

GPU TECHNOLOGY CONFERENCE

S4671 - SEE THE BIG PICTURE: SCALABLE VISUALIZATION SOLUTIONS FOR HIGH RESOLUTION DISPLAYS

Doug Traill - Senior Solutions Architect

LARGE FLAT WALL DISPLAYS



Image courtesy of Vislogix 6x6 interactive display wall built using MOSAIC

MOSAIC

Creating a single unified Desktop Up to 16 Displays Supported on Quadro + NVS Linux, Windows 7 + Windows 8

IMMERSIVE DISPLAYS

Quadro Sync

Sync's up to 4 GPUs in workstation

MOSAIC with Sync

Supported on Quadro K5000 + K6000

Linux, Windows 7 + Windows 8



Image courtesy of Visbox Immersive Room - driven by 1 workstation with 4 Quadro K5000s + Quadro Sync

ULTRA HIGH RESOLUTION DISPLAYS USING CLUSTERS



Image Courtesy of BARCO/Elbit Systems - 4k cluster

Quadro Sync

Up to 50 Quadro Sync cards in a cluster

Control via NVAPI

Control + Monitor using NVWMI

NOT EVERY SURFACE IS FLAT

Warp + Intensity Adjustment API

Projection Correction

Curved Surfaces

Projection Mapping



Image courtesy of Christie Digital -Projection mapping on to a one fifth scale physical car

S4622 - Virtual Automotive: Projection Mapped Graphics for Automotive Design - Tuesday 3.00pm Room 210G

QUADRO FEATURES FOR HIGH RESOLUTION DISPLAY WALLS

Custom Resolutions	MOSAIC	Tiled Displays	10/12 bit Color
GTF, DMT, CVT, CVT-RB, Manual timing	Seamless Desktop across multiple GPUs	Automatic MOSAIC setup on tile displays using Display ID	Support High Dynamic Range Displays
EDID Management	MOSAIC + Sync	Ultra high resolution Desktop	3D Stereo
Capture and Read EDID from file	Framelock, Overlap support, 3D stereo	Up to 16k by 16k	OpenGL/DirectX, active, passive, pixel packed
4K resolution	GPU Direct 4 Video	External or Internal Sync	Display Port MST
DP1.2 per connector or HDMI1.4b	Picture-in-Picture support	Genlock/TTL Sync. Internal Sync	Support multi-streaming devices
Warp + Intensity API	NVAPI/NVWMI	Display Clone Modes	GPU Affinity
Edge-blending, projection mapping. Windows + Linux	Programmatically control driver	Display Port Clone, Pan & Scan clone, 4K cloning	Multi-GPU support and Swap Groups

MOSAIC - WHY IS IT NEEDED? - WINDOWS ON ITS OWN - INDEPENDENT DESKTOPS

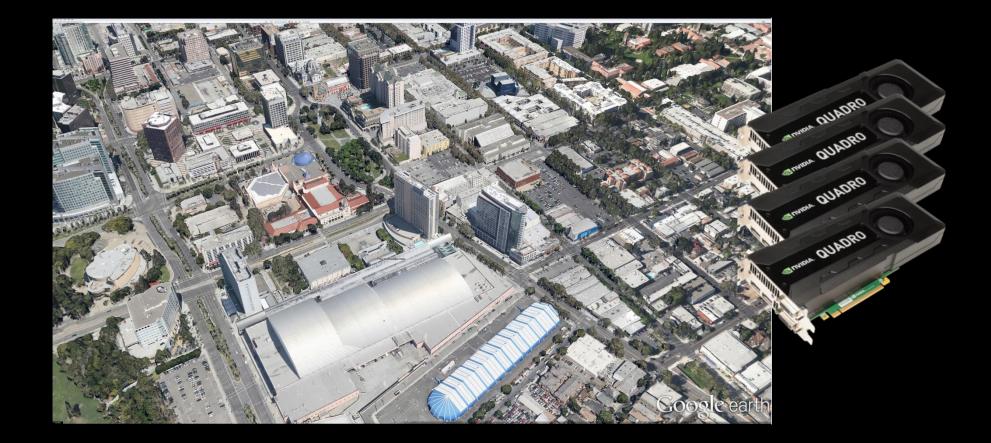




- INDEPENDENT DESKTOPS



WITH MOSAIC - ONE LARGE DESKTOP



MOSAIC - SUPPORTED ON NVS + QUADRO

- Unified Desktop up to 16 Displays*
 - i.e. for Digital Signage 4 NVS510 cards for 16 displays
 - For interactive content 4 K5000s
- All cards in the system must be identical
- All displays must support common display timing
- Support Bezel Correction
- Windows 7, 8 + Linux support.

*All displays need to have identical timing. *16 display support for Kepler GPUs



MOSAIC WITH SYNC FEATURES

	Number of Syr	nchronized displays	s/projectors fro	m a single system	with MOSAIC
GPU Options	Up to 2	Up to 4	Up to 8	Up to 12	Up to 16
K6000	1 GPU	1 GPU	SLI (2GPUs) or 2GPUs + Quadro Sync	3GPUs + Quadro Sync	4GPUs + Quadro Sync
K5000	1 GPU	1 GPU	SLI (2GPUs) or 2GPUs + Quadro Sync	3GPUs + Quadro Sync	4GPUs + Quadro Sync
Q5000	1 GPU	SLI (2GPUs)			
Q6000	1 GPU	SLI (2GPUs)			
Quadro Plex 7000	1 System	1 System	2 Systems + DHIC		

- Seamless, Tear-Free Displays
- Projector Overlap
- API for Warp & Intensity Adjustment
- Active and Passive 3D Stereo support

- Windows 7 & Linux
- XP support limited to 2 displays per GPU

*SLI support - must be certified platform - <u>http://www.nvidia.com/object/quadro_sli_compatible_systems.html</u> *XP - R319 is last released driver branch

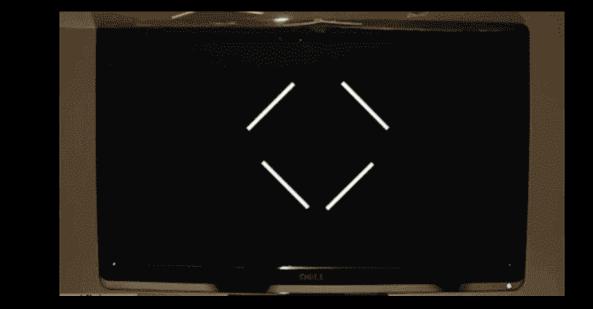
SIDE NOTE - ON MOSAIC NAMING

Display Card	Windows	Linux	Notes
1 NVS510	MOSAIC	metatmodes	Bezel correction - no overlap
Multiple NVS510	MOSAIC	Option "BaseMOSAIC"	Bezel correction - no overlap
Single K4000	MOSAIC	metatmodes	Bezel correction - no overlap
Multiple K4000s	MOSAIC	Option "BaseMOSAIC"	Bezel correction - no overlap
1 K5000	Premium MOSAIC MOSAIC with Sync	Metamodes	Over lap supported
Two K5000s (no SLI or Sync)	MOSAIC	Option "BaseMOSAIC"	Bezel correction - no overlap
Two K5000s with SLI or Quadro Sync	Premium MOSAIC MOSAIC with Sync	Option "SLI" "MOSAIC"	Overlap support. Even using Quadro Sync its called "SLI" "MOSIAC"

Synchronization

Focus on the image and not the artifacts

WHY IS SYNC IS IMPORTANT?



Bezel's hide sync issues !!!

