

Discussions on Integrating AN and UPF

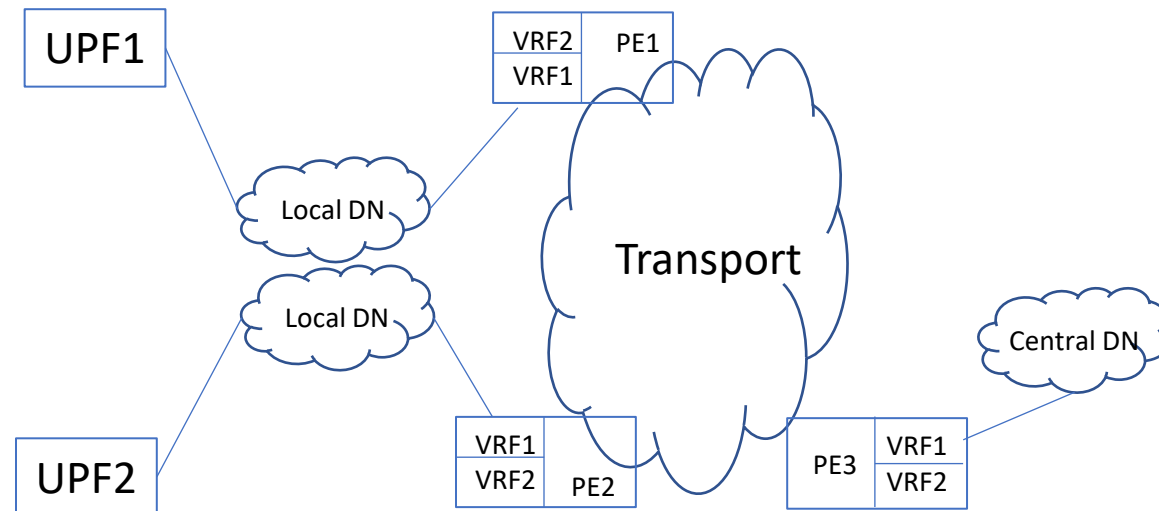
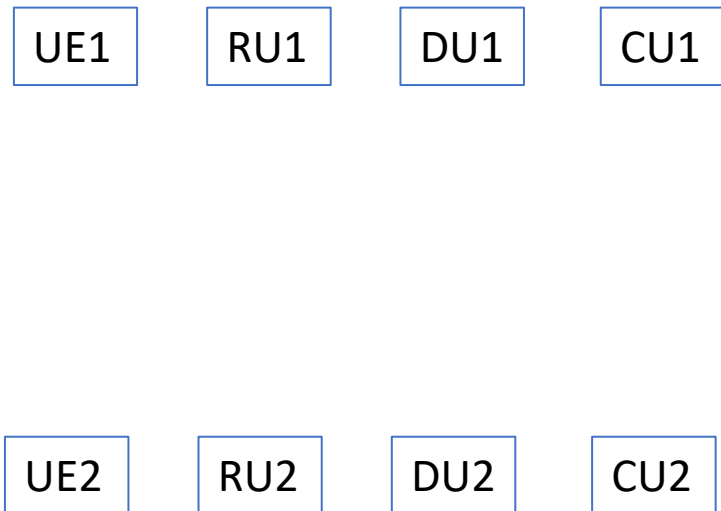
draft-zhang-dmm-mup-evolution-02

