WiFi Integration in Evolution to 5G networks

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WiFi Knowledge Summit, Bangalore

March 9, 2018

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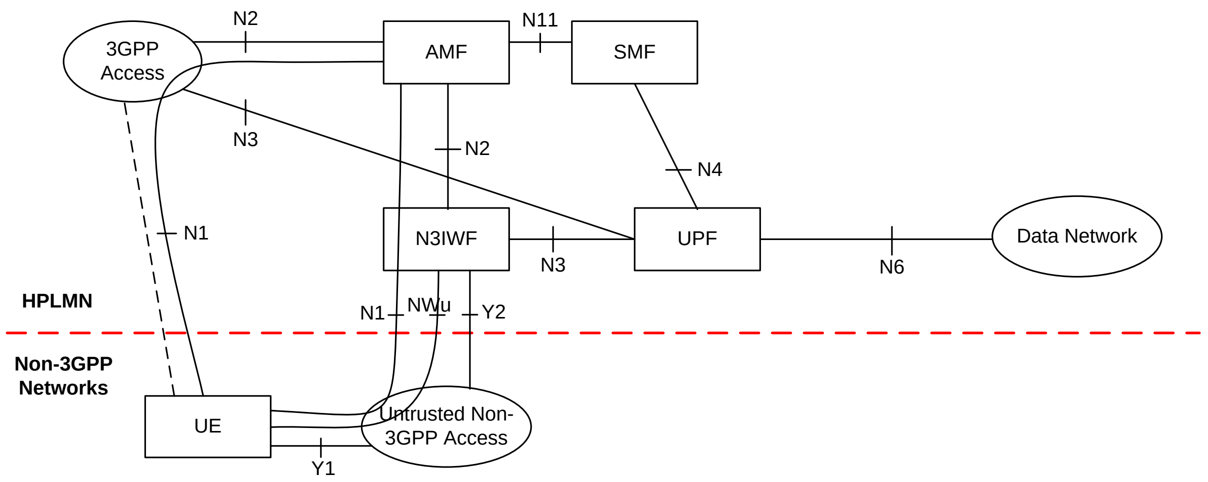
Outline

- Integrating WiFi Access into the 5G Core
- Multi-Access Edge Computing and WiFi Access
- Common Capacity Management Frameworks
  - IETF - Multi Access Management Services (MAMS)
  - 3GPP – Access Traffic Steering, Switching and Splitting (ATSSS)

Integrating WiFi Access into the 5G Core

- Non-3GPP access networks are connected to 5G core network via a Non-3GPP Inter-Working Function (N3IWF).
- The N3IWF interfaces to 5G core network control-plane functions and user-plane functions via N2 interface and N3 interface, respectively.
- Only Untrusted Non 3GPP Access is currently in scope, Trusted being discussed for R-16



Non-roaming architecture for 5G core network with non-3GPP access

Source: 3GPP TS 23.501

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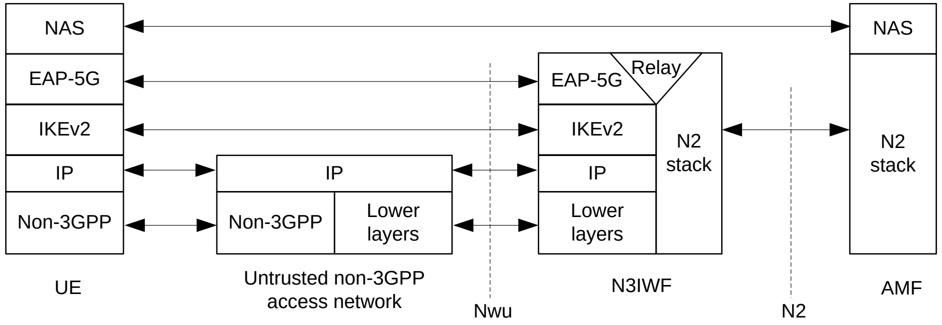
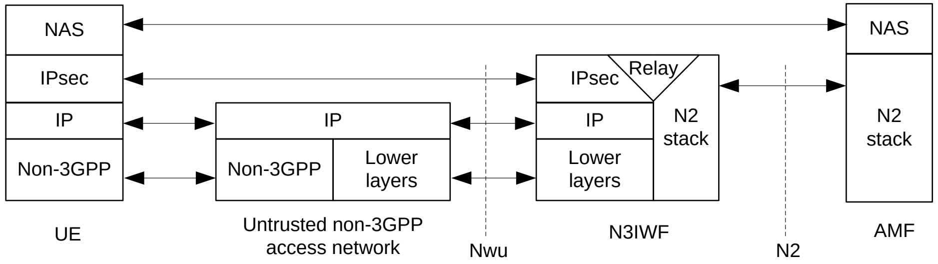
5G Control Plane for WiFi Access

