

Parallel WIRELESS

An Introduction to OpenRAN Concept

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Presented By

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Zahid is a technologist with a deep understanding of architecting world-class mobile products and solutions. With over 20 years of experience in telecom industry as an engineer, programmer, analyst, researcher, architect, trainer, product manager and technical marketer, he has witnessed the highs and lows of this industry. He is a skeptic and often challenges conventional wisdom. He was a part of the team responsible for the first 3G network rollout in Japan and Europe. Since then he has worked extensively in mobile technologies like 3G, 4G and now 5G. He is also widely recognized as an evangelist for new technologies, often talking about them in various industry fora, conferences and blogs; separating the hype from the real-world applications & services.



Zahid's blog link: <https://blog.3g4g.co.uk/>

Company Introduction: Reimagine Your Network



VISION

- Modernize the global cellular network to an all IP network with OpenRAN
- Accelerate the global adoption of 5G and subsequent wireless innovations
- Coverage and capacity solutions



TEAM

- Founded in 2012, Headquarter in Nashua, NH – a US-based company
- Global Sales offices and support
- Experienced leadership (Starent, Acme Packet, Endeca) and engineering team (4,000 +years combined R&D experience)



INNOVATION

- Pioneer of the OpenRAN movement: coverage and capacity
- Cloud-native for all Gs: world's only SW defined multi-technology "ALL G" Solution
- Simplify the network build/opex
- Easy interoperability with current network/radios
- Software upgradable to 5G



STRONG CUSTOMER MOMENTUM

- Engaged with 50 Operators on 6 Continents (public: Telefonica, Vodafone, Zain, BT, Cellcom, Inland, Optus)
 - Rural, Urban/Dense Urban, Enterprise, Public Safety, Smart Cities, 5G

Parallel Wireless Engaged Around the World



The Big Picture

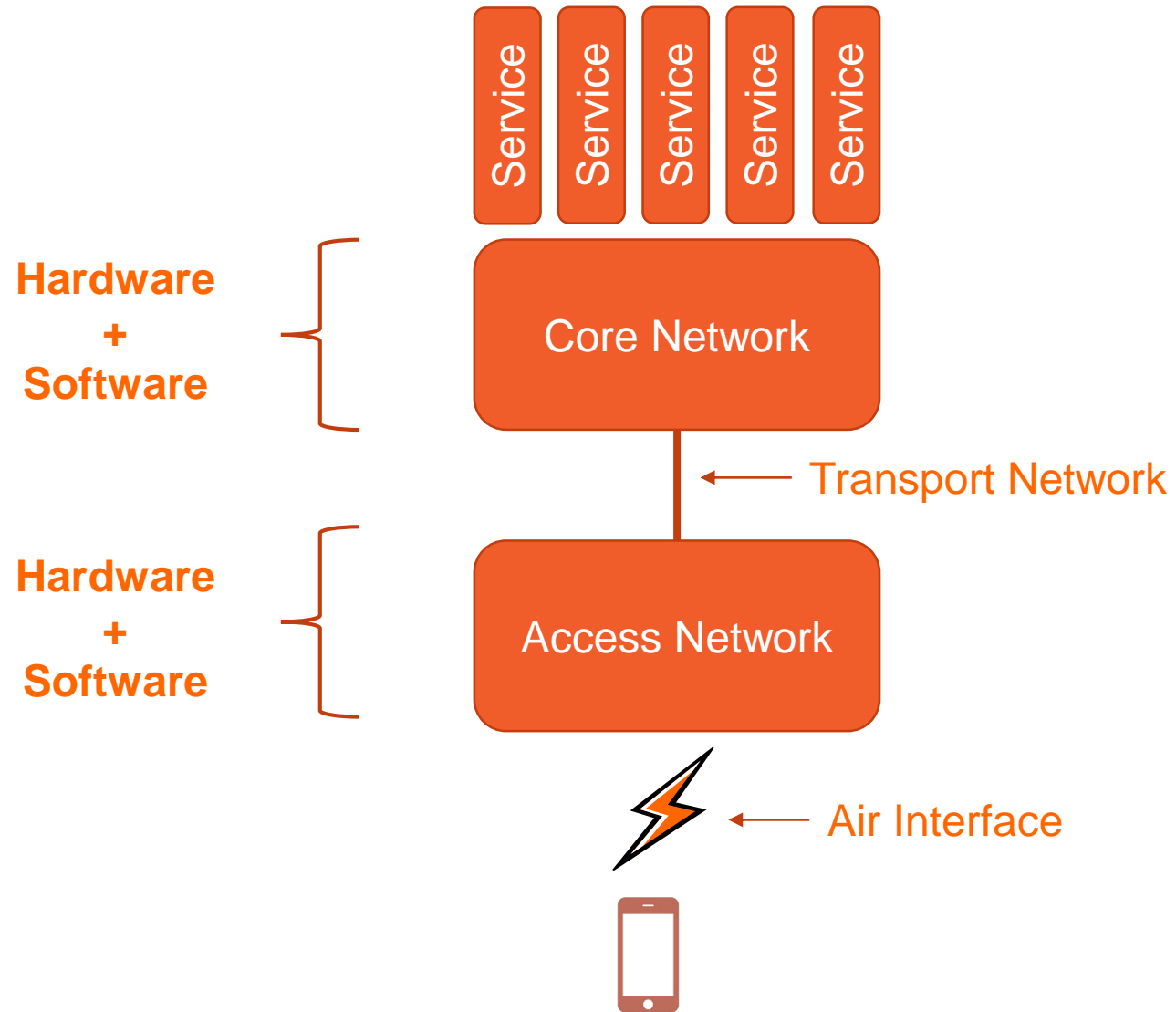
- World's first 5G native architecture for ALL Gs, fully virtualized to scale up or scale out as needed.
 - *Agility to respond based on demand. Reduces CAPEX & OPEX*
- World's first ALL IP native architecture.
 - *Allows internet like innovation, much cheaper compared to legacy. Reduces CAPEX & OPEX*
- World's first edge centric architecture for ALL Gs, enabling low latency applications and network simplifications. This also disaggregates the whole network.
 - *Brings low latency to ALL Gs, makes network resilient, reduces datacenter costs*
- World's first controller that brings “bird's eye view” for the whole network, enables analytics, SON and large-scale automation.
 - *New insight into the network, automation saves massive services costs*
- World's first transport agnostics RAN/ Core splits, allows major savings on the transport.
 - *Saves on transport costs, as cells become denser and technology evolves, the savings continue.*
- World's first network that seamlessly integrates femto, small cell, macro and massive MIMO ALL-G into one converged architecture.
 - *Native heterogeneous network architecture allows dense urban to rural agility in a cost-effective way.*



