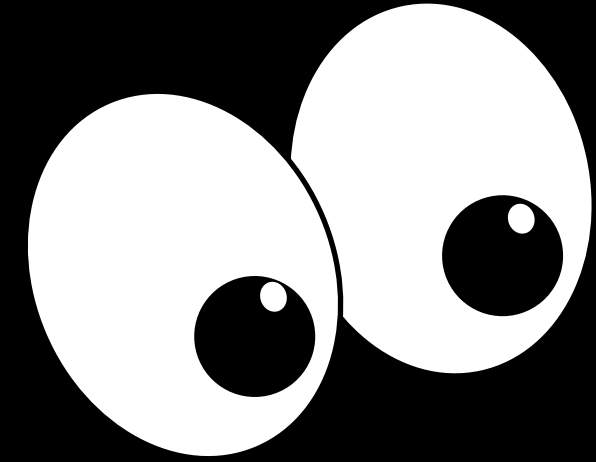


EUC Score Introduction

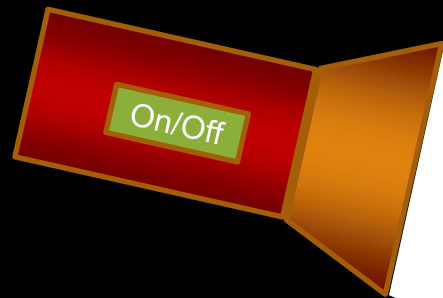
Q1/2024

Benny Tritsch | info@eucscore.com | [@drtritsch](https://twitter.com/drtritsch)

EUC Score in a Nutshell













Look before you leap!



EUC Score 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

Perceived End-User Experience Quality Criteria

	Time to first byte (TTFB)	Measure boot time + logon time + user session load time
	Application load time	Measure time from user starting an application until the content appears and the application is ready for user input
	User input delay	Measures responsiveness of graphical elements after user-initiated triggers (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	Detect image, animation, and audio/video compression and decompression artifacts, anomalies, and out-of-sync effects
	Frame rate	Measure the number of times per second that the desktop or application can draw consecutive images on the screen (fps)
	Input and output devices	Ensure that connected input and output devices are working properly. Detect client screen resolution and visual dimensions
	Application stability	Detect application hangs, freezes, crashes or unhandled exceptions
	Session availability and resilience	Detect user session hangs, disconnects and reconnects

Six Benefits of Using EUC Score

Diagnose end-user pain symptoms and solve IT support sorrows with proactive synthetic testing



Identify potential pain

Pre-production capabilities, performance and load testing



Examine existing pain

Ad-hoc diagnostics in production environments



Prevent new pain

What-if analysis and comparison of system designs and migration scenarios



Quantify pain relief success

Before-after analysis of system optimizations and software updates



Measure chronic pain

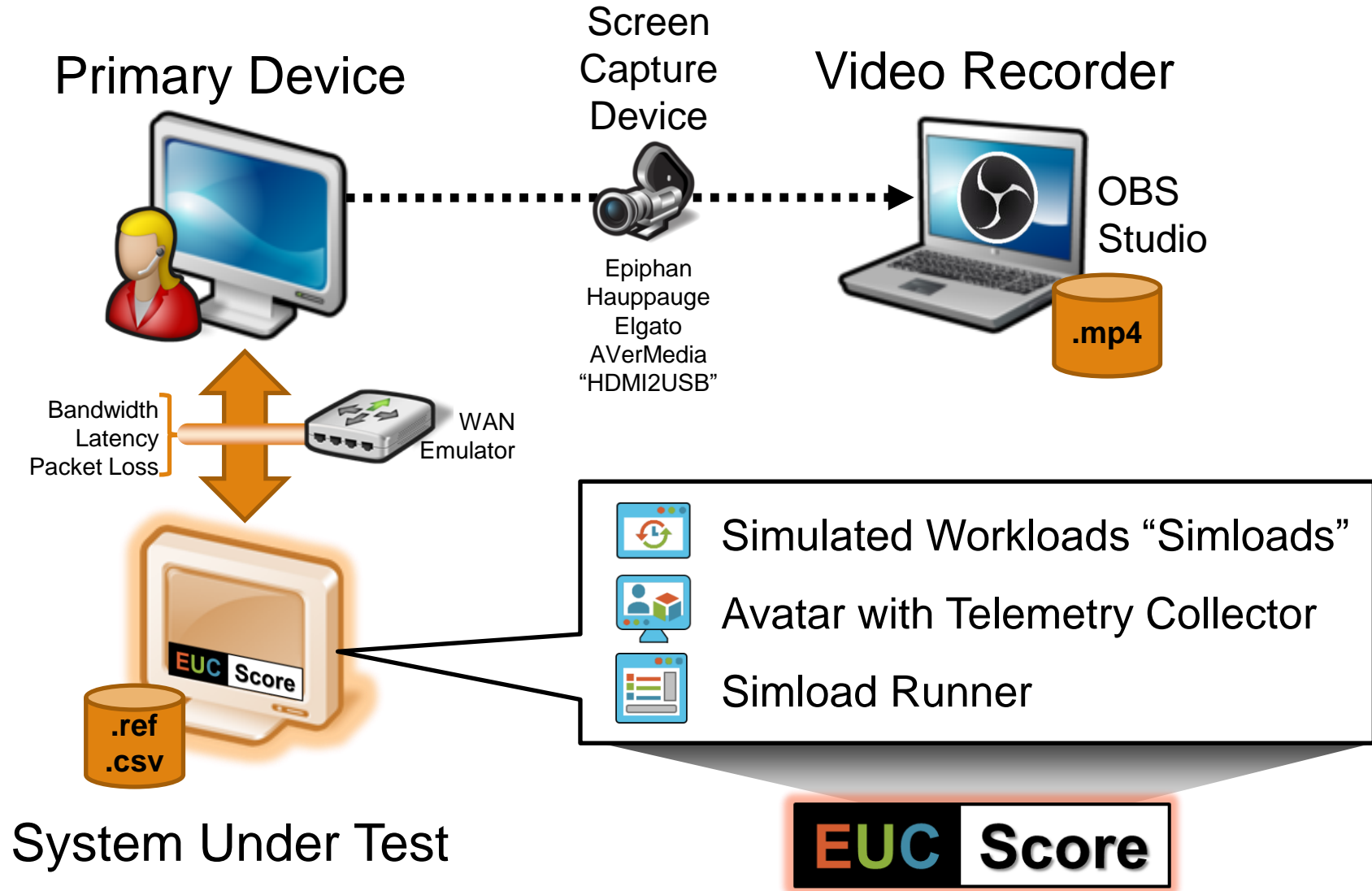
DaaS and VDI service level agreement management



Deliver less pain by design

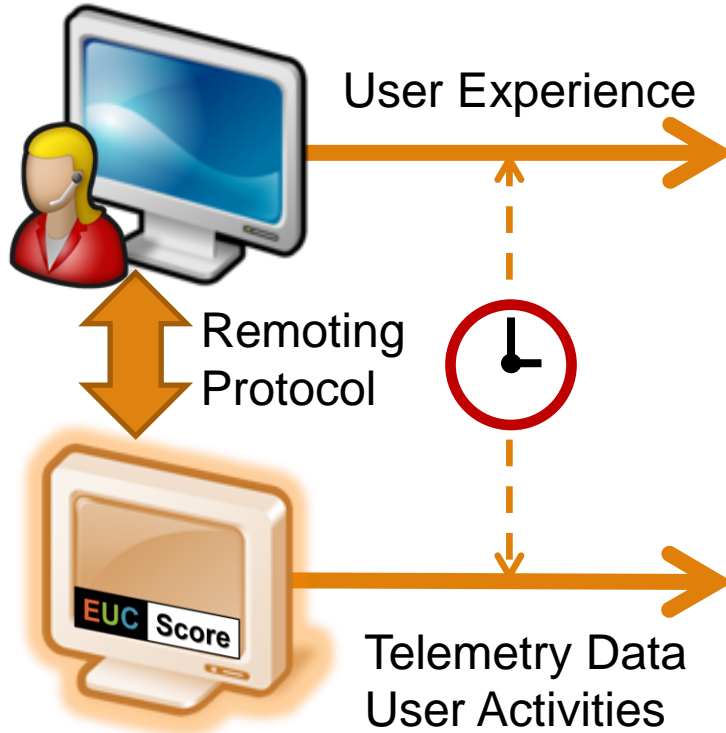
EUC software quality assurance and quality control

EUC Score Lab Overview



Visual Data Analytics – Sync Player

Primary User Endpoint



System Under Test

Timeline and Video Controls

Title

Specs Button

Maximize Button

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

Activities

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

Screen Video

Telemetry Charts

CPU%

Memory[MBytes]

Network Received[KBytes/sec]

Network Sent[KBytes/sec]

GPU 3D%

GPU Video Decode%

GPU Video Processing%

GPU Memory[MBytes]

00:00:38

00:00:45

Help

Report

EUC Score

Report Button

EUC Score Testing Methodology

EUC Score project phases

1. **Design & Build**: Pose testable question, state hypothesis, design experiment, and setup test environment (target system with test toolset, network, client device and test user accounts)
2. **Perform & Test**: Connect to target system from client device, select test workloads, prepare data collection, perform controlled and reproducible experiments, and collect/record test datasets
3. **Visualize, Analyze & Publish**: Review test results, visualize datasets, analyze test results, draw conclusions, and publish findings (and sometimes start all over again)

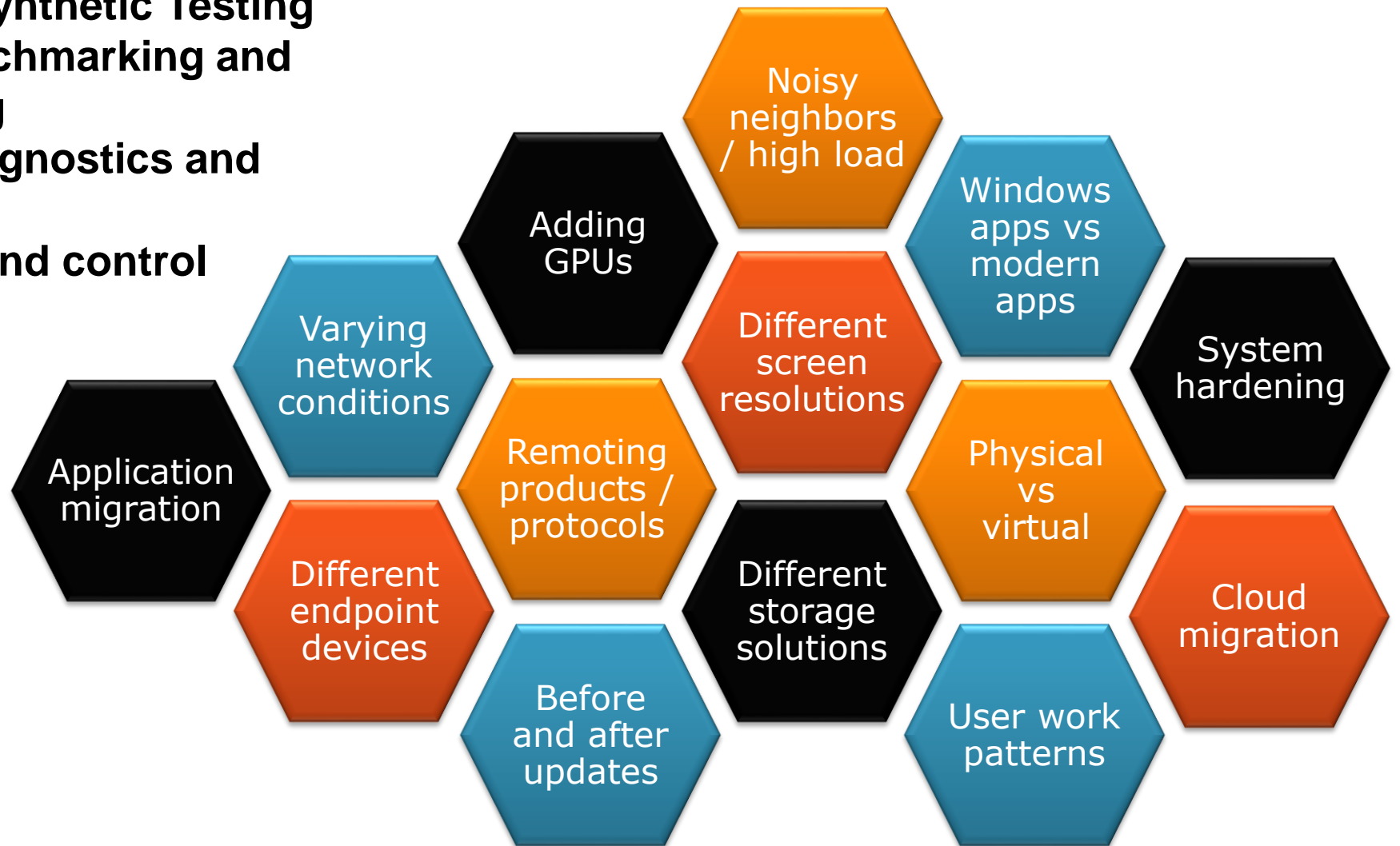
NOTE: Benchmarking experiments or simulations may not reflect the real world, but they help us to understand certain aspects of the real world

