Presentation Agenda

- Observations of a Former Trader
- Fixed Income Technical Architectures
  - Architecture Development Methodology
  - Fixed Income Business Process Maps
  - Fixed Income Solution Capabilities Matrix
  - Deriving a Conceptual Technology Vision
  - From the Conceptual Technology Vision to a Logical Infrastructure
  - From the Logical Infrastructure to a Physical Solution
  - Physical Solution Implementation Steps
- Conclusion

Observations of a Former Trader
Trading Environment Characteristics

- Anonymity
- Liquidity
- Transparency

Brokers’ Broker
Were They Efficient?

- Human factor
- Limited network of contacts
- Largest firms control the inventory
- Regional broker/dealers not well serviced
- Difficult to unwind odd-lot positions
- Phantom trades
- Buy-side firms are not a part of the equation
Where Are We Now? Automated Trading Systems (ATS)

- Eliminates the Human Factor
- Buy-side is involved
- More regional bank and foreign institution participation
- Internet – A border-less enterprise

All of which creates better Liquidity and more Transparency in an Anonymous environment.

Six Drivers for Change

- Institutional and Retail customers
- Brick and mortar sell-side institutions
- Traditional buy-side firms
- Broker’s brokers
- Regulatory
- Entrepreneurs
Challenges

• Existing legacy systems and newer ATS's will need to handle anticipated increases in trade volume implied by the development of STP.
• Fixed Income securities can have complex structures. Trading systems will need to incorporate proper analytics to calculate various essential data.
• There are many types of Fixed Income securities which trade in different ways. Standardized trading methodologies will need to be applied.
• Security information repositories will need to be large enough to hold data on millions of securities.
• Present front-end interfaces are no more than client/server versions of legacy systems.
• Back-office systems are antiquated. It may not be feasible to integrate them if they cannot support the new economy business.
• The new Fixed Income market of tomorrow may require an Application Program Interface (API) to a single Fixed Income exchange.
• T+1 must be incorporated into new technology.

Architecture Development Methodology
Architecture Vision

The eHub Securities Framework

Personal Blotter and Services

Message Handlers

Execution Engines

Continuous Net Settlement Systems

Ledger Operations

Information Engines

Security Master

Processing Centers

Distributed Hubs

Direct systems interfaces

Browser/streaming interface

Client Sites

System Blotter and Services

Personal Blotter and Services

Portal and Service Interfaces

Adapters, connectors, Message brokers, linkages Distributed rules processors

Valuations and Market data feeds

Order and NOE Rules and Routing

Trading and Order Management

Service Manager

Price Manager

Order and NOE Verification Validation Rules Execution

Price Subscriptions Personalization Rules

Clearing and Settlement Rules Execution

Portfolio, Trust, Asset Ledger Rules

Risk, Forecast CRM, Budgets and Rules

Transfer Agency, Custody Rules Assets/Institutions/Prices

Portal and Service Interfaces

The eHub

Vision and Objectives

Process Model

Solution Architecture

Mapping Vision to Solution
Fulfilling the Objectives to Support the Vision

<table>
<thead>
<tr>
<th>WORK STREAMS</th>
<th>OUTPUT</th>
<th>FUTURE STATE REALIZATION PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer facing</td>
<td></td>
<td>Extraction of Capabilities</td>
</tr>
<tr>
<td>IT analysis and design</td>
<td></td>
<td>Preliminary Future State Model</td>
</tr>
<tr>
<td>Business processes</td>
<td></td>
<td>– Preliminary IT Architecture Design</td>
</tr>
<tr>
<td>Competitive analysis</td>
<td></td>
<td>– Preliminary Business Process Design</td>
</tr>
<tr>
<td>Regulatory analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounting and fiscal analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business case</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JV and partnership analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go-to-market strategy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Architecture Design Methodology
For every 1M visitors, 40% don't return due to incomplete content; lost cost of their lifetime value is $2.8M - $2.1M wasted on site redesigns that don't fix the right problem.

Right to Left Thinking...

Architecture Development Map

As information is collected, work effort, estimates and solution becomes concrete.

