THE READY FOR
ANYTHING NETWORK

WHITE PAPER

An "Open" Approach to Building 5G Networks

How to Transform your Network and your Business by Combining Telco-Grade Features with High-Performance Cloud-Native Architectures and Open-Source Technology

An Open Approach to Building 5G Networks

Contents

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Get Ready for a World of Change

5G isn't just about redesigning your network around a new set of architectural standards. It's about rethinking the way you deliver services. In other words, it's as much a business transformation as a network transformation.

With many 5G opportunities on the horizon, communications service providers (CSPs) need to mimic web-scale companies that are cloud-native and therefore born into a world of efficiency, scalability and agility. Web-scale companies leverage cloud-based architectures for a competitive advantage and place a premium on open-source systems that allow rapid innovation, integration and collaboration.

To compete effectively, CSPs also need to adopt open-source, cloud-native strategies as part of their next-gen transformation. However CSPs are different from web-scale companies and face different cost constraints because, unlike their over-the-top (OTT) competitors, CSPs still need to provide "Telco-grade" services that have higher availability and regulatory concerns.

About this white paper

This whitepaper will explain how CSPs can compete more effectively for 5G services and dramatically reduce their operational costs by as much as 90 percent by delivering services using:

- Cloud-native architecture that increases software velocity and reduces time and complexity of capacity and high availability planning
- Open-source technology that provides a common infrastructure for orchestration, service assurance, and API management
- "Telco-grade" cloud capabilities that support multi-network interfaces, data plane acceleration, integrated network probes and more

The Enterprise Opportunity

Traditionally, CSPs have focused on consumer-based services for the bulk of their revenue. That's about to change. The enterprise communications market is poised to explode in the next several years, driven by 5G mobile applications that include connected cars, smart manufacturing facilities, virtual/augmented reality and drone delivery systems.

While these applications share a common mobile platform (5G), they each have very different requirements. Some require low latency (e.g., healthcare applications), while others depend upon high bandwidth (e.g., mobile gaming).

