Testing methodologies on FCoE and DCB
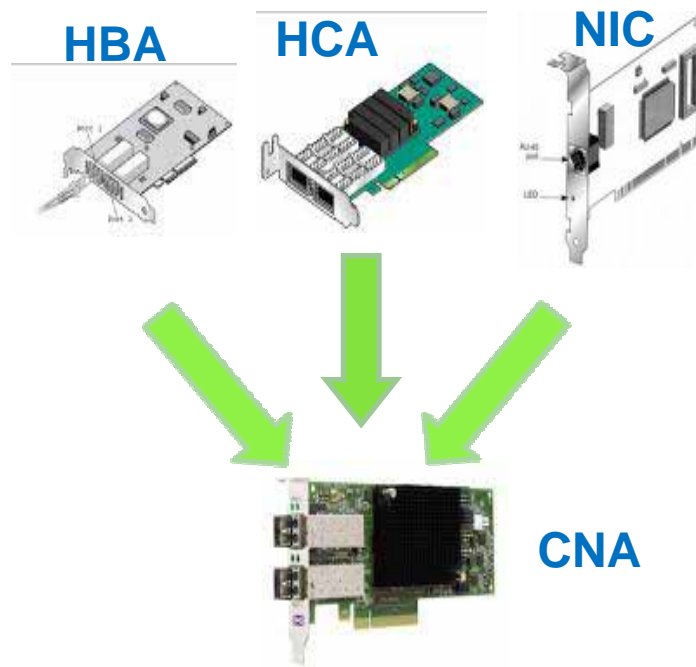
Joy Jiang

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New Devices for Next-Gen Network Convergence

- Next-Gen consolidated data center networks based on enhanced Ethernet
  - DCB
  - FCoE

- Demand new network devices based on the DCB/FCoE technologies
  - Host adapters – CNA
  - DCB and FCoE switches
  - Unified storages

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Converged Network Adapter (CNA)

HBA HCA NIC

CNA

- Integrate three functions into one hardware
- Optimized performance for server virtualization

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FCoE and DCB Switches

FCoE Switch

Ethernet

FC modules

FCoE switch to connect to Fibre Channel SAN

DCB switches to form enhanced lossless Ethernet for converged traffics

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FCoE and Unified Storages

Initiator with CNA

Lossless Ethernet

FCoE Switch

FC SAN

Unified Storage with FCoE, iSCSI, NFS, CIFS, LAN interfaces

FC Storage

- Consolidate file-based and block-based accesses via single interface
  - FCoE
  - iSCSI over DCB
  - NAS
  - And more!

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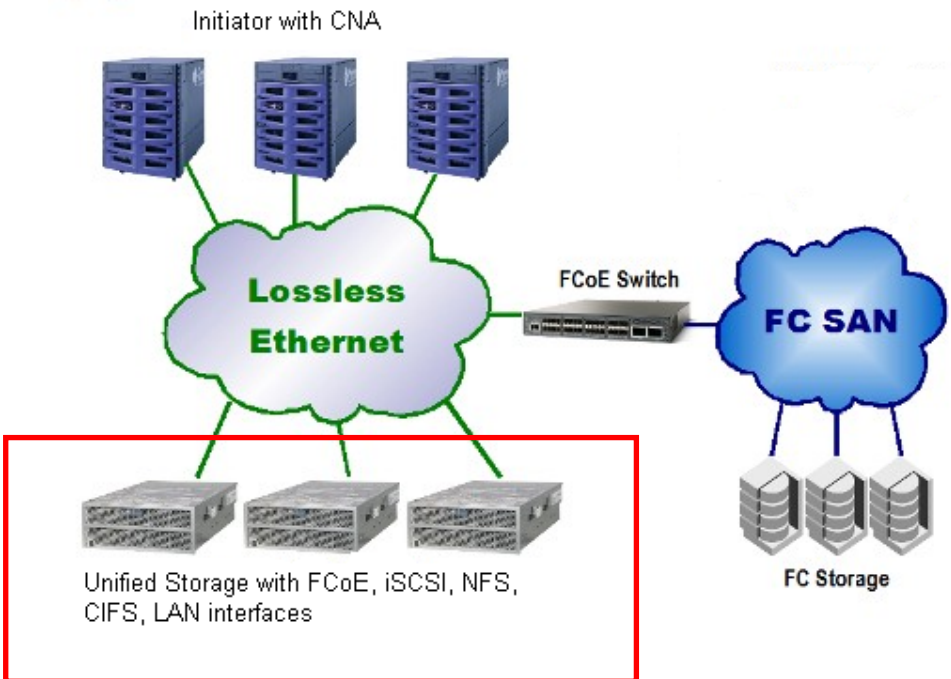
Key Focus on Testing Consolidated Networks

