EUC Score

Performance and price comparison of GPU-accelerated (Cloud) AVD VMs when running high-end CAD/CAM and CIM workloads

E2EVC 2023, Rome

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EUC Score

control UP

GO-EUC

VC 2 GO

Performance Data Scientist
EUC Documentary Cameraman
MVP | CTP | vExpert EUC
NGCA | VIPP

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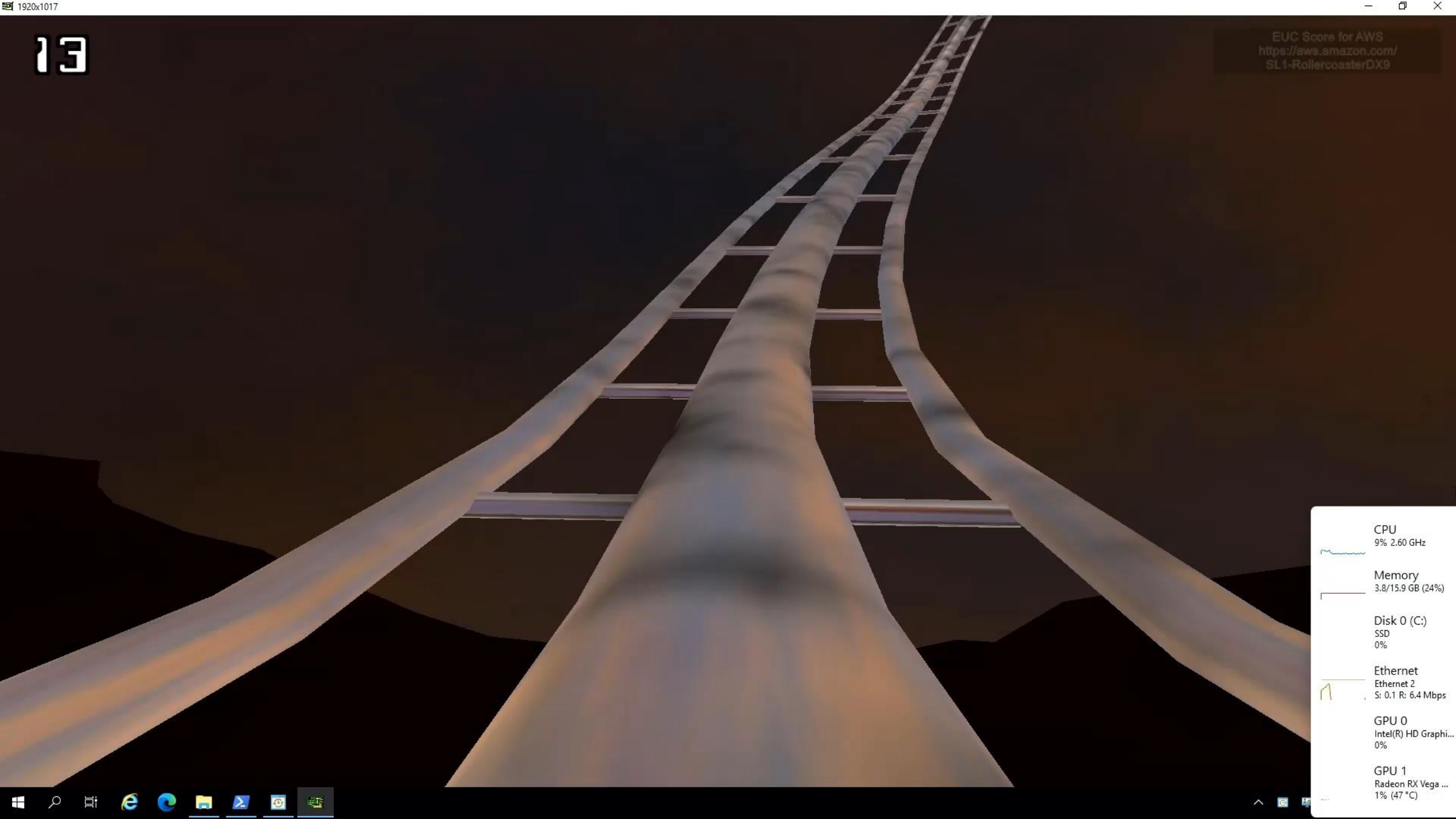
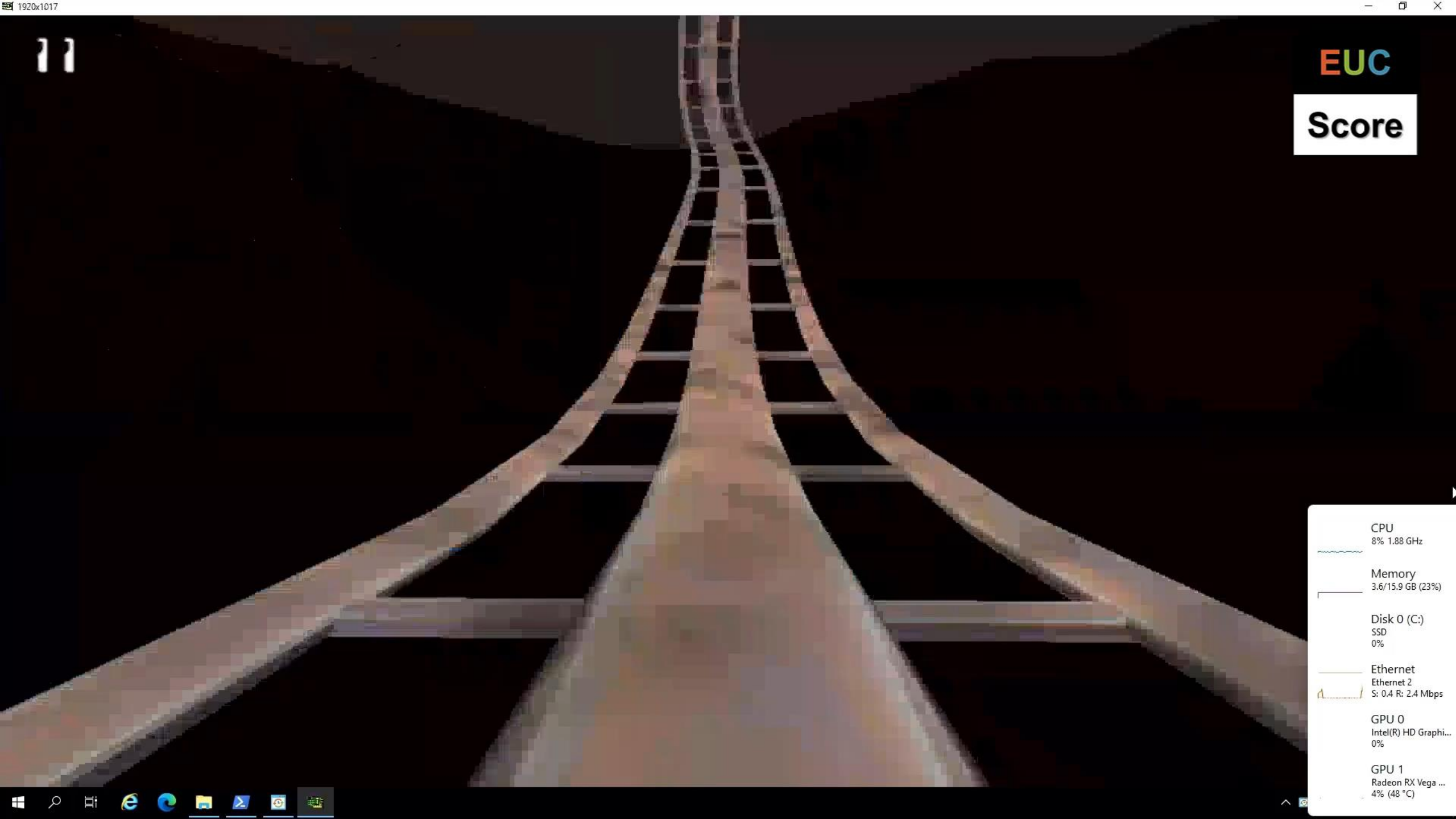
E2 EXPERTS EXPERTS Virtualization Conference
www.e2evc.com

Thank you, Ruben Spruijt, for running so many of the time-consuming tests and sharing the results

And a big thank you goes to Frame-Dizzion for providing cloud workstation resources

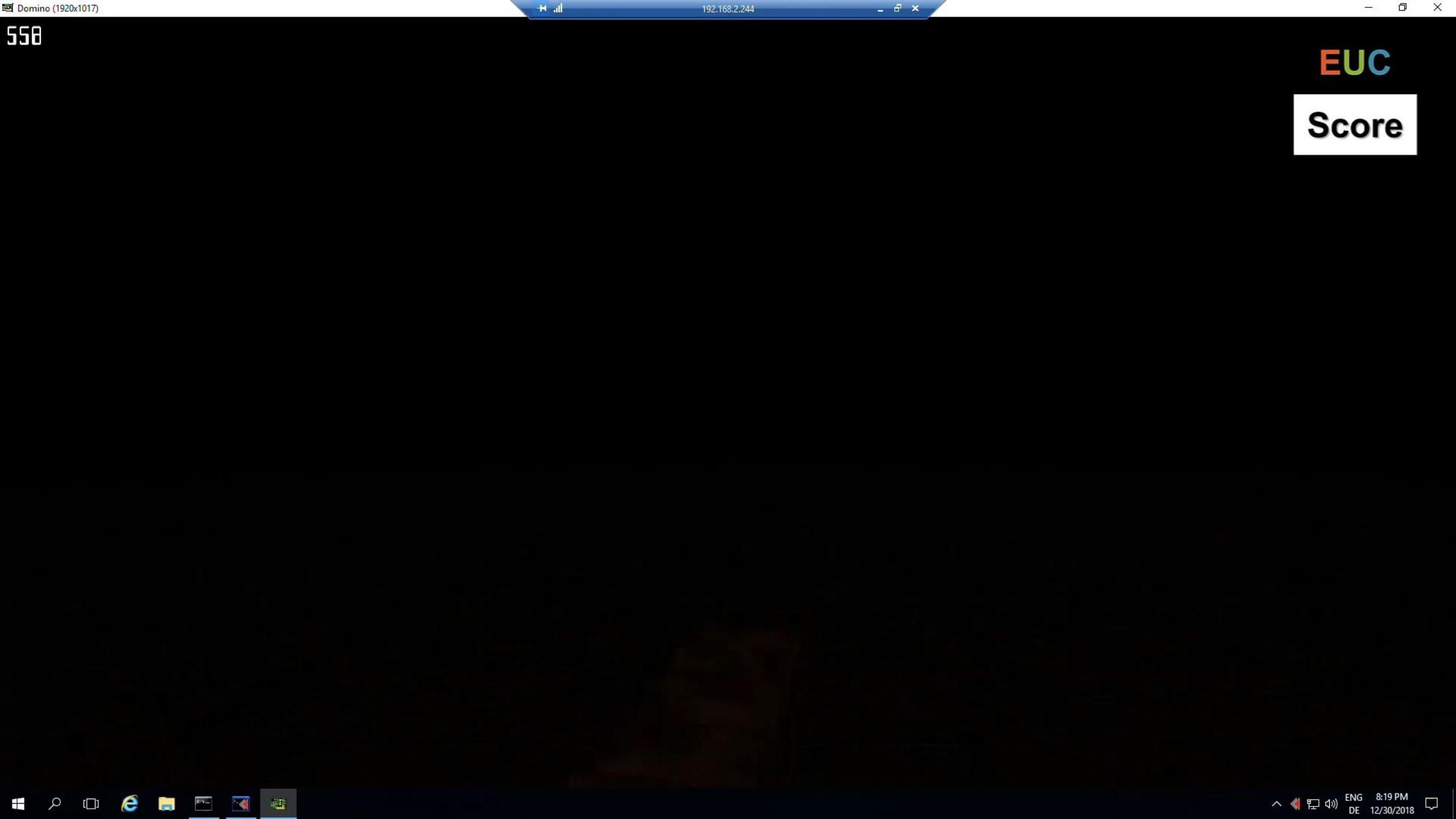

1920x1017
13
EUC Score for AWS
https://aws.amazon.com/
SL1-RollercoasterDX9
CPU
9% 2.60 GHz
Memory
3.8/15.9 GB (24%)
Disk 0 (C:)
SSD
0%
Ethernet
Ethernet 2
S: 0.1 R: 6.4 Mbps
GPU 0
Intel(R) HD Graphi...
0%
GPU 1
Radeon RX Vega ...
1% (47 °C)


