



S9156: STREAMING VR CONTENT FROM THE CLOUD

Rouslan Dimitrov, NVIDIA

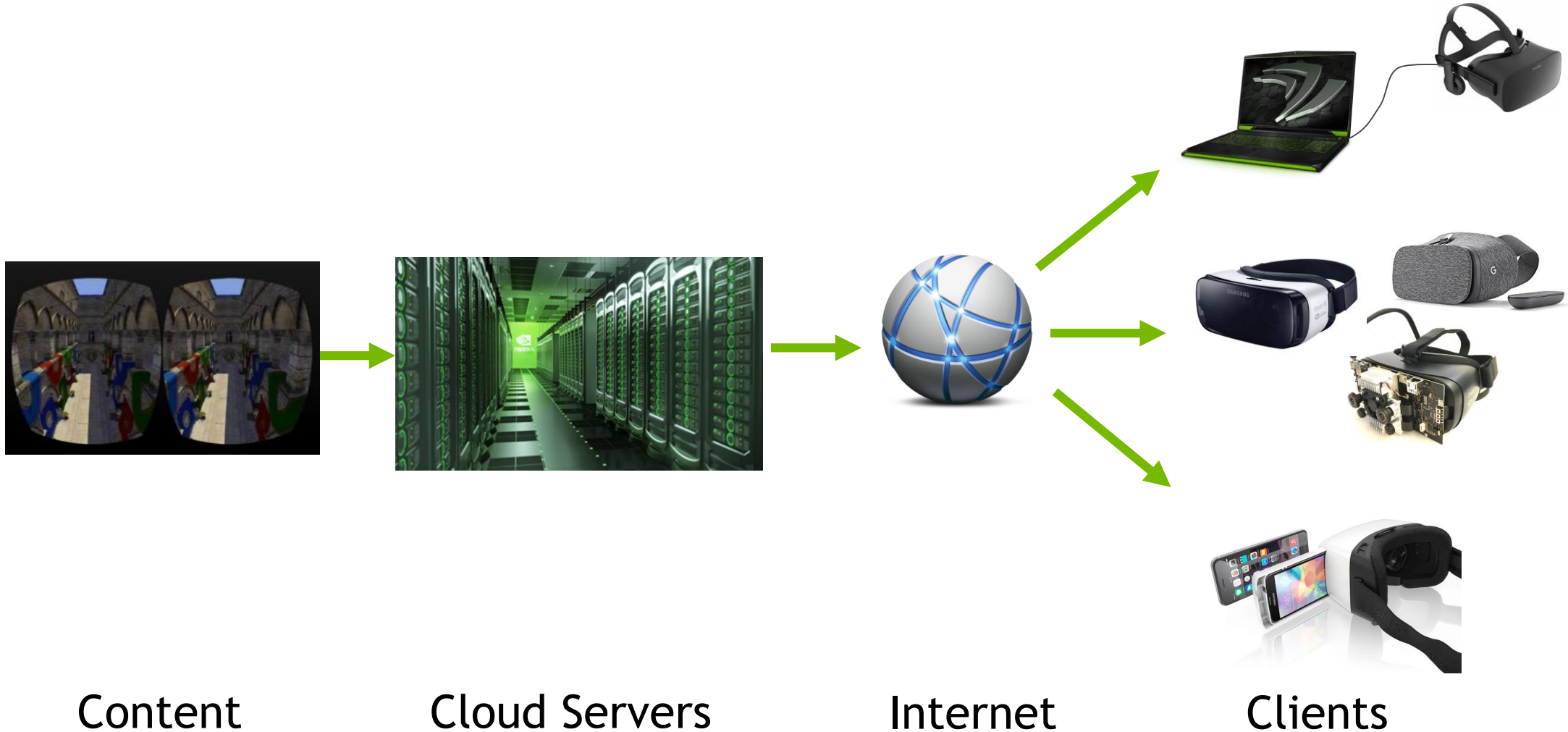
3/19/2019

Workstation Graphics For Low-Power Devices



VR STREAMING TO ANY DEVICE

