How to get the best User Experience for 3D Workloads

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>4m (13 feet) below sea level

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Joined Citrix July 2021

Graphics geek

It’s all about the User Experience

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SECURITY
php
git
NODE

High Definition Experience

Graphics | video | audio | collaboration | seamless app integration | printing | peripherals | policies

Video Codecs

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Video Codecs

Video codecs are very common

- Remoting protocols
- And many, many more!

They are optimized to reduce bandwidth of moving images

Codecs & introduction date:

- H.264 (AVC) – 2003
- H.265 (HEVC) – 2013
- AV1 - 2018

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Video Codecs

- Most common codec in the world
- Many devices support hardware decoding & Software decoding possible

But…

In 2003, high-res screen were not standard or even available. HDR? 10-bit?

- Commonly used for Blu-rays
- Broad support for HW Enc / Dec
- CPU decoding is costly

	Encoding	Decoding
NVIDIA	Maxwell (2014)	Pascal (2016)
Intel	6th gen (2016)	6th gen (2016)
AMD	Raven (2017)	GCN 3 (2015)

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AV1

AV1 support

AV1 is one of the latest codecs

- Superior compression
- Supported with “Selective” & “Entire Screen”
- Needs Hardware Encoder & Decoder

	Encoding	Decoding
NVIDIA	Lovelace (2022)	Ampere (2020)
Intel	Arc (2022)	11th gen (2021)
AMD		RDNA2 (2020)

Requires VDA & CWA for Windows 2305+

Requires VDA 2308 for encoding on Intel GPUs

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AV1 support

Bandwidth utilization compared to H.264:

Quality	H.265	AV1
Low Quality	-46.5%	-56,6%
Medium Quality	-17.6%	-44.1%
High Quality	-3.1%	-36%

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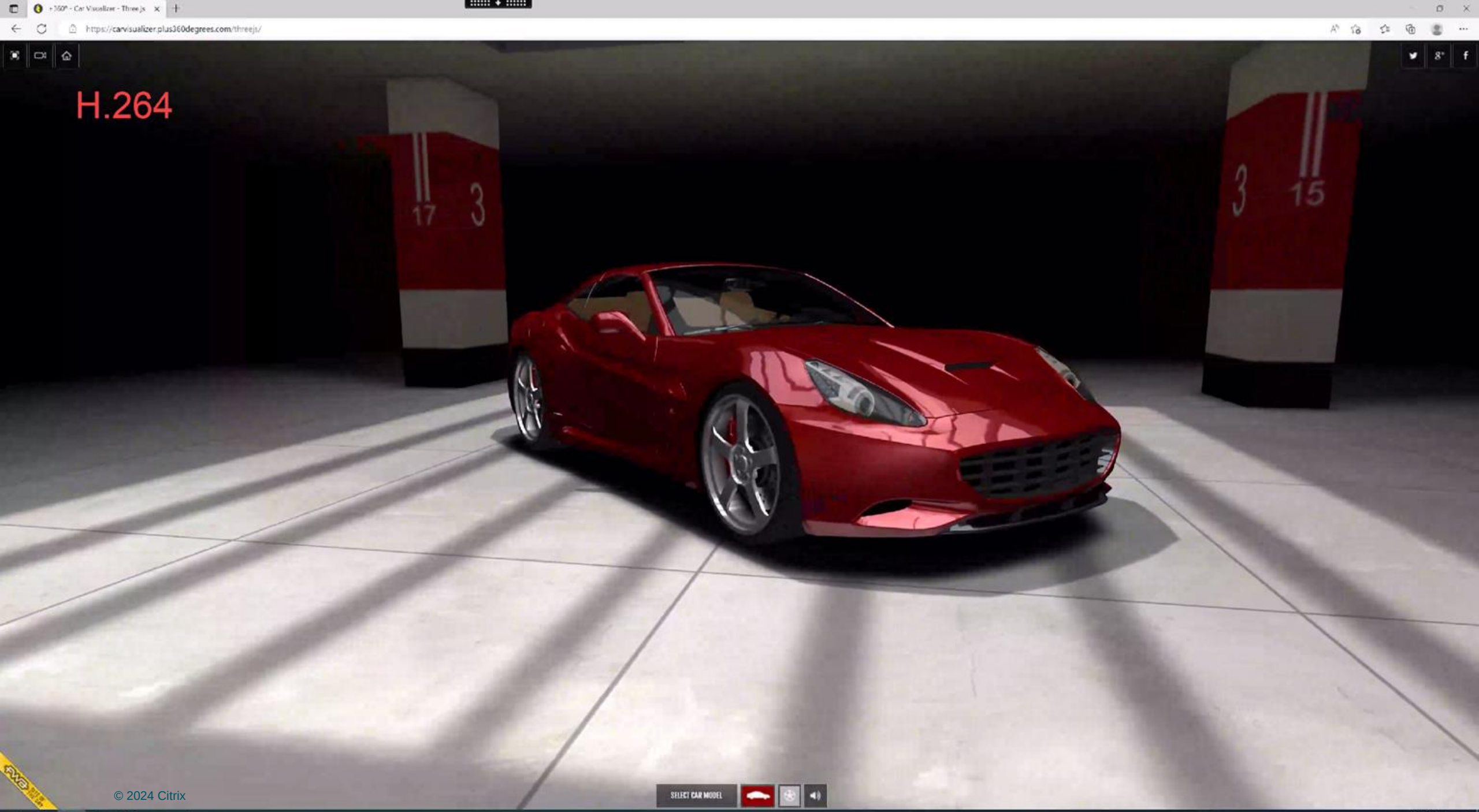
H.264
MPEG-4/AVC

