Creating Infinite Possibilities.

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Holographics Over 10G: Paving the Way for the Immersive Future

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SCTE CABLE-TEC EXPO 22
SEPTEMBER 19-22 • PHILADELPHIA, PA

2022 Fall Technical Forum
SCTE • CABLELABS • NCTA

COMING UP:

- ✓ Introduction to Immersive Media
- ✓ IDEA: The Immersive Digital Experiences Alliance
- ✓ Delivering Immersive Media: 3D Streaming

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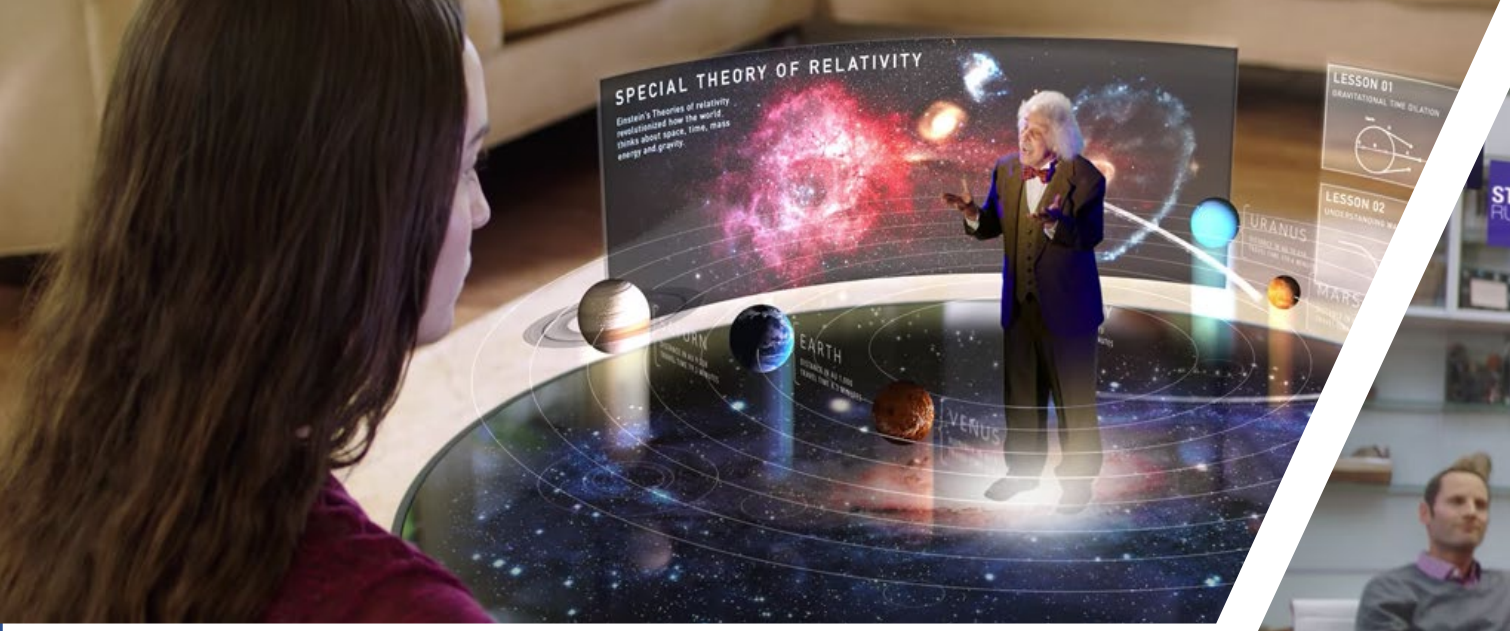
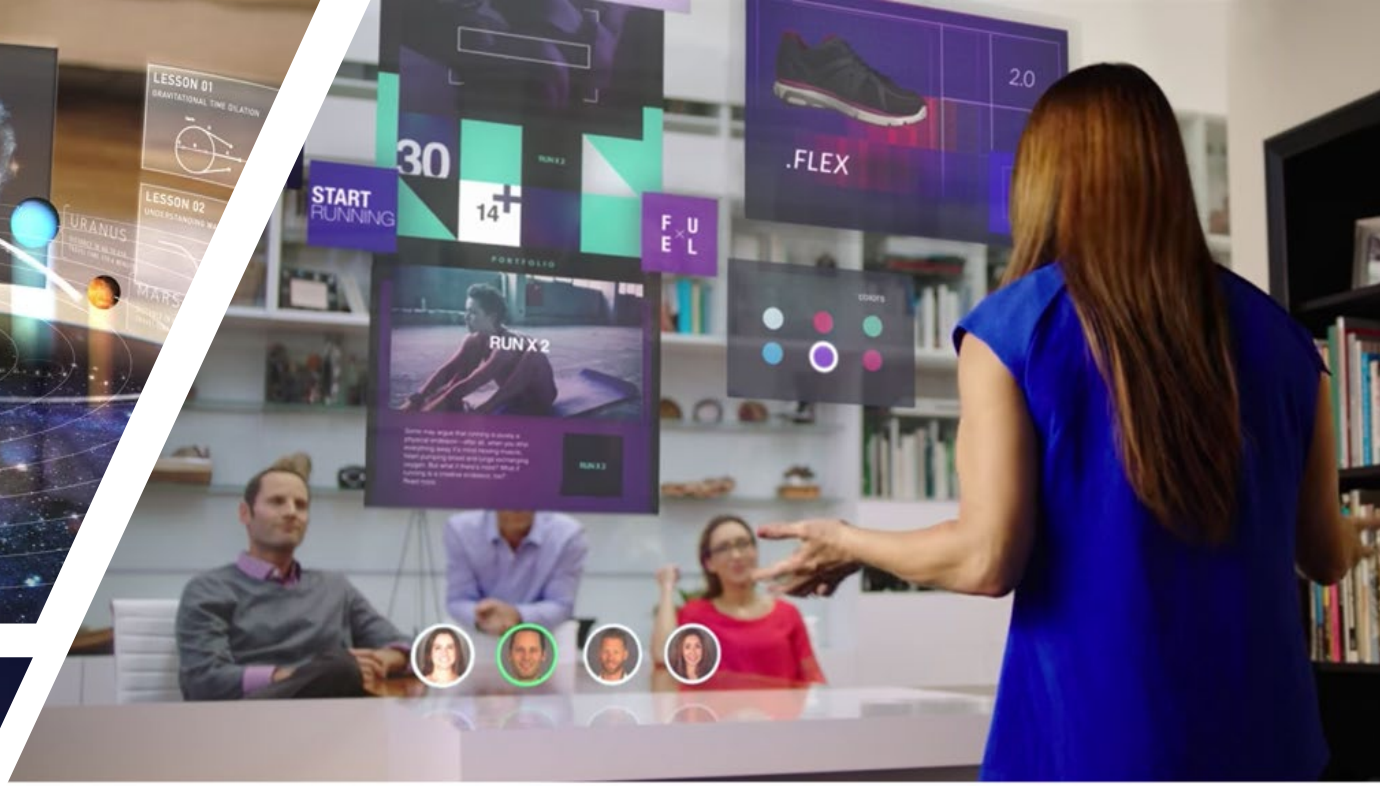

