

Network 2030

Focus Group at ITU-T for SG13

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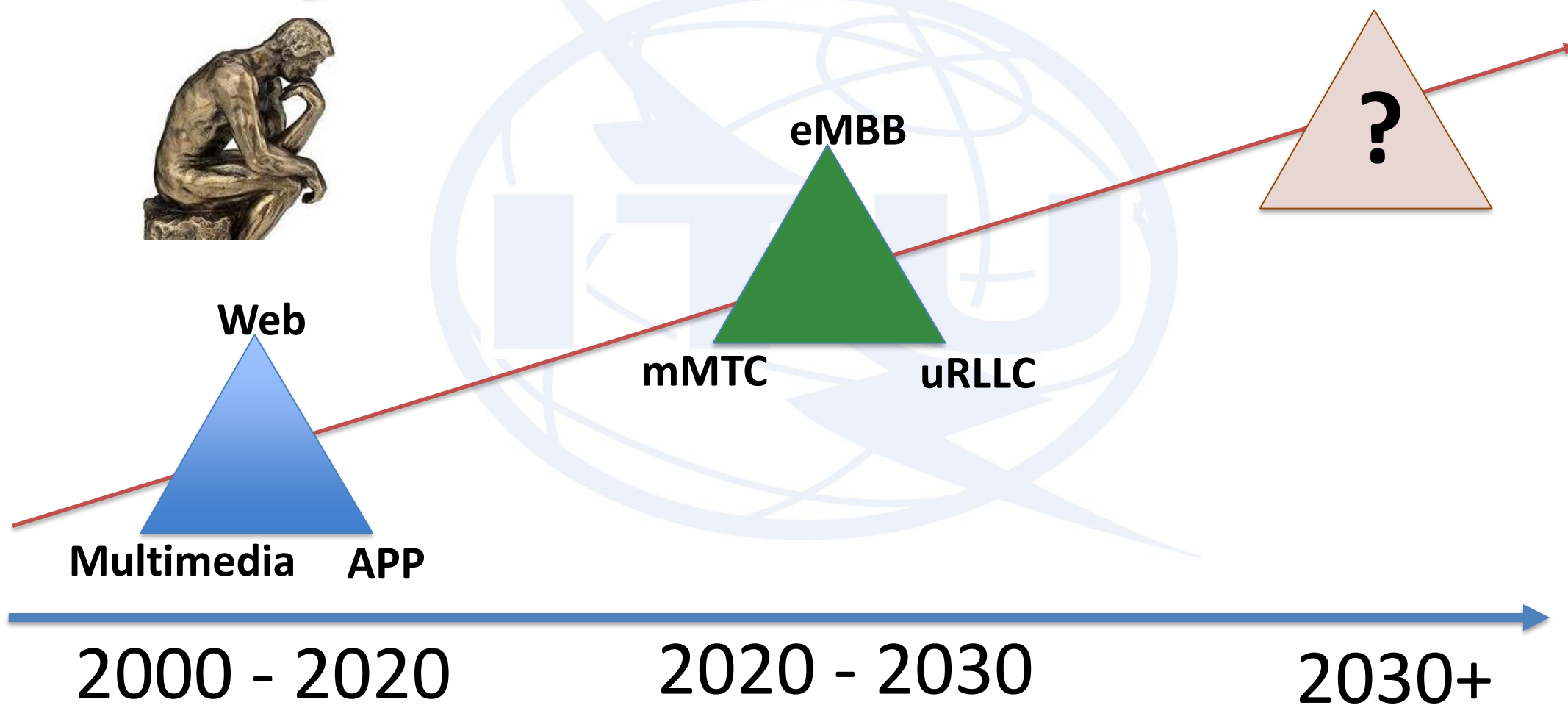
*On behalf of Richard Li, Ph.D., Chairman, ITU-T FG Network 2030
Chief Scientist and VP of Network Technologies, Futurewei Technologies, Inc., USA*

**Presentation at 2nd Visions for Future Communications Summit
Lisbon, Portugal, November 27, 2019**

Agenda


- ITU-T FGNET 2030 – From vision to results
- Networks, Services, Applications
- Summary

2030 and beyond: What will be (needed)?



ITU-T Focus Group on Network 2030

<https://www.itu.int/en/ITU-T/focusgroups/net2030/Pages/default.aspx>

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[Focus Group on Vehicular Multimedia](#)

[Focus Group on Technologies for Network 2030](#)

FG NET-2030

"Network 2030: A pointer to the new horizon for the future digital society and networks in the year 2030 and thereafter." – Dr Richard Li, FG NET-2030 chairman

The ITU-T Focus Group Technologies for Network 2030 (FG NET-2030) was established by ITU-T Study Group 13 at its meeting in Geneva, 16-27 July 2018.

The Focus Group, intends to study the capabilities of networks for the year 2030 and beyond, when it is expected to support novel forward-looking scenarios, such as holographic type communications, extremely

[Meetings and Related Event](#) [Focus Group News](#) [Focus Group Videos](#)

Workshop: 14 - 16 October 2019

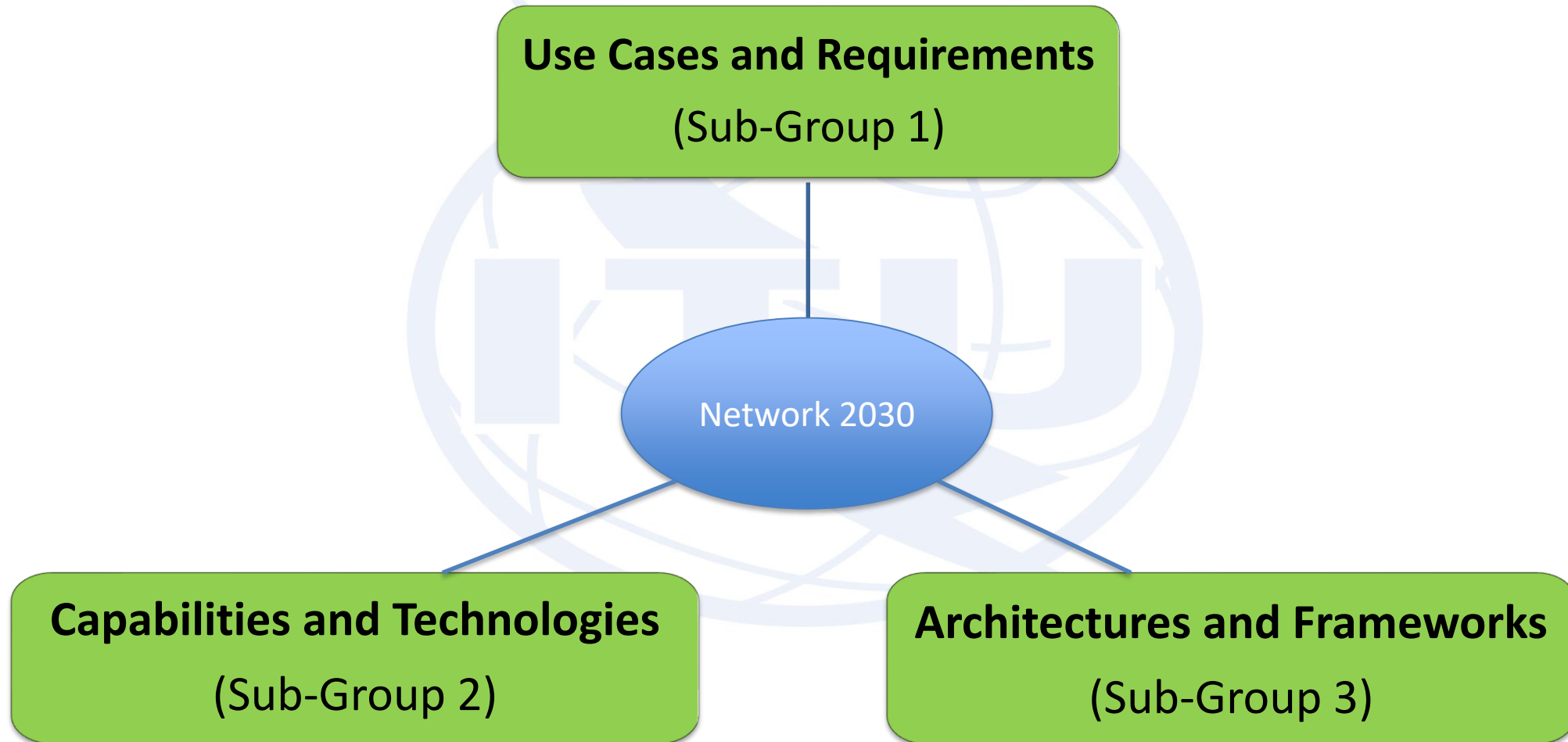
5th meeting of FG NET-2030:
16-19 October 2019,
Geneva, Switzerland

