Metaverse @IETF

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The immersive spaces powered by VR and AR can also be seen as a **network problem**

Combined high bandwidth demands and high sensitivity to latency and dropped packets

- Adaptive Streaming helps but may not be enough
- Client-controlled HTTP streaming has limitations
- Intelligent QoE-centric approach can be complex to apply

Different technologies have been discussed in IETF recently dealing with media applications

- **ICN** aims to put media contents as the central concept as opposed to the host

  https://datatracker.ietf.org/rg/icnrg/about/
- **QuicR** uses delivery mechanisms similar to CDN and named objects to provide ultra low latency

  https://www.ietf.org/archive/id/draft-jennings-moq-quicr-proto-00.html
- **Blockchain ensures security, privacy, and trust among stakeholders**

  https://datatracker.ietf.org/doc/draft-ietf-satp-architecture/00/
- **L4S** relies on ECN to indicate queue build-up in the radio access network to the application

  https://datatracker.ietf.org/doc/rfc9330/
- **CATS** proposes to use dyncast to connect the distributed computing to the network

  https://datatracker.ietf.org/wg/cats/about/
- **APN** allows the network to provide fine-granularity and application group-level SLA

  https://datatracker.ietf.org/wg/apn/about/
- **MSR6** extends Multicast to SRv6 to carry more real-time applications

  https://datatracker.ietf.org/wg/msr6/about/

1st Metaverse side meeting @IETF 115

- QuicR and standardization of the metaverse - Cullen Jennings, Cisco - 10min
- ICN and networking for distributed AR/VR - Dirk Kutscher, The Hong Kong University - 10min
- Low Latency, Low Loss, Scalable Throughput (L4S) Internet Service - Koen De Schepper, Nokia - 10 min
- Network innovation and standardization for metaverse: CAN, MSR6, APN, Generalized IPv6 - Robin Li, Huawei - 10min

https://github.com/giuseppefioccola/Metaverse-side-meeting-at-IETF/tree/main/IETF%20115

Metaverse Standards

- Volumetric Video
  - Texture mapped mesh
  - Point Cloud
  - Light fields
- Game State Sync
- Common Inventory
- Roster & Friends
- Messaging
- Real time translation
- Scene Description & Composition
- Insertable Applications
- Distributed Name System
- Content Distribution at Scale
- Haptics
- Low Latency Transports
- Connection to Real World
- Permissions
- Privacy

https://github.com/giuseppefioccola/Metaverse-side-meeting-at-IETF/blob/main/IETF%20115/Standardization%20for%20Metaverse%20(Cullen%20Jennings).pdf

2nd Metaverse side meeting @IETF 116

- **IEEE MetaCom Workshop on Metaverse as a network problem (MANP 2023)** - Shuping Peng - 5min
- **Metaverse-focused IRTF ICNRG and IEEE MetaCom Workshop (DORM 2023)** - Dirk Kutscher, The Hong Kong University - 10min
- **3GPP activities on Metaverse in SA1 WG and SA2 WG** - Tianji Jiang, China Mobile - 10min
- **Network innovation and IETF standardization for metaverse** - Robin Li, Huawei - 10min
- **ITU-T Focus Group on metaverse (FG-MV)** - Jungha Hong, ETRI - 10min
- **Open Metaverse project in Linux Foundation** - Royal O'Brien, The Linux Foundation - missed
- **ChatGPT and metaverse** - Eduard Vasilenko, Huawei - 10min
- **Blockchain and metaverse** - Mike McBride, Futurewei - 10min

https://github.com/giuseppefioccola/Metaverse-side-meeting-at-IETF/tree/main/IETF%20116

MoQ @IETF

Develop a simple low-latency media delivery solution for ingest and distribution of media.

