TRADING PLATFORM ARCHITECTURE
FOR A WALL STREET INVESTMENT BANK

JOSH WEST
SOLUTIONS ARCHITECT
RED HAT FINANCIAL SERVICES

RED HAT SUMMIT
USE CASE

ORDER PROCESSING AND MARKET DELIVERY

EMERGENCY ORDER ENTRY

UPSTREAM ORDER ENTRY SYSTEMS

EQUITIES & OPTIONS EXCHANGES

TRACKING & REPORTING
LEGACY SOLUTION

- Expensive to maintain
- Dedicated Staff
- Specialized Support Skills
- Difficult to Update
- Scalability

PROPRIETARY HIGHLY AVAILABLE HARDWARE - STRATUS
MODERN SOLUTION

DISTRIBUTED OPEN SOURCE SOFTWARE STACK

- Modular
- Enable Agility
- Lower Cost
- No-Lockin
- Transparent
- Viable Support

COMMODOITY HARDWARE
FSI ... NOT SILICON VALLEY

- Always consistent, versus eventually
- ACID Transactions
- High Throughput, versus Internet Scale
OPERATIONAL REQUIREMENTS

- UPTIME
- DISASTER RECOVERY
- FAULT TOLERANT
- SLA
- SCALABLE
OPERATIONAL REQUIREMENTS

UPTIME
- 99.9999% uptime required
- Operation hours only
- Loss of availability = $$$$ and customers
OPERATIONAL REQUIREMENTS

DISASTER RECOVERY

- Geographic replication
- 5min switchover or less
- Need to replicate across DCs without big latency impact
OPERATIONAL REQUIREMENTS

- Tolerate single node failure
- Guaranteed delivery
- Alert on any failure
- Monitor at business and technical levels
OPERATIONAL REQUIREMENTS

- **UPTIME**
- **DISASTER RECOVERY**
- **FAULT TOLERANT**
- **SCALEABLE**

**SLA**

- Initial Minimum Acceptance
  - 200 messages / second
  - 120 orders / second
  - 600,000 orders / day
  - 900,000 executions / day
  - 3,750,000 activities / peak
OPERATIONAL REQUIREMENTS

SCALABLE

- Increasing upstream sources
- Planned throughput growth
- Ability to add capacity easily
NOTABLE REQUIREMENTS

- State Management
- Transactional
- Modularization
- Declarative Business Logic and Validations
- Content Based Routing
- Destination specific formatting
- System Monitoring and Alerting
- User Auditing
- System Wide Reporting
- Web Front-End
BUILDING BLOCKS

- **TOMCAT**
  - web front-end

- **CXF**
  - web services

- **DROOLS EXPERT**
  - declarative rules

- **DROOLS FUSION**
  - monitoring & alerting

- **CAMEL**
  - integration and routing

- **INFINISPAN**
  - distributed state management

- **KARAF**
  - modular OSGI container

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*x86 Hardware, 16 core, 128MB RAM*
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SUPPORTED BY:

- RED HAT JBOSS WEB SERVER
- RED HAT JBOSS BPM SUITE
- RED HAT JBOSS DATA GRID
- RED HAT JBOSS FUSE

x86 Hardware, 16 core, 128MB RAM
Order State Management
- Validate, Manage State, Enrich,
  Determine Route, Transform, Transmit

Market Connectivity
- Select Session, Enrich Session Details,
  Execution matching, Deliver, Persist, Maintain Session

Load and Affinity Routing
- Route, Maintain Affinity State, Balance Load

Monitoring and Management
- Emergency Order Entry, Routing Management

Upstream Order Systems
- FIX/CMS+ over MQ
- FIX over SOAP

Scale

UI Server Cluster
- Load and Affinity Routing,
  Emergency Order Entry, Routing Management

Mainframe System of Record
- Copybook over MQ

FIX Sessions, Execution Venues
- FIX Sessions, Execution Venues

Ref: NYSE, Fidessa, IB
INTERESTING PATTERNS

- Distributed State
- Data Affinity & Correlation
- Data Processing with Updatable Logic
- Performance Instrumentation
DISTRIBUTED STATE MANAGEMENT

In-memory cache
LevelDB Backed
Transactional
3 Node Replicated Cluster
Tolerates 1 failure

CAP Theorem
Infinispan with Fencing
JGroups API
Master Election

CONSISTENCY
AVAILABILITY
PARTITION TOLERANCE
DATA AFFINITY & CORRELATION

Load Balance & Affinity

Accumulate Payload from Multiple Correlated Messages
Blackboard Pattern
Smart Load Balancing
Fast Data Lookup with Cache

Watch then Transmit

Accumulate / Enrich
UPDATABLE LOGIC

- Plumbing versus and Processing
- Represent business rules in a declarative model using Drools
- Plumbing with Enterprise Integration Patterns using Camel
- Future goal to enable editing and deployment of rules
PERFORMANCE INSTRUMENTATION

- Gather metrics and events from the cluster

- Process with Complex Event Processing

- Enforce SLAs and alert on issues

- Business Oriented Policies
CONCLUSIONS

- Ultimate Toolkit with Open Source
- Modern Design Patterns for FSI
- Cost Savings
- Maintainability