Ampere for openEDGE

October 2019

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Compute Project

Who is Ampere?

We are a passionate, experienced team committed to building & delivering what comes next for cloud and edge computing.

Consume. Collaborate. Contribute.

Ampere Product Family

Planned

5nm

Defined

7nm

"Next Gen Ampere"

Developed

7nm

- Arm v8.2+
- Improved IPC
- Higher power efficiency
- Enhanced scalability of cores, memory bandwidth, IO
- Greater TDP range

Ampere eMAG™

Shipped

16nm

- Arm v8.0
- Up to 32 Cores
- 3.3 GHz Sustained Turbo
- 8x DDR4-2667
- 42 lanes of PCIe Gen 3
- 4 SATA Gen 3 ports
- TDP: 75-125W

Multi-generation roadmap to a powerful, efficient, and scalable platform architected for the future of the Cloud and Edge

Increase Performance, Power Efficiency, and Scalability of Cloud-to-Edge Platform at Regular Cadence

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eMAG Advantages for Telco and Edge

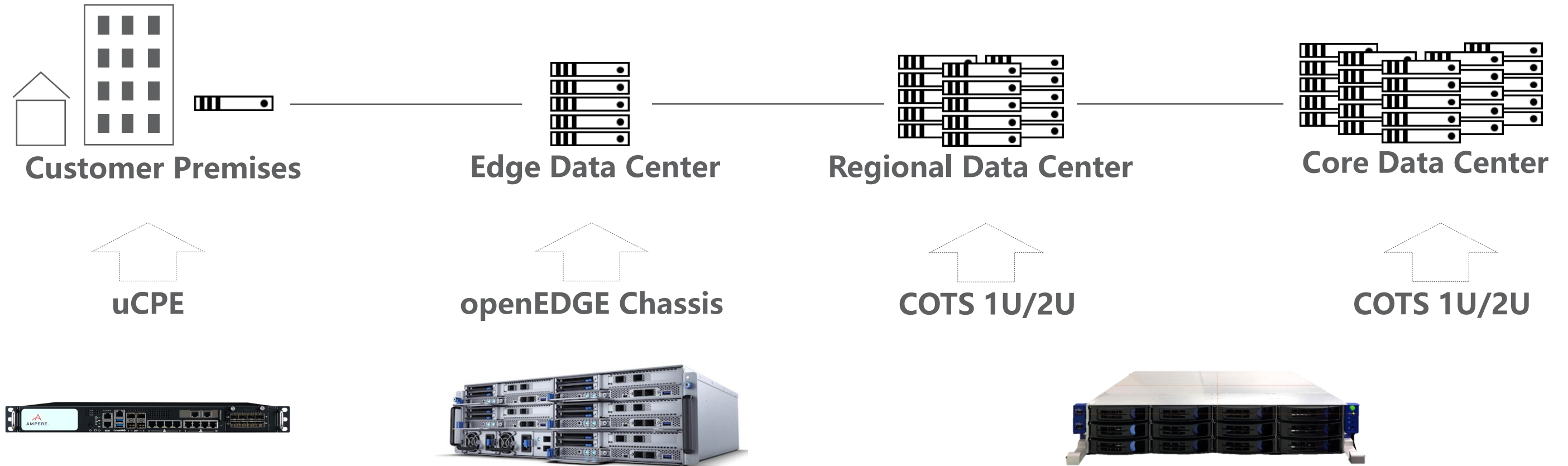| High performance, scalable, and efficient cores	Same architecture as Arm devices that dominate the Edge	Security, Reliability, Scalability at the Edge	Turnkey software and hardware solutions with customizability

AMPERE™
eMAG™
PROCESSOR

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Ampere eMAG for Wireline Data Networks

Customer Premises

Edge Data Center

Regional Data Center

Core Data Center

uCPE

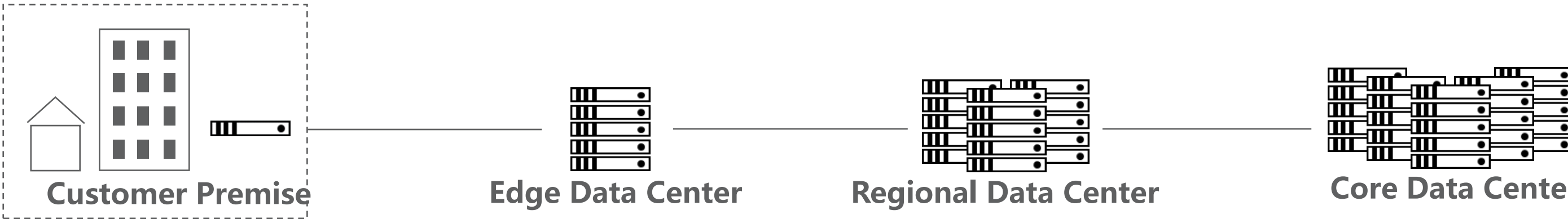openEDGE Chassis

COTS 1U/2U

COTS 1U/2U

uCPE : Universal Customer Premises Equipment
Based on **eMAG** Arm-based processor
Runs NVFI, VNFs, customer workloads
Ampere HW and uCPE Stack available

