[S61898]

6G Computing Architecture:

Distributed, Software Defined Accelerated and AI-enabled

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Rajesh Gadiyar, NVIDIA

NVIDIA Delivers Best Value 5G DataCenter

High Performance | High Utilization | AI Native

EFFICIENT PERFORMANCE

Power : Watts/Gbps
Cost : $/Gbps

MULTI-TENANCY

Highest utilization & ROI

AI MONETIZATION

Increase revenue with same assets
Reduce OPEX with AI optimization

SW Defined, Scalable and Accelerated DC for 5G adv. and 6G

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Contents

- NTT Labs 6G network architecture study
  - Previous Architecture Transition (4G→5G+MEC)
  - Architecture Evolution toward 6G
- Introduction of related research activities
  - dUPF Implementation on DPU (BlueField-3)
    - Performance Evaluation
    - Planned Future Development
  - End-to-End HW acceleration leveraging MGX GH200 Platform

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NTT Labs 6G network architecture study

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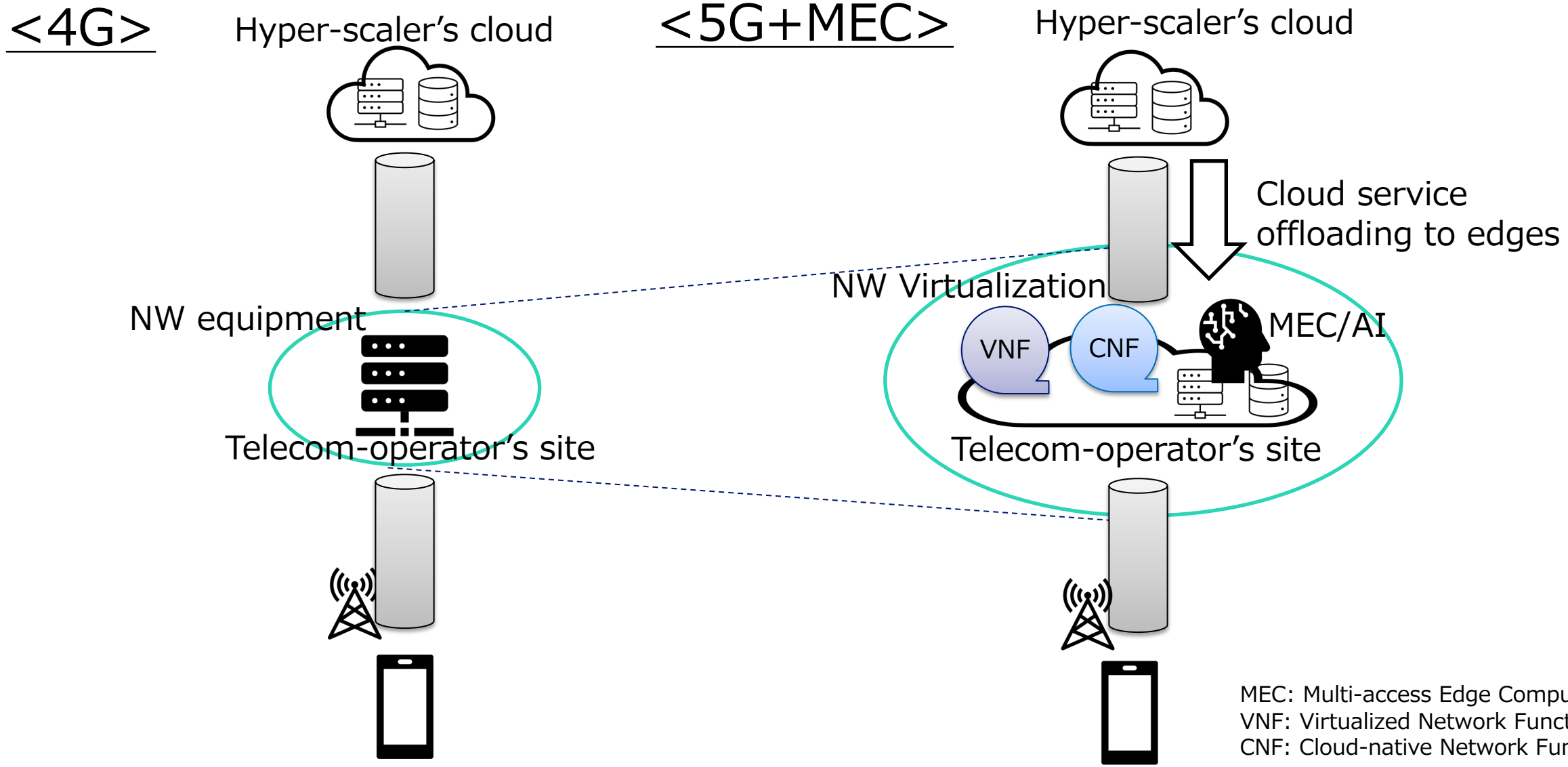
Previous Architecture Transition (4G→5G+MEC)



MEC: Multi-access Edge Computing
VNF: Virtualized Network Function
CNF: Cloud-native Network Function