- Meeting Announcement (to come)
- Registration (to come)
- Fifth Workshop on Network 2030**
14 (afternoon), 15 (all day), 16 (morning)

- **Study capabilities of networks for the year 2030 and beyond**
 - Expected to support novel forward-looking scenarios (app/networks)
 - Answer what kinds of network architecture are required
 - Enabling mechanisms are suitable to enable novel scenarios
- **Explore new communication mechanisms from a broad perspective**
 - Not restricted by existing network paradigms or existing technologies
 - Network 2030 may be built upon a new or refined network architecture
- **Output to feed into ITU-T SG13, other ITU-T study groups or other SDO**



FGNET2030 Focus and Deliverables



2018-2019 Plenary Meetings and Workshops



[Link to All Workshops and Plenary Meetings on Network 2030](#)

Agenda

- ITU-T FGNET 2030 – From vision to results
- **Networks, Services, Applications**
- Summary

Convergence of Satellite Networks and Terrestrial Networks

Co.	Support (Data are from the Internet, not yet verified)	Scale
Starlink	SpaceX (Elon Musk)	4K by 2019, then 12K
Oneweb	Softbank	650 by 2019
Boeing	Apple (spec)	2956, 1350 in 6 yrs
O3Nb	Virgin group, SES	400
CASIC	China	300 (54 trial)

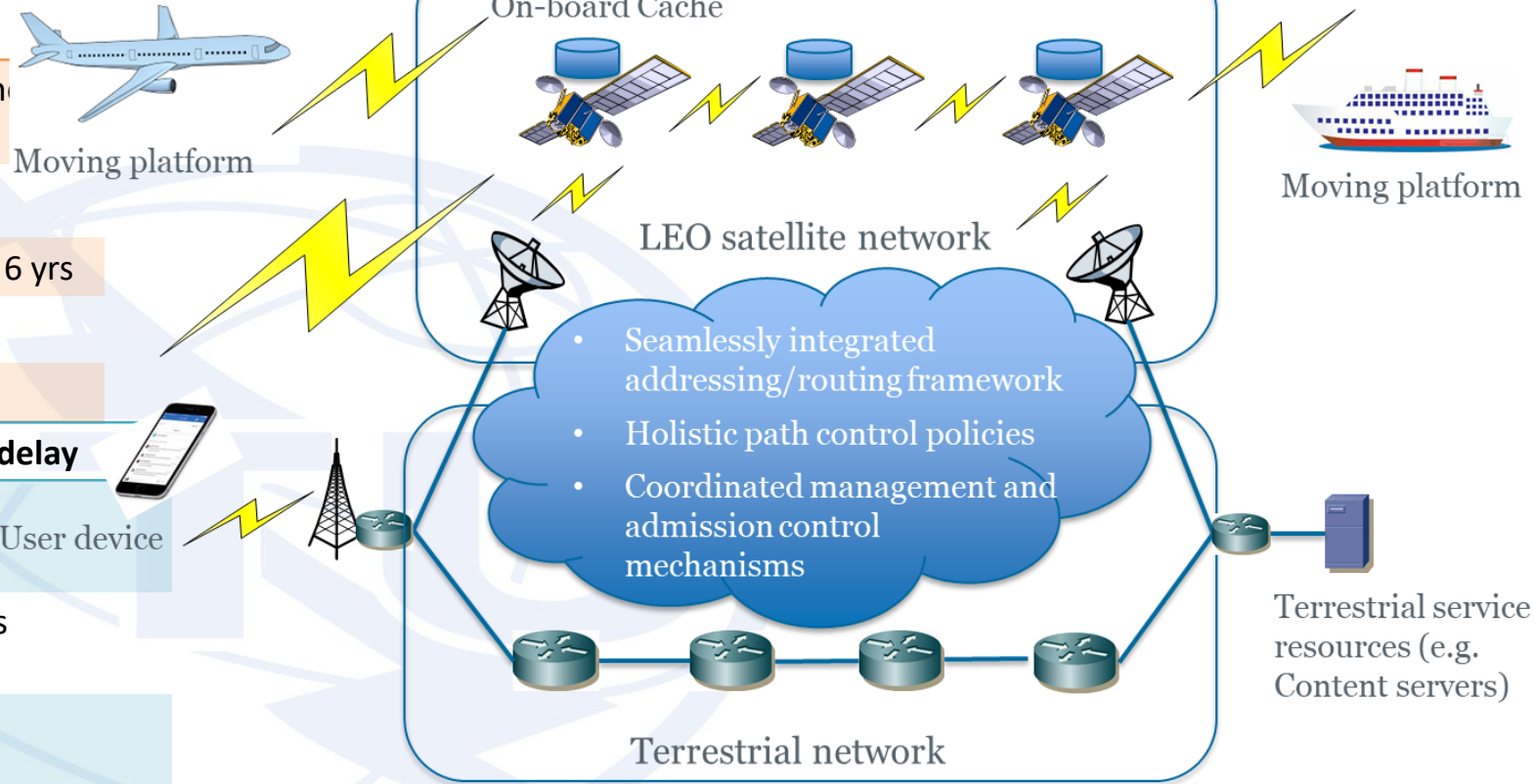
Distances	Bandwidth	delay
(LEO) 900-1200 KM	1—200 Gbps	35ms
(MEO) ~2000 KM	1-200 Gbps	~60ms
Space to space	~100 KM – ~Tbps ~1000 KM ~10 Gbps	

