


# The Case for Disaggregation of Compute in the Data Center

## - Maximizing Data Center Performance in Financial Services

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**Andrew Bach**, Chief Architect for Financial Services, Juniper Networks

HPC – Monday, April 6<sup>th</sup>, 2015

A decorative graphic in the bottom right corner consisting of several overlapping, semi-transparent circles in shades of blue, green, and orange, creating a stylized, abstract shape.

# Agenda

The Need for High Performance

The Challenge

The Limitations Today

Redistribute Computing as a Solution

A Customer View



# Agenda

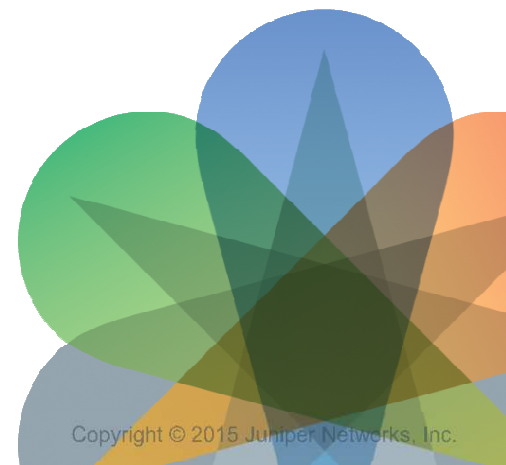
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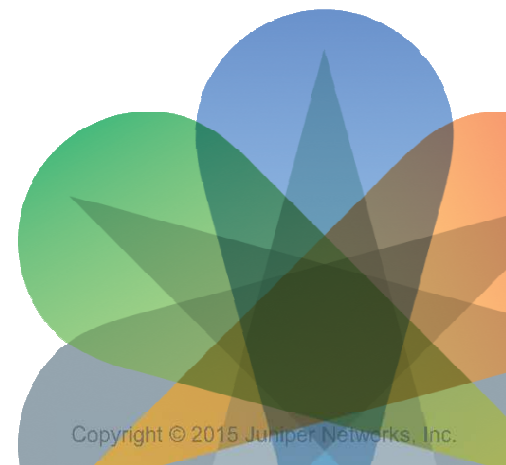
A Customer View



# 400+ Years of Rapid Technology Adoption

And a rich history of technology innovation in markets

- First stock ticker to disseminate data (1867)
- First telephones on the trading floors (1878)
- First electronic ticker display board (1966)
- Wireless handheld devices on Trading floors 15 years before iPad invented (1995)
- Industry's first private network offering global connectivity
- Industry's private network exceeds 1TbS



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# Financial Services Sector (FSS) Challenges

## Regulatory Model is Driving Change

- Requirement for long term retention of data
- Requirement to archive meta data
- Real time risk management is now required
- Requirement for precision timing
- Increasing focus on cyber security

## FSS is Evolving to a Commodity Industry

- Time to market must be faster
- Product life time is shorting
- Margins are driving OPEX reduction
- Regulation is increasing the cost of business

## Technology Adoption is Accelerating to Meet Accelerating Business Needs

- Technology is a strategic weapon
- Fueling the race to the triple crown of technology (0 cost, 0 latency, 0 time to market)
- Bandwidth demand continues to grow at 30% - 50% per year
- Rate of data growth is also increasing

## Business Model Continues to Evolve

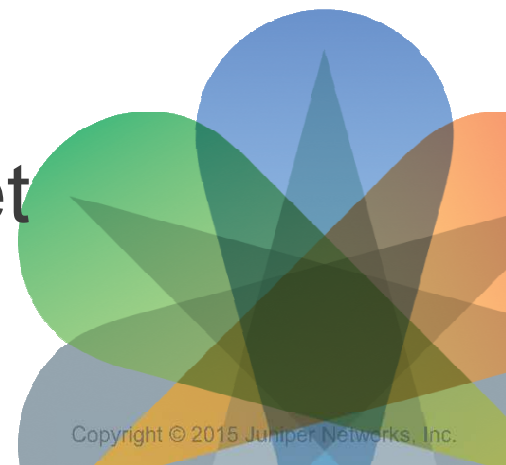
- Exchange trading floors continue to fade away
- Machine assisted trading dominates
- Heuristic trading based on hyper-contextual information is growing
- Risk assessment is now routinely based on massive near real time data bases
- Shared public/private cloud solutions

# The Evolving Business Model – One Example



# Where We Were

- Floor trader gathers information:
  - Listens to the news
  - Watches the activity on a trading floor
  - Watches the ticker
  - Watches the NBBO
- Floor trader reacts to the above
- Floor trader takes a position in the market





# Where We Are

- Traders are augmented by machine base predictive programs
  - Process classic market data and propriety data
  - Compute an implied sense of the market
  - Execute many small trades based on micro discontinuities in the market
  - Analysis now occurs across markets and asset classes in real time
- Traders supervise the trading machine and refine the process/algorithms