AV1



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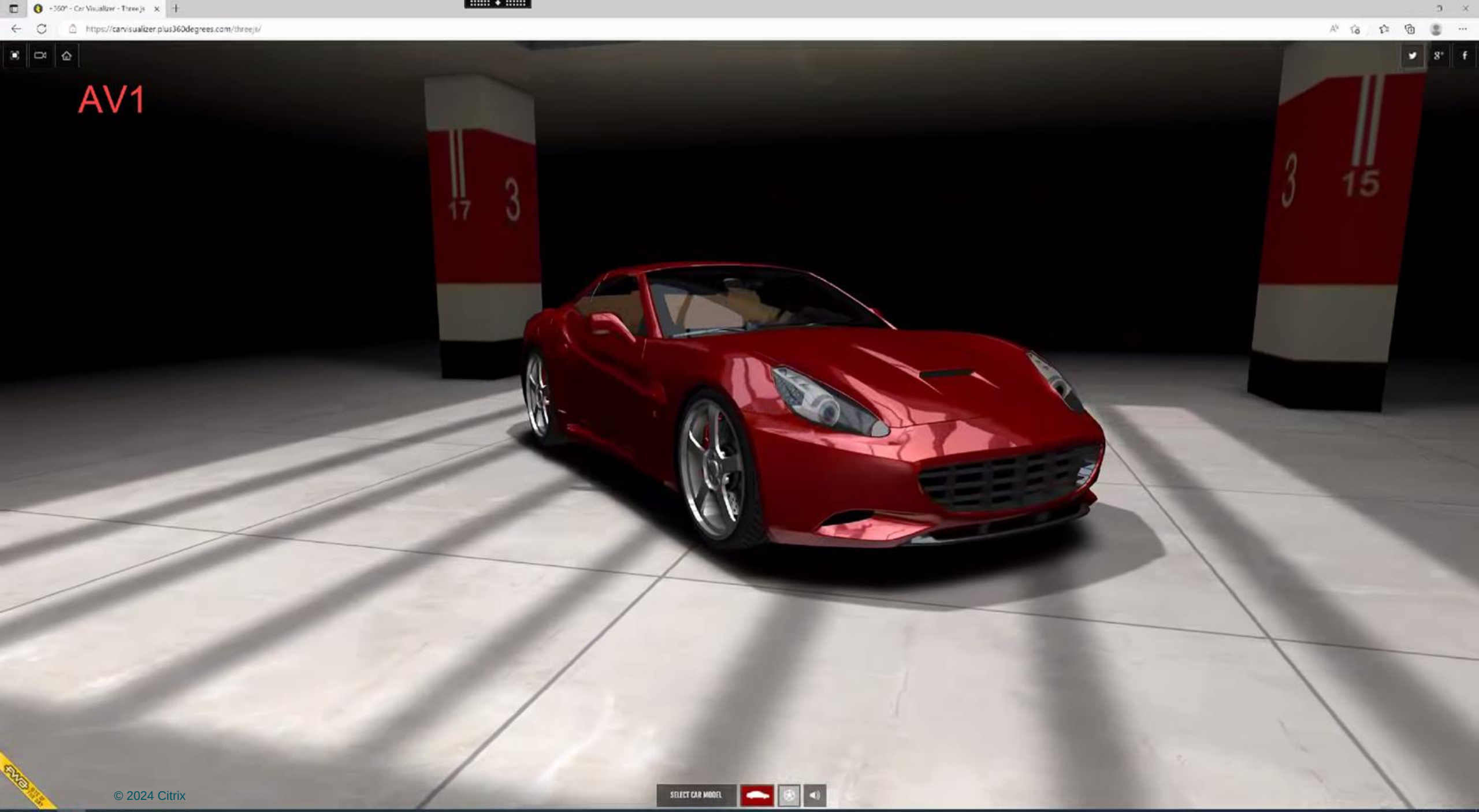
H.264



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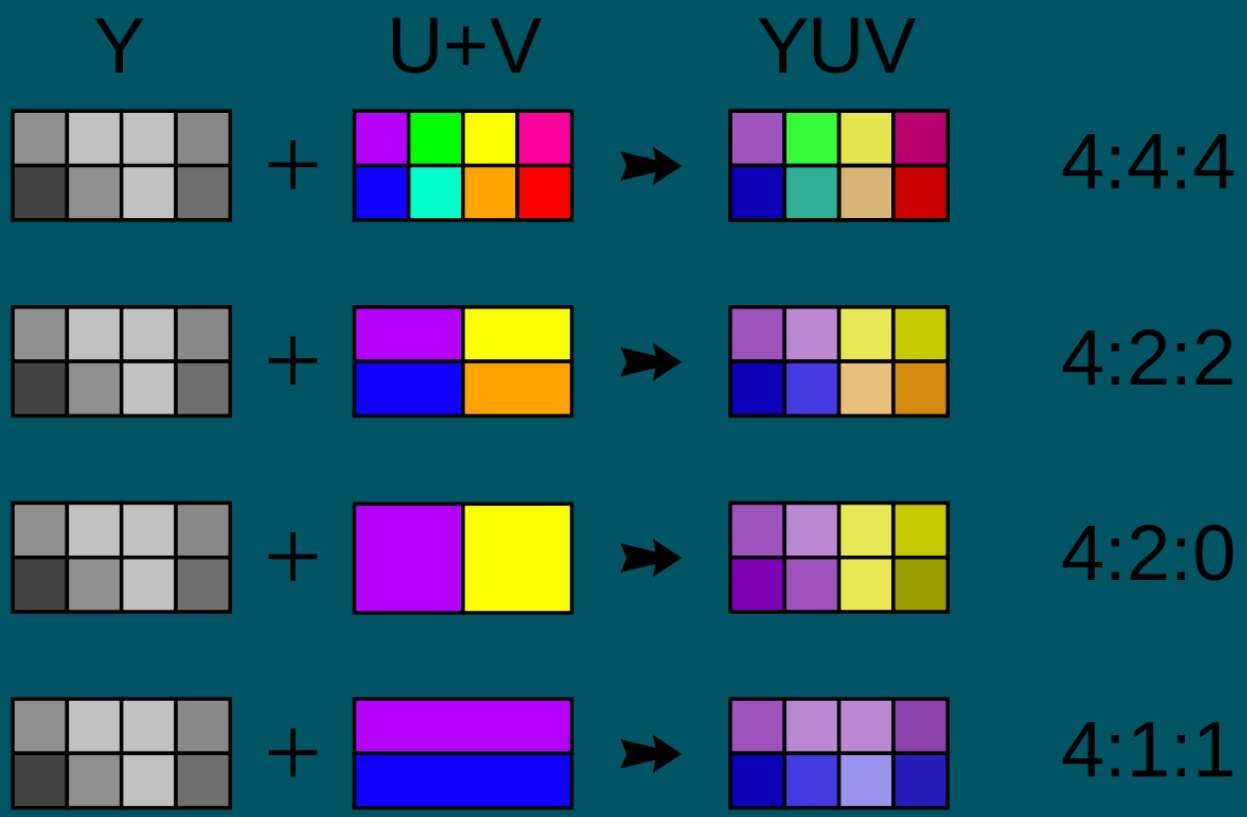
Chroma Subsampling



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Chroma Subsampling - Downside

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Let’s talk policies!

Want to get the best User Experience in most scenarios?