1920x1017
EUC
Score
CPU
8% 1.88 GHz
Memory
3.6/15.9 GB (23%)
Disk 0 (C:)
SSD
0%
Ethernet
Ethernet 2
S: 0.4 R: 2.4 Mbps
GPU 0
Intel(R) HD Graphi...
0%
GPU 1
Radeon RX Vega ...
4% (48 °C)

Coral_Reef_1080p

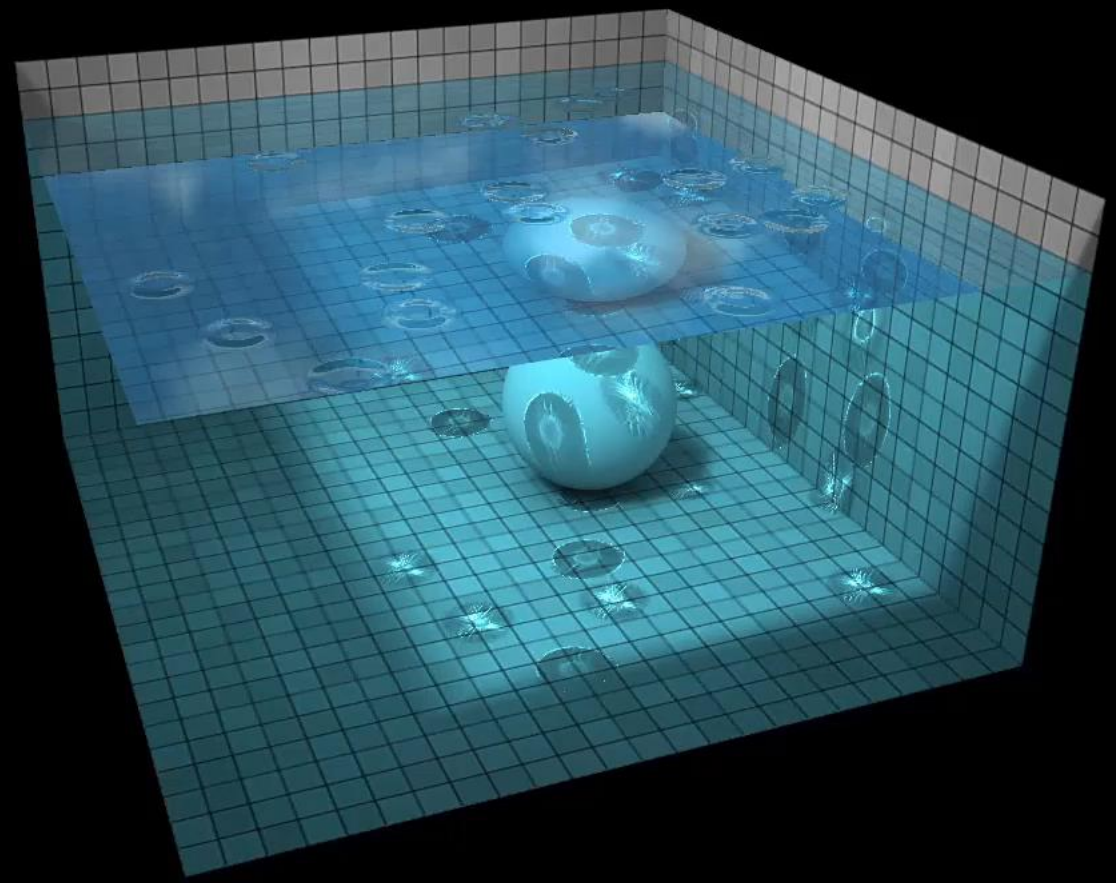
EUC

Score


Domino (1920x1017)
192.168.2.244
558
EUC
Score
ENG
DE
8:19 PM
12/30/2018

WebGL Water

Not secure | madebyevan.com/webgl-water/



WebGL Water

Made by Evan Wallace

This demo requires a decent graphics card and up-to-date drivers. If you can't run the demo, you can still see it on YouTube.

Interactions:

- Draw on the water to make ripples
- Drag the background to rotate the camera
- Press SPACEBAR to pause and unpause
- Drag the sphere to move it around
- Press the L key to set the light direction
- Press the G key to toggle gravity

Features:

- Raytraced reflections and refractions
- Analytic ambient occlusion
- Heightfield water simulation *
- Soft shadows
- Caustics (see this for details) **

* requires the OES_texture_float extension
** requires the OES_standard_derivatives extension

Tile texture from zooboing on Flickr

Views

CPU 100%

60 Seconds 0%

Disk 100 KB/sec

0

Network 1 Mbps

0

Memory 100 Hard Faults/sec

0

Task Manager

File Options View

Processes Performance Users Details

CPU
88% 2.60 GHz

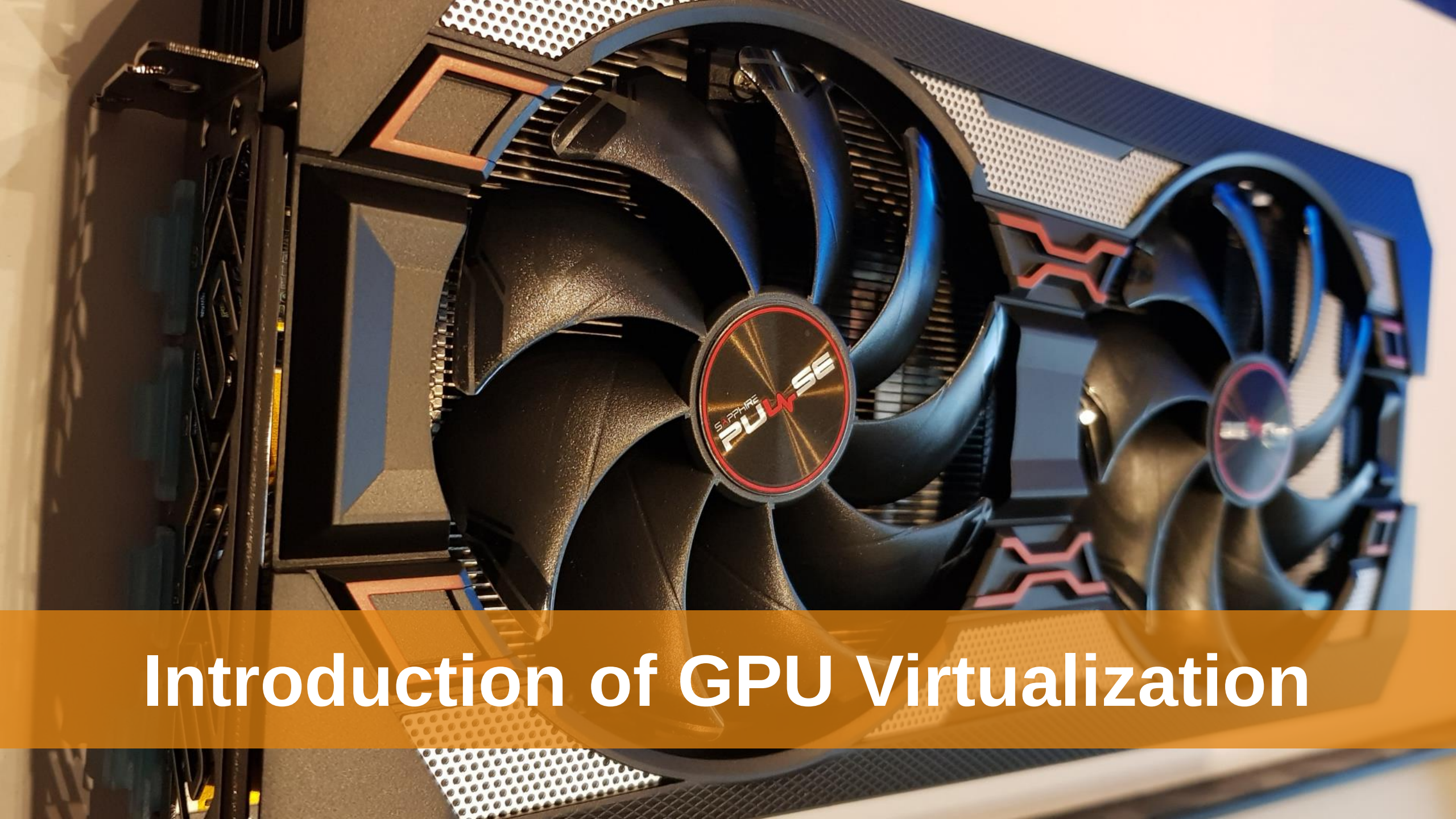
Memory
1.7/4.0 GB (43%)

Ethernet
S: 16.0 Kbps R: 16.0 Kbps

Fewer details | Open Resource

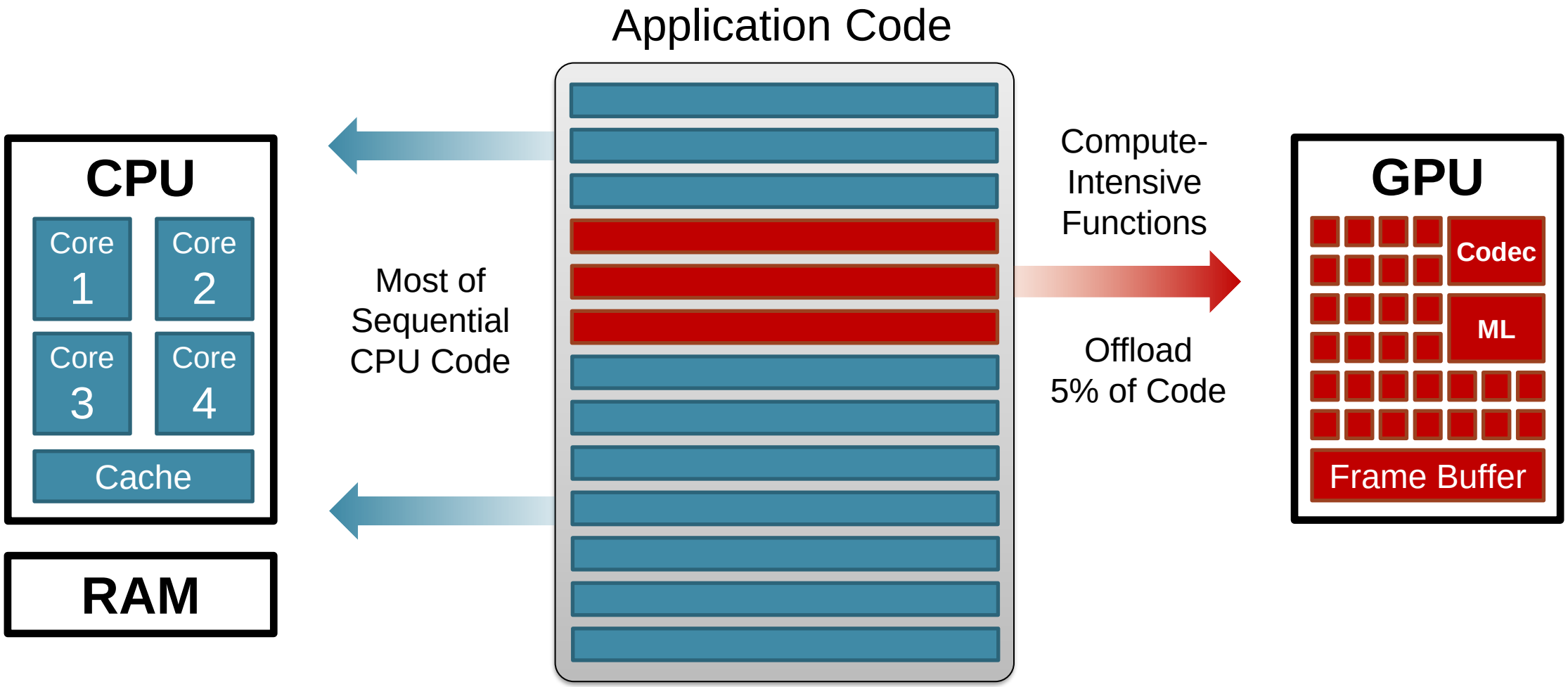
WebGL Water - Pro... Task Manager Resource Monitor