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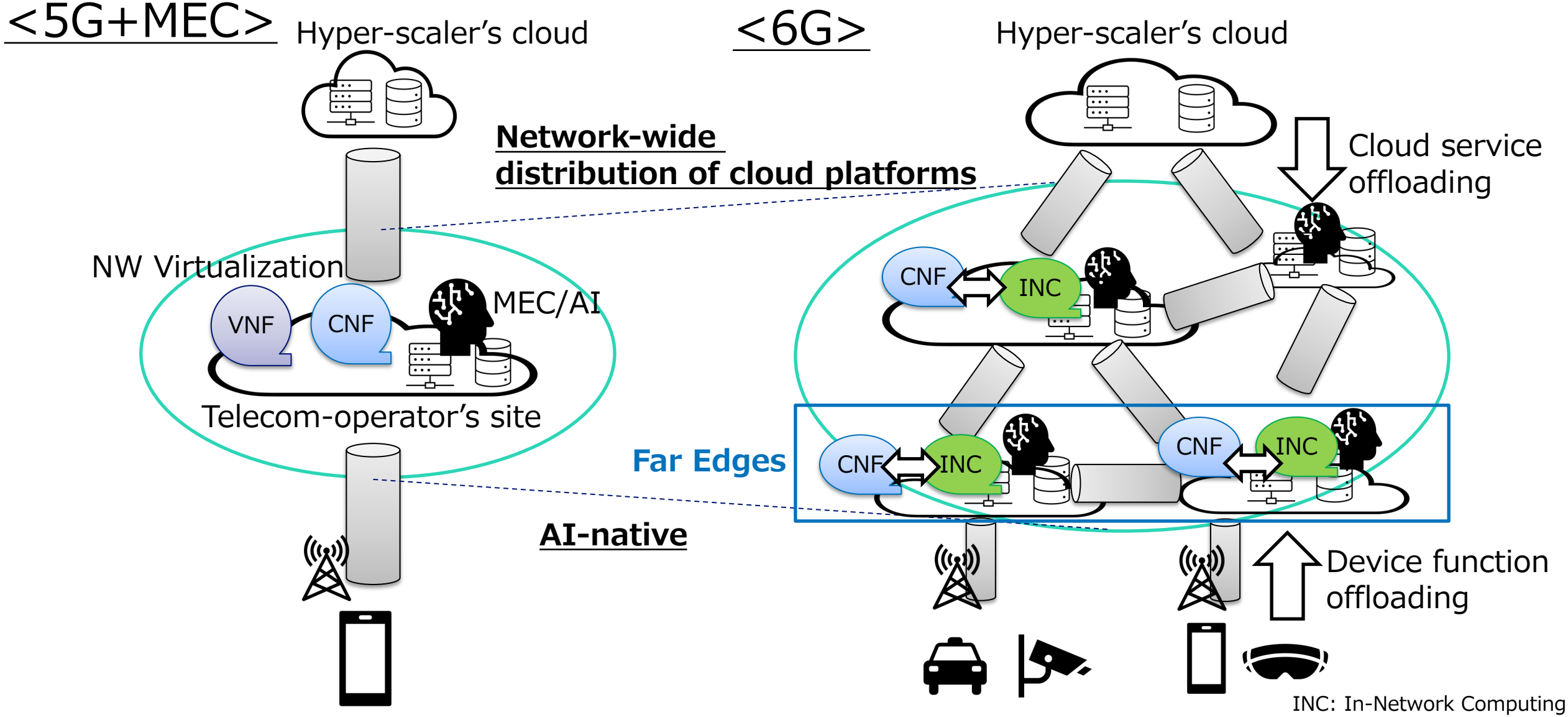
Architecture Evolution toward 6G



INC: In-Network Computing

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Ref:

Published 6G White Paper (Next G Alliance)

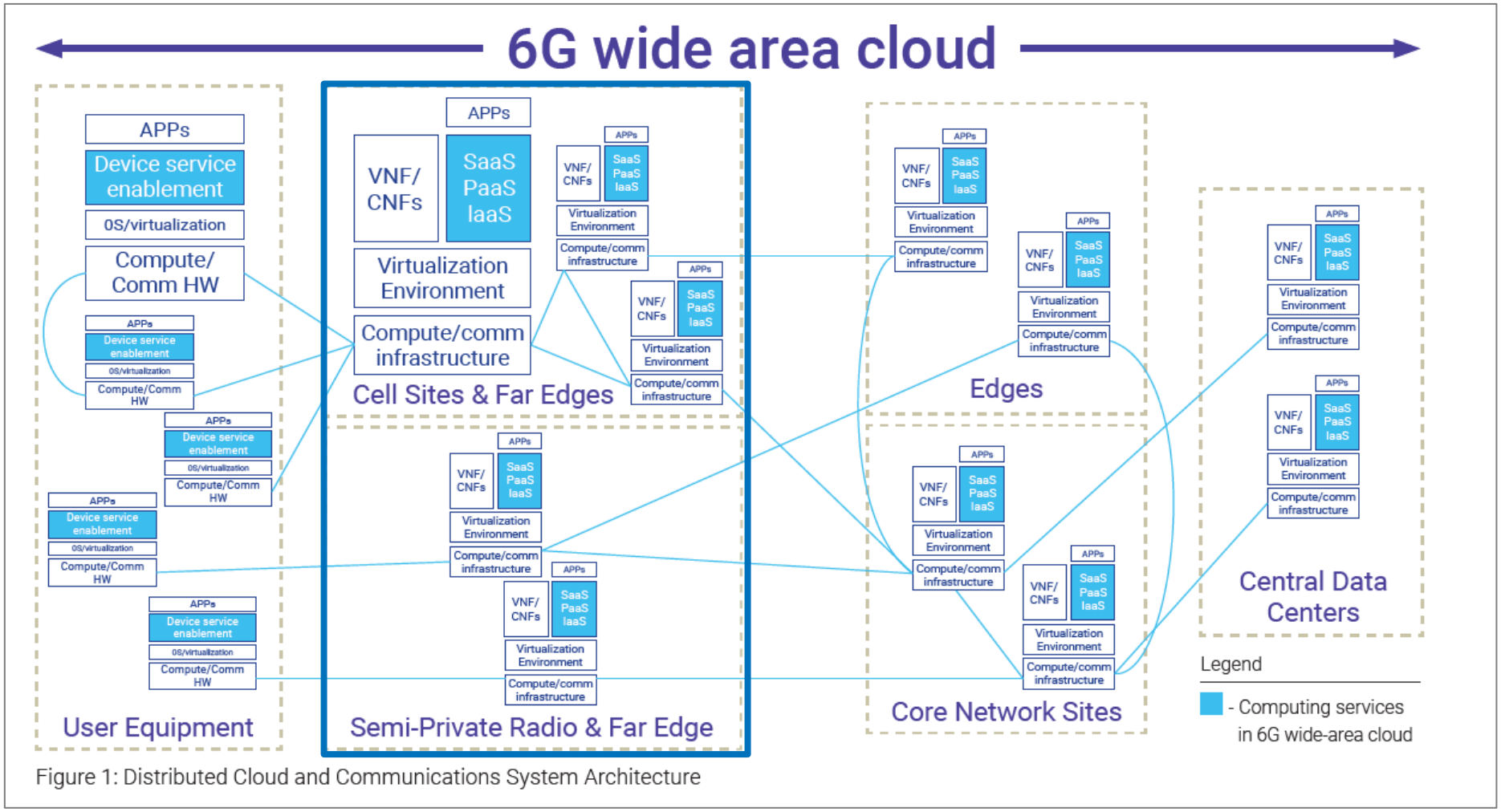

Figure 1: Distributed Cloud and Communications System Architecture

Sourced from:
Next G Alliance Report: 6G Distributed Cloud and Communications Systems