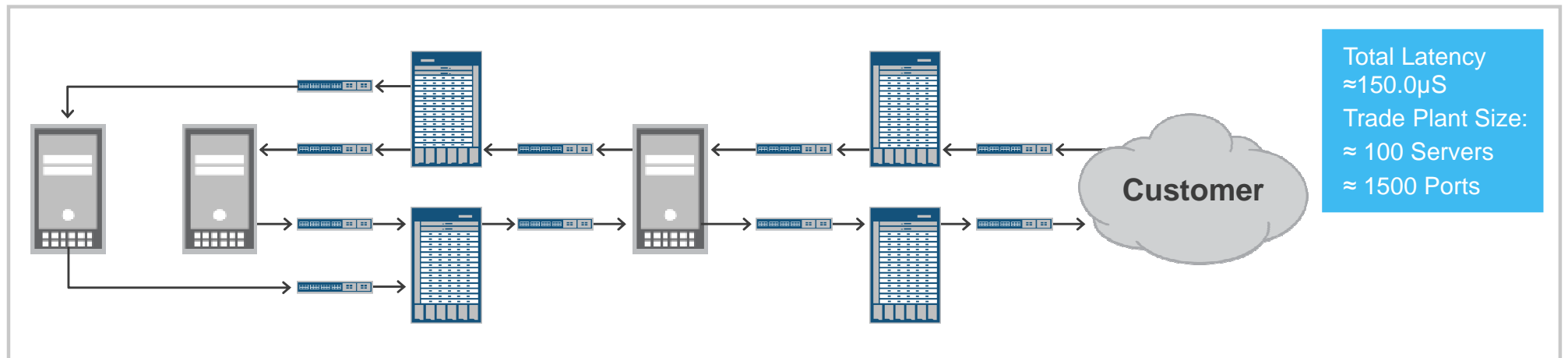


# Where We are Going: To the Cloud and Beyond, In Real Time

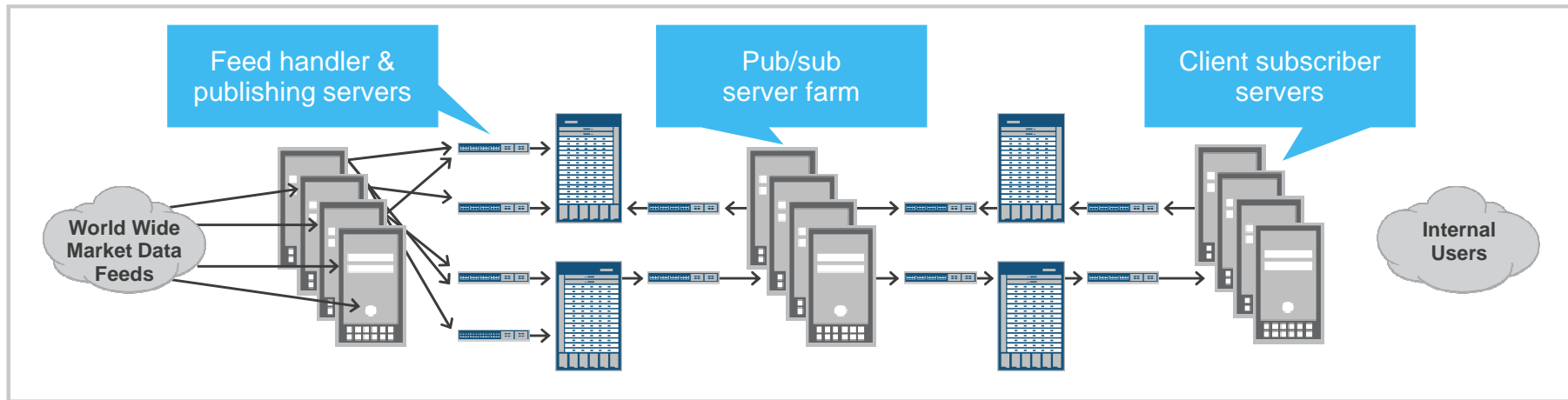
- Market data world wide becomes part of the analysis/prediction process
- Broad product classes and sector information influence the process
- Real time heuristic interpretation of news
- Real time heuristic interpretation of social feeds
- Historical assessment of news and impact on forward prediction
- Risk on trade in the context of current overall portfolio



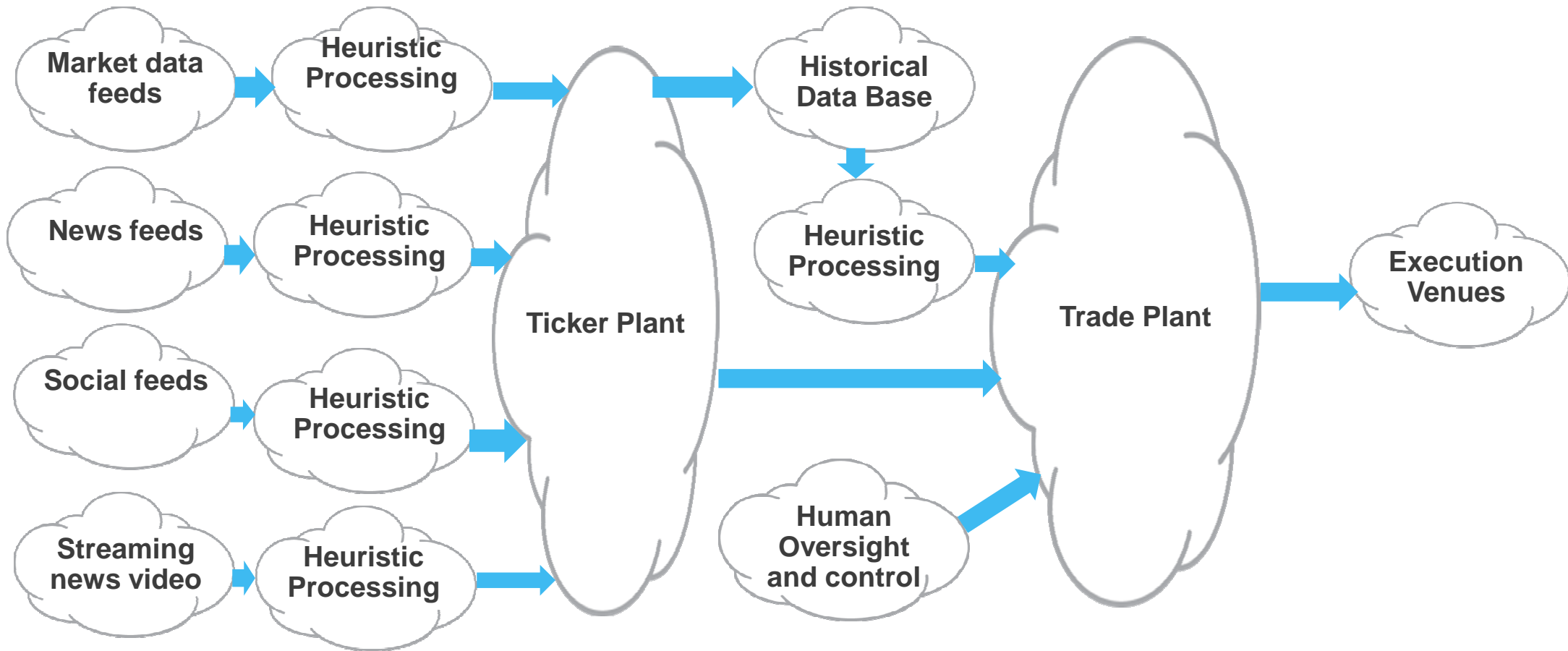
# A Typical Challenge – Exchange Gateway Trade Plant



