

Compliance and Interop Test Services

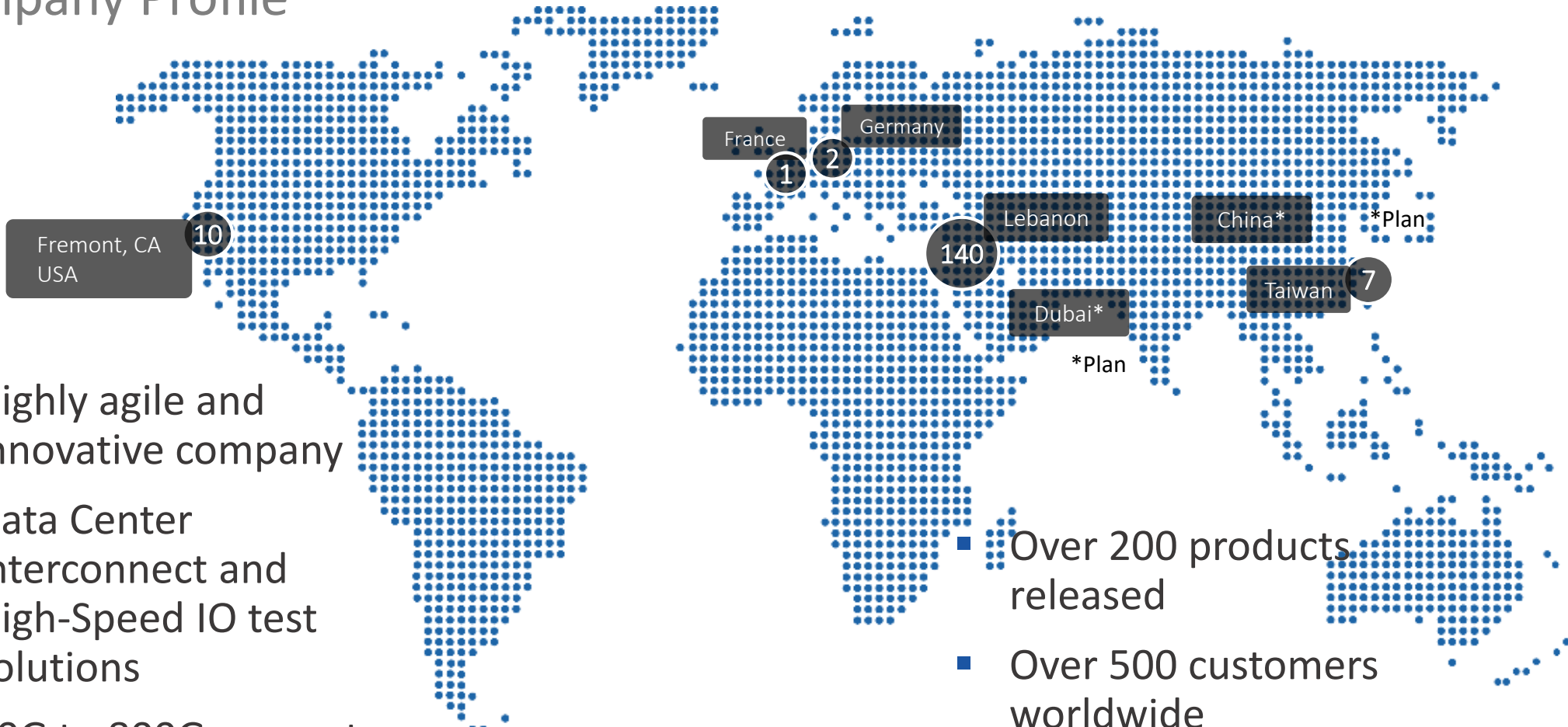
August 2021

Outline

- 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