SEBA
SDN Enabled Broadband Access
Ported to **eMAG** Arm-based processor
Source code and demo available

5G Core
"Next Gen Ampere" targeted at Core DC
High core count, memory channels
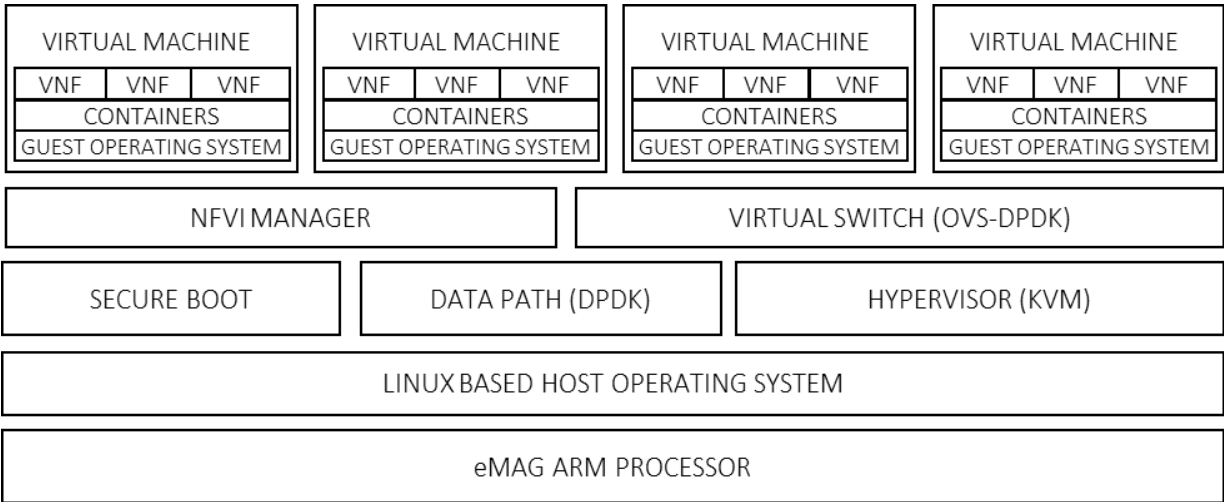Very high performance compute

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Ampere eMAG for uCPE

Customer Premise **Edge Data Center** **Regional Data Center** **Core Data Center**

uCPE TYPE		
uCPE Size	SMALL	MEDIUM	LARGE
Approx. System ASP	$500	$1000 - $2000	$6000 - $9000
Example x86 CPU	Atom	Xeon D	Xeon SP
x86 Cores	4	8	16-26
Ampere SKU	N/A	eMAG	eMAG & "Next Gen"
Ampere Cores	N/A	16 or 32	32 and Higher
Ampere TDP	N/A	75-125W	125W
# of VNFs	3	4+	10+
Throughput	1 Gbps	1-5 Gbps	> 10 Gbps
RAM	32 GB	64 GB	128 GB
Storage	256 GB	512 GB	1 TB+
LAN 1G Ports	4	8+	8+
WAN SFP 1G / 10G	2 / 0	2 / 2	0 / 4
Power supply	Single/Dual	Single/Dual	Dual
Form Factor	Desktop / 1U	1U	1U

Ampere uCPE 1U hardware Concept

VIRTUAL MACHINE	VIRTUAL MACHINE	VIRTUAL MACHINE	VIRTUAL MACHINE
VNF VNF VNF	VNF VNF VNF	VNF VNF VNF	VNF VNF VNF
CONTAINERS	CONTAINERS	CONTAINERS	CONTAINERS
GUEST OPERATING SYSTEM	GUEST OPERATING SYSTEM	GUEST OPERATING SYSTEM	GUEST OPERATING SYSTEM

NFVI MANAGER	VIRTUAL SWITCH (OVS-DPDK)

