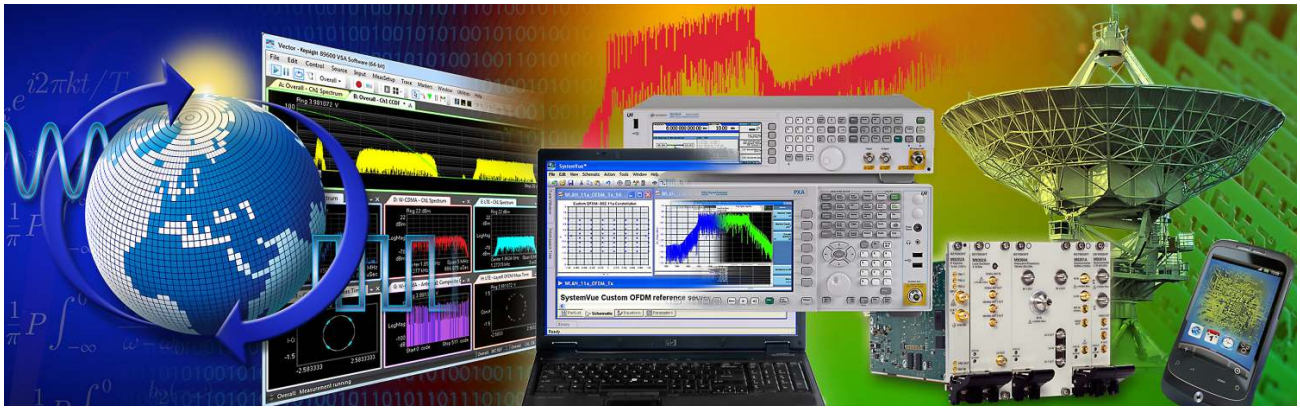
Keysight Technologies
Faster Validation with Design and Test Integration

Turn great ideas into validated products—faster



KEYSIGHT TECHNOLOGIES

A Changing Industry

In RF comms development, aggressive specs and evolving technologies shouldn't slow you down. Keep moving forward with the Keysight Technologies, Inc. RF workflow environment: It's the comprehensive way to simulate, measure and analyze communications components and systems. Through application-specific solutions, we can help you achieve greater levels of confidence in your designs, products and schedules. The foundation is proven hardware and software products that let you leverage our decades of experience in high-frequency systems.

Communication systems used for commercial wireless, military and satellite communications, radar, and electronic warfare (EW) applications have grown increasingly complex. Adding to that challenge are extreme competitive pressure and the need for ever higher performance and design robustness.

Enabling fast and effective RF and microwave (MW) communication systems and component development demands a workflow with better integration between design and test to help teams:

- Reduce development cycle time
- Achieve higher performance
- Attain earlier system validation

The Challenge with a Traditional Workflow

Traditional RF/MW communication system development follows a sequential progression from idea through verification and involves limited interaction between baseband and RF teams, and between design and test. With the traditional workflow:

- Different tools and design languages used by each team introduce discontinuities and system integration risks that can increase product development time.
- Most design tools have poor to no real-world basis, and rely on closed-form mathematical models to represent real-world effects.
- Limited interconnection with test equipment hinders improving modeling accuracy, preventing high-fidelity predictive design.

