Exploring DPDK's Role in 5G Architecture

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Agenda

- Antitrust Policy Notice
- Webinar Goal
- Speaker Introduction
- 5G Network Introduction
- Where can 5G be used in 5G Ran
- Purpose Built RAN, Open RAN & Cloud RAN
- Evolution and Advancements in 5G RAN
- Exploring DPDK's Role in 5G Architecture
- Q&A Session

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Speaker Introductions

Thomas Monjalon
Lead Maintainer, DPDK
Senior Staff Engineer, Nvidia

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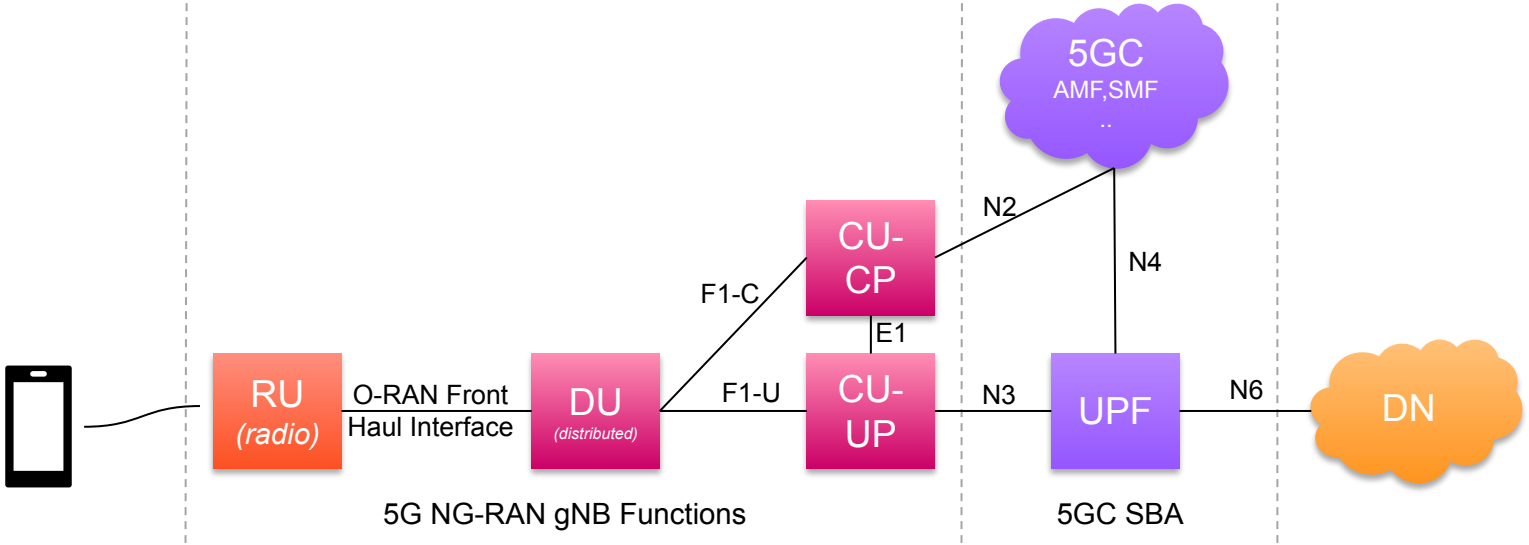
Cloud RAN Solutions Architect, Intel

Oscar Toorell
Head of Technology, Engineering Unit Cloud RAN, Ericsson

Elena Agostini
Senior Software Engineer, Nvidia

5G Network Introduction



3GPP Defined 5G System Architecture

Open RAN Alliance Front Haul interface between O-RU and O-DU (O-RAN compliant 3GPP Network Functions)

Purpose Built RAN, Open RAN & Cloud RAN

Purpose Built RAN

Black Box

Appliance Type Implementation

Fully 3GPP Compliant

gNB

Cloud RAN

GPP Platform

VM's or Kubernetes

Cloud Native

Fully 3GPP Compliant

gNB NFs

Kubernetes

GPP (CPU, I/O, Memory)