# A Typical Challenge – Market Data Ticker Plant



# Next Challenge – Heuristic Based Trading



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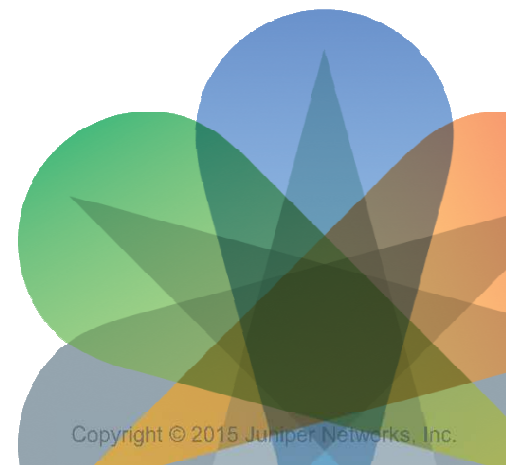
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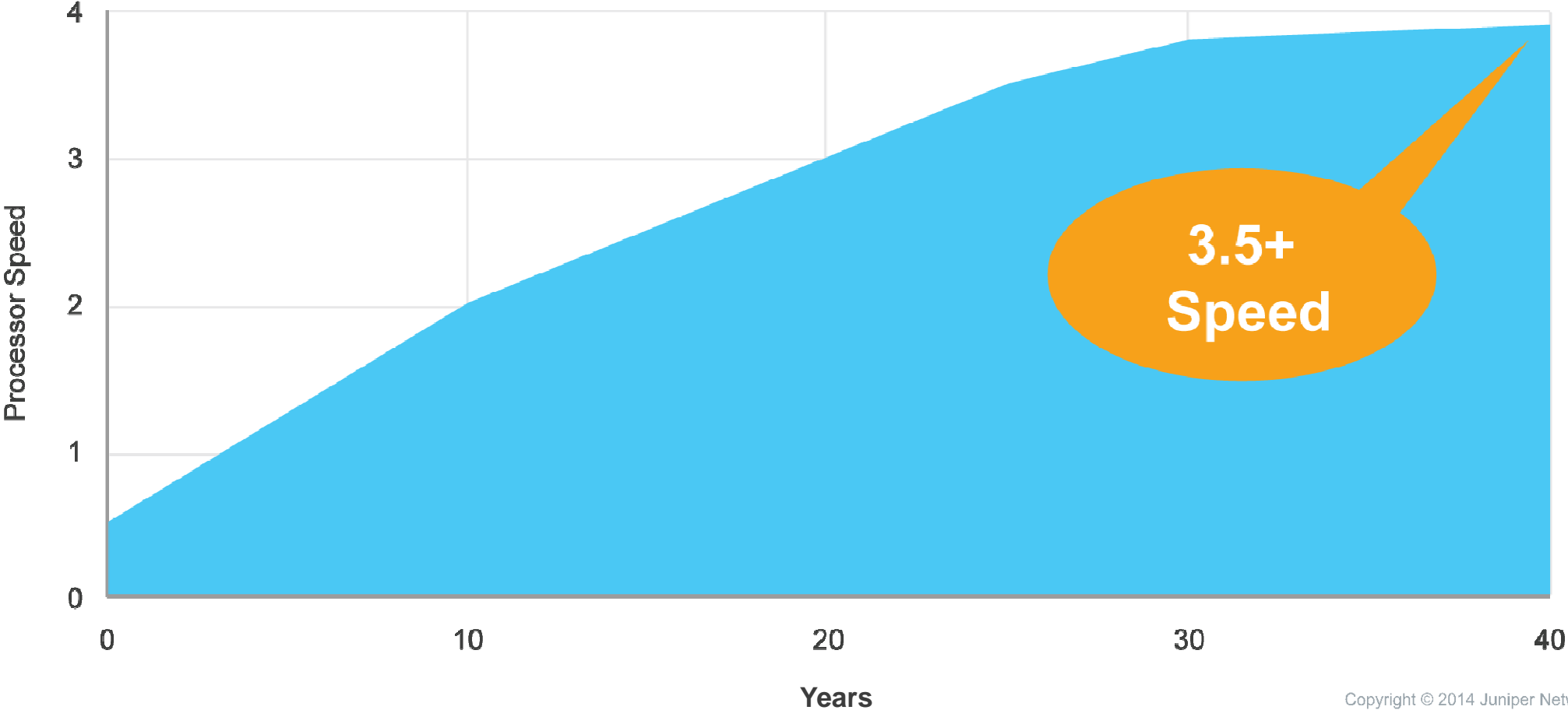
**The Limitations Today**

