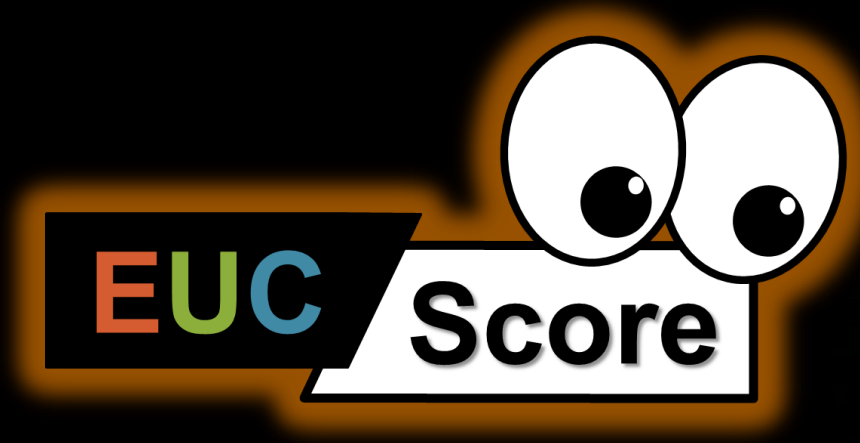

EUC World
AMPLIFY

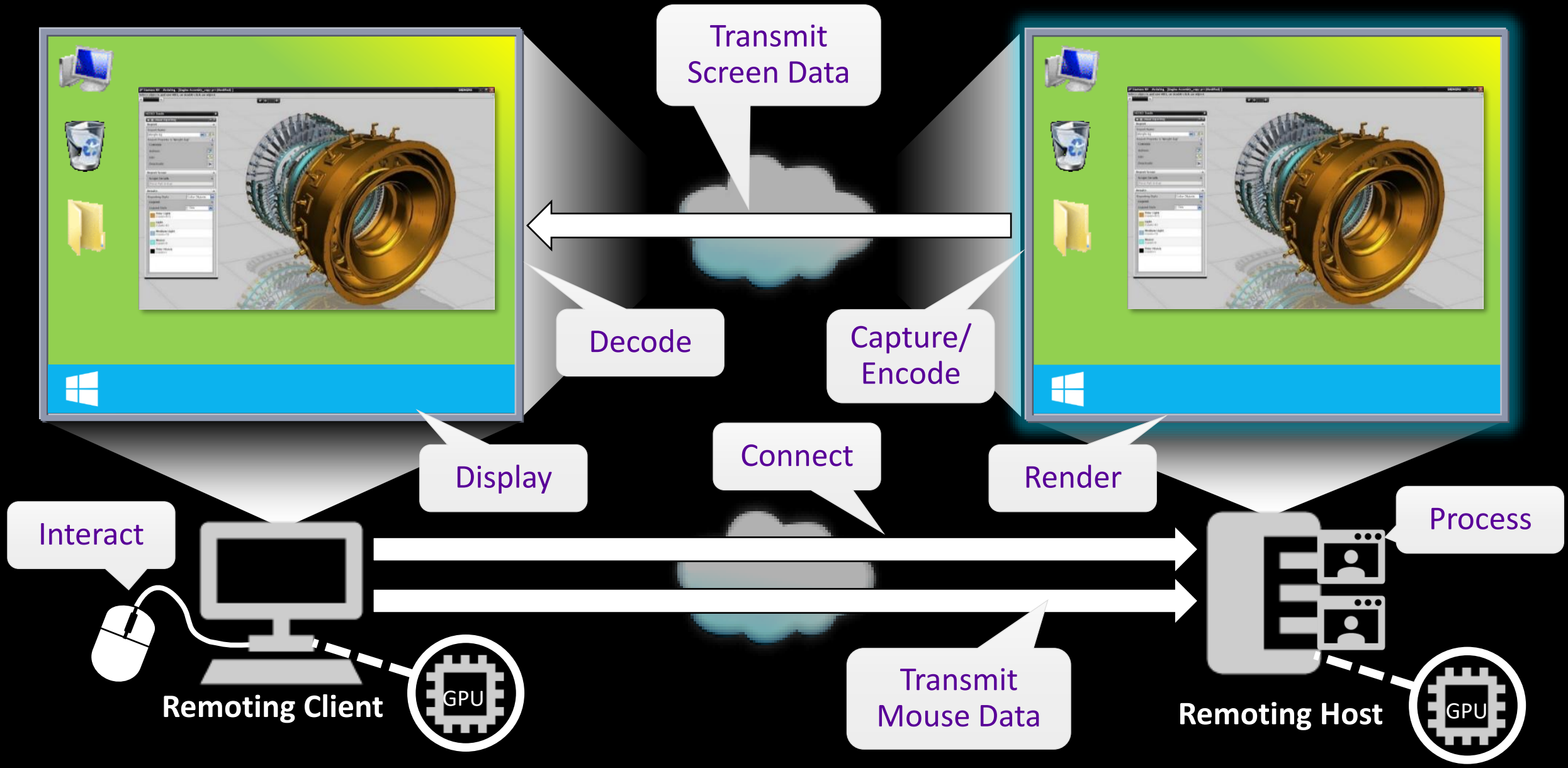


What users really expect from Windows in the cloud - and three ways to (not) deliver it

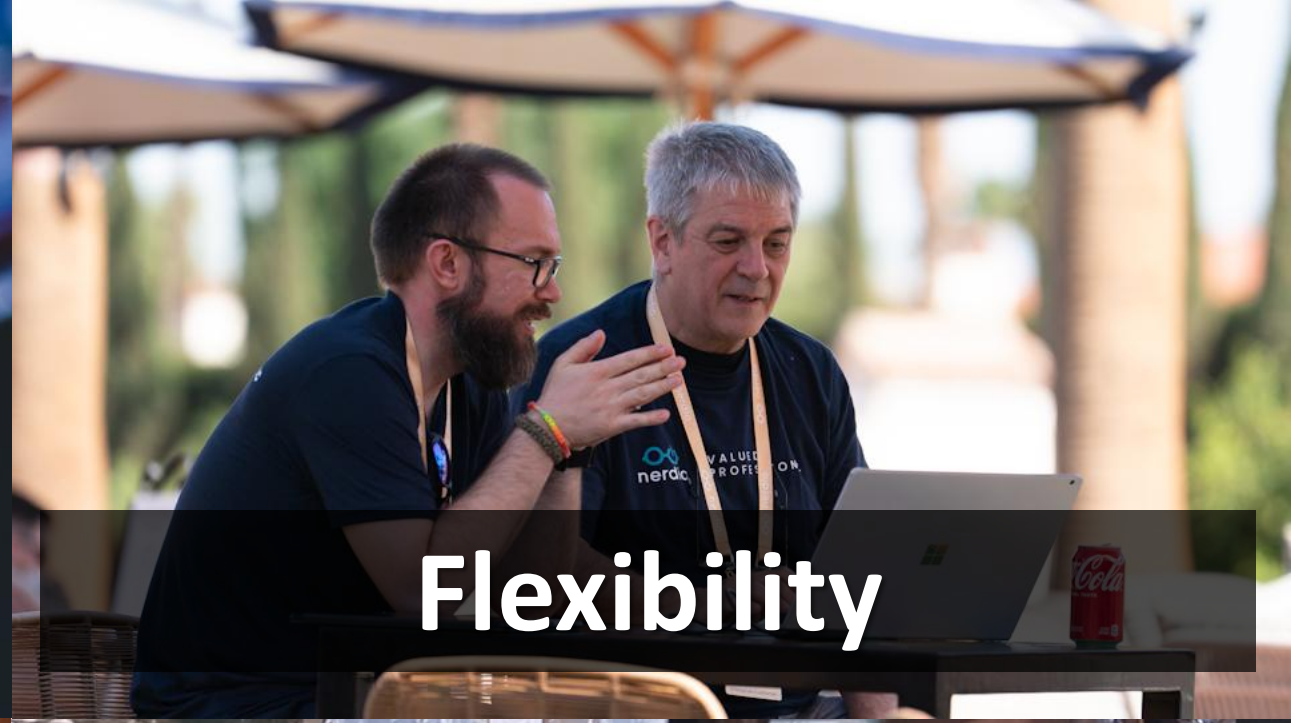
Dr. Benny Tritsch | Independent Performance Data Scientist
info@eucscore.com | https://drtritsch.com | linkedin.com/in/drtritsch


Trend: From EUC Expert to IT Generalist

Hosting Windows in the Cloud




Security

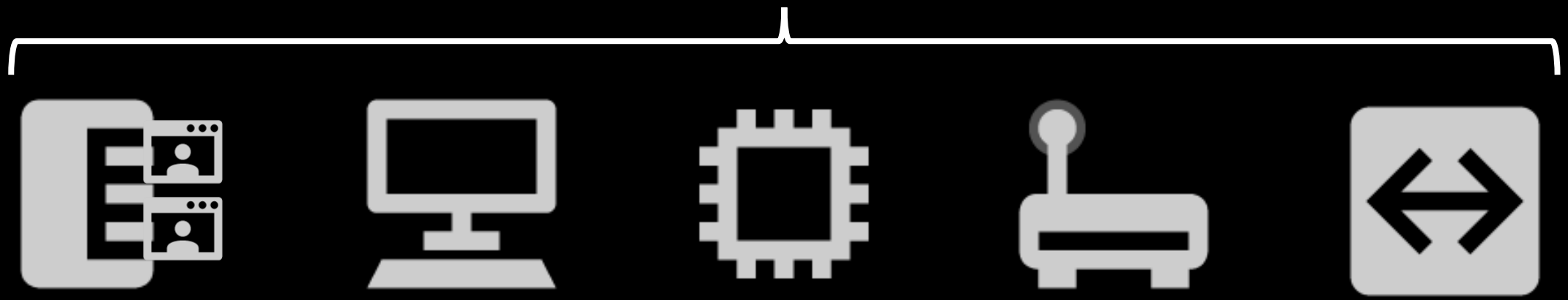

Flexibility


Management


Cost

Cloud Windows User Experience Influencers

Only one inadequate factor can prevent a good perceived user experience



Host System “VM Type”

