Waves Cloud MX

Audio Mixer

Deployment and User Guide (V3.1)

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Waves Cloud MX Product Overview

Waves Cloud MX is a cloud-based professional audio mixer for broadcast and media organizations using cloud production workflows on Amazon AWS or Google Cloud Platform. Cloud MX offers pristine audio, high-precision mix control, and creative processing capabilities with full Waves plugin integration, in a scalable, broadcast-ready cloud workflow.

Waves Cloud MX is deployed by customers on Amazon Elastic Compute Cloud (Amazon EC2) or Google Compute Engine (Google GCE) within the customer's Virtual Private Cloud (VPC) to ensure reliable, secure, high-performance and cost-effective compute infrastructure throughout an event. Customers can also deploy the mixer on instances at any of the available Amazon EC2 or Google GCE geographical locations (availability zone) to optimize network performance between the cloud, remote operators, and on-premises equipment.

Waves Cloud MX is NDI®-compatible, so it fits easily into NDI-based cloud network environments. An intuitive Waves NDI control panel is included to provide easy patching and routing of NDI audio streams processed by the mixer.

Waves Cloud MX is also Dante®-compatible, integrating smoothly into the Dante Connect™ cloud networks. By using the Dante® Virtual Soundcard as the mixer's audio transport engine, Waves Cloud MX streams uncompressed audio in and out of the mixer within the Dante Connect ecosystem.

Waves Cloud MX features include:

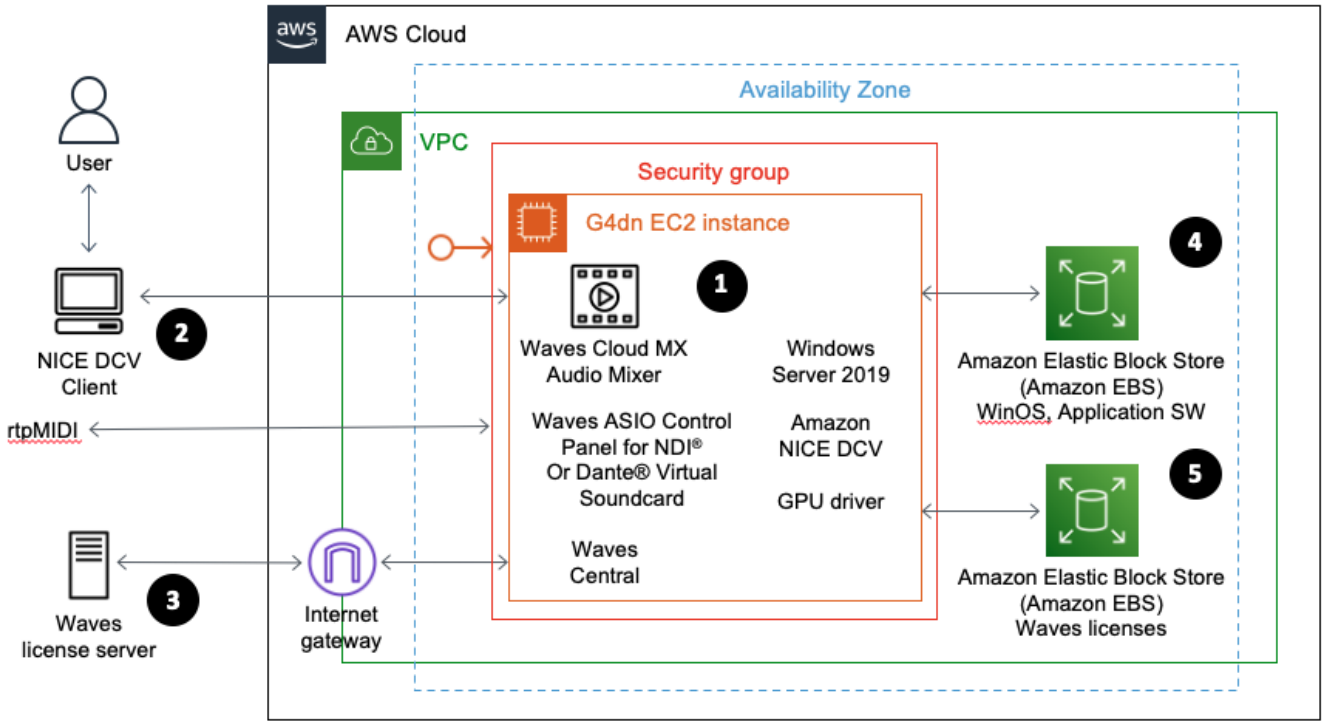
- 100% cloud-based audio mixing solution
- Easily scalable to any broadcast requirement
- NDI compatible, with easy routing of NDI audio for all ingress/egress streams, using the Waves NDI Control Panel.
  Dante compatible, using Dante Virtual Soundcard for all ingress/egress streams.
- Easy deployment on AWS and GCP
- 32-bit floating point mix engine
- 64 stereo/mono input channels, 44 buss/return channels
- 16 monitor auxes and 8 FX auxes (stereo/mono), 8 audio groups, L/R/C/Mono, 8-channel matrix (stereo/mono)
- 16 DCA faders, 8 mute groups, 16 user-assignable shortcut keys
- Channel strip eMo plugins (EQ, filter, dynamics) included in all Cloud MX packages
- Full operator control using the tactile Waves FIT controller and/or up to four touchscreen displays connected via high-performance PCoIP virtualization software remote protocols.

Deployment Overview

Waves Cloud MX is deployed on an Amazon EC2 instance or Google GCE owned and managed directly by the user. This guide assumes that the user has a basic understanding of setting up, launching, and using Amazon EC2 and Google GCE Windows instances.

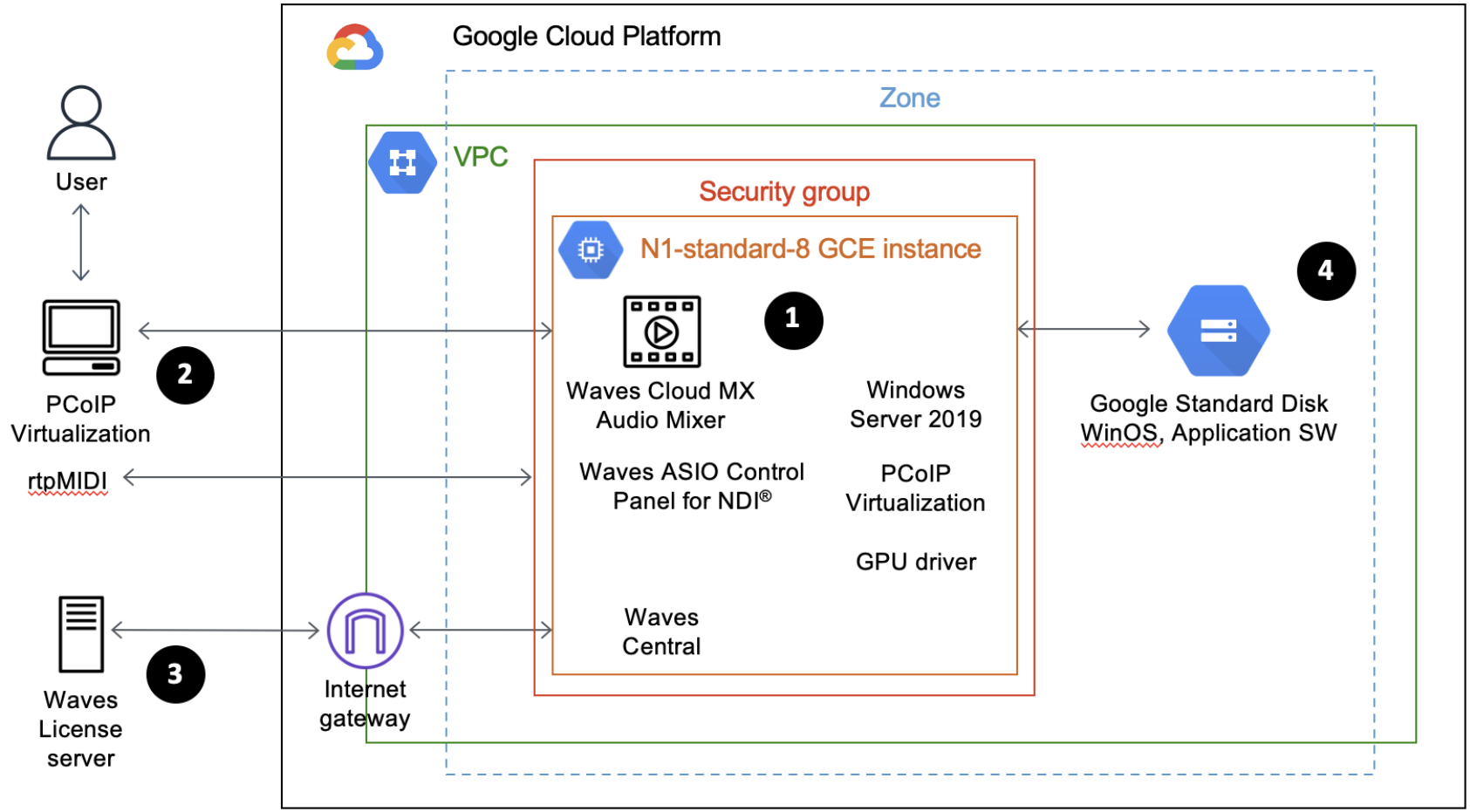
Detailed documentation for Amazon AWS can be referenced here: docs.aws.amazon.com.
Detailed documentation for Google GCE can be referenced here: cloud.google.com/compute/docs

Waves Cloud MX Audio Mixer AWS Architecture



1. An Amazon Elastic Compute (Amazon G4dn EC2) instance for Windows Server 2019 (or later), with NICE DCV and NVIDIA® GPU drivers, is used to run the Cloud MX Audio Mixer, the Waves ASIO Control Panel for NDI, and/or Dante Virtu al Soundcard and the Waves Central application within the customer's VPC.
2. Amazon NICE DCV remote display protocol is used for high-performance remote access to the Cloud MX Audio Mixer application.
3. An Internet Gateway allows communication between the instance in the VPC and the Waves license server, to authorize and activate Waves software licenses.
4. Waves Cloud MX application software is installed on an Amazon EBS Volume that stores the Windows Server OS and related software.
5. Waves software licenses are stored on an Amazon EBS Volume to easily move and re-activate licenses between instances in the VPC.

Waves Cloud MX Audio Mixer GCP Architecture



1. A Google Compute Engine (n1-standard-8) instance for Windows Server 2019 (or later) with PCoIP virtualization software and NVIDIA GPU drivers is used to run the Waves Cloud MX Audio Mixer, Waves ASIO Control Panel for NDI and Waves Central Applications.
2. PCoIP virtualization software such as Teradici ® or Parsec® is used for high performance remote access to the Waves Cloud MX audio mixer application.
3. An internet gateway allows communication between the instance in the VPC and the Waves license server to authorize and activate Waves software licenses.
4. Waves Cloud MX application software is installed on a Google Standard Persistent Disk or better (SSD Persistent Disk), that stores the Windows Server OS, the Waves licenses and related software.

Waves and Third-Party Software

Waves Cloud MX and the Waves ASIO Driver for NDI are installed and activated on the Amazon EC2 instance using Waves Central. Instructions for installing Waves Central and installing and activating Waves software is included in “Step 3” below.

Additional third-party software must be installed by the user to use all features of the product.

The list below summarizes the third-party software that should be installed by the user, as referenced in the setup instructions. Links to the relevant software and/or documentation are included.

NVIDIA GRID™ drivers for Amazon EC2 or Google GCE

PCoIP remote display application for Amazon EC2, such as NICE DCV

PCoIP remote display application for Google GCE, such as Teradici or Parsec

NDI Tools

Dante Virtual Soundcard v4.4 or higher for Dante Connect, and Dante Controller application.

rtpMIDI

Deployment Considerations

Quotas

Before deploying Waves Cloud MX in AWS, it may be necessary to request a vCPU limit increase based on the G4dn instance size you want to run. For details about submitting a limit increase, refer to How do I request an EC2 vCPU limit increase for my On-Demand Instance?

