SOFTWARE VERSION v5.0.0

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MBOX® REMOTE

USER MANUAL (rev. A)

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Mbox® Remote v5.0.0 User Manual
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REVISION HISTORY

This manual has been revised as follows:

Version	Release Date	Notes
5.0 (revA)	October 2, 2023	Initial Release

INTRODUCTION

About This Manual

This user manual provides necessary information regarding the operation of the Mbox Remote v5 software. This guide is provided to explain the features in the Mbox Remote v5 software in detail. This manual is written to cover the use of Mbox Remote with all four license levels of the Mbox application - Designer, Studio, Studio+, and Mini. Differences between the operation of the software license levels are noted wherever applicable.

This manual assumes a basic understanding of Mbox Media Server concepts. For more in-depth explanations of the configuration and use of the Mbox application and its features, refer to the latest version of the Mbox User Manual.

Important Note About Companion Applications

The Mbox Remote v5 software is designed to work with other applications in the Mbox v5 software family. There are new versions of the Mbox application as well as Mbox Daemon and Mbox Director.

Additional Documentation

For more information about DMX512 and sACN protocols, refer to the following documents available from the American National Standards Institute (ANSI) at :

+ ANSI E1.11 - 2008 (R2013): Entertainment Technology - USITT DMX512-A, Asynchronous Serial Digital Data Transmission Standard for Controlling Lighting Equipment and Accessories
+ ANSI E1.31 - 2009: Entertainment Technology - Lightweight streaming protocol for transport of DMX512 using ACN

The above documents are also available in electronic format free for PLASA members at www.plasa.org

For more information about Art-Net, refer to the following document available from Artistic Licence Engineering at www.artisticlicence.com:

+ Specification for the Art-Net ethernet Protocol

Customer Service

For technical assistance, contact your nearest PRG office. Contact information for all PRG offices can be found on our website at: www.prg.com

For Mbox support, please contact: mboxsupport@prg.com

For additional resources and documentation, please visit our website at: www.prg.com

Notes

GENERAL OPERATION

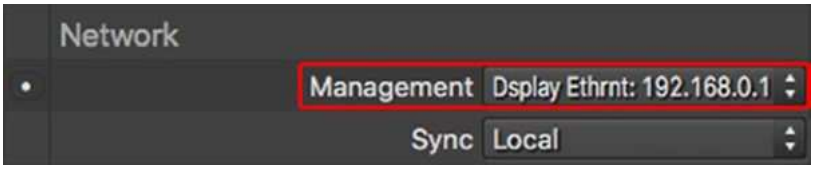
About Mbox Remote

The Mbox Remote application is used for remote monitoring, content management, and configuration of the many aspects of the Mbox application. The Remote application is included with the Mbox software and can be used on any Mac® computer (running OS X 10.14.6 or greater) to monitor/manage/configure from a remote location.

Mbox Daemon

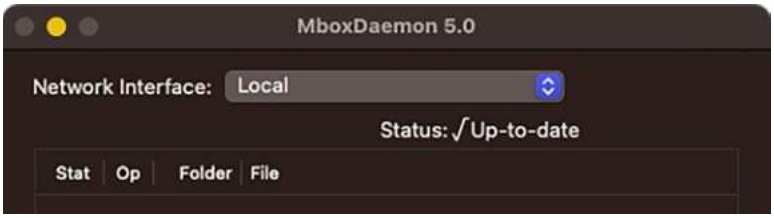
It is important to note that Mbox Daemon software is required on all Mbox servers to enable remote feedback to both Mbox Remote and to CITP/MSEX enabled devices. When the Mbox application launches, it will automatically launch the last version of Mbox Daemon used on that computer.

The network interface that Mbox and Daemon will use to communicate with external monitoring devices (like Remote or CITP enabled consoles and visualizers) must be configured; use the Network > Management pop-up on the Mbox Preferences tab as shown below:



Mbox Daemon is also required on any computer running Mbox Remote that is ALSO acting as a Master from the point of view of Content Management. (Refer to "Content Management" on page 11 for more information)

When running only Mbox Remote and Daemon, the management interface must be set using the Network Interface pop-up available in the Daemon application's window (rather than on the Mbox Preferences tab as shown above).



Mbox Content Folder

Beginning with Mbox v4.4.1, the location of the default Mbox content folder changed from the root of the computer's boot drive to the /Applications folder on the computer's boot drive. This change is necessary for forwards compatibility because the old location (/Mbox) is not allowed in newer versions of macOS (10.15 Catalina and beyond).

Note: This manual uses file paths formatted like "Mbox/Media" or "Mbox/plugins". Paths using the 'Mbox' prefix resolve to the Mbox content folder. e.g. /Applications/Mbox/Media and /Applications/Mbox/plugins for the paths above.

Starting Mbox Remote

Before opening the Remote application, ensure that your computer is on a network with one or more Mbox servers. Ensure that each Mbox server's instance of Mbox Daemon, and optionally the Mbox application, are running. Confirm that the Mbox and Daemon Management network interfaces are set to the same ethernet interface and that this is the interface to which the Remote application is connected. The network interfaces on all computers must be set to the same subnet.

When Mbox Remote starts, it will either resume with its previous state or start with a blank configuration. The user interface and configuration can be reset by opening the preferences window and pressing the "Reset All to Defaults" button.

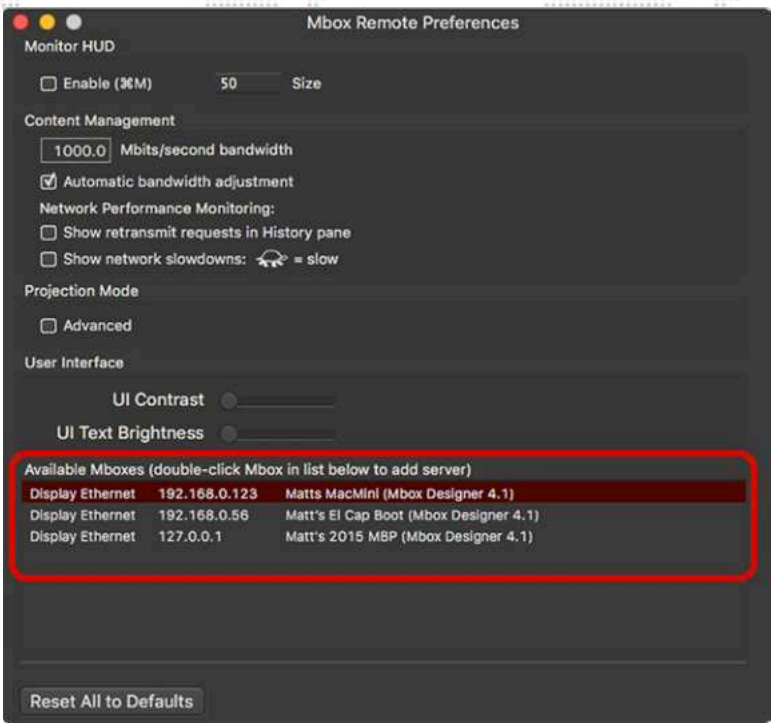
Adding Servers

Once the network is configured, servers can be added to the Mbox Remote window for the purpose of monitoring and management.

To add servers:

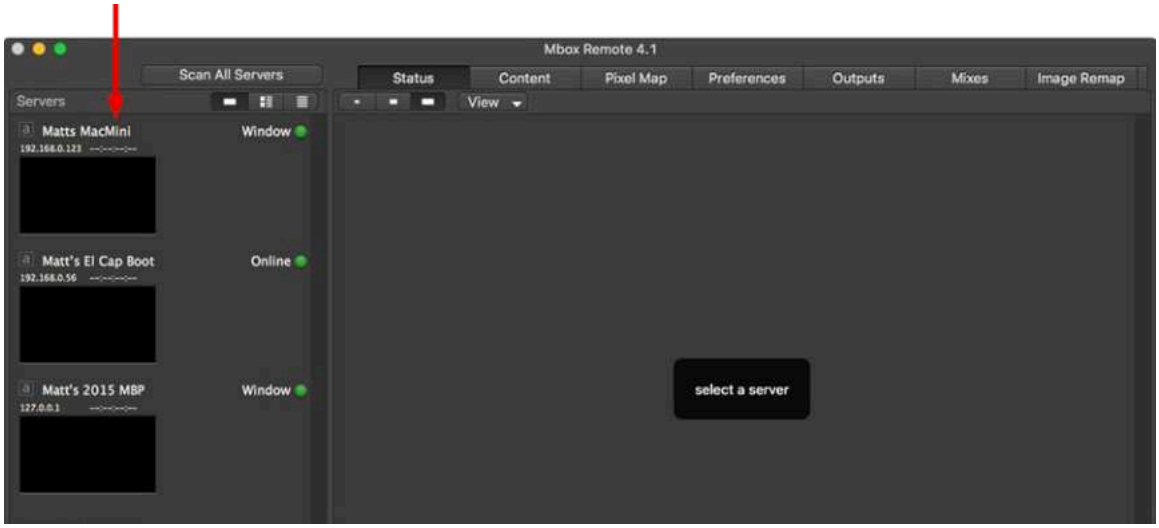
Step 1. On the Mbox Remote main window, click the Edit Servers button or press [⌘,] on the keyboard to open the preferences window.

Step 2. On the preferences window, double-click on any available Mbox server in the list to add that server to the group of servers being managed. Servers will be added to the Servers column in Mbox Remote's main window.



Step 3. When at least two servers have been added, click on the red button to close the preferences window. Managed servers are displayed as a scrollable list in the Servers column of Remote's main window.

Servers that can now be managed



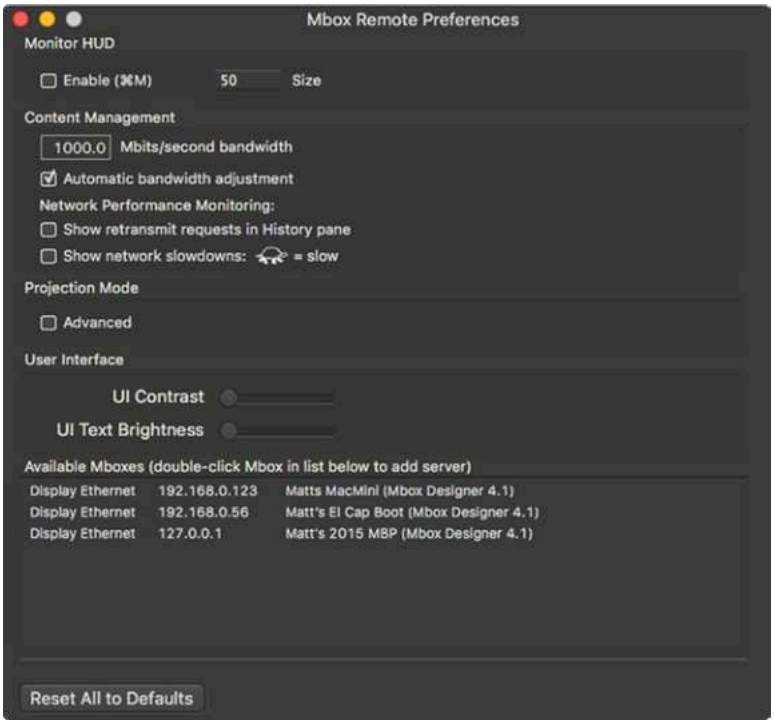
Note: No matter which tab is selected in Remote's main window, the Servers column on the left will always display the list of managed servers. The selected server in the Servers column will dictate what information is displayed or being edited on the selected tab.

Setting Mbox Remote Preferences

Open Mbox Remote's preferences window at any time by clicking the Edit Servers button on the main window or by pressing [⌘,] on the keyboard.

Monitor HUD

+ **Enable** - The Monitor HUD can be toggled on and off by clicking the Enable checkbox in the Preferences window or by pressing [⌘M] on the keyboard. The Monitor HUD is a floating window showing the default layer breakout view for the servers that is currently selected (designated by a dark red highlight) in the Servers column. The Monitor HUD allows the feedback from a server to be visible even while the Status tab is not the active tab.
+ **Size** - The size of the Monitor HUD can be adjusted using the Size field.



Content Management

The Content Management section is used to configure the network bandwidth which the Content Management system will utilize to transfer content. Refer to "Configuring Network Bandwidth" on page 13 for more instructions.

Projection Mode

The Projection Mode checkbox is used with the Projection Mapping Advanced mode feature. Refer to "Advanced Projection Setup" on page 34.

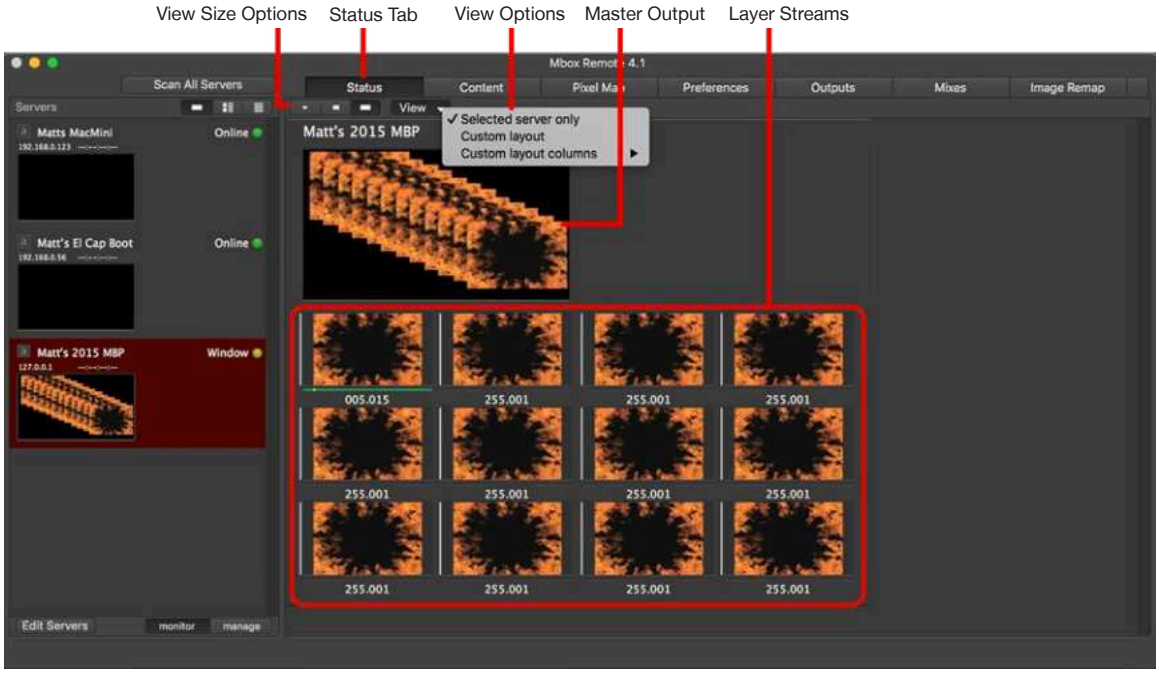
Note: Projection Mapping Advanced mode is only applicable to the Mbox Designer and Studio/Studio+ license levels.

Server Status

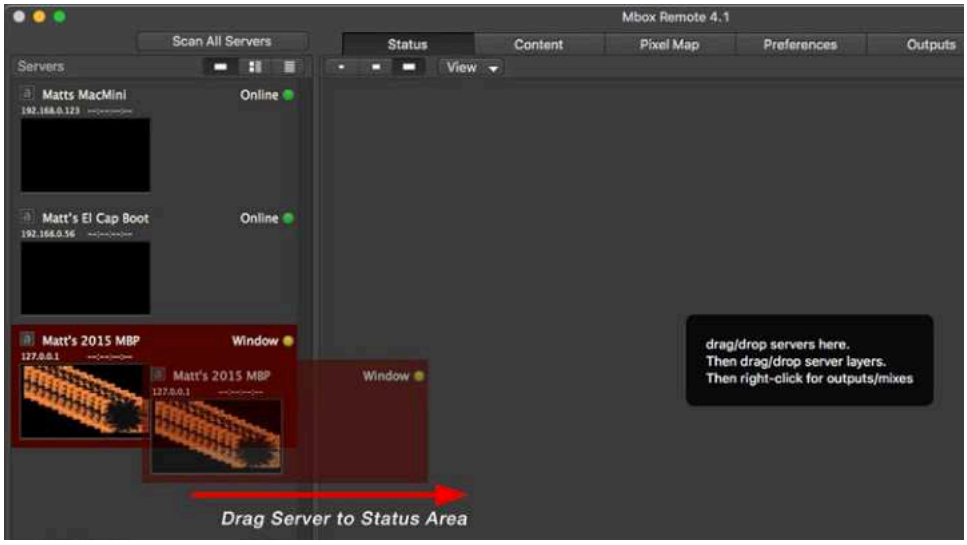
By default, in “Selected Server Only” mode, the Status tab of the Remote window shows feedback streams of a server’s Global Surface and individual layers.

Setup

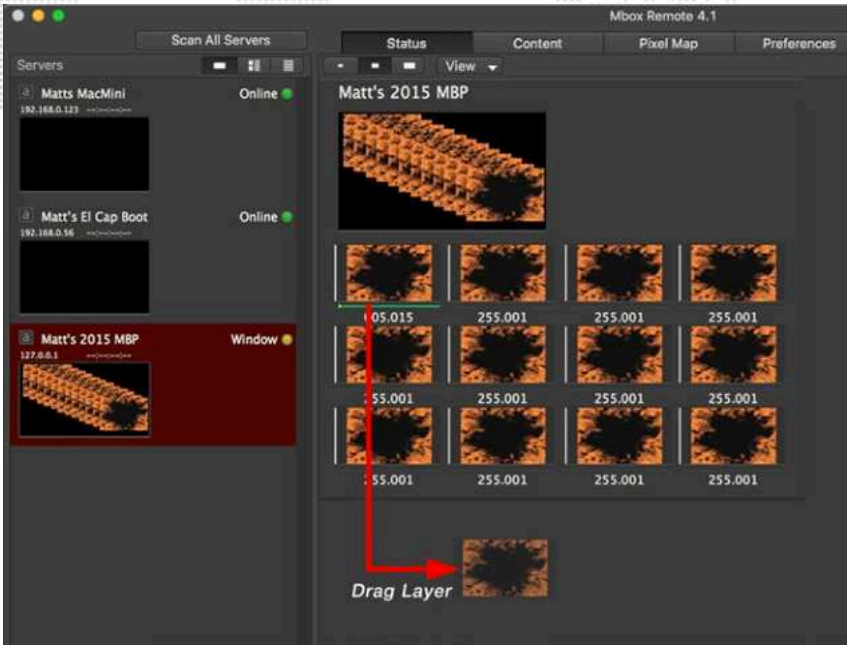
The window provides options for how the streams are displayed. Click the view size options and/or use the View drop-down menu to customize the view.



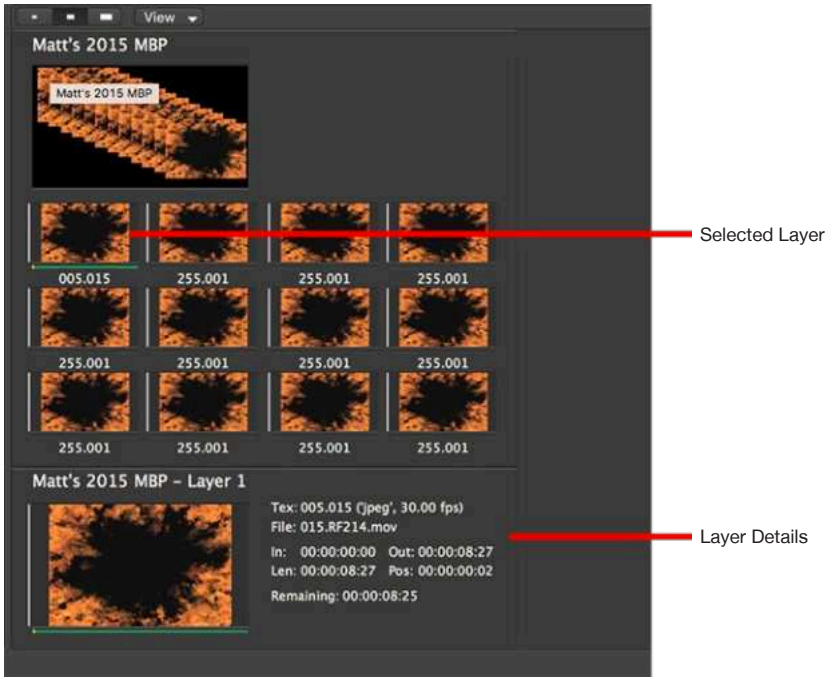
In the custom layout mode, server status can be setup by dragging a server into the status area.



More-detailed layer status information can be viewed by dragging a layer icon to the bottom of the status area.



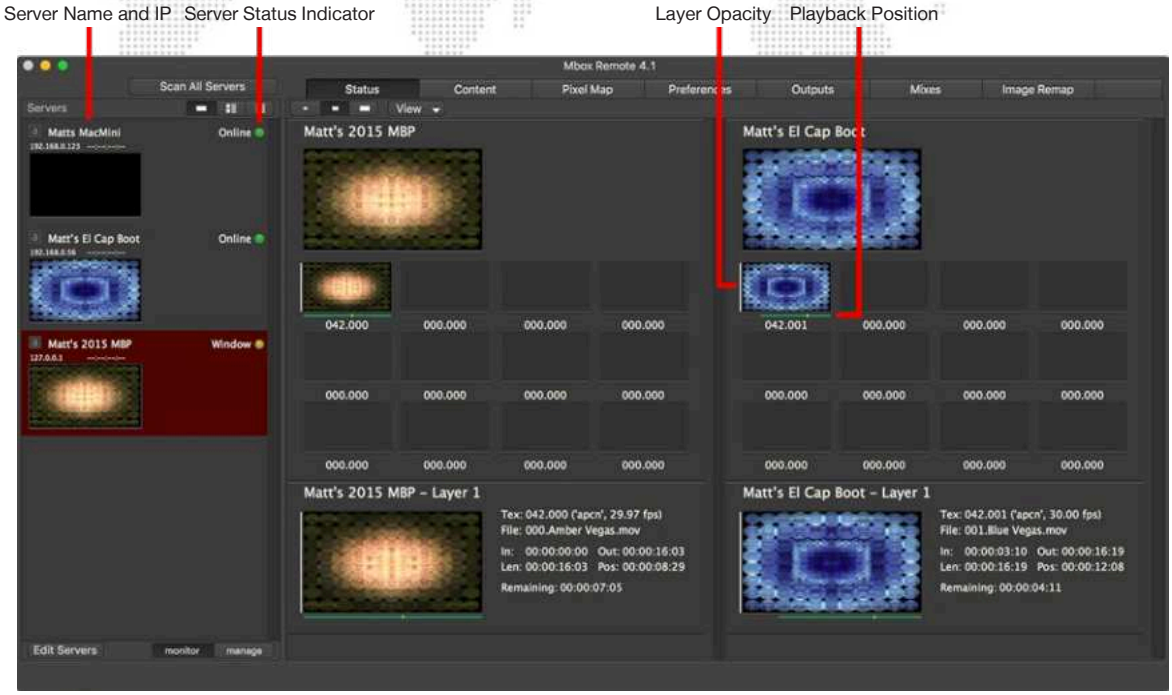
The picture below shows the result of dragging Layer 1 into the bottom area:



Additionally, right-clicking on an existing element reveals a menu allowing any Output, Mix, or Layer to be added to the status area and for the current element to be removed.

Indicators

The Mbox Remote window has several indicators that provide system information.



Server status - The color-coded dot in the Servers column indicates the running status of the server:

+ **Green** - Server connection good, Mbox running in Fullscreen mode.
+ **Green/Yellow Flashing** - Server connection good, Mbox running in Window mode.
+ **Yellow** - Server connection good, Mbox not running.
+ **Red** - No server connection (Mbox Daemon not running on server, or network set up incorrectly/not connected).
+ **Blue** - server in Backup mode running in Fullscreen mode.
+ **Blue/Yellow Flashing** - server in Backup mode running in Window mode.

Note: The server connection status is dependent on the Mbox Daemon application running on the Mbox server. The Mbox application can be running, but unless the Daemon application is also running, Remote will display a red dot and will not provide any feedback. It will also display a red dot if the network is not set up correctly or is not connected regardless of whether Daemon is running.

Server IP Address - each Mbox server's IP address is shown under the server's name. (For more information about IP Address settings for Mbox, refer to "Appendix A. Mbox Networking Guidelines" on page 125.)

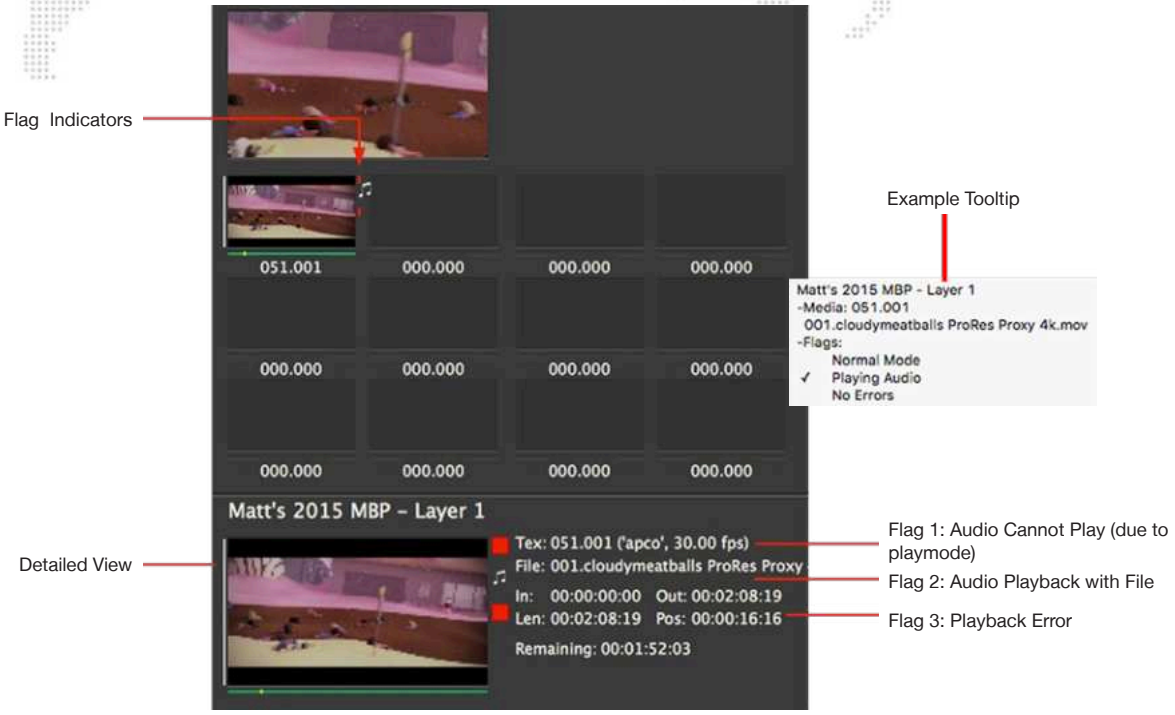
Server Timecode Value - if an Mbox server is receiving timecode locally or over the network, that timecode value will be show to the right of the server's IP address in the Servers column.

Layer Opacity - the vertical white line to the left of each layer video stream represents the opacity value of that layer.

Playback Position, In/Out Points - the length of the green line below each layer video stream represents the position of the layer's current in and out point values, and the yellow dot represents the current playhead position.

Flags

"Flags" are another type of indicator that may appear to the right of a layer thumbnail during operation. The flags indicate various conditions, some that need to be resolved for proper playback. Hovering the cursor over either of the thumb images for the layer will bring up a tooltip explanation.



Flag indication type:

1) **Audio Cannot Play** - The movie has embedded or sidecar audio (see Flag 2) but the audio is not playing due to the selected playmode - e.g. Reverse Loop, Random, etc. (Refer to the Mbox product manual for more information about audio output and playmodes.) Resolution: Use a forward playmode.

2) **Audio Playback with File** - The movie has sidecar audio or embedded that has been enabled for playback. Resolution: If not intending to play audio, then remove the ".audio" suffix from the file name or remove the sidecar audio file.

3) **Playback Error** - The movie has an issue such that Mbox cannot play it properly. This can be an incorrect codec or an issue in the movie's header data. Resolution: Re-encode the movie using a preferred codec. (Refer to the Mbox product manual for more information about recommended codecs.)

Guidelines:

+ Flag 3 is obviously undesirable, as the movie is not playing.
+ Flag 1 may not an optimal situation, as the audio is not playing. However, this is unavoidable if the movie uses a non-forward playmode.
+ Flag 2 is okay if you intend to play audio.
+ Flags 1 and 2 are not necessarily indications of a error. However, if there is no intention to play audio, then it is recommended that the audio is removed.

If you have selected a layer for more detailed information (see page 8), it will be displayed in the detailed view at the bottom of the window. The flag indicators will then be visible in two places as shown in the illustration above.

CONTENT MANAGEMENT

Overview

About Mbox Remote Content Management

The Mbox Remote Content Management system allows quick and easy management of movie, still image, and audio content between Mbox servers. For this purpose, the Remote application window provides three main areas for display of managed servers (left), status/content (middle), and file details/history (right) as shown in the example below:

The following components are required in order to use the Mbox Content Management system:

+ The first required application is Mbox Remote. Remote is the user interface for the Content Management system and must be running on at least one machine and connected to the same network as the other Mboxes in the system.
+ The second required application is Mbox Daemon. Daemon is the service provider that allows Mbox Remote to control, monitor, and manage content and settings of an Mbox server. Mbox Daemon must be running and correctly configured in order for Mbox Remote to function. When an instance of Mbox is started, the last version of Daemon will be will also be started automatically. If the Mbox application is not needed, Mbox Daemon can be manually launched without Mbox.
+ Typically, the Mbox application itself should be running on at least one computer. Although Mbox is not required to be running in order to use the Content Management system for basic synchronization, the intention is to sync content for Mbox to use.

Terminology

In order to fully understand how content management works, it's important to understand some basic terminology.

+ **Server** - An Mbox server consists of two major software components with respect to Content Management: Mbox Daemon and Mbox. Although the Mbox application is required for some features of Remote and Content Management to function, it does not need to be running for basic Content Management.
+ **Server Roles** - Within Content Management, each server takes the role of either the Master or a Member server in a Collection (described later). Each Collection of servers must contain exactly one Master and at least one Member in order to synchronize content between the servers.

- **Master** - The Master server acts as the “source” for Content Management in a Collection; meaning that content on the Master server can be synchronized to all of the Member servers in the same Collection. Masters are denoted in the server list with a letter between a-z and a light colored background. For example, a is the icon for the Master of Collection “a.”
- **Member** - The Member server acts as the “destination” for Content Management in a Collection; meaning that the Member’s content will be synchronized to mirror the content on the Master in the Collection. Members are denoted in the server list with a letter between a-z and a dark colored background. For example, a is the icon for a Member of Collection “a.”
- **Collection** - A Collection of servers forms a logical group to be synchronized. This allows a number of Collections to exist on the same network and to synchronize independent of each other. A Collection is identified by a letter; all versions of Mbox software allow 26 total collections on a network (a-z). Each Collection must have at least one Master and one Member server in order to allow synchronization.
- **Archive** - Each server may maintain a percentage of the available free storage space as an “archive” for files that have been modified or deleted during Content Management. This option requires that Mbox is running in order to set its value, but once set, Mbox does not need to be running to perform the archiving.
- **Monitor / Manage** - Remote has two main states with respect to Content Management: Monitor, where each instance of Remote may monitor the state of the server without actively managing content, and Manage, where Remote can actively manage content in a Collection. Note that only one instance of Remote is allowed to manage a Collection.
- **Managed Folders** - a list of folders which can be synchronized.
- **Sync** - Synchronizing a Collection will copy the content of a selected folder - or folders - on the Master server to each Member server over the network. The synchronization utilizes a Multicast stream where the synced files are sent to all servers on the same network at the same time.

Networking Hardware

Switches / UDP / Multicast / IGMP Snooping

The type of network switch used may have a great impact on the performance of Mbox Content Management. Choosing a switch capable of switching large amounts of broadcast or multicast data is imperative to the overall performance of the system. PRG recommends professional-grade, managed, non-blocking gigabit switches for use with content management. However, it should be noted that an incorrectly setup managed switch may cause more problems than it solves.

Many non-managed gigabit switches should perform well, however, there are some consumer-grade switches that slow down the switching of the entire switch based on the connected devices (e.g., when a 100Mb device is connected to a 1 Gb switch), which can have a negative impact on the whole switch, not just the single port.

Managed switches can employ IGMP snooping, a protocol that listens to special network management data, allowing the switch to send multicast data only to those ports that have requested it. This allows systems with mixed protocols (Content Management, Art-Net, etc.) on the same switch to function efficiently. For example, broadcast Art-Net data will be sent to all devices connected to the switch, whereas multicast content-managed data will only be sent to other content management computers on an IGMP snooping enabled switch.

When choosing an ethernet switch, a multicast-aware switch (such as the Pathport VIA series) will provide the best results and transfer speeds in a number of configurations, whereas many low cost consumer switches will under-perform based on the system network topology.

Managing Content

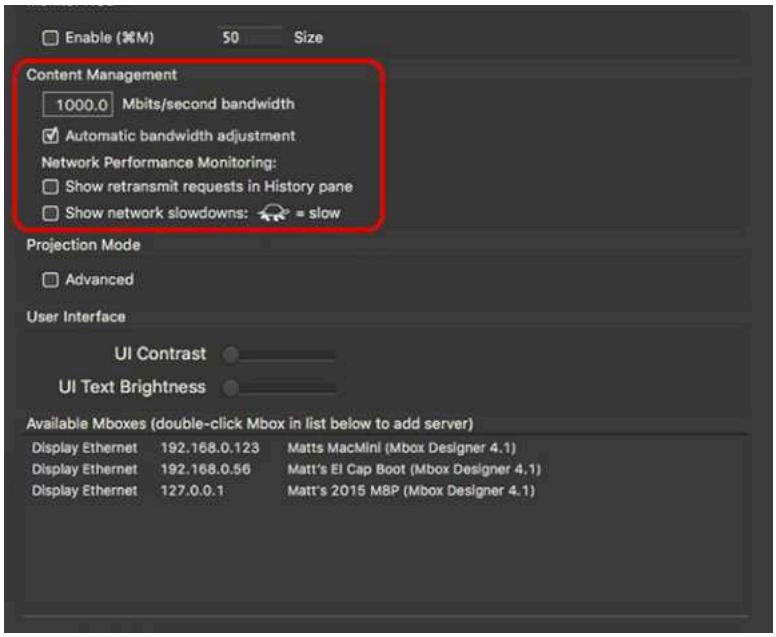
In order to manage content, servers must first be added to Mbox Remote. Refer to "Adding Servers" on page 4 for instructions.

Configuring Network Bandwidth

There are two properties that control the available network bandwidth which the Content Management system will utilize to transfer content. To configure the bandwidth, open Remote's preferences window by clicking the Edit Servers button on the main window or pressing [⌘,] on the keyboard.

+ Automatic bandwidth adjustment - With this option checked, the Content Management system will automatically adjust the transfer rate to either utilize all available bandwidth on the network or utilize the bandwidth of the slowest connected Mbox when transferring files. In this case, the Mbits/second bandwidth field is used as a hint for the starting network speed.
+ Manual bandwidth - With Automatic bandwidth adjustment unchecked, the Content Management system will always try to transfer at the rate entered in the "Mbits/second bandwidth" field.

CAUTION! Setting the bandwidth value higher than the available network bandwidth will have an adverse effect on transfer speeds.



Network Performance Monitoring

In addition to the bandwidth properties, there are two further properties that allow Remote to show feedback information for Content Management performance:

+ Show retransmit requests in History pane - When checked, the content management History pane (see page 19) will show retransmit requests for each piece of synced content. High numbers of retransmit requests can indicate network issues or that manual bandwidth settings are too high.
+ Show network slowdowns - When checked, Remote will display a yellow "turtle" icon in the Server column, next to the Member server that is making the most retransmit requests - indicating that this server may be causing content syncing to slow down. This condition may indicate a network issue between the Master and that Member.

Configuring Server Master/Member Roles

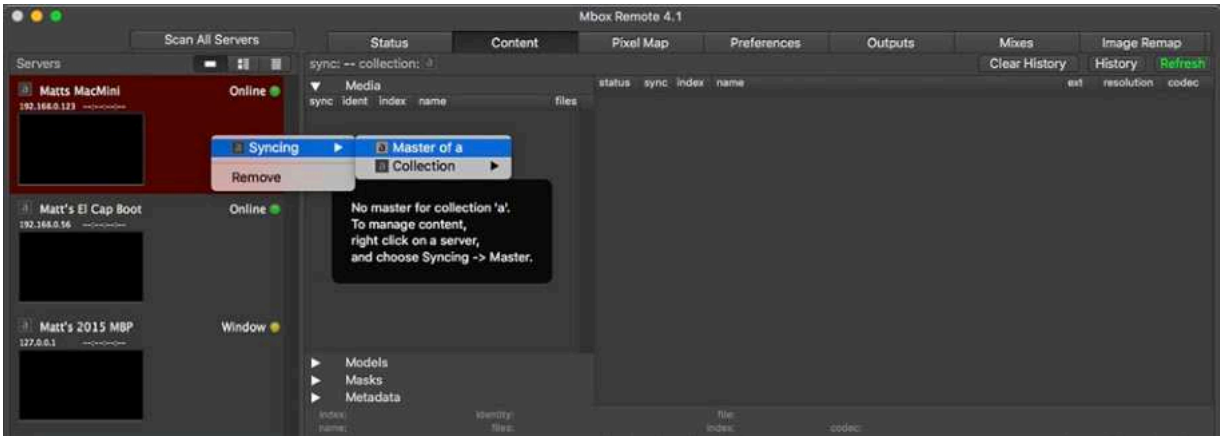
In order to start using Content Management, a Master server must be assigned for a given Collection. By default, all Mbox servers are in the same collection (a).

IMPORTANT! The Servers area on the left will always display the list of managed servers. After the Collection has been configured, the Status/Content tabs and file detail/history columns at the right side of the window will reflect the content of whichever server is currently selected. Content is always displayed from the perspective of the Master server, however, if a Member server is selected, any unique files that may exist on that particular machine will be highlighted in the content area.

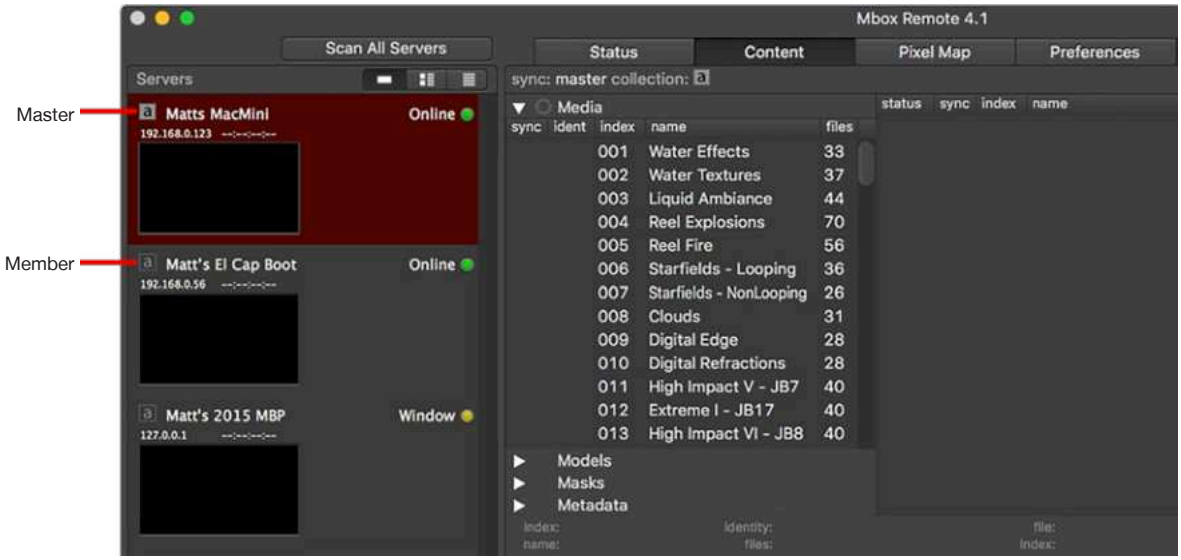
To configure a Master server:

Step 1. At Servers column, right-click on server that will be the "master."

Step 2. At Syncing pop-up menu, choose Master of a. (The letter of the Collection depends on the selection made in the Collection menu. By default, this is "a," but can be changed by selecting a new letter from the Collection menu.)



Step 3. The server's icon will change to light gray to denote that this machine is now the Master and content will be copied from this server to all of the other servers in the same collection. All other servers are now considered as "Members" of the collection.



Selecting Content to Sync

In order to synchronize movie, still image, and audio files between Master and Member servers, folders must first be added to the managed folders list.

Note: At present time (v5.0), Image Sequences cannot be synced using Mbox's content management tools.

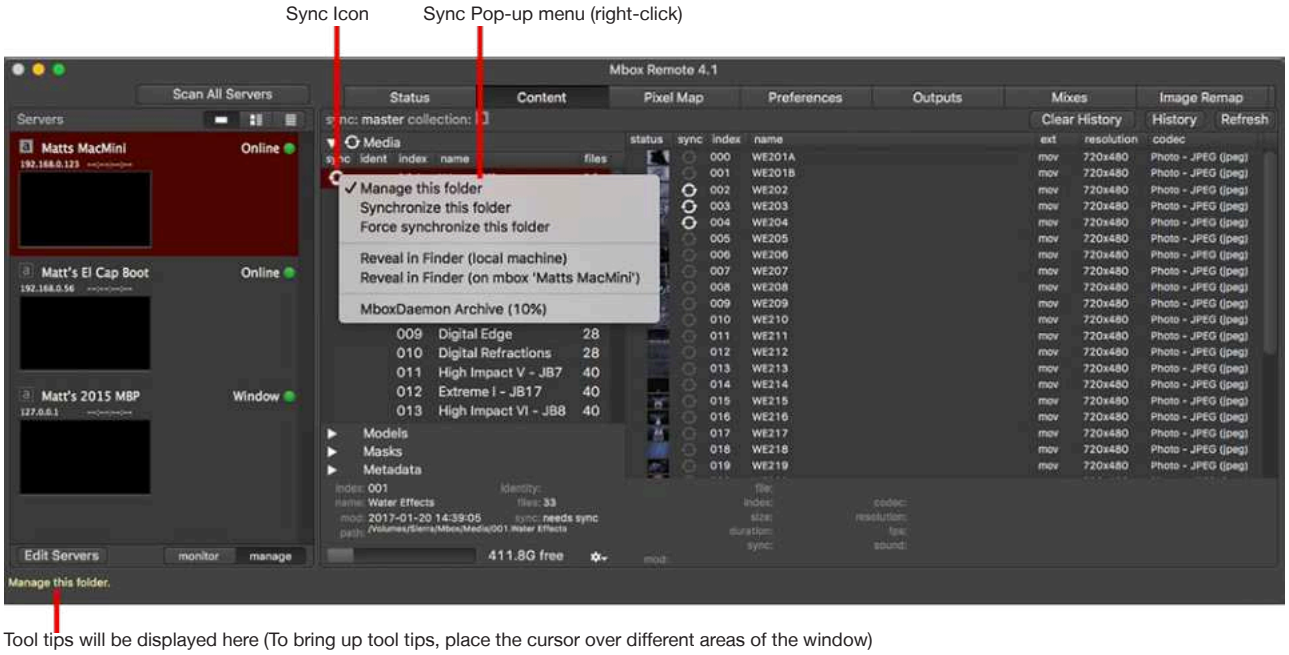
To add a folder to the managed list:

Step 1. Select Master server.

Step 2. Do one of the following:

a. At a content folder row (in the Content Tab), mouse-over the blank Sync column. The sync icon will highlight (and a tooltip will appear in the bottom-left corner of the window). Click on the sync icon to manage this folder.

b. Select one or more folders in the Content column (using Shift and/or Command keys), then right-click on one of the selected folders and select Manage this folder from the pop-up menu.



Tool tips will be displayed here (To bring up tool tips, place the cursor over different areas of the window)

The folder's sync icon has four states to indicate current status:

+ Blank - Folder is not a "managed" folder.
+ White - One or more files in this folder need to be synchronized.
+ Gray - This folder is synchronized.
+ Rotating - This folder is currently being synchronized.

Synchronizing Content

After a folder has been added to the managed folders list (see previous page), content can then be synchronized. The window allows for synchronization of a single file, a single folder, or multiple folders.

To synchronize content:

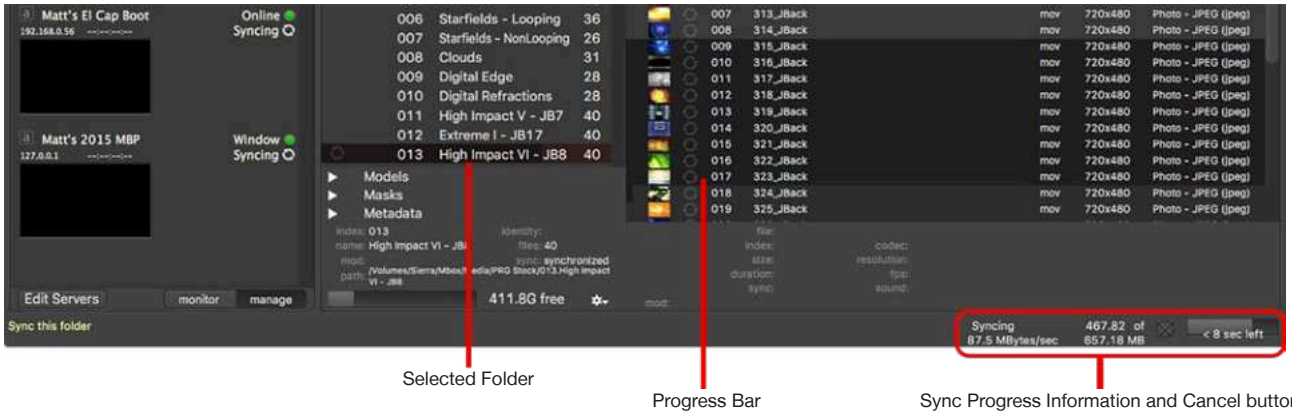
Step 1. To start synchronization from the Master to the Member servers, do one of the following:

a. At a folder, click its white Sync icon to synchronize all files in that folder.

b. Select one or more folders (using Shift and/or Command keys), then right-click on one of the selected folders and select Synchronize this folder or Force synchronize this folder from the pop-up menu. The Force command will synchronize all files within the selected folders, even those with the same Size, Name and Modification Date.

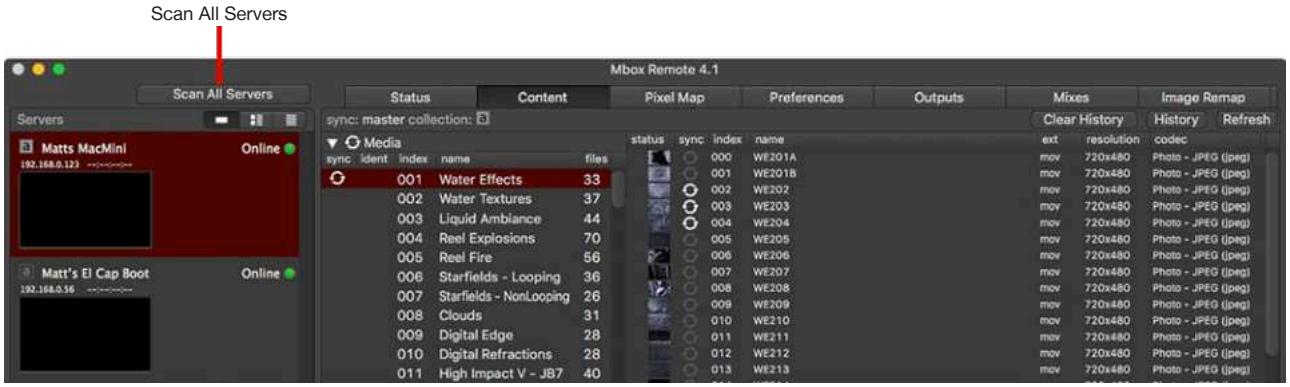
c. Select a folder, then right-click on an individual file to synchronize it.

Step 2. The progress of the sync action can be viewed by clicking on the folder currently being synced. This will display the status of each file within the folder with a progress bar in the content items row, as well as a white or gray sync icon based on the synchronization state of the file.



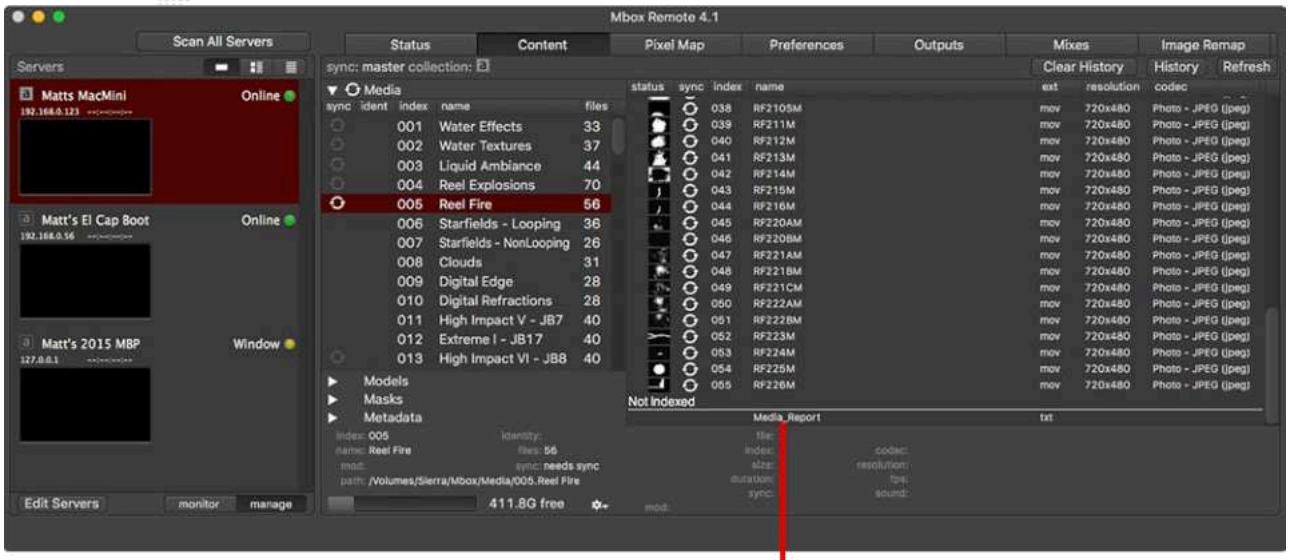
Step 3. Once synchronization is complete and the specified item (folder or file) has successfully been transferred (i.e., copied from the Master to the Members), the sync icon will change to gray (unless there was an error - refer to "File Conflicts" on page 21).

