine wave generator with a frequency of 440 Hz and an amplitude of 0.2.

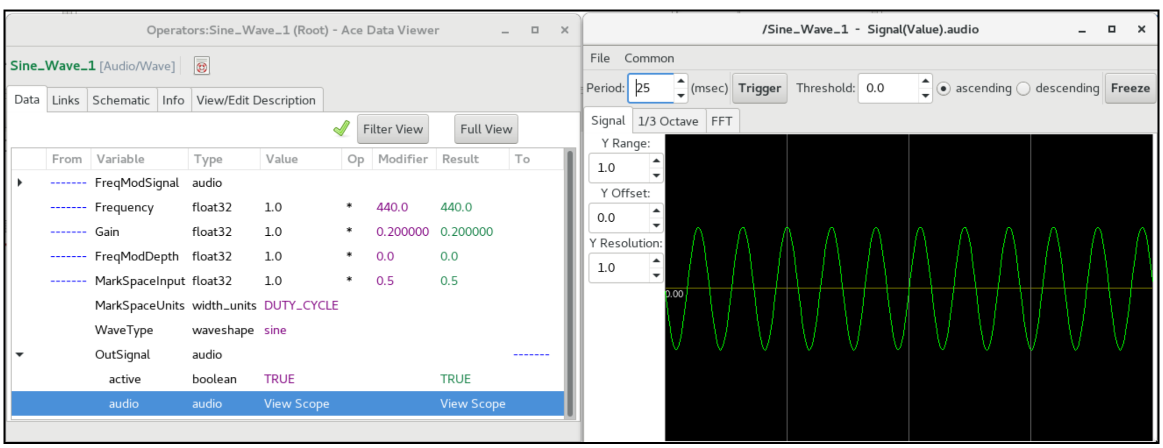


Figure 68: Sine wave

9.1.2 Connect an ACU2 to the model

To connect an ACU2 to the model, follow these steps:

1. To add an item, right-click **Model** on the canvas.
2. Under **IOInterfaces**, select **ACU2channel**, and name it **ACU2_1**.
3. Select **Add**.
4. Double-click **ACU2_1** to open **ACE Data Viewer**.
5. In **Identifier**, under **Value**, double-click and enter the ACU2's name. If an ACU2 is connected to ACENet, select it from the drop-down box.

> ***Note***: *By default, each ACU2 comes with a unique name. You can change this name in the Remote Management System (RMS). To view the names of all ACU2s on the network, go to* ***RMS Network*** *>* ***ACUNet****.*

6. In **Channel**, double-click **None**.
7. In the drop-down box, select **Channel A**.

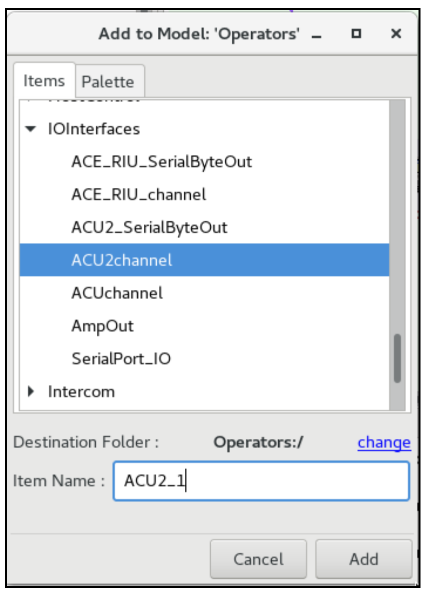


Figure 69: Add ACU2

Figure 70, "Channel A ACU2" below shows **acu2_channel A**:

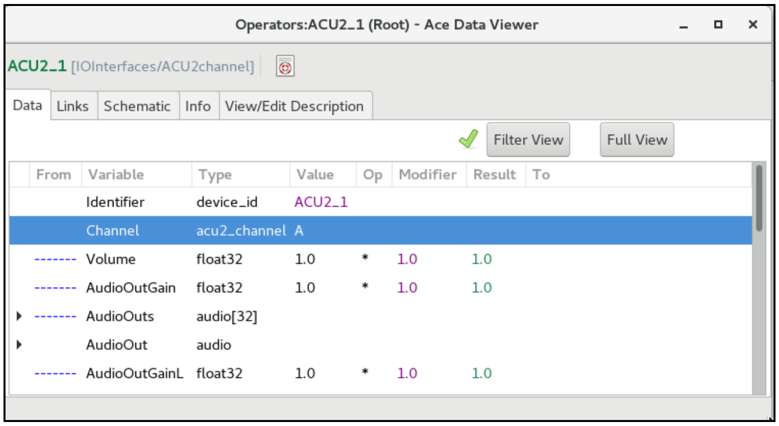


Figure 70: Channel A ACU2

8. To route the generated audio out, link **Sine_Wave1** to **ACU2_1**.

9. To connect **Sine_Wave1** to **ACU2_1**, select **Sine_Wave1**, which opens **ACE MODEL LINK EDITOR**.

10. To link the signal, select **Sine_Wave1** with the *OutSignal* to ACU2_1 with the *AudioOuts* signal, as shown in Figure 71, "ACE MODEL LINK EDITOR" below. The signal options appear after selecting each component.

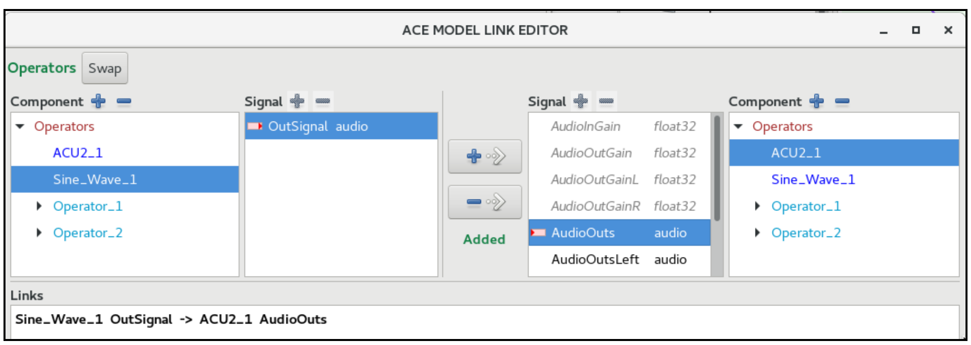


Figure 71: ACE MODEL LINK EDITOR

11. To create the link, select .

12. Apply the changes.

13. Connect a headset to Channel A of the ACU2, and listen to the sine wave.

9.2 Mixer

Mixer mixes up to eight signals into a single, composite signal. The **Mixer** variables determine which of the eight signals should mix with individual and overall gain control. A ninth signal always mixes into the output signal and cascades multiple **Mixers**.

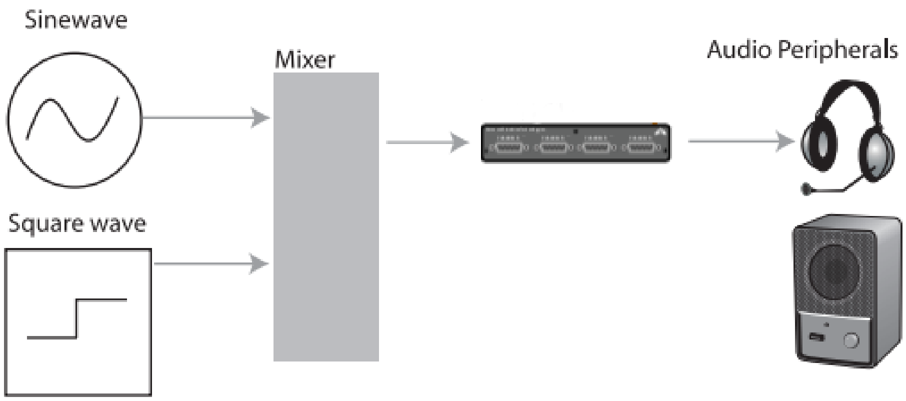


Figure 72: Mixer project

To add a **Mixer**, follow these steps:

1. Add a new project, and install it.
2. In the load, add a simulation model, and name it.
3. Open the new model.
4. Add two **Wave** components, and name them **Sine_Wave** and **Square_Wave**.
5. Add a **Mixer** and **ACU2 Channel** component.
6. Name the components **Mixer** and **ACU2channel_A**.
7. Open **Sine_Wave**, and set the frequency (e.g., 400).
8. Route **Sine_Wave** *OutSignal* to **Mixer** *signal1*.
9. Open **Square_Wave**, and set the frequency (e.g., 300). Route the **Square_Wave** out signal to the **Mixer** input **signal2**.
10. Open the ACU2 object, and select an ACU2 and channel A.

11. Route the **Mixer** *OutSignal* to the ACU2 channel *AudioOut*.

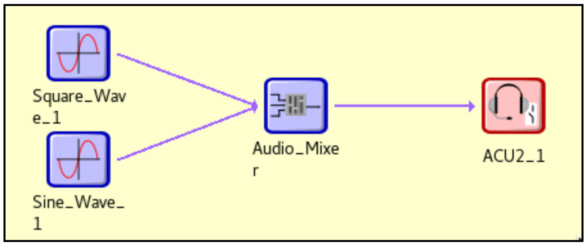


Figure 73: Mixer links

12. Apply the changes.

13. Listen to the mixed sound waves from the output device connected to the proper ACU2 channel.

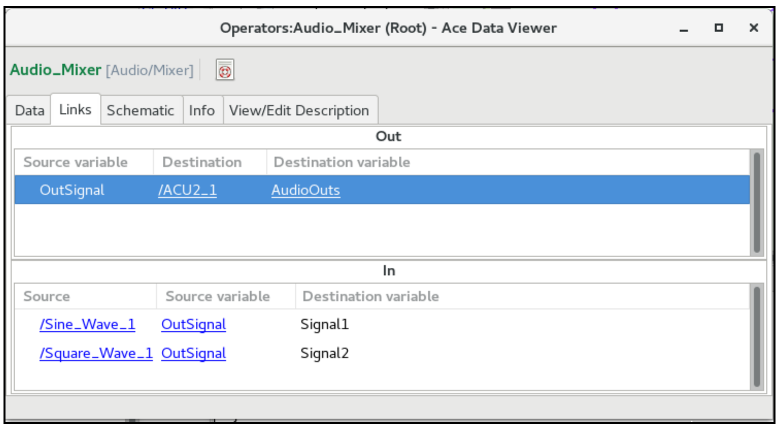


Figure 74: Mixer component links

9.3 Vox folder organization

Vox allows voice-activated or press-to-talk (PTT) control over an audio input signal. The model also demonstrates using model folders for organization.

Note: First connect a speaker to the ACU2 on Channel A and connect a headset with the microphone and PTT to the ACU2 on Channel B.

To use the **Vox** component, follow these steps:

1. Add a new project, and install it.

2. Open **Model Viewer**, add a new simulation model, and name it.

3. Open the model, and add two folders. Name the folders **ACU2_Folder** and **Audio_Folder**.

4. Open **ACU2_Folder**, add two **ACU2 Channels**, and name them **Channel_A** and **Channel_B**.
5. Open **Audio_Folder**, and add **Vox**, **Mixer**, and **Wave**.
6. Open **Wave**, and set *Frequency* and *Gain*.
7. Using the link editor, route **Wave** *AudioOut* to **Mixer**.
8. Open **Vox**, and route *AudioOut* to **Mixer**.
9. Open **Mixer**, and route *AudioOut* to **ACU Channel_B**.
10. Open **Channel_A**, and route the audio in to **Vox**. In **Model View**, the folders show connections between them:

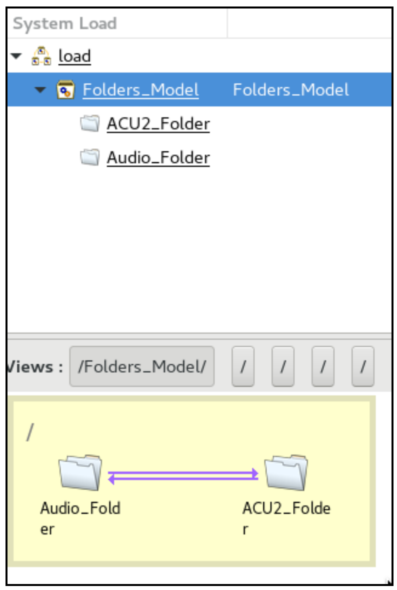


Figure 75: Folders_Model

Opening **Audio_Folder** shows the objects in other folders that are connected to the **Audio_Folder** objects.

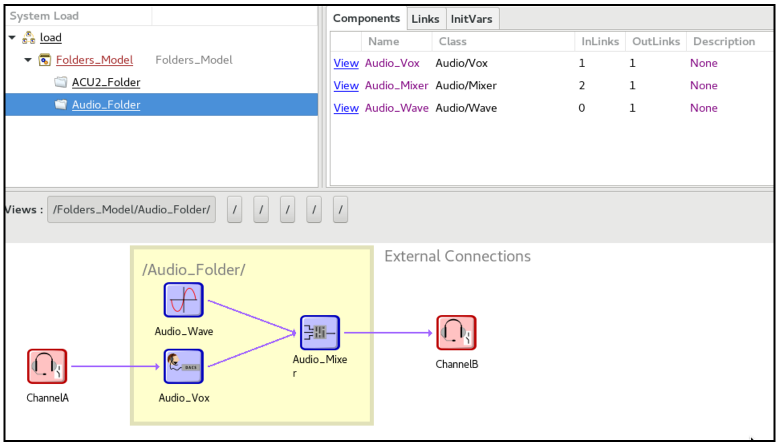


Figure 76: Folders_Model links

When opened, **ACU2_Folder** shows the objects in other folders that are connected to **ACU2_Folder**:

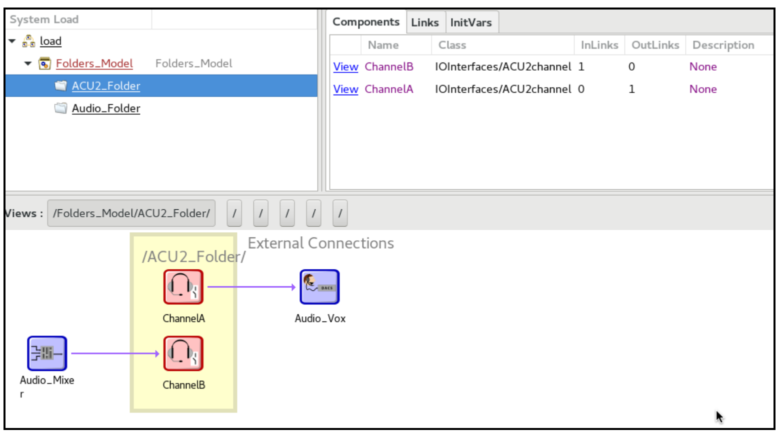


Figure 77: ACU2_Folder

To add PTT capability to the headset and microphone using **Vox**, add a link from **Channel A** *PTT* output to the **Vox** *PTT* input.

9.4 Math Plan

The **Math Plan** in ACE Studio provides access to various mathematical functions, which may be applied to the layout. The functions permit local manipulation of data within the models. The **Math Plan** objects include the following:

- Add
- Subtract
- Multiply
- Divide
- Logical-AND
- Logical-OR
- Logical-XOR
- Table
- TableDB
- TableXY
- Scale and Limit
- Lag Filter
- Random Number
- Comparator
- Max Min
- Switch
- Polynomial
- Log
- Antilog

Figure 78, "Mathplan Editor" below shows **Mathplan Editor**:

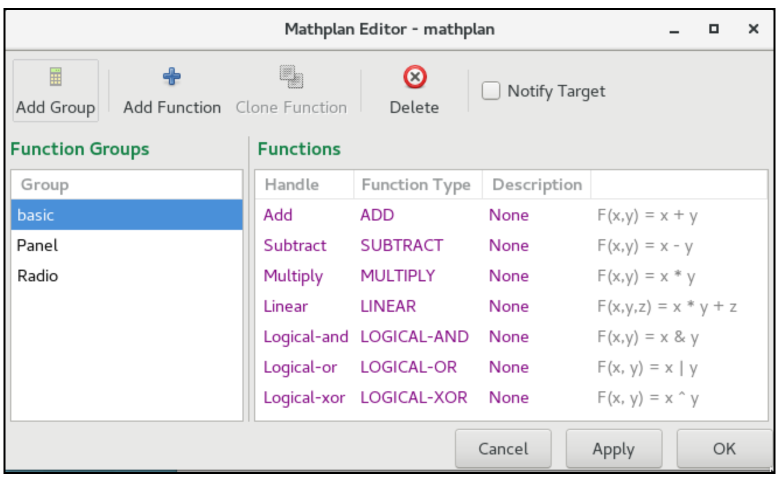


Figure 78: Mathplan Editor

9.5 Playsound

Figure 79, "Playsound process" below demonstrates the use of a **Playsound** and the sound library by creating a simple **Playsound** model. **Playsound** plays digitally encoded sound files. Sounds that have no dynamically varying elements except for overall volume level are best handled as fixed, offline, recorded sound files (e.g., missile launch).

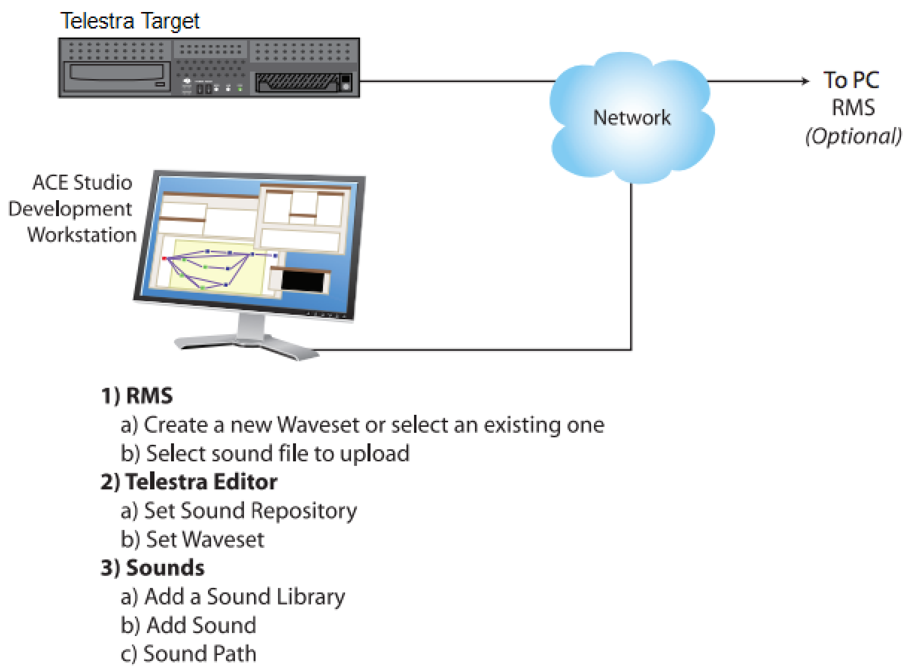


Figure 79: Playsound process

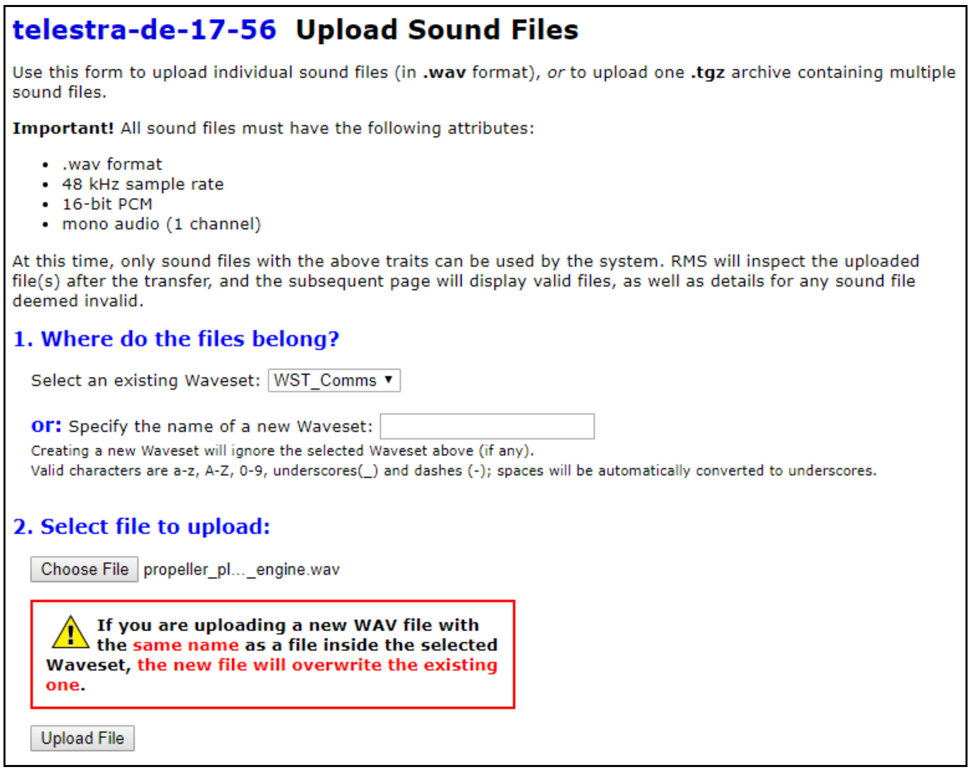
This section discusses how to do the following:

- Upload Sound Files
- Add a sound library

9.5.1 Upload Sound Files

Upload Sound Files provides a two-step process to uploading sound files on the system. You must first select a waveset or create a new one. The **waveset** folder contains the sound files in the sound repository. Upload the selected sound files to **waveset**.