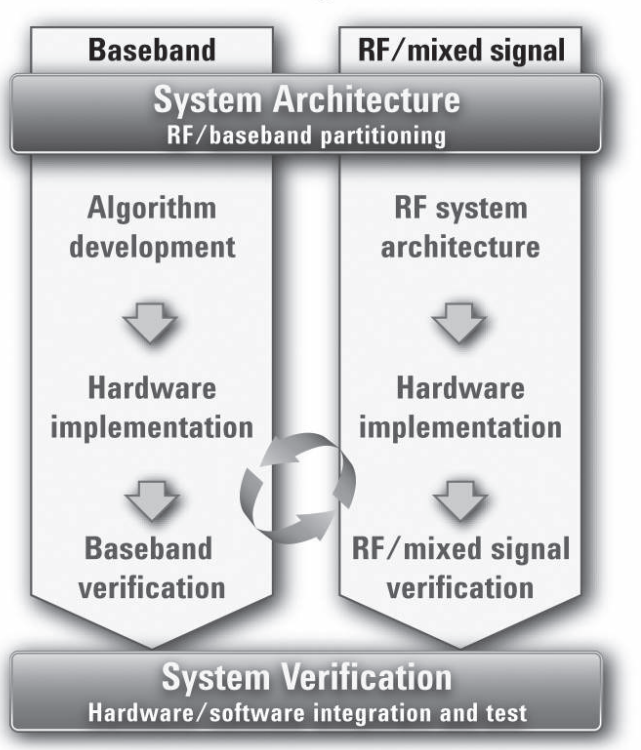


Figure 1. Traditional RF/MW communication system development workflow

Without common methods and test benches, there are many places in the workflow where design flaws and performance issues can be masked. This leads to either expensive over-design or rework cycles, since there is no methodology to validate and optimize design performance throughout the product development lifecycle.

Want more information? For more details, please visit www.keysight.com/find/rfworkflow

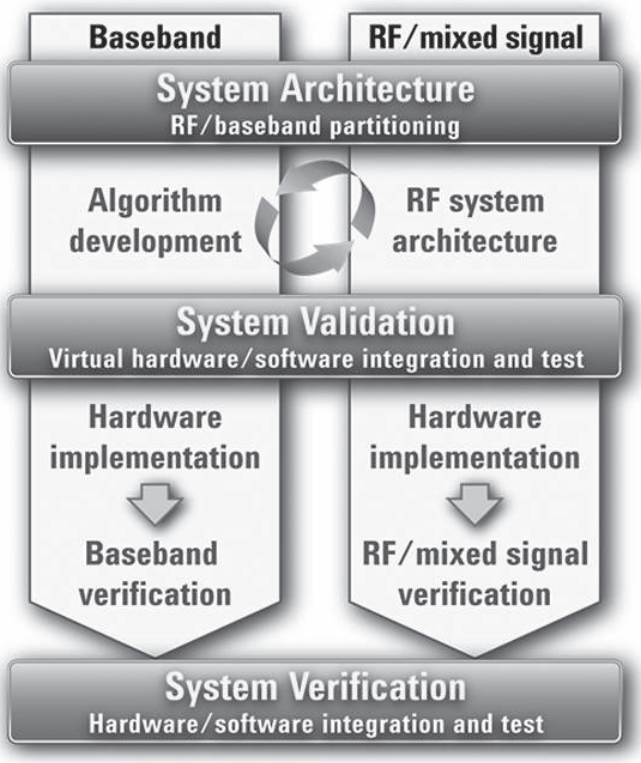


Figure 2. RF/MW workflow with design and test integration

Why an Integrated Design and Test Approach is Better

Integrating design and test within the RF/MW communication system development workflow allows multi-discipline design teams to efficiently interact using common tools, methods and test benches. With this workflow:

- Laboratory-quality measurement is available to the design creation process, first enabling more accurate device models based on measurement.
- In system-level simulation, measured behavior can substitute for higher-level models as hardware components become available, resulting in more accurate simulations.
- Design intellectual property (IP) is available to the hardware measurement space for more specialized and accurate hardware validation.

Bringing real-world measurement and test earlier into the design process enables design flaws to be captured early and corrected in a time- and cost-efficient manner, reducing overall development cost and improving design-to-manufacturing cycle time.

How Keysight's RF Workflow Environment Helps

With Keysight's RF workflow environment you can:	
Reduce development cycle time	Increase design predictability and cross-domain team collaboration with well-connected tools
	Find/fix integration problems earlier
Achieve higher performance	Optimize design margins with more accurate simulations
	Demonstrate performance to your customers earlier
Attain earlier system validation	Quickly interpret/adapt to evolving requirements
	Validate designs meet customer requirements before building prototypes
	Reduce risk of finding problems late in the integration phase

Examples of how Keysight's RF workflow environment helps in wireless and aerospace/defense (A/D) applications are found on the following pages.

