



Simplify 5G

Fulfilling the Promise of Quickly, Safely, and Cost-Efficiently Delivering 5G Innovation

Finding Solid Ground in a Shifting Landscape

Testing and assurance is a bedrock for telecom services, but never more so than in the 5G era. Ushering in blazingly fast speeds, vast coverage density and traffic capacity, ultra-reliability and super low latency, 5G is more than a step up from 4G. It's a radical leap that will bestow significant new capabilities, dramatically improve mobile broadband services, and empower the Internet of Things (IoT) by enabling connectivity to billions of global devices. 5G will enable use cases we can't even imagine today and herald a move from personal communication to general purpose technology.

Network operators are feeling the urgency to be first to market with 5G, especially since the 5G timeline has accelerated. Trials of 5G technology are already progressing and innovation is moving forward rapidly. We'll see the first commercial launches rolling out in 2018. Service providers can't afford to allow the multi-layered, hybrid complexity brought by 5G delay progress and slow time-to-market.

Testing, assurance, measurement, and security become exponentially more critical if we are to assure that the communications industry fulfills its promise of 5G innovation.

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A New Network, Still Evolving

With 5G, prepare for major paradigm shifts, beginning with completely new architectures from a new Core, new radio (NR), and new spectrum to new devices and chipsets. The first non-standalone standards for 5G (3GPP R15 New Radio Non Stand Alone, or NSA) were released at the end of 2017. NSA utilizes the existing LTE radio and core network as an anchor for mobility management and coverage, while adding a new 5G radio carrier. In June 2018, the 3GPP TSG #80 Plenary Meeting approved the standalone (SA) Release 15, 5G specifications. The completion of SA specifications not only gives 5G NR the ability to be independently deployed, it also creates a brand new end-to-end network architecture as the entire industry takes the final sprint towards 5G commercialization.

But so much else is still in flux. NEMs equipment is still in the pre-standards (proprietary) or early beta stage. 5G Phase 2, or 3GPP R16, will focus on key technology innovations such as ultra-reliable low latency communication and industry use cases such as 5G New Radio based Cellular Vehicle-to-X (C-V2X). That won't be available until end of 2019. And mmWave and beamforming is also still not fully characterized or proven.

It's apparent that we will have to conduct more prototyping and develop new risk mitigation techniques in a complex multi-layer and multi-vendor environment. To assure safe and successful early 5G launches, Test and Assurance will take a lead role.

High Expectations for the New Cloud

Network function virtualization (NFV) promises an array of benefits, from increasing speed to deployment and reducing operating costs to enabling a wide variety of ecosystems and even potentially reducing energy consumption. Telco Cloud, moreover, has stringent requirements compared to Public Cloud, so current cloud designs are becoming inapplicable. While the industry has been working towards virtualization, for a number of reasons we only have limited deployments today.

Yet, 5G is contingent on the success of RAN and CORE network virtualization, particularly if we are to enable Network Slicing, a cornerstone of 5G. To generate new revenue, operators must be able to simultaneously service different industry verticals. To differentiate themselves, operators must be agile, act quickly, and be flexible—characteristics best enabled by virtualization. Operators are expecting virtualization to help them achieve 5G's promised savings by reducing costs and realizing network efficiencies.

Virtualization is a critical factor for 5G Cloud-RAN, where the Radio processing (Baseband) can be distributed from the lower levels hosted on the physical Radio tower heads and pooled in edge cloud data centers. Cloud-hosted Radio (baseband) processing needs unique capabilities around time-sensitive networking, acceleration, and availability, which current cloud architectures cannot deliver. The business case for 5G depends on cost-efficiently utilizing large numbers of urban small cell sites while moving the costly and complex processing to a shared, centralized, and cloud-hosted environment.

New Radio Signals a New Era

New frequencies such as sub 6Ghz and mmWave, and new technology such as Massive MIMO and beamforming mean the complexity and cost of traditional testing are no longer practical or sustainable for operators. Traditional testing of MIMO Radio antenna arrays was based on a conducted (cable) connection to the array elements. This was reasonably practical so long as the array only consisted of a limited number of elements. Massive MIMO in 5G can have as many as 256 array elements or more, requiring a large number of radio channels. Beamforming, for its part, means that the array elements serving the device can dynamically change. As a result, traditional conducted testing is not always viable or cost-effective.

