A deep DaaS analysis in Azure, AWS and GCP: Understanding Performance, Price and User Experience

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Ruben Spruijt, Sr. Technologist FRAME

FRAME

EUC Score

Experts Live Netherlands

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@drtritsch

Ruben Spruijt

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@rspruijt

cegeka INSPARK kpn Partner Network PATCH MY PC PINK YDENTIC


System Performance
User Experience


22:03
Outlook
5G
Subway
47 Hz
Upgrade
MIN
76.1
PEAK
116.9
20m:4s
AVG
102.8
104.4
MAX
111.4
Camera
Dosimeter
Meter
Data
Settings


WHY

- How do the performance and cost-effectiveness of DaaS instances on AWS, Azure, and GCP compare?

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- What distinguishes storage offerings on Azure, AWS, and GCP in terms of performance and cost?

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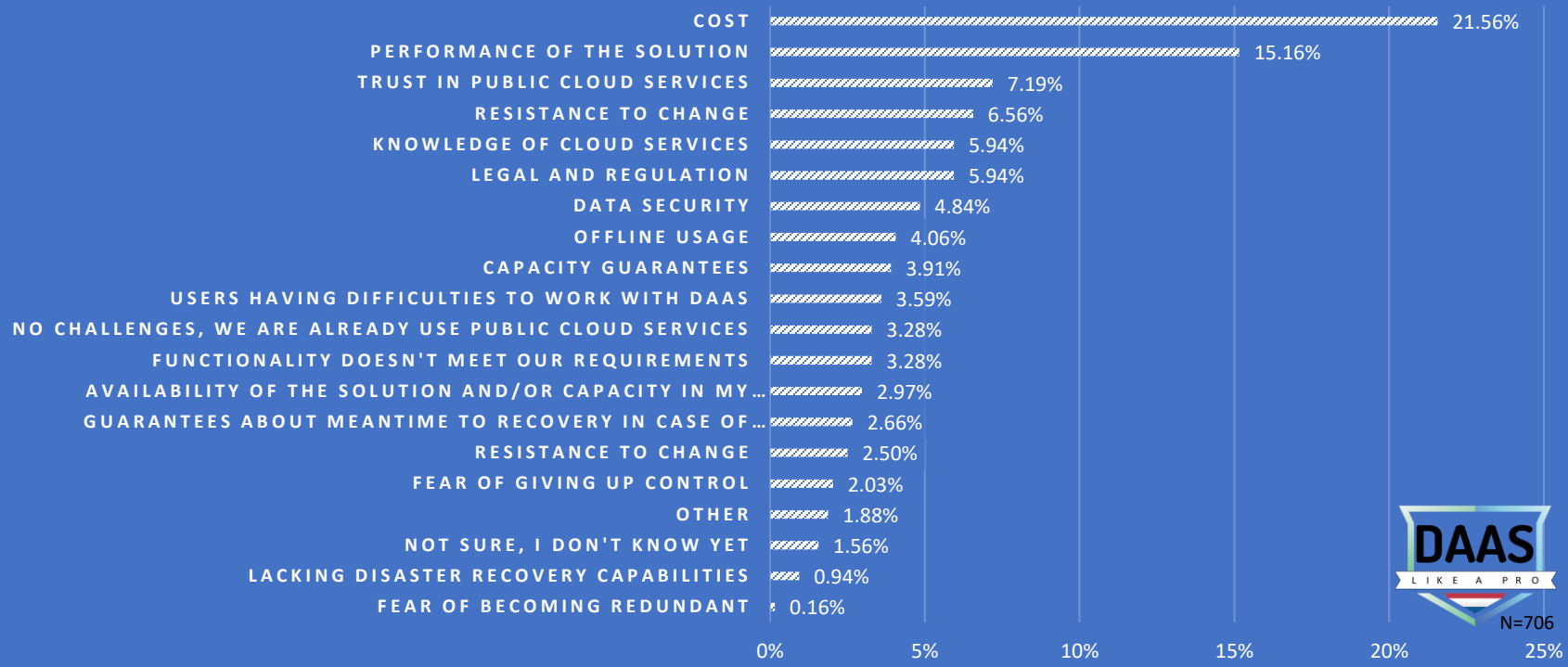
- What distinguishes storage offerings on Azure, AWS, and GCP in terms of performance and cost?
- Analyzing User Experience: A Comparison between Physical Workstations, On-Premises Remote Desktops, and Cloud-Based Desktops!


System Performance
User Experience

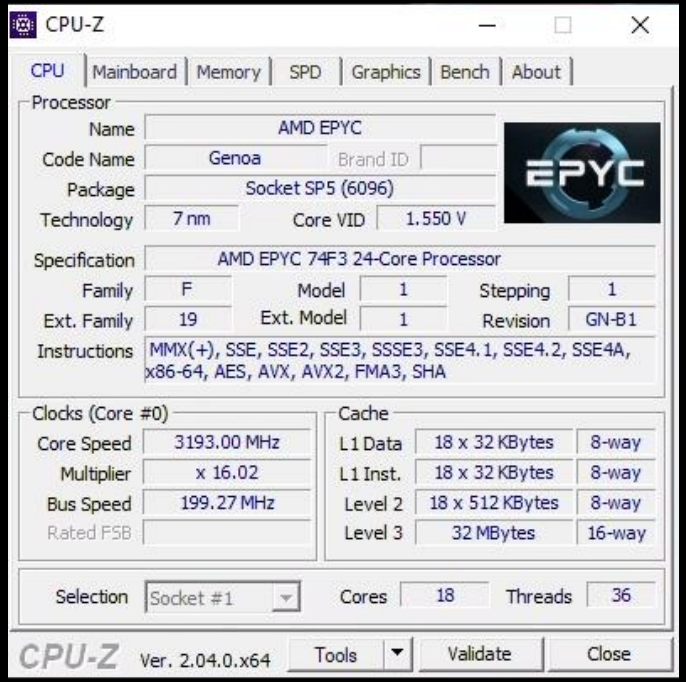

DAAS
LIKE A PRO

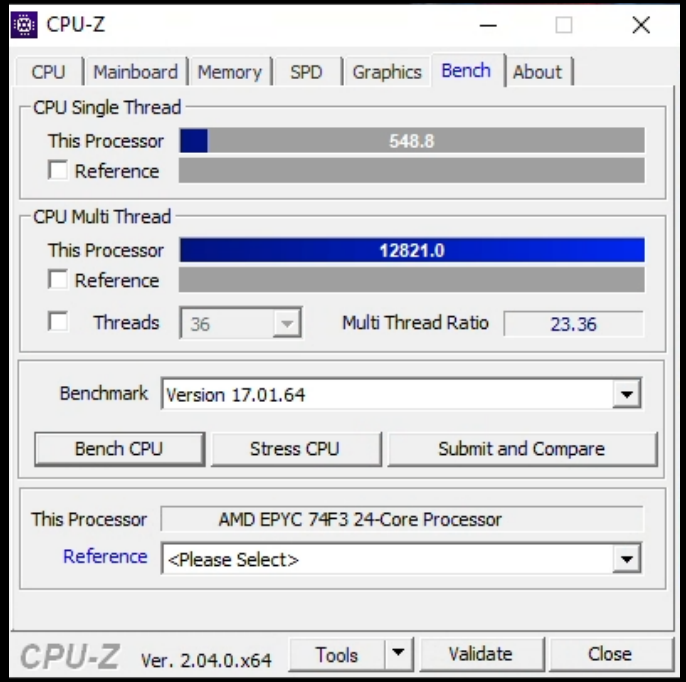
WHAT ARE THE BIGGEST CHALLENGES IN YOUR ORGANIZATION CAUSED BY USING OR ADOPTING DAAS?



System Performance

Applications/Tools Used


CPU-Z
CPU
Mainboard
Memory
SPD
Graphics
Bench
About
Processor
Name
AMD EPYC
Code Name
Genoa
Brand ID
Package
Socket SP5 (6096)
Technology
7 nm
Core VID
1.550 V
EPYC
Specification
AMD EPYC 74F3 24-Core Processor
Family
F
Model
1
Stepping
1
Ext. Family
19
Ext. Model
1
Revision
GN-B1
Instructions
MMX(+), SSE, SSE2, SSE3, SSSE3, SSE4.1, SSE4.2, SSE4A, x86-64, AES, AVX, AVX2, FMA3, SHA
Clocks (Core #0)
Core Speed
3193.00 MHz
Multiplier
x 16.02
Bus Speed
199.27 MHz
Rated FSB
Cache
L1 Data
18 x 32 KBytes
8-way
L1 Inst.
18 x 32 KBytes
8-way
Level 2
18 x 512 KBytes
8-way
Level 3
32 MBytes
16-way
Selection
Socket #1
Cores
18
Threads
36
CPU-Z
Ver. 2.04.0.x64
Tools
Validate
Close


