Keysight Technologies
Measurement Leadership in Modular

April 2015

Modular Products
Market Development Manager

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KEYSIGHT TECHNOLOGIES

Modular Advantages

Small Footprint

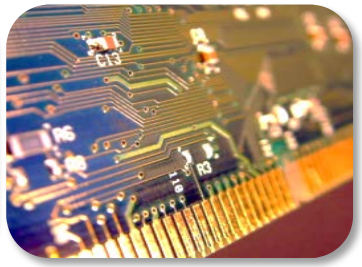
- Smaller machine or higher channel density

High Throughput

- Productivity
- Speed to detection/decision

Total Cost of Ownership

- Lower cost of designed-in
- Interoperability
- Very high reliability
- Reusability and upgradability
- Support and maintenance



Measurement Fidelity

- See and find what you couldn't see before

Keysight in Modular

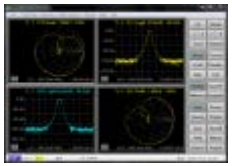
Providing confidence in measurement results across development

Keysight's extensive measurement expertise is applied across form factors, software, and solutions for design through manufacturing applications.

Design simulation	R&D	Design validation	Manufacturing
Save money	Time to Market	Flexibility, Configurability	Lowest cost per test

Consistent software across product lifecycle

EEsof EDA



Network analysis

Signal generation

Signal analysis

One Measurement Science, Common IP across platforms

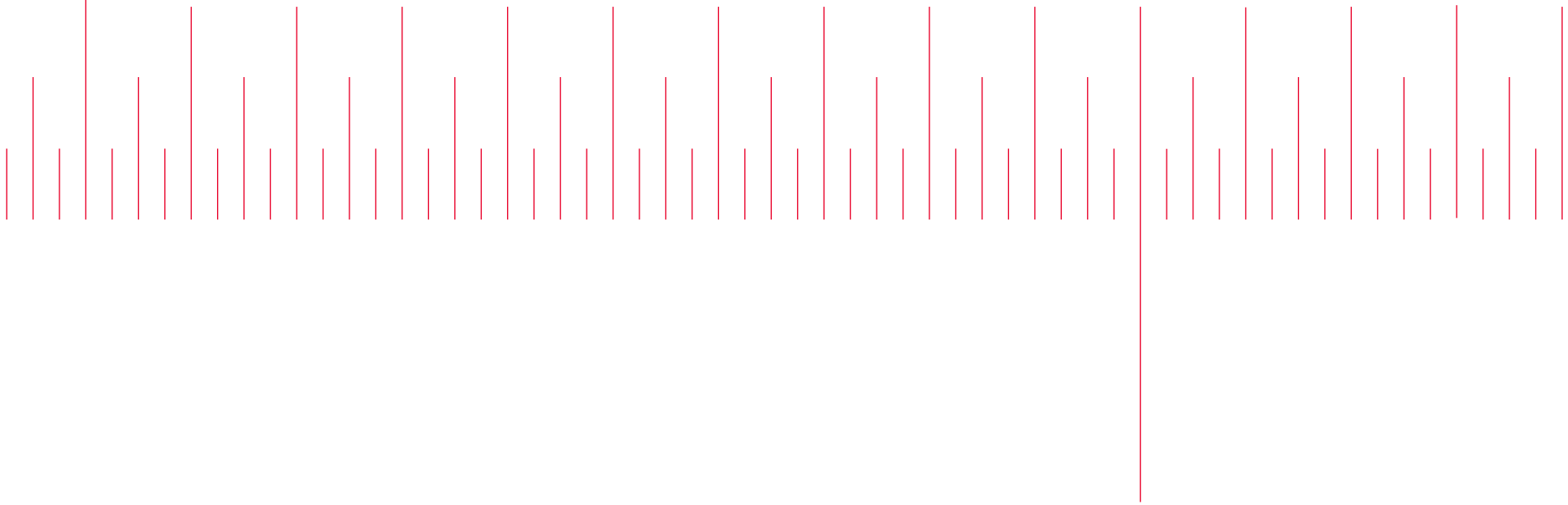
Remove the constraints of "one size fits all"

Benchtop

Modular

Handheld

New Products Overview



KEYSIGHT TECHNOLOGIES

Keysight in Modular- A Growing Portfolio

Functional Test	Digital Comms	A/D	Wireless
High speed DMMs	Logic analyzers	uW VSA	M9393A PXIe performance VSA
Low frequency awitching	PCI express	M9290A CXA-m PXIe signal analyzer	M9391A RF VSA
RF switching	HDMI	PXI VNA	Signal conditioning
DAQ	M8195A AWG	PXI 10 & 15-bit AWG	uWave switches
VI source	16/32GB BERT	uWave switches	Digitizing scopes
Digital IO	Protocol analysis	PXI dual channel VSA	IF digitizers
		M8190/95A AXI AWG	N7109A 8-channel MIMO analyzer
		M9703A AXIe digitizer	M9380/81A RF VSG
			PXI wideband MIMO VSA

