Extending the Value of Open Cloud Foundations to the 5G Network Core with Telecom Infrastructure Blocks for Red Hat

Paul Parker-Johnson

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Requirement: Cloud Consistency Everywhere

A guiding principle in developing cloud-native applications has been that they can rely on the infrastructures in which they run to have the same fundamental capabilities in place to support their operation regardless of the site where they are running. This has been a major contributor to the versatility, efficiency and scale at which cloud-native applications have been implemented to date.

The pattern employed in achieving this goal in general-purpose cloud computing has been to consistently enhance the openness and versatility of the *software* environments in which workloads run, allowing them to add functionality and value at large scale with astonishing velocity. Simultaneously, there has been progress in simplifying and streamlining the processing *infrastructures* on which the applications run. This allows them to be rapidly and flexibly assembled and efficiently adapted to the needs of the environments for which they are targeted.

Cloud-Native Network Services Need the Same Consistency

This pattern is generally holding true in developing cloud-native functions to support operations that communications service providers (CSPs) require for the delivery of their services. This includes high-reliability, low-delay voice communication between subscribers on any network anywhere in the world; seamless and efficient subscriber roaming (with features active); and flawless delivery of video and multimedia services, to name a few. The trajectory in CSPs' environments has been aggressive in developing software-based functions that allow capabilities to be run on virtually any cloud infrastructure, so the desired agility, efficiency and reach of CSPs to their target markets can be achieved. The service-based architecture of the 5G core used in the industry's specifications for 5G network cores is one example of cloud-native architectural principles being used at the heart of CSPs' future implementations[1].

[1] See *System Architecture for the 5G System,* ETSI TS 123 501 v 15.3.0, September 2018, for the fundamental description of the service-based architecture of the 5G network core, https://www.etsi.org/deliver/etsi_ts/123500_123599/123501/15.03.00_60/ts_123501v150300p.pdf

Location Diversity Ups the Ante

Development of software-based functions using cloud-native designs has been necessary and of strong value to CSPs to date. At the same time the variety of *physical* locations in which they must run their workloads (including distributed edge data centers and customers' premises) along with the variety of services they must support puts an equally important premium on being able to support the same kind of consistent, open, distributed cloud computing infrastructure in place as has been used in the broader cloud computing market. This is an area in which the industry has made less broad-based progress to date, though solutions focused on accomplishing the goal are beginning to appear.

The Challenge: Making Infrastructures Both Open *and* Efficient

Achieving this goal produces an imperative for CSPs to create highly elastic, distributed and versatile cloud foundations for delivering their services as widely and consistently as they can.

This creates a significant conundrum for CSPs, which they must overcome in order to achieve the goal (which we described in a recent research brief[2]). The conundrum is, on the one hand there is a powerful appetite among CSPs to deploy *open, distributed* cloud computing infrastructures on which to deliver their services. On the other hand, they must realize the benefits of this openness and flexibility at the *same time* that they increase the *efficiency* of their operations. If CSPs master this challenge they will reap the benefits of higher revenues and lower TCO that are required for them to retain their competitive position.

In our prior research brief we highlighted Dell Telecom Infrastructure Blocks as an innovative solution CSPs can deploy in accomplishing this goal. The novelty (and value) in Telecom Infrastructure Blocks is embedded in their delivery of pre-engineered, pre-validated configurations of cloud platform infrastructures tuned to meeting the requirements of CSPs' highest priority network use cases. The first use case and set of deployment configurations supported by Telecom Infrastructure Blocks are for the virtualized radio access network (vRAN) deployments in CSPs' 5G networks.

[2] *Accelerating Cloud-Native Deployments and Economic Returns*, ACG Research, December 2022.

Extending the Flexibility of Infrastructure Blocks to Additional Sites

Although significant on their own in producing a key part of the overall solution to deploying efficient cloud-native infrastructures at scale for CSPs, the scope of the requirements extend beyond the RAN to other sites. The next logical target to address is the the network core, the functional nucleus of CSPs' mobile networks.

