

CREATE
CONNECT
LIVE
inspire

Edge-Native XR Gaming

OEC Fall Workshop, December 2020
Robert (Bob) Gazda - [IDCC Profile Link](#)



interdigital™

Agenda



- 1) Short InterDigital Background
- 2) Importance of Edge-Native in XR Gaming
- 3) Edge-Native XR Gaming Proof-of-Concept Platform
- 4) Instrumentation and Results
- 5) Some other interesting things: AdvantEDGE, MEC Sandbox

Why InterDigital, *More than Ever*



One of the Largest Pure Research, Innovation and Licensing Companies in the World



Over four decades of pioneering wireless innovation



Now expanded to consumer electronics with a world-class video and AI research team



Brought to market through substantial contributions to global standards



The result: new innovation in products, services and networks worldwide



With our contributions protected by one of largest patent portfolios in the world related to wireless and video technologies

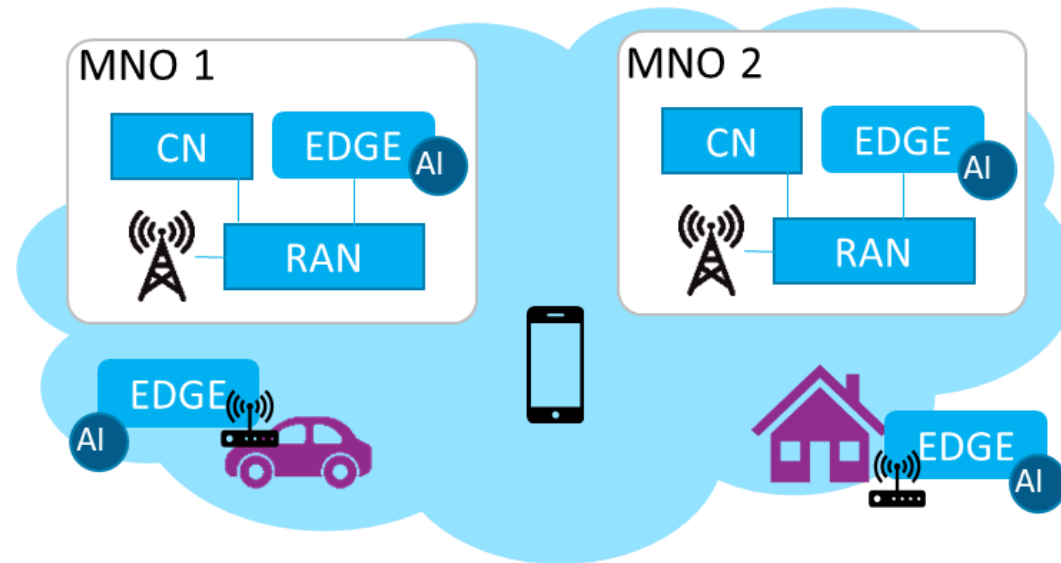
<https://www.interdigital.com/wireless>

InterDigital's Edge Networking Vision



Future – Ubiquitous Edge-Native Computing

*Edge resources
leveraged across the
network hierarchy*



*Seamless migration
across access
networks & edge*



Interactive XR Gaming – Inspiration Vision

Gaming is a promising and high-value application vertical likely to grow to \$300 billion by 2025.¹

Beyond 5G – Future Home Interactive Gaming Experience

A family plays a game of laser tag in their home. Each player wears lightweight glasses with limited capabilities, but enjoys a fully immersive XR experience as the home and players are transformed with new textures, objects, clothing...

Achieving this experience requires:

- Perfect synchronization of the physical and virtual worlds, within extremely low ***motion-to-photon latency***
- Offload rendering from the lightweight glasses ***via local / device edge***
- User mobility in across the home, full wireless in-home coverage achieved via multiple radio access technologies ***Smart Multi-RAT management***



Extracted from: CableLabs video “The Near Future. Bring it on”.²

¹ GlobalData 2019 Video Games – Thematic Research

² <https://www.youtube.com/watch?v=-kTeavB3IGg>

Edge Importance for XR Gaming



XR Games demand significant processing and low-latency

- 7 to 15 ms motion-to-photon latency
- Require high capabilities found in gaming-level computers and consoles
- Limits XR on mobile and constrained devices

Game Engines enforce a “Game Loop” architecture

- OO design pattern, tightly couple with video frame rate

Latency demands make XR games unviable on Cloud-Gaming platforms

Edge is required to enable XR gaming on constrained devices, such as light-weight AR glasses



“Fat client” XR headsets do not provide enough HW capabilities

Advanced “made-for-VR” games require VR headsets to be cabled to gaming-level PCs.

