Tech Brief

#1: The hybrid-ready inventory system: why 5G depends on it

Enabling hybrid networks with inventory modernization

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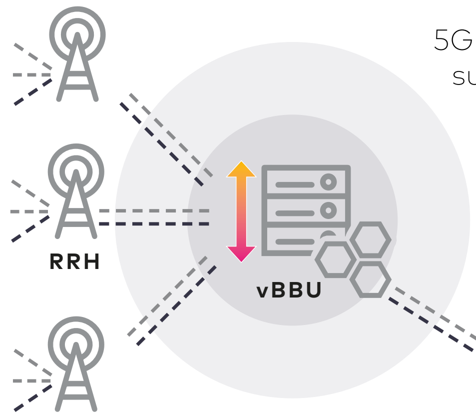
5G and the hybrid radio access network

5G offers significantly faster connectivity, higher security, and lower latency than 4G. 5G network deployments are happening at a rapid pace due to 5G's game-changing capabilities, competitive realities, and the new revenue opportunities it enables for service providers.

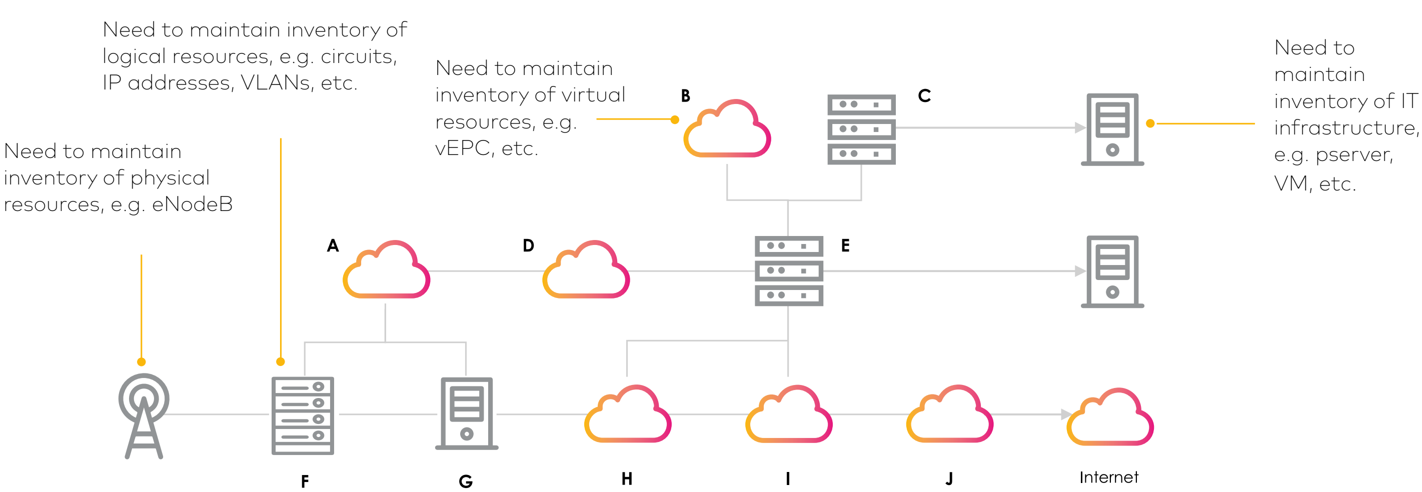
However, 5G deployment presents new operational challenges for service providers especially in the wake of network virtualization. 5G leverages software defined networking (SDN) and network function virtualization (NFV) running in a cloud computing environment to benefit from its dynamic, rapidly configurable set of network capabilities. The 5G cloud RAN (C-RAN) will coexist with non-virtualized network infrastructure creating a complex hybrid RAN for the foreseeable future.



5G capabilities such as **elastic service scaling** and **network slicing** require a highly dynamic inventory system

This means that physical network resources such as eNodeB's need to be maintained in an inventory along with their related logical resources such as link, circuit and port numbers. In addition, virtual network resources such as vEPC's need to be tracked and managed alongside the physical network in an active inventory, together with the IT cloud infrastructure needed to support them.

