Transport Network aware Mobility for 5G

draft-clt-dmm-tn-aware-mobility-01

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DMM WG, IETF 102, Montreal
July 17th, 2018.

Background

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REL15: TS23.501/502 specify 5G architecture and procedures for gNB mobility, which is similar to 4G mobility scenarios. These specifications also specify new mobility scenarios which are specific to 5G, viz., UPF mobility.

Problems

1. With various SSTs (eMBB, URLLC, MIOT) and different traffic characteristics
    - needing low and deterministic latency, real-time, mission-critical or networked AR/VR on 5G networks.
    - However with current approach, it is difficult to provide SLA guarantees for the above, in various 5G procedures including mobility.
    - This is mostly because 5G architecture focused only on Radio Access Network and Core Network and backhaul transport network is not seen in an integrated fashion.
2. An under specified mapping function from PDU session to transport network paths. Where multiple technologies are possible in transport network to create the transport path.

Objectives

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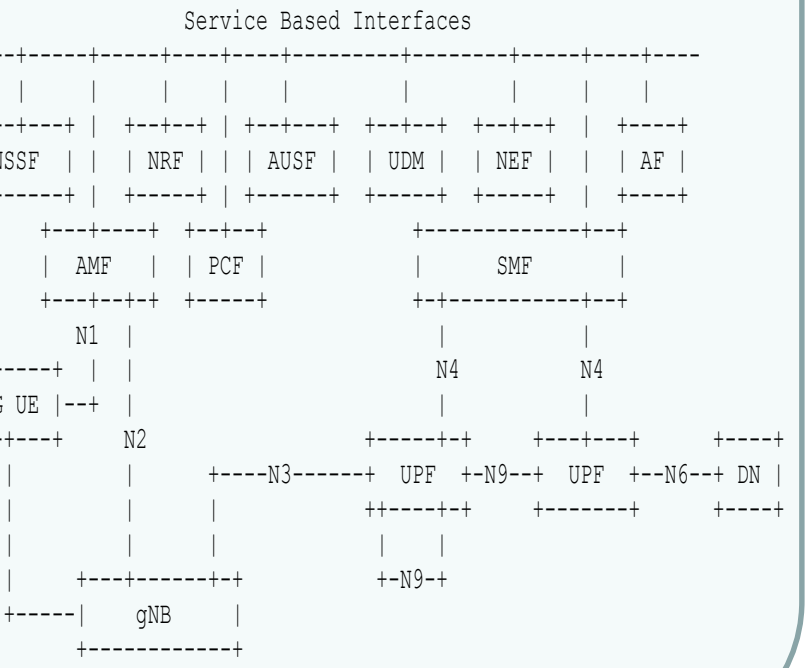
- Creating a reference architecture to integrate the transport backhaul network in 5G Service based Architecture.
- Providing a clear mapping function to integrate the PDU session to the underlay TE paths, which can be established with various IETF transport technologies.
- Describe how Preferred Path Routing (PPR) [I-D.chunduri-lsr-isis-preferred-path-routing] fits into this framework in various Session and Service Continuity (SSC) Modes.
- Also discuss how new IETF mobility technologies can be leveraged with undelay backhaul transport

Notes

- The approach specified does not change existing N3 user plane encapsulation
- And it can work with any encapsulation (including GTP-U) for the N9 interface

5GS with Integrated Transport Network Function

- TS 23.501 defines the above architecture where all control plane functionalities are virtualized and a pub/sub approach is used to advertise and consume services through a service based interface.
- It also introduces a new interface called N9 between 2 UPFs