SECURE BOOT	DATA PATH (DPDK)	HYPERVISOR (KVM)

LINUX BASED HOST OPERATING SYSTEM

eMAG ARM PROCESSOR

Ampere uCPE Software Stack

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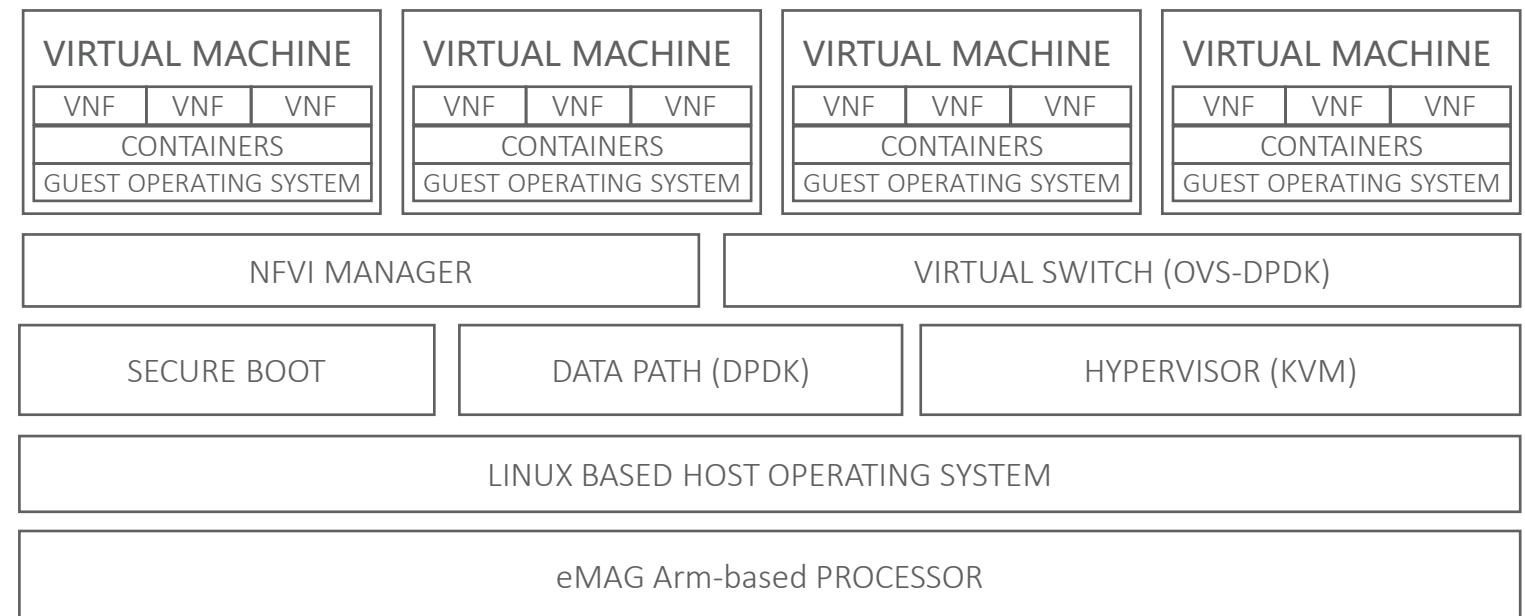OPEN Compute Project

