

# Compliance and Interop Test Services

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August 2021

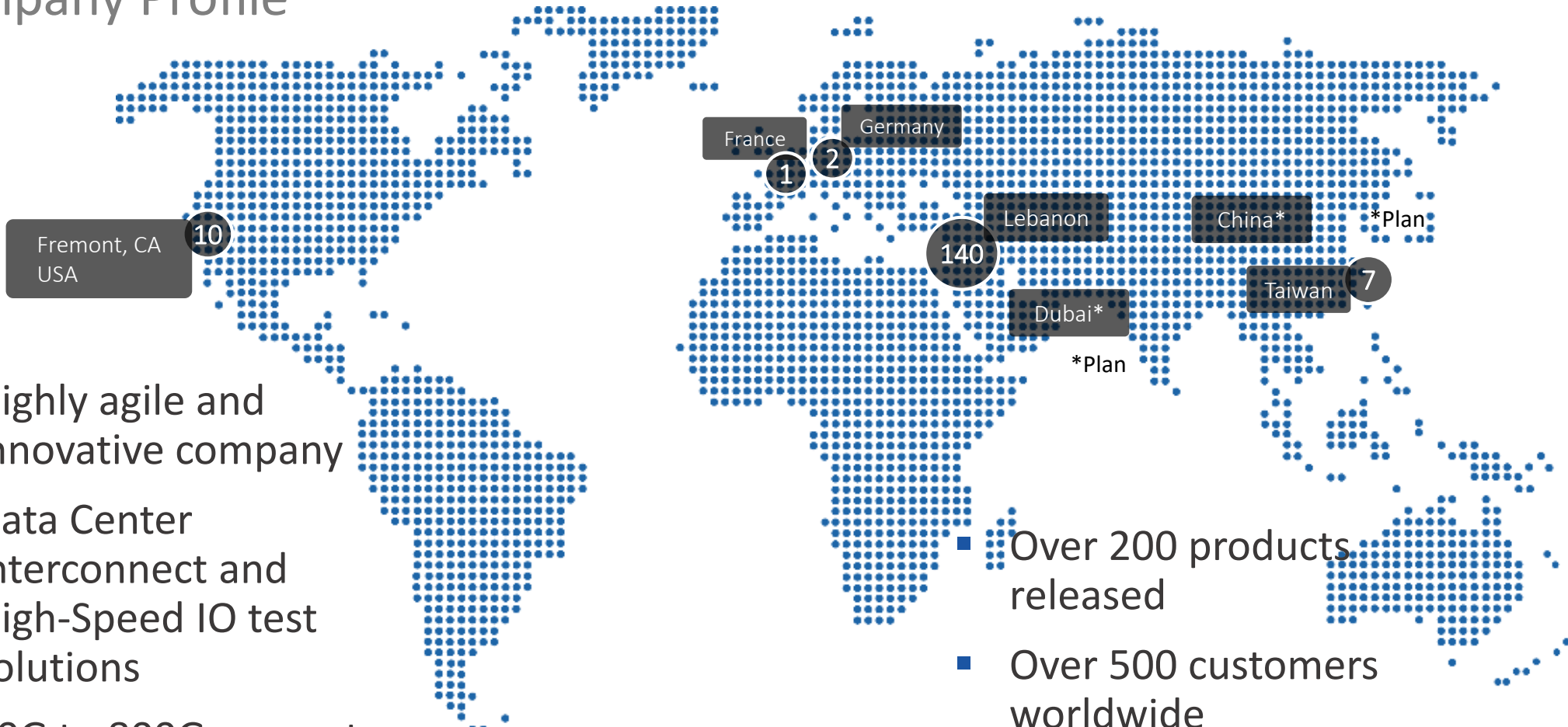
# Outline

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- Overview
- Supported DUTs
- Compliance Testing
  - Electrical Test
  - Optical Test
  - VNA Testing
  - Multi-Corner Testing
- System Interoperability Test Services
  - Switch BER Testing
  - Pre/Post-FEC Link Testing
  - CMIS Testing
- Equipment