CPU-Z
CPU
Mainboard
Memory
SPD
Graphics
Bench
About
CPU Single Thread
This Processor
548.8
Reference
CPU Multi Thread
This Processor
12821.0
Reference
Threads
36
Multi Thread Ratio
23.36
Benchmark
Version 17.01.64
Bench CPU
Stress CPU
Submit and Compare
This Processor
AMD EPYC 74F3 24-Core Processor
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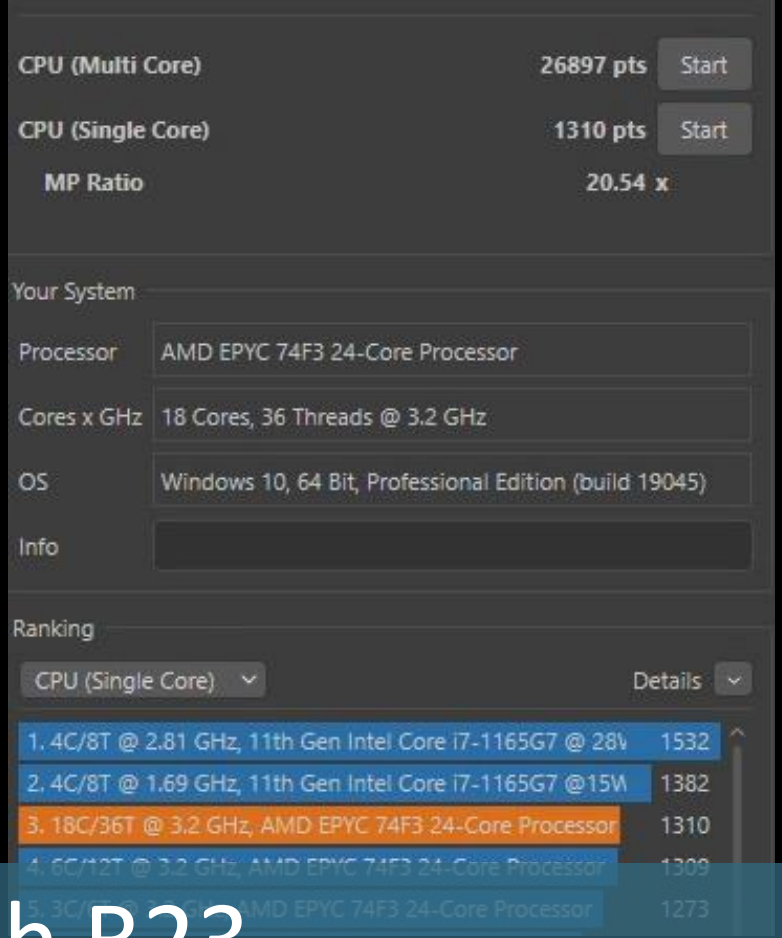
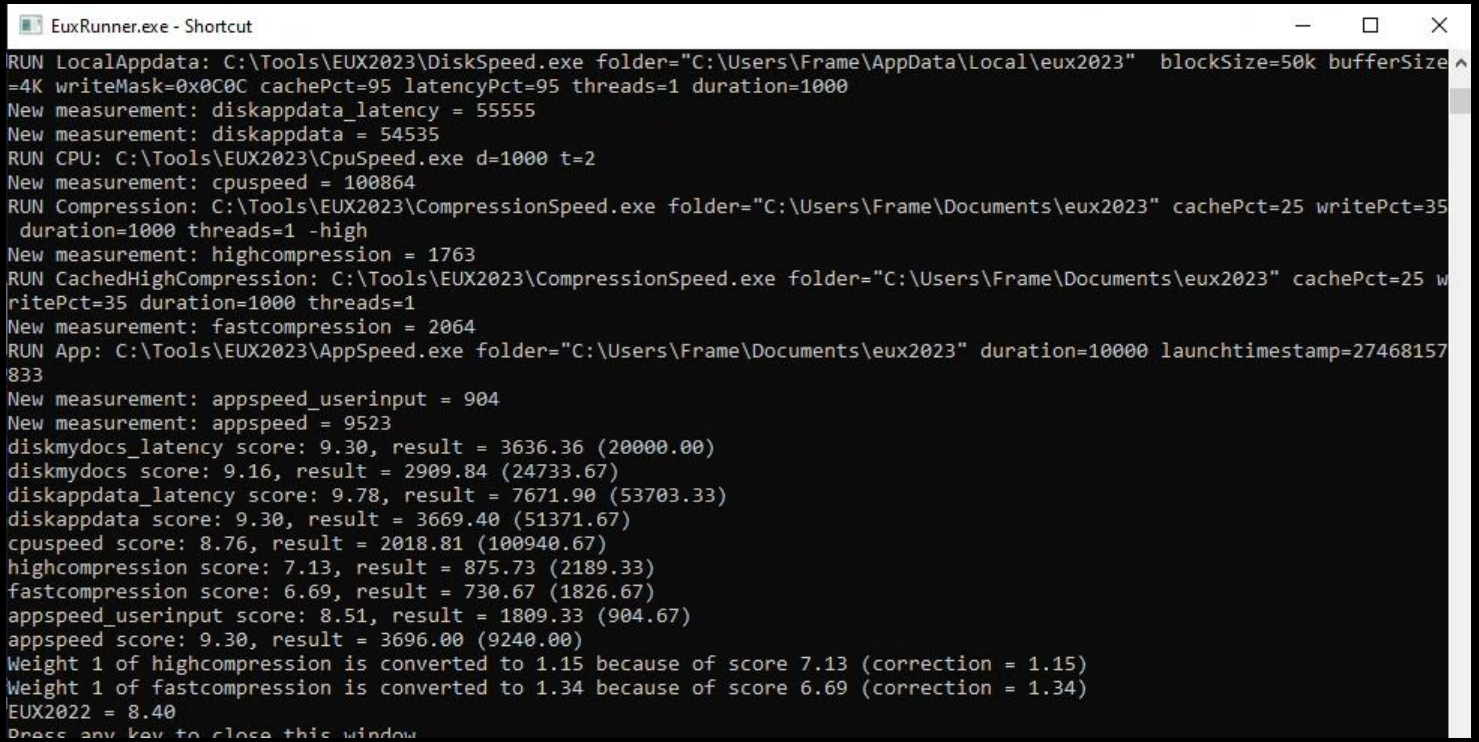
Tools
Validate
Close

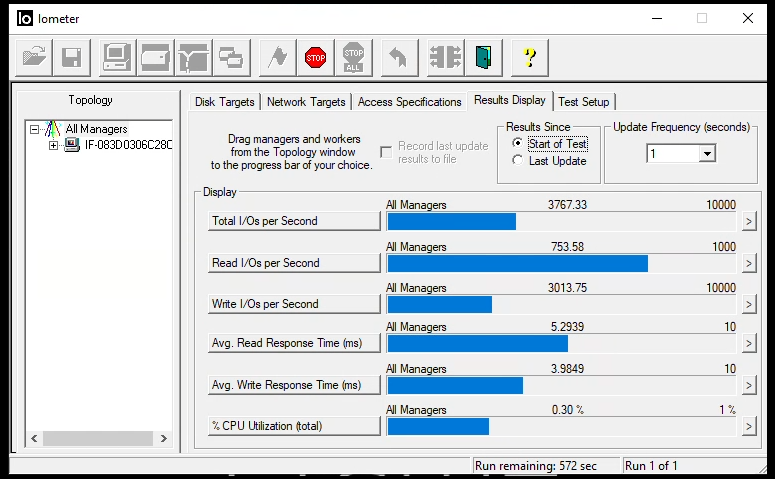
CPU-Z

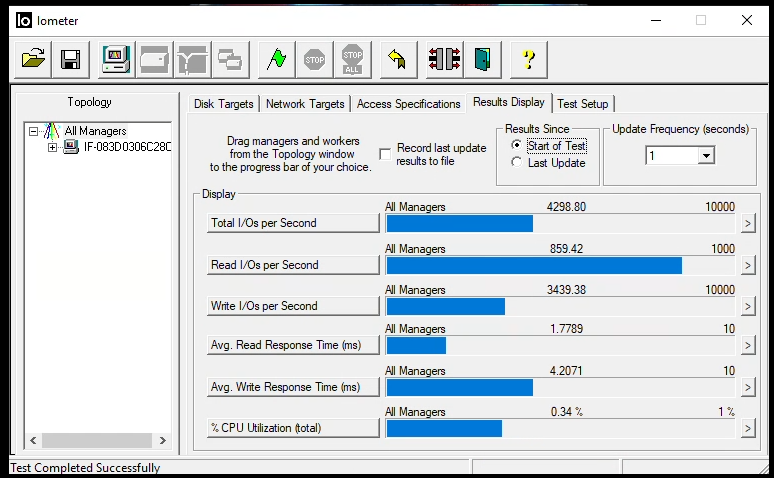


CineBench R23



Login Enterprise - EUX Score


Iometer
Topology
All Managers
IF-083D0306C28C
Disk Targets
Network Targets
Access Specifications
Results Display
Test Setup
Drag managers and workers from the Topology window to the progress bar of your choice.
Record last update results to file
Results Since
Start of Test
Last Update
Update Frequency (seconds)
1
Display
Total I/Os per Second
All Managers 3767.33 10000
Read I/Os per Second
All Managers 753.58 1000
Write I/Os per Second
All Managers 3013.75 10000
Avg. Read Response Time (ms)
All Managers 5.2939 10
Avg. Write Response Time (ms)
All Managers 3.9849 10
% CPU Utilization (total)
All Managers 0.30 % 1 %
Run remaining: 572 sec
Run 1 of 1


Iometer
Topology
All Managers
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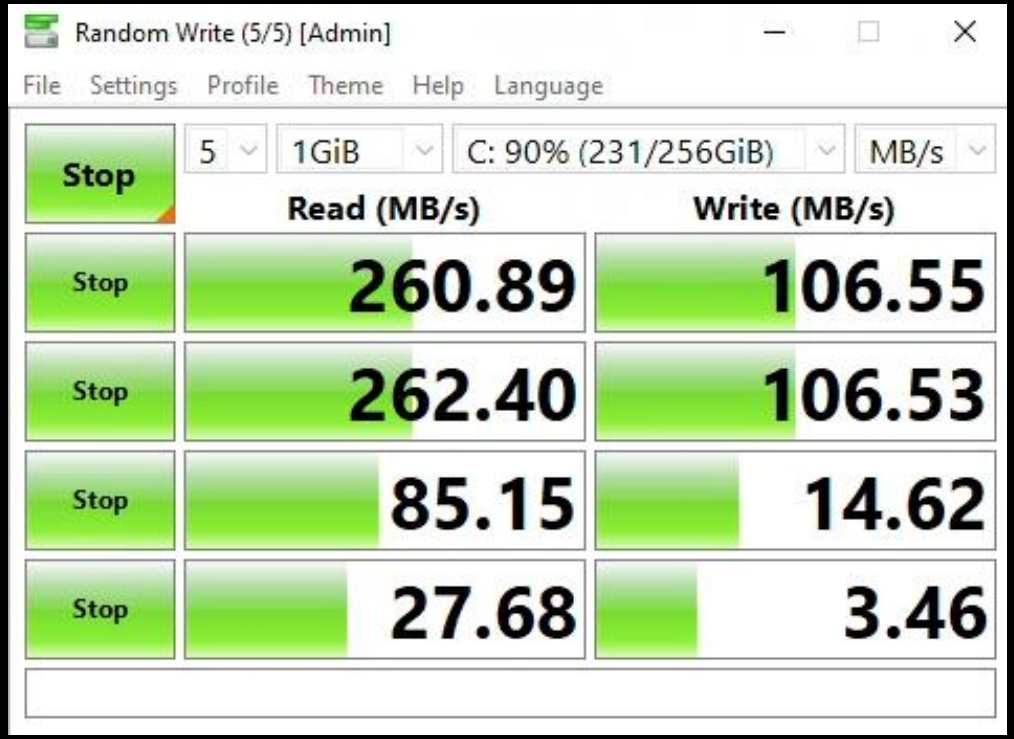
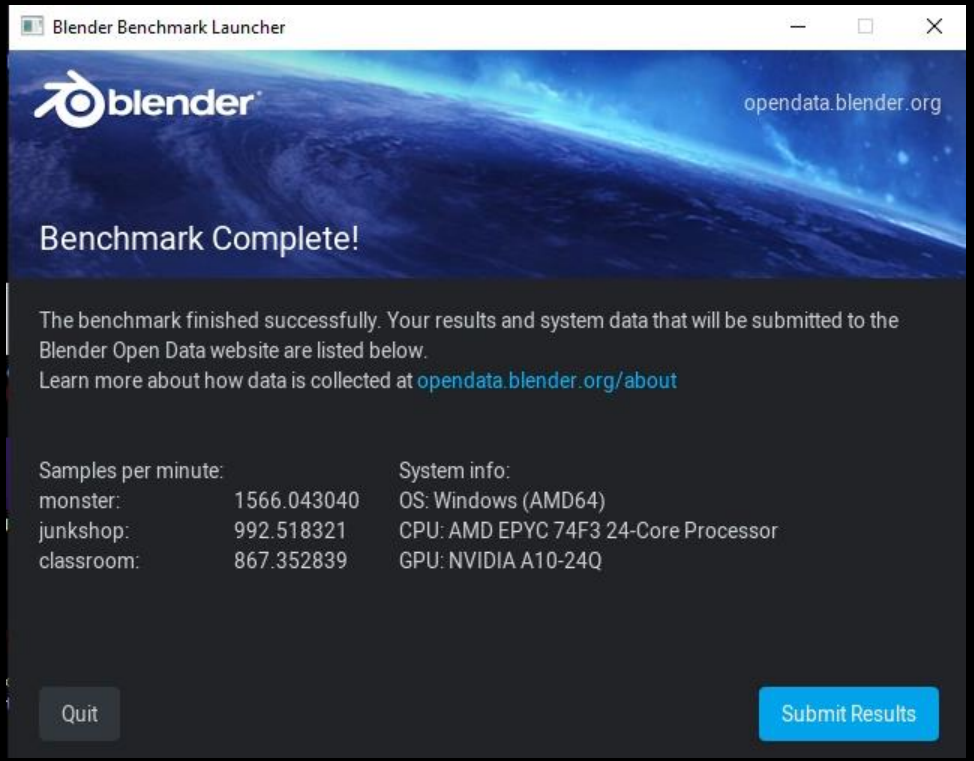
Disk Targets
Network Targets
Access Specifications
Results Display
Test Setup
Drag managers and workers from the Topology window to the progress bar of your choice.
Record last update results to file
Results Since
Start of Test
Last Update
Update Frequency (seconds)
1
Display
Total I/Os per Second
All Managers 4298.80 10000
Read I/Os per Second
All Managers 859.42 1000
Write I/Os per Second
All Managers 3439.38 10000
Avg. Read Response Time (ms)
All Managers 1.7789 10
Avg. Write Response Time (ms)
All Managers 4.2071 10
% CPU Utilization (total)
All Managers 0.34 % 1 %
Test Completed Successfully