Use Cases

- Satellite as access, and terrestrial networks as backhaul
- Satellite as transport
- Hybrid and Integrated

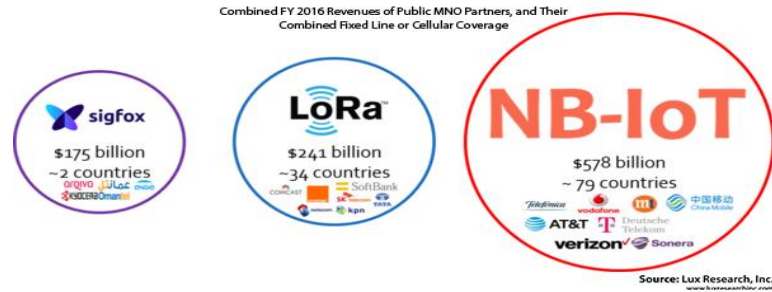
Requirements

- Uniform Addressing and Converged Routing
- Bandwidth capacity at the satellite side
- Admission control by satellites
- Edge storage and computing



ManyNets: Embracing Diversity, Variety, and Economy

Non-IP Networks (Growing market segment)



Spread Networks



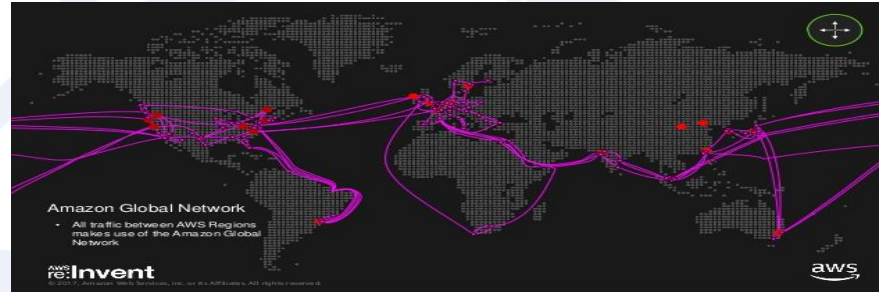
LoRaWAN™ Network Coverage



All information contained herein is current as of time of publishing—LoRa Alliance is not responsible for the accuracy of information presented



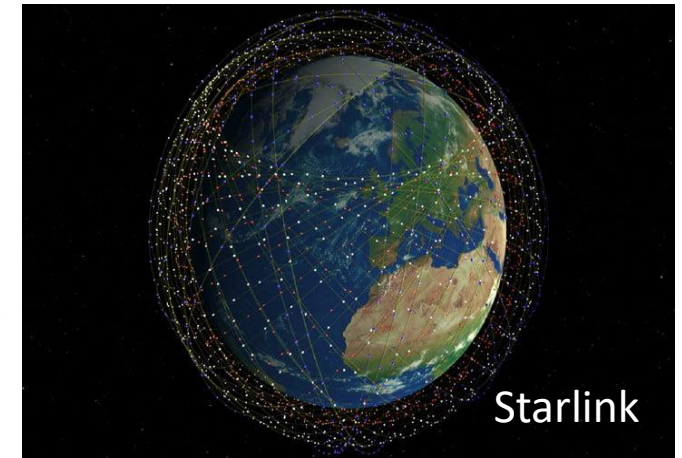
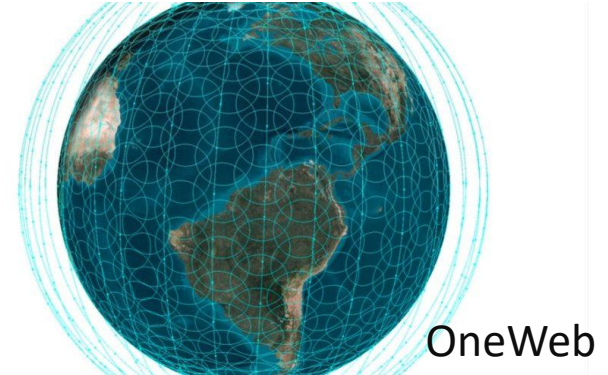
Private Global Backbones (Death of Internet Transit)



GCP Network and Regional Support



Emerging Satellite Constellations (Global Broadband connectivity for 4 billion people who are not connected to any network today)