Open RAN

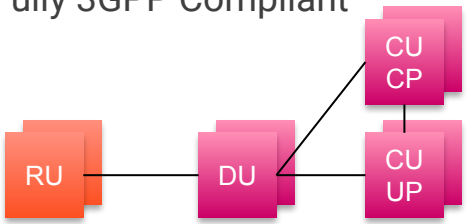
Open Interfaces

RAN Intelligent Controller

Open Radio interface

Orchestration & Management

Fully 3GPP Compliant

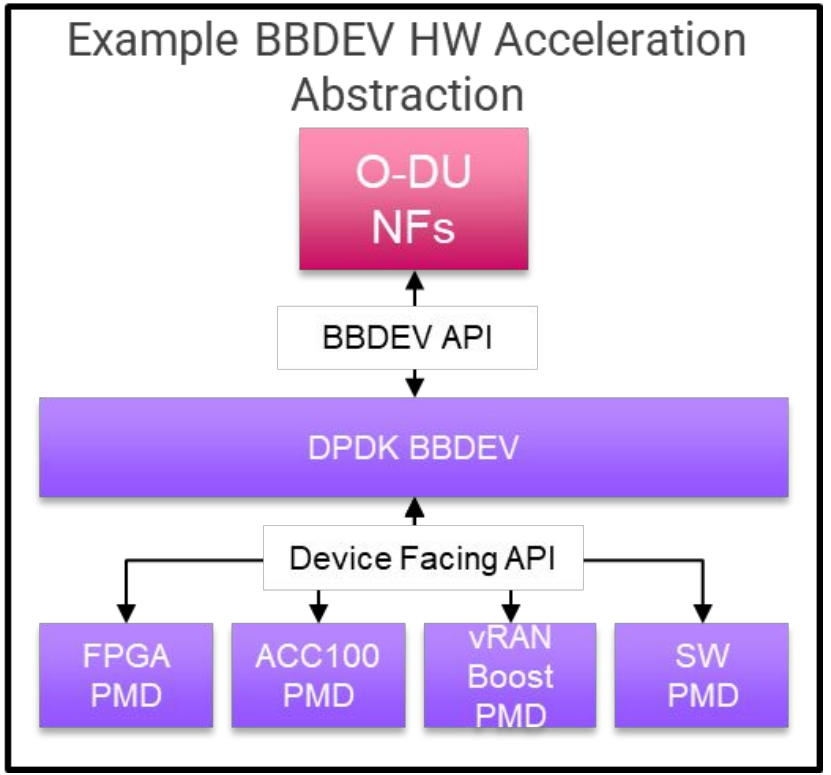


DPDK for O-RAN AAL Implementation

O-RAN AAL Acceleration Abstraction Layer for HW Accelerators

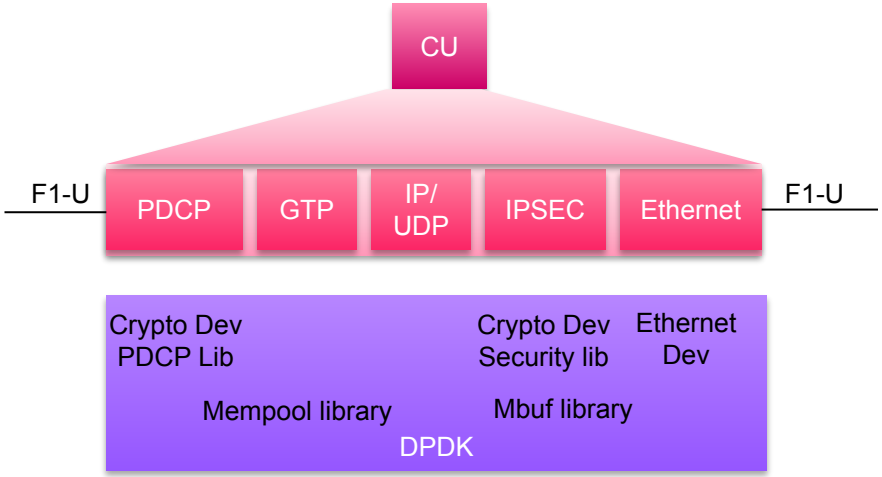
DPDK EAL Provides many more abstractions that are needed

- Memory
- Instructions
- CPU
- OS
- Interrupt handling



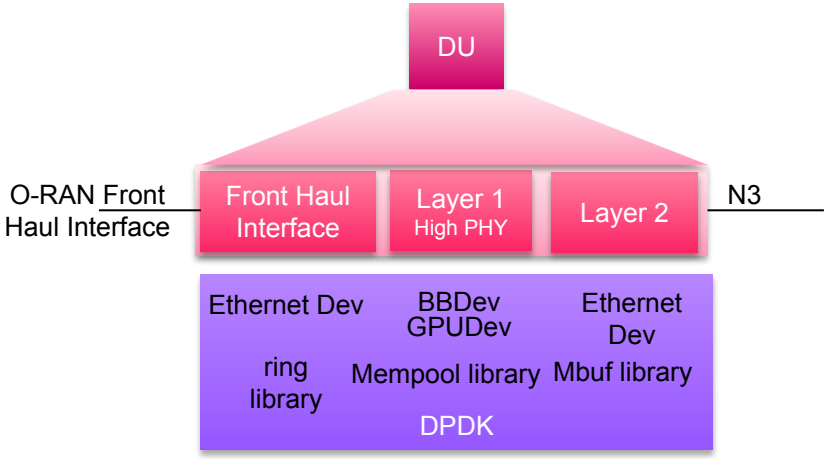
Where can DPDK be used in 5G RAN

- Centralized Unit
  - General Packet Processing workload
  - Packet Data Convergence Protocol (PDCP) implements main functionality of CU-UP consisting of PCDP sequencing, Robust header compression, Authentication and Ciphering
- Ethernet Dev
  - Generic low latency packet processing
- Crypto Dev, Security Dev
  - Used for selective offload of IPSEC processing where required
- Crypto Dev, PDCP Lib
  - Used for selective offload of PDCP and/or PDCP Wireless Ciphers