ENG DE 5:37 PM 1/6/2021

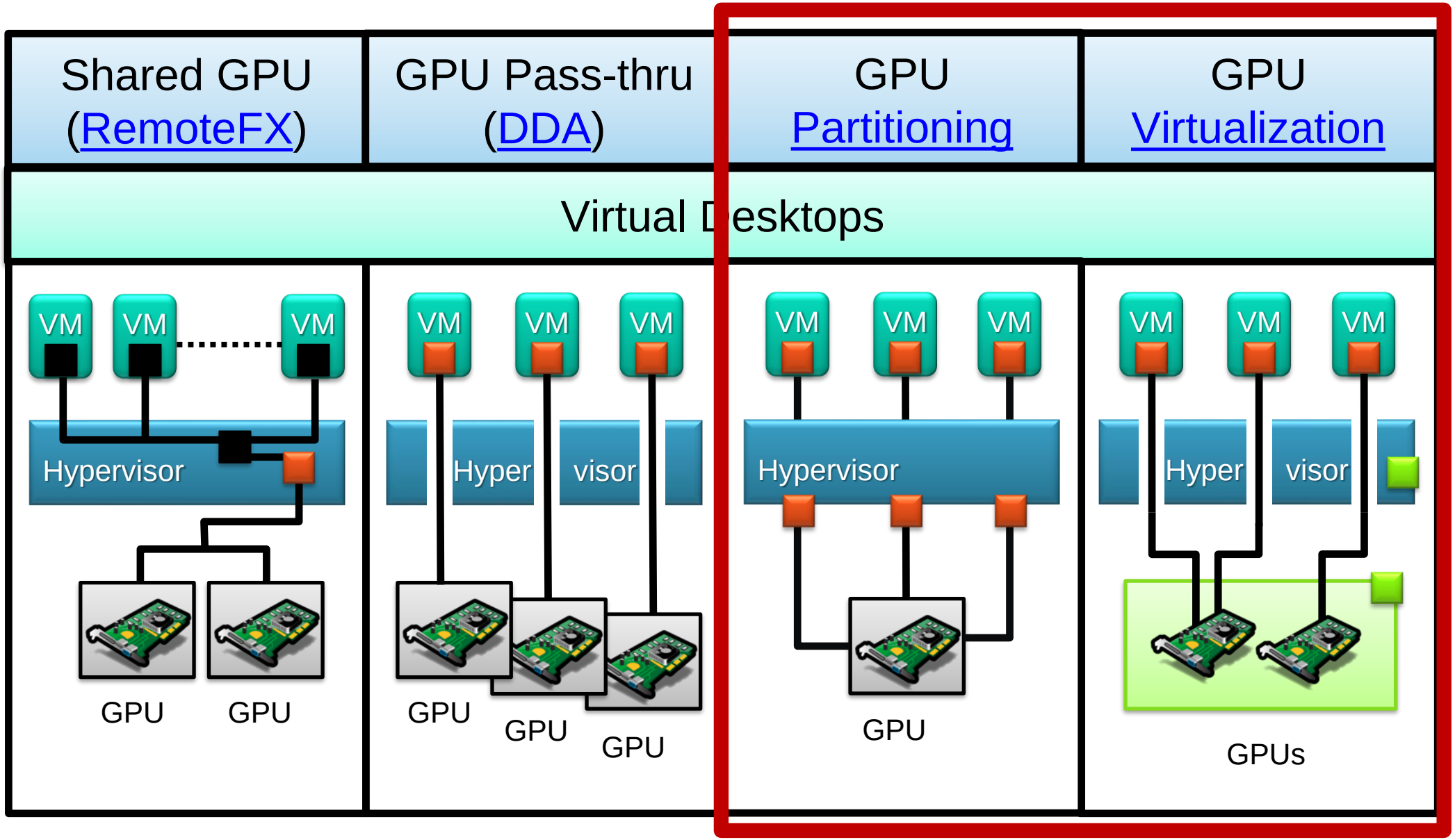


Introduction of GPU Virtualization

The Benefits of GPUs



GPU Virtualization



GPU Benefits to Remoting

- Hardware-accelerated video encode and decode (codec) – H.264/H.265 aka MPEG-4 AVC (Advanced Video Coding)
- Hardware-accelerated encoding of the remoting protocol data stream
- Rendering graphical objects created by Windows Desktop Manager and applications into the frame buffer – GDI, GDI+, DirectX, OpenGL

GPU-Accelerated VM Types for AVD

- **NV-series** (retired) and **NVv3-series** VMs with virtualized NVIDIA M60 GPUs (1 GPU with 8GB VRAM = one-half M60 card, GRID vGPU) - Aug 2016
- **NVv4-series VMs** with partitioned AMD MI25 GPUs (1/8, 1/4, 1/2, or 1 GPU with 2 to 16 GB VRAM) - Jun 2017
- **NCasT4_v3-series VMs** with AMD EPYC2 Rome CPU and NVIDIA T4 GPU (1 or 4 full GPUs with 16GB or 64GB VRAM) - Sep 2018
- **NVadsA10 v5-series VMs** with AMD EPYC Milan CPUs and partitioned NVIDIA A10 GPU (1/6, 1/3, 1/2, 1 or 2 GPUs with 4 to 48GB VRAM) - Apr 2021
- **[Preview] NGads-series VMs** with AMD V620 GPUs (1/4, 1/2 or 1 GPU with 8 to 32GB VRAM)
- **On my personal wish list**: VMs with NVIDIA L4 GPUs

Azure VM Types under Test with GPU

Instance	CPU	CPU Base Clock Speed	Max CPU Speed	vCPUs	RAM	Storage Type	Storage Size	GPU	GPU VRAM	Display	OS	GPU Release Year
Microsoft Azure												
Azure NV6	Intel Xeon E5-2690v3	2.6 GHz	3.5 GHz	6	56 GB	Standard SSD	256GB	NVIDIA M60	8 GB	FHD	Win10 22H2	Aug 2015
Azure NV4as_v4	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	4	14 GB	Premium SSD	256GB	AMD MI25	2 GB	FHD	Win10 22H2	Jun 2017
Azure NV8as_v4	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	8	28 GB	Premium SSD	256GB	AMD MI25	4 GB	FHD	Win10 22H2	Jun 2017
Azure NV16as_v4	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	16	56 GB	Premium SSD	256GB	AMD MI25	8 GB	FHD	Win10 22H2	Jun 2017
Azure NV32as_v4	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	32	112 GB	Premium SSD	256GB	AMD MI25	16 GB	FHD	Win10 22H2	Jun 2017
Azure NC4asT4_v3	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	4	28 GB	Premium SSD	256GB	NVIDIA T4	16 GB	FHD	Win10 22H2	Sep 2018
Azure NC8asT4_v3	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	8	56 GB	Premium SSD	256GB	NVIDIA T4	16 GB	FHD	Win11 22H2	Sep 2018
Azure NC16asT4_v3	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	16	110 GB	Premium SSD	256GB	NVIDIA T4	16 GB	FHD	Win10 22H2	Sep 2018
Azure NV6adsA10_v5	AMD EPYC 74F3 - Milan	3.2 GHz	4.0 GHz	6	55 GB	Premium SSD	256GB	NVIDIA A10 4Q	4 GB	FHD	Win11 22H2	Apr 2021
Azure NV12adsA10_v5	AMD EPYC 74F3 - Milan	3.2 GHz	4.0 GHz	12	110 GB	Premium SSD	256GB	NVIDIA A10 8Q	8 GB	FHD	Win10 22H2	Apr 2021
Azure NV36adsA10_v5	AMD EPYC 74F3 - Milan	3.2 GHz	4.0 GHz	36	440 GB	Premium SSD	256GB	NVIDIA A10 24Q	24 GB	FHD	Win10 22H2	Apr 2021

NCas_T4_v3 and NV6ads_A10_v5

Size	vCPU	Memory: GiB	Temp storage (SSD) GiB	GPU	GPU memory: GiB	Max data disks	Max NICs / Expected network bandwidth (Mbps)
Standard_NC4as_T4_v3	4	28	180	1	16	8	2 / 8000
Standard_NC8as_T4_v3	8	56	360	1	16	16	4 / 8000
Standard_NC16as_T4_v3	16	110	360	1	16	32	8 / 8000
Standard_NC64as_T4_v3	64	440	2880	4	64	32	8 / 32000

Size	vCPU	Memory: GiB	Temp storage (SSD) GiB	GPU partition	GPU memory: GiB	Max data disks	Max uncached disk throughput: IOPS/MBps	Max NICs / Expected network bandwidth (Mbps)
Standard_NV6ads_A10_v5	6	55	180	1/6	4	4	6400 / 100	2 / 5000
Standard_NV12ads_A10_v5	12	110	360	1/3	8	4	12800 / 200	2 / 10000
Standard_NV18ads_A10_v5	18	220	720	1/2	12	8	25600 / 384	4 / 20000
Standard_NV36ads_A10_v5	36	440	1440	1	24	16	51200 / 768	4 / 40000
Standard_NV36adms_A10_v5	36	880	2880	1	24	32	51200 / 768	8 / 80000
Standard_NV72ads_A10_v5	72	880	2880	2	48	32	80000 / 1200	8 / 80000