Step 4. To tell all servers to rescan for new content, click the Scan All Servers button or perform a rescan [⌘R] on each Mbox server individually.



Note: A file's new sync status will be reflected in the window approximately 10 seconds after it has been changed.

Note: Files with extensions not recognized by Mbox will not be indexed. These will be placed at the bottom of the file list.



File(s) not indexed

If new content is added while the Mbox application is running, the Media and Models folders must be re-scanned in order to use that content. To have all servers automatically perform a rescan after each content transfer, press and hold the Shift key while clicking the Scan All Servers button. The button will now display the text "Scanning After Transfers" as shown below:

To return to normal, manual re-scanning, click on the button again and it will revert to displaying the text "Scan All Servers."

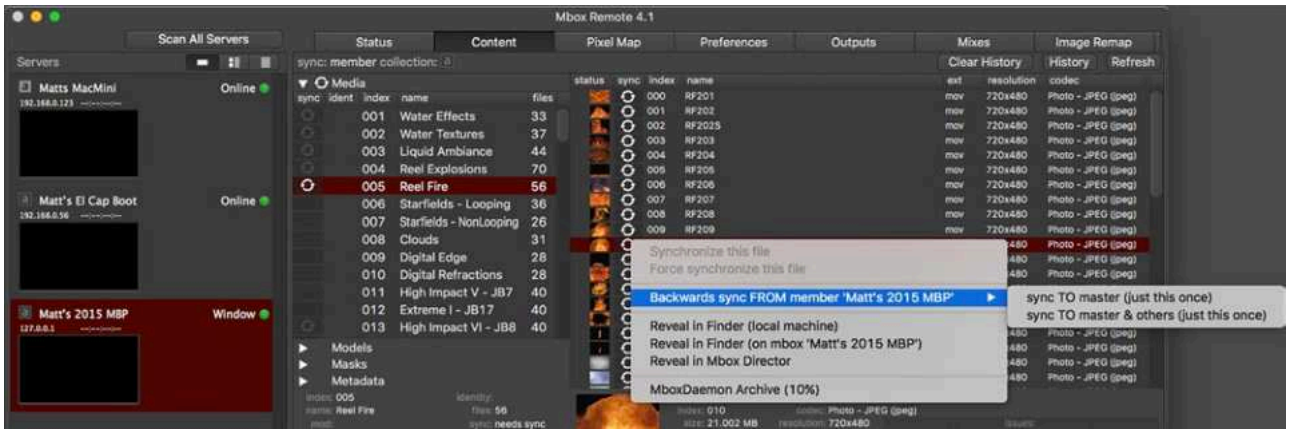
Reverse Sync

The Reverse Sync feature allows a single file to be “reverse synced” from a member to the master, or from a member to master and all other members.

Step 1. Select a member server.

Step 2. Locate file to be synced (backwards) and right-click on its sync circle icon.

Step 3. At pop-up menu, select Backwards sync FROM member... and a sync TO option. File will sync as directed.



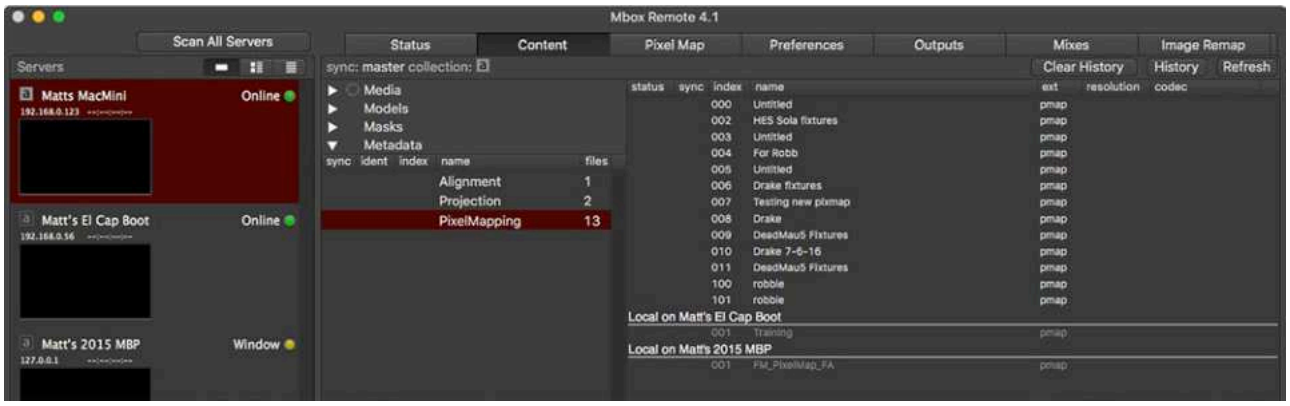
Important! You will only be able to reverse sync if the Master computer already has a folder of the same index number with at least one indexed file in it.

Synchronizing Pixel Map, Plugin, Script, and Image Remapping Files

Pixel mapping files, plugin image files, scripts, and Image Remapping files can also be synced between servers using Content Management.

Requirements:

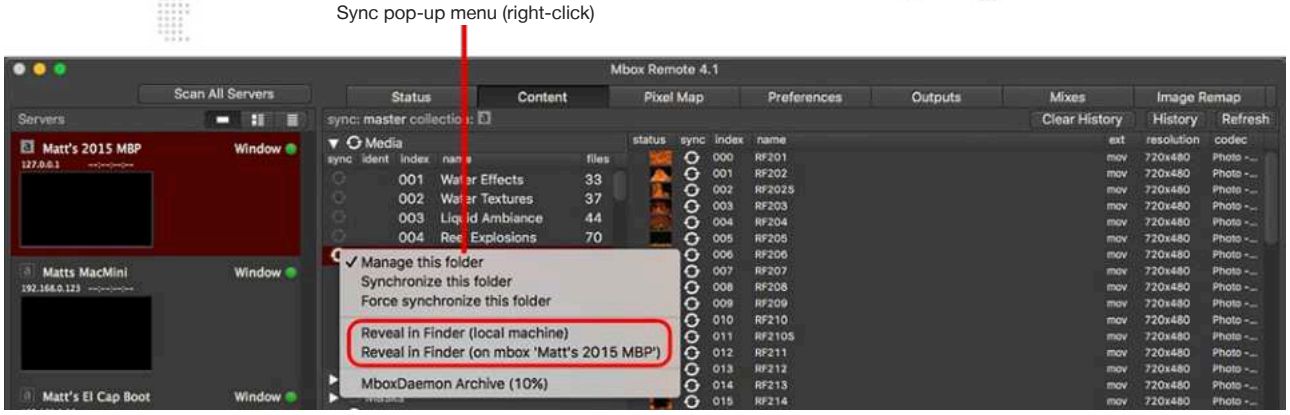
+ Files other than the Image Remapping file (MultiScreenData.plist) must have an index number prefix (8-bit).
+ The Image Remapping file (MultiScreenData.plist) must be placed in the Mbox content folder.
+ Pixel mapping files must be placed in the Mbox/PixelMapping folder. Plugin image files must be placed in the Mbox/plugins/images folder. Scripts must be placed in the Mbox/plugins/scripts folder.



Organizing Content Files

Organization of a server's media files is completely under user control using the Finder on the computer, rather than a large opaque database. Any changes to name, index number, or file extension can be done using the Finder. As a convenience, folders and files can be quickly viewed in the Finder by selecting the Reveal in Finder (local machine) or Reveal in Finder (remote machine) options from the pop-up menu.

Sync pop-up menu (right-click)



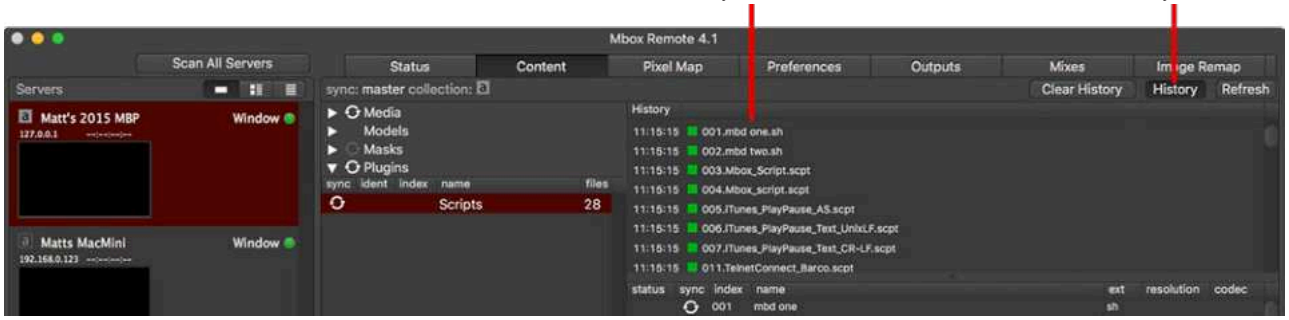
Sync History

The History button, available at the top-right of the window, will display status information for all pending and past synchronization tasks.

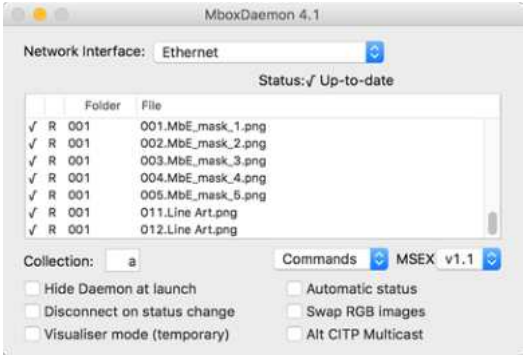
To view the History, first select a folder, then click the History button. Clear History or Refresh the information by clicking the applicable button.

History Information

History Button



Note: On the Master and Member servers, there is a status area within Mbox Daemon that displays the status of the current and past file transfers.



Content Management Archive

Mbox's Content Management system can be configured on each server to use a specific percentage of the free disk drive space to store archived content files as result of deletions or replacements during synchronization. Archives will be placed into a folder within the default archive folder (Mbox/archive) and organized into sub-folders by type (media, models, metadata), parent folder index number, and file number. The archived file's name will have a prefix with a time/date stamp.

If the drive holding the archive folder runs out of space, the oldest files (by date) are deleted from the archive until there is enough space available. The archive size preference specifies a percentage of the total FREE space available on the drive. Because of this, while the total space available for the archive shrinks (to zero) as the drive fills up, it is possible to make sure that the archive never uses up all the free space on the drive.

To configure an archive:

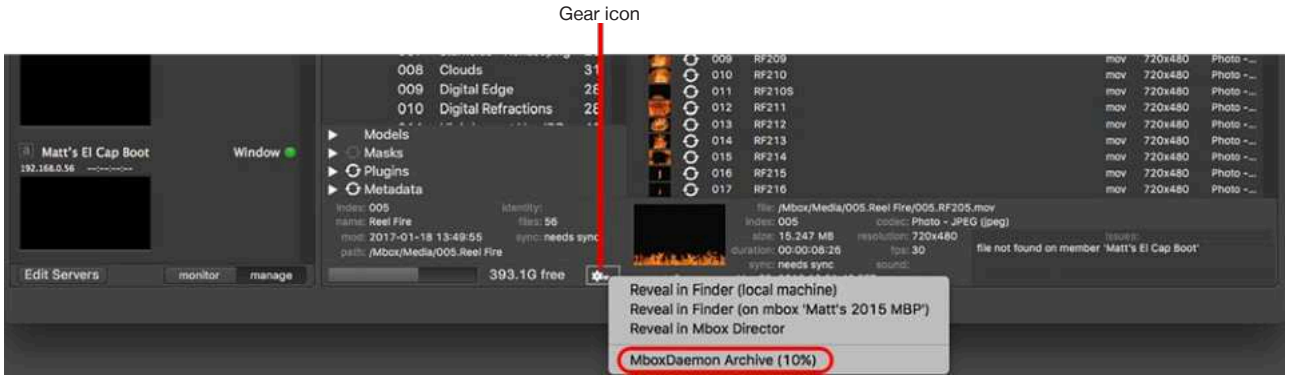
Step 1. Ensure Mbox and Daemon are running on the target Mbox server.

Step 2. In the Remote application, select the target server in Servers column. Use one of the following options:

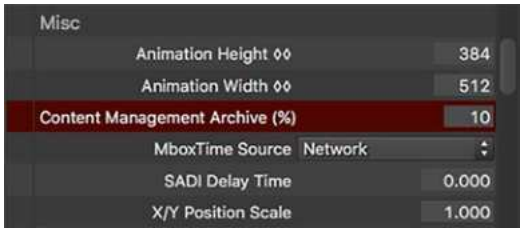
a. Click on the Preferences tab to view/edit preferences for the selected server. Scroll down to the Misc section and find the Content Management Archive (%) preference.

b. Right-click on a folder or file in management area and select Mbox Daemon Archive from the pop-up that opens.

c. Click on the gear icon at the bottom of the Content tab view and select Mbox Daemon Archive from the pop-up that opens.



Step 3. In the preference's value field, enter a percentage of disk space that the archive will occupy. (Note that entering a value of 0 turns off the archive feature. In which case, files that have been deleted from the Member machine will not be archived.)



To restore an archived file:

+ Manually move the file back into the correct location using the Finder and edit its name as required.

File Conflicts

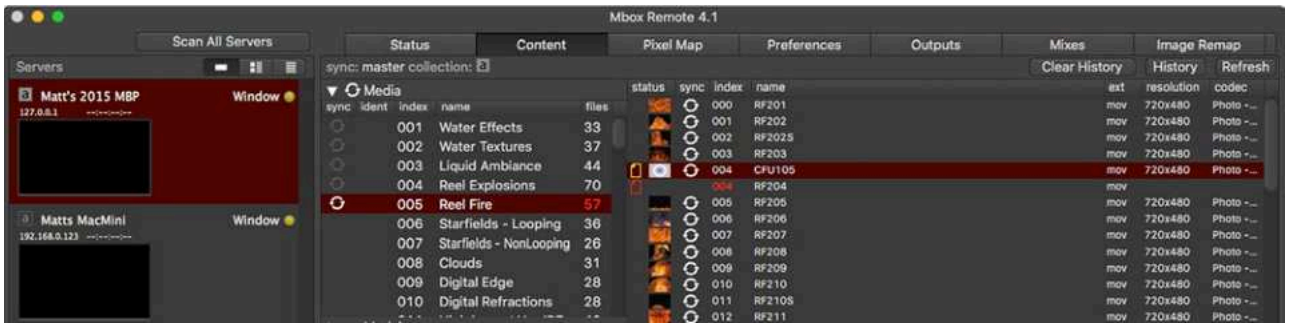
During synchronization, file conflicts can occur as a result of the following:

+ Two files in the same folder with the same Index number.
+ Two folders with the same Index number.

Other issues can be caused by:

+ Folder permissions.
+ Insufficient disk space.

Media files with the same Index number will be flagged with a yellow icon (indexed file) and a red icon (duplicate file) as shown below:



Folders with the same Index number will be flagged with the <multiple folders> bar as shown below:

The file(s) with yellows icon are the ones that Mbox will play when asked to play the file having that index. The file(s) with red icons will not play.

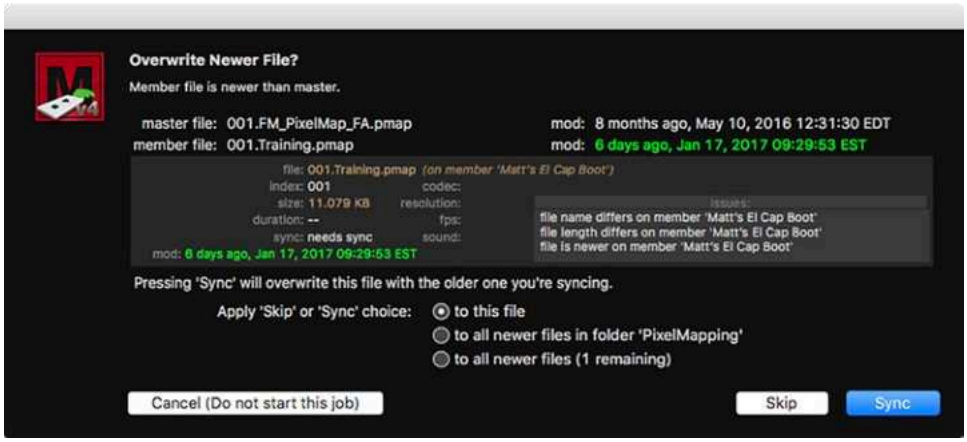
File conflicts can be resolved by either deleting the duplicate files/folders or by renaming/indexing them using the Finder. (Refer to "Organizing Content Files" on page 19.)

Newer File Warning

Mbox Remote will provide an alert if an older file (based on modification date) is about to be synced onto a newer file that is judged to be the same file (by index number and name). In these cases, three choices are possible:

1) Overwrite only this individual newer file. If more than one file is being synced and other files are found to be newer on the Member, the same alert will be shown again.
2) Overwrite all newer files in this folder. If more than one folder is being synced and other files in other folders are found to be newer on the Member, the same alert will be shown again.
3) Overwrite all newer files during this sync (assuming more than one folder is being synced). No further alerts will appear if newer files are found.

In the dialog window, choose an option using the radio buttons and click Sync or Skip. Or press Cancel to do nothing.



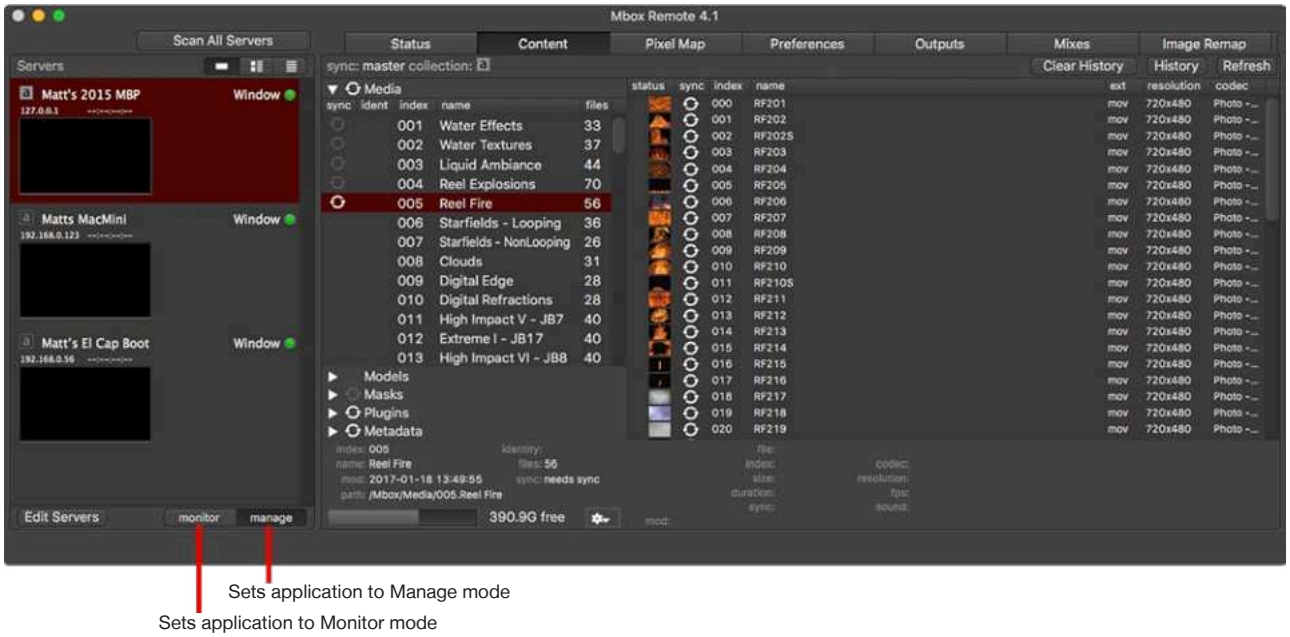
Monitor and Manage Modes

Mbox Remote includes two modes for managing and monitoring the Content Management system.

+ Manage - allows the Mbox Remote application to perform Content Management actions.
+ Monitor - allows the Mbox Remote application to monitor Content Management operations.

Mbox Remote automatically assumes the Manage role. Typically, no action is required unless the Remote application is being used on more than one machine. In which case, to specify which instances of Remote are allowed to monitor or manage, click on one of the two mode buttons located at the bottom of the Servers column.

Note: Multiple instances of Mbox Remote are allowed to run as managers, but only one manager is allowed for each Collection. To become the manager for a specific collection, first select the Master for a Collection, then press the Manage button.



Sets application to Manage mode

Sets application to Monitor mode

If an instance of the Mbox Remote application is set to Manage mode for a Collection that is already being managed by another copy of Mbox Remote, a warning message will be displayed. If it is okay to assume the Content Management role, then click the Attempt Takeover button. If not, click Cancel.

REMOTE SERVER CONFIGURATION AND PREFERENCES SETTING

Configuring Mbox Server Outputs, Mixes, Preferences, and Image Remapping Configurations Remotely

By selecting an available, networked server in the Servers column of the Mbox Remote application's main window and then clicking on the Outputs, Mixes, Preferences, or Image Remap tabs, it is possible to view and edit the output and mix configuration on that server or to view and edit that server's preferences or to compare them to preferences on another networked server. The Outputs, Mixes, Preferences, and Image Remap tabs in Remote work in the same manner as those same tabs in the Mbox application itself.

Refer to the Mbox User Manual, Chapter 3: Configuration > Application Windows for more in-depth information on how to use the Outputs, Mixes, Preferences, and Image Remap tabs.

CAUTION! Changes made to configuration and preferences will be immediately applied to the affected Mbox server. Note that there is no undo functionality on the Outputs, Mixes, Preferences, or Image Remap tabs in Mbox Remote.

Server Control Commands

With a server selected in the Server column of Remote's main window, there are a number of control commands available in the Commands section of the menu bar that will affect that server. The following tasks are available:

+ Rescan Media - rescans Media and Models folder.
+ Update Thumbnails - scans for new content and builds thumbnails.
+ File Sharing On/Off - turns File Sharing on/off. Requires Accessibility to be enabled for the Mbox application.
+ Clear Keyboard HUDs - turns off all onscreen HUD displays that were enabled using the computer's keyboard.
+ Go Fullscreen - if the Mbox software is in Window mode, it will enter Fullscreen mode.
+ Exit Fullscreen - if the Mbox software is in Fullscreen mode, it will enter Window mode.
+ Relaunch Mbox - immediately quits and relaunches the Mbox software.
+ Quit Mbox - immediately quits the Mbox software.
+ Restart Computer - immediately restarts the computer.
+ Shutdown Computer - immediately shutdowns the computer.
+ Make Primary/Make Backup - turns off/on the "Backup Mode" preference. Backup Mode disables the output of layer sync and pixel mapping, allowing a server to be a hot backup without it duplicating that protocol data on the network. (To take over from a failed unit, turn off Backup Mode on the backup and turn on Backup Mode on the failed unit.)
+ Show Mbox Daemon - if the Mbox Daemon application is hidden on the server, it will be unhidden.
+ Launch Mbox - launches the Mbox software. (Only works if Mbox Daemon is running.)
+ Mount Server - opens a File Sharing session with the server. Requires SMB file sharing to be enabled on the Mbox computer.
+ Share Screen - opens a Screen Sharing session with the server. Requires VNC screen sharing (with password) to be enabled on the Mbox computer.
+ Send Network Probes - sends a proprietary network ping to Mbox servers, to check for proper communication.
+ Close Probe Windows - closes the window that opens when a successful network probe reaches an Mbox server.

PROJECTION MAPPING

Projection Mapping is an advanced Mbox feature. If you are unsure about its operation, contact PRG support for assistance.

Overview

The Mbox Remote application can be used to configure settings for simple keystone and warp of configured outputs for Mbox. Beyond those settings, projection surfaces (Topography files) and more complex projection mapping settings can be created, applied, and adjusted for use with Mbox when a Designer or Studio license is active. The Mbox Mini license level does not support topography and projection mapping.

Compatible functionality works the same way with all three versions of Mbox, although the reduced function set with an Mbox Studio or Mbox Mini license will restrict some options. Configuration requires compatible versions (i.e. all applications are running the same major and minor version) of Mbox, Mbox Daemon, and Mbox Remote.

Important Notes:

+ Some or all of the functionality detailed here is intended to replace/override the default Output Master Keystone and Camera fixture control parameters. Mbox allows for multiple Output Masters, up to 16, depending on the license level.
+ The Mbox application has control parameters to enable/disable the DMX-controlled Output Master Keystone and Camera (where applicable) functionality. Each Output Master must have its Keystone and Camera DMX controls separately enabled or disabled
+ On the controller (console or Mbox Director), the Keystone > Mode/Curve parameter must be set to a value of 000 for remote keystone or warp to be applied. Likewise, in Mbox Director, the Camera > Enable Projection Camera parameter must be set to a value of 255 for camera to be applied. Other values will disable the remote keystone and camera settings, and revert to the default DMX control over Keystone and Camera parameters.
+ For outputs (i.e. output mixes), all projection properties can be edited. But only the 3D camera properties of non-output mixes can be edited, and not the keystone/warp and vignette properties.

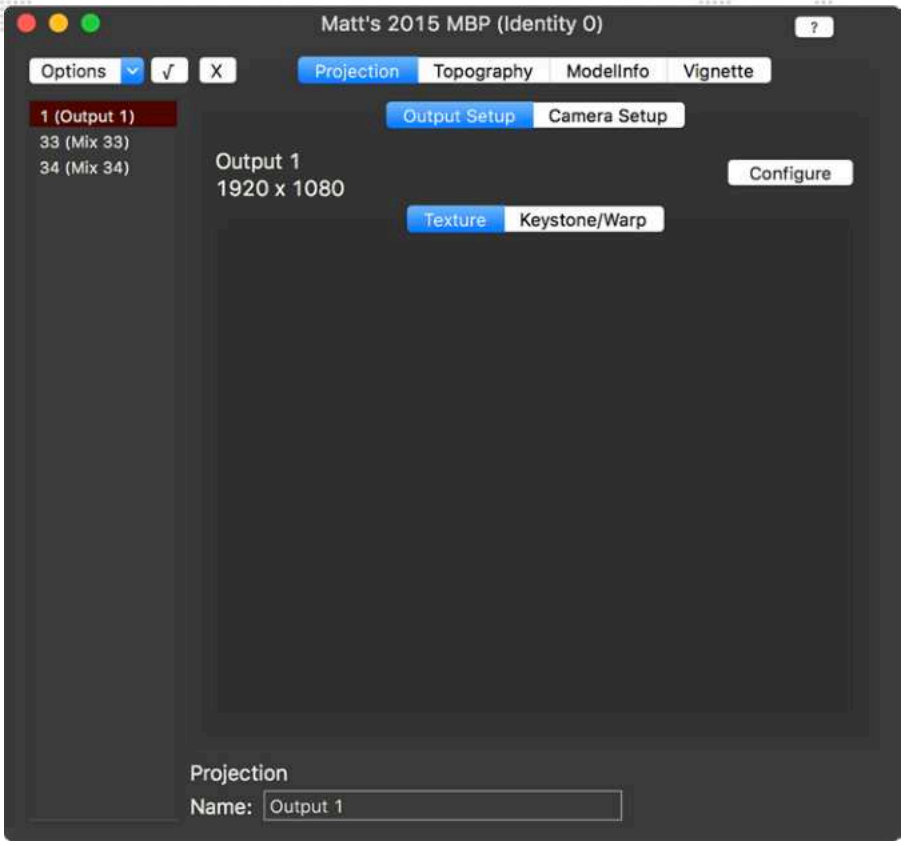
Getting Started

Step 1. To begin with, launch all three required applications - Mbox, Mbox Daemon, and Mbox Remote. Mbox and Daemon must be running on the same computer (the Mbox server), but Mbox Remote can be used on a separate, networked computer, if desired. In a networked situation, make sure that the correct network interface is selected in the Mbox and Mbox Daemon applications, and that this interface is configured correctly to communicate with the networked computer (i.e. they are on the same subnet).

Step 2. In the Mbox Remote application, make sure to add the server(s) that you want to configure projection mapping for. Press the Edit Servers button or press [⌘,] on the keyboard to open Remote's preferences window. (Refer to "Adding Servers" on page 4 for information)

Step 3. If configuration beyond keystone and warp is desired, make sure to check the Advanced checkbox in the Projection Mode section of Remote's preferences window.

Step 4. In the Server column of Remote, select a server. Press [⌘E] on the keyboard to open the Projection Editor window. At the top of the Projection Editor window, you will see the name of the selected server with its Identity value in parentheses - e.g. “Mbox123 (Identity 1)”. On the left side of the Editor window you will see a column listing the outputs and mixes belonging to the selected server. To edit the settings for an output or mix, select the appropriate item in this column.



Note: Mbox Studio and Mini licenses do not support changes to <u>any</u> settings for non-output mixes. And while non-output mixes can have their 3D camera properties edited, such changes only take effect when an Mbox Designer license is active.

The remainder of the Projection Editor window is devoted to the area where the settings will be configured. In Basic Mode, you will only see a tab called “Projection” on the primary level and a tab called “Output Setup” on the secondary level. In the illustration above all of the available tabs have been revealed because Advanced Projection mode is enabled and the selected server has an Mbox Designer license.

The tabs in the Projection Editor window are hierarchical, with different tabs being revealed on the lower level depending on which tab is selected at a higher level. The following examples use hierarchical notation to explain which tabs have been selected. For example, in the illustration above, the selected view would be referred to as Projection > Output Setup > Texture.

Basic Projection Mode

Setup of Outputs

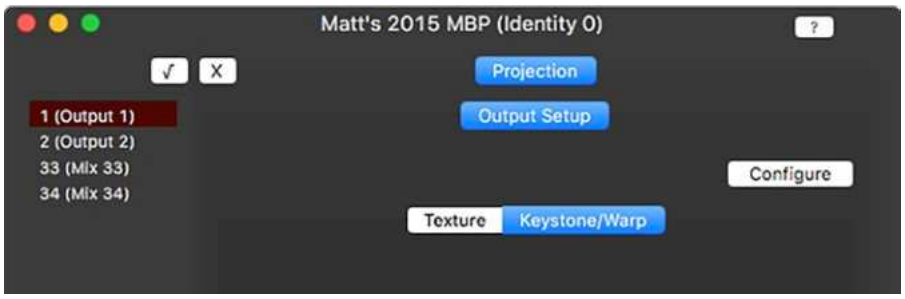
In all cases, the first step for configuring outputs is to add the outputs to the Mbox server using the Outputs tab in either the Mbox application or in Mbox Remote. (Refer to the Mbox User Manual, Chapter 3: Configuration > Application Windows) It does not matter whether the outputs are discrete or part of a parent/child relationship (e.g. using a multihead adapter like a Datapath FX4) or whether they have an output master assigned to them or not.

Note: All output settings for layout, overlap, sampling, and multihead setup are now set on the Outputs tab. The Projection Editor window in Remote is only used for remote keystone, vignette (edge-blend), and camera configuration.

Setup of Keystone/Warp

Once all outputs have been added, the Projection Editor window will show the list of the selected server's outputs in the column at the left side of the window. If all of the server's outputs are not listed, click on another server or on the empty area below the last server in the Servers column of Remote's main window, and then click back on the server to be configured.

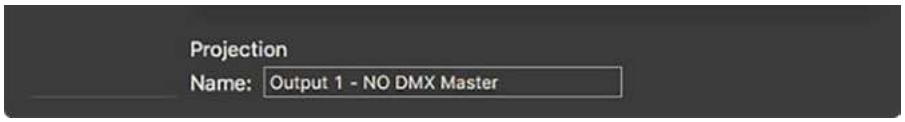
In Basic Projection Mode there are only two tabs to select from: Texture and Keystone/Warp. Depending on the previous usage of the Projection Editor window, either Texture or Keystone/Warp may be selected when the window opens.



Important! To view the results of keystone/warp configuration created in Mbox Remote on an output, the output must either have no output master assigned, or must have the Output Master > Keystone Mode/Curve parameter set to a value of 0.

To setup Keystone/Warp:

Step 1. Select Output 1 in the left column of the Projection Editor window. With an output selected, all configuration changes made in the pane to the right will apply only to that output of the server. Any other output(s) on the server must be configured separately by selecting them.



At the bottom of the Projection Editor window, the full name of the currently-selected item is shown. For an output this will be "Output" followed by the output's index number and an added suffix of "NO DMX MASTER" if no output master has been assigned to the output. This name is not editable in Remote, but it can be edited on the Outputs tab of Mbox or Remote.

Step 2. Click the Configure button below the Output Setup tab to enable the editor for the selected output. The Output Setup tab will now show the selected output's name and size. The Options pop-up menu will be visible at the top-left of the window.

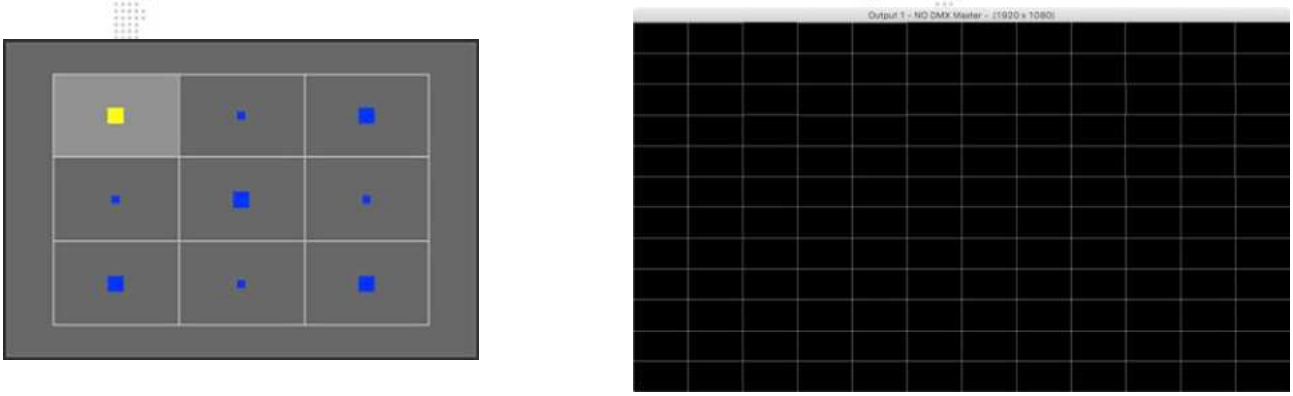
Step 3. Click on the Options pop-up menu and select Create Keystone/Warp. The area below the Keystone/Warp tab will now show the controls for editing the keystone and warp of the output.

Step 4. Either keystone or warp configuration is selected using the radio buttons below the gridded area. Only keystone or warp can be active, not both. In the gridded area, the larger blue squares represent the control points used to adjust the keystone or warp. The smaller blue squares on the keystone grid are not adjustable.

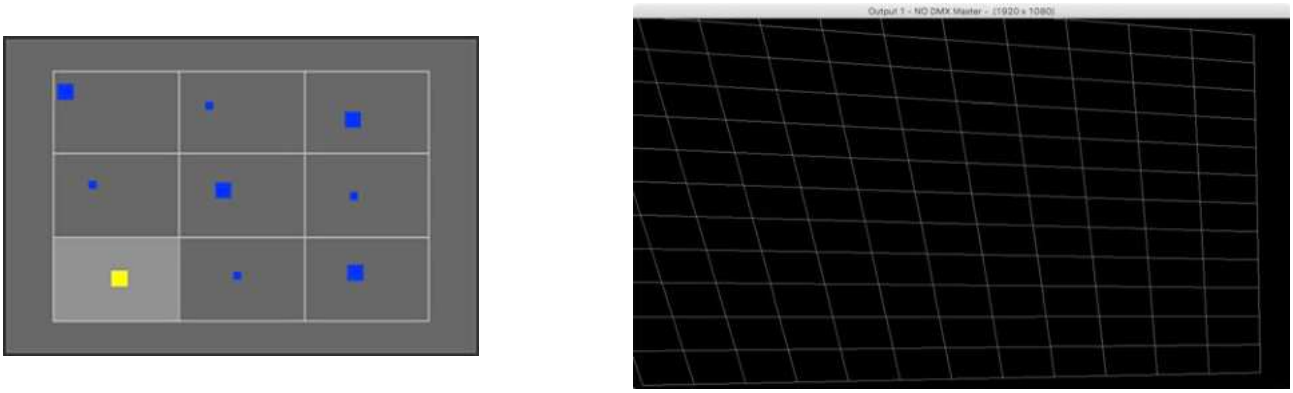
a. For keystone configuration there are five adjustable points, one in each corner and one in the middle. The corner points represent the corners of the output and may be dragged inwards or outwards. The middle point is used to modify the linearity of the keystone correction. The smaller blue squares move automatically to represent the center points of the lines between their adjacent corner points.

b. For warp configuration there are nine points. As with keystone, the corner points represent the corners of the output. Each of the other five points represents the center point of a line between the points to either side (left/right or above/below). These five points can be adjusted to vary the center point of the bezier curve that is drawn between the points to either side.

Step 5. To adjust a control point, click anywhere inside the rectangle that contains the point to be adjusted. The corresponding point will turn yellow indicating that the mouse can be used (click and drag) to adjust the geometry. The keyboard arrow keys can also be used to move in a more precise fashion, using the [option] key for even finer control. Note that the points can move outside of their original rectangle in any direction, and that it is the selection of the original rectangle (their "home base") that selects the point, rather than a selection of the blue square that represents the point.

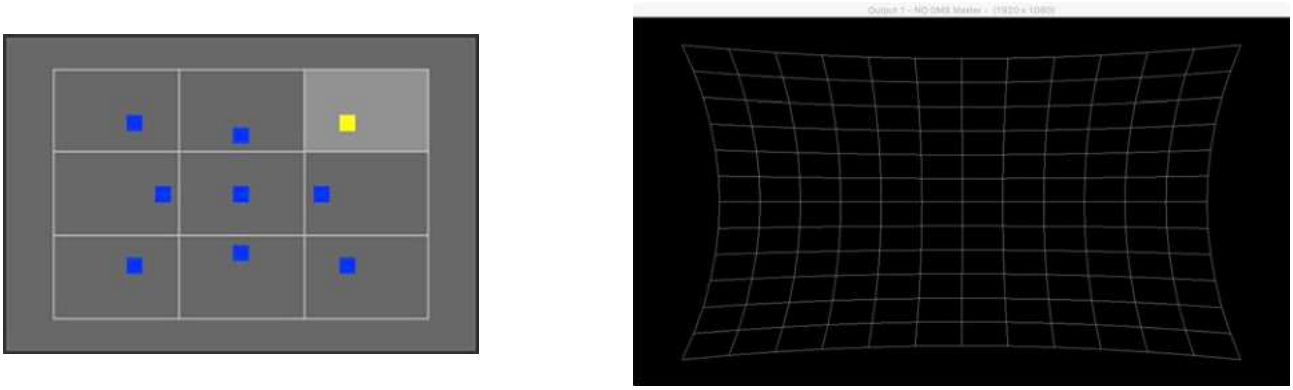


Keystone with default values



Keystone with modified values

Tip Double-clicking inside a rectangle will reset the geometry for that area of the output. Pressing the "Reset All" button will reset the geometry for all points.



Warp with modified values

Setup of Vignettes

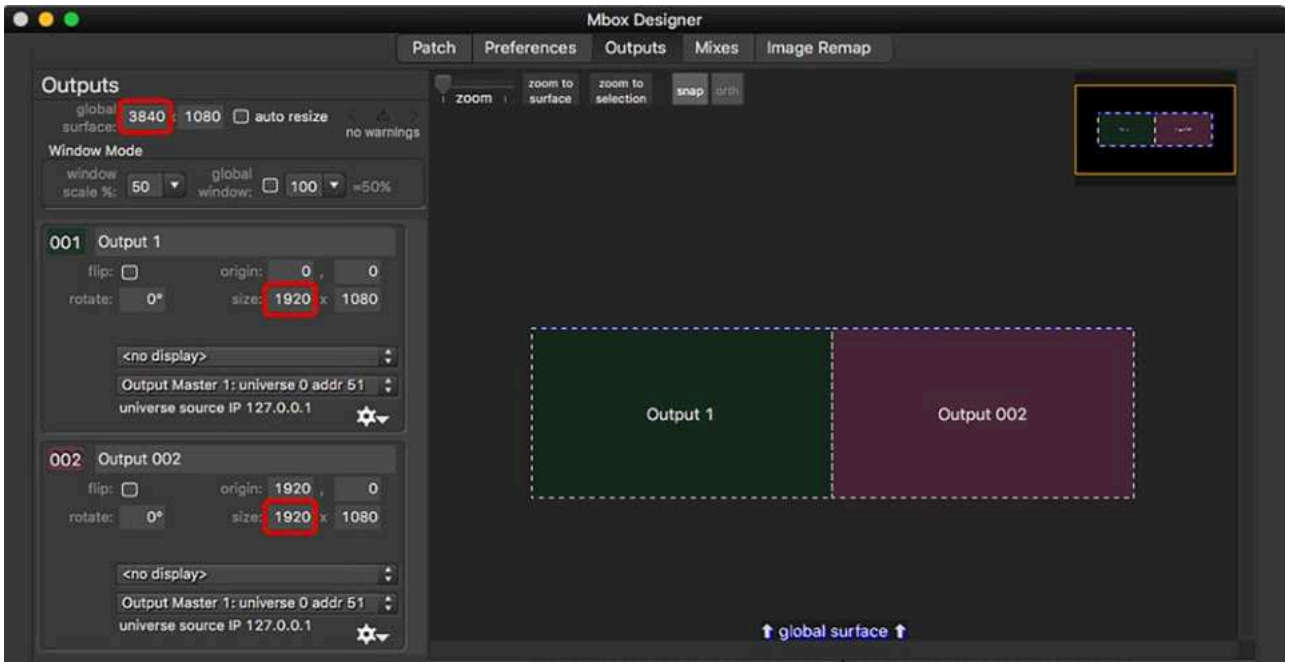
Vignettes can be used to create the soft-edge blending areas for overlapped outputs, or as simple vignettes to frame the edge of an output in black. Vignettes are essentially the same as the Mbox Keystone fixture's Edge Top/Right/Bottom/Left parameters. However, Vignettes can have separate curve types and gamma for each edge whereas the DMX-controlled Keystone fixture's edges must all use the same curve and gamma.

Vignettes are applied parallel to their corresponding edge, following the line or curve of the output's keystone/warp geometry. The vignette extends from the edge of the output towards the center. The area affected by the vignette may appear to fade to black onscreen when the output is viewed individually, but is actually fading to transparent. The transparency will become apparent if the output is used with another outputs as part of an overlapped and blended projection setup.

Important! To view the results of vignette configuration created in Mbox Remote on an output, the output must have an output master assigned, and must have that Output Master > Keystone Mode/Curve parameter set to a value of 0.

To set up Vignettes:

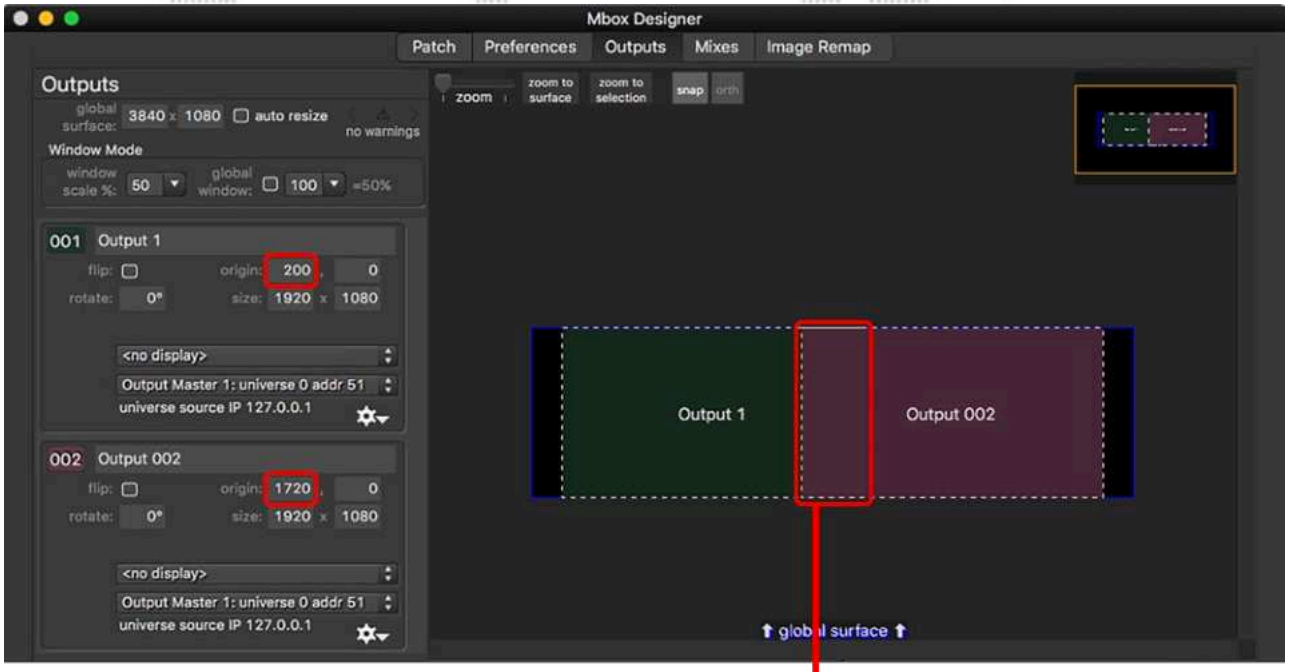
Step 1. On the Outputs tab of the Mbox or Remote application, configure the Mbox server to have two equal-sized outputs. At the same time, make sure the Global Surface's width is equal to the combined width of the two outputs.



Step 2. Assuming that this is going to be an overlapped and blended projection setup, change the X Origin of each of the outputs to give them a 400 pixel overlap:

a. Output 1 will have an X Origin of 200 to move it 200 pixels to the right.

b. Output 2 will have an X Origin of 1720 to move it 200 pixels to the left.



Overlap ares (400 pixels wide)

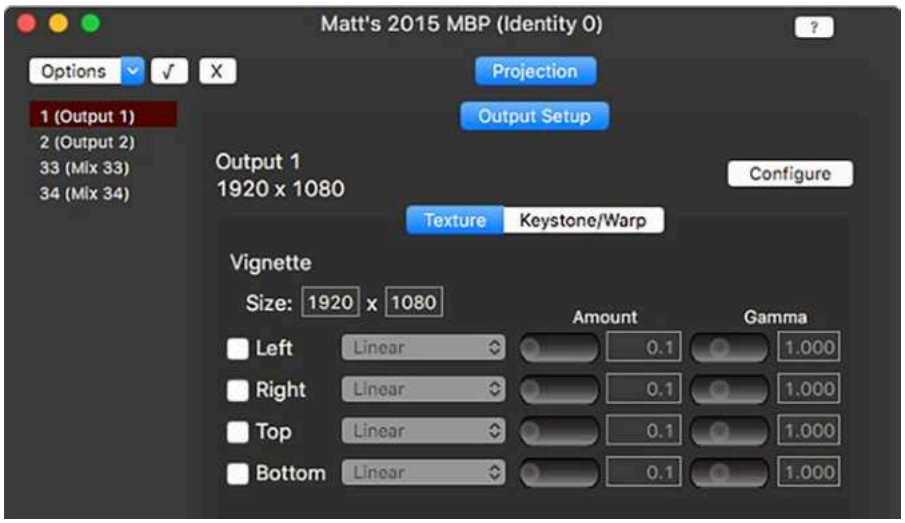
This will lead to the following result on the outputs from Mbox, note the repeated pixels caused by the overlap of the two outputs on the Global Surface:

Step 3. Switch to the Mbox Remote application and open the Projection Editor window if it is not already open. Output 1 and Output 2 should be shown in the left-hand column of the window. Select each output in turn and perform the following:

a. Click on the Configure button to enable the editor for the output.

b. Click on the Texture tab if it is not already selected.

c. Click on the Options pop-up and select Add Vignette.



Step 4. The Vignette editing tools provide separate vignette controls for each edge of the output.

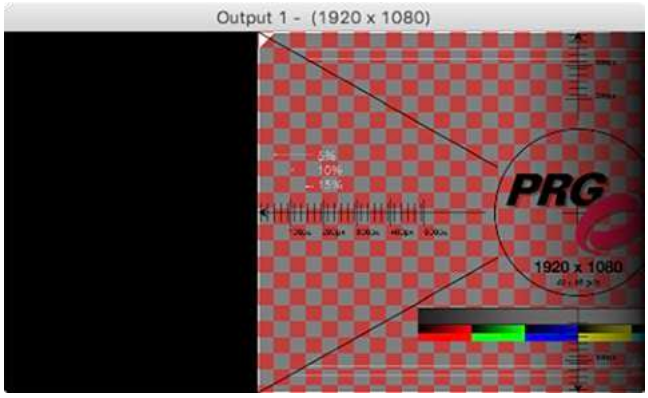
a. The Enable checkbox turns the vignette on/off.

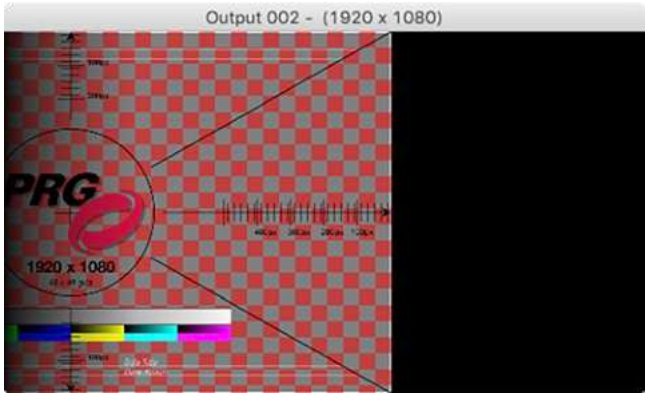
b. The Curve pop-up selects from three available curves for the vignette: Linear, Raised Cosine, or Sine.

c. The Amount value sets how far the vignette extends (in pixels) inwards from the edge of the output.

d. The Gamma value sets the gamma (the linearity) of the vignette's transparency fade.

Step 5. For Output 1, enable the right side vignette and set its Amount value to 400. For Output 2, enable the left side vignette and set its Amount value to 400. This following images show the result on the outputs of Mbox.





Step 6. At this point the outputs from Mbox would need to be connected to a pair of projectors to continue to adjust the vignette settings (including curve and gamma) to get the best blend results.

