1000+ Test Runs Benchmarking Cloud PC User Experience

Dr. Benny Tritsch

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

Ruben Spruijt

ruben@rspruijt.com
linkedin.com/in/rspruijt


COBR
M

Thank you to all our SPONSORS!

End User Computing Tech

Table of Content

1000+ Community Test Runs

Individual Test Runs

Microsoft Windows 365 | 4 AMD vCPUs [123 test runs]
Microsoft Windows 365 | 8 INTEL vCPUs [117 test runs]
Azure D8ads v7 | AVD | 8 AMD vCPUs | OS Optimizers [108 test runs]
Azure D8s v5 | Windows 11 Cloud PC | 8 INTEL vCPUs [168 test runs]
Azure D2s v5 | Citrix CVAD | 2 INTEL vCPUs | HDX Superresolution [56 test runs]
Citrix for Windows 365 | 8 INTEL vCPUs [181 test runs]
Azure D8s v5 | Citrix CVAD | 8 INTEL vCPUs [167 test runs]
Omnissa Horizon with Windows 365 | 8 INTEL vCPUs [110 test runs]
Azure D4s v5 | Dizzion Cloud Desktop | 4 INTEL vCPUs [30 test runs]
Azure D8s v5 | Dizzion Cloud Desktop | 8 INTEL vCPUs [225 test runs]
Azure D8s v5 | HP Anyware | 8 INTEL vCPUs [96 test runs]

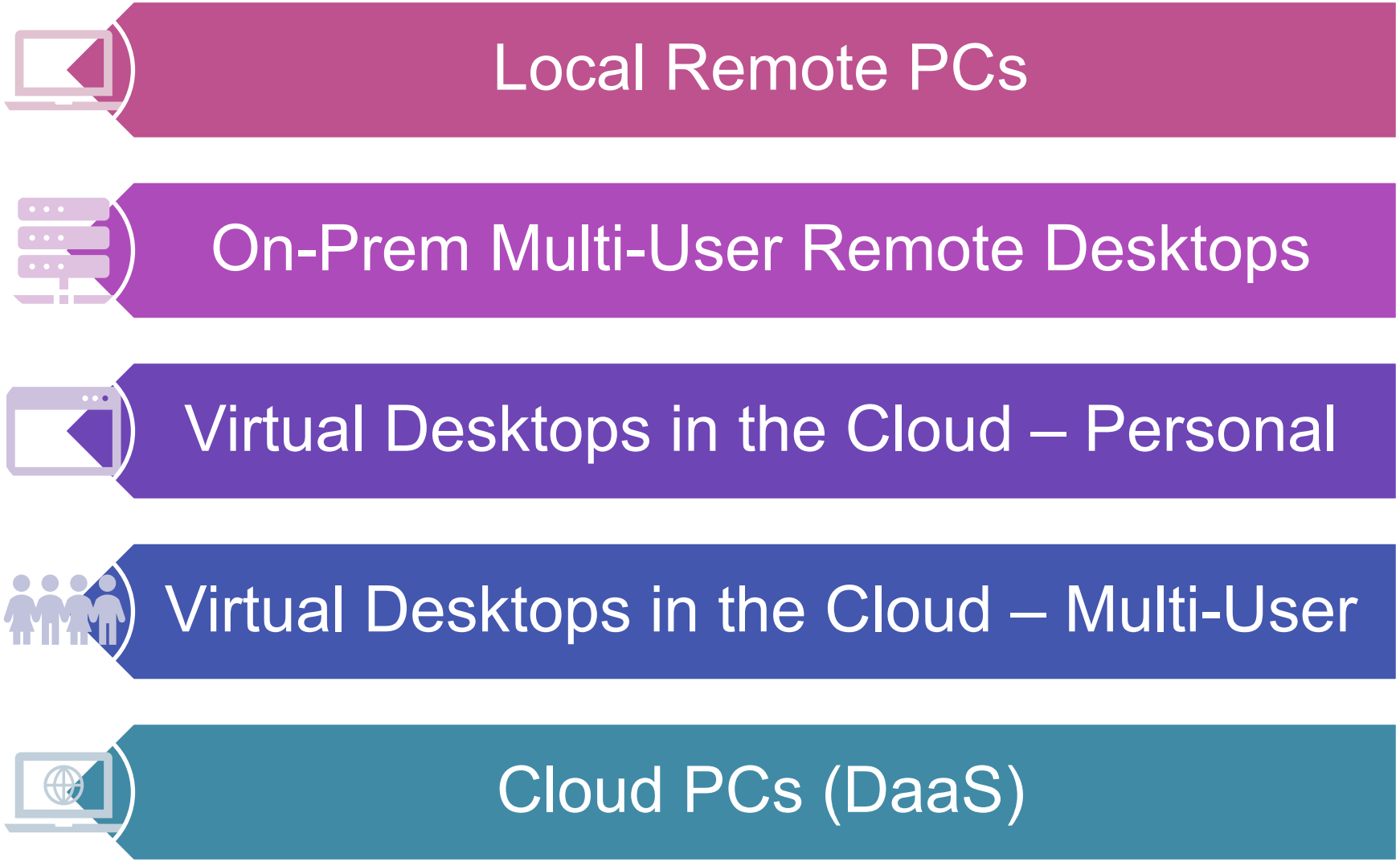
Azure NV6adsA10 | AVD | 6 AMD vCPUs | A10-4Q [157 test runs]
Azure NV6adsA10 | Citrix on AVD | 6 AMD vCPUs | A10-4Q [119 test runs]
Azure NV6adsA10 | Omnissa on AVD | 6 AMD vCPUs | A10-4Q [275 test runs]
Azure NV6adsA10 | HP Anyware | 6 AMD vCPUs | A10-4Q [128 test runs]
Windows 365 GPU Standard | 12 AMD vCPUs | A10-8Q GPU [32 test runs]
Windows 365 GPU Super | 18 AMD vCPUs | A10-12Q GPU [147 test runs]