- ## NEMs – design new network devices
  - Functional verifications for LAN, SAN and HPC applications
  - Protocol compliance tests and interoperability tests on new protocols: FCoE and DCB

- ## Enterprises – adopt consolidated networks
  - Proof-of-concept tests on network consolidation
    - Flow control management of lossy and lossless traffic in the consolidated networks
    - QoS management of different traffic types to optimize the performance of individual application
    - Network congestion management
  - Seamlessly integrate with the existing infrastructure
    - FCoE technology connecting Fibre Channel SAN
    - Performance improvements in the enhanced Ethernet network

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New Testing Challenges

- Different test interests in LAN and SAN
  - Networking only versus comprehensive verifications
  - QoS best effort versus complete traffic flow control
  - A new dimension of performance and latency requirements

- Key to the success of network consolidation is a thorough understanding of the critical storage traffic *Protocol Tests from Development through Deployment*

Hardware *Software* *SQA* *Manufacturing* *Field Service* *Enterprise*

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Testing DCB/FCoE with Hardware Based Tools

- ## DCB protocols involve mostly link level activities
  - PFC is a MAC layer control
  - ETS manages bandwidth and congestion per PCP

- ## Same as FC, testing FCoE requires 100% data captures to provide meaningful results

- ## Hardware based protocol tester provides:
  - 100% wire rate capture on high-speed links (10GE)
    - This is a real challenge for software-based protocol tester (Wireshark) and SPAN port monitoring
  - Complete visibility of PFC and ETS behaviors
  - In-line monitoring station to station activities
    - necessary for testing congestion management protocols such as QCN

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Time Correlated Tests with Mixed Link Interfaces

- ## Mixed physical links and transport protocols in one network
  - FCoE maps native FC SAN to Ethernet
- ## New testing challenge
  - Mixed and correlated protocol test: E to FCoE to FC and back

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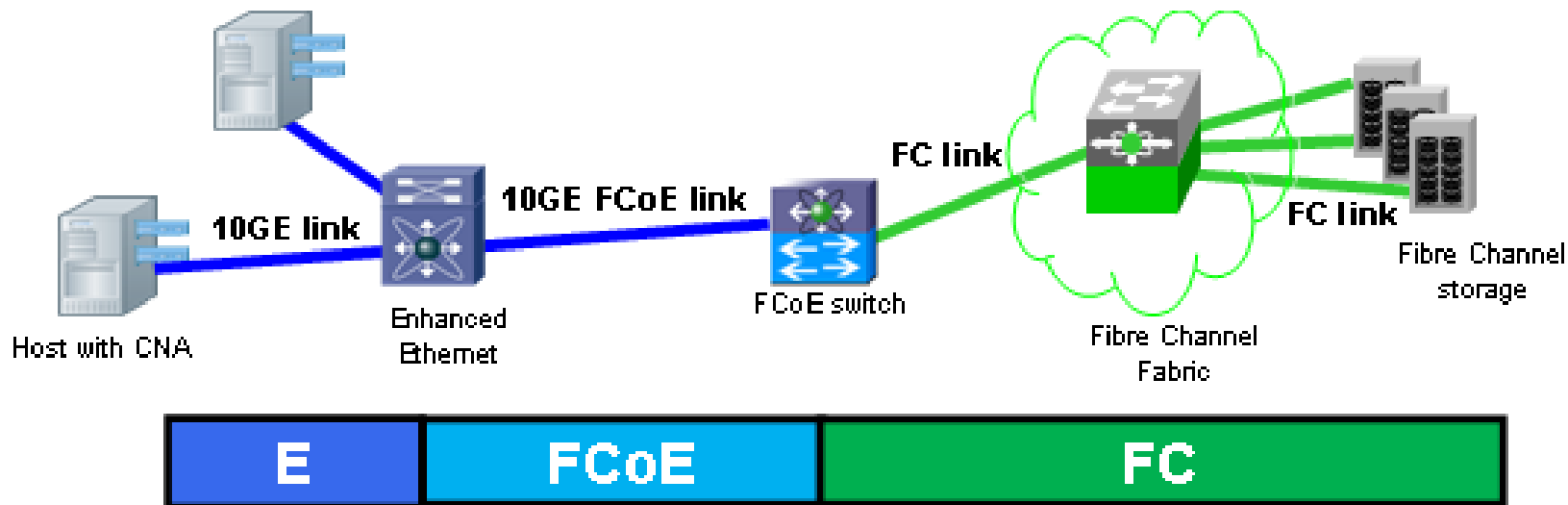
Xgig- Integrated Hardware Based Test Solution

