Parallel WIRELESS

5G NR LOGICAL ARCHITECTURE AND ITS FUNCTIONAL SPLITS

5G ENABLERS AND PRINCIPLES

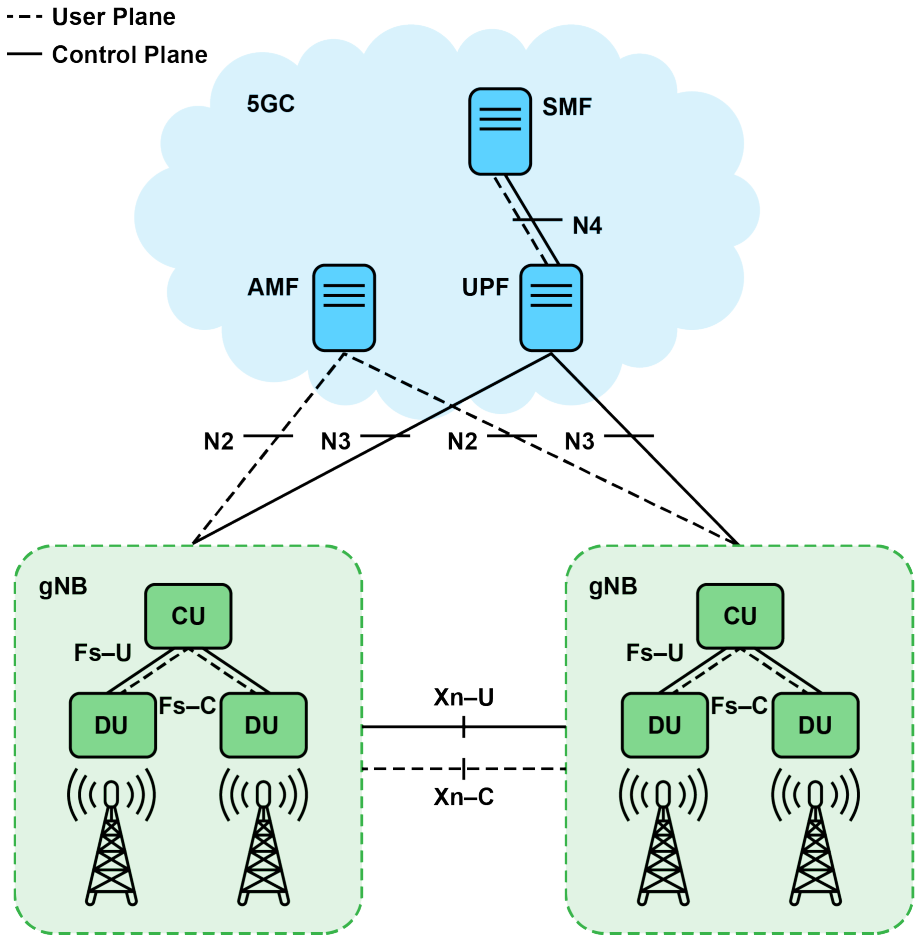
Novel Concepts That Were Not Envisioned by the Previous Generation Architectures

- Modularization
  - Previous networks: monolithic network functions corresponding to physical network elements
  - 5G networks: modular network functions (NFs) for both control plane (CP) and user plane (UP) for both access network (AN) and core network (CN)
- Network Slicing
  - NFs to provides specific network capabilities for service verticals
  - Resource abstractions by utilizing software-based NFs
- Network Softwarization
  - “Network programmability” by extending SDN to all control and data layers
    - In network slices supporting URLLC, virtual NFs deployed closely to the users → reduced latency
- Multi-Access Edge Computing (MEC)
  - Native support of MEC → reduced E2E latency and increased network efficiency