To solve these complex challenges, a new testing and assurance strategy is needed for 5G New Radio in a lab environment, one that minimizes hardware resources and combines conducted testing and Over the Air (OTA) testing.

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The Three Pillars of a 5G Testing Strategy

The promise of speedily, safely and cost-effectively delivering 5G can be fulfilled by leveraging three innovations in testing and assurance: intelligent automation, network and traffic emulation, and new test methodologies. Let's look at each of these and the opportunities they offer.

Automation: Applying Machine Intelligence to Meet 5G Demands

In a 5G world of increasing complex and dynamic networks—where capabilities such as Network Slicing require unprecedented operational agility and a

DevOps culture is imperative—changes will happen faster than humans can process. Automation will be critical.

This automation must be intelligent, actionable, real-time, and driven by analytics and machine learning. Intelligent automation (IA) will be at the heart of our ability to harmonize continuous processes such as testing and validation, lab management, and launching and assuring networks and services across development and operational domains. Full Network Automation will be dependent on Test and Service Assurance Automation to reduce the complexity and economics of testing, verifying, and delivering 5G. Some of the opportunities we see are:

Type of Automation	Opportunities
Lab Automation	Coordinate, orchestrate, and manage labs and test resources to accelerate test cycles, optimize utilization, reduce costs, and increase Rols.
Test Automation	Automated test orchestration and authoring, with restful APIs, allows the entire testing lifecycle to be automated.
Service Turn-up Automation	Rapidly turn-up new services using automated workflows that seamlessly integrate back office systems and test functions and network elements.
Service Assurance Automation	Proactively monitor the health and performance of the network, functions, and services and verify SLA compliance with automated and orchestrated active testing using test agents and synthetic traffic.
Automated Troubleshooting	Enable zero touch problem resolution, rapid fault isolation, and reduced mean time to repair (MTTR) with automated troubleshooting workflows.
Automated Analytics	Transform network and test data into proactive, predictive, and prescriptive insights. Gain end-to-end quality and performance visibility for closed-loop actions.

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Emulation—Real-World Network Conditions in a Lab Environment

As 5G standards become ratified and early deployments draw closer, network and traffic emulation can play a pivotal role in simplifying the complex testing of our networks and services to help validate their readiness.

Why emulation rather than simulation?

Test Emulation and Test Simulation are often used interchangeably. However, they are not the same. Test Emulation is to imitate, replicate, or reproduce an exact scenario and context, whereas Test Simulation is a fabrication of a network scenario with the goal to resemble such a scenario that it could be passable or plausible if not evaluated closely. While seemingly subtle, these differences are crucial when it comes to ensuring realistic testing.

A network emulator can be used to test the performance of a real network and/or to test networks functions and services that are physically unavailable or are complex and costly to configure and access. For instance, you might test a 5G New Radio by emulating 5G RF Channel models or by emulating a Next Generation 5G Core network.

By allowing for simple, cost-effective, repeatable, and predictable testing of real-world conditions in a lab environment, emulation reduces the complexity and economics of testing, verification, and delivering 5G. The primary opportunities for emulation are:

Type of Emulation	Opportunities
Radio Channel Emulation	Emulate the new 5G RF channel frequencies (sub 6GHz and mmWave) and densities, and the new RAN technologies (i.e. Massive MIMO, Beamforming) to simplify the prototyping and testing of 5G Radio equipment and devices.
Network Emulation	Emulate the evolving 5G Core network and features to efficiently test the 5G New Radio, validate key Radio to Core connectivity capabilities, and simplify the prototyping and design of industry-specific Network Slices for Automotive, Industry 4.0, and others.
RAN and Device Emulation	Emulate 5G Base Stations and millions of devices with complex traffic mixes to efficiently test that the evolving Core network is capable of supporting 5G and delivering new capabilities such as Control and User Plane Separation (CUPS).
Traffic Emulation	Emulate various types of communication traffic to validate the performance of the 5G network, interfaces, and infrastructure.
Real World Emulation	Record and playback real-world captured signals and traffic and replicate them in the test-bed through emulators. This provides increased realism, repeatability, and predictability.
Impairment Emulation	Emulate network impairments to validate how the network behaves and performs and thereby gain insight into how best to configure and architect the network.
Security Threat Emulation	Emulate complex multi-vector attacks to test and audit the 5G environment to preemptively identify vulnerabilities and prioritize risk mitigation.

