EUROPEAN CLOUD SUMMIT 2024

Comparing digital employee experience - Azure Virtual Desktop versus on-prem Windows desktops

Benny Tritsch | info@drtritsch.com

EUC Documentary Cameraman
Microsoft MVP
Citrix CTP Fellow
VMware EUC Expert
NVIDIA NGCA

EUC Score

Parallels®

GO—EUC

TeamRGE
Remoting Graphics Experts

EUROPEAN CLOUD SUMMIT

Microsoft

run.events

AURUM

AvePoint
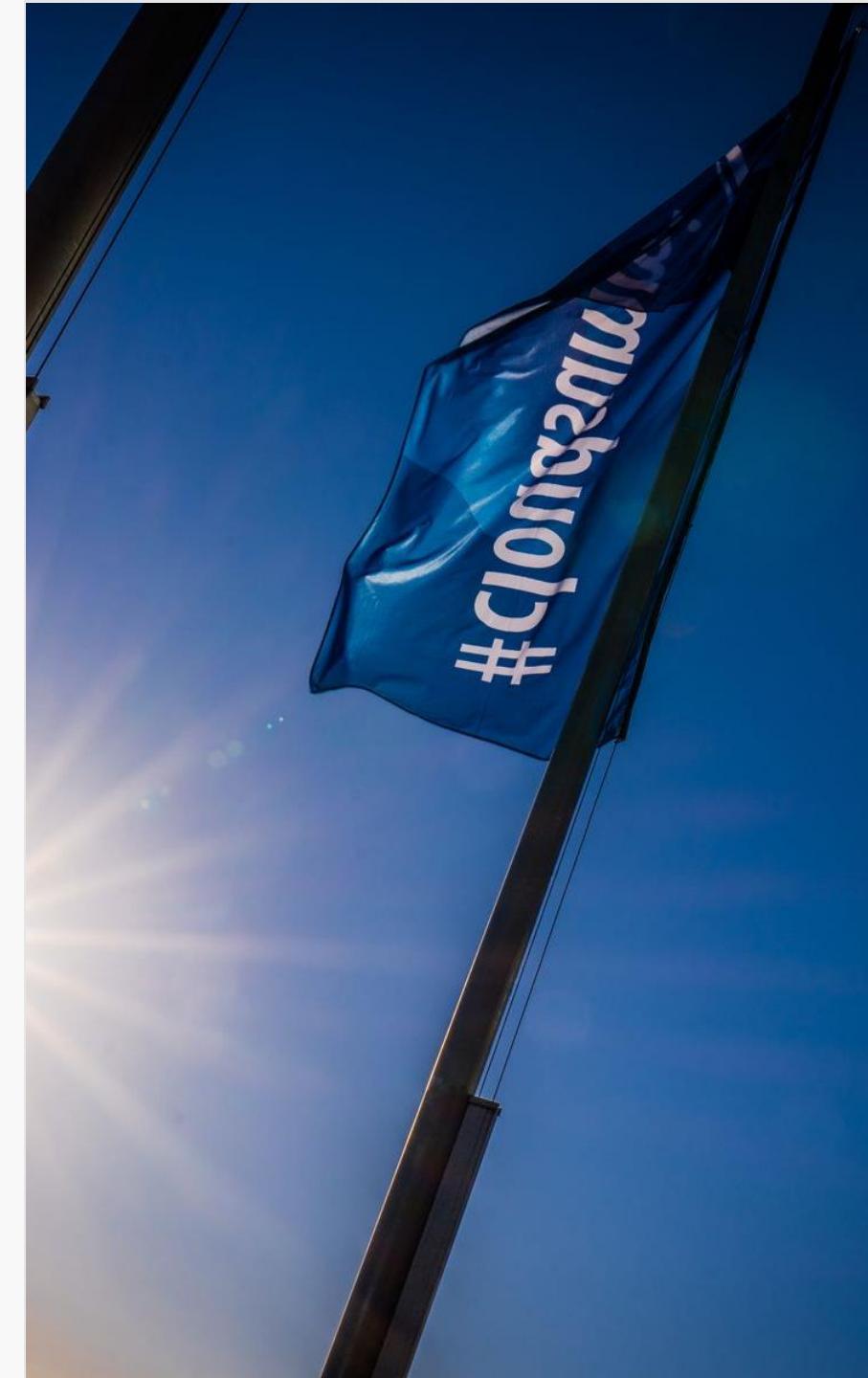
CoreView

dox42

EasyLife 365

resco

veeam

adesso business. people. technology.