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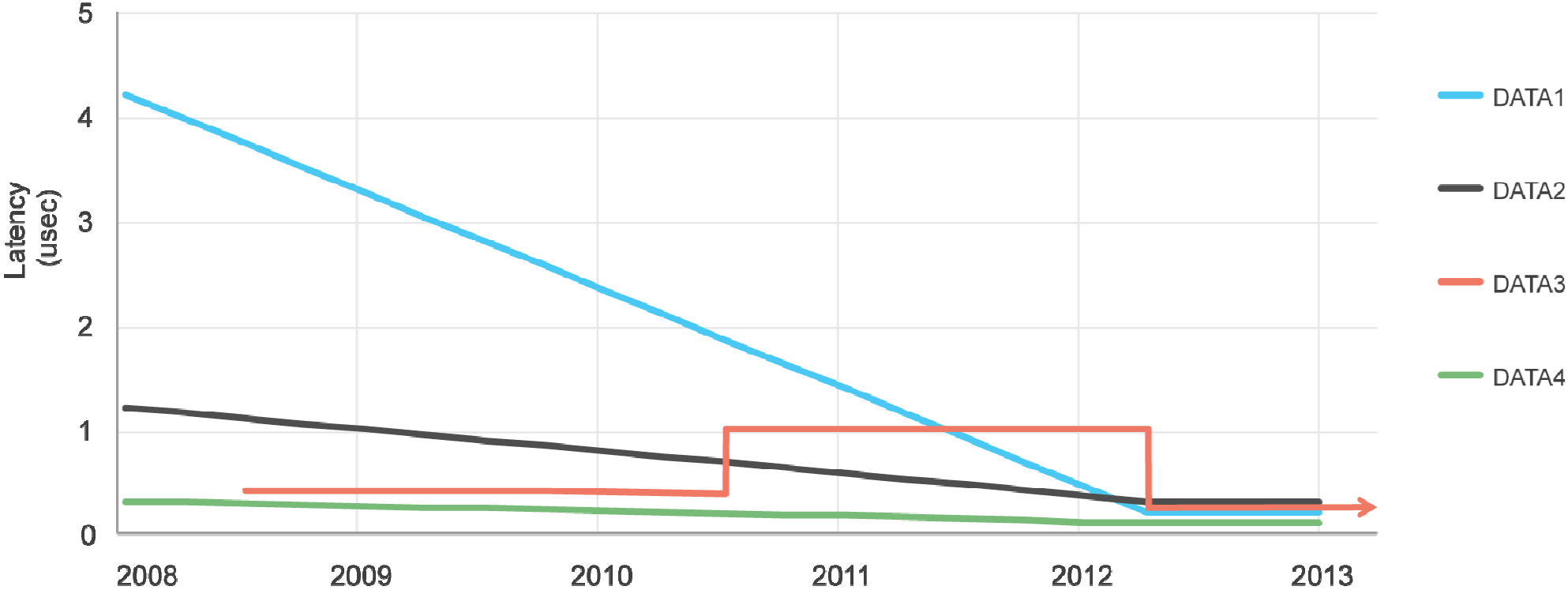


