Can My WiFi Handle the Metaverse? A Performance Evaluation Of Meta’s Flagship Virtual Reality Hardware

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How to Deploy Metaverse Infrastructure?

1. User input
2. Frames (≥72Hz)
3a. Home
3b. Rendering component
3c. Edge
4. Frame/user-input stream
5. Wireless connection
6. Cloud

- Rendering component
- Simulator
- Other application

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Experiment Setup

#1 Local
Experiment Setup

#2 Wired

Wireless AP
ISP Modem
Internet
VR
Offload device
Other devices
Home

Halo: Half-Life Alyx

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#3 Wireless

VR Offload device

Wireless AP

ISP Modem

Internet

Home

Other devices

HALF-LIFE: A L Y X

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Experiment Design Goals

Q1 What is the performance and resource usage of VR applications on state-of-the-art VR hardware?

Q2 What are the advantages and disadvantages of VR workload offloading compared to native processing on VR headsets?

Q3 What are the network requirements to enable wireless compute offloading for VR?
Resource Usage for All Tested Setups

- Setup: Wireless, Wired, Local
- GPU utilization [%]:
  - Wireless: 0-25, 50-75
  - Wired: 0-25, 50-75
  - Local: 0-25, 50-75

- Setup: Wireless, Wired, Local
- CPU utilization [%]:
  - Wireless: 0-20
  - Wired: 0-20
  - Local: 0-20
Good Performance for All Tested Setups
Experiment Design Goals

Q1 What is the **performance and resource usage** of VR applications on **state-of-the-art VR hardware**?

Q2 What are the **advantages and disadvantages of VR workload offloading** compared to native processing on VR headsets?

Q3 What are the **network requirements** to enable wireless compute offloading for VR?
Older WiFi Types Support VR Streaming

- 5GHz WiFi 6
- 2.4GHz WiFi 6
- 5GHz WiFi 5/6
- 5GHz WiFi 5
- 2.4GHz WiFi 4

Frames per second

- 5GHz WiFi 6
- 2.4GHz WiFi 6
- 5GHz WiFi 5/6
- 5GHz WiFi 5
- 2.4GHz WiFi 4

Bytes received [Mbps]
Performance Deteriorates Quickly When WiFi Signals Are Obstructed

![Graph showing performance deterioration with obstructed WiFi signals]

- AP distance
  - Far
  - Near
  - Wired

Frames per second
Performance Deteriorates Quickly When WiFi Signals Are Obstructed

Proximity of wireless access point

Far  Near

Target frame rate: 72 Hz. Higher is better
Take-Home Message

1. Metaverse is an emerging ecosystem with **promising applications** (games, digital twins, tourism, shopping, …)

2. We have insufficient knowledge about **design trade-offs and system behavior** in the metaverse ecosystem

3. Current state-of-the art metaverse systems show **surprising behavior**