Embarking on the evolution to Packet Fronthaul

Content

Introduction

Commercial 5G networks are going live around the world and Ericsson technology is leading the way. With 5G come several new opportunities but also new ways to evolve networks. This paper will explore the opportunities and the considerations that the evolution of the Fronthaul interface will create.

With the advent of NR, and the widespread deployment of Massive MIMO radios with active antenna systems, Fronthaul technology has evolved. This evolution is required to mitigate the otherwise explosive bandwidth requirements on the digital Fronthaul interface as a result of enhanced radio access technologies and additional NR spectrum.

Since existing CPRI Fronthaul technology does not scale well with high antenna bandwidths and many antenna branches, Packet Fronthaul was introduced by the CPRI forum. A new specification was created, defining the evolution of CPRI, called eCPRI. This specification defines the option to support functional splits between the Radio unit and the Digital unit using Packet Fronthaul technologies.

The functional split determines the Fronthaul bandwidth, while radio features determine the latency requirements and the eCPRI specification defines industry-standard transport technologies, e.g. Ethernet and 1588v2 for synchronization. Using mature, standard transport technologies reduces the cost of hardware components and introduces the possibility of promoting a more flexible relationship between the Radio unit and the Digital units.

Background

The concept of 'Fronthaul' was introduced with CPRI in 2003 when an internal interface was specified for the new Main-remote building practice where the Radio unit (radio frequency processing) was moved from the base of the antenna mast to near the antenna (see Figure 1). The Digital unit (radio control processing) stayed at the foot of the mast. Moving parts of the processing to the top of the mast optimized both radio performance and site costs. The split between the Digital unit and Radio unit is the division of the radio physical layer processing and is referred to lower layer split (LLS) in a Radio Base Station (RBS). Evolved CPRI (eCPRI) was introduced in 2017 to address new Fronthaul requirements introduced by NR and Active Antenna Systems (AAS).

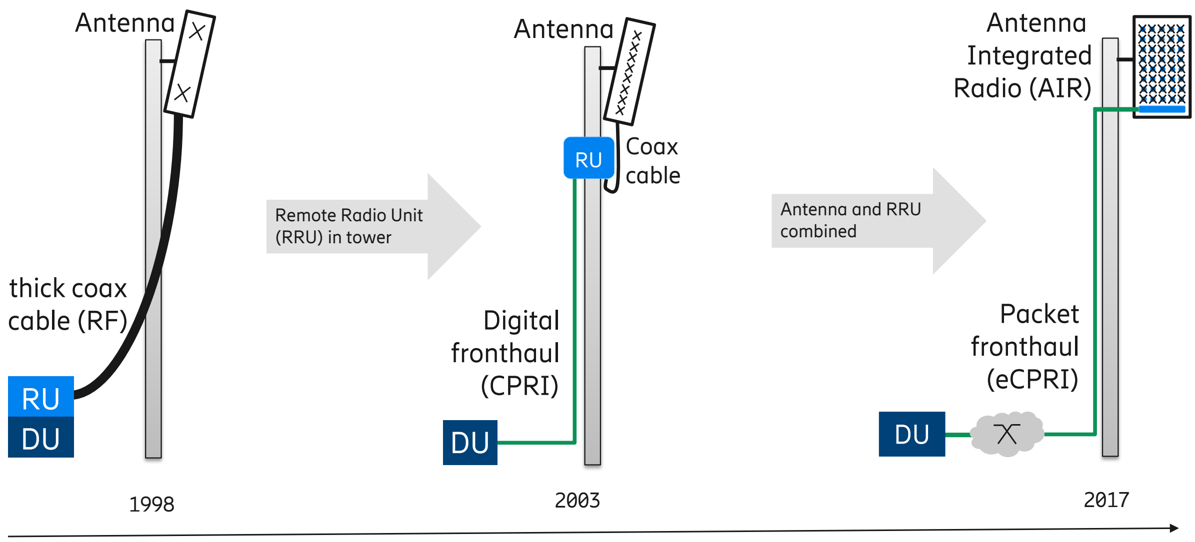


Figure 1: RBS evolution to today's Fronthaul and CPRI/eCPRI

What is CPRI?

CPRI is standardized by the Common Public Radio Interface forum [1] , an industry wide initiative. The first specification was released in 2003 and it covers user plane data, control plane transport mechanisms, and means for synchronization. CPRI does not mandate a functional split between the Radio unit and the baseband processing unit but does reference one radio functional split which is RF-PHY (3GPP option 8). [2] The transport has a TDM structure with a constant bit rate and scale with the number of antenna branches and supported antenna bandwidth in the air. CPRI is suitable for point-to-point connections between the Radio unit and Digital unit, where the Digital unit is close to the antenna site.

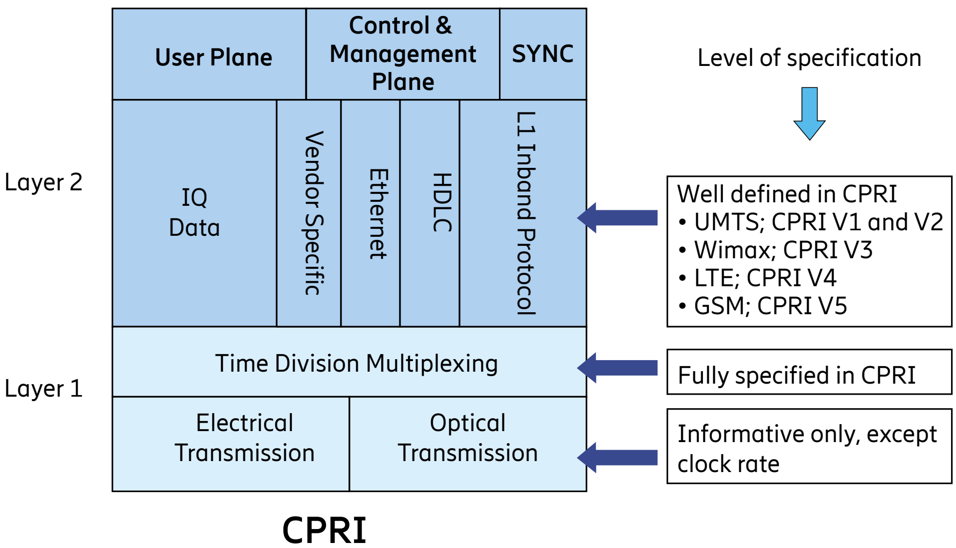


Figure 2: Description of the CPRI interface [3]

What is eCPRI (evolved CPRI)?

eCPRI specification is Packet based and recommends (does not mandate) three different radio functional splits [3] the interface could support. The functional splits determine the Fronthaul capacity requirements and with what parameters the Fronthaul bandwidth scales. For some of these splits, the Fronthaul bandwidth scales with real active user data. eCPRI gives the radio access network more flexibility and, by leveraging industry-standard technologies like Ethernet and 1588v2(PTP) synchronization, enables a reduction in Fronthaul costs.

