



# BATTLESPACE VISUALIZATION AND INTERACTION (BVI) FLOOR PROJECTION

Setup and Calibration Instructions

MAR 2023


[DIVISION/UNIT] | [RANK] [FIRSTNAME LASTNAME], [GROUP]

# OBJECTIVES



1. Overview of the BVI Floor Projection system
2. Install and setup the BVI Floor Projection system
3. Calibrate the BVI Floor Projection system
4. Startup Floor Projection setup

# BVI FLOOR PROJECTION OVERVIEW



- BVI Floor Projection evolved from the BVI Sand Table
- Battlespace visualization tool used to help plan military exercises and analyze AAR
- Low-cost COTS system
- Using multiple projectors and ScalableDesktop software, enables projector blending to cancel out shadows when people are briefing on the floor
- Large floor space to accommodate larger audience than a 7ft sand table
- Can be extended using AR/VR technology (HTC Vive and Microsoft Hololens)





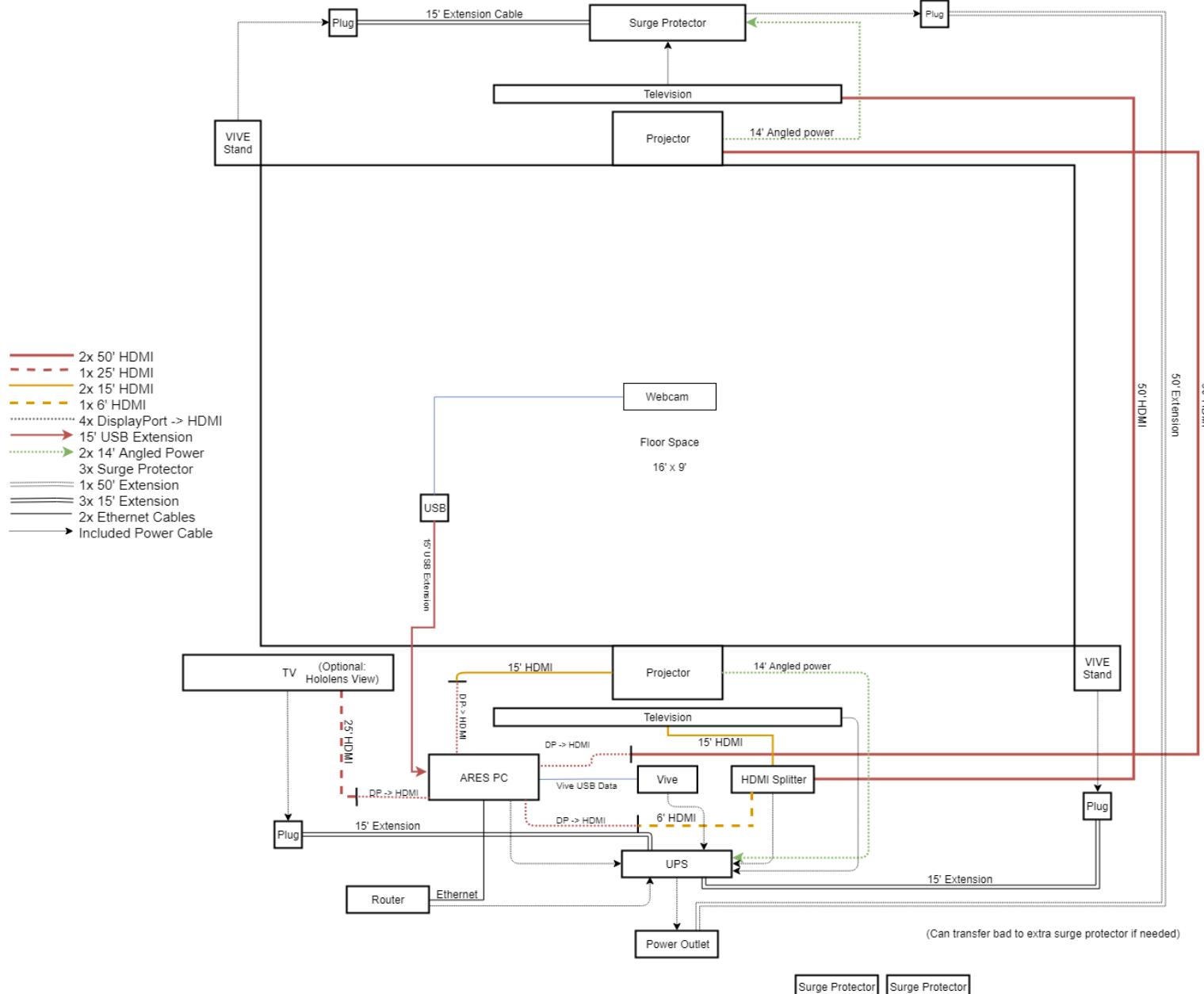
# Floor Projection Installation

## PRE-SETUP CHECKS



- Ensure all items from the BVI Floor Projection Handoff sheet are accounted for
- Verify install location space and power requirements are met
  - Minimum floor area of 20'x15'
  - Minimum ceiling height clearance of 8'4"
  - At least 1 20A power outlet within 10-15 feet of setup
- Assemble hardware according to the following Hardware System Diagram

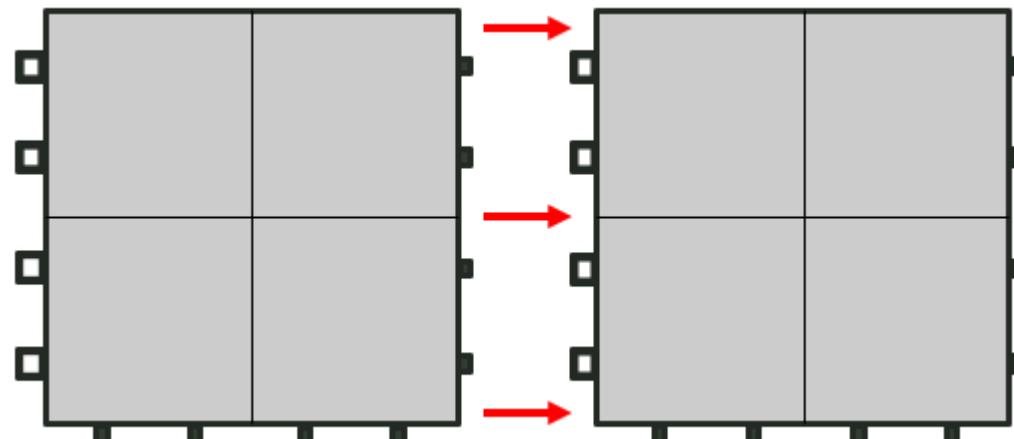
# HARDWARE SYSTEM DIAGRAM



# FLOOR SPACE SETUP



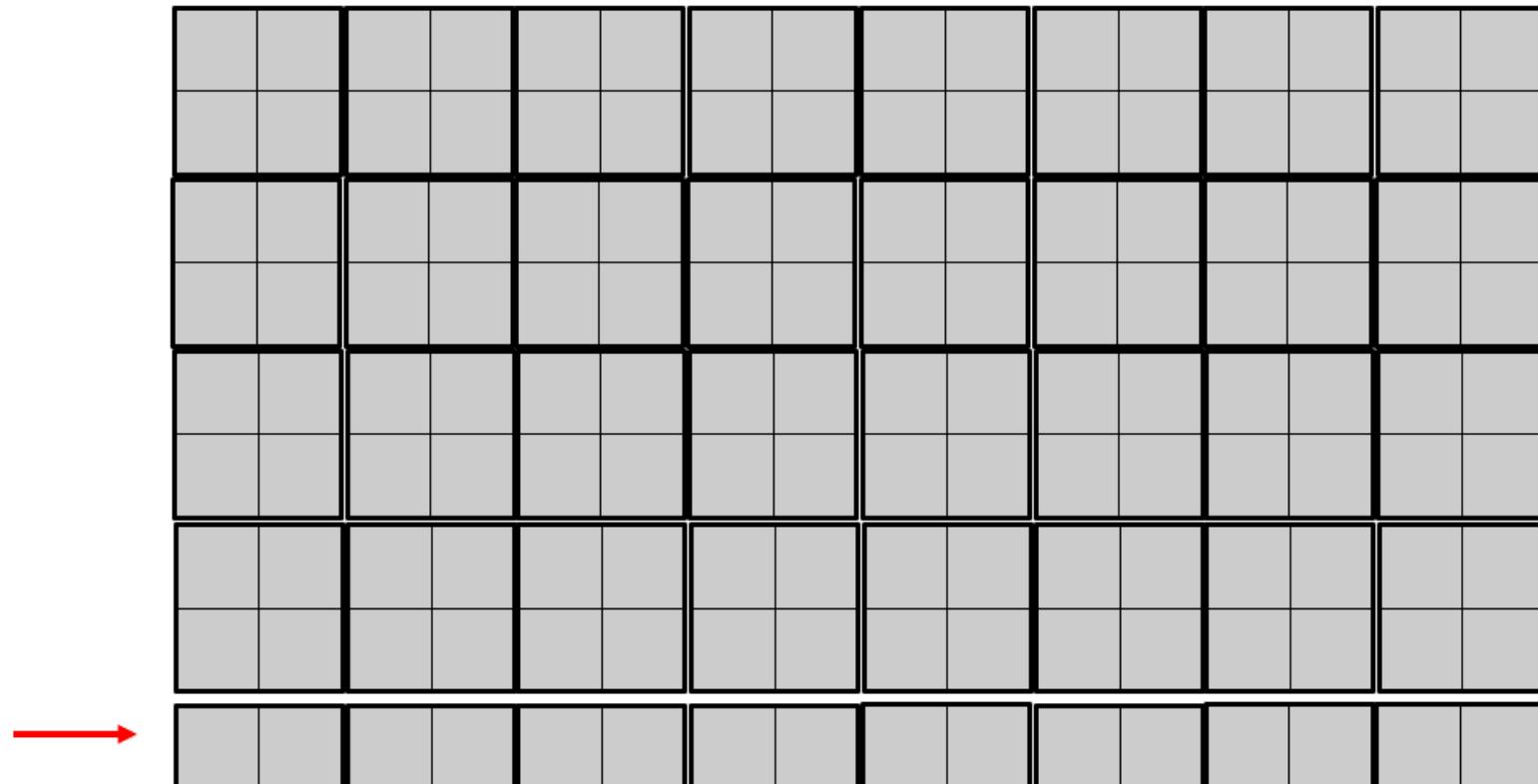
- Assemble the white floor tiles in sections of 4 (4 1'x1' pieces assembled in a square)
- Attach 8 sections of 4 side-by-side to achieve the 16' length requirement
- Create 4 rows of these to achieve 8' in width
- Overlap one edge of a tile section over the edge of another and snap them together (small teeth on one edge snap into the open grooves on the other)



# FLOOR SPACE SETUP (CONT.)



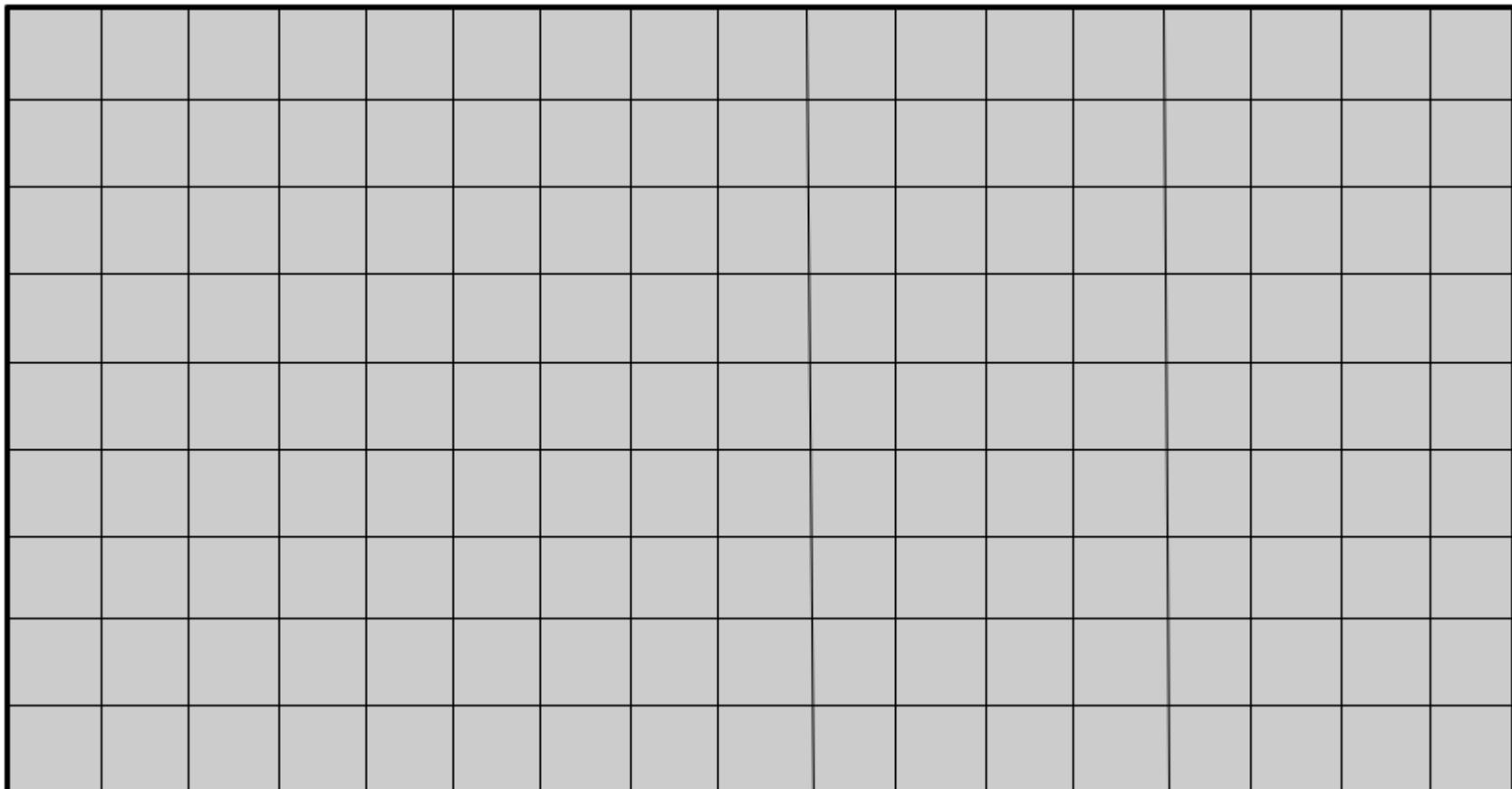
Create 1 row of 16 1'x1' tiles at the end to reach the 9' width requirement