SPECIAL THEORY OF RELATIVITY
Einstein's Theories of relativity revolutionized how the world thinks about space, time, mass energy and gravity.
LESSON 01
GRAVITATIONAL TIME DILATION
LESSON 02
URANUS
EARTH
VENUS
MARS


START RUNNING
30
14
FUEL
.FLEX
2.0
RUN X 2

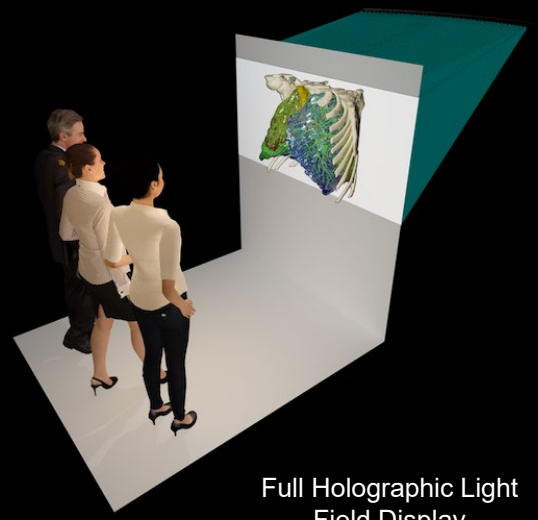
CURRENT LOCATION
336 Alameda St.
Cafe Basileie
Video call

Types of immersive viewers

VR head-mounted Display

Multifocal head-mounted Display

3D Stereo Display



Full Holographic Light Field Display

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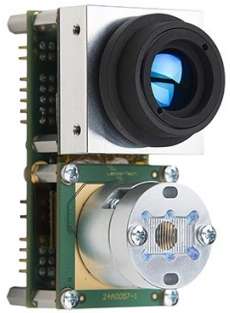
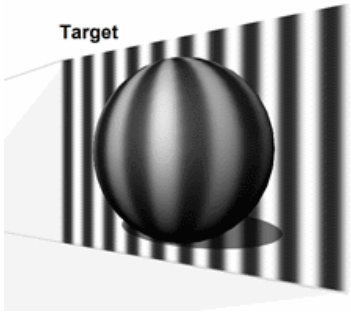
Types of immersive capture

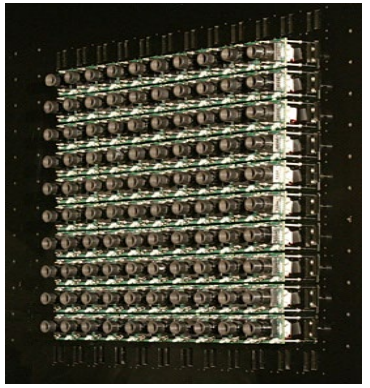
Depth Camera
(e.g. Time of Flight)



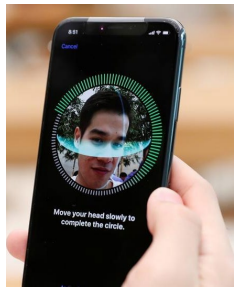
LIDAR



Structured Light



Camera Array



Cameras + AI

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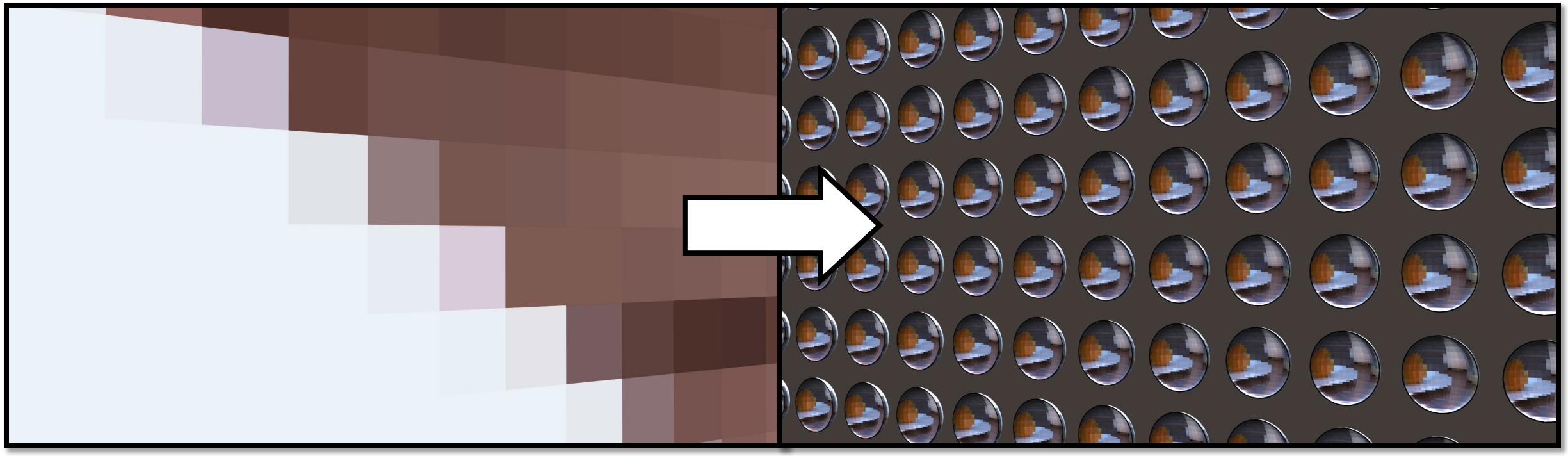
Light Field Displays are unprecedented