Ampere VNF Ecosystem

- Ampere eMAG processor enables more VNF's in uCPE power and cost envelope
- Ampere is partnering with industry leaders to provide a complete uCPE software
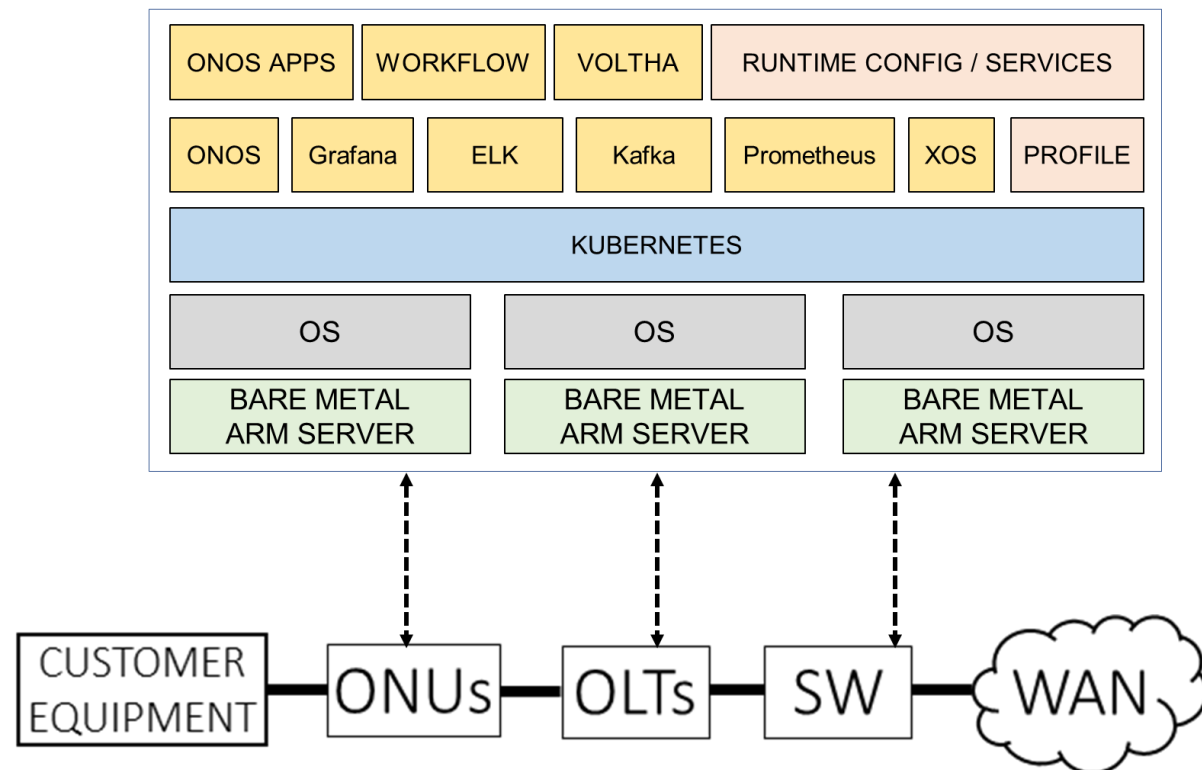- Ampere plans to contribute Arm-based uCPE spec to OCP

NFVI	Enea, Telco Systems
SD-WAN	FatPipe
Firewall	Checkpoint, Clavister
Routing	6WIND
Security	Trend Micro
Deep Packet	Trend Micro, Enea
Telco	SEBA, RIC/REC

VIRTUAL MACHINE	VIRTUAL MACHINE	VIRTUAL MACHINE	VIRTUAL MACHINE
VNF | VNF | VNF	VNF | VNF | VNF	VNF | VNF | VNF	VNF | VNF | VNF
CONTAINERS	CONTAINERS	CONTAINERS	CONTAINERS
GUEST OPERATING SYSTEM	GUEST OPERATING SYSTEM	GUEST OPERATING SYSTEM	GUEST OPERATING SYSTEM

NFVI MANAGER	VIRTUAL SWITCH (OVS-DPDK)

SECURE BOOT	DATA PATH (DPDK)	HYPERVISOR (KVM)

LINUX BASED HOST OPERATING SYSTEM

eMAG Arm-based PROCESSOR

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Ampere eMAG for SEBA

Customer Premise — **Edge Data Center** — **Regional Data Center** — **Core Data Center**

SEBA

ONOS APPS	WORKFLOW	VOLTHA	RUNTIME CONFIG / SERVICES		
ONOS	Grafana	ELK	Kafka	Prometheus	XOS	PROFILE
KUBERNETES					
OS		OS		OS	
BARE METAL ARM SERVER		BARE METAL ARM SERVER		BARE METAL ARM SERVER	

