

Laurent de Barry

# Beyond Latency

*June 5th - STAC NYC*



**enyx**



# Who are we?

We are FPGA experts creating next generation solutions dedicated to enhancing performance across the industry.

## **We believe that. . .**

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- Performance is not an excuse for complexity,
- Performance is as important as transparency,
- Aiming for a good Average latency is too easy and the real challenge is to aim for a good Maximum



## **Speed is a Must, But...**

**The trading latency scale has decreased year-over-year, but other challenges arose. . .**

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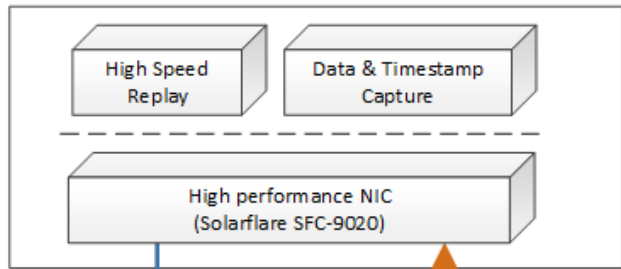
- Profits resulting solely based on speed shrank and the investment to keep up increased.
- Liquidity is global and trading firms need to connect to a large number of venues.
- Trading strategies need to be smarter as well as faster to succeed.

**So as a vendor, how can we help?**



# Transparency is as important

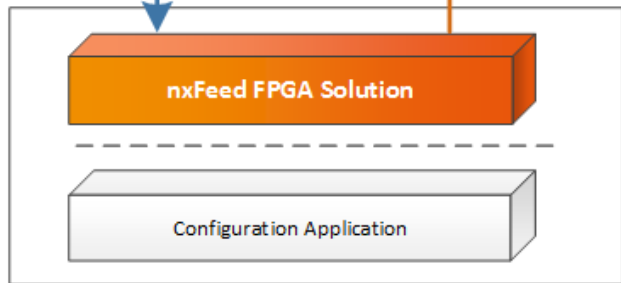
*Exchange Simulator Server (HP DL360 G9)*



L1  
Switch



L2 Switch  
(Arista 7150S)



*nxFeed Host Server (HP DL380 G9)*

## Standard Equipment

- HP Servers
- Solarflare NIC
- Arista Switch

## Clear test conditions

- 20x replay rate
- Processing 8 000 Symbols
- SOP-to-SOP measures

## Post analysis

- Replay rate verification
- Packet rate / Latency correlation



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# Transparency is as important

Performance Reports nxFeed NYSE XDP INTEGRATED

Overview

Setup Configuration

Host Server

Replay and Capture Server

Layer 1 Device

Solution Under Test

Wire-to-Wire Latency Test

## nxFeed NYSE XDP Integrated Latency Report

### Overview

This aims to describe the latency of the nxFeed XDP Integrated (1.x and 2.x) support along with a description of the benchmark setup and methods.

### Setup Configuration

The test bed uses two distinct machines respectively as the host server and the replay and capture server. Here are the configuration of these servers:

#### Host Server

Server Model	HP DL380p Gen8
Operating System	CentOS 6.6
Processor(s)	2x Intel Xeon E5-2643 V2 @3.5GHz
Server Memory (RAM)	16 GB DDR3
FPGA Card	Enyx FPB1

#### Replay and Capture Server

Server Model	HP DL380e Gen8
Operating System	CentOS 6.6
Processor(s)	2x Intel Xeon E5-2420 V2 @2.20GHz
Server Memory (RAM)	16 GB DDR3
Solarflare Card	SFC-9020

#### Layer 1 Device

Model	Exablaze Exalink 50
Version	0.4.6.0-WIP
Port Speed	100Mb/1Gb/10Gb

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#### Layer 1 Device

Model	Exablaze Exalink 50
Version	0.4.6.0-WIP
Port Speed	100Mb/1Gb/10Gb
Port-to-Port advertised latency	20 ns

#### Layer 2+ Device

Model	Aruba 7100
Version	0705.4.14.001
Port Speed	10Gbps
Timestamping Resolution	0.200 nanoseconds
Timestamping Trigger	First byte of the PDU

#### Solution Under Test

FPGA Card	Enyx FPB1 Card
Hardware	0.100 Gbps throughput version 0.2.2 (WIP)
Software	Enyxfeed version 0.1.10

#### Wire-to-Wire Latency Test

##### Schematic



Port to Port advertized latency	4 ns
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Model	Arista 7150S
Version	EOS-4.14.6M
Port Speed	1Gb/10Gb
Timestamping Resolution	2.857 nanoseconds
Timestamping Trigger	First Byte of the FCS