## FLOOR SPACE SETUP (CONT.)



Repeat the tile snapping process until the floor tiles reach a total size of 16' x 9' as shown below



# TV STAND SETUP



- Assemble the 2 TV Stands (3 if using a third TV for Hololens) according to the assembly instructions packaged in the box
- Attach the 4 wheels to the base of the TV Stand using the provided hardware



## TV STAND SETUP (CONT.)



- Attach the main TV stand central beams to the base
- Extend each of the TV stand inner poles from outer poles and raise them to maximum height, securing them in place using a single hex screw as shown below



## TV STAND SETUP (CONT.)



- Slide the 2 TV mount fixture arms onto each pole and secure them using a single hex screw



## TV STAND SETUP (CONT.)



- Use a single Hex screw to secure the camera shelf pole to the top of the extended TV stand pole



# TV MOUNT ASSEMBLY



- Locate the appropriate screws from the mounting hardware to mount the two brackets on the back of the TV using the TV Vesa mount holes.

*Note: TV models may contain varying size VESA mount holes. Locate the size of screw appropriate for the holes*



## TV MOUNT ASSEMBLY (CONT.)



- Use the spacers included in the mounting hardware if needed
- Lift the TV and align the top 2 Hex screws on the top TV bracket with the holes on the TV mount arms on the TV stand
- Secure the bottom bracket with 2 more hex screws



# PROJECTOR MOUNTING - PROJECTOR MOUNTS ARE PRE-ASSEMBLED



- Attach the projector to the projector mount on the camera shelf
- Slide the camera shelf arm with the projector over the top of the extended TV stand pole and make sure it is positioned at the maximum height
- Tighten the camera shelf arm in place using the small lever

# PROJECTOR MOUNTING - PROJECTOR MOUNTS ARE NOT PRE-ASSEMBLED



- Proceed to the next slide if the projector mounts are not yet attached to the projectors or if the camera shelves do not already have the mounts attached
- If the projector mounts are already assembled on the projectors and camera shelves, proceed to [slide 31](#).

# CAMERA SHELF MODIFICATION



- To properly attach the projectors onto the TV stand camera shelves, 2 new holes will need to be created
- Expose the screw on the joint of the camera shelf closest to the tray by removing the plastic covers shown below
- Use an appropriately sized Allen wrench to remove the screw



## CAMERA SHELF MODIFICATION (CONT.)



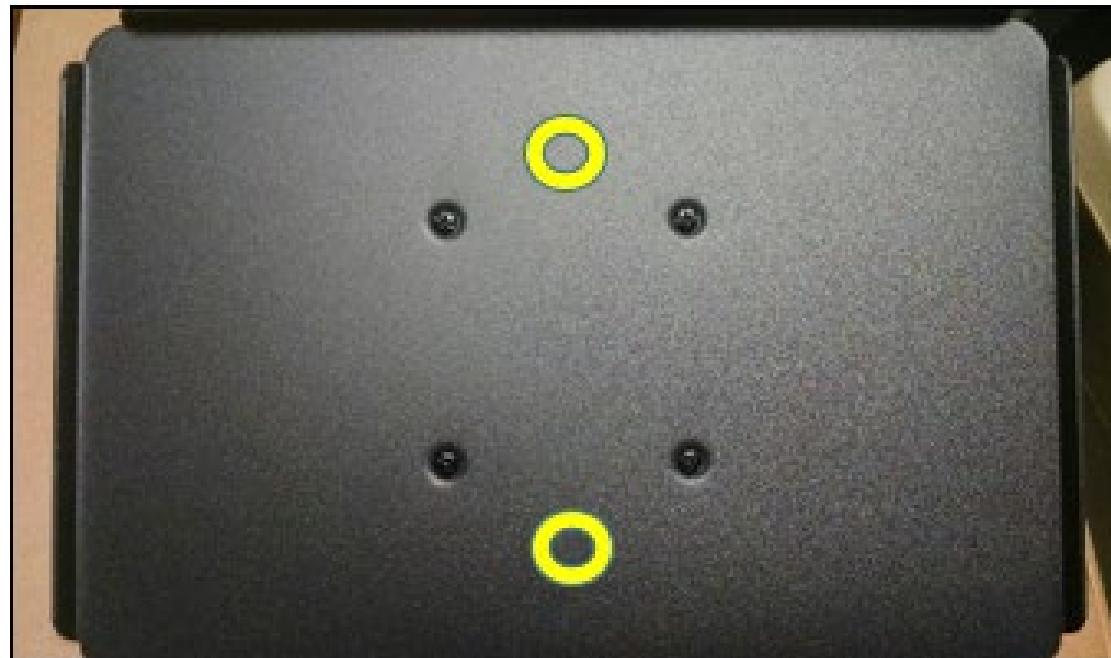
- Remove the four small screws holding the shelf to the bracket



# CAMERA SHELF MODIFICATION (CONT.)



- Drill two  $\frac{1}{4}$ " holes in the shelf in order to attach the projector mount at the locations specified below



# CAMERA SHELF MODIFICATION (CONT.)



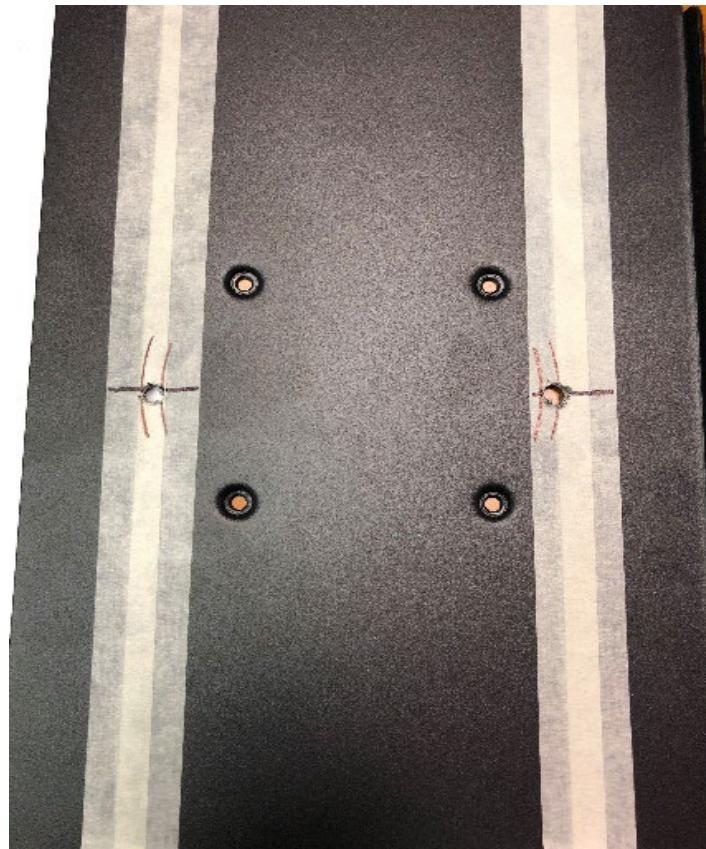
- Position the projector mount onto the shelf in the orientation of the arrow pointing away from the shelf lip as seen below



# CAMERA SHELF MODIFICATION (CONT.)



- Center the projector mount over the 4 shelf holes and use masking tape to trace out the arcs on either side where the holes are to be drilled as shown below



# CAMERA SHELF MODIFICATION (CONT.)



- Use the 1/8" drill bit to drill a hole at the center of each arc (relative to the two shelf holes on each side) as shown below



# CAMERA SHELF MODIFICATION (CONT.)



- Use the  $\frac{1}{4}$ " drill bit to widen the two  $\frac{1}{8}$ " holes to  $\frac{1}{4}$ " as shown below



# CAMERA SHELF MODIFICATION (CONT.)



- Reattach the shelf to the arm using the four screws that were removed earlier.

*Note: Make sure to reattach the shelf BEFORE securing the projector mount since the 4 holes will be inaccessible once the mount is attached*

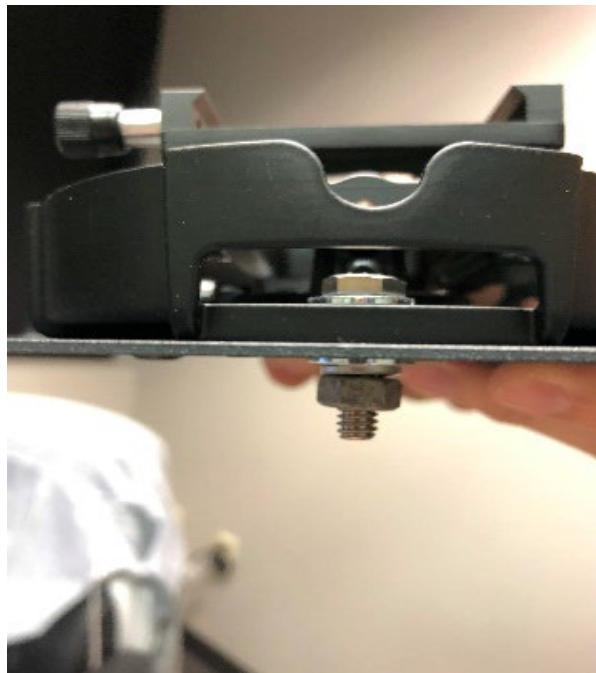
- Use two  $\frac{1}{4}$ "x1" hex bolts, four  $\frac{3}{4}$ " flat washers, two  $\frac{1}{4}$ " split lock washers, and two  $\frac{1}{4}$ " hex nuts to attach the projector mount to the tray (shown below)



# ATTACHING PROJECTOR MOUNT TO SHELF



- Place one flat washer on either side of the assembly (i.e., between the screw head and the shelf and also on the end of the screw after inserting through the projector mount).
- Add lock washers to the end of the screws and secure each with a nut. Ensure proper alignment before fully tightening (as shown below)



# ATTACHING MOUNT TO PROJECTOR



- Remove the 3 legs from the bottom of the projector
- Ensure the leg in the middle is longer than the other 2 in the corners (see image on next slide)



# ATTACHING MOUNT TO PROJECTOR



- Position the projector mount over the bottom of the projector with the 3 arms extended in the orientation shown below
- Center the mount as best as possible and make sure the edges of the mount are parallel to the edges of the projector



# ATTACHING MOUNT TO PROJECTOR



- Use 1x M4 screw to secure the center leg to the projector and 2x M3 screws to secure the corner legs (use a washer on all 3 screws)



# MOUNTING THE PROJECTOR



- Take the projector with its mount and slide it onto the camera shelf assembly so that the projector mount catches the slot for the mount on the shelf
- Several knobs are located on the projector mount for adjusting rotation and translation of the projector when calibrating its position

# REASSEMBLING CAMERA SHELF ARM



- Prior to reattaching the bracket to the arm of the Camera Shelf, remove the brass washer (seen as the small bump on the bracket on the shelf), to allow the shelf to freely rotate vertically



## REASSEMBLING CAMERA SHELF ARM (CONT.)



- With the washer removed, re-assemble the joint with the shelf to a vertical position (i.e., perpendicular to the arm)
- Tighten the screw so that the hinge is tight, but still allows for some movement when forced

# PROPERLY ATTACHING DEVICES TO GPUS



- If the BVI PC contains 2 dedicated GPUs (Usually contains 1 Nvidia P2000 GPU and 1 Nvidia P4000 GPU) make sure to attach the display devices to them in the following configuration:
  - P2000 (Top set of DisplayPort/HDMI ports on back of PC): Projectors
  - P4000 (Bottom set of DisplayPort/HDMI ports on back of PC): TVs (HDMI Splitter containing TVs), HTC Vive Hub
    - *Note: Do not connect the HTC Vive until calibration is complete*