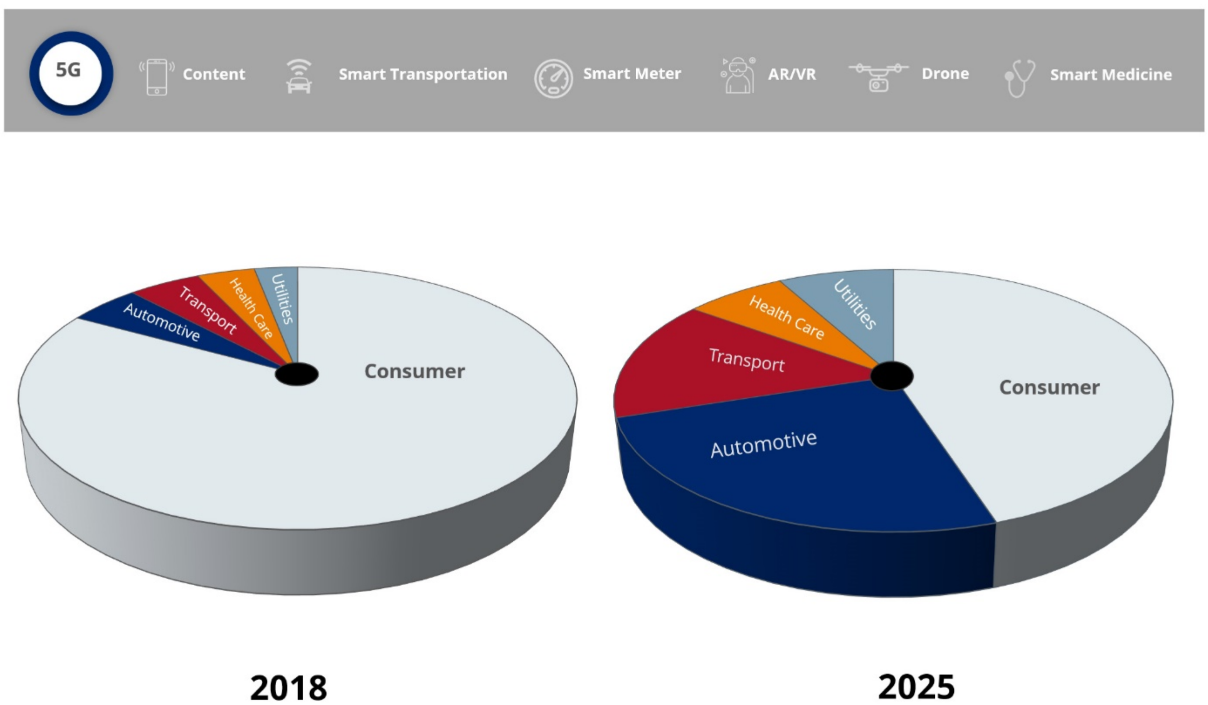

Figure 1. 5G revenue growth will come more from enterprise service growth over the next 7 years

The pricing tiers, policies and prioritization for these applications will vary as well. This means that CSPs can no longer view their network as a one-size-fits-all proposition centered on a single subscriber experience. They need to view it as a multi-tenant network designed to support very different requirements and experiences.

A New Architectural Approach

Although they have an important role to play in 5G networks, virtualized network functions alone do not constitute a 5G network. The first wave of virtualization was actually part of the push towards 4G/LTE which sought to reduce costs and increase performance by finding grounds for commonality and efficiency. This included deploying software-based network functions on common off-the-shelf hardware in place of purpose-built appliances.

Like the image in Figure 2, this approach, while more efficient and scalable, did little to improve operational efficiency.

Figure 2.
Despite common elements, the first wave of virtualization was still difficult to manage

Figure 3.
Cloud-native networks share more common elements for a more elegant design.

Even with a shared hardware infrastructure, every network function vendor had its own proprietary provisioning and configuration tools, scaling and redundancy mechanisms, logging, monitoring, performance management and northbound APIs which made the network difficult to manage and nearly impossible to automate. In effect, CSPs simply shifted the cost burden from Capex to Opex. Even when virtualization was introduced to simplify the hardware management aspect, virtualized network functions (VNFs) still used vendor-specific management tools.

A cloud-native architecture bears a greater resemblance to the more streamlined image in Figure 3. Instead of just a common hardware and hypervisor platform, a cloud-native architecture also features common orchestration, a common database, common monitoring… well, you get the point. This layer will be referred to as Platform as a Service (PaaS).

Benefits of a Shared Commonality

A shared commonality across the network architecture has important benefits for CSPs including:

- It simplifies network functions and unburdens them by reusing their common functions. This significantly reduces the "snowflake" effect where every vendor's network functions are so unique that each one requires completely different skills for management.
- It allows CSPs to scale network functions and resources horizontally where all components share the same scaling and redundancy strategies. This dramatically reduces the complexity of capacity and high availability planning.
- It simplifies operations by reducing the variety of processes needed to maintain and manage the network.

Why a Cloud-Native Architecture?

If virtualization was the first wave of digital transformation, then cloud-native is the second wave of that journey (see Figure 4). The cloud-native shift is a global phenomenon that extends far beyond the world of telecommunications providing a common architectural framework that every vendor can employ.