- UE gets an IP address via the non-3GPP access.
- UE initates IPsec Security Association (SA) with the selected N3IWF by initiating an IKE initial exchange
- UE initiates an IKE_AUTH exchange indicating the use of EAP (EAP-5G) signalling.
- The N3IWF responds with an IKE_AUTH response message which includes an EAP-Request/5G-Start packet and informs UE to encapsulated NAS messages within EAP-5G packets.
- Once the IPsec SA is established between the UE and N3IWF, "signalling IPsec SA", all NAS messages between the UE and N3IWF are exchanged via this SA.



Control Plane before the signalling IPsec SA is established between UE and N3IWF
Source: 3GPP TS 23.501



Control Plane after the signalling IPsec SA is established between UE and N3IWF
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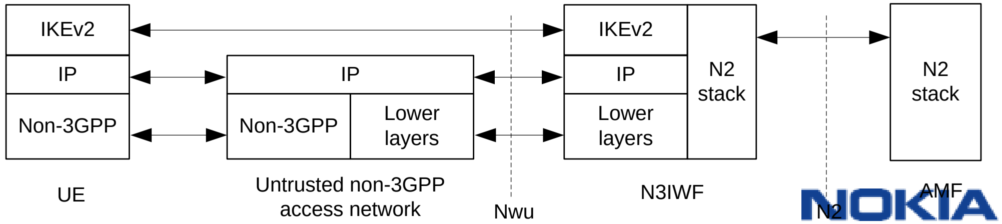

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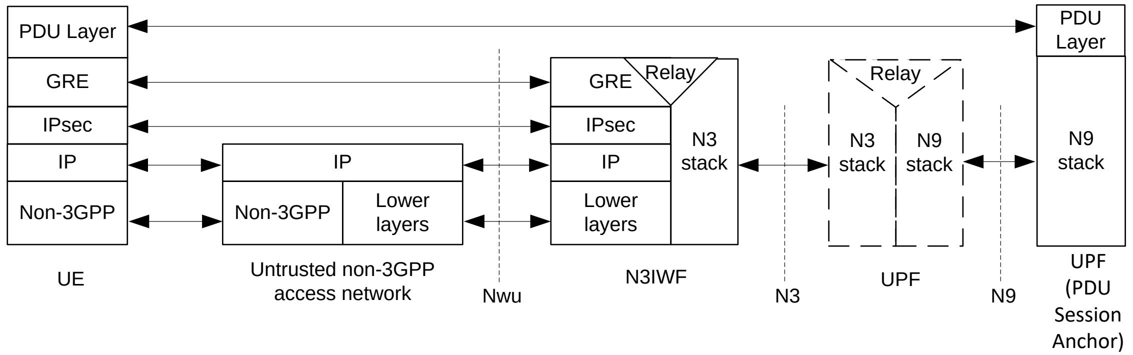
Control Plane for establishment of user-plane via N3IWF
Source: 3GPP TS 23.501

5G User plane for WiFi Access

- Data, 5G PDUs, over the Non 3GPP access is sent inside the secure tunnel between UE and N3IWF
- UDP can be used as tunnelling protocol in IPsec for NAT traversal.



