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Keysight E7515A
UXM Wireless Test Set



Make a Clear Call

The team looks to you: Will a new chipset or UE pass the crucial tests? Clarity comes from accumulated – insights enabled by the Keysight Technologies, Inc. UXM wireless test set. When the team counts on you, count on the UXM to help you make a clear call.

KEYSIGHT TECHNOLOGIES

Assess Design Readiness with Greater Confidence

The UXM is a highly integrated signaling test set created for functional and RF design validation in the 4G era and beyond. It provides the capabilities you need to test the newest designs, delivering LTE-Advanced (LTE-A) Pro data rates up to 1 Gbps now and handling more complex requirements later.

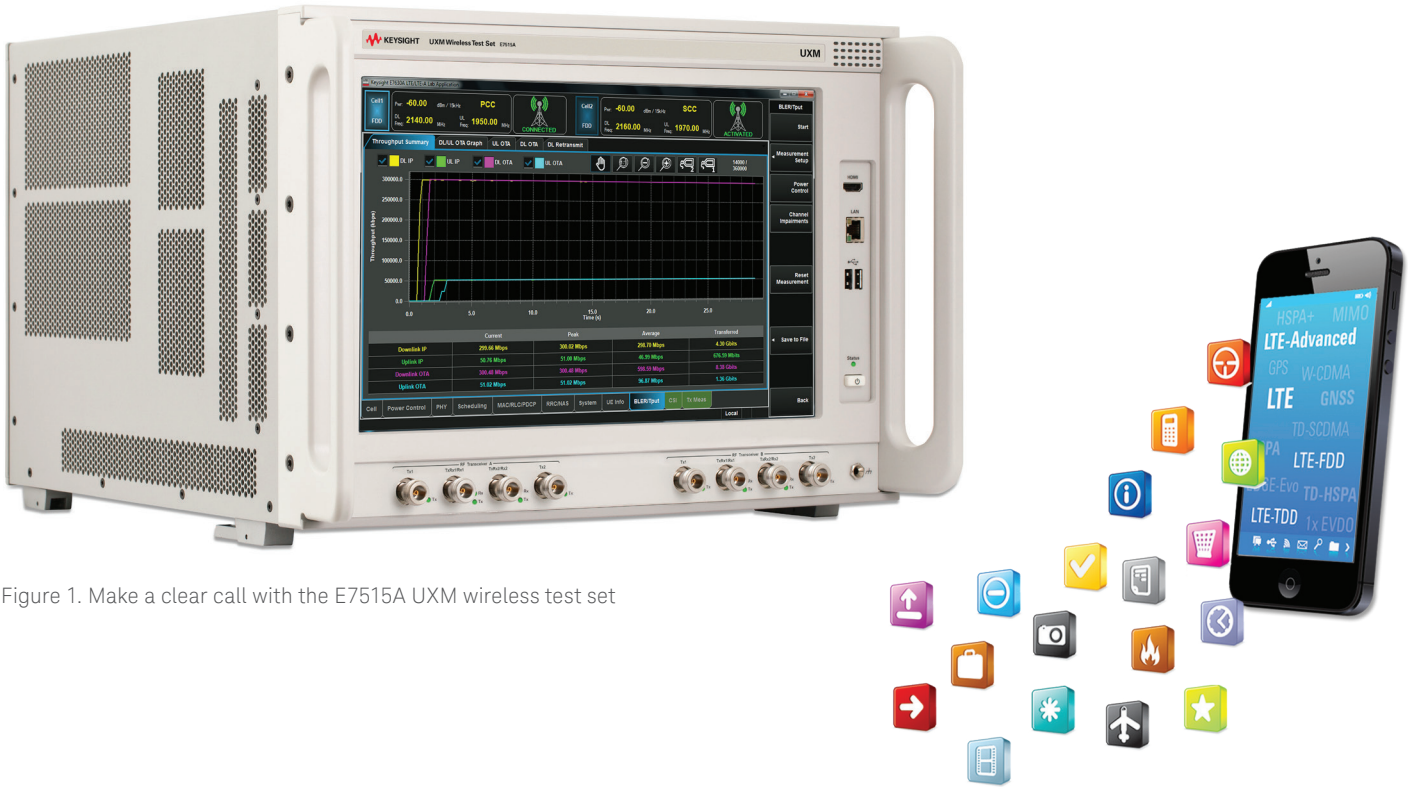


Figure 1. Make a clear call with the E7515A UXM wireless test set

Gain new insights with a broad range of integrated capabilities

- Stable, bi-directional, end-to-end data throughput and flexible, yet easy to configure, receiver test
- Highly integrated solution with multiple cells, carrier aggregation, multiple-input/multiple-output (MIMO), internal fading, and built-in server
- Emulation of complex network scenarios for extensive functional performance test
- Proven Keysight X-Series measurement science for RF performance test

Be ready for functional and RF design validation in 4G and beyond

- Future-ready, multi-format platform to handle the next advancements in antenna techniques, component carriers, and data rates
- Extensible architecture includes high-speed interconnects, upgradeable processors, and multiple expansion slots
- Versatile display capabilities with 15-inch touch screen interface

Make a seamless transition to the UXM

- New-yet-familiar user interface based on popular Keysight solutions
- Get more from every budget dollar through Keysight's tradition of investment protection

Wireless Design Validation: Market Trends and Test Challenges

An incredible amount of technology is packed into every smartphone and tablet. The list is long and getting longer: new and legacy cellular formats, multiple wireless-connectivity links, GPS capabilities, cameras, music players, Web browsers, and more. As wireless applications multiply and more users adopt data-centric devices over traditional voice and text-only cell phones, networks are experiencing an explosion of data consumption.



In response, the latest cellular standards include advanced techniques such as MIMO and carrier aggregation (CA) to help operators squeeze more capacity, better coverage, and higher data rates from their existing frequency spectrum. Operators must also provide high-quality voice services on all-IP networks such as LTE/LTE-A, and have an opportunity to offer a better overall voice experience with integrated services such as video, chat, and file sharing.

On top of these complexities, networks need to be optimized to effectively support existing devices and infrastructure, and new formats. The nature of today's heterogeneous networks requires verification of interoperability and mobility of new 4G and small cells with existing 2G, 3G, Wi-Fi, macro cells, emerging unlicensed spectrum, and IoT (internet of things).



This innovation and evolution presents challenges for device design validation, as it adds complexity to characterizing the performance of transmitters and receivers, and evaluating the behavior of an assembled device, e.g. battery drain, MIMO antenna performance, and VoLTE.

Using wireless test solutions enabled by the Keysight UXM simplifies device validation. These solutions take advantage of UXM's integrated sources and analyzers for transmitter and receiver testing, standards-based measurements, and extensive built-in capabilities to validate the functional and RF performance of user equipment (UE) while on a connection.



Real-World Functional and RF Test with the UXM

Today's wireless devices must perform in highly dynamic environments. Users expect a high-quality experience regardless of complexities created by higher data rates, mobility, MIMO, carrier aggregation, fading, noise, and interference. LTE-A networks are designed to adapt to these real-world operating conditions with dynamic link allocation and complex handover scenarios. This variability results in thousands of potential scenarios under which the mobile device is expected to perform well.

