Solution Brief

**MNOs, O-RAN suppliers, Private 5G, CEOs, CTOs and Radio Engineering Teams
Communications Service Providers**

Symware™ 2.0 Reference Design Reduces 4G/5G DU Cost, Complexity

Rakuten Symphony and Intel develop reference design for next generation of highly successful Symware™ platform for Open RAN distributed units (DU) using 4th Gen Intel® Xeon® Scalable processors with Intel® vRAN Boost

Before Open RAN, each cellular base station had a dedicated baseband unit (BBU), which, when combined with the radio unit (RU) provided the radio access network (RAN). The BBU was a proprietary system that has been described as a "supercomputer" in terms of cost and performance. It was a one-size-fit-many network element that resulted in base station overprovisioning in many cases.

Open RAN changed that by breaking the BBU into two network elements: the centralized unit (CU) and the distributed unit (DU) (see Figure 1). The DU is a critical network element to delivering the benefits of Open RAN to mobile networks.

Because the DU is separate from the CU, networks can be built in a manner that break the legacy BBU's costly 1:1 CU/DU deployment ratio in favor of the CU serving multiple DUs depending on the network workload.

The DU's place in a RAN is between the RU and the CU. It is responsible for real time L1 (radio link control) and L2 (media access control) scheduling functions. As part of the L1 processing, the DU manages forward error correction (FEC), which corrects and resolves data transmission errors. FEC is one of the most compute intensive workloads processed by DU.

The DU also faces increased spectrum management workloads as MNOs deploy 5G massive MIMO antennas to drive more bandwidth.
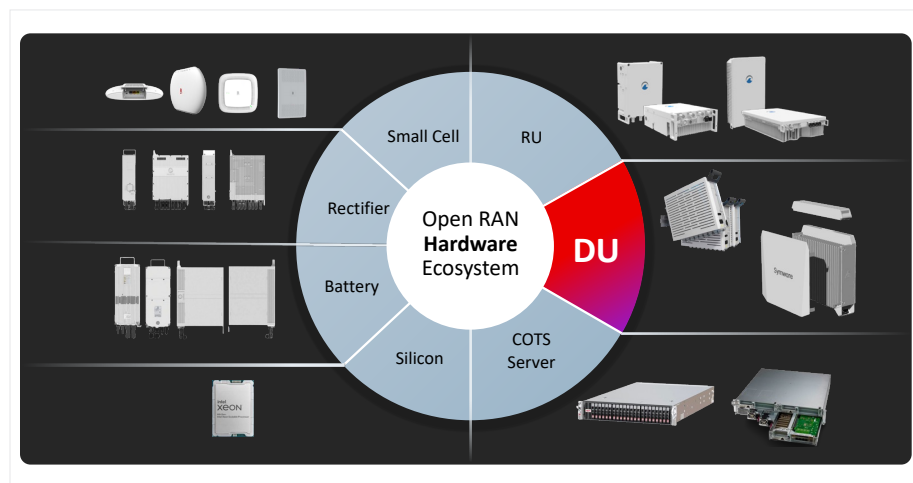

Figure 1. This figure demonstrates a complete Open RAN-based base station including the DU running on the Symware™ 2.0 reference design, RU and ancillary power and other systems.

First-generation DU products utilized discrete accelerators to handle the FEC workloads and free up processor cores for other DU workloads. But Rakuten Symphony believes that it is critical to design the DU with as few discreet ICs as possible, instead integrating as much as possible into the CPU. This is especially important for brownfield networks where the biggest obstacle to adopting Open RAN networks is the complexity of managing spectrum holdings using carrier aggregation technology.

These trends led Rakuten Symphony, an Intel® Networks Builder Titanium ecosystem member, to develop Symware™ 2.0 next-generation DU reference design for mass scale deployment at 4G and 5G radio cell sites. It is designed to use 4th Gen Intel Xeon Scalable processors with Intel vRAN Boost as a single SoC solution that offers high performance with a simplified board design and reduced power consumption when compared with Symware™ 1.0 servers.