User Plane for Non 3GPP Access via N3IWF
Source: Figure 8.3.2-1, 3GPP TS 23.501

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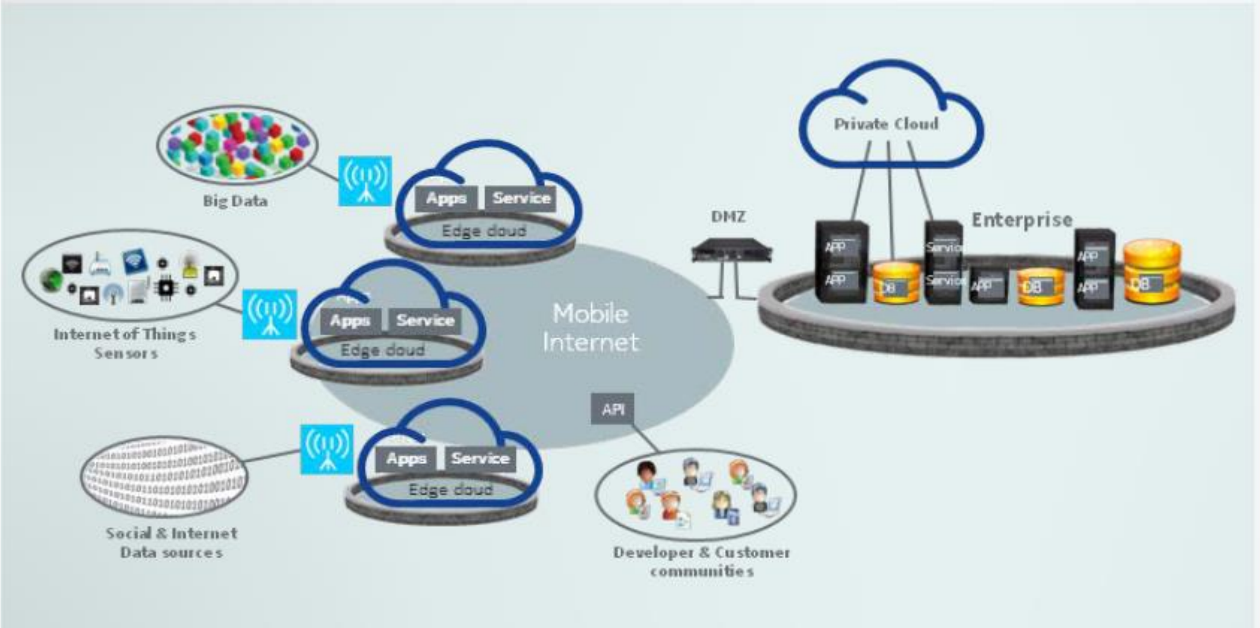
Edge Computing –"Mobile" to "Multi Access"

- ETSI MEC is working on standards for enabling benefits of Edge Computing framework to applications
- In Phase 1, MEC (Mobile Edge Computing) focused on Edge Computing framework for Mobile (cellular) networks
- In Phase 2, Scope has evolved into a Multi Access Edge Computing Platform with support 3GPP and non-3GPP access technologies (WiFi and fixed)



Overview of Multi Access Edge Computing [1]

Extending MEC to WiFi networks

- ETSI MEC Phase 1 has published Radio Network Information Service (RNIS) APIs for Applications take advantage of real time radio network information to improve service delivery
    - http://www.etsi.org/deliver/etsi_gs/MEC/001_099/012/01.01.01_60/gs_MEC012v010101p.pdf
    - MEC applies Analytics (e.g. Mashup) on information coming from multiple RATs and provide feedback (e.g. ETSI RNIS APIs) in a way suitable for use by applications
    - Can be easily extended to support information exposure from additional RATs, like Wi-Fi, 5G, DSL, individually or in combination.
- ETSI MEC Phase 2 will extend the information exposure to other access technologies
- New Service to specify WiFi access information. Some examples of nature of information that could be exposed:
    - BSS Load (station count, channel utilization, admission capacity)
    - STA statistics (STA counters, BSS avg delay, etc)
    - Estimated throughput UL/DL
    - WAN metrics (DL speed/load, UL speed/load)
    - STA RSSI
- Builds on existing and ongoing work from WFA e.g. Multi-AP Services, Data Elements and Hotspot 2.0.

