

Spirent Managed Solutions

Competitive Mobile Network Benchmarking for 5G

The Challenge of Validating Mobile Networks

To win in the marketplace, communication service providers (CSPs) need to answer several questions as they bring their 5G offerings into production. Examples include: How is my user's experience vs. competitors? Where must I improve to be competitive? Where can I get unbiased evidence of my differentiators for marketing purposes? Have we been successful in our differentiation strategy? How is my spectrum strategy progressing relative to our competitors?

What's required to adequately answer these questions?





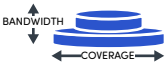









Accept 5G complexity. Building a world-class mobile network was never easy, but 5G takes it to a whole new level. There are more services and more customer types and multiple traffic classes. There is also a higher rate of change, requiring continuous integration and deployment to maintain technology leadership. Further, this integration involves components from many more vendors than were used in the past. How do you know when you have it right?

Focus on end user experience. Ultimately, you have it right when your technology selections and deployments come together to deliver a winning user experience. Mobile operators with the best user experience gain subscribers and command a higher ARPU, producing the top line necessary for business success. Understanding your user's quality of experience (QoE), in the form of statistically valid, quantified scientific measurements, is essential information.

Handle the logistics. Getting this information is far from easy. It involves defining test criteria, selecting testing gear, developing and executing the test plan, gathering the data, and analyzing it to gain the insights needed to prioritize investments and validate marketing claims.

How can this be achieved in a cost-effective way?

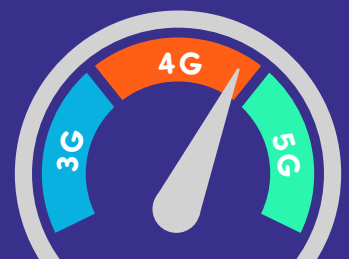
5G Benchmarking goes far beyond 4G

Target Customers	Applications	Traffic Classes	Coverage
4G and below  Consumers & Business Smartphones	 Voice, Video, Data  Limited IoT	Same for all traffic 	<ul style="list-style-type: none"> Low Band Medium Band 
5G  Consumers & Business Smartphones  Fixed Wireless Access  Enterprise	 Voice, Video, Data  Cloud Gaming  Augmented Reality  Massive IoT (10 times devices per square km)	<ul style="list-style-type: none"> Enhanced Mobile Broadband (eMBB) Ultra-Reliable Low-Latency Communications (URLLC) Massive Machine-Type Communications (mMTC) 	<ul style="list-style-type: none"> Low Band Medium Band High Band (mmWave)  <ul style="list-style-type: none"> Dynamic Spectrum Sharing Handoffs

Testing with a traditional 4G approach is inadequate, as 5G encompasses many more technologies.

Highlights

- To win in the complex world of 5G, you must **know yourself** and **know your competition** through objective, scientific measurement of the user experience.
- This is accomplished through a combination of drive, walk, and stationary testing to ensure statistically valid assessment throughout of your coverage area.
- Uses proven, scientific methods to measure voice, video, data, and gaming quality and performance.
- Program is customized to your needs, from assessment of specific, specialized 5G services to broad, nationwide user experience evaluation.
- Given 5G complexity, a world leader in 5G testing is required to perform this work.
- Acquire the insights you need to win in the marketplace. Know where to invest to get the best business outcome. And get verified neutral validation of your key marketing claims.





The Solution: Competitive Mobile Network Benchmarking for 5G

Spirent's solution for Competitive 5G Network Benchmarking is a sophisticated, proven program that delivers independent network performance analysis. Spirent has provided the world's leading operators and OEMs with customized measurement and reporting to help meet research objectives, minimize network impact, improve products, optimize the subscriber experience, and build brands. Spirent's ability to quickly deploy teams of engineers helps carriers make decisions on key strategies that can impact customers in the long term. Our team of specialists will build a test plan tailored to your needs that can answer specific questions regarding your network's interaction.