Additional Guidelines for Keystone/Warp and Vignettes:

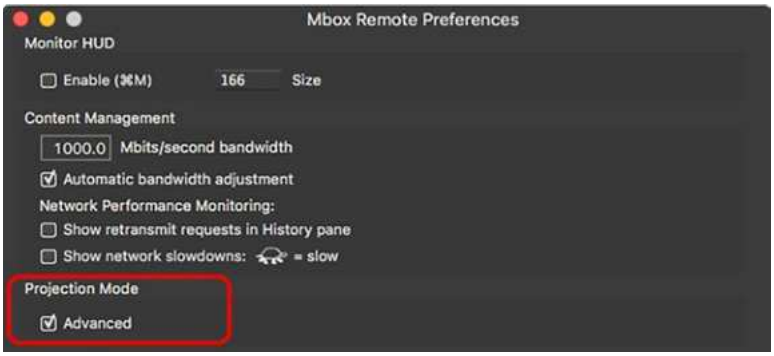
+ An onscreen grid overlay for keystone and warp can be applied by setting the Global Master fixture's Control Channel parameter to a value of 227.
+ Switching from keystone mode to warp mode (or vice versa) will not affect the geometry of the keystone or warp. However, after switching from warp to keystone mode, if any point is adjusted, the geometry will revert to the keystone method of drawing straight lines between the corner adjustment point.
+ Keystone/Warp settings can be copied from one output to another by using the Copy Keystone/Warp and Paste Keystone/Warp options found in the Options pop-up.
+ To delete only the Keystone/Warp setup, click on the Options pop-up and select the Delete Keystone/Warp option.
+ To delete only the Vignette setup, click on the Options pop-up and select the Delete Vignette option.
+ To delete all Output, Keystone/Warp, and Vignette settings, click on the Options pop-up and select the Clear Output Settings option.
+ If you intend to use the Advanced Projection Mode to setup a 3D camera, you should clear the Output Setup before continuing.

CAUTION! Clicking on the Configure button will reset all keystone/warp settings and vignette settings!

Advanced Mode (Mbox Designer/Studio License Levels Only)

Advanced Projection Setup

The Advanced Projection mode is enabled by checking the checkbox in the Mbox Remote Preferences window. (Open the Remote Preferences window by clicking the Edit Servers button on the main window or pressing [⌘,] on the keyboard.)



Projection > Output Setup

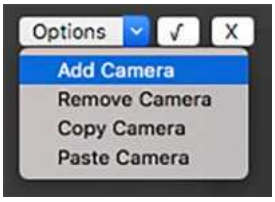
In Advanced Projection mode, the Output Setup tab is the same as it is in Basic Projection mode.

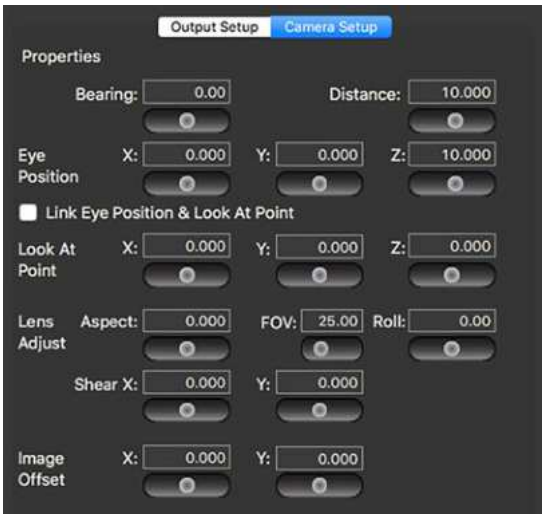
CAUTION! Using the keystone/warp or vignette features of the **Projection > Output Setup** tab will have an impact on the result of the camera's rendering of the 3D environment. To use the features on the **Projection > Camera Setup** tab to best effect, first remove any output settings by clicking on the **Projection > Output** Setup tab and selecting Clear Output Settings from the Options pop-up.

Projection > Camera Setup (Mbox Designer License Level Only)

All three versions of Mbox have a default 3D camera that is used when rendering 3D objects. The default camera is assigned to the Global Surface and is not configurable. The Mbox Designer license allows additional 3D cameras to be created - one for each output or mix. Each added 3D camera uses real-world measurements for its position, the point that it is looking at, and other adjustable parameters.

With an output or mix selected in the left-hand column of the Projection Editor window, clicking on the Camera Setup tab initially shows a blank work area. To add a camera, click on the Options pop-up and select Add Camera.





The camera's Eye Position and Look At coordinate are entered in generic real-world units (e.g. inches, feet, millimeters, meters, etc.). The system of units must be the same as the measurement units used when creating objects - either within a 3D modeling application or when making Topo objects in Mbox's Projection Editor window. (Refer to "Topography" on page 36)

For example, if the show requires projection upon a cube that is 1 meter on each edge, a 3D model of a cube that is one unit on each edge can be created in a 3D modeling application. Based on 1 unit equaling 1 meter, meters should be the units for measurements when entering values on the Camera Setup tab. If the 3D model cube is made to be 1000 units on each edge (as if using millimeters), then use millimeters as the units for measurements on the Camera Setup tab.

When setting up a projection mapping system and the objects used, also consider the 3D coordinate origin for the entire system - objects and projectors. The origin should be a real-world reference point that can be marked and used for measurements when physically setting up the objects and projector(s) in the performance venue. 3D models created for use in any projection mapping system must also be created with this origin in mind; as without correct placement and/or rotation they will not be in the correct place in Mbox's 3D environment.

Note: Measurements use decimal notation with an accuracy of three decimal places. It is recommended to use measurement units that are appropriate to realistic and accurate numbers. Ideally, large projection mapping setups should not be scaled in small units of measure like millimeters or inches. Use of metric units is recommended as they work far better than standard units with decimal notation.

CAUTION! By default all layers are rendered in 3D using the Global Surface's default 3D camera. In order to use the configurable 3D camera on a specific output or mix, the layer must be assigned to the correct mix number using the Mix Select parameter. Additionally, the layer's mix mode should be set to a mode that centers the layer within the mix. (Refer to the Mbox User Manual, Chapter 4: Operation > 3D Perspective Camera for more information)

Camera Property Descriptions:

+ Bearing: camera's horizontal angular offset from the Z axis, measured in degrees.
+ Distance: camera's horizontal distance from the origin, measured in generic units.
+ Eye Position: camera location, measured in generic units.
  - X: camera's distance from the origin along the X axis.
  - Y: camera's distance from the origin along the Y axis.
  - Z: camera's distance from the origin along the Z axis.
+ Link Eye Position & Look At Point checkbox: links Eye Position and Look At X and Y parameters to allow easy lateral shifting of the image.
+ Look At Point: focus point (along a line through the center of the lens) for the camera, measured in generic units.
  - X: look at point's distance from the origin along the X axis.
  - Y: look at point's distance from the origin along the Y axis.
  - Z: look at point's distance from the origin along the Z axis.

+ Lens Adjust: adjustments to correct the effects of lens zoom or distortion in the output device (typically a projector).
  - Aspect: widens or narrows the image to correct for aspect ratio differences between the video signal and the projector's native resolution.
  - FOV: adjusts the Field of View to match the camera's vertical FOV to that of the projector, measured in degrees.
  - Roll: rotates the camera around the axis drawn through the lens to the Look At Point.
  - Shear X: applies a horizontal rotation to the camera while maintaining both Eye Position and Look At Point. Used to correct the effects of lens shift or keystoning.
  - Shear Y: applies a vertical rotation to the camera while maintaining both Eye Position and Look At Point. Used to correct the effects of lens shift or keystoning.
+ Image Offset
  - X: moves entire image horizontally without affecting perspective.
  - Y: moves entire image vertically without affecting perspective.

Tip Eye Position, Look At Point, and FOV, can be entered in advance from known measurements to set up projection mapping. To correct minor issues with perspective or line-up, other parameters like Aspect, Roll, or Shear may need to be adjusted manually once the projector is positioned.

FOV can be hard to calculate in advance as projector manufacturers don't always publish FOV numbers for their lenses. To determine FOV for an actual projector and lens combination:

Step 1. Position the projector such that the lens is perpendicular to a flat projection surface.

Step 2. Make sure the projector has no lens shift. Set all scaling/keystone/warp parameters to off.

Step 3. Bring up a test pattern on the projector that is the same size as the projector's native resolution.

Step 4. Measure the distance from the projector's focal point (this is sometimes marked on the body of the projector) to the projection surface.

Step 5. Measure the height of the projected image.

Step 6. The FOV will = (2 * arctan(0.5 * height/distance))

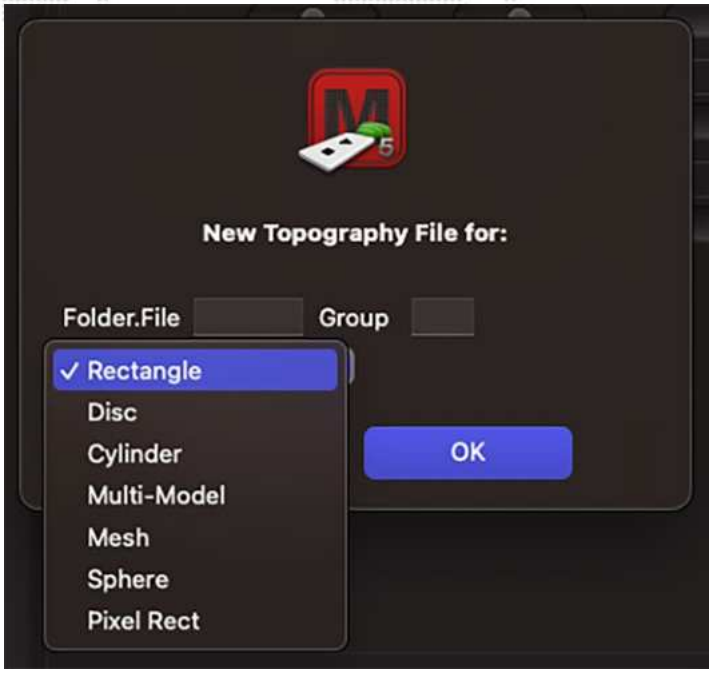
Note: The FOV value of Mbox's 3D camera matches the FOV (vertical) value used in Cinema4D and is 1/2 the FOV value in Blender. (e.g. a FOV value of 25° in Mbox is equal to an FOV of 50° in Blender)

Topography

Mbox's Topography files (topo objects) are 3D objects constructed programmatically within the Mbox and Mbox Remote interactions. Topo objects are intended primarily as projection surfaces to be used for projection mapping. Because they can be created in Remote, there is no need for an external modeling application. UV mapping (texturing) coordinates are also created and manipulated. There are several topo object types to choose from. Topo object can be resized, positioned, rotated, and curved as required to create the correct projection surface.

Topo objects (with the exception of the Pixel Rect) use units of measure equivalent to the units of measure used for the Camera positioning. Therefore, if you are using meters for measurement in the projector locations in your venue, any projection objects should be measured in meters as well and their respective topo objects created with dimensions in meters.

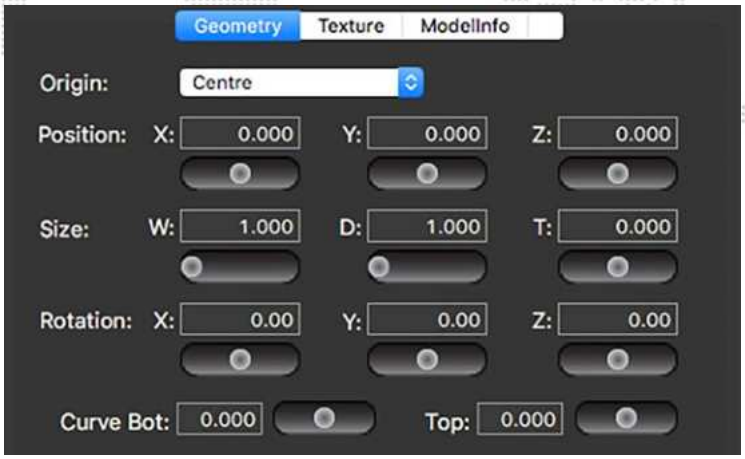
The initial step in using topo file is to create the base object. With the Topography > Geometry or Topography > Texture tabs selected, select New Topography… from the Options pop-up. In the window that appears, there are five settings to configure for the new topo file.



+ **Folder.File:** 8-bit index folder and file numbers for the topo object file that you are creating. This must be a unique index that does not currently exist. If the index already exists an error message will be displayed, and the topo item will not be created. The value must be formatted with the period between the two numbers but does not need leading zeros (e.g. 21.132). Note: With Mbox Studio or Mini license levels, the folder number MUST always be 0 as only one object folder (256 possible objects) is allowed.
+ **Group:** 8-bit number for the group this topo file should belong to. If this topo file is to be used on all servers, do not enter a group number. (Refer to the Mbox User Manual for more information about grouped content.)
+ **Type:** selection of one of seven different types of topo files.
  - Rectangle: rectangular shape with no thickness that can have a horizontal curvature
  - Disc: round shape with no thickness.
  - Cylinder: rectangular shape that can be bent into a cylindrical shape.
  - Multi-model: collection of object files (obj, topo, svg) that can be used together on one layer. (Mbox Designer license level only.)
  - Mesh: rectangular shape with no thickness and adjustable grid divisions for enhanced geometric correction.
  - Sphere: spherical shape with adjustable curvature.
  - Pixel Rect: rectangular shape with no thickness. The Pixel Rect's dimensions use actual pixels rather than the generic units that all other topos use.
+ **Mesh dimensions:** horizontal and vertical divisions for the mesh. The divisions entered must use even numbers for best results. If an odd number of divisions is entered, the number will be increased by one to make it even.

Topography > Geometry

The Geometry tab allows you to define the position, rotation, size, and curvature of the selected topo file.



+ Origin: anchor point for the topo object's position coordinates.
+ Position: object's home position in 3D space.
+ Size: object's size. W refers to width, D refers to depth, T refers to thickness. The different topo objects make different use of the three dimensions depending on their geometry. (Note: the T setting is not used for Rectangles, Discs, Meshes, and Pixel Rects.)
+ Rotation: object's rotation around global X/Y/Z axes.
+ Curve (Bottom/Top): specific to rectangles. Curve refers to the curvature of two distinct edges of a rectangle. Top and Bottom refer those edges of the rectangle when the X Rotation value is set to 0°.
+ Curve (Arc/Angle): specific to discs and cylinders. Arc refers to the coverage of the object in degrees (e.g., 180° is half a disc/cylinder, 360° is a fully closed disc/cylinder). Angle refers to the rotation of the disc/cylinder around its axis.

+ Hole: specific to discs. The Hole parameter is used to create a hole (like a donut hole) in the center of the disc. The value entered is expressed as a percentage - i.e., the hole's diameter as a percentage of the disc's diameter - with 0.5 being 50%, etc.

+ Lune (Arc/Angle): specific to spheres. Lune refers to the curvature arc and coverage along the horizontal axis. i.e. as around the equator.

+ Zone (Arc/Angle): specific to spheres. Zone refers to the curvature arc and coverage along the vertical axis. i.e. as around a line of longitude.

Topography > Texture

The Texture tab allows you to define how a texture will be applied to the topo object. When a topo is used on a layer, the layer's 2D texture will be applied to the topo. Topo objects are typically created for specific texture sizes. Content having a size that is different to the topo's intent can be applied to a topo, but some amount of scale, aspect, and position adjustment may be required to get a proper fit.

The Texture settings define the manner in which the layer's texture gets applied to the topo. A layer's texture is defined here as the 2D content (movie, image sequence, or still image) on the layer and will be the same size (in pixels) as that content.

Each topo has a Context, which is defined as its rendered area. A topo also has a Sample, which is defined as the rectangular portion of the layer's texture that will be applied to the topo's context. The sample has properties that affect its size, origin, rotation, and flip value.

Sample properties:

+ Origin (X and Y): positions the texture on the context such that the point with these coordinates is placed at the top-left corner of the context - which corresponds to the top-left of the topo.
  - The origin values can be set such that portions of the texture are not visible on the topo, because they extend beyond the edges of the context.
+ Width and Height: dictates how much of the texture, beginning from the origin and extending to the right and downwards, is applied to the context.
  - As noted above, if the origin is shifted and the width/height of the sample is not reduced, portions of the texture will not be visible on the topo.
  - Reducing the Sample width or height will result in the image on the topo becoming larger on the corresponding axis. Although less of the texture is being displayed, since the topo's context has not changed size, fewer pixels will be stretched across the same area.
+ Flipped: reverses the texture (left to right) on the topo as if it is being viewed in a mirror.
+ Rotation: sets an arbitrary rotation of the texture around the center of the topo.

When a topo is first created, its context has a size of 1x1. The topo's sample has a width and height of 1x1 also, and an origin of 0,0, no rotation, and no flip. These default values result in the entirety of the layer's texture being force-fit (stretched or squished) to fit onto the topo's context. If the intention is that the layer's content, no matter its size, should always fit onto the topo, then no changes need be made to the topo's texture settings. However to provide the ability to have pixel-accurate sampling of the layer's texture and placement onto the topo, the context size must be edited to be exactly the size of the layer's texture, followed by editing the sample's properties so as to display the correct portion of the texture on the topo.

To set up the texture properties of a topo:

Step 1. Create a new topo object. Edit its geometry properties as required. Make sure the aspect ratio of the topo matches the aspect of the content that will be shown on it.

Step 2. On the Texture tab, edit the Context size (width and height) to be equal to the overall width and height of the content that will be used with the topo. The Sample width and height will change to the same values. This happens automatically to maintain the existing aspect ratio of the content.

Step 3. Edit the Sample origin, width and height, rotation, and flip properties to display the correct portion of the content on the topo.

Note: Changing a topo's Context size width or height will result in the Sample origin, width, and height changing values automatically to maintain the existing aspect ratio and to continue to display exactly the same portion of the texture on the topo. In general, the Context size should not be changed, and any sizing should be handled by adjusting the Sample size.

As explained on the preceding page, topos can have a preset context size and sampling properties. Because the topo's texturing properties are set up to allow for pixel-accurate texture placement and scaling, it is important to explain what happens when a topo is used with a texture that is not the same size as the context size.

+ If the Context size and Sample width and height are equal to each other, the entire texture will be stretched or squished to fit the topo. Depending on the aspect ratio of the texture and the topo, this may result in a change in aspect ratio for the texture.
+ If the Context size and Sample width and height are not equal, then only a portion of the texture will be shown on the topo. The visible portion will be stretched or squished to fit the topo. At this point, the sampling of the texture is no longer pixel-accurate. The visible width/height of the texture can be determined by the following formulas:
  - Visible Width = Texture Width * (Sample Width/Context Width)
  - Visible Height = Texture Height * (Sample Height/Context Height)
+ Furthermore, when the Context size does not match the texture width and height, the Sample origin values also are no longer pixel-accurate. The actual X and Y origins can be determined using the following formulas:
  - Actual Origin X = Texture Width * (Origin X value/Context Width)
  - Actual Origin Y = Texture Height * (Origin Y value/Context Height)

Because the calculations involved in determining the texturing results when the Context size and the layer's texture are not the same, it is recommended that this situation be avoided whenever pixel-accurate texturing is required.

Vignettes on Topos

Similar to how they can be applied to outputs, Vignettes can be also applied to topos. While they could be used as edge-blends between two different topos, vignettes on topos are more typically used to soften the hard edge of the topo, either as an effect or to provide a cleaner edge when projecting.

Important! As with vignettes on outputs, vignettes on topos cause the edge of the object to become transparent, not to become black.

Vignettes can be manually added to topos by clicking on the Options pop-up and selecting Add Vignette. The setup of vignettes on topos is the same as for vignettes applied to outputs. Refer to "Setup of Vignettes" on page 30 for detailed instructions on the setup of vignettes.

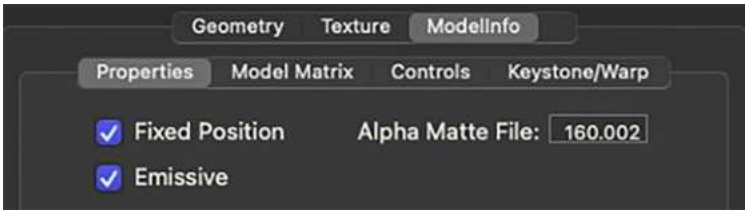
By default, the vignette is created with a size of 1x1. If the size is not altered, the Vignette amount properties will operate with a range of 0.0 to 1.0, with 0.0 being no vignette and 1.0 being a full vignette. If the Vignette size is edited to be the same size as the Context size (i.e. the size of the texture used on the topo) then the Vignette amount properties will have a range from 0.0 to a value equal to the width or height of the Vignette size. In this manner is possible to have pixel-accurate vignettes on the topo if desired.

Topography > ModelInfo

ModelInfo settings for a topo files are used to define properties for how the topo object reacts to layer positioning, rotation, and scaling, special case projection mapping, external Art-Net or sACN control (e.g. for remote control of position or rotation), and keystone/warp.

The Topography > ModelInfo tab shares its tabs with the main ModelInfo tab. The Topography > ModelInfo tab is used to set ModelInfo properties for topo objects, while the main ModelInfo tab is used to set ModelInfo properties for other object files - .svg or .obj files. The controls found on both tabs are identical, but some controls work with exclusively with obj files and not with topos, and vice versa. The differences will be noted in the following sections.

Topography > ModelInfo > Properties



The Properties tab has three settings:

+ Fixed Position: causes the object's position, rotation, and scale to be disconnected from the normal layer position, rotation, and scale parameters. The layer's normal position and scale parameters will now control the position and scale of the texture on the object instead. The layer's Z rotation parameter will now control the rotation of the texture on the object.
  - The position, rotation, and scale of a topo may still be adjusted using the Projection Editor.
  - The position, rotation, and scale of .svg or .obj objects must be adjusted in the file itself.

CAUTION! Projection mapping will not be accurate unless the objects used have their fixed position checkbox checked!

+ Emissive: causes the object to be fully lit as if from a fully ambient lighting fixture. This setting overrides the output of any of the standard Art-Net/sACN controlled lighting fixtures.
+ Alpha Matte File: 8-bit index number for Folder.File of a vignette, JPEG, or PNG file to be used as an alpha matte on the topo object. The matte will be force-fit onto the object based on the object's size not the matte file's size.
  - Simple, four-sided mattes can be created as vignettes on the Vignette tab. More-complex mattes can be applied using JPEG or PNG files. When using such files, the resulting alpha value from applying the matte is based on the varying brightness of the image - full black being totally transparent and full white being totally opaque, with values in between being partially transparent.

Note: When adjusting the ModelInfo properties for any objects other than topos, it may be necessary to perform a rescan [⌘R] after setting the property, as some changes will not take effect immediately.

Topography > ModelInfo > Model Matrix (Mbox Designer License Level Only)

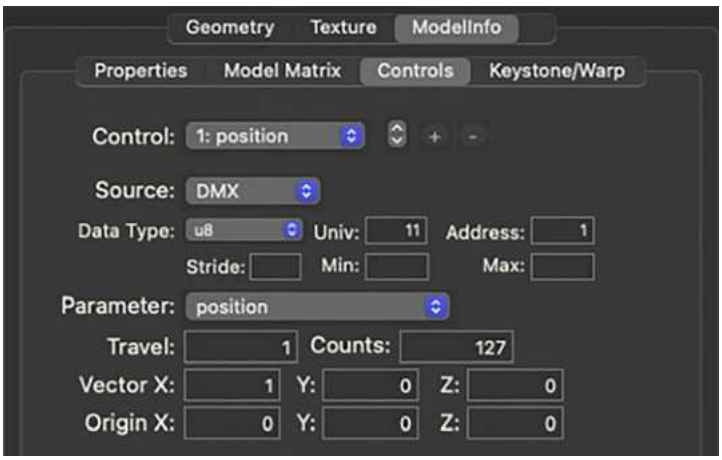
The Model Matrix functionality allows an object to have its own unique perspective camera that is separate from the Global Surface's default camera and any output or mix cameras. If an object has a Model Matrix, the Model Matrix will override any other camera's influence on the perspective view of the object.

Model Matrices can make it easier to give multiple objects differing perspectives while keeping them all within the same output or mix. This is especially useful in the case of Multi Models, where several objects are combined on the same layer and must therefore always be in the same output or mix. (Refer to "Topography > Multi Model" on page 44) Using separate matrices allows multi-angle projection onto a single object to be completed using fewer layers and a less-complex programming setup.

An object's Model Matrix properties are the same as those used for projection camera's and therefore the controls on the Model Matrix tab are the same as those on the Projection > Camera Setup tab. Refer to "Projection > Camera Setup" on page 34 for information on setting up these properties.

Topography > ModelInfo > Controls (Mbox Designer License Level Only)

ModelInfo controls can be added to an object to allow additional Art-Net patched into the Mbox server to modify four aspects of the object - position, rotation, texture position, and opacity. Controls should be added with care and may require consultation with a PRG Mbox specialist before use.



To add a control, click on the [+] button. To remove the currently selected control, click on the [-] button. If more than one control exists, use the up/down arrows or Control pop-up to toggle between the controls. Use the Source pop-up to select the type of control data being received - Constant, DMX (Art-Net or sACN), or SADI.

+ Constant: offset values set on the Controls tab will affect the parameter, but there is no external control.
+ DMX: additional Art-Net can be patched to the Mbox server to control the parameter.
+ SADI: reserved (i.e. DO NOT USE).

Constant controls can be used to make adjustments to an object or the texture on the object without affecting the Geometry or Texture settings of the original file. Using controls with external Art-Net/sACN control is where the power and flexibility lies. When you select DMX as the source for data, additional settings will be available for setup.

+ Data Type: refers to the format of the incoming Art-Net data.
  - u8: unsigned 8-bit integer, 0 - 255 with a default of 0.
  - o8: offset 8-bit integer, 0 - 255 with a default of 127.
  - s8: signed 8-bit integer, -128 - 127.
  - u16: unsigned 16-bit integer, 0 - 65535 with a default of 0.
  - o16: offset 16-bit integer, 0-65535 with a default of 32767.
  - s16: signed 16-bit integer, -32768 - 32767.
  - s32: signed 32-bit integer, -2,147,483,648 - 2,147,483,647.

+ Univ: Art-Net Universe (0 - 255).
+ Address: start address for this control, within the selected universe (1 - 512).
+ Stride: if this control is to be repeated for each patched layer of Mbox, the Stride parameter sets the offset per layer for the control. For Example: If your server has eight different 8-bit controls, each using one channel of data, then your Stride should use a value of 8. Without a Stride setting, the control will affect all layers at the same time.
+ Min: sets a minimum value for the control using the scale of the selected Data Type.
+ Max: sets a maximum value for the control using the scale of the selected Data Type.

The most common Data Types are the u8, o8, u16, and o16. These types are easily created by any external Art-Net or sACN source and the ranges work well for manual or automated control of any of the selectable parameters (see below). The signed integer types are typically reserved for data coming from a scenic system and require additional data conversion that is not available from normal Art-Net/sACN sources.

The Control Parameter refers to the property of the layer that the control will affect.

+ Position: position of the object in 3D (X/Y/Z) coordinates.
+ Rotation: rotation of the object in 3D (X/Y/Z) coordinates.
+ Texposition: position of the texture on the object in 2d (X/Y) coordinates.
+ Opacity: transparency of the object.
+ Intensity: brightness of the object.

Position, Rotation, and Texposition are well suited for unsigned or offset 8, 16, or even 32-bit controls. Opacity and Intensity are best suited for an unsigned 8-bit control.

The remaining settings on the Controls tab configure the direction and scaling factor between the control and the incoming data source.

+ Travel: range of adjustment that you want the object to attain. The Travel setting should be entered in the unit scale of the control type and the object type.
    - Position is entered in the same units of measurement used for the topo file's geometry settings. This is typically the real-world measurement as used for object and projector positioning. However in the case of Pixel Rects this would be pixels.
    - Rotation is entered in degrees.
    - Texposition is entered in pixels.
    - Opacity is a value between 0.0 (fully transparent) and 1.0 (fully opaque).
    - Intensity is a value between 0.0 (fully dimmed) and 1.0 (fully bright).
+ Counts: number of steps of incoming data that equal the Travel setting's value. For Example: Using an unsigned 8-bit (u8) parameter with a range of 0-255, if you want your topo object to move 2 meters across the range of 0-255, you would enter a Travel of 2.0, and Counts of 255.
+ Vector (X/Y/Z): direction of travel described as a directional vector -1.0 - 1.0. X is left/right, Y is up/down, Z is towards/away. Positive values cause movement to the positive side of each axis - right, up, towards. Negative values cause movement to the negative side - left, down, away. For the most flexibility, add a position control for each axis, setting each with a single vector. For "diagonal" vectors, a combination of vector values can be entered. For the opacity and intensity control types, one of the vector properties should be set to a value of 1.0.
+ Origin (X/Y/Z): the origin point of position adjustment. This is analogous to entering an offset for object positioning.

Important! Controls must have at least one vector property with a non-zero value for the control to work!

To reverse the direction of motion for any incoming value, flip the sign on the appropriate vector. For example, if the vector is 1.0 and the direction needs to be reversed, make the vector value -1.0 instead.

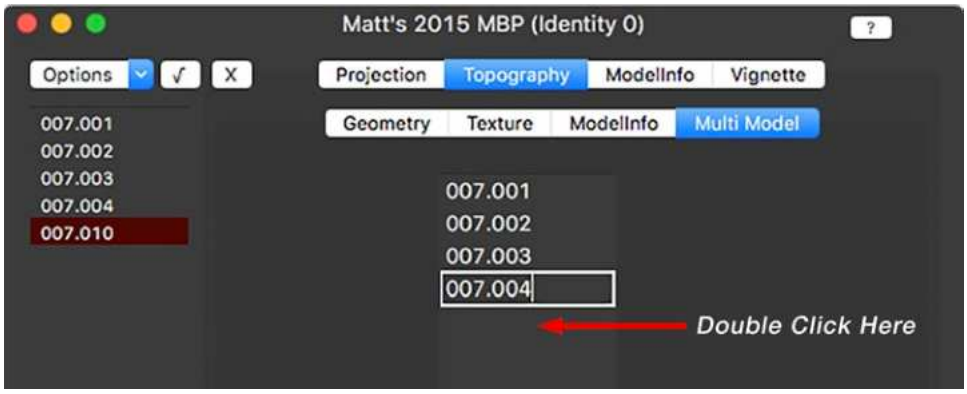
Topography > ModelInfo > Keystone/Warp

A keystone/warp can be added to topography files. Refer to "Setup of Keystone/Warp" on page 27 for information on how to create and configure a keystone or warp for a topo object.

Topography > Multi Model (Mbox Designer License Level Only)

As mentioned previously in the Topography > Geometry section, one of the topo objects that Remote can create is a Multi Model. A Multi Model is made up of references to more than one object file, which become grouped together so they can be recalled as one rather than separately. Multi Models are very powerful as they provide the means to use more than one object on a layer, sharing the same texture (or a portion thereof) but with each object having its own projection mapping properties.

The object files that make up a Multi Model are assigned on the Multi Model tab. The Multi Model must be created first and will have its own unique Folder.File index. To assign an object to a Multi Model, first select the Multi Model in the left-hand column, then double-click within the empty gray field immediately below any existing object index references to enter editing mode, then type in the object's index (using Folder.File syntax, leading zeros are not necessary) and press the [return] key to accept the edit.



Important! Because Multi Models use references to the original objects, changes to the properties of the original, referenced objects will affect the Multi Model.

ModelInfo

In addition to being able to affect the Modelinfo properties of Mbox-created topo objects, Remote also allows you to add modelinfo properties to other object files (i.e. obj and svg). This functionality provides the means to set fixed and emissive properties, override existing camera perspective, add controls, and apply a keystone/warp.

Note: When editing the ModelInfo properties of .obj and .svg objects, it may be necessary to perform a rescan [⌘R] in the Mbox application in order for the changes to take affect.

ModelInfo > Properties

Refer to "Topography > ModelInfo > Properties" on page 41 for information.

+ Alpha Matte files are not available with .obj or .svg files.

ModelInfo > Model Matrix

Refer to "Topography > ModelInfo > Model Matrix" on page 41 for information.

ModelInfo > Controls

Refer to "Topography > ModelInfo > Controls" on page 42 for information.

ModelInfo > Keystone/Warp

Refer to "Setup of Keystone/Warp" on page 27 for information.

+ Keystone and warp are not currently available with .obj or .svg files.

Vignettes

The Vignette tab provides the controls to create custom four-sided edge masking that can be used on any topo object. Refer to "Setup of Vignettes" on page 30 for more detailed information on the adjustment of vignette settings.

Vignettes created on the Vignette tab have a default size of 1x1. If the size is not altered, the Vignette amount properties will operate with a range of 0.0 to 1.0, with 0.0 being no vignette and 1.0 being a full vignette. The vignette size can use any arbitrary values, and can be set to match the pixel dimensions of the topo if desired. The blend amount values are automatically recalculated when the vignette size is changed. Therefore, there is little or no visual difference between a vignette size of 100 x 100 with an amount of 5.0 and a vignette size of 1 x 1 with a size of 0.05.

When vignettes are created on the Vignette tab, a file is created and saved in the Mbox/Media folder of the Mbox server. Vignette files follow the standard Folder.File index structure and use the .vign file extension.

3D Object Creation Guidelines

Recommendations for 3D object creation for use with the Mbox projection mapping features.

Use the .noscale compile switch

When using .obj files for projection mapping with Mbox, it is absolutely necessary that the .noscale filename "switch" be used with the object. The .noscale switch will force the object to appear at the designed scale rather than being rescaled (normalized) by Mbox when it is compiled into a vertex array file. To apply the .noscale switch, add ".noscale" to the object's file name, before the file extension. (Refer to the Mbox User Manual, Chapter 4: Operation > 3D Objects: Normalization)

For example: 001.MyObject.obj becomes 001.MyObject.noscale.obj

Use .obj & topo objects, but not kmz

Obj and topo files are recommended for use with projection mapping functionality. While Mbox can use kmz files for basic 3D objects, they are not recommended for use with projection mapping.

Avoid using .svg and .svge objects

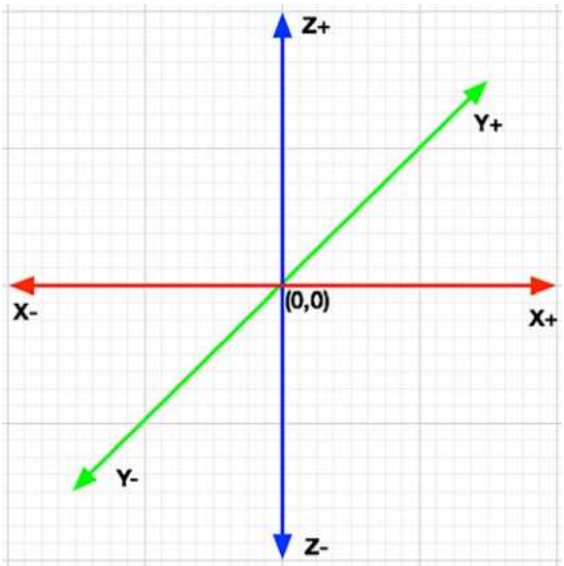
Mbox can use .svg files for projection mapping, but topo files are far more useful and flexible. [Note: to work with the thumbnail generator for Mbox, the svg file extension must be changed to “svge”.]

Axes - Mbox’s XYZ axes are different to most modeling applications” XYZ axes

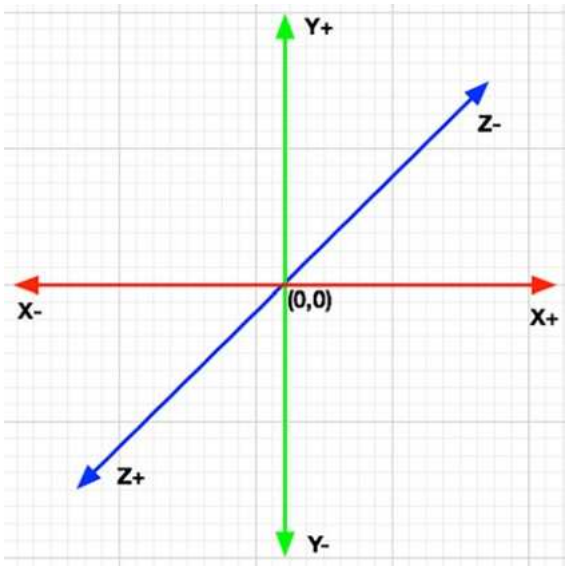
Mbox labels its 3D axes differently that most 3D modeling applications. Mbox uses a front view version of the axes and most modeling applications use a top view version.

In Mbox:

+ X axis is left<->right, left is negative and right is positive.
+ Y axis is down<->up, down is negative and up is positive.
+ Z axis is away from<->towards from the viewer, away from is negative and towards is positive.



3D Modeling Application (e.g. Blender)



Mbox

Most 3D modeling applications swap the Y and Z axes when compared to Mbox. The Y axis now being the towards <-> away and the Z axis being up <-> down. When exporting .obj files from your modeling application for use in Mbox, make sure to swap the appropriate axes to ensure the model appears with the correct orientation within the Mbox 3D environment.

Unit scale

While many 3D modeling applications allow you to create objects using real-world units such as feet or meters, the .obj file format does not support specific units of measure. Therefore, a cube having sides that are 1 meter square will typically export as an .obj with sides that are 1 unit square. The same cube could also be designed with sides being 3.3 feet square in the modeling application, which would then export as an obj with sides that are 3.3 units square.

While these two objects would appear to be the same size within the original 3D modeling application, they will not be the same size when used for projection mapping purposes in Mbox. Assuming the .noscale switch has been applied to both .obj files, one of them is going to appear to be 3.3x larger than the other.

The proper way to work with 3D objects is to always use the same intent for units in every application. And remember to use that same unit scale for all measurements in the real world too.

Texturing (UV mapping)

When obj files are used by Mbox, they must have some form of UV mapping created and applied by the originating 3D modeling application. The UV mapping must then be embedded in the .obj file when it is exported for use in Mbox. Mbox cannot create UV mapping from scratch on .obj files. Object files without embedded UV mapping will not be rendered correctly in Mbox.

Typically, UV mapping is very specific to the geometry of the object and the desired look of the object. While some simple objects can have default cylindrical or spherical mapping, most objects used for projection mapping require complex mapping. The UV mapping created by the modeling application will generate texture coordinates that are usable by <u>any</u> texture (movie or still image) file applied to the object within Mbox. However, UV mapping is often designed for specific texture sizes and using textures with different sizes my result in incorrect mapping.

PIXEL MAPPING

Overview

What is Pixel Mapping

Pixel Mapping is a feature that allows the mapping of specific functions of sACN, Color Kinetics KiNET, or Art-Net controlled fixtures (RGB, Intensity, CMY, etc.) to each of the pixels in Mbox's composite video image. Pixel mapping data is generated from the onscreen imagery of the server and may be output from one or more ethernet interfaces of the Mbox computer. While pixel mapping, Mbox retains its normal video output(s) allowing a video signal to be sent to a display device.

With a Designer license, Mbox v5 can output data for an unlimited number of pixel mapping output pixels, with a Studio+ license it can output data for up to 16,000 output pixels, with a Studio license 8000, and with a Mini license 3600.

Pixel mapping data is typically used to apply color to LED or moving light fixtures by taking color info from a video source rather than programming the fixtures as discrete light sources using a lighting console.

What Can Be Mapped

Any pixel data from the Mbox final composite rendering surface (pre-dimming and pre-keystone/warp) can be mapped. Pixel mapping can sample directly from the entire Global Surface, or be limited to one or more outputs, mixes, or layers. Pixel color data from these sources can be sampled (individually or in averaged, rectangular groups) to determine an RGB value for the sample. The RGB value can then be used as-is (RGB) or converted to a different color format (CMY, Intensity, etc.) and output as one of four different entertainment protocols.

Depending on how the Mbox software is configured, the following items can be used as sources for pixel mapping:

+ Global Surface: the entire rendering area of the Mbox software can be mapped.
+ Outputs: one or more of the server's outputs can be mapped.
+ Mixes: one or more of the server's mixes can be mapped.
+ Layers: one or more of the server's layers can be mapped.

A simplified outline of how pixel mapping data is sampled, generated, and output would look like:

Rendering Surface > Source > Context > Sampling Rectangle > Color Information > Patch > Output

How Does Mbox Convert Onscreen Color to Pixel Map Data

Pixel mapping data is generated from the color of pixels rendered on Mbox's Global Surface, outputs, or layers. Which pixels are used depends on the pixel mapping configuration - the pixel mapping source, the context size/location, and where patched pixels are placed on the context. Each patched output pixel designates an area of the source to be sampled and if necessary, averaged, in order to generate RGB color data for that area.

After the RGB color data for each output pixel has been generated, that RGB data is converted (if necessary) to the data type specified for the pixel. Mbox supports many different pixel types including - RGB, CMY, RGBW, and RGBAmber - with most types having both 8-bit and 16-bit variants.

Note: Whereas Mbox v4 derived 16-bit output values from 8-bit values, Mbox v5 generates true 16-bit output values for 16-bit pixel types.

Depending on the pixel type, the actual output data is converted in different ways:

+ **RGB** - The sampled RGB value is converted directly to three values - R,G,B - which are then output. Pixel types with RGB in alternate orders are generated in the same way, with the R, G, and B components rearranged.
+ **RGB+1/RGB+2** - The sampled RGB value is converted directly to three values - R,G,B. Either one or two additional values, fixed at 0, are added to the end of the RGB values.
+ **Luma601/Luma709** - The sampled RGB value is converted to one value - Luma - by performing a Rec601 or Rec709 Luma calculation. In this calculation, each of the values R, G, and B are multiplied by a coefficient and the three resulting values are added together and then output as a single value.
+ **CMY** - The sampled RGB value is converted directly to three values - R,G,B - which are then inverted and output.
+ **CYM** - As with the CMY pixel type, but with the Yellow and Magenta values swapped.
+ **RGBW** - The sampled RGB value is converted directly to three values - R,G,B - which are output as-is and also used to generate the White output value. The RGB values are compared, and the lowest value is multiplied by the luma value for the pixel (see Luma above) with the result being output as the white value. This conversion method results in a white component that is full when the RGB value is equal to white, but which gets dimmer and dimmer proportional to the overall brightness of the pixel. This pixel type can be useful in achieving greater brightness when white while, not washing out more saturated colors, but the trade-off can be white output with a color shift.
+ **RGBW_2** - The sampled RGB value is evaluated to determine the predominant hue and luma value. The luma value is output as the white value and is also subtracted from the R, G, and B output values. This conversion method results in an output that only includes white when the RGB value is white, and reduces the white output when mixing down to saturated colors. This pixel type can be useful in achieving better color accuracy than the RGBW pixel type, but the trade-off is less overall brightness. The RGBW_2 White Tuning preference allows the actual shade of white to be tinted with some amount of red, green, or blue. Refer to "RGBW_2 Pixels" on page 102 for more information on the RGBW_@ White Tuning preference.
+ **RGBAmber/Lime** - The sampled RGB value is evaluated to determine how "amber" or "lime" it is, and in similar fashion to the RGBW_2 pixel type, the amber/lime output is adjusted while also being proportionally mixed with the R, G, and B output values. The RGBAmber/Lime White Point preferences allow the actual value used as amber/lime to be adjusted based on a test fixture. Refer to "RGBAmber and RGBLime Pixels" on page 103 for more information on the RGBAmber/Lime White Point preferences.
+ **HSV/HSI** - The sampled RGB value is converted directly to three values - Hue,Saturation,Value/Intensity - which are then output. This pixel type can be useful for HSV/HSI-only fixtures or fixtures that provide better internal color mixing with HSV/HSI input as compared to the their color mixing when receiving RGB or RGBW input.
+ **CIE 1931 xy** - The sampled RGB value is converted to CIE XYZ values, and then to the xy coordinate value that matches the color on the CIE 1931 chromaticity diagram. The x and y values are then converted to 8/16-bit values for output using a range of 0.0 - 0.8. This pixel type only outputs the chromaticity values for the pixel, not the luma value. A Luma709 pixel can be used to generate the luma component as required.
+ **Maximum** - The sampled RGB values are compared, and only the highest value is output as a single value.
+ **Parked** - Parked pixels do not use any sampled RGB values. Their data is fixed and is set by editing the profile or fixture data.

Note: All individual/single pixel types (e.g. Red, Value, Cyan, etc.) are generated from the RGB data by first converting the RGB data to the correct color model if applicable, then selecting only the relevant value for output.

How Does Mbox Output Pixel Map Data

Data is output from the Mbox server as an ethernet signal using one of four different entertainment protocols: Art-Net, sACN, KiNET PORTout, or KiNET DMXout. The Mbox computer's ethernet interfaces must be configured correctly to talk to the attached equipment.

When pixel mapping, it is typically advisable to use one or more additional ethernet interfaces on the computer to output the pixel mapping data. If the control input and the pixel mapping output share a single ethernet interface, the volume of network traffic generated by complex pixel mapping configurations may affect the reception of incoming control data. This problem is far more prevalent when using Art-Net (versus sACN or KiNET) since it is typically broadcast.

Ethernet Interface Guidelines

If you need to use two different interfaces for Art-Net input and pixel mapping output, you will need to set up the ethernet interfaces of your computer properly.

+ When receiving one protocol for control input and using a different protocol for pixel mapping output, two separate ethernet interfaces may be required, as the different protocols typically use different subnets.
+ When using more than one protocol for pixel mapping output, different ethernet interfaces may be required for each protocol, as the different protocols typically use different subnets.

Knowledge of IP addressing and subnetting practices is required to set up a proper pixel mapping configuration. (Refer to "Appendix A. Mbox Networking Guidelines" on page 125 for more detailed information) The computer's network settings can be changed from the Mac's System Preferences > Network preferences pane. The following guidelines assume that the computer's first ethernet interface is set to receive Art-Net to control Mbox and a second ethernet interface is being used to output pixel mapping data.

+ Art-Net is typically sent to the broadcast destination IP address for the local network being used. For Art-Net this destination address is usually 2.255.255.255. Art-Net can also be unicast (sent to specific IP addresses).
+ sACN is a multicast protocol that can be sent to any/all devices on the same subnet provided they are members of the appropriate multicast group.
+ KiNET (PORTout & DMXout) devices have user-configurable IP addresses. One of the computer's ethernet interfaces will need to be configured to use the same subnet as the KiNET devices that is being controlled. Destination IP addresses for KiNET are always unicast.
+ If the computer uses an overlapping or ambiguous IP/subnet scheme for two more ethernet interfaces (e.g. the interfaces are on the same subnet), then the pixel mapping output may not be routed from the correct ethernet interface on the computer. This can result in the pixel mapped fixtures not receiving the data. Ensure that the computer's ethernet interfaces have settings that allow Mbox to send the data from the correct interface.
    - If two interfaces are on the same subnet, then Mbox can't guarantee the pixel mapping data will leave the computer from one interface vs. the other.
    - For example: The interface with the IP address of 2.0.0.1 and a subnet mask of 255.0.0.0 is on the same subnet as the interface with an IP address of 2.23.45.134 and a subnet mask of 255.0.0.0. If the pixel mapping destination is set to 2.255.255.255 then the data may leave the computer on either one of these interfaces.
+ You must coordinate the IP/subnet of the pixel mapping output interface to be compatible with the destination IP address(es) entered on the Destination tab of the pixel mapping editor in Mbox Remote (Refer to "Appendix A. Mbox Networking Guidelines" on page 125.). If a destination uses an IP address that the computer's ethernet interfaces cannot communicate with, then that destination's data will not be output.
    - For example: If the destination is 10.45.255.255 and the computer has no ethernet interfaces with an IP address that is 10.45.x.x with a subnet mask of 255.255.0.0 then the pixel mapping data will not be output.
+ Mbox pixel mapping output is structured using Universes for Art-Net and sACN. For KiNET output, Mbox uses Devices (DMXout) or Devices and Ports (PORTout)
+ For Art-Net, the universes are numbered 0-255, with each universe having a total of 512 addresses.
+ For sACN, the universes are numbered 1 - 63,999, with each universe having a total of 512 addresses.

+ For KiNET DMXout, the device may have a number 1 - 65,535, with each device having a total of 512 addresses. [DMXout power supplies can have either one or two ports, but the ports are not addressable as with PORTout.]
+ For KiNET PORTout, the device may have a number 1 - 65,535, with each device having up to 16 physical ports, and each port having a total of 512 addresses. PORTout destinations use the following notation in the fixture patch editor: “device #.port #”

Protocols

As part of the pixel mapping process, RGB data is sampled, averaged, converted, and then output. The data leaves the Mbox server computer as an ethernet signal using one of four protocols: Art-Net, sACN, KiNET PORTout, or KiNET DMXout. The operational principles of each protocol within Mbox is discussed in the sections below. (Refer to “Appendix A. Mbox Networking Guidelines” on page 125 for more detailed information about these protocols.)

Note: Because some equipment cannot receive typical ethernet control protocols, other conversion devices may be required to convert the data into other protocols (for example, DMX).

Art-Net - Art-Net can be broadcast or unicast, but is typically broadcast. By default, Mbox will use ArtPOLL to set up automatic unicasting to compliant devices. The ArtPOLL functionality can be disabled if necessary (e.g., when using both ArtPOLL compliant and non-compliant devices that need to receive the same universe). Art-Net has no priority structure and up to 256 universes available.

sACN - sACN is multicast by default in order to reduce bandwidth (though it can be broadcast or unicast). Up to 63,999 universes are available, with each universe having a priority value to allow devices to receive multiple universes of the same number and use the one deemed most important.

Guidelines:

+ Mbox supports a single, global priority setting for all pixel mapping output via sACN. The value can be changed in the Source settings for each pixel mapping configuration.
+ The priority value can be between 0 and 200, with 100 being the default.

KiNET - KiNET is unicast and specific to Color Kinetics power supplies only. Due to the unicast nature of this protocol, universes aren’t used. In this case, data is sent to a specific device or a specific port on a specific device.

Ethernet interfaces on both the Mbox server computer and the receiving device must be set up correctly for the desired protocol to 1) leave the Mbox, and 2) pass through the physical network (cables and switches), and 3) be received by the device on the other end.

Guidelines:

+ Both transmitter and receiver must be on the same subnet. (Refer to “Appendix A. Mbox Networking Guidelines” on page 125 for more information regarding the setup of an IP address and subnet)
+ Switchgear in between may require some or all of the following features to pass the data:
  - Allow broadcasts (broadcast storm control off).
  - Allow multicast (multicast aware).
  - Ability to en/disable IGMP snooping.
  - VLANs, if desirable, to segregate different data types.