Building on Mass Deployment Success

The Symware™ 2.0 platform was designed with knowledge gained through the success of the first generation Symware™ server, which has many units being deployed in the Rakuten Mobile 4G network in Japan. The original Symware™ 1.0

server features an Intel Xeon D processor with a separate Intel® vRAN Dedicated Accelerator ACC100, which accelerates FEC algorithms and frees up CPU processing power for increased channel capacity.

Advanced Hardware Design

The Symware™ 2.0 design will be available in two models. One is a sleek server for external deployments that is a fanless cabinet-free design protected by a weatherproof (IP67) enclosure. This outdoor model will have a single-person carry form factor making it easy to install. For ease of management, the server has built-in zero-touch provisioning functionality.

A second model is designed for data centers and telecom equipment cabinets. It will have the same processing and performance specifications but will be housed in a short-depth (600 mm) chassis ideal for telecom rack installations. The data center model is designed for edge network deployments. Figure 2 shows the distributed RAN and cloud RAN network architectures using Symware™ 2.0 design.

Both designs will support Class C precision timing and Synchronous Ethernet. They will be suitable for deployment in greenfield and brownfield mobile networks use-case scenarios.
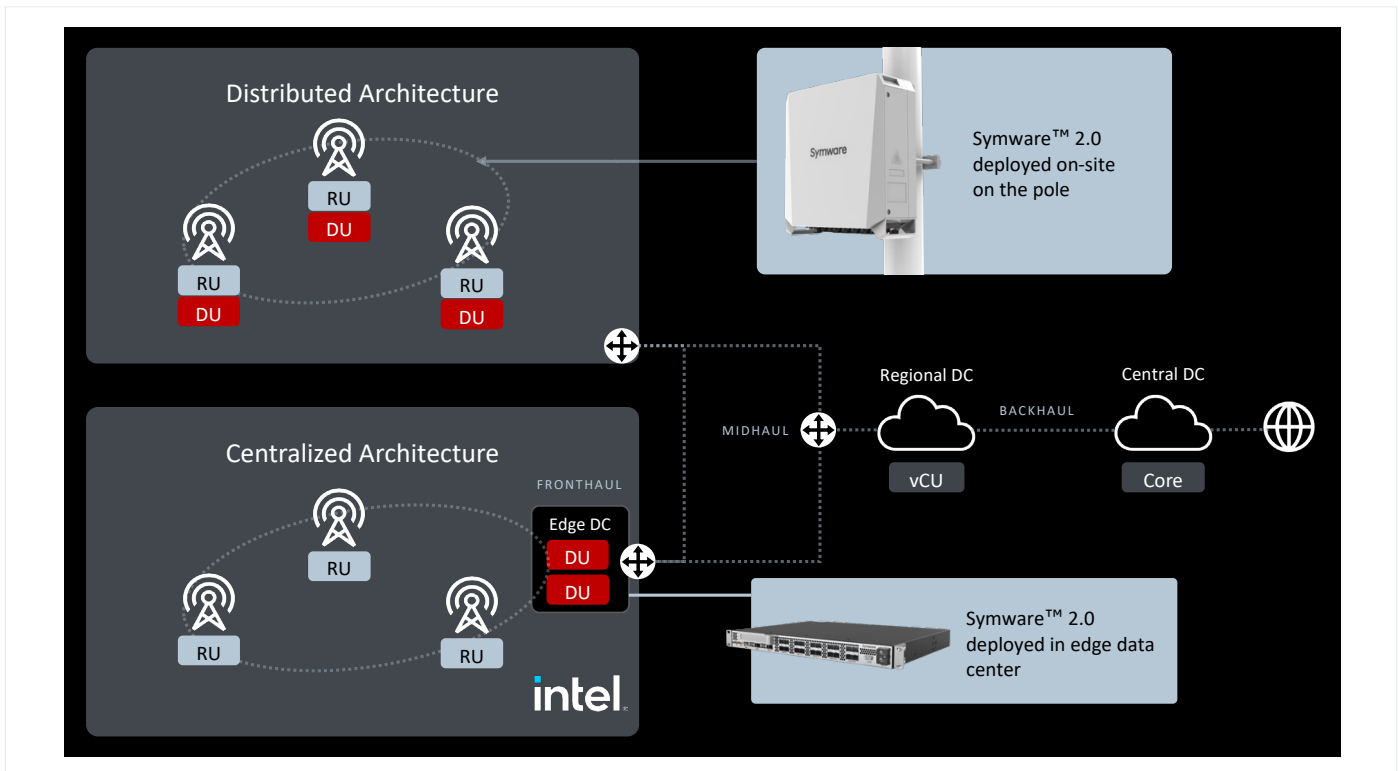

Figure 2. How Symware™ 2.0 design can be used in distributed RAN and cloud RAN architectures.

