YADSL

(Yet Another DSL --> (Domain Specific Language))

John Davies | Co-founder, CTO - C24

Models 2013 - DSLFIN | Miami Beach

1st October, 2013

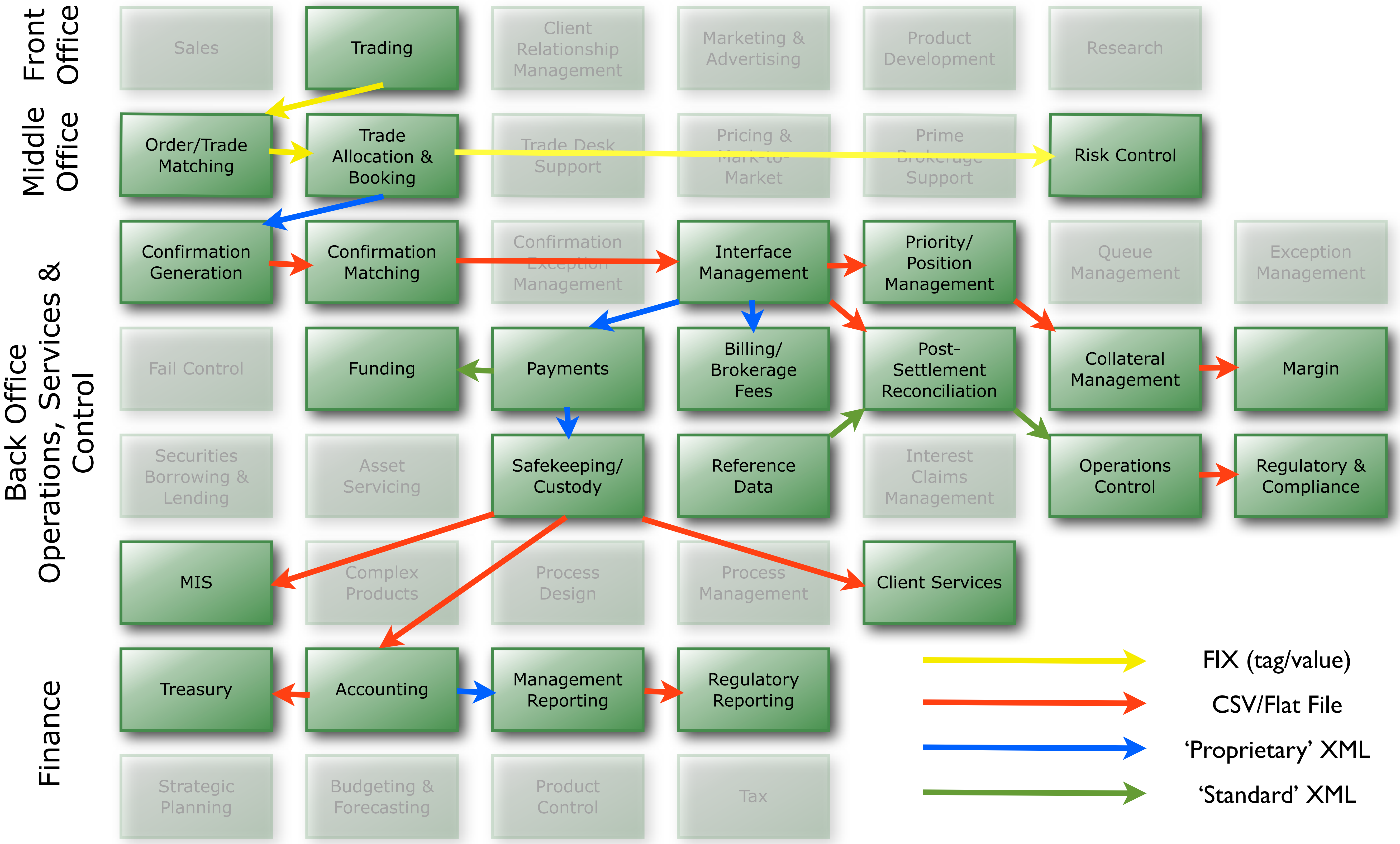
Why do we need a DSL?

- Dozens of ways to encode a message
  - Binary, CSV, Tag/Value, Delimited (not a ,), XML, ASN.1
- Dozens of standards
  - ISO 8583, ISO 2865, ISO-7775, FpML, FIX, ISO 20022
- Each with dozens of versions
  - 1.0, 1.1, 2013 you get the idea
- And then this is just a part of what we see in real life
  - Most messages only vaguely respect the core standards
  - The academics writing the standards can't keep up with the people trying to make money