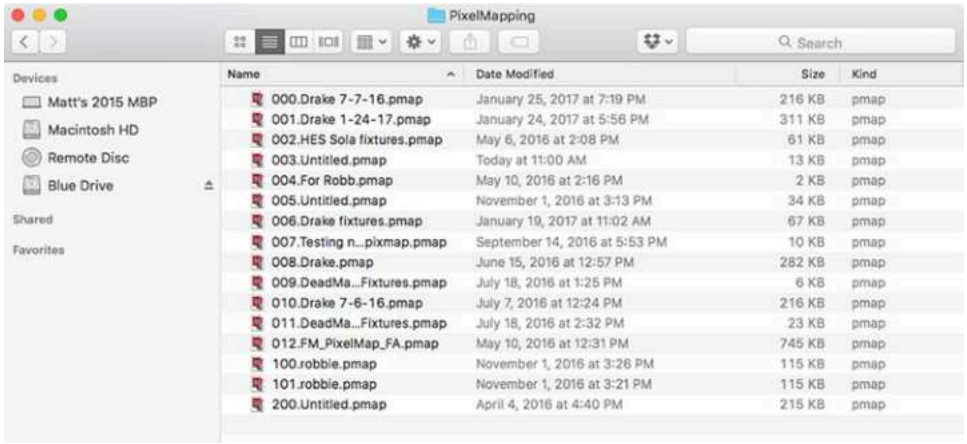
Fixture Profile Model

The fixture reference model used with Mbox pixel mapping allows for rapid global changes to all patched fixtures of one type. This concept is similar to the reference models used by lighting consoles for fixture profiles and presets. Mbox provides built-in fixture profiles, as well as the ability to create custom fixture profiles.

File Structure

Applications in the Mbox family use Property List files for saving data, but instead of the .plist file extension, Mbox uses the .pmap file extension for pixel mapping configuration files. The .pmap files can be uncompressed or compressed. While the uncompressed files can be read by Xcode (and others such as PrefSetter, Plist Pro, etc.), the compressed files can only be read by Mbox and Mbox Remote.

Pixel mapping files must be placed in the Mbox/PixelMapping folder for Mbox to use them, or for live editing from Mbox Remote. For offline editing with Mbox Remote, the files can be stored anywhere.



Like all 2D and 3D content for Mbox, pixel mapping files must be given an 8-bit numerical index as prefix to the file name. The index ensures that the files can be synced using the Content Management features, and also that they can be switched on the fly without reconfiguring the server or leaving Fullscreen mode (the switch can be made using Mbox Remote, Director, or a lighting console).

Pixel mapping files can also be imported or exported in a comma separated values format (csv).

Compatibility Between Mbox License Levels

No matter the licensed level of the Mbox software the same configuration files may be used for pixel mapping. While each license level has a different maximum number of pixels (a Designer license has no limit, Studio+ is limited to 20000 pixels, Studio to 10000, and Mini to 5000), there are no other restrictions or differences between the pixel mapping functionality between the various Mbox license levels.

Pixel mapping (.pmap) files created by Mbox v5 are not compatible with versions of Mbox software prior to Mbox v4. And some Mbox v5 pixel mapping files are not 100% compatible with Mbox v5 - if the v5 file uses pixel types that are new in Mbox v5 and not found in Mbox v4.

Mbox v5 can attempt to import .plist files created by Mbox v3. If possible, old profiles and fixtures from Mbox versions prior to v3.9 will be upgraded to the new format, but all fixtures may not import correctly. The imported fixtures will appear as if every parameter is overridden, since the old .plist files had no concept of profile reference (which will be explained later in this manual). Fixtures and contexts imported from pixel mapping files created by previous versions of Mbox will all use the Global Surface as their sampling source.

Syncing Between Servers

Pixel mapping files can be synced between servers using the Content Management file synchronization features. For the file syncing to work, ensure that the pixel mapping files are placed in the Mbox/PixelMapping folder and are indexed.

Refer to "Content Management" on page 11 for more information about this feature.

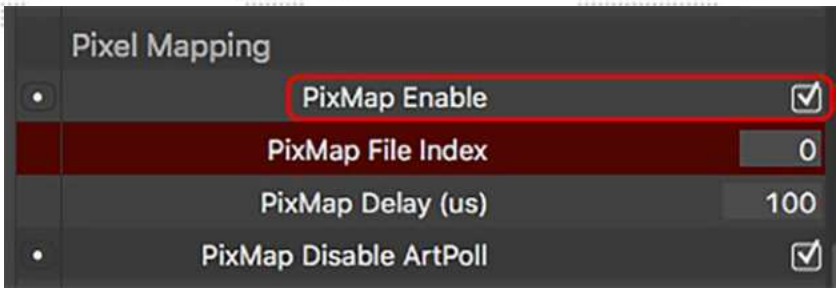
Important Pixel Mapping Preferences in Mbox

The following preferences for Mbox are related specifically to pixel mapping. They can be adjusted on the Preferences tab of either the Mbox application or the Mbox Remote application.

+ **PixMap Enable:** enables the processing required for pixel mapping and also the actual output of pixel mapping data as Art-Net, sACN, or KiNET.
+ **PixMap File Index:** selects (by 8-bit by index) which pixel mapping configuration file is used by Mbox.
+ **PixMap Constant Update:** enables constant maximum rate output rather than the default rate. The default rate is variable based on the amount of onscreen changes in areas that are being sampled for pixel mapping output. The variable rate may be reduced if the current content is a still image or does not have constant motion.
+ **PixMap Delay:** sets added interpacket gap time between universe data packets from Mbox's pixel mapping output. While extra time between packets can give time for slower receivers to process the data, this value must be reduced from its default (100µs) for best output rate when attempting to output a large number of universes.
+ **PixMap Disable ArtPoll:** disables the default ArtPoll functionality which enables Mbox to unicast universe data to devices that reply to the ArtPoll. This default behavior can reduce network congestion, but with a mix of ArtPoll compliant and non-compliant devices, it may be necessary to allow broadcast even in the presence of ArtPoll devices.
+ **RGBAmber White Point:** sets the custom white point used for the RGBAmber pixel type. This pixel type uses a calculation of the amber component of onscreen color to derive RGB and Amber output values. The white point represents the individual RGB component amounts added to full Amber to mix to visible white on the RGBAmber fixtures being used. This value is entered as R,G,B with values from 0-255 and the value for Amber is automatically set to 255.
+ **RGBLime White Point:** as above, but for RGBLime pixel type, substituting Lime for Amber.
+ **RGBW_2 White Tuning:** as above but for RGBW_2 pixel type. The white tuning represents the individual RGB component amounts added to full white to mix to visible white on the RGBW_2 fixtures being used.

Enabling Mbox Pixel Mapping

To enable the processing of pixel mapping configurations and the output of pixel mapping data, the PixMap Enable checkbox must be checked in the Preferences tab of the main Mbox window.



Note: When this checkbox is not enabled, it is still possible to create and edit pixel mapping configurations in both offline and live modes.

When Pixel Mapping is enabled on the Preferences tab, the Global Master Control parameter can be used to stop or start overall pixel mapping output, and to enable or disable the pixel mapping mask feature.

To enable/disable these features, set the Global Master Control channel to the value noted below, then send it directly to a value of 0, not hitting any values in between.

Global Master Control parameter settings are as follows:

+ 244 = start pixel mapping output
+ 245 = stop pixel mapping output
+ 246 = disable masked fixtures
+ 247 = enable masked fixtures

Stopping output using the Global Master Control parameter is not the same as unchecking the PixMap Enable checkbox, and is only intended to be a temporary state where the output can be turned off and back on again from the control console or Mbox Director. In this case, “stopping” the output means that no data will be output at all. If the Mbox application is quit while pixel mapping has been stopped using this method, pixel mapping will restart when the Mbox application is restarted.

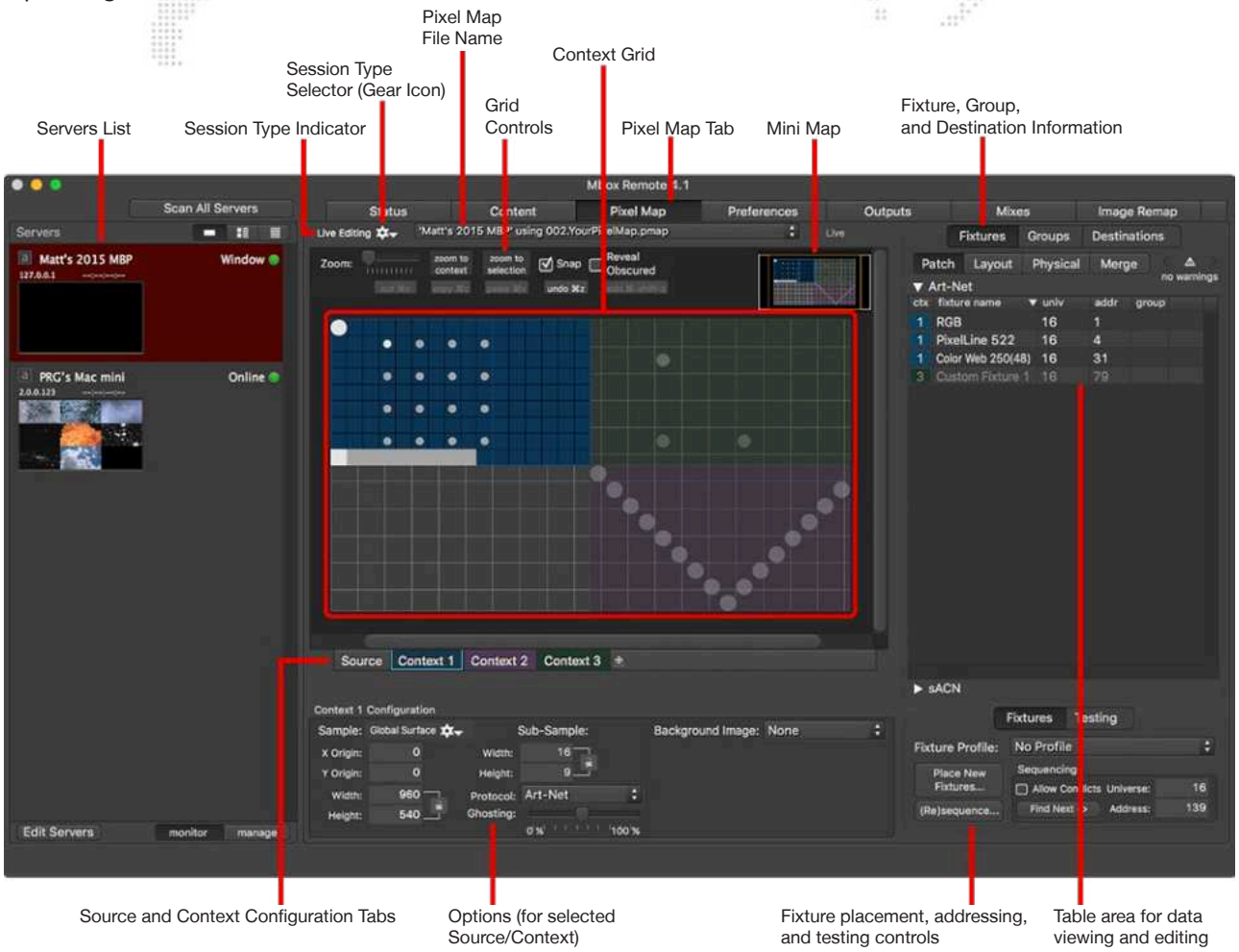
The pixel mapping mask feature can be used to turn off a single subset of pixel mapping fixtures - those with the mask function enabled. “Turn off” in this case means that the fixtures will continue to output data, but that their output data will be forced to a level of 0.

Note: For more information about the Global Master Control parameter, refer to the Mbox software user manual.

Getting Started

Pixel Map Tab

Pixel maps are created using the controls available on Remote's Pixel Map tab. The example below illustrates a basic pixel map configuration:

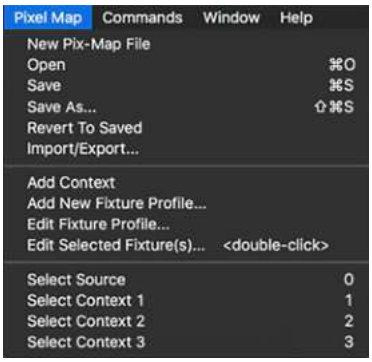


The grid area is the pixel mapping context. This is where fixtures can be arranged in order to assign their pixels to various areas of the screen image. The grid lines are colored white every tenth division. The fixture table to the right of the grid shows fixture patch and destination information. Fixtures can be selected on either the grid or in the table (they will become highlighted in both places). Other controls allow auto-addressing and testing fixtures.

Pixel Map Menu

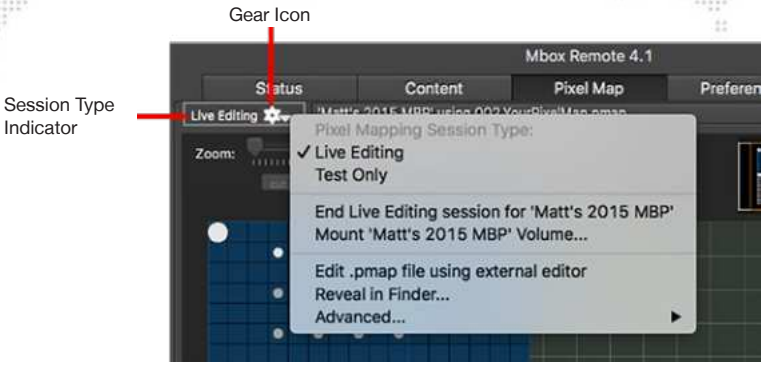
The Mbox Remote application's Pixel Map menu can be used in combination with the Pixel Map interface window. Many of the options provide an alternate method for the same functionality available in the window (via keyboard shortcuts, buttons, or pop-up menus). Some, such as New Pix-Map File, Open, Save, and Save As are intended only for use with offline editing of files. Refer to "Offline Editing" on page 57.

The Import/Export option is covered in detail later in this document. Refer to "Import/Export" on page 121.

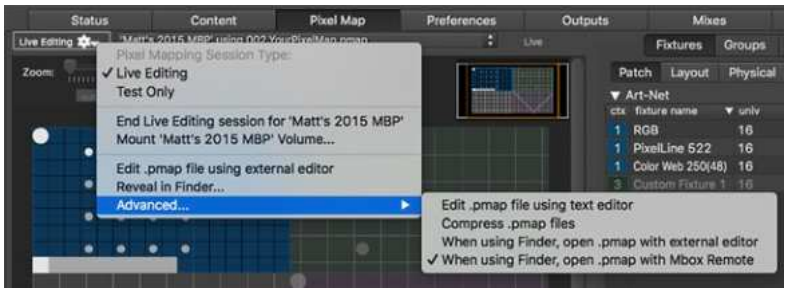


Session Types

There are three different session types: Offline, Live Editing, and Test Only. The session type defaults to Offline. The session type can be changed by clicking on the gear icon next to the Session Type Indicator. The indicator text will display the current session type (Offline, Live Editing, or Test Only), as applicable.



+ **Offline** - allows pixel mapping configuration files to be created and edited without running Mbox software or being connected to an Mbox server. Refer to "Offline Editing" on page 57 for more information.
+ **Live Editing** - allows pixel mapping configuration files to be created and edited while the Mbox Remote application is connected to an Mbox server. Refer to "Live Editing" on page 58 for more information.
+ **Test Only** - allows pixel mapping fixtures to be tested while locking out changes to the configuration. Refer to "Testing" on page 119 for more information.
+ **Begin Live/Test session for Mbox** - click to begin the session. (This will either be "Live Editing" or "Test Only" depending on which type of session is currently selected.)
+ **Mount Mbox Volume** - remote volumes (hard drives on remote Mbox servers) can be mounted on the computer running Mbox Remote so that files on that computer may be edited and saved in an offline session.
+ **Edit .pmap file using external editor** - allows the current pixel mapping file to be edited in an external application.
+ **Reveal in Finder** - shows the current pixel mapping (.pmap) file in the Mac Finder.
+ **Advanced** - advanced options for selecting editing applications:



- **Edit .pmap file using text editor** - opens the current pixel mapping file using the default text editor application on the computer (e.g. TextEdit).
- **Compress .pmap files** - allows the use of compressed .pmap files instead of standard XML. Enabling compression helps reduce the transfer time of very large pixel mapping configuration files from Remote to Mbox during a live editing session. Compressed files can only be opened by Mbox or Remote, and not by a text editing application or a plist editing application.
- **When using Finder, open .pmap with external editor/Mbox Remote** - selects which application opens the .pmap file when it's double-clicked in the Mac Finder. Selecting both is allowed.

Offline Editing

Offline editing allows pixel mapping configuration files to be created and edited without running Mbox software. In this case, a new or existing pixel mapping configuration file (.pmap) can be opened on the computer that is running Mbox Remote. This mode is useful for creating a configuration in advance without the need for an Mbox server (or license).

Guidelines:

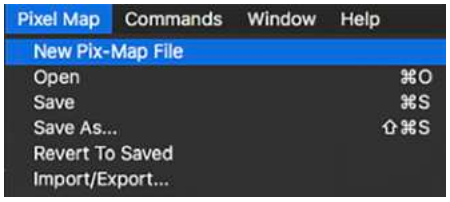
+ The .pmap file to be opened can be local or on any network-connected drive.
+ Changes to the file may be saved locally or to any network-connected drive. Saving must be done manually using the Pixel Map menu, since it is not automatic.
+ When making changes with offline editing, the changes will not be immediately apparent on an Mbox server, even if it is networked to the Mbox Remote computer and the configuration file is stored on the Mbox in the proper location.
+ Content can be manually rescanned on an Mbox server by pressing [⌘R]. This will reload the current pixel mapping configuration from disk. If changes have been made using the offline editing and these changes have been saved, then these changes will be applied.

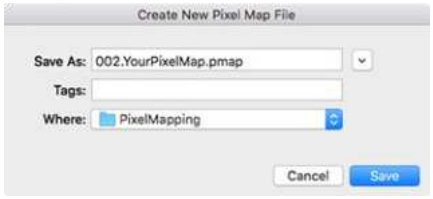
To create a new pixel mapping file on a local computer or network drive:

Step 1. On the Pixel Map menu, select New Pix-Map File.

Step 2. In the Save As dialog, enter a file name and choose a location to save.

Step 3. Click Save.





To open a pixel mapping file:

Step 1. On the Pixel Map menu, select Open.

Step 2. Using the Open dialog, locate and open the desired file.

The Save and Save As options can also be used with the local or network file.

CAUTION! Before using the pixel mapping configuration file with an Mbox server, or attempting to edit it in a live session, the file must be copied to the correct folder on the Mbox server. Refer to "Copy To Mbox" on page 61.

Live Editing

The Live Editing session allows pixel mapping configuration files to be created and edited while the Mbox Remote application is connected to an Mbox server. In this case, changes made to the file have an immediate effect on the output of the Mbox's pixel mapping engine. This mode is useful so that the configuration can be tested and adjusted without having to go back and forth between offline editing and live playback to view the results.

To operate in Live Editing mode, a server must be selected from the server list at the left side of the window and the Mbox application itself must be running along with Mbox Daemon. The selected server is indicted with a red highlight.

IMPORTANT! For live editing to work on a remote server, File Sharing must be enabled on the remote server. Remote attempts to connect using an SMB connection. SMB sharing is the only option for file sharing with macOS 11 and above, therefor SMB is no longer available.

Guidelines:

+ For remote Mbox systems that have the actual Mbox content folder located on a secondary drive and use a link or alias on the boot drive, both the boot drive and the secondary drive must be mounted to edit in a live session.
+ Editing in a Live Editing session from more than one computer at the same time is not recommended. Likewise, editing the a file in offline mode while the same file is being edited in a live session is not recommended and will lead to the loss of some data.
+ During a Live Editing session, the current, active .pmap file is loaded into the editor.
+ Changes may be made to the file, or fixtures may be tested, with the changes having immediate effect on the output of the Mbox pixel mapping engine.
+ The edited file does not need to be saved on the connected computer, but may be saved locally for backup.

CAUTION! No manual rescan on the Mbox server is needed, but live edits will cause a slight pause in playback. Therefore, it is not recommended to make live updates during a show.

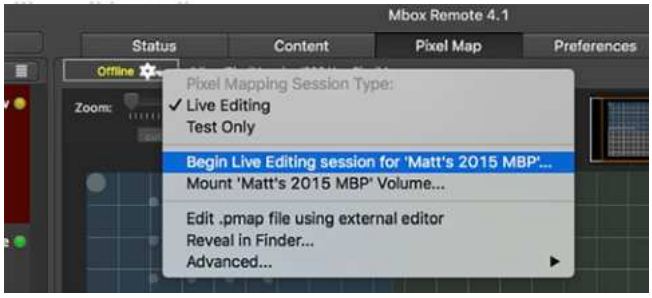
Whenever a Live Editing session is started with an Mbox server that is not local, Mbox Remote must connect to the remote computer. Make sure that both computers are on the same physical network and same subnet, and that File Sharing is turned on. Remote attempts to connect using an SMB connection. During the connection process, OS alerts may appear if there is an issue.

If a connection is possible, the username and password for the Mbox computer must be entered. Finally, if the username and password are accepted, the correct drive(s) need to be mounted: **Always make sure to mount both the boot drive and the drive that the actual Mbox content folder is on if they are not the same drive!**

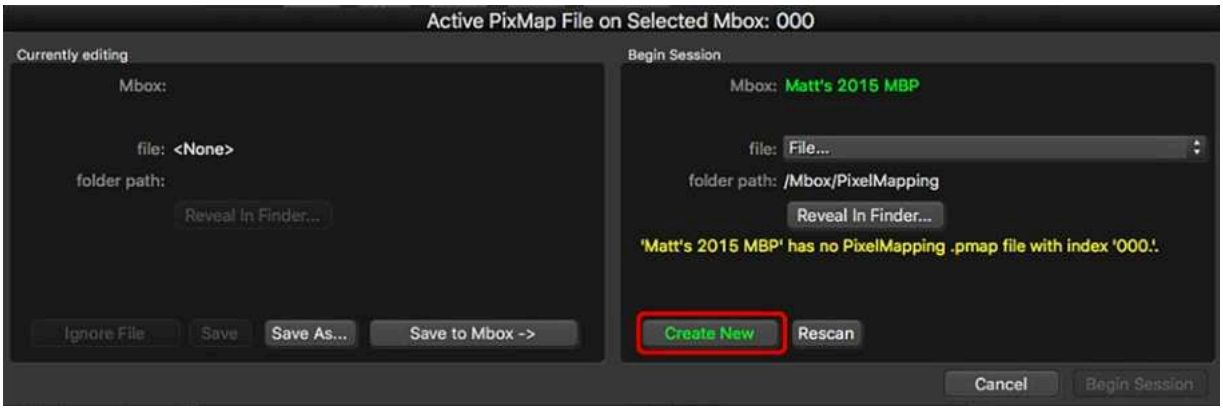
To begin a Live Editing Session and create a new file:

Step 1. In the Servers list, select the required server.

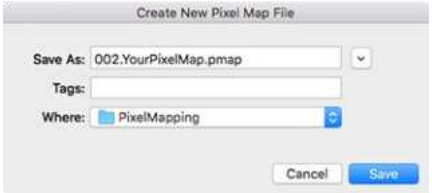
Step 2. Click on the gear icon and select Begin Live Editing session for...



Step 3. On the Begin Session window, click the Create New button.

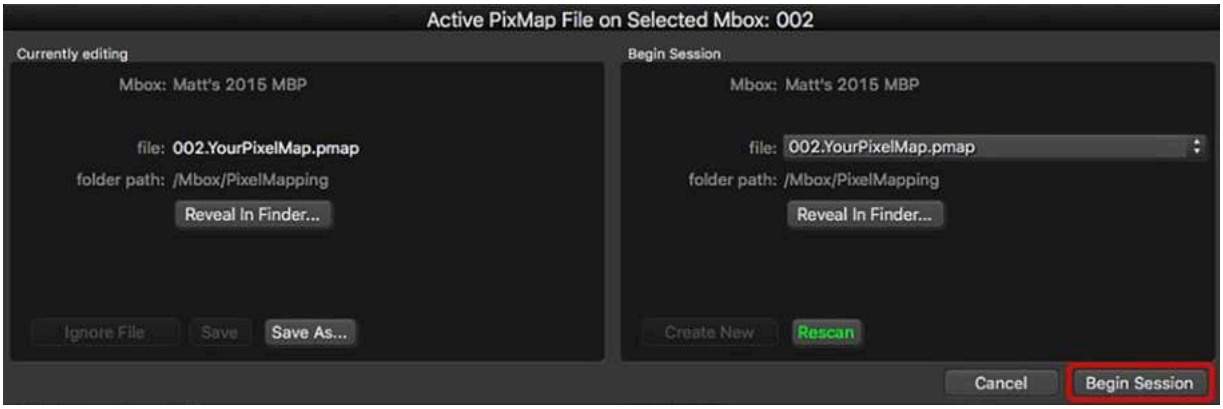


Step 4. In the Save dialog, enter a file name and choose a location to save to.



Step 5. Click Save.

Step 6. On the Begin Session window, click Begin Session. (Once the file is created, the button will no longer be grayed out)

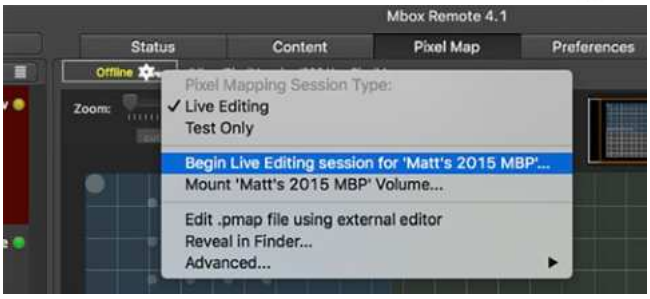


To begin a live editing session and choose a different file:

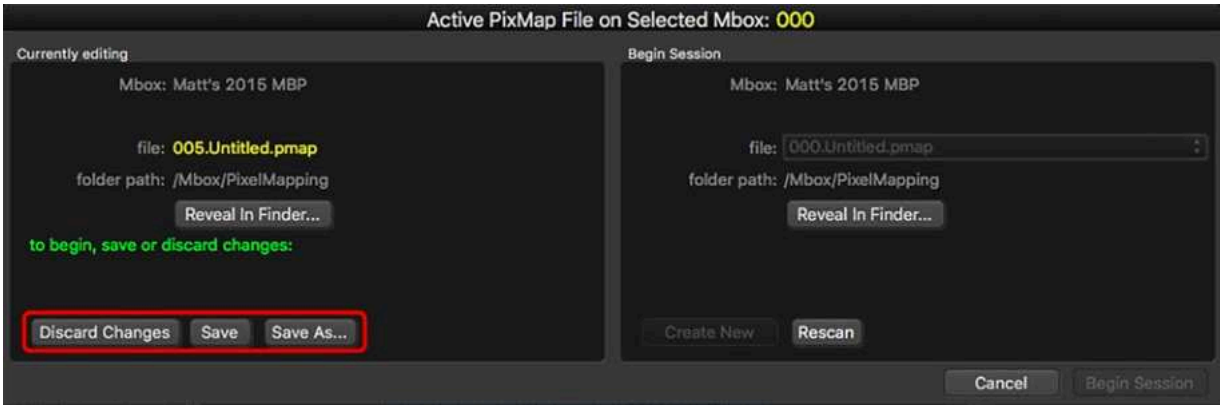
In this step-by-step example, a pixel mapping file different than the one Mbox is currently using has been edited in Offline mode. Changes to the file have not been saved.

Step 1. In the Servers list, select the desired server.

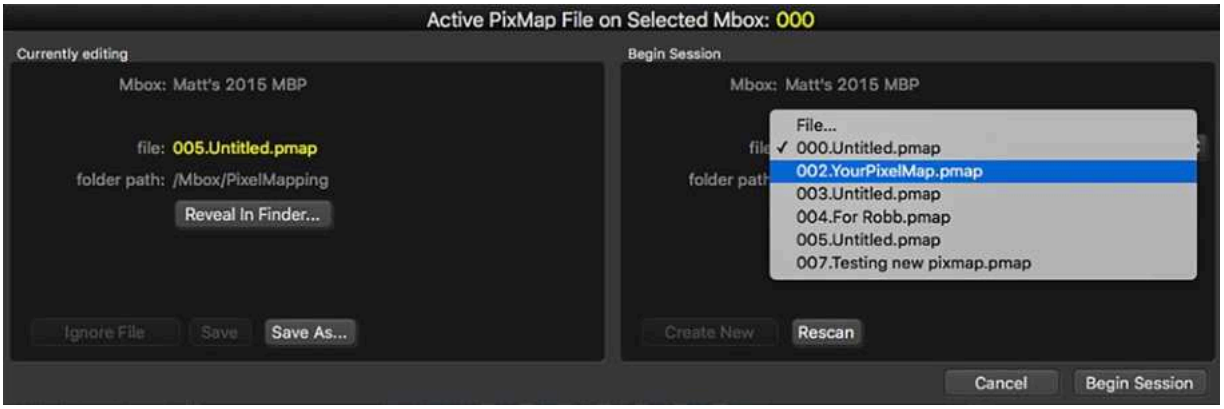
Step 2. Click on the gear icon and select Begin Live Editing session for...



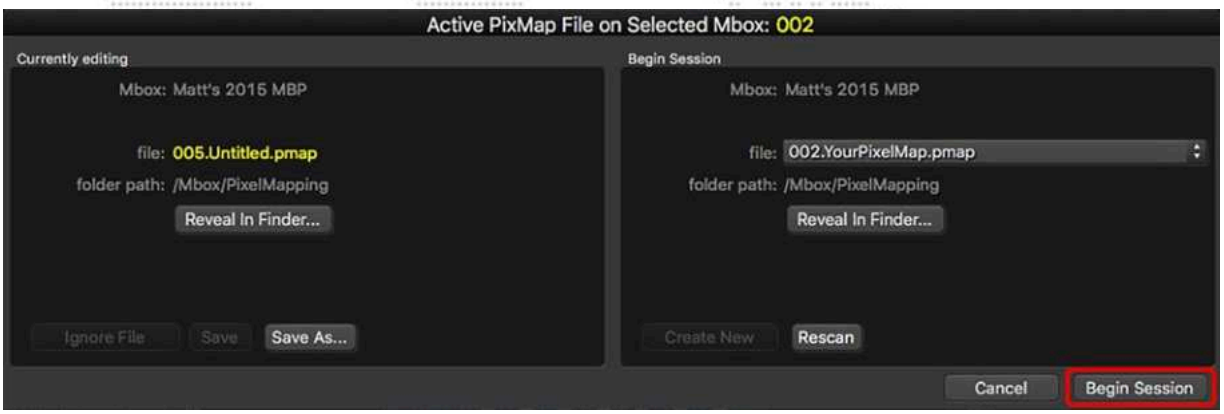
Step 3. On the Begin Session window, save or discard changes to current file by clicking either Discard Changes, Save, or Save As on the left side of the window. If saving, follow Save dialogs to save file.



Step 4. In the “Begin Session” section of window, choose a new pixel mapping file using the File pop-up menu.



Step 5. Once selected, the file will be displayed in the window. Click Begin Session to begin live editing.

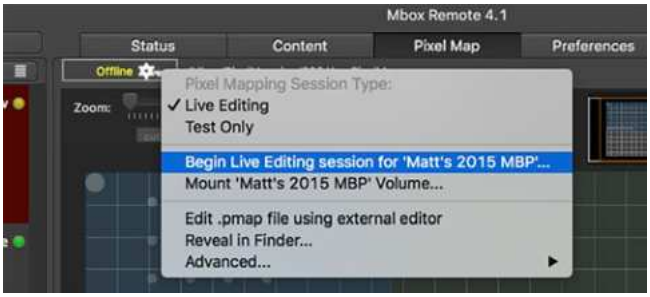


Copy To Mbox

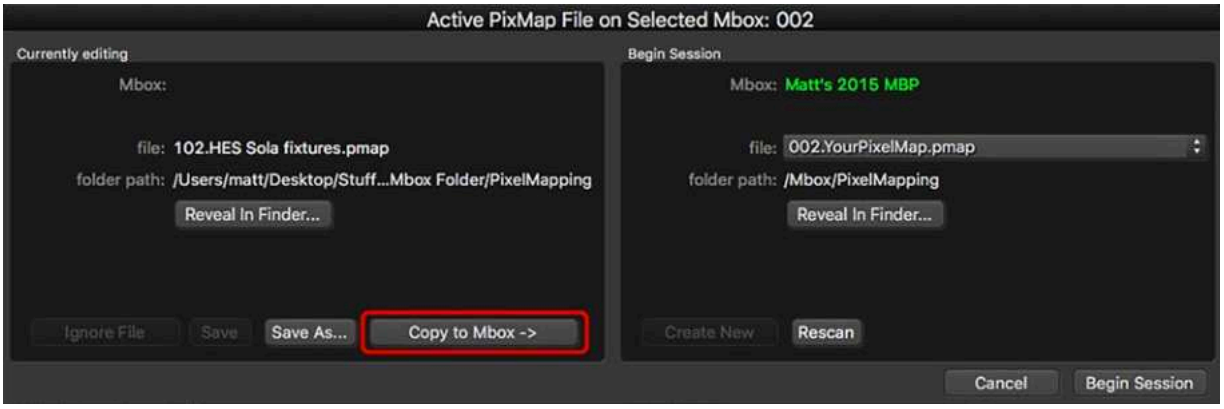
If the current pixel mapping configuration file does not reside on the Mbox server when starting a Live Editing session, the file can be copied to the Mbox server using the Begin Session / Currently Editing window.

Step 1. In the Servers list, select server that the file will be copied to.

Step 2. Click on the gear icon and select Begin Live Editing session for...



Step 3. On the Begin Session window, click the Copy to Mbox button. This button will only be available if the current file has already been saved locally - i.e., on the computer running Remote - before attempting to enter the live edit mode. If the file has not been saved, the button will read: Save to Mbox instead.



Step 4. In the Save dialog, click Save. The correct folder on the Mbox is automatically chosen.

Source

A pixel mapping context samples pixel data from a source and uses it to create pixel mapping output. The source is the rendering surface within the Mbox software. The source can be the Global Surface (the entire rendering surface of the Mbox server), an output or mix, or a single layer.

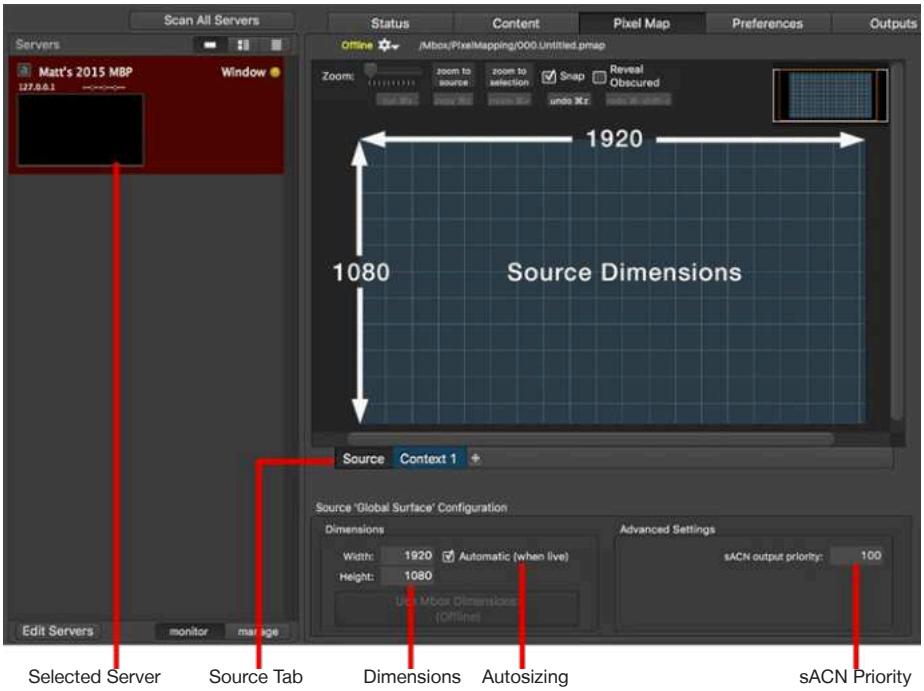
Note: Pixel mapping sources are not affected by keystone and warp settings.

Source Dimensions

The size of a source is different depending on the rendering surface it uses:

+ Global Surface - the Global Surface size is set on the Outputs tab of the Mbox application.
+ Outputs and Mixes - the size for outputs and mixes are set on the Outputs and Mixes tabs of the Mbox application.
+ Layers - layers do not have a fixed size; the size of each layer changes dynamically based on the size of the 2D content being used on the layer..

With the exception of layer sources, the size of a source is not something that often changes once the initial configuration of the server's outputs has been completed. Typically, a pixel mapping source will use the entire rendering surface and the dimensions shown in the pixel mapping interface are for reference only. However, it may be desirable to use only a portion of a source rather than its entirety. Therefore, controls are provided to allow this.

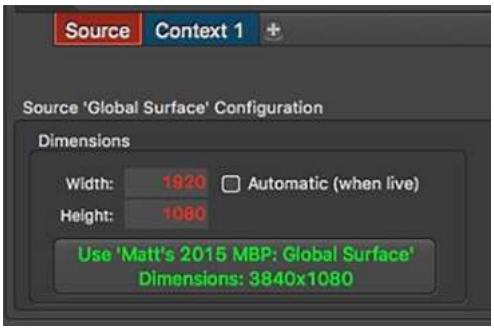


When a context is created and assigned to use a source, a tab for that source will appear. When a source tab is selected, the source's size (for the purposes of pixel mapping only) can be manually or automatically configured using the Source Dimensions controls in the lower portion of the Pixel Map tab.

+ Dimensions - used to manually set the width and height of the source in screen pixels.
+ Autosize checkbox - allows the pixel mapping source size to change automatically if the source changes size. This setting only works if a live editing session is being used.

CAUTION! Incorrectly sized source dimensions may lead to unexpected results when pixel mapping - sampling happening in an unexpected place on the source. But it is important to note that the size of a source in the pixel mapping interface does not affect the size of the rendering surface in Mbox, rather the source size is used to define where a context samples pixels from. Therefore, while incorrect source sizes will affect the pixel mapping output, they won't affect how and where Mbox plays content on its video outputs.

Ideally a pixel mapping configuration will be created in a live editing session. In this case, as contexts are added and have sources assigned to them, the correct source sizes will be entered as well. While in a live editing session, if the autosize checkbox for a source is checked and the rendering surface changes size, this will automatically be reflected in the user interface. But if the autosize checkbox is not checked, any changes to the size of the source's rendering surface will cause the source tab to turn red and an indication of the size difference to appear:



Tip: To automatically resize the source to match the new size of its rendering surface, press the button at the bottom of the Dimensions area.

On the other hand, if a pixel mapping configuration is created in an offline session, then the sizes of the sources can't be automatically entered. Because of this, only the Global Surface can be selected as a source while in an offline session. In an offline session, the size of the Global Surface defaults to 1920x1080, but this can manually be changed if the size of the Global Surface is known. If outputs, mixes, or layers are to be used as sources, then those must be assigned while in a live edit session, at which point their current sizes will be correctly entered automatically.

Because the sizes of rendering surfaces generally don't change and because the most common practice with pixel mapping is to use the entire rendering surface as a source, it's usually fine to get the source sizes correct when first creating the pixel mapping configuration and then just leave them alone.

If it is anticipated that the size of rendering surfaces may change and the intention is always to use the entire rendering surface as the source, then checking the autosize checkbox will ensure that a context which uses that source can also resize to fit the source. Automatic resizing for contexts is a separate property, which is discussed in "Automatically Resizing Contexts" on page 68.

Layers should be treated as a special case when dealing with source sizes as they will change size depending on the content used on the layer. Therefore it's almost always best to use the automatic sizing properties of both a layer source and any context that uses that source.

Tip: When creating a pixel map configuration while connected to an Mbox server, it is very useful to enable Live Editing in order to immediately visualize the results of pixel mapping changes (in the Mbox window). This scenario will also allow Mbox Remote to provide feedback (flags and warnings) whenever errors are made in the configuration. Refer to "Live Editing" on page 58 for more information about how these elements work together.

Note: The sACN output priority setting also appears in the source configuration area. This setting is global and not limited to one source or another. This setting assigns a priority value for all pixel mapping output via sACN and can be a value between 0 and 200, with 100 being the default. (Refer to "Protocols" on page 51 for more information.)

Adding and Configuring Sources

Sources cannot be added manually, but will be added automatically when a context is added as is then assigned a source. Once the source is assigned, a tab for the source will appear. If all contexts that use a source are deleted, or if they have other sources assigned, the tab for the unused source will be removed automatically. (Refer to "Contexts" on page 65 for more information on adding and editing the properties of contexts)

Click on the source tab to select it, and then either manually edit the source dimensions, or check the box to enable the autosizing. Keep in mind that the autosizing will not update the dimensions unless a live edit session is in progress.

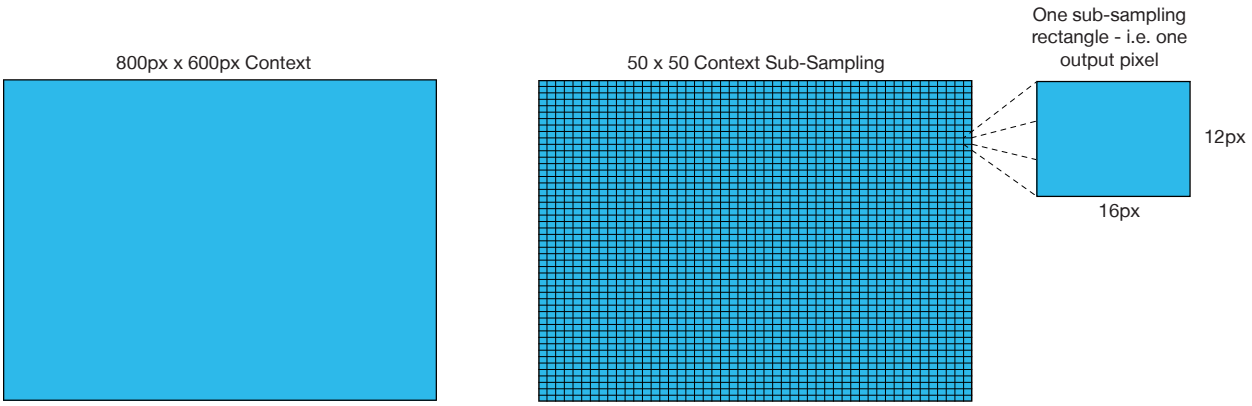
Manually determining source dimensions:

The current dimensions of each source can be determined manually by looking at the Outputs or Mixes tab in the Mbox application or by checking the size of the content being used on a layer.

Contexts

A “context” is a rectangular area taken from a source and onto which fixtures are placed. Each context can be some or all of the source area, and has its size specified by width and height settings and its position upon the source specified by X and Y offsets from the top-left corner of the source. The context is laid directly over the source image, and is then divided into rectangular subdivisions. The context is subdivided by assigning width and height values for sub-sampling. These subdivisions represent sub-sampled areas of the screen image, with each one being a possible location for one pixel on a patched fixture.

In the concept illustration below, a context with 50 x 50 subdivisions has placed on an area of the source with a size of 800px x 600px. Each rectangular subdivision of the context will be (800px/50) x (600px/50), or 16px x 12px. Mbox will average (sample) the color/intensity values for each 16px x 12px area of the screen image. Each sample can be used to create one “pixel” in the map. This pixel is then used to generate pixel mapping output levels.

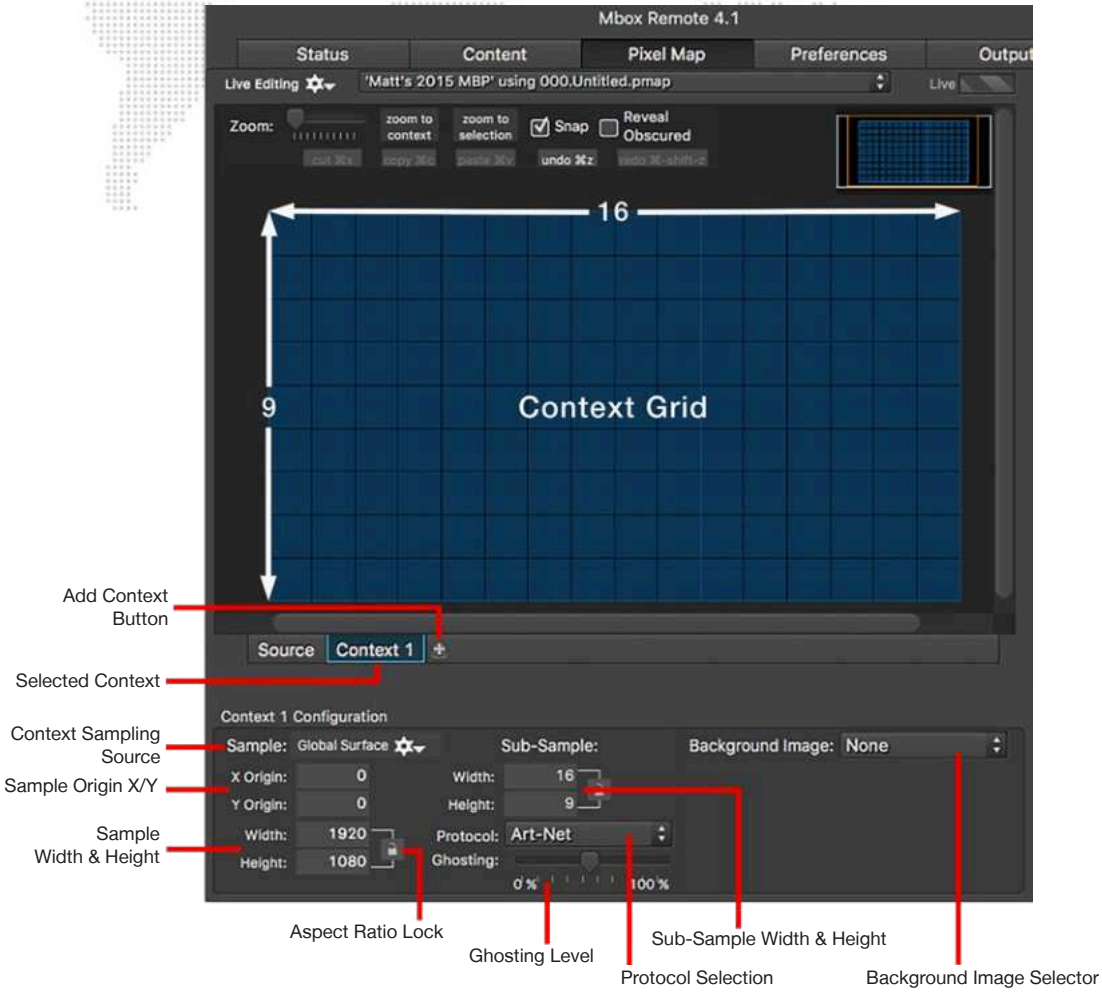


The size and sub-sampling of the pixel mapping context plays a large role in how the pixels in the source are converted into output data. A context that is the same size as the source, can be configured to have one sub-rectangle (sub-sampling width and height of 1 x 1) or a million sub-rectangles (width and height of 1000 x 1000). In the first case, the entire source would be reduced to one sub-sampling rectangle in the context and therefore only one pixel in the map; the results would not be very useful. The second case results in a very high resolution map, but it would require a great number of fixtures to make full use of the context. In general, try to avoid extremely large context sizes, as doing so requires extra processing. It is possible to keep context sizes smaller and add more contexts to cover the necessary onscreen pixels for the desired pixel mapping output.

If a very large amount of pixel-for-pixel mapping of your video to LED fixtures is required, it may be better to use an existing video pixel mapping product rather than the Mbox pixel mapping feature. Always strive to create a pixel mapping context that is as small as possible while still allowing content to be mapped to fixtures in the manner desired. Initially some trial and error may be required. If unsure where to begin, start with the context at its default size of 16 x 9 and then experiment once some fixtures have been patched.

A pixel mapping configuration in Mbox may have more than one context, thereby providing for organization, and allowing multiple sampling factors and multiple output protocols. Trying to determine how large to make a context may be difficult before placing fixtures, however it is possible to modify the size of a context at any time.

Contexts are configured using the Context controls in the lower portion of the Pixel Map tab.



- **Context Sampling Source** - selects which rendering surface the context uses as its source.
- **Sample X/Y Origin** - a pixel location on the source which marks the top-left corner of the context's rectangular area.
- **Sample Width/Height** - a measurement in screen pixels which specifies the size of the context. This may be some or all of the source.
- **Sub-Sample Width/Height** - a measurement in 'sub-sampling rectangles' which specifies the sub-sampling factor. The sub-sampling factor determines which pixels are averaged to create one set of RGB values for output. (Refer to overview on previous page)
- **Protocol** - the output protocol selection for the context (Art-Net, sACN, KiNET PORTout, or KiNET DMXout).
- **Ghosting** - a slider to control the transparency level of the context from 0% to 100%.
- **Background Image** - allows a background to be added to the context for better visualization of the pixel mapping configuration. The background can either be a still image or a live stream image. (For instructions on adding a background, refer to "Background Image" on page 96.)

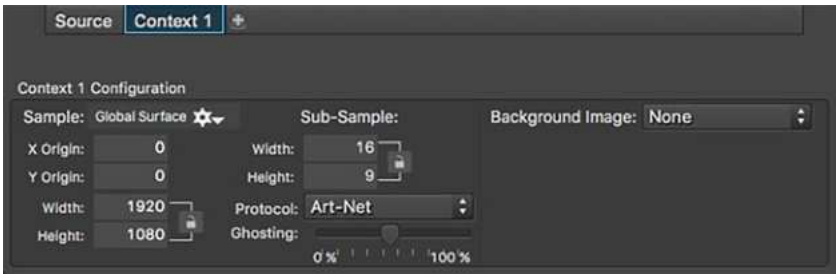
Note: The boundaries of two or more contexts can overlap each other, but they don't have to overlap or even be directly adjacent to each other.

Note: There is no theoretical limit to the number of contexts allowed, but it is best to have no more than 20.

To add contexts:

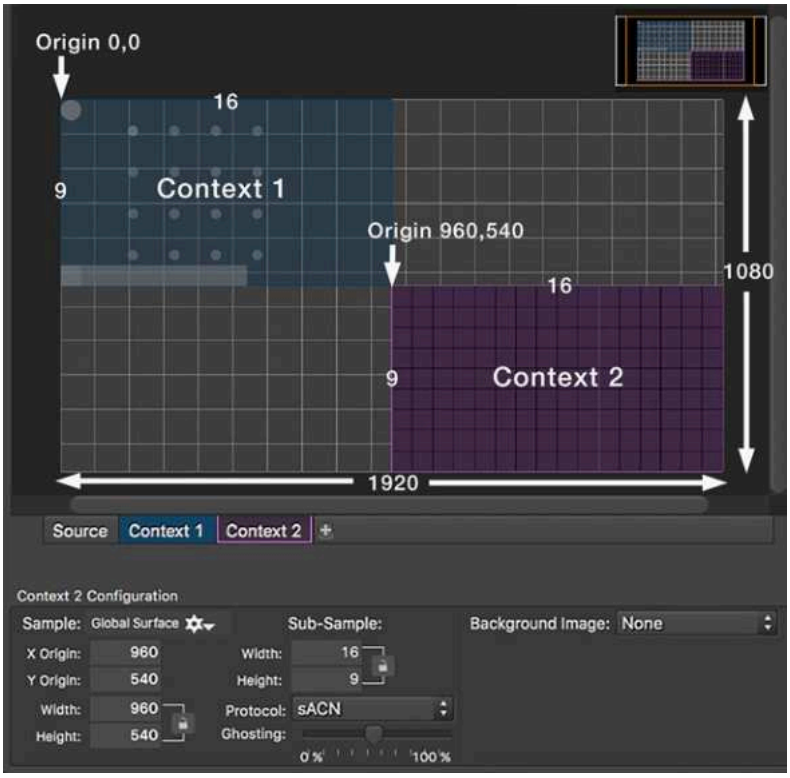
Step 5. Click Context 1 tab.