Architecture Design Approach

Object-Oriented Analysis and Design

- UML models and diagrams

Design Assumptions

- Architectural capabilities are based on a limited set of business and technical requirements
- Simplicity, elegance, intelligibility, well-defined levels of abstraction, and clear separation between interface and implementation at all levels

Architecture Object Model

- Application architecture model
- Application infrastructure
  - Application Framework
- Technology infrastructure model
  - Physical architecture instance(s)
“4+1” Architecture View Model

Describes the Architectural Vision
Model helps represent the various constraints on the architecture
Provides multiple perspectives to represent the system
• Logical view
  – Static and dynamic aspects
• Implementation view
  – Organization of modules within the development environment
• Process view
  – Decomposition in terms of execution flows, and flow synchronization
• Deployment view
  – Describes hardware resources and associated software deployment
• Use case view
  – Motivates and justifies the architectural choices (i.e., “the glue”)
**Application Architecture Overview**

Enterprise Application Suite

- Channels
  - Web Portal
    - Web Interface
      - Web View
      - Web Controller
- Enterprise Services
  - Application Enterprise Services
    - Business Controller
      - Client Interface
      - Client Handler
      - Component Manager
  - Business Object Model
  - Infrastructure
    - Services
    - Common Facilities
    - Domain Specific Facilities

**Architecture Design Summary**

Driving Forces:
- Functional Requirements document
- Internal design guidelines
- Technology Preferences
- Software Architecture = Elements + Patterns + Motivations
- "4 + 1" View Model
- Model View Controller (MVC) Concept
Average Present Day Solution
Fixed Income Trading Process Map

Sample Target Business Process Hierarchy

Legend:
- Primary Process Group
- Process Thread
- Process Thread - does not currently exist
- Process Threshold
Resulting Solution
Fixed Income Trading Process Map

Typical Fixed Income Legacy Systems

<table>
<thead>
<tr>
<th>Order Process</th>
<th>System</th>
<th>Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing/Settlement</td>
<td>Rossi (OPICS)</td>
<td>Used for accounting purposes</td>
</tr>
<tr>
<td></td>
<td>S.A.M.</td>
<td>Order routing system</td>
</tr>
<tr>
<td></td>
<td>SIOPEL</td>
<td>System that shows the market</td>
</tr>
<tr>
<td></td>
<td>CRYL</td>
<td>The central clearing system for Argentina fixed income products</td>
</tr>
<tr>
<td></td>
<td>EUROCLEAR</td>
<td>A clearing vehicle for international trades</td>
</tr>
<tr>
<td></td>
<td>CEDEL</td>
<td>A clearing vehicle for international trades</td>
</tr>
</tbody>
</table>

Custody
Rossi
Performs Custody role for retail fixed income products

Order Process
System
OPICS
Functionality
Order routing system

Clearing/Settlement
INDEVAL
The central clearing system for Mexican Securities

Custody
OPICS
Performs Custody role for retail fixed income products
## Fixed Income Solution Capabilities Matrix

### Drivers
- **Technical**
  - Customization / Personalization
  - Customer Relationship Management
  - Efficient cross- and inter-enterprise communication
  - Fast, cost-efficient data links with partners
  - True integration
  - Continuously available hardware platform (24 x 7)
- **Competitive**
  - Flexibility
  - Global portal (multi brand, multi channel)
  - Localization
  - Open, extensible, flexible architecture
  - Global eTrading business application support
- **Customer**
  - Online operation (order status, billing & pricing, accounting, portfolio management, etc.)

