
IP anyhaul network fabric
provides maximum flexibility
NOKIA

A North American Tier 1 MNO implements a common IP anyhaul network fabric to support diverse 5G implementations

The challenge

This Tier 1 North American mobile network operator (MNO) has made a significant investment in 5G spectrum and network infrastructure to support a variety of new 5G services. The MNO has many architectural choices to make in relation to the centralization and distribution of radio access network (RAN) and core functions, virtualization and disaggregation of functional components, and location of storage and compute resources for end-user applications.

Implementations will vary from city to city and over time depending on user trends, population distribution, geography, application requirements and partnerships.

The MNO needs an IP anyhaul network that will provide flexibility to place RAN, core and application functions at different network sites (cell, hub, edge or core) to balance performance optimization and cost effectiveness in each situation.

How Nokia helps

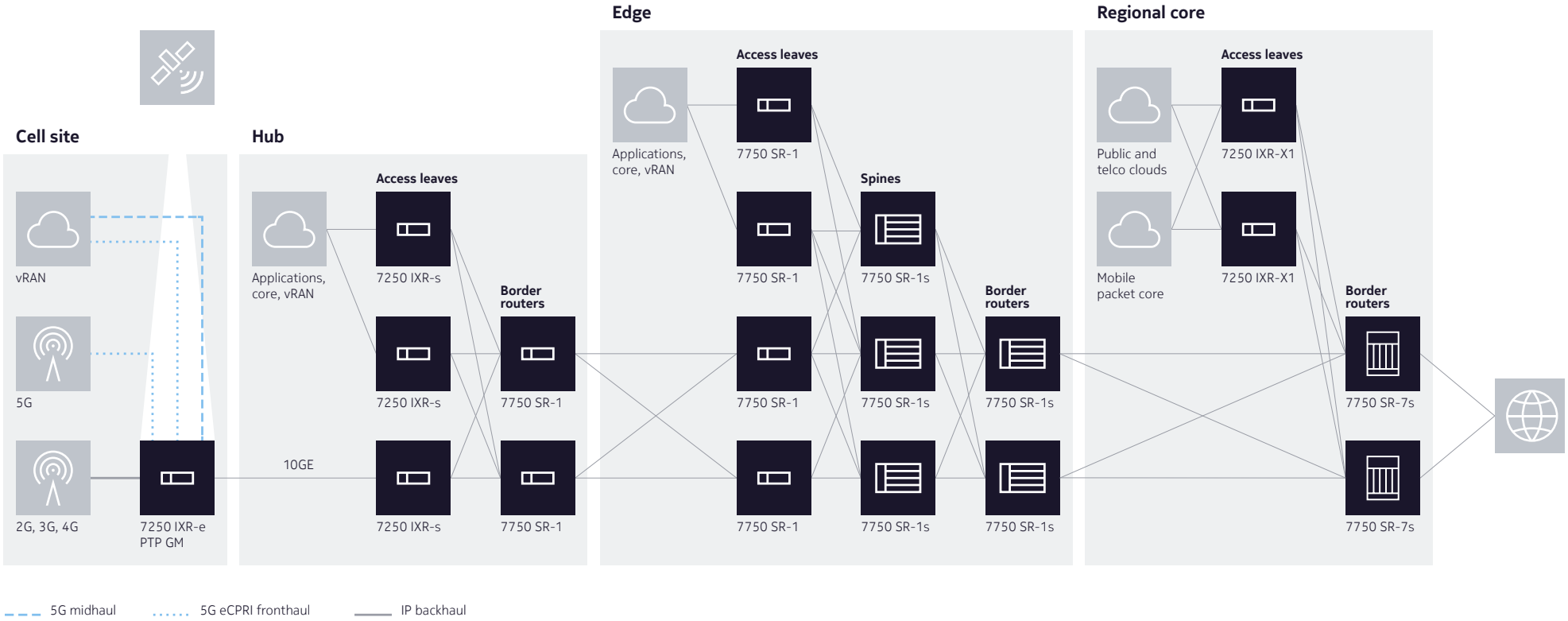
Nokia has worked with this MNO to design and implement an IP network fabric that gives the MNO the flexibility to place network functions and user applications at whichever network site makes the most sense. With this flexible fabric, the MNO can place:

- 5G RAN functions at cell, hub or edge sites to reduce cost and address specific bandwidth, space, power and latency challenges
- Application elements at any location depending on the transport cost and latency requirements of the application
- Core functions where they are needed to support the applications' requirements

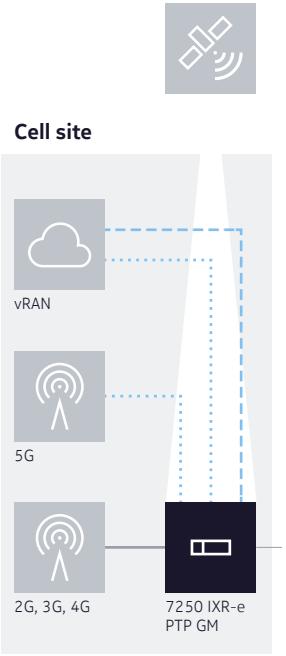
Figure 1 shows this anyhaul network design, along with some examples of possible RAN and core function placements. The design fully supports legacy 2G, 3G and 4G RAN.

