

Application Note

Centralized Radio Access Network (C-RAN) Transport

Increasing Bandwidth, Decreasing Cost



The demand for bandwidth capacity is growing at an exponential rate. Based on the popularity of over-the-top (OTT) and video streaming services – primarily on mobile devices like Smart phones, tablets, laptops, connected TVs, and other connected devices – as well as flat-rate data plans, industry analysts predict that mobile traffic growth will increase by 45% CAGR through 2021. As data networks only grow over time and never get smaller, this forecast presents some very real challenges to today’s mobile network operators (MNO).

Present Mode of Operation

Currently, many MNOs operate using a Distributed Radio Access Network (D-RAN), in which the 4G radio at the macro site tower (or eNodeB) consists of a collocated Baseband Unit (BBU) at the base of the tower and a Remote Radio Head (RRH) at the top, interconnected by a fiber optic cable using the Common Protocol Radio Interface (CPRI). The BBU is further connected to an aggregation device where traffic is groomed with other services, including 2G, 3G, synchronization, and telemetry. After aggregation, this traffic is processed for backhaul over Carrier Ethernet facilities to the Mobile Switching Center (MSC).

Application Benefits

The Fujitsu C-RAN transport solution comes with a host of benefits, including:

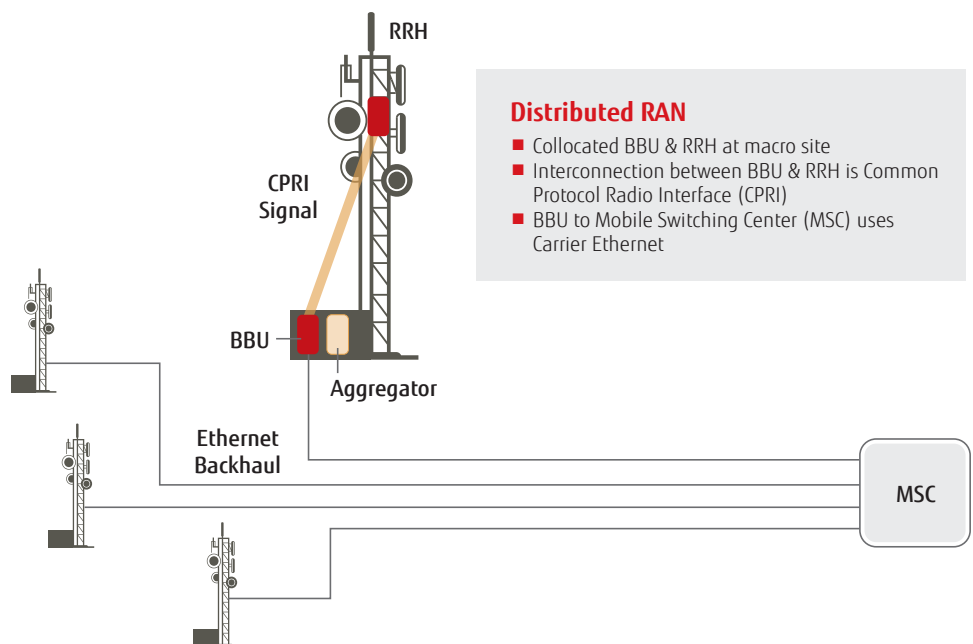
- Easy installation
- Higher bandwidth capacity
- Advanced self-healing
- Early fault detection
- Decreased cost

Functional Elements

- Fujitsu Smart CPRI Transport
 - Hardware
 - Software
 - Services

Distributed RAN

- Collocated BBU & RRH at macro site
- Interconnection between BBU & RRH is Common Protocol Radio Interface (CPRI)
- BBU to Mobile Switching Center (MSC) uses Carrier Ethernet



Increasing Bandwidth Economically and Scalably

Evolving to C-RAN

The MNO's challenge is twofold: find a way to increase bandwidth capacity that is both economical and scalable allowing for future growth, and do so in a way that reduces both CAPEX and OPEX.

Evolving current networks to a Centralized Radio Access Network (C-RAN) addresses the issues of both maintenance and spectral efficiency, resulting in higher capacity support for the cell site. In a C-RAN configuration, BBUs are no longer at the macro site but deployed at a central location known as the "BBU hotel." This is connected to the RRHs at the cell sites via CPRI fronthaul transport. The Carrier Ethernet backhaul is no longer maintained from the cell site, but in a C-RAN architecture is interconnected between the BBU hotel and the MSC.