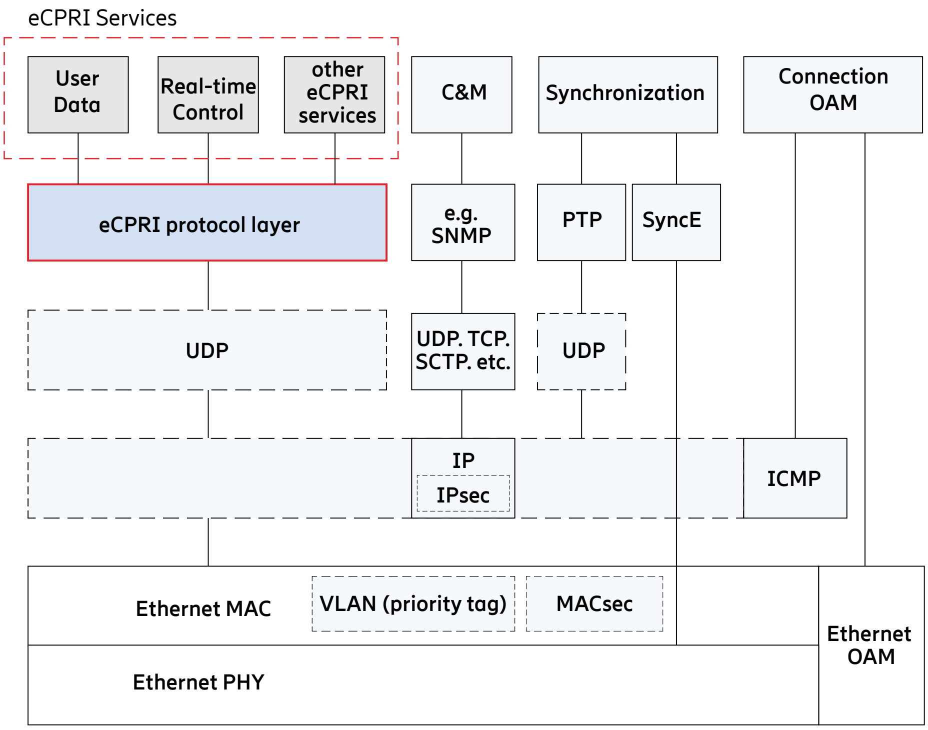


Figure 3: Description of the eCPRI interface [3]

In summary, the eCPRI interface is a real-time traffic interface that uses a new LLS, using standard technologies that have proved better bandwidth scalability and thus enable the use of sophisticated coordination algorithms to guarantee the best possible radio performance.

How can these technologies be deployed to achieve best TCO?

The illustration in figure 4 describes the different technologies (CPRI/eCPRI) and the different physical layer splits within eCPRI for NR/LTE and deployment options. It shows a very flexible architecture with the ability to support a wide range of deployment options. Packet Fronthaul enables the communications service provider to deploy Radio processing for maximum benefit both for performance and TCO.

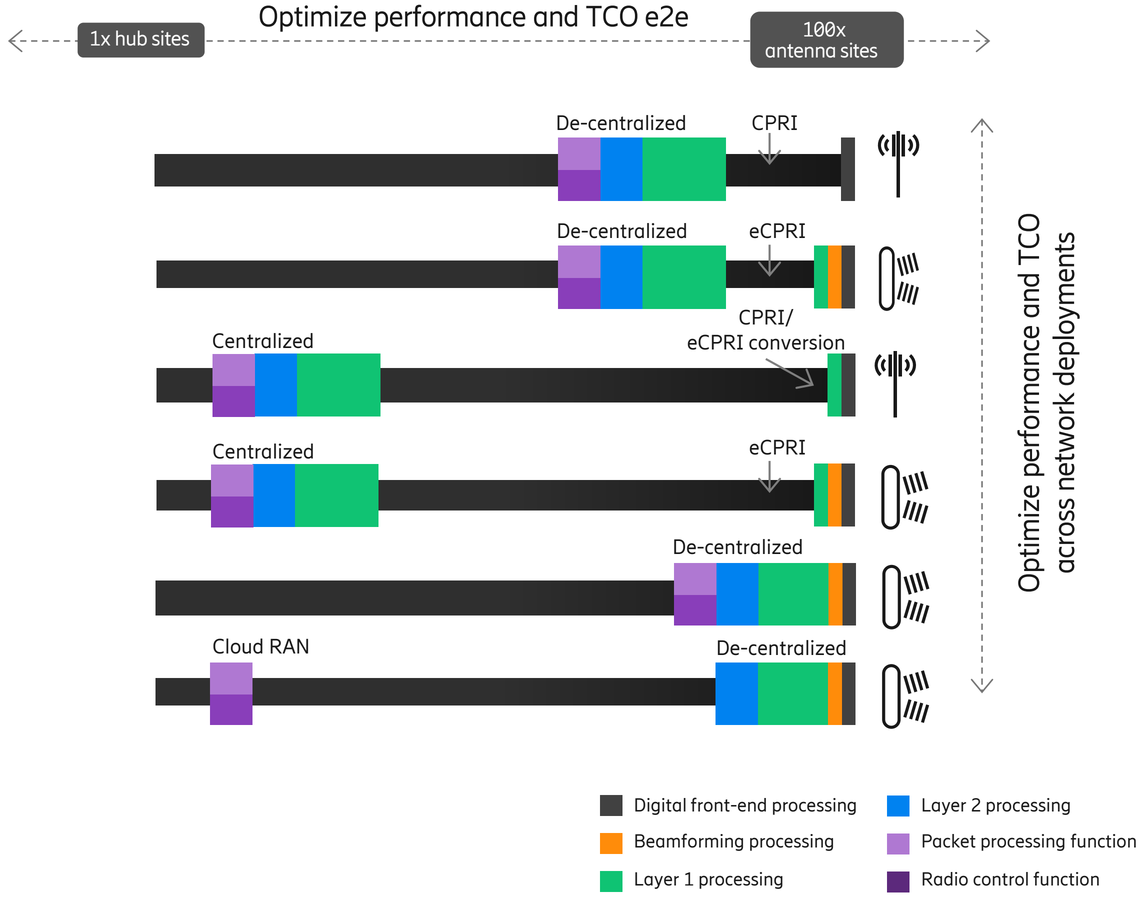


Figure 4: Flexible architecture to optimize TCO and performance

Benefits of Packet Fronthaul

Ericsson introduced eCPRI for the first time in 2017 and has since implemented eCPRI for Ericsson Massive MIMO AAS TDD radios. Our experience with Packet Fronthaul has led to an all-Packet Fronthaul strategy for the complete LTE/NR radio portfolio.

- The eCPRI interface enables up to a ten-fold reduction (depending on the functional split between DU and RU) of the required bandwidth and in addition the required bandwidth can scale flexibly and proportionally with user plane traffic.
- eCPRI enables the efficient use of Packet-based transport technologies. Mainstream technologies like Ethernet open the possibility to carry both eCPRI traffic and other traffic simultaneously in the same Packet Fronthaul network. Packet Fronthaul also provides the ability to automate the rehoming of Radio units, therefore decreasing OPEX.
- The interface is future proof, allowing new feature introductions by software updates of the radio network.

More information about the benefits of Packet Fronthaul can be found in Packet Fronthaul – design choices towards versatile RAN deployments white paper.