Allied Global

ASCENT

BCC

DE CIX

devoteam

empowerID

FPT Software

glueck kanja

Jabra GN

kaspersky

LightningTools

nintex

Rencore

ShareGate:

Spot by NetApp

SysCloud

Syskit

WEBCON LOW-CODE, BUT BETTER.

Use ECS Coins for Swag!

Top 3 win an Atari 2600+

1 Get the app

2 Visit sessions and sponsors, rate sessions

**3** Earn ECS Coins

4 Spend ECS Coins

csmmt.eu/app

ATARI 2600+

run.events

The Journey from Physical Machine to Azure Virtual Desktop and Cloud PC

On-Prem Windows
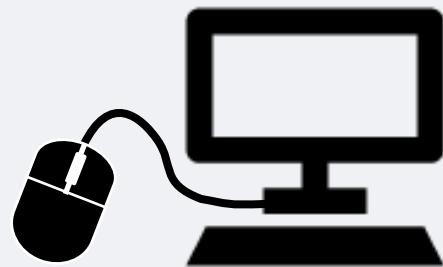
VDI / RDSH on LAN

AVD / Win365

EUROPEAN CLOUD SUMMIT

Transmit Screen Data

Decode

Capture/ Encode

Connect

Display

Render

Interact

Process

Remoting Client

GPU

Transmit Mouse Data

Remoting Host

GPU
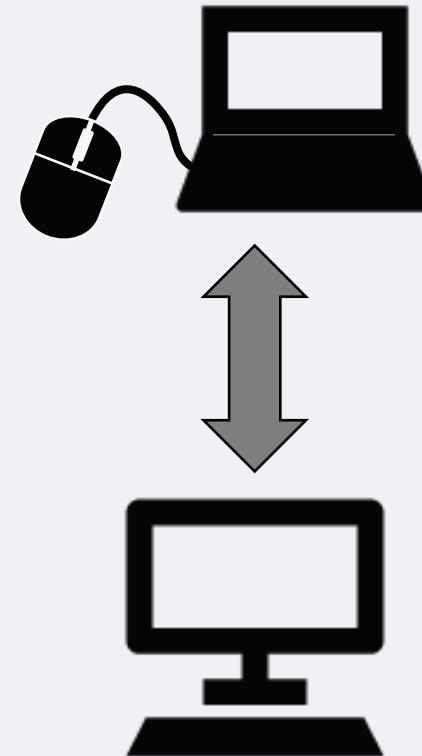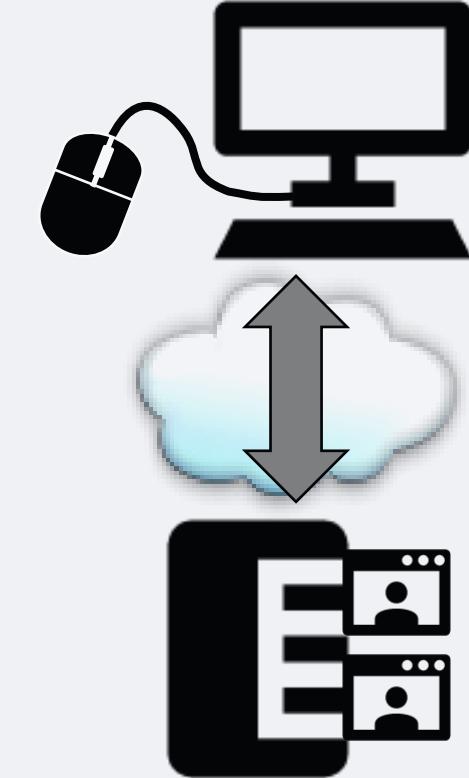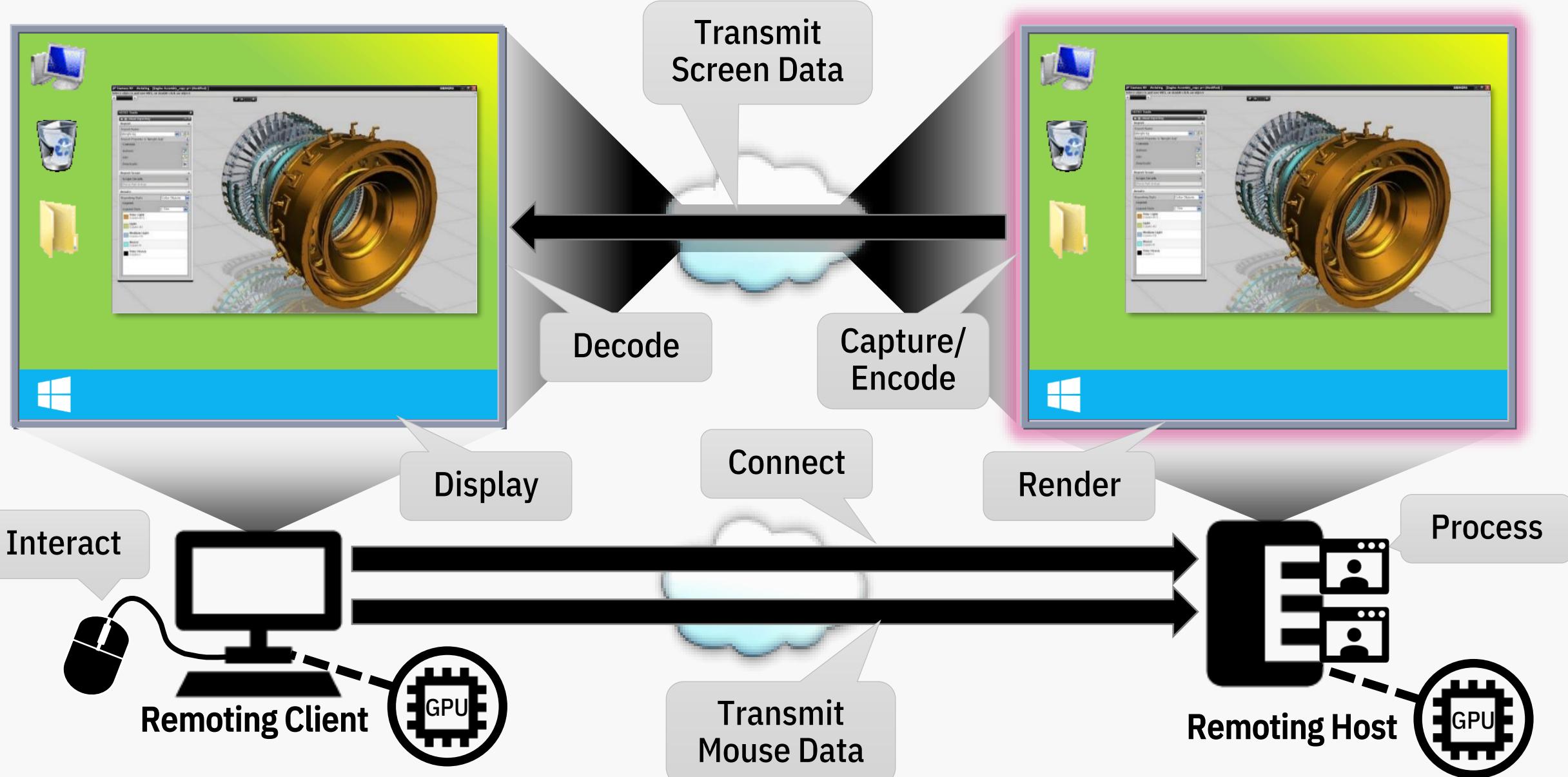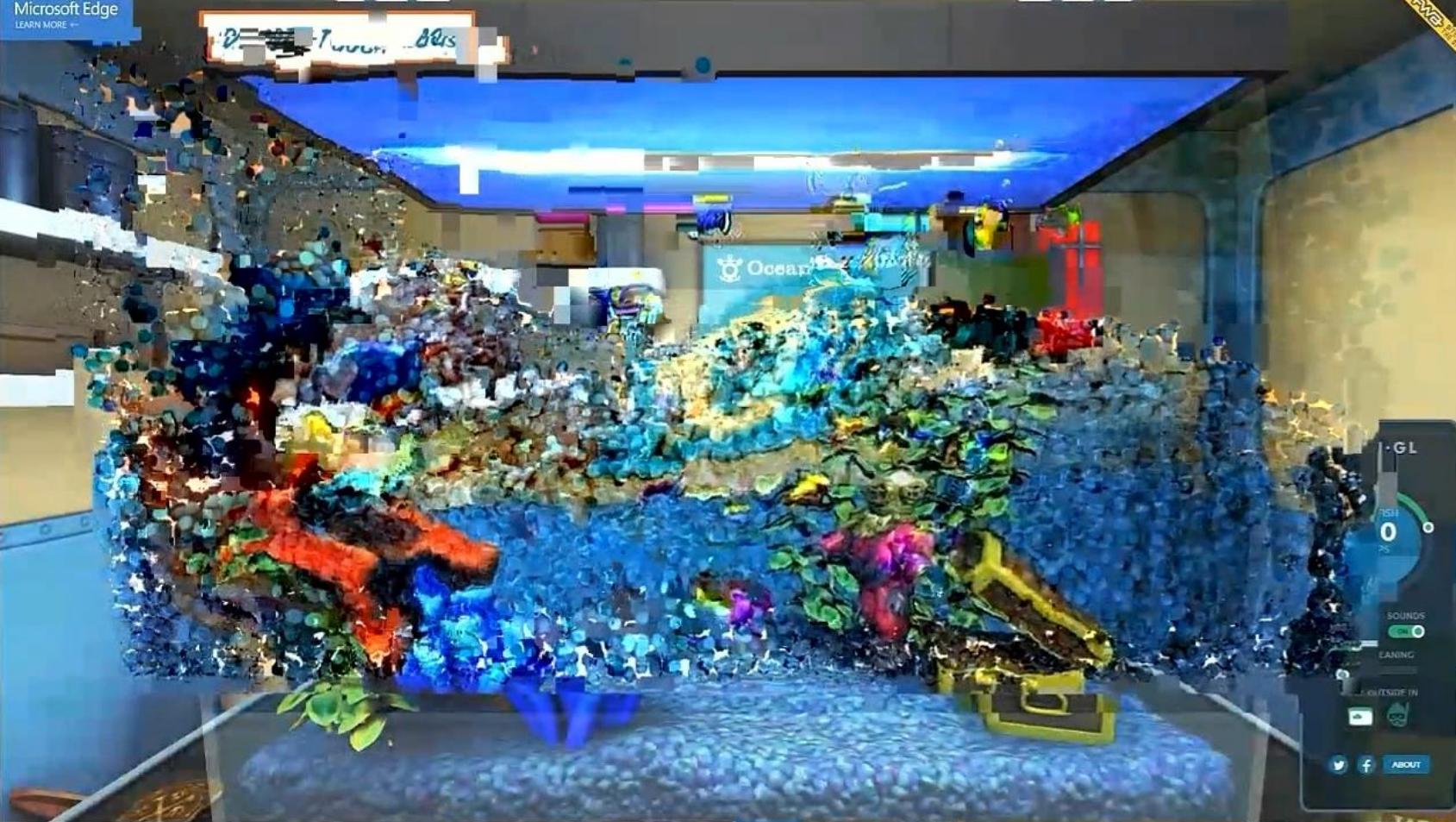
From a User's Perspective: (Remote) Windows Desktop Quality Criteria - #DEX4DaaS

