

# 5G Cloud-Native Network Function Resiliency Validation

# 5G Cloud-Native Network Functions Overview

Unlike previous generations of network functions that were built as monolithic applications, 5G Core cloud-native network functions are built and operated using container-based technologies and principles (see Figure 1).

5G cloud-native network functions (CNF) share the following characteristics:

- **Containerization:** Network functions are built using lightweight, portable containers that can be easily deployed and scaled up or down, based on demand.
- **Orchestration:** They are orchestrated using cloud management platforms, such as Kubernetes, which automate deployment, scaling, and monitoring.
- **Microservices:** They are designed as small, independent services that can be developed and deployed separately, for greater flexibility and agility.
- **API-driven:** They expose application programming interfaces (APIs) that enable other network functions and services to interact with them, for easy integration and interoperability.
- **Self-healing:** They are designed with the ability to self-heal, to ensure high availability and reliability for the network services provided by these applications.

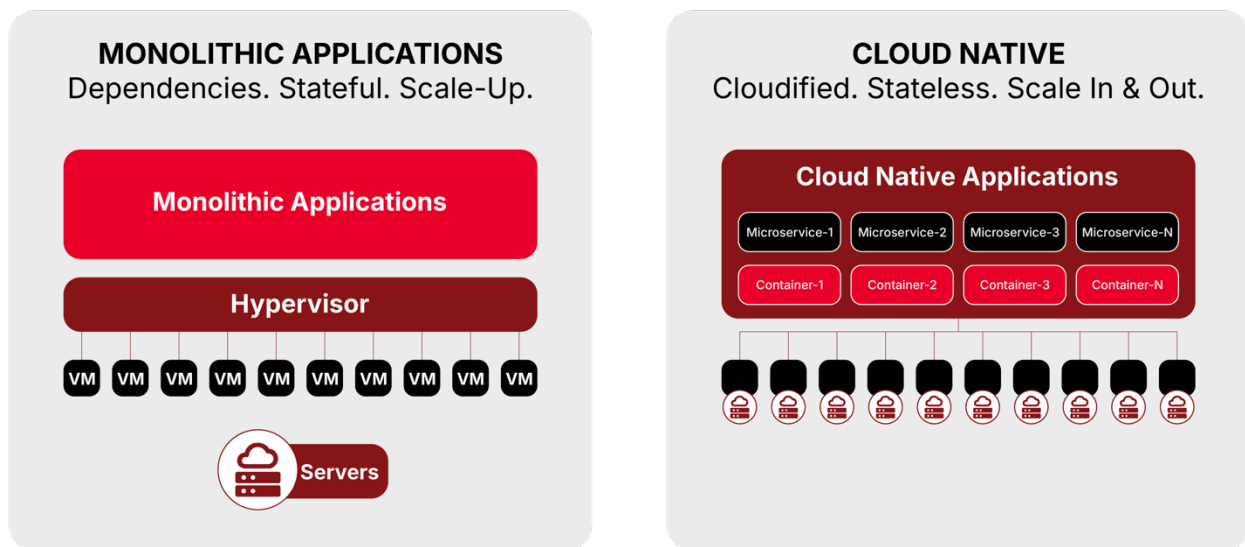


Figure 1. Monolithic vs. cloud-native applications

# The Case for Cloud-Native Network Function Validation

CNF validation offers tremendous value for 5G operators:

- **Ensure long-term revenue:** By optimizing deployments and delivering high-quality 5G services, operators can drive increased customer satisfaction resulting in lower churn rates, higher new account sign-up rates, and higher revenue per account.
- **Reduce operational costs:** Avoiding outages will save multi-million dollar costs of service-impacting operational issues diagnosing and repairing issues, leading to reduced operating expenses for the provider.
- **Improve reputation:** Ensuring resilient and reliable 5G user experiences will lead to improved customer trust and loyalty, with possible long-term effects on revenue.
- **Avoid Service Level Agreement (SLA) penalties:** Ensuring resilient design, configuration and performance will help avoid outages impacting SLA commitments with customers, and related fines or legal consequences.
- **Avoid regulatory fines:** By proactively testing the resiliency of 5G services and the infrastructure they run on, operators ensure there is no breach of regulatory requirements and avoid related fines.

The true impact to a 5G operator may vary depending on the severity and duration of the outage, the number of customers affected, among other factors. With potential losses in the millions of dollars, operators need to prioritize network reliability and resilience to the highest degree.

## Why Testing Resiliency Matters

In a complex and dynamic cloud world, more things can go wrong, making lab and pre-production testing even more important.

It's not just that CNFs are new, but the way they interact with each other and the cloud they're deployed on is so different that communication service providers (CSP) and vendors are still figuring out what to test. CSP organizations aiming to deliver high-quality service experiences — especially under service-level agreements (SLAs) — need to answer the following questions:

- How can you make sure 5G CNFs will work as expected when pushed into production in a cloud environment you don't own, that behaves in ways you can't predict?
- How can you ensure that cloud will provide the right performance characteristics (networking, storage, memory, latency) to meet your SLAs?
- How can you predict what will happen if the cloud doesn't provide the required performance and how can you address it?

The answer is thorough resiliency testing of every CNF. You may not know exactly how the cloud you're deploying on will perform on a given day. However, by gaining visibility into what each CNF needs from the cloud and how each CNF is vulnerable, will help avoid issues before they arise.

Resiliency testing is more complicated in cloud-native environments, but it also offers higher rewards. Get it right, and you can push new CNFs into production without worrying about the unexpected. It will ensure fewer issues in the live network and allow you to respond quicker if they do arise.

