Optimized Mobile User Plane Solutions for 5G

draft-bogineni-dmm-optimized-mobile-user-plane-01.txt

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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
- The new revision of the draft has gone through many reviews conducted over multitude of conference calls and online discussions.
- Comments from IETF 101 meeting in London have also been reflected into the new version of the draft.
- Several protocol candidates in IETF: SRv6, LISP, ILA, Hybrid-ICN, etc.
- Document prepared as submission to CT4 for consideration draft-bogineni-dmm-optimized-mobile-user-plane-01.

Overview of updates

- Overview of updates
  - Focus of 5G architecture only on mobility management parts
  - Roaming architectures: policy aspects; details on LBO and Home Routed
  - Support for different mobility protocols within same operator network using 5G network slices
  - Roaming architectures when operators use different mobility management protocols on N9
  - Data Plane architecture models for N9: Locator based; Locator-ID based; ID-based
  - Reviewed approaches: add tree in Section 5.2

Reviewed Approaches for Mobility Management

The document discusses the ability to introduce several approaches for mobility management, some able to provide anchor-less mobility management, useful in some of the mentioned use cases. The user plane architectures for UPF connectivity fall into two broad categories:

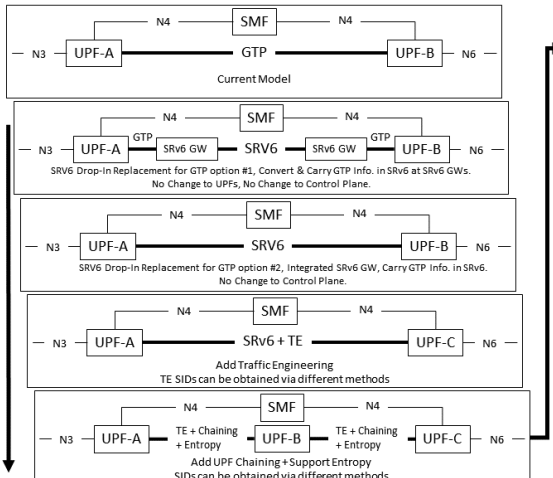
- Interworking
  - This model uses GWs.
  - UPFs and 3GPP control remain unchanged.
  - 3GPP user plane becomes an overlay on top of the new user plane.
  - GWs convert GTP traffic to underlying user plane format.
- Integrated
  - In this model UPFs transmit/receive packet in accordance with the new user plane format.
  - UPFs and 3GPP control are modified.
  - 3GPP and transport user plane are collapsed into one user plane.

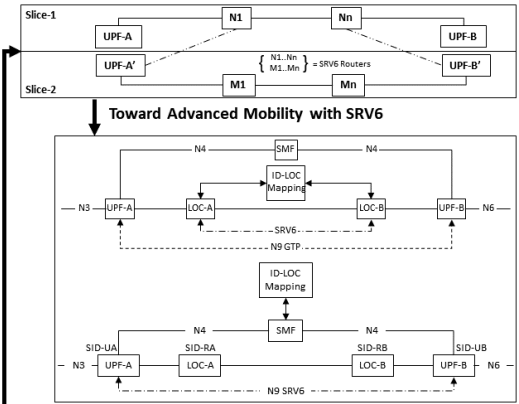
The draft also made an attempt to classify different approaches based on forwarding and mobility paradigm The following shows the first pass at such a classification which still requires further study.

- Locator-based
  - Tunnelling, 3GPP / GTP-U, Packet steering, SRv6 (backward-compatible)
- Loc/ID split
  - Packet steering: SRv6
  - Encapsulation: LISP
  - Address rewrite: ILA
- ID-based
  - Hybrid-ICN

The draft also discusses an approach that takes advantage of Up Link Classifier (ULCL) to allow coexistance of new user plane proposals with today's GTP based user plane.