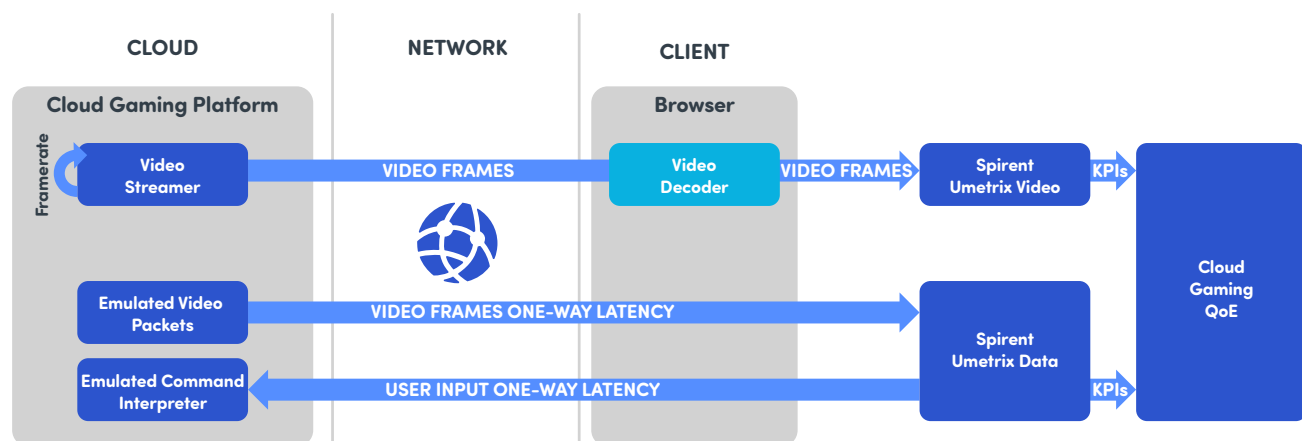
The Spirent Competitive 5G Network Benchmarking offer.

- **Define the benchmarking program.** Do you need to differentiate your mobile edge computing offer? Are you trying to ensure better performance in sports venues? Are you looking for broad nationwide competitive evaluation? Whatever your questions, Spirent will develop a customized benchmarking program to meet your requirements.
- **Complete the testing.** Spirent will execute the formal test plan through a combination of drive tests, walk tests, and stationary tests. Then we will gather the data and run analytics on it to produce the information critical to your success.

Example test methodologies include:

- **Drive Testing.** Video, data, web, and voice assessment for large, medium, and small markets. Global networks; select Android devices (iOS available); 5G connection rate, quality, performance, and reliability KPIs.
- **5G Data Methodology.** Testing multiple protocols: UDP, HTTP, HTTPS, FTP; record underlying RR assignment (MIMO, CA, etc.) for data on competitive differences. Focus on 5G connection rate, latency, throughput, and reliability in mobility and stationary scenarios including sub6, DSS, mmWave, and mobile edge computing.
- **Video Methodology.** Addresses over-the-top (OTT) streaming with a multi-pronged methodology for complementary views of QoE including Netflix, Hulu, Prime, or others, and YouTube. Approach includes buffering, freezing, over-compression (MOS), and time-to-first frame statistics. OTT algorithms provide unique competitive insight into streaming applications. Includes video stress testing while analyzing the network.
- **Cloud Gaming Experience.** Taking elements of 5G Data and Video methodology to provide insights into performance and assess KPI components of the cloud gaming experience for uplink and downlink telemetry latency, as well as video frame – latency, loss, buffering, freezing, MOS. These components are aggregated into a single gaming experience score derived from ITU-T G.1072.
- **Venue / Walk Testing.** Periodic benchmarking of major venues with fixed agents running active tests during events. This includes provider versus competitors throughout the venue and in parking structure with test kits adapted for indoor testing. User experience KPI's reported on actual venue maps/plans.

Cloud Gaming Experience Testing



Why Spirent?

Our customizable TaaS Competitive 5G Network Benchmarking solution employs test and validation efficiencies and strategies drawn from an authoritative portfolio of capabilities and established leadership in broad technology and domain expertise. This stems from offering a comprehensive suite of solutions for cutting-edge technologies in networking, cybersecurity, and positioning including 5G, 5G Core, Cloud, SD-WAN, SDN, NFV, Wi-Fi 6, and more. A pioneer in lab and test automation, our expertise includes DevOps and CI/CD, which employs industry-recognized best practices for test and assurance to achieve comprehensive continuous testing.