The Project's Vision



ARCHITECTURE

Cloud Server to HMD



VR App

OpenVR Runtime

Virtual HMD Driver

Virtual Audio Driver

Video Encoder

Audio Encoder

GeForce Now

Driver



HMD

Late & Lens Warp

VR Runtime

Video Decoder

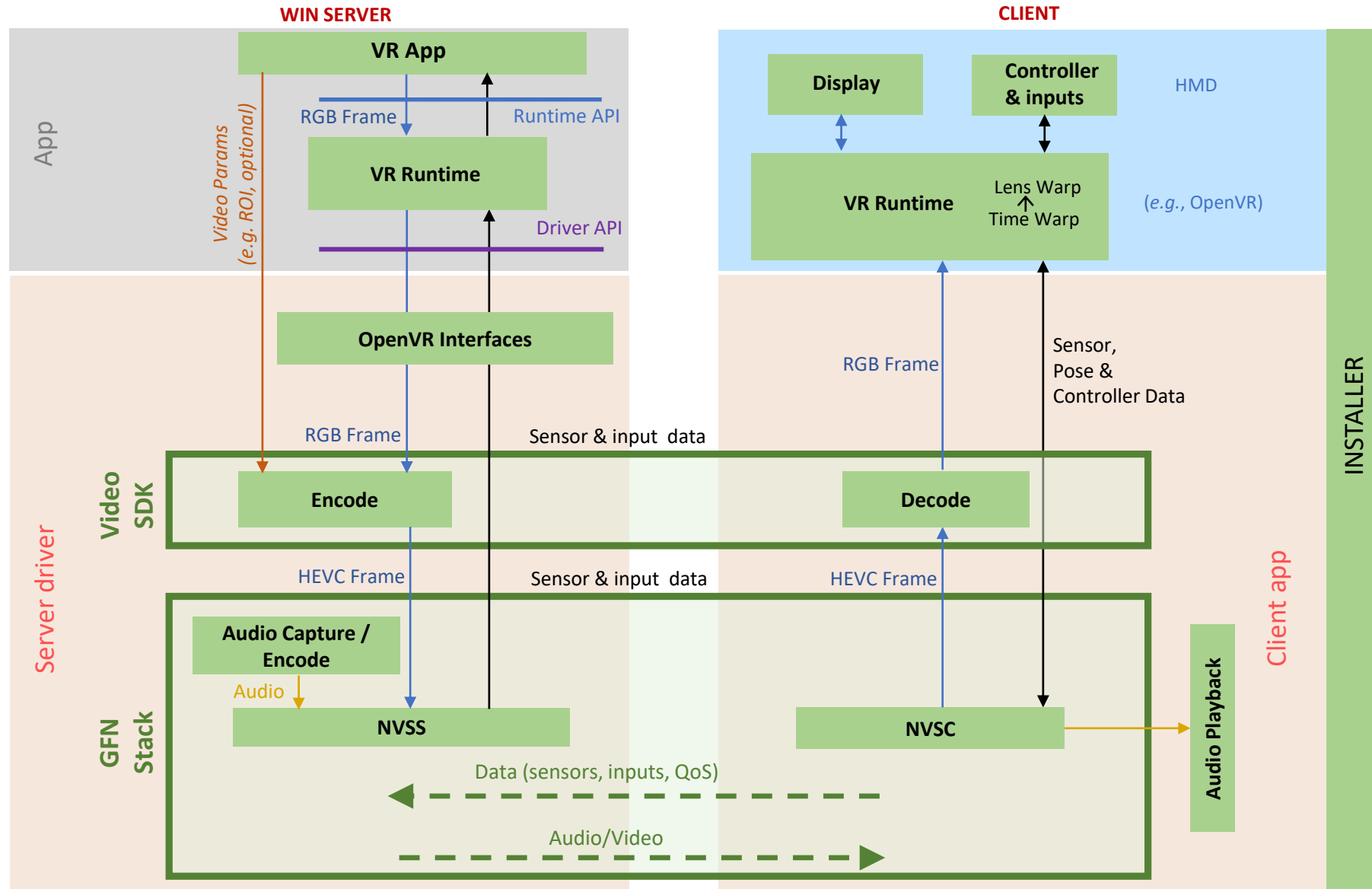
Audio Decoder

GeForce Now

App

Internet

ARCHITECTURE

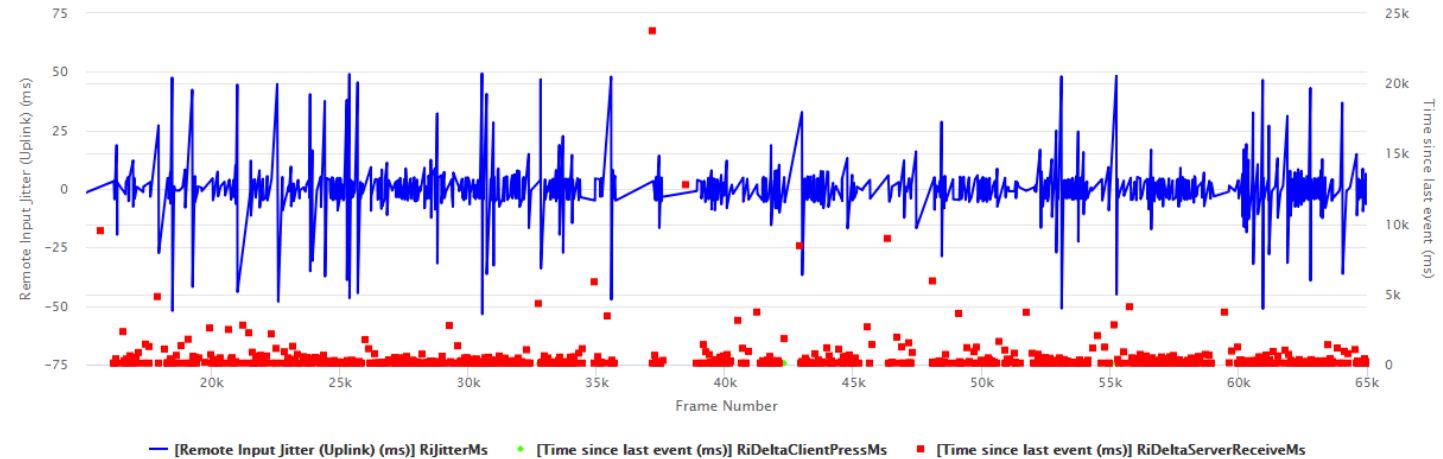


QOS

Reliability & Resilience

Relevant Internet problems:

- Jitter
- Missed packets
- Bandwidth variation

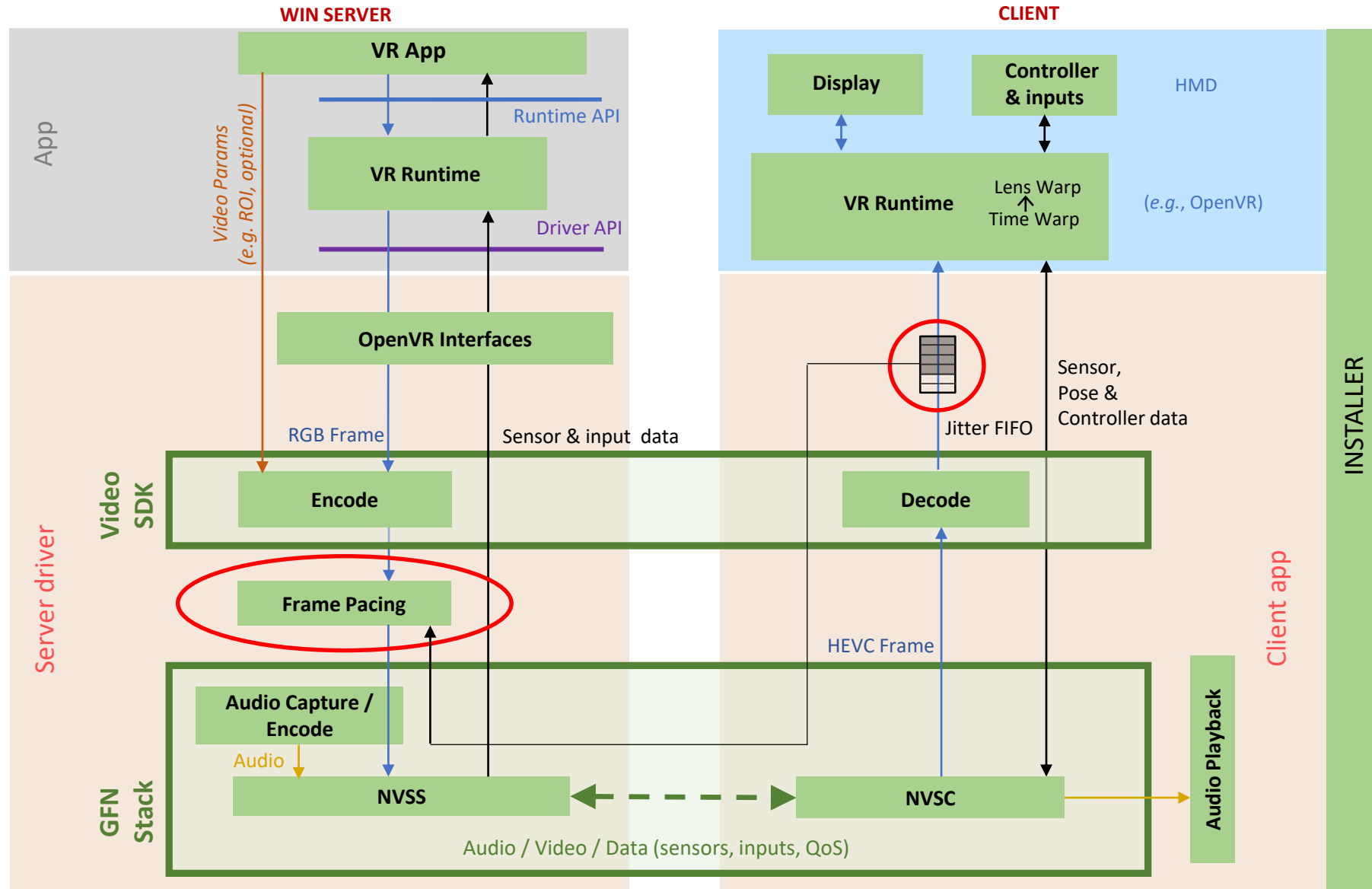


QoS

Need to dynamically adjust:

- Jitter absorption queue size (for jitter)
- Forward error correction strength (for dropped packets)
- Video compression rate (for bandwidth variation)