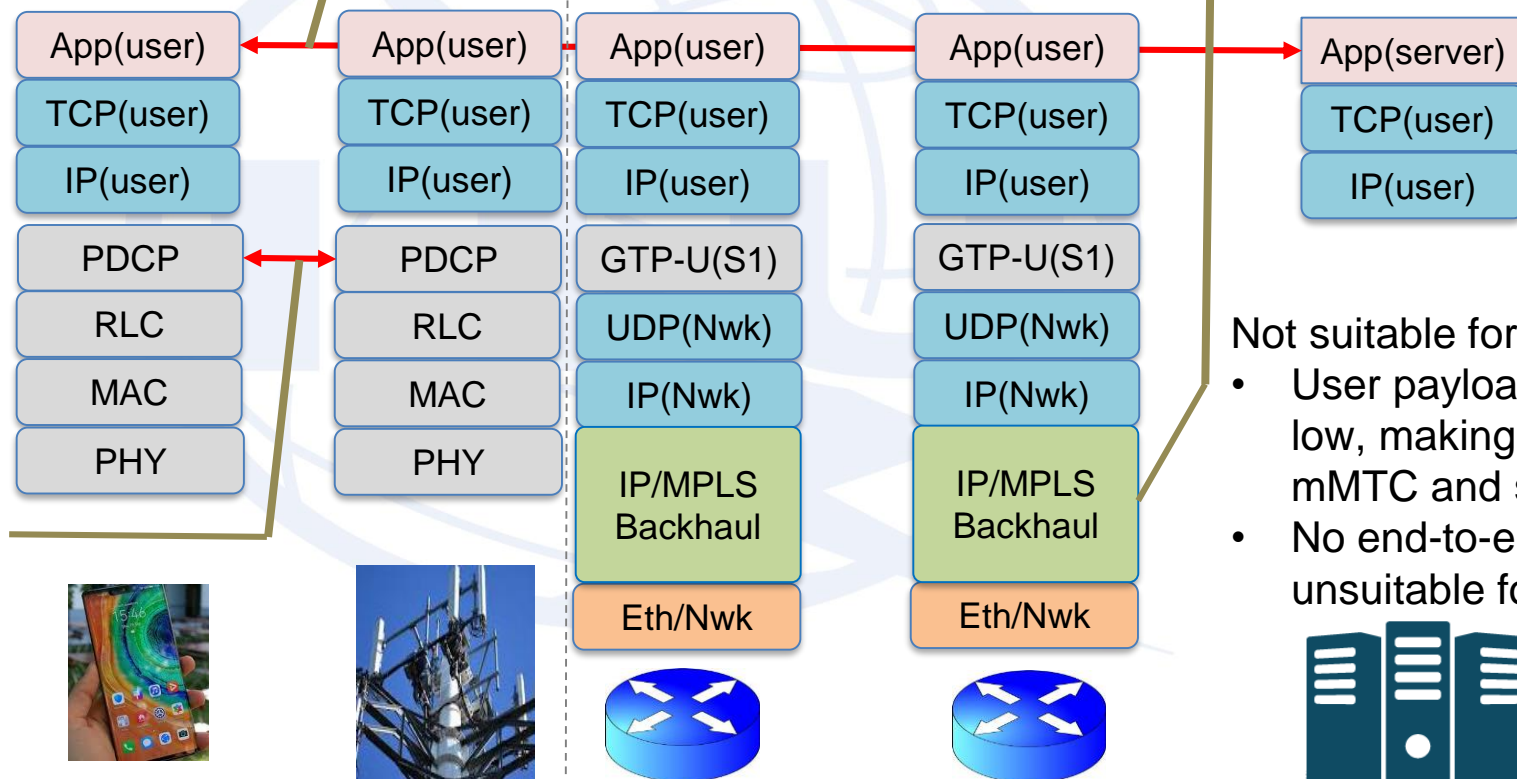


End-to-End Guarantees and Differentiation

Throughput, Latency, Losslessness

Throughput and latency are not guaranteed by the current End-to-end Internet TCP/IP

Delay variations: Radio retransmissions are not synchronized with TCP flow control, causing TCP to wastefully retransmit packets



Cellular network

Fixed, IP based wireline network

Inefficient use of protocols

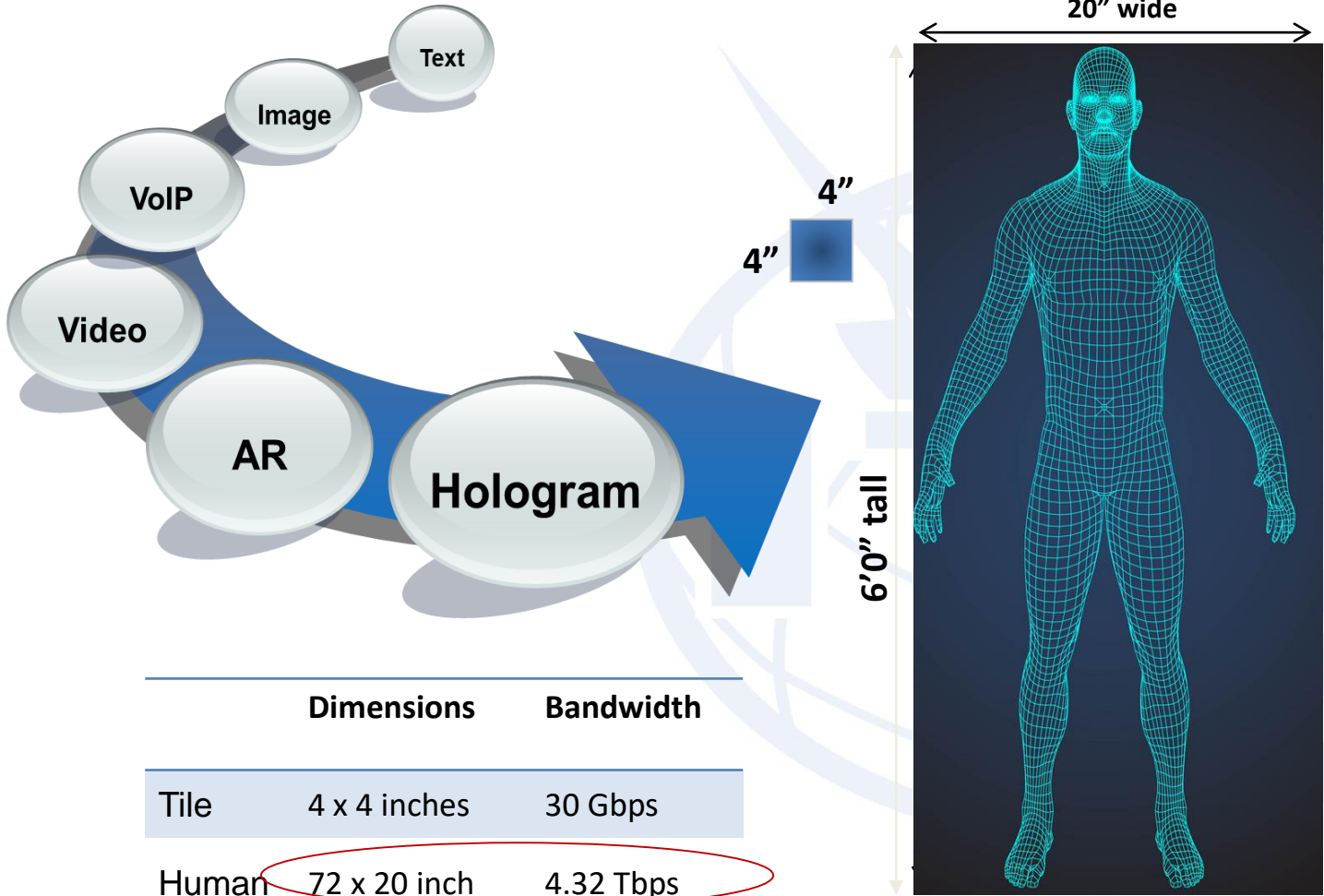
- Tunnels over tunnels
- Some header fields repeat each other

Not suitable for mMTC and uRLLC

- User payload efficiency is too low, making it unsuitable for mMTC and short messages
- No end-to-end QoS, making it unsuitable for uRLLC