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Graphics Policy – Deep Dive

Starting point:

Use video codec for Compression:

- Use when Preferred (Default)
- For Actively Changing Regions
- Do not use video codec
- For the entire screen

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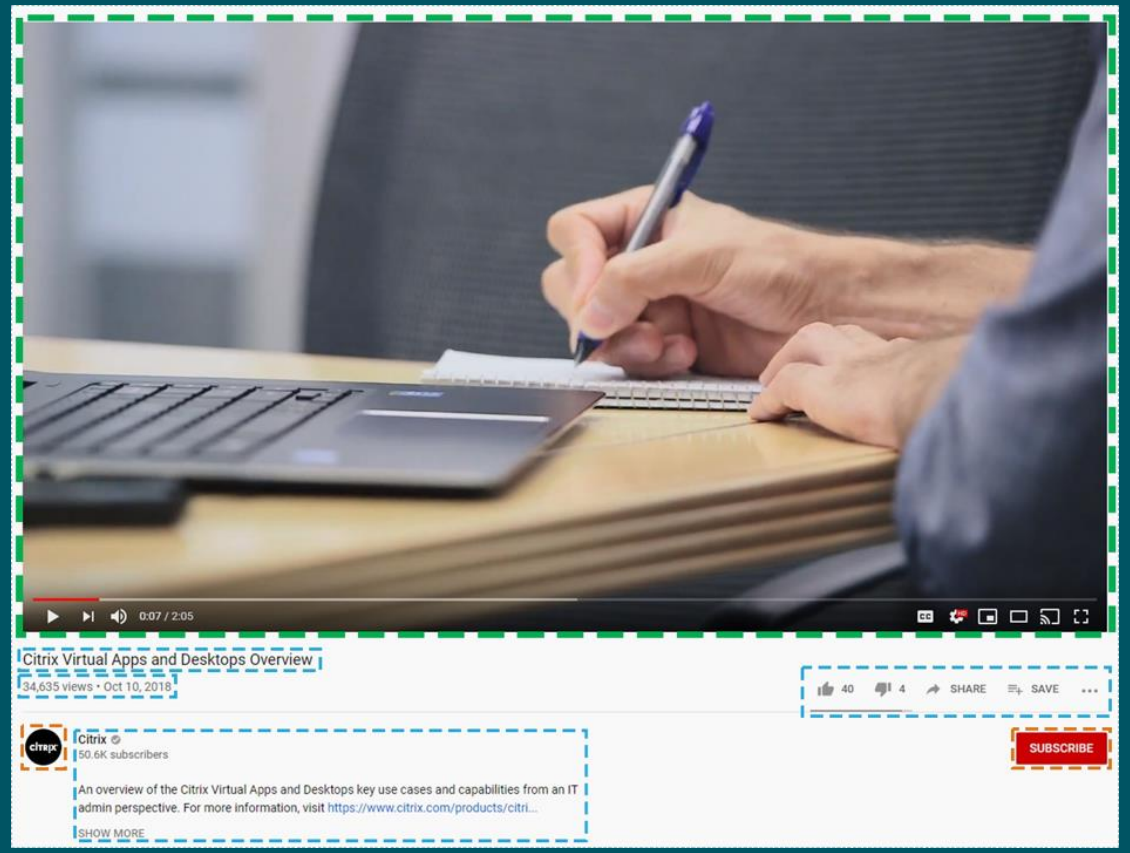
Graphics Policy – Use video codec for Compression



- Text, Simple Images and Solid Colors
- Static Image Content
- Moving (Transient or Fluid) Images

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Graphics Policy – Use video codec for Compression

For Actively Changing Regions

- Text: **RLE**
- Simple Images & Solid Colors: **RLE**
- Static Images: **JPEG**
- Moving Images: **H.264 / H.265 / AV1 (4:2:0)**

Also referred to as: **Selective**

Do not use video codec

- Text: **RLE**
- Simple Images & Solid Colors: **RLE**
- Static Images: **JPEG**
- Moving Images: **Adaptive JPEG**

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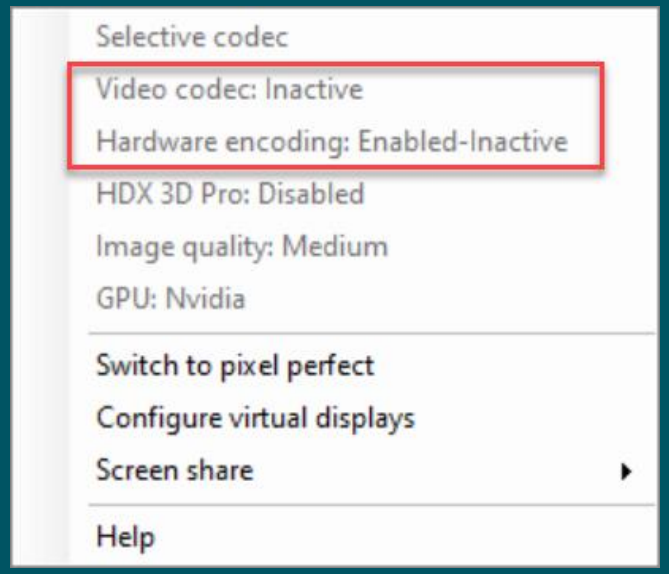
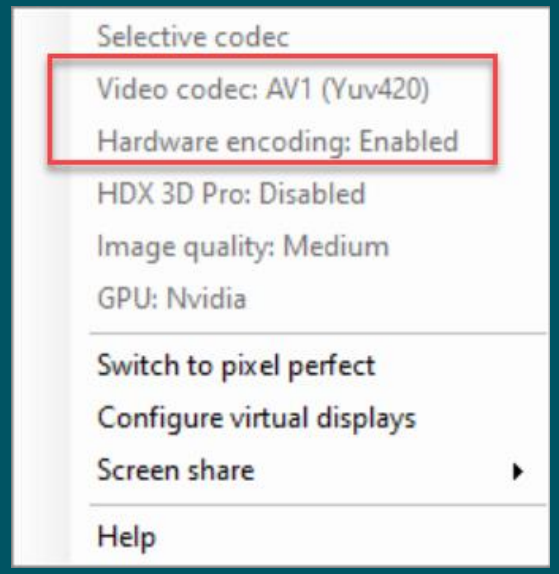
Graphics Policy – Use video codec for Compression



No fluid graphics detected
Codec Inactive



Fluid graphics detected,
AV1 for selected region

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Graphics Policy – Use video codec for Compression

For the Entire Screen (a.k.a. HDX 3D Pro)

- Text: **Video Codec (4:2:0)**
- Simple Images & Solid Colors: **Video Codec (4:2:0)**
- Static Images: **Video Codec (4:2:0)**
- Moving Images: **Video Codec (4:2:0)**

Video Codec = H.264 / H.265 / AV1

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Graphics Policy – Use when Preferred

Use when Preferred

- **Citrix Default**
- Will be the same as “**For Actively Changing Regions**”
- **Except**, when “Optimize for 3D Graphics” is enabled -> “For the Entire Screen”

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Graphics Policy – Visual Quality

Visual Quality

- High
- Medium
- Low

Affects JPEG Quality level of static images and Moving Images in Selective mode.