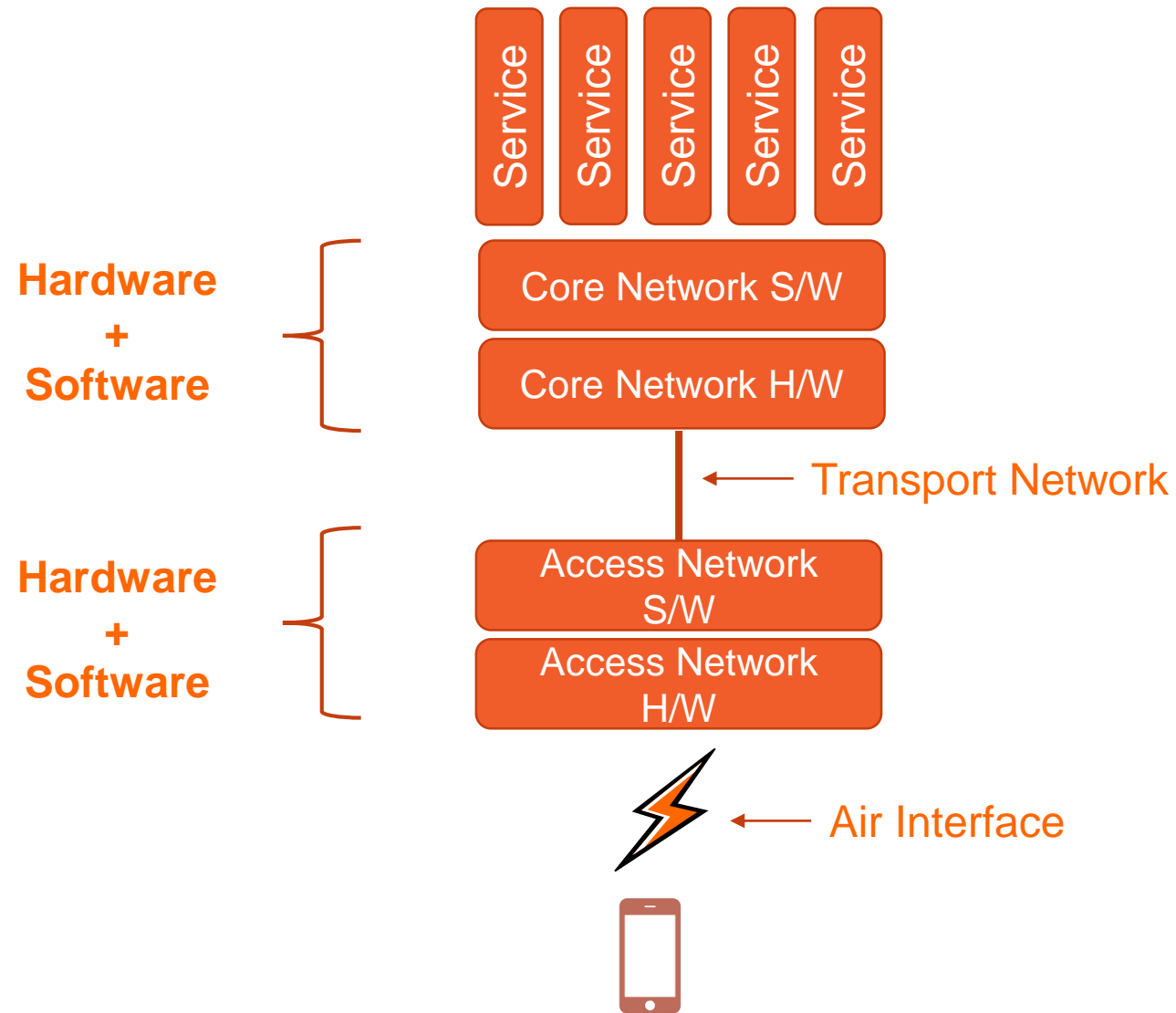
Open RAN Concept

BASIC INTRODUCTION

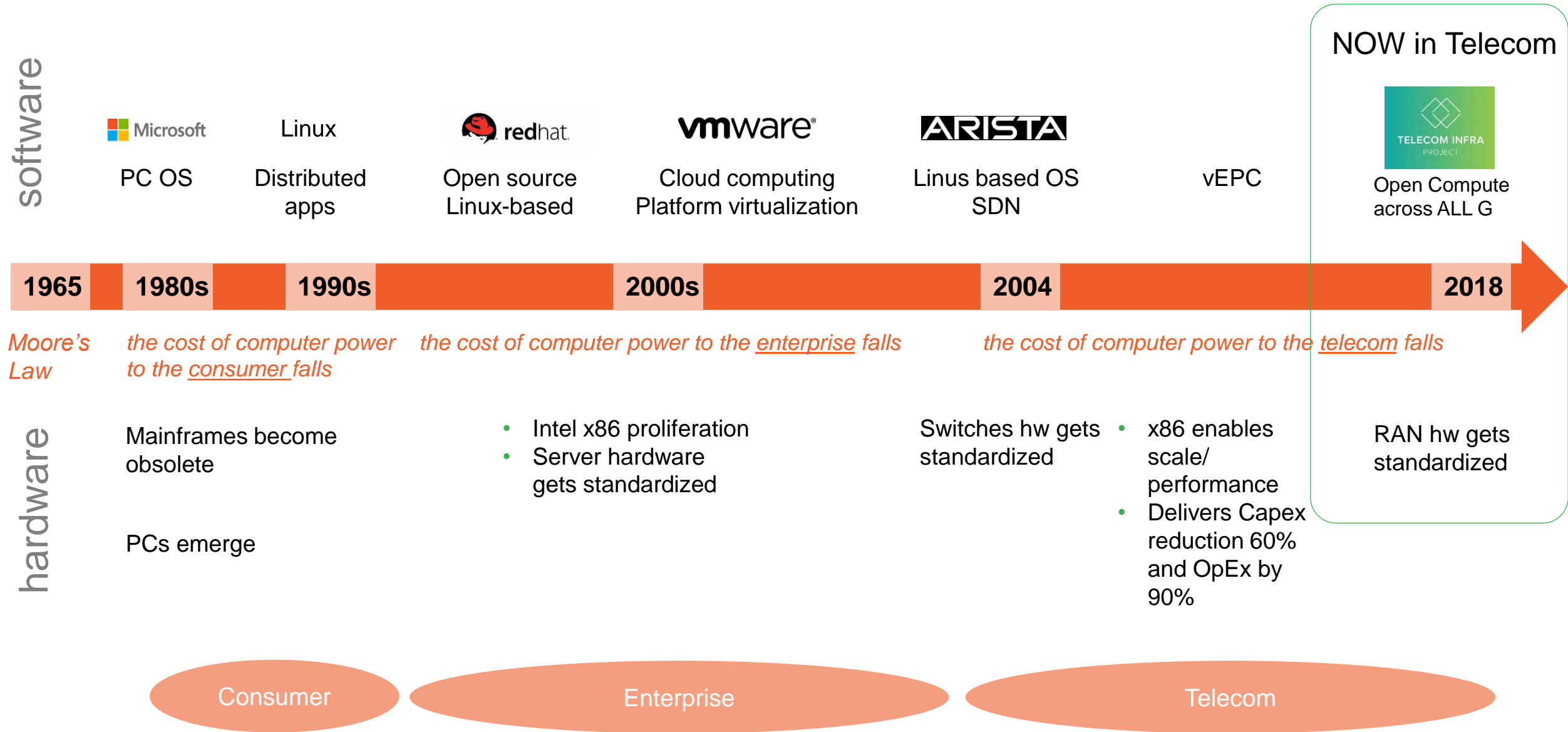
Typical Mobile Network Architecture



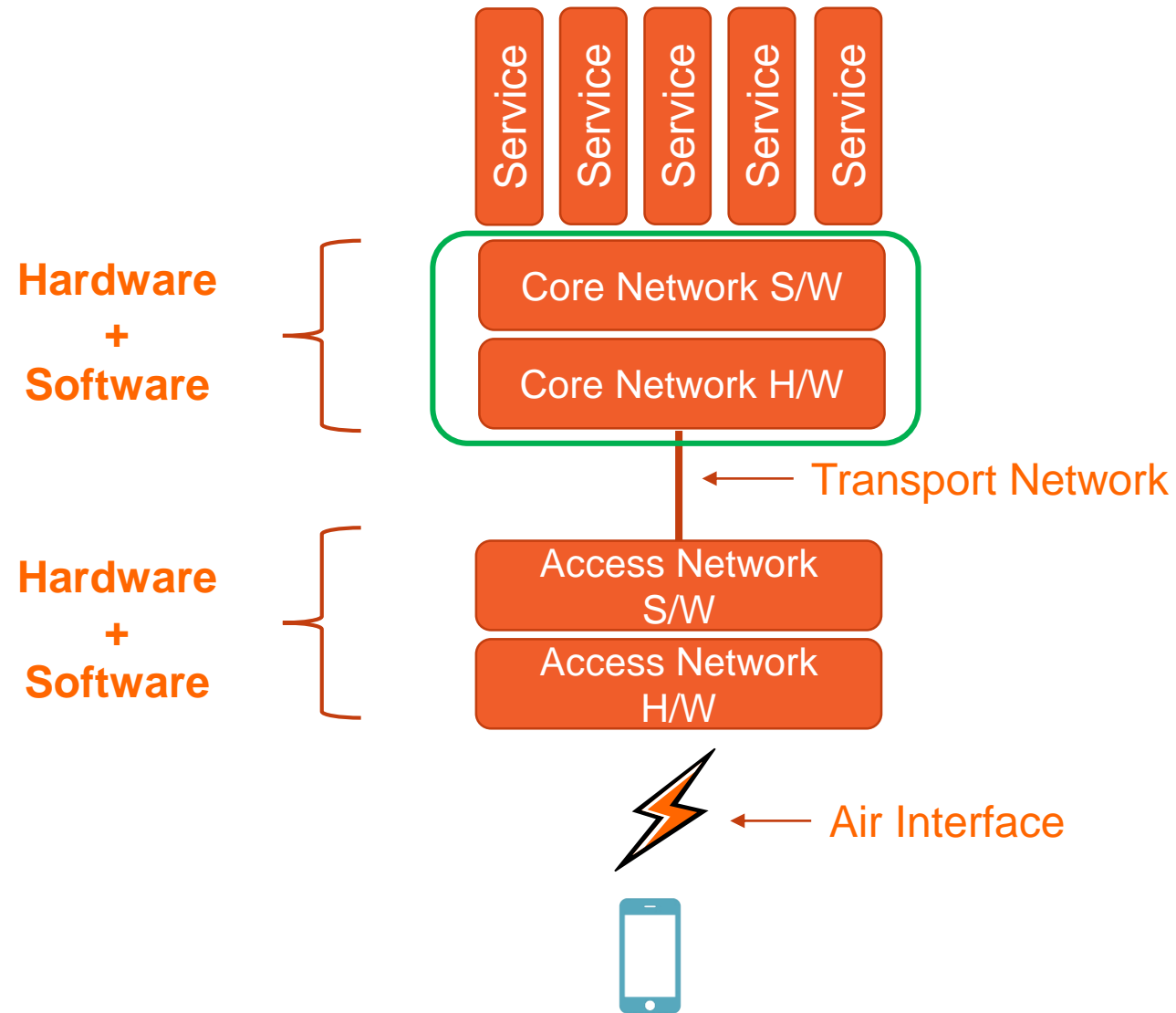
Disaggregated Mobile Network Architecture



Evolution of HW/SW Disaggregation



Disaggregation of the Core Network

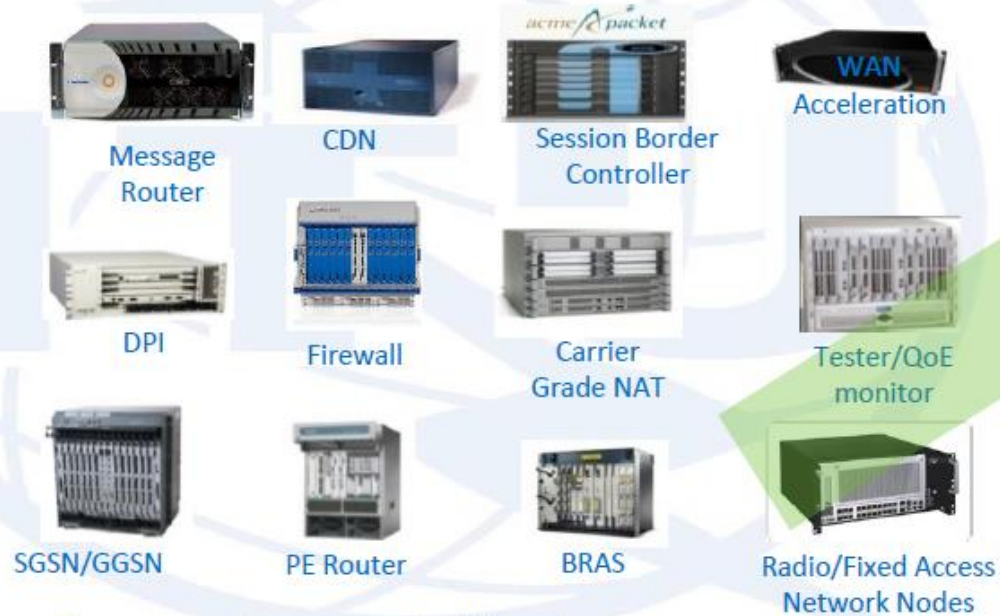


Disaggregation of the Core Network

- 3GPP Started the journey with Control and User Plane Separation (**CUPS**) of EPC nodes in 3GPP Release-14
 - CUPS provides the architecture enhancements for the separation of functionality in the Evolved Packet Core's SGW, PGW and TDF.
 - This enables flexible network deployment and operation, by distributed or centralized deployment and the independent scaling between control plane and user plane functions - while not affecting the functionality of the existing nodes subject to this split.
- 5G Core (5GC) continues this Control & User Plane Separation with the Service Based Architecture (**SBA**)
 - SBA leverages the service-based interactions between different network functions, aligning system operations with the Network Functions Virtualization (NFV) and Software Defined Networking (SDN) paradigms.

Disaggregation of the Core Network – Virtualization

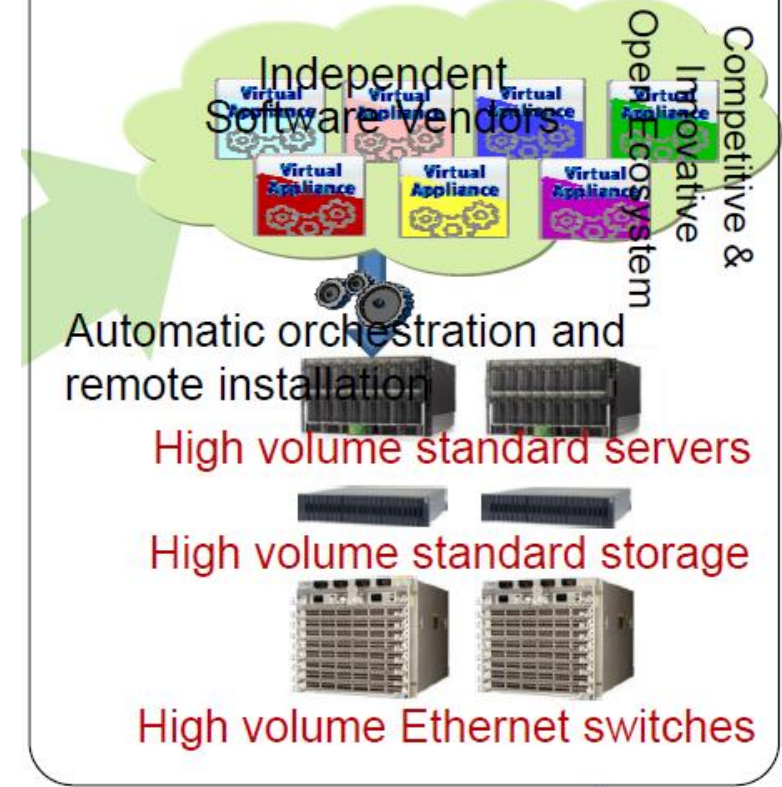
Classical Network Appliance Approach



- Fragmented, purpose-built hardware
- Physical install per appliance per site
- Hardware development: large barrier to entry for new vendors, constraining innovation & competition



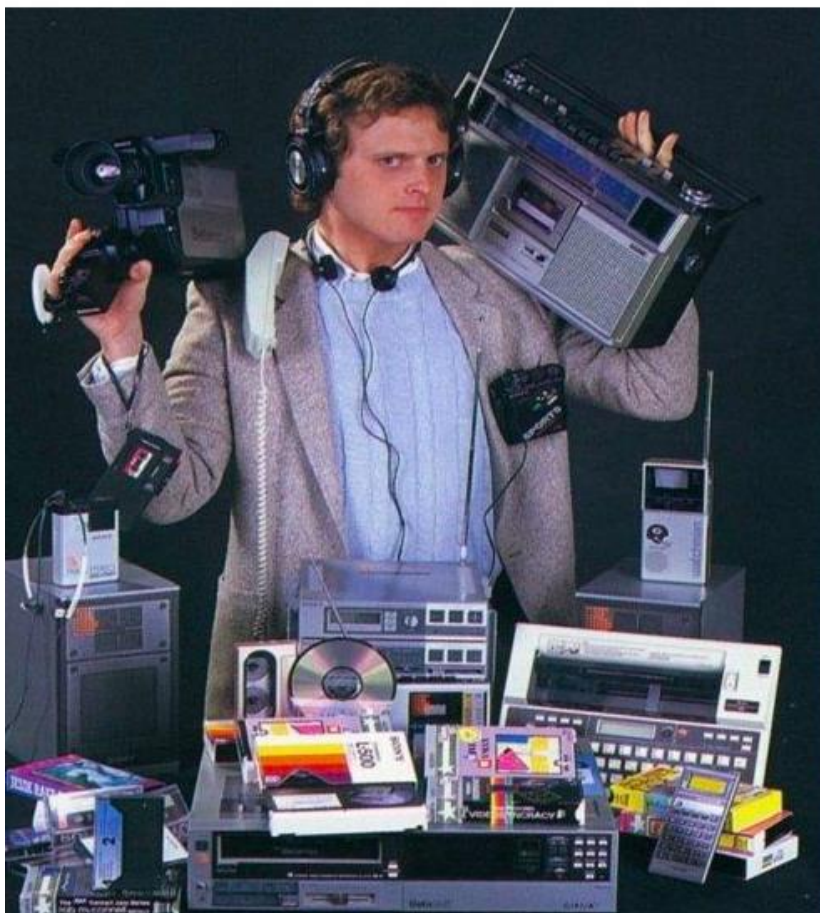
Network Functions Virtualisation Approach