Traditional 2D Pixels

Holographic Pixels, “Hogels”



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IDEA: The Immersive Digital Experiences Alliance

IMMERSIVE DIGITAL EXPERIENCES
ALLIANCE

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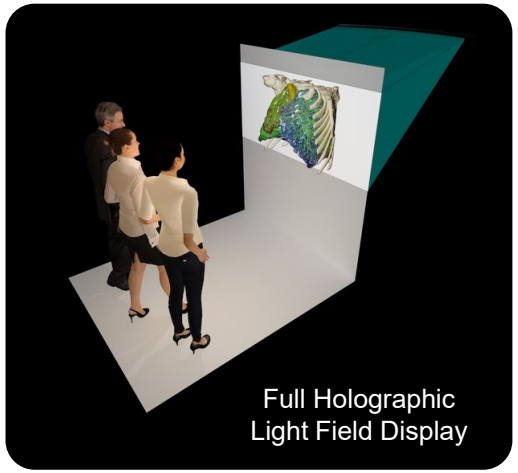
IDEA's Vision
A Display Agnostic Approach

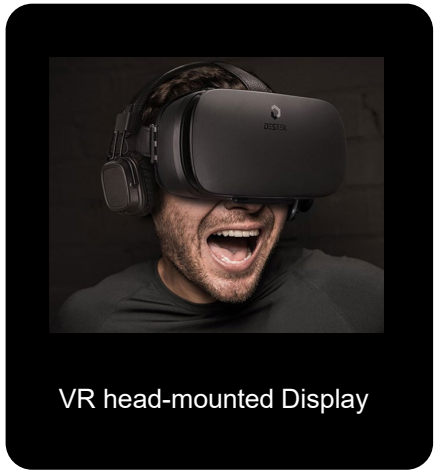
ITMF
Scene Graph
File or Stream

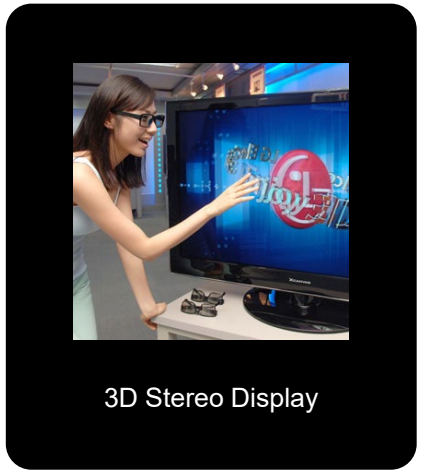
***I**mmersive*
***T**echnologies*
***M**edia **F**ormat*

Media-Aware Network + Display-Specific Renderer


Full Holographic
Light Field Display

Multifocal head-mounted Display


VR head-mounted Display


3D Stereo Display

Legacy 2D Displays

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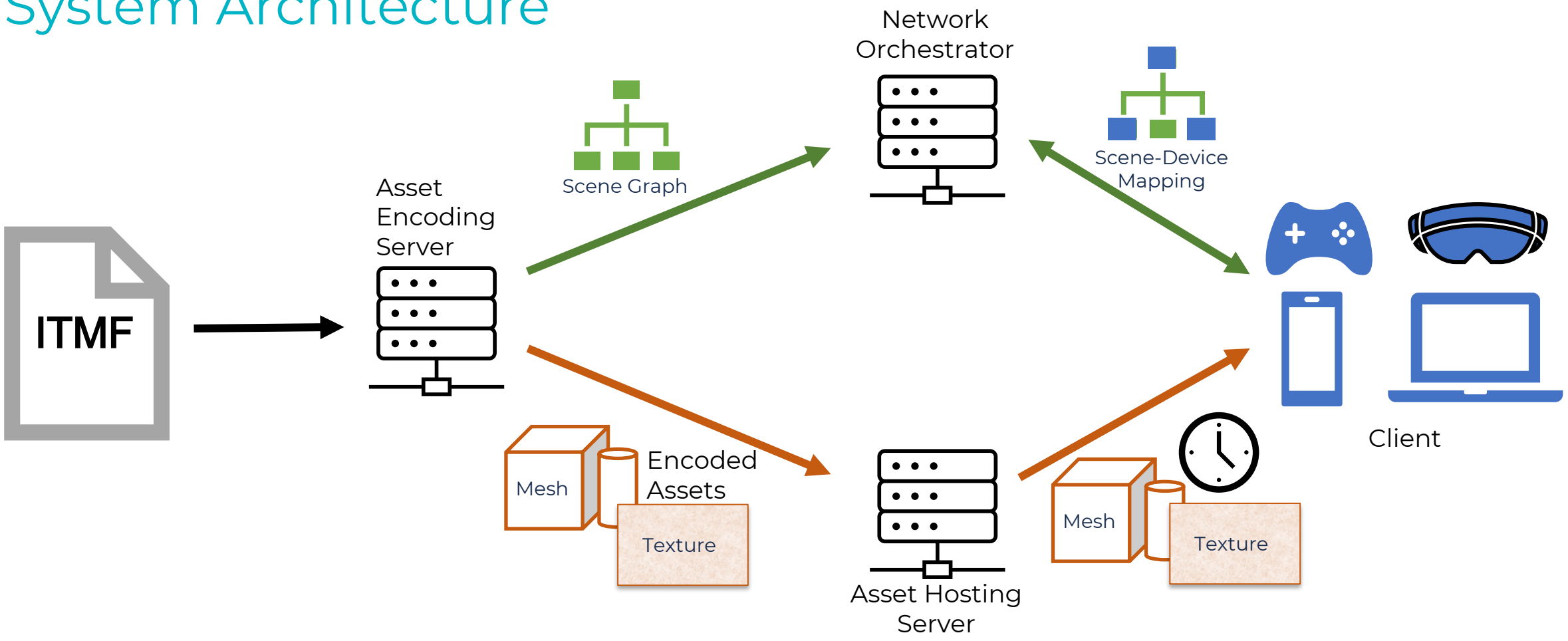
System Architecture