New

Chassis, Controllers and IO

AXIe Chassis & controller

PXI Chassis & controller

M940xA PXI optical extenders

The performance edge in PXI, M9393A VSA

Validate true device performance at µW frequencies

75 Years of Measurement Expertise

Leverages proven technology
- Downconverter derived from PXA
- Calibrator from FieldFox handheld analyzer

Innovative Design & Production Processes

Incorporates cutting-edge advances
- Novel solid-state switches for speed & reliability
- Production process to shrink footprint

A Breakthrough in Signal Analysis

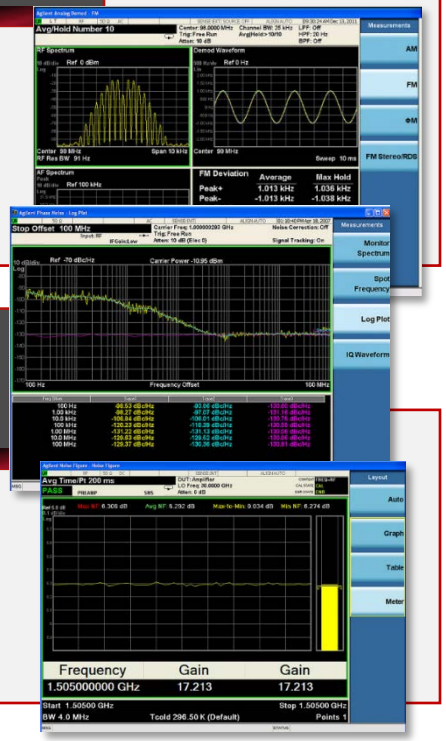
Delivers performance previously unseen in modular	
Frequency range	9 kHz to 8.4/ 14/ 18/ 27 GHz
Analysis BW	40/100/160 MHz
Amplitude accuracy	± .13 dB @1 GHz, < ± .5 dB @ 1 MHz–27 GHz
Freq. switching speed	135 us
Size	5 slots (4 slots + reference)

CXA-m PXIe Signal Analyzer, M9290A

Deploy a smaller microwave footprint up to 26.5 GHz

Get accurate, repeatable test results with best-in-class fully specified performance (*preliminary*)

- *-163* dBm displayed average noise level
- *-110* dBc/Hz phase noise (@ 1 GHz, 10 kHz offset)
- *+17* dBm third-order intercept (TOI)



Count on trusted X-Series measurement science and calibration routines

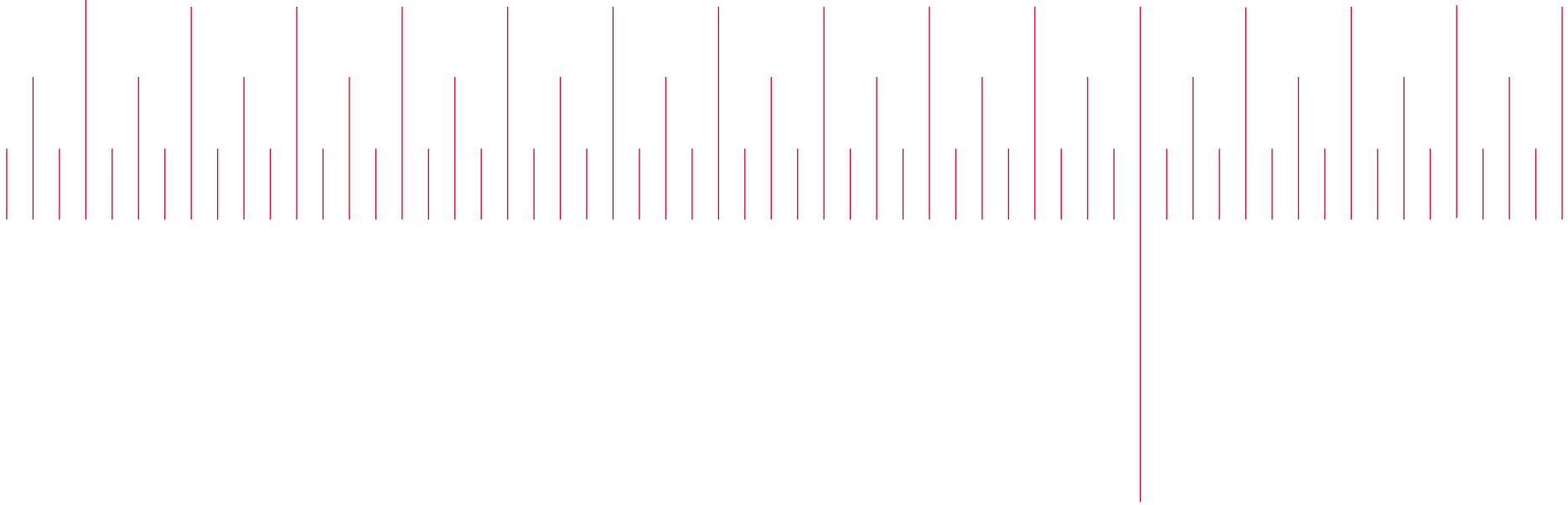
- Analog demodulation, phase noise, noise figure
- Accelerate spur and harmonic searches with swept and FFT modes in any frequency span

