An Overview of MAMS (Multiple Access Management Services)

draft-kanugovi-intarea-mams-protocol-03

draft-zhu-intarea-mams-control-protocol-00

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[* will be reflected in the next revision]

Motivation

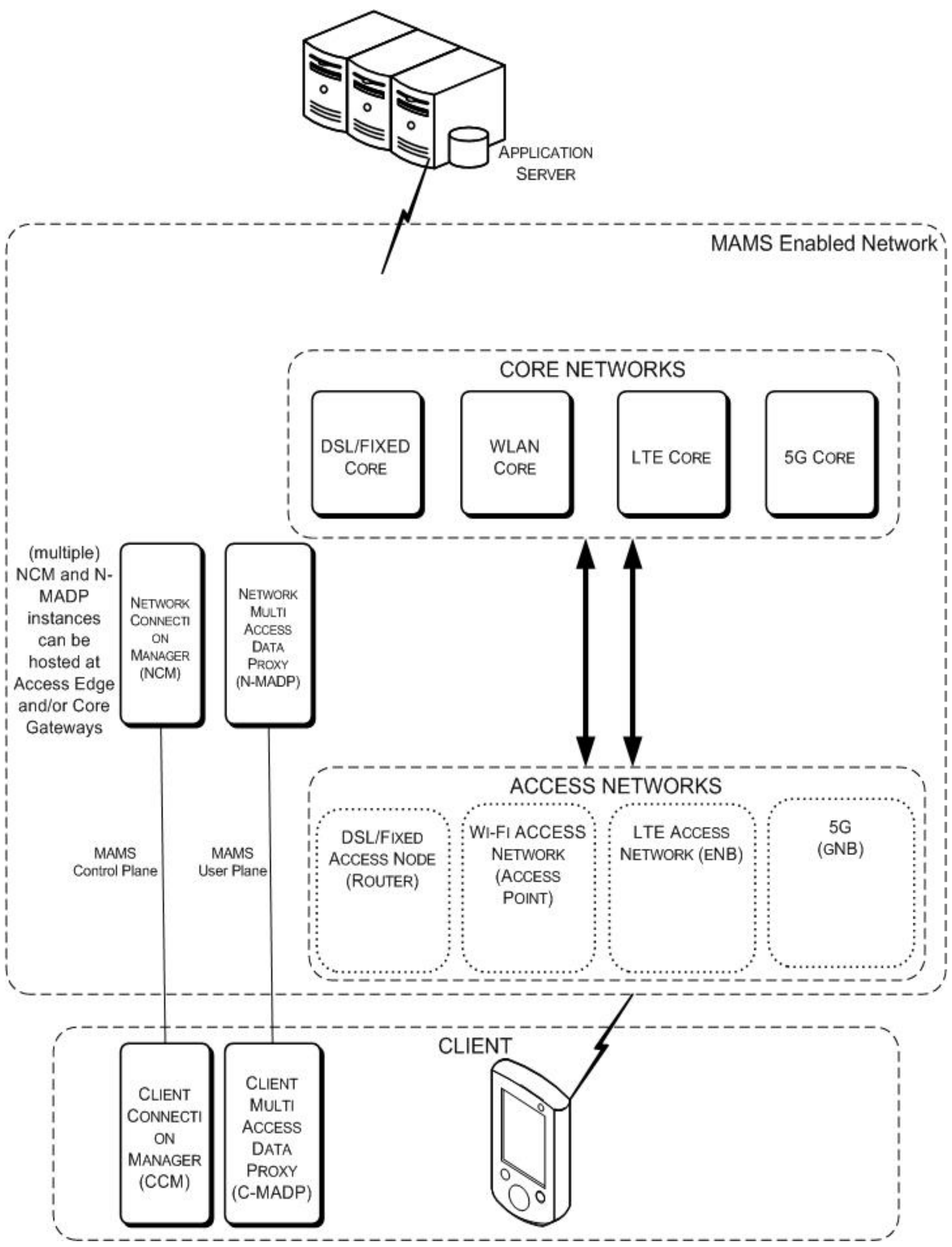
- Devices are capable of Multiconnectivity – Applications have ability to leverage multiple networks
- Application QoE (quality of experience) varies with choice of network paths
  - Performance varies dynamically based on network conditions, e.g. radio conditions, user population, actual network utilization
    - e.g. 1, Wi-Fi offers good capacity with small number of users which quickly degrades, low throughputs and large unpredictable delays due to uplink contention with larger user population.
    - e.g. 2, LTE capacity is limited by available licensed spectrum but offers predictable performance even with increasing number of users
- Deployment configurations determine certain network path choices for applications
  - e.g. Enterprise apps available only via Wi-Fi IP gateway, Cellular operator hosted Cloud only available via cellular IP gateway, VPNs
- Different traffic types require different user plane treatment
  - e.g. MPTCP based aggregation of link capacity for TCP based video flows, Encapsulating Trailer/Header (e.g. GRE) based reordering support for UDP traffic over multiple links
- Selecting best combination of network paths and user plane treatment is essential for consistent and high QoE
  - Dynamically adapt to changing network conditions
  - e.g. Improve enterprise conferencing service (e.g. Skype) by choosing Wi-Fi access in uncongested conditions, Switch only uplink to LTE access as Wi-Fi radio link condition degrades or congestion increases