# Slowing of Processor Speed



# Latency Reduction Trends

Industry tracking to  $\approx 450\text{ns}$





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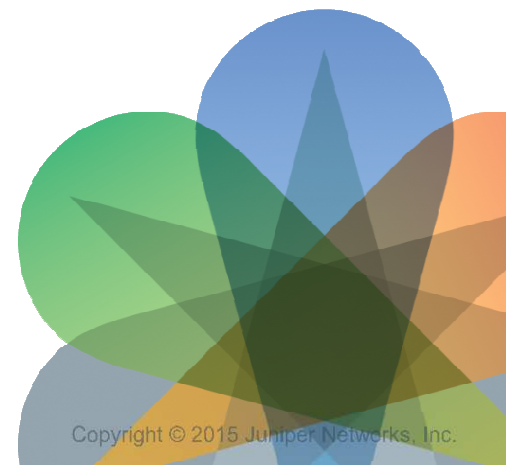
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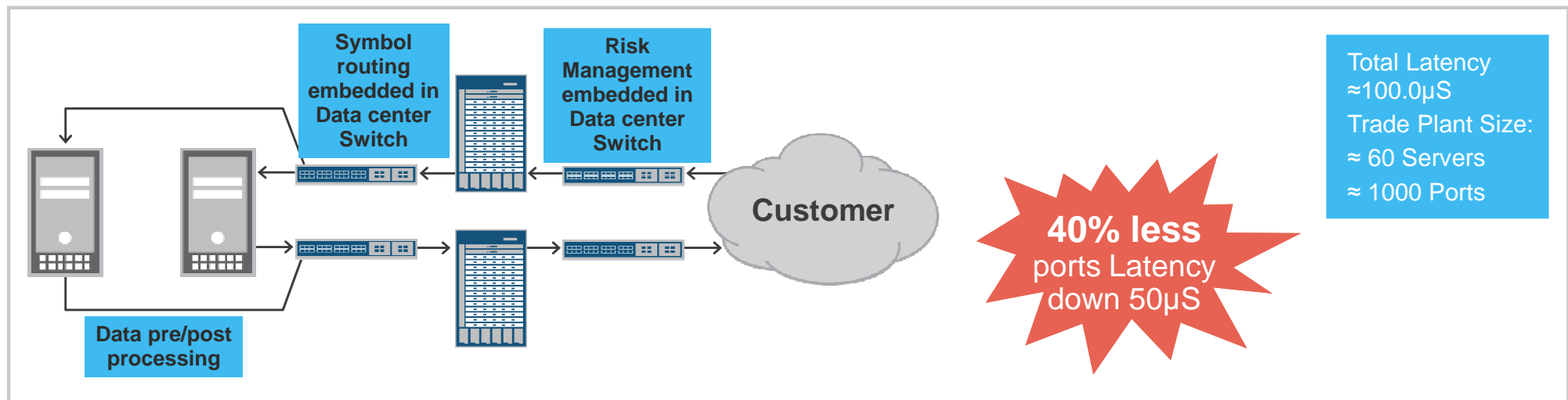
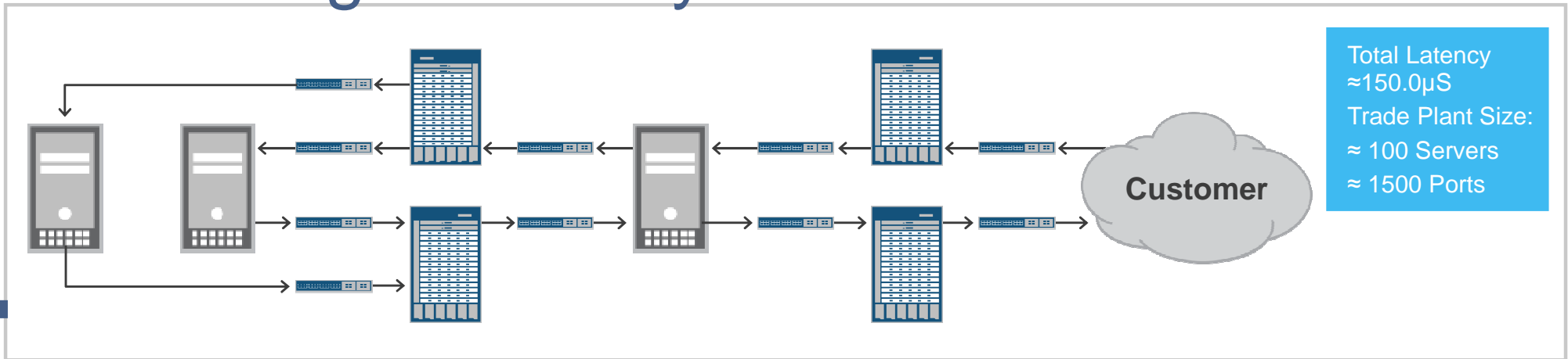
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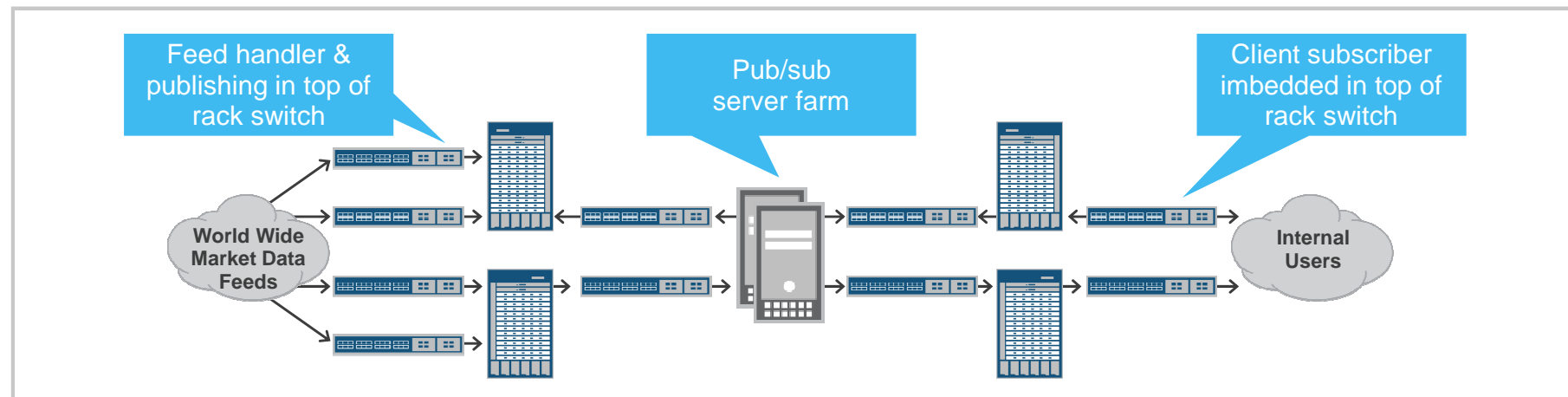
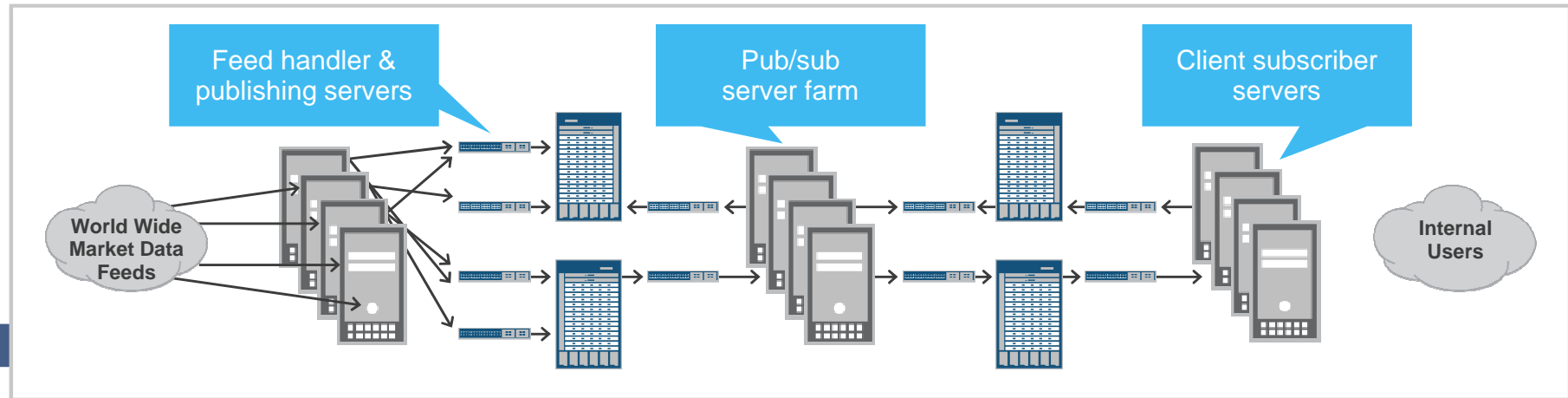
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# A Different Approach: Distributed Computing for an Exchange Gateway Trade Plant



# A Different Approach: Market Data Ticker Plant



# Compute-Integrated Networking

The new way to reduce latency and cost.