CUSTOMER EQUIPMENT — ONUs — OLTs — SW — WAN

- SEBA: SDN Enabled Broadband Access
- Manages wireline customer broadband services
- Ported to scalable and versatile eMAG Arm-based processor
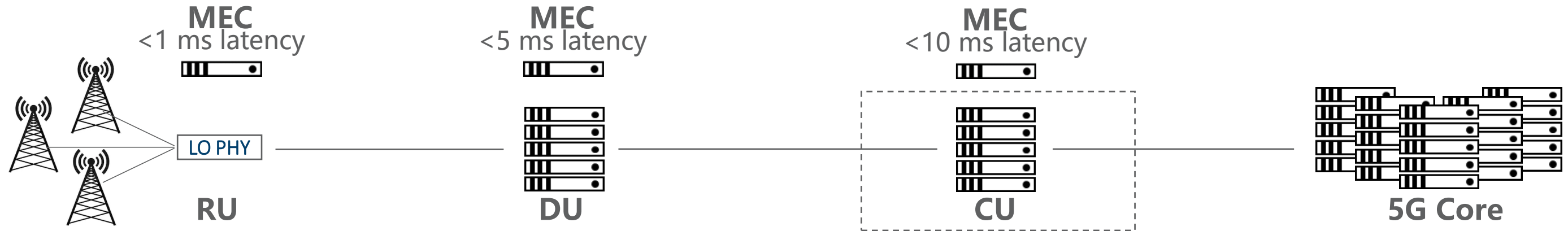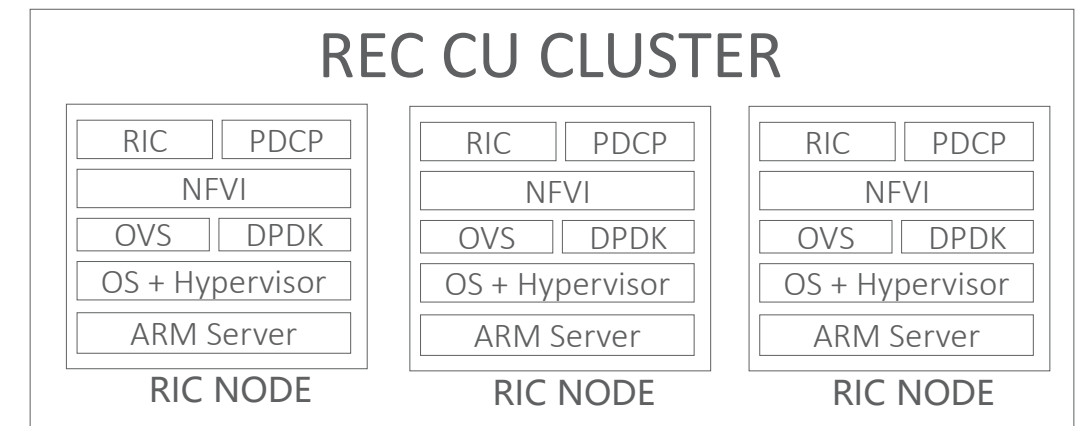- Source code and demo available

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Ampere eMAG for 5G Wireless Networks

MEC
<1 ms latency

MEC
<5 ms latency

MEC
<10 ms latency

LO PHY

RU

DU

CU

5G Core

openEDGE Chassis

openEDGE Chassis

openEDGE Chassis

COTS 1U/2U

Mobile Edge Compute
Autonomous devices
Immersive experiences
IOT, analytics, on-demand NFV

Distributed Unit
Manages radio packet traffic
eMAG + hardware acceleration
Development platform available

Centralized Unit
vRAN Virtual Radio Access Network
Akrainio **REC Blueprint** on **eMAG**
openEDGE chassis CPU cluster

5G Core
"Next Gen" targeted at Core DC
High core count, memory channel
Very high performance compute

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Ampere eMAG for vRAN

MEC
<1 ms latency

MEC
<5 ms latency

MEC
<10 ms latency

LO PHY

RU

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CU

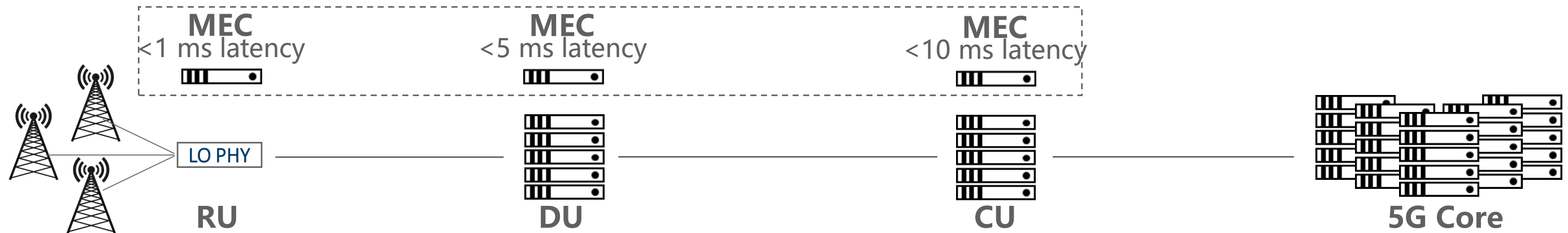**5G Core**

- vRAN: Virtual Radio Access Network

- Implemented with ORAN RIC: RAN Intelligent Controller

- Akraino REC Blueprint running on eMAG processor

- Demo and source code available

REC CU CLUSTER

RIC	PDCP
NFVI	
OVS	DPDK
OS + Hypervisor	
ARM Server	

RIC NODE

RIC	PDCP
NFVI	
OVS	DPDK
OS + Hypervisor	
ARM Server	

RIC NODE

RIC	PDCP
NFVI	
OVS	DPDK
OS + Hypervisor	
ARM Server	

RIC NODE

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Ampere eMAG for Mobile Edge Compute