Functional Landscape

Front Office	Sales	Trading	Client Relationship Management	Marketing & Advertising	Product Development	Research	
Middle Office	Order/Trade Matching	Trade Allocation & Booking	Trade Desk Support	Pricing & Mark-to-Market	Prime Brokerage Support	Risk Control	
Back Office Operations, Services & Control	Confirmation Generation	Confirmation Matching	Confirmation Exception Management	Interface Management	Priority/ Position Management	Queue Management	Exception Management
	Fail Control	Funding	Payments	Billing/ Brokerage Fees	Post-Settlement Reconciliation	Collateral Management	Margin
	Securities Borrowing & Lending	Asset Servicing	Safekeeping/ Custody	Reference Data	Interest Claims Management	Operations Control	Regulatory & Compliance
	MIS	Complex Products	Process Design	Process Management	Client Services		
Finance	Treasury	Accounting	Management Reporting	Regulatory Reporting			
	Strategic Planning	Budgeting & Forecasting	Product Control	Tax			

One Transaction



Front Office

Sales | Trading | Client Relationship Management | Marketing & Advertising | Product Development | Research

Middle Office

Order/Trade Matching | Trade Allocation & Booking | Trade Desk Support | Pricing & Mark-to-Market | Prime Brokerage Support | Risk Control

Back Office Operations, Services & Control

Confirmation Generation | Confirmation Matching | Confirmation Exception Management | Interface Management | Priority/ Position Management | Queue Management | Exception Management

Fail Control | Funding | Payments | Billing/ Brokerage Fees | Post-Settlement Reconciliation | Collateral Management | Margin

Securities Borrowing & Lending | Asset Servicing | Safekeeping/ Custody | Reference Data | Interest Claims Management | Operations Control | Regulatory & Compliance

MIS | Complex Products | Process Design | Process Management | Client Services

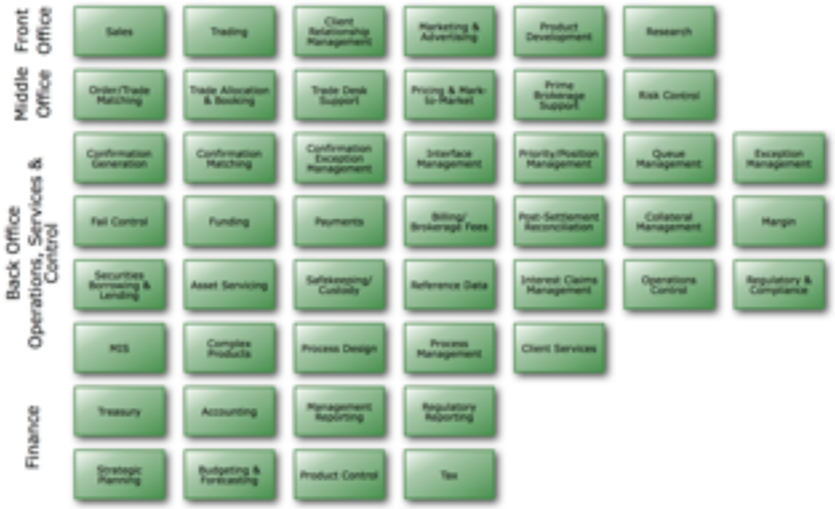
Finance

Treasury | Accounting | Management Reporting | Regulatory Reporting

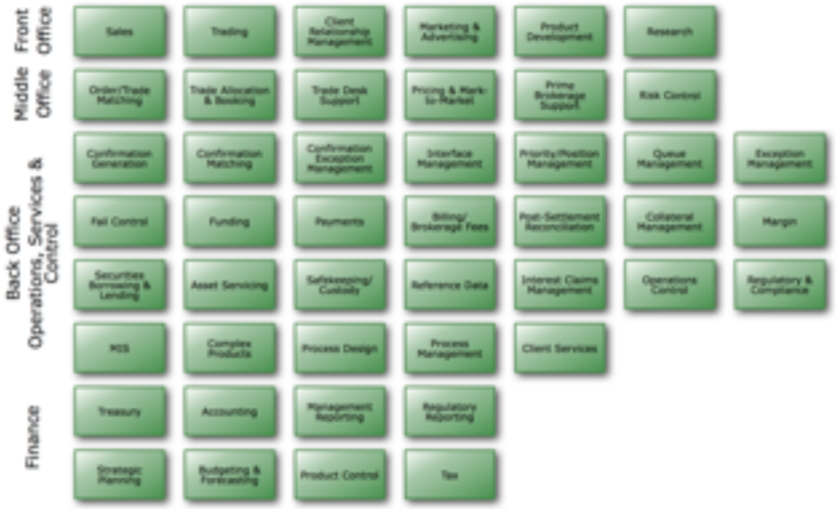
Strategic Planning | Budgeting & Forecasting | Product Control | Tax

