



SOFTWARE VERSION 3.10

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# MBOX<sup>®</sup> REMOTE

## USER MANUAL

AutoPar<sup>®</sup>, Bad Boy<sup>®</sup>, Best Boy<sup>®</sup>, Followspot Controller<sup>™</sup>, Mbox<sup>®</sup>, Mini Node<sup>™</sup>, Nocturne<sup>®</sup>, Series 400<sup>®</sup>, ReNEW<sup>®</sup>, Super Node<sup>™</sup>, UV Bullet<sup>™</sup>, V476<sup>®</sup>, V676<sup>®</sup>, Virtuoso<sup>®</sup>, and White Light Bullet<sup>™</sup>, are trademarks of Production Resource Group, LLC, registered in the U.S. and other countries.

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Mbox<sup>®</sup> Remote User Manual  
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Production Resource Group  
Dallas Office  
8617 Ambassador Row, Suite 120  
Dallas, Texas 75247  
[www.prg.com](http://www.prg.com)



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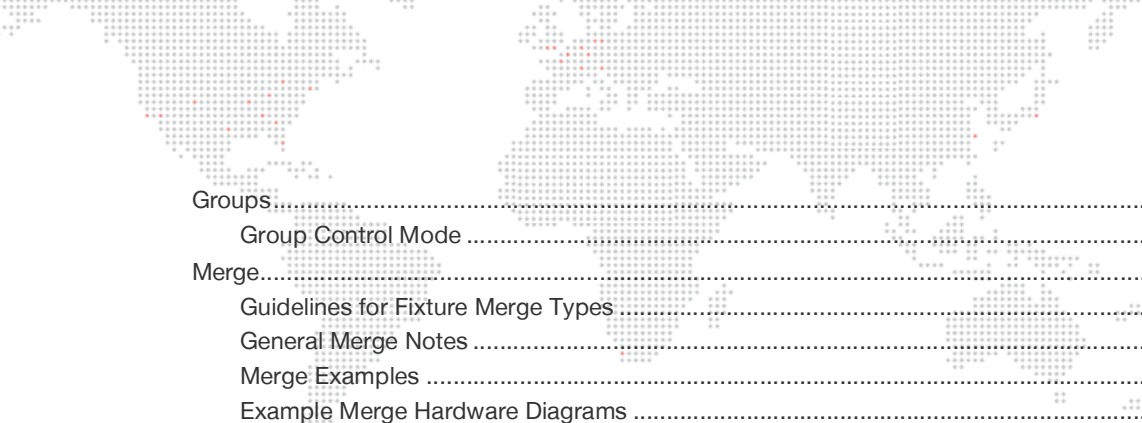
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## REVISION HISTORY

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This manual has been revised as follows:

Version	Release Date	Notes
3.9	December 19, 2014	Initial release / updated to software version 3.9. Note that this document was previously included as an appendix within the other Mbox manuals. It is now a stand-alone document.
3.10	August 31, 2015	Updated to software version 3.10



## INTRODUCTION

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### About This Manual

This manual provides necessary information regarding product safety, installation, and operation for the following PRG product:

- + Mbox® Remote

This manual applies to software version 3.10.

Familiarizing yourself with this information will help you get the most out of your PRG product.

This manual assumes a basic understanding of Mbox Media Server concepts. For more in-depth explanations of Mbox parameters (layers, cameras, lighting, effects, textures, shutters, etc.) and media features, refer to the latest version of the Mbox Media Server User Manual (02.9800.0001.xx).

### Additional Documentation

For information, refer to the following PRG manuals:

- + Mbox® Designer User Manual (02.9800.0001.xx)
- + Mbox® Director User Manual (02.9800.0002.xx)
- + Mbox® Studio User Manual (02.9800.0003.xx)
- + Mbox® Mini User Manual (02.9800.0004.xx)
- + PRG Lighting Systems Networking Guide (02.3004.1000.0)
- + Vx76 Software User Manual (02.9814.0001.xx)

For more information about DMX512 and sACN protocols, refer to the following documents available from the American National Standards Institute (ANSI) at [www.ansi.org](http://www.ansi.org):

- + 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 to PLASA members at [www.plasa.org](http://www.plasa.org)

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

- + Specification for the Art-Net Ethernet Protocol

## Training Videos

Mbox Media Server Training Videos are available online. The following is a list of videos that apply to Mbox Remote:

- + Patching: <http://www.youtube.com/watch?v=07L0DA9pAb0>
- + Director Media Picker: <http://www.youtube.com/watch?v=vWa83nZREqA>
- + CITP – Streaming Feedback & Thumbnails: <http://www.youtube.com/watch?v=ZQMg9VmJYNM>
- + Daemon Application: <http://www.youtube.com/watch?v=zpuxdZOErqE>
- + Simple Playback: <http://www.youtube.com/watch?v=916vFB0wAwY>
- + Director Interface: <http://www.youtube.com/watch?v=a-J41U-VRtg>
- + Media Server Concepts: <http://www.youtube.com/watch?v=8jS1TAd1Thg>
- + Parameter Timing: <http://www.youtube.com/watch?v=QTAsmLayppY>
- + Cueing in Director: [http://www.youtube.com/watch?v=SbN\\_Xk6HLJl](http://www.youtube.com/watch?v=SbN_Xk6HLJl)
- + Scene Timing: [http://www.youtube.com/watch?v=Dv-\\_mGw1sgs](http://www.youtube.com/watch?v=Dv-_mGw1sgs)
- + Advanced Cueing: <http://www.youtube.com/watch?v=rgdE7N3glxo>
- + Pixel Mapping (playlist): [https://www.youtube.com/playlist?list=PL5WLNako6zrhFBPzW5kRENdf\\_49n7Z7KW](https://www.youtube.com/playlist?list=PL5WLNako6zrhFBPzW5kRENdf_49n7Z7KW)
- + Projection Mapping (playlist): <https://www.youtube.com/playlist?list=PL5WLNako6zriEURCQKaQ8z-BTY2Ah-zJs>
- + Image Remapping (playlist): <https://www.youtube.com/playlist?list=PL5WLNako6zrgt6xO6t9f3h3cp32loayhW>



Direct links to the videos are also provided throughout this manual, where applicable.

## Customer Service

For technical assistance, contact the PRG International Service Center or contact your nearest PRG office. Contact information for all PRG office locations can be found on our website at: [www.prg.com](http://www.prg.com)

### PRG Dallas (International Service)

8617 Ambassador Row, Suite 120  
Dallas, Texas 75247 USA  
Phone: 214.630.1963  
Fax: 214.630.5867  
Service Fax: 214.638.2125  
Service Email: [orders@prg.com](mailto:orders@prg.com)

For Mbox support, please contact: [mboxsupport@prg.com](mailto:mboxsupport@prg.com)

For additional resources and documentation, please visit our website at: [www.prg.com](http://www.prg.com)



# GENERAL OPERATION

## About Mbox Remote



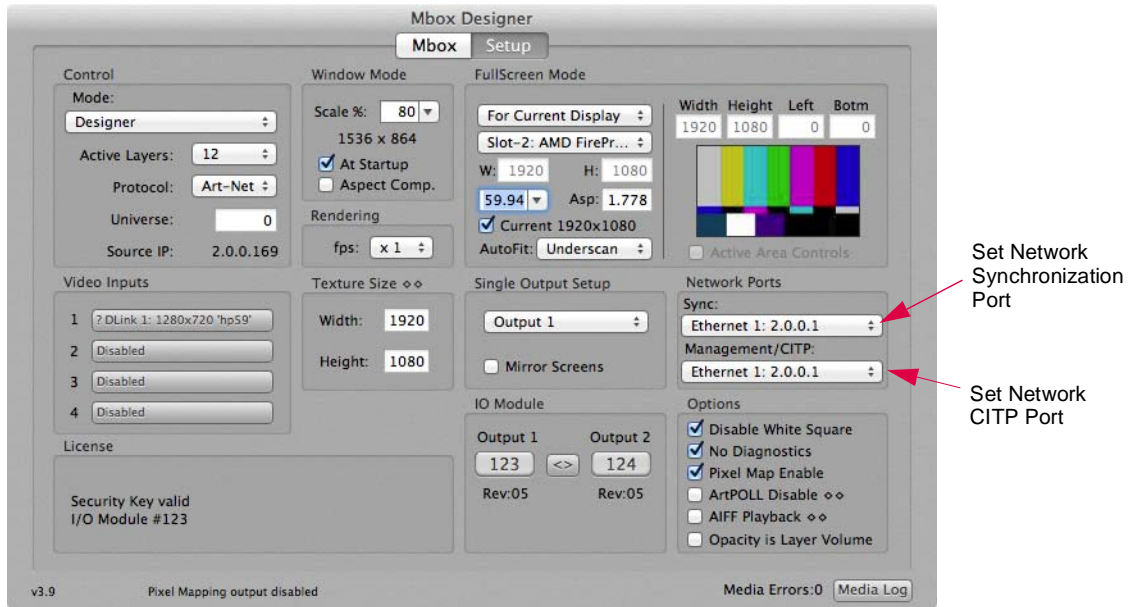
The Mbox Remote application is used for remote monitoring and management of the Mbox application. The Remote application is included with the Mbox software and can also be used on any Mac® computer (running Snow Leopard® OSX 10.6.7 or greater) to monitor/manage from a remote location.

## Mbox Daemon



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

To set the network port that Mbox and Daemon will use to communicate with external monitoring devices (like Remote or CITP-enabled consoles and visualizers), use the CITP pop-up on the Mbox Setup 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 only running Mbox Remote and Daemon, the Interface (port) must be set using the pop-up available in the Daemon window (not in the Mbox Setup window above).



Training Video: Daemon Application: <http://www.youtube.com/watch?v=zpuXdZOErgE>

## 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 servers' instance of Mbox Daemon, and optionally, Mbox applications, are running and that Mbox / Daemon CFTP ports are set to the same Ethernet port that the Remote application is connected.

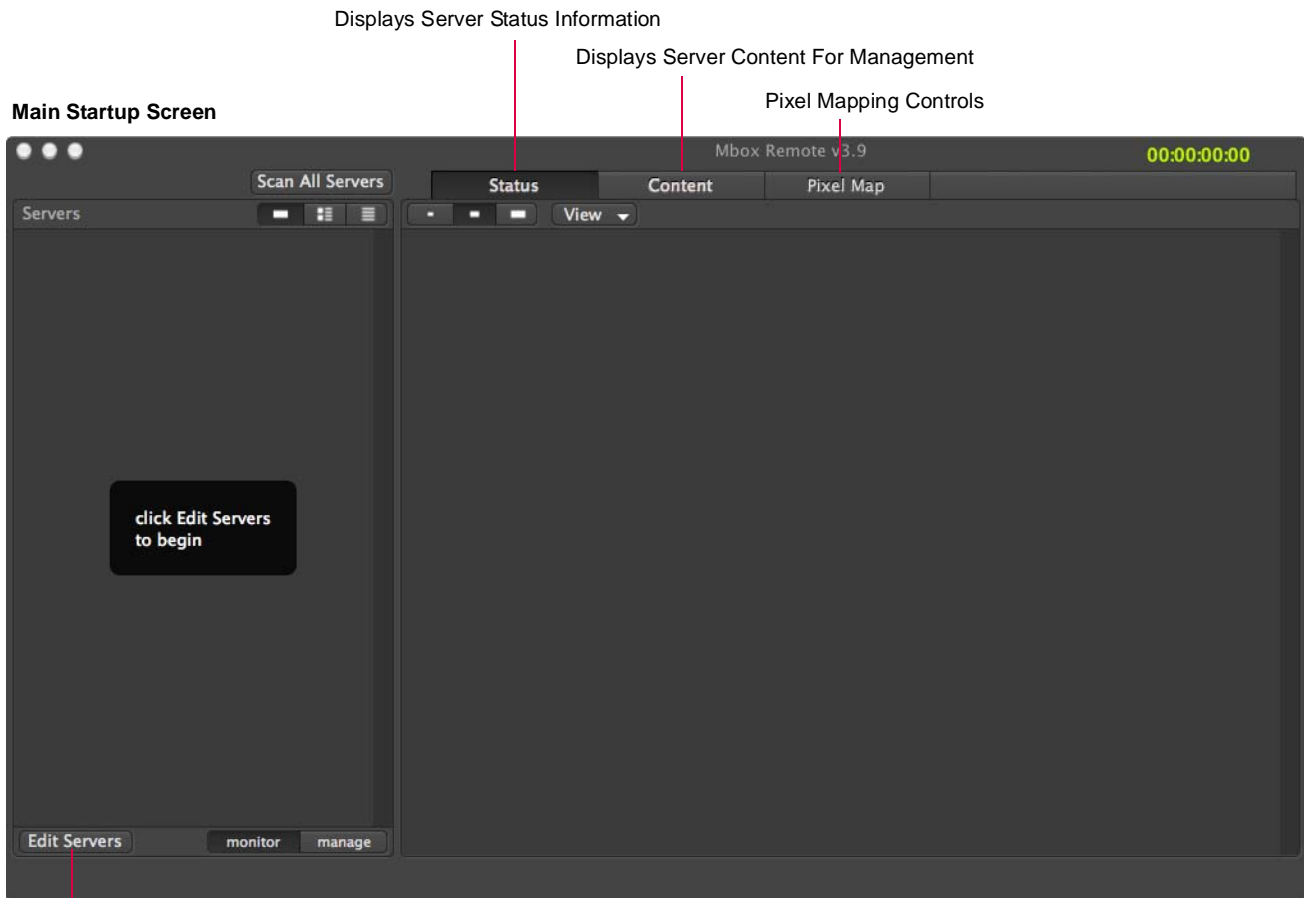
When Mbox Remote starts, it will either resume with its previous state or start with a blank configuration.

## 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. At Mbox Remote main window, click **Edit Servers** button or press [⌘ ,] on the keyboard to open the Mbox Remote Preferences window.



Displays Server Status Information

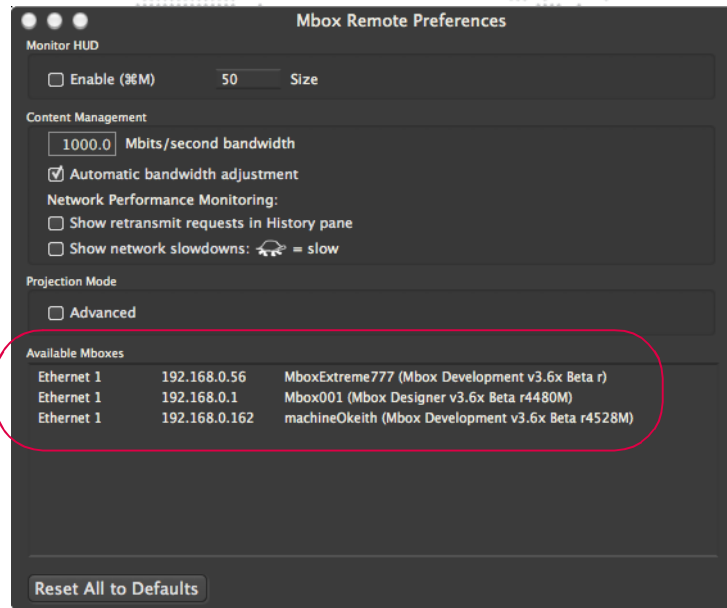
Displays Server Content For Management

Pixel Mapping Controls

Main Startup Screen

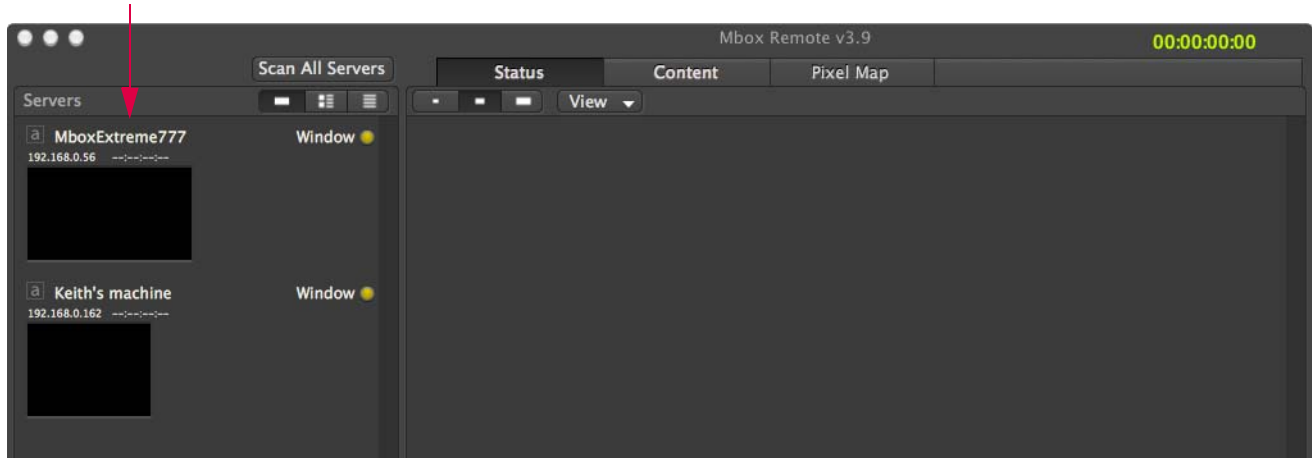
Opens Mbox Remote Preferences window

Step 2. At Remote Preferences window, double-click on any available Mbox servers in the list. They will be added to the main window.



Step 3. When at least two servers have been added, click red X button to close Preferences window. Servers will be displayed in the Servers column of the Remote main window.

Servers that can now be managed



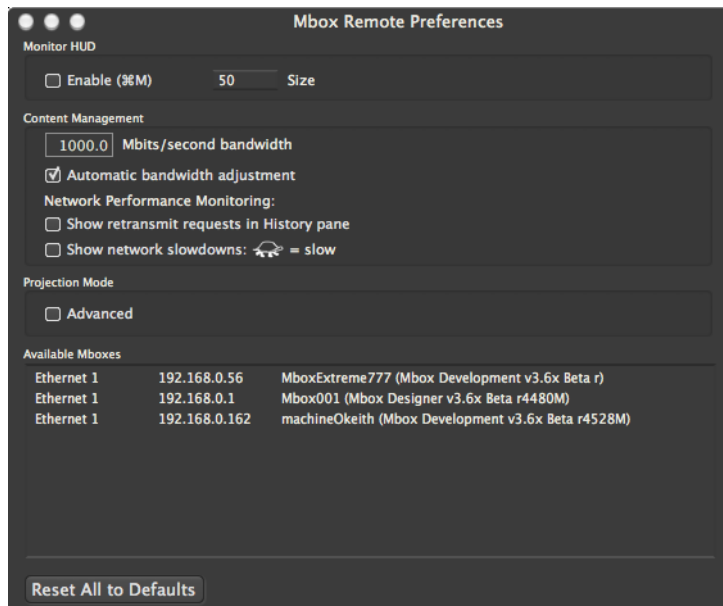
**Note:** No matter which tab is selected in the window (Status or Content), the Servers area on the left will always display the list of managed servers.

## Setting Mbox Remote Preferences

Open the Mbox Remote Preferences window at any time by clicking the **Edit Servers** button on the main window or 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. It will show a floating window of the Breakout View that is currently selected (designated by a surrounding white box) in the main window.
- + **Size** - The size of the Monitor HUD can be adjusted using the Size field. This allows you to set the main application window images to be quite small to save space, but still have a large view of the selected server or layer.



### Content Management

The Content Management section is used to configure the available 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 37.

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**Note:** Projection Mapping Advanced mode is only applicable to Mbox Designer and Mbox Studio.

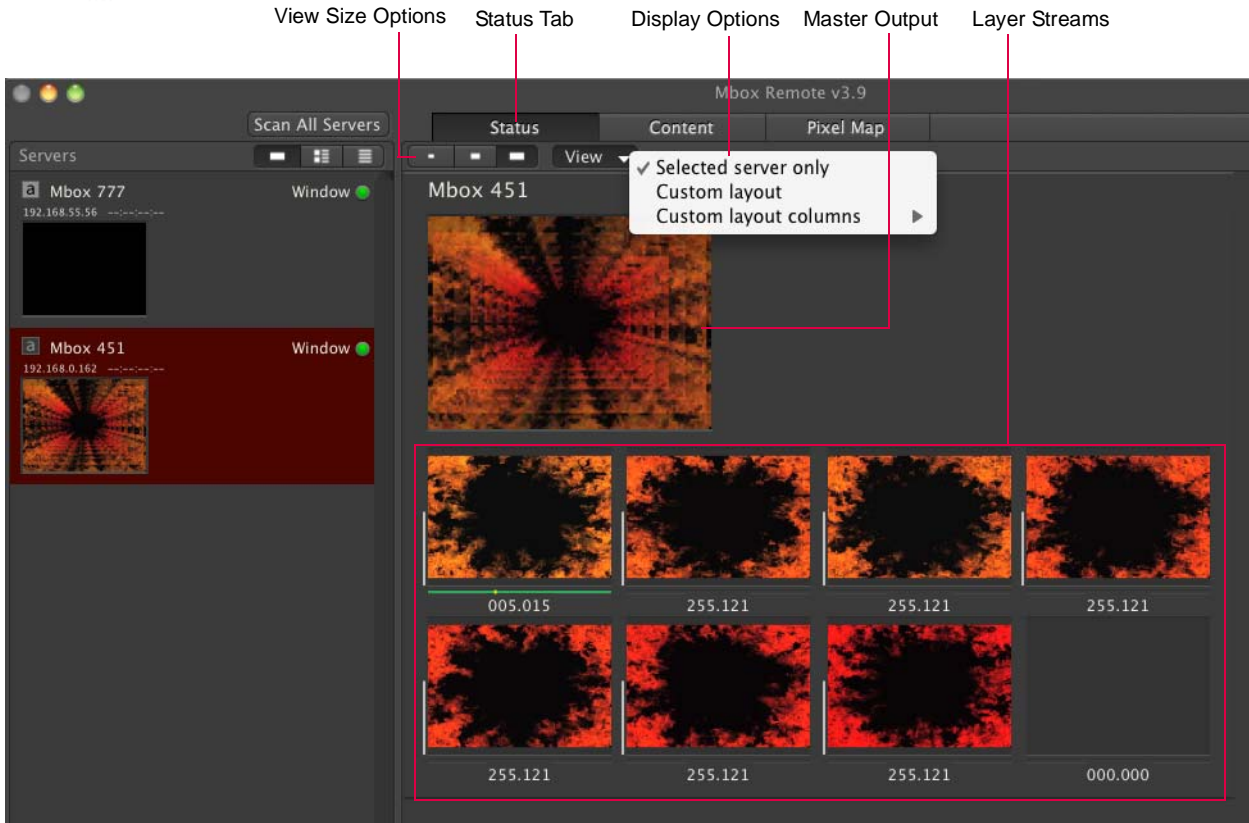
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## Server Status

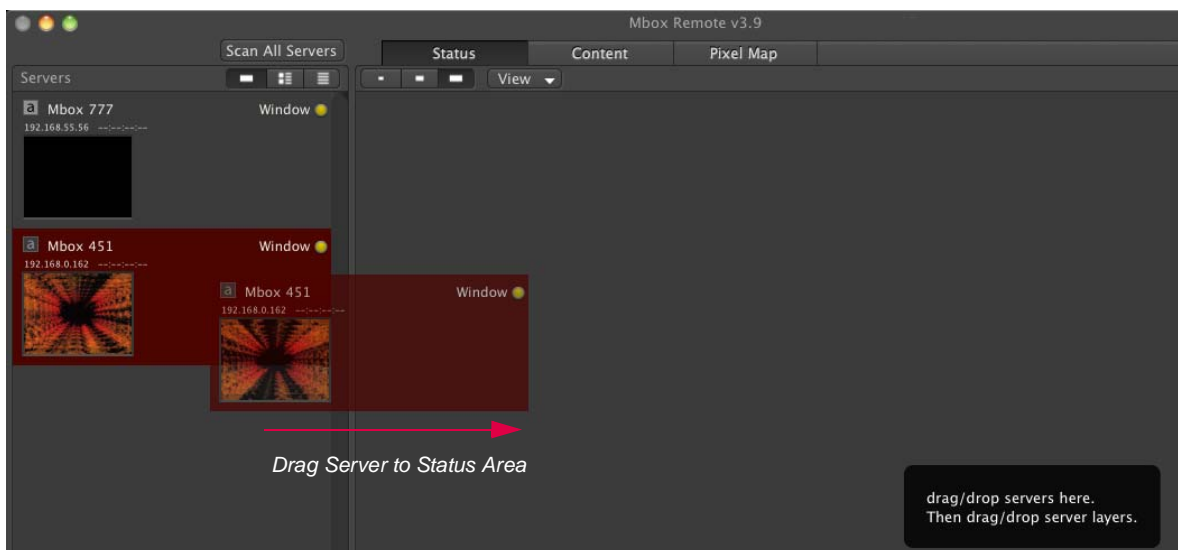
The Status tab of the Remote window shows, by default, the server's master output and individual layer streams.

### Setup

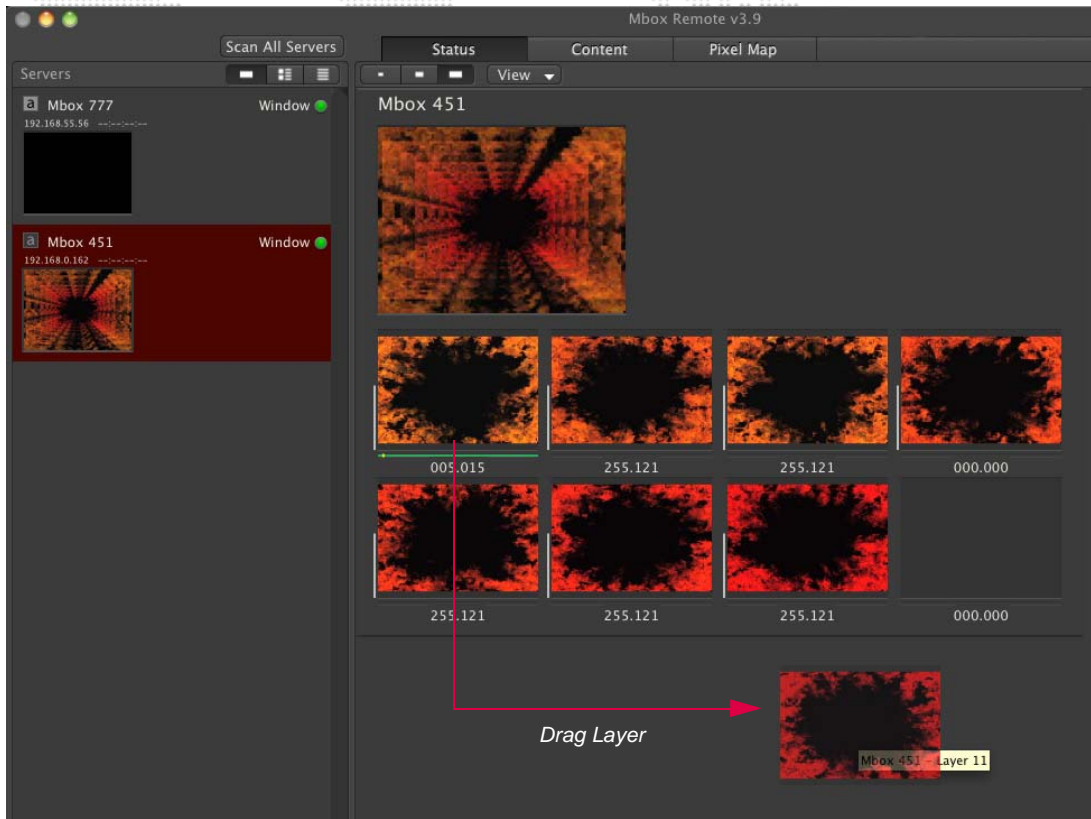
The window provides options for how the streams are displayed. Click the view size options and/or use the View drop-down menu to customize.



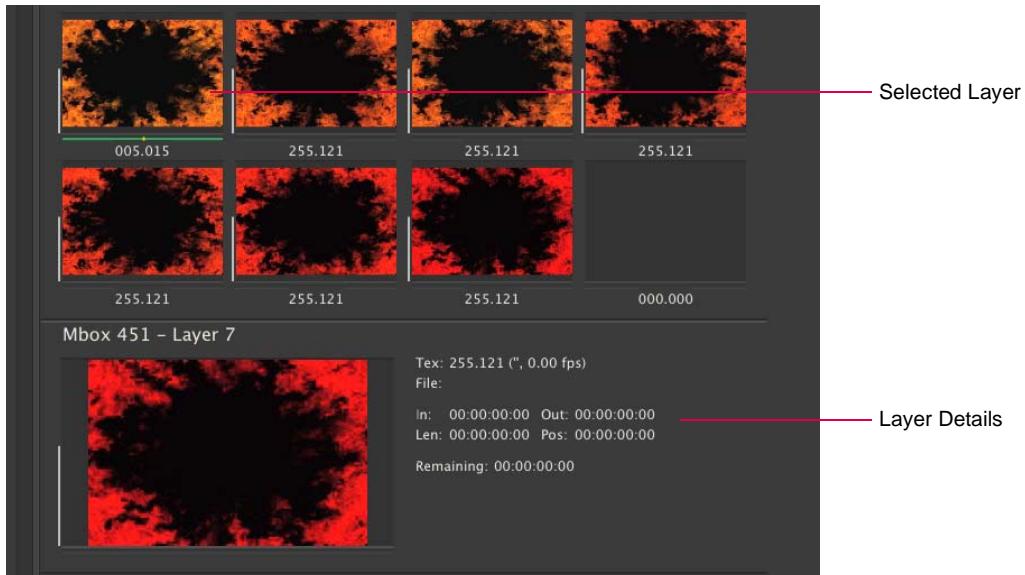
Server status can be setup by dragging components into the status area.



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

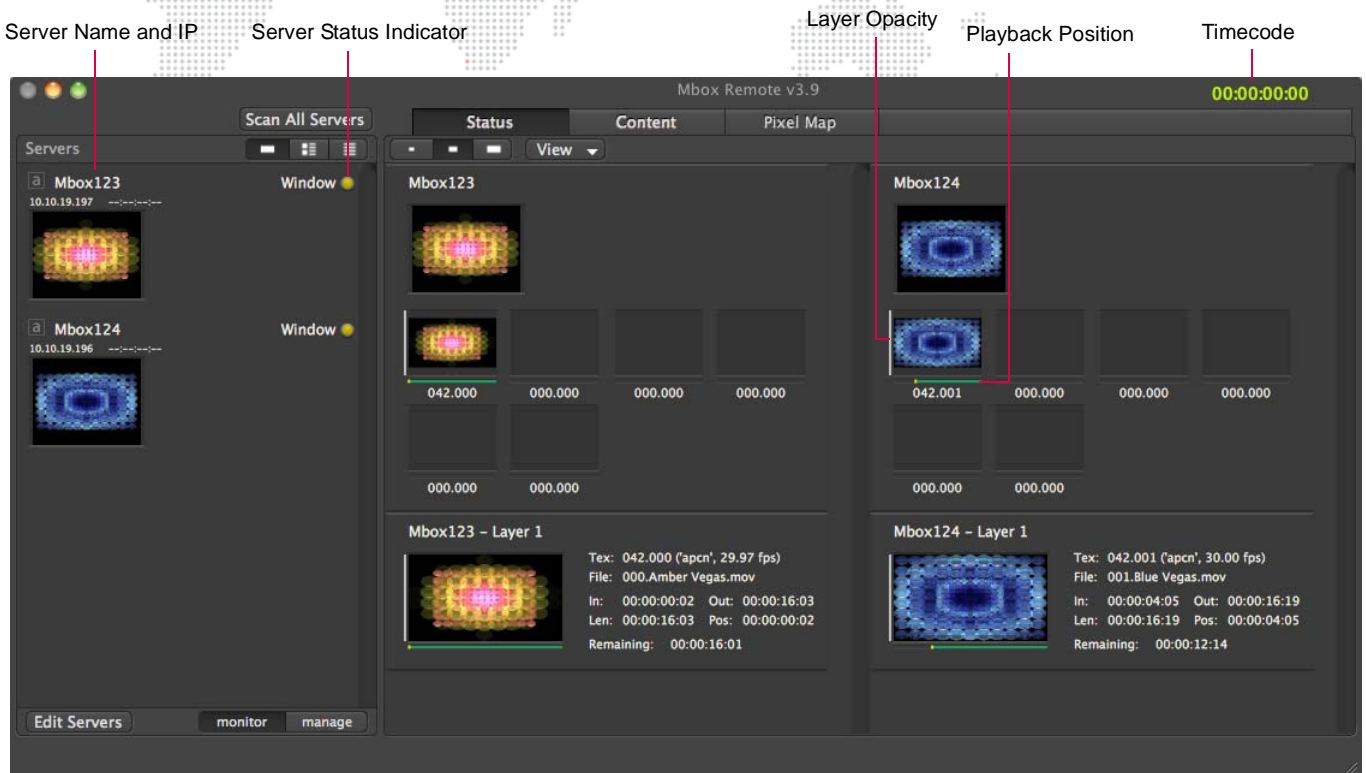


The picture below shows the result of dragging Layer 1 into the bottom area:



## 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(s). 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. Networking For Mbox](#)" on page 119.)

**Local Timecode Value** - if the computer running the Remote application is receiving timecode locally, that timecode value will be displayed at the top-right of the Mbox Remote window.

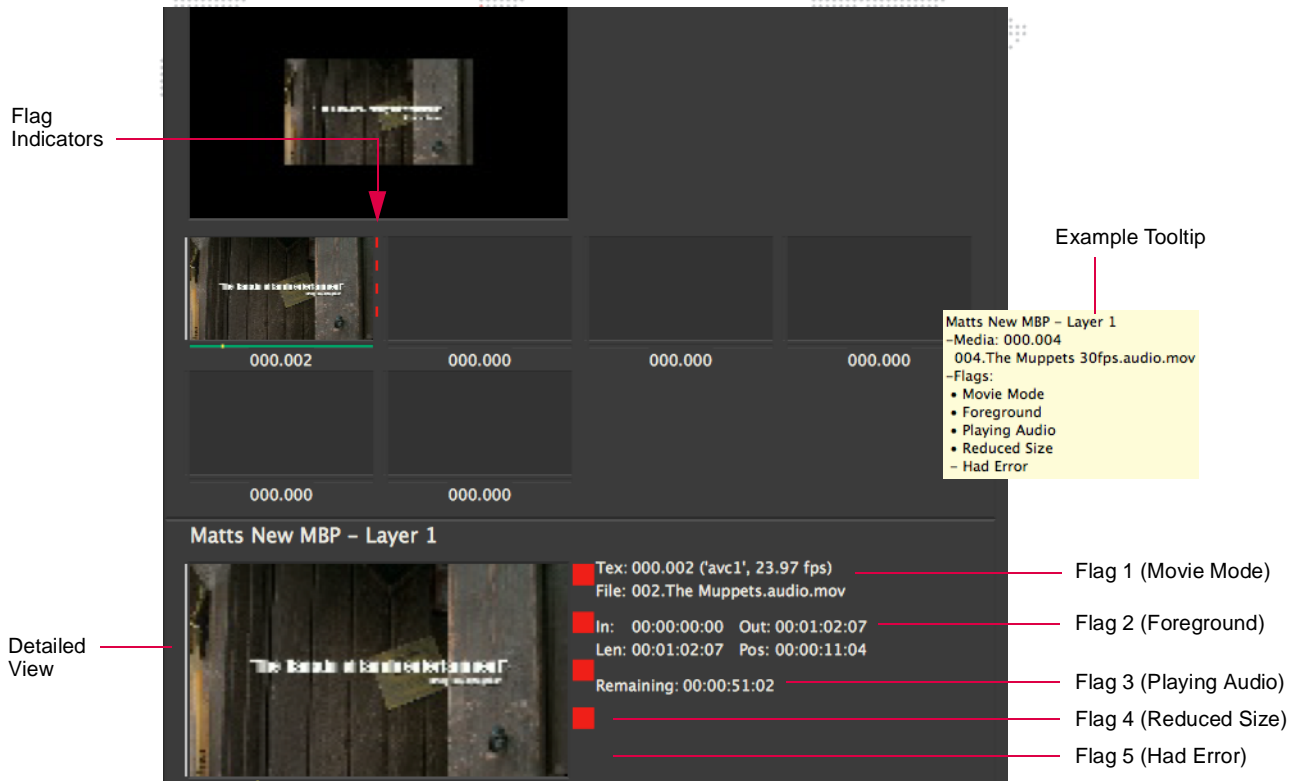
**Server Timecode Value** - if an Mbox server is receiving timecode locally or over the network, that timecode value will be show to the right of the server's IP address in the Servers column.

**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 types:

- 1) **Movie Mode** - Any movie that is a) not a preferred codec but is thread-safe, or b) that is playing audio will have this flag. Resolution: If not playing audio, re-encode movie using preferred codec. (Refer to the appropriate Mbox product manual for more information about recommended codecs.)
- 2) **Foreground** - Any movie that is a) playing audio, or b) that is not a preferred codec and not thread-safe. Resolution: If not playing audio, re-encode movie using preferred codec.
- 3) **Playing Audio** - Any movie playing embedded audio. (Note that if this flag is displayed, then flags 1 and 2 will also be displayed). Resolution: If not intending to play audio, then remove the ".audio" from the file name.
- 4) **Reduced Size** - The movie is larger (in pixel dimensions) than the server's current Texture Size setting (width and/or height). Resolution: a) re-encode the movie to make it smaller, or b) increase Texture Size.
- 5) **Had Error** - The movie has an issue such that Mbox cannot play it properly. Resolution: Re-encode the movie using a preferred codec. (Refer to the appropriate Mbox product manual for more information about recommended codecs.)

### Guidelines:

- + Flag 5 is obviously undesirable, as the movie is not playing.
- + Flag 4 is not an optimal situation, as the movie appears smaller and pixelated.
- + Flag 3 is okay if you intend to play audio.
- + Flags 1 and 2 are unavoidable at times. However, if you are not playing audio, then it is recommended that you avoid Flags 1 and 2 by encoding the movie using a preferred codec (ProRes, P-JPEG, AIC, Animation).

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 screen example above.

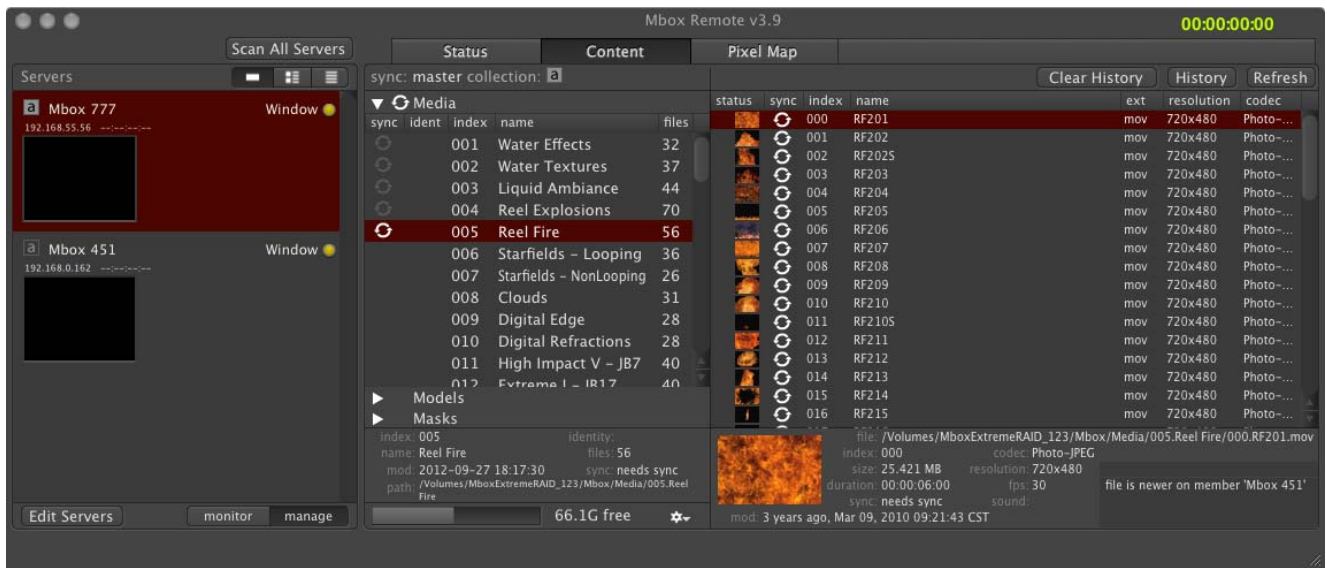


# CONTENT MANAGEMENT

## Overview

### About Mbox Remote Content Management

The Mbox Remote Content Management system allows quick and easy management of 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 into 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.)
- + Finally, an Mbox application itself must be running (i.e., Mbox Designer, Mbox Studio, or Mbox Mini). Although Mbox is not required to be running in order to use the Content Management system in its basic form, having Mbox running exposes all of the features of Remote for management.

### 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 application. 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 changes made on the Master server synchronize 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; This means that the Member will be synchronized to mirror the state of 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 on 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 UDP Multicast network stream where the data is 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, broadcasted 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 underperform 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

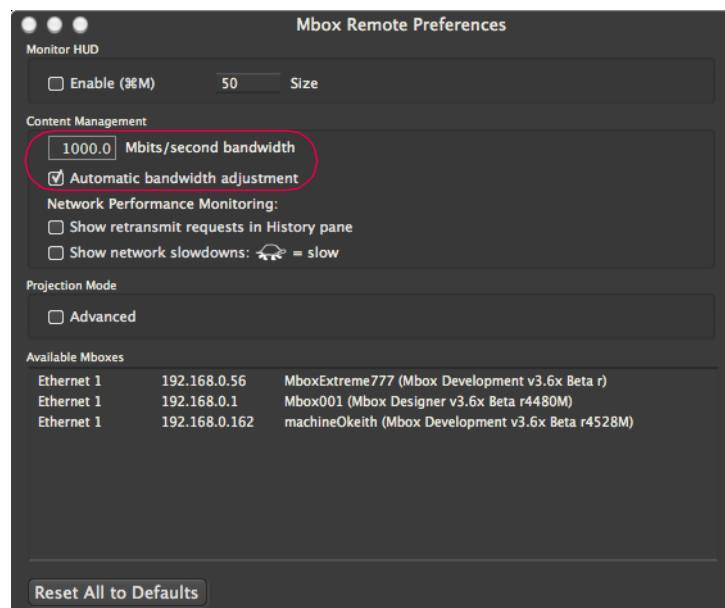
There are two properties that control the available network bandwidth which the Content Management system will utilize to transfer content. To configure the bandwidth, open the Mbox Remote Preferences window by clicking the **Edit Servers** button on the main window or pressing [⌘ ,] on the keyboard.