Meeting

- **MoQ Side Meetings @IETF112**
- **MoQ BOF @IETF113 & 114**
- **MoQ WG @IETF115**
  - https://datatracker.ietf.org/group/moq/about/

Media Over QUIC (moq)

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WG	Name	Media Over QUIC
	Acronym	moq
	Area	Applications and Real-Time Area (art)
	State	Active
	Charter	charter-ietf-moq-01 Approved
	Document dependencies	Show
	Additional resources	GitHub Repository Zulip stream
Personnel	Chairs	Alan Frindell, Ted Hardie
	Area Director	Murray Kucherawy
	Tech Advisor	Zaheduzzaman Sarker
Mailing list	Address	moq@ietf.org
	To subscribe	https://www.ietf.org/mailman/listinfo/moq
	Archive	https://mailarchive.ietf.org/arch/browse/moq/
Chat	Room address	https://zulip.ietf.org/#narrow/stream/moq

Draft

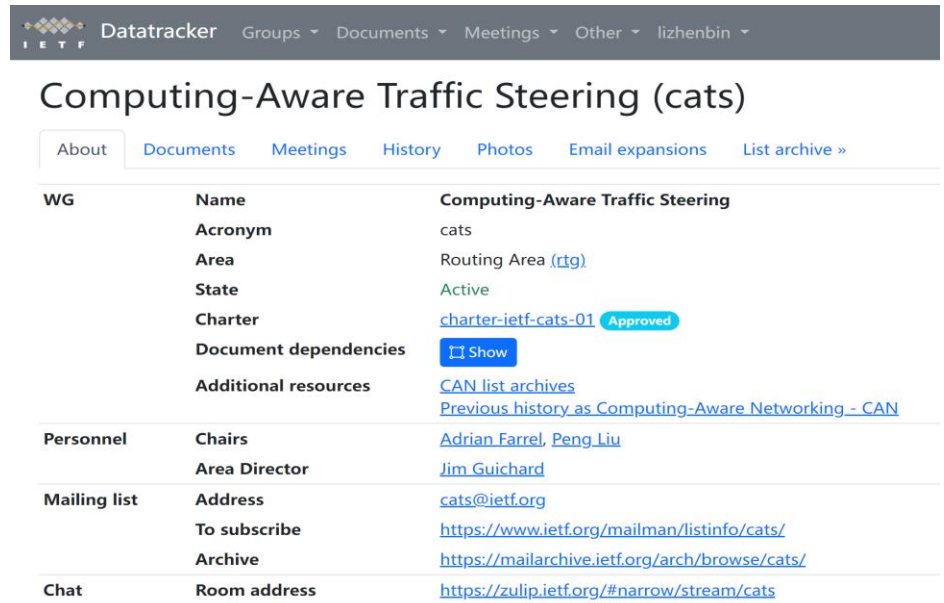
Document		Date	Status
Active Internet-Draft (1 hit)			
draft-ietf-moq-requirements-00 **Media Over QUIC - Use Cases and Requirements for Media Transport Protocol Design**	17 pages	2023-06-05	I-D Exists WG Document
Related Internet-Drafts (13 hits)			
draft-law-moq-warpstreamingformat-00 **WARP Streaming Format**	8 pages	2023-06-07 New	I-D Exists
draft-lcurley-moq-transport-00 **Media over QUIC Transport**	26 pages	2023-05-26	I-D Exists
draft-kpugin-rush-02 **RUSH - Reliable (unreliable) streaming protocol**	17 pages	2023-05-10	I-D Exists
draft-jennings-moq-proto-00 **QuicR - Media Delivery Protocol over QUIC**	16 pages	2023-03-13	I-D Exists
draft-law-moq-catalog-00 **Catalog Specification for MoQ compliant streaming formats**	5 pages	2023-03-13	I-D Exists
draft-mzanaty-moq-loc-00 **Low Overhead Media Container**	5 pages	2023-03-13	I-D Exists
draft-nandakumar-moq-arch-00 **Media Over QUIC Media and Security Architecture**	15 pages	2023-03-13	I-D Exists
draft-nandakumar-moq-scenarios-00 **Exploration of MoQ scenarios and Data Model**	9 pages	2023-03-13	I-D Exists
draft-nandakumar-moq-transport-00 **MoQ Transport (moqt) - Unified Media Delivery Protocol over QUIC**	22 pages	2023-03-13	I-D Exists
draft-shi-moq-design-space-analysis-of-moq-01 **Design Space Analysis of MoQ**	8 pages	2023-03-13	I-D Exists