Where can DPDK be used in 5G RAN

- Distributed Unit
  - Layer 1 or Physical Layer processing
    - Complex algorithms for encoding and decoding the air interface signals
    - Channel estimations, equalizations, Forward Error Correction…
  - Layer 2 consists of packet processing component and a scheduling component
- Ethernet Dev
  - Generic low latency packet process
- Wireless Baseband (BBDev) or GPU devices
  - Used for selective offload of Physical layer functions as specified by the O-RAN Alliance
- Ring Library
  - can be used for inter process communication to meet strict real time and low latency requirements



Front Haul Interface Library Overview — o-du-phy master documentation (o-ran-sc.org)
O-RAN Downloads (orandownloadsweb.azurewebsites.net)

- O-RAN Acceleration Abstraction Layer General Aspects and Principals
- O-RAN Acceleration Abstraction Layer FEC Profiles 3.0
- O-RAN Acceleration Abstraction Layer High-PHY Profiles 5.0

DPDK in Ericsson Cloud RAN

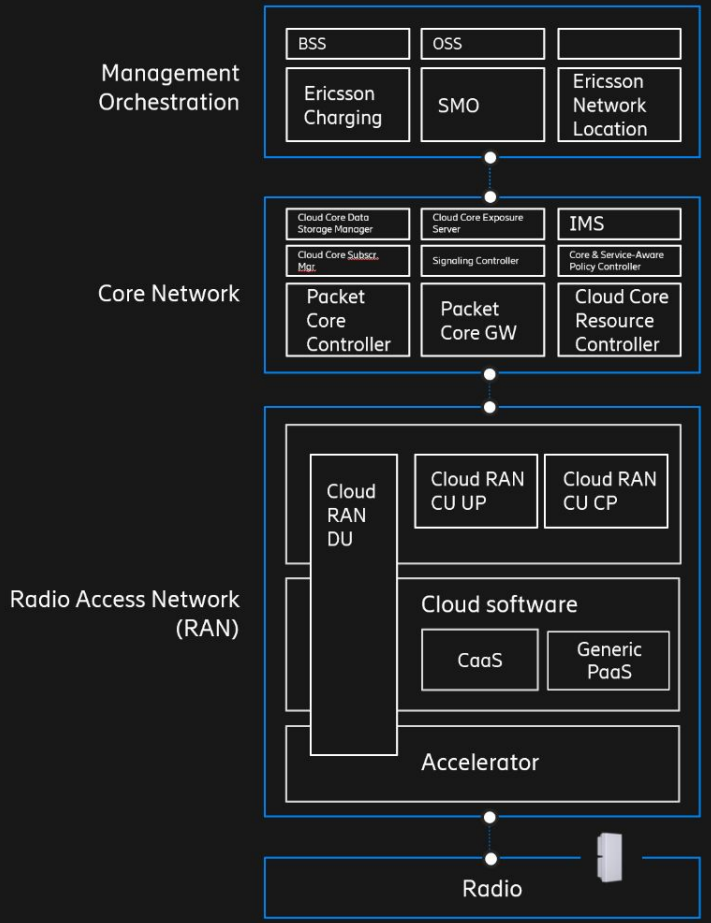
Oscar Toorell

Head of Technology Cloud RAN, Ericsson

2023-12-07


SMO
5G Core
5G Core
vCU-CP
vCU-UP
UPF
vDU
vCU-UP
vCU-CP
vDU
vCU-CP
vDU
vCU-UP
Radio
Baseband
Server
Single server 5G Cloud