MAMS - Introduction

- MAMS is a framework for
  - Integrating different access network domains based on IP layer interworking,
  - with ability to select access and core network paths independently
  - and user plane treatment based on traffic types
  - that can dynamically adapt to changing network conditions
  - based on negotiation between client and network

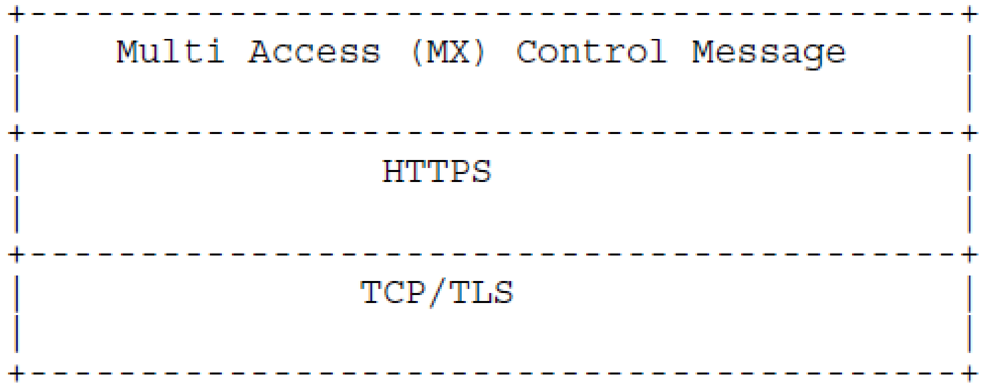
Architectural Framework

- MAMS functional elements
  - Network Connection Manager (NCM)
    - Intelligence in the network to configure network paths and user plane protocols based on client negotiation
  - Client Connection Manager (CCM)
    - Negotiates client’s capabilities and needs with the NCM and configures network path usage
  - NCM – CCM message exchange enables
    - Dynamic selection of best network paths
    - Flexible configuration of MADP protocols and parameters
    - Overlay and Extensible messaging (e.g. JSON over HTTP)
  - Multiple Access Data Proxy (C/N-MADP)
    - C-MADP handles user plane functions at the client and N-MADP at network.
    - User plane distribution and aggregation across configured network paths.
    - Supports any user plane protocols including existing IETF protocols like TCP, UDP, MPTCP, SCTP, QUIC, GRE, …

