MODeX
Model Oriented Data eXchange

Eclipse Banking Day

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What is MODeX?

A domain-specific modeling language for enterprise messaging.

Components include:

- Graphical modeling IDE
- Code generator
- Language-specific runtime components
- Lifecycle management tools

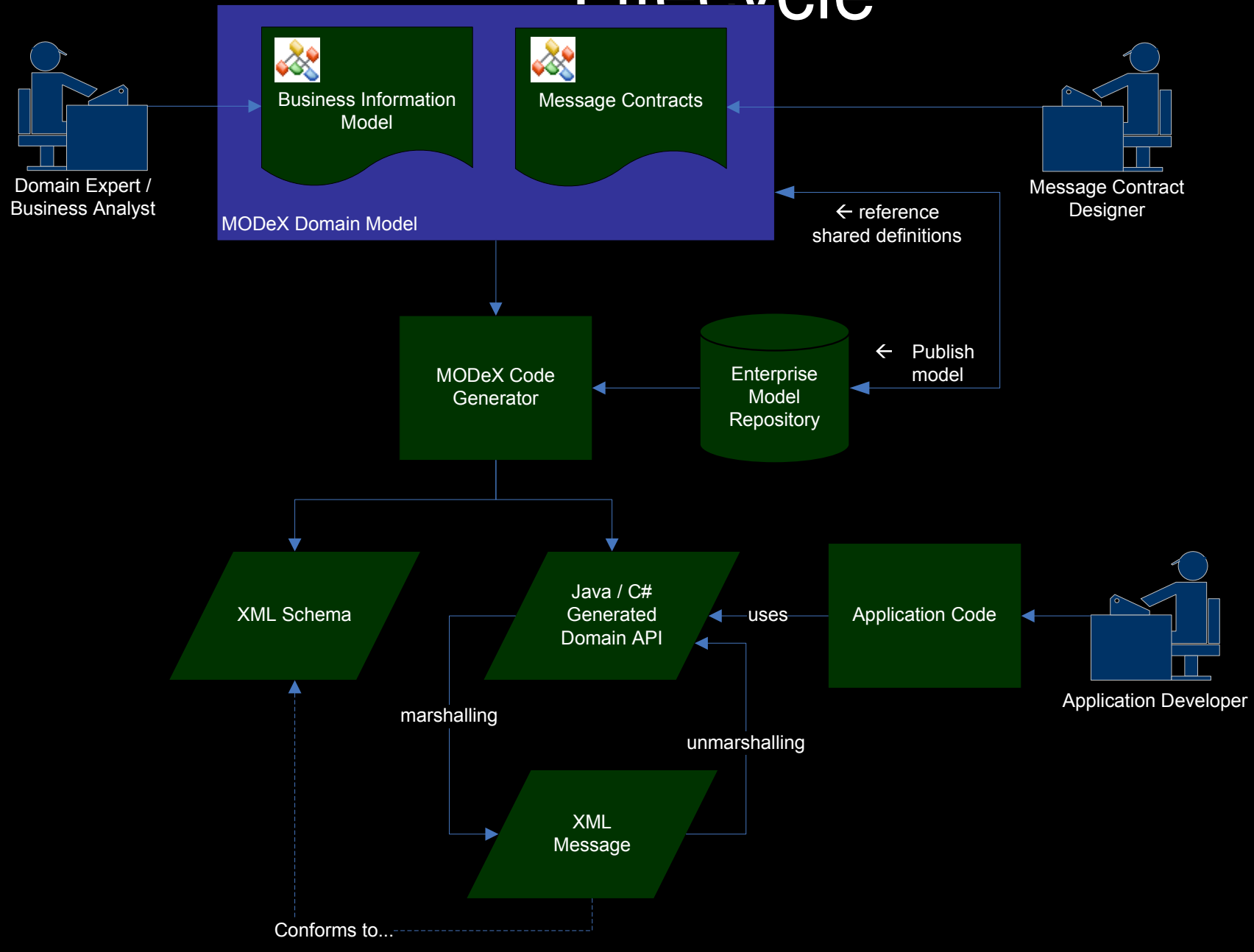
Current State of XML Messaging in the Enterprise

- Direct XML manipulation is the least common denominator.
- Toolkits handle basic SOAP envelopes, transport, message dispatching and handling.
- Developers may use JAXB, XSD.EXE for marshalling/unmarshalling.
- Adopting CxF and WCF as standards
- Ambivalent relationship with schema:
  - Most developers ignore it or treat it as a design-time exercise.
  - Some developers invest heavily and want to use schema as "the model"
- Developers and designers have been left to translate business concepts to XML formats.
  - Elements or attributes?
  - Type substitution or element substitution?
  - Nesting or IDREF for shared references?
  - …
- Big problems:
  - Cost of coding directly against XML or even mapping is a drag on developer productivity
  - Proliferation of formats makes integration extremely expensive.
  - Weak contracts affect data quality.