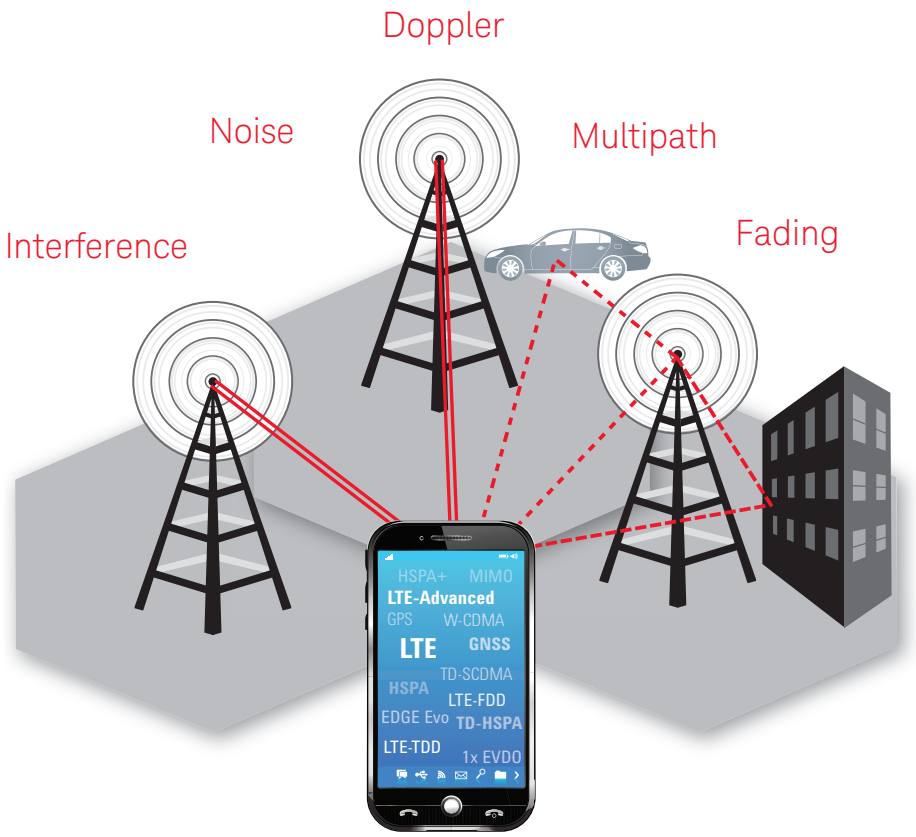


Figure 2. Today's UEs must perform under demanding network and channel conditions

This strenuous environment makes testing UE performance degradation, recovery, and responsiveness imperative as well as challenging. To fully assess LTE-A design performance requires emulating both the network and the wireless channel. Testing devices under both ideal and non-ideal network and channel conditions helps isolate design issues early, and ultimately ensure a high-quality user experience.

Real-World Functional and RF Test with the UXM (Continued)

Effectively emulating this dynamic and demanding environment requires incorporation of fading, noise, and network emulation, often resulting in a complex test setup with various components that is prone to stability and calibration issues. The UXM eliminates that complexity by providing integrated base station and channel emulation along with flexible control, measurement capability, and diagnostic ability.

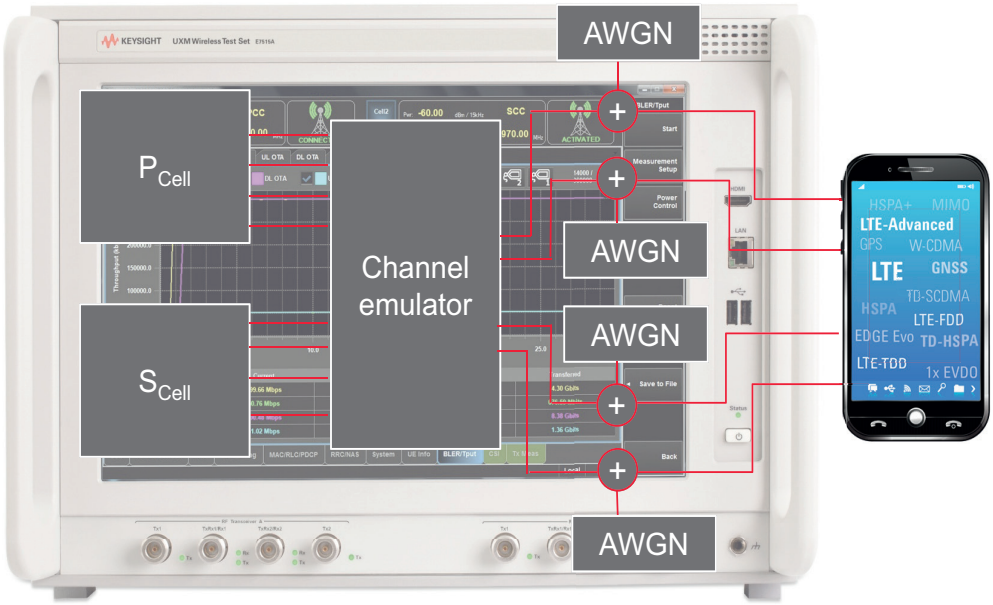


Figure 3. The UXM simplifies your bench-top with integrated network and channel emulation

The UXM's test application (TA) software provides the tools design validation engineers need to be confident about their device's RF and functional performance. The base TA includes flexible receiver test, trusted X-Series transmitter measurement science, and basic network emulation. This enables you to set up defined conditions with varying frequencies, power, and modulation, measure to limits, and determine the root-cause of failures with reliable, repeatable results that can be automated and easily shared. To add more capabilities such as multiple component carriers or advanced MIMO techniques, or functional test features including IP data and handovers, choose the appropriate feature option(s). You can also test from early designs to finished products, as the UXM supports measurements with signaling or using test modes, making it easy to "just connect" and focus on RF validation.

Gain New Insights with a Broad Range of Integrated Capabilities

Ensure multi-format devices can sustain maximum data rates and handle realistic fading and MIMO scenarios

In order to satisfy user expectations, today's wireless devices must reach and sustain their full specified data rate, and maintain that connection throughout changing channel and network conditions. The UXM's powerful hardware architecture provides stable, bidirectional, end-to-end data throughput for up to 5CC[1] downlink and 2CC uplink, including support for FDD-TDD mixed CA, LTE-U, LAA and CSAT, 8x4 DL MIMO, and 256QAM downlink, ensuring any data rate issues encountered are those of the UE, not the test set.

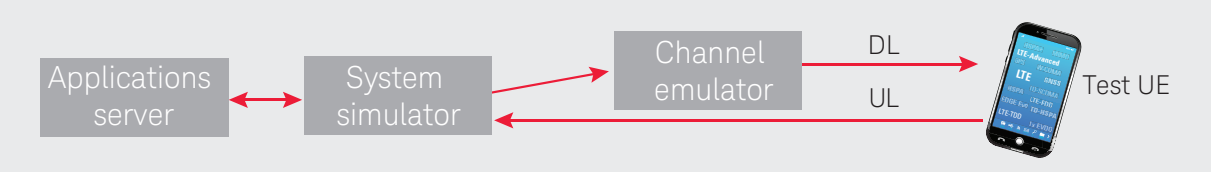


Figure 4. Realistic end-to-end data throughput testing is essential for today's wireless devices

To fully assess your design's data throughput performance, it is critical to test at both the physical and application layers, with both TCP and UDP, and in different RLC modes (acknowledged and unacknowledged). The UXM's end-to-end data throughput functionality allows you to isolate throughput bottlenecks and integration issues. You can also easily test receiver performance under varying channel conditions and downlink configurations with the UXM's integrated fading, highly configurable downlink allocation, and closed-loop receiver test capabilities.