# Floor Projection Calibration

# PRE-CALIBRATION STEPS



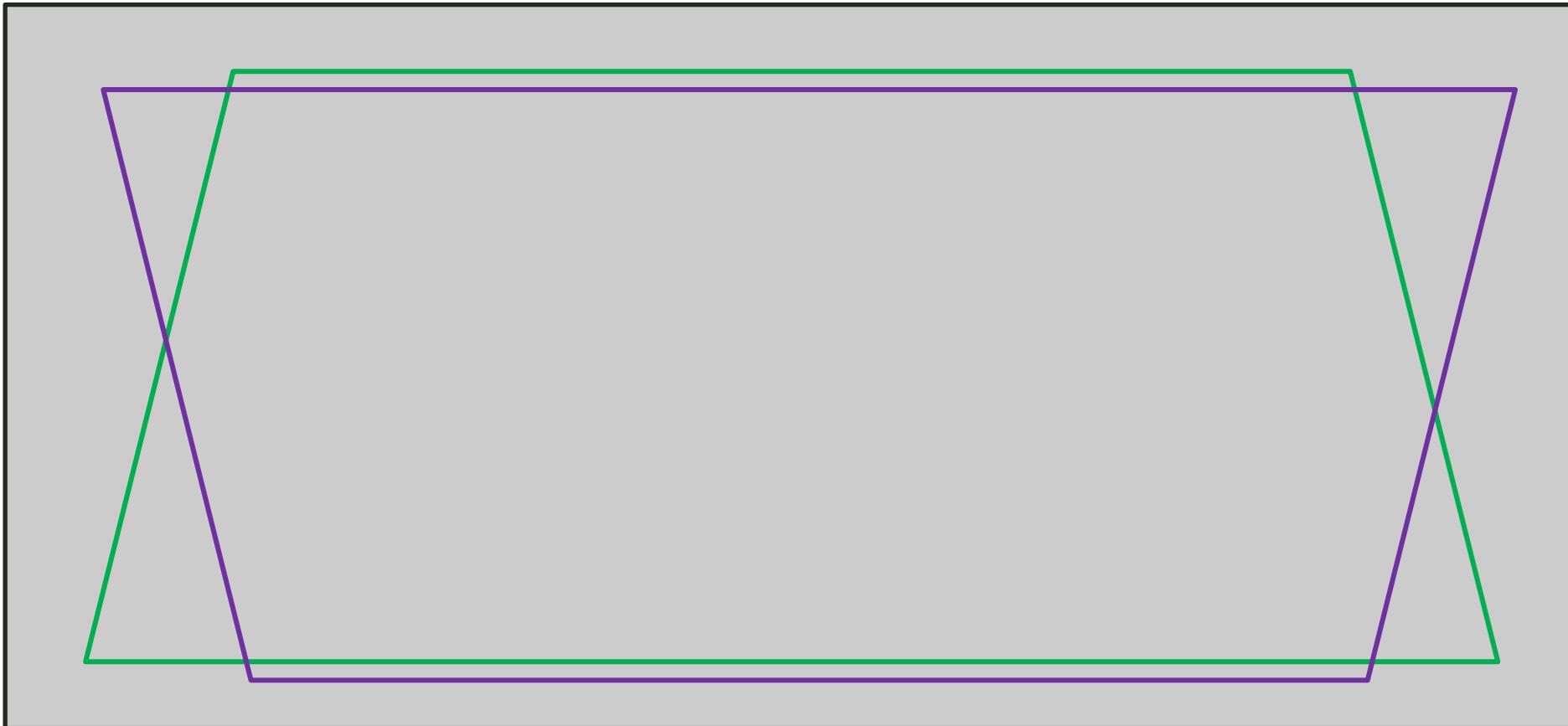
- Ensure all of the BVI Floor Projection hardware is properly set up and connected according to the Hardware System Diagram
- Clear the floor space of any loose objects, items and debris
- Ensure the lighting in the room is set to a dim level to increase the chance of a successful calibration

# CALIBRATION - PROJECTORS



- Power on the projectors
- On each projector, activate the “Test Pattern” mode from the projector menu to display a trapezoidal grid onto the floor
- Change the colors of the grids to be two different colors (e.g., purple and green)
- Center the two overlapping trapezoidal grids over one another on the floor space and adjust the projectors so that the top and bottom edges are roughly parallel to one another (as seen in the following image)

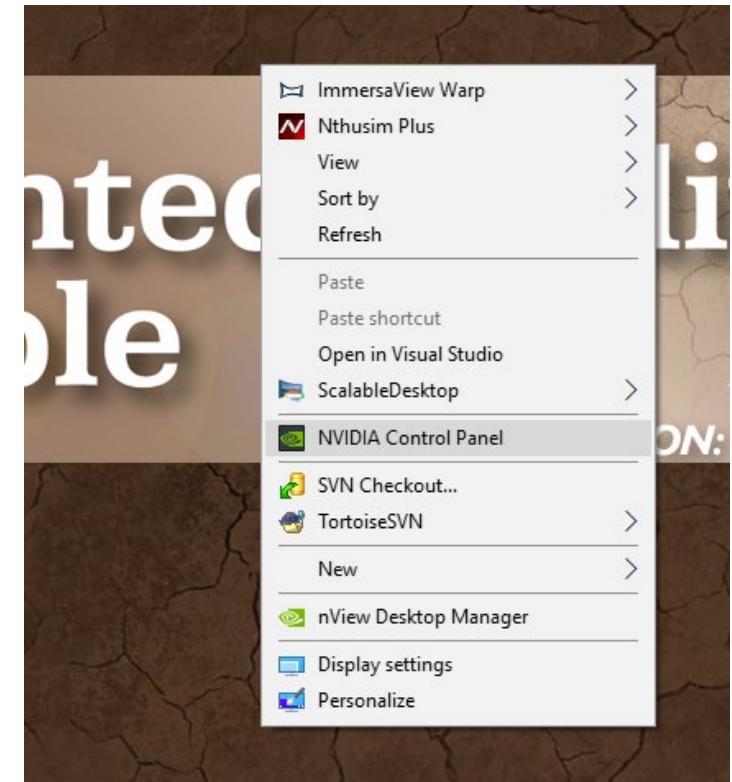
# CALIBRATION – PROJECTORS (CONT.)



## CALIBRATION – PROJECTORS (CONT.)



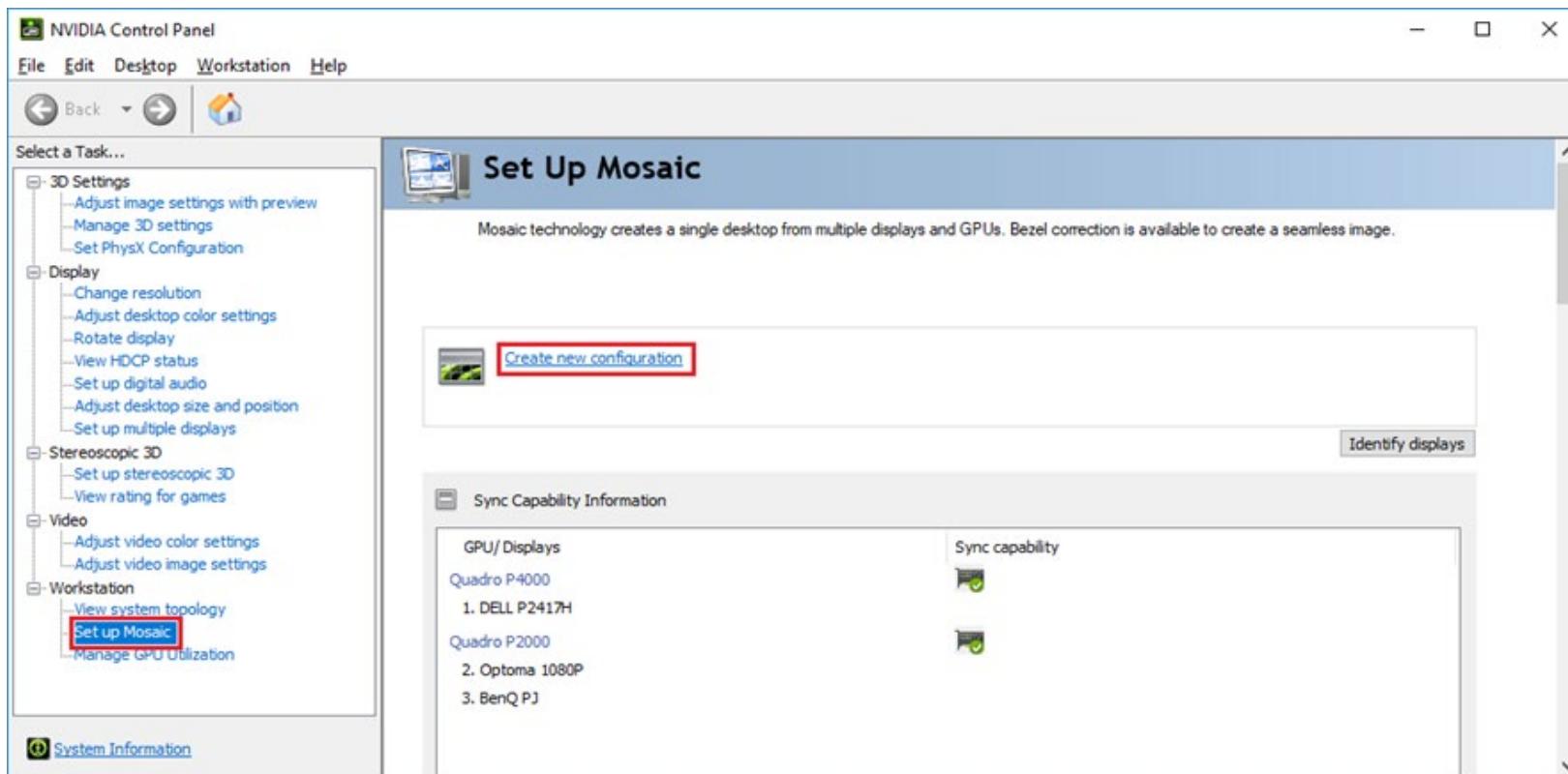
- Once the projectors are in position and their images are properly overlapping, ensure the BVI PC, tablets, and any other related devices are powered on.
- Right-click in any empty space on the desktop, then click NVIDIA Control Panel.



# CALIBRATION – PROJECTORS (CONT.)



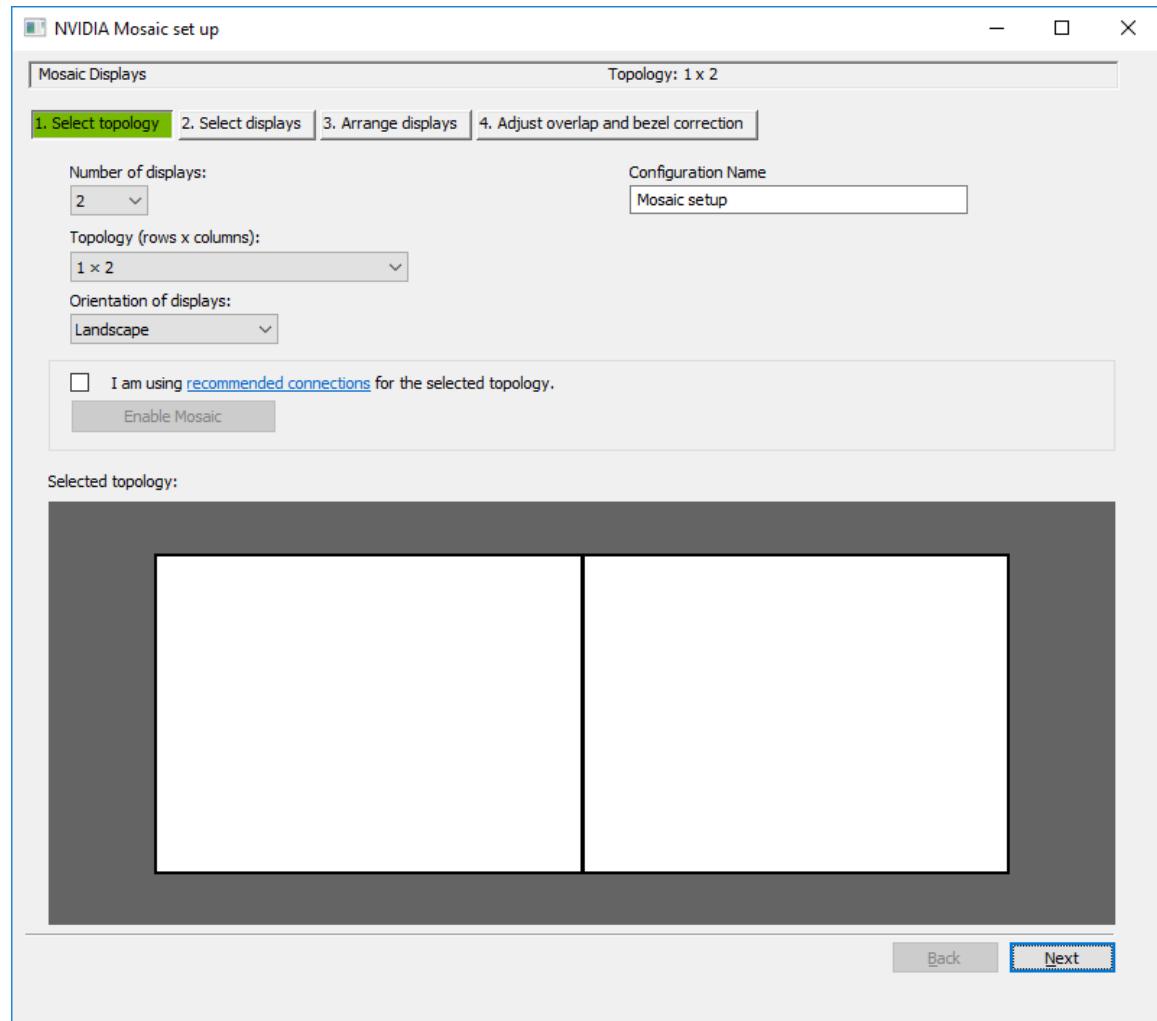
- From the left menu, select ‘Set up Mosaic’ under the ‘Workstation’ section.
- Select ‘Create new configuration’.