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New Test Methodologies

The dynamic 5G network will involve new antennas and chipsets, new architectures, new KPIs, new vendors, cloud distributions, and new frequencies—and, as we've pointed out, unprecedented complexity. It will also entail adopting a DevOps culture with continuous testing across the lifecycle. Current test methodologies and strategies are simply not optimal or cost effective for 5G. To realize the promise of 5G, we need a new approach to testing and assurance.

This new approach will include new testing methodologies and strategies that simplify the validation process to ensure that the 5G system under

test meets and continues to meet expectations. It will also provide development and operations teams with a unified set of metrics, methodologies, and systems that supports DevOps. And it will be driven by analytics and machine learning to help optimize testing.

As standards become ratified, we need to move beyond experimental 5G setups to affordable and repeatable test methodologies that can deliver services faster, simpler, and more cost effectively. We will apply new methodologies for:

Type of Test	Opportunities
5G Radio	Testing 5G Massive MIMO by combining a phase matrix with channel emulation. This would reduce the required number of fading channels and form a cost-effective, yet realistic, test system.
5G Devices	Testing key tenets of device performance such as link utilization, audio and video quality, and location accuracy.
5G Core	Testing 5G Core network evolution, 5G Core performance, and interoperability with the New Radio, as well as automated turn-up of new Core nodes and services.
5G Virtual Infrastructure	Validating and benchmarking the common NFV infrastructure, service chains, and lifecycle management for the critical multi-vendor and multi-distribution virtual infrastructure used for hosting the Cloud-RAN and the virtual Core and the enablement of Distributed Data Centers.
5G Fronthaul & Backhaul	Validating the new multi-speed Fronthaul Ethernet connectivity and evolving High Speed Ethernet Backhaul performance.
5G User Perceived Experience	Measuring and evaluating the perceived user experience for the new 5G Mobile Broadband services.

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About Spirent Communications

Spirent Communications (LSE: SPT) is a global leader with deep expertise and decades of experience in testing, assurance, analytics and security, serving developers, service providers, and enterprise networks.

We help bring clarity to increasingly complex technological and business challenges.

Spirent's customers have made a promise to their customers to deliver superior performance. Spirent assures that those promises are fulfilled.

For more information visit:
www.spirent.com

Spirent Helps You Simplify 5G

According to an economic impact study conducted by IHS Markit, the 5G value chain is estimated to be worth \$3.5 trillion by 2035 (IHS& Qualcomm)¹. In heralding a move from personal communication to general-purpose technology servicing the digital landscape, 5G embodies tremendous potential—some say it might be the biggest opportunity since the Industrial Revolution.

Spirent has assembled a suite of solutions that integrate Automation, Emulation and new Test Methodologies to reduce the complexity and economics of testing, verifying, and delivering 5G.

We'll work with you to formulate your 5G test and assurance strategy for the New Network, New Radio, and New Cloud to achieve your intended business outcomes, reduce overall development costs, and shorten time to market.

As you move forward, you make a promise to your customers of quickly, safely, and cost-efficiently delivering 5G. We're here to help simplify the path to 5G and assure that you fulfill your promise of 5G innovation.

Spirent.

Promise. Assured.

Savings enabled by Spirent Automation, Emulation, and Test Methodologies

- >50% reduction in the length of test cycles
- >40% lab CapEx savings through better resource utilization
- 300% increase in testing capacity improving Time-to-Market for New Services

¹IHS ECONOMICS & IHS TECHNOLOGY | The 5G economy: How 5G technology will contribute to the global economy, 2017



Contact Us

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