SRv6: A Smooth Transition & Pragmatic Approach to Change N9

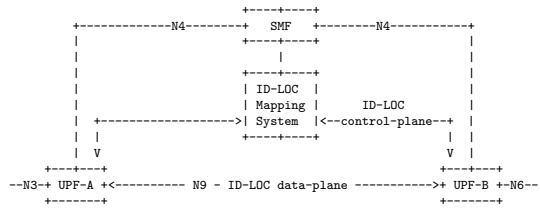




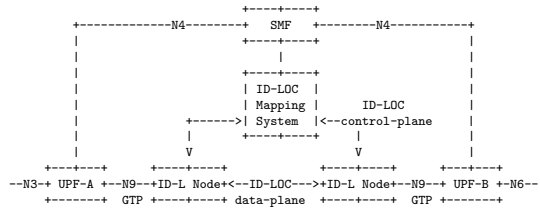
1. Drop in SRV6 to replace GTP-U in data plane without changing the control plane.
2. Gradually introduce SRV6 features as needed.
3. Optionally add advanced mobility support either at global, 5G slice level, or for a particular set of flows

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
    - draft-farinacci-lisp-mobile-network
- **LISP Data-Plane (RFC6830bis)**
  - Uses dynamic tunnel encapsulation
  - Fixed headers (16 bytes) are used between outer and inner IP headers
- **LISP Control-Plane for ILA**
  - draft-rodrigueznatal-ila-lisp
- **LISP Control-Plane for SRv6**
  - draft-rodrigueznatal-lisp-srv6



Integrated



Interworking

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-01
- Identifier Locator Addressing Mapping Protocol: draft-herbert-ila-ilamp-00
- Identifier Locator Addressing for Mobile User-Plane: draft-herbert-ila-mobile-01
- Identifier groups: draft-herbert-idgroups-00
- Mobility Management Using Identifier Locator Addressing: draft-mueller-ila-mobility-03
- Use of BGP for dissemination of ILA mapping information: draft-lapukhov-bgp-ila-afi-02

ID-native > Hybrid-ICN Anchorless Mobility Management (hICN-AMM)

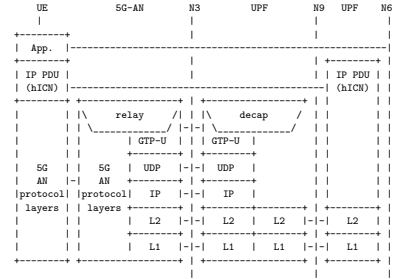
Hybrid ICN mobility management overview

- Routable, location-independent identifiers (ID) [draft-vonhugo-5gangip-ip-issues-03]
  - NO address overloading, NO data plane anchor
  - NO mapping system, NO control plane anchor
- Hybrid-ICN: an ICN communication model within IPv6 [draft-muscariello-intarea-hicn]
  - native consumer mobility; lightweight FIB update for producer
  - ICN benefits for mobility [RFC7476] including:
    - multi-source/multi-path/hetnet support
    - fine-grained forwarding and security policies
    - low-latency, multicast (in-path caching)
    - network-assisted transport
- MAP-Me : a pure-ID mobility management scheme [draft-irtf-icnrg-mapme]
  - ensuring connectivity through **data plane** mechanisms
  - using data plane messages [Lui et al, NSDI'13]

Drafts

`draft-auge-dmm-hicn-mobility-00`
`draft-auge-dmm-hicn-deployment-options-00`

GTP replacement on N9 (N9+N3)

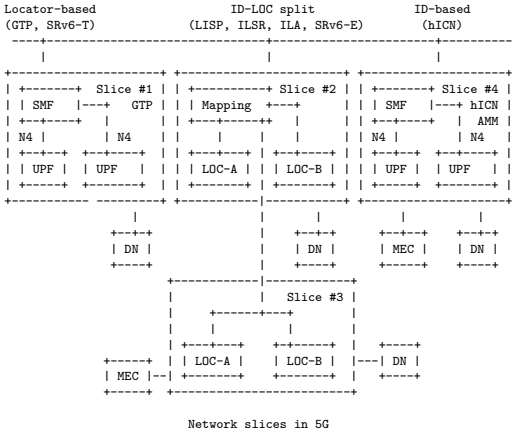


Deployment options

- Partial deployment on few selected nodes
  - transparent for IPv6 nodes
  - eventually exploiting SRv6 DP in between
- full-benefits with hICN on endpoints, or proxy
- benefits of ID-native by replacing N9 (+N3)
  - even for non-hICN traffic
- alternative hICN insertion in MEC/UPF
  - transport benefits

Network Slicing in 5G

The ability to support several mobility management protocols to fit different use cases using 5G slicing.



