ICN- From Streaming to Metaverse

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Background

- ICN proposed as an architecture to deliver content object without binding the content objects to a specific servers
  - "turbocharged" content delivery
- Main Internet content is video streaming
  - North of 80% of all Internet traffic
- RFC7933
  - Adaptive Video Streaming over Information-Centric Networking (ICN)
  - Considers how to adapt video streaming for ICN and ICN for video streaming
- Metaverse?
  - How does it relate to streaming?

Metaverse and ICN: Use cases and challenges

- Presentation at ICNRG 3/29/23 IETF 116 Yokohama
  - Slides only, but document to follow
- Draft that captures the main ideas from the talk
- Draft version 00 uploaded 7/10
- Version 01 uploaded 7/25 but not in the system there
  - Check what's going on?
- Version 02 with new co-author imminent

Metaverse: Definition

- Def 1: "an integrated immersive ecosystem where the barriers between the virtual and real worlds are seamless to users, allowing the use of avatars and holograms to work, interact and socialize with simulated shared experience" (Meta 2022)

- Def 2: "a 3D virtual shared world where all activities can be carried out with the help of augmented and virtual reality services" (Damar 2021)

- Def 3: "the next generation Internet that is always real-time and mostly 3d, mostly interactive, mostly social and mostly persistent" (John Ricobello)

Metaverse: Taxonomy

- From "Metaverse beyond the Hype" (Dwivedi et al, 2022)
- Environment
  - Realistic, unrealistic, fused
- Interface
  - 3D, immersive, physical methods
- Interaction
  - Social networking, collaboration,
- Security
  - Data security, privacy, software/hardware/network security

- Different instantiations with different property along these dimensions
- Adding: Centralized/Distributed?

Key issues for video streaming in ICN?

From RFC7933:

- Video Streaming and ICN
  - Client-Driven Streaming and DASH / Layered Encoding
  - Interactions of Video Streaming w/ ICN
  - Possible Integration of Video Streaming and ICN
- P2P Video Distribution and ICN
- IPTV and ICN
- Digital Rights Management in ICN

Metaverse mapping:

Streaming metaverse views

- with what encodings?

- How to interact w/ ICN

- How to integrate w/ICN

- Distributed content
- Multipath/multicast?
- ACL, owner, authentication?

Metaverse & ICN?

- From the infrastructure perspective, the metaverse would be a distributed system that shares content in real time on a massive global scale with QoE requirements for users in a secure way with complex ownership/access privileges

- Massive content distribution of objects with their own security and access policy? Did I hear you say ICN?

- Consider to adapt ICN for metaverse, and Metaverse for ICN?

What are the research challenges for the Metaverse in ICN?

- Interoperability
- Scalability
- Privacy/Security
- Low-latency
  - Cf. "Networking at the speed of light" project
  - Or via LEO Satellites
- Machine learning for behaviors within the metaverse
  - Predictability of immersive video streaming (say, FoV) applies to Metaverse
- Programmability to support application requirements?
  - COIN as the new architecture opportunity?
- High Precision of the traffic
- What models are needed to evaluate research proposals?
- Sustainability? Green networking?

What are the ICN research challenges for the Metaverse?

- For you to define and solve!

- Is this worth exploring in a RFC7933 for the metaverse?
    - Draft in progress, missed cut off, will email to list after IETF

- Questions?