AOC 2025 International Symposium & Convention

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AOC 2025 International Symposium & Convention

Enabling Navy Readiness Through Real-Time Test Innovation

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December 10, 2025

PROGRAM MANAGER BRIEFING SERIES
WHERE GOVERNMENT & INDUSTRY MEET

The RF/μwave Test & Measurement Challenge

Challenges

1. *How do we test and validate our next-generation RF/μwave, EW, EMSO, CEW, and AI-Enabled CEW / EMSO Systems?*

2. *How do we accelerate deployment & improve System Readiness Level?*

RF/µwave Test & Measurement Challenges

Traditional Sequential RF Testing

- Sequential, channel-by-channel measurements
- Non-real-time processing significantly extends total test duration

RF Testing Bottleneck

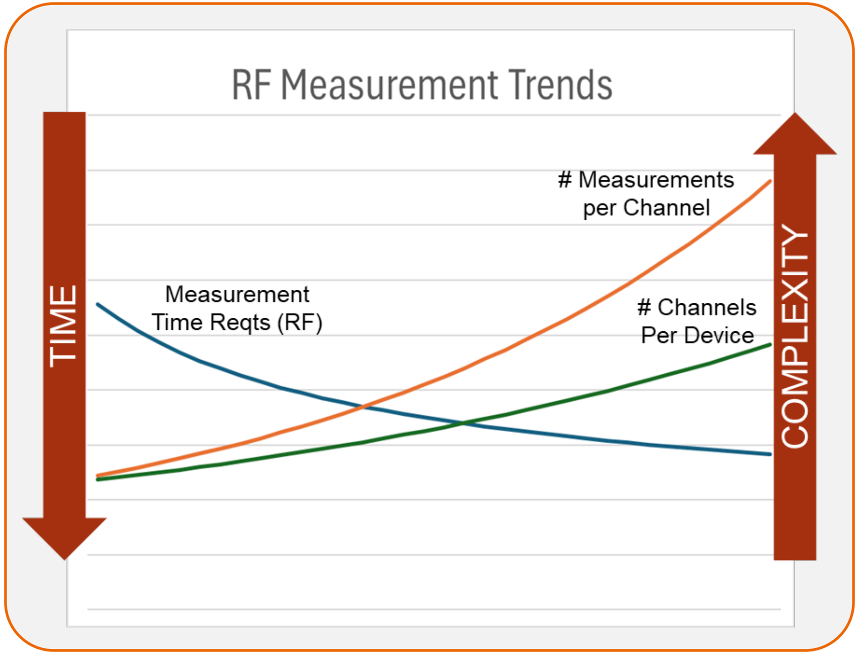
- Limited parallelism reduces throughput as channel count increases

Expensive to Parallelize

- Requires capital-intensive investments to deploy and maintain multiple test stations

Resulting in Long Test Cycles

- Leading manufacturers cite measurement duration as a major production bottleneck