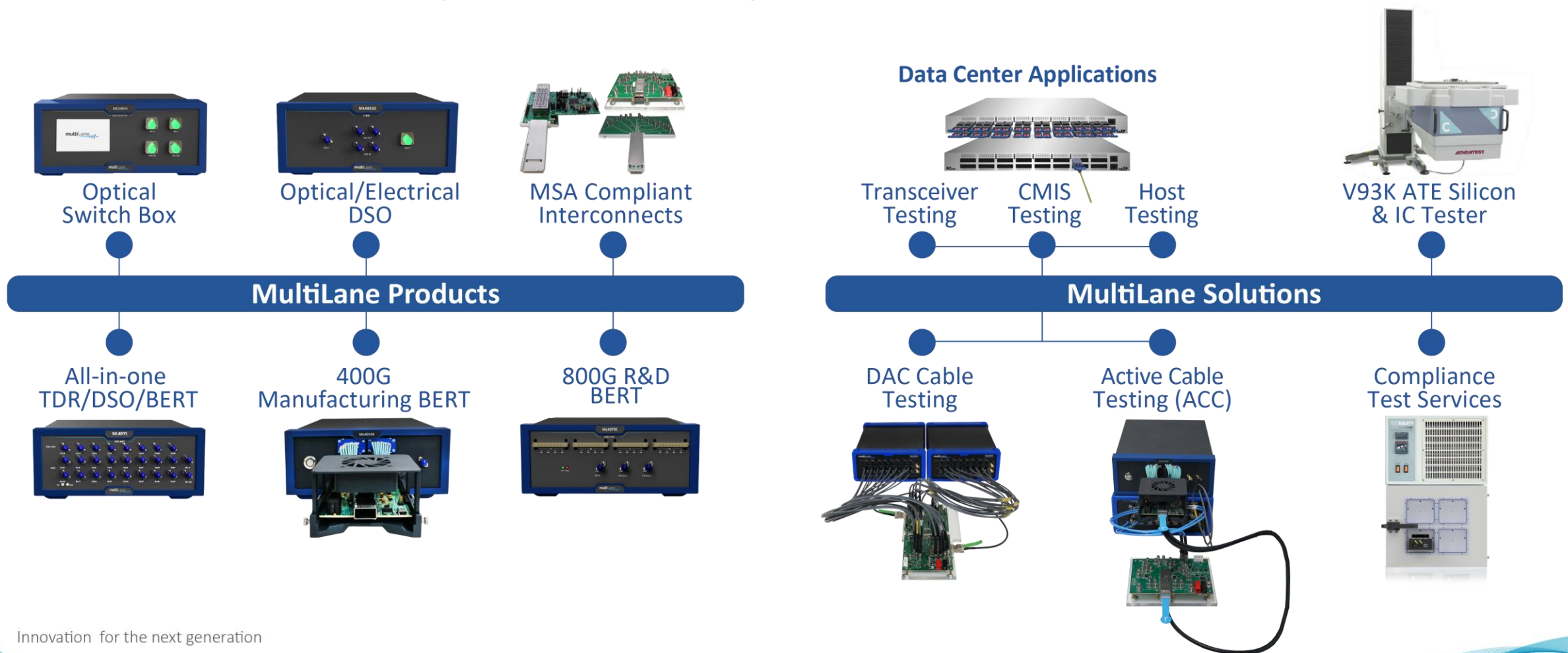


- Highly agile and innovative company
- Data Center Interconnect and High-Speed IO test solutions
- 10G to 800G support