Figure 5. The UXM provides stable, bidirectional end-to-end data throughput

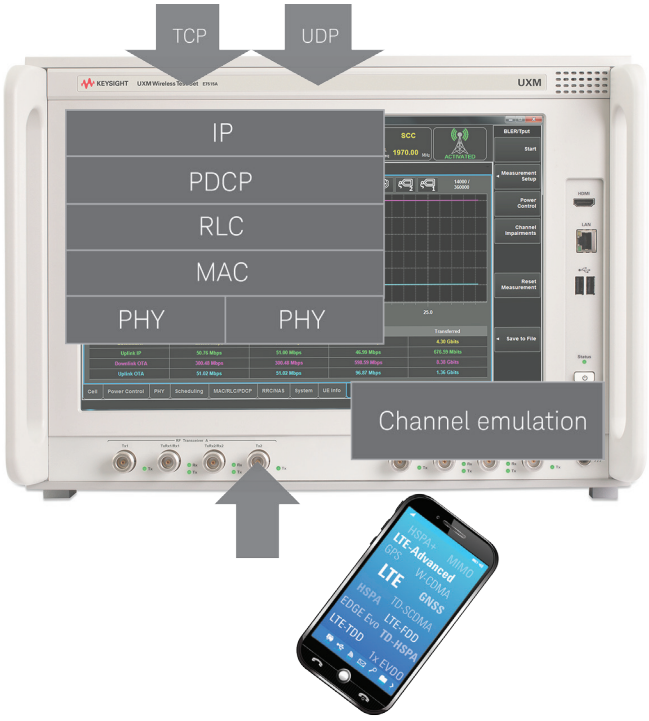


Figure 6. Thoroughly test your device's throughput performance to isolate and resolve issues

1. Connect UXMs in an array to enable up to five component carriers and handovers between multiple synchronized cells

With UXM array (which consists of a main UXM and an auxiliary UXM), the bench-top solution does not require any additional hardware, and can support up to five component carriers in combination with MIMO and modulation schemes settings embedded in the application to achieve end-to-end data throughput beyond 1 Gbps.

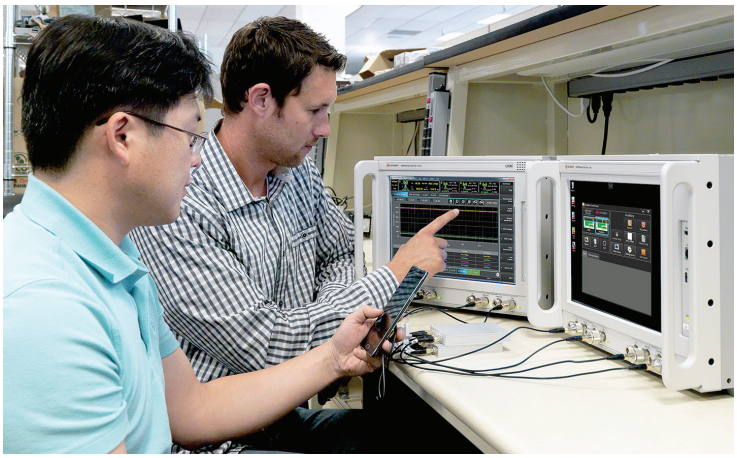


Figure 7. UXM array (left unit: main UXM, right unit: aux UXM)

When using un-licensed spectrum (5 GHz ISM band), the UXM solution can aggregate legacy LTE bands with up to 4 SCCs (secondary cells) in LTE-U/LAA bands at MAC level. This aids design engineers with validating throughput and performance techniques aimed at helping operators boost network coverage by using more bandwidth resources.

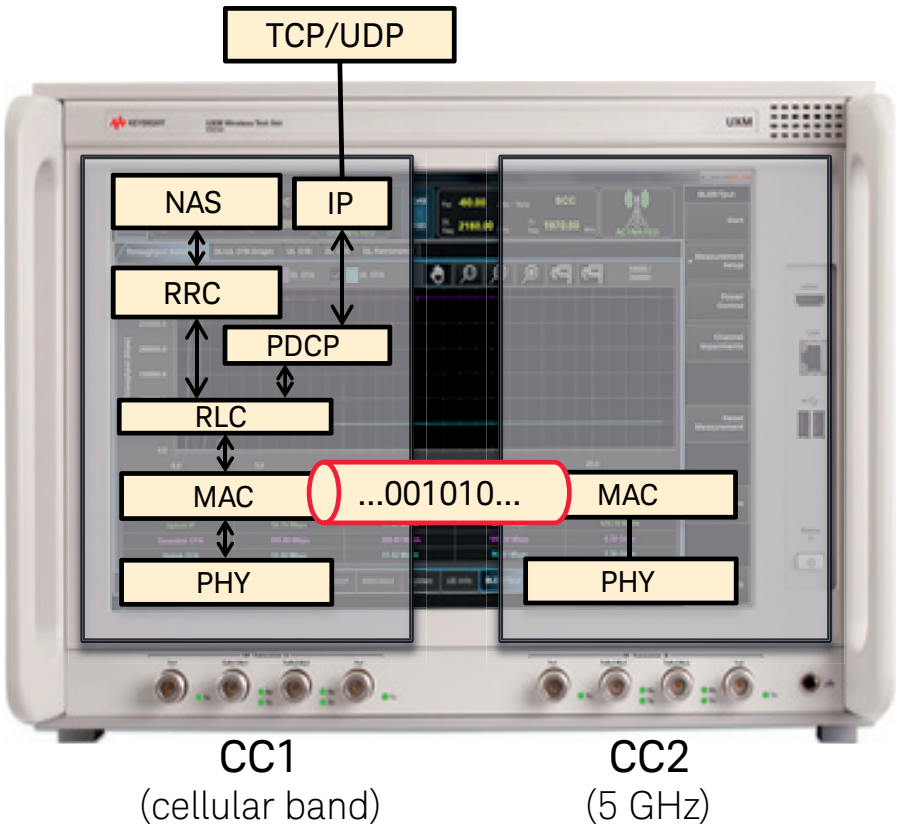


Figure 8. Carrier aggregation of an un-licensed 5 GHz band with existing LTE band in UXM

Gain New Insights with a Broad Range of Integrated Capabilities (Continued)

Reduce bench-top complexity

The UXM is highly integrated, offering multiple cells, carrier aggregation, MIMO, built-in fading, internal applications server, and integrated iPerf and IMS. The UXM makes it easy to verify receiver performance with independent fading and noise available for each component carrier, bringing complex test capability to your bench-top in one simple interface.



Figure 9. Easily add and remove fading and noise to either or both component carriers and evaluate the resulting changes to throughput

You can directly manage the UXM's MIMO scenarios together with internal fading, carrier aggregation, and transmission mode settings up to transmission mode 9 (TM9) with advanced selectable settings including beamforming model, CSI reference signal port, and layer/codeword number.

Gain New Insights with a Broad Range of Integrated Capabilities (Continued)

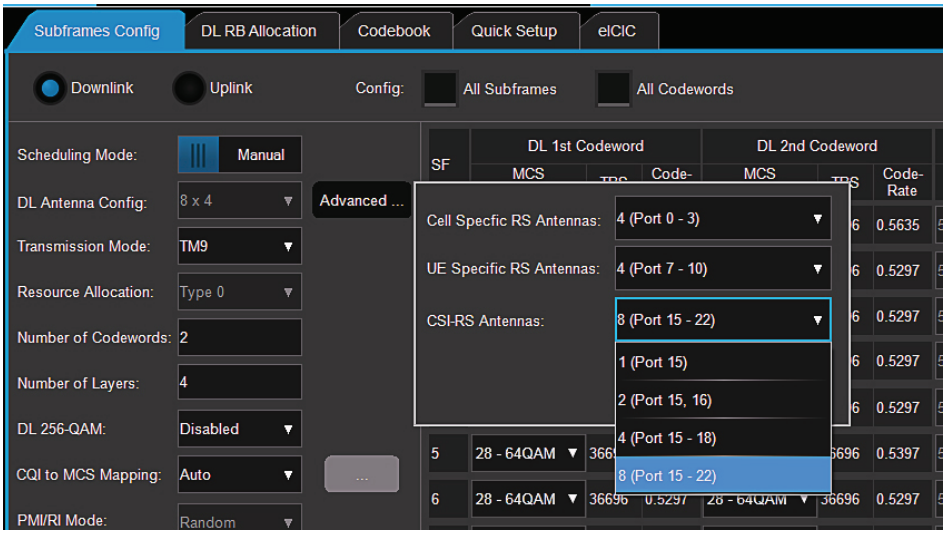


Figure 10. 8x4 DL MIMO and TM9 with advanced settings

The combined system flow and configuration can be easily managed for both transceivers from the UI to validate the combined effect for data throughput improvement on the user devices.

