DZS Enabling the Hyper-Connected World

WHITEPAPER

Rakuten

Open RAN Mobile Network Project

An Overview of the DZS Outdoor Mobile FrontHaul Solution

With the development of distributed and open architectures for the mobile Radio Access Network (RAN), operators are now promised the ability to use products from different vendors at the same mobile site -- something not possible in older networks. The O-RAN Alliance, an operator-led group, has played a central role in establishing architecture and interface specifications for interoperable multi-vendor networks for the RAN.

In legacy RAN architectures, an operator may be limited to the use of dedicated equipment from a single vendor for each band, each air interface technology, each base station site, or each region in order to assure compatibility. A lack of interoperability can mean all the RAN elements at a mobile site must come from the same vendor, such as the radio units, the baseband processing units, and front-haul / back-haul elements too.

In an Open RAN model, an operator can implement an architecture that offers vendor choice for each element so long as each is designed to conform to the agreed reference points or interfaces used by the other adjacent elements. This model also provides for a consistent definition of functional subsystems separating those that are radio dependent from those that are entirely digital or baseband in nature, and that can in turn be readily virtualized to run general purpose hardware.

This world-leading Open RAN model is being put into commercial deployment TODAY. Rakuten, a major e-commerce company in Japan, is building a new 5G-centric mobile network based on virtualization and open RAN principles. Vodafone has also initiated Open RAN trials with the aim to “actively expand our vendor ecosystem.” Other operators like Telefónica in Spain have also invested in Open RAN based systems.

What are the Benefits to Open RAN?

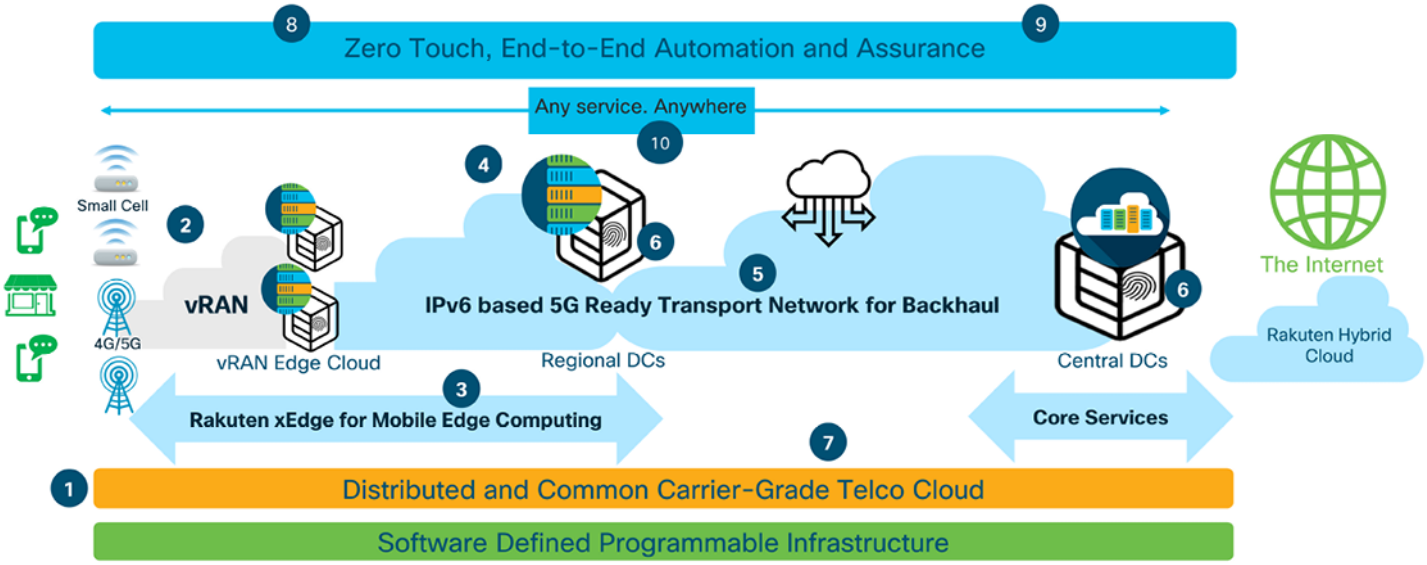
Service providers have several motives for embracing virtualization and Open RAN technologies:

+ **Drive innovation** by reducing the barriers to new functions and new vendors in the network
+ **Bring more competition into the supplier market** to lower prices for operators facing price and margin pressures, especially for those considering new and developing markets
+ **Address industry or regulator concerns** that large vendors may exercise too much control over the economically significant market represented by 5G
+ **Reduce the baseline costs of the network** through with an architecture based on general purpose compute / network hardware and open-source derived technologies

Industry forecasts predict 5G deployment costs between now and 2022 falling 30% if a network is built in the traditional way but 50% if open architecture is used.

How is Rakuten Implementing Open RAN?

Rakuten announced bold plans in 2018 to build a greenfield fourth mobile network to serve its 100 million-strong customer base in Japan, one of the world's most developed telecom markets. Today, Rakuten has turned this vision into reality by commercially deploying at scale the industry's first truly cloud-native network, fully virtualized and highly automated from the radio access network (RAN) to the core.



Source: Rakuten

By implementing Open RAN principles, Rakuten is proving that it can build a mobile network at a fraction of the typical cost.

To achieve this, Rakuten has established a policy against "tightly coupled" hardware / software solutions in its network, so all of the hardware used in the Rakuten network is standardized, off-the-shelf equipment. By doing so, it has created a single vendor strategy for each technology domain, which simplifies systems integration while maintaining the cost benefits of separating hardware from software.

Following the model of web-scale data centers where comprehensive automation enables hundreds of thousands of servers to be managed by a small number of personnel, Rakuten has adopted this operating model in its own cloud-based mobile network. The goal is to create a network with approximately 45,000 4G base stations and 35,000 5G base stations across Japan, covering 96% of the population using an operations team of just 100 people.

The cloudification of the radio access network (RAN) is paramount when it comes to cost. Although on the order of 60% of all network capital expenditure is typically spent on installing equipment in the RAN, Rakuten has eliminated as much equipment as possible from each mobile site leaving only a remote radio head running Altiostar software. Installing this element can take as little as 15 minutes, compared with the days required for a typical eNodeB / base station site. All other functions have been moved into a large number of distributed "edge" data centers that have no local maintenance staff.

By separating the control plane from the user plane, Rakuten is able to localize user plane workloads in edge facilities while hosting the control plane functions at larger, centralized data center type locations.

Rakuten also uses a common Network Functions Virtualization Infrastructure (NFVI) to deploy, automate, and manage network functions throughout the entire network.

Together, these strategies afford huge cost savings, estimated to be 50-60% less than traditional networks. Rakuten believes these cost efficiencies will translate into an advantage in Japan's crowded mobile market, allowing it to undercut its rivals on price without affecting profitability.

What Is the Status of Rakuten's Deployment?

Rakuten is reporting 1 million sign-ups at the end of June for the service it launched in April 2020. This puts Rakuten within reach of its stated 3 million subscriber target by end of year 2020.