5G NR RADIO ACCESS NETWORK

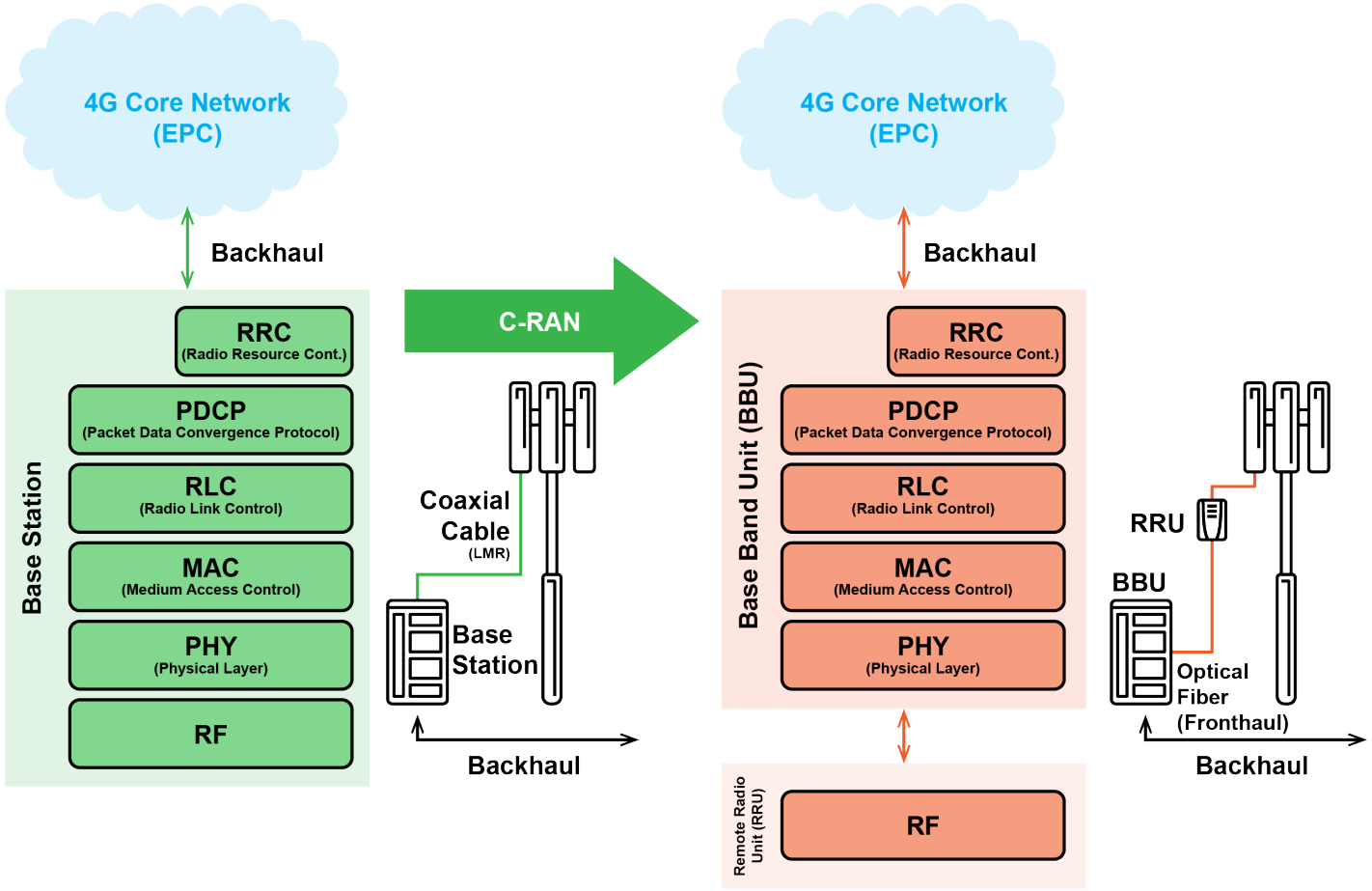
Basic Architecture

- The gNB is responsible for all radio-related functions in one or several cells
  - RRM and admission control and
  - Routing of user-plane (UP) data to UPF through N3
  - Routing control-plane (CP) information to AMF through N2
- 3GPP considered the split concept (DU and CU) for NR from the beginning
- Xn interface connecting gNBs directly to support active-mode mobility and DC functionalities
  - It may also used for multicell RRM functions
- Standard Fs interface for connecting gNB-CU and gNB-DU
- No specific split proposed by 3GPP
  - General guidance RRC, SDAP and PDCP reside in gNB-CU and remaining protocol entities (RLC, MAC and PHY) in gNB-DU



WHERE DID THE SPLIT CONCEPT START?