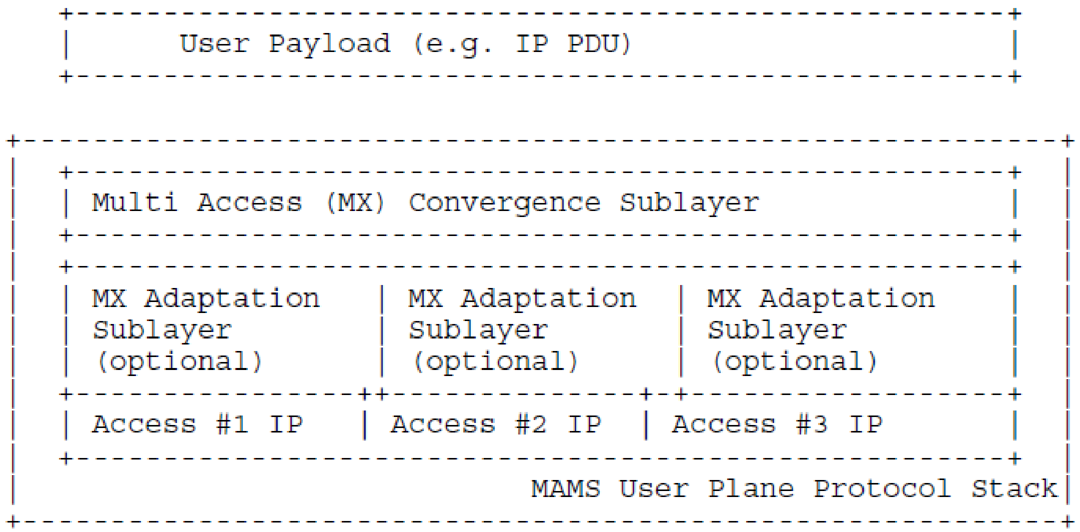


MAMS Control and User Plane Protocols

- Control Plane
  - Messages carried over HTTPS/TLS agnostic to underlying transport network
  - Configures user plane protocols per application needs and client and network capabilities
  - Supports dynamic adaptation of network paths and user plane protocol selection triggered by changing network conditions
- User Plane
  - Provides services like Traffic Aggregation and distribution
    - Can be use existing protocols like MPTCP, GRE Proxy
    - Or new user plane protocols (e.g. Trailer Adaptation)
  - Divided into:
  - MX Convergence Sublayer: Aggregation and Distribution
  - MX Adaptation Sublayer (optional): access and transport specific aspects of a single path (e.g. NAT, User plane security)



MAMS Control Plane Protocol



MAMS User Plane Protocol

Summary

- Lightweight integration of different access technology domains
  - multi-tech/vendor/operator network – e.g. LTE, DSL, Wi-Fi, 5G
  - any layer – e.g. IP, MPTCP, PDCP

- Flexible function placement:
  - RAN, Core or MEC, all can be managed independently
  - Device implementation as SW upgrade (application or OS)

- Use cases benefitting from MAMS
  - Ideal for LTE/Wi-Fi integration for enterprises, public venues and stadiums
  - Introduction of local (e.g. hotspot) 5G deployments and co-operation with the rest of existing infrastructure
  - Improved use of existing fixed line assets, unified platform for managing utilization and joint traffic steering across multiple networks

BACK-UP

Relation to other IETF work

- MAMS is a framework for negotiation, configuration and delivery of network paths in a multi-network scenario.
    - Control layer for flexible combination of access and core network paths and user plane treatment
    - Efficient delivery of user plane over multiple paths with no impact to existing network/transport protocols
    - Dynamic best path selection based on real-time network conditions and utilization.
    - Minimal impact to actual underlying network technology and architecture
- IETF groups are engaged in development of multipath user plane protocols
- MAMS is not bound to any specific user plane protocol, e.g. TCP, UDP, MPTCP, GRE but provides mechanism to negotiate use and configuration of the protocols.
- Network state information from MAMS framework can be used to optimize user plane operation.
    - e.g. CCM-NCM can exchange policy [1] or optimal path information [2] to complement MPTCP operation
- MAMS framework is agnostic to underlying network technology
    - Applicable to multi-network integration discussions including LTE, Wi-Fi, DSL, and 5G
- MAMS framework is complementary to such IETF work

References

[1] Lance Hartung and Milind M. Buddhikot, “Policy Driven Multi-band Spectrum Aggregation for Ultra-broadband Wireless Networks”, 7th IEEE Dynamic Spectrum Access Networks (DySPAN) 2015. Stockholm, Sweden.

[2] S. Borst, A. O. Kaya, D. Calin, H. Viswanathan, “Optimal Path Selection in Multi-RAT Wireless Networks”, in Proc. of IEEE INFOCOM 2016 Wkshp on 5G & Beyond – Enabling Technologies and Applications, April 2016, SF, CA