Optimized Mobile User Plane Solutions for 5G

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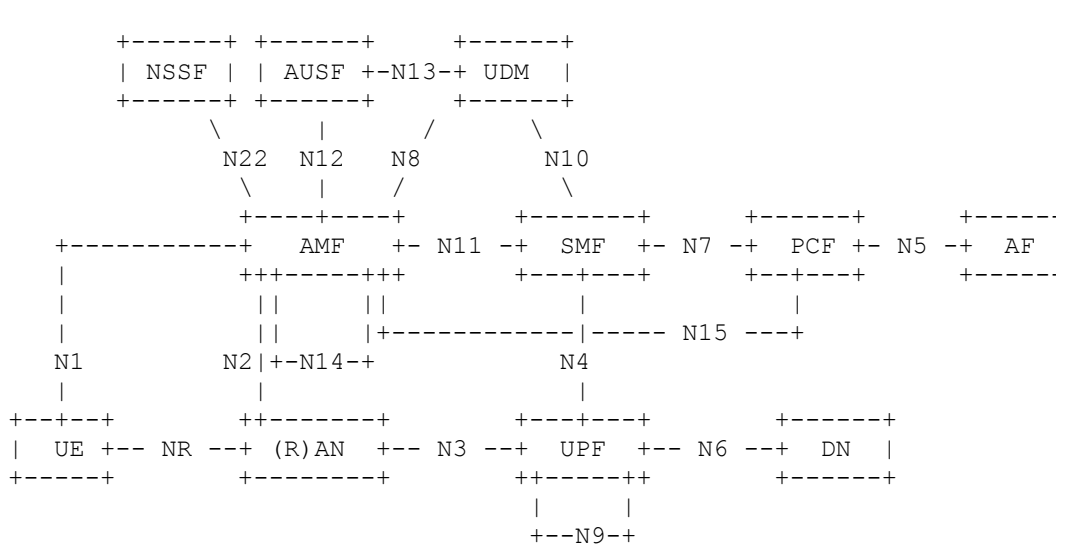
Background

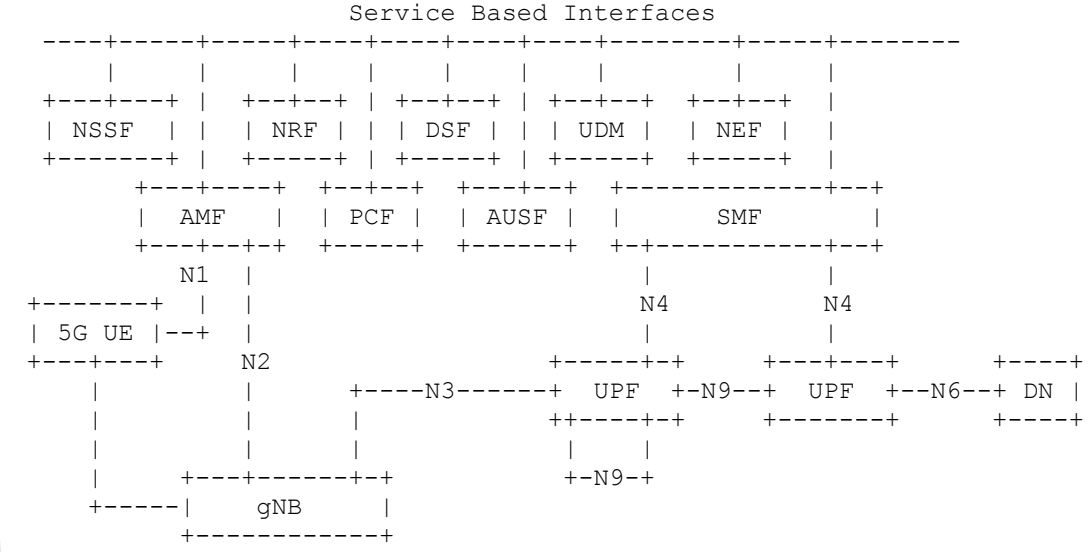
- 3GPP CT4 has initiated a study item to study different mobility management protocols for potential replacement of GTP tunnels between UPFs (N9 Interface) in the 3GPP 5G system architecture of Release 16 (5G Phase 2)
- References
  - 3GPP TS 29.281 (V15.1.0): GPRS Tunnelling Protocol User Plane (GTPv1-U)
  - 3GPP TR 29.891 (V15.0.0): 5G System – Phase 1; CT4 Aspects
  - 3GPP TS 23.501 (V15.0.0): System Architecture for the 5G System
  - 3GPP TS 23.503 (V15.0.0): Policy and Charging Control Framework for the 5G System, Stage 2
  - ETSI GR NGP 004 (V1.1.1): Next Generation Protocol (NGP): Evolved Architecture for mobility using Identity Oriented Networks
- Several protocol candidates in IETF: SRv6, LISP, ILA, etc
- Document being prepared in DMM WG as submission to CT4 for consideration

3GPP Release 15 5G NGC Architecture

Non-Roaming Architecture: Reference Point Representation



Non-Roaming Architecture: Services Based Interfaces



AUSF: Authentication Server Function
AMF: Access and Mobility Management Function
DN: Data Network (e.g.operator services, Internet access or 3rd party services)
NEF: Network Exposure Function
NRF: NF Repository Function
NSSF: Network Slice Selection Function

PCF: Policy Control Function
SMF: Session Management Function
UDM: Unified Data Management
UPF: User Plane Function
AF: Application Function
UE: User Equipment
RAN: (Radio) Access Network

Roaming Architectures

Acronymns:

HPLMN: Home Public Land Mobile Network
VPLMN: Visited PLMN

Defnitions (3GPP TS 21.905)

Mobility: The ability for the user to communicate whilst moving independent of location.