IOmeter



Crystal Disk Mark



Blender BenchMark

SPECviewperf® 2020 Results

http://www.spec.org/gwpg

Composite Scores (1920x1080)

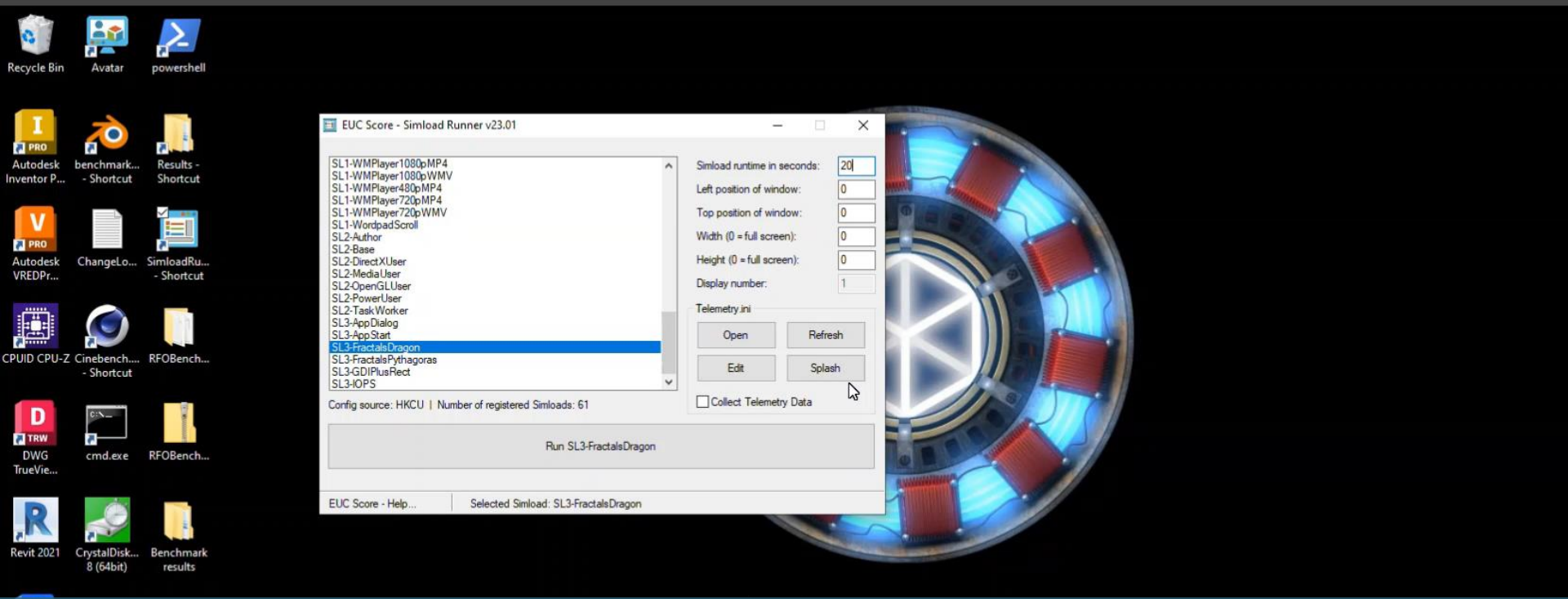
SPECviewperf measures the frame rate, or frames per second (FPS), at which your graphics card can render scenes across a wide variety of applications and usage models. Each viewset represents an application or a usage model, and each composite score below is based on a weighted geometric mean of many different scenes and rendering modes.

Composites by Viewset

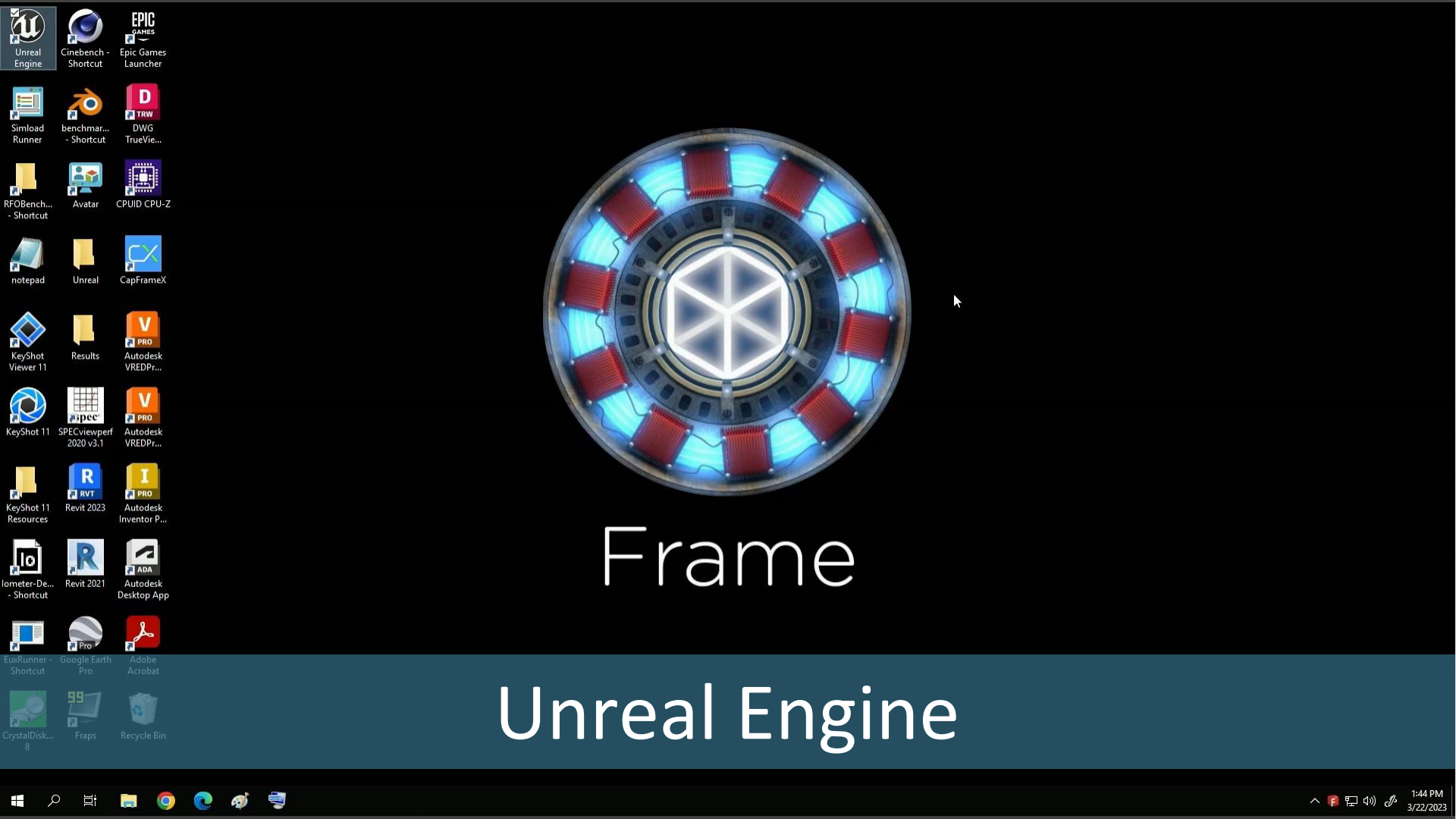
To explore a viewset in more detail, including the measured frame rate for each test of which the composite score is comprised, click on the viewset name in the menu to the left.

Viewset	Composite Score	Window
3dsmax-07	144.37	1900 x 1060
catia-06	97.79	1900 x 1060
creo-03	108.25	1900 x 1060
energy-03	86.31	1900 x 1060
maya-06	419.07	1900 x 1060
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
solidworks-07	259.86	1904 x 1060

SPECViewPerf 2020



EUC Score
(30+ SimLoads w/ Office, browser, media)