- + **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.

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

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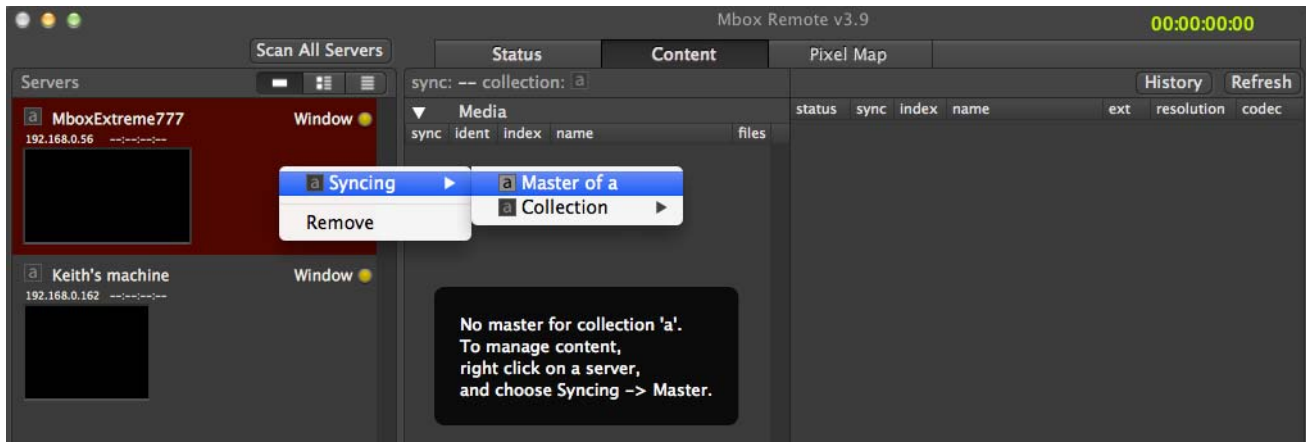
## Configuring Server Master/Member Roles

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

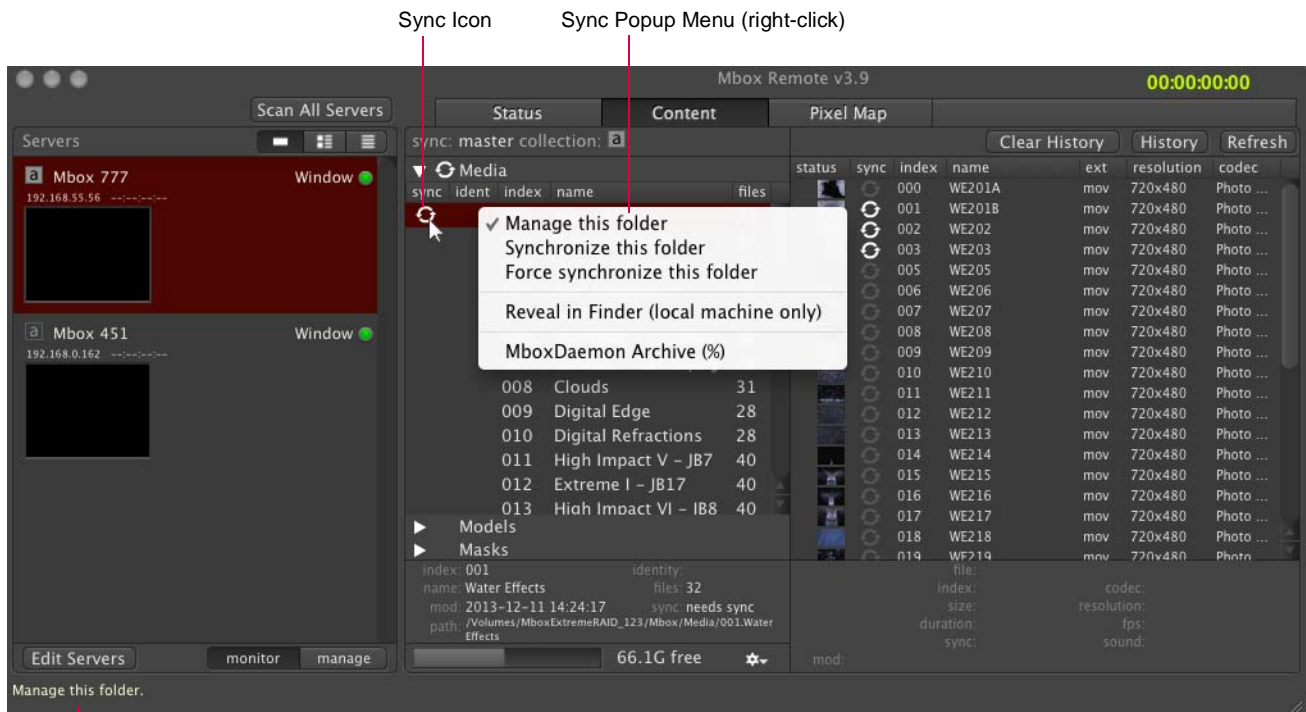
In order to synchronize files between Master and Member servers, folders must first be added to the managed folders list.

### 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.



Tooltips will be displayed here. (To bring up tooltips, place the cursor over different areas of the window.)

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

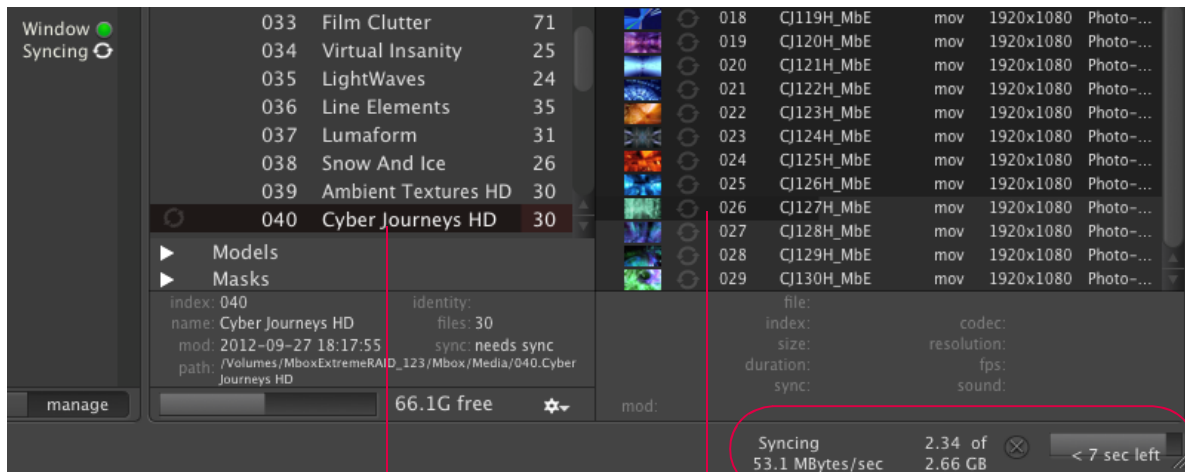
- + **Blank** - Folder is not a "managed" folder.
- +  **White** - One or more files in this folder need to be synchronized.
- +  **Gray** - This folder is synchronized.
- +  **Rotating** - This folder is currently being synchronized.

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



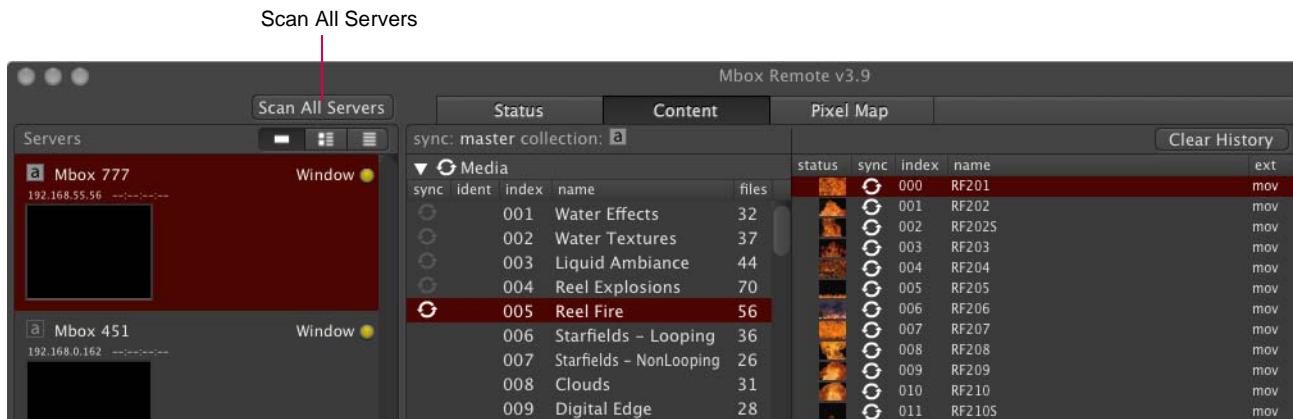
Selected Folder

Progress Bar

Sync Progress Information

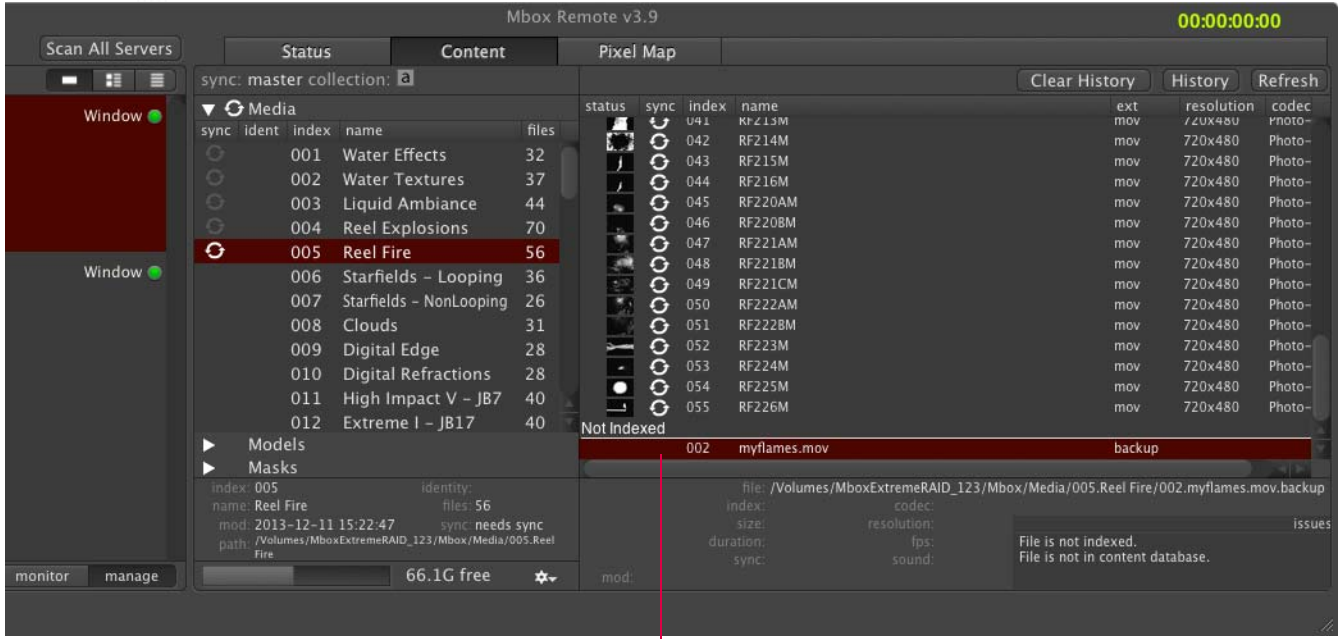
- Step 3. Once synchronization is complete and the specified item (folder or file) has successfully been transferred (i.e., copied from the Master to the Members), the sync icon will change to gray (unless there was an error - refer to **"File Conflicts"** on page 21).

- 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.



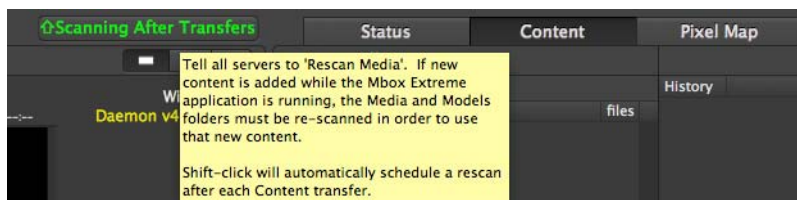
**Note:** A file's new sync status will be reflected in the window approximately 10 seconds after it has been changed.

**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 Designer/Studio/Mini 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 and it will now display the text "Scan All Servers."

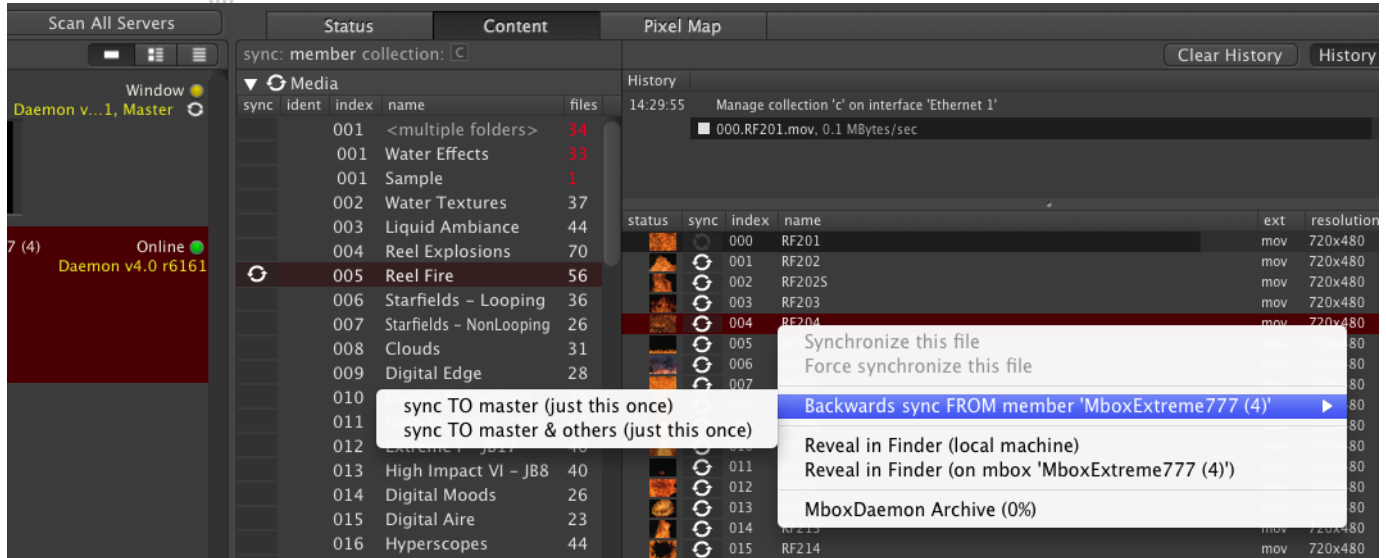
## To reverse sync an individual file:

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.



**Note:** 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.

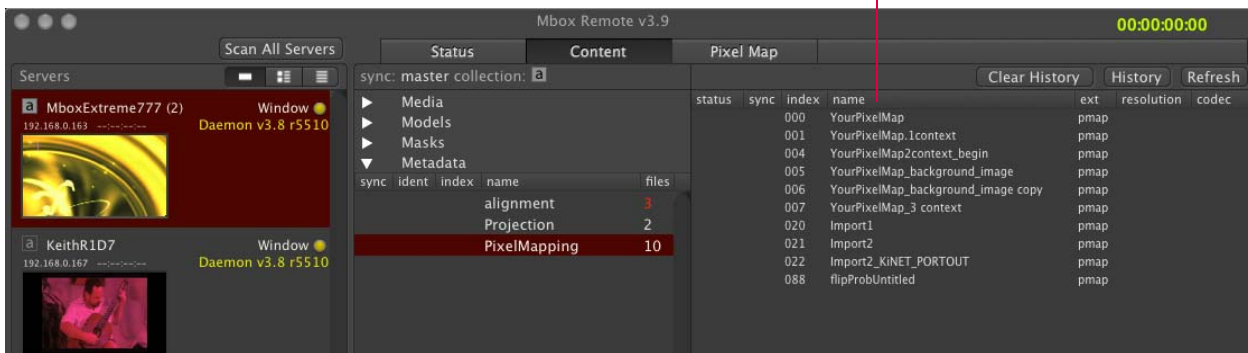
## Synchronizing Pixel Map, Alignment Rectangle, and Script Files

Pixel mapping files, Alignment Rectangle .plist, and scripts can also be synced between servers using Content Management.

*Requirements:*

- + Files must have an index number prefix (8-bit).
- + Pixel mapping files must be placed in the `/Mbox/PixelMapping` folder.
- + Alignment Rectangle plist must be placed in the `/Mbox/alignment` folder.
- + Scripts must be placed in the `/Mbox/plugins/scripts` folder.

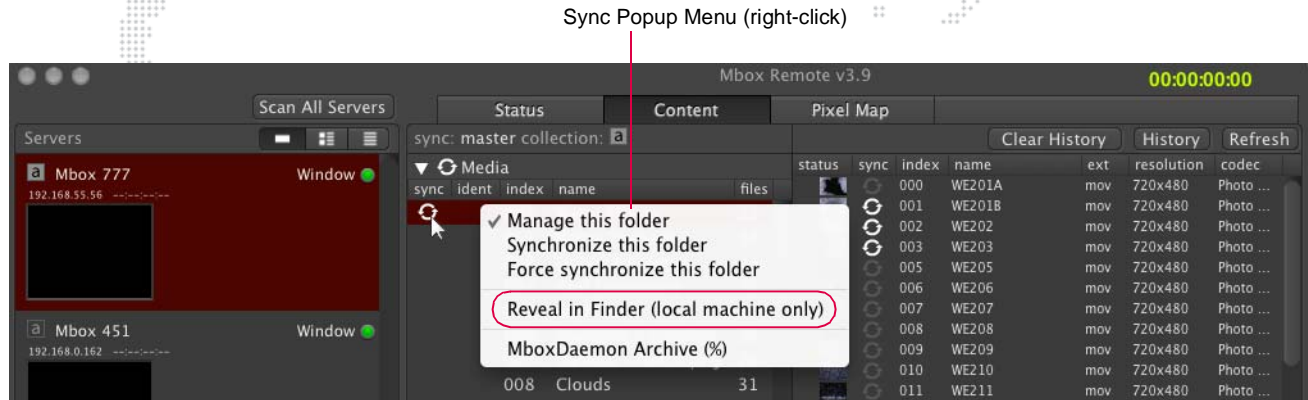
### Pixel Mapping Files





## Organizing Content Files

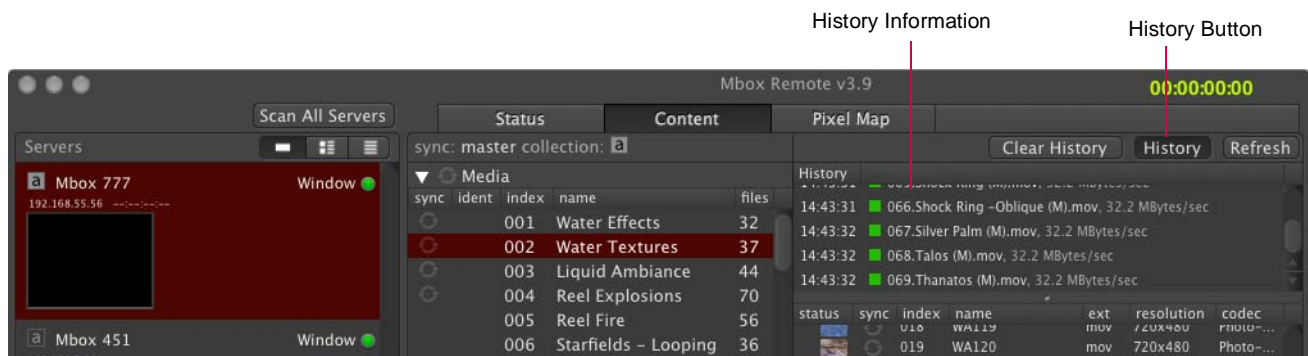
Organization of a server's media files is completely under user control using the Mac Finder, rather than a large opaque database. Any changes to name, index number, or file extension can be done using the Mac Finder. As a convenience, folders and files can be quickly viewed in the Finder by selecting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



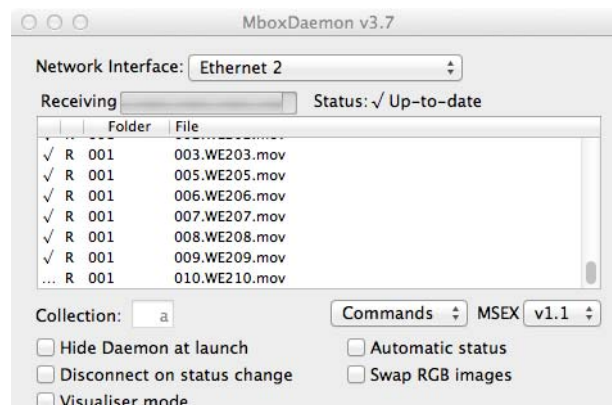
## Sync History

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.



**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.



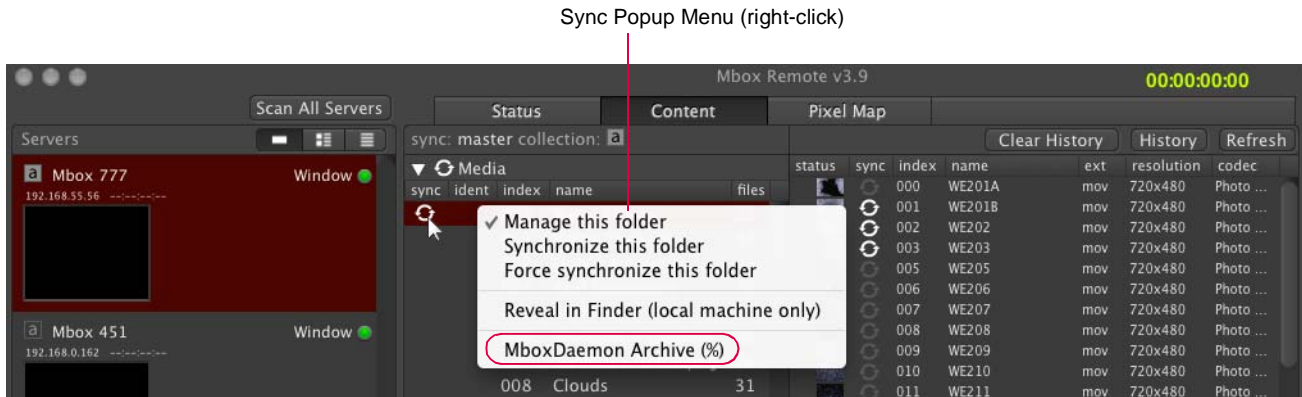
## Content Management Archive

Each server can be configured 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 stored in the `/Mbox/archive/<Type>/<Folder #>/<File #>` where the file name will be a time/date stamped version of the archived file.

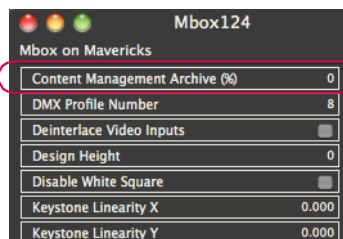
When the archive runs out of space, the oldest files (by date) are deleted from the archive until there is enough space available. The archive size preference specifies a percentage of the total FREE space available on the drive. For this reason, the total space available for the archive shrinks (to zero) as the drive fills up.

### To configure an archive:

- Step 1. Ensure Remote, Mbox, and Daemon are running on the target Mbox server.
- Step 2. At Remote application, select target server in Servers column.
- Step 3. Open Mbox Server Preferences window using one of two options:
  - a. Press [⌘ P].
  - b. At Sync pop-up menu, select **Mbox Daemon Archive**.



- Step 4. Locate "Content Management Archive %" preference. In the 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 this 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 Mac Finder and edit its name as required.

## File Conflicts

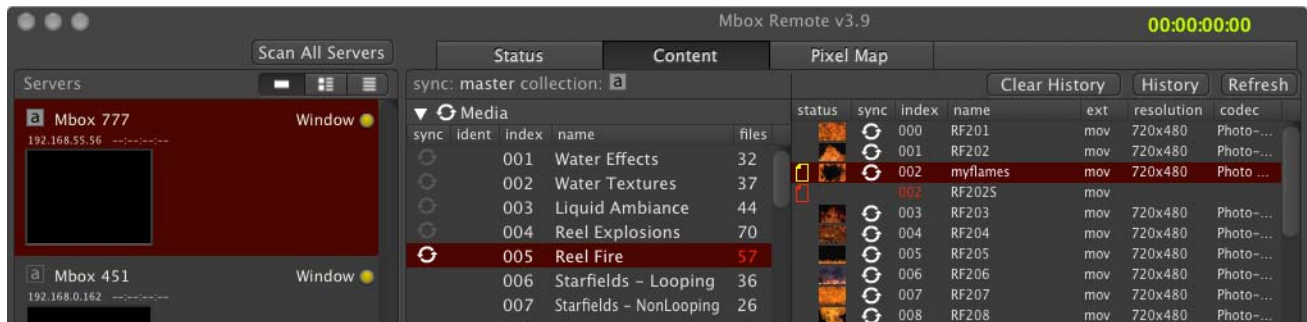
During synchronization, file conflicts can occur as a result of the following:

- + 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 with the yellow icon is the one that Mbox will play when asked to play that index. The file(s) with red icons will not play.

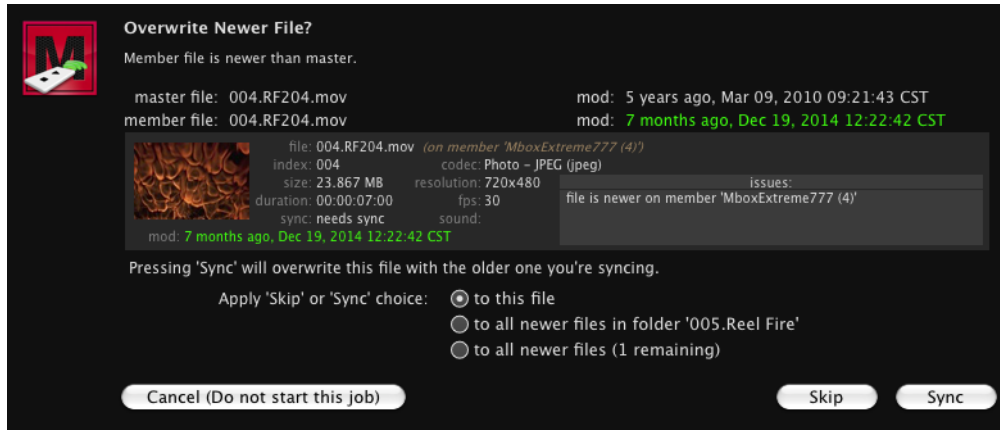
File conflicts can be resolved by either deleting the duplicate files/folders or by renaming/indexing them using the Mac Finder. (Refer to "[Organizing Content Files](#)" on page 19.)

## Newer File Warning

Mbox Remote will provide a warning 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 this cases, three choices are possible:

- 1) Overwrite only this individual newer file.
- 2) Overwrite all newer files in this folder (assuming you're syncing an entire folder).
- 3) Overwrite all newer files during this sync (assuming you're syncing more than one folder).

At dialog window, choose an option using the radio buttons and click **Sync** or **Skip**.



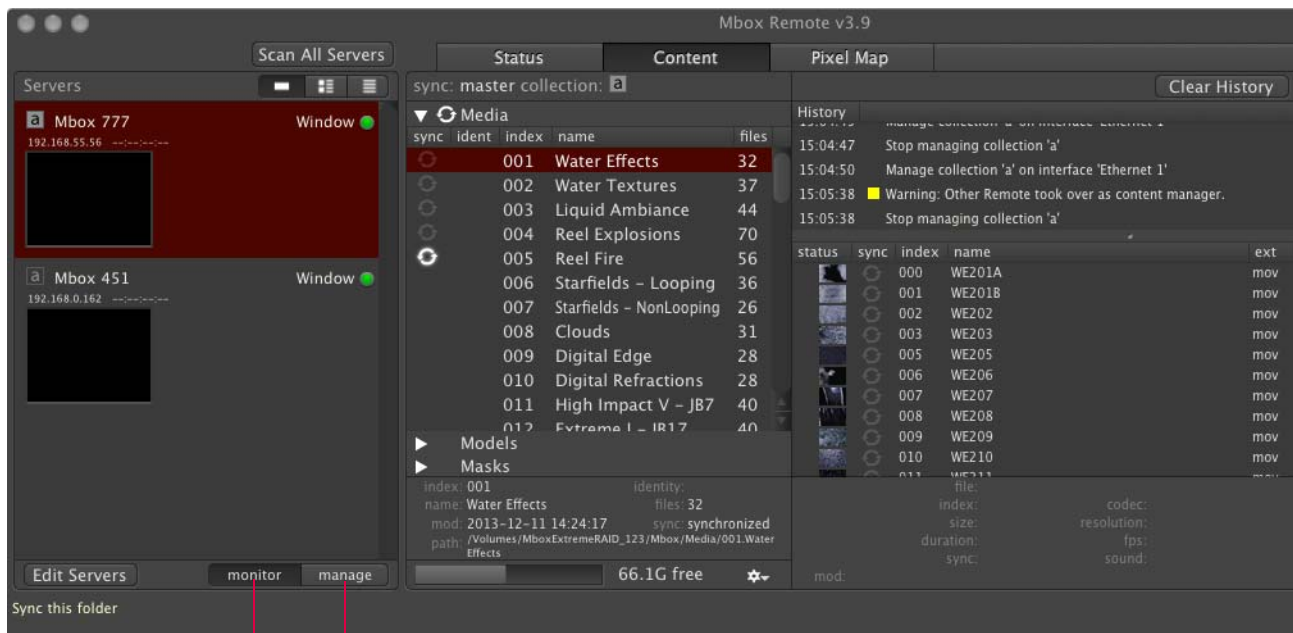
## Monitor and Manage Modes

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 run on more than one machine. In this case, to specify which instances of Remote are allowed to monitor or manage, use the two mode buttons located in the bottom-left of the window.

**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 another 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**.



## SETTING SERVER PREFERENCES

### Setting Mbox Server Preferences Remotely

If you select a server or layer on the Remote main window and then press [⌘ P], the Mbox Server Preferences window will open. This window allows you to remotely set the preferences of the server: Art-Net Universe, Number of Layers, Alignment Rectangles.

To edit a setting, click inside the box that surrounds the name of the setting. The preference will become active so that it can be edited. Note that text values will require pressing [enter] to accept them.

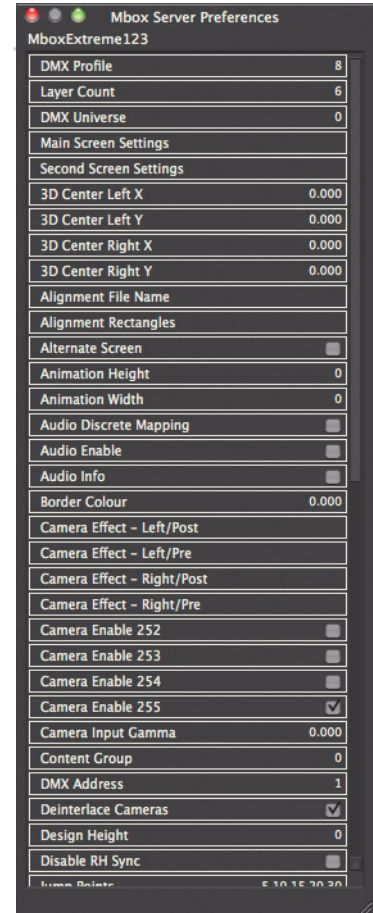
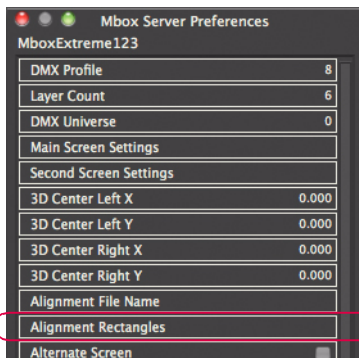
**Note:** Some preferences require the Mbox application to be relaunched before they take effect. These preferences are noted by the presence of two diamonds after the pref's name.

### Example: Setting Up Alignment Rectangles Using Remote

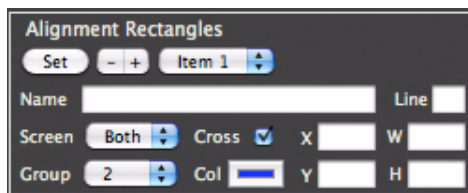
Certain preferences have more complex settings, such as the Alignment Rectangles configuration. (Refer to the appropriate Mbox product manual for more information about Alignment Rectangles.)

To setup Alignment Rectangles on a server using Mbox Remote application:

- Step 1. Using Remote, open Mbox Server Preferences window (for the desired server).
- Step 2. Click inside Alignment Rectangles box.

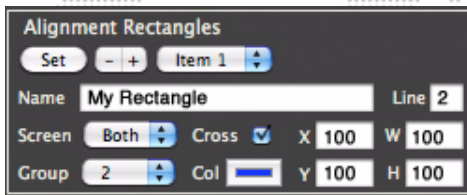


- Step 3. At Alignment Rectangles edit window, press "+" button to add a rectangle or "-" to delete a rectangle. When a rectangle is added, it will receive an index number (beginning with 0). You may have up to 256 rectangles (0 - 255).



- Step 4. Use Name field to enter a name for the rectangle.
- Step 5. Use X, Y, W, and H fields to specify an origin (X, Y) and size (Width, Height) for the rectangle. Keep in mind that the origin (0,0) of the Mbox display is the top-left corner.

- Step 6. Use Line field to enter a linewidth for the rectangle. (The default linewidth is 1.)
- Step 7. Use Col (Color) pop-up to specify a color.
- Step 8. Specify a Screen and Group as required.



- Step 9. Press "Set" button to apply rectangle settings. If rectangles are not currently being displayed, all rectangles in the selected group will appear briefly to show the location of the new rectangle. If rectangles are being displayed, the new rectangle will appear and remain until the alignment rectangle display is turned off.

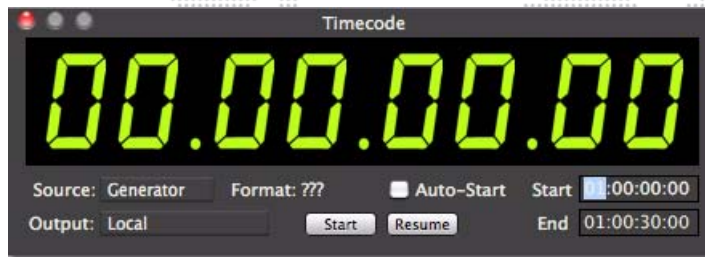
## Server Control Commands

With a server selected in the Remote main window, there are a large number of commands in the Commands section of the menubar 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** - turns File Sharing on.
- + **File Sharing Off** - turns File Sharing off.
- + **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.
- + **Show Mbox Daemon** - if the Mbox Daemon is hidden on the server, it will be unhidden.
- + **Launch Mbox** - launches the Mbox software. (This only works if Mbox Daemon is running.)
- + **Mount Server** - opens a File Sharing session with the server. (Assumes default user name and password, but will allow substitute entry if the default is not correct.)
- + **Share Screen** - opens a Screen Sharing session with the server. (Assumes default user name and password, but will allow substitute entry if the default is not correct.)
- + **Make Backup** - turns on the "Backup Mode" preference found in the Mbox Server Preferences window. Backup Mode, when on, disables the output of layer sync and pixel-mapping outputs so that the server can be a hot backup without affecting the show. (If it is necessary to take over from a failed unit, turn off Backup Mode on the backup and turn on Backup Mode - or physically disconnect - the failed unit.)
- + **Make Primary** - turns off the "Backup Mode" preference.

## Timecode Window

To toggle the Timecode window on and off, press [⌘ T] on the keyboard.



- + **Source** - choose the appropriate source for timecode: Generator, Audio In Left, Audio In Right, or MTC (MIDI timecode).
- + **Output** - Local (internal routing only), or an active Ethernet port (for sending timecode over the network to Mbox servers).
- + **Auto-Start** - enabling this will cause timecode be active as soon as the Remote application launches. Depending on the source setting, the application will immediately begin generating or listening for external timecode.
- + **Start** - starts generating code from Start Time value if generator is selected, or will start listening for external code if not.
- + **Pause** - pauses/resumes generating internal code or listening for external code (toggle action).
- + **Start** - specifies a time where the internal generator will start.
- + **End** - specifies a time where the internal generator will loop back to the start time.

---

**Note:** The Timecode window does not have to be visible to function. If timecode is being received, it will be shown at the top-right of the Remote main window.

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**CAUTION!** The TC Reader application is designed to perform best when receiving audio streams at a sampling rate of 44.1KHz. If a USB or FireWire audio interface is being used to receive timecode on the computer, open the Audio MIDI Setup application on the computer and set the interface's sampling rate to 44.1KHz. (If the computer's line-in jack or a MIDI timecode input is being used, you do not need to change any settings.)

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# 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 output settings for simple keystone, warp, and multihead output. Beyond those settings, projection surfaces (Topography files) and more complex projection mapping settings can be created, applied, and adjusted for use with Mbox Designer and Mbox Studio only.

Compatible functionality works the same way with all three versions of Mbox, although the reduced function set in Mbox Studio and Mbox Mini will restrict options. Configuration requires compatible versions (v3.6.1 or better) of Mbox, Mbox Daemon, and Mbox Remote.

### Important Notes:

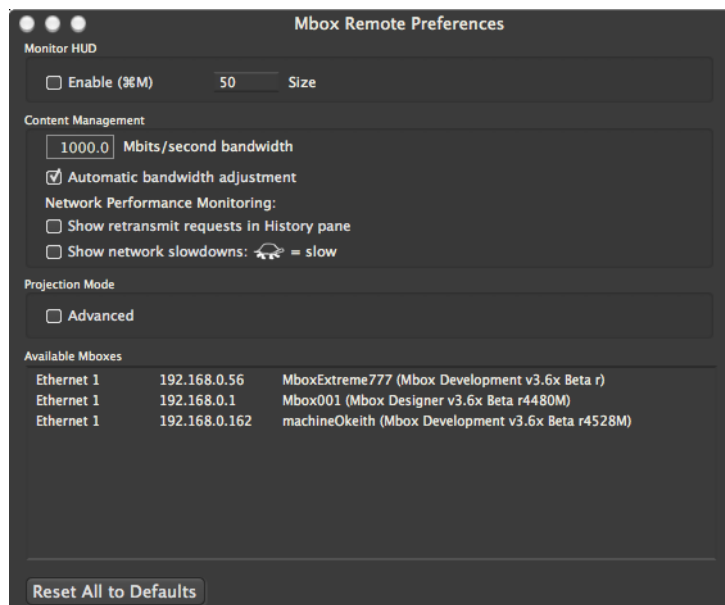
- + Some or all of the functionality will affect or even disable the default Keystone and Camera fixture controls.
- + On your controller (console or Mbox Director), the Keystone Mode must be set to a value of 000 for any of this functionality to work. Other values will disable the output and projection settings, and revert to the default Keystone and Camera controls.

## Getting Started

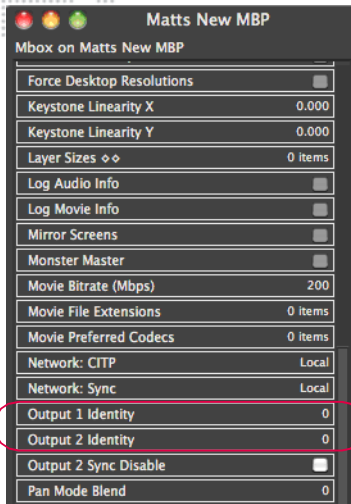
To begin with, launch all three applications. Mbox and Mbox Daemon must be running on the same computer (the Mbox server), but Mbox Remote can be used on a second computer, if desired. In this situation, make sure that the network settings (Management / CITP port) for the Mbox server and Mbox Daemon are set correctly to communicate with the second computer.

### To configure preferences:

- Step 1. Open the Mbox Remote Preferences window by clicking the **Edit Servers** button on the main window or pressing [⌘ ,] on the keyboard.
- Step 2. The Mbox server should be visible. Double-click on it to add it to the browser window. Make sure (for now) that the "Advanced Projection Settings" checkbox is not checked. Set any other sizing or layout preferences that you would like and press [⌘ ,] again to close the Mbox Remote Preferences window.




Step 3. Press [⌘ P] to open the Mbox Server Preferences window and scroll down to the settings called "Output 1 Identity" and "Output 2 Identity." (You may have to click off then back on the server in the browser window to refresh the Server Preferences window.)



Step 4. By default the Output Identity preferences will both be set to a value of "0". Do one of the following:

- If you are only using one output from the Mbox server, you don't have to change this setting unless you want unique Identities for all outputs in the your system.
- If you are using both outputs, then set the preferences to unique values. You can use any number 0 thru 255. For this exercise, set the Output 1 Identity to a value of 1 and the Output 2 Identity to a value of 2. Remember to press [return] after editing each value.



 In a system with more than one (1) Mbox server, you will probably want to have unique Identities for each output of each server.

