Hardware Acceleration for Disaggregated RAN

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vRAN Market Trends and Opportunity

vRAN v/s Traditional RAN

- vRAN Market is small but growing
  - Standard server + Accelerator cards
  - Larger opportunity in 6G

- Traditional RAN is large but shrinking
  - Vendor/platform lock-in not desirable

- O-RAN presents an opportunity to have multi-vendor solutions for RU, DU, CU

- Increasing interest in open-source RAN, Core and Orchestration solutions

Source: “Virtual RAN”, April 2022, Mobile Experts
Drivers For Open RAN/vRAN Acceleration

- Heavy Reading conducted a survey of operators in early 2021
- Topic- Accelerating Open RAN Platforms

- The important business drivers for Open RAN-
  - Faster roadmap and ability to bring new features
  - Reduce vendor lock-in
  - Reliability improvement and cost savings with virtualization

- The three key drivers for acceleration-
  - Price,
  - Power
  - Performance
    - L1 has many high compute modules that are expensive to implement on GPPs.
    - Requires many more CPU cores and is expensive and not power efficient.

Source: Heavy Reading Webinar, May 2021

Software Infrastructure

- Key drivers for moving to software and virtualizing RAN
  - Improved reliability
  - Ease of deployment
  - Maintenance

- This is a trend continuing from the virtualization of the Core and network automation

- A large majority (~85%) preferred the use of open-source software, either vendor supported or internal development starting with an open-source solution

Source: Heavy Reading Webinar, May 2021

The Disaggregated RAN

- The disaggregated RAN distributes the RAN functionality over the RU, DU and CU (optionally)
- Some functionality from the core (i.e., UPF) could move to the CU
- Varied customer base: Telco, Enterprises with Private 5G, etc.
- Numerous deployment scenarios lead to many product skews
- One size does not fit all
  - Optimizing for price, performance and power is difficult
  - Leads to significant challenges to equipment provider eco-system
Hardware Acceleration Trends

- **Look-aside FEC Acceleration**
  - Enables software centric RAN and virtualization
  - High complexity modules impact performance
  - Look-aside acceleration improves performance
  - But limited by PCIE bandwidth

- **Inline L1 Acceleration**
  - Offloads complete L1 functionality
  - Removes PCIE BW issue
  - Performance limited to thermals and power constraint of PCIE slot
  - Mismatched server and card can lead to inefficiencies

- One size does not fit all!
- Solution needs to:
  - Scalable
  - Support various deployment scenarios
  - Cost effective across varying deployment and customer scenarios
  - Matched CPU and acceleration capability
  - Not constrained by PCIE BW
  - Not constrained by thermal requirements
  - Energy efficient

- Numerous interesting proposals on the table
T2 Telco Accelerator Card - Look-aside Acceleration

- T2 is a high bandwidth Look-aside FEC Accelerator
  - Gen4 x8 PCIe – 200Gbps
  - Capable of offloading 4-sector 64TRx (16DL/8UL) massive MIMO
  - Power dissipation - ~40W-45W

- Look-aside acceleration reduces the compute requirement of L1 by ~75% for smaller configurations (4T4R/8T8R)
- Results in significant cost and power savings
- Massive MIMO will require further offloading of complex functionality related to beamforming
- For many deployment scenarios especially Private 5G and Enterprise offloading FEC is good enough
### T1 Telco Accelerator Card – Hybrid Inline and FEC Acceleration

#### 5G NR L1/L2 software

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#### Diagram

- **FEC Offload**
- **Fronthaul and PTP Timing**

- T1 card accelerates FEC and fronthaul
- Has IEEE 1588 timing circuitry onboard
- Two devices with 100Gbps chip-to-chip interconnect enables inline acceleration (4T4R)
- Good for the Enterprise 5G market
The 5G NR Software Stack

- Much attention given to 4G/5G Layer 1
  - With inline acceleration this problem may be solved

- But Layer 2, Layer 3 (RRC) and 5G Core are equally important
  - Portions of Layer 2 (PDCP) especially in the disaggregated CU require acceleration of air-crypto and security functions
  - Support for Massive MIMO
  - Many protocols between disaggregated RAN and Core elements required
  - Radio Intelligent Controller plays an important role
  - In general O-RAN architecture and protocols needs to be supported
Where Can OAI Contribute?

- Open-source is gaining a lot of attention
  - Success of open-source projects such as Kubernetes is bringing attention to the 5G NR stack

- Deployable 5G NR-
  - (Layer 1 may be solved by inline acceleration)
  - High quality Layer 2/3 required
    - Focus on testing realistic Telco traffic models
    - Complete all the features

- Fully embrace the O-RAN architecture

Recap

- We will build our own; 12%
- We will use a proprietary vendor supported solution; 1%
- We will build our own starting with an open source solution; 38%
- We will use a vendor supported open source solution; 48%
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