Assuring the Promise of 5G

A New Approach to Assurance and Testing to Accelerate 5G Innovation

Few technologies have arrived with more fanfare and greater promise than the mobile standard known as 5G. Expect blazingly fast speeds—peak data rates 100 times that of 4G. Vast coverage density—1 million devices for every square kilometer. Large area traffic capacity—10Mbps per square mile. And super low latency—1-5 milliseconds.

5G is more than a step up from 4G; it's a radical leap that will bestow significant new capabilities, dramatically improving mobile broadband services and empowering the Internet of Things (IoT) by enabling connectivity to billions of global devices. It will make possible use cases we can't even imagine today and herald in a move from personal communication to general purpose technology.

To make 5G possible, everything will change, literally as well as figuratively. The 5G network will involve new antennas and chipsets, new architectures, new KPIs, new vendors, cloud distributions and new frequencies—and unprecedented complexity.

There's urgency to be first to market with 5G, especially since the 5G timeline has accelerated. The first standards were released at the end of 2017 (3GPP R15 New Radio Non Stand Alone) and the first commercial launches are rolling out in 2018. Trials of 5G technology are already progressing and innovation is moving forward rapidly. Operators can't afford to allow the multi-layered, hybrid complexity brought by 5G to delay progress and slow time to market.

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When such complexity meets such urgency, we can no longer approach testing, assurance, measurement, and security as an afterthought. As essential as testing and assurance has always been in bringing any new technologies to market, it will become exponentially more critical in order to assure that the communications industry fulfills its promise to its customers of flawless 5G performance.

Spirent has been early out of the gate with test and assurance solutions for 5G technologies. Drawing on our work, this paper identifies six core industry challenges in 5G and outlines solutions that service providers and enterprises can access right now to reduce the complexity and costs of 5G testing and accelerate 5G innovation and time to revenue for new services.

The Six Challenges of 5G

1. New architecture, new complexity
From several perspectives, 5G will introduce major paradigm shifts. Let's start with the fact that it will entail a completely new architecture including a new core, new radio, new spectrum, and new devices and chipsets.

5G will take antenna technologies to a new level. It will advance the industry's MIMO and multi-user MIMO antenna techniques with a new massive MIMO approach that will yield substantial improvements in spectral efficiency and ensure users have very high throughput to download files, even at the edge of the cell. The antennas will be used with Beamforming to carefully shape the signals arriving at any end point. With Massive MIMO, the number of antennas will be multiples of what's used for LTE, and so will the number of potential signal paths.

2. Being all things to all users
A significant challenge with 5G is the need to simultaneously support multiple industry verticals and use cases, from enhanced mobile broadband services to immersive video, gaming, and virtual reality; billions of IoT devices that could include swarms of connected sensors; and self-driving cars requiring a mission-critical level of service ensuring ultra-reliable and low-latency connections. 5G will also enable operators to offer fixed-wireless services with fiber-like performance for homes and businesses. The range of options puts pressure on base stations and small cell vendors and operators to be all things to all users.

3. Lofty goals and huge expectations
The ambition of 5G cannot be understated. As we stated above, we're looking at massive improvements in data rates, device density, traffic capacity, throughput, latency, and spectrum efficiency. 5G will be as transformational as the switch from black-and-white TV to color.

4. Millimeter wave frequencies
The cellular industry has looked upon millimeter wave frequencies with trepidation because of these frequencies' challenging propagation and penetration characteristics. Applications are limited to short-range scenarios since signals are compromised by rain or trees and can't travel well through barriers like walls or even the hand of the person holding a device.

But the industry better get used to them. With 5G, millimeter wave frequencies, from 28 GHz to 60 GHz and higher, will become the norm.

5. Network virtualization
Virtualization will put all network resources in the cloud, providing competitive advantages but also requiring new tools and methodologies for analyzing and managing quality of service (QoS). Applying forms of virtualization such as NFV and SDN, mobile operators will be able to provision and support services much more quickly and cost-effectively, and with greater scalability and flexibility, compared to traditional architecture. But virtualization also comes with a steep learning curve and greater complexity.

The ability to mix vendors is one of virtualizations benefits and also its greatest hurdle since there is no unified, rigorously defined standard to guarantee interoperability nor a methodology to assure continuous and consistent performance.

6. Security

5G introduces wide-ranging new security challenges, while making security more important than ever given the volume of devices coming onto the network and the ongoing risk of cyber threats. Vendors will need to employ a multi-dimensional strategy employing encryption, privacy management, and other techniques to protect their devices and the networks used. Both vendors and operators will have to ensure that third-party components used in their products adhere to their security requirements. And all stakeholders will have to test against risks consistently and regularly, not only for specific threats for the possibility of multiple simultaneous attacks.