- MEC = 5G speed + wireless connectivity + edge compute
- Enables virtual high performance compute in edge devices
- Deploying MEC closer to the edge lowers latency
- Examples:
  - Autonomous infrastructure (driving, traffic control, etc.)
  - Wireless industrial automation
  - IOT gateways, analytics, gaming, content delivery

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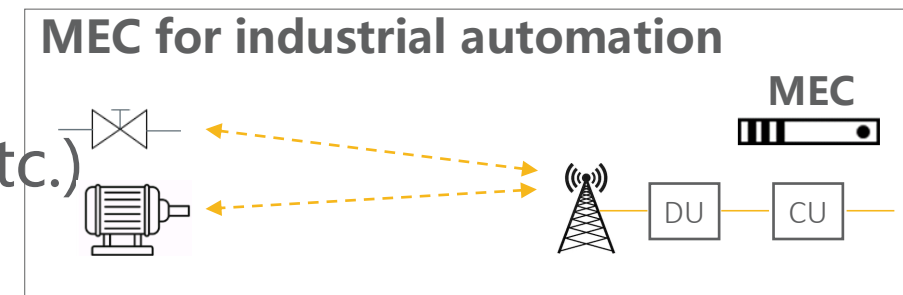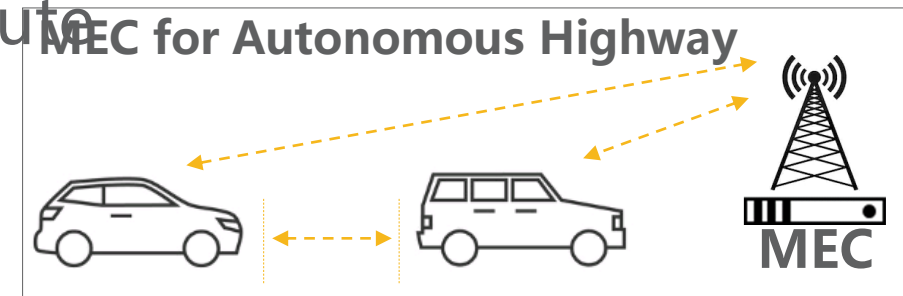
Ampere Hawk Motherboard

Overview
- Compatible with OCP openEDGE Chassis CPU sled
- 6.5" x 13.85"
- 32 and 16 core eMAG SKUs
- 32bit and 64bit Support
- TSMC 16 nm FinFET

Processor
- 32/16 Ampere eMAG Armv8 64-bit CPU cores @ 3.3 GHz Sustained Turbo
- 32 KB L1 I-cache, 32 KB L1 D-cache per core
- Shared 256 KB L2 cache per 2 cores
- 32MB globally shared L3 cache

Memory
- 8x 72-bit DDR4-2667 channels
- Up to 16 DIMMs and 1 TB/socket
- ECC, ChipKill, and DDR4 RAS features