Step 6. Configure options as required.



Note: Some text fields can perform math operations such as add, subtract, multiply, and divide. For example, if setting the Sample Width for a context to half of 1920, enter 1920/2 in the field then press [return] on the keyboard.

Step 7. To add additional contexts, click [+] button and configure options. Each context's configuration is unique to that particular context. Note that the default Sample Origin for a context is 0,0 so it may overlap another context that uses the same source until its X and/or Y origins are changed.

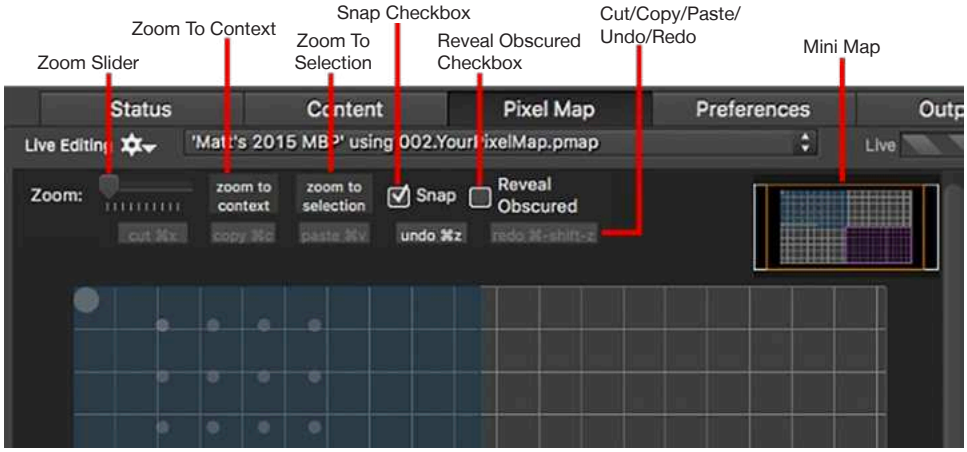


Note: To delete a context, right click on the context grid and select the context to delete.

Context Grid Controls

Several special tools are available in the Context Grid area:

+ Zoom slider - adjusts the zoom level of the current view.
+ Zoom To Context button - zooms to extents of current view.
+ Zoom To Selection button - zooms and scrolls so that currently selected fixture(s) are visible.
+ Snap checkbox - snaps fixture placement to the sample rectangles (when checked).
+ Reveal Obscured checkbox - increases the transparency of layered contexts to allow those below to show through (when checked).
+ Cut/Copy/Paste/Undo/Redo buttons - provide standard copy/paste type functionality for fixtures in the Context Grid area and show equivalent keyboard shortcuts.
+ Mini Map - provides quick navigation of the Context Grid area. The orange rectangle can be dragged around to quickly move the view, and while hovering over the Mini Map, the scroll wheel/buttons on the mouse can be used to zoom in/out.



Automatically Resizing Contexts

Because the source that a context samples from can resize automatically, it is important that the context be able to resize automatically as well. The resizing ensures that a context designed to use the entire source will continue to use the entire source if the source changes size. The fixtures placed on the context won't be inadvertently positioned off the source or in the wrong portion of the source.

Automatically resizing a context can only happen if the context's source is set to resize automatically. (Refer to "Source Dimensions" on page 62) To set a context to resize automatically, first make sure its source is set to resize automatically, then click on the context's Sampling Source pop-up and select the "Automatic Source Dimensions" option. Thereafter, when in a live editing session, the context's Sample Width and Height will resize to match that of its source.

Note: The automatic resizing of context and source are intended as aides for creating or editing a pixel mapping configuration. Once the configuration is completed and is being used by Mbox, changes to the size of the source and/or context are not possible unless Mbox Remote is being used in a live editing session. However, it's very uncommon that source or context sizes will need to change once the configuration is complete.

Fixtures

Fixtures are controllable devices placed onto the context. The fixtures are created using profiles, which are then used as reference when individual fixtures are patched. (For more detailed information about profiles, refer to "Fixture Profiles" on page 99.)

Fixtures can be added and edited using the Fixture tab.

Guidelines:

+ Fixtures may have one or more pixels. The maximum number of pixels in one fixture is 512, assuming they are all single 8-bit pixels (e.g. Luma pixels).
+ Simple fixtures will only have one pixel type, but more complex fixtures can have more than one type.
+ A fixture may have any arrangement of pixels (linear, rectangular, arbitrary).
+ Fixtures may not exceed 512 total channels or span more than one universe.
+ A single fixture can only output one protocol, but different fixtures of the same type can output different protocols for each patched instance.
+ Fixtures have properties which define how they receive RGB information and how that information is eventually output: width, height, position X/Y rotation, etc.
+ Fixtures can have a custom name to identify them.
+ Fixtures can have their own refresh rate.
+ Fixtures can have an overall level master (inhibitive) to reduce their full output.
+ Fixtures can have a slew value (hysteresis), which limits the rate at which the output data can change from zero to full (or vice-versa). This can provide relief for moving lights with mechanical color flag systems that may break if moved to rapidly, or which are noisy.
+ Fixtures can have a mask property assigned, which allows them to be forced to a zero value by using the Control Channel control on the Mbox Master fixture.
+ Fixtures can have a custom rotation. (Rotations are made around the top-left corner of the fixture.)

Pixels

Pixels are the building blocks of fixtures. In this case, a pixel is defined as a single sample of RGB screen data that makes up one addressable portion of the fixture. A typical pixel will occupy one sub-sampling rectangle (although exceptions are possible in more advanced operation).

Guidelines:

+ Pixels may be rectangular or circular in shape, but this only affects how they look in the editor, not their eventual output. (All pixels in one fixture must have the same shape.)
+ Pixels can be of different sizes, but this only affects how they look in the editor. (All pixels in one fixture must have the same size.)
+ There are many different types of pixels. (RGB, HSV, RGB16, CMY, CMY16, Luma, CYM, CYM16, R, G, B, etc.)

Protocols

Fixtures can output one of the four available protocols: Art-Net, sACN, KiNET DMXout, and KiNET PORTout.

Guidelines:

+ Each fixture's output data may only use one protocol.
+ Every fixture placed onto the same context will have the same protocol. To place fixtures that output a second protocol, a new context must be created for those fixtures. (The second context may have identical sample and sub-sample properties as another context.)
+ Each protocol is bound by the specification of the protocol as to transmission method, number of universes, number of channels per universe, and devices that can receive it.
+ Protocols may be routed to one or more ethernet interfaces on the computer.
+ Protocols may be routed to one of more destinations (IP Addresses).

Note: Refer to "Overview" on page 48 for more detailed information about protocols and ethernet setups.

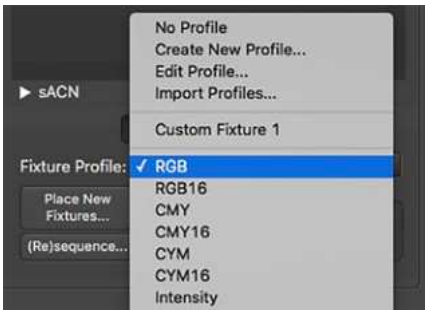
Adding Fixtures

Fixtures can be added using the Place New Fixture controls. When the fixture is first placed on the grid, it will reference the defaults in its profile. (The fixture and/or fixture profile can be edited, as discussed later in this section.) Mbox Remote provides a list of built-in fixture profiles which can be selected using the Fixture Profile menu. The fixtures in this list are a combination of RGB LED fixtures and moving light fixtures (both CMY and CYM).

To add a fixture:

Step 1. Be sure either the Offline or Live Editing mode is active, rather than Test Only. (Refer to "Session Types" on page 56.)

Step 2. On the Fixture Profile pop-up menu, select a profile type to be added.



Step 3. Click Place New Fixtures button to enable fixture placement mode. The button's text will be highlighted in green and a green box will be shown around the Context Grid while this mode is active. Alternately, press [n] on the computer keyboard.

Step 4. Click on a sub-rectangle inside Context Grid to place fixture in that location. (Fixtures are anchored by their top-left corner.)

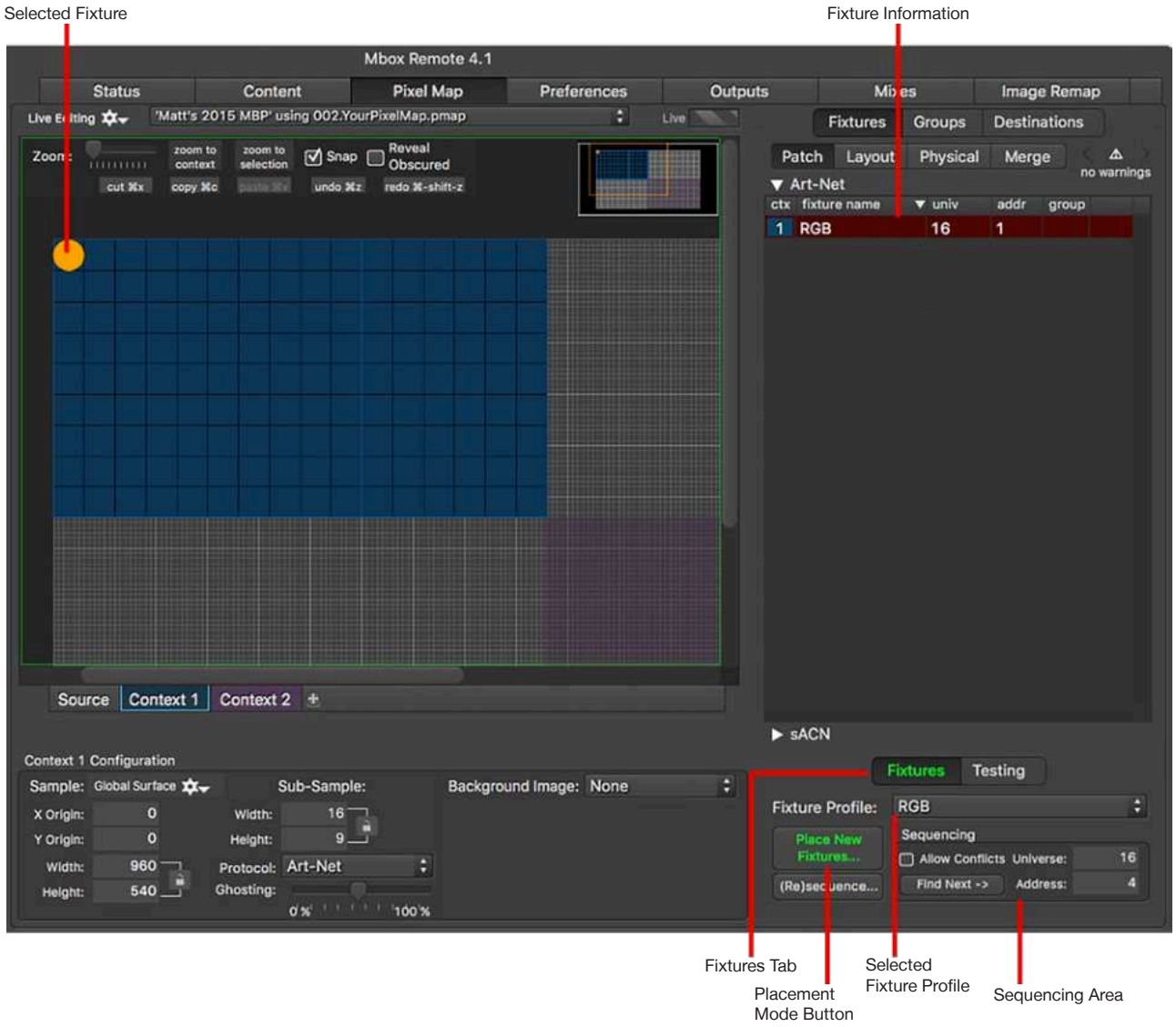
When selected, placed fixtures have one darker pixel (the fixture's first pixel in its patch order) while the remaining pixels are lighter. Even when not selected, the first pixel will be slightly darker than the rest.

Step 5. Place more fixtures of the same type by continuing to click within the Context Grid, switch fixture type by selecting a new type from the pop-up menu, or turn off placement mode by clicking the Place New Fixtures button again or pressing [n] on the computer keyboard.

When a fixture is placed on the context grid, an entry for that fixture is added to the table on the right of the grid. Fixtures will be patched sequentially using the next available universe and address as they are placed, thereby allowing a reduction in patch time if fixtures are placed in order. If fixture placement requires a new universe and/or address starting point, this can be entered in the Sequencing area before additional fixtures are placed.

During fixture placement, the automatic patching does not allow for the creation of patch conflicts unless the Allow Conflicts checkbox is checked.

Note: Patch information can be modified at any time after fixtures are placed.



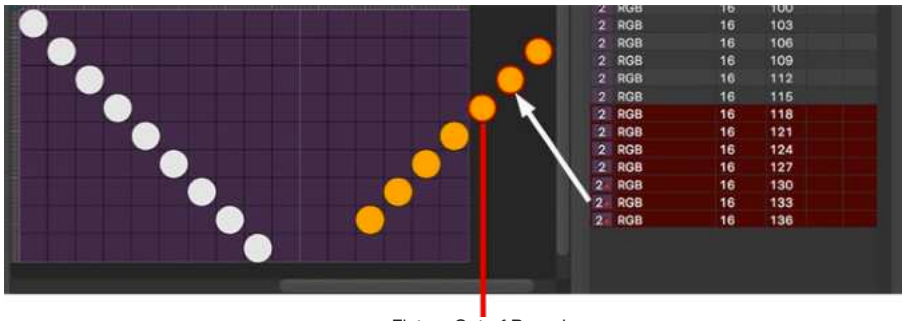
Fixtures Out of Bounds

It is possible for a fixture to have some or all of its pixels outside the boundaries of its context, or even the entire source. Pixels that are outside the boundary of their context will not output any pixel mapping level data. Pixels can end up outside the context's boundary:

+ If the fixture is positioned such that some of its pixels end up outside the boundary.
+ If the context or source is resized to be smaller after the fixture has been added to the configuration.

Fixtures that have pixels outside their context show this in two ways:

+ Pixels that are outside the boundary are outlined in red.
+ Fixtures that have pixels outside the boundary will have a red dot shown in the Fixtures table.



Fixture Out of Bounds

Tip Geometry Tools can be used to adjust fixture placement. Refer to "Geometry Tools" on page 81.

Addressing Fixtures

As fixtures are added to a context, they are automatically assigned an output protocol, then a universe, device, or device.port within that protocol, and finally an address for the first pixel in the fixture. Subsequent pixels in the same fixture receive an address that is offset from the first pixel by a set amount. The amount is typically based on the number of channels (addresses) that the previous pixel uses.

+ Art-Net - universe & address
+ sACN - universe & address
+ KiNET PORTout - device.port & address
+ KiNET DMXout - device & address

A fixture's protocol is based on the protocol of the context that it is placed upon, while the address is based on the next available address within the universe/device as shown in the sequencing box at the lower right of the window.

For Art-Net and sACN, the universe defaults to 16 when a new configuration is started. These values increment automatically as fixtures are placed. Press the Find Next button to increment the universe and address fields to the next available address based on currently patched fixtures. (Note that you may need to select the appropriate context before pressing the Find Next button.) These values may be manually changed before a fixture is placed to allow the assignment of different starting values.

The Allow Conflicts checkbox specifies whether Mbox Remote is allowed to patch fixtures to universes and/or addressed that would lead to a patch conflict. By default, the box is unchecked, which does not allow any conflicts.

+ **Unchecked** - when a fixture is placed, if assigning it the current universe and address values would cause a patch conflict, the fixture will automatically receive the next free address (and universe, if necessary) in order to avoid a conflict. The address (and if necessary the universe) field(s) will then be incremented to the next free address/ universe.
+ **Checked** - when a fixture is placed, if giving it the current universe and address values would cause a patch conflict the fixture will receive that address and universe. This would inevitably lead to a conflict, which would have to be remedied manually.

Each context has a single output protocol assignment. Therefore, if the show requires both Art-Net and sACN output, two contexts will need to be created and fixtures placed into the appropriate context.

+ When adding fixtures connected to a KiNET_DMXOUT power supply, addresses 1- 256 will be on the first port of the DMXOUT power supply, and addresses 257-512 will be on the second port (if the supply has more than one port).
+ To add fixtures connected to a KiNET_PORTOUT power supply, enter the device number then a period and then a numerical suffix 1 - 16 (e.g. 301.1), with the suffix being the number of the fixture's physical output port on the power supply. Addresses 1-512 may be used for each port.
+ The device number for KiNET power supplies is not actually used outside of Mbox (power supplies are identified by IP Address) and is only an organizational tool to help with patching in the editor and assigning fixtures to power supplies on the Destinations tab.

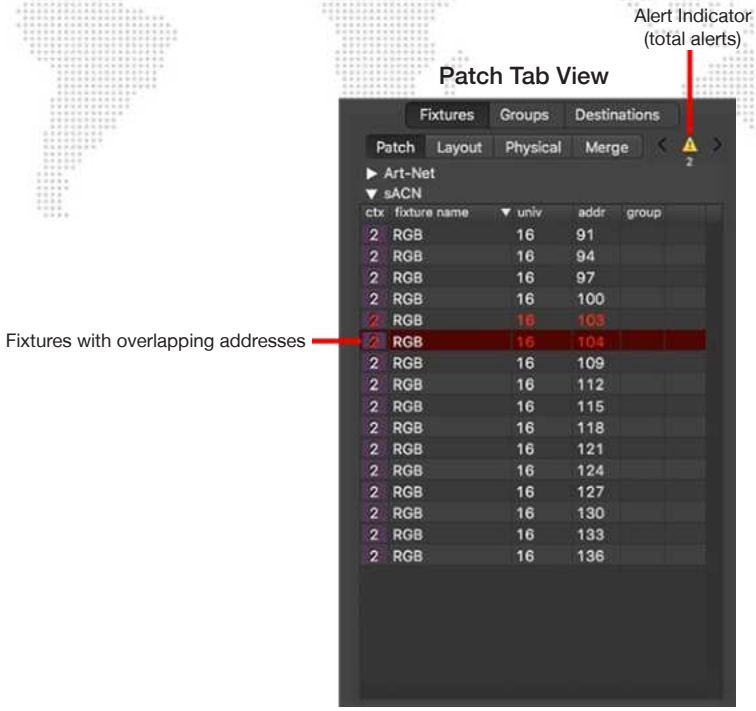
CAUTION! Always avoid duplicate Art-Net and sACN universes anywhere on your system. Avoid duplicating sACN or Art-Net universe numbers between incoming control data and outgoing pixel mapping data. Also avoid duplicating output universes across more than one Mbox server in the system - unless there is a backup system and some means of merging data or switching control between one server and the other. (Use the "Backup Mode" setting in Mbox Remote to suppress pixel mapping output from a backup server. Refer to "Server Control Commands" on page 24.)

If addressing conflicts (address overlaps) occur, the Pixel Map tab will provide several indications.

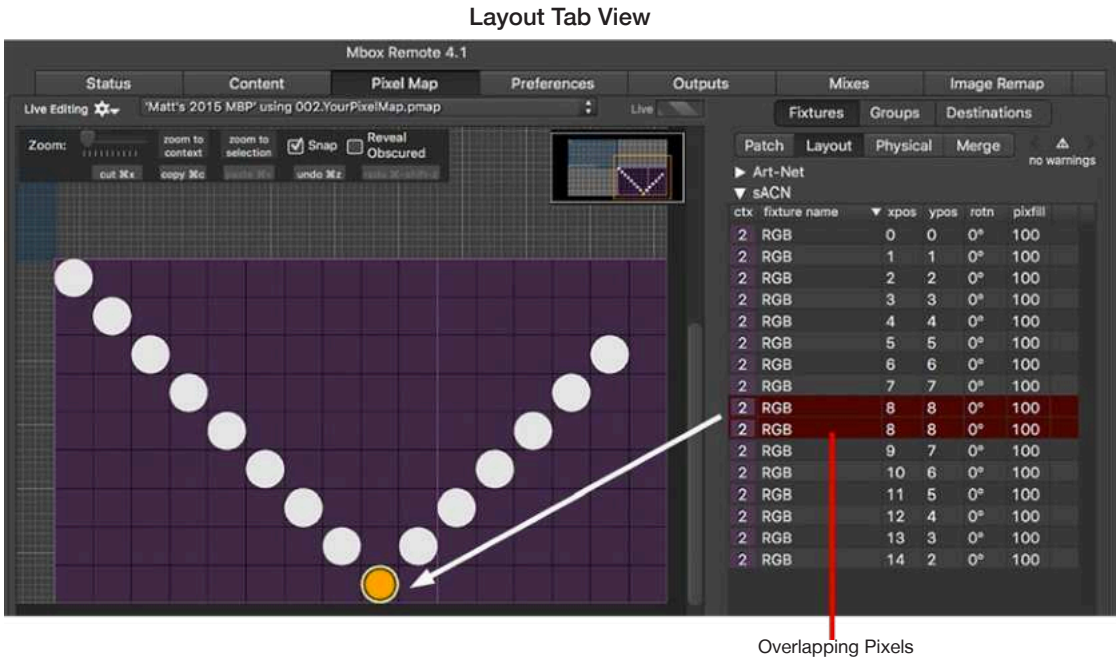
+ Addressing overlaps are shown in the table as red highlights on the Fixture Patch tab, and the Alert triangle will have a non-zero value.
+ Patch errors are also shown by an alert indicator at the top right of the table view. Step forwards and backwards through the errors by clicking on the < or > arrow buttons. The number of total alerts are also shown below the indicator.

Note: Overlaps of actual pixels on the context will be shown with a yellow highlight drawn around the pixel in the Context Grid, but are not indicated as an error as overlapping pixels may be desirable at times.

Example showing fixtures with overlapping addresses:



Example showing overlapping pixels on two separate fixtures:



Re-Addressing Fixtures

When fixtures are first placed onto a context, they are automatically given an address as explained in "Addressing Fixtures" on page 72. If the patch needs to change, however, fixtures can be quickly re-addressed using one of three methods:

+ Patch table.
+ Re-Address Fixtures window.
+ Sequential re-addressing feature.

Each of these methods is explained below.

Patch Table

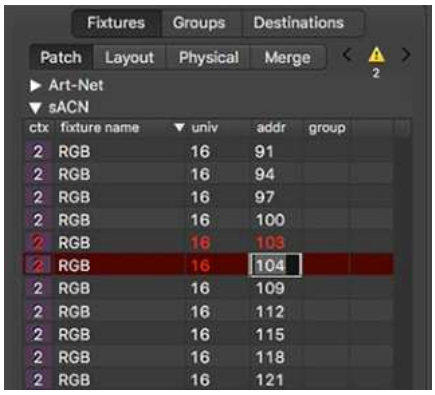
A fixture's universe and address can be edited directly in the Patch table. This is useful when re-addressing a single fixture.

To edit patch in the Fixture table:

Step 1. On the right side of the Pixel Map tab, select the Fixtures > Patch tab.

Step 2. On the Patch tab, double-click on universe (univ) or address (addr) field. Use the [tab] key to move from column to column, or use the up and down arrow keys to move vertically while staying in the same column.

Step 3. Make changes as required. Be sure to press [tab] or [return] on the keyboard to accept any edits.



Note: To make changes to multiple fixtures at the same time, use the Re-Address Multiple Fixtures window. Refer to the instructions below.

Re-Address Multiple Fixtures Window

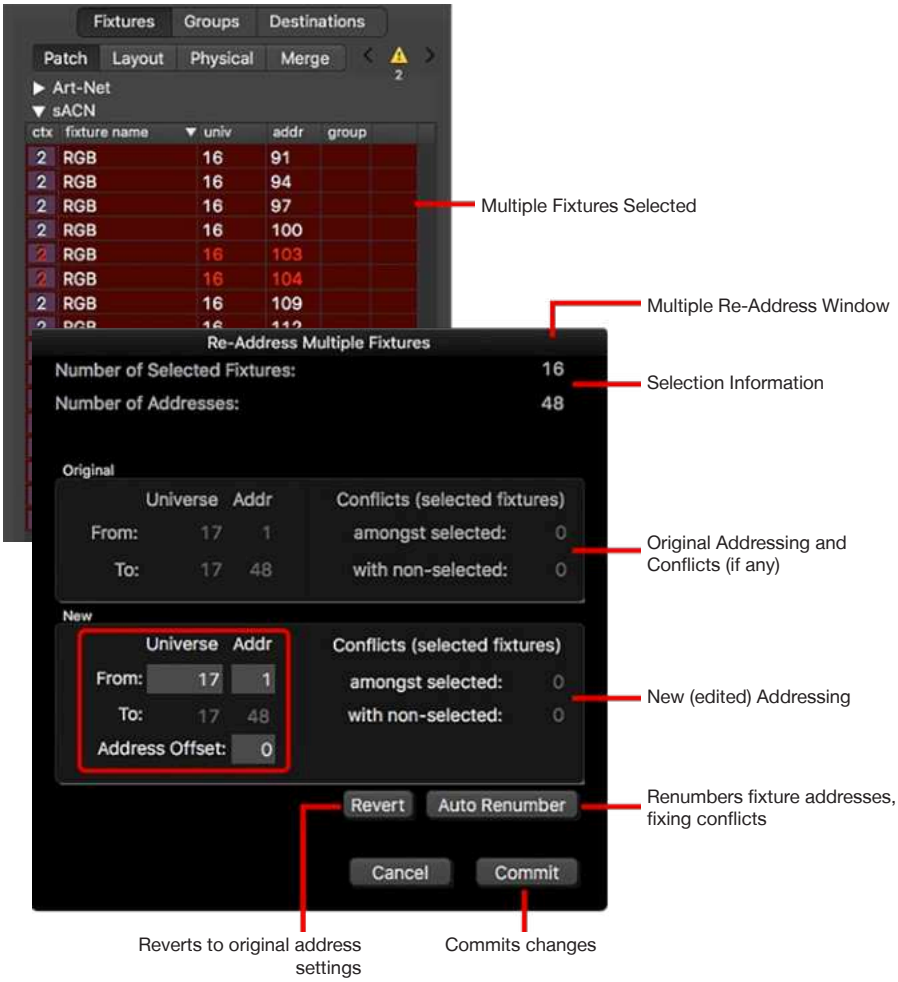
The Re-Address Multiple Fixtures window can be used to quickly re-address a large group of fixtures or their merge data.

To assign a new starting point using Re-Address Fixtures window:

Step 1. On the right side of the Pixel Map tab, select the Fixtures > Patch tab.

Step 2. On the Patch tab, select multiple fixtures (using cmd or shift), then double-click on the univ or addr field on any selected line to open the Re-Address Multiple Fixtures window.

Step 3. In the From Universe field, enter a new starting universe if desired. Enter any changes to the start address in the From Address field.



Step 4. Do one of the following:

a. Click the Auto Renumber button to renumber the selected fixtures starting at the new universe and address. This method will fix any overlap conflicts in the process. Click the Commit button to accept the changes.

b. Click the Commit button (without clicking the Auto Renumber button) to renumber the selected fixtures starting at the new universe and address, but without fixing any overlap conflicts. Conflicts will be noted in the table after the window is closed.

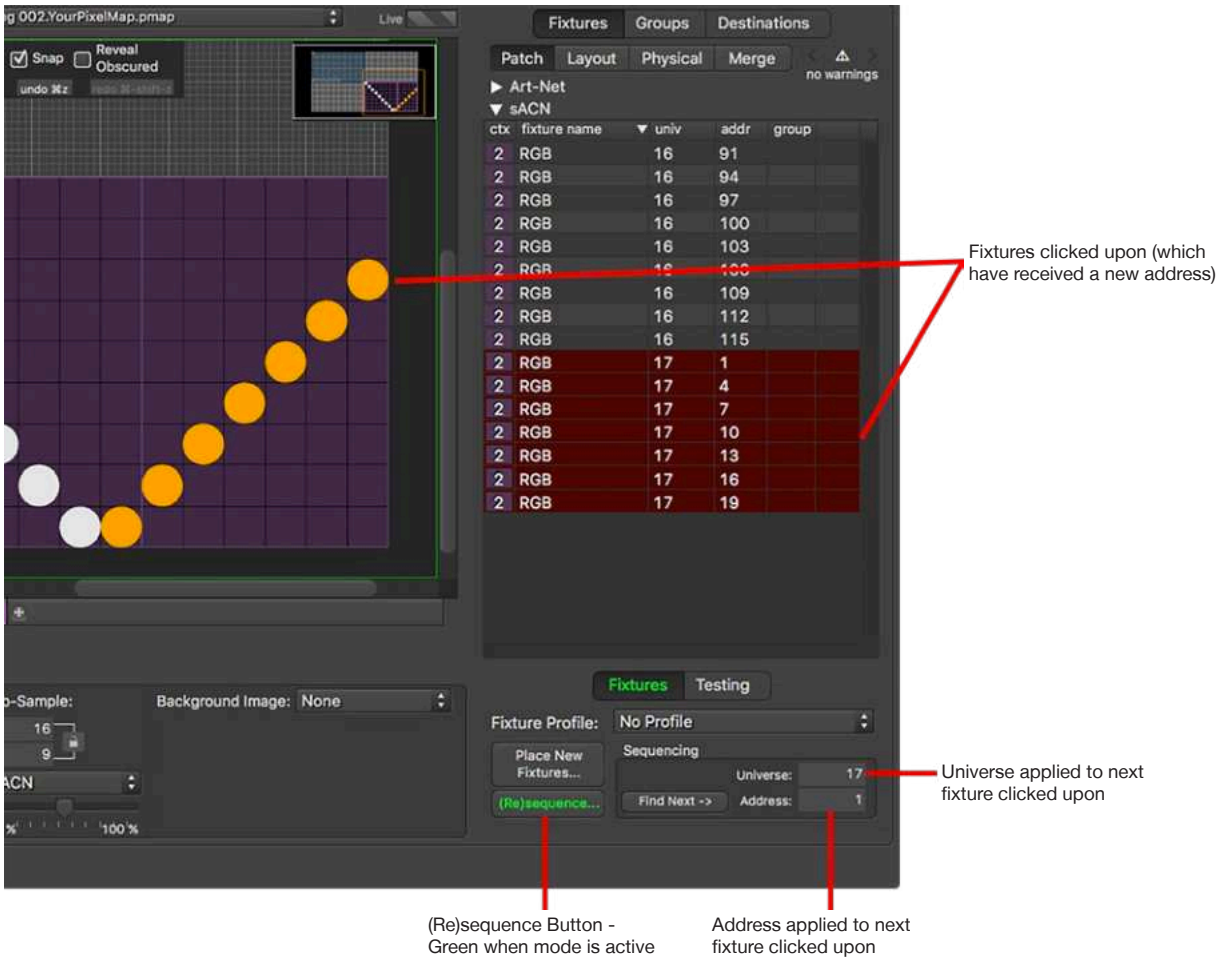
Note: If the Merge tab is selected, the Re-Address fixture window will change merge addressing. However, merge addressing cannot be changed unless the fixture use a merge type other than “no merge.”

The Address Offset field can be used to insert additional address spacing between fixtures when re-addressing them. For example:

+ A range of selected fixtures starts at address 1 and each fixture uses 3 channels. Therefore the fixtures' addresses are 1, 4, 7, 10...
+ If the fixtures are re-addressed with an Address Offset value of 10, their new addresses with be 1, 14, 27, 40...

Re-Sequence Feature

The re-sequence feature can be used to re-address fixtures one by one as they are clicked in the Context Grid.



To re-address using re-sequence feature:

Step 1. At right side of the Pixel Map tab, select the Fixtures > Patch tab.

Step 2. Click on the (Re)sequence button to enter re-addressing mode. (The button's text will change from white to green to indicate mode is active.)

Step 3. Enter a start Universe and Address in the fields to the right of the button.

Step 4. On the Context Grid, click on fixtures one-by-one to apply new addressing. The universe and address will increment by the correct amount as each fixture is clicked.

Step 5. Click the (Re)sequence button to exit the re-sequencing mode when done.

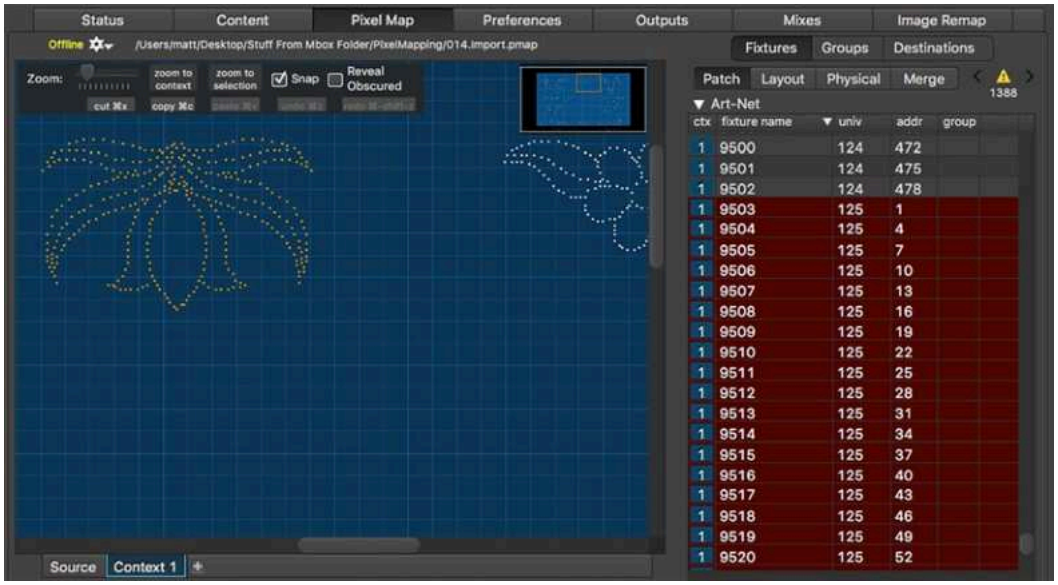
Copy and Paste Fixtures

A convenient way to quickly add fixtures is to use the copy and paste feature.

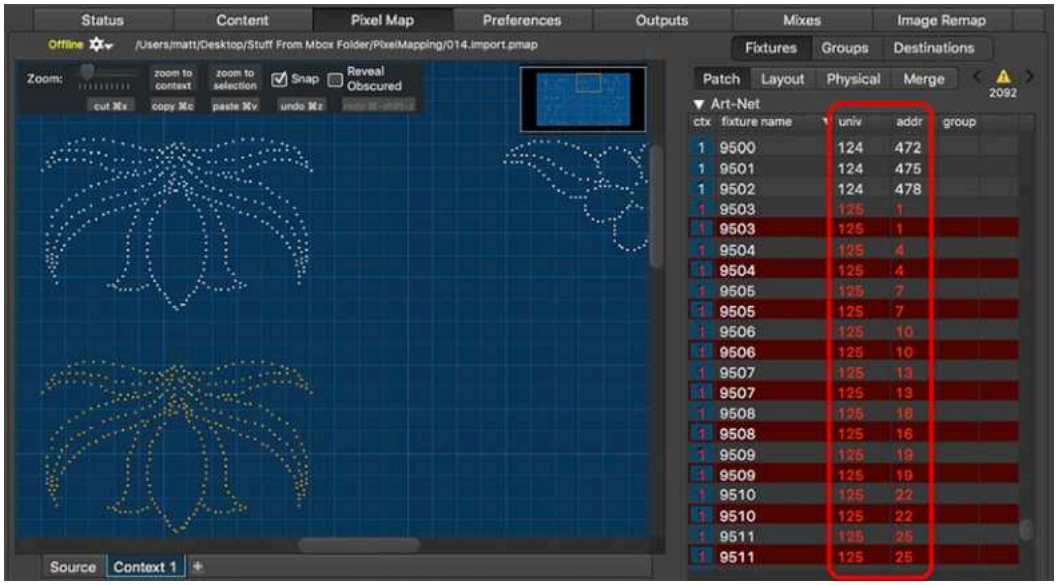
To copy and paste fixtures:

Step 1. On the Context Grid, select a fixture or fixtures to copy. Multiple fixtures can be selected by using click and drag to draw a box around their pixels.

Step 2. Press [⌘C] to copy the selected fixture(s).

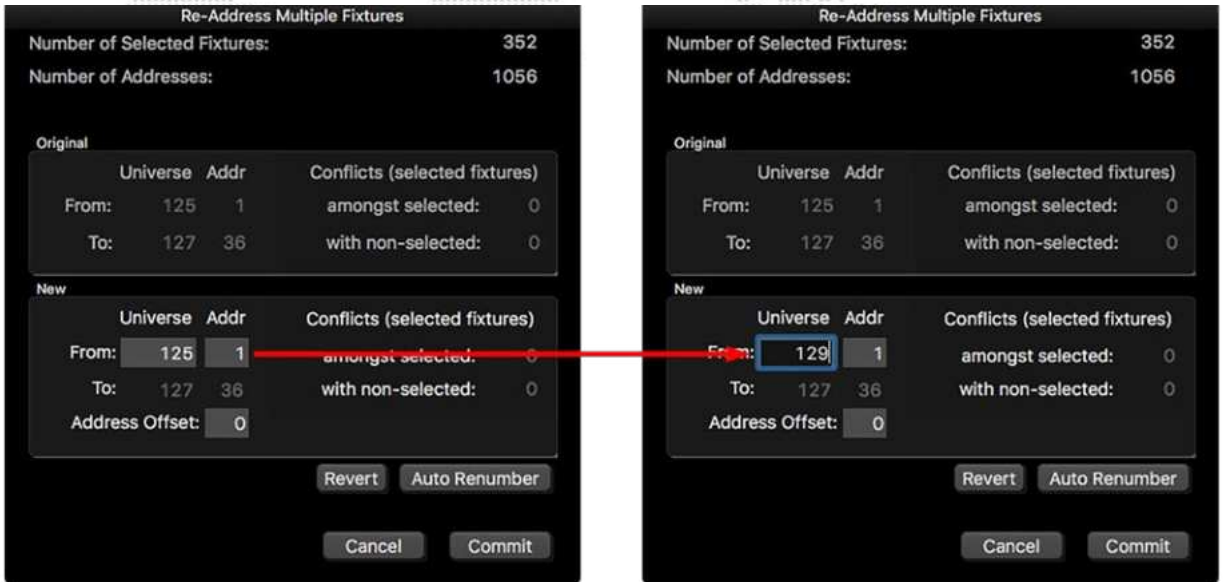


Step 3. Press [⌘P] to paste the fixture(s). They will be dropped where the cursor is located. The pasted fixtures will be automatically selected and addressing conflicts will be shown in the table.

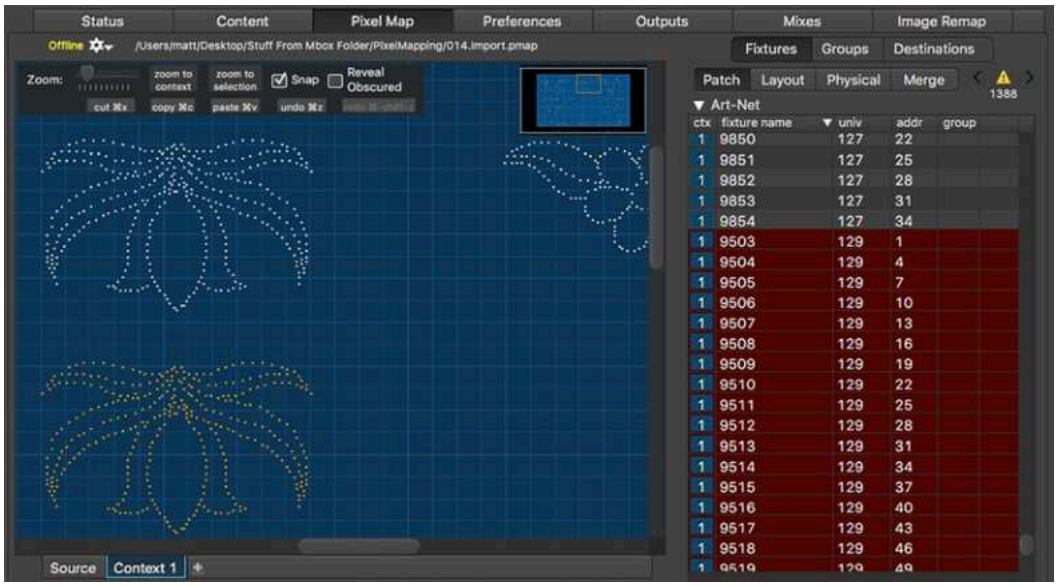


Step 4. In the Patch table, double-click on univ or addr field of one of the selected fixtures. The Re-Address Multiple Fixtures window will open.

Step 5. On the Re-Address Fixtures window, enter an unused starting universe and address.



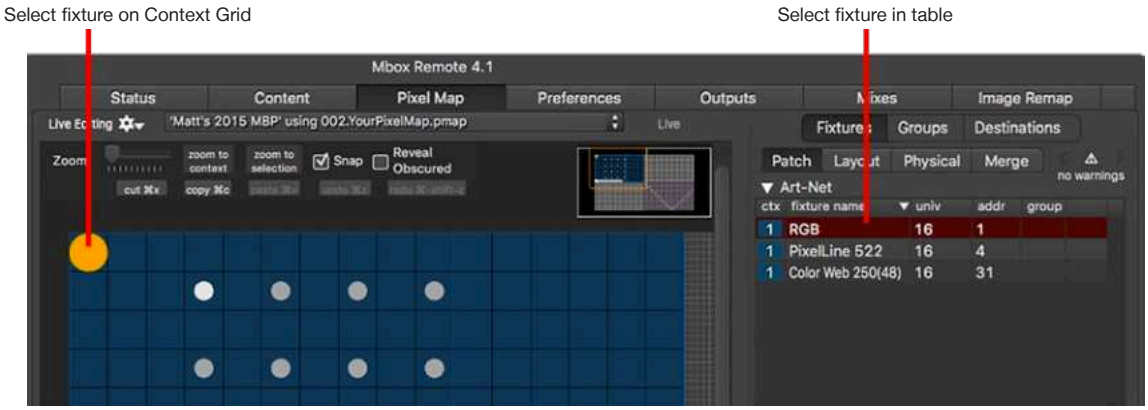
Step 6. Click the Commit button. The conflicts in Patch table will now be resolved.



Fixture Editing

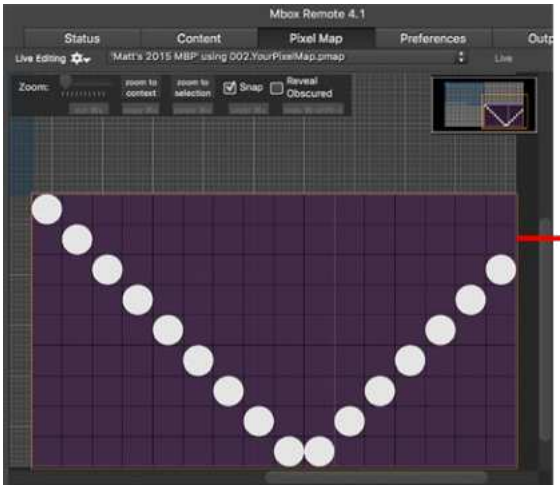
To select a fixture for editing, deletion, movement, etc., do one of the following:

+ Click on one of its pixels on the Context Grid.
+ Click and drag on the Context Grid to draw a box around the fixture.
+ Click on the line for the fixture in any of the three tabs in the Fixture table (Patch, Layout, and Physical).



Multiple fixtures can be selected in three ways:

+ Click and drag to draw a box around multiple fixtures on the Context Grid.
+ Shift-click on multiple fixtures on the Context Grid.
+ Shift-click or command-click on multiple lines in the Fixture table.



Deleting Fixtures

To delete a fixture, first select it using one of the methods outlined above, then press the [delete] key on the computer keyboard.

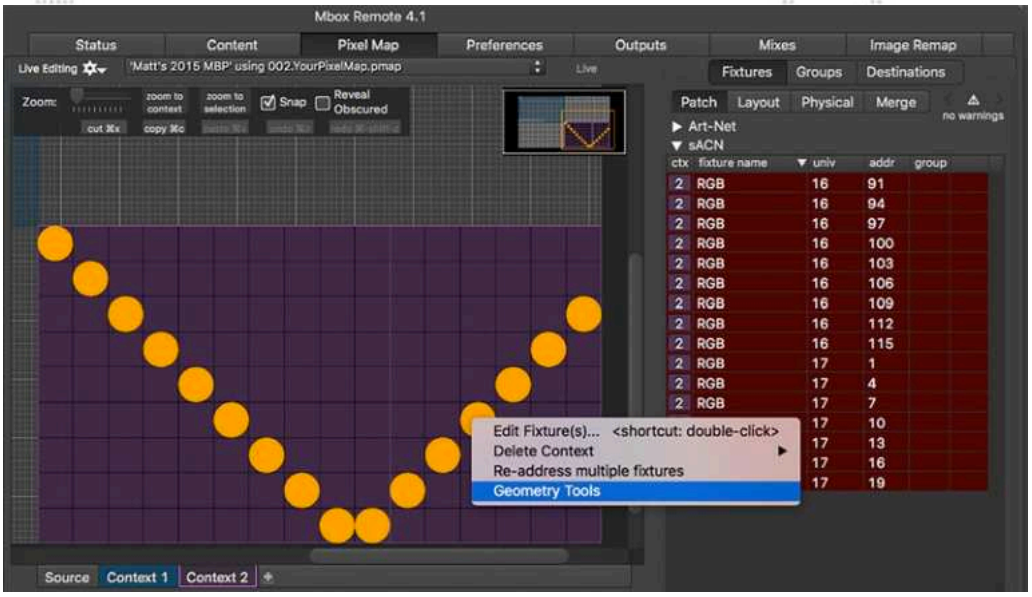
Undo and Redo

Use [⌘Z] to undo.
Use [⌘⇧Z] to redo.

Geometry Tools

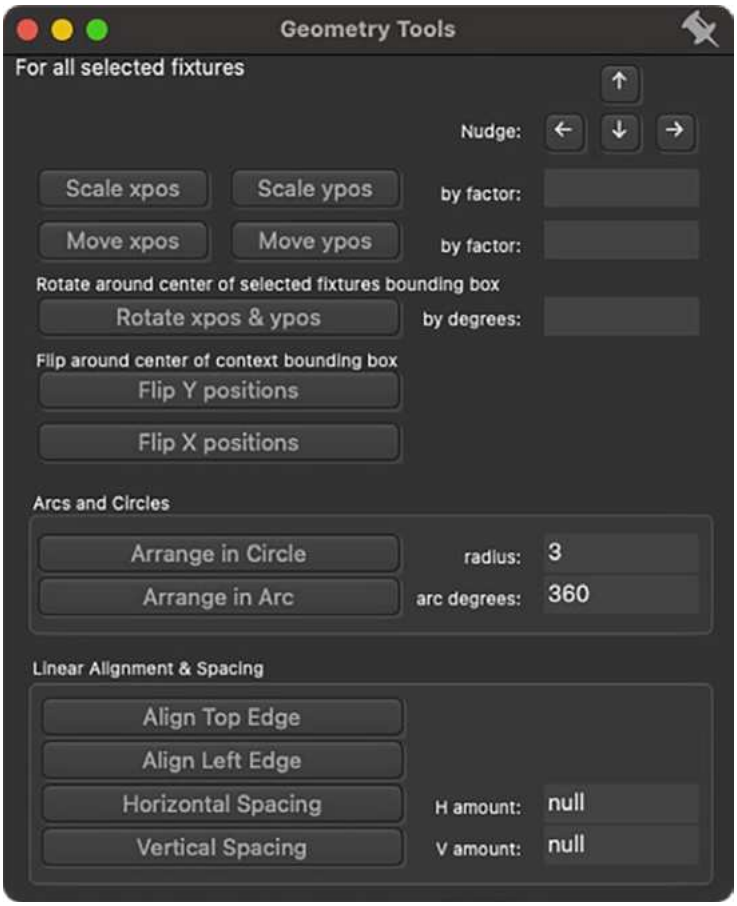
The Geometry Tools feature can be used to move, scale, rotate, flip, and arrange fixtures as a group.

To open the Geometry Tools window, first select one or more fixtures, then right-click on one of them. On the pop-up menu, select Geometry Tools.

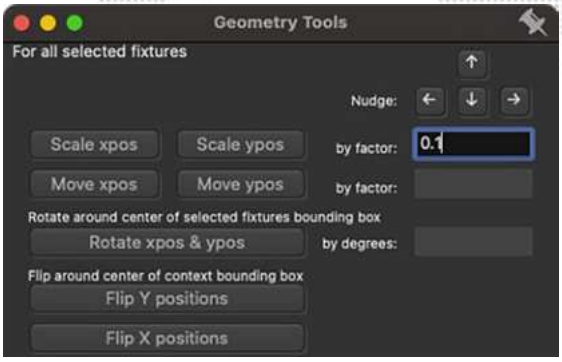


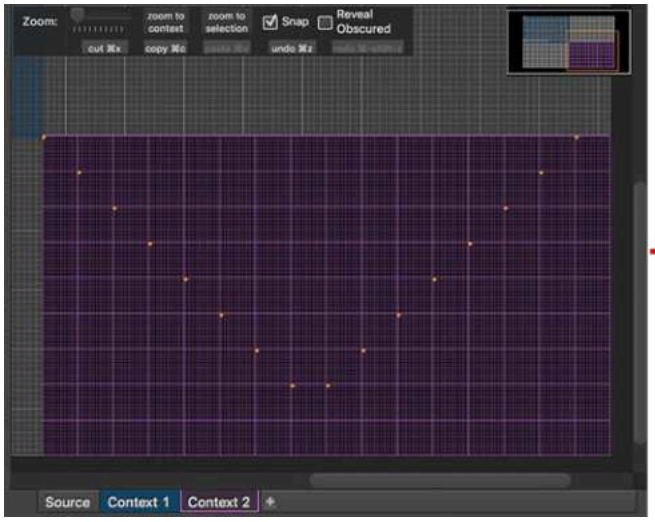
The Geometry Tools window provides several options:

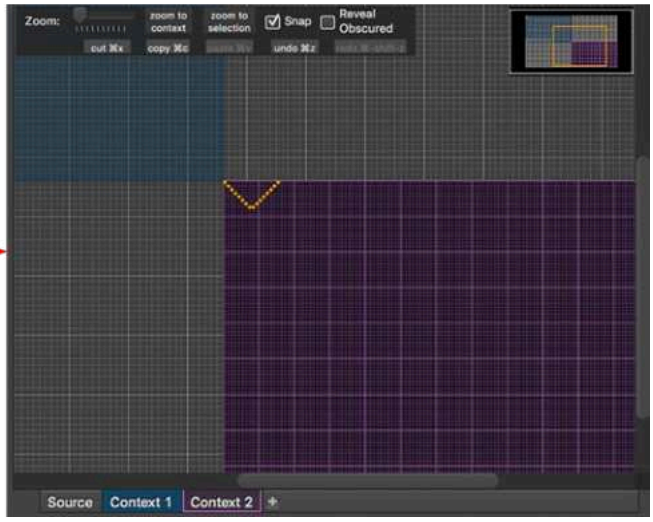
- Nudge the selected fixtures in any direction by one sub-sampling rectangle. In addition to clicking on the buttons, whenever the Geometry Tools window is open, the arrow keys on the keyboard can be used for nudging selected fixtures.
- Move or scale the selected fixtures' positions by a certain factor.
- Rotate the selected fixtures as a unit.
- Flip the fixtures around the X or Y axis as a unit.
- Arrange the fixtures in a circle or arc.
- Align the top edge of the selected fixtures.
- Align the left edge of the selected fixtures.
- Apply specific horizontal spacing between selected fixtures.
- Apply specific vertical spacing between selected fixtures.