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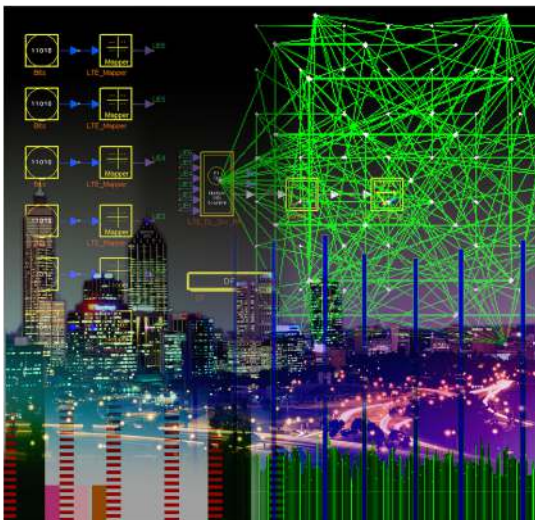

In Wireless you can accelerate next-generation designs with earlier validation. Fine-tune amplifier performance earlier in the development cycle. Validate your RFIC designs before building prototypes or baseband hardware becomes available. Start sooner with Keysight's early support of the latest standards.

Accelerate Next-Generation Wireless Designs with Earlier Validation

Complex emerging technologies and severe competitive pressure pose technical and time-to-market challenges to developers of communication systems and components. Keysight's RF workflow environment enables faster design validation and greater confidence in the project schedule with application-specific solutions that combine design software with test instruments.

Wireless Industry	
Industry drivers	Time
	Cost
Challenges driving the need for design and test integration	Ever-faster time-to-market
	Ever-shorter product cycles
	Ever-greater device integration
	Commoditization of wireless products
	Continuing pressure on price, cost, and profit margins

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Digital Pre-Distortion (DPD)

Challenge

DPD is a cost-effective linearization technique enabling a power amplifier (PA) to operate in its high power-added-efficiency region, near saturation and without significant signal distortion. It is ideal for addressing a key base station/mobile device PA design challenge. However, it requires a highly specialized skill set for modeling, implementation and verification.

Solution: Keysight's RF Workflow Environment

Make implementing DPD during PA development faster and more practical. Designers can prove their PA may be linearized with DPD in minutes, before building a prototype or after hardware is available. Implementation of DPD linearization networks is also accelerated, first with a PA model in the virtual world or later with PA hardware/test instruments.

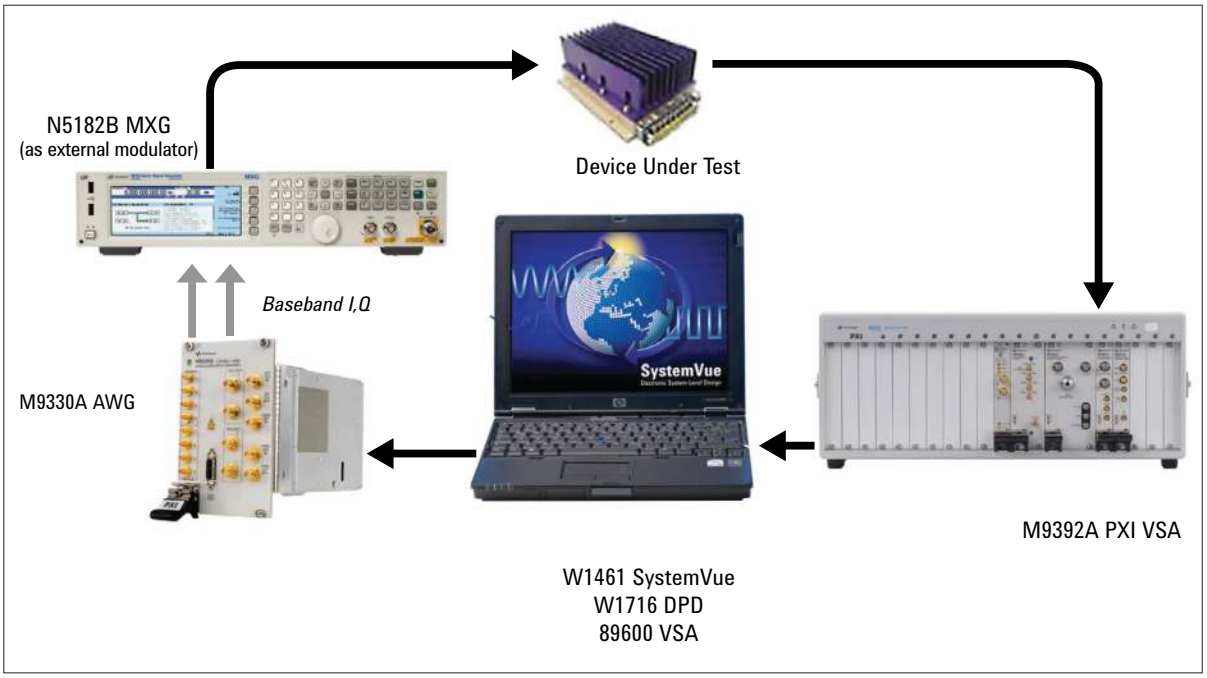

Figure 3. DPD measurement setup for a wideband power amplifier

Reduce development cycle time

SystemVue and DPD Builder work together to evaluate DPD algorithms on PA hardware before implementing them on an FPGA or ASIC. Flexible built-in links to test instruments and software like the MXG signal generator, M9330A AWG, and 89600 VSA, enable faster hardware verification.