RAN architecture

5G RAN Deployment architecture alternatives

The different types of possible architectures across the Ericsson RAN portfolio are described in Figure 5.

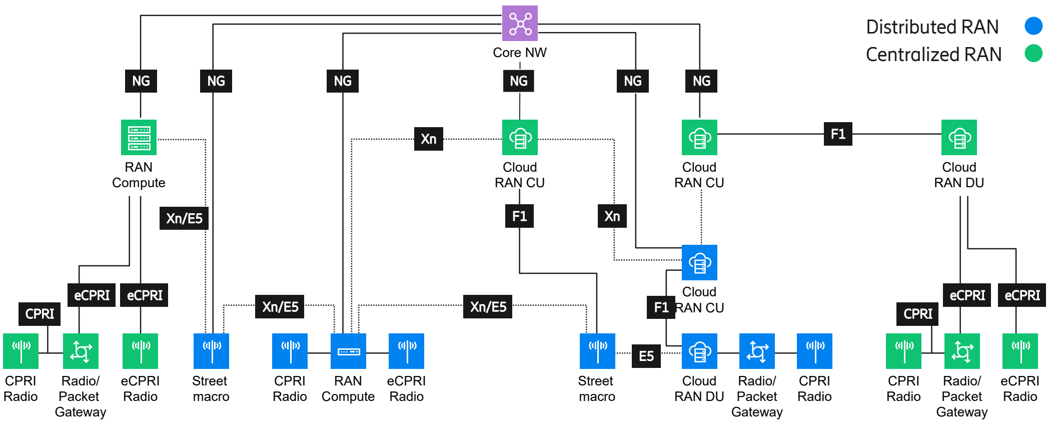


Figure 5: 5G RAN architectures

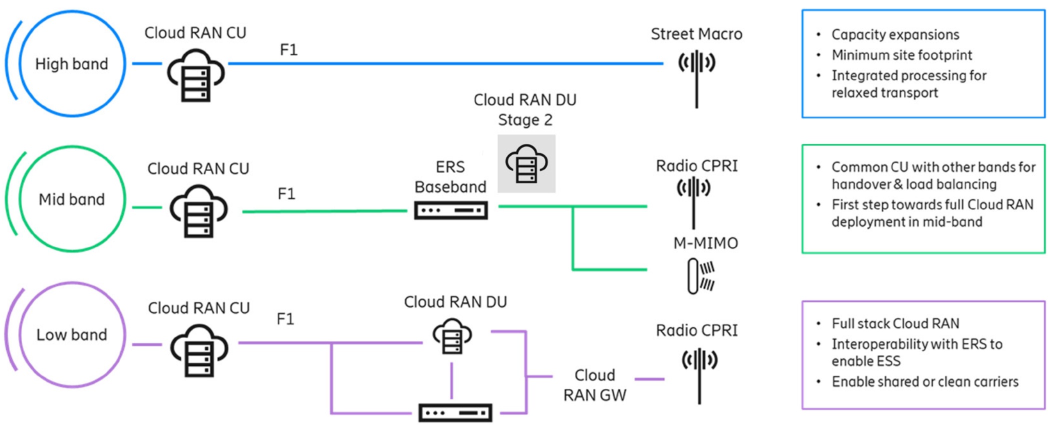
RAN traffic can be divided into different categories as seen in Figure 5. Fronthaul with CPRI or eCPRI for communication between the Radio unit and RAN Compute. RAN coordination traffic, Xn and E5, for information exchange between RAN Compute units and Backhaul traffic, NG, for communication between the RAN Compute and the Core network. F1 traffic is only applicable if the RAN Compute is separated into a DU (Distributed Unit) and CU (Central Unit) function, mainly applicable for Cloud RAN architectures.

The two main deployment architectures affecting Fronthaul are when the baseband processing, called RAN Compute (L1 processing) is distributed to each antenna site (Distributed RAN, D-RAN) or the RAN Compute is centralized, and serving many antenna sites (Centralized RAN, C-RAN).

Packet Fronthaul facilitates centralized RAN architectures by lowering the transport deployment and maintenance costs using standard technologies, but it is also suitable for Distributed RAN.

Ericsson Cloud RAN

Ericsson Cloud RAN supports both Distributed and Centralized RAN architectures and uses generic hardware instead of purpose-built hardware. It does this by using virtualization for parts of L1 and all of L2 radio processing. Ericsson Cloud RAN architecture will support all 5G bands, including low-band, mid-band and high-band deployment scenarios, through the Cloud RAN vCU and vDU, as shown in the figure below.



For Cloud RAN to support Ericsson CPRI based NR capable radios, Cloud RAN GW such as R608 and Router 6673 with CPRI LC can be used for converting CPRI to eCPRI, see [Ericsson Packet Fronthaul solutions](#).

Figure 6: Cloud RAN supporting all 5G bands

Deployment benefits and architecture considerations with Packet Fronthaul

Transport architecture considerations

The interface requirements are independent of deployment architecture (C-RAN or D-RAN) and are dependent on the radio access technologies used: NR/LTE, TDD and FDD. For Packet Fronthaul, the transport requirements can be different between LTE/NR and TDD/FDD due to differing RAN functional distribution.

Capacity requirements for Fronthaul are dependent on antenna bandwidth, utilization of beamforming technology, the number of layers in the air, radio access technology and baseband split option. In comparison with backhaul capacity, the Fronthaul capacity requirement is higher. A good illustration of this is the existing RAN Compute hardware, where there are 12 x 25GE interfaces for Fronthaul traffic and 1-2 25GE interfaces for backhaul.

Synchronization in Packet Fronthaul

With the introduction of Packet Fronthaul, L1 time operations have moved to the Radio unit enabling precision timing protocol for synchronization of the air interface. Ericsson eCPRI is using PTP over Ethernet according to the ITU Telcom Profile for full timing support 1588v2. For a more in-depth understanding how synchronization plays an important role for new 5G use cases and how transport solutions can be used to distribute sync , please read the paper Synchronization solutions in 5G transport network

TDD radio networks require a maximum time alignment error between antennas in the radio network of 3 microsecond (+/- 1.5 microsecond relative to a common time). This puts strict requirements on error contribution allowed from the Packet Fronthaul network. It is applicable for both NR and LTE TDD, but also for coordination services such as Carrier Aggregation. Some more advanced coordination functions used for co-located antennas/Radio units requires even tighter time alignment.

FDD networks requires time alignment on network level for the UEs to measure differences between neighboring cells for handover. This is required for both NR and LTE FDD networks.

Latency

A Fronthaul network need to be designed according to the traffic with tough latency requirements. This will set the size of a centralized network. In switched Packet Fronthaul, latency will no longer be related only to fiber lengths but also to the latency introduced by switching and buffering. To maximize the serving area (the distance between radio and baseband units) of hub sites in Fronthaul networks, a combination of low-latency devices and minimizing the use of buffers is needed for latency-critical traffic.