Design & Build

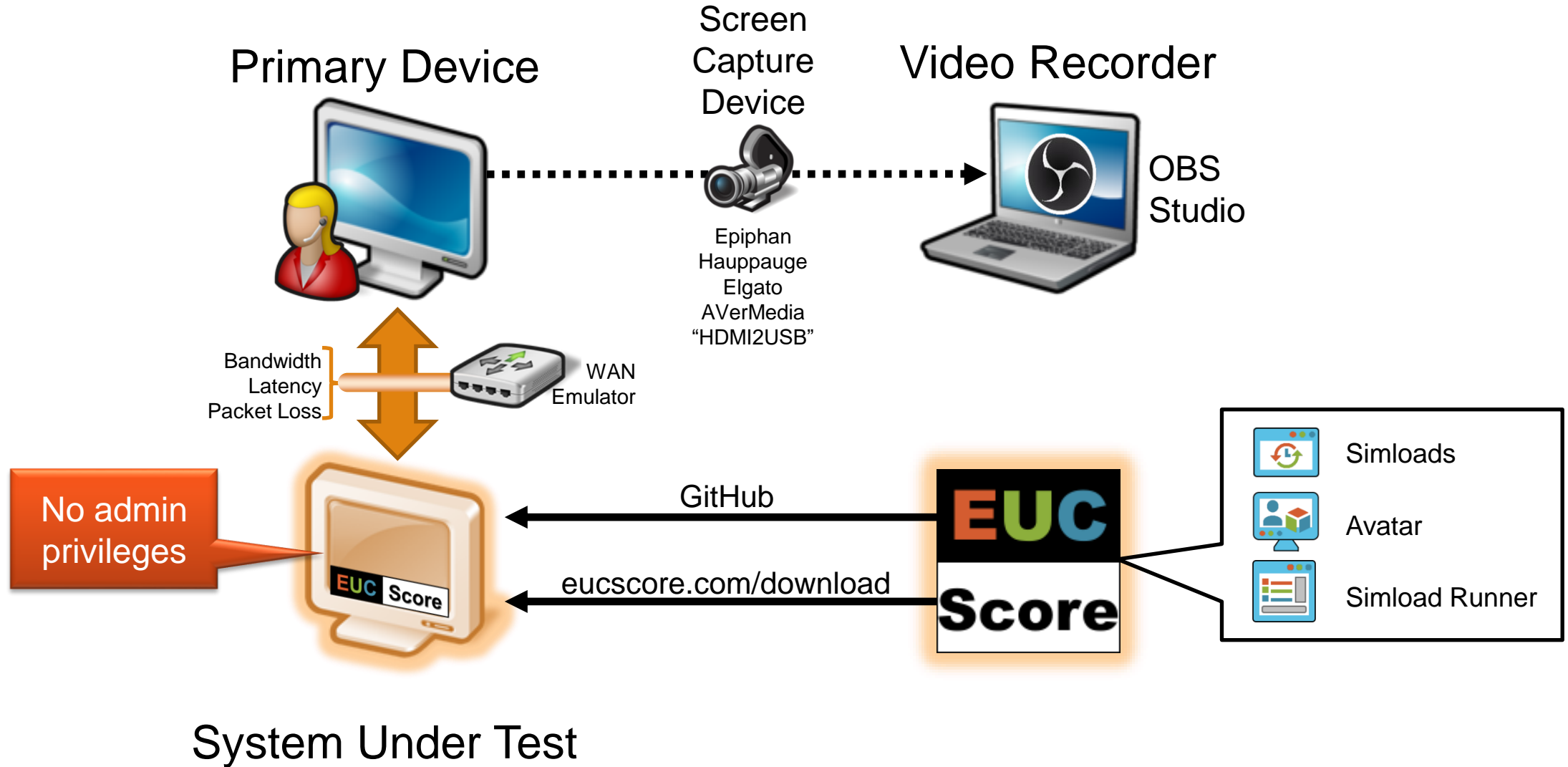
EUC Score Test Goals – Testable Questions

Proactive Host-Side Synthetic Testing

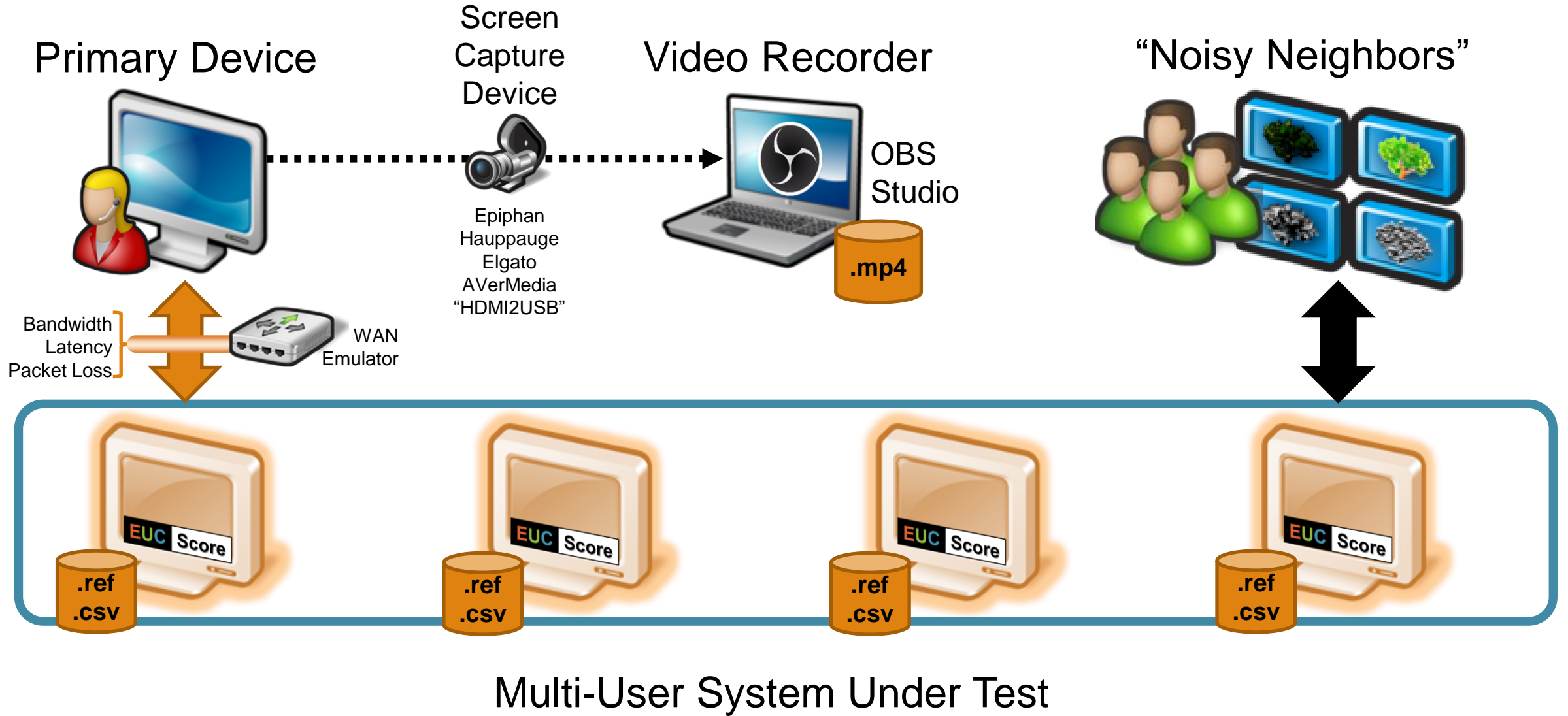
- Pre-production benchmarking and performance testing
- Ad-hoc systems diagnostics and analysis
- Quality assurance and control
- SLA management



Build a Single-User Test Lab



Build a Multi-User Test Lab






Lab Components

Digital workspace experience benchmarking and rating

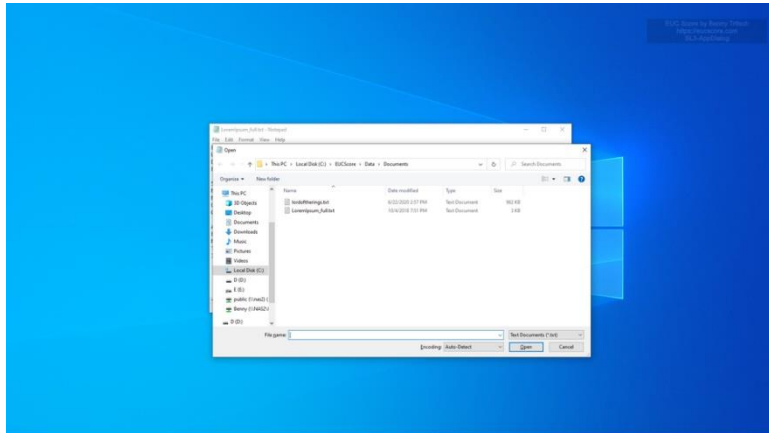
- Simulated Workloads = “Simloads”
- Avatar with Telemetry Collector
- Simload Runner
- [Frame Grabber](#) + Screen Video Recorder
- Startup Simload and Data Miner
- Sync Player (HTML5) + Build Scripts
- Simload SDK
- [WAN Emulators](#)
- “Click-to-Photon” Devices (NVIDIA LDAT)
- Reference Client + Host Machine (Lancelot)



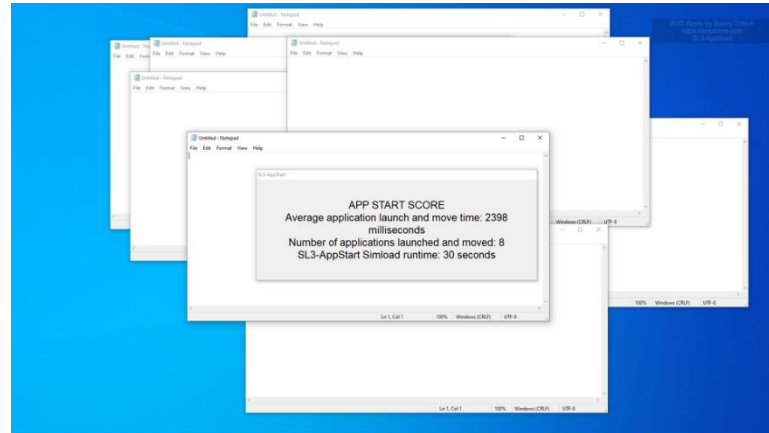
Simulated Workloads – “Simloads”

	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 overlaid 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.