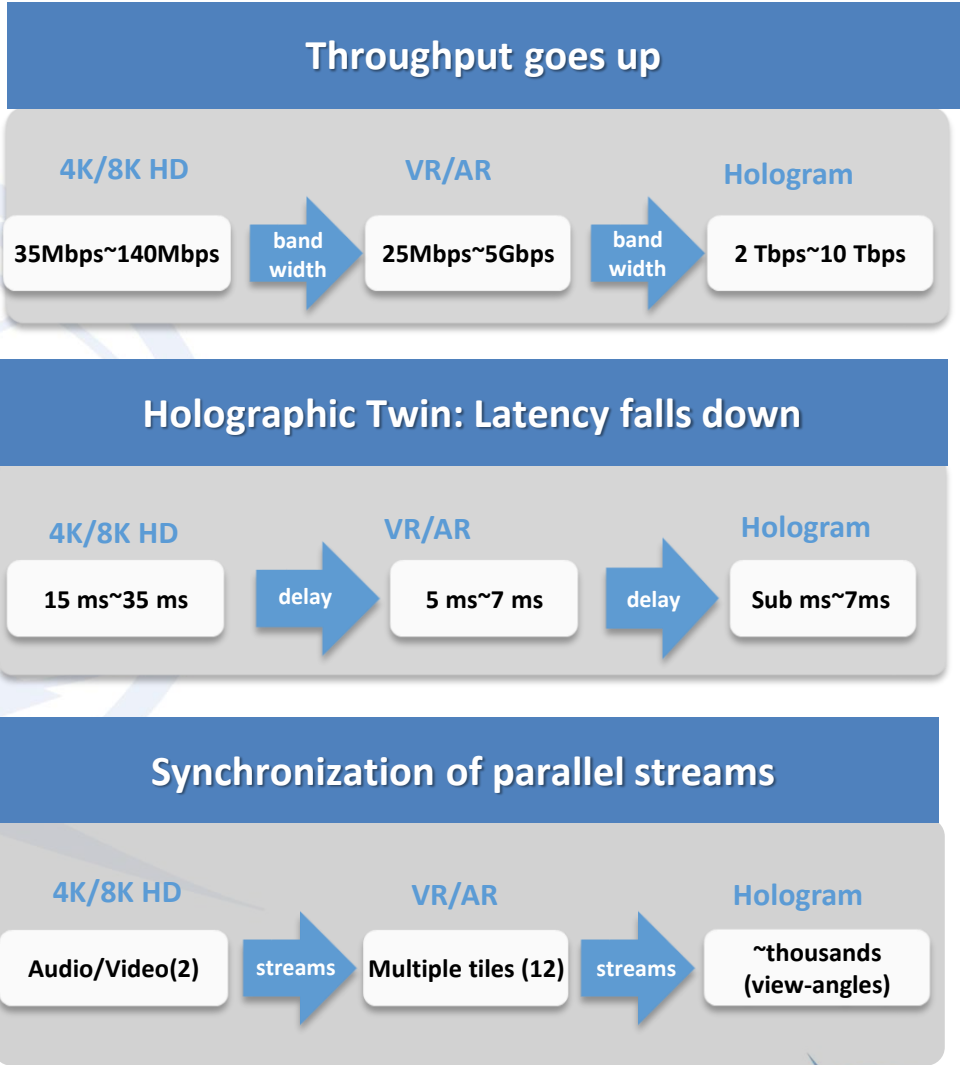


(Video) Holograms and Holographic Type Communications

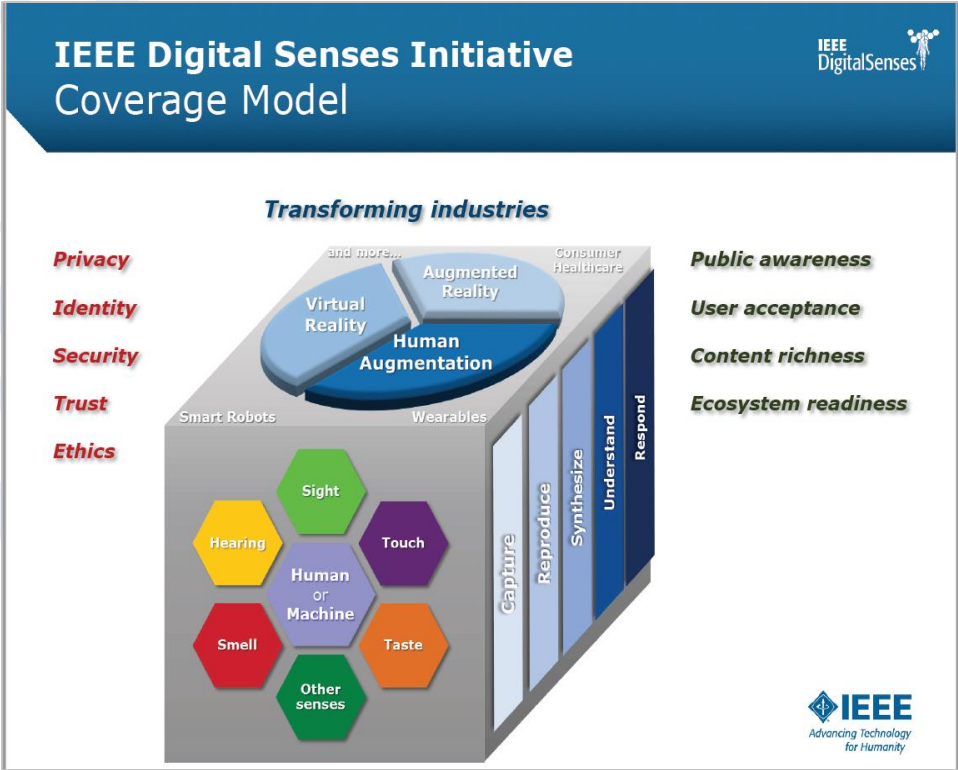
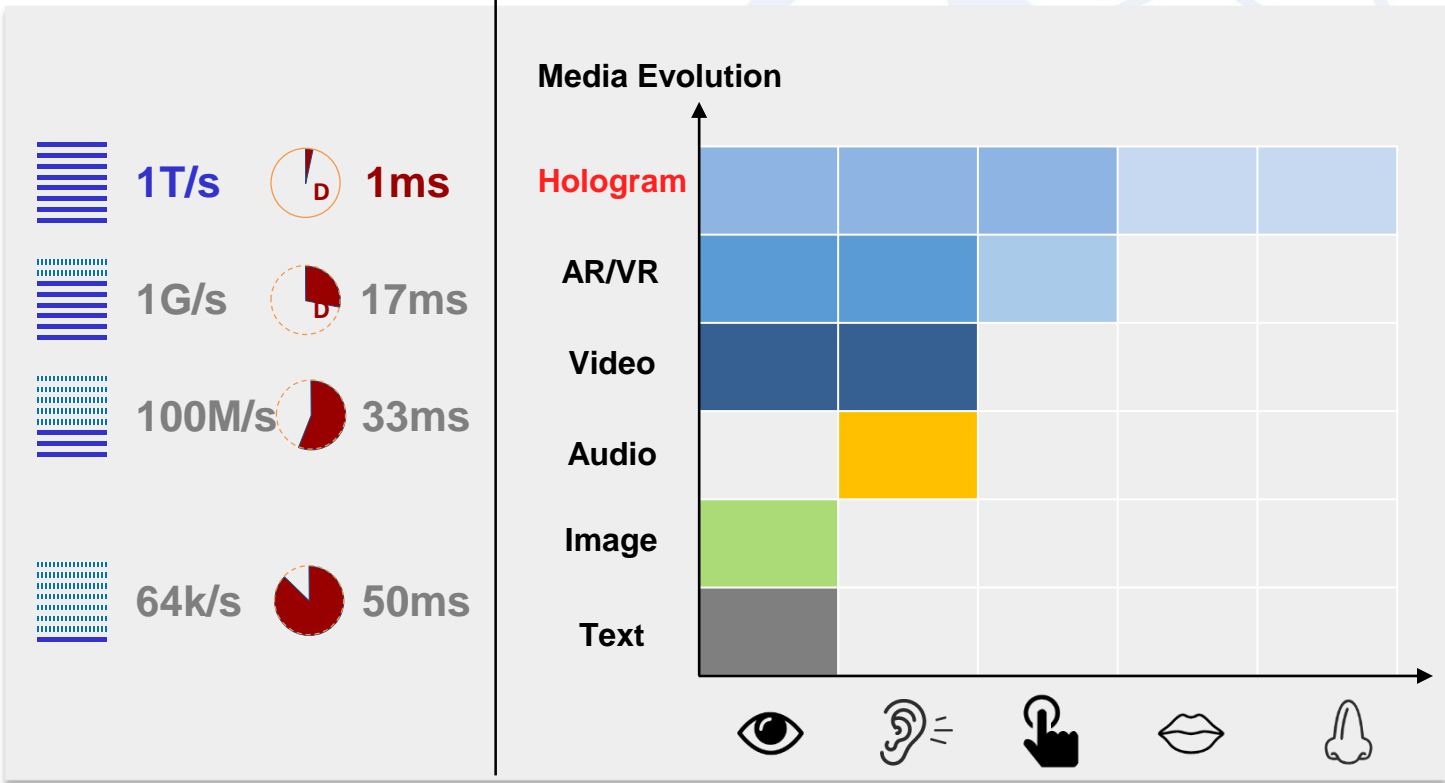


