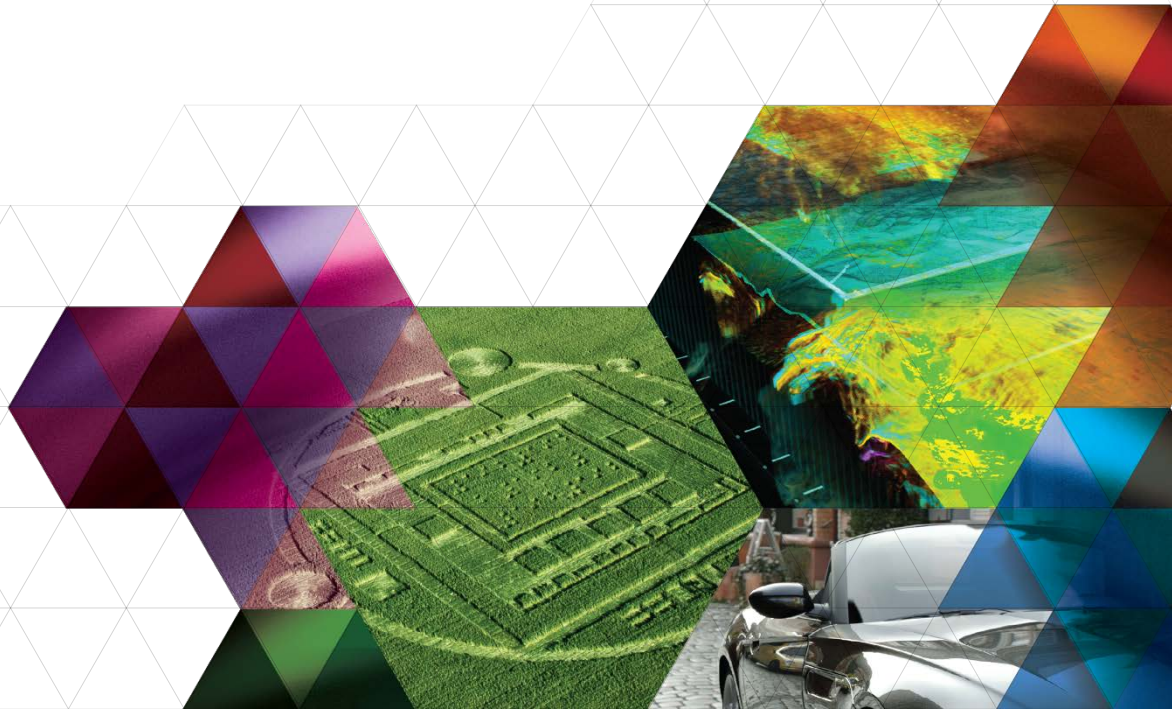
NVIDIA Quadro and NVS Video Walls

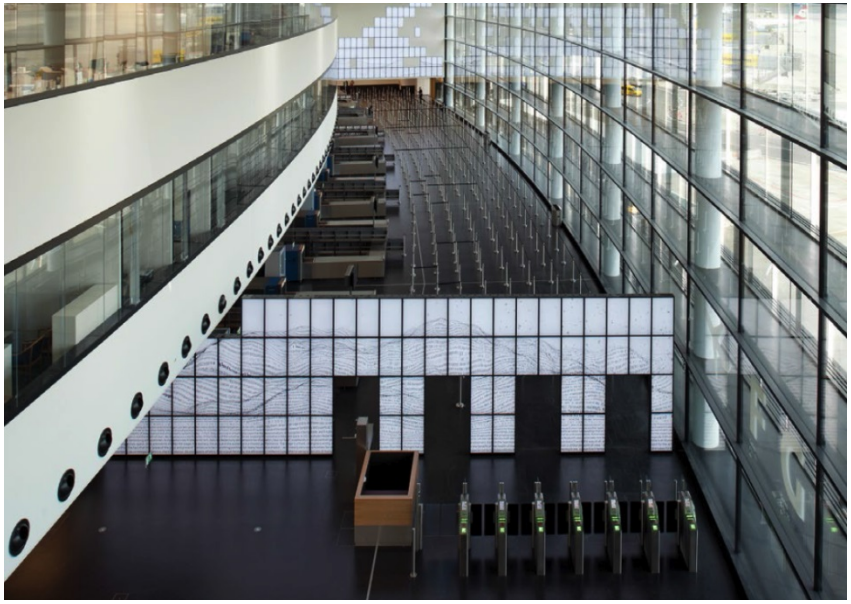
NVIDIA® QUADRO®
AUTHORIZED PARTNER
PNY®

NVIDIA® NVS™
AUTHORIZED PARTNER
PNY®



NVIDIA Quadro and NVS Video Walls

Using NVIDIA technology to reduce complexity and cost



Opens up new sales opportunities	
▪	Quad display Quadro boards and compatible PCIe x16 motherboards increase capabilities while lowering costs
▪	Up to 16 4K displays can be driven from a single system
▪	NVIDIA Mosaic and Quadro Sync simplify solutions development
▪	PNY offers turnkey video wall kits

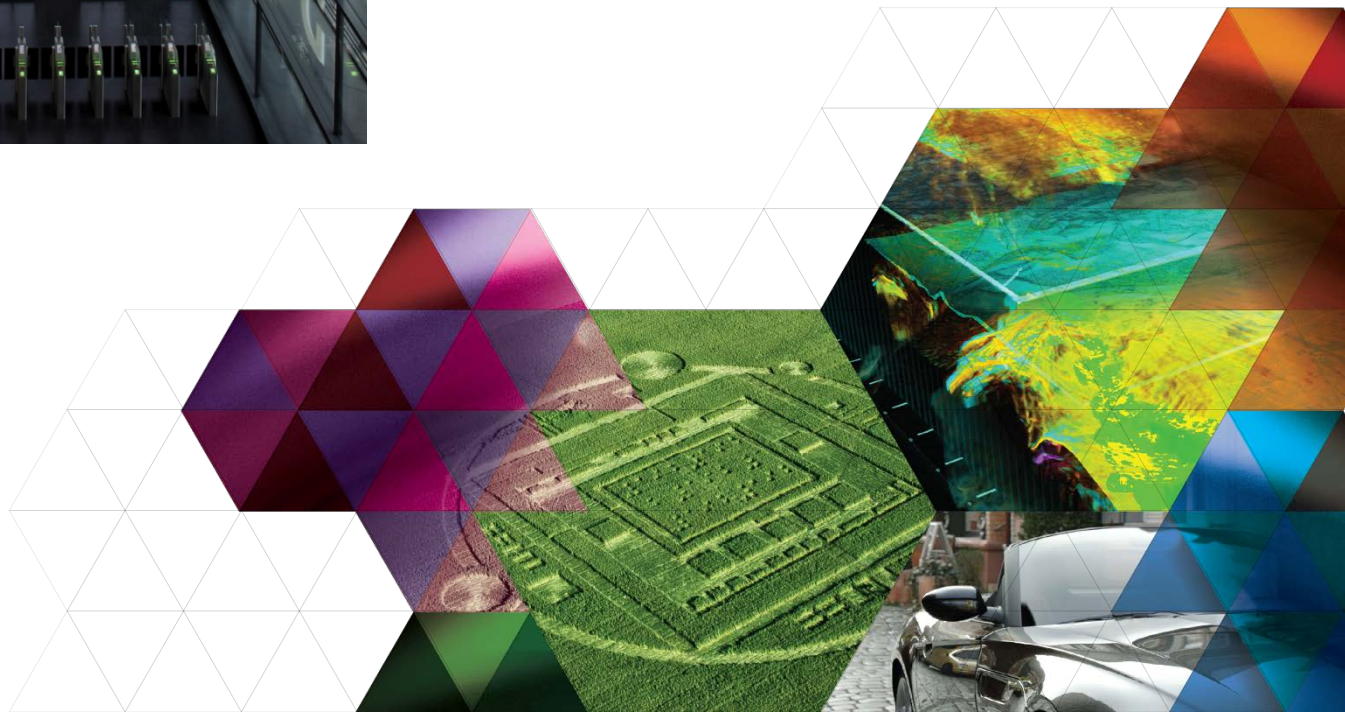
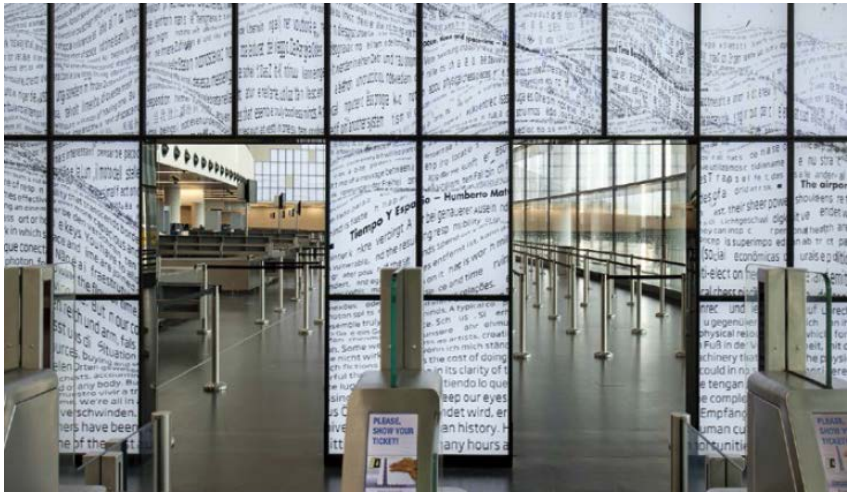


Image courtesy Vienna International Airport.

Implementing Ultra-High-Resolution Video Walls

NVIDIA Quadro, Quadro Sync, NVS and Mosaic make it possible



NVIDIA Mosaic	
▪	Creates a single unified desktop
▪	Supports up to sixteen 4K displays
▪	Supported on Quadro, with or without Sync, and NVS
▪	Windows 8.1, 8, 7, and Linux
NVIDIA hardware and software technologies hide complexity	

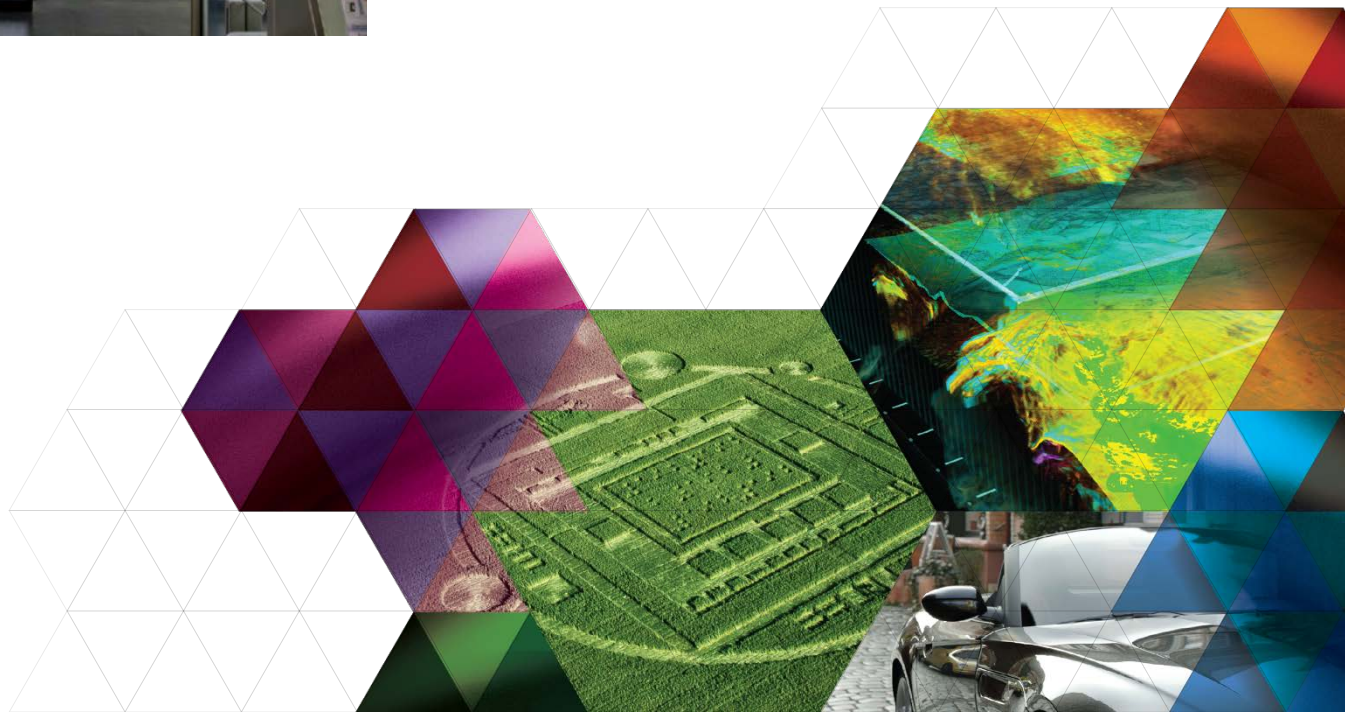
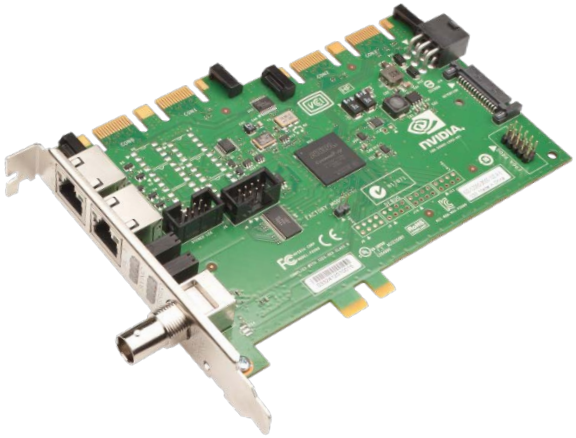


Image courtesy Vienna International Airport.

What Does Quadro Sync Do?

Synchronization features and benefits

Synchronizes 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
Coordinate buffer swaps	
▪	Hardware based swap synchronization within a node or between clusters
▪	Prevents tearing and image misalignment



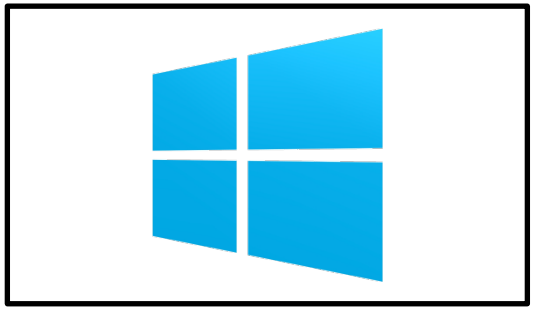
Implementing Video Walls

NVIDIA infrastructure simplifies development and deployment

Custom Resolutions	Mosaic	Tiled Displays	10 and 12-bit Color
GFT, DMT, CVT, CVT-RB, Manual timing	Seamless desktop across multiple GPUs	Automatic Mosaic setup on tiled displays using DisplayID	Support High Dynamic Range (HDR) 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 for Video**	**External or Internal Sync**	**DisplayPort MST**
DP 1.2 or HDMI 1.4B connectors or later	Picture-in-picture (POP) support	Genlock/TTL sync or internal sync	Support for multi-streaming devices
Warp + Intensity API	**NVAPI/NVWMI**	**Display Clone Modes**	**GPU Affinity**
Edge-blending and projection mapping for Windows or Linux	Programmatically control driver	DisplayPort clone, pan and scan clone, 4K cloning	Multi-GPU support and Swap Groups

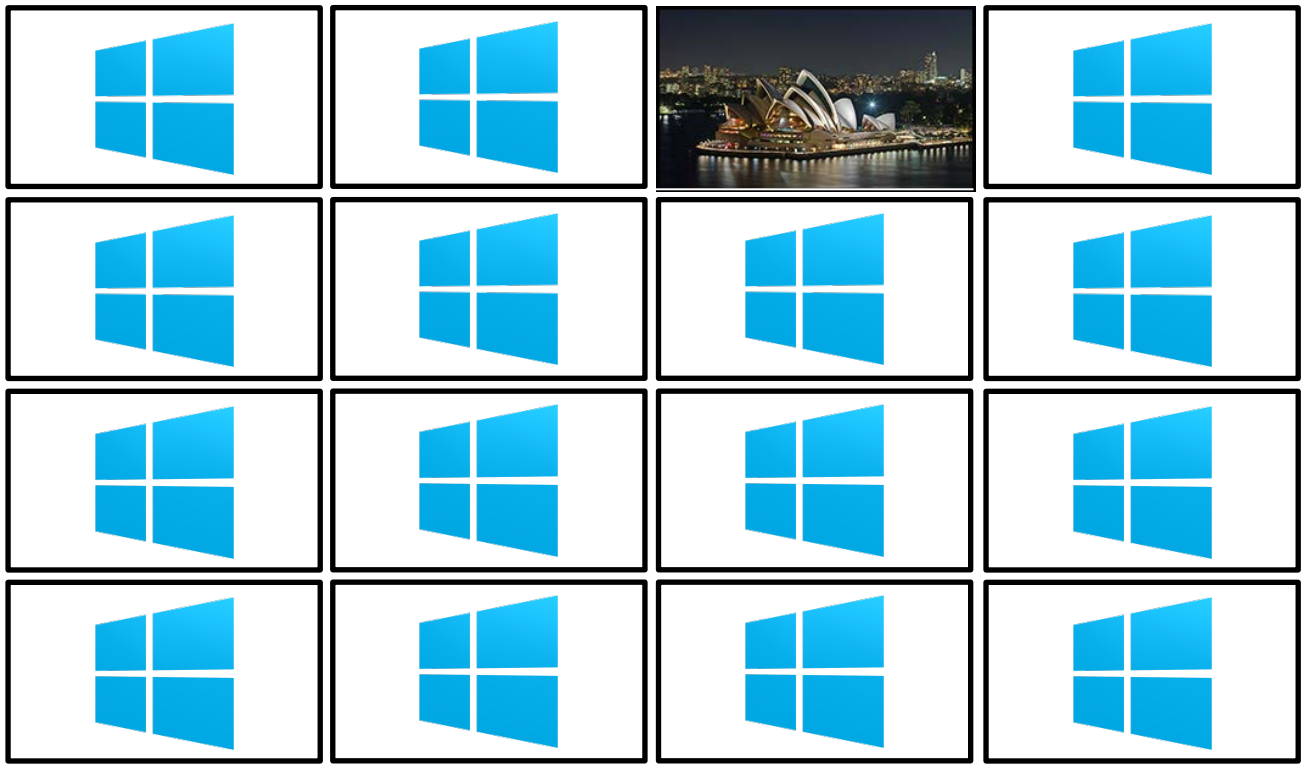
NVIDIA Mosaic: Why is it Necessary?

