



NYSE PILLAR ARCA OPTIONS

August 17, 2021

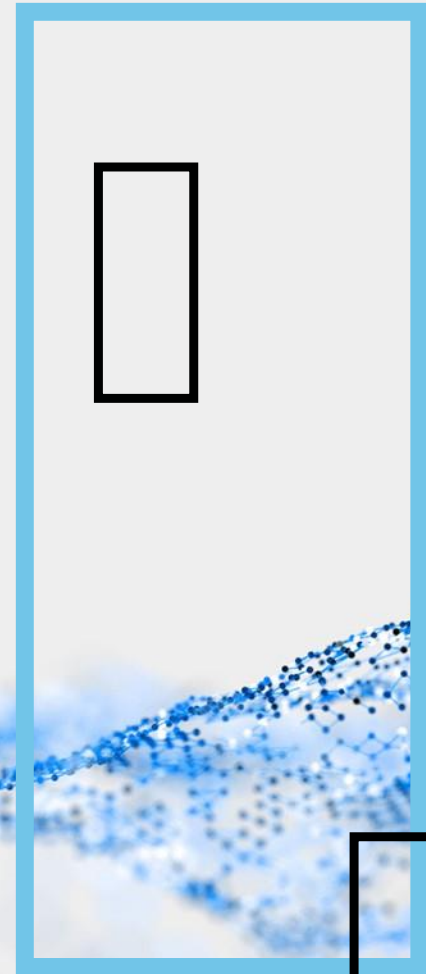


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INTRODUCTION AND OPENING REMARKS

Meaghan Dugan, Senior Director
Head of NYSE Options Product and
Competitive Strategy



AGENDA

- Migration Timeline, Overview and Strategy
- NYSE Arca Options Pillar Certification and Customer Testing
- NYSE Pillar Architecture, Design and Performance
- Functional Differences
- Q&A

MIGRATION TIMELINE

| Date | | Event |
|---------------------|--|--|
| October 21, 2020 | <ul style="list-style-type: none"> ✓ ✓ | <ul style="list-style-type: none"> ▪ NYSE Options Virtual Forum ▪ Launched NYSE Pillar migration website https://www.nyse.com/pillar-migration |
| November 10, 2020 | <ul style="list-style-type: none"> ✓ | <ul style="list-style-type: none"> ▪ Initial specifications for outright order entry, MM quoting and Proprietary Market Data |
| January 25, 2021 | <ul style="list-style-type: none"> ✓ | <ul style="list-style-type: none"> ▪ Certification environment opened for session requests and connectivity provisioning |
| February 8, 2021 | <ul style="list-style-type: none"> ✓ | <ul style="list-style-type: none"> ▪ Certification opens for electronic Outright functional testing |
| March 15, 2021 | <ul style="list-style-type: none"> ✓ ✓ | <ul style="list-style-type: none"> ▪ NYSE Pillar Functional Differences document published ▪ Updated Specs including Complex Order Book and Risk Controls posted on website |
| May 28, 2021 | <ul style="list-style-type: none"> ✓ ✓ | <ul style="list-style-type: none"> ▪ Certification available for Risk Controls ▪ Certification available for Trading Floor OMS Gateway and Trade Processing |
| June 28, 2021 | <ul style="list-style-type: none"> ✓ | <ul style="list-style-type: none"> ▪ Certification available for Complex Order Book |
| July - October 2021 | | <ul style="list-style-type: none"> ▪ Production order entry/quoting and market data retransmission session provisioning - Certification required (July) ▪ 7 Weekend production test dates <ul style="list-style-type: none"> › July 24 ✓, August 7 ✓, August 28, September 11, September 18 mandatory opportunity #1, October 16 mandatory opportunity #2, October 30 Final confidence test › Weekend testing will include T+1 outputs and CAT submissions (Sept. – Oct.) ▪ NYSE Pillar is available for weekday Production trading with test symbols after July 24 |
| November 1, 2021 | | <ul style="list-style-type: none"> ▪ 3-week symbol migration starting November 1, 2021 and finishing before Thanksgiving |