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

Overview

Solutions for the complete HSIO Ecosystem







Overview

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

Ensure Pluggables Comply with Industry Standards

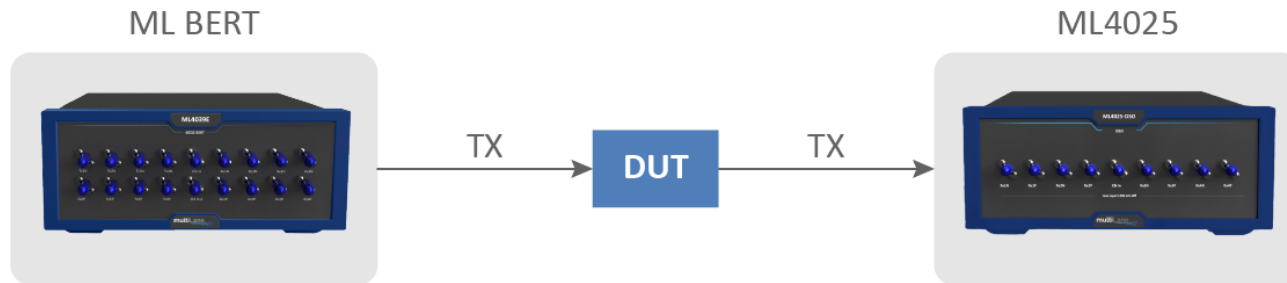
Electrical Compliance Test

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"> ▪ Rise Time ▪ Fall Time ▪ Near End ESMW ▪ Near End Eye Height ▪ Far End ESMW ▪ Far End Eye Height ▪ Differential output voltage ▪ Differential PK-PK Input ▪ Voltage
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"> ▪ BER ▪ Stress Input Low & High Loss Channel ▪ JTOL*

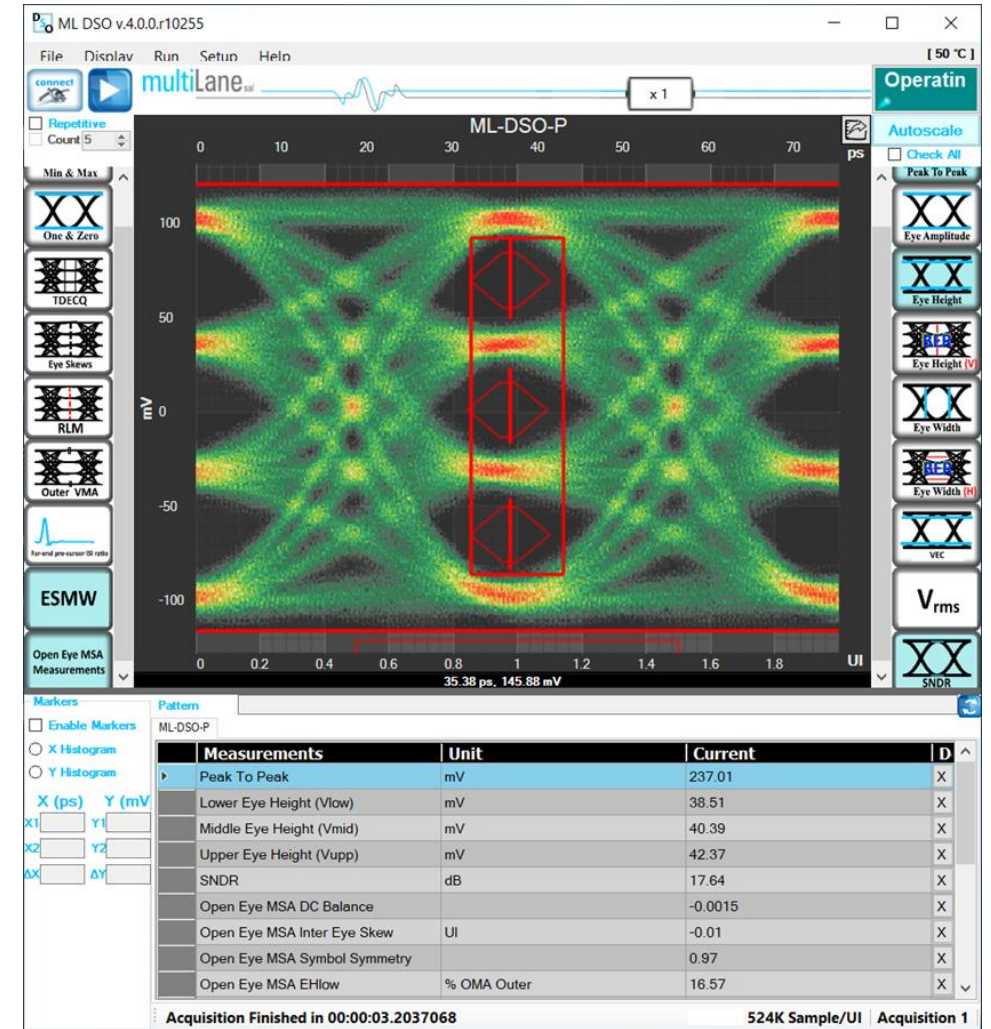
* PAM4 Jitter injection supported up to 4 MHz