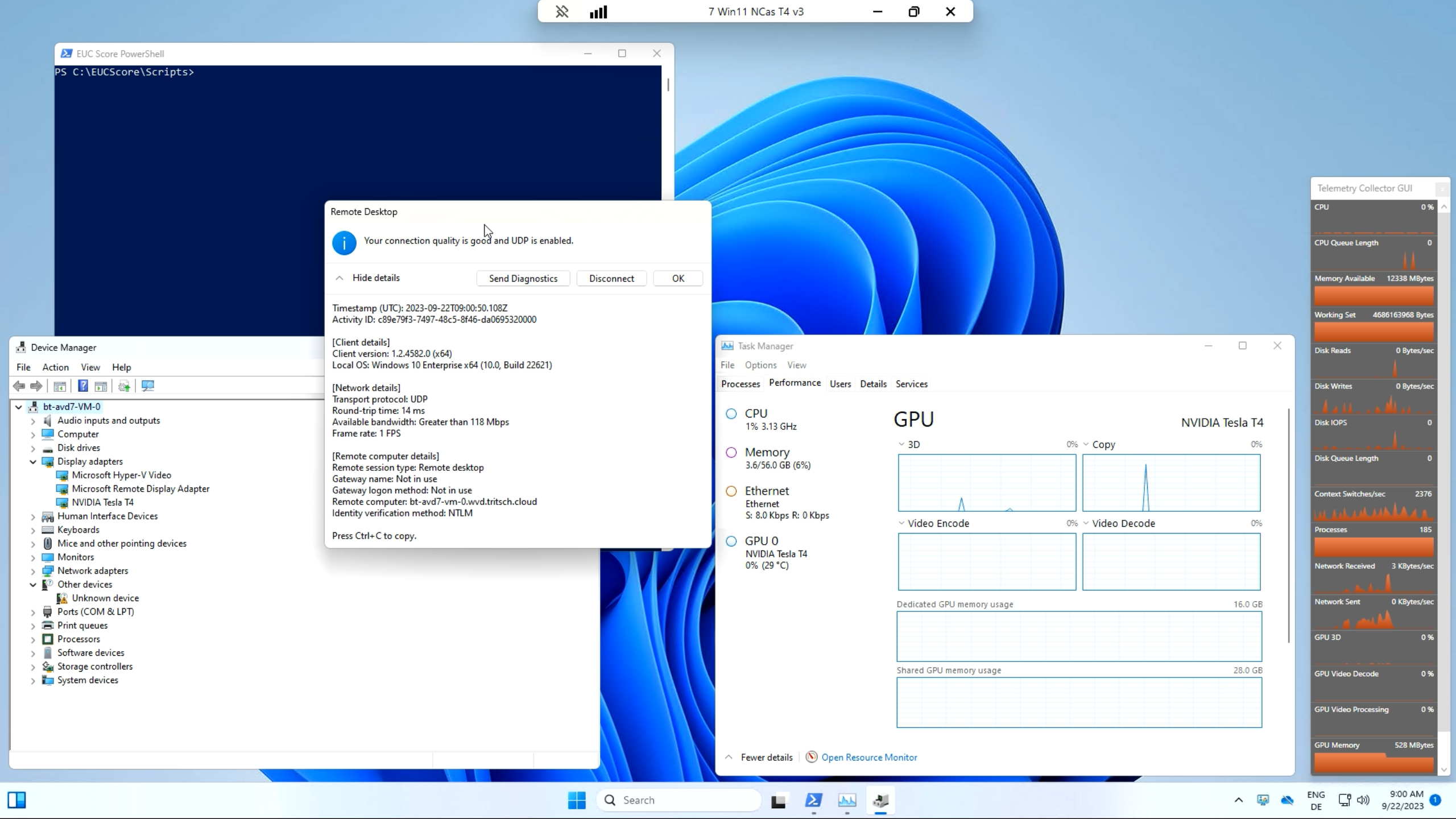
Installing GPU Drivers

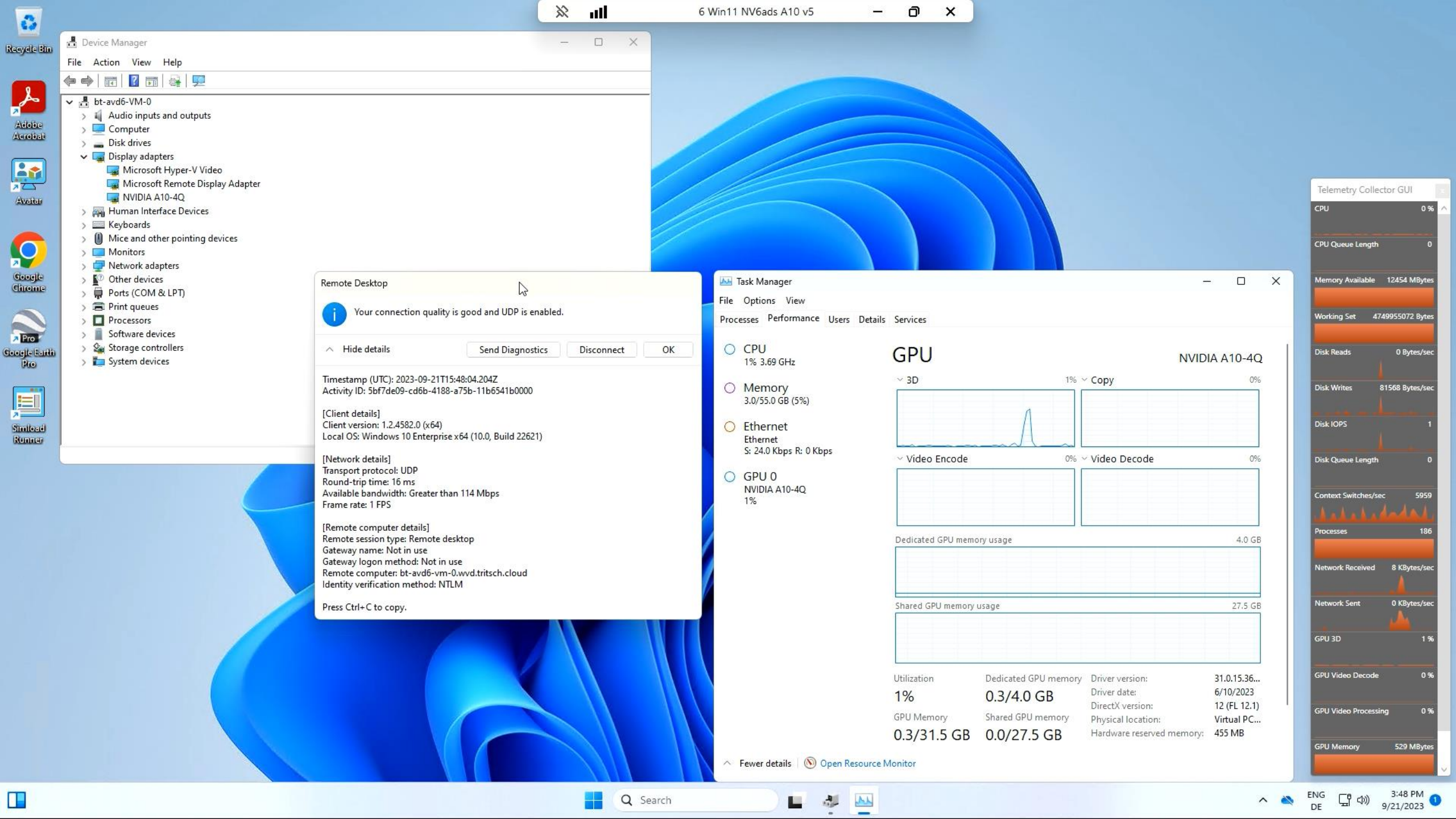
NVIDIA GRID Drivers

- The NVIDIA GPU Driver Extension installs appropriate NVIDIA CUDA or GRID drivers
- Alternatively, you may install NVIDIA GPU drivers manually
- NVIDIA GRID driver installers for NV,NVv3 and NVads A10 v5-series VMs used as virtual workstations
- The GRID drivers redistributed by Azure don't work on non-NV series VMs, the one exception is the NCas_T4_V3 VM series

AMD GPU Drivers

- The AMD GPU Driver Extension installs AMD GPU drivers on a NVv4-series VM (MI25 MxGPU)
- The NGads V620 Series VMs support the AMD Cloud Software driver (preview)
- You can use Azure Resource Manager templates to deploy Azure VM extensions


7 Win11 NCas T4 v3
EUC Score PowerShell
PS C:\EUCScore\Scripts>
Remote Desktop
Your connection quality is good and UDP is enabled.
Hide details
Send Diagnostics
Disconnect
OK
Timestamp (UTC): 2023-09-22T09:00:50.108Z
Activity ID: c89e79f3-7497-48c5-8f46-da0695320000
[Client details]
Client version: 1.2.4582.0 (x64)
Local OS: Windows 10 Enterprise x64 (10.0, Build 22621)
[Network details]
Transport protocol: UDP
Round-trip time: 14 ms
Available bandwidth: Greater than 118 Mbps
Frame rate: 1 FPS
[Remote computer details]
Remote session type: Remote desktop
Gateway name: Not in use
Gateway logon method: Not in use
Remote computer: bt-avd7-vm-0.wvd.tritsch.cloud
Identity verification method: NTLM
Press Ctrl+C to copy.
Device Manager
File Action View Help
bt-avd7-VM-0
Audio inputs and outputs
Computer
Disk drives
Display adapters
Microsoft Hyper-V Video
Microsoft Remote Display Adapter
NVIDIA Tesla T4
Human Interface Devices
Keyboards
Mice and other pointing devices
Monitors
Network adapters
Other devices
Unknown device
Ports (COM & LPT)
Print queues
Processors
Software devices
Storage controllers
System devices
Task Manager
File Options View
Processes Performance Users Details Services
CPU
1% 3.13 GHz
Memory
3.6/56.0 GB (6%)
Ethernet
Ethernet
S: 8.0 Kbps R: 0 Kbps
GPU 0
NVIDIA Tesla T4
0% (29 °C)
GPU
NVIDIA Tesla T4
3D 0%
Copy 0%
Video Encode 0%
Video Decode 0%
Dedicated GPU memory usage 16.0 GB
Shared GPU memory usage 28.0 GB
Fewer details
Open Resource Monitor
Telemetry Collector GUI
CPU 0 %
CPU Queue Length 0
Memory Available 12338 MBytes
Working Set 4686163968 Bytes
Disk Reads 0 Bytes/sec
Disk Writes 0 Bytes/sec
Disk IOPS 0
Disk Queue Length 0
Context Switches/sec 2376
Processes 185
Network Received 3 KBytes/sec
Network Sent 0 KBytes/sec
GPU 3D 0 %
GPU Video Decode 0 %
GPU Video Processing 0 %
GPU Memory 528 MBytes
Search
ENG
DE
9:00 AM
9/22/2023