Interfaces	Transport technology	Latency RTT
CPRI	Constant Bit Rate (TDM)	150µs
eCPRI	Variable Bit Rate (L2 Packet traffic)	150µs
E5(LTE)/E5(NR)	Variable Bit Rate (L2 Packet traffic)	120/900µs
F1	Variable Bit Rate (L3 Packet traffic)	10ms
NG/Xn	Variable Bit Rate (L3 Packet traffic)	10/30ms
S1/X2	Variable Bit Rate (L3 Packet traffic)	10/30ms

Figure 8: Latency requirement and transport technology for different interfaces

Quality of Service (QoS)

The main requirement for QoS schemes in the Packet Fronthaul domain is to safeguard the latency sensitive traffic such as eCPRI. By applying QoS attributes, it's possible to ensure that all types of traffic can co-exist and achieve the characteristics needed to reach overall optimal performance. Introduction of Packet Fronthaul enables the use of standardized Packet functions for QoS and TSN profile A.

Availability

A Fronthaul architecture requires high degrees of availably to ensure high spectrum efficiency and low system downtime. Introducing Packet Fronthaul enables usage of resiliency principles like TI-LFA from the Packet domain to fulfill the availability requirement. The recommended solution is to utilize a routed underlay for more centralized deployments to maximize the re-use of Packet technologies. An additional benefit is that it enables a combination of L2/L3 traffic over the same fiber. With L3VPN and EVPN type of services, it is possible to emulate a p2p link required for transporting eCPRI utilizing EVPN over a routed underlay such as MPLS-SR.

A more in-depth explanation of this topic is found in Packet Fronthaul – Design Choices Towards Versatile RAN Deployments under the heading "Packet Fronthaul Transport Network Architecture".

Observability and O&M

To achieve good availability for a Fronthaul system, correlation between the RAN and the Transport domains is recommended. A degradation in the Transport domain will impact cell throughput and degrade the end-user performance. Since these types of degradations can also be caused by issues in the RAN domain like antenna failures, it is imperative to have the right level of visibility for fault isolation and network performance monitoring across both domains. A solution in this area requires automated discovery of association/relation between RAN and Transport elements to create topology understanding, common KPIs between RAN and Transport for improved observability and fault consolidation for quick troubleshooting. By utilizing a routed underlay, converged provisioning of L2VPN (ex EVPN) and L3VPN, it is possible to enable the Fronthaul network to be used for other traffic types like backhaul or enterprise services. The provisioning solution can be further enhanced, by automatic creation of end-to-end RAN services including the required transport service such as an EVPN.

Handling of installed base of CPRI radios

In all networks there will be a mix of CPRI and eCPRI radio solutions and to be able to capture all benefits with a Packetized Fronthaul network there is a need to handle the installed base of CPRI radios.

There are two alternatives to handling CPRI radios in a Packetized network environment: Radio over Ethernet (RoE), standardized as 1914.3, and CPRI to eCPRI Conversion. The main difference between them is that the RoE keeps the CPRI stream and transports it over a Packet structure, whereas Conversion terminates the CPRI stream and processes them to the eCPRI lower-layer split interface signals. Ericsson's recommendation is Conversion.

Radio over Ethernet (RoE)

RoE mapping can be done in the Transport domain because CPRI data is not processed, only transported. RoE mapping is done by using standard Ethernet technologies and is working in a similar way to Circuit Emulation of TDM interfaces. Even though mapping is done in the Transport domain, it still requires knowledge of the RAN as CPRI implementations are RAN vendor specific. The main drawback with RoE is that there is minimal bandwidth reduction in comparison to native CPRI traffic. When there is no user-plane traffic, it still consumes the same bandwidth. CPRI is built on the assumption that upstream and downstream traffic flow have the same latency. To achieve this symmetry, the RoE systems needs to have jitter buffers to handle variations and asymmetry in the Fronthaul network. The jitter buffers introduce additional latency, reducing the potential distance of the Fronthaul network.

Since RoE is built around static CPRI streams, it limits the ability to aggregate and automate traffic flows. One can use Ethernet to reduce the cost of WDM-optics, but since RoE is a book-ended solution, not much else is improved in terms of reduced capacity requirement and CAPEX reduction. In addition, RoE can degrade sync accuracy between Radio and Baseband since the sync is transported inside the CPRI stream and cannot be corrected by the Packet network, this may impact what RAN features can be supported by a RoE network.

- Encapsulate CPRI to Ethernet
- Book-ended solution
- Point-to-point configurations
- Encapsulates the constant bitrate into Ethernet Packets
- Can achieve up to 20% bandwidth saving with line code removal if enabled

Conversion

The most efficient method is to convert CPRI into eCPRI within the RAN domain and this can be done by using an Ericsson Radio or Fronthaul Gateway (see next chapter). This approach leverages baseband processing of their CPRI data streams and convert the time domain signal to frequency domain. The benefit of the CPRI to eCPRI Conversion is that it drastically reduces the capacity required for Ethernet Fronthaul by scaling traffic with used antenna bandwidth and by removing the constant bit rate of the CPRI traffic. Since the conversion is done in the RAN domain, the conversion process will not introduce any additional latency in the Fronthaul network, enabling longer radio site to CRAN hub site distanced compare to RoE and greater flexibility in building the Fronthaul network.

Combining CPRI to eCPRI conversion with Packet aggregation at the antenna site is the most efficient approach. The Fronthaul capacity demands can be reduced by 60-80% depending on radio configuration, in comparison to other technologies such as traditional CPRI or encapsulating of CPRI with RoE.

- Converts CPRI to eCPRI
- Up to 60% to 80% bandwidth savings depending on radio configuration
- Fewer fiber needed compared with RoE
- Non-book-ended solution
- Enable efficient Fronthaul networking

Ericsson Packet Fronthaul solutions

Ericsson's portfolio is designed to allow flexible deployment scenarios need by service providers with support for both eCPRI and CPRI. Considerations of the needs of carrying different traffic types and deployment in different physical locations are reflected in the flexible and modular platform. Ericsson's radio portfolio strategy is to eventually offer Radio units that can support either eCPRI or CPRI. For Radio units that cannot support eCPRI, Ericsson has two alternative solutions:

- Radio over Ethernet (RoE)
- CPRI to eCPRI conversion

Ericsson Packet Fronthaul offering includes three gateway products with different capabilities, ensuring the best solution for each deployment scenario and site requirement. With an Ericsson solution, it is not only pre-verified but can visualize the end-to-end setup from RAN Compute, Transport and Radio, including all intermediate connections and their relationships. All alarms and KPI data are collected in one management system, allowing for correlation and end-to-end visualization of network health and including mapping of RAN traffic to corresponding Transport flows for easier fault isolation. This solution can be complemented with automation schemes.

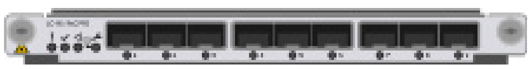
Deployment scenarios are described in the Packet Fronthaul deployment scenarios and include Cloud RAN deployments.

Router 6673 with CPRI Line card

Ericsson Router 6673 is a Fronthaul gateway with embedded RAN Compute functionality using the unique Ericsson Silicon solution. This enables efficient conversion to eCPRI for Ericsson RAN sites, and can also use RoE to cater for older types of radios in the network.