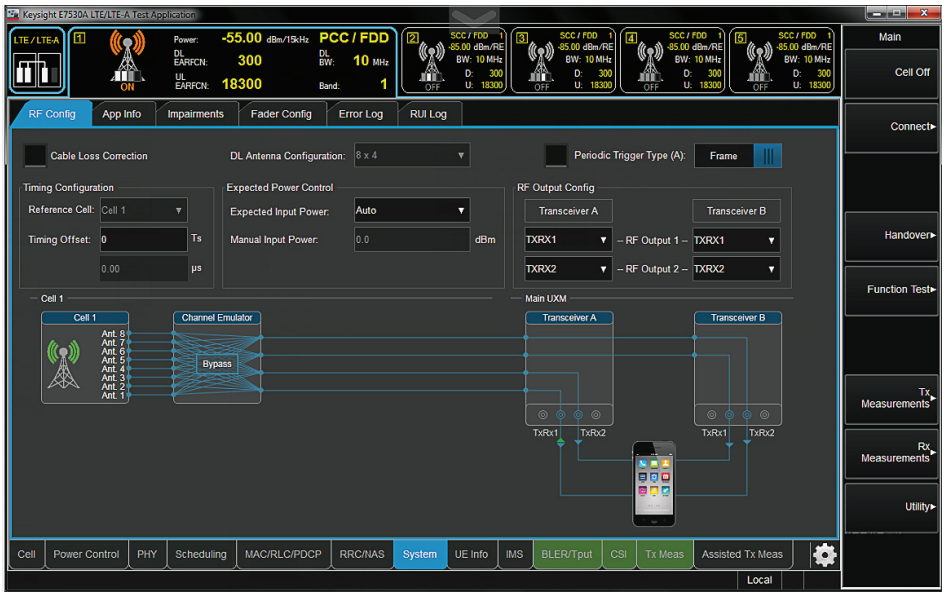


Figure 11. View the integrated system workflow directly from UI

To further simplify end-to-end data throughput test, engineers can access the integrated iPerf functionality directly on the UXM user interface, verify data throughput performance, view results, and export logs for futher analysis.

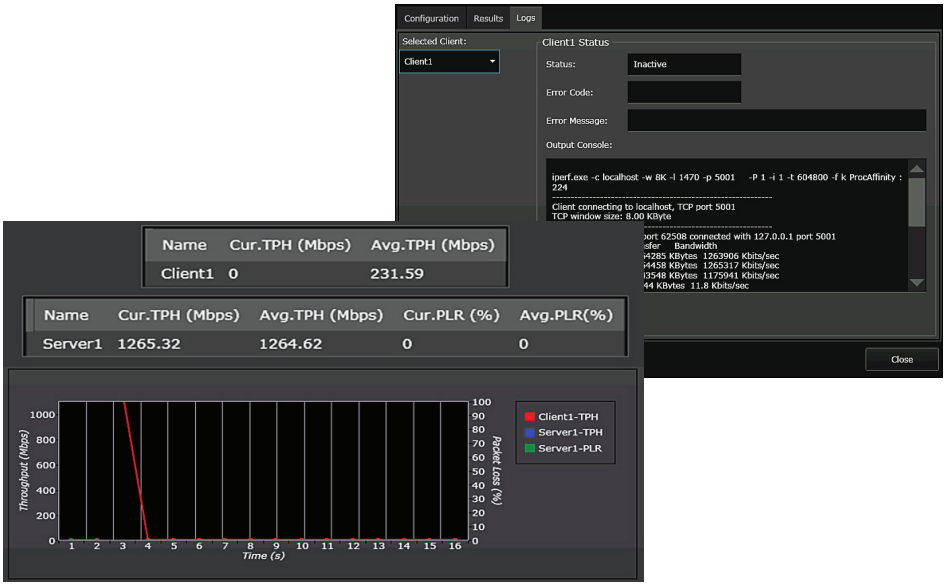


Figure 12. Integrated IPerf in UXM application

Go deeper in functional test

In addition to testing throughput and receiver performance, the UXM's comprehensive network emulation capabilities let you go deeper in functional test by emulating a wide range of complex operations such as handovers, IMS/VoLTE, (F)eICIC, CPC, and sleep modes (for battery and current drain characterization).

Check LTE intraRAT and LTE inter-RAT mobility with W-CDMA, TD-SCDMA, or GSM using two independent cells (built-in), or connect to another UXM or Keysight 8960 Series 10 wireless communications test set to verify multi-cell wireless handover scenarios.

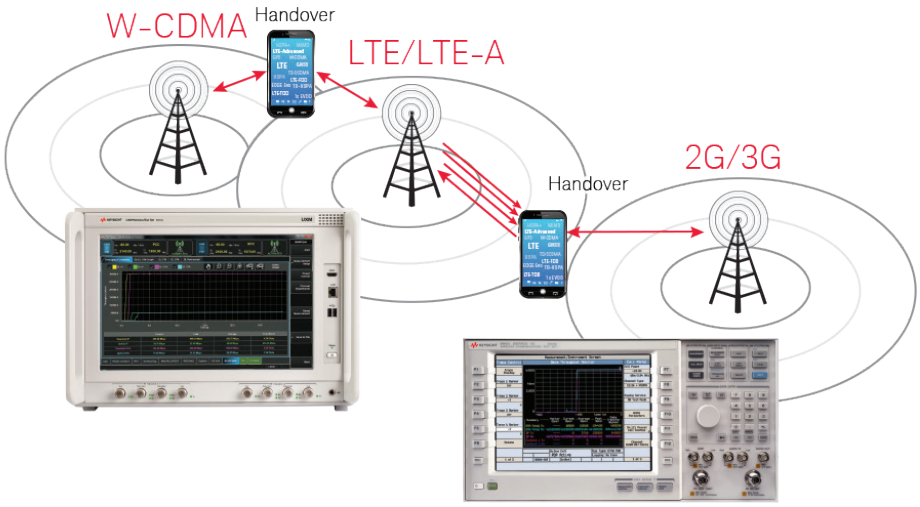


Figure 13. Test the various handover scenarios required to provide high-quality continuity of service

Ensure your Internet of Things devices meet requirements for stability, power consumption, and interoperability: the UXM supports Cat-1, NB-IoT and eMTC CAT-M1 with eDRX and Power Saving Mode for comprehensive battery drain testing.

Gain New Insights with a Broad Range of Integrated Capabilities (Continued)

With the UXM and Keysight's E6966B IMS-SIP network emulator software, verify your UE fully supports VoLTE features such as SPS, multi-DRB, and RoHC, as well as end-to-end voice calls (VoIP) between two VoLTE UEs.



Figure 14. Verify your UE fully supports the complex demands of VoLTE with the UXM and E6966B

To assess VoLTE voice quality, the U8903B high-performance audio analyzer from Keysight offers many powerful signal generation and analysis features, as well as an expanding array of digital and analog audio interfaces. PESQ and POLQA voice quality analysis are standard tests for VoLTE development and qualification. For more information, please refer to the application note: Testing Voice Over LTE (VoLTE) Phones.