Extending to CEW/EMSO Applications

X Traditional Sequential RF Testing

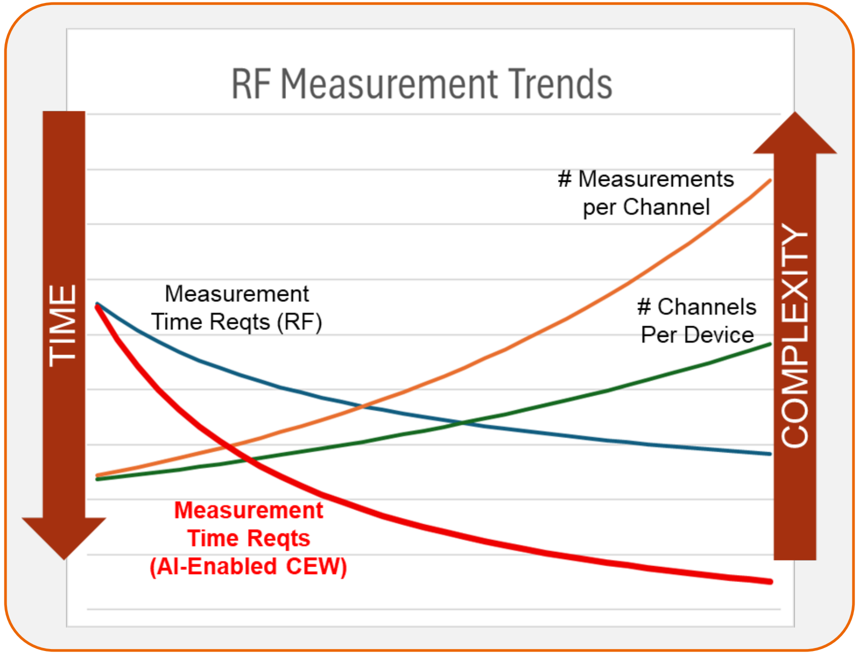
- Non-real-time processing

X Limited Parallelism Bottleneck

- Restricts throughput

X Expensive

- Requires capital-intensive investments



AI-Enabled CEW Increases Test Demands

- Adaptive, multi-function CEW, EMSO, & emerging AI-Enabled CEW systems dramatically raise measurement complexity
- Requires real-time measurements and low latency responses
- Requires adaptive measurement software
- Requires real-time measurement reconfigurability

Several Industries are Facing These Challenges

Parameter Trends	AESA
Higher frequency	X
Wider Bandwidth	X
Multi-channel	X
High beam count	X
Phase coherent	X
Complex modulation	X
Complex multipath	
Spectrum coexistence, interference	
AI-Enabled & Cognitive	X
Multi-functional	
Integrated architectures	X
Real-time test/eval	X

Several Industries are Facing These Challenges

Parameter Trends	AESA	CEW/EMSO
Higher frequency	X	X
Wider Bandwidth	X	X
Multi-channel	X	X
High beam count	X	X
Phase coherent	X	X
Complex modulation	X	X
Complex multipath		X
Spectrum coexistence, interference		X
AI-Enabled & Cognitive	X	X
Multi-functional		X
Integrated architectures	X	X
Real-time test/eval	X	X

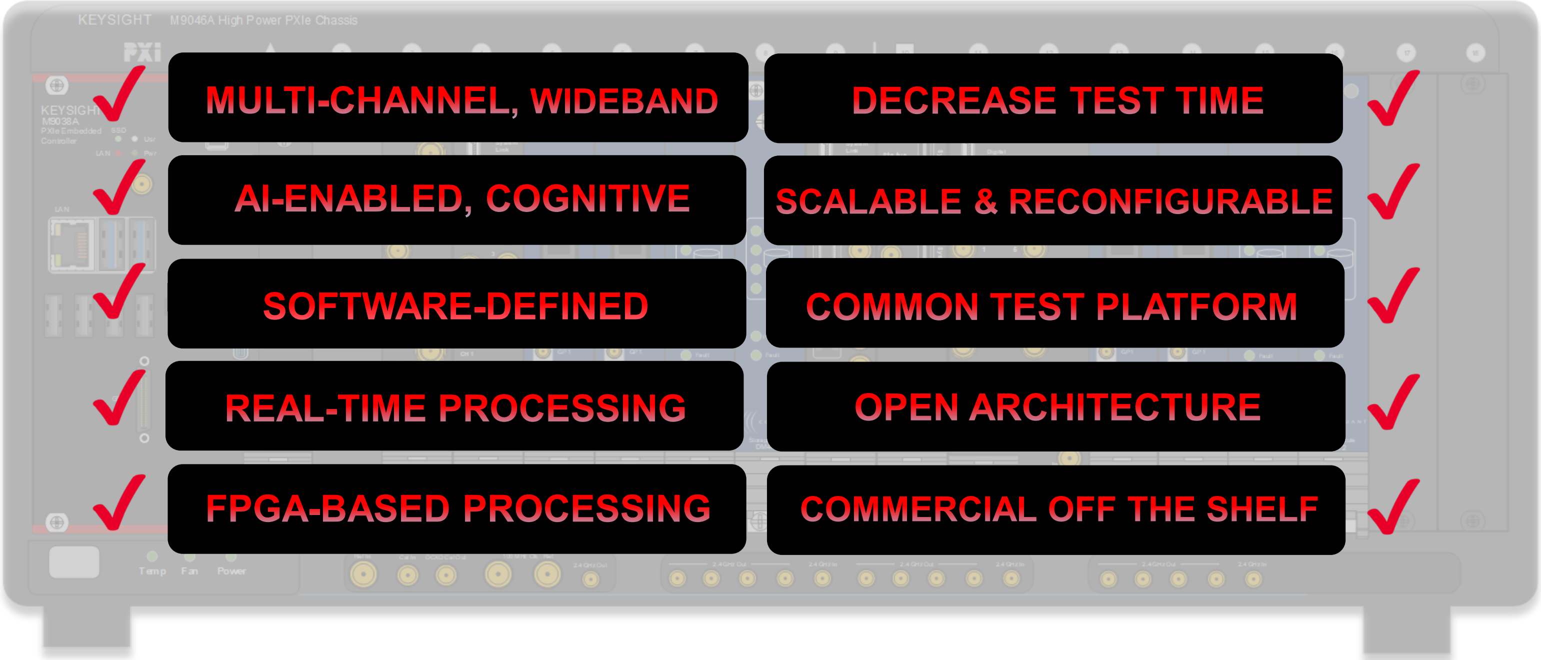
Several Industries are Facing These Challenges