# Overview

## Company Profile

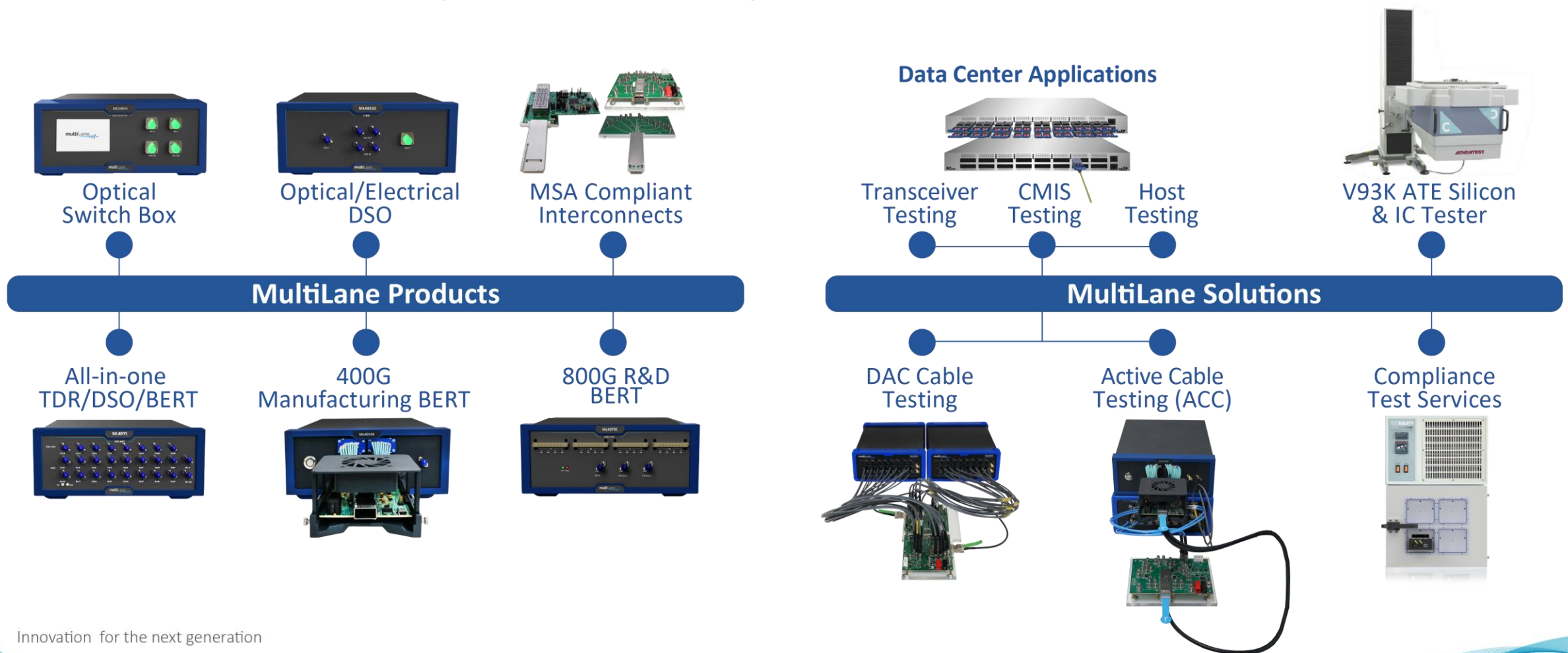


- Highly agile and innovative company
- Data Center Interconnect and High-Speed IO test solutions
- 10G to 800G support

- Over 200 products released
- Over 500 customers worldwide
- Global presence

# Overview

## Solutions for the complete HSIO Ecosystem



# Overview





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## MultiLane's Position

- MultiLane is a leading test and measurement instrument supplier for the High-Speed I/O industry
- Our instruments and interconnects have served the industry for over a decade; branching out into compliance products *and* services is the logical next step and a natural progression for the company
- MultiLane's Compliance and System Interoperability Lab
  - ensures your devices are up to international standards
  - offers custom interoperability testing for a clear picture of performance in a real-life networking environment





# Supported DUTs

## Transceivers

Supported DUT	Speed	Class	Pictures
QSFP	40G	ER4/LR4/SR4	
	100G	SR4/LR4/ER4/CWDM4/SWDM4/FR1/DR1	
QSFP-DD	400G	DR4/DR8/FR4/FR8/LR4/LR8/SR16	
SFP	10G	SR/LR/ER	
	25G		
OSFP	400G	DR4/DR8/FR4/FR8/LR4/LR8/SR16	

# Supported DUTs

## Cables

Supported DUT	Speed	Class	Pictures
QSFP-DD QSFP OSFP	40G	Active Optical Cables (AOC)	
	100G	Active Electrical Cables (AEC)	
	200G	Direct Attach Copper Cables (DAC)	
	400G	Active Copper Cables (ACC)	

# Compliance Testing

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Ensure Pluggables Comply with Industry Standards