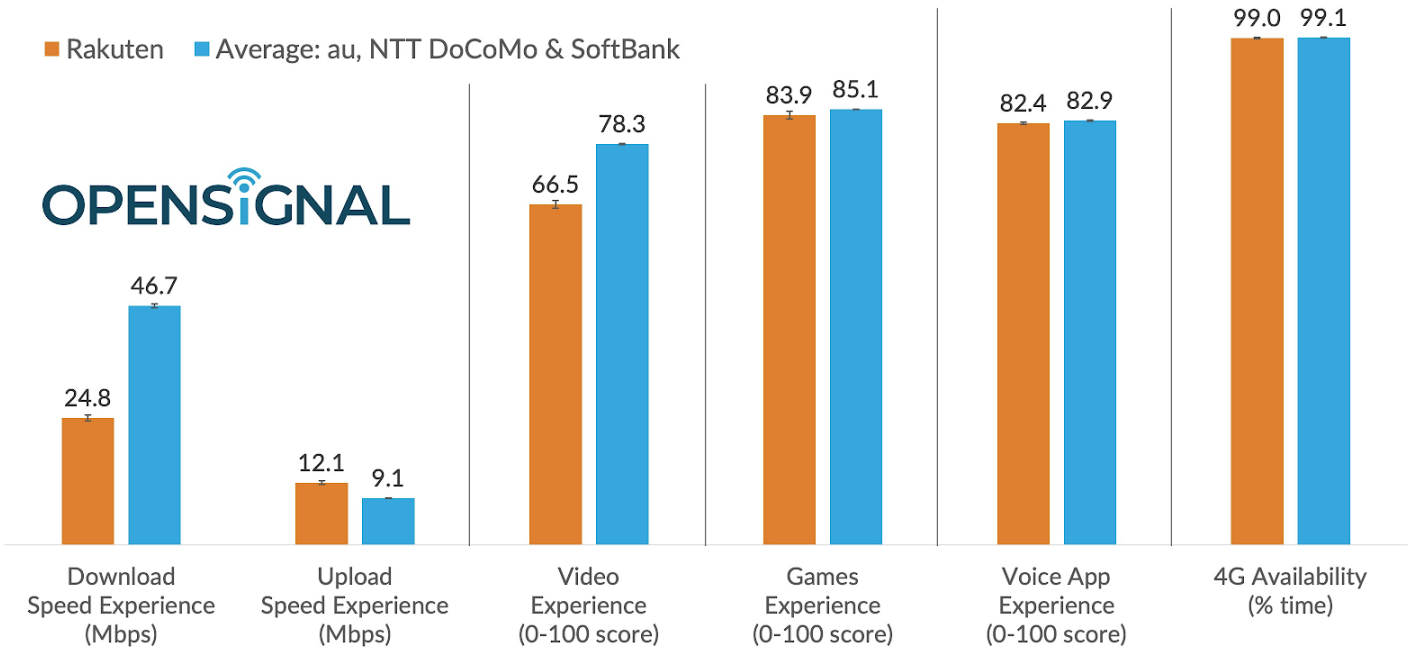
The operator has also advanced its network deployment targets

significantly. Originally, the aim was to cover about 96% of Japan's population by 2026, but now Rakuten predicts it can achieve this level by the summer of 2021.

The increased speed of rollout has been aided by technology simplification. Rakuten's deployment foregoes much of the cable assemblies, hardware, furnishings and complex equipment that are normally used by operators building mobile networks. By combining remote radio units with special adapters, Rakuten claims to have made installation a simple affair akin to "building with Lego toys".

In additional to speed, Rakuten is also now reporting a 30% coverage improvement per site compared with its rivals.

What Has Performance Looked Like Relative to its Peers?



Data collection period: 5 May – 4 June, 2020. © Opensignal Ltd

What Technologies are Being Used?

Beyond the Open RAN concept, several other important technologies are used to create the Rakuten environment. These include edge compute, network slicing, comprehensive automation, an IPv6-based transport network, a single Operational Support System (OSS) layer and a packet core that also fully separates control and user planes.

Reduction in the signaling latency that is achieved through this simplified architecture is envisioned to enable low latency applications and use cases with 5G that rivals of Rakuten may not be able to easily exploit.

The company has actively sought out partners willing to challenge the status quo, sharing the same philosophy and "DNA" … **this "search" was the catalyst that brought together Rakuten and DZS.**

DZS joins an array of other announced suppliers to the Rakuten Open RAN network including Altiostar, Cisco, Nokia, Intel, Red Hat, OKI, Fujitsu, Ciena, Netcracker, Qualcomm, Mavenir, Quanta, Sercomm, Allot, Innoeye and Viavi.

What is the Architectural Vision for Rakuten's Mobile Network Operator (MNO)?

The Rakuten MNO is based on one of the first zero touch, fully automated "Mobile Telcocloud" environments built to scale to tens of millions of subscribers across the globe. The Mobile Telcocloud is software defined, fully virtualized and uses cloud native technologies.