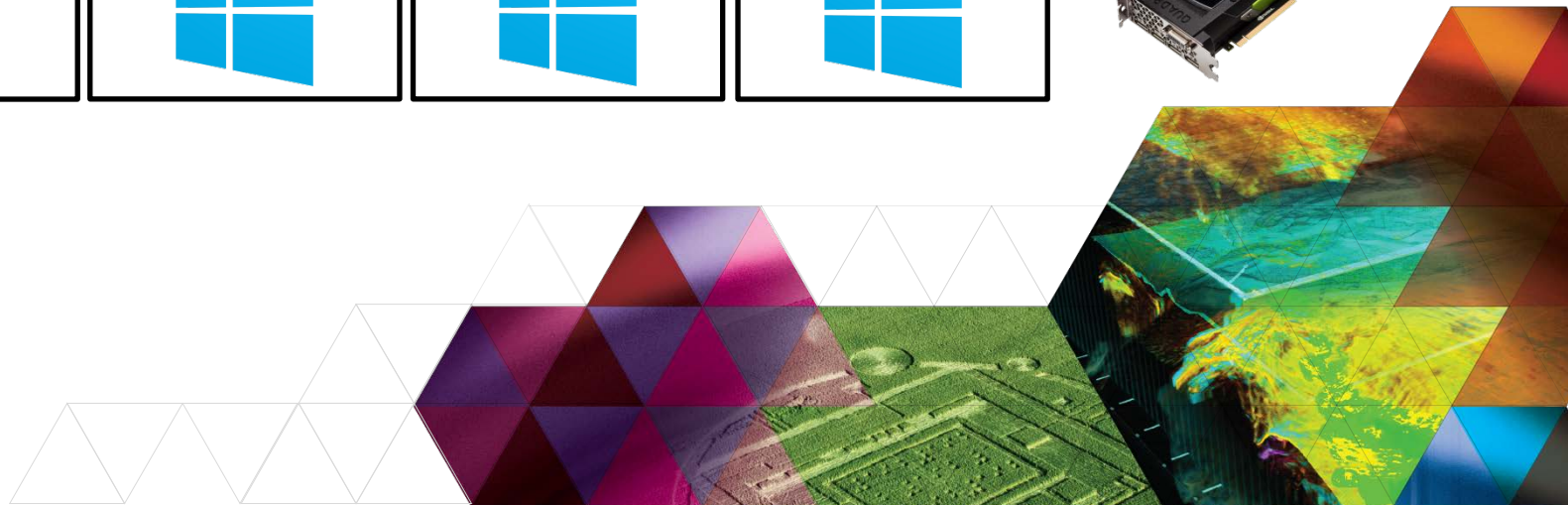
Windows on its own presents independent desktops



Windows Presents Independent Desktops

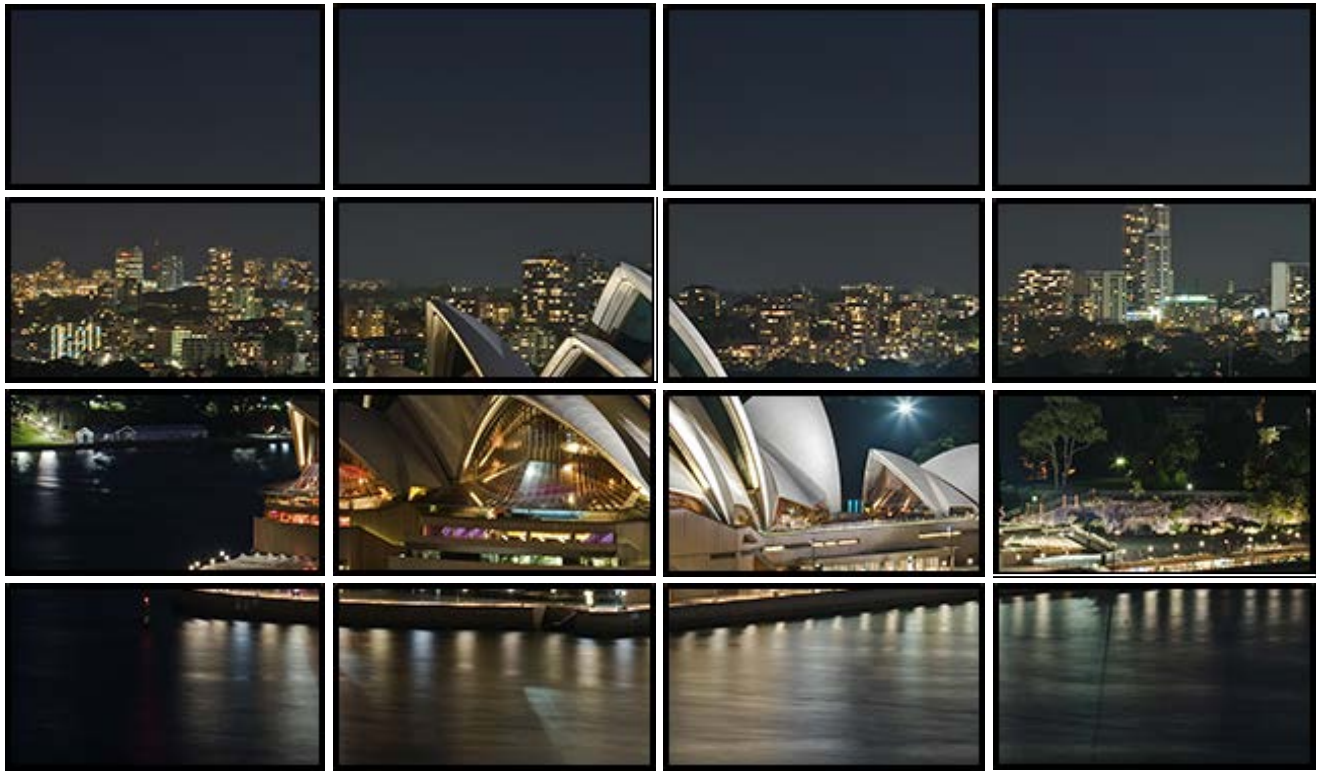
Even when used with multiple GPUs





NVIDIA Mosaic with Quadro

One large logical desktop without complexity or app modification



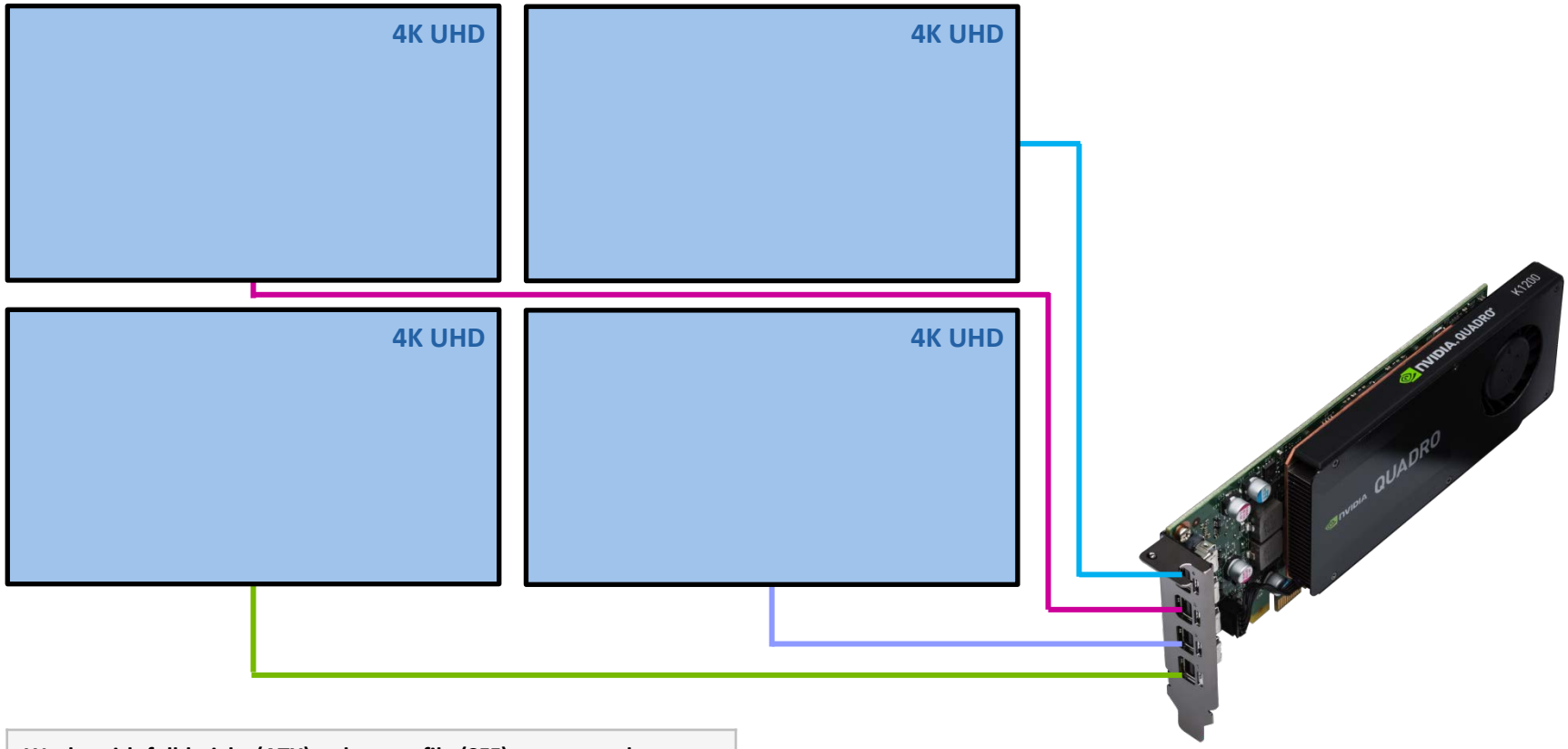
NVIDIA Quadro K1200 and Mosaic

Ideal entry 3D digital signage solution for ATX or SFF enclosures

Unified desktop for up to 16 displays	
▪	**One to four Quadro K1200 boards hosted by a single system (enclosure permitting)**
Mosaic and NVIDIA Quadro K1200 graphics board display requirements	
▪	**All displays must run at the same timing and resolution**
▪	**Bezel correction supported**
▪	**Windows 8.1, 8, 7 and Linux operating systems**

NVIDIA Quadro K1200 4K Display Support

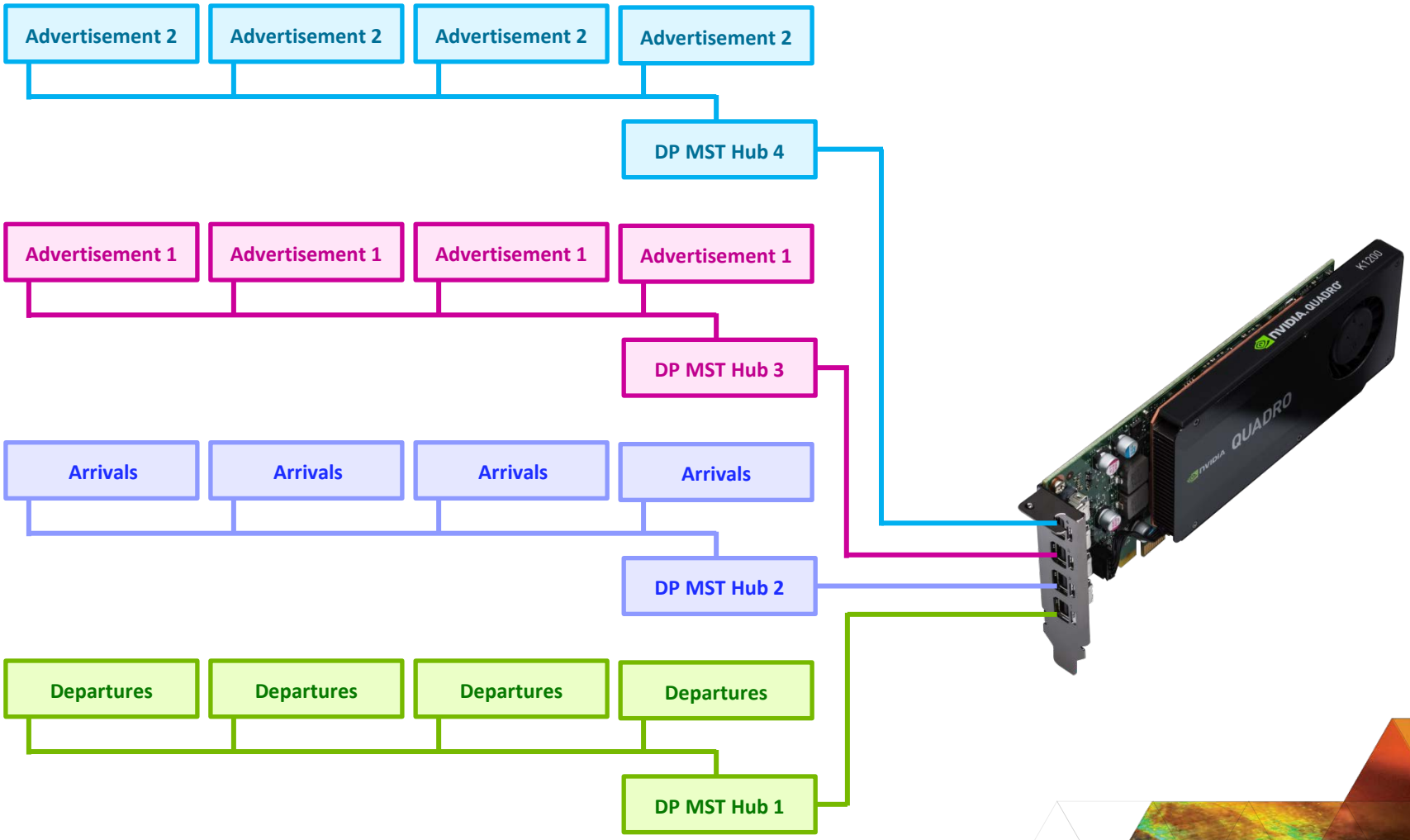
Drives four 4K displays simultaneously



Works with full-height (ATX) or low-profile (SFF) system enclosures	
▪	**Low cost ultra-high-resolution video wall solution**
▪	**Ideal for 3D content and video**
Works with NVIDIA Mosaic	
▪	**Logical display assignment simplifies cable routing**