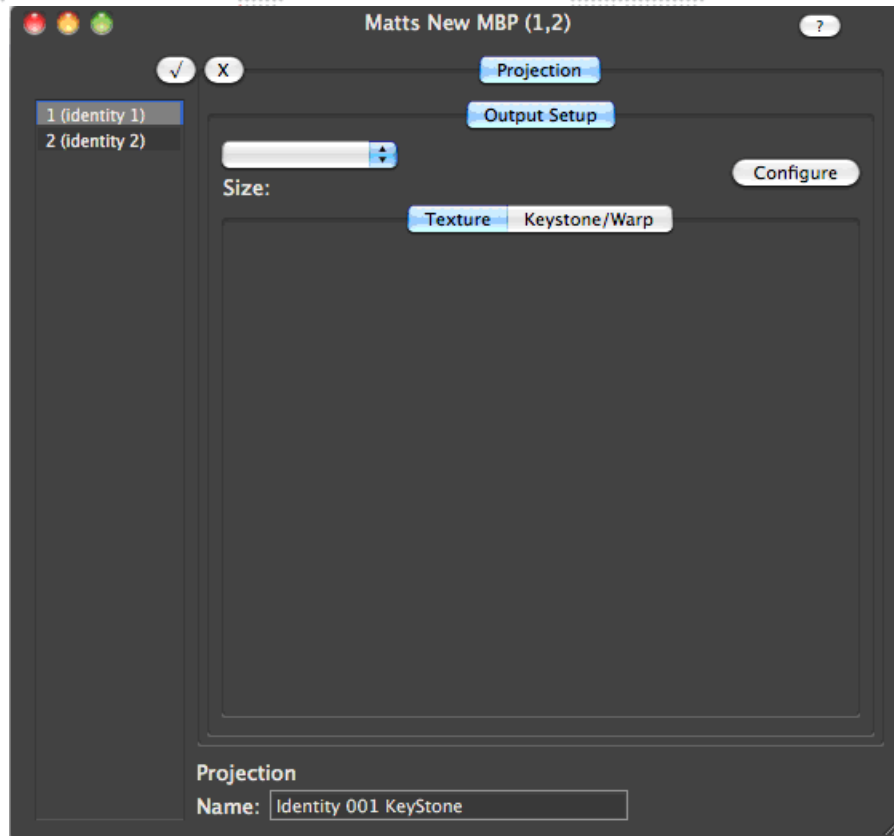
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**Note:** The Identity preference is also used for grouped content management. Therefore, the server identity setting also dictates what group content the server will play when grouped content is available. (Refer to the appropriate Mbox product manual for more information about grouped content.)

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Step 5. Press [⌘ P] again to close the Server Preferences window.

Step 6. Press [⌘ E] to open the Projection Editor window. At the top of the Projection Editor window, you will see the name of the selected server and the two Identity values in parentheses - e.g. "Mbox123 (1,2)". On the left side of the Editor window you will see a column listing the two Output Identities belonging to the selected server. To edit the settings for an output, select the appropriate Identity in this column.



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. (Hereafter referred to using hierarchical notation: Projection > Output Setup.)

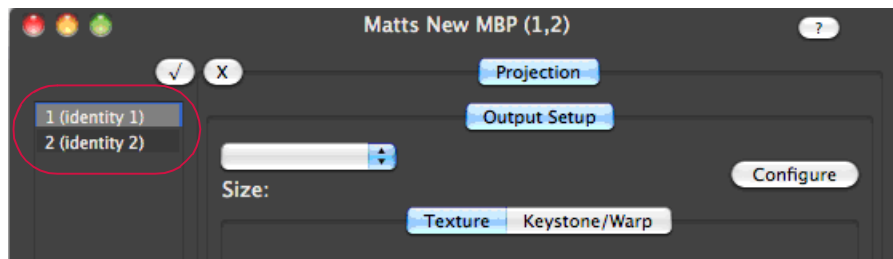
## Basic Mode

### Setup of Output and Keystone/Warp

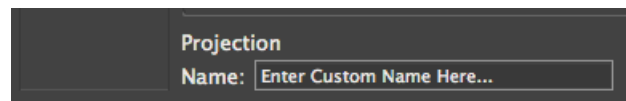
In Basic Mode, the first step to configuring the output is to select the number of outputs that each physical video output on the Mbox server computer is using. Depending on the computer used, each Mbox server can have up to two (2) physical video outputs. Through the use of multi-head adapters, each of these video outputs can be split into up to three (3) outputs. (For this purpose, use a dual/triple head adapter product such as Matrox TripleHead2GO.) Even if you are not using a multi-head adapter, these settings are required to configure a keystone or warp setup.

#### To set Output and Keystone/Warp:

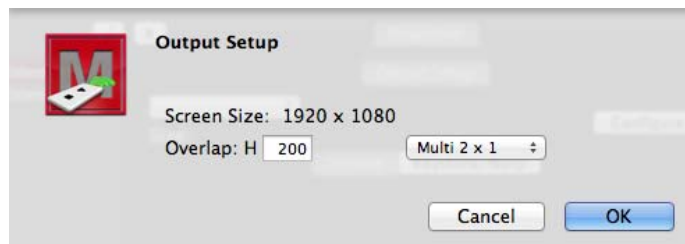
Step 1. Select Identity 1 at left column of the Projection Editor window. This should correspond to the first output of your Mbox server. With an Identity selected, all configuration changes made in the Output Setup pane will apply only to that output of the server. The other output (if applicable - e.g., in Pan or Dual mode) must be configured separately by selecting the other Identity.



At the bottom of the Projection Editor window, you can enter a custom name for the currently selected item.



Step 2. Click **Configure** button to open the Output Setup pane. This pane shows the current Screen Size (equivalent to the FullScreen Mode resolution on the Setup tab in the Mbox software) for the physical video output of the Mbox server. Below this you will see a box for overlap, a pop-up to select the multihead arrangement of the output, and if the Mbox software is using a Panoramic mode, a checkbox labeled "Combined"



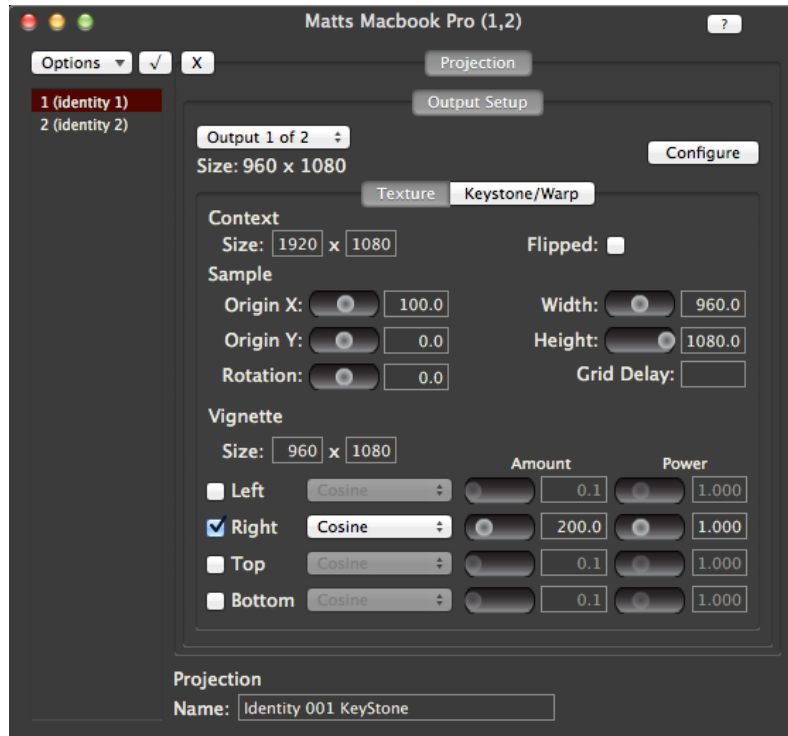
Step 3. Using pop-up menu, select the number of multihead outputs that this physical video output is split to (1, 2x1, 3x1, or 2x2). If there is an overlap required, enter that value (in pixels) in the box. The "Combined" checkbox should be checked if these outputs will be blended and overlapped with outputs from the other physical video output of the Mbox server (in panoramic modes only). When the settings are correct, click **OK** button.

---

**Note:** This explanation will proceed using a multihead 2x1 setup. Your particular system may be configured differently.

---

Step 4. On the Output Setup tab, you will now see a pop-up labeled "Output 1 of 2" that allows the selection of each multihead output for editing. Below this pop-up is a label stating the actual resolution of this output. In a 2x1 Output setup, this will be 1/2 of Mbox's FullScreen Mode resolution. Below this you will see two tabs labeled "Texture" and "Keystone/Warp." The Texture tab will be set correctly for you, but may be edited as required to adjust image position and scale. If you set a positive overlap (you can have a negative overlap, if desired) on the Output Setup pane, you will see information on the Vignette settings below the Texture settings. The Keystone/Warp tab is for editing those specific attributes once they are applied.



### Projection > Output Setup > Texture


The Texture settings define the manner in which the Available Texture gets applied to the physical video output to work properly with the multi-head setup of that output. Available Texture is defined here as the result of all layers composited together on this output of the server and will be the same size as the FullScreen Mode resolution for this output of Mbox.

The Available Texture is force-fit (stretched or squished) to fit into the Context, therefore the Context size values have an effect on the overall force-fit sizing of the image. By default the Context size is the same as Mbox's FullScreen Mode resolution and the same size as the Available Texture. Note that changing the Context size width or height will result in the Sample Origin X, Width, and Height changing values to maintain the correct aspect ratio. In general, the Context size should not be changed, and any sizing should be handled by adjusting the Sample size.

The Sample refers to the area of the Context that is shown on the final rendering surface for this output in the multi-head setup. By default, the Sample size will be equivalent to the actual output size shown below the output selector pop-up. Depending on the output type, the Sample will be sized as follows:

- + Single Output: same size as the Context.
- + 2x1 Output: 1/2 the size of the Context.
- + 3x1 Output: 1/3 the size of the Context.
- + 2x2 Output: 1/4 the size of the Context.

As with the Context size parameters, adjusting the Sample size will affect the size of the image on screen.



Other Texture settings are:

- + Flipped - Reverses the image (left to right) as if seen in a mirror.
- + Rotation - Sets an arbitrary rotation of the texture around the center of the topo.
- + Grid Delay - If a value greater than 0 is entered, whenever edits are made to the topo's properties, the topo's mesh will appear for that number of seconds. (This is useful for highlighting the object being edited in order to understand the impact of the edits.) This does not require the HUD value of 221 to be turned on, and may be preferable, as HUD = 221 shows the mesh on all objects, rather than just the one being edited.

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**Note:** Reducing the Sample width or height will result in the image becoming larger on the corresponding axis. This is because less of the texture is being displayed, and since the Context has not changed size, fewer pixels will be stretched across the same area.

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When a positive overlap is entered during output configuration, the outputs will be offset accordingly to create the necessary overlap.


The Vignette settings are used to apply a vignette (i.e. edge-blend) to each output. A vignette will be added to the appropriate side(s) of the output by default if you enter a positive overlap value when you configure the output. Even with no overlap or a negative overlap, you can manually add a vignette by clicking on the **Options** pop-up above the column list of Identities and selecting **Add Vignette**.

By default, the vignette is created with the same size as the Sample. When a positive overlap is applied, each output receives vignettes on the overlapping sides. Vignettes can be added to any side by clicking the checkbox next to each side. Each vignette will receive a default curve of Cosine, an Amount (width in pixels) equal to the overlap width, and a Power of 1.0.

 You can view guide lines for vignettes by setting the Master HUD parameter to a value of 222 and then performing a media rescan [⌘ R] on the Mbox server. To disable the guide lines, set the HUD parameter to a value other than 222 and perform another rescan.

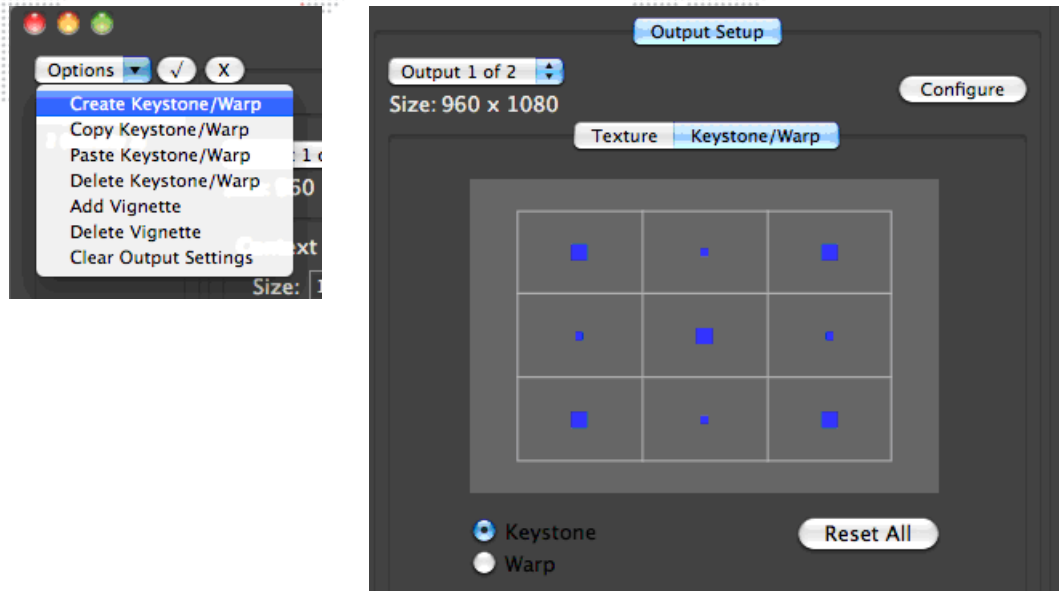
There are three available curves: Cosine, Raised Cosine, and Linear.

- + For the Cosine and Raised Cosine curves, increasing the Power setting increases the width of the blend curve in the direction of the center of the image.
- + For the Linear curve, increasing the Power setting compresses the blend curve towards the center of the blend area.

 Outputs that overlap each other should use the same curve type for best results.

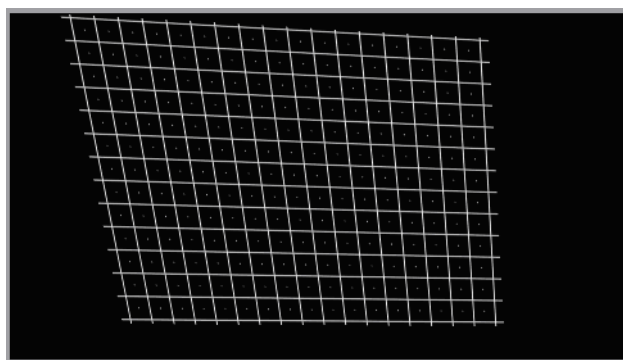
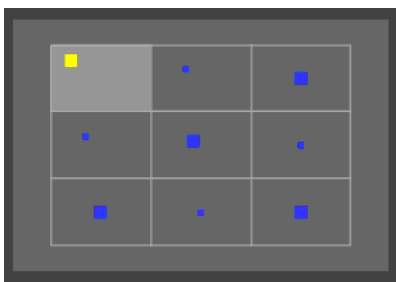
## Projection > Output Setup > Keystone/Warp

You must create a keystone/warp setup for each output in a multihead setup. To do this, select **Create Keystone/Warp** from the **Options** pop-up to enable Keystone or Warp functionality. The interface will default to Keystone mode. Switch to Warp mode by clicking on the relevant radio button at the bottom of the window.



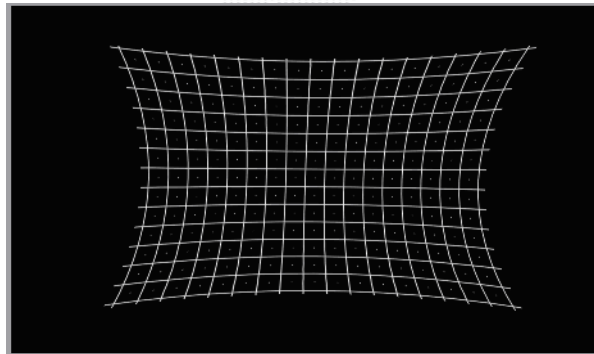
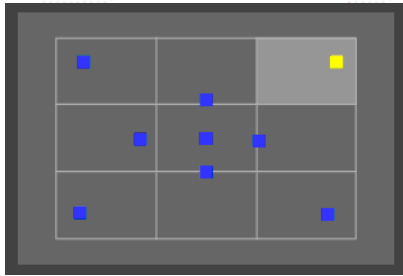
**Keystone mode** is shown as a 3x3 array of rectangles, with five of the rectangles having large, blue points and the other four rectangles having small blue points. The points are a visual reference for the amount of transformation of that area of the keystone surface. Keystone mode allows you to adjust the four corners by changing the position of the four corner points and to adjust the linearity of the entire image by changing the position of the center point. The smaller points will reposition themselves to remain on a straight line between adjacent corner points. You cannot edit these intermediate points.

Click inside the rectangle that contains the area you want to adjust. The corresponding point turns yellow indicating that you can use the mouse to click and drag to adjust the geometry. You may also use the keyboard arrow keys 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 point itself.



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

**Warp mode** is shown as a 3x3 array of rectangles, with all nine of the rectangles having a large, blue point. Warp mode allows you to adjust the four corners by changing the position of the four corner points and to adjust the intermediate curve using the other points. The warp is drawn as a Bezier curve between the corner points, using the intermediate points as the third point on the curve.





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**CAUTION!** Clicking on the **Configure** button and changing the output setup will reset all keystone/warp settings!

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**Note:** Switching from one mode to the other will not affect the current settings, but if you switch from Warp mode to Keystone mode and then adjust any point, the curves will revert to straight lines between the corner points.

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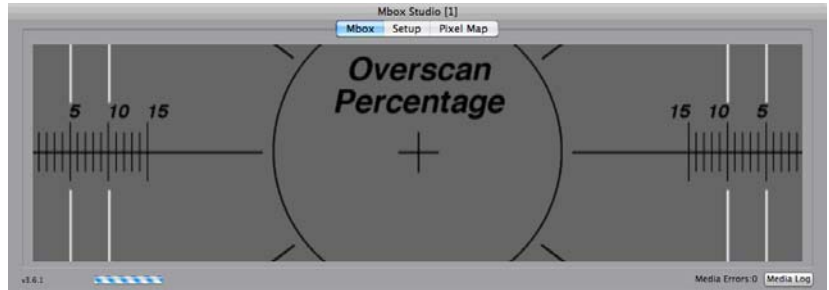
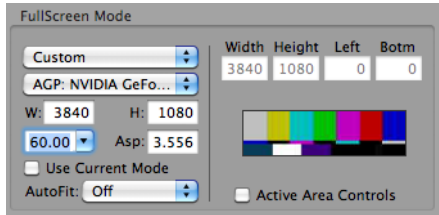
-  You can apply a grid overlay for keystone and warp by setting the Master HUD parameter to a value of 221 and/or use the Grid Delay setting in the Output Setup. Refer back to "[Projection > Output Setup > Texture](#)" on page 31.
-  To reset the Output Setup, click on the **Options** pop-up above the column list of Identities and select the **Clear Output Settings** option. This will remove all Texture, Vignette, and Keystone/Warp settings. If you intend to use the Advance Projection Mode, you should clear the Output Setup first.



## Multihhead Setup

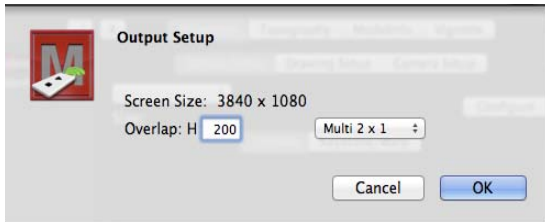
First, connect the multihhead adapter to the computer and confirm that the computer sees the adapter and that you are able to output the desired resolution from the desktop. If the desktop can't run at the desired resolution, then Mbox can't either. (Some devices may need additional software to tell the computer what to do or to reprogram the EDID in the device.)

Next, determine the resolution that needs to be sent to the multihhead adapter. In the case of a dualhead adapter doing a double 1920x1080 output, that will be 3840x1080. In Mbox, go to the Setup tab and select the "Custom" fullscreen mode and enter 3840 in the width field and 1080 in the height field. Make sure the frequency is set to something that the multihhead adapter supports.

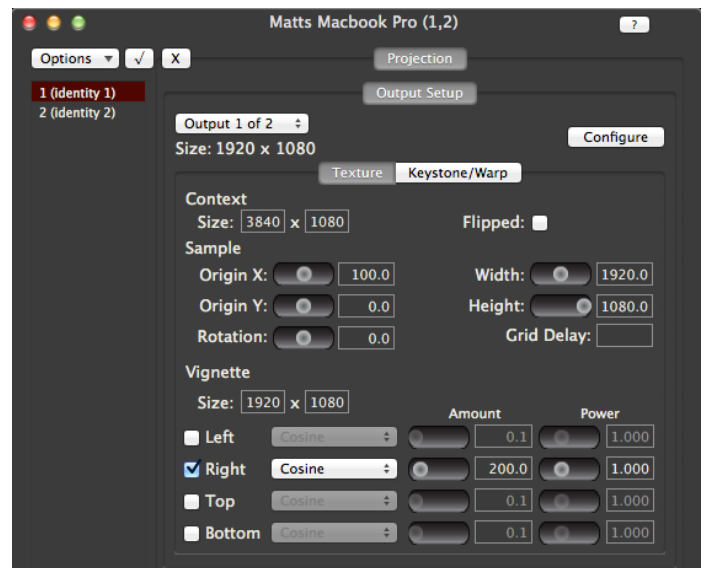


If all the settings are correct, Mbox will output the desired resolution. In Window mode, the window will now be the same aspect ratio as the Fullscreen output (32:9 in the case of 3840x1080). Unless content has been specifically created at the fullscreen resolution it will have to be scaled up to fill the entire output.

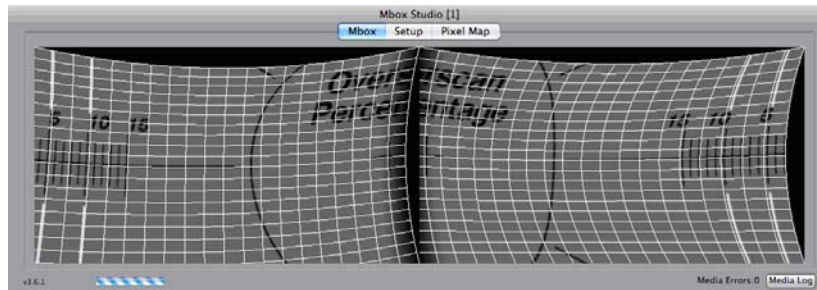
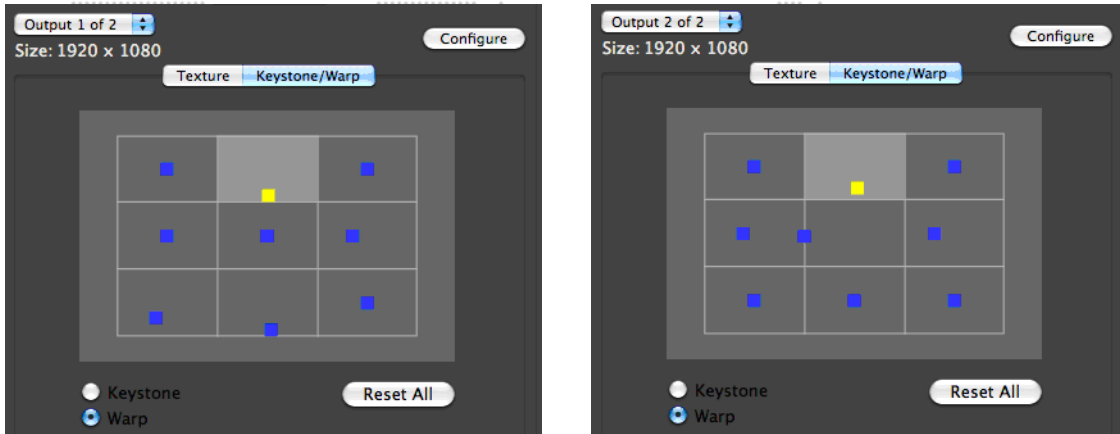
In Mbox Remote, on the Projection Editor window, select the Identity that matches the output of the Mbox server, press the **Configure** button and select the **Dual Head** option and add an overlap (in screen pixels).



The Projection Editor window will now show the settings for Output 1 of 2 (the left side) or Output 2 of 2 (the right side) depending on the selection in the pop-up. Note that the size of each output is the same and that both share the same sized Context and Sample Width and Height. But note that each output has a unique Origin X. This is so that the image is located properly, both for the left and right halves of the image, but also for the overlap between the two outputs. Also, if you entered an overlap, a vignette will have been created with an amount on both halves equal to the overlap amount.



At this point, the settings can be adjusted to affect the overlap between the two halves, the blend, the aspect ratio, and the orientation. A keystone or warp may be added as described in the previous section (refer to [page 33](#)).

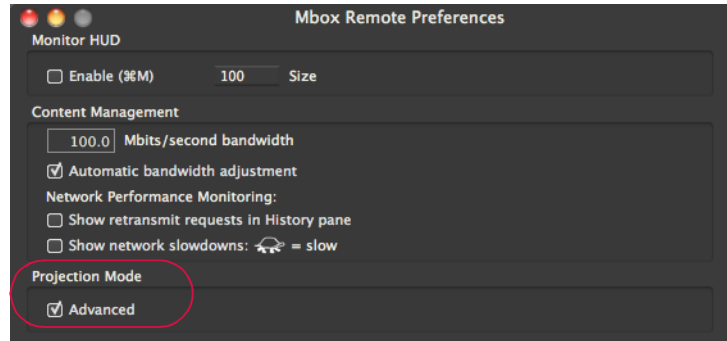


To reset the settings, you can either press the **Configure** button again and enter some other multihead and overlap settings, or return to the **Options** pop-up and select **Clear Output Settings**.

## Advanced Mode (Mbox Designer/Studio Only)

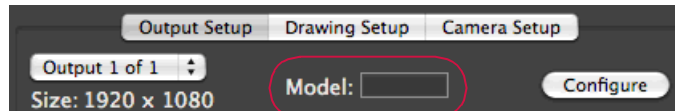
### Advanced Projection Setup

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 except for the addition of a field for entering a model (i.e. object) file for use as the keystone rendering surface. The model used must be compatible with Mbox (obj, topo, svg) and must be placed within the standard Mbox/Models folder's 8-bit structure. The model is selected by typing the 8-bit folder and file index numbers in to the field (e.g. 005.023) and pressing the [return] key.



**Note:** Different models can be selected for each output of a multihead configuration.

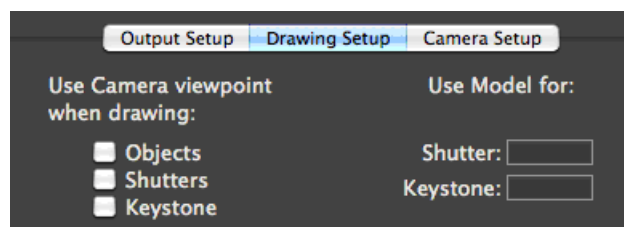
Selecting a model as the keystone surface will immediately disable any keystone or warp settings that have been used. To return to the keystone/warp settings, delete the model index number from the field and press [return].

**CAUTION!** Using the features of the Output Setup tab will also override or disable some or all of the features of the **Projection > Drawing Setup** and **Projection > Camera Setup** tabs. To use the features on these tabs properly, you must remove the basic output settings by selecting **Clear Output Settings** from the **Options** pop-up while the **Projection > Output Setup** tab is selected.

### Projection > Drawing Setup

The Drawing Setup tab allows you to configure which on-screen elements will be rendered using the perspective of the active camera for that output, and if models will be used for creating shuttering or keystone rendering.


Click the appropriate checkbox to enable perspective rendering for each element: Objects (obj, topo, svg), Shutters (when a shutter model index number is entered), and the keystone surface (when a keystone model index number is entered).



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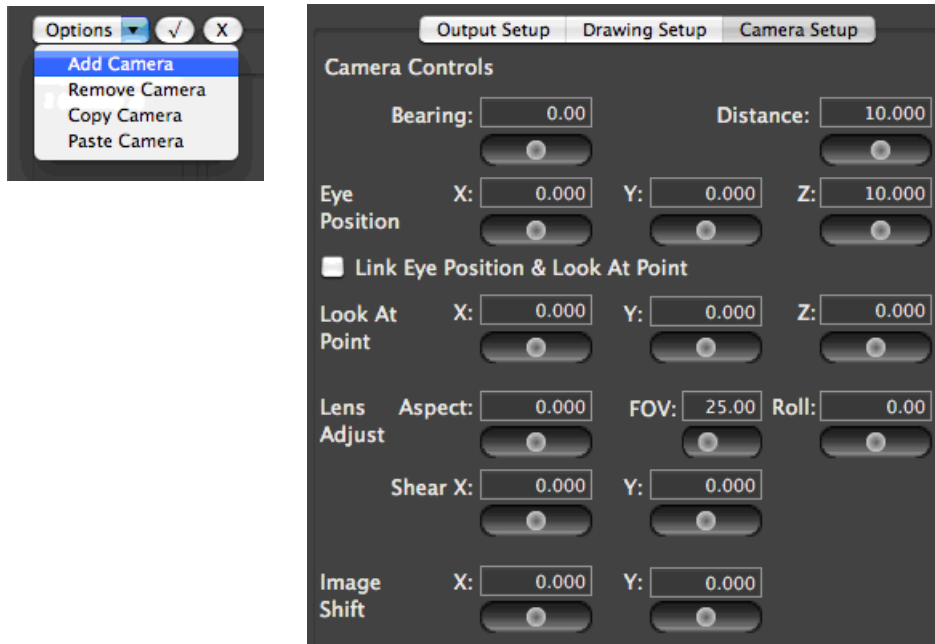
**CAUTION!** Models created by external 3D modelling applications may not be appropriate for use as shutters or as keystone rendering surfaces. Great care must be taken in UV mapping such objects when they are created. This functionality is best matched with the simpler Topography (topo) objects created by the Mbox system.

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 If you are using model files on individual playback layers within Mbox as a tool for projection mapping, it is not recommended that you also try to use a keystone model. As a general rule of thumb you will probably never have the Objects and Keystone checkboxes checked at the same time.

## Projection > Camera Setup

The Camera Setup tab allows you to add and configure a camera whose perspective will be used to render the 3D entities selected on the Drawing Setup tab. This camera uses a true, accurate coordinate space for its position, the point that it is looking at, and other adjustable parameters.



The camera's Eye Position and Look At coordinate are entered in generic real-world units (e.g. inches, feet, millimeters, or meters) that must be matched to the measurement scale used when creating objects within your 3D modeling application. For example, if your show requires projection upon a cube that is 1 meter on each edge, you could create that cube as one unit on each edge within your 3D modeling application. In which case you would use meters as your unit of scale when entering values on the Camera Setup tab. If you made your cube 1000 units on each edge (as if using millimeters), then you would need to use millimeters as your unit of measure on the Camera Setup tab.

When setting up a projection mapping system and the objects used, you must also consider the 3D coordinate origin for your system. This should be a real-world reference point that you can mark and measure from when you are physically setting up the objects and projector in the performance venue. Objects created for use in this system must also be created with this origin in mind; without additional manipulation they will appear in space.

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**Note:** Measurements use decimal notation with an accuracy of three decimal places. It is recommended that you use a measurement scale appropriate to realistic numbers. Therefore, large projection mapping setups should not be scaled in small units of measure like millimeters or inches.

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### Camera Control Descriptions:

- + **Bearing:** camera's horizontal angular offset from the Z axis.
- + **Distance:** camera's horizontal distance from the origin.
- + **Eye Position:** camera location.
  - 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.
  - 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 changes between output and projector's native resolution.
  - FOV: adjusts Field of View to match lens angle of camera to that of the projector.
  - 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 keystoneing.
  - 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 keystoneing.
- + **Image Shift**
  - X: moves entire image horizontally without affecting perspective.
  - Y: moves entire image vertically without affecting perspective.



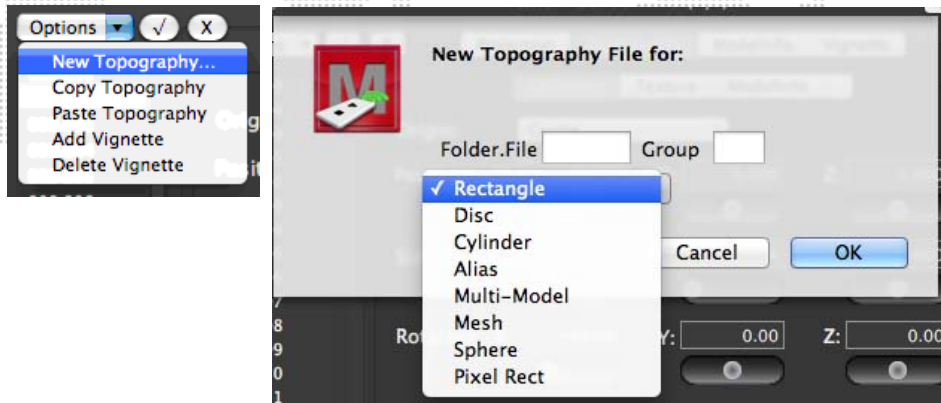
Eye Position, Look At Point, and if known, FOV, can be entered in advance from known measurements to set up projection mapping. Other parameters like Aspect, Roll, or Shear may need to be adjusted manually to correct minor issues with perspective or line-up.

## 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.

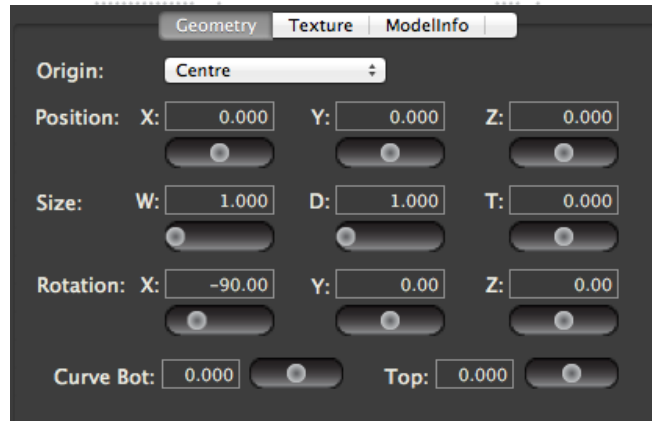
The initial step in using topo file is to create the base object. With the Topography > Geometry or Topography > Texture tabs selected, select **New Topography...** from the **Options** pop-up. In the window that appears, there are five settings to configure for the new topo file.



- + **Folder.File:** 8-bit index number 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, the topo item will not be created (currently there is no error message to indicate this). Entry must be formatted with the period between the two numbers. **Note:** For Mbox Studio, the folder number **MUST** be 0 as only one 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 appropriate Mbox product manual for more information about grouped content.)
- + **Type pop-up:** selection of one of seven different types of topo files.
  - Rectangle: rectangular shape with no thickness.
  - Disc: round shape with no thickness.
  - Cylinder: rectangular shape that can be bent into a cylindrical shape.
  - Alias: reference to another topo file that can be used to apply different ModelInfo data to an identical physical shape.
  - Multi-model: collection of object files (obj, topo, svg) that can be used together on one layer. (*Mbox Designer only.*)
  - Mesh: rectangular shape with no thickness and adjustable grid divisions for enhanced warping control.
  - Sphere: spherical shape with adjustable curvature.
  - Pixel Rect: rectangular shape with no thickness. The Pixel Rect's dimensions are translated to actual pixel count.
- + **Mesh dimensions:** horizontal X vertical divisions for the mesh.

## Topography > Geometry

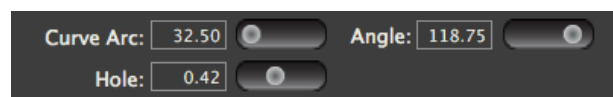
The Geometry tab allows you to define the position, rotation, size, and curvature of the selected topo file.



- + 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 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 Vertical checkbox is checked.
- + 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.



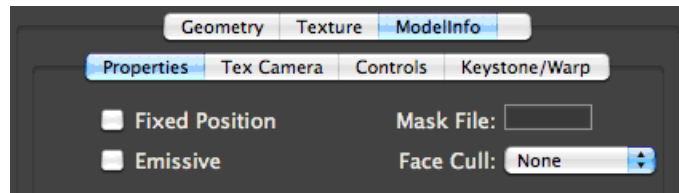
## Topography > Texture

The Texture tab allows you to define how a texture will be applied to the topo object. Generally topo objects are created for specific texture sizes (movie or still image content). Different-sized content can be applied to topo files, but some amount of scale, aspect, and position adjustment may be required to properly fit such content on a topo file with mismatched texture settings.

The settings on this tab are virtually identical to the texture and vignette settings used in the Projection > Output Setup > Texture tab (refer to [page 31](#) for details). In this case the available texture is the content selected for use on the layer that is using the topo object. By default, content is stretched or squished to fit both the size and aspect ratio of the topo file. Content is cropped to the edge of the topo file.

## Topography > ModelInfo > Properties

ModelInfo settings for a topo file are used to define core functions of how the topo object reacts to layer scaling and positioning, UV mapping, external Art-Net control (e.g. for remote control of positioning), and keystone/warp.



The Properties tab has four settings.

- + Fixed Position checkbox: causes the object's position and scale to be disconnected from Art-Net control. These Art-Net controlled parameters will now control the texture position and size on the object instead. Object position and scale may still be adjusted using the Projection Editor. **Projection mapping will not be accurate unless the models have the fixed position checkbox checked!**
- + Emissive checkbox: causes the object to be fully lit. Overrides Art-Net controlled Ambient and Spot lighting fixtures.
- + Mask File: 8-bit index number for folder.file of vignette of PNG files to be used as a mask on the object. Files will be force-fit onto the object based on the object's size not the size of the mask. [Tip: Masks should typically only be used on topo or svg files as the result of applying a mask to an object with more than one face may be undesirable unless great care is taken with the mask.]
- + Face Cull pop-up: selects which faces of the object are not drawn. You can choose not to render the front or rear faces of an obj file.

## Topography > ModelInfo > Tex Camera

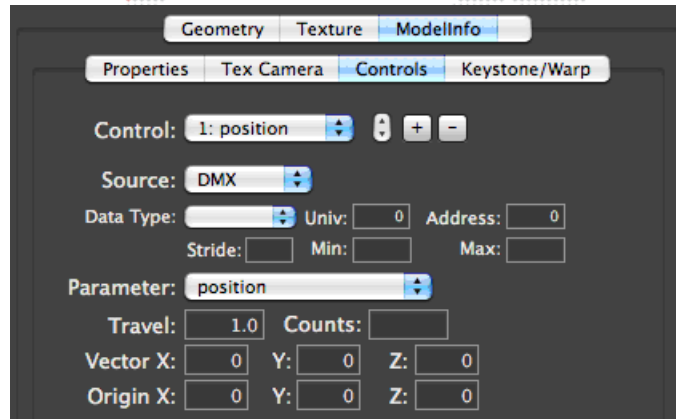
The Tex Camera tab allows you to create a custom UV map for the topo file based on a specific viewing location unique to that topo file. This viewing location can be different from the viewing position implied by the UV map settings in the original file. The Tex Camera causes Mbox to apply the texture to the topo object in a manner that allows the image to appear undistorted from a specific viewpoint - by default topo objects are UV mapped in a "flat map" manner where the optimal viewing position is perpendicular to the origin of the topo object.

This tab uses the same setup procedure and settings as the Projection > Camera Setup tab. Refer to [page 38](#) for details.



## Topography > ModellInfo > Controls (Mbox Designer Only)

ModellInfo 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. Next, use the Source pop-up to select the type of control data being received - Constant, DMX (Art-Net), 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 additional Art-Net 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 ArtNet 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 ArtNet 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 as require additional data conversion that is not available from normal Art-Net sources.

The Control Parameter refers 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

Position, Rotation, and Texposition are well suited for unsigned or offset 8, 16, or even 32-bit controls. Opacity is 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 travel 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).
- + 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 would 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 you may add a position control for each axis, setting each with a single vector. For "diagonal" vectors, a combination of vector values must be entered. [Tip: to reverse the direction of motion for any incoming value, flip the sign on the appropriate vector.] [Warning: you must have a non-zero vector value in at least one direction to allow controls to work!]
- + Origin (X/Y/Z) - the origin point of position adjustment. This is analogous to entering an offset for object positioning

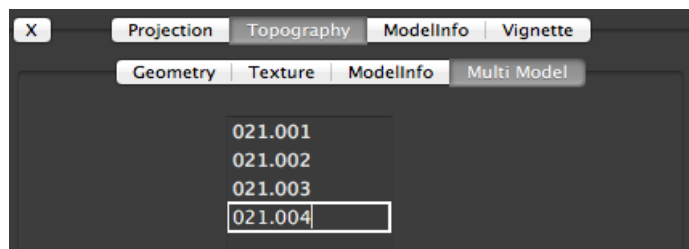
### Topography > ModellInfo > Keystone/Warp

A keystone/warp can be added to topography files. Refer to "[Projection > Output Setup > Keystone/Warp](#)" on page 33 for information on how to create and configure a keystone or warp for a topo object.

### Topography > Multi Model (Mbox Designer Only)

As discussed in the Topography > Geometry section, Remote allows you to create a Multi Model, which is a collection of more than one object file. A Multi Model allows you to use more than one object on a layer, with each object having its own properties. The Multi Model tab is where you designate the object files (in Folder.File syntax) that belong to the Multi Model.

Double-click on the empty grey field to enter editing mode, type in the object's index and press the [return] key.



## 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 existing object files (obj, svg). This functionality provides the means to set fixed and emissive properties, override UV mapping, add controls, and apply a keystone/warp.

### ModelInfo > Properties

Refer to "[Topography > ModelInfo > Properties](#)" on page 42 for information.

### ModelInfo > Tex Camera

Refer to "[Topography > ModelInfo > Tex Camera](#)" on page 42 for information.

### ModelInfo > Controls

Refer to "[Topography > ModelInfo > Controls \(Mbox Designer Only\)](#)" on page 43 for information.

### ModelInfo > Keystone/Warp

Refer to "[Projection > Output Setup > Keystone/Warp](#)" on page 33 for information.

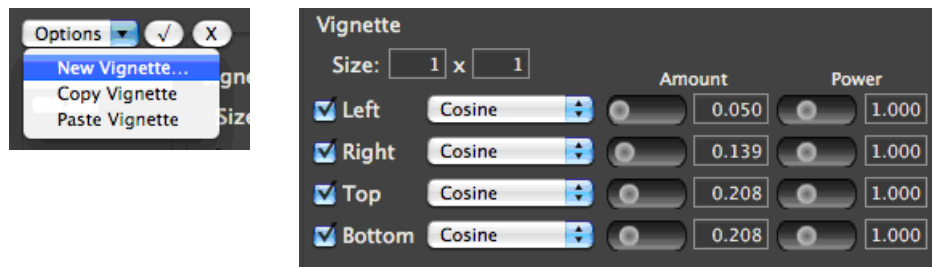
---

**Note:** Keystone and warp changes can only be made to obj files, and not to svg files. Changes are not made immediately; you must perform a media rescan in Mbox for the changes to take effect.

---

## Vignette

The Vignette tab provides the controls to create custom rectilinear edge masking that can be used on any object. Refer to "[Projection > Output Setup](#)" on page 37 for more information on the adjustment of vignette settings. Vignettes created here can use any arbitrary size. The blend amount is reconfigured automatically when the size is changed. Therefore on screen, there is little or no visual difference between a size of 100 x 100 with an amount of 5.0 and a size of 1 x 1 with a size of 0.05.



Vignettes are created as .vign files inside the /Mbox/Media folder's folder.file 8-bit structure.