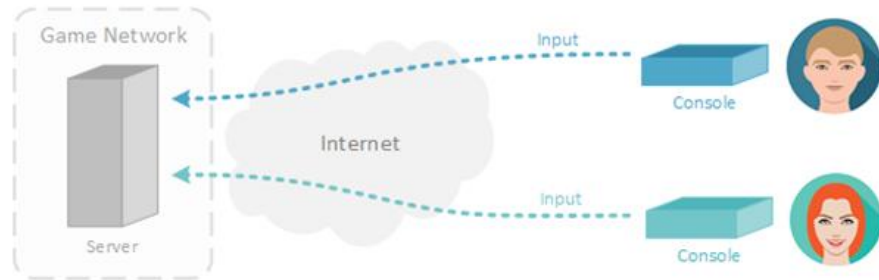


Gaming Models

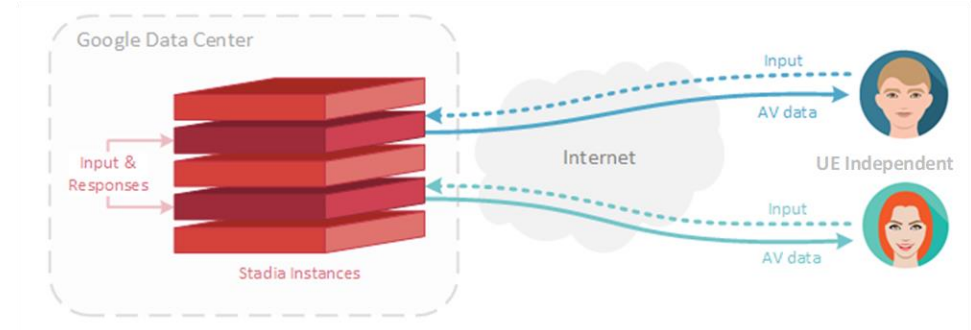


Ref: <https://dzone.com/articles/a-first-look-at-google-stadia>

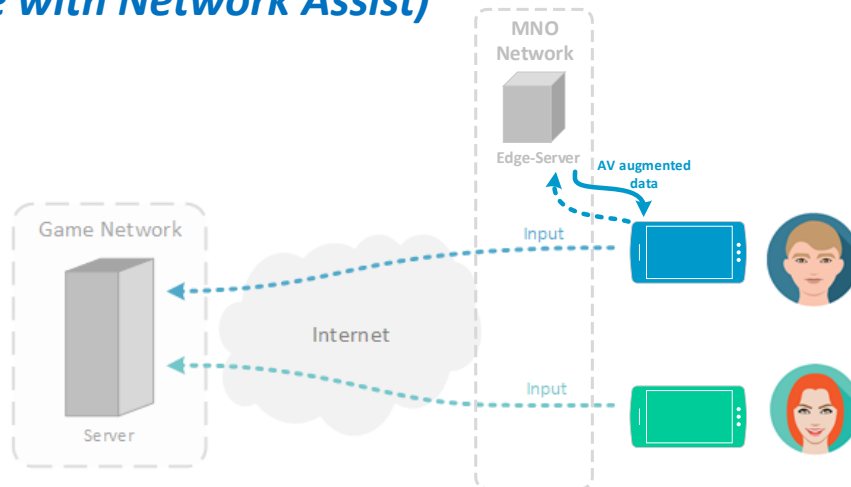
1. Console Gaming (Device Side)



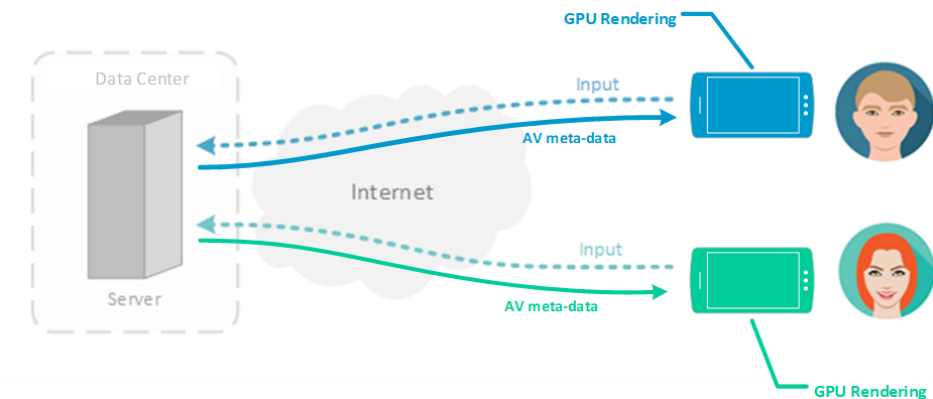
2. Cloud-Gaming (Network Side)