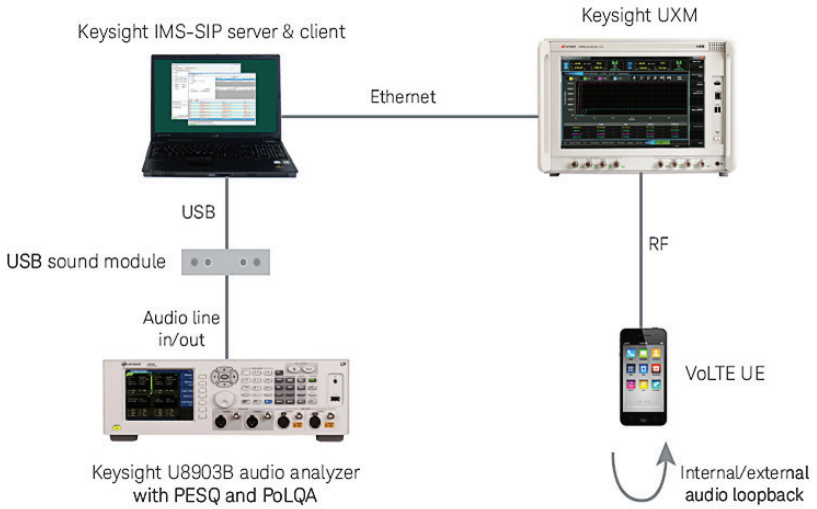


Figure 15. VoLTE audio test solution example includes UXM, U8903B, and IMS-SIP server and client

Battery operating time continues to be a critical factor in the design of mobile wireless devices. With the trend towards creating smaller and lighter smart phones, the UXM helps you to validate the optimization of the battery. Test scenarios covered by this solution include both Idle mode DRX and Connected mode DRX.



Figure 16. Battery drain test solution example includes UXM and N6705B power analyzer

The OTA test for antenna performance of single input single output (SISO) devices is achieved by measuring the total radiated power (TRP) and TIS (total isotropic sensitivity) of the UE. UXM supports SISO OTA testing performed in system with anechoic chamber.

The multiplexing capacity gains achievable using a multiple input and multiple output (MIMO) antenna has generated significant interest in recent years. Different methods have been implemented for characterizing the performance of the LTE MIMO antenna device under simulated channel conditions. Keysight is working with system providers to integrate the UXM with their systems to simply your MIMO OTA antenna performance verification.

UXM works with three main MIMO OTA test methods, including multi-probe anechoic chamber, radiated two-stage, and reverb chamber. The UXM provides integrated SCME UMa and UMi fading profiles to enable radiated two-stage and reverb chamber methods without any additional fading instrumentation, allowing developers to characterize and verify device performance under more realistic conditions.

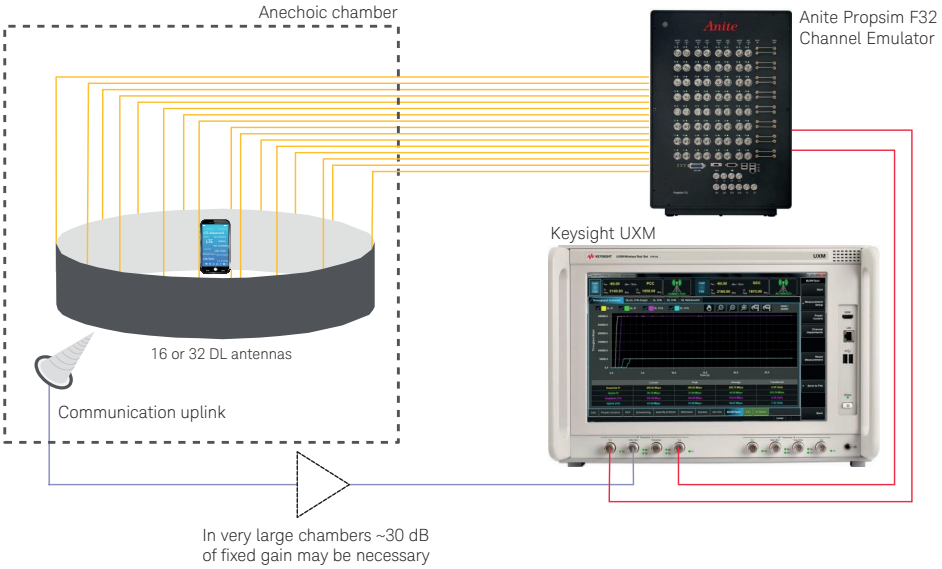


Figure 17. Typical multi-probe anechoic chamber MIMO OTA test system.
(Note: Anite is now part of Keysight Technologies)

Gain New Insights with a Broad Range of Integrated Capabilities (Continued)