MIGRATION OVERVIEW

- 3-week symbol migration to NYSE Pillar begins **November 1, 2021**
- Legacy order, quote, market data protocols will **not** be supported
- NYSE Pillar gateways are sole entry point for orders and quotes
 - › Certification is required
 - › Existing LCN and IGN Connectivity can be utilized
- Migration from TPIDs to MPIDs
- Proprietary Market Data
 - › Top, Deep and Complex Market Data Feeds
 - › NYSE Pillar Deep Feed modified to order-by-order feed
 - › Top and Deep Feeds shift from alpha alignment to symbol TXN alignment
 - › Gap fill and refresh replaces existing legacy in-line periodic refresh

MIGRATION STRATEGY: PORTALS, TOOLS, COMMUNICATION

Portals and Tools

- NYSE Pillar Trade Operations Portal (TOP) replaces GEMS and Client Management Tool (CMT)
 - › Clients must request TOP connectivity
- Drop Copy and customer reports replace GEMS On-Line Extract

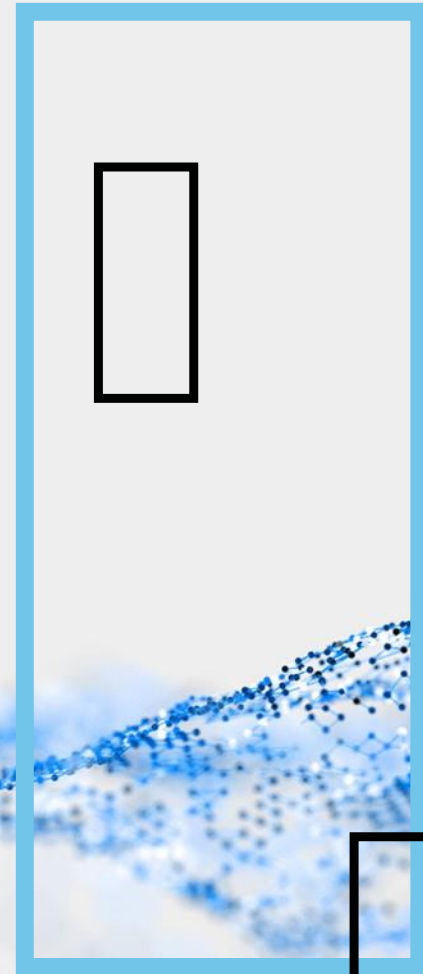
Client Communication

- NYSE Pillar Options [webpage](#) is available with up-to-date information
 - › Specification Documents, Order Type Matrices, Functional Differences Document ([now including Complex](#))
- Monthly Trader Updates published with latest updates
- Hosting 45-minute monthly calls focusing on specific NYSE Pillar Options migration topics

CERTIFICATION & CUSTOMER TESTING

Jignesh Desai, Director

NYSE Technology Member Services (TMS)



NYSE PILLAR CERTIFICATION ENVIRONMENT

- To access, submit a [Pillar Certification Session Request Form](#) to TMS
- Free of Charge
- Opened since January 2021
- Mirrors Production Structure
- Supports Floor Trading Workflow
- Incorporates TOP
- Connectivity to OPRA Test System and Proprietary Market Data Feeds
- Available Weekdays With Dedicated Support Staff

NYSE PILLAR CERTIFICATION

Available Now

- Vast majority of functionality for Outright, Complex, Market Maker Quoting, Risk Controls, Proprietary Market Data and Trading Floor

Functionality Pending Roll Out (End of August 2021)

- Complex Order Book: Opening Auctions, Complex Order Auctions and Complex Risk Controls
- Trading Floor: Complex Order Book, FLEX using TOP, TOP Allocation Handling

PRODUCTION DOCUMENTATION REQUIREMENTS

NYSE Pillar Documentation Requirements

- NYSE Master User Agreement (MUA) or Additional Platform Agreement
- NYSE Pillar Connectivity Questionnaire (One Questionnaire per MPID)
- NYSE Pillar Service Bureau Connection Agreement
- NYSE Pillar Trading Operations Desk Authorized Traders Form