- Guarantee capturing every bit on the wire
- Unified testing environment for Ethernet and FC
- 5ns time-sync accuracy across different protocols
- Multi-functions on single platform giving dramatic testing flexibilities

8G FC Blade
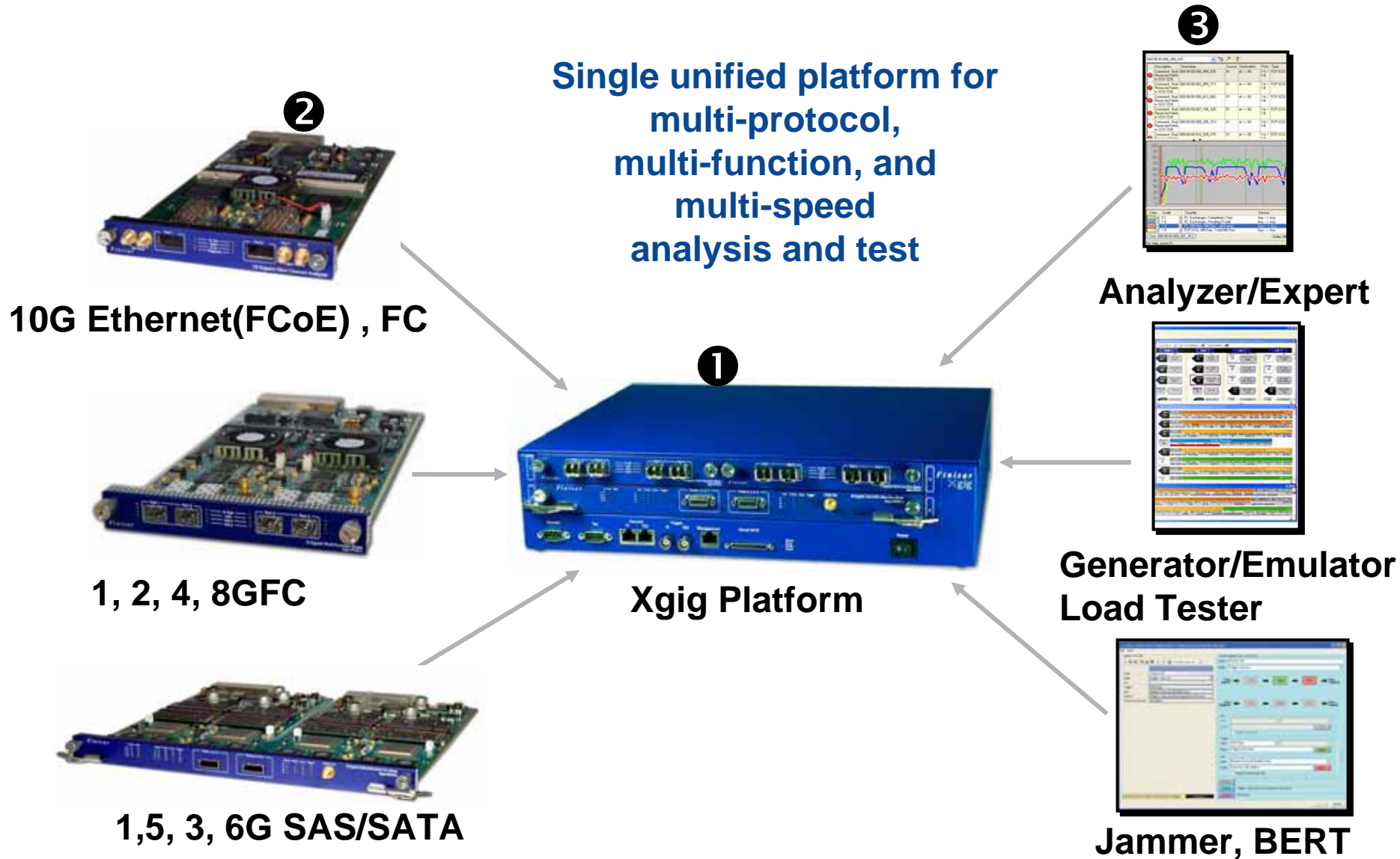
JDSU Xgig Protocol Test Platform

10G Blade (SFP+)

10G Blade (XFP)

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Xgig Platform Structure

Single unified platform for multi-protocol, multi-function, and multi-speed analysis and test

❷

10G Ethernet(FCoE) , FC

❶

1, 2, 4, 8GFC

Xgig Platform

1,5, 3, 6G SAS/SATA

❸

Analyzer/Expert

Generator/Emulator Load Tester

Jammer, BERT

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Available Functions on Xgig

In-Line Tester

Analyzer   Capture and decode the traces and provide debug support

**Jammer**   Live traffic frame/packet manipulation and corruption

Delay Emulator   Physical link distance time delay
Queue based time delay
Reordering frames