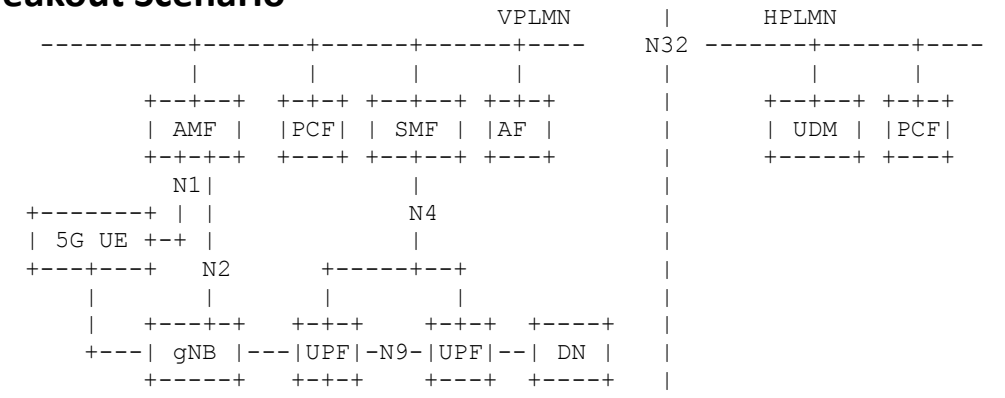
Roaming: The ability for a user to function in a serving network different from the home network. The serving network could be a shared network operated by two or more network operator.

Requirements:

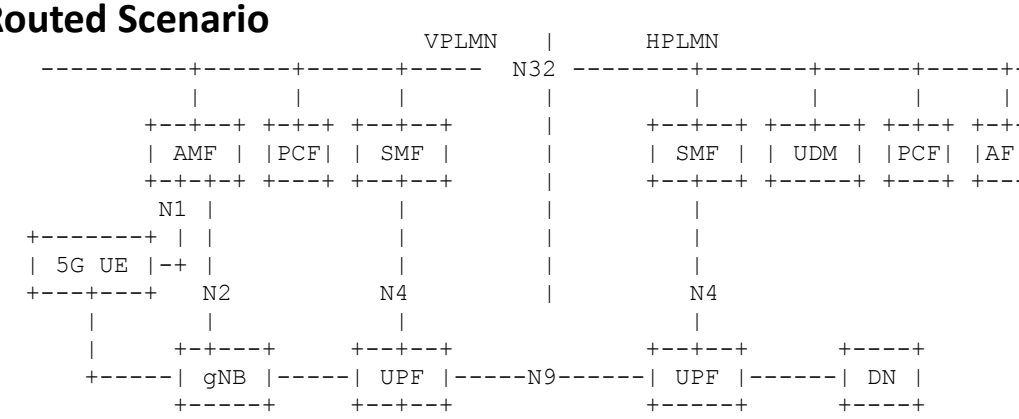
Roaming Requirements: 3GPP TS 22.011 Section 2

Mobility Requirements: 3GPP TS 22.278 Section 7

Local Breakout Scenario

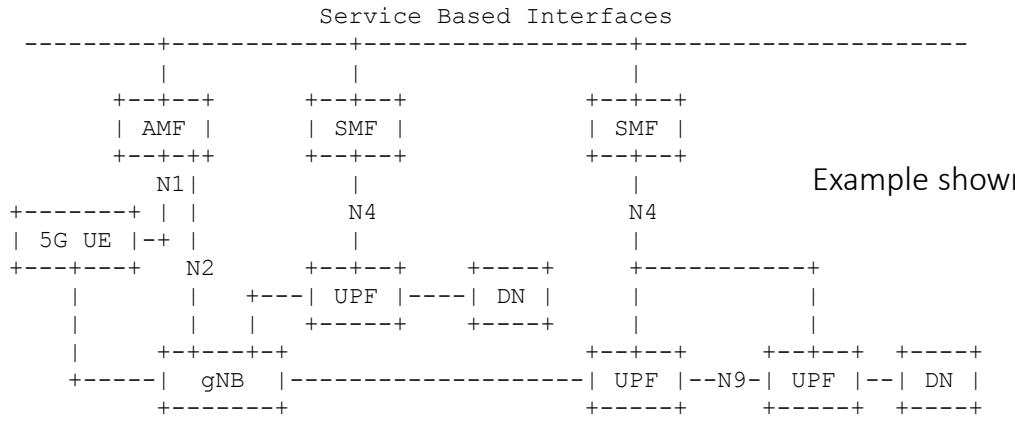


Home Routed Scenario



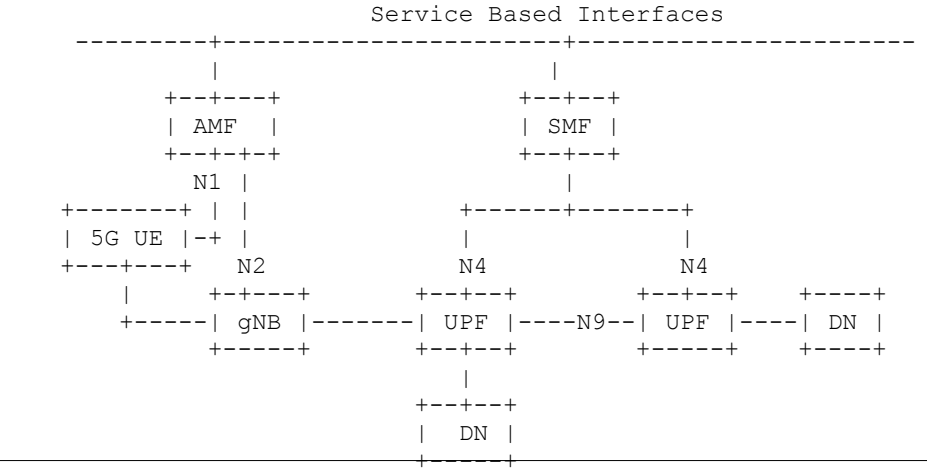
Sample Configurations for Access to Two DNs