Client Device “Endpoint”

GPUs

Network Parameters

Remoting Protocol

EUC
"Admin Experience"
Hard Metrics

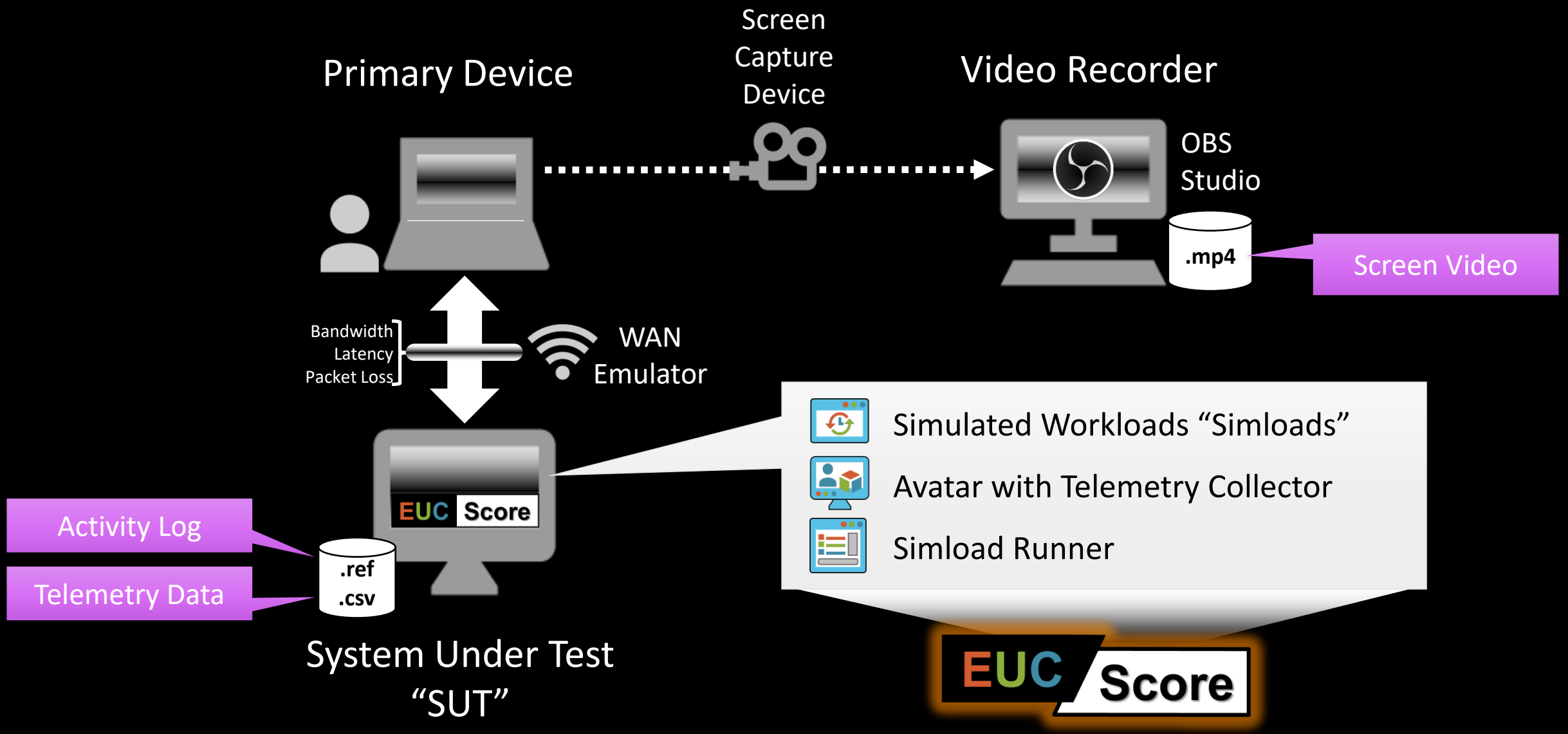
DEX
"User Experience"
Soft Metrics

From a User's Perspective: Quality Criteria

Boot and logon duration	Measure boot time + logon time + user session load time until it is ready for user interaction. 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 and playing 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.

Measuring DEX Quality - EUC Score Test Lab

EUC Score Enterprise Test Lab

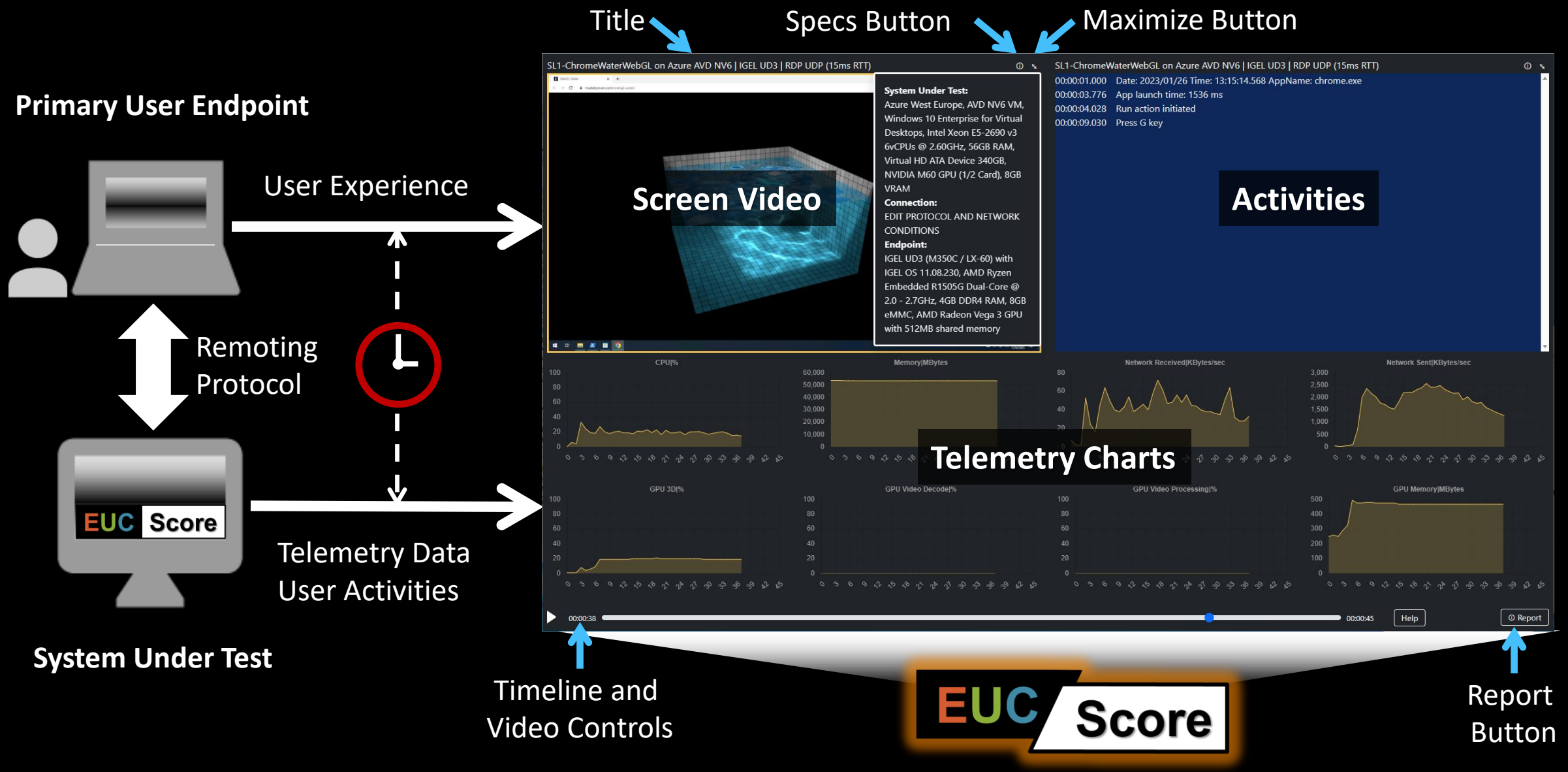


Simulated Workloads – “Simloads”

	Type	Description
	**Type 1 Primary**	Test run with an application that highlights a specific graphic or multimedia format (GDI, DirectX, OpenGL or video) – may require a pre-installed application.
	**Type 2 Persona**	Sequence of chained or overlayed user activities, orchestrated in such a way they generate the characteristic behavior and consistent load pattern of a predefined interactive user type.
	**Type 3 Score**	Measures predefined system metrics used to produce a number (= score) that represents the performance. Typically, each Score Simload is associated with a specific theme.