Technical Prerequisites and Requirements to Complete Deployment Process

Regions / Data Centers	Waves Cloud MX can be installed on any center/region that provides the required instance type. For faster service and lower latency, we recommend that you choose an availability zone closest to you.
Instance Type	AWS: The recommended GPU instance type is g4dn.4xlarge. You can also use a smaller instance (g4dn.2xlarge) or larger instance, such as g4dn.8xlarge. The size depends on the total number of channels, mix buses, and plugins used for audio processing. If the instance cannot be launched in the selected Availability Zone (AZ), you can try to use another AZ. GCP: The recommended GPU instance type is n1-standard-8 or better.
OS	Microsoft Windows Server 2019 or later
GPU	AWS: NVIDIA GPU with GRID drivers GCP: NVIDIA T4 type GPU or higher with NVIDIA GRID drivers
Storage	AWS: Amazon EBS volume (General Purpose SSD) for OS and application installation, and a separate Amazon EBS Volume (minimum size, 1GB) for Waves license management GCP: Google Standard Persistent Disk or better for OS and application installation and activation. For optimal performance, use a Persistent SSD type disk.
Remote Display	AWS: NICE DCV or other high-performance PCoIP (e.g., Teradici). GCP: Teradici. Parsec, or other high-performance PCoIP applications.
Remote Controller (optional)	Waves FIT Controller via rtpMIDI
Other Required Software	Dante Virtual Soundcard V4.4 or higher, NDI Tools

Skills or Specialized Knowledge Needed by the User

Users that deploy Waves Cloud MX on AWS should possess sufficient knowledge and skills with AWS or GCP to log on to an account, launch an instance, attach an AWS EBS volume, configure security/firewall groups, and install required software, as described in this document.

Time to Complete Deployment

This document describes all steps necessary to complete deployment of Waves Cloud MX on AWS or GCP. For typical deployments, experienced users should be able to install all required software and drivers, and activate licenses in less than one hour.

Security Considerations

When you build systems on AWS or GCP infrastructure, security responsibilities are shared between you and your cloud vendor. The AWS shared responsibility model and the GCP shared responsibility model reduce your operational burden because your cloud vendor operates, manages, and controls the components, including the host operating system, the virtualization layer, and the physical security of the facilities in which the services operate.

For more information about AWS security, visit AWS Cloud Security.

For more information about GCP security, visit Google Cloud Security.

Root User Privileges are Not Required

The user deploying Waves Cloud MX on AWS or GCP does not require the use of root privileges for deployment or operation. Users should not use root access for any deployment or operation of Waves Cloud MX.

Least Privileges Principal

Waves Cloud MX software is deployed on a single instance. Provisioning of the instance and its storage is done through AWS or GCP Console using an IAM user access of the customer. Installation of software components is done using Windows Remote Desktop or any other pre-installed PCoIP virtualization software.

Users of the tool can operate only on audio content and cannot change any administrative configuration of the tool. Access to users is additionally limited by whitelisted IP addresses—a block of source IP addresses defined in the AWS or GCP Security Group/Firewall Rules.

Security Groups/Firewall Rules

The security groups/firewall rules created in this solution are designed to control and isolate network traffic between specified IP ranges and the Waves Cloud MX instance. Security groups/firewall rules are also used to control access between instances to send and receive media streams using NDI or Dante.

You can configure the Security Group (AWS) or Firewall Rules (GCP) at the VPC level or at the instance level.

AWS: Additional information about Security Groups is available at;
https://docs.aws.amazon.com/vpc/latest/userguide/VPC_SecurityGroups.html.

GCP: Additional information about Google's Firewall rules is available at https://cloud.google.com/firewall/docs/firewalls.

Costs

There are two components of the customer costs associated with deploying Waves Cloud MX on AWS or GCP. Each is described below.

AWS Resource Costs

The AWS costs to consider are:

1. EC2 instance costs
2. Elastic Block Storage (EBS) costs
3. Data Transfer Out (DTO)
4. Elastic IP costs

General information for these cost considerations is shown below.

1. Customers must license an Amazon EC2 instance (g4dn.4xlarge) with an NVIDIA GPU driver to deploy Waves Cloud MX. Costs associated with each AWS billable service is owned and maintained solely by AWS and is separate from costs associated with licensed Waves software.

The default EC2 this solution deploys is a g4dn.4xlarge EC2 instance for running Windows. As of September 2023, the cost of running this EC2 with the default settings in the US East (N. Virginia) region is $1,416.80 per month ($1.97 per hour) based on the on-demand hourly rate. Prices are subject to change. To save money, consider turning off your Windows EC2 instance when not in use.

2. Waves Cloud MX also uses an EBS storage for activating the Waves license. The minimum required storage is 1GB. Cost of the storage in US East (N. Virginia) region for the Throughput Optimized HDD (st1) Volumes is $0.045 per GB/month of provisioned storage.

3. Another component to consider is the Data Transfer Out (DTO).

- Data Transfer Out to Internet shall be considered at $0.09 per GB for the first 10 TB/month.
- If the traffic goes over AWS Direct Connect (https://aws.amazon.com/directconnect/) the cost to consider will be $0.02 per GB

4. One Elastic IP address is free to use with an EC2 Instance. However, there is a charge of $0.005 per every hour the instance is not running (for example, stopped overnight).

Details of the costs can be estimated using AWS Pricing Calculator. (https://calculator.aws/#/).

For complete details, refer to the pricing webpage for each AWS service you will be using, or contact your AWS account manager.

Google GCP Resource Costs

The Google GCE costs to consider are:

1. Compute Engine costs
2. Network Egress costs
3. Static IP Address

General information for each of these cost considerations is shown below.

1. Customers must license a Google GCE (n1.standard-8) equipped with an Windows Server 2019, Standard Persistent Disk and NVIDIA GRID drivers to deploy Waves Cloud MX. Costs associated with each GCE billable service are managed solely by Google and are separate from costs associated with licensed Waves software.

The default GCE this solution deploys is a n1.standard-8 instance for running Windows. As of September 2023, the cost of running this GCE with the default settings in the US East (N. Virginia) region is $1,005 per month ($1.38/hour) based on the On-Demand hourly rate. Prices are subject to change. To save money, consider turning off your Windows GCE instance when not in use.

Refer to the Google Compute Engine pricing page for more information: https://cloud.google.com/compute/all-pricing.

2. Another component to consider is the Network Egress costs. The prices are dependent per destination and whether you are transferring data between cloud instances or between Cloud to Ground. For example, Network Egress Premium Tier from a GCE instance in N.Virginia to the Americas shall be considered at $0.12 per GiB/month.

   If the traffic goes over Google Cloud Interconnect (https://cloud.google.com/network-connectivity/docs/interconnect) then the price will differ.

   If you send traffic between two VMs, then the traffic is counted as egress traffic as it leaves one VM and counted as ingress traffic as it arrives at the other VM.

3. Static IP Address (assigned but unused) price/hour is $0.01

   More details on network and VPN pricing can be found in the VPC pricing page.

Details of the costs can be estimated using the Google Cloud Pricing Calculator.

Waves Cloud MX Software License Costs

Waves Cloud MX is offered as a Bring Your Own License (BYOL) model that is installed and activated on the cloud instance. There are three options for license duration (one-week, one-month, and one-year) and three options for audio processing plugins included with the Cloud MX audio mixer application. Pricing is based on the choice of these options and can be found on the Waves website (https://www.waves.com/cloud-mx).

Cost and payments for the Waves software is managed directly between Waves and the customer. Charges and payment options are not included in the cloud vendor's payment process.

Dante Connect License Costs

Dante Connect is offered as a Bring Your Own License (BYOL) model. Licenses for Dante Domain Manager® and Dante Virtual Soundcard nodes are installed and activated on their respective Amazon EC2 instances. Pricing is based on an up-front time-limited model and is dependent on the components and options selected. Cost and payments for the Dante Connect software is managed directly between the client and the official reseller.

Step 1A: Configure the Amazon EC2 Instance

The following instructions provide important information about configuring the Amazon EC2 instance that will be used for the Waves Cloud MX audio mixer.

Initial EC2 Configuration Instructions

1. Create an EC2 Instance with Windows Server 2019 (or newer). Note: A g4dn.4xlarge type or better instance is recommended, depending on total number of channels, mix busses, and plugins that will be used with the mixer.

   To streamline configuration, you can use a pre-made EC2 image (AMI) with the NVIDIA GRID drivers and NICE DCV server preinstalled from the AWS AMI Marketplace. One such example is AMI the High-End Windows Desktop - NICE DCV for NVIDIA-GPU with GRID drivers.

   For more information, refer to: https://docs.aws.amazon.com/AWSEC2/latest/WindowsGuide/EC2_GetStarted.html

2. Connect to the instance using Remote Desktop Client or NICE DCV (if already installed as part of the AMI).

3. Download, and install the Microsoft Edge or Google Chrome browser to simplify downloading of other software.
   Install and license NVIDIA GRID Drivers. For more details, see:
   https://docs.aws.amazon.com/AWSEC2/latest/WindowsGuide/install-nvidia-driver.html
   If you're using an AMI with pre-installed NVIDIA GRID drivers, you can skip this step.

4. Install the AWS NICE DCV Client and Server (using default options). The files can be downloaded from the AWS website using these links.
   NICE DCV Windows Server Installation Instructions:
   https://docs.aws.amazon.com/dcv/latest/adminguide/setting-up-installing-windows.html
   For lowest latency, the QUIC UDP configuration is recommended:
   https://docs.aws.amazon.com/dcv/latest/adminguide/enable-quic.html
   NICE DCV client Installation Instructions:
   https://docs.aws.amazon.com/dcv/latest/userguide/client.html
   (For more information about AWS NiceDCV, refer to: https://docs.aws.amazon.com/dcv/latest/adminguide/setting-up-

installing-windows.html)

If you're using an AMI that already has NICE DCV pre-installed, there is no need to reinstall it within the cloud instance.

5. Configure the AWS security settings to open TCP port 8443 for connecting to the instance using AWS NICE DCV from your remote location. Also, open UDP port 8443 if you are using the NICE DCV QUIC UDP configuration.

You should be now able to connect to the instance with the NICE DCV client of your choice (using the application or within a browser). It is no longer necessary to use the Microsoft Remote Desktop (Windows RDP)

6. Next, create a second EBS Volume (1 GB, standard/magnetic) to store the Waves software licenses. For more details, see: https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/ebs-creating-volume.html
7. Attach the EBS Volume for licenses to the EC2 instance and prepare it for use. Note that if you have created a new EBS Volume, you will need to initialize and mount the volume to the relevant instance. The license volume should be assigned to the next logical letter to the volume containing the application software (typically “D:”, if “C:” is the primary drive).

   There are various ways to mount an EBS volume, a streamlined method is using the Disk Management utility within the Computer Management application.

   For details and instructions, see: https://docs.aws.amazon.com/AWSEC2/latest/WindowsGuide/ebs-using-volumes.html

Configure Additional AWS Security Settings

Configure Instance Metadata System Version 2 (IMDSv2) when you launch the EC2 instance. This is described at https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/configuring-IMDS-new-instances.html.

Configure Security Group of the instance or of the VPC to allow Remote Desktop Protocol (RDP) – port 3389.

You can define and specify a range of allowed IP addresses (CIDR bock) to control access to the system: https://docs.aws.amazon.com/vpc/latest/userguide/VPC_SecurityGroups.html.

In addition to the ports required for RDP Connection and AWS NICE DCV, a few more ports need to be opened to allow communication from the EC2 instance to other production elements. The list below details additional ports that must be opened to facilitate the transmission of audio, control information, and to enable installation and activation capabilities.