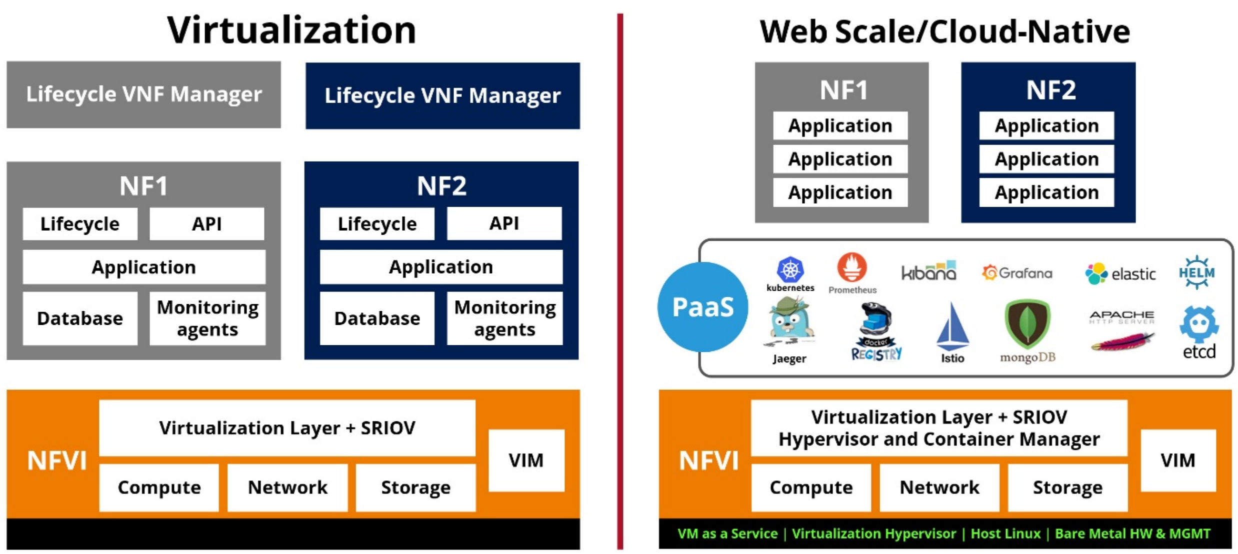

Figure 4. The evolution from virtualization to cloud-native

There are specific benefits for CSPs that adopt a cloud-native approach to building their network architecture. Service orchestration, for example, becomes much simpler in a cloud-native architecture. Where the first wave of virtualization required CSPs to manage their virtualized network functions (VNFs) using proprietary VNF managers, in a cloud-native architecture, everything is “containerized” so CSPs simply need to orchestrate the containers using a single tool like Kubernetes.

Scaling network services is also much simpler in a cloud-native architecture. CSPs typically spend a lot of time thinking about scalability: How much demand can we expect? How do we size our VMs correctly? And so on. All of those concerns disappear with a cloud-native architecture. You can size it out based on your initial need, and it automatically scales up or down as demands increase or decrease. This carries over to network resiliency as well. Here again, CSPs historically have spent a lot of time and effort building 1:1 redundancy into their network. With a cloud-native architecture, resiliency is the natural byproduct of adding servers—think of it as more of a 1+1+1, etc. model.

Another key component of the cloud-native architecture is the existence of microservices: service components that can be easily mixed and matched to create new applications or containerized network functions (CNFs). Microservices not only speed up the service creation and deployment process, but they also allow CSPs to update or change applications and CNFs quickly and consistently by modifying the underlying microservice. Finally, cloud-native architectures provide CSPs with a much greater level of “observability” into their network. The traditional network model involved a series of different network monitoring tools that each had to be correlated to get an accurate, broader view of things such as service assurance. In a cloud-native architecture, a common infrastructure means that logs and KPIs all feed into the same system and therefore can be observed much more quickly and easily.

Cloud-Native Benefits

- **Orchestration is simplified** using a single tool such as Kubernetes to manage containerized network functions
- **Reduce time and complexity** in capacity and high availability network planning as this is dynamically managed
- **Simplified feature delivery** and software/patch upgrade process using microservices

Yes, Microservices are a Big Deal

Microservices represent a reduction of services to basic elements that can be re-composed to create new services and applications. A microservice can consist of one or several service modules; an example of a microservice might be TLS encryption or deep packet inspection. A microservices-based architecture has a myriad of benefits:

- It allows CSPs to easily invoke and re-use service components in nearly endless combinations to create new network functions (e.g., to support network slicing)
- It simplifies upgrades and fixes for service components, allowing these tasks to be performed quickly without impacting other service components
- It provides a highly extensible architecture that uses lightweight messaging instead of complex signaling protocols to communicate between services
- It can easily expose services to third-party applications for enhanced functionality, again without the need for complex protocol conversion.

Microservices have a number of advantages over traditional network services. It's important to note that while CSPs can create VNFs using open-source tools, these may not meet Telco-grade standards for performance, latency and security. For this reason, Affirmed recommends creating the VNFs directly from microservices that already meet these Telco-grade standards.