CATS WG @IETF

Traffic Steering based on Comprehensive Network and Computing Service Metrics

Meeting

- **Dyncast Side Meeting @IETF109 & @IETF110**
  - https://github.com/dyncast/ietf109
  - https://github.com/dyncast/ietf110
- **CAN BOF @IETF113**
  - https://datatracker.ietf.org/group/can/about/
- **CATS WG @IETF115**
  - https://datatracker.ietf.org/group/cats/about/



Draft

Document		Date	Status
Related Internet-Drafts (13 hits)			
draft-yao-cats-ps-usecases-01 **Computing-Aware Traffic Steering (CATS) Problem Statement, Use Cases and Requirements**	26 pages	2023-06-19	I-D Exists New Candidate for WG Adoption
draft-ddcb-cats-sfc-bgp-applicability-00 **Using SFC BGP Control Plane for CATS**	11 pages	2023-05-05	I-D Exists
draft-jaehwoon-cats-mobility-00 **Network-based mobility management in CATS network environment**	9 pages	2023-04-30	I-D Exists
draft-dunbar-cats-edge-service-metrics-00 **IP Layer Metrics for Edge Services**	20 pages	2023-04-25	I-D Exists
draft-wang-cats-green-challenges-00 **Green Challenges in Cats**	5 pages	2023-04-05	I-D Exists
draft-shi-cats-analysis-of-metric-distribution-00 **Design analysis of methods for distributing the computing metric**	6 pages	2023-03-13	I-D Exists
draft-ldbc-cats-framework-01 **A Framework for Computing-Aware Traffic Steering (CATS)**	17 pages	2023-03-10	I-D Exists
draft-zhang-cats-computing-aware-sdwan-usecase-00 **Use Cases for Computing-aware Software-Defined Wide Area Network(SD-WAN)**	4 pages	2023-03-10	I-D Exists
draft-zhang-cats-computing-aware-sfc-usecase-00 **Use Cases of Computing-aware Service Function Chaining (SFC)**	7 pages	2023-03-10	I-D Exists
draft-shi-cats-ipv6-based-con-00 **IPv6-based Cloud-Oriented Networking (CON)**	23 pages	2023-03-09	I-D Exists
draft-huang-cats-two-segment-routing-00 **Hierarchical segment routing solution of CATS**	12 pages	2023-03-07	I-D Exists
draft-du-cats-computing-modeling-description-00 **Computing Information Description in Computing-Aware Traffic Steering**	17 pages	2023-03-05	I-D Exists
draft-yao-cats-gap-reqs-00 **Computing-Aware Traffic Steering (CATS) Gap Analysis and Requirements**	19 pages	2023-03-03	I-D Exists

APN @IETF

Facilitate fine-grained service provisioning and flexible policy enforcement

Meeting

- **APN Side Meeting @IETF105&108**
  - https://github.com/APN-Community/IETF105-Side-Meeting-APN6
  - https://github.com/APN-Community/IETF108-Side-Meeting-APN
- **Hackathons @IETF108 & IETF109 & IETF110**
- **APN BOF @IETF111**
  - https://datatracker.ietf.org/group/apn/about/

Application-aware Networking (apn)

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WG	Name	Application-aware Networking
	Acronym	apn
	Area	Routing Area (rtg)
	State	Abandoned
	Charter	charter-ietf-apn-00-01 Not currently under review
	Document dependencies	Show
Personnel	Chairs	Donald E. Eastlake 3rd, Melchior Aelmans
	Area Director	Andrew Alston
Mailing list	Address	apn@ietf.org
	To subscribe	https://www.ietf.org/mailman/listinfo/apn
	Archive	https://mailarchive.ietf.org/arch/browse/apn/
Chat	Room address	https://zulip.ietf.org/#narrow/stream/apn