Important*: All sound files must be in the following format: 16-bit, PCM, MONO, WAV files with a 48 kHz sample rate. The RMS yields you an error if the file is not in this format.*



telestra-de-17-56 Upload Sound Files

Use this form to upload individual sound files (in **.wav** format), *or* to upload one **.tgz** archive containing multiple sound files.

Important! All sound files must have the following attributes:

- .wav format
- 48 kHz sample rate
- 16-bit PCM
- mono audio (1 channel)

At this time, only sound files with the above traits can be used by the system. RMS will inspect the uploaded file(s) after the transfer, and the subsequent page will display valid files, as well as details for any sound file deemed invalid.

1. Where do the files belong?

Select an existing Waveset: WST_Comms

or: Specify the name of a new Waveset:

Creating a new Waveset will ignore the selected Waveset above (if any).
Valid characters are a-z, A-Z, 0-9, underscores(_) and dashes (-); spaces will be automatically converted to underscores.

2. Select file to upload:

Choose File propeller_pl..._engine.wav

If you are uploading a new WAV file with the same name as a file inside the selected Waveset, the new file will overwrite the existing one.

Upload File

Figure 80: Upload Sound Files

9.5.2 Add a sound library

By default, when a new project is created, ACE Studio automatically creates a default sound repository called **sounds**. *(Optional)* To rename the sound repository, follow these steps:

1. Right-click **sounds** on the canvas.
2. Select **Clone and Replace**.
3. Enter a new name for the repository.
4. Right-click **Telestra**, and select **edit**. Under **core**, you can view the sound repository's new name.

To upload sound files to the Target, open the Remote Management System (RMS), and go to the **Audio** section. Open **Upload Sound Files**, and follow the instructions to add individual .wav files, or upload one .tgz archive containing multiple sound files. For more information about uploading sound files, go to the *Remote Management System User Guide* (support.asti-usa.com/media/pdf/t4/rms4_ug.pdf).

Important: *All sound files must be in the following format: 16-bit pulse-code modulation (PCM) MONO .wav files with a 48 kHz sample rate. The RMS gives you an error if the file is not in this format.*

To locate sound files on the Target, log into the Target via Secure Socket Shell (SSH) protocol. From the **Project Manager**, right-click **Telestra** in the layout, and select **ssh**. In the terminal, enter the following: **cd /var/local/asti/soundfiles/***waveset*, where *waveset* represents the waveset's name.

To add a sound library, follow these steps:

1. Create a new project, and install it.
2. In the layout, open **Telestra Editor**.
3. Add a folder name in **Waveset**. The **waveset** folder contains the sound files when you upload them to the Target.

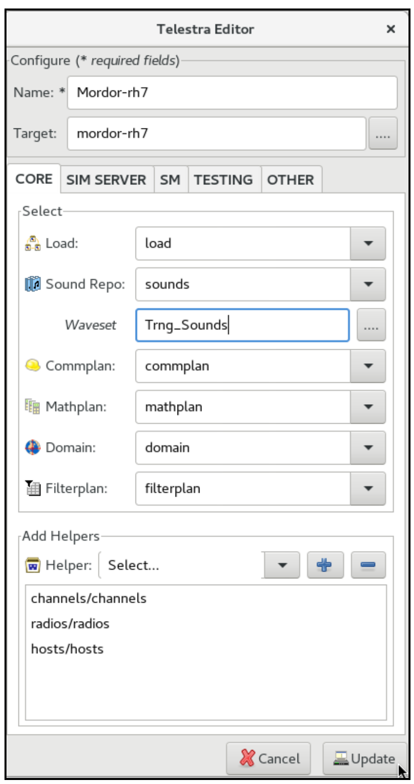


Figure 81: Set a waveset

4. Select **Update**.

5. Open **Model Viewer**, add a new simulation model, and name it.

6. Go to to the model canvas, and add **Playsound**.

7. Add two **ACU2channel** components, and name them **ACU2Channel_A_Speaker** and **ACU2Channel_B_PTT**.

8. Save and close **Model Viewer**.

9. On a web browser, go to **RMS Audio** > **Upload Sound File**. Follow the directions on the page to upload two sound files. The files must be previously located the work-station to do this.

> ***Note**: All sound files must be in the following format: 16-bit PCM MONO wave files with a 48 kHz sample rate. If needed, convert the audio files to this format using Audacity, which is included on the ACE Studio virtual machine.*

10. Go to the project, and open the sound repository by double-clicking **Sounds**.

11. Add a new sound library, and name it.

12. Add a new sound, and enter the name of the sound. Double-click **Path**, where it says **Select...**, and choose the sound file to associate with that name.

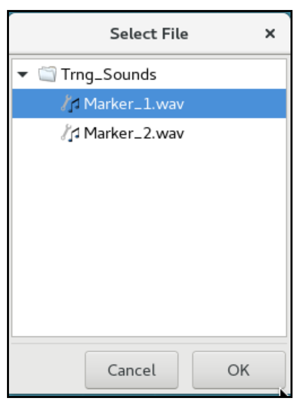


Figure 82: Select a playsound

13. Repeat Step 2 for the second sound file.

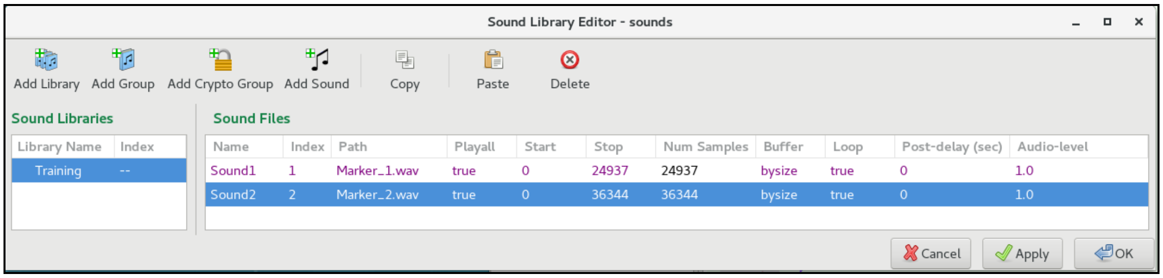


Figure 83: Sound Library Editor

14. To close the window, select Apply and OK.
15. Save the project, and reinstall the layout.
16. Open **Model Viewer**, go to the **Model** canvas, and open the **Playsound** component. In the **Value** of *LibraryId*, enter the sound library's name.
17. Open **ACU2channel_B_PTT**, and set the ACU2 *Identifier* and *Channel*.
18. Open **ACE MODEL LINK EDITOR**, and route the **ACU2channel_B_PTT** *PTTselect* to the **Playsound** *SoundIndex*.

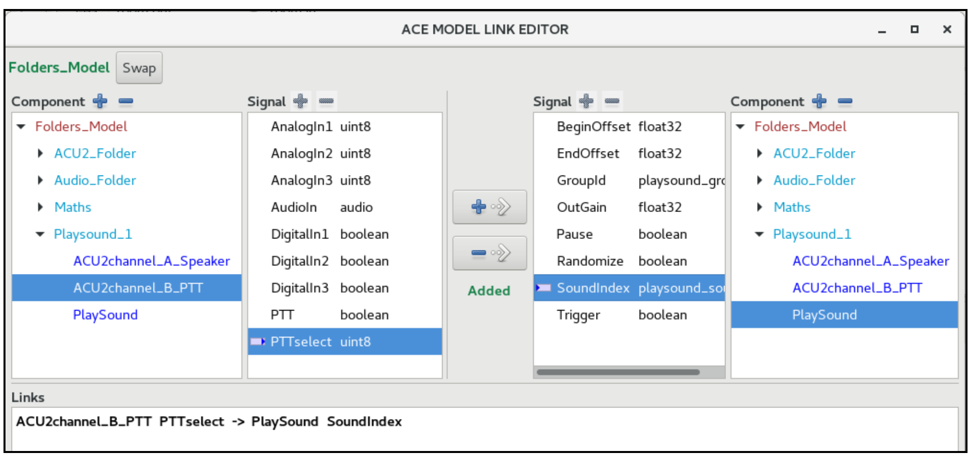


Figure 84: PTTselect link

19. To trigger the **Playsounds**, route the **ACU2Channel_B_PTT** component's *PTT* output to the **Playsound** component's *Trigger* input.

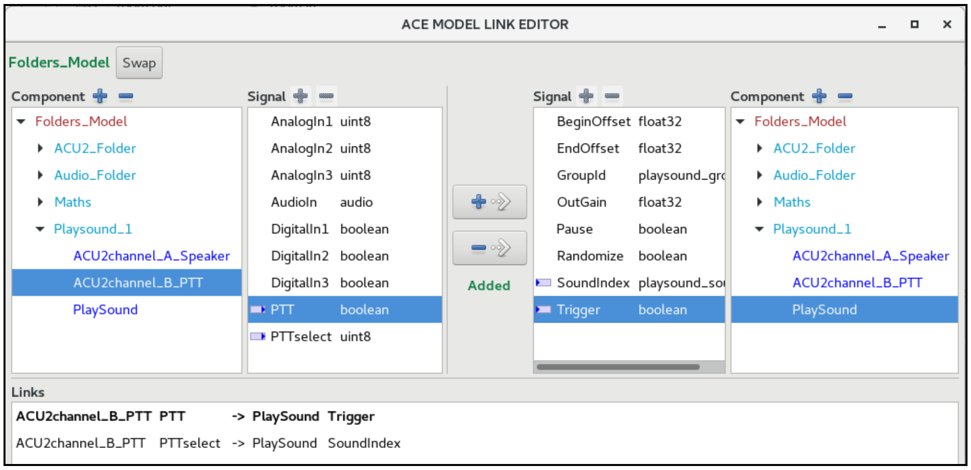


Figure 85: PTT link

20. Route the **Playsound** audio output to the ACU2 audio output to play through the speaker.

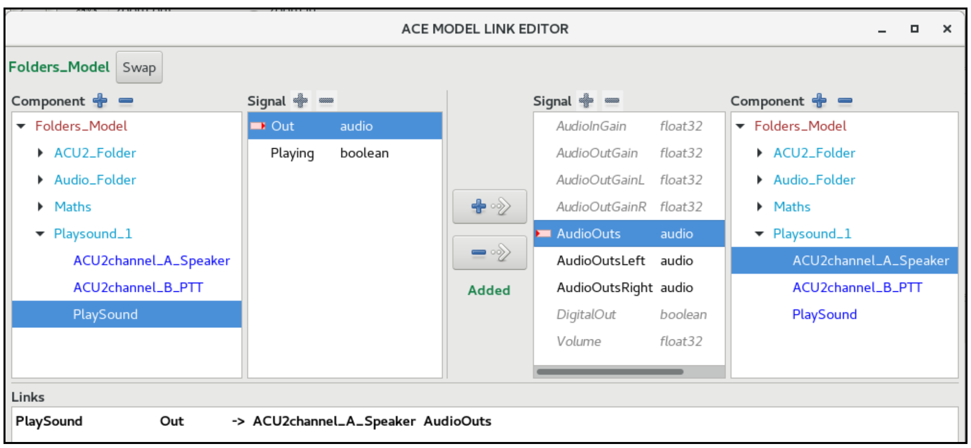


Figure 86: Audio output link

21. Open **ACU2channel_A_Speaker**, and set the *Identifier* and *Channel A*.

22. Save and exit **Model Viewer**.

23. In **Project Manager**, save and reload the model. Each sound should play from the speaker by switching between PTT Channels 1 and 2.

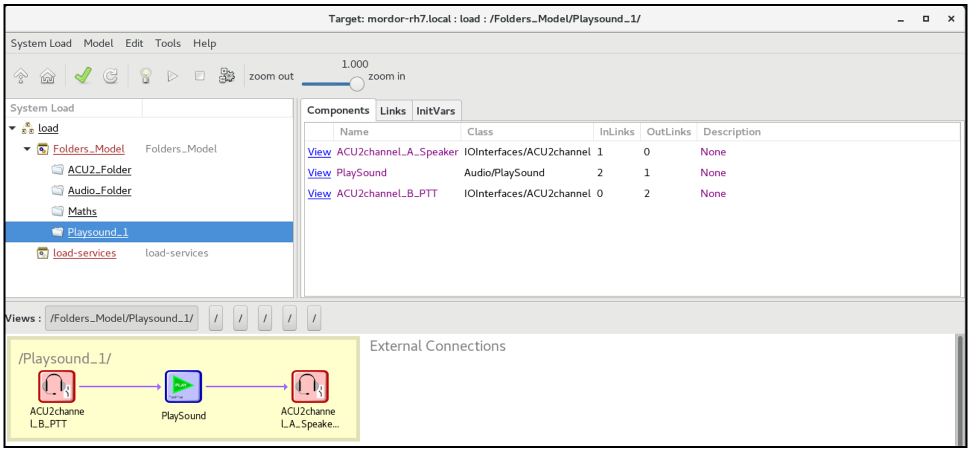


Figure 87: Playsound model

24. Connect a speaker to the ACU2 in Channel D, and connect a headset with a microphone and four-channel PTT to the ACU2 in Channel B. Use the PTT channel select to choose a **Playsound** to review.

9.6 Intercoms

This section demonstrates the use of Intercoms by creating a model with two operators operating on four buses using a PTT switch with the **CommPanel** component. The basic concept of the **CommPanel** is the connection of an operator input (usually a microphone, often via a **Vox** component) through a PTT gate and gain stage with an optional control input and scaling factor via a control selector switch to an intercom channel (bi-directional) provided by the **Intercom** service. The intercom channel may be connected to various other component types to provide connectivity to other audio components, or may simply be used as a basic intercom to provide standard intercom voice communications.

A simple example using the intercom bus includes two operators each with a four-channel PTT switch. When both operators are on the same channel (intercom bus) they can communicate and listen to the same audio. Each operator needs their own **CommPanel** component.

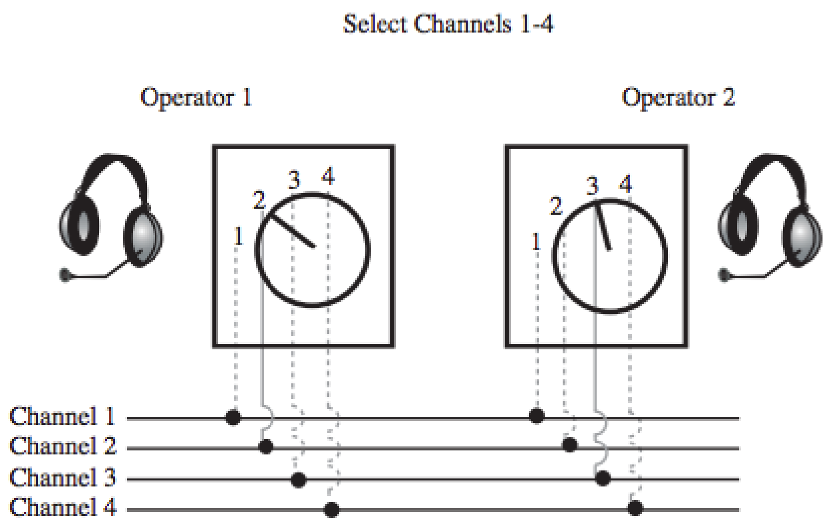


Figure 88: Intercom system diagram

9.6.1 Intercom exercise

To complete the **Intercom** exercise, follow these steps:

1. In ACE Studio, create a new project, and install it. In **Model Viewer**, add a simulation model to create the canvas for building the model.

2. In the model canvas, add a new folder, and name it **Op1**.

3. In the folder, add a **CommPanel4** component, and name it **Op_Panel**.

4. Add an **I/OInterface** > **ACU2channel** component, and name it **Op_ACU2channel**.

5. Add a link to route the audio in from the headset microphone to the **Op_Panel** (**CommPanel**), select the **Op_ACU2channel** *AudioIn*, and link it to the **Op_Panel** *InSignal*.

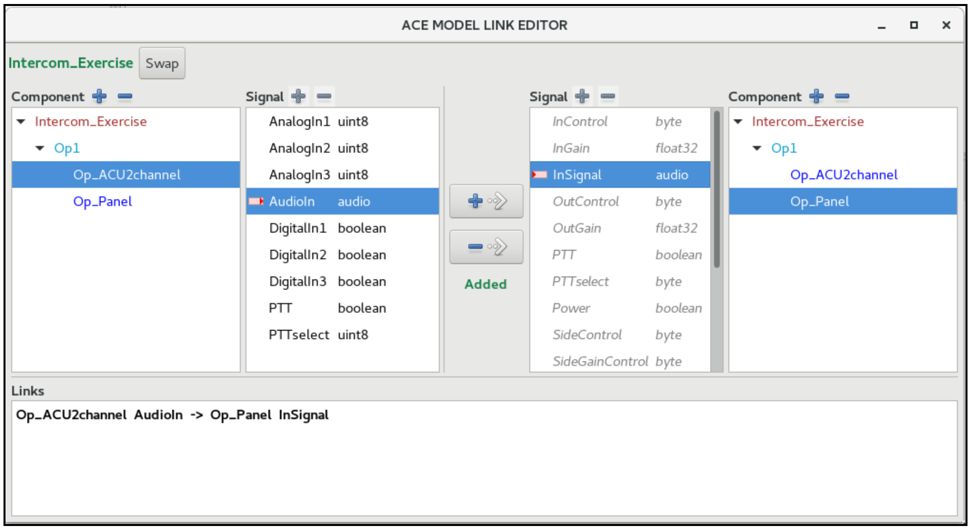


Figure 89: Audio input connection

6. Add a link to route the PTT from the ACU2 to the **Op_Panel** (**CommPanel**) PTT, select the **Op_ACU2channel** *PTT* signal, and link it to the **Op_Panel** *PTT* signal.

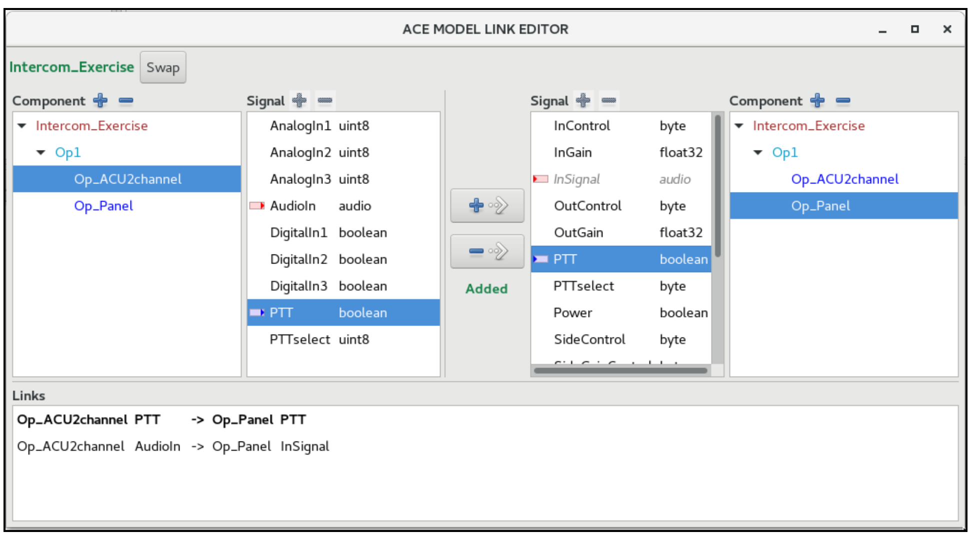


Figure 90: PTT connection

7. Create a link to route the audio out to the headset. Select the **Op_Panel** *OutSignal*, and link it to the **Op_ACU2channel** *AudioOuts* signal.