# MOSAIC SETUP (CONT.)



- First step, “1. Select topology”
  - Default settings are usually correct. Verify they match and select ‘Next’ from the bottom right.

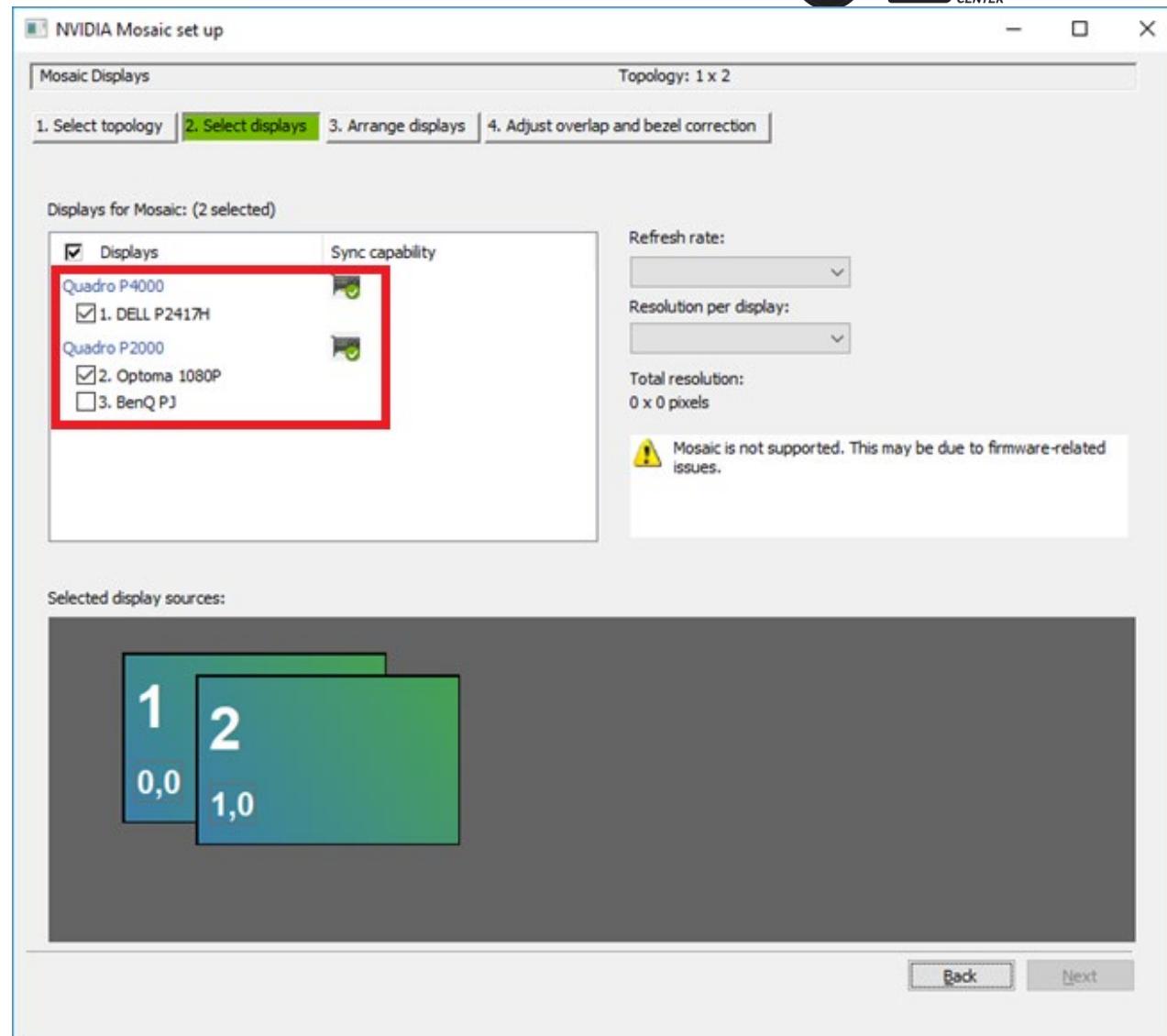


## MOSAIC SETUP (CONT.)

- Second step, “2. Select displays”
  - Ensure the two projectors are selected. They should be the two entries under ‘Quadro P2000’

*Note: In the image on the right, we would uncheck the DELL P2417 and check the BenQ PJ*

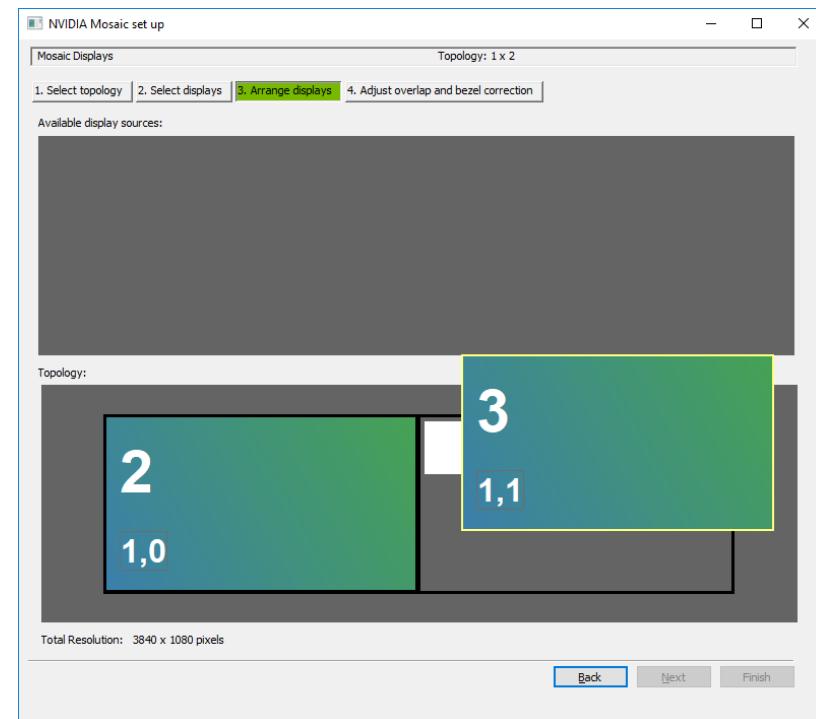
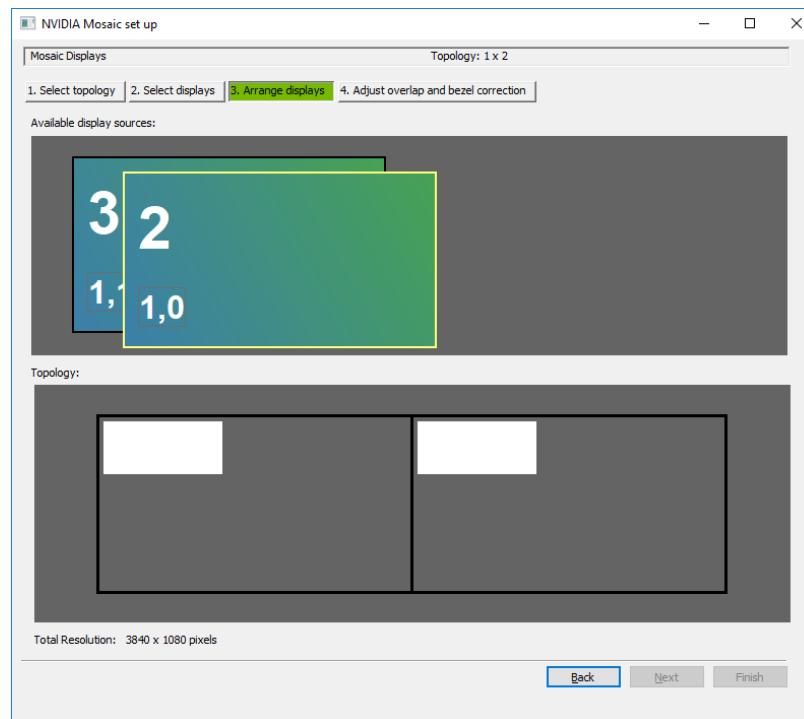
*Default settings are usually correct*
  - Select ‘Next’ from the bottom right.



# MOSAIC SETUP (CONT.)



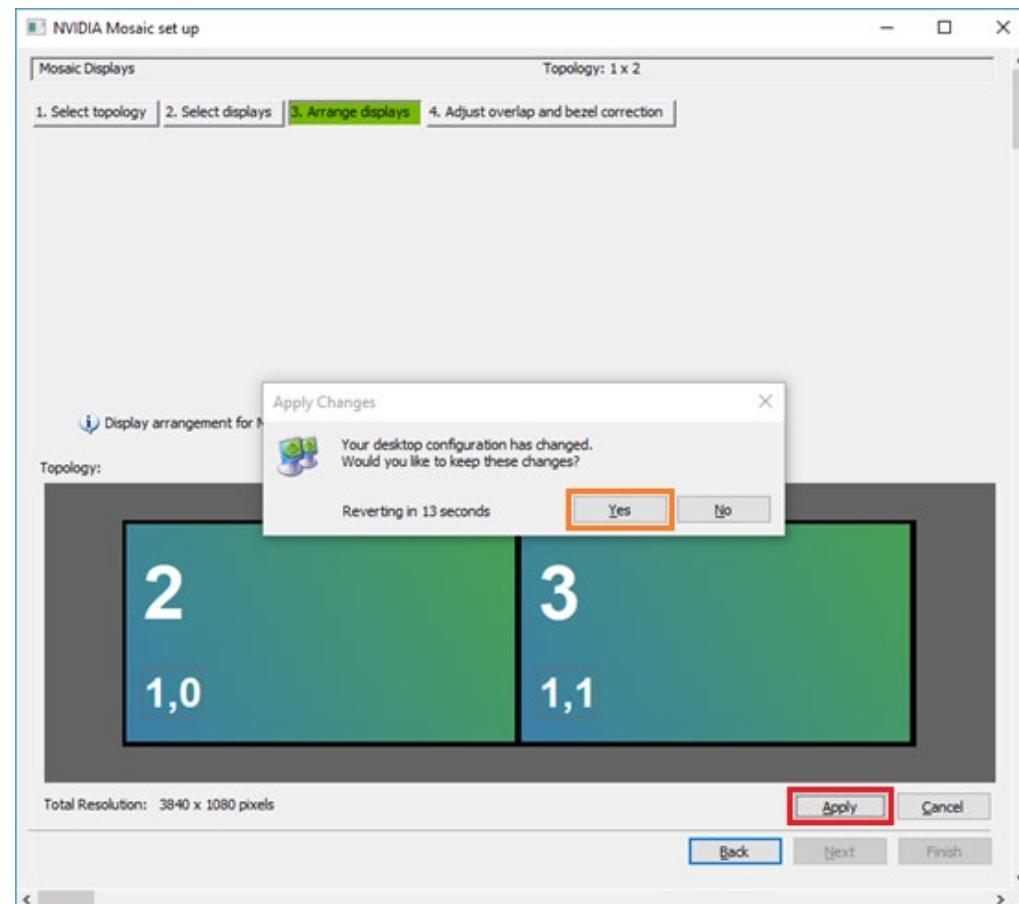
- Third step, “3. Arrange displays”
  - From the ‘Available display source’ section (top section), click and hold the two blue/green colored display boxes and drag them to the ‘Topology’ bottom section.