4th Gen Intel Xeon Scalable Processor Provides Performance and Power Efficiency

The Symware™ 2.0 design is accelerated by 4th Gen Intel Xeon Scalable processors that were developed to enhance performance for vRAN workloads. These processors are the first to feature built-in vRAN acceleration. By fully integrating acceleration directly into the CPU, Intel has eliminated the

need for an external acceleration card. This unique design innovation—Intel vRAN Boost—not only reduces system complexity, but also provides substantial power savings. In fact, 4th Gen Intel Xeon Scalable processors with Intel vRAN Boost deliver up to twice the capacity and an additional ~20% compute power savings versus their previous generation processor[1]. The processors also have a range of features for managing power to further optimize performance per watt.

With the 32-core Intel Xeon Scalable processors with Intel vRAN Boost, Symware™ 2.0 design can support 27 sectors which is three times the capacity of the first-generation Symware™ 1.0 server with a smaller form factor.

Reduced Power Consumption

In tests by Rakuten Symphony, Symware™ 2.0 design leverages the CPU's power management features to reduce power consumption per sector by 50% compared to the first-generation Symware™ server. This reduction not only improves efficiency and cost-effectiveness but also has a positive impact on sustainability by significantly decreasing energy consumption and reducing the network's carbon footprint.

Integrated Software

Symware™ 2.0 design can be deployed as a bare metal server or with cloud native containerization. Also included is integrated software including containerized DU software from Rakuten Symphony. Also, Symware™ 2.0 design features integrated virtual cell site routing (CSR) functionality decreasing costs for operators who no longer need to purchase a separate CSR.

This next-generation DU server is built upon the Rakuten Symphony Open RAN full stack software, allowing operators to build and deploy highly optimized, feature rich, 4G and 5G scalable cloud-native RAN solutions. The solution leverages portions of the Intel FlexRAN™ reference architecture;

specifically, the Task Scheduler / eBBU pooling framework and the Intrinsic functions from the SDK modules of FlexRAN. Rakuten Symphony has designed the platform with support for O-RAN fronthaul specifications across a wide range of O-RU vendors, allowing customers flexibility in terms of the radio they deploy.

Conclusion

The DU is a critical link to the benefits and success of an O-RAN deployment. And with massive MIMO and other network evolutions creating processing challenges, it is important that the performance of the DU keep pace with the network and yet still use COTS components. The Symware™ 2.0 next generation DU reference design was created by Rakuten Symphony to meet these needs and is based on the success of its previous DU platform which is being deployed in many live network sites across Japan.

Rakuten Symphony partnered with Intel to design Symware™ 2.0 platform, which utilizes the vRAN-specific performance enhancements included in the 4th Gen Intel Xeon Scalable processor. With vRAN acceleration integrated into the processor, Symware™ 2.0 platform benefits from a simplified and reduced-power board design.

The Symware™ 2.0 reference design is the ideal combination of real-world experience and cutting-edge technology resulting in a system that will meet the needs of the highest performance mobile networks.

Learn More

Rakuten Symphony Symware™ 2.0 Next Generation Distributed Unit

4th Gen Intel® Xeon® Scalable processor with vRAN Boost

Intel and Rakuten Power a Revolution in How Mobile Networks are Built

FlexRAN™ Reference Architecture

Intel® Network Builders

Accelerated— By Design

Accelerated by Intel® is reserved for solutions that take advantage of one or more Intel® technologies, such as built-in accelerators, specialized software libraries, optimization tools, and others, to give you great experiences on Intel hardware.

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