Multiple Geographies

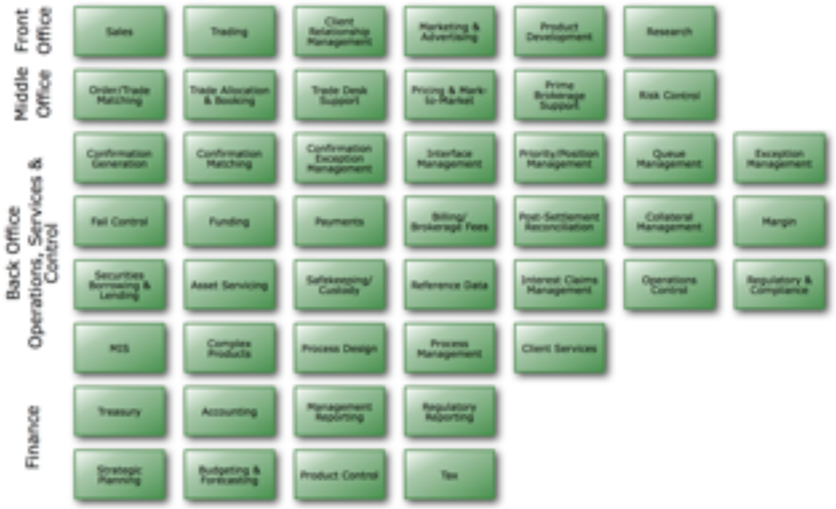
Americas ←→ Europe ←→ Asia Pac



Front Office	Sales	Trading	Client Relationship Management	Marketing & Advertising	Product Development	Research	
Middle Office	Order/Trade Matching	Trade Allocation & Booking	Trade Desk Support	Pricing & Mark-to-Market	Prime Brokerage Support	Risk Control	
Back Office Operations, Services & Control	Confirmation Generation	Confirmation Matching	Confirmation Exception Management	Interface Management	Priority/Position Management	Queue Management	Exception Management
	Fail Control	Funding	Payments	Billing/ Brokerage Fees	Post-Settlement Reconciliation	Collateral Management	Margin
	Securities Borrowing & Lending	Asset Servicing	Safekeeping/ Custody	Reference Data	Interest Claims Management	Operations Control	Regulatory & Compliance
	MIS	Complex Products	Process Design	Process Management	Client Services		
Finance	Treasury	Accounting	Management Reporting	Regulatory Reporting			
	Strategic Planning	Budgeting & Forecasting	Product Control	Tax			