Electrical Test

Electrical TX Testing Setup



Electrical —————
 Optical - - - - -



Electrical Test

Electrical RX Testing Setup

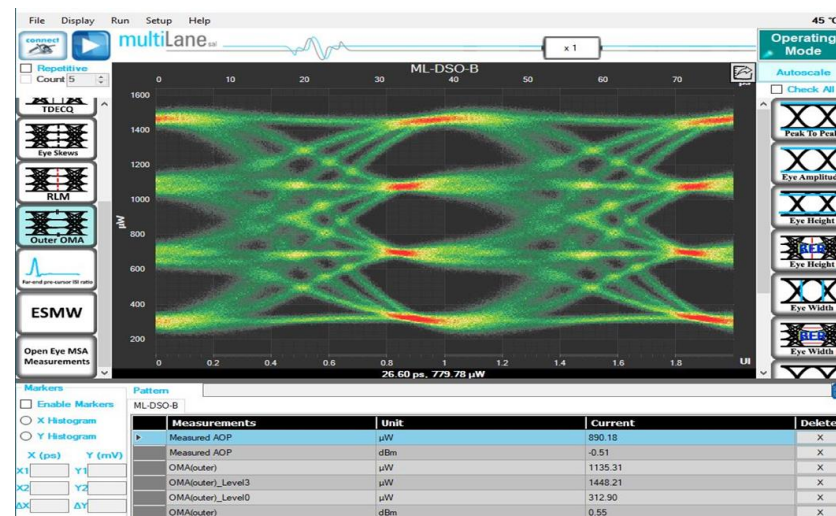
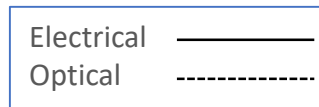
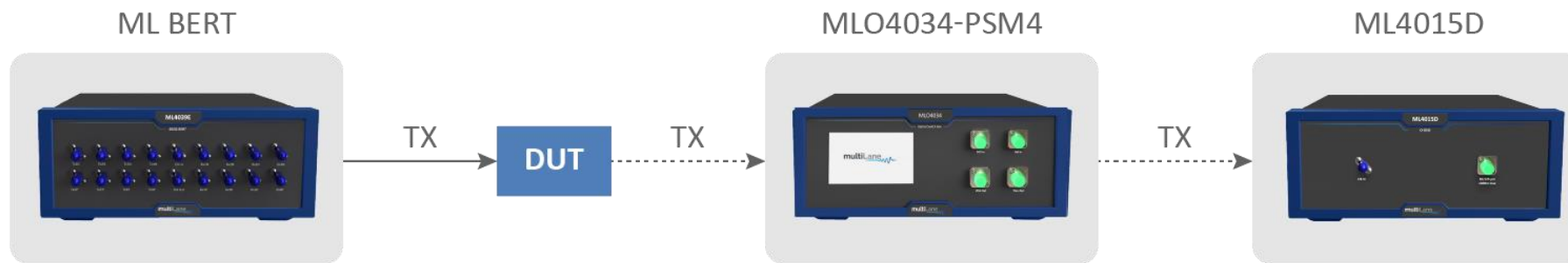