- Raw data; no optimization or compression.
- color, FP (full parallax), 30 fps

(reference: 3D Holographic Display and Its Data Transmission Requirement, 10.1109/IPOC.2011.6122872), derived from for 'Holographic three-dimensional telepresence'; N. Peyghambarian, University of Arizona)



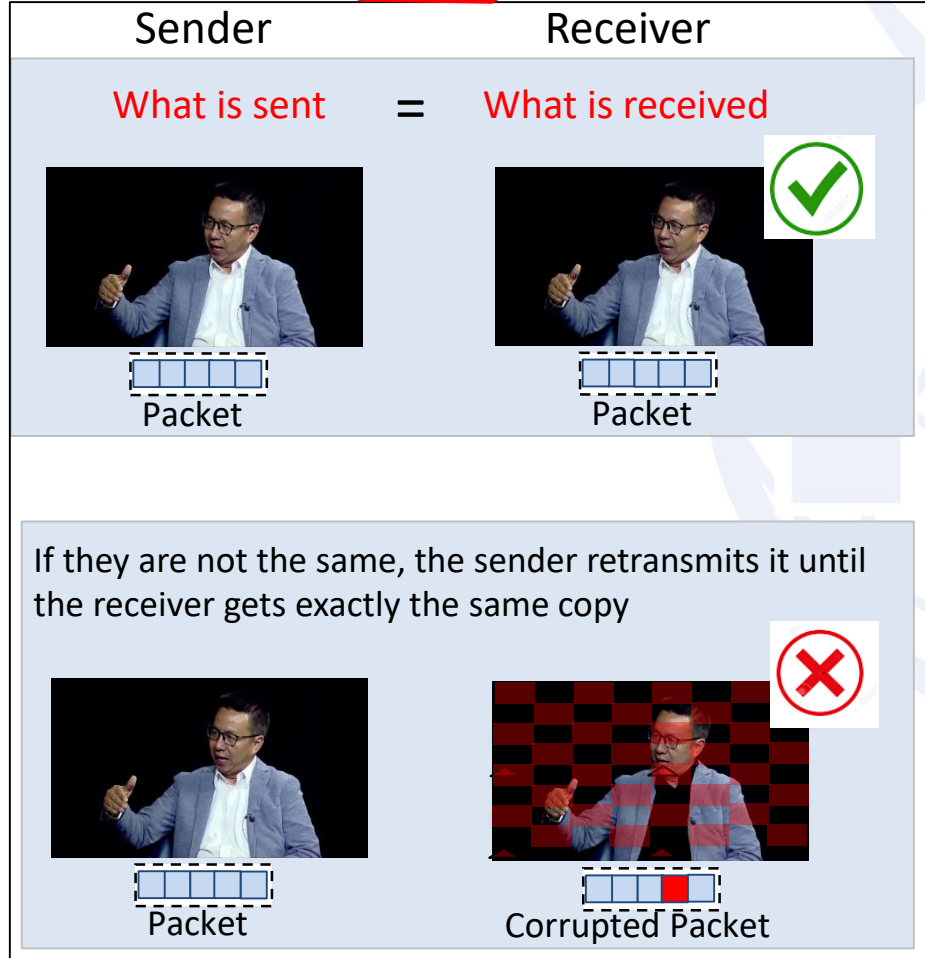
Digital Senses for Holographic Type Communications



