Intel® Network Builders Insights Series

Intel® Ethernet 800 Series: Delivering High Timing Accuracy for 5G vRAN

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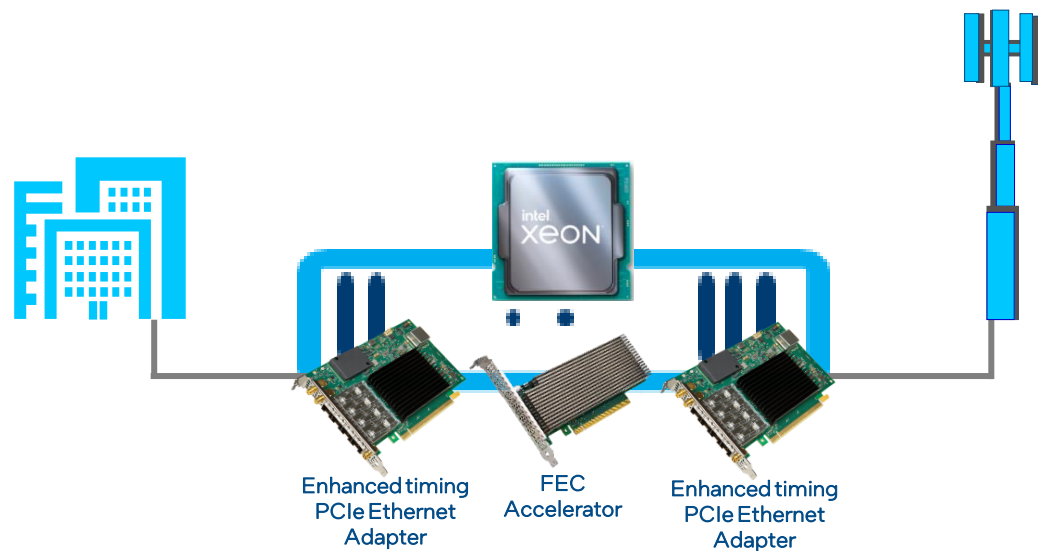No product or component can be absolutely secure.

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Understanding the vRAN Opportunity

With 4G/5G vRAN deployments, CoSPs are moving toward open and disaggregated IA-based stacks

- Easily scalable
- Simpler deployments
- Cost effective

Enhanced timing PCIe Ethernet Adapter

FEC Accelerator

Enhanced timing PCIe Ethernet Adapter

Intel® Ethernet 800 Series
and Intel® vRAN Accelerator ACC100 adapter acceleration advantages

Platform Balance

Comprehensive timing capabilities

Dedicated FEC acceleration

Intel® Xeon® processor

OSV collaboration and integration

Red Hat

WNDRVR

vmware

## Platform-level integration with Intel® FlexRAN™ software

Challenges

- Interconnects
- Thermal
- Limited slots on edge severs
- New protocols, PPPOE
- Layers of SW (operators), containers, in-tree/out-of-tree, Real time (RT) OS

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Meeting 5G Network Timing Requirements

Intel® Ethernet 800 Series Network Adapter with Hardware-Enhanced 1588 Precision Time Protocol (PTP) and SyncE

Challenge

5G deployments demand high timing synchronization across the network and affordable infrastructure costs

5G Use Case

GPS

| Core Network | BBU | RRU |

Grand Master

Phase Accuracy Target = ± 100 ns
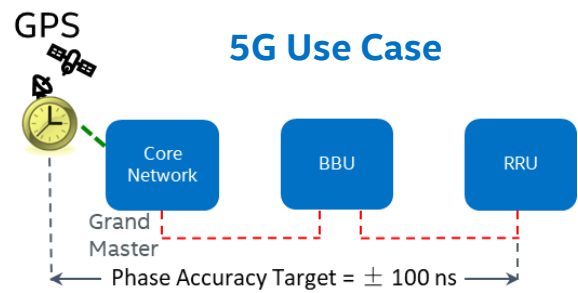
Insufficient timing accuracy can lead to service disruptions – dropped calls, less accurate location services, loss of advanced network capabilities