Parameter Trends	AESA	CEW/EMSO	SATCOM-GND
Higher frequency	X	X	X
Wider Bandwidth	X	X	X
Multi-channel	X	X	X
High beam count	X	X	X
Phase coherent	X	X	
Complex modulation	X	X	X
Complex multipath		X	
Spectrum coexistence, interference		X	X
AI-Enabled & Cognitive	X	X	X
Multi-functional		X	
Integrated architectures	X	X	
Real-time test/eval	X	X	X

Several Industries are Facing These Challenges

Parameter Trends	AESA	CEW/EMSO	SATCOM-GND	NG-Wireless
Higher frequency	X	X	X	X
Wider Bandwidth	X	X	X	X
Multi-channel	X	X	X	X
High beam count	X	X	X	X
Phase coherent	X	X		X
Complex modulation	X	X	X	X
Complex multipath		X		X
Spectrum coexistence, interference		X	X	X
AI-Enabled & Cognitive	X	X	X	X
Multi-functional		X		X
Integrated architectures	X	X		X
Real-time test/eval	X	X	X	X

Demands for Next-Generation RF/μwave Test Solutions



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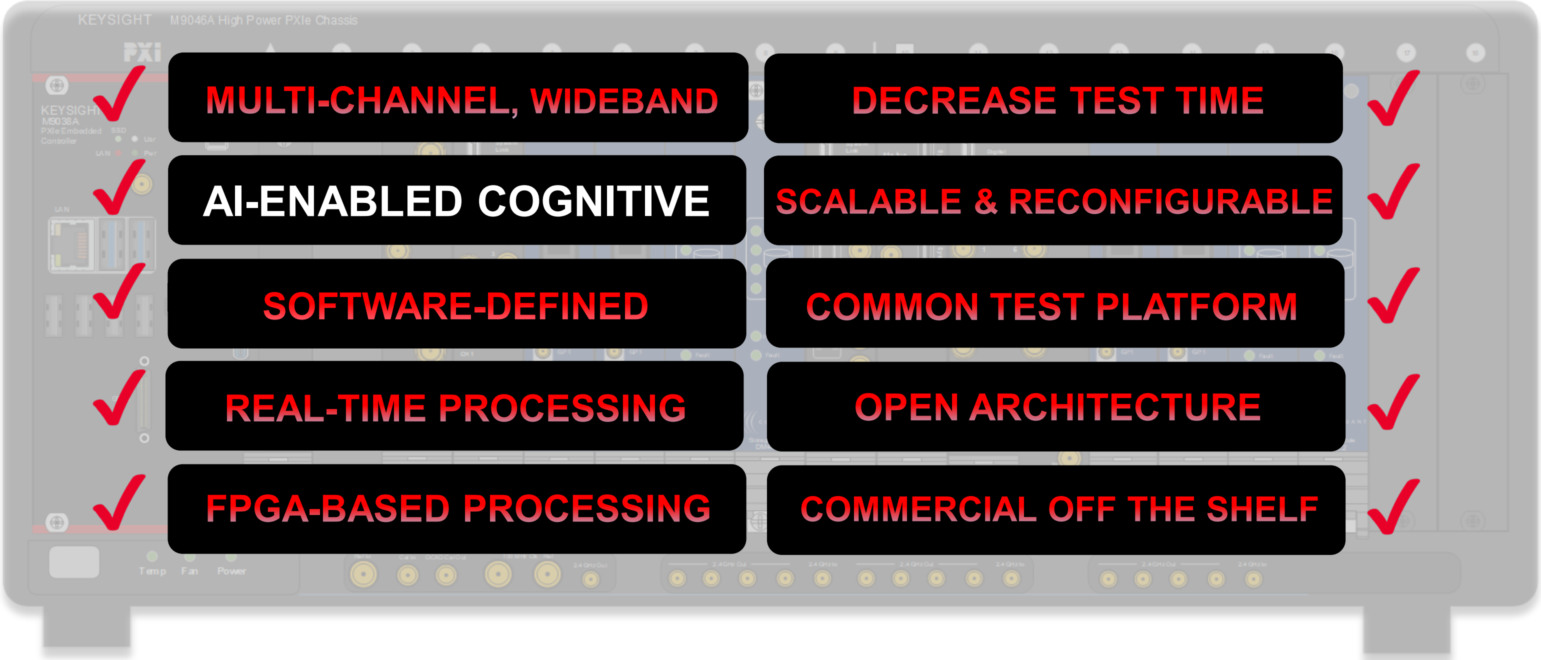
Demands for Next-Generation RF/µwave Test Solutions