PXIe Vector Network Analyzer, M937XA

Driving down the size of test

- Full two-port network analyzer in just one slot
- Widest available frequency range: 300 kHz to 4, 6.5, 9, 14, 20, 26.5 GHz
- Best PXI VNA performance in four key areas:
  - Speed: 28-33 msec across 401 points
  - Dynamic range: > 116 dB (9 GHz), > 98 dB (20 GHz)
  - Trace noise: < 0.001 dB
  - Stability: 0.005 dB/°C

Reference Solution

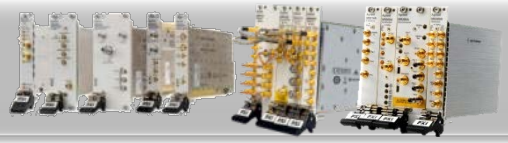


KEYSIGHT TECHNOLOGIES

Modular Solutions Strategy

Modular Solutions

More products

	Power Amplifier Test	LTE-A Multi-channel CA / MIMO	Phased Array Antenna Test	Milcom and Public Safety Radio Test	Satellite Signal Monitoring
RF Microwave 	✓	✓		✓	✓
High Speed Digital, AWGs and Digitizers 			✓		
Chassis, Switching and Basic Instruments 	✓	✓	✓	✓	✓
Software 	✓	✓	✓	✓	✓

The Value of a Reference Solution

Confidence,
Time,
Money

Turnkey Solution Level

efforts & risk

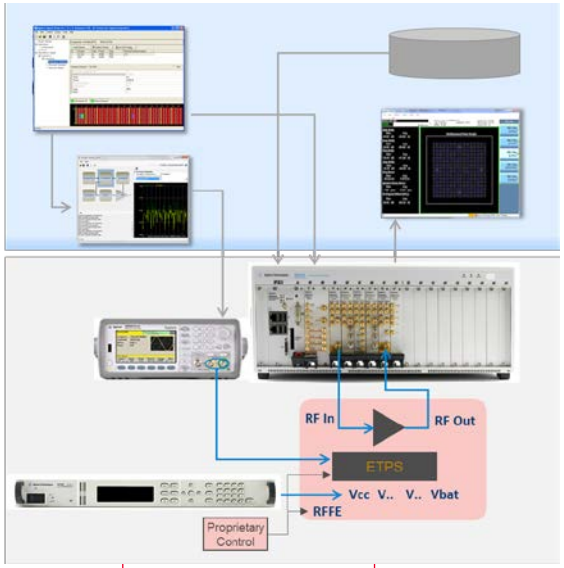
efforts & risk

efforts & risk

Keysight Reference Solution

Components and Concepts

Components



KEYSIGHT TECHNOLOGIES

LTE-A Multi-Channel Reference Solution

M9381A PXIe Vector Signal Generator
M9391A PXIe Vector Signal Analyzer

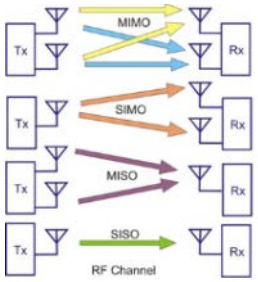
KEYSIGHT TECHNOLOGIES

Multi-Channel Trends and Challenges

Number of antennas per device increasing

– More multi-channel techniques being employed:

- Diversity, MIMO (spatial multiplexing), Beamforming, Carrier Aggregation
  - To drive:
    - Higher data rates
    - More capacity (number of users)
    - Quality of service

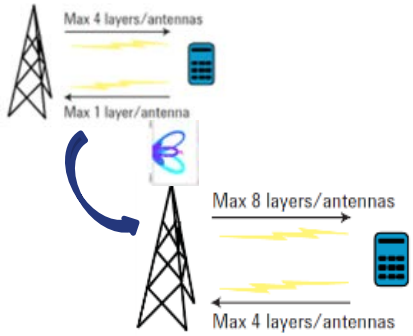


– Application examples:

- Commercial wireless communications like LTE-Advanced, 802.11ac WLAN and emerging 5G research

– Test challenges:

- Ability to visualize and verify complex MIMO and beamforming signals
- Complex higher order MIMO configurations
- Physical size and cost of test