## MOSAIC SETUP (CONT.)



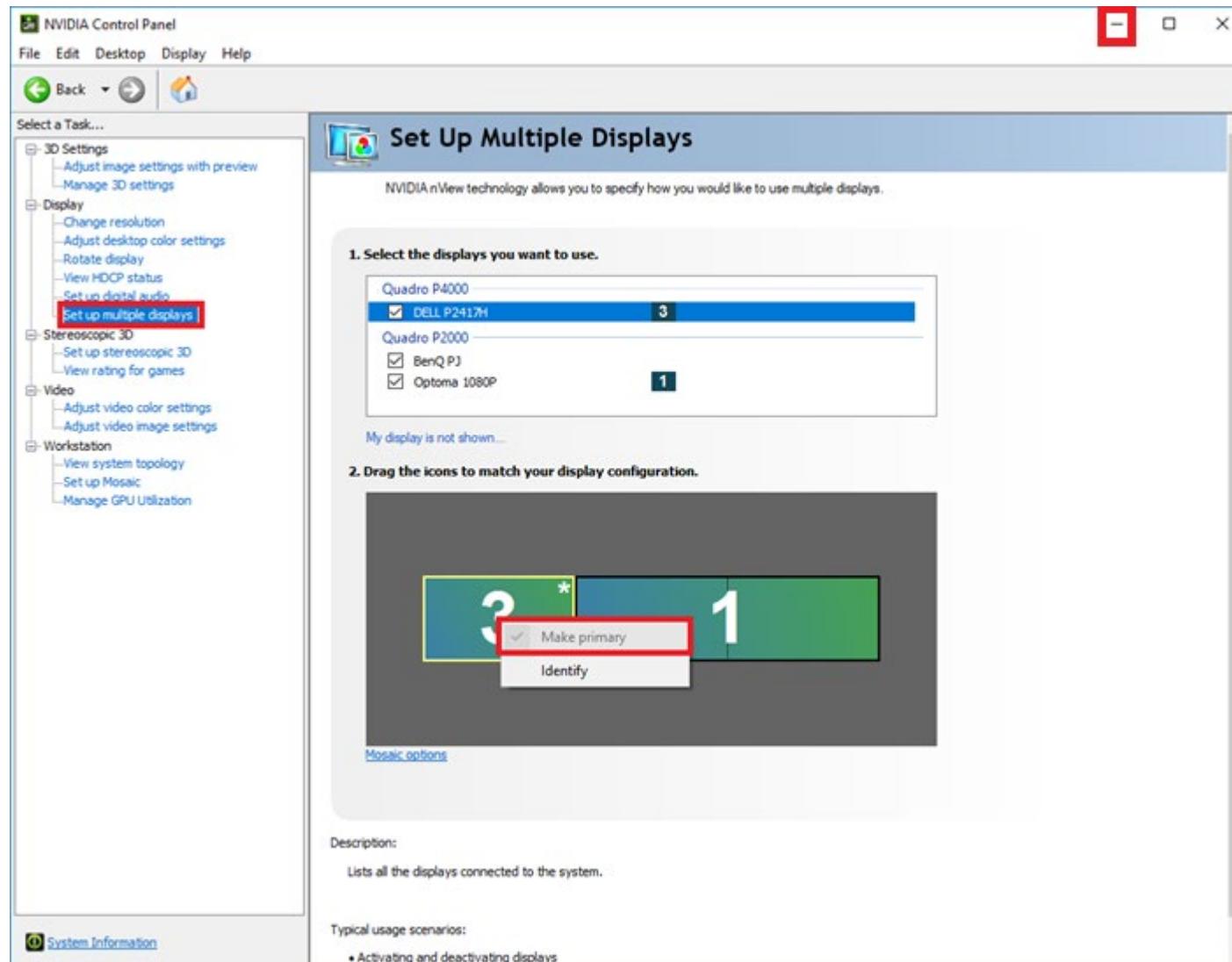
- Select “Apply” on the bottom right.
  - Note: *The screens will flicker and go black several times while applying these changes. Select ‘Yes’ as shown in the orange box to the right within 15 seconds or changes will be reverted and you will need to select ‘Apply’ again.*
- Select ‘Finish’ from the bottom right. The window will return to the NVIDIA Control Panel menu.



# MOSAIC SETUP (CONT.)



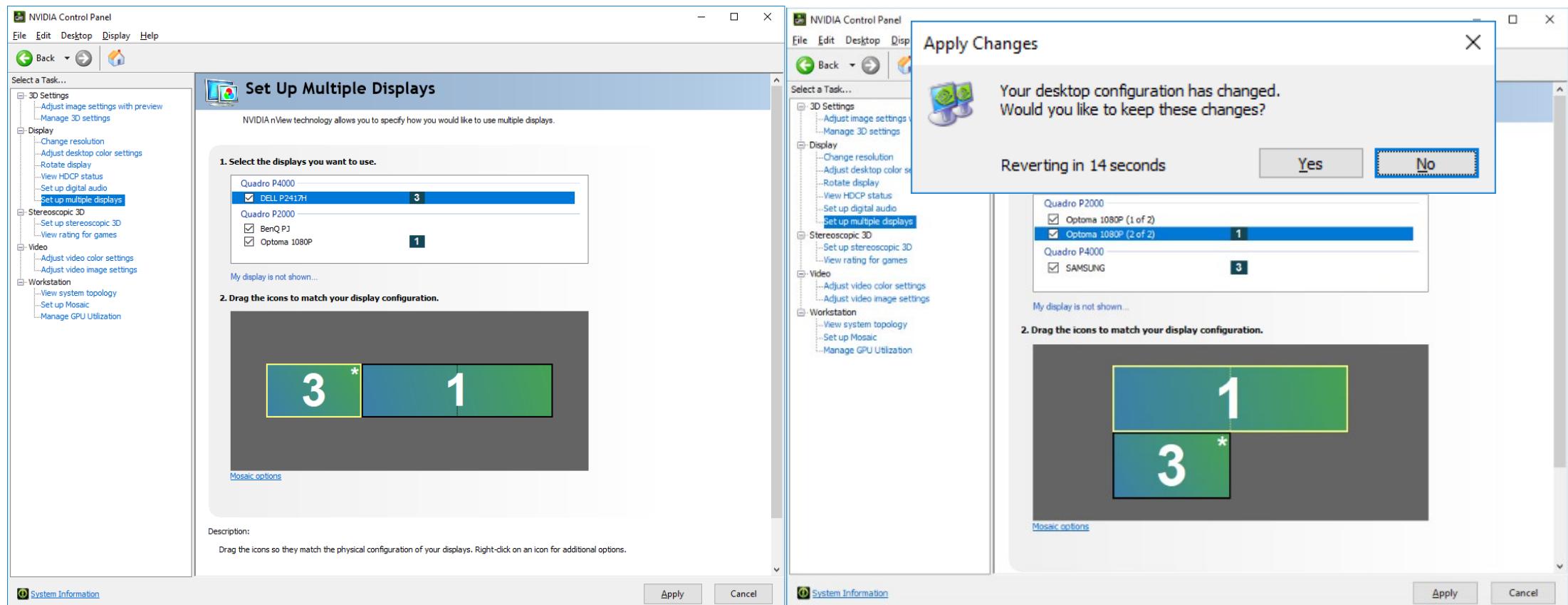
- From the menu on the left, select 'Set up multiple displays' on the left bar.
- Configure the TV/Monitor as the Primary display. In the image to the right, it would be the box labeled as '3' with an asterisk.
- Right-click the box select 'Make primary'.



# MOSAIC SETUP (CONT.)



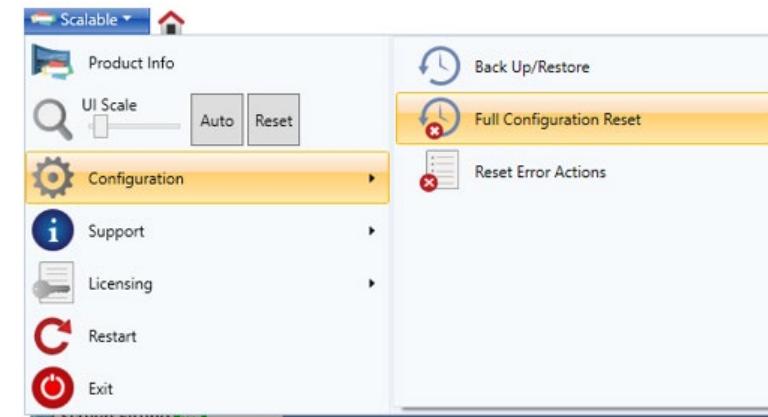
- Click and hold the Primary display (marked with an asterisk) to drag it underneath the newly created ‘Mosaic’ display (box labeled ‘1’), as shown below in the right image.
- Select ‘Apply’ from the bottom right. *Note: The screen will flicker, then select ‘Yes’ on the ‘Apply Changes’ window **within 15 seconds** or else the changes will be reverted.*



# SCALABLE DESKTOP



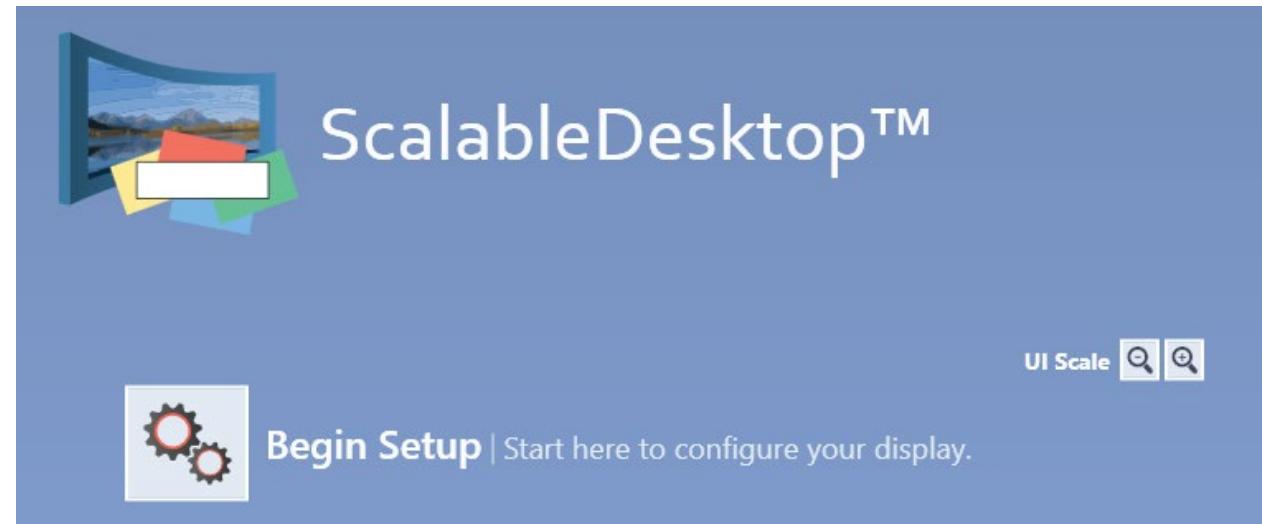
- Minimize the NVIDIA Control Panel via the flat icon in the top right
- Launch ScalableDesktop from the shortcut located on the BVI PC's Desktop
- From the Scalable window, reset the Configuration by selecting the Scalable drop down → Configuration → Full Configuration Reset



# SCALABLE DESKTOP CALIBRATION SOFTWARE



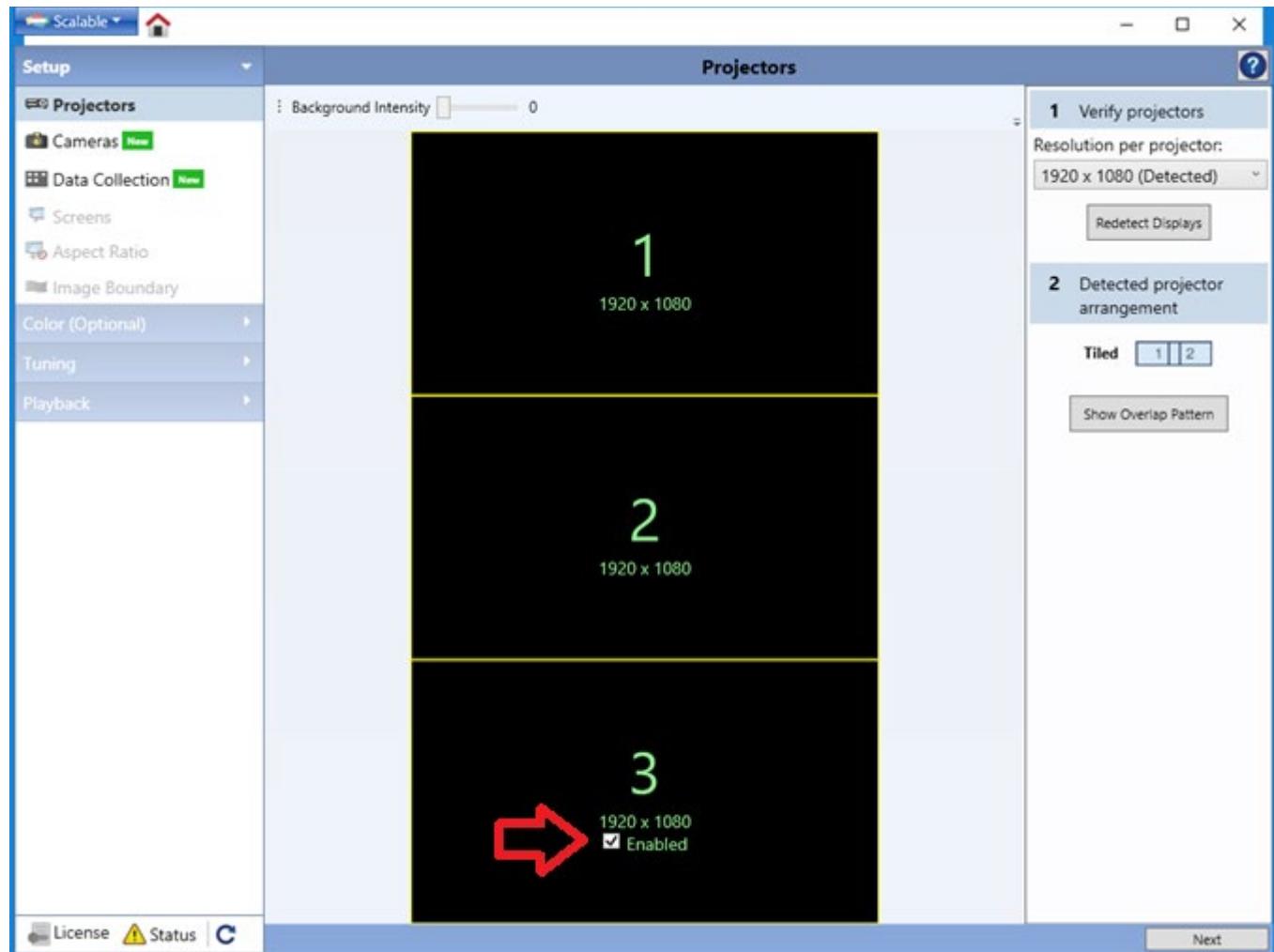
- Previous Configurations of Scalable have been removed
- Create a new configuration by selecting 'Begin Setup'



# SCALABLE – PROJECTORS PANEL



- The first step is to verify the projector resolutions (1920 x 1080).
- **Uncheck** ‘Enabled’ for the non-projector display.
- Select ‘Next’ from the bottom right to continue the setup.