- ✓ MULTI-CHANNEL, WIDEBAND
- ✓ AI-ENABLED COGNITIVE
- ✓ SOFTWARE-DEFINED
- ✓ REAL-TIME PROCESSING
- ✓ FPGA-BASED PROCESSING
- ✓ DECREASE TEST TIME
- ✓ SCALABLE & RECONFIGURABLE
- ✓ COMMON TEST PLATFORM
- ✓ OPEN ARCHITECTURE
- ✓ COMMERCIAL OFF THE SHELF

Multi-channel, modular, COTS, FPGA-based, real-time Software-Defined Synthetic Instrument

Real-Time RF/μwave Test – Requirements

Frequency Ranges
10MHz to 40GHz, up to 54GHz

Per Channel Bandwidth (Wideband)
1GHz (now), 2GHz (next), 4GHz (hoping)

Real-Time Processing
Gapless Processing
Measurement Time: >>10x reduction
Latency: <<10 μsec

Multi-Channel (Real-Time Processing)
RF Record: 4x0, 8x0, 16x0, 20x0, ….
RF Record & Playback: 4x4, 8x8 (MIMO)
Antenna Testing: 4Ch, 8Ch, … 28Ch

Channel Match (across bandwidth)
Amplitude: $< \pm 0.5$dB, Phase: $< \pm 0.5^\circ$
Time Alignment (Skew): $<< \pm 500$ femtosec

Coherency
Frequency & phase (selectable)

Record/Playback Modes
Snapshot (DDR) & Stream-to-RAID
Concurrent RF Record & RF Playback
RF Record & Loopback (modified)

Record/Playback Time
Minimum: 10μsec
Maximum: Several hours

The “Golden Radio” RF/μwave Test Method

The golden radio method is acceptable for

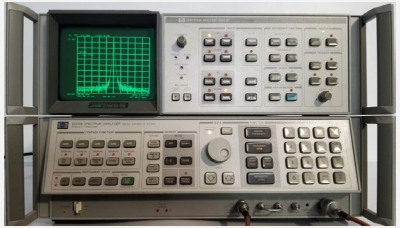
- Simple RF modules
- Basic transceiver validation
- Low-performance, narrowband systems

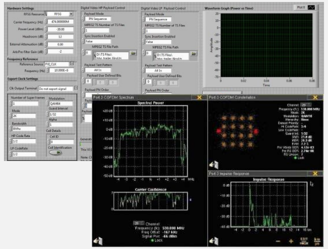
But it is inadequate and risky for

- Wideband EW receivers
- AESA or multi-element RF systems
- AI-enabled CEW systems
- Any architecture requiring deterministic real-time, low-latency, phase, timing, or closed-loop measurement

As system complexity rises, the golden radio test method introduces error, hides defects, and cannot serve as a traceable reference.