Comparisons

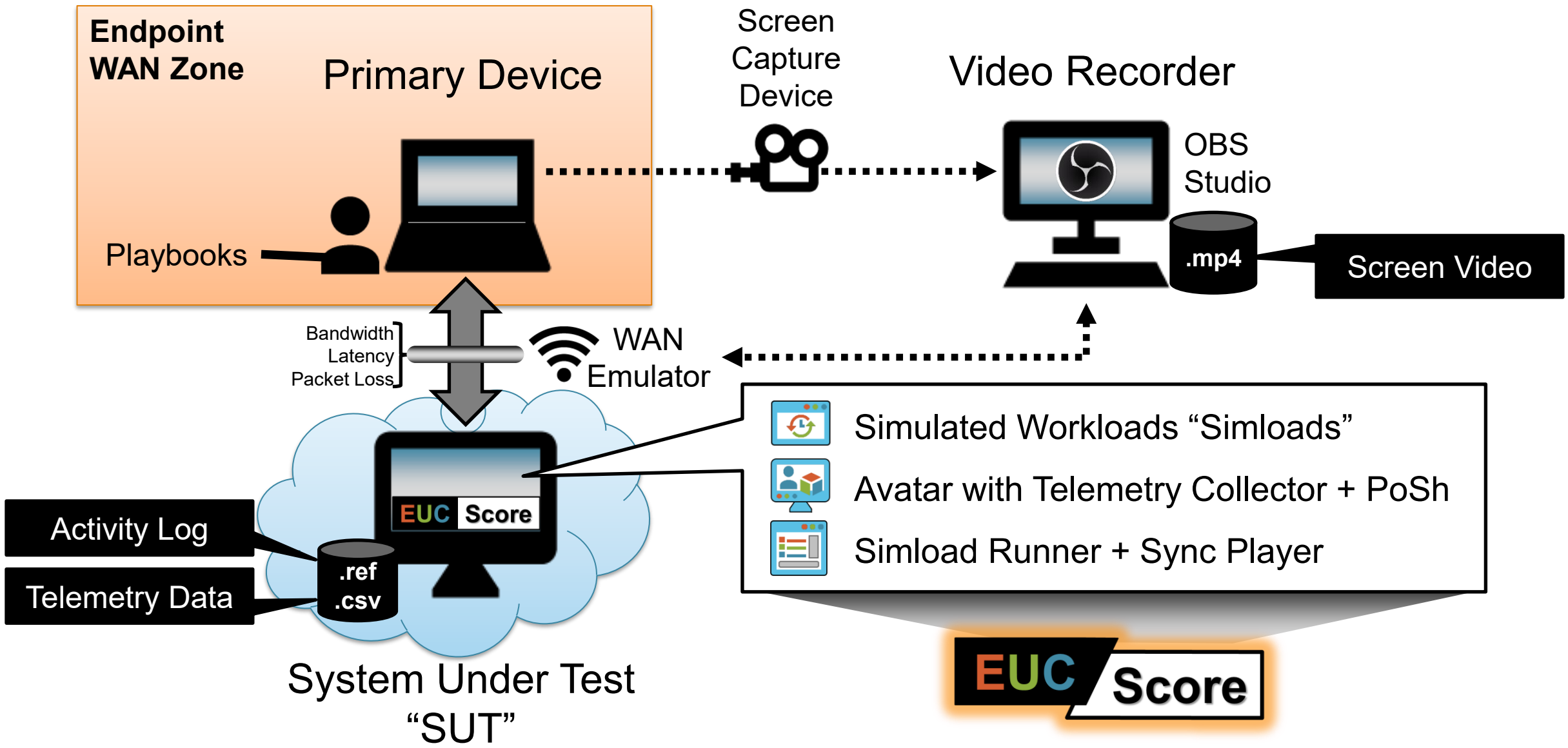
SxS RDP on Win365 under different network conditions | 8 vCPUs [87 comparisons]
SxS RDP on D8adsv7 with different OS optimizers | 8 vCPUs [81 comparisons]
HDX on Win365 under different network conditions | 8 vCPUs [152 comparisons]
HDX on D8sv5 versus HDX on Citrix for Windows 365 | 8 vCPUs [167 comparisons]
HDX on D2sv5 versus HDX Superresolution on D2sv5 | 2 vCPUs [27 comparisons]
HDX on D8sv5 versus SxS RDP on Win365 | 8 vCPUs [98 comparisons]
HDX on D8sv5 versus Classic RDP on D8sv5 | 8 vCPUs [167 comparisons]
Blast on Win365 versus SxS RDP on Win365 | 8 vCPUs [110 comparisons]
FRP on D8sv5 under different network and infra conditions | 8 vCPUs [225 comparisons]
FRP on D8sv5 versus HDX on D8sv5 | 8 vCPUs [168 comparisons]
FRP on D8sv5 versus Classic RDP on D8sv5 | 8 vCPUs [168 comparisons]
PCoIP on D8sv5 under different network conditions | 8 vCPUs [72 comparisons]
PCoIP on D8sv5 versus SxS RDP on Win365 | 8 vCPUs [80 comparisons]