<b>FPGA Card</b>	Enyx FPB1 Card
<b>Firmware</b>	NYSE XDP Integrated version 2.2.2 (rev 21547)
<b>Software</b>	Libenymd Version 2.1.16

```

graph TD
    RCS[Replay and Capture Server  
(HP DL360e Gen8)]
    TS[Timestamping Device  
(Arista 7150S)]
    subgraph HS [Host Server  
(HP DL380p Gen8)]
        EC[Enyx FPGA Card]
        CA[Configuration Application]
    end

    HS -- "Raw Market Data (Purple)" --> RCS
    HS -- "nxFeed Normalized Protocol (Orange)" --> TS
    TS -- "Raw Market Data (Purple)" --> RCS
    TS -- "nxFeed Normalized Protocol (Orange)" --> RCS
  
```

Legend:

- Raw Market Data (Purple line)
- nxFeed Normalized Protocol (Orange line)
- 10Gb Ethernet (Grey arrow)

nxFeed wire-to-wire 10Gb Latency Measure Setup

nxFeed wire-to-wire 10Gb Latency Measure Setup

Performance Reports [mlFeed+](#) NYSE XDP INTEGRATED

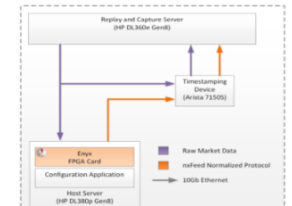
## Overview

Model	Exastore Exastore S0
Version	0.4.0-WSP
Port Speed	100Mb/1Gb/10Gb
Port to Port advertised latency	4 ns

Model	Ariela 7150S
Version	EOS-4.14.6M
Port Speed	10Gbit/s
Timestamping Resolution	2.857 nanoseconds
Timestamping Trigger	First Byte of the FCS

<b>FPGA Card</b>	Enys FFB1 Card
<b>Firmware</b>	NYSE XDP Integrated version 2.2.2 (rev 21547)
<b>Software</b>	LibertyLink Version 2.1.16

### Schematic



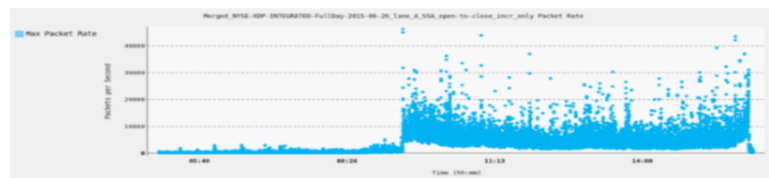
refed wire-to-wire 10Gb Latency Measure Setup.



# Transparency is as important

## Capture Characteristics

Capture	NYSE ARCA XDP Integrated June 26 2015 Full Day
Packet Count	103,803,158
Channel Count	4
Capture Duration	11:09:59
Capture Beginning Date	Fri, 26 Jun 2015 04:55:00
Capture End Date	Fri, 26 Jun 2015 16:04:59
One Second Packet Rate Peak	46,279
One Second Bit Rate Peak	144.99 Mbit



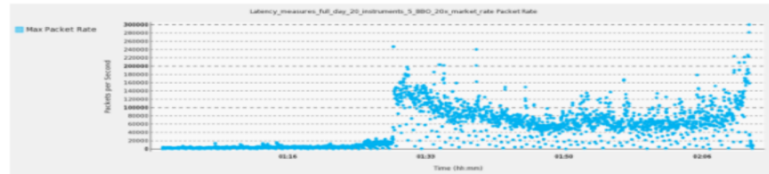
## Test #1: 20x Market Rate with 20 Instruments

### Conditions

Instrument Count	20
Subscribed Channel Count	1
Instruments List	20 most traded US Stocks SPY, BAC, AAPL, EEM, VXX, PBR, GDV, GE, IWM, MSFT, SIRI, XLF, QQQ, INTC, FB, EWJ, F, CSCO, VALE, UWTI
Book Builder	Delta Updates
Configuration	5 Levels
Output Book Depth	5 Levels
Output Packet Count	415,574

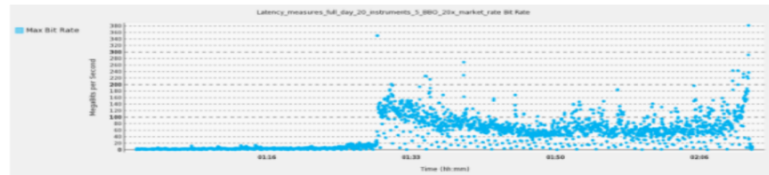
### Replay

#### Observed Packet Rate:



Requested Replay Rate	20 times market rate
Effective Replay Rate	19.1 times market rate
Average Packet Rate	42,259 Packets Per Second
Maximum Packet Rate	360,720 Packets Per Second