Unreal Engine
Cinebench - Shortcut
Epic Games Launcher
Simload Runner
benchmar... - Shortcut
DWG TrueVie...
RFOBench... - Shortcut
Avatar
CPUID CPU-Z
notepad
Unreal
CapFrameX
KeyShot Viewer 11
Results
Autodesk VREDPr...
KeyShot 11
SPECviewperf 2020 v3.1
Autodesk VREDPr...
KeyShot 11 Resources
Revit 2023
Autodesk Inventor P...
Iometer-De... - Shortcut
Revit 2021
Autodesk Desktop App
EuxRunner - Shortcut
Google Earth Pro
Adobe Acrobat
CrystalDisk... 8
Fraps
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Frame
Unreal Engine
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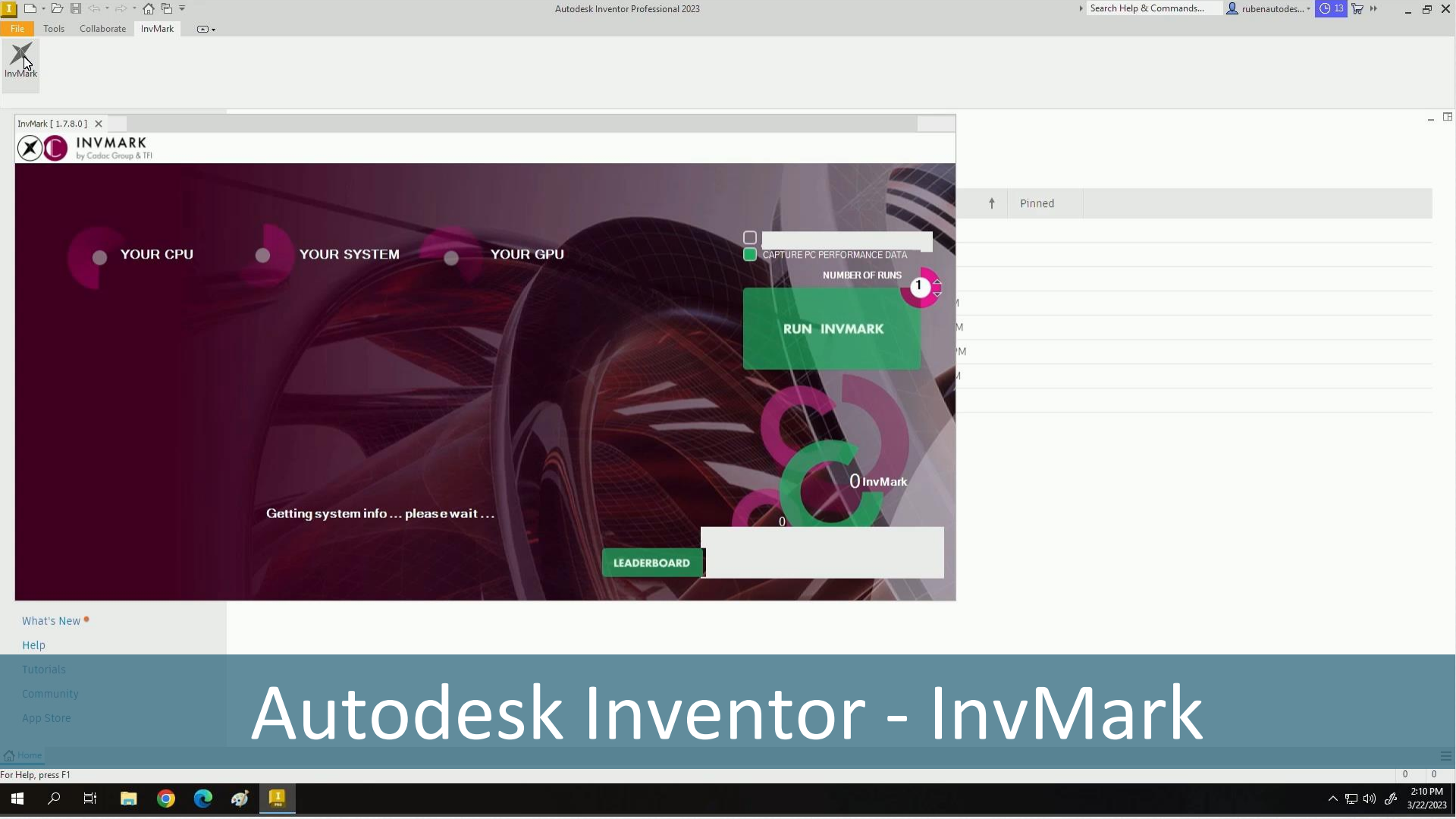
3/22/2023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File
Tools
Collaborate
InvMark
InvMark
InvMark [1.7.8.0]
INVMARK
by Cadac Group & TFI
YOUR CPU
YOUR SYSTEM
YOUR GPU
CAPTURE PC PERFORMANCE DATA
NUMBER OF RUNS
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RUN INVMARK
0 InvMark
Getting system info ... please wait ...
LEADERBOARD
Pinned
What's New
Help
Tutorials
Community
App Store
Home
For Help, press F1
2:10 PM
3/22/2023
Autodesk Inventor - InvMark


E:/OneDrive - autodesk/Projects/__Spacecraft02/VRED/SC02_09_54_Rendertests_05_0013_side_view.vpb * - Autodesk VRED Professional 2019
File Edit View Visualization Scene Animation Interaction Rendering Window Help
New Open Import Save Antialias Raytracing Downscale Region Isolate Backplate Wireframe Boundings Headlight Statistics Fullscreen Presentation Show All Zoom To Grid Ruler Transform Selection Texturing Simple UI
Florian Coe...
Scenegraph
File Edit Create View Select
Scene Graph
Cable
AliasWorld - SC_02_v05_05_beveled_09
Alias Shape Rep
AirIntake_02
Main_Body_09
Antenna_bottom
Wings_Back
Wing_Front_02
Wing_Side_09-2
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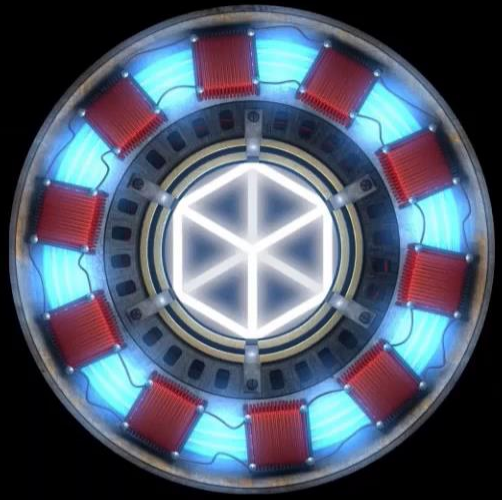
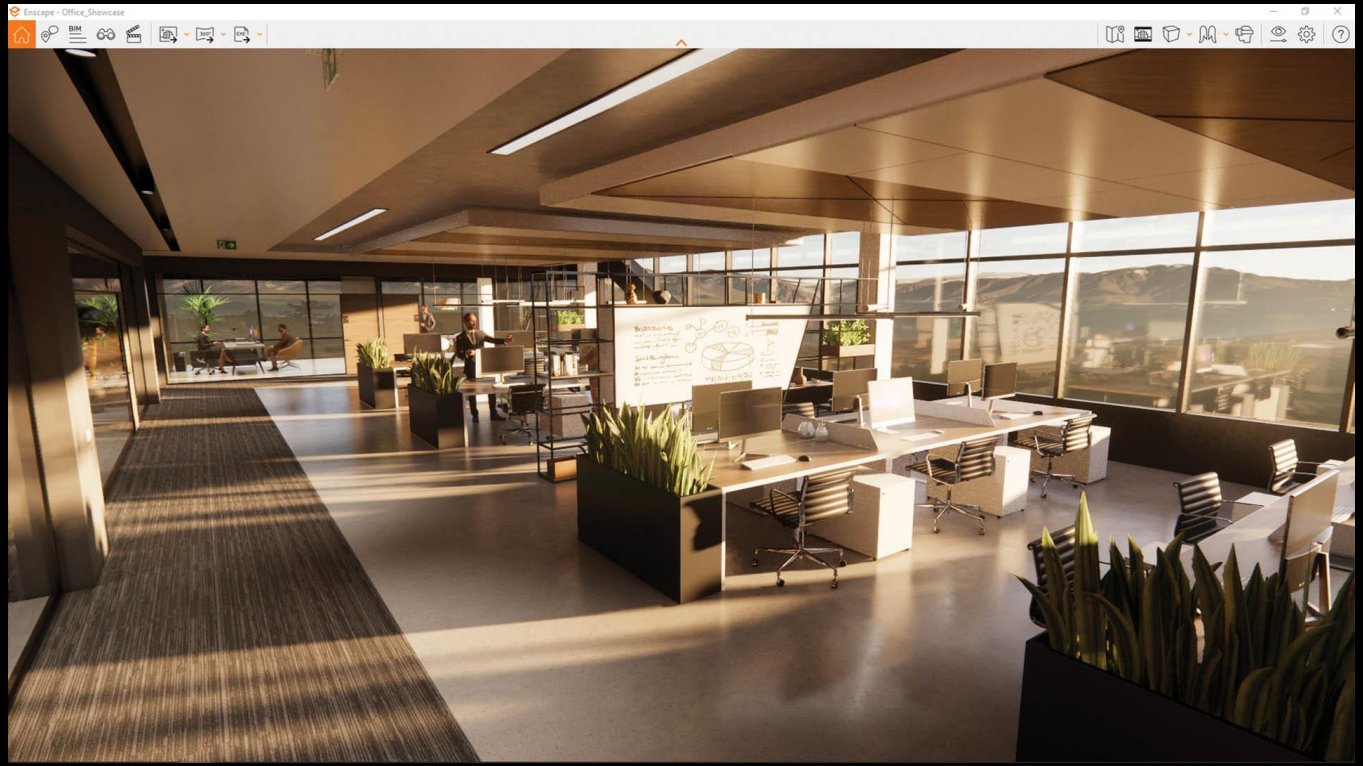
Scene Graph
Root
Perspective
Front
Side
Top
EnvironmentsTransform
SC_02
SC_02_lowpoly
Plane1
ROOT - round_floor.wire
Camera
Backplate
RectangularLight_Viewpo
RootNode - Edit_City_flo_01_embeded_me
AUTODESK
SPEEDGRIP 100
Autodesk VRED
Graph Transform Materials Cameras Clips Curves VSets Render
8899.8 MB RR-RT AA: 41.895% CPU Usage: 89.382% Rendertime Left: 25m 53s
using focal distance of 799.389282
Units mm Up Z NCP 10.00 FCP 1000000.00 FOV 45.00 ICV