### Preliminary Capabilities Matrix

<table>
<thead>
<tr>
<th>Drivers</th>
<th>Technical</th>
<th>Competitive</th>
<th>Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customization / Personalization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer Relationship Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficient cross- and inter-enterprise communication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast, cost-efficient data links with partners</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>True integration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuously available hardware platform (24 x 7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global portal (multi brand, multi channel)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Localization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open, extensible, flexible architecture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global eTrading business application support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Best-of-breed global e-trading solution</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
  - Secure transactions
  - Collaboration (online chat)
  - Real-time quotes, financial news, research
  - Online help and training
  - Alerts
  - Analytics ("what if" scenarios)
  - Online operation (order status, billing & pricing, accounting, portfolio management, etc.) |   |   |   |
Deriving a Conceptual Technology Vision

Using an Architecture Framework

<table>
<thead>
<tr>
<th>Security</th>
<th>Personalization</th>
<th>Community</th>
<th>Content Management</th>
<th>Catalogs</th>
<th>Commerce</th>
<th>Information Access</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Enterprise Frameworks /Servers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Other Application Frameworks /Servers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Systems Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hardware/Operating Software</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hosting Services</td>
</tr>
</tbody>
</table>
Operations & Technology Support Vision

Technology support should support a vision that will guarantee a unique experience for e-Trading customers anywhere in the world.

Sample Trading Process

Message Broker
From a Conceptual Technology Vision to a Logical Infrastructure

Logical Architecture Diagram

[Diagram showing logical architecture and various components such as users, business functions, data management, and technology layers.]
Architecture Enabled Capabilities

- Work & Enterprise Integration Portal
- Front Office Interfaces
  - Call Forwarding
  - Teleconferencing, etc.
- Remote Access
- Maintenance Apps
  - BSCH LAO Office only
- Web-Enabled Applications
- E-Trading Customer Interfaces
  - Telephony-Based Services
  - Web-Enabled Applications
- "Lights Out" Svcs
- Web & Enterprise Integration Portal
- Relationship Commerce Application Server
- Enterprise Application Integration (EAI) Server
- DataWarehouse-Driven Decision Processing
- Application Package
- Content Management System
- Integrated Value Chain Support System

- Front Office Apps
  - Data Mining
- Financial Applications
  - (Main and Country Offices)
  - Communication
  - (Incoming Call Monitoring Agent)
  - Business Intelligence
  - (Customer Analysis, Supply Chain Planning)
  - Customer Care Services
  - (Call Center Support: Financial & Systems)
  - Personalization Interface
  - Content Mgmt. Interface
    - (Browsers, PDAs, WAPs)
  - Remote Training Interface

- Customer Calls Handling
  - (ACD, Flex-Routing, Call Center Mgmt.)
- CSR Assisted Services
  - (Product Support, Issue Resolution, Proactive Account Mgmt.)
- Email
  - SWIFT, FIX, XML
- Fax
- Internet-Based Services
  - (XML/SWIFT/FIX, Email, Browser)
- Collaborative Applications
  - (Forums, etc.)
- Real Time Services
  - (Financial Web Channels, Chat, TV Events, etc.)

- Security
  - (Firewall / Proxy Server)
- Internet Services
  - (web, ftp, email & news servers)
- Voice/Data Integration
  - Teleweb / Web Integration Services
    - (Consolidated Messaging, Telephone-Based Web Services, Video Conf., etc.)
- Search Engine
  - Transaction Service
  - Messaging Service
  - Analytical Applications
    - (Performance Reports, Performance Measurement Analysis, Trend Analysis and Forecasts, etc.)
- DataWarehouse Information Template
- Document Mgmt.
- Image/Graphics Mgmt.
- Video Server (future)
- Process Automation & Dynamic Content Mgmt.
- Session/State Mgmt.
- Personalization Server

- Customer Care Services
  - (Cust. Service, Help Desk, Sales Automation, QA)
  - Financial Apps Logic
    - (e.g., order book mgmt.)
  - Site Development Svc.
    - (Updates Staging Server)
  - Integrated Trading Data Warehouse Server
  - Metadata Repository
  - OLAP & Staging Engines

- Software / Global Content Monitoring / Backup
- Financial Applications
  - (Market Facing Applications)
- Legacy Integration Middleware
  - (straight through processing support software)
- Trading & 3rd Party Interfaces
  - (local exchanges, OTC, ECNs)
- Regulatory Management
- Order Fulfillment
  - (FI, Equity, Funds, Others)
- Order Management & Accounting

Architecture Scalability Features

- “Statelessness”
- Subject-based distributed queues (EAI)
- Load distribution
- Fault-tolerance
  - Notification: Primary/Secondary failover
  - Recovery
  - Verification against state signature
  - True Hot Standby
Architecture Support for Fixed Income Market Inventory