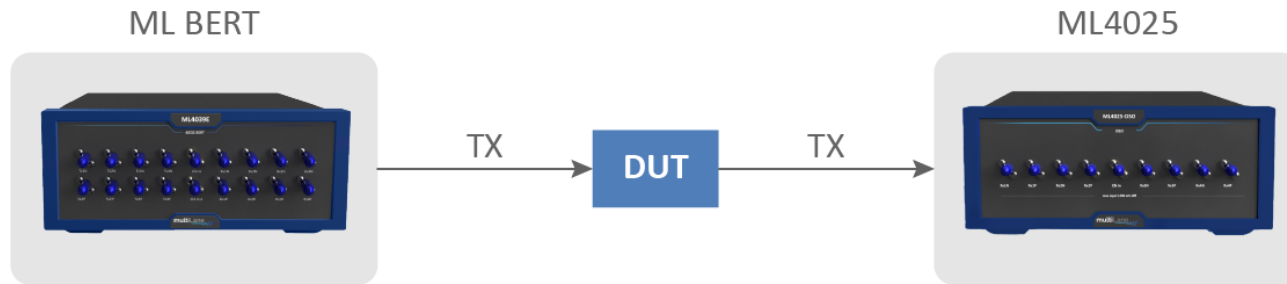
# Electrical Compliance Test

Test Category	Publication	Subset of Supported Measurements
Electrical TX Test	40G (XLAUI): 802.3 Table 83A-1 100G (CAUI-4): 802.3bm Table 83E-3 200G/400G (GAUI-8): 802.3bs Table 120E-3	<ul style="list-style-type: none"> <li>▪ Rise Time</li> <li>▪ Fall Time</li> <li>▪ Near End ESMW</li> <li>▪ Near End Eye Height</li> <li>▪ Far End ESMW</li> <li>▪ Far End Eye Height</li> <li>▪ Differential output voltage</li> <li>▪ Differential PK-PK Input</li> <li>▪ Voltage</li> </ul>
Electrical RX Test	40G (XLAUI): 802.3 Table 83A-2 100G (CAUI-4): 802.3bm Table 83E-3 200G/400G (GAUI-8): 802.3bs Table 120E-3	<ul style="list-style-type: none"> <li>▪ BER</li> <li>▪ Stress Input Low &amp; High Loss Channel</li> <li>▪ JTOL*</li> </ul>

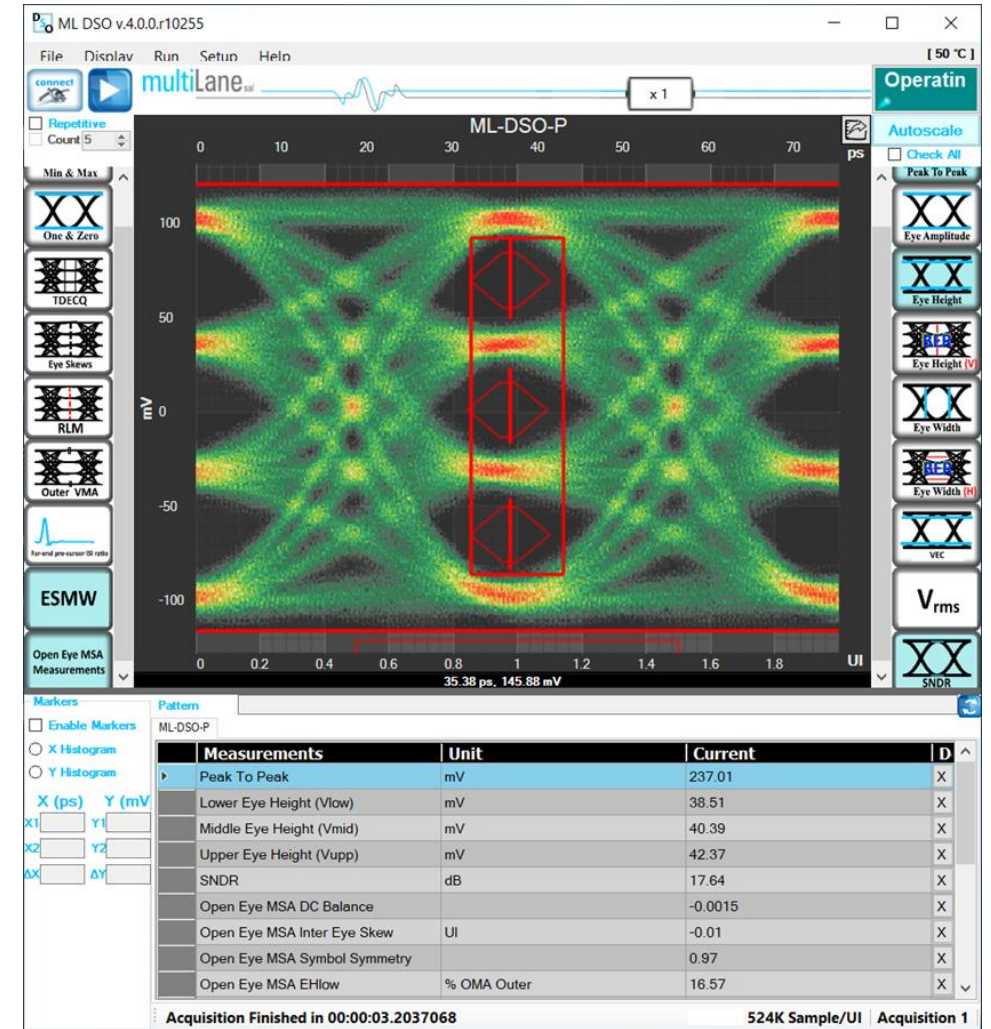
\* PAM4 Jitter injection supported up to 4 MHz