Frame

Autodesk Revit - RFOMark

KeyShot



Enscape

V-Ray


Azure
aws
NUTANIX
Google Cloud Platform
FRAME


Observations & Lessons Learned

Storage Performance & Costs

Instance	Price	IOMeter						Crystal Disk Mark								Performance/Price				Performance/Price			
		Total IOs/s	Read IOs/s	Write IOs/s	Avg. Read Response Time (ms)	Avg. Write Response Time (ms)	%CPU Utilization	READ (MB/s) - SEQ1M-Q8T1	READ (MB/s) - SEQ1M-Q1T1	READ (MB/s) - RND4K-Q32T1	READ (MB/s) - RND4K-Q1T1	WRITE (MB/s) - SEQ1M-Q8T1	WRITE (MB/s) - SEQ1M-Q1T1	WRITE (MB/s) - RND4K-Q32T1	WRITE (MB/s) - RND4K-Q1T1	IOMeter IOPS /Price	IOMeter Latency /Price	Crystal ReadPerf / Price	Crysyal WritePerf / Price	IOMeter IOPS /Price	IOMeter Latency /Price	Crystal ReadPerf / Price	Crysyal WritePerf / Price
																				Normalised performance / price			
Microsoft Azure						ruben@fra.me							ruben@fra.me					ruben@fra.me				ruben@fra.me	
Azure Standard SSD - 128GB-D2sv5	10.29	680.0	136.2	543.8	13.36	26.07	4.34	213.1	214.5	38.7	38.3	153.5	130.5	2.48	2.47	66.1	1.92	12.26	7.02	16.9	100.0	100.0	100.0
Azure StandardSSD - 256GB- D2sv5	20.58	687.5	137.2	550.3	15.08	25.3	2.37	213.3	214.8	38.7	38.6	151.3	133.3	2.50	2.46	33.4	0.98	6.14	3.52	8.5	51.2	50.1	50.1
Azure Standard SSD - 256GB D4s_v5	20.58	689.7	137.3	552.3	9.90	26.48	1.04	419.5	420.7	80.8	49.3	149.0	77.1	2.48	1.27	33	.88	11.79	2.79	8.6	46.1	96.1	39.8
Azure Premium SSD - 256GB D2sv5	40.60	4083.8	816.4	3267.4	2.98	4.14	6.51	213.1	212.8	38.8	30.3	173.3	111.4	1.75	3.19	00	.09	3.05	2.07	25.7	4.6	24.9	29.5
Azure Premium SSD - 256GB D4s_v5	40.60	4221.3	846.9	3374.4	2.80	4.03	2.99	419.4	420.2	80.0	47.3	171	141.7	.61	3.17	04.0	0.08	5.91	2.04	26.6	4.4	48.2	29.1
GCP						ruben@fra.me							ruben@fra.me									ruben@fra.me	
GCP Zonal SSD PD - 128GB E2-Std-4	25.19	9860.9	1970.0	7890.9	1.53	1.64	15.04	25.7	25.7	42.7	6.4	255.0	251.0	42.90	4.97	391.5	0.06	5.56	5.50	100.0	3.3	45.4	78.3
GCP Zonal SSD PD - 256GB E2-Std-4	50.38	13709.2	2744.1	109 .2	.04	1.	1.13	25.7	25.6	59.	6.8	255.0	255.4	59.26	5.57	272.1	0.02	2.86	2.85	69.5	1.2	23.4	40.7
GCP Zonal balanced PD - 128GB E2-Std-4	14.81	3696.0	738.6	29 8.1	3.80	4.4	14.	187.	187.5	16.2	8.4	187.7	187.7	16.01	6.55	249.6	0.28	6.75	6.72	63.8	14.5	55.0	95.7
GCP Zonal balanced PD - 256GB E2-Std-4	29.63	4379.0	875.1	35 3.9	3.19	3.7	24.0	225.9	225.2	18.9	11.0	225.0	225.4	19.29	5.44	147.8	0.12	4.06	4.01	37.8	6.1	33.1	57.1
AWS																		ruben@fra.me				ruben@fra.me	
AWS EBS GP3 - 128GB - G4dn.xl	11.58	3000.2	600.8	2399.4	5.12	5.38	3.17	133.0	132.9	12.6	8.2	132.8	132.8	12.55	5.69	259.1	0.45	6.19	6.13	66.2	23.7	50.5	87.3
AWS EBS GP3 - 256GB - G4dn.xl	23.16	2999.5	599.5	2400.0	5.1	5.38	2.9	132.7	132.7	12.6	7.3	132.9	133.0	12.62	4.94	129.5	0.23	3.08	3.06	33.1	11.8	25.1	43.6
OVH						ruben@fra.me							ruben@fra.me					ruben@fra.me				ruben@fra.me	
OVH HGR-HCI1 (AF) - 100GB - air8GB (4c/8m)	N/A	26419.3	5284.9	21134.4	0.42	0.64	12.83	1106.1	598.2	129.4	11.0	853.3	314.2	123.2	11.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Date:	5/20/2023	Notes about pricing:	Price $/month
Author:	ruben@fra.me		On-demand pricing
Version	v5202023		Average price across all regions
Notes:	Results are indication - not exact science		
	results might vary		
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FRAME

Storage performance/costs observations

- Azure Premium SSD = 6x IOPS compared to standard SSD
- Azure Standard SSD = 5x higher latency than Premium SSD
- Azure Premium SSD = 2x price of Standard SSD
- Azure Temporary Storage disk = ~10% more expensive e.g. D4ds_v5 vs D4s_v5
- GCP Zonal SSD PD = very low latency
- GCP Zonal SSD PD = 3x faster than Azure Premium SSD
- GCP Zonal SSD PD = 3x lower latency compared to Premium SSD

Storage performance/costs observations

- GCP storage solutions = higher CPU usage compared to Azure/AWS
- GCP larger disk size is better performance
- GCP Zone Balanced PD vs Azure Prem. GCP is 25% cheaper ~same performance
- GCP Zone SSD PD vs Azure Premium SSD is 25% more expensive
- GCP Zone SSD PD vs Azure Premium SSD 3 x performance
- AWS EBS GP3 = overall good/average storage performance

CPU instance Performance & Costs

Instance	CPU	CPU Base Clock Speed	Max CPU Speed - single-core	vCPUs	RAM	Storage Type	Storage Size	GPU	GPU RAM	Display	OS	CPUZ - ST	CPUZ - MT	CBR23 - MC	CBR23 - SC	EUX 2023	EUC Score AppDialog	EUC Score App Start	EUC Score GDI+ Dragon	EUC Score Tree	EUC Score Rectangles	EUC Score IOPS	Price	CPU-Perf /Price	EUC-Score-CPU /Price	EUX Score /Price	CPU-Perf /Price	EUC-Score-CPU /Price	EUX Score /Price
Microsoft Azure											ruben@fra.me									ruben@fra.me					ruben@fra.me		Normalized perf/price	ruben@fra.me	
Azure D2s_v3	Intel Xeon 8272 - Cascade Lake	2.6 GHz	3.7 GHz	2	8 GiB	Premium-SSD	256GB	N/A	N/A	FHD	Win10 22H2	241.1	427.2	489	N/A	7.37	0.54	0.72	5.68	9.52	6.44	7.82	0.21	1837	36.19	35.10	50.17	60.64	61.88
Azure D4s_v3	Intel Xeon 8272 - Cascade Lake	2.6 GHz	3.7 GHz	4	16 GiB	Premium-SSD	256GB	N/A	N/A	FHD	Win10 22H2	250.7	817.2	1308	659	7.85	0.31	0.69	3.27	5.57	3.28	6.4	0.42	1886	10.52	18.69	51.49	17.63	32.96
Azure D2s_v5	Intel Xeon 8370C - IceLake	2.8 GHz	3.5 GHz	2	8 GiB	Premium-SSD	256GB	N/A	N/A	FHD	Win10 22H2	323.4	545.4	1284	N/A	8.23	0.35	0.63	3.12	5.51	3.58	7.62	0.20	3588	21.58	41.15	97.98	36.15	72.56
Azure D2s_v5	Intel Xeon 8370C - IceLake	2.8 GHz	3.5 GHz	2	8 GiB	Standard-SSD	256GB	N/A	N/A	FHD	Win10 22H2	308.9	570	1216	N/A	7.38	0.33	0.67	3.36	5.06	3.28	10.96	0.20	3492	21.05	36.90	95.35	35.27	65.06
Azure D4s_v5	Intel Xeon 8370C - IceLake	2.8 GHz	3.5 GHz	4	16 GiB	Premium-SSD	256GB	N/A	N/A	FHD	Win10 22H2	410	1101	2724	1055	8.03	0.3	0.61	1.83	3.31	1.36	6.64	0.41	3443	6.27	19.59	94.03	10.50	34.53
Azure D4s_v5	Intel Xeon 8370C - IceLake	2.8 GHz	3.5 GHz	4	16 GiB	Standard-SSD	256GB	N/A	N/A	FHD	Win10 22H2	390	1092	2521	960	6.87	0.29	0.59	2.02	3.33	1.55	9.03	0.41	3254	6.52	16.76	88.88	10.93	29.54
AWS											ruben@fra.me									ruben@fra.me					ruben@fra.me			ruben@fra.me	
AWS t3.medium	Intel Xeon 8259 – Cascade Lake	2.5 GHz	3.5 GHz	2	4 GiB	EBS GP3	256GB	N/A	N/A	FHD	Server 2019	208.2	396.6	773	N/A	7.94	0.36	0.65	5.48	8.77	6.41	7.47	0.14	3280	50.71	56.71	89.59	84.97	100.00
AWS t3.large	Intel Xeon 8259 – Cascade Lake	2.5 GHz	3.5 GHz	2	8 GiB	EBS GP3	256GB	N/A	N/A	FHD	Server 2019	222.8	425.8	594	N/A	7.92	0.34	0.62	[illegible]	8.77	[illegible].12	[illegible].48	0.20	2071	34.88	39.60	56.56	58.44	69.82
AWS t3.xlarge	Intel Xeon 8259 – Cascade Lake	2.5 GHz	3.5 GHz	4	16 GiB	EBS GP3	256GB	N/A	N/A	FHD	Server 2019	260	774	1604	[illegible]0	7.86	0.33	0.6	5.33	9.79	[illegible]88	[illegible]7	0.33	2665	22.91	23.82	72.77	38.39	42.00
AWS m6i.large	Intel Xeon 8375C - IceLake	2.9 GHz	3.5 GHz	2	8 GiB	EBS GP3	256GB	N/A	N/A	FHD	Server 2019	[illegible]	520	981	N/A	19	0.28	0.5[illegible]	[illegible].33	5.37	[illegible]98	8.53	0.20	2978	21.75	42.45	81.33	36.44	74.85
AWS m6i.xlarge	Intel Xeon 8375C - IceLake	2.9 GHz	3.5 GHz	4	16 GiB	EBS GP3	256GB	N/A	N/A	FHD	Server 2019	38[illegible]	81	1574	6[illegible]	8.1	0.3	0.6	[illegible].9	[illegible].71	4.59	5.41	0.40	2533	13.26	20.28	69.18	22.22	35.75
AWS m6i.2xlarge	Intel Xeon 8375C - IceLake	2.9 GHz	3.5 GHz	8	32 GiB	EBS GP3	256GB	N/A	N/A	FHD	Server 20[illegible]	[illegible].7	[illegible]09	5406	10[illegible]	8.[illegible]	0.29	0.55	1.69	3.04	0.97	8.2	0.80	3342	2.96	10.76	91.27	4.95	18.98
GCP											ruben@fra.me									ruben@fra.me					ruben@fra.me			ruben@fra.me	
GCP N1-Standard-2-Win	Intel Xeon - Skylake	2.0 GHz	3.5 GHz	2	7.5 GiB	Zonal SSD PD	[illegible]6GB	N/A	N/A	FH[illegible]	Server 201[illegible]	167.[illegible]	32.5	544	N/A	7.6	0.35	0.62	7.53	12.16	5.08	5.57	0.20	1777	50.49	38.97	48.54	84.59	68.72
GCP N1-Standard-4-Win	Intel Xeon - Skylake	2.0 GHz	3.5 GHz	4	15 GiB	Zonal SSD PD	[illegible]6GB	N/A	N/A	FH[illegible]	Server 201[illegible]	213.9	681.6	[illegible]	594	8.09	0.3	0.6	3.93	7.04	4.86	6.08	0.39	2086	14.06	20.74	56.96	23.57	36.58
GCP E2-Standard-2-Win	Intel Xeon - Broadwell	2.2 GHz	3.7 GHz	2	8 GiB	Zonal SSD PD	[illegible]6GB	N/A	N/A	FHD	Server 2019	188.8	360.6	736	N/A	7.53	0.35	0.62	6.89	11.85	7.56	6.24	0.16	2729	59.68	47.96	74.53	100.00	84.57
GCP E2-Standard-4-Win	Intel Xeon - Broadwell	2.2 GHz	3.7 GHz	4	16 GiB	Zonal SSD PD	256[illegible]	N/A	N/A	FHD	Server 2019	225.2	701	1626	637	8.01	0.3	0.61	4.19	7.09	5.34	6.15	0.32	2634	17.46	24.80	71.93	29.26	43.73
GCP N2d-Standard-2-Win	AMD EPYC - Rome	2.25	3.3 GHz	2	8 GiB	Zonal SSD PD	256GB	N/A	N/A	FHD	Server 2019	275.7	538.7	1163	N/A	8.46	0.29	0.58	3.71	6.60	3.56	4.68	0.18	3662	28.64	47.00	100.00	47.99	82.87
GCP N2d-Standard-4-Win	AMD EPYC - Rome	2.25	3.3 GHz	4	16 GiB	Zonal SSD PD	256GB	N/A	N/A	FHD	Server 2019	343.8	1054	2523	882	8.62	0.29	0.57	2.29	4.12	1.81	4.39	0.36	3631	8.90	23.94	99.15	14.92	42.22
GCP custom-2-4096-Win	Intel Xeon - Skylake	2.0 GHz	3.5 GHz	2	4 GiB	Zonal SSD PD	256GB	N/A	N/A	FHD	Server 2019	170	315	691	N/A	7.5	0.34	0.65	7.87	11.16	8.17	6.63	0.18	2190	53.16	41.90	59.80	89.07	73.88
Physical PC											ruben@fra.me									ruben@fra.me					ruben@fra.me			ruben@fra.me	
Workstation-RSP	AMD Ryzen 7 5800X	3.8 GHz	4.7 GHz	16	128 GB	NVMe	2TB	NVIDIA RTX A6000	48 GB	FHD	Win11 22H2	647	6461	13674	1463	9.22	0.29	0.63	3.71	6.90	0.71	0.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nutanix AHV											ruben@fra.me									ruben@fra.me					ruben@fra.me			ruben@fra.me	
AIR8GB - OVH	Intel Xeon Gold 622R - Dempsey	2.9 GHz	3.9 GHz	4	8 GB	HGR-HCI-1 (AF)	100GB	N/A	N/A	FHD	Win10 22H2	393.6	1377	3151	815	8.52	0.3	0.65	2.24	3.51	1.8	3.19	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Date: 5/20/2023
Author: ruben@fra.me
Version v5202023
Notes: Results are indication - not exact science
results might vary