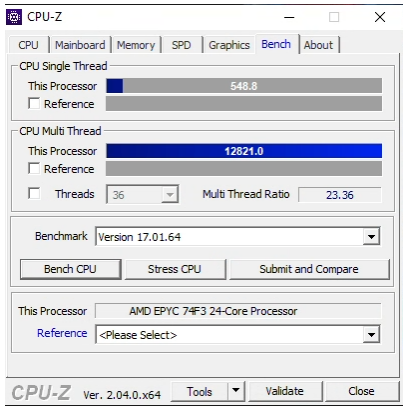

6 Win11 NV6ads A10 v5
Recycle Bin
Adobe Acrobat
Avatar
Google Chrome
Google Earth Pro
Simload Runner
Device Manager
File Action View Help
bt-avd6-VM-0
Audio inputs and outputs
Computer
Disk drives
Display adapters
Microsoft Hyper-V Video
Microsoft Remote Display Adapter
NVIDIA A10-4Q
Human Interface Devices
Keyboards
Mice and other pointing devices
Monitors
Network adapters
Other devices
Ports (COM & LPT)
Print queues
Processors
Software devices
Storage controllers
System devices
Remote Desktop
Your connection quality is good and UDP is enabled.
Hide details
Send Diagnostics
Disconnect
OK
Timestamp (UTC): 2023-09-21T15:48:04.204Z
Activity ID: 5bf7de09-cd6b-4188-a75b-11b6541b0000
[Client details]
Client version: 1.2.4582.0 (x64)
Local OS: Windows 10 Enterprise x64 (10.0, Build 22621)
[Network details]
Transport protocol: UDP
Round-trip time: 16 ms
Available bandwidth: Greater than 114 Mbps
Frame rate: 1 FPS
[Remote computer details]
Remote session type: Remote desktop
Gateway name: Not in use
Gateway logon method: Not in use
Remote computer: bt-avd6-vm-0.wvd.tritsch.cloud
Identity verification method: NTLM
Press Ctrl+C to copy.
Task Manager
File Options View
Processes Performance Users Details Services
CPU
1% 3.69 GHz
Memory
3.0/55.0 GB (5%)
Ethernet
Ethernet
S: 24.0 Kbps R: 0 Kbps
GPU 0
NVIDIA A10-4Q
1%
GPU
NVIDIA A10-4Q
3D 1%
Copy 0%
Video Encode 0%
Video Decode 0%
Dedicated GPU memory usage 4.0 GB
Shared GPU memory usage 27.5 GB
Utilization
1%
Dedicated GPU memory
0.3/4.0 GB
GPU Memory
0.3/31.5 GB
Shared GPU memory
0.0/27.5 GB
Driver version: 31.0.15.36...
Driver date: 6/10/2023
DirectX version: 12 (FL 12.1)
Physical location: Virtual PC...
Hardware reserved memory: 455 MB
Fewer details
Open Resource Monitor
Telemetry Collector GUI
CPU 0 %
CPU Queue Length 0
Memory Available 12454 MBytes
Working Set 4749955072 Bytes
Disk Reads 0 Bytes/sec
Disk Writes 81568 Bytes/sec
Disk IOPS 1
Disk Queue Length 0
Context Switches/sec 5959
Processes 186
Network Received 8 KBytes/sec
Network Sent 0 KBytes/sec
GPU 3D 1 %
GPU Video Decode 0 %
GPU Video Processing 0 %
GPU Memory 529 MBytes
Search
ENG DE
3:48 PM 9/21/2023

Sync Player Showtime

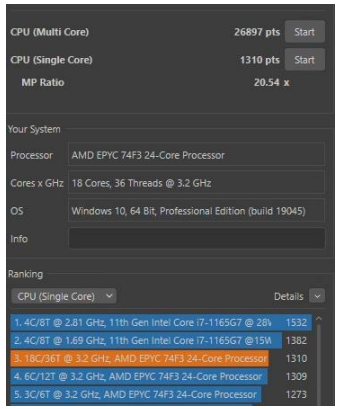
VM Types with GPU Across Multiple Clouds

Instance	CPU	CPU Base Clock Speed	Max CPU Speed	vCPUs	RAM	Storage Type	Storage Size	GPU	GPU VRAM	Display	OS	GPU Release Year
Microsoft Azure												
Azure NV6	Intel Xeon E5-2690v3 - Haswell	2.6 GHz	3.5 GHz	6	56 GiB	Standard-SSD	256GB	NVIDIA M60	8 GB	FHD	Win10 22H2	Aug 2015
Azure NV4as_v4	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	4	14 GiB	Premium-SSD	256GB	AMD MI25	2 GB	FHD	Win10 22H2	Jun 2017
Azure NV8as_v4	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	8	28 GiB	Premium-SSD	256GB	AMD MI25	4 GB	FHD	Win10 22H2	Jun 2017
Azure NV16as_v4	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	16	56 GiB	Premium-SSD	256GB	AMD MI25	8 GB	FHD	Win10 22H2	Jun 2017
Azure NV32as_v4	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	32	112 GiB	Premium-SSD	256GB	AMD MI25	16 GB	FHD	Win10 22H2	Jun 2017
Azure NC4asT4_v3	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	4	28 GiB	Premium-SSD	256GB	NVIDIA T4	16 GB	FHD	Win10 22H2	Sep 2018
Azure NC8asT4_v3	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	8	56 GiB	Premium-SSD	256GB	NVIDIA T4	16 GB	FHD	Win10 22H2	Sep 2018
Azure NC16asT4_v3	AMD EPYC 7V12 - Rome	2.45 GHz	3.3 GHz	16	110 GiB	Premium-SSD	256GB	NVIDIA T4	16 GB	FHD	Win10 22H2	Sep 2018
Azure NV6adsA10_v5	AMD EPYC 74F3 - Milan	3.2 GHz	4.0 GHz	6	55 GiB	Premium-SSD	256GB	NVIDIA A10 4Q	4 GB	FHD	Win10 22H2	Apr 2021
Azure NV12adsA10_v5	AMD EPYC 74F3 - Milan	3.2 GHz	4.0 GHz	12	110 GiB	Premium-SSD	256GB	NVIDIA A10 8Q	8 GB	FHD	Win10 22H2	Apr 2021
Azure NV36adsA10_v5	AMD EPYC 74F3 - Milan	3.2 GHz	4.0 GHz	36	440 GiB	Premium-SSD	256GB	NVIDIA A10 24Q	24 GB	FHD	Win10 22H2	Apr 2021
Amazon Web Services												
AWS G4ad.XL	AMD EPYC 7R32 - Rome	2.8 GHz	3.3 GHz	4	16 GiB	EBS GP3	256GB	AMD V520	8 GB	FHD	Server 2019	Dec 2020
AWS G4ad.2XL	AMD EPYC 7R32 - Rome	2.8 GHz	3.3 GHz	8	32 GiB	EBS GP3	256GB	AMD V520	8 GB	FHD	Server 2019	Dec 2020
AWS G4ad.4XL	AMD EPYC 7R32 - Rome	2.8 GHz	3.3 GHz	16	64 GiB	EBS GP3	256GB	AMD V520	8 GB	FHD	Server 2019	Dec 2020
AWS G4ad.8XL	AMD EPYC 7R32 - Rome	2.8 GHz	3.3 GHz	32	128 GiB	EBS GP3	256GB	AMD V520 x2	8 GB	FHD	Server 2019	Dec 2020
AWS G4dn.XL	Intel Xeon 8259 - Cascade Lake	2.5 GHz	3.5 GHz	4	16 GiB	EBS GP3	256GB	NVIDIA T4	16 GB	FHD	Server 2019	Sep 2018
AWS G4dn.2XL	Intel Xeon 8259 - Cascade Lake	2.5 GHz	3.5 GHz	8	32 GiB	EBS GP3	256GB	NVIDIA T4	16 GB	FHD	Server 2019	Sep 2018
AWS G4dn.4XL	Intel Xeon 8259 - Cascade Lake	2.5 GHz	3.5 GHz	16	64 GiB	EBS GP3	256GB	NVIDIA T4	16 GB	FHD	Server 2019	Sep 2018
AWS.G4dn.8XL	Intel Xeon 8259 - Cascade Lake	2.5 GHz	3.5 GHz	32	128 GiB	EBS GP3	256GB	NVIDIA T4	16 GB	FHD	Server 2019	Sep 2018
AWS G5.xl	AMD EPYC 7R32 - Rome	2.8 GHz	3.3 GHz	4	16 GiB	EBS GP3	256GB	NVIDIA A10G	24 GB	FHD	Server 2019	Apr 2021
AWS G5.2xl	AMD EPYC 7R32 - Rome	2.8 GHz	3.3 GHz	8	32 GiB	EBS GP3	256GB	NVIDIA A10G	24 GB	FHD	Server 2019	Apr 2021
AWS G5.4xl	AMD EPYC 7R32 - Rome	2.8 GHz	3.3 GHz	16	64 GiB	EBS GP3	256GB	NVIDIA A10G	24 GB	FHD	Server 2019	Apr 2021
AWS G5.8xl	AMD EPYC 7R32 - Rome	2.8 GHz	3.3 GHz	32	128 GiB	EBS GP3	256GB	NVIDIA A10G	24 GB	FHD	Server 2019	Apr 2021
Google Cloud Platform												
GCP N1-STD-2-GPU-T4	Intel Xeon 3647 – Skylake	2.0 GHz	3.5 GHz	2	8 GiB	Zonal SSD PD	256GB	NVIDIA T4	16 GB	FHD	Server 2019	Sep 2018
GCP N1-STD-4-GPU-T4	Intel Xeon 3647 – Skylake	2.0 GHz	3.5 GHz	4	16 GiB	Zonal SSD PD	256GB	NVIDIA T4	16 GB	FHD	Server 2019	Sep 2018
GCP N1-STD-8-GPU-T4	Intel Xeon 3647 – Skylake	2.0 GHz	3.5 GHz	8	30 GiB	Zonal SSD PD	256GB	NVIDIA T4	16 GB	FHD	Server 2019	Sep 2018
GCP N1-STD-16-GPU-T4	Intel Xeon 3647 – Skylake	2.0 GHz	3.5 GHz	16	60 Gib	Zonal SSD PD	256GB	NVIDIA T4	16 GB	FHD	Server 2019	Sep 2018
Physical Workstation												
Workstation-RSP	AMD Ryzen 7 5800X	3.8 GHz	4.7 GHz	16	128 GB	NVMe	2TB	NVIDIA RTX A6000	48 GB	FHD	Win 11 22-H2	Oct 2020

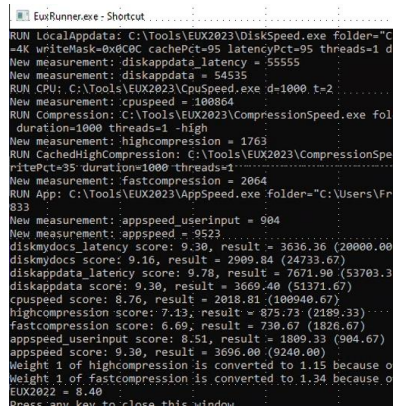
More Test Apps



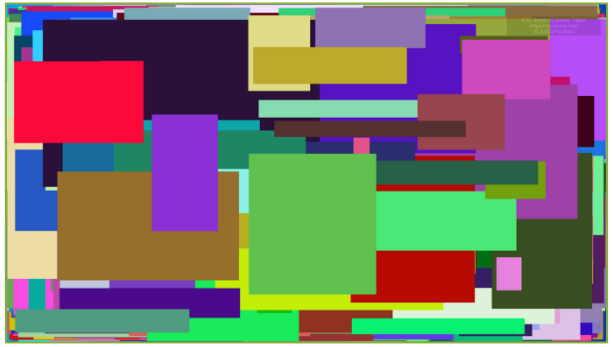
GPU-Z



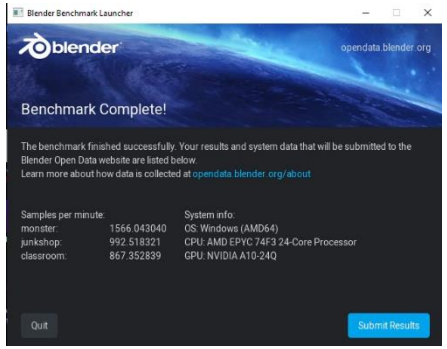
CineBench



Login Enterprise EUX Score



EUC Score – Sore Simloads



Blender

SPECviewperf

AVD GPU Instances – Performance & Costs

Instance	CPUZ - ST	CPUZ - MT	CBR23 - MC	CBR23 - SC	EUX 2023	EUC Score App Dialog	EUC Score App Start	EUC Score GDI+ Fractals Dragon	EUC Score GDI+ Fractals Pythagoras	EUC Score GDI+ Rectangles	EUC Score IOPS		Price		EUC Score GDI+ /Price	EUX Score /Price
	better▶	better▶	better▶	better▶	better▶	◀better	◀better	◀better	◀better	◀better	◀better					
Microsoft Azure																
Azure NV6	256	1789	3843	671	7.37	0.28	0.62	8.71	15.31	1.55	5.57		1.33		6.41	5.54
Azure NV4as_v4	348	997	2304	893	7.95	0.29	0.68	106.89	194.31	1.3	14.08		0.47		214.54	16.91
Azure NV8as_v4	375	2107	4673	937	8.25	0.29	0.65	26.52	49.36	1.05	6.34		0.94		27.29	8.78
Azure NV16as_v4	395.7	4246	9445	945	8.03	0.29	0.66	10.36	20.83	1.3	3.98		1.88		5.76	4.27
Azure NV32as_v4	395.4	8414	17896	959	8.37	0.29	0.65	4.3	8.96	1.18	2.88		3.76		1.28	2.23
Azure NC4asT4_v3	365.8	1490	2988	909	8.22	0.28	0.61	4.21	8.58	1.08	11.3		0.81		5.68	10.11
Azure NC8asT4_v3	376.7	3059	7029	942	8.3	0.28	0.61	4.14	8.21	1.12	3.92		1.24		3.62	6.69
Azure NC16asT4_v3	395.9	6020	13959	956	8.28	0.28	0.61	4.52	8.87	1.16	3.67		2.14		2.27	3.87
Azure NV6adsA10_v5	494.4	2105.2	4895	1273	8.41	0.28	0.57	36.32	78.85	0.73	5.26		0.82		47.29	10.29
Azure NV12adsA10_v5	511.7	4016	9818	1309	8.36	0.28	0.57	19.12	36.42	0.82	2.68		1.63		11.50	5.12
Azure NV36adsA10_v5	548.8	12821	26897	1310	8.4	0.28	0.56	3.8	7.91	0.82	1.9		5.47		0.76	1.54