Does **not** have effect in “For the Entire Screen”

Two additional options:

- Always Lossless
- Build-to-Lossless

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Graphics Policy – Visual Quality – Always Lossless

Pixel Perfect image quality

“For Actively Changing Regions” & “Do not use video codec”

- Uses RLE instead of JPEG / Video codec

“For the Entire Screen”

- Need “Allow Visually Lossless” set to “Enabled”
- Uses YUV 4:4:4 instead of YUV 4:2:0
- Supports H.264 4:4:4 and H.265 4:4:4 (8-bit & 10-bit HDR)*

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*H.265 4:4:4 8-bit Added in VDA 2209 + CWA for Windows 2305

Graphics Policy – Visual Quality – Always Lossless

Always Lossless uses a **significant** amount of bandwidth

- Impact on interactivity when bandwidth is insufficient
- Use “Allow visually Lossless” for higher FPS, but requires GPU on VDA
- For YUV 4:4:4, H.265 is recommended but requires certain hardware

	Encoding	Decoding
NVIDIA	Pascal (2016)	Turing (2018)
Intel	10th gen (2019)	10th gen (2019)
AMD	Not supported	Not supported

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H.265 YUV 4:4:4 - 4K Performance

H.264

Software encoding

H.265

Hardware Encoding

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Graphics Policy – Visual Quality – Build-To-Lossless

Build-To-Lossless is a unique mode

- Balance between “Pixel Perfect” and “Bandwidth consumption”
- Combines Fullscreen video codec with Lossless sharpening (RLE)

If “Allow visually lossless” is enabled:

- Build-to-Visually Lossless
- H.264 / H.265 4:4:4 (8-bit or 10-bit + HDR)
- Lower Quality for Moving Images, builds up to “Visually Lossless”

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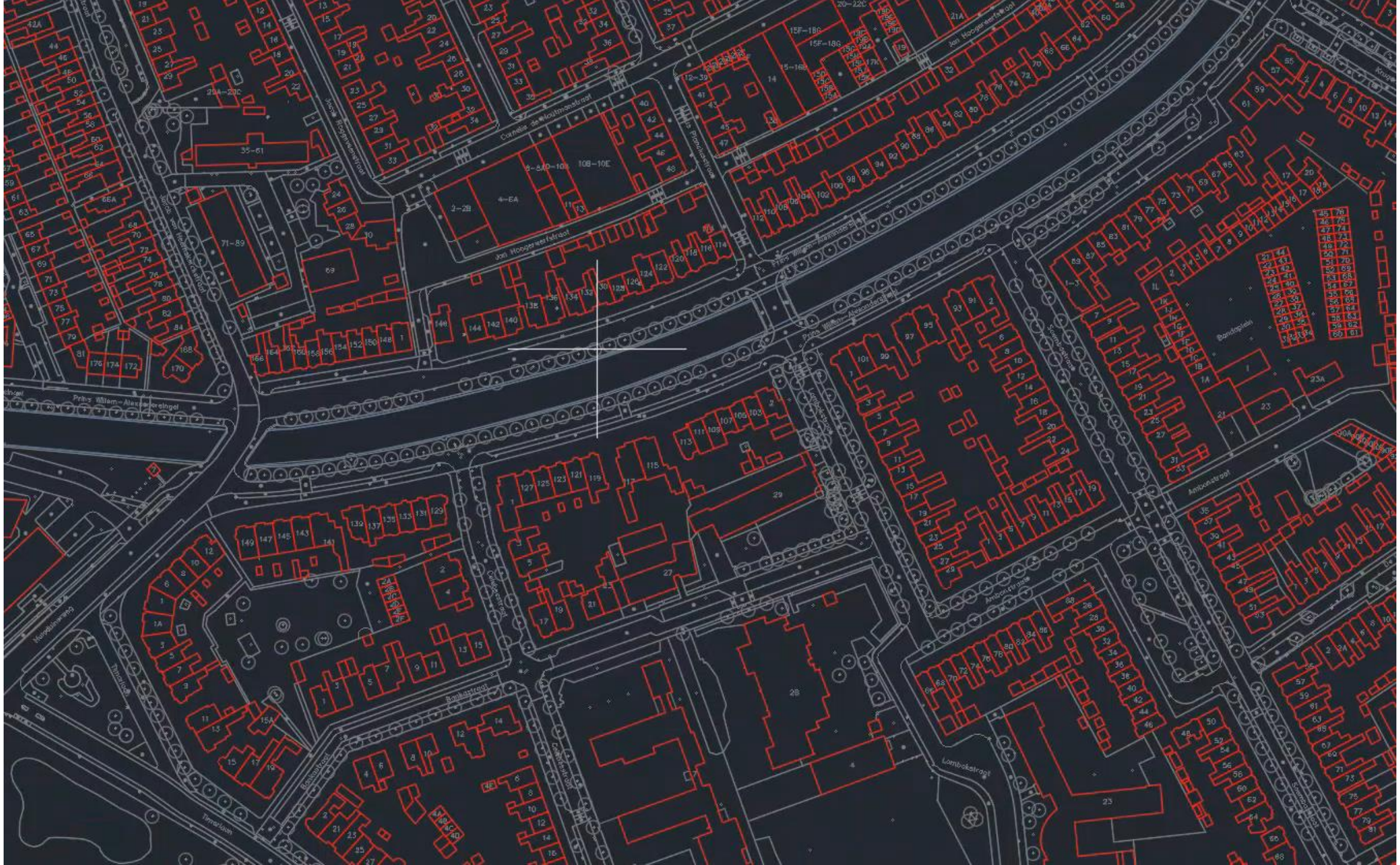
Jan Hoogerwerfstraat
Prins Willem-Alexanderstraat
Bandaplein
Ambonstraat
Lombokstraat
Timorlaan

