



5 Tactics to Win the 5G Device Volume Demand

Succeed at High-Volume Manufacturing for 5G and Accelerate Your Time to Market

Overview

Mobile network operators (MNOs) around the world have set aggressive targets for 5G mobile network deployments — eager to deliver new services to consumers. Operators must deploy 5G networks and need 5G devices to capture 5G market opportunities. Many device makers announced their new lineup of 5G smartphones in 2019.

High-volume 5G device manufacturing is imminent. Increasing throughput while controlling the cost of test will be the top priority. In the context of 5G, added pressure comes from accelerating timelines and high technical complexity. 5G introduces significant disruption in the mobile communications industry with a shift to millimeter-wave (mmWave) frequencies, wider bandwidths, and over-the-air (OTA) test methods.

Disruption provides the opportunity for market challengers to displace incumbents. Device makers need to accelerate their time to market to win the 5G race. In the manufacturing cycle of the device workflow, new strategies are necessary to meet ever-challenging goals and tighter schedules. This white paper highlights tactics that enable device makers to succeed in high-volume manufacturing of 5G devices by accelerating their time to market and reducing the cost of test.



In this paper, learn how you can:

- Achieve production goals with multi-DUT testing
- Eliminate delays with common measurement science
- Maximize throughput with high-performance instrumentation
- Stay relevant with flexible test equipment
- Address rapidly rising demand with financial services

Achieve Production Goals with Multi-DUT Testing

Testing multiple devices at the same time is critical to increase production capacity and reduce the cost of test. Device makers can use parallel device testing to push the concept to its limits by using instrumentation designed with multi-device testing in mind.

5G represents a brand-new way of thinking about high-volume device manufacturing for 5G mmWave devices. Simultaneously testing multiple 5G mmWave devices requires radio heads and chambers for each device under test (DUT).

This also means higher real estate costs in addition to the capital equipment costs. The production capacity of device makers is limited to the real estate they have with contract manufacturers that typically charge by the square foot. Device makers are at a crossroad between higher real estate costs and lower production capacity. They can overcome this challenge by adopting innovative multi-DUT testing solutions that minimize floor space.

For example, with Keysight's EXM wireless test set, device manufacturers can test four 5G DUTs in Frequency Range 2 (FR2) at once using the four transceiver (TRX) modules.

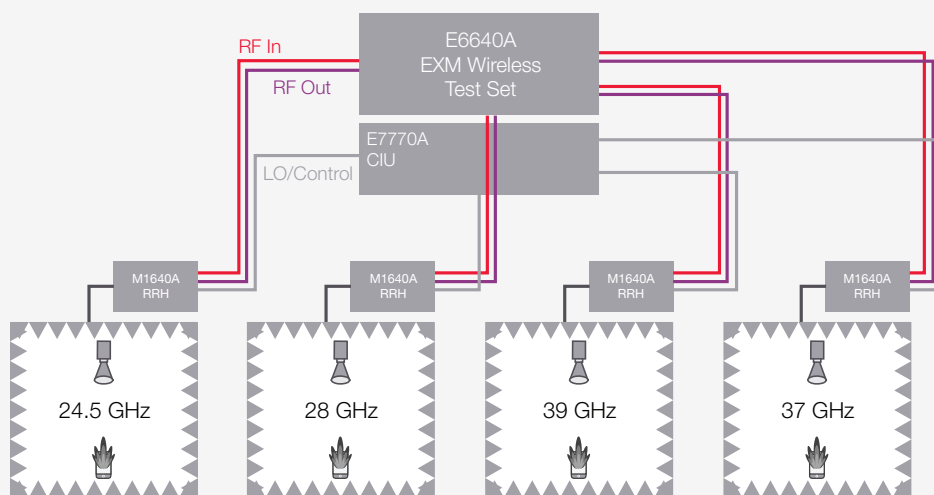


Figure 1: 4-port mmWave 5G solution testing four DUTs simultaneously for four different 3GPP-specified operating bands

Remote radio heads (RRHs) provide scalability, enabling the solution to work against a wide range of mmWave frequencies (FR2) while adding configurability to the test environment. RRHs' physical placement close to the measurement probe reduces cable loss. However, when test engineers switch them out manually on the manufacturing line, RRHs can introduce errors and generate calibration issues. To avoid these issues, some device manufacturers have opted to dedicate wireless test sets to different bands. With the Keysight solution, device manufacturers do not have to sacrifice flexibility because the same RRH covers all 3GPP specified bands.

