WHITEPAPER

DZS Saber 4400 Platform

Use Case

Redefining the Distributed Radio Access Network with an Industry-First Deployment Strategy

Executive Overview

The DZS Saber 4400 Modular Optical platform serves as a unique solution for expanding the service reach of optical edge wireless networks with the most cost-effective deployment scenarios and increased revenue generation. The environmentally hardened 1RU Saber ROADM platform installs in any outside plant cabinet and supporting multiple use cases for the Optical Edge. One key use case is providing a fast and effective way of transporting high-bandwidth midhaul and fronthaul DWDM circuits in Centralized RAN (C-RAN) and Open RAN (O-RAN) networks.

The Saber 4400 offers a new and unique way of deploying fronthaul and midhaul functionality within the RAN network, while providing next-generation capabilities that not only meet the demands of the present, but also the future 6G and higher networks.

The DZS Solution benefits for the service provider

- Redefining 5G RAN networks by providing lightning fast, cost-effective deployment scenarios for front and midhaul transport
- Reduced OpEx and CapEx with expanded fronthaul coverage from more connected 4G and 5G radios
- Reduced latency and cost topologies in fronthaul and midhaul scenarios using the industry’s first extended temperature modular ROADM platform to control all aspects of RAN transport
- Reducing infrastructure investment – eliminating the need to deploy temperature-controlled huts and active transport equipment at cell sites
- Redefining where your money goes – deploying a DZS DWDM transport front/midhaul network allows more investment in expandable, high-bandwidth solutions and less investment in the buildings to house them

DZS Saber 4400 in a C-RAN network

The Saber 4400 modular optical platform is the first to bring hardened, coherent and non-coherent DWDM transport and ROADM optical solutions to the edge in a modular 1RU solution. It can be deployed in standard remote cabinets resulting in savings of up to $200K per site versus traditional hut solutions. The platform also brings the industry's first hardened ROADM to the edge of the network, significantly enhancing both the automation and bandwidth capabilities of the Access Edge for wireless and/or wireline use cases.

C-RAN edge topology

In an O-RAN or vRAN disaggregated radio topology, the real-time DU L2 processing functions (RLC/MAC) for a cluster of cell sites are localized at one location. In the Distributed RAN (D-RAN) model, midhaul traffic is transported between multiple regional DU sites to a central office that hosts the non-real-time L3 packet processing functions of the BBU (RRC/PDCP). Due to the distance limitations on fronthaul networks, these DU locations are themselves distributed across the network. As a general rule, the maximum one-way fronthaul delay should not exceed 100 micro-seconds. A typical DU site might serve 10 to 25 remote cell sites. At the C-RAN Edge/DU location where the cluster of BBU/DUs is located, there is a fronthaul transport requirement to get the fronthaul traffic (CPRI or eCPRI) to each of the remote cell sites. There is also a midhaul/backhaul requirement to get the processed traffic from the edge DU location back to the network for additional CU or Core processing. This topology is shown in Figure 1.

In this topology, it is common to encounter fronthaul configurations in linear chains following the path of a fiber route, which itself is following the path of a road or train tracks. This is shown in the C-RAN edge location at the bottom of Figure 1. In these use cases, our 1RU ROADM platform offers a unique way of transporting dedicated fronthaul bandwidth from a vDU to a linear chain of multi-radio cell sites down the length of a highway or train track without requiring any active components at each of the cell sites within the chain. Additionally, the system also provides an extremely low-latency, high-bandwidth solution to aggregate all the midhaul/backhaul traffic from the remote C-RAN edge locations back to the core where the non-real-time L3 CU processing is performed. Figure 2 illustrates the Saber ROADM being used for both midhaul and fronthaul simultaneously.