#### Observed Bit Rate:



Requested Replay Rate	20 times market rate
Effective Replay Rate	19.2 times market rate
Average Bit Rate	45.6 Mbit/s
Maximum Bit Rate	363.25 Mbit/s

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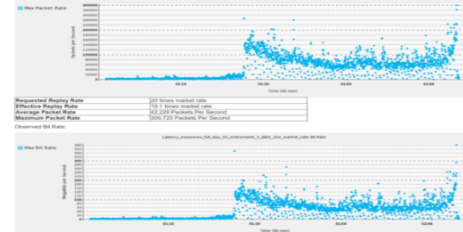
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Book Builder	Delta Updates
Configuration	5 Levels
Output Book Depth	5 Levels
Output Packet Count	415,574

### Replay

#### Observed Packet Rate:



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## Results

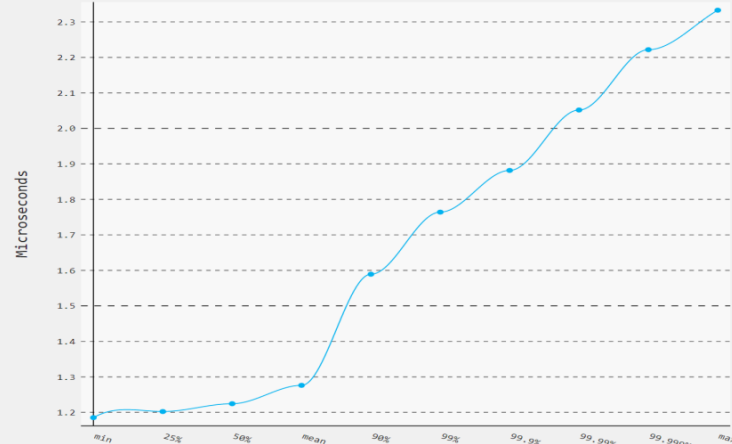




# Transparency is as important

## Results

Latency\_measures\_full\_day\_20\_instruments\_5\_BBO\_20x\_market\_rate-wire\_to\_wire

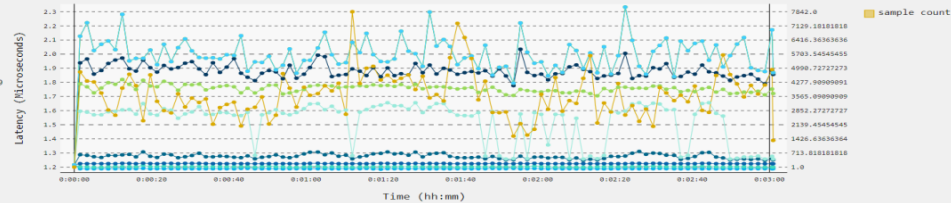


Latency statistics (microseconds)					
Minimum	50th Perc	Mean	90th Perc	99th Perc	Maximum
1.185	1.224	1.276	1.589	1.764	2.332

Number of packets per percentile					
Minimum	50th Perc	Mean	90th Perc	99th Perc	Maximum
1	103,893	207,787	374,016	411,418	415,574

## Latency Distribution Over Time

NYSE-XDP-INTEGRATED-nxFeed Latency\_measures\_full\_day\_20\_instruments\_5\_BBO\_20x\_market\_rate wire\_to\_wire Latency Evolution



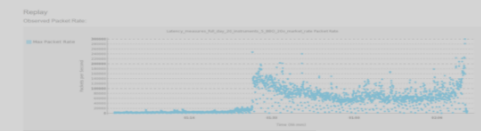
## Capture Characteristics

System	NIOS2-6800-200 Integrated core 20 2016-06-12
Packet Count	2,332,192
Packet Size	1,024
Capture Beginning Date	2016-06-12 00:00:00
Capture End Date	2016-06-12 00:00:00
Wire Network Packet Rate Peak	2,332,192
Wire Network Bit Rate Peak	2,332,192



## Test #1: 20x Market Rate with 20 Instruments

Configuration	
Instrument Count	20
Instrument Channel	1
Instrument List	NYSE-XDP-INTEGRATED-nxFeed
Instrument Rate	2,332,192
Instrument Rate Peak	2,332,192
Instrument Rate Peak	2,332,192