LTE-Advanced Multi-Channel Reference Solution

Accelerate LTE-A designs and gain deeper insight faster

Reference Solution includes:

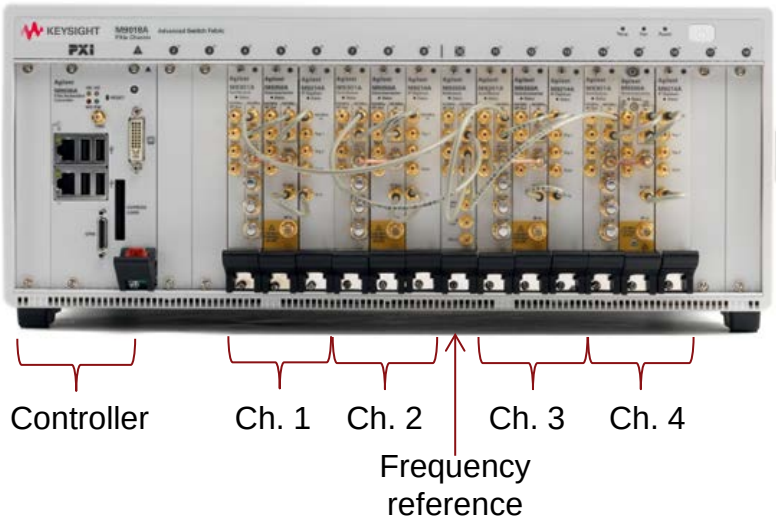
- *M9391A PXIe VSA(s)*
- *M9381A PXIe VSG(s)*
- *89600 VSA software*
- *Signal Studio software*
- *Multi-channel configuration & correction utilities*

- Easily configure complex MIMO systems with LTE/LTE-Advanced signal generation or analysis software
- MIMO toolkit accelerates multi-channel hardware synchronization and software setup
- Correction utility for accurate time & phase measurements at the device-under-test
- 2x2, 4x4 or 8x8 MIMO for spatial multiplexing/MIMO/ beamforming and carrier aggregation applications
  - < 1 ns time synchronization between channels ensures accurate chan-chan timing analysis
  - < 1 deg phase jitter for precise generation and analysis of beamforming patterns
  - Carrier aggregation with independently tuned channels for inter-band & up to 160 MHz bandwidth for intra-band support
  - Simultaneous UL & DL measurements

Easily Scale to Multi-Channel Instruments

Up to 8-channel, phase-coherent PXIe VSG & VSA

Target Performance Channel-to-Channel Synchronization	
Timing jitter	≤ 1 ns
Timing repeatability	≤ 1 ns
Phase jitter	≤ 1°
Phase repeatability	≤ 1°



Configuration:

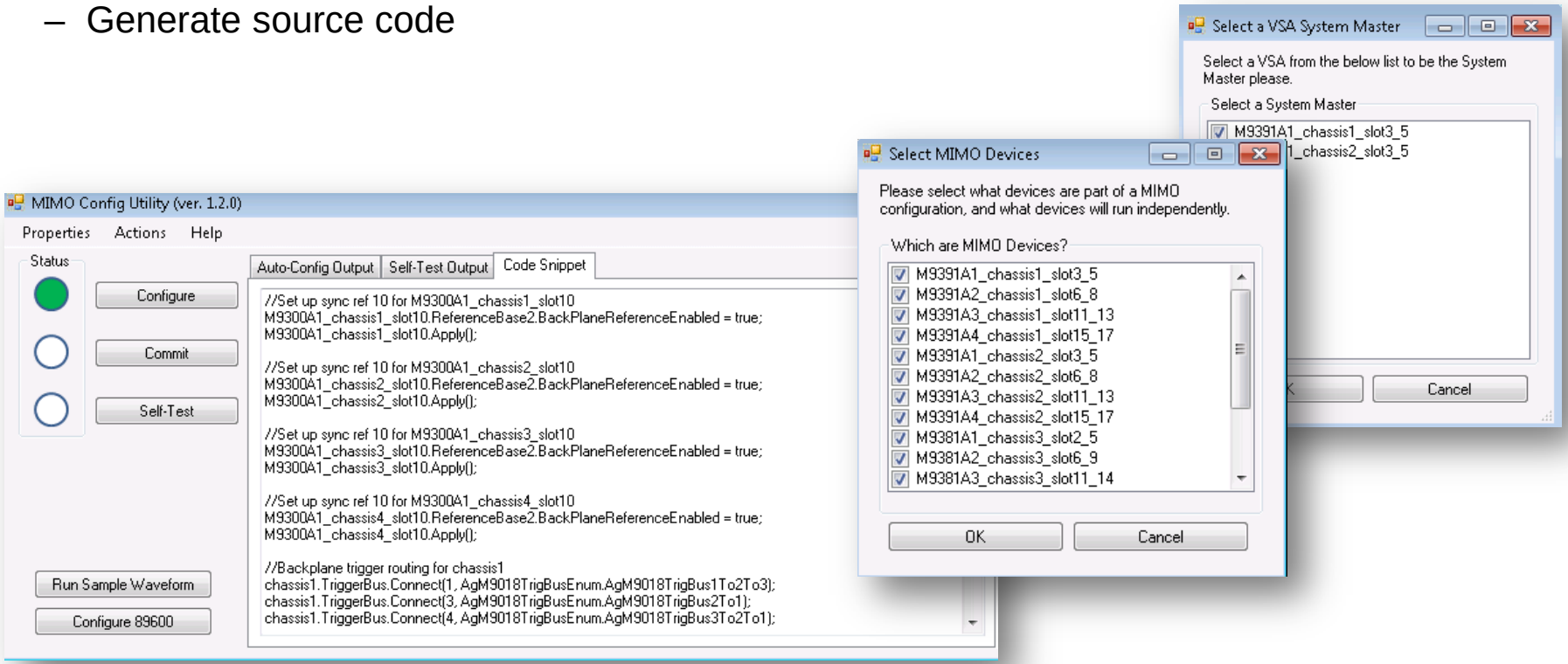
- Fit a 4-ch VSA or VSG in 1 chassis
- Multi-chassis configurations for up to 8 ch.
- 1 M9300A freq. reference per chassis
- 1 controller for entire system
- M9021A PCIe interface modules & cables to connect chassis
- Optional phase coherency capability