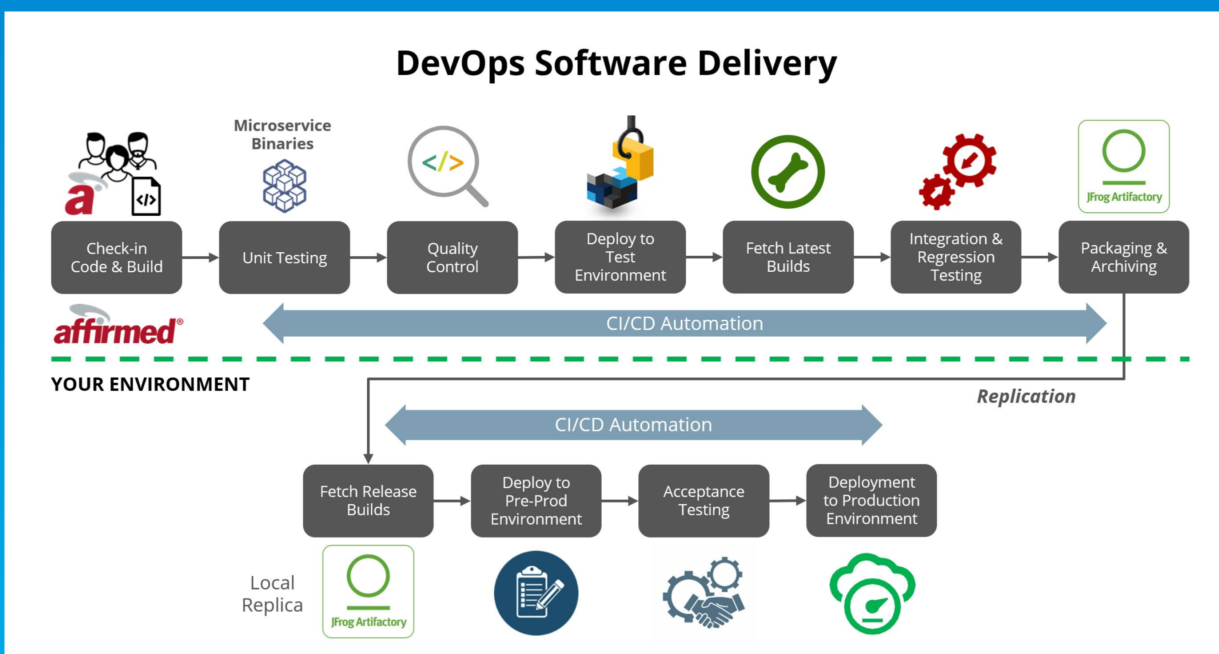

Figure 5. Microservices-based architecture results in faster service creation & deployment

Yes, Microservices are a Big Deal—continued

Once microservices-based network functions are in place, CSPs need to create an environment that supports the deployment, orchestration, networking and monitoring of these new services. This can be achieved by adding and enabling the following capabilities in the network:

- **Containers—**Container/orchestration platforms such as Docker and Kubernetes bring clear advantages to a cloud-native architecture by making applications more lightweight, open and portable. Containerization also requires a runtime engine to manage and run the containers.
- **Service Mesh Architecture—**Because a cloud architecture is distributed, it presents unique challenges around latency, resiliency, topology and other issues as it scales. A service mesh architecture solves this problem by allowing services to communicate through a "mesh" of proxies that provides better control over troubleshooting, performance, security and reliability.
- **Orchestration—**Microservices naturally benefit from an orchestration tool to seamlessly tie them together into richer services and VNFs.
- **Continuous Integration and Delivery—**By automating the steps between development and deployment, CSPs can have their microservices in a continuous state of production readiness which leads to faster service delivery.
- **Distributed Database Management System—**Here again, the distributed nature of cloud architectures lends itself to a distributed database architecture for optimal scale and performance of microservice.
- **Monitoring and Analysis—**CSPs need tools that can monitor and analyze VNFs to accurately report on service states and troubleshoot issues.
- **Container-Based Routing—**IP routing works for VM-based applications but not for container-based applications. Instead, a container-based network routing model is required.
- **Software Authentication—**In a cloud-based architecture, external software needs to be authenticated for security, requiring an open-source software authentication tool such as Notary.
- **Robust Messaging—**Microservices for Telco applications have different requirements than web applications and benefit from a more robust messaging system than Representational State Transfer (REST), such as Remote Procedure Call (RPC) messaging.