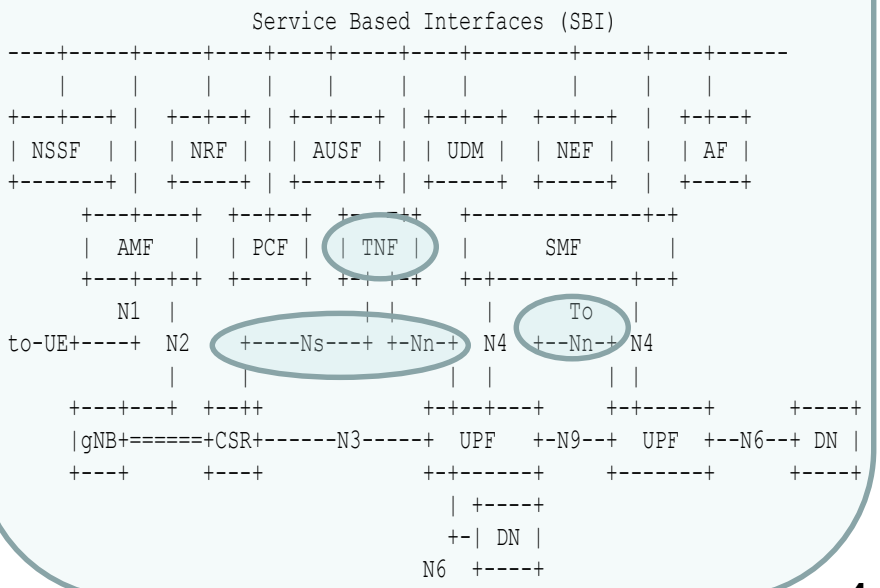


Discrete approach:

- Underlying transport network path setup, Life cycle management independent of 5G RAN and 5GC.
- This only gives limited benefits and is being done today for 4G/LTE deployments

Integrated Approach:

- a new control plane function, Transport Network Function (TNF) in the 5G CP
- This has the view of the underlying transport network (on N3 and N9 interfaces) with all links and nodes as well as various possible underlay paths with different characteristics (from gNB to UPF).



TNF Functionalities

With the TNF in 5GS SBI the following additional functionalities are required:

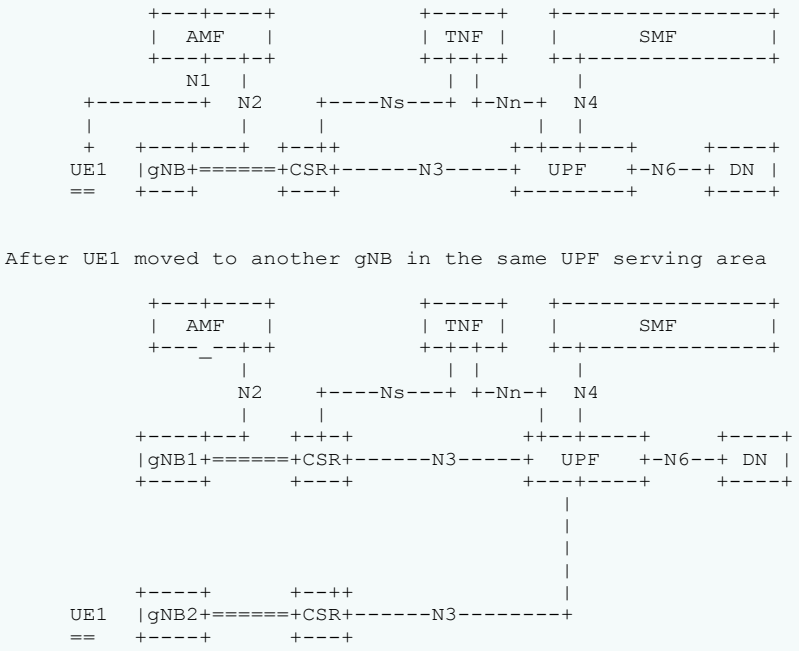
- ✓ In the Network Slice Selection Assistance Information (NSSAI) PDU session's assigned transport VPN and/or the TE path information is needed.
- ✓ For transport slice assignment for various SSTs (eMBB, URLLC, MIoT) corresponding underlay paths need to be created and monitored from each transport end point (gNB/CSRs and UPFs).
- ✓ During PDU session creation, apart from radio and 5GC resources, transport network resources needed to be verified matching the characteristics of the PDU session traffic type.
- ✓ Mapping of PDU session parameters to underlay SST paths need to be done.
  - For Uplink(UL): One way to do this is through 5QI/QFI information in the GTP-U header and map the same to the underlying transport path (including VPN or PW).
  - For Downlink(DL): RQI from the encapsulated (GTP-U/chosen-N9-encap) DL packet to one of the underlay paths at the UPF.
- ✓ During UE mobility: gNB mobility (Xn based or N2 based), for target gNB selection apart from radio resources, transport resources MUST be factored.