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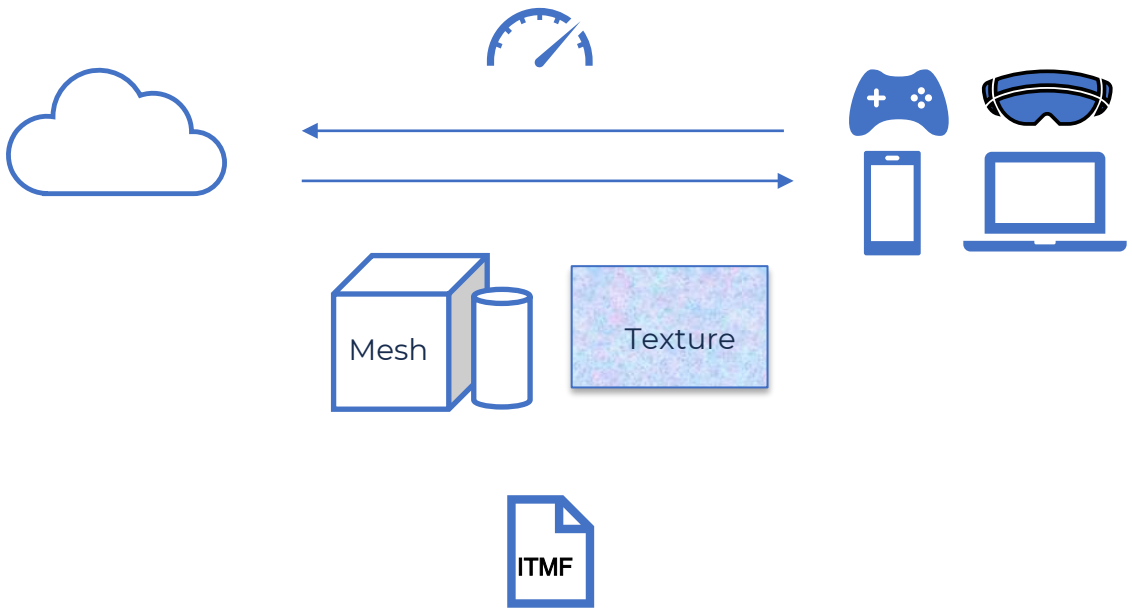
Intelligent Buffering



- Intelligent buffering is defined as a client fetching 3D assets from content delivery network (CDN) servers in a network-aware order during runtime.
.
- Network awareness: Enable cloud orchestration for scalable, adaptive streaming of 3D assets of different LODs, compression based on latency, BW.
- Objective: Minimize fetch times and network traffic while streaming 3D content on heterogeneous platform.

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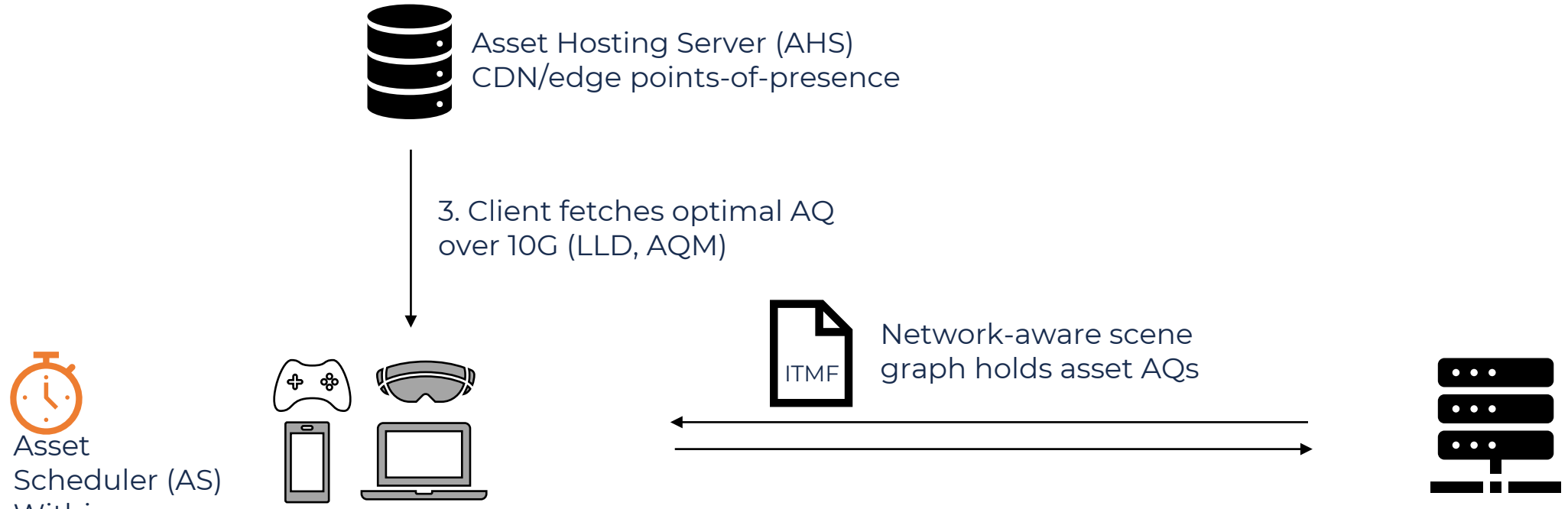
Intelligent Buffering



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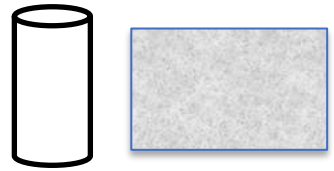
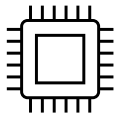
Asset Scheduling and Compression

Network conditions
Latency, bandwidth determine Asset Quality (AQ)

Asset Scheduler
Optimize client-AHS fetch latencies



Asset Fetch Call
Minimal impact on Quality of Experience (QoE)



Compute capability
CPU memory, GPU memory, encoding support for immersive display units

Asset Quality
Provide optimal visual quality under adverse network, compute conditions

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Delivering Immersive Media: 3D Streaming