Strong growth in 5G RAN will demand cost-effective deployment options

Solution

Intel Ethernet 800 Series Network Adapter with hardware-enhanced IEEE 1588 PTP and SyncE and IA servers deliver high-accuracy network synchronization

Cost Savings via Hardware Consolidation

Dedicated timing HW

Intel® Ethernet 800 Series Network Adapter and Intel® architecture server
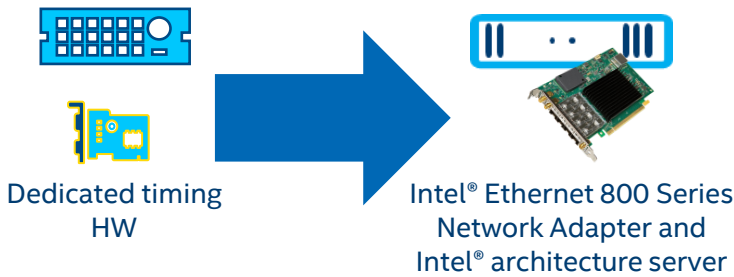
Multiple Market Appeal

Intel Ethernet 800 Series Network Adapters with hardware-enhanced timing deliver synchronization capabilities across workloads and markets

5G RAN

Industrial **Financial** **Energy**

EMERGENCY RESPONSE LOCATION SERVICES

30m RADIUS

50m RADIUS

100m RADIUS

Timing Accuracy	Positional Accuracy (Radius)
75 nsec	30 meters
125 nsec	50 meters
250 nsec	100 meters

Intel® Ethernet Network Adapter E810-XXVDA4T

Hardware Enhancements

1 Oven-controlled external oscillator (OCXO)
- Maintains adapter timing precision
- Up to four hours of holdover time

2 SyncE enabled by Intel® Ethernet Connection C827

3 GNSS mezzanine (optional)
- Integrated support for most GNSS satellite systems

4 Dual SMA connectors connected to SDPs
- Connect to external timing resources, receive input
- Connect to performance-auditing equipment

5 SMB connector
- Connectivity for optional external GNSS antenna

Software Enhancements

Intel® Ethernet 800 Series driver and Open Source support for 1588 PTP and SyncE

Intel® Ethernet 800 Series Features
- Quad SFP28 ports (25/10/1Gbps)
- PCIe 4.0 x16
- Advanced features: Application Device Queues, Dynamic Device Personalization, RDMA (iWARP and RoCEv2)

Product Ordering Info

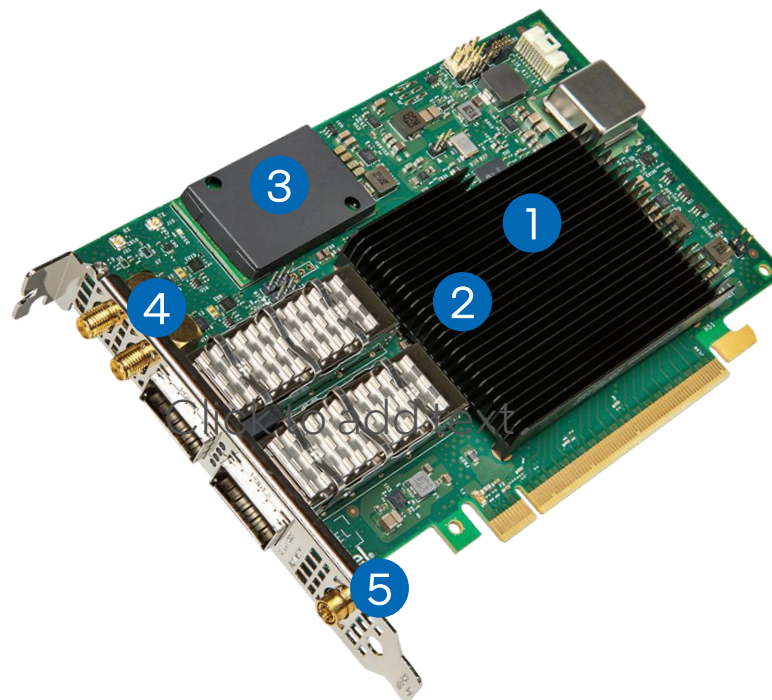| Product Order Code	MM#
E810XXVDA4TG1 (without GNSS)	99AD9D
E810XXVDA4TGG (with GNSS)	99ADGH