3. Hybrid Gaming (Device with Network Assist)



4. Hybrid Gaming (Network with Client Assist)



Today's
Gaming
Models



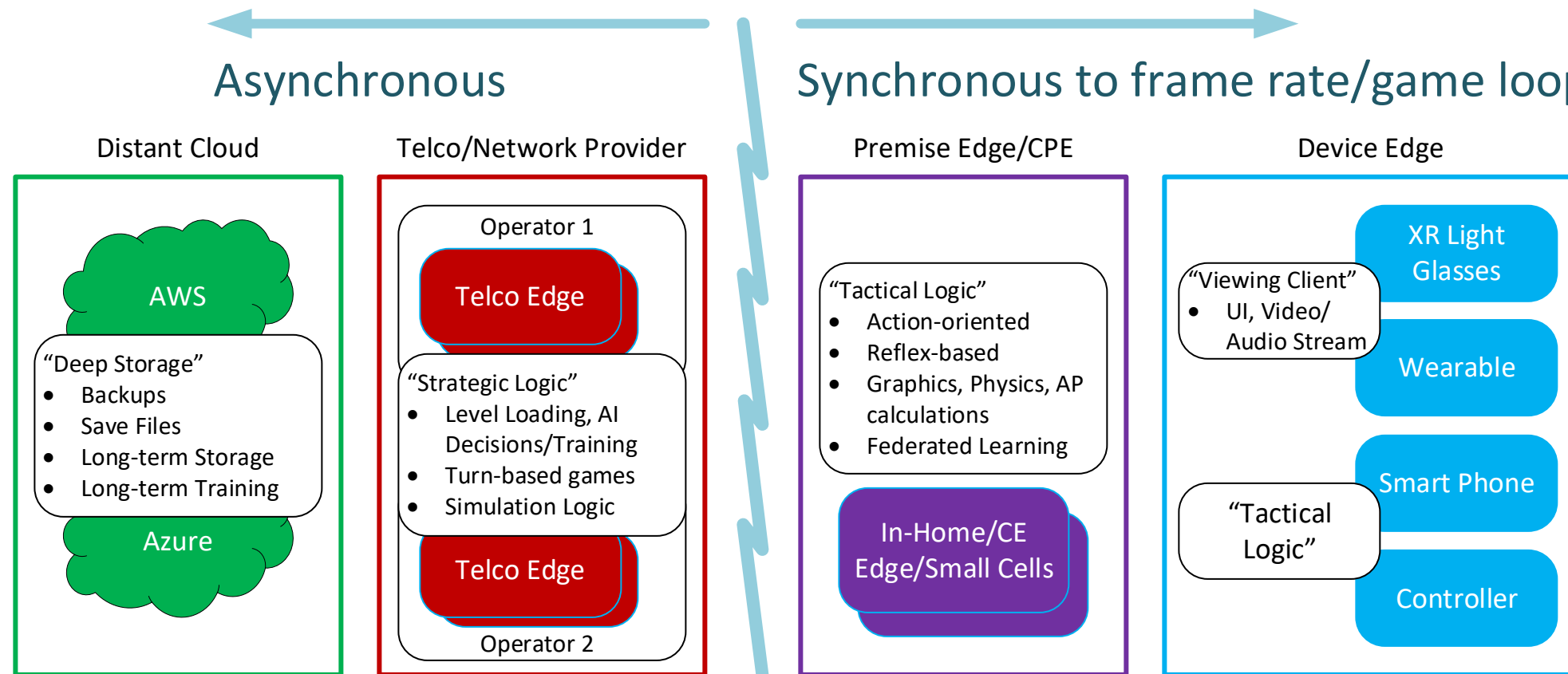
Emerging
Gaming
Models



Edge-Native XR Gaming – “Key Question”



How can game functions be flexibly distributed across an edge system: device edge, premise edge, telco edge, and cloud?