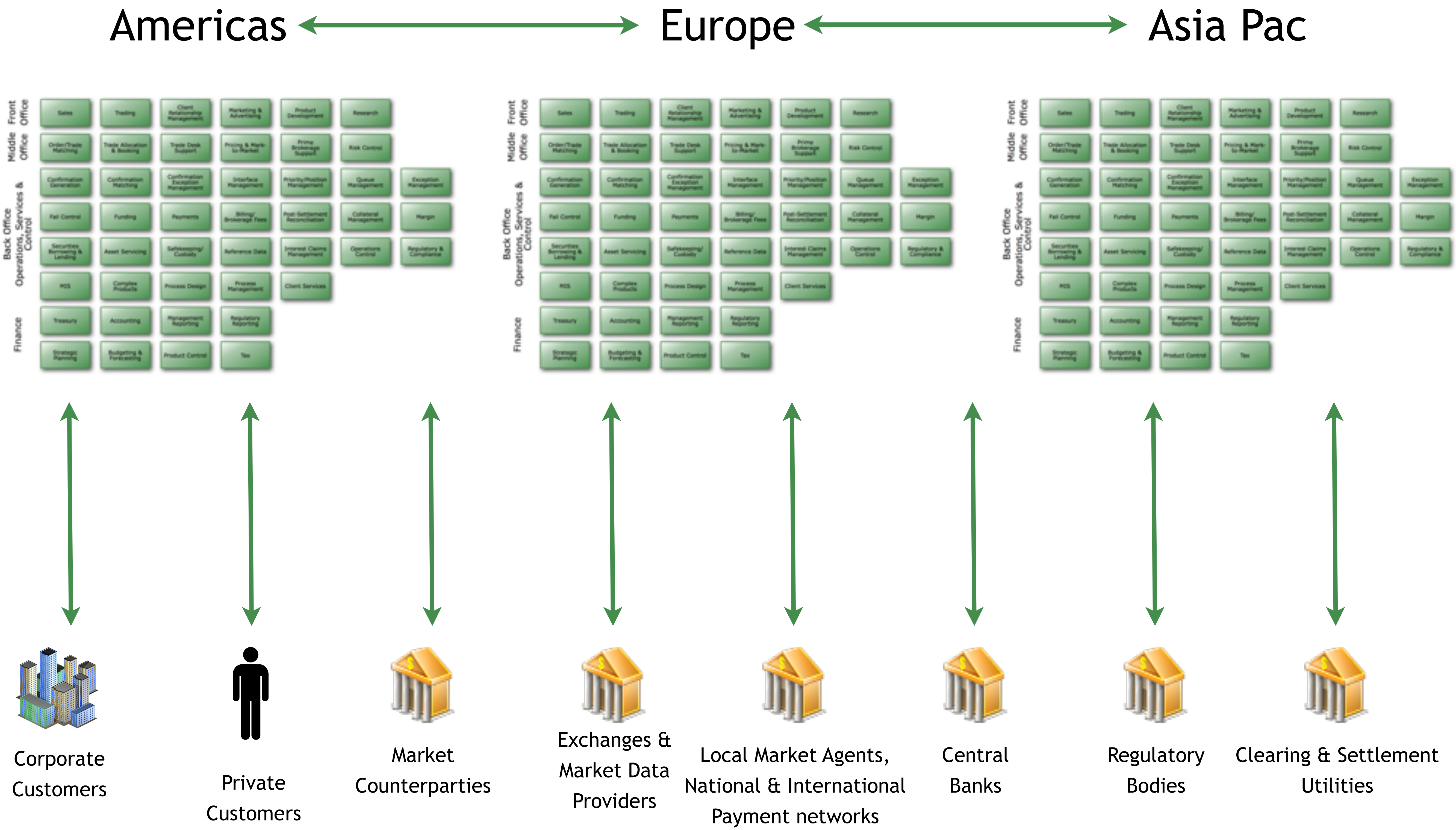


Front Office	Sales	Trading	Client Relationship Management	Marketing & Advertising	Product Development	Research	
Middle Office	Order/Trade Matching	Trade Allocation & Booking	Trade Desk Support	Pricing & Mark-to-Market	Prime Brokerage Support	Risk Control	
Back Office Operations, Services & Control	Confirmation Generation	Confirmation Matching	Confirmation Exception Management	Interface Management	Priority/Position Management	Queue Management	Exception Management
	Fail Control	Funding	Payments	Billing/ Brokerage Fees	Post-Settlement Reconciliation	Collateral Management	Margin
	Securities Borrowing & Lending	Asset Servicing	Safekeeping/ Custody	Reference Data	Interest Claims Management	Operations Control	Regulatory & Compliance
	MIS	Complex Products	Process Design	Process Management	Client Services		
Finance	Treasury	Accounting	Management Reporting	Regulatory Reporting			
	Strategic Planning	Budgeting & Forecasting	Product Control	Tax			



Front Office	Sales	Trading	Client Relationship Management	Marketing & Advertising	Product Development	Research	
Middle Office	Order/Trade Matching	Trade Allocation & Booking	Trade Desk Support	Pricing & Mark-to-Market	Prime Brokerage Support	Risk Control	
Back Office Operations, Services & Control	Confirmation Generation	Confirmation Matching	Confirmation Exception Management	Interface Management	Priority/Position Management	Queue Management	Exception Management
	Fail Control	Funding	Payments	Billing/ Brokerage Fees	Post-Settlement Reconciliation	Collateral Management	Margin
	Securities Borrowing & Lending	Asset Servicing	Safekeeping/ Custody	Reference Data	Interest Claims Management	Operations Control	Regulatory & Compliance
	MIS	Complex Products	Process Design	Process Management	Client Services		
Finance	Treasury	Accounting	Management Reporting	Regulatory Reporting			
	Strategic Planning	Budgeting & Forecasting	Product Control	Tax			

And everyone else...



Americas ↔ Europe ↔ Asia Pac

Corporate Customers

Private Customers

Market Counterparties

Exchanges & Market Data Providers

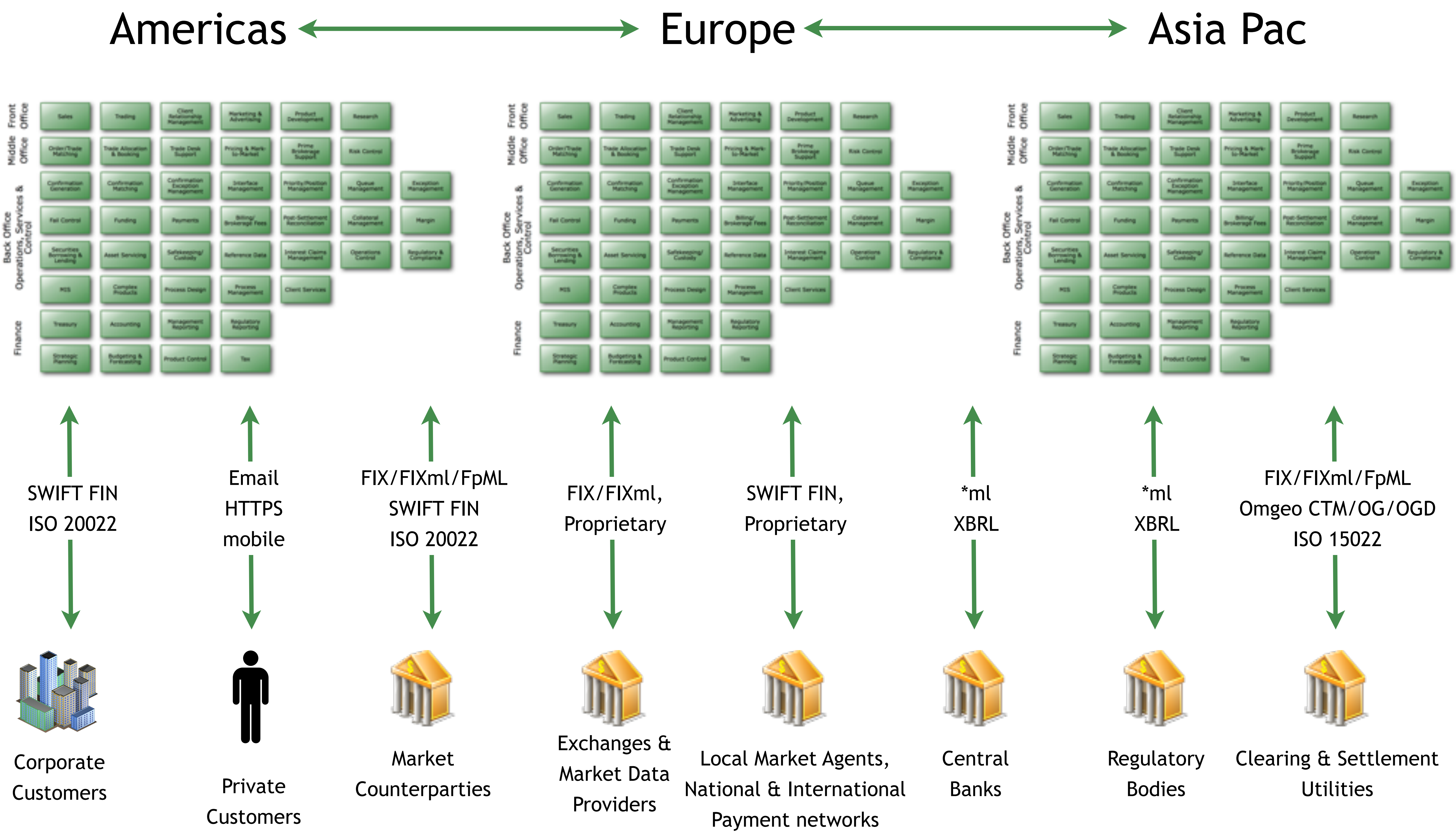
Local Market Agents, National & International Payment networks