Quantitative vs. Qualitative

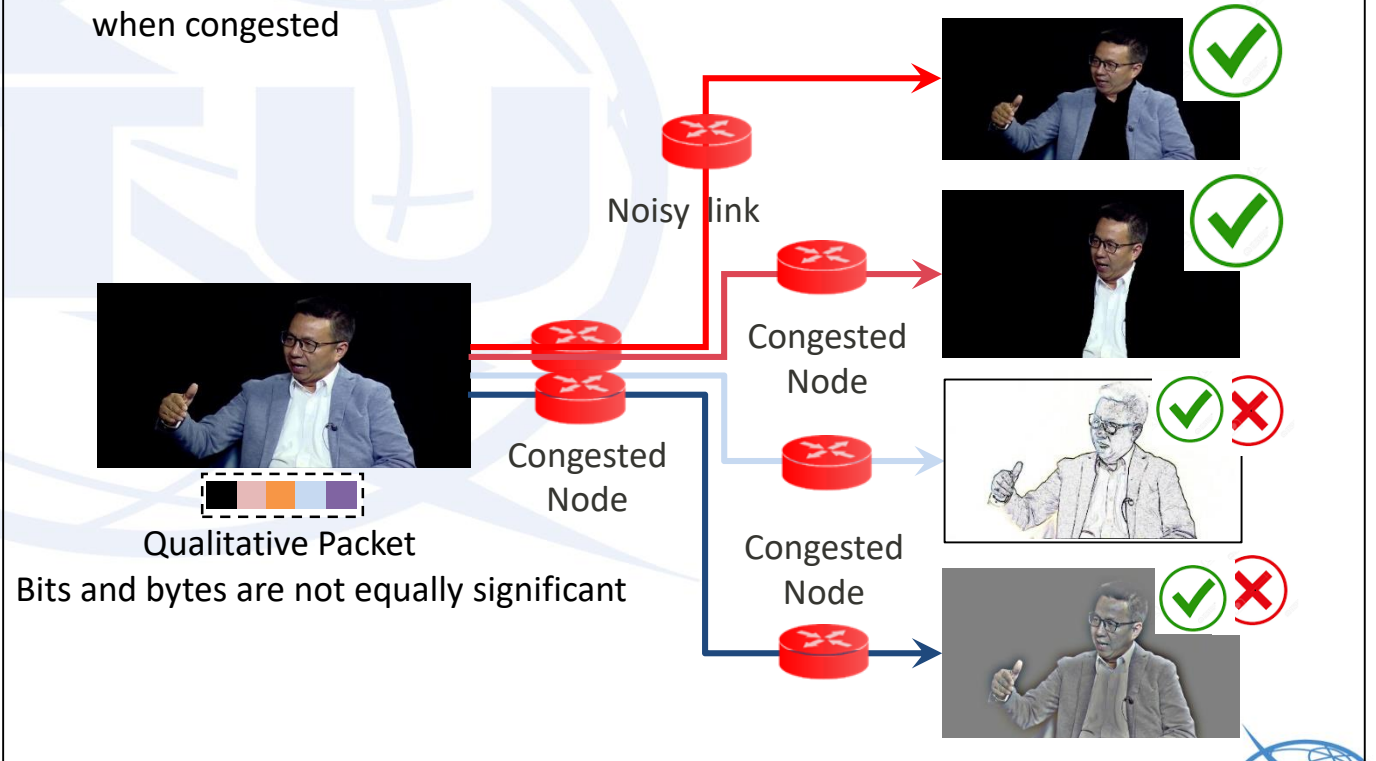


Current: Quantitative Communications



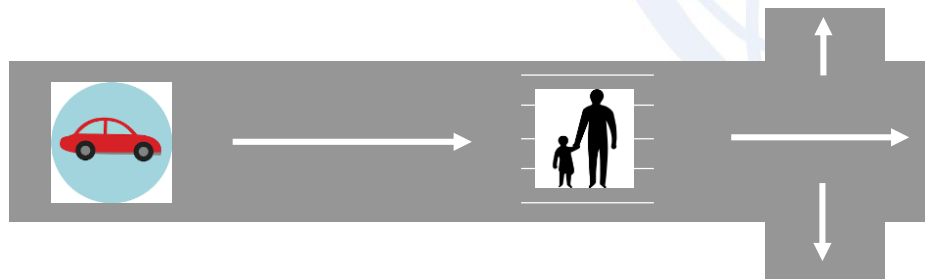
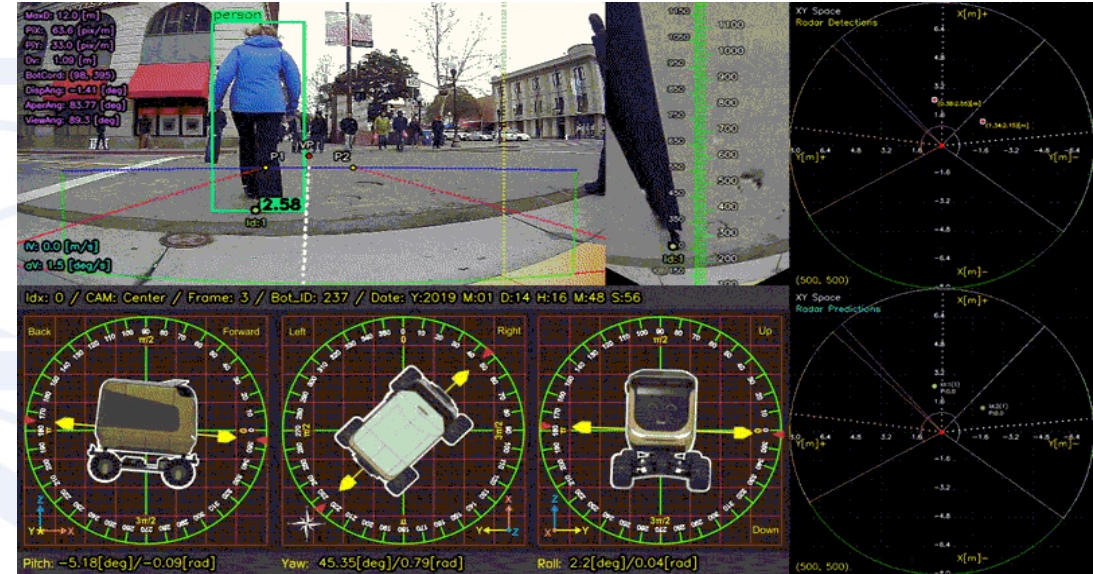
New: Qualitative Communications

- ❖ What is received is not required to be exactly the same as what is sent, accepting partial or degraded, yet useful, delivery of a packet
- ❖ What is received may be repaired and recovered before being rendered
- ❖ Intermediate routers may drop less significant chunks to avoid being discarded when congested



High Precision Latency Services

Case Study: Tele-Driving research at UCB



Sensory Image Capture: 40ms

Framing + Encoding: 120 ms

Decoding + Display: 100ms

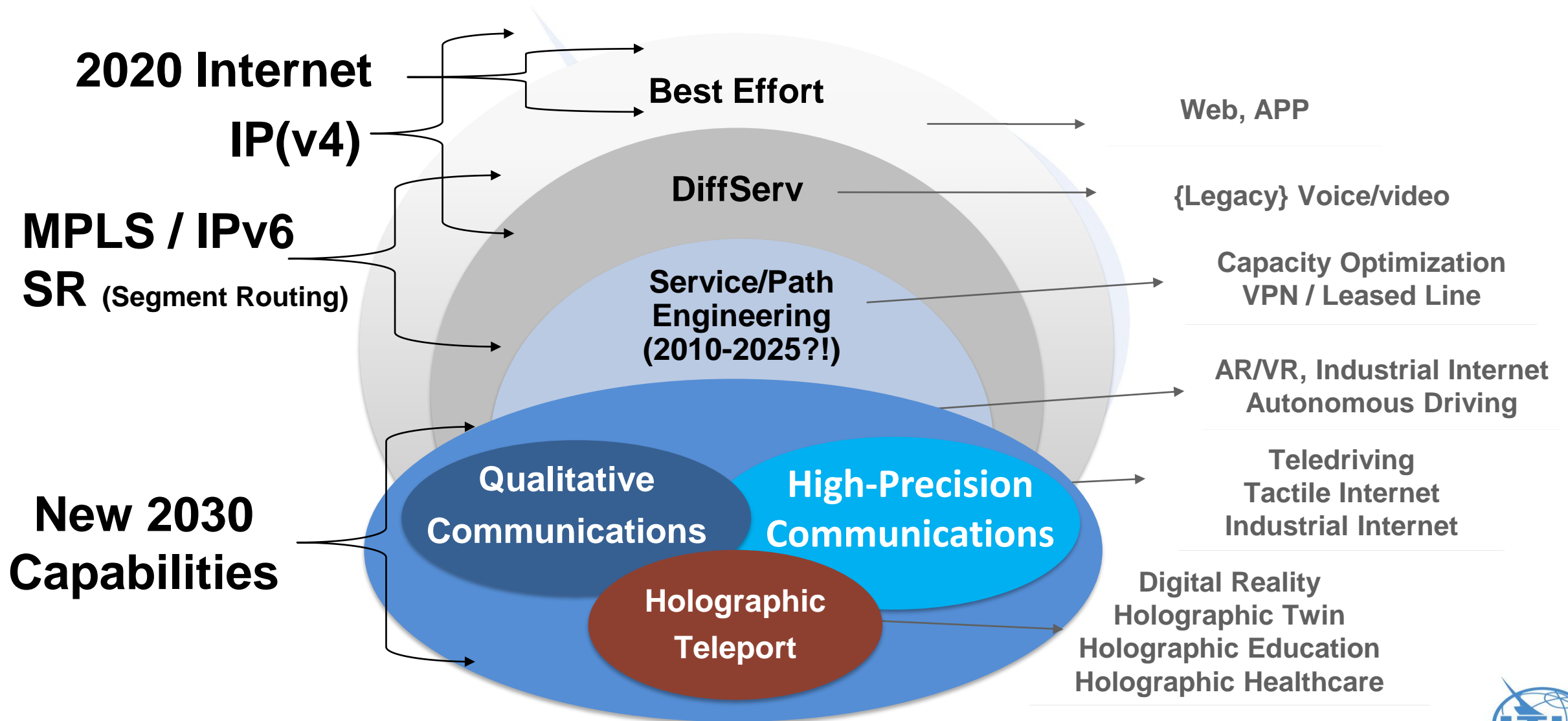
RTT between Colombia to San Francisco: 300 – 400ms