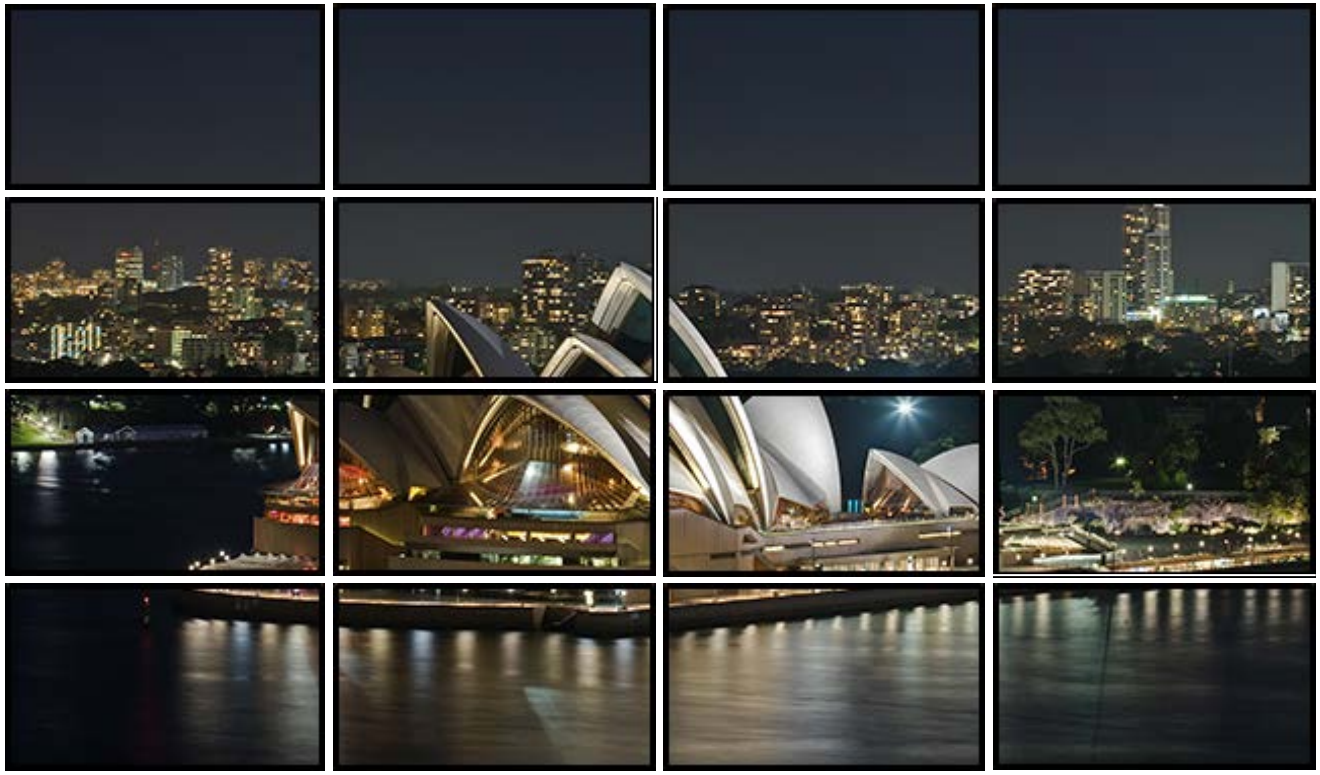
NVIDIA Quadro K1200 DisplayPort 1.2 Stream Cloning

Send the same content to multiple displays



NVIDIA Mosaic with NVS

One large logical desktop without complexity or app modification



NVIDIA NVS and Quadro

4K multi-display support

	1 Card	2 Cards	3 Cards	4 Cards
Quadro M6000	**4** Overlap + Bezel Correction	**8** Overlap + Bezel Correction and Quadro Sync	**12** Overlap + Bezel Correction and Quadro Sync	**16** Overlap + Bezel Correction and Quadro Sync
Quadro M5000	**4** Overlap + Bezel Correction	**8** Overlap + Bezel Correction and Quadro Sync	**12** Overlap + Bezel Correction and Quadro Sync	**16** Overlap + Bezel Correction and Quadro Sync
Quadro M4000	**4** Overlap + Bezel Correction	**8** Overlap + Bezel Correction and Quadro Sync	**12** Overlap + Bezel Correction and Quadro Sync	**16** Overlap + Bezel Correction and Quadro Sync
Quadro K1200	**4** Overlap + Bezel Correction	**8** Bezel Correction	**12** Bezel Correction	**16** Bezel Correction
NVS 810	**8** Overlap + Bezel Correction	**16** Bezel Correction	**24** Bezel Correction	**32** Bezel Correction
NVS 510	**4** Overlap + Bezel Correction	**8** Bezel Correction	**12** Bezel Correction	**16** Bezel Correction

NVIDIA NVS 810 provides highest density and lowest TCO (Total Cost of Ownership)

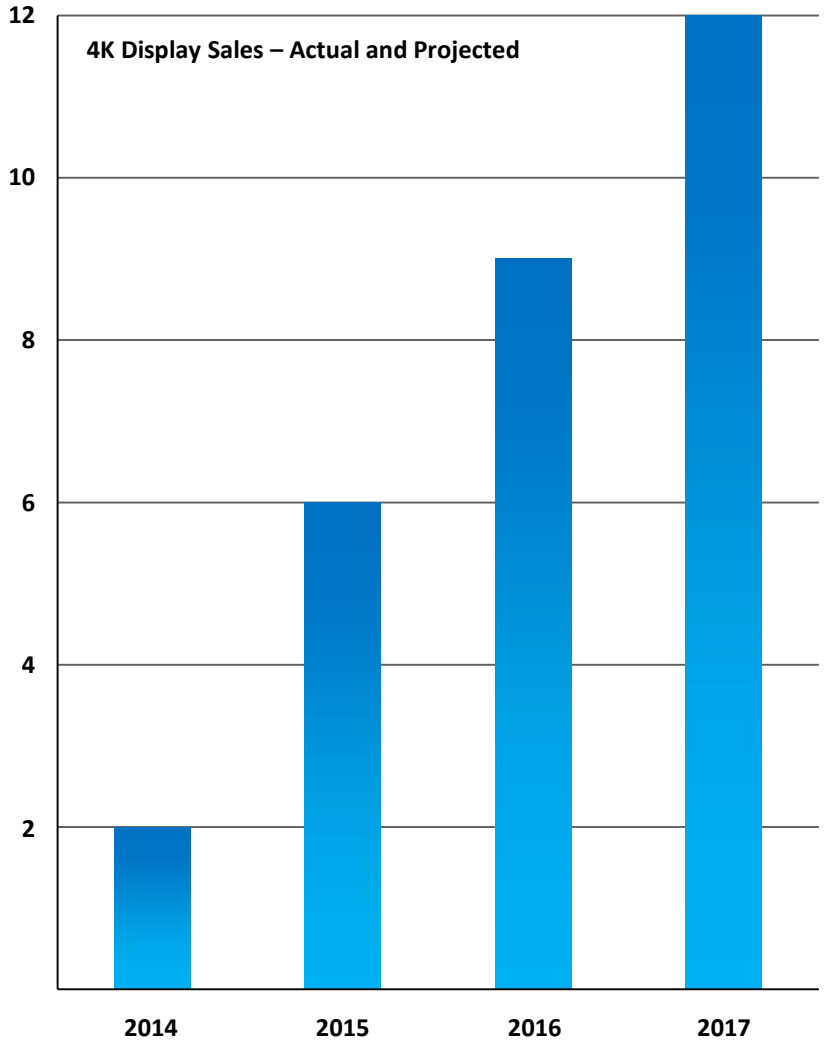
NVIDIA NVS 810 and Mosaic

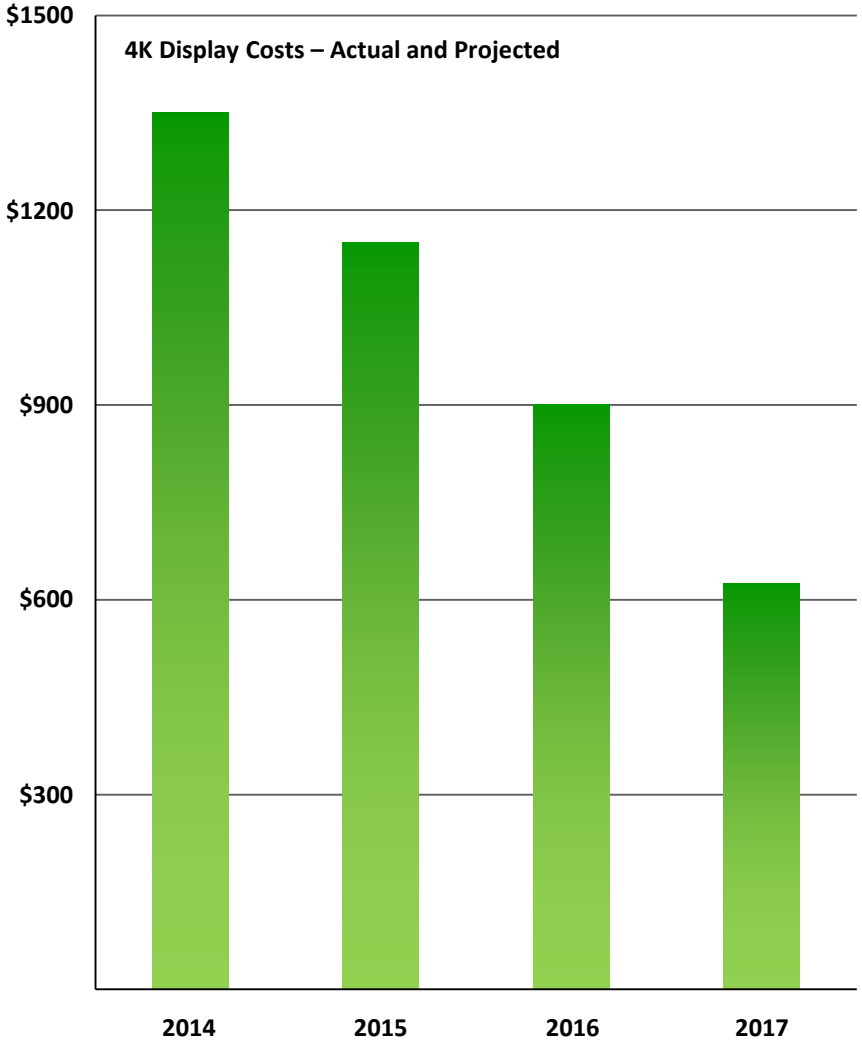
Lowest TCO and highest GPU density digital signage solution

Unified desktop for up to 16 displays	
▪	**Two NVS 810 boards hosted by a single system**
Mosaic and NVIDIA NVS 810 graphics board display requirements	
▪	**All displays must run at the same timing and resolution**
▪	**Bezel correction supported**
▪	**Windows 10, 8.1, 8, 7 and Linux operating systems**

4K Display Sales Trends

Shipments are growing rapidly while prices continue to fall[1]





[1] Source: 2014 DisplaySearch an NPD Group Company.

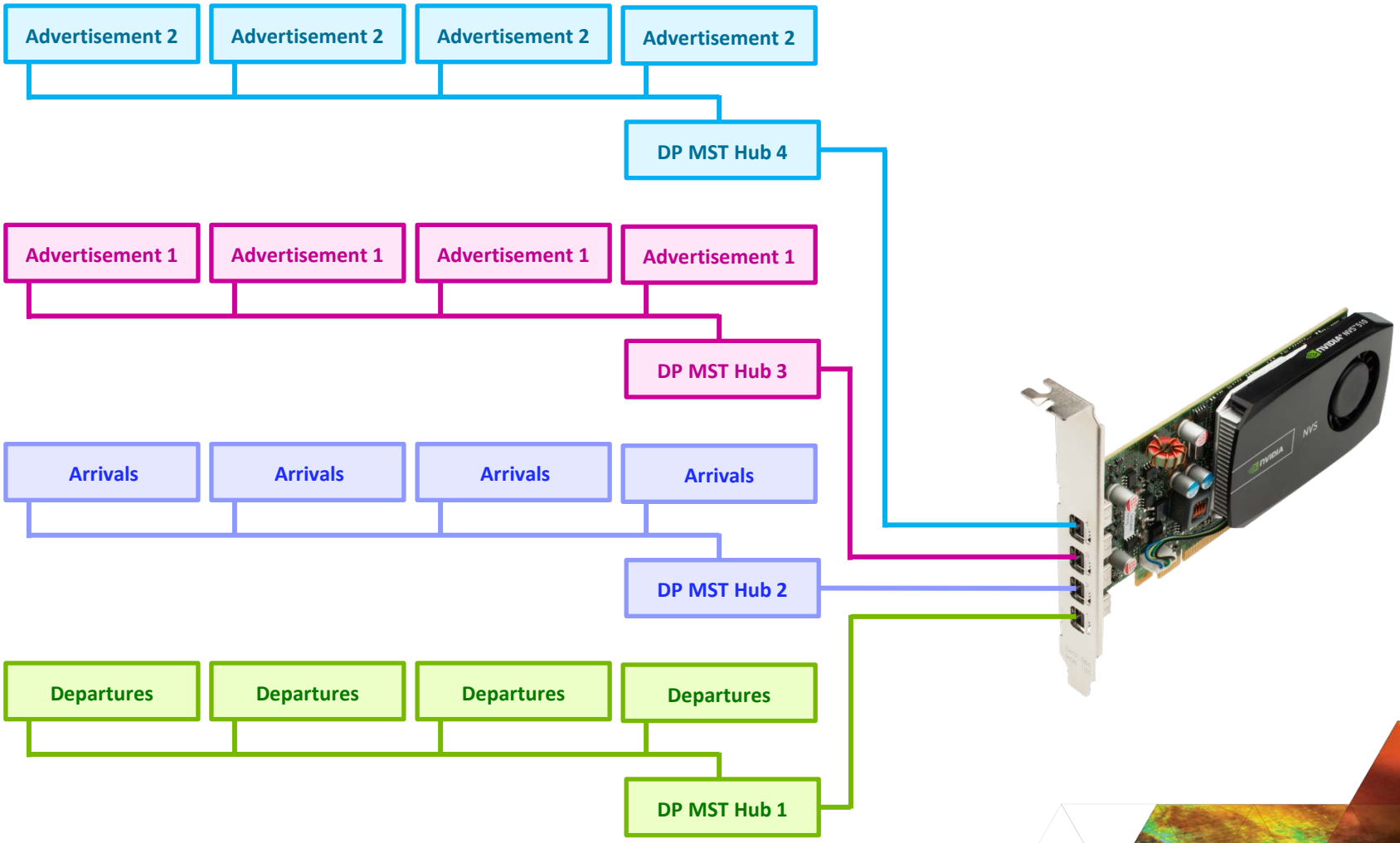
NVIDIA NVS 510 and Mosaic

Ideal entry digital signage solution

Unified desktop for up to 16 displays	
▪	**Four NVS 510 boards hosted by a single system**
Mosaic and NVIDIA NVS 510 graphics board display requirements	
▪	**All displays must run at the same timing and resolution**
▪	**Bezel correction supported**
▪	**Windows 10, 8.1, 8, 7 and Linux operating systems**