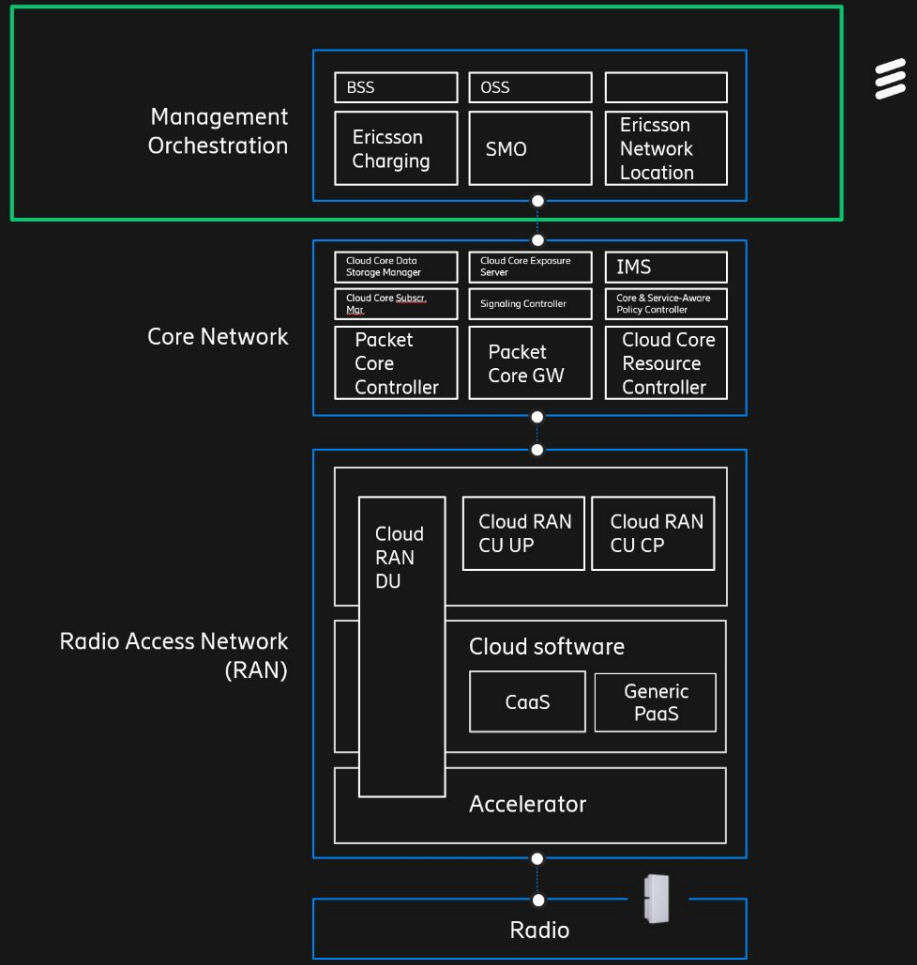
5G architecture overview from a DPDK perspective