TOP Documentation Requirements

- The NYSE Pillar TOP replaces GEMS, CMT
- TOP provides a variety of on demand reporting capabilities
- A User Request form is required for each individual
- Multiple user types and permission options available
- Forms will be made available on the NYSE Pillar Options migration page

PRODUCTION TESTING

- NYSE Pillar is available for weekday testing using test symbols
- The Exchange is supporting seven weekend testing opportunities with Production and test symbols. Weekend testing opportunities are:
 - › July 24, 2021 ✓
 - › August 7, 2021 ✓
 - › August 28, 2021
 - › September 11, 2021
 - › September 18, 2021* Mandatory (option 1)
 - › October 16, 2021* Mandatory (option 2)
 - › October 30, 2021 - Final confidence test

* To access NYSE Pillar in Production, participants MUST participate in at least one of the two mandatory test dates. Mandatory weekend tests will include T+1 outputs and CAT submissions.

RESOURCES AND SUPPORT CONTACT

- Dedicated migration web site
 - › www.nyse.com/pillar-migration
- Relationship Management (RM)
 - › RMTeam@nyse.com | +1 855 898 9012
- NYSE Trading Operations
 - › Trading@nyse.com | +1 212 896 2830, Options, 1, 2
- Technology Member Services (TMS)
 - › Tms@nyse.com | +1 212 896 2830, Options, 2, 2
- Client Relationship Services (CRS)
 - › Crs@nyse.com