- Waves Central Installation and Activation:
  Add the following domains to your firewall rules to provide https access for:
  - *waves.com
  - *wavescdn.com
  - *cloudfront.net

  In order to be able to log in to Waves.com website, provide access to Google and Google ReCaptacha:
  - www.google.com
  - www.gstatic.com
- NDI:
  - NDI:
    TCP: 5960 to 6024
    UDP: 5960 to 6024
  - NDI Bridge:
    UDP port 5990 - If ground-to-cloud or cloud-to-ground (on-premise) streaming is needed, this port should be opened for the corresponding route(s).
  - NDI Discovery Server:
    TCP port 5959 - Must be opened on all machines participating in the NDI network.
  - Note: if using NDI 4 devices, consult the NDI documentation for specific port details.
- Dante Connect:
  The Dante Domain Manager and Dante Virtual Soundcard instances should be configured using AWS Security Groups to allow the specific protocols, ports, and IP address ranges required for operation—including routing of media between nodes, connection between nodes, Dante Domain Manager, and Dante Controller.
  Details for configuration of Security Groups and the specific IP and Ports that should be opened are listed in the Security section of the Dante Connect Deployment Guide (p. 18).

- External Controller:

  If a fader controller, such as Waves FIT Controller will be used for remote control of Cloud MX, it is also necessary to open ports between the client and EC2 for rtpMIDI control.

  - rtpMIDI: Open two ports per MIDI device, starting from UDP 5004:
    UDP 5004-5005 (for one device)
    UDP 5004-5007 (for two devices)

  For all NDI Bridge and rtpMIDI ports, define the CIDR of the connected sources to limit the access only to desired sources and destinations.

Step 1B: Configure the Google GCE Instance

The following instructions provide important information regarding the configuration of the Google GCE instance that will be used for the Waves Cloud MX audio mixer.

Initial GCE Configuration Instructions

1. Create a GCE Instance with Windows Server 2019 (or newer). Note: An n1-standard-8 instance, or better ,is recommended, depending on total number of channels, mix busses, and plugins that will be used with the mixer.

   For more information, refer to: https://cloud.google.com/compute/docs/create-windows-server-vm-instance.

2. Connect to the instance using Remote Desktop Client (Windows RDP).

3. If not already installed, download, and install the Microsoft Edge or Google Chrome browser to simplify downloading of other software.

4. Install the NVIDIA GRID GPU Drivers. For more details and instructions: https://cloud.google.com/compute/docs/gpus/install-grid-drivers

5. Install your preferred high-performance PCoIP virtualization software, such as Teradici, Parsec, etc.

6. Configure the security settings to open relevant ports per the requirements of the relevant PCoIP application that you are using.

Configure Additional GCE Security Settings

Configure Instance Metadata System Version 2 (IMDSv2) when you launch the GCE instance. This is described at https://cloud.google.com/compute/docs/metadata/overview.

Configure Security Group of the instance or of the VPC to allow Remote Desktop Protocol (RDP): port 3389.

You can define and specify a range of allowed IP addresses (CIDR bock) to control who can access the system: https://docs.aws.amazon.com/vpc/latest/userguide/VPC_SecurityGroups.html.

In addition to the ports required for your PCoIP software and RDP Connection, a few more ports need to be opened to allow communication from the GCE instance to other production elements. The list below details additional ports that must be opened to facilitate the transmission of audio, control information, and to enable installation and activation capabilities.

- Waves Central Installation and Activation:

  Add the following domains to your firewall rules to provide https access for:
  - *waves.com
  - *wavescdn.com
  - *cloudfront.net

  In order to be able to log in to Waves.com website, provide access to Google and Google ReCaptacha:
  - www.google.com
  - www.gstatic.com

- NDI:

  The following ports need to be opened between machines that will be sending and receiving NDI data.
  - NDI:
    TCP: 5960 to 6024
    UDP: 5960 to 6024
  - NDI Bridge:
    UDP port 5990 - If ground-to-cloud or cloud-to-ground (on-premise) streaming is needed, this port should be opened for the corresponding route(s).
  - NDI Discovery Server:
    TCP port 5959 - Required to be opened on all machines participating in the NDI network.

- Note: if using NDI 4 devices, consult the NDI documentation for specific port details.

  External Controller:

  If a fader controller, such as Waves FIT Controller, will be used for remote control of Cloud MX, it is also necessary to open ports between the client and EC2 for rtpMIDI control.

  rtpMIDI: Open two ports per MIDI device, starting from UDP 5004:
  - UDP 5004-5005 (for one device)
  - UDP 5004-5007 (for two devices)

Step 2: Install 3rd Party Software

Most deployments will need to utilize tools from NDI or Dante for network configuration and management, and also connect a remote controller (such as the Waves FIT or other Mackie/MIDI controller). This section provides information to install these 3rd party software tools.

1. Install the NDI 5 Core Suite on the Windows EBS. The latest-NDI Core Suite tools can be downloaded here: https://ndi.video/tools/ndi-core-suite/
2. Dante Connect:
   The following applications should be installed on the AWS EC2:
   - Dante Virtual Soundcard V4.4 or higher for Dante Connect as described in the Dante Connect Deployment Guide (p. 17) "Bootstrap Dante Virtual Soundcard (DVS)"
   - Dante Controller. Dante Controller can be downloaded here: https://www.audinate.com/products/software/dante-controller In order to download it you must have a registered Audinate account.
3. Install rtpMIDI Setup on the Windows volume using the installer, with the default options. rtpMIDI can be downloaded here: https://www.tobias-erichsen.de/software/rtpmidi.html. Inside the link, click on "download rtpMIDI" at the top right.

   Install rtpMIDI on the cloud instance (server) and the local Windows PC (client), where devices such as Waves FIT or other MIDI controllers are connected.

   For more information about rtpMIDI, see: https://www.tobias-erichsen.de/software/rtpmidi/rtpmidi-tutorial.html.
   (Also note that contrary to the documentation provided by rtpMIDI, it is not necessary to enable port forwarding on the local/ground side. Just opening the ports on the AWS side is adequate for proper communication.)

See "step 7" in this document for additional information regarding configuring rtpMIDI and the Waves FIT Controller.

Step 3: Install and Activate Waves Software

Waves software installation and activation for Cloud MX is accomplished using Waves Central. Follow the instructions in this section to complete the software installation.

IMPORTANT NOTES:

- AWS EC2: The Waves Cloud MX license must be activated on a separate Amazon EBS volume to avoid losing the licenses if the Amazon EC2 instance is terminated. Be sure to create, initialize, and mount the separate EBS volume to the instance before installing and activating the Waves software.

- Google GCE: At present, licenses within GCE are exclusively supported on the Local Disk C: drive, associated with the virtual NIC Mac Address. Notably, as long as the instance is not terminated but is merely stopped/restarted, the license should continue working. Should an instance need termination, remember to deactivate the license within Waves Central first, as explained on page 24, step 5.

Amazon EC2

1. Create a free Waves account. This account is used to manage your Waves products and licenses. Make sure that you are logged in when purchasing the Cloud MX product from the Waves.com website.

2. Install Waves Central on the Amazon EC2 instance. The Waves Central Installer for Windows can be downloaded here: https://www.waves.com/downloads/central

3. Launch Waves Central and log in with your account credentials. Go to the Install Products section and select the relevant Waves Cloud MX.
   At the right, under “Target for Licenses,” click “Choose” and make sure to choose the second EBS Volume that you created previously for the purpose of placing the Waves licenses (Step 1A, item 6). Click on Install & Activate.
   If you do not wish to activate a license but to only install Cloud MX software then under Target For Licenses choose “Don’t Activate Licenses” and then click “Install.”
   Once installation is finished, the Cloud MX mixer will be installed directly to the EBS Volume that stores Windows and

applications (Local disk C) with its corresponding license activated to the second EBS Volume that you prepared beforehand.

To view the license status or to activate/deactivate licenses, visit the 'Licenses" section in Waves Central.

For details about moving licenses, see: https://www.waves.com/support/move-licenses.

Notes:
All Waves licenses should be activated on the EBS volume to avoid losing them when the EC2 instance is terminated. As noted earlier, the license volume should be assigned to the next logical letter after the main volume.

It is possible to install Waves Cloud MX on multiple Amazon EC2 instances and detach/attach the EBS Volume (that includes the licenses) when you wish to run Cloud MX for a production. Similarly, an instance image can be created to quickly spin up new instances, with the Waves license retained on this EBS Volume.

Google GCE

1. Create a free Waves account. This account is used to manage your Waves products and licenses. Make sure that you are logged in when purchasing the Cloud MX product from the Waves.com website.

2. Install Waves Central on the Google GCE instance. The Waves Central Installer for Windows can be downloaded here: https://www.waves.com/downloads/central.

3. Launch Waves Central and log in with your account credentials. Go to the Install Products section and select the relevant Waves Cloud MX. On the right side, under "Target for Licenses," click "Choose" and make sure that your Local Disk C is chosen. Click on Install & Activate. If you do not wish to activate a license but to only install Cloud MX software then under 'Target For Licenses' choose 'Don't Activate Licenses' and then click on "Install."

4. Once the installation is finished, the Cloud MX mixer and its license will be installed and activated to the Persistent Disk Volume that stores your Windows OS and applications (Local disk C:).

Note: At present, licenses within GCE must be activated/supported on the Local Disk C: drive associated to the virtual NIC Mac Address. Notably, as long as the instance is not terminated but merely stopped/restarted, the license should continue working.

5. Should an instance need termination, make sure, before terminating, to deactivate by launching Waves Central on the relevant instance, go to the Licenses section, select “Connected Devices” at the top. Choose the relevant Cloud MX license and click on “Deactivate.” At this point, the license will be available for activation on another machine.

   For details about moving licenses, see: https://www.waves.com/support/move-licenses.

Step 4A: Configure NDI Utilities

At this point the software installation is complete. Depending on your cloud environment, you may also need to use the NDI utilities for NDI device discovery and network access management. This section outlines some of the additional configuration or setup steps you may need to complete your cloud production environment.

- **NDI Discovery:** The NDI Discovery server needs to be run on any one machine which is reachable from all Cloud instances that need to participate in discovery. Note: After installing NDI Tools, the NDI Discovery utility is located here: Local Disk (C:) > Program Files > NDI > NDI 5 Tools > Discovery

- **NDI Access Manager:** The NDI Access Manager needs to be configured on each machine to point to the IP address of the machine running NDI Discovery. Note that all systems using NDI Discovery will need to have the appropriate security rule configured to open the associated port for NDI Discovery.

Please refer to the NDI documentation for detailed information.

Step 4B: Configure Dante Connect

The Dante Connect solution allows professional-quality audio to be shared between applications residing in separate Amazon Elastic Compute Cloud instances (Amazon EC2), including across AWS Regions and between On-Prem locations to the Cloud.

Dante Connect consists of the following key components:

- Dante Domain Manager (DDM): Facilitates the discovery, enrollment, licensing, and management of Dante nodes. DDM functionality can also be accessed via a web interface.
- Dante Virtual Soundcard (Dante Connect edition for Windows “DVS”): Enables up to 256 x 256 channels of audio to be transmitted and received by applications residing in the same Amazon EC2 instance. The Dante Virtual Soundcard is installed and licensed on the Cloud MX mixer instance where it is used as the audio device driver running within Cloud MX.
- Dante Controller: Allows the user to remotely configure and monitor the Dante nodes via a user interface that can be accessed from any location. The Dante Controller manages the patching between Dante Devices and the DVS running inside Cloud MX.
- Dante Gateway: Provides region clocking, based on AWS NTP servers. It can relay audio over long-distance links (>40ms).

Please refer to the Dante Connect documentation for detailed information here:
https://my.audinate.com/support/downloads/dante-connect

Step 5: Using the ASIO Control Panel for NDI

The following instructions provide an overview of the Waves ASIO Control Panel for NDI that is used to assign NDI audio streams to ASIO channels on the Waves Cloud MX audio mixer.