	Criteria	Description
	Boot and logon duration	Measure boot time + logon time + user session load time until it is ready for user interaction. This includes identity management and authentication methods.
	Application and content load time	Measure time from user starting an application until the content appears and the application is ready for user input, including access to the storage system.
	User input delay ("Lag")	Measures responsiveness of graphical elements after user-initiated triggers = "time from mouse click to screen update" (lag, latency, system response time).
	Graphics APIs supported	Detect incompatibilities when running graphics applications using the DirectX, OpenGL, Vulkan and WebGL APIs.
	Media formats supported	Detect incompatibilities when opening media files, such as MP4, MPEG, MOV, WMV or AVI.
	Distortion of media	Measure media and screen output quality. Detect image, animation, and audio/video compression and decompression artifacts and anomalies.
	Screen refresh rate	Measure the number of times per second that the desktop or application can draw consecutive images on the screen and in the host frame buffer (frames per sec = fps).
	Endpoint specs and quality	Determine the screens' number of pixels, density, and visual dimensions – frame buffer requirements grow with resolution and screen number. Detect periphery incompatibilities.
	Application reliability and stability	Detect application hangs, freezes, crashes or unhandled exceptions. Measure consistency, dependability and robustness of applications.
	Session consistency and resilience	Check if user state is preserved across subsequent sessions. Measure session disruptions, hangs, disconnects/reconnects, availability, timeouts and redundancy.