Commercial off-the-shelf (COTS) Hardware

Disaggregation of the Core Network – Virtualization

1994

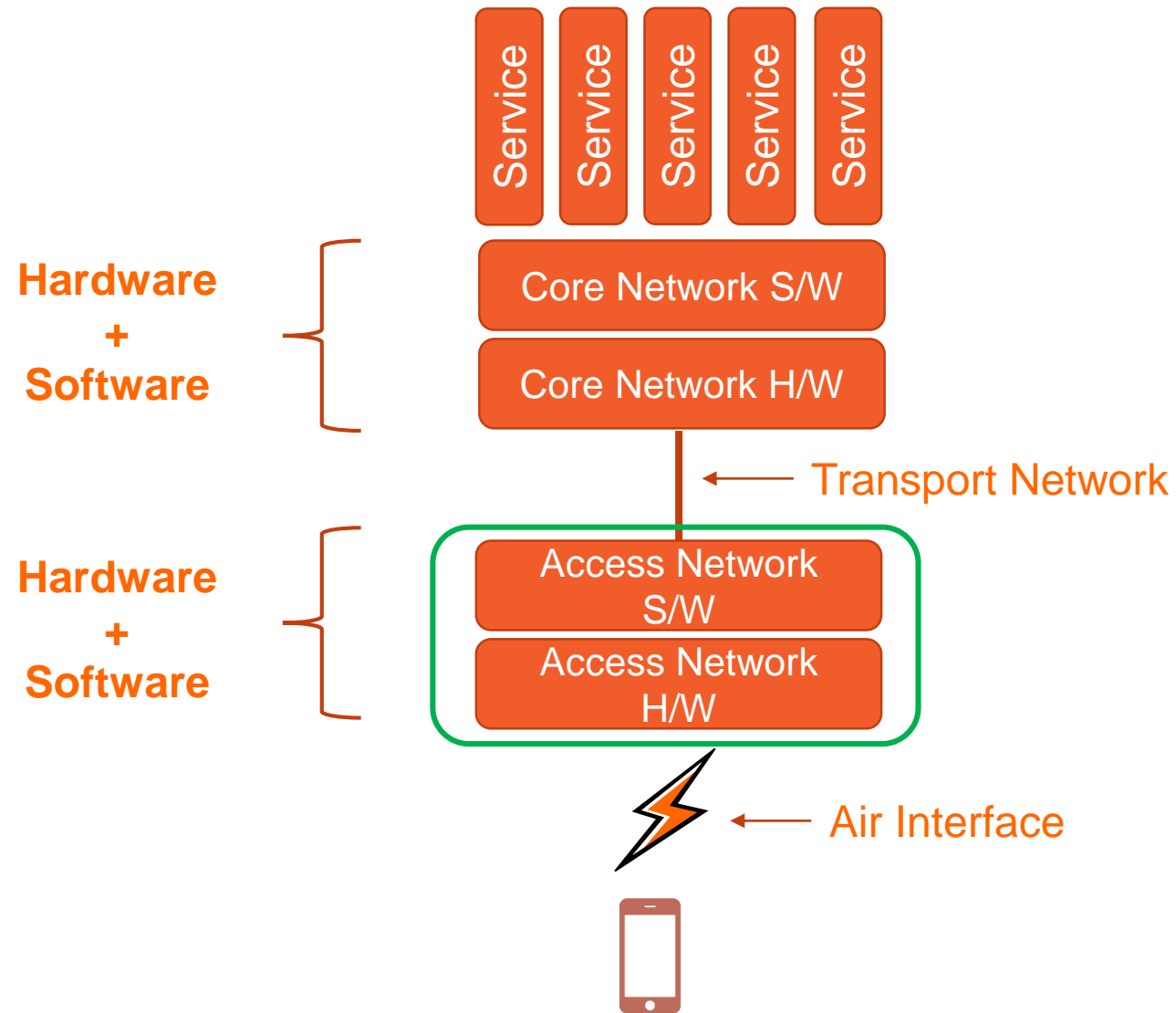


2014

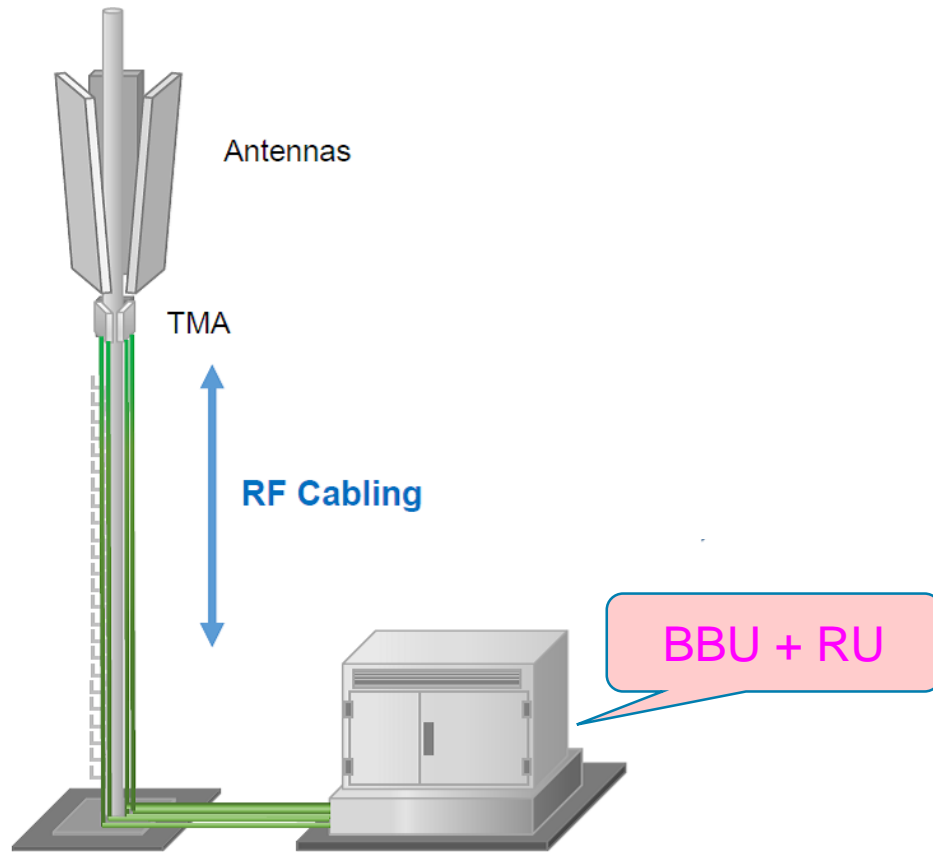


NFV (Network Functions Virtualization) has enabled moving of hardware into software

Disaggregation of the Access Network



Mobile Towers in Real Life

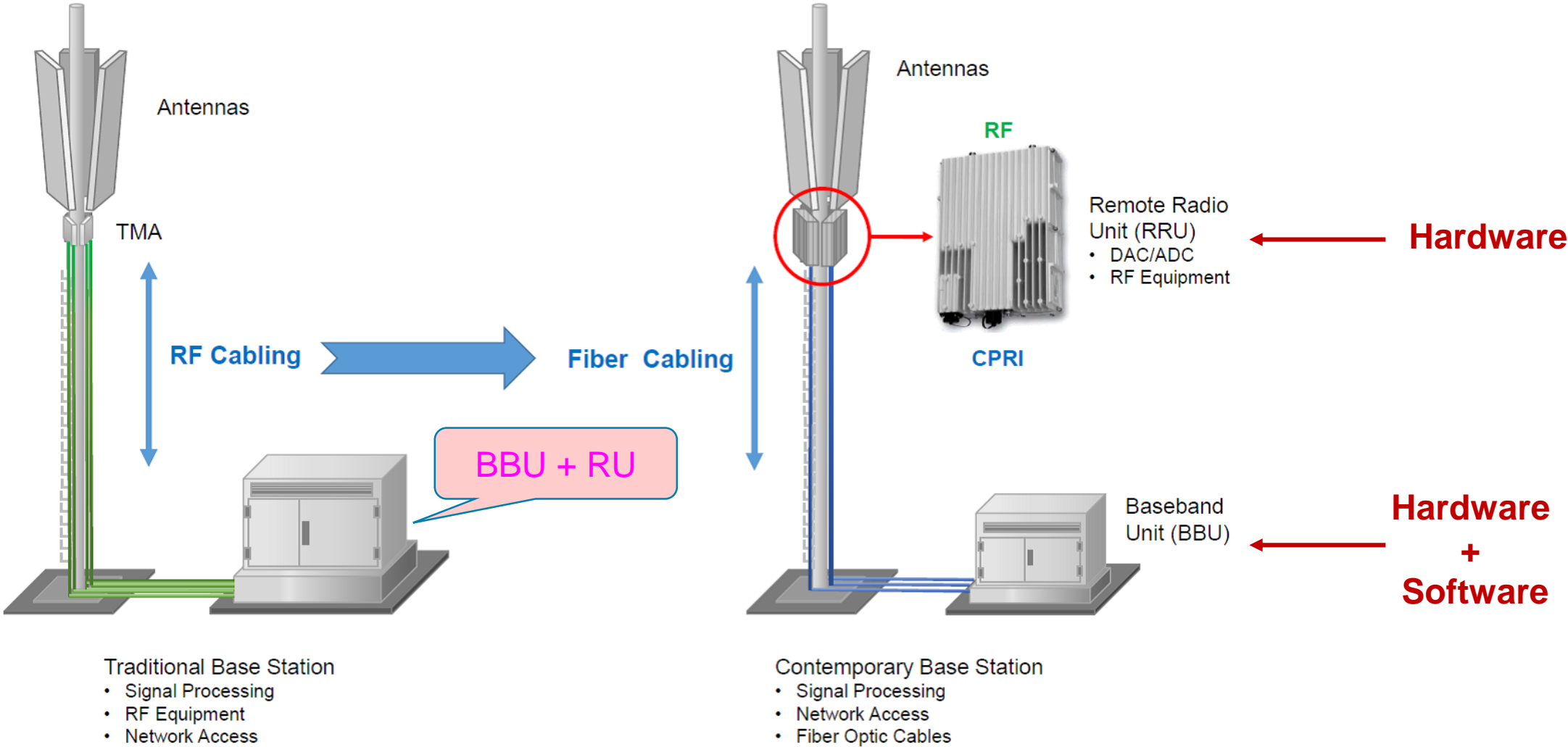


Traditional Base Station

- Signal Processing
- RF Equipment
- Network Access
- Long RF Cables

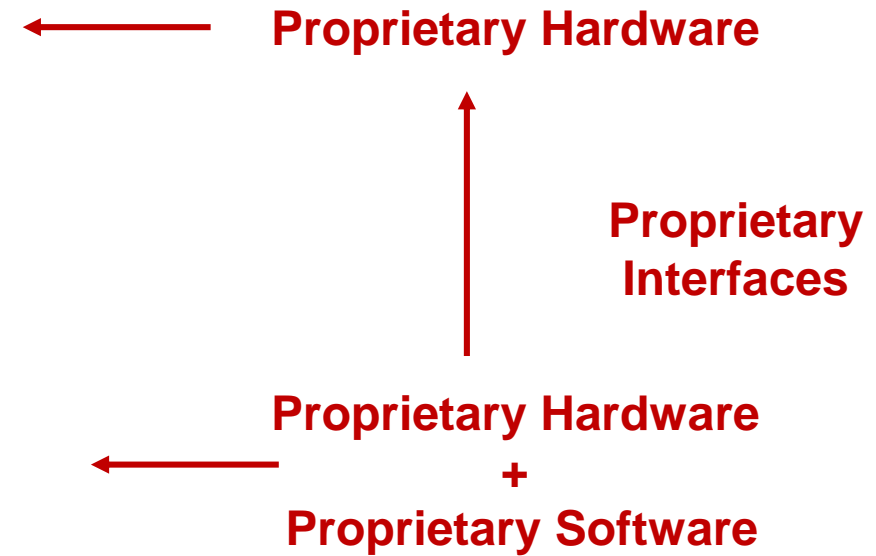
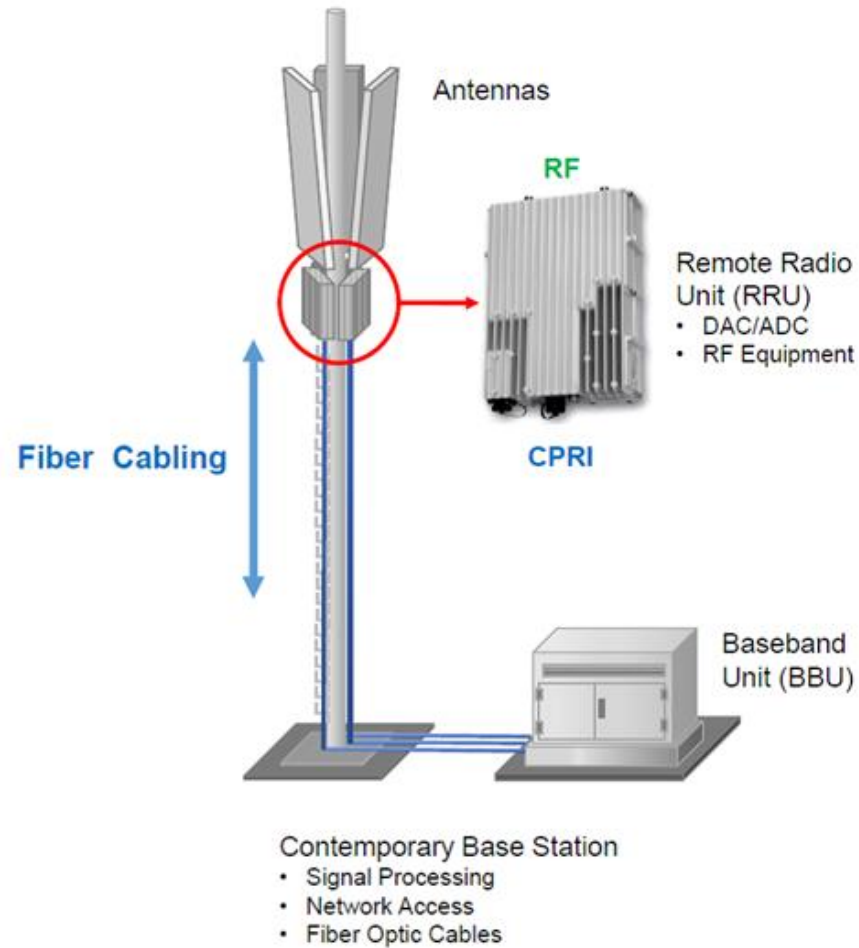
Base station picture source: [NI](#)

Mobile Towers in Real Life

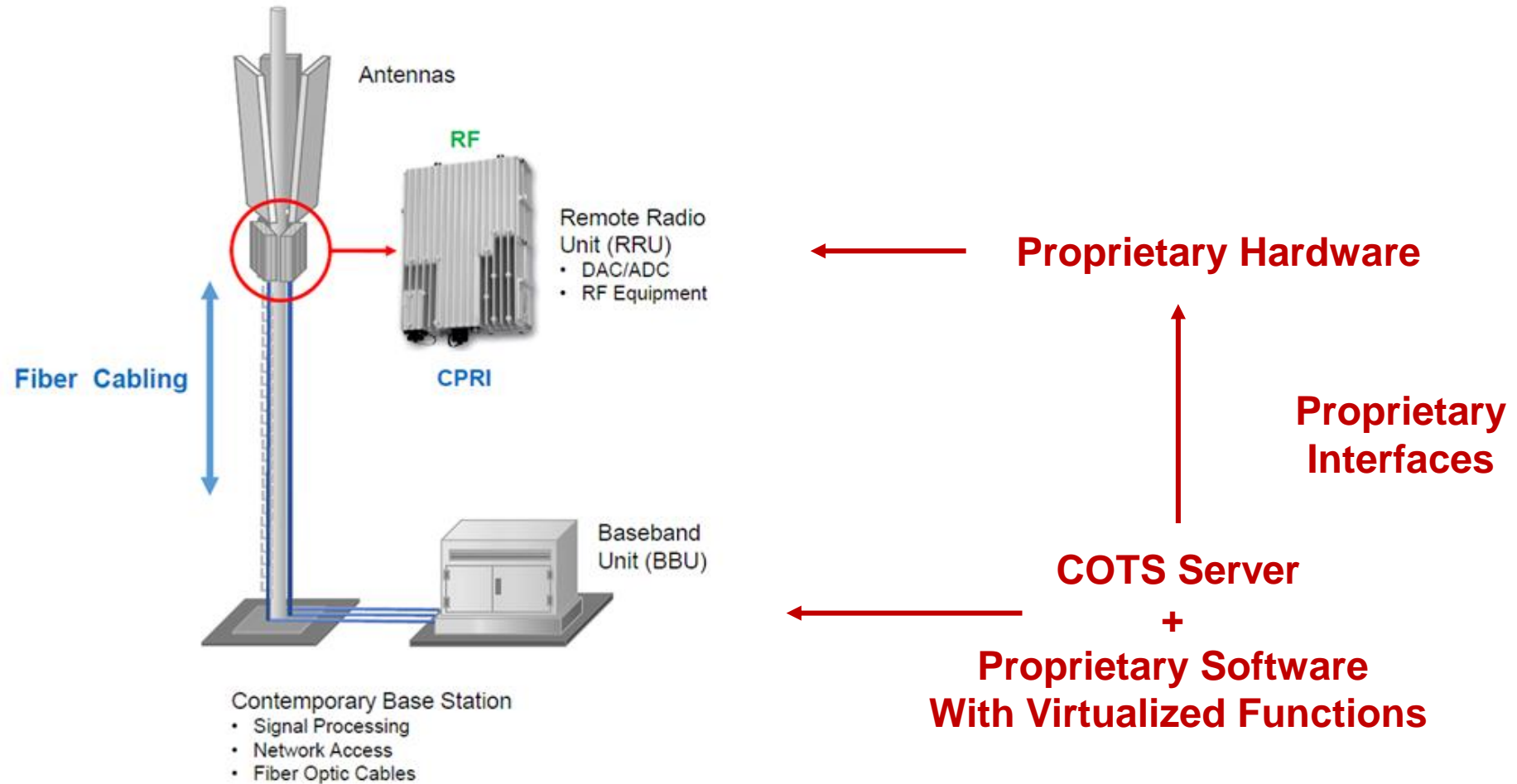


Base station picture source: [NI](#)