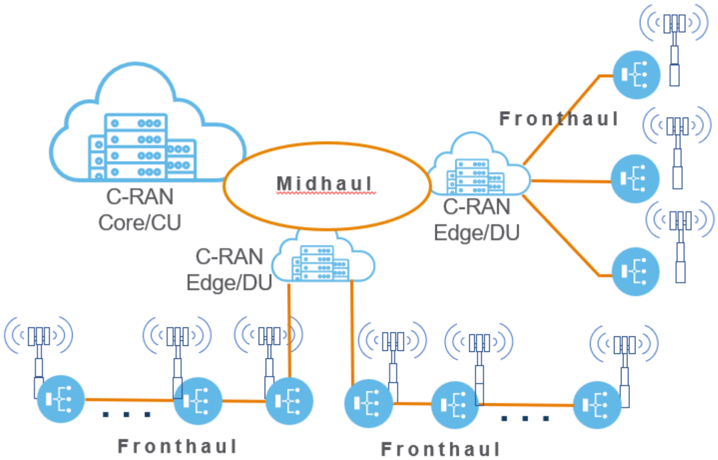
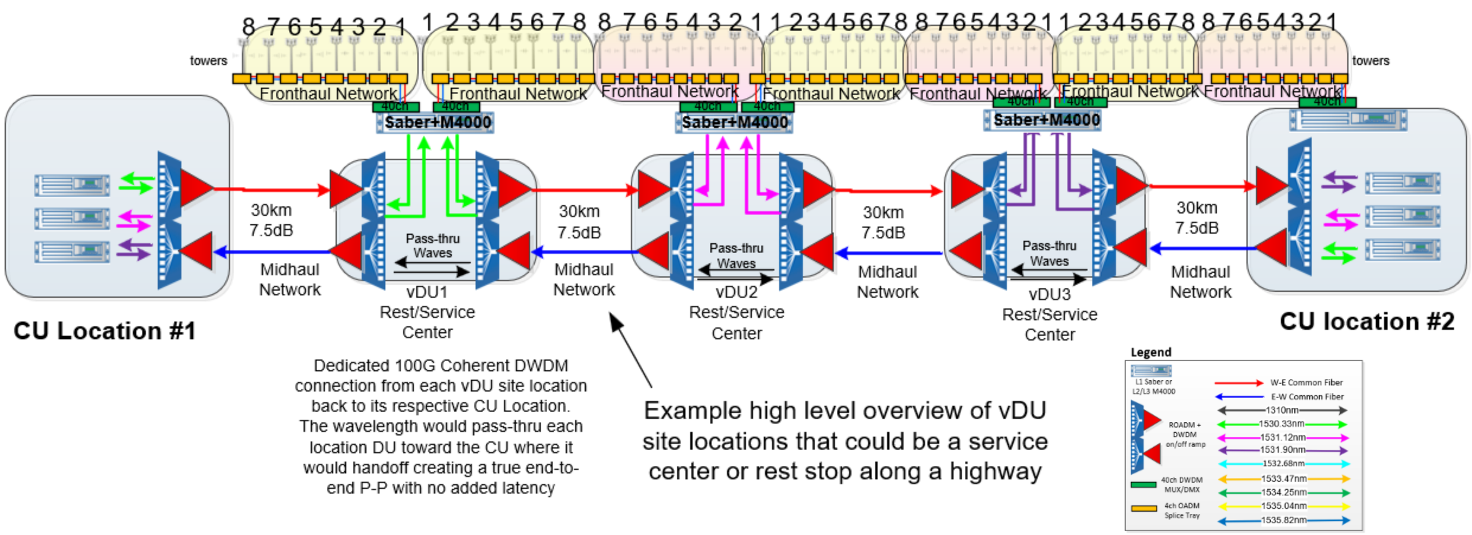


Figure 1: C-RAN edge/DU locations with fronthaul and midhaul transport requirements

Figure 2: Saber ROADM for low-latency midhaul traffic from DU back to CU, and linear fronthaul chains from DU to RUs