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Creating Simulation Models From Measurements and Simulation

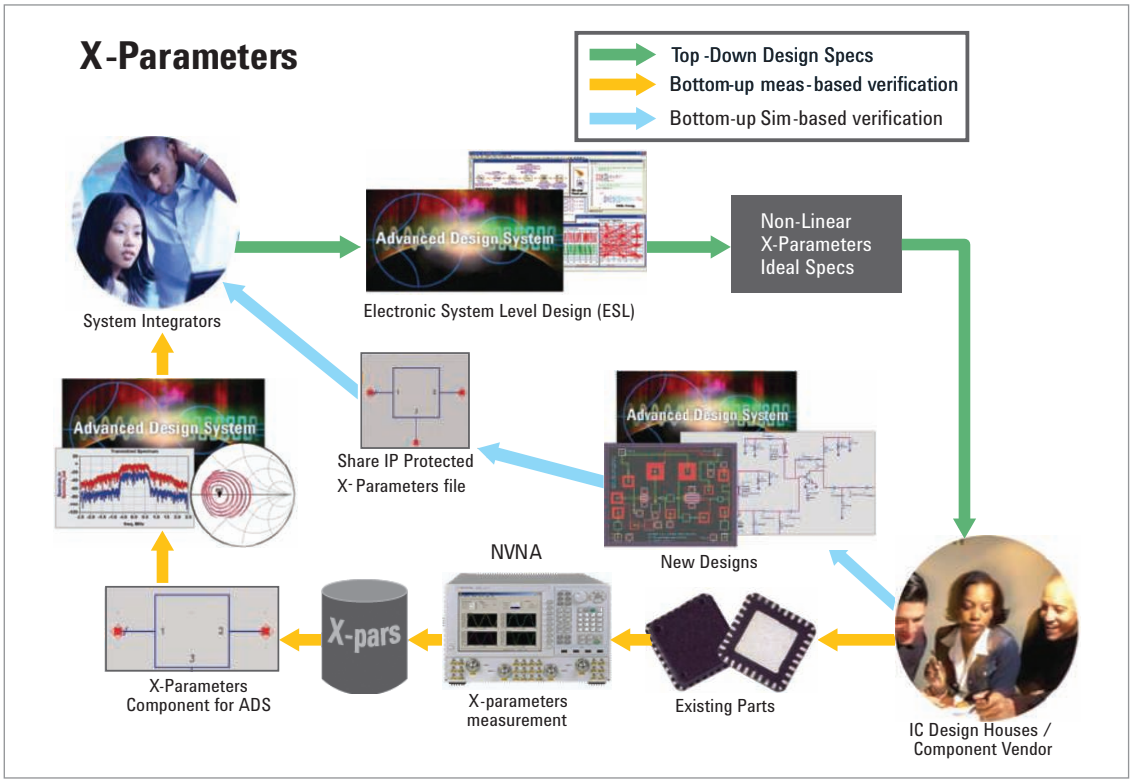

Figure 4. Generate X-parameters behavioral model from simulation or measurement

Challenge

Detailed circuit designs can provide design component vendors with a means of sharing their component performance with system integrators; however, issues concerning IP protection often prevent the designs from being shared. Instead of sharing IP, vendors typically make system integrators wait for actual hardware prototypes.

Solution: Keysight's RF Workflow Environment

Vendors can create X-parameters* models of their circuit-level designs, which may then be provided to customers before a physical prototype is available. The models retain the design's nonlinear characteristics, allowing this information to be accurately communicated and simulated with full IP protection.