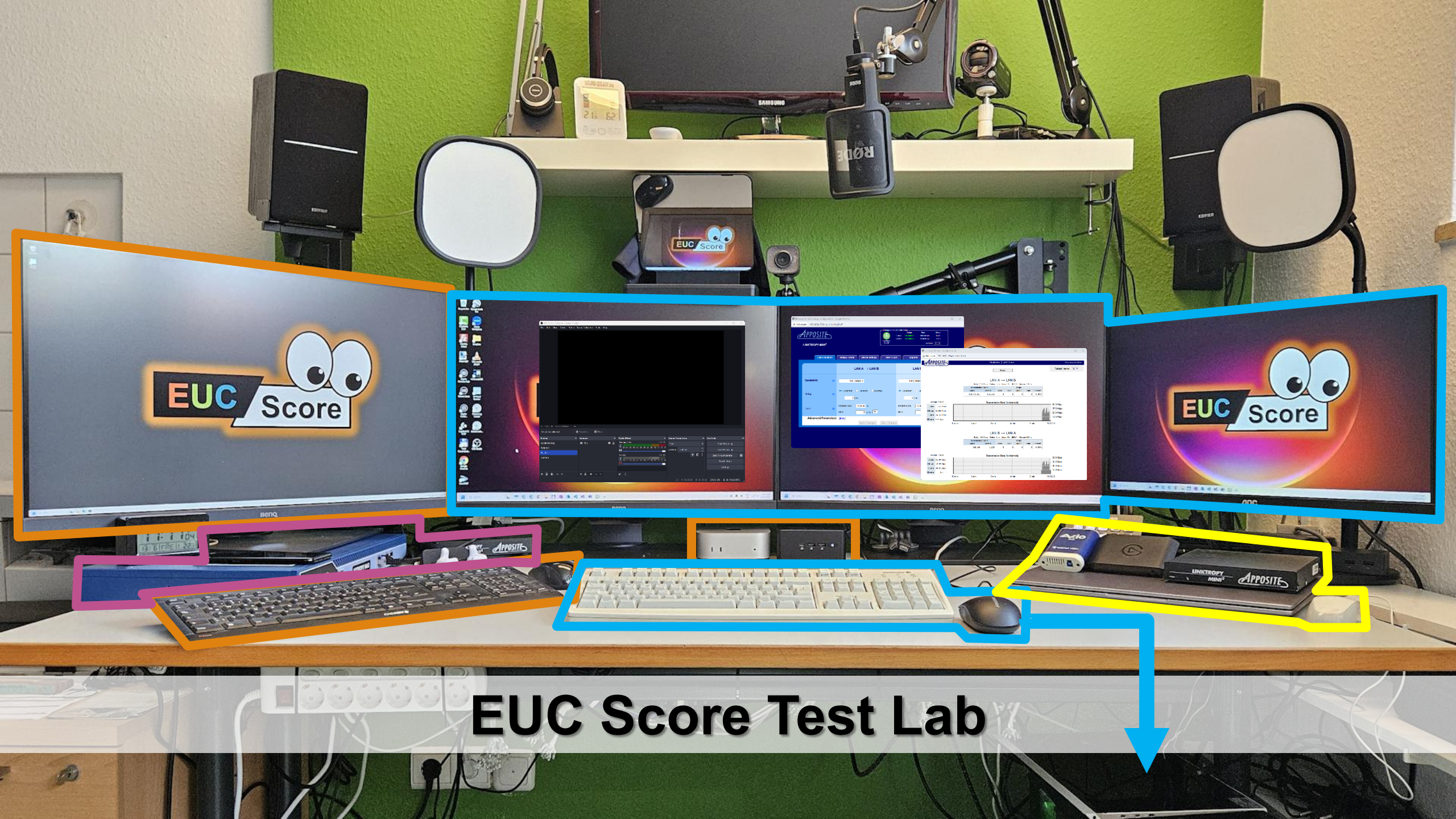
SxS RDP on NV6adsA10 under different network conditions | 6 vCPUs | A10-4Q [114]
HDX on NV6adsA10 under different network conditions | 6 vCPUs | A10-4Q [114]
HDX on NV6adsA10 versus SxS RDP on NV6adsA10 | 6 vCPUs | A10-4Q [157]
Blast on NV6adsA10 under different network conditions | 6 vCPUs | A10-4Q [232]
Blast on NV6adsA10 versus SxS RDP on NV6adsA10 | 6 vCPUs | A10-4Q [156]
PCoIP on NV6adsA10 under different network conditions | 6 vCPUs | A10-4Q [92]
PCoIP on NV6adsA10 versus SxS RDP on NV6adsA10 | 6 vCPUs | A10-4Q [128]
SxS RDP on Win365 GPU Super under diff. network conditions | 18 vCPUs | A10-12Q [86]