Central Banks

Regulatory Bodies

Clearing & Settlement Utilities

Standards galore!



Americas ↔ Europe ↔ Asia Pac

Americas

Front Office	Sales	Trading	Client Relationship Management	Marketing & Advertising	Product Development	Research	
Middle Office	Order/Trade Matching	Trade Allocation & Booking	Trade Desk Support	Pricing & Mark-to-Market	Prime Brokerage Support	Risk Control	
Back Office Operations, Services & Control	Confirmation Generation	Confirmation Matching	Confirmation Exception Management	Interface Management	Priority/Position Management	Queue Management	Exception Management
	Fail Control	Funding	Payments	Billing/ Brokerage Fees	Post-Settlement Reconciliation	Collateral Management	Margin
	Securities Borrowing & Lending	Asset Servicing	Safekeeping/ Custody	Reference Data	Interest Claims Management	Operations Control	Regulatory & Compliance
	MIS	Complex Products	Process Design	Process Management	Client Services		
Finance	Treasury	Accounting	Management Reporting	Regulatory Reporting			
	Strategic Planning	Budgeting & Forecasting	Product Control	Tax			

Europe

Front Office	Sales	Trading	Client Relationship Management	Marketing & Advertising	Product Development	Research	
Middle Office	Order/Trade Matching	Trade Allocation & Booking	Trade Desk Support	Pricing & Mark-to-Market	Prime Brokerage Support	Risk Control	
Back Office Operations, Services & Control	Confirmation Generation	Confirmation Matching	Confirmation Exception Management	Interface Management	Priority/Position Management	Queue Management	Exception Management
	Fail Control	Funding	Payments	Billing/ Brokerage Fees	Post-Settlement Reconciliation	Collateral Management	Margin
	Securities Borrowing & Lending	Asset Servicing	Safekeeping/ Custody	Reference Data	Interest Claims Management	Operations Control	Regulatory & Compliance
	MIS	Complex Products	Process Design	Process Management	Client Services		
Finance	Treasury	Accounting	Management Reporting	Regulatory Reporting			
	Strategic Planning	Budgeting & Forecasting	Product Control	Tax			

Asia Pac

Front Office	Sales	Trading	Client Relationship Management	Marketing & Advertising	Product Development	Research	
Middle Office	Order/Trade Matching	Trade Allocation & Booking	Trade Desk Support	Pricing & Mark-to-Market	Prime Brokerage Support	Risk Control	
Back Office Operations, Services & Control	Confirmation Generation	Confirmation Matching	Confirmation Exception Management	Interface Management	Priority/Position Management	Queue Management	Exception Management
	Fail Control	Funding	Payments	Billing/ Brokerage Fees	Post-Settlement Reconciliation	Collateral Management	Margin
	Securities Borrowing & Lending	Asset Servicing	Safekeeping/ Custody	Reference Data	Interest Claims Management	Operations Control	Regulatory & Compliance
	MIS	Complex Products	Process Design	Process Management	Client Services		
Finance	Treasury	Accounting	Management Reporting	Regulatory Reporting			
	Strategic Planning	Budgeting & Forecasting	Product Control	Tax			

SWIFT FIN
ISO 20022

Corporate Customers

Email
HTTPS
mobile

Private Customers

FIX/FIXml/FpML
SWIFT FIN
ISO 20022

Market Counterparties

FIX/FIXml,
Proprietary

Exchanges & Market Data Providers

SWIFT FIN,
Proprietary

Local Market Agents, National & International Payment networks

*ml
XBRL

Central Banks

*ml
XBRL

Regulatory Bodies

FIX/FIXml/FpML
Omgeo CTM/OG/OGD
ISO 15022

Clearing & Settlement Utilities

ISO 20022 (:2013)

- A Standard for standards
  - No messages defined, just metadata and rules
  - Not restricted to XML implementation

- The 20022 Registration Authority (SWIFT) has made the repository publicly available
  - http://www.iso20022.org/e_dictionary.page?