Higher performance

X-parameters are created from measurements using the PNA-X nonlinear vector network analyzer or generated via ADS simulation from a circuit-level design using ADS's X-parameter generator. The resulting models are fast, drop-in useable and accurate. Customers can use them to perform more accurate, "closer to real" system simulation and request earlier spec changes prior to prototyping; increasing the vendor's chance of winning a design socket in the customer's device before hardware is delivered.

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Performing System-Level Verification with EVM and BER

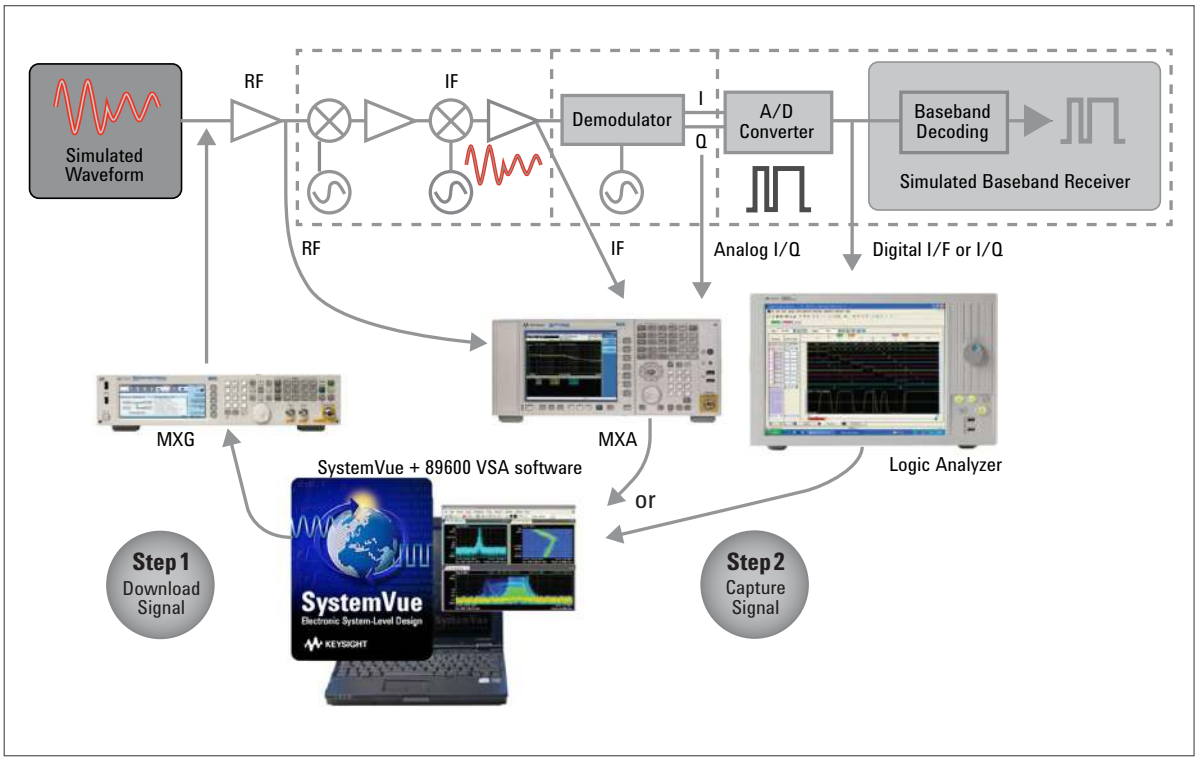

Figure 5. Measure coded BER at any stage of a receiver chain

Challenge

System-level RFIC verification is critical to understanding the design performance and requirements needed to achieve transmitter and receiver system-level metrics like error-vector-magnitude or bit-error-rate. Improper verification may result in poor correlation between simulation and measured hardware.

Solution: Keysight's RF Workflow Environment

Make system-level verification faster and more cost-effective by reducing post-silicon design turns. The environment provides designers with a greater level of confidence in the correlation between simulation measurements and those made with actual hardware.

Earlier system validation

Ensure transmitter EVM meets requirements before prototype hardware is built using the 89600 VSA software and SystemVue. EVM contribution from multiple signal formats in multiple bands can be simultaneously measured at every stage of the transmitter chain. Links to test instruments enable faster and more accurate testing once hardware is available. Measure receiver coded BER at every stage of its chain, before baseband hardware is available, by combining test instruments with SystemVue's baseband source and receiver simulation capability.

Want more information?