Open-Source Technologies: An Open Approach to Cloud-Native Architectures

The advantages a cloud-native architecture are compelling on their own with exponential acceleration of service creation and deployment, higher levels of business agility and resiliency, seamless hyper scalability and simplified network management. And when cloud-native architectures are coupled with open-source technology, the benefits are even more dramatic.

The first wave of digital transformation introduced some of the core concepts of cloud computing, primarily at the hardware level: virtual machines (VMs) based on COTS servers and managed by a shared, OpenStack-compatible hypervisor.

In the second wave of digital transformation, the concepts of a common orchestration platform (e.g., Kubernetes), service mesh (e.g., Istio), database (e.g., MongoDB), logging (e.g., Jaeger) and monitoring (e.g., Prometheus) all gained traction. Each of these "common" elements are being delivered through the open-source community providing a global base of software developers vs. a much smaller group of companies only focused on Telco features and capabilities.

Creating a cloud-native architecture using open-source systems is important because it allows Telco operators to move forward using standardized methods. In the absence of an approved set of 5G standards, network function vendors are apt to create their own solutions for managing their virtualized/containerized network functions (VNFs/CNFs). This presents a significant stumbling block for the automation and orchestration that are critical in a cloud-native architecture. Specifically, the use of non-standardized VNF/CNF managers leads to incompatibility with other critical elements in the network (e.g., hypervisors, management/orchestration tools, networking tools) and inconsistencies in the onboarding processes for new VNFs/CNFs.