<https://eucscore.com/gallery.html>



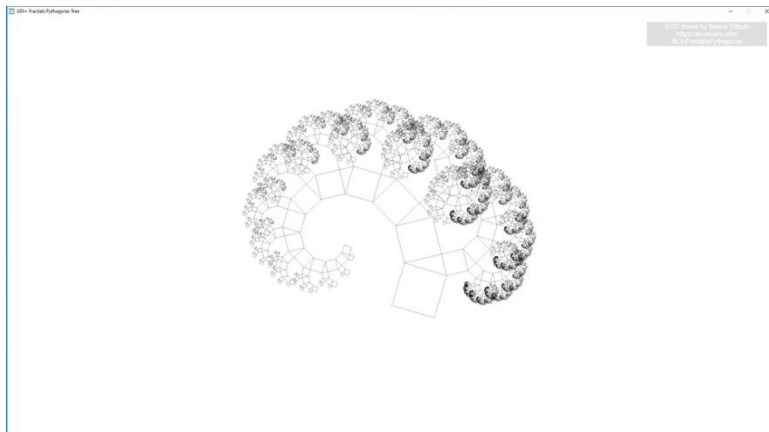
SL3-AppDialog



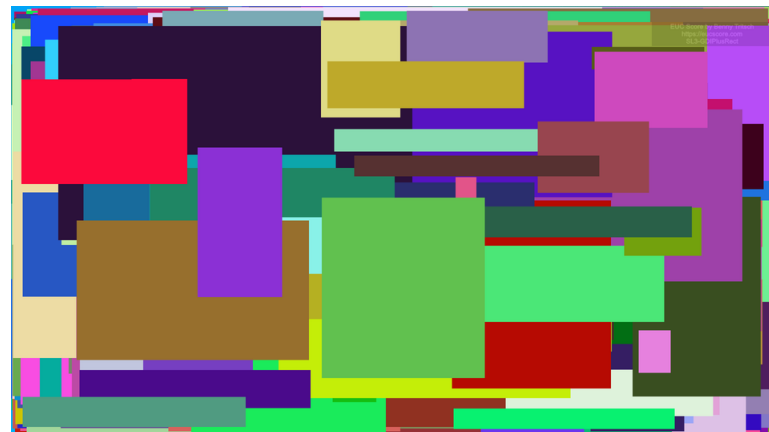
SL3-AppStart



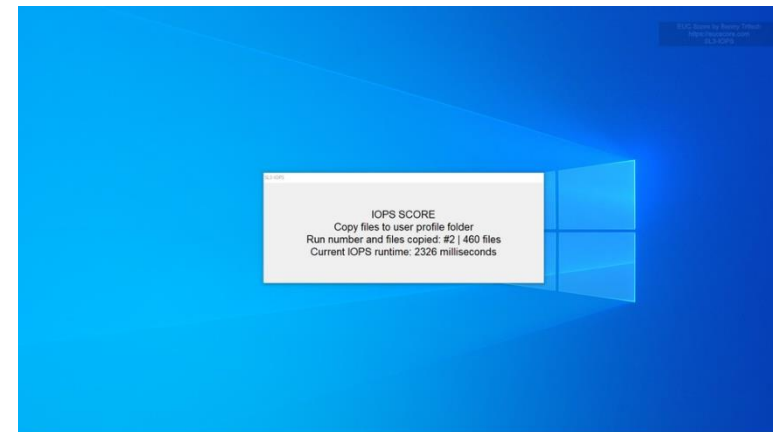
SL3-FractalsDragon



SL3-FractalsPythagorasTree



SL3-GDIPlusRect



SL3-IOPS

Score Simloads

Simload Components – Setup

Setup - EUC Score Simloads and Media version 22.12

Select Components
Which components should be installed?

Select the components you want to install; clear the components you do not want to install. Click Next when you are ready to continue.

Full installation: All Type-1 and Type-2 Simloads including media files

<input checked="" type="checkbox"/>	Video Simloads and media files	556.6 MB
	<input checked="" type="checkbox"/> Video media files	550.8 MB
	<input checked="" type="checkbox"/> WMPPlayer video Simloads (video media files required)	5.9 MB
<input checked="" type="checkbox"/>	Browser Simloads and media files	809.0 MB
	<input checked="" type="checkbox"/> Browser media files	777.1 MB
	<input checked="" type="checkbox"/> Microsoft Edge Simloads (browser media required)	16.0 MB
	<input checked="" type="checkbox"/> Google Chrome Simloads (browser media required)	16.0 MB
<input checked="" type="checkbox"/>	Adobe Simloads (Adobe Acrobat Reader required)	4.3 MB
<input checked="" type="checkbox"/>	Microsoft Office Simloads (Microsoft Office required)	176.6 MB
<input checked="" type="checkbox"/>	Humus Simloads (GPU required by some Humus apps)	17.7 MB
<input checked="" type="checkbox"/>	Geeks 3D Simloads (GPU required)	10.6 MB
<input checked="" type="checkbox"/>	Cinebench Simloads (GPU required)	200.6 MB
<input checked="" type="checkbox"/>	Google Earth Simloads (Google Earth required)	1.5 MB
<input checked="" type="checkbox"/>	Personas (Type-2 Simloads)	888.5 MB

Current selection requires at least 2.61 GB of disk space.

Next Cancel

Perform & Test

Client-Side vs Host-Side User Simulation

Client-Side Synthetic Users



Logon simulator and Robotic Process Automation (RPA)

