PERSONAL ENTERTAINMENT VR

Gaming

Sports

Movies

Concerts

Travel

Retail
QUADRO PROFESSIONAL VR/AR

DIGITAL CONTENT CREATION

MEDICAL

ARCHITECTURE

DESIGN

MANUFACTURING

COLLABORATION
FUNDAMENTAL VR GRAPHICS CHALLENGES

Pixel Throughput and Perceived Latency

Very High Pixel Rendering Throughput

TRADITIONAL = 60 MP/S
(1920 x 1080 @ 30 FPS)

VIRTUAL REALITY = 450 MP/S
(3024 x 1680* @ 90 FPS)

Must Maintain Very Low Latency

HMD updates pose

CPU triggers redraw

GPU computes new image

HMD flashes display

Motion to Photon: ≤ 20 ms
WANTED: THE BEST OF BOTH WORLDS

Highest Quality Graphics + Mobile Freedom
CLOUDXR VISION

XR Streaming to Any Device

Content → RTX Servers → Network → Clients
MOBILE WORLD CONGRESS (LA), OCT 2019

CloudXR Announcement
ARCHITECTURE OVERVIEW
Server-Side Driver, Client-Side Application and SDK

Audio, video, haptics
pose, control inputs, video

VR App
OpenVR Runtime (Valve)
Virtual HMD Driver
Virtual Audio Driver
Video Encoder
Audio Encoder
Cloud
SERVER driver (Nvidia)

HMD
Late & Lens Warp
VR Runtime
Video Decoder
Audio Decoder
Cloud
CLIENT app (Nvidia)

Internet
QoS
Reliability & Resilience

Relevant Internet problems:

- Jitter
- Missed packets
- Bandwidth variation
## QOS

### Reliability & Resilience

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<th>Solutions</th>
<th>Control parameters</th>
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<td>Server has no display</td>
<td>Frame pacing to match client display rate</td>
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ARCHITECTURE

WIN SERVER

VR App

Video Params (e.g., ROI, optional)

VR Runtime

OpenVR Interfaces

Encode

Frame Pacing

Audio Capture / Encode

Server driver

CLIENT

Display

Controller & inputs

HMD

VR Runtime

Lens Warp

Time Warp

Sensor, Pose & Controller data

Jitter FIFO

HEVC Frame

Audio Playback

Audio / Video / Data (sensors, inputs, QoS)

INSTALLER

Audio Capture / Encode

Display

VR Runtime

Controller & inputs

Sensor, Pose & Controller data

Jitter FIFO

HEVC Frame

Audio Playback

Audio / Video / Data (sensors, inputs, QoS)
LATENCY

Button to Photons

Using:

- HelloVR sample modified to change color on button press
- Latency meter (instrumented switch + photodiode)
- Local Cloud with Client on WiFi (average ping time 4 ms)
## LATENCY

**Button to Photons**

### Results:

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<th>Latency [ms]</th>
<th>Stdev</th>
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Server Driver + Client App latency = 12.1 ms.

The Jitter FIFO can be downsized at the cost of occasional missed frames.
CLOUDXR CONFIGURATIONS

Total Flexibility

5G
Ethernet
WiFi
EARLY ACCESS PROGRAM
Test CLOUDXR for VR
@ https://developer.nvidia.com/nvidia-cloudxr-sdk-early-access-program

NVIDIA CloudXR™ SDK - Early Access Program

This is an NDA program available to a limited number of applicants. Please register or log in using your company email credentials: your patience as we ramp up this program.

The NVIDIA CloudXR SDK provides a way to stream graphics-intensive augmented reality (AR), virtual reality (VR) or mixed reality (MR) to one or more devices. The SDK also enables the streaming of OpenVR applications to a number of 56-connected Android devices as well as enabling access to graphics-intensive applications on relatively low-powered graphics hardware.

For this Early Access Program we are looking for:

- **Telco provider** that wants to evaluate integrating CloudXR into your infrastructure
- **HMD manufacturers** that would like to investigate adding CloudXR support to your platform
- **Independent software vendor** that would like to support CloudXR solutions

If you would like to apply to become a member of the program, please click the “Join now” button below and complete the form. Ne to join the program.
NVIDIA 5G MEC XR DEVKIT
THE OPPORTUNITY: VR/AR/VGPU OVER 5G
A Convergence of Visual Compute + 5G and a New Edge Topology

Powerful GPUs
Incredible compute capabilities redefining graphics

Bandwidth and Low Latency
Both are required for VR/AR

Compute is at the Edge
Very few hops - Low Latency
ENTERPRISE MARKETS
Success Across Verticals

AEC
Entire Design Process, Sales, Moving to Construction

M&E
Virtual Production

Training
Possibly the Largest Market

Location-Based Entertainment
Enterprise/Consumer

Autodesk
Manufacturing
Engineering, Design, Marketing/Sales

Enscape
Nurulize

ESI
ENTERPRISE AR
Driving Value Propositions

INSTRUCTION/COLLABORATION

DIGITAL MODELS

ANNOTATED
THE FUTURE OF MOBILE XR

5G + VR/AR + vGPU at the Edge

Requirements:

• Ultra Low Latency
• High Bandwidth
• Cutting-edge Compute
• Cost Effective Delivery
• Valuable Use Cases
NVIDIA RTX SERVER
RTX Performance in a Server

- Powered by Quadro RTX 8000/6000
- Ray Traced Global Illumination up to 96 GB Scenes
- Remoting and Multi-GPU Virtualization with Quadro virtual Datacenter Work Station (vDWS)
- All the technical advantages of Turing
XR/vGPU 5G EDGE STACK

Software/Hardware Stack Demands a Diverse Effort

- Containerized Edge Applications
- 5G transmission
- Enabling SDKs
- Fundamental GPU Drivers
- 5G Network
- Cloud Orchestration
- Low Latency Streaming
- Virtualization
- Visual Computing and AI
COME TRY THE DEMO & REGISTER ONLINE FOR EARLY ACCESS

Visit the VR Village on the Expo Floor

https://developer.nvidia.com/nvidia-cloudxr-sdk-early-access-program

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Join now