Implications for Assurance

It's not hard to see that the challenges of 5G have significant implications for the assurance of reliability and quality of service for networks and devices. Channel emulators could become prohibitively expensive for typical vendor budgets because the equipment might need to accommodate hundreds of RF ports. Each port will need to integrate new electronics for simulating millimeter wave frequencies. Test calculations will require faster signal processing capabilities.

5G will also require more over-the-air (OTA) testing than companies are accustomed to. Beamforming and multi-user MIMO, for example, will introduce testing complexities that will be more accurately represented, controlled, and measured by OTA than conducted approaches. OTA will also confer better ability to evaluate how end-user devices and user behaviors might impact millimeter wave signals. Considering that the antennas used for millimeter waves could be as small as ¼ inch in some form factors—precluding testing via cable—OTA testing will be an order of magnitude more necessary with 5G than it was with LTE.

Designs will need to be tested for all potential conditions. And testing against risk will require constant vigilance across multiple fronts in an increasingly complex environment.

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Meeting the Challenges of 5G

As we can see, 5G is more than just a technology transformation—it's a business transformation and a paradigm shift that calls for a new approach to assurance. Spirent believes that just as the 5G transformation ties together previously distinct technologies and businesses, so must the response to 5G's challenges be a unified, synergistic suite of solutions. Our solutions work together to address all six challenges outlined for 5G and help our customers safely accelerate into 5G. We provide the industry's broadest set of 5G test and assurance solutions to:

- Simplify 5G by reducing the complexity and economics of testing, verifying, and delivering 5G.

- Accelerate 5G by accelerating 5G innovation (R&D) and time-to-market of new services.

- Assure 5G by operationally assuring 5G delivers the new revenues, savings, and experiences:

Spirent **Velocity and iTest** work seamlessly together to create an autonomous lab and test management platform that provides a complete, differentiated Lab-as-a-Service solution. With Velocity and iTest, we can automate, simplify, and accelerate the testing of complex 5G multi-vendor elements and E2E services.	The versatile Spirent **Vertex** Channel Emulator supports applications from SISO to high-density Massive MIMO applications, new RAN technologies such as Beamforming, and new frequencies such as mmWave to enable the streamlined prototyping and testing of 5G new radio.
Spirent **Landslide** emulates 5G devices, user traffic, and network functions to test the Core Network's evolution to support 5G and deliver new capabilities such as New Radio interoperability and Network Slicing.	Spirent's **8100 5G** system provides performance and carrier acceptance testing of the new 5G mobile devices and chipsets going beyond simple conformance tests to address stringent operator and industry vertical specific performance test areas.
Spirent Test Center (STC) provides an end-to-end test solution for Cloud and Virtual Network environments validating the critical multi-vendor and multi-distribution virtual infrastructure and interconnects for 5G Cloud RAN and web-scale distributed Data Centers. It's a key component to developing test solutions that bridge the gap between public and telco clouds with 5G.	Spirent **VisionWorks** completely automates testing processes such as verification of end-user service quality and isolation of problems to a specific network segment. VisionWorks provides intelligent and automated active test and assurance across the lifecycle of the evolving 4G/5G hybrid network to enable service agility, cost reductions, network efficiencies, and increased revenues.
Umetrix automates the entire user experience evaluation process, accelerating user experience evaluation for new devices and services and assuring a successful, on-time launch.	**Cyberflood, Avalanche, and Security Labs** continuously test and audit the 5G environment to pre-emptively identify vulnerabilities and prioritize risk mitigation.

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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

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Think customer expectations are high today? With 5G, they will become downright formidable. Getting to 5G will be an intense journey.

Spirent has assembled a suite of integrated solutions designed to help service providers address the many challenges of assurance in the 5G world and tailored to our customers' needs. We're leading the way in virtualized testing and in integrating assurance into our customers' complete lifecycle. As members of the Linux Foundation Networking Fund (LFN), we're working with other leaders in the field to support the new Open Source ecosystem and foster interoperability because they're necessary for the success of our customers and our industry.

As you explore 5G, we'll work with you to formulate your 5G test strategy and determine the minimal set of testing you'll require to achieve your specific business outcomes. We'll help you simplify the testing process, reduce overall development costs, and shorten time-to-market. We're committed to an ongoing engagement with our customers to support your success as the 5G journey unfolds.

Every day, you make a promise to your customers of superior quality of service and experience. We're here to assure that you can navigate the complexities and exploit the advantages of 5G in order to fulfill your promise.

Spirent.
Promise. Assured.