NOTE: Each Simload stores system and user activities in a .ref file and may collect telemetry data into a .csv file if configured accordingly

Visual Data Analytics – Sync Player



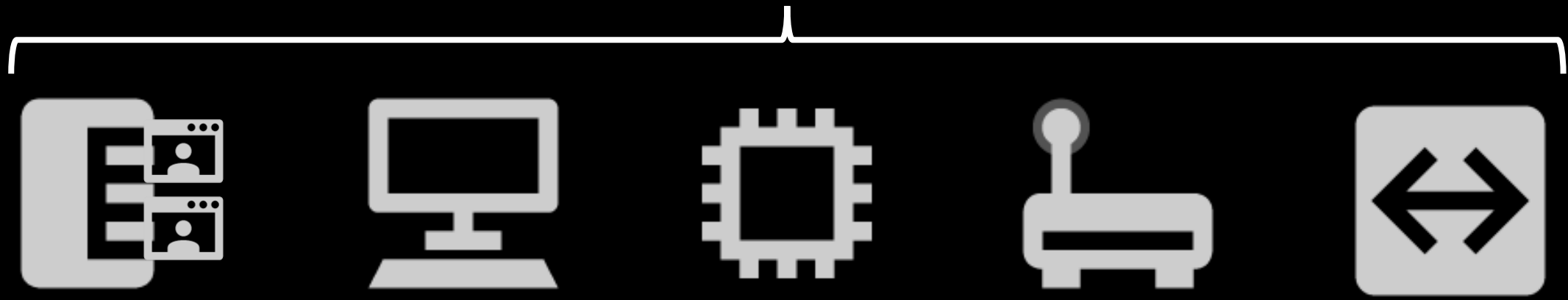

Now that we've learned about quality criteria
What makes users happy
(or unhappy)?

1

Understand that bandwidth is not the only important network factor for a “good” Cloud PC

Cloud Windows User Experience Influencers

Let’s focus on the network parameters and the remoting protocol



Host System “VM Type”

Client Device “Endpoint”