## Model (Object) Creation Guidelines

Recommendations for Model (object) creation for use with the Mbox projection mapping features.

### .noscale compile switch

When using obj files for projection mapping with Mbox, it is absolutely necessary that you apply the .noscale filename "switch." The .noscale switch will force the object to appear at the designed scale rather than being rescaled (normalized) by Mbox when it is precompiled. To apply the .noscale switch, add ".noscale" to the object's file name, before the file extension.

001.MyObject.obj becomes 001.MyObject.noscale.obj

### obj & topo, 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.

## svg/svge

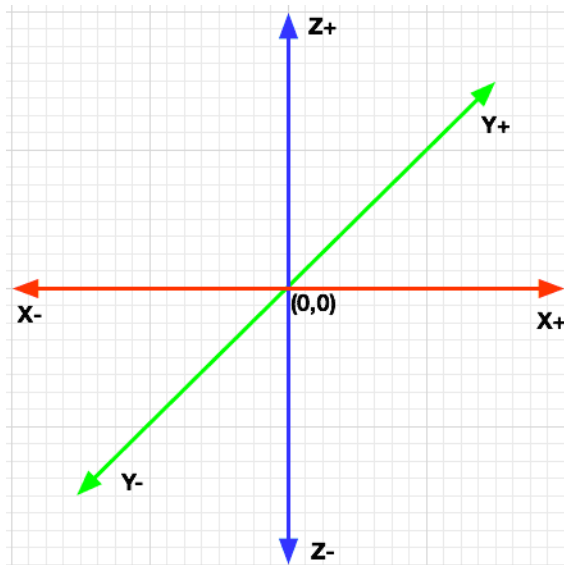
Mbox can use svg files for projection mapping, but topo files are far more useful and flexible. [Note: to work with the thumbnail generator for Mbox, the svg file extension must be changed to "svge".]

## axes - Mbox XYZ different to modeling apps' XYZ!!

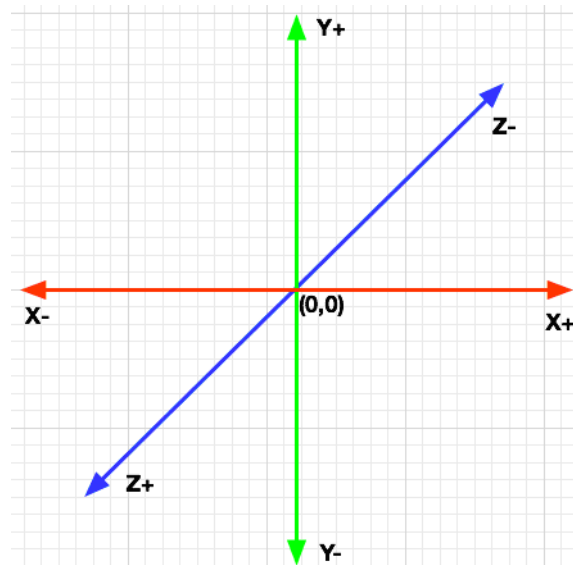
Mbox labels its 3D axes differently than most 3D modeling applications. Mbox uses a front view version of the axes and most modeling applications use a top view version.

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 (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 that 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 may appear to be the same size within the original 3D modeling application, they will not be the same size when used within Mbox.

## texturing (uv map)

When obj files are used by Mbox, they must have some form of UV mapping created by the originating 3D modeling application. Mbox cannot create UV mapping from scratch on obj files. The UV mapping created by the modeling application will generate texture coordinates for any texture (movie or still image) file applied to the object within Mbox. Typically UV mapping is very specific to the geometry of the object and the desired look of the object. Mbox is able to adjust the UV mapping of the object allow for correct texturing from differing viewpoints. Mbox can also override existing UV mapping using a Tex Camera.

# PIXEL MAPPING

## Overview

### What is Pixel Mapping?

Pixel Mapping is a feature that allows 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 the normal video output so a video signal can still be sent to a display device.

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?

Pixels from the Mbox final composite rendering surface (pre-keystone/warp) can be mapped. These pixels can be sampled (individually or in averaged, rectangular groups) to determine an average 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 which Mbox output mode is used, the following screens can be mapped:

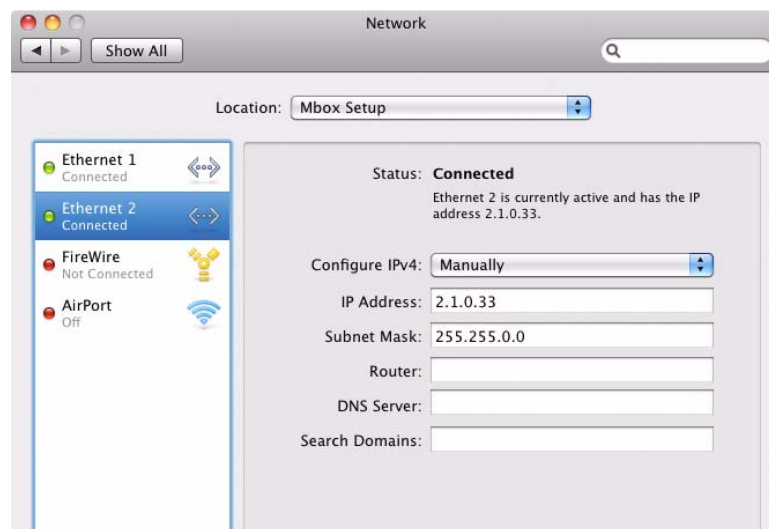
- + Single Output mode - the entire screen can be mapped.
- + Panoramic Wide and Panoramic Dual modes - the entire width of the two screens can be mapped. \*
- + Dual Independent mode - only first screen (Output1) can be mapped.

\* It is not recommended to use pixel mapping with Panoramic modes if you have an overlap.

### How is the Pixel Map Output?

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 can affect the reception of 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 ports for Art-Net input and pixel mapping output, you will need to set up the Ethernet ports of your computer properly.

- + If you are receiving one protocol for control input and output a different protocol for pixel mapping output, you will almost certainly use two separate Ethernet ports, as the different protocols use different subnets.
- + If you are outputting more than one protocol for pixel mapping output, you may need to use different Ethernet ports for each protocol.

Knowledge of IP addressing and subnetting practices is required to set up a proper pixel mapping configuration. (For more detailed information, refer to "[Appendix A. Networking For Mbox](#)" on page 119.) Network settings can be changed from the Mac's Network preferences window. The following guidelines assume that your computer's first Ethernet interface is set to receive Art-Net to control Mbox and you are using a second Ethernet interface 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).
- + KiNET (Portout & DMXout) devices have user-configurable IP addresses. One of the computer's Ethernet ports will need to be configured to use the same subnet as the KiNET devices you want to control. Destination IP addresses for KiNET are always unicast.
- + If your computer uses an overlapping or ambiguous IP/subnet scheme for one or more Ethernet ports, then your pixel mapping output may not be routed from the correct Ethernet interface on your computer. This will result in the pixel mapped fixtures not working properly or at all. You must ensure that the computer's ports have settings that allow Mbox to send the data from the correct interface.
- + 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. Networking For Mbox](#)" on page 119.). If a destination uses an IP address that the computer's Ethernet ports cannot communicate with, then that destination's 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. [Note that 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. (For more detailed information about these protocols, refer to "[Appendix A. Networking For Mbox](#)" on page 119.)

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**Note:** Because some equipment cannot receive Ethernet control protocol, 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. 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. Networking For Mbox](#)" on page 119 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 disable IGMP snooping.
  - VLANs, if desirable, to segregate different data types.

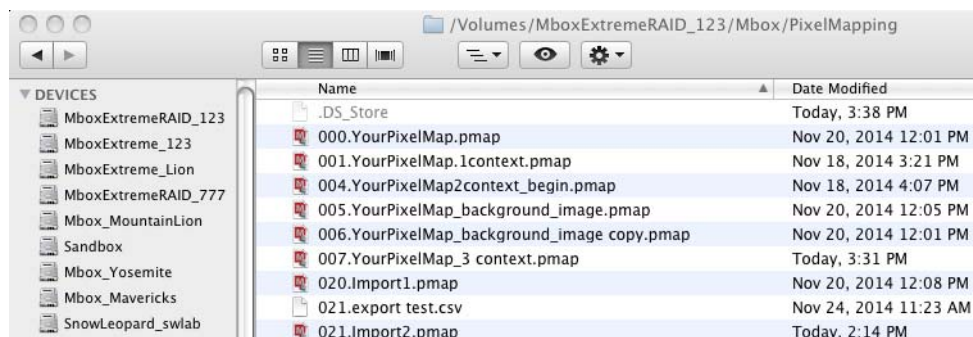
### Fixture Profile Model

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

Mbox and Mbox Remote v3.9 still use Property List files for saving data, but instead of the .plist file extension used with v3.8 and earlier, Mbox 3.9 uses a .pmap file extension. The .pmap files can be uncompressed or compressed. While the uncompressed files can be read by Apple's Property List Editor application (and others such as Xcode, 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.



As of Mbox 3.9, pixel mapping files must be given an 8-bit index prefix. 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 (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 Versions

All versions of Mbox software (Designer, Studio, and Mini) use the same configuration files for pixel mapping. While each version has a different maximum number of pixels (none, 6144, and 3072 respectively), there are no other restrictions or differences between the functionality of Mbox software versions.

Pixel mapping (.pmap) files created by Mbox 3.9 are not compatible with older versions of Mbox software. However, Mbox 3.9 supports the import of .plist files created by prior versions of Mbox. In this case, old profiles and fixtures will be upgraded to the new format. 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).

## Syncing Between Servers

Pixel mapping files can be synced between servers using the Content Management features. To do this, ensure that the pixel mapping files are placed in the */Mbox/PixelMapping* folder.

Refer to "[Content Management](#)" on page 11 for more information about this feature.

Pixel Mapping Files

The screenshot displays the Mbox Remote v3.9 interface. On the left, the 'Servers' panel shows two servers: 'MboxExtreme777 (2)' and 'KeithR1D7'. The main area is divided into 'Content' and 'Pixel Map' sections. The 'Pixel Map' section contains a table of files:

status	sync	index	name	ext	resolution	codec
		000	YourPixelMap	pmap		
		001	YourPixelMap_1context	pmap		
		004	YourPixelMap2context_begin	pmap		
		005	YourPixelMap_background_image	pmap		
		006	YourPixelMap_background_image copy	pmap		
		007	YourPixelMap_3 context	pmap		
		020	Import1	pmap		
		021	Import2	pmap		
		022	Import2_KINET_PORTOUT	pmap		
		088	flipProbUntitled	pmap		

The 'PixelMapping' file is highlighted in red in the 'Content' section. Below the table, the 'PixelMapping' file details are shown:

index: 3  
name: PixelMapping  
mod: 2014-11-26 15:31:47  
path: /Volumes/MboxExtremeRAID\_123/Mbox/PixelMapping

identity: files: 10  
sync: not managed

59.0G free



## Enabling Mbox Pixel Mapping

To enable pixel mapping, the Pixel Map Enable checkbox must be checked in the Mbox Setup window. Checking this box enables the processing of pixel mapping patches and the resulting output.



When Pixel Mapping is enabled in the Setup window, the Mbox Master Control parameter can be used to enable/disable overall pixel mapping output, and to enable/disable the pixel mapping mask feature. Master Control parameter settings are as follows:

- + 244 = enable pixel mapping output
- + 245 = disable pixel mapping output
- + 246 = disable mask feature
- + 247 = enable mask feature

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

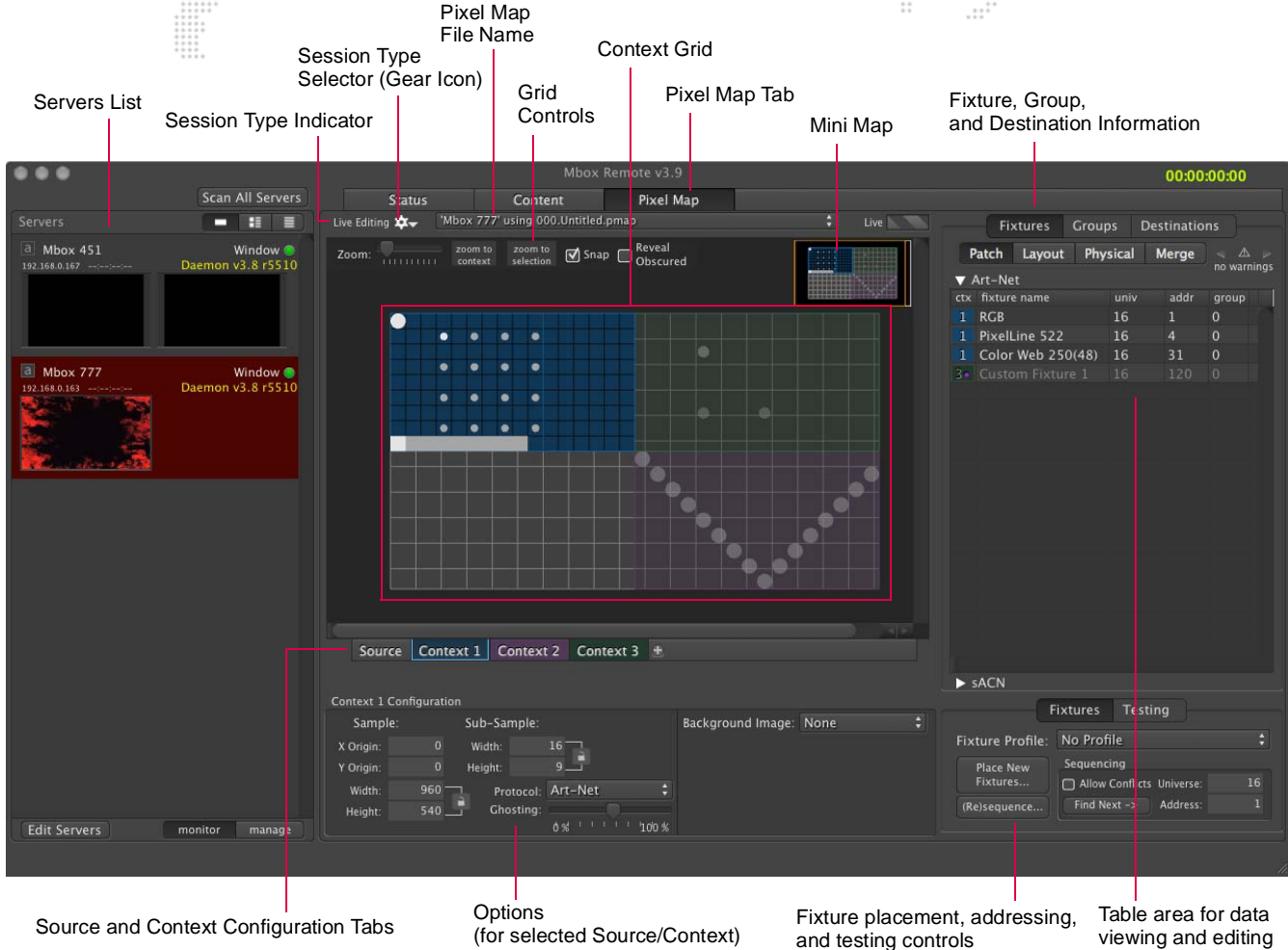
Designer Master: Lights/Master/Shutter/Keystone								
PARAM	AMB	SPOT1	SPOT2	SPOT3	SPOT4			
00	inten	000	000	000	000	000		
01	red	255	255	255	255	255		
02	green	255	255	255	255	255		
03	blue	255	255	255	255	255		
MASTER	SHUTTER		KEYSTONE					
A-021	A-053		A-073					
00	fx 1	000	00	shape	000	00	mode	000
01	mod1a	000	01+	x pos	32767	01+	x pos	32767
02	mod1b	000	03+	y pos	32767	03+	y pos	32767
03	fx 2	000	05	red	000	05	tile M	000
04	mod2a	000	06	green	000	06	ovrlp	000
05	mod2b	000	07	blue	000	07+	scale	65535
06	inten	255	08+	scale	65535	09	edge 1	000
07	red	255	10	edge	000	10	edge 2	000
08	green	255	11	sh 1a	000	11	edge 3	000
09	blue	255	12	sh 1b	000	12	edge 4	000
10+	orb x	32767	13	sh 2a	000	13	key 1a	000
12+	orb y	32767	14	sh 2b	000	14	key 1b	000
14+	dolly	32767	15	sh 3a	000	15	key 2a	000
16+	roll	32767	16	sh 3b	000	16	key 2b	000
18	spin	127	17	sh 4a	000	17	key 3a	000
19+	fov	32767	18	sh 4b	000	18	key 3b	000
21+	pitch	32767	19	shRot	127	19	key 4a	000
23+	yaw	32767				20	key 4b	000
25	ctrl	000				21	keyRot	127
26	decay	000						
27	rsrvd	000						
28	sDamp	000						
29	pm lev	255						
30	ctrlSel	000						
31	audio	255						

**Note:** For more information about the Master fixture, refer to the appropriate Mbox software user manual (Designer, Studio, or Mini).

## Getting Started

### Pixel Map Tab

Pixel maps are created using the controls available in the Mbox Remote 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

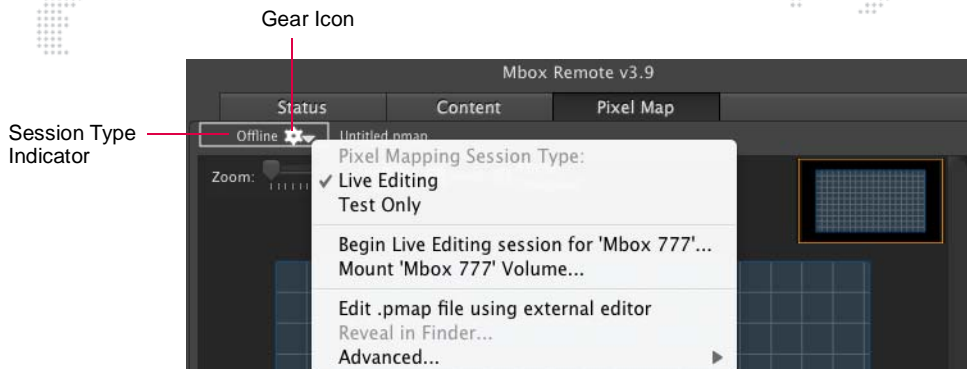
The Mbox Remote application's Pixel Map menu can be used in combination with the Pixel Map interface window. Many of the options provide an alternate method for the same functionality available in the window (via buttons and pop-up menus), however, a few such as **New Pix-Map File**, **Open**, and **Save** and **Save As** are intended for use with files offline. Refer to "Offline" on page 54.

The **Import/Export** option is covered in detail at the end of this document. Refer to "Import/Export" on page 115.

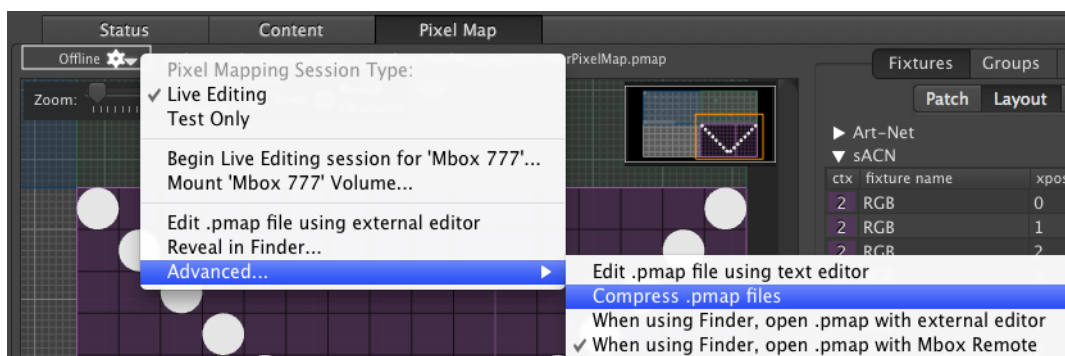
Pixel Map	Commands	Window	Help
	New Pix-Map File		
	Open		⌘O
	Save		⌘S
	Save As...		⇧⌘S
	Revert To Saved		
	Import/Export...		
	Add Context		
	Add New Fixture Profile...		
	Edit Fixture Profile...		
	Edit Selected Fixture(s)...		<double-click>
	Select Source		0
	Select Context 1		1

## Session Types

When working with pixel mapping configuration files, there are three different "session" types: Offline, Live Editing, and Test Only. The session type will be Offline unless either Live Editing or Test Only is chosen from the Pixel Mapping Session menu available by clicking on the gear icon next to the Session Type Indicator. The indicator text will display the current status (Offline, Live Editing, or Test Only), as applicable.



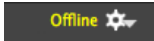
- + **Offline** - allows pixel mapping configuration files to be created and edited without running Mbox software or being connected to an Mbox server. Refer to "**Offline**" on page 54 for more information.
- + **Live Editing** - allows pixel mapping configuration files to be created and edited while the Mbox Remote application is connected to an Mbox server. Refer to "**Live Editing**" on page 55 for more information.
- + **Test Only** - allows pixel mapping fixtures to be tested while locking out changes to the configuration. Refer to "**Testing**" on page 113 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 (for example, 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. (Keep in mind that 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 or Mbox Remote** - selects what application opens the .pmap file when it's double-clicked in the Mac Finder. (A multiple selection is allowed.)

## Offline

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).

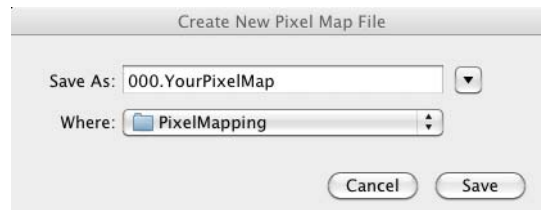
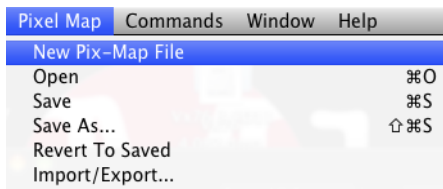


### Guidelines:

- + 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. At **Pixel Map** menu, select **New Pix-Map File**.
- Step 2. At **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. At **Pixel Map** menu, select **Open**.
- Step 2. Using **Finder**, locate and open required 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, the file must be copied to the correct folder on the Mbox server. Refer to "[Copy To Mbox](#)" on page 58.

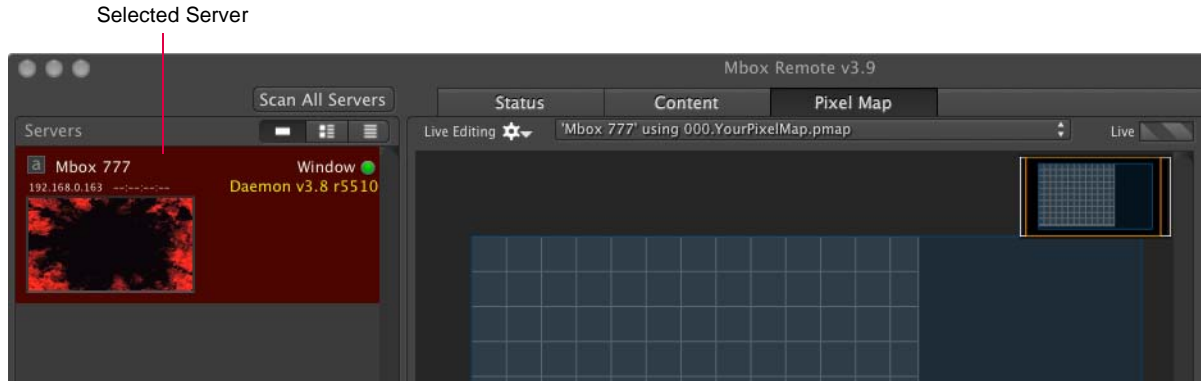
---

## 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.

Live Editing 

To operate in Live Editing mode, a server must be selected from the server list at the left side of the window and an Mbox application itself must be running (Mbox Designer, Mbox Studio, or Mbox Mini) along with Mbox Daemon.



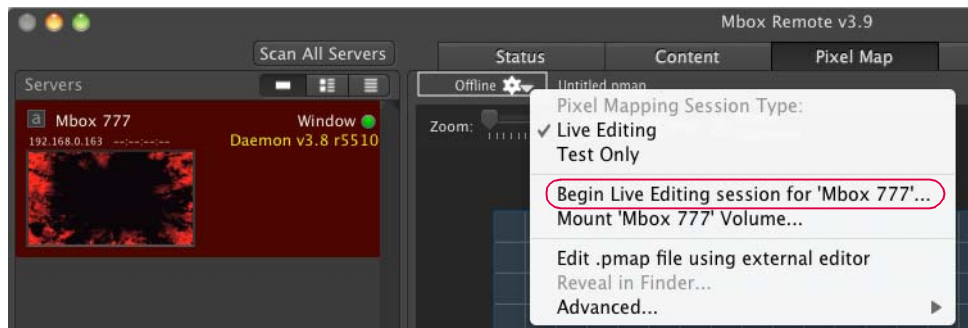
### Guidelines:

- + 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.

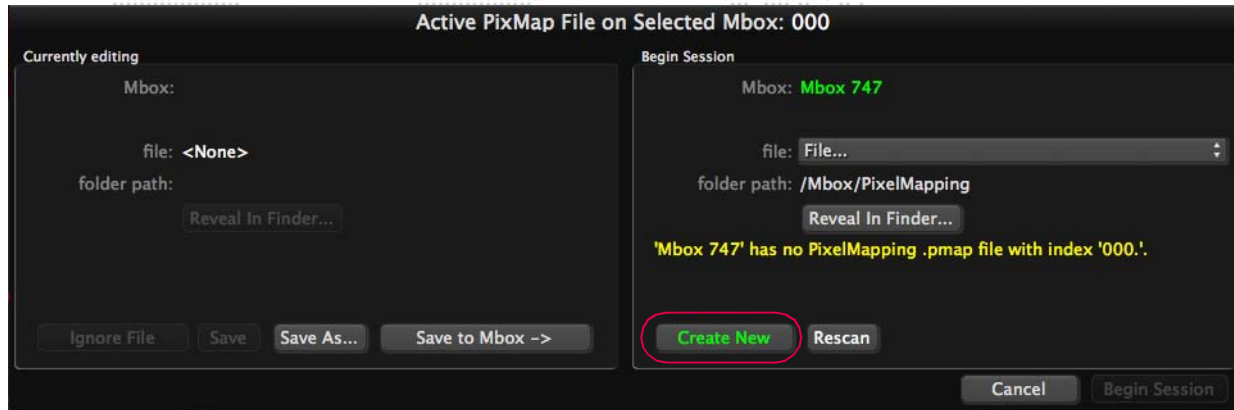
**CAUTION!** No manual rescan on the Mbox server is needed, but live changes do cause a slight pause in playback. Therefore, it is not recommended to make live updates during a show.

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

- Step 1. At Servers list, select required server.
- Step 2. Click gear icon and select **Begin Live Editing session for...**

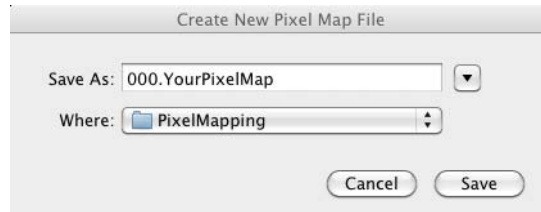


Step 3. At Begin Session window, click **Create New** button.

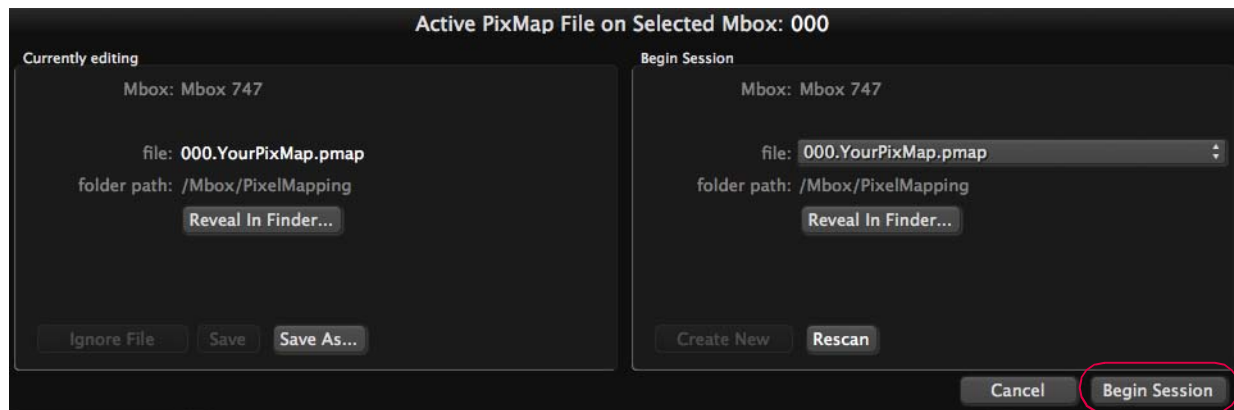


Step 4. At Save dialog, enter a file name and choose a location to save.

Step 5. Click **Save**.



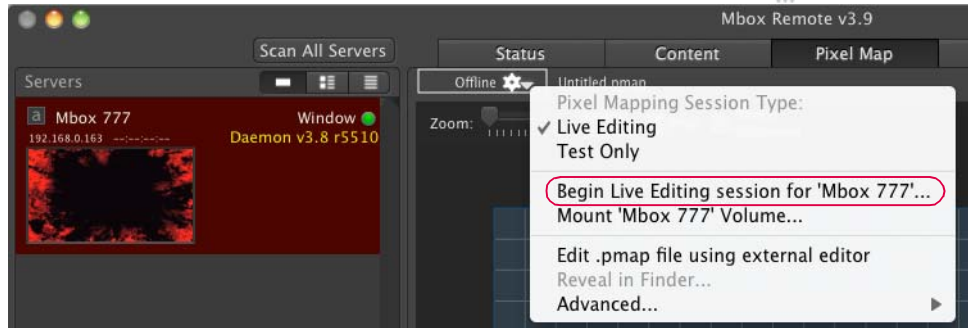
Step 6. At Begin Session window, click **Begin Session**. (Once the file is created, the button will no longer be grayed out.)



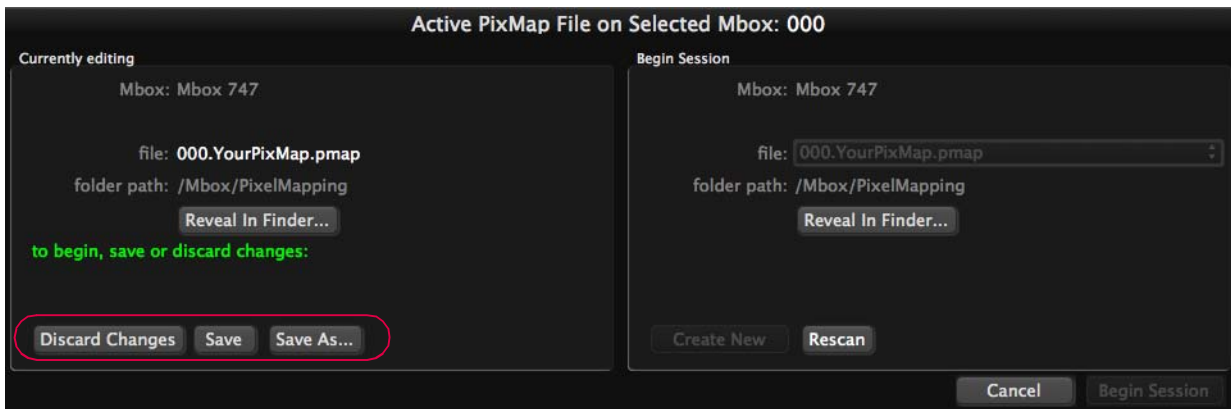
**To begin a live editing session and choose a different file:**

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.

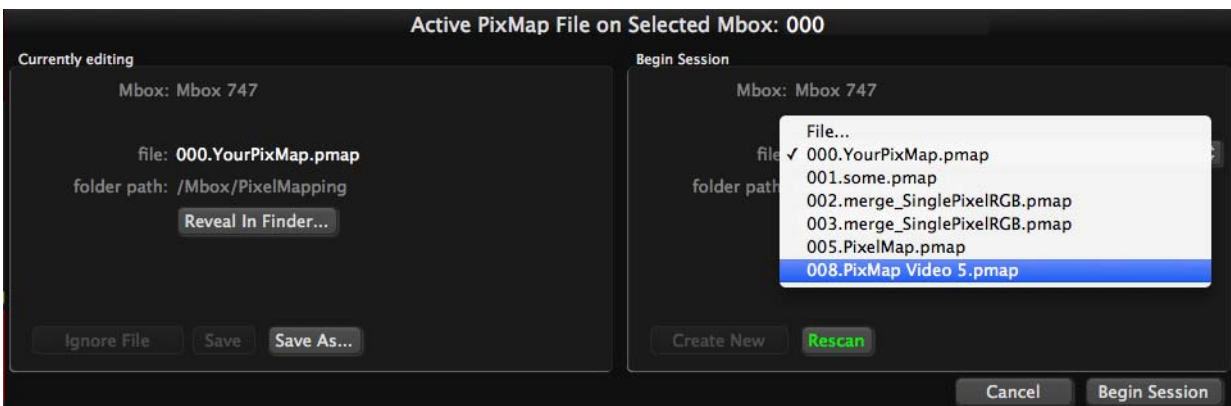
- Step 1. At Servers list, select required server.
- Step 2. Click gear icon and select **Begin Live Editing session for...**



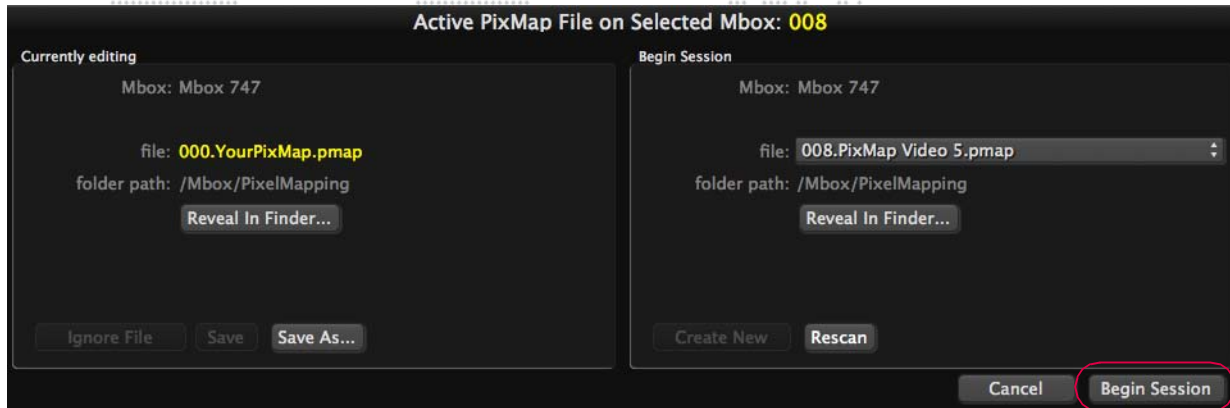
- Step 3. At Begin Session window, save or discard changes to current file by clicking either **Discard Changes**, **Save**, or **Save As** at left side of window. If saving, follow Save dialogs to save file.



- Step 4. At "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.

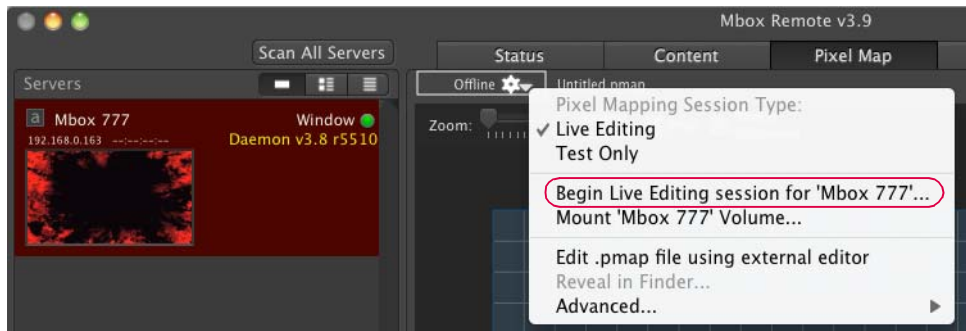


### Copy To Mbox

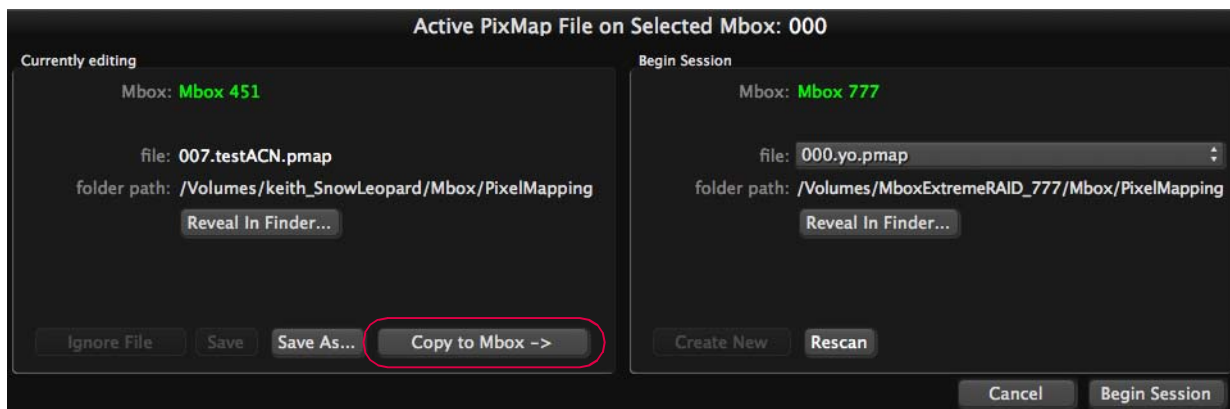
If the current pixel mapping configuration file does not reside on the Mbox server when starting a Live Editing session, the file can be copied to the Mbox server using the Begin Session / Currently Editing window.

Step 1. At Servers list, select server where file will be copied.

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



Step 3. At Begin Session window, click **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**.)



Step 4. At Save window, click **Save**. (The correct folder on the Mbox will be automatically chosen.)



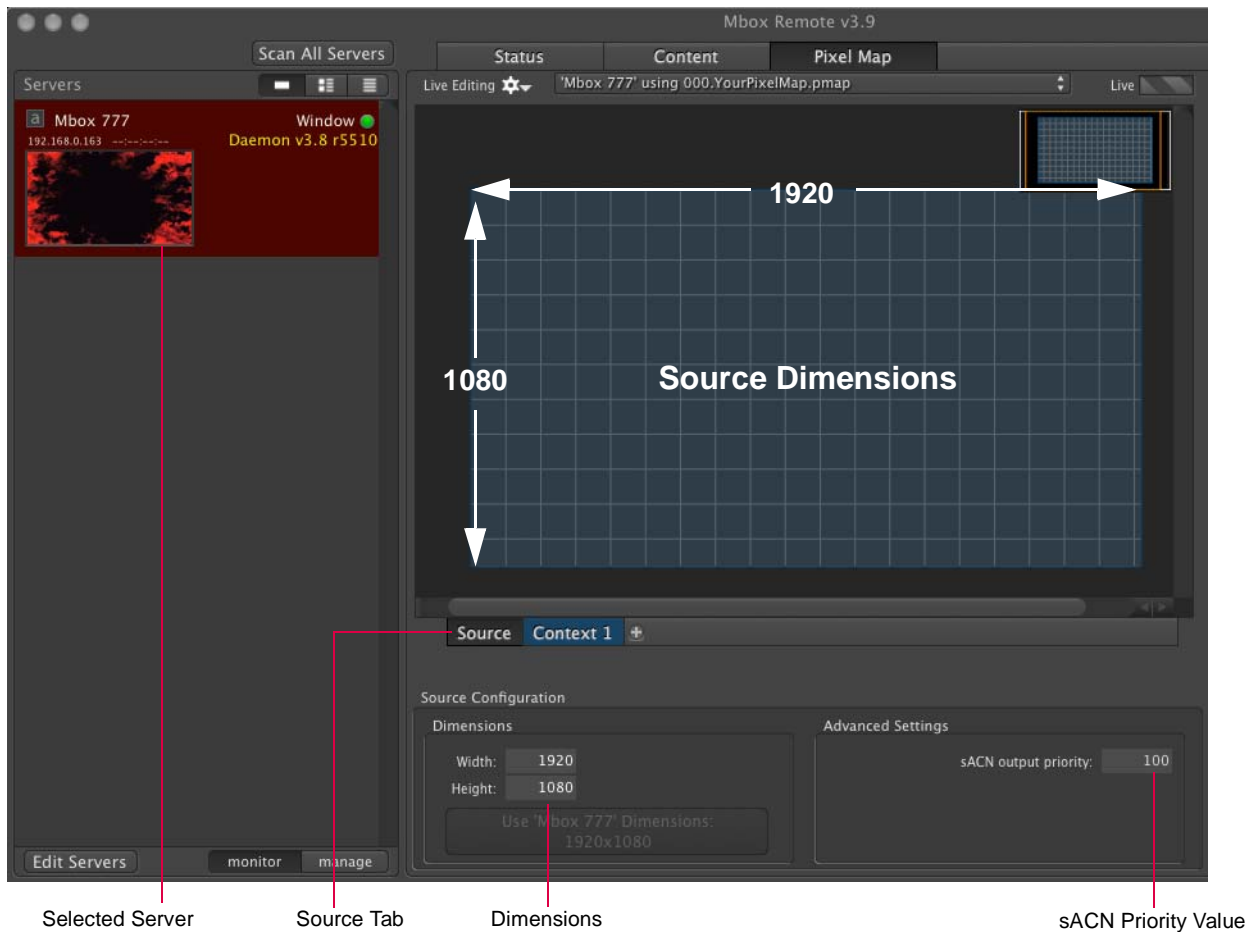
## Source

The "source" is the surface from which pixel data can be sampled to create a pixel map output. In this case, the source is the final, composited rendering surface of the Mbox server. Note that this surface will not be affected by the overall keystone and warp functionality.

The size of the source is based on the rendering surface used, which is different depending on the operating mode:

- + **Single Output mode** - rendering surface is the one output.
- + **Panoramic modes** - rendering surface is the combination of both outputs; overlap area is not repeated.
- + **Dual Independent mode** - rendering surface is Output 1 only.

The source is configured using the Source controls in the lower portion of the Pixel Map tab.