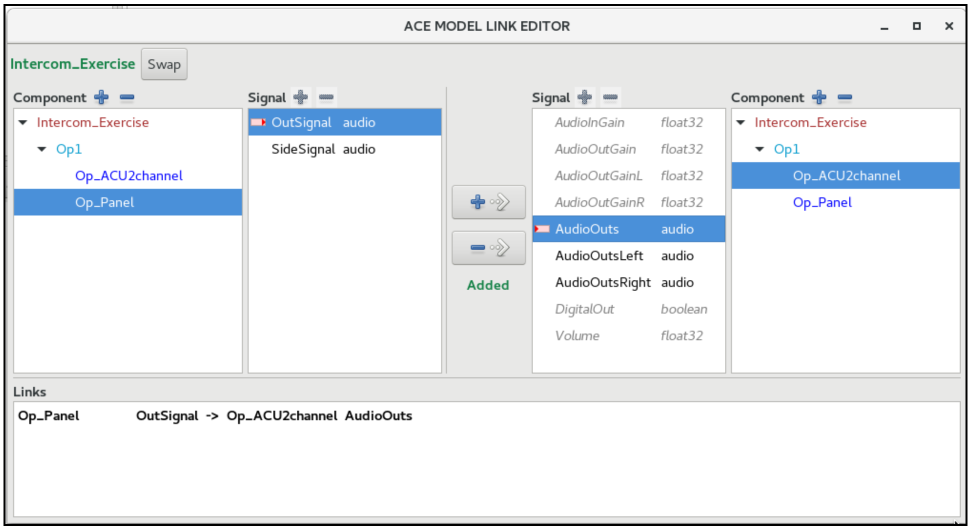


Figure 91: OutSignal connection

8. Add a link to route the sidetone of the headset back into the headset. This allows you to hear yourself through the headset. Select the **Op_Panel** *SideSignal*, and link it to the **Op_ACU2channel** *AudioOuts*.

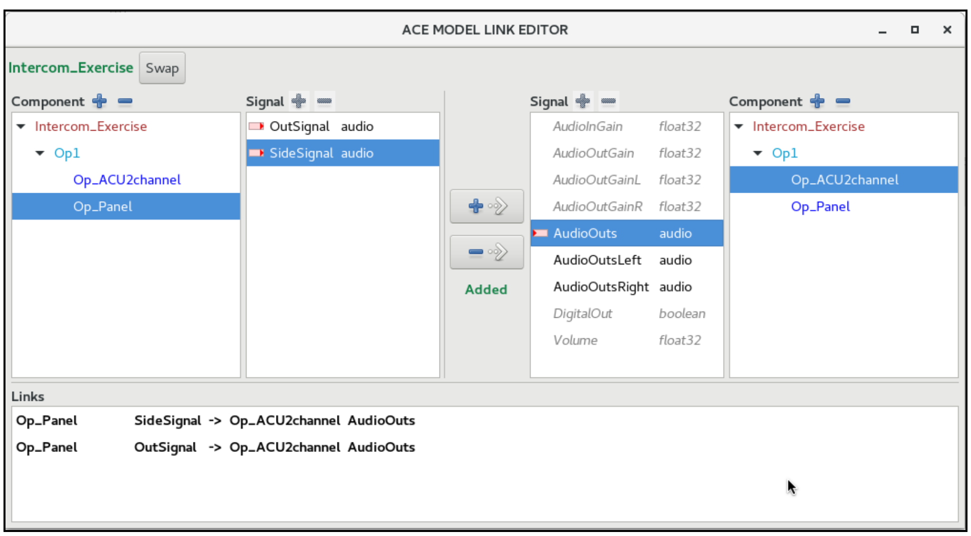


Figure 92: Side signal connection

9. Add three links for the PTT knob selection control. Select the **Op_ACU2channel** PTT-select, and link it to the **Op_Panel** *OutControl*, *InControl*, and *SideControl*.

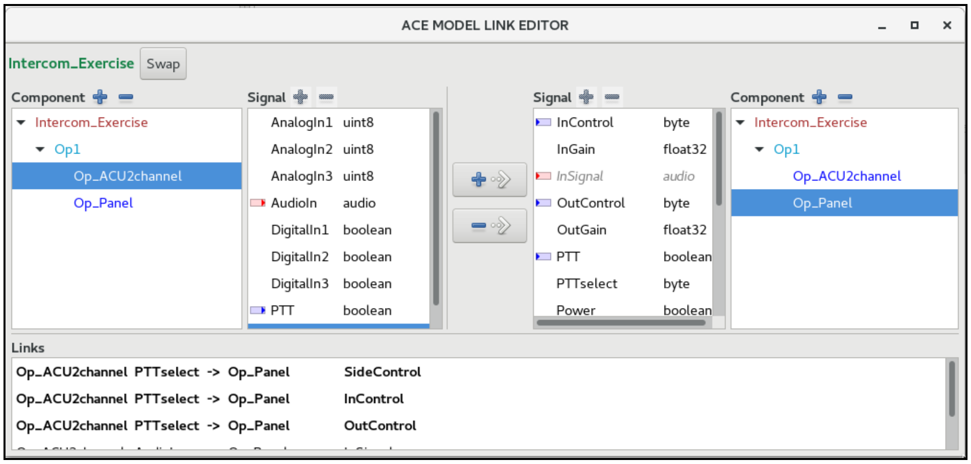


Figure 93: PTTselect connection

10. To open the **Intercom Bus Service**, in **Op_Panel**, select **IntercomBusService**.

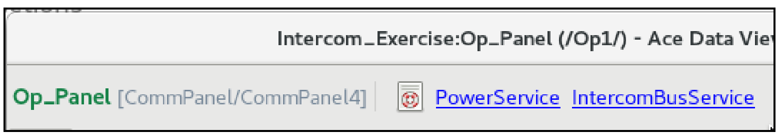


Figure 94: IntercomBusService link

11. In **IntercomBusService**, add four new buses, and name them.

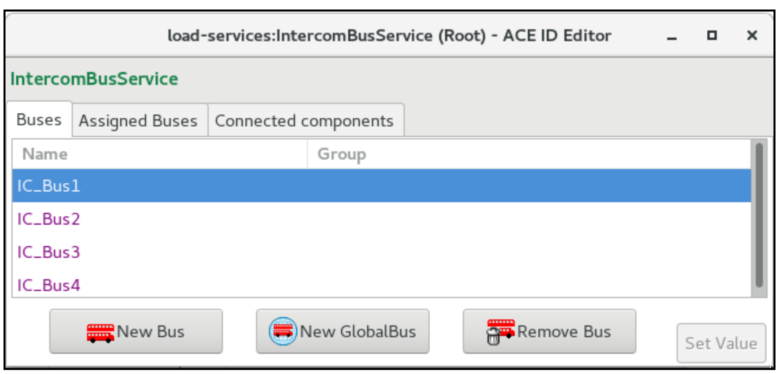


Figure 95: Add intercom buses

12. Go to **Op_Panel**, and assign **Signals 1–4** to the buses by double-clicking in **Value**. In **Intercom Bus Service**, select a bus, and select **Set Value**.

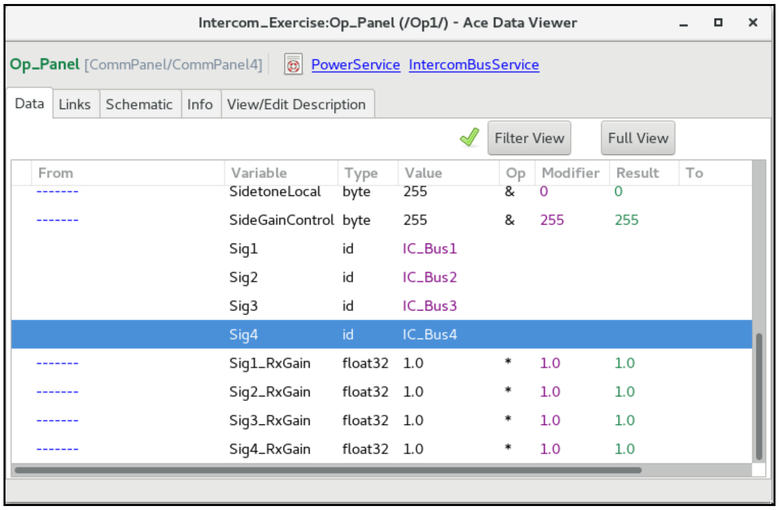


Figure 96: Operator panel intercom bus assignments

13. Open the **Op_ACU2channel**, and assign the *Identifier* and *Channel*.

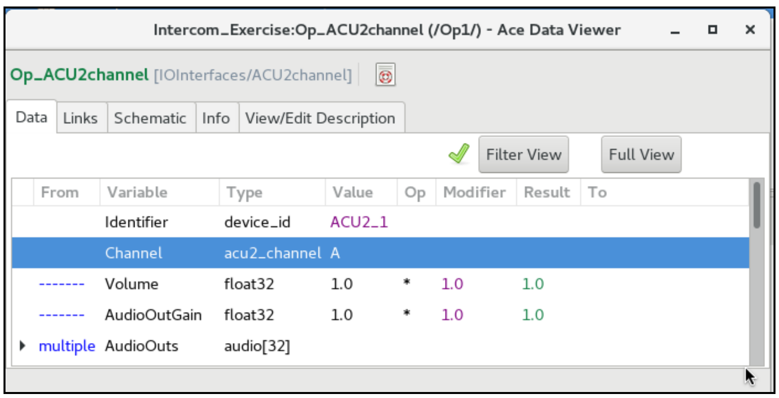


Figure 97: ACU2 channel assignment

14. Copy and paste the **Op1 folder**, and name it **Op2 folder**.

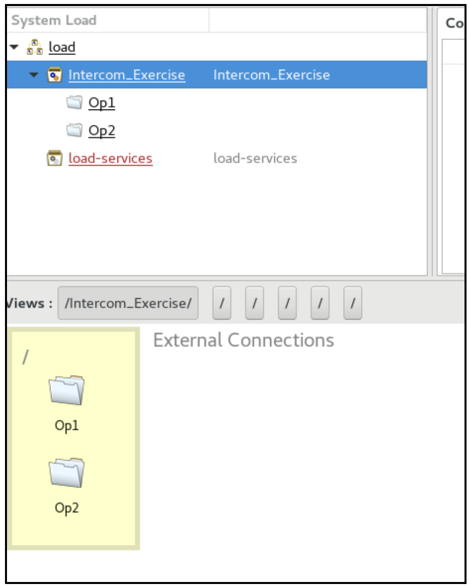


Figure 98: ACU2 channel assignment

15. In **Op2 folder**, change the ACU2 channel to a different channel that has a connected PTT and headset.

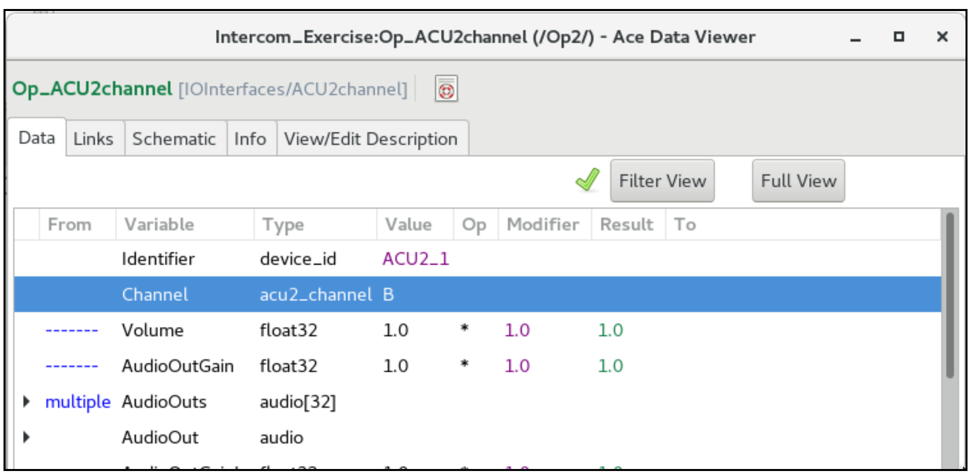


Figure 99: Op2_ACU2 channel assignment

16. Verify the ACU2 channel gains set in the RMS. These gains will vary depending on the ACU firmware.

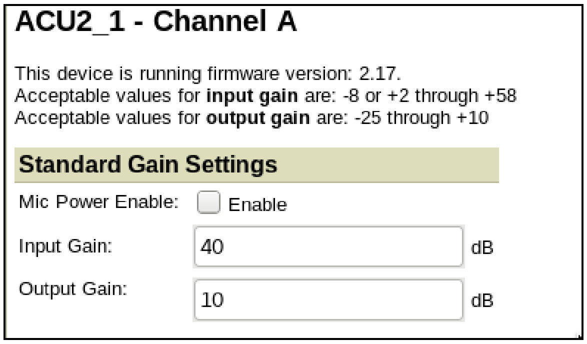


Figure 100: ACU2 channel gains

17. In **Model Viewer**, select **Reload**. Apply the changes. Two users should be able to talk to each other through all four-channel selections on the PTTs when the selector switches are in matching positions.

9.7 Radios

Radios are the largest, most complex, and most used components in ACE Studio. The following is a summary list of radio features for all simulated radios:

- ***World Position***: defines the X, Y, Z coordinates of the radio's location.
- ***Frequency***: defines the center of the radio tune frequency for transmit and receive. Optionally, it can define separate transmit and receive frequencies.
- ***Antenna Gain***: simulates the size and radiative efficiency of the antenna. All modeled antennae are isotropic.
- ***Squelch***: a noise gate that only allows signals exceeding a specified strength to filter through and play.
- ***Background Noise***: the general noise created when using radios.
- ***Fill***: allows you to choose one of a set of *N* predefined radio fills, as defined in a global comm plan.
- ***Multiple Net Support***: provides the radio with the ability to support multiple nets per a specific fill. Nets define the following core radio characteristics:
    - ***Multiple Modulation Type***: describes the modulation parameters of the radio, such as AM, FM, SATCOM, HQ, Intercom, etc.
    - ***Amplitude Modulation (AM) and Frequency Modulation (FM)***: two primary modulations for radio operation.

- *Modulation Discrimination:* occurs when radios can only receive signals from radios with the same modulation type.
- *AM Mixing:* when multiple AM signals broadcast on the same channel frequency, the AM receiver will receive all signals and mix them according to signal strength.
- *FM Capture Effect:* when several FM radios are transmitting on the same frequency, an FM receiver will only be able to receive the strongest signal.
- *Sensitivity:* receiver sensitivity in dB.
- *Bandwidth and Bandwidth Overlap:* determines the amount of audio noise mixed into the received audio, based on the simulated bandwidth of the radio band. This parameter does not affect the in-tune calculation.
- *Encoding Type and Rate:* defines the audio encoding type, including muLaw, continuously variable slope delta (CVSD), pulse-code modulation (PCM), and the sample rate.
- *Transmit Power:* indicates the transmission power of the radio in Watts/dBm
- *Automatic Gain Control (AGC):* adjusts the gain to appropriate levels for a range of input signal levels.
- *SATCOM Parameters:* defines satellite mode parameters, if applicable.
- *Frequency Hopping:* a method of rapidly switching frequencies while a receiver and transmitter communicate. The receiver and transmitter have to jump between the same frequencies, at the same speed, and at the same time.
- *Crypto Parameters:* radios that scramble the signals before they are transmitted so that only receivers who know the special key will have the ability to decode them, producing a secure voice transmission across any frequency.

- ***Half Duplex and Full Duplex:*** half-duplex mode is when the radio is able to transmit and receive signals but cannot do both at the same time. Full-duplex mode allows radios to transmit and receive signals at the same time. Typically, full-duplex mode is only used for intercom systems but never for real radios.
- ***Propagation:*** the movement of the radio waves as they move away from the transmitting antenna.
  - ***Ranging:*** an effect that occurs as a result of the distance between two radios. The greater the distance between the radios, the weaker the signal due to the dissipating power of the signal as it traverses a large area.
  - ***Occulting:*** the loss of radio signal due to the curvature of the earth's horizon.
  - ***Ionosphere Effects:*** the loss of signal due to the changes in the earth's atmosphere such as time of day or different seasons. The ionosphere effects only occur with high-frequency (HF) radios.

- ◦ ***Line of Sight (LOS)****:* when radio waves traveling in a straight line are dispersed due to obstacles or obstructions.
- ◦ ***Fresnel Diffraction****:* loss of signal due to the reflection of off obstacles in the path of the radio waves from transmitter to receiver.
- ◦ ***Terrain Effects****:* the loss of signal due to land obstruction, such as a mountain.

This section discusses the following topics:

- Local radios
- Comm Plan
- Add a model

9.7.1 Local radios

This section focuses on the radio in its simplest form: the local radio. Local radios operate between two operators on one Target. In this exercise, the following services will be used:

- **IntercomBusService**
- **RadioControlService**

IntercomBusService passes audio signals between the radio transceivers and the associated **CommPanels**. **RadioControlService** links the **RCUbasic** components to their associated **Transceiver** components. The components for the first operator and radio are located in a folder named **Operator1**; the second operator and radio is located in a folder named **Operator2**.

Each folder contains the following components and names:

Component	Name
ACU2channel	Headset_PTT
CommPanel4	Panel
RCUbasic	Control_Head
Transceiver	RX_TX
GeodeticWorldPosition	Position

Table 1: Local radio components and names

As in the previous exercise, create a new project. This time, call it **Local_Radios**. Do not install it at this time.

9.7.2 Comm Plan

On **Project Manager**, there is an icon that looks like a hard hat and is named Comm Plan. Double-clicking it opens **Commplan Editor**, which has two panes:

- *Left pane:* a tree-type view of the major sections of the **Comm Plan**.
- *Right pane:* contains details of each of the major section.

The Comm Plan is a road map for the radios and allows or disallows the radios to operate in certain manners. Initially, the Comm Plan is created with a default plan installed. To see the default plan, in the left pane, select **Fill** twice. In the right pane, select the arrowhead next to **Fill**.

The default Comm Plan contains functions most commonly used in typical radio models. Use the default Comm Plan or modify it to suit your requirements. For this exercise, you will remove the majority of the functionality and add what you need.

In the right pane, highlight the default fill. To delete, select the minus sign ().

Figure 101: Comm Plan fill cleared

In the left pane, select **Net**. In the right pane, select **Net**. To delete all of the default nets, at the top of the window, select the minus sign ( ).

Figure 102: Comm Plan net cleared

In the left pane, select **Waveform**. To delete all of the default waveforms, at the top of the window, select the minus sign ( ).

Figure 103: Comm Plan waveform cleared

The Comm Plan is structured in a bottom-up format. You cannot build it using a top-down method.

In the left pane, highlight **Waveform**. To create a highlighted line that includes the name **file1**, at the top of the window, select the plus sign ( ). Enter the various modulations here. Select **file1**, and replace it with **Modulations**.