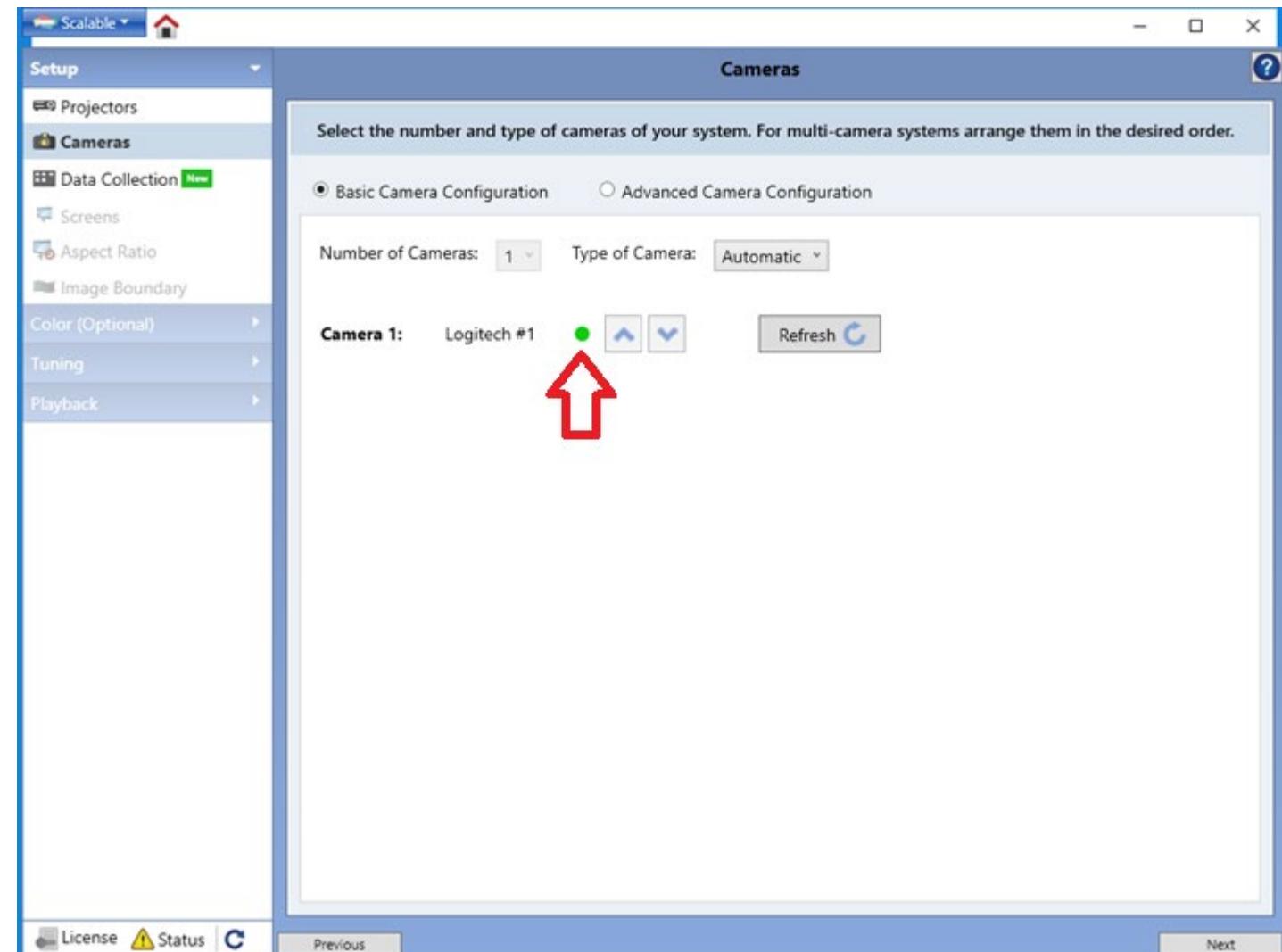


# SCALABLE – CAMERAS PANEL



- This step allows for camera management.
- Typically, the connected camera will appear here with a GREEN status indicator.

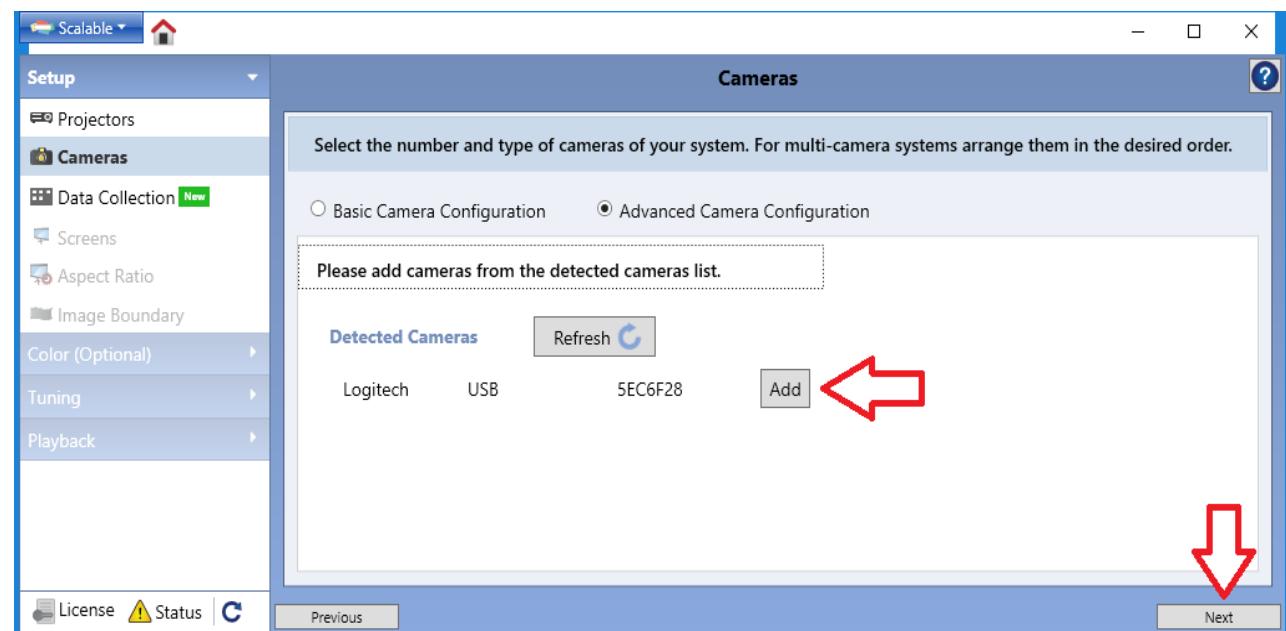
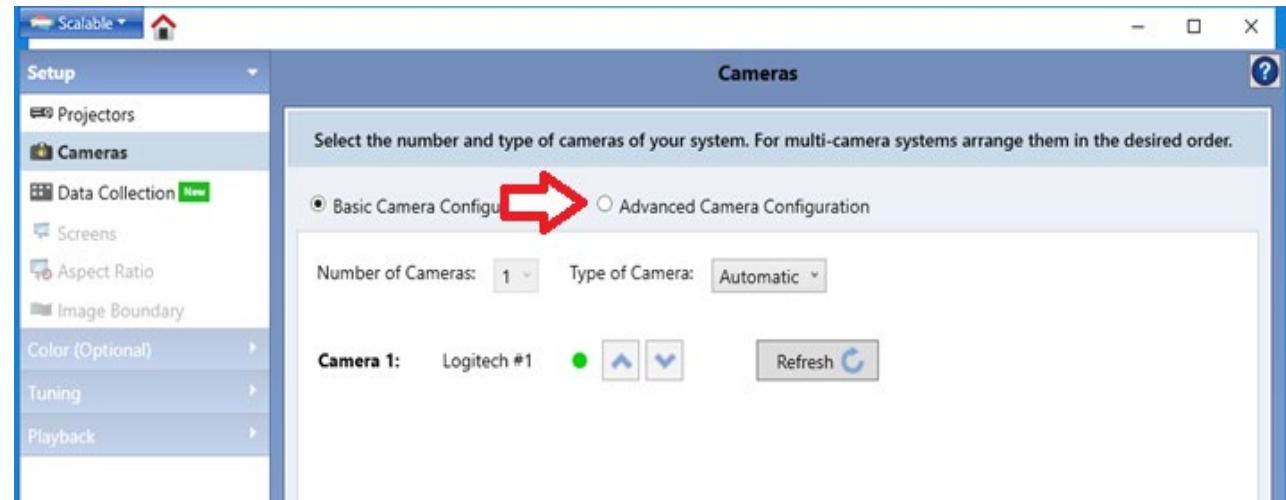
*Note: Occasionally, cameras are not detected by default, see the details on the next slide*



# SCALABLE – CAMERAS PANEL



- If the camera is not detected, select ‘Advanced Camera Configuration’.
- Find the attached camera, select ‘Add’, then select ‘Next’ from the bottom right.



# SCALABLE – DATA COLLECTION PANEL



## Important Notes on Data Collection Panel

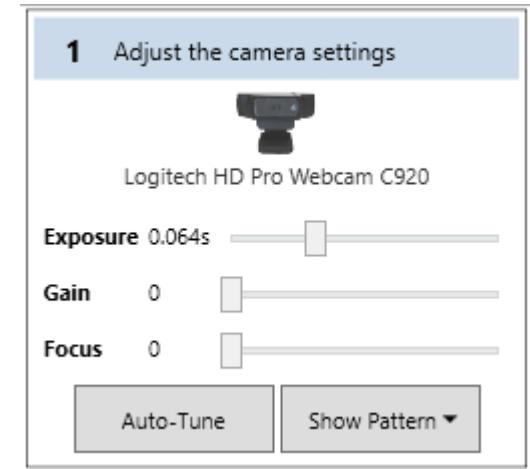
- This part of the setup will display the Floor Projection setup from the attached webcam. Use this display to verify that the webcam is centered properly and angled straight down at the center of the floor projection area.
- If necessary, adjust the webcam boom for height, centering, and roll
- If necessary, adjust the webcam itself for pitch, to ensure the floor projection is displayed in full.

*Note: The higher the webcam position, the greater the floorspace surface area to assist with calibration.*

# SCALABLE – DATA COLLECTION PANEL



- Clear the floor projection area of any obstacles and ensure the space is as dimly lit as reasonably possible.
- Select 'Auto-Tune' on the right side of the screen.
- Once the auto-tune completes, select 'Begin Data Collection' and wait for the data collection to complete

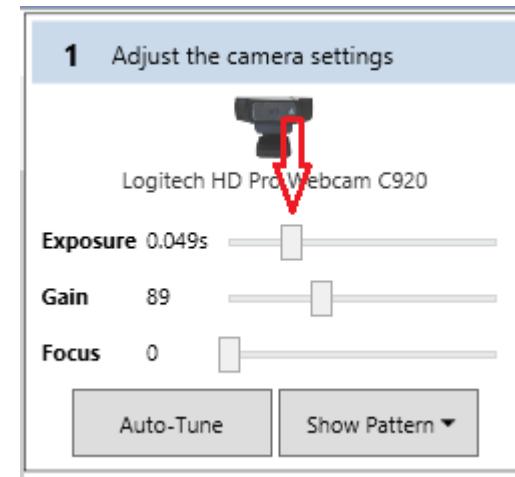


# SCALABLE – DATA COLLECTION PANEL (CONT.)



- Adjust the 'Exposure' and 'Gain' sliders until the white boxes are bright and clear.