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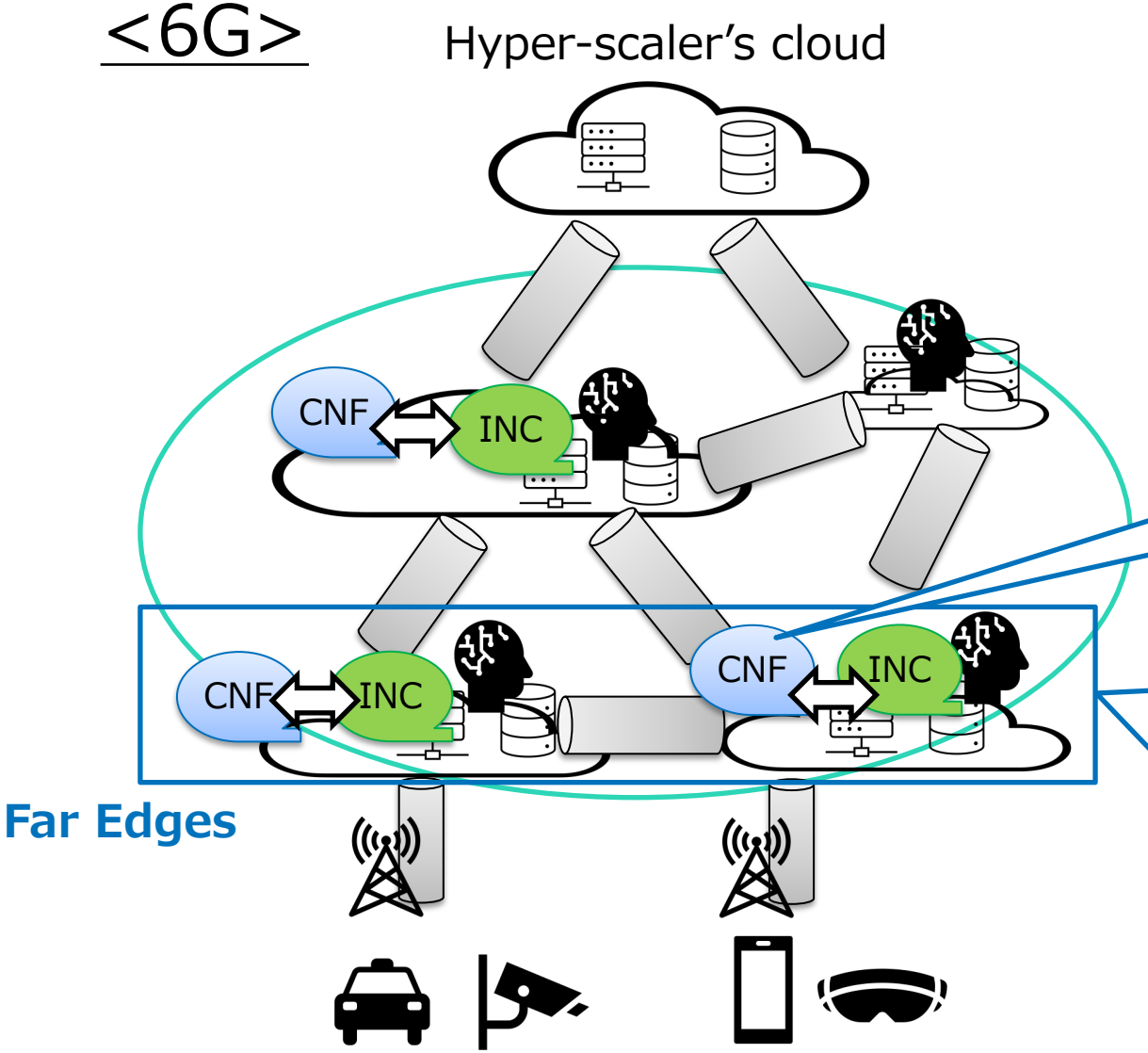
NTT Labs Architecture Research Scope

<6G>



UPF is one of the key functions to link mobile and service domains.

→ **Distributed UPF (dUPF) on DPU (BlueField-3)**

- Lightweight, high-performance, energy-efficient and reliable

Dynamic control of vRAN and MEC unified platform.

→ **End-to-End HW Acceleration leveraging MGX GH200**

- Including mobile access, core, and apps

INC: In-Network Computing
UPF: User Plane Function
vRAN: virtualized Radio Access network

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Introduction of related research activities

- dUPF Implementation on DPU (BlueField-3)
- End-to-End HW acceleration leveraging MGX GH200 Platform

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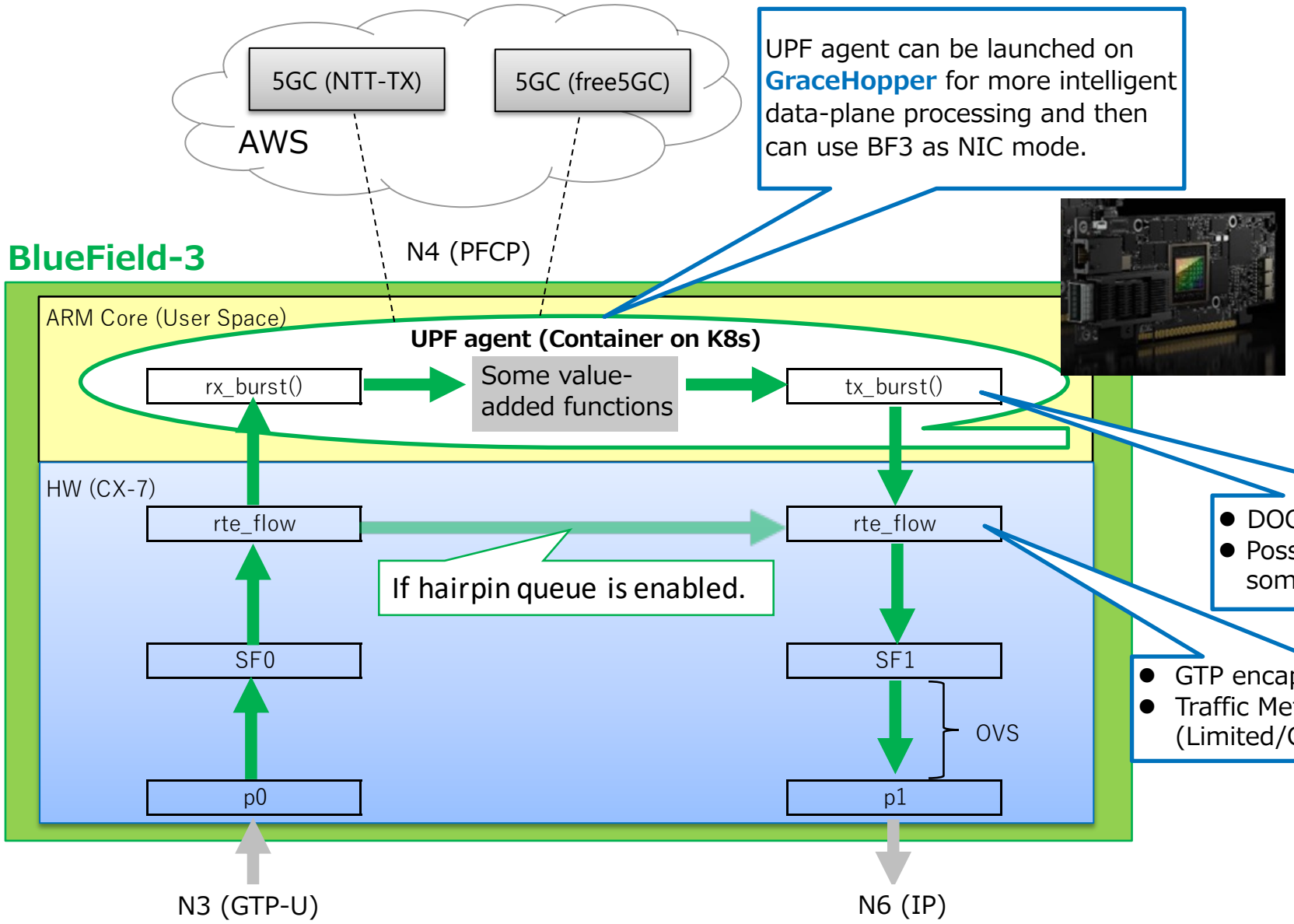
dUPF Architecture on DPU (BlueField-3)