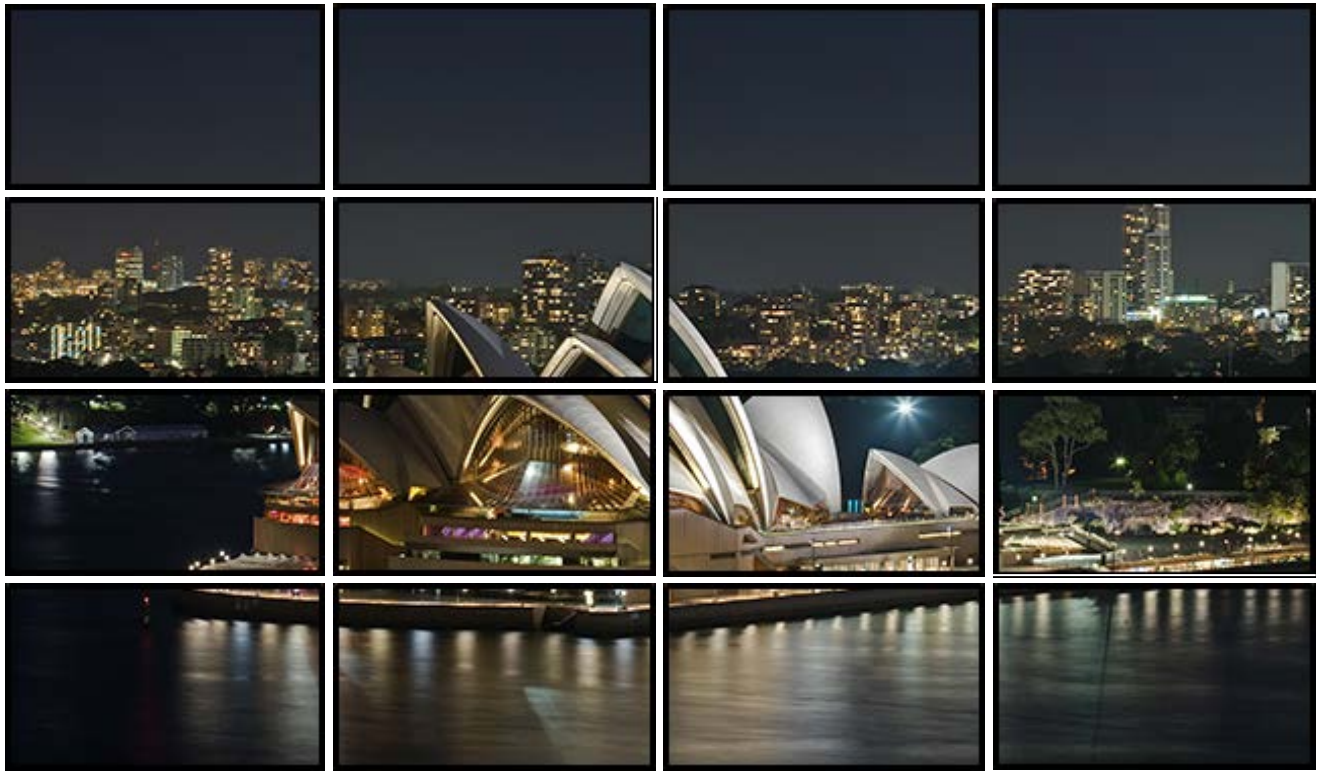
NVIDIA NVS 510 DisplayPort 1.2 Stream Cloning

Send the same content to multiple displays



NVIDIA Mosaic + Quadro Sync

One large logical desktop with additional features



NVIDIA Mosaic + Quadro Sync

Quadro product support

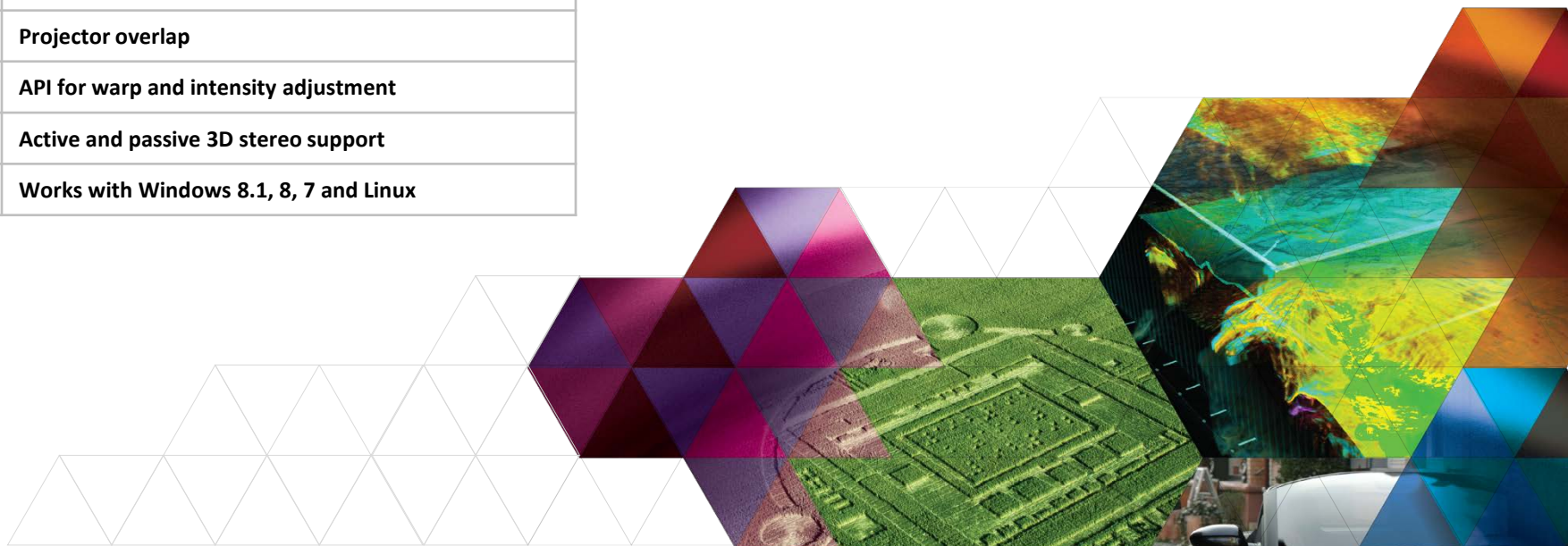
Unified desktop for up to 16 4K displays with Maxwell architecture products	
▪	**Four Quadro M6000, K6000, K5200, or K4200 cards supported for 3D interactive content**
Mosaic graphics board and display requirements	
▪	**All cards in the system must be identical**
▪	**Bezel correction supported**
▪	**Windows 8.1, 8, 7 and Linux operating systems**

Mosaic with Quadro Sync Features

NVIDIA Quadro + Quadro Sync

	Number of synchronized displays or projectors from a single system with Mosaic				
GPU Options	**Up to 2**	**Up to 4**	**Up to 8**	**Up to 12**	**Up to 16**
M6000	**1 GPU**	**1 GPU**	**2 GPUs + Quadro Sync**	**3 GPUs + Quadro Sync**	**4 GPUs + Quadro Sync**
K6000	**1 GPU**	**1 GPU**	**2 GPUs + Quadro Sync**	**3 GPUs + Quadro Sync**	**4 GPUs + Quadro Sync**
K5200	**1 GPU**	**1 GPU**	**2 GPUs + Quadro Sync**	**3 GPUs + Quadro Sync**	**4 GPUs + Quadro Sync**
K5000	**1 GPU**	**1 GPU**	**2 GPUs + Quadro Sync**	**3 GPUs + Quadro Sync**	**4 GPUs + Quadro Sync**
K4200	**1 GPU**	**1 GPU**	**2 GPUs + Quadro Sync**	**3 GPUs + Quadro Sync**	**4 GPUs + Quadro Sync**

Key features and benefits	
▪	**Seamless tear-free displays**
▪	**Projector overlap**
▪	**API for warp and intensity adjustment**
▪	**Active and passive 3D stereo support**
▪	**Works with Windows 8.1, 8, 7 and Linux**

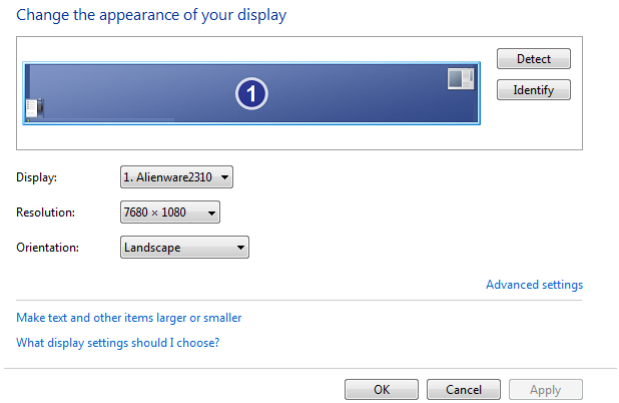


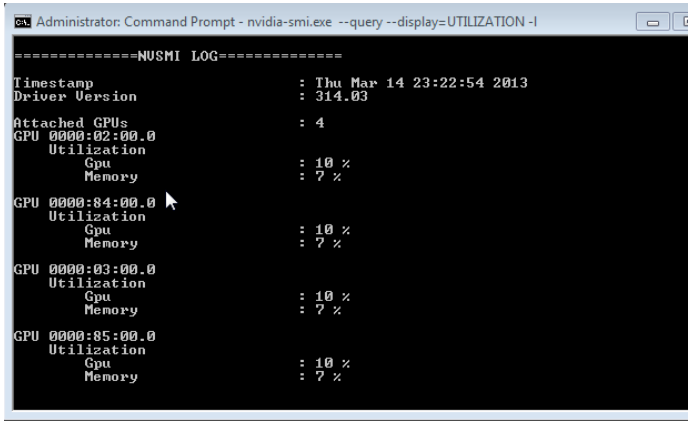
NVIDIA Mosaic Hides the Complexity

Transparent application scaling across multiple displays

Logical GPU

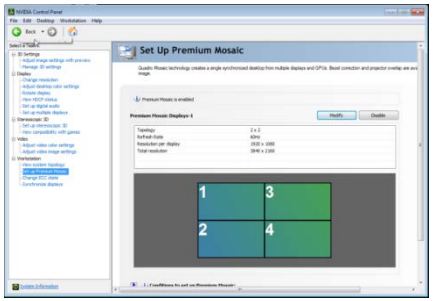
Application

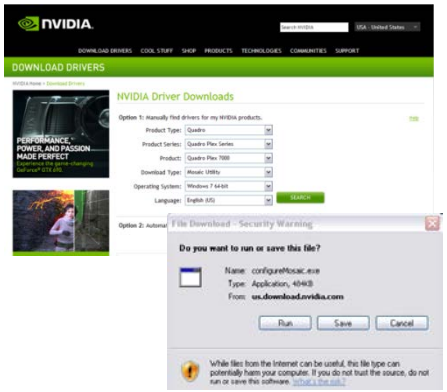


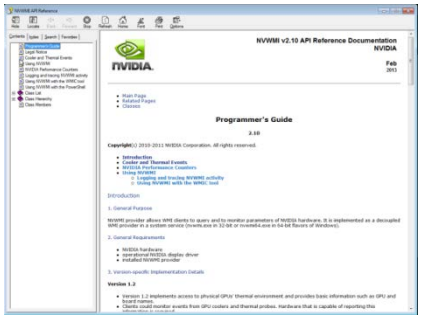


Mosaic Setup

Options range from end user tools to developer APIs







NVIDIA Control Panel
Driver Install

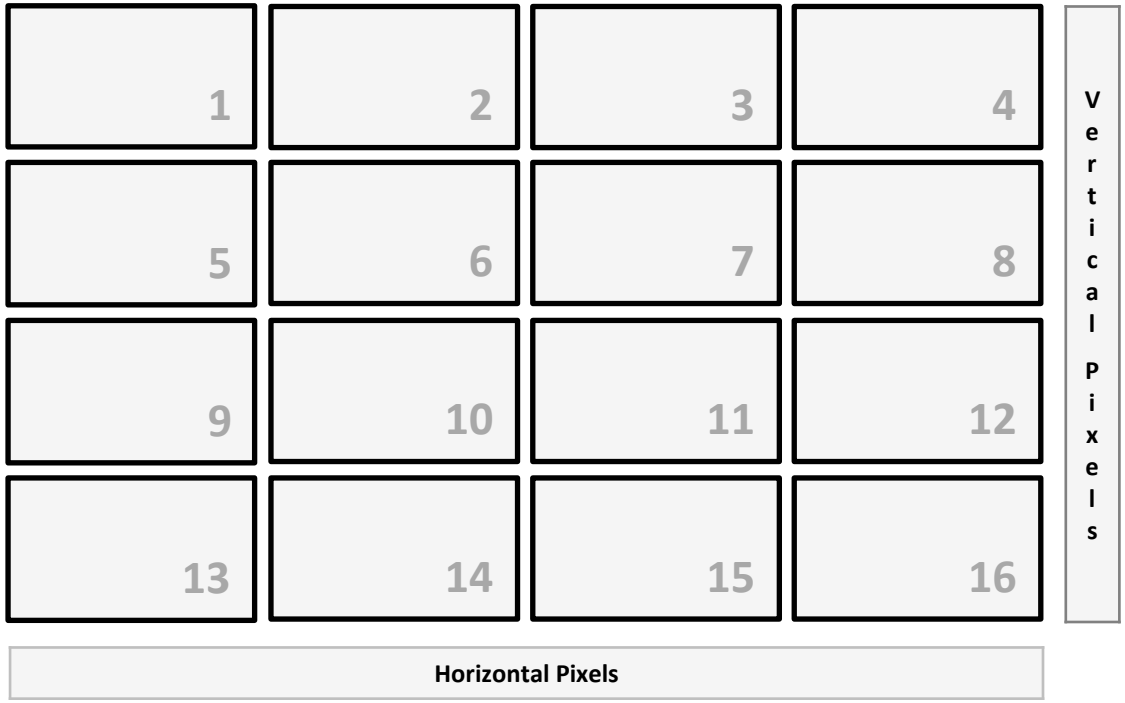
Configuremosaic
Large Display Walls
Download from NVIDIA

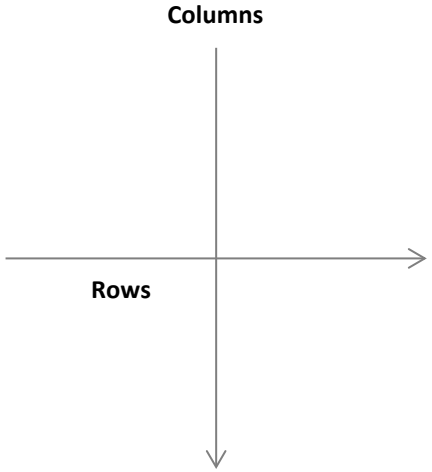
NVWMI
Remote Setup
Powershell Scripts
Program Directly

NVAPI
Incorporate Mosaic setup directly into custom applications

Mosaic Grids

Rows, columns, and up to 16,384 x 16,384 pixels

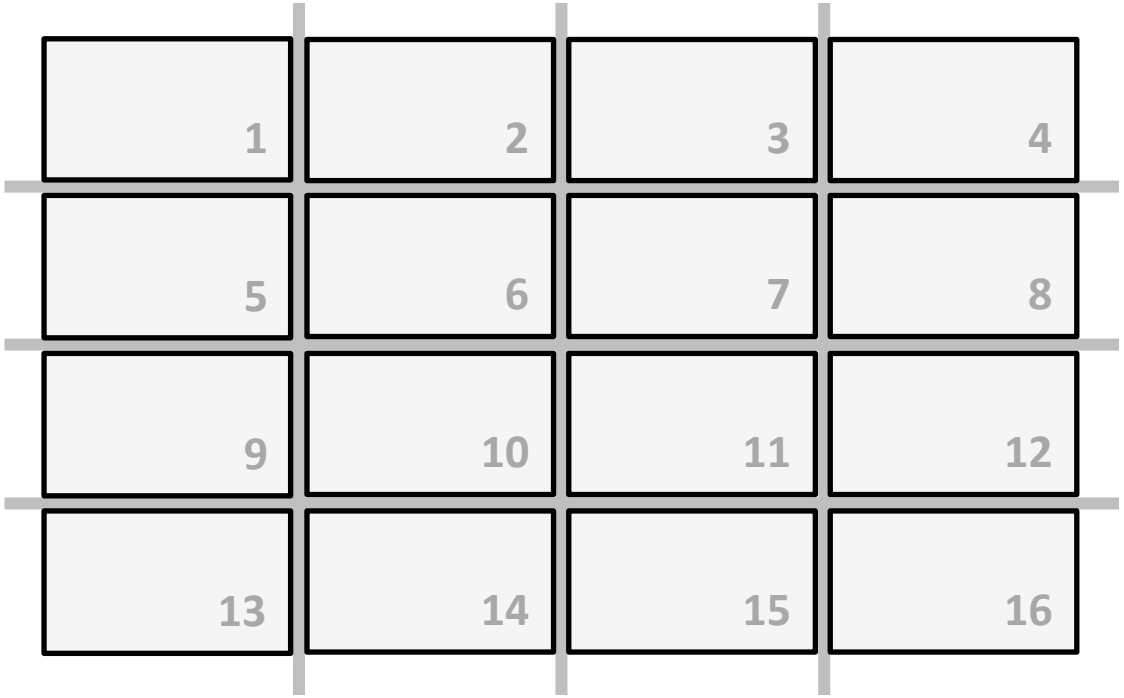




Essential Parameters	
▪	Rows x columns < = 16
▪	Maximum horizontal or vertical pixels < = 16,384
▪	Grid enumeration always starts top left and goes left to right