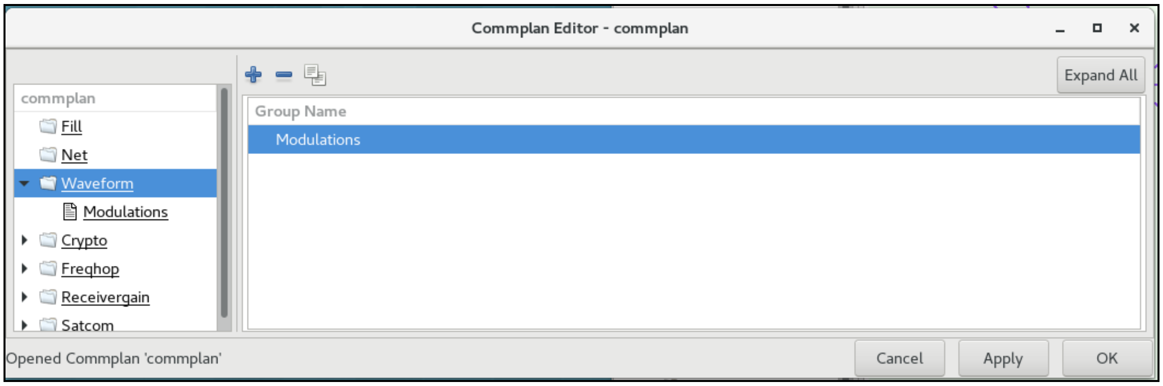


Figure 104: Add modulations to waveform

In the left pane, highlight **Modulations**. Radio functionality headings now display at the top of the right pane.

At the top of the window, select the plus sign ( ) to add a new line of data.

In **Name**, the entry name is **wavef1**. Change this to a more meaningful name: **INTERCOM**.

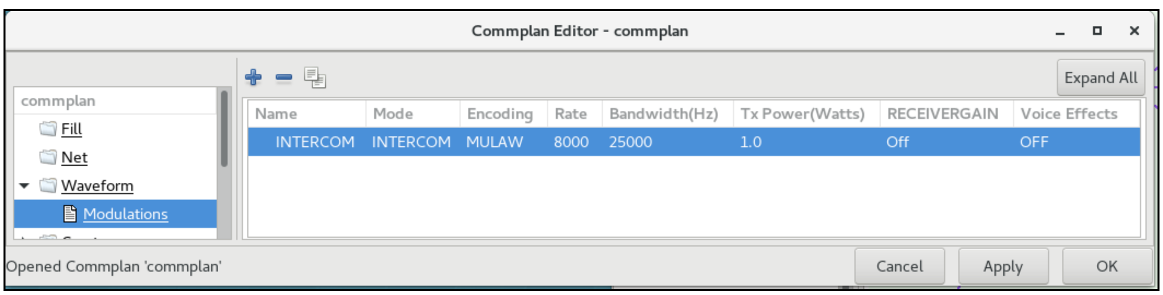


Figure 105: Add intercom to modulations

At the top of the window, select the plus sign ( ) to add a new line of data.

In **Name**, the entry is called **wavef1**. Change this to a more meaningful name: **AM**.

Note*: The pane automatically saves entries in alphabetical order, so check that your new entry hasn't moved before making changes to other columns.*

In **Mode**, select **INTERCOM**. When the list opens, press the Down arrow to select **AM**.

Important*: Select the window's background before applying changes. This action ensures the drop-down arrow is not still in view. If it is, when you select* ***Apply*** *and close the window, ACE Studio won't save your changes.*

The *Encoding* and *Rate* are typical for this type of modulation, as is the bandwidth. You can leave *TxPower* as is and enter the default value directly into **RCUbasic**, or enter the *TxPower* value here.

The radio receiver must have a gain and AGC profile. By default, it is off. Select this entry, and press the Down arrow to access the drop-down list. Select **rxgain.rxgain**, a default entry that's typical for AM and FM radios.

Voice Effects adds an effect that makes the radios sound more realistic. Several parameters derive the effect. Turn on **Voice Effects**.

Create another entry named **FM** for FM radios. All other columns must be the same as the **AM Mode**.

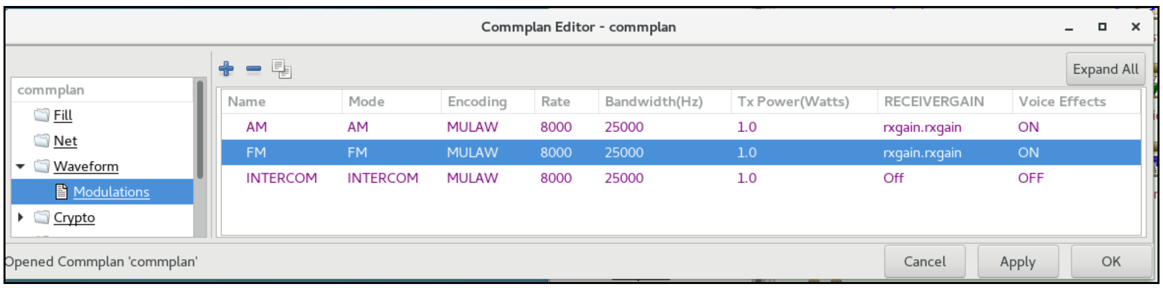


Figure 106: Completed waveform section

Ensure that no drop-down arrows are visible.

In the left pane, highlight **Net**. To add a new line named **file1**, at the top of the window, select the plus sign ( ). You can enter details about the net here. Select **file1**, and rename it **Nets**.

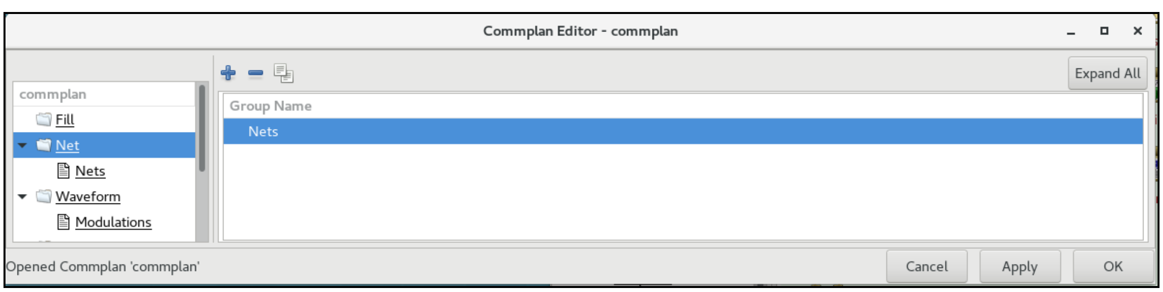


Figure 107: Add nets to net

In the left pane, select **Nets**. Along the top of the right pane, there are now headings related to some radio specifics.

At the top of the window, select the plus sign ( ) three times. Three blank nets have been created. In **Name**, rename **net1**, **net2** and **net3** to **AM**, **FM**, and **INTERCOM**.

In **AM**, select **Off** in **Waveform**. From the drop-down box, select **Modulations.AM**. This action links the values in **Waveform**, which are relevant to the AM modulation to the AM net. Link the **FM** and **INTERCOM** lines also.

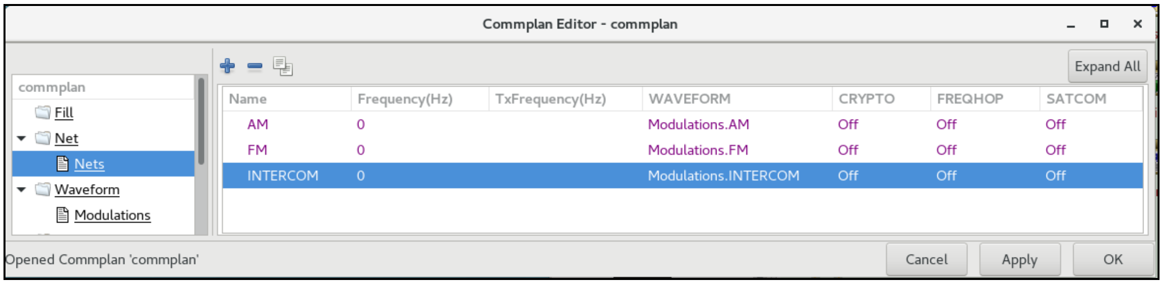


Figure 108: Completed nets

If **Crypto**, **Frequency Hopping**, or **SATCOM** modes are required, link them in a similar manner in their respective columns. Make default value selections here for default values for the radio to function in those modes. For example, if you don't make cipher selections, and cipher modes correctly populate in **RCUbasic** and **Transceiver**, they do not function in cipher mode.

You can also set a default frequency or receive and transmit frequency. In this case, if no input is set in the **RCUbasic** for frequency, ACE Studio uses this value.

***Note**: If the input frequency to **RCUbasic** is set back to 0, **RCUbasic** uses the frequency of 0, not the default in the Comm Plan.*

In the left pane, select **Fill**. At the top of the window, select the plus sign ( ) to create a highlighted line called **file1**. You can add the fills here. Rename **file1** to **Plan**.

In the left pane, select **Plan**, and select the plus sign ( ) twice. This action adds two entries to the right pane. Rename **fill1** and **fill2** to **RADIO** and **INTERCOM**. RCUbasic references **Plan**, **INTERCOM**, and **RADIO** as the fill.

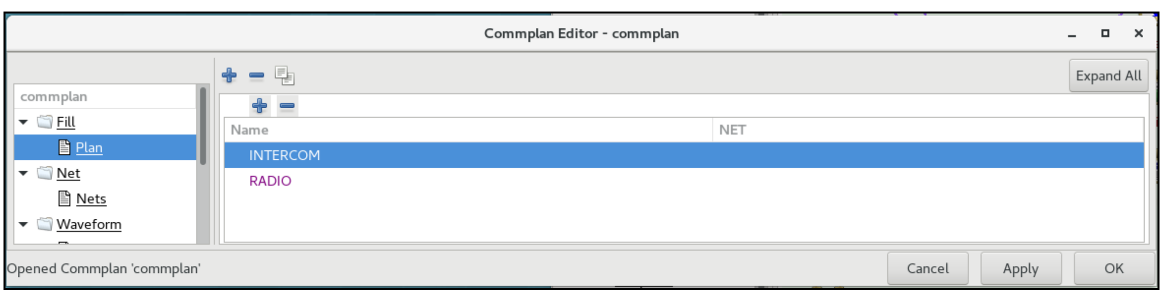


Figure 109: Added fills

Select **INTERCOM**, and then select the plus sign ( ).

A subentry appears with the number 1. **RCUbasic** references this number as the net number. **None** is highlighted in red because **none** is not a valid net name. Select **none**, and from the drop-down list, select **Nets.INTERCOM**. This action links the appropriate net and waveform to this net number.

Select **RADIO**, and then select the plus sign (). Complete this action again.

Two subentries appear. **None** highlights red, as **none** is not a valid net name. In line 1, select **none**, and select **Nets.AM**. To link the appropriate net and waveform to this net number. For line 2, reference to **Nets.FM**.

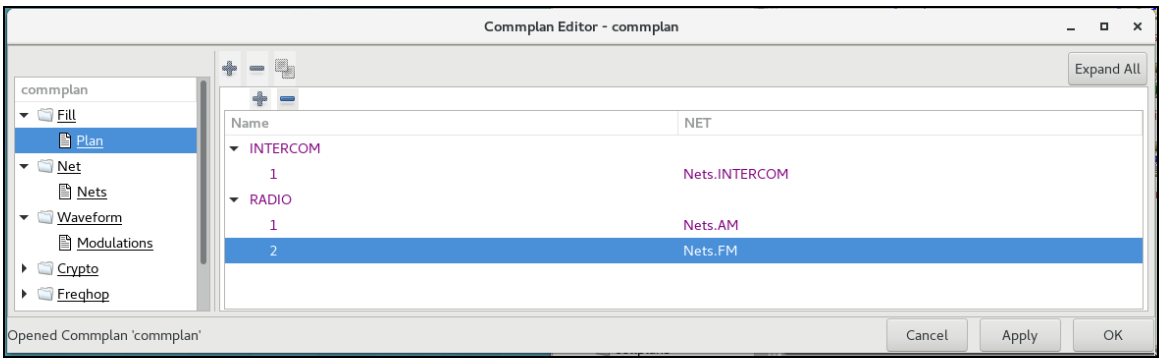
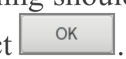
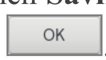


Figure 110: Completed fills

Nothing should be highlighted red. The Comm Plan is now complete. Select 

, then select 

.

In the toolbar, select **Save Project**. When **Saving Changes** appears, make a relevant entry (e.g., “Completed Commplan”). Select 

.

Figure 111: Save Comm Plan

9.7.3 Add a model

To add a model, follow these steps:

1. To install the layout, in **Project Manager**, select **Install Layout**.
2. Wait for installation to complete. To open **Model Viewer**, double-click **Telestra**.
3. Right-click the main canvas, and select **Add**.
4. In **Add to Load**, select **SimModel**.

5. In **Item Name:**, enter **Radios**, and select **Add**.
6. In **Item Name:**, enter **Operators**, and select **Add**.
7. Two simulation models now exist on the canvas. Close **Add to Load**.
8. You can build the operators, panels, audio inputs, and audio outputs in the **Operators Sim Model**, and you can build the radios in the **Radios Sim Model**. Open the **Operators Sim Model**.
9. Right-click the canvas, and select **Add**.
10. In **Add to Model**, add a folder, and name it **Operator_1**.
11. Open **Operator_1**.
12. Add the following components and names:

Components	Names
CommPanel4	Panel
ACU2channel	Operator
Filter	Mic_Filter
MathFunction	Rad_Int_Select

Table 2: Components and names

Figure 112, "Add components to Operator_1" below shows adding a component to **Operator_1**:

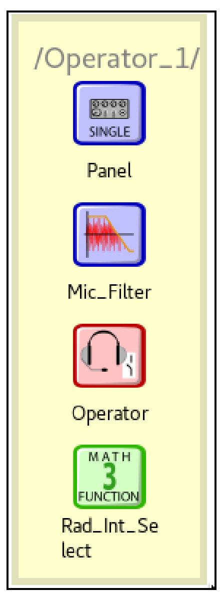


Figure 112: Add components to Operator_1

13. The setup includes two intercom buses: one for intercom communication, and one for radio communication. Open **Panel**, assign **Sig1** to **Intercom**, and assign **Sig2** to **Radio1**. Close **Panel**.

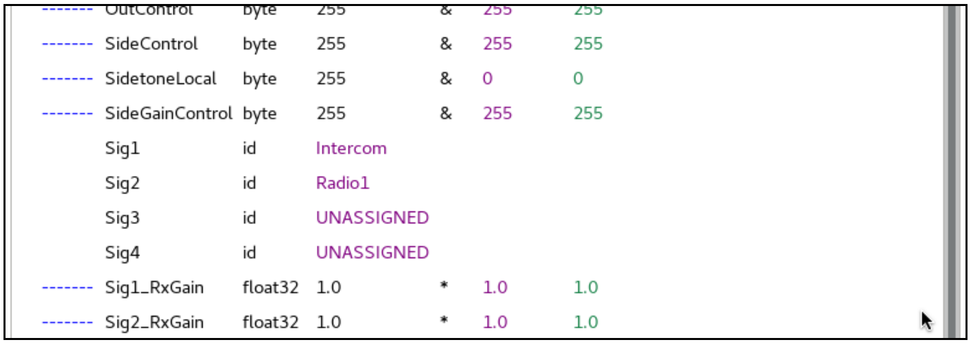


Figure 113: Assign intercom buses

14. Open **Operator**. For **Identifier**, double-click **Select**, and select the ACU2. For the channel, choose a channel connected to the first headset and four-way PTT device.

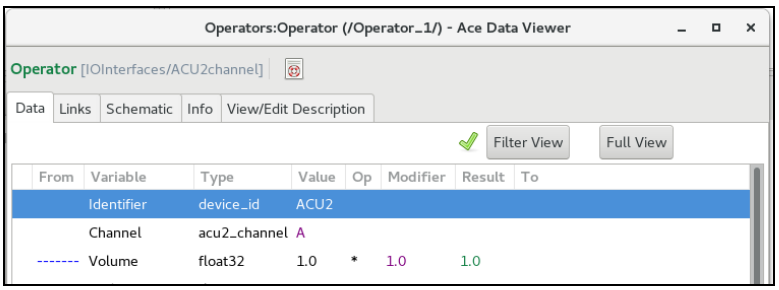


Figure 114: Assigning Operator 1 ACU2

15. Link the following components and variables:

    a. **Operator's** *AudioIn* to the **Mic_Filter's** *InSignal*

    b. **Operator's** *PTT* to the **Panel's** *PTT*

    c. **Operator's** *PTTselect* to the **Rad_Int_Select's** *Input_X*

    d. **Mic_Filter's** *OutSignal* to the **Panel's** *InSignal*

    e. **Rad_Int_Select's** *Result* to the **Panel's** *InControl*

    f. **Rad_Int_Select's** *Result* to the **Panel's** *OutControl*

    g. **Rad_Int_Select's** *Result* to the **Panel's** *SideControl*

    h. **Panel's** *OutSignal* to the **Operator's** *AudioOuts*

    i. **Panel's** *SideSignal* to the **Operator's** *AudioOuts*

16. Close **ACE MODEL LINK EDITOR**.

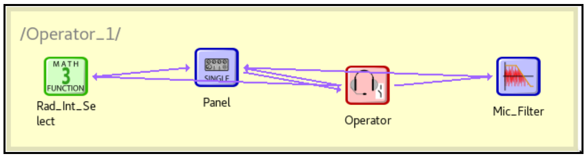


Figure 115: Operator_1 component links

17. Open **Mic_Filter**. By default, the filter is a low-pass filter with a roll-off frequency of 2000 Hz and a Q Factor of 0.7071. This filter often acts as a microphone filter. These default values help remove audio feedback, especially when the audio input and output are closely coupled.

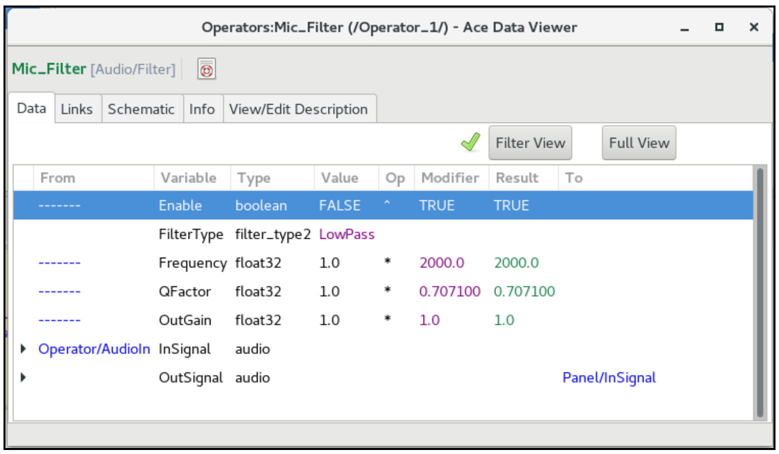


Figure 116: Mic_Filter

18. Close the filter.

19. Open **Rad_Int_Select**. This component connects to a **MathFunction**, which is defined in the **Math Plan**.

20. To use this feature, you must establish what you want the **MathFunction** to do, build it, and link it. *PTTSelect's* output is binary-weighted based on switch position 1, 2, 3, and 4 resulting in 1, 2, 4, and 8. The first three positions are relevant to this exercise:

    - *Position 1:* intercom communication
    - *Position 2:* AM
    - *Position 3:* FM

    Panel includes two buses: *Intercom* and *Radio*. Choose **AM** or **FM** in the radio, not the panel.

21. Next, add a table with no interpolation:

Input	Output
0	0
1	1
2	2
3	2

22. Select **ACE STUDIO Project Manager**.

23. Open **MathPlan Editor**.

24. To create a new group, in the toolbar, select **Add Group**, and name it **Panel**. Store any panel-related **MathFunctions** in this group.