For more details, please visit www.keysight.com/find/rfworkflow

In Aerospace and Defense you can build greater assurance in system readiness with earlier validation. Evaluate radar/EW system performance with highly realistic signal scenarios. Easily test components and systems that carry proprietary communication signal formats.

Build Greater Assurance in System Readiness with Earlier System Validation

Programs and missions evolve with a changing mix of people and technology. As technology becomes more complex, assuring readiness gets tougher. For high-performance designs used in mobile/satellite communications, radar and EW, Keysight's RF workflow environment minimizes system integration risks with application-specific solutions combining design software with test instruments.

Aerospace/Defense Industry	
Industry drivers	Minimizing risk
	Demand for a more future-proof investment
Challenges driving the need for design and test integration	Having to do more with less
	Utilization of commercial off-the-shelf (COTS), rather than custom, solutions
	Need to quickly turn product revisions due to rapid changes on the front lines

Want more information? For more details, please visit www.keysight.com/find/rfworkflow

Realistic Scenario Generation and Analysis

Challenge

Radar and EW systems face an increasingly cluttered spectral environment. Evaluating radar/EW hardware under a variety of highly realistic scenarios can help characterize system performance in the presence of multiple interference signals.

Solution: Keysight's RF Workflow Environment

Simplify creation and analysis of highly realistic multi-emitter test signals for lab-based testing of radar/EW devices still in development with COTS software and instrumentation. The combination of software and hardware makes it possible to alter an offending emitter's frequency, power or bandwidth, including scalable emitters such as OFDMA signals.

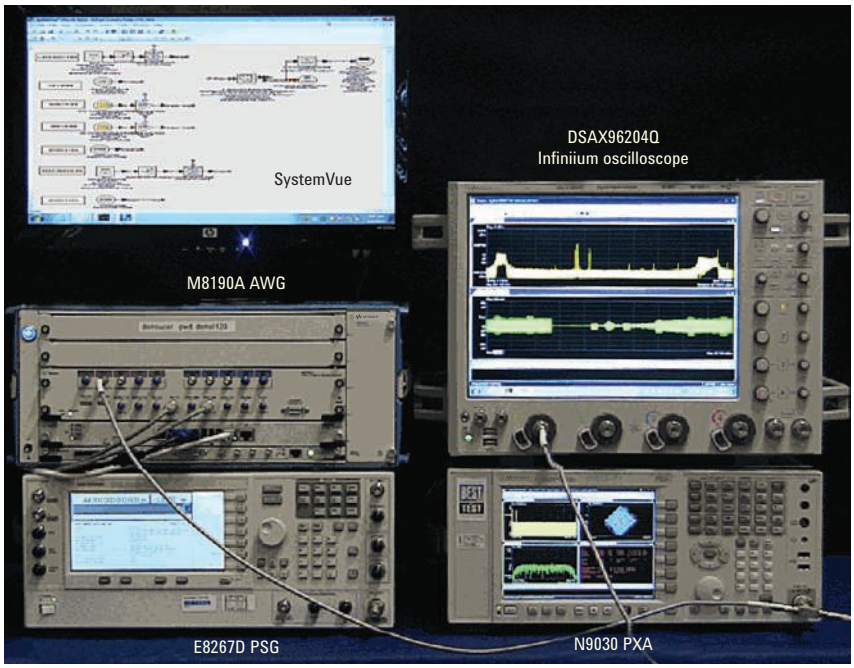

Figure 6. Multi-emitter test signal generation and analysis

Reduce development cycle time

SystemVue's SignalCombiner enables creation and combination of multi-emitter signals within the simulation environment, such as LTE/WCDMA and GSM/EDGE. Through resampling, multiple emitters are combined into a single waveform that can be downloaded to a high-precision AWG, such as the Keysight M8190A, for playback. The 89600 VSA software runs inside an oscilloscope or the PXA signal analyzer, providing demodulation capabilities.

The RF workflow environment covers a significant number of likely use cases for testing in R&D applications. Its lower cost makes it possible to equip multiple designers or teams with individual systems, facilitating better analysis of various scenarios prior to testing a device with a real-time system.

Want more information?

For more details, please visit www.keysight.com/find/rfworkflow

Software Defined Radio (SDR)

Challenge

Designing and testing SDRs is challenging, requiring a substantial amount of time and resources, and involving different baseband and RF design teams using different tools. Additionally, OFDM waveforms are becoming much more complex (e.g., LTE) and when used in military communications applications are often custom or non-standard.