CVAD 2209+ Build-To-Lossless from mouse cursor

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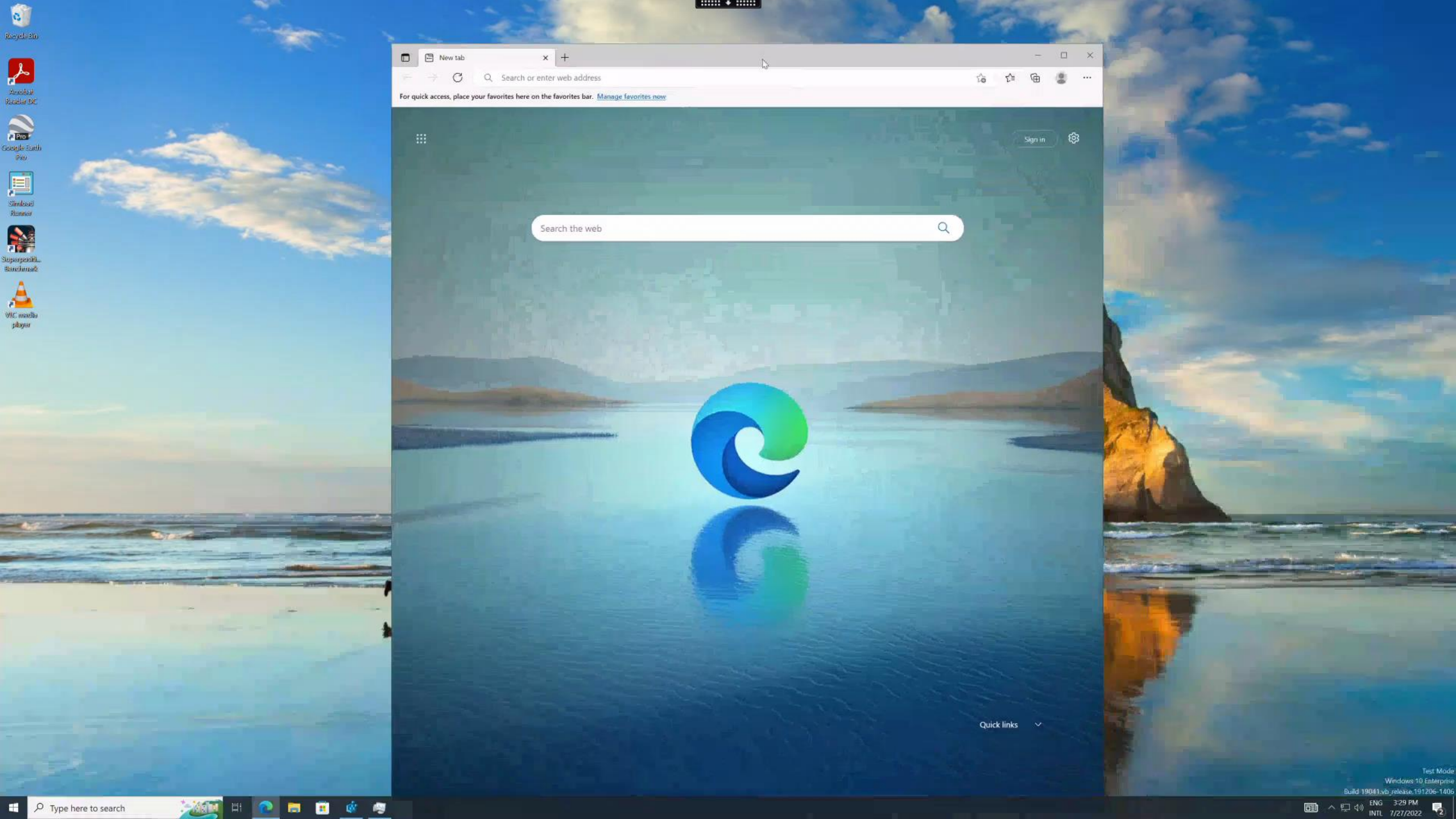
Recycle Bin
Acrobat Reader DC
Google Earth Pro
Simboard Runner
Superposition Benchmark
VLC media player
New tab
Search or enter web address
For quick access, place your favorites here on the favorites bar. Manage favorites now
Sign in
Search the web
Quick links
Type here to search
Test Mode
Windows 10 Enterprise
Build 19041.vb_release.191206-1406
ENG
INTL
3:29 PM
7/27/2022

Graphics Policy – Visual Quality – Build-To-Lossless

Build-To-Lossless

- Better interactivity then “Always Lossless”
- Recommended mode if you choose “Allow Visually Lossless”

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Graphics Policy – Target Frame Rate

Target Frame Rate

- Default: 30 FPS
- Range: 1-60 FPS -> Can be increased to **120 FPS** via Registry

Be aware:

- High FPS requires high performing hardware (VDA / Client)
- Impacts scalability / User Experience
- NVIDIA vGPU FPS Limits

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Graphics Policy – Additional options

Display Memory Limit

- Only needed for Non-GPU
- Memory depth in bytes = (color-depth-in-bits-per-pixel) / 8) x (vertical-resolution-in-pixels) x (horizontal-resolution-in-pixels)
- Deprecated in CVAD 2311

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Use
cases

Too many options… Let’s get into some Use Cases!

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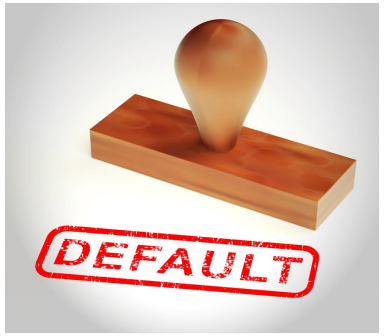
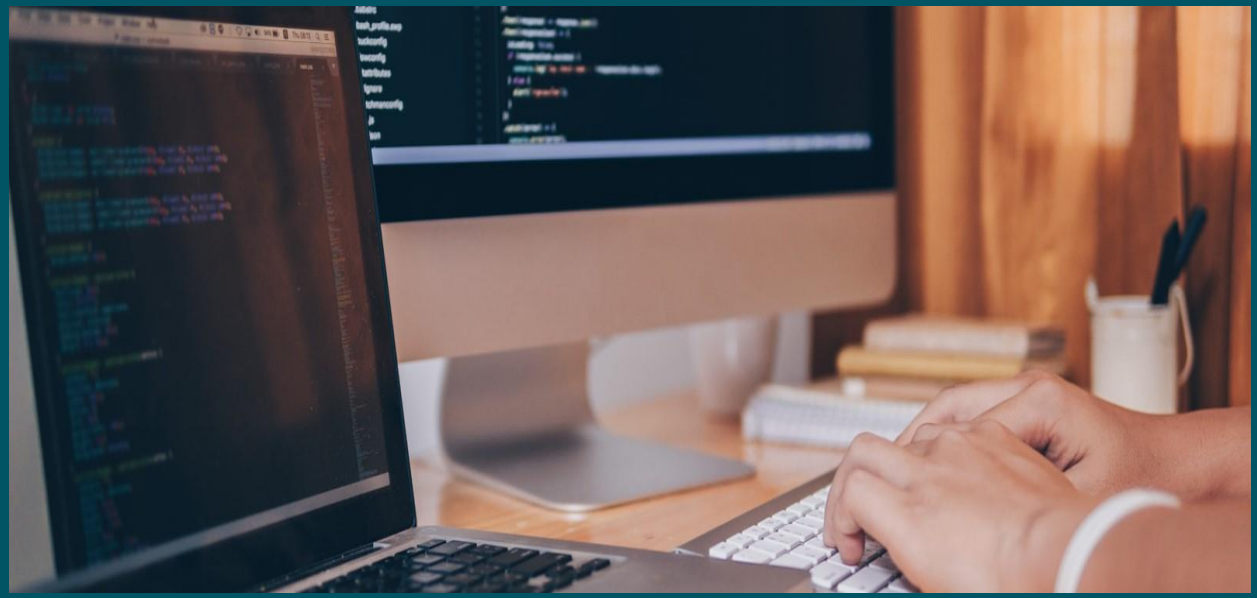
Office Workers / Developers