ARCHITECTURE, DESIGN AND PERFORMANCE



Hayk Mkrtchyan, Senior Director

NYSE Pillar Architect and Co-Head of Development

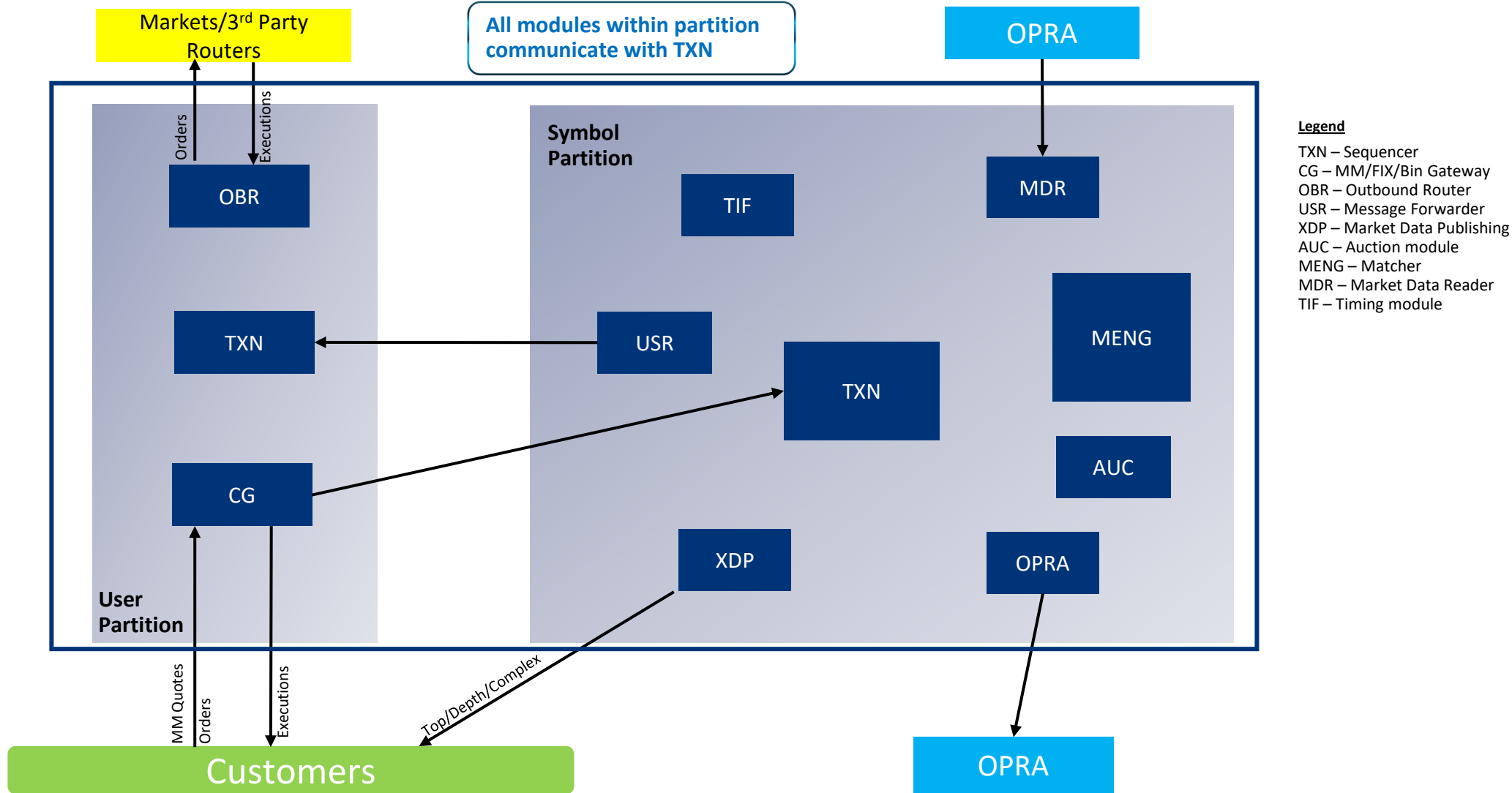
SYSTEM OVERVIEW

- Integrated trading platform with:
 - › Order entry gateways
 - › Matching engines
 - › Market data systems
- Single codebase and connection specification supporting equities and options exchanges
- Reduced complexity, enhanced performance, resiliency and improved time to market
- Full hardware and network redundancy