Understanding Mosaic Topologies

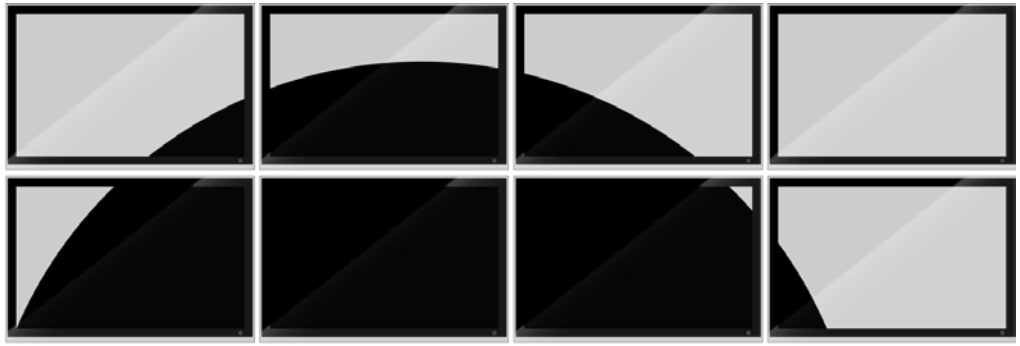
Column overlap and bezel correction



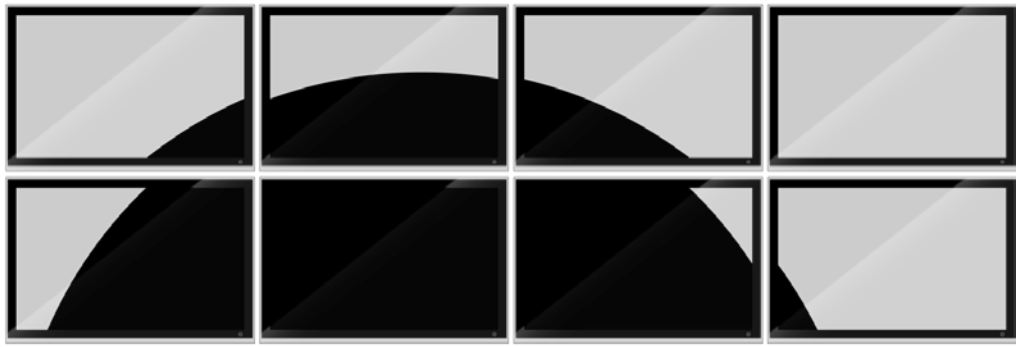
Bezel correction increases overall pixel size	
▪	**Here each display is 1920 x 1080, bezel per column is 100**
▪	**Total horizontal width = 1920 * 4 + 100 * 3 = 7980**
Overlap correction will decrease overall pixel size	

Bezel Correction

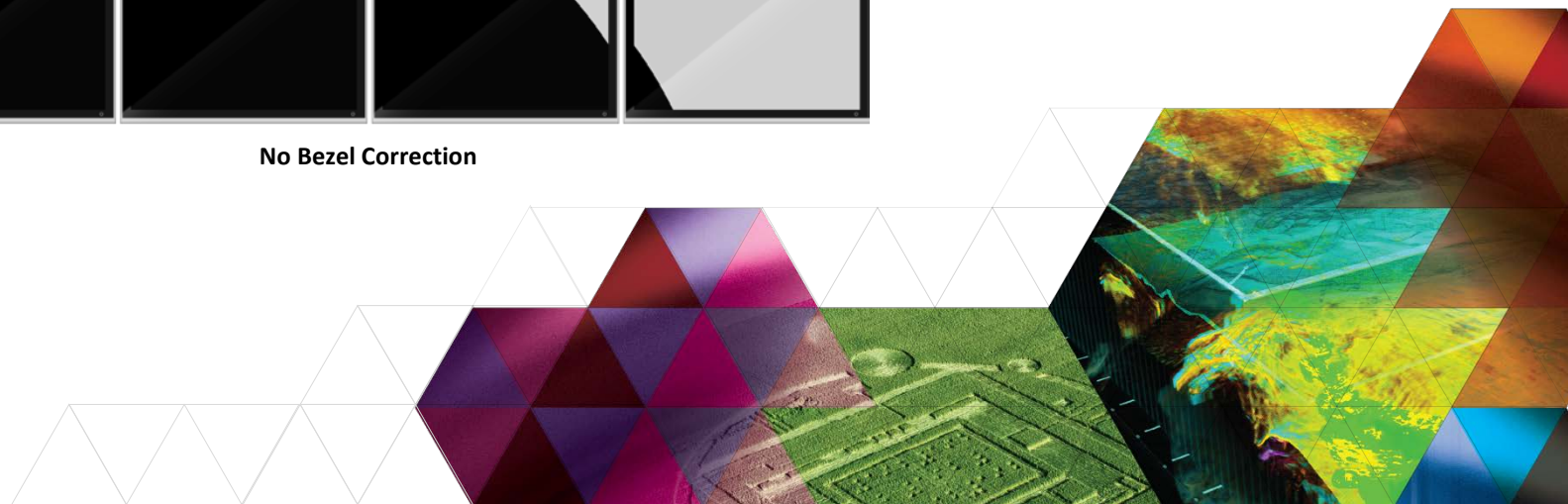
Image looks continuous by rendering under the bezel



With Bezel Correction

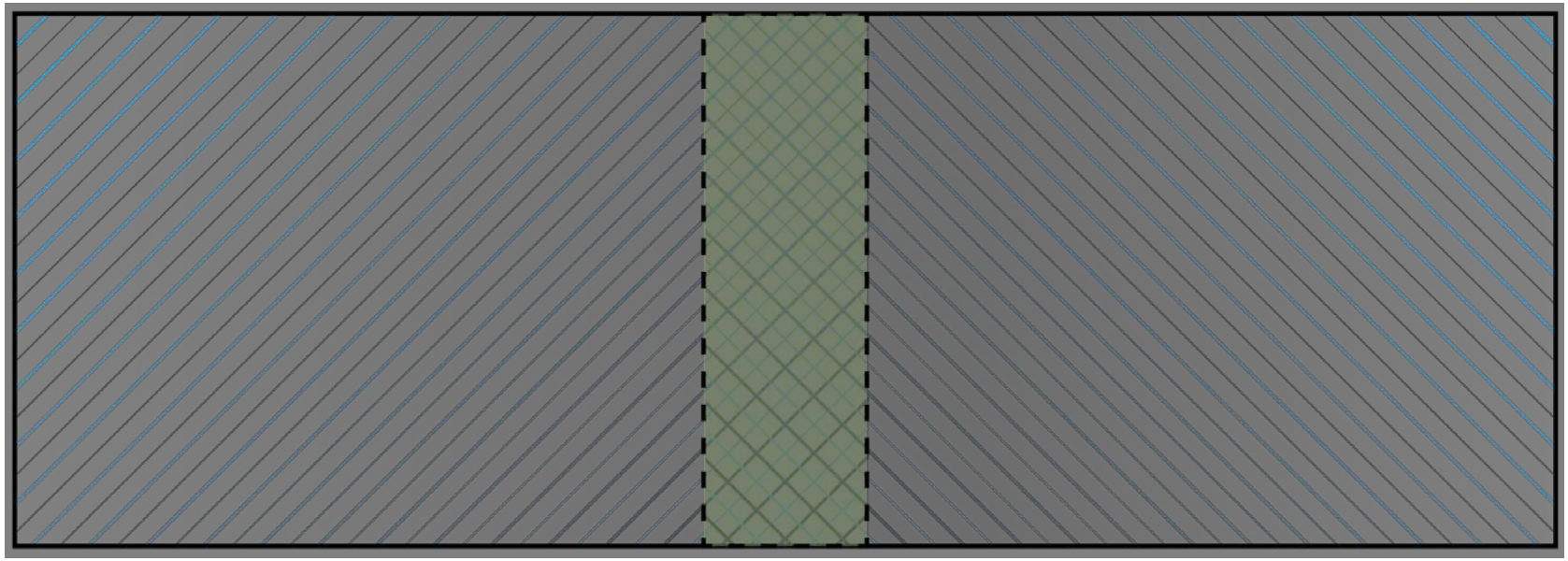


No Bezel Correction



Projector Overlap Correction

Maintains proper aspect ratio and more…



Projector Overlap

Compensates for geometry and brightness differences between projectors to present a visually seamless image | These are known as Warp (geometry corrections) or Blend (intensity adjustments) | Mosaic + Quadro Sync compatible products have the graphics and compute performance necessary to make these adjustments in real-time.

Warp + Intensity Adjustment API

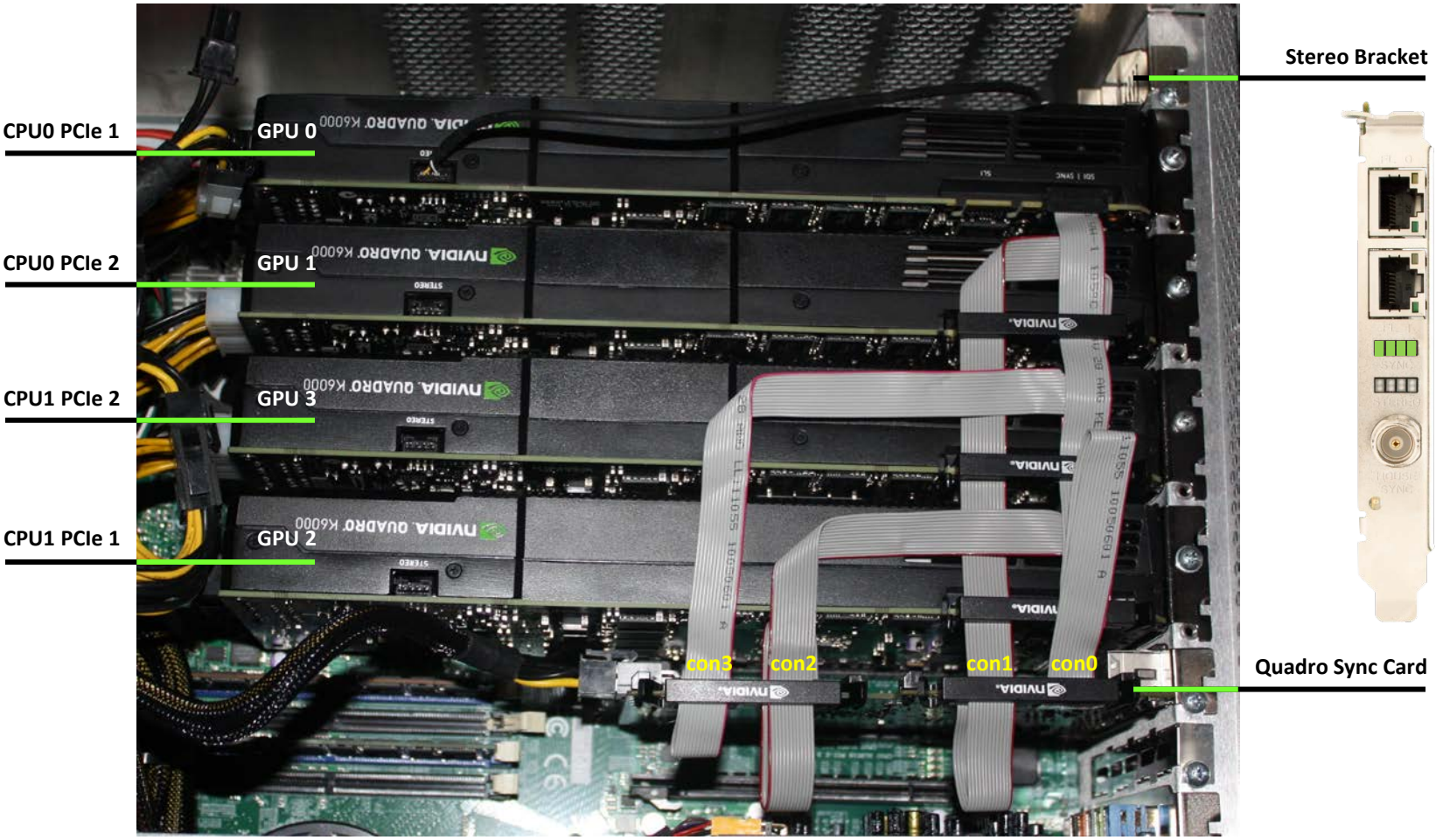
Not every surface is flat

Capabilities supported include:	
▪	Projection correction
▪	Curved surfaces
▪	Projection mapping

Image courtesy VYV.

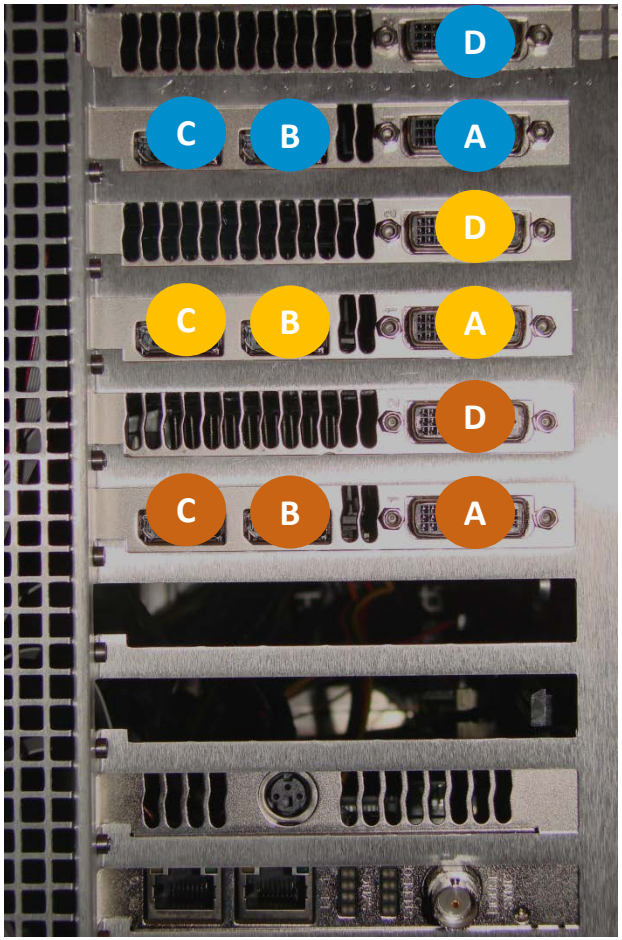
Quadro Video Walls

Anatomy of a system



Port Numbering

Ports auto enumerate depending on what is attached



GPU 0: A + D are attached	
▪	A = 0,0 | D = 0,1

GPU 1: A + B + D are attached	
▪	A = 1,0 | B = 1,1 | D = 1,2

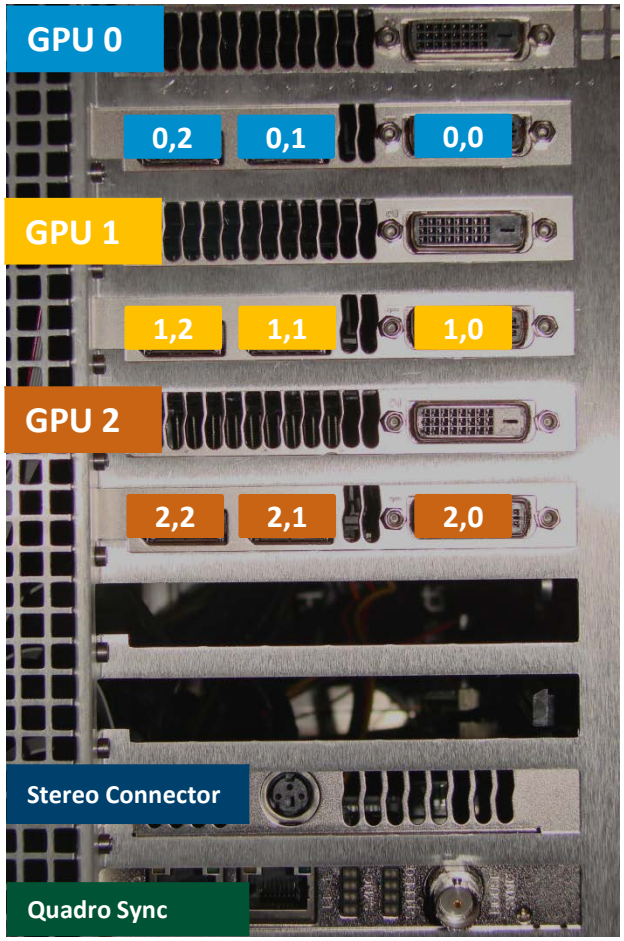
GPU 2: A + B + C + D are attached	
▪	A = 2,0 | B = 2,1 | C = 2,2 | D = 2,3