UPF agent can be launched on **GraceHopper** for more intelligent data-plane processing and then can use BF3 as NIC mode.

Feature	Support
QoS	●
DPI	●
N4 (PFCP)	●
Paging	-
Charging	-
Roaming	-
Uplink Classifier (Multi-step UPF)	-

- DOCA Sending/Receiving API
- Possible to be combined with some value-added functions

- GTP encap/decap
- Traffic Metering for QoS (Limited/Guaranteed Bit Rate)

5GC: 5G Mobile Core
QoS: Quality of Service
DPI: Deep Packet Inspection
PFCP: Packet Forwarding Control Protocol
GTP: GPRS Tunneling Protocol

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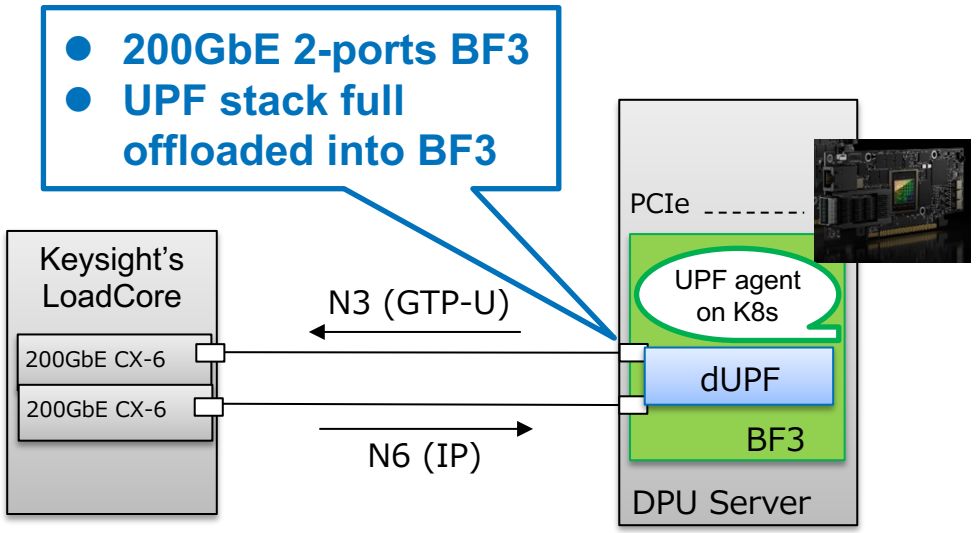
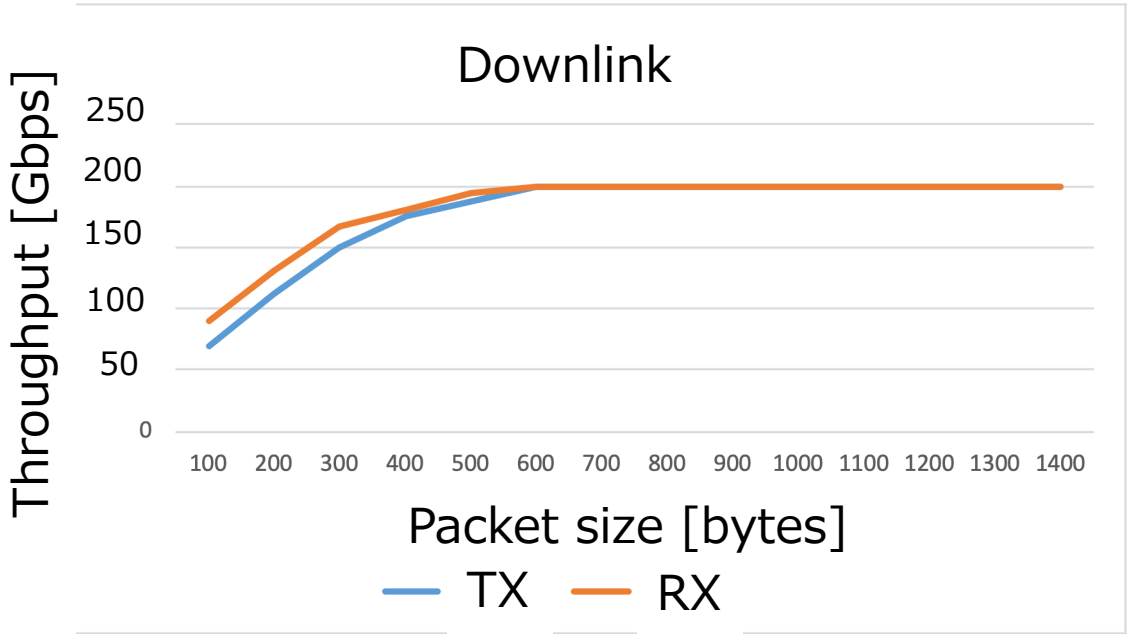
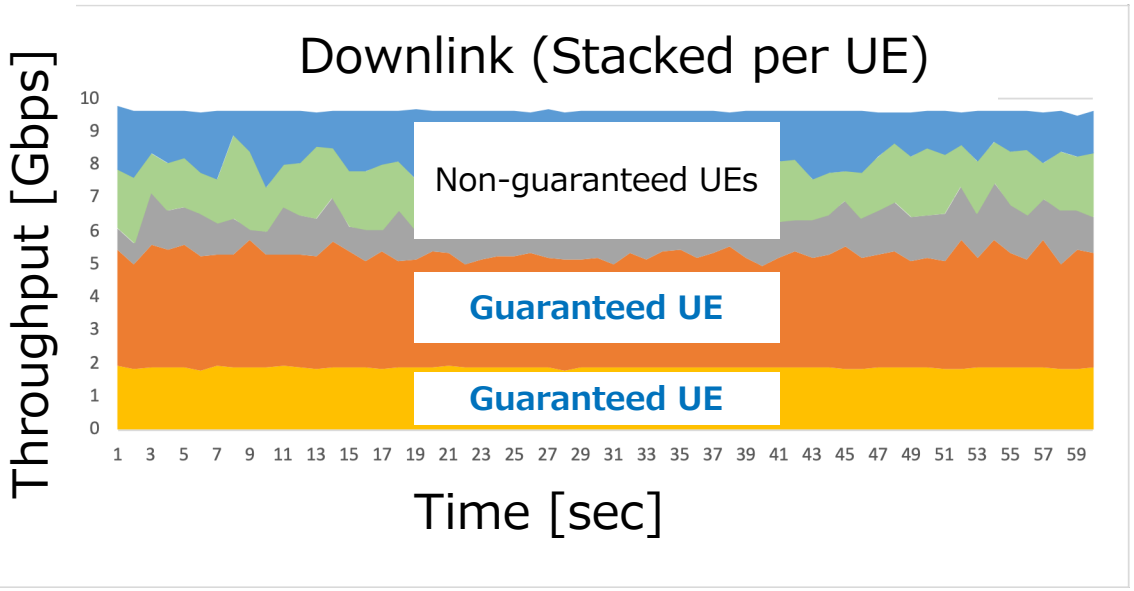
Performance Evaluation #1