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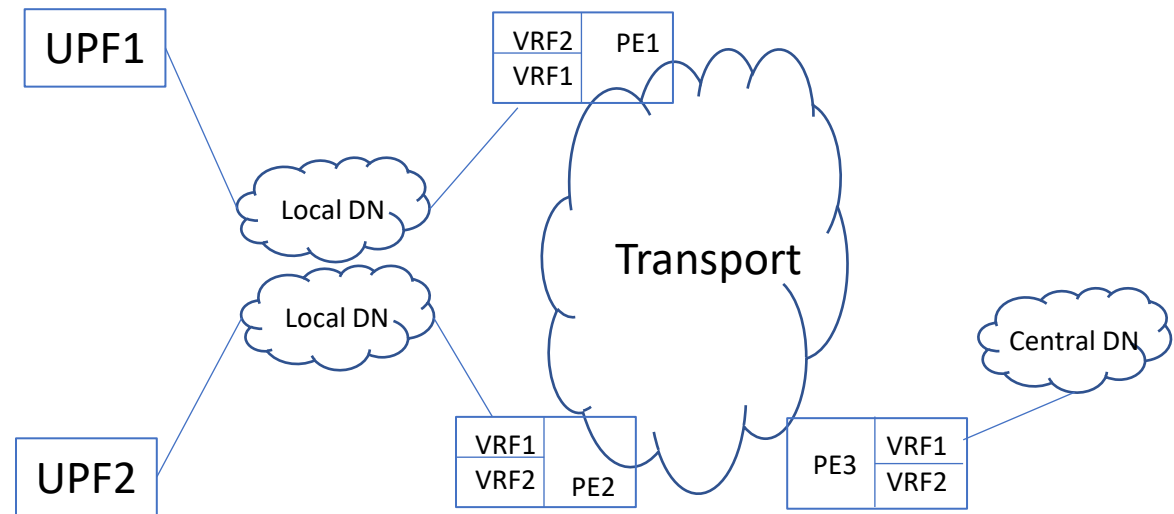
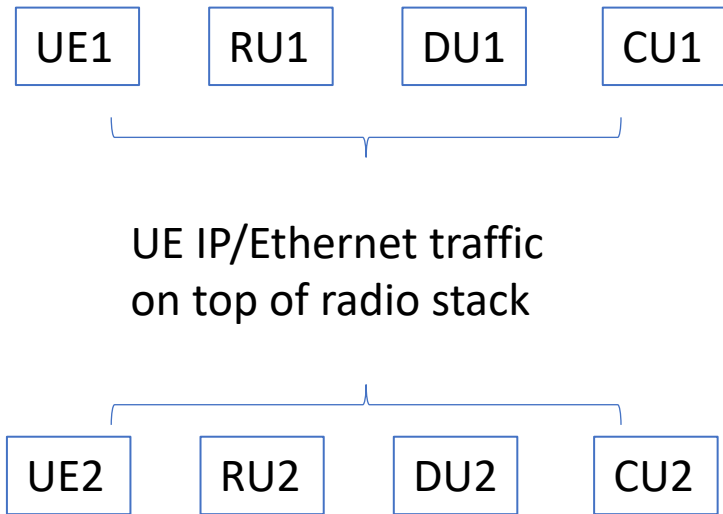
IETF 115, London