GPUs

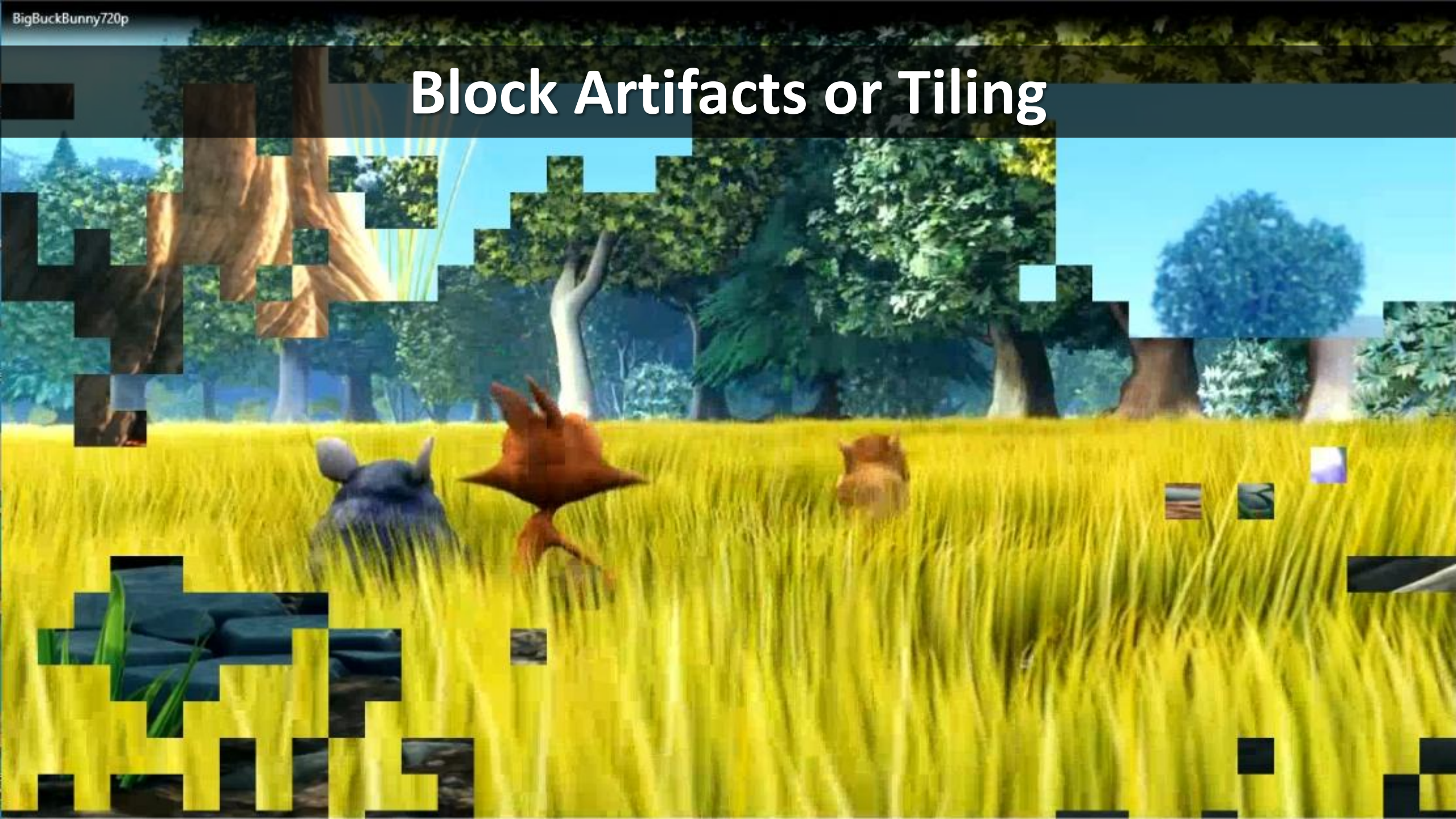
Network

- Bandwidth
- Latency
- Packet Loss

Remoting Protocol

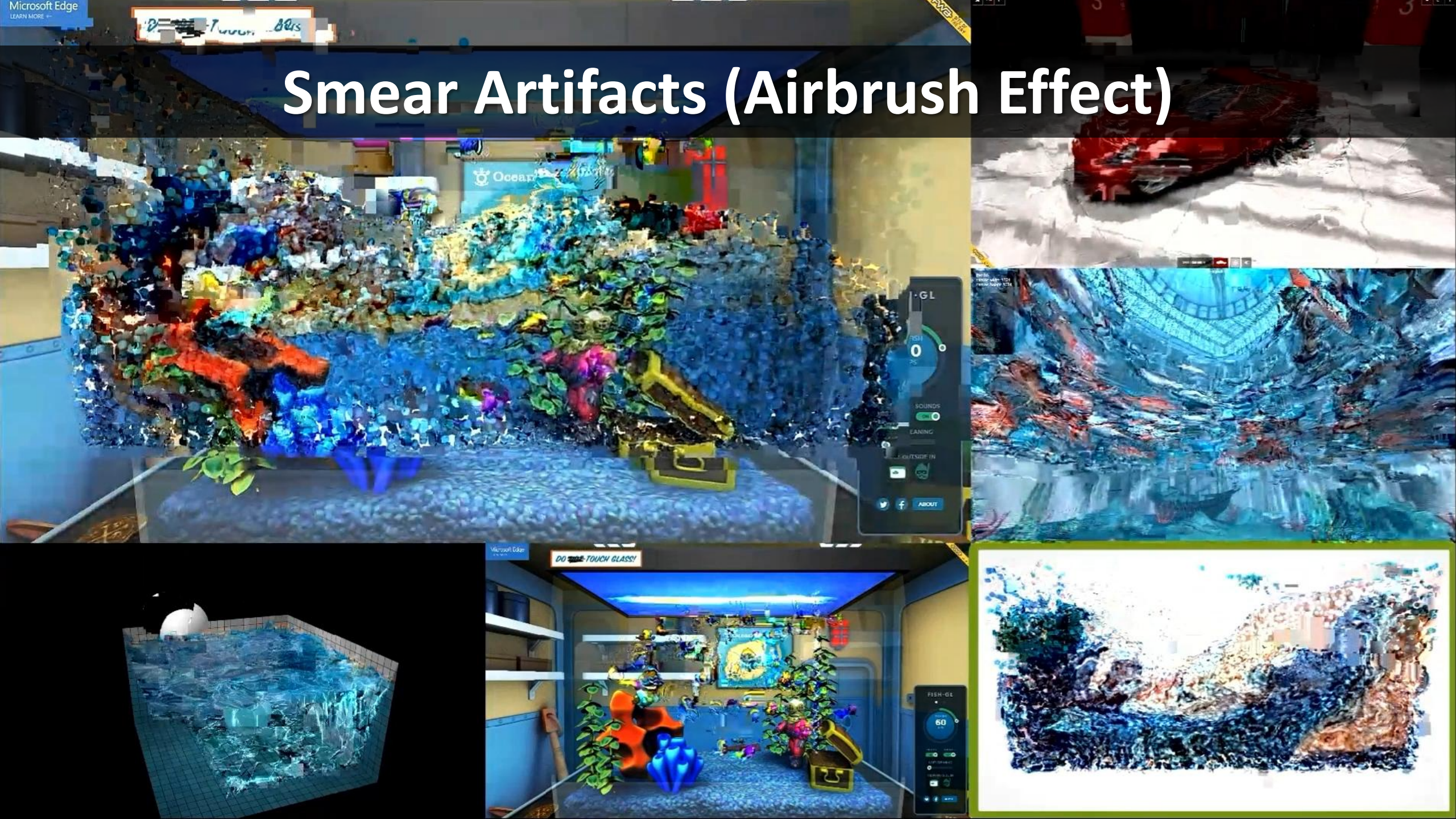

VIDEO GAMES
DON'T MAKE
US VIOLENT
LAG DOES

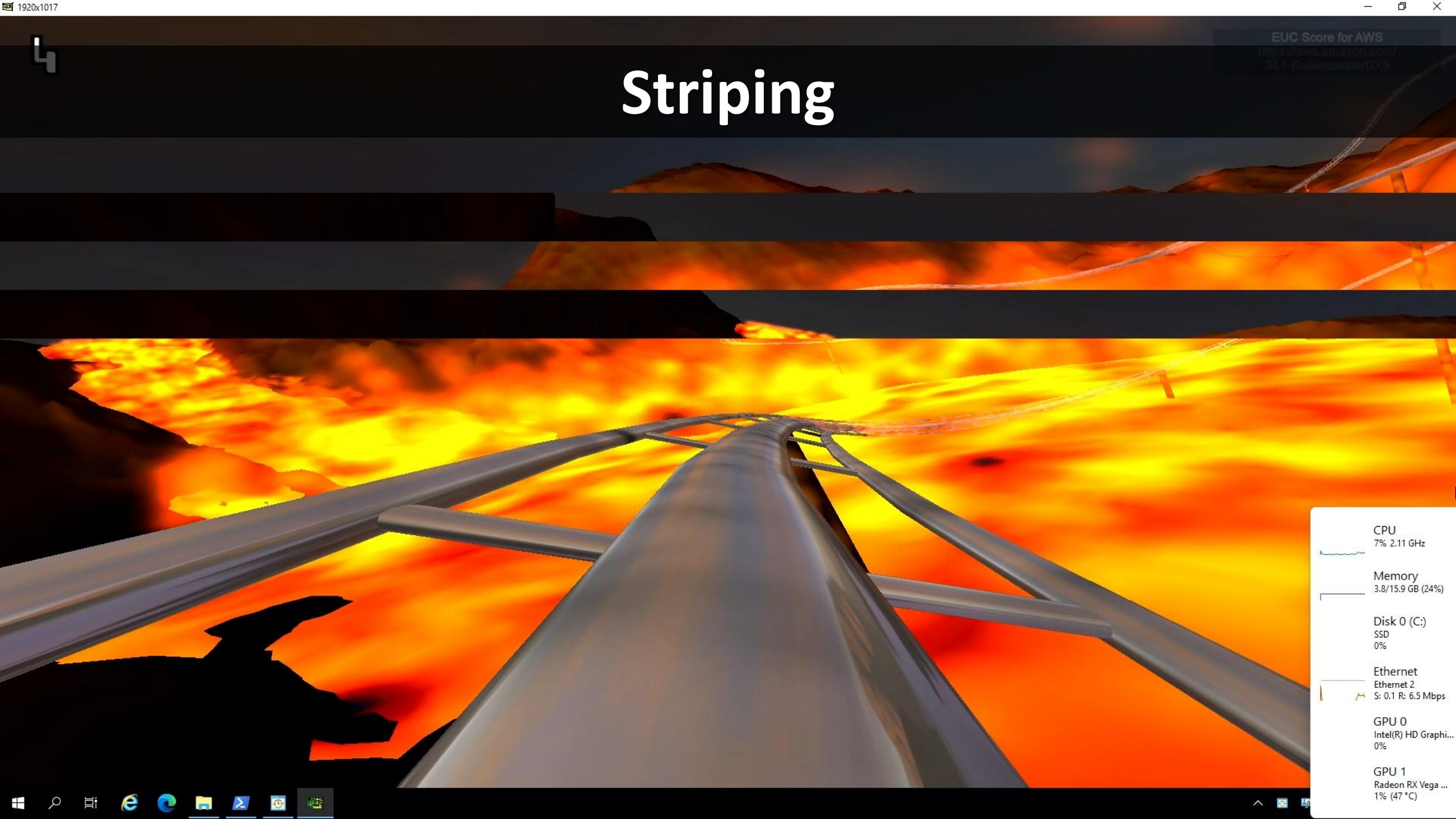

...AND
ARTIFACTS
DO



Block Artifacts or Tiling

Smear Artifacts (Airbrush Effect)




1920x1017
EUC Score for AWS
https://awa.amazon.com/
SL1-RollercoasterDX9
Striping
CPU
7% 2.11 GHz
Memory
3.8/15.9 GB (24%)
Disk 0 (C:)
SSD
0%
Ethernet
Ethernet 2
S: 0.1 R: 6.5 Mbps
GPU 0
Intel(R) HD Graphi...
0%
GPU 1
Radeon RX Vega ...
1% (47 °C)

Blurriness

Mosquito Noise

Color Artifacts (CLUT)

Remoting Protocol Features

Remoting protocols run on top of the Internet Protocol (IP), using Transmission Control Protocol (TCP), User Datagram Protocol (UDP) or a combination a TCP and UDP for different aspects of remoting. While older remoting protocols only used TCP, the modern ones use UDP for the graphics remoting aspect.

TCP is a connection-oriented protocol providing high reliability through error checking, congestion control and a built-in mechanism that rearranges data packets in the order specified. It also guarantees that all data remains intact in the packets transferred. But all this makes TCP relatively heavy-weight, significantly reducing graphics remoting performance on low bandwidth and high latency/packet loss networks.

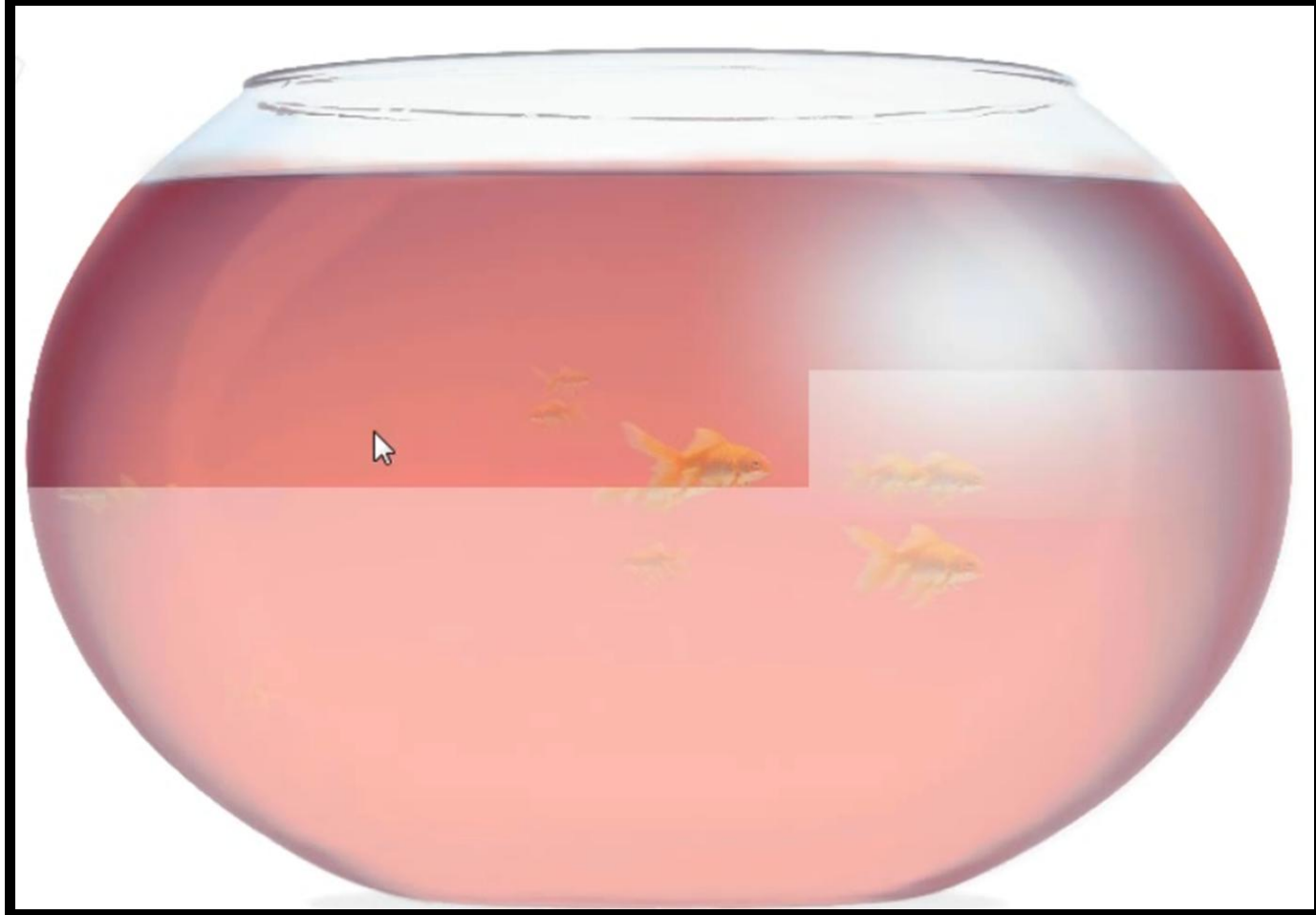
[redacted]

[redacted] there is more to a remoting protocol, in particular when it comes to extensibility. The concept of virtual channels provides a way to establish separate streams of data communication while taking advantage of the remote session communication already established. Many remoting protocols use virtual channels to add functions that allow a strict separation from the core features or are not yet specified in the protocol. They represent a platform that future developments can be based on without having to modify the communication methods between host and clients. Examples for virtual channel use cases are joint client and server clipboards or redirecting print jobs to local client printers.