Image from gizmodo.com

MULTI-GPU SYNC

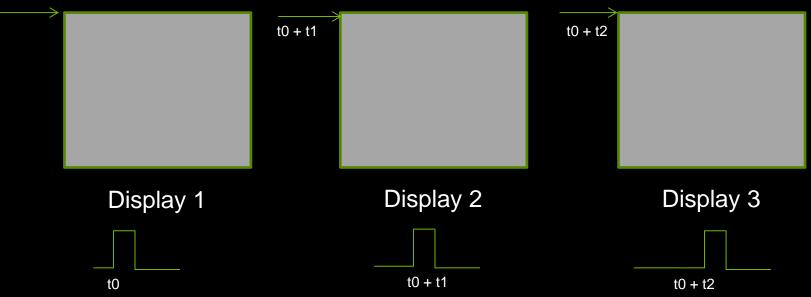
Framelock

Stereo lock

Swap lock

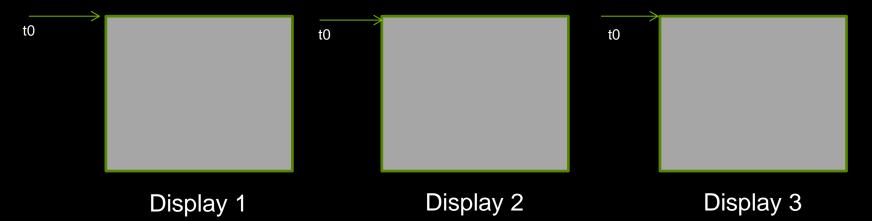
t0

VERTICAL SYNC



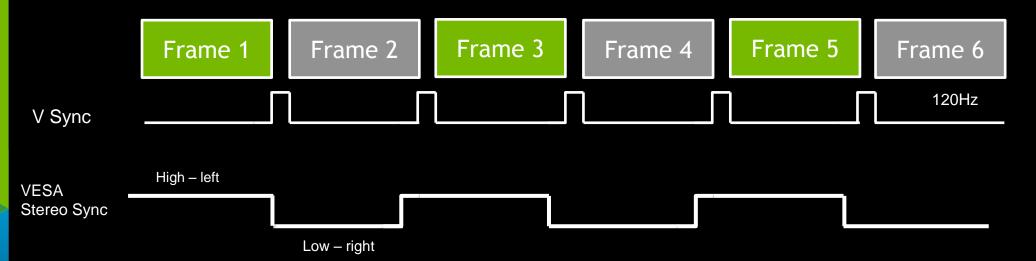
- Vertical Sync is the pulse that indicates the start of the display refresh.
- To avoid *tearing* on a single screen the application swap buffers are synced to *vertical sync*.
- Although all three displays may have the same refresh rate *vertical sync* start may be different.
- This can result in *tearing* between displays.





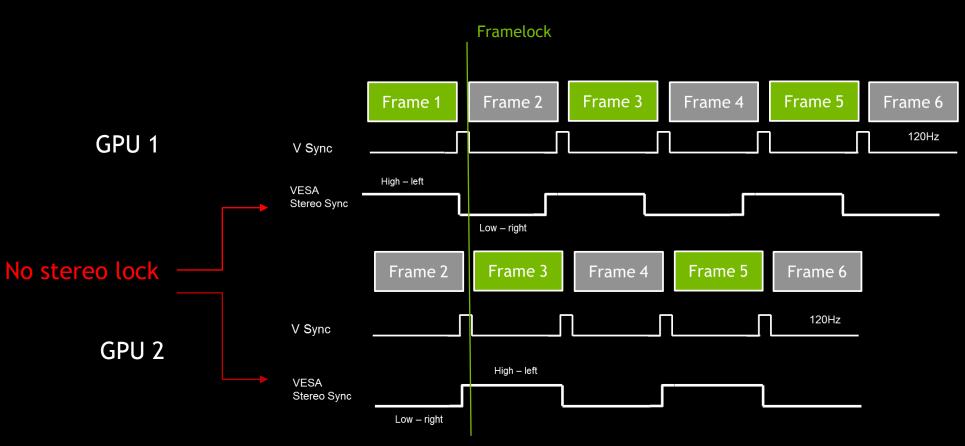
- *Framelock/Genlock provides a* common sync signal between graphics cards to insure the vertical sync pulse starts at a common start.
- This is commonly referred to as *Frame Synchronization*
- *Framelock* Synchronization is generated from a master node. All other nodes would be sync to this.
- *Genlock* synchronization is from an external sync generator (house sync). Each node attached to the genlock signal is synced from that signal.
- Framelock & Genlock can be mixed in the cluster. With the master node being synchronized from the genlock pulse

STEREO LOCK



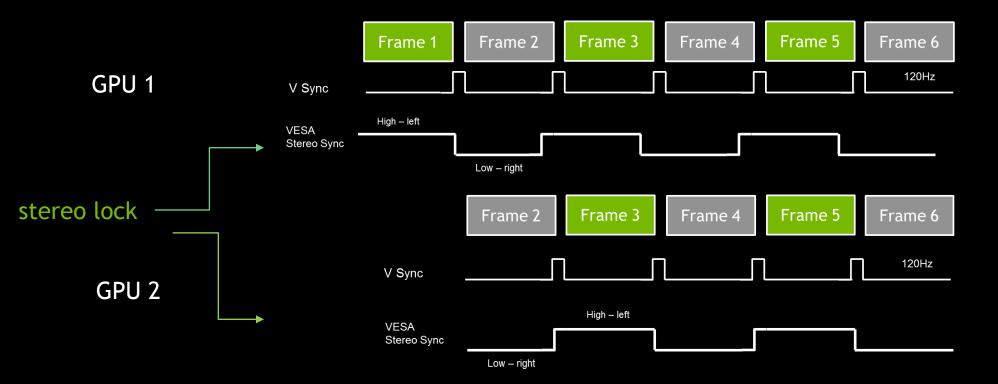
No information that tells a display or stereo glasses which eye is left or right

STEREO LOCK



This will result in eyes being swapped between displays

STEREO LOCK



Stereo sync is in phase between GPUs

SWAPBUFFERS



SWAPBUFFERS



Time (ms)

SWAPBUFFERS IN A CLUSTER



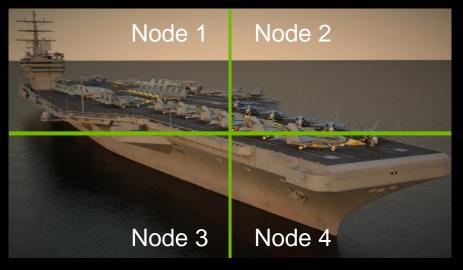
Each node is now rendering a scene with different complexity i.e from least to highest we get:

- 1. node 3 ~ 16ms = 60fps
- 2. node 4 ~ 36ms = 30fps
- 3. node 2 ~ 53ms = 15fps
- 4. node 1 ~ 99ms = 10fps

- With each node running at a different rate the user would perceive tearing on the screen.
- We need a mechanism to ensure that each node will *swap* at the same time.

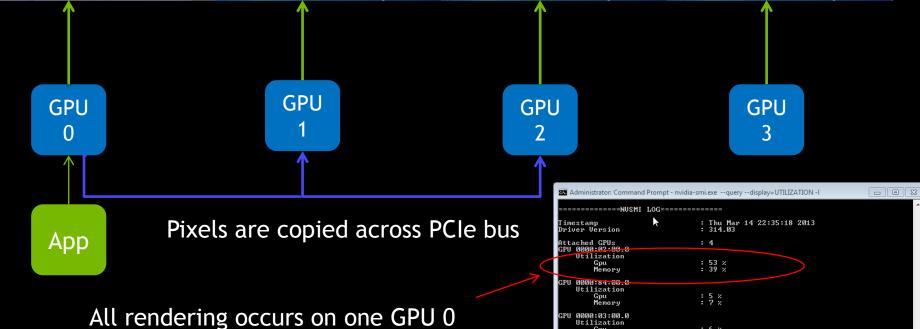
SWAP GROUP AND SWAP BARRIER

- NVIDIA Extensions to OpenGL / DirectX (via NVAPI)
 - Swap Group provides synchronization multiple GPUs in a single host
 - Swap Barrier provides synchronization of GPUs across multiple nodes.
 - Use RJ45 (framelock) connection on Quadro Sync so faster than sync over a network