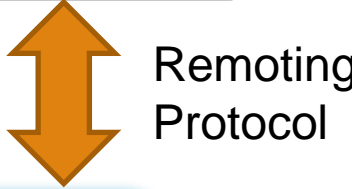


User session(s) with monitoring solution

Host-Side Synthetic Users

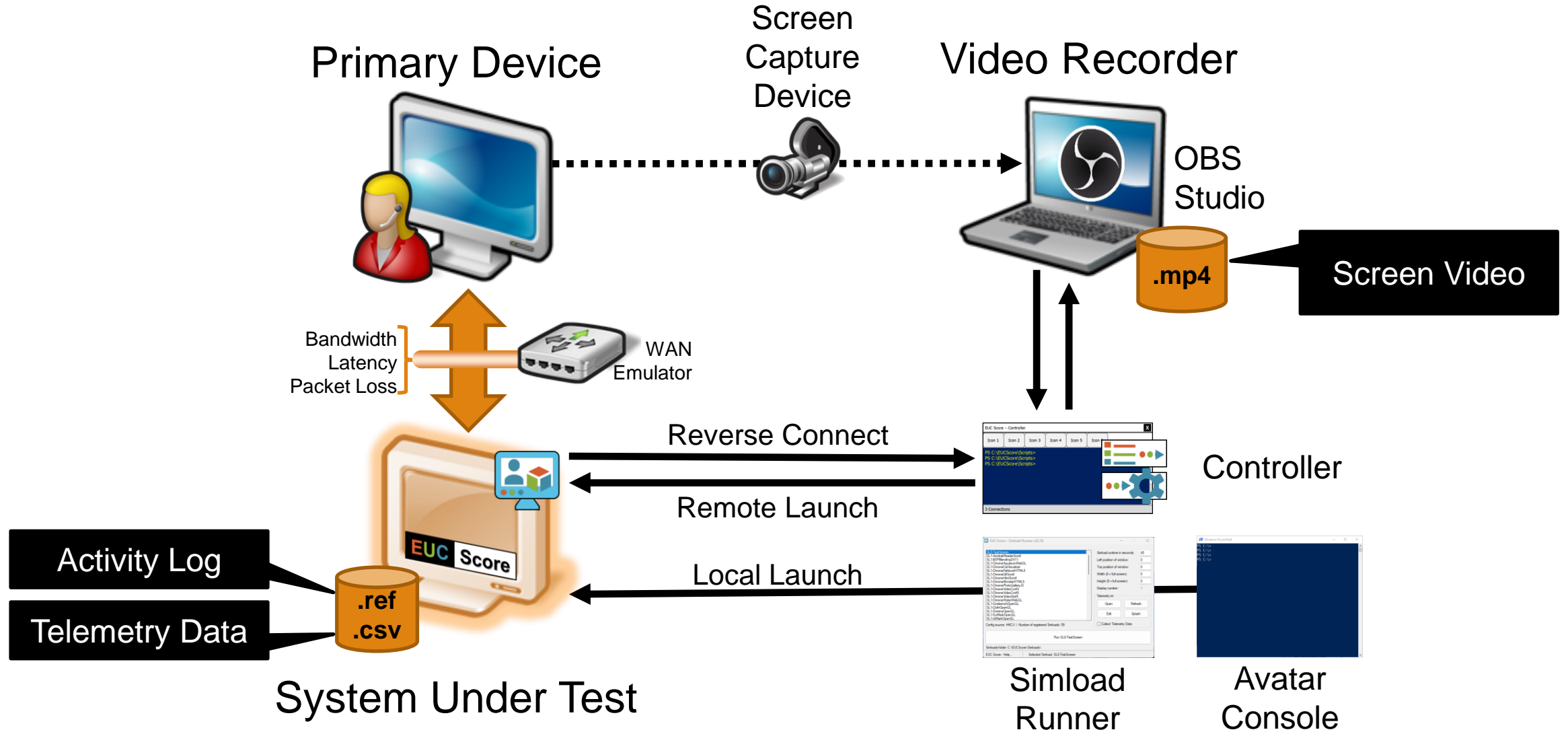


Full range of Remote Connection Clients

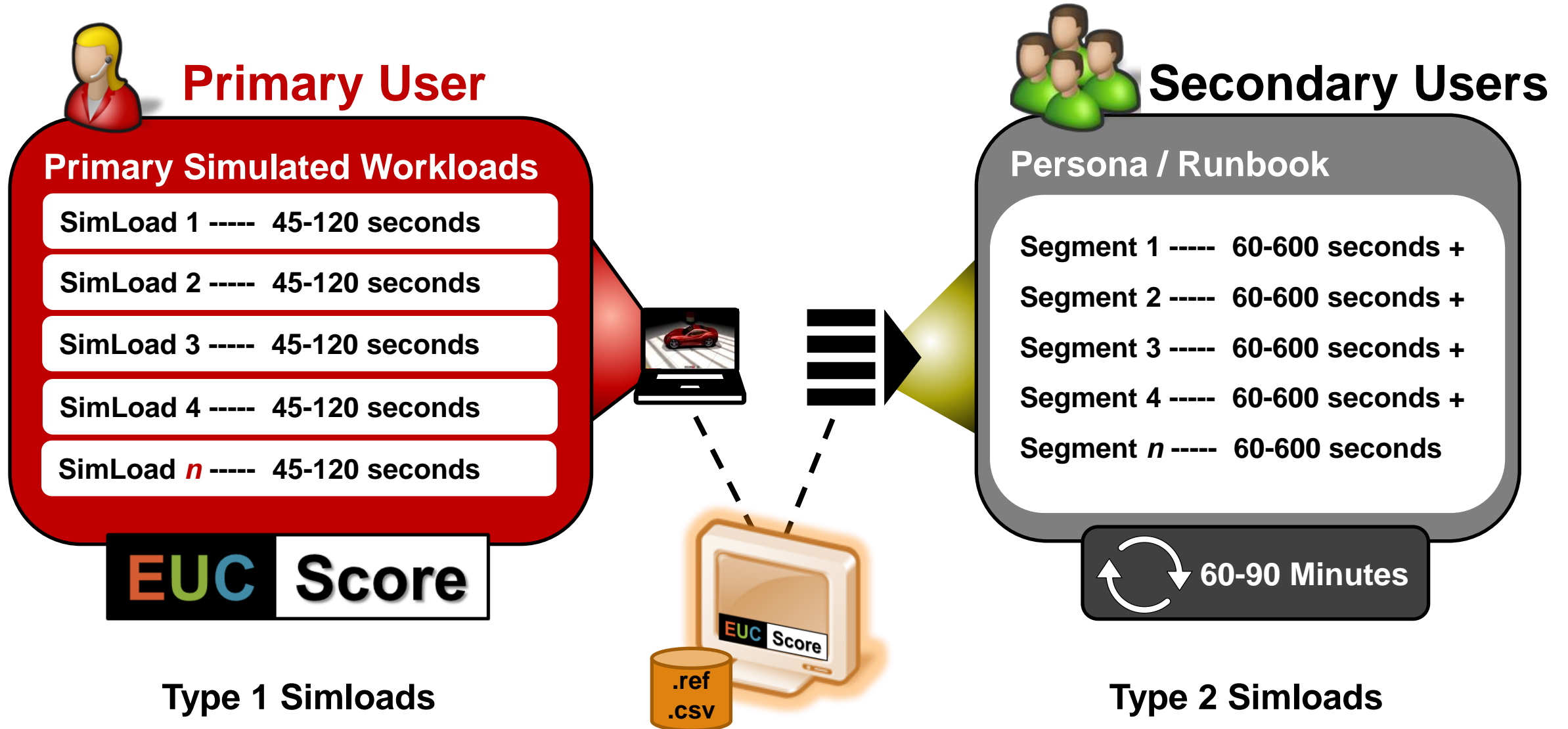


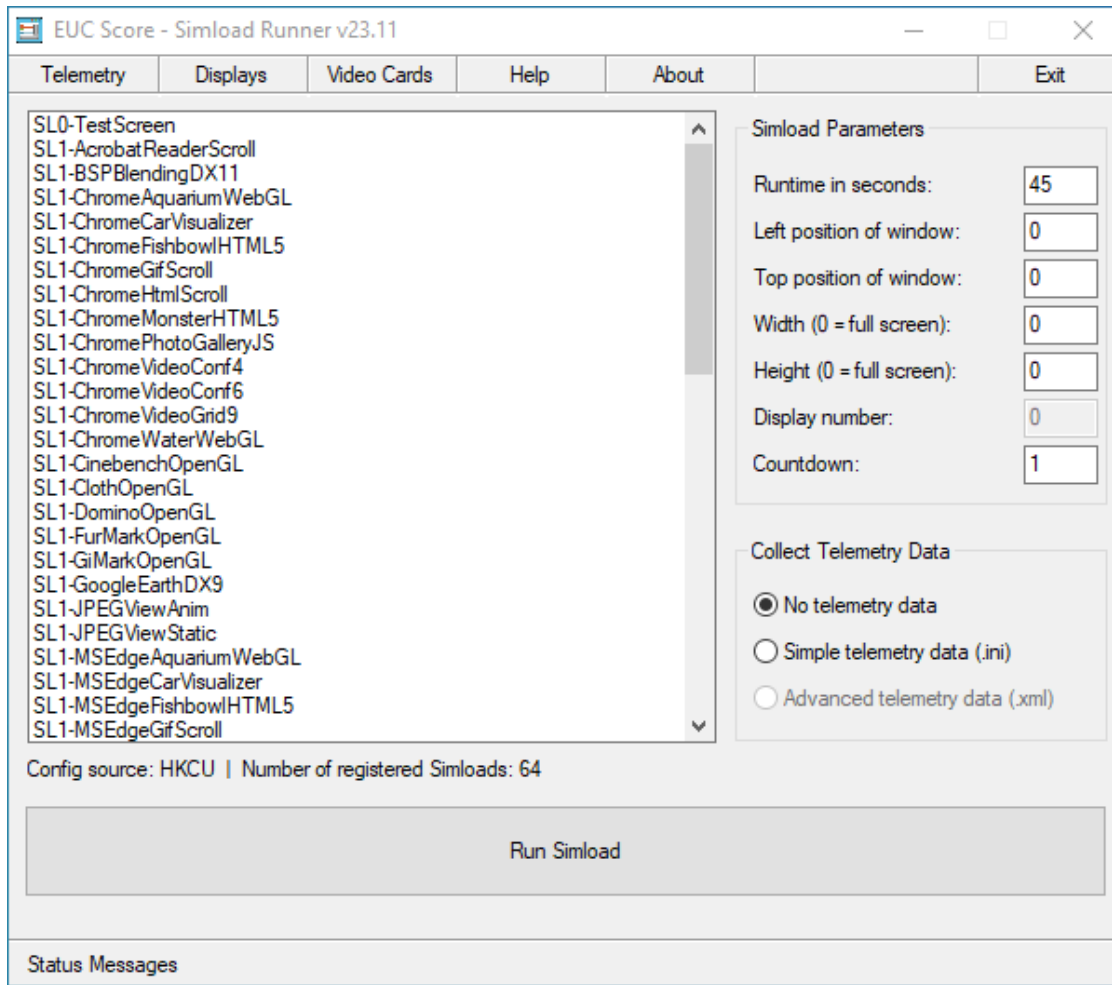
User session(s) with Simloads, Avatar and Telemetry Collector

Perform EUC Score Test Runs

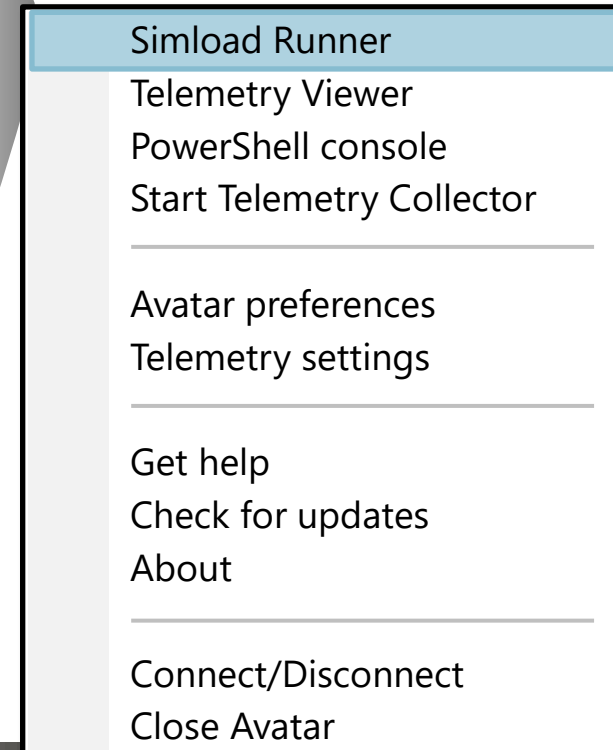


Running Tests – EUC Score “Simloads”



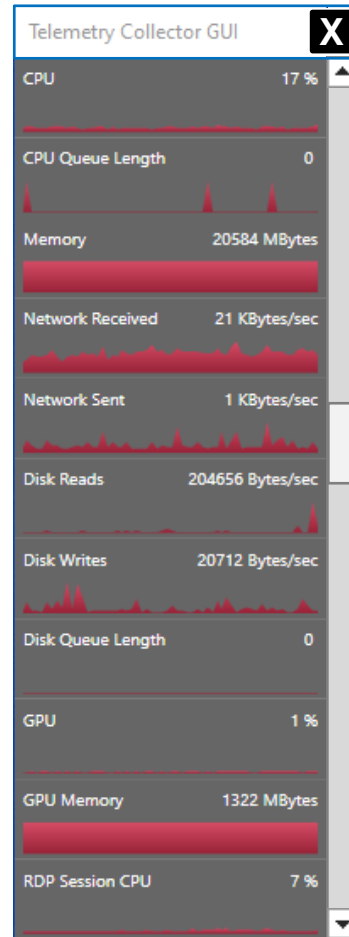


SimloadRunner.exe



Telemetry Collector

Store performance counters and additional metrics in a .csv file



- Simload Runner
- Telemetry Viewer**
- PowerShell console
- Start Telemetry Collector

- Avatar preferences
- Telemetry settings

- Get help
- Check for updates
- About

- Connect/Disconnect
- Close Avatar



```
EUC Score PowerShell
PS C:\EUCScore\Scripts>
PS C:\EUCScore\Scripts>
PS C:\EUCScore\Scripts> .\Run-ApsTestScreen.ps1
```

- Simload Runner
- Telemetry Viewer
- PowerShell console**
- Start Telemetry Collector

- Avatar preferences
- Telemetry settings

- Get help
- Check for updates
- About

- Connect/Disconnect
- Close Avatar

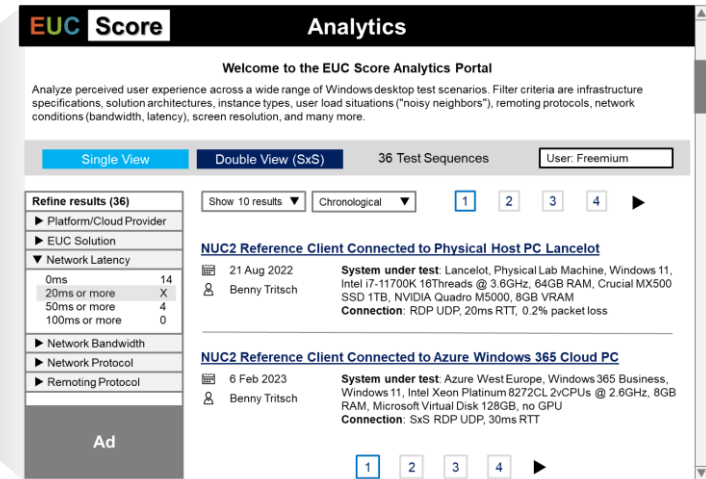
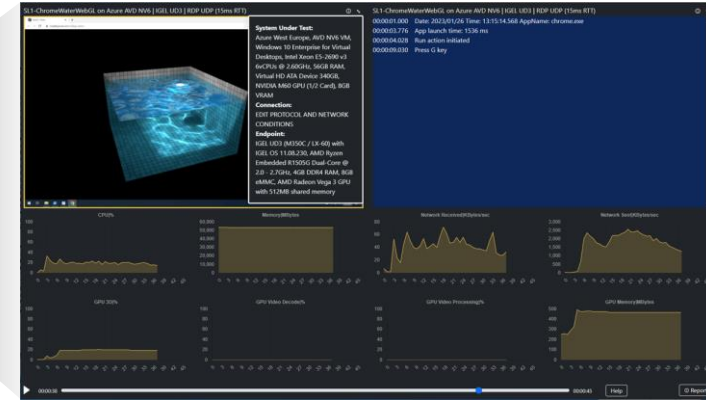
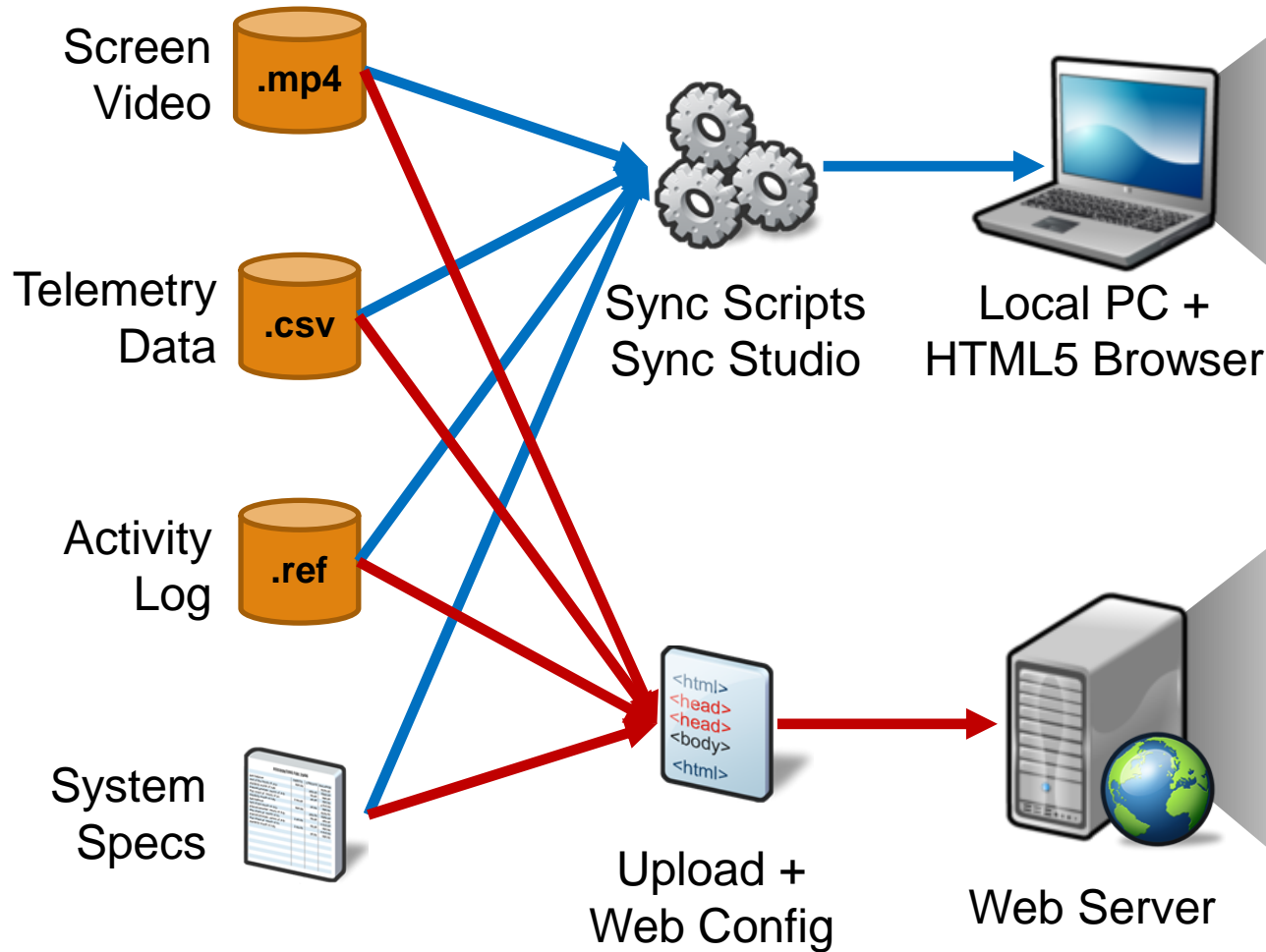


```
EUC Score PowerShell
PS C:\EUCScore\Scripts> .\Run-ApsChromeWaterWebGL.ps1
PS C:\EUCScore\Scripts>
```