Multiple PDU sessions



Example shown with 2 separate SMFs and 2 separate UPFs

Concurrent Access



Requirements

- UPF Requirements: 3GPP TS 23.501 Section 6.2.3
- N9 Requirements: 3GPP TR 29.891 Section 5.1.1

Reference Scenarios for Evaluation

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Non-Roaming Scenarios

UE- Internet Connectivity (mobility cases)
UE-UE IP Packet Flow (mobility cases)
UE – 2 DNs with multiple PDU sessions
UE – 2 DNs single PDU session

Roaming Scenarios

Local Break out
Home routed

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UE mobility SSC Mode 1

Single UPF
Multiple UPF

UE Mobility SSC Mode 2

Single UPF
Multiple UPF

UE Mobility SSC Mode 3

Single UPF
Multiple UPF

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Support for independent slices using GTP and/or other protocol will be covered. Mobility Management will be within each slice.
Support for one UE connected to multiple slices using different mobility protocols will be described.

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Impacts to N2, N3, N4, N6, gNB, AMF and SMF

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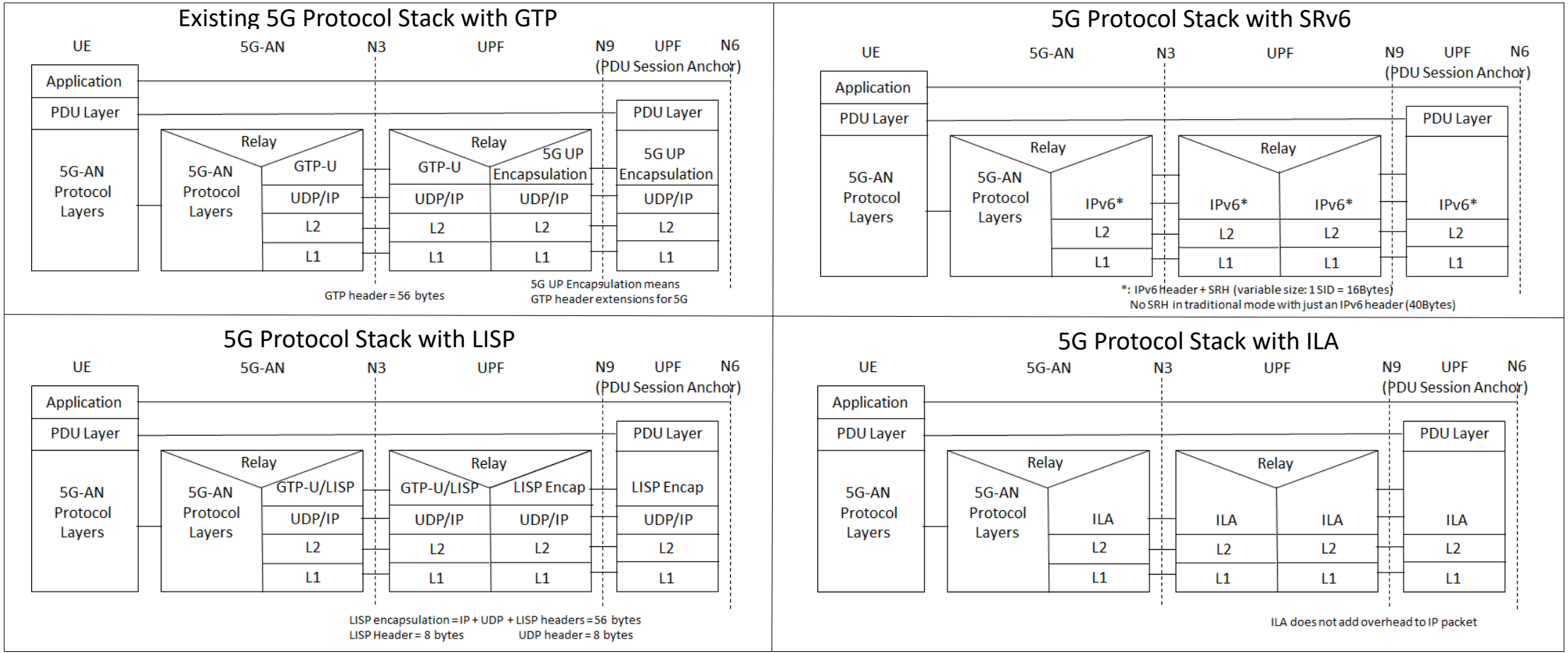
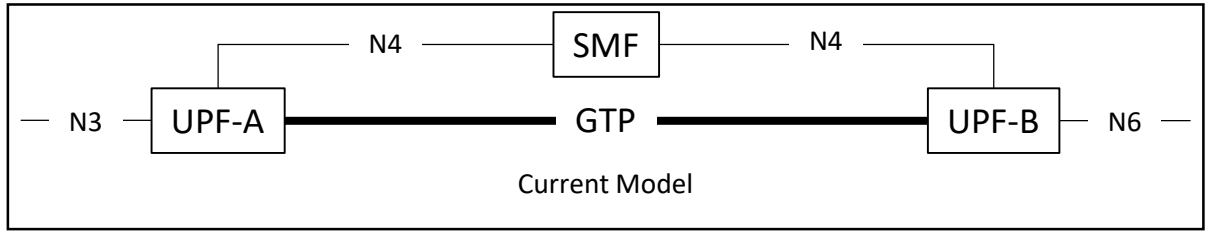
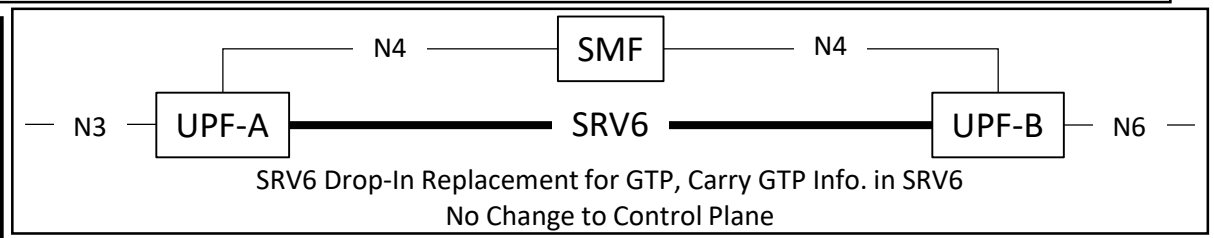
Protocol Stacks