Typical RAN

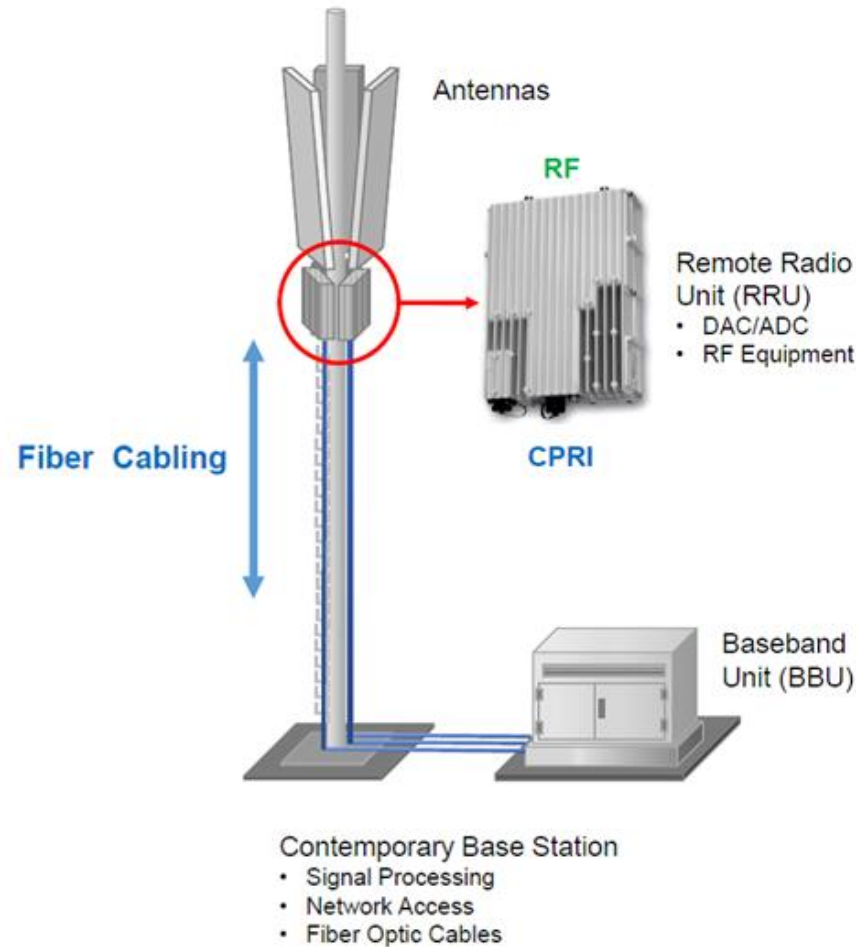


Virtualized RAN (vRAN) Approach



vRAN is not necessarily Open RAN

Open RAN: Disaggregating Hardware and Software

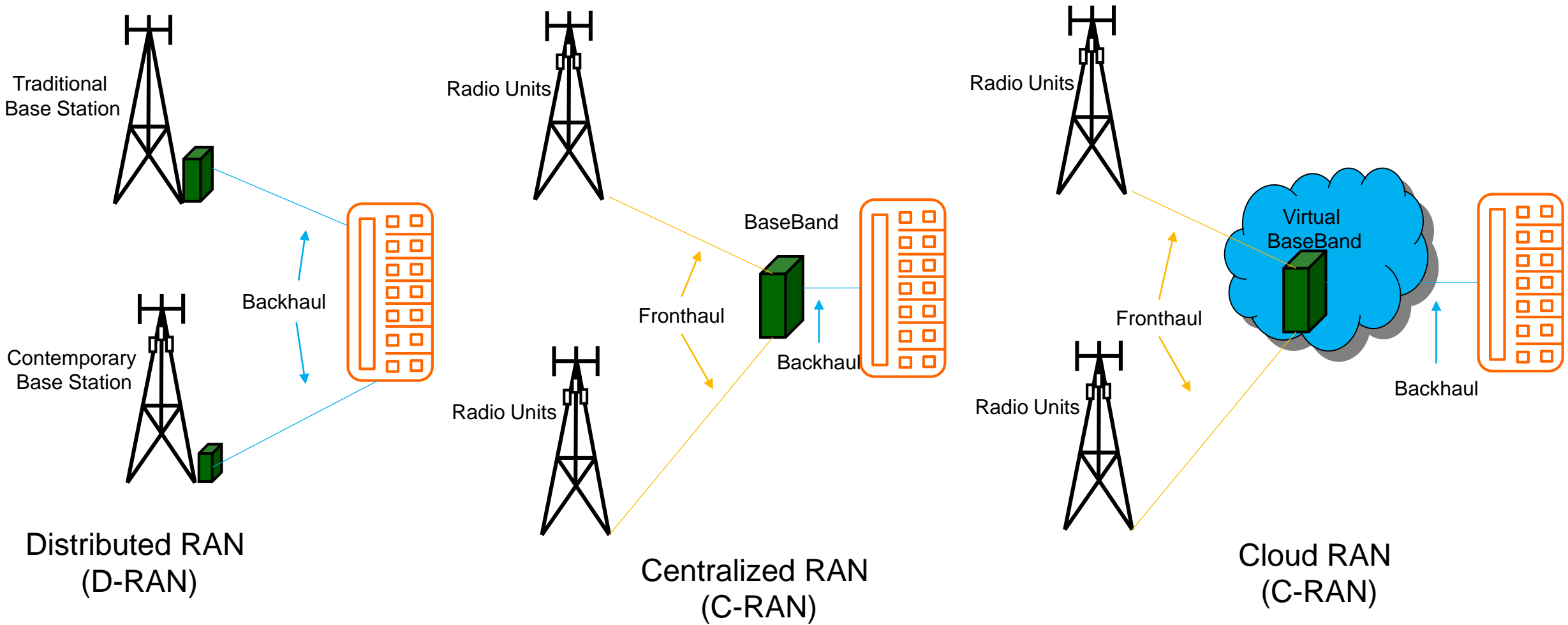


← **GPP based COTS Hardware (SDR)**
Can be purchased from any ODM / OEM / RAN Hardware Vendor

Open Interface
Any vendor software can
work on this hardware

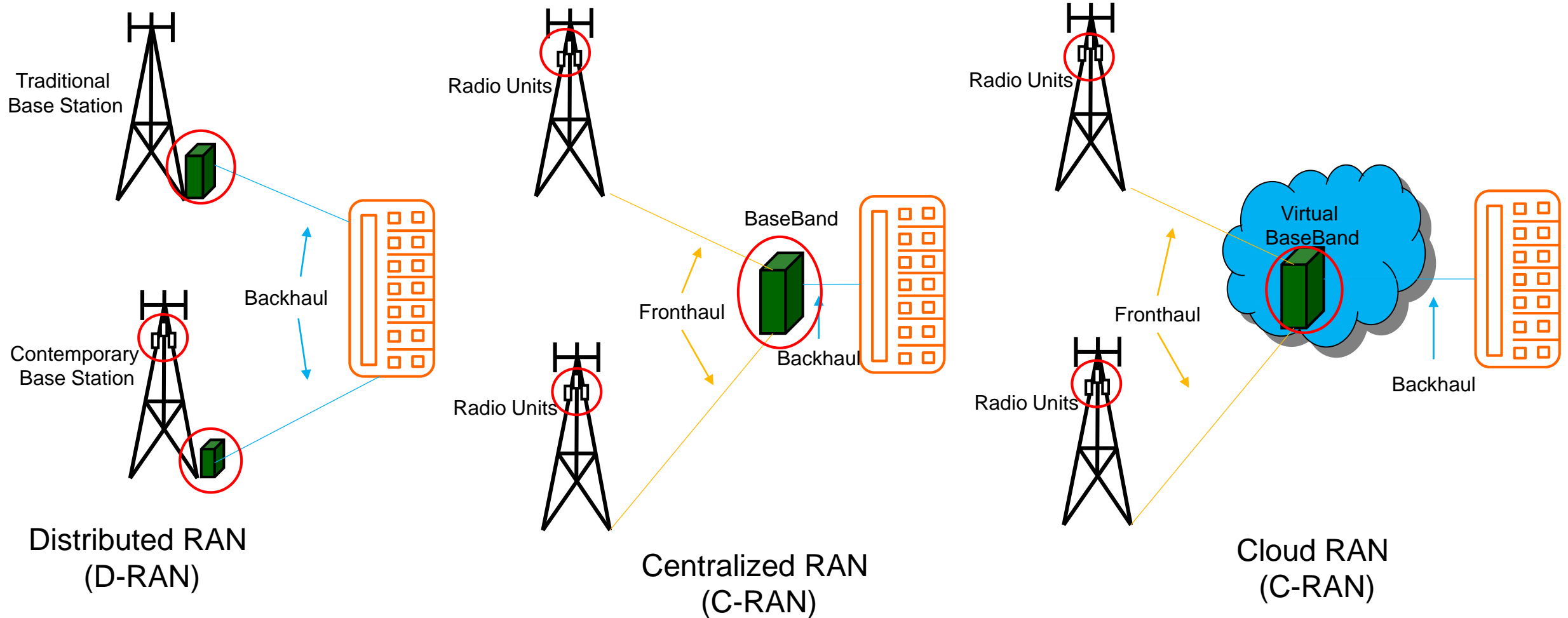
COTS Server
+
**Proprietary Software
With Virtualized Functions**

Different Types of Network Architecture

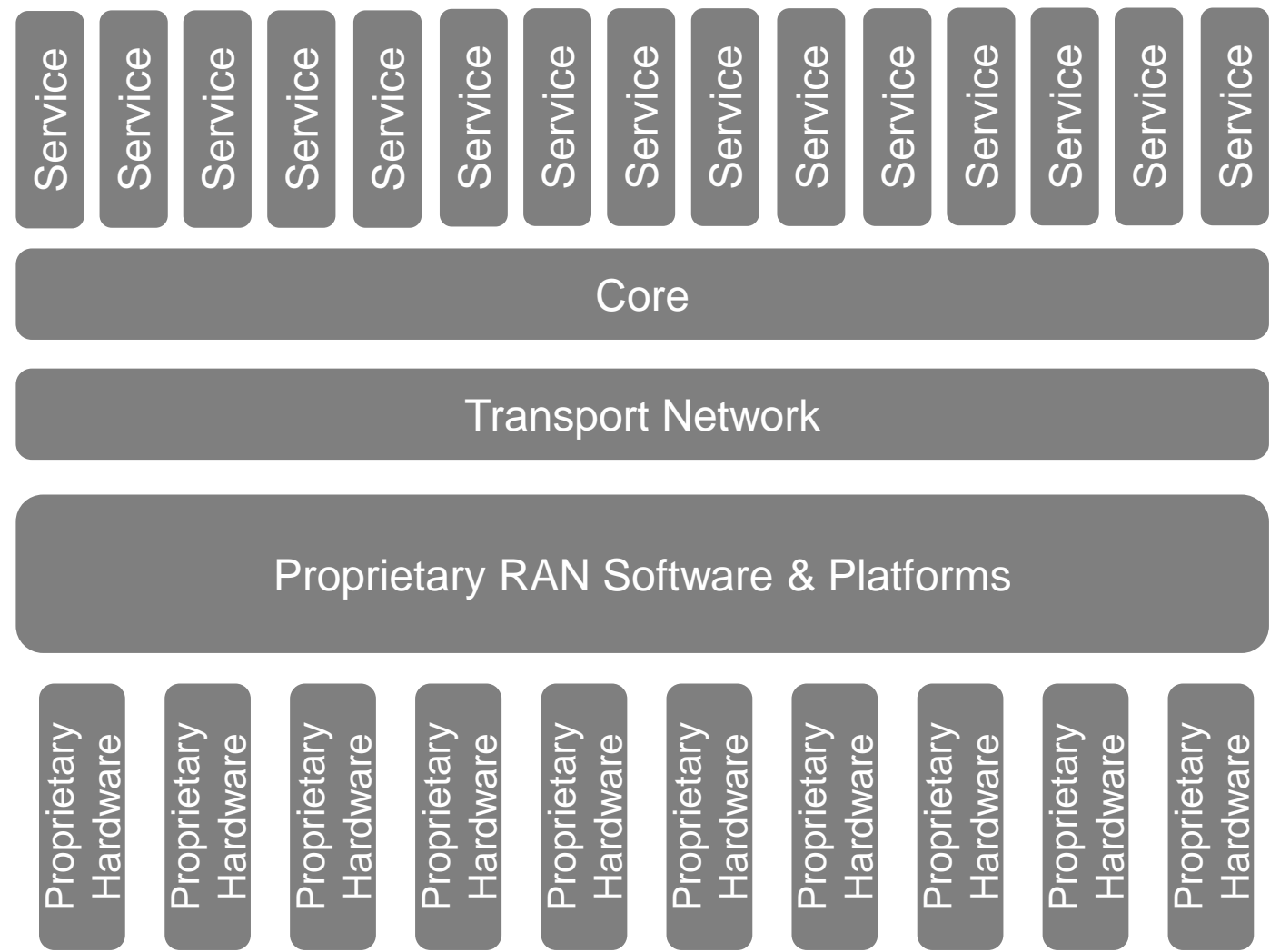


Different Types of Network Architecture

- Whitebox RAN = All-in-one GPP based base station
- But you can have a Whitebox RRU + COTS BBU