Draft

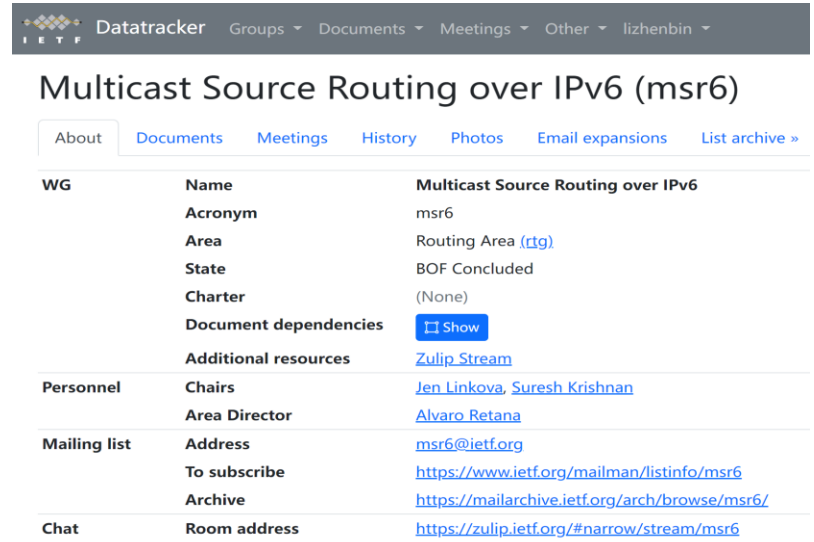
Document		Date	Status
Related Internet-Drafts (6 hits)			
draft-peng-apn-bgp-flowspec-03 **Dissemination of BGP Flow Specification Rules for APN**	18 pages	2023-05-09	I-D Exists
draft-peng-apn-yang-03 **A YANG Model for Application-aware Networking (APN)**	19 pages	2023-05-09	I-D Exists
draft-li-apn-header-04 **Application-aware Networking (APN) Header**	12 pages	2023-04-12	I-D Exists
draft-li-apn-framework-07 **Application-aware Networking (APN) Framework**	23 pages	2023-04-03	I-D Exists
draft-li-apn-problem-statement-usecases-08 **Problem Statement and Use Cases of Application-aware Networking (APN)**	16 pages	2023-04-03	I-D Exists
draft-peng-apn-scope-gap-analysis-06 **APN Scope and Gap Analysis**	15 pages	2023-03-13	I-D Exists

MSR6 @IETF

Multicast has great potential in carrying future applications.

Meeting

- **MSR6 Side Meeting @IETF112**
  - https://github.com/XuesongGeng/IETF-112-MSR6-Side-Meeting
- **MSR6 BOF @IETF114**
  - https://datatracker.ietf.org/group/msr6/about/



Draft

Draft topic	Draft name
Problem Satement of IPv6 Multicast Source Routing (MSR6)	draft-liu-msr6-problem-statement
Yet another Problem Statement for IPv6 Multicast Source Routing (MSR6)	draft-eckert-msr6-problem-statement
MSR6(Multicast Source Routing over IPv6) Use Cases	draft-liu-msr6-use-cases
Design Consideration of IPv6 Multicast Source Routing (MSR6)	draft-cheng-msr6-design-consideration
RGB (Replication through Global Bitstring) Segment for Multicast Source Routing over IPv6	draft-lx-msr6-rgb-segment
Recursive Bitstring Structure (RBS) for Multicast Source Routing over IPv6 (MSR6)	draft-eckert-msr6-rbs
IPv6 Multicast Source Routing Traffic Engineering	draft-geng-msr6-traffic-engineering
RLB (Replication through Local Bitstring) Segment for Multicast Source Routing over IPv6	draft-geng-msr6-rlb-segment

Summary and Next Steps

To continue the discussions in IETF and eventually propose solutions in specific WGs.

•Mailing list (metaverse@ietf.org) to discuss

Thank you!