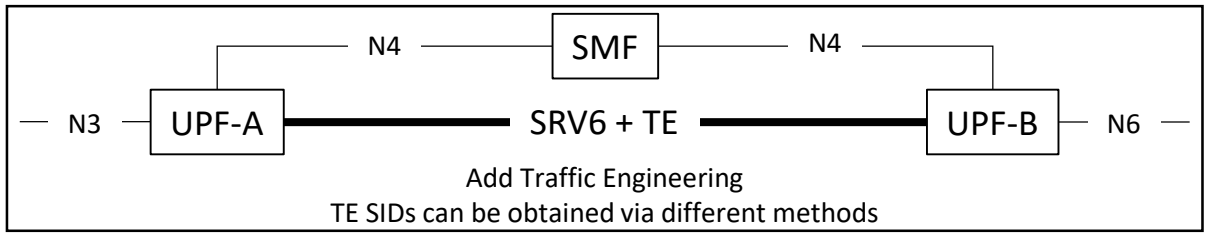


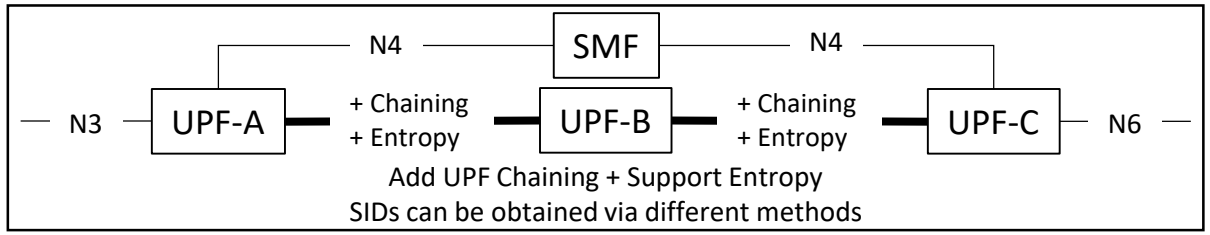
Segment Routing v6

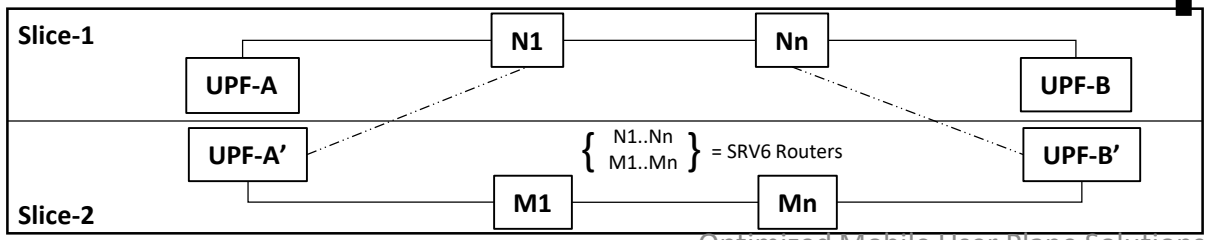
Smooth Transition and Pragmatic Approach for Changing N9