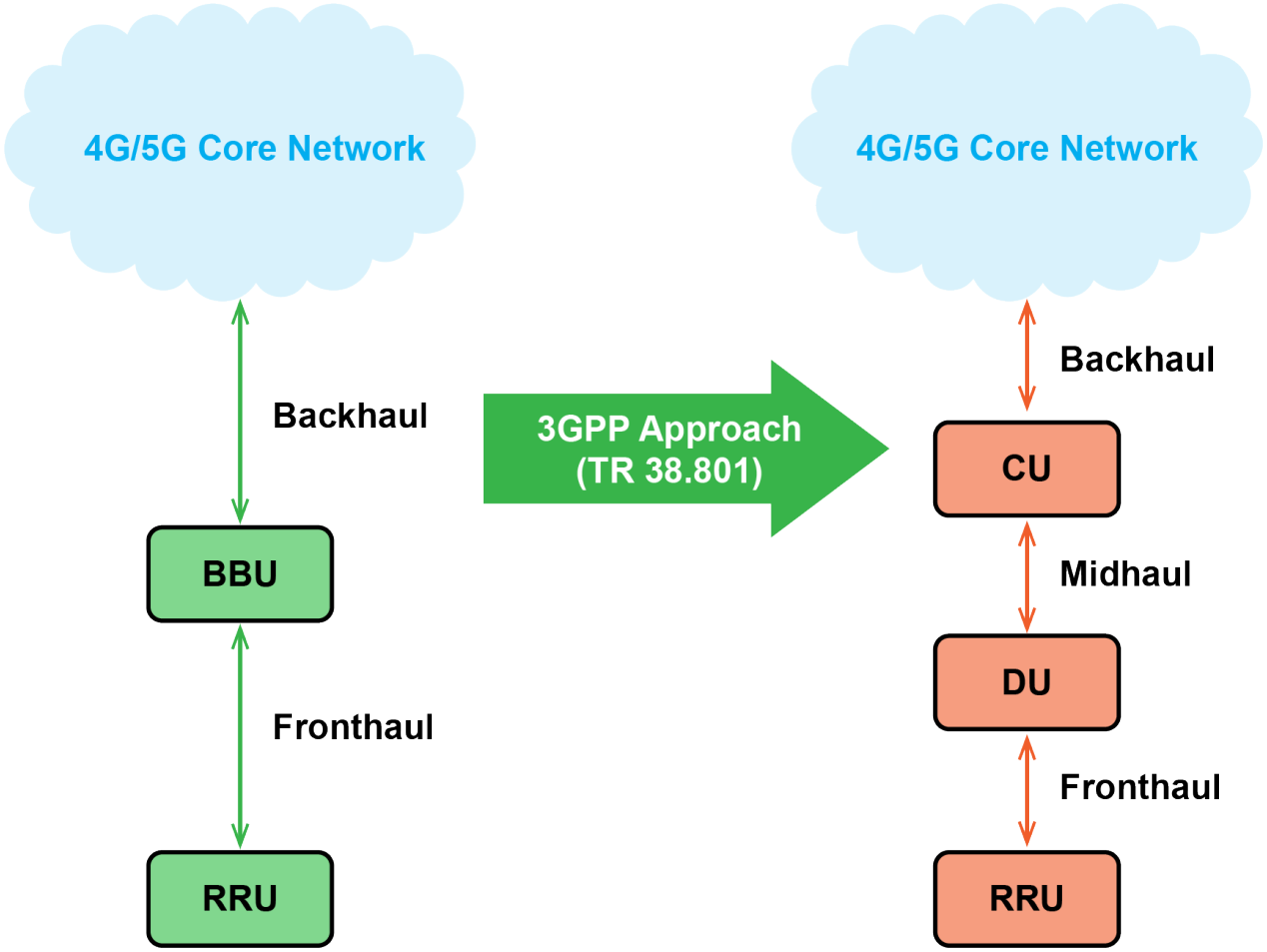
It Started with C-RAN



EVOLUTION TO OPENRAN

Distributed and Central Units

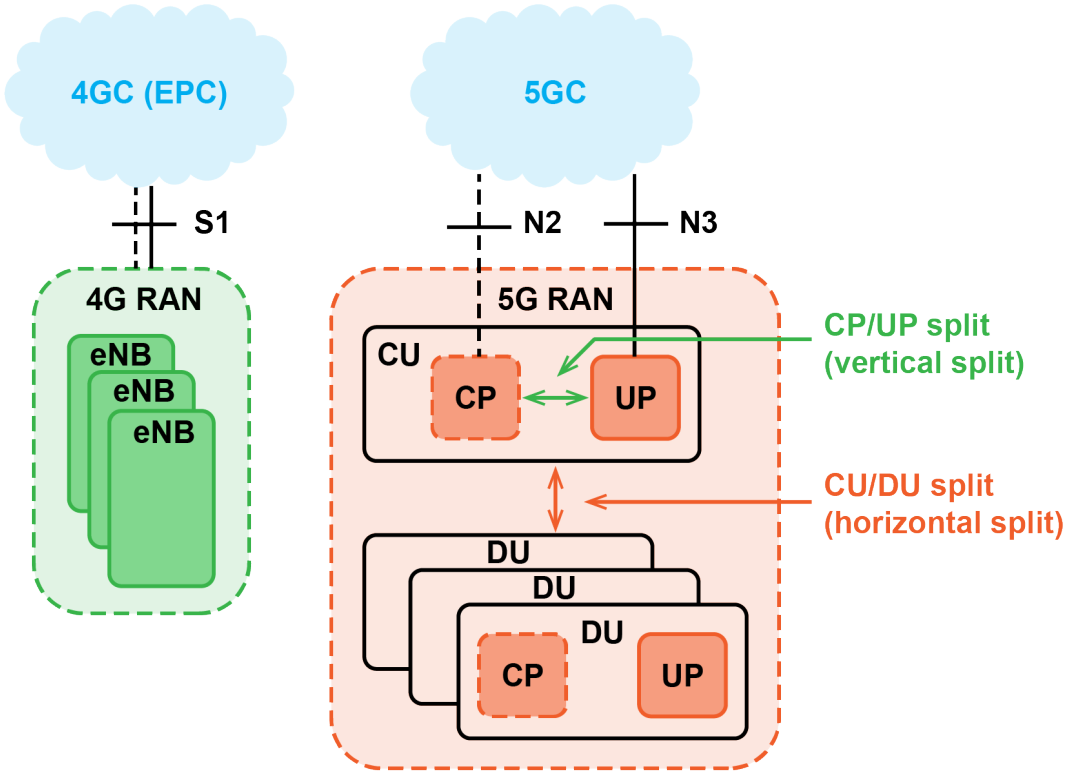
- 3GPP introduced the DU and CU concept as the evolution path toward vRAN
- Introduction of midhaul provides more flexibility for transport options