# Electrical Test

## Electrical TX Testing Setup



Electrical —————  
 Optical - - - - -



# Electrical Test

## Electrical RX Testing Setup

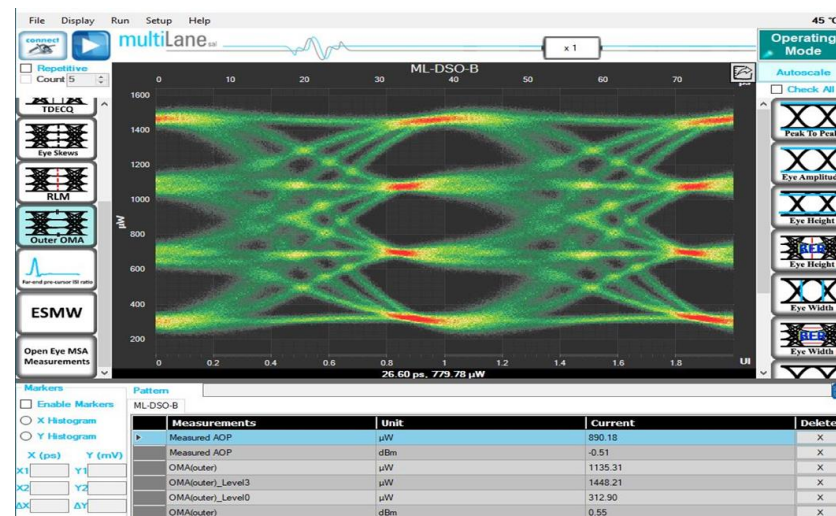
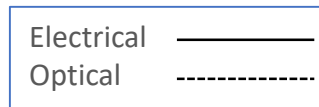
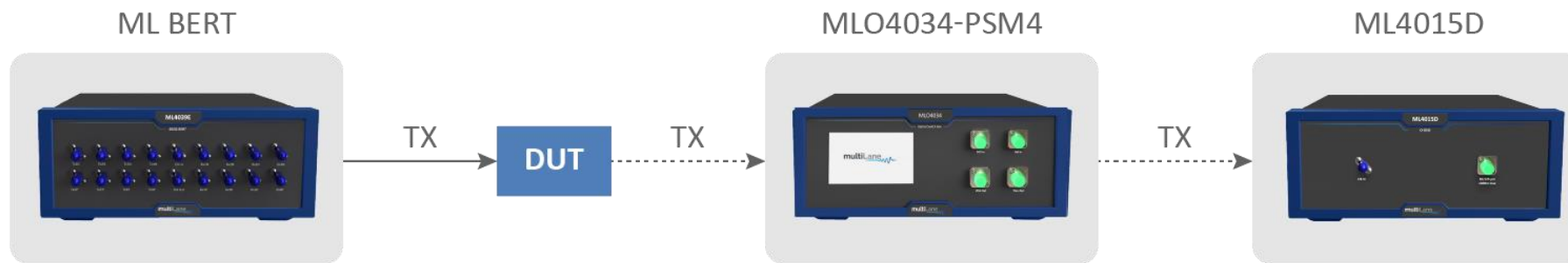


# Optical Compliance Tests

Test Category	Publication	Subset of Supported Measurements
Optical TX Test	DR1/4 (400G): 802.3bs Table 124-6	<ul style="list-style-type: none"> <li>■ Transmit Power (OMA, AOP)</li> <li>■ TDEC(Q)</li> <li>■ Extinction Ratio</li> <li>■ Transmitter Eye Mask Definition</li> <li>■ Rise Time</li> <li>■ Fall Time</li> </ul>
	FR1/4 (400G): 100G Lambda MSA	
	SR4/SR16 (100G): 802.3bm Table 95-6	
	LR4/ER4 (40G): 802.3bm Table 87-7	
	LR4/FR4 (200G): 802.3bs Table 122-9	
	LR8/FR8 (400G): 802.3bs Table 122-10	
	SW/SR (10G): 802.3 Table 52-7	
Optical RX Test	DR1/4 (400G): 802.3bs Table 124-7	<ul style="list-style-type: none"> <li>■ Receiver sensitivity</li> <li>■ Waterfall curve</li> <li>■ SRS for 25G NRZ</li> </ul>
	FR1/4 (400G): 100G Lambda MSA Table 2.4	
	SR4/SR16 (100G): 802.3bm Table 95-7	
	LR4/ER4 (40G): 802.3bm Table 87-8	
	LR4/FR4 (200G): 802.3bs Table 122-11	
	LR8/FR8 (400G): 802.3bs Table 122-12	
SW/SR (10G): 802.3 Table 52-9		