Edge-Native XR Gaming Concept Platform



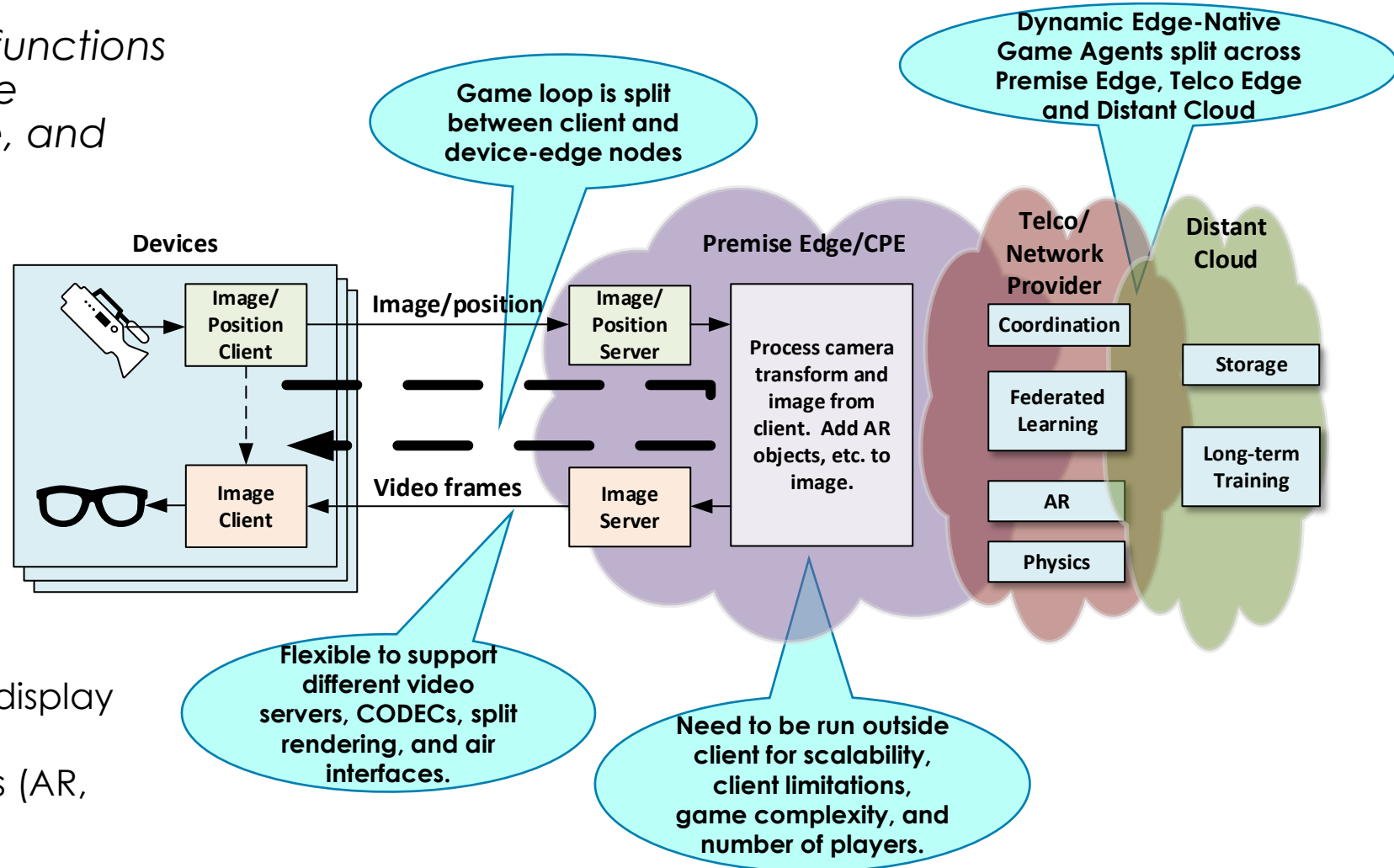
Purpose: Evaluate how XR game functions can be distributed across an edge system: device edge, telco edge, and cloud

Approach:

- Leverage Unity game development environment
- Incremental experiments & evaluation of KPI tradeoffs

Key Attributes:

- Video rendering de-coupled from display client and gameplay functionality
- Flexible distribution of game agents (AR, physics, AI, game logic, etc.)



Concept Platform Evolution



1st PoC Iteration – Single Player Split Game Loop - *Done*

- User movement on client sent to edge server which renders complex image based on client position/orientation.
- Rendered video is sent back to client and displayed.