- The expectation is that the financial services messaging vendor community will integrate the model into their products
  - ... and that banks and financial institutions will now be able to leverage the 20022 model as a basis for their internal Enterprise Architecture

- Beware though it has 49,209 elements and 8,765 types
  - Build that into your DSL!

Let’s take the extremes

- Our business user lives on PowerPoint and Excel
  - Usually a very sad combination of both in dozens of versions emailed back and forth
- The vast majority of integration and transformation requirements come in Excel spreadsheets
  - That’s all they know and it’s the only thing on their corporate desktop
- The *doers*, possibly an intellectually level higher prefer something a lot more precise and ideally machine readable
  - XSLT, Schematron, UML etc.
- And the programmers just want it in Java
  - And occasionally C, C++ & .NET
  - And of course the traders work on FPGA and GPU cards too

Java Binding

- Ultimately if you can bind everything to Java you’re starting to close the gap
  - Obviously this would extend to other VMs such as .NET
- We can bind all of the formats, all of the standards and all of the versions - Now we can start to look at a DSL
- DSLs can help us in a number of ways but we still have a lot of issues to solve
  - Multiple domains in financial services
    - Derivatives, FX, Option, Commodities, Retail, Private, Corporate
  - Multiple functions within those domains
    - Front / Client facing, Middle (accounting, matching, reconciliation), Back - payments etc
  - Multiple skill levels

DSL Usage

- Defining standards
  - Limited because most modern standards are UML or XML - meaning they're already covered
- Defining message-level validation rules
  - Schematron is one way but it's XML only so there are opportunities here
  - XPath & XQuery, while not exactly DSLs provide good capabilities for many standards
- Defining transformation rules
  - XSLT is the de-facto standard but it's extremely restricted to XML and 90% of requirements arrive in Excel - Ultimately the GUI wins out
- Defining routing, querying and matching rules
  - Probably the best area of research

Using DSLs

- We tried to define SWIFT (ISO 7775 & 15022) messages using ANTLR
  - It was good especially with ANTLR 4’s support with Java
  - We looked at LEX & YACC but ANTLR was the favourite

```
{1:F01FRNYUS30AXXX4218327520}
{2:O1030947040127FRNYUS33AXXX4218183425040127094 7N}{3:{108:MARKETS/
07740}}{4:
20:MT103-10c
:13C:/RNCTIME/0231-0156
:23B:CRED
:32A:050407USD93959,99
:50K:MINECOFIN,KIGALI/RWANDA
:57A:/054001314
AABAFI22
:59:/0043571601
```