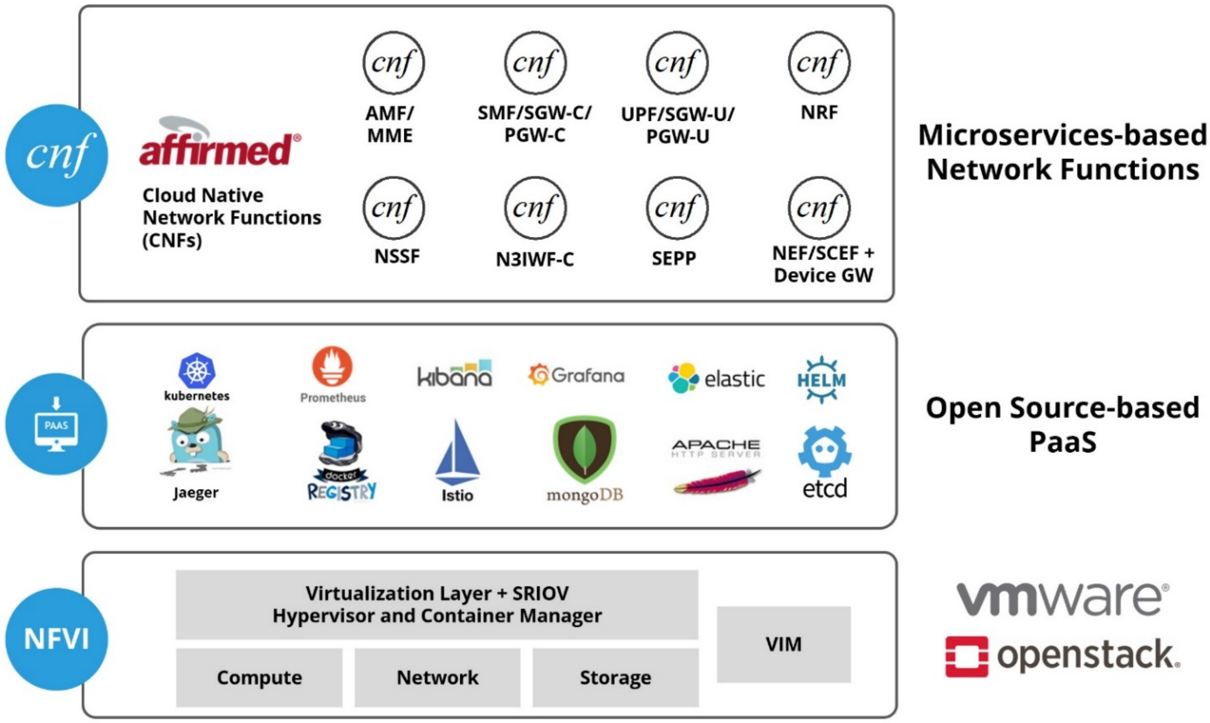

Figure 6. Recommended 5G Architecture

We call this ecosystem of common applications that provide supporting functions, a Platform as a Service (PaaS). In the enterprise world, the PaaS model drives DevOps costs down and productivity up in dramatic fashion:

- 40% lower overall development costs
- 140% increase in the number of programs under development
- 78% reduction in development costs per program
- 5X more resources driving innovation

Heavy Reading Survey

In the Telco world, Affirmed sees CSPs reducing their operational expenses by as much as 90% in the following areas:

- Simplified capacity planning activities
- Simplified planning and execution of new service introduction testing and upgrading the service infrastructure
- Service assurance by using common infrastructure capabilities

According to a Heavy Reading survey, 75 percent of CSPs saw open-source technologies as the key to reducing Capex (by leveraging high-volume servers) and Opex (through automation).

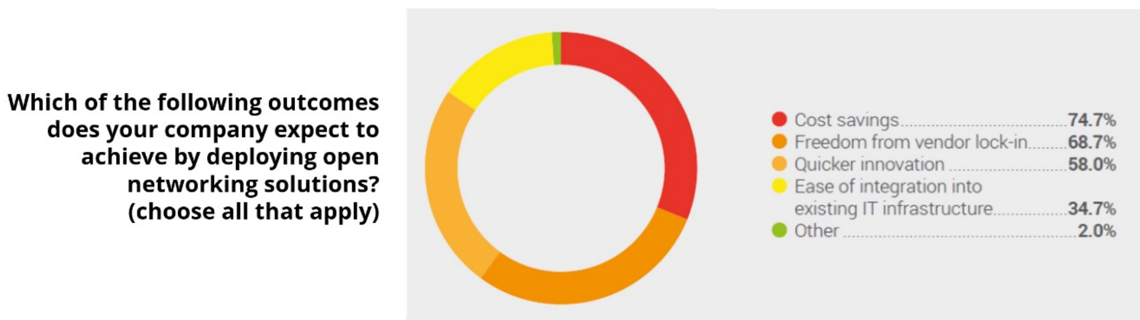

Figure 7. Results of Heavy Reading survey on open networking solutions

More than half (58 percent) also believe open-source systems will accelerate innovation by liberating them from a single vendor's roadmap for the future, and more than two-thirds (69 percent) cite freedom from vendor lock-in as a primary benefit of open-source technology.

The Missing Link? Telco-Grade Features

While all this “commonality” is beneficial, it ignores the fact that telecommunications networks face some very uncommon challenges around interoperability, latency, service delivery and policy management. What needs to be added to the cloud-native and open-source equation are Telco-grade features that customize the cloud model for CSPs.

Creating a cloud-native, Telco-grade architecture leveraging open-source technology is the task that Affirmed set for itself and is delivering today. The Affirmed 5G mobile core provides the missing link between cloud-native architectures and Telco-grade requirements:

Multi-network interfaces—Contrary to IT applications, Telco workloads may require sophisticated network models to support multi-homing with various QoS. Indeed a VNF Component (VNFC) can be connected to different networks. The latter can belong to different planes: control, management and data. Also, they may be associated with different QoS requirements and different network isolation domains. Affirmed’s solutions support multi-network interfaces with Multus (another open-source phenomenon), that supports container networking interfaces like Calico and high performance DPDK-based technologies like SR-IOV.

Data plane acceleration—5G networks are expected to handle 1,000X more data than they do today. To help CSPs handle higher throughput rates, Affirmed and Intel worked together to push the limits of server performance for our vEPC application, setting a new performance benchmark by boosting single-server speeds of 150 Gbps and targeting 400 Gbps in the near future.