Remote Windows Desktop Categories

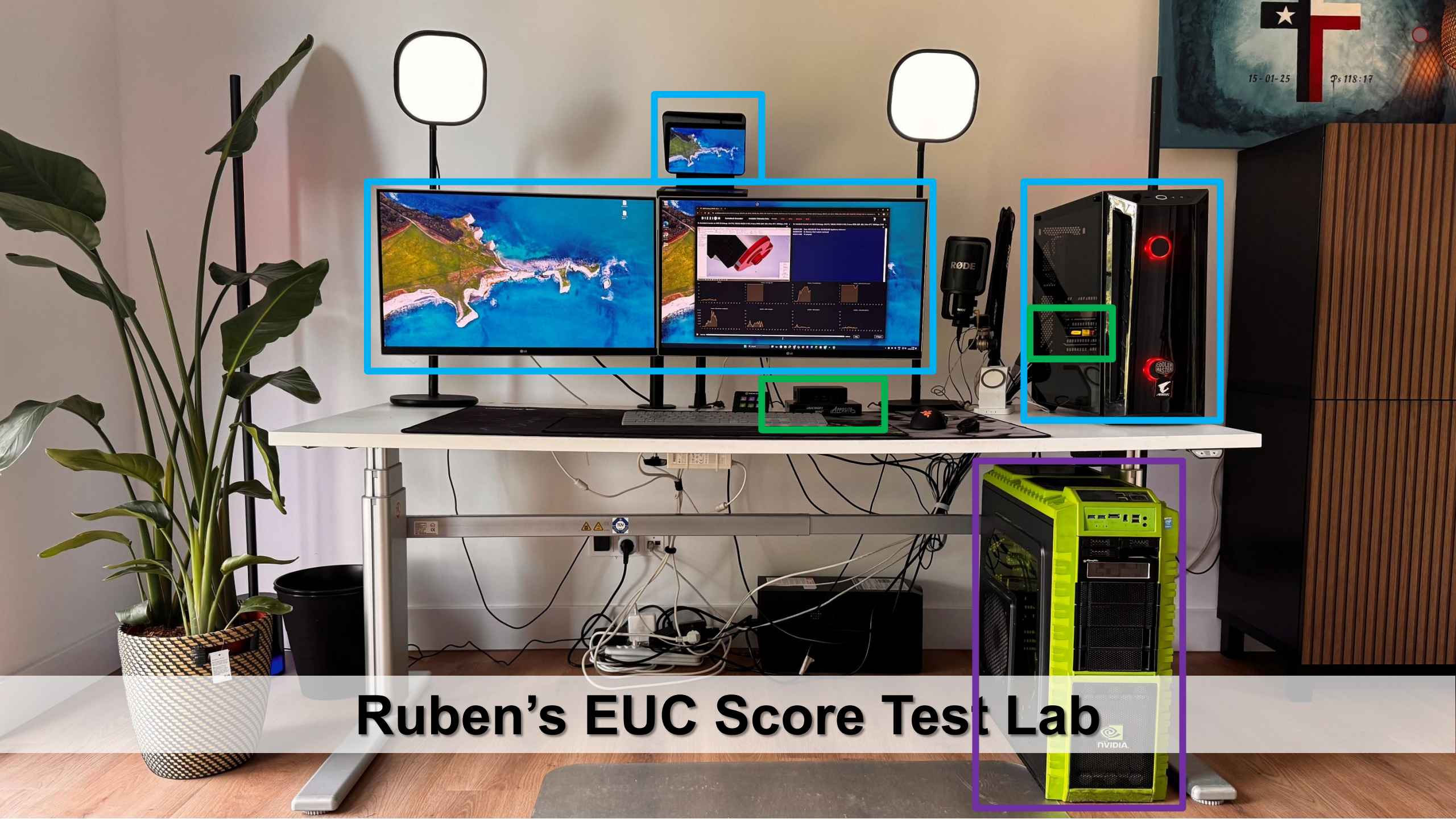


Cloud PC Test Lab





EUC Score Test Lab



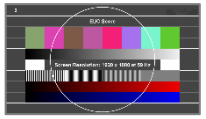
Ruben’s EUC Score Test Lab

WAN Emulator Network Profiles

Name	Bandwidth Limit	Round Trip Time	Packet Loss
Baseline (Unconstrained)	100 Mbit/s	10 milliseconds	0% (0.01%)
High packet loss	100 Mbit/s	10 milliseconds	**2%**
High round trip time	100 Mbit/s	**110 milliseconds**	0%
Low bandwidth	**8 Mbit/s**	10 milliseconds	0%
Very high packet loss	100 Mbit/s	10 milliseconds	**5%**
Very high round trip time	100 Mbit/s	**310 milliseconds**	0%
Very low bandwidth	**2 Mbit/s**	10 milliseconds	0%