With Swap Barrier each node will wait until all nodes have completed their render 1. node 3 ~ 16ms = 10fps 2. node 4 ~ 36ms = 10fps 3. node 2 ~ 53ms = 10fps 4. node 1 ~ 99ms = 10fps

LET THE OS MANAGE MULTIPLE DISPLAYS



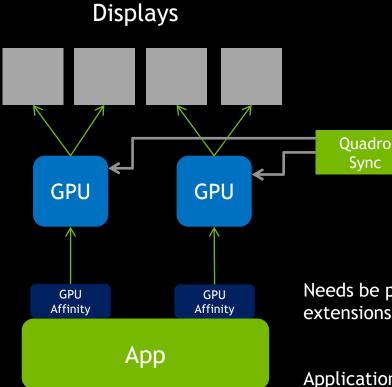
Utilization

Gpu Memory GPU 0000:85:00.0 Utilization Gpu Memory

: 6 % : 7 %

: 0 % : 5 %

APPLICATION WITH GPU AFFINITY



Quadro Sync needed for framelock

Needs be programmed using GPU Affinity (nvidia extensions) for Max performance

Application should use NV swap groups to sync swap buffer between GPUs

Application needs to be multi-threaded (4 Draw threads)

MOSAIC HIDES THE COMPLEXITY



Change the appearance of your display

	1	Detect Identify
Display:	1. Alienware2310 🔻	
Resolution:	7680 × 1080 -	
Drientation:	Landscape 🔹	
		Advanced settings
vlake text and o	ther items larger or smaller	
	ttings should I choose?	

Logical GPU



Administrator: Command Prompt - nvidia-smi.exe --query --display=UTILIZATION -I

	====== N USM	I LOG=======				
	estamp ver Version			Thu Mar 14 314.03	23:22:54	2013
	ached GPUs 0000:02:00.0 Utilization			4		
	Gpu Memory			10 % 7 %		
GPU	0000:84:00.0 Utilization Gpu Memory			10 % 7 %		
GPU	0000:03:00.0 Utilization Gpu Memory			10 × 7 ×		
GPU	0000:85:00.0 Utilization Gpu Memory		-	10 % 7 %		

WHAT DOES SYNC DO

Synchronize Multiple Displays

- Align the scan out of multiple displays, GPU's, and systems
- Maintain Stereo alignment between multiple systems
- Synchronize to an internal or external timing source

Co-ordinate Buffer Swaps

- HW based swap synchronization within a node or between clusters
- Prevent tearing and image mis-alignment

G-SYNC GAMING MONITORS

- Approaches the problem differently
 - GSYNC is a module put into the display
 - Currently vsync tells GPU when to update
 - Gsync tells the display when to update
- Currently only works for single displays attached
- Future version may support multiple displays.



MOSAIC Setup and configuration

SETTING UP MOSAIC			

VIDIA Control Panel			
Edit Desktop Workstation Help			
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Rotate deplay -View HDCP status -Set up digital audio -Set up multiple displays	Prenium Mosaic is enabled Premium Mosaic Displays-1		Hodfy Disable
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PERFORMANCE, POWER, AND PASSIO	Product Series:	Quadro Plex Series				
MADE PERFECT	Product:	Quadro Plex 7000	×			
GeForce® GTX 690.	Download Type:	Mosaic Utility	~			
	Operating System:	Windows 7 64-bit	×	_		
mr.	Language:	English (US)		SEARCH		
	Option 2: Auto File	Download - Se	ecurity Wa	urning		X
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Legal Notice Cooler and Thermal Events Lang M/Will NATERA Performance Counters Logan and tacons M/Will activity			VAPI HAT IS
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	Copyright(c) 2010-2011 NVIDIA Corporation. All rights reserved.		PPLIC
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	1. General Purpose		W Measure unterviti
	NVWHI provider allows WHI dients to query and to monitor parameters of NVIDIA hardware. It is implemented as a decoupled WHI provider in a system service (nvwm.exe in 32-bit or nvwm64.exe in 64-bit flavors of Windows).	Enut	aplay B unoratik W Tepol
	2. General Requirements		dity to : one Re
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	3. Version-specific Implementation Details		TV Con
	Version 1.2	Web	dea Coa
	 Version 1.2 implements access to physical GPUs' thermal environment and provides basic information such as GPU and based runners. 	Com	unecting dity to a
	 Clients could monitor events from GPU costers and thermal probles. Hardware that is capable of reporting this advantation is remained. 		W Owere

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DEVELOPER CENTERS TECHNOLOGIES TOOLS RESOURCES CONNILI	ITY
NVAPI	DOWNLOAD
WHAT IS NVAPI, AND WHY DO YOU NEED IT?	NEAPE Apr-2012 NMEXI's core software development bit or both 32- and 64-
MARTE IN NYDAYs care to these development bit that vibral devot access to MARTA GPUb and detern on all windows platforms. NYDB (preddes space) for unsignifies of operations that range beyond the scope of those found in familiar graphics APIs such as BreetX and OperaGL.	MEAPI Teb-2012 NICKII core software development lift or both 22- and
initially exposed only to OEHs and game developer tools, NVAPI is now available for download to all developers interested in building Windows applications on NVDA GPUs.	64
DOWNLOADS	NMDR's core software development bit or both 22- and 64
 WWP (2013-Jun) (108 ZP) 	HTAPI Sep-2011
WYDA Driver Setting: Programming Guide (SER. PSF) APPLICATION TYPES	NMEW's core software development lift or both 32- and 64
MARP allows full access to MIDIA GPUs and drivers in any III and non-UI application. Under Windows Vista, the application content using MARP must be loanshed in Session 1 or Nigher.	NULL Aug 2011 NULDU's core software development kit or both 22- and
NVAPI FEATURE CATEGORIES	64
Driver Recognisent	PUBLICATIONS
Initialization and driver version controls.	HITEGA Driver Settings
toPE Management Enumeration of absolval and logical GPUs. Thermal and Cooling controls.	Programming Guide (January
Disalar Beamment	
Enumeration of MADA display, display portion and tinings controls.	OUICILINES
GPU Tepology	
Ability to enable SSI and Hybrid GPU topologies."	The HVE&A Registered Developer Program
Frame Readering	Registered Developers Website
Ability to control Video and DX rendering not available in DX nurtice.*	
System Recomment AMRy to every chapet and poten specific information.	Hilberelaper (ald site)
ROTY Controls	HITERA Graphics SDR 11
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Extended video angine controls.*	PligsX
Connecting and Configuring Monitors	APEX
Ability to set views on multiple target monitors.	
GPU Overclockieg	FEATURED ARTICLES
(2)) coarcipritus fift along and to run and at avoinup particle riprir.*	

Control Panel

Configuremosaic

Large display walls

NVWMI

Setup from a remote machine Powershell scripts Program directly NVAPI

Incorporate MOSAIC setup into your own application

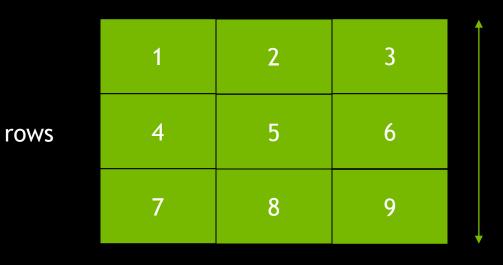
Driver Install

Download from NVIDIA driver section Install with Driver under advanced options

Registered Developer for NDA access NVAPI

MOSAIC GRIDS

columns



Rows x columns <= 16 Max Horizontal or vertical Pixels <= 16384

Vertical Pixels

Enumeration of the Grid always starts top left and goes left to right

Horizontal pixels

Ove Bezel c

UNDERSTANDING TOPOLOGIES

Column overlap or bezel correction

	1	2	3	4	
Row erlap or correction	5	6	7	8	
	9	10	11	12	
	13	14	15	16	

Bezel correction will increase overall pixel size

i.e each display is 1920x1080 Bezel per column is 100

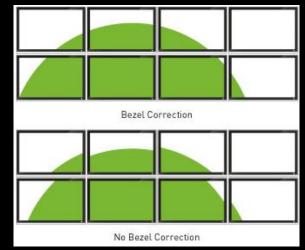
Total horizontal width = 1920*4 + 100*3 = 7980