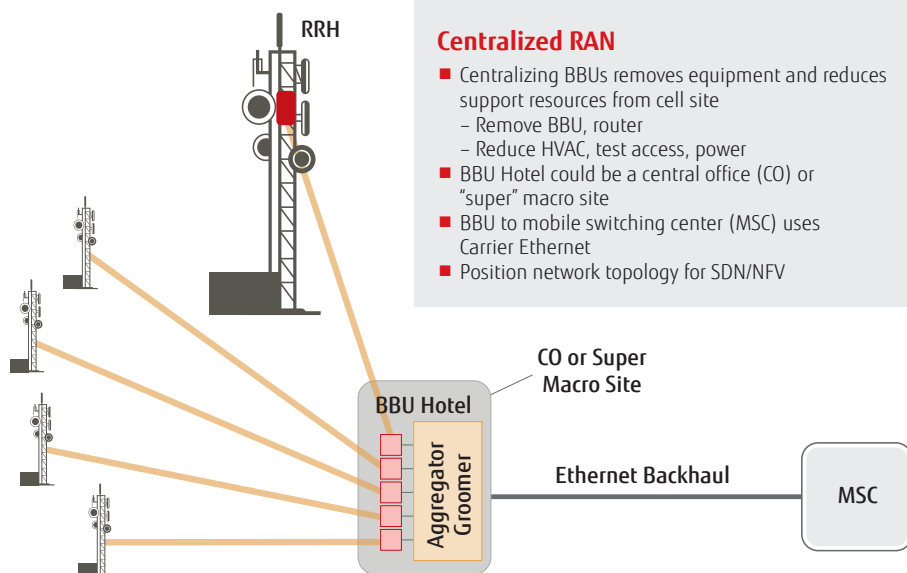
The C-RAN architecture allows for more efficient maintenance, as multiple BBUs can be serviced by one technician in a single visit, thereby significantly reducing truck rolls to cell sites and improving Mean Time to Repair (MTTR). CAPEX and OPEX are lowered by significantly reducing or eliminating resources previously required at each site, such as routers, HVAC, power, site acquisition costs, etc. By reducing or eliminating these resources at the cell site, CAPEX savings of up to 30% and OPEX savings of up to 50% can be realized.

C-RAN improves spectral efficiency, enabling cell site aggregation, resulting in a performance improvement of up to 30%. Cell site aggregation is where multiple cell sites aggregate available bandwidth capacity to individually connected mobile devices. This centralization also makes the RAN easier to scale for transport.

C-RAN architecture expedites deployment and scaling, resulting in a faster time to market and considerable savings in both CAPEX and OPEX.

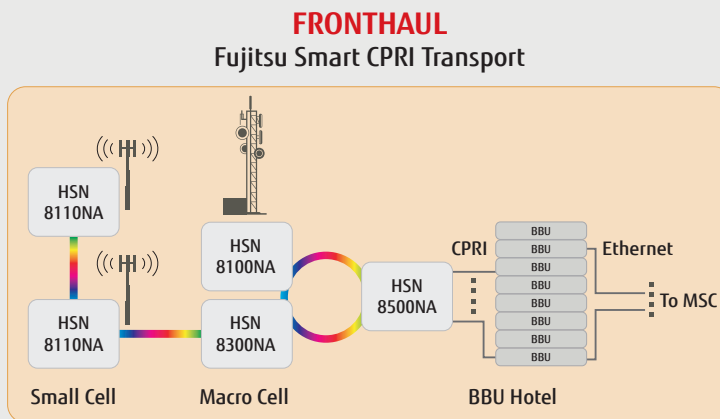
Better. Faster. More Efficient.

By relocating the BBUs to a central location, and using one intermediate sized router instead of many smaller ones, the C-RAN architecture expedites deployment and scaling, resulting in a faster time to market and considerable savings in both CAPEX and OPEX. In addition, it positions the BBU for Network Functions Virtualization (NFV) and the RAN for Software-Defined Networking (SDN), allowing for the evolution to a self-optimizing network.



Reduce the Total Cost of Ownership

Introducing Fujitsu Smart CPRI Transport



The Smart CPRI Transport solution provides flexible CPRI fronthaul and Ethernet backhaul transport in C-RAN architectures. The highly-scalable architecture transports up to 46 CPRI and/or Gigabit Ethernet (GbE) channels using low-latency WDM with standard Coarse Wavelength Division Multiplexing (CWDM) and Dense Wavelength Division Multiplexing (DWDM) optics over a single dark fiber core, while facilitating easy operation and maintenance. The solution supports point-to-point, linear chain and protected ring network topologies. To enable CPRI or GbE service delivery, it utilizes a remote terminal at a cellular tower or small cell site, and transports these services over a single or dual fiber pathway to BBUs residing at a BBU hotel, central office or super macro cell site. Four models are available:

- The **HSN8100NA** serves as a remote terminal for the aggregators. The 2U shelf has two service slots and supports up to eight CPRI channels, or six CPRI and two GbE.
- The **HSN8110A/D** serves as a remote terminal at small cells for the aggregators, with its own outdoor enclosure for wall or pole mount. The integrated four-port transponder supports up to four CPRI channels, or three CPRI channels and one GbE.
- The **HSN8300NA** can function as either a remote terminal or a midsize aggregator. The 4U shelf has six service slots and supports up to 24 CPRI channels, or 20 CPRI and four GbE.
- The **HSN8500NA** is a high-capacity aggregator. The 8U shelf has 20 service slots and supports up to 80 CPRI channels, or 60 CPRI and 20 GbE.

From a physical perspective, the Fujitsu Smart CPRI Transport Solution offers a more compact footprint, with up to 400 CPRI channels per rack, requiring 50% less space than alternative transport platforms. This high-density design conserves critical space at BBU hub locations while serving wire center co-location sites.

Transport of up to 46 CPRI channels over one fiber core, using both ITU DWDM and CWDM optics, offers better fiber plant utilization. If a fiber pair already exists, one fiber core is used for production transport and the other can be used for maintenance or future scaling, further reducing the total cost of ownership.

Designed to be Simple, Reliable, and Efficient

The Fujitsu Smart CPRI Transport solution for C-RAN fronthaul deployment has many benefits that distinguish it from offerings serving the current D-RAN model.

Easy to Install

First, it is easy to install and expedites time to revenue. Latency budget is a critical factor to C-RAN fronthaul operation. Exceeding this budget will result in disrupted to no communications between the BBU and RRH. Therefore, verification of the latency budget must be established across all optical spans prior to service turn-up. Typically, verification is done discretely, coordinating technicians with test sets at either end of each optical span. This utilizes highly skilled resources in the field and can take an inordinate amount of time, as truck rolls at each site are required. Instead, the Fujitsu Smart CPRI Transport Solution integrates the latency and Bit Error Rate (BER) test into the platform, allowing skilled technicians at the Network Operations Center (NOC) to do the latency and BER performance tests remotely. Field technicians need only rack and stack equipment at each site, expediting the service turn-up and provisioning. If performance tests fail due to low quality fiber, the integrated forward error correction (FEC) option can be activated resolving the issue.

A Simple, Reliable, and Efficient Solution

C-RAN architecture using the Fujitsu Smart CPRI Transport solution positions the network for future expansion, as it can evolve with future deployment requirements, thus maximizing the initial CAPEX investment.

Simplified Upgrades

Second, bandwidth capacity upgrades are simplified, thanks to multi-rate pluggable optics and multi-rate transponders. As demands require CPRI rates to increase from their initial capacity, provisioning is issued remotely from the NOC. Since bandwidth capacity is adjusted using remote provisioning, service capacity is executed in minutes, maintaining fronthaul transport investment while optimizing the service for high demand performance.

Highly Reliable

Third, the system is highly reliable, based on its advanced, self-healing capabilities and remote fault detection, thus boosting efficiency, reducing downtime and lowering both capital and operational expenses.

Early Fault Detection

Fourth, the early fault detection system, using custom and standard threshold alerts, provides the ability to address and repair faults before they become service affecting, maximizing service availability, and saving time, money and reputation. The Smart CPRI Transport System can distinguish between remote radio and optical transport impacts by automatically monitoring the overall optical transport operation and CPRI frames. When a fault is detected it determines whether it occurred in the radio or in the transport. If a tech has to be dispatched, the right tech and spares are sent the first time, minimizing or eliminating No Trouble Found (NTF) truck rolls.

Future 5G Migration

The Fujitsu Smart CPRI Transport portfolio is 5G ready and will support a new transponder and associated optics for 5G xHaul. This new transponder will support standards based IEEE 1904.3 Radio-over-Ethernet (RoE, a.k.a Time Sensitive Ethernet) at 100Gbps, and will interoperate with currently deployed ITU DWDM optics, allowing coexistence of 3G, 4G and 5G services on the Fujitsu Smart CPRI Transport Solution. This coexistence enables a smooth evolution path to 5G without network overlay, leveraging the initial Fujitsu investment.

A Full End-to-End Solution

Evolving from a point-to-point fronthaul network to a self-healing diverse path or ring architecture is easily accomplished using the Fujitsu Smart CPRI Transport Solution. Its modular equipment design easily allows for field configuration changes while maintaining most, if not all, of the initial investment. When dark fiber is not readily available, the Fujitsu Network BroadOne GX4000 series offers CPRI and Gigabit Ethernet transport using E-band impulse radio technology.