Router 6673 characteristics
1.5 RU multiservice node
800 Gbps with 8 x 10/25GE and 4 x 100 GE ports
Three line-card slots, for 9 port CPRI line-card or Ethernet line cards
Support Class C sync, G.8275.1 and G.8275.2 T-BC with integrated T-GM with Ericsson GPS/GRU

CPRI Line Card characteristics



RoE Mode supports CPRI 2.5, 4.9, 9.8 & 10.1Gbps
Software upgradable to support CPRI 2.5, 4.9, 9.8 & 10.1Gbps Conversion to eCPRI

Radio Gateways

The Radio Gateway family is an evolution of the Baseband R503 CPRI mux/demux product. The new Radio Gateways switches and converts multiple CPRI streams to one eCPRI 25GE stream. The Radio Gateways are part of the gNode/eNodeB system and managed via the RAN Compute O&M interface.

Radio Gateway R608 and R308

There are two product variants: indoor 19" and an outdoor version that follows the RAN Compute outdoor building practice.

Hardware characteristics:
12 ports CPRI (10G SFP+ 3W limit) • CPRI 3 (2.5Gbps), CPRI 5 (4.9Gbps), CPRI 7 (9.8Gbps) or CPRI 8 (10.1Gbps)
4 Ports eCPRI (25G SFP28) • eCPRI 25G (4 x SFP28)
Sync and LMT RJ45
R608: Indoor unit 1RU • Dimension: 442 x 267 x 44 mm (17.40 x 10.51 X 1.72 in) • Power: Dual DC
R308: Outdoor unit 15 liters (915.36 in^3) • Power: DC

Packet Fronthaul deployment scenarios

Ericsson Radio System provides solutions for almost every network scenario and service provider needs. Each product in the portfolio fits under at least one, and often two, of the three categories: Capacity, Compact and Coverage. The 3Cs are therefore useful tools for quickly identifying which products fit the requirements of the customer's network. Cloud RAN solution leverages general compute hardware to compliment the Ericsson Radio System portfolio as it addresses additional deployment scenarios.

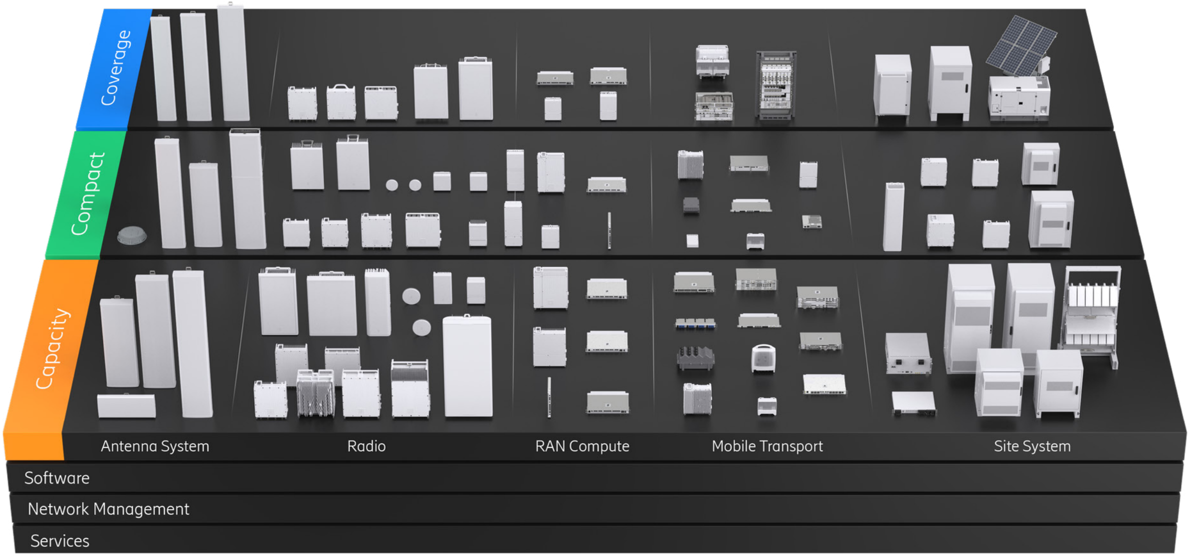


Figure 9: Ericsson Radio System

Packet Fronthaul in D-RAN networks

The illustration below depicts the following scenarios,

- Radio Gateways acting as a port fan out for the RAN Compute by converting and multiplexing CPRI-eCPRI
- Radio Gateway and Fronthaul gateway supporting CPRI radio connectivity to Cloud RAN vDU by Conversion

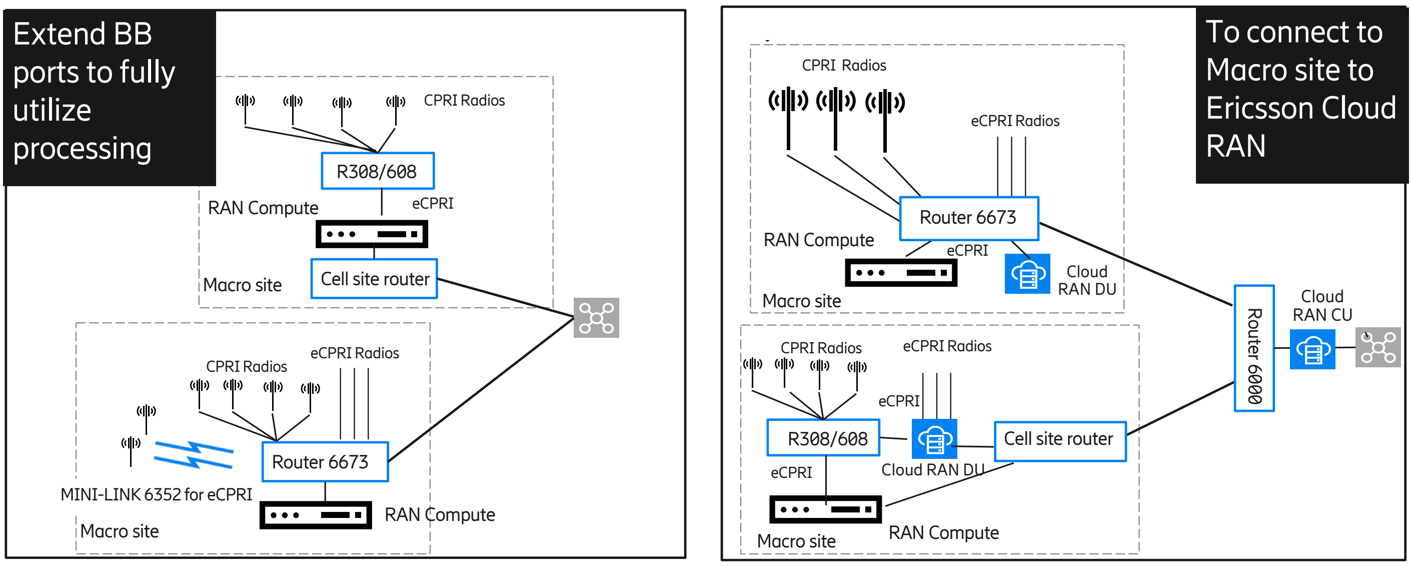


Figure 10: Packet Fronthaul in D-RAN networks

In the Coverage type of sites, Radio Gateway R608 is ideal as Ethernet aggregation function is not needed. Radio Gateway R608 makes it possible to fully utilize RAN Compute capacity as multiple radios can be supported using a single eCPRI port on the RAN Compute node.