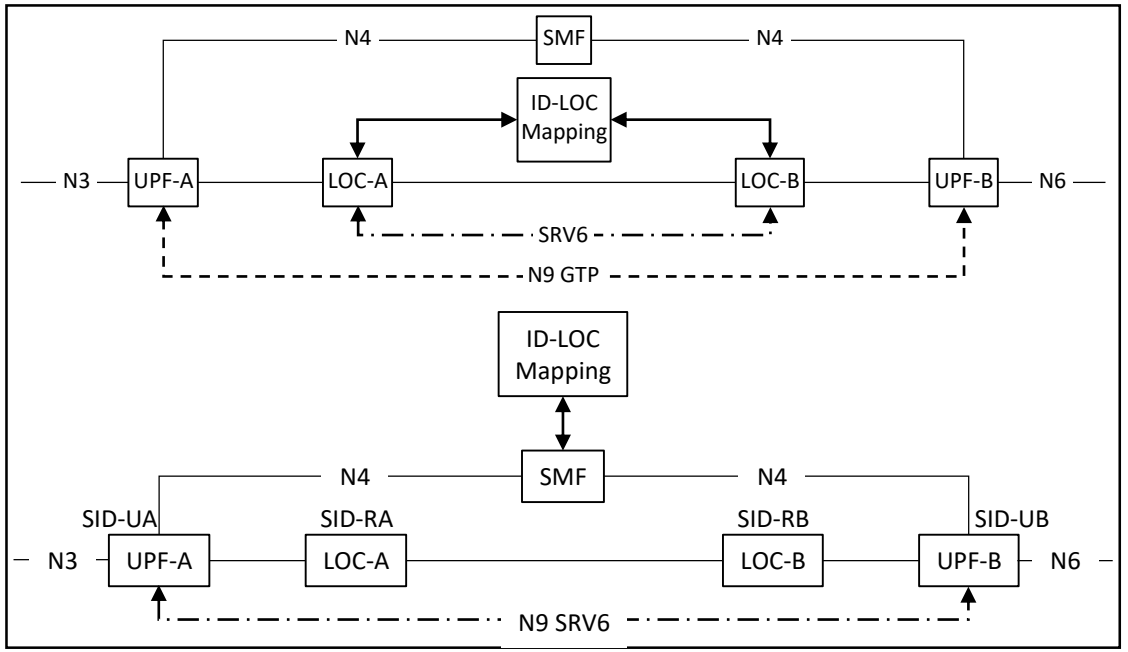








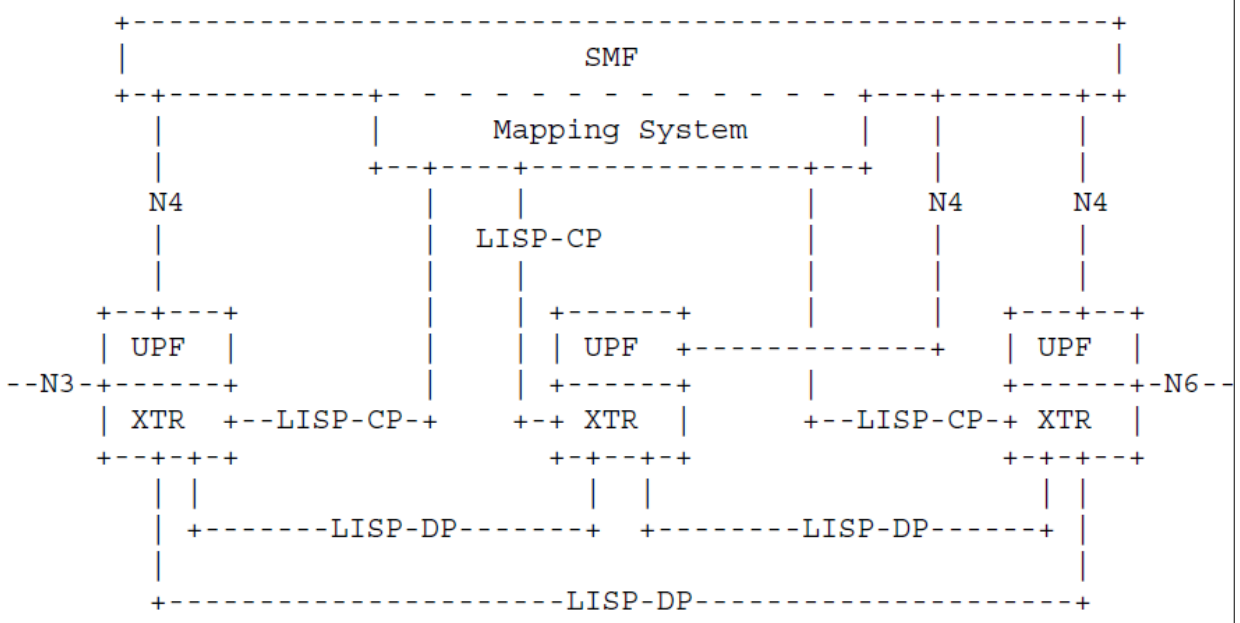
Toward Advanced Mobility with SRV6



1. Drop in SRV6 to replace GTP-U in data plane without changing the control plane.
2. Gradually introduce SRV6 features as needed.
3. Optionally add advanced mobility support either at global, 5G slice level, or for a particular set of flows