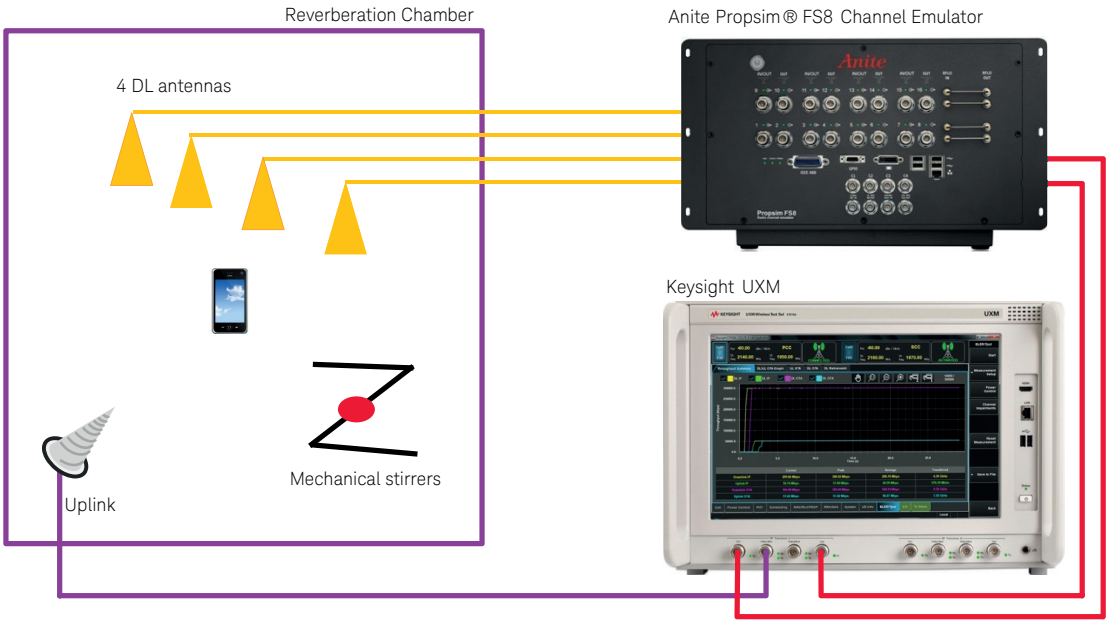


Figure 18. Typical reverb chamber with channel emulation MIMO OTA test system

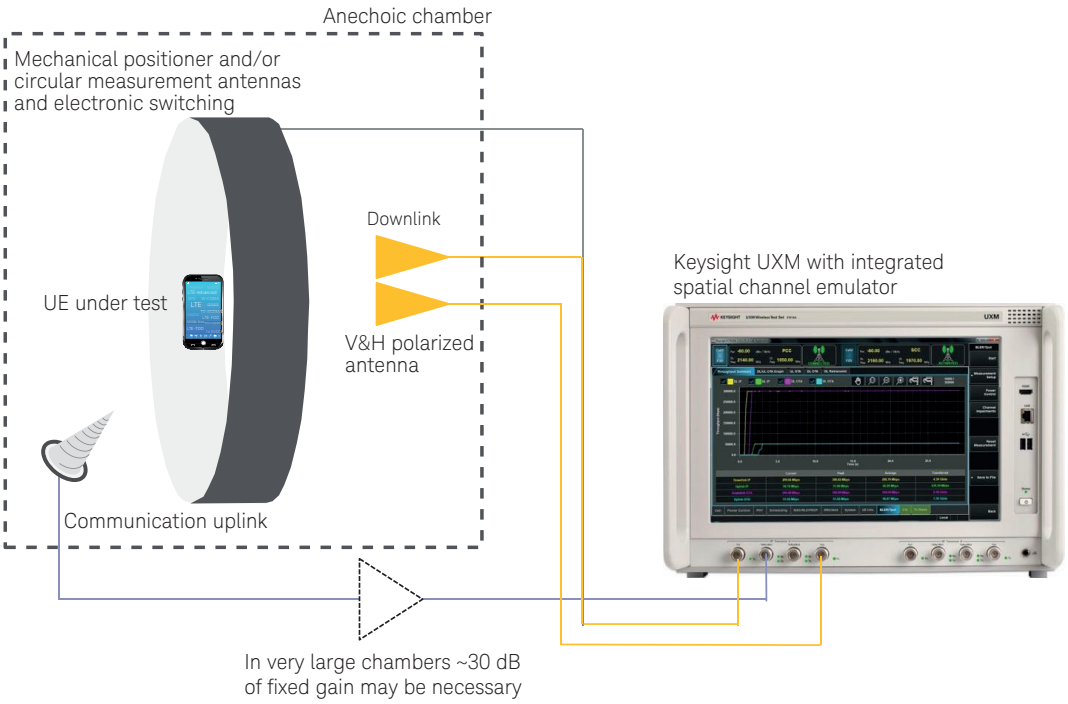


Figure 19. Typical radiated two-stage MIMO OTA test system

Gain New Insights with a Broad Range of Integrated Capabilities (Continued)

Use the UXM's protocol logging capabilities to analyze and troubleshoot network and UE messaging. In addition to the UXM's built-in protocol logger, Keysight has created stand-alone protocol logging and analysis software for use with the UXM, leveraging the open-source Wireshark network protocol analyzer software.

Log and decode both wireless protocols (MAC, RLC, RRC, NAS, and PDCP) and IP protocols (UDP, TCP, FTP, SDP, SIP, and RTP), all within the familiar Wireshark interface.

The protocol logging and analysis software supports both real-time and post-capture analysis, and provides multi-format, time-aligned logging between multiple LTE/LTE-A, and W-CDMA, GSM, or TD-SCDMA cells.

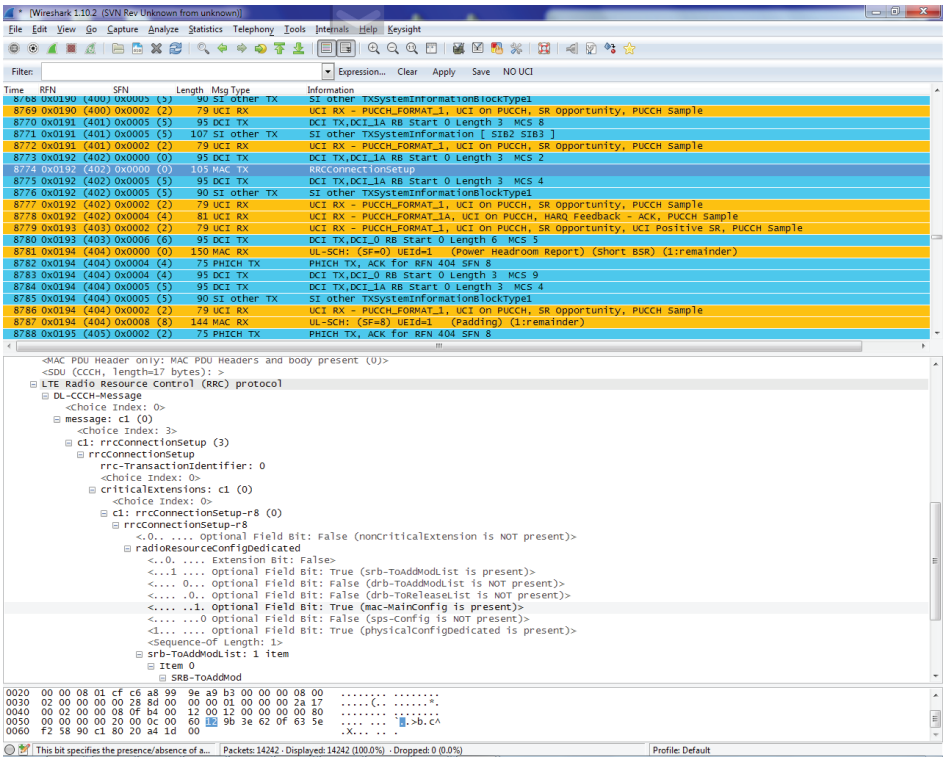


Figure 20. Use filtering to log and view only the data of interest, and color display options to identify messages from different technologies and test sets.

Gain New Insights with a Broad Range of Integrated Capabilities (Continued)

Achieve greater confidence in RF performance

Every UXM test application software product includes the industry-proven X-Series measurement applications for consistent, repeatable transmitter testing. Run measurements per the 3GPP 36.521 and 34.121 test specifications. Run measurements per the test specifications:

- LTE/LTE-A 3GPP 36.521
- W-CDMA/HSPA+ 3GPP 34.121
- GSM/GPRS/EGPRS 3GPP 51.010
- TD-SCDMA 3GPP 34.122.

Use the full range of X-Series capabilities to explore beyond the specifications. The X-Series applications' comprehensive test coverage, built-in context-sensitive help, and familiar user interface get you up-and-running quickly, with the flexibility required to check compliance and troubleshoot tough transmitter issues. With the UXM's integrated fading and MIMO, you can also characterize your receiver performance under realistic and varying channel conditions, in one simple-to-use interface.

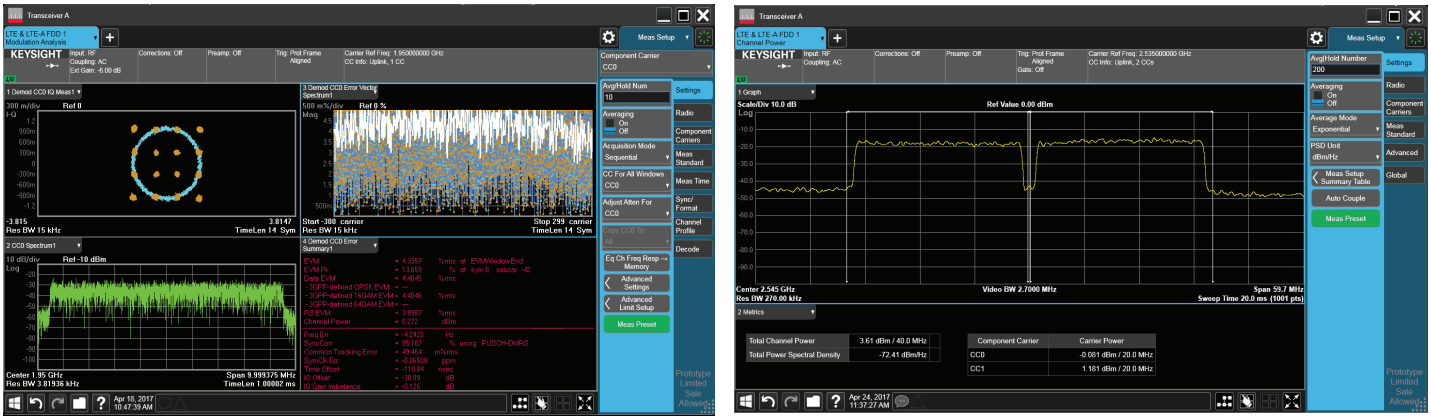


Figure 21. The UXM's built-in X-Series measurement applications provide consistent, repeatable transmitter testing

Effectively test your multi-format devices

Verifing multi-format devices is easy with UXM's fast switch capability between LTE TDD and LTE TDD, or between GSM, TD-SCDMA, and W CDMA using 2G/3G/4G applications.