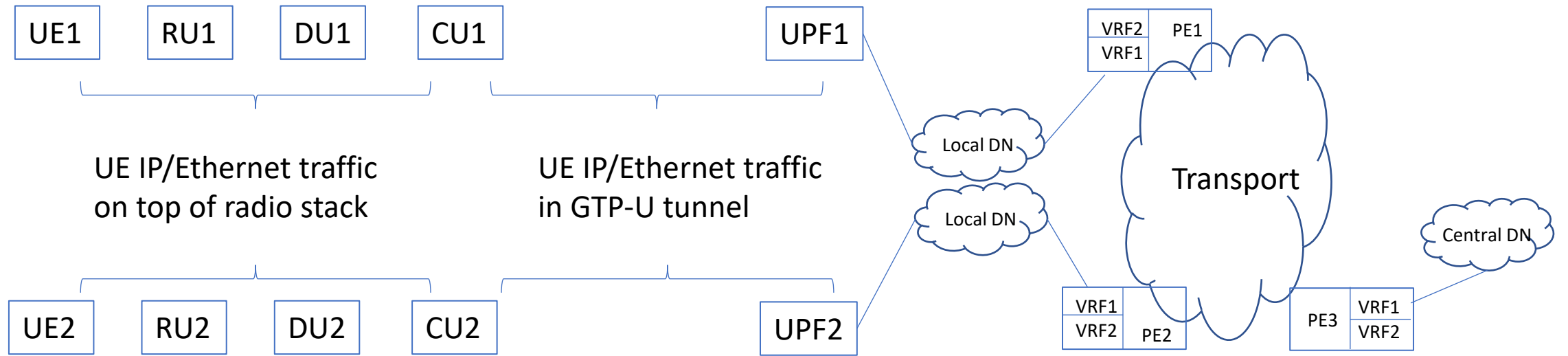
Basic Idea

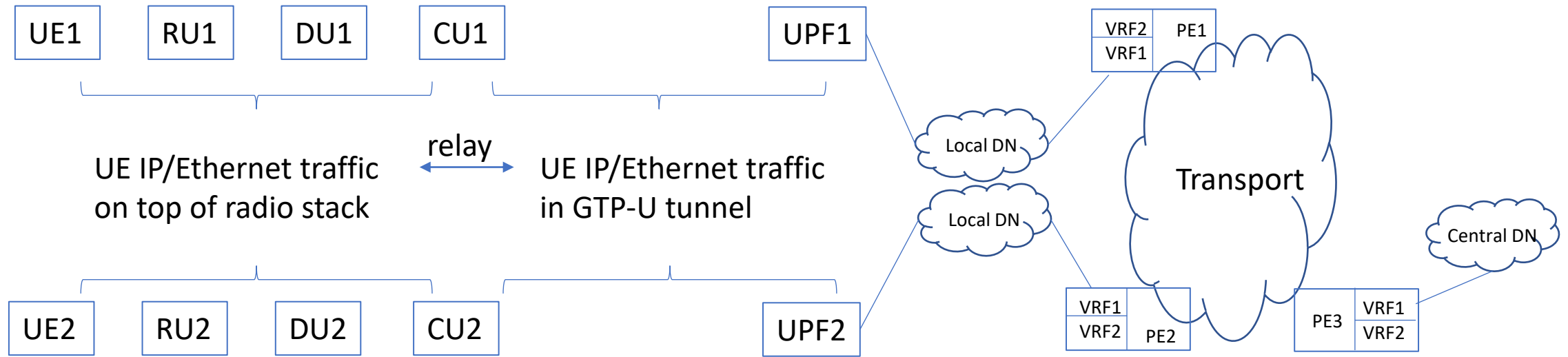
- In 5G, UPFs are more and more distributed close to gNB-CU (AN)
 - For MEC, private networks, or local Internet peering
 - Could be co-located – with direct link in between or even running on the same server
 - Distributed UPF means distributed DNS – implemented as VPNs
- In 6G, what if AN and UPF are 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