5G network cores are topologically adjacent to the RAN and complement the RAN in building out a full, cloud-native infrastructure for mobile services. They run the most important policy control, security, subscriber and service management functions that define what the CSP is offering. As 5G services expand, their network cores will grow not only in size and footprint, but also in the variety of workloads and applications they support. The requirement for them to be versatile, elastic, reliable, consistently manageable and efficient will only increase.

With this as the path for how 5G network cores will evolve, it is that much more important for CSPs to deploy a foundation for their 5G operations that supports this diversity and scale and at the same time simplifies the deployment and life-cycle operation of the services being offered.

Enter Dell Telecom Infrastructure Blocks for Red Hat in the 5G Network Core

Dell Technologies with its cloud platform software partner Red Hat are continuing to deliver on the vision of providing simplified, scalable telco cloud foundations for CSPs to deploy. Using the same architectural framework employed in its Telecom Infrastructure Blocks for 5G RANs, Dell and Red Hat have developed pre-engineered, pre-validated infrastructure blocks for the deployment scenarios most prevalent in CSPs' 5G cores. The offerings address the requirements for scaling, performance, availability, and distribution of CSPs' 5G network cores. Designs integrate Dell's hardware and software with Red Hat's Kubernetes Advanced Cluster Management (ACM) and OpenShift software offerings to support Red Hat's OpenShift and Kubernetes in both central/national and regional/distributed 5G network sites.

Figure 1 depicts the architectural model of Telecom Infrastructure Blocks for Red Hat in the 5Gnetwork core. Dell Telecom Multi-Cloud Foundation (shown at lower left) integrates Dell's Bare Metal Orchestrator (BMO) infrastructure management software with Red Hat's cloud platform software to automate the deployment and life-cycle management of OpenShift clusters on Dell servers throughout the core. The Dell and Red Hat components are pre-integrated and pre-validated into configurations that include all the hardware, software and licenses needed to build and scale out OpenShift clusters to support 5G core network workloads.