8-channel VSA configuration

Simplifying System Setup

Multi-channel configuration and correction utilities

- Automatically set up backplane triggers and hardware configurations and aliases
- Verify correct software revisions
- Perform self test of MIMO hardware
- Automated correction routine time and phase alignment between channels
- Generate source code



89600 VSA and WLA Software

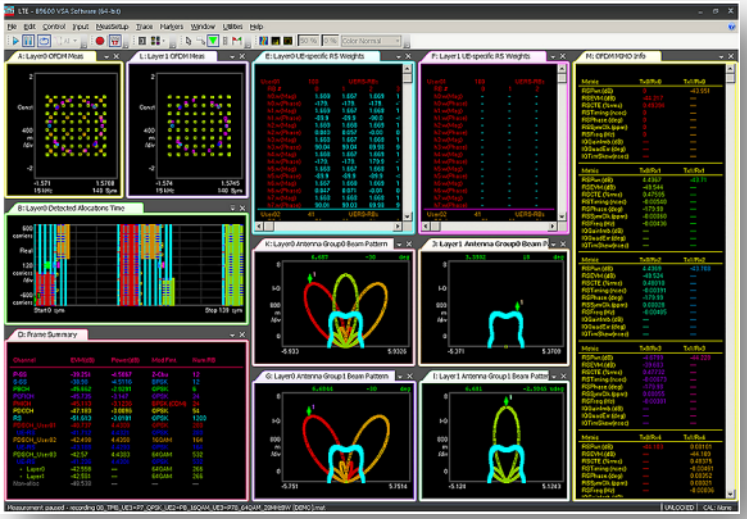
Comprehensive multi-channel analysis

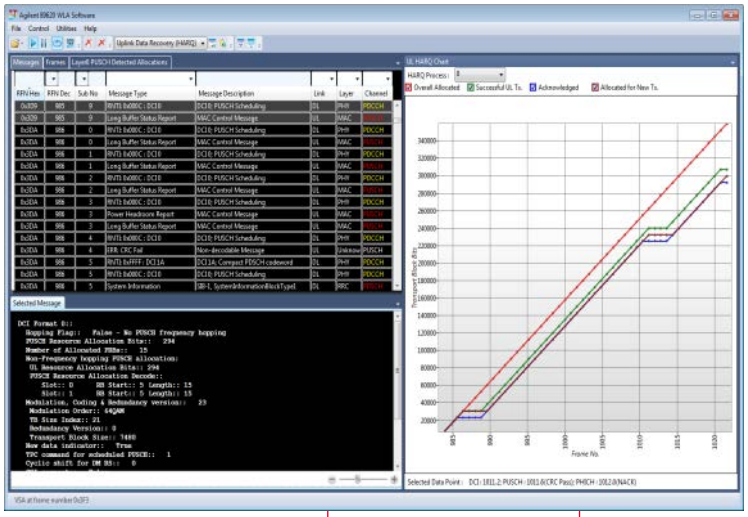
89600 VSA Software:

- Industry-leading with support for over 75 signal formats including MIMO, Beamforming
- In-depth RF troubleshooting tools
- Cross-channel analysis
- Analyze at any stage of design -- baseband to RF, simulation to design validation)

89600 WLA Software:

- MAC, RRC, RLC layer add-on to the 89600 VSA for UL & DL LTE FDD
- Enables multi-frame, multi-layer analysis
- LTE transmission modes 1-6 in DL





KEYSIGHT TECHNOLOGIES

Leverage Across Platforms

From design simulation to test

Design Simulation | Module and Chipset Development | RF and BB Design Integration | System Design Validation | Manufacturing Test

Benefits

- Leverage from signal channel measurements
- Quickly validate multi-channel designs for emerging standards
- Eliminate time spent implementing new standards

Thank you!