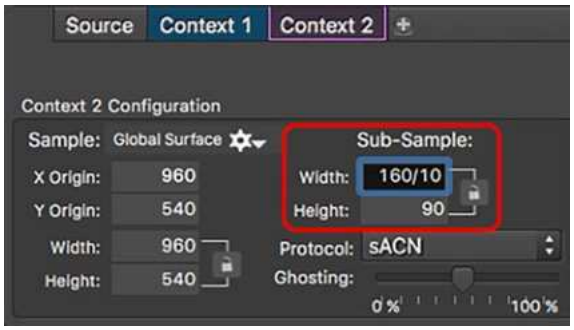
For example, when reducing the context size from 160 x 90 to 16 x 9, it would be time-intensive to manually move all the fixtures so they will fit into the smaller context. In this case, the Geometry Tools could be used to move all the fixtures at once. To do this, select all fixtures, enter a factor of 0.1 in the “by factor” field and click Scale xpos and Scale ypos buttons. (This will divide the scale by 10.) Once the fixtures are moved, then reduce the context size in the usual manner.



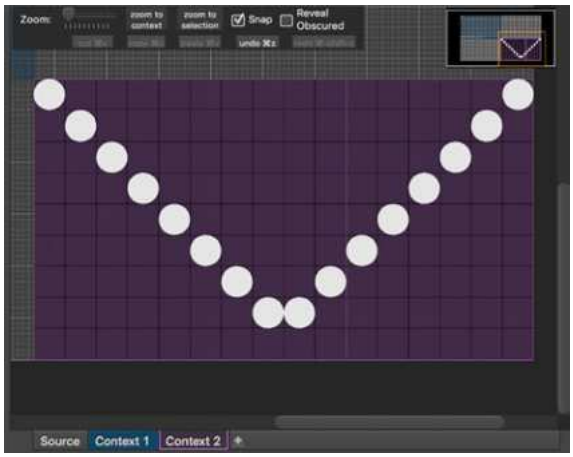




The context’s sub-sample width and height can be changed by entering a math equation in the context’s Sub-Sample fields. For example, ’/10’ (divide by 10) as shown below:



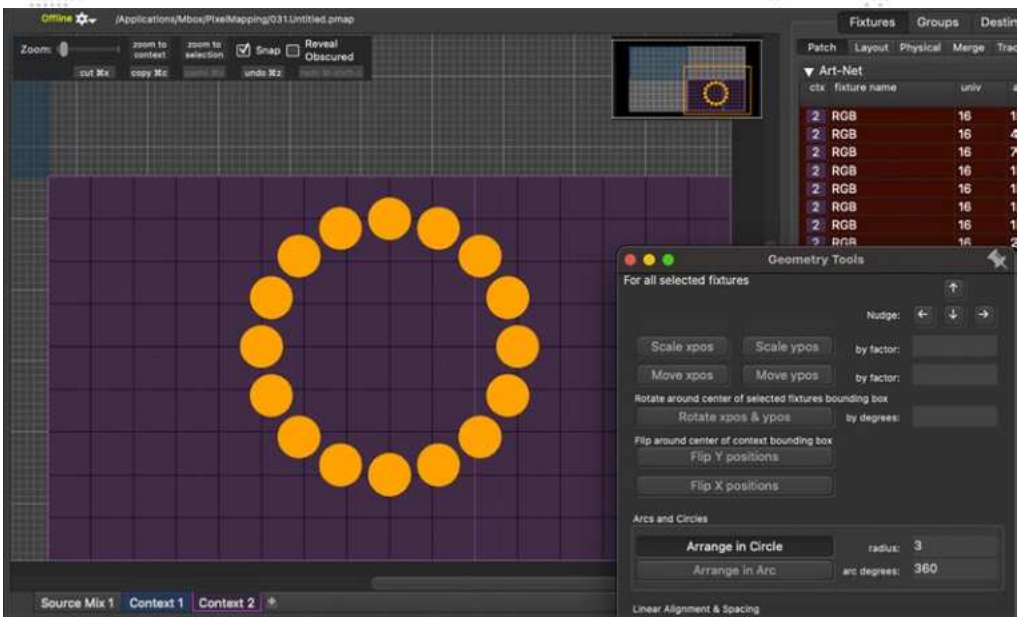
The final result of the moved fixtures and reduced context size is shown below:



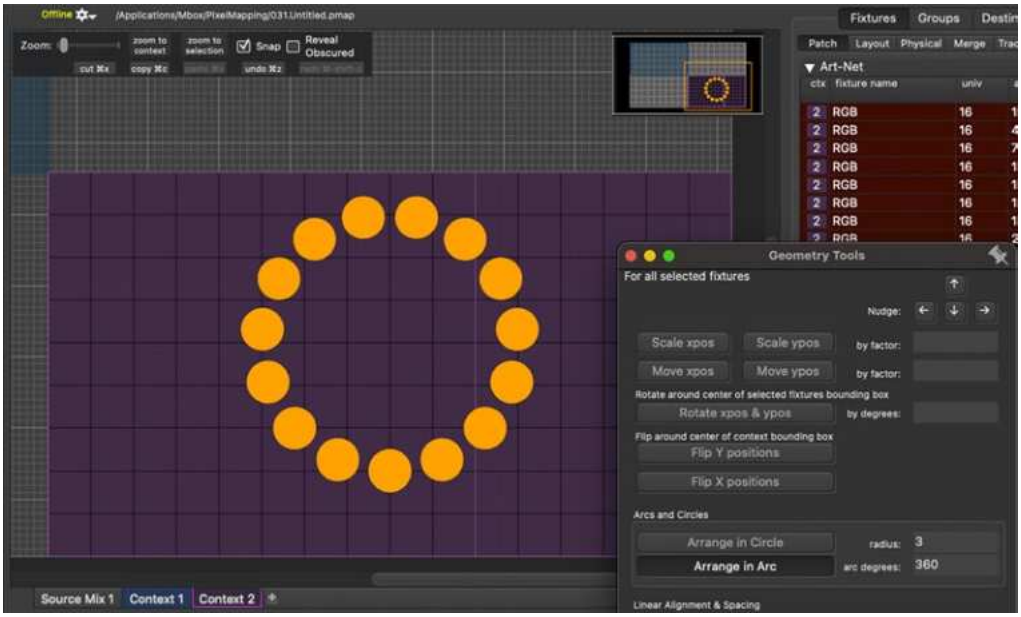
The following examples illustrate the difference in the Arrange in Circle and Arrange in Arc tools.

If “arc degrees” is set to a value of 360:

+ Arrange in Circle places the first fixture at 0 degrees and the last fixture at 360 * (n-1) / n, where ’n’ is the number of selected fixtures.

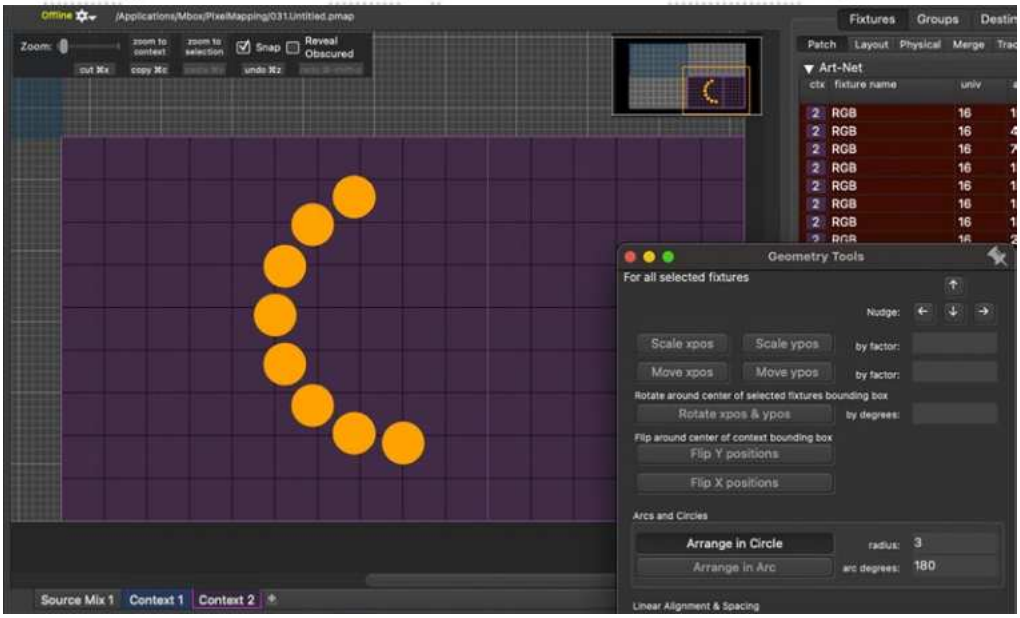


+ With the same Arc Degrees value (360°), Arrange in Arc places the first fixture at 0 degrees and the last fixture at 360. The first and last fixture are placed on top of each other.

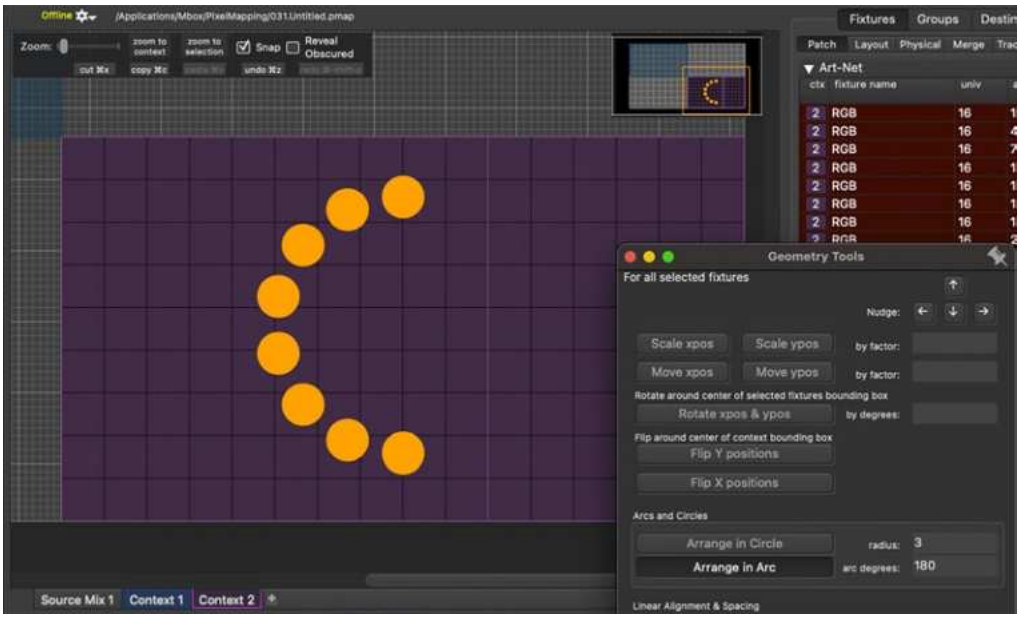


If “arc degrees” is set to a value 180:

+ Arrange in Circle places the first fixture at 0 degrees and the last fixture at 180 * (n-1) / n, where ’n’ is the number of selected fixtures.



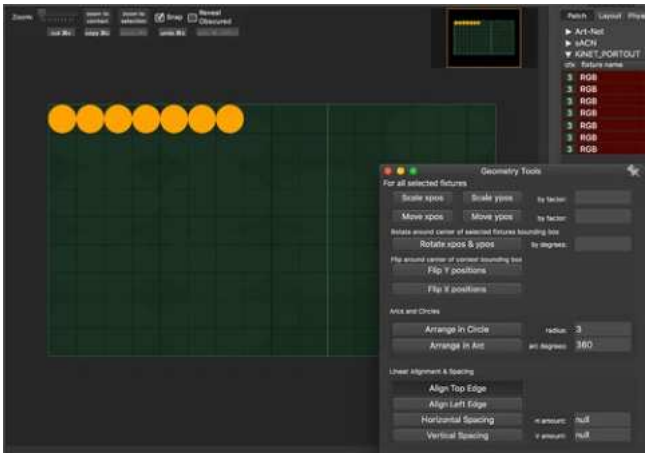
+ Arrange in Arc places the first fixture at 0 degrees and the last fixture at 180.



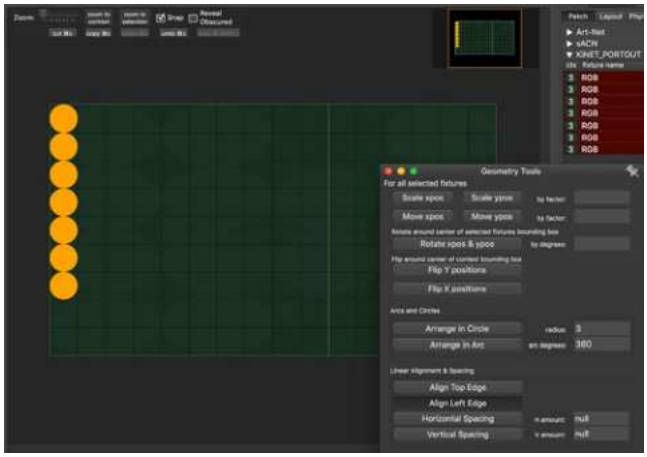
The following examples illustrate the use of the alignment and spacing tools.

Starting with a random arrangement of single RGB fixtures:

+ Arrange them in a horizontal row, using the top edge of the first fixture.

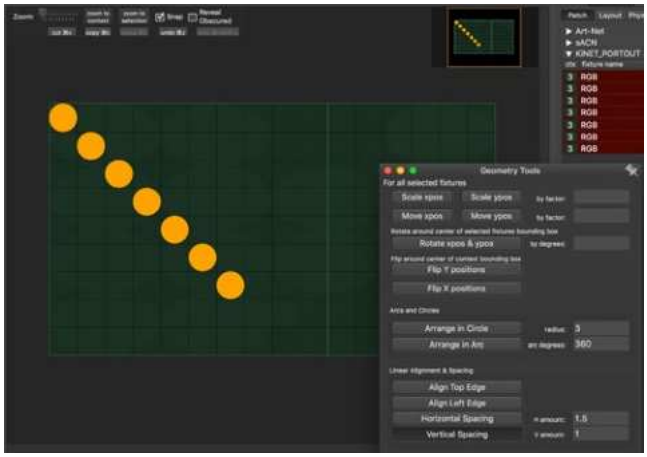


+ Arrange them in a vertical column, using the left edge of the first fixture.



+ Re-space the fixtures horizontally by 1.5 rectangles on the context grid.

+ Re-space the fixtures vertically by 1 rectangle on the context grid.



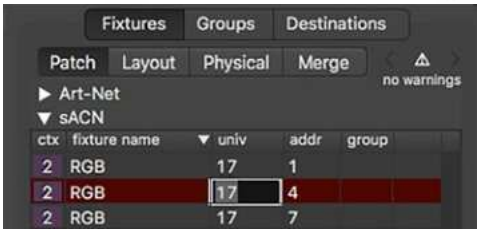
Note: The Geometry Tools rearrange multiple fixtures in order based on their universe.address or device.port.address (i.e. the order they are listed in the patch table) rather than the order in which they are selected.

Editing Fixture Properties

Once a fixture has been added to a context, its properties can be edited.

Some of the fixture-level properties can be edited directly in the table when the Fixtures tab is selected. These are:

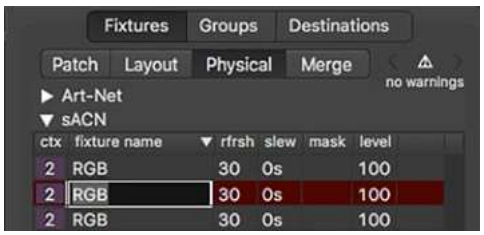
- Patch tab: universe/device, address, group
- Layout tab: X position, Y position, rotation
- Physical tab: name
- Merge: address, merge



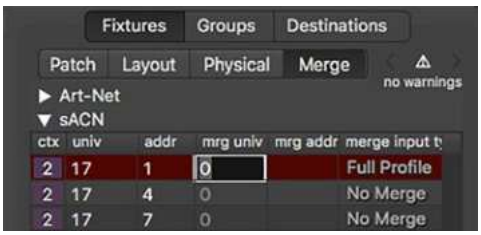
Patch

Layout

Other fixture-level properties can only be edited using the Edit Fixture window. The window can be used to edit a single fixture or multiple fixtures at once, if multiple fixtures are selected before opening.

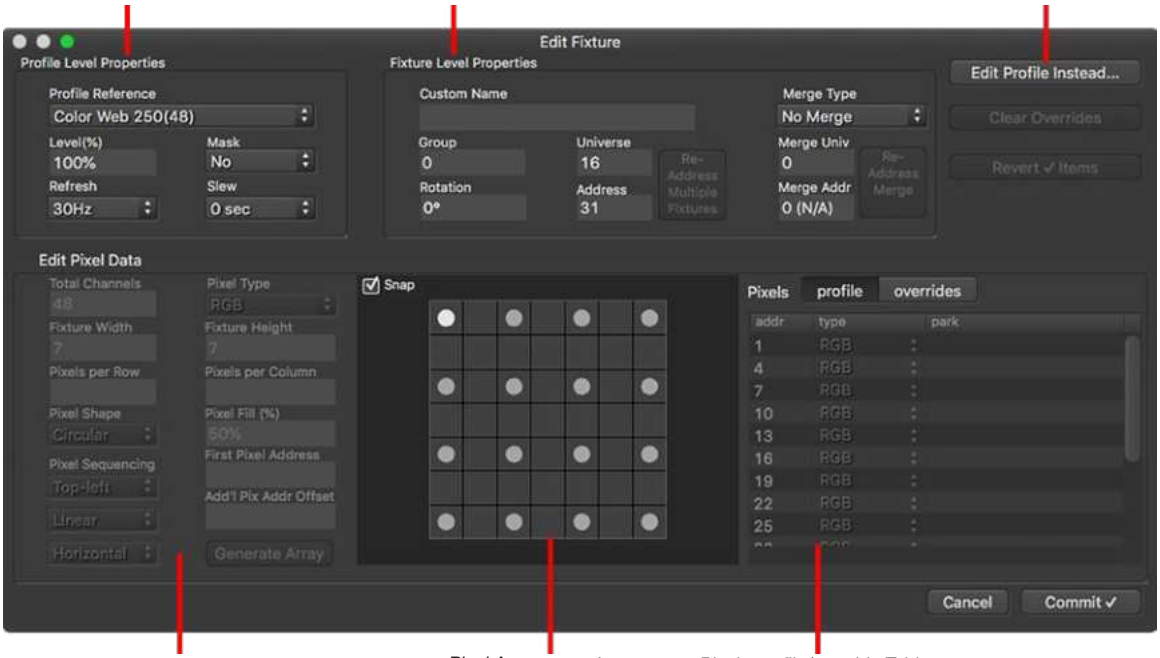


Physical



Merge

The Edit Fixture window also allows some profile-level properties to be changed without affecting the referenced profile. In other words, these profile-level property settings can be unique to the selected fixture(s). The profile reference can also be swapped to another profile. The Edit Profile Instead button provides access to all profile-level properties. (Refer to "Editing Fixture Profiles" on page 105.)



Pixel data is displayed in the window, but cannot be edited. However, it is possible to apply parked pixel overrides to existing pixels using the overrides tab. To add more parked pixels, use the Edit Profiles feature. Refer to "Editing Fixture Profiles" on page 105.

To use the Edit Fixture window:

Step 1. Open the Edit Fixture window using one of the following methods:

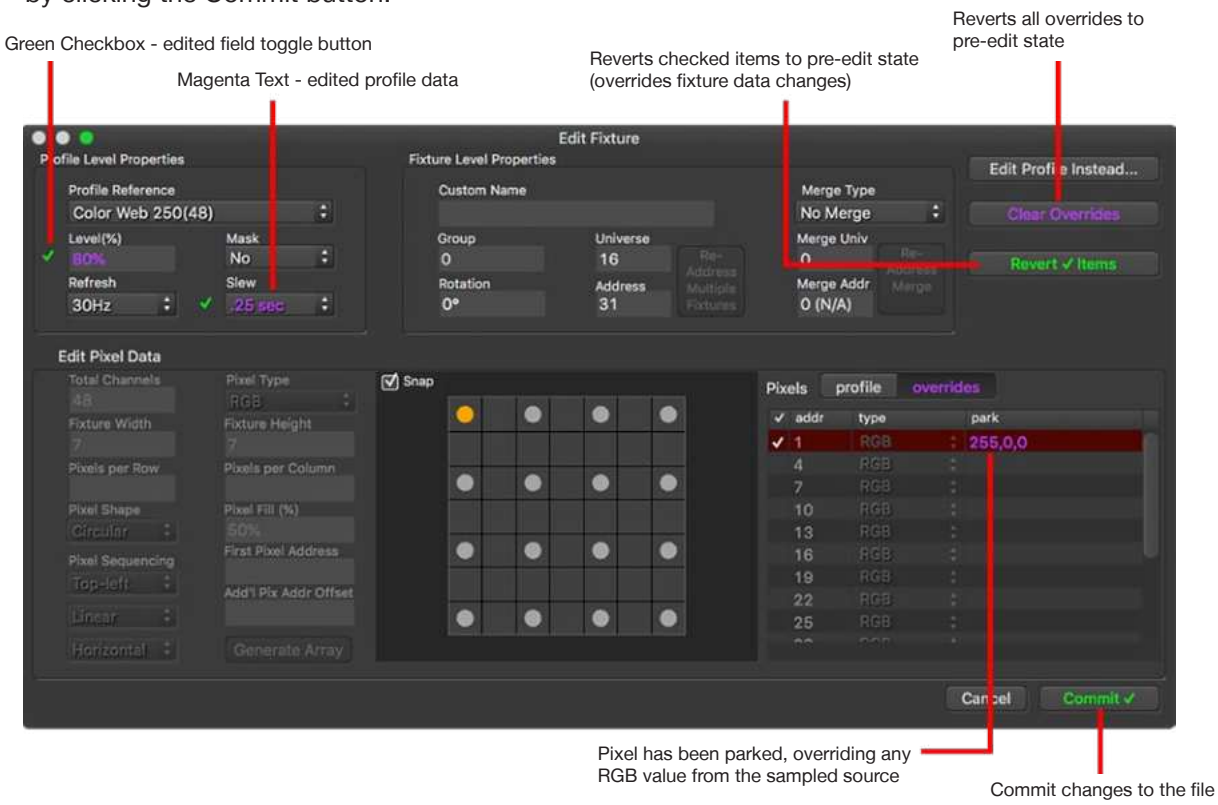
a. Double-click on a fixture's pixel in Context Grid.

b. Double-click on a fixture's ctx or fixture name field in the Fixture table.

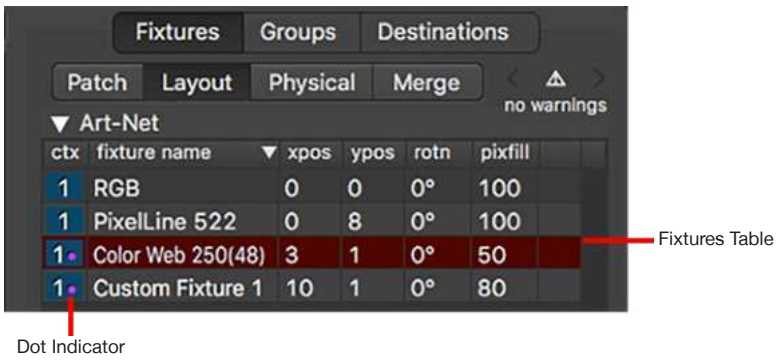
c. Select multiple fixtures in Fixture table (using cmd or shift), then double-click on one of the fixtures' ctx or fixture name field.

Step 2. On the Edit Fixture window, make changes to properties as required. During this process, the window will place a green checkbox beside edited fields.

Step 3. Changes can be cleared by unchecking the green checkboxes, or the changes can be accepted and applied by clicking the Commit button.

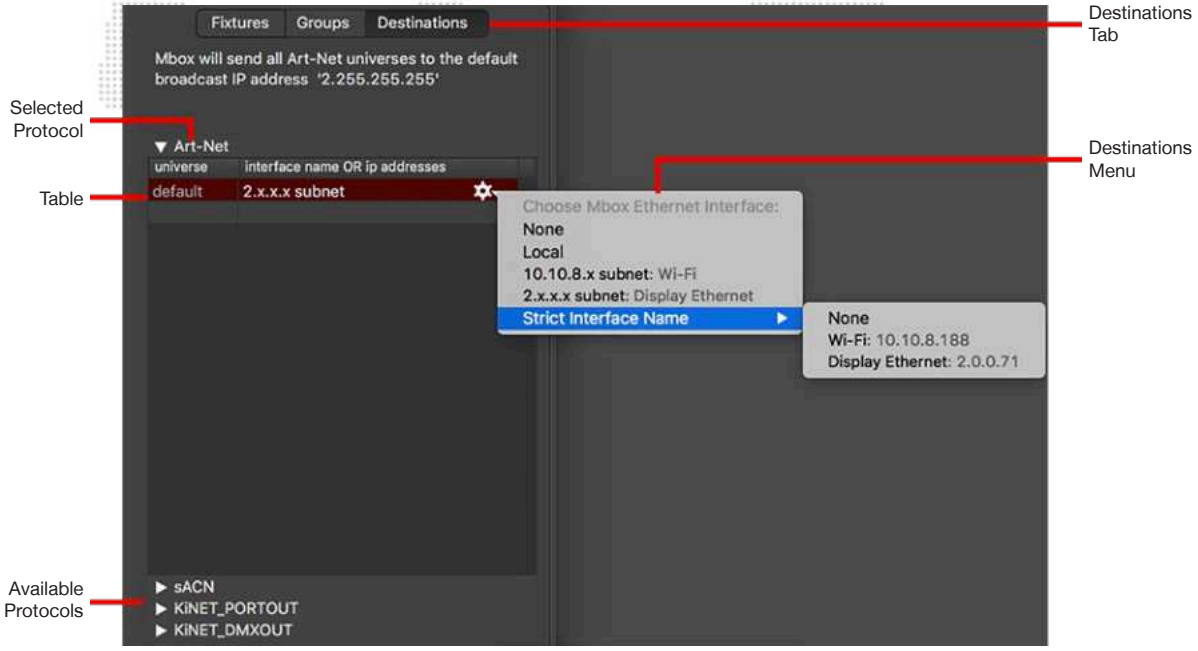


Fixture values that are edited to be different from the profile data are considered "overrides." Fixtures with overrides will have a magenta dot indicator in the Fixture table. If the Edit Fixture window is opened again these overrides can be cleared, thereby reverting to the original property from the fixture profile.



Destinations

Once fixtures have been placed onto the Context Grid, their data will need to be routed to a destination. This can be done using the Destinations tab.



There is a separate area of the Destinations tab for each of the protocols. When the Destination tab is selected, the protocol of the current context will be displayed. A different protocol can be viewed by clicking on the name of the protocol.

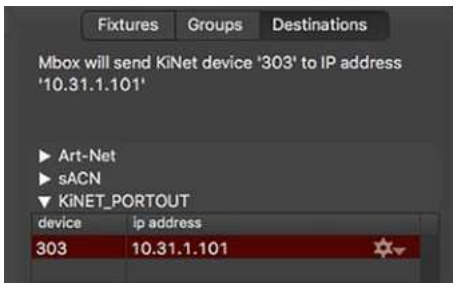
Destination Protocol Information

IMPORTANT! If you are using KiNET PORTOUT, please read the section below when entering device.port numbers on the Destinations tab.

KiNET has two protocol versions: v1 = DMXOUT and v2 = PORTOUT. You must select the correct protocol type depending on the Color Kinetics power supply that is used. Check with the manufacturer's documentation to determine what type of supply you have and how it should be configured.

For Art-Net and sACN only - and only once in the table - there may be an entry of "default" in the universe field. This will cause all patched universes without a discrete destination entry in the table to be sent to the corresponding default IP address. With Art-Net only, if the default entry is given a broadcast IP address then ArtPOLL discovery will be used (as long as it is not disabled at the Mbox Setup window). This would lead allow for automatic unicasting to all ArtPOLL compatible devices on that subnet.

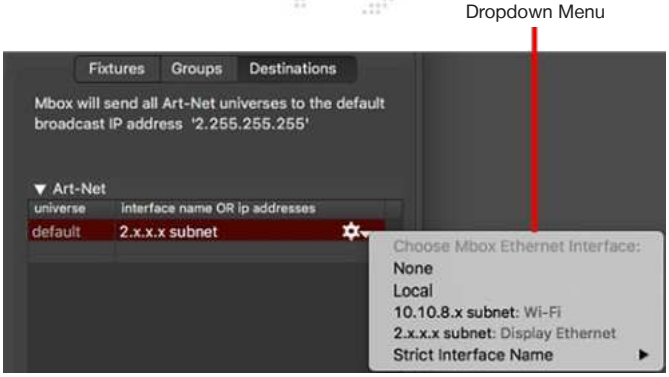
For KiNET PORTout or DMXout, the device number (for example, 303) must be entered for each connected power supply. This will cause Mbox to send data for fixtures using that device number to the designated IP address and routed to the appropriate port on that device.



To enter discrete destinations, double-click in the blank fields below the default destination and enter the universe or device number and IP Address for the new destination. This IP address is where all data for fixtures using that destination will be sent. Several different values can be entered in this field. Clicking on the gear icon at the right of the destination IP Address field will reveal a dropdown menu to help with this process. The menu allows the selection of a particular interface or subnet. (Note that Mbox Remote must be in a Live Editing session to view the available interfaces or subnets. Refer to "Live Editing" on page 58.)

Manual Destination Entry

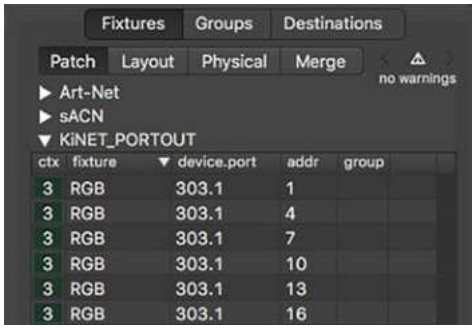
Dropdown Menu

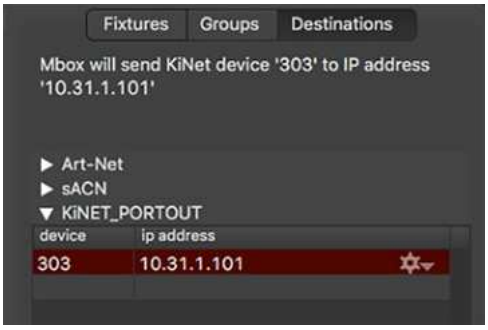


+ **Unicast IP Address** - Enter a static IP Address (e.g.,2.23.45.136) to send all data for that destination to one single IP Address. Optionally, one destination's data can be sent to up to four individual unicast IP addresses by separating several IP addresses with a "+" when entering them. (e.g.,2.23.45.136+2.23.67.123)
+ **Subnet Broadcast IP Address** - Enter a subnet broadcast IP Address (e.g.,2.255.255.255) that matches the subnet broadcast IP address of one ethernet interface on the computer. The dropdown menu can be used to simplify this process by displaying the available interfaces with their subnet broadcast address. Rather than having to enter the subnet broadcast address manually, just select it from the menu.
+ **Strict Interface Name** - Enter the exact name of the ethernet interface on the Mbox computer that the data should be sent from. The data will automatically be sent to the IP address matching the subnet broadcast IP address for that interface. (e.g. if the interface has an IP of 2.0.0.1 and a subnet mask of 255.255.0.0 then the data will be sent to 2.0.255.255)

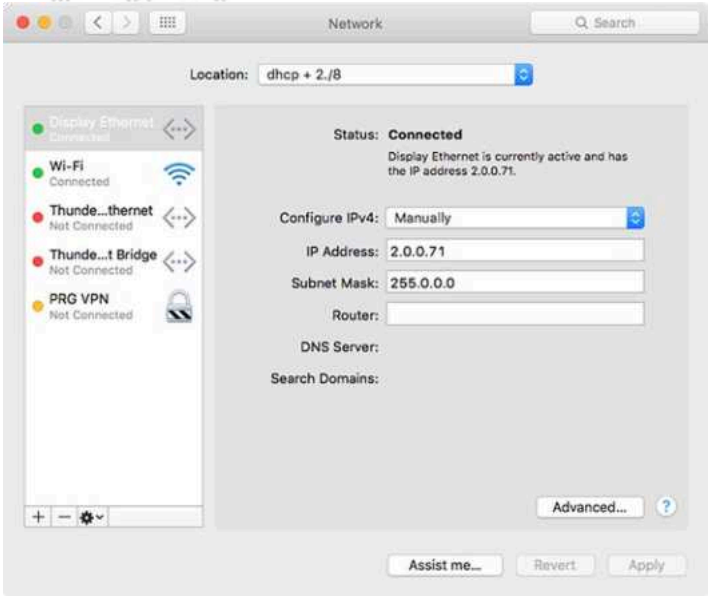
IMPORTANT! For KiNET you should always use a static IP address!

The example below shows the correct way to enter the destination for the fixtures patched to device 303, port 1.





Destination IP Addressing



The configuration of the ethernet interface on the Mbox computer and the destination IP address on the Destinations tab of the fixture table should be coordinated. Destination IP addresses determine both how the outgoing pixel mapping packets are addressed, but also which ethernet interface on the computer they will be output from. (Refer to "Appendix A. Mbox Networking Guidelines" on page 125 for more detailed information.)

If there are two ethernet interfaces on the computer, recommended practice is to receive Art-Net or sACN to control Mbox on one interface and to output pixel mapping data from the other interface. Therefore the two interfaces must be on separate subnets to ensure that Mbox can determine which interface to use. If a broadcast IP address is used for Art-Net destinations, Mbox will broadcast pixel map Art-Net using that broadcast address. But in cases where the computer is connected to ArtPOLL compliant devices (e.g., Artistic Licence Ether-Lynx) Mbox can unicast universes to the specific IP Address for those devices. Note: If two more devices respond to an ArtPOLL replying that they require a universe of data, that universe will be broadcast instead of being unicast.

CAUTION! While most Art-Net devices use an IP address of 2.#.#.# and subnet mask of 255.0.0.0, some devices can be configured to use other IP addresses. Don't assume that setting the Mbox's IP address and subnet mask to a 2.#.#.#/8 scheme are correct, always check!

Some Art-Net devices do not respond to ArtPOLL requests and should always receive broadcast data. If the system includes both ArtPOLL compliant and non-compliant devices, and these devices are required to receive the same universe(s), the default action of Mbox will be to unicast the data to the ArtPOLL-compliant devices only. At which point the non-compliant devices would not receive the Art-Net. In such cases, ArtPOLL should be disabled by checking the "ArtPOLL Disable" checkbox on the Preferences tab and then performing a rescan in Mbox.

Suggested Ethernet Setup for Art-Net Output using two interfaces:

+ Interface 1 (receiving Art-Net for control) - IP=2.1.0.123 Subnet Mask=255.255.0.0
+ Interface 2 (sending pixel mapping Art-Net) - IP=2.0.0.123 Subnet Mask = 255.0.0.0
+ Pixel-map destination IP address for default destination - 2.255.255.255 or Ethernet 2

Example Ethernet Setup for sACN Output (to ETC Net3 device, using ETC's suggested addressing for media servers):

+ Interface 1 (receiving Art-Net for control) - IP=2.0.0.123 Subnet Mask=255.0.0.0
+ Interface 2 (sending pixel mapping sACN) - IP=10.101.130.123 Subnet Mask = 255.255.0.0
+ Pixel-map destination IP address for default sACN destination - 10.101.255.255 or Ethernet 2

Example Ethernet Setup for KiNET Output:

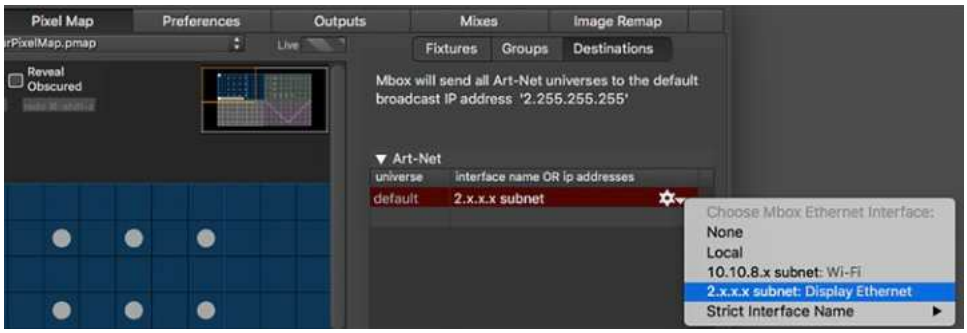
+ Interface 1 (receiving Art-Net for control) - IP=2.0.0.123 Subnet Mask=255.0.0.0
+ Interface 2 (sending pixel mapping KiNET) - IP=10.0.0.123 Subnet Mask = 255.0.0.0
+ Pixel-map destination IP addresses are all unicast

The above setups ensure that the computer can receive Art-Net on the first interface, and that it will also send pixel mapping output from the second interface. The key factors being the use of the correct IP address for the interface in question, and the "coordination" between the subnet mask of the second interface and the destination broadcast IP address for the pixel mapping data. These are only a few of many possible IP address/subnet mask configurations that will work. Depending on your requirements and other devices on the network, you may require different settings. Refer to "Appendix A. Mbox Networking Guidelines" on page 125 for more information on subnet masks.

Note: It is possible to receive control data and output pixel mapping data from the same interface on the computer. Sometimes this is unavoidable due to the control data distribution required for the show. If using the same interface is required, take care that the network bandwidth is not exceeded and that the control input to Mbox is not affected. Of course the IP address/subnet mask setup of the single interface must work for both input and output devices.

CAUTION! The pixel map level channel on the Master fixture masters the overall output levels generated when pixel mapping. If this channel is at a level of 0, then you will be outputting valid pixel mapping data, but all levels will be suppressed. In addition, the Global Master control channel can be used together with the Global Master Control Selector channel to enable/disable all pixel mapping output or to force all fixtures using the mask property to output zero.

For most situations, choose a subnet entry from the pop-up menu:



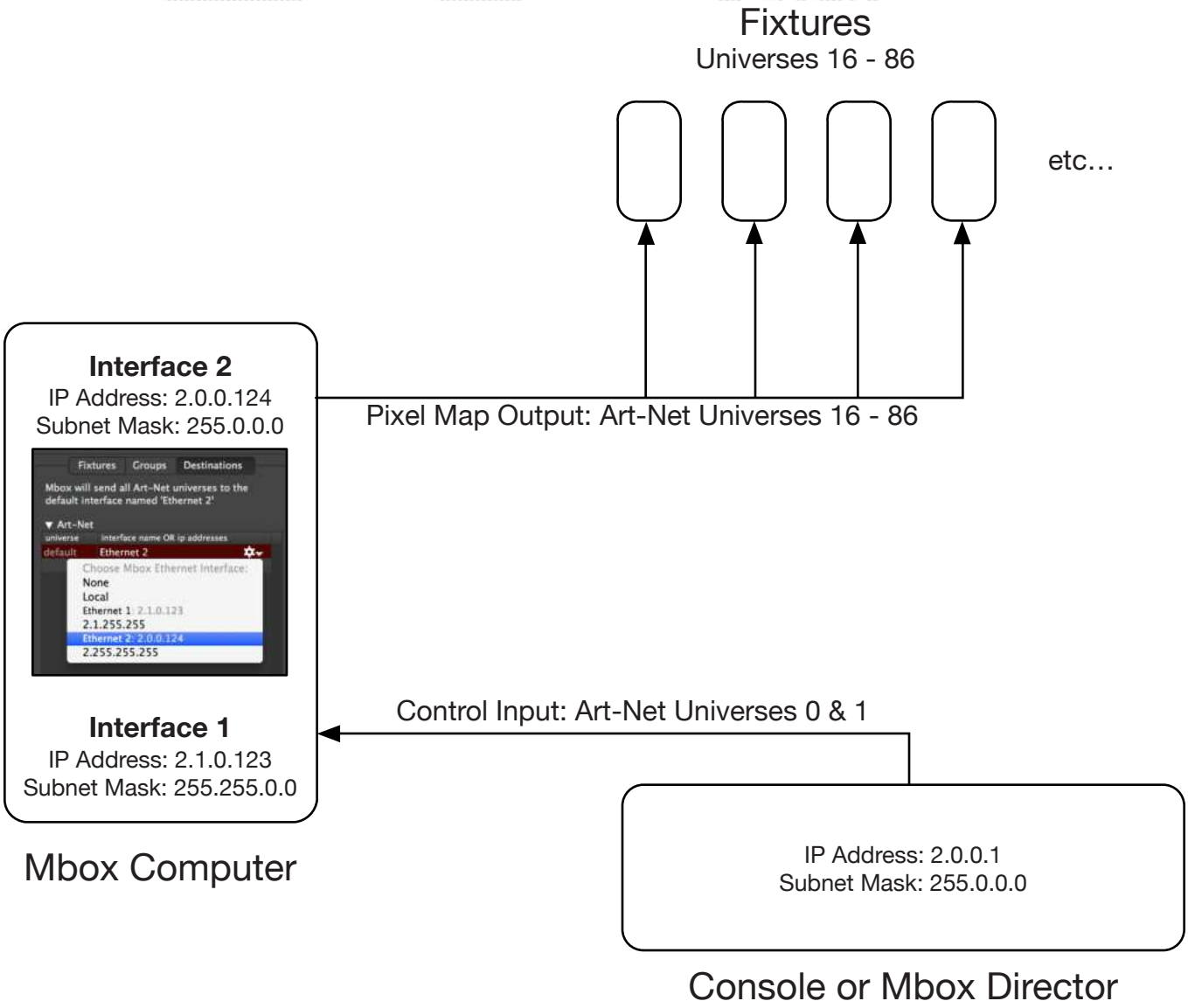
Guidelines:

+ An active protocol must have at least one destination, but may have more than one destination.
+ Art-Net and sACN can have a default destination. All universes of that protocol that lack a specific destination are sent to the default destination.
+ For Art-Net, the use of the default destination means that an ArtPOLL request will be sent out if ArtPOLL is not disabled. ArtPOLL may be disabled using the checkbox on Mbox's Setup tab.
  - If an ArtPOLL response is received from a compatible device, then that device may receive unicast Art-Net transmissions for the universes that it requests.
  - Universes not requested by ArtPOLL compatible devices will be broadcast to the specified subnet.
  - If no ArtPOLL responses are received, all data will be broadcast to the specified subnet.
  - If more than one ArtPOLL responder requests the same universe, that universe will be broadcast to the subnet, rather than unicast.
+ For sACN, the use of the default destination means that multicast will be used.
  - Each universe is sent to a specific multicast IP Address.
  - Receiving devices listen for data on the appropriate multicast addresses.

+ The default destination entry for Art-Net and sACN can be disabled by choosing an interface of “None” in the setup menu (reached by clicking on the gear icon) in the IP address/Interface name column.
+ Any Art-Net or sACN universe that has a discrete entry in the Destinations table will be sent directly to the specified destination, not to the default destination.
  - Discrete entries can be used cause a universe to be unicast or sent to a different sub-net broadcast address.
  - In certain cases, it may be useful to unicast sACN in this manner.
+ A discrete entry may direct the universe to be output from a different interface than the default.
+ KiNET may not have a default destination, as transmission of this protocol is typically unicast.
+ Destinations may be expressed in one of three ways: by subnet, by interface name, or by manually entering IP Addresses. This is true for both the default destination and any discrete destinations.
+ Selecting the destination by subnet is the recommended method. When using a subnet destination, Mbox will ignore interface names and select the appropriate interface based on its subnet. Pixel mapping data will be output to that subnet’s broadcast address.
  - Selecting the destination by subnet helps to confirm that the data will be sent to the right place based on the current setup of the computer. When selecting a subnet from the pop up menu, the name of the interface matching that subnet is displayed as a reference. If this is not the expected interface for the desired subnet, then you should check your ethernet configuration.
  - Selecting a subnet allows the same configuration to be used without modification on computers that have differing interface names. Of course, the other computers must have an ethernet interface configured to be on the same subnet.
+ Selecting the destination by interface name may be used for simple, quick configurations where the user is unfamiliar with the concept of subnets, or where the configuration doesn’t need to be transferred to another computer. When using an interface name destination, Mbox will output pixel mapping data to the subnet broadcast address for that interface.
  - Interface names may be entered manually rather than selecting them from the pop up menu. However, if the name is entered incorrectly, data will not be output.
  - When a destination is selected by interface name, if the interface name then changes, the interface becomes disconnected, or the configuration is used on a computer with differently named interfaces, the output of data to that destination will fail.
  - If the selected interface’s subnet is changed, then the destination for the data will also change; possibly causing the data to not reach the intended destination.
+ Selecting the destination by IP Address allows data to be send to specific locations. When using an IP Address destination Mbox will send data only to that address.
  - IP Addresses may be any valid IP Address that can be routed internally or externally. This may be Unicast, Subnet Broadcast, or Full Broadcast.
  - When using discrete IP Addresses, if there is no route (as determined by the computer’s OS and network stack) to a device with the specified IP Address, no data will be output to that destination. There is no fall-back if the configuration is wrong or if the device is not present on the network.

IMPORTANT! Refer to “Appendix A. Mbox Networking Guidelines” on page 125 for more information about IP address and subnet mask setup.

Pixel Map Network Sources and Destinations example diagram:

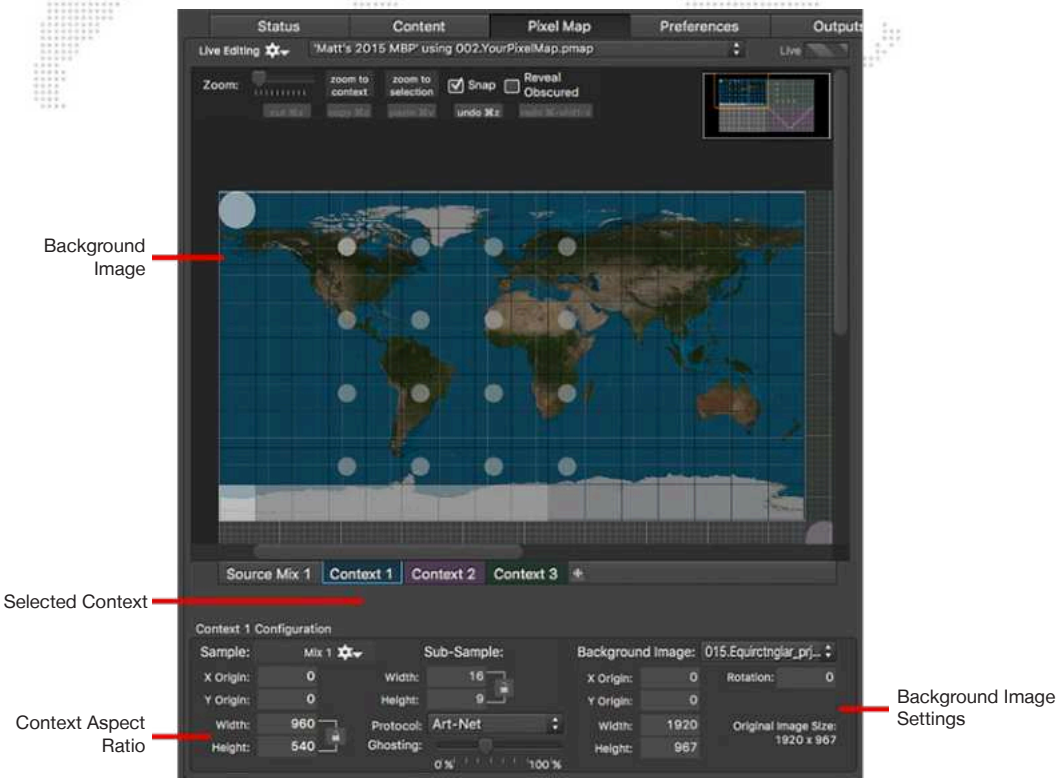


Previsualization

Mbox v4 included functionality that allowed an onscreen previsualized version of portions of the pixel mapping output to be viewed on the outputs of the Mbox application. At present time, this functionality is not available in the Mbox v5 application.

Background Image

A background image can be added to a context in order to better visualize the pixel mapping configuration. The background type can be either a still image from a file on disk or a live stream image from Mbox.