A flexible IP network fabric allows the MNO scale up as 5G traffic increases. This fabric easily accommodates different RAN architectures and edge cloud implementations.

Figure 1. Flexible IP network fabric



Accurate timing is essential for 5G RAN functionality. Nokia 7250 IXR-e routers have built-in GNSS receivers that collect timing data from satellites. The routers act as grandmaster time clocks for IEEE 1588v2 timing distribution. In addition, they conform to the ITU-T G.8273.2 Class C specification for low time error required by fronthaul applications and provide field-proven timing reliability.



Cell site

The 7250 IXR-e router performs several functions at the cell site. When 4G and 5G networks are deployed in distributed RAN configurations, the 7250 IXR-e aggregates IP backhaul from the RAN equipment and routes it through the IP network to the mobile packet core. For centralized 5G RAN implementations, the 7250 IXR-e aggregates 5G eCPRI fronthaul traffic from 5G radio units at the cell site and routes it to virtual RAN (vRAN) servers hosting baseband unit (BBU) functionality at the cell site or hub site.

The MNO wants the flexibility to place BBU functionality at any site as requirements change over time.

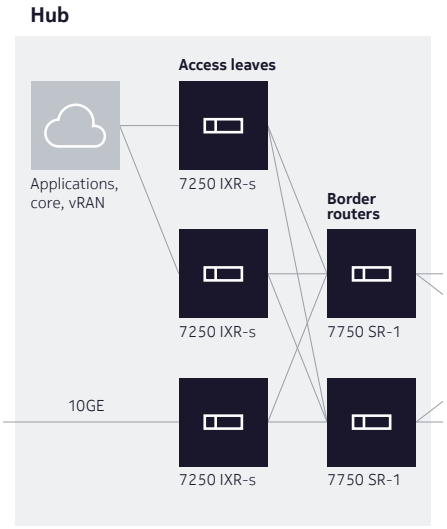
For example, it may decide to place distributed unit (DU) functionality at cell sites and centralized unit (CU) functionality at hub sites in some locations. This approach will require a fronthaul connection from the 5G radio unit (RU) to the distributed unit (DU) at the cell site and a midhaul connection from the DU to the centralized unit (CU) hosted on a vRAN server at a hub site.

7250 IXR-e routers provide backhaul, fronthaul and midhaul connectivity for multiple RAN technologies. Their multi-rate ports will allow the MNO to economically scale up port speeds and bandwidth over time.

The 7250 IXR-e eliminates the cost of installing and maintaining an external time source platform by receiving GPS signals and providing accurate, reliable timing to connected RAN elements at the cell site using the IEEE 1588v2 Precision Time Protocol (PTP).

This MNO uses leased and its own fiber between cell and hub sites with 10 or 100GE capacity.

The MNO has chosen to use a leaf-spine architecture at its hub, edge and distribution sites to support edge cloud data centers with maximum flexibility, scalability and resilience. It can add data center servers to the leaves in this architecture as needed to support vRAN, disaggregated core functions, and application compute and content.



Hub site

At the hub site, eCPRI fronthaul and midhaul transmission is routed through a leaf–spine architecture to BBU functions running on vRAN servers. When RAN processing is complete, what is now IP backhaul transmission is forwarded to the mobile core and application functions.

Traditionally, the mobile core was centrally located, and applications were hosted by the application provider or in a public cloud. In the future, servers that support applications and the required core user plane functions may be located in data centers at hub or edge sites anywhere in the MNO's network.