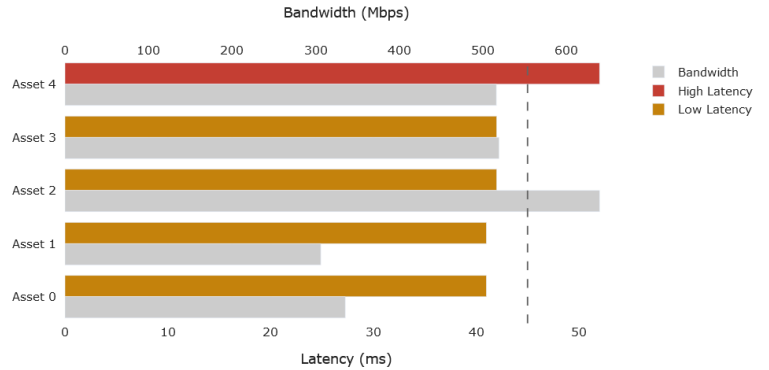
Intelligent Buffering
- Need rich network awareness

Performance evaluation
- We built a dashboard to measure and enhance our approach to buffering

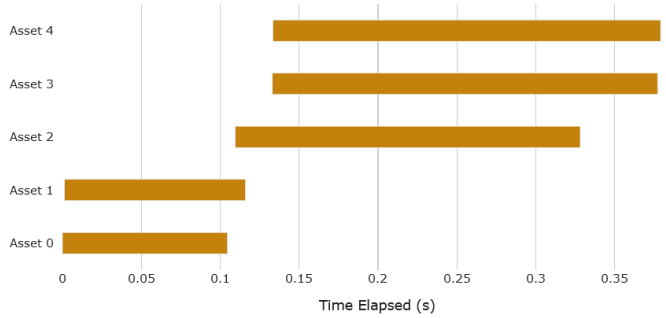
Streaming Metrics

Distributed Content for Edge Localization

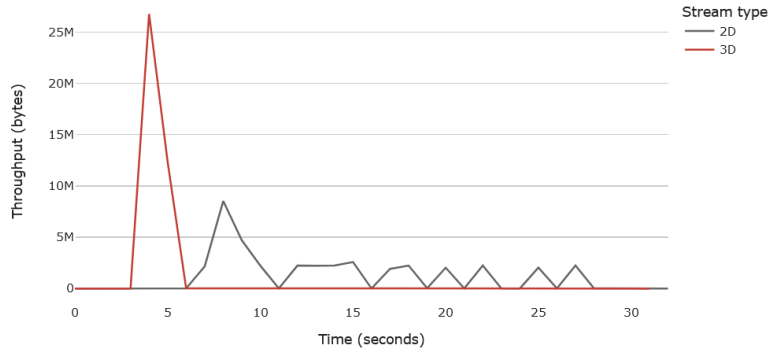
Latency-Bandwidth Based Asset Selection



Asset Scheduler Minimizes Buffering Times



2D vs. 3D Downstream Traffic



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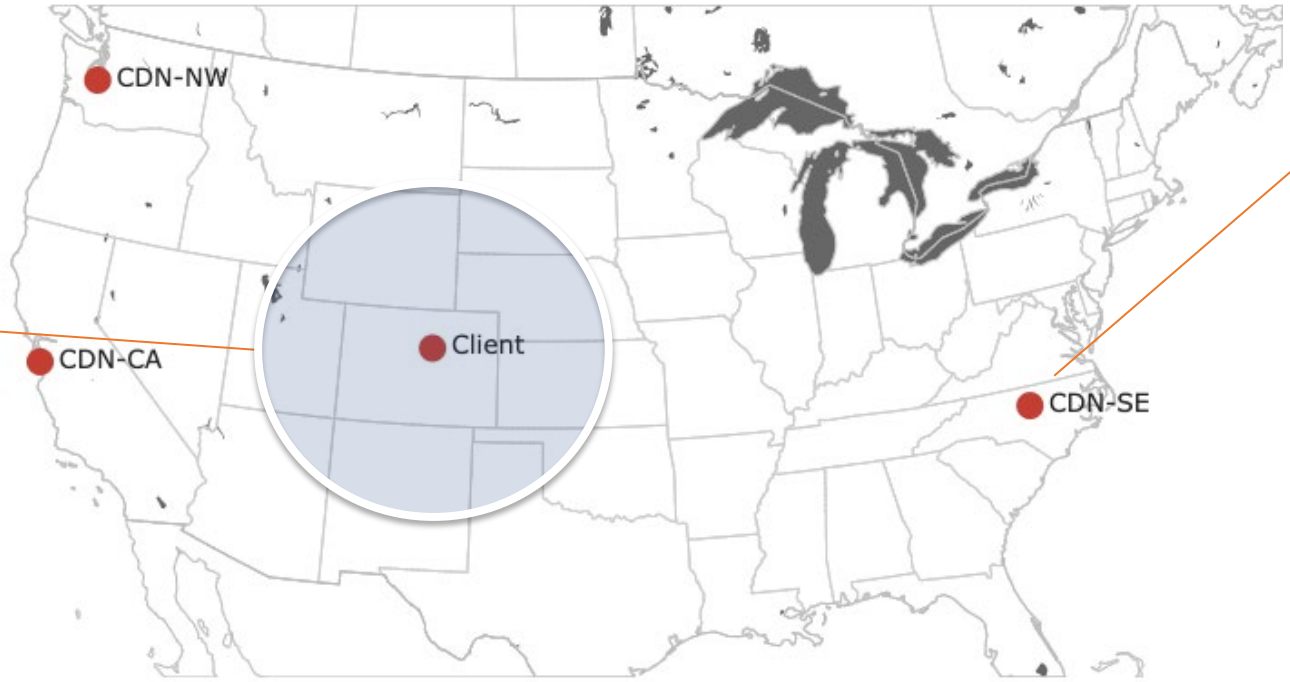
Delivering Immersive Media: 3D Streaming