## The Race to Zero is Ending

At about 200 – 500NS for a reasonable switch

Need to focus on a different approach

## Embed Application Snippets into the Switching Fabric

Lower latency

Eliminate servers

Reduce network ports

## Embed Snippets at the Control or Data Plane of the Network

Application can be embedded in

- A VM in the switch

- A FPGA in the data path of the switch

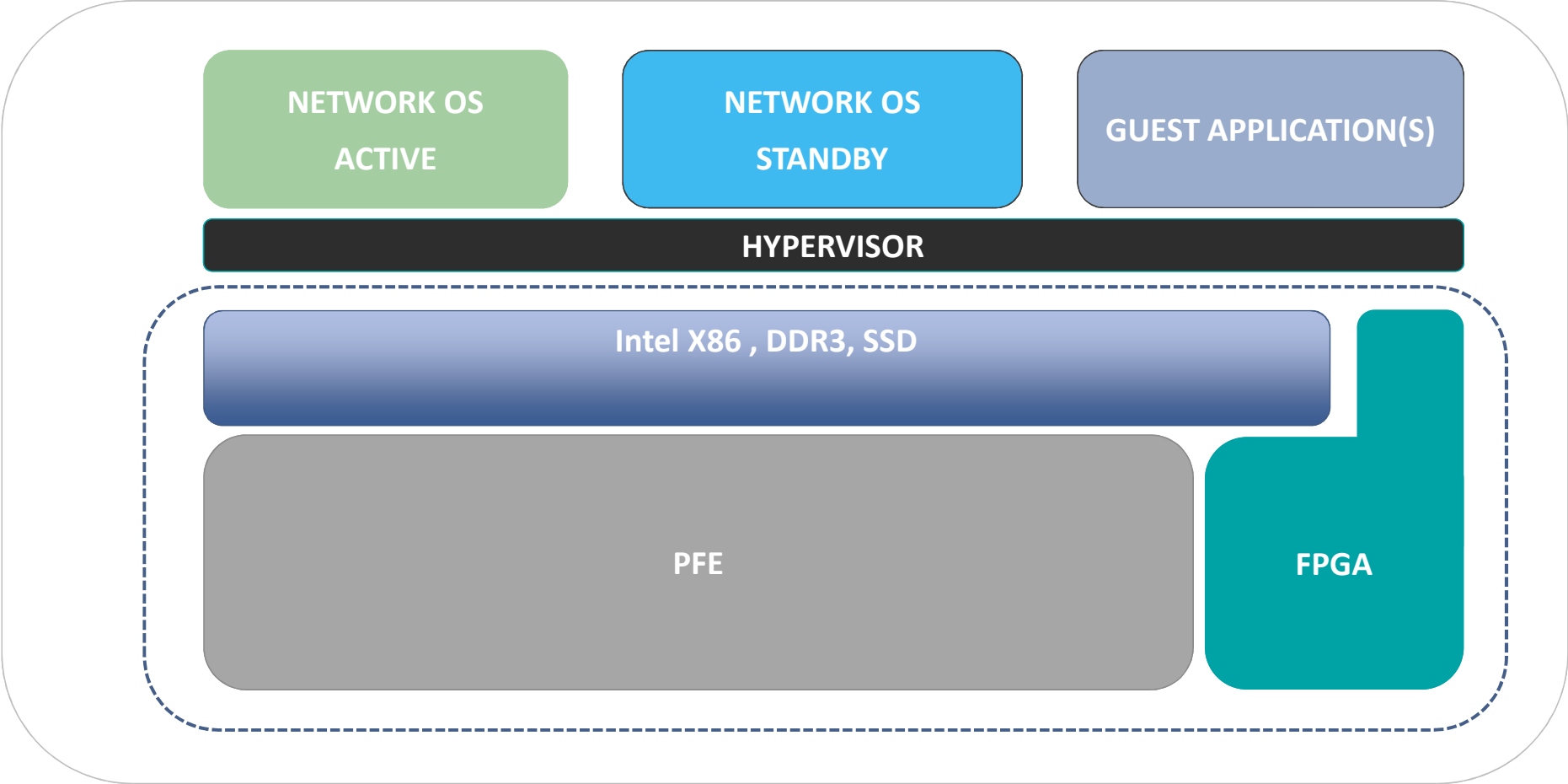
- ASIC Packet forwarding engine (PFE)

# What Types of Computing Can We Use

- CPU
  - Good for general purpose and data flow management
- FPGA
  - Highly optimizable field programmable hardware executing custom code
- ASIC
  - Highly optimized purpose built processor, a Packet Forwarding Engine (PFE) for example



# Network Switch/Application Acceleration/Packet Forwarding Accelerator



# Impact on Compute and Network

## Centralize Processing Where You Can, Distribute Where You Must

- Processors and network switches are hitting natural limits
- To achieve a high performance infrastructure compute resource must be distributed
- Optimize computing in the server, NIC (FPGA), and data flow engines
- Architect compute resources across the data center - not just one place

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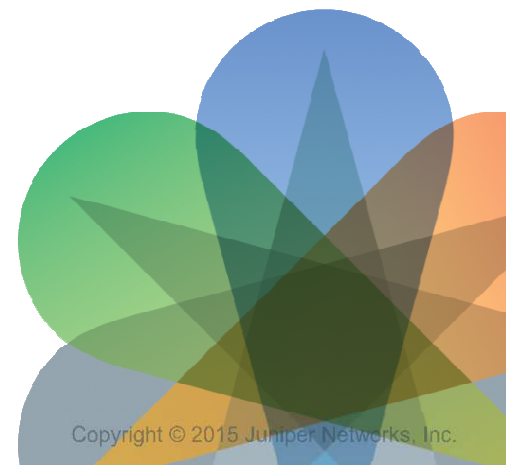
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# Performance and Data Complexity

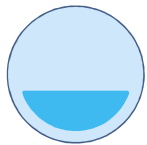
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Ryan Eavy

Executive Director, Architecture – CME Group

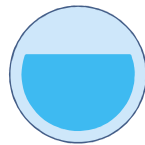
# CME Group

***CME Group is the world's leading and most diverse derivatives marketplace – handling 3 billion contracts worth approximately \$991 Trillion annually, on average. We bring buyers and sellers together through our CME Globex electronic trading platform and our trading facilities in Chicago and New York.***



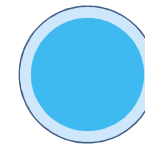
## Global Products

CME Group exchanges offer the widest range of global benchmark products across all major asset classes, including futures and options based on interest rates, equity indexes, foreign exchange, energy, agriculture commodities, metals, weather and real estate.