I/O
- OCP Mezzanine v2 (Conn. A/B) 10/40/100 GbE NIC
- 1 x16 PCIe slot
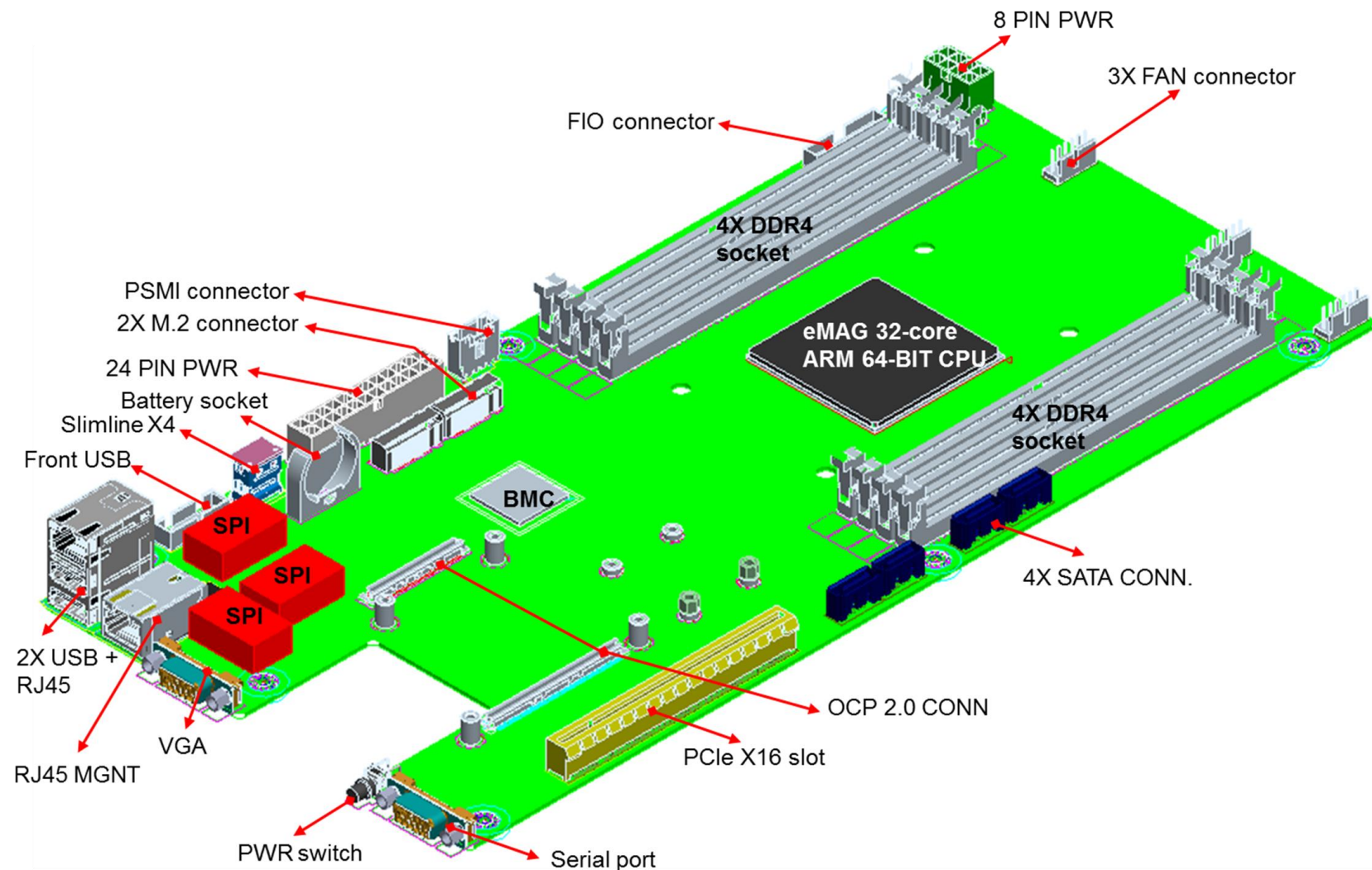- 2 x M.2 x4 NVME
- 4 x SATA3
- 2 x USB 2.0

Power
- 125W TDP for 32 cores
- 75W TDP for 16 cores
- Advanced Power Management

Performance
- SPECrate2017_int_peak est.: 68*
- SPECrate2006_int_peak est.: 502*

Availability
- Sampling: Q4'19
- Volume Production: Q1'20

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8 PIN PWR
3X FAN connector
FIO connector
4X DDR4 socket
PSMI connector
2X M.2 connector
24 PIN PWR
Battery socket
Slimline X4
Front USB
eMAG 32-core ARM 64-BIT CPU
4X DDR4 socket
BMC
SPI
SPI
SPI
4X SATA CONN.
2X USB + RJ45
VGA
RJ45 MGNT
OCP 2.0 CONN
PCIe X16 slot
PWR switch
Serial port

* Estimated based on measured Ampere 8180 and 8140 using gcc 8.2 -ofast, lto, jemalloc

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Ampere Edge Computing Platforms
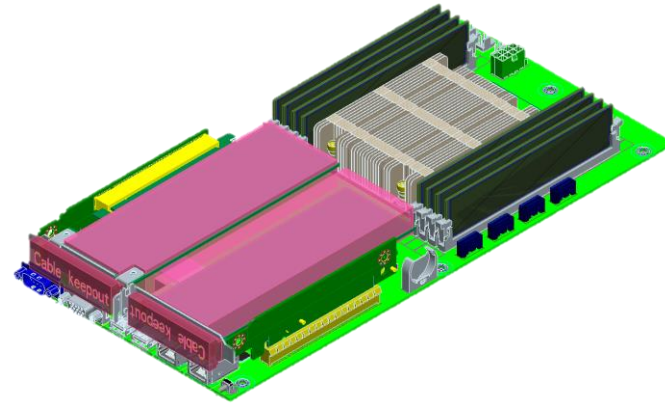
OCP
openEDGE
CPU Sled