Simulated Workloads (GPU not required)

Simple / Continuous



TestScreen
System info

NotepadEdit
Simple typing

NotepadMove
Moving app window

WordpadScroll
Office app scrolling

MSEdgeHtmlScroll
HTML doc scrolling

JPEGViewAnim
Simple animation

MSEdgeMonsterHTML5
Simple HTML5 app

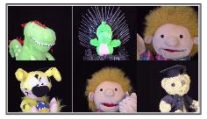
Videos / HTML5

WMPlayer480MP4
480p MP4 video

WMPlayer720MP4
720p MP4 video

WMPlayer180MP4
1080p MP4 video

MSEdgeVideoConf4
4 separate videos



MSEdgeVideoConf6
6 separate videos

MSEdgeVideoGrid9
9 separate videos

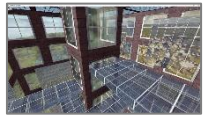
MSEdgeFishbowlHTML5
HTML5 app

Animations

MSEdgeGifScroll1 / 2
Medium animation

MSEdgePhotoGalleryJS
JPG photo gallery

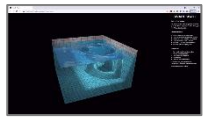
RollercoasterDX9
Medium DirectX 9 app



BSPBlendingDX11
Demanding DirectX 11 app

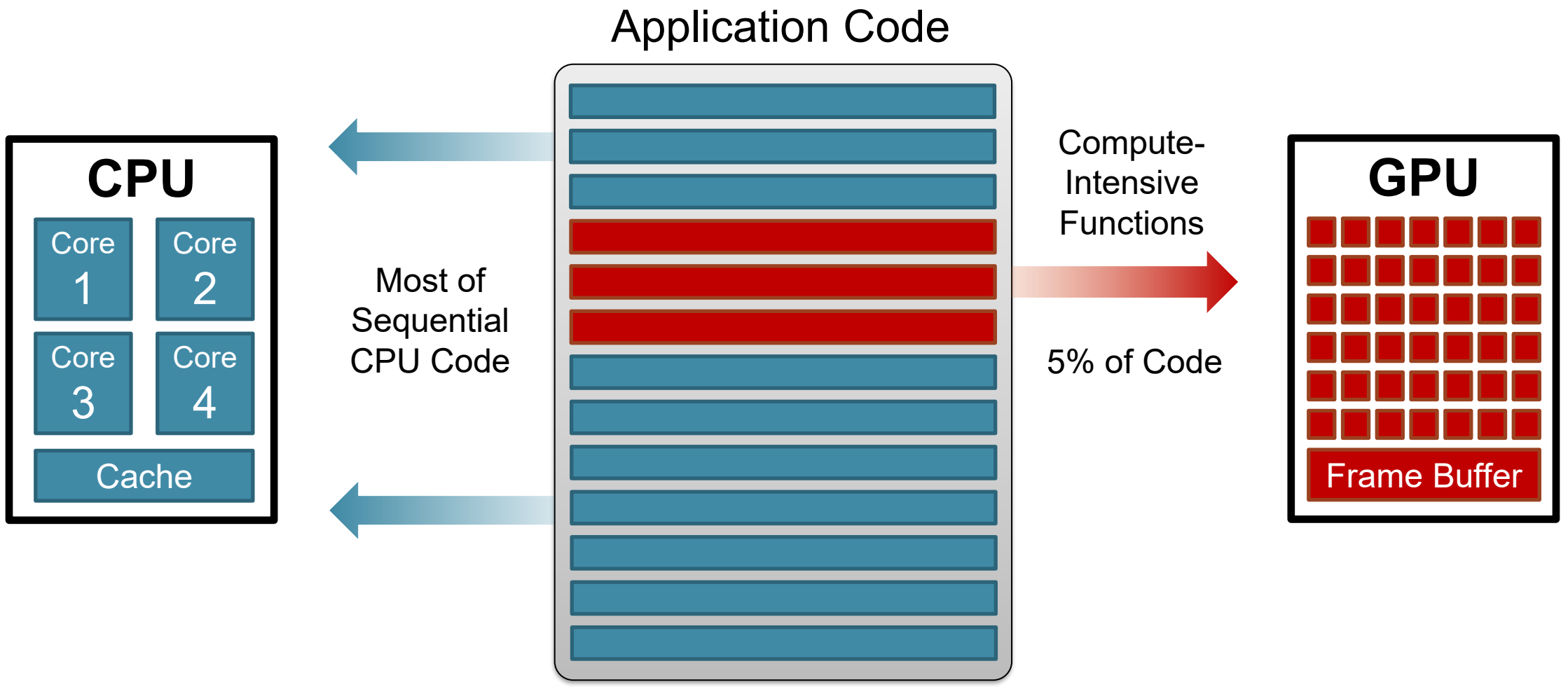
MSEdgeCarVisualizer
Demanding WebGL app

MSEdgeAquariumWebGL
Demanding WebGL app



MSEdgeWaterWebGL
Demanding WebGL app

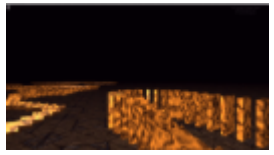
The Benefit of GPUs



Simulated Workloads (GPU required)