[redacted]

Client Side Rendering versus Host Side Rendering

In a graphics remoting environment, the Windows desktop including its applications is rendered in a



Motion Screen Artifacts / Anomalies

Choppy, laggy, jumpy, jerky, stuttering (“micro stutters”) – the motion appears uneven, irregular, or discontinuous

Jitter – loss of transmitted image or video data

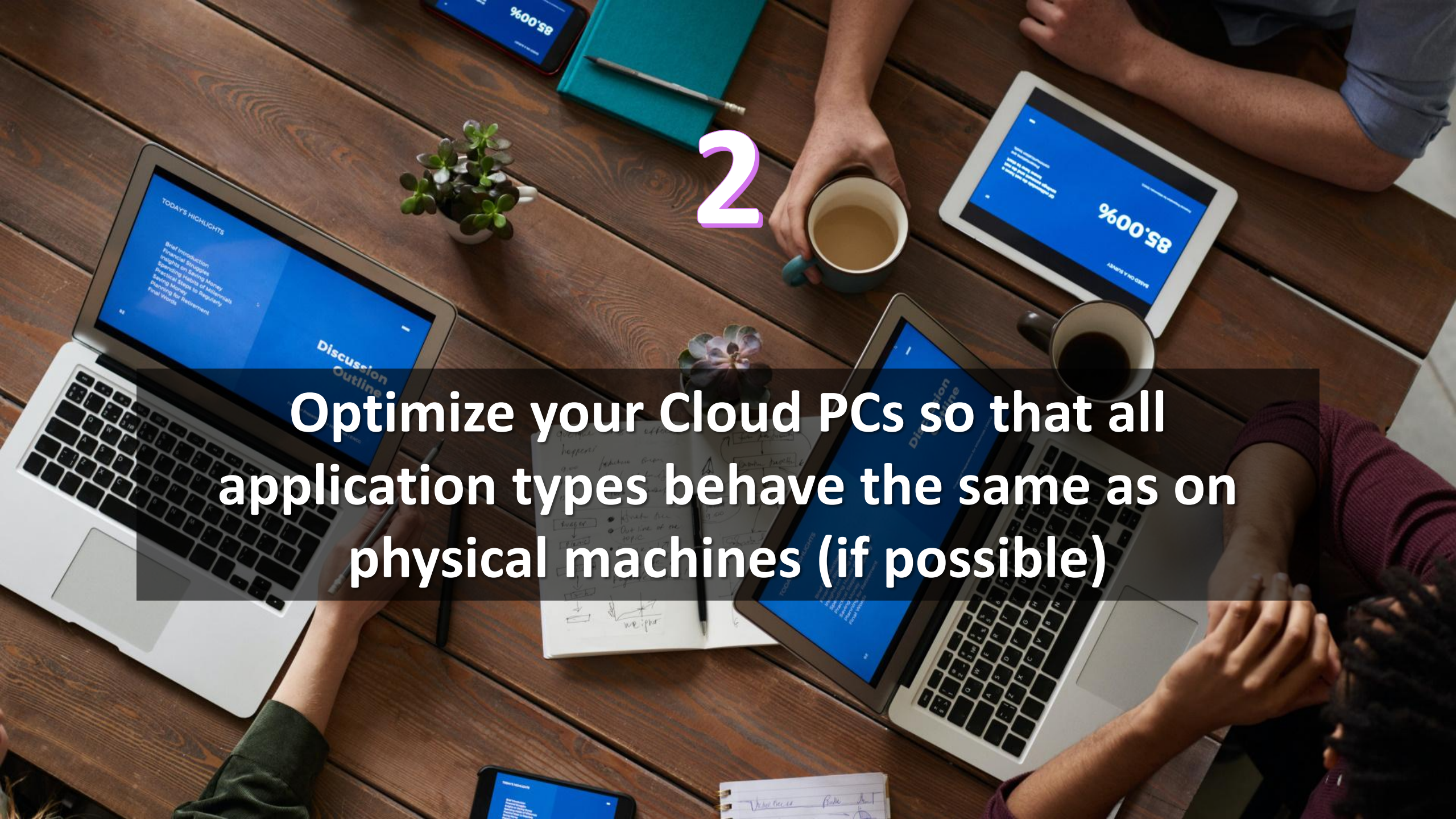
Freeze frame – a single frame forming a motionless image from a video

Slow motion – playing back video more slowly than it was made or recorded

Ringing, echoing, ghosting – a repeating pattern of lines or waves that appear around sharp corners and edges

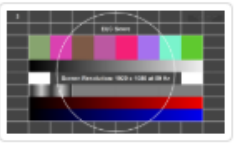
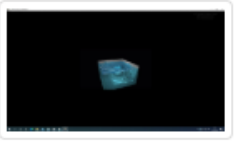
Floating – illusory motion in certain regions while the surrounding areas remain static