Control Panel Overview

The Waves ASIO Control Panel for NDI can be launched using the desktop icon or by selecting the application, using the Windows Start button. It can also be launched from the SETUP tab of the mixer, by clicking the “Open Control Panel” button.

The Control Panel enables you to “map” any available NDI audio stream to an ASIO channel and assign a name that can be easily identified for each stream.

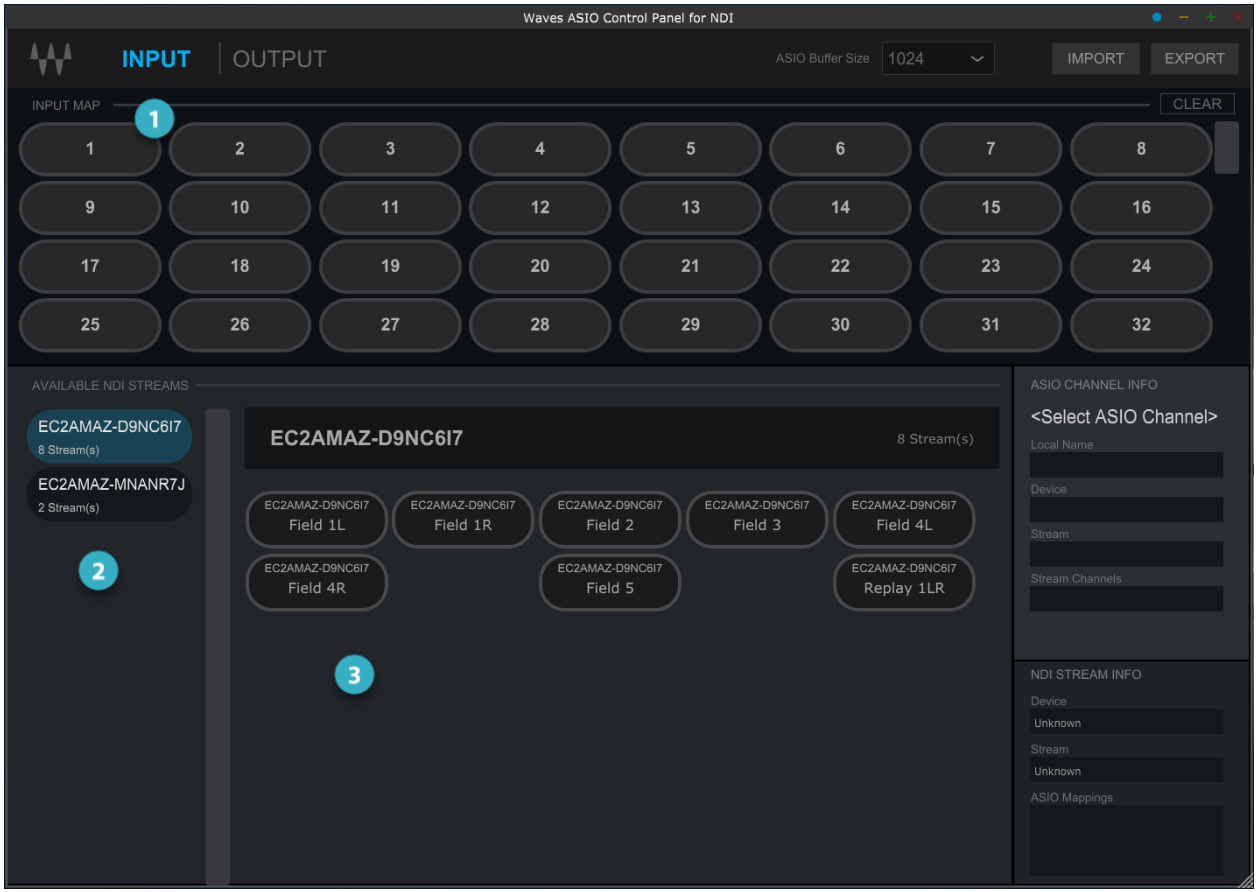
The Waves Cloud MX Audio Mixer uses the ASIO channels for input and output patches. Up to 128 inputs and 128 outputs (total) can be assigned. For example, if 10 stereo streams from NDI audio sources are assigned, they will use 20 (10x2) ASIO channels.

The Control Panel includes two tabs: INPUT and OUTPUT. The top section of both tabs includes the global setting for the ASIO Buffer Size, and IMPORT and EXPORT buttons for the mapping configuration.

ASIO Buffer Size

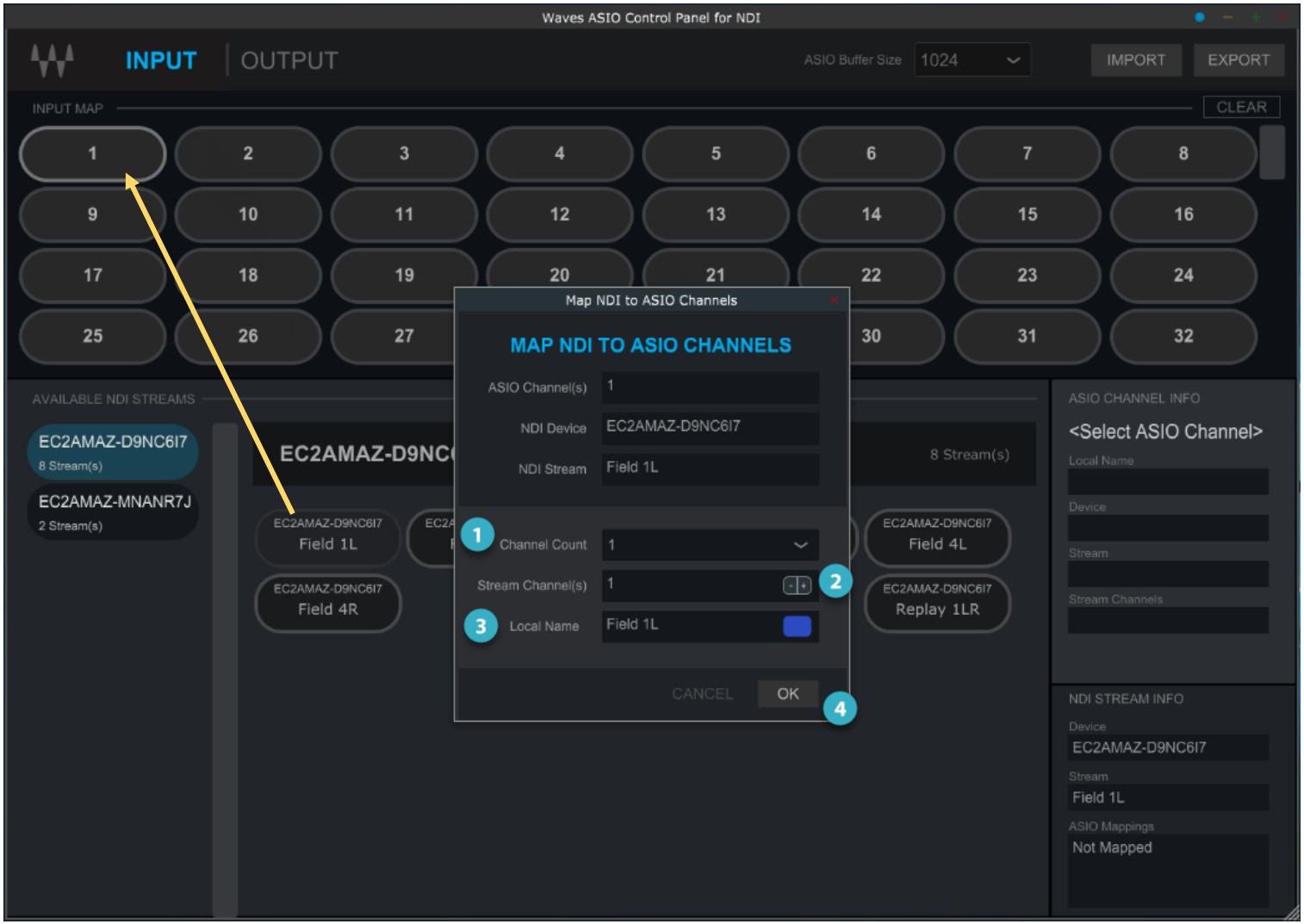
1	ASIO Buffer Size	Select buffer size: 512, 1024, or 2048 (using a larger buffer may help prevent audio dropouts for connections with higher latency).

INPUT Tab Overview



1	Input Map	ASIO view for all mapped NDI streams (128 channels total).
2	Available NDI Devices	Displays all NDI devices on the network and devices that were previously mapped but are currently not available.
3	Available NDI Streams	Displays available NDI streams for a selected NDI Device.

INPUT Tab: Map Input to ASIO Channel

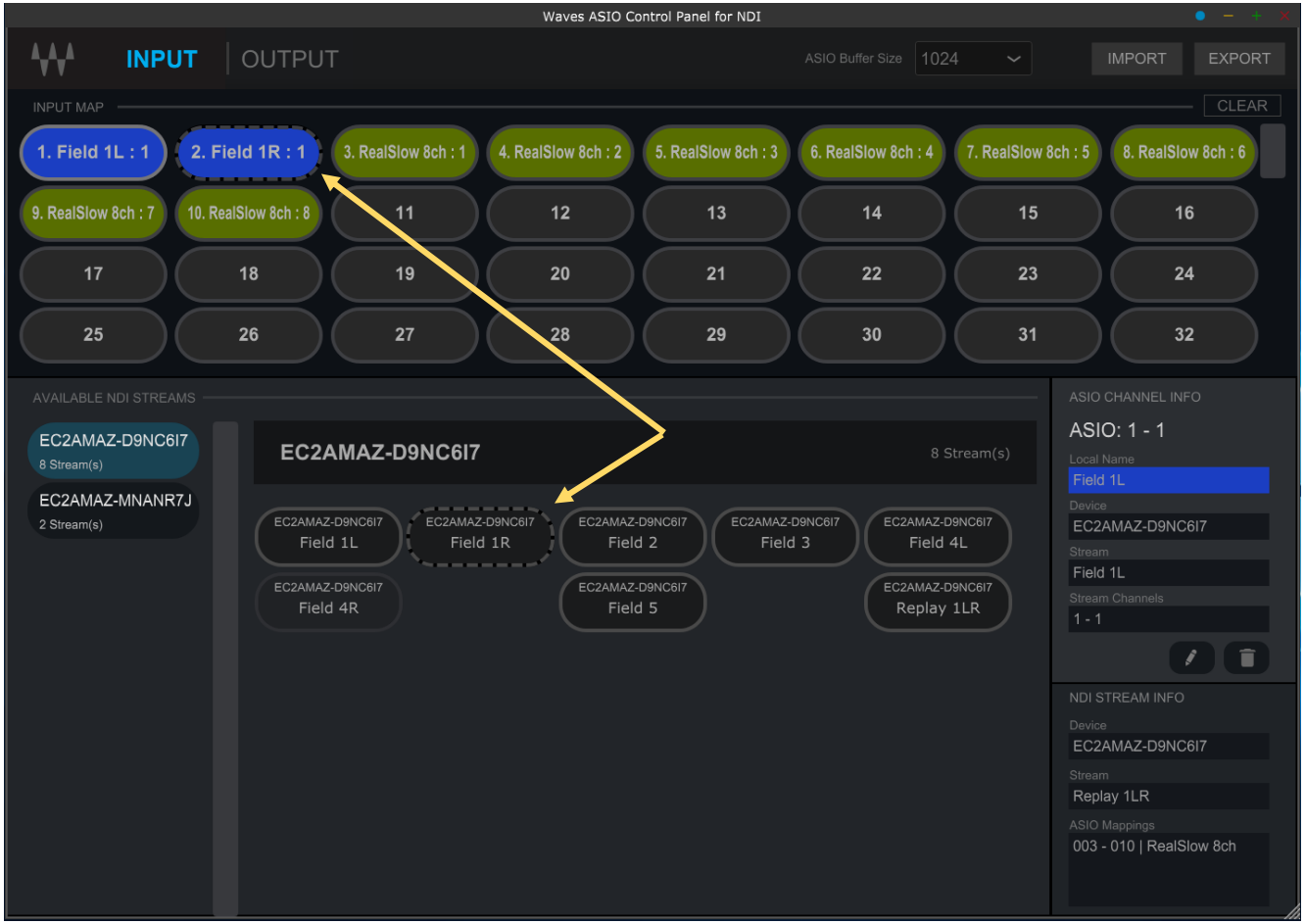


To map an audio channel, drag an available NDI stream to an ASIO channel to open the configuration dialog box.