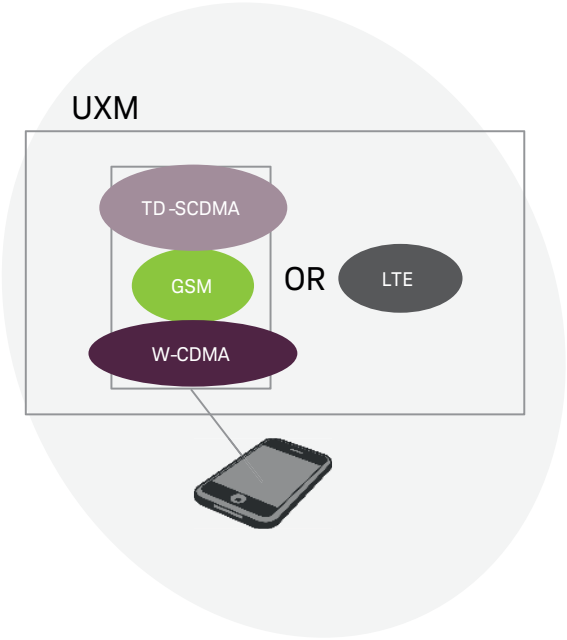


Figure 22. Using one TRX transceiver module set to test a multi-format device on a UXM

The UXM supports multi-format device RF and functional testing including 2G/3G/4G, and it supports the testing of two devices in parallel for RF measurements and IP data connections. The UXM's two independent cells support the simultaneous testing of two LTE devices, two devices with different formats, or a device with dual-SIM. Dual automation executives can also be running in parallel for duel device test.

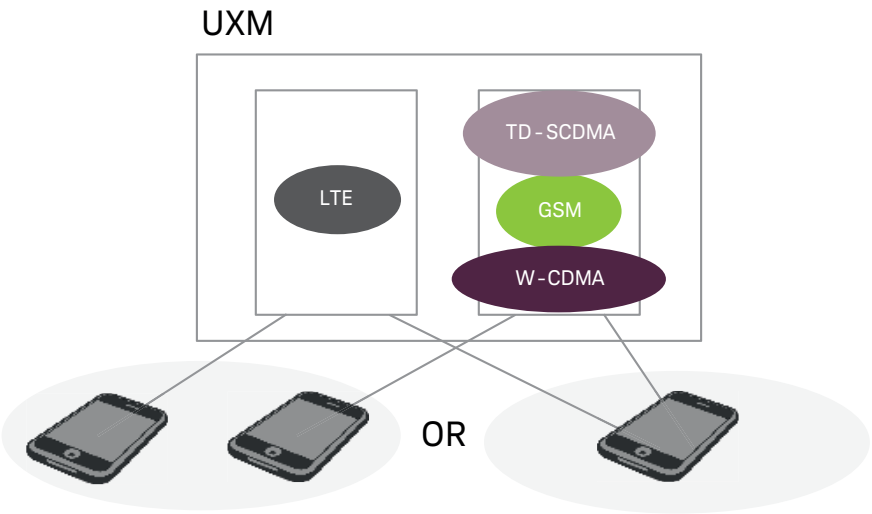


Figure 23. Using two TRX transceiver modules set to test two devices simultaneously or a dual-SIM device

Be Ready for Functional and RF Design Validation in 4G and Beyond

Test the latest LTE-A features now and easily expand capabilities and test coverage later

The UXM's power-packed hardware is ready to meet the 4G demands of today, and the test challenges of tomorrow. Eliminate the cost and downtime of upgrades with UXM's future-ready, multi-format platform that will handle the next advancements in antenna techniques, component carriers, and data rates.

The UXM features two, fully-independent 100-MHz RF transceivers, and every source and analyzer is MIMO-enabled. This flexible foundation enables multiple cells, carrier aggregation, higher order MIMO, and integrated fading, to address wireless test needs now and into the future.

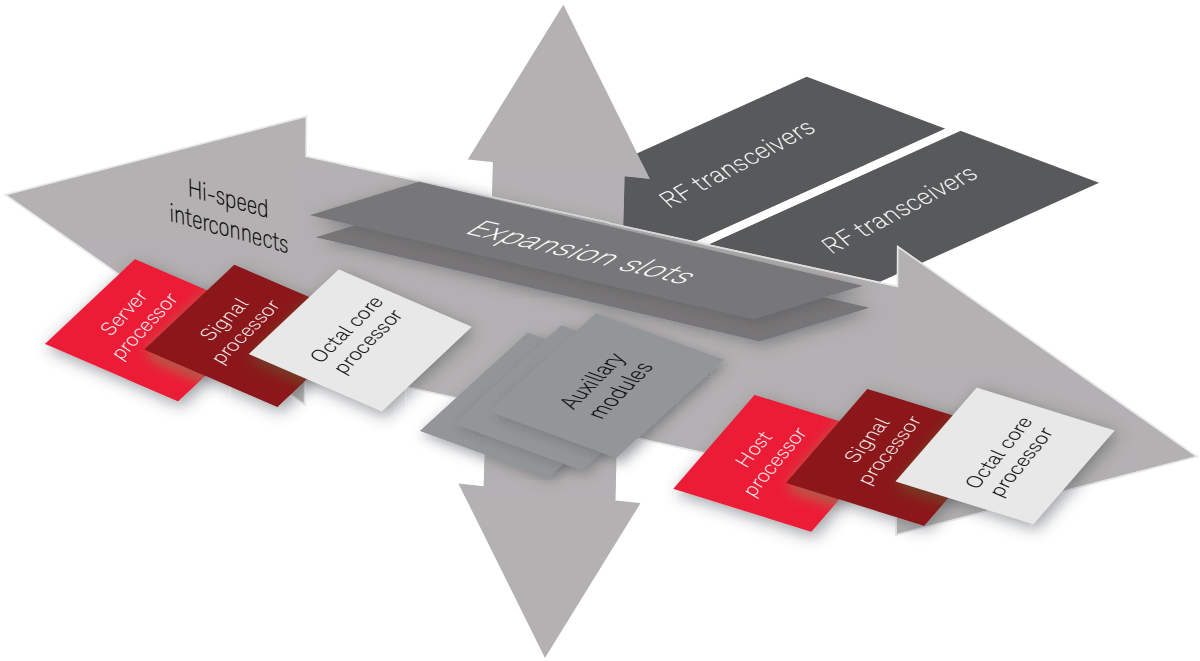


Figure 24. The UXM is built on a future-ready platform to handle the test challenges of tomorrow

Be Ready for Functional and RF Design Validation in 4G and Beyond (Continued)

Evolve as technology advances

The UXM was designed with the future in mind. Its extensible architecture includes high-speed interconnects, upgradeable processors, and multiple expansion slots, so it can readily adapt to the evolution of wireless technology.

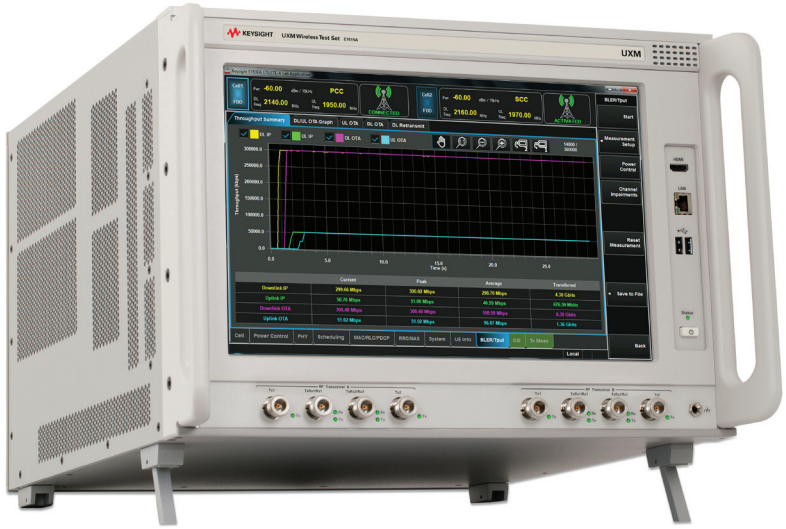


Figure 25. The UXM was designed to easily evolve with technology

The UXM's powerful backplane can readily handle the high data flows required for today's 4G applications and was architected for extensibility. Multiple UXMs can be interconnected, enabling numerous synchronized cells and component carriers.