Key concepts of this vision are as follows:

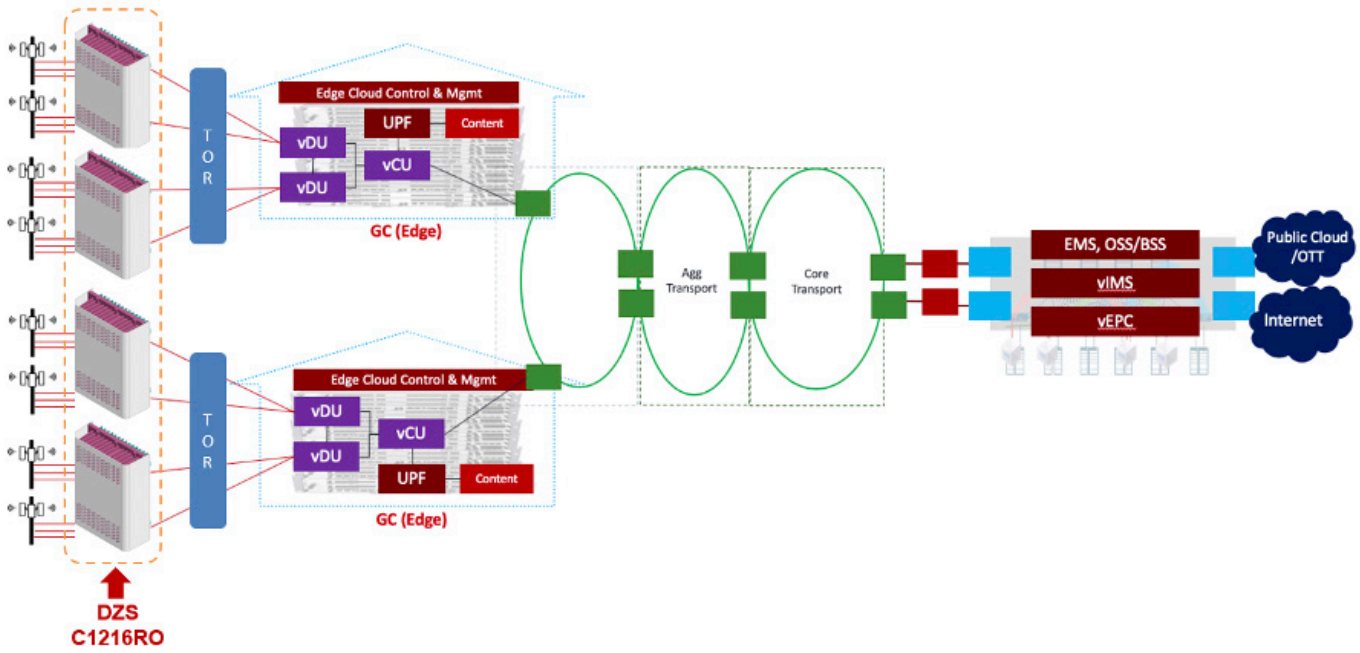
+ **An IT-centric network** where services are instantiated and the entire lifecycle is managed without dependencies on the underlying infrastructure
+ **Integration of the Rakuten Mobile Network (RMN) with hybrid cloud infrastructures** spread across globe, enabling mobility of workloads from Rakuten Telcocloud to hybrid cloud without service impact
+ **Maximized use of native IPv6** for networking
+ **A highly resilient software-defined network operations center (SD-NOC)** using machine learning, advanced analytics, and self-healing capabilities
+ **A single operations support system (OSS) layer** to manage services and infrastructures seamlessly
+ **Ability to perform software upgrades of all components at runtime** to eliminate downtime

Why was the Rakuten FrontHaul Gateway Introduced?

The Open FrontHaul Gateway (FHG) requirement emerged in the Rakuten network after substantial impacts to vendor manufacturing and supply chain capacity were experienced because of the onset of the COVID-19 epidemic. This resulted in a low stock of available Radio Interface Units (RIUs) in Rakuten inventory, potentially limiting the scheduled pace of base station deployments and affecting the overall business plan.

DZS innovation addressed these challenges head-on. The open design provided by DZS combined standardized multilayer switching and FrontHaul network functions managed by the DZS provided NOS software, with hardware accelerated radio offload functions. This approach optimized the equipment footprint at the radio site, consolidating the functions of multiple separate elements while maintaining open, standard interfaces for software-based control, networking, and the RAN functions provided by ecosystem partners.