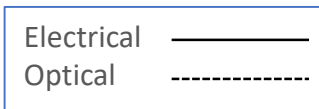
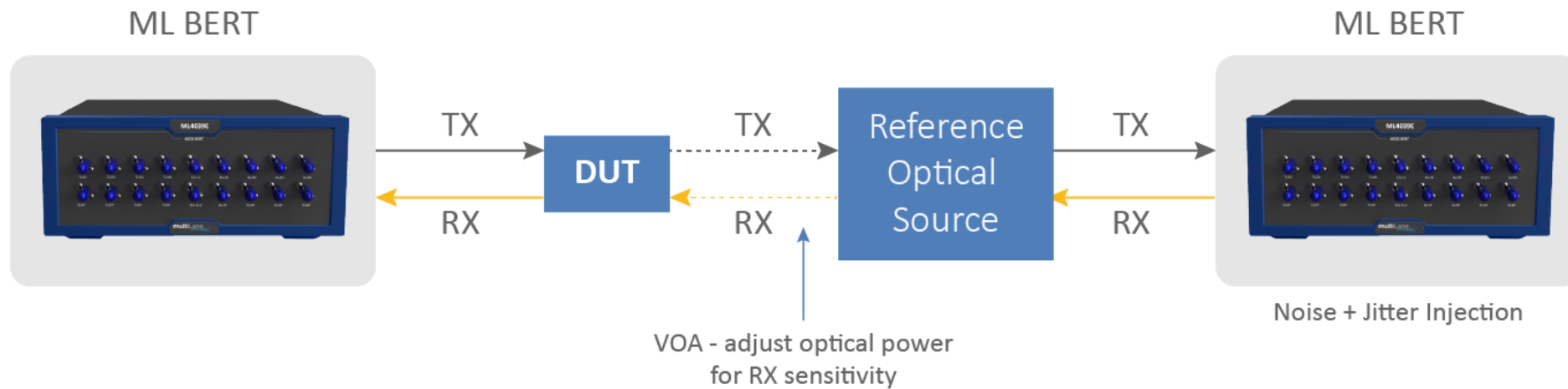
# Optical Tests

## Optical TX Testing Setup



# Optical Tests

## Optical RX Testing Setup

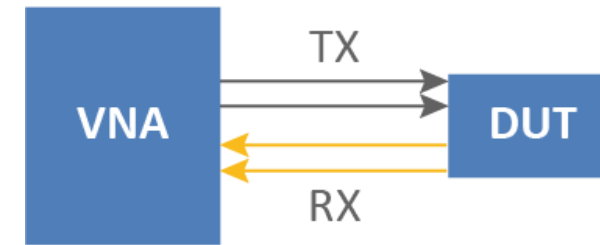
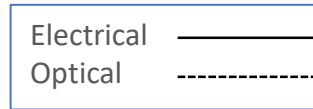