Evolution to Real-Time RF/μwave Test & Validation

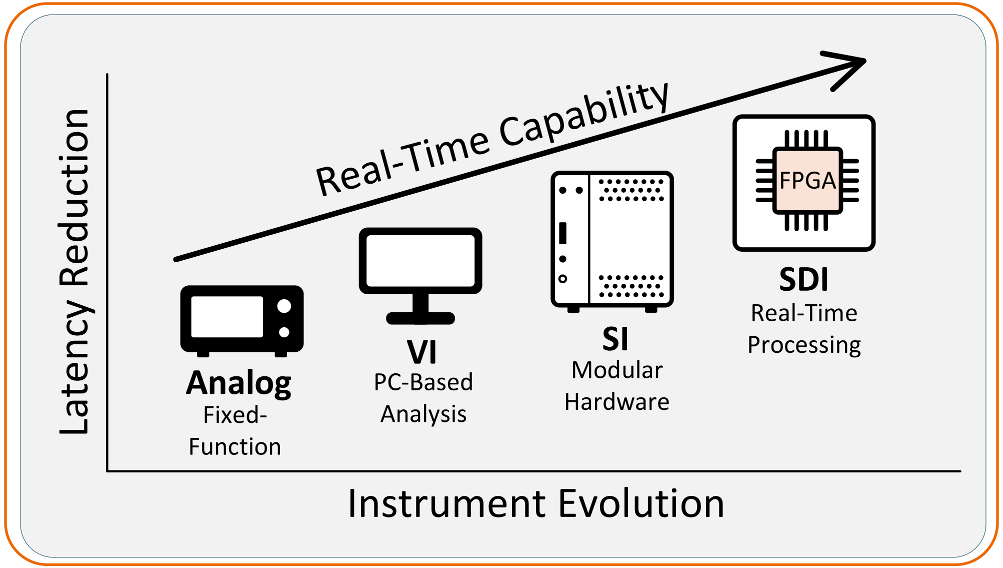




1960s	1990s	2005	2019
Box Instruments	**Virtual Instruments**	**Synthetic Instruments**	**Software-Defined Instrument**

Multi-channel, modular, reconfigurable, COTS-based, FPGA-based, real-time Software-Defined Instruments addresses next-generation RF systems test requirements.

Evolution to Real-Time RF/μwave Test & Validation

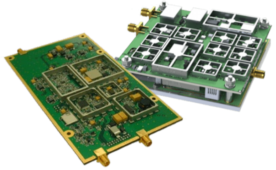


Multi-channel, modular, reconfigurable, COTS-based, FPGA-based, real-time Software-Defined Instruments addresses next-generation RF systems test requirements.

System Readiness Level (SRL) Improvement

Common modular RF/µwave test platform across all product phases

Phase 1
RF Modules
Fab and Assembly



1-2 RF Channels
per RF Module

Typical Test Approach
- Unique Test Equipment
- 1-2 RF Channels
- Testing: Connectorized

Phase 2
RF System
Assembly and Test

Multiple RF Modules
per RF Assembly

Typical Test Approach
- Unique Test Equipment
- > 20 RF Channels
- Testing: Connectorized

Phase 3
Antenna System
Assembly and Test

Multiple RF Channels
Antenna System

Typical Test Approach
- Unique Test Equipment
- > 20 RF Channels
- Testing: Connectorized & Radiated

Phase 4
Antenna System
Sustainment

Typical Test Approach
- Unique Test Equipment
- > 20 RF Channels
- Testing: Connectorized & Radiated

Summary: RF/μwave Test & Measurement

Challenges

How do we test and validate our next-generation RF/μwave, EW, EMSO, CEW, and AI-Enabled CEW / EMSO Systems?

How do we improve System Readiness Level?

Solution

Multi-channel, modular, reconfigurable, COTS-based, FPGA-based, real-time Software-Defined Instruments