Overlap correction will decrease overall pixel size

BEZEL AND OVERLAP CORRECTION

Bezel Correction

 Will make the image look continuous as we render under the bezel





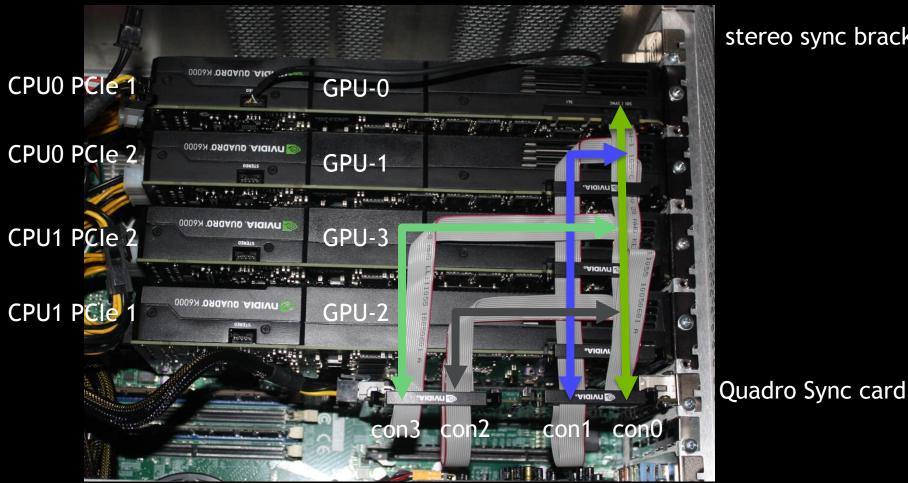
Projector Overlap



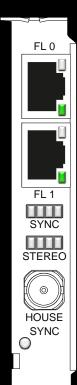
No Projector Overlap

- Overlap Correction
 - For projectors it maintain the Aspect Ratio of the display.

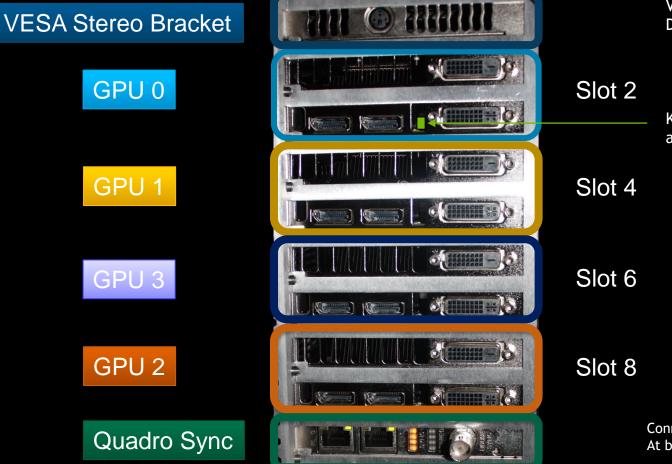
ANATOMY OF A SYSTEM



stereo sync bracket



REAR PANEL - BOXX 8950 - 4 K6000S

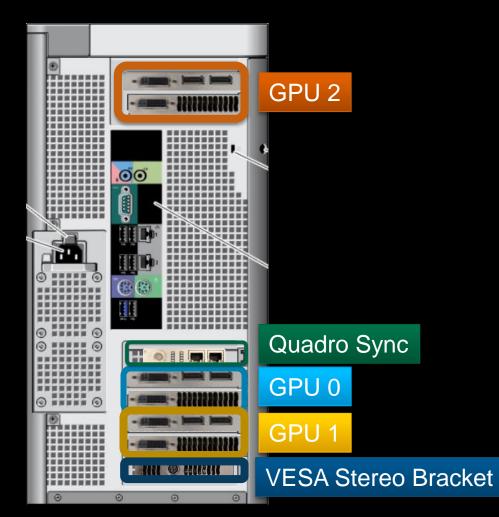


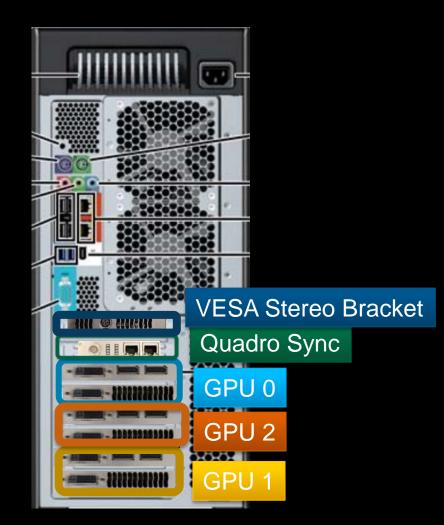
VESA stereo - only one per system required Doesn't require PCIe slot - just a blank

K6000 - Master GPU will have a green LED after POST

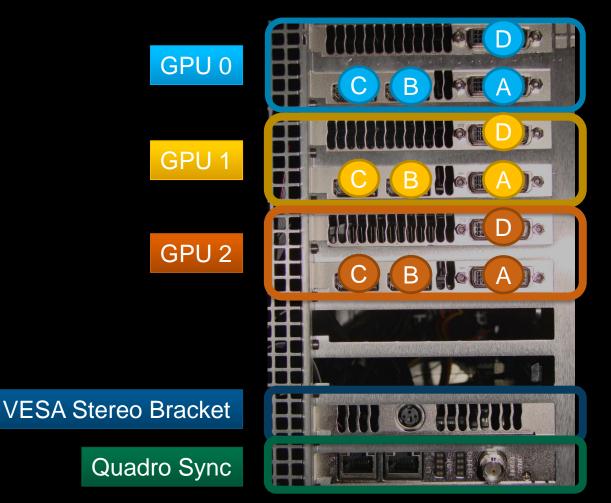
Connect to all 4 GPUs. At boot-up LEDs will be amber showing GPU connected

DELL T7600 + HP Z820



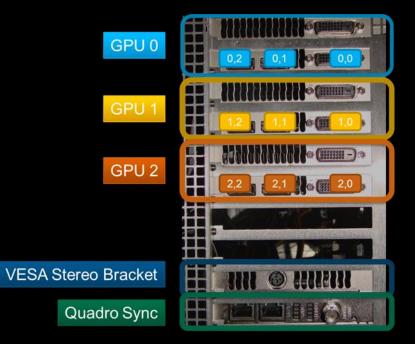


PORT NUMBERING



Ports auto enumerate depending what is attached i.e. A + D are attached A = 0,0D = 0,1A + B + D are attached A = 1,0B = 1,1D = 1.2A + B + C + D are attached A = 2,0B = 2,1C = 2,2D = 2,3

RELATING PORTS TO GRID





9

configureMosaic.exe set rows=3 cols=3 configureMosaic.exe set rows=3 cols=3 out=0,0 out=0,1 out=0,2 out=1,0 out=1,1 out=1,2 out=2,0 out=2,1 out=2,2

3

4

5

6

MANAGE EDID

NVIDIA Control Panel					X
File Edit Desktop Workstation Help					
🌍 Back 🝷 🜍 🛛 🏠					
Select a Task		ow System Topol	0.011		-
- 3D Settings Adjust image settings with preview Manage 3D settings Set PhysX Configuration		ew System Topol		1 this system.	
- Display					E
Change resolution Adjust desktop color settings	Expan	d all 🕐 <u>R</u> efresh			
Rotate display	System to	pology	Status	Settings	
View HDCP status Set up digital audio	🗆 System	n			
Adjust desktop size and position	Dr	iver version		334.95	
Set up multiple displays	Ve	rtical sync	O	3D Application controlled	
	3D	Stereo		Disabled	
	Ξ.	Quadro Sync			
- Video		Framelock 0	23	Not used	
Adjust video color settings Adjust video image settings		Framelock 1	ᄈ	Not used	
- Workstation		External sync signal		Not present	
····View system topology ····Set up Mosaic		Framelock sync pulse		Not present	
Change ECC state		Sync settings		Synchronize Displays	
Synchronize displays	E	Quadro K6000 (1 of 4)			
		DVI		Not connected EDID (Monitor)	
		DisplayPort (2)		Not connected <u>EDID</u> (Monitor), <u>Multi-Display Cloning</u> (Disabled)	
		DisplayPort (1)		Not connected <u>EDID</u> (Monitor), <u>Multi-Display Cloning</u> (Disabled)	
		DVI		Connected: Dell Alienware2310 EDID (Monitor)	
		SLI Mode		Disabled	
O System Information	(Usage Mode III		WDDM	▼ 1.1