1	Channel Count	Select the number of audio channels to be mapped from selected NDI stream to ASIO channels.
2	Stream Channel(s)	Select the stream channel offset if the desired audio stream(s) do not start with the first stream on the selected NDI stream.
3	Local Name	Use this field to rename the NDI stream name as you want it to be displayed. A color can also be selected to display on the ASIO channel map.
4	OK (or Cancel)	Click OK to assign the channel(s) to the map. The setting is automatically saved.

INPUT Tab (Example – Stream Not Connected)

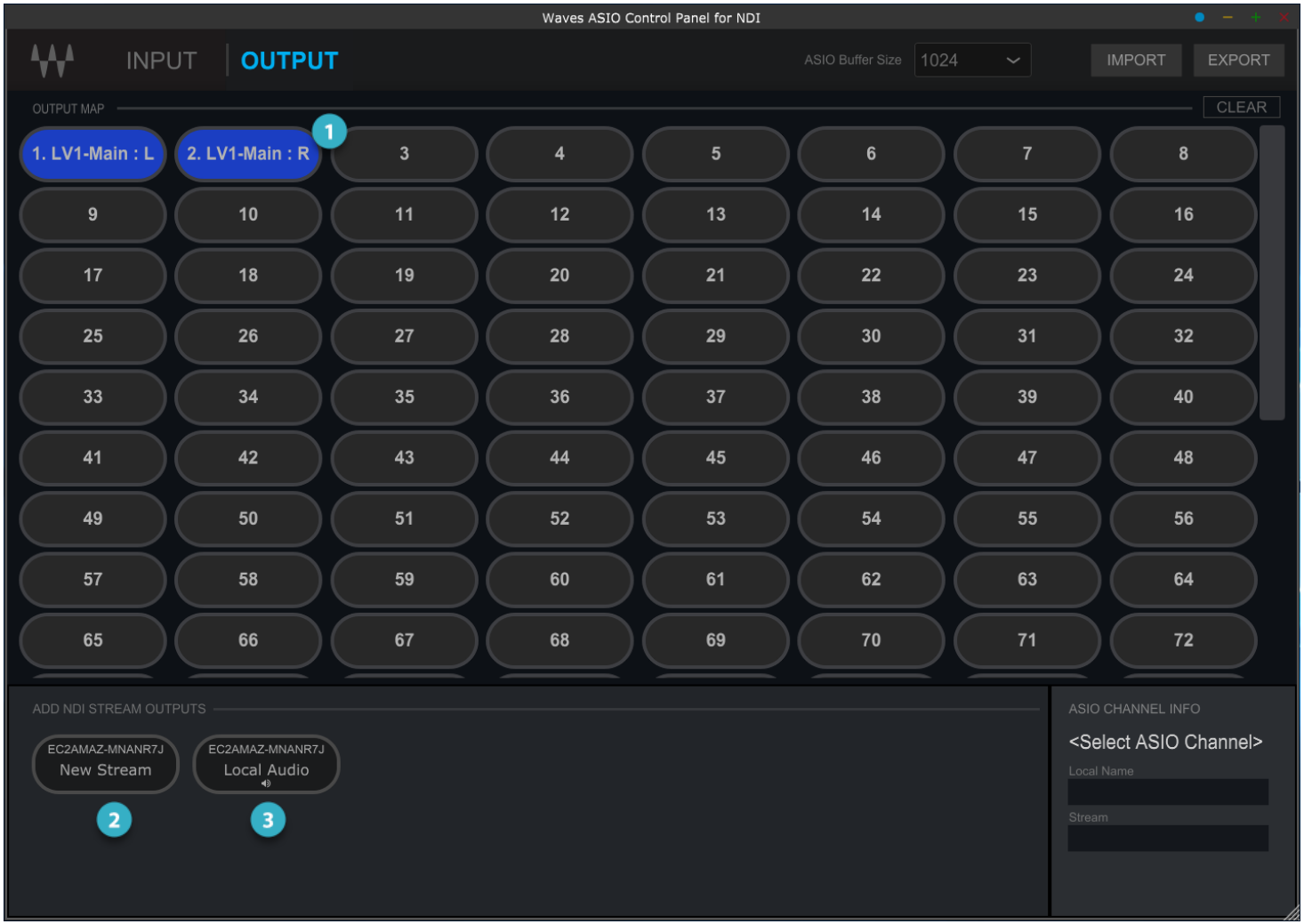
If a previously mapped audio stream is not connected, the NDI stream and associated mapped channel(s) will be displayed with a dashed-line border as shown.



All streams on a previously mapped NDI device will have the dashed-line border if the device is no longer available on the network.

OUTPUT Tab

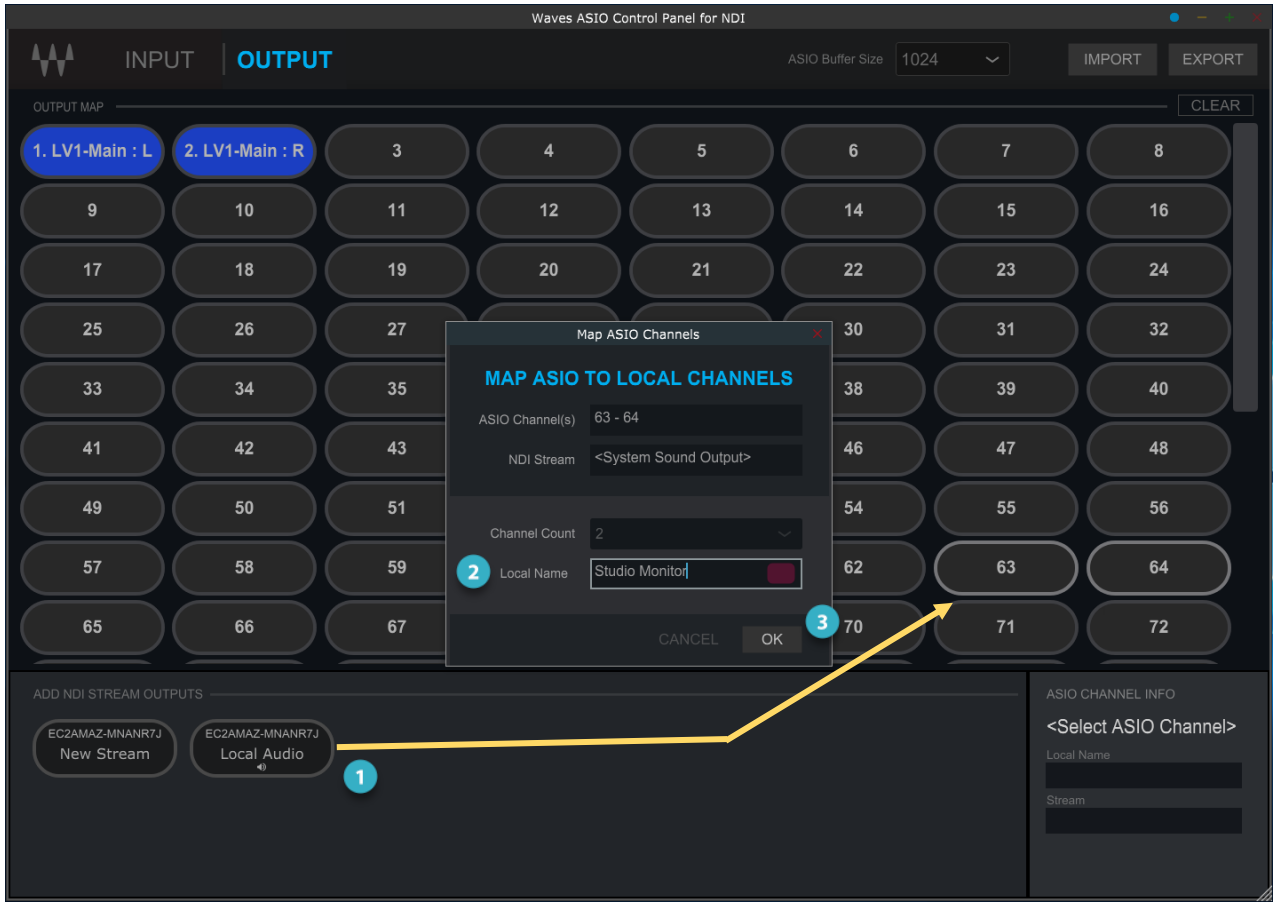
The OUTPUT tab is used to assign NDI streams to mixer output channels, including a “Local Audio” stream.



1	Output Map	ASIO view for all mapped NDI streams (128 channels total).
2	Add New NDI Stream	Drag to an available ASIO channel to create an NDI output stream.
3	Map Local Audio	Drag to an available ASIO channel to assign the Local Audio function to the selected ASIO channels (note: the default configuration is stereo). When selected, the Local Audio provides audio routing through Windows system audio, so that the corresponding audio can be monitored remotely using a PCoIP application such as AWS NICE DCV. This is an easy way to remotely listen to the output mix or cue bus of the mixer without using an NDI stream. See “Step 6” of this document for example patching of this feature.

To map an NDI output stream to an audio mixer output channel, drag the “New Stream” or “Local Audio” selectors to an ASIO channel to open the configuration dialog box.

OUTPUT Tab (Example: Map Output to Local Audio)



1	Select and Drag	Drag “Local Audio” to the desired channel pair for a stereo monitor (ASIO channels 63-64 in this example).
2	Local Name	Enter a name to identify the Local Audio channels on the mixer. A color may also be selected.
3	OK Button	Click OK to assign the output and save changes to the ASIO driver setup.

OUTPUT Tab (Example: Output Configuration Settings)

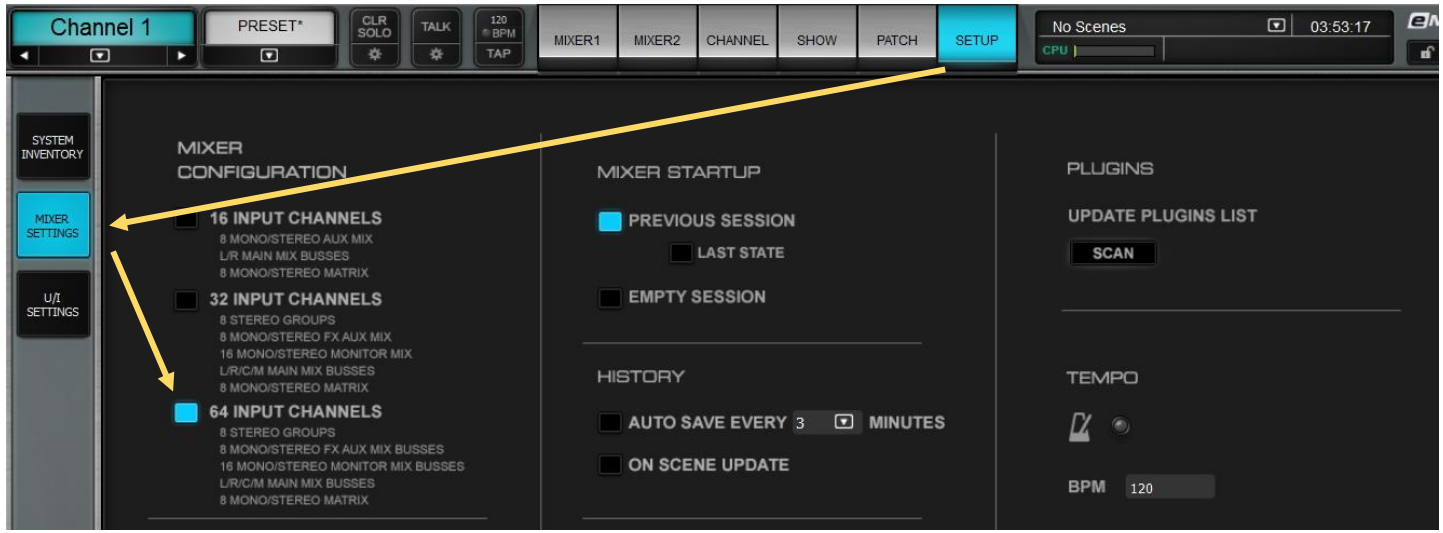
Note: The configuration dialog box appears after dragging the “New Stream” selector to the ASIO channel map.