ARCHITECTURE

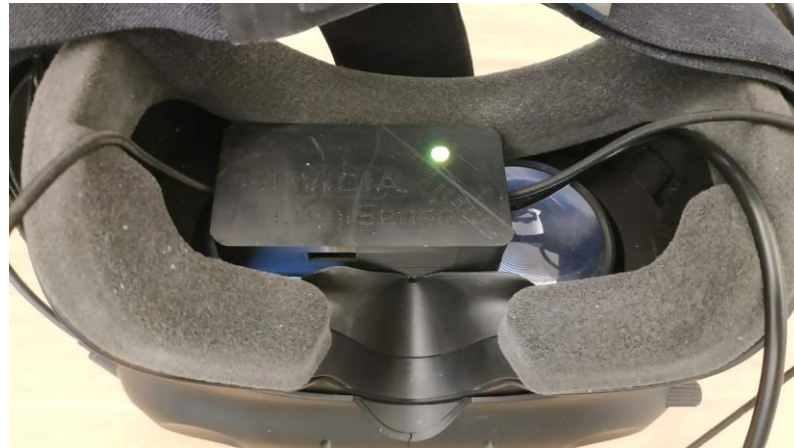


LATENCY

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

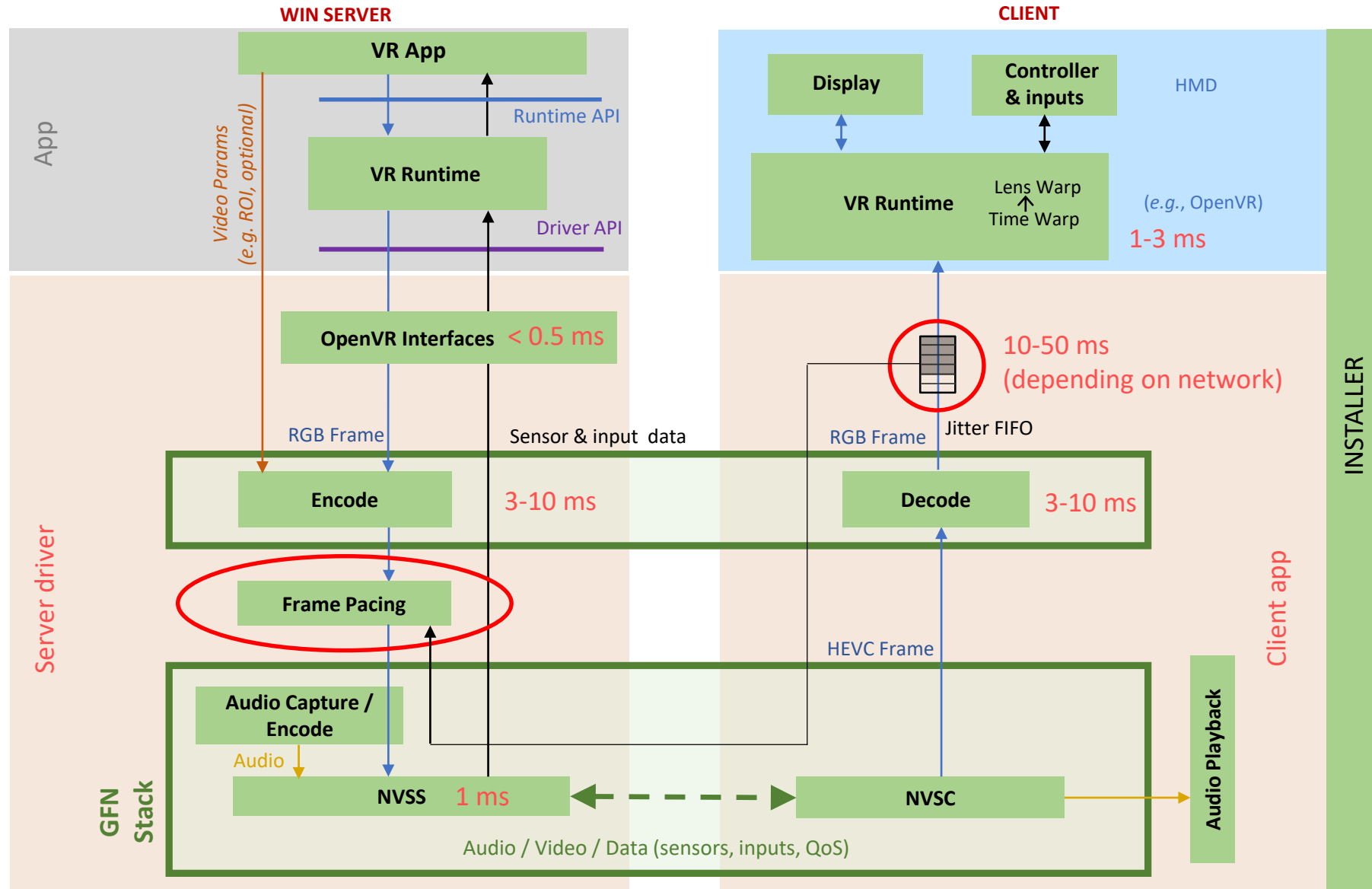
Results:

	Latency [ms]	Stdev
Local VR	38.3	3.4
CloudVR	81.6	3.3
Diff	43.3	-0.1
Jitter FIFO + Ping	31.2	
Diff – Above	12.1	

Server Driver + Client App latency = 12.1 ms.