notes about pricing:
Price $/hour
On-demand pricing
Average compute price across all regions
Windows OS License included
Storage costs not included

FRAME

CPU instance performance/costs observations

- Azure: use v5 machine instead of v3 – 25% better performance and sightly lower price.
- AWS: use the m6i.larger instead t3.large when available – same price, better CPU performance.
- Azure machines in favor AWS – same price but better CPU performance.
- GCP overall cheapest but also lowest CPU performance.
- Azure Standard SSD has (negative) impact in End User Experience score (EUX) – 6.87 vs 8.03
- If applications are less CPU demanding GCP is in favor because of attractive price compared to Azure/AWS

GPU instance Performance & Costs

Instance	CPUZ - ST	CPUZ - MT	CBR23 - MC	CBR23 - SC	EUX 2023	Blender CPU Monster	Blender CPU Junkshop	Blender CPU Class	Blender GPU Monster	Blender GPU Junkshop	Blender GPU Class	EUC Score App Dialog	EUC Score App Start	EUC Score GDI+ Dragon	EUC Score Tree	EUC Score Rect	EUC Score IOPS	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	EUC-Score-CPU /Price	EUX Score /Price	SPEC Perf /Price	GPU Perf /Price	CPU-Perf /Price	EUC-Score-CPU /Price	EUX Score /Price
Microsoft Azure																		ruben@fra.me																	Normalized price/performance				ruben@fra.me	
Azure NV6	256	1789	3843	671	7.37	26.73	16.21	14.2	157	97	79	0.28	0.62	8.71	15.31	1.55	5.57	44.67	43.35	67.31	23.05	151.39	24.73	194	96	1.33	60.6	83.41	710.6	9.03	5.54	37.8	9.56	29.4	2.8	32.8
Azure NV4as_v4	348	997	2304	893	7.95	15.63	9.09	7.8	FAIL	FAIL	FAIL	0.29	0.68	106.89	194.31	1.3	14.08	4.09	4.10	4.22	1.42	12.72	2.22	28	11	0.47	18.1	FAIL	1390.4	320.43	16.91	11.3	FAIL	57.6	100.0	100.0
Azure NV8as_v4	375	2107	4673	937	8.25	33.4	19.53	16.55	78	16	30	0.29	0.65	26.52	49.36	1.05	6.34	9.99	11.95	19.70	25.87	35.47	7.05	59	27	0.94	26.0	43.68	1240.6	40.37	8.78	16.2	5.00	51.4	12.6	51.9
Azure NV16as_v4	395.7	4246	9445	945	8.03	66.53	40.07	32.68	162	56	79	0.29	0.66	10.36	20.83	1.3	3.98	23.53	23.64	37.92	37.22	86.62	14.41	120	56	1.88	26.5	52.68	1153.0	8.30	4.27	16.5	6.04	47.7	2.6	25.3
Azure NV32as_v4	395.4	8414	17896	959	8.37	134.32	80.9	67.02	358	148	197	0.29	0.65	4.3	8.96	1.18	2.88	69.54	48.36	54.79	49.64	202.09	31.84	277	128	3.76	28.6	62.29	1061.9	1.76	2.23	17.8	7.14	44.0	0.6	13.2
Azure NC4asT4_v3	365.8	1490	2988	909	8.22	21.24	12.38	11.04	725	485	465	0.28	0.61	4.21	8.58	1.08	11.3	83.68	64.26	102.26	38.48	241.46	46.62	293	155	0.81	157.5	686.44	1018.2	7.86	10.11	98.1	78.65	42.2	2.5	59.7
Azure NC8asT4_v3	376.7	3059	7029	942	8.3	45.94	27.18	23.12	725	485	463	0.28	0.61	4.14	8.21	1.12	3.92	83.64	62.40	92.56	38.55	246.50	46.88	292	155	1.24	102.6	449.59	1325.2	4.98	6.69	63.9	51.51	54.9	1.6	39.6
Azure NC16asT4_v3	395.9	6020	13959	956	8.28	90.92	55.74	47.12	709	471	466	0.28	0.61	4.52	8.87	1.16	3.67	84.00	59.04	80.78	39.10	248.49	47.17	295	158	2.14	59.1	256.39	1436.9	3.13	3.87	36.8	29.38	59.5	1.0	22.9
Azure NV6adsA10_v5	494.4	2105	4895	1273	8.41	32.72	19.74	16.09	FAIL	FAIL	FAIL	0.28	0.57	36.32	78.85	0.73	5.26	14.40	18.09	24.58	11.30	51.07	10.73	51	31	0.82	32.5	FAIL	1545.1	70.48	10.29	20.3	FAIL	64.0	22.0	60.9
Azure NV12adsA10_v5	511.7	4016	9818	1309	8.36	67.11	41.5	33.44	371	216	196	0.28	0.57	19.12	36.42	0.82	2.68	42.69	41.44	51.57	32.51	125.94	21.93	109	67	1.63	37.6	159	1380.9	16.99	5.12	23.4	18.30	57.2	5.3	30.2
Azure NV36adsA10_v5	548.8	12821	26897	1310	8.4	199.24	125.35	97.6	1566	992	867	0.28	0.56	3.8	7.91	0.82	1.9	144.37	97.79	108.25	86.31	419.07	74.67	451	260	5.47	5	20	1097.0	1.07	1.54	23.4	23.92	45.4	0.3	9.1
AWS																		ruben@fra.me																		ruben@fra.me				ruben@fra.me	
AWS G4ad.XL	316	960	2317	898	8.45	15.14	9.2	7.55	FAIL	FAIL	FAIL	0.3	0.6	7.67	12.37	2.49	8.12	47.09	28.09	34.1	41.64	79	29.4	24	121	0.58	15.7	FAIL	1119.4	17.36	14.64	94.5	FAIL	46.4	5.4	86.5
AWS G4ad.2XL	334	1991	4663	923	8.55	31.33	18.62	15.45	FAIL	FAIL	FAIL	0.31	0.59	5.59	13.83	1.7	8.5	43.04	31.22	42.1	41.1	1.20	29.66	25	13	0.82	11.9	FAIL	1389.6	11.84	10.43	71.0	FAIL	57.5	3.7	61.6
AWS G4ad.4XL	342	4205	9564	956	8.62	65.6	40.76	32.4	FAIL	FAIL	FAIL	0.32	0.58	6.31	12.88	1.1	8.51	42.1	33.58	17.7	41.1	1.70	29.38	26	13	1.64	60.2	FAIL	1327.2	5.86	5.27	37.5	FAIL	55.0	1.8	31.1
AWS G4ad.8XL	354	7917	18173	943	8.61	132	83.06	64.94	FAIL	FAIL	FAIL	0.3	0.59	6.3	13.16	1.3	8.5	41.2	34.26	9.4	42.0	17.69	29.67	269	140	1.64	59.6	FAIL	2414.9	5.95	5.26	37.1	FAIL	100.0	1.9	31.1
AWS G4dn.XL	296	859	1615	744	8.32	11.62	7.34	5.59	636	396	367	0.28	0.59	4.87	9.46	1.4	8.5	75.1	6.16	4.4	36.6	193.65	45.89	288	138	0.79	147.4	591.72	641.4	9.73	10.56	91.8	67.80	26.6	3.0	62.4
AWS G4dn.2XL	334	1804	3949	786	8.44	25.43	16.59	12.1	640	400	375	0.28	0.5	4.91	9.1	1.3	8.73	77.5	57.1	1.04	36.04	195.34	45.30	276	137	1.23	94.0	383.00	803.6	5.66	6.85	58.6	43.88	33.3	1.8	40.5
AWS G4dn.4XL	342	3566	8117	785	8.6	53.09	34.05	25.04	643	405	376	0.29	0.57	4.37	8.3	1.12	8.3	77.30	61	02.83	35.45	202.16	45.00	272	137	2.19	53.1	216.90	843.6	2.91	3.93	33.1	24.85	34.9	0.9	23.2
AWS G4dn.8XL	345	7290	16195	816	8.61	109	71.63	52.48	636	397	367	28	0.57	4.4	8.03	1.13	7.18	78.04	56.12	102.91	33.38	193.24	44.11	275	147	4.10	28.4	113.91	867.5	1.52	2.10	17.7	13.05	35.9	0.5	12.4
AWS G5.xl	320.3	1008	2299	919	8.4	16.03	9.2	7.81	1483	914	931	0.28	0.59	4.48	10	1.48	7.92	145.16	94.78	100.43	102.19	352.26	76.11	464	244	1.23	160.5	872.80	532.3	6.69	6.83	100.0	100.00	22.0	2.1	40.4
AWS G5.2xl	320.8	2090	4614	928	8.61	30.98	19.13	15.83	1515	944	843	0.28	0.58	5.35	9.9	1.2	8.52	140.76	98.00	109.27	103.27	359.78	74.97	473	265	1.63	124.5	675.26	702.8	4.68	5.28	77.6	77.37	29.1	1.5	31.2
AWS G5.4xl	374	4306	9509	887	8.63	65.31	40.47	32.43	1502	942	850	0.29	0.57	4.56	8.51	1.15	8.62	142.71	101.73	117.42	104.03	375.98	77.06	482	272	2.42	86.4	453.72	898.1	2.70	3.57	53.8	51.98	37.2	0.8	21.1
AWS G5.8xl	371	8692	18484	965	8.61	132.43	82.46	65.76	1519	933	839	0.28	0.57	4.35	8.74	1.42	8.42	142.95	102.61	117.19	103.98	376.15	77.38	488	273	4.01	52.4	273.57	1025.7	1.63	2.15	32.6	31.34	42.5	0.5	12.7
GCP																		ruben@fra.me																		ruben@fra.me				ruben@fra.me	
GCP N1-STD-2-GPU-T4	195	402	869	FAIL	8.5	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	0.31	0.62	8.48	16.08	4.63	5.05	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	1.36	FAIL	FAIL	FAIL	9.06	6.27	FAIL	FAIL	FAIL	2.8	37.1
GCP N1-STD-4-GPU-T4	262.8	803.5	1456	694	8.55	12.2	7.16	5.64	FAIL	FAIL	FAIL	0.29	0.6	6.43	15.27	1.56	4.46	73.25	51.12	81.95	34.93	170.11	42.98	266	134	1.65	64.7	FAIL	280.7	6.58	5.18	40.3	FAIL	11.6	2.1	30.6
GCP N1-STD-8-GPU-T4	269.4	1566	3419	707	8.65	22.54	13.77	10.9	608	382	347	0.29	0.58	5.98	12.43	1.5	3.13	73.81	52.22	88.14	34.97	180.27	44.00	272	136	4.02	27.4	110.87	213.5	2.29	2.15	17.1	12.70	8.8	0.7	12.7
GCP N1-STD-16-GPU-T4	275.5	3190	6966	694	8.63	45.72	29.69	21.75	630	382	356	0.29	0.58	6.62	12.07	1.31	3.17	73.55	52.84	90.59	34.39	179.02	43.68	269	135	8.52	12.9	53.52	188.2	1.10	1.01	8.0	6.13	7.8	0.3	6.0
Physical PC																		ruben@fra.me																		ruben@fra.me				ruben@fra.me	
Workstation-RSP	647	6461	13674	1463	9.22	99.22	63.58	49.49	2608	1625	1446	0.29	0.63	3.71	6.9	0.71	0.74	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	N/A	N/A