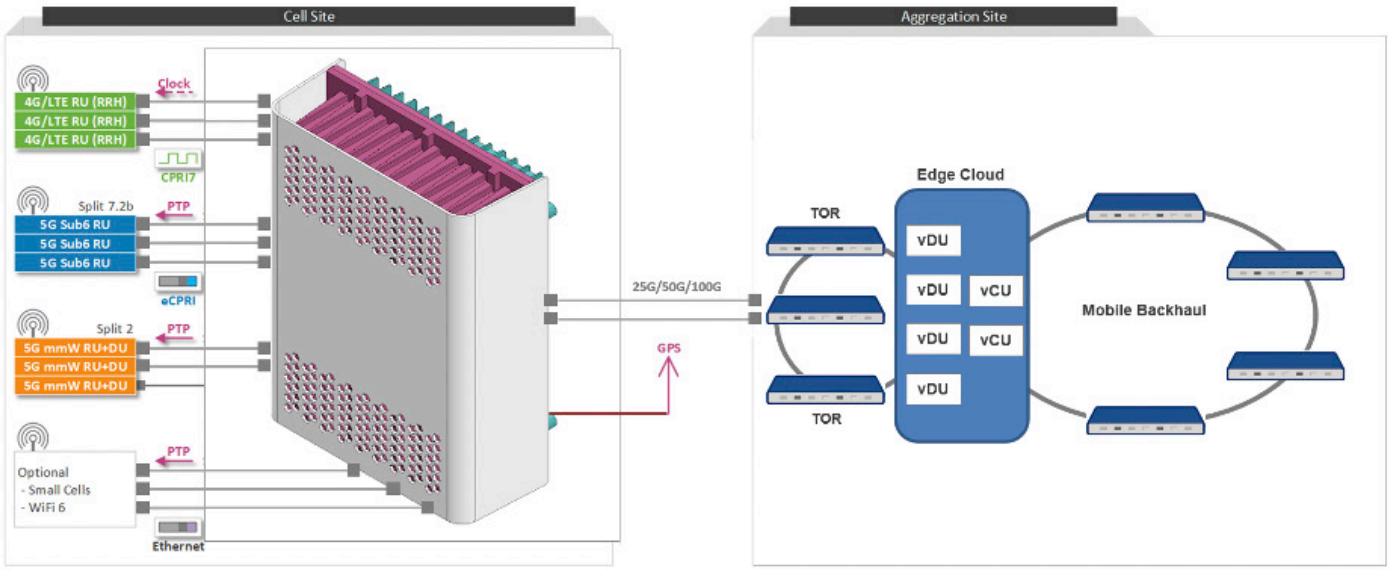
Flexible interface options and NOS software allowed a single unit to be deployed for multiple base station types, band plans, and densities in a uniform way across the network. The operational standardization of the DZS Chronos C1216RO Open FrontHaul Gateway (FHG) by Rakuten also helped facilitate automation in deployment and repeatability in installation procedures to speed deployment and minimize variable costs.



Source: DZS

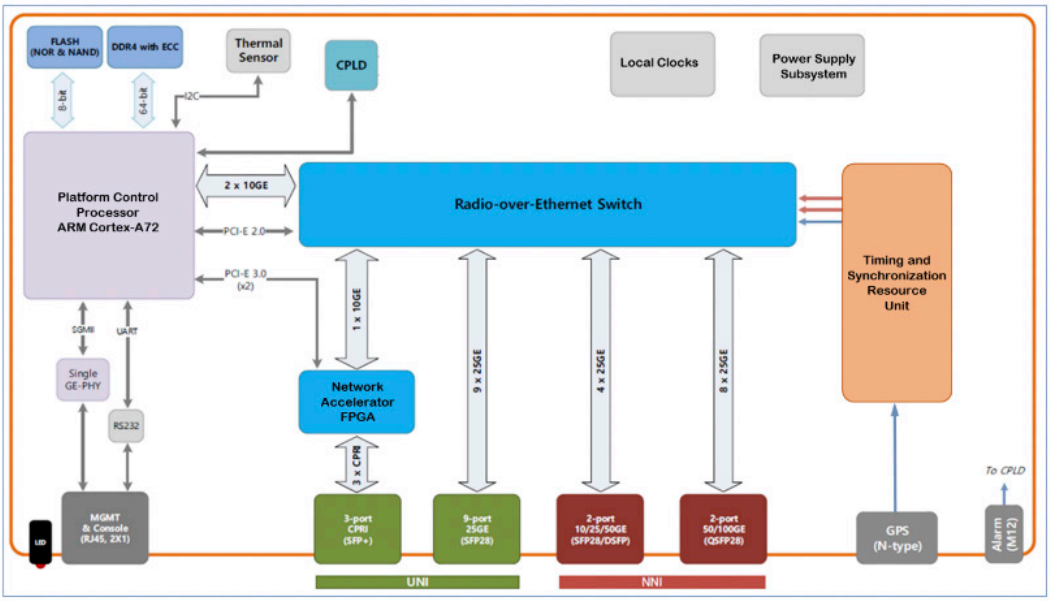
What Technology Does DZS Provide in the Rakuten Network?

