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Challenges in Wireless XR

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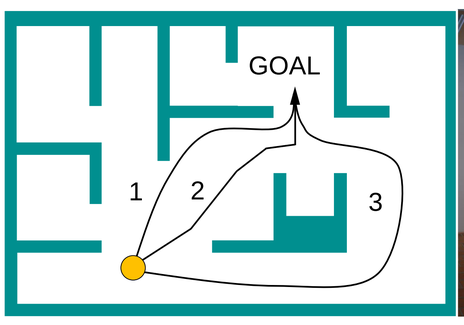
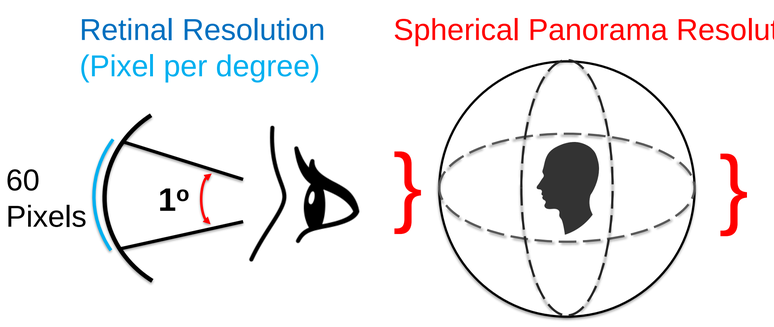
INTRODUCTION

- With rapid display advances, virtual reality (VR), augmented reality (AR), mixed reality (MR) are becoming unified (XR).
- Both consumer and enterprise use cases demand an unprecedented level of network capabilities in terms of low latency, high bandwidth, and high reliability.
- Imagine millions of people, distributed around the world, collectively inhabiting and interacting in a virtual world.
- Imagine robots carrying panoramic cameras, offering a level of telepresence or tele-embodiment that was not previously available.