Smart CPRI Transport is part of a broader network solution offered by Fujitsu. A full end-to-end solution, including fronthaul, backhaul, core and management is available using Fujitsu 1FINITY, FLASHWAVE and Virtuora SDN Controller platforms.

The Fujitsu 1FINITY Programmable Disaggregated family of blades provides the packet optical transport for the backhaul and core network segments. The S100 1.2 Tbps Ethernet Switch and L100 ROADM on a blade are the building blocks powering this network, offering GE & 10GE service delivery, aggregation and grooming to 100GE lambdas and colorless, directionless ROADM transport.

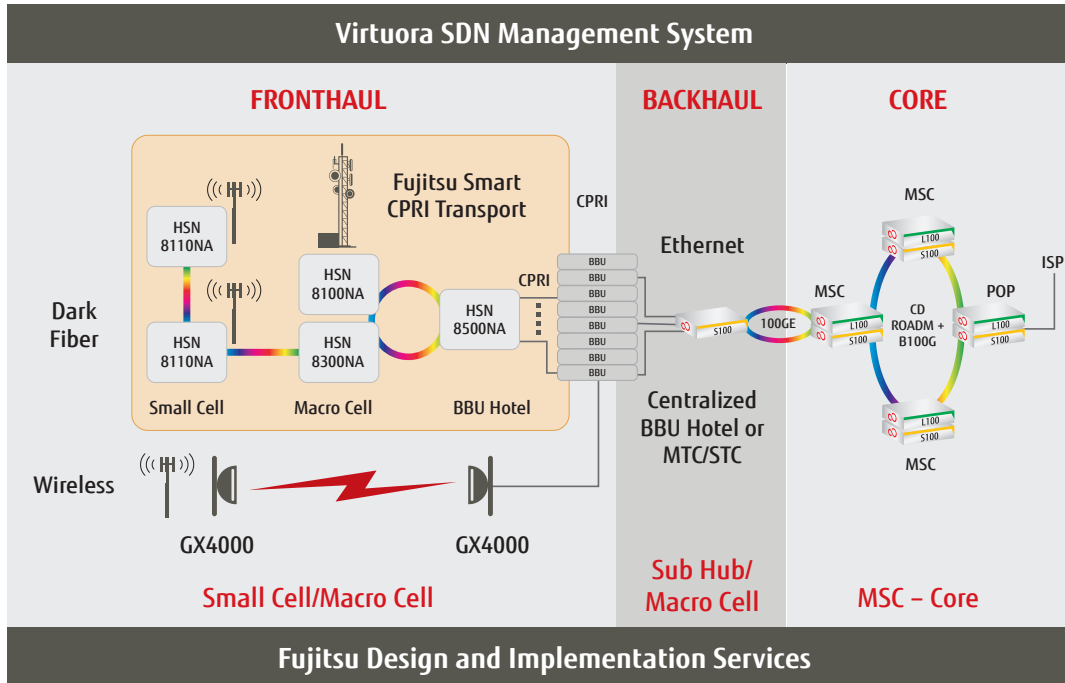
Alternatively, for existing FLASHWAVE 9500 and FLASHWAVE CDS networks, the S100 can interoperate, providing grooming and aggregation to efficiently backhaul 100GE Carrier Ethernet traffic onto a self-healing packet ring.

The metro core supports packet optical operation for interconnection between mobile switching centers and, ultimately, to the point of presence for interconnect to the ISPs.

All of this – fronthaul, backhaul and core, 1FINITY and FLASHWAVE – are fully managed end-to-end using the Virtuora SDN Controller offering fast and flexible scalability for a complete SDN experience.

C-RAN architecture using the Fujitsu Smart CPRI Transport solution positions the network for future expansion, as it can evolve with future deployment requirements, thus maximizing the initial CAPEX investment. Fujitsu offers full turnkey services, supply chain management, engineering integration and carrier-level support, all designed to support the network now and in the future.

Lower Costs, Higher Bandwidth



C-RAN Solution Delivers Lower Costs, Higher Bandwidth

Migrating from D-RAN to C-RAN architecture using the Fujitsu Smart CPRI Transport Solution improves service performance by up to 30% while effectively lowering both CAPEX and OPEX. Further, the ease of installation through integrated test functionality minimizes time to market, thereby increasing revenue. Scaling the CPRI channel capacity as demand grows is done remotely from the NOC, eliminating truck-rolls. The modular design of the Smart CPRI Transport Solution allows the original point-to-point network to easily evolve to a self-healing diverse path or ring solution, improving service availability. High CPRI service availability and reduced operational expenses are further realized through the early fault detection capabilities, enabling service providers to address and repair faults before they become service impacting, saving time, money and reputation.

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