Hybrid Network

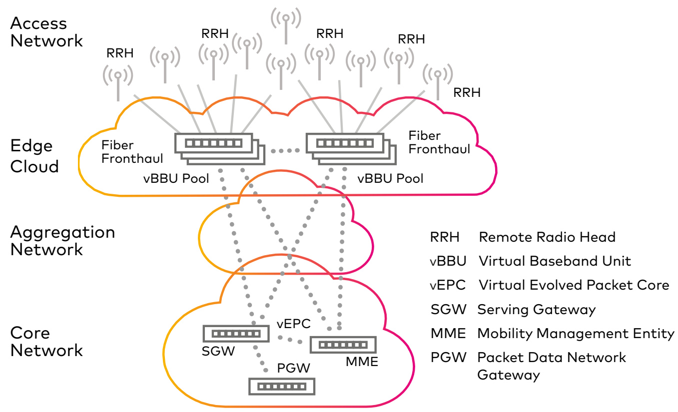


Need to maintain E2E visibility across hardware and software-based network domains

The impact of network virtualization

NFV, SDN, and the rapid move to cloud-based infrastructure are changing the face of traditional network design and implementation. By replacing physical network elements with virtual network functions (VNFs) and cloud network functions (CNFs), significant savings can be made in both cost and operational efficiency. Networks become much more flexible, dynamic, and scalable, automatically spinning up CNF's and VNF's on-demand, when and where they are needed, and removing them to free up computing resources once their capacity is no longer required.

Network virtualization can be applied to both the core and radio access networks. Virtual evolved packet core (vEPC) and virtual RAN (vRAN) are examples of this. Virtualization offers a more cost-effective way to push some essential processor intensive functions out to the edge of the network where they can enable high-bandwidth, ultra-low latency applications, such as video servers, cyber security, and voice over LTE (VoLTE) performance management functions. Furthermore, a vRAN can simplify the network and make it more open and flexible by replacing most of the RAN functions with virtual functions supported on a general-purpose computing platform. A standards-based virtual environment, combined with the ability to pool previously distributed functions onto a centralized platform improves efficiency and reduces hardware and upgrade costs..



Centralized or Cloud RAN (C-RAN) enables network flexibility and reduces cost

Building faster, resilient networks by centralizing the RAN

Centralized or cloud RAN (C-RAN) architecture effectively moves baseband processing functions out of conventional, standalone base stations and consolidates them in a centralized "shared" computing infrastructure. This simplifies the RAN, which ends up simply as a "cloud" of remote radio heads (RRHs), each of which consist of just the radio transceivers and antennas. Fiber optic cable is used to "front-haul" baseband signals between coordinated RRHs and a centralized baseband unit (BBU), which carries out all the processing for the combined RAN functions.

