

Data-Oriented Metaverse

IETF-116 Metaverse Side Meeting

Dirk Kutscher
2023-03-30

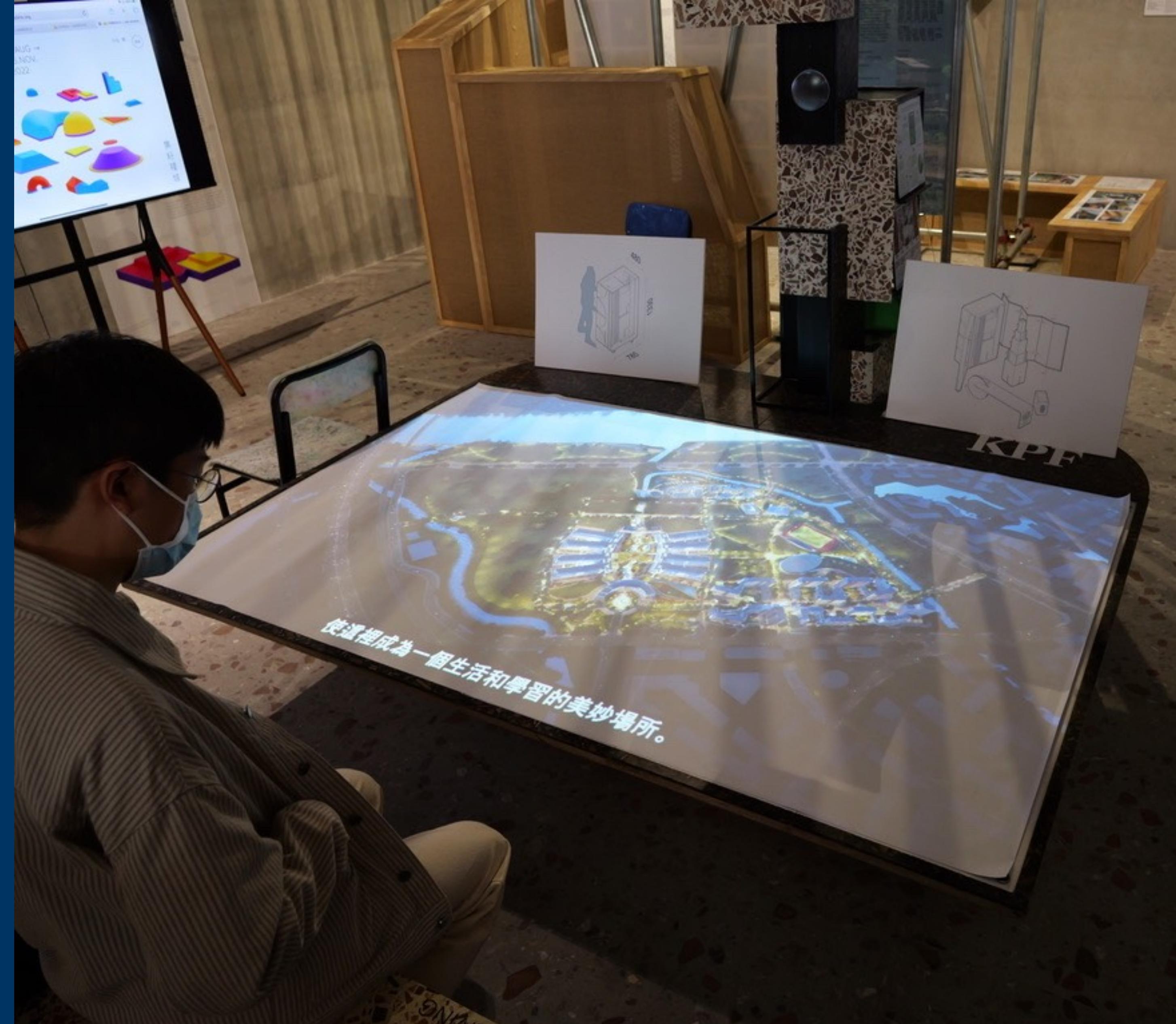
Topics

- **Named Data Metaverse Panel @ NDNComm-2023**
- **ICNRG@IETF-116**
- **Named Data Microverse Project**
- **IEEE MetaCom Workshop on Decentralized, Data-Oriented Networking for the Metaverse (DORM)**