Policy	Value
Use Video Codec for Compression	Use when preferred
Hardware Encoding	Enabled
Visual Quality	Medium / High
Target Frame Rate	30



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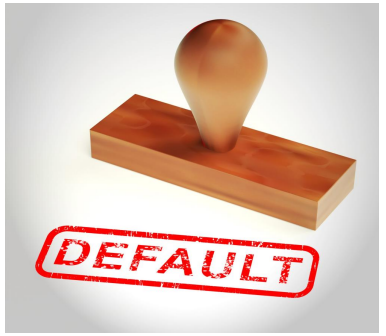
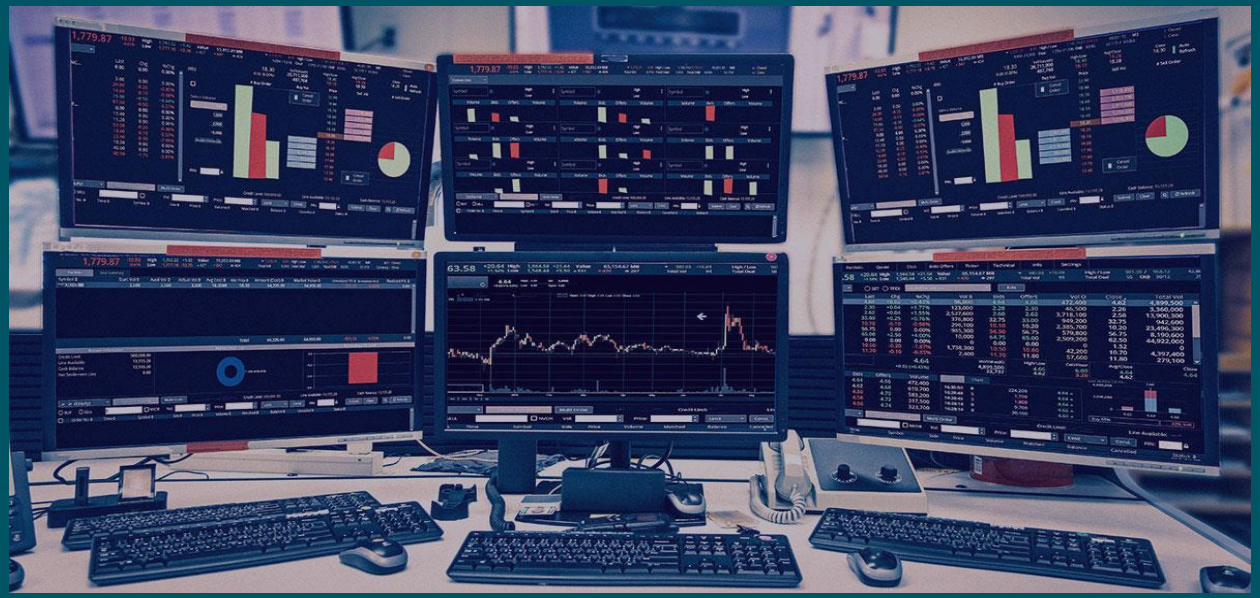
Financial Traders



Policy	Value
Use Video Codec for Compression	Use when preferred
Hardware Encoding	Enabled
Visual Quality	Medium / High
Target Frame Rate	30



https://www.citrix.com/blogs/2022/09/22/how-to-give-financial-traders-the-citrix-hdx-performance-they-need/

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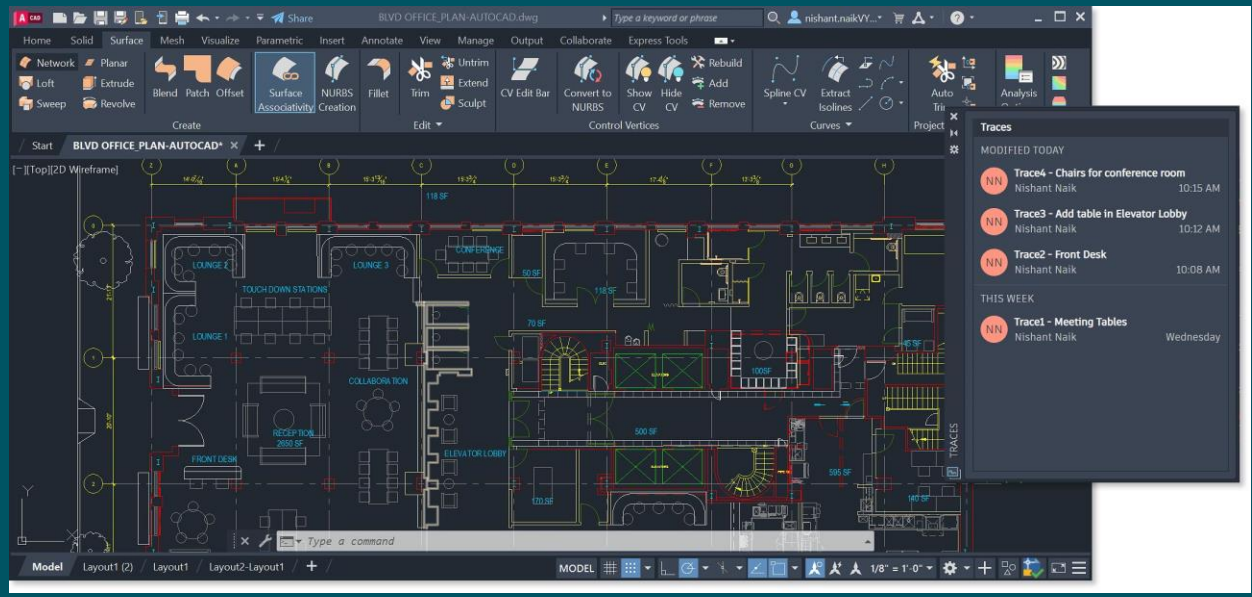
2D CAD Workload