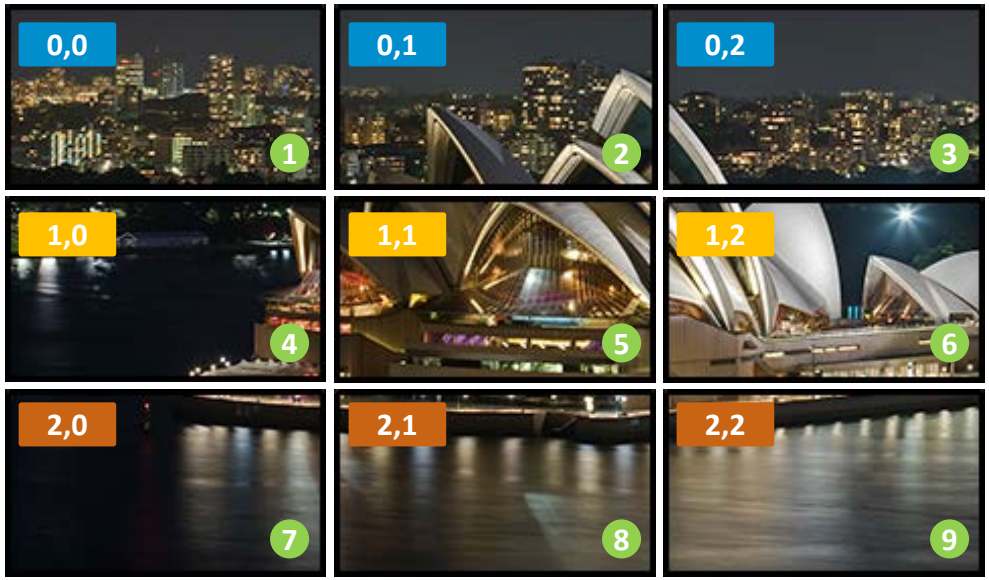
Stereo Connector Bracket

Quadro Sync Board

Relating Ports to Grid

3 x 3 video wall example





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

1 2 3 4 5 6 7 8 9

Managing EDID

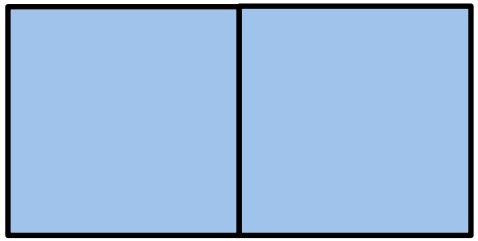
Extended display identification data

Benefits of managing EDID	
▪	EDIDs can be lost due to switchers or extenders
▪	If a cable is unplugged it doesn't cause a hot plug event
▪	Can help with staging a system
▪	Can fake a display that's not present
Limitations	
▪	Not supported on DisplayPort 1.2 compliant displays

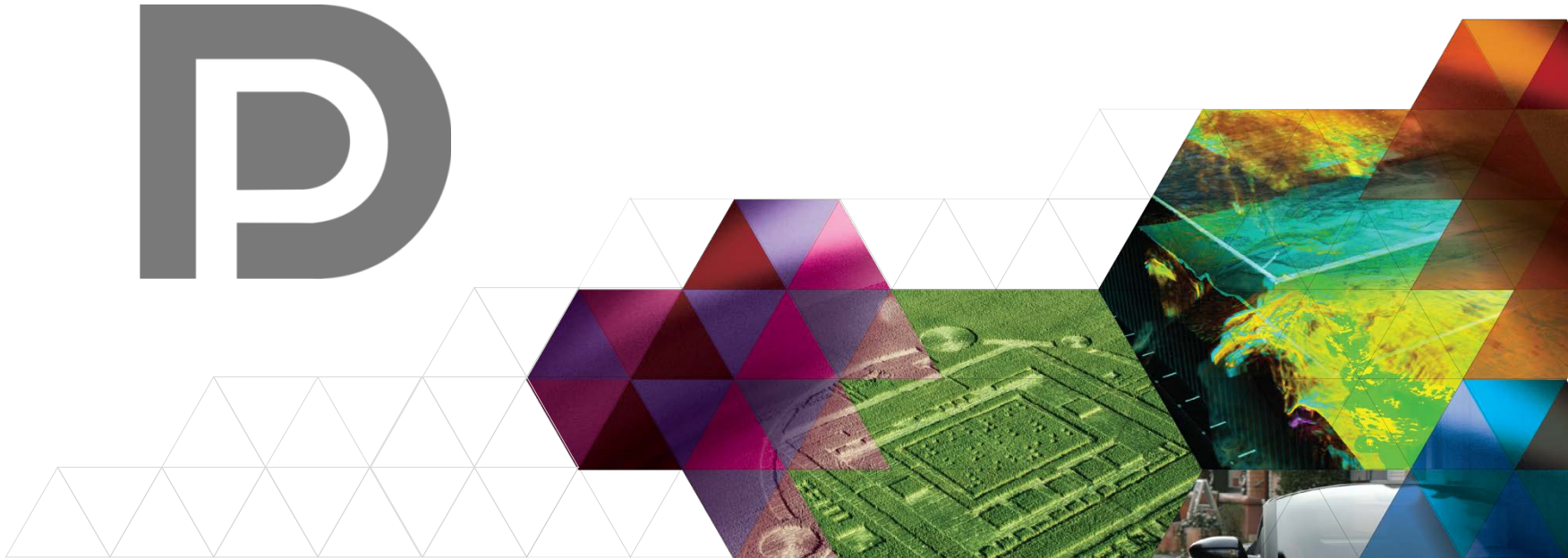
DisplayPort 1.2 and VESA Display IDs

Ultra-high-resolution panel use

DisplayPort 1.2 input	
▪	Panel acts as a multi-streaming hub
▪	Enables two 1920 x 2160 channels over a 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 automatically enables Mosaic when it detects these displays



DP 1.2 carries two 1920 x 2160 at 60Hz channels



NVIDIA Quadro M6000 and M5000 Display Outputs

Four display connectors → four 4K displays

M6000 Bracket

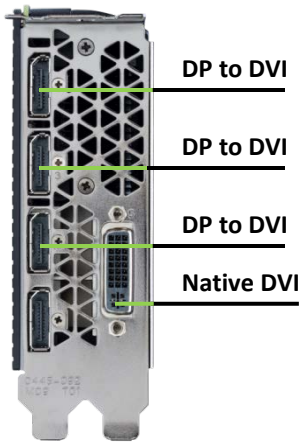
Four DisplayPort 1.2 + DVI-I DL	
▪	Total of 4 independent heads
▪	Legacy DVI and VGA support (DVI to VGA adapter)

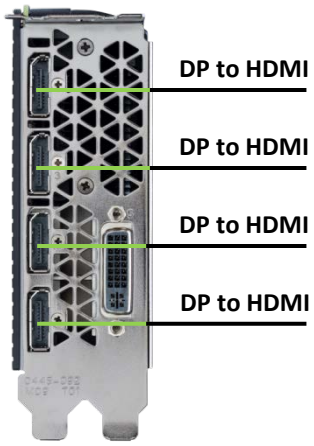
DisplayPort 1.2 High Bit Rate 2 (HBR2) and Multi-Stream support	
▪	M6000 | 4096 x 2160 30 bpp at 60Hz on all DP connectors
▪	M6000 | 3820 x 2160 30 bpp at 60Hz on all DP connectors

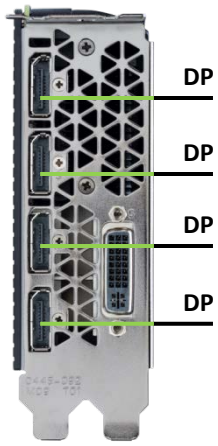
Stereo via provided connector bracket	
▪	PNY ships this accessory with all compatible boards

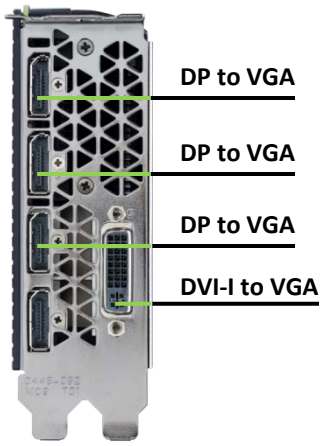
NVIDIA Quadro M6000 and M5000

Supported display outputs









Up to four Single Link or Dual Link DVI	
▪	Dual Link DVI via active DisplayPort to DVI adapters
Up to four HDMI	
▪	Via DP to HDMI adapters
Up to four DisplayPort	
▪	4 directly attached DP displays
▪	4 attached DP displays with MST (daisy chaining)

Up to four VGA	
▪	Three DP to VGA adapters
▪	DVI-I to VGA adapter

NVIDIA Quadro K6000 and K5200 Display Outputs

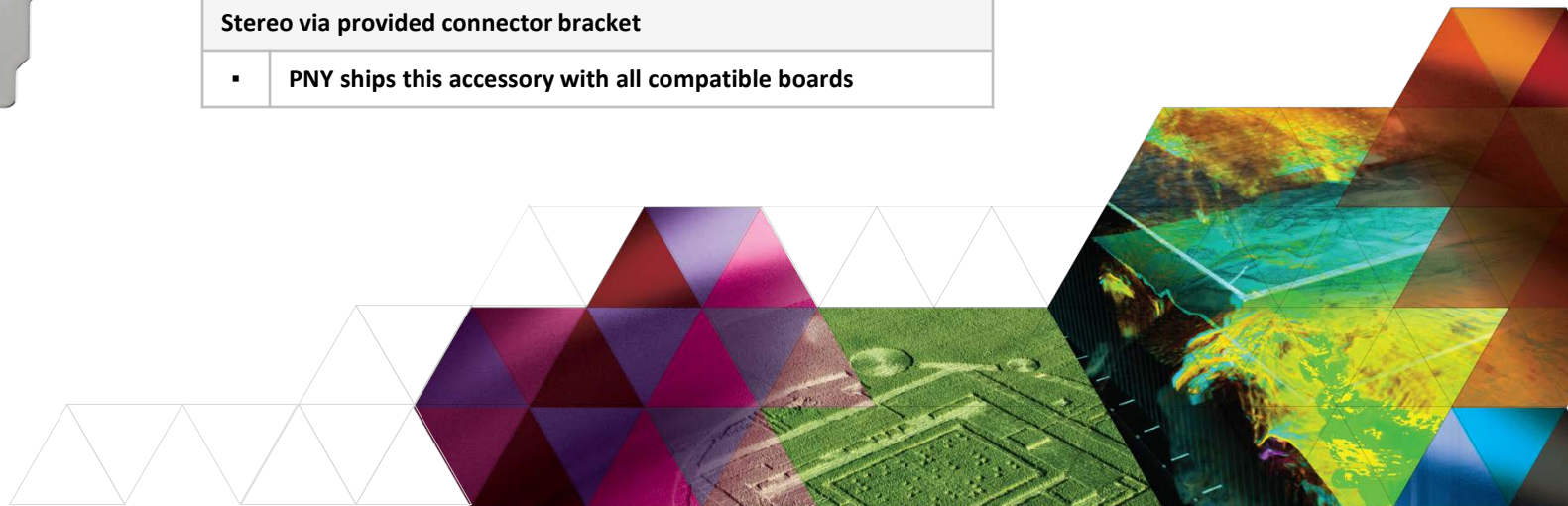
Four display connectors → four displays

K6000/K5200 Bracket

Two DVI DL and Two DisplayPort 1.2	
▪	Total of four independent heads
▪	Only one VGA output on DVI

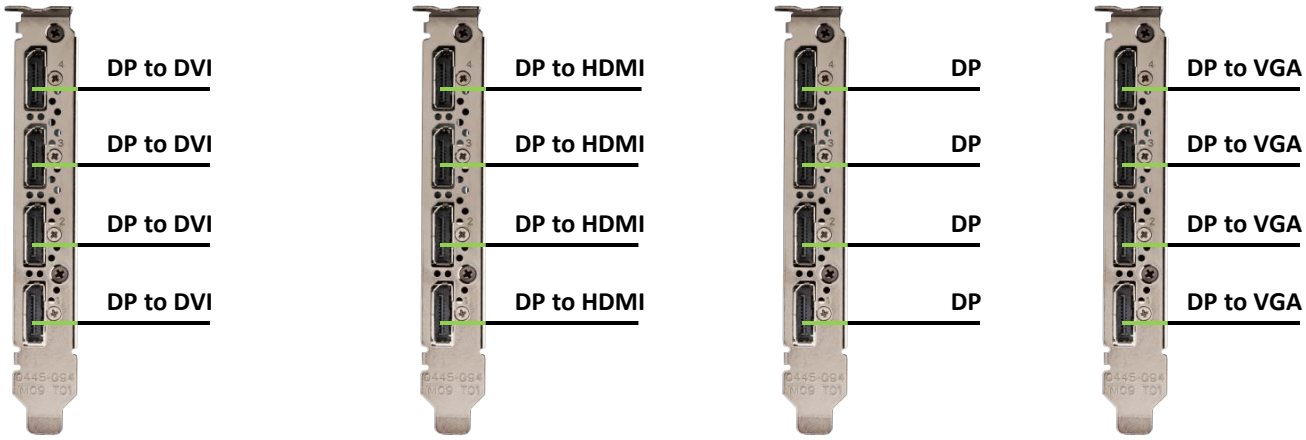
DisplayPort 1.2 High Bit Rate 2 (HBR2) and Multi-Stream support	
▪	K6000 | 4096 x 2160 30 bpp at 60Hz on a single connector
▪	K5200 | 4096 x 2160 30 bpp at 60Hz on a single connector
▪	K4200 | 3840 x 2160 30 bpp at 60Hz on a single connector

Stereo via provided connector bracket	
▪	PNY ships this accessory with all compatible boards



NVIDIA Quadro M4000

Supported display outputs

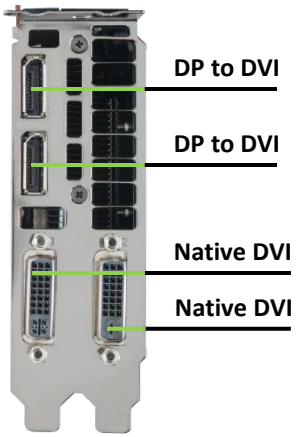


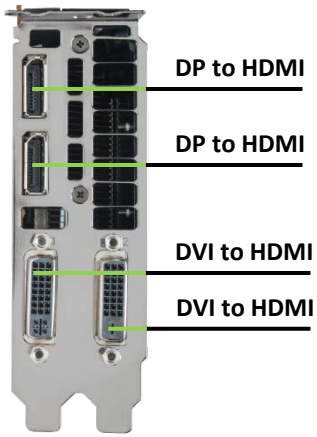
Up to four Single Link or Dual Link DVI	
▪	Dual Link DVI via active DisplayPort to DVI adapters
Up to four HDMI	
▪	Via DP to HDMI and DVI to HDMI adapters
Up to four DisplayPort	
▪	4 directly attached DP displays
▪	4 attached DP displays with MST (daisy chaining)

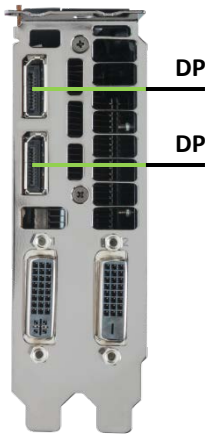
Up to four VGA	
▪	Via DP to VGA adapters

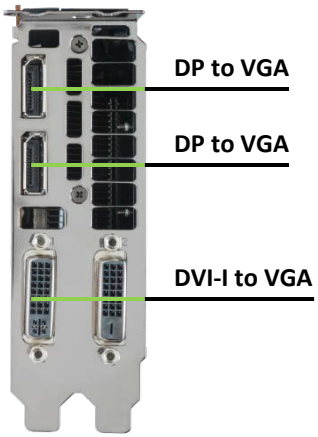
NVIDIA Quadro K6000 and K5200

Supported display outputs







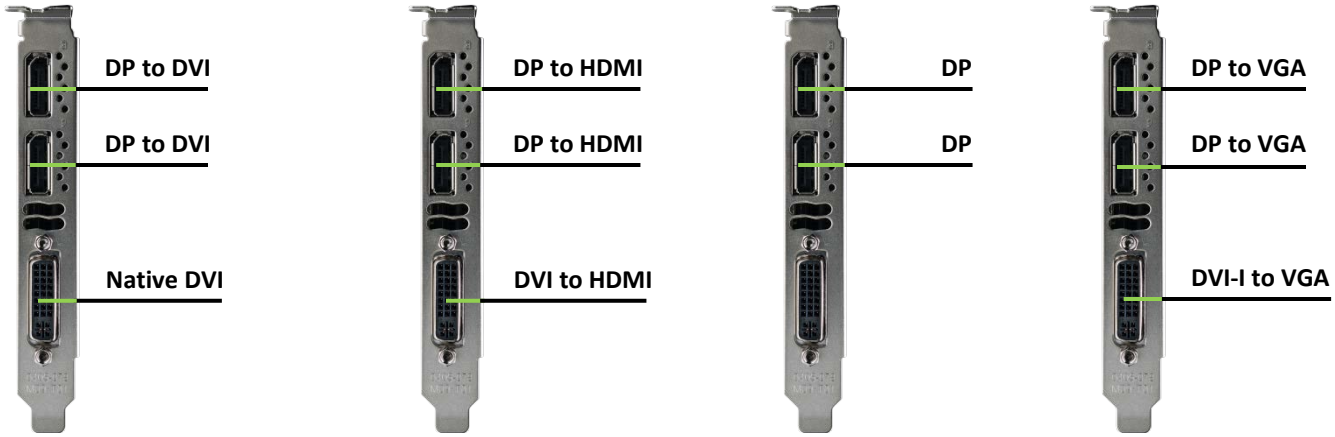


Up to four Single Link or Dual Link DVI	
▪	Dual Link DVI via active DisplayPort to DVI adapters
Up to four HDMI	
▪	Via DP to HDMI and DVI to HDMI adapters
Up to four DisplayPort	
▪	2 directly attached DP displays
▪	4 attached DP displays with MST (daisy chaining)