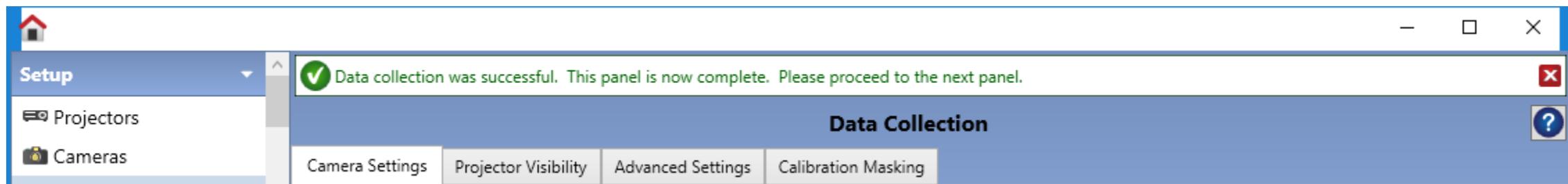
*Note: Average adjustments are usually increases less than 15-40%.*



# SCALABLE – DATA COLLECTION PANEL (CONT.)



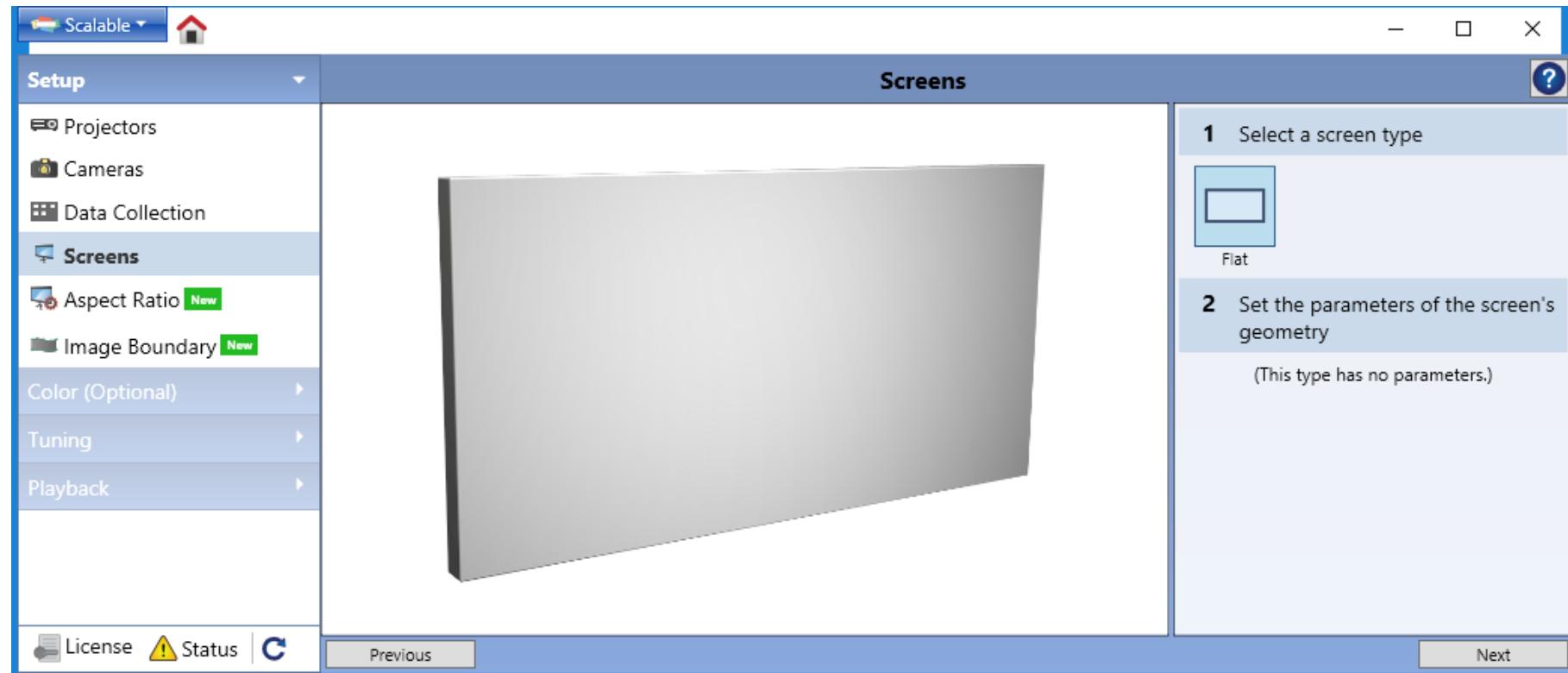
- If there are still errors after initiating the “Begin Data Collection” process, check the following:
  - The webcam is properly positioned, and it has clear view of the trapezoidal projection areas of both projectors.
  - Do not move the mouse cursor or have any pop-up overlays present on the floor when performing the data collection.
  - It may be necessary to further dim the lighting in the room for successful data collection.
- Once data collection is successful, select ‘Next’ from the bottom right.



# SCALABLE – SCREENS PANEL



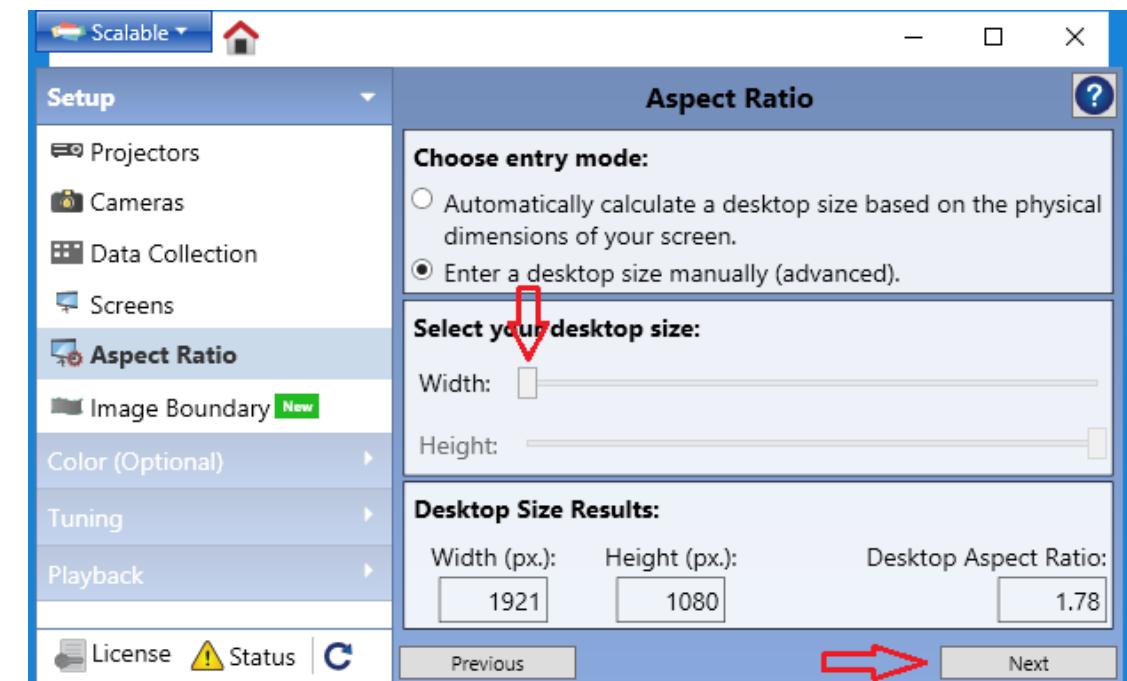
- From the Screens Panel, select “Flat” as the screen type (typically selected by default).
- Select ‘Next’ from the bottom right.



# SCALABLE – ASPECT RATIO PANEL



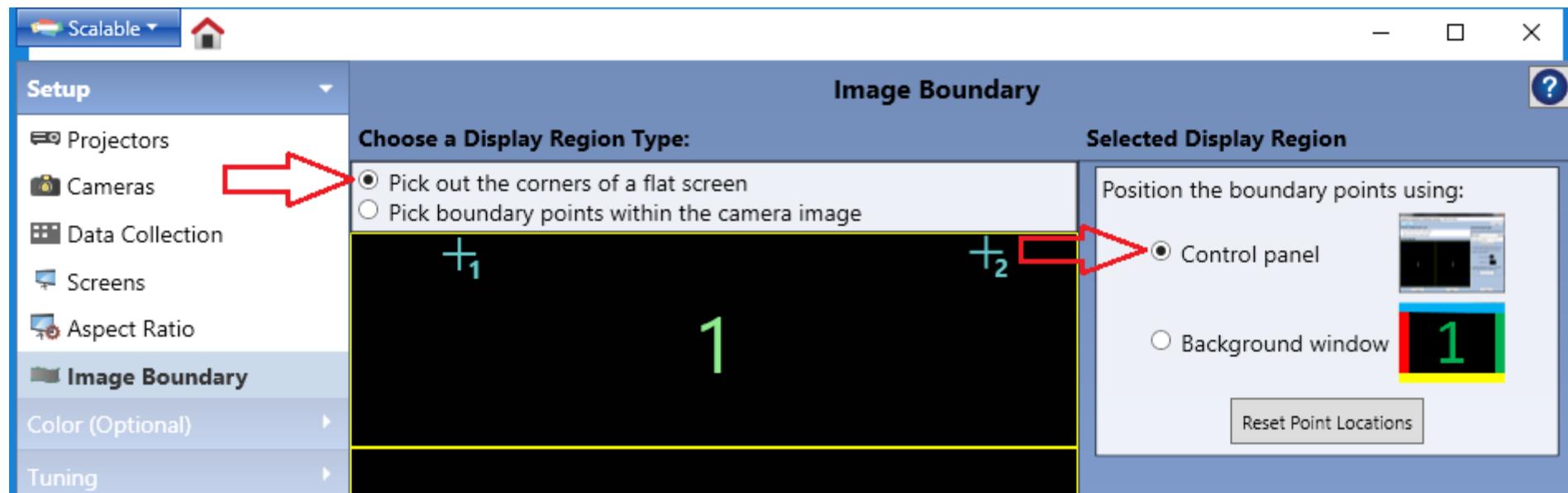
- For entry mode, select ‘Enter a desktop size manually (advanced)’.
- Drag the slider for ‘Width:’ all the way to the left.
- Select ‘Next’ from the bottom right.



# SCALABLE – IMAGE BOUNDARY PANEL



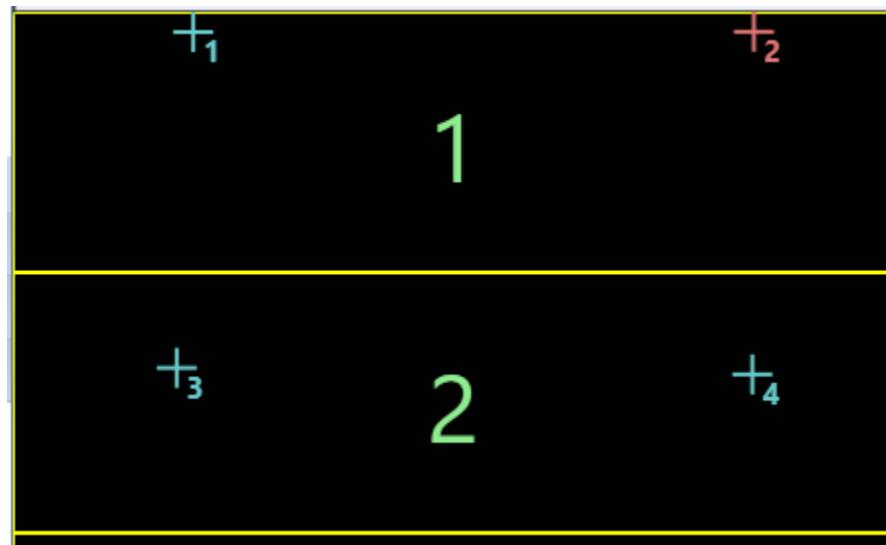
- This step sets the outer limits (or boundary points) of the space the two projectors share. Move each of the four markers to represent a corner of the projection.
- Under display region type, select ‘Pick out the corners of a flat screen’.
- Under selected display region, select ‘Control Panel’.



## SCALABLE – IMAGE BOUNDARY PANEL (CONT.)



- While watching the floor, drag the markers around the given space to establish the outer edges of projection. Typical setups usually land around here:

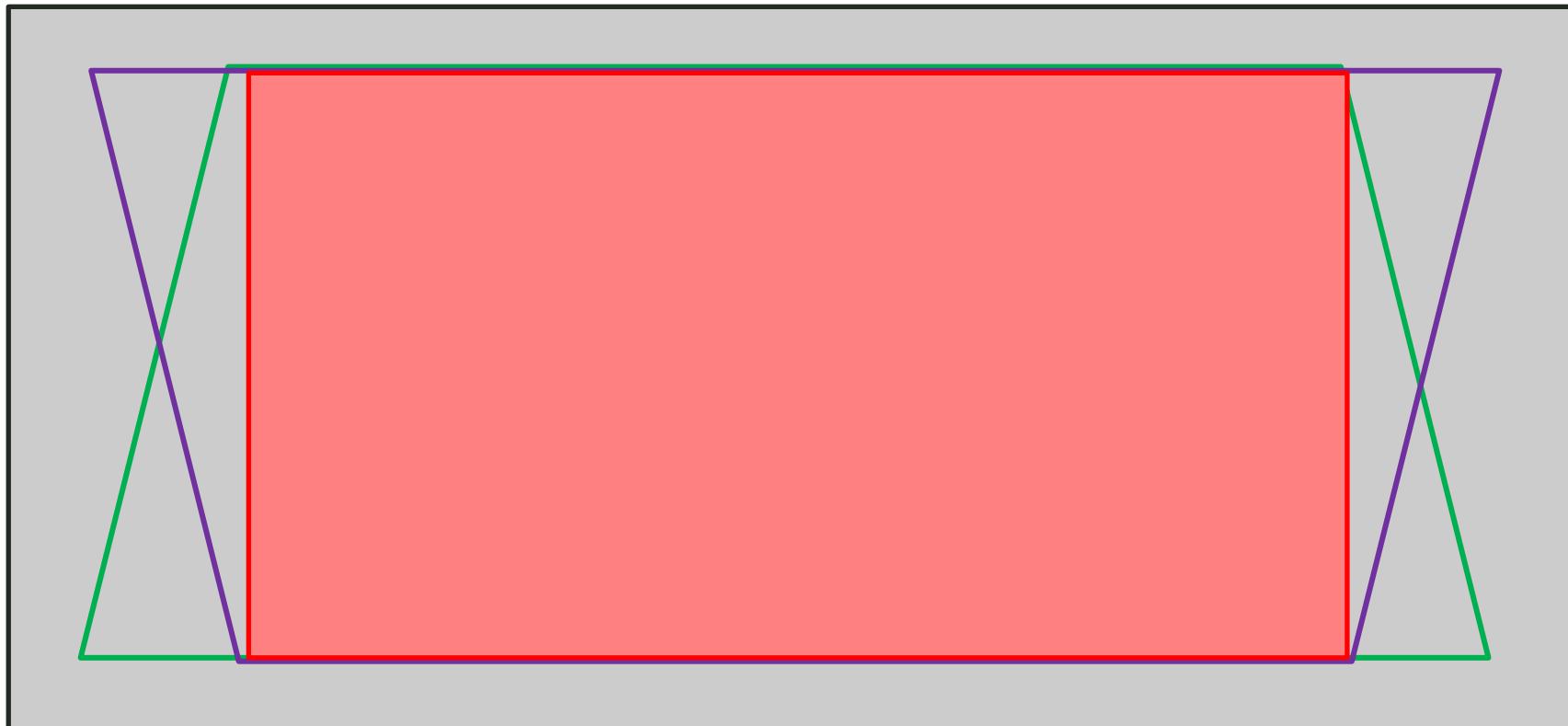


- Each marker can be fine-tuned by clicking on it, then using the arrow keys to move it pixel-by-pixel.