Flickering – fine-grain flickering and coarse-grain flickering

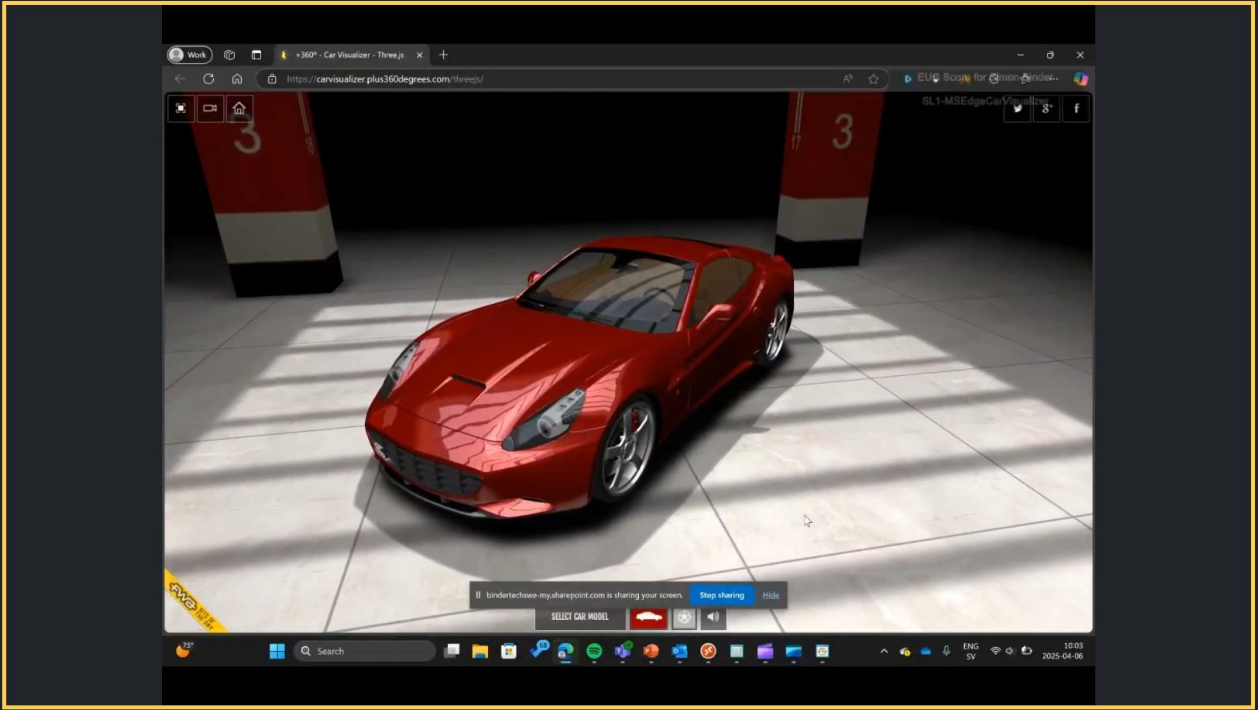

2
Optimize your Cloud PCs so that all application types behave the same as on physical machines (if possible)

Simloads representing different app types

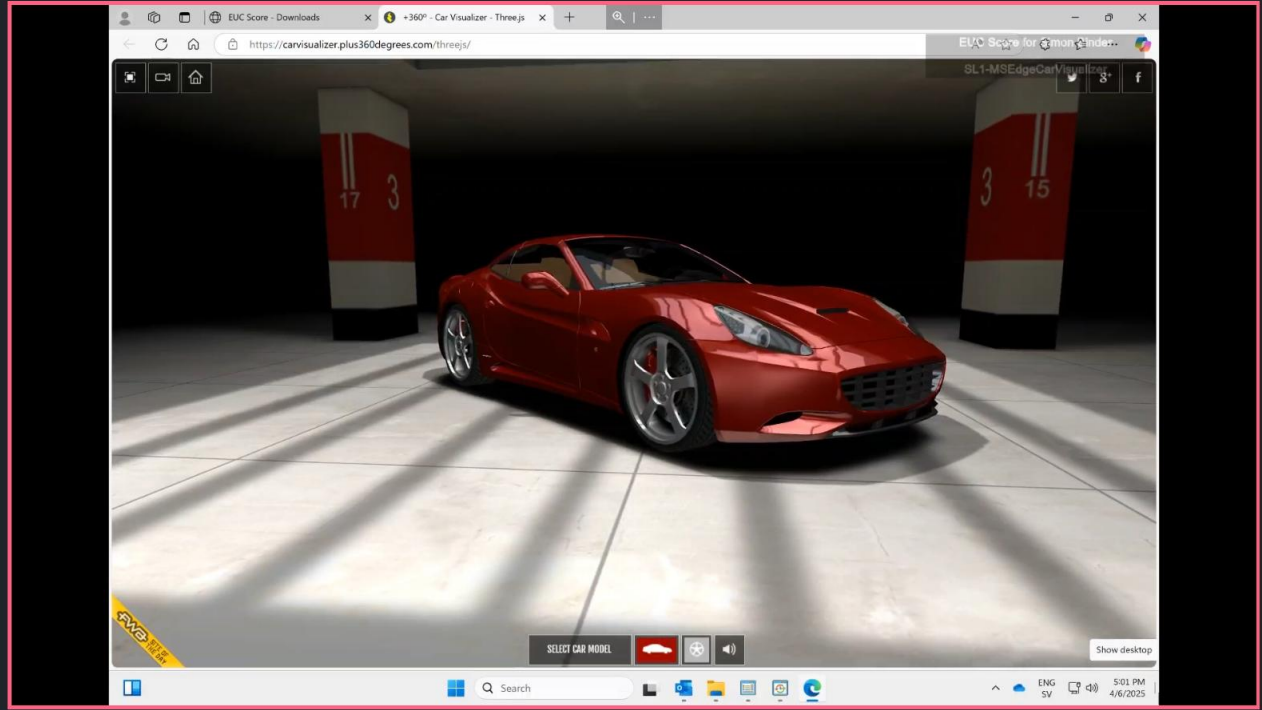
https://eucscore.com/gallery

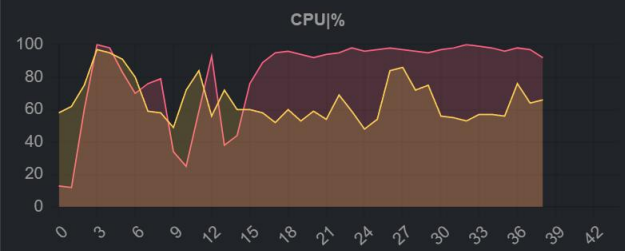
Thumbnail	Simload Type	Description
	**System** Light user type SL0-System folder	**SL0-TestScreen** Open an animated test pattern screen and save system information in the EUCScore\Results folder. The system information can be used to document the system under test.
	**Primary** Light user type SL1-Base folder	**SL1-NotepadEdit** Open Notepad2 and start writing a novel with random type speed. The Notepad2 executable is located in the EUCScore\Data\Bin\Notepad2\ folder.
	**Primary** Light user type SL1-Base folder	**SL1-NotepadMove** Open Notepad2 and move the application window randomly across the screen. The Notepad2 executable is located in the EUCScore\Data\Bin\Notepad2\ folder.
	**Primary** Light user type SL1-Base folder	**SL1-WordpadScroll (deprecated)** Open local DOCX file with PNG images in Microsoft Wordpad and randomly move pages up and down every second. **NOTE**: WordPad will be removed from all editions of Windows starting in Windows 11, version 24H2 and Windows Server 2025.
	**Primary** Light user type SL1-JPEGView folder	**SL1-JPEGViewStatic** Open JEPG image in JEPG View. The executable is located in the EUCScore\Simloads\SL1-JPEGView\Bin\JPEGView64\ folder. **NOTE**: This is the most basic Simload as it includes neither animations nor user interactions.
	**Primary** Medium user type SL1-JPEGView folder	**SL1-JPEGViewAnim** Open animated GIF image in JEPG View. The executable is located in the EUCScore\Simloads\SL1-JPEGView\Bin\JPEGView64\ folder.

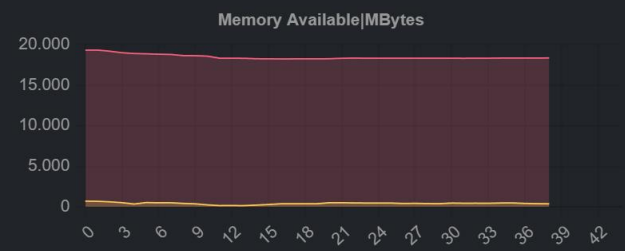
SL1-MSEdgeCarVisualizer on Surface Pro X

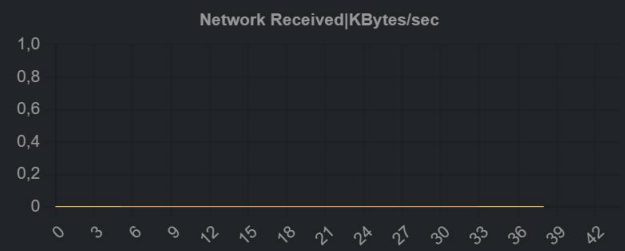


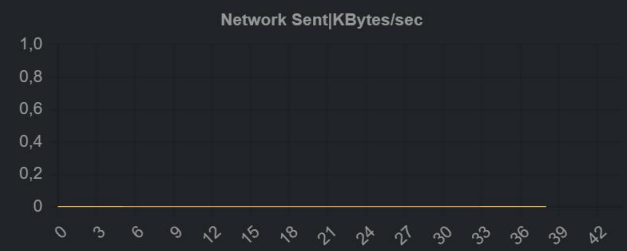
SL1-MSEdgeCarVisualizer on AVD

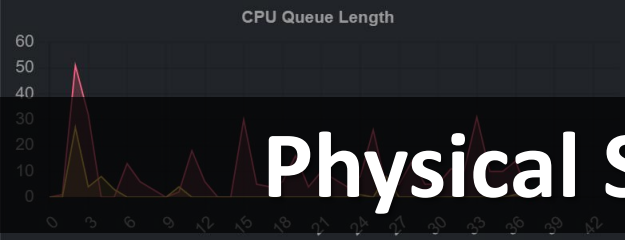


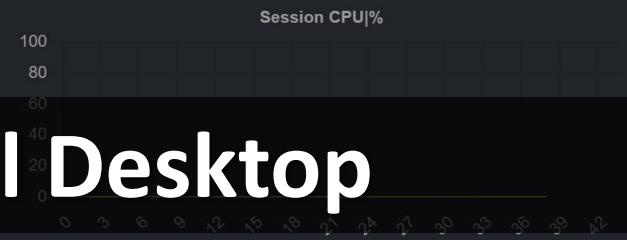








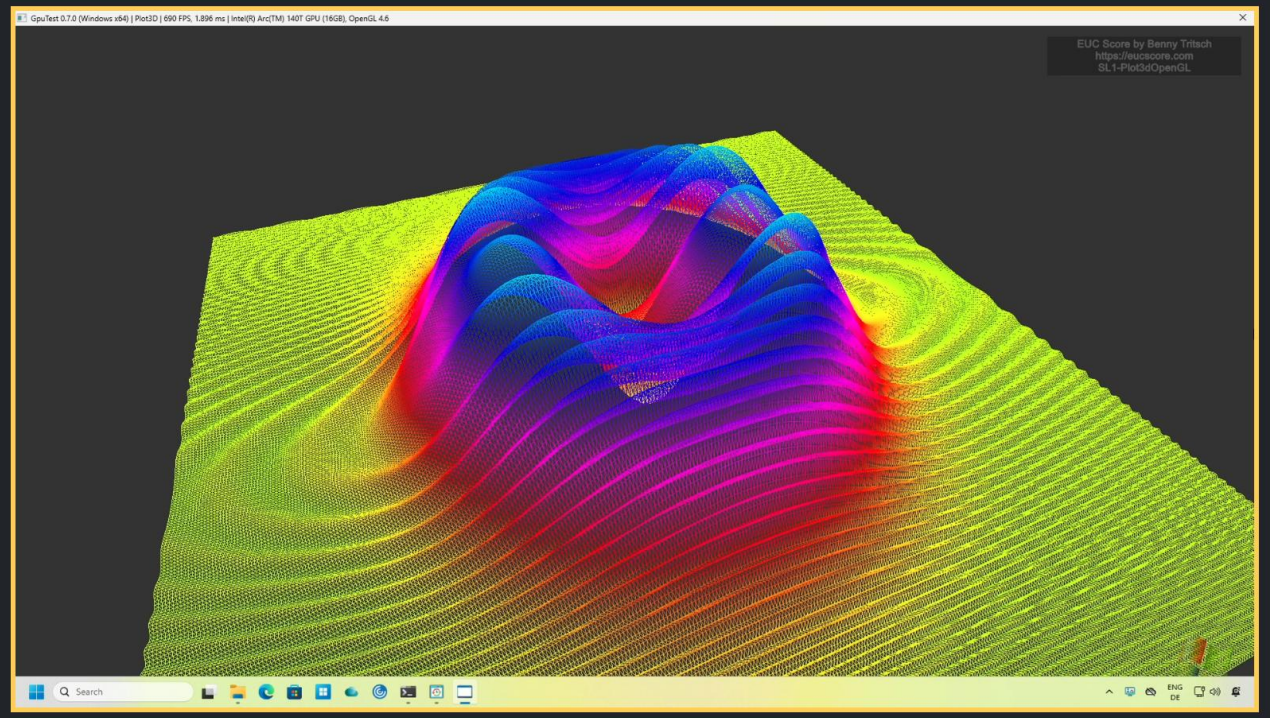




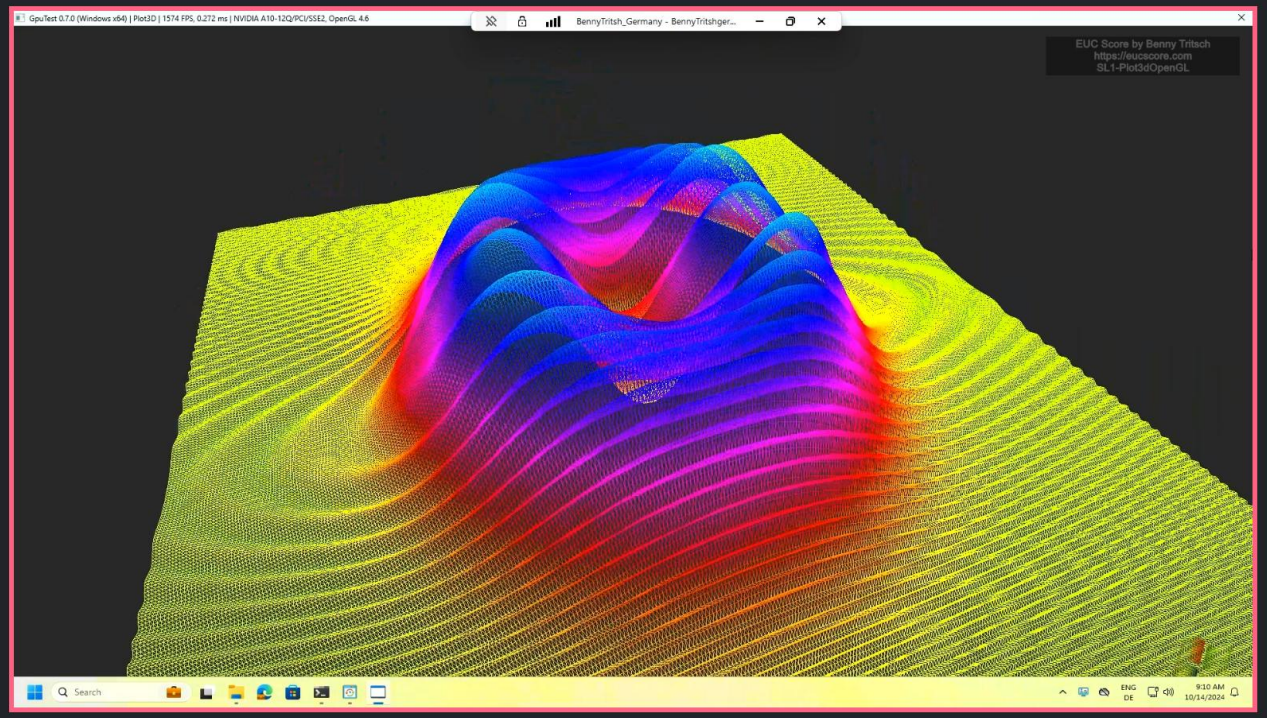
Physical Surface Pro X versus Azure Virtual Desktop