Integrated network probing—Affirmed developed the industry’s first virtualized, integrated network probe solution, vProbe, to provide better analytics for 5G networks. vProbe requires no hardware—it’s built into the VNF as a service—and allows CSPs to collect and analyze data in near real-time without impacting network performance or draining network bandwidth.

Integrated workflows—The ability to create new communications services is critical for CSPs to compete in the 5G arena. Affirmed’s GiLAN services chaining allows CSPs to quickly and easily create new services by simply dragging and dropping microservices into the workflow.

Topology and environmental awareness—Telecommunications networks have unique topologies (e.g., a network edge and core) that enterprise cloud workloads don’t take into consideration when building their applications. To address this, Affirmed has built topology and environmental awareness into its platform.

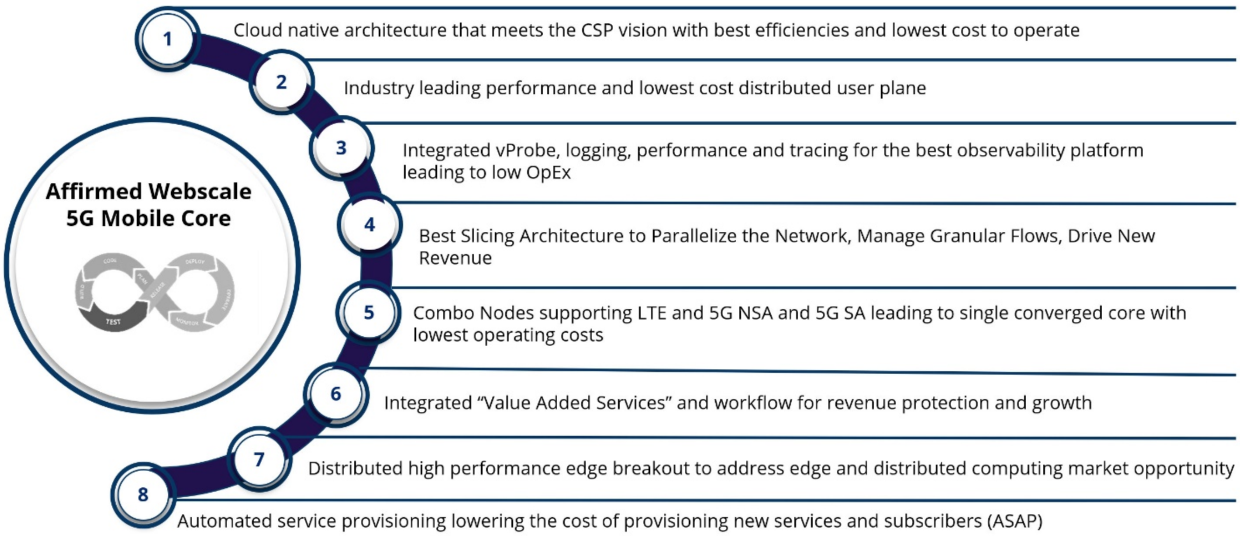

Figure 8. Affirmed Networks' Industry-Leading, 5G Webscale Mobile Packet Core

Pick the Right Partner for Transformation

A high-performance, cloud-native architecture leveraging open-source technology opens your 5G future to more agility, flexibility and opportunity. It should not, however, be an open invitation to bring more vendors into the management mix. Rather, CSPs should select a partner they can trust to manage the 5G transformation process, enforce standards and ensure that open-source technologies are embraced. Very few network equipment vendors can provide this service today, as most come from a proprietary, legacy-based past that favors ownership over openness.

Affirmed Networks is different. Virtualization and the cloud is our legacy. We have the people, the technology, the experience and the vision to guide CSPs through the network and business transformation that 5G requires. The Affirmed architecture provides CSPs with a cloud-native platform that leverages open-source technology delivering web-scale performance, speed and simplicity through automation, orchestration, analytics and a full library of microservices. When you choose Affirmed to lead your 5G transformation, the future is wide open.

To learn more about Affirmed 5G solutions, visit us at affirmednetworks.com.