## Clearing

CME Group operates CME Clearing, one of the world's leading central counterparty clearing providers. We are the guarantor of every transaction that happens in our markets, providing unparalleled safety and soundness for our customers.



## Electronic Trading

Through our CME Globex electronic trading platform, users worldwide are able to access the broadest array of the most liquid financial derivatives markets available anywhere. In addition, CME Globex offers speed of execution, transparency anonymity and market integrity. This makes up around 85% of all trades at CME.

# CME Group's history of successful partners includes examples of complex, large-scale technology and commercial relationships across geographies

The map displays the following partnerships and services across different regions:

- North America:** MGEX (Minneapolis Grain Exchange)
- Europe:** CME Clearing Europe (A CME Group Company)
- Asia:** Bank of China (Bank of China, New York Branch is a CME Clearing settlement bank and collateral custodian), OSE, KRX
- South America:** BM&F BOVESPA (The New Exchange)
- Africa:** DME
- India:** NSE, MCX (India's No. 1 Commodity Exchange)
- Asia-Pacific:** BURSA MALAYSIA, SINGAPORE EXCHANGE
- Other:** CBOT Black Sea Wheat, JSE

**Partnerships include:**

- Order routing linkages (BVMF, BMV)
- Joint product development
- Trade matching services (BMD, DME, KRX, MGEx)
- Product licensing – Benchmark equity indexes and commodity products (OSE, NSE, JSE, NSE, MCX)
- Joint marketing
- European clearing services
- Equity investments

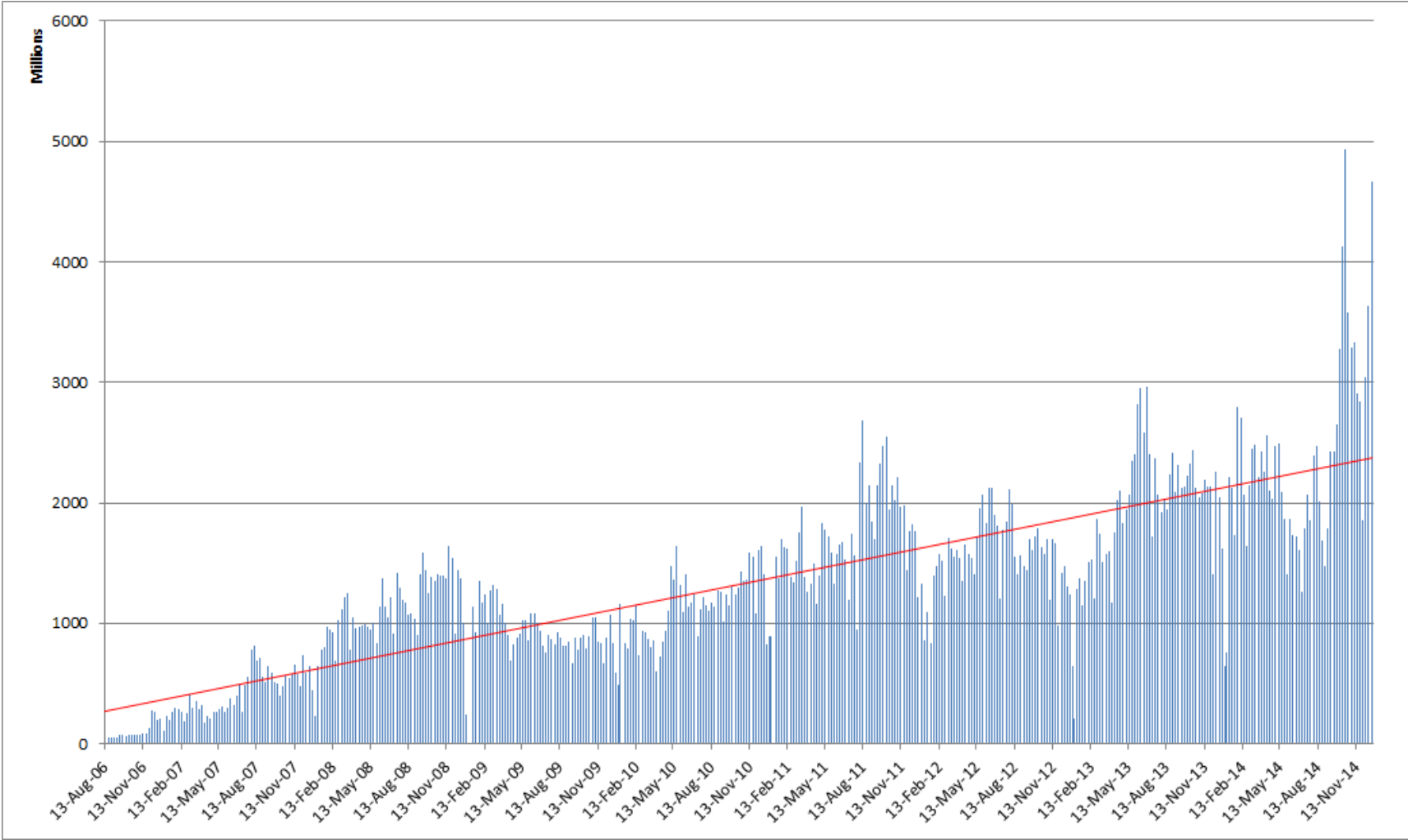
# CME Group Evolution

- *First mover, strong vision, consistently reinventing as markets evolve*
- *Well positioned for future opportunities through successful strategic execution*