Still Image Backgrounds

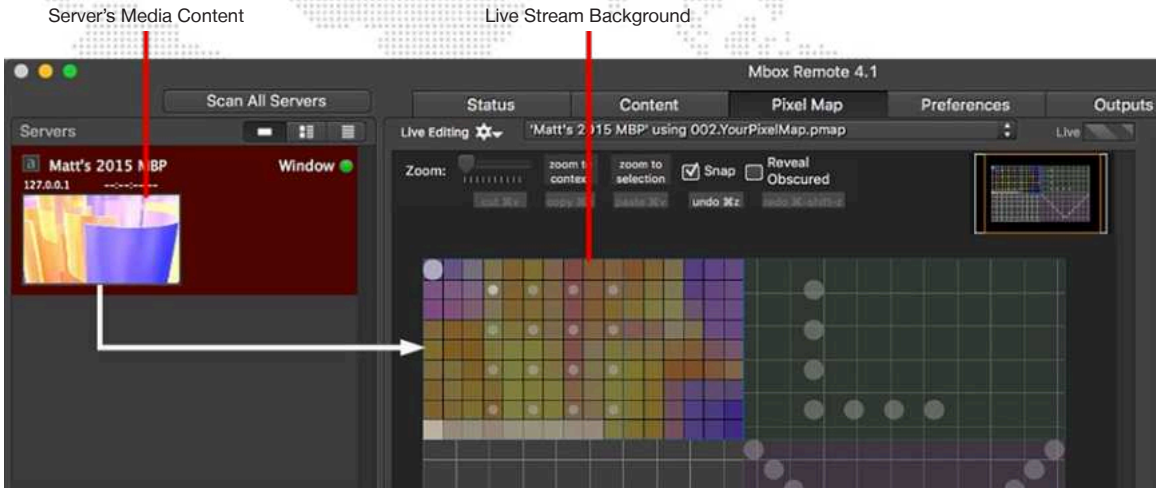
A still image must be in JPEG or a PNG format (PNG images can have an alpha channel). The image is imported and saved within the pixel map (.pmap) configuration file, so it stays with the file. The pixel mapping file size can get large if numerous background images are used, and this affect transfer times when opening or saving the file. There is a pop-up menu option to remove unused image files if file size becomes an issue - see instructions on page 97.

The background image has X and Y origin values to allow placement in the correct position within the context. The image can be rotated by entering an value in the Rotation field. The image also has width and height settings to designate which portion of the image will be displayed on the context.

The designated portion of the background image will be force-fit onto the context. Therefore, if the aspect ratios of that portion and the context do not match, the image will not be displayed at the correct aspect ratio. For best results, the background image needs to be the same aspect ratio as the context, or the background image's width and height need to be adjusted to match the context's aspect ratio. For example, if a background image is 1280 x 1024 but the context is 1920 x 1080, the background height could be reduced to 720 (clipping the bottom of the image), or the background width could be increased to 1820 (adding blank space on the right side of the image) to correct the aspect ratio.

Live Stream Backgrounds

A live stream image comes from the connected Mbox during a live session with the Mbox Remote application. (Refer to "Live Editing" on page 58 for instructions on this type of session.) In this case, the live stream will show the moving imagery that Mbox is generating for the area of the source that the context is sampling. The live stream will be pixelated to match the sub-sampling the context performs upon the source's imagery.



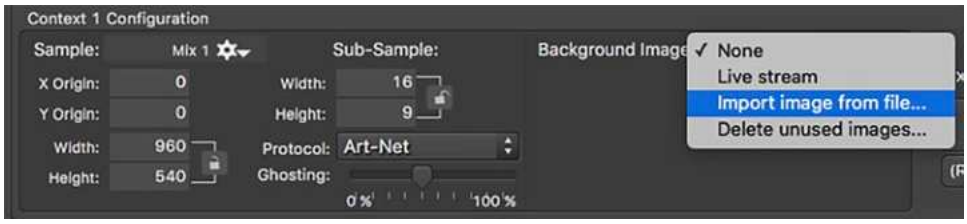
Ghosting

The Ghosting control on each context can be used to adjust the visibility of patched fixtures in a context against the sub-sampled background image for the context. The ghosting level will adjust the balance between the brightness of patched fixtures against the background image.

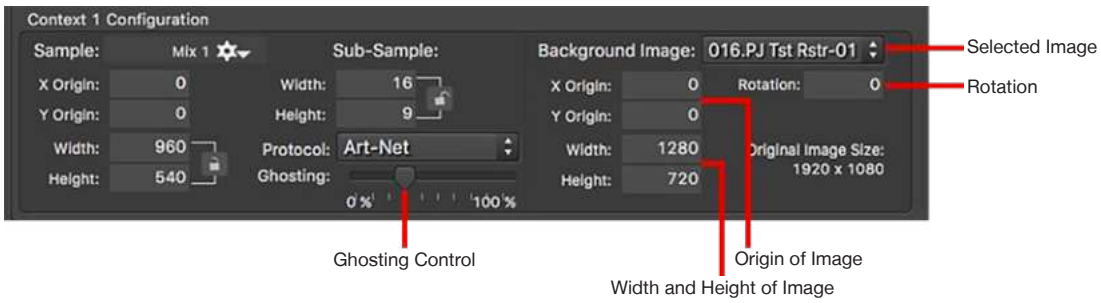
To set a background image:

Step 1. In the context configuration area, click on the Background Image pop-up menu.

Step 2. Select Live stream, or Import image from file...



Step 3. Configure background image settings as required.



Note: When using Rotation, the background image is rotated around its X and Y origin rather than around its center. The X and Y origins may need to be set to negative numbers in order for the entire background image to be fully visible.

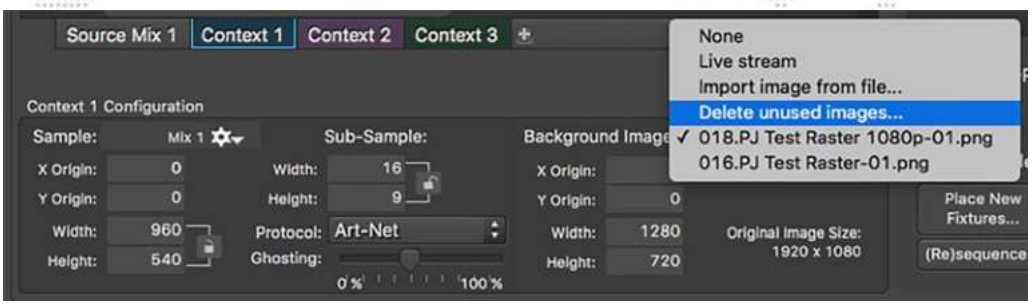
Step 4. Adjust the ghosting level to change the brightness of patched fixtures against the background image.

Deleting unused background images

If the pixel mapping file contains unused still images, these can be deleted to reduce overall file size.

Step 1. In the context configuration area,, click on the Background Image pop-up menu.

Step 2. Select Delete unused images. All unused images will be deleted from the file.



Fixture Profiles

The fixture reference model used with Mbox's pixel mapping allows for rapid global changes to all patched fixtures of one type. Mbox Remote provides a selection of built-in fixture profiles, as well as the ability to create custom fixture profiles. Custom fixture profiles are saved in the pixel mapping configuration (.pmap) file, while built-in profiles are not saved since they are resident in the application itself.

With the Mbox fixture reference model, all patched fixtures reference profile-level fixture information for data except for:

+ Custom name, x/y position in context, rotation, universe, address, and group.
+ Overrides.

Changes made to profile-level data will sweep to all fixtures of the same type unless fixture overrides have been applied. Profile-level data includes level, mask, refresh, slew, and base pixel data (shape, type, pixfill). Some of this data can be overridden on a per-fixture basis, along with parked pixels. These overrides may be cleared at any time, reverting the fixture back to the profile defaults.

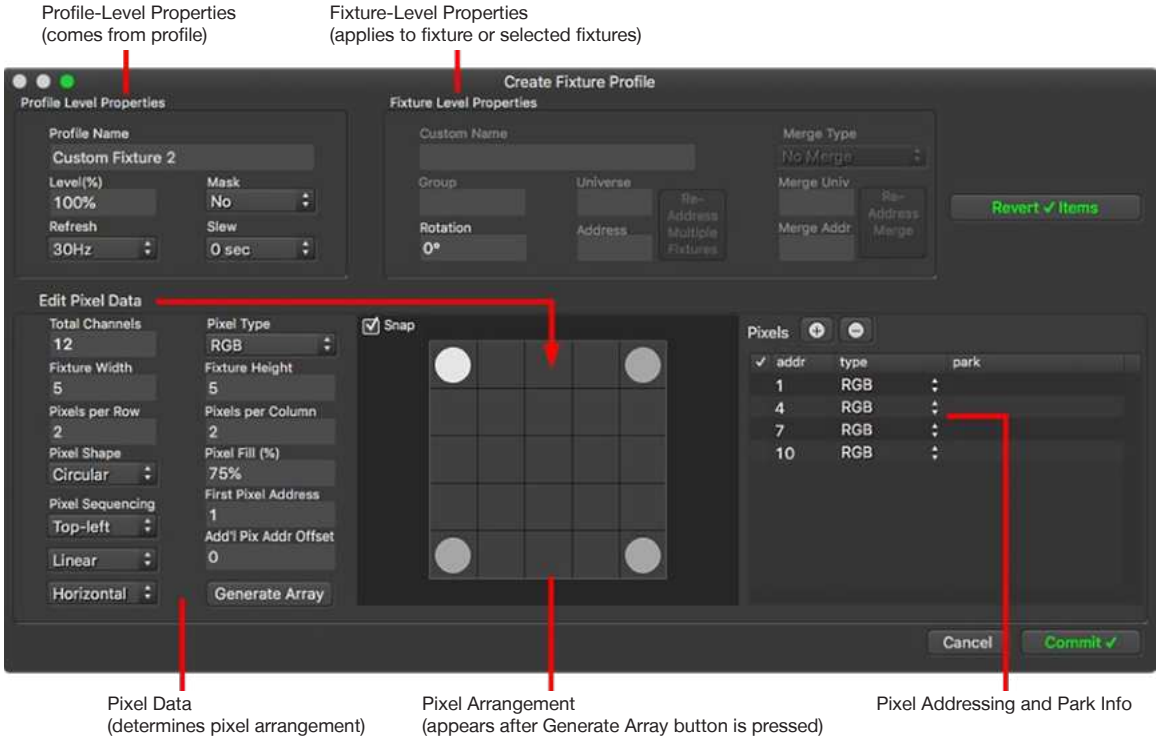
Creating Custom Fixtures

Mbox Remote provides the ability to create both simple and complex fixture types beyond simple arrays.

Guidelines:

+ Custom fixtures have pixels, which generate output based upon the onscreen imagery color and the type of pixel.
+ Custom fixtures can have up to 512 channels total.
+ Custom fixtures can have extra channels. These extra channels will output a level of zero unless they are assigned static output levels using the Parked Pixels feature or the Merge feature is being used with pass-through data.

Custom fixtures are created using the Create Fixture Profile window.



Profile Level properties:

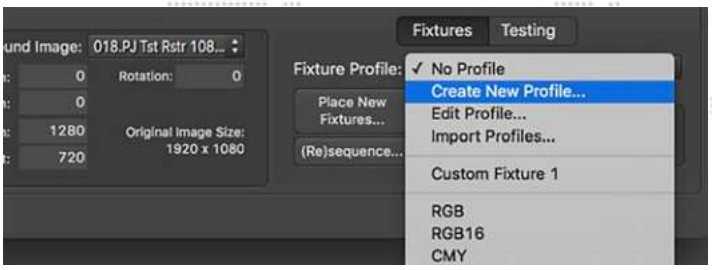
+ **Profile Name** - the profile name used for the fixture and for the reference model. Note that this is not the same as the custom name of a patched fixture.
+ **Level** - overall level maximum. This value can't be changed live, only by editing the fixture.
+ **Mask** - property that allows the fixture's color output to be forced to zero when the correct control values are sent. This is intended for use with CMY fixtures when using external HTP merging.
+ **Refresh** - specifies how many updates per second this fixture will deliver to the pixel mapping engine.
+ **Slew** - the minimum time allowed for a change from no level to full level. This is intended to slow down the speed of changes when the receiving fixture can't move fast enough, or might be damaged by rapid changes.
+ **Rotation** - sets fixture rotation. This is strictly a fixture-level property (not a profile-level property), but it can be assigned when making a profile so as assign a default rotation to a fixture profile whenever it is placed.

Pixel Data properties:

+ **Total Channels** - the total number of channels that the fixture uses. Be aware that this number may be more than just the channels required for color control (e.g. pan, tilt, and iris channels may need to be accounted for). The number must be greater than or equal to: the number of pixels per row times the number of pixels per column times the number of channels per pixel for the selected pixel type. If this number is greater than the number of channels required by the actual pixels in the fixture, any additional channels will have an output level of zero unless parked pixels are added or the merge feature is used.
  - For example: when creating a simple RGB-only fixture, if an RGB pixel is used, it has three channels per pixel. A fixture is created that is 5 pixels per row and 3 pixels per column, the math would be (5 x 3) x 3 = 45. The total channels for this fixture should be 45. If the same fixture were to have more channels for added functionality, the total channel count would be greater than 45.
  - If the total number of channels is greater than the number of channels used for patched pixels in the fixture, a warning message will be displayed when the fixture profile is saved. The message will note which extra channels will have an output level of zero.
+ **Pixel Type** - one of the available pixel types to base the fixture upon. For example, RGB, HSV, CMY, Luma.
+ **Fixture Width/Height** - the width and height of the fixture in context sub-rectangles.
+ **Pixels per Row/Column** - the number of horizontal or vertical pixels in the fixture. These numbers, together with the Fixture Width and Height, will determine the initial spacing of pixels within the fixture's footprint.
+ **Pixel Shape** - circular or rectangular. The shape is seen in the editor only, and has no effect on output.
+ **Pixel Fill** - size of the pixels as a percentage of the size of the context sub-rectangle. Viewable in the editor only, and has no effect on output.
+ **Pixel Sequencing** - the addressing order of the pixels in the fixture. This can start at any corner and proceed through the pixels of the fixture in a vertical or horizontal fashion, using a linear or zigzag path.
+ **First Pixel Address** - the start address of the first pixel in the fixture. This value defaults to 1 (i.e. the first channel in the fixture's control layout), but can be changed to accommodate complex fixtures where the pixel mapped pixels are not at the beginning of the fixture's control layout. Pixels are added sequentially with no spacing starting at this address unless the Add'l Pix Addr Offset value is edited.
+ **Add'l Pix Addr Offset** - additional channel "padding" to be inserted between each pixel in the fixture. For example, a simple RGB fixture could start at address 11 and use pixel addresses 11, 14, 17, and so on. With an additional offset value of 2, and starting at address 11, the fixture's pixels would use addresses 11, 16, 21, and so on.

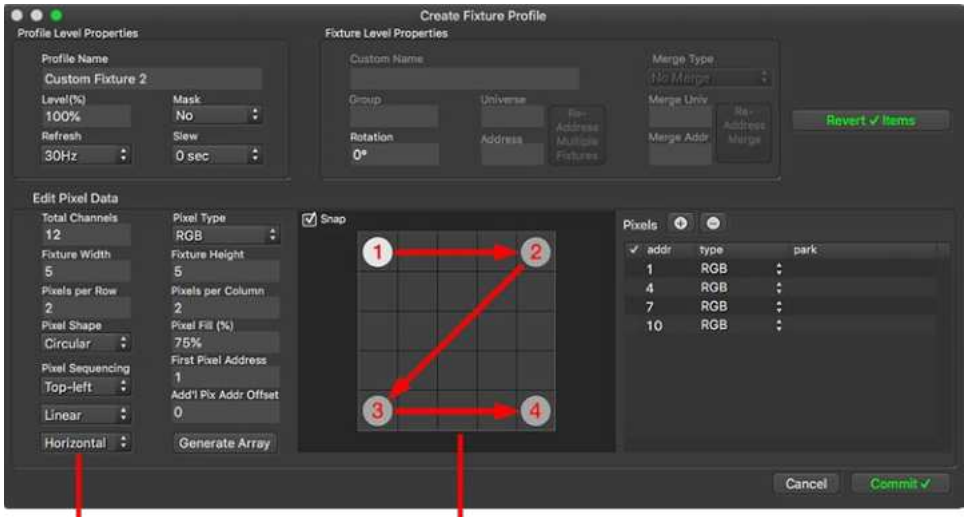
To create a new fixture:

Step 1. On the Fixture Profile pop-up menu, select Create New Profile. The Create Fixture Profile window will open.



Step 2. On the Create Fixture Profile window, enter necessary values/properties for the fixture profile. (Refer to the explanations and guidelines on previous pages.)

Step 3. Enter necessary values/properties for the pixels in the fixture. (Refer to the explanations and guidelines on previous pages) All active pixels must be of the same type to begin with, but can be changed in a later step (see below).



The sequencing pattern in the array is determined by the Pixel Sequence settings

Step 4. Click the Generate Array button to create the initial arrangement of pixels. Values can be changed and the array rebuilt at any time if the desired result is not achieved.

Note: Changes made in the property fields to the left of the grid require the Generate Array button to be pressed again to apply those changes

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Step 5. Once the initial array has been created, properties can still be changed:

a. The address of the first pixel can be changed. Note that modifying this value will change the address of all pixels in the fixture.

b. The address spacing between pixels can be changed. Note that this will change the address of all pixels in the fixture.

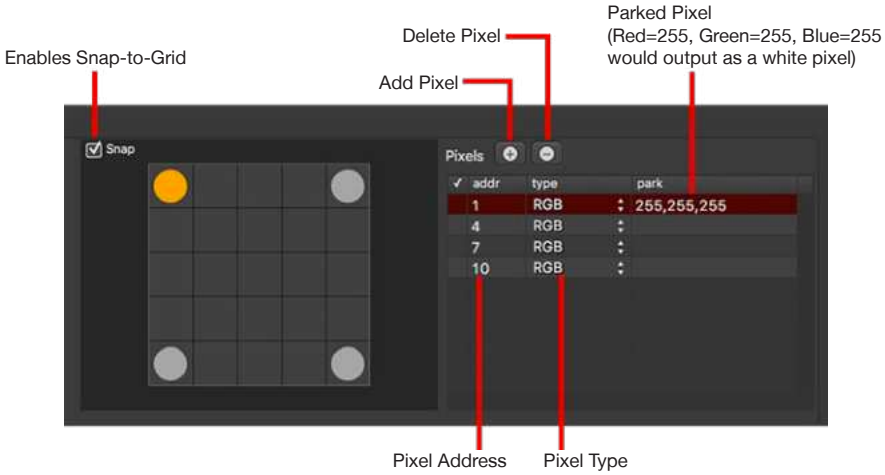
c. Layout of individual pixels (pixels can snap to the grid or have arbitrary positions). Click and drag on any pixel to move it to a new position on the grid.

d. Individual pixel addressing within the profile's total channel count (using each pixel's address field).

e. Individual pixel types (using the type pop-up menu).

f. Park values can be assigned and additional pixels can be added (parked pixels or extra color pixels) by clicking the [+] button. (For complete instructions on park values, refer to "Parked Pixels" on page 103.)

g. Pixels can be removed by selecting a pixel and pressing the [-] button.



Step 6. When finished editing, press the Commit button to accept the entered data and create the profile.

RGBW_2 Pixels

The RGBW_2 pixel type uses special processing to convert Mbox's rendered onscreen RGB values into RGBW values. This is achieved by first determining how "white" the sampled RGB color is, and by then increasing the level of the W component's output and decreasing the levels of the R, G, and B components' outputs proportionally as the sampled RGB value gets whiter. If the sampled onscreen RGB value is pure white, only the W component has an output value.

Because the color temperature or tint of white LEDs can vary, the RGBW_2 White Tuning preference allows a configurable amount of R, G, and B to be added back into to the pure white output generated by the W component. This preference has a default value of 0, 0, 0 (R, G, B) meaning that no red, green, or blue is added to the white color. Increasing the color values in the this preference can tint - e.g. add red to make the white "pinker" - or adjust the color temperature - e.g. add blue to make the white "cooler" - of the white that the pixel outputs.

This adjustment is purely subjective, there is no right or wrong value for the color tuning.

Note: There is only one RGBW_2 White Tuning preference. Therefore, all fixtures with RGBW_2 pixels receive the same tuning. This means that for different fixture types, the tuning may not give the same result.

RGBAmber and RGBLime Pixels

The RGBAmber and RGBLime pixel types require special processing by Mbox's pixel mapping engine. This is because the balance of the red, green, blue, and amber/lime output from the pixel needs to be calibrated to best match the actual hue of the amber or lime LEDs in the fixture. In a theoretical sense, amber is a mix of red and green, with more red than green, but with no blue, and lime is a mix of red and green, with more green than red, but with no blue. Mbox uses default values of 255,192,0 (R,G,B) for amber and 192,255,0 (R,G,B) for lime. These values are a good starting point, but may result in a slight color shift when the RGBAmber/Lime fixture outputs white. Not all fixtures use amber/lime LEDs with precisely the same hue or may use different curves for those LEDs.

In order to cause an RGBAmber or RGBLime fixture to output white, its amber/lime LEDs can be set to full output, and then the appropriate amount of red, green, and blue LED output is added to blend to white. For the purposes of the RGBAmber and RGBLime pixel types in Mbox, this is considered the fixture's "white point" - full amber/lime plus some mix of red, green, and blue.

Different fixture types will require different amounts of red, green, and blue mixed with the amber/lime to reach their white point. Mbox has two preference settings - RGBAmber White Point and RGBLime White Point - to allow these RGB values to be adjusted for the RGBAmber and RGBLime pixel types, thereby allowing the fixture to output pure white.

Note: There is only one RGBAmber/Lime White Point preference. Therefore, all fixtures with RGBAmber/Lime pixels receive the same calibration. This may mean that for different fixture types, the result of the calibration is not the same.

The RGBAmber/Lime White Point values are set on the Preference tab of either the Mbox or Remote application, in the Pixel Mapping section. Each value is entered as three integers, 0-255, separated by commas (e.g. 0,202,220) which represent the amount of red, green, and blue respectively. The red, green, and blue LEDs on the fixture would be set to these three values and combined with the full amber/lime output to make white. The default value for RGBAmber is 0,63,255, and for RGBLime the default is 63,0,255 - based on the theoretical values for amber and lime mentioned above.

To determine the correct white point value for an RGBAmber or RGBLime fixture:

Step 1. Connect the RGBAmber/Lime fixture directly to a lighting console and patch the console as required so as to be able to control the red, green, blue, and amber/lime channels independently.

Step 2. Set the amber or lime channel to full (e.g. 255).

Step 3. Adjust the red, green, and blue channels until the output of the fixture is white. Make a note of the red, green, and blue channel values.

Step 4. In Mbox or Mbox Remote, replace the default RGBAmber/Lime White Point preference value with the new RGB values, entering them as three comma-separated integer values (e.g. 0,202, 220)

Step 5. To test the value, create a pixel mapping configuration with an RGBAmber or RGBLime fixture and use white content onscreen. The output of the fixture should also be white. If not, the RGBAmber/Lime White Point preference can be adjusted live until the fixture outputs white.

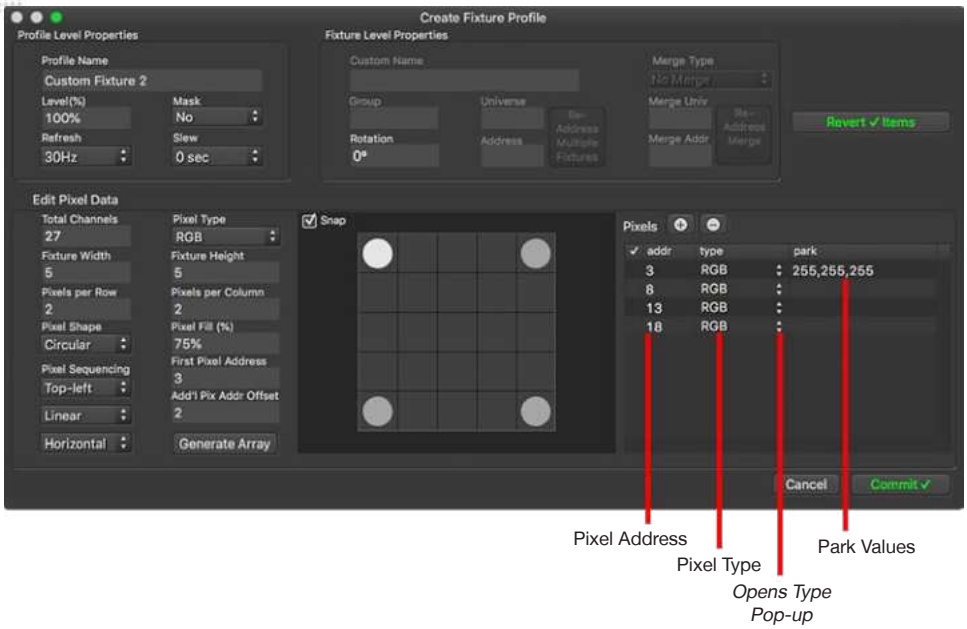
For RGBAmber the resulting value should have a red value of 0, an intermediate value for green. For RGBLime the resulting value should have a green value of 0, an intermediate value for red. Both should have a high value for blue. The overall tint of the RGBAmber or RGBLIme fixture can be adjusted in small amounts by varying the red, green, and blue values slightly and viewing the results:

+ Add more blue or remove green and red to give the white a cooler appearance.
+ Add more red to give the white a warmer appearance.
+ Add more green to remove a magenta tint.

Parked Pixels

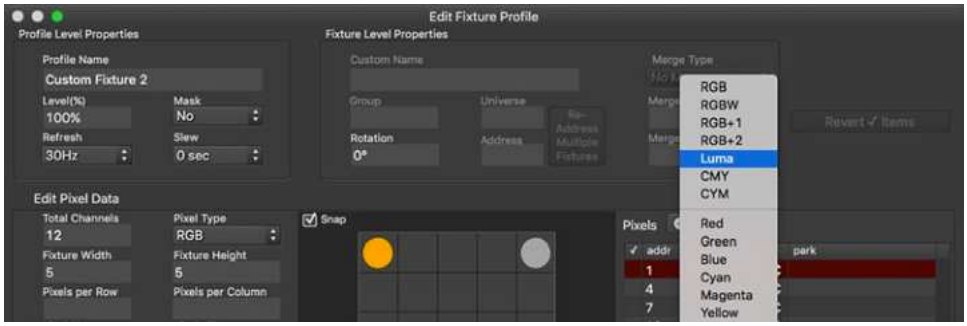
When editing a fixture or a profile, individual pixels included in the fixture can be parked at a specific (static) level so as to override the RGB data that would be taken from the source, or to provide output levels for additional channels that might otherwise sit at a level of 0. For example, setting values for pan and tilt on moving light fixtures when there is no merge.

The park values are entered in the Pixels table at the right side of the Edit Fixture Profile window.



The syntax for the park value depends on the type of pixel. With an RGB pixel: a park value of 255, 0, 0 represents Red=255, Green=0, and Blue=0. If park values are an override, they will be displayed in magenta text. If they are part of the profile, they will be displayed in white text.

The pixel type is chosen in the type pop-up menu:



Park Syntax Guidelines:

+ If multiple values are expressed in one line they must be separated by commas, but no spaces.
+ Do not use commas in numbers greater than 999 (e.g. use 65535 not 65,535).
+ RGB = R,G,B color ordering as three 8-bit values (e.g. 127,255,0). This would be the same for CMY, HSV, BGR, etc. The color is always entered in RGB order, Mbox will re-order the output values as necessary to match the pixel type.
+ RGBW, RGBW_2, RGBAmber, RGBLime = R,G,B color ordering as three 8-bit values. (e.g. 127,255,0). The white, amber, or lime color components are automatically derived from the RGB levels for the pixel.
+ RGB 16 = R,G,B color ordering as either three 8-bit values (e.g. 127,255,0) or three 16-bit values (e.g. 32767,65353,12789). CMY 16 and CYM 16 pixels use the same syntax. As with 8-bit RGB, the color is entered in RGB order, and therefore, Mbox will re-order the values as necessary for correct output.
+ RGBW 16, RGBW_2 16, RGBAmber 16, RGBLime 16 = R,G,B color ordering as three 8-bit or 16-bit values. (e.g. 127,255,0 or 32767,65535,0). The white, amber, or lime color components are automatically derived from the RGB levels for the pixel.
+ Luma601/Luma709 = Luma as a single 8-bit value (e.g. 127), or as three 8-bit values (e.g., 100,255,45 -> an RGB color) from which a luma calculation will be made.
+ Luma601 16/Luma709 16 = Luma as a single 8-bit value (e.g., 223), or as a single 16-bit value (e.g. 21537), or as three 8-bit or 16-bit values (e.g. 89,127,123 or 12635,43267,3000) that represent an RGB color, from which a luma calculation will be made.
    - If a single 8-bit number is used, that single number will be used for <u>both</u> the MSB and LSB in the output.
    - If a single 16-bit number is used, separate MSB and LSB are calculated from that number and used as-is in the output.
    - When using three 8-bit or 16-bit numbers, the luma calculation will result in separate calculated MSB and LSB values.
+ Single Pixels (R, G, or B, etc.) = one 8-bit value (e.g. 123)
+ Parked Pixel = one 8-bit value (e.g. 255)
+ Parked 16 Pixel = two 8-bit values, or one 16-bit value (e.g. 127,127 or 32767)
+ Incorrect syntax means the park value is either calculated incorrectly or ignored/not applied.
+ If at least one 16-bit number is used, then <u>all</u> values are assumed to be 16-bit; even if other values are less than 256.

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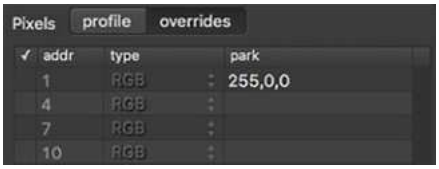
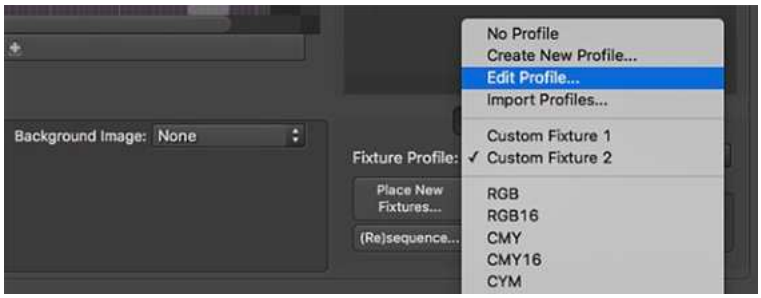
In the fixture editor, if a fixture profile has pixels with parked values, those parked values will be displayed on the profile tab - in gray to show they are not editable there. They can also be seen on the overrides tab - where they can be overridden. On the overrides tab the pixels will be white if not overridden or magenta if overridden.



Editing Fixture Profiles

Custom fixture profiles can be edited at anytime after they have been created. Built-in fixture profiles are not directly editable. However, a copy can be made of any of the built-in profiles and the copy can then be edited. There are two ways to begin editing these profiles:

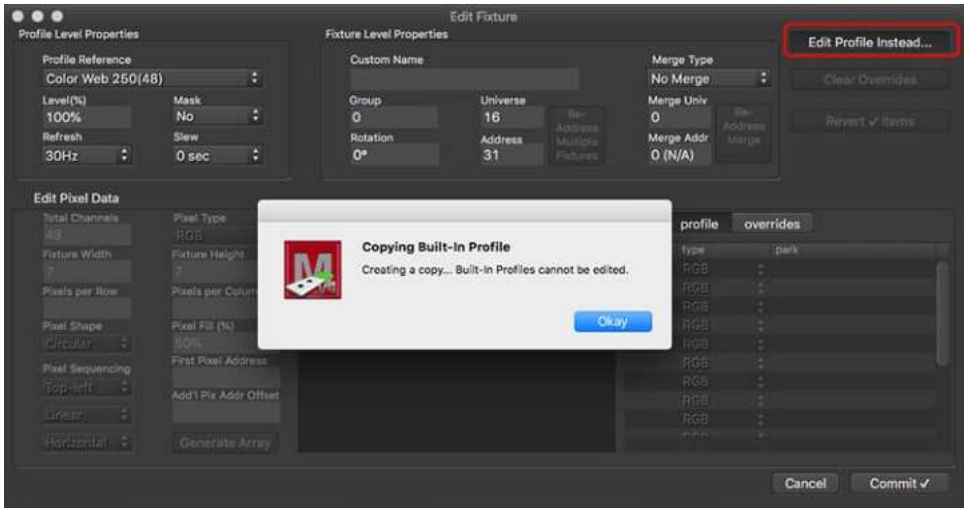
1) In the Fixture Profile menu, select Edit Profile…



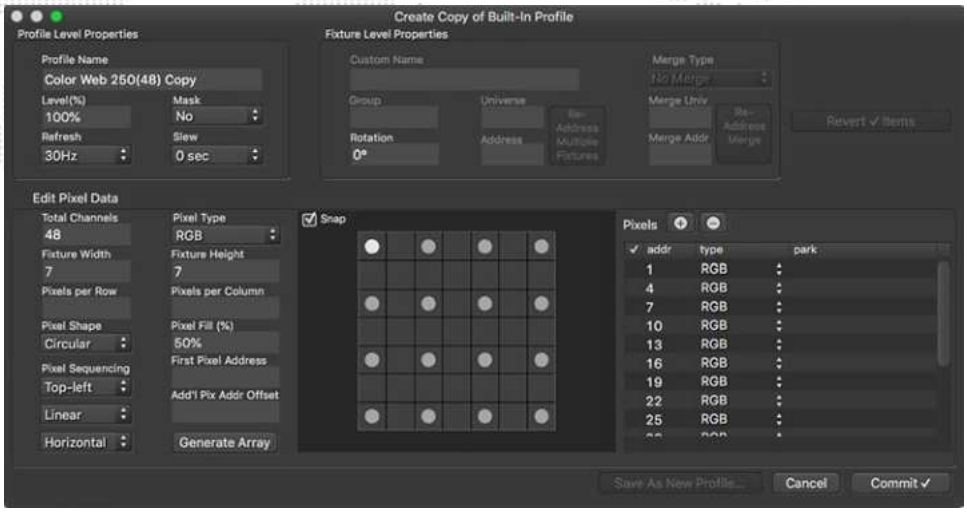
If a profile was previously selected in the menu then the profile editing window will open immediately. If no profile was previously selected, a window will appear, allowing the selection of the profile to edit.

2) Double-click on a patched fixture to open the Edit Fixture window, and then click on the Edit Profile Instead… button.

Attempting to edit a built-in profile will cause a warning message to appear and Mbox Remote will make a copy of the built-in profile that can be edited and used.



Both methods result in the same window opening, allowing the profile to be edited. (If it was created as a copy of a built-in profile, this will be noted in the window title as shown below.)

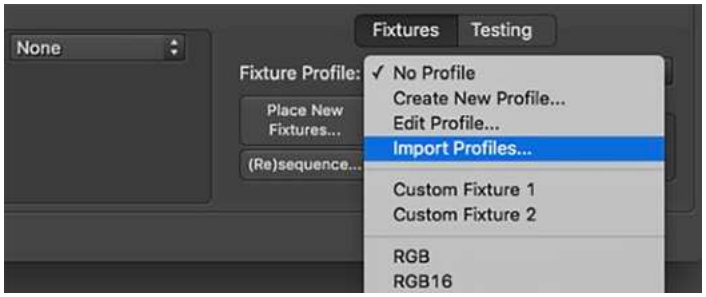


Importing Profiles

Fixture profiles can be imported from other Mbox pixel mapping configurations including .pmap files (Mbox v3.9) and .plist files (Mbox v3.8 and earlier).

To import profiles:

Step 1. In the Fixture Profile menu, select Import Profiles... This will open a standard file dialogue window.



Step 2. On the dialogue screen, select a pixel mapping configuration file containing profiles to import.

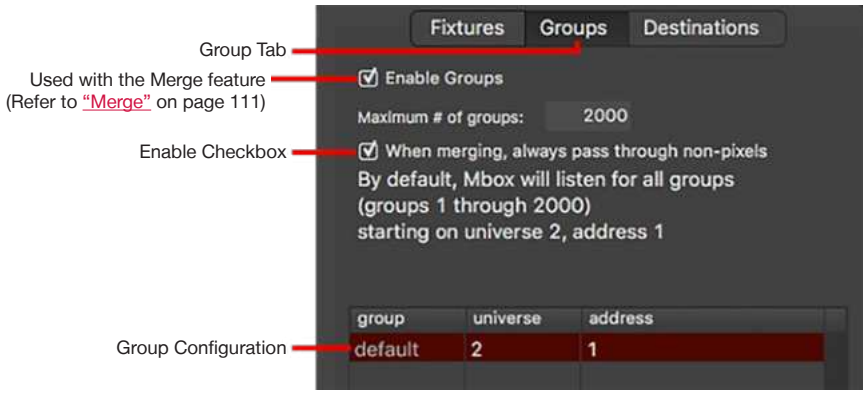
Step 3. Click Open.

Groups

The Groups feature provides additional group master, merge, and crossfade control of the pixel mapping output. Groups can be used for:

+ Live-mastering of output levels for some fixtures while not affecting others.
+ Disabling (zero output) fixtures without affecting others.
+ Adjusting color balance (subtractive mix) of fixtures without affecting the content or other fixtures.
+ Replacing the color generated by Mbox with color values supplied by a lighting console without the use of an external merge system. Note that this is not a replacement for a merge in some cases, as the console may still need full control over the fixtures with a "normal" patch rather than the group control patch.
+ Assigning pixel map groups for use with the Merge feature. (Refer to "Merge" on page 111.)

Groups can be enabled and configured using the Groups tab:



Mbox Remote allows up to 2000 Groups. If the default Group patch is used, all Groups will be patched sequentially starting with the selected start universe and address. Group controls will not be split across universes, allowing for a maximum of 85 Groups per universe (510 channels) per universe. Each group uses six 8-bit channels for control of Mode, Intensity Master, Red/Cyan, Green/Magenta, Blue/Yellow, and White/Amber/Lime.

Note: HSV and HSI pixels are always treated as RGB pixels for the purpose of group control and merging. All calculations are made based on the RGB values of the pixel's source, and that data is converted to HSV format for output.

Table 1: Group Universe Map

Channel:	**1**	**2**	**3**	**4**	**5**	**6**
Group 1:	M	I	R/C	G/M	B/Y	W/A/L
Channel:	**7**	**8**	**9**	**10**	**11**	**12**
Group 2:	M	I	R/C	G/M	B/Y	W/A/L
Channel:	**13**	**14**	**15**	**16**	**17**	**18**
Group 3:	M	I	R/C	G/M	B/Y	W/A/L
etc.	**...**	**...**	**...**	**...**	**...**	**...**
Channel:	505	506	507	508	509	510
Group 85:	M	I	R/C	G/M	B/Y	W/A/L

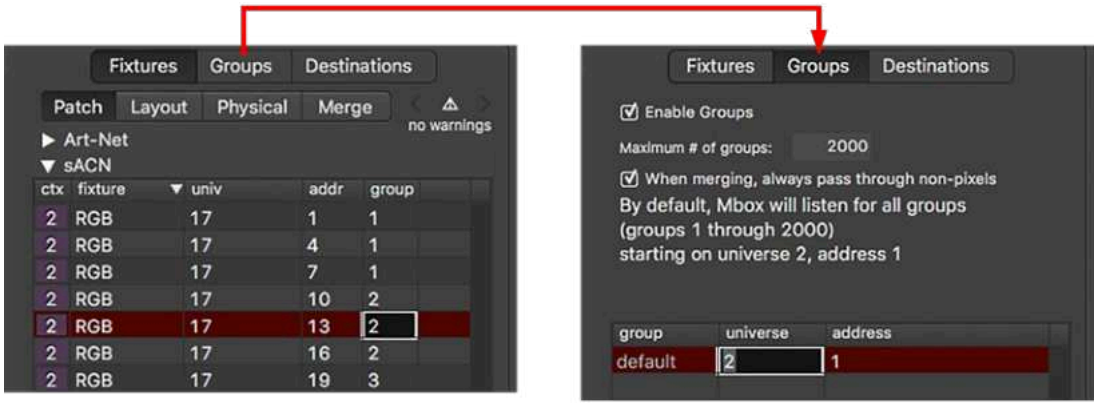
M = Mode, I = Intensity, R/C = Red/Cyan, G/M = Green/Magenta, B/Y = Blue/Yellow, W/A/L = White/Amber/Lime

The Intensity Master is inhibitive.

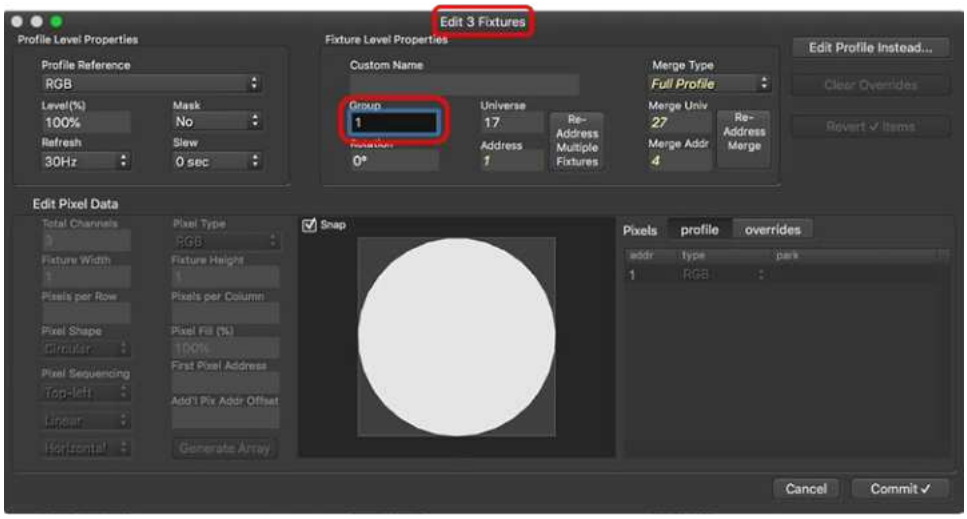
The color channels for red, green, and blue work no matter if the fixture is RGB or CMY. However, the group control fixture on the lighting console is always patched in RGB order. If the console has an advanced color picker, then this can be used with CMY sliders while still outputting RGB values. The color channel for white/amber/lime only affects the corresponding additional color found on RGBW_2, RGBAmber, and RGBLime pixels.

The protocol used to control the groups must be the same as the protocol selected for control of Mbox. This is set on the Mbox Patch tab.

To create and add fixtures to a group, edit the group field in the Fixtures Patch tab. As fixtures are assigned to groups, those groups will automatically be created and the channels required will automatically be assigned. Use the Groups tab to enable/disable the Groups feature, set the maximum number of groups, and configure the universe setting.



Fixtures may also be assigned to groups using the Edit Fixtures window. This is useful when adding many fixtures to the same group. (Refer to "Editing Fixture Properties" on page 84 for more information about this window.)



Group Control Mode

The Group Control Mode specifies how the group will respond to Mbox data and merge actions. (Refer to "Merge" on page 111 for more information about the Merge feature.)

Table 2: Group Control Modes

Mode	Description	Merge
0	No Group control. Mbox data is used without modification.	Merge data is ignored
1	Group Intensity + RGBW Master -> Group controls affect Mbox data.	Merge data is ignored
2	Group Intensity + RGBW Replace -> Group RGBW levels replace Mbox data (with Intensity mastering of replacement levels).	Merge data is ignored
3	Merge Replace + Group Intensity + RGBW Master -> Replace Mbox data with merge data. The result is then mastered by the Group controls.	Merge data replaces Mbox data.
4	Merge Multiply + Group Intensity Master + RGBW Master -> Group controls affect Merge data.	Mbox data is multiplied by the merge data.
5	Merge/Mbox crossfade + RGBW Master -> Group RGBW levels affect Merge data and Mbox data.	Group Intensity control is used to crossfade between the merge data and the Mbox data.
6	Group RGBW/Mbox Crossfade -> Group RGBW levels create color data. Group Intensity control is used to crossfade between the color data and Mbox data.	Merge data is ignored
7	Merge HTP + Group Intensity Master + RGBW Master -> Mbox data and merge data are merged using HTP. The Group controls then affect the result of the merge.	Merge data mixes with Mbox data using HTP.
8	HTP + Group Intensity Master + RGBW Master -> Group RGB levels create color data. The resulting color data and Mbox data are merged using HTP.	Merge data is ignored
101-108	These modes operate just like modes 1-8 respectively, except their color controls are treated as CMY rather than RGB. *	*See notes in 1-8 above.*
255	Force Off. All fixtures in group are forced to zero output.	Merge data is ignored

* The separate RGB and CMY modes are intended to handle the situation where the Group controls are being treated intentionally as CMY. However, most lighting consoles treat color in a generic fashion and therefore the Group controls can usually be treated as RGB, even if the fixture is a CMY fixture.

Guidelines:

+ The order of the actions (e.g. master then merge, and so on) in the descriptions above is intentional and specific to the mode, as performing the actions in a different order would lead to a different result on the output.
+ Modes 1-8 have color controls that use the RGB convention where 0,0,0 is black and 255,255,255 is white. Modes 101-108 operate like modes 1-8 except their color controls use the CMY convention where 0,0,0 is white and 255,255,255 is black. The Intensity control continues to master the output of the color channels normally in the modes that have an intensity master.
+ The separate RGB and CMY group modes are intended to handle the situation where the group controls are being treated specifically as CMY on the lighting console. This means that if you switch from mode 1 to mode 101, you would also need to invert the color control values.
+ However, most lighting consoles now allow color in a non-specific fashion (using a color picker) and therefore the Group controls can always be treated as RGB, even if the fixture is a CMY fixture.
+ Using HTP merge modes with CMY fixtures can be confusing because of the color inversion. HTP merges allow the source with higher levels (typically equaling brighter output) to be exerted. But an HTP merge with CMY color will not work as expected since brighter colors have lower values. Trying to make the fixture's output whiter/brighter requires reducing the CMY levels and if there is a source already sitting at a level an HTP merge can never reduce that level further. Meaning that unless there is total control over both sources, there isn't full control over what value will be exerted. Therefore, the use of HTP modes with CMY fixtures is not recommended.

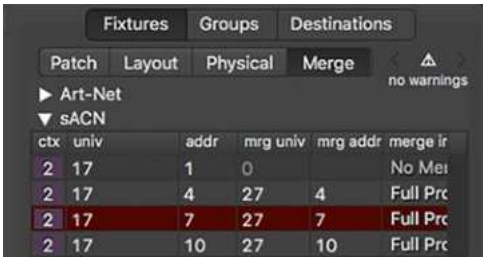
+ In the two crossfade modes, the Group intensity control becomes a simple A/B crossfade between the two sources of data. When the control is at zero the source is Mbox, when it's at full the source is either the merge (mode 3) or the Group's color controls (mode 6).
+ In the case of mode 4, 'multiply' means mastered. If the Mbox data is at 100% and the incoming merge data is at 50%, then the result is 100 x 50% = 50%. Similarly, if the Mbox data is at 75% and the merge data is at 33%, then the result will be 75 x 33% = 25%.

Merge

The Merge feature allows the server to receive additional Art-Net or sACN universes that can be combined in different ways with the pixel mapping output of the server. A primary use for this feature would be to allow both a console and Mbox to control the same pixel mapped fixtures, with the console operator deciding which device has control.

Note: While Mbox can output Art-Net, sACN, KiNET v1, and KiNET v2 to pixel mapped fixtures, Mbox can only receive Art-Net or sACN for the merge input. The protocol used must be the same protocol as the main control input to Mbox - as set on the Mbox application's Patch tab. It is possible for the merge input to use universes which are already being used for Mbox control, but it is not recommended. If the same universes are used, be sure to use unique, unused addresses within those universes.

The Merge operation is configured at the Fixtures > Merge tab by assigning a merge universe, merge address, and merge type to all fixtures that will be merged. In addition, all fixtures that are to be merged must be assigned to a pixel map group using the Groups feature, as explained in "Groups" on page 108.



Group controls (listed on page 110) are used to select a Group Control Mode which enables or disables the merge actions and selects what data is merged. There are eight merge modes that allow the Mbox output data to be replaced by the merge data, mastered by the merge data, or cross-faded with the merge data. The mode may be changed at any time.

Data will be handled differently depending on the pixel type(s) used in a pixel mapping fixture profile, and whether there are "non-pixels" (i.e. unpatched channels) in the pixel map fixture profile. For example, when patching a moving light, Mbox might control the color as a CMY pixel but the profile could also include empty space (non-pixels) for functions like pan and tilt to allow a console to control those parameters.

How different pixel types will react to merging:

+ Color pixels (RGB - in all orders, HSV, HSI, CMY/CYM, R, G, B, C, M, Y, Luma, etc. no matter whether 8-bit or 16-bit) - these pixel types will always be affected by merge data when using a group mode that enables the merge.
+ RGB+1 & RGB+2 - the RGB channels in these pixel types will always be affected by merge data when using a group mode that enables the merge. The extra channels (the +1 or +2) will be treated as non-pixels (see below).
+ Parked pixels (Park8 and Park16) - these pixel types will be unaffected by merge data unless the fixture is using the "Profile Non-Pixels Force" merge type.
+ Non-Pixels (any unpatched or skipped channels in a fixture profile) - these pixel types will always pass through merge data a.) when using a group mode that turns on the merge, or b.) when the "When merging always pass through non-pixels" preference is turned on at the Pixel Map > Groups tab and the fixture is using the Full Profile or Profile Non-Pixels Force merge type.

Note: If Color pixels are parked either in the profile or as an override, the park value will be affected by merge data in group modes that enable the merge.

To configure a merge:

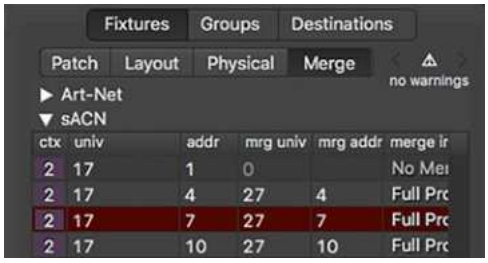
Step 1. In Mbox Remote, start a live pixel mapping session, create and configure a context, and place some pixel mapping fixtures using methods described earlier in this manual.

Step 2. On the Fixtures > Patch tab, patch fixtures to desired output universe and address.

Step 3. On the Patch tab, assign a group number (1-2000) to the fixtures that require a merge with external data. The general idea is to group fixtures that would always share the same control or merge state.

Step 4. On the Groups tab, check the "When merging always pass through non-pixels" preference. This preference allows merge data for non-pixels (i.e. unpatched channels) to always pass through to the Mbox output, BUT only when the merge type is set to Full Profile or Profile Non-Pixels Force. This preference defaults to being on, as the most common usage of unpatched channels would be for additional parameters on fixtures; features like pan and tilt that can't be affected by Mbox, and which should be passed through unaltered.

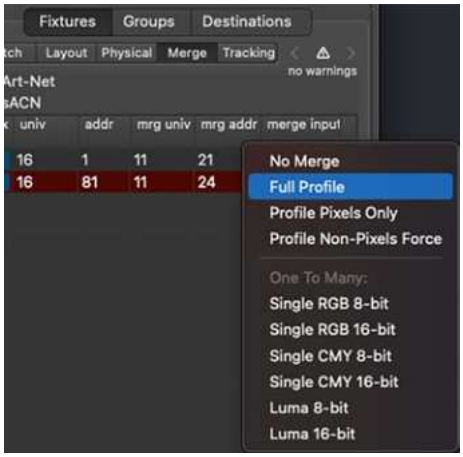
Step 5. Switch to the Fixtures > Merge tab. All patched fixtures will automatically appear on this tab, arranged by output universe and address. Note that only fixtures with a group number may be merged, but all fixtures, regardless of group number, will be shown here. Initially, the merge universe and merge address field will be empty for all fixtures.



