BGP Signaling for 5G ANUP

Jeffrey Zhang, Keyur Patel

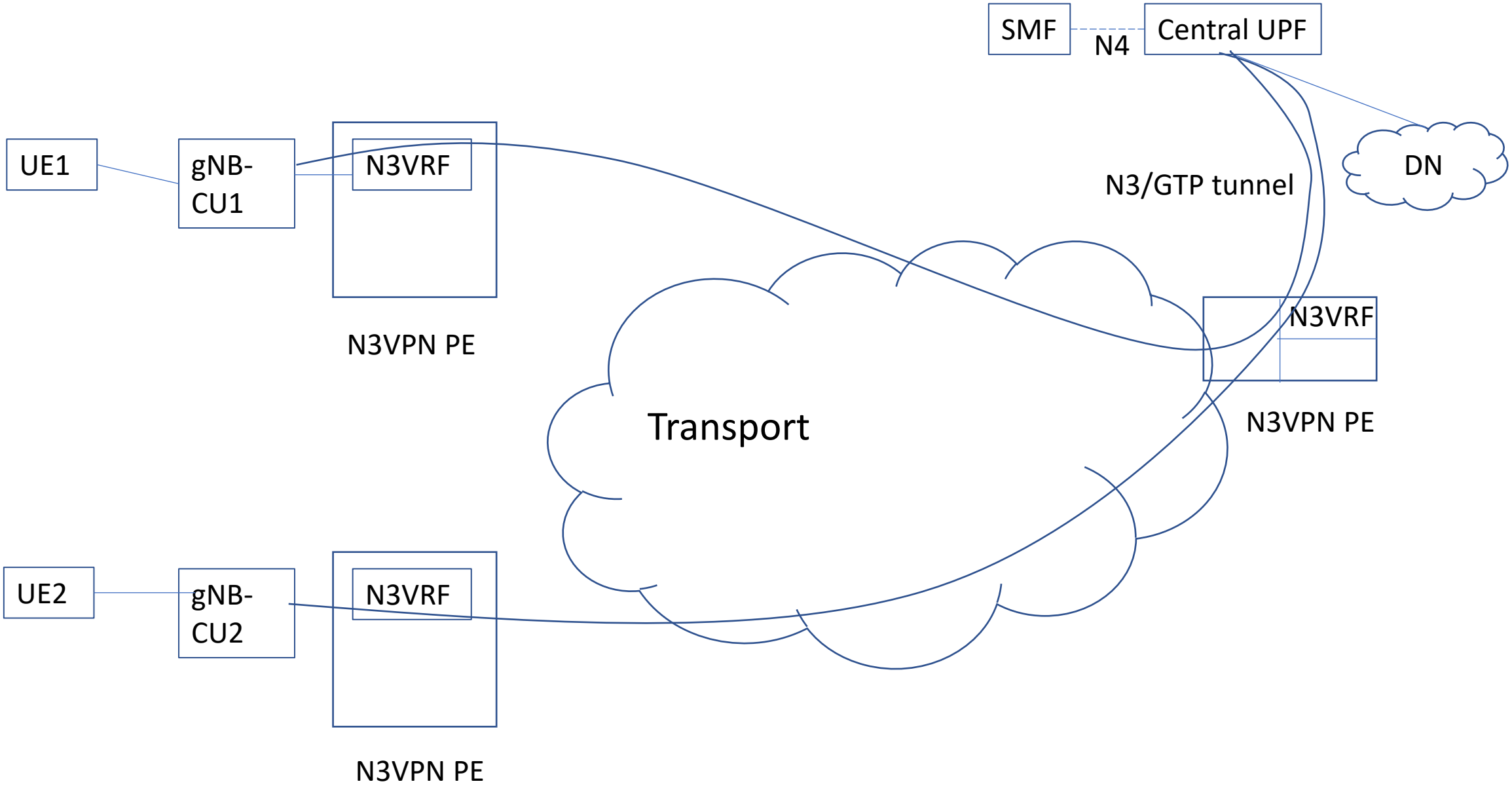
DMM, IETF117

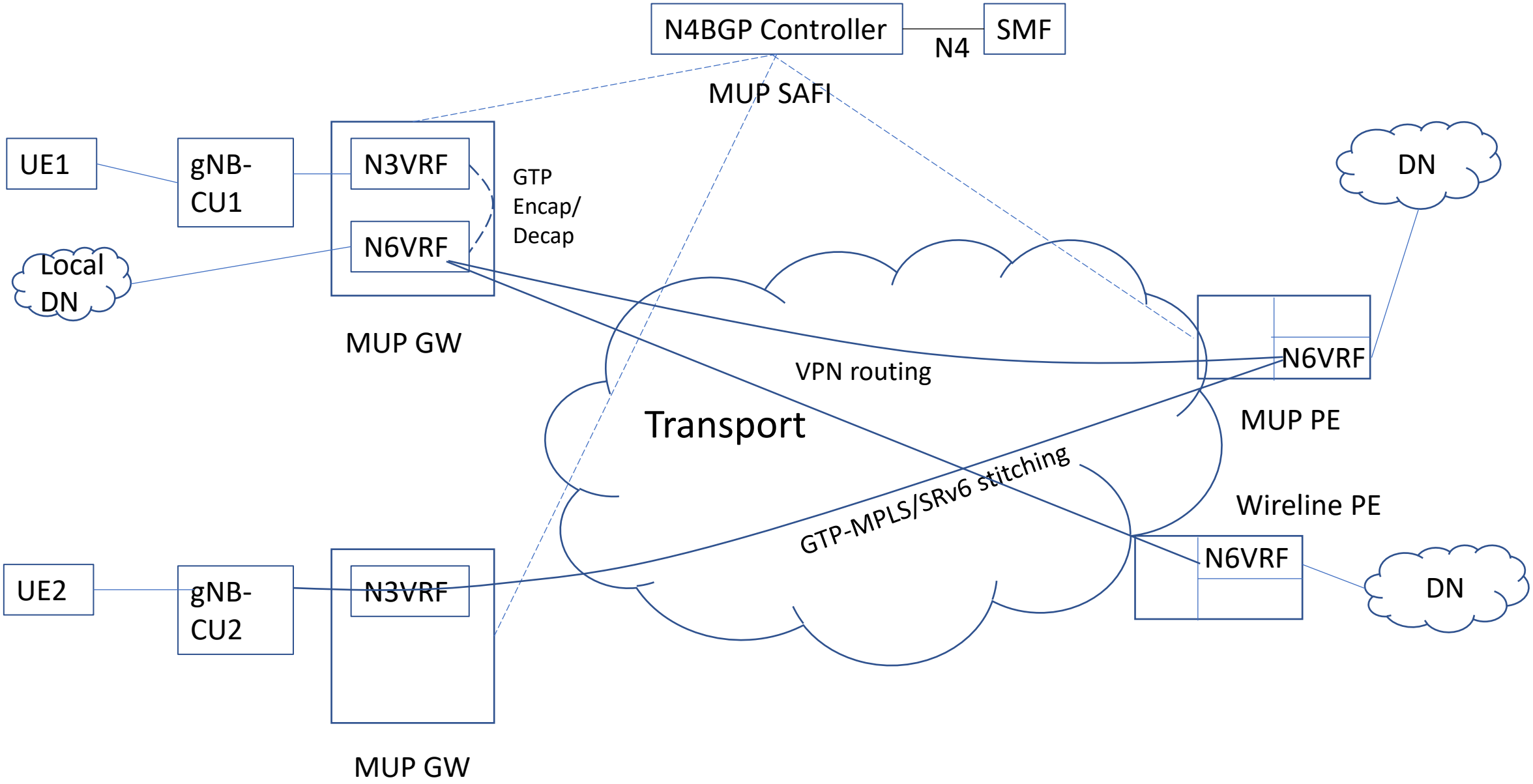
ANUP - Integrated AN-UPF

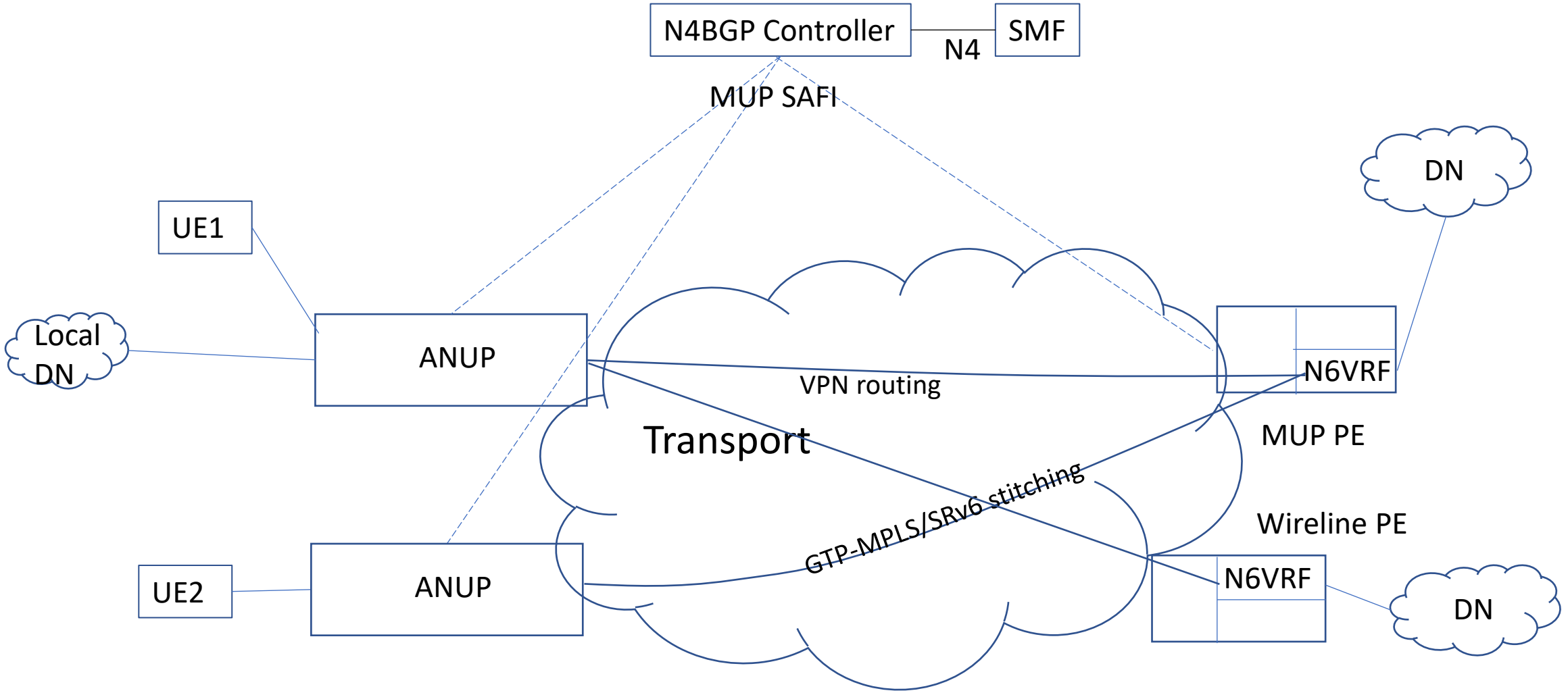
- Co-located AN (gNB-CU) and UPF integrated into a single ANUP
  - No N3 tunneling – optimized data plane
  - No signaling needed for the N3 tunnel – reduced/simplified signaling
    - Only with signaling changes in 6G – referred to as ***6G ANUP***
- N3 tunneling can be removed in 5G w/o signaling changes
  - Referred to as ***5G ANUP***
  - ANUP with separate 5G N2/N4 signaling
    - Implementation might already exist
    - When it realizes that the AN and UPF addresses are the same local one, it skips the GTP
  - Alternatively, N4 can be replaced by BGP signaling as in MUP-GW architecture