1	Channel Count	Select the number of consecutive audio streams that should be contained on the NDI stream.
2	Local Name	Enter an NDI stream name. This name will be visible through NDI Discovery to other NDI devices on the network in addition to the mixer outputs. A color can also be selected to display on the ASIO channel.
3	OK Button	Click OK to assign the output and save changes to the ASIO driver setup.

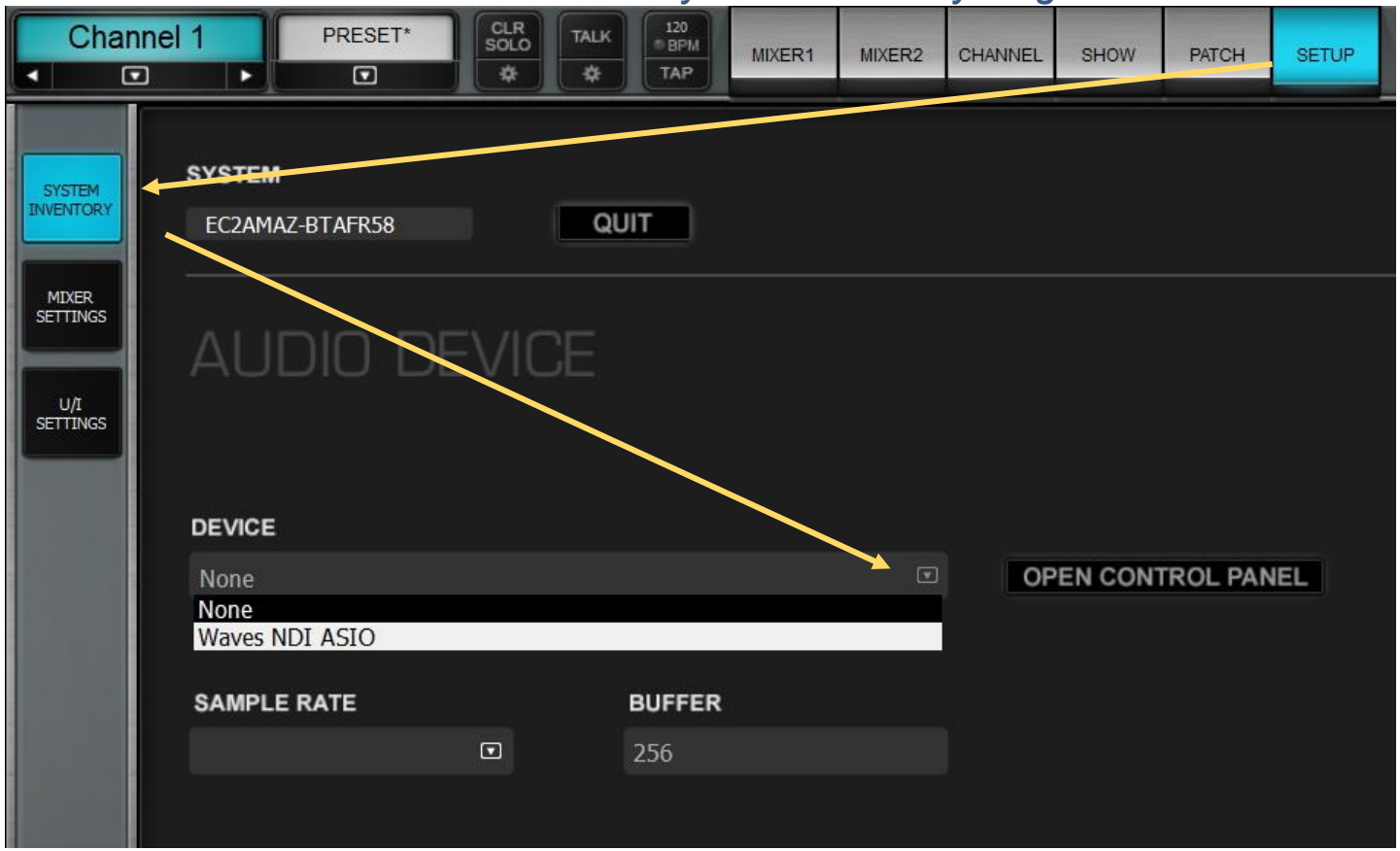
Step 6A: Initial Setup of Cloud MX Audio Mixer with NDI

This section provides important configuration information to use the Waves Cloud MX audio mixer.

1. Select 64-channel Mixer Configuration on Mixer Settings Page



2. Select Waves NDI ASIO on the System Inventory Page



3. Patch Audio Feed to Cloud MX Input Channels

There are various ways to patch audio from NDI audio feed channels to Cloud MX input channels.

Mixer Window

1. Click on the Input Patch box at the top of the channel to open the drop-down menu.
2. Select the audio input device.
3. Choose the input channel.

From here you can also flip the channel from mono to stereo, and vice versa. When you flip a channel from mono to stereo, the mono patch becomes the left channel of the stereo signal. Patch the right channel manually. When you flip a channel from stereo to mono, the left channel becomes the mono patch.

Patch Window

The Patch input page is a grid: NDI audio source channels on the top, and Cloud MX input channels on the left. Select the Input Patch View to patch between the two.

1. Click on the intersection of an audio source and a Cloud MX input to form a patch. Drag a straight line to patch contiguous channels (see example on the left).
2. Click again on a patch to cancel it.
3. Click on the device channel number to reveal the local name of the NDI input feed.

To flip a channel between mono and stereo in the Patch window, double-click on the small “M” on the left side. The single line M will become two lines, “L” and “R.” This enables you to patch left and right separately. Double-click on the L or R button to return to mono.

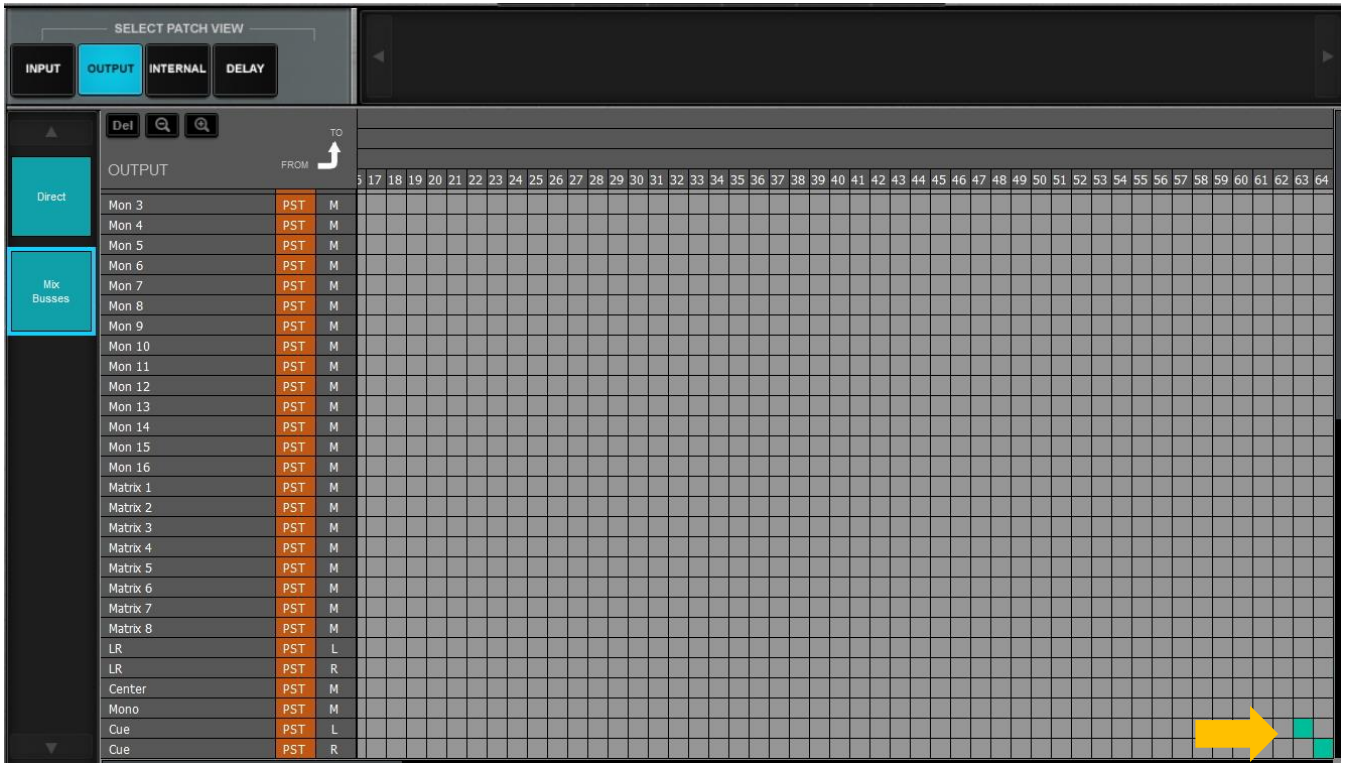
4. Patch Local Audio for Remote Monitoring Via PCoIP

The “Local Audio” option in the Waves ASIO Control Panel for NDI allows for audio to be monitored remotely using a PCoIP application such as AWS NICE DCV. This is an easy and powerful way to remotely listen to the output mix or cue bus of the mixer without using an NDI stream.

The Local Audio monitor can be patched to any available ASIO channels, as a stereo pair.

The following example assumes that the Local Audio selector was mapped to ASIO channels 63-64 in the Control Panel (see the output mapping section above).

The image below shows how to patch the Cue bus outputs to ASIO output channels 63-64, so that audio will be routed to the remote client computer via PCoIP. In this configuration, the main LR mix can be monitored in addition to any channel(s) selected for the Cue (or Solo) buss.



5. Add eMo Plugins to Channel Strip

As the mixer is not yet populated with Waves plugins, you can use these instructions to populate the input and output channel strips with the eMo plugins (F2 Filter, D5 Dynamics, and Q4 Equalizer).

Click small arrow above the channel plugin rack, select “Factory Presets”, then Select “Reset”.

The channel plugin rack will be populated with the three eMo channel strip plugins as shown below.