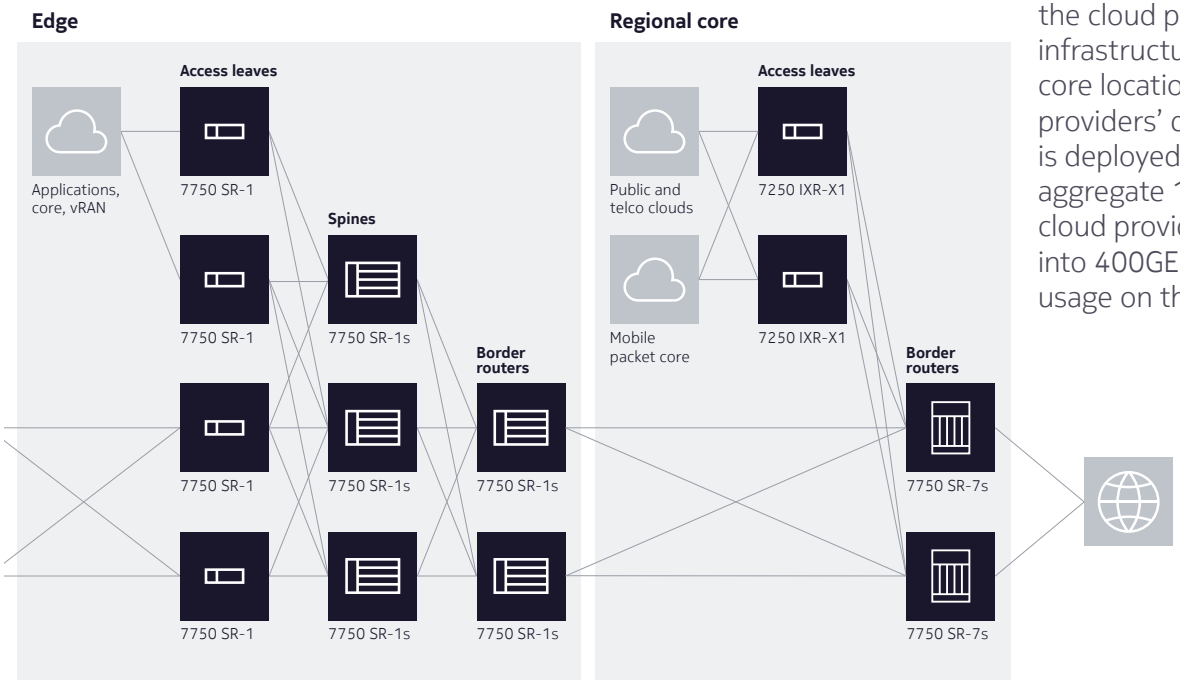
Traffic from cell sites connects to leaf nodes at the hub site. These leaf nodes route the traffic to functions at the node or forward it on through the network. With this common network fabric, the MNO can place user applications and physical RAN, vRAN and virtual core functions anywhere in its network depending on density, latency, power and space requirements.

As shown in Figure 1, the MNO uses Nokia 7250 IXR-s routers for the access leaves at the hub site and Nokia 7750 SR-1 platforms for the border leaf nodes. The 7750 SR-1 platforms provide higher scale, throughput and 100 GE port density and support the gateway functions that are needed at the border routers.

Edge site

At the edge sites, the MNO uses 7750 SR-1 platforms for the leaves and 7750 SR-1s platforms for the spine and border router nodes. The 7750 SR and SR-s product families are multipurpose platforms.

As such, the MNO has the option to use them for hosting virtual core functionality, in addition to performing aggregation and routing duties, rather than placing this functionality on other servers.



Regional core

At the regional core sites, the MNO uses high-scale, high-performance 7750 SR-7s platforms for aggregation and as border routers.

The MNO has an arrangement with public cloud providers to support end-user applications by hosting the cloud providers' data center infrastructure at dozens of its regional core locations. Wherever the cloud providers' data center infrastructure is deployed, 7250 IXR-X1 platforms aggregate 100GE traffic from the cloud providers' top-of-rack servers into 400GE links to optimize port usage on the border routers.

Segment routing

The MNO uses segment routing to create end-to-end connectivity for vRAN, core and application functions across the anyhaul network fabric and across data center fabrics. It is in the process of migrating some older network equipment from Label Distribution Protocol (LDP) to segment routing and will have both running in the network for some time.

The use of segment routing simplifies the MNO's operations and eases the process of creating paths between network functions that run in different locations. Nokia Network Services Platform (NSP) automation tools facilitate path creation, restoration after faults and load balancing. Segment routing will also provide a foundation for implementing network slicing in the future.

Benefits

The Nokia IP anyhaul solution allows the MNO to place RAN, core and application functions at locations that optimize performance and cost for each application. This solution supports a scalable and redundant architecture that is ready for the unanticipated changes that 5G may bring. By choosing a uniform and extensible design and replicating it across the network, the MNO is minimizing the operational impact of its network architecture choices.

The Nokia solution provides the advanced routing services and automation necessary to dynamically provision the interconnectivity of physical and virtual network functions as well as application storage and compute. The service assurance and network optimization features guarantee an excellent customer experience.

Nokia uses the Service Router Operating System (SR OS) software to provide uniform, end-to-end routing services and operations across all products in its IP routing portfolio.

This software delivers excellent network performance and reliability. It improves the customer experience and provides opportunities for the MNO to offer premium services.

The Nokia solution also uses a Nokia Bell Labs-proprietary implementation of the standard PTP protocol to provide highly accurate timing with support for new timing specifications that are essential for disaggregated RAN operation.

The Nokia IP routing portfolio ensures that the solution will have a long lifetime. The chosen platforms have ample capacity and scale for many years of network growth.

With help from Nokia, the MNO has created an IP transport fabric that will help it to meet its 5G service delivery goals. The MNO is ready to implement new 5G services, knowing that its network will support fast service implementation and a superior customer experience in the most cost-effective manner.

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