Optical Compliance Tests

Test Category	Publication	Subset of Supported Measurements
Optical TX Test	DR1/4 (400G): 802.3bs Table 124-6	<ul style="list-style-type: none"> ■ Transmit Power (OMA, AOP) ■ TDEC(Q) ■ Extinction Ratio ■ Transmitter Eye Mask Definition ■ Rise Time ■ Fall Time
	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"> ■ Receiver sensitivity ■ Waterfall curve ■ SRS for 25G NRZ
	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		

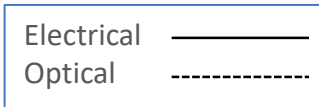
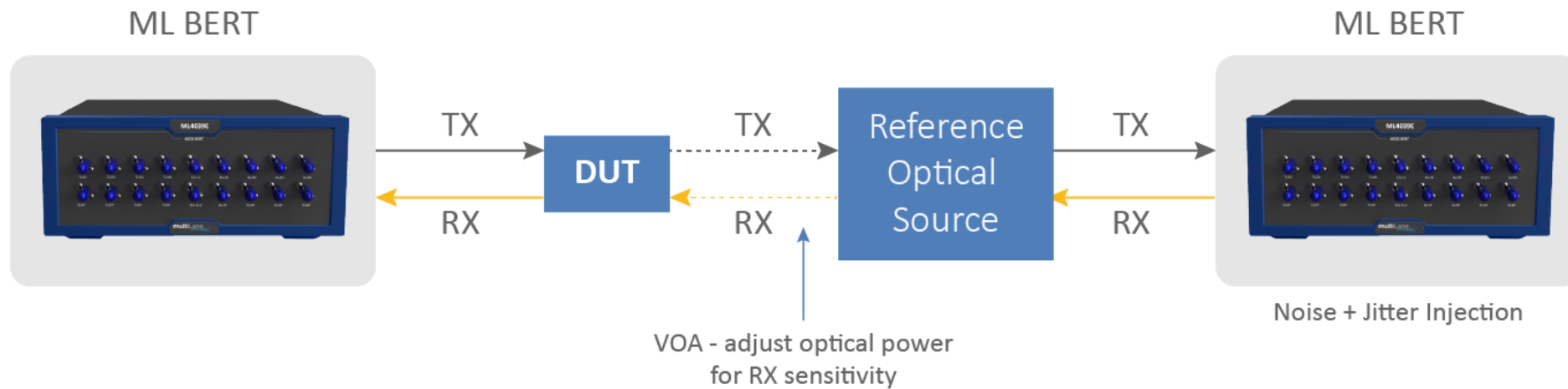
Optical Tests

Optical TX Testing Setup



Optical Tests

Optical RX Testing Setup

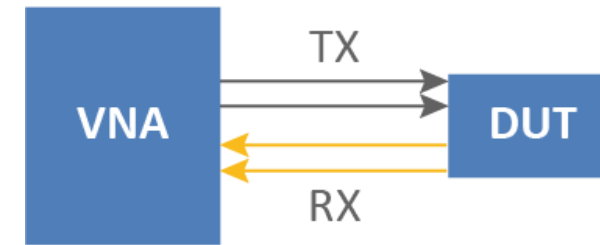
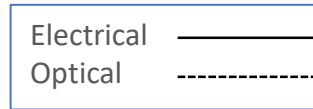