25. In the toolbar, select **add function**. Rename the new function **Rad_Int_Sel**.

26. In **Function Type**, select **None** on **Rad_Int_Sel**. From the drop-down box, select **TABLE**.

27. To open **Table Function**, in the right column, select **edit**.

28. To make the function switch between values when selected, clear **Interpolate**.

29. Under **x=**, enter **0.0**, **1.0**, **2.0**, **4.0**, and **8.0**.

Note*: PTTSelect yields a transient value of 0.0 between channels.*

30. Under **f(x)=**, enter **0.0**, **1.0**, **2.0**, and **2.0**.

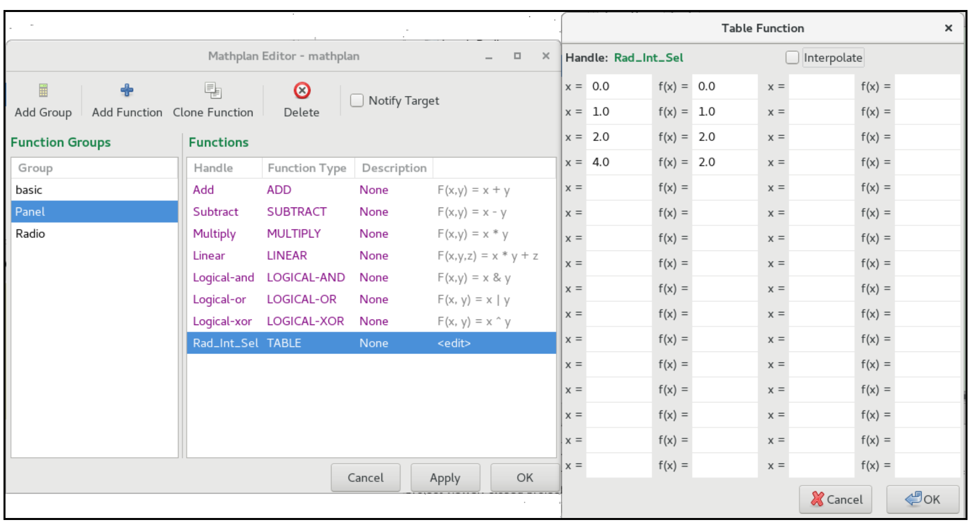


Figure 117: Rad_Int_Sel MathFunction

31. Go to **MathPlan Editor**. To implement changes immediately after application, select **Notify Target**. You do not need to save and reload the layout.

32. Apply your changes, and select **Yes** to confirm.

33. Go to **Model Viewer**, and open **Rad_Int_Select**.

34. On **function**, double-click **Select**, and **Select File** opens.

35. To link **Rad_Int_Select** to **Math Plan**, select **Panel** > **Rad_Int_Sel**, and select **OK**. The first operator is now complete.

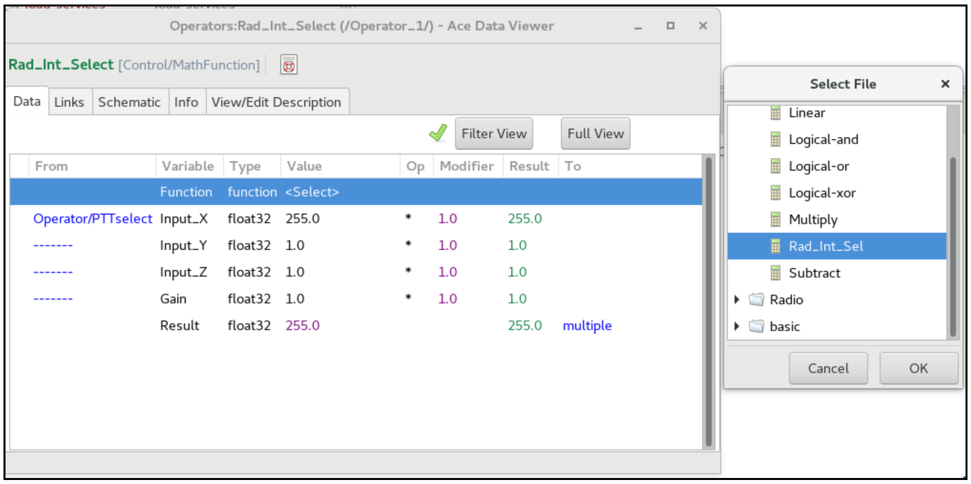


Figure 118: MathFunction selected

36. To view the **Operator_1** folder, in the top-left of **Model Viewer**, select **Operators**.

37. Copy and paste the folder, and rename it **Operator_2**.

38. Open **Operator_2** and the **Operator** component.

39. Change the *Identifier* and *Channel* to the ACU2 channel connected to the second head-set and PTT device.

40. Open **Panel**, and change the *Radio1* value to **Radio2**.

41. Close the component window and **Model Viewer**. Apply the changes.

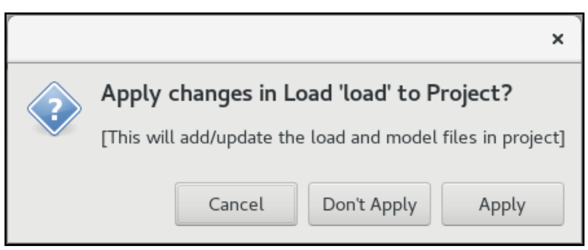


Figure 119: Apply changes

42. Close **MathPlan Editor**.

43. On the **Project Manager**, select **Save Project**. In the commit dialog, make a useful comment (e.g., "Operators completed"). The operators section of the model is now complete.

44. From the toolbar, reinstall the layout. When complete, open the **Model Viewer**.

45. Open the **Radios Sim** model.

46. Right-click on the canvas, and select **Add**. Add a folder, name it **Operator1_Radio**, and open it.

47. Add the following components, and name them:

Components	Names
RCUbasic	Controller
Transceiver	RX_TX
MathFunction	AM_FM_Select

Table 3: Components and names

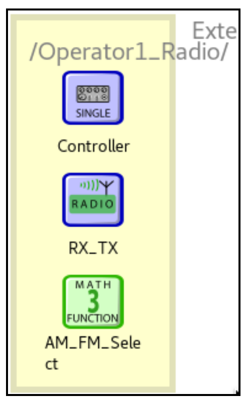


Figure 120: Adding components to Operator1_Radio

48. Open **Controller** and **RX_TX**.

49. To open **RadioControlService Editor** in **Controller**, double-click **UNASSIGNED** in *TransceiverId*. Select **New Bus**, and rename it **RX_TX1**. Press Enter, and select **Set Value**.

50. To open **RadioControlService Editor** in **RX_TX**, double-click **UNASSIGNED** in *TransceiverId*. Select **New Bus**, and rename it **RX_TX1**. Press Enter, and select **Set Value**.

51. *TransceiverId* pairs **RCUbasic** and **Transceiver** together for control purposes. In the **Controller**, double-click **Select** in the **Value** column of the **Fill** line. Using the drop-down box, select **Plan.RADIO**.

52. In the **Modifier** column of the *Frequency* row, enter **200,000,000**. The **RX_TX** values for *Frequency* and *Mode* fill in.

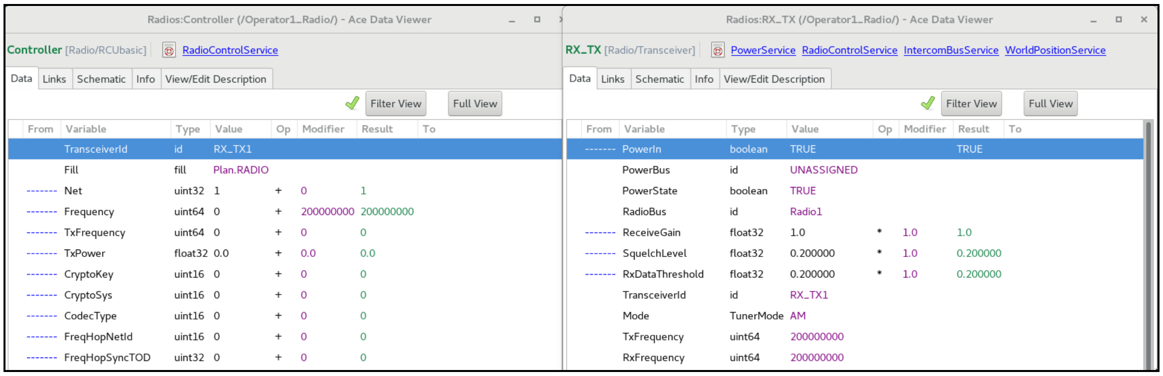


Figure 121: Initial radio entries

53. For **RadioBus**, double-click **UNASSIGNED**, and **IntercomBusService** opens. **Panel** in **Operators** creates three entries.

54. Highlight **Radio1**, and select **Set Value**. Audio to and from the **RX_TX** is present on **Radio1** of the **IntercomBusService**. **Panel** and **RX_TX** can now communicate with each other.

55. For **RadioName**, double-click **Edit**, and enter a valid name for the radio (e.g., **Operator1_Radio**).

56. Fill **DomainName**. For radios to communicate, they must be on the same domain and have matching radio parameters. Even if the parameters match, if the domains do not match, the radios cannot see each other. Double-click **Edit**, and enter **local_radios**.

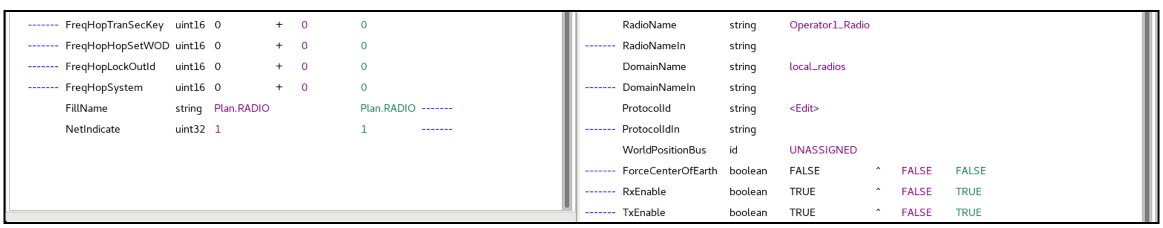


Figure 122: Final radio entries

57. The radio needs to know to whether to choose AM or FM modes. For this, we will use the **AM_FM_Select** component. In **Project Manager**, open **MathPlan Editor**.

58. Add a new group called **Radio**. This group stores any **MathFunctions** relevant to the radios. Add a new function table called **AM_FM_Sel**.

59. *PTTSelect*, a binary-weighted value, drives the table. **AM** is 2, and **FM** is 4. For the table to work, an input of 2 produces an output of 1 and an input of 4 produces an output of 2. Add the table with interpolate off and the following values:

Input	Output
0	0
1	1
2	2
3	2

Figure 123, "Mathplan Editor" below shows the radio select table in **Mathplan Editor**:

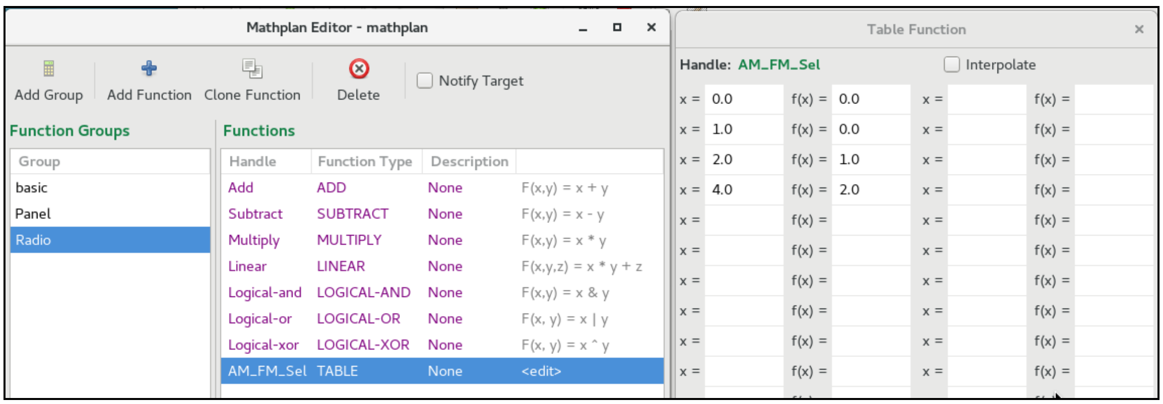


Figure 123: Mathplan Editor

60. In **MathPlan Editor**, select **Notify Target**, and apply your changes.

61. In **Model Viewer**, link the **AM_FM_Select** component to that **MathFunction**.

62. Link **AM_FM_Select** *Result* to **Controller** *Net*.

63. In **ACE MODEL LINK EDITOR**, use a bus to link the **Radios** and **Operators** simulation models.

64. Close **ACE MODEL LINK EDITOR**.

65. Go to the **Radios** simulation model, and copy the **Operator1_Radio** folder to **Operator2_Radio**. Open the **Operator2_Radio** folder.

66. Open **Controller**, and change the *TransceiverId* to **RX_TX2** by adding a new entry in the **Radio Control Service**.

67. Close **Controller**, and open **RX_TX**.

68. Change *RadioBus* to **Radio2**.

69. Change the *TransceiverId* to **RX_TX2**.

70. Change *RadioName* to **Operator2_Radio**.

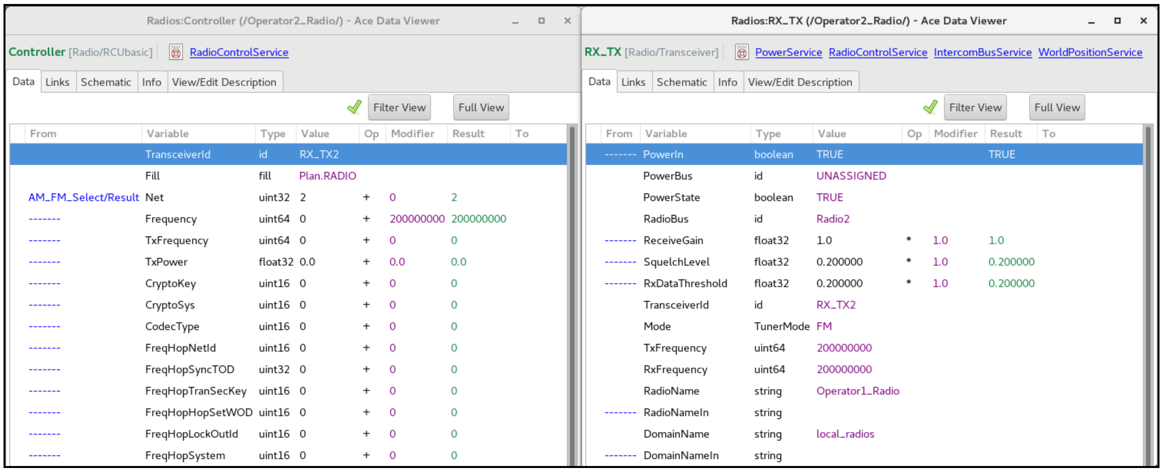


Figure 124: Radio2 final values

71. Close **RX_TX**.

72. In **Operator2_Radio**, right-click in the canvas, and select **Add**. Add a connector, and name it **PTT_data**. Open the connector.

73. At the top of the window, next to **Group: Unassigned**, select **change**. Set the group to **Operator2**.

74. To add a signal, select the plus sign ( ). Name the new signal **PTT_Select**. Close the connector.

75. Right-click the connector, and select **Create Link…**

76. Link **PTT_Data**/*PTT_Select* to **AM_FM_Select**/*Input_X*. Close **ACE MODEL LINK EDITOR**.

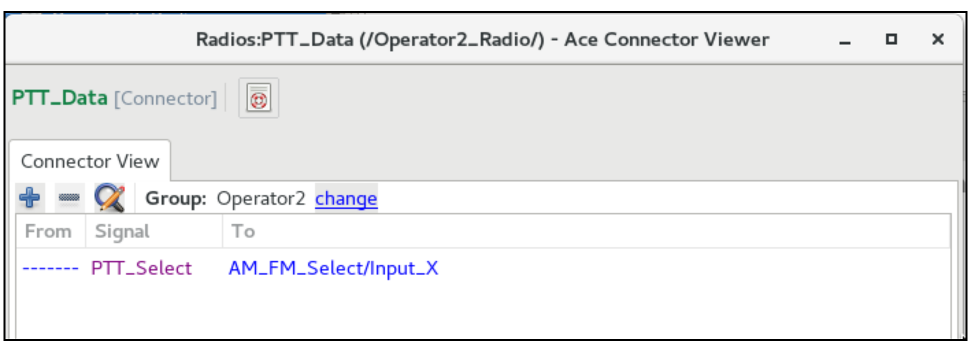


Figure 125: Connector group assign

77. Right-click the connector, and select **Assign to Bus**. Name the bus **Inter_Model_Data**.

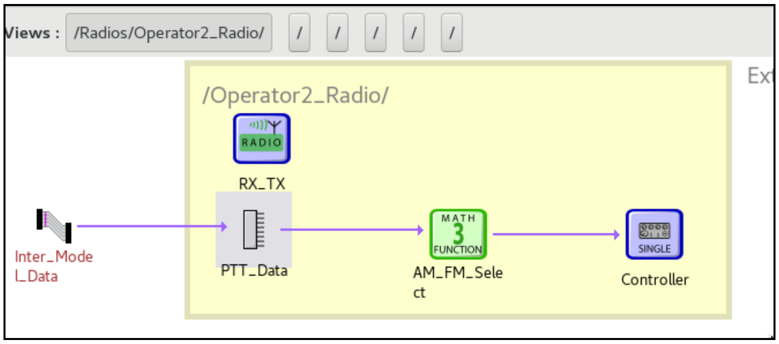


Figure 126: Operator2 radio completed

78. Right-click the connector, and select **Copy**.

79. Go to **Operator1_Radio_Folder**.

80. Right-click the canvas, and select **Paste**. Open the new connector. Change the **Group** to **Operator1**.

81. Right-click the connector, and select **Create Link…**

82. Link **PTT_Data**/*PTT_Select* to **AM_FM_Select**/*Input_X*. Close the **ACE MODEL LINK EDITOR**.

83. Right-click the connector, and select **Assign to Bus**. Select the bus **Inter_Model_Data**.

84. Go to **Operators** > **Operator_2**.

85. Right-click the canvas, and select **Paste**.

86. Link **Operator**/*PTT_Select* to **PTT_Data**/*PTT_Select*.

87. Assign the **PTT_Data** connector to the **Inter_Model_Data** bus.

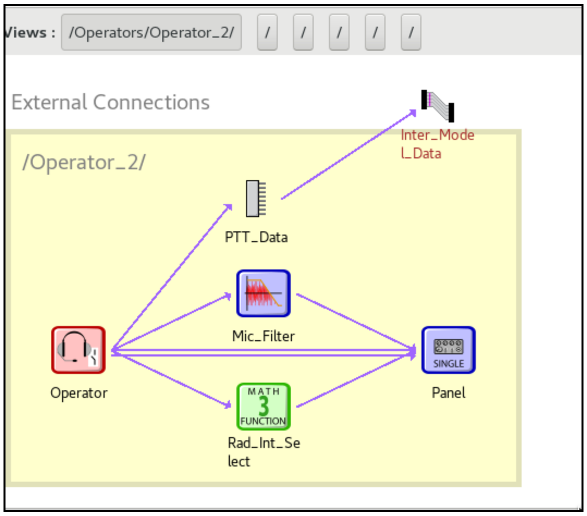


Figure 127: Operator2 panel completed

88. Go to **Operators** > **Operator_1**.

89. Right-click the canvas, and select **Paste**. Open the connector, and change the group to **Operator1**.

90. Link **Operator**/*PTT_Select* to **PTT_Data**/*PTT_Select*.

91. Assign the **PTT_Data** connector to the **Inter_Model_Data** bus.

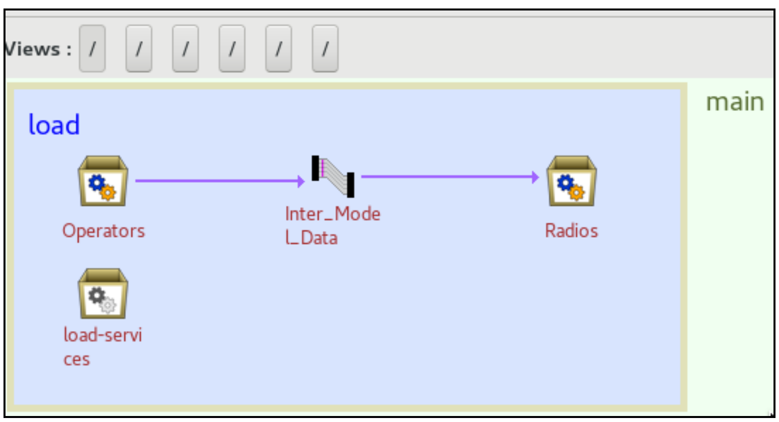


Figure 128: Completed layout

92. Open the **Inter_Model_Data** bus.

93. Two groups display in **Ace Bus Viewer**. If you expand the groups, you can see the signals in the groups and the sources and destinations. The signal names in the groups are the same, but because they are in different groups; they are not connected to each other.