Solution: Keysight's RF Workflow Environment

Rapidly create OFDM waveforms for custom/proprietary SDR implementations using a COTS system design and test solution capable of supporting baseband and RF methodologies. Performing more accurate simulations that include baseband and RF accelerates SDR design activities and increases design predictability, while reducing baseband/RF system integration risks. Testing hardware implementation minimizes risk and completes the integrated SDR design-to-test flow faster.

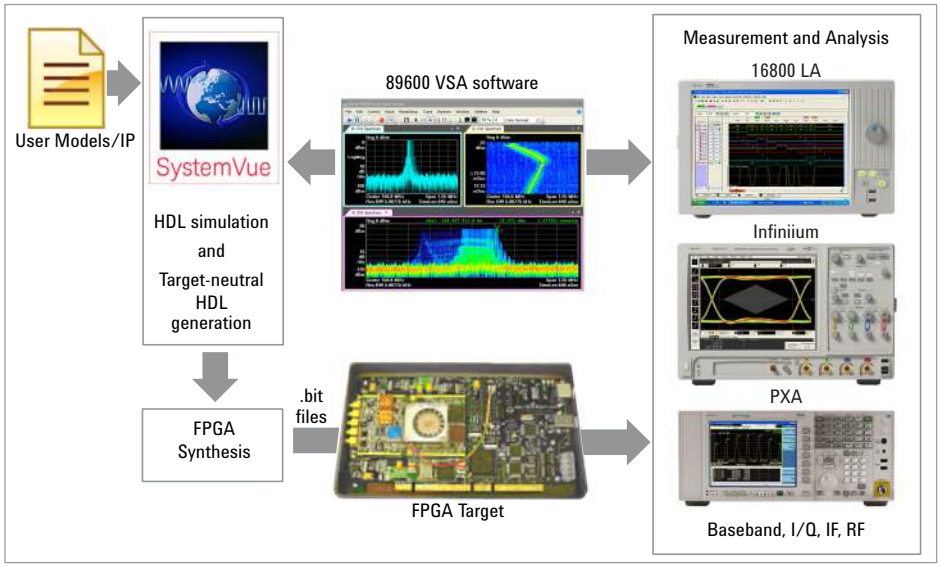

Figure 7. Design and test integration with FPGAs and RF for an SDR development workflow

Reduce development cycle time

SystemVue's customizable LTE and WiMAX™ baseband exploration libraries and custom OFDM library provide the starting point for baseband and system design. The models can be used as-is or modified for a custom/proprietary SDR implementation. Baseband FPGA HDL is co-simulated in SystemVue with the RF transceiver design, prior to building actual hardware, reducing the risk of finding errors during hardware integration.

Earlier system validation

Integrated links with test equipment and the 89600 VSA software enable SDR RF/baseband testing at every step of the design phase. During hardware implementation, the design is demodulated using a signal analyzer. The 89600 VSA software provides in-depth analysis and troubleshooting of OFDM signals, first in simulation with SystemVue and then in a mixed-signal hardware environment at baseband with a logic analyzer and at I/Q, IF or RF with an oscilloscope or RF signal analyzer.

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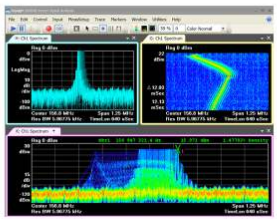
Keysight's RF workflow environment is the comprehensive way to simulate, measure and analyze communications components and systems. Through application-specific solutions, we can help you achieve greater levels of confidence in your designs, products and schedules. The foundation is proven hardware and software products that let you leverage our decades of experience in high-frequency systems. Accelerate with Keysight and turn great ideas into validated products—faster.

Depending on the application-specific solution, a subset of the following software, signal generation and signal analysis products is used:

SystemVue

Advanced Design System

89600 VSA software



MXG Signal Generator

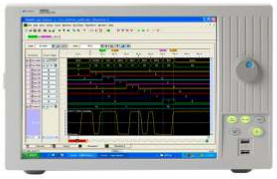
PXA Signal Analyzer

DigRF RDX

PSG Signal Generator

Infiniium 90000 Oscilloscope

16800 Logic Analyzer



M8190A AWG

M9381A
PXIe VSG

Wideband MIMO PXI VSA

PNA-X NVNA

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