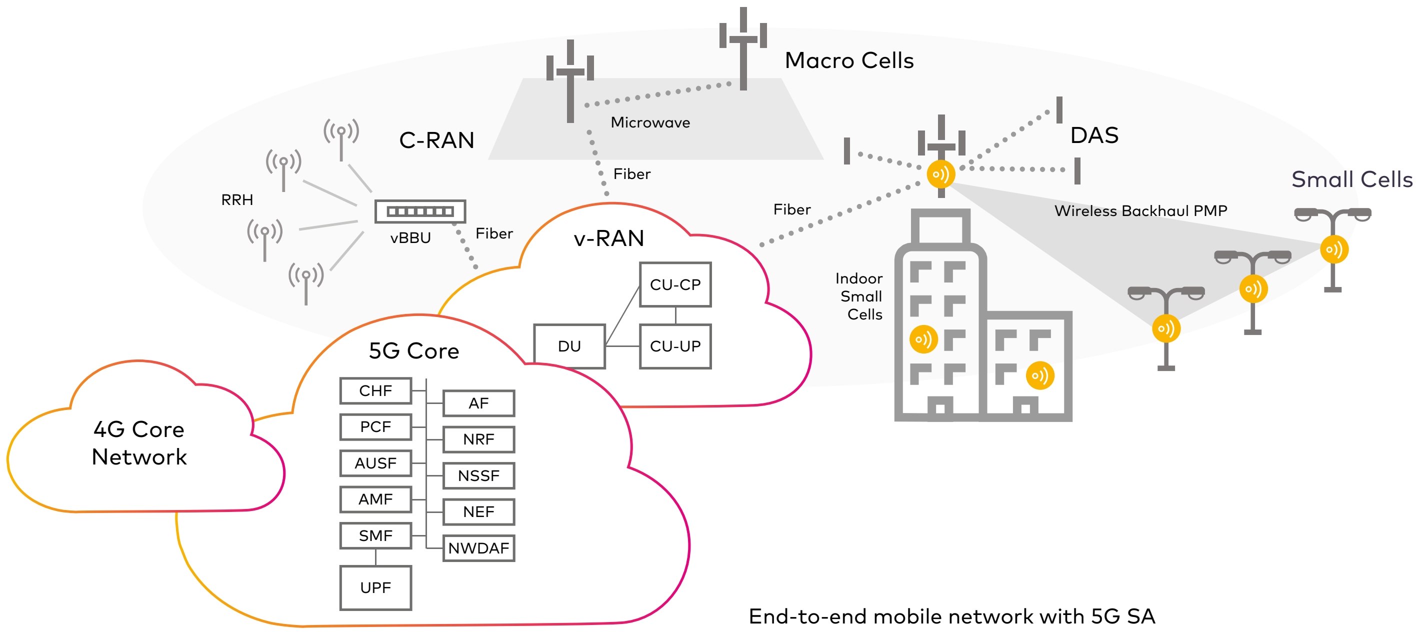
C-RAN networks can take advantage of virtualized RAN technology to achieve this. In comparison to a conventional RAN, a C-RAN can provide better control and coordination across a wider cluster of RRHs. Furthermore, it's centralized computing capabilities increase reliability, while significantly reducing overall hardware equipment, power consumption, and backhaul complexity. BBUs can be pooled together, where they can dynamically allocate computing resources to base station software stacks. Many thousands of RRHs can be supported in this way from a single BBU pool, enabling elastic network service scaling.

A dynamic network requires a dynamic inventory system

To be ready for 5G, the network inventory system needs to be as dynamic as the self-configuring network it describes. The virtualized and cloudified areas of the network, as well as the network areas functioning under an SDN control plane, can self-configure to respond to traffic demands, network faults, or service requests from the service orchestration layer. The inventory system needs to be capable of rapid updates in response to such rapid, autonomous network changes. The current state of the virtual and logical network layers, and their interrelationships with the physical network underlay are critical for service fulfillment, which will leverage 5G network slicing and inventory data to provision hybrid services that typically cross several network domains.

These interrelationships are also critical for service assurance, in particular for root-cause analysis of service impacting network faults and configuration issues that manifest themselves at higher network layers or in other network domains. In such situations, virtual test agents, element managers and domain controllers operating alone are not able to provide operations staff and automated systems with the full, end-to-end network view needed for root-cause analysis and rapid fault resolution. Only an inventory system with end-to-end network coverage can provide that view.

An up-to-date inventory system is also critical for service impact analysis. When a major fault or performance issue is identified, it is important to know the nature and extent of the service impact, which can ripple through several network domains. A hybrid inventory system will also enable vendor-neutral, historical monitoring and performance analysis that includes both the physical network and virtualized network components, thereby enabling service providers to set and enforce performance agreements with multiple vendors who will supply the components of a 5G network.



End-to-end mobile network with 5G SA

Inventory as the master – the traditional role will also be needed

In the past, the inventory was always the master: a design was created using inventory data, then pushed out to the network, and the inventory updated after the network change was executed. While in the future this type of workflow will be required far less, it will still be the mode of interaction with the physical network underlay, such as RRH's, fiber fronthaul and backhaul, and the core network physical infrastructure. Consequently inventory systems will need to excel in both the 'inventory as master' and 'network as master' scenarios.

Summary

5G promises a faster, more secure and low latency network that is delivered by a complex, multi-technology physical and virtualized hybrid RAN. But that performance promise depends on network operations teams and automated systems having near-real-time, end-to-end visibility across the hybrid network, including the RAN, backhaul, and core networks, from the physical underlay up to the virtualized overlay. Only an advanced, hybrid-ready inventory system can provide this visibility; the success of 5G operations depends on it.

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