Science of End User Computing: Performance Influencers

"Remoting Protocol Stack"
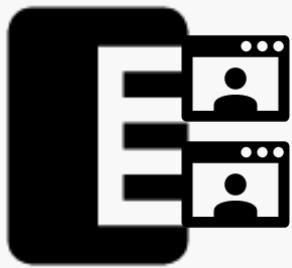
**Host System
"VM Type"**

**Client Device
"Endpoint"**
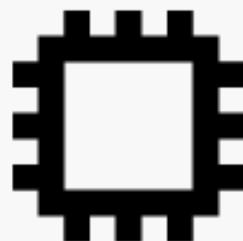
GPUs

Network

DEX4DaaS – Simulate and Benchmark

Build a Test Lab with EUC Score, a benchmarking toolset that is **free** for the EUC community

Primary Device

Video Recorder

"Click-to-Photon" Device

OBS Studio

Primary User

Screen Capture Device

.mp4

Playbooks

Bandwidth Latency Packet Loss

WAN Emulator

Simulated Workloads "Simloads"

Avatar with Telemetry Collector

Simload Runner

No admin privileges

EUC Score

.ref .csv

System Under Test (SUT)

EUC Score

EUROPEAN CLOUD SUMMIT
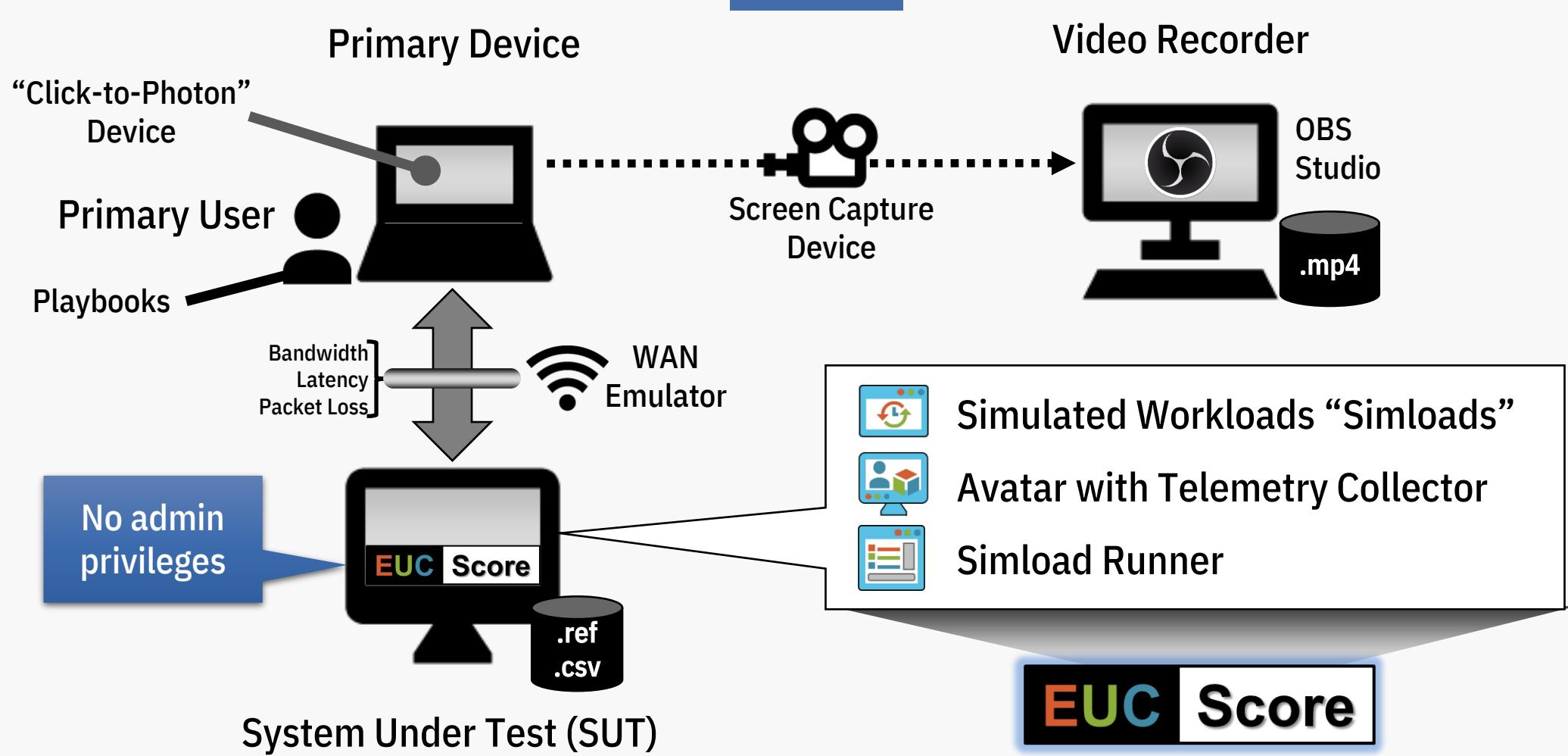
Visual Data Analytics – Sync Player