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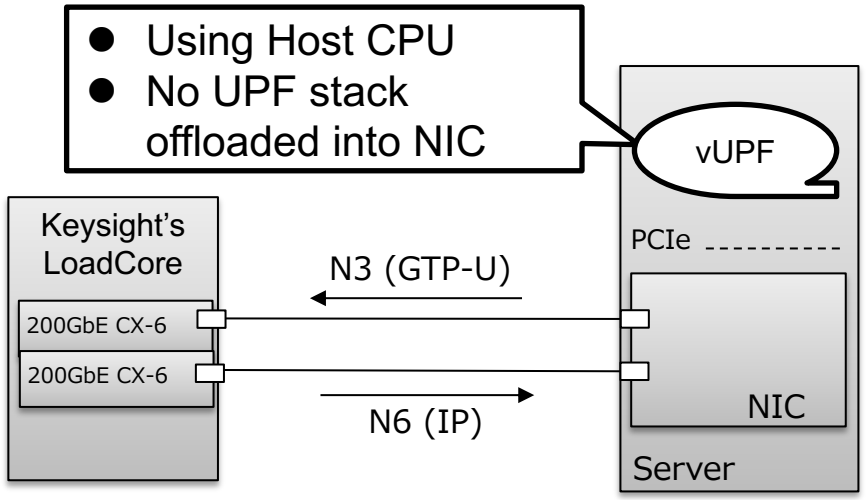
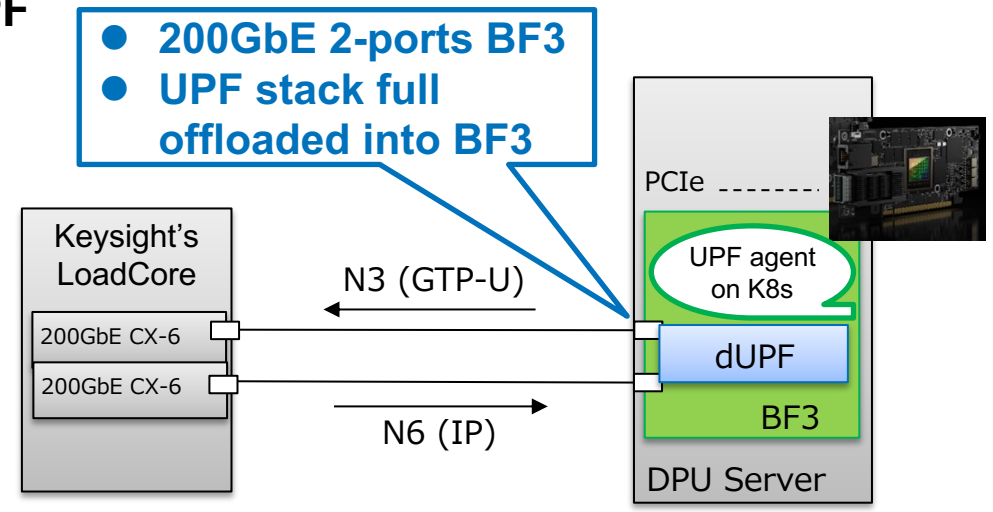
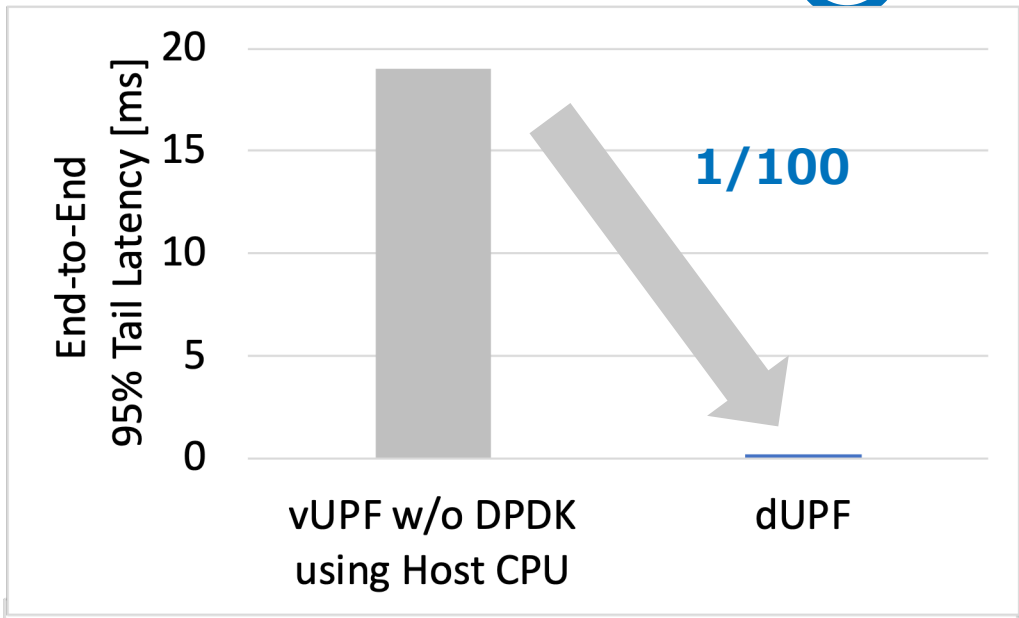
Performance Evaluation #2