Eliminate Delays with Common Measurement Science

Device makers face tremendous technology evolution with 5G because of wider bandwidths and mmWave frequencies. At the same time, they are under extreme cost and time pressure to win the 5G race. Many device makers adopt a silo approach to device development and test, with dedicated test teams for each phase. Each team typically selects test equipment best-suited for their phase of the workflow. This can lead to measurement correlation issues. Such issues often occur when transitioning from R&D to manufacturing. Migrating the test intellectual property (IP) can add 3-6 months of delay, and correlation problems affect yield.

Many device makers overlook the time to market efficiencies they could gain by adopting a common measurement science across the device workflow. They need instruments tailored for each phase of the device workflow that also minimizes test IP migration efforts to ensure measurement correlation. Keysight PathWave facilitates the transfer of IP from design validation and test (DVT) to manufacturing. Keysight's UXM and EXM test solutions use the same hardware components, common interface unit (CIU), and RRHs. Teams across the device workflow are familiar with the same test equipment, and common measurement science makes the transition of IP easier. RRHs used in R&D and manufacturing perform similarly. Additionally, the various equipment types make measurements such as error vector magnitude (EVM) the same way. Consistency in measurements reduces the chance of errors and accelerates time to market.



Maximize Throughput with High-Performance Instrumentation

Testing each device faster is another strategy device makers can use to accelerate the testing process and increase their production output while reducing the cost of test. Instrumentation featuring quad-core controllers and leveraging a high-speed PXIe backplane provides ultra-fast data processing.

In addition to raw hardware speed, advanced sequencing techniques and single-acquisition multiple measurements can help to maximize throughput by accelerating test execution. Sequencing capability is essential for device makers because of the sheer number of 5G devices that require production as fast as possible. They allow device makers to select the most efficient sequence for their DUT.

First pass yield (FPY) is an essential metric for device makers, and even more so in the context of 5G. With the complexity of 5G, FPY could likely drop. The top smartphone manufacturers will need to deliver tens of millions of phones on an annual basis by 2023. They are potentially looking at significant rework or scraps with 5G. Instrumentation with superior signal purity and measurement accuracy can increase FPY.

The error vector measurement (EVM) performance and absolute level accuracy of the instrumentation used to make the measurements is critical for optimizing FPY. 5G mmWave also drives a shift from conducted to radiated test methods. The integration of test equipment with OTA chambers is essential to ensure reliable measurements.

Production line uptime is also critical to maximize in the context of 5G as device makers face significant competitive pressure. Production delays can have a dire impact on market share. Deploying robust equipment designed for the production floor is essential.



Stay Relevant with Flexible Test Equipment

In addition to throughput and product quality, device manufacturers are also concerned with aligning instrumentation with production needs. 5G continues to evolve, and 5G use cases are multiple and varied. They span the traditional cellular use case of faster data rates in enhanced mobile broadband (eMBB), the new Internet of Things (IoT) use cases with massive machine-type-communications (mMTC), and demanding critical applications like autonomous driving with ultra-reliable and low-latency communications (URLLC).