Generation Tools

Load Tester   Emulate end nodes and generate full line rate traffic for switch/fabric performance test

Generator/Emulator   Emulate initiator or target for functional and compliance tests

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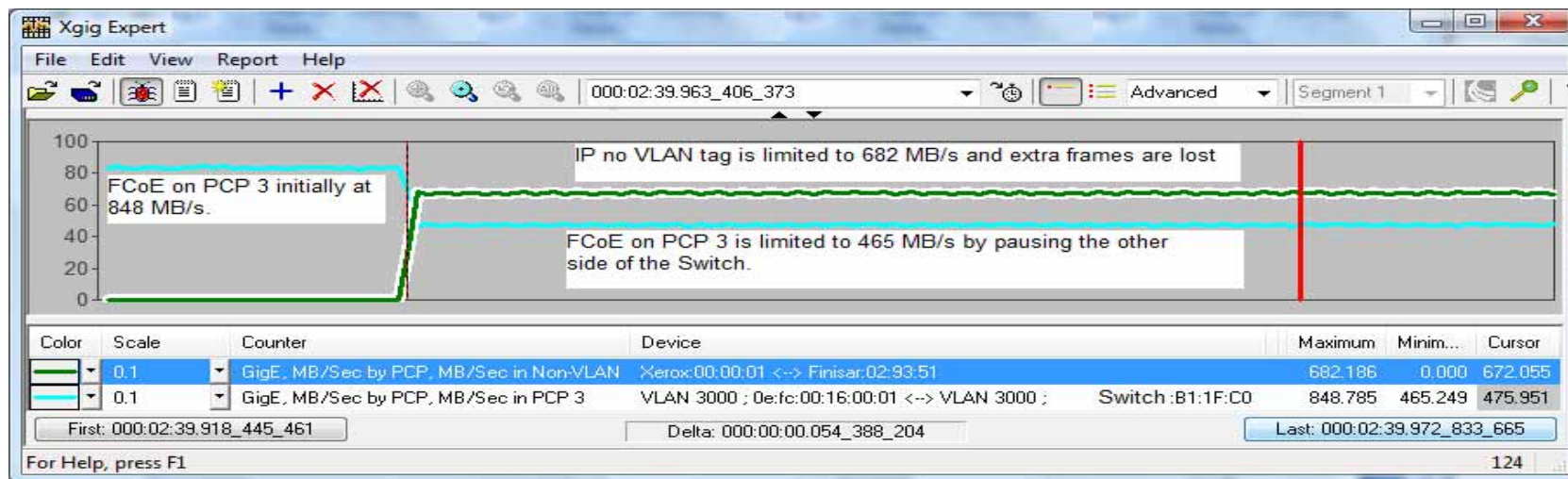
Gigabit Ethernet - PFC Flow Control Timings

From FCoE Source(1,1,1) - To FCoE Source(1,1,2)	% PFC Pause Time	PFC Pause Time (Avg. - us)	PFC Pause Time (Min - us)	PFC Pause Time (Max - us)	PFC Pause Time (Total - us)	Frame overlap time (Avg. - us)	Frame overlap time (Min - us)	Frame overlap time (Max - us)	Frame overlap time (Total - us)
Switch:B1:1F:CA —> IEEE Std 802.3x Full Duplex PAUSE operation	60.608	43.582	31.831	53.787	25,931.464	0.000	0.000	0.000	0.000
VLAN 3000 ; Switch:B1:1F:C0 —> VLAN 3000 ; 0e:fc:00:16:00:04	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Any —> Any	30.304	21.791	0.000	53.787	25,931.464	0.000	0.000	0.000	0.000
Switch:B1:1F:CA <— IEEE Std 802.3x Full Duplex PAUSE operation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VLAN 3000 ; Switch:B1:1F:C0 <— VLAN 3000 ; 0e:fc:00:16:00:04	0.000	0.000	0.000	0.000	0.000	1.470	0.013	1.820	865.719
Any <— Any	0.000	0.000	0.000	0.000	0.000	0.735	0.000	1.820	865.719

