Platform Lab Seminar - Stanford University

The Future of Markets
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Markets Everywhere
Conceptual Overview and Strategy
Nasdaq Strategic Vision

Enable **The World’s Markets** through the frictionless discovery and exchange of any asset by any producer or consumer thereby creating value for all participants.

**Build an ecosystem that allows participants to:**
- Discover Markets
- Access Order Entry & Market Data
- Run their compute co-resident w/Market(s)
- Deploy Exchange Services On-Demand
- Perform data analytics and engage AI/ML
- Interact bilaterally with other clients
- Access post-trade facilities

**Market Operator**
Leverage Nasdaq’s expertise and experience with operations, surveillance and infrastructure

**Market Solution Partner**
Collaborate with relevant partners and leverage their expertise and experience to elevate offerings and reduce risk

**Technology Provider**
Nasdaq is a world leader and trusted technology vendor for both point and platform solutions

Migrate existing Nasdaq systems and Nasdaq Market Technology clients to the cloud.

Develop and monetize new business opportunities unlocked by cloud.
The Nasdaq Financial Framework
A New Paradigm for Powering Tomorrow’s Markets

Create new offerings based on interconnectivity and collaboration

Expand SaaS and PaaS offering, as NFF is built out and clients’ readiness increase

Current position with growing share of SaaS based on NFF

Service a Hyper-connected World
Operating in a World of Platforms
Market Fabric

Servicing Your Eco-System
Platform as a Service
Cloud Deployment Paradigm
Derive Insights via Data Analytics

The Technology Foundation
Enterprise Architecture for the Capital Markets
Mission Critical Business Applications
Fintech R&D & Global User Community
We Operate Market Infrastructure Everyday

Nasdaq
Markets Everywhere
Enabling Technologies
Cloud for Markets
A Foundation for Innovation

<table>
<thead>
<tr>
<th>SECURE</th>
<th>SCALABLE</th>
<th>COMPLIANT</th>
<th>RESILIENT</th>
<th>MODERN</th>
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<tbody>
<tr>
<td>World Class Security Controls and Tools</td>
<td>Dedicated and Partitioned Computing Environments</td>
<td>In Country Locations and Adherence to Data Governance Rules</td>
<td>Resiliency Designs Exceed Traditional Datacenters</td>
<td>Well-Structured APIs, Architected around Microservices</td>
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Global Presence Map

Cloud providers are establishing presence in many Nasdaq and Nasdaq client locations.

**LEGEND:**
- Amazon / Amazon AWS
- Microsoft / Microsoft Azure
- Google / Google Cloud Platform
- New over the last 1-2 years
Realizing a Fabric of Markets
Regional Building Blocks

- Transform the way in which products and services are developed and delivered
- Derive insights using advanced analytics and AI/ML
- Unlock the ability to leverage Nasdaq technology outside of the traditional customer base
- Transform the way participants interact with data through the use of modern APIs
- Democratize access to markets and data with PaaS and SaaS offerings at scale
- Greater flexibility via on-demand infrastructure and decreased time to market
- Provide a rich portfolio of mission critical business applications

Business Capabilities
- On-Prem Services
- Cloud Services
- Data Lake
Creation of a Global Eco-system
Born of Collaboration and Platform Innovation
DLT - Tokenized Market Solution

- Target spot markets of fungible assets with immediate settlement and configurable market models
- Initial focus on un-regulated markets and assets
- Support the entire transaction value chain
- Issuance, settlement and custody performed on DLT
- Support the DLT universe (1 to N, public/private DLTs)
- Use DLT for golden source of reference data
- Smart securities to automate corporate actions

Any type of asset can be traded and settled i.e. any asset can be tokenized
Markets Everywhere
Future Tech
Quantum Computing and FinTech

**CRYPTOGRAPHY**  
Quantum computers are famous for code breaking, but their real power may lie in making cloud computing more secure.

**MODELING & OPTIMIZATION**  
A Quantum computer mimics the computing style of nature, allowing it to simulate, understand and improve upon natural things.

**MACHINE LEARNING & PREDICTION**  
Research indicates that quantum computing could significantly accelerate machine learning and data analysis tasks.

**SEARCHING BIG DATA**  
A machine that can search the ever-growing amount of data being created, and locate connections within it, could have tremendous impact across many industries.

“Nature isn't classical, dammit, and if you want to make a simulation of nature, you'd better make it quantum mechanical, and by golly it's a wonderful problem, because it doesn't look so easy.” - Richard Feynman.
Why Should We Care?

**Cryptography**
- Hardened Encryption Techniques
- Enhance Data Privacy
- Accelerate Encryption Algorithms
- Blockchain at scale

**Modeling & Optimization**
- Simulate Market Events
- Optimize Market Behavior
- Portfolio Optimization
- Dynamic Portfolio Management
- Risk Analysis

**Machine Learning & Prediction**
- Find Alpha
- Predict the affect of changes to market structure
- Dynamic Indicative Pricing
- Better Fraud Detection

**Searching Big Data**
- Credit Scoring
- AML
- Pattern Recognition
- “Real-time” historical search
- Matching orders is a search problem.
Markets Everywhere
And One More Thing...
Location, Location, Location...
“Where” Matters

- **Performance**
  - Order Entry
  - Market Data
  - Determinism

- **Regulatory**
  - Fairness
  - Transparency
  - Compliance

- **Data Governance**
  - Sovereignty
  - Privacy
  - Integrity

Highly synchronized clocks are formative in addressing these concerns.
Thank You.