# VNA Testing

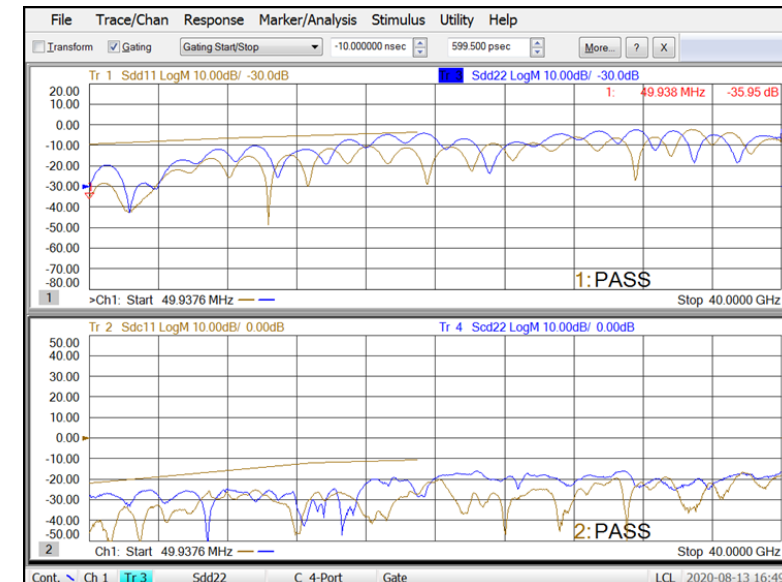
## Test Measurements & Setup

### Measurement Example

Meaning of the VNA Curves

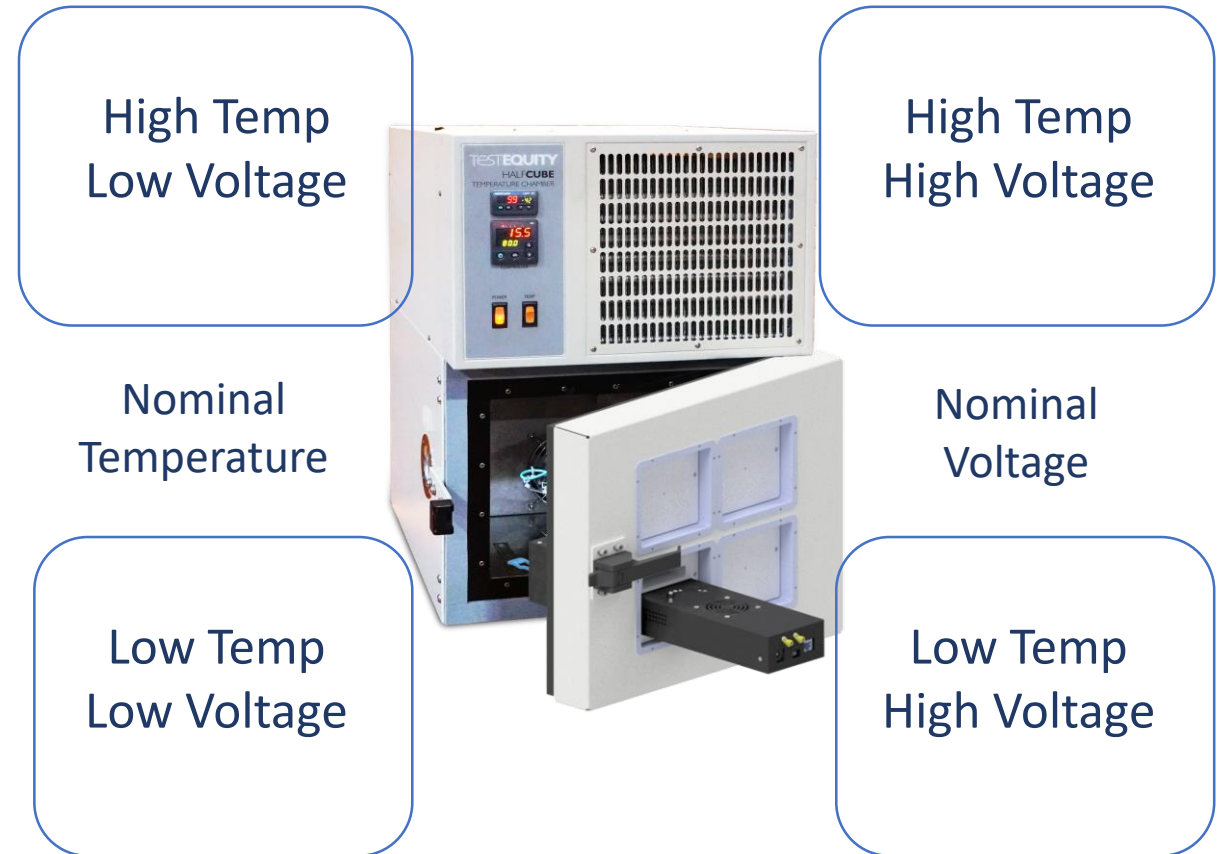


Trace Number	Measurement
1	Output return loss Sdd22
2	Output common to differential mode conversion Scd22
3	Input return loss Sdd11
4	Input differential to common mode conversion Sdc11



# Multi-Corner Environmental Test

- Supported Temperatures from -40 °C to 130 °C
- Supported Voltages between 3.1 V and 3.45 V



All tests could be done with one nominal condition



# System Interoperability Testing

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Interop Compliance Through the Lens of the Data Center

# System Interoperability Services

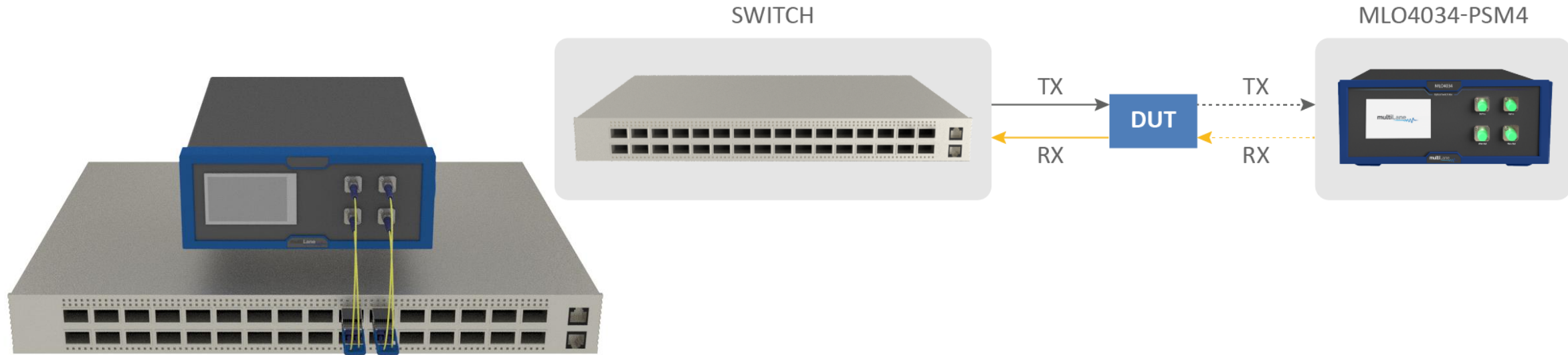
## Why System Interop Testing?