Visualize, Analyze & Publish

Visualize, Analyze & Publish



Analytics Portal

Left Media Tile
“Screen Recording”
[.mp4]

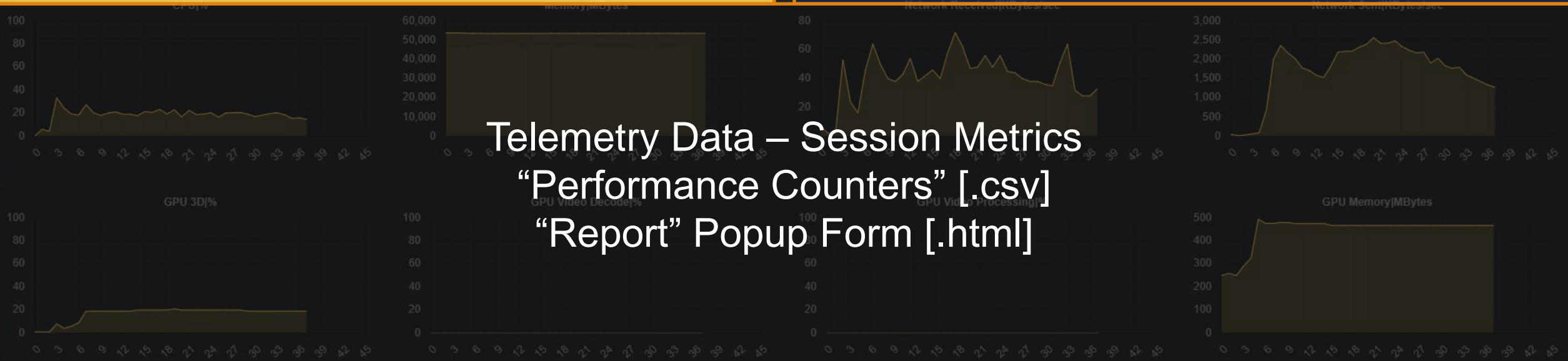
Description

System & User Activities
[.ref]

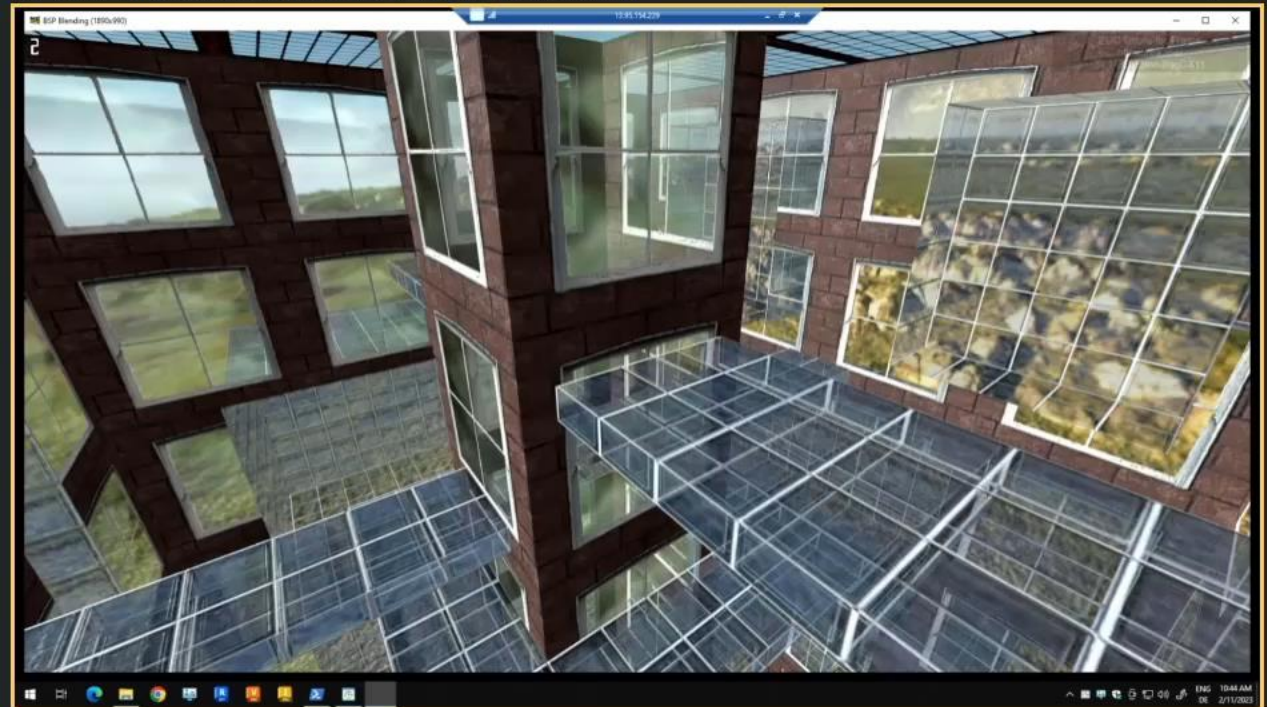
```

00:00:01.000 Date: 2023/01/26 Time: 13:13:14.508 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

```

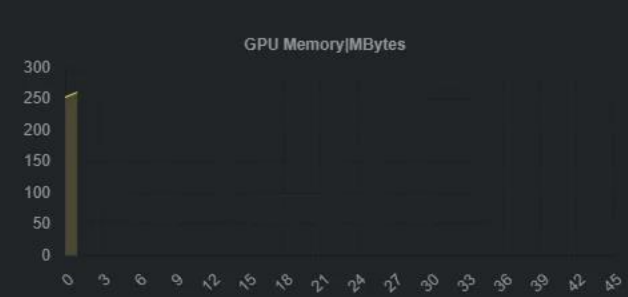
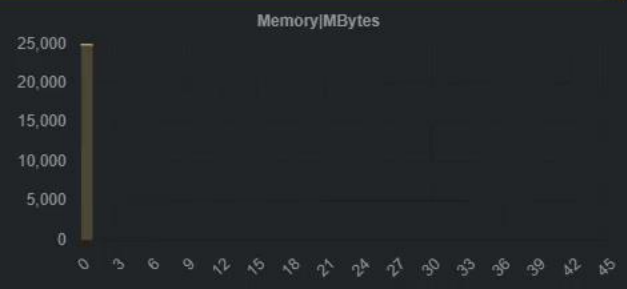


Telemetry Data – Session Metrics
“Performance Counters” [.csv]
“Report” Popup Form [.html]



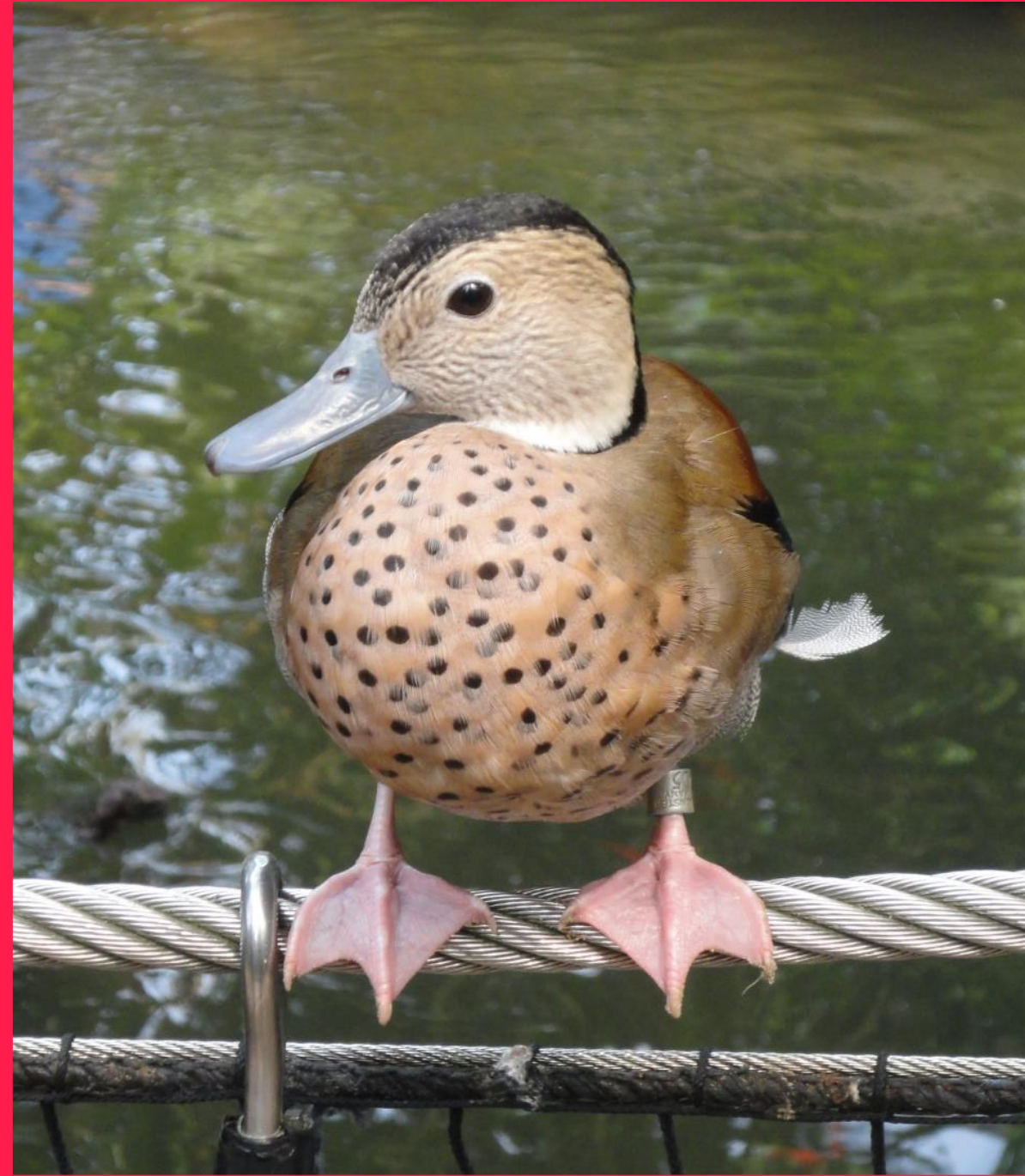
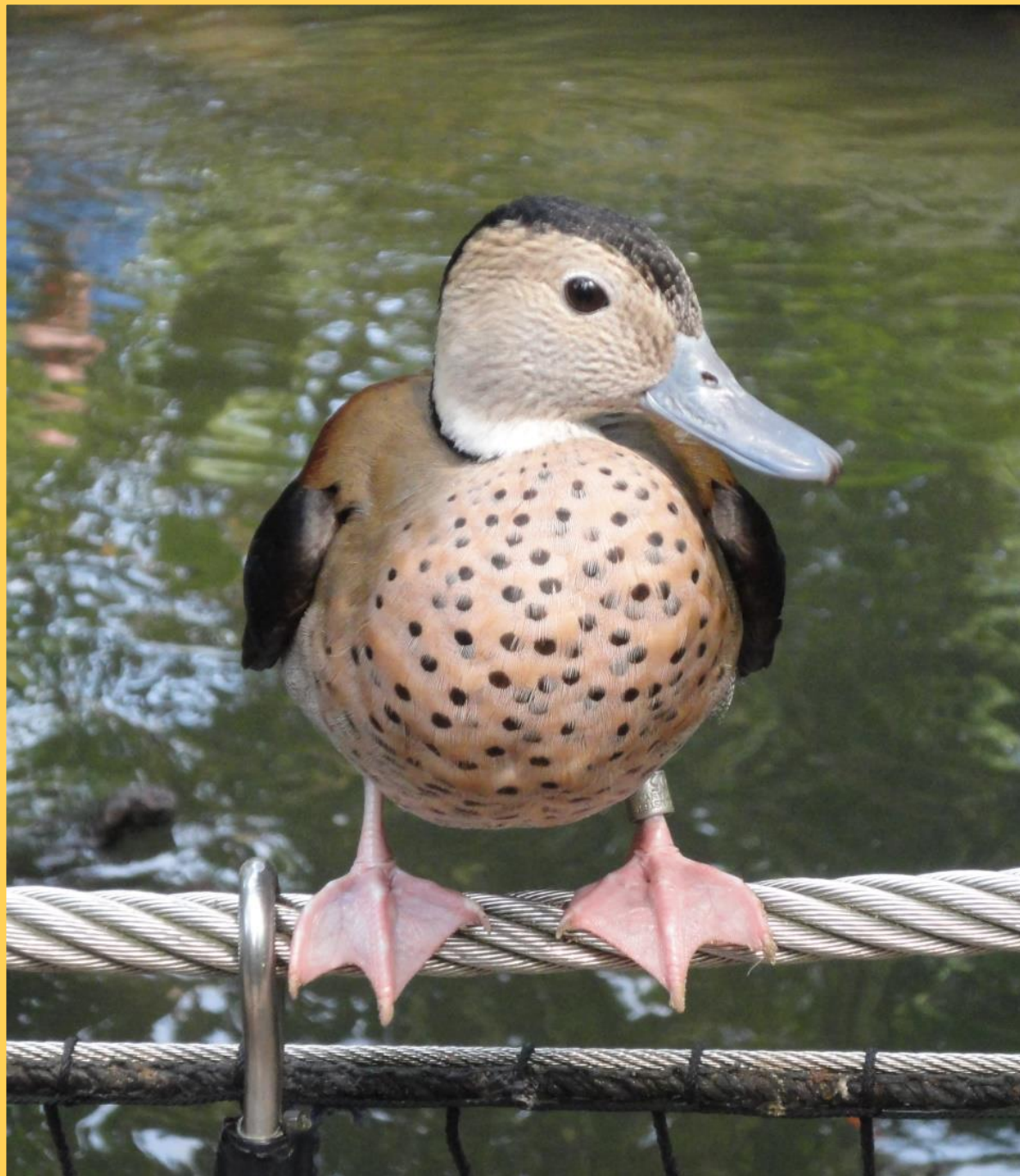
```

00:00:01.000 Date: 2023/02/11 Time: 10:44:19.351 AppName: BSPBlending.exe
00:00:01.631 App launch time: 602 ms
00:00:01.887 Run action initiated
  