Network slices in 5G

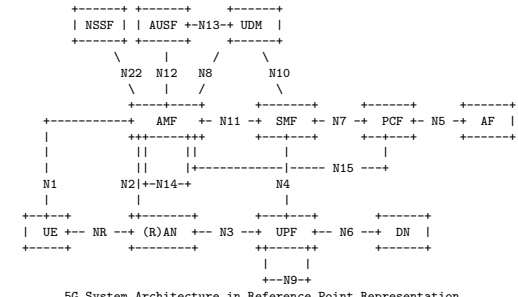
Next Steps

- Feedback from 3GPP CT4

Backup Slides

3GPP Release 15 5G NGC Architecture

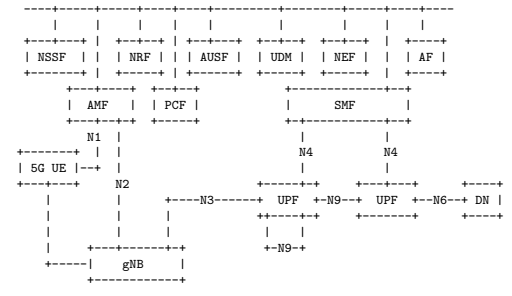
Non-Roaming Architecture: Reference Point Representation



5G System Architecture in Reference Point Representation

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

Non-Roaming Architecture: Services Based Interfaces

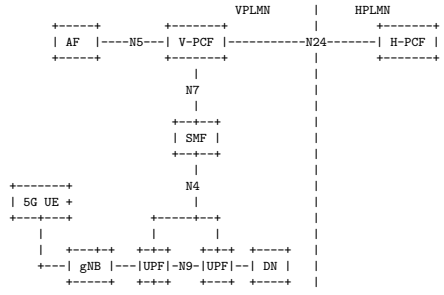


5G Service Based Architecture

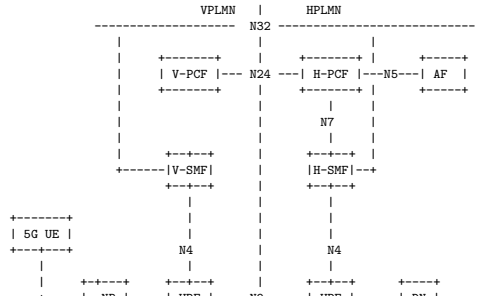
PCF: Policy Control Function
SMF: Session Management Function
UDM: Unified Data Management
UPF: User Plane Function
AF: Application Function
UE: User Equipment
RAN: (Radio) Access Network

Roaming Architectures

- Acronymns:
  - HPLMN: Home Public Land Mobile Network
  - VPLMN: Visited PLMN
- Definitions (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

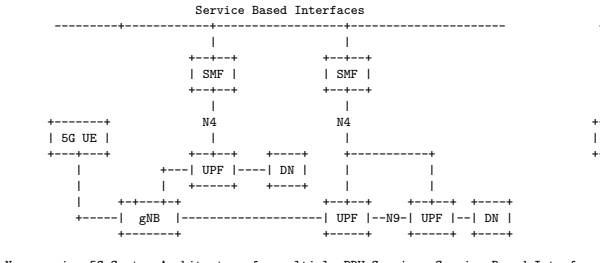


Roaming 5G System Architecture - Local Breakout Scenario

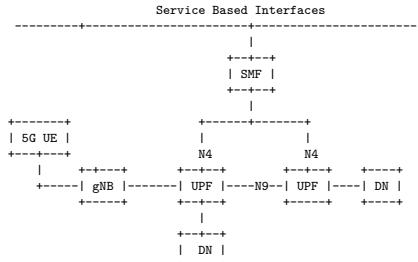


Roaming 5G System Architecture - Home Routed Scenario

Sample Configurations for Access to Two DNs



Non-roaming 5G System Architecture for multiple PDU Sessions Service Based Interface



Requirements

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