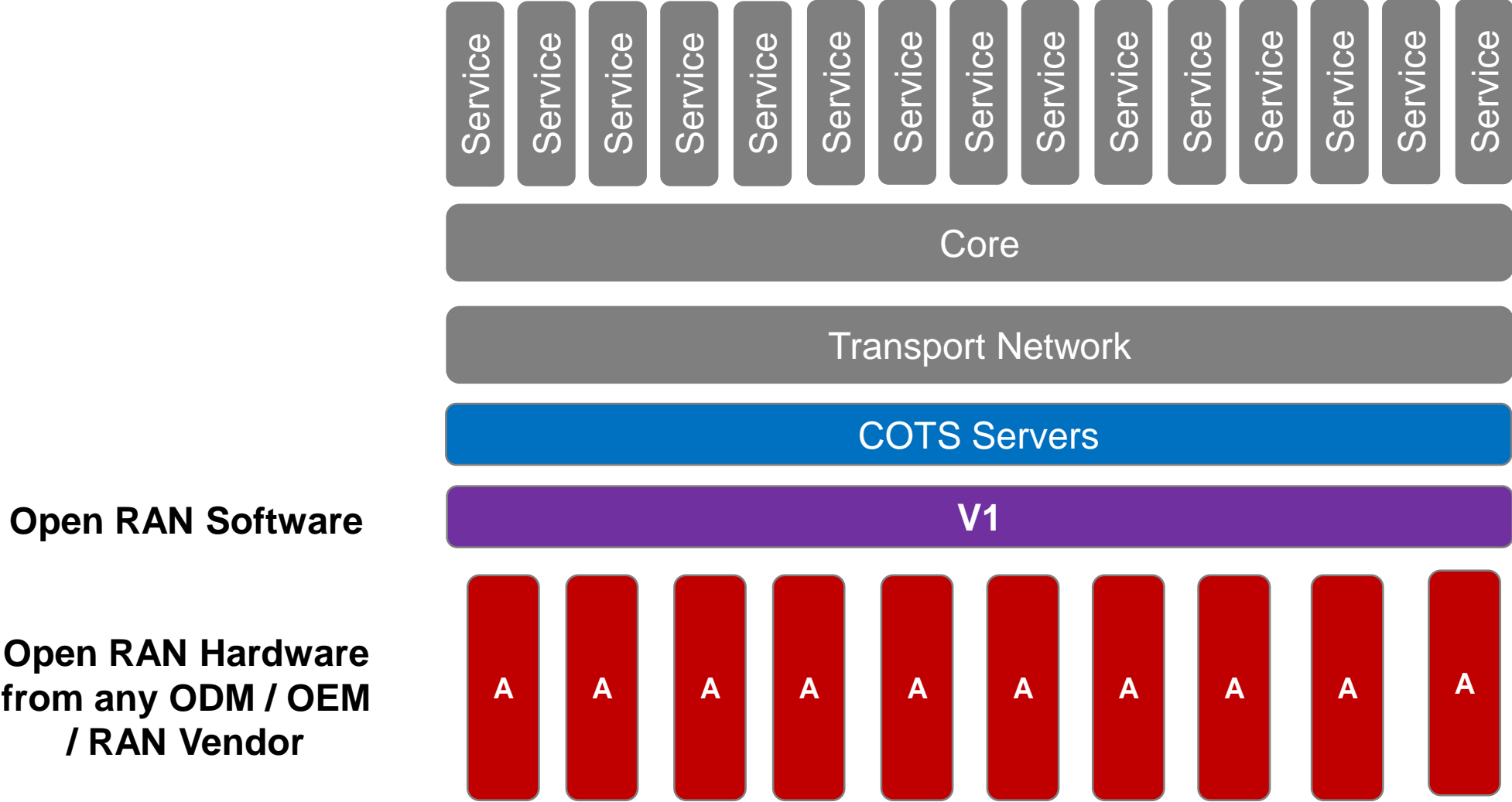


Example Scenario: Legacy Deployment Model



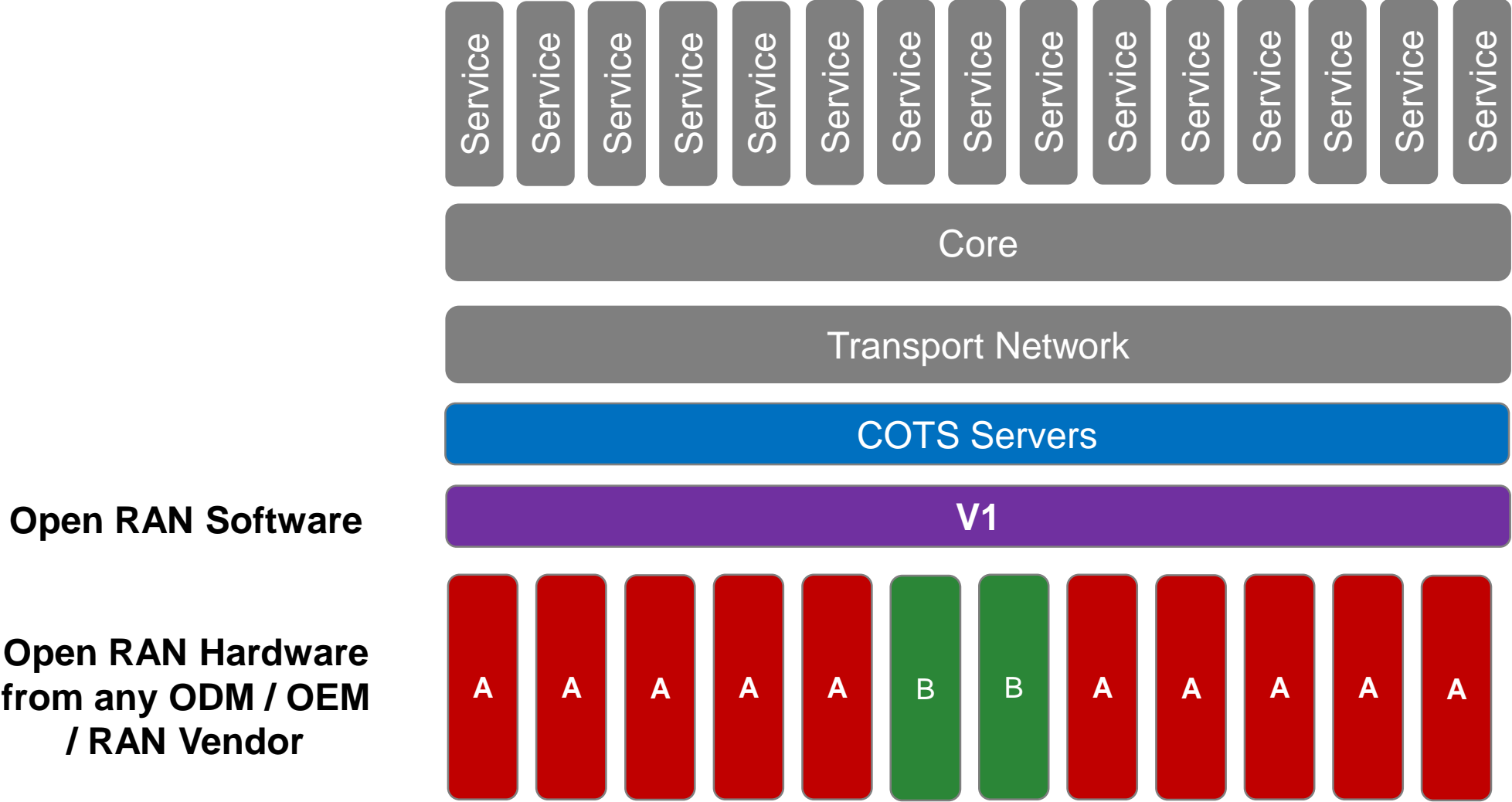
Example Scenario: OpenRAN Deployment Model

- Let's take an example scenario where Vendor V1 is supplying virtualized software and ODM/OEM A is supplying hardware



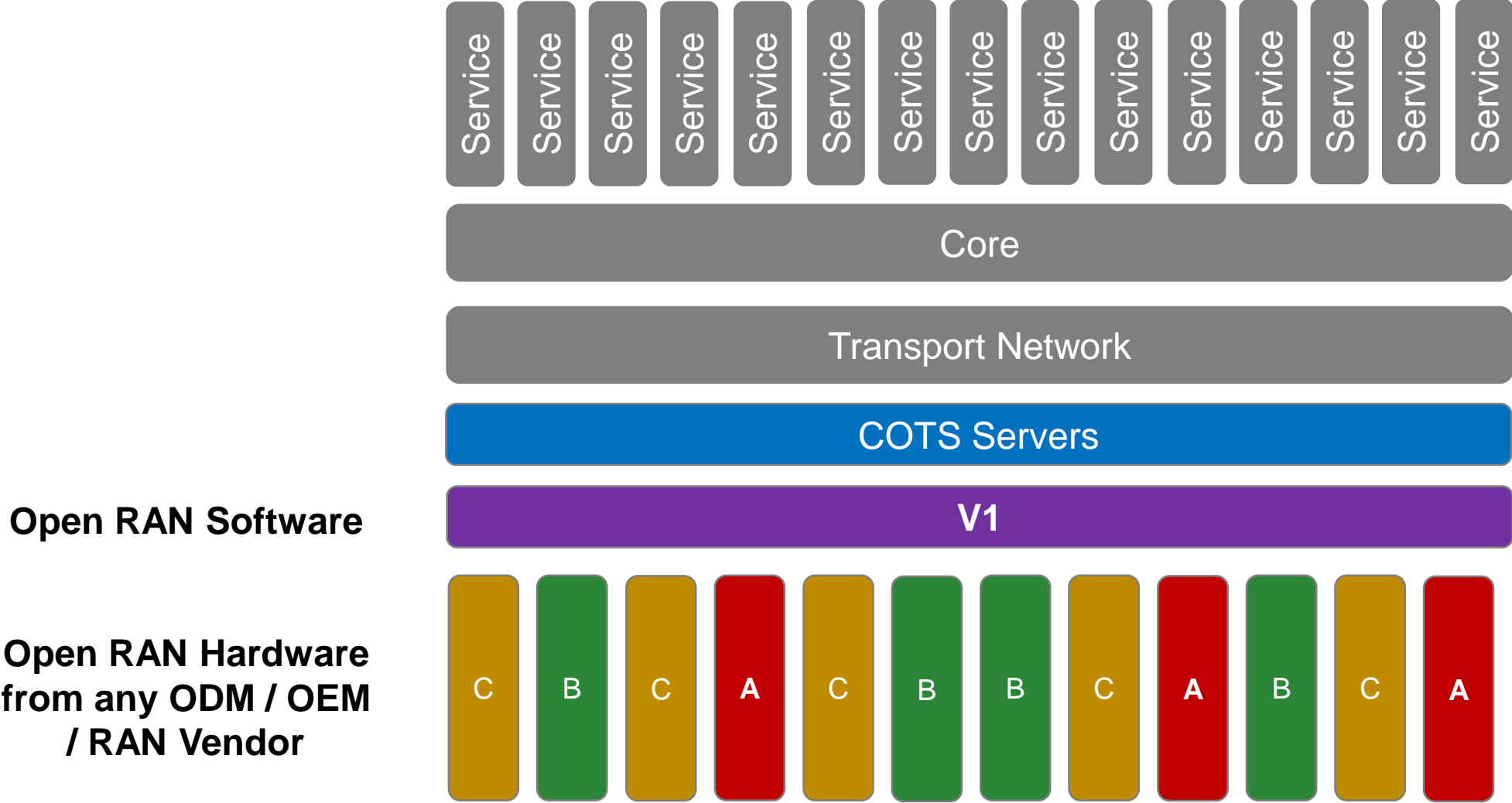
Example Scenario: OpenRAN Deployment Model

- New ODM/OEM B OpenRAN hardware can work out of the box with Vendor V1 software



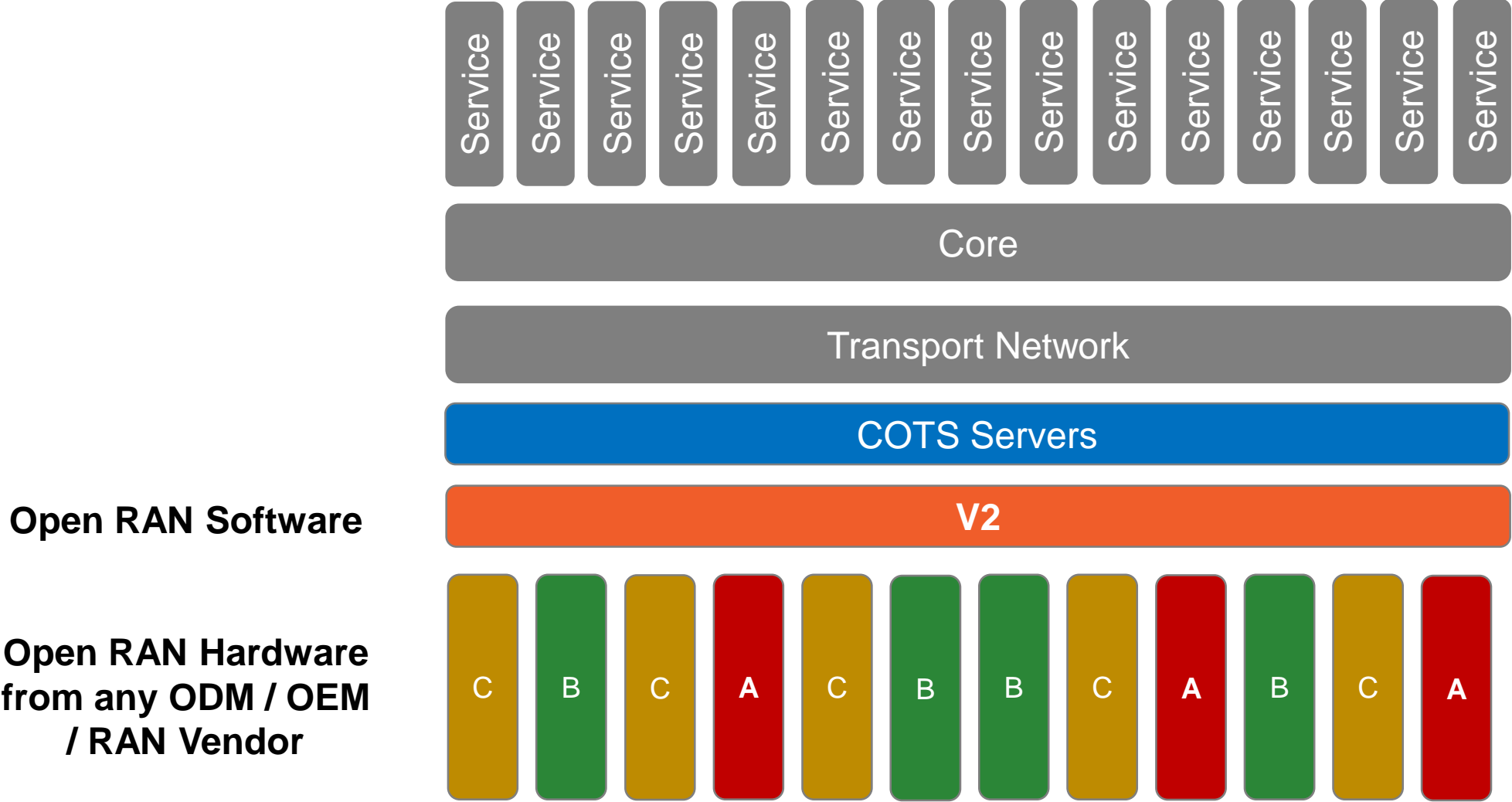
Example Scenario: OpenRAN Deployment Model

- Existing ODM/OEM A hardware could be swapped out easily when required with a new hardware either from ODM/OEM B or a newer ODM/OEM C