Configuration	
Instrument Count	20
Instrument Channel	1
Instrument List	NYSE-XDP-INTEGRATED-nxFeed
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Minimum	50th Perc	Mean	90th Perc	99th Perc	Maximum
1.185	1.224	1.276	1.589	1.764	2.332









# Taking You Beyond Latency

## Our solutions are designed for...

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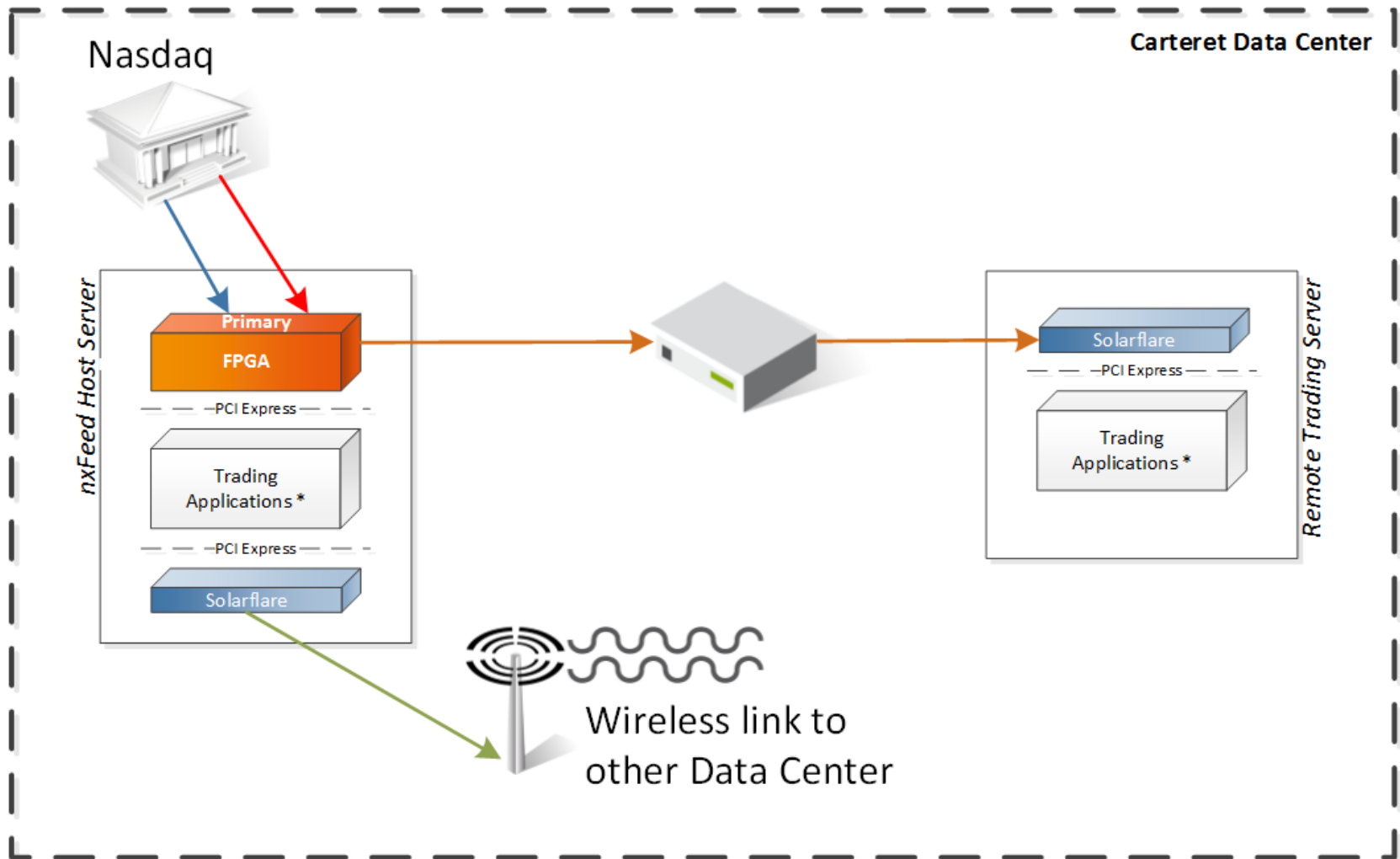
- Ease of configuration and monitoring
- Plug and play solutions
- Full featured product set

**Performance doesn't need to equal complexity!**



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# Taking you Beyond Latency



# THANK YOU

**For more details about our numbers  
and testing methods, visit us at:**

**[www.enyx.com/performance](http://www.enyx.com/performance)**



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