The DZS Chronos C1216RO Open FrontHaul Gateway (FHG) is a single, integrated unit combining a Radio Interface Unit (RIU) offload capability and a FrontHaul-enabled low latency network switching and traffic management functions. The gateway combines separate functions that would typically be deployed independently at a base station site. The DZS Open FHG includes several additional ports for connecting collocated elements at the radio base station site, allowing them to share common backhaul facilities. An integrated GPS solution can also serve as a local Telecom Grandmaster (T-GM) clock for the RIU and vDU.



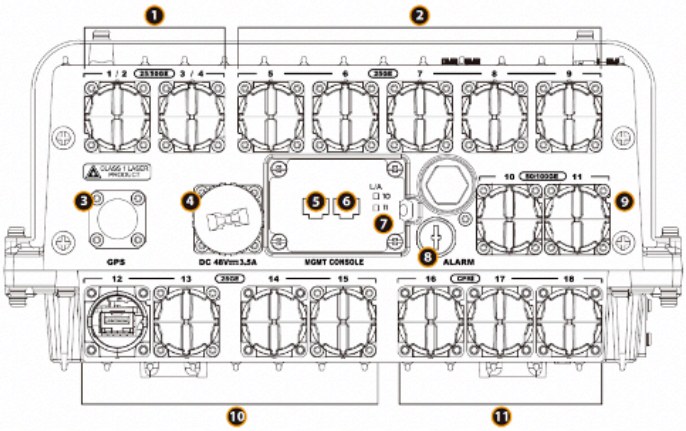
Open FrontHaul Gateway Example Deployment
Source: DZS

With a variety of supported service interfaces including CPRI, eCPRI and 10/25Gbps Ethernet, the Open FHG can simultaneously aggregate traffic from 5G RUs (Radio Units), 5G mmWave gNBs, 4G RUs, Small Cells and Wi-Fi APs (Access Points) using multilayer switch capabilities. Redundant transport capable 25/50/100Gbps Ethernet uplink interfaces deliver access traffic to upstream BBU, CU, DU elements or directly to the EPC / 5GC as appropriate. With high-precision timing, and TSN (Time-Sensitive Networking) features the Open FHG offers synchronization to cell site remote radios, while maintaining deterministic low latency and prioritization for aggregated 4G and 5G traffic.



Open FHG High Level Architecture

A total of 16 access, multifunction, and uplink specific I/O ports are provided at the bottom panel of the Chronos C1216RO Open FHG. These are comprised of 3x CPRI (SFP+) access ports for radio units, 9x 10/25GBase-R class (SFP28) multifunction ports, 2x 25G/50GBase-R class (SFP28/DSFP) and 2 x 50/100GBase-R class (QSFP28) uplinks, as shown below:



Position	Description
1	2 x 25/50GBase-R class Ethernet uplink ports (SFP28 / DSFP)
2	5 x 10/25GBase-R class Ethernet multifunction ports (SFP28)
3	GPS Antenna Connection
4	DC Power Terminal
5	1000Base-T Ethernet out-of-band management
6	RJ45 CLI / serial terminal interface
7	High speed uplink status LEDs
8	Alarm contacts
9	2 x 50/100GBase-R class Ethernet uplink ports (QSFP28)
10	4 x 10/25GBase-R class Ethernet multifunctionports (SFP28)
11	3 x CPRI ports (SFP+)

C1216RO Open FrontHaul Gateway I/O Configuration

The DZS Open FHG is environmentally hardened and uses fan-less convection cooling. The unit is suitable for pole, mast, wall and edge mount installation configurations.