Named Data Metaverse

Panel at NDNComm 2023

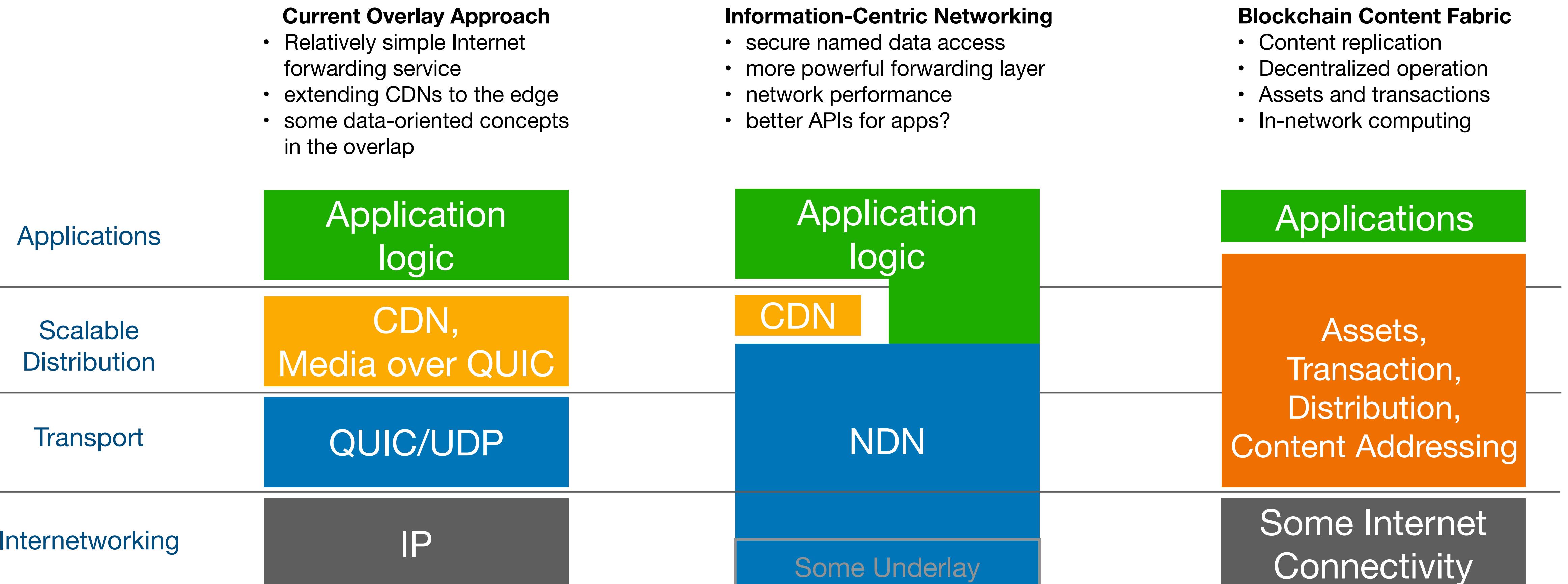
Dirk Kutscher – HKUST(GZ)



The Hong Kong University of Science and Technology (Guangzhou)

Different Perspectives on the Technology Stack

Features and Structure



Panel Today

High-Level Topics

- **What do certain Metaverse systems need?**
 - Judging from today's systems
 - And with some creative design approach...
- **Named Data – but on which layer?**
 - What are good ways to structure the functionality set?
 - Confluence/synergies for data-oriented applications and Named Data Networking
- **Named Data Networking future**
 - How can we support applications better?
 - Research opportunities?