The UXM also includes several rear expansion slots, for easy addition of internal servers and extension of processing power and FPGA capabilities to support complex antenna configurations and advanced modulation formats.

Easily handle tomorrow's demanding test needs

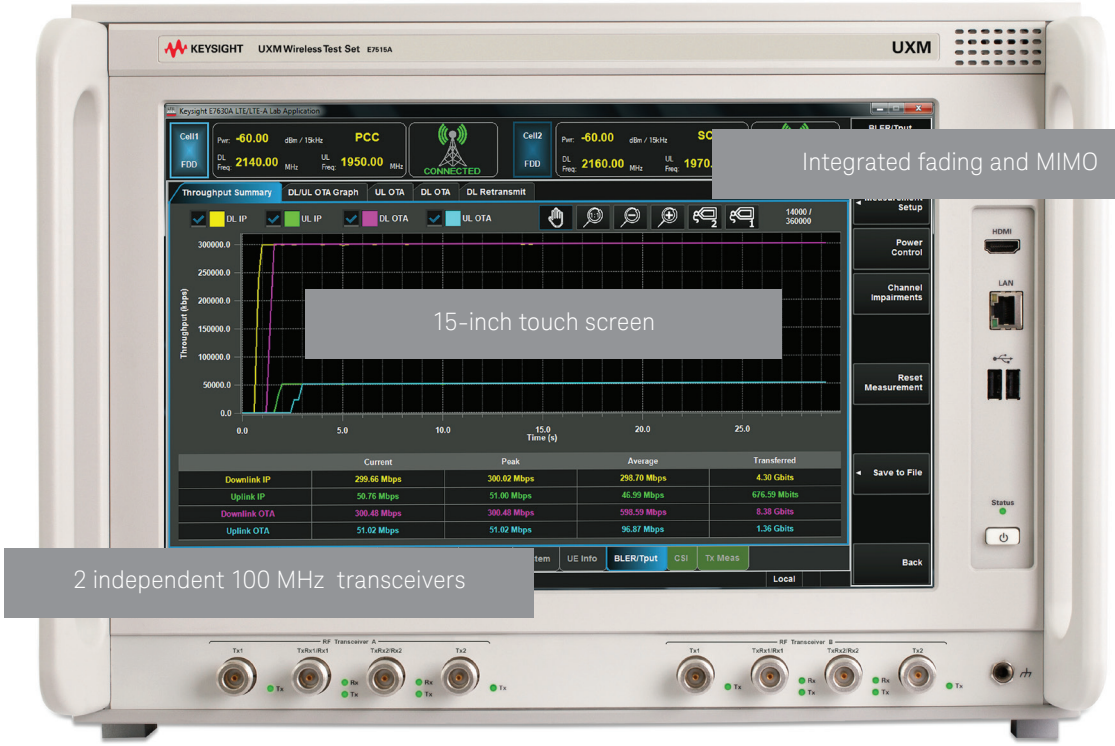


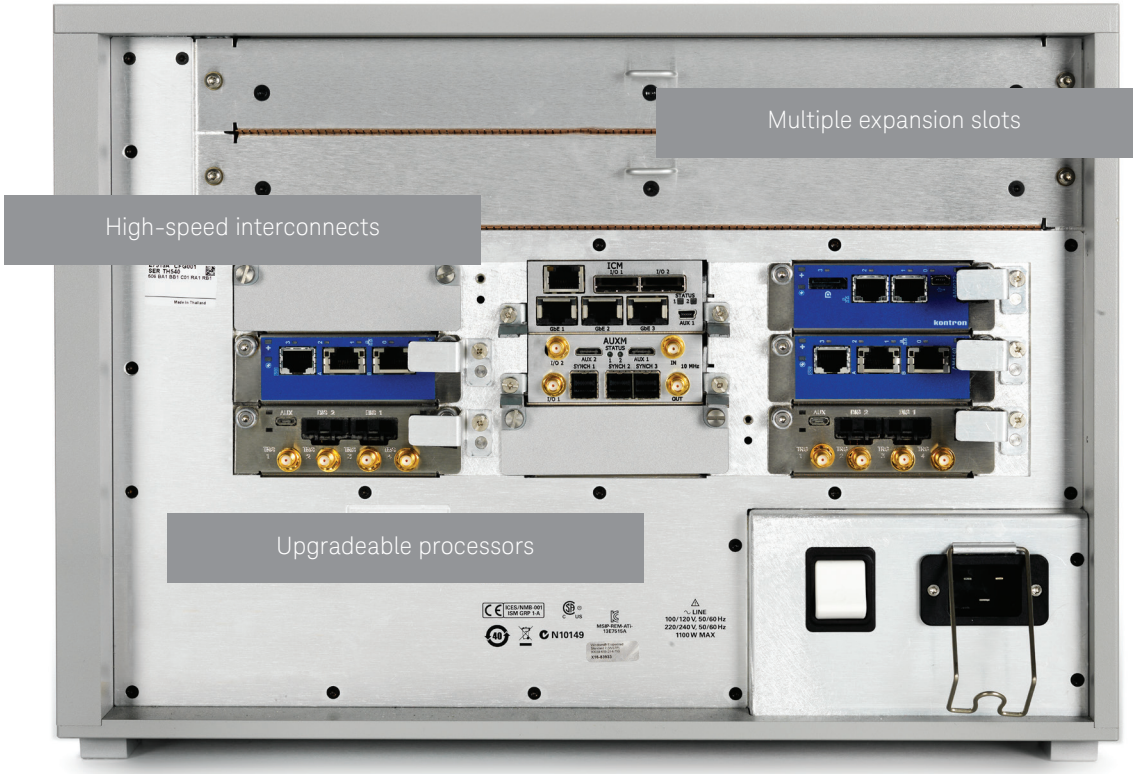
The UXM's versatile 15-inch touch-screen interface affords ultimate flexibility for the future and intuitive ease of use today.

With a click of a mouse or the touch of a finger, efficiently navigate UXM's depth of features and configurability, investigate issues, and get to the root of problems quickly.

The UXM's soft key and tab-driven interface makes true remote instrument control a reality, without the need for hardkey emulation.

UXM: Designed with the Future in Mind





Make a Seamless Transition to the UXM

Leverage existing test software and product experience

The UXM's new-yet-familiar user interface allows you to apply your knowledge of X-Series measurement applications and Keysight's other wireless test sets and supporting software to get up and running quickly.

Save time. Leverage existing test software with minimal changes and simplify your transition with the expertise of local application engineers.

Get more from every budget dollar through Keysight's tradition of investment protection. Find the optimum migration path with programs such as cost-effective upgrades, bundled offerings, and trade-in credits. Leverage your existing and 8960 software investments with UXM Equivalent Seat Licenses (ESL).



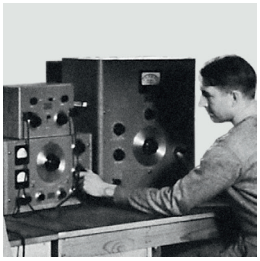
Figure 26. The UXM is built on a foundation of trusted Keysight solutions

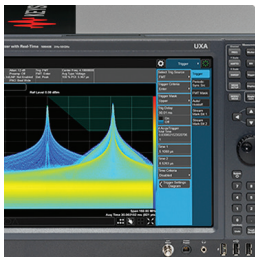
Related Resources

- *E7515A UXM Wireless Test Set*, flyer, literature number 5991-3849EN
- *E7515A UXM Wireless Test Set*, configuration guide, literature number 5991-4078EN
- *E7515A UXM Wireless Test Set*, data sheet, literature number 5991-4634EN

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