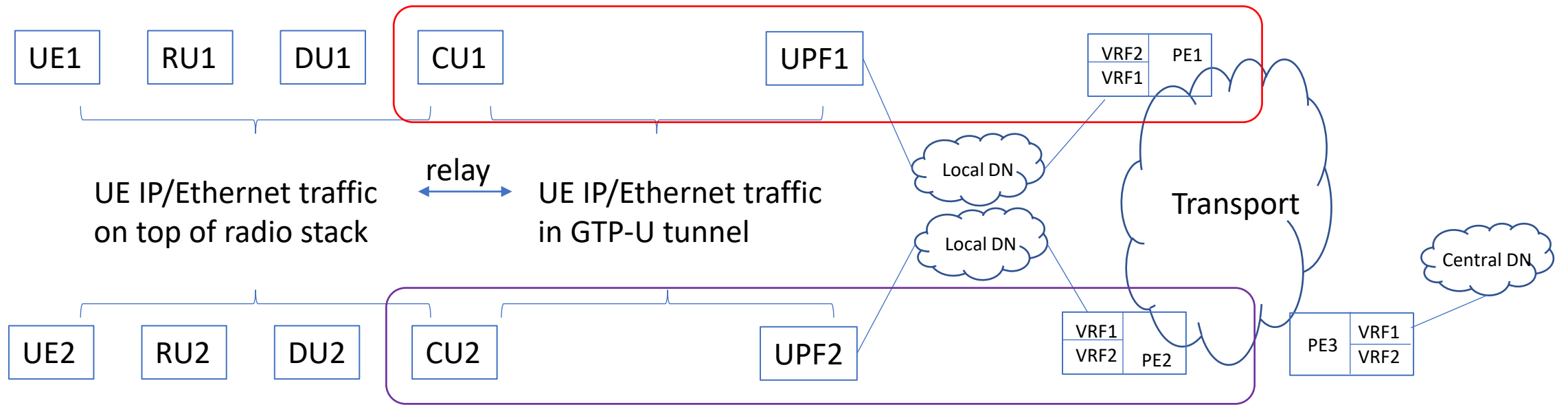


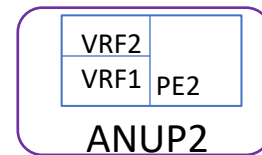
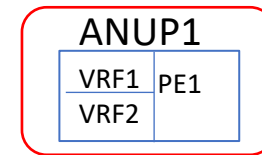
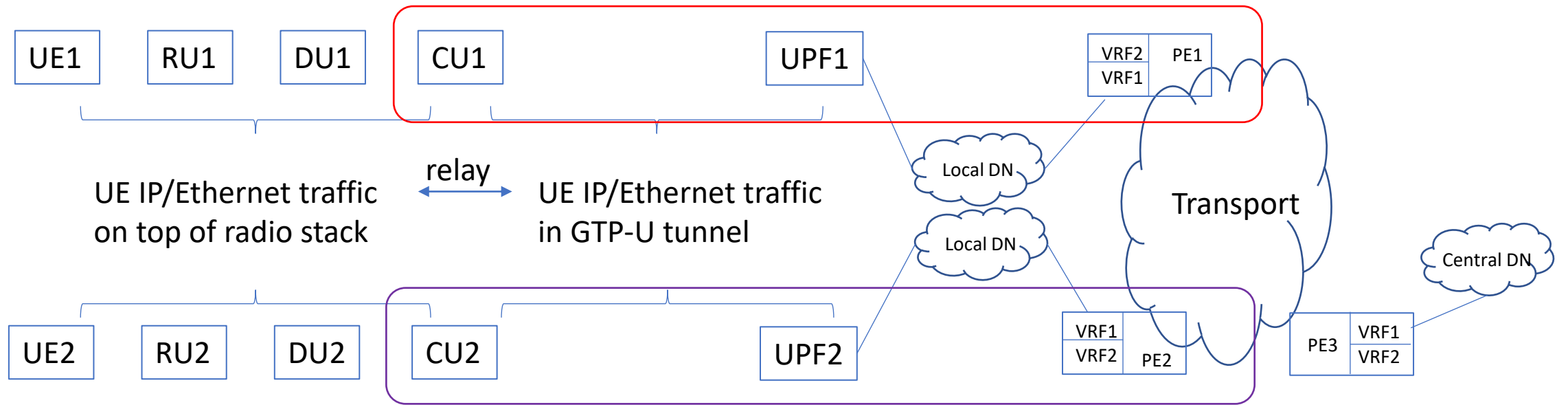
Animation
In use