```



Glossary – Screen Artifacts / Anomalies

- Block boundary – mosaicking, pixelating, quilting, checkerboarding
- Tiling, striping – rendering each section of an image grid, a tile, or a stripe separately
- Smear artifact – grime, smudge, airbrush effect
- Blurriness – out of focus, fuzziness, unsharpness
- Color artifacts – false colors, color bleeding
- Mosquito noise – edge busyness
- Ringing – echoing, ghosting
- Choppy – laggy, jumpy, jerky
- Floating – illusory motion in certain regions while the surrounding areas remain static
- Jitter – loss of transmitted data between network devices
- Flickering – fine-grain flickering and coarse-grain flickering
- Slow motion
- Video stuttering (“micro stutters”)
- Freeze frames



Left Media Tile
“Pacemaker” Video
[.mp4]

Right Media Tile
Comparison Video
[.mp4]

Color-Coded Telemetry Data – 2 x Session Metrics
“Performance Counters” Overlay [.csv]
“Report” Popup Form [.html]



System Under Test:

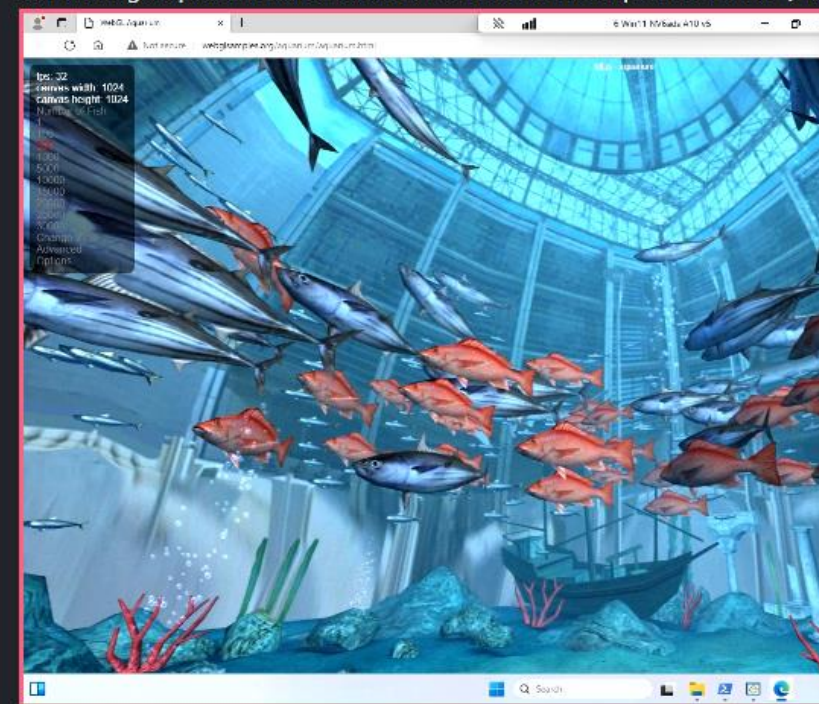
Local Remote PC Lancelot,
Windows 11, i7-11700K 3.60GHz
16Threads, 64GB RAM, 1TB
Crucial MX500 SSD, NVIDIA
Quadro M5000, 8GB VRAM,
Microsoft Remote Display
Adapter

Connection:

RDP UDP, 0ms RTT

Endpoint:

Intel NUC 8i7HNK with Windows
11, Intel i7-8705G 8Threads @
3.10GHz, 16GB RAM, 500GB
Samsung SSD 850 EVO M.2, AMD
Radeon RX Vega M GL GPU with
4GB VRAM, Remote Desktop
Connection 10.0.22621



System Under Test:

Azure West Europe,
NV6ads_A10_v5, Windows 11
22H2 Multi-Session, AMD EPYC
74F3 Milan 6vCPUs @ 3.2GHz,
55GB RAM, 256GB Premium SSD,
NVIDIA A10-4Q, 4GB VRAM

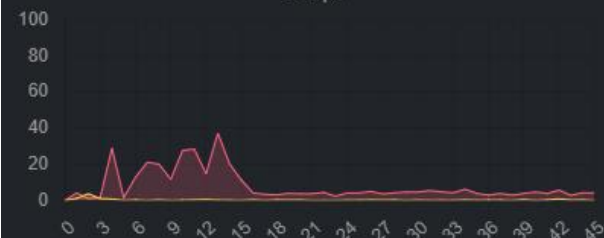
Connection:

SxS RDP UDP, 15ms RTT

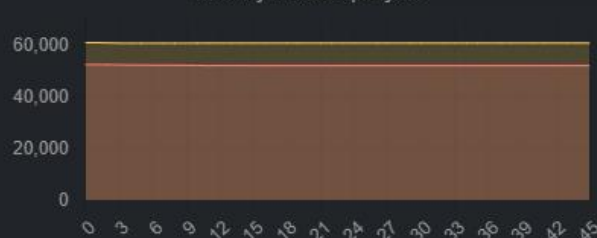
Endpoint:

Intel NUC 8i7HNK with Windows
11, Intel i7-8705G 8Threads @
3.10GHz, 16GB RAM, 500GB
Samsung SSD 850 EVO M.2, AMD
Radeon RX Vega M GL GPU with
4GB VRAM, AVD HostApp
1.2.4582.0

CPU%



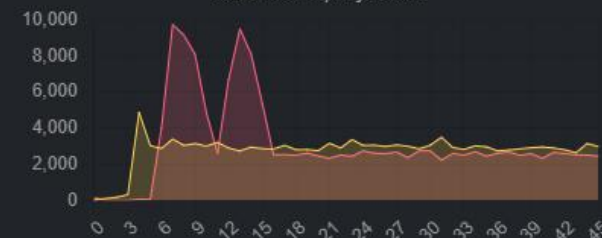
Memory Available|MBytes



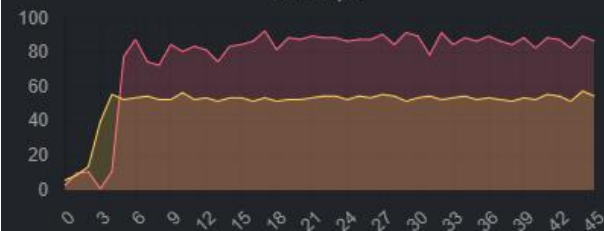
Network Received|KBytes/sec



Network Sent|KBytes/sec



GPU 3D|%



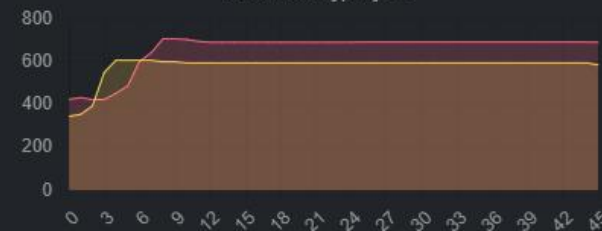
GPU Video Decode|%



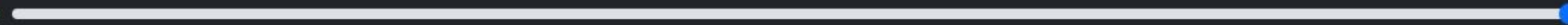
GPU Video Processing|%



GPU Memory|Mbytes



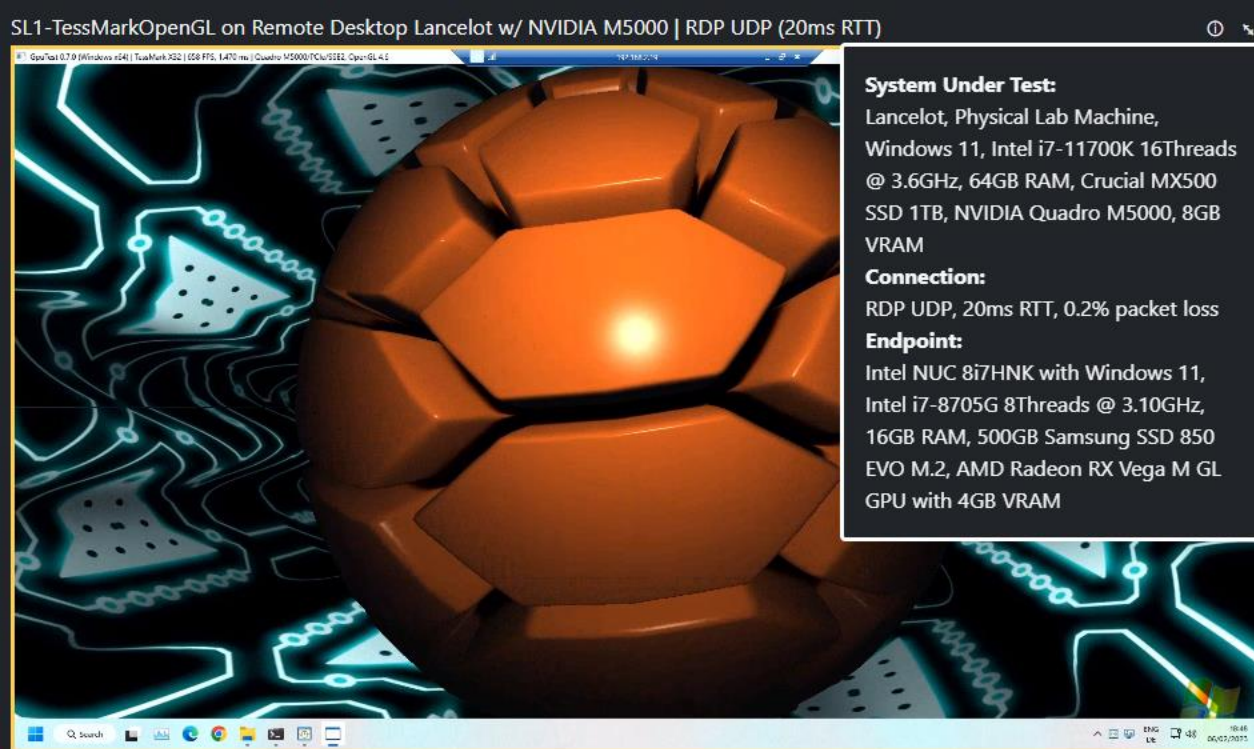
00:00:44



00:00:44

Help

Report



SL1-TessMarkOpenGL

SL1-TessMarkOpenGL: Open locally stored Geeks3D GpuTest TessMark (OpenGL 4.0). Requires a physical or virtual GPU.