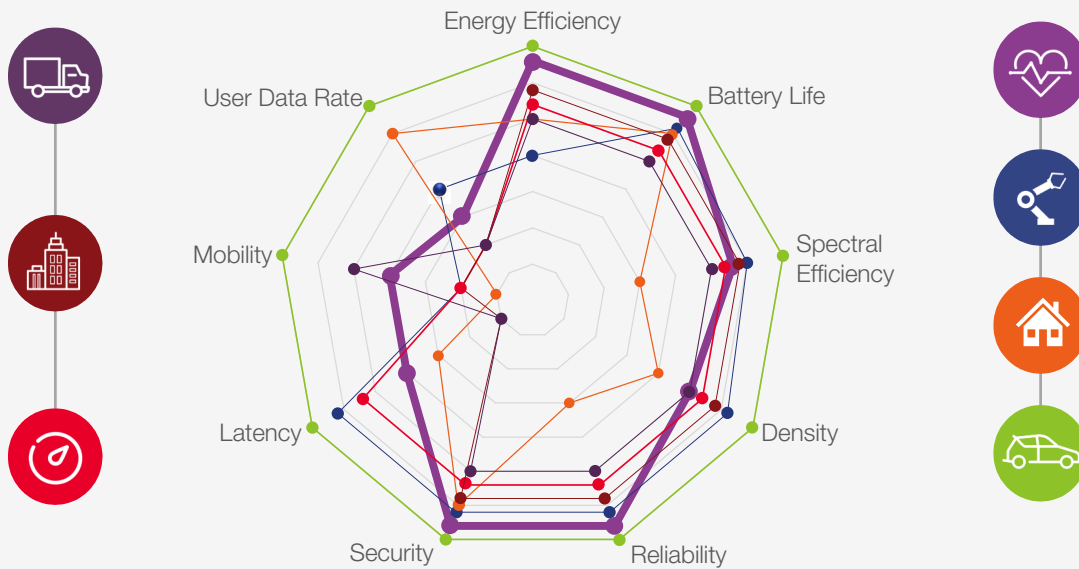


Figure 2: 5G NR use cases

Upcoming 3rd Generation Partnership Project (3GPP) releases will address new use cases over the next 2-3 years. These releases will bring new requirements for device manufacturers across the workflow. In parallel, the use of mmWave frequencies will likely expand. While mmWave is important in the US and South Korea currently, the need for higher throughput could drive interest in mmWave frequencies in other parts of the world. With the EXM wireless test set, device makers can easily upgrade from a sub-6 GHz system to a mmWave test system, by adding the E7770A CIU and the M1740A remote radio head.

In addition to addressing the challenge of the 5G technology evolution, the cost of test is another primary concern for device manufacturers. The greater complexity of 5G technology mandates highly flexible instrumentation that reduces upfront costs and the overall cost of ownership. Device manufacturers need to control the costs of acquiring test assets with capital expenditures (CapEx) and operating the assets over their useful life with operational expenditures (OpEx). Modular test platforms and software licenses address that need.

Address Rapidly Rising Demand with Financial Services

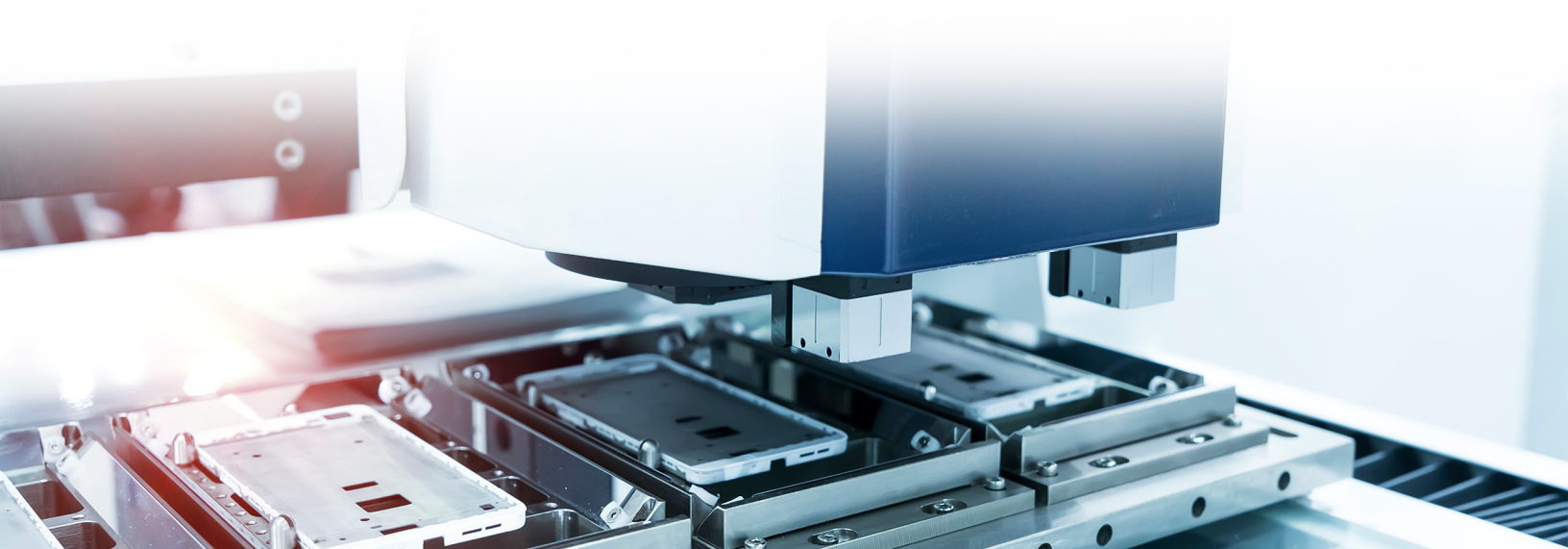
Device makers compete to win contracts to deliver their products in volume and on time. Sharp increases in production volume are a significant challenge in device manufacturing. As standards continue to evolve, production planning must account for a wide range of order quantities since 5G devices are complex due to the various use cases. The manufacturing operations of device makers must be dynamic and responsive to demand and technology trends.