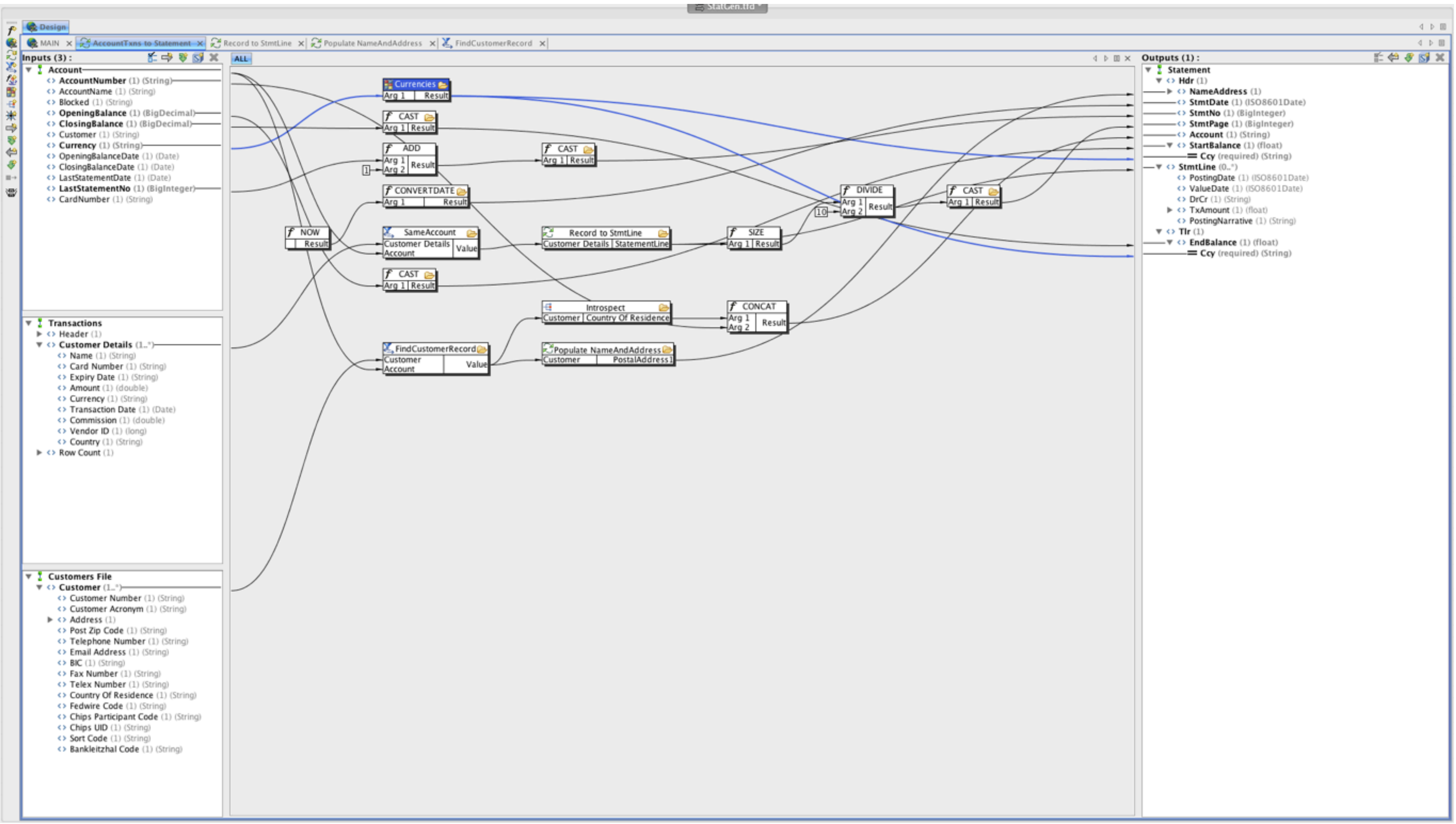
- Ultimately we already have SWIFT models and the standard is relatively static so we dropped it (for now)

XPath a DSL?

- OK so XPath and XQuery are not DSLs as such but when used to define rules for non-XML sources they are effectively DSLs
- Take a CSV and define a rule so that date in column D (Trade Date) is never past the date in column N (Settlement Date)
  - //TradeDate > //SettlementDate
- This works well as many of the canonical models are now XML based so the rules are easily extendable
  - FpML, ISO 20022 etc.
- Rules defined against the meta-data work across the various formats and standards

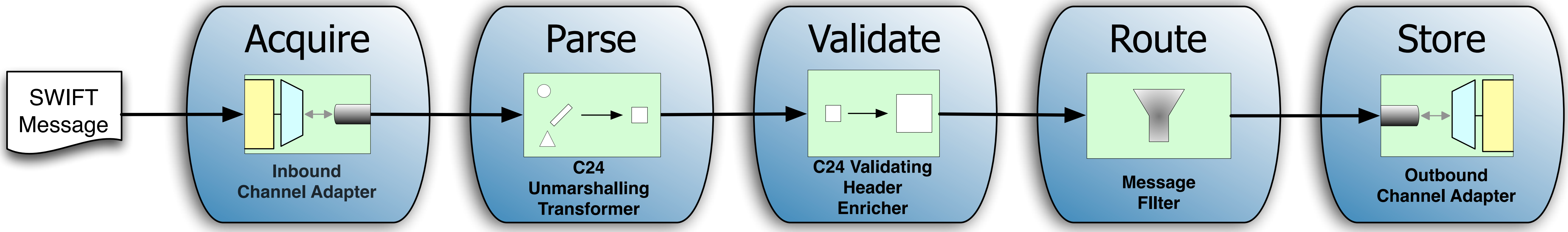
No DSLs here (yet)

- Functions (boxes below) can be and often are DSL-based



A Scala alternative

- Part of out work with Spring Integration...



```
file.poll("directory").atFixedRate(1000) -->

handle {file: File => println(file.getCanonicalPath()); file} -->

transform {m: Message[File] => parser.transform(m)} -->

transform {m: Message[ComplexDataObject] => validator.transform(m)} -->

filter {m: (_, headers:Map[String, Any]) =>

headers.containsKey("c24_valid")}.additionalAttributes(exceptionOnRejection=true) -->

transform {m: Message[ComplexDataObject] => converter.transform(m)} -->

split {confirmations: Array[Confirmation] => confirmations} -->

handle { conf: Confirmation => mongoTemplate.insert(conf) }
```

Exposing DSLs to clients

- Whether we’re looking at messages distributed over 200 machines, coming out of a map/reduce or a GPU the business users just want a simple interface

- And guess what, they really like Excel!
  - SUM, AVG, MIN, MAX, SQR etc.