Step 6. Decide what merge input type each fixture should have. There are ten different types:

a. No Merge - this fixture's data will not be merged.

b. Single RGB 8-bit - every color pixel on this fixture will output the same color, using three channels of merge data - using RGB ordering (e.g. 255,255,255 = white). Similarly, all luma pixels on this fixture will output the same intensity, based on the luma calculation derived from the incoming RGB values.



c. Single RGB 16-bit - every color pixel on this fixture will output the same color using six channels of merge data - using RRGGBB ordering (e.g. 255,255,255,255,255,255 = white). Similarly, all luma pixels on this fixture will output the same intensity, based on the luma calculation derived from the incoming RGB values.

d. Single CMY 8-bit - every color pixel on this fixture will output the same color, using three channels of merge data - using CMY ordering (e.g. 255,255,255 = black). Similarly, all luma pixels on this fixture will output the same intensity, based on the luma calculation derived from the incoming CMY values.

e. Single CMY 16-bit - every color pixel on this fixture will output the same color, using six channels of merge data - using CCMMYY ordering (e.g. 255,255,255,255,255,255 = black). Similarly, all luma pixels on this fixture will output the same intensity, based on the luma calculation derived from the incoming CMY values.

f. Luma 8-bit - every luma pixel on this fixture will output the same value, using one channel of merge data (e.g. 255 = brightest). Similarly, all color pixels on this fixture will output that same value for each of their color values.

g. Luma 16-bit - every luma pixel on this fixture will output the same value, using two channels of merge data (e.g. 255,255 = brightest). Similarly, all color pixels on this fixture will output that same value for each of their color values.

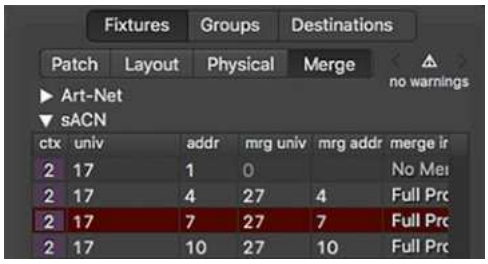
h. Full Profile - Color and luma pixels are merged. Parked pixel values ignore any incoming merge data. If using a Group mode that supports merging, or if the "merge pass through non-pixels" preference is enabled, the Merge data on non-patched channels is passed through.

i. Profile Pixels Only - Color and luma pixels are merged. Parked pixel values ignore any incoming merge data. Merge data on Non-patched channels is discarded (i.e. these pixels have no output).

j. Profile Non-Pixels Force - Color and luma pixels are merged. Parked pixel values are replaced by any incoming merge data. If using a Group mode that supports merging, or if the "merge pass through non-pixels" preference is enabled, the Merge data on non-patched channels is passed through.

Note: Refer to the Pixel Mapping Merge Types chart below for a more detailed description of what happens for the most common pixel types when using the various merge modes.

Step 7. Enter merge universe and merge address values for each fixture in the table. Fixture values can be edited one at a time, or select multiple fixtures and double-click on one of them to open fixture edit window, then click on the "Re-Address Merge" button to assign a range of consecutive addresses to the selected fixtures. Make sure not to overlap universes and/or addresses with those being used to control Mbox or for the actual pixel mapping output!



Step 8. At Destinations tab, create the necessary output destinations for the pixel map. (Refer to "Destinations" on page 89 for more information.)

Step 9. Mbox is now ready to receive group control and merge data, and output pixel map data.

Table 3: Pixel Mapping Merge Types
(This chart assumes that a group mode that includes merge is being used)

Merge Type	Color Pixels	Color Pixels (Parked)	Parked Pixels (Profile)	Parked Pixels (Override)	Unpatched Pixels
No Merge	-	-	-	-	-
Single RGB 8-bit	Merged	Merged	Not Merged	Not Merged	Passed Through *
Single RGB 16-bit	Merged	Merged	Not Merged	Not Merged	Passed Through *
Single CMY 8-bit	Merged	Merged	Not Merged	Not Merged	Passed Through *
Single CMY 16-bit	Merged	Merged	Not Merged	Not Merged	Passed Through *
Intensity 8-bit	Merged	Merged	Not Merged	Not Merged	Passed Through *
Intensity 16-bit	Merged	Merged	Not Merged	Not Merged	Passed Through *
Full Profile	Merged	Merged	Not Merged	Not Merged	Passed Through *
Profile Pixels Only	Merged	Merged	Not Merged	Not Merged	Not Passed
Profile Non-Pixels Force	Merged	Merged	Merged	Merged	Passed Through *

* In these cases, data for unpatched pixels is passed through only if the "merge pass through non-pixels" preference is enabled in the Group tab.

Using the merge:

Note: Refer to "Example Merge Hardware Diagrams" on page 117 for possible hardware I/O connections.

Step 1. Begin by playing content on Mbox and verifying correct output and control over all fixtures. It's best to confirm this before introducing the merge data, as the merged data may add to the confusion if there is a problem with the addressing or other setup.

Step 2. Add the merge data input to the Mbox server, confirming that this connection does not affect the pixel mapping output (assuming that all pixel mapping groups are set to Group mode 0). If the pixel mapping output is affected at this stage, then there may be an addressing conflict or a group mode is selected that affects the output. It is recommended that testing happen with all Group modes set to 0!

Step 3. At the control console, locate the pixel map group channels and confirm that there is control over the groups. Do this as follows:

a. Set each group's Intensity, Red, Green, Blue, and White channels to full (255) - this should be their default.

b. Set each group's mode channel to the "off" mode (0) - this should be the default mode.

c. Set one group's mode channel to mode 1 (Intensity and RGBW mastering) and confirm that the corresponding intensity and RGBW output levels for all fixtures in that group can be mastered from the console. Repeat with other groups as necessary.

d. Set one group's mode channel to mode 3 (Merge Replace with Intensity and RGBW mastering) and confirm that the console's output for the fixtures in that group has replaced the Mbox output for the same fixtures. Test the intensity and RGBW mastering using the group controls. Repeat with other groups as necessary.

Step 4. If the test provides the correct result, select the correct mode to the obtain the desired merge result. Modes can be changed at any time to achieve different merge results. However, making mode changes live may result in an undesired jump in output levels. (Refer to "Group Control Mode" on page 110 for a list of possible modes)

Guidelines for Fixture Merge Types

+ The Merge Types are used to determine how incoming merge data will be applied to the patched pixel mapping fixtures in Mbox.
+ In many cases with simple RGB LED fixtures, the type can be set to Single RGB 8-bit. This allows three channels (RGB data) to apply the <u>same</u> color/intensity to <u>every</u> patched, non-parked pixel in the fixture.
+ If every pixel in the fixture should not be the same color, then use one of the last three modes - Full Profile, Profile Pixels Only, or Profile Non-Pixels Force.
+ To use merge data to control unpatched channels in a fixture, use either merge type "Full Profile" or merge type "Profile Non-Pixels Force". When using one of these merge types, merge data on unpatched channels is passed through by default, no matter what Group Control mode is used. (The "When merging, always pass through non-pixels" preference on the Groups tab in Mbox Remote can disable this, if desired.)
+ When using one of the first three merge types, the type selected depends on how parked pixels and unpatched channels in the fixture should be treated.
  - "Full Profile" allows all the color and luma pixels on the fixture to be affected and merge data to be passed through on unpatched channels. However, parked pixels will be unaffected by any merge data.
  - "Profile Pixels Only" allows only the color and luma pixels to be affected. Parked pixels will not be affected by merge data and merge data will not be passed through on unpatched channels.

- "Profile Non-Pixels Force" allows all the color and luma pixels on the fixture to be affected, merge data to be passed through on unpatched channels, and parked pixel levels will be overridden by merge data.

+ The single RGB/CMY/Luma merge types may not work as desired if using a complex fixture that includes more than one pixel type.
+ It is not recommended to use the single RGB or CMY merge types for fixtures having both RGB and CMY pixels (e.g. High End Showgun), as doing so would invert the color controls for one set of pixels and therefore make group color mastering confusing. In this case, either split the fixture into two parts or use one of the first three merge types.
+ If a fixture uses 16-bit color mixing, don't select an 8-bit merge type, and vice-versa.
+ If a fixture is CYM (e.g. PRG Bad Boy) rather than CMY, or if the fixture uses non-standard RGB ordering, don't use the single RGB or single CMY modes. Instead, use one of the first three modes. If the CMY or RGB modes are used, the color ordering for the group controls will not be correct.

General Merge Notes

+ The Pixel Mapping Intensity parameter on Mbox's Master fixture will still master the output level of all pixel map output from color or luma pixels. It does not master the output of parked pixel types. The Master intensity also does not affect any levels from the merge data that are passed through on unpatched channels.
  - Parked pixels and passed through levels are things that typically Mbox should not or cannot control (e.g., pan and tilt on a moving light). Mbox can control the color of the light, but typically the pan and tilt will be fixed (use a parked pixel) or controlled separately by a console (use merge data passed through).
+ Using the Pixel Mapping merge may have a performance impact on the entire Mbox application, especially when merging large amounts of data (many fixtures and/or universes). The slower/older the computer, the less capable it will be in merging large amounts of data.
+ When dealing with a large merge, it is recommended to use non-blocking gigabit ethernet switches (e.g., Pathway Connectivity Via10 or Via12). Make sure to configure the switch appropriately. Note that on cheaper switches (even gigabit switches), plugging in a slower device (e.g., a 10Mb/s Artistic Licence Art-Net node) may affect throughput on the entire switch. This may lead to poor results when trying get the smoothest pixel map output or when low latency is critical.
+ Merge data can be received by the Mbox computer on any interface, as long as it is of the same protocol as the main control protocol (i.e., either Art-Net or sACN as set on the Mbox Setup tab).
+ The Pixel Mapping output can be made from any interface(s) on the computer as long as the pixel mapping Destinations are set up correctly.

Merge Examples

The following section contains several operational examples using the Merge feature.

1) Setup with RGB LED fixtures having only one pixel each:
   - When controlling only simple three-channel RGB fixtures (e.g. Color Kinetics ColorBlast) a very complex merge setup is not required. Each fixture in the patch will have a unique output universe and address. Each fixture can have its own unique merge universe and address, allowing the merge to control every fixture independently. Alternately, multiple fixtures can have the same merge universe and address and allow Mbox to pixel map to them individually, but have the merge source control them as one (i.e. they will all be the same color when control comes from the merge source). In both of these cases either the "Single RGB 8-bit" or "Full Profile" merge types can be used.

2) Setup with RGB LED fixtures having more than one pixel each:

- In this situation decide if the merge source should control the entire fixture as one unit (all pixels the same color) or if independent control over each pixel in the fixture is needed. In the former case, use the “Single RGB 8-bit” merge type for the fixtures. In the latter case, use the “Full Profile” merge type for the fixtures.

3) Setup with LED fixtures having RGB plus non-typical colors (e.g., deep red, cyan, etc.):

- The onscreen color of Mbox is limited to RGB. While there may be standard methods to convert an RGB color to simpler additional LED emitter colors as with RGBW, RGBAmber, or RGBLime, each LED fixture manufacturer may use different methods when they do this. To accommodate such differences, Mbox has preferences that allow for the white balance or tuning of the RGBW_2, RGBAmber, and RGBLime output. These preferences are universal - applied in the same way to all pixels of that type - and not adjustable per-fixture.

- An alternative solution for more-complex fixture types or non-typical colors is to let Mbox control the RGB pixels and then use merge data to control the additional colored pixels. While the color selection won’t be automatic, this will allow precise control over the color of the fixture. Use either the “Full Profile” or “Profile Non-Pixels Force” merge type.

- The RGBW and RGBW_2 pixel types provide two different methods for converting the RGB color to RGBW color data. The RGBW pixel type sets the RGB channels to the RGB color of the pixel and sets the W channel to the CIE luma calculated value for the dimmest of the R, G, or B channels. The RGBW pixel type lacks the preference to allow for tuning of the white output; white output is always the same as the dimmest of the R, G, or B pixels. The RGBW_2 pixel type finds the overall hue of the RGB color of the pixel and as the color becomes brighter/lighter adds in the W channel and reduces the RGB channels.

4) Setup with fixtures having additional parameters that need some form of control (e.g., moving lights):

- Because Mbox can only generate color data for pixel mapping output, and because moving lights have additional parameters, some other source of control the additional parameters is needed. In situations like this, the fixture profile should include either parked pixels or unpatched channels for the additional parameters.

- Parked pixels can be used to set the additional parameters to fixed values. Useful for locking things like pan and tilt or the dimmer. If parked pixels are used in a profile and need to be overridden with merge data, the “Profile Non-Pixels Force” merge type must be used, otherwise the parked pixel values cannot not be affected by merge data. This can be quite useful if there are times when the merge data will not be present and you still want the parameters still need to have a useful value (albeit fixed).

- If the fixture profile has unpatched channels for the additional parameters, then merge data can be passed through when using either the “Full Profile” or “Profile Non-Pixels Force” merge type. However, when using unpatched channels, merge data must be provided all the time for fixture parameters that need to be at a level above 0.

- Parked pixels and unpatched channels can be combined, but keep in mind that if the parked pixel values need to be overridden the “Profile Non-Pixels Force” merge type <u>must</u> be used.

Example Merge Hardware Diagrams

In the diagram below, the console outputs control data to Mbox through an ethernet switch. The necessary data for controlling the pixel mapping groups (mode, intensity, color) is also included in that output, as is fixture control data to be merged with the Mbox output. The Mbox server responds to the control data and merges the other data when requested. The pixel mapping data is then output to the fixtures through a second ethernet switch.

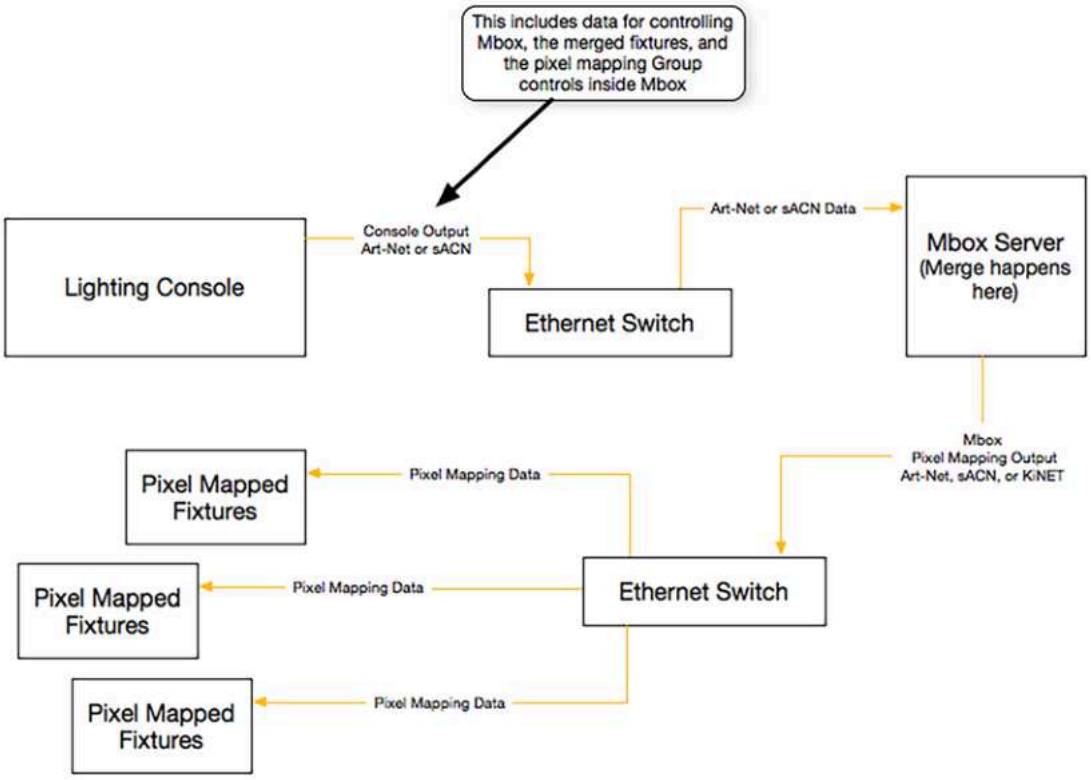


Figure 1: Example Merge Hardware I/O Diagram 1

In many cases, the system could work with only one ethernet switch. But the practicality of this may depend on the switches used and the number of universes of control data on the network. Wherever possible, we recommend using separate physical networks for control input and pixel mapping output.

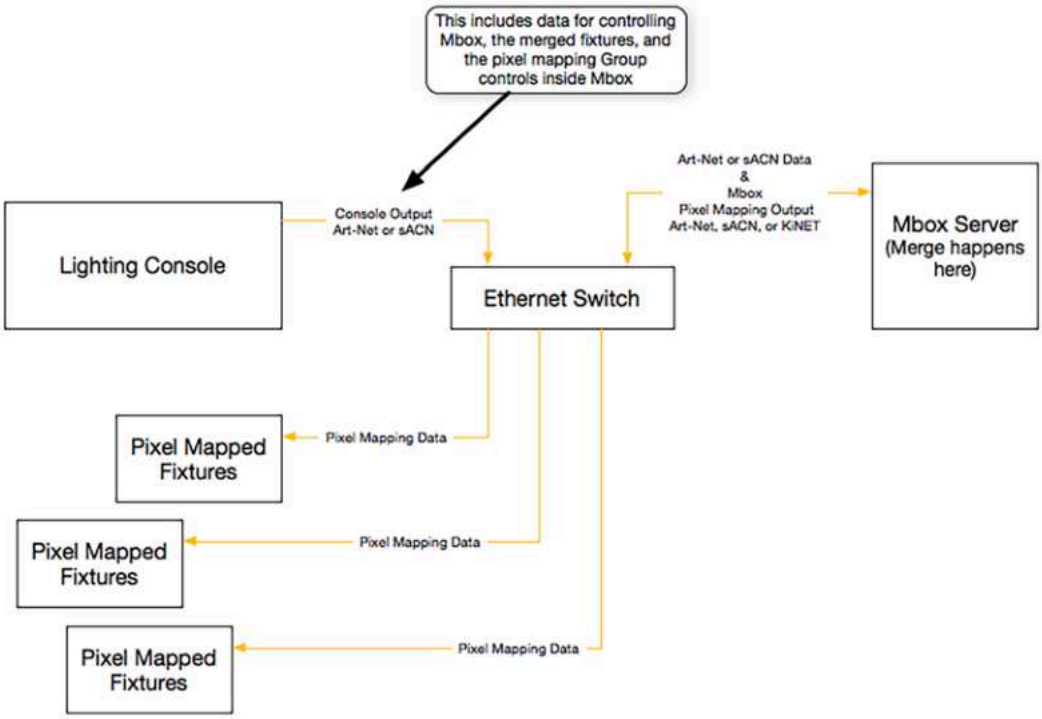


Figure 2: Example Merge Hardware I/O Diagram 2

Testing

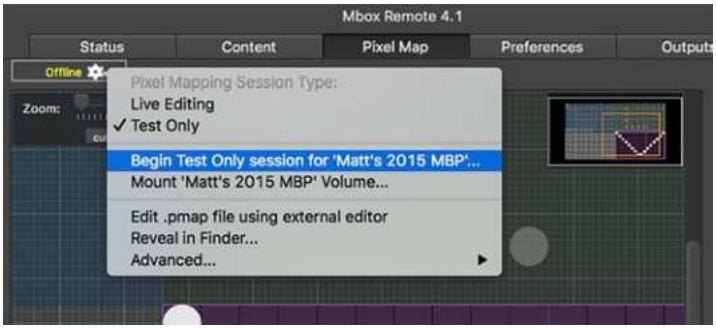
The Testing feature provides a way to easily locate and test fixtures in order to verify the correct pixel mapping configuration. During testing, selected fixtures can be highlighted statically or flashed between highlight and lowlight states. (This testing functionality mimics highlight/lowlight functionality in lighting consoles.)

The Testing feature can be used while Mbox Remote is in a Live Editing session or a Test Only session. While in the Test Only session, the pixel mapping fixtures can be tested but the configuration is locked out from changes.

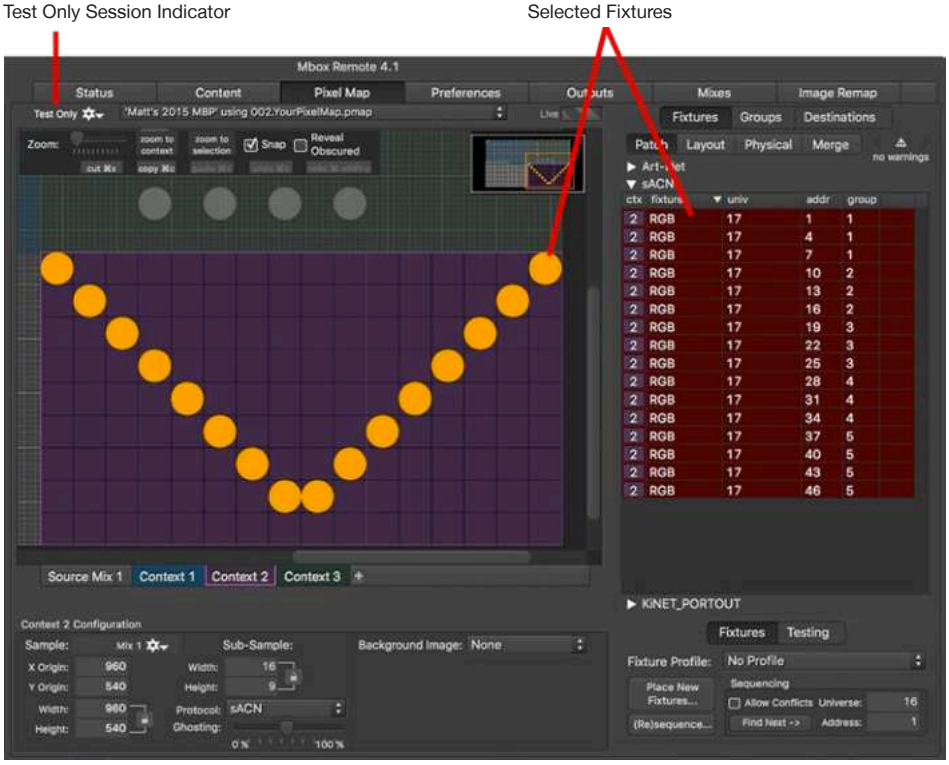
To test fixtures:

Step 1. On Mbox Remote's Servers list, select the required server. Select the Pixel Map tab.

Step 2. Click gear icon and select Begin Test Only session for... The pixel mapping configuration will now be locked from changes.



Step 3. Choose a context and select one or more patched fixtures.



Step 4. At the bottom-right of the tab, select the Testing tab then click the Test button. (The Testing tab text will be displayed in green and the Test button will be dark gray to indicate that the Testing mode is active.)

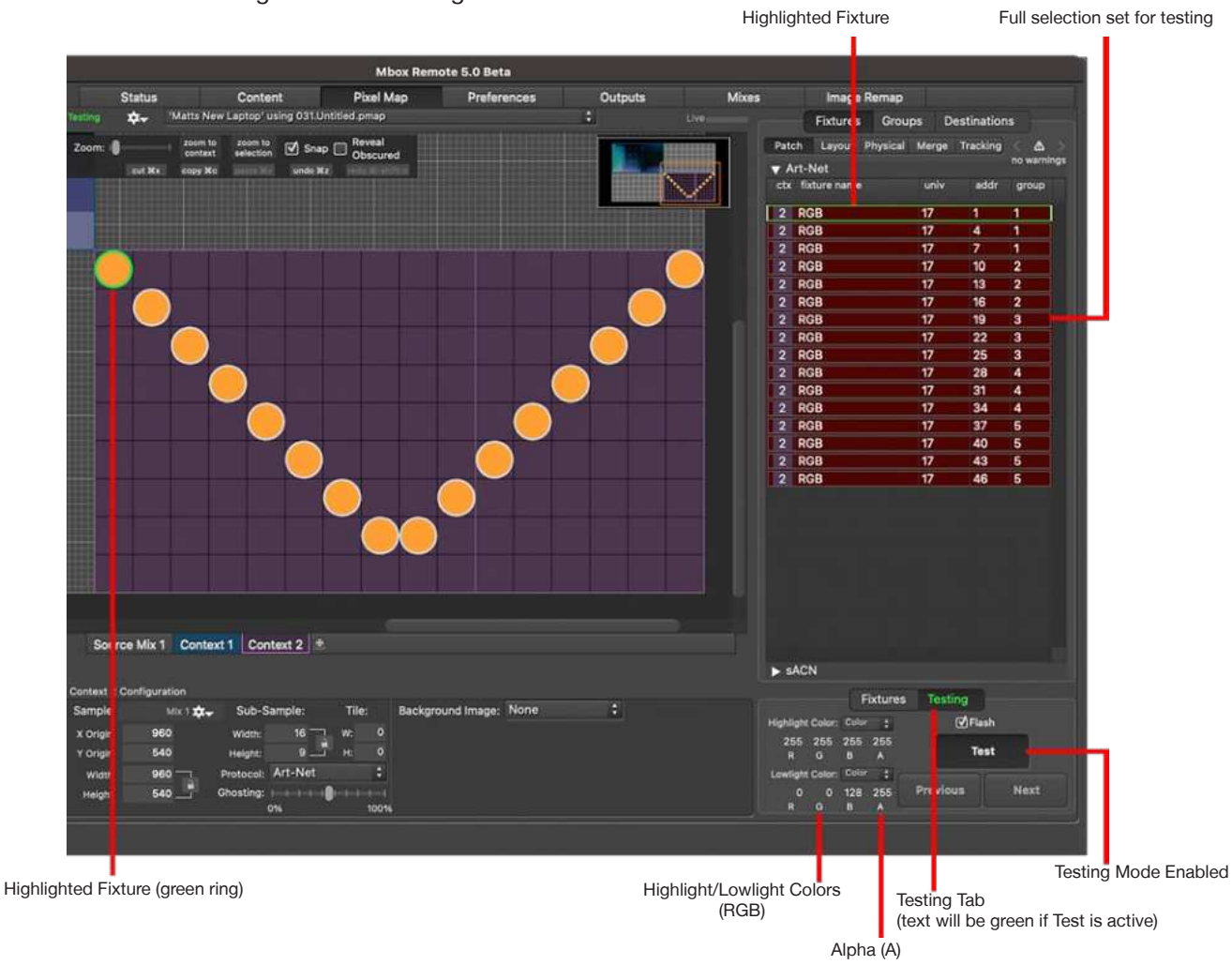
Step 5. Once the Text button is clicked, the selected fixtures will start flashing between the specified highlight and lowlight colors.

a. If multiple fixtures were selected in Step 3, clicking the Previous and Next buttons will cycle through the selection set. One fixture at a time will be highlighted with a green ring on both the context grid and in the fixture table.

b. Use the Flash checkbox to enable/disable flashing.

c. To change highlight/lowlight color scheme, enter custom RGB values.

Step 6. Click Test button again to exit Testing mode.

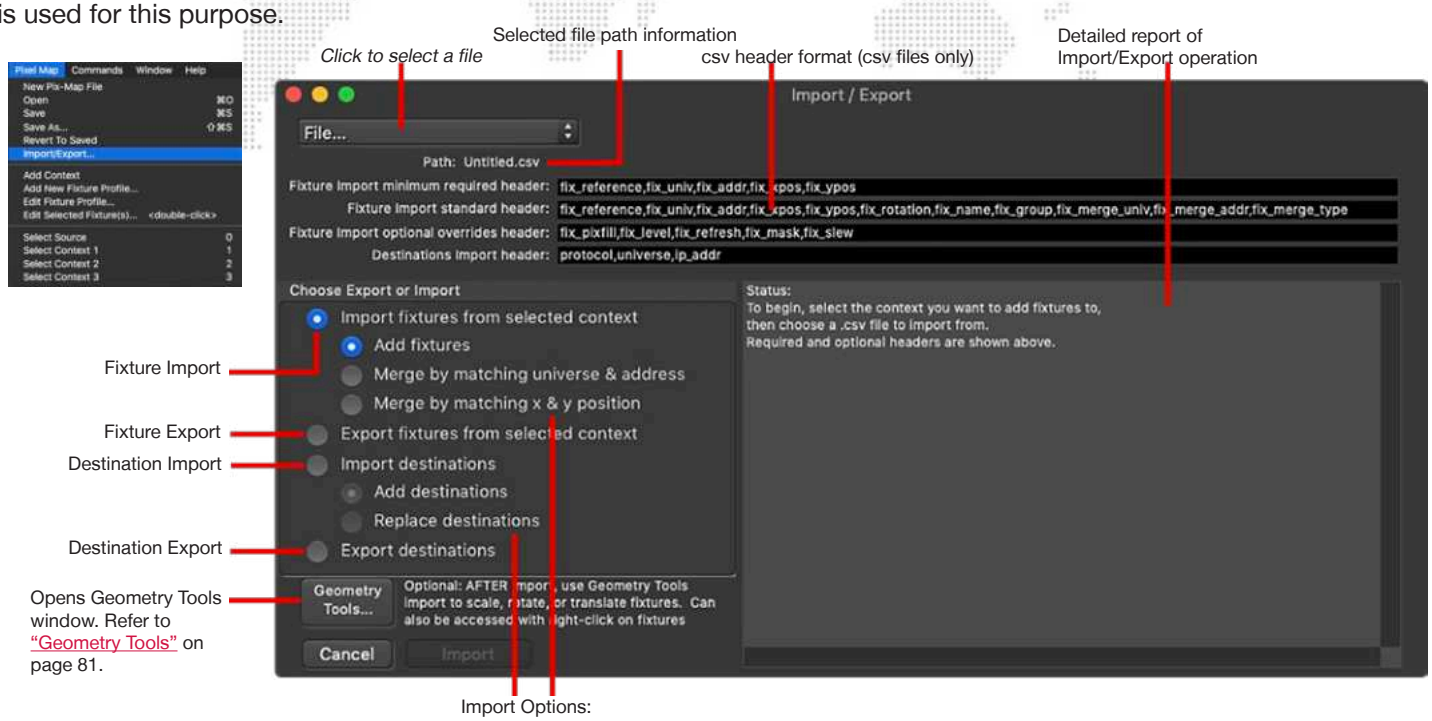


+ RGB - The highlight and lowlight colors are configurable with 8-bit RGB values.

+ A (Alpha) - The only two correct options for the field are 255 or 0. If the value is 255, the color (highlight or lowlight) will be completely opaque. If the value is 0, then the color values are ignored and the high/lowlight will be the color values that Mbox is actually sending out.

Import/Export

Mbox Remote has the ability to import and export pixel mapping fixture and destination data. The Import/Export window is used for this purpose.



Import Options:

+ Add fixtures - adds imported fixtures (may create conflicts)
+ Merge by matching universe and address - merges imported fixtures with those having the same universe and address, replacing X/Y position
+ Merge by matching x & y position - merges imported fixtures with those having the same z/y position, replacing universe and address
+ Add destinations - adds imported destinations to existing destinations
+ Replace destinations - replaces existing destinations with imported destinations

Property List Files

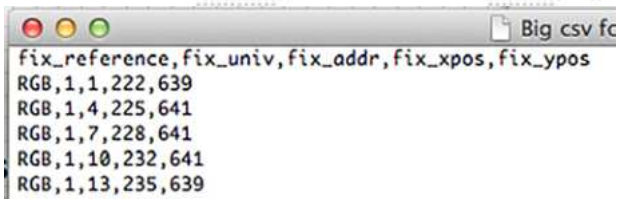
Mbox Remote can import and export fixture data from any pixel mapping .pmap file. Use the Import/Export window options to configure how this data will be imported (see above). When importing and exporting fixtures, the context that is currently selected on the main Mbox Remote window is taken into account. When importing, only fixtures from the context of the same number in the import file are imported into the selected context. If the import file does not have a context with the same number, no fixtures will be imported. When exporting, only fixtures from the currently selected context are exported.

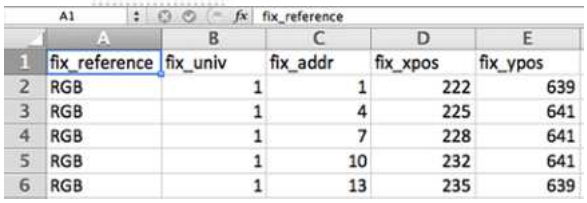
The import of fixture data from .plist files created by prior versions of Mbox is supported. In this case, old profiles and fixtures will be upgraded to the new format and the imported fixtures will appear as if every parameter is overridden since the old .plist files had no concept of profile reference.

CSV Files

Pixel mapping fixture and destination data can also be imported and exported using the comma separated values (.csv) format. This functionality allows large or complex pixel mapping configurations to be created from or saved in a data format that can be more quickly edited as a spreadsheet rather than attempting to place and patch the same fixtures or create destinations using Mbox Remote.

The csv format is a plain text format using commas to separate values on the same line and a carriage return to separate lines. Many different applications can create text files with the appropriate formatting. Microsoft Excel can convert spreadsheet data into a csv format or data can be created/edited in a standard text editor. For example, the following images represent the same fixture data in text and spreadsheet formats:





A1 fix_reference

	A	B	C	D	E
1	fix_reference	fix_univ	fix_addr	fix_xpos	fix_ypos
2	RGB	1	1	222	639
3	RGB	1	4	225	641
4	RGB	1	7	228	641
5	RGB	1	10	232	641
6	RGB	1	13	235	639

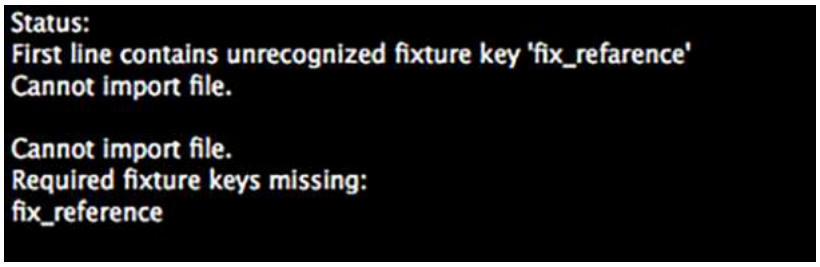
The csv import functionality requires that the csv file be formatted properly for handling by Mbox Remote. If the formatting is not correct, Mbox Remote will not be able to read the file, or errors may occur when the file is being read.

Guidelines:

+ When importing fixture data, the csv file may only hold data for one context. If data is created for more than one context, the data should be saved as multiple csv files, one for each context.
+ The csv file requires that data be organized into lines of text, with each line representing either organizational data (the header data) or one fixture or destination's data.
+ The first line of the file, known as the "header," holds the names (in order, separated by commas) of the properties listed (in corresponding order) in the data in the following lines. The import window notes what the header should include and shows the correct order, spelling, and formatting of the header items. For example:

+ Property names must follow the standards dictated and must be spelled and capitalized correctly. These are:
  - Fixture Required: fix_reference, fix_univ, fix_addr, fix_xpos, fix_ypos
  - Fixture Optional additions: fix_rotation, fix_name, fix_group, fix_merge_univ, fix_merge_addr, fix_merge_type
  - Fixture Override additions: fix_pixfill, fix_level, fix_refresh, fix_mask, fix_slew
  - Destination Required: protocol, universe, ip_addr

If an incorrect property name is detected during the import process, Mbox Remote will display an error such as the one below (where "fix_reference" has been spelled incorrectly):



+ The lines following the header are known as the "body." These lines hold the fixture or destination data corresponding to the property names in the header, in the order specified.

+ The fixture or destination data lines should be of the correct data format only, no punctuation (other than decimal points where appropriate), symbols, etc.
  - fix_reference - text (includes characters A-Z, 0-9, some punctuation (+ - _ ( ) [ ] etc.), but no commas.)
  - fix_univ - integer (0-63999)
  - fix_addr - integer (1-512)
  - fix_xpos - integer or float
  - fix_ypos - integer or float
  - fix_rotation - integer or float (0.0 - 360.0)
  - fix_name - text (same note as for fix_reference)
  - fix_group - integer (1-100)
  - fix_merge_univ - integer (0-63999)
  - fix_merge_addr - integer (1-512)
  - fix_merge_type - integer

    0 = no merge
    1 = Single RGB 8-bit
    2 = Single RGB 16-bit
    3 = Single CMY 8-bit
    4 = Single CMY 16-bit
    5 = Intensity 8-bit
    6 = Intensity 16-bit
    7 = Full Profile
    8 = Profile Pixels Only
    9 = Profile Non-Pixel Force
  - fix_pixfill - float (0.0-1.0) equivalent to 0-100%
  - fix_level - float (0.0-1.0) equivalent to 0-100%
  - fix_refresh - integer (1-30)
  - fix_mask - integer (0 or 1) 0 = off, 1 = on
  - fix_slew - integer (0-255)

    0 = 0 seconds
    1 = 8 seconds
    2 = 4 seconds
    4 = 2 seconds
    8 = 1 second
    11 = 0.75 seconds
    16 = 0.5 seconds
    32 = 0.25 seconds
    85 = 0.1 second
  - protocol - text “Art-Net”, “sACN”, “KiNET_PORTOUT”, or “KiNET_DMXOUT” are the only valid options
  - universe - text “default” or integer (0 - 63999). When adding destinations, items with a value of “default” are ignored. When replacing destinations, if no default item is imported, a default item is added automatically.
  - ip_addr - text e.g. “Local”, “Ethernet”, or “2.0.0.1”

Note: When importing address data for KiNET v2 (PORTOUT) fixtures, use the device.port notation (e.g. 12.1) and place that in the 'fix_univ' field of the csv file. You must still have a fix_addr column in your csv file, but any data in that column will be ignored. Remember to only import KiNET data into a context that has been previously set to use the KiNET protocol.

Errors will occur if any required formatting is missing. For example, if commas are missing then the entire fixture or destination swill be ignored and an error such as the one below will be displayed:

```
Status:
Required values missing for fixture at row 1!

Summary:
added 7 fixtures
merged 0 fixtures
discarded 1 fixtures with errors

You can undo/redo an import (Cmd-Z or Cmd-Shift-Z).
```

+ If commas are included, but values are missing, default values will be substituted as follows:
  - fix_reference - fixture will be ignored (not imported)
  - fix_univ - univ = 0
  - fix_addr - addr = 0 (this is invalid)
  - fix_xpos - xpos = 0
  - fix_ypos - ypos = 0
  - fix_rotation - rotation = 0°
  - fix_name - name = fixture reference name
  - fix_group - group = none
  - fix_merge_univ - univ = 0
  - fix_merge_addr - addr = 0
  - fix_merge_type - type = No Merge
  - fix_pixfill - pixfill = 100%
  - fix_level - level = 100%
  - fix_refresh - refresh = 30Hz
  - fix_mask - mask = No
  - fix_slew - slew = 0 sec
  - protocol/universe - destination will be ignored (not imported)
  - ip_addr - no value
+ Each line must end in a standard line feed/carriage return.
+ When importing fixture data, the fixture reference model is used, and therefore, fixture profiles with names that match those in the csv file exactly must be present in Mbox Remote before importing the csv file.
  - Fixture profiles can be imported into Mbox Remote. Fixture profiles must be imported or created before the csv file is imported. (Refer to "Importing Profiles" on page 107.)
+ Fixture data in the csv file is not pixel level; rather it represents the fixture-level properties. Pixel positioning, size, shape, etc. will be created using the fixture reference model (i.e., taken from the fixture profile with the same name).

IMAGE REMAPPING

Overview

What is Image Remapping

The Image Remapping functionality of the Mbox software allows the creation of one or more configurations of two-dimensional rectangular “screen objects” that may be used to reposition, copy, or alter pixels on a layer, while keeping everything absolutely pixel-accurate.

Screen objects within each configuration receive the texture that is provided by 2D content used on the layer. Two separate set of coordinate values determine first - which portion of the source texture is sampled from the content, and then second - where that imagery is drawn on the Global Surface. This allows different portions of a layer’s imagery to be moved, copied, chopped up, and/or rescaled. These tolls can be used to aid composition or to rearrange onscreen pixels to better suit the configuration of the output device.

Each screen object can also have extra control parameters added, allowing for changes to the imagery shown on the screen object. Standard control parameters for image remapping allow for intensity or opacity changes, position changes, rotations, and color changes. Additional parameters allow for further mastering and the creation of repetitive identical elements with a regular offset.

The Mbox application’s image remapping file (found at Mbox/MultiScreenData.plist) can hold multiple configurations, and each configuration may be made up of multiple screen objects that can each have unique controls and mapping properties. This structure creates a hierarchical relationship: File > Configuration > Screen Object > Control. External control over screen object parameters is handled through Art-Net or sACN input to the Mbox server.

Note: With an Mbox Designer license, Mbox can have 255 Image Remapping configurations, the Studio+ license allows 16, the Studio license 8, and the Mini license 2.

For More Information

Image Remapping is covered in detail in the Mbox Manual. Refer to Chapter 5: Image Remapping in that document for a full explanation of the user interface, plus detailed information (and a tutorial) on setting up a remapping configuration.

APPENDIX A. MBOX NETWORKING GUIDELINES

Concepts

The majority of communications to and from Mbox use ethernet protocols. This means that ethernet networks route the data into the Mbox server and from the server to other connected devices. Because all of these protocols need to live in harmony, steps need to be taken to avoid interference between protocols, and to maximize the available network bandwidth/speed. Due to these requirements, it is recommended that the computer used as an Mbox server have more than one network interface. For more complex setups, three or four network interfaces may be preferable.

While all the network interfaces on a computer could be connected to the same network to gain some amount of additional bandwidth, doing so would bypass the desire to keep certain protocols separate. Therefore, it is much more useful if each network interface on the computer is configured for and connected to a separate physical ethernet network. If multiple interfaces must be connected to the same physical network, then the network should have a system of VLANs enabled to help segregate different protocols.

Connecting more than one network interface to different networks is only the first step. Each interface needs to have its IP Address and subnet mask set correctly for the network that it is being connected to. Getting the IP Address and subnet mask correct ensures that communications to and from the computer will leave the computer through the correct interface and arrive at the intended destination without any ambiguity or loss of data.

Concept definitions:

+ **Network Interface** - the physical ethernet connection (typically RJ-45) on the computer that a cable is connected to in order to connect the computer to a physical network.
+ **Network** - a group of devices connected to each other that can potentially communicate using ethernet IP protocols The word “network” describes not just the physical connection of multiple devices, but also the “web” of electronic communication between them.
+ **Subnet (subnetwork)** - a logical subdivision of a network such that multiple interfaces can be connected to the same physical network, but are placed on different subdivisions of that network for the purposes of routing or for keeping some communications separate. (Note: a subnet is not the same as a VLAN.)
+ **IP Address** - an interface property using the dot-decimal (e.g., 2.0.0.123) notation, where each of the four numbers separated by decimal points is referred to as an octet (because each is an 8-bit number). In combination with the interface’s subnet mask, the octets in the IP address designate either the device’s sub-network or the device’s unique identifier on that subnet.
+ **Subnet Mask** - a second interface property, also using dot-decimal notation (e.g., 255.0.0.0). The value of each octet in the subnet mask determines which of the octets in the device’s IP address specify the sub-network and which specify the interface’s unique identifier on that sub-network. The subnet is specified by setting one or more of the octets in the subnet mask to a value other than 0.

Subnet Masking Basics

For pretty much all communication to and from Mbox, each octet in an interface's subnet mask will be set to either 0 or 255. Values other than 0 or 255 can be used for more complicated subnetting, but are typically not needed with Mbox and won't be discussed here.

In order to understand how an interface's subnet mask works, it needs to be viewed together with the interface's IP address. If an octet in the subnet mask has a value of 255, then the corresponding octet in the interface's IP address is used to designate the subnet that the interface belongs to. If an octet in the subnet mask has a value of 0, the corresponding octet in the IP address is used as part of the interface's unique identifier on that subnet. Within the structure of sub-networks and unique identifiers, it is possible to have multiple interfaces on the same subnet, each being uniquely identifiable. Data can be sent to all interfaces in the subnet by broadcasting, to groups by multicasting, or to individual members by unicasting.

How the IP Address and Subnet Mask Work Together

For a device with the IP address of 192.168.0.123 and a subnet mask of 255.255.0.0, the first two octets of the IP address "192.168" are used to specify the sub-network, and the last two octets "0.123" specify the device's unique identifier within that network.

	Network		Unique ID	
Subnet Mask:	255	255	000	000
IP Address:	192	168	000	123

Depending on the number of octets with a value of 255 in the subnet mask, different descriptions may be given to the interface. A subnet mask of 255.0.0.0 leads to a description of "/8" for the interface. Combined with the interface's IP address, this information would be written as "192.168.0.123/8". A subnet mask of 255.255.0.0 gets a description of "/16" and 255.255.255.0 a description of "/24".

Note: There is no such thing as a /32 subnet mask, as the last octet in an interface's IP address must always be used as a unique identifier.

Routing Ethernet Communications

+ **Full Broadcast** - data packets that are sent to the full broadcast destination IP address (255.255.255.255) will be received by all devices on the physical network provided the packets are not blocked by a switch or router between devices. Full broadcast is akin to shouting in a crowded room. Everyone can hear the yelling, but must decide whether to listen or not. Full broadcast is simple and guarantees for the most part that every device on the network can get the data. However, it places a lot of data onto the network, thus using up more of the available bandwidth. Another downside is that receiving devices may need to spend more time than is desirable to filter out data that they don't need to listen to.
+ **Subnet Broadcast** - packets that use a subnet broadcast IP address (x.255.255.255, x.x.255.255, or x.x.x.255) will only be received by interfaces on the matching subnet - i.e., those with a subnet mask that places them into the same subnet. This is one step down from shouting, as subnet filtering allows receiving devices to immediately discard any subnet broadcast data that isn't destined for their subnet.

To obtain the subnet broadcast address for a particular subnet:

Step 1. Take the IP address for a device on that subnet and the subnet mask for that device.

Step 2. Line the address and subnet mask up one above the other, in four columns with each octet being a column.

Step 3. In columns where the subnet mask has a value of 255, write down the value from the IP address' octet.

Step 4. In columns where the subnet mask a value of 0, write down a value of 255.

IP Address:	192	168	000	123
Subnet Mask:	255	255	000	000
Subnet Broadcast Address:	**192**	**168**	**255**	**255**

+ **Unicast** - packets using a specific, unique destination IP address. This is most comparable to two people having a single face-to-face conversation without anyone else able to hear them. Interfaces can have more than one unicast communication at a time. Unicasting cuts down on network overhead as it places the minimum amount of data on the network and because packets are addressed specifically, it eliminates the requirements that a device filter out data it doesn't need to listen to.
+ **Multicast** - packets that are sent to an IP address belonging to a predetermined range of IP addresses. Interface's may join a multicast group to be able to send and receive packets within the group. This is comparable to a group of listeners who all choose to listen to one speaker, or to other members of the group who take on the role as speaker. The conversation doesn't leave the group.

It is possible for interfaces to send packets to or receive packets sent to a multicast address without joining the corresponding multicast group. But unless the interfaces join the multicast group, switches between the devices may not forward the multicast packets correctly.

Most of the time a /8 subnet mask (255.0.0.0) can be used with Mbox. When using multiple interfaces on the same computer, with each having a /8 subnet mask, a general rule is to make sure that each interface has a different first octet. Otherwise there may be ambiguity when trying to determine which interface to use for various communications. While all interfaces on a computer may receive packets from any source, packets sent by the computer almost always should leave through only one interface. If that interface is not on the correct subnet (or indeed the correct physical network) then the packets will never get to the intended destination.

CAUTION! IP addresses starting with 2 and 192 and having a subnet mask of 255.0.0.0 are actually publicly routable IP addresses. Therefore, if the computer has an interface connected to a router (e.g. connecting to the internet), and also has an interface with a 2./8 or 192./8 then there may be some connection issues with certain websites.

For example, if two interfaces are configured with IP addresses of 2.0.0.1 and 2.1.0.1 and both have a subnet mask of 255.0.0.0. -> Both interfaces are on the same sub-network (i.e. 2.x.x.x), but have unique IDs on that network. Because this is a valid IP scheme, the computer will allow this; but using this setup will cause issues with Mbox software. One or both of these interfaces should use a /16 subnet mask instead of the /8 subnet mask, thereby placing the two interfaces onto different subnets. -> 2.1.x.x and 2.0.x.x

With all protocols, especially those detailed below, it's best that one and only one interface on the computer be on the same subnet as the destination devices. When the computer is told to output data to a specific destination device it avoids confusion if only one interface can "talk" to that device.

Standard Control Protocols

Art-Net

Art-Net packets can be fully broadcast (i.e., not restricted to a particular subnet) which makes a device's subnet inconsequential. Some Art-Net devices use full-broadcast to transmit their data, potentially flooding the network with data.

To reduce overhead, most Art-Net devices use a subnet mask of 255.0.0.0 and generally use either 002 or 010 as the first octet in their IP address. This places these devices into a specific subnet and they only talk to other Art-Net devices on the same subnet. Art-Net data would be sent to the subnet broadcast IP address - either 2.255.255.255 or 10.255.255.255. While this cuts down on some bandwidth usage vs. a full broadcast, it should be noted that subnet broadcasts still aren't the most efficient use of bandwidth.

For the best efficiency possible, Art-Net can be unicast from device to device. This cuts down on overhead, but means that the IP address for each device must be known in advance and the precise destination for every piece of data must be specified. This can make the hardware configuration and software setup more complex. Additionally, the device to be unicast to must still be on the same subnet as an interface on the Mbox computer, otherwise the packets won't be received at all.

sACN

sACN packets are typically multicast, which sidesteps the restrictions of subnets and subnet masks, meaning that any interface can send or receive data for any multicast group it joins. Of course, the interface must still be on the correct physical network for the multicast group. Joining a multicast group is most important when receiving data. Switches can monitor multicast data on the network, and then filter out data that a connected interface has not elected to receive (i.e. for a multicast group the interface has not joined).

Any interface on the computer can be used for multicast, but as noted earlier, the interface has to be specifically identified and registered as a member of the appropriate multicast group. sACN uses predetermined multicast groups, one for each sACN universe, with each group having a preset IP address. Without registering as a member of all of the necessary multicast groups (for transmitting or receiving), Mbox will not be able to send or receive sACN data. For the purposes of receiving multicast data, it is possible to have all the interfaces on a computer join a multicast group, so that the data is received no matter what interface it arrives on. But for the purposes of outputting multicast data, only one interface should join the group.

sACN does allow for broadcast or unicast but this functionality is not widely used.

KiNET

KiNET is intended to be unicast only. Therefore all packets are addressed to specific IP addresses. This is efficient, but as with Art-Net unicast, the user must know all of the IP addresses of the connected devices that they want to communicate with in advance. And as always, the Mbox computer must still have a interface that is on the same physical network and subnet as the receiving device.

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