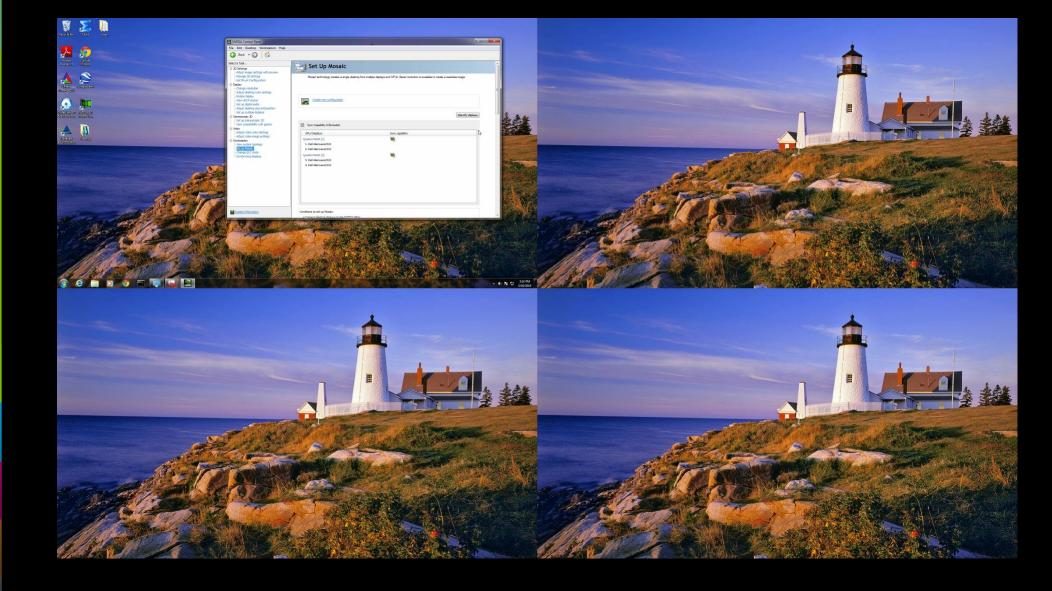
BENEFITS OF MANAGING EDID

- EDIDs can be lost due to switches/extenders
- If a cable is unplugged its doesn't cause a hot plug event
- Can help with staging a system
- Can fake a display if it is not present.

Limitations

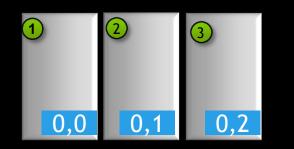
- Not supported on DP1.2 displays.

GPU TECHNOLOGY CONFERENCE



PORTRAIT MODE

- Some operations are best done by Command line
 - i.e. Portrait mode requires that GUI starts in Landscape mode it's a feature ;-)



Rotate values 90 180 270

configureMosaic set rows=1 cols=3 rotate=90



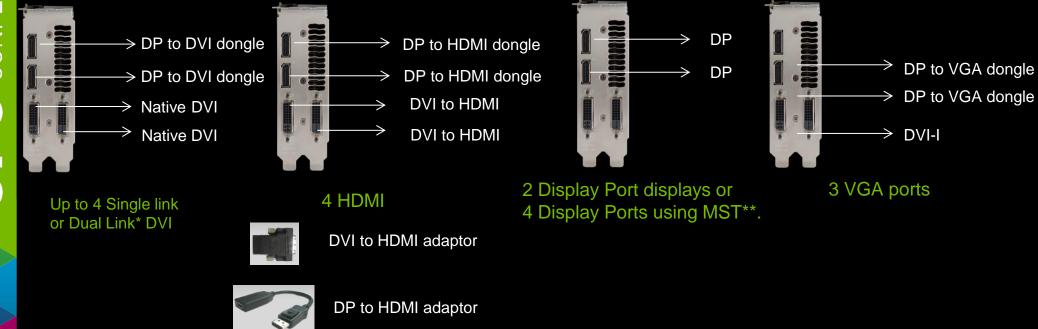
QUADRO DISPLAY OUTPUTS

■4 Display Connectors → 4 Displays __2 DVI-DL, 2 DP 1.2

- Only one VGA output on DVI
- DP 1.2 support High Bit Rate 2 (HBR2) and Multi-Stream
 - Total of 4 independent heads
 - High Bit Rate 2
 - K5000 3840x2160 30bit @ 60Hz on a single connector
 - K6000 4096x2160 30bit @ 60Hz on a single connector

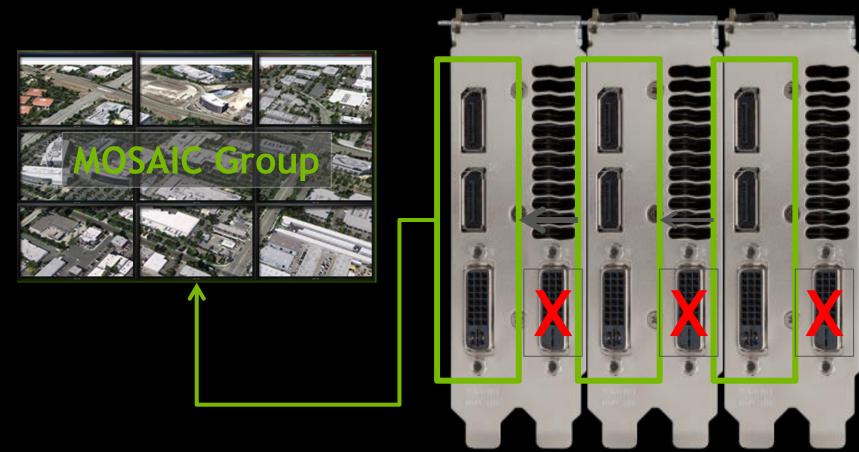
 Stereo through an optional Stereo Bracket same as Quadro 4000

K5000/K6000 - SUPPORTED OUTPUTS

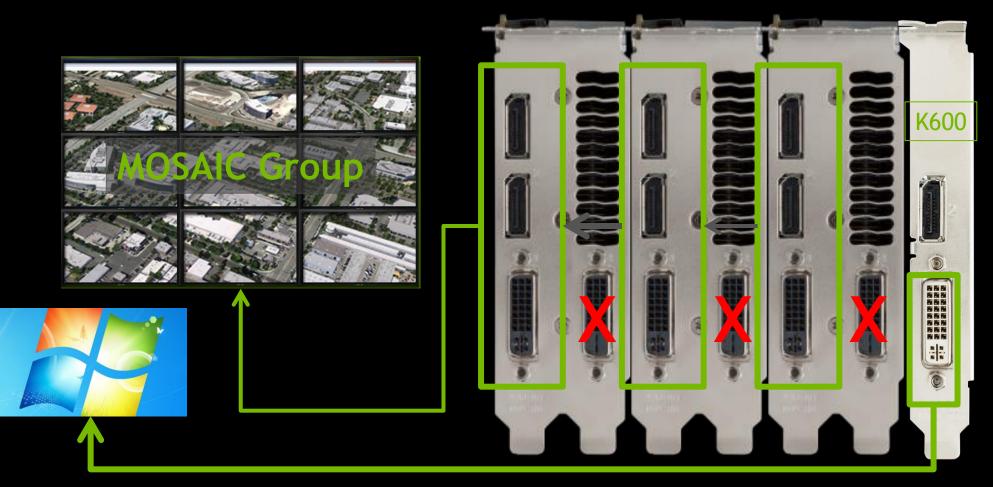


- Dual link requires active dongle for DP connectors
- **MST allows for DP to be daisy-chained. Support 4 displays per card

MOSAIC ACROSS MULTIPLE GPUS + 1



MOSAIC ACROSS MULTIPLE GPUS + 1



NEW FEATURES IN R334 DRIVER

Premium MOSAIC= MOSAIC with Sync

Sync Capability Information

Indicates whether or not card or system can be sync'd.