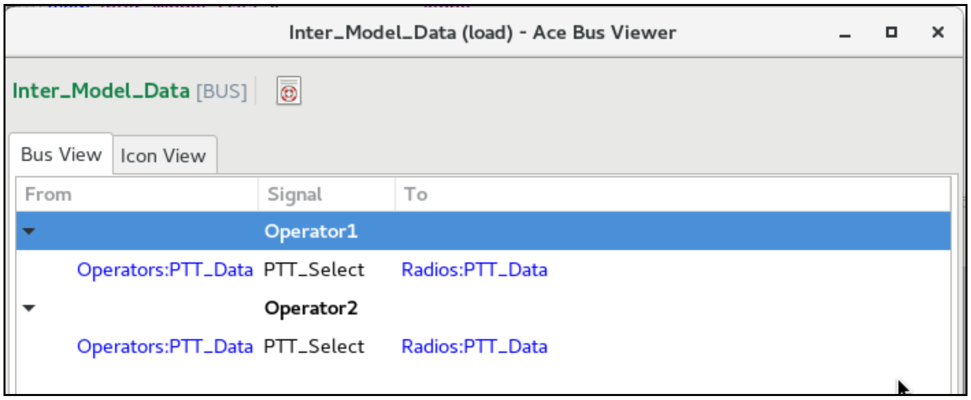


Figure 129: Inter Model Bus

An analogy would be a large cable containing two multicore cables.

94. **Icon View** gives a visual representation of the source and destination connectors and the groups within the bus.

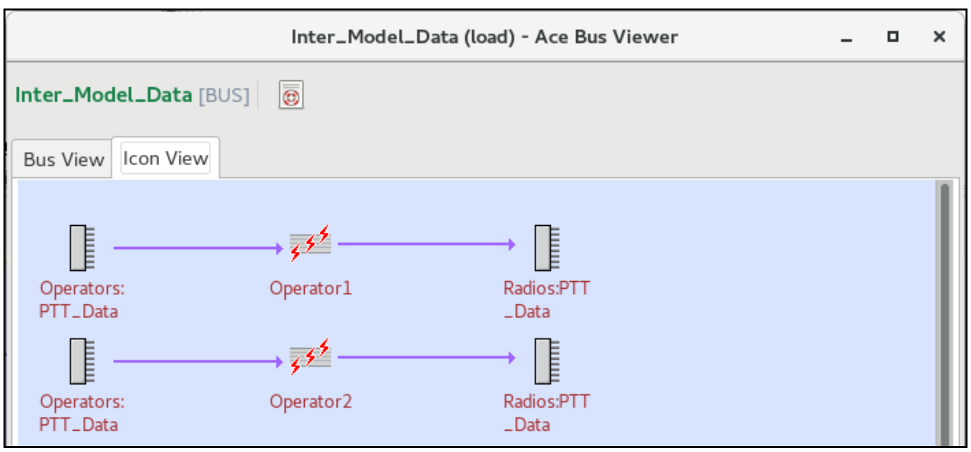


Figure 130: Inter Model Bus icon view

Exit **Model Viewer**, and apply the changes. In **Project Manager**, save the project, and reload the layout.

The project is complete. Two operators can now communicate over a local intercom or a radio in AM or FM mode. Radios and intercoms in the same Target can communicate with each other, but radios and intercoms in different Targets cannot.

9.8 Add a communication model with helpers

The following instructions explain how to create a communication model using the ACE Studio helpers. This example assumes a level of familiarity with ACE software. To create a communication model with ACE Studio helpers, follow these steps:

1. Add a new project called **Helpers**.
2. Under **Servers**, create a **DIS_Gateway**.
3. Set the DIS **version** to **6**.
4. Set the **DIS interface** to **eth0**.
5. Set the DIS RX/TX **port** to **53000**.
6. Next to **main**, set the outgoing destination address for DIS packets to **192.168.255.255**. Select **bcast**.

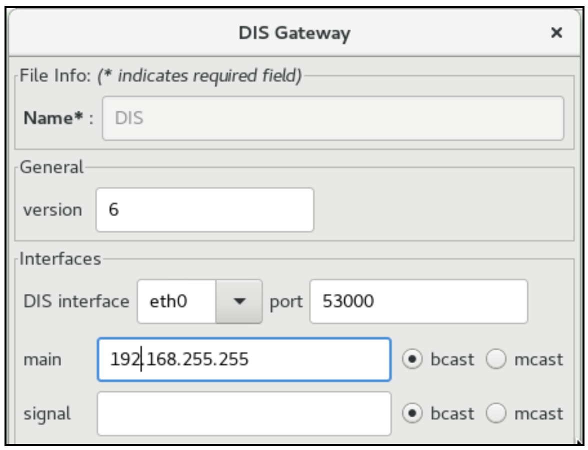


Figure 131: DIS Gateway

7. To create the domain, follow these steps:
   a. In the tree view, select **main**.
   b. To add a domain, in **Domain Editor**, select the plus sign ().
   c. In **Set Domain Name**, enter **DIS**.
   d. Set the **Exercise ID** to **24**.
   e. Set the **Site** and **App ID** to the last two octets of the Telestra's IP octet.

f. Select **Apply** and **OK**.

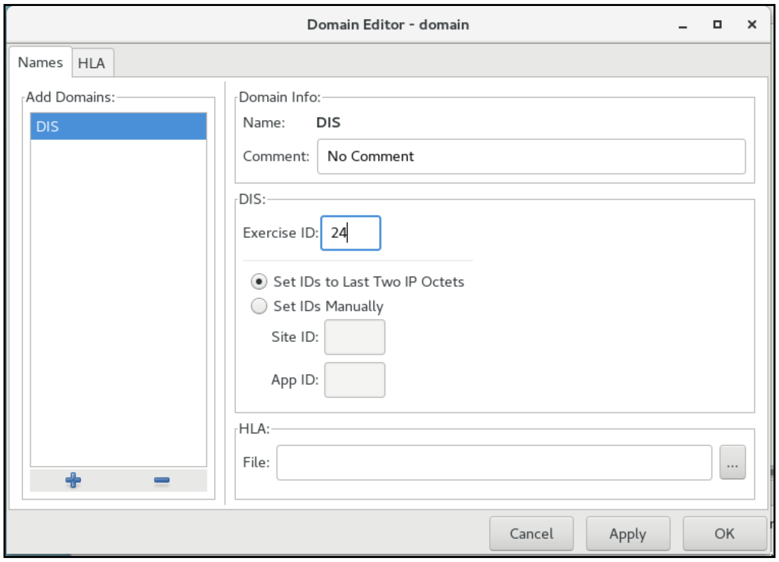


Figure 132: Domain Editor

8. Create a Comm Plan with four FM nets (i.e., FM1–FM4).

9. Set the following default frequencies:
    - **201000000**
    - **202000000**
    - **203000000**
    - **204000000**

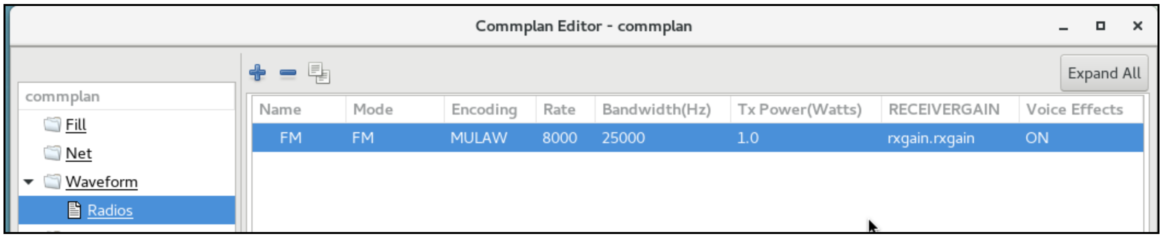


Figure 133: Commplan waveform

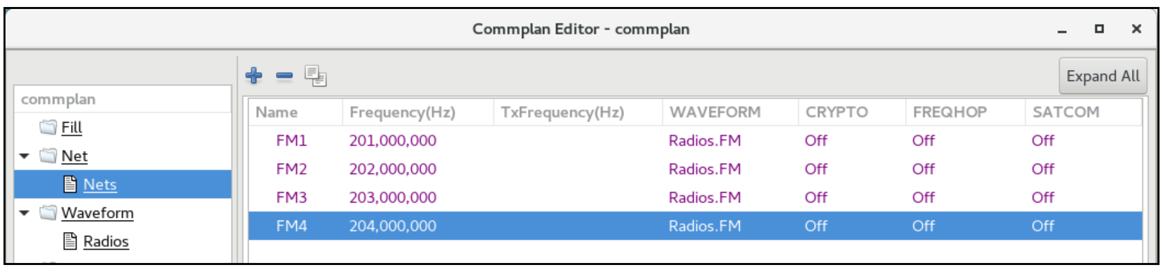


Figure 134: Commplan nets

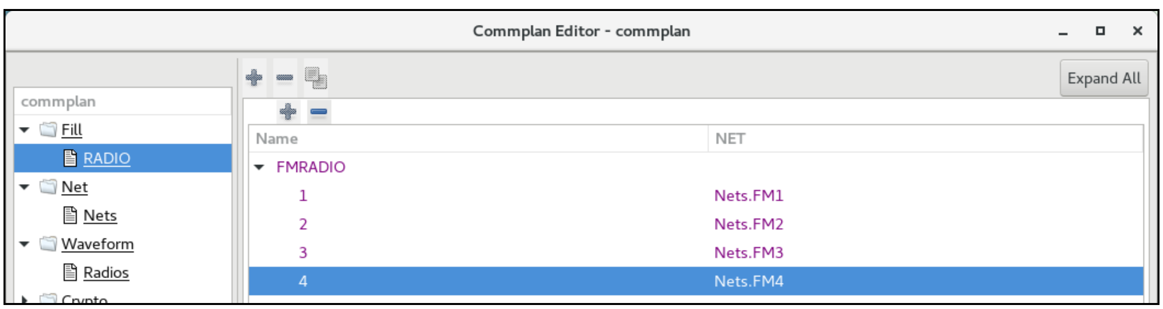


Figure 135: Commplan fills

10. Install the layout.

11. On the main canvas, double-click **radios**.

12. In the bottom-left of the **Radio Helper**, select the plus sign ( ). Add a **World Position**, and name it **WP1**.

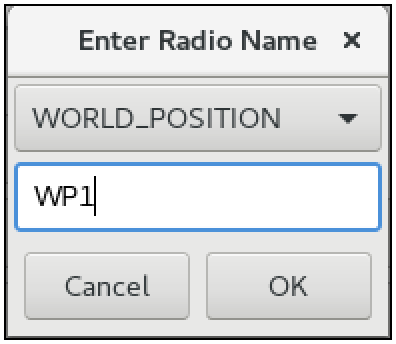


Figure 136: Add a WORLD_POSITION

13. Select the plus sign ( ), add a radio, and name it **RADIO_1**.

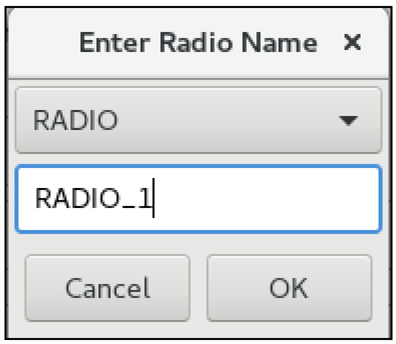


Figure 137: Add a radio

14. Select **Domain**, and then select DIS.
15. Set the **Entity ID** (e.g., 5) and the **Radio Number** (e.g., 1).
16. Select **Fill**, and then select **Radio.FMRADIO**.
17. From **World Position**, select **WP1**.

18. Repeat this for the next three radios (i.e., RADIO2, RADIO3, and RADIO4), and use the radio numbers 2, 3, and 4.

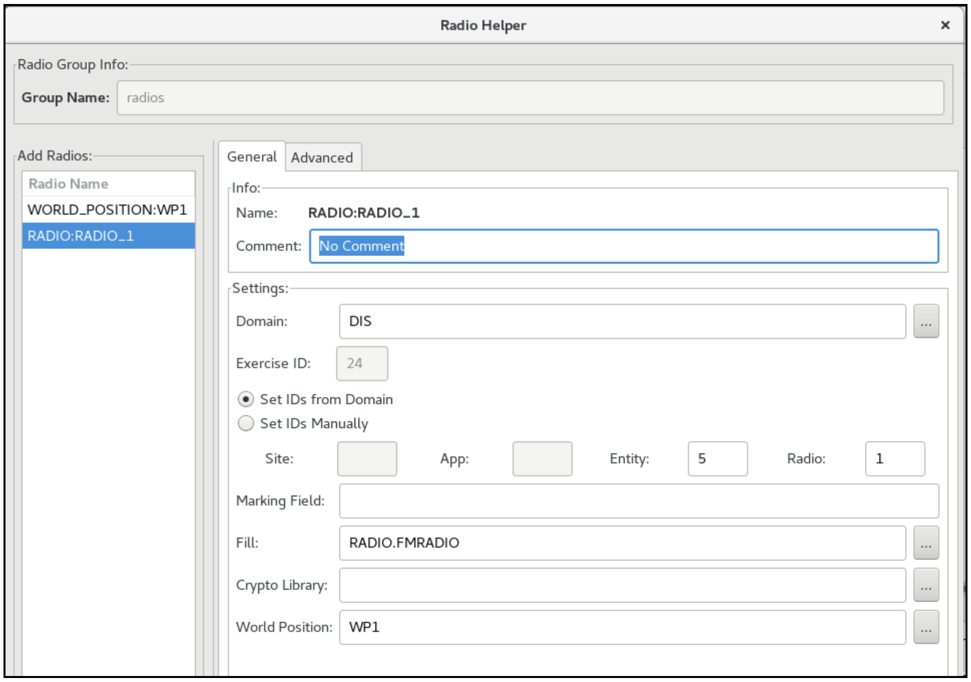


Figure 138: Radio information

19. To close the window and update the layout, select **Update**.

20. On the main canvas, double-click **channels**.

21. In **Channel Helper**, select the plus sign (), add a **RADIO_OPERATOR**, and name it **OPERATOR1**.

22. For the bus, enter **Operators**.

23. For the **Bus Group**, enter **Operator1**.

24. For **bus1**, **bus2**, **bus3**, and **bus4**, select **RADIO_1–RADIO_4**.

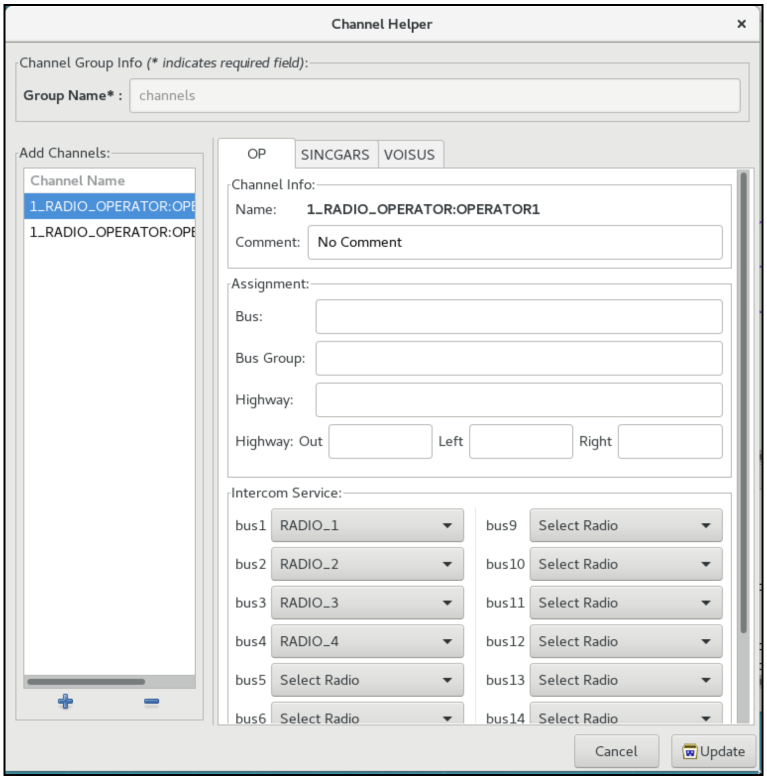


Figure 139: Add an operator

25. Add **Operator2**.

26. For the **Bus Group**, enter **Operator2**.

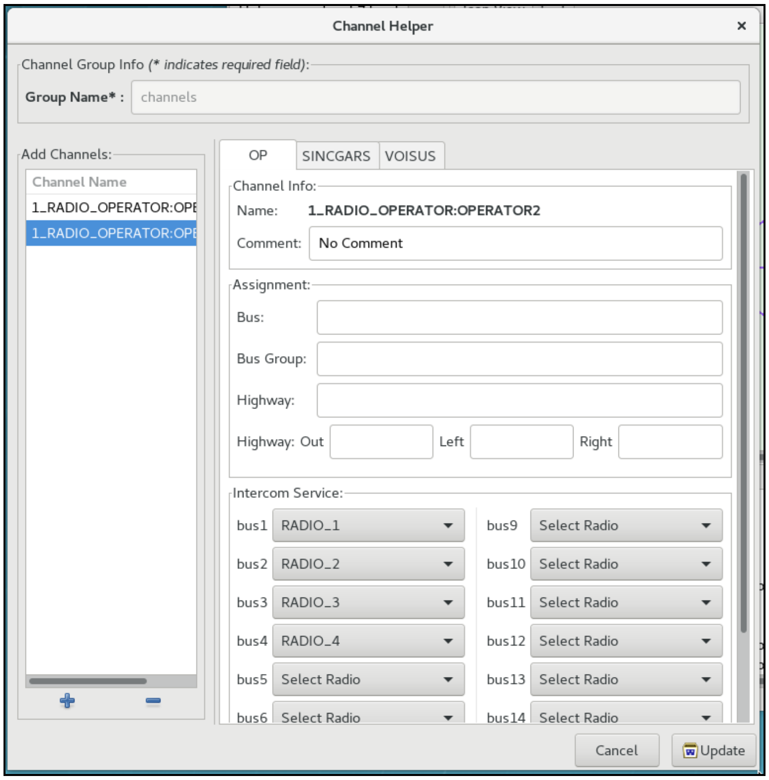


Figure 140: Add a second operator

27. Select **Update**.

28. Right-click the main canvas, and add an ACU2. Identify it, and set channel A to be channels > 1_RADIO_OPERATOR:OPERATOR1 and channel B to be channels > 1_ RADIO_OPERATOR:OPERATOR2. Select **Add**.

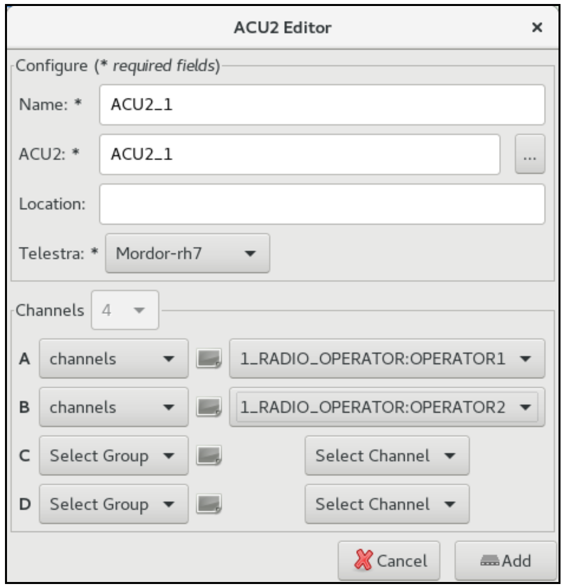


Figure 141: ACU2 Editor

29. Save and install the layout.

30. Open **Model Viewer**.

31. In **Model Viewer**, substantial chunks of the layout are now automatically built, thus saving time in model generation. This method is not for everyone due to helpers' limitations, but it may be worth considering.