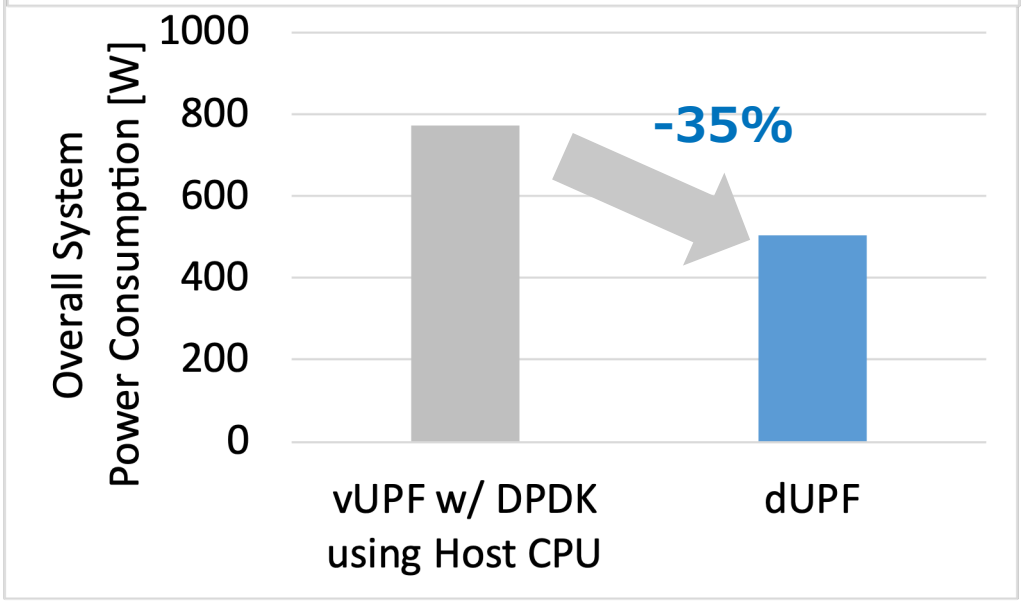
(a) vUPF



(b) dUPF







DPDK: Data Plane Development Kit

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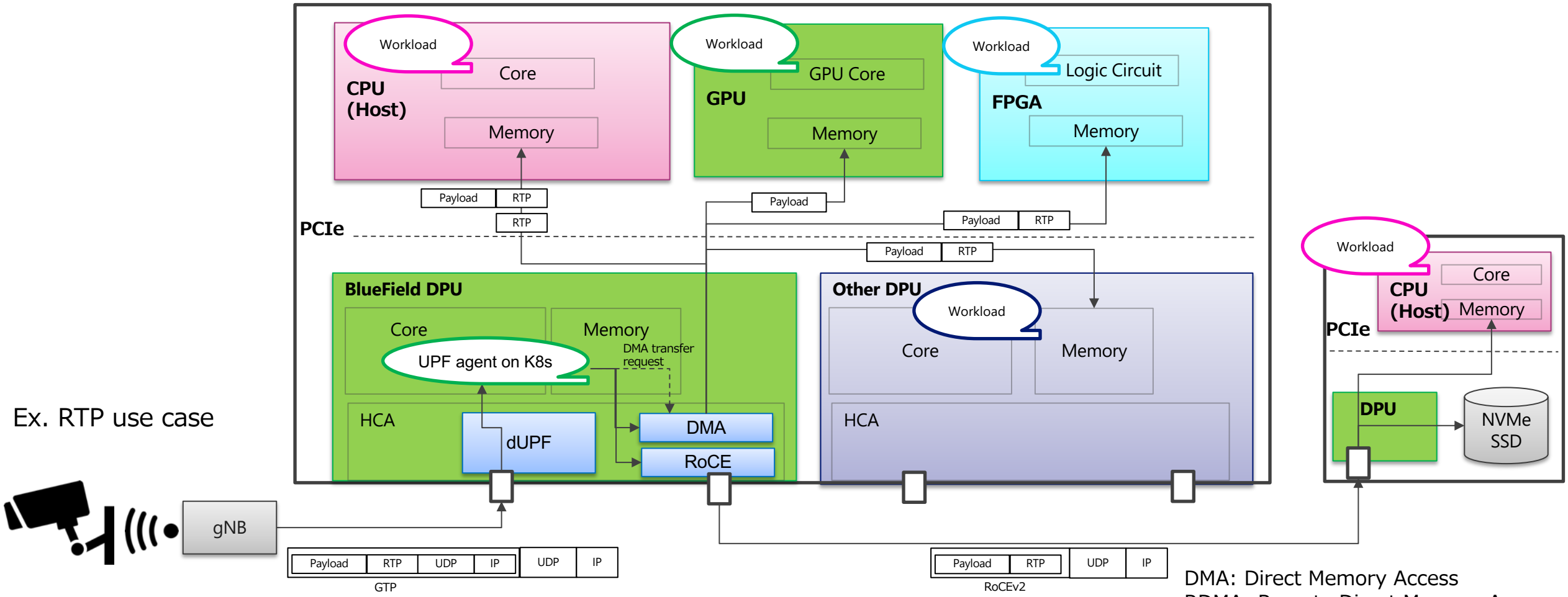
Planned Future Development

Advanced data processing based on memory-centric architecture

Ex. RTP use case



DMA: Direct Memory Access
RDMA: Remote Direct Memory Access
RoCE: RDMA over Converged Ethrenet
RTP: Real-time Transport Protocol