VNA Testing

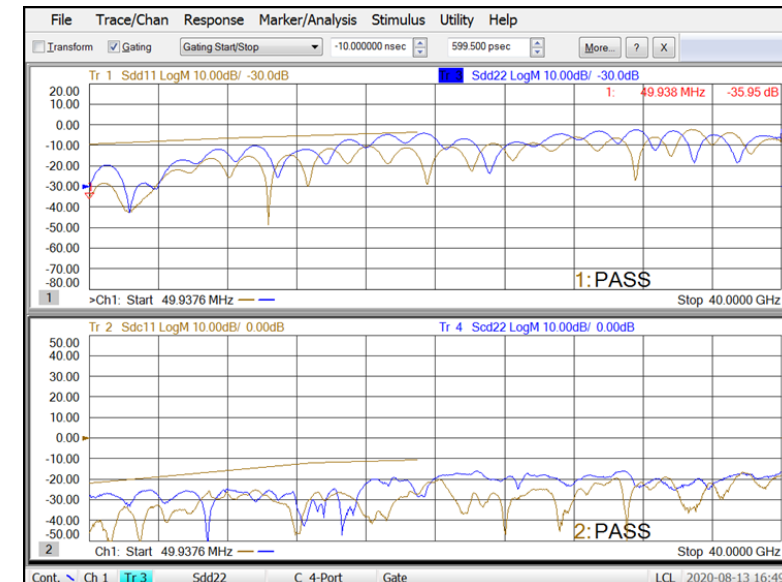
Test Measurements & Setup

Measurement Example

Meaning of the VNA Curves

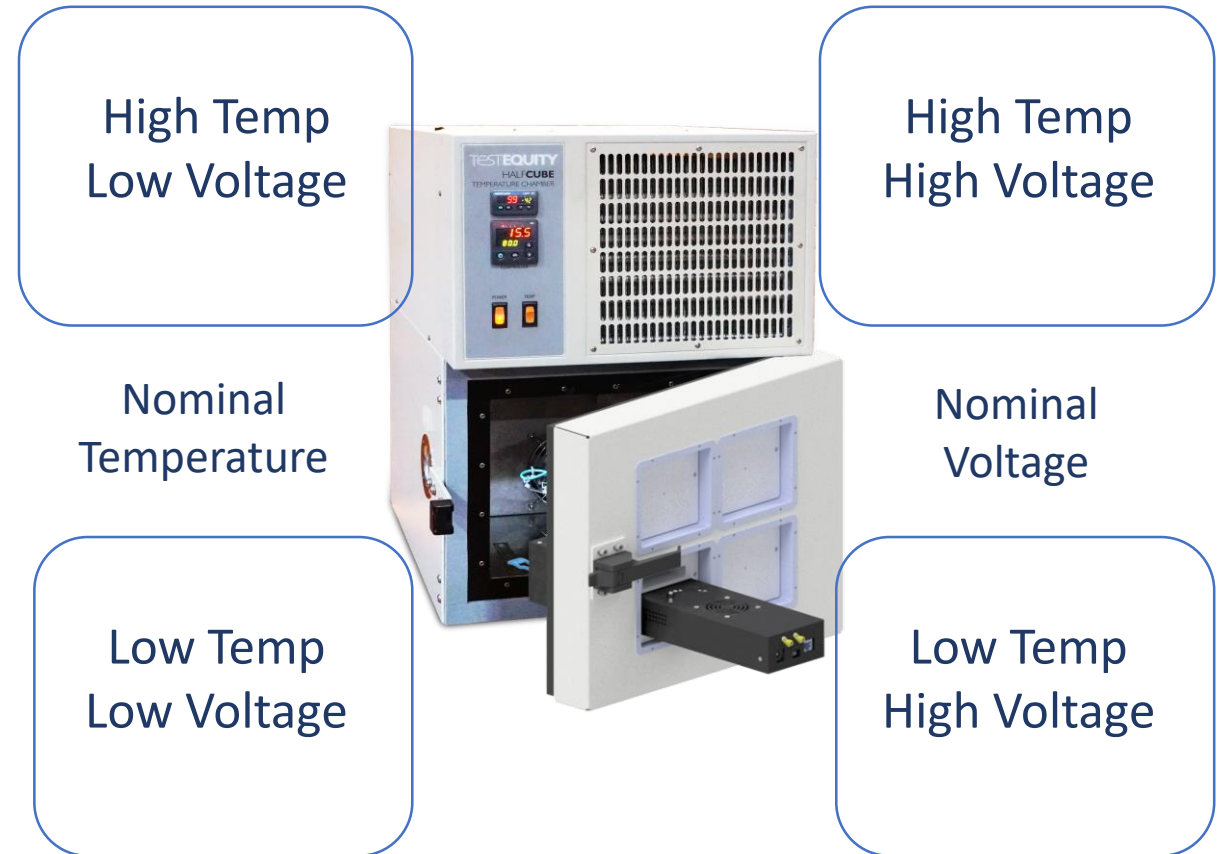


Trace Number	Measurement
1	Output return loss Sdd22
2	Output common to differential mode conversion Scd22
3	Input return loss Sdd11
4	Input differential to common mode conversion Sdc11