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WiFi + Cellular – Common Capacity Management

- Application QoE (quality of experience) varies with choice of access technology
- Performance depends on factors like radio conditions, user population, actual network utilization
- Wi-Fi offers good capacity with small number of users which quickly degrades, low throughputs and large unpredictable delays due to poor MAC efficiency.
- LTE offers predictable performance but capacity is limited by available licensed spectrum
- Combining the best of WiFi and Cellular can deliver the best value from the network

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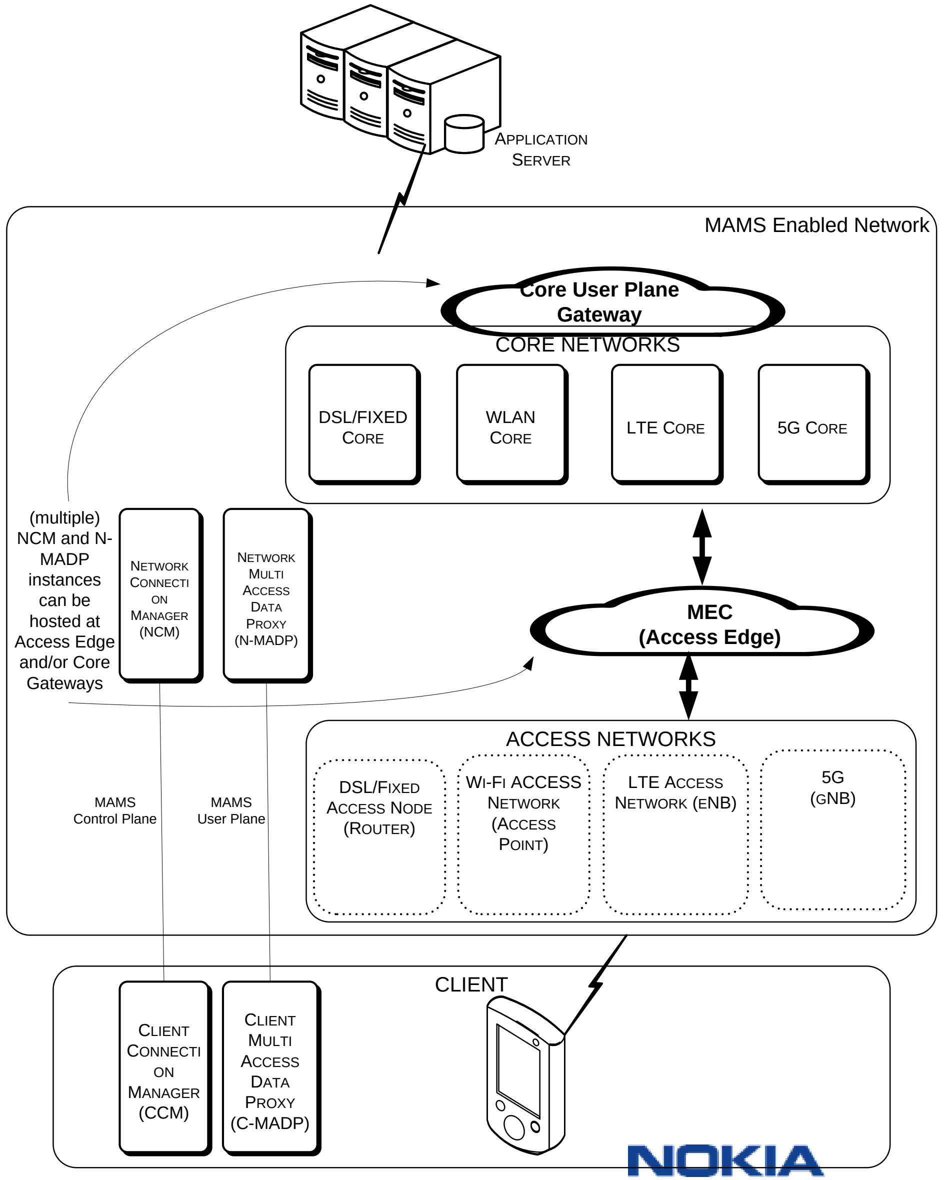
IETF MAMS