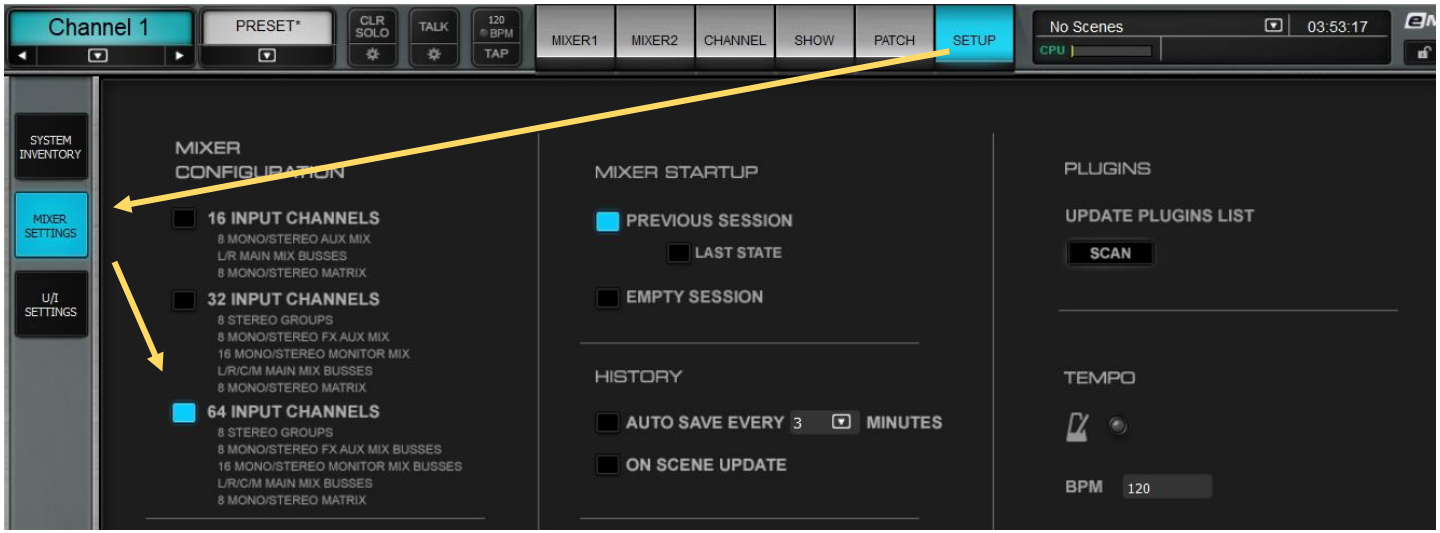
Detailed documentation for the audio mixer features and functionality can be accessed by clicking on the Waves logo at the top right side of the mixer window. Clicking on the logo will open a window showing the software version and provide a link to open the user guide for the audio mixer.

Step 6B: Initial Setup of Cloud MX Audio Mixer Using Dante Virtual Soundcard

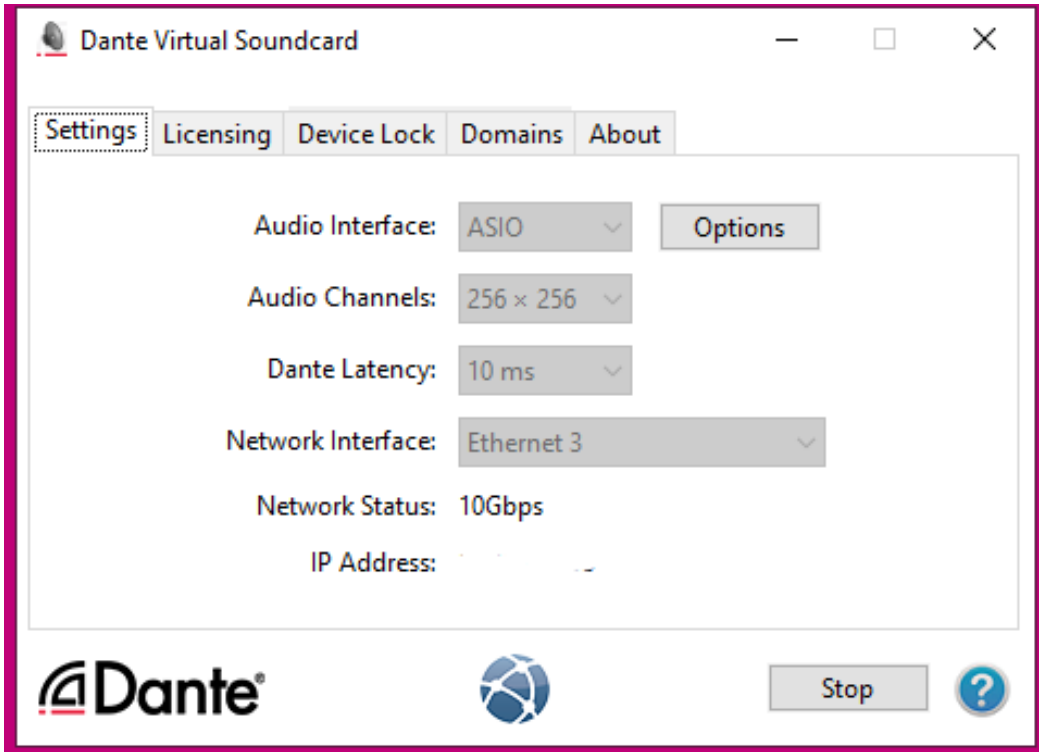
This section provides important configuration information on how to use Dante Virtual Soundcard for Dante Connect with Cloud MX.

These instructions presumes that you have already installed, licensed, and enrolled the Dante Virtual Soundcard with your Dante Domain Manager. For more information, please refer to the Dante Connect deployment guide available here: https://my.audinate.com/support/downloads/dante-connect

1. Select 64-channel Mixer Configuration on the Mixer Settings Page



2. *Select the Dante Virtual Soundcard on the System Inventory Page*



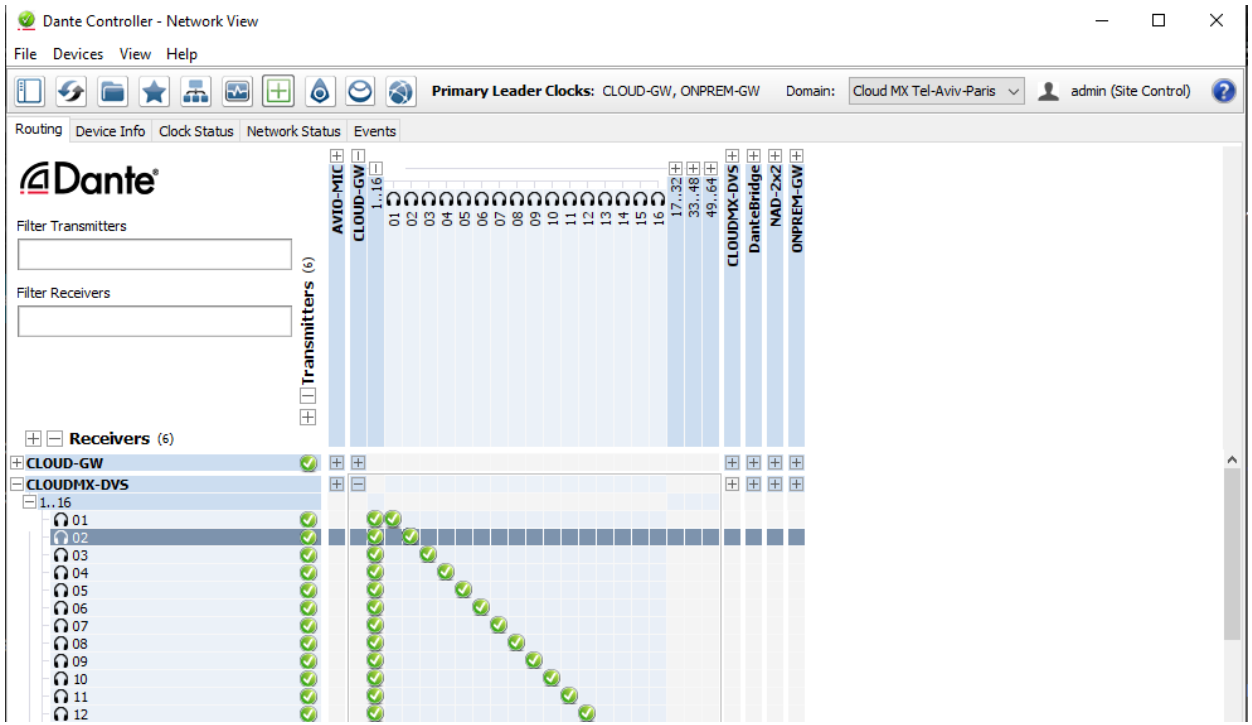
Make sure that Dante Virtual Soundcard is in a running state. You can access the DVS by pressing on ‘Open Control Panel’ within the System Inventory.

Notes:

- Buffer Settings: A recommended starting configuration is to set ”'Dante Latency” and “ASIO Latency” to 10ms, with a Buffer Size of 512 samples or 1024 samples.
- Clocking Configuration: Ensure that the 'Unicast clocking' option on the Dante Virtual Soundcard for Cloud MX is enabled. This setting can be adjusted via the Dante Domain Manager web interface, under the Domains > Advanced Settings section.

3. *Use Dante Controller to patch between Dante Devices and the mixer's DVS*

Within Dante Controller, press on the Globe icon to Login to your Dante DDM / Dante Cloud Login. Once logged in, choose your relevant Domain (top right) and the relevant Dante devices will be revealed. Patch your desired Dante device(s) channels into the Cloud MX Dante Virtual Soundcard's channels.



Notes:

You can operate the Dante Controller from any location, be it the Cloud MX instance or your personal computer.

In most scenarios, the Dante Gateway device operating in the Cloud will receive audio from your on-site Dante devices and then route its outputs to the Cloud-based Dante Virtual Soundcard inputs in the mixer.

4. Patch Audio Feed to Cloud MX Input Channels

There are two ways to patch audio from Dante audio feed channels to Cloud MX input channels.

Mixer Window

1. Click on the Input Patch box at the top of the channel to open the drop-down menu.
2. Select the audio input device.
3. Choose the input channel.

From here you can also flip the channel from mono to stereo, and vice versa. When you flip a channel from mono to stereo, the mono patch becomes the left channel of the stereo signal. Patch the right channel manually. When you flip a channel from stereo to mono, the left channel becomes the mono patch.

Patch Window

The Patch input page is a grid: Dante audio source channels on the top, and Cloud MX input channels on the left. Select the Input Patch View to patch between the two.

1. Click on the intersection of an audio source and a Cloud MX input to form a patch. Drag a straight line to patch contiguous channels (see example on the left).
2. Click again on a patch to cancel it.

To flip a channel between mono and stereo in the Patch window, double-click on the small “M” on the left side. The single line M will become two lines, “L” and “R.” This enables you to patch left and right separately. Double-click on the L or R button to return to mono.

5. Add eMo Plugins to Channel Strip

As the mixer is not yet populated with Waves plugins you can use these instructions to populate the input and output channel strips with the eMo plugs (F2 Filter, D5 Dynamics, and Q4 Equalizer).

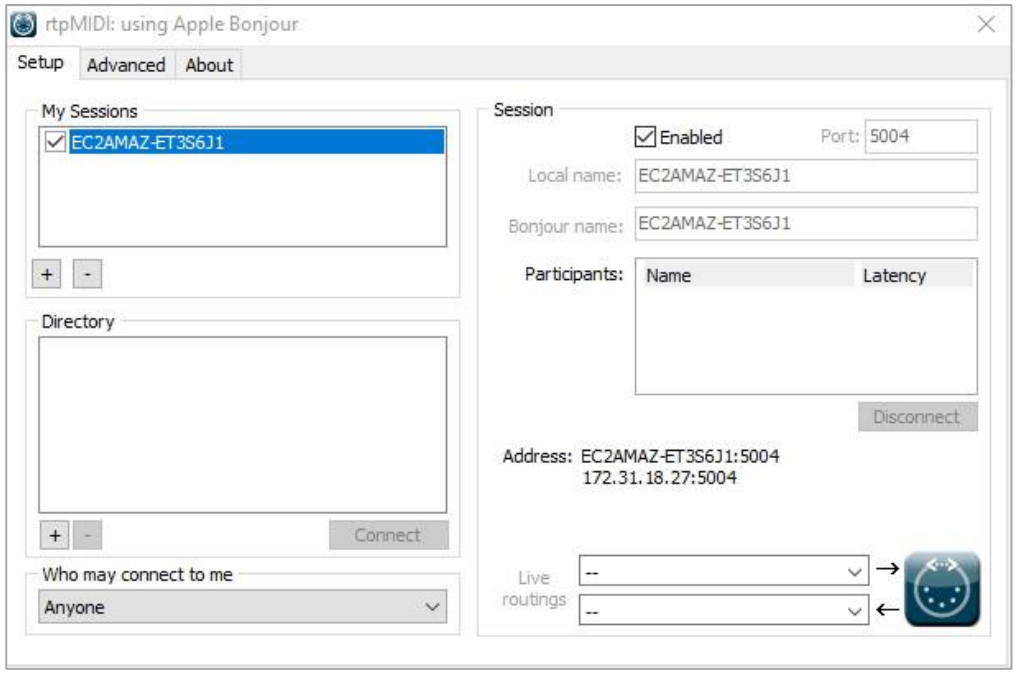
Click small arrow above the channel plugin rack, select “Factory Presets”, then Select “Reset.”