5G RAN FUNCTIONAL SPLITS

Native Support for Various Functional Splits Along Two Dimensions

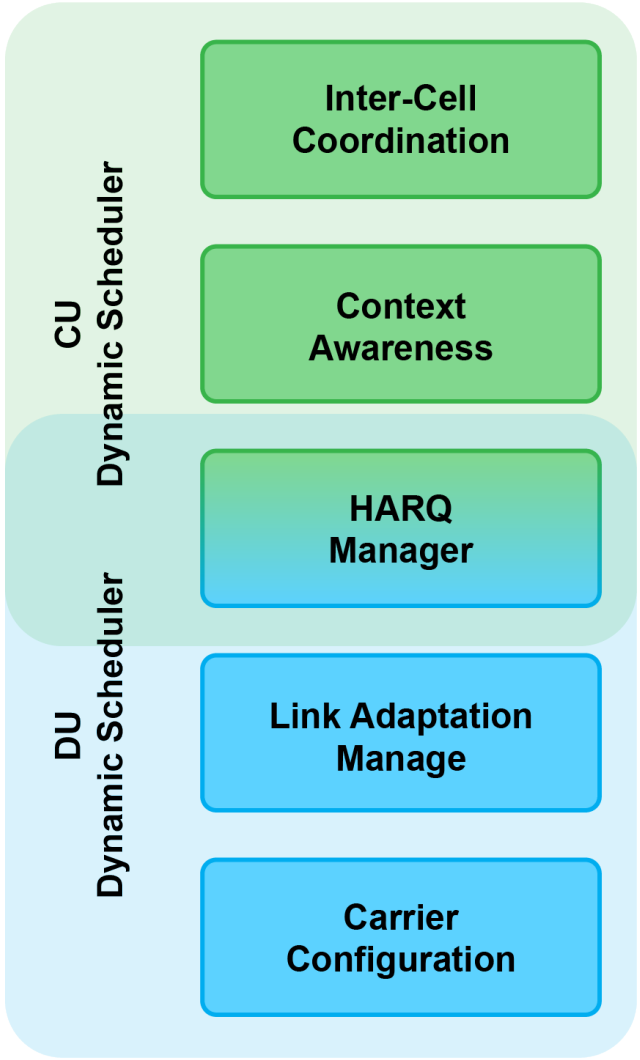
- Control Plane/User Plane split (Vertical split)
  - First step for introduction of SDN in the RAN
  - Allows separate optimization of CP and UP
  - Consistent CP in multi-vendor networks
  - More challenges for lower layer splits
- Central Unit/Distributed Unit split (Horizontal split)
  - Obtain centralization gain, both in terms of performance gains and economy of scale
  - Shift functionalities to deferent locations based on morphologies and transport availabilities
  - Make overall RAN more future proof and less costly for future generation upgrades