- MAMS (Multi Access Management Services) is a framework for
  - Integrating different access network domains based on user plane (e.g. 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
- The technical content is available as the following drafts*
  - Multi Access Management Services (MAMS) Framework – https://datatracker.ietf.org/doc/draft-kanugovi-intarea-mams-framework/
  - MAMS JSON definitions of Control Plane Messages: https://www.ietf.org/id/draft-agarwal-intarea-mams-protocol-json-00.txt
  - MAMS User Plane Specification: https://tools.ietf.org/html/draft-zhu-intarea-mams-user-protocol-02

*Currently under review, Co-authors: Nokia, Intel, Broadcom, Huawei, AT&T, KT,

MAMS 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
    - Gateway for common multi-network view, network policy input and Interface to Application Platforms
  - 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 WebSocket)
  - 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, …



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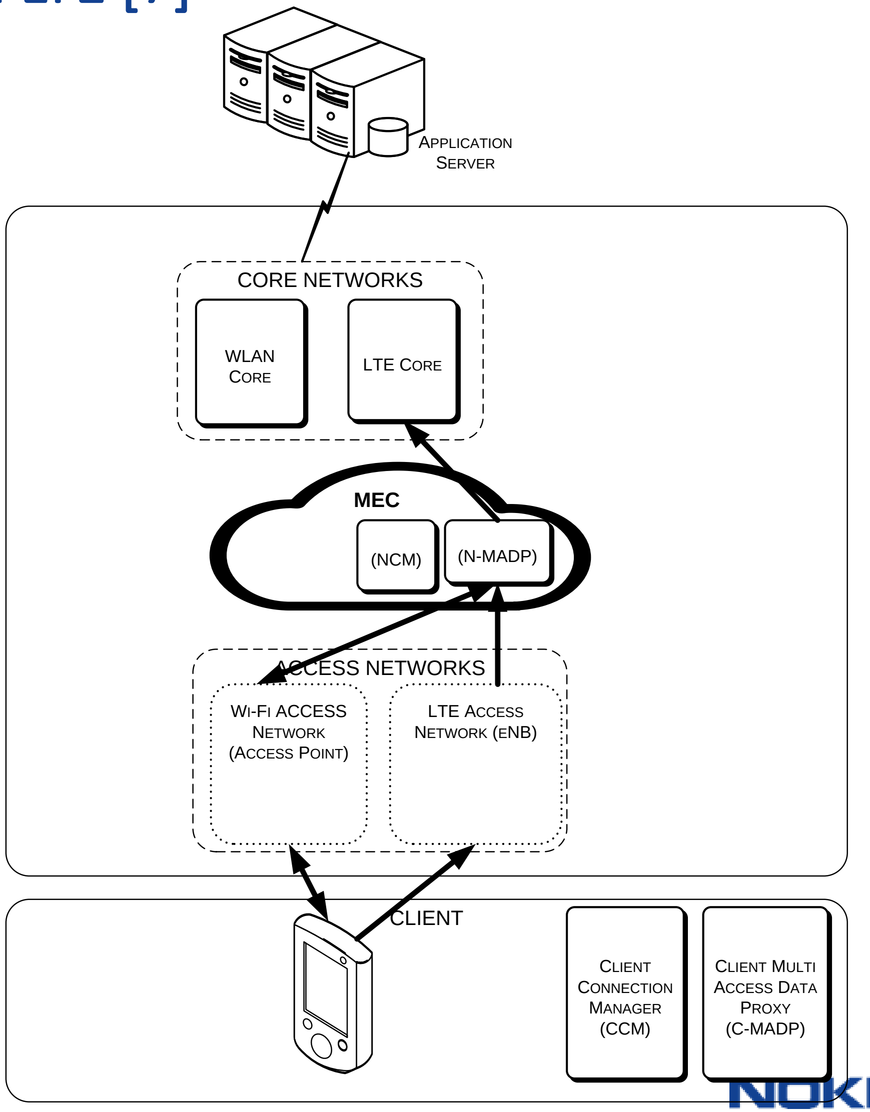
MAMS at MEC integrating LTE and Wi-Fi networks

Use case 1: Support high UL/DL BW applications with LTE [7]