R331 driver

- GPU and port number OSD

B NVIDIA Control Panel <u>File Edit Desk</u> top <u>W</u> orkstation <u>H</u> elp		
Back + (2)		
Select a Task	Set Up Mosaic Mosaic technology creates a single desktop Image: Create new configuration Image: Create new configuration <	o from multiple displays and GPUs. Bezel correction is available to create a seamless image. Identify dis Sync capability Multi GPU Sync Quadro Sync
	•	m +

MOSAIC TIPS

MOSAIC does not work with ECC on

Make sure it is off

3. Arrange displays	Adjust overlap and bezel correction
Sync capability	Refresh rate:
1	Resolution per display:
	Total resolution: 0 x 0 pixels Mosaic is not supported when ECC state is enabled. Go to the 'Change ECC state' page and disable ECC for all Quadro GPUs.

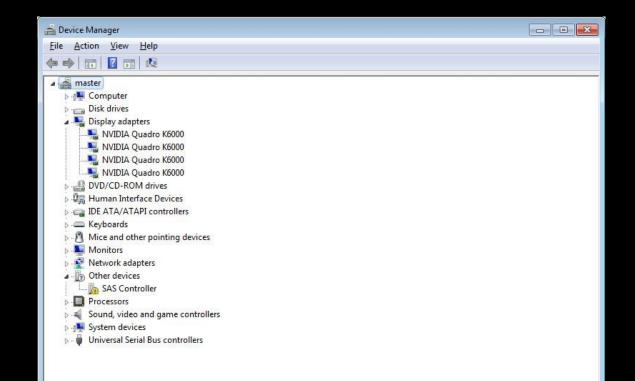
MOSAIC TIPS

Make sure there is no Mirror Driver installed

Mirror Driver is installed by remote admin software. It will sit between the OS and graphics driver.

Will often break

- 3D stereo
- accelerated video playback
- MOSAIC + Sync



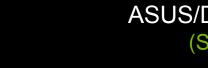
4K DISPLAYS + MOSAIC

Prosumer



4K 84" TV (Single HDMI input)





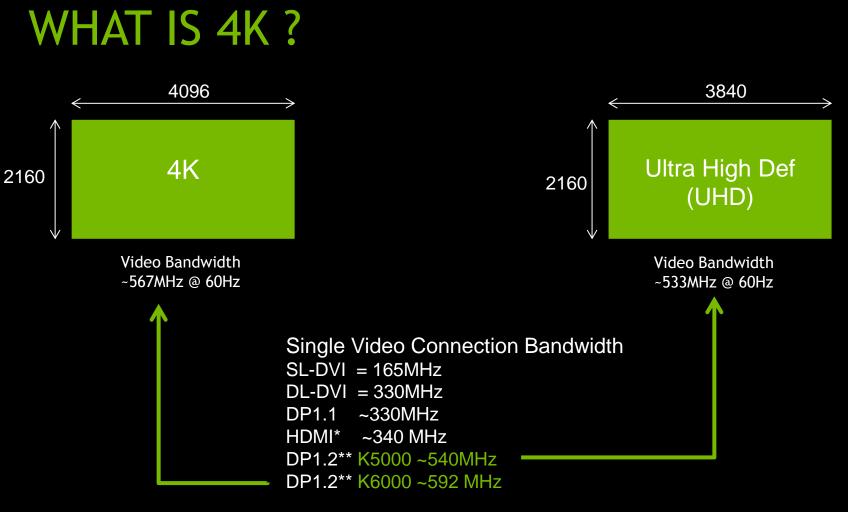
CTT

ASUS/Dell/Sharp 32" monitor (Single DP1.2 input)



4K 84" panel (four HDMI input)

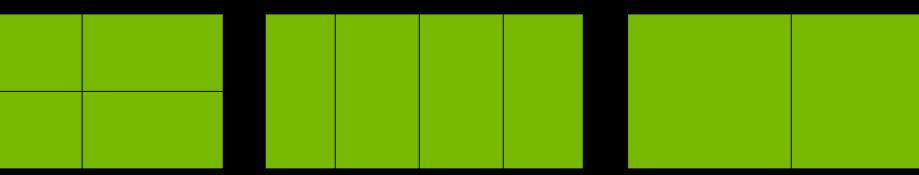
4K Stereo Projector (Up to 8 inputs)



- HDMI 1.4 supports 4k/UHDTV at 24 & 30 Hz for single cable
- HDMI 2.0 will support 4K @60Hz at 4:2:0 color

** DP1.2 can drive 4K but implementation will vary per Graphics card.

DRIVING 4K - MULTIPLE CONNECTIONS



Quadrants 4 DVI or HDMI/DP Each input is 4K – 2048 x 1080@60Hz UHD – 1920x1080@60Hz Stripes 4 DVI or HDMI/DP Each input is 4k - 1024x2160@60Hz UHD – 960x2160@60Hz

Side by side 2 DL-DVI/DP Each input is 4k – 2048x2160@60Hz UHD -1920x2160@60Hz

Display Port can support higher color depth desktop

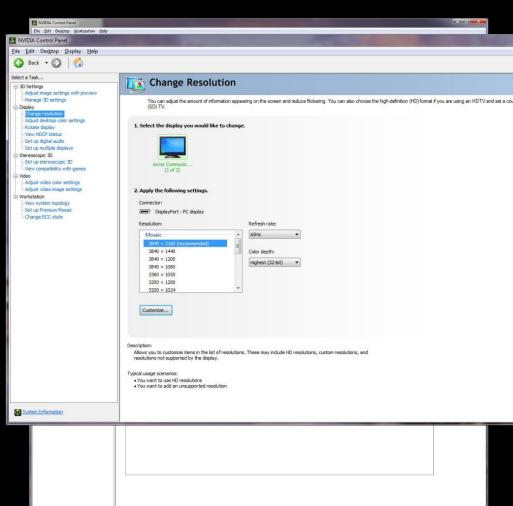
DP1.2 AND VESA DISPLAY IDS

• Display Port 1.2 input

- Panel acts a Multi-streaming hub
- So two 1920x2160 channels over single cable

• Vesa Display ids

- New extension to VESA EDID standard
- EDID identifies its preferred display resolution.
- New extension identifies position in tiled display
- NVIDIA driver (R331) will automatically enable MOSAIC when it detects these displays to give single Desktop.



MOSAIC USING SCRIPTS

- Configure MOSAIC
 - NVIDIA developed tool
 - Can be used in batch file
 - Useful for complex installs
 - i.e. mutli-GRIDs

NVWMI

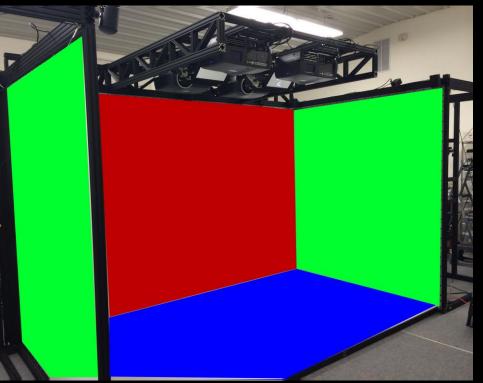
- Powershell, WMIC, C# etc
- Example script in backup.
- Can be used remotely

<mark> NVIDIA</mark> .			S	earch NVIDIA	USA - United States		
DOWNLOAD D	RIVERS COOL STUFF SH	HOP PRODUCTS	TECHNOLOGIES	COMMUNITIES	SUPPORT		
DOWNLOAD DRIVERS							
NVIDIA Home > Download Drivers	NVIDIA Driver [Downloads					
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POWER, AND PASSION MADE PERFECT Experience the game-changing GeForce® GTX 690.	Product:	Quadro Plex 7000 Mosaic Utility		Name: configu	ureMosaic.exe		
		Windows 7 64-bit English (US)		Type: Applica From: us.do	ation, 484KB wnload.nyidia.com		
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			🔣 🚺 pol	tentially harm you	Internet can be useful, ir computer. If you do n ware. <u>What's the risk?</u>	this file type can ot trust the source, do not	

MOSAIC GRIDS

- 12 Projectors, driven by 3 K5000s
- Floor and Front wall 4 projectors
- Side walls are 2 projectors
- 4th GPU used a console output
- After configuring MOSAIC set Sync.
- Dual boot works with Linux.