Hardware-enhanced 1588 Precision Time Protocol and SyncE for 5G RAN deployments

Intel® Ethernet Network Adapter E810-CQDA2T

Hardware Enhancements

1 Oven-controlled external oscillator (OCXO)
- Maintains adapter timing precision
- Up to four hours of holdover time

2 SyncE enabled by Intel® Ethernet Connection C827

3 GNSS mezzanine (optional)
- Integrated support for most GNSS satellite systems

4 Dual SMA connectors connected to SDPs
- Connect to external timing resources, receive input
- Connect to performance-auditing equipment

5 SMB connector
- Connectivity for optional external GNSS antenna

Software Enhancements

Intel Ethernet 800 Series driver and Open Source support for 1588 PTP and SyncE

Intel® Ethernet 800 Series Features
- Dual QSFP28 ports (100/50/25/10Gbps)
  - Supports 8x 10Gbps via PSM4 modules and breakout cables
- PCIe 4.0 x16
- Advanced features: Application Device Queues, Dynamic Device Personalization, RDMA (iWARP and RoCEv2)

Product Ordering Info

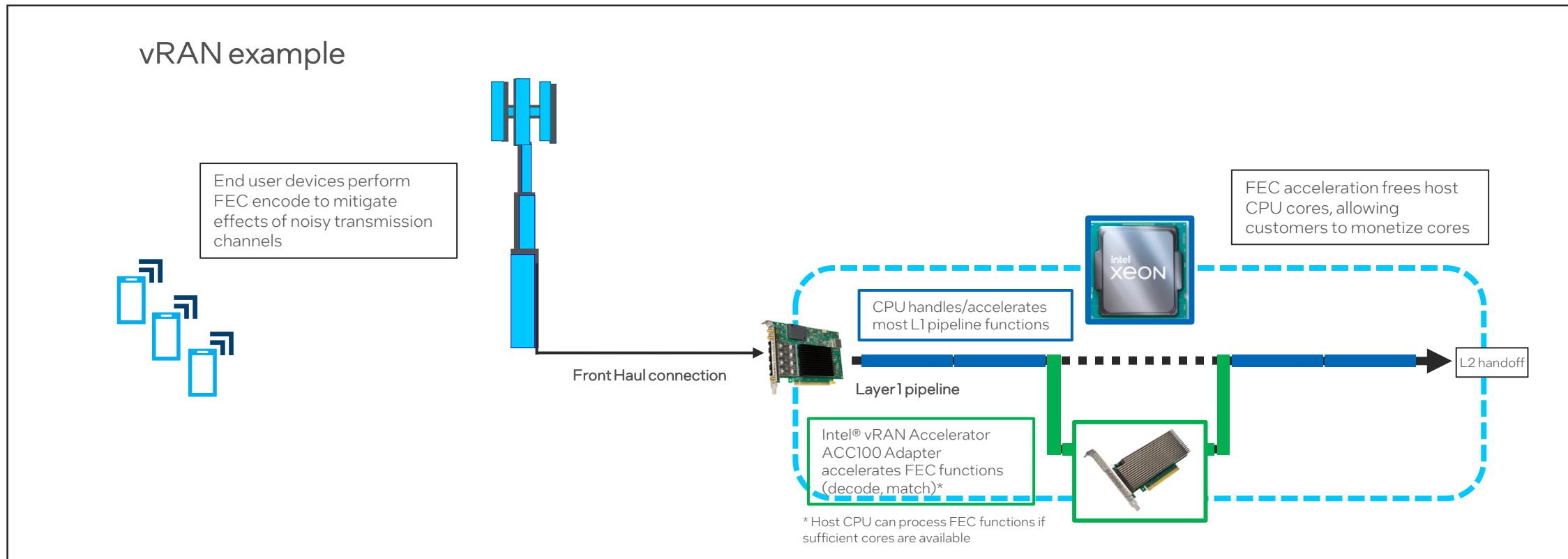| Product Code	MM#
E810CQDA2TG1 (without GNSS)	99ARL5
E810CQDA2TGG1 (with GNSS)	99ARL6