For more information please visit

www.keysight.com/find/solution-lte
www.keysight.com/find/pxi-mimo

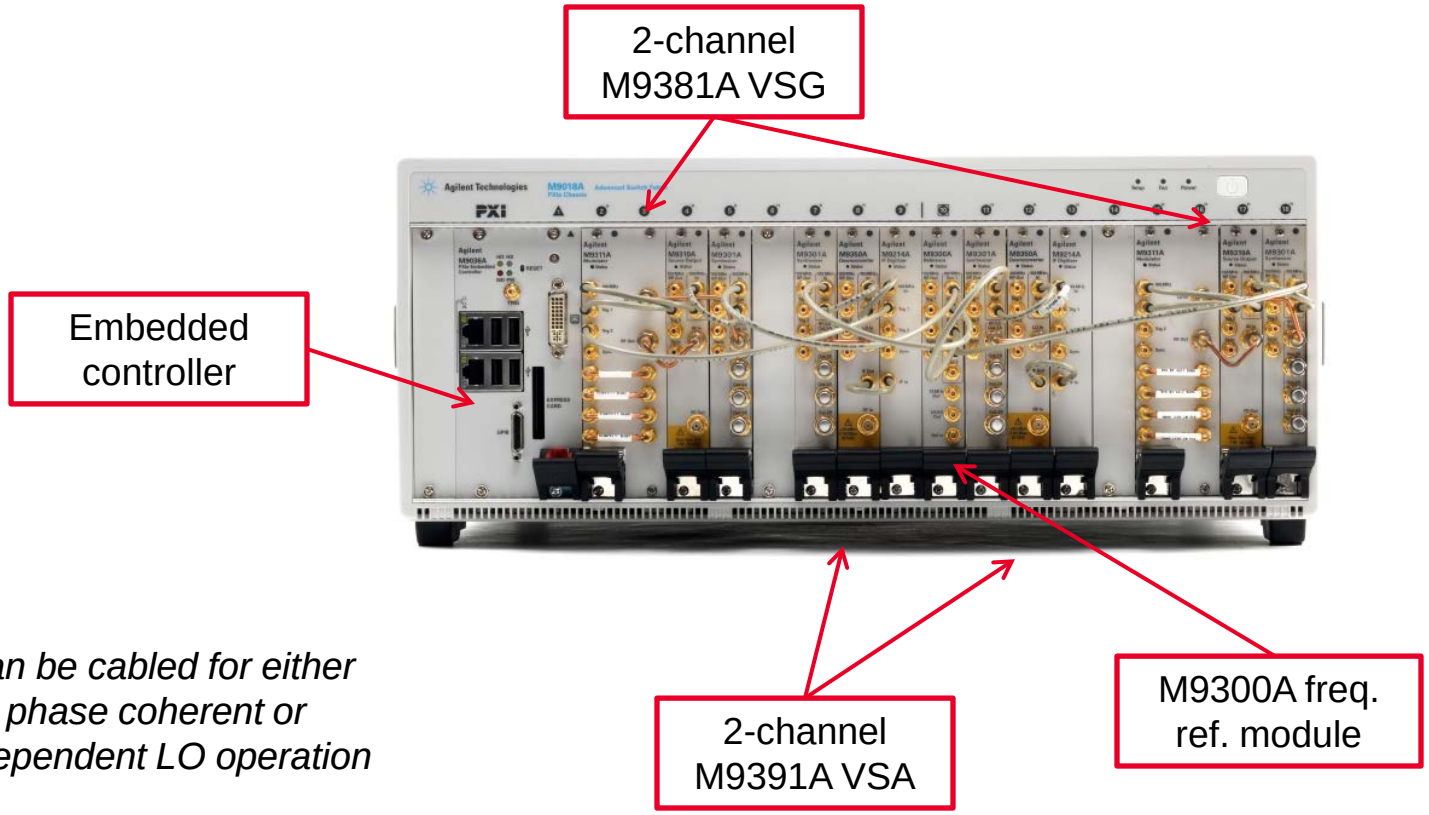
Access to solution brochure, videos, configurations, application note