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Date: 5/20/2023
Author: ruben@fra.me
Version v5202023
Notes: Results are indication - not exact science
results might vary

Notes about pricing:
Price $/hour
On-demand pricing
Average compute price across all regions
Windows OS License included
Storage costs not included

FRAME

GPU instance Performance & Costs

CAD, BIM, Real Time Visualization Apps

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					ruben@fra.me																			ruben@fra.me				
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	[illegible]	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	[illegible]	12[illegible]	[illegible]	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.[illegible]	23.9	41.8	[illegible]	[illegible]	[illegible]	121	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.[illegible]	24.[illegible]	40.9	[illegible]	[illegible]	[illegible]	121	[illegible]	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	15.[illegible]	12.[illegible]	7.[illegible]	2.1[illegible]	FAIL	2.6	51[illegible]	[illegible]	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	2.78	39.[illegible]	22.4	11.[illegible]	11.5	FAIL	27.6	1174	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.[illegible]	2[illegible]	2.[illegible]	138.[illegible]	[illegible]	41.[illegible]	4.2	4.[illegible]	88.9	1742	1194	1040	1480	2937	3928	929	1312	1470	12409	9280	5.47
AWS					ruben@fra.me																			ruben@fra.me				
AWS G4ad.XL	1391	FAIL	0.32	FAIL	12.1	175.7	508.0	2[illegible]3.0	52.[illegible]	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	[illegible]67.8	109.[illegible]	43.[illegible]	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.[illegible]	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					ruben@fra.me																			ruben@fra.me				
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-RW1300G3	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

FRAME

Date: 5/20/2023
Author: ruben@fra.me
Credits: Greg Corke - Managing Editor and Co-founder at AEC Magazine, DEVELOP3D, NXT BLD. Director X3D Media
Version v5202023
Notes: Results are indication - not exact science
results might vary

Notes about pricing:
Price $/hour
On-demand pricing
Average compute price across all regions
Windows OS License included
Storage costs not included

GPU instance Performance & Costs

CAD, BIM, Real Time Visualization Apps

Instance	Price	vRay CPU Perf / Price - FHD	vRay GTX GPU Perf / Price - FHD	Keyshot CPU Perf / Price - FHD	Keyshot GPU Perf / Price - FHD	VRED med AA Perf / Price - FHD	Enscape Perf / Price - FHD	Unreal Engine RT ON Perf / Price - FHD	Unreal Engine RT OFF Perf / Price - FHD	Inventor ST Perf / Price - FHD	Inventor MT Perf / Price - FHD	Inventor gfx Perf / Price - FHD	Revit Update Perf / Price - FHD	Revit Create Perf / Price - FHD	Revit Export Perf / Price - FHD	Revit Render Perf / Price - FHD	Revit Graphics Perf / Price - FHD
Microsoft Azure														ruben@fra.me			
Azure NV6_v3	1.32	1965	FAIL	0.37	3.52	14.83	31.08	FAIL	19.81	5739	2573	1298	45.97	40.34	13.85	52.71	156.04
Azure NV12_v3	1.84	1861	FAIL	0.36	2.52	10.67	23.08	FAIL	14.40	4316	2222	943	37.72	30.37	10.43	51.83	117.84
Azure NV8as_v4	0.94	3485	FAIL	0.68	FAIL	5.11	16.39	FAIL	4.69	7780	4269	1402	[illegible]	[illegible]	21.80	[illegible]	88.26
Azure NV16as_v4	1.88	3345	FAIL	0.66	FAIL	5.00	14.42	FAIL	9.86	4612	2876	1030	[illegible]	[illegible]	[illegible]	86.1	19.44
Azure NC4asT4_v3	0.81	2829	724	0.54	28.94	46.35	91.68	[illegible]	50.52	12496	[illegible]	2767	9[illegible]	[illegible]	5.0	81.5	38.70
Azure NC8asT4_v3	1.24	3995	534	0.72	19.05	29.80	57.85	19.27	33.69	[illegible]	4084	1391	[illegible]	[illegible]	[illegible]	[illegible]	15.34
Azure NC16asT4_v3	2.14	4455	343	0.84	11.50	17.69	36.20	11.58	19.1	47	2981	1[illegible]	37[illegible]	32.5[illegible]	[illegible]	98.6	117.23
Azure NV6adsA10_v5	0.82	4166	FAIL	0.82	8.05	15.36	2.51	FAIL	[illegible]	149[illegible]	6067	243	132.47	106.42	34.85	[illegible]	330.09
Azure NV12adsA10_v5	1.63	4302	215	0.81	8.50	15.53	31.51	FAIL	6.88	[illegible]	4325	160	69.46	60.48	19.47	108.46	197.46
Azure NV36adsA10_v5	5.47	3708	282	0.73	9.58	14.28	24.54	[illegible]	16.26	2269	1697	537	19.90	18.56	5.78	66.92	70.48
AWS														ruben@fra.me			
AWS G4ad.XL	0.58	2410	FAIL	0.55	FAIL	42.01	96.50	FAIL	70.77	12449	4270	2192	143.65	98.62	34.11	75.98	330.49
AWS G4ad.2XL	0.82	3839	FAIL	0.80	FAIL	29.15	70.21	FAIL	50.57	10200	4773	2052	107.73	78.24	26.07	111.55	281.64
AWS G4ad.4XL	1.64	3935	FAIL	0.84	FAIL	14.92	35.13	FAIL	25.21	5208	3234	1203	51.56	39.35	13.40	100.86	153.36
AWS G4dn.XL	0.79	1537	497	0.33	28.97	46.59	95.20	30.62	36.45	10945	2800	2147	94.98	78.28	24.14	41.39	255.98
AWS G4dn.2XL	1.23	2357	425	0.41	19.12	29.77	54.16	19.89	31.91	7454	2928	1623	65.54	53.02	16.50	50.27	199.02
AWS G4dn.4XL	2.19	2987	266	0.53	10.64	16.75	31.56	10.58	18.30	4181	1683	944	40.69	32.53	8.87	59.14	132.49
AWS.G4dn.12XL	4.10	4904	580	0.89	12.14	8.86	17.29	6.09	10.24	2395	1667	586	22.88	18.15	5.56	72.34	73.36
AWS G5.xl	1.23	1180	893	0.24	46.37	73.29	103.42	49.52	59.67	7237	2174	1382	65.09	47.83	15.62	35.05	166.09
AWS G5.2xl	1.63	1933	812	0.40	34.84	56.32	91.52	38.24	62.84	6391	2679	1331	51.17	38.95	12.84	55.83	151.97
AWS G5.4xl	2.42	2663	471	0.55	18.83	38.03	57.62	24.91	43.37	4199	2379	970	37.43	27.48	8.82	62.85	112.63
AWS G5.8xl	4.01	3171	376	0.69	14.40	23.34	37.43	15.07	26.85	2602	1699	584	21.52	15.73	5.30	65.82	68.27
GCP														ruben@fra.me			
GCP N1-STD-4-GPU-T4	1.65	702	462	0.14	13.55	21.31	41.19	FAIL	23.73	4502	1213	838	43.79	32.36	10.70	18.14	109.17
GCP N1-STD-8-GPU-T4	4.02	599	363	0.12	5.54	8.63	16.75	5.74	9.22	2074	838	431	18.87	14.98	4.97	15.77	59.28
Physical Workstation														ruben@fra.me			
HP Z2 Mini G9	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
Scan 3XS GWP-ME A13C	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
Armari Magnetar M64TP-RW1300G3	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
Scan 3XS GWP-ME A1128T	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