- + **Dimensions** - defines the width and height of the source in screen pixels.
- + **sACN output priority** - assigns a global priority value for all pixel mapping output via sACN. The priority can be a value between 0 and 200, with 100 being the default. (Refer to "Protocols" on page 48 for more information.)

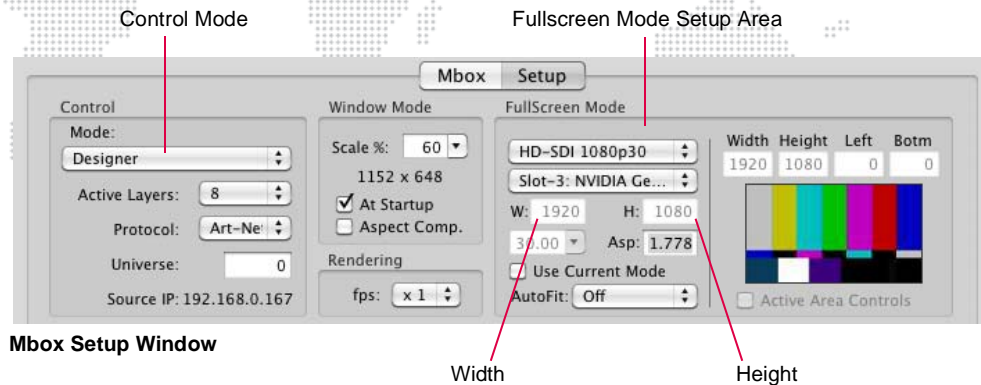
**CAUTION!** Incorrectly sized source dimensions may lead to unexpected results.



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 55 and "Previsualization" on page 90 for more information about how these elements work together.

## Calculating source dimensions:

The default width (W) and height (H) of a new configuration is 1920 x 1080 as shown in the example below:



The source's width and height in pixels are equal to the size of the rendering surface based on the output mode used. This is simple to calculate no matter what mode is used. Use the following guidelines:

- + All measurements are made in screen pixels.
- + Unless a Panoramic mode with portrait orientation is used, source height is always equal to the Fullscreen mode height.
- + With a Single Output setup, the source width = Fullscreen mode width.
- + With a Dual Independent setup, the source width = Output 1's Fullscreen mode width.
- + With a landscape Panoramic setup and no overlap, the source width = Fullscreen mode width x 2.
- + With a landscape Panoramic setup that uses overlap, the source width = Fullscreen mode width x 2. Due to the overlap, the context X/Y origin may need to be adjusted to ensure the entire context is visible on screen.\*



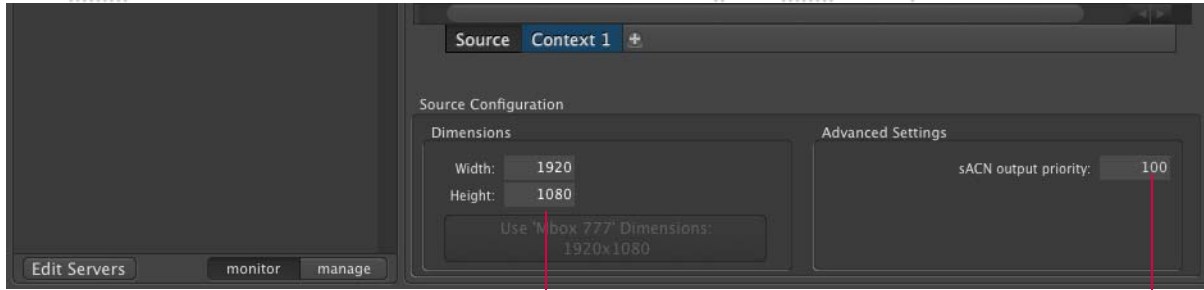
**Panoramic Output Mockup (No Overlap)**

- + With a portrait Panoramic setup and no overlap, the source height = Fullscreen mode height x 2 (source width = the Fullscreen mode width).
- + With a portrait Panoramic setup that uses overlap, the source height = Fullscreen mode height x 2 (source width = the Fullscreen mode width). Due to the overlap, the context X/Y origin may need to be adjusted to ensure the entire context is visible on screen.\*

\* It is not recommended to use pixel mapping with Panoramic modes if you have an overlap. If this is required, please contact [mboxsupport@prg.com](mailto:mboxsupport@prg.com) for assistance.

### To setup source :

- Step 1. Be sure Source tab is selected.
- Step 2. Enter Width and Height in Dimensions fields.
- Step 3. Enter a priority value for sACN output, if required.

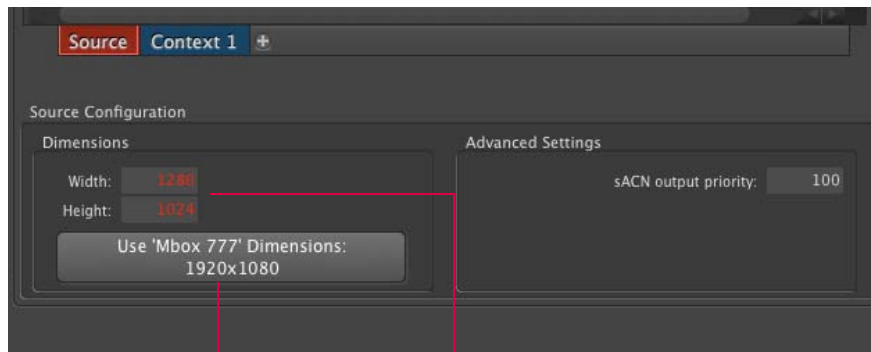


Dimensions

sACN Priority Value

### Source Errors / Auto-Detect

During a Live Editing session, the Width and Height fields of the Source tab will color the text red if the value does not match the current dimension for Mbox. A button below the fields allows the correct values to be easily entered:



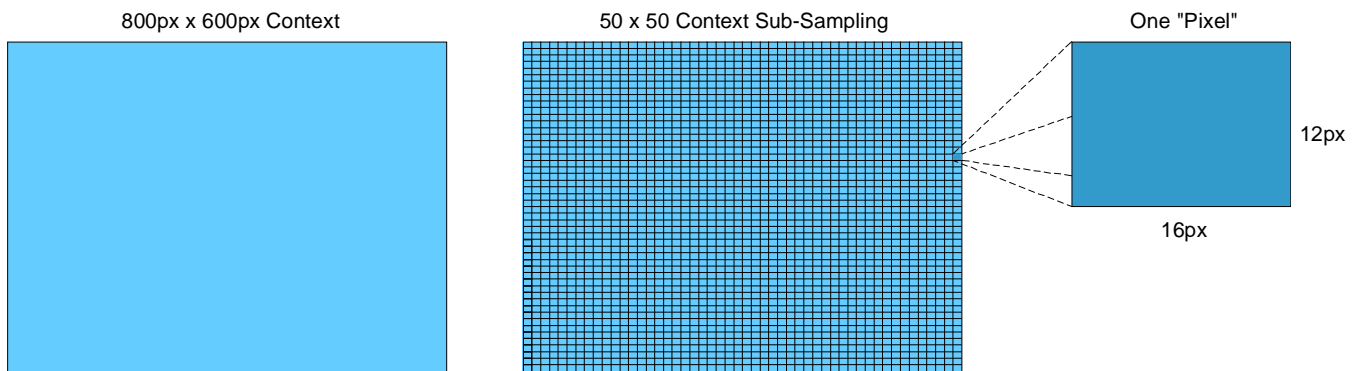
Apply Mbox Dimensions Button

Incorrect Width and Height

## Contexts

A "context" is a rectangular area taken from the source area 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 50x50 subdivisions has placed on an area of the source with a size of 800px x 600px. Each rectangular subdivision of the context will be  $(800\text{px}/50) \times (600\text{px}/50)$ , 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.

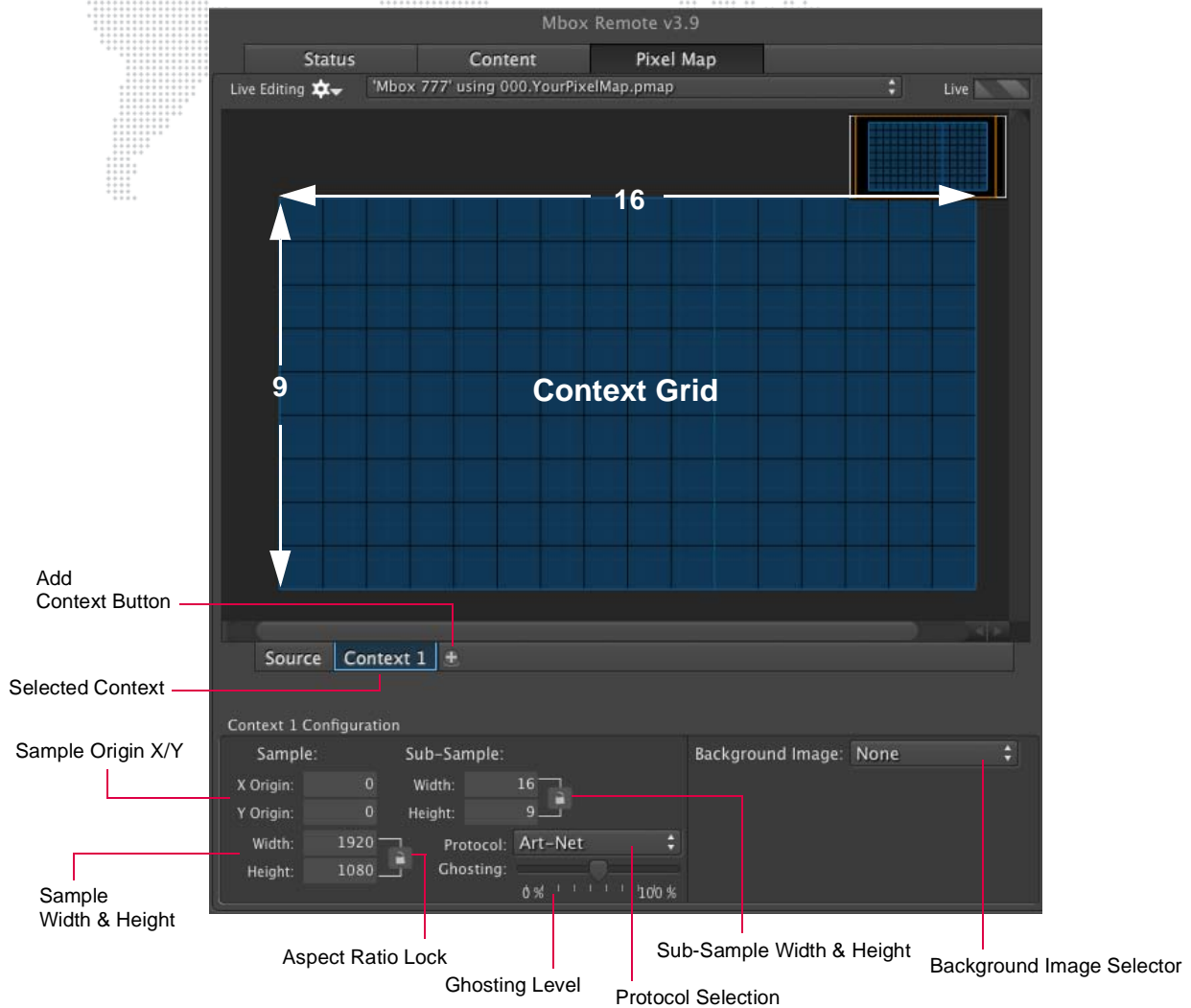


The size and sub-sampling of the pixel mapping context plays a large role in how the pixels in the source are converted into output data. Assuming you create a context that is the same size as the source, you could either configure it to have one sub-rectangle (sub-sampling width and height of 1 x 1) 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 be fairly pointless. In the second case, you could have 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 your output.

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

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.



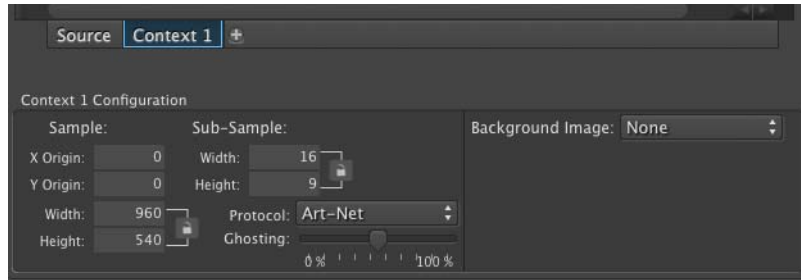
- + **Sample X/Y Origin** - a pixel location on the source which marks the top-left corner of the context's rectangular area.
- + **Sample Width/Height** - a measurement in screen pixels which specifies the size of the context. (This may be some or all of the source.)
- + **Sub-Sample Width/Height** - 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 "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." on page 105.)

**Note:** The bounds of two or more contexts may overlap each other, but need not.

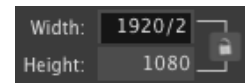
**Note:** There is no theoretical limit to the number of contexts allowed, but it is best to have no more than 20.

**To add contexts:**

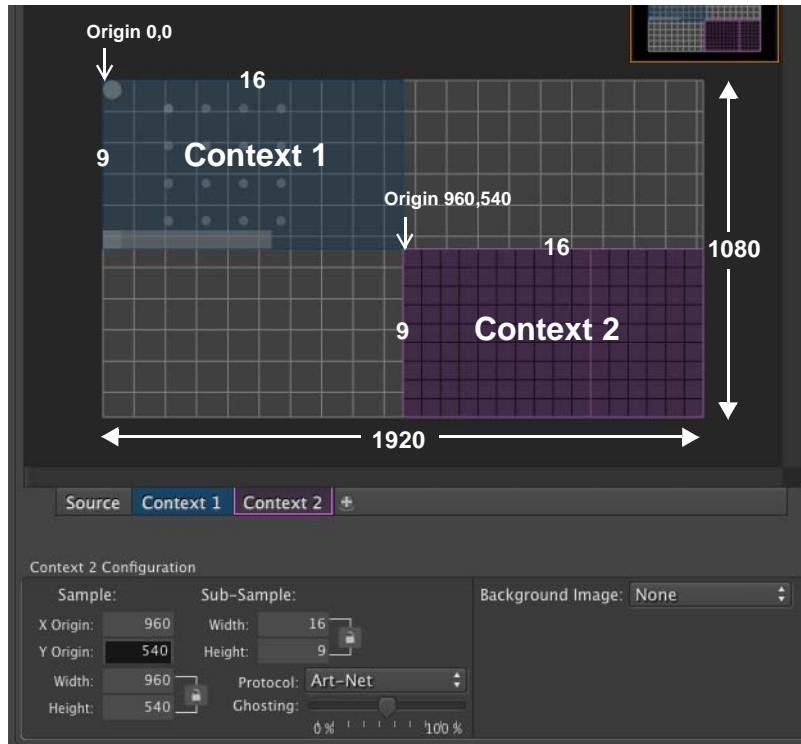
- Step 1. Click Context 1 tab.
- Step 2. Configure options as required.



**Note:** Mbox fields can perform math operations such as add, subtract, multiply, and divide. For example, if you would like to set the Sample Width for a context at half of 1920, enter 1920/2 in the field then press [Enter] on your keyboard.



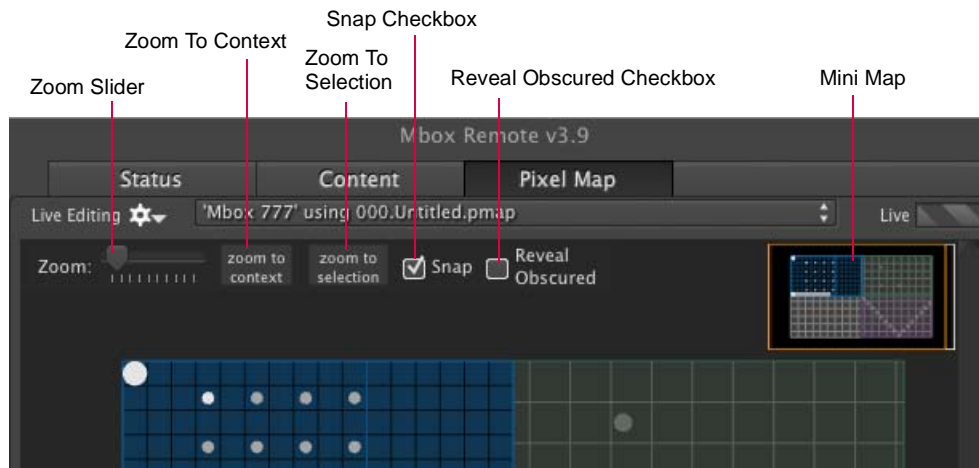
- Step 3. To add additional contexts, click [+] button and configure options. (Each context's configuration is individual to that particular context.) Note that the default Sample Origin for a context is 0,0 so it may overlap another context until its X and/or Y origins are changed.



## 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).
- + **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.



## 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 95.)

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 (for example, 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. A pixel, in this case, is defined as a single sample of RGB data that makes up part 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 and the previsualization, 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 and previsualization. (All pixels in one fixture must have the same size.)
- + There are many different types of pixels. (RGB, RGB16, CMY, CMY16, Luma, Luma16, CYM, CYM16, R, G, B, C, M, Y, etc.)

Fixture Tab  
Fixture Information Table  
(Patch, Layout, Physical, Merge)



Fixture and Fixture Profile Controls



## 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 ports on the computer.
- + Protocols may be routed to one of more destinations (IP Addresses).

---

**Note:** Refer to "[Overview](#)" on page 47 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:

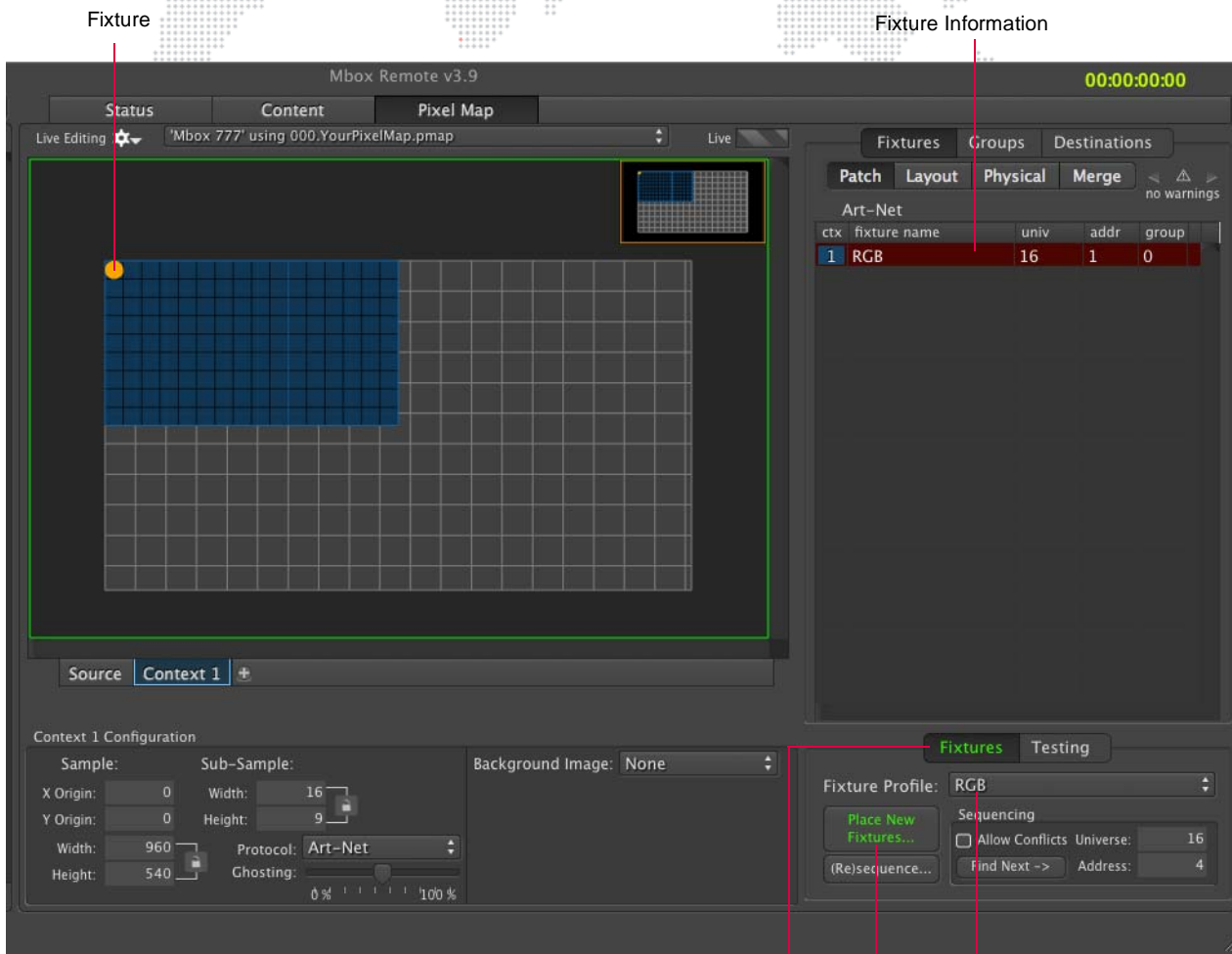
- Step 1. Be sure either the Offline or Live Editing mode is active. (Refer to "[Session Types](#)" on page 53.)
- Step 2. At Fixture Profile pop-up menu, select a profile type to be added.



- 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.) You can also 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.)

Notice that the fixture, when highlighted, has one darker pixel (the fixture's origin pixel in its patch order) while the remaining pixels are lighter. Even when not highlighted, the origin pixel will be slightly darker than the rest. 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. Mbox will automatically patch fixtures in order as they are placed. Therefore, you can reduce your patch time by placing fixtures in order. You can also modify the patch information for any fixture at any time.

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



Fixtures Tab  
 Placement Mode Button  
 Selected Fixture Profile

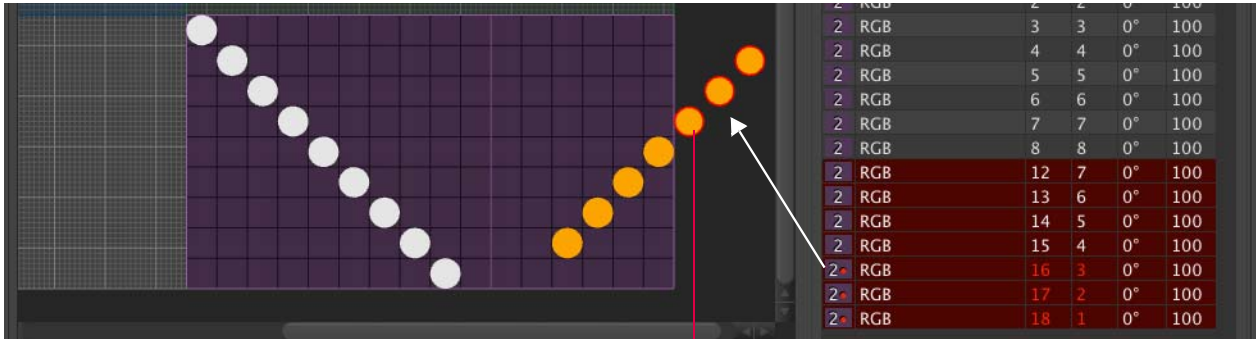
## Fixtures Out of Bounds

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



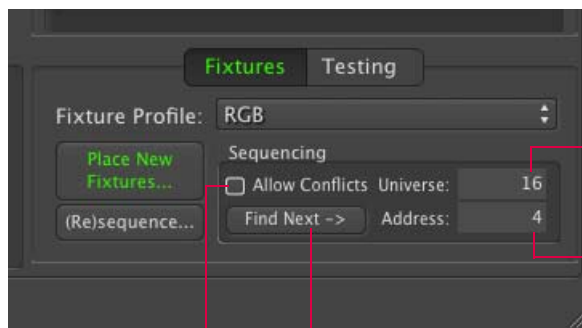
Geometry Tools can be used to adjust fixture placement. Refer to "[Geometry Tools](#)" on page 78.

## 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

The protocol is based on the protocol of the context that it is placed upon, while the address is based on the universe/device and address shown in the sequencing box at the lower right of the window.

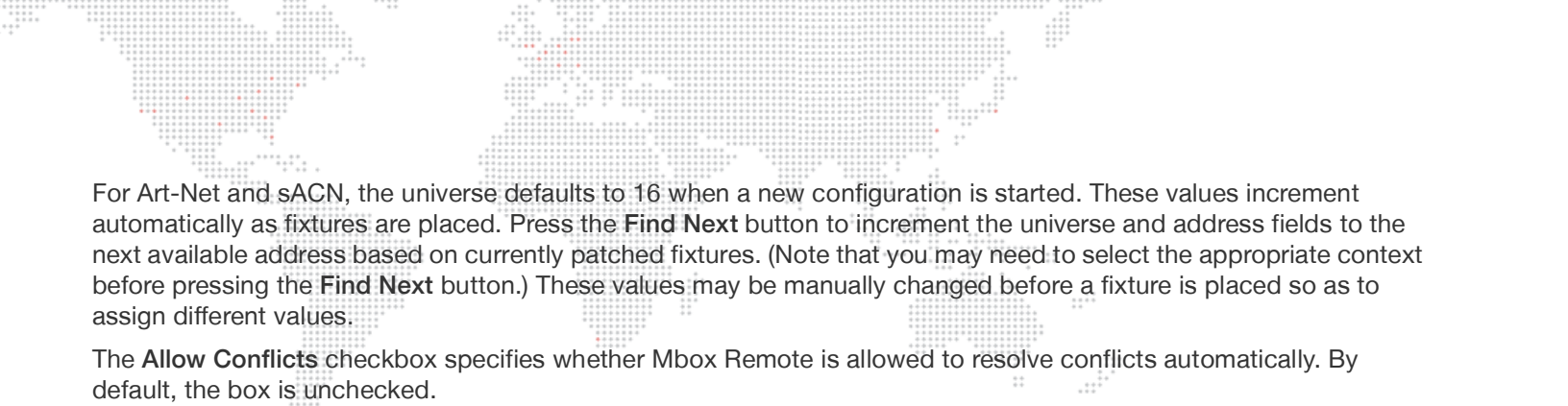


Universe for next fixture placement

Address for next fixture placement

Find Next Universe/Address

Allow Conflicts Checkbox



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 so as to assign different values.

The **Allow Conflicts** checkbox specifies whether Mbox Remote is allowed to resolve conflicts automatically. By default, the box is unchecked.

- + **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 you need to output both Art-Net and sACN, you will need to create two contexts and place the appropriate fixtures onto each context.

- + When adding fixtures connected to a KiNET\_DMXXOUT power supply, addresses 1- 256 will be on the first port of the DMXXOUT 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!** You should always avoid duplicate Art-Net 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 your system - unless you are running a backup system and have some means of merging data or taking control from one server or 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 25. If addressing conflicts (overlaps) occur, the Pixel Map screen 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.
- + Overlaps of actual pixels on the context will be shown with a yellow highlight drawn around the pixel in the Context Grid.
- + Errors in the Fixture table 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.



**Layout Tab View**

Alert Indicator  
(total alerts)

Mbox Remote v3.9 00:00:00:00

Status Content Pixel Map

Offline /Volumes/MboxExtremeRAID\_123/Mbox/PixelMapping/000.YourPixelMap.pmap

Fixtures Groups Destinations

Patch Layout Physical Merge 2

► Art-Net

▼ sACN

ctx	fixture name	xpos	ypos	rotn	pixfill
2	RGB	0	0	0°	100
2	RGB	1	1	0°	100
2	RGB	2	2	0°	100
2	RGB	3	3	0°	100
2	RGB	4	4	0°	100
2	RGB	5	5	0°	100
2	RGB	6	6	0°	100
2	RGB	7	7	0°	100
2	RGB	8	8	0°	100
2	RGB	8	8	0°	100
2	RGB	9	7	0°	100
2	RGB	10	6	0°	100
2	RGB	11	5	0°	100
2	RGB	12	4	0°	100
2	RGB	13	3	0°	100

Fixtures with overlapping pixels

Alert Indicator  
(total alerts)

**Patch Tab View**

Fixtures Groups Destinations

Patch Layout Physical Merge 2

► Art-Net

▼ sACN

ctx	fixture name	univ	addr	group
2	RGB	16	1	
2	RGB	16	4	
2	RGB	16	7	
2	RGB	16	10	
2	RGB	16	13	
2	RGB	16	14	
2	RGB	16	19	
2	RGB	16	22	
2	RGB	16	25	
2	RGB	16	28	
2	RGB	16	31	
2	RGB	16	34	
2	RGB	16	37	
2	RGB	16	40	
2	RGB	16	43	
2	RGB	16	46	

Fixtures with overlapping addresses

## Re-Addressing Fixtures

When fixtures are first placed onto a context, they are automatically given an address as explained in "Addressing Fixtures" on page 69. 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.

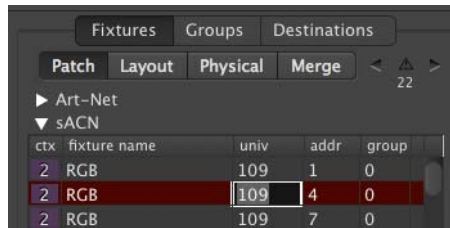
Each of these methods is explained below.

### 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. At right side of window, select Fixtures tab.
- Step 2. At Patch tab, double-click on universe (univ) or address (addr) field.
- Step 3. Make changes as required.



ctx	fixture name	univ	addr	group
2	RGB	109	1	0
2	RGB	109	4	0
2	RGB	109	7	0

---

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

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

- Step 1. At right side of window, select Fixtures tab.
- Step 2. At Patch tab, select multiple fixtures (using cmd or shift), then double-click any selected line to open Re-Address Multiple Fixtures window.
- Step 3. At From Address field, enter new starting address. Also enter any changes to universe in the Universe field.

Multiple Fixtures Selected

Re-Address Window

Selection Information

Original Addressing and Conflicts (if any)

New (Edited) Addressing

Renumbers fixtures and fixes conflicts

Reverts to original settings    Renumbers fixtures without fixing conflicts

Step 4. Do one of the following:

- a. Click **Auto Renumber** button to renumber the selected fixtures. This method will fix any overlap conflicts in the process.
- b. Click **Commit** to renumber the selected fixtures without fixing any overlap conflicts. (Conflicts will be noted in the table after the window is closed.)

Conflicts

## 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 window, select Fixtures tab.
- Step 2. Click **(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. At Context Grid, click on fixtures one-by-one to apply new addressing. The universe and address will increment as required as each fixture is clicked.
- Step 5. Click **(Re)sequence** button to exit re-addressing mode.

NET\_PORTOUT.pmap Live

Fixtures Groups Destinations

Patch Layout Physical Merge 20

▼ Art-Net

ctx	fixture name	univ	addr	group
1	RGB	129	382	0
1	RGB	130	1	0
1	RGB	130	4	0
1	RGB	130	7	0
1	RGB	130	10	0
1	RGB	130	13	0
1	RGB	130	16	0
1	RGB	130	19	0
1	RGB	130	22	0
1	RGB	130	25	0
1	RGB	130	28	0
1	RGB	130	31	0
1	RGB	130	34	0
1	RGB	130	37	0
1	RGB	130	40	0
1	RGB	130	43	0

► sACN  
► KINET\_PORTOUT  
► KINET\_DMXXOUT

Fixtures Testing

Fixture Profile: No Profile

Place New Fixtures...

**(Re)sequence...**

Sequencing

Find Next -> Universe: 130 Address: 10

Background Image: None

Fixtures clicked upon (which have received a new address)

Universe applied to next fixture clicked upon

Re(sequence) Button - Green when mode is active

Address applied to next fixture clicked upon

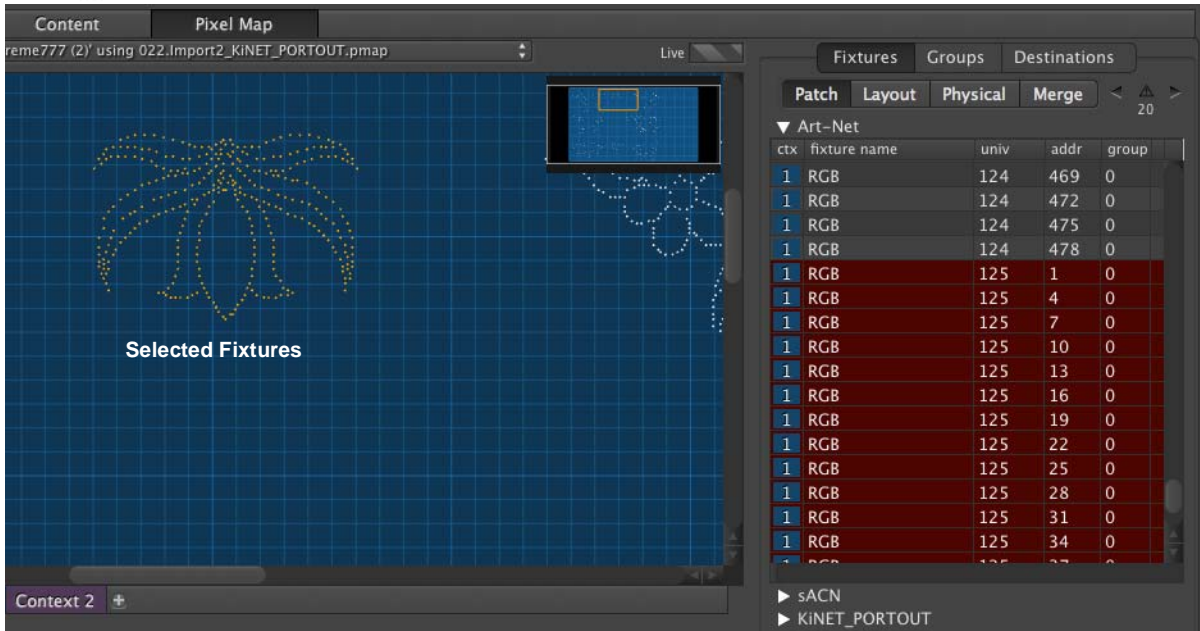


## Copy and Paste Fixtures

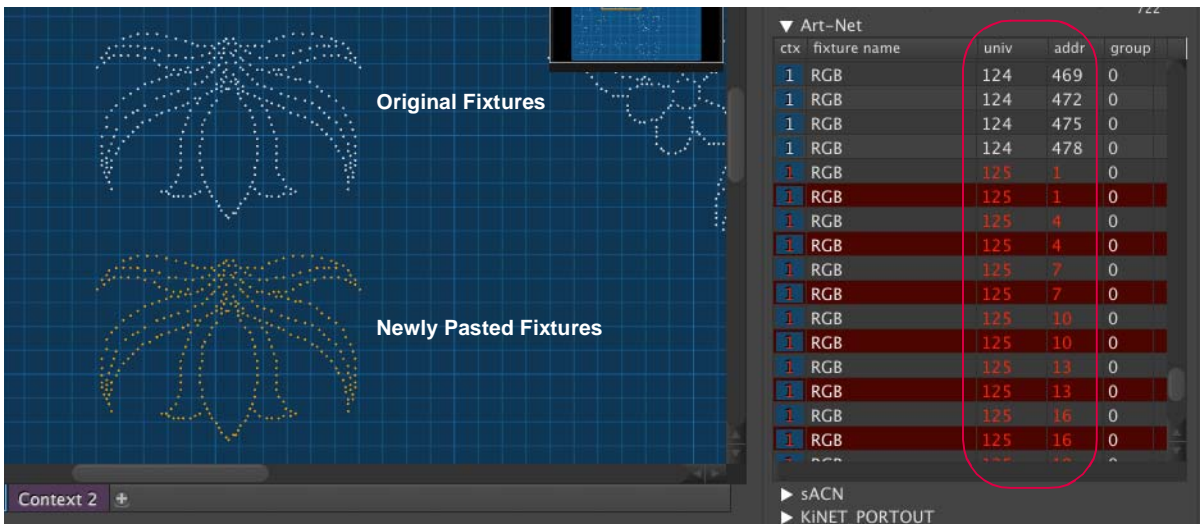
A convenient way to quickly add fixtures is to use the copy and paste feature.

### To copy and paste fixtures:

- Step 1. At 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 icons.)
- Step 2. Press [⌘ C] to copy.

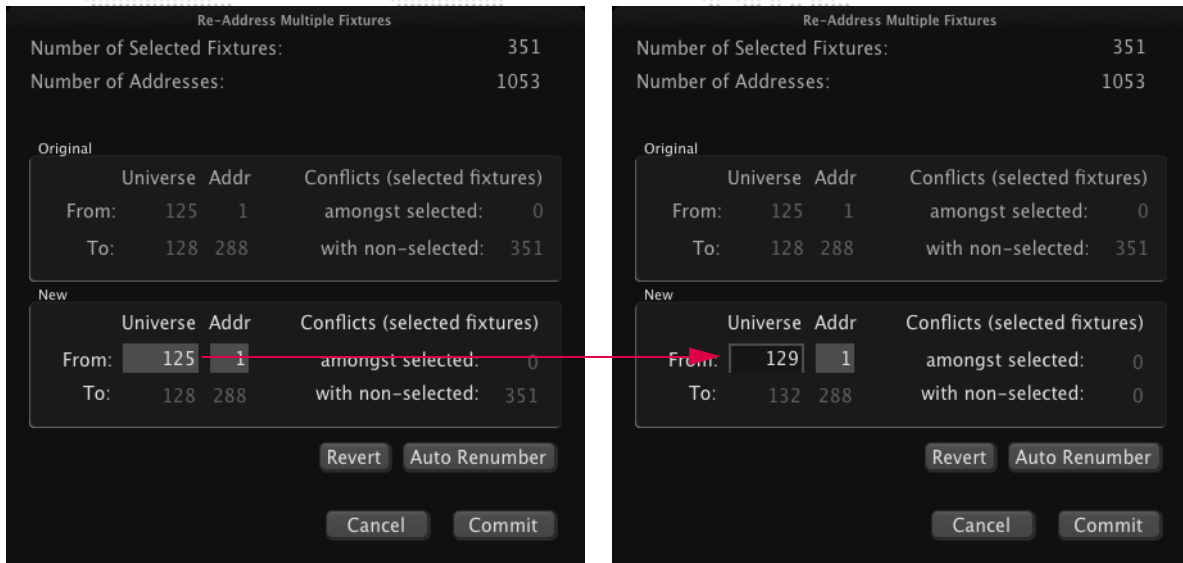


- Step 3. Press [⌘ P] to paste. The pasted fixtures will be automatically selected and conflicts will be shown.

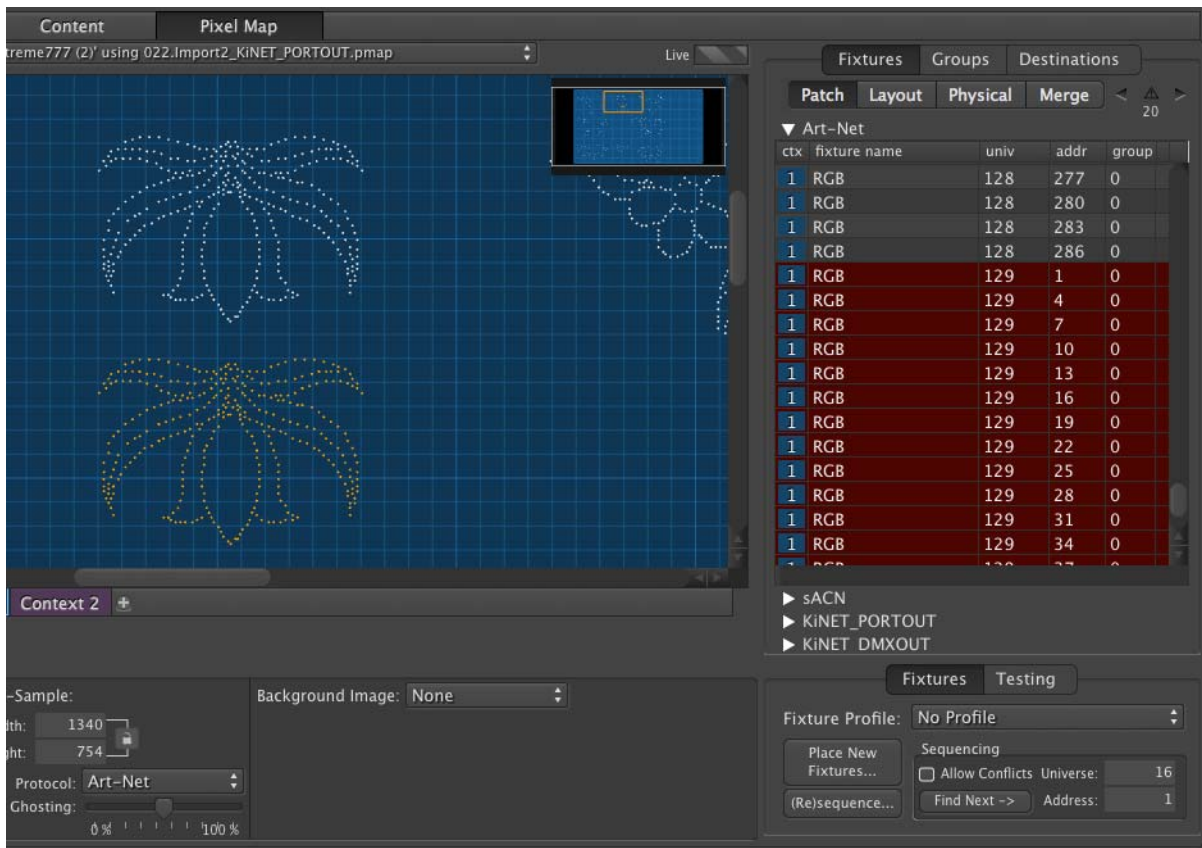


- Step 4. At Patch table, double-click on univ or addr field of one of the selected fixtures. Re-Address Multiple Fixtures window will open.

Step 5. At Re-Address Fixtures window, enter a free universe and address.