Policy	Value
Use Video Codec for Compression	Use when preferred
Hardware Encoding	Enabled
Visual Quality*	High / Build-To-Lossless
Target Frame Rate	30
Allow Visually Lossless*	Disabled / Enabled



*Setting depend on customer / end-user requirements

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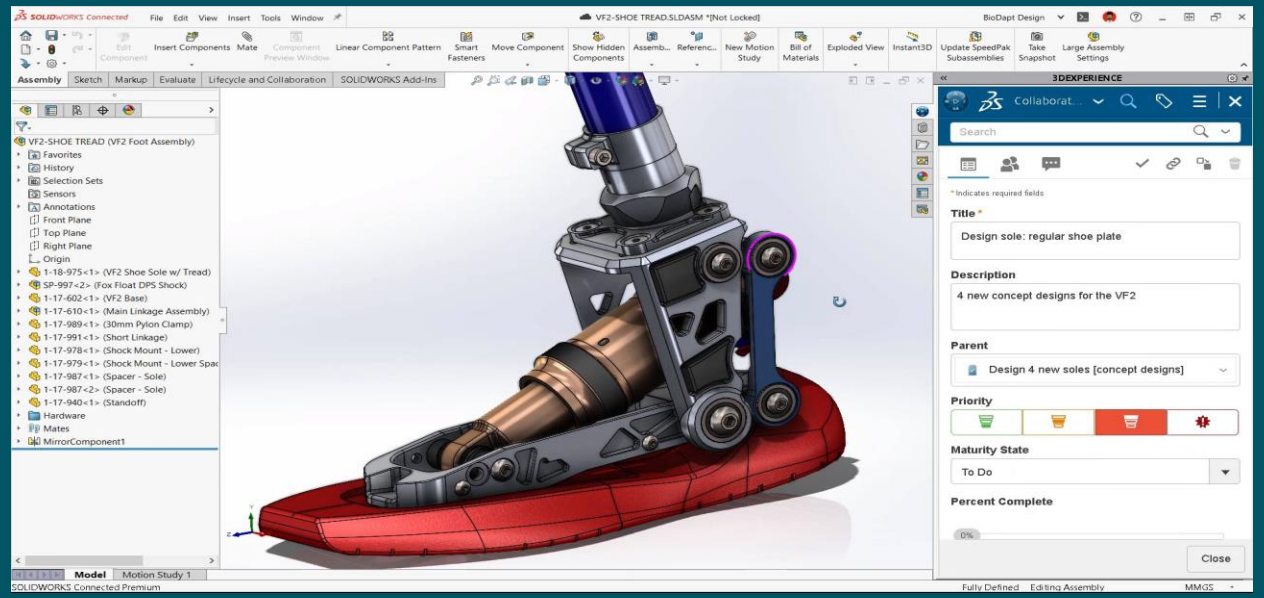
3D CAD Workload

Policy	Value
Use Video Codec for Compression	Use when preferred
Hardware Encoding	Enabled
Visual Quality	Build-To-Lossless
Target Frame Rate	30 (45 or 60 optional)



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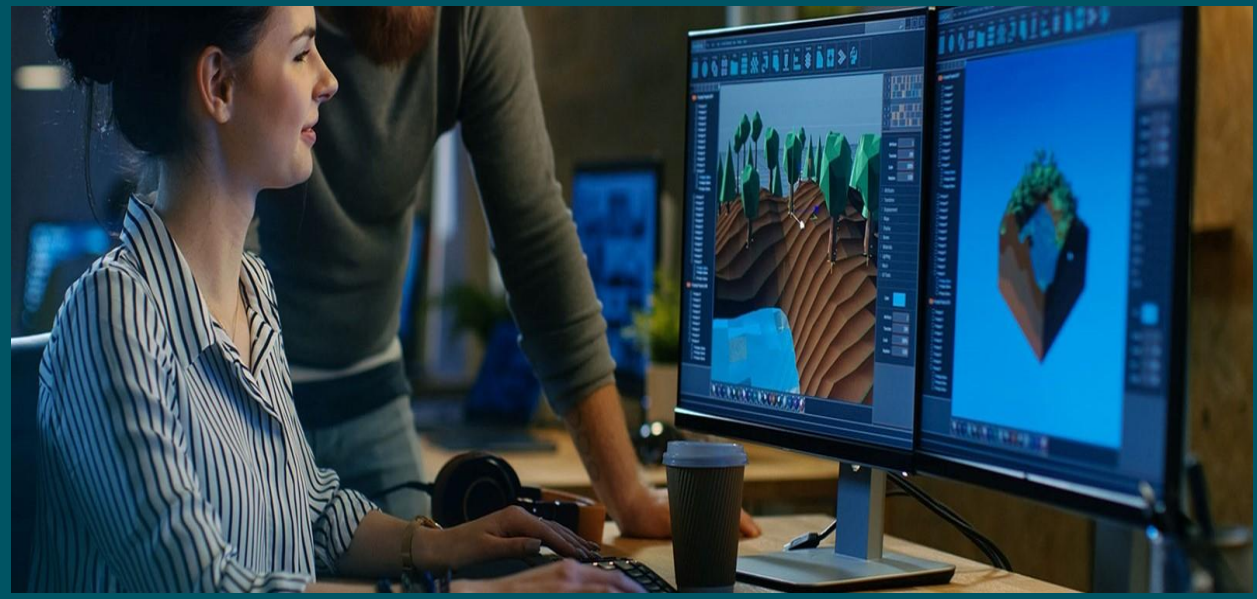
Game Developers / Video editors

Policy	Value
Use Video Codec for Compression	Use when preferred
Optimize for 3D Graphics	Enabled
Hardware Encoding	Enabled
Visual Quality	High*
Target Frame Rate	60 (120 optional)