- Role-based market views
- Pre and post-trade workflow supported
- All Fixed Income instruments supported

Architecture Support for Client Access

- Local, specialized user interfaces
- API’s
- Internet access
- Legacy order streams
Architecture Security Features

- Encryption standards: 128 bit RSA: RVDS
- X.509 compliant certificates: TIBCA
- Level 5 firewall architecture

Architecture Support for Legacy Order Stream

- Legacy messaging interfaces seen as a user of the system
- Interoperates with existing users
- Can act as a bridge between deployed hubs
From a Logical Infrastructure to a Physical Solution

Considering Mainstream Tools

<table>
<thead>
<tr>
<th>Applications</th>
<th>Custom Integration and/or Integrated Applications (SAP, Baan, Lotus Notes, PeopleSoft)</th>
</tr>
</thead>
</table>

Typically read as Vendor/Product Name

Hosting - Digex, EMC, Exodus, GlobalCenter.com, GTE Internet, Incisive, InterPro, MCi, Navigant, PSnet, Ulster...
Evaluating Alternatives

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>(1) Web Enabled Legacy</th>
<th>(2) Combined Vendor Packages</th>
<th>(3) Component Web</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed to Business</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-Term Viability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of Ownership</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alignment with Vision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simplicity/Ease of Use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Rating</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

〇 Worst 〇 Good 〇 Best

Physical Architecture (Example 1)
### Physical Solution Implementation Steps

#### Practice Areas

- Business System Development
- Management and Quality

#### Stages

<table>
<thead>
<tr>
<th>Practice Areas</th>
<th>Discover</th>
<th>Design</th>
<th>Develop</th>
<th>Deploy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business System Development</td>
<td>Business Modeling</td>
<td>User Experience</td>
<td>Content Development</td>
<td>Application Architecture and Development</td>
</tr>
<tr>
<td>Technical Architecture and Development</td>
<td>Testing</td>
<td>Performance Engineering</td>
<td>Program/Project Management</td>
<td>Configuration Management</td>
</tr>
</tbody>
</table>
Identifying Domains of Change

**Organizational**
- Implementation team
- Training team
- Data conversion
- Supplied volume data
- Hardware
- Standard system software
- Reporting software
- Ad-hoc spreadsheet functions
- Security and performance

**Business Process**
- Projects creation and update
- Projects approval
- KPI creation
- Project information retrieval
- System administration

**Application**
- Site navigation design
- Site content design
- Reusable components
- Security workflow
- Help

**Technology**
- Office hosting development

**Data**
- Data conversion
- Supplied volume data

**Location**
- Sites

Requirements Analysis
- Discover
- Design
- Develop
- Deploy

Release 1
- Discover
- Design
- Develop
- Deploy

Release 2
- Discover
- Design
- Develop
- Deploy

Release 3...
- Discover
- Design
- Develop
- Deploy

Proposed Project Lifecycle

Development is an iterative process, where for each subset of requirements, components must be analyzed, designed, developed and deployed.
Conclusion

Feature Summary

- Ubiquitous Client Access
- Pushes Status in Real-time
- Framework Inter-operates with Legacy
- Support for Current and Emerging Standards
- Scales in Capacity and Function
- Optimization of Integrated Services
- Secure, Mission-Critical Infrastructure
Addressing the Challenges

- Existing legacy systems and newer ATS’s will still need to handle anticipated increases in trade volume implied by the development of STP.
- Fixed Income securities can have complex structures. Trading systems can plug and play analytics to calculate various essential data.
- There are many types of Fixed Income securities which trade in different ways. Standardized trading methodologies will need to be applied.
- Security information repositories will need to be large enough to hold data on millions of securities.
- Present front-end interfaces are no more than client/server versions of legacy systems.
- Back-office systems are antiquated. It may not be feasible to integrate them if they cannot support the new economy business.
- The new Fixed Income market of tomorrow may require an Application Program Interface (API) to a single Fixed Income exchange.
- T+1 must be incorporated into new technology.