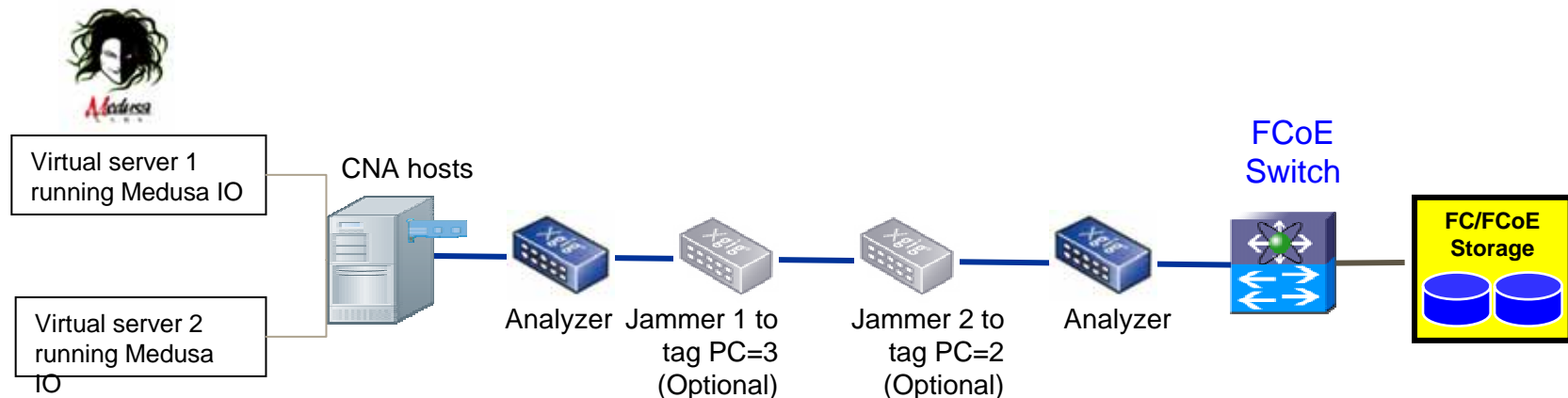**JDSU CONFIDENTIAL & PROPRIETARY INFORMATION**

JDSU Leads Efforts on Testing Virtualized Server

- JDSU/Medusa offers I/O performance test software suites and services
  - MLTT is the industry leading I/O benchmark software
    - Demonstrated 1.6M I/O at Interop08
- MLTT is ready for virtualization performance test
  - Protocol agnostic (FCoE, iSCSI, PCIe, infiniband, etc.)
  - Benchmarking and data integrity testing
    - I/O performance test on virtualized machines
    - Verify data integrity and report errors
  - Software based on commercial devices
    - Create end-to-end testing environment needed for DCB
    - Create I/O that could saturate the network for testing PFC and ETS

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TEST CASE EXAMPLES

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End-to-End PFC Testing Using IO Applications

Test target:

PFC requests from receiving side

PFC response behaviors from CNA and switch

Test tools used:

Protocol Analyzer
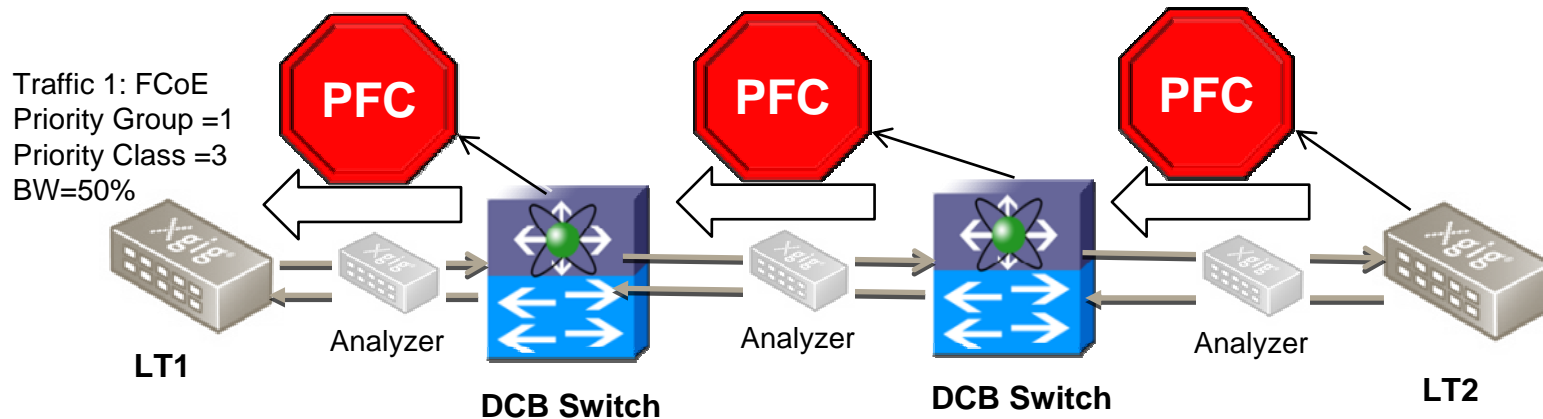Jammer
Medusa IO Application