Global MNO Platform and the Path Forward

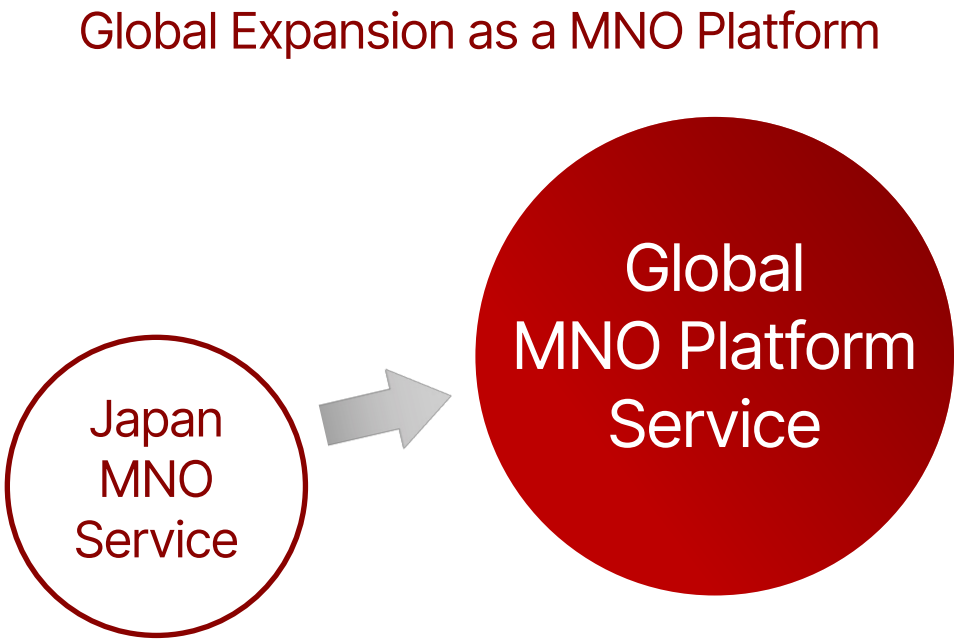
Rakuten Mobile CTO Tareq Amin describes the world-class network they have built in this way:

"Rakuten is built for the telco industry … we understand how to build a platform optimized for real time. It is open source and collaborative and puts us in a unique position."

As a result of this success, Rakuten is turning its O-RAN success into a global mobile platform – Rakuten Communications Platform (RCP). Rakuten has packaged the cloud and software tools used for its own network deployment in Japan and syndicated these as a wholesale offering to other service providers.

To date, the company has engaged more than 70 service providers and governments worldwide who have shown interest in emulating and potentially deploying RCP.