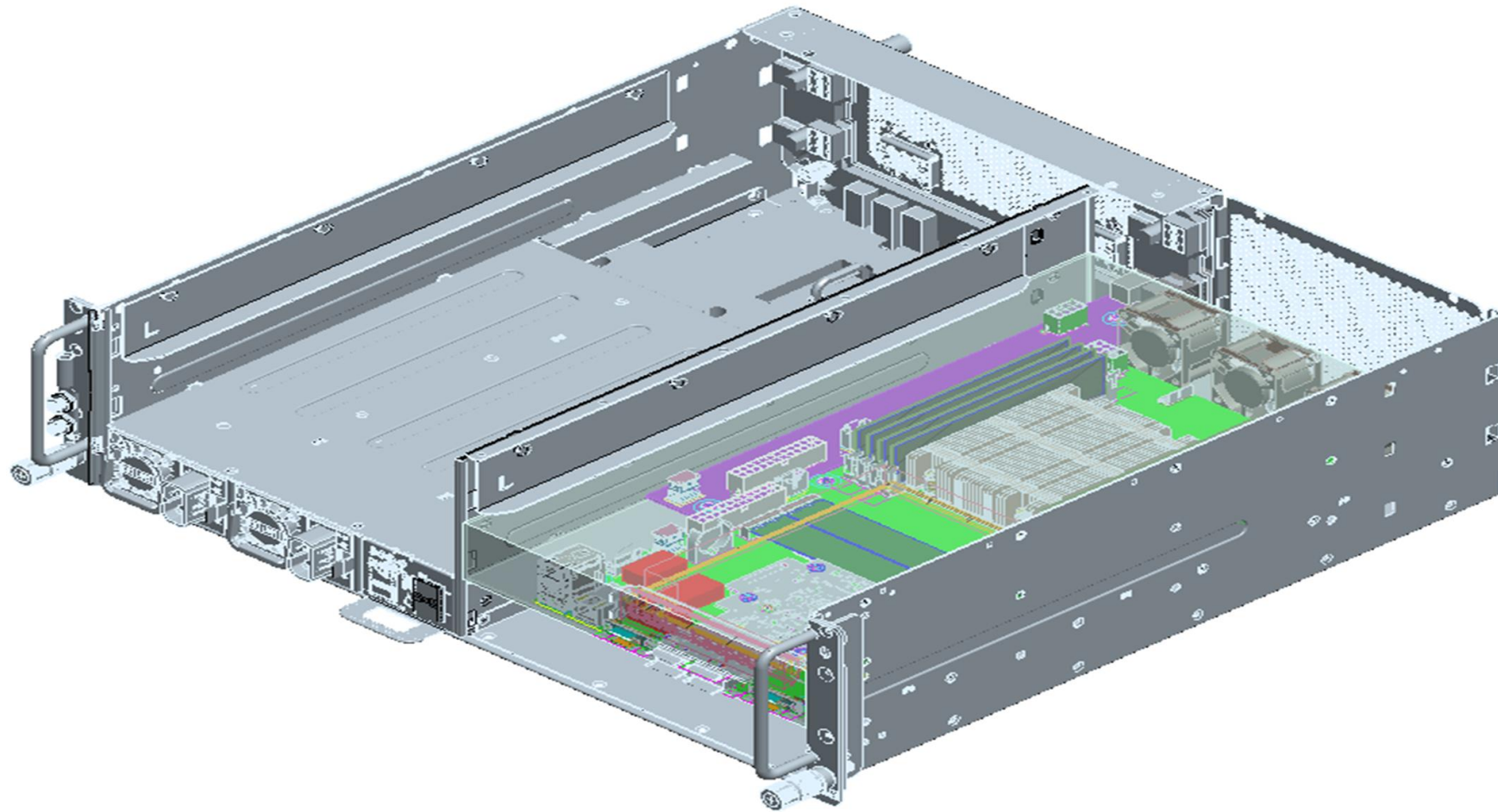Twin Server

Open19
CPU Brick

EP100
wiwynn®

NOKIA
AirFrame

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Hawk in openEDGE / AirFrame CPU Sled

ODM Production by Wiwynn and Available Now

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THANK YOU

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