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Price in US$/hour (global average)

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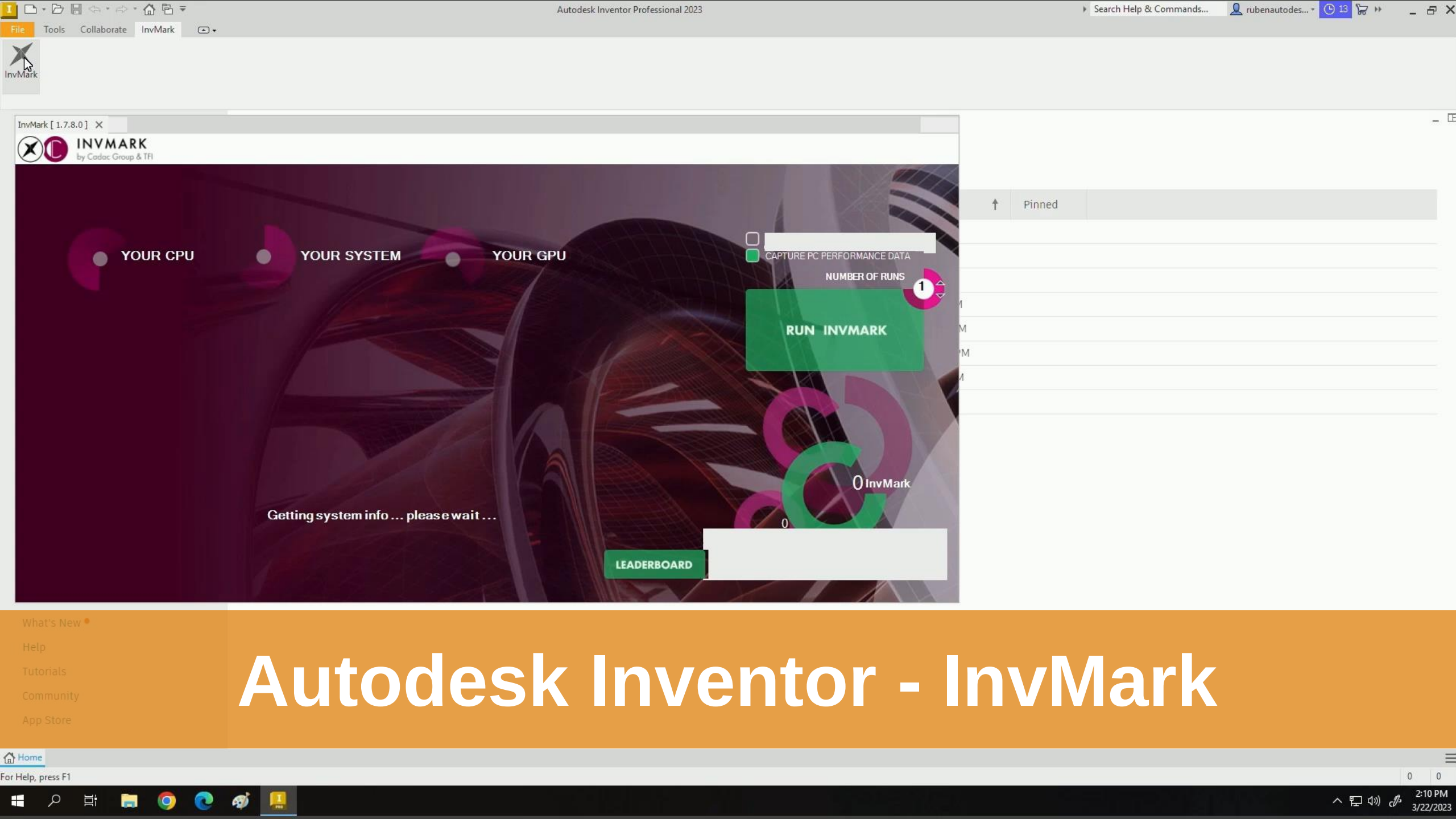
CAD – BIM – Visualization
supported by Greg Corke

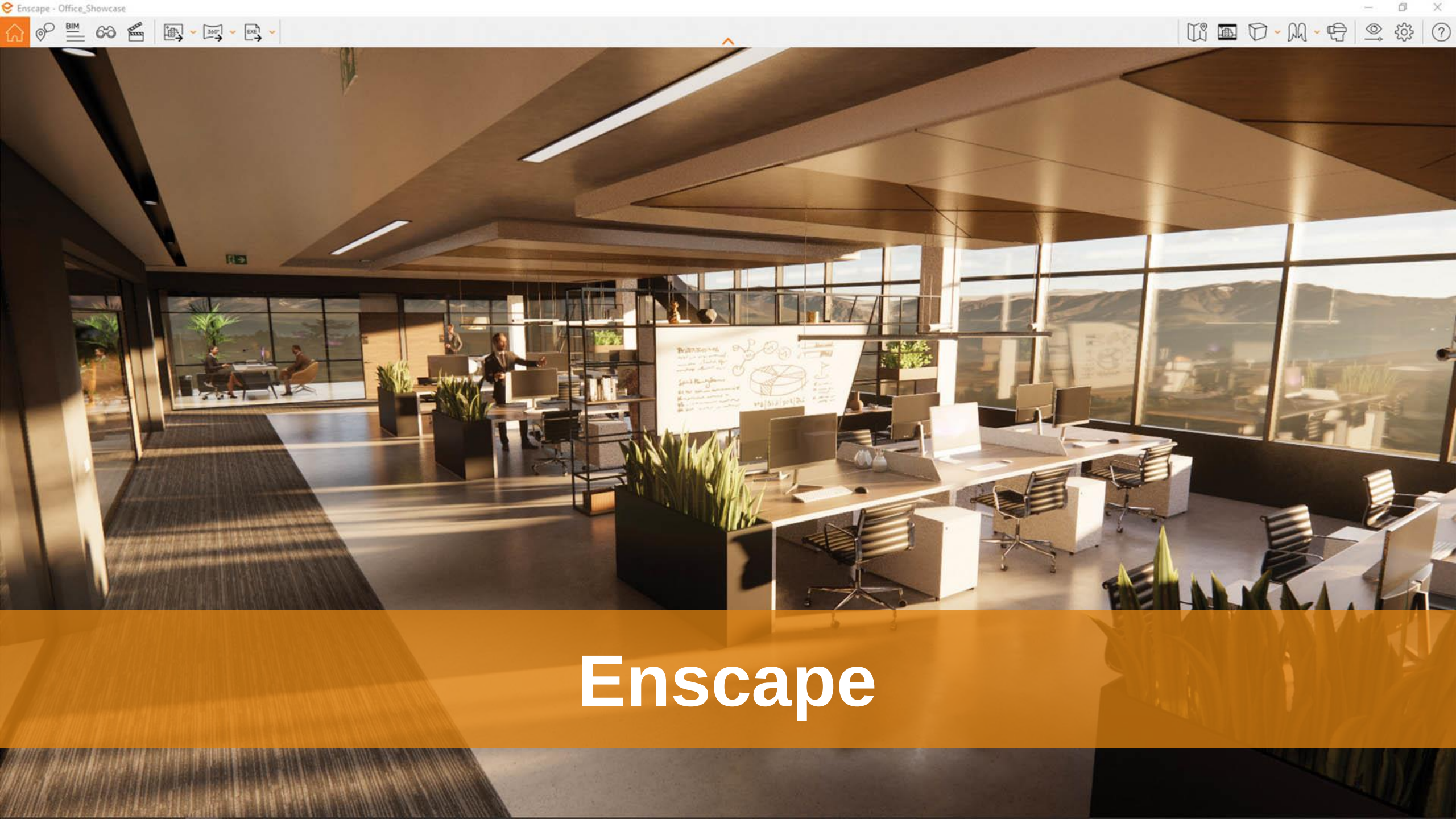

CarConfigurator_Main
CarConfigurator2
File
Edit
Window
Help
Save Current
Source Control
Modes
Content
Marketplace
Settings
Datasmith
Blueprints
Cinematics
Build
Play
Launch
Perspective
Lit
Show
38.50 FPS
25.97 ms
Level: CarConfigurator_Main (Persistent)
Unreal Engine