5G architecture overview from a DPDK perspective

Management Orchestration

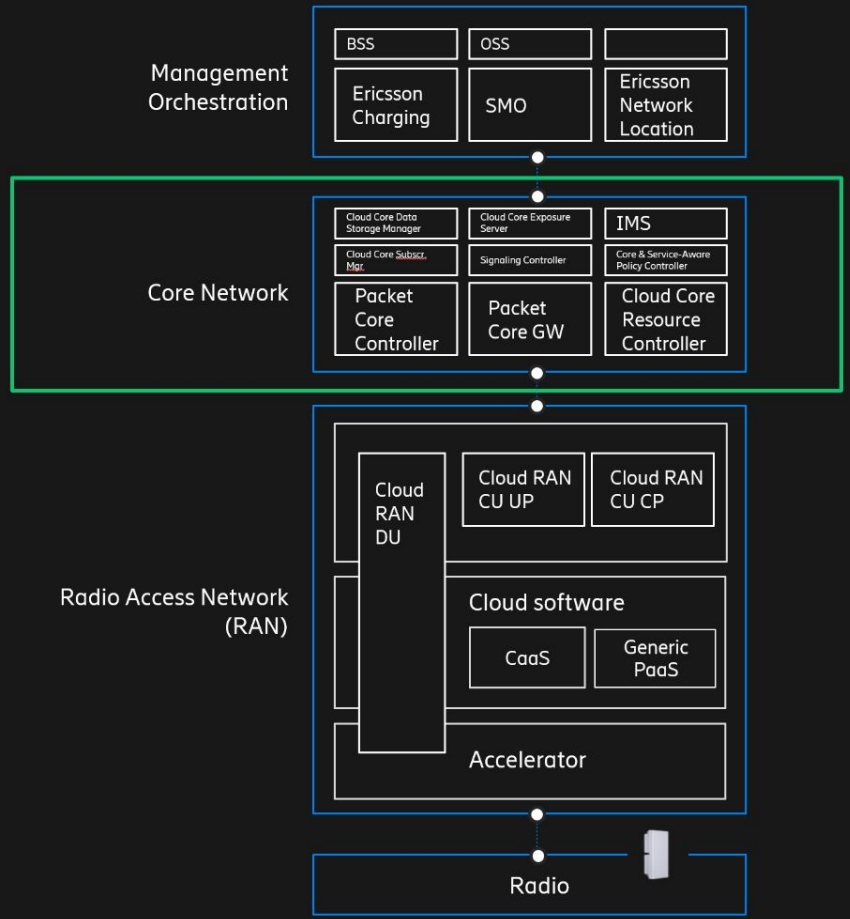
- Ericsson Charging



5G architecture overview from a DPDK perspective

Core network

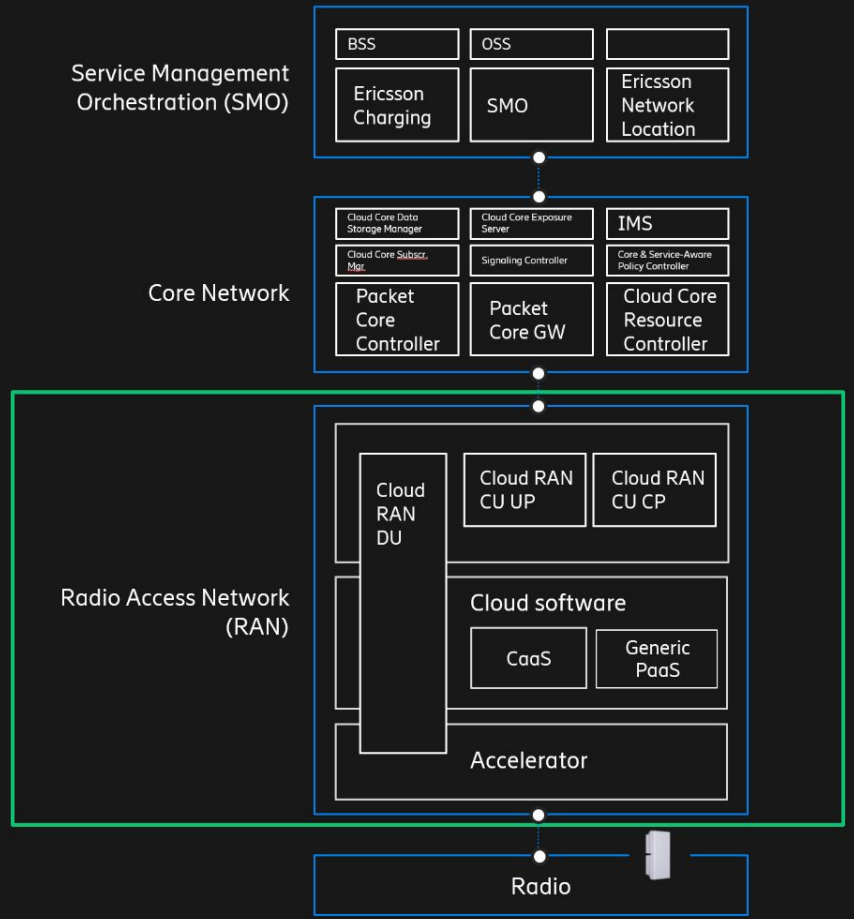
- Packet Core GW (Perf & Telco Req)
- Packet Core Controller (Telco Req)
- IMS (Telco Req)



5G architecture overview from a DPDK perspective

RAN

- PDCP in vCU/UP
- BBDEV in vDU



Ericsson Data Plane Acceleration in the cloud

Ericsson´s shifting landscape

- Biggest shift in future mobile networks is the move towards a cloud-native, intelligent and open network
- The need to shift toward more readily deployable commercial off-the-shelf (COTS) hardware solutions.

Exploring DPDK´s role

- Need for high-speed packet processing
- Ability to split packet flows into multiple parallel streams