Title

Specs Button

Maximize Button

Primary User Endpoint

User Experience

Remoting Protocol

System Under Test

Telemetry Data User Activities

SL1-ChromeWaterWebGL on Azure AVD NV6 | IGEL UD3 | RDP UDP (15ms RTT)

Screen Video

System Under Test:
Azure West Europe, AVD NV6 VM, Windows 10 Enterprise for Virtual Desktops, Intel Xeon E5-2690 v3 6vCPUs @ 2.60GHz, 56GB RAM, Virtual HD ATA Device 340GB, NVIDIA M60 GPU (1/2 Card), 8GB VRAM
Connection:
EDIT PROTOCOL AND NETWORK CONDITIONS
Endpoint:
IGEL UD3 (M350C / LX-60) with IGEL OS 11.08.230, AMD Ryzen Embedded R1505G Dual-Core @ 2.0 - 2.7GHz, 4GB DDR4 RAM, 8GB eMMC, AMD Radeon Vega 3 GPU with 512MB shared memory

SL1-ChromeWaterWebGL on Azure AVD NV6 | IGEL UD3 | RDP UDP (15ms RTT)

00:00:01.000 Date: 2023/01/26 Time: 13:15:14.568 AppName: chrome.exe
00:00:03.776 App launch time: 1536 ms
00:00:04.028 Run action initiated
00:00:09.030 Press G key

Activities

CPU|%

Memory|MBytes

Network Received|KBytes/sec

Network Sent|KBytes/sec

Telemetry Charts

GPU 3D|%

GPU Video Decode|%

GPU Video Processing|%

GPU Memory|MBytes

00:00:38   00:00:45   Help   ⊙ Report

Timeline and Video Controls

EUC Score

Report Button

EUROPEAN CLOUD SUMMIT

Azure VM Types under Test without GPU

Instance	CPU	CPU Base Clock Speed	Max CPU Speed - single-core	vCPUs	RAM	Storage Type	Storage Size	Display	OS
Microsoft Azure									
Azure D2s_v3	Intel Xeon 8272 - Cascade Lake	2.6 GHz	3.7 GHz	2	8 GB	Premium SSD	256GB	FHD	Win10 22H2
Azure D4s_v3	Intel Xeon 8272 - Cascade Lake	2.6 GHz	3.7 GHz	4	16 GB	Premium SSD	256GB	FHD	Win10 22H2
Azure D2s_v5	Intel Xeon 8370C - IceLake	2.8 GHz	3.5 GHz	2	8 GB	Premium SSD	256GB	FHD	Win10 22H2
Azure D2s_v5	Intel Xeon 8370C - IceLake	2.8 GHz	3.5 GHz	2	8 GB	Standard SSD	256GB	FHD	Win10 22H2
Azure D4s_v5	Intel Xeon 8370C - IceLake	2.8 GHz	3.5 GHz	4	16 GB	Premium SSD	256GB	FHD	Win10 22H2
Azure D4s_v5	Intel Xeon 8370C - IceLake	2.8 GHz	3.5 GHz	4	16 GB	Standard SSD	256GB	FHD	Win10 22H2
Win356 Business	AMD EPYC 7763 - Milan	2.45 GHz	3.4 GHz	2	8 GB	HDD	128GB	FHD	Win11 22H2
Azure D8ads_v5	AMD EPYC 7763 - Milan	2.45 GHz	3.4 GHz	8	32 GB	Premium SSD	256GB	FHD	Win11 22H2

SUT: Windows 365 Business "Entry Level", 2 vCPUs, 8GB RAM, 128 GB Storage, $45.00 per user per month (= $0.061/hour)
Alternative: 4 vCPUs, 16GB RAM, 128 GB Storage, $70.00 per user per month (= $0.095/hour)

EUROPEAN CLOUD SUMMIT

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

We've learned a lot about DEX4DaaS

But there is more…
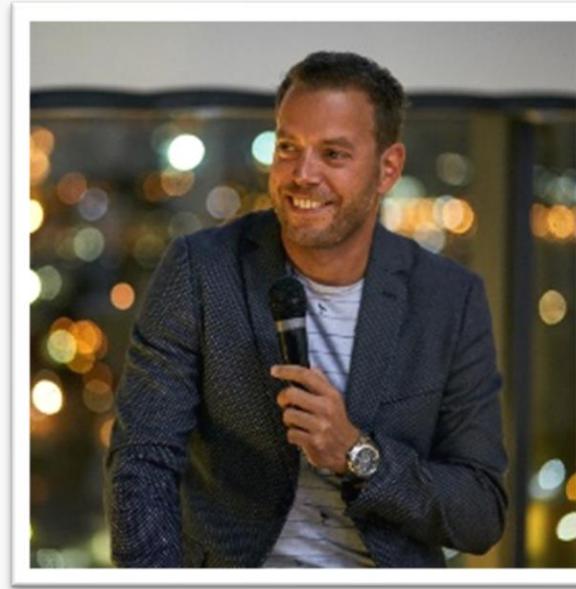
Thank you to fellow MVP Ruben Spruijt for running so
many of the time-consuming tests and sharing the results