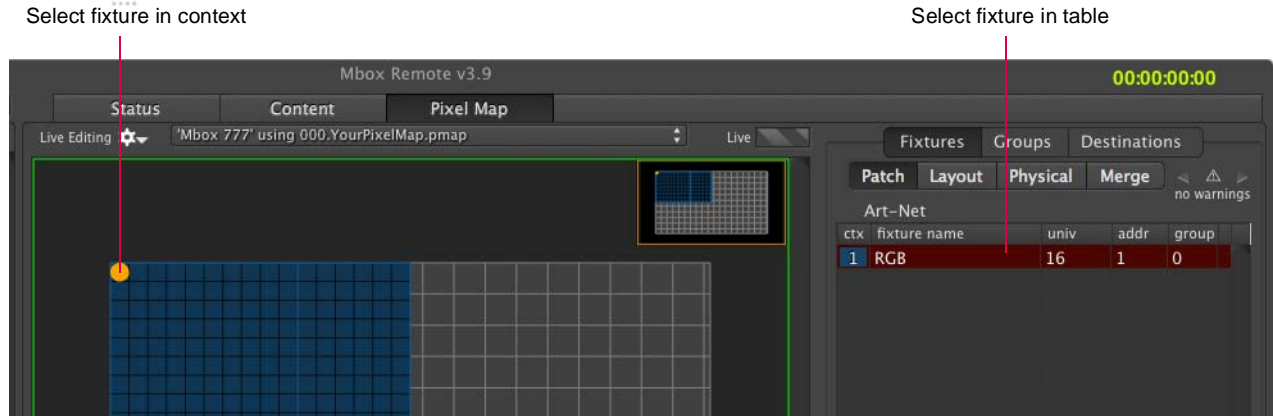
Step 6. Click **Commit** button. (Conflicts in Patch table will now be resolved.)



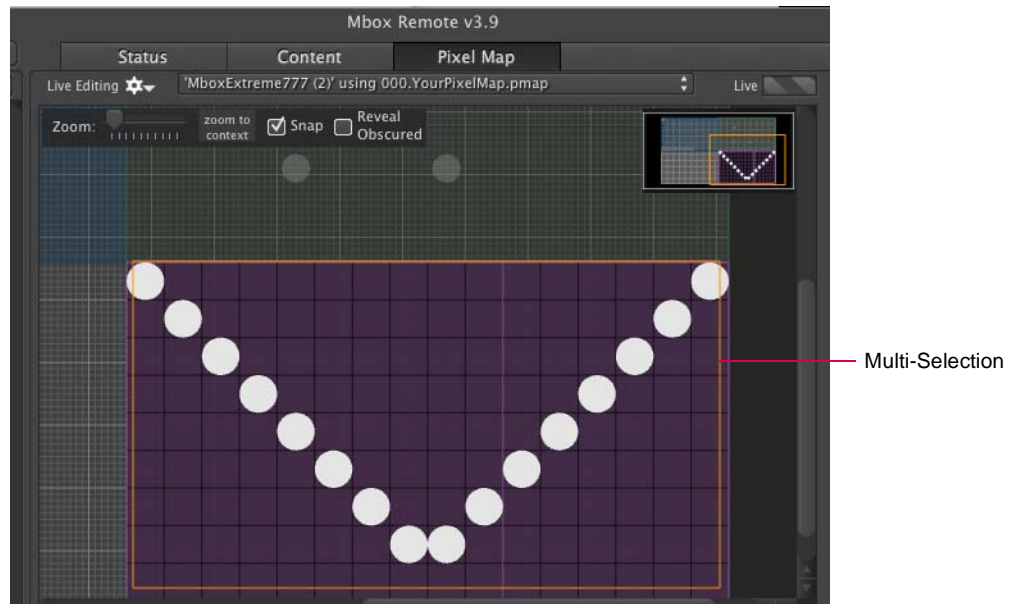
## Fixture Editing

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

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



Multiple fixtures can be selected by using click and drag to draw a box around multiple fixtures in the Context Grid.



## 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

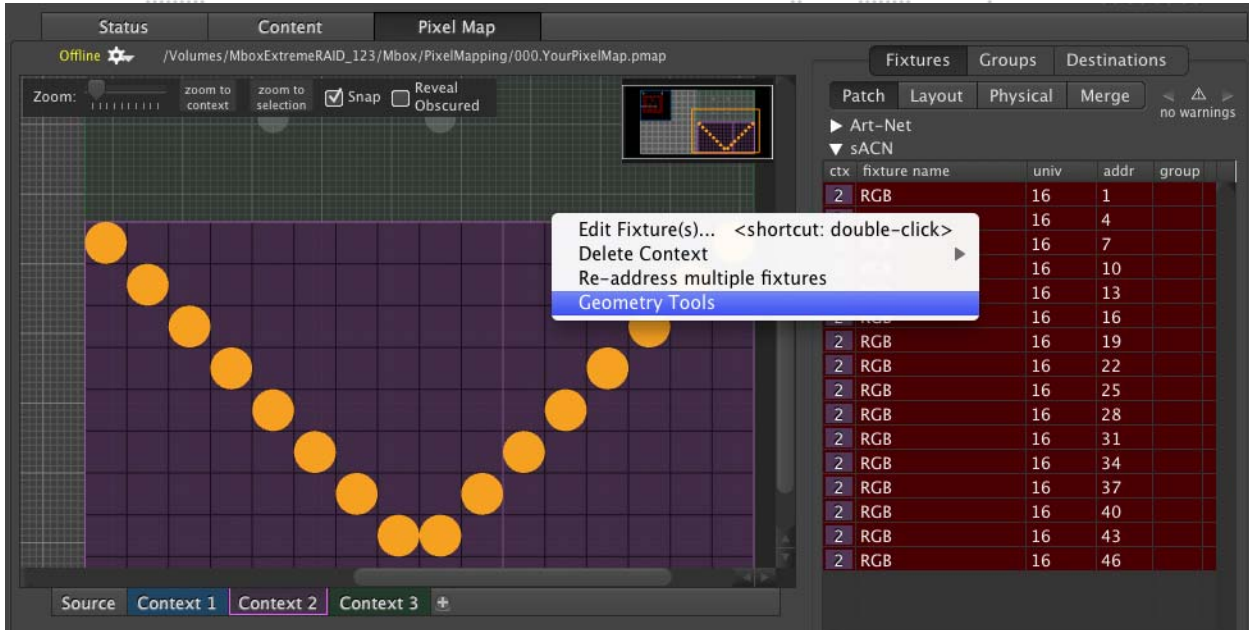
Use [⌘ Z] to undo.

Use [⌘-shift-Z] to redo.

## Geometry Tools

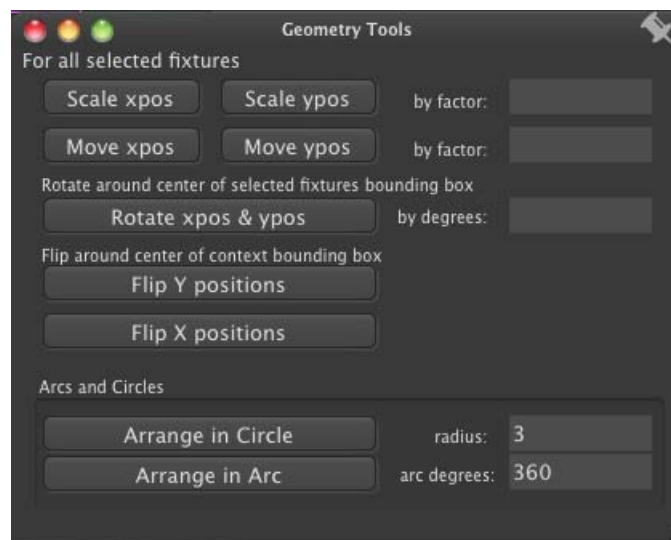
The Geometry Tools feature can be used to move, scale, rotate, flip, and arrange fixtures as a group.

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

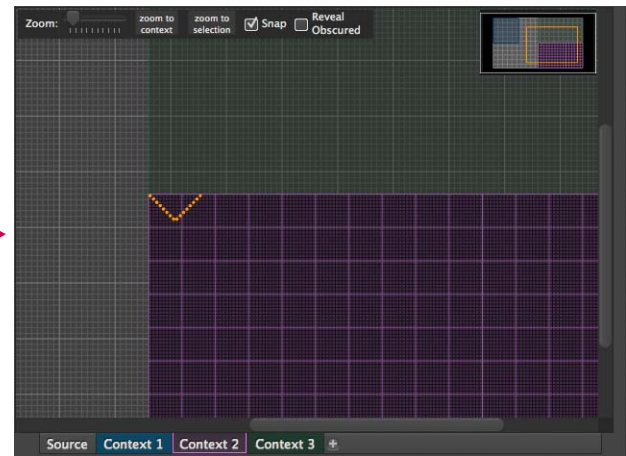
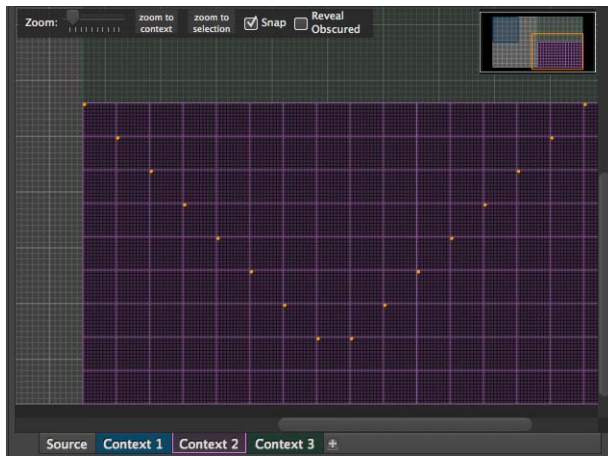
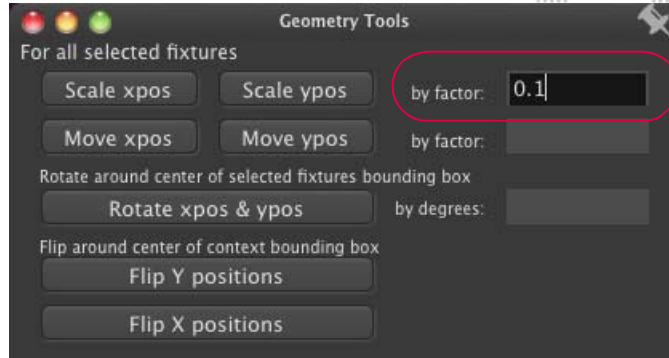


The Geometry Tools window provides several options:

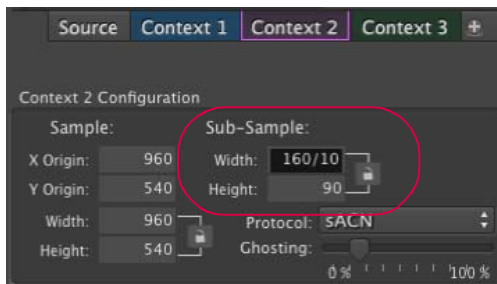
- + Move or scale the selected fixtures' positions by a certain factor.
- + Rotate the selected fixtures as a unit.
- + Flip the fixtures around the X or Y axis as a unit.
- + Arrange the fixtures in a circle or arc.



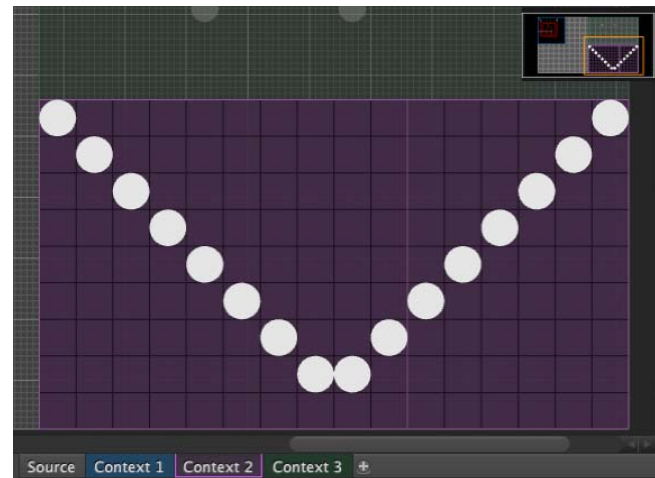
For example, when reducing the context size from 160 x 90 to 16 x 9, it would be time-intensive to manually move all the fixtures so they will fit into the smaller context. In this case, the Geometry Tools could be used to move all the fixtures at once. To do this, select all fixtures, enter a factor 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, '1/10' (divide by 10) as shown below:



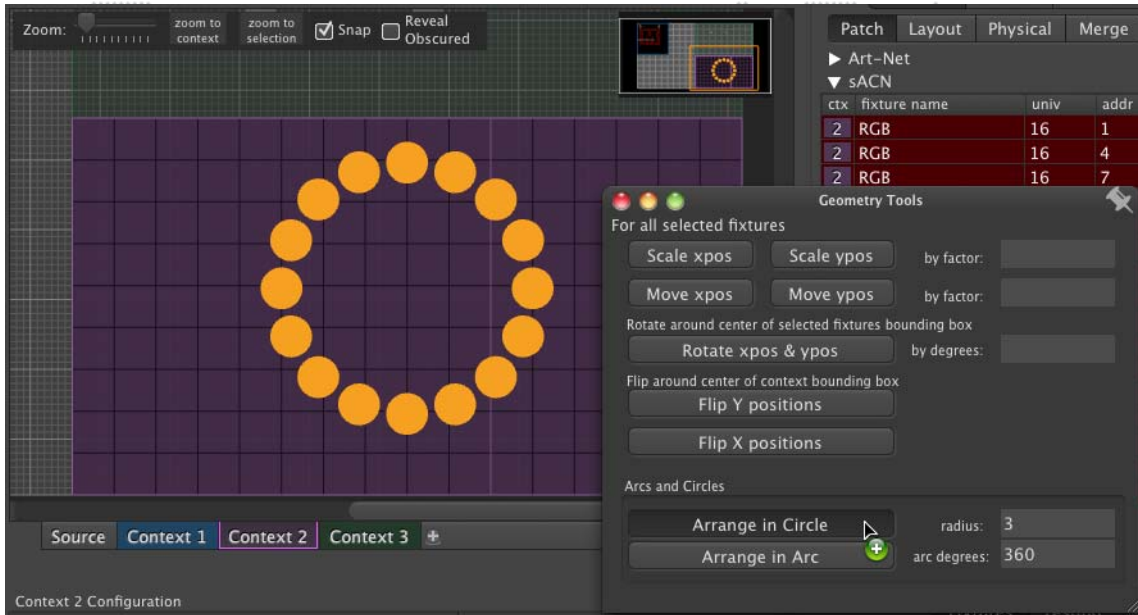
The final result of the moved fixtures and reduced context size is shown below:



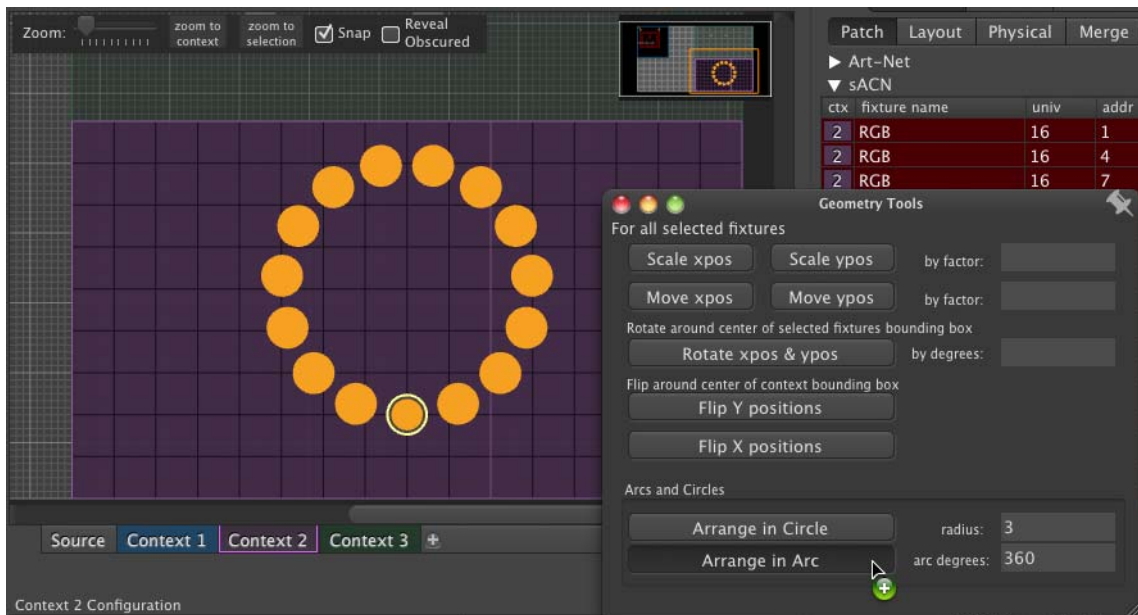
The following examples illustrate the difference in the Arrange in Circle and Arrange in Arc tools.

If "arc degrees" is 360:

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

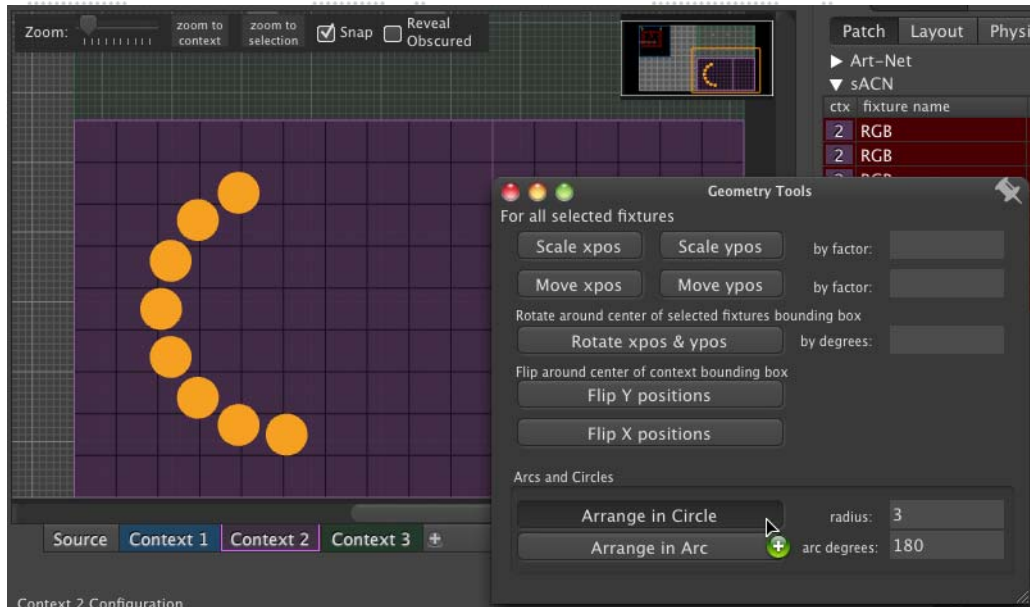


- + **Arrange in Arc** places the first fixture at 0 degrees and the last fixture at 360. (The first and last fixture are placed on top of each other.)

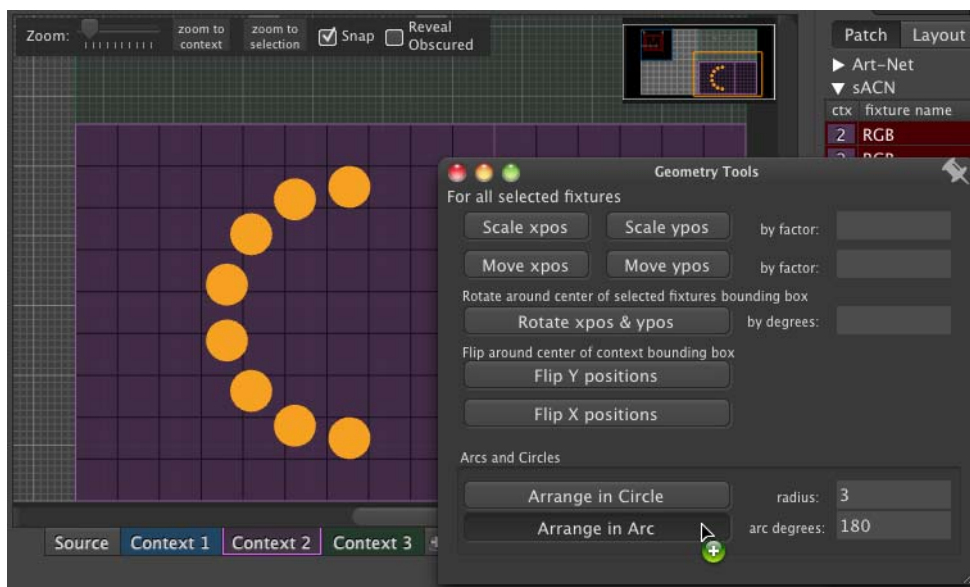


If "arc degrees" is 180:

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



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



## 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

ctx	fixture name	univ	addr	group
2	RGB	109	1	0
2	RGB	109	4	0
2	RGB	109	7	0

Patch

ctx	fixture name	xpos	ypos	rotn	pixfill
2	RGB	238	69	0°	100
2	RGB	235	69	0°	100
2	RGB	232	69	0°	100

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.

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 100.)

ctx	fixture name	rfrsh	slew	mask	level
2	RGB	30	0s		100
2	RGB	30	0s		100
2	RGB	30	0s		100

Physical

ctx	univ	addr	mrg univ	mrg addr	merge
1	17	502	13	9	Full f

Merge

Profile-Level Properties  
(comes from profile)

Fixture-Level Properties  
(applies to fixture or selected fixtures)

Click to edit profile  
instead of patched fixture

**Profile Level Properties**

Profile Reference: Color Web 250(48)

Level(%): 100%    Mask: No

Refresh: 30Hz    Slew: 0 sec

**Fixture Level Properties**

Custom Name: \_\_\_\_\_

Group: 0    Universe: 16

Rotation: 0°    Address: 31

Edit Profile Instead...

Clear Overrides

Revert ✓ Items

**Edit Pixel Data**

Total Channels: 48    Pixel Type: RGB

Fixture Width: 7    Fixture Height: 7

Pixel Shape: Circular    Pixel Fill (%): 50

Pixel Sequencing: Top-left

Linear    Horizontal

Generate Array

**Pixels/Profile/overrides Table**

addr	type	park
1	RGB	+
4	RGB	+
7	RGB	+
10	RGB	+
13	RGB	+
16	RGB	+
19	RGB	+
22	RGB	+
25	RGB	+

Pixel Data  
(cannot be edited here)

Pixel Arrangement  
(cannot be edited here)

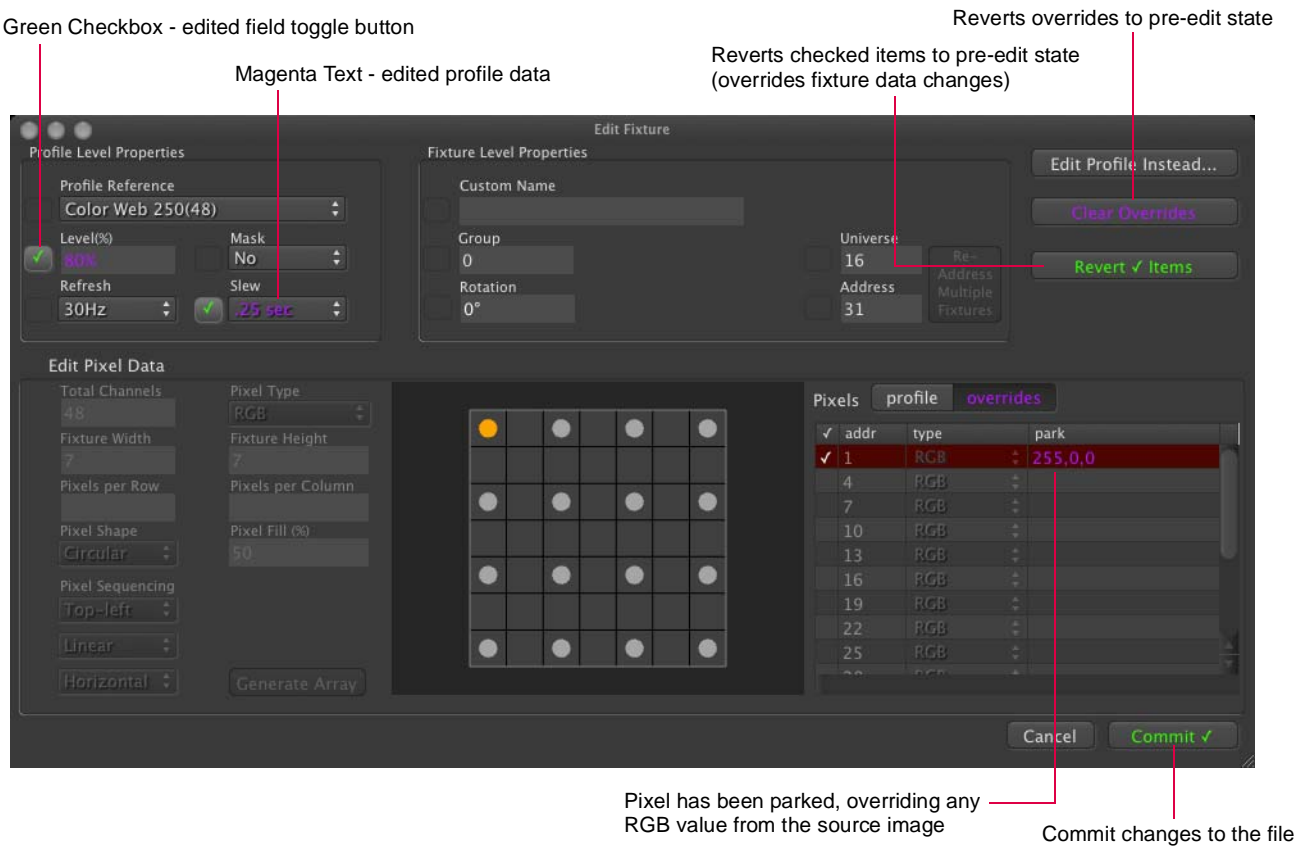
Pixels/Profile/overrides Table

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 100.

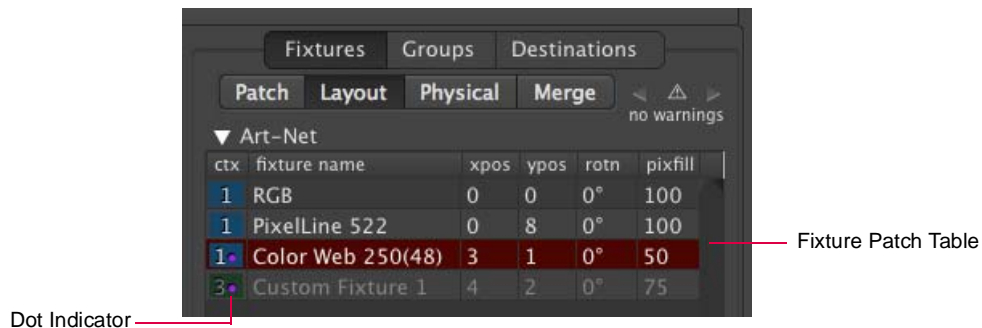


**To use the Edit Fixture window:**

- Step 1. Open Edit Fixture window using one of the following methods:
  - a. Double-click on fixture's icon in Context Grid.
  - b. Double-click on fixture's ctx or fixture name field in Fixture table.
  - c. Select multiple fixtures in Fixture table (using cmd or shift), then double-click on one of the fixture's ctx or fixture name field.
- Step 2. At 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 using the green checkboxes, or the changes accepted and applied by clicking the **Commit** button.

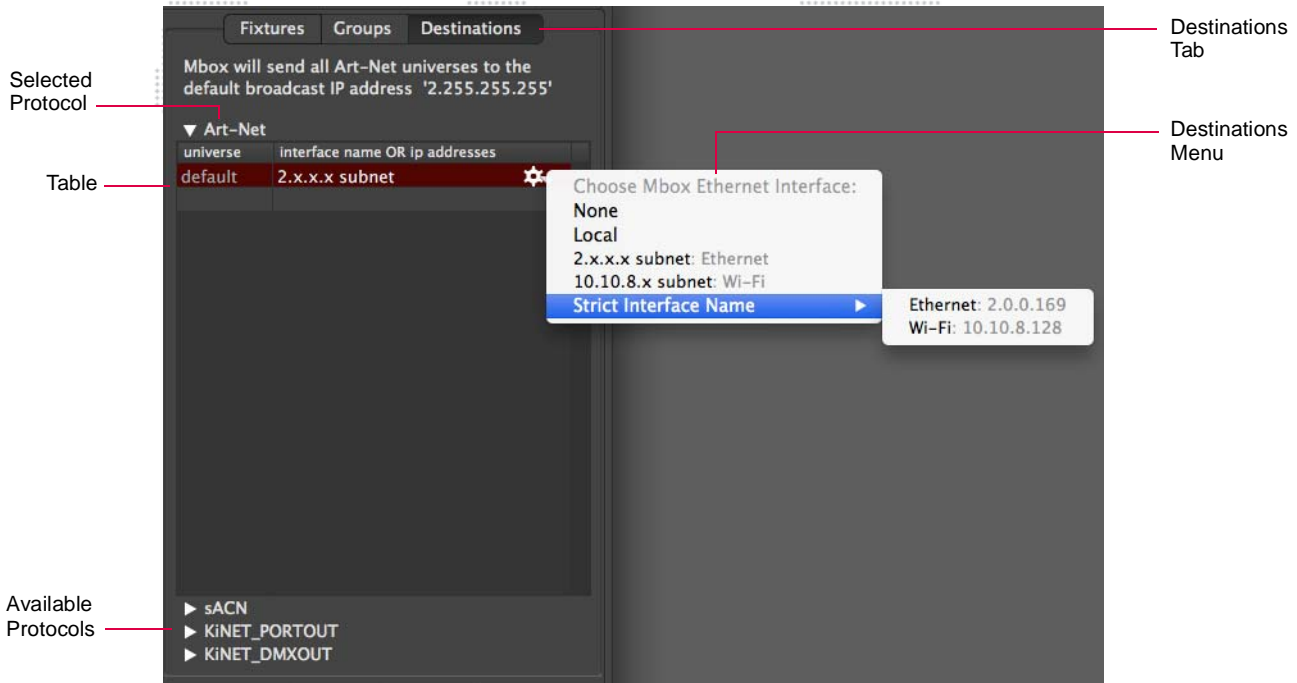


Fixture values that are edited to be different from the profile data are considered "overrides." Fixtures with overrides will have a magenta dot indicator in the Fixture table. If the Edit Fixture window is opened again these overrides can be cleared, thereby reverting to the original property from the fixture profile. (In other words, you don't have to remember the original values.)



## 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.



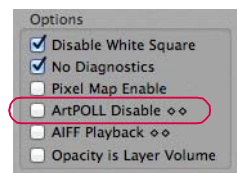
There is a separate area of the Destinations tab for each of the protocols. When the Destination tab is selected, the protocol of the current context will be displayed. A different protocol can be viewed by clicking on the name of the protocol.

### Destination Protocol Information

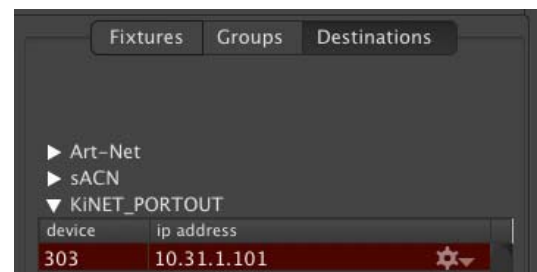
**IMPORTANT!** If you are using KiNET PORTOUT, please read the section below when entering device.port numbers on the Destinations tab.

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.

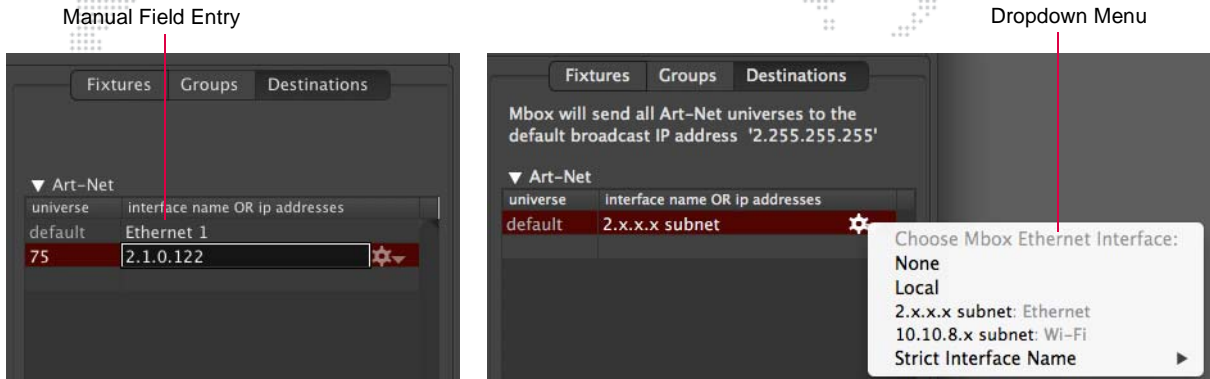
For Art-Net and sACN only - and only once in the table - there may be an entry of "default" in the universe field. This will cause all patched universes without a discrete destination entry in the table to be sent to the corresponding default IP address. If the default entry is given a broadcast IP address 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/ device number and IP Address for the new destination. The IP address is where all data for fixtures using that destination will be sent. Several different values can be entered in this field. There is a dropdown menu to help with this process if you want to pick a particular interface or subnet. (Note that you must be in a Live Editing session to view the available interfaces or subnet. Refer to "Live Editing" on page 55.)



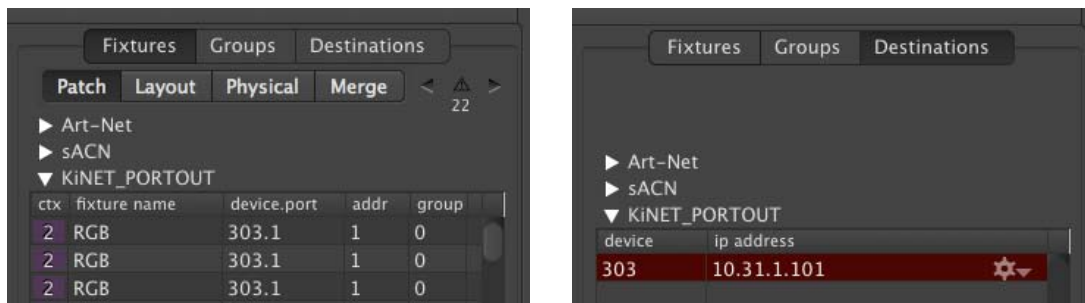
- + **Unicast IP Address** - Enter a static IP Address (e.g., 2.23.45.136) to send all data for that destination to one single IP Address.

Optionally you can send one destination's data to up to four individual unicast IP addresses by separating the 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.
- + **Strict Interface Name** - Enter the exact name of the Ethernet interface on the Mbox computer that you want the data to 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.

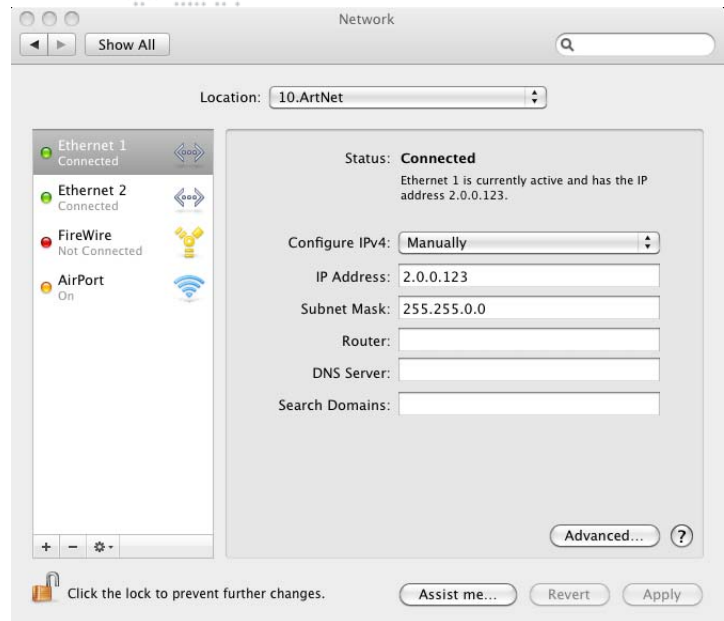


## Destination IP Addressing

The configuration of the Ethernet interface on your 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 your computer they will be output from. (Refer to "[Appendix A. Networking For Mbox](#)" on page 119 for more detailed information.)

If you have two Ethernet ports on your 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 ports 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 more than one device responds to an ArtPOLL stating that they require a universe of data, then 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 you are using a system with ArtPOLL compliant and non-compliant devices, where 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 this point the non-compliant devices will not receive the Art-Net. In such cases, you will need to disable ArtPOLL by checking the "ArtPOLL Disable" checkbox on the Setup tab and then restarting the Mbox application.

Suggested Ethernet Setup for Art-Net Output:

- + 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

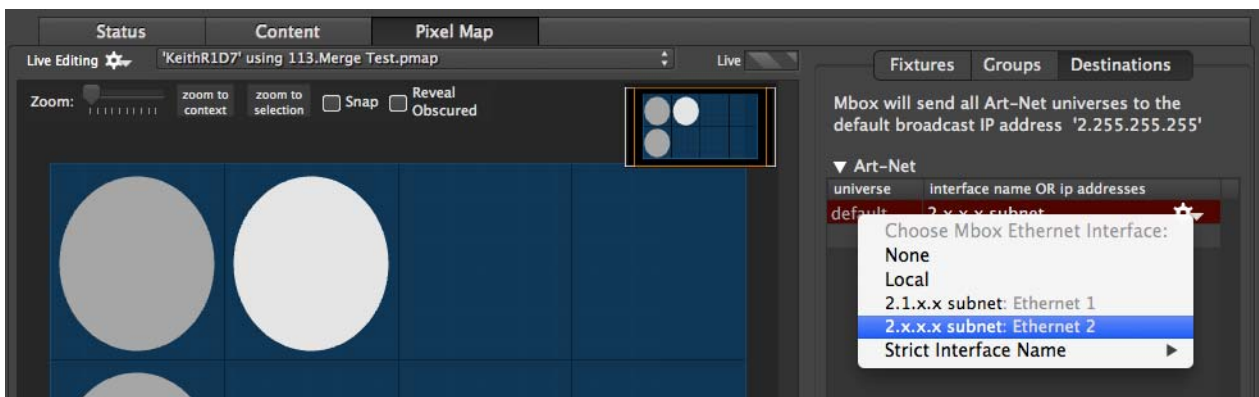
The above setups ensure that the computer can receive Art-Net on the first interface, and that it will also send pixel mapping output from the second interface. The key factors being the use of the correct IP address for the interface in question, and the "coordination" between the subnet mask of the 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. Networking For Mbox](#)" on page 119 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, but this is not recommended except in very simple configurations with only a few universes of data both in and out. And of course the IP address/subnet mask setup of the single interface must work for both input and output devices.

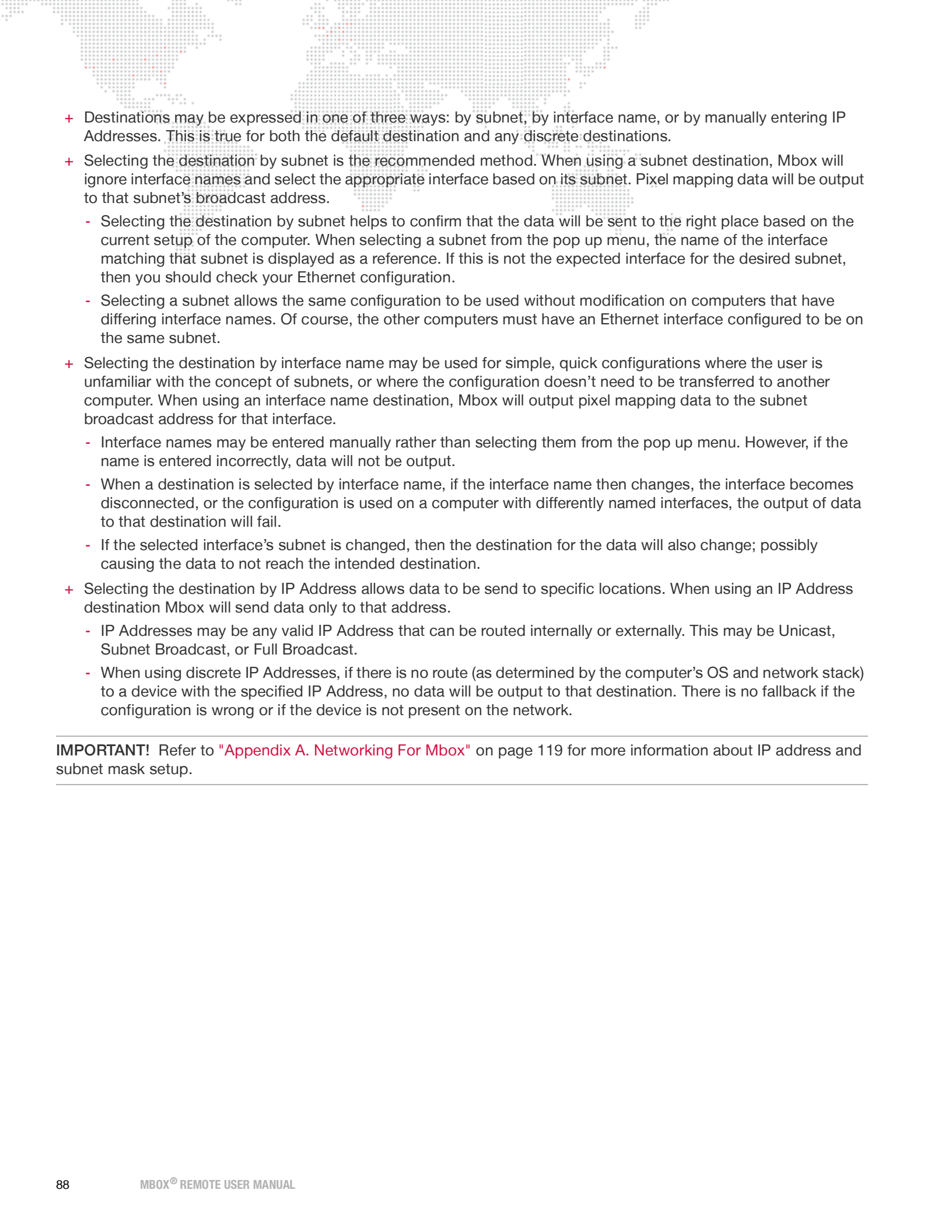
**CAUTION!** The pixel map level channel on the Master fixture masters the overall output levels generated when pixel mapping. If this channel is at a level of 0, then you will be outputting valid pixel mapping data, but all levels will be suppressed. In addition, the Master control channel can be used together with the 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 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 addresses.
- + You can disable the default entry for Art-Net and sACN 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.
- + 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.