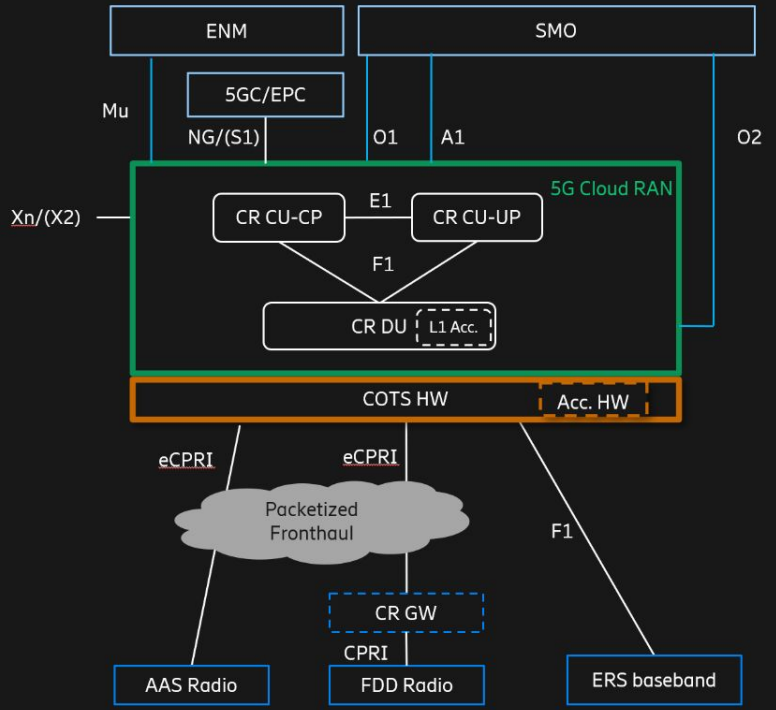
Flexibility and cost efficiency

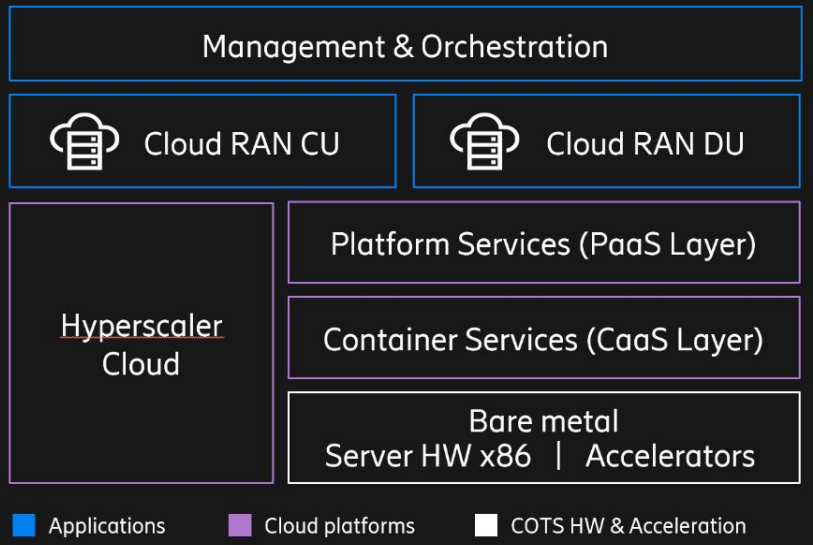
- Flexibility to deploy packet processing solutions across a range of HW configurations
- Scale applications and efficiently utilize the available CPU resources
- Compatibility of DPDK with multiple drivers leverage hardware-specific features

Challenges of cloud-native adoption

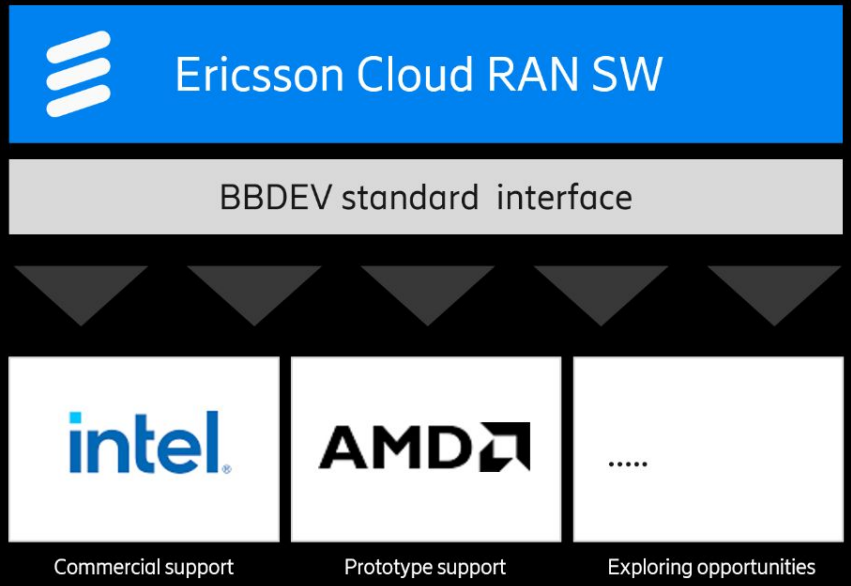
- Observing and comprehending the behavior of a complex system
- Balancing observability with performance optimization becomes crucial
- Ensuring seamless performance monitoring in these environments

Ericsson Cloud RAN





Portable L1 software enables compute diversity



Independent L1-L3 stack

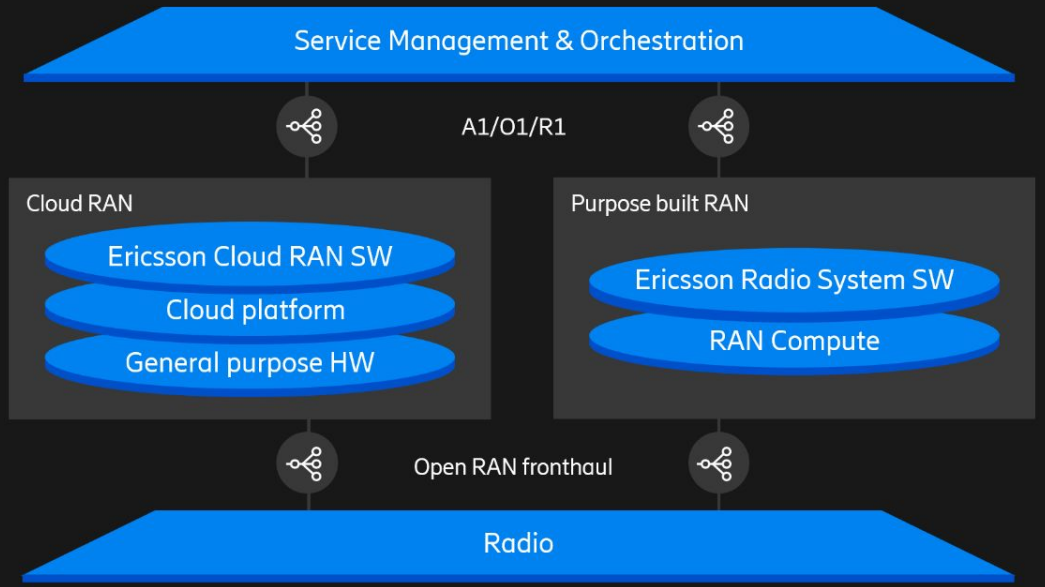
Common acceleration architecture
DPDK and BBDEV standardization

Open RAN – Open Hardware

Freedom of choice

Ericsson fully committed to industrialize Open RAN

Our commitment



Announcement Dec 4

Ericsson and AT&T strategic agreement to pioneer networks of the future

Ericsson and AT&T are collaborating in an industry-defining roughly USD 14 billion five-year network transformation and digitalization strategic agreement to pioneer the path to programmable and intelligent networks of the future. The deal is the largest financially in Ericsson's history.