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

LATENCY



DELIVERED FRAMES

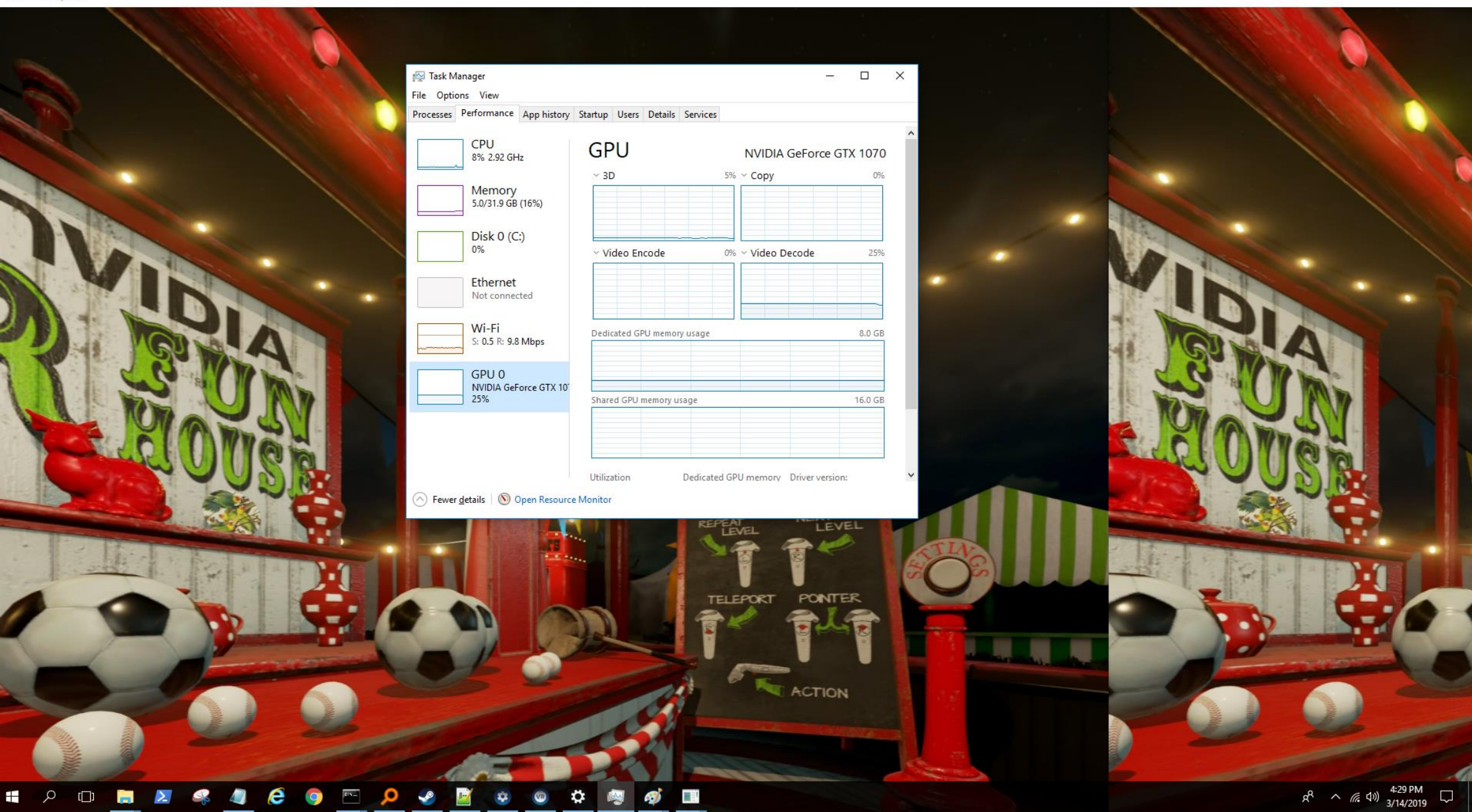
No Motion, 1440x1600x2 @ 50 Mbps



DELIVERED FRAMES

No Motion, 1440x1600x2 @ 10 Mbps





Task Manager

File Options View

Processes Performance App history Startup Users Details Services

CPU

8% 2.92 GHz

Memory

5.0/31.9 GB (16%)

Disk 0 (C:)

0%

Ethernet

Not connected

Wi-Fi

S: 0.5 R: 9.8 Mbps

GPU 0

NVIDIA GeForce GTX 1070

25%

GPU

NVIDIA GeForce GTX 1070

3D 5%

Copy 0%

Video Encode 0%

Video Decode 25%

Dedicated GPU memory usage

8.0 GB

Shared GPU memory usage

16.0 GB

Utilization

Dedicated GPU memory

Driver version:

Fewer details

Open Resource Monitor

DELIVERED FRAMES

Fast Motion, 1440x1600x2 @ 50 Mbps



DELIVERED FRAMES

Fast Motion, 1440x1600x2 @ 10 Mbps



See More VR on the Exhibition Floor Expo Hall 3, Concourse Level



VR VILLAGE

Explore the VR Village to get hands-on with the latest advances in virtual reality (including Cloud VR Streaming)



VR THEATER

Go to the VR Theater to see and experience narrated VR demos built by our partners



VR PARTNERS

Explore a great lineup of VR partners around the VR Village showcasing their groundbreaking technology

COME EXPLORE ALL THINGS VR AT GTC 2019

VR VILLAGE HOURS Tuesday: 12:00pm - 7:00pm Wednesday: 12:00pm - 7:00pm Thursday: 11:00am - 2:00pm