Example Scenario: OpenRAN Deployment Model

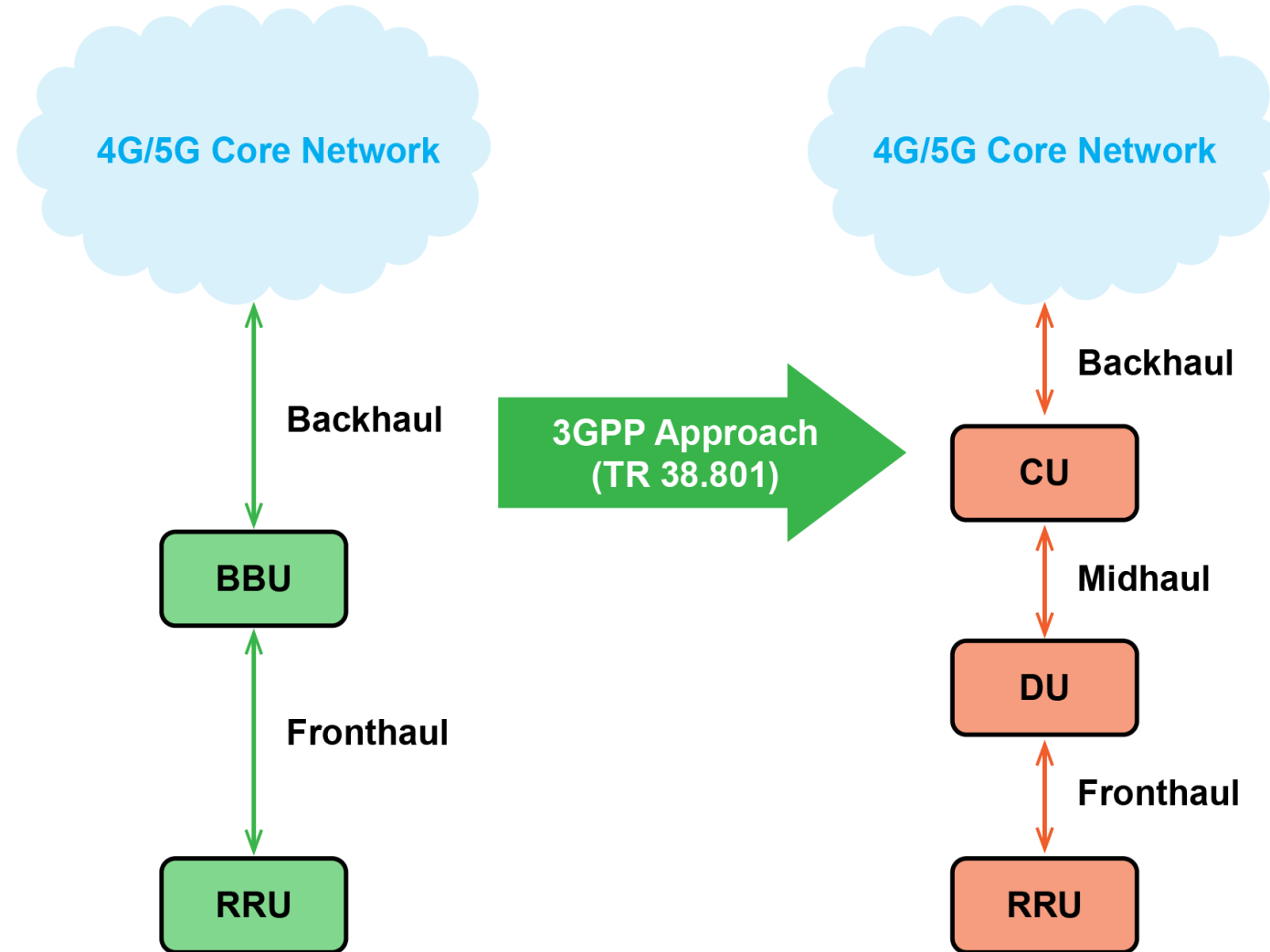
- SP / MNO could replace the OpenRAN software as easily as they did the hardware. Existing OpenRAN hardware continues to work with the new software from Vendor V2



Evolution to 5G OpenRAN

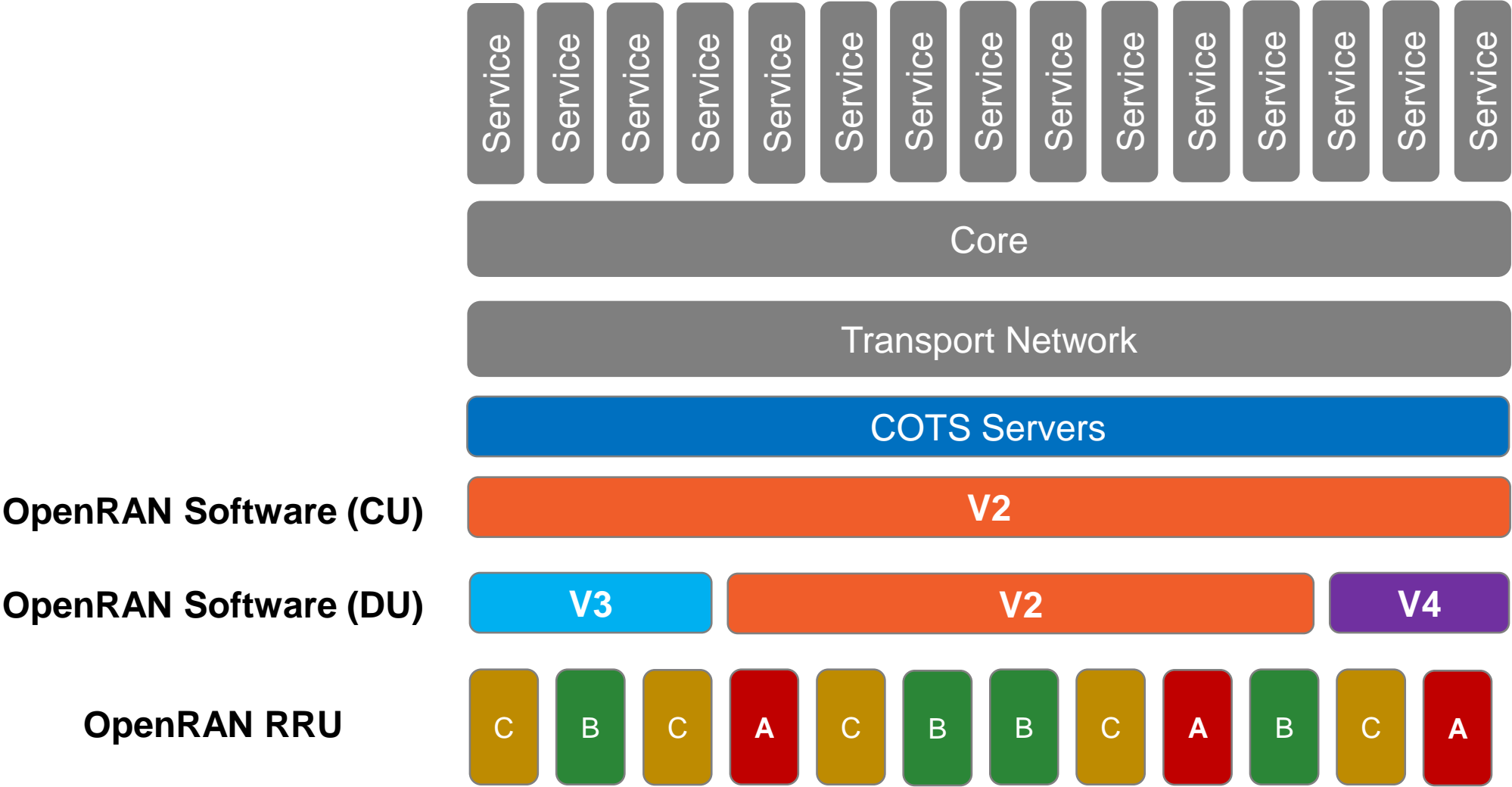
Distributed and Central Units

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

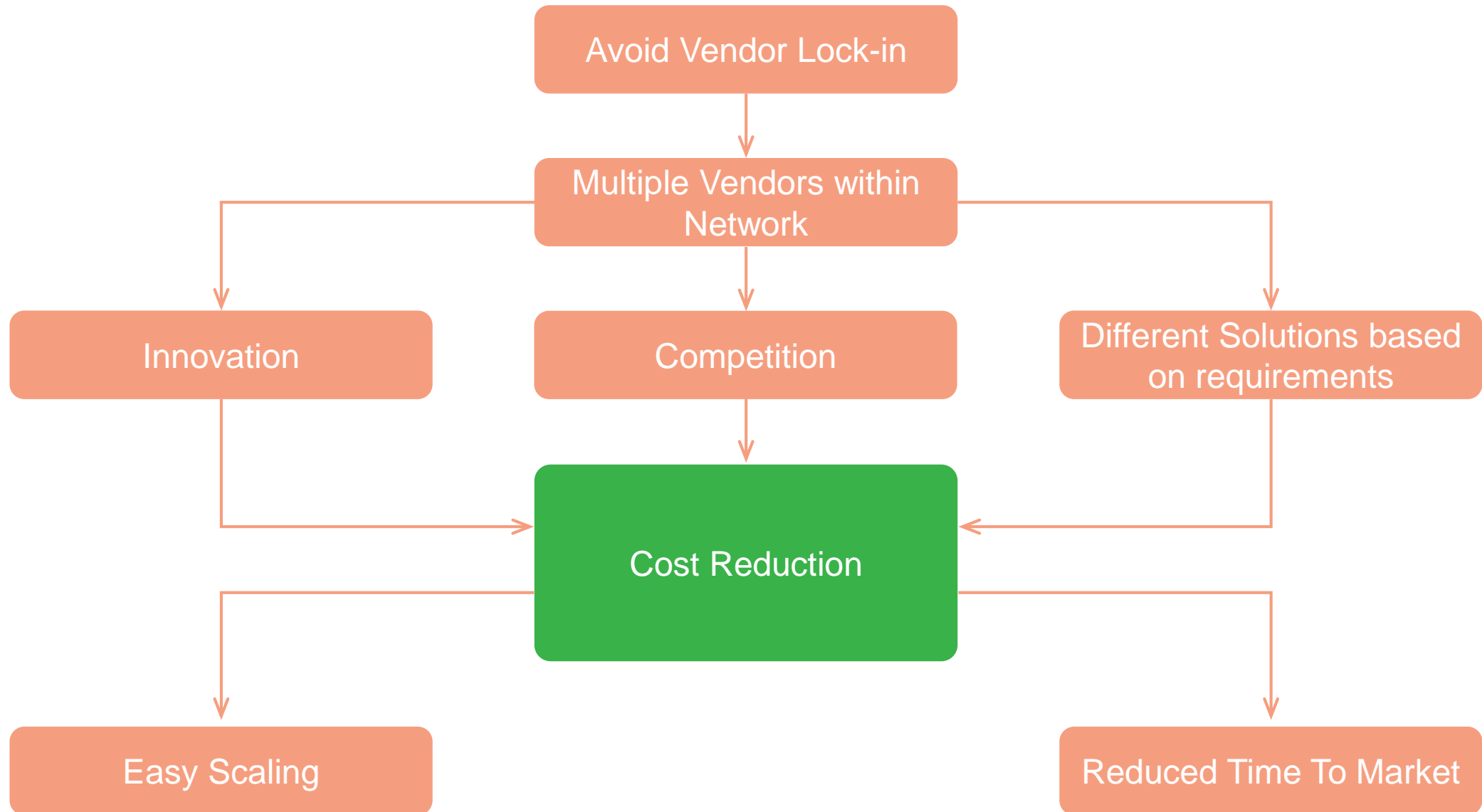


Example Scenario: 5G OpenRAN Deployment Model

- With CU, DU & RRU



Why are Service Providers Embracing Open RAN?



Some Facts About Open RAN

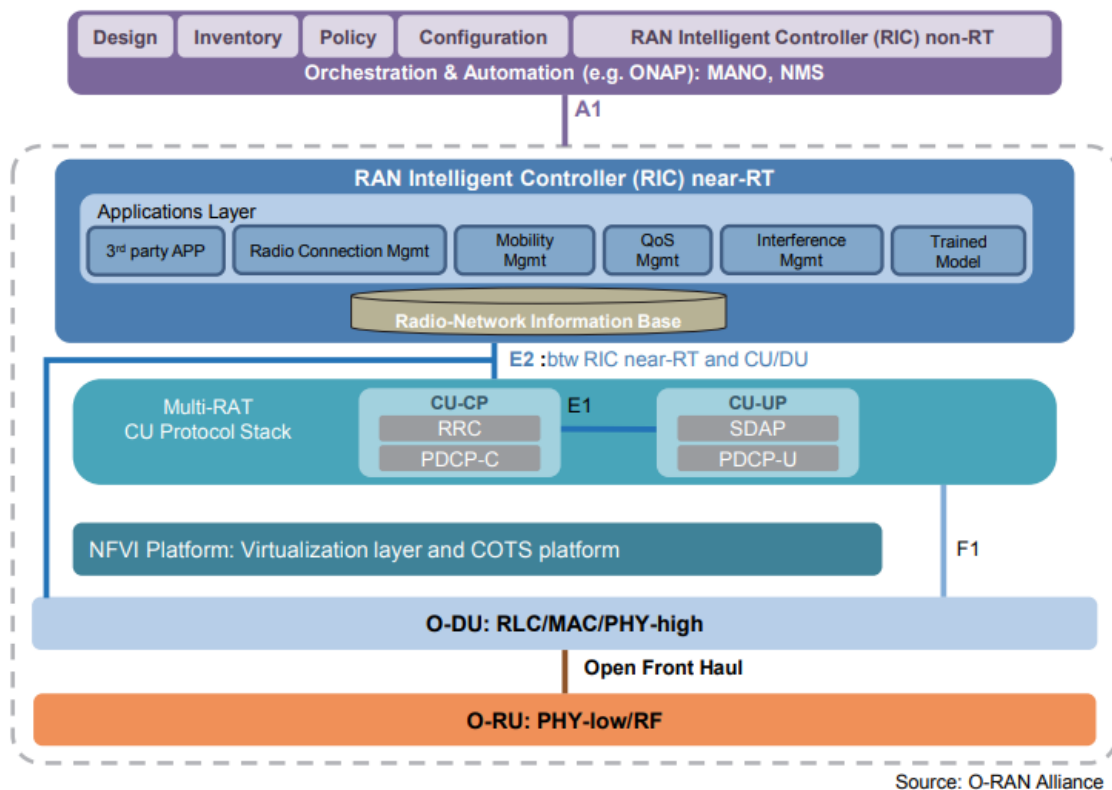
- Open RAN does not mean Open Source
- Open RAN does not apply to 4G & 5G only, but also to legacy 2G & 3G as well
- Open RAN vendors do not necessarily have to be part of some group