LISP – Locator Identifier Separation Protocol

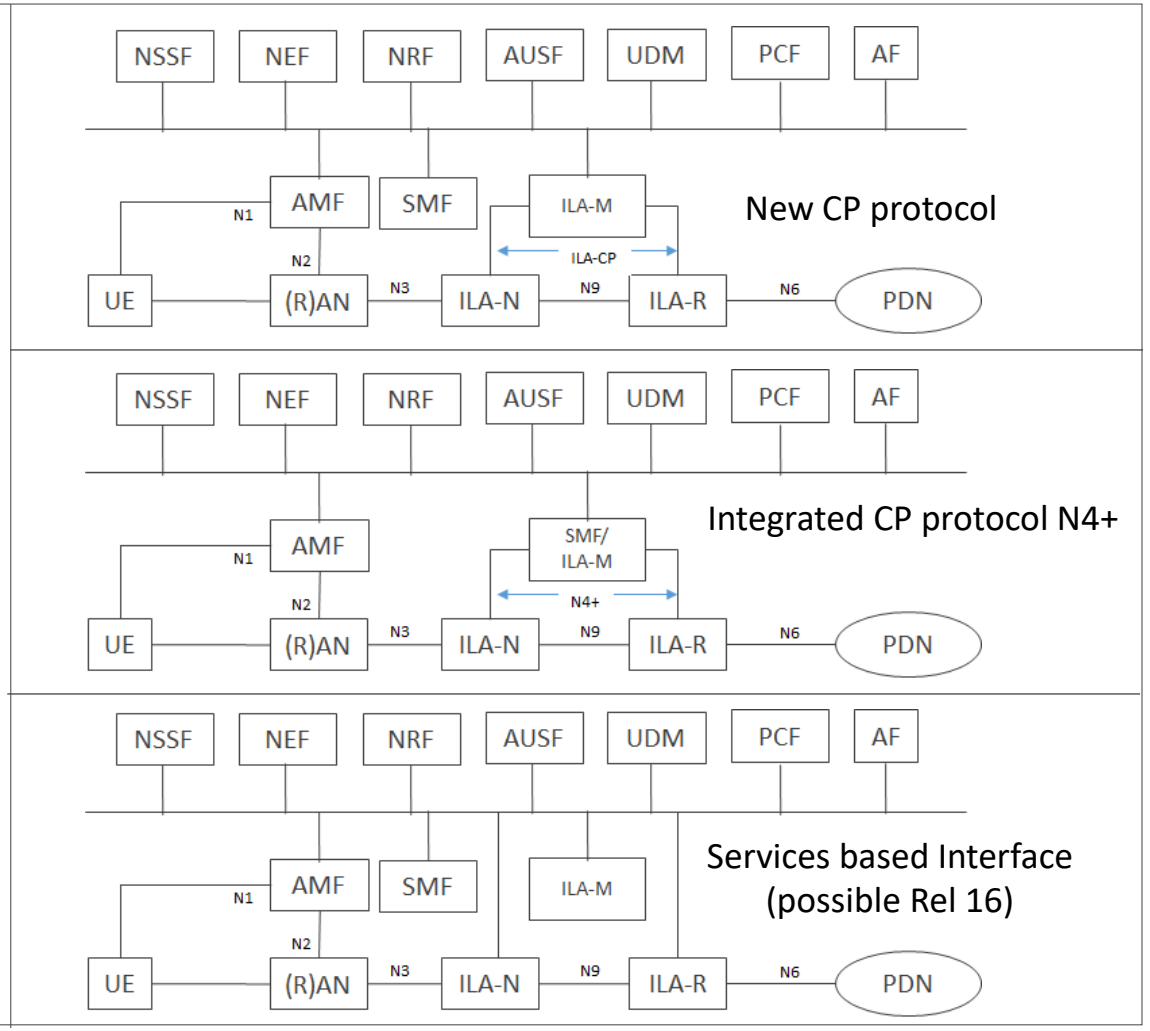
- LISP Control-Plane (RFC6833bis)
  - Supports many data planes: ILA, SRv6, VXLAN, LISP, GTP, …
  - Mature mapping control-plane (10+ years) with large deployments
  - Mobility related drafts:
    - draft-ietf-lisp-eid-anonymity
    - draft-ietf-lisp-eid-mobility
    - draft-ietf-lisp-mn
    - draft-ietf-lisp-predictive-rlocs
- LISP Data-Plane (RFC6830bis)
  - Uses dynamic tunnel encapsulation
  - Fixed headers (16 bytes) are used between outer and inner IP headers



ILA – Identifier Locator Addressing

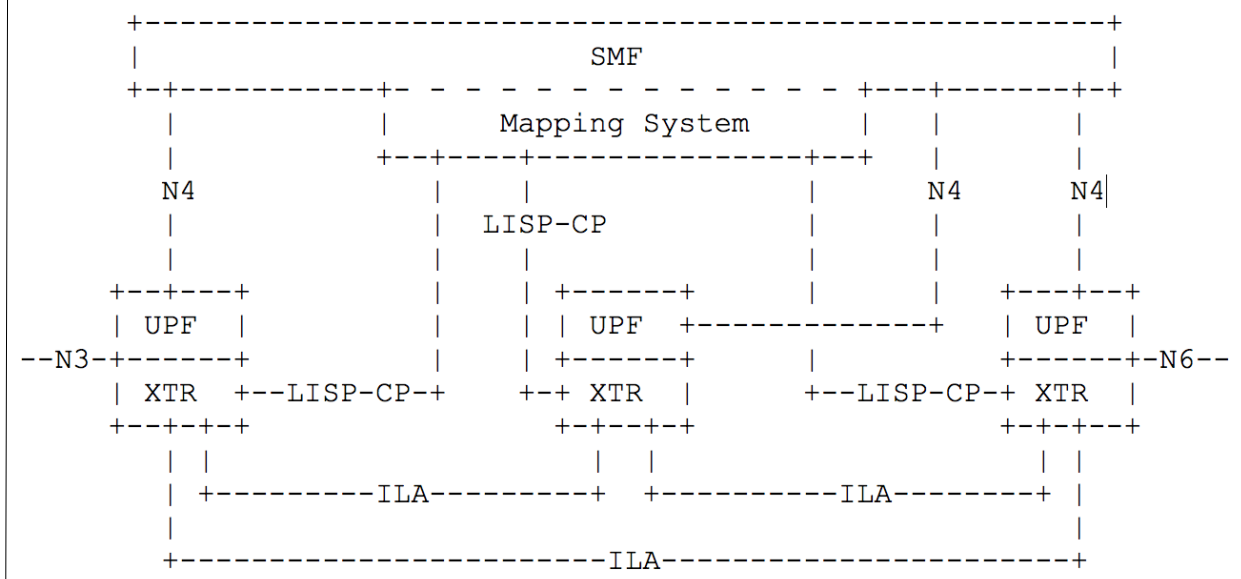
- Identifier Locator Addressing: Problem areas, Motivation, and Use Cases: draft-herbert-ila-motivation-00
- Identifier-locator addressing for IPv6: draft-herbert-intarea-ila-00
- Identifier Locator Addressing Mapping Protocol: draft-herbert-ila-ilamp-00
- Identifier Locator Addressing for Mobile User-Plane: draft-herbert-ila-mobile-00
- Identifier groups: draft-herbert-idgroups-00
- Mobility Management Using Identifier Locator Addressing: draft-mueller-ila-mobility-02
- Use of BGP for dissemination of ILA mapping information: draft-lapukhov-bgp-ila-afi-02