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

Interop Compliance Through the Lens of the Data Center

System Interoperability Services

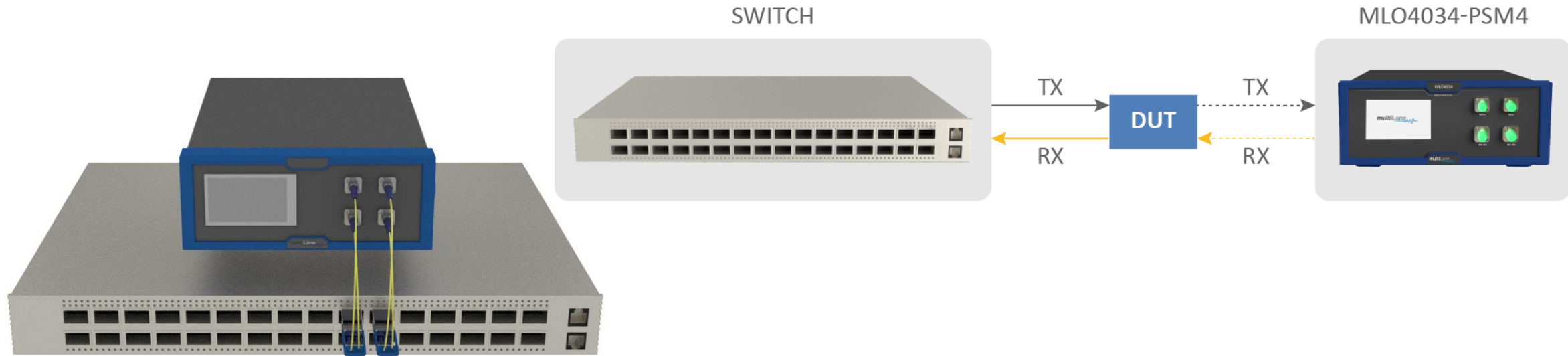
Why System Interop Testing?

- 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

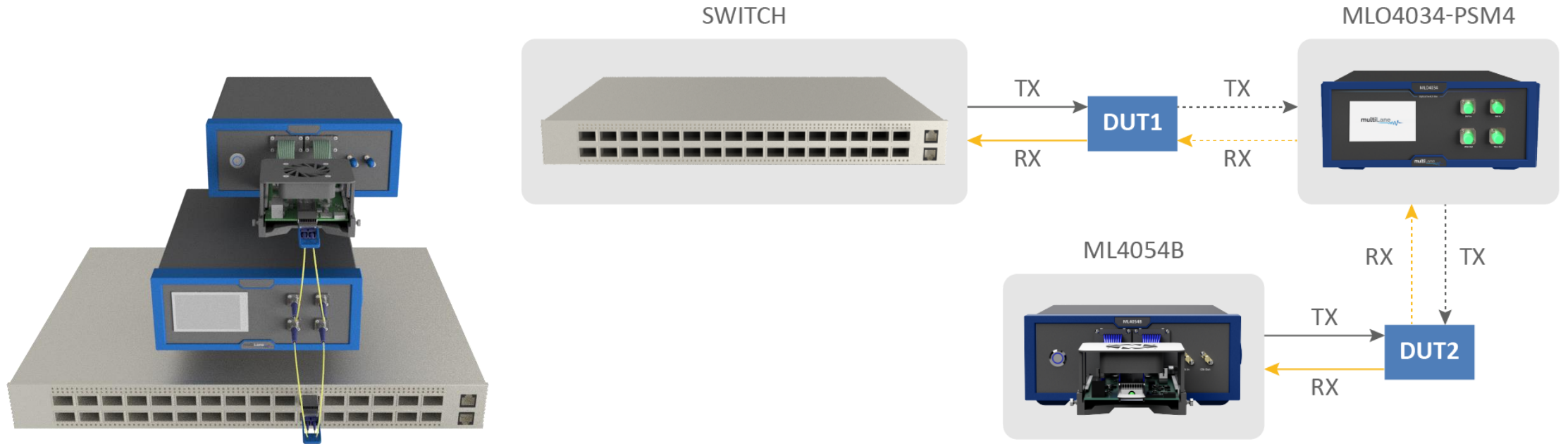
- BER switch test
- Pre-FEC BER link test
- Post-FEC SER link test

