Discussions on Integrating AN and UPF

draft-zzhang-dmm-mup-evolution-06

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Basic Idea

• In 5G, UPFs are more and more distributed close to gNB-CU (AN)
  • For MEC, private networks, or local Internet peering
  • Could be co-located – with direct link in between or even running on the same server
  • Distributed UPF means distributed DNs – implemented as VPNs

• In B5G/6G, what if AN and UPF are integrated into a single NF (ANUP)?
  • A flattened, routing/switching-based architecture
    • ANUP is a router/switch with wireless/wired connections
      • Foundation of Internet
    • 3GPP/wireless technologies responsible for wireless access
      • Mobility Management, UE authentication/authorization, ...
    • IETF/wireline technologies for the rest
UE1 → RU1 → DU1 → CU1 → UPF1

UE IP/Ethernet traffic on top of radio stack

UE IP/Ethernet traffic in GTP-U tunnel

UE2 → RU2 → DU2 → CU2 → UPF2

Relay

Transport

Local DN

PE1

VRF1

VRF2

PE2

VRF1

VRF2

PE3

VRF1

VRF2

Central DN

3

UE1 → RU1 → DU1

UE IP/Ethernet traffic on top of radio stack

Transport

Local DN

PE1

VRF1

VRF2

PE2

VRF1

VRF2

PE3

VRF1

VRF2

Central DN

3

UE2 → RU2 → DU2
Disclaimer

• The work needs to be done in 3GPP

• We’re discussing here to socialize the idea among IETF/wireline-friendly people

• Yes, we are getting more interests and/or supports among mobile operators. The 3GPP Rel-19 planning is on-going. We are considering to bring it to 3GPP for further study (Rel-19 & 6G planning)
Discussion Points: IETF-116 => 117 (San Francisco)

- I.D. changes: draft-zzhang-dmm-mup-evolution-04 => 06

I.D. contents updated to add in:
- 3GPP ‘ANUP-like’ work in 4G : Local IP Access (LIPA)
  - bodes well for 5G (B5G, 6G)
- ANUP-like work will benefit some high-profile use cases, e.g. 3GPP Satellite-Access
LIPA enables a UE connected via a HeNB to access DN network without the user plane traversing the mobile operator's network.

The local IP access (LIPA) feature is achieved using a local-GW (L-GW) collocated with the HeNB.

The functionalities of HeNB and L-GW are integrated to provide the direct UP path between the HeNB and the L-GW; there is NO interface between HeNB and L-GW. **ANUP-like integration**
I.D. Updated: 3GPP Satellite Access

Satellite Network for 3GPP Wireless Access

UE: User Entity
GS: Ground Station

UE/GS via Satellite-based Mobile Access Network
1. **3GPP SA2 Satellite Access (Ph2, Rel-18, Completed)**
   - To support the satellite-based wireless access under the discontinuous coverage:
     - gNB on board-SAT while UPF may or may not on the ground (i.e., on-board SAT)
     - UEs have to remain with no service or attempt to re-register during discontinuous coverage; reduce the signaling impact to target RAT or system
     - Enhance power saving mechanisms, e.g. PSM, MICO and eDRX, etc., to optimize the discontinuous coverage (NO attempt PLMN access w/o network coverage; attempt as needed otherwise)

2. **3GPP SA2 Satellite Access (Ph3, Rel-19, Planning)**
   - Use-case study on service requirements via satellite access taking into account 5G new capabilities:
     - gNB on board-SAT while UPF may or may not on the ground (i.e., on-board SAT)
     - UE-to-UE communication via satellite(s) without going through the ground network
     - UE LAN using satellite access
     - Store and forward satellite operation for delay-tolerant communication services

  Reduced complexity & simplified control if both gNB & UPF are **collocated** on Satellite(s).
Discussion Points across IETFs: IETF-114,115,116 & 117

• Simplified & Reduced signaling w/ optimized data plane
• ULCL I-UPF for MEC case : local breakout (LBO)
• NAT with overlapping private address spaces in different regions
• Increased burden on more complicated AN; QoS handling
• Routing, VPN PE in ANUP
• Mobility Handover: The scenario of distributed UPFs (i.e., dUPFs, being co-located with ANs) and the handover procedures for dUPFs (not integrated with ANs) apply to ANUP transparently as well.
• Paging: For UEs in power-saving mode (PSM), or eDRX, MICO, etc., downlink messages could be processed more efficiently via msg buffering, paging, transmitting, under the ANUP framework.
• Microservice architecture: discussed the pros and cons along with the justification to champion ANUP (UP vs. CP)
• Existing similar work in LTE: Local IP Access (LIPA)
• Use case discussion: Satellite scenarios will benefit from the ANUP-like scheme.
• And more ......
Summary & Next Steps:
• Really appreciate the comments
• Will continue to discuss with more mobile architects and update the draft accordingly

Boosted by 3GPP already:
• 3GPP 4G LIPA work bodes well for 5G (B5G, 6G) ‘ANUP-like’ proposal
• The 3GPP Rel-19 planning (5G) is on-going. We are considering to bring it to 3GPP for further study (Rel-19)
• The 3GPP Rel-20 (6G roadmap) targets toward the beginning of Y-2025, a perfect timing for exploration and even adoption of the ANUP-like work

WG Adoption?