Major Ecosystem Influencers:

- O-RAN Alliance
- Telecom Infra Project
- Small Cell Forum

O-RAN Alliance



CP: Control Plane
MAC: Media Access Control
MANO: Management and Orchestration
NFVI: Network Functions Virtualisation Infrastructure
ONAP: Open Network Automation Platform
PDCP: Packet Data Convergence Protocol

PHY: PHYsical layer
RAT: Radio Access Technology
RF: Radio Frequency
RLC: Radio Link Control
RRC: Radio Resource Control
SDAP: Service Data Adaptation Protocol
UP: User Data Plane

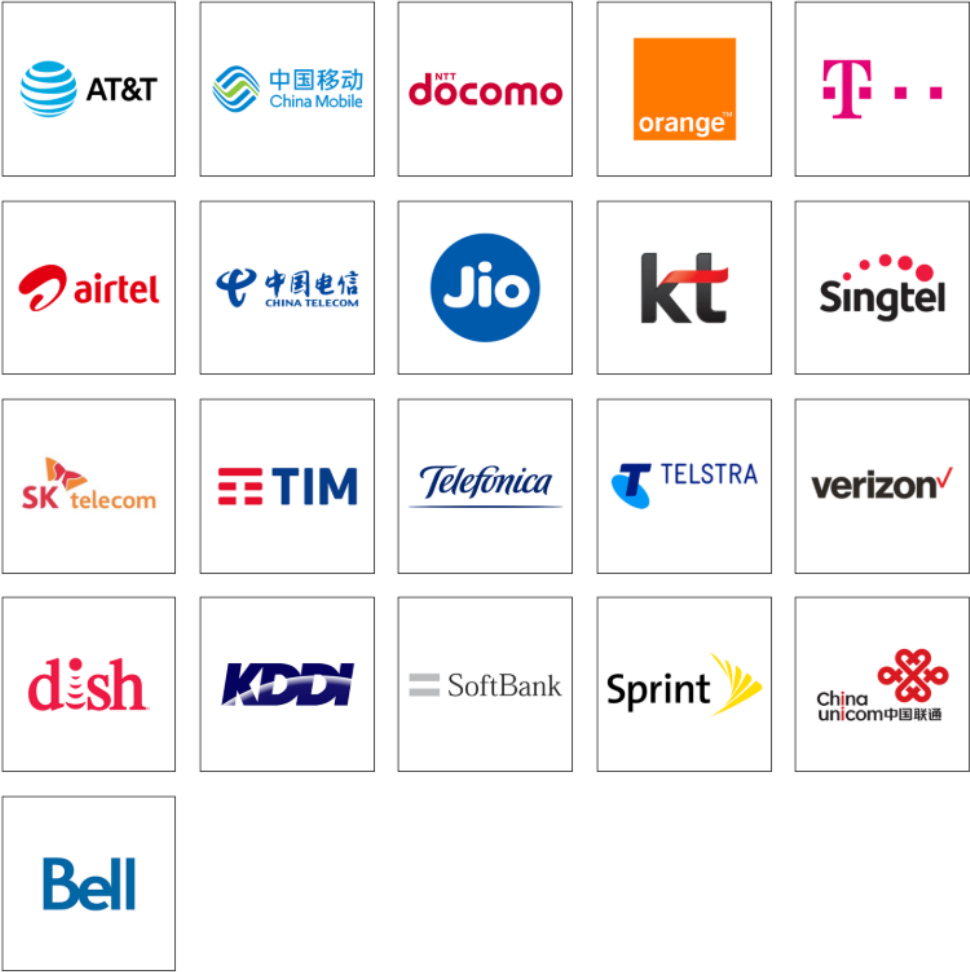
O-RAN Alliance Reference Architecture



- Official O-RAN alliance [website](#)
- NTT Docomo Technical Journal, July 2019 has a good summary:
 - O-RAN Alliance [Standardization Trends](#)
 - Overview of O-RAN [Fronthaul Specifications](#)

O-RAN Alliance Members

OPERATOR MEMBERS



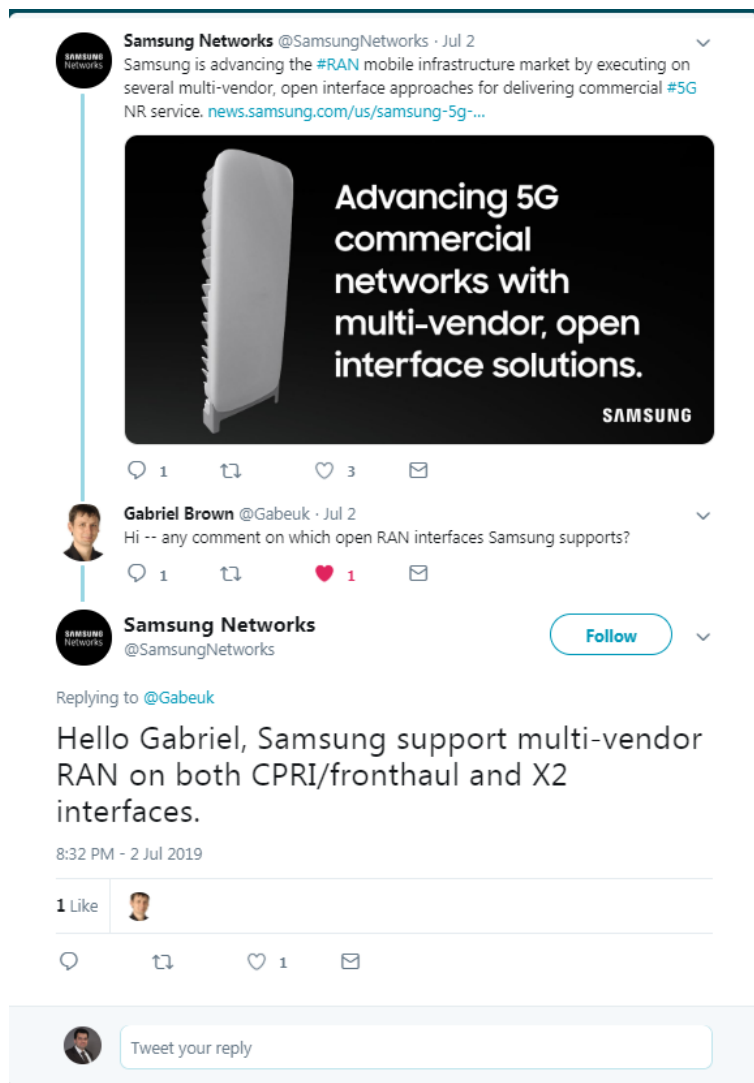
O-RAN ALLIANCE CONTRIBUTORS

The O-RAN Alliance Membership package is now available and contributors are now able to join. Contributor logos will be added below as each completes the on-boarding process.

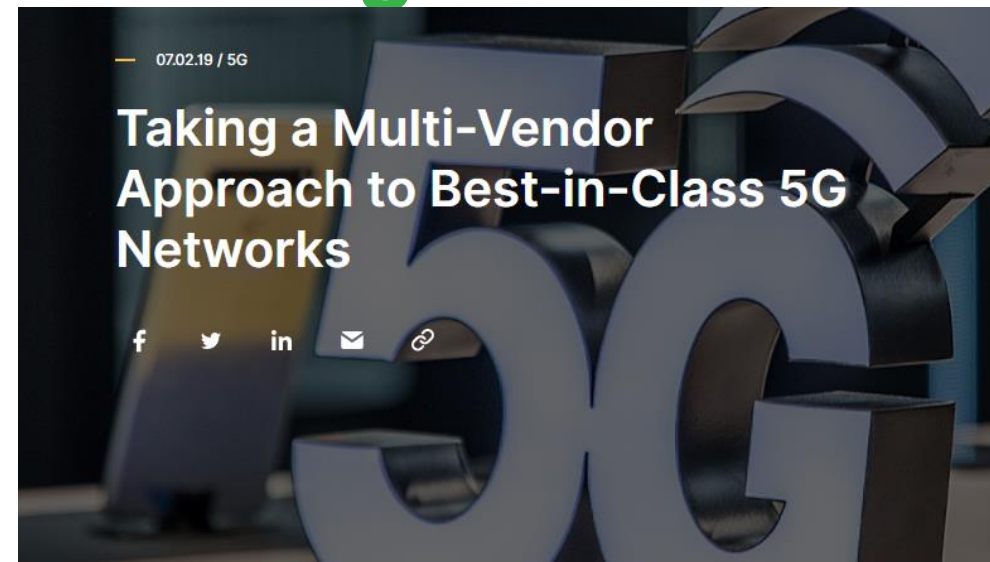
MEMBERSHIP INFORMATION



Vendor Announcements: Samsung



Source [Tweet](#)



Through open interfaces, Samsung helps accelerate rollouts of commercial 5G New Radio (NR) markets

Over the last few years, Samsung Networks has worked closely with its carrier partners to advance 5G, beginning with pre-commercial trials that tested the power of 5G in moving vehicles, test labs, and on-site locations ranging from stadiums to businesses to schools. Those trials led to the [commercial launch of Verizon 5G Home in four U.S. cities](#) last October. And the innovation continues with Samsung's support of the recent launch of Verizon 5G Ultra Wideband, available in Providence and Denver.

[Samsung PR](#): Taking a Multi-Vendor Approach to Best-in-Class 5G Networks

O-RAN Announcements

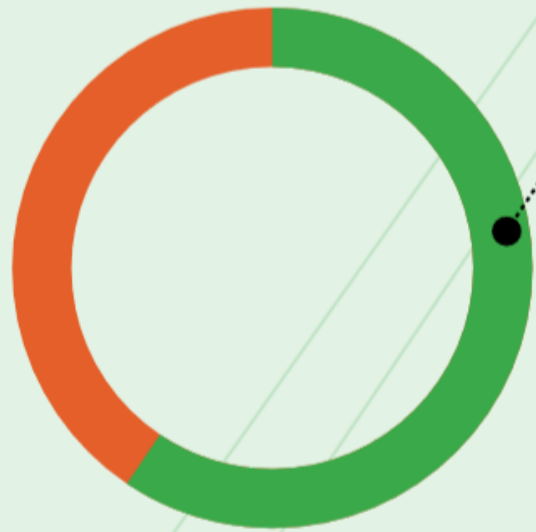
- 18 Sep 2019 - Docomo achieves multi-vendor interoperability across a variety of 4G and 5G base station equipment in collaboration with Fujitsu, NEC and Nokia ([link](#))
- 03 July 2019 - Radisys contributes 5G software code to the O-RAN Alliance ([link](#))
- 25 June 2019 - Radisys, Intel and China Mobile Team Up to demonstrate a 5G New Radio reference architecture and use cases based on the O-RAN Alliance specification. ([link](#))
- 14 June 2019 - Telecom TV: Orange reveals O-RAN interoperability breakthrough ([link](#)) - *successfully completed an implementation test of the X2 interface between equipment from Nokia and Ericsson.*
- 13 June 2019 - Fierce Wireless: AT&T, Nokia open up the radio's edge to third party apps ([link](#))
- 03 April 2019 - AT&T: Opening Up for 5G and Beyond: Open Source and White Box Will Support New Data Demands ([link](#))

Telecom Infra Project (TIP)

TIP Project Groups		
Access Projects	Backhaul Projects	Core & Management Projects
Edge Computing	Millimeter Wave (mmWave) Networks	Artificial Intelligence and Applied Machine Learning
Edge Application Developer	Open Optical Packet Transport	End-to-End Network Slicing (E2E-NS)
Power and Connectivity		People & Process
System Integration and Site Optimization		
Open Cellular		
Solutions Integration		
Open RAN		
CrowdCell		
vRAN Fronthaul		
5G NR		
WiFi		
TIP Community Labs		
TEAC		

Telecom Infra Project [Website](#)

The Facebook TIP Open Compute Initiative started the movement towards Open RAN –



Since RAN is

60% **of Capex and Opex**

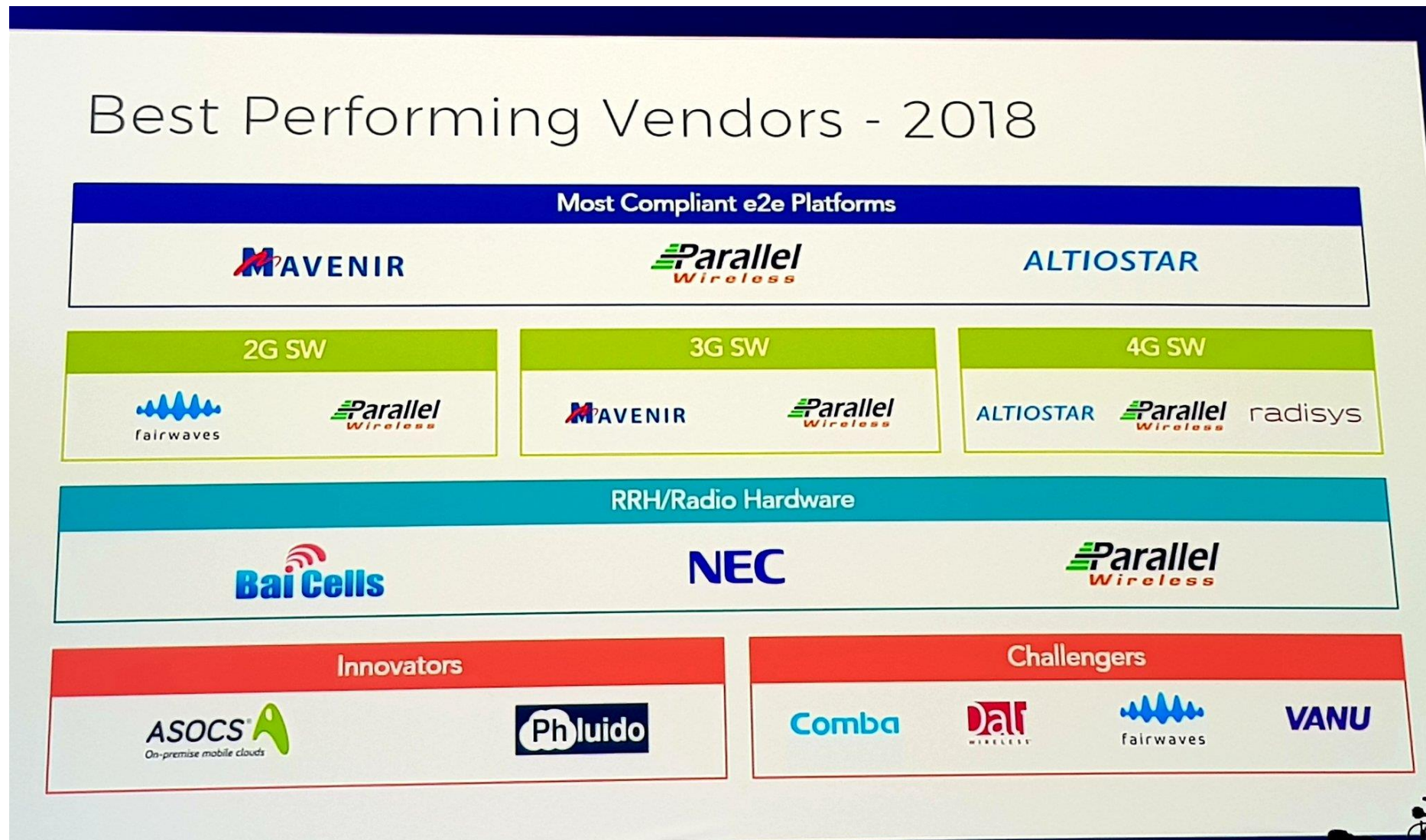
it is the most important cost factor to focus on in telecom