Findings: 650 FPS vs 800 FPS and smoother animation on the Azure side (40% CPU load)

Screen Recording (Left)

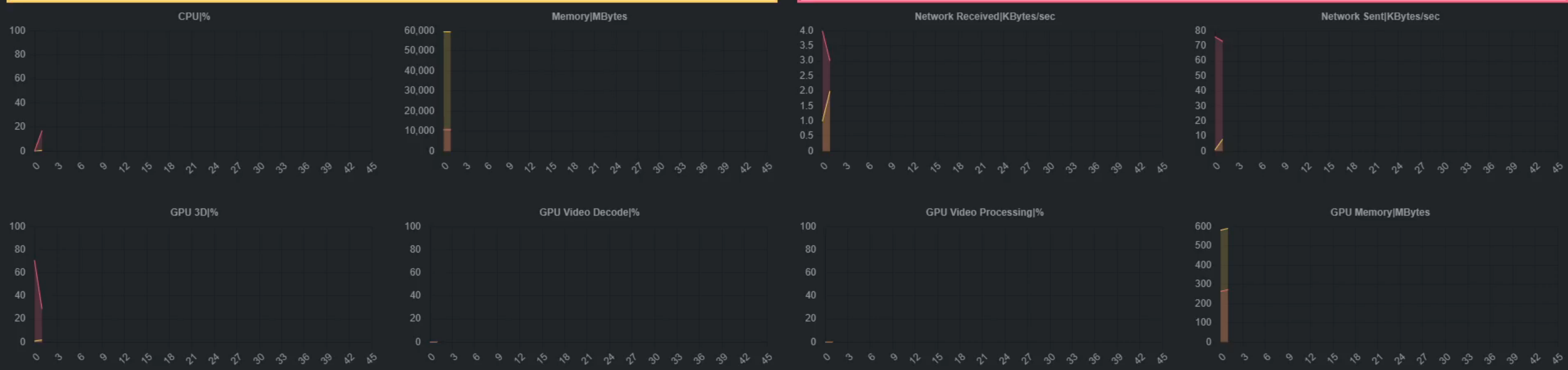
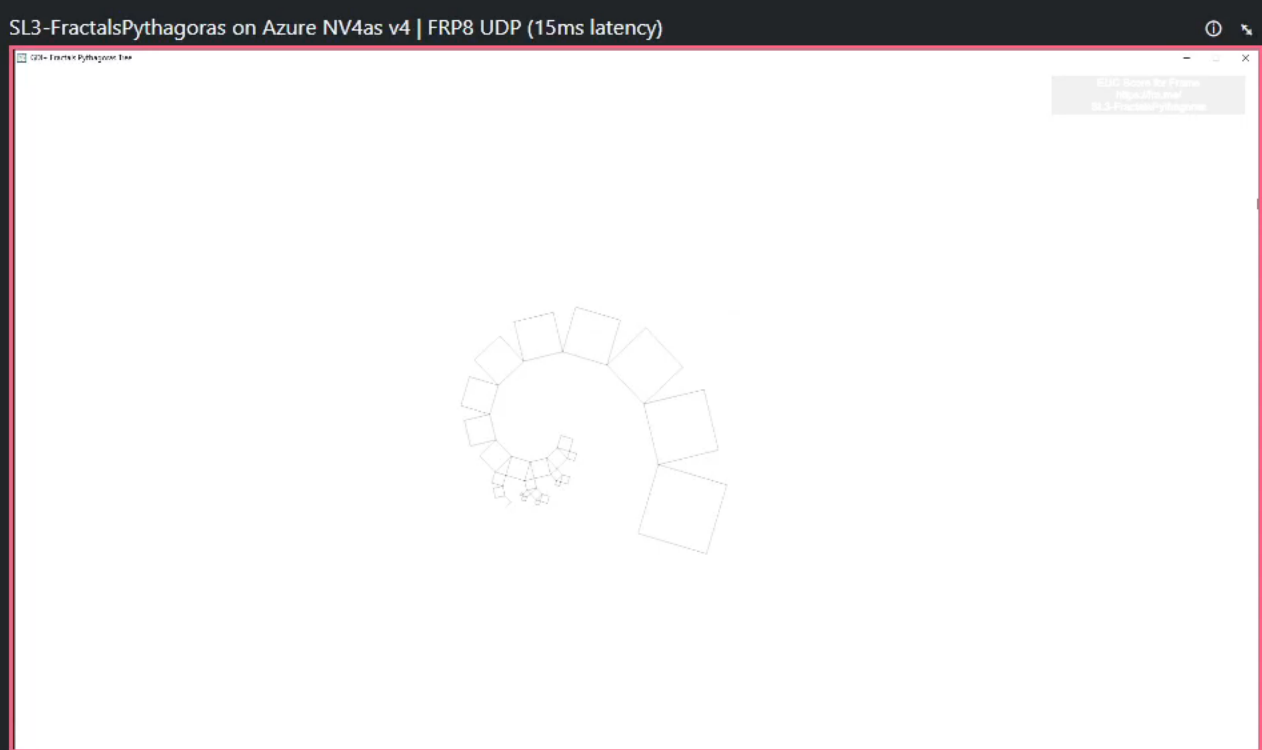
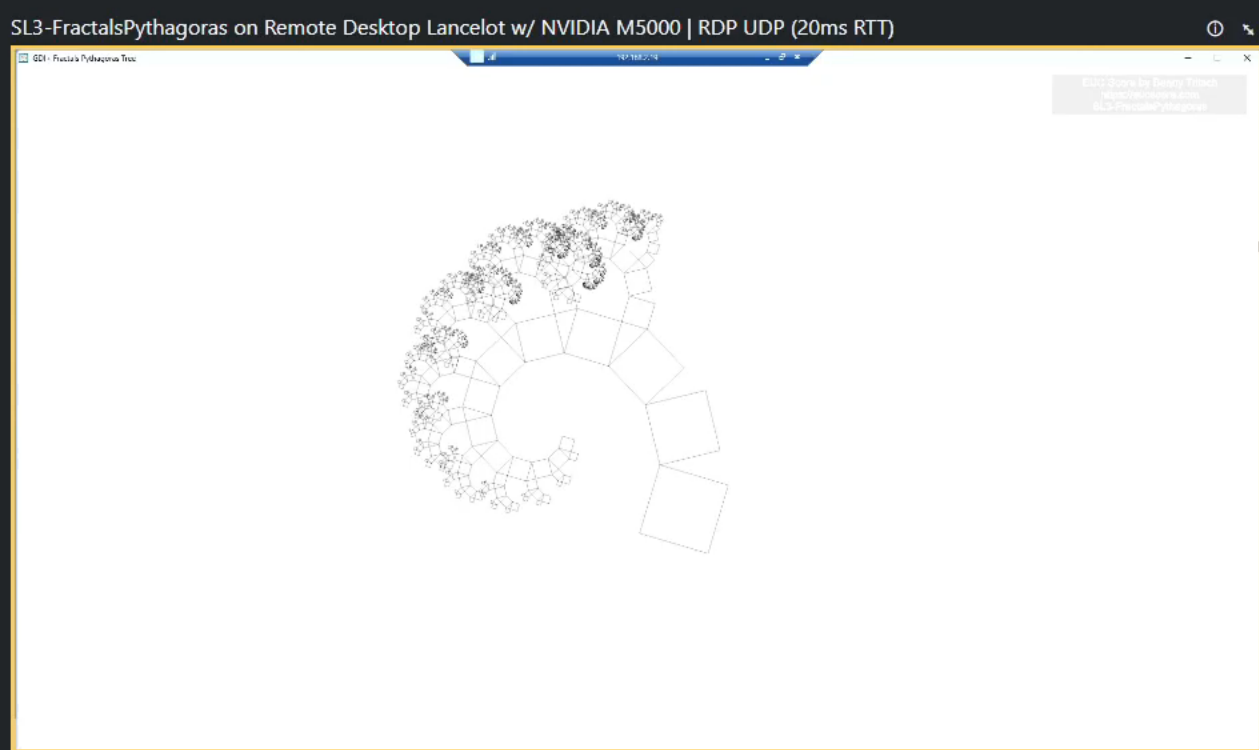
Screen video captured with a frame grabber and recorded with OBS Studio at full HD resolution and 60 frames per second.

Lancelot, Physical Lab Machine, Windows 11, Intel i7-11700K 16Threads @ 3.6GHz, 64GB RAM, Crucial MX500 SSD 1TB, NVIDIA Quadro M5000, 8GB VRAM

Screen Recording (Right)

Screen video captured with a frame grabber and recorded with OBS Studio at full HD resolution and 60 frames per second.

Azure West Europe, NC4asT4 v3 VM, Windows 10 21H2, AMD EPYC 7V12 (Rome) 4vCPUs @ 2.4GHz, 28GB RAM, 256GB + 176GB P-SSD, NVIDIA T4, 16GB VRAM, Frame Display Driver



Future Analytics Portal Single View

Welcome to the EUC Score Analytics Portal

Analyze perceived user experience across a wide range of Windows desktop test scenarios. Filter criteria are infrastructure specifications, solution architectures, instance types, user load situations ("noisy neighbors"), remoting protocols, network conditions (bandwidth, latency), screen resolution, and many more.

Single View

Double View (SxS)

36 Test Sequences

User: Freemium

Refine results (36)

▶ Platform/Cloud Provider

▶ EUC Solution

▼ Network Latency

0ms	14
20ms or more	X
50ms or more	4
100ms or more	0

▶ Network Bandwidth

▶ Network Protocol

▶ Remoting Protocol

Ad

Show 10 results ▼

Chronological ▼

1

2

3

4



NUC2 Reference Client Connected to Physical Host PC Lancelot

📅 21 Aug 2022

👤 Benny Tritsch

System under test: Lancelot, Physical Lab Machine, Windows 11, Intel i7-11700K 16Threads @ 3.6GHz, 64GB RAM, Crucial MX500 SSD 1TB, NVIDIA Quadro M5000, 8GB VRAM
Connection: RDP UDP, 20ms RTT, 0.2% packet loss

NUC2 Reference Client Connected to Azure Windows 365 Cloud PC

📅 6 Feb 2023

👤 Benny Tritsch

System under test: Azure West Europe, Windows 365 Business, Windows 11, Intel Xeon Platinum 8272CL 2vCPUs @ 2.6GHz, 8GB RAM, Microsoft Virtual Disk 128GB, no GPU
Connection: SxS RDP UDP, 30ms RTT

1

2

3

4



**Future
Analytics Portal
Double View**

Welcome to the EUC Score Analytics Portal

Analyze perceived user experience across a wide range of Windows desktop test scenarios. Filter criteria are infrastructure specifications, solution architectures, instance types, user load situations ("noisy neighbors"), remoting protocols, network conditions (bandwidth, latency), screen resolution, and many more.