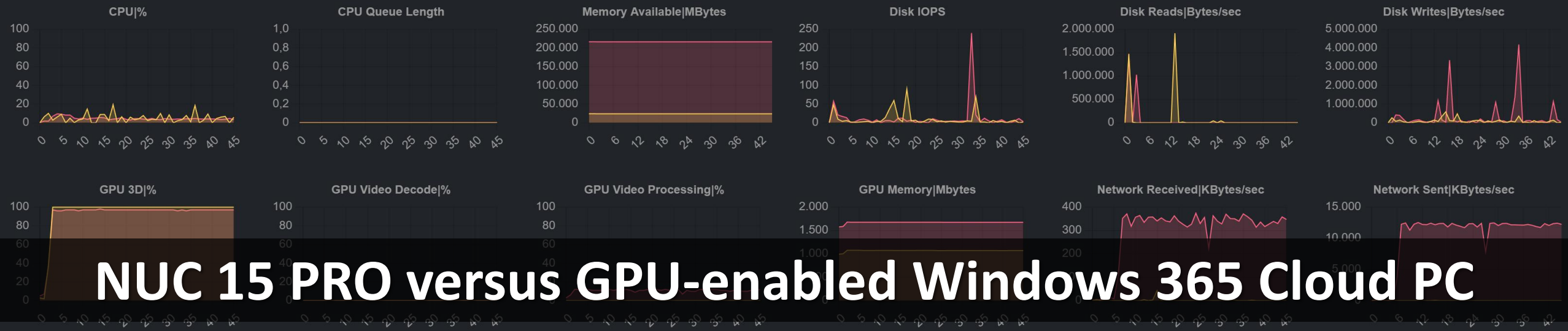
00:00:39 00:00:45 Help Report

SL1-Plot3dOpenGL on Physical Machine NUC15Pro w/ Arc GPU | Local Console



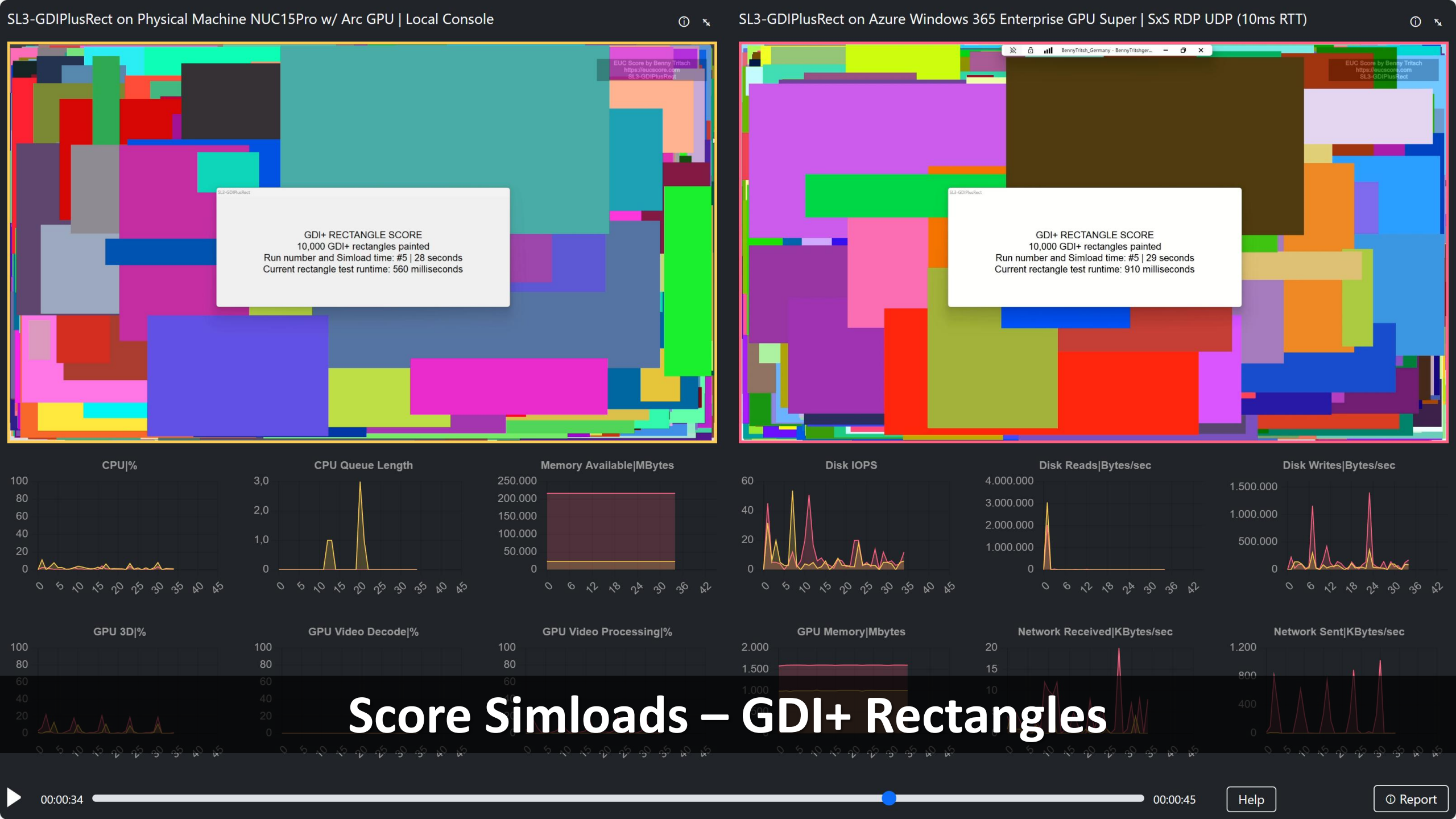
SL1-Plot3dOpenGL on Azure Windows 365 Enterprise GPU Super | SxS RDP UDP (10ms RTT)





NUC 15 PRO versus GPU-enabled Windows 365 Cloud PC

00:00:45 00:00:45 Help Report


SL3-GDIPlusRect on Physical Machine NUC15Pro w/ Arc GPU | Local Console
SL3-GDIPlusRect on Azure Windows 365 Enterprise GPU Super | SxS RDP UDP (10ms RTT)
GDI+ RECTANGLE SCORE
10,000 GDI+ rectangles painted
Run number and Simload time: #5 | 28 seconds
Current rectangle test runtime: 560 milliseconds
GDI+ RECTANGLE SCORE
10,000 GDI+ rectangles painted
Run number and Simload time: #5 | 29 seconds
Current rectangle test runtime: 910 milliseconds
CPU|%
CPU Queue Length
Memory Available|MBytes
Disk IOPS
Disk Reads|Bytes/sec
Disk Writes|Bytes/sec
GPU 3D|%
GPU Video Decode|%
GPU Video Processing|%
GPU Memory|Mbytes
Network Received|KBytes/sec
Network Sent|KBytes/sec
Score Simloads – GDI+ Rectangles
00:00:34
00:00:45
Help
Report