Total: 560 – 660 ms

CAD caused by RTT alone:

- 1) 5 km/hour = 1.4m/sec. Crash-Avoidance Distance = 1.4m/sec x 660ms = 0.92m
- 2) 30 km/hour = 8.4m/sec. Crash-Avoidance Distance = 8.4m/sec x 660ms = 5.54m
- 3) 60 km/hour = 16.8m/sec. Crash-Avoidance Distance = 16.8m/sec x 660ms = 11.08m

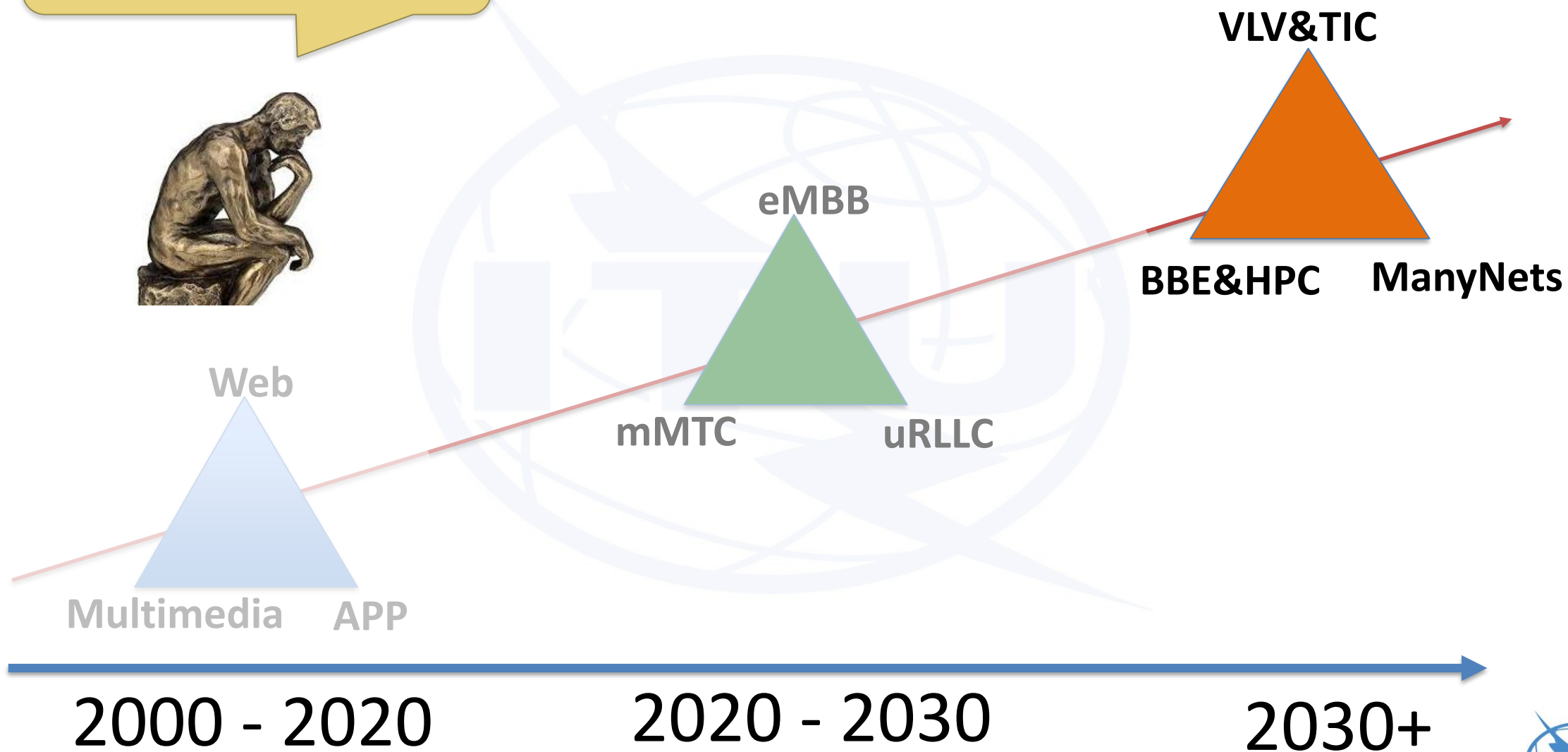
New Capabilities and Services Required from Networks



Agenda

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Eurêka



2030 Target Research Areas Summary

Very Large Volume &
Tiny Instant Communications

VLV & TIC

Transport / Services

- High Precision Communications
 - Lossless Networking
 - Throughput Guarantee
 - Latency Guarantee
 - In-Time Guarantee
 - On-Time Guarantee
 - Coordinated Guarantee
- User-Network Interface

Session / Coding / Application

- Holographic Type Communications
- Very High Throughput (> Tbps)
- Holographic Teleport (< 5ms)
- Digital Senses
- Qualitative Communications
- Coordinated Streams

Network / Routing

- Satellite Networks
- Internet-Scale Private Networks
- MEC
- Special-Purpose Networks
- Dense Networks
- Network-Network Interface
- Operator-Operator Interface

BBE & HPC

Beyond Best Effort and
High-Precision Communications

ManyNets

Output and Deliverables

A. *Network 2030 Whitepaper (2019)*

A Blueprint of Technology, Applications, and Market Drivers towards the Year 2030 and Beyond, a White Paper on Network 2030, ITU-T, May 2019 ([Download](#))

B. *Sub-Group 2 output document (2019)*

New Services and Capabilities for Network 2030: Description, Technical Gap and Performance Target Analysis, ITU-T FG Network 2030, Oct 2019 ([Download](#))

C. Use Cases and Requirements for Network 2030 (In Progress)

D. Architecture and Framework for Network 2030 (In Progress)

Touched on, but not fully studied yet

- Manageability
 - Intent-Based Networking
 - Lifecycle: Virtual Network Operations & Development (including programming e.g.: beyond P4)
 - Accounting, Accountability and Validation
- Security and Trust
 - ITU-T SG13 Y.3053 2020 – Framework of trustworthy networking/trust-centric network domains
<https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13465>
 - ITU-T SG13 Y.3054 - Framework for trust-based media services
<https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13609>
- AI & ML
 - Y.3172 - Architectural framework for machine learning in future networks including IMT-2020
<https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13894>).
- Privacy
- Resilience
- Mobility
- ...