- Enable system-level insight.
- Assesses pluggable DUTs performance in real life networking environments thanks to diagnostic capabilities of Gigabit Ethernet Switches

## Types of System Interoperability Testing

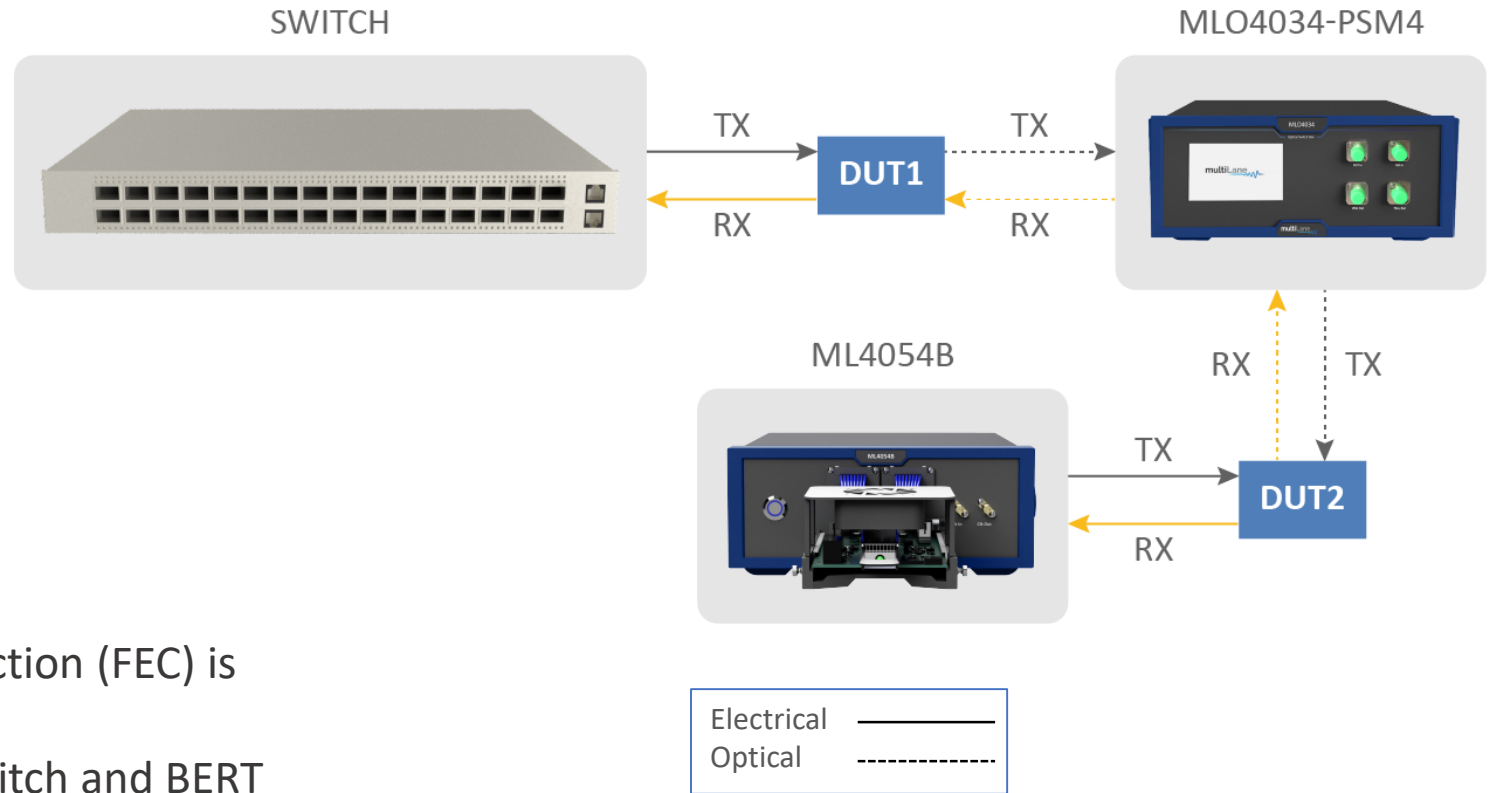
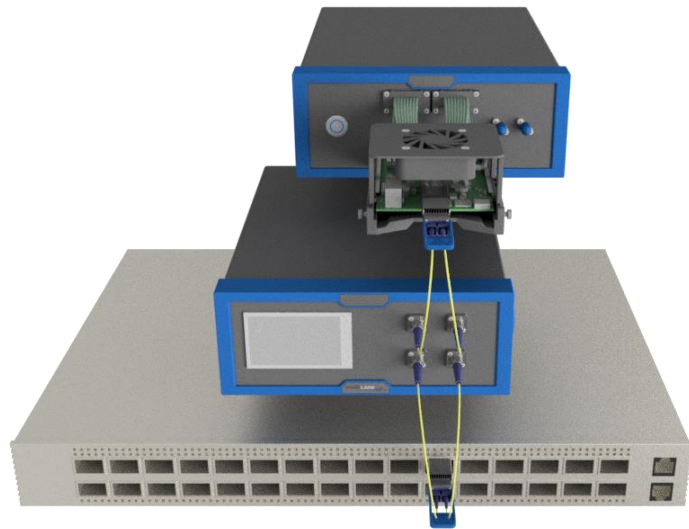
- BER switch test
- Pre-FEC BER link test
- Post-FEC SER link test