Test interests:

Saturate BW to trigger PFC request
Verify Tx paused after receiving PFC
PFC response time within spec
Pause time at Tx

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Inter-Switch PFC Testing with Load Tester

Traffic 1: FCoE
Priority Group =1
Priority Class =3
BW=50%

PFC **PFC** **PFC**

LT1   Analyzer   Analyzer   Analyzer   LT2

DCB Switch   **DCB Switch**
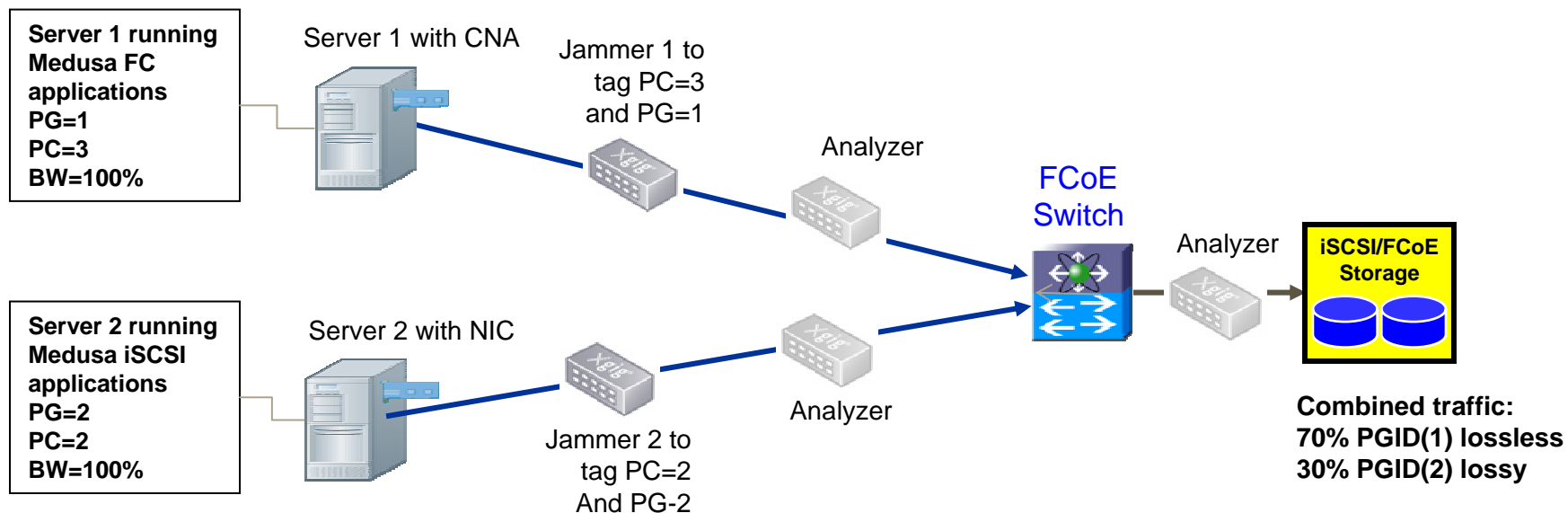
Test target:

ISL PFC performance

Test tools used:

Load Tester: create PFC requests to push back traffic from one end to the other
Protocol Analyzer: to evaluate and verify PFC behavior of DCB switches

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ETS Testing (switch + server)