# SCALABLE – IMAGE BOUNDARY PANEL (CONT.)



- Adjust the corners of the image bounds until they form a nearly perfect rectangular image.
- If the markers are moved past the outer edges of one of the projectors, the extra space is shown dimmer. If this happens, simply move the marker back into range.

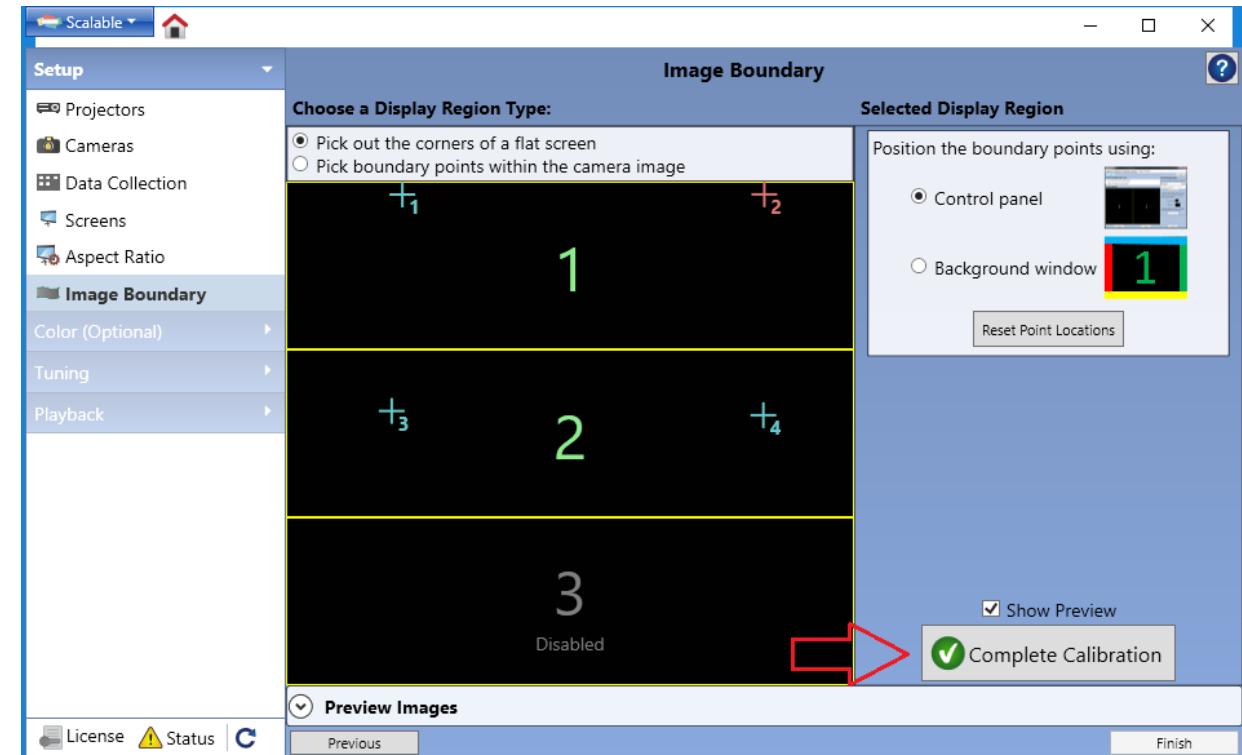
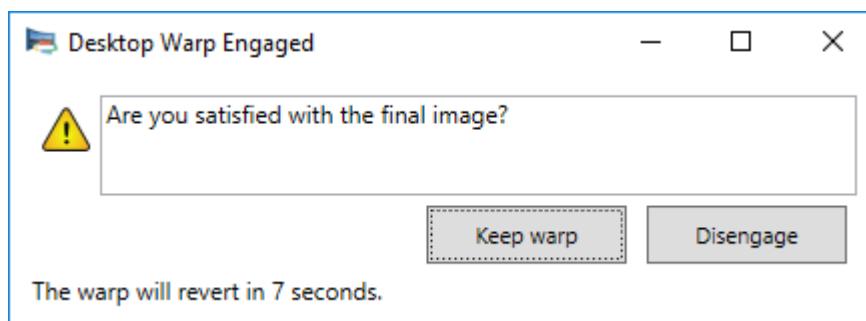


# SCALABLE – IMAGE BOUNDARY PANEL (CONT.)



- When all adjustments and settings are completed, select 'Complete Calibration' from the bottom right.

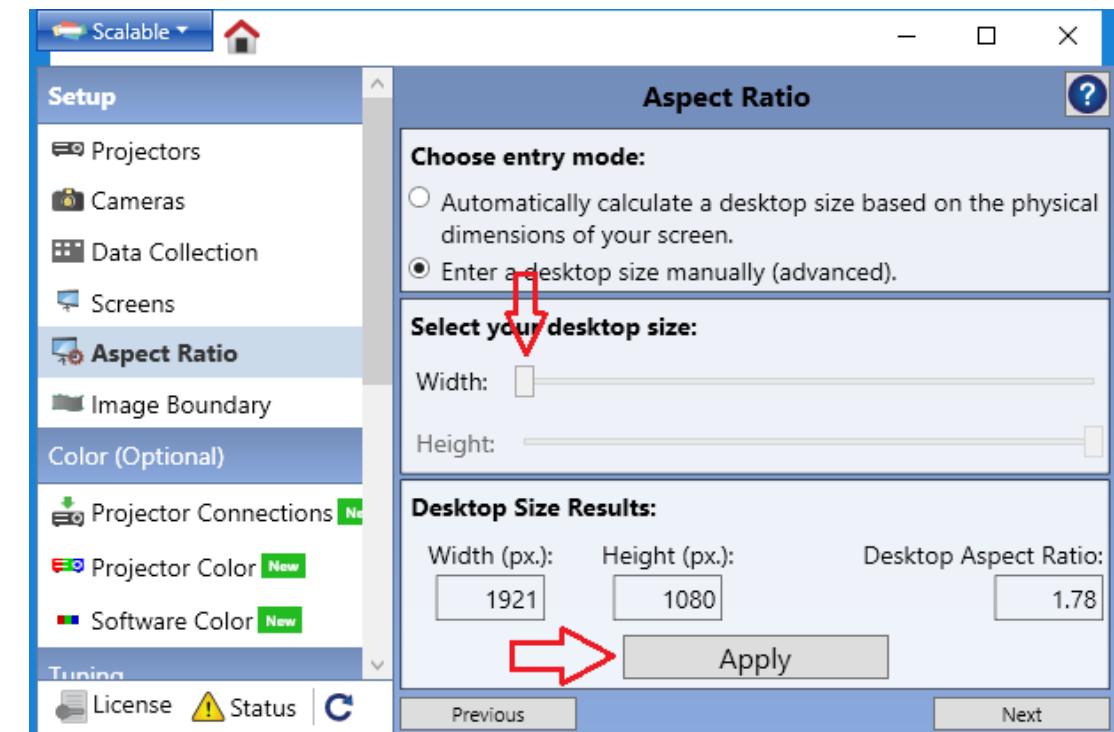
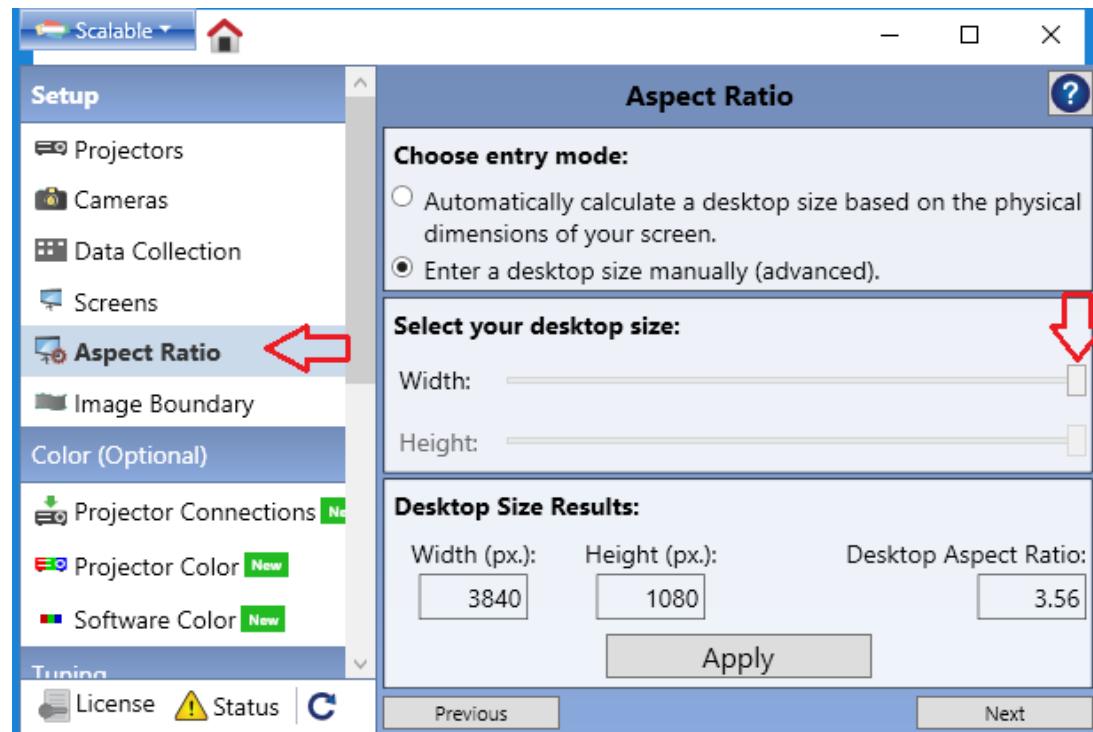
*Note: On the next screen, be ready to select 'Keep warp' within 10 seconds.*



# SCALABLE – IMAGE BOUNDARY PANEL (CONT.)



- Once complete, re-open the ‘Scalable’ software and navigate to the ‘Aspect Ratio’ tab from the left menu.
- Drag the ‘Width’ slider all the way to the left, and select ‘Apply’.



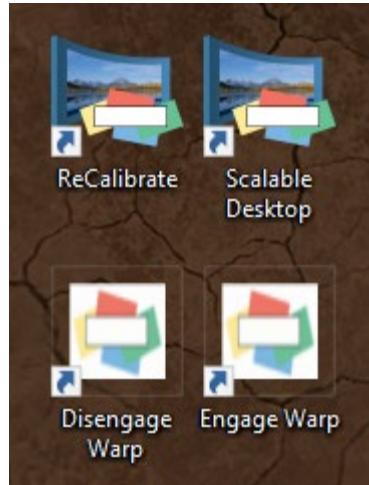
## SCALABLE – FINAL STEPS



- At this point it **may** become necessary to re-orient the displays and to set the television as the primary display again.
- Navigate back to NVIDIA Control Panel → ‘Set up multiple displays’
- Follow steps from slides 48-49.



- These icons will be located on the BVI PC's Desktop.
- Engage/Disengage Warp starts and stops the blending effect on the projectors.
- ReCalibrate is a one-click solution to solving blurriness or shifting issues as a result of the projector stands moving.



**More details on recalibration on the next slide →**

# CALIBRATION – MAINTENANCE



- Be sure not to bump into or move the TV stands holding the projectors at any point when operating the BVI Floor Projection setup
- If the floor image becomes blurry or the projector images are shifted out of focus for any reason, follow the steps below to recalibrate:
  - Be sure to clear the floor space of any objects and people
  - Make sure the lighting in the room is set to a dim level
  - Click the “Recalibrate” icon on the BVI PC’s Desktop to recalibrate the projector blending
  - Wait a few minutes for the recalibration process to complete

# TROUBLESHOOTING – MAINTENANCE



If the image appears blurry, or as though its out of focus:

- Clear all obstacles from the table, ensure the room is as dimly lit as reasonable, and click 'ReCalibrate' on the desktop. Allow time for the process to complete.
  - *Note: this happens when the projector stand moves for any reason. If the stand has moved too far, it may be wise to adjust the physical positioning as well.*

If the image appears to be disproportional, such as text appearing to be much smaller than normal:

- 'Disengage Warp' from the desktop, then check settings from [this slide](#).
- When settings are verified, don't forget to 'Engage Warp' from the desktop again.

If the desktop icons appear on the floor instead of the television, [check these slides again](#).



# Floor Projection Startup

## STANDARD STARTUP



1. Verify all equipment is powered on, including the PC, TVs, and projectors.
2. After allowing some time for the projectors to power on and for their bulbs to warm up, check for accuracy of blending.
  - If the floor projection seems blurry, misplaced, or otherwise odd, check the page on troubleshooting by [clicking here](#).
3. Start the BVI software by double-clicking the 'Start BVI...' icon on the desktop.