Panel

Opportunities and challenges for building Metaverse systems with a Named Data Networking approach

Paulo Mendes



Expert in
Network Architectures & Protocols
at **AIRBUS**

Associated Researcher at
Technical University of Munich

Michelle Munson



Co-Founder, **Eluvio, Inc.**
Previously founded **Aspera** / FASP
bulk-data transport protocol

Co-Creator of
Content Fabric Protocol

Todd Hodes



Principal Architect, **Eluvio, Inc.**

Previously built **Location Labs**

Distributed Systems

Jeff Burke



Professor and Associate Dean,
Research and Technology at the
UCLA School of Theater, Film and Television

Co-Director of the
**UCLA Center for Research in Engineering,
Media and Performance (REMAP)**

Networking Technologies
and Architectures

Blockchain Content Fabric
for content storage, distribution, ownership management

Architectures for
emerging arts, media, entertainment

ICNRG@IETF-116

Cullen Jennings: Evolving Media Requirements

ICNRG@IETF-116

Two converging problems



Live streaming

Twitch, YouTube, Facebook Live

Wants interactivity

Wants scalability



Real time collaboration

Webex, Zoom, Teams



We need something disruptive.

Incremental improvements and new iterations won't solve these problems. We need a whole new way of thinking.

Cullen Jennings: Evolving Media Requirements

ICNRG@IETF-116



What we need is something like

ICN

NDN

hICN

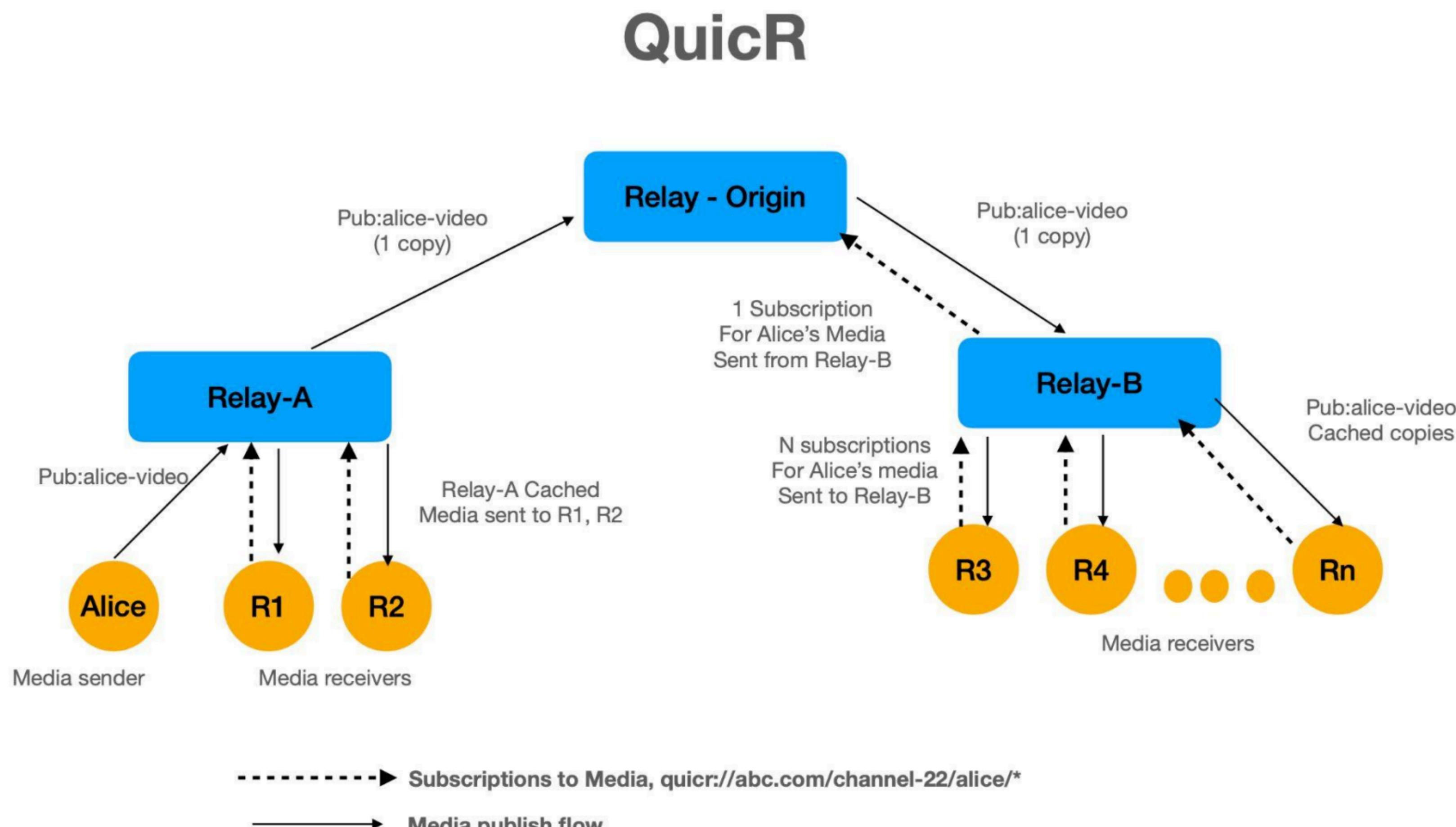
Multicast

Pub/Sub

Message Bus

Cullen Jennings: Evolving Media Requirements

ICNRG@IETF-116



Cedric Westphal: ICN – from Streaming to Metaverse

ICNRG@IETF-116

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?

Cedric Westphal: ICN – from Streaming to Metaverse

ICNRG@IETF-116

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?

Cedric Westphal: ICN – from Streaming to Metaverse

ICNRG@IETF-116

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?

Cedric Westphal: ICN – from Streaming to Metaverse

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Metaverse & ICN: Objects

- Content objects to render a metaverse environment
- Within that environment, “virtual physical” objects
 - Objects/avatars for the users within the virtual world
 - Persistence of objects left within the metaverse by users?
 - Access right: who sees what? Who can see, use, modify, remove? (rwxrwxrwx?)