- Applications accessed via LTE core (cellular service subscription and authentication) can take advantage of Wi-Fi capacity in uplink and downlink
- Flexibility in choosing Wi-Fi access even when LTE core is used as IP anchor
- Support high bandwidth demanding video downloads on LTE connections using Wi-Fi DL
- Support LTE Core routed cloud video content uploads using Wi-Fi UL
- MEC controls and monitors usage of Wi-Fi access



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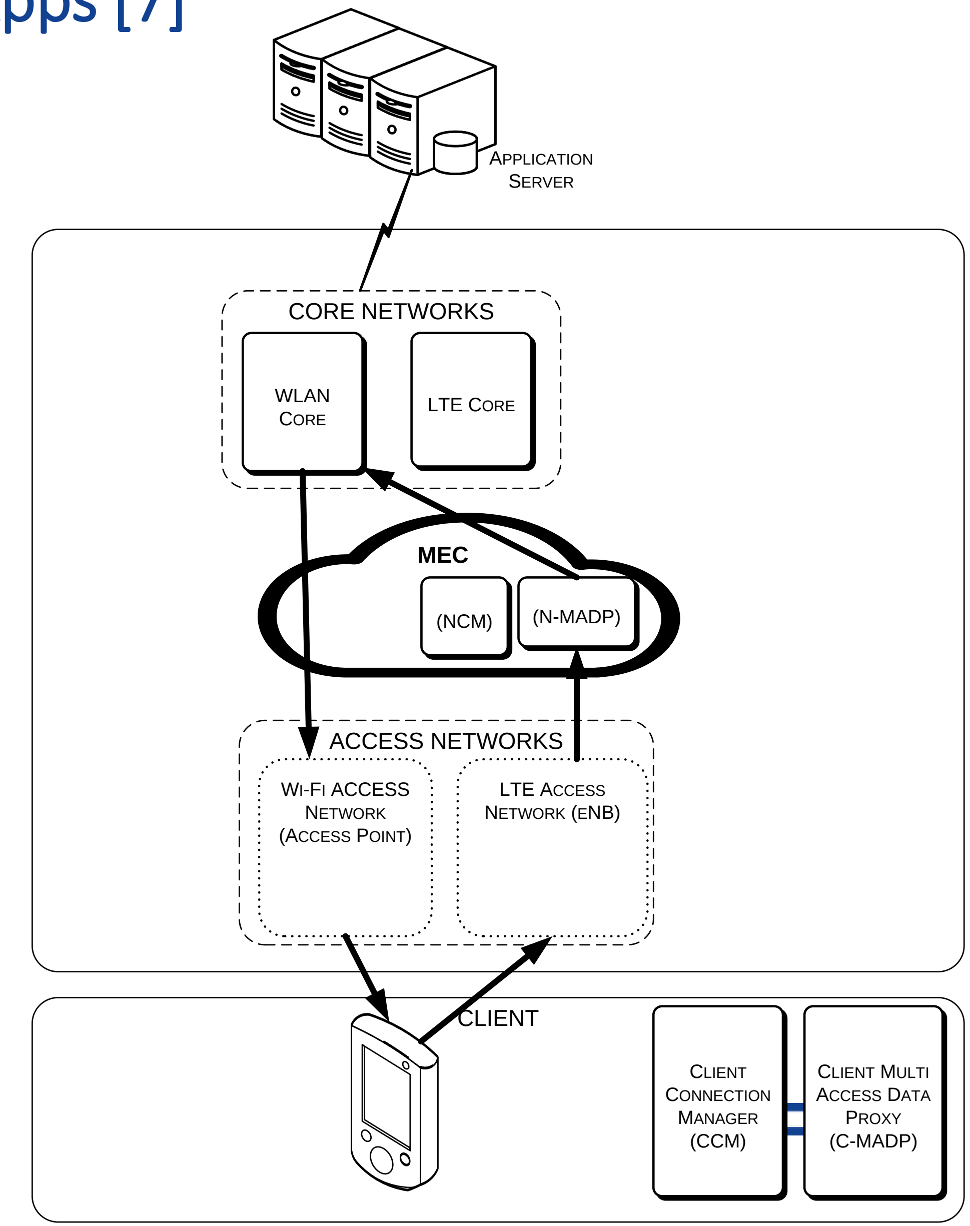
MAMS at MEC integrating LTE and Wi-Fi networks
Use Case 2: Using LTE UL to improve QoE for 'Wi-Fi' Apps [7]