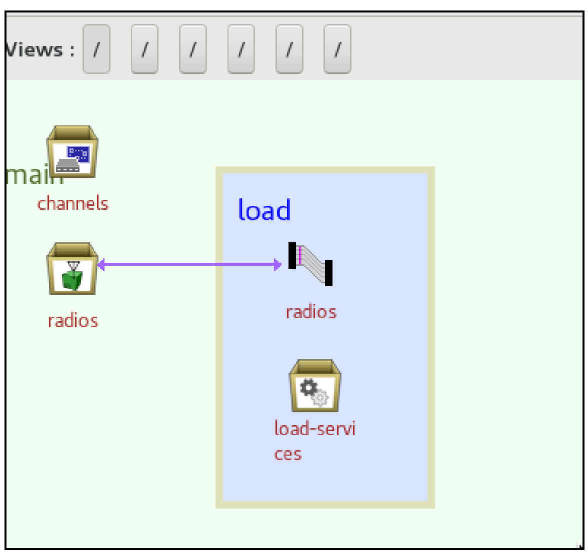


Figure 142: Model layout

10.0 Advanced topics and examples

This chapter discusses the following topics:

- ACE Scope
- ACE GLOBAL LINK EDITOR

10.1 ACE Scope

The scope function in ACE Studio is a graphical representation of an oscilloscope display. Various additional features are included in the scope function. This section discusses the following topics:

- Main display
- 1/3 Octave display
- FFT display
- Comparison display

10.1.1 Main display

Below is a typical scope display. It is displaying a sine wave, amplitude +1 to -1 peak-to-peak with a frequency of 500 Hz.

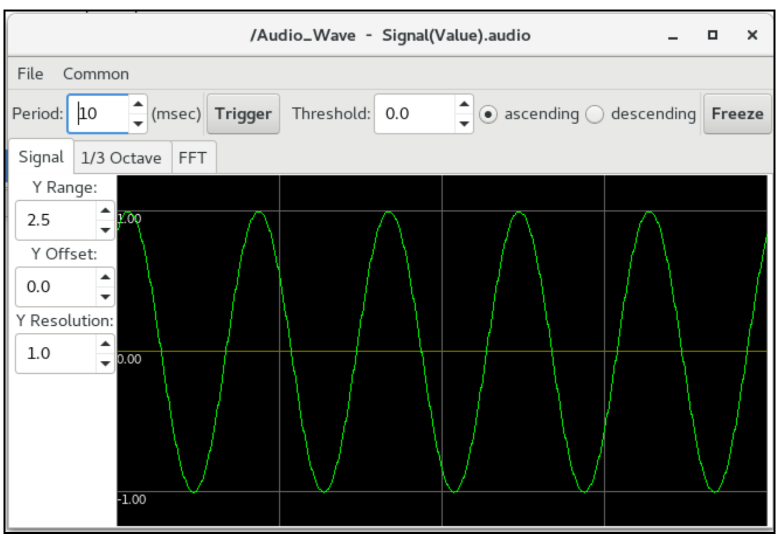


Figure 143: Scope main display

When the scope is first initiated, the default **Period** is 100 msec. To make the screen clearer, you can change it to 10 msec.

The peak-to-peak value is exactly 2, or +1 to -1. The main display shows five wave cycles, which equate to 500 Hz.

In **Threshold**, enter a trigger value for the time base. Select an **ascending** or **descending** signal, exactly like an oscilloscope.

To freeze the screen for detail inspection, select **Freeze**.

The Y axis has several adjustments. Figure 144, "Adjusted scope display" below shows the display after making several adjustments.

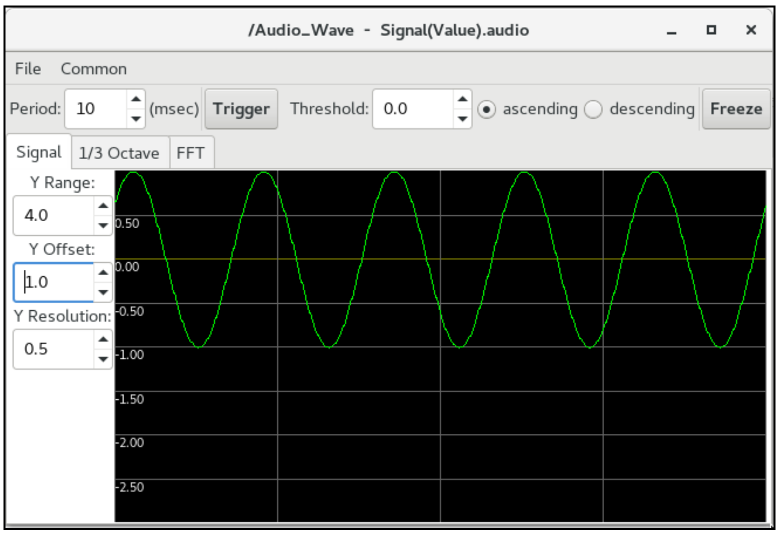


Figure 144: Adjusted scope display

In this example, **Y Range** is **4**. The vertical range goes from -3.0 to 1.0, which is 4 units.

Y Offset is **1.0**, so the vertical center of the scope is -1.0. The +1 refers to moving the 0 reference up by 1 unit.

Y Resolution changes to **0.5**. This value has no effect on the signal; however, it moves the grid lines closer together for more detailed examination of the plot. In this case, they are 0.5 units apart.

10.1.2 1/3 Octave display

To view an alternate display, select **1/3 Octave**:

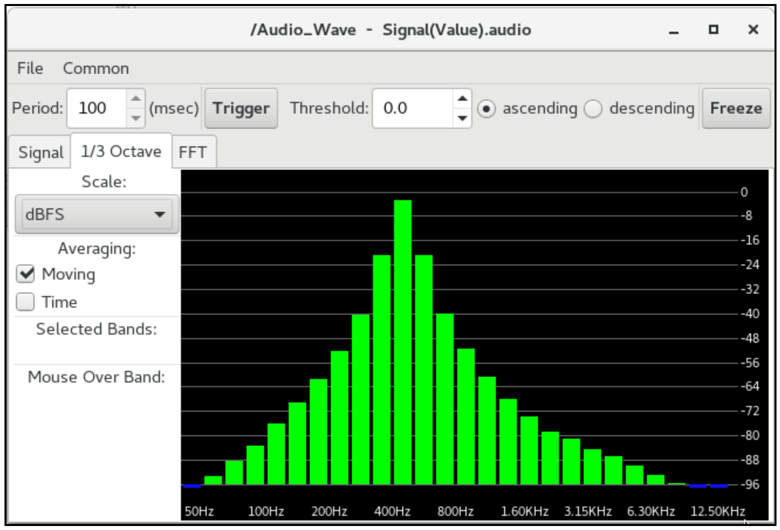


Figure 145: 1/3 Octave view

In Figure 145, "1/3 Octave view" above, the amplitude of the signal displays in 1/3 octave increments from 50–16,000 Hz. Since the signal is a 500 Hz sine wave, the peak is at 500 Hz, and the signal amplitude rapidly drops off on both sides of the peak.

To see the amplitude of the signal at any 1/3 octave step, move the mouse over the display, and the band's value shows under **Mouse Over Band**. Alternatively, select individual bands, and the amplitude values display under **Selected Bands**.

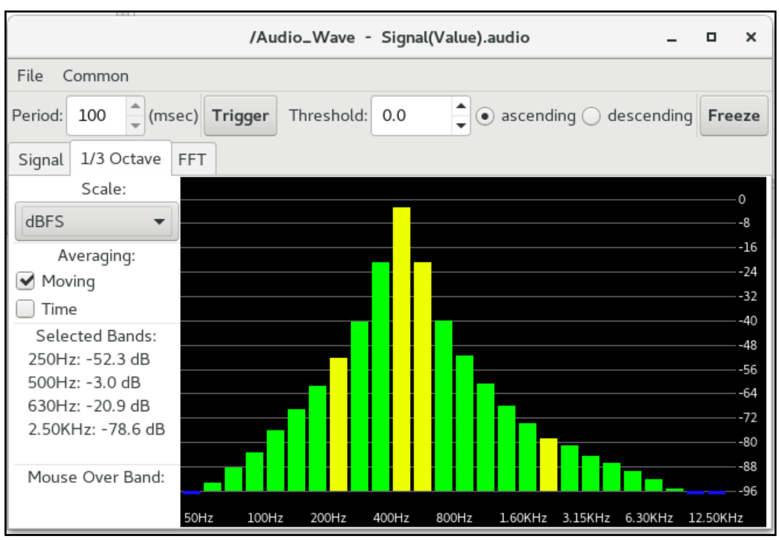


Figure 146: Highlighting bands

In Figure 146, "Highlighting bands" on the previous page, no indications exist in **Mouse Over Band**. However, four bands are highlighted:

- 250 Hz with an amplitude of -52.3 dB
- 500 Hz with an amplitude of -3.0 dB
- 630 Hz at an amplitude of -20.9 dB
- 2,500 Hz at an amplitude of -78.6 dB

These amplitudes update in real time.

Scale includes four selections:

- ***dBFS or Full Scale**:* scales the display vertically from -96 dB to 0 dB. This scale is provided with a 96 dB range, since the 16-bit audio used in the .wav files for use with the Telestra gives a dynamic range of 96 dB.
- ***Normalized**:* scales the display from 0 to 1. Unlike the dB scales, this is a linear scale and has the effect of compressing the parts of the signal with a lower level.
- ***Cal94DB SPL**:* useful for sound tuning.
- ***Cal114dB SPL**:* useful for sound tuning.

***Important**: Do not use **Cal 94 dB**.*

Figure 147, "Calibration tone" below shows a plot at 94 dB, 1000 Hz:

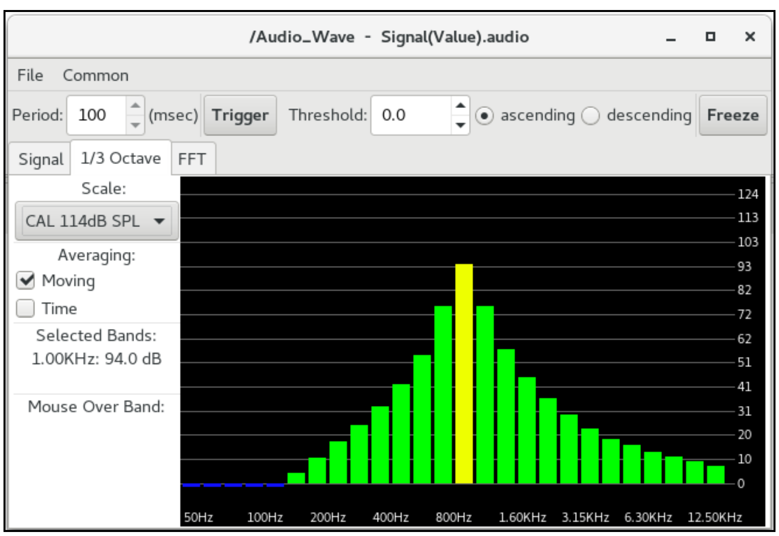


Figure 147: Calibration tone

When you are making Level D recordings on an aircraft, a 1000 Hz calibration tone records at the start of each recording session. The audio source is normally a 1000 Hz tone at either 94 dB SPL or 114 dB SPL. For most applications, 94 dB is more than adequate. For extremely loud aircraft, normally military transport or rotary wing, the reference is usually 114 dB SPL.

When tuning an aural cue system, use a calibrated microphone. Start by recording a reference level just like in the aircraft. We use the scope **1/3 Octave** display set to 114 SPL mode (not 94 dB), and adjust the input channel gain until we see either 94 dB or 114 dB at the center frequency, depending upon the reference level calibrating the microphone. The input channel is now calibrated to the microphone. For comparison purposes, if we were to compare the aircraft calibration recording to the microphone level, they should match.

As a result, the signal amplitude could be the same for both 94 dB SPL and for 114 dB SPL. It all depends upon the sensitivity and scaling of the microphones being used. All we are doing is adjusting the scale of the display to make it easier to read and giving us a calibrated display of the actual signal amplitude.

Clearing **Moving** and **Time** when a dynamic signal displays causes the band amplitudes to change rapidly, making them difficult to read. Level D tuning requires you to compare sounds over a period of time (e.g., 15 seconds to three minutes, in some cases). You can use individual band averages.

Moving averages each individual band over time. The longer **Moving** is selected, the longer the averaging period. If **Time** is selected, the display shows the peak value of each band and a line showing the average values.

10.1.3 FFT display

Any time signal (e.g., noise, speech, music) is a function of fundamental frequencies, a combination of sinusoidal waves of varying frequency, amplitude, and phase. The FFT display shows the amplitudes and frequencies of these root sine waves, which build the resultant sound. This theory is useful while duplicating an engine sound, for example. You can transpose the frequencies and amplitudes in the display directly into the **Engine** component.

Figure 148, "FFT display" below is the FFT display for the sine wave:

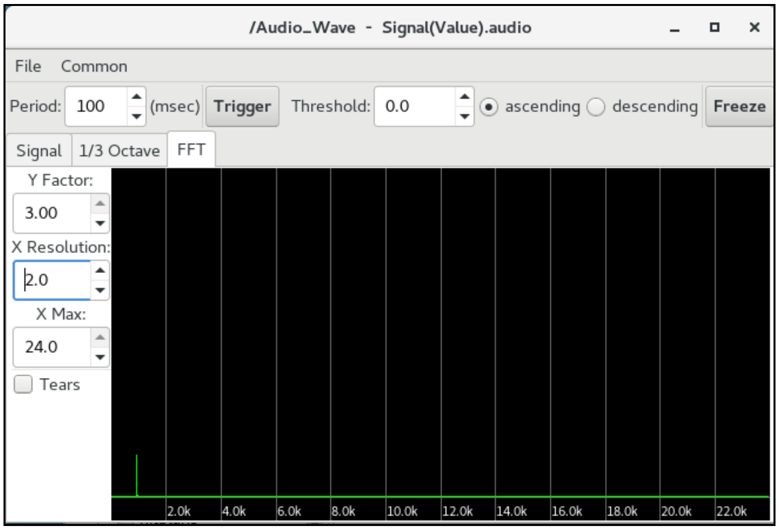


Figure 148: FFT display

The peak is 1000 Hz, as expected.

To assist in the analysis, adjust the Y gain with **Y Factor**. The **X Max** limits the upper frequency for analysis, which stretches the lower frequency end of the display, improving clarity. The **X Resolution** adjusts the graphical scale's resolution.

Tears detects transients that may appear and disappear too quickly to analyze. The tears show the max value for a few seconds and return to their original value.

In Figure 149, "Filtered noise FFT display" below, the 1000 Hz sine wave was replaced with a noise source after passing through a bandpass filter set to 1000 Hz.

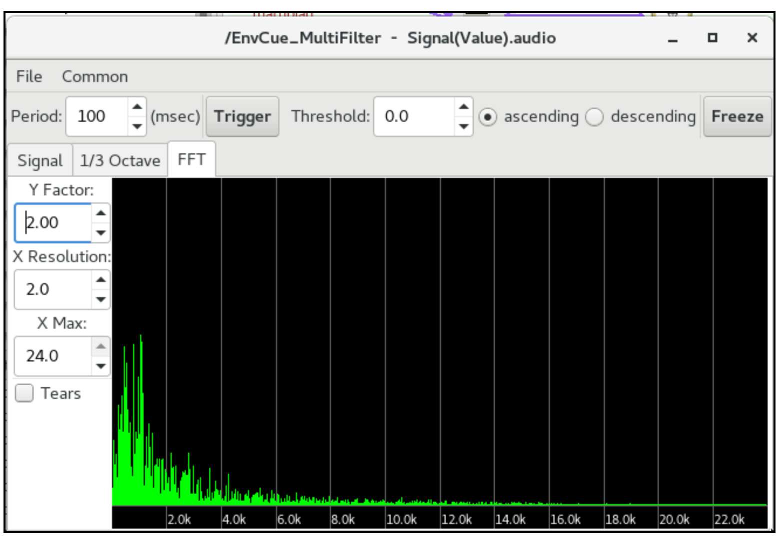


Figure 149: Filtered noise FFT display

Even though the filter is a bandpass type, it has a finite bandwidth. Below, the display sums three sine waves of equal amplitude with the following frequencies:

- 500 Hz
- 1750 Hz
- 6500 Hz

The scope display doesn't look like sine waves. The peaks in **1/3 Octave** give some idea of what is going on, but the FFT display has isolated the three frequencies that created the wave.

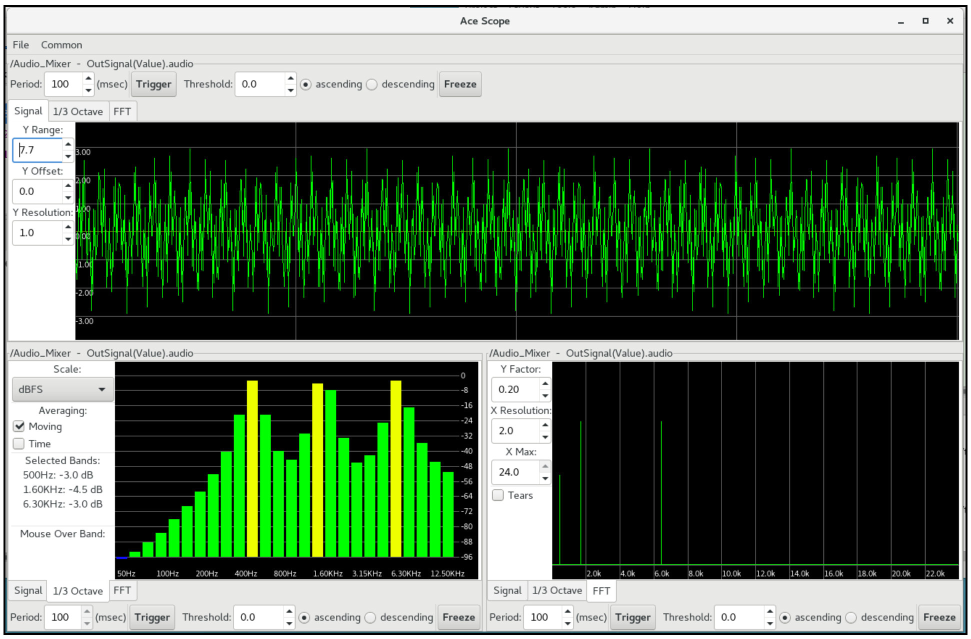


Figure 150: Three sine waves scope

To recreate the display, view the normal scope display. To repeat the scope display three times, from **File**, set the frame number to three. From these displays, choose the individual tabs and scaling as desired.

10.1.4 Comparison display

When tuning an aural cue system, you can use the scope in **1/3 Octave** as a comparison tool. When creating a reference file during Level D recordings, a tightly controlled known set of conditions exists. Convert the reference file to a calibrated format, and store them on the Telestra server.

You may now use the known conditions to drive the aural cue system, which is set to a calibrated volume (i.e., normally 100 percent). The spectral analysis microphone can pick up the signal once you seal it for calibration. Listen to it with a **Playsound**, and compare it to the referenced sound file.

To use the comparison display, follow these steps:

1. Instigate a scope using **View Scope** from **Pink Noise Reference**. Open **Pink Noise Filtered**, and right-click **View Scope**. Figure 151, "Add to Scope" below shows how to compare a pink noise reference source to a 1000 Hz bandpass-filtered pink noise source.