Autodesk Inventor - InvMark

Autodesk VRED

KeyShot


Enscape - Office_Showcase
BIM
Enscape

V-Ray

AVD GPU Instances – Performance

Instance	vRay 5 - CPU	vRay 5 - RTX GPU	Keyshot 11 - CPU	Keyshot 11 - GPU	Revit 2021 RFO - update (sec)	Revit 2021 RFO - create (sec)	Revit 2021 RFO - export (sec)	Revit 2021 RFO - Render (sec)	Revit 2021 RFO - Graphics (sec)	Revit 2021 RFO - Rotate (sec)	VRED 2023 - no AA	VRED 2023 - med AA	VRED 2023 - ultra high AA	Enscape 3.1 - sample	Unreal Engine 4.26 Audi - RT ON	Unreal Engine 4.26 Audi - RT OFF	Inventor 2023 - Modelling	Inventor 2023 - Drawing	Inventor 2023 - FEA	Inventor 2023 - SIM	Inventor 2023 - Graphics	Inventor 2023 - RT	Inventor 2023 - Data Translate	Inventor 2023 - Assy Pattern	Inventor 2023 - Assy Constraint	Inventor 2023 - ST	Inventor 2023 - MT
Microsoft Azure																											
Azure NV6_v3	2594	FAIL	0.49	4.6	16.5	187.8	546.9	143.7	48.6	4.15	34.0	19.6	9.2	41.0	FAIL	26.2	748	539	709	865	1714	512	557	626	824	7576	3397
Azure NV12_v3	3425	FAIL	0.66	4.6	14.4	178.9	521.0	104.9	46.1	3.96	34.0	19.6	9.2	42.5	FAIL	26.5	806	590	724	891	1736	765	580	676	831	7942	4088
Azure NV8as_v4	3275	FAIL	0.64	FAIL	12.7	160.4	488.2	115.6	56.5	5.63	10.1	4.8	2.8	15.4	FAIL	4.4	896	577	876	539	1318	689	616	558	572	7312	4012
Azure NV16as_v4	6288	FAIL	1.24	FAIL	12.8	149.4	455.1	61.6	44.5	3.69	17.4	9.4	4.9	27.1	FAIL	18.5	1136	693	879	774	1936	1382	654	697	783	8669	5407
Azure NC4asT4_v3	2301	589	0.44	23.5	12.7	147.3	490.9	150.1	41.2	3.84	65.8	37.7	18.2	74.6	25.1	41.1	770	581	869	1259	2251	469	620	981	1116	10164	3452
Azure NC8asT4_v3	4954	662	0.89	23.6	12.4	141.4	452.7	81.6	37.5	3.28	64.7	37.0	17.9	71.7	23.9	41.8	1000	755	907	1244	2345	954	670	988	1148	10473	5064
Azure NC16asT4_v3	9533	734	1.79	24.6	12.6	143.6	455.1	47.4	39.9	3.23	63.5	37.9	17.9	77.5	24.8	40.9	1321	857	881	1217	2523	1981	681	895	1162	10240	6379
Azure NV6adsA10_v5	3404	FAIL	0.67	6.6	9.2	115.0	351.2	112.6	37.1	2.78	19.5	12.6	7.5	2.1	FAIL	2.6	961	811	1095	1384	1988	715	865	1256	1387	12236	4953
Azure NV12adsA10_v5	7030	351	1.32	13.9	8.8	101.2	314.3	56.4	31.0	2.28	39.7	25.4	15.1	51.5	FAIL	27.6	1274	1027	1101	1525	2616	1411	933	1165	1450	12735	7068
Azure NV36adsA10_v5	20283	1544	3.99	52.4	9.2	98.5	316.4	27.3	25.9	2.09	138.3	78.1	41.1	134.2	47.1	88.9	1742	1194	1040	1480	2937	3928	929	1312	1470	12409	9280

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Price in US$/hour (global average)

Quantitative results, no exact science

Powered by FRAME

Instance	Blender CPU Monster	Blender CPU Junkshop	Blender CPU Class	Blender GPU Monster	Blender GPU Junkshop	Blender GPU Class	SPEC 2020 3dsmax	SPEC 2020 catia	SPEC 2020 creo	SPEC 2020 energy	SPEC 2020 maya	SPEC 2020 medical	SPEC 2020 smx	SPEC 2020 solidw	Price	SPEC Perf /Price	GPU Perf /Price	CPU-Perf /Price	SPEC Perf /Price	GPU Perf /Price	CPU-Perf /Price
	better▶	better▶	better▶	better▶	better▶	better▶	better▶	better▶	better▶	better▶	better▶	better▶	better▶	better▶					Normalized price/performance		
Microsoft Azure																					
Azure NV6	26.73	16.21	14.2	157	97	79	44.67	43.35	67.31	23.05	151.39	24.73	194	96	1.33	60.6	83.41	710.6	37.8	9.56	29.4
Azure NV4as_v4	15.63	9.09	7.8	FAIL	FAIL	FAIL	4.09	4.10	4.22	1.42	12.72	2.22	28	11	0.47	18.1	FAIL	1390.4	11.3	FAIL	57.6
Azure NV8as_v4	33.4	19.53	16.55	78	16	30	9.99	11.95	19.70	25.87	35.47	7.05	59	27	0.94	26.0	43.68	1240.6	16.2	5.00	51.4
Azure NV16as_v4	66.53	40.07	32.68	162	56	79	23.53	23.64	37.92	37.22	86.62	14.41	120	56	1.88	26.5	52.68	1153.0	16.5	6.04	47.7
Azure NV32as_v4	134.32	80.9	67.02	358	148	197	69.54	48.36	54.79	49.64	202.09	31.84	277	128	3.76	28.6	62.29	1061.9	17.8	7.14	44.0
Azure NC4asT4_v3	21.24	12.38	11.04	725	485	465	83.68	64.26	102.26	38.48	241.46	46.62	293	155	0.81	157.5	686.44	1018.2	98.1	78.65	42.2
Azure NC8asT4_v3	45.94	27.18	23.12	725	485	463	83.64	62.40	92.56	38.55	246.50	46.88	292	155	1.24	102.6	449.59	1325.2	63.9	51.51	54.9
Azure NC16asT4_v3	90.92	55.74	47.12	709	471	466	84.00	59.04	80.78	39.10	248.49	47.17	295	158	2.14	59.1	256.39	1436.9	36.8	29.38	59.5
Azure NV6adsA10_v5	32.72	19.74	16.09	FAIL	FAIL	FAIL	14.40	18.09	24.58	11.30	51.07	10.73	51	31	0.82	32.5	FAIL	1545.1	20.3	FAIL	64.0
Azure NV12adsA10_v5	67.11	41.5	33.44	371	216	196	42.69	41.44	51.57	32.51	125.94	21.93	109	67	1.63	37.6	159.75	1380.9	23.4	18.30	57.2
Azure NV36adsA10_v5	199.24	125.35	97.6	1566	992	867	144.37	97.79	108.25	86.31	419.07	74.63	451	260	5.47	37.5	208.74	1097.0	23.4	23.92	45.4
AWS																					
AWS G4ad.XL	15.14	9.2	7.55	FAIL	FAIL	FAIL	42.09	28.09	34.43	41.64	157.69	29.45	246	121	0.58	151.7	FAIL	1119.4	94.5	FAIL	46.4
AWS G4ad.2XL	31.33	18.62	15.45	FAIL	FAIL	FAIL	43.04	31.33	42.12	41.89	173.20	29.66	251	135	0.82	113.9	FAIL	1389.6	71.0	FAIL	57.5
AWS G4ad.4XL	65.6	40.76	32.4	FAIL	FAIL	FAIL	42.71	33.58	47.76	41.56	190.70	29.38	264	138	1.64	60.2	FAIL	1327.2	37.5	FAIL	55.0
AWS G4ad.8XL	132	83.06	64.94	FAIL	FAIL	FAIL	41.12	34.26	49.41	42.08	175.69	29.67	269	140	1.64	59.6	FAIL	2414.9	37.1	FAIL	100.0
AWS G4dn.XL	11.62	7.34	5.59	636	396	367	75.83	56.16	94.43	36.61	193.65	45.89	288	138	0.79	147.4	591.72	641.4	91.8	67.80	26.6
AWS G4dn.2XL	25.43	16.59	12.1	640	400	375	77.55	57.77	101.04	36.04	195.34	45.30	276	137	1.23	94.0	383.00	803.6	58.6	43.88	33.3
AWS G4dn.4XL	53.09	34.05	25.04	643	405	376	77.30	58.61	102.83	35.45	202.16	45.00	272	137	2.19	53.1	216.90	843.6	33.1	24.85	34.9
AWS.G4dn.8XL	109	71.63	52.48	636	397	367	78.04	56.12	102.91	33.38	193.24	44.11	275	147	4.10	28.4	113.91	867.5	17.7	13.05	35.9
AWS G5.xl	16.03	9.2	7.81	1483	914	821	145.16	94.78	100.43	102.19	352.26	76.11	464	244	1.23	160.5	872.80	532.3	100.0	100.00	22.0
AWS G5.2xl	30.98	19.13	15.83	1515	944	843	140.76	98.00	109.27	103.27	359.78	74.97	473	265	1.63	124.5	675.26	702.8	77.6	77.37	29.1
AWS G5.4xl	65.31	40.47	32.43	1502	942	850	142.71	101.73	117.42	104.03	375.98	77.06	482	272	2.42	86.4	453.72	898.1	53.8	51.98	37.2
AWS G5.8xl	132.43	82.46	65.76	1519	933	839	142.95	102.61	117.19	103.98	376.15	77.38	488	273	4.01	52.4	273.57	1025.7	32.6	31.34	42.5
GCP																					
GCP N1-STD-2-GPU-T4	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	1.36	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
GCP N1-STD-4-GPU-T4	12.2	7.16	5.64	FAIL	FAIL	FAIL	73.25	51.12	81.95	34.93	170.11	42.98	266	134	1.65	64.7	FAIL	280.7	40.3	FAIL	11.6
GCP N1-STD-8-GPU-T4	22.54	13.77	10.9	608	382	347	73.81	52.22	88.14	34.97	180.27	44.00	272	136	4.02	27.4	110.87	213.5	17.1	12.70	8.8
GCP N1-STD-16-GPU-T4	45.72	29.69	21.75	630	382	356	73.55	52.84	90.59	34.39	179.02	43.68	269	135	8.52	12.9	53.52	188.2	8.0	6.13	7.8
Physical PC																					
Workstation-RSP	99.22	63.58	49.49	2608	1625	1446	206.64	157.05	157.25	129.16	528.00	93.11	665	403	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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Price in US$/hour (global average)