Image courtesy of VisBox



configureMosaic.exe set rows=1 cols=1 out=0,0 nextgrid rows=2 cols=2 overlap=384,240 out=1,0 out=1,1 out=1,2 out=1,3 nextgrid rows=2 cols=2 overlap=0,240 out=3,0 out=3,1 out=3,3 out=3,2 nextgrid rows=2 cols=2 overlap=384,480 out=2,0 out=2,1 out=2,2 out=2,3

MOSAIC VERSUS EQUALIZER

MOSAIC with Clip

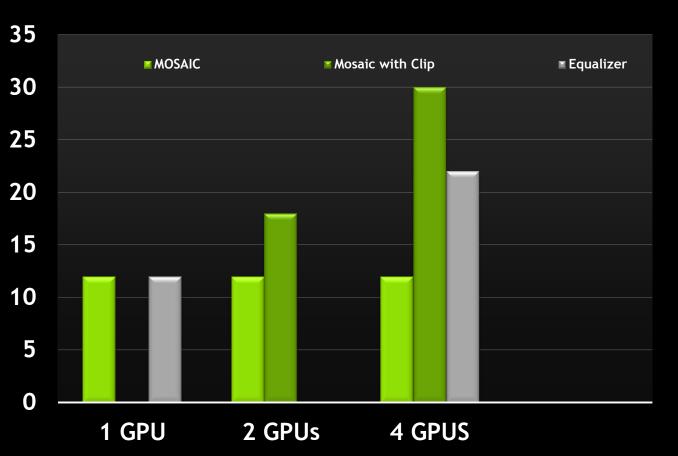
- Improves fill performance

Flat Wall

- 4 1920x1200 monitors
- 2x2 MOSAIC layout

Equalizer

- Open source
- API intercept to convert applications to run on multi-GPUS



Quadro K6000s - driving 3840x2400 display

ADVANTAGES OF MOSAIC

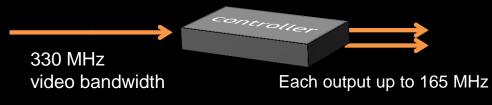
- Advantages
 - Performance
 - Reduce model load time
 - Reduce System complexity

- Disadvantages
 - Performance gain will be app specific
 - Increased memory usage on the card
 - May limit memory size.

- MOSAIC with clipping enabled with command line tool configure_mosaic_clip_to_subdev
- Full screen apps only (if you drag windows over GPU boundary you will see tearing).
- Supports DirectX and OpenGL
- Contact QuadroSVS@nvidia.com if you want a copy of the utility

VIDEO DISPLAY CONTROLLERS

- Features
- Dual link DVI or DP input
- 2 or more DVI outputs



- Examples
 - CYVIZ XPO.3
 - DataPath X4
 - Pixell VP-4xx
 - Planar Quad Controller
 - Black Diamond Video DVI splitter
 - Matrox Triple head to Go
 - Etc

1:1 pixel mapping of input to output

VIDEO CONTROLLER VERSUS DP MULTI-STREAM HUB

- Video Controller
 - Splits a high resolution video signal across multiple displays
 - Single K5000 could have 4 controllers each splitting 4 ways to give a total of 16 displays

Display Port Multi-Stream hub

- Video signal for 4 monitors is carried by one Display Port cable
- Multi-Stream hub routes signal to 4 separate displays
- Max displays from a single K5000/K6000 using MST is 4!!

36 DISPLAYS DRIVEN BY 9 OUTPUTS

- Planar Quad Controller
- 3840x2160@30z
 - Split to 4 1920x1080 panels
- MOSAIC makes it easy for multitouch

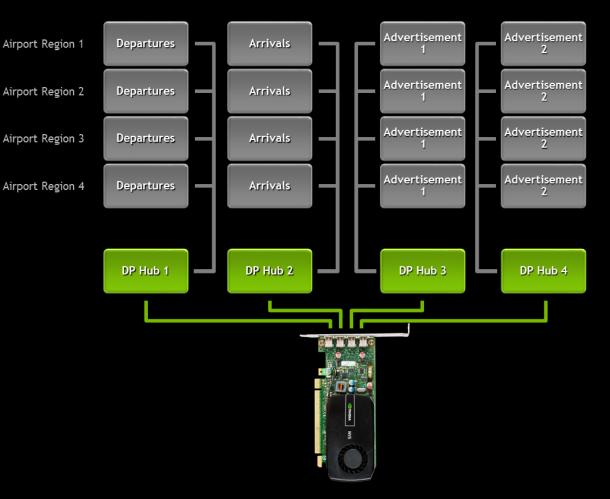


Image courtesy of Vislogix

NVS 510 DISPLAYPORT 1.2 STREAM CLONING

Allows 4 Display Heads to drive 16 Displays

- 4x4 cloned images.
- Primarily used in digital signage markets such as airports, restaurants, and hospitality.



Building a cluster

QUADRO SYNC - HARDWARE + SOFTWARE

Hardware

- RJ45 Framelock for synchronization of multiple displays to a common internal sync
- BNC/Genlock Framelock for synchronization of multiple displays to a common external house sync

Software

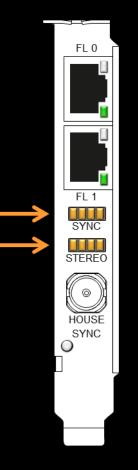
- Requires application to be written with extensions
- Swap Group and Swap Barrier are OpenGL & DirectX Extensions that provide enhanced synchronization of the graphics swap buffer.



QUADRO SYNC FEATURES

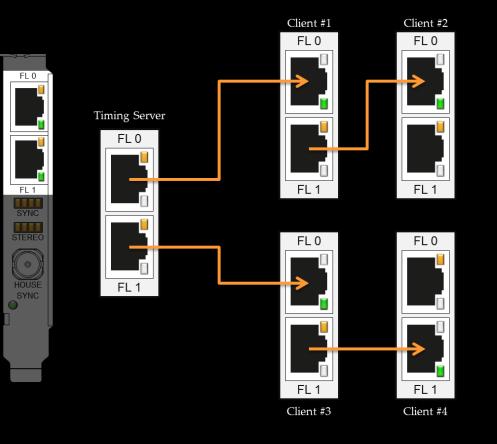
- Increased Swap Barrier Support
 - Up to 25 Quadro Sync cards in single chain.
 - 50 Quadro Sync cards in a cluster
 - 4 GPUs per Quadro Sync 200 GPUs with Swap Barrier Support
- Sync Delay and Skew settings
 - Ability to adjust sync delay per Quadro card.
- Control via NVAPI
 - public developer version
 - Example code on how to control Quadro Sync (works with GSyncII)
- Control via NVWMI
 - Allows remote access control across a cluster

BOOTING



- When the board boots after shutdown ALL the Sync and Stereo lights turn Solid Amber, like at the left
 - $-\,$ A reboot will not change the LEDs from the previous state, only a power cycle does
 - The LEDs change to the correct status after the driver loads
- If there are no LEDs illuminated on system boot, check the power cable