Instance	vRay CPU Perf / Price - FHD	vRay GTX GPU Perf / Price - FHD	Keyshot CPU Perf / Price - FHD	Keyshot GPU Perf / Price - FHD	VRED med AA Perf / Price - FHD	Enscape Perf / Price - FHD	Unreal Engine RT ON Perf / Price - FHD	Unreal Engine RT OFF Perf / Price - FHD	Inventor ST Perf / Price - FHD	Inventor MT Perf / Price - FHD	Inventor gfx Perf / Price - FHD	Revit Update Perf / Price - FHD	Revit Create Perf / Price - FHD	Revit Export Perf / Price - FHD	Revit Render Perf / Price - FHD	Revit Graphics Perf / Price - FHD
Normalised performance / price																
Microsoft Azure												ruben@fra.me				
Azure NV6_v3	40.08	FAIL	4[illegible]	7.58	[illegible]24	30.0[illegible]	FAIL	27.99	38.32	42.45	46.92	32.00	37.91	39.75	47.25	47.22
Azure NV12_v3	37.96	FAIL	40.1[illegible]	[illegible]43	1[illegible]56	22.32	[illegible]	20.35	28.82	36.65	34.09	26.26	28.54	29.93	46.46	35.65
Azure NV8as_v4	71.06	FAIL	70[illegible]3	FAIL	[illegible]07	15.84	FAIL	6.63	51.95	70.42	50.67	58.51	62.35	62.54	82.52	56.96
Azure NV16as_v4	68.22	FAIL	73[illegible]	FAIL	6.82	13.94	FAIL	13.93	30.79	47.45	37.22	28.93	33.47	33.54	77.46	36.14
Azure NC4asT4_v3	77.69	61.13	60.55	62.41	63.24	88.65	62.29	71.38	83.44	70.01	100.00	67.39	78.43	71.87	73.42	90.38
Azure NC8asT4_v3	81.47	59.81	80.34	41.08	40.66	55.94	38.91	47.60	56.39	67.36	68.33	45.13	53.61	51.12	88.55	65.16
Azure NC16asT4_v3	90.84	38.43	93.63	24.81	24.13	35.00	23.38	27.01	31.95	49.17	42.60	25.90	30.58	29.47	88.45	35.47
Azure NV6adsA10_v5	84.97	FAIL	91.80	17.37	20.96	2.43	FAIL	4.55	100.00	100.00	87.92	92.22	100.00	100.00	97.49	99.88
Azure NV12adsA10_v5	87.73	24.06	90.42	18.33	21.19	30.47	FAIL	23.85	52.03	71.34	57.84	48.35	56.83	55.87	97.22	59.75
Azure NV36adsA10_v5	75.63	31.63	81.66	20.66	19.48	23.73	17.38	22.98	15.15	27.99	19.40	13.85	17.44	16.58	59.99	21.33
AWS												ruben@fra.me				
AWS G4ad.XL	49.14	FAIL	62.06	FAIL	57.32	93.31	FAIL	100.00	83.12	70.44	79.19	100.00	92.67	97.86	68.11	100.00
AWS G4ad.2XL	78.29	FAIL	90.10	FAIL	39.77	67.89	FAIL	71.46	68.11	78.73	74.16	75.00	73.52	74.80	100.00	85.22
AWS G4ad.4XL	80.25	FAIL	94.38	FAIL	20.36	33.97	FAIL	35.62	34.77	53.35	43.47	35.89	36.98	38.44	90.41	46.41
AWS G4dn.XL	31.34	55.72	36.93	62.47	63.58	92.06	61.83	51.51	73.08	46.19	77.58	66.12	73.55	69.26	37.10	77.45
AWS G4dn.2XL	48.07	47.67	45.45	41.24	40.62	52.37	40.17	45.09	49.77	48.30	58.65	45.62	49.82	47.34	45.07	60.22
AWS G4dn.4XL	60.92	29.85	59.85	22.94	22.86	30.51	21.36	25.86	27.92	27.75	34.10	28.33	30.57	25.45	53.01	40.09
AWS.G4dn.12XL	100.00	64.95	100.00	26.19	12.09	16.72	12.29	14.47	15.99	27.49	21.19	15.92	17.06	15.96	64.85	22.20
AWS G5.xl	24.06	100.00	27.32	100.00	100.00	100.00	100.00	84.31	48.32	35.86	49.92	45.31	44.95	44.82	31.42	50.26
AWS G5.2xl	39.41	90.93	44.64	75.13	76.85	88.49	77.22	88.80	42.68	44.19	48.10	35.62	36.60	36.85	50.05	45.98
AWS G5.4xl	54.31	52.82	61.52	40.62	51.89	55.71	50.31	61.28	28.04	39.24	35.04	26.06	25.82	25.31	56.34	34.08
AWS G5.8xl	64.67	42.16	76.77	31.06	31.85	36.19	30.44	37.94	17.38	28.02	21.09	14.98	14.78	15.22	59.00	20.66
GCP												ruben@fra.me				
GCP N1-STD-4-GPU-T4	14.33	51.78	15.60	29.21	29.07	39.83	FAIL	33.53	30.06	20.02	30.29	30.49	30.41	30.70	16.26	33.03
GCP N1-STD-8-GPU-T4	12.22	40.62	13.09	11.94	11.78	16.20	11.58	13.03	13.85	13.82	15.56	13.14	14.08	14.25	14.13	17.94
Physical Workstation												ruben@fra.me				
HP Z2 Mini G9	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
Scan 3XS GWP-ME A13C	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
Armari Magnetar M64TP-RW1300G3	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
Scan 3XS GWP-ME A1128T	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

FRAME

FRAME

GPU instance performance/costs observations

- Azure NVv4 machines with SPEC is not great performance; Low 3D performance, no video encoding / no hardware encoding exposed.
- Azure NV4v4 is limited in fps (18 is max)
- Azure NV4v4 GPU compute is bad compared to CPU, the CPU outperforms the GPU looking at EUC Score ‘Tree’ and ‘Dragon’.
- Azure NVv4 CPU/Price performance is good – cheap & decent CPU performance.
- Azure NVv4 if you don’t need a GPU … don’t go for the cheap accelerated VM (NV4v4/NV8v4) use e.g., D4s_v5.

GPU instance performance/costs observations

- 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
- Azure if you realy need GPU performance don’t use NVadsA10 with smaller GPU partitions, the NCasT4 with dedicated GPU outperforms big time
- 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

GPU instance performance/costs observations

- AWS G4ad (AMD GPU) do have a very good performance/price ratio.
- AWS G4ad does provide the not highest GPU performance but decent.
- AWS G4ad some applications crash, maybe AMD driver issues?
- AWS G5 (NVIDIA A10) outstanding performance also compared to Azure.
- GCP - CPU performance is limiting – why is it 2.0GHz …
- GCP - Double the price compared to AWS (G4dn) – Azure (NC4v4) and lower (CPU) performance – not great!

GPU instance performance/costs observations

- Cloud Workstations beats the 2–4-year-old CAD/CAM workstations.
- Cloud Workstation cannot beat physical Workstation in performance. GPU in Cloud is years behind; CPU has lower CPU clockspeed.
- Very few people need extreme high-end workstation.
- Performance is only one (key) topic in decision making.

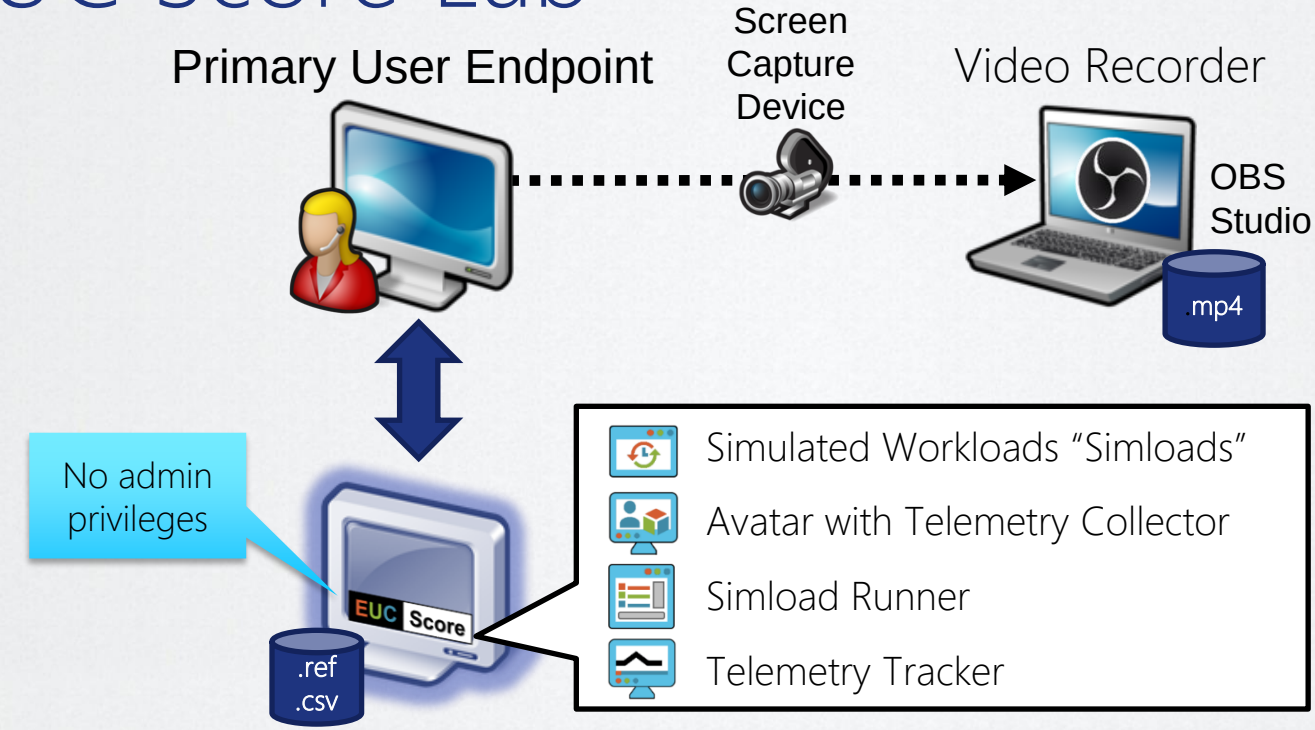

System Performance
User Experience

EUC Score captures, measures and quantifies perceived end-user experience in Windows remoting and digital workspace environments, both on premises and in the cloud – fast, precise, repeatable and intuitive

https://eucscore.com

EUC Score

EUC Score Lab



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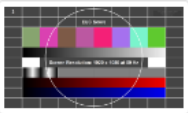
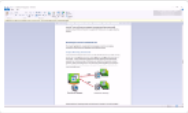
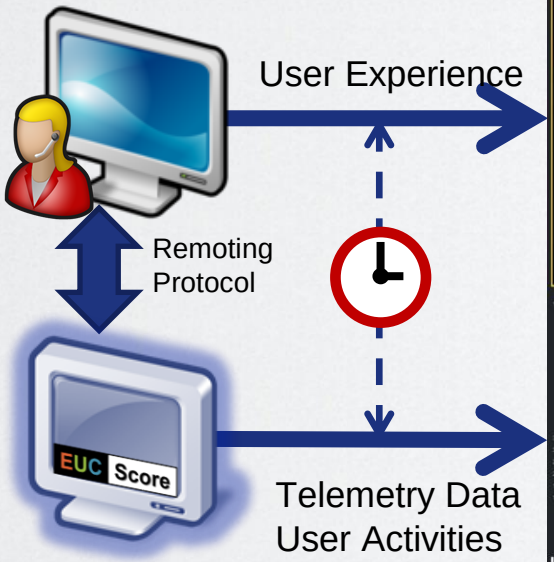
Thumbnail	Simload Type	Description
	**System**	SL0-TestScreen Open a test pattern screen and save system information.
	**Primary** Base	SL1-NotepadEdit Open Microsoft Notepad and start writing a novel with random type speed.
	**Primary** Base	SL1-WordpadScroll Open local DOCX file with PNG images in Wordpad and randomly move pages up and down every second.
	**Primary** JPEGView	SL1-JPEGViewStatic Open JEPG image in JEPG View. **NOTE**: This is the most basic Simload as it includes neither animations nor user interactions.
	**Primary** JPEGView	SL1-JPEGViewAnim Open animated GIF image in JEPG View.
	**Primary** WMPlayer	SL1-WMPlayer480pWMV Open local 480p WMV video in Windows Media Player, switch from windowed to fullscreen mode.
	**Persona** Base	SL2-Base **Foreground**: SL3-AppDialog **Background**: SL1-JPEGViewAnim

Synthetic Testing – Visual Data Analytics

Primary User Endpoint



System Under Test

EUC Score

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Show Time

- Performance and cost-effectiveness of 40+ CPU and GPU instances on AWS, Azure, and GCP compared in heatmaps
- Performance and cost-effectiveness of 5 cloud storage solutions on AWS, Azure, and GCP compared in heatmaps
- Analyzing User Experience: A comparison of workloads over Microsoft RDP and Frame FRP8 in LAN and WAN using EUC score sync

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Thanks!

You want access to the data?!

Benny Tritsch - benny@drtritsch.com
Ruben Spruijt – ruben@fra.me

Experts Live Netherlands