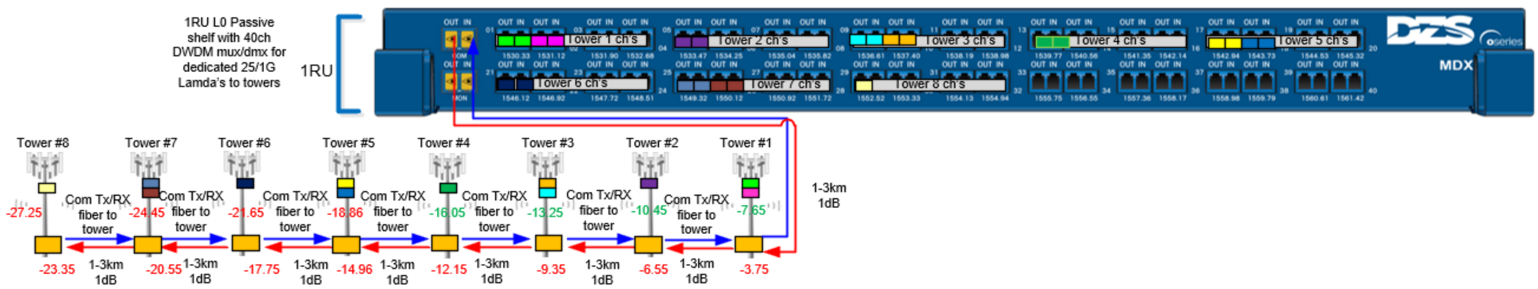
4 dedicated DWDM channels per tower from vDU location providing 1G or 25G (4CH Passive OADM) splice trays



Existing fronthaul capabilities provide a passive approach from DU locations to the towers. The problem with this approach is that individual optical channel power levels start to be exhausted as you try and transmit to the towers/radios that are further away from the DU site.

Figure 3 illustrates the optical link budget problem when interfacing with towers spaced 1 to 3km apart, and the increased insertion losses when typical 5G and 25G transceivers are used.

Figure 3: Passive 40CH MUX/DMX at DU location that aggregates channels which interface with each Tower/Radio unit



Typical 25G long-range transceivers are fixed DWDM with a maximum reach of 20km and 19dB of link budget. The problem we address is the ability to compensate for the accumulation of optical power loss as you propagate specific channels through each tower segment along a linear chain via a splitter. Deploying our advanced ROADM designed for outside plant environments, we achieve an industry-first edge-controlled ROADM/Amplification solution with complete spectrum visibility, allowing a Radio Access Network to go further with increased bandwidth and management capability to troubleshoot the network.

DZS Saber for the O-RAN – fronthaul and midhaul

A revolutionary new way of transporting 10G/25G CPRI and eCPRI circuits to towers connected in a linear point-to-point chain up to 20km from the DU

To reduce fiber requirements, it is common for a 4G C-RAN fronthaul network to deliver the BBU TDM CPRI streams via DWDM. These are typically 10G or 25G DWDM optics plugged directly into each radio at the site. A passive OADM is used on each end to aggregate the DWDM wavelengths onto a single fiber, then disaggregate them at the BBU. This solution is very attractive because it does not require active elements at the cell site – only the passive DWDM OADM at the cell site and the pluggable DWDM optics.

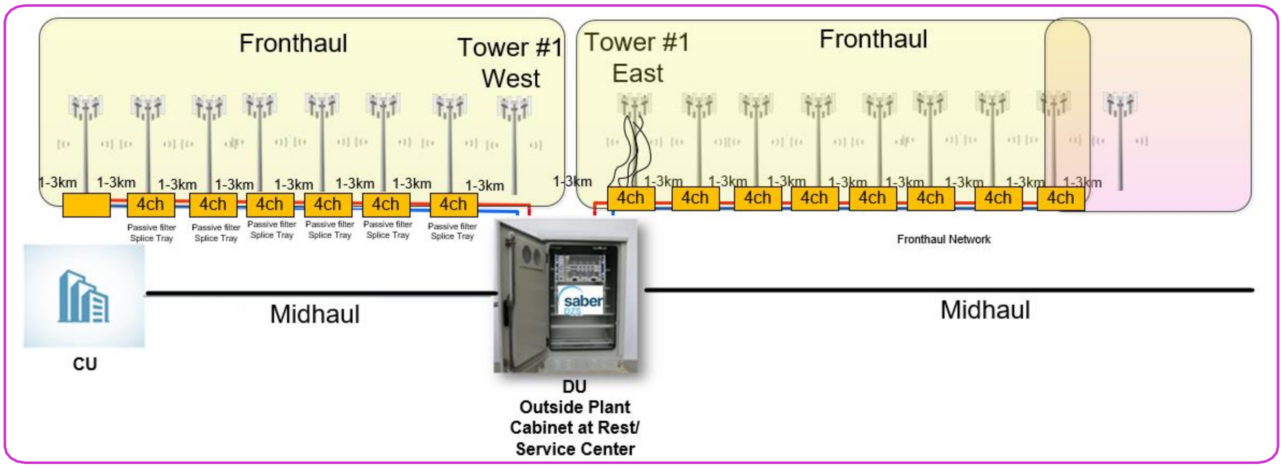
This DWDM solution can also be used for next-generation eCPRI-based fronthaul between the DUs and RUs. In the eCPRI case, the fronthaul is packet based, but this DWDM option is still an excellent option when a passive solution is preferred at the cell site.