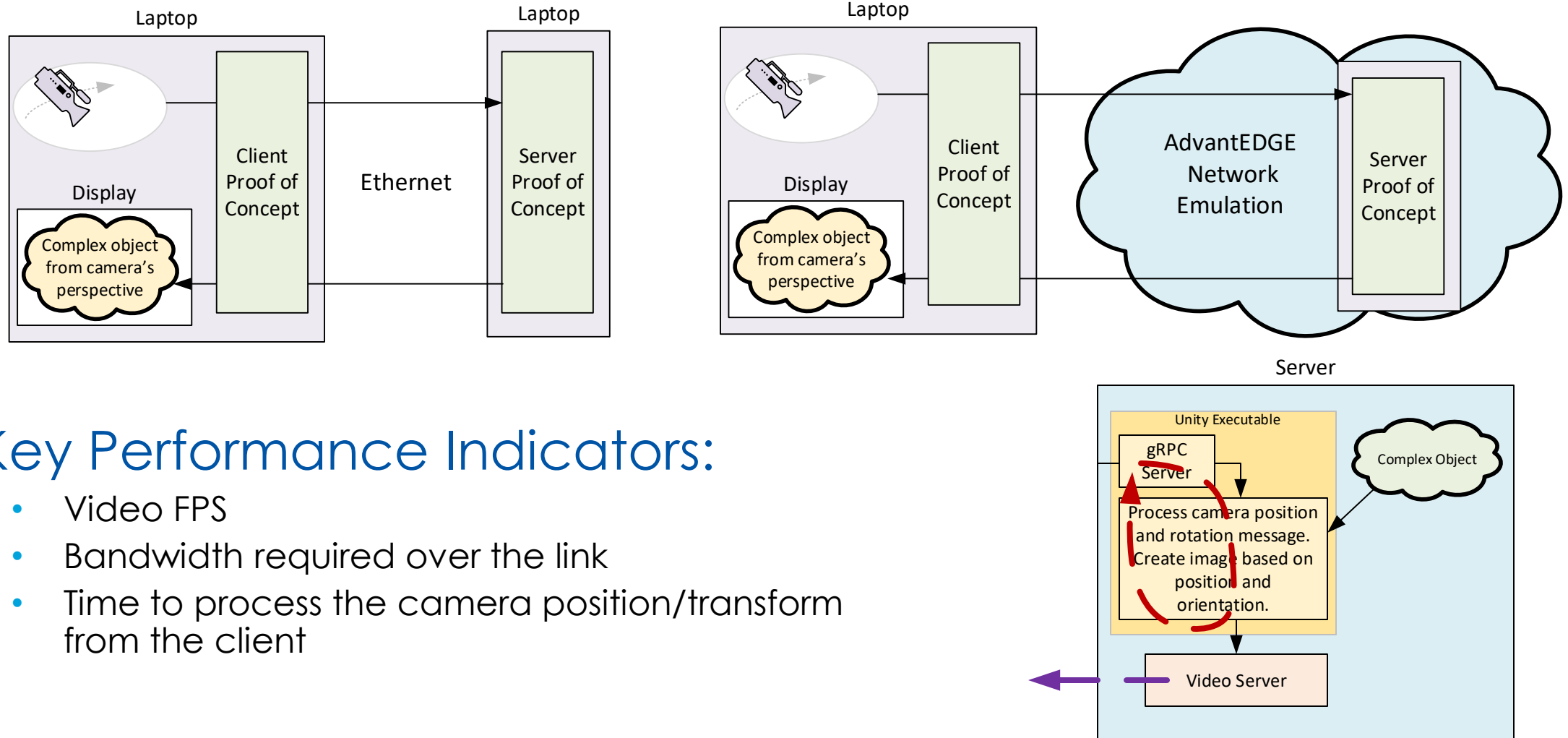
2nd PoC Iteration – Multi-Player Split Game Loop (shared renderer) - *Done*

- Multiple clients would perform actions and the rendered video to each client was consistent – reflecting the actions taken by all players.

3rd PoC Iteration – Table-top XR Game – *In Progress*

- Full Unity game with *thousands* of user-controlled objects.
- Each object requiring physics, intelligence, and complex rendering (i.e. they must be distributed over the edge to realize the game).

Instrumentation



Key Performance Indicators:

- Video FPS
- Bandwidth required over the link
- Time to process the camera position/transform from the client

Test Benches



Different compute configurations with varying HW capabilities:

- System 76 Meerkat* clients
- System 76 laptops client and edge
- Acer E3-111-C32T** client and edge
- Google Pixel 5 clients