ILA BOF 22nd February 18:10 – 19:10



LISP Control Plane with ILA User Plane

- LISP Control-Plane (RFC6833bis)
  - Supports many data planes: ILA, SRv6, VXLAN, LISP, GTP, …
  - Mature mapping control-plane (10+ years) with large deployments
  - Mobility, traffic engineering, multihoming…
- ILA Data-Plane (draft-herbert-intarea-ila)
  - Address transformation (no encapsulation)
- **LISP Control-Plane with ILA Data-Plane**
  - **No ILA or LISP architectural changes**
  - **IETF draft for LISP+ILA specific details**
    - **draft-rodrigueznatal-ila-lisp**



Next Steps

- This draft aims to provide a useful comparison among different contending options. Work will continue on roaming, charging, security, scalability, etc aspects.
- We would like to encourage interested members to work with us in an accelerated pace to complete this work in accordance with the deadlines put forward by 3GPP.
- We would like to ask the DMM WG to adopt the draft and incorporate it as part of the response back to 3GPP.
  - To attach this ongoing work to a formulated response LS back to CT4 and SA2.
  - Seek cooperation from interested teams in 3GPP to work with us in further development of this draft into a useful document to 3GPP.
  - Propose joint 3GPP-IETF meetings (CT and SA2).

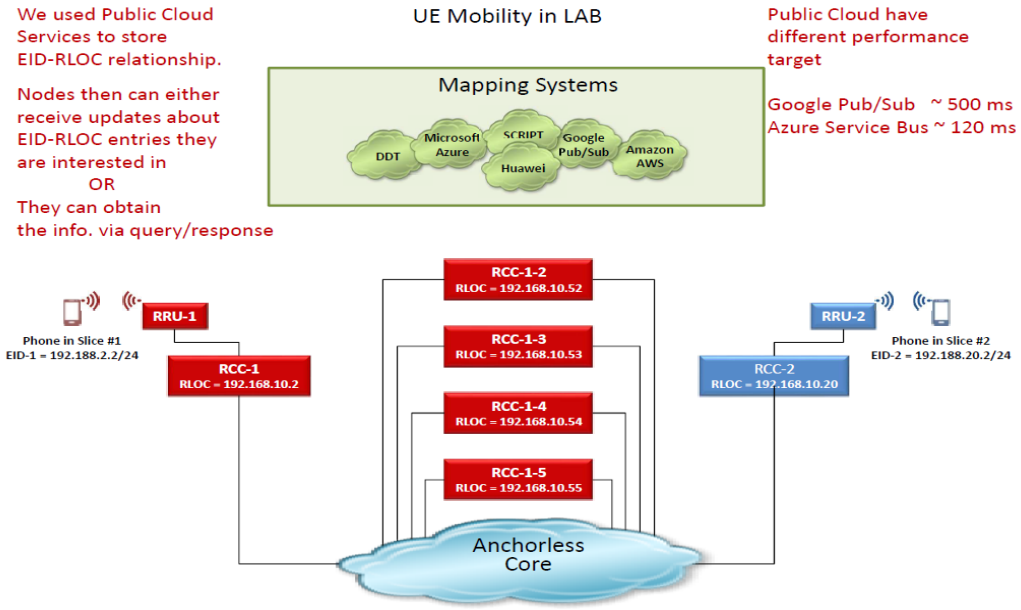
Backup Slides

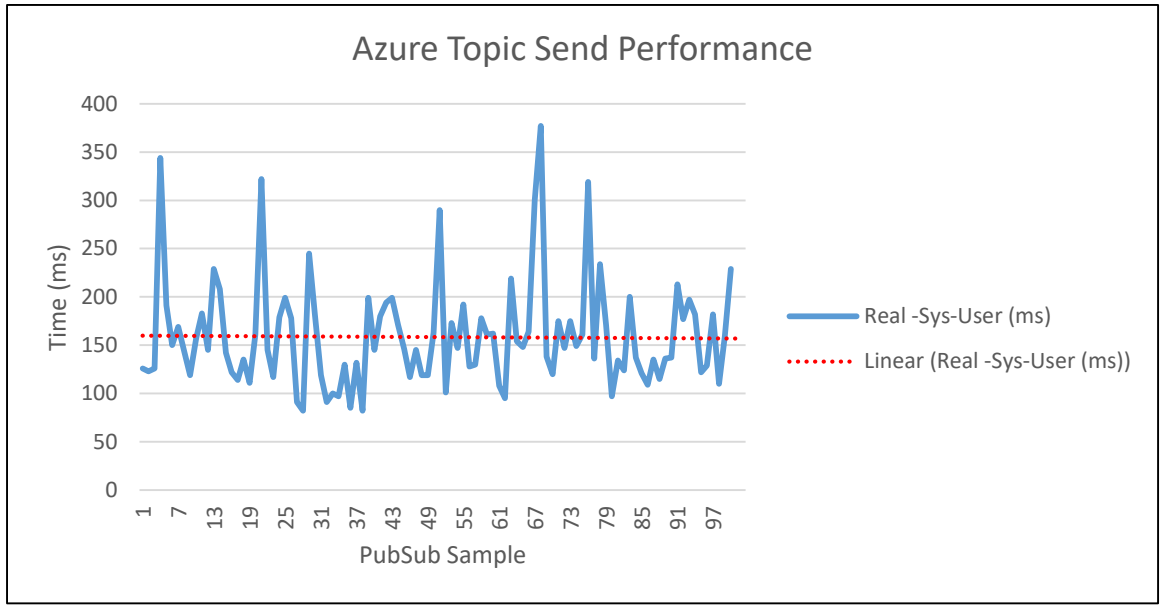
Some Test Results

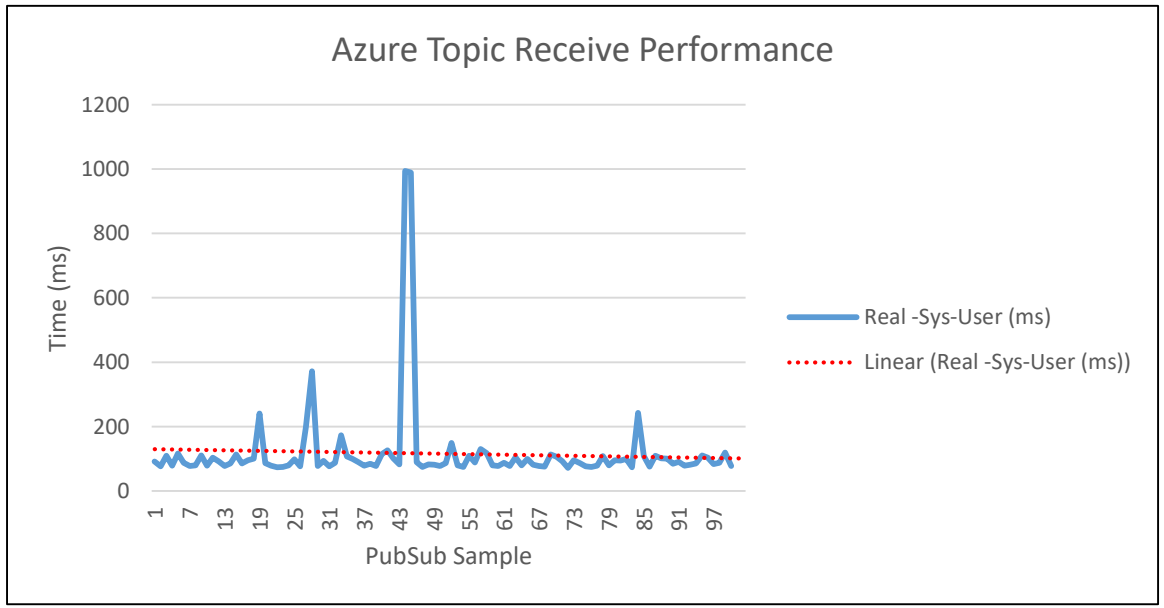
Employed open source LTE in conjunction with public Cloud Pub/Sub service to demonstrate enhanced mobility and anchorless mobile core

These sort of distributed databases show very promising results for distributing ID/LOC relationship.

The performance can be further improved as public services are design to move large data. We deal with much smaller data for ID-LOC.







LISP Control-Plane for other Data-Planes

LISP-MS Site Information:

Site Name	EID-Prefix or (S,G)	Registered	Last Registerer	Last Registered	First Registered	Registration Flags
SRv6	[1545]	(ams)	--	never	never	--
	[1545]'facebook'	yes (dynamic)	[0]127.0.0.1	0:00:19	3:57:26	p-s-I-t-r-m-n
	[1545]2001:5:face:b00c::/64	yes (dynamic)	[0]127.0.0.1	0:00:19	3:57:26	p-s-I-t-r-m-n
	[1545]'google'	yes (dynamic)	[0]127.0.0.1	0:00:19	3:57:26	p-s-I-t-r-m-n
	[1545]2001:5:6006:1e00::/64	yes (dynamic)	[0]127.0.0.1	0:00:19	3:57:26	p-s-I-t-r-m-n
ila	[1540]	(ams)	--	never	never	--
	[1540]2001:5:face:b00c::1/128	yes (dynamic)	[0]127.0.0.1	0:00:19	3:57:26	p-s-I-t-r-m-n
	[1540]2001:5:face:b00c::2/128	yes (dynamic)	[0]127.0.0.1	0:00:19	3:57:26	p-s-I-t-r-m-n
	[1540]'facebook-sir-prefixes'	yes (dynamic)	[0]127.0.0.1	0:00:19	3:57:26	p-s-I-t-r-m-n

ILA SIR-Prefix

IPv6 EID

ILA Locator

SRv6 SIDs

Mapping System - References

- Scalability
  - LISP Delegated Database Tree (LISP-DDT) - RFC8111
  - Jakab, Loránd, et al. "LISP-TREE: a DNS hierarchy to support the lisp mapping system." *IEEE Journal on Selected Areas in Communications* 28.8 (2010): 1332-1343.
  - Mathy, Laurent, and Luigi Iannone. "LISP-DHT: Towards a DHT to map identifiers onto locators." *Proceedings of the 2008 ACM CoNEXT Conference*. ACM, 2008.
  - Hoefling, Michael, Michael Menth, and Matthias Hartmann. "A survey of mapping systems for locator/identifier split internet routing." *IEEE Communications Surveys & Tutorials* 15.4 (2013): 1842-1858.
- Security
  - LISP-Security (LISP-SEC) - draft-ietf-lisp-sec-14
  - LISP Threat Analysis – RFC7835
  - LISP Control-Plane ECDSA Authentication and Authorization - draft-farinacci-lisp-ecdsa-auth-01
- Privacy
  - LISP EID Anonymity - draft-ietf-lisp-eid-anonymity-01
  - Rodriguez-Natal, Alberto, et al. "Location and identity privacy for LISP-MN." *Communications (ICC), 2015 IEEE International Conference on*. IEEE, 2015.