Backup

System Configurations

Hardware Configurations

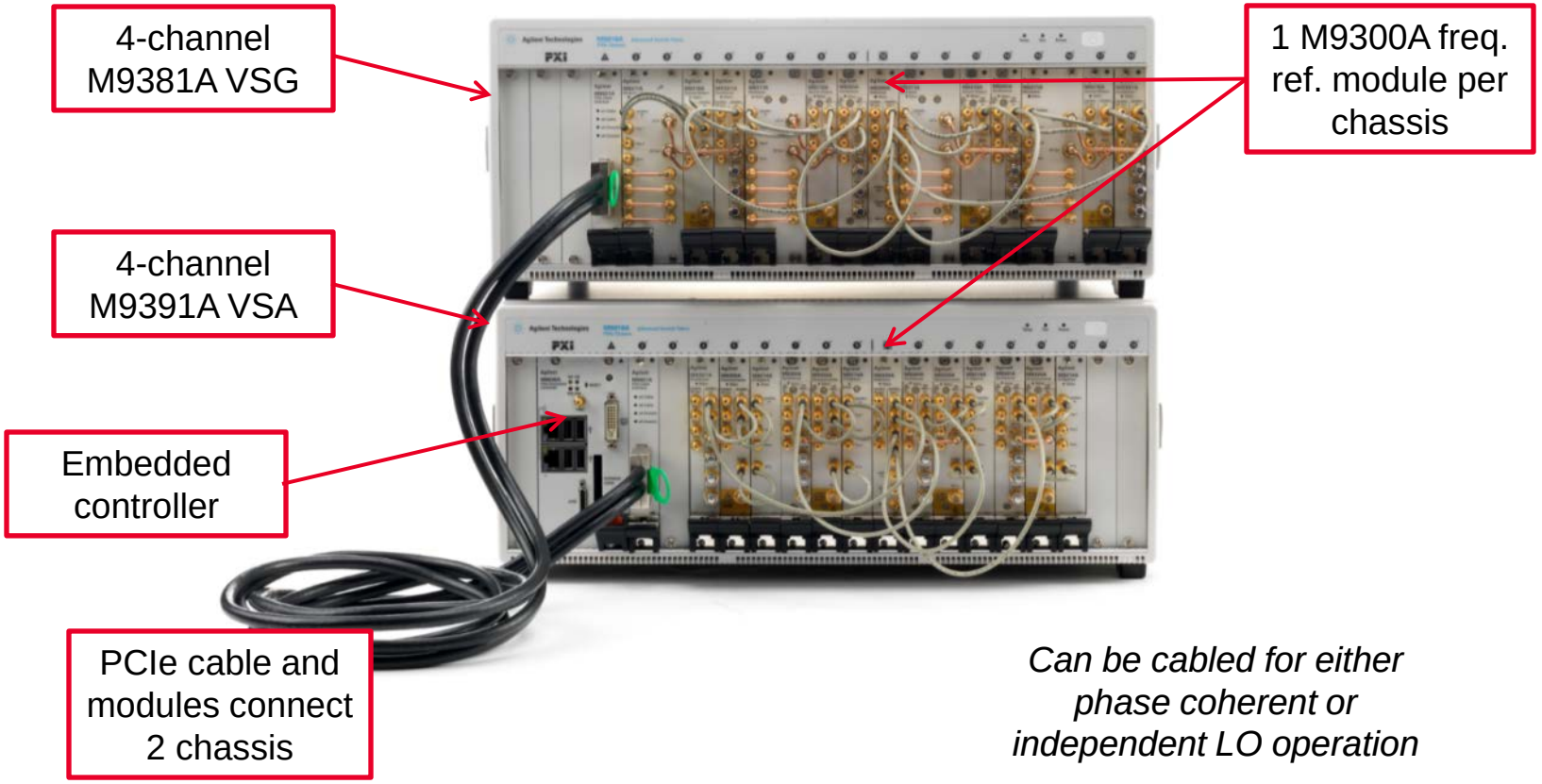
2x2 (2-channel source and 2-channel analyzer)



Can be cabled for either phase coherent or independent LO operation

Hardware Configurations

4x4 (4-channel source and 4-channel analyzer)