Server 1 running Medusa FC applications PG=1 PC=3 BW=100%

Server 1 with CNA

Jammer 1 to tag PC=3 and PG=1

Analyzer

Server 2 running Medusa iSCSI applications PG=2 PC=2 BW=100%

Server 2 with NIC

Jammer 2 to tag PC=2 And PG-2

Analyzer

FCoE Switch

Analyzer

iSCSI/FCoE Storage

Combined traffic: 70% PGID(1) lossless 30% PGID(2) lossy

Test target:
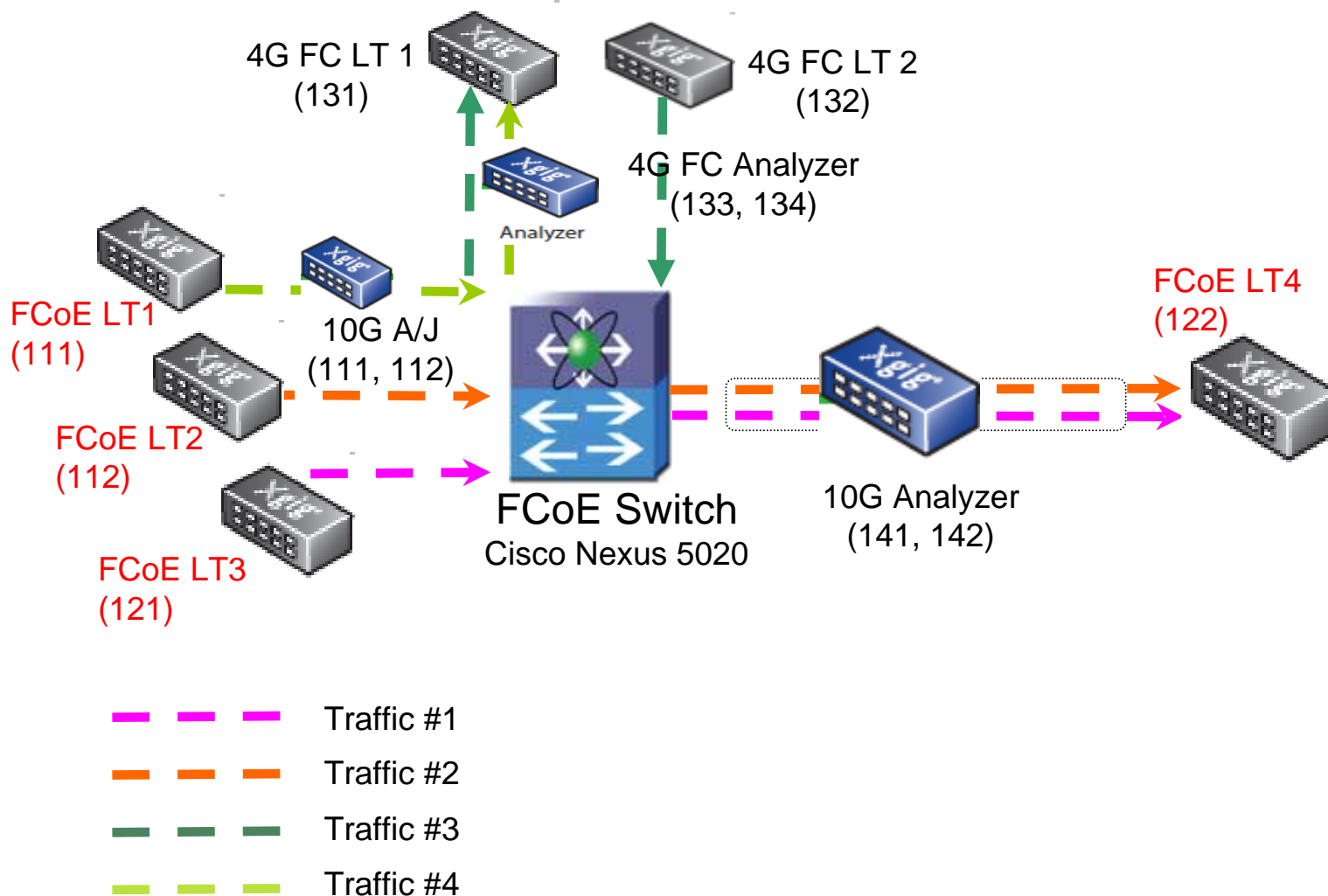
ETS performance of DCB networks end-to-end

Test tools used:

Protocol Analyzer – verify the ETS results and troubleshoot errors

Jammer – assign PG_IDs and traffic class to different traffic types

MLTT – generate high I/O to over subscribe the virtual links

Lab Session Diagram – Testing FCoE Switch

4G FC LT 1 (131)

4G FC LT 2 (132)

4G FC Analyzer (133, 134)

Analyzer

FCoE LT1 (111)

10G A/J (111, 112)

FCoE LT2 (112)

FCoE LT3 (121)

FCoE Switch
Cisco Nexus 5020

10G Analyzer (141, 142)

FCoE LT4 (122)

— — — Traffic #1

— — — Traffic #2

— — — Traffic #3

— — — Traffic #4

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Traffic Setup and Test Results

Traffic	Topology	Traffic Type	Traffic Class	VLAN
#1	FCoE LT3 to FCoE LT4	10GE non-FCoE	7 (50%)	10
#2	FCoE LT2 to FCoE LT4	10GE FCoE	3 (50%)	20
#3	FC LT2 to FC LT1	4G FC	N/A	N/A
#4	FCoE LT1 to FC LT1	10GE FCoE and 4G FC	3	20

- 10G A/J (111,112)
  - FIP VLAN discovery and login
  - Keep-live virtual link management
- 10G A/J (111, 112) and 4G Analyzer (133, 134)
  - FCoE encapsulation/decapsulation
  - Lossless link managed by PFC
- 10G Analyzer (141, 142)
  - ETS bandwidth management between priority 2 and 3 (50% each)
- 10G and 4G Load Tester
  - Oversubscribing to kick-off ETS management
  - Throughput and latency comparisons between 4G FC and 10G FCoE links