NEWS | DEC 04, 2023

#EricssonOpenRAN #NetworksOfTheFuture #5GOpenRAN

AT&T ERICSSON

Ericsson will deploy a wide range of Ericsson 5G Open Radio Access Networks products and solutions to support AT&T's nationwide Open RAN ambitions in the U.S.

The company will build a 5G network platform for AT&T, utilizing cloud-native technologies built on O-RAN standardized interfaces - with industry scale, cost efficiency, sustainability and high performance top of mind. Through time AT&T and Ericsson will transform this to a cloud-native open network.

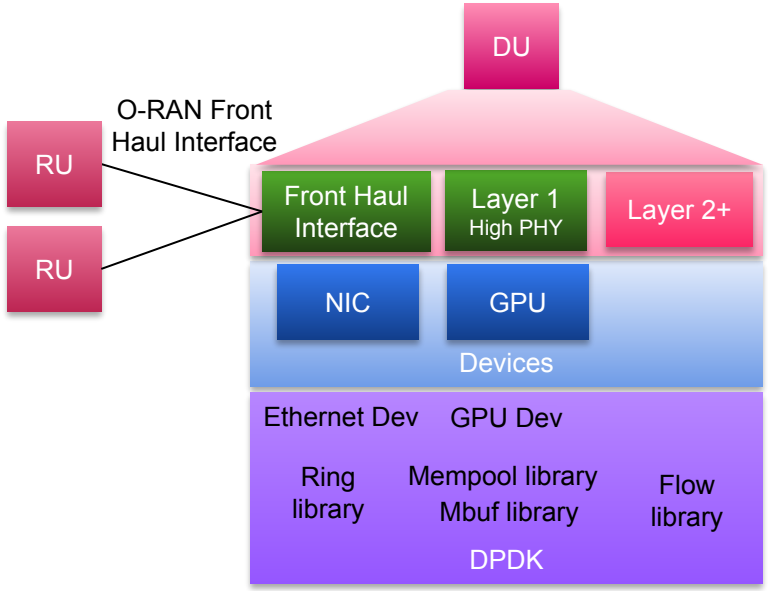
Ericsson will utilize its recently expanded 5G Smart Factory in Lewisville, Texas, for production of related infrastructure for the deal. The factory's products are labelled Made in USA as Ericsson's facility complies with the Build America, Buy America infrastructure laws Act.

NVIDIA Aerial 5G with DPDK

Elena Agostini
Senior Software Engineer, NVIDIA

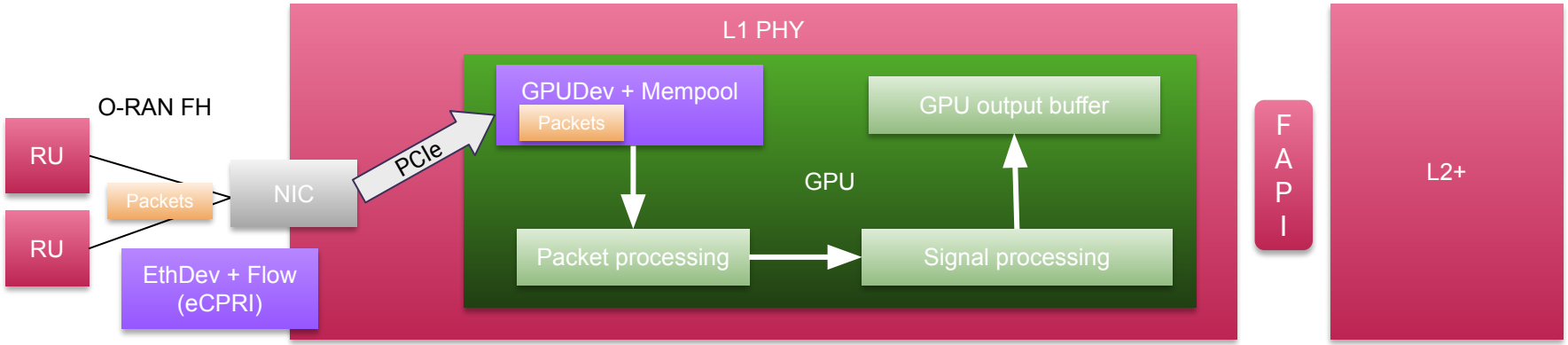
NVIDIA Aerial 5G RAN DPDK components

- Aerial 5G sits in the DU Layer 1 (Physical layer)
  - Signal processing on GPU
    - encoding and decoding the air interface signals
  - Infrastructure to communicate with
    - Radio Units (RU) with O-RAN FH interface
    - DU L2+ layers through FAPI protocol
- Ethernet Dev
  - Generic low latency CPU packet processing on the C-plane
- GPU Dev
  - Let the network card directly access U-plane packets in GPU memory (directly send/receive U-plane packets)
- Flow
  - eCPRI flow steering rules to receive from different RU
- Timestamping
  - Send U-plane packet at a specific time in future