AdvantEDGE edge-network emulation

- Simulate various network delays

Ethernet, WiFi

- Simulate various network configurations

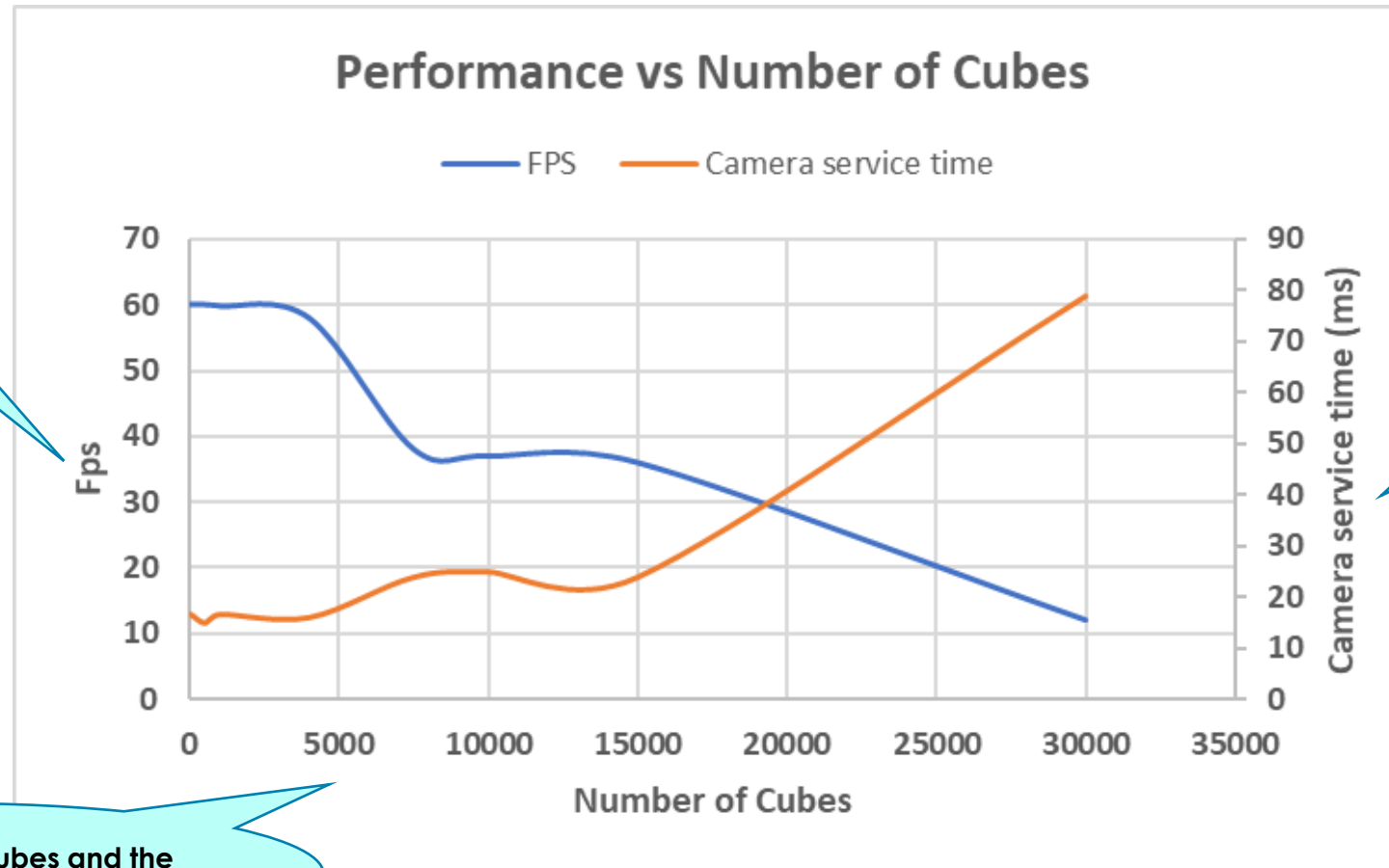
AWS Servers