Lab Session Diagram – Application Demo on Converged Ethernet

File Copy

CNA
Qlogic QLE8140

FCoE
Switch
Brocade 8000

CNA
Brocade 1010

Windows
Network Share
Drive

Server#1
Windows Serve 2008 R2

Server#2
Windows Server 2008 R2

FCoE

FC

MLTT
I/O

iPerf
TCP/IP

iPerf
TCP/IP

Windows
Messenger
Voice conversation

8G FC
RAID

Windows
Messenger
Voice conversation

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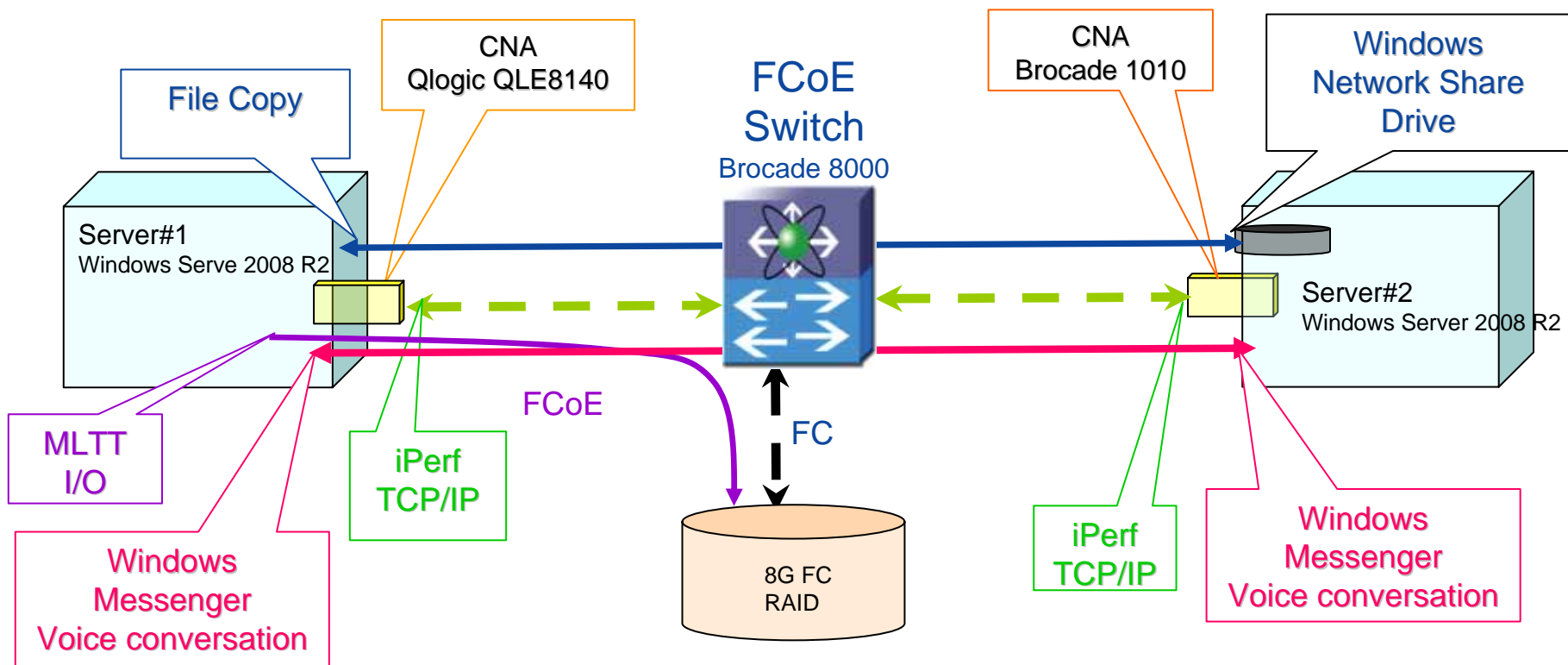
Application Setup and Test Results

- ## Application setup
  - MLTT generates FCoE I/O to 8G FC RAID
  - iPerf generates high bandwidth TCP/IP applications between two servers
  - VoIP phone conversation between two servers
  - Copy files from network share drives; traffic between two servers
- ## Test results
  - Two traffic classes on the converged Ethernet
    - FCoE 50%
    - TCP/IP 50%
  - MLTT shows the I/O performance of storage traffic
  - iPerf shows the TCP performance

THANK YOU!

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