Quantitative results, no exact science

Instance	vRay 5 - CPU	vRay 5 - RTX GPU	Keyshot 11 - CPU	Keyshot 11 - GPU	Revit 2021 RFO - update (sec)	Revit 2021 RFO - create (sec)	Revit 2021 RFO - export (sec)	Revit 2021 RFO - Render (sec)	Revit 2021 RFO - Graphics (sec)	Revit 2021 RFO - Rotate (sec)	VRED 2023 - no AA	VRED 2023 - med AA	VRED 2023 - ultra high AA	Enscape 3.1 - sample	Unreal Engine 4.26 Audi - RT ON	Unreal Engine 4.26 Audi - RT OFF	Inventor 2023 - Modelling	Inventor 2023 - Drawing	Inventor 2023 - FEA	Inventor 2023 - SIM	Inventor 2023 - Graphics	Inventor 2023 - RT	Inventor 2023 - Data Translate	Inventor 2023 - Assy Pattern	Inventor 2023 - Assy Constraint	Inventor 2023 - ST	Inventor 2023 - MT		Price
Microsoft Azure																													
Azure NV6_v3	2594	FAIL	0.49	4.6	16.5	187.8	546.9	143.7	48.6	4.15	34.0	19.6	9.2	41.0	FAIL	26.2	748	539	709	865	1714	512	557	626	824	7576	3397		1.32
Azure NV12_v3	3425	FAIL	0.66	4.6	14.4	178.9	521.0	104.9	46.1	3.96	34.0	19.6	9.2	42.5	FAIL	26.5	806	590	724	891	1736	765	580	676	831	7942	4088		1.84
Azure NV8as_v4	3275	FAIL	0.64	FAIL	12.7	160.4	488.2	115.6	56.5	5.63	10.1	4.8	2.8	15.4	FAIL	4.4	896	577	876	539	1318	689	616	558	572	7312	4012		0.94
Azure NV16as_v4	6288	FAIL	1.24	FAIL	12.8	149.4	455.1	61.6	44.5	3.69	17.4	9.4	4.9	27.1	FAIL	18.5	1136	693	879	774	1936	1382	654	697	783	8669	5407		1.88
Azure NC4asT4_v3	2301	589	0.44	23.5	12.7	147.3	490.9	150.1	41.2	3.84	65.8	37.7	18.2	74.6	25.1	41.1	770	581	869	1259	2251	469	620	981	1116	10164	3452		0.81
Azure NC8asT4_v3	4954	662	0.89	23.6	12.4	141.4	452.7	81.6	37.5	3.28	64.7	37.0	17.9	71.7	23.9	41.8	1000	755	907	1244	2345	954	670	988	1148	10473	5064		1.24
Azure NC16asT4_v3	9533	734	1.79	24.6	12.6	143.6	455.1	47.4	39.9	3.23	63.5	37.9	17.9	77.5	24.8	40.9	1321	857	881	1217	2523	1981	681	895	1162	10240	6379		2.14
Azure NV6adsA10_v5	3404	FAIL	0.67	6.6	9.2	115.0	351.2	112.6	37.1	2.78	19.5	12.6	7.5	2.1	FAIL	2.6	961	811	1095	1384	1988	715	865	1256	1387	12236	4953		0.82
Azure NV12adsA10_v5	7030	351	1.32	13.9	8.8	101.2	314.3	56.4	31.0	2.28	39.7	25.4	15.1	51.5	FAIL	27.6	1274	1027	1101	1525	2616	1411	933	1165	1450	12735	7068		1.63
Azure NV36adsA10_v5	20283	1544	3.99	52.4	9.2	98.5	316.4	27.3	25.9	2.09	138.3	78.1	41.1	134.2	47.1	88.9	1742	1194	1040	1480	2937	3928	929	1312	1470	12409	9280		5.47
AWS																													
AWS G4ad.XL	1391	FAIL	0.32	FAIL	12.1	175.7	508.0	228.0	52.4	4.93	51.9	24.3	9.6	55.7	FAIL	40.9	585	422	768	465	1265	303	534	604	703	7186	2465		0.58
AWS G4ad.2XL	3148	FAIL	0.66	FAIL	11.3	155.9	467.8	109.3	43.3	3.80	52.7	23.9	9.3	57.6	FAIL	41.5	895	578	832	674	1683	655	602	688	767	8364	3914		0.82
AWS G4ad.4XL	6441	FAIL	1.38	FAIL	11.9	155.3	456.1	60.6	39.8	3.38	53.5	24.4	9.4	57.5	FAIL	41.3	1170	663	853	706	1969	1477	644	676	773	8524	5293		1.64
AWS G4dn.XL	1211	392	0.26	22.8	13.4	162.1	525.7	306.6	49.6	4.88	63.7	36.7	17.8	75.0	24.1	28.7	469	414	732	1000	1692	257	525	721	955	8626	2207		0.79
AWS G4dn.2XL	2903	524	0.50	23.6	12.4	153.1	492.2	161.5	40.8	3.82	65.3	36.7	18.3	66.7	24.5	39.3	727	613	760	1086	1999	528	583	759	1000	9179	3606		1.23
AWS G4dn.4XL	6537	583	1.17	23.3	11.2	140.5	515.2	77.3	34.5	3.15	64.8	36.7	17.8	69.1	23.2	40.1	753	618	769	1069	2065	537	601	748	984	9150	3682		2.19
AWS.G4dn.12XL	20090	2375	3.66	49.8	10.7	134.5	438.7	33.7	33.3	3.03	64.5	36.3	17.8	70.8	24.9	41.9	1356	884	803	1194	2402	3210	630	829	1093	9811	6829		4.10
AWS G5.xl	1450	1097	0.30	57.0	12.5	170.1	520.9	232.2	49.0	4.81	152.9	90.1	52.3	127.1	60.9	73.3	572	453	725	1085	1698	354	529	762	1023	8894	2672		1.23
AWS G5.2xl	3150	1323	0.65	56.8	12.0	157.5	477.7	109.9	40.4	3.65	157.8	91.8	52.9	149.2	62.3	102.4	870	680	850	1279	2170	750	624	864	1158	10418	4367		1.63
AWS G5.4xl	6445	1141	1.33	45.6	11.0	150.4	468.4	65.8	36.7	3.33	157.7	92.0	53.0	139.4	60.3	105.0	1179	793	812	1264	2347	1411	658	860	1140	10162	5757		2.42
AWS G5.8xl	12716	1509	2.75	57.8	11.6	158.5	470.3	37.9	36.5	3.31	155.8	93.6	52.8	150.1	60.5	107.7	1386	865	840	1257	2340	2837	656	918	1181	10435	6811		4.01
GCP																													
GCP N1-STD-4-GPU-T4	1159	366	0.23	22.4	13.8	187.3	566.5	334.2	55.5	5.56	58.0	35.2	17.3	68.0	FAIL	39.2	436	356	646	842	1383	241	466	643	801	7428	2002		1.65
GCP N1-STD-8-GPU-T4	2408	507	0.47	22.3	13.2	166.1	500.8	157.8	42.0	3.87	57.7	34.7	17.1	67.3	23.1	37.1	703	555	697	973	1731	507	536	716	889	8339	3367		4.02
Physical Workstation																													
HP Z2 Mini G9	13288	N/A	2.67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	30.7	16.4	7.8	36.7	N/A	13.1	1912	1745	1328	2171	N/A	2707	1440	1975	2163	N/A	N/A		N/A
Scan 3XS GWP-ME A13C	26952	1012	32.05	N/A	N/A	N/A	N/A	N/A	N/A	N/A	68.2	38.2	18.7	72.2	N/A	43.3	2307	2166	1473	2611	N/A	5706	1743	2327	2652	N/A	N/A		N/A
Armari Magnetar M64TP-RW	66461	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	44.3	38.9	29.0	40.4	N/A	101.4	1941	1394	1132	1449	N/A	11744	1124	1424	1701	N/A	N/A		N/A
Scan 3XS GWP-ME A1128T	59982	5277	187.45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A

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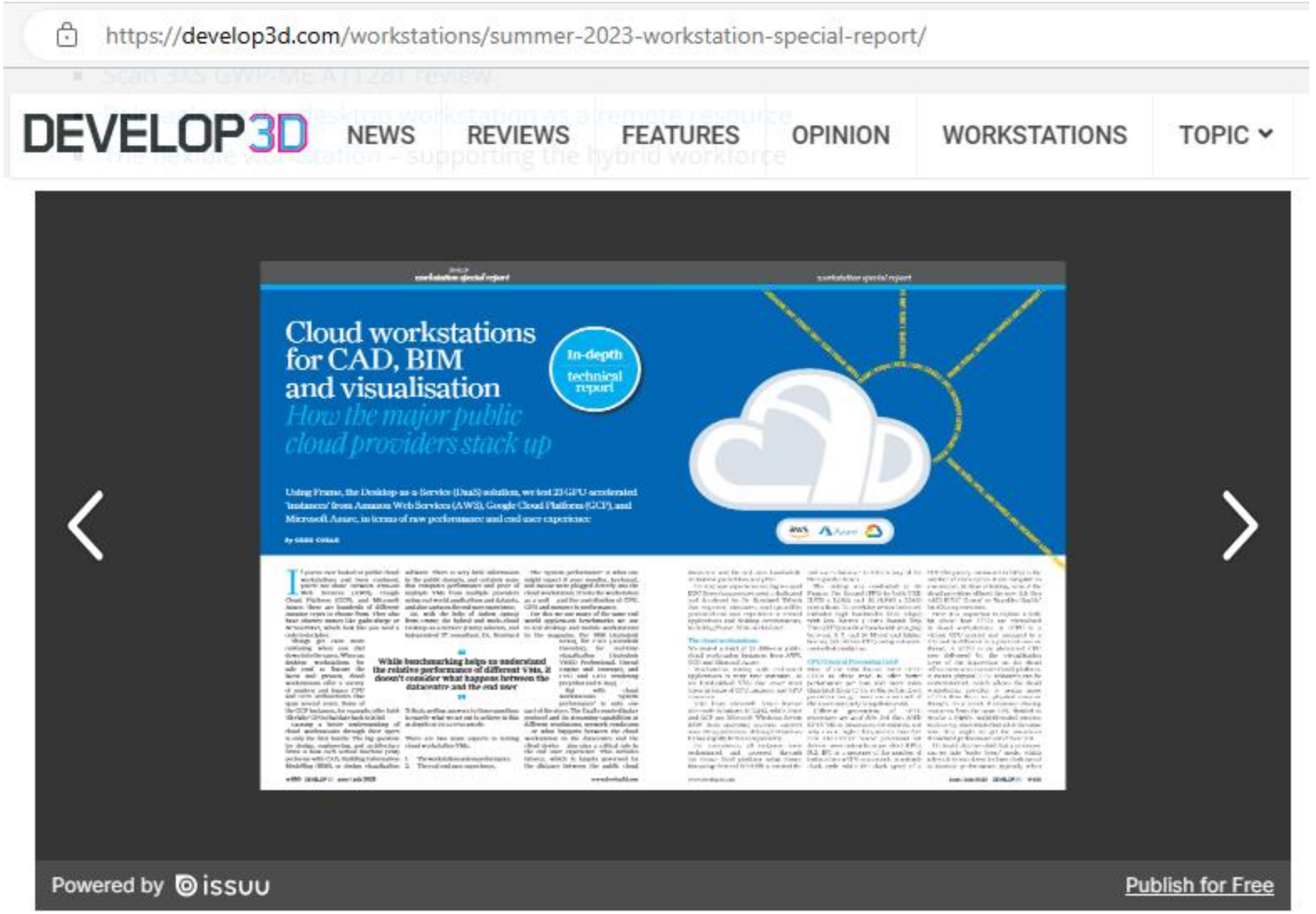
Test infrastructure provided by FRAME

https://ux.fra.me/
https://aecmag.com/workstations/cloud-workstations-for-cad-bim-and-visualisation/
https://develop3d.com/workstations/summer-2023-workstation-special-report/



Autor: Greg Corke, DEVELOP3D's Managing Editor and resident workstation specialist

AVD Observations

- Azure NVv4 VMs do not provide great performance, despite the AMD M25 GPU – low 3D performance, no video encoding / no hardware encoding exposed
- Azure NC8asT4 – if you don’t need the vCPUs or RAM – go for the NC4asT4 – same GPU; SPEC performance almost the same, 30% cheaper
- Azure NV6adsA10 more CPU and RAM at the same price as the NC4asT4; NC4asT4 provides much better GPU performance because of full GPU vs GPU partition
- If you really need GPU performance don’t use Azure NVadsA10 with smaller GPU partitions, the NCasT4 with dedicated GPU provides better performance
- Azure NVadsA10 has high base clock speed – 3.2 GHz
- Winner on Azure: NC4/NC8asT4 – Great price/perf ratio – dedicated GPU!
- If you have still the NV6/NV12 running switch to NC4/NC8 – migrate away; check GPU availability
- CAUTION: NCasT4 VM types with missing certification for CAD applications may be a deal breaker

Cross-Cloud Observations

- AWS G4ad (AMD GPU) VMs: Very good performance/price ratio
- AWS G4ad VMs: Does not provide the highest GPU performance but it’s decent
  - But some applications crash, maybe an AMD driver issue – Ruben is testing new driver
- AWS G5 (NVIDIA A10) VMs: Provides outstanding performance, also compared to Azure
- GCP VMs: CPU performance is the limiting factor – why is it only 2.0GHz …
- GCP VMs: Double the price compared to AWS (G4dn)

High-End Cloud Workstations

- Cloud Workstations beat 2–4-year-old CAD/CAM workstations
- But a Cloud Workstation cannot beat a modern physical Workstation in performance, as the GPUs in the Cloud are years behind and CPUs have a lower clock speed
- Only very few people need an extreme high-end workstation (CAD/CAM and media designers – I’m not taking gamers into account)
- Performance is only one (key) topic in decision making
- GPU-accelerated VM types are approx. factor 1.5 to 2 more expensive than comparable CPU-only VM types, but in multi-session setups scalability may be better
- Availability of GPU-accelerated VM types is a massive challenge!!!

Call to Action

If you want to learn more about EUC Score, send me an email

info@eucscore.com

EUC Score

https://eucscore.com

NOTE: The EUC Score toolset is free for community benchmarking tests when the results are made publicly available

Thank You

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