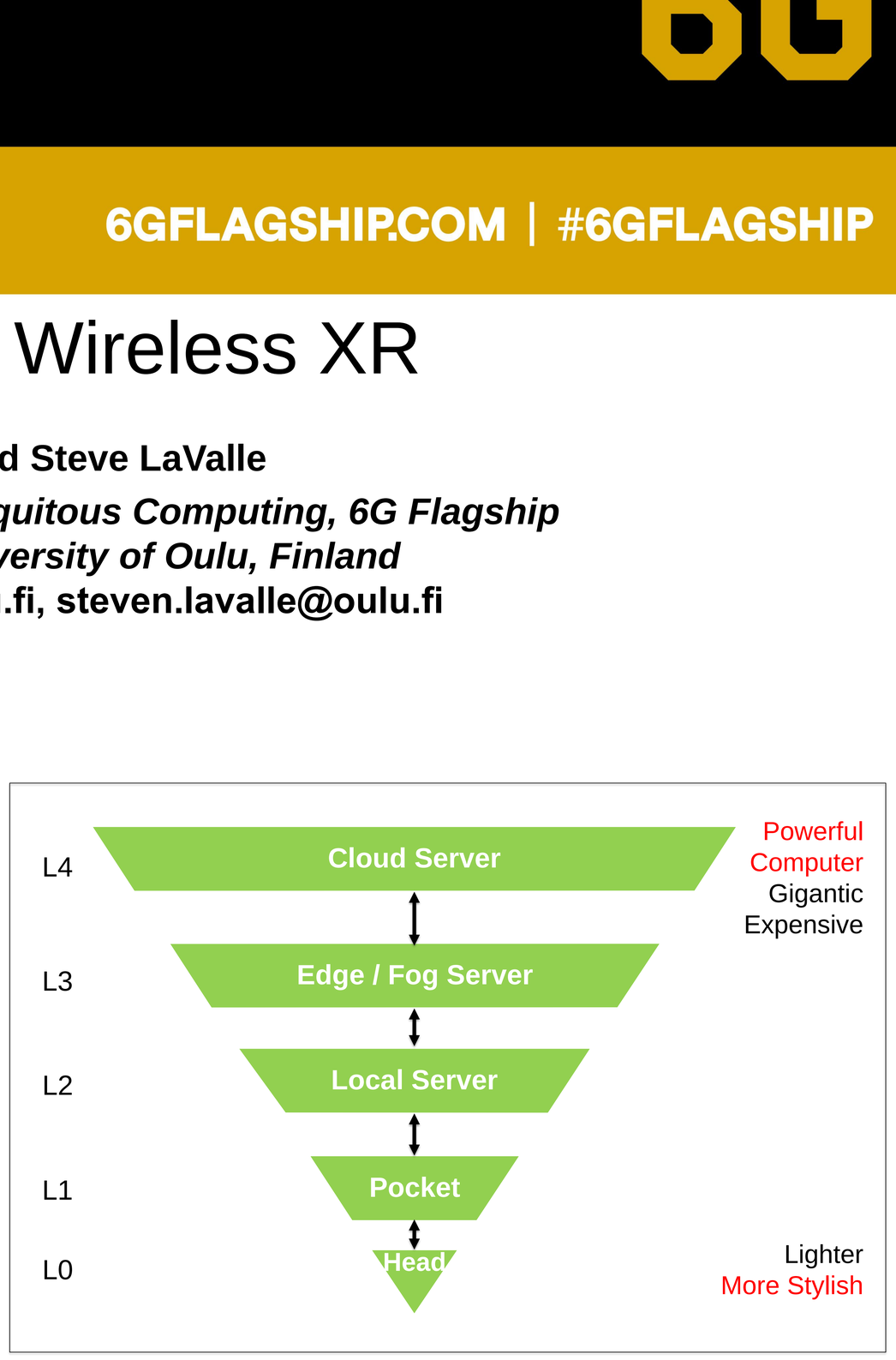


- XR works by creating a perceptual (e.g., optical) illusion.
- The key to making XR successful is to understand the human **perception-based criteria**, in terms of resolutions, frame rates, latencies, interactivity, field-of-view, and so on.
- Poor network performance can cause catastrophic side effects in people, including fatigue and nausea.
- Perception-based criteria must be translated into network requirements, leading to the development of coding, transceiving, and distributed computation methods that enable effective XR experiences while being comfortable to humans.



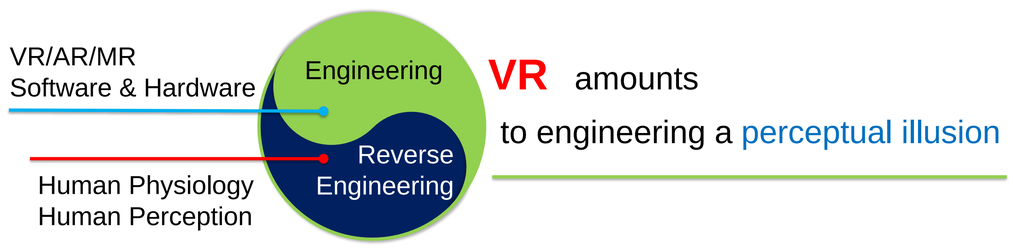
Retina Resolution Panorama Streaming Requirements

ppd / fps	10	30	60	Note
30	3	27	107	Gbit/s
60	6	53	214	
100	10	89	356	
1000	100	891	3564	



- **L4**: Remote cloud server and processor
- **L3**: Nearby servers with lower latencies
- **L2**: Home PC or STB (set top box); wired Internet; powerful graphics card (Nvidia, AMD); expensive
- **L1**: Carried in a pocket or purse; exploits 5G or WiFi; mobile GPU; streaming
- **L0**: Worn on the head; mostly a display; low power, low weight, low cost, high-bandwidth communication

✓ What pieces to distribute across the levels? Content dependent
✓ Network connections: Bandwidth, latency, stability, dropouts
✓ Different designs for public XR and private XR
✓ Minimize perceptual consequences



Note that AR, MR, XR are included with VR once display technologies advance.

ACKNOWLEDGMENTS

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REFERENCE

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