 - Collection of objects associated with a specific space
 - FLIC/Manifests
- Ownership
 - Platform owns the virtual environment
 - Users owns object within the platform
 - Intellectual property: who owns what is generated within the platform
 - How to represent these different levels of ownership, authentication, access control within the definition of an object?

Cedric Westphal: ICN – from Streaming to Metaverse

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Metaverse & ICN: Decentralization

- One of the dimensions of the taxonomy
- Meta vs Decentraland;
- App overlay or embedded within network?
- Hierarchical structure imposed for scalability considerations
 - But can the edge run independently?
 - Can a metaverse runs disconnected from a central authority?
- ICN decouples the objects from the origin server
 - A step into the right direction
 - Can the operation of the metaverse be decoupled as well?
 - NFN?

Data-Oriented Metaverse



Omidyar Network Announces Winners of the Future of

Omidyar Network Announces Winners of the Future of Data Challenge

Honors 15 new ideas that challenge, disrupt, and reimagine the way the data economy operates



Project

Architecture

Codebase

Testbed

Named Data Microverse

Jeff Burke – UCLA School of Theater, Film and Television | REMAP

Lixia Zhang – UCLA Department of Computer Science | Internet Research Lab

Dirk Kutscher – The Hong Kong University of Science and Technology (Guangzhou) | Future Networked Systems Lab

Winner of the Future of Data Challenge

<https://named-data.net/microverse/>

Named Data Microverse

microverses: virtuality as if people mattered*

jeff burke
lixia zhang
dirk kutscher

can the metaverse be a 'network of networks' ?

“the **immense promise** that accompanied the development of the Internet stemmed from its design: it is an **open ‘network of networks’**, a single interconnected communications system for all of humanity”



microverse project goals

enable the **metaverse as a network of networks**

building blocks: **microverses of named data**,
ecosystems of platform-independent content controlled
by entities as small as an individual, interoperating via
NDN with or without cloud support

balance **democratization, trust, and scale**, as well as
opportunities for market-based innovation