Edge Deployment
Low latency interactive use cases
- Cloud Gaming
- Metaverse

Distributed Content for Edge Localization



CDN Deployment
- Reliable
- Performant
- Scalable

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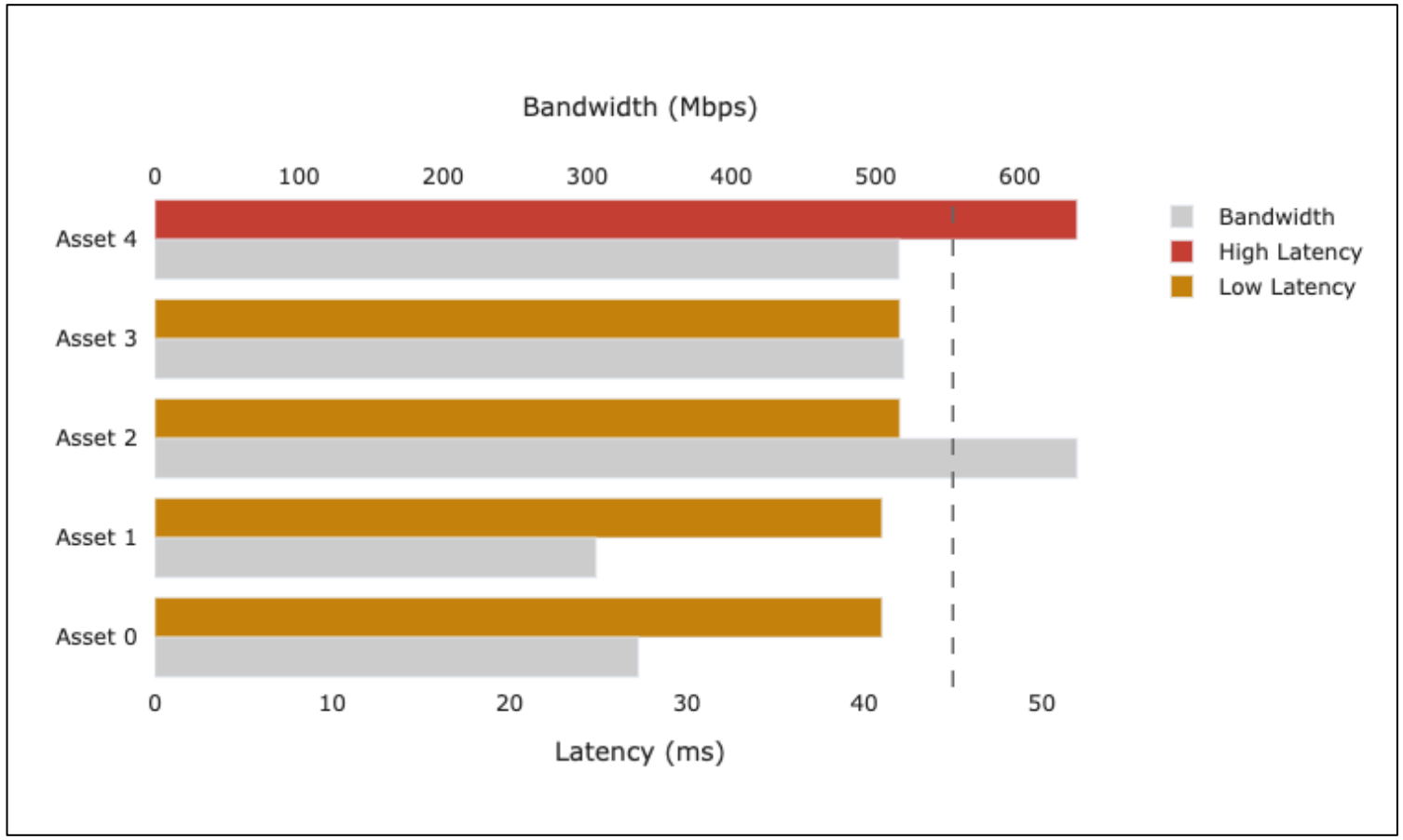
Delivering Immersive Media: 3D Streaming

Asset Scheduling
Make decisions in real time by observing throughput and latency of asset transfers

Basic Approach
Latency threshold for LOD selection

Latency-Bandwidth Based Asset Selection



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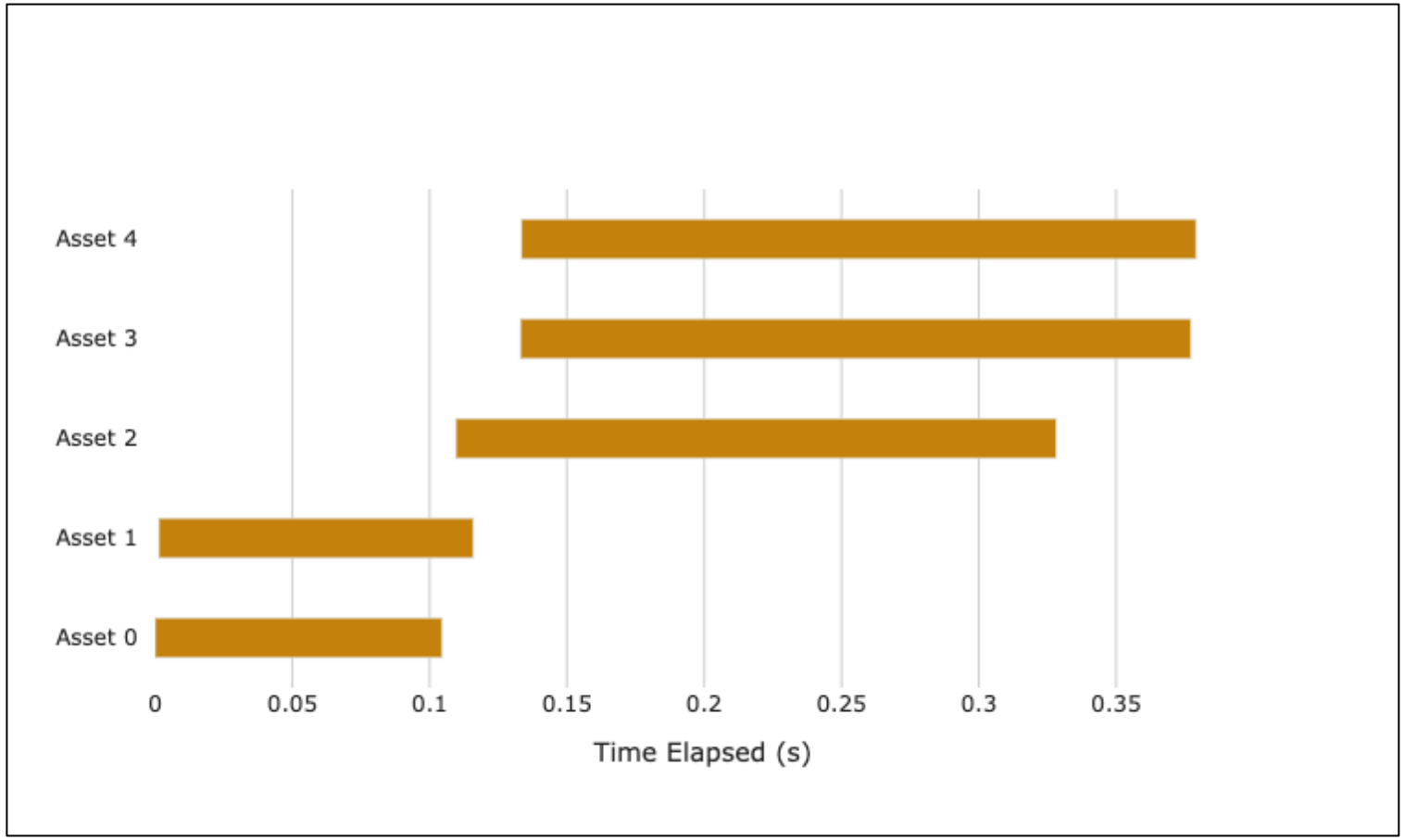
Delivering Immersive Media: 3D Streaming