Up to three VGA	
▪	Two DP to VGA adapters
▪	DVI-I to VGA adapter

NVIDIA Quadro K4200

Supported display outputs



Up to three Single Link or Dual Link DVI	
▪	Dual Link DVI via active DisplayPort to DVI adapters
Up to three HDMI	
▪	Via DP to HDMI and DVI to HDMI adapters
Up to 4 DisplayPort	
▪	2 directly attached DP displays
▪	4 attached DP displays with MST (daisy chaining)

Up to three VGA	
▪	Two DP to VGA adapters
▪	DVI-I to VGA adapter

36 Displays Driven by 9 Outputs

Complexity hidden by NVIDIA Quadro + Sync and Mosaic

Planar Quad Controller	
▪	3840 x 2160 at 30Hz
▪	Split to 4 1920 x 1080 panels
▪	Mosaic makes it easy for multi-touch

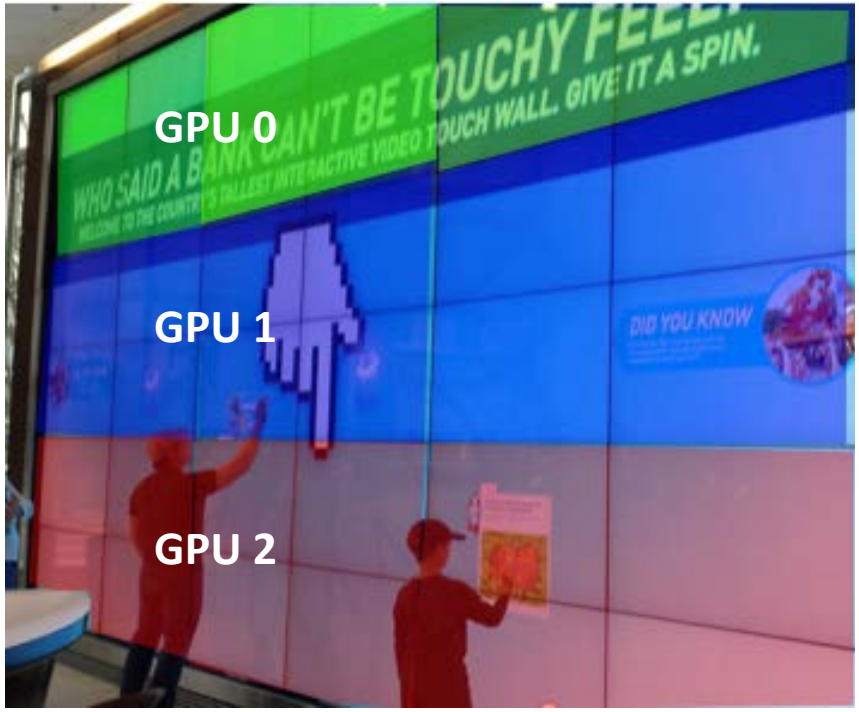


Image courtesy Vislogix.

UHD and 4K Displays + Mosaic

Works with prosumer and professional displays

Prosumer

UHD 84” UHD TV	
▪	Driven by 1 HDMI input

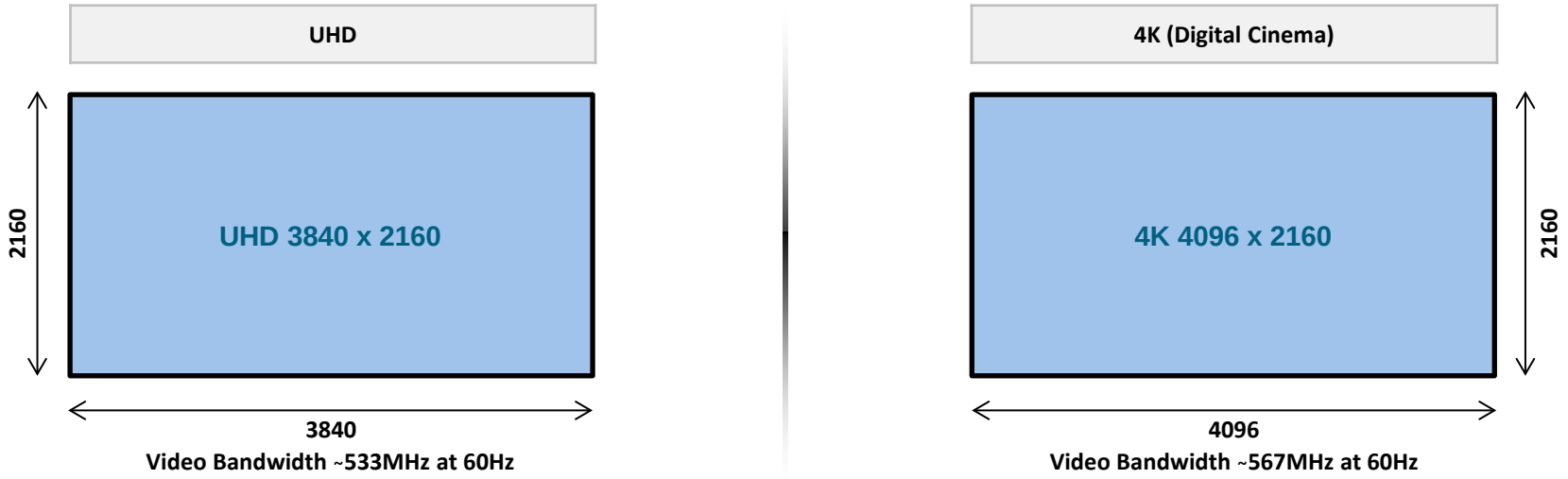
Professional

4K 84” Panel	
▪	Driven by 4 HDMI inputs

4K Stereo Projector	
▪	Up to 8 inputs

What are UHD and 4K Displays?

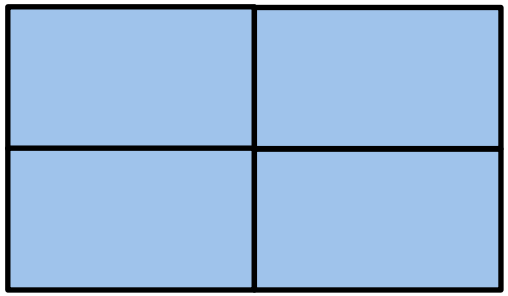
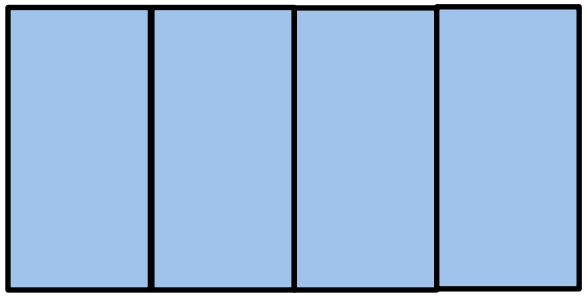
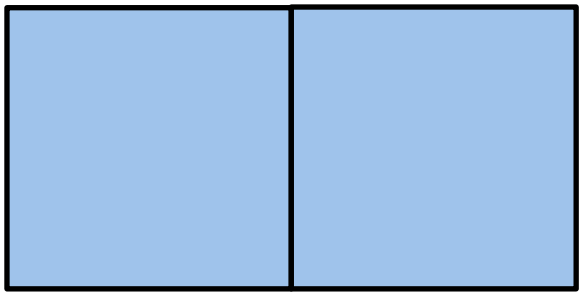
Overview and specifications



Video Connection Bandwidth	
▪	DVI SL = 165MHz
▪	DVI DL = 330MHz
▪	DisplayPort 1.1 ~330MHz
▪	HDMI 1.4a ~340MHz (UHD at 24 or 30 Hz with a single cable)
▪	DisplayPort 1.2 ~540 MHz (NVIDIA Quadro K4200)
▪	DisplayPort 1.2 ~592 MHz (NVIDIA Quadro K6000)

Driving UHD or 4K Digital Cinema Displays

Multiple connection options available

Quadrants	Stripes	Side by Side
		
4 DVI or HDMI/DP inputs ▪ 4K 2048 x 1080 at 60Hz ▪ UHD 1920 x 1080 at 60Hz	4 DVI or HDMI/DP inputs ▪ 4K 1024 x 2160 at 60Hz ▪ UHD 960 x 2160 at 60Hz	2 DVI DL/DP inputs ▪ 4K 2048 x 2160 at 60Hz ▪ UHD 1920 x 2160 at 60Hz

From SD to 8K – Exponential Pixel Growth

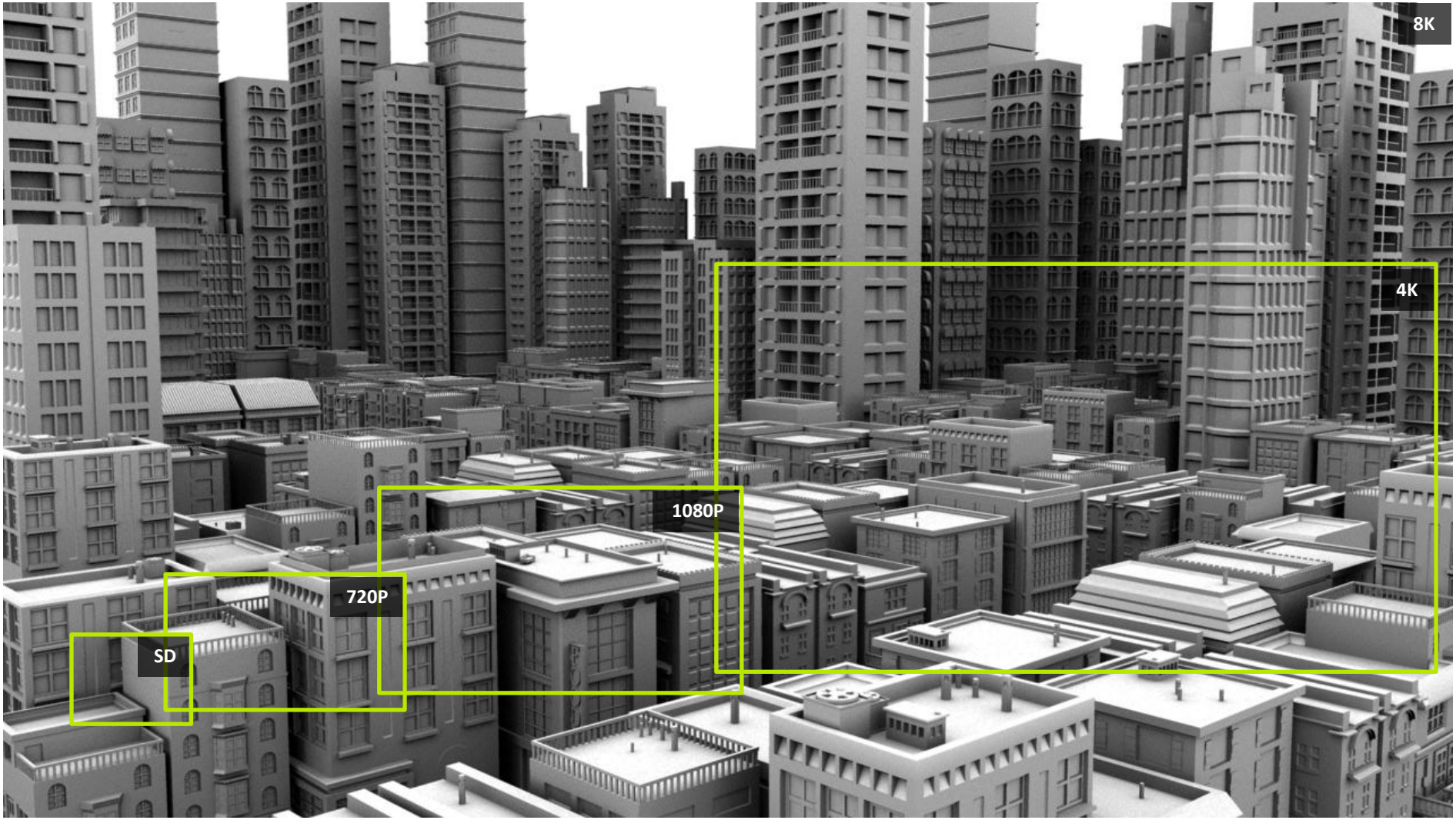
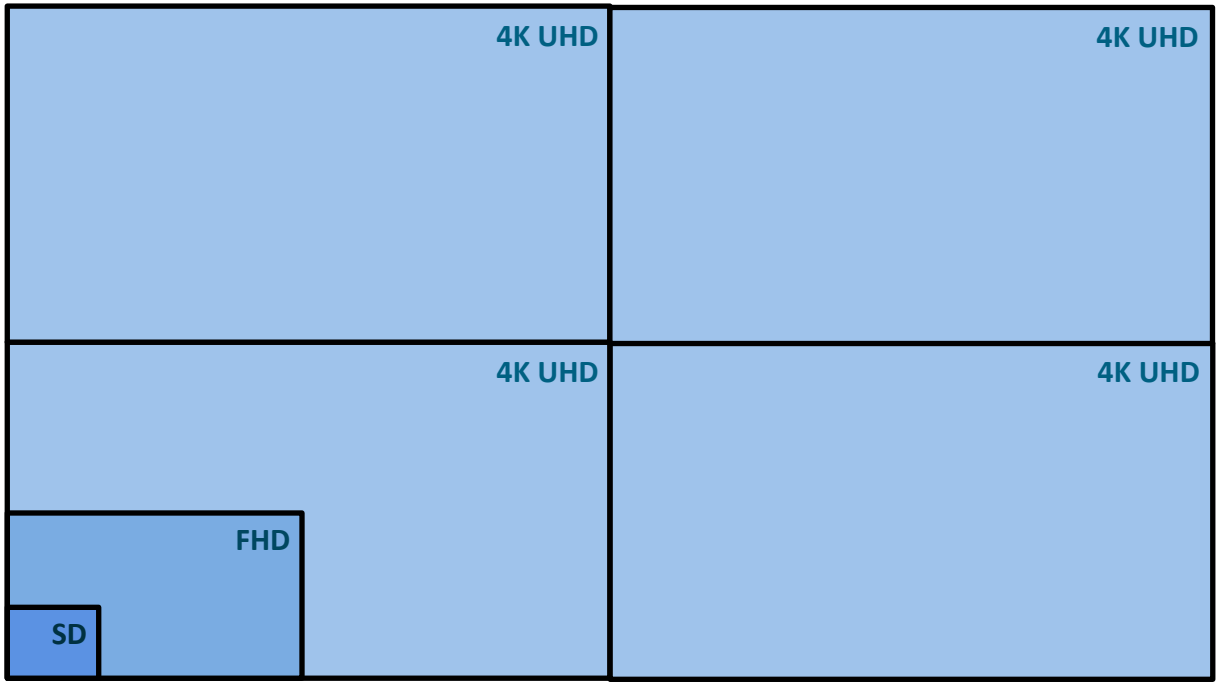


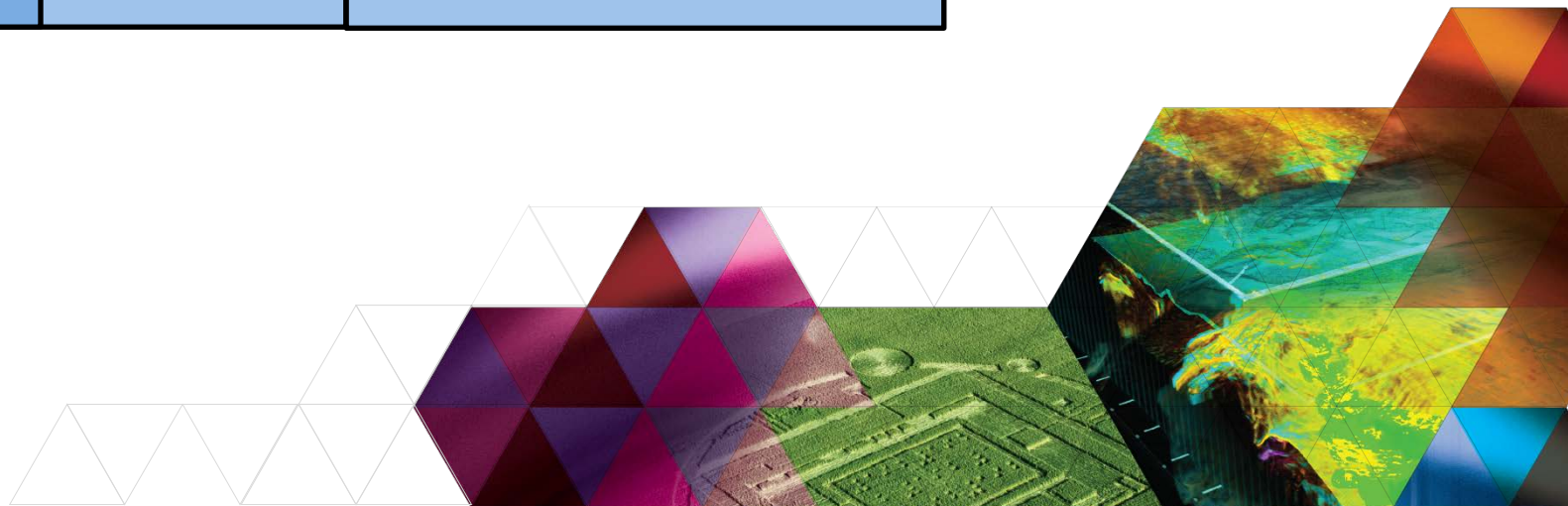
Image courtesy of Rose Adler, Leighana Ginther and Jackie Osterday.