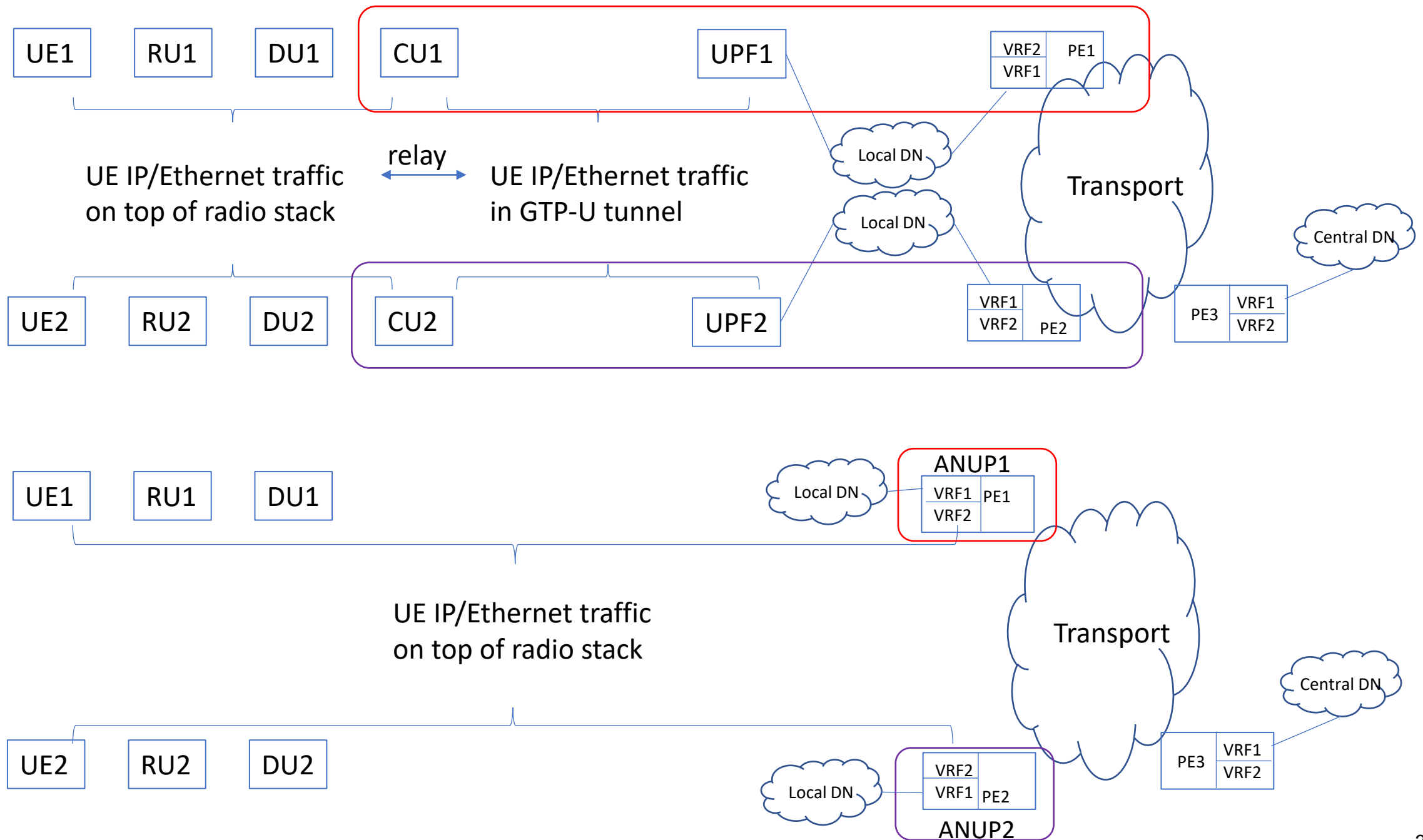












Disclaimer

- The work needs to be done in 3GPP
- We're discussing here only to first socialize the idea among IETF/wireline-friendly people
- Only if we get enough support among mobile operators may we bring it to 3GPP for further work

Advantages

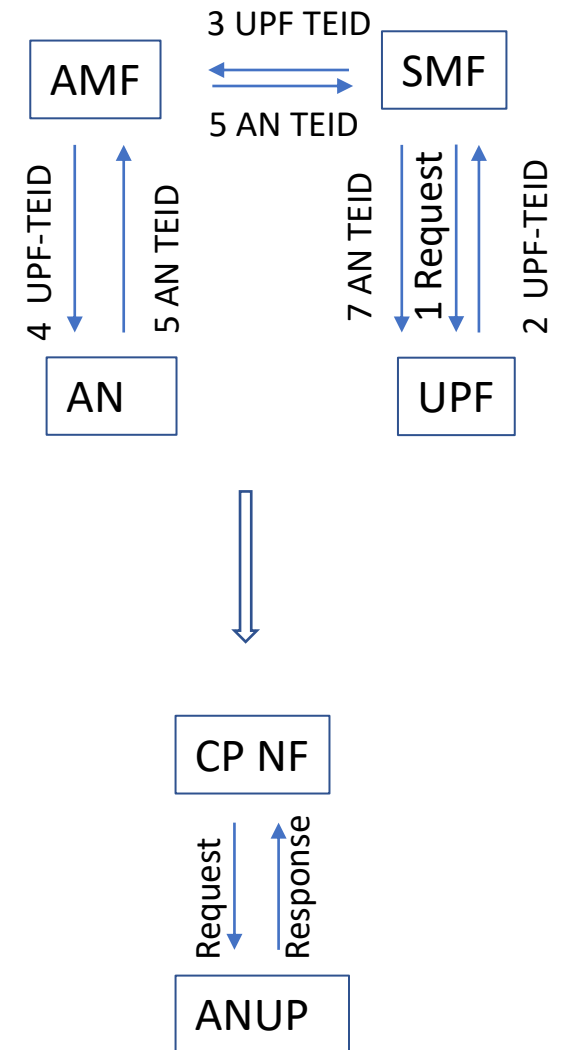
- Simplified signaling and optimized data plane
- Simplified and flattened architecture unified for wireline/wireless
- Many 5G special features/procedures are not needed anymore or can be greatly simplified
 - MEC
 - 5MBS
 - LAN-type services
 - ...