When multiple cell sites are connected along a single fiber for fronthaul in a linear chain topology, the DWDM solution becomes more complicated. At each cell site, specific wavelengths are dropped and others continue down the line. When an all-passive solution is used, the number of sites that can be connected in this manner is very low due to the optical losses through the chain.

The Saber 4400 can eliminate this problem. By using an active Saber 4400 ROADM system at the DU site, while retaining a passive solution at each of the cell sites, longer linear chains of cell sites can be connected, significantly reducing costs.

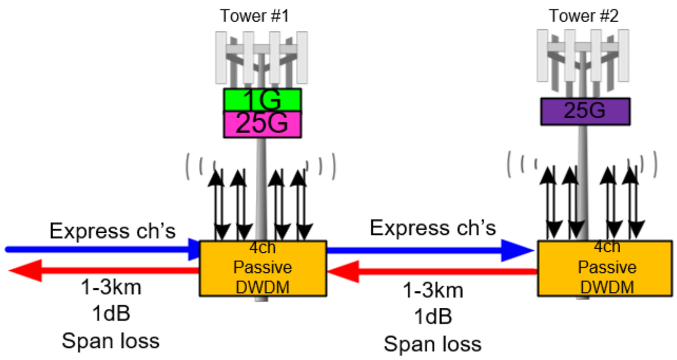
In the example shown in Figure 4, the Saber 4400 could be located in an outside plant cabinet to aggregate up to 48 or 96 DWDM channels onto a single pair of fibers that can be shared along a single path between towers. Each tower will add/drop 4 or more dedicated channels that can be 1G, 10G or 25G DWDM circuits connected directly to the Radio Units.

Figure 4: Saber 4400 ROADM at DU site for longer chains, per-channel visibility and control



Without the active Saber 4400, the span losses and passive OADM losses start to add up as you travel down the linear chain. The optical link budget is exhausted by the time you reach Towers 5/6/7/8. Loss characteristics are shown in Figure 5.

Figure 5: Typical optical losses using passive OADM filters at the cell sites



Channel	4 CH ADD	4 CH DROP
1	4.1 dB	2.4 dB
2	3.6 dB	2.9 dB
3	3.1 dB	3.4 dB
4	2.6 dB	3.9 dB
Express	1.8 dB	1.8 dB