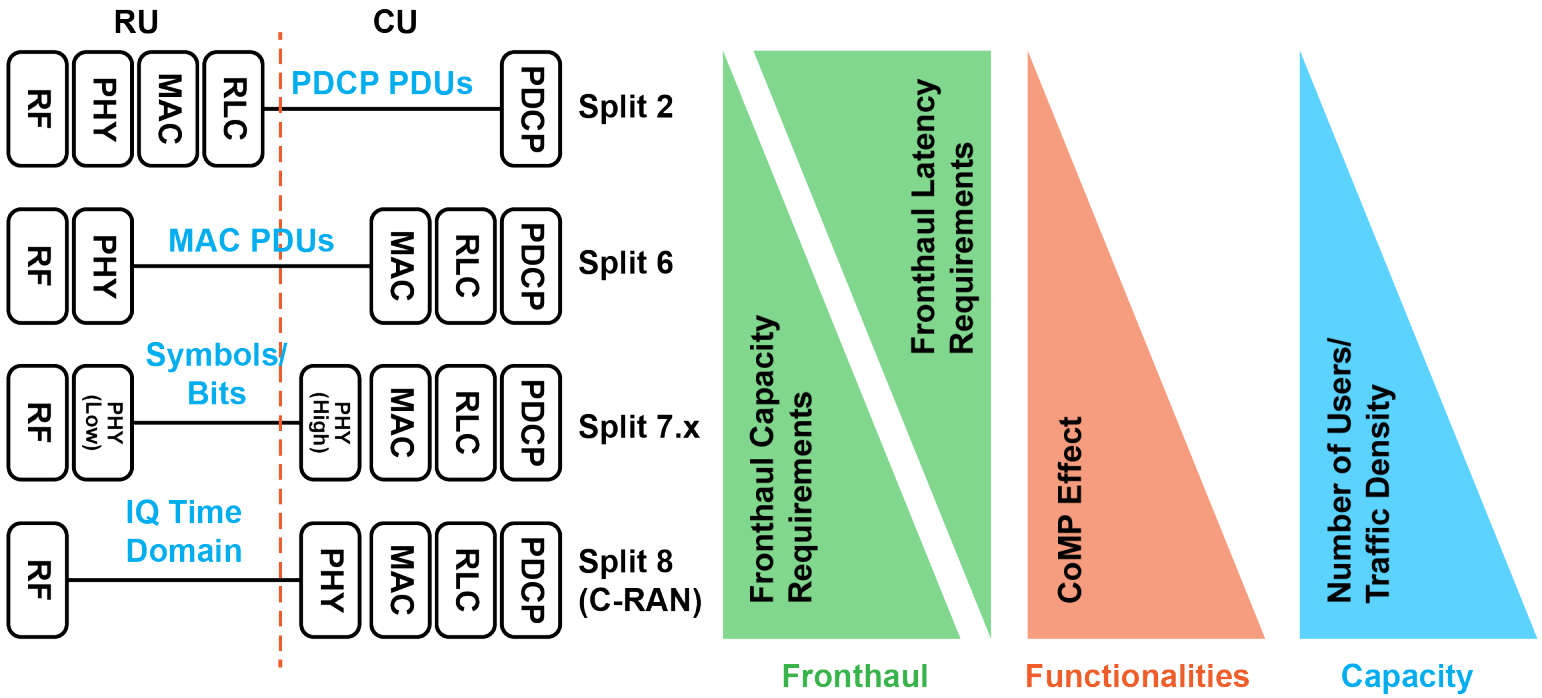
HIERARCHICAL RRM

5G CU/DU Split and Hierarchical RRM

- Central RRM located at CU coordinate the lower layer functions across multiple DUs
- The general functionalities of central RRM are:
  - Radio resource allocation
  - Call admission
  - Call selection
  - Load balancing
  - Mobility
  - Multi-connectivity
- MAC dynamic schedular is the most important part of RRM
  - Dynamic scheduler needs context information for the users under it control to fulfill the user QoS
  - Variable TTI size scheduling
  - Punctured/preemptive scheduling



SPLITS TRADE-OFFS



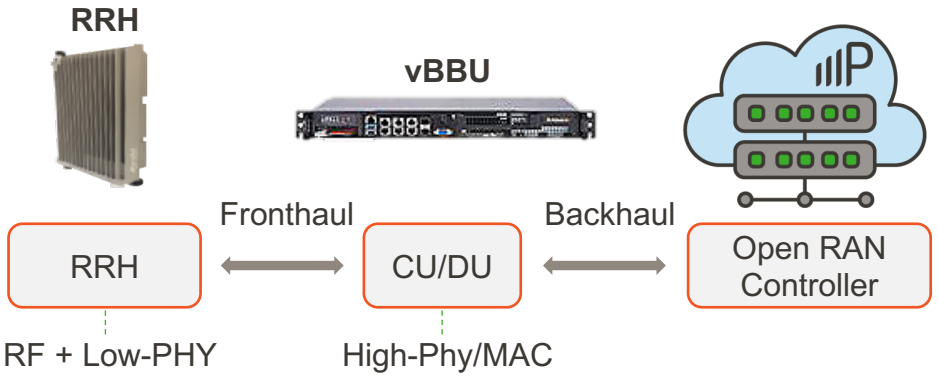
- Not a single split is going to fit all
- Different morphologies require different splits