In Compact type of sites, such as street pole where space is limited, Radio Gateway R308, in combination with the all-outdoor RAN Compute solution, can be used together to reduce the physical footprint needed.

In the Capacity type of sites, many CPRI Radios, 25GE eCPRI based AAS and associated RAN Compute nodes exist in addition to possible Enterprise traffic. Router 6673 can provide the Ethernet switching connectivity (eCPRI, E5, L2VPN/L3VPN) for these functions. Router 6673 can also be used as part of the synchronization solution and cell site router for the D-RAN site.

With the introduction of Cloud RAN, there is a need for Cloud RAN Gateway to convert CPRI from existing CPRI radios to eCPRI. In addition, Ericsson Spectrum Sharing (ESS) functionality will be placed on the Cloud RAN Gateway in this setup. This is because servers where Cloud RAN is deployed will only have Ethernet interfaces and Ericsson Cloud RAN only supports 5G. Radio Gateway 608 can be used for this conversion and ESS function. In larger, Capacity-type of sites where more radios and Ethernet connectivity are needed, Router 6673 can provide the same functionality at a higher scale for Cloud RAN. Both Radio Gateway and Fronthaul Gateway products are part of Ericsson Cloud Gateway family

Packet Fronthaul in C-RAN networks

In C-RAN type of deployments, Radio and RAN Compute functions are typically physically located at different locations. Radios are deployed at antenna sites with RAN Compute deployed at larger C-RAN hub sites in a distance typically within 15km. A Packet Fronthaul transport solution can be used to connect between and within the antenna and C-RAN hub sites.

Packet Fronthaul dimensioning for the C-RAN case will depend on an operators' traffic model as stated earlier in the document. The Fronthaul bandwidth is determined by user bit rate and the RAN features that drive user bit rate. Depending on the traffic model conversion from LTE/NR low band Ericsson CPRI to eCPRI radios will reduce the Fronthaul bandwidth between 30 - 50% via Conversion. As eCPRI is a variable bit rate technology (VBR) it also enables trunking gains that can increase bandwidth savings further – a total of 60 - 80%. A more in-depth explanation of this topic is found in [Packet Fronthaul – design choices towards versatile RAN deployments] white paper.

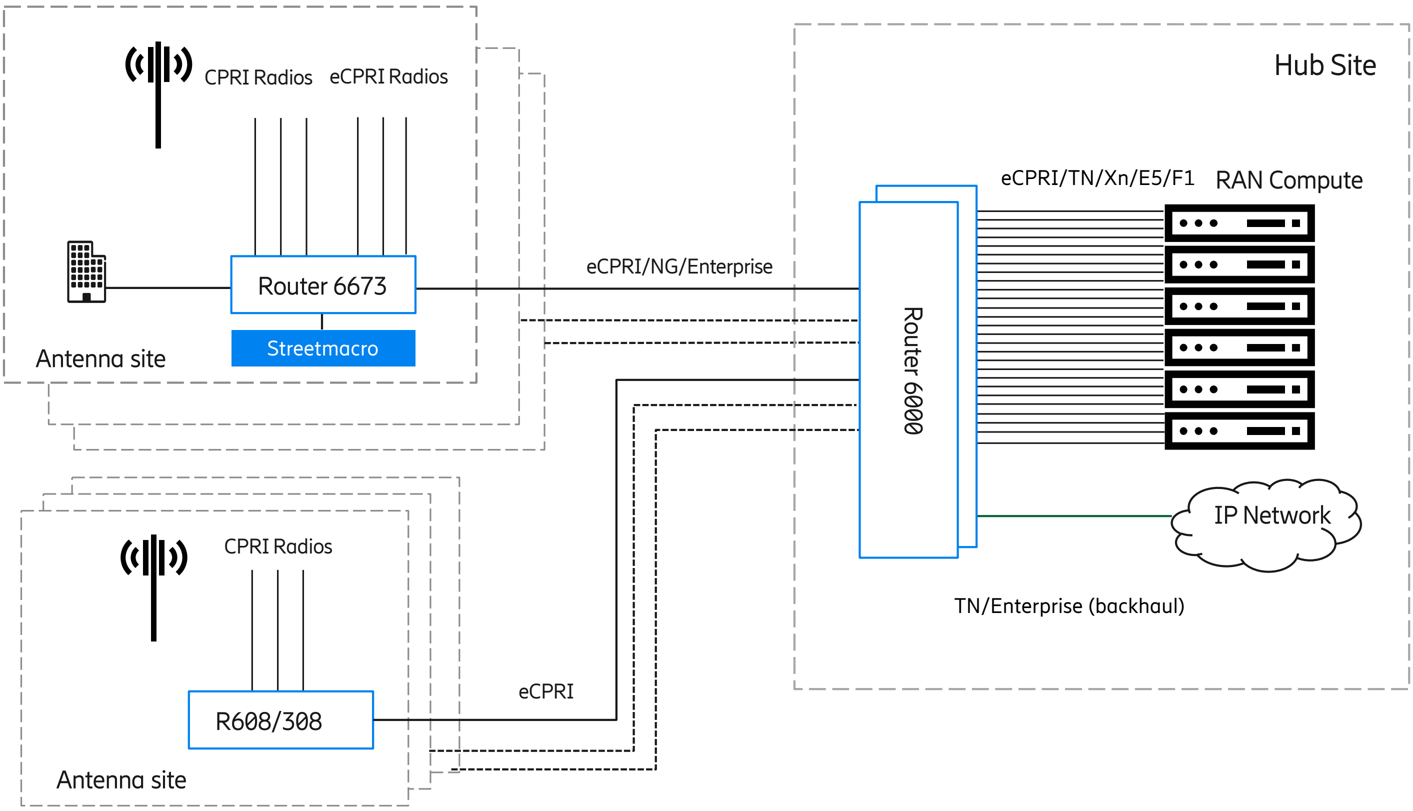


Figure 11: Packet Fronthaul in C-RAN networks

It may be desirable to convert CPRI to eCPRI at the antenna site to optimize the connectivity from our new RAN Compute basebands with high speed 25GE Fronthaul interfaces. For example, in a compact antenna site, one Radio Gateway R308 could connect the site back to RAN Compute at a hub location using one fiber per antenna site.

The Radio Gateway R308 and R608 products at the antenna site can aggregate multiple CPRI radios onto a single 25GE eCPRI connection toward RAN Compute at the hub site. For compact sites with NR capable CPRI based Radios, R308 and R608 offers the lowest footprint and most cost-effective solution.

For larger capacity radio sites with mix of legacy and NR capable CPRI/eCPRI radios, Router 6673 offers the most flexible solution. Router 6673 can aggregate multiple CPRI radios, eCPRI radios and potential enterprise services traffic to a 100GE connection (alternatively to 100GE connections) towards a hub site, while providing feature rich synchronization and Packet functionalities.