- Simulates cloud-based gaming

* *Mini-PC*

** *Constrained Device*

Exemplary Results



FPS rendered on client

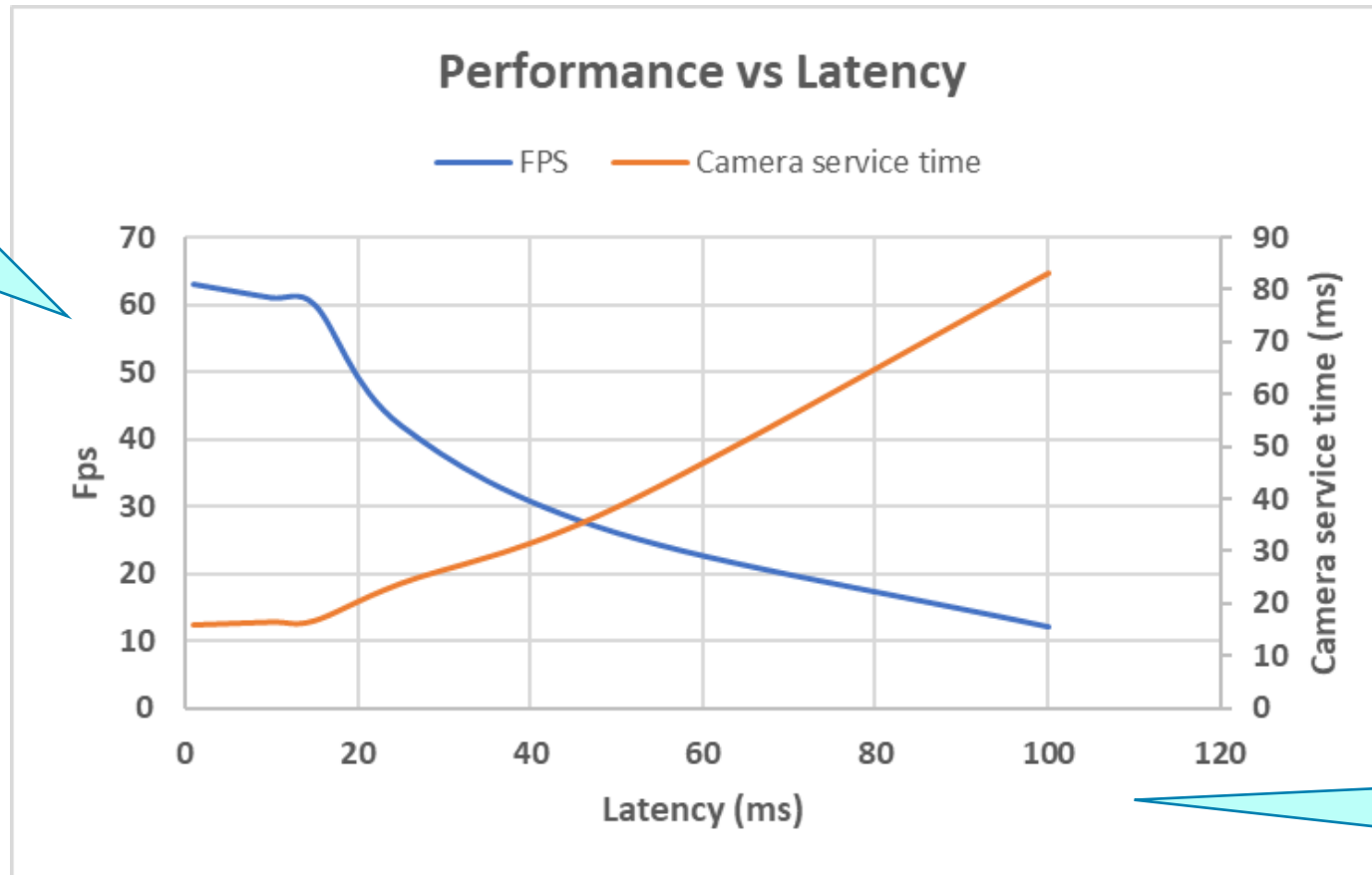
Time between successive services of the camera transform