Business value:

- Work with the pioneers in testing mobile QoE under real-world conditions and global leaders in 5G validation
- Employ extensive experience with new and existing mobile technologies from leading industry players
- Maximize capital expense budgets, especially for quick-turn analysis based on near-term or evolving requirements
- Utilize proven methodologies and test plans, based on global cloud-based measurement systems
- Rely on complete confidentiality of results and reports to substantiate marketing claims

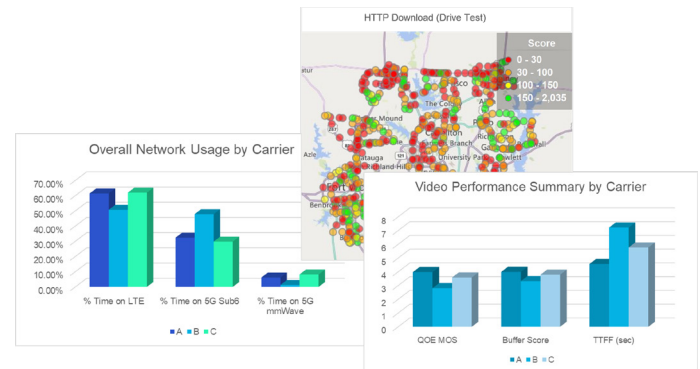


Case Study: Benchmarking 5G Network Performance

The Challenge. A major US service provider needed regular nationwide reports to help prioritize optimization efforts and feed marketing claims for 5G and video.

The Solution. Spirent's Umetrix user experience analytics suite was deployed by Spirent's Managed Solutions team to measure 5G data, voice, and OTT video quality of experience. Additional tools provided insight into network statistics associated with the drive test programs for over 100 markets, twice per year.

The Impact. Spirent provided valuable comparisons of user quality of experience between different network spectrum usage, infrastructure differences, and 5G deployment strategies. The program received glowing remarks from the service provider's market managers, who now use this data to prioritize optimization.



Understand the end-user experience for hundreds of key performance indicators – for your network as well as the competition's.

The Global Services Delivery Process



Discover: Gather requirements; perform gap analysis

Define: Identify solutions that scale seamlessly to integrate flexibly with disparate systems; present roadmap; illustrate ROI

Develop: Create next-gen end-to-end solutions driven by our technology and service portfolio

Deliver: Manage projects; ensure outcomes are measurable, tracked by KPIs and improved over time

Debrief: Ensure customer requirements and expectations have been met

Our Customers

Spirent has been a pioneer since the advent of network, wireless and GNSS testing, validation and assurance, and has provided services to customers across a broad range of global industries. These varied business sectors include global navigation satellite systems, aircraft and automotive manufacturers, as well as telecommunications and wireless service providers, network equipment manufacturers, petroleum, education, the media, financial institutions and stock exchanges, technology enterprises and publishing giants. Spirent also services governments worldwide, which includes military and space agency projects.

Spirent Expertise

Spirent provides services expertise for all major communications vendors — **from Lab to Live**. This end-to-end proficiency draws from a deep bench of seasoned professionals who are qualified experts in our technology portfolio. Our services cover devices, infrastructure, cloud infrastructure, networks, network applications, security and assurance, all powered by state-of-the-art lab and test automation. Such industry expertise maximizes your solution capabilities and ensures you deliver your product or service to market on time and with optimal quality.

Spirent Services Portfolio

Spirent's Competitive Mobile Network Benchmarking for 5G is part of a comprehensive suite of services and solutions. Spirent's portfolio of services for an initiative's entire lifecycle – **from Lab to Live** – helps organizations achieve their short-term testing and validation goals, while building a strong framework for future and enduring business success.



Managed Solutions

Performing strategic operational functions for customers:

- Lab as a Service
- Test as a Service
- Certification as a Service
- Deployment as a Service



Product Services

Enabling customers to realize optimal use of Spirent products:

- Implementation & Integration
- Product Training
- Resident Engineers
- Product Support



Consulting Services

Supporting custom projects, helping customers with specific strategies and objectives:

- Assessments & strategy
- Planning & design
- Network architecture & engineering
- Test methodologies

For more information on Spirent's Product Services, please visit: www.spirent.com/products/services-managed-solutions

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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