- Enterprise improves its services by offloading Uplink of Enterprise services to LTE uplink that are then shunted across back to the enterprise WLAN infrastructure
- All enterprise traffic stays local – avoids traversal through operator core
- 'Big' gains in VoWiFi capacity
- Simple, scalable solution towards all-wireless enterprise that leverages LTE
  - Internet access possible through enterprise core



3GPP Access Traffic Steering, Switching and Splitting (ATSSS)

- 3GPP TR 23.793 has in its scope the study of architectural aspects and solutions for extending the 5G System (5GS) to support Access Traffic Steering, Switching and Splitting (ATSSS) between 3GPP and non-3GPP access networks.
- Initially, the study considers ATSSS solutions that enable traffic selection, switching and splitting between NG-RAN and untrusted non-3GPP access networks.
- Subsequently, after the 5GS architecture is enhanced to support trusted non-3GPP access networks.

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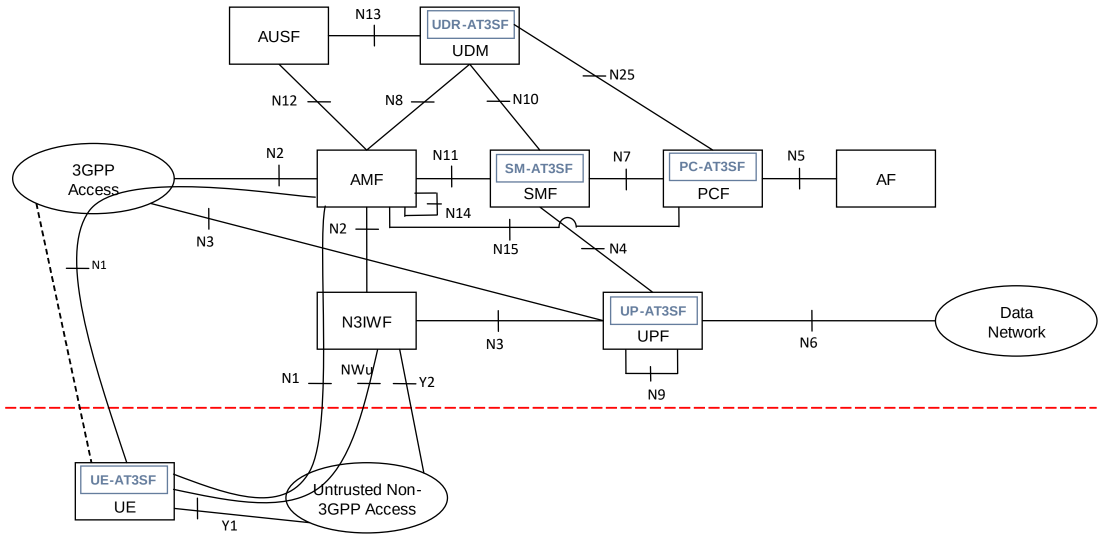