# Switch BER Test



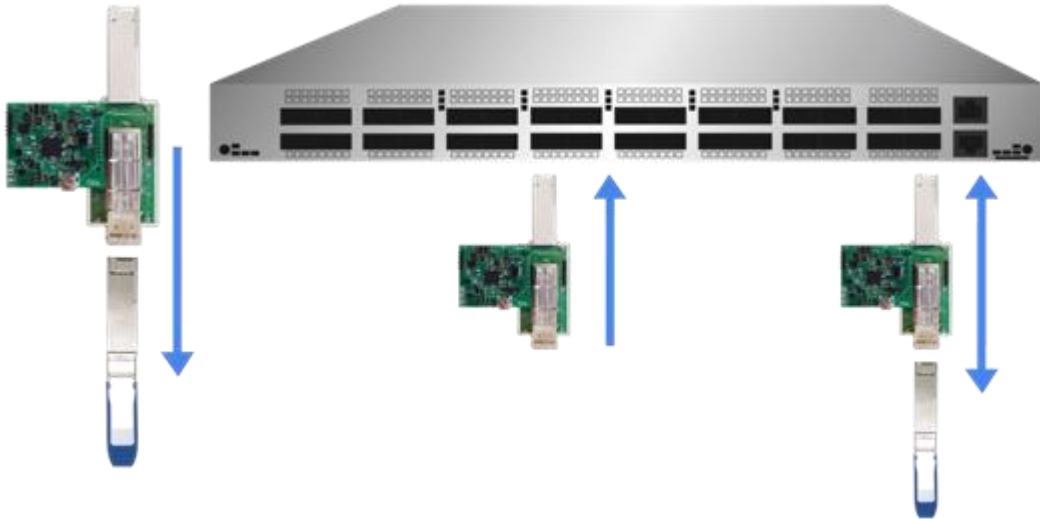
- Single or Dual-DUT BER testing in switch
- Configure switch port(s) to PRBS of choice
- Monitor BER via switch OS
- ML Optical Attenuator: BER vs RX Power Curve

# Pre/Post-FEC Link Testing



- Real RS(544) or RS(528) Forward Error Correction (FEC) is transmitted from ML4054B
- Pre-FEC Test; PRBS is exchanged between switch and BERT platform
- Post-FEC Test; Idle ethernet FEC traffic exchanged between switch and BERT platform
- ML Optical Attenuator: BER or FEC SER vs RX Power Curve

# CMIS Testing



- Validate host/module CMIS implementation
- QSFP-DD, OSFP, QSFP28, and SFP
- Certify optic DOM and ID parameters
- Monitors I2C transactions between host and pluggable
- Pass/Fail state machine test
- Force host alarms



# Equipment Used

**ML4035**



Cable test, impedance 4 CH 35 GHz

**ML4039D**



BERT 4CH  
28 GBd, 56 Gbps

**ML4015D**



Optical DSO 25/40 GHz  
SM/MM

**ML1016D-CR**



Optical Clock Recovery  
26/53 GBd PAM4

**ML4079D**



BERT 8CH  
28 GBd, 56 Gbps

**ML4025**



Electrical DSO  
32/50 GHz

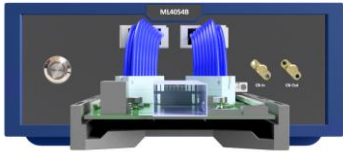
**ML4015D**



Electrical DSO  
32/50 GHz

# Equipment Used

**ML4054B**



BERT 8CH  
28 GBd, 56 Gbps

**ML4039EN**



BERT 4CH  
56 GBd, 112 Gbps

**ML4079EN**



BERT 8CH  
56 GBd, 112 Gbps

**ML4039E**



BERT 4CH  
56 GBd, 112Gbps

**MLO4034-CWDM4**



CWDM4 wavelength grid

**MLO4034-PSM4**



DR4 quad parallel fiber

**ML407-PAM**



JTOL Clock Source

# Equipment Used

Switch



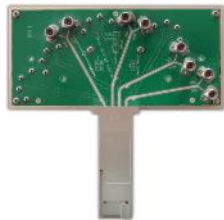
BER Test

ML4062-MCB



QSFP-DD800

ML4062-HCB



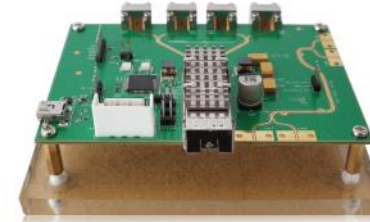
QSFP-DD800

ML4064



OSFP

ML4024



SFP

ML4041-K



QSFP28

ML4024



CFP2

ML4020-K-56



QSFP56





THANK YOU

**Innovation for the next generation**

**North America**

48521 Warm Springs Boulevard  
Suite 310  
Fremont, CA 94539, USA  
+1 510 573 6388

**Worldwide**

Houmal Technology Park  
Askarieh Main Road  
Houmal, Lebanon  
+961 81 794 455

**Asia**

14F-5/ Rm.5, 14F., No 295  
Sec.2, Guangfu Rd. East Dist.,  
Hsinchu City 300, Taiwan (R.O.C)  
+886 3 5744 591

[www.multilaneinc.com](http://www.multilaneinc.com)