Humus / Maxon / Google

ClothOpenGL
Humus



DominoOpenGL
Humus

ShadingDX11
Humus

CinebenchOpenGL
Maxon

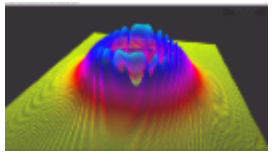
GoogleEarthDX9
Google

Geeks3D

FurMarkOpenGL
Geeks3D GpuTest

GiMarkOpenGL
Geeks3D GpuTest

PixMarkOpenGL
Geeks3D GpuTest



Plot3dOpenGL
Geeks3D GpuTest

TessMarkOpenGL
Geeks3D GpuTest

Score Simloads

Windows / Storage

AppDialog
Windows Dialog

AppStart
Windows App Start

IOPS
Storage Perf Test

UserProfileLarge
Storage Perf Test

UserProfileSmall
Storage Perf Test

GDI / GDI+

GDIPlusGraphics
GDI+ Perf Test

GDIPlusRect
GDI+ Perf Test

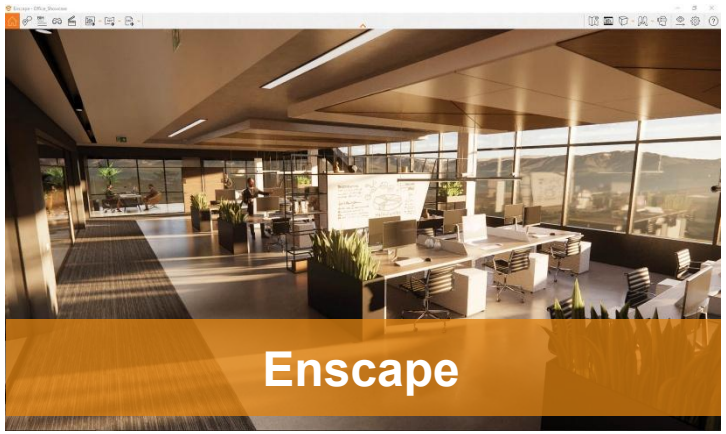
WhiteNoise
GDI Perf Test

FractalsDragon
GDI+ Perf Test

FractalsPythagoras
GDI+ Perf Test

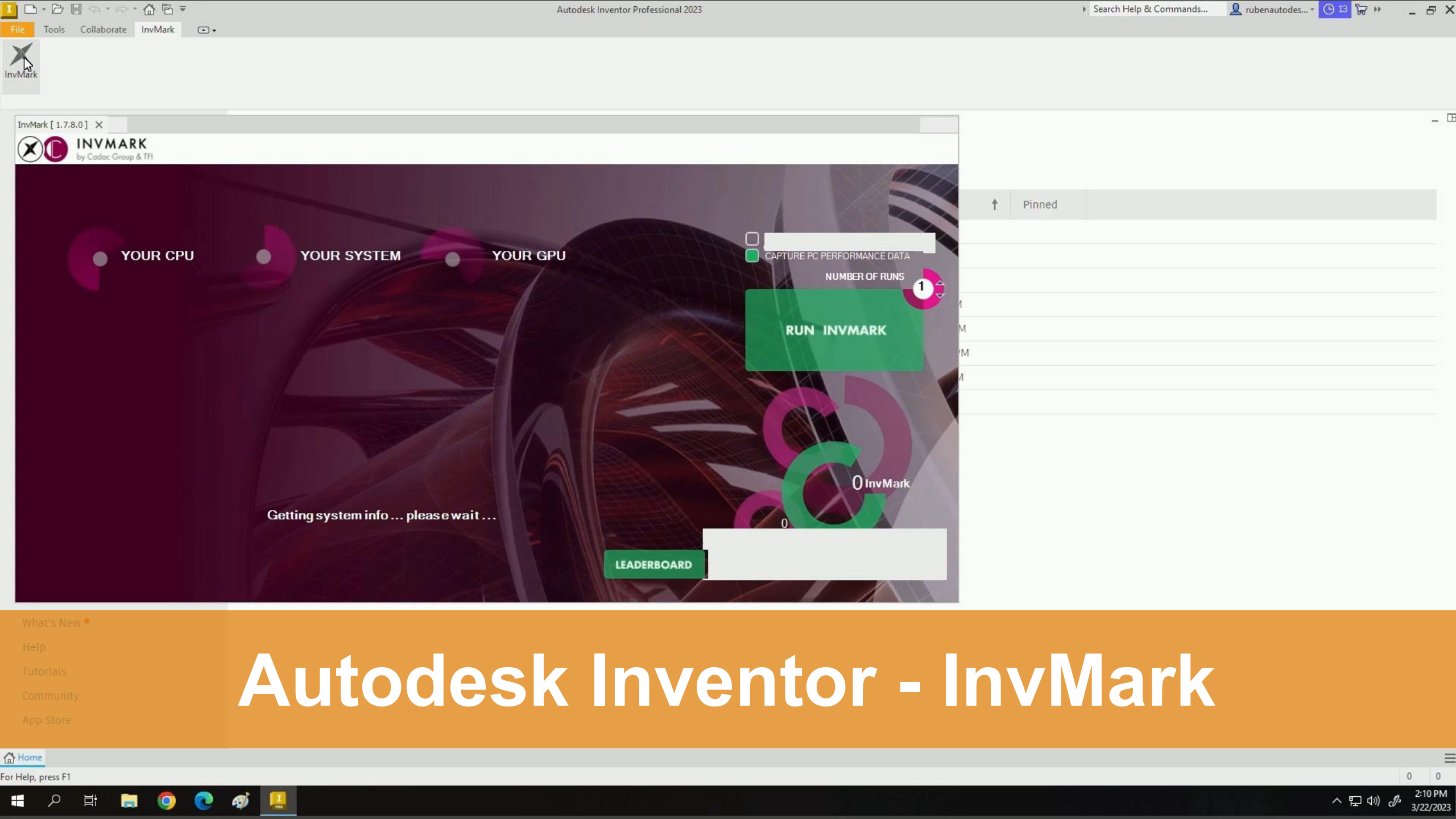
Playbooks: High-End Graphics Benchmarks

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



Test Details: https://ux.dizzion.com/


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

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

Azure VM 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

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

SPECviewperf

BennyTritsh_Germany - BennyTritshger...