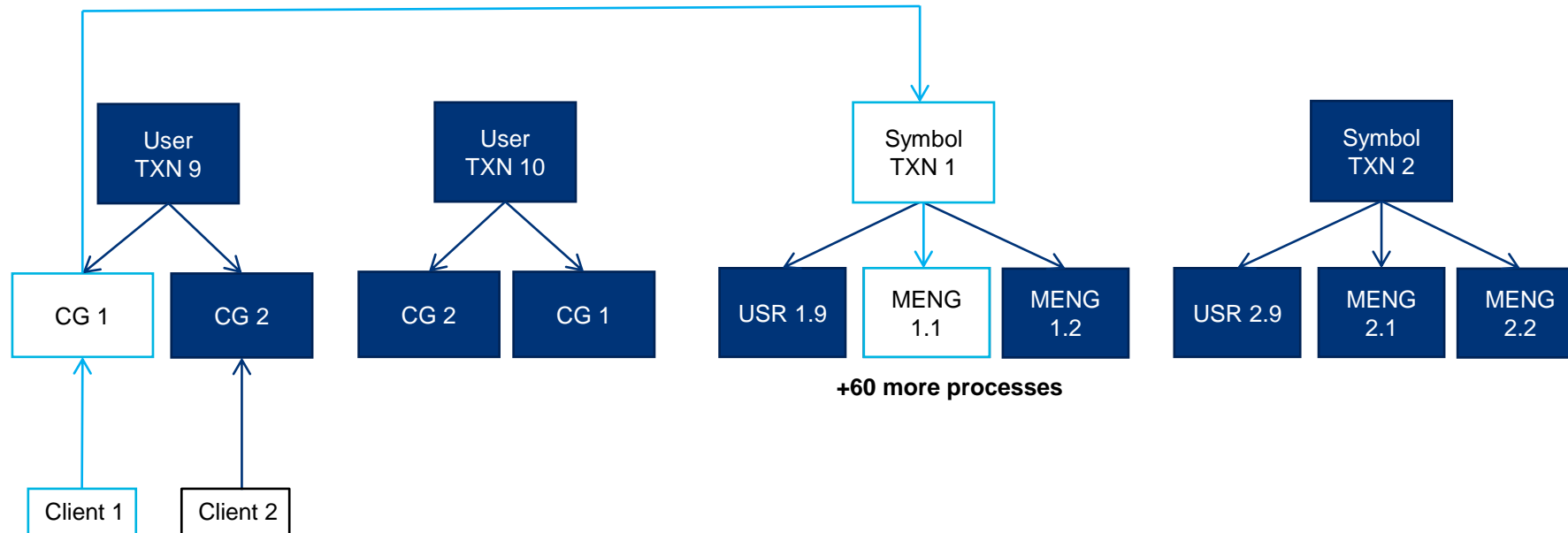
SYSTEM ARCHITECTURE

- Physical Architecture
 - › Blade server architecture
 - › Hundreds of cores communicating through Infiniband
- System Architecture
 - › Processes are single-threaded
 - › Each process is assigned:
 - › Single isolated core
 - › Fixed memory to operate
- Application Architecture
 - › Append only ledger (TXN)
 - › Ledger and processes around it is a transaction partition
 - › Globally unique identifier for each message

MESSAGE FLOW

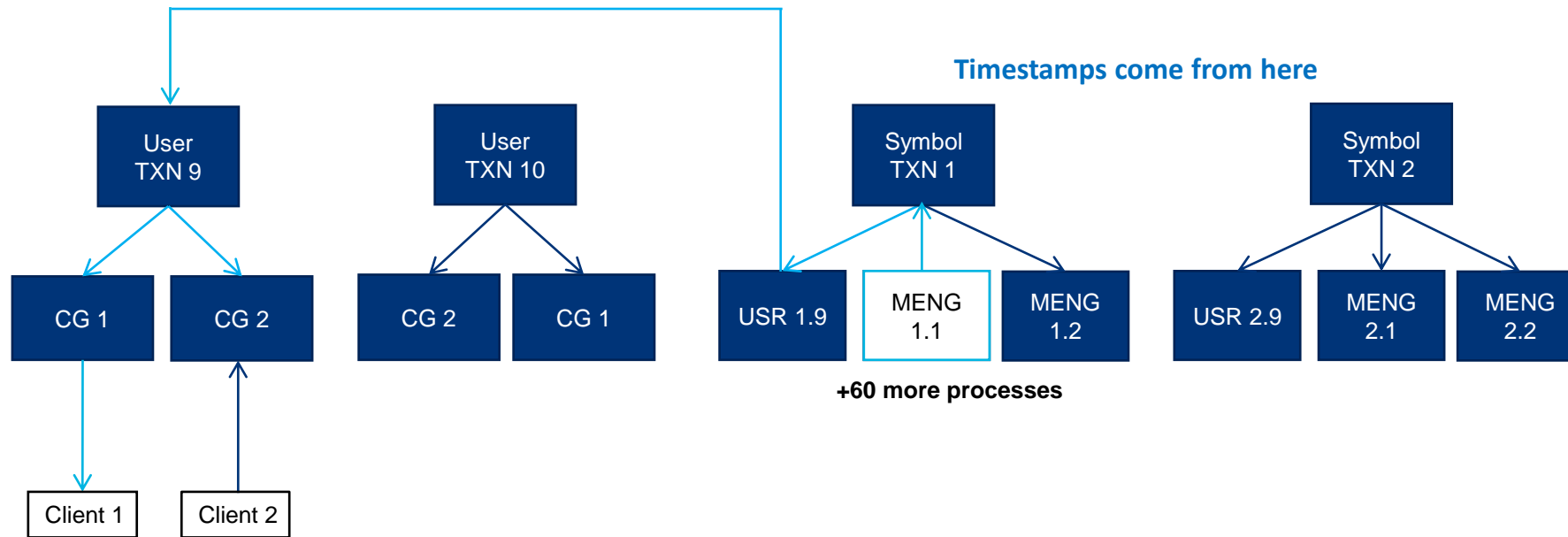


DATA FLOW FOR AN ORDER



- CGs spend the same amount of time processing different order types
- CGs publish incoming messages to Symbol TXN
- At this point, transaction order is fully determined: whichever message gets to the TXN first, trades first. No racing
- CGs use edge triggered epoll