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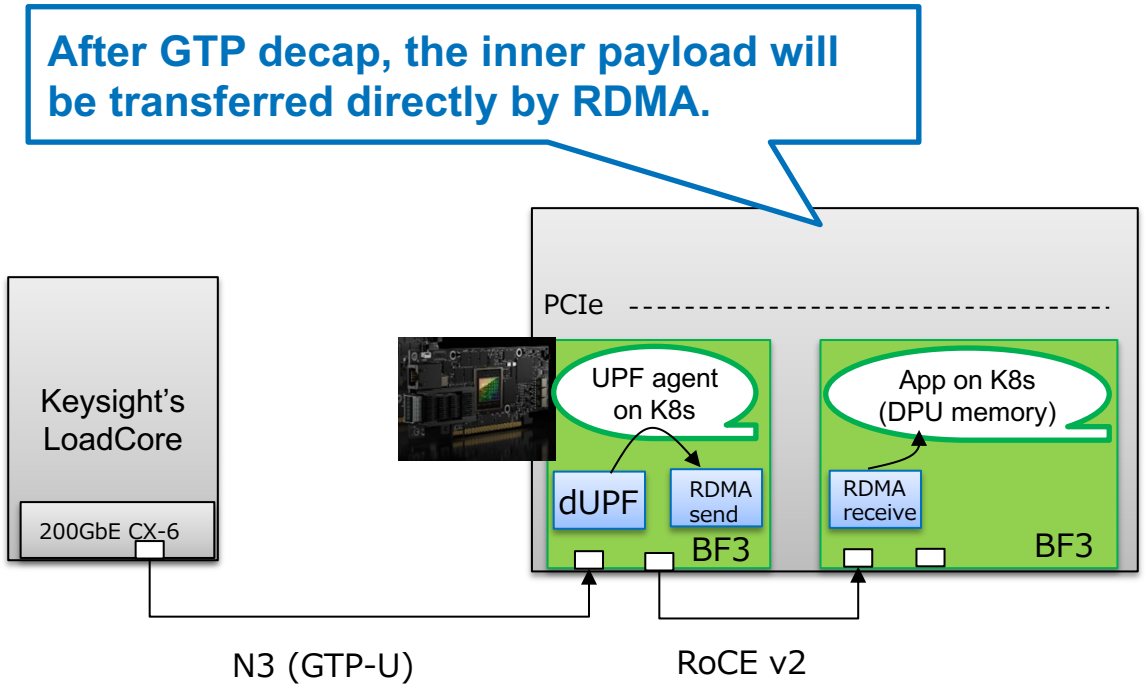
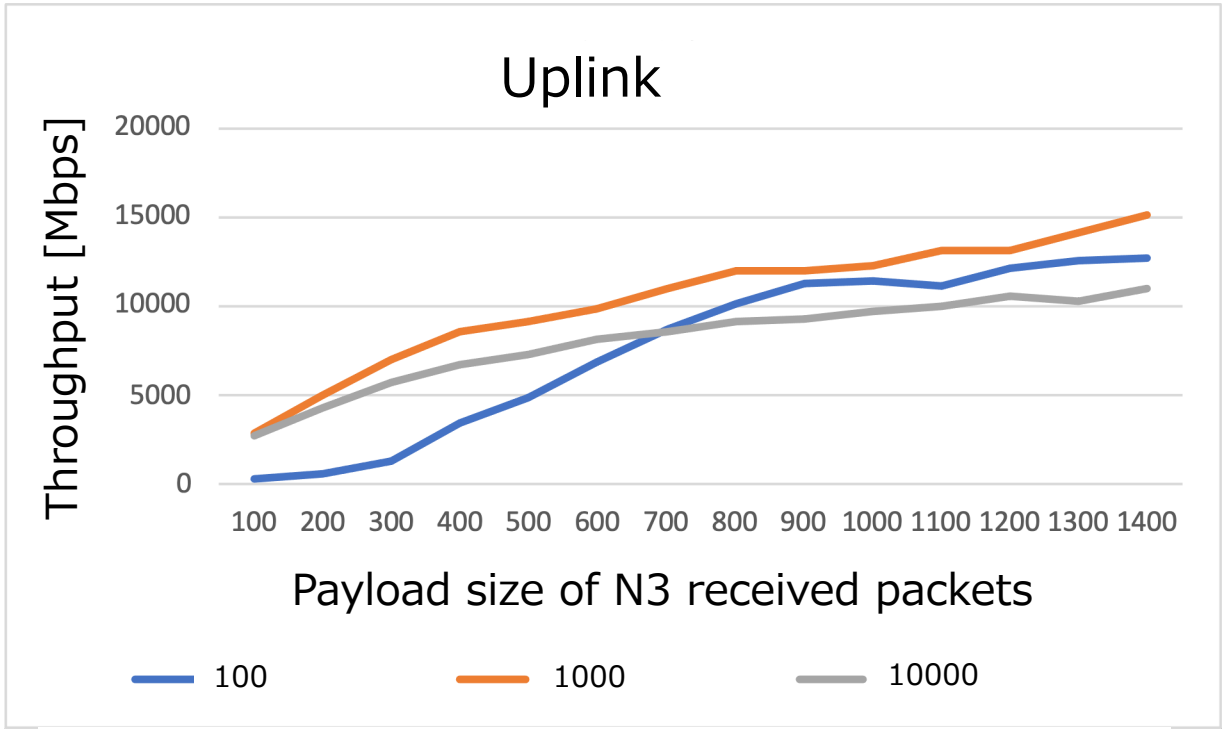
Combining UPF with RDMA function