SPECviewperf- CREO

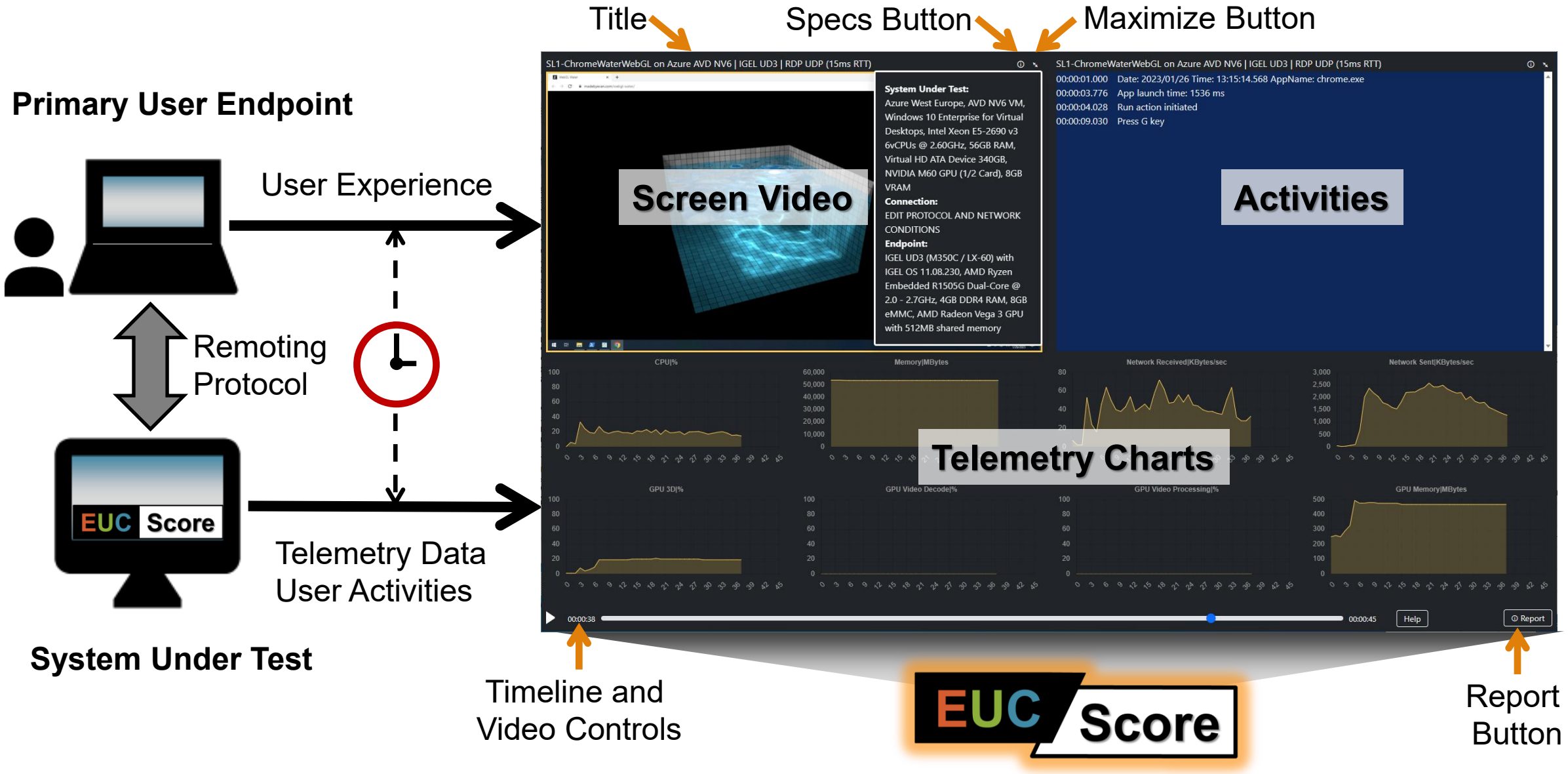
Search

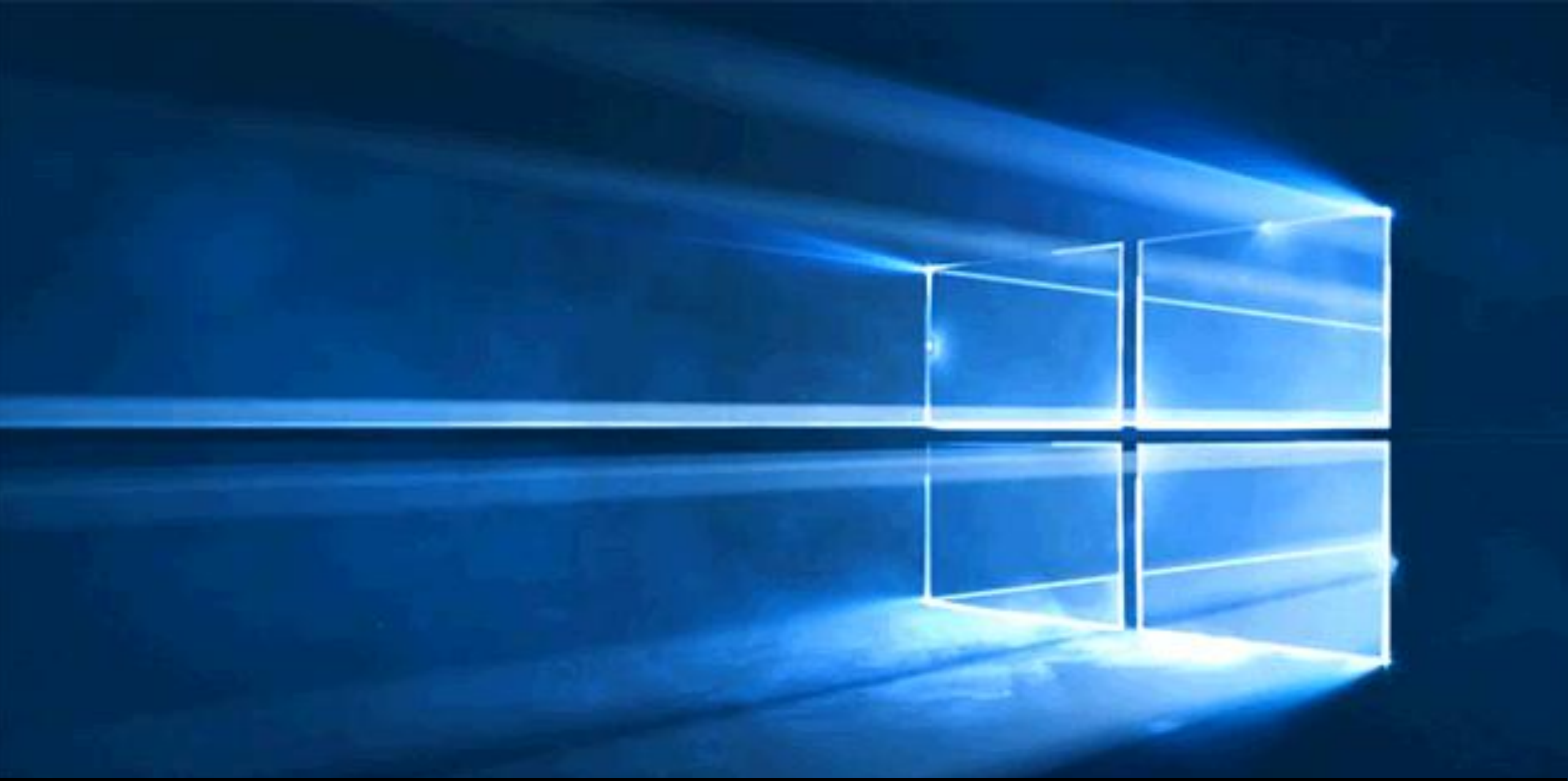
ENG
DE

9:49 AM
10/14/2024

SPECviewperf- CATIA

Visual Data Analytics – Sync Player





Show Time

Conclusions

Advantages of moving to a Cloud PC

- Anywhere access for multi-location organizations
- Any device access for a hybrid workforce
- Simplified IT management
- Enhanced security
- Scalability and flexibility for rapidly scaling teams
- Business continuity & disaster recovery

Considerations

- Is the internet connection stable enough?
- Is the datacenter close enough for high-end graphics?

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 freely available to the public

Bedankt voor mij

Tack för mig

Thank you

میرے لئے شکریہ

Tak for mig

Takk fyrir mig

Takk for meg

Danke für mich

Merci pour moi

Gracias por mi

Kiitos minulle