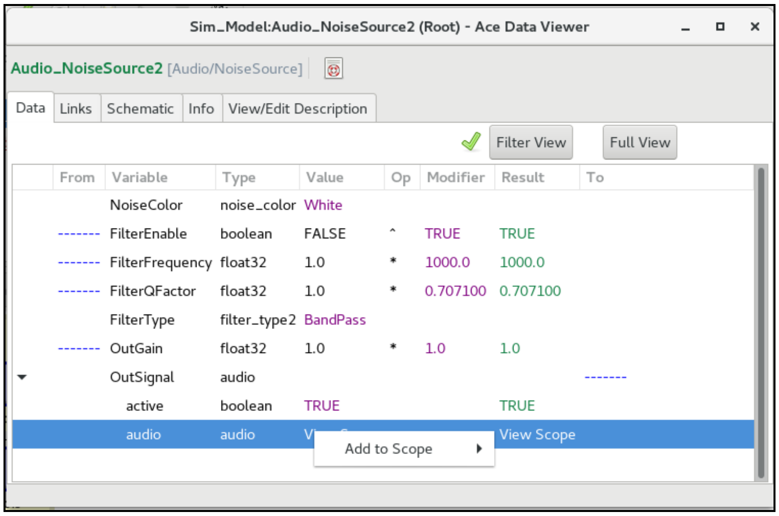


Figure 151: Add to Scope

2. Select **Add to Scope**.

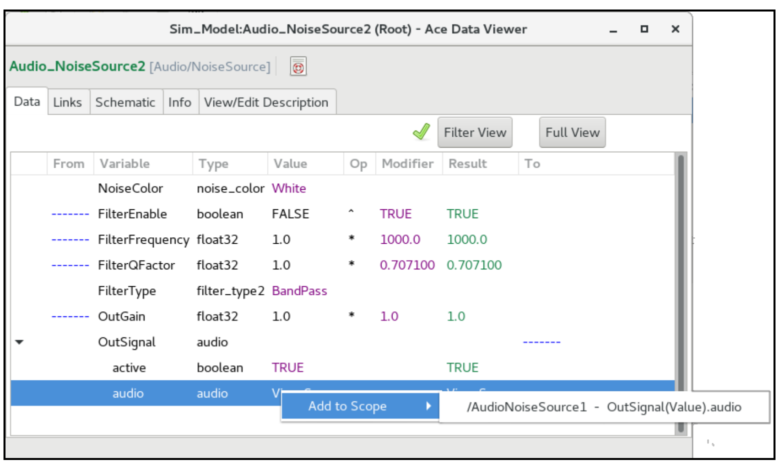


Figure 152: Select Add to Scope

3. Choose a scope, and add a signal to it.

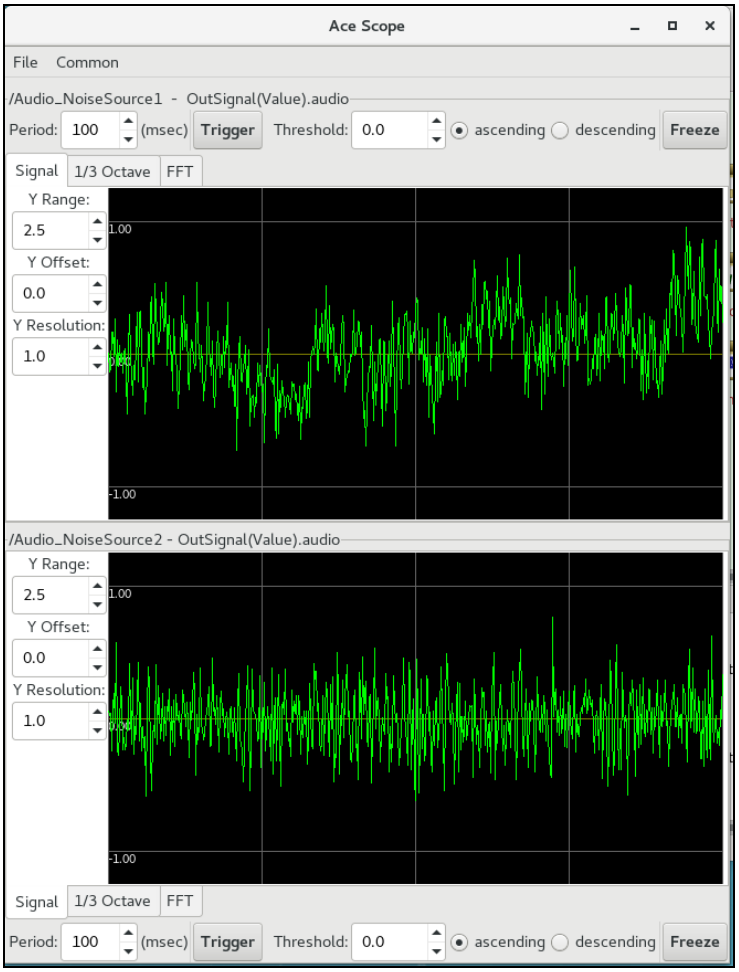


Figure 153: Added to scope

Both scope displays display in a single window. They are different, but it would be nice to see the spectral difference so you can tune the pink noise to match the reference.

4. At the top of the window, select **File**.

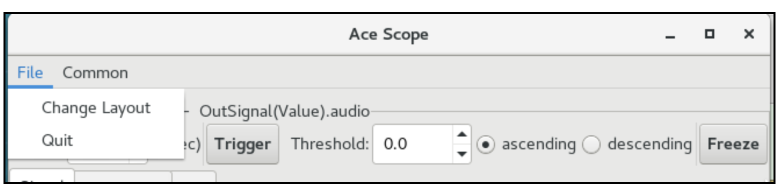


Figure 154: Change Layout

5. Select **Change Layout** to reset the display.

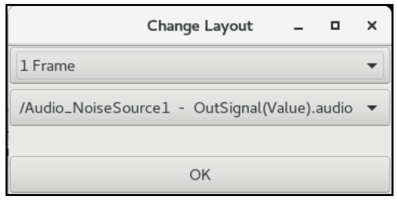


Figure 155: Change Layout window

6. To use the comparison function, we need to show the display in one frame, so the top line is correct. The next line shows **Pink_Noise-Reference**. Select **OK**, and the scope shows a scope display with a single window showing the **Pink_Noise_Reference** signal.

7. To select the comparison mode, select the second line, and then select **Comparison**.

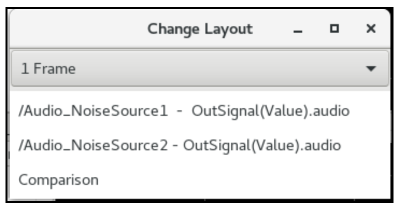


Figure 156: SelectComparison layout

8. When **Comparison** opens, choose which signals to compare.

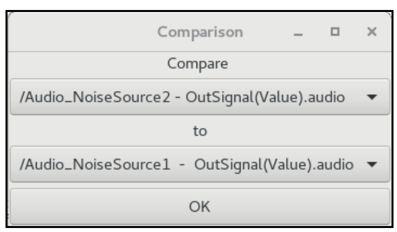


Figure 157: Select comparison signals

9. Compare the filtered signal to the reference signal. The decision as to which signal is the master and which is the one to compare it to is important.

10. Select **OK** twice, and select **Change Layout**.

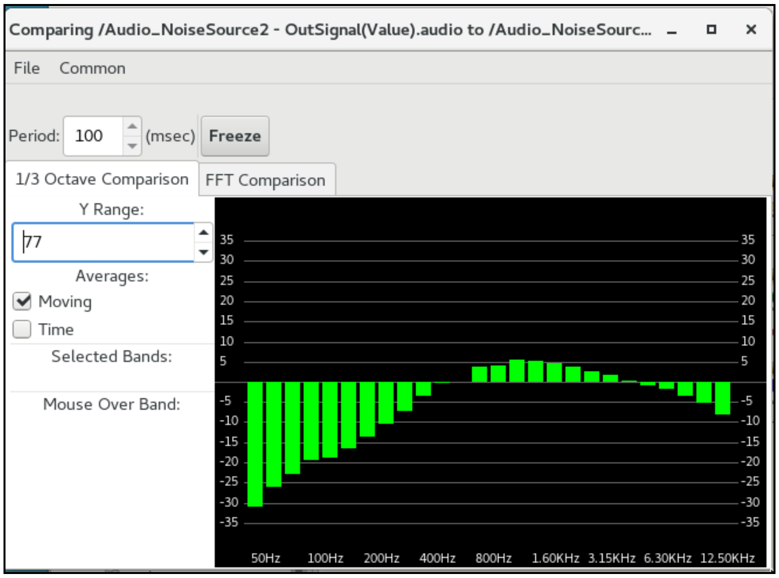


Figure 158: Comparison mode

11. In **Comparison**, choose which signals to place on Lines 1 and 2.

12. Compare the filtered source to the reference source. In the display, if the amplitude of a frequency band in the filtered signal is lower that the same band in the reference signal, the display shows the band dropping from the 0 dB reference level.

    In the displayed comparison, the filtered signal passes through a bandpass filter of 1,000 Hz. At the 1000 Hz band, a positive gain of around 7 dB exists. On either side, the bands move farther away from the center frequency. The filtered signal's amplitude drops to 50 Hz and 16,000 Hz, approximately 30 dB and 10 dB below the reference signal.

13. To make a display match, remove the bandpass filter. In a complex simulated audio system, use selective dynamic filtering of the propellers or engines to increase or decrease gains at different frequencies to match the output from the model to the referenced audio.

10.2 ACE GLOBAL LINK EDITOR

ACE GLOBAL LINK EDITOR is an alternative method to create buses and connectors, interlinking sim models. The tool allows a visualization of a bus connection from the source component to the destination component. You can use this feature to add signals to existing connectors and buses.

10.2.1 Example model

To create an example model and layout, follow these steps:

1. Install the layout, and in **Model Viewer**, create a new simulation model, and a new host model.

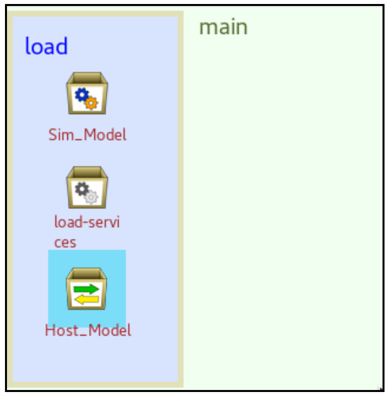


Figure 159: Example model

2. Add a **HostIn** component, which provides the labels to connect to the simulation model.

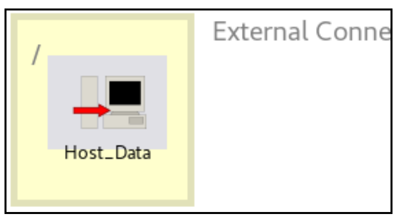


Figure 160: Host interface

3. Populate **Host Packet** in **Host Packet Editor**.

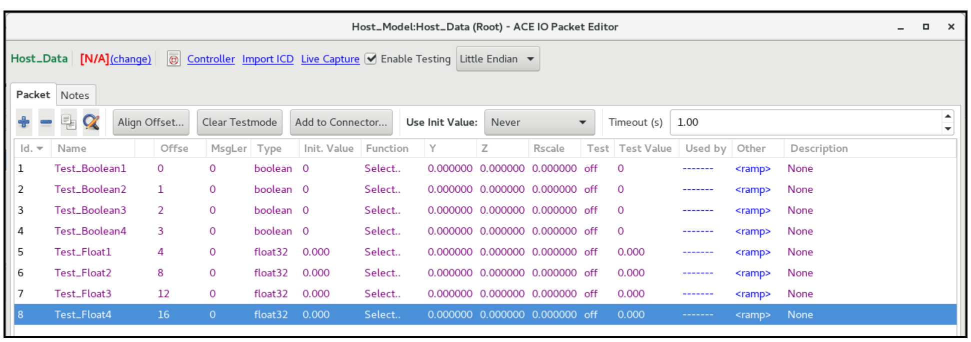


Figure 161: Test host packet

4. In **Host Packet Editor**, highlight all of the signals, select **Add to Connector…**, and add these signals to a new connector.

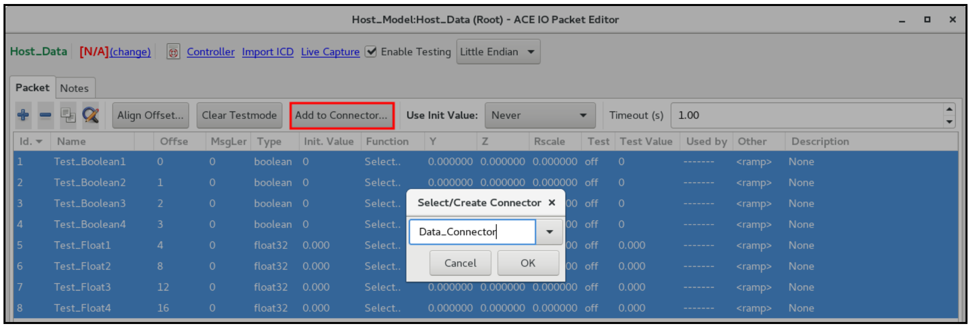


Figure 162: Add signals to connector

5. Assign the connector to a bus named **Data_Bus**, and copy the connector.

6. Go to the simulation model, and paste the connector to the canvas, keeping its name. Add ten **MathFunctions** (i.e., **Function1–10**).

7. Link the eight signals in the connector to **Functions1–8** (x) inputs, and assign the connector to the **Data_Bus**.

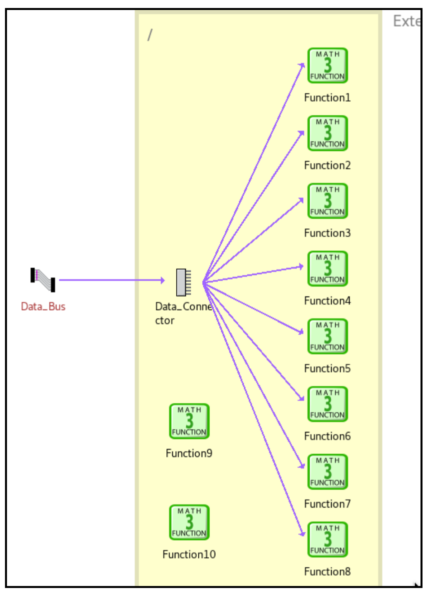


Figure 163: simulation model example

8. A bus connects the host and simulation models:

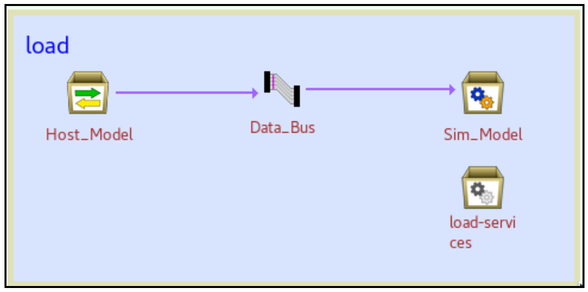


Figure 164: Load overview

To refresh the load and ensure all changes are current in the temporary files, select **Reload** in **Model Viewer**.

9. Go to **Host Packet Editor**, and add two signals to the host packet.

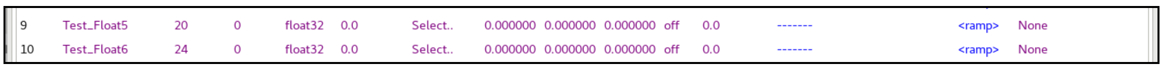


Figure 165: Labels in host packet

10. Next, use **ACE GLOBAL LINK EDITOR** to connect these labels to **Function9** and **Function10** in the simulation model. At the top of **Model Viewer**, select **Tools** > **Global Link Editor**.

11. **ACE GLOBAL LINK EDITOR** is arranged from top to bottom, from source to destination. From the top, select your source model (i.e., **host_model**) in **Select Src Model**. This action populates the next pane down with the relevant components in the selected model.

12. In this case, select **Host_Data**, which populates the right pane with signals that you can link.

13. Select **Test_Float5**, which is the first signal.

14. In **Host Model**, select the connector, which populates the left **Signal** pane. To add a signal to the connector, select the plus sign ( ), and enter a name. **Load** only displays one bus. As a result, the bus displays in the right **Bus** pane. Normally, **Load** would display all buses.

15. Select **Data_Bus**.

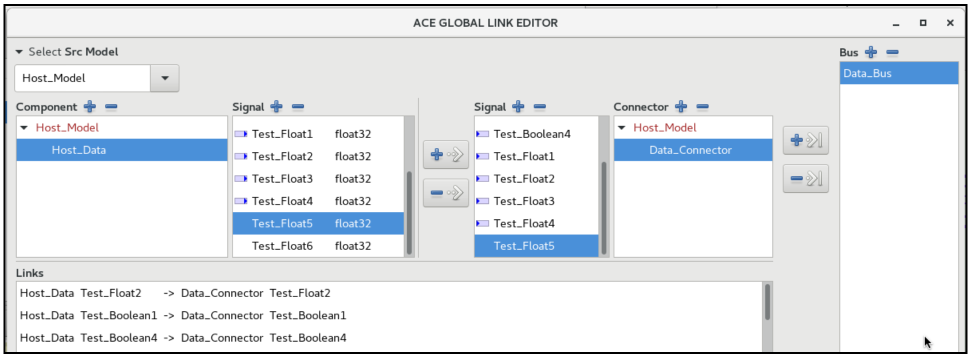


Figure 166: Source selections

16. Follow the same procedure for destinations. From **Select Dest Model**, select **Sim_ Model**.

17. To populate **Signal**, in the lower-right pane, select **Data_Connector**.

18. Add the signal label to match the new signal label you added in the source connector. This is done in the exact same way we added the signal in the source connector.

Important*: The signal names in the source and destination connectors must be an exact match. The system allows you to use differing names, and they both appear in the bus but are not connected.*

19. In the lower left panel, select **Function9**. In the right pane, select **input_X**.

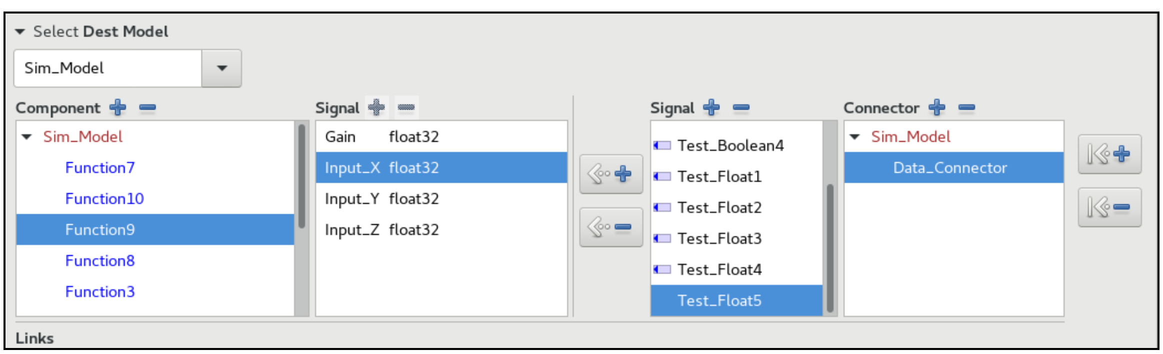


Figure 167: Destination selections

20. The entire signal path now displays. If everything is correct, select **Link All**. This creates the link for that signal. Do the same for **Test_Float6**.

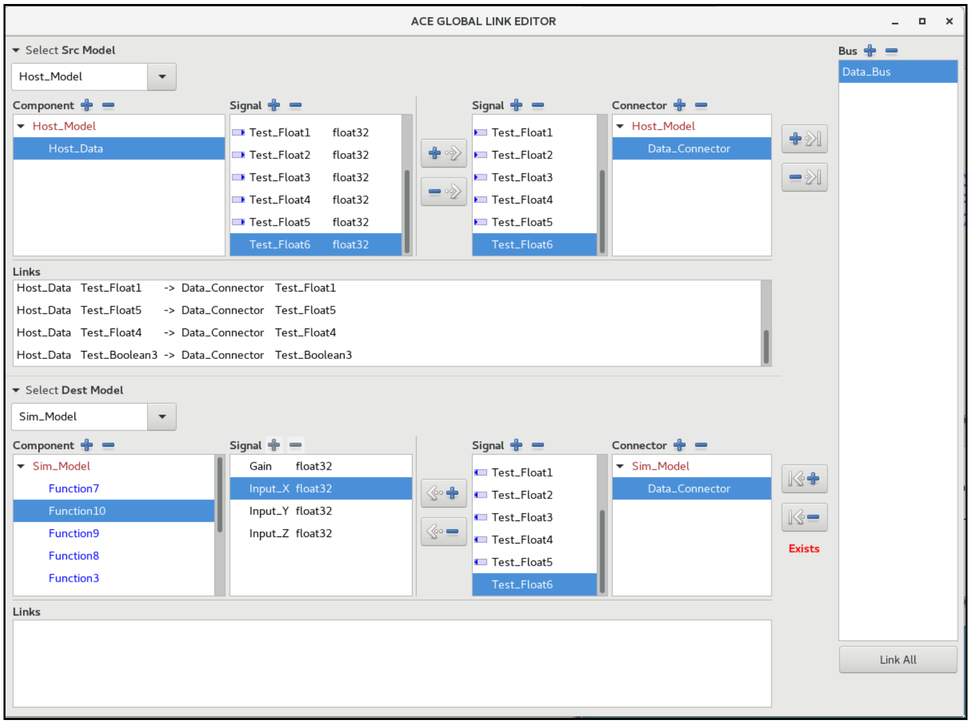


Figure 168: Test_Float6 links

21. Close **ACE GLOBAL LINK EDITOR**. In the model, the load contains two additional signals.