Hardware-enhanced 1588 Precision Time Protocol and SyncE for 5G RAN deployments

Intel® Ethernet 800 Series Options for vRAN

	E810-XXVDA4T	E810-CQDA2T	E810-XXVDA4	E810-CQDA1, CQDA2	E810-2CQDA2
Maximum port speed	25Gbps	100Gbps	25Gbps	100Gbps	100Gbps
Max Throughput on Adapter	100Gb	100Gb	100Gb	100Gb	200Gb
Flexible port configurations (QSFP28 ports only)	N/A (25/10Gb only)	2x100, 2x50, 4x25, 2x 2x25, 8x10	N/A (25/10Gb only)	2x100, 2x50, 4x25, 2x 2x25, 8x10	2x100, 8x25, 8x10
Port # and type	Quad SFP28	Dual QSFP28	Quad SFP28	Single, Dual QSFP28	Dual QSFP28
Targeted Applications	4G and 5G vRAN requiring high precision timing, SyncE, boundary clock, and integrated GNSS support		General 4G and 5G vRAN. Does not support boundary clock implementation due to lack of 1pps and GNSS support		
SMA Header for 1PPS signal	Yes – for Master Clock in/out	Yes – for Master Clock in/out	No	No	No
1588 PTP	Yes	Yes	Yes	Yes	Yes
SyncE	Yes	Yes	No	No	No
Integrated GNSS	Yes (optional)	Yes (optional)	No	No	No
Temp	0-65 °C	0-65 °C (target)	0-60 °C	0-60 °C	0-60 °C (target)

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FEC Overview

Forward error correction (FEC) introduces redundancy into a data-bearing signal so that errors incurred during transmission can be corrected at the receiver[1]

vRAN example

End user devices perform FEC encode to mitigate effects of noisy transmission channels

FEC acceleration frees host CPU cores, allowing customers to monetize cores

CPU handles/accelerates most L1 pipeline functions

Front Haul connection

Layer 1 pipeline

Intel® vRAN Accelerator ACC100 Adapter accelerates FEC functions (decode, match)*

L2 handoff

* Host CPU can process FEC functions if sufficient cores are available

[1] Gracie, Ken and Hamon, Marie-Hélène (2007) "Turbo and Turbo-Like Codes: Principles and Applications in Telecommunications." Proceedings of the IEEE, July 2007.
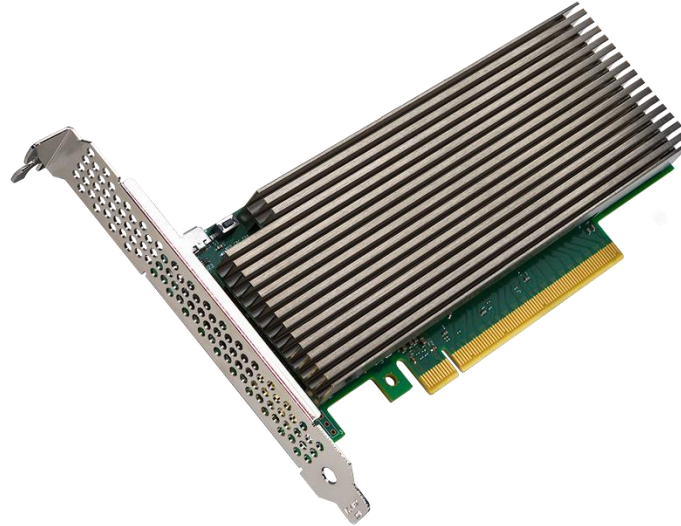
Intel® vRAN Accelerator ACC100 Adapter

Key Features

Concurrent 5G and 4G FEC Acceleration

Powered by Intel® vRAN Dedicated Accelerator ACC100 SoC

Thermal solution validated using same methodologies as Intel® Ethernet product line

Ease of Integration

Integrated with Intel® FlexRAN™ software reference architectures for rapid platform validation, faster TTM