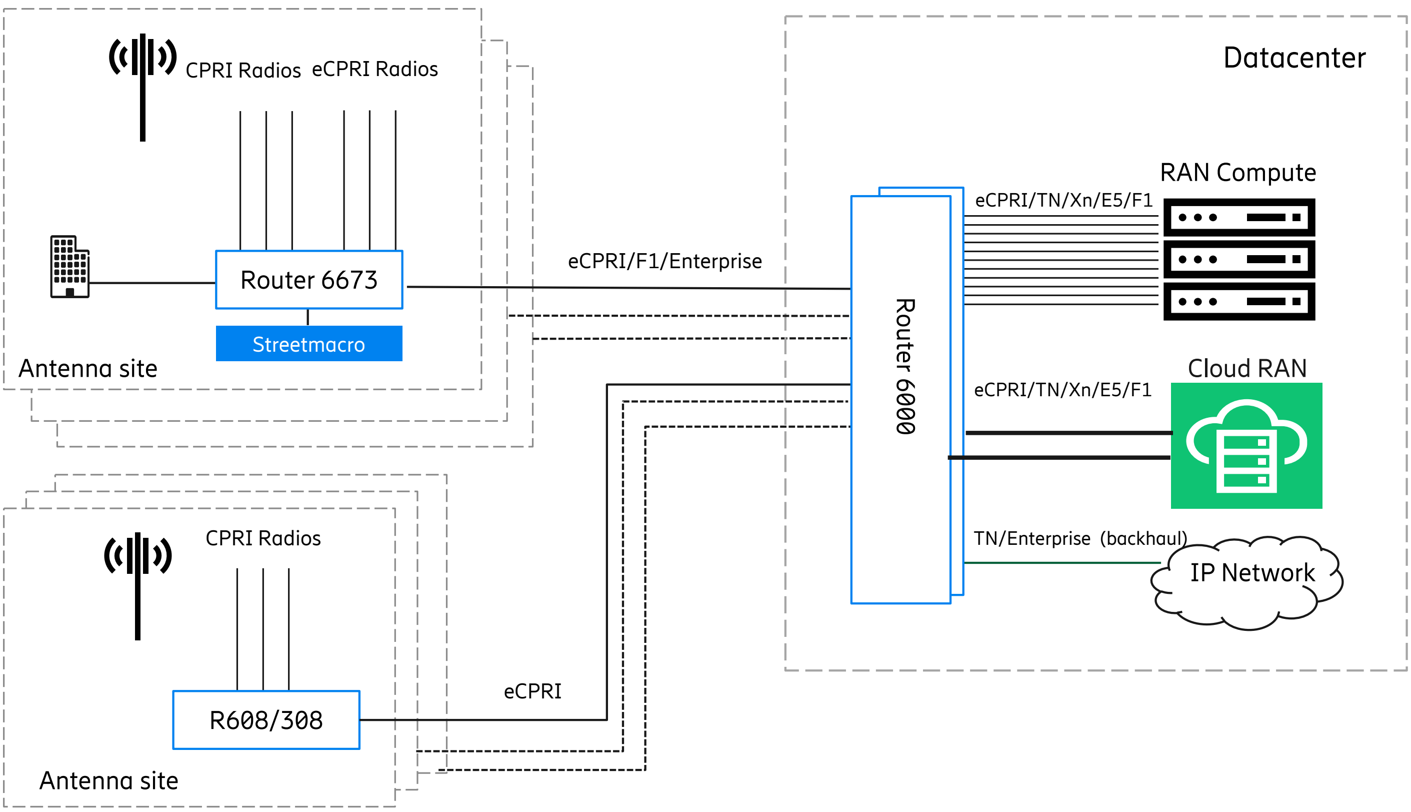


Figure 12: Packet Fronthaul in C-RAN networks with Ericsson Cloud RAN

With C-RAN type of deployments, C-RAN hub sites can also serve as the location for edge compute. The Ericsson Cloud RAN solution fits a deployment scenario where DU functionality runs over server-based compute platforms. The Ericsson Packet Fronthaul solution with Cloud RAN and ERS Basebands allows to service providers to seamlessly fit the different pieces together and work in concert. Service providers have the flexibility to deploy, manage and adjust the solution as they migrate and evolve with 5G.

Packet Fronthaul in hybrid networks (mixed C-RAN and D-RAN)

We understand that actual deployment of 5G and choice of C-RAN vs D-RAN is not always straightforward. With a Packet Fronthaul solution from Ericsson, we can accommodate different deployment scenarios due to our solution flexibility. In the following example, an operator chooses to centralize newly deployed 5G only basebands for mid-band AAS and low-band FDD while leaving existing 4G/5G dual mode ESS basebands at the macro site. Ericsson solution allows this flexibility by using inter-site advanced coordination services with Packet Fronthaul solution transporting eCPRI, CPRI, E5 and backhaul traffic across sites. In addition, Packet-based connectivity at the macro sites allows for integrating other site equipment's such as environmental monitoring solution via Ethernet.