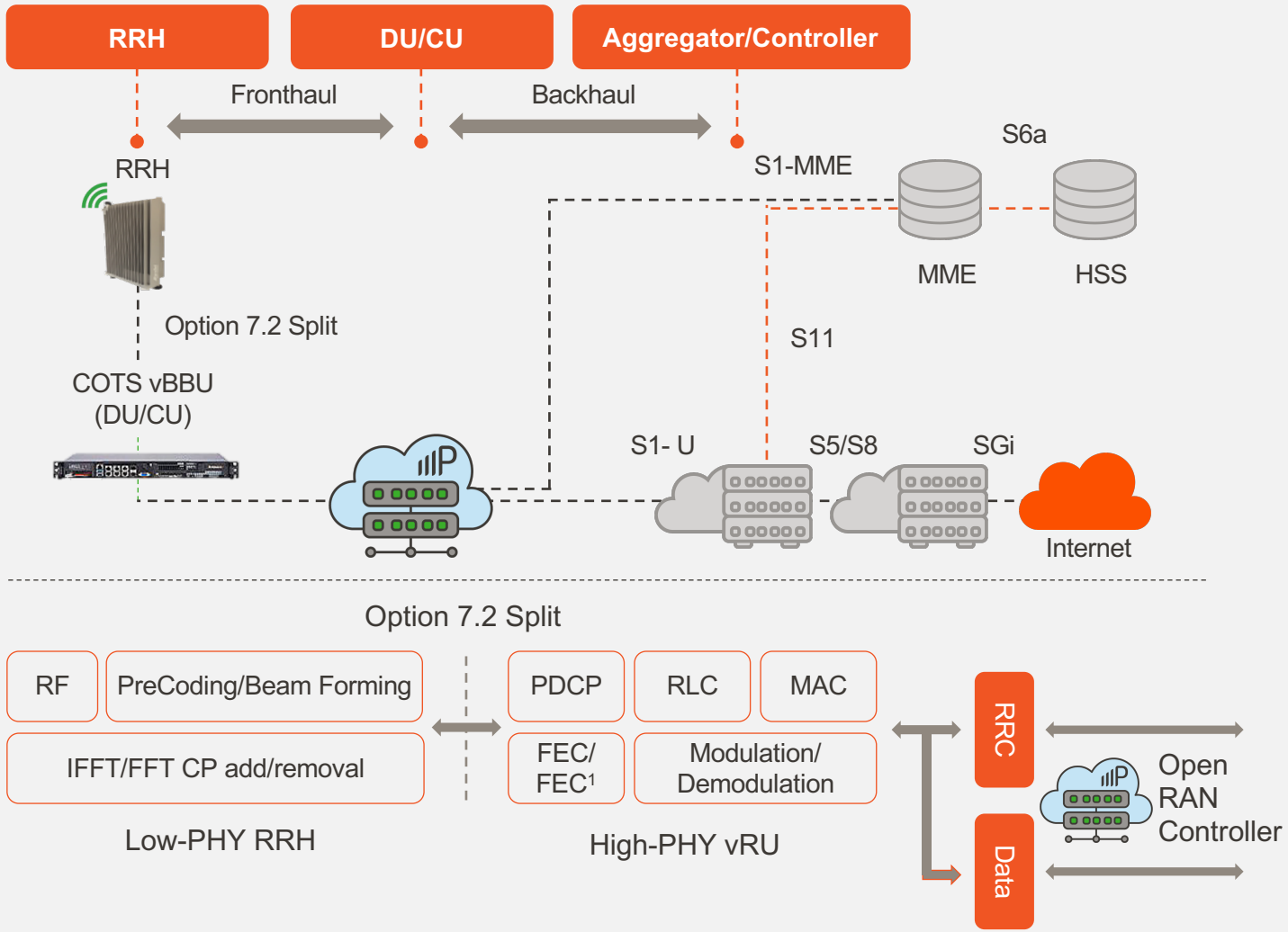
- Only a software based RAN can support dynamic and fluid split options
- Control plane splits (vertical) are as important as user plane splits (horizontal)

PARALLEL WIRELESS SPLIT ARCHITECTURE

Split Architecture for All Gs

- Open RAN
- Virtual Radio Unit vBBU: COTS server to act as a CU/DU
- Open RAN Controller: full software based All G SON and orchestrator
- Split 7.2 for efficiency and fronthaul scalability





Reimagine Your Network. Reimagine Your Economics.