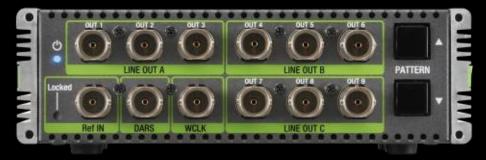
WIRING A CLUSTER



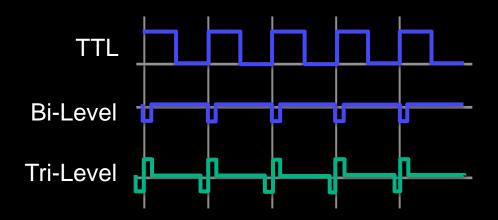
- Connect the nodes with quality CAT 5 cables, no longer than they need to be
- Put the timing server in the middle
 - This system should have the stereo connector for active stereo if needed

EXTERNAL SYNC

- 3 Formats of Sync Sources
 - TTL: 3.3V, 50% duty cycle, high impedance
 - Bi-Level Composite (NTSC/PAL): 75 Ω , \pm 300mV
 - Tri-Level Composite (HDTV): 75Ω , ± 300 mV



Grass Valley ADVC G4 (bi/tri level) <= 60Hz





Agilent 3350B (TTL, bi/tri level) variable

CHECKING SYNC STATUS

FI 0

FL 1

SYNC

STEREC

HOUSE

LEDs on the board

- Frame Lock Sync & Stereo Phase per GPU (not display)
- House/External Sync
 - Solid Green Present
- Frame Lock connectors
 - Amber Output
 - Green Input

Control Panel

• System Topology Viewer provides per display sync information

_							
= 🗖	automated computer con (1 of 2)						
	Display state	Server					
	Resolution, refresh rate	1920 × 2160 pixels,	. 49.996 Hz				
		Horizontal (2200)	Vertical (2300)				
	Active	1920	2160				
	Border	0	0				
	Front porch	13	8				
	Sync width	140	10				
	Back porch	127	122				
	Polarity	Negative (-)	Negative (-)				
	Timing	The display is lock	ed to an internal timing sign.				
	EDID source	Monitor					
	OS Screen Identifier	1	1				

SYNC + POWERSHELL

query_sync.ps1

.\query_sync [-auth] node1 node 2 node 3

-auth - prompt for username/password

node1.. is the list of machines to query.

					Sel	ect Win	dows Pow	erShell			 ×
target No	odeName Dri	iver G	PU0	GPU1	GP 	U2 GPU3					^
master MA	ASTER 320	0.86 Q	uadro H	(6000 Quadro	o K6000						
NodeName	Global_Pro	ofile	Vertica	alSync		Stereo	StereoMod	e Stereol	Dongle	PowerManagement	
MASTER	Base Profi	ile	[D]3D /	Application	settings	Enabled	On-board	DIN nvidia	3D emitter	Max Perf	
NodeName	DisplayNar	ne		DisplayTy	pe SyncSta	te Widtl	h Height R	efresh			
MASTER MASTER MASTER MASTER MASTER	Alienware2 Alienware2 Alienware2 Alienware2	 2310 (2310 (2310 (2310 (1 of 4) 2 of 4) 3 of 4) 4 of 4) Server) Client) Client	Interna True True True True	1 1920 1920 1920 1920	0 1080 0 1080	60 60 60 60 60			
NodeName									:e_Hz FL_Po	rt0 FL_Port1	
MASTER	Quadro Syr	nc 0x5	4.00	True	Tr	ue	False		59 Outpu	t Output	
PS C:∖Use	ers\doug\De	esktop	ı∖sync_:	scripts> _							

Contact us at <u>QuadroSVS@nvidia.com</u> if you want a copy of the script

SYNC + POWERSHELL + NVWMI

- Query Sync
- Set Sync on remote machines
- Monitor Sync events
 - Report to log if framelock status changes.

						Windows	Power	Shell						-		>
target M sync1 S sync2 S sync3 S	SYNC1 SYNC2	320.78 320.78		 K5000 K5000	J1 GPU2 GPU3											
NodeName	e Global	_Profil	e Vertio	alSync		Stereo	Ste	reoMode		Ster	eoDongle	PowerManag	ement			
SYNC1 SYNC2 SYNC3	Base P Base P Base P	rofile rofile rofile	[D] 3D [D] 3D [D] 3D [D] 3D	Applicati Applicati Applicati	on settings on settings on settings	[D]Disable [D]Disable [D]Disable	ed [D](ed [D](ed [D](Dn-board Dn-board Dn-board Dn-board	DIN DIN DIN			[D] NVIDIA [D] NVIDIA [D] NVIDIA	DRIVER	Co	ntro	
NodeName	e Displa	yName		Displayl	Type SyncSta	te Width He	ight I	Refresh								
SYNC1 SYNC2 SYNC2 SYNC2		408WFP 408WFP 408WFP 408WFP	(1 of 2) (2 of 2)	Internal Internal Internal		1280 1280 1280 1280	720 768 720	60 60 60								
NodeName	e Card	F	irmware	isSynced	isStereoSyn	ed isHouse	Sync	SyncSigna	alRat	e_Hz	FL_Port	0 FL_Port1				
SYNC1 SYNC2 SYNC3	Quadro Quadro Quadro Quadro	Sync 0 Sync 0 Sync 0 Sync 0	x52.00 x54.00 x54.00	False False False	Fa Fa Fa	lse F	alse alse alse			60	Input Input Input	Output Output Output Output				
PS C:∖Us	sers\dou	g\Deskt	op>													

PARTNER/CUSTOMER PRESENTATIONS

Tue

- 3.00pm, Roy Anthony, Kevin Moule Christie Digital RM 210G Virtual Automotive: Projection Mapped Graphics for Automotive Design
- 5.00pm, Tim Woodward, Diamond Visionics RM 210C -GPU-based Visualization for Flight Simulation.

Wed

- 2.00pm Room 2101 Erik Beaumont, Ventuz Beyond 4k: Video Walls and Interactive Displays at High Resolutions using multi-machine Clusters
- 2.30pm Room 210H William Paone, Boeing NVIDIA Driven Image Generation in Immersive Fast-Jet Simulators.

Thurs

- 2.00pm Room 211A Julian Berta, MechDyne- Stereo3d Video Streaming for Remote Collaboration
- 2.30pm Room 211A Raj Surati, Scalable Display Technologies Mid-tier VR: Cost Reducing the Cave by Embracing the GPU

EXHIBITORS

- Workstation OEMS
 - HP
 - Dell
 - Lenovo
 - Boxx Technologies
 - Exxact Corp
 - GraphStream
- Display/Software
 - IGI (#932)
 - Scalable Display Technologies
 - VizRT
 - RTT

SUMMARY/QUESTIONS

- Quadro SVS
 - Reduces complexity.
 - Contact us at QuadroSVS@nvidia.com

WMI EXAMPLE - POWERSHELL SCRIPT

\$namespace = "root\CIMV2\NV" # Namespace of NVIDIA WMI provider \$class = "DisplayManager" # class to be queried \$computer = "localhost" # substitute this values with remote machine names or IP of the \$executionTime = 3 # Allow a delay of 3 seconds for execution of the method \$displayManagerInstance =Get-WmiObject -class \$class -computername \$computer -namespace \$namespace # Validate the Grids first \$method = "validateDisplayGrids" \$grids = @()

```
$grids += "rows=1;cols=2;stereo=0;layout=0.0 0.1;mode=1600 1200 32 60" #add grid 1 parameters
$grids += "rows=1;cols=2;layout=1.0 1.1;mode=1280 1024 32 60" #add grid 2 parameters
$params = $displayManagerInstance.GetMethodParameters($method)
$params.grids = $grids
```

```
#Validate the Grids
Start-Sleep $executionTime
"Calling $classname.$method()"
$result= $displayManagerInstance.InvokeMethod($method,$params,$null)
$result
```

```
if($result.ReturnValue)
```

```
#Validation passed now create the DisplayGrids
$method="createDisplayGrids"
Start-Sleep $executionTime
"Calling $classname.$method()"
$result= $displayManagerInstance.InvokeMethod($method,$params,$null)
$result
```