Varied number of cubes and the performance was measured

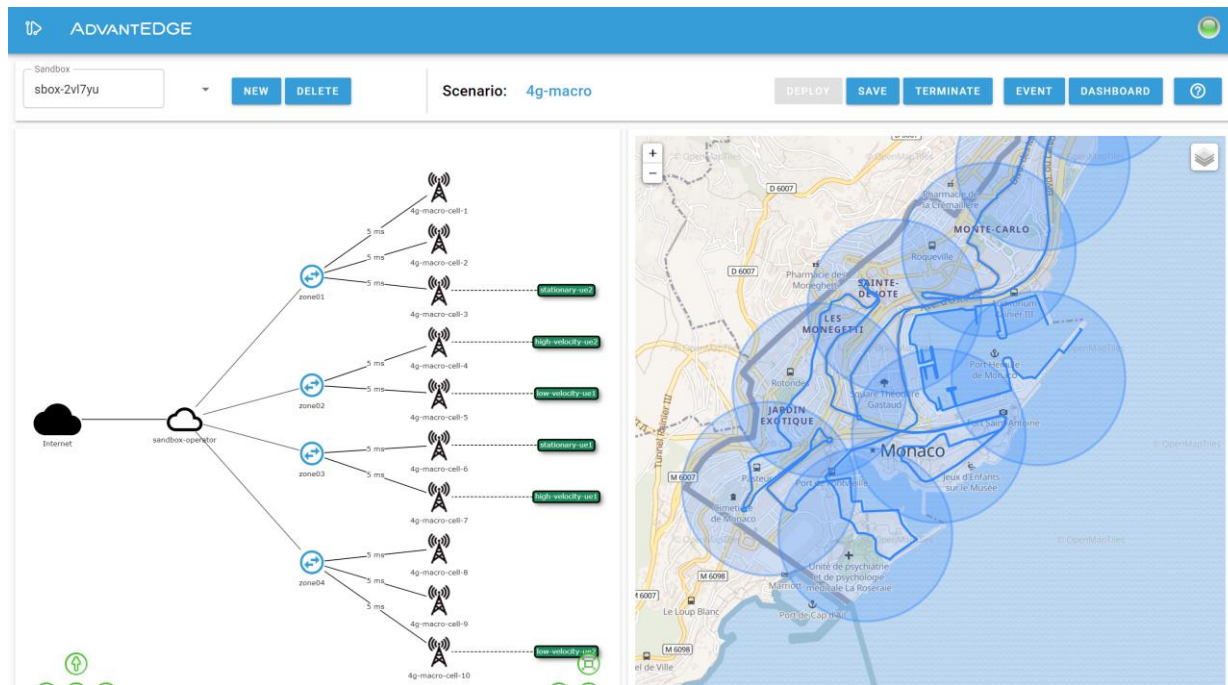
Exemplary Results



Number of cubes in image remained constant and canvas size constant, varied network delay.



As server moves "away" from the edge to the cloud, performance degrades.



Interested to Learn More?

GitHub: <https://github.com/InterDigitalInc/AdvantEDGE>

Wiki: <https://github.com/InterDigitalInc/AdvantEDGE/wiki>

E-mail Us at: AdvantEDGE@InterDigital.com

- Tool for programmers and network designers to develop edge-native services
- Enables a range of Edge Network Topologies, from 4G/5G networks to indoor WiFi networks and hybrids
- Containerized Environment based on Kubernetes
- Emulated & External Clients / Apps / Edge Nodes
- Dynamic and adaptable network characteristics: mobility, throughput, latency, jitter, and packet-loss
- Scalability: Small (≤ 25 nodes) to Large (1,000+ nodes)
- Edge Services:
 - MEC012 3GPP Radio Network Info; MEC013 Location; MEC028 WLAN Info
 - Edge App State / Context Transfer
 - Scenario configuration & monitoring; Geo-spatial Service, Metrics Service, AI / GPU at the Edge

ETSI MEC Sandbox



- ✔ Online edge environment for edge app developers can learn and interact with MEC Service APIs
- ✔ Supplements the ETSI Forge OpenAPI (<https://forge.etsi.org/rep/mec>)
- ✔ Users remotely call MEC service end-points from their application or via a web-portal “Try-it” page

Swagger Select a definition: WLAN Access Information Service REST API

ETSI GS MEC 028 - WLAN Access Information API

2.1.1 GAS

<https://try-mec.etsi.org/sbxtf5a6m61/api/wai-api.yaml>

The ETSI MEC ISG MEC028 WLAN Access Information API described using OpenAPI
the developer - Website
BSD-3-Clause
ETSI MEC028 V2.1.1 WLAN Information API

Servers
<https://try-mec.etsi.org/sbxtf5a6m61/wai/v2>

wai

- GET /queries/ap/ap_information Retrieve information on existing Access Points
- GET /queries/sta/sta_information Retrieve information on existing Stations
- GET /subscriptions Retrieve information on subscriptions for notifications
- POST /subscriptions Create a new subscription

ETSI HOME SANDBOX HELP

Configuration

Network: 4g-5g-wifi-macro

Pause ☐

Stationary UE - 4 / 4 +

Low Velocity UE - 4 / 4 +

High Velocity UE - 4 / 4 +

API Console

ID	SERVICE	RESP. CODE	TYPE	METHOD	ENDPOINT	Time ↓
1	028	200	Request	GET	/wai/v2/queries/sta/sta_information	2020-12-01T19:30:23.857457392Z
1	012	200	Request	GET	/rnl/v2/queries/rab_info	2020-12-01T19:30:04.918569255Z
1	013	200	Request	GET	/location/v2/queries/users	2020-12-01T19:29:43.54568655Z

MEC API: WLAN Access Information(028)

Try-it in the browser

Click [here](#) to start a MEC client in the browser.

The client allows to send HTTP requests to MEC Service APIs in your MEC Sandbox; the returned values reflect the current state of the network.

Thank you!!