scaling microverse-by-microverse

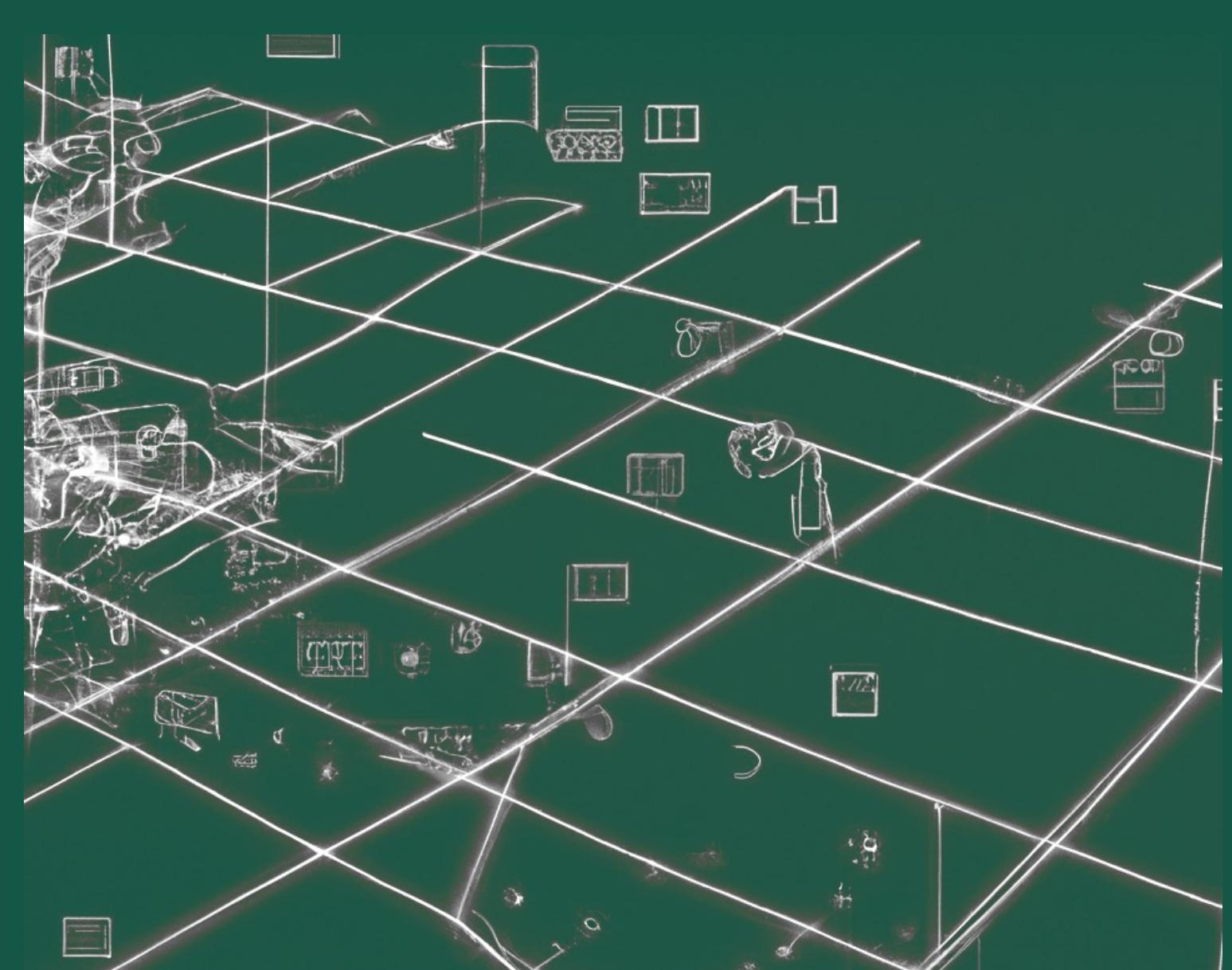
named data strategies enable global interactions to scale independently from producer capacity