Performance Evaluation
Criteria to analyze and compare future buffering algorithms

Asset Availability
Assets present on the client when needed

Transmission Time
Minimize total time transmitting assets

Asset Scheduler Minimizes Buffering Times



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Delivering Immersive Media: 3D Streaming

Existing Approach:
"2D" Streaming
Excels at

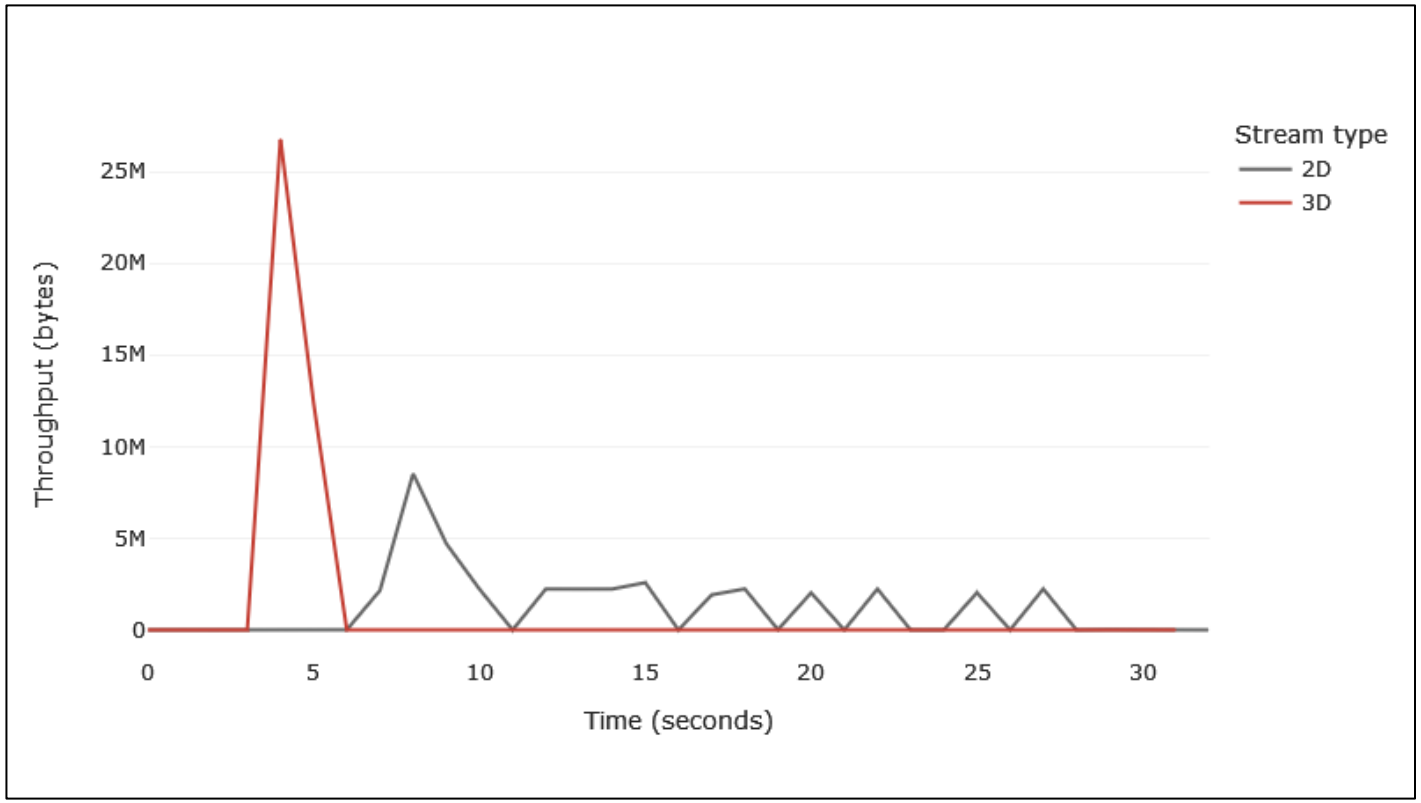
- Homogeneous displays
- Existing resolutions
- Short form content

Our Approach:
3D Streaming
Excels at

- Heterogeneous displays
- Future resolutions
- Long form content

Split Rendering - Future Work
Mix 2D and 3D streaming to provide the best possible quality of service for every client.