Single View
Double View (SxS)
36 Test Sequences
User: Freemium

Refine results (36)

- ▶ Platform/Cloud Provider
- ▶ EUC Solution
- ▼ Network Latency

0ms	14
20ms or more	X
50ms or more	4
100ms or more	0
- ▶ Network Bandwidth
- ▶ Network Protocol
- ▶ Remoting Protocol

COMPARE

Ad

Show 10 results ▼
References only ▼

NUC2 Reference Client Connected to Physical Host PC Lancelot

📅 21 Aug 2022
 ✓

👤 Benny Tritsch
 ✓

System under test: Lancelot, Physical Lab Machine, Windows 11, Intel i7-11700K 16Threads @ 3.6GHz, 64GB RAM, Crucial MX500 SSD 1TB, NVIDIA Quadro M5000, 8GB VRAM

Connection: RDP UDP, 20ms RTT, 0.2% packet loss

Show 10 results ▼
Chronological ▼

NUC2 Reference Client Connected to Azure Windows 365 Cloud PC

📅 6 Feb 2023
 ✓

👤 Benny Tritsch
 ✓

System under test: Azure West Europe, Windows 365 Business, Windows 11, Intel Xeon Platinum 8272CL 2vCPUs @ 2.6GHz, 8GB RAM, Microsoft Virtual Disk 128GB, no GPU

Connection: SxS RDP UDP, 30ms RTT

Call to Action

EUC Score Business Model

- Individual - \$495/year or \$149/3mo
- Enterprise - \$5,000/yr or \$1,500/3mo
- Project-in-a-Box - \$7,500 - \$25,000

info@eucscore.com



<https://eucscore.com>

NOTE: The EUC Score toolset including the Simloads is free for community benchmarks








EUC Score Links

- Home Page: <https://eucscore.com/>
- Terminology (Glossary): <https://eucscore.com/terminology.html>
- Lab Equipment: <https://eucscore.com/equipment.html>
- Test Methodology: <https://eucscore.com/methodology.html>
- Toolset Documentation: <https://eucscore.com/docs/index.html>
- Simload Gallery: <https://eucscore.com/gallery.html>
- Test Results (Sync Player): <https://eucscore.com/results>
- Freeware Downloads: <https://eucscore.com/freeware>

Addendum Science of EUC

Benny Tritsch | info@eucscore.com | [@drtritsch](https://twitter.com/drtritsch)

Science of EUC: Personas

	Persona Name	Rendering	IT Workforce	Description
	Task Worker	CPU	25-80%	Well-defined, repetitive, and delineated tasks, using a limited number of applications
	Information Worker	CPU or shared GPU	25-80%	Find facts quickly, create documents, edit, write & process information
	Knowledge Worker	High-end CPU or shared GPU	10-50% ~400m	Tasks include accessing the Internet, using email, and creating complex documents, presentations, and spreadsheets
	Power User	Shared GPU or dedicated GPU	5-50% ~200m	People who use multiple compute, network and graphics-intensive applications
	CAD/CAM Professional Designer	Dedicated GPU	5-25% ~25m	People who use graphically-intense applications for computer-aided design (CAD) and computer-aided manufacturing (CAM)

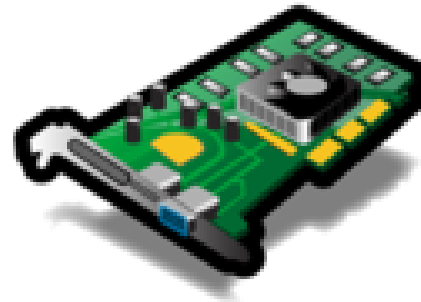
Science of EUC: Performance Influencers



Host System



Client Device



GPUs



Network

Science of EUC: Network Factors

The richer the graphics, the more bandwidth it will take



Bandwidth

Data transfer rate of a network connection



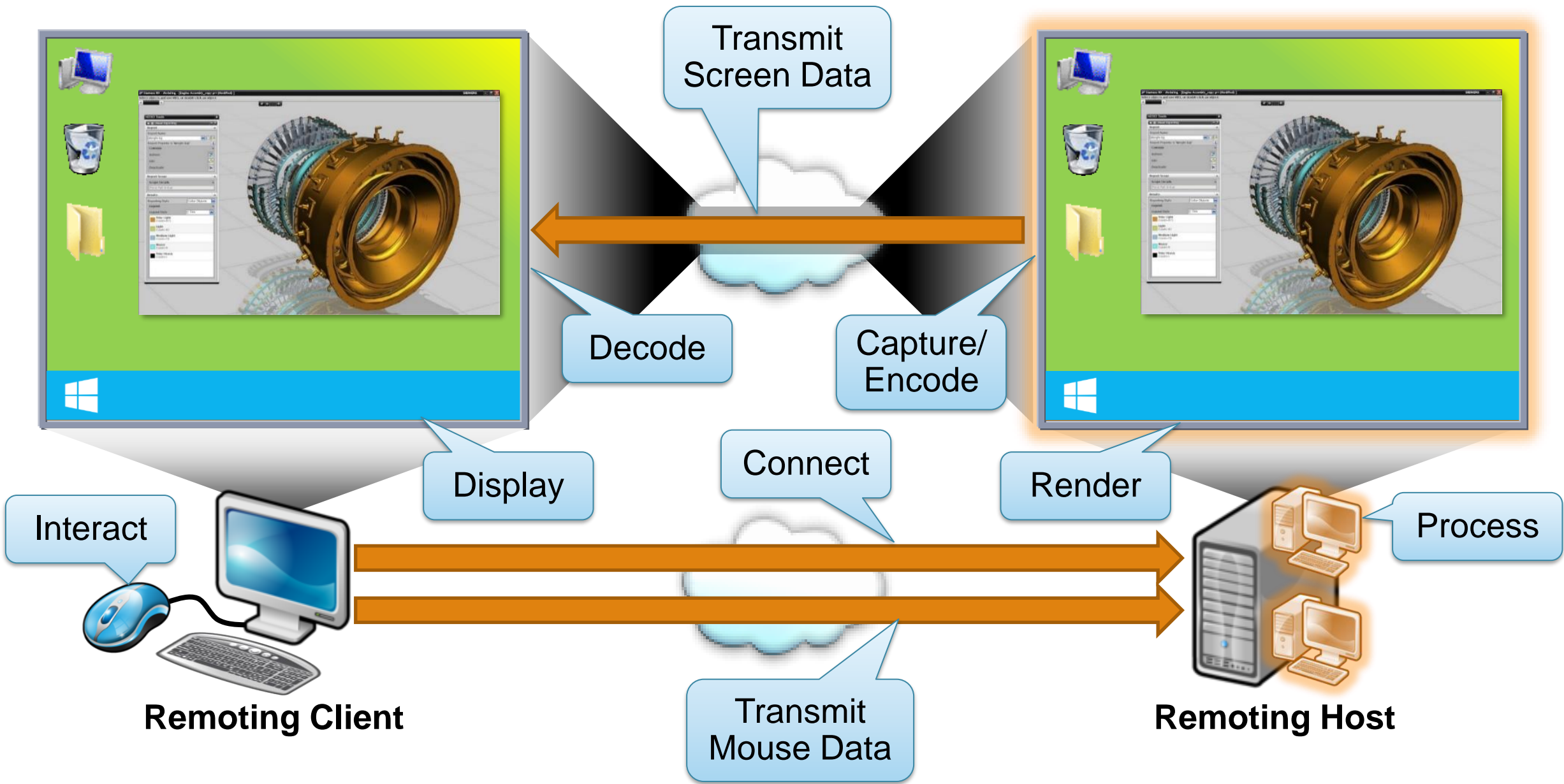
Latency

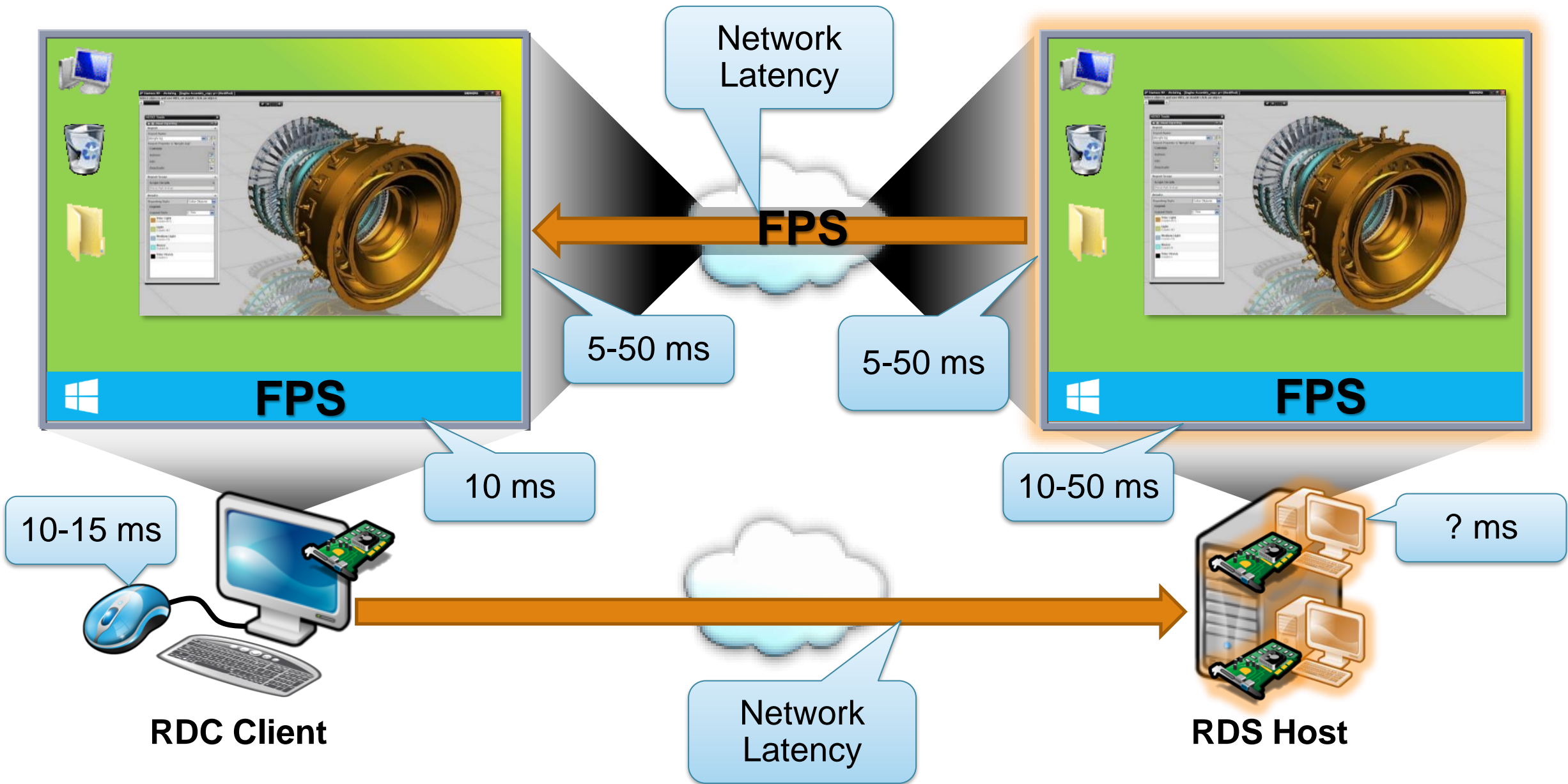
Delay; amount of time to traverse a system



Packet Loss

Discarding of data packets (in percent)





Measure Response Times

0.1 second

- System is reacting instantaneously
- No special feedback is necessary except to display the result
- Limit for users feeling that they are directly manipulating objects in the UI

1.0 second

- User's flow of thought stays uninterrupted, even though the user will notice the delay
- Normally, no special UI feedback is necessary
- Limit for users feeling that they are freely navigating the command space

10 seconds

- Limit for users keeping their attention on the task
- User should be given feedback indicating when the computer expects to be done

The Effect of Visual-Feedback Delay

“Temporal perception of visual-haptic events in multimodal telepresence system” by Zhuanghua Shi, Heng Zou and Hermann J. Müller; April 2010

- User performance is affected by delays exceeding 75ms
- Increase of task completion time when the delay is longer than 250ms
- Starting at a delay around 400ms, the users came to gradually adopt a move-and-wait strategy

DoD: MIL-STD-1472F/G (1999, 2012)

TABLE V. Acceptable system response times.

System Interpretation	Response Time Definition	Time (seconds)
Key response	Key depression until positive response, e.g., “click”	0.1
Key print	Key depression until appearance of character	0.2
Page turn	End of request until first few lines are visible	1.0
Page scan	End of request until text begins to scroll	0.5
XY entry	From selection of field until visual verification	0.2
Pointing	From input of point to display point	0.2
Sketching	From input of point to display of line	0.2
Local update	Change to image using local data base, e.g., new menu list from display buffer	0.5
Host update	Change where data is at host in readily accessible form, e.g., a scale change of existing image	2.0
File update	Image update requires an access to a host file	10
Inquiry (simple)	From command until display of a commonly used message	2.0
Inquiry (complex)	Response message requires seldom used calculations in graphic form	10
Error feedback	From entry of input until error message appears	0.2

Thank You

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