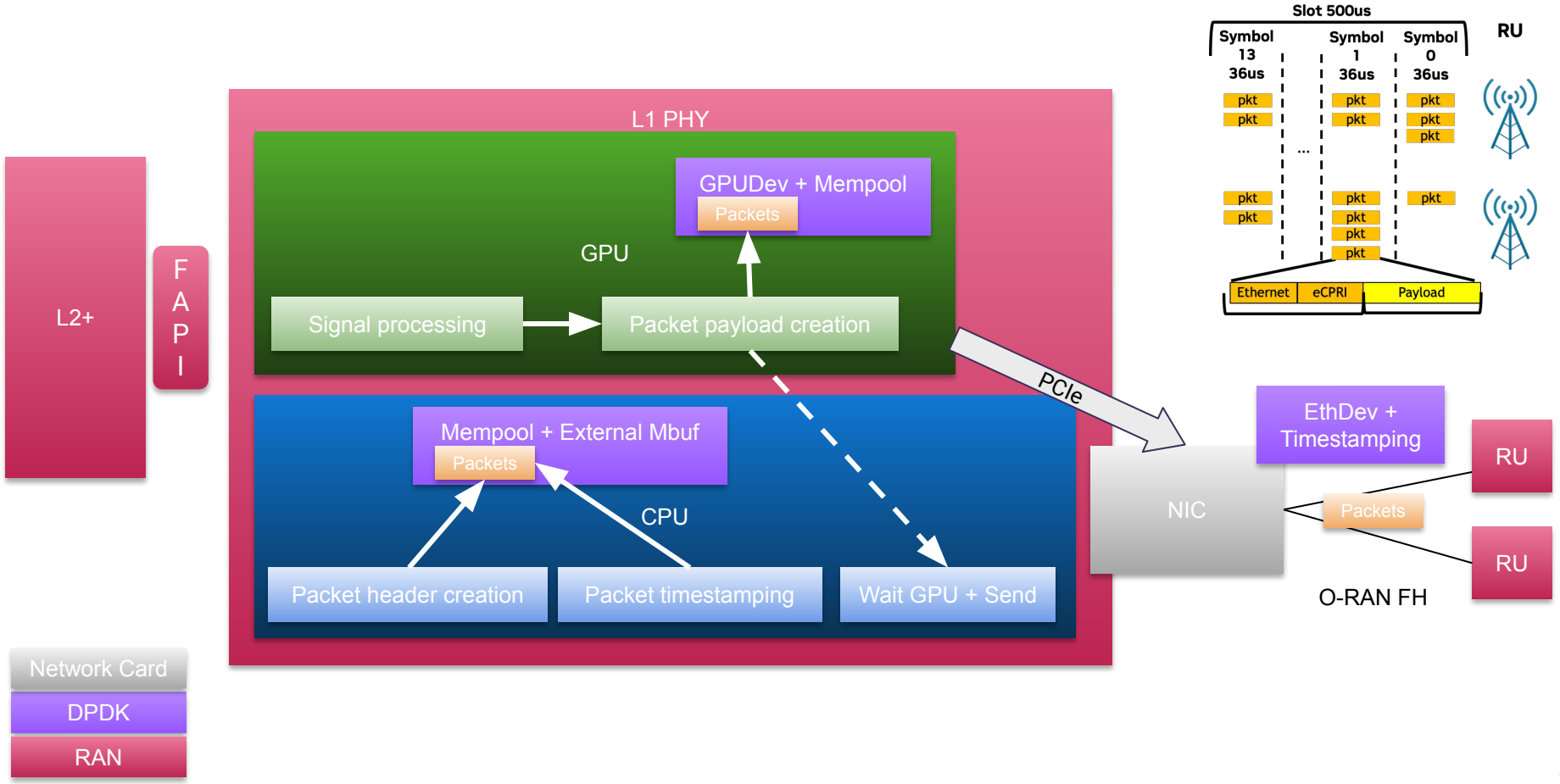
Hardware Acceleration for Open Radio Access Networks: A Contemporary Overview
Lopamudra Kundu; Xingqin Lin; Elena Agostini; Vikrama Ditya; Tim Martin

Uplink, U-Plane packets flow



Network Card
DPDK
RAN

Downlink, U-Plane packets flow



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