PW Are Active in the Open RAN & 5G NR Groups



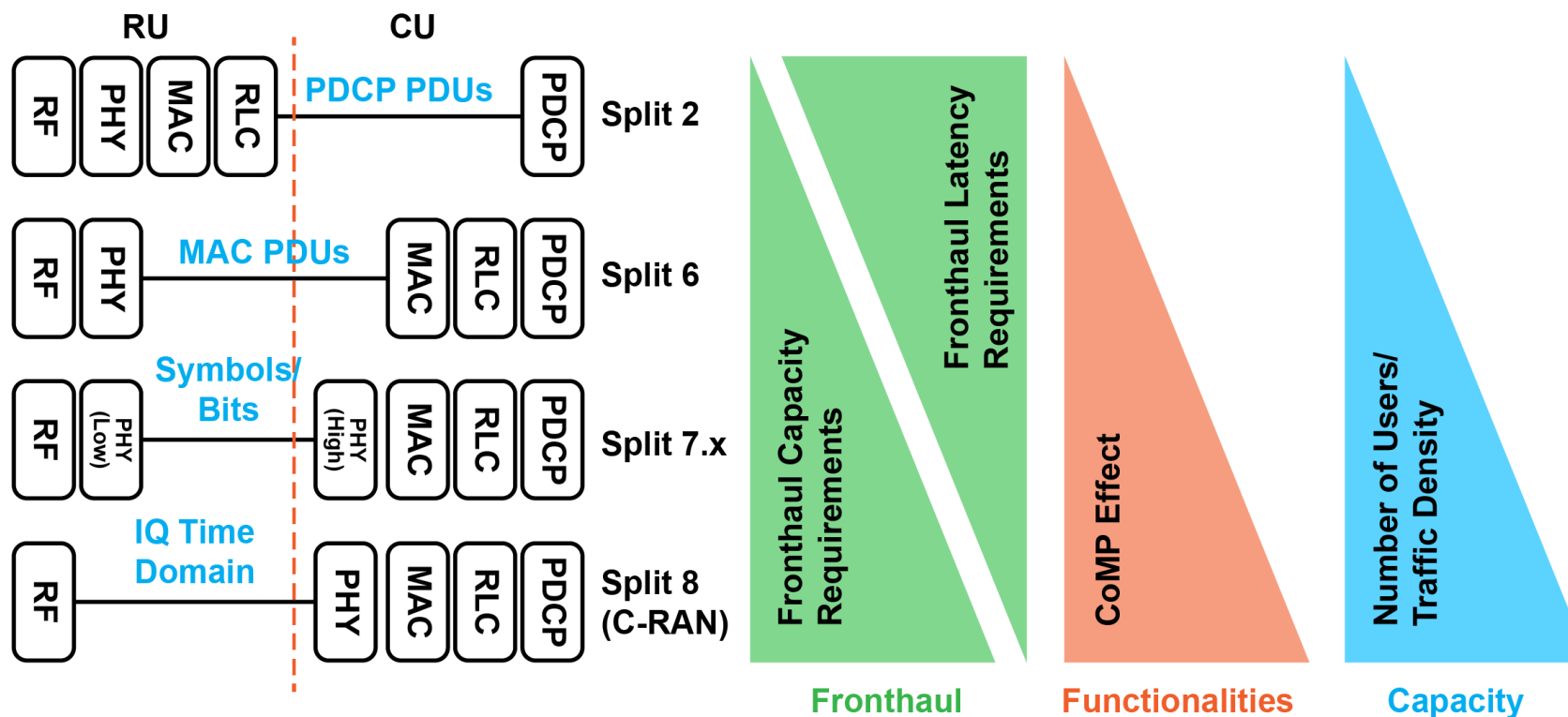
TIP Summit 2018

Best Performing Vendors for Joint Vodafone / Telefonica RFI



Picture Source: [Andy Sutton](#)

5G RAN Functional Splits Trade-Offs

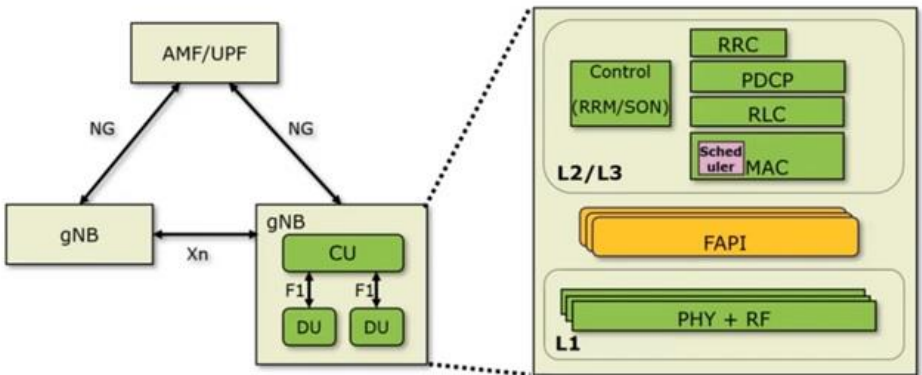


- Not a single split is going to fit all
- Different morphologies require different splits
- Only a software-based RAN can support dynamic and fluid split options
- Control plane splits (vertical) are as important as user plane splits (horizontal)

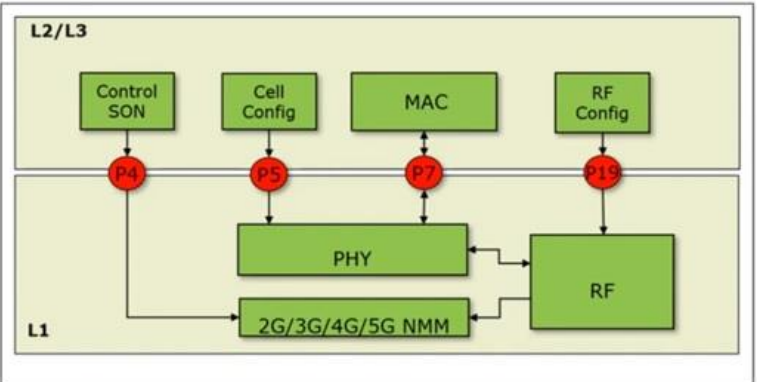
Small Cell Forum (SCF)

5G-nFAPI between DU and CU

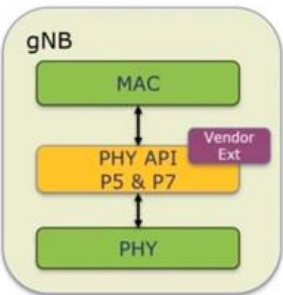
FAPI Location



Defined FAPI Interfaces



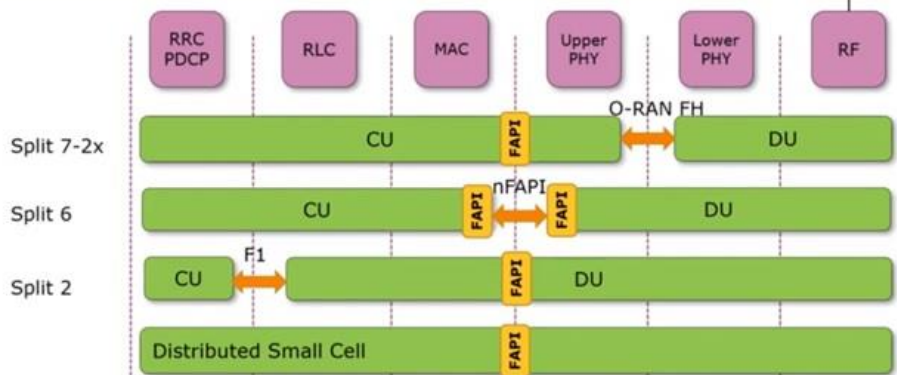
5G PHY API



- Interface is abstracted from underlying architecture
- Control messages (P5) move PHY through a state machine to RUNNING state where a small cell becomes active
- Per Slot/TTI messages (P7) define what is transmitted and received over the air every subframe



Multiple Architectures for Small Cells

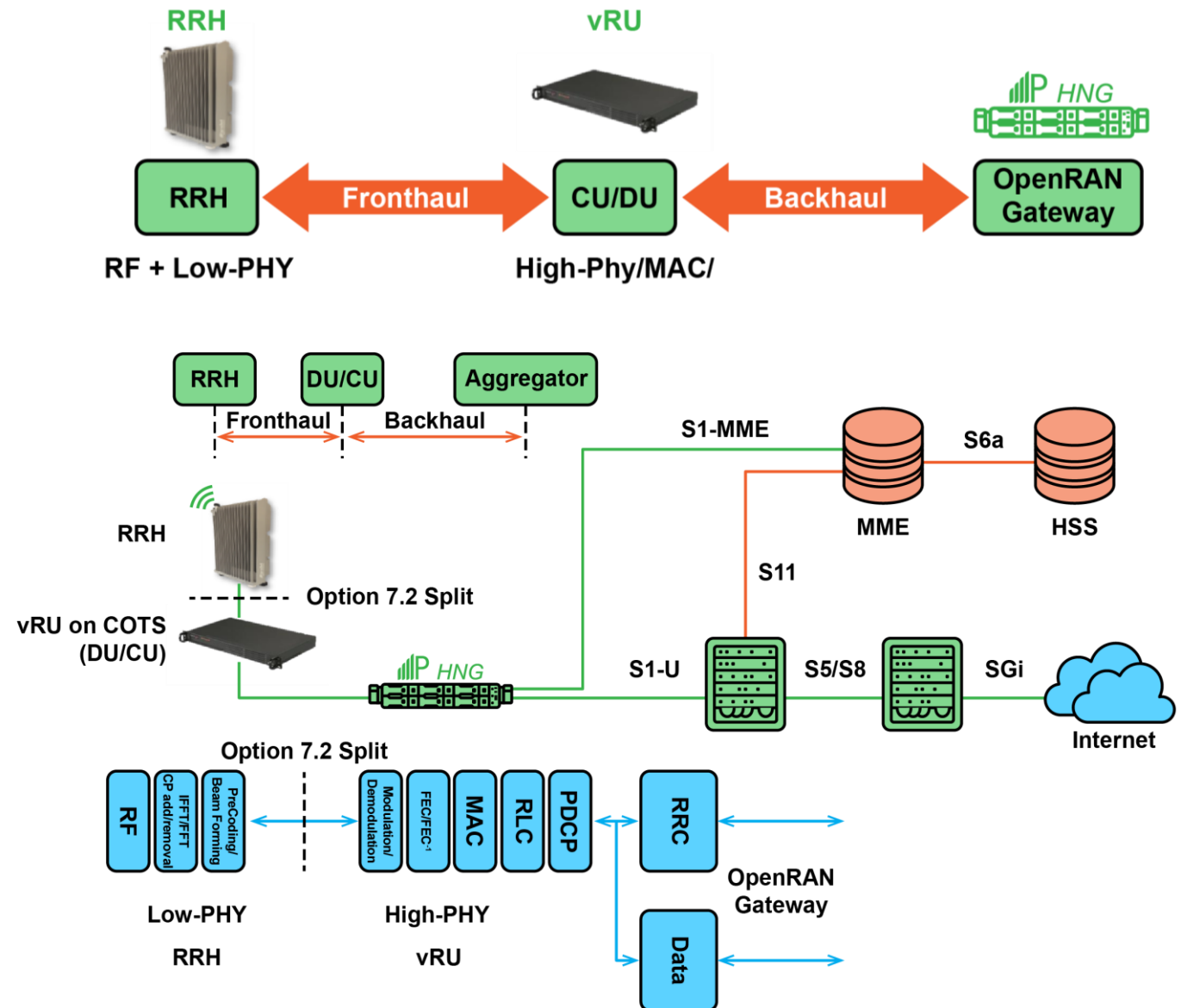


More details on [3G4G Small Cells Blog](#)

Parallel Wireless Split Architecture

Split architecture for All Gs

- Remote Radio Head (RRH): third party off the self RRH
- Virtual Radio Unit (vRU): COTS server to act as a CU/DU
- HetNet Gateway (HNG): full software based All G SON and orchestrator
- Split 7.2 for efficiency and fronthaul scalability



Long-Term Benefits of OpenRAN

- Software Defined
 - Space & Energy Savings for legacy networks
- Disaggregation
- Interoperability
 - Multi-vendor networks
- Future-proofed
- Network Automation
- Scalable & Agile
- Capex & Opex Savings

Articles on Open RAN

- Sep 2019: [OpenRAN - 7 Vital Benefits For MNOs](#) – Modern Ghana
- March 2019: [Open RAN at the TIP-ping point](#) – The Mobile Network
- March 2019: [Taking the Open RAN commercial](#) – The Mobile Network
- March 2019: [O-RAN aims to eliminate vendor lock-in at the radio access network](#) – Fierce Wireless
- Feb 2019: [Altiostar gets big RAN win in Rakuten's virtual network showcase](#) – The Mobile Network
- Dec 2018: [Open RAN, Open Innovation](#) – Light Reading
- March 2018: [Opening up on the Open RAN](#) – The Mobile Network
- The 3G4G Blog: A quick tutorial on Open RAN, vRAN & White Box RAN ([link](#))

Parallel Wireless Technical Training Webinars

#PWTechTrain

- July 2019 - [Introduction to Open RAN: Informational overview of Open RAN initiatives](#)
- July 2019 - [How Open RAN Drives Down Cost: Open RAN case studies](#)
- March 2019 - [5G 101 Part 1](#)
- April 2019 - [5G 101 Part 2](#)
- April 2019 - [5G at MWC 2019](#)
- May 2019 - [5G NR Logical Architecture and its Functional Split Options](#)



www.parallelwireless.com