Device manufacturers need to adjust test capacity quickly and easily and modify their manufacturing test operations to meet volume goals and target dates while conserving capital. The competitive nature of the 5G device market also demands that manufacturers maximize their operational and capital budgets to produce 5G devices. OpEx can help address that need. While OpEx budgets cannot be used to purchase new test assets, they can fund operating leases. Leases provide instant access to leading technologies with lower impact on budgets.

Leases are not necessarily short-term contracts. They can also provide long-term use of needed test assets and generate significant cost savings compared to purchase equipment. For 5G, they also offer the added flexibility device manufacturers need to keep up with the evolution of the technology as standards require new, different, or upgraded equipment.

The Key Issues	The Solution	The Results
<ul style="list-style-type: none">No CapEx budget remainingMaximize test resources and double test capacity	<ul style="list-style-type: none">18-month operating lease with OpExImmediate access to \$8 million in instruments for only \$4.7 million	<ul style="list-style-type: none">6 months faster time to market42% cost savingsFlexibility to change/update test assets

Case study: 5G NR device manufacturer doubles test capacity with zero additional CapEx



High-volume 5G Device Manufacturing Demands Innovative Test Solutions

The 5G market is thriving. Fixed 5G emerged in 2018 to deliver home internet service to customers in select cities. In 2019, 5G mobile networks appeared, building the base for operators to provide 5G mobile services to enterprises and consumers. 5G devices will complete the 5G story.

After years of research and development efforts, device makers are on the brink of capturing the 5G opportunities. With 5G, the challenges are higher than they have ever been with previous cellular technologies. Testing 5G mmWave devices requires high-performance test equipment and a shift from standard conducted test methods to new OTA testing. These requirements have implications on production real estate that impact the cost of test. Device manufacturers need powerful, highly integrated, yet flexible test solutions to succeed in the manufacturing phase of the device workflow.

For more information on 5G device manufacturing challenges and solutions, review the following resources:

- White Paper: [Mastering 5G Manufacturing](#)
- Solution Brief: [5G Non-Signaling Manufacturing Solution](#)
- Data Sheet: [E6640A EXM Wireless Test Set](#)
- Case Study: [5G NR Device Manufacturer Doubles Test Capacity with Zero Additional CapEx](#)
- Brochure: [5G New Radio Solutions for Chipset and Device Designers](#)

You can also find out more about each solution at the following webpages:

- For Keysight's 5G non-signaling UE manufacturing solution that addresses device and chipset manufacturing for FR1 and FR2, click [here](#).
- For Keysight's E6640A EXM Wireless Test Set that addresses device and chipset manufacturing for FR1 and legacy technologies, click [here](#).

Learn more at: www.keysight.com

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