*For best quality AV1 preferred, otherwise H.265

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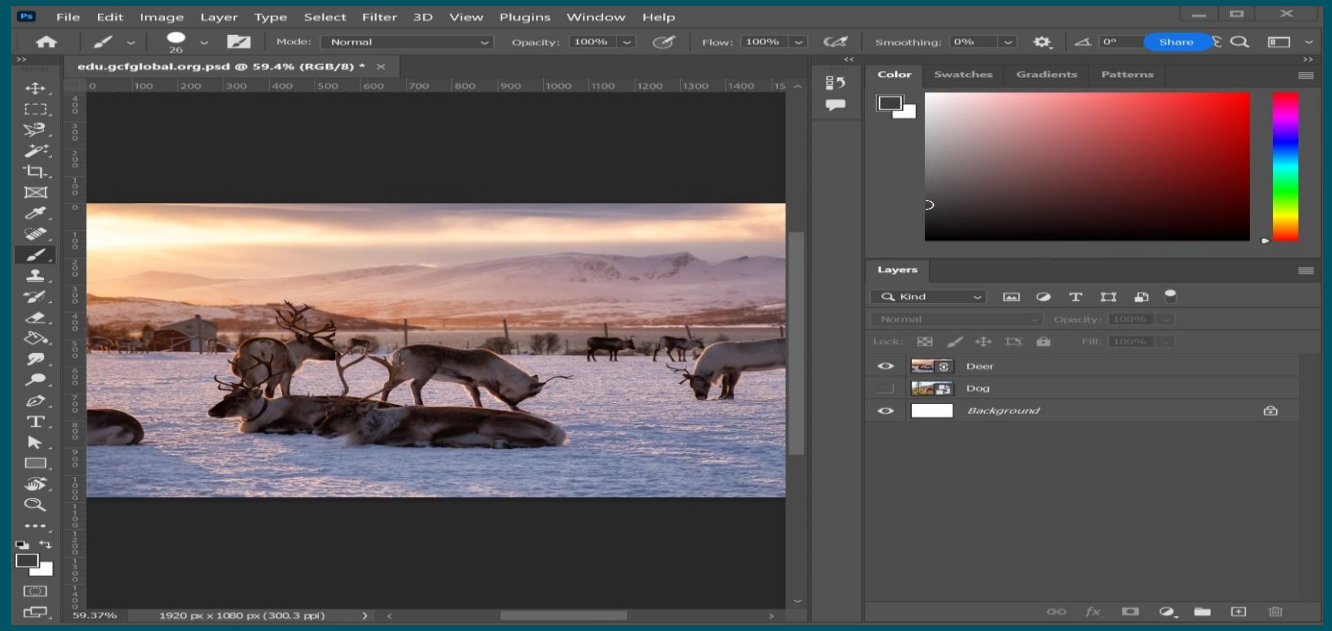
Content Creators

Policy	Value
Use Video Codec for Compression	Use when preferred
Optimize for 3D Graphics	Enabled
Hardware Encoding	Enabled
Visual Quality	Build-To-Lossless / Always Lossless
Allow Visually Lossless	Enabled
Target Frame Rate	30 (60 Optional)
Color Depth	8 or 10 bit / 10bit HDR



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HDX
Innovations

Loss tolerant mode for Graphics

EDT Lossy

- Ensures the session remains interactive when packet loss is detected
- Once network conditions degrade beyond pre-defined bandwidth, latency and packet loss thresholds, loss tolerant mode kicks in
- The thresholds can be configured via policy, with the defaults being 300ms latency and 5% packet loss.
- CWA 2311 for Windows is currently supported.
- EDT must be enabled + EDT Lossy must also be enabled on GGS.

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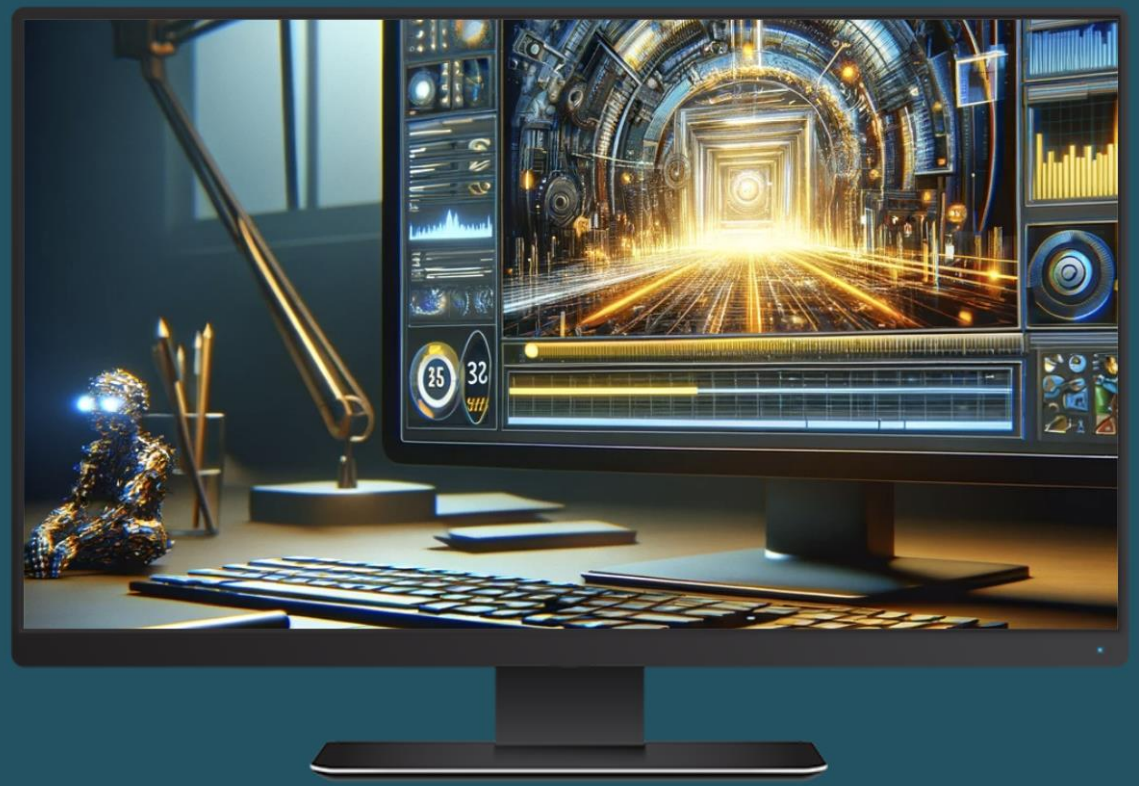
Next-Gen User-Experience

Loss Tolerant Mode

Enhanced Video Codec Selection

Citrix Workspace App for Windows 2311.1

- Experience seamless video streaming as Citrix Workspace App now automatically detects the best video codec to use, ensuring superior performance
- Automatic endpoint's decoding capabilities during installation
- Customize your experience with 'Visual Quality' settings, while still benefiting from automatic codec selection
- Whether it's AV1, H.265, or H.264, our app ensures compatibility with both VDA and client, guaranteeing a seamless experience



Upgrade your Citrix Workspace experience today and enjoy enhanced video codec selection for optimal performance and quality!

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Lessons learned

- Default policies are a good starting point
- Test your workloads and include your end-users
- GPUs accelerate the encoding process
- Latest GPU generations have the best encoding options

Q&A

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