DATA FLOW FOR AN ORDER

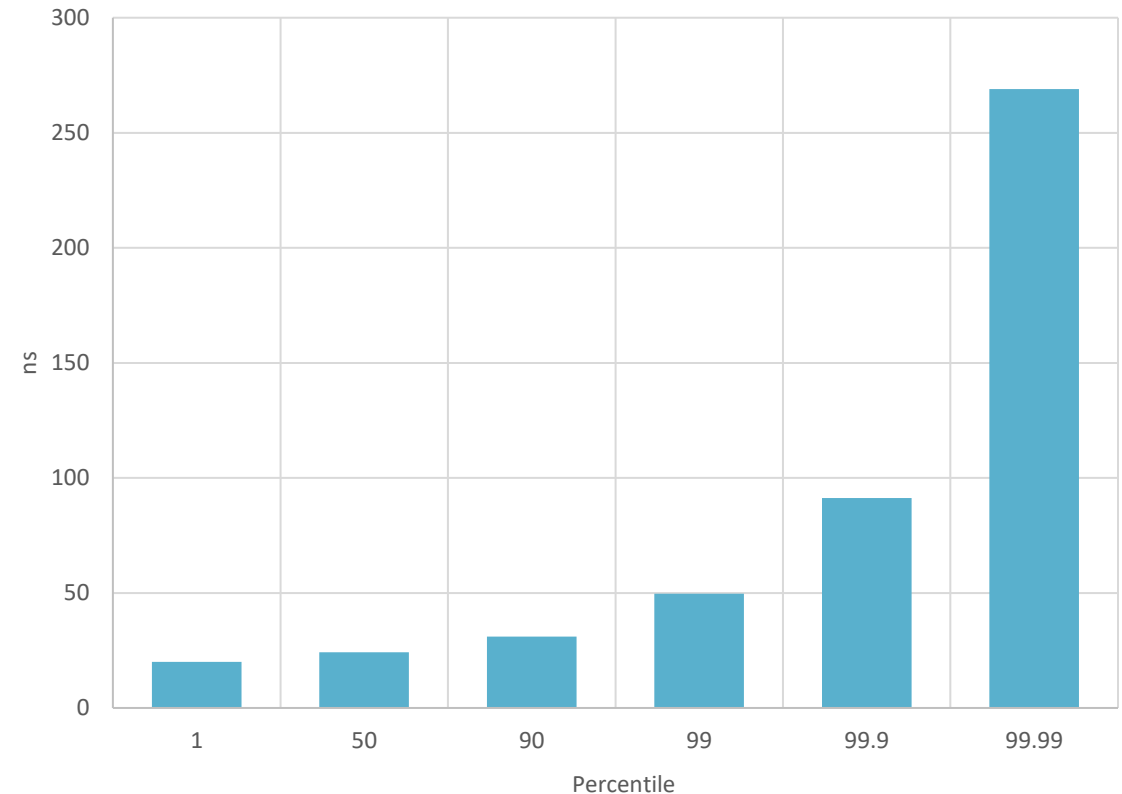


- Timestamps are produced by the Symbol TXN and are consistent for all messages for a given underlying

BY THE NUMBERS

- NYSE Arca Options*
- 2462 isolated cores on 192 nodes
- 224 matchers (112 + 112)
- 14 symbol partitions
- 130 market data processes (including persistence, publication, retransmission)
- 288 gateway processes (Binary, MM, FIX)
- Median latency: 24 μ s; 90% latency: 30 μ s