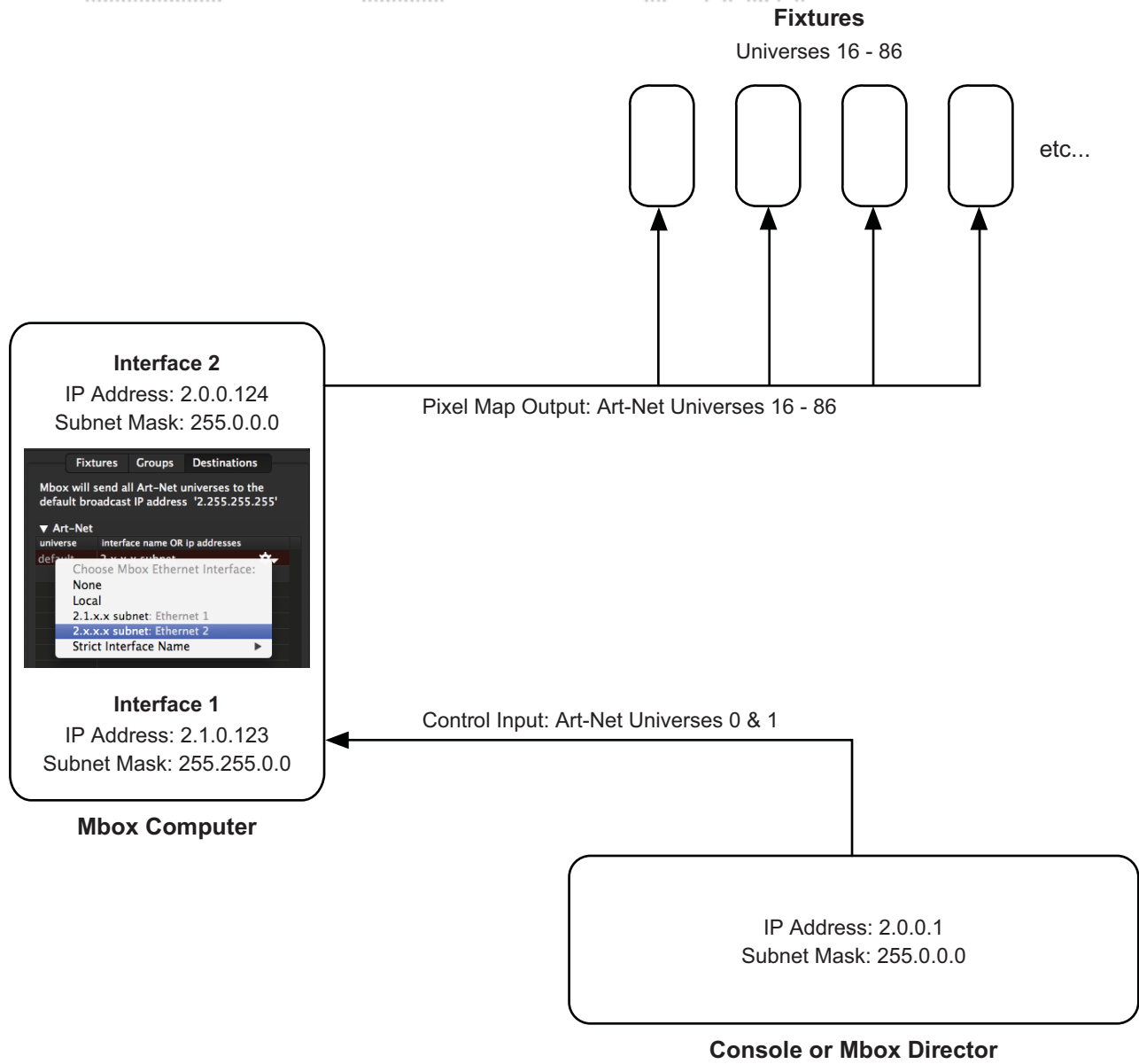
- 
- + Destinations may be expressed in one of three ways: by subnet, by interface name, or by manually entering IP Addresses. This is true for both the default destination and any discrete destinations.
  - + Selecting the destination by subnet is the recommended method. When using a subnet destination, 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 fallback if the configuration is wrong or if the device is not present on the network.

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**IMPORTANT!** Refer to "[Appendix A. Networking For Mbox](#)" on page 119 for more information about IP address and subnet mask setup.

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**Pixel Map Network Sources and Destinations example diagram:**



## Previsualization

A previsualized version of the pixel mapping output can be viewed within the Mbox application. The previsualization can be recalled from the computer's keyboard (using the F5 key) or via external control signal (using DMX values on the Master control channel parameter).

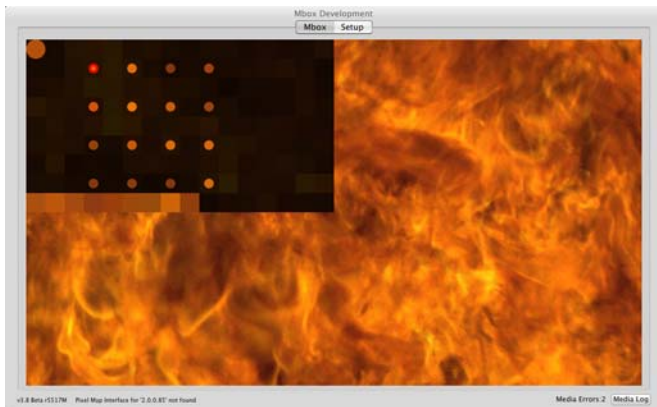
There are ten (10) discrete views. The first view is the combined overall previsualization, all contexts overlaid, with the highest numbered context on top. (Note that some contexts may be obscured.) Views 2 through 10 each show a single context with the corresponding number (Contexts 1-9).

In order to see the previsualization, the "Pixel Map Enable" checkbox on the Mbox Setup tab must be checked.

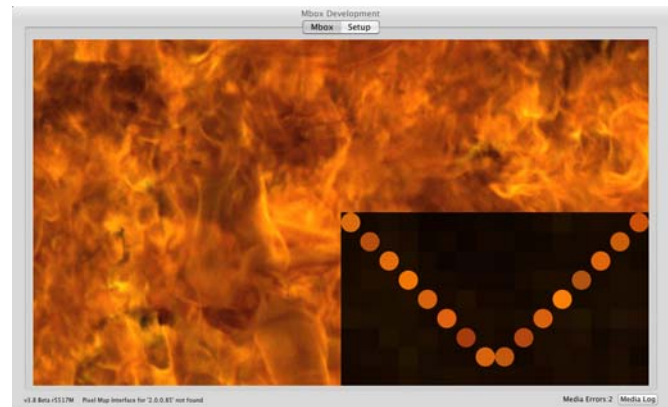
To recall the previsualization HUDs via the Master control channel, use DMX values 80-89 where 80 is the combined view and 81-89 are Contexts 1-9.

To recall the previsualization in the Mbox window, press [F5] on the computer keyboard while Mbox is in Fullscreen or Window mode. As [F5] is repeatedly pressed, the view will change.

Press once to see all contexts, a second time to see Context 1, a third time to see Context 2, and so on up to Context 9.

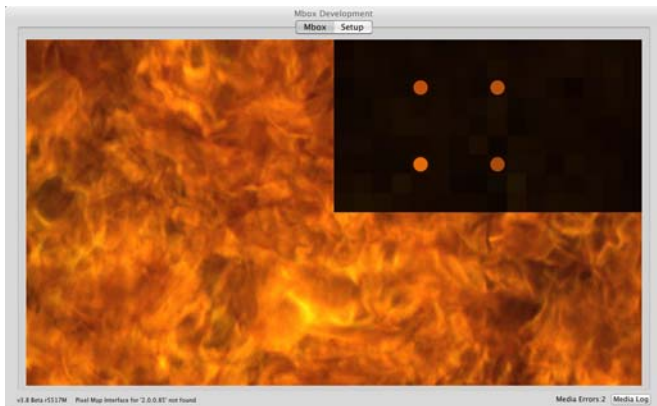


Context 1



Context 2

Indicates Pixel Map Source



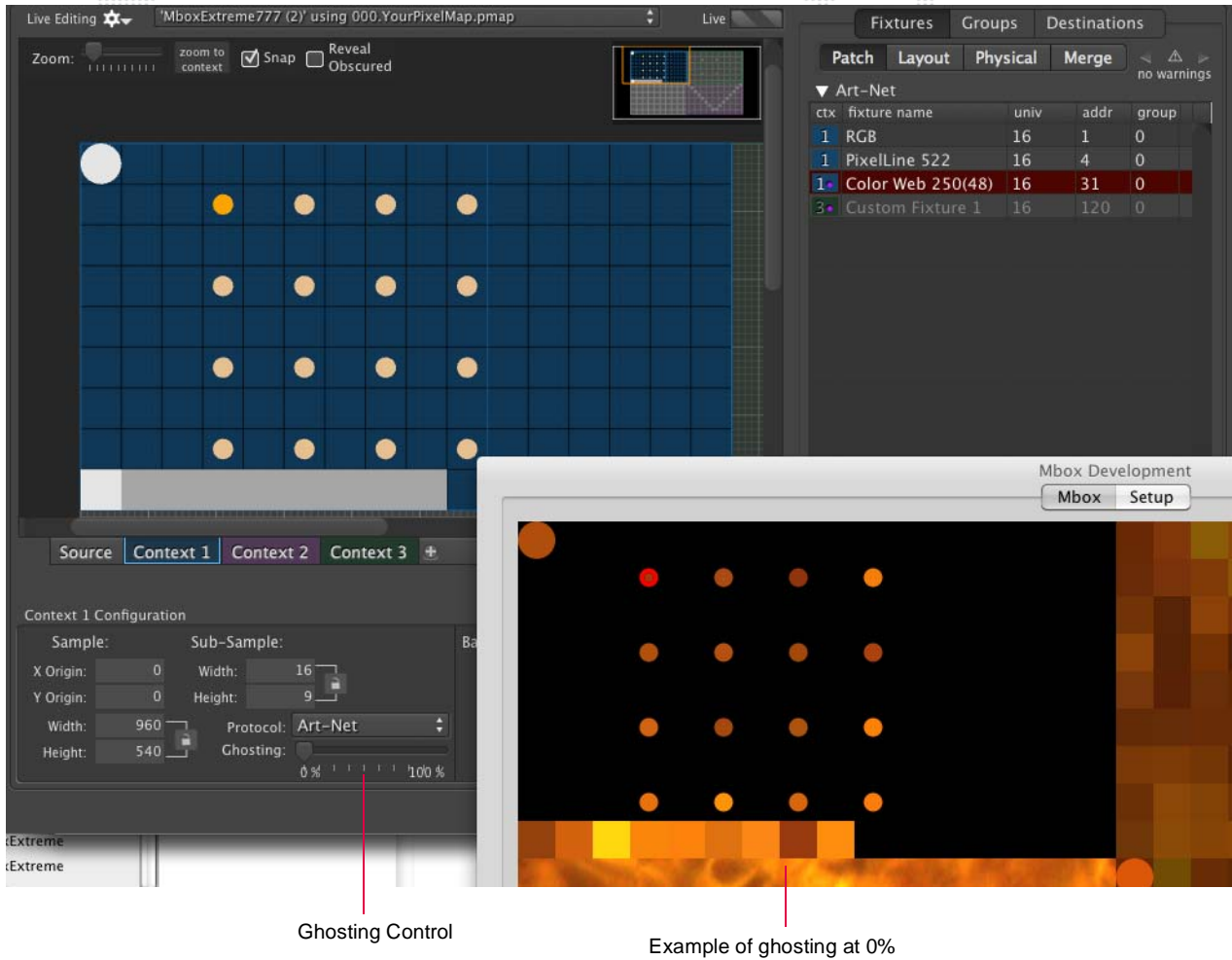
Context 3

To cycle through context views, press [F5] on the computer keyboard or use Master control channel DMX values 80-89.

**CAUTION!** Pressing [F5] affects the video output of the Mbox application (both the preview output and the stage outputs!), so if you are using one Mbox server for both pixel mapping and video output, you should not leave the view set to a pixel mapping previsualization when outputting video for your show.



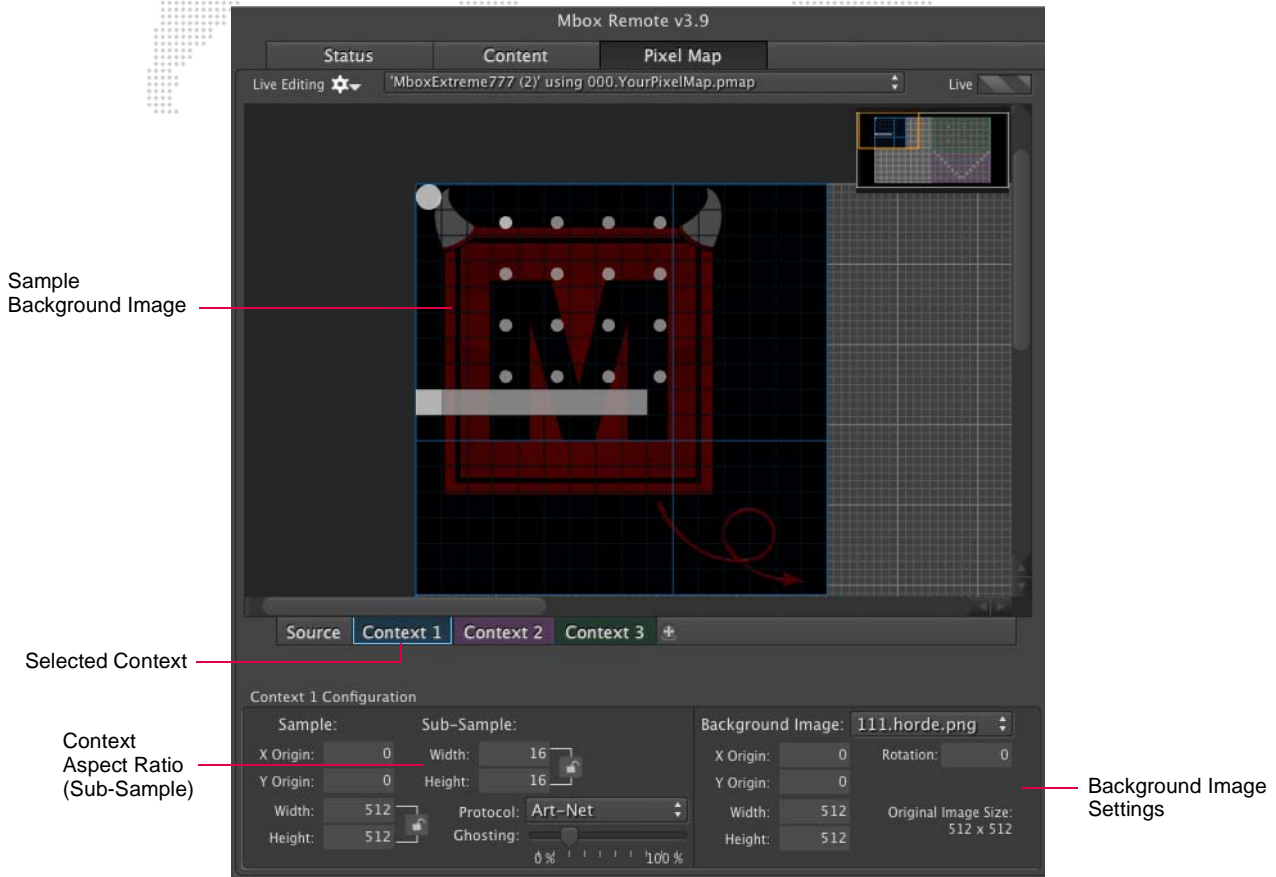
The DMX Ghosting control on each context can be used to adjust the visibility of patched fixtures on the context against the background of the sub-sampling for the context. The control defaults to 25%, at which point the context view will display the pixels of patched fixtures at full brightness and unused areas at a reduced intensity. This enables better visualization of the setup (both context sizing and fixture placement) without needing to connect the actual pixel mapping fixtures.



**Note:** Each context can have a background image which can be set and viewed in Mbox Remote. The background can be set to receive a live stream from Mbox. This essentially allows the placement of fixtures on top of a "previsualized" image of the output. Refer to "Background Image" on page 92.

## Background Image

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



### Still Image Backgrounds

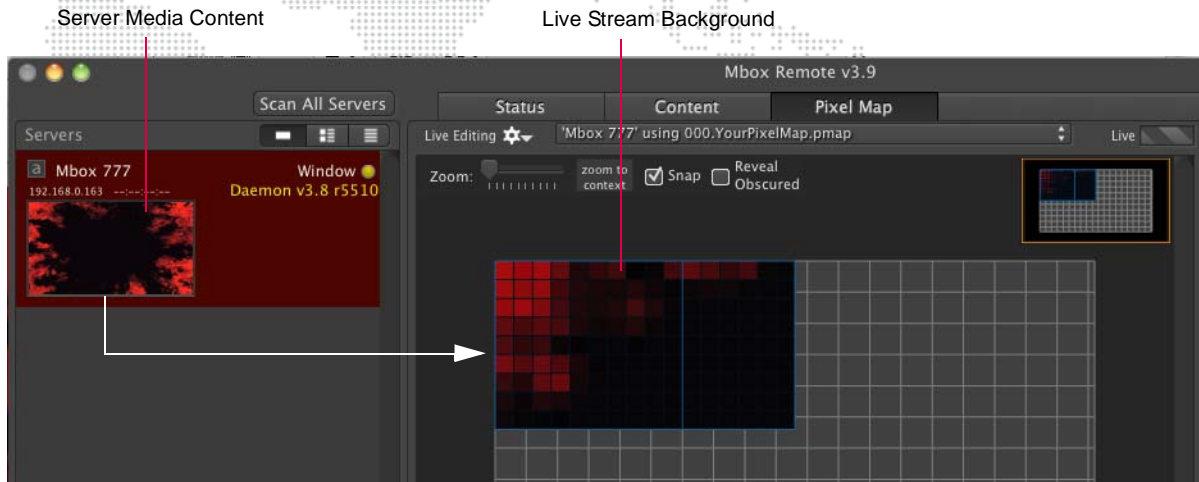
A still image must be in JPEG or a PNG format. A PNG can have an alpha channel (transparency). The image is imported and saved within the pixel map (.pmap) configuration file, so therefore it moves with the file - though it may increase the file size if numerous background images are used. (There is a pop-up menu option to remove unused image files if file size becomes an issue - see instructions below.)

The background image has an offset (x and y) so it can be placed in the correct position within the context. The origin, in this case, is the top-left corner. The image can be rotated by entering an arbitrary degree value in the Rotation field.

The background image has width and height settings to determine what gets squashed or stretched to fit onto the context. Therefore, if the aspect ratio of the image and the context do not match, the image will not be displayed at the correct aspect ratio unless some portion of it is clipped (or there is blank area with no background image). For best results, either the context needs to be the same aspect ratio as the background image, or the background image width and height need to be adjusted to correct the aspect ratio. For example, if a background image is 1280 x 1024 but the context is 16 x 9, the background height could be reduced to 720 (clipping), or the background width could be increased to 1820 (blank space).

### 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 55 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 (averaged samples) just as the context is a sub-sampled area of the source.

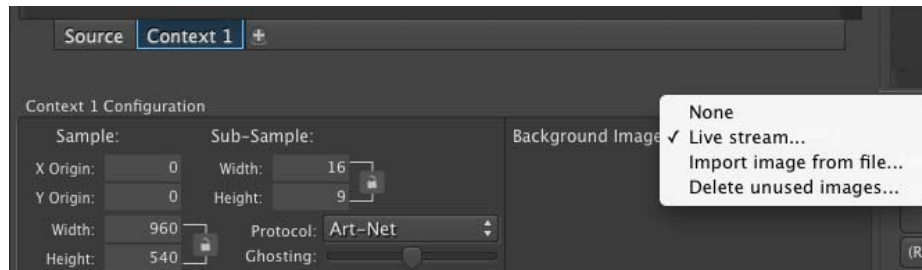


### Ghosting

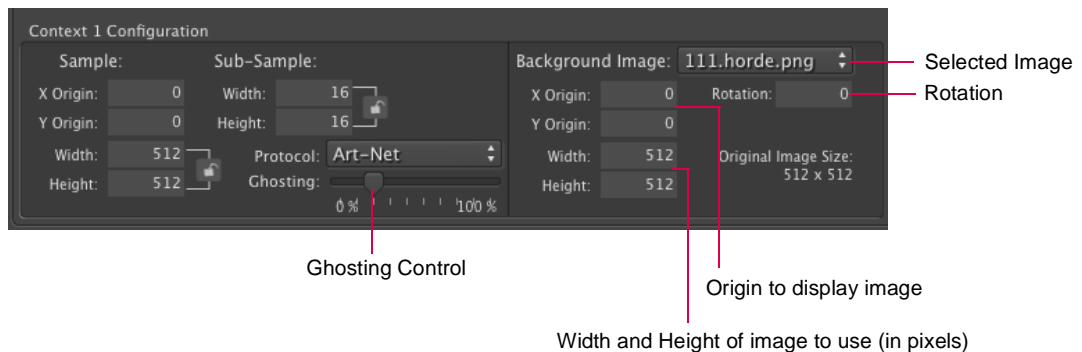
When using a background image, the ghosting level will adjust the brightness of patched fixtures against the background image. The ghosting level may need to be re-adjusted to give the desired level of brightness when using the pixel mapping HUDs in Mbox.

#### To set a background image:

- Step 1. At context, click on Background Image pop-up menu.
- Step 2. Select None, Live stream, or Import image from file...



- Step 3. Configure settings as required.



**Note:** When using Rotation, the background image is rotated around the X and Y origins. You will typically need to set the X Origin and Y Origin to negative numbers in order for the background image to be fully visible.

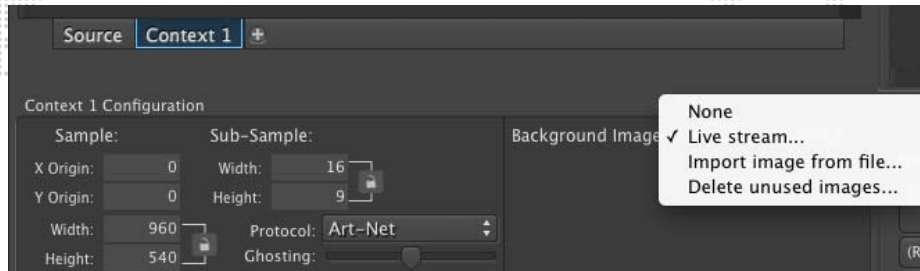
- Step 4. Adjust Ghosting level to change the brightness of patched fixtures against the background image.

### To delete unused images:

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

Step 1. At context, click on Background Image pop-up menu.

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



## Fixture Profiles

The fixture reference model used with Mbox pixel mapping allows for rapid global changes to all patched fixtures of one type. Mbox provides built-in fixture profiles, as well as the ability to create custom fixture profiles (see below). 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 base fixture information for data except for:

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

Changes to profile-level data will sweep to all fixture properties unless fixture overrides have been applied. These include level, mask, refresh, slew, and base pixel data (shape, type, pixfill). This data can be overridden on a per-fixture basis, along with parked pixels. These overrides may be cleared at anytime, 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 can have pixels, which generate varying output based on the color of screen pixels.
- + Custom fixtures can have up to 512 channels total.
- + Custom fixture 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 (see below).

Custom fixtures are created using the Create Fixture Profile window.

The screenshot shows the 'Create Fixture Profile' window with the following sections:

- Profile Level Properties (comes from profile):** Profile Name (Custom Fixture 1), Level (%) (100%), Mask (No), Refresh (30Hz), Slew (0 sec).
- Fixture Level Properties (applies to fixture or selected fixtures):** Custom Name, Group, Universe, Address, Rotation (0°), Re-Address Multiple Fixtures.
- Edit Pixel Data:** Total Channels (12), Fixture Width (5), Pixels per Row (2), Pixel Shape (Circular), Pixel Sequencing (Top-left, Linear, Horizontal), Pixel Type (RGB), Fixture Height (5), Pixels per Column (2), Pixel Fill (%) (75), Snap (checked), Generate Array button.
- Pixel Arrangement:** A 5x2 grid of pixels with four grey circles at the corners.
- Pixel Addressing and Park Info:** A table with columns 'addr', 'type', and 'park'. The table contains four rows: (1, RGB), (4, RGB), (7, RGB), (10, RGB).

Red arrows point from the labels below to the corresponding sections in the window:

- Profile-Level Properties (comes from profile)
- Fixture-Level Properties (applies to fixture or selected fixtures)
- Pixel Data (determines pixel arrangement)
- Pixel Arrangement (appears after Generate Array button is clicked)
- Pixel Addressing and Park Info

### Profile Level properties:

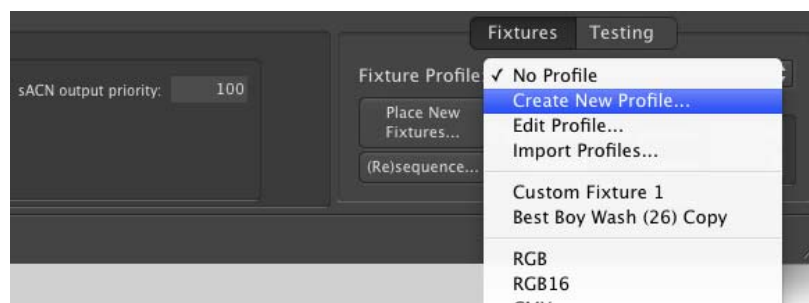
- + **Profile Name** - the profile name used by patched fixtures (for the referencing model). Note that this is not the same as the name of a patched fixture!
- + **Level** - overall level mastering. (This value can't be changed live, only by editing the fixture.)
- + **Mask** - property that allows 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 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. This number may be more than just the channels required for color control (for example, pan, tilt, and iris). 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 total channels required by the pixels in the fixture, the additional channels will have an output level of zero unless additional pixels are added (Parked Pixels or otherwise).
  - For example, if you select an RGB pixel that uses three channels per pixel, and then create a fixture that is 5 pixels per row and 3 pixels per column, the math would be  $(5 \times 3) \times 3 = 15 \times 3 = 45$ . So the total channels for this fixture needs to be 45 or higher.
  - 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, CMY, Luma.
- + **Fixture Width/Height** - the width and height of the fixture in context sub-rectangles.
- + **Pixels per Row/Column** - the number of horizontal and vertical pixels in the fixture. These numbers, together with the Fixture Width and Height, will determine the initial spacing of the pixels within the fixture's footprint.
- + **Pixel Shape** - circular or rectangular. The shape is viewable in the editor and the previsualization, but has no effect on actual output.
- + **Pixel Fill** - size of the pixels as a percentage of the size of the context sub-rectangle. This is viewable in the editor and the previsualization, but has no effect on actual 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.

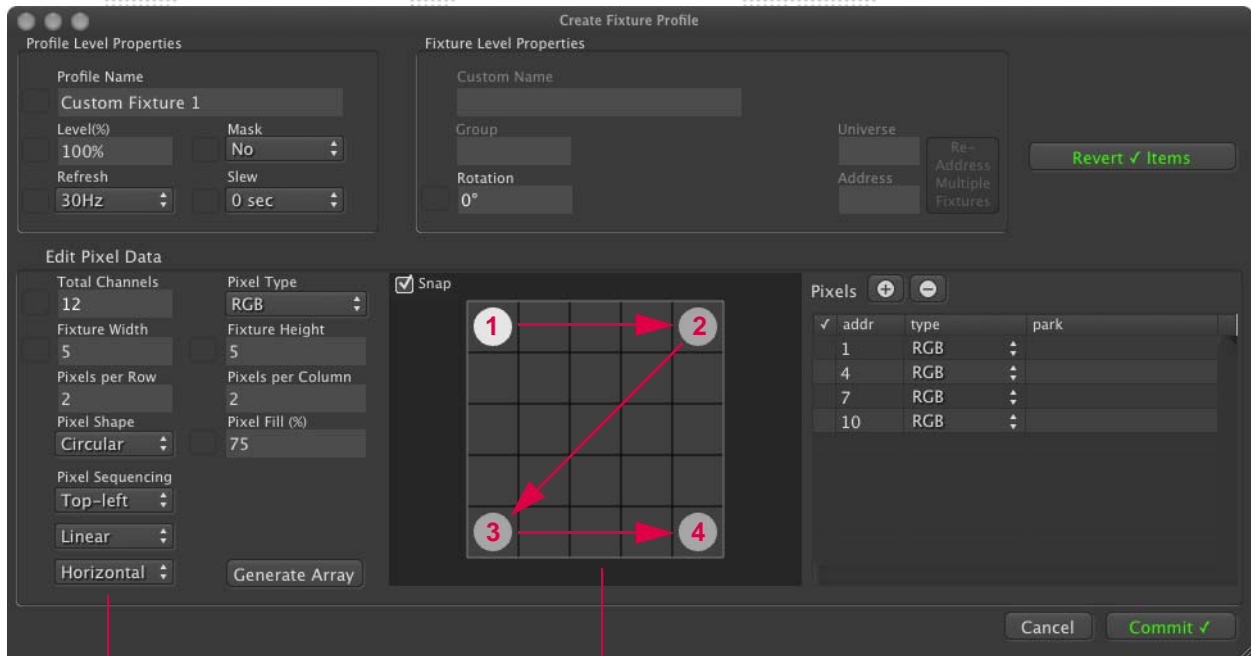
### To create a new fixture:

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



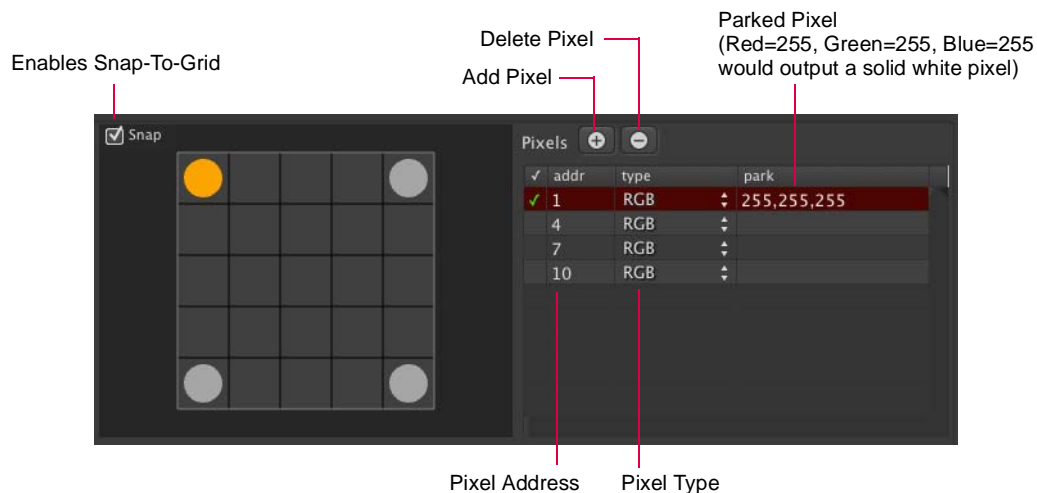
Step 2. At Create Fixture Profile window, enter necessary values/properties for the fixture profile. (Refer to the explanations and guidelines above.)

- Step 3. Enter necessary values/properties for the pixels in the fixture. (Refer to the explanations and guidelines above.) All active pixels must be of the same type to begin with, but can be changed in a later step (see below).
- Step 4. Click **Generate Array** button to create the initial arrangement of pixels.



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

- Step 5. Once the initial array has been created, various properties can be changed:
- Layout of the pixels (snap or arbitrary).
  - Pixel addressing within the profile's total channel count (address field).
  - Pixel types (using the type pop-up menu).
  - 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 98.)
  - Pixels can be removed by selecting a pixel and pressing the **[-]** button.

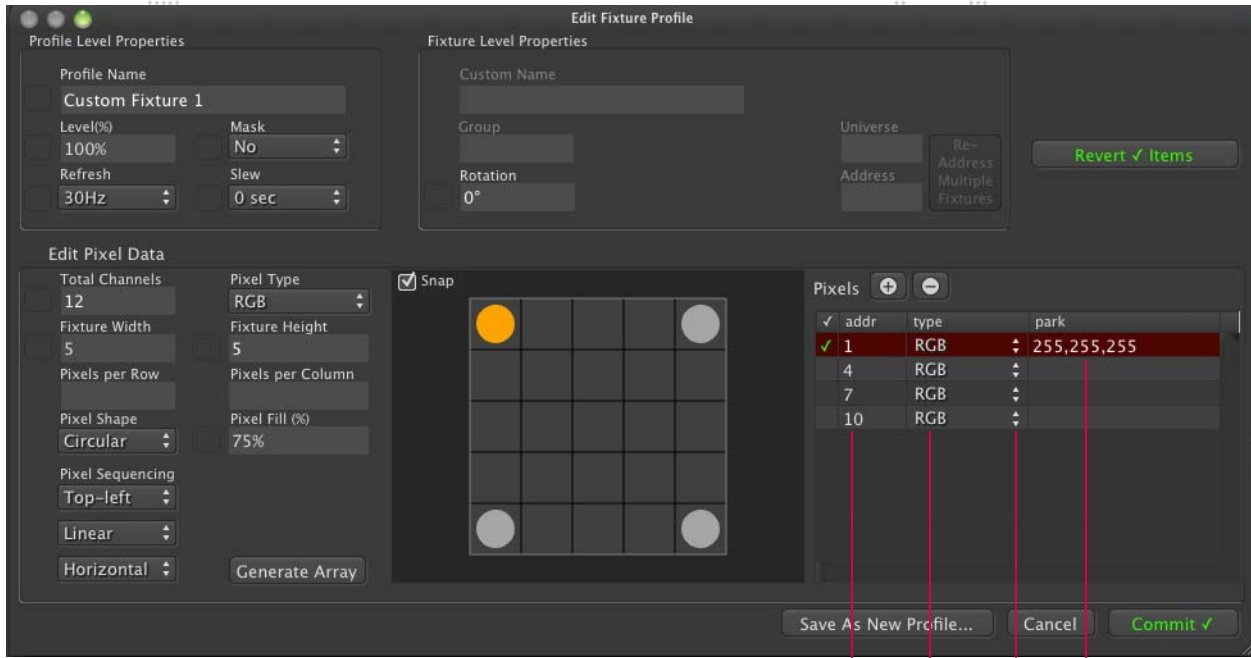


- Step 6. Press the **Commit** button to accept the entered info and create the profile.

## Parked Pixels

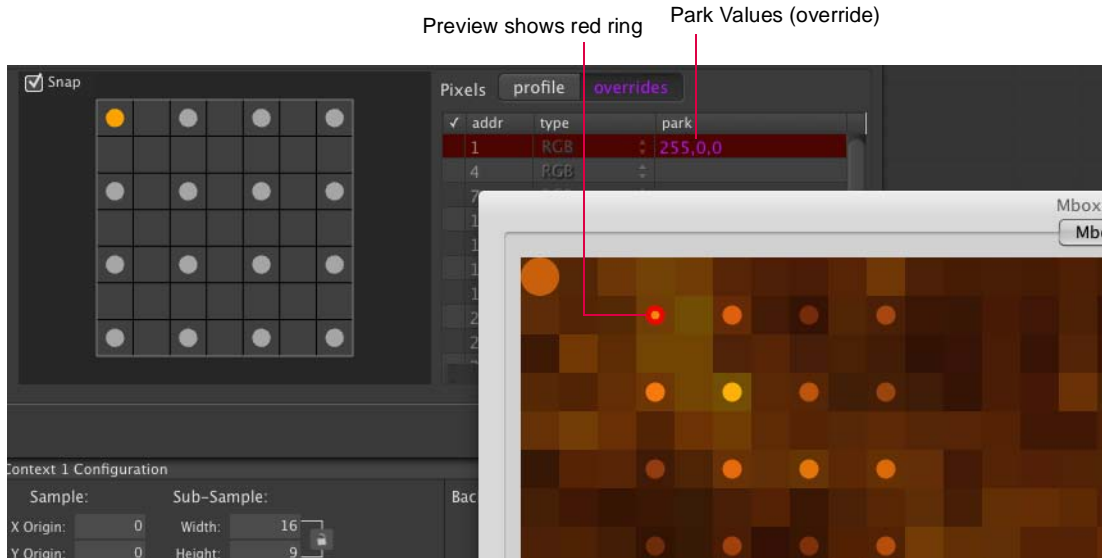
When editing a fixture or a profile, individual pixels included in the fixture can be "parked" at a specific (static) level so as to override the RGB data that would be taken from the source, or to provide output levels for additional channels that might otherwise sit at a level of 0. For example, setting static values for pan and tilt on moving light fixtures.

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



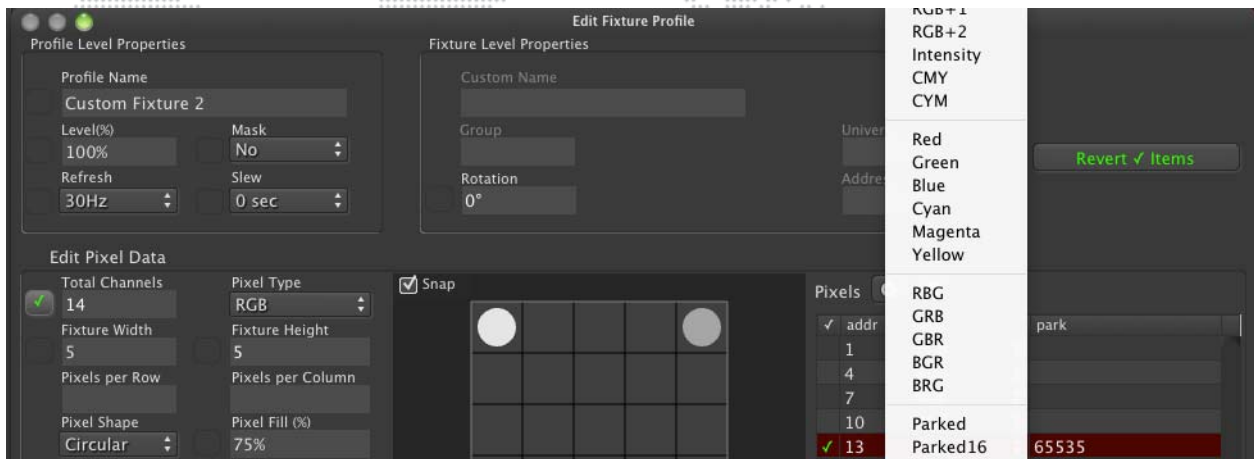
Pixel Address      Pixel Type      Park Values  
*Opens Type Popup*

The syntax of the park value depends on the type of pixel. For example: 255, 0, 0 where R=255, G=0, and B=0. In this case, the red value (255) would be represented by a red circle around the pixel in the previsualization view as shown below. If the values are an override, they will be displayed in magenta text. If they are not an override, they will be displayed in white text. (Refer to "[Previsualization](#)" on page 90 for more information about the preview feature.)





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



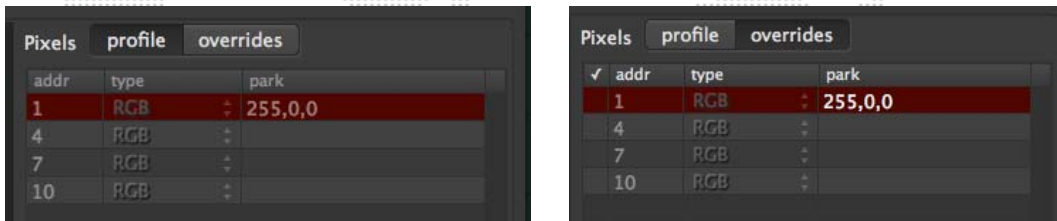
### Park Syntax Guidelines:

- + If multiple values are expressed in one line they must be separated by commas.
- + 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, CYM, BGR, etc. The color is always expressed in RGB order, and therefore, Mbox will re-order the values appropriately.
- + RGBW = R,G,B color ordering as three 8-bit values. (e.g., 127,255,0). The white color component is automatically derived from the RGB levels for the pixel.
- + RGB16 = **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). This would be the same for CMY16 and CYM16. As with 8-bit RGB, the color is always expressed in RGB order, and therefore, Mbox will re-order the values appropriately.
- + Luma = **I** as single 8-bit value (e.g., 127) or as three 8-bit values (e.g., 100,255,45 -> as an RGB color) from which a CIE luma calculation will be made.
- + Luma16 = **I** as a single 8-bit value (e.g., 223), which is used to create a 16-bit output value, or as a single 16-bit value (e.g., 21537), or as three 8-bit values (e.g., 89,127,123 -> an RGB color) from which a CIE luma calculation will be made.
  - If you use a single 8-bit or 16-bit number, then that number will be used/converted as the MSB in the output. The LSB will be sent out as 0.
  - If you use three 8-bit numbers, then the luma calculation will result in both MSB and LSB values.
- + Single Pixels (R, G, or B, etc.) = 8-bit value (e.g., 123)
- + Parked Pixel = 8-bit value (e.g., 255)
- + Parked16 Pixel = two 8-bit values, or one 16-bit value (e.g., 127,127 or 32767)
- + Incorrect syntax means the override is ignored/not applied.
- + If one 16-bit number is used, then all values are assumed to be 16-bit; even if they are less than 256.

### Parked pixels in the previsualization:

- + 8-bit or 16-bit pixels with override values may appear in the previsualization with the parked color shown as a ring around the pixel.
  - The colored ring will only appear if the override uses three values - expressed as RGB.
  - The colored ring always shows the RGB color of the override, even if the pixel is not RGB.
- + Single-channel color pixels with overrides do not show a parked color ring.
- + Luma and Luma16 pixels with overrides do not show a parked color ring.
- + Parked and Parked16 pixels do not show up in the previsualization, therefore, will not show a parked color ring.

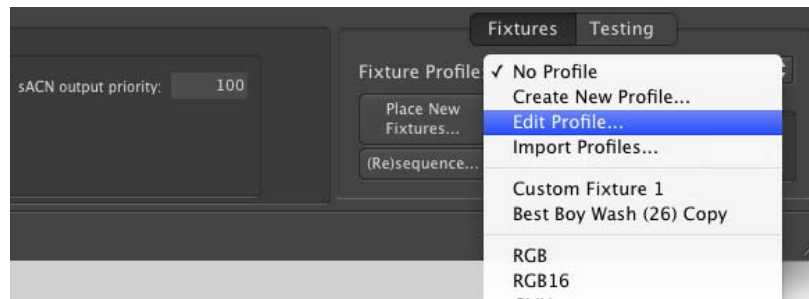
In the fixture editor, if a fixture profile has pixels with parked values the parked values will be displayed on the profile tab - in grey to show they are not editable there. They can also be seen on the overrides tab - where they will be white if not overridden or magenta if overridden.