Score Simload Results

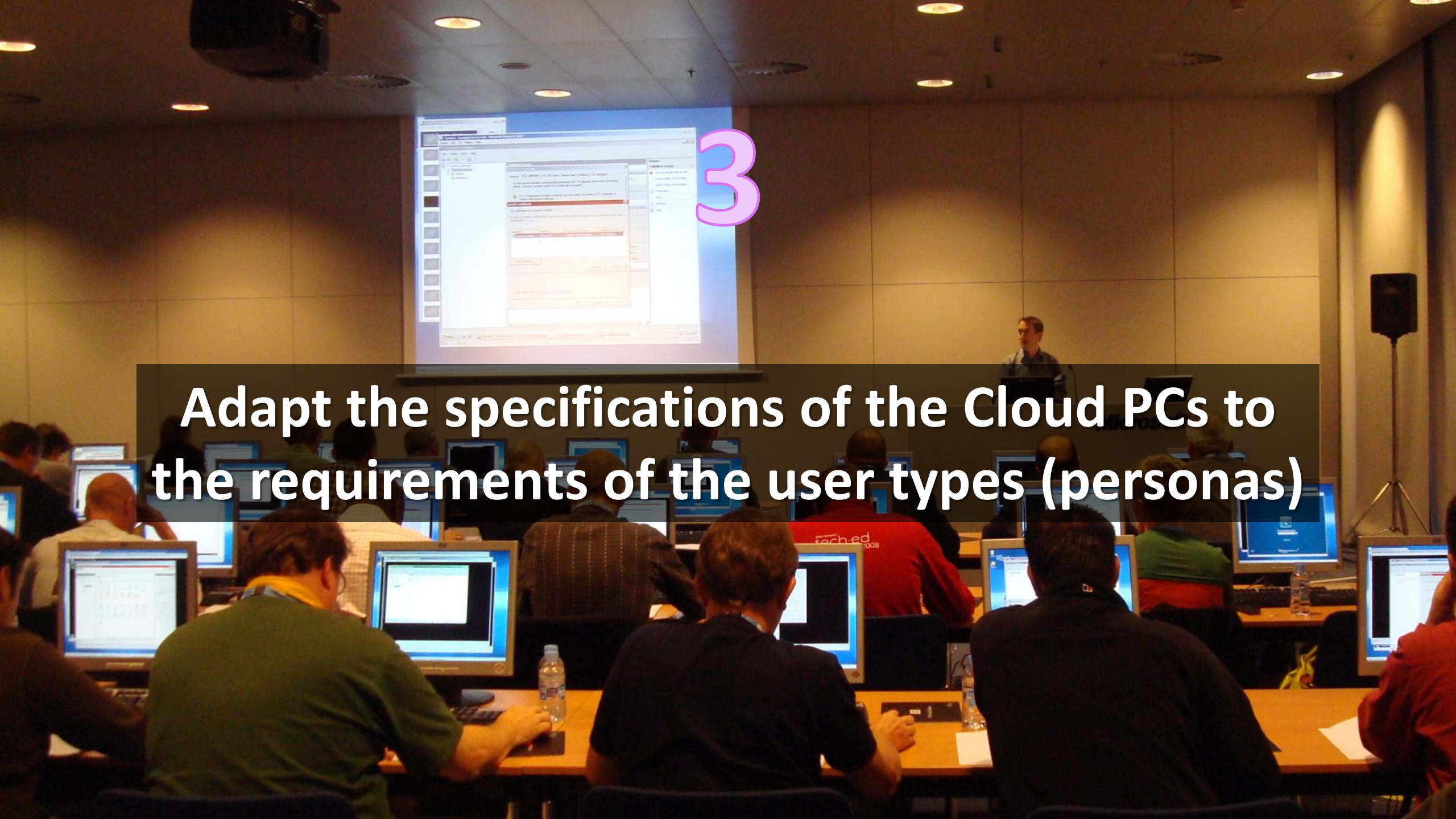
		C	D	E	F	G	H		J	K	L		M
Test Sequence	**Date**	**App Dialog**	**App Start**	**GDI Rectangles**	**IOPS**	**User Profile Large**	**User Profile Small**		**Apps**	**GDI**	**Storage**		**Overall**
		◀better	◀better	◀better	◀better	◀better	◀better		better▶	better▶	better▶		better▶
Lancelot 8 Intel CPU Cores / 16 Threads RTX 4060 GPU Physical	2025-06	**0.28**	**0.74**	**0.73**	**1.97**	**4.68**	**1.50**		**4.92**	**6.85**	**3.79**		**5.19**
NUC15Pro 16 Intel Cores Arc 140T GPU Physical	2025-06	**0.30**	**0.63**	**0.56**	**0.79**	**2.51**	**1.11**		**4.92**	**8.93**	**7.66**		**7.17**
Windows 365 4 AMD vCPUs RDP	2025-06	**0.30**	**0.63**	**1.21**	**9.39**	**8.66**	**2.67**		**4.92**	**4.13**	**1.41**		**3.49**
Windows 365 8 Intel vCPUs RDP	2025-06	**0.30**	**0.60**	**1.23**	**6.23**	**7.46**	**2.52**		**5.00**	**4.07**	**1.70**		**3.59**
Win365GPUSuper-High 18 AMD vCPUs A10-12Q GPU RDP	2024-10	**0.28**	**0.61**	**0.90**	**6.35**	**7.24**	**2.25**		**5.21**	**5.56**	**1.80**		**4.19**
Win365GPUSuper-Medium 18 AMD vCPUs A10-12Q GPU RDP	2024-10	**0.28**	**0.60**	**0.88**					**5.24**	**5.68**	**1.80**		**4.24**
Win365GPUStd 12 AMD vCPUs A10-8Q GPU RDP	2024-09	**0.29**	**0.64**	**0.91**	**5.82**	**8.99**	**2.13**		**5.01**	**5.49**	**1.85**		**4.12**
Win365GPUStd NoAVC444 12 AMD vCPUs A10-8Q GPU RDP	2024-08	**0.28**	**0.60**	**0.89**	**4.84**	**8.93**	**2.21**		**5.24**	**5.62**	**1.96**		**4.27**
Azure NC4as_T4_v3 4 AMD vGPUs T4 GPU PCoIP	2024-08	**0.29**	**0.89**	**1.60**	**23.80**	**15.29**	**3.54**		**4.57**	**3.13**	**0.86**		**2.85**
AVD D2asv5 2 AMD vGPUs RDP	2024-07	**0.31**	**0.62**	**1.58**	**8.69**	**6.99**	**2.73**		**4.84**	**3.16**	**1.48**		**3.16**
Windows 365 Enterprise 2 vCPUs RDP	2023-10	**0.36**	**0.78**	**2.04**	**13.83**				**4.06**	**2.45**	**1.45**		**2.65**
Lancelot 8 Intel CPU Cores / 16 Threads NoGPU RDP	2023-09	**0.30**	**0.61**	**0.88**	**2.43**				**4.97**	**5.68**	**8.23**		**6.29**
Lancelot 8 Intel CPU Cores / 16 Threads M5000 GPU RDP	2023-09	**0.30**	**0.61**	**0.73**	**2.93**				**4.97**	**6.85**	**6.83**		**6.22**
AVD D8adsv5 8 AMD vCPUs RDP	2023-09	**0.31**	**0.57**	**1.10**	**9.03**				**4.98**	**4.55**	**2.21**		**3.91**
AVD NC8asT4v3 8 AMD vCPUs T4 GPU RDP	2023-09	**0.28**	**0.62**	**1.26**	**10.72**				**5.18**	**3.97**	**1.87**		**3.67**
AVD NV6adsA10v5 6 AMD vCPUs A10-4Q GPU RDP	2023-09	**0.28**	**0.58**	**0.83**	**12.32**				**5.30**	**6.02**	**1.62**		**4.31**
Windows 365 Business 2 AMD vCPUs RDP	2023-09	**0.33**	**0.69**	**1.98**	**14.67**				**4.48**	**2.53**	**1.36**		**2.79**
NUC2 4 Intel CPU Cores / 8 Threads Radeon RX Vega GPU Physical	2023-01	**0.30**	**0.74**	**1.27**	**2.84**				**4.68**	**3.94**	**7.04**		**5.22**
Reference		**0.15**	**0.30**	**0.50**	**0.55**	**2.50**	**1.00**		**10.00**	**10.00**	**10.07**		**10.02**

J = (1/C) + (1/D)

K = 1/E * 5

L = (1/F*4)+(1/G*2)+(1/H*2)

M = (J+K+L)/3


3
Adapt the specifications of the Cloud PCs to the requirements of the user types (personas)

Individual requirements

- Logon time / reconnection time
- User input delay (“lag”)
- Screen refresh rate and graphic quality
- App start time and app compatibility

Personas, Requirements & VM Types

	Persona Name	VM Specs		Network		VM Type Examples
	**Task Worker**	CPU Memory GPU	2-4 vCPUs minimum of 2GB no	Bandwidth Latency Packet loss	low 0-200ms 0-2%	Win365 Basic or Standard Azure D2s_v5, D2ads_v5
	**Information Worker**	CPU Memory GPU	2-4 vCPUs minimum of 4GB no	Bandwidth Latency Packet loss	low 0-100ms 0-1%	Win365 Standard or Premium Azure D4s_v5, D4ads_v5
	**Knowledge Worker**	CPU Memory GPU	4-8 vCPUs minimum of 8GB no or shared	Bandwidth Latency Packet loss	medium 0-50ms 0-0.5%	Win365 Premium or GPU Standard Azure D8s_v5, D8ads_v5 NG8ads_V620_v1
	**Power User**	CPU Memory GPU	4-16 vCPUs minimum of 16GB shared or dedicated	Bandwidth Latency Packet loss	medium 0-50ms 0-0.1%	Win365 Premium+ or GPU Standard Azure D16s_v5, D16ads_v5 NG16ads_V620_v1, NC4as_T4_v3
	**CAD/CAM Designer**	CPU Memory GPU	8-16 vCPUs minimum of 16GB high-end	Bandwidth Latency Packet loss	high 0-20ms 0%	Win365 GPU Super or GPU Max Azure NG16ads_V620_v1 NC8as_T4_v3, NC16as_T4_v3
	**Media Designer**	CPU Memory GPU	8-16 vCPUs minimum of 16GB high-end	Bandwidth Latency Packet loss	very high 0-30ms 0%	Win365 GPU Super or GPU Max Azure NG16ads_V620_v1 NC16as_T4_v3, NC16as_T4_v3

Three Ways to User Happiness (or not)

Make sure that users understand the impact of network constraints, such as latency and packet loss

Provide cloud PCs that run required applications (almost) as well as physical PCs, if possible

Assign Cloud PCs that meet the requirements of the user types (personas)

Conclusions

Don’t walk in the dark: Test labs and POCs are your friends

- **Analyze network constraints** and consider Cloud PC location change
- **Check VM specs** and select adequate VM types (performance vs. price)
- **Identify personas** based on app and user requirements

Ask simple and clearly defined questions that can be answered by experiments (the “MythBusters” principle)

Both quantitative (= scores) and qualitative data are the prerequisite for rating user happiness

Human intervention is an integral part of the rating process

- Inform selected users regularly about the status and listen to them

Call to Action

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

info@eucscore.com

https://eucscore.com
https://eucscore.com/results

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

EUC Score Links

https://eucscore.com

Home Page

https://eucscore.com/freeware

Freeware Download

Blog articles: https://drtritsch.com

Toolset documentation: https://docs.eucscore.com

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

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

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

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

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

Thank You

Benny Tritsch | info@eucscore.com