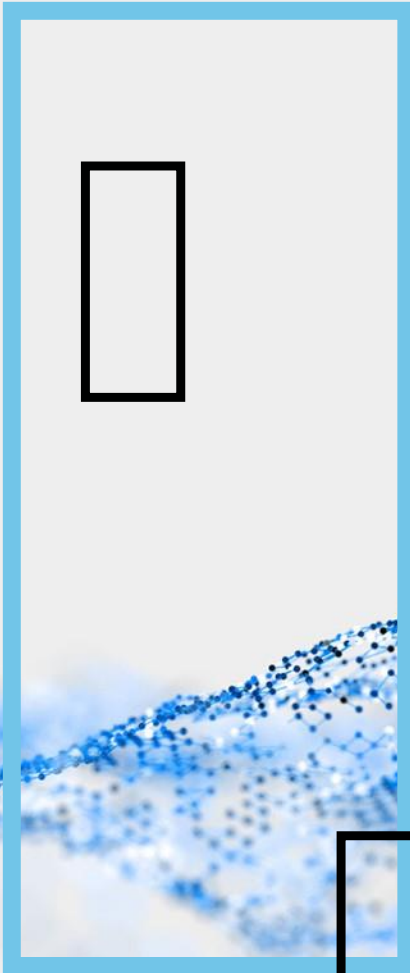
Latency Distribution



*NYSE Pillar architecture processes are subject to change without notice

FUNCTIONAL DIFFERENCES

Michael DeGaeta, Director
NYSE Product Management



AGENDA

- Complex Order Types + Messaging
- Complex Order Book
- Complex Order Auctions
- Risk Controls

COMPLEX ORDER TYPES + MESSAGING

- All existing order types continue to be offered
 - › Fill-or-Kill (FOK) Complex Limit order added
 - › PNP+ Complex Order renamed to Complex Only Order, with modifications to functionality including that Complex Orders are not repriced
- Messaging support
 - › Complex FIX allows the explicit legs to be identified in the order messages
 - Response messages sent for both the complex and leg; executions are provided for leg only
 - › Complex Binary uses a series ID number to identify the complex series
 - Response messages sent for complex only; executions are provided for both complex and leg
 - › OrderID is consistent on all complex and leg level messages for a complex
- Complex series creation is conducted from FIX order messages and Binary complex series request messages
 - › Consistent Complex series ID numbers utilized between Binary order entry and NYSE Pillar Complex Market Data

COMPLEX ORDER BOOK

- Complex series is defined from the perspective of the Buyer
- Electronic Complex strategies with up to 12 legs supported
 - › Strategies of 6 legs or more not eligible for legging
 - › Non-standard complex strategies accepted for complex to complex only
- Complex Debit/Credit pricing aligned to industry standards
 - › Net Debit price - identified without a sign indicates the intent to pay
 - › Net Credit price - identified with a negative sign indicates the intent to receive payment
- Marketable Complex Orders display to NYSE Pillar Complex Market Data at their Limit prices (Complex BBO can be locked/crossed)
- New Complex to Complex trade price protection

COMPLEX ORDER AUCTIONS

- COA designated orders auction upon receipt
 - › Rejected if received in pre-open and during a Trading Halt
 - › Auction requirements include:
 - Order must be priced through the midpoint of the Derived BBO
 - Order must be priced more aggressively than a COA order with an auction in progress
- Auctions have a maximum run time of 100 milliseconds
 - › Auction trades follow the Exchange price-time allocation algorithm
- Auction responses (except IOC and GTX) are published to NYSE Pillar Complex Market Data at the time of receipt
- GTX orders only trade versus a COA order
 - › Any GTX order balance remaining at the conclusion of the auction is cancelled

RISK CONTROLS

- Pre-Trade and Activity-Based Risk Controls configurable via Binary Protocol or TOP
- Pre-trade Risk Controls:

| | |
|-----------------------------|-----------------------------------|
| › Single Order Max Quantity | › Single Order Max Notional Value |
|-----------------------------|-----------------------------------|

 - › Controls set at MPID with availability to segregate within an MPID
- Activity-Based Risk Controls:

| | | |
|---------------|----------|--------------|
| › Transaction | › Volume | › Percentage |
|---------------|----------|--------------|

 - › New client-configurable rolling timer
 - › New choice of automated breach action:

| | | |
|---------------|--------------|--------------------|
| › Notify Only | › Block Only | › Cancel and Block |
|---------------|--------------|--------------------|
- Global Risk Controls:

| | | | |
|-------------------|-------------------------|---------------------------|----------------------------|
| › Arbitrage Check | › Intrinsic Value Check | › Limit Order Price Check | › Complex Net Debit/Credit |
|-------------------|-------------------------|---------------------------|----------------------------|
- Enhanced Self-Trade Prevention
 - › Self-Trade support for all clients at MPID level with availability to segregate within an MPID
 - › Complex to Complex Self-Trade Prevention available

NYSE PILLAR ARCA OPTIONS

Q & A