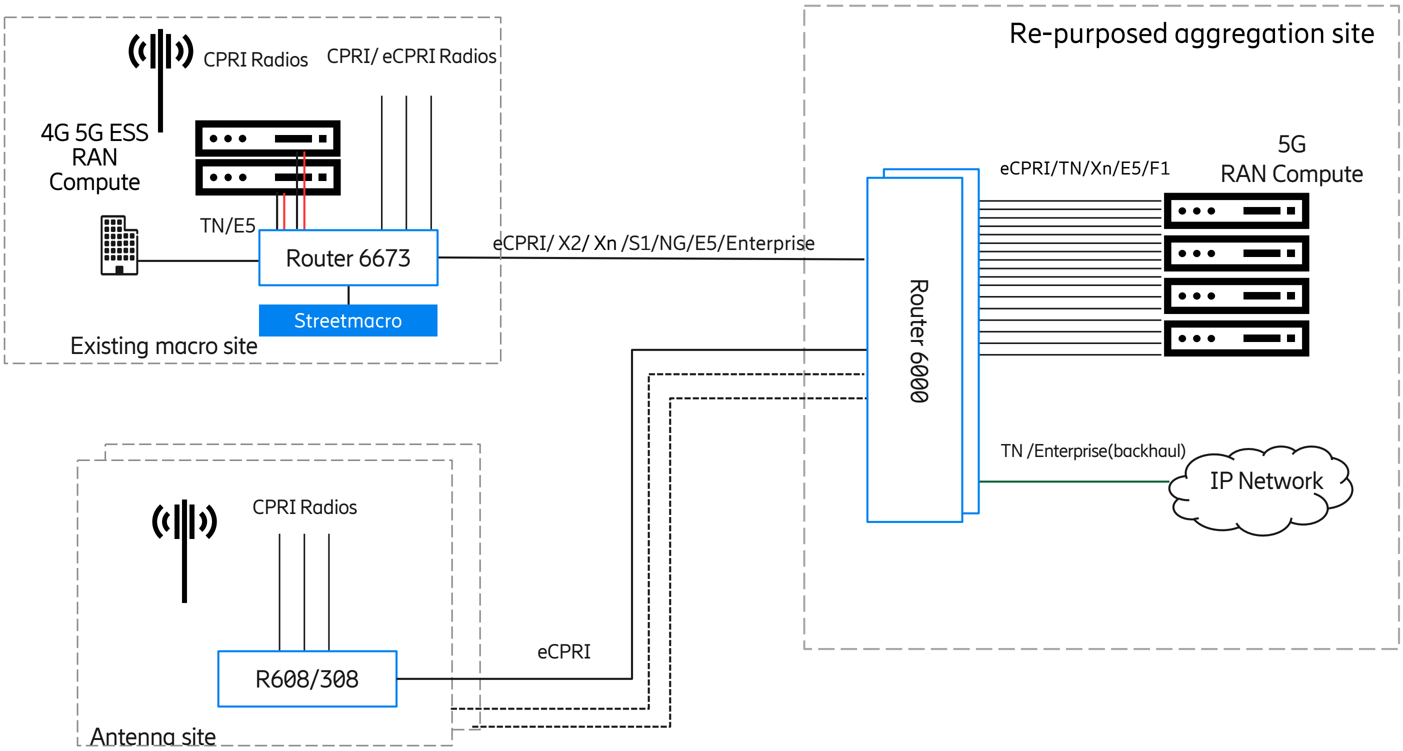


Figure 13: Packet Fronthaul in hybrid networks

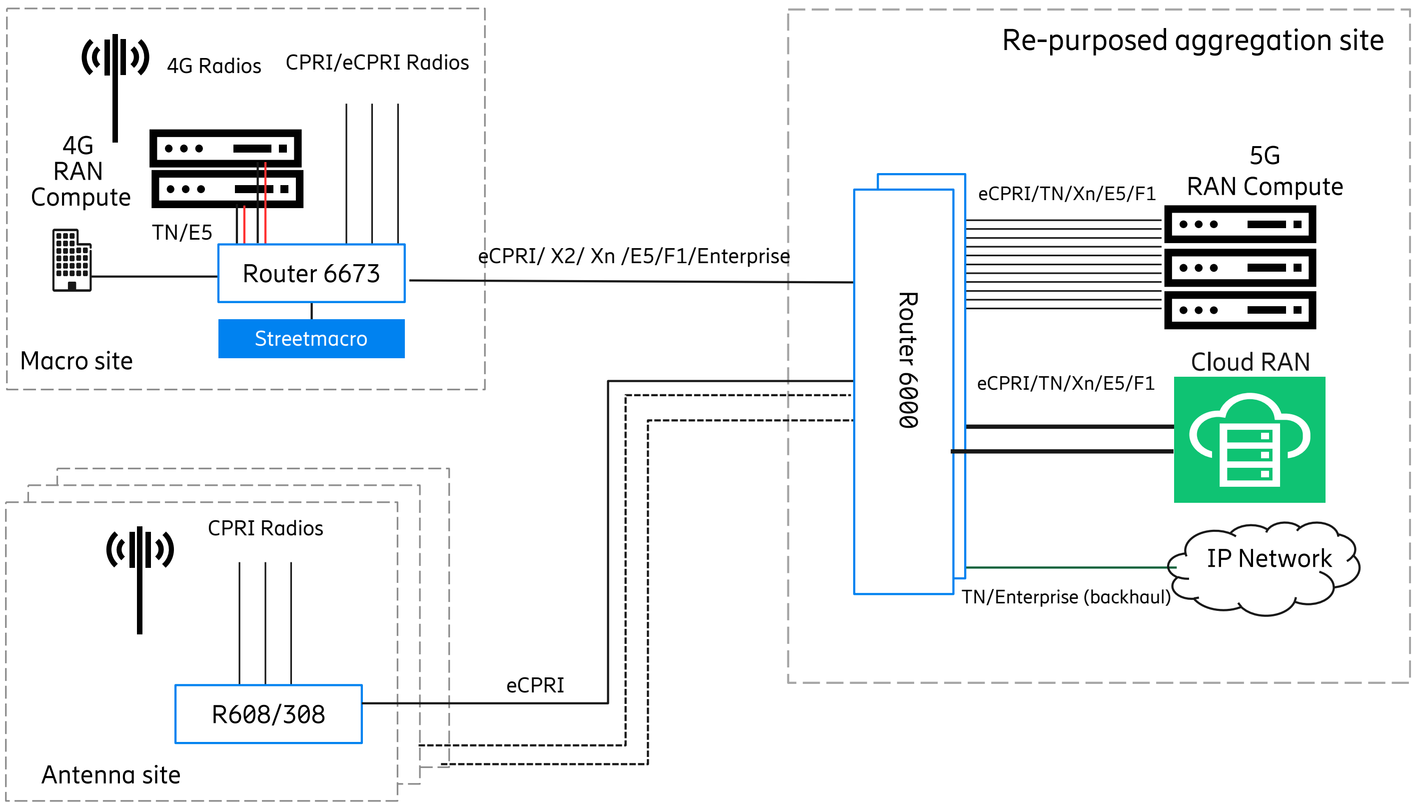


Figure 14: Packet Fronthaul in hybrid networks with Ericsson Cloud RAN

On top of the flexibility shown, Ericsson Cloud RAN solution can be seamless deployed in the C-RAN hub site for additional 5G capacity in this example. This is because the infrastructure needed to for Cloud RAN to operate with the rest of the network is available with this transport network architecture. Cloud RAN through this architecture will be able to interact with CPRI based radios at macro site, coordinate with RAN Compute basebands, and communicate with 5G core.

O&M solutions

Ericsson Packet Fronthaul products are part of Ericsson Radio System utilizing a common management system, Ericsson Network Manger (ENM). This enables alarm consolidation between RAN and Transport elements for improved fault isolation, e2e visualization and coordinated self-healing functions. An example: cell degradation can be caused by issues in the transport domain or in the air interface. By combining a set of KPIs from RAN and Transport like Packet loss, air interface performance and connection status, the root-cause can be clearly visualized. This can be complemented with consolidated alarms, constructed either rule based or by AI/Machine learning, pin-pointing the issue regardless if it is in the RAN or Transport domains. ENM includes a solution for automatic provisioning on transport services on top of a routed underlay, with an evolution path to offer automatic end-to-end provisioning for RAN services including setup of the transport infrastructure and by that simplifying reconfigurations and deployments.

Today we are providing this solution as part of our ENM offering and it can be used as an integrated solution in ENM or through the supported north bound interfaces for integration with other management systems and tools including Ericsson Intelligent Automation Platform.

Conclusion

Ericsson's strategy is all Packet Fronthaul for the complete radio portfolio to ensure the most cost-effective transport solution regardless of RAN architecture. As we migrate our radio portfolio from native CPRI Fronthaul to eCPRI Packet Fronthaul we have solutions to convert the existing Ericsson CPRI interface to Ericsson LLS eCPRI by moving baseband processing from the Digital unit to our new Radio Gateway, Router 6673 CPRI line card products leveraging Ericsson Silicon.

With Ericsson's Packet Fronthaul solutions, you have an efficient and flexible toolbox for all your different deployments needs, that can also cater for continued network evolution. Using verified end-to-end solutions and products managed with a common management system, you will make sure you have the best performing networks and ease of use.

Reference

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2. 3GPP specification series: 38series
3. http://www.cpri.info/downloads/eCPRI_Presentation_2017_08_30.pdf
4. Packet Fronthaul – design choices towards versatile RAN deployments
5. Synchronization in 5G transport

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business and is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

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