And a big thank you goes to Dizzion-Frame for providing
Azure Virtual Machine resources

EUROPEAN CLOUD SUMMIT

Test Apps
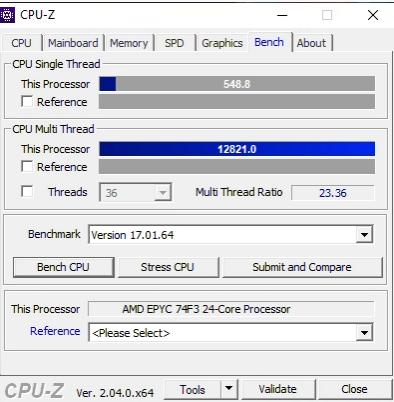
GPU-Z
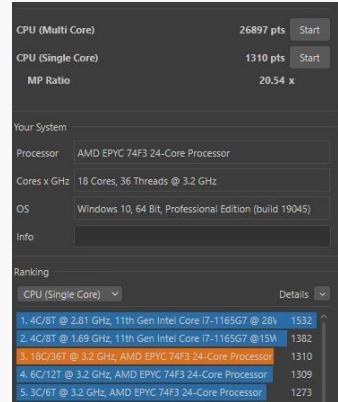
CineBench
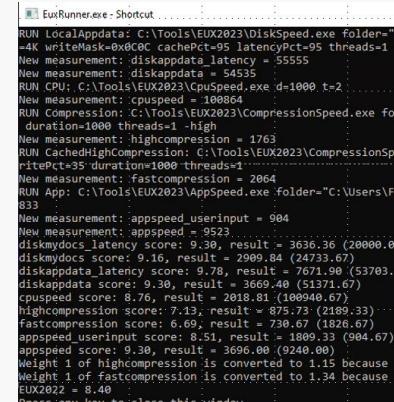
Login Enterprise EUX Score
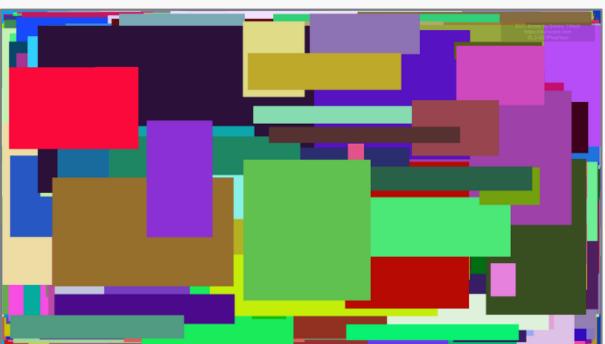
EUC Score – Score Simloads

Blender

SPECviewperf

AVD CPU Instances – Performance & Costs

European Cloud Summit

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		CPUZ Perf /Price	EUC Score GDI+ /Price	EUX Score /Price
	better▶	better▶	better▶	better▶	better▶	◀better	◀better	◀better	◀better	◀better	◀better						
Microsoft Azure																	
Azure D2s_v3 - Premium SSD	241.1	427.2	489	N/A	7.37	0.54	0.72	5.68	9.52	6.44	7.82		0.21		1837	34.35	35.10
Azure D4s_v3 - Premium SSD	250.7	817.2	1308	659	7.85	0.31	0.69	3.27	5.57	3.28	6.4		0.42		1886	9.62	18.69
Azure D2s_v5 - Premium SSD	323.4	545.4	1284	N/A	8.23	0.35	0.63	3.12	5.51	3.58	7.62		0.20		3588	20.35	41.15
Azure D2s_v5 - Standard SSD	308.9	570	1216	N/A	7.38	0.33	0.67	3.36	5.06	3.28	10.96		0.20		3492	19.50	36.90
Azure D4s_v5 - Premium SSD	410	1101	2724	1055	8.03	0.3	0.61	1.83	3.31	1.36	6.64		0.41		3443	5.28	19.59
Azure D4s_v5 - Standard SSD	390	1092	2521	960	6.87	0.29	0.59	2.02	3.33	1.55	9.03		0.41		3254	5.61	16.76