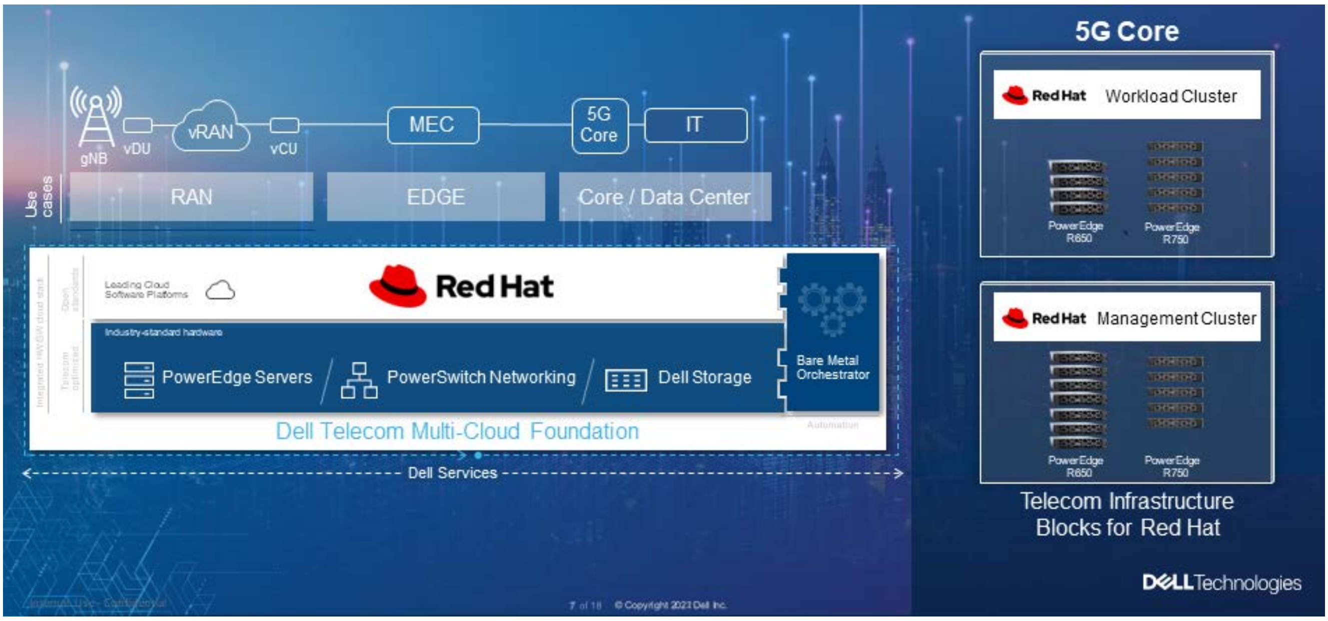

Figure 1. Telecom Infrastructure Blocks for Red Hat for the 5G Network Packet Core (Source: Dell Technologies)

Figure 2 illustrates a deployment of Telecom Infrastructure Blocks for Red Hat in both national and regional data center sites in a CSP's 5G core. Infrastructure Blocks are installed in national data center and regional data center sites. The scalability and flexibility of the Infrastructure Blocks model is illustrated in its use of a centralized management cluster and multiple supported workload clusters in both centralized and distributed sites. Dell has plans to expand its portfolio of Telecom Infrastructure Blocks for Red Hat to support workloads at Edge and RAN sites in a future release.