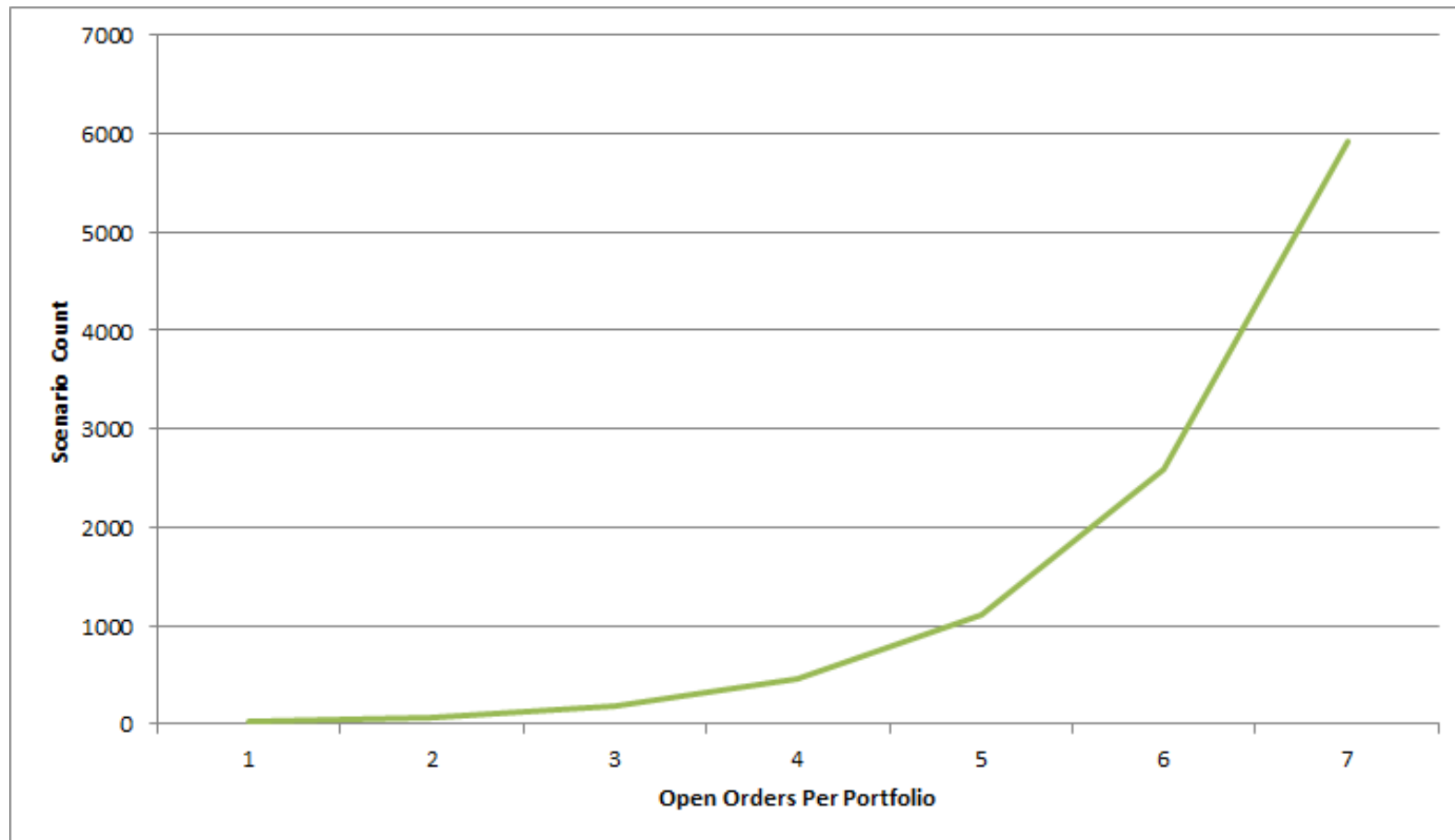
1980s	1990s	2000s	2010s
<i>Innovation / Electrification / Demutualization....</i>	<i>Innovation / Diversification / Globalization</i>		
<b>0% electronic</b>	<b>2% electronic</b>	<b>70% electronic</b>	<b>Highest 85% electronic Averaging 5% PNT/OTC</b>
<ul style="list-style-type: none"> <li>• Chicago-based open outcry trading floor</li> <li>• Mutual Offset System w/SGX</li> <li>• Anticipating electrification</li> </ul>	<ul style="list-style-type: none"> <li>• Launch of CME Globex trading platform</li> <li>• Product innovation – i.e. E-mini S&amp;P 500 contract</li> <li>• Less than 5 employees outside of U.S.</li> </ul>	<ul style="list-style-type: none"> <li>• Diversifying product and venue</li> <li>• CME first U.S. exchange to go public</li> <li>• CBOT demutualizes / goes public</li> <li>• CME / CBOT merge</li> <li>• CME Group acquires NYMEX</li> <li>• CME Group partners w/BM&amp;FBOVESPA</li> </ul>	<ul style="list-style-type: none"> <li>• OTC clearing capability growth / offering expansion beyond energy base</li> <li>• Numerous global partnerships / building out global offices</li> <li>• Diversify beyond futures transaction-related sources of revenue                             <ul style="list-style-type: none"> <li>– CME Group / Dow Jones / McGraw Hill partner on index services business</li> <li>– Launch Co-Location Services</li> </ul> </li> </ul>

# How To Handle The Growing Data Trend...



# The effect of complex data for risk management...

Take the case that 2.5Bln order messages are received in a single trading session (120 hours), plus a high number of long dated OTC transactions



# Thank You!

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