MUP GW Architecture

- A previously central UPF is replaced by a collection of <N4BGP Controller, MUP GW, MUP PE>
  - “under the hood” – no 3GPP architecture/signaling changes
    - AN still does N3/GTP tunnel to a central UPF address
    - SMF still does N4 signaling to a central UPF address
      - which is actually the N4BGP controller
      - N4BGP controller translate N4 signaling to BGP signaling (to MUP GW and MUP PEs)
- MUP GW is the N3VPN PE connected to the AN
  - N3VPN provides IP transport for the N3 tunnel
  - N6VPN connects distributed sites of a DN
  - UL traffic in N3/GTP tunnel is decap’ed in the N3VRF and directed to the N6VRF for routing to local or remote VPN sites
  - DL traffic arrives at N6VRF via normal VPN routing, then routed to local DN or UEs (with GTP encap)


SMF
N4
Central UPF
DN
UE1
gNB-CU1
N3VRF
N3/GTP tunnel
N3VPN PE
N3VRF
N3VPN PE
Transport
UE2
gNB-CU2
N3VRF
N3VPN PE


N4BGP Controller
N4
SMF
MUP SAFI
UE1
gNB-CU1
N3VRF
N6VRF
GTP Encap/ Decap
Local DN
MUP GW
DN
VPN routing
Transport
N6VRF
MUP PE
GTP-MPLS/SRv6 stitching
Wireline PE
UE2
gNB-CU2
N3VRF
N6VRF
DN
MUP GW


N4BGP Controller
N4
SMF
MUP SAFI
DN
UE1
Local
DN
ANUP
VPN routing
N6VRF
Transport
MUP PE
GTP-MPLS/SRv6 stitching
Wireline PE
UE2
ANUP
N6VRF
DN

BGP Signaling for MUP GW

- PDU Session information signaled via N4 is translated to two route types
  - Of a new BGP SAFI
- Session Translated Route Type 1 (ST1)
  - NLRI encodes <UE prefix, AN address, AN TEID>
  - Imported by MUP GW into N6VRF due to N6VPN Route Target
    - UE prefix routes point to NHs that does GTP encapsulation based on AN address and TEID
  - Imported by MUP PE into N6VRF
    - UE prefix routes point to NHs to do one of the following:
      - Direct traffic to an N6VRF on a MUP GW for routing to UEs
      - Direct traffic to a MUP GW that does GTP encap w/o routing in N6VRF
        - Using SRv6 SID and SRH with <AN address, TEID> encoded, or,
        - Using an MPLS label stack with a GTP header (w/o IP/UDP header)
- Session Translated Route Type 2 (ST2)
  - NLRI encodes <UPF address, UPF TEID>
  - MUP GW installs forwarding state in N3VRF to do GTP decap and direct traffic to N6VRF
    - Based on an Extended Community derived from (and maps to) the Route Target for the N6VPN

BGP Signaling for 5G ANUP

- ST1/ST2 routes go to ANUPs instead of MUP GWs
- The TEID in ST1 routes is originally assigned by the AN for a PDU session
  - Matching on the received TEID against ANUP's assignment record causes the UE prefix routes in N6VRF to have a NH corresponding to the PDU session for DL traffic
- The TEID in ST2 routes is assigned by the controller on behalf of UPF for a PDU session, and it is also signaled to the AN via N2
  - Matching on the TEID in N2 and ST2 allows the ANUP to direct UL PDU traffic to the corresponding N6VRF (identified by the EC derived from the N6VPN)
- No GTP encap/decap is used

Comments Appreciated!