- So we implemented these along with new functions
  - Moving averages, StdDev, Bollinger band, Best price, Price at Volume

- And this seems to work nicely
  - To implement these we’re generally using Scala Parser Combinators and Groovy - both of which allow us to define new DSLs for Java and run in the JVM

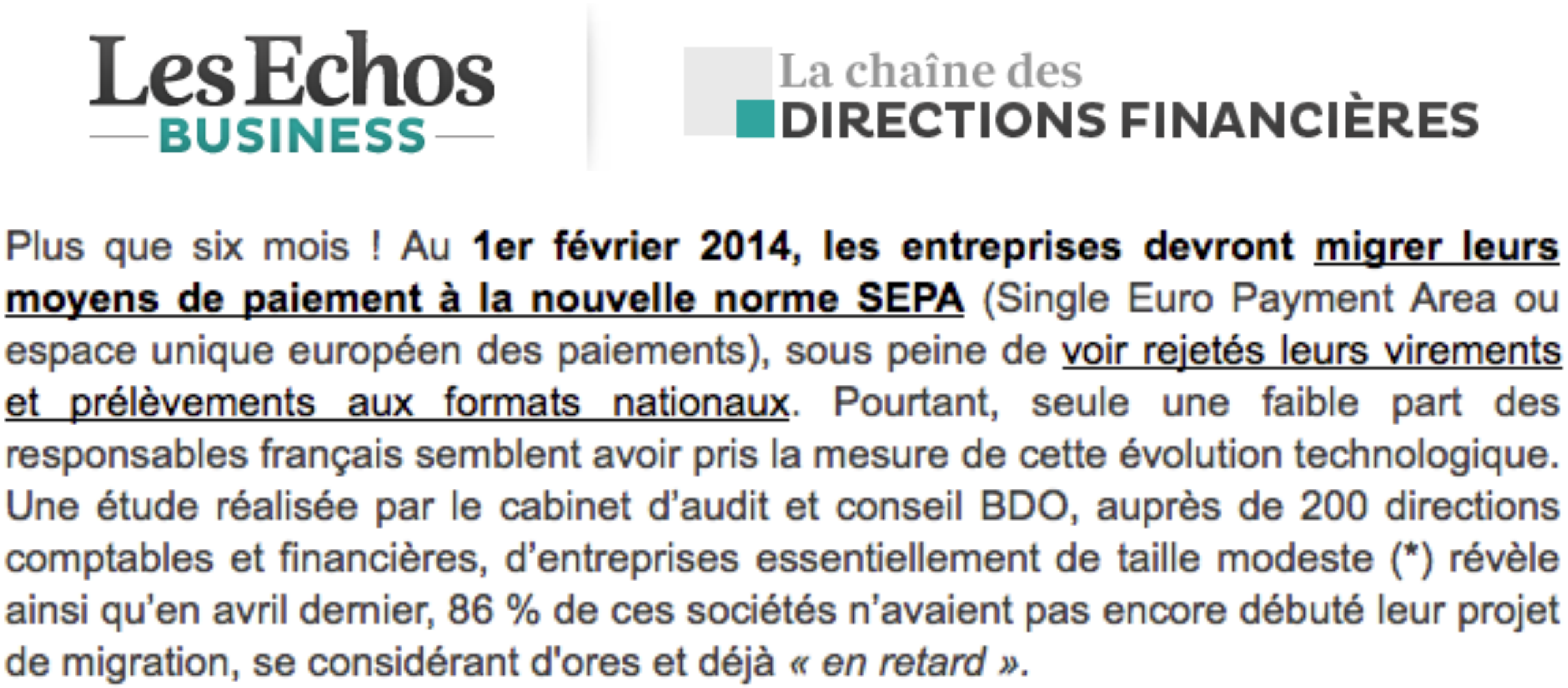
Performance

- All integration generates code, recently we moved to use ByteBuffers internally
- We can now parse over 1 million messages per core but performance is now hit by the dynamic routing and queries
  - This is due to "reflection" in the JVM from the DSLs
- The DSLs usually generate code but the dynamic routing and queries generally result in reflection
- The solution is to now take the dynamic routing or query and compile it down to code and execute in the JVM
  - Our clients can hit 500k messages per second, over 7 billion / day

The Pressure is on!

- The Euro-zone goes live with SEPA (based on ISO 20022) in February 2014 (less then 4 months away)

- Very few banks are ready
  - And then there's Dodd-Frank regulation and plenty of others



Les Echos BUSINESS

La chaîne des DIRECTIONS FINANCIÈRES

Plus que six mois ! Au **1er février 2014, les entreprises devront migrer leurs moyens de paiement à la nouvelle norme SEPA** (Single Euro Payment Area ou espace unique européen des paiements), sous peine de voir rejetés leurs virements et prélèvements aux formats nationaux. Pourtant, seule une faible part des responsables français semblent avoir pris la mesure de cette évolution technologique. Une étude réalisée par le cabinet d'audit et conseil BDO, auprès de 200 directions comptables et financières, d'entreprises essentiellement de taille modeste (*) révèle ainsi qu'en avril dernier, 86 % de ces sociétés n'avaient pas encore débuté leur projet de migration, se considérant d'ores et déjà *« en retard »*.