2D vs. 3D Downstream Traffic



Note: 2D video here is 1080p, h.264

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Delivering Immersive Media: 3D Streaming

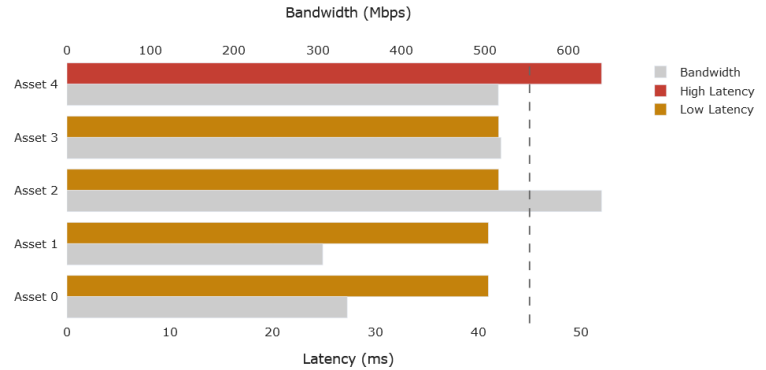
Together, these network metrics give us a **broad design space** to develop streaming solutions that **maximize quality of service** for immersive media

More to come soon!

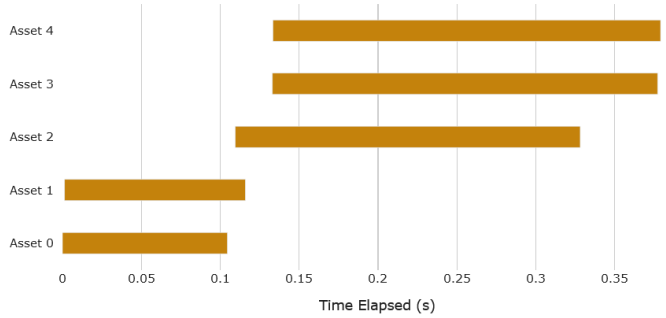
Streaming Metrics

Distributed Content for Edge Localization

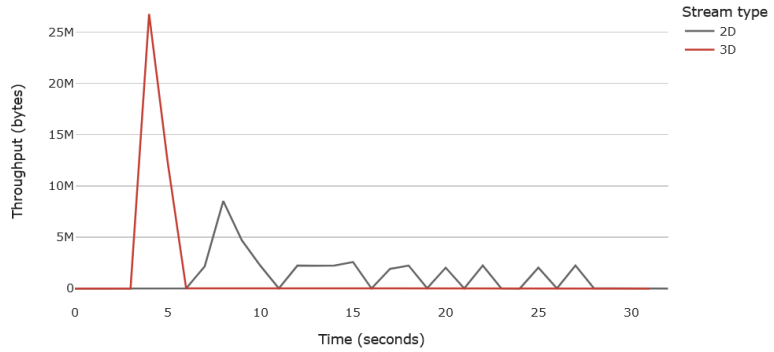
Latency-Bandwidth Based Asset Selection



Asset Scheduler Minimizes Buffering Times



2D vs. 3D Downstream Traffic



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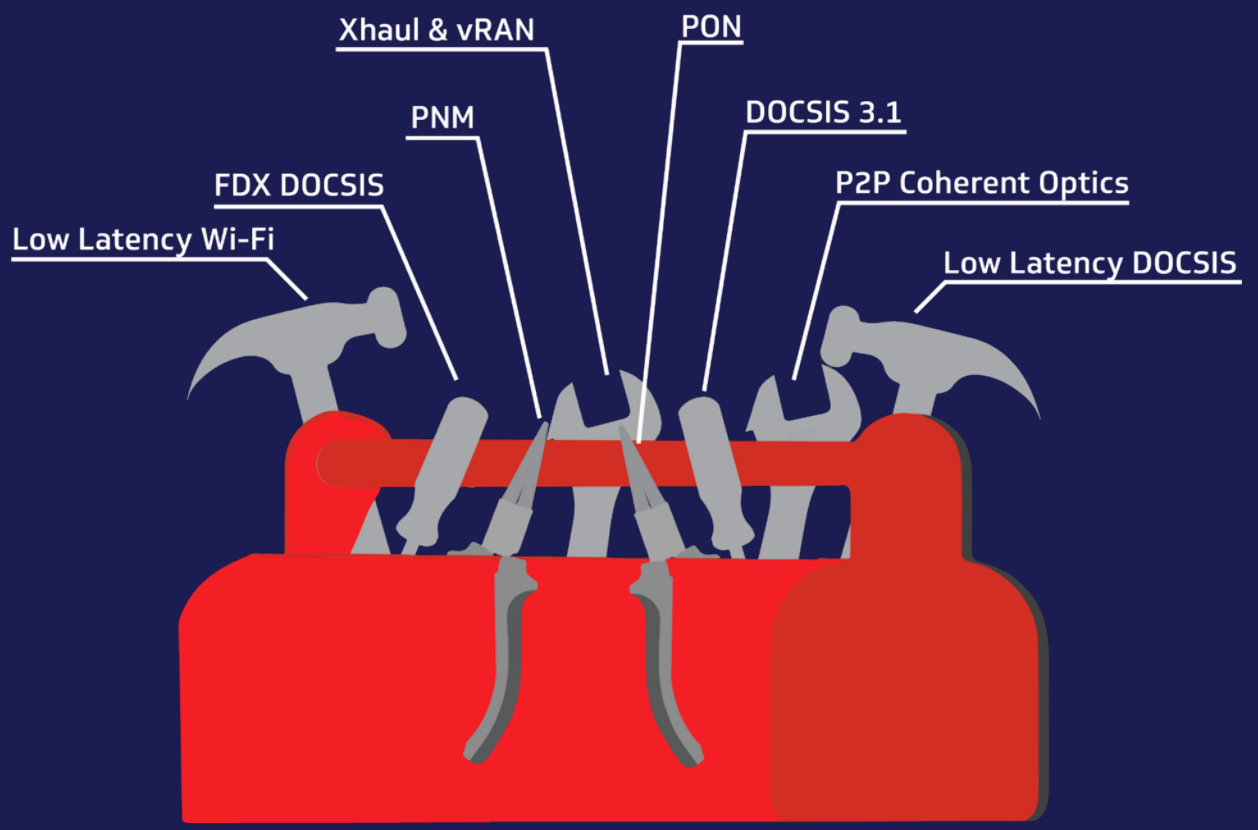
10G



10x Speed

More Reliable

Better Security

Lower Latency

Creating Infinite Possibilities.

Thank You!

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