Hardware Configurations

8-channel, time-synchronized source & analyzer

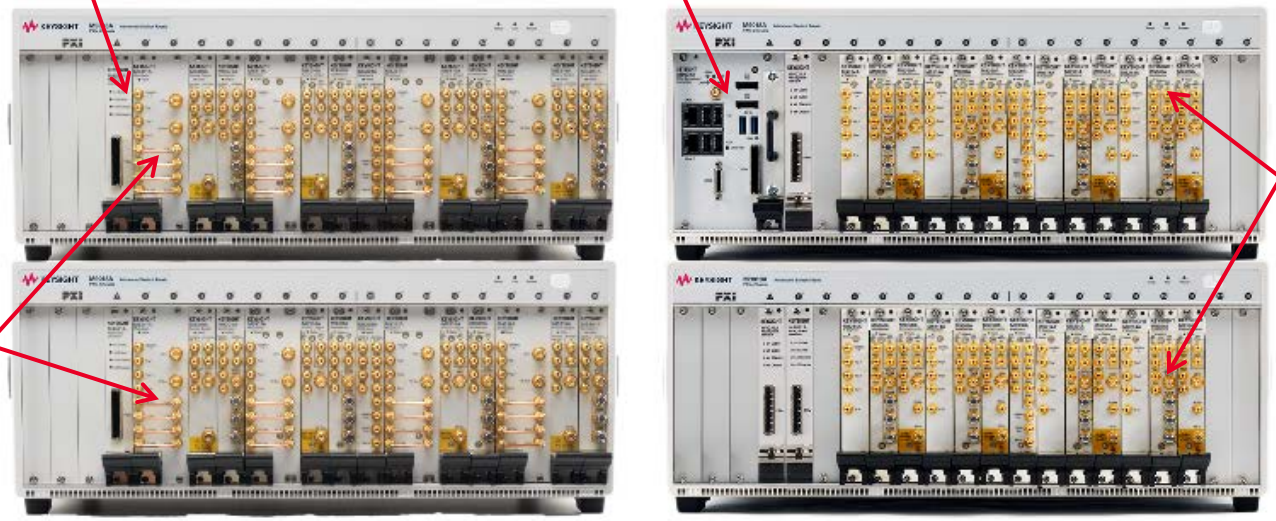
PCIe cable and modules connect chassis

Embedded controller

M9300A freq. ref. module in slot 10 of each chassis

8-channel M9391A VSA

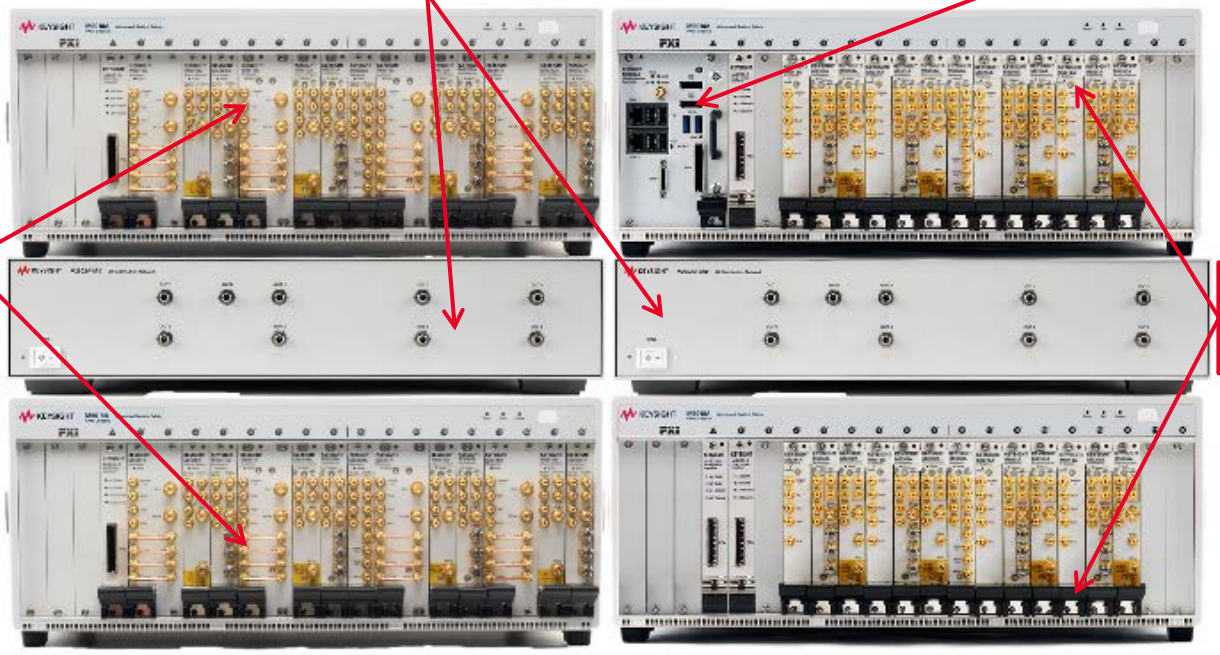
8-channel M9381A VSG



This 8x8 configuration is for independent LO operation for time synchronization only

Hardware Configurations

8-channel, phase-coherent source & analyzer



This 8x8 configuration is for shared LO operation for phase coherency

Phase and Timing Calibration

Multi-channel corrections wizard

- Fixed time and phase skew need to be calibrated/corrected out prior to testing
  - Cables, temperature, module placement can also affect correction factor
  - Dependent on center frequency and span
- Wizard walks you through creating a corrections file step-by-step
- Corrections then available for application through wizard