Backhaul Transport Underlay

- Above framework is applicable with RSVP-TE (**Underlay:** MPLS)
- Applicable for SR (**Underlay:** MPLS or IPv6 with SRH)
- with PPR (**Underlay:** SR supported user planes with optimizations + Native IP Support)
  - What is Preferred Path Routing (PPR): [I-D.chunduri-lsr-isis-preferred-path-routing]
  - For SR data planes PPR provides 2 key benefits
    - low transport path overhead
    - TE characteristics with specified bandwidth, Latency and burst rate support, which can be signaled along the path [I-D.draft-cls-ppr-resources-00].
  - For 3 different SSTs 3 PPR-IDs can be signaled from any node in the network.
    - For UL gNB will choose the right PPR-ID of the UPF based on the 5QI vale.
    - Similarly in the DL direction right PPR-ID of the gNB is chosen.
  - More details in the draft.

TNF role in Various SSC Modes

SSC Mode1

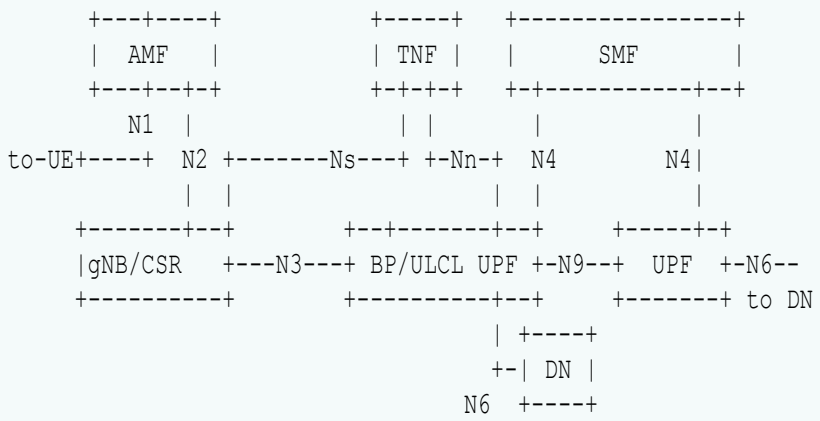


- During Xn mobility, AMF has to ensure respective transport resources from TNF are available at the target gNB.

SSC Mode2

- For PDU Session, Service Request and Mobility cases mechanism to select the transport resource and appropriate PDU is similar to Mode 1.

SSC Mode3



- Respective transport path on N3 and N9 has to be selected with appropriate transport characteristics from TNF.
- For N2 based mobility AMF/SMF has to ensure transport resources are available for N3 Interface to new ULCL UPF and from there to the original anchor point UPF.
- For Service continuity with multi-homed PDU session same transport network characteristics of the original PDU session (both on N3 and N9) need to be observed for the newly created PDU session.
- More details in all 3 modes in the draft.

New Mobility Paradigms

- How to integrate LISP in 3GPP is discussed in https://tools.ietf.org/html/draft-farinacci-lisp-mobile-network-03
    - This offers a highly scalable solution with session survivable mobility (not merely service continuity)
- Other novel mobility management with low transport overhead is also briefly discussed.
- Only Traffic Engineering characteristics needed in the transport network for the above approaches are briefly discussed in the draft.

Summary

- This draft specifies a reference architecture to integrate the transport backhaul network in 5G Service based Architecture.
    - Maintains the independence of any PDU session type (IPv4, IPv6, IPv4v6, Ethernet, Unstructured) to ← →any underlay backhaul transport network (IPv4, IPv6, MPLS) deployed

- Provides a clear mapping function to integrate the PDU session to the underlay TE paths, which can be established with various IETF transport technologies.

Next Steps:

- Seeking comments and suggestions

Thank you!