Switch BER Test



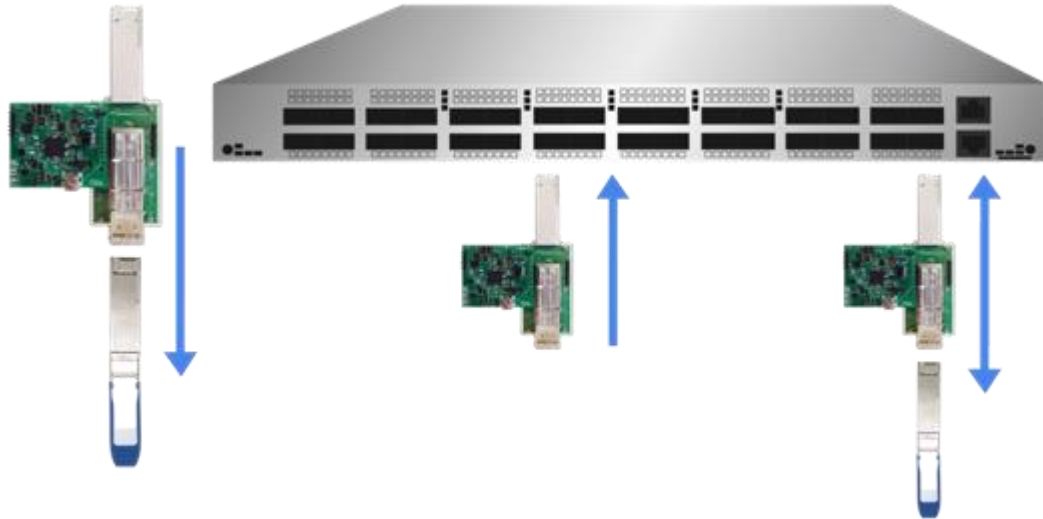
- Single or Dual-DUT BER testing in switch
- Configure switch port(s) to PRBS of choice
- Monitor BER via switch OS
- ML Optical Attenuator: BER vs RX Power Curve

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

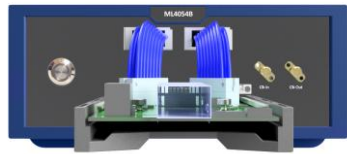
ML4015D



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



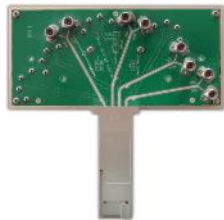
BER Test

ML4062-MCB



QSFP-DD800

ML4062-HCB



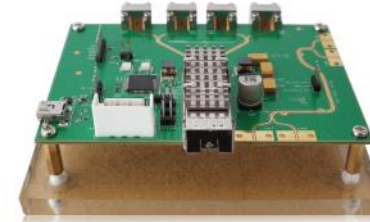
QSFP-DD800

ML4064



OSFP

ML4024



SFP

ML4041-K



QSFP28

ML4024



CFP2

ML4020-K-56



QSFP56



THANK YOU

Innovation for the next generation

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