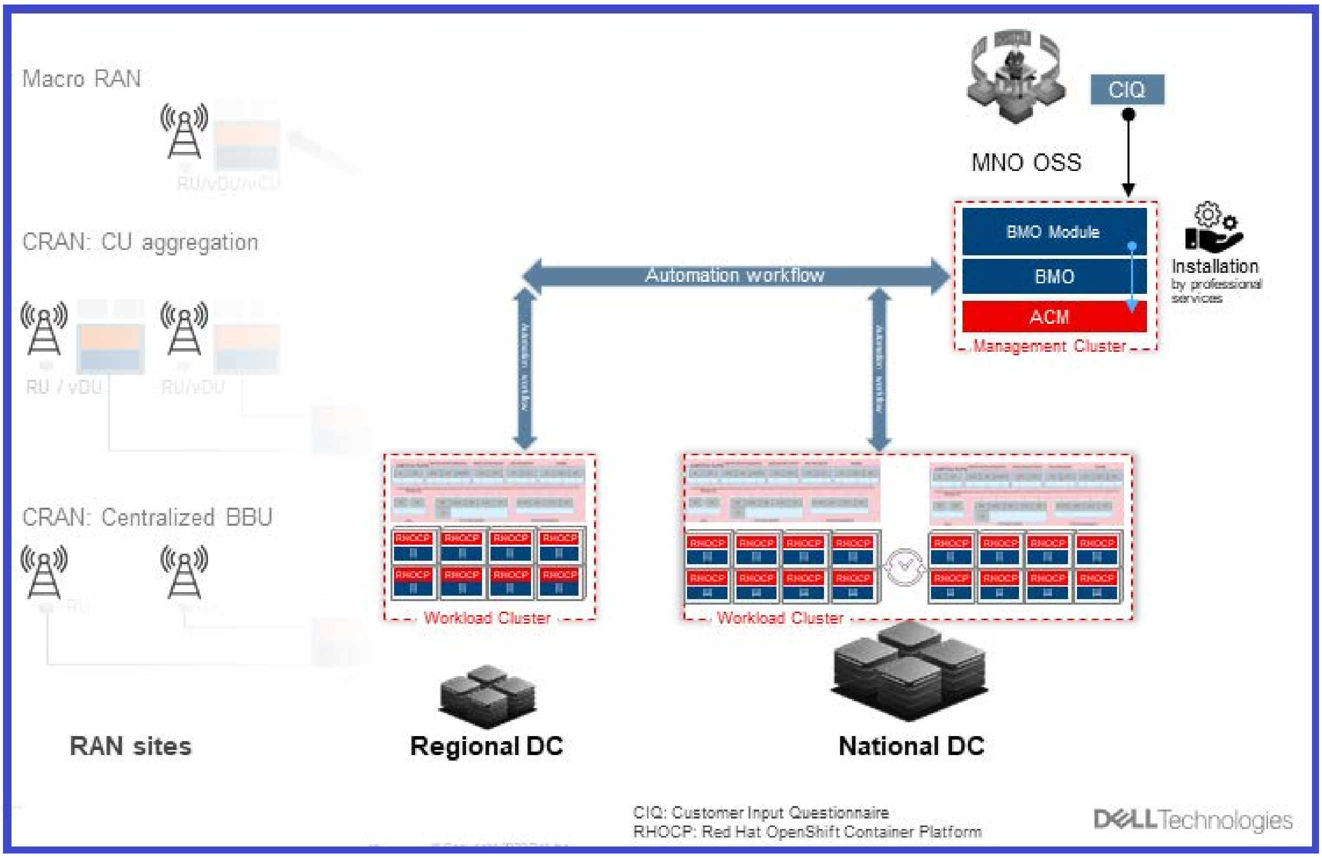

Figure 2. Telecom Infrastructure Blocks for Red Hat in a Representative CSP Deployment
(Source: Dell Technologies)

Beyond meeting the size and functional requirements of supporting workloads in each site, Infrastructure Blocks streamline the *management* of the configurations over the full life cycle of their deployment using integrations between Dell's BMO and Red Hat's ACM. Infrastructure Blocks are pre-validated to verify this functionality and confirm the levels of simplification that the partners are seeking to provide for the CSP teams.

The resulting automation dramatically simplifies tasks for CSP teams, ranging from Day 0 design to Day 1 validation and deployment to ongoing Day 2+ operations, including fault and performance management and configuration upgrades. Our analysis of deploying Telecom Infrastructure Blocks for Red Hat in a representative CSP's 5G network core shows savings in operational expenses of 40% over five years[3]. The majority of these savings occur from efficiency gains in labor tasks of working with Infrastructure Blocks versus working with vertically integrated 5G core network stacks.

[3] *The TCO Benefits of the Dell Telecom Infrastructure Blocks in a 5G Core Network Deployment,* ACG Research, February 2023.

An additional benefit of using Infrastructure Blocks is increased efficiency in utilization of the servers in which the CSP workloads run. By consolidating functions in the clusters of the deployment, Infrastructure Blocks consume less power and space than what is consumed using separately deployed configuration stacks. Our analysis shows a 15% improvement in server utilization using Infrastructure Blocks and a reduction in power and cooling consumption equivalent to running 179 fewer gas-powered cars per year. This is a clear example of efficiency in deployments contributing to reductions in CO^2 emissions and to making progress on CSPs' environmental, sustainability and governance operating goals.

Consistency and Simplification: Delivered

By continuing to execute on the Telecom Infrastructure Blocks initiative and delivering the new suite of Telecom Infrastructure Blocks for Red Hat for the 5G network core, Dell and Red Hat are:

1. helping CSPs *master the challenge* of implementing a consistent, scalable and distributed cloud systems infrastructure for running their operations; and at the same time
2. operating with *increased efficiency* compared with other options. Pre-integrated Telecom Infrastructure Blocks provide increased efficiency compared to *a la carte* do it yourself (or DIY) deployments. And while they are more open architecturally, Infrastructure Blocks provide measurably increased efficiencies compared with deploying separate vertically integrated solutions for individual 5G use cases (fixed wireless, cellular IoT, and general-purpose mobile broadband, as examples).

See the companion paper to this brief which describes our analysis of the economic benefits of employing Telecom Infrastructure Blocks for Red Hat in the 5G network core for an elaboration on each of these points[4].

By continuing to execute on its vision of delivering openly architected and simplified, efficient foundations to CSPs for building their future cloud infrastructures Dell Technologies and its partners are providing a differentiated and valuable offering to the market and helping to shape its ongoing direction.

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[4] *The Economic Benefits of the Dell Telecom Infrastructure Blocks in a 5G Core Network Deployment, ACG Research, February 2023.*

Paul Parker-Johnson

Paul Parker-Johnson is ACG's research lead in cloud and virtual system infrastructures and their use in private, hybrid, edge and multi-cloud designs. His work encompasses physical, virtual and cloud-native infrastructures; use of intent-based modeling and automation; fusion of OT and IT in distributed cloud designs; and support of use cases in 5G, industry 4.0, and digital transformation.