The Channel Pugin Rack will be populated with the three eMo channel strip plugins as shown below.

Detailed documentation for the audio mixer features and functionality can be accessed by clicking on the Waves logo at the top right side of the mixer window. Clicking on the logo will open a window showing the software version and provide a link to open the user guide for the audio mixer.

Step 7: Connect FIT Controller with rtpMIDI

Use these instructions to connect the Waves FIT Controller to Cloud MX from a remote client using rtpMIDI.



1. Install rtpMIDI on the Amazon EC2 or Google GCE instance (see also “Step 2” of this document). The installation utility will install Bonjour and the rtpMIDI driver. Confirm that the EC2 or GCE security settings have been opened for the appropriate ports (UDP ports 5004-5005 should be opened if using one FIT Controller).

2. Launch rtpMIDI on the cloud instance and add the server to "My Sessions." Make sure that “Enabled” is checked and take note of the Port number (5004).

3. Install rtpMIDI on the client Windows computer. The installation utility will install Bonjour and the rtpMIDI driver. Also confirm that the rtpMIDI driver and ports are not blocked by any firewall.

4. Launch rtpMIDI on the client computer and add your client session. In the “Directory” add a name for the AWS instance running Cloud MX, the public IP address of the cloud instance and the relevant port (5004).

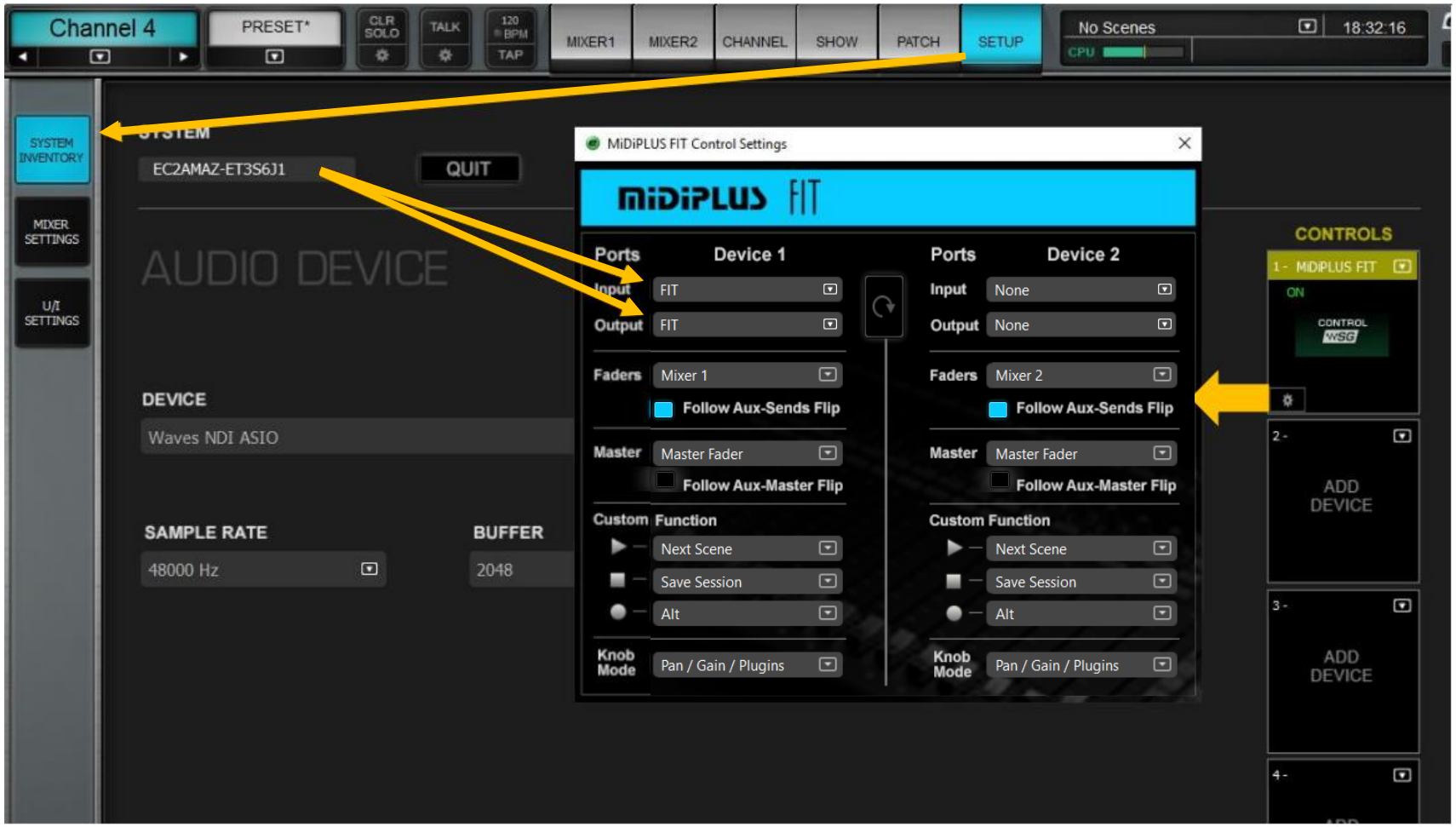
5. Connect the FIT Controller using a USB cable to the client computer and power on the FIT.

6. On the client computer, go to in the “Live Routings” section of rtpMIDI and choose 'FIT' from both dropdown menus.

7. On the client computer connect the FIT to the cloud instance by clicking on the “Connect” button under the Directory. Confirm that the “Enabled” box is checked under the “Sessions” section on right side of panel.

   After a short moment, you should see an indication of a running active session within the cloud instance rtpMIDI Session window (under “Participants”).

8. After connecting via rtpMIDI, you can configure the FIT Controller in the SETUP tab on the mixer under System Inventory > Controls. See the image below for details.



NOTE: It is possible to use two FIT controllers working together, but this requires specific settings. For assistance setting two FIT controllers with Cloud MX, contact our [customer support team].

Troubleshooting Guidelines for Cloud MX

This section provides some guidance for issues that may occur when deploying Waves Cloud MX.

Issue	Potential Steps to Solve
NDI streams do not appear on the Waves ASIO control panel for NDI.	Check that NDI Tools have been installed on the instance. Check that all ports for NDI are open between instances using NDI in the security groups. Check that the NDI Discovery Server is running on at least one instance in the NDI network. Check that the NDI Access Manager is running on the instance running Waves Cloud MX and that it points to the proper IP for the NDI Discovery Server.
Waves Cloud MX displays a missing license error when launched.	Amazon: Check that the Amazon EBS Volume is attached to the instance. Check that the EBS Volume includes the Waves licenses (using the Waves Central application). Google: Launch the Waves Central application, go to the Licenses section and make sure that the license is listed under the Connected Devices section. Then re-launch Cloud MX. If the issue persists, please contact Waves technical support.
Screen displays and plugin windows appear very sluggish or pixelated.	Check that the proper GPU drivers have been installed on the cloud instance.

Waves NDI ASIO driver cannot be loaded on the Cloud MX setup tab.	Check that NDI Tools have been installed on the instance. If not, install them, relaunch Cloud MX, and select the Waves NDI ASIO Driver.
The FIT rtpMIDI session is not showing up in the FIT Control Panel under the MIDI Input/Output drop-down.	Make sure that you are not using Windows RDP while trying to set up your MIDI In/out configuration. Instead, confirm that you are using a high performance PCoIP virtualization software, such as NICE DCV, Teradici , Parsec, etc, and make sure that Windows RDP is no longer running. Only then, re-launch Cloud MX, go to the FIT Control Pane, and assign the MIDI IN/OUT with the relevant rtpMIDI session name.
The Local Audio sound stops and mixer meters are frozen.	Make sure that you are not using Windows RDP while operating the mixer.

In addition to the above, the Cloud MX Support Notes page offers valuable information regarding support, compatibility and known behavior that you should be aware of.

Waves Cloud MX Diagnostic Tools

Waves Cloud MX includes built-in diagnostics and logging functions that can be used to diagnose issues that you may have with the mixer.

Diagnostics

Complete diagnostics are accessed through the Setup tab. Select “Mixer Settings,” and then select the “Diagnostics” button in the Troubleshooting section of the screen.

A privacy notice will appear. If you agree to its conditions, the diagnostics file will be placed on the instance desktop.

Logging

Waves Cloud MX constantly logs its activity with comprehensive logging. This information can assist you and Waves technical support in identifying and resolving issues.

To enable verbose logging for troubleshooting purposes on Cloud MX, select the Setup tab, then select “Mixer Settings”. Select “Enable Logging” in the “Troubleshooting” section of the screen.

Log files can be viewed or downloaded by clicking the “Logs” button in the Troubleshooting section of the screen.

Backup and Recovery

Auto-Recovery for application crashes

Should the Cloud MX mixer crash unexpectedly, an automatic recovery feature is provided. A Waves WatchDog prompt will appear, inquiring if you'd like to restart the application. By selecting 'Yes', Cloud MX will automatically relaunch.

Backing up your mixer session file

It's advisable to regularly back up your mixer session file. To do this, navigate to the default Sessions folder in C:\Users\Public\Waves Audio\eMotion LV1 Native\Sessions, copy the appropriate “.emo” session file, and save it to your preferred backup location.

Setting up a backup Cloud MX mixer

To implement a backup Cloud MX mixer setup, an auxiliary Cloud MX mixer can be deployed. This additional compute instance should be equipped with its own Cloud MX license and have a separately Waves NDI driver or a licensed Dante Virtual Soundcard driver installed. It is essential that both the original and backup mixers/compute instances maintain identical specifications to guarantee consistent performance.

Emergency Maintenance and Support

Waves Cloud MX is supported directly by Waves Technical Support for licensed customers. Contact information for Waves Technical Support is provided with the license purchase and is available 7 days per week.

Waves also maintains a user-accessible product knowledge base on the Waves Technical Support website, with self-guided assistance for the audio mixer and processing plugins.

Waves Technical Support team can be reached here: https://www.waves.com/contact-us

Application and Software Management

All Waves software and plugins used by the Waves Cloud MX audio mixer are managed by Waves Central. Waves Central is an installation and license activation application that is accessed from the Cloud MX instance via the Internet and is installed during the deployment of the Cloud MX application on the Amazon EC2 or Google GCE instance (see Step 3, “Install and Activate Waves Software,” in this document).

Waves Central provides an intuitive interface that gives the user complete control of the Waves software licenses they have purchased. Use Waves Central to:

- Install software on the Amazon EC2 or Google GCE instance(s)
- Install and activate software licenses on the Amazon EBS Volume(s) or to the local disk system drive within Google GCE.
- Check for patches and upgrades for installed software.
- Move licenses from Amazon’s EBS Volume(s) or from Google’s local disk system drive to the Waves Central account, to be re-activated on different instances or EBS Volume