New Discussion Points

- Reduced signaling
- Can't you use ULCL I-UPF to do local breakout already?
- What if I have to use NAT with overlapping private address spaces in different regions?
- Aren't you increasing the burden on the AN?
- Aren't you making the AN more complicated?
- Aren't you going against the microservice architecture that breaks up functionalities?

Simplified Signaling

- In 5G, N3 tunneling is used between separate AN and UPF
 - Even if they're co-located
 - Multi-step N2/N4/N11 signaling needed for:
 - Initial setup
 - *Periodical refreshes to maintain the state*
- Since no tunnel is used with a router/switch ANUP:
 - No need to setup and *maintain* the state
 - Signaling only needs to tell ANUP which DN a PDU session belongs to
 - It's a new signaling, but for 6G a lot of change will happen anyway



NAT with Overlapping Private Address Spaces

- An operator may have to use overlapping private address spaces for different regions
- With central UPF:
 - One UPF for each region with a NAT GW attached to each UPF
 - UE \leftrightarrow Internet traffic goes through the NAT GW
 - Intra-region UE \leftrightarrow UE traffic does not need NAT
 - Inter-region UE \leftrightarrow UE traffic goes through two NAT GWs
- With distributed UPF/ANUP:
 - One hub DN router for each region with NAT GW attached to the hub router
 - The rest is the same as the central UPF case
 - No difference whether ANUP is used or not

What about ULCL I-UPF for MEC

- 5G ULCL I-UPF does allow local breakout for MEC purpose even with central UPF deployment
- It is a special and extra “user plane function”
 - Sits in the path of N3 tunnels and exams **all** N3 traffic
 - Intercepts local breakout traffic based on filtering rules signaled from SMF
 - AN puts on GTP-U encapsulation, then all traffic gets peeked through the encapsulation and some traffic gets decapsulated by a nearby ULCL I-UPF
 - A waste avoided by distributed UPF/ANUP
- Target scenario of ANUP is distributed UPF co-located with AN
 - The ANUP or the distributed (anchoring) UPF replaces the special ULCL-UPF
 - ANUP can be used together with central UPF
 - Some sessions tunneled to the central UPF
 - Some sessions terminated and traffic routed locally
 - In other words, no need for the special ULCL I-UPF anymore

Increased Burden on the AN?

- All necessary UPF functionalities need to be done either on previously separate UPF or on the integrated ANUP
 - All in the same edge DC
 - Note that ANUP is to integrate *co-located* AN and UPF
- In case of cloud-native implementation, it does not matter if the load is on AN, UPF, or ANUP
 - It's actually easier for capacity planning in case of ANUP
 - Previously one needs to decide how much resource to allocate to UPFs
 - Besides the compute resources (and PDU sessions) allocated to ANs
 - Now one only needs to decide how much compute resources and which sessions are assigned to which ANUPs

Increased Complexity on AN?

- UPFs and ANs effectively are hub and spoke PEs for the DN VPN
 - ANs are spokes and UPFs are hubs
 - GTP-U tunnels correspond to <base label, VPN label> label stacks
 - TEIDs correspond to per-prefix labels
 - No VRFs on ANs because there is no need for IP lookup
 - UL traffic is always sent to the hub (UPF)
 - DL traffic is relayed to UEs based on TEID
 - Just like that pre-prefix labels removes the need for IP lookup for to-CE traffic
- What is added in ANUP is the routing in VRFs
 - For local routing purpose
 - Routing functions are becoming commoditized
 - especially with server-based implementations

Isn't This against Microservices Architecture?

- Per <https://microservices.io/>:

Microservices is an architectural style that structures an **application** as a collection of services that are:

Highly maintainable and testable; Loosely coupled; Independently deployable;

Organized around business capabilities; Owned by a small team

The microservice architecture enables the rapid, frequent and reliable delivery of **large, complex applications**

- Microservices is about decomposing complex applications
- ANUP is about integrating forwarding functions for high performance data forwarding

Keep the Discussion Going!

- Really appreciate the comments
- Could you discuss this with your (3GPP/wireless) colleagues?
- Will continue to discuss with more mobile architects and update the draft accordingly