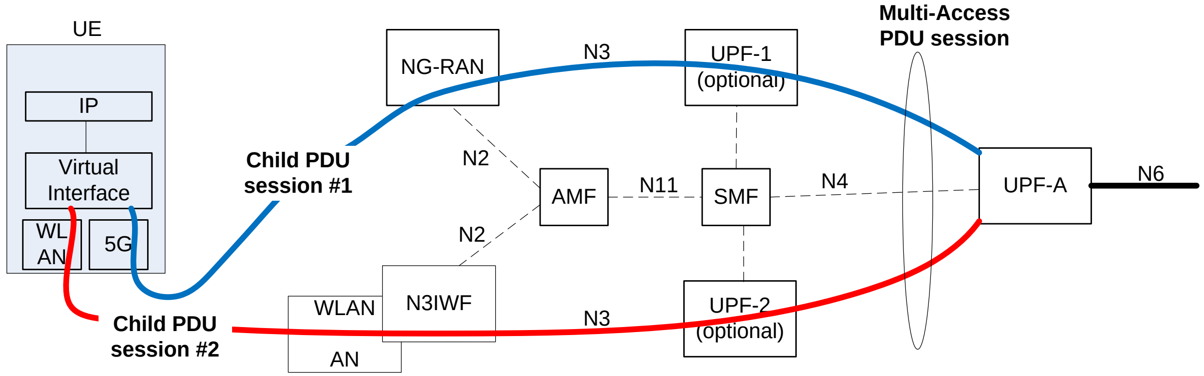
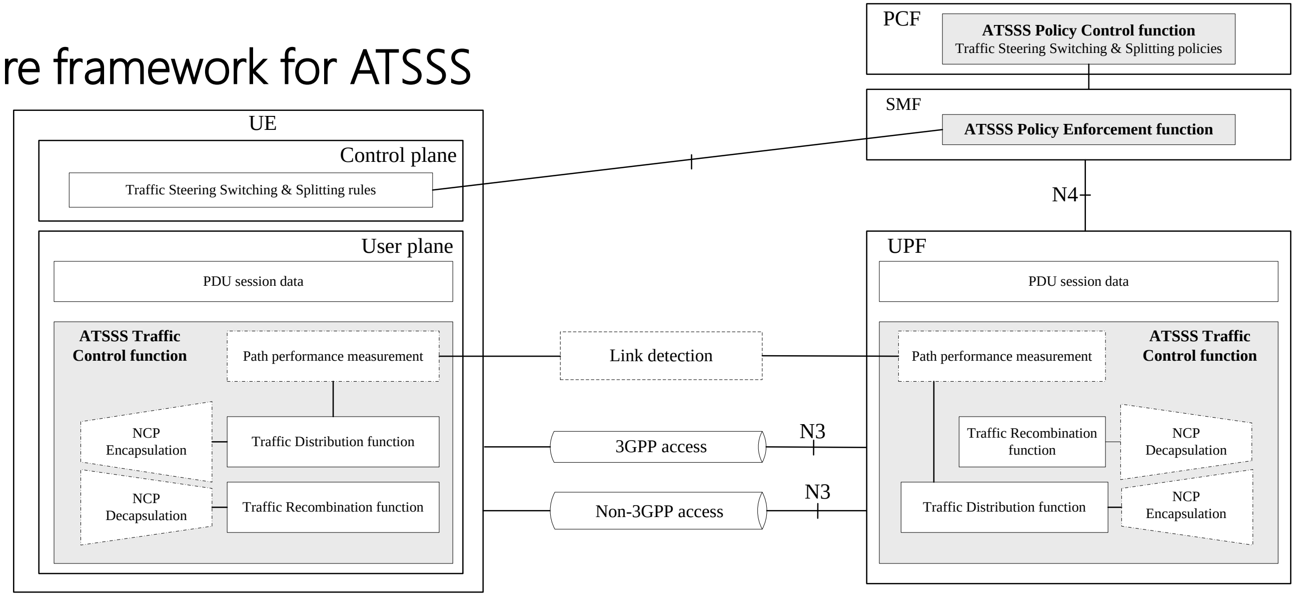
Proposed Solutions in ATSSS TR 23.793 (0.2.0, work in progress)



Solution 1: Proposed architecture framework for ATSSS



Solution 2: Support of Multi-Access PDU Sessions



Solution 3: NCP based architecture framework for ATSSS

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References

[1]MEC Introduction Slides, ETSI MEC

[2] MEC Deployments in 4G and Evolution Towards 5G, ETSI MEC Whitepaper

[3] 3GPP TS 23.501, System Architecture for the 5G System; Stage 2 (R15)

[4] 3GPP TS 23.502, Procedures for the 5G System; Stage 2 (R15)

[5] 3GPP TR 23.793, Study on Access Traffic Steering, Switching and Splitting support in the 5G system architecture (R16)

[6] IETF MAMS Framework draft (under review) - http://www.ietf.org/id/draft-kanugovi-intarea-mams-framework-00.txt

[7] MAMS (Multi Access Management Services) framework for MEC, Broadband Forum Birds of a Feather Webinar - MEC Part 2, BBF2017.556

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