Support for Cloud Native, VM, and Bare Metal environments

Product Ordering Info

Product Order Code	MM#
VACC100G1P5	99AF12

Intel Advantages

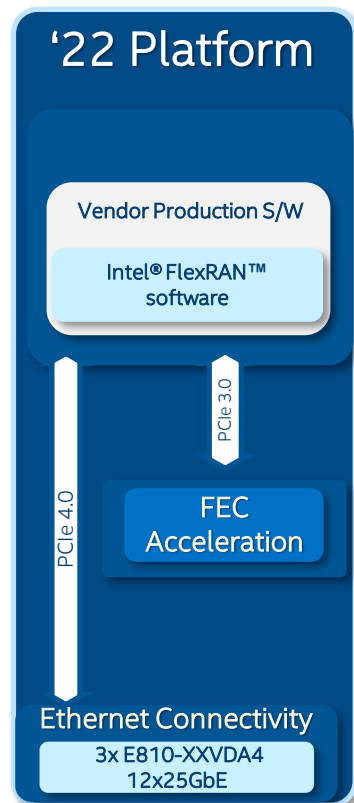Manageability consistent with Intel Ethernet product line, designed with OEMs for OEM applications

Cost-effective, high-performance FEC Acceleration for 5G vRAN

Intel FEC Acceleration Options for vRAN

	Intel® FPGA PAC N3000	Intel® vRAN Accelerator ACC100 Adapter
FEC accelerator	Intel® Arria® 10 GT FPGA	Intel® vRAN Dedicated Accelerator ACC100 SoC
Form factor	Full Height Half Length Passive Heatsink	Half Height Half Length Passive Heatsink
PCIe	PCIe 3.0 x16	PCIe 3.0 x16
4G and 5G support	4G vRAN package Or 5G vRAN package	Concurrent 4G and 5G FEC support
Board power	100W	53W
Intel® FlexRAN™ software support	Yes	Yes
System Level NEBS testing (by OEM)	No	No

- Early vRAN deployments used FPGAs for FEC acceleration, great for Proof of Concept yet power and cost prevented broad market scaling
- Fixed function Intel® vRAN Dedicated Accelerator ACC100 SoC delivers cost-effective, low power, high-performance FEC acceleration
- Easy migration: Intel® FPGA Programmable Acceleration Card N3000 and Intel® vRAN Accelerator ACC100 Adapter share common BBDEV API, DPDK kernel driver, and Intel® FlexRAN™ software code base

EPG vRAN Platform Ingredients

'22 Platform

Vendor Production S/W

Intel® FlexRAN™ software

PCIe 3.0

PCIe 4.0

FEC Acceleration

Ethernet Connectivity
3x E810-XXVDA4
12x25GbE

FEC Acceleration

Intel® vRAN Accelerator
ACC100 Adapter

Ethernet Connectivity + PTP/SyncE: Intel® Ethernet 800 Series
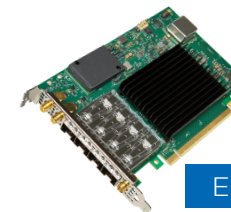
Enhanced timing

E810-XXVDA4T
4x 25GbE

E810-CQDA2T
2x 100GbE
(100Gb total BW)
(Q2 '22)

Ethernet Connectivity: Intel® Ethernet 800 Series

E810-XXVDA4
4x 25GbE

E810-CQDA2
2x 100GbE
(100Gb total BW)

E810-2CQDA2
2x 100GbE
(200Gb total BW)

A comprehensive Ethernet and FEC Acceleration portfolio for vRAN

Challenges

- Interconnects
    - New non datacenter link partners in use
    - New Cell site routers in ecosystem with new features
- Thermal
    - Edge sites may have less optimal cooling than typical data centers
    - OCP vs PCIe form factors experience different cooling profiles
    - 1U servers can strain thermal budgets
- Limited slots on edge severs
    - Cards that support multiple application or cards with maximum I/O density
- New vRAN specific protocols
    - ECPRI, PPPOE
- Many layers of SW (operators), containers, in-tree/out-of-tree, Real time (RT) OS
    - Containerization, readiness, immutable OSs, new application (non-hardened application), RT OSs

Resources

- Intel® Ethernet Network Adapter E810-XXVDA4T product brief

- Animation: Simplicity for Timing Synchronization from the Cloud to the 5G Edge

- Intel® vRAN Accelerator ACC100 Adapter product brief

Questions?

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September 7th @ 8am PDT

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