Price in US$/hour (global average)   Quantitative results, no exact science

Powered by ◇ FRAME

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

Price in US$/hour (global average)   Quantitative results, no exact science   Powered by ◈ FRAME

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

https://develop3d.com/workstations/summer-2023-workstation-special-report/, from page 30

High-End Graphics Benchmarks

- Unreal Engine
- Autodesk Inventor – InvMark
- Autodesk VRED
- KeyShot
- Enscape 3D
- Chaos V-Ray

Autodesk VRED

KeyShot

Enscape
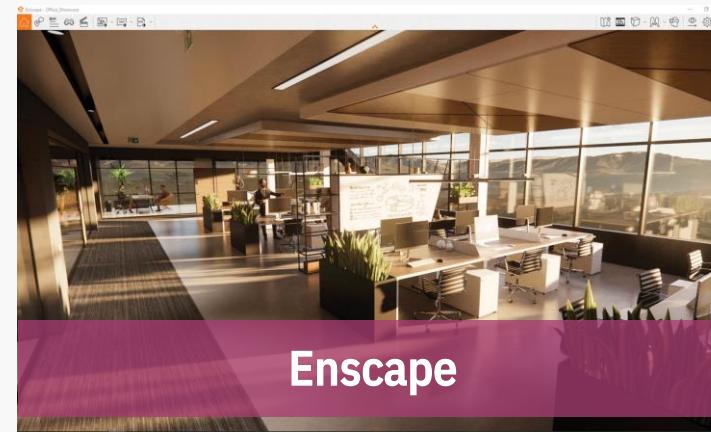
V-Ray

Unreal Engine

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	37.7	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

Price in US$/hour (global average)   Quantitative results, no exact science   Powered by FRAME

Science of End User Computing: Personas

	Persona Name	Rendering	IT Workforce	Description
	Task Worker	CPU	25-80%	Windows 365 Entry-Level (2 vCPUs, 4GB RAM)
	Information Worker	CPU or shared GPU	25-80%	AVD VM with CPU only or with shared GPU
	Knowledge Worker	High-end CPU or shared GPU	10-50% ~400m	
	Power User	Shared GPU or dedicated GPU	5-50% ~200m	AVD VM with dedicated GPU
	CAD/CAM Professional Designer	Dedicated GPU	5-25% ~25m	

AVD Findings

- Windows 365 Cloud PC "Entry Level" performs better than expected – it's ideal for Task Worker and Information Worker workloads at a 24/7 price that is hard to beat (< $0.07/hour)

- Use Azure v5 VM types instead of v3 – 25% better performance and sightly lower price

- The Azure D4s_v5 and D8ads_v5 VM types are my personal favorites for single-session scenarios

- Azure NVv4 VMs do not provide great performance, despite the AMD M25 GPU – low 3D performance, no video encoding / no hardware encoding exposed

- Azure NV4v4 is limited in fps (18 is max) and it may fall behind CPU-only VM types

- Azure NC8asT4 – if you don't need the vCPUs or RAM, then go for the NC4asT4 – same GPU; SPEC performance almost the same, but 30% cheaper

- Azure NV6adsA10 provides more CPU and RAM at the same price as the NC4asT4; But NC4asT4 provides much better GPU performance because of full GPU vs GPU partition

- CAUTION: NCasT4 VM types with missing certification for CAD applications may be a deal breaker

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 1 to 2 years behind and CPUs have a lower clock speed

- Only very few people need an extreme high-end workstation (CAD/CAM pros 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 in Azure is a massive challenge!!!

- If the network conditions are bad (<12mbps, >20ms latency, >1% packet loss) even the best GPU-accelerated Azure VM cannot deliver adequate user experience

EUC Score Links – From the Community for the Community

- Home Page: https://eucscore.com/

- Test Results (Sync Player): https://eucscore.com/results

- Test Methodology: https://eucscore.com/methodology.html

- Toolset Documentation: https://eucscore.com/docs/index.html

- Simload Gallery: https://eucscore.com/gallery.html

- Terminology (Glossary): https://eucscore.com/terminology.html

- Lab Equipment: https://eucscore.com/equipment.html

- Blog Articles: https://drtritsch.com/articles.html

info@eucscore.com

EUC Score

#DEX4DaaS

The EUC Score toolset is free for community benchmarking tests when the results are made freely available to the public

THANK YOU,
YOU ARE AWESOME ❤️

PLEASE RATE THIS SESSION IN THE MOBILE APP.

info@drtritsch.com | info@eucscore.com
drtritsch.com | eucscore.com
linkedin.com/in/drtritsch