Resiliency testing will enable a more agile and effective business through:

- Harnessing cloud-native efficiencies to reduce power consumption and operating costs
- Dynamically scaling of network resources instead of overprovisioning to unlock huge capital savings
- Offering more stringent and lucrative SLAs, knowing what you can deliver in a dynamic, unpredictable world

Proactively characterizing the performance that each CNF needs from the cloud is critical. That way, as CNFs are pushed into production, you are prepared if something does go wrong, and able to respond quickly to avoid the potentially multimillion-dollar costs of unplanned downtime.

## Balancing Complexity and Reliability

Kubernetes, as the primary orchestration system for automating deployment, scaling, and management of 5G CNFs, provides a powerful yet complex system for container orchestration. As with any complex system, there are potential failure modes that can impact its availability and reliability.

The most common types of Kubernetes failures include:

- **Node/pod failure:** Nodes are the worker machines that run containerized applications in Kubernetes. Node failures can occur due to software or resource availability issues, resulting in the loss of running containers and applications.
- **Network degradation:** Kubernetes relies heavily on networking, and network degradation and outright failures can impact the ability of nodes and containers to communicate with each other and with external systems and services.
- **Storage failure:** Kubernetes relies on various forms of storage, such as local storage, network-attached storage (NAS), and storage area networks (SANs). Storage failures can result in persistent data loss, such as configuration data or application state.
- **Configuration errors:** Kubernetes is highly configurable, but incorrect or misconfigured settings can result in a range of issues, from performance issues to outages.
- **API server failure:** Kubernetes API server is the primary control plane component of the system, if it fails, it can result in cluster-wide outages.

To mitigate these failures, it is essential to follow Kubernetes cluster management best practices, such as implementing high availability (HA) configurations, monitoring and logging, regular backups, and security measures. However, additional measures need to be taken to effectively validate 5G CNF's optimal response to these common failure and degradation scenarios.

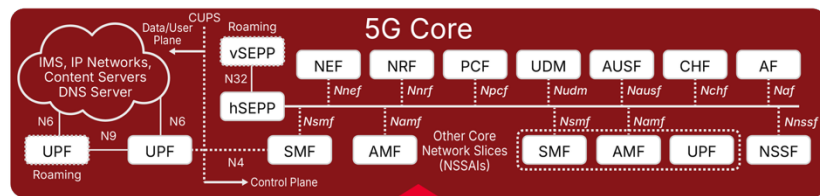
The cost of not knowing the impact of failures before a 5G CNF is deployed into production can be extremely high both financially and reputationally, especially when it leads to unplanned operational issues or service outages.

# Proactive, Continuous Resiliency Validation

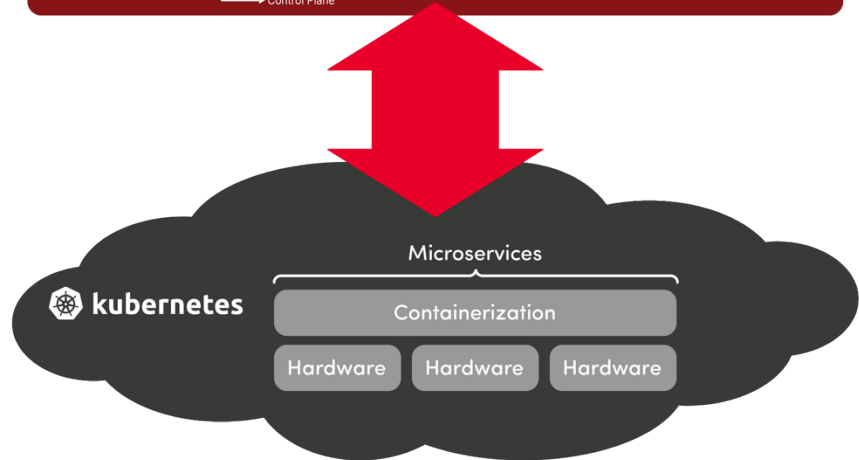
Testing the resiliency of 5G application workloads and the infrastructure they run on with real-world traffic and impairments is essential for avoiding degraded performance and costly service outages impacting 5G user experiences.

Keysight provides the essential tools and processes for automated resiliency testing, to proactively and continuously validate the effective resiliency of 5G CNFs. Our solution helps baseline their resiliency to determine key failure indicators, and ensure resilient design, configuration, and performance in a highly dynamic, disaggregated environment with constant release cycles (see Figure 2).

## Cloud-native Network Functions (CNF)



## Cloud-native Infrastructure (CI)



**Figure 2.** Ensuring successful cloud-native deployments through proactive and continuous validation

The solution combines extensive 5G functional and performance testing capabilities with the ability to inject real-world impairments into a cloud-native infrastructure and monitor their impact.

Measuring the effects of common cloud-native failures on 5G key performance indicators (KPI) offers communication service providers numerous benefits:

- **Reliable service delivery:** Ensuring 5G cloud-native network functions remain reliable under the most challenging network conditions will enable uninterrupted service delivery and long-term revenue growth.
- **Reduced operational costs:** Optimizing resource utilization and automating fault recovery mechanisms will help avoid costly outages and service interruption and reduce operating expenses.
- **Enhanced customer experiences:** Ensuring resilient 5G service design, configuration and performance will lead to delivering high-quality user experiences for improved customer satisfaction and retention.
- **Competitive advantage:** Offering reliable, high-performing 5G services that meet customer expectations consistently will provide a competitive edge in the 5G space and help attract new customers.

To learn more about proactive and automated cloud-native network function validation, visit:

<https://www.spirent.com/products/cloud-native-testing>.



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