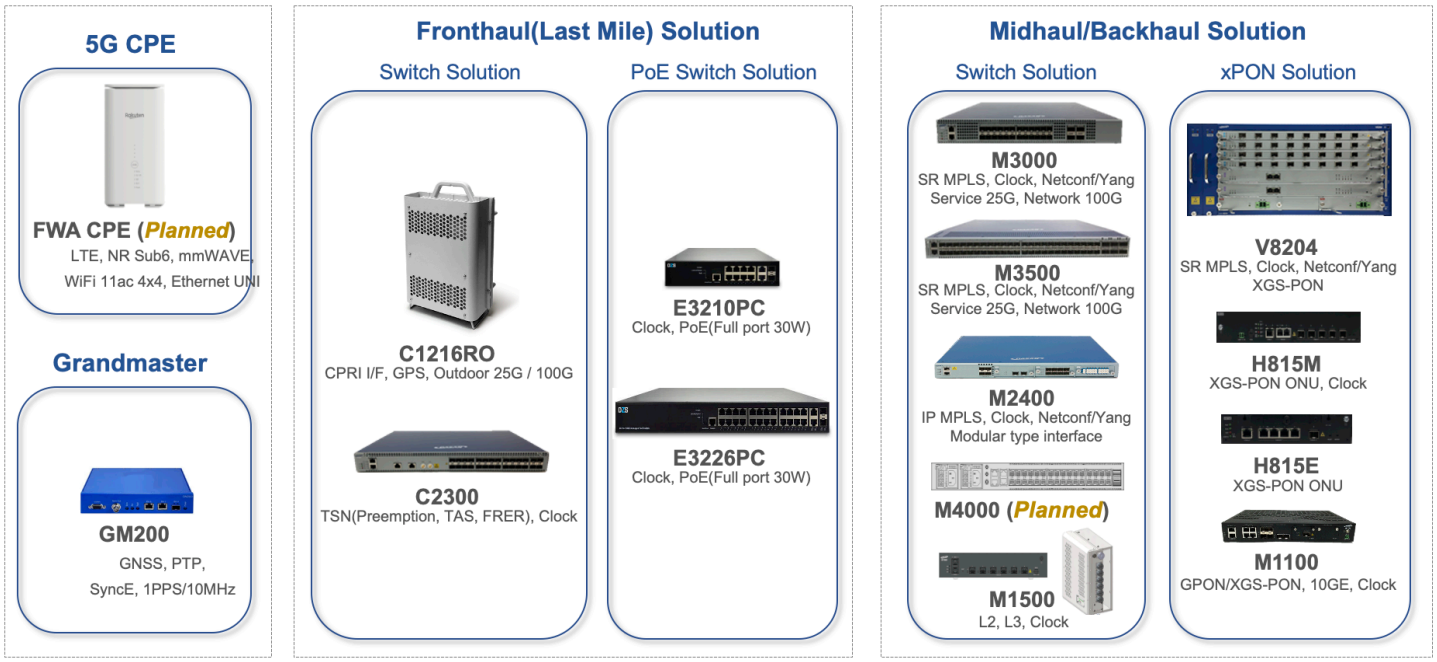
DZS continues working with Rakuten to complete an ambitious rollout across Japan ahead of schedule by the end of 2021, and helping extend this model to offer the RCP solution globally.



A World-Class Portfolio of AnyHaul Solutions

DZS has established itself as a pioneer in mobile AnyHaul solutions working in partnership with Rakuten. The DZS Chronos Open FHG is part of a 4G and 5G-ready access network connectivity solution portfolio with Front-, Mid-, and Backhaul capable products for indoor and outdoor deployments at cell sites, central offices, and network edge datacenters. These solutions include standards-based compute and network functions that form the basis of a versatile, distributed, "micro-cloud" designed for latency-critical real-time edge services.The AnyHaul solutions portfolio uses these edge compute cloud capabilities to support partner-provided network functions for virtualized RAN, Open RAN, and Multi-Access Edge Computing (MEC) architectures - including software-based baseband units (BBU) or distributed units (DU) and centralized units (CU) with special syncronization and time sensitive networking (TSN) requirements for direct Radio Unit (RU) connectivity.

The DZS Solutions Portfolio for Mobile Networks



In addition, DZS is adding 5G capable CPE solutions to the portfolio enabling Fixed Wireless Access (FWA) with support for LTE / 5G NR sub6 / mmWave / Wi-Fi6 and Ethernet access technologies. Ideally suited as an alternative to fixed line broadband, 5G class connectivity can also be a complement to add capacity, coverage, and backup options for established 10G class optical and wireline broadband services.

With a variety of high-performance mobile solutions ranging from RAN and core transport aggregation to AnyHaul and 5G capable CPE, DZS solutions provide subscriber and RAN network connectivity spanning from user equipment to small cells and macro cells all the way to the core network sites. By ensuring flexibility, scalability, and operational simplicity, DZS mobile solutions enable operators to accelerate the delivery of mobile capacity, coverage, and QoS for the 5G era.

To learn more about our groundbreaking work with Rakuten, the DZS Chronos C1216RO Open FrontHaul Gateway, or the innovative DZS portfolio of mobile transport, next generation fiber access, and connected premises solutions that complement this leading-edge work in Open RAN multi-vendor networks, visit www.DZSi.com or contact us here.