live performances



exchange of virtual goods

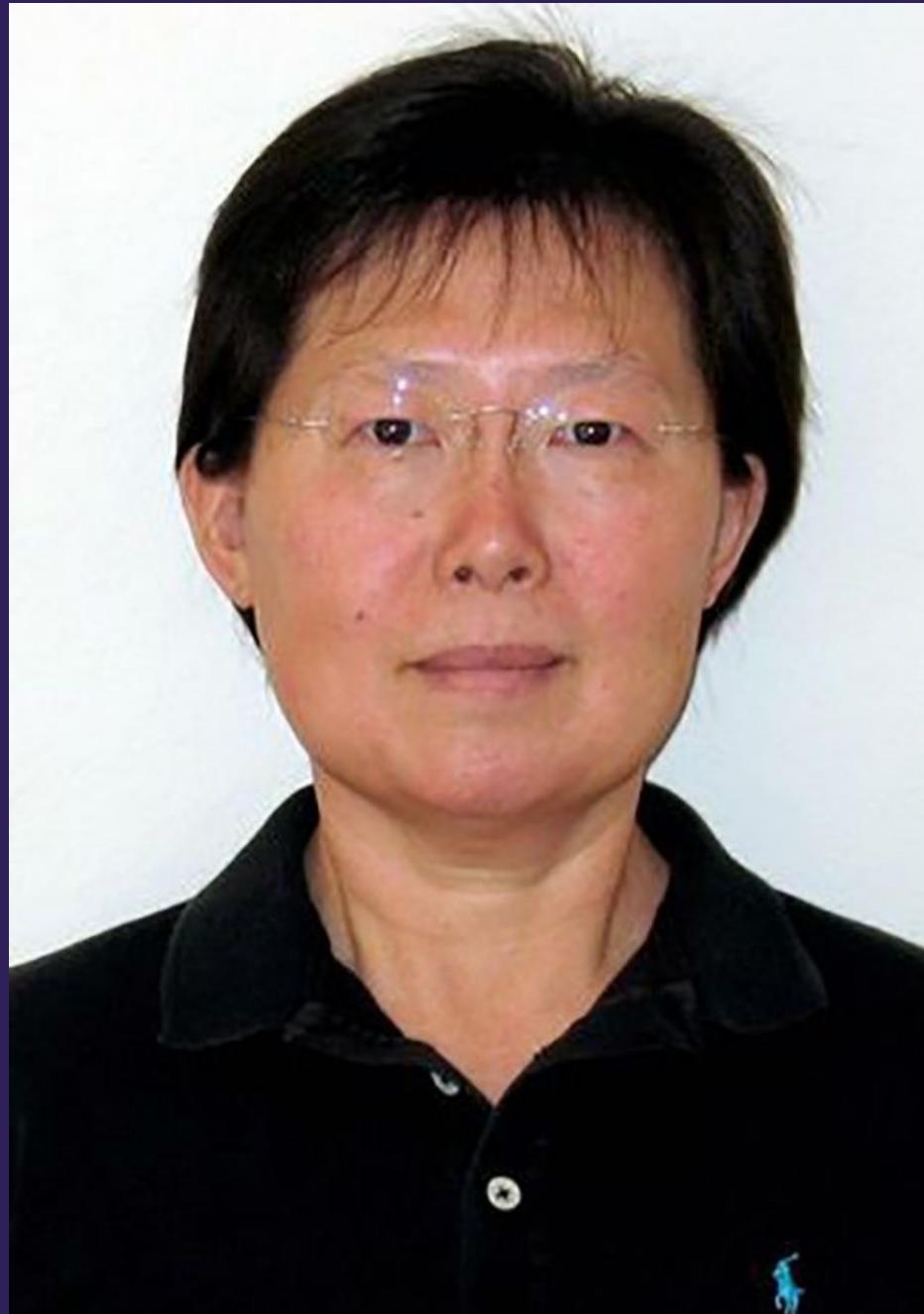


public datasets

team



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IEEE International Conference on Metaverse Computing, Networking and Applications (IEEE MetaCom 2023)

June 26-28, 2023 · Kyoto, Japan



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Conference Venue

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June 26-28, 2023 · Kyoto, Japan.

<http://www.ieee-metacom.org/2023>

IEEE MetaCom Workshop on Decentralized, Data-Oriented Networking for the Metaverse (DORM)

Call for Papers

The Decentralized Data-Oriented Networking for the Metaverse (DORM) workshop is intended as a forum to explore new directions and early research results on the system architecture, protocols, and security to support Metaverse applications, focusing on data-oriented, decentralized system designs. We view Metaverse as a new phase of networking with multi-dimensional shared views in open realms.

Most Metaverse systems today replicate the social media platform model, i.e., they assume a cloud platform provider-based system architecture where identities and the trust among them is anchored via a centralized administrative structure and where communication is mediated through servers and an extensive CDN overlay infrastructure operated by that administration. The

Workshops

DORM 2023

DIM 2023

MANP 2023

MetaXP 2023

VSM 2023

Important Days

April 7, 2023 Hard Submission Due

April 28, 2023 Author Notification

May 10, 2023 Camera-Ready Due