Loss chart
For each filter

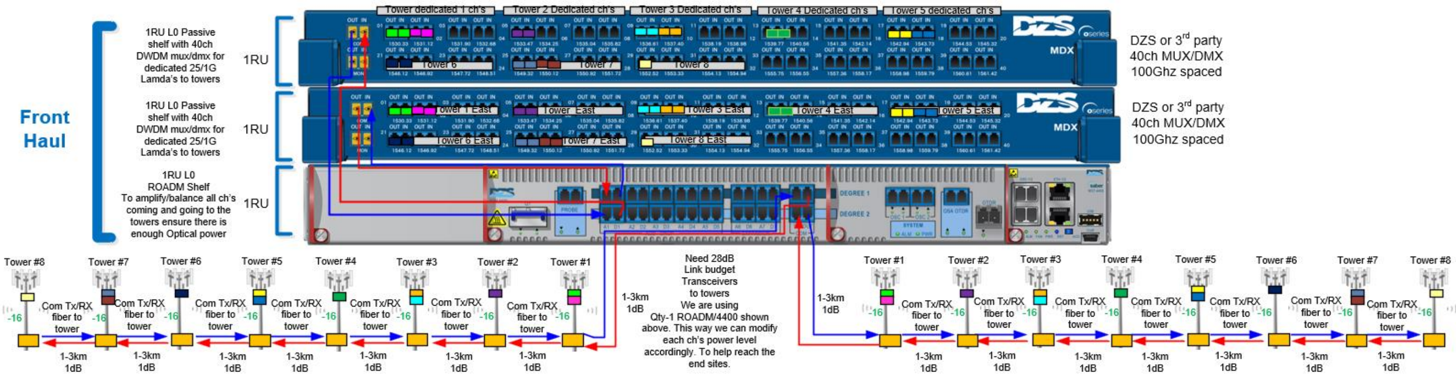
One way to resolve this is to place some combination of EDFA amplifiers at the head-end, then manually attenuate/balance the individual DWDM channels so that some channels receive more amplification than others to go further down the line and compensate for different span losses. This is a very difficult approach that is prone to errors and requires truck rolls when issues arise. It is very difficult to remotely monitor this configuration accurately from the NOC.

Solving the problem with the Saber 4400 ROADM

Figure 5 highlights how DZS proposes to resolve the link budget problem described above, while providing per-channel control and visibility. A Saber 4400 ROADM is deployed at the head-end, while the cell sites continue to use passive optical filters. This solution not only provides amplification, but allows service providers to dynamically control the amplification and attenuation across the entire C-Band DWDM spectrum on a per-channel basis. Service providers can use the Saber 4400 ROADM to adjust power levels for all channels traveling along the fronthaul linear chain. The channels for the more distant cell sites get amplified, while the channels for the nearer cells sites can be attenuated.

In this unique configuration, longer linear chains of fronthaul cell sites can be created. Furthermore, the Saber 4400 ROADM adds zero latency, and offers a dynamic way of monitoring, configuring, adjusting, and troubleshooting the fronthaul Radio Access Network. Per-channel visibility eliminates the need for on-site troubleshooting, and longer chains of cell sites significantly reduces overall OpEx.

Figure 5: Saber 4400 ROADM at DU site for longer chains, per-channel visibility and control



Key advantages of this solution in the C-RAN Network

1. Only hardened (-40 to +65ºC) compact ROADM solution in the market to support fronthaul and midhaul deployments in any environment
2. Reduced OpEx, with less CapEX via expanded coverage and more connected radios
3. Support for longer linear chains of fronthaul to cell sites, while using passive optics at the cell sites themselves
4. Unprecedented visibility and monitoring of fronthaul channels with automated power adjustment, effectively modernizing the RAN network while adding no latency and ensuring future demands after 5G are met
5. The same solution can be applied to a 10/25/100/400G DWDM midhaul and 1/10/25G DWDM fronthaul network for future 6G/7G+
6. Advanced diagnostics and troubleshooting eliminate truck rolls
7. Future-proofed for adding more channels and/or faster channels. Additional services can share the same fibers as needed.

Reimagine Your **EDGE**

About DZS

Nasdaq DZSI | Founded 1999 | Headquarters Dallas, Texas

A global leader in **access**, **optical** and **cloud-controlled software defined** solutions

400+ CUSTOMERS

70+ COUNTRIES

70+ Million CLOUD CONNECTED HOMES/ BUSINESS

Our Mission

Transforming today's communications service providers to tomorrow's experience providers

Our Product Portfolio

Access EDGE | Subscriber EDGE | Optical EDGE | Cloud EDGE

We Give Our Customers

Competitive EDGE

- Agile
- Open
- Cloud Native
- Future-ready

Software

Abstract the network to create and deliver **any service** over an **always optimized converged network**

Cloud EDGE

DZS Xtreme | DZS Expresse | DZS CloudCheck

Networking

Build networks with the **Capacity, Flexibility** and **Architectural Headroom** to support **any service**

Optical EDGE | Access EDGE | Subscriber EDGE

Find Out More

For more information about DZS Saber and the many Optical Edge use cases supported

Visit our website

Reimagine Your **EDGE**

 |