Prototype that combines UPF with RDMA using DOCA RDMA Library





Number of N3 received packets that are bundled in one RDMA transmission

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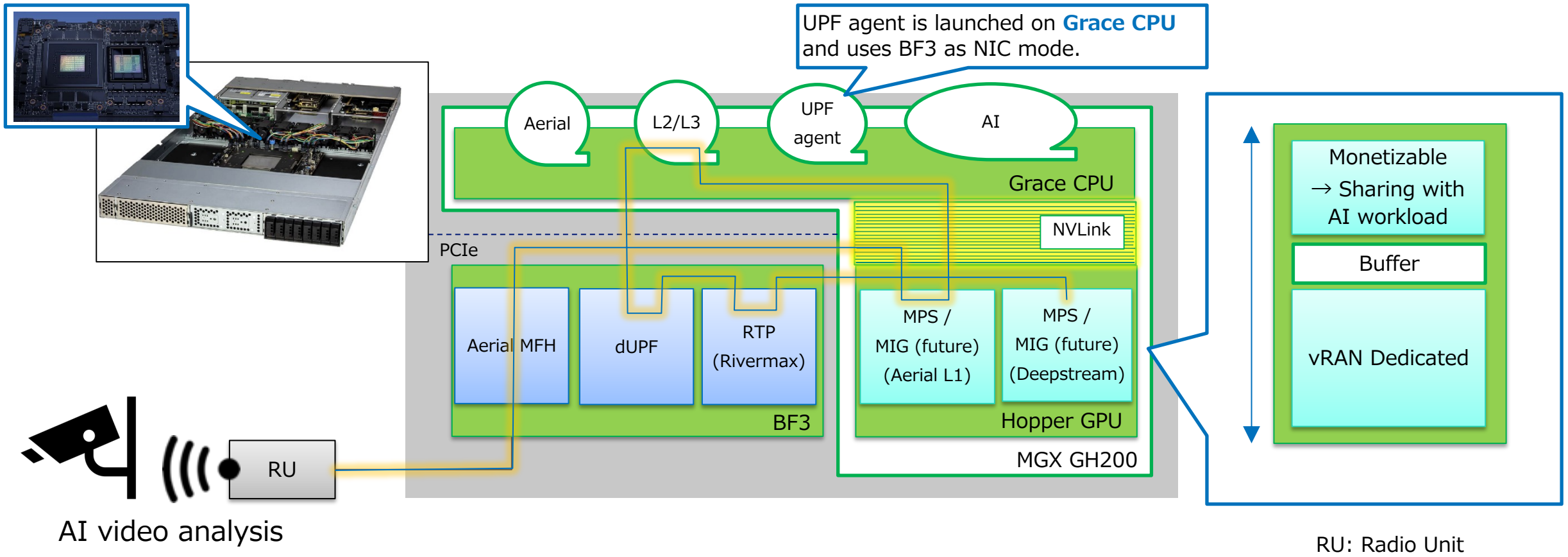
E2E acceleration leveraging MGX GH200 Platform

Dynamic control of vRAN and MEC unified platform:

End-to-End HW acceleration including mobile access, core, and apps



RU: Radio Unit
MFH: Mobile Front Haul

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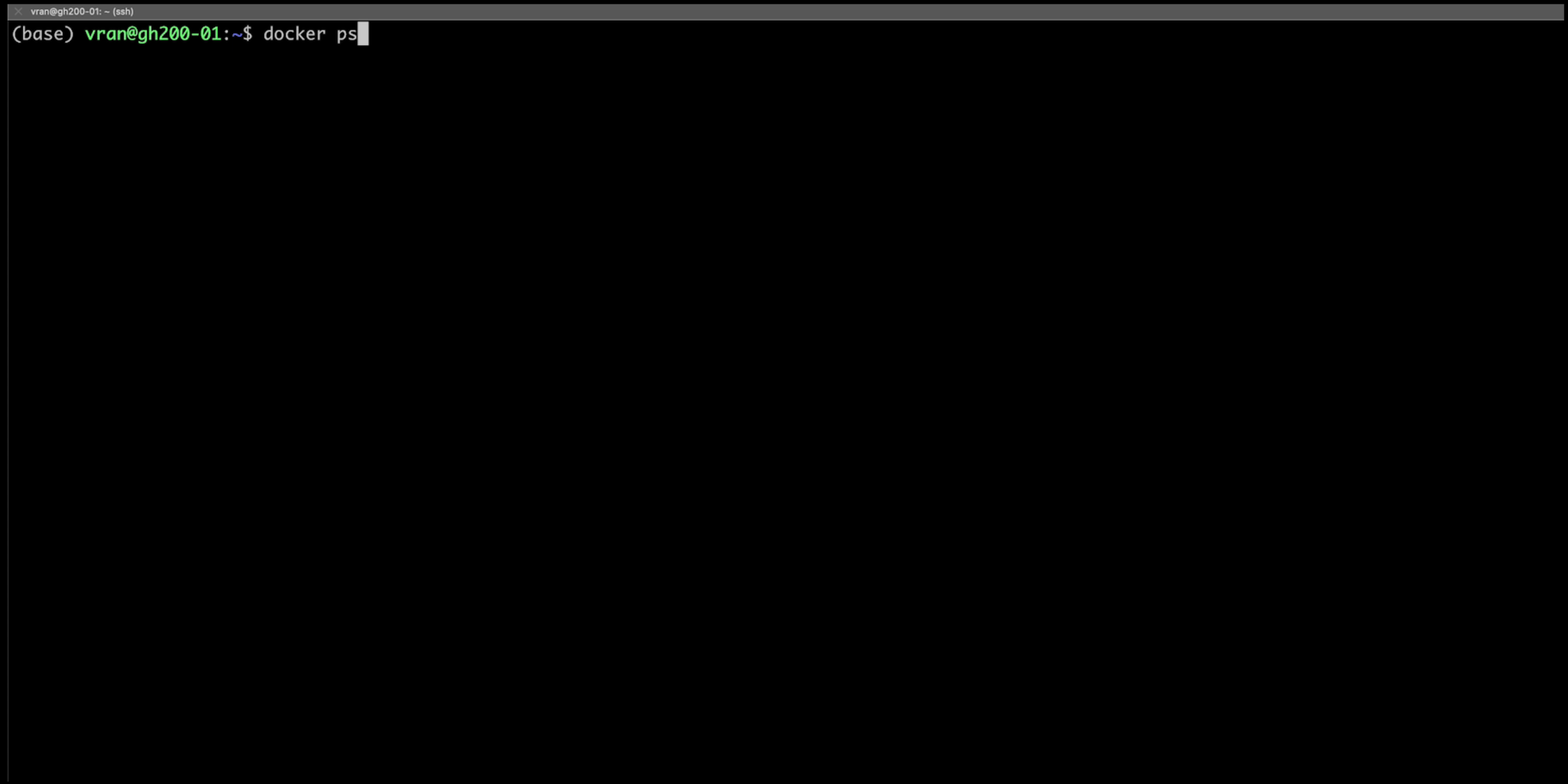
vran@gh200-01: ~ (ssh)
(base) vran@gh200-01:~$ docker ps

Summary

- NTT Labs is working on designing future 6G network architecture.
- dUPF is a key function to connect mobile and service domains in the distributed architecture. BlueField DPUs have the capability to realize lightweight, high-performance, energy-efficient, and reliable dUPF.
- E2E acceleration and resource sharing between multiple applications are important requirements for telecom operators toward 6G. We expect the high performance and flexible infrastructure like MGX GH200 in the age of AI-native.
- We will input our efforts to related standardization and OSS communities such as 3GPP, ESTI NFV, O-RAN, and LF OPI ,etc.

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