Quadro M6000, M5000 and M4000: 4K and Beyond

Four 4K displays

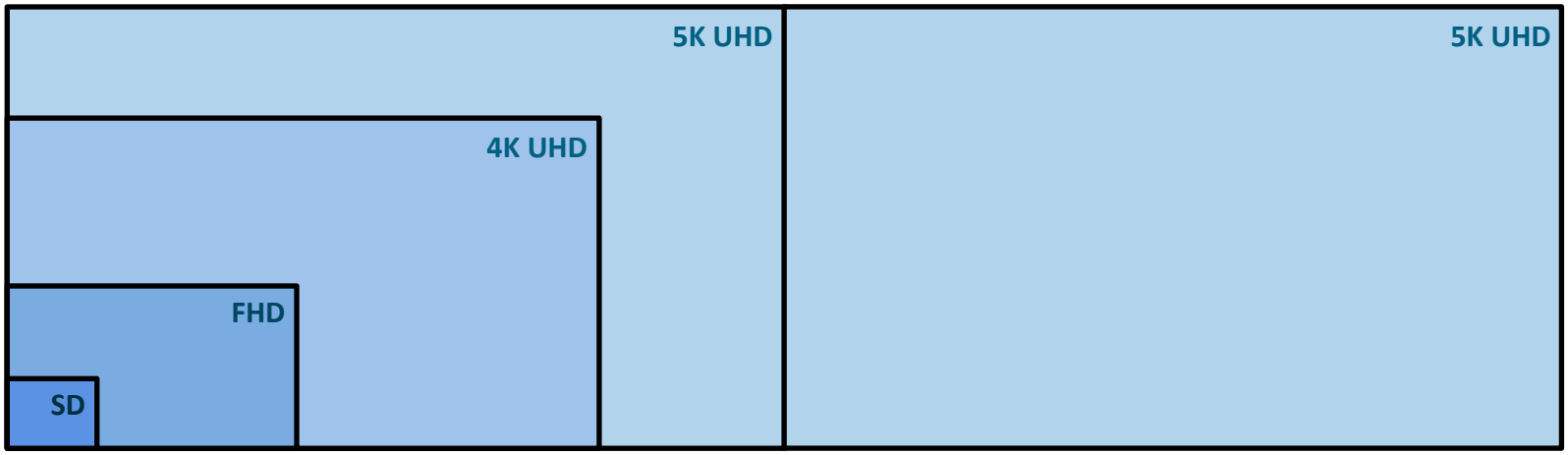


4K Resolution Table	
UHDT	3840 x 2160
UWT	5120 x 2160
WHXGA	5120 x 3200
DCI 4K	4096 x 2160
DCI 4K CinemaScope	4096 x 1716
DCI 4K Flat Cropped	3996 x 2160



Quadro M6000, M5000 and M4000: 4K and Beyond

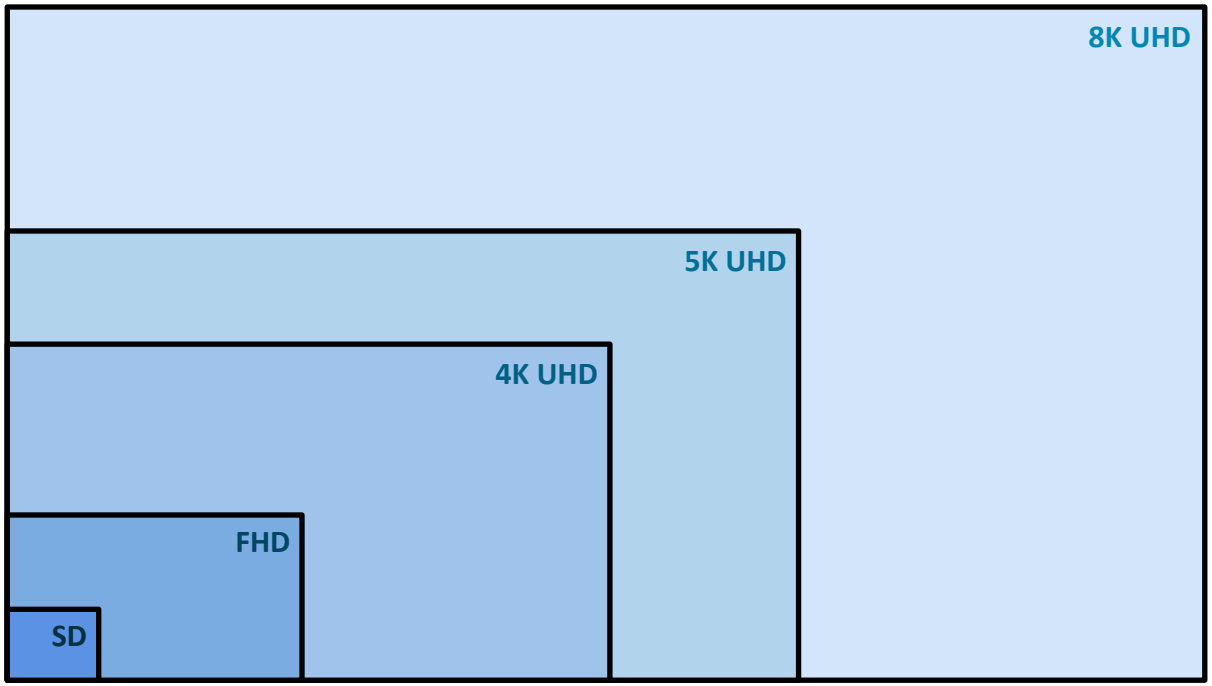
Two 5K displays



5K Resolution Table
5120 x 2880 | 16:9 | 14.75 Megapixels
5120 x 3840 | 4:3 | 19.66 Megapixels
5120 x 2700 | 1.896:1 | 13.82 Megapixels
5120 x 2160 | 21:9 | 11.06 Megapixels

Quadro M6000, M5000 and M4000: 4K and Beyond

Single 8K display

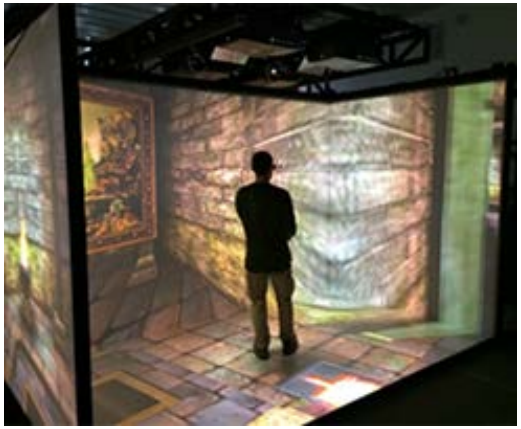


8K Resolution Table
8192 x 4320 | 17:9 | 35.4 Megapixels
7680 x 4320 | 16:9 | 33.2 Megapixels
8192 x 5120 | 16:10 | 41.9 Megapixels
8192 x 8192 | 1:1 | 67.1 Megapixels

NVIDIA Quadro Scalable Visualization Systems (SVS)

M6000, M5000 and M4000 scale from 4K up…

Mosaic	
▪	Single workstation
▪	Single desktop
▪	4 GPUs (16 display heads)
▪	Application independent
▪	~142 Megapixels (16K x 4K)



GPU Affinity	
▪	Single workstation
▪	Multiple desktops
▪	8 GPUs (32 display heads)
▪	Application dependent
▪	~284 Megapixels (32K x 4K)

Cluster Solution	
▪	Multiple workstations
▪	Multiple desktops
▪	~200 GPUs (800 display heads)
▪	Application dependent
▪	~7,087 Megapixels (800K x 4K)

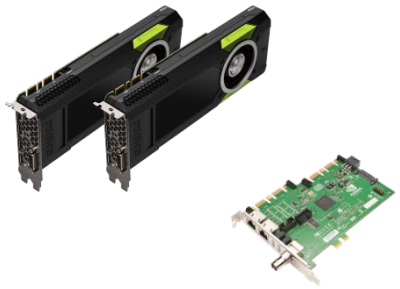
NVIDIA Quadro M6000 Video Wall Kits

Turnkey solutions for industry standard hardware

4 Quadro M6000s + Quadro Sync	3 Quadro M6000s + Quadro Sync	2 Quadro M6000s + Quadro Sync
PNY PN: VCQM6000SYNC-4M6KIT	PNY PN: VCQM6000SYNC-3M6KIT	PNY PN: VCQM6000SYNC-2M6KIT

NVIDIA Quadro M5000 Video Wall Kits

Turnkey solutions for industry standard hardware

4 Quadro M5000s + Quadro Sync	3 Quadro M5000s + Quadro Sync	2 Quadro M5000s + Quadro Sync
		
PNY PN: VCQM5000SYNC-4M5KIT	PNY PN: VCQM5000SYNC-3M5KIT	PNY PN: VCQM5000SYNC-2M5KIT

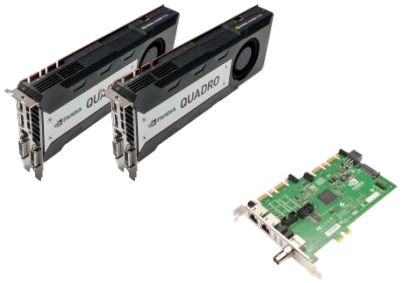
NVIDIA Quadro M4000 Video Wall Kits

Turnkey solutions for industry standard hardware

4 Quadro M4000s + Quadro Sync	3 Quadro M4000s + Quadro Sync	2 Quadro M4000s + Quadro Sync
PNY PN: VCQM4000SYNC-4M4KIT	PNY PN: VCQM4000SYNC-3M4KIT	PNY PN: VCQM4000SYNC-2M4KIT

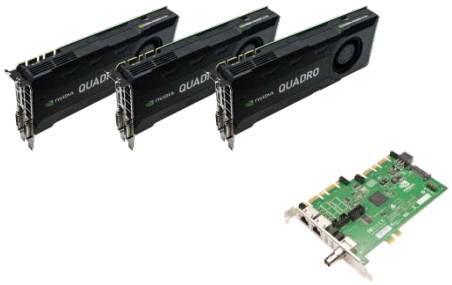
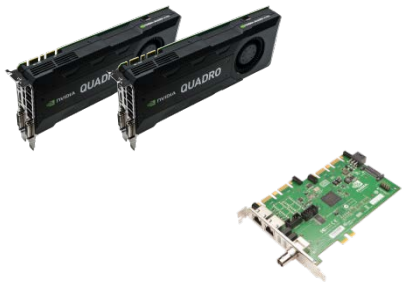
NVIDIA Quadro K6000 Video Wall Kits

Turnkey solutions for industry standard hardware

4 Quadro K6000s + Quadro Sync	3 Quadro K6000s + Quadro Sync	2 Quadro K6000s + Quadro Sync
		
PNY PN: VCQK6000SYNC-4K6KIT	**PNY PN: VCQK6000SYNC-3K6KIT**	**PNY PN: VCQK6000SYNC-2K6KIT**

NVIDIA Quadro K5200 Video Wall Kits

Turnkey solutions for industry standard hardware

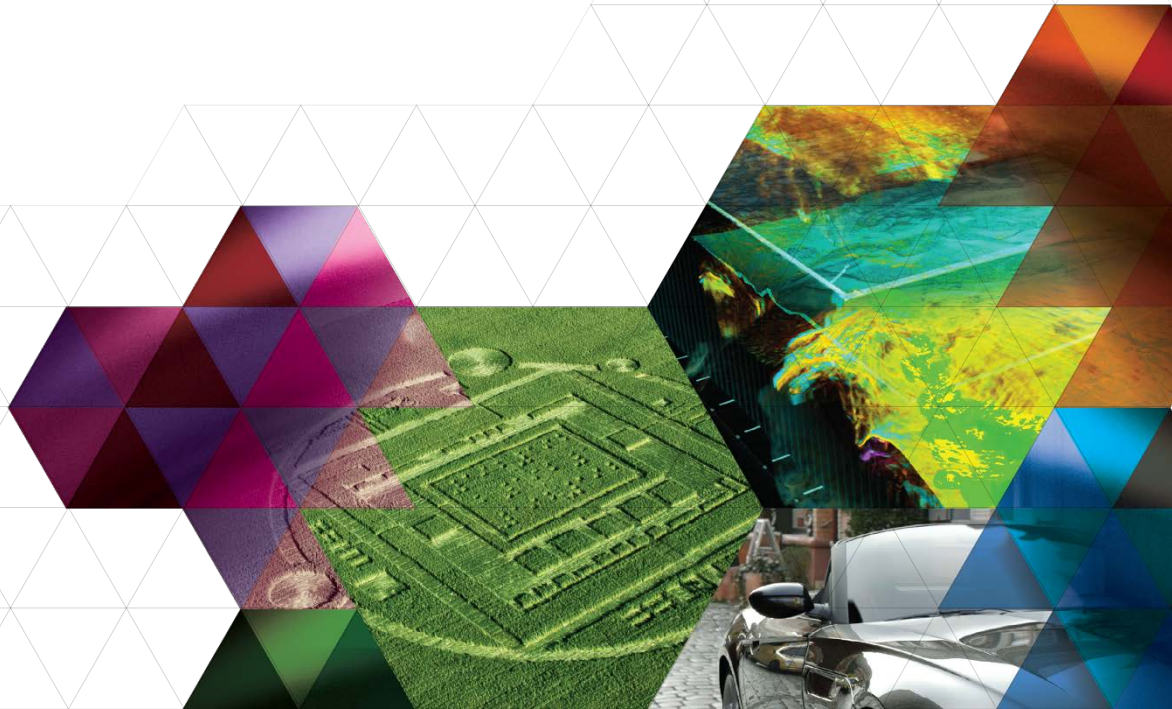
4 Quadro K5200s + Quadro Sync	3 Quadro K5200s + Quadro Sync	2 Quadro K5200s + Quadro Sync
		
PNY PN: VCQK5200SYNC-4K52KIT	PNY PN: VCQK5200SYNC-3K52KIT	PNY PN: VCQK5200SYNC-2K52KIT

NVIDIA Quadro K4200 Video Wall Kits

Turnkey solutions for industry standard hardware

4 Quadro K4200s + Quadro Sync	3 Quadro K4200s + Quadro Sync	2 Quadro K4200s + Quadro Sync
PNY PN: VCQK4200SYNC-4K42KIT	PNY PN: VCQK4200SYNC-3K42KIT	PNY PN: VCQK4200SYNC-2K42KIT

NVIDIA Quadro and NVS Video Walls

NVIDIA® QUADRO®
AUTHORIZED PARTNER
PNY®

NVIDIA® NVS™
AUTHORIZED PARTNER
PNY®