## Editing Fixture Profiles

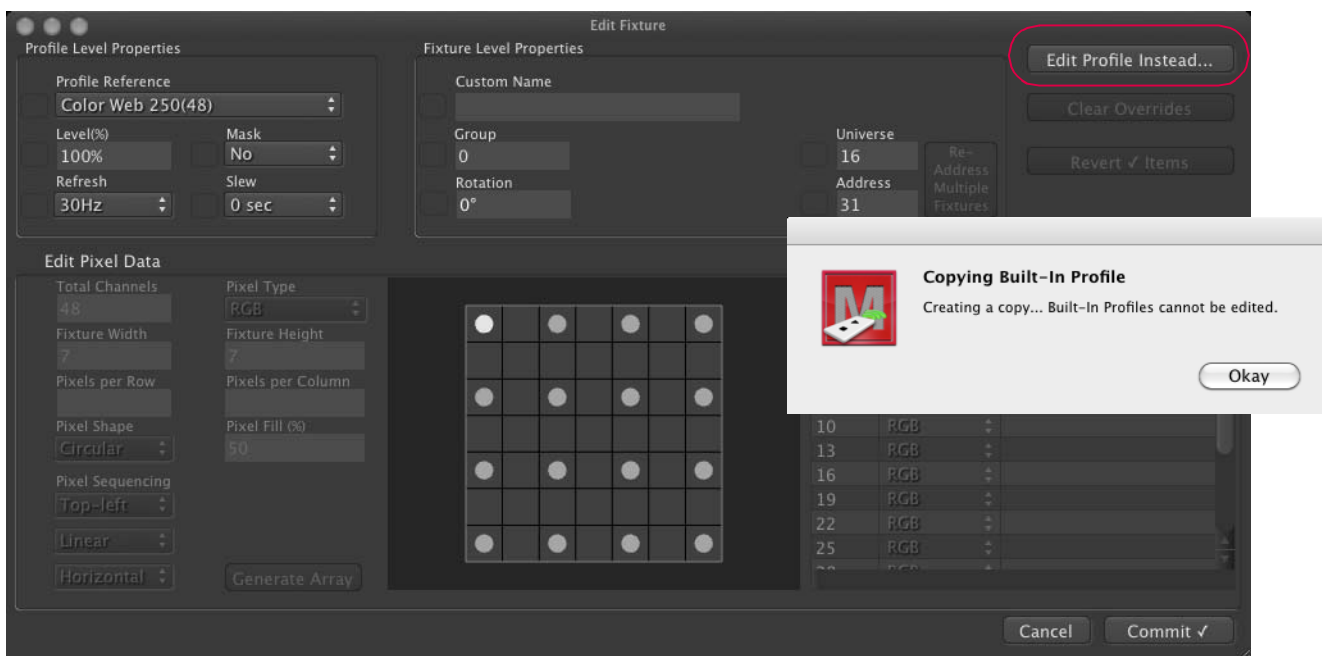
Custom fixture profiles can be edited at anytime after they have been created. Built-in fixture profiles are not directly editable, however, a copy can be made of any of the built-in profiles which can then be edited. There are two ways to begin editing these profiles:

- 1) At Fixture Profile menu, select **Edit Profile...**, then select the profile from the pop-up in the window.

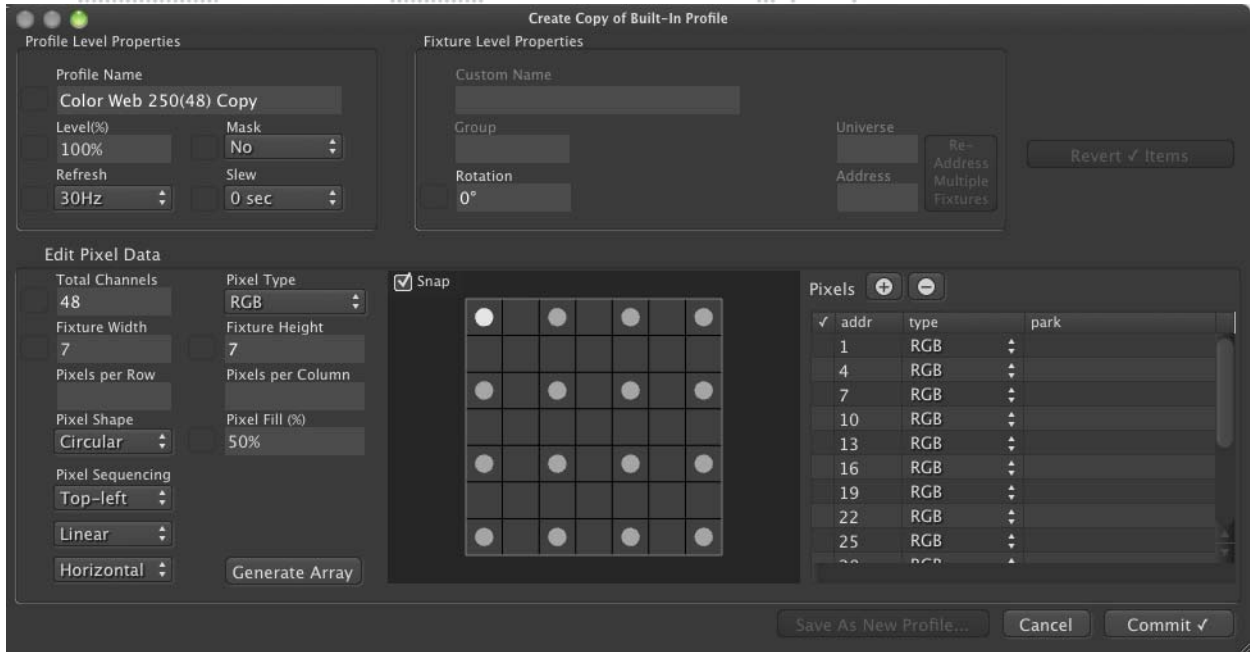


- 2) Double-click on a patched fixture to open the Edit Fixture window, and then click on the **Edit Profile Instead...** button.

If you try to edit a built-in profile you will see a warning message 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.)

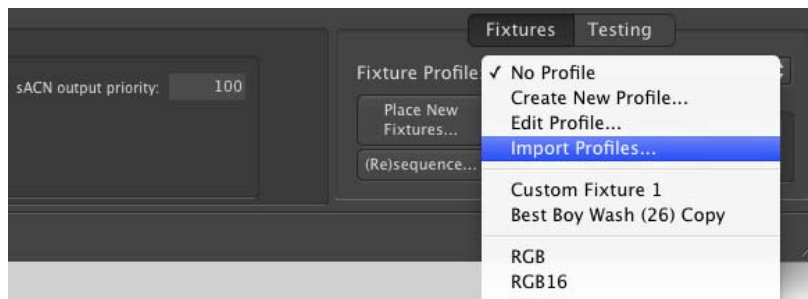


## Importing Profiles

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. At Fixture Profile menu, select **Import Profiles...**



Step 2. At dialogue screen, select configuration file containing profiles to import.

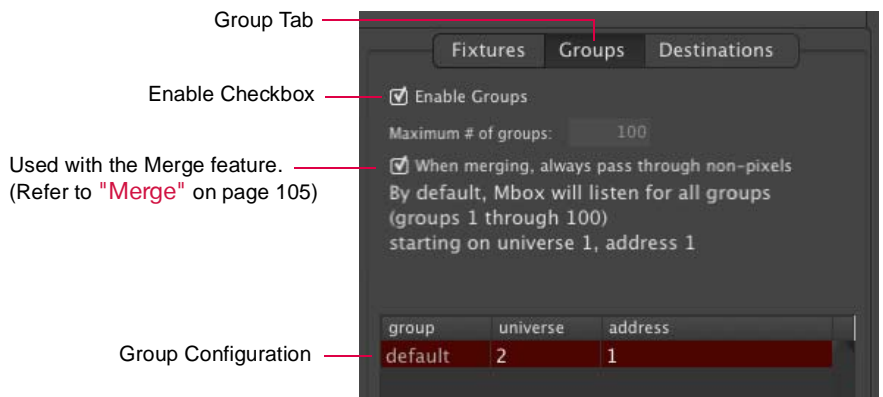
Step 3. Click **Open**.

## Groups

The Groups feature provides an additional input universe for added 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 a 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 105.)

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 start universe and address. Group controls will not be split across universes, allowing for a maximum of 102 Groups per universe (510 channels). Each group uses five 8-bit channels for control of Mode, Intensity Master, Red/Cyan, Green/Magenta, and Blue/Yellow.

**Table 1: Group Universe Map**

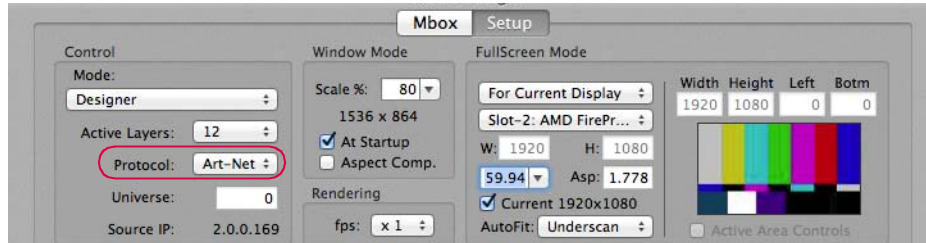
Channel:	1	2	3	4	5
Group 1:	M	I	R/C	G/M	B/Y
Channel:	6	7	8	9	10
Group 2:	M	I	R/C	G/M	B/Y
Channel:	11	12	13	14	15
Group 3:	M	I	R/C	G/M	B/Y
<i>etc.</i>	...	...	...	...	...
Channel:	496	497	498	499	500
Group 100:	M	I	R/C	G/M	B/Y

M = Mode, I = Intensity Master, R/C = Red/Cyan, G/M = Green/Magenta, B/Y = Blue/Yellow

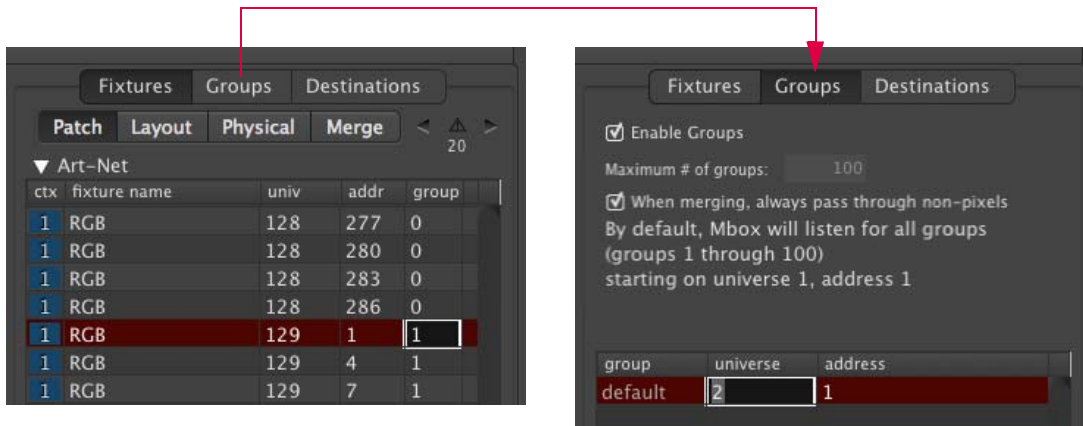
The Intensity Master is inhibitive.

The color channels work no matter if the fixture is RGB or CMY, however, the fixture on the lighting console should be 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.

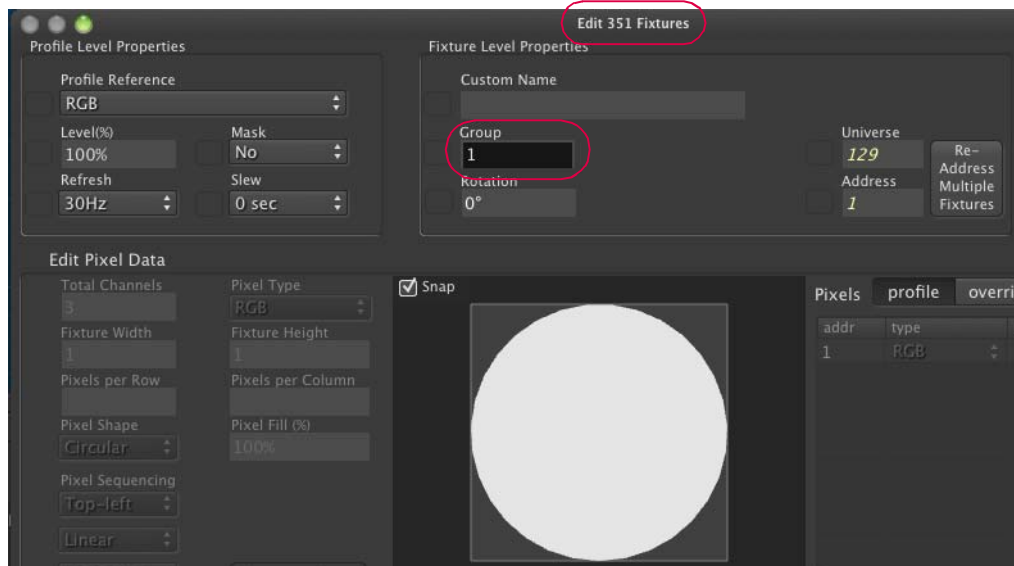
The protocol used to control the groups must be the same as the protocol selected for control of Mbox. (As set in the Mbox Setup window.)



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 and to configure the universe setting.



Fixtures may also be assigned to groups using the Edit Fixtures window. This is useful when adding numerous fixtures to a group. (Refer to "Editing Fixture Properties" on page 82 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 105 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 + RGB Master -> Group controls affect Mbox data.	Merge data is ignored.
2	Group Intensity + RGB Replace -> Group RGB levels replace Mbox data (with Intensity mastering of replacement levels).	Merge data is ignored.
3	Merge Replace + Group Intensity + RGB 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 + RGB Master -> Group controls affect Merge data.	Mbox data is 'multiplied' by the merge data.
5	Merge/Mbox crossfade + RGB Master -> Group RGB levels affect Mbox data.	Group Intensity control is used to crossfade between the merge data and the modified Mbox data.
6	Group RGB/Mbox Crossfade -> Group RGB 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 + RGB 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 + RGB 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. *	<i>See notes in 1-8 above.</i>
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 just 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. An HTP merge allows the source with the 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 you have one source already sitting at a level you can never reduce that level further. Meaning that unless you have total control over both sources, you don't really have

full control over what value will be exerted. Therefore, in general, the use one of HTP modes with CMY fixtures is not recommended. But if they are used, group control mode

- + 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. So if the Mbox data is at 100% and the incoming merge data is at 50%, then the result is  $100 \times 50\% = 50\%$ . Similarly, if the Mbox data is at 75% and the merge data is at 33%, then you end up with  $75 \times 33\% = 25\%$ .

## 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 Setup 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 102.

Group controls (listed on page 104) 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 crossfaded 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 - e.g. GRB, etc.), CMY/CYM, R, G, B, C, M, Y, Luma, and Maximum pixels, 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.

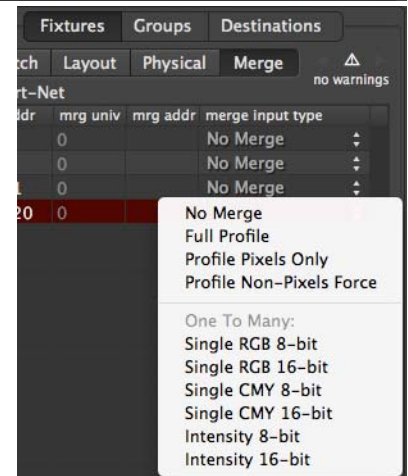
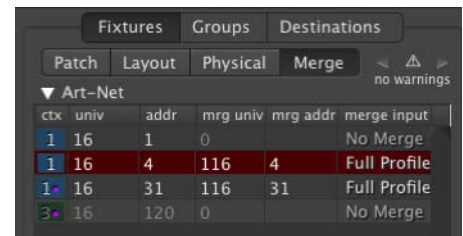
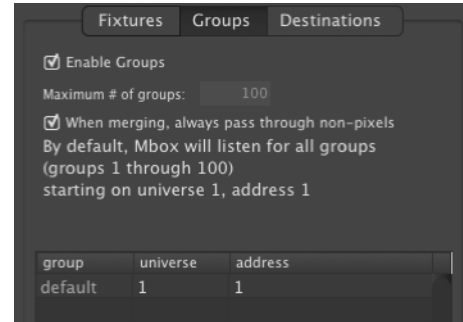
ctx	univ	addr	mrg univ	mrg addr	merge input
1	16	1	0		No Merge
1	16	4	116	4	Full Profile
1	16	31	116	31	Full Profile
3	16	120	0		No Merge

group	universe	address
default	1	1

**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, create and configure a context and place some pixel mapping fixtures using methods described earlier in this manual.
- Step 2. At Fixtures > Patch tab, patch fixtures to desired output universe and address.
- Step 3. At Groups tab, assign a group number (1-100) to the fixtures that you want to be able to merge with external data. (The general idea is to group fixtures that would always share the same control or merge state.)
- Step 4. At 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 you don't want to be affected by Mbox, just passed through all the time 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. Intensity 8-bit - every luma pixel on this fixture will output the same intensity, using one channel of merge data (e.g. 255 = white). Similarly, all color pixels on this fixture will output that same intensity value for each of their color values.

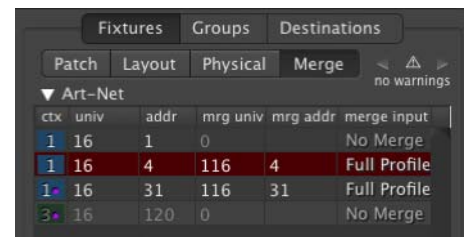




- g. Intensity 16-bit - every luma pixel on this fixture will output the same intensity, using two channels of merge data (e.g. 255,255 = white). Similarly, all color pixels on this fixture will output that same intensity value for each of their color values.
- h. Full Profile - Color and luma (intensity) 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 (intensity) 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 (intensity) 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. *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 84 for more information.)

Step 9. Mbox Remote 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 111 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 there are no pixel mapping groups set to a mode that uses the merge). 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 you test 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, and Blue 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 RGB mastering) and confirm that you can modify the corresponding intensity and RGB output levels for all fixtures in that group. Repeat with other groups as necessary.
  - d. Set one group's mode channel to mode 3 (Merge Replace with Intensity and RGB 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 RGB mastering using the group controls. Repeat with other groups as necessary.
- Step 4. If the test provides the correct result, select the desired mode to obtain the desired merge result for your specific situation. 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 104 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 fixture 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 same color/intensity to every 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 you select depends on how you want to treat parked pixels and unpatched channels in the fixture.
  - "Full Profile" allows you to affect all the color and luma pixels on the fixture and pass merge data through on unpatched channels. However, parked pixels will be unaffected by any merge data.
  - "Profile Pixels Only" allows you to affect only the color and luma pixels. 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 you to affect all the color and luma pixels on the fixture, pass merge data through on unpatched channels, and parked pixel levels will be overridden by merge data.
- + The single RGB/CMY/Intensity merge types may not work as desired if you have 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 you can opt to have the pan and tilt fixed (use a parked pixel) or controlled separately by a console (use merge data passed through).
- + Using the Pixel Mapping merge will 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 Destinations are set up correctly.
- + The Pixel Mapping pre-vis HUD (F5) in Mbox does not show any aspect of a.) Group control levels, b.) incoming merge data, or c.) the affect of Group controls and/or merge data on the final pixel mapping output of Mbox. The HUD continues to show only the raw color values from the sub-sampling done on the Mbox output.

## 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 or similar) you don't need to have a very complex merge setup. Each fixture in your patch will have a unique output universe and address. You can assign each fixture its own unique merge universe and address, allowing the merge to control every fixture independently. Alternately you can give multiple fixtures 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 you can use either the "Single RGB 8-bit" or "Full Profile" merge types.
- 2) Setup with RGB LED fixtures having more than one pixel each:
  - In this situation you need to decide if you want the merge source to control the entire fixture as one unit (all pixels the same color) or if you want to have independent control over each pixel in the fixture. In the case of the former you could use the "Single RGB 8-bit" merge type for the fixtures. In the case of the latter you would need to use the "Full Profile" merge type for the fixtures.
- 3) Setup with LED fixtures having RGB plus other colors (e.g., white or amber pixels):
  - The color output of Mbox is limited to RGB and RGB's inverse, CMY. There isn't a standard way to convert an RGB color to RGBW or RGBA, and each LED fixture manufacturer uses different methods when they do this.



The simplest solution 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. You will need to use either the "Full Profile" or "Profile Non-Pixels Force" merge type.

4) Setup with fixtures having additional parameters that you want to control (e.g., moving lights):

- Because Mbox can only generate color data for pixel mapping output, and because moving lights have additional parameters, you need a way to control the additional parameters. In situations like this, you must create a fixture profile that includes either parked pixels or unpatched channels for the additional parameters.
- With parked pixels you can set the additional parameters to fixed values. Useful for locking things like pan and tilt or the dimmer. If you use parked pixels in your profile and want to override them with merge data, you must use the "Profile Non-Pixels Force" merge type, 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 to have a usable value (albeit fixed).
- If you leave 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 you will need to provide merge data all the time for fixture parameters that need to be at a level above 0.
- You can combine parked pixels and unpatched channels if you like, but keep in mind that if you want to override the parked pixel values you have to use the "Profile Non-Pixels Force" merge type no matter what.

## 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.

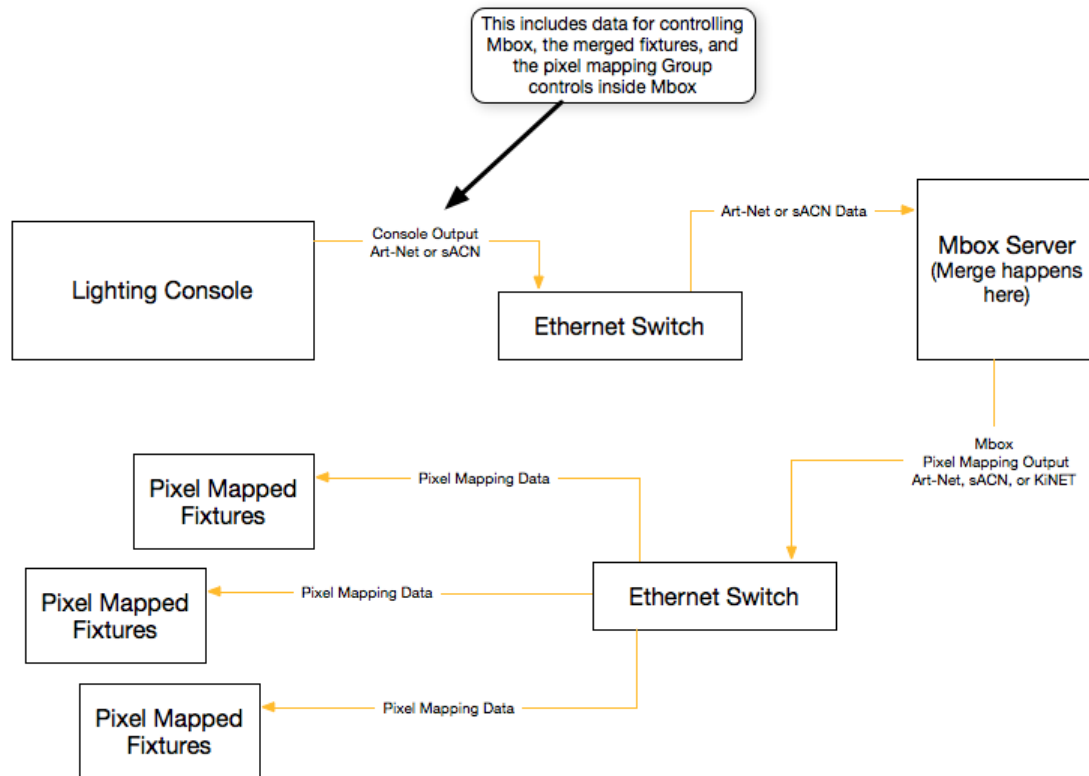


Figure 1: Example Merge Hardware I/O Diagram 1

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.

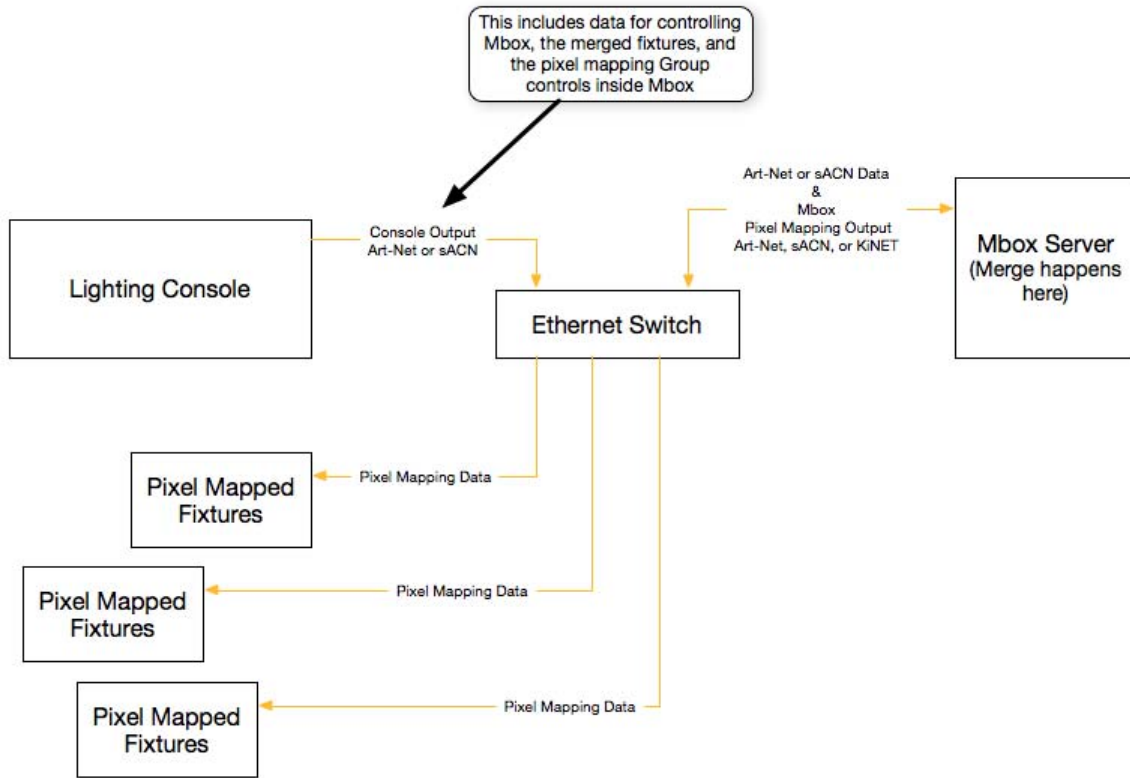
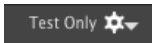


Figure 2: Example Merge Hardware I/O Diagram 2

## Testing

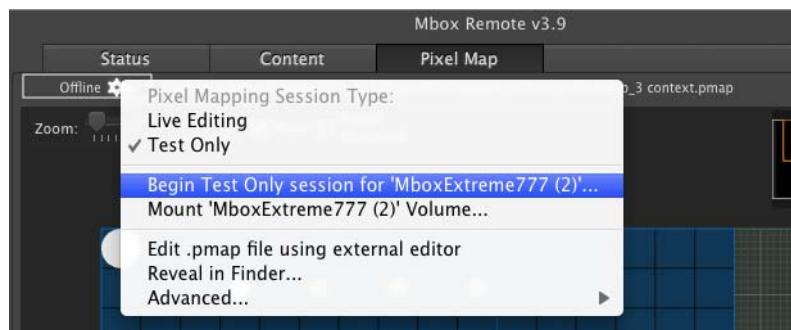
The Testing feature provides a way to easily locate and test fixtures in order to verify the correct pixel mapping configuration. During testing, selected fixtures can be highlighted statically or flashed between highlight and lowlight states. (This testing functionality mimics highlight/lowlight functionality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

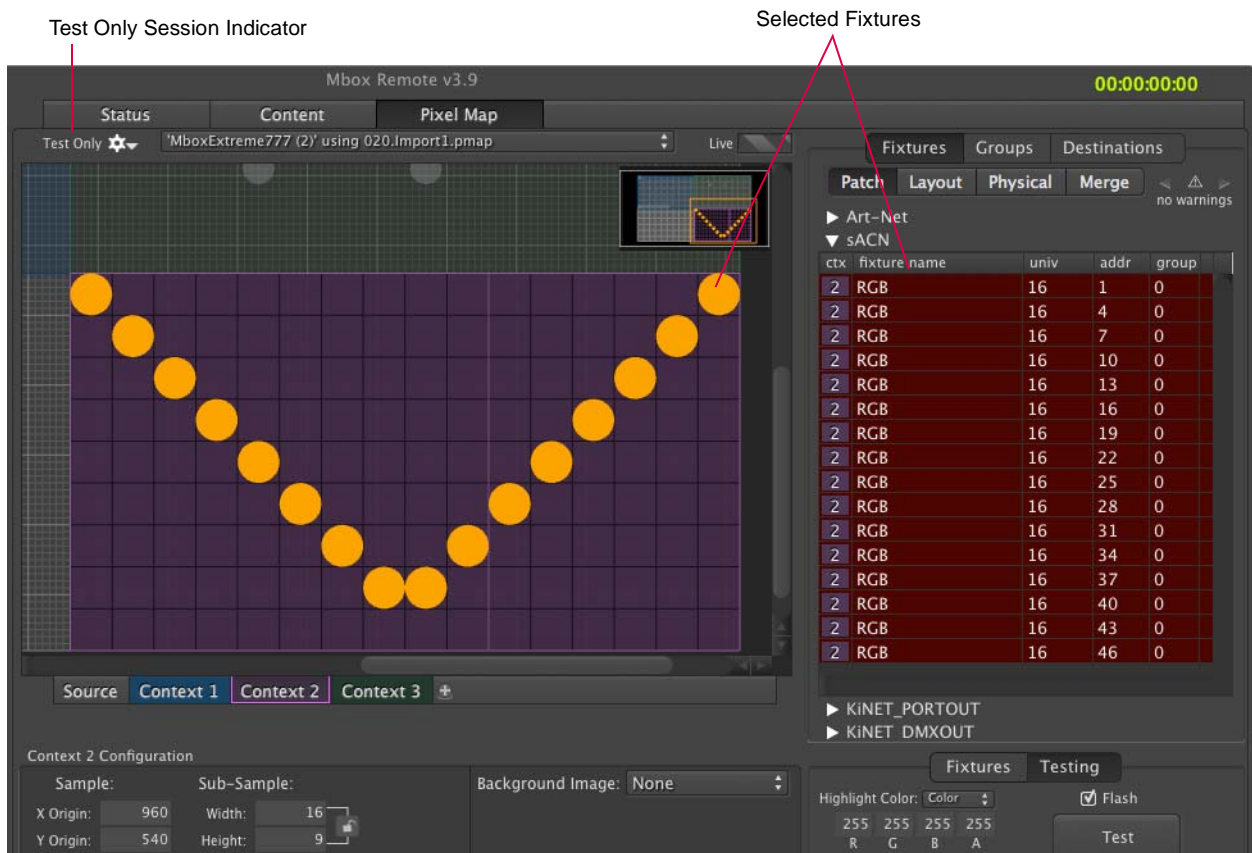


### To test fixtures:

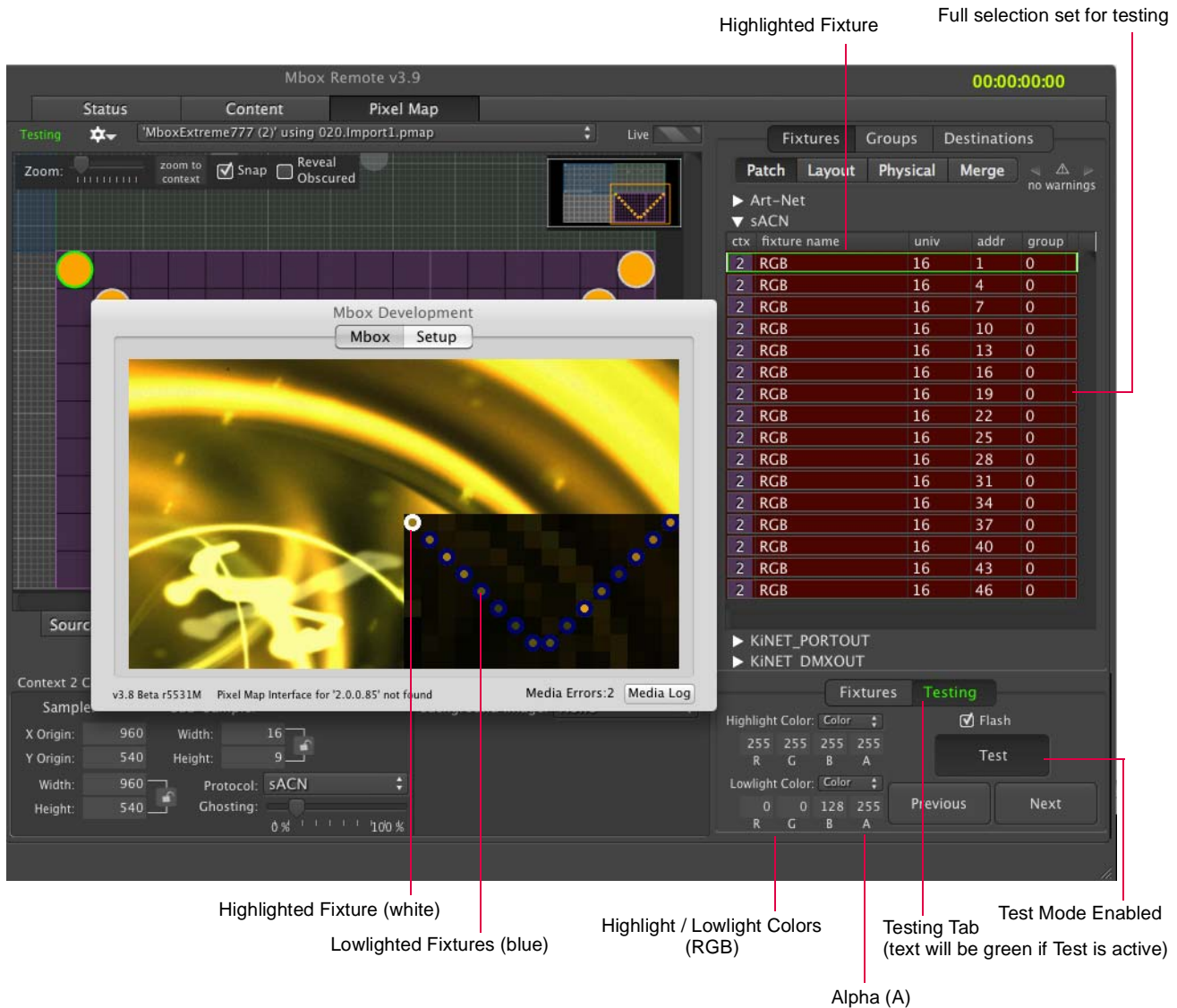
- Step 1. At Servers list, select required server.
- Step 2. Click gear icon and select **Begin Test Only session for...** The pixel mapping configuration will now be locked from changes.



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



- Step 4. At bottom right of window, select **Testing** tab then click **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. (The rings around the fixtures represent the actual values sent to the fixtures.)
- If multiple fixtures are selected, click **Previous** and **Next** buttons to cycle through the selection set. One fixture at a time will be highlighted.
  - Use the Flash checkbox to enable/disable flashing.
  - To change highlight/lowlight color scheme, enter custom RGB values.
- Step 6. Click **Test** button again to exit Testing mode.

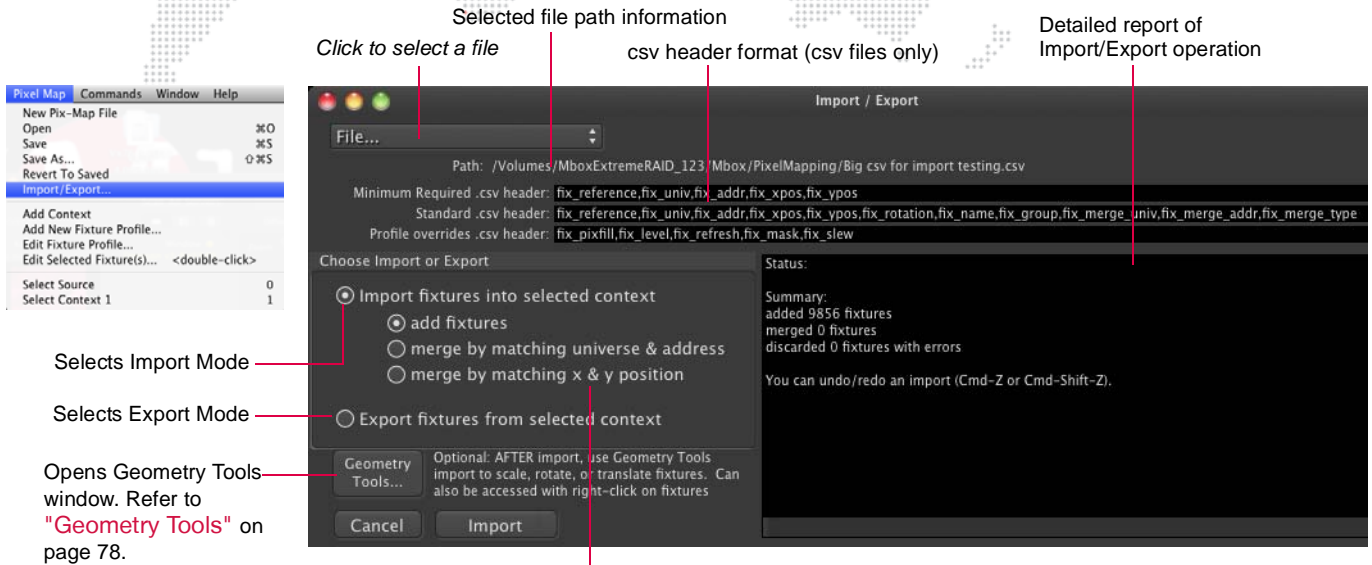


- + **RGB** - The highlight and lowlight colors are configurable with 8-bit RGB values.
- + **A (Alpha)** - The only two correct options for the field are 255 or 0. If the value is 255, the color (highlight or lowlight) will be completely opaque. If the value is 0, then the color values are ignored and 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 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

## 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).

Mbox also supports the import of .plist files created by prior versions of Mbox. 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 data can also be imported and exported in comma separated values (.csv) format. This functionality allows large or complex pixel mapping configurations to be quickly created from automatically generated data.

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 data in text and spreadsheet formats:

```

fix_reference,fix_univ,fix_addr,fix_xpos,fix_ypos
RGB,1,1,222,639
RGB,1,4,225,641
RGB,1,7,228,641
RGB,1,10,232,641
RGB,1,13,235,639
    
```

	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

**Note:** The csv import/export tool is intended for the creation of large or complex pixel mapping configurations from automatically generated data. Beyond a certain point it can be quicker to create a script to convert some other data into position and patch information, and save that in a csv format rather than attempting to place and patch the same fixtures individually using Mbox Remote.

The 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:*

- + 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 or one fixture'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 fixture data in the following lines. The import window notes what the header should include and shows the correct order, spelling, and formatting. For example:

Minimum Required .csv header: `fix_reference,fix_univ,fix_addr,fix_xpos,fix_ypos`

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

If a wrong name is detected during the import process, Mbox Remote will display an error such as the one below:

```
Status:
First line contains unrecognized fixture key 'fix_refarence'
Cannot import file.

Cannot import file.
Required fixture keys missing:
fix_reference
```

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

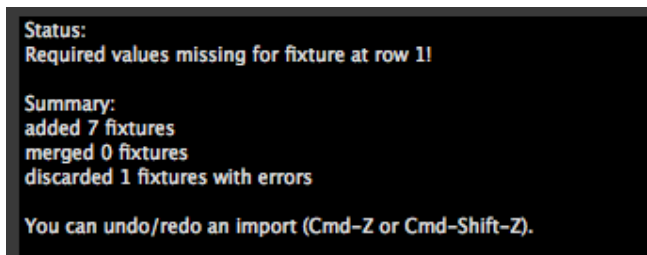
- fix\_pixfill - float (0.0-1.0) equivalent to 0-100%
- fix\_level - float (0.0-1.0) equivalent to 0-100%
- fix\_refresh - integer (1-30)
- fix\_mask - integer (0 or 1) 0 = off, 1 = on
- fix\_slew - integer (0-255)
  - 0 = 0 seconds
  - 1 = 8 seconds
  - 2 = 4 seconds
  - 4 = 2 seconds
  - 8 = 1 second
  - 11 = 0.75 seconds
  - 16 = 0.5 seconds
  - 32 = 0.25 seconds
  - 85 = 0.1 second

---


**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 will be ignored and an error such as the one below will be displayed:



- + 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

- + Each line must end in a standard line feed/carriage return.
- + The csv file will use the fixture reference model, and therefore, fixture profiles with names that match 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 101.)
- + 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).

## APPENDIX A. NETWORKING FOR MBOX

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### Concepts

The majority of communications to and from Mbox use Ethernet protocols. This means 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 are 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 far more useful if each network interface on the computer is configured for and connected to a separate physical Ethernet network - or, if connected to the same physical network, then with a system of VLANs enabled to 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 use 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 may be used to connect the computer to a physical network.
- + **Network** - a group of devices physically 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 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, you need to look at it together with the interface's IP address. If an octet in the subnet 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.

	<u>Network</u>		<u>Unique ID</u>	
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".

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**Note:** You can't have a /32 subnet mask, as the last octet in an interface's IP address must be used as a unique identifier.

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## 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:	192.	168.	0.	123
Mask:	255.	255.	0.	0
Subnet B'cast 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 you can use a /8 subnet mask (255.0.0.0) with Mbox. When you use 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.

For example, you can have two interfaces set up with IP addresses of 2.0.0.1 and 2.1.0.1 where 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 ports 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 port 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 port 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 2 or 10 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 a port 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 it 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 and therefore the address for each group is preset as well. With its registering as a member of all of the necessary groups (for transmitting or receiving), Mbox will not be able to send or receive sACN packets. For the purposes of receiving multicast data, it is possible to have all the interfaces on a computer join a multicast group. 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. Also, the Mbox computer must still have a port that is on the same subnet as the receiving device.





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**Production Resource Group, LLC**  
**Dallas Office**  
**8617 Ambassador Row, Suite 120**  
**Dallas, Texas 75247**  
**[www.prg.com](http://www.prg.com)**