Solution:

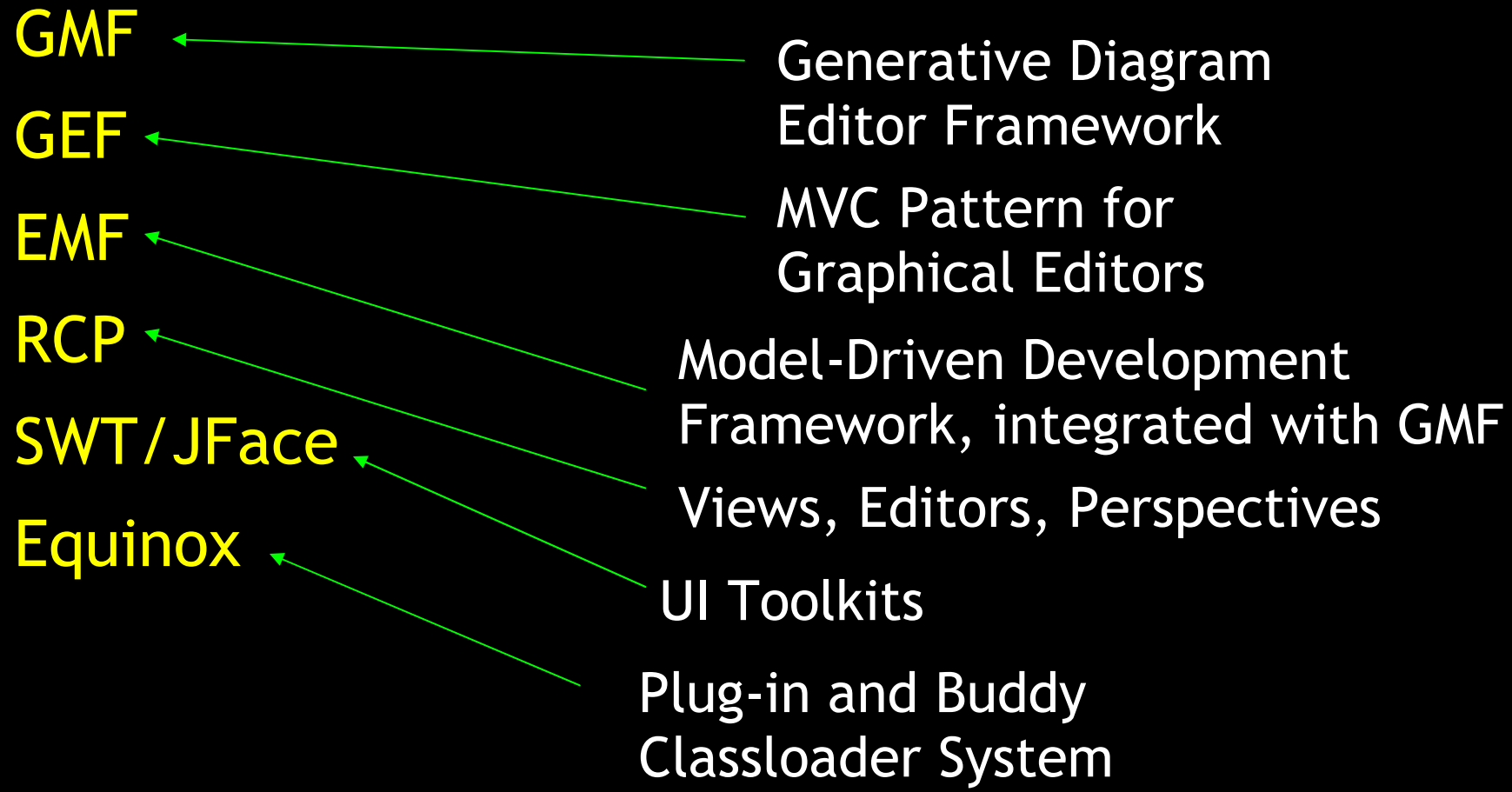
- Create a simple graphical modeling language for enterprise data and message contracts
- Create a federated model repository for shared models and lifecycle management
- Generate schemas from well-specified message contracts
- Generate code and provide runtime support for multiple languages
- Build on this basic foundation to address other large-scale issues

Model-Driven Development Lifecycle



Eclipse Modeling Technologies

Proven open source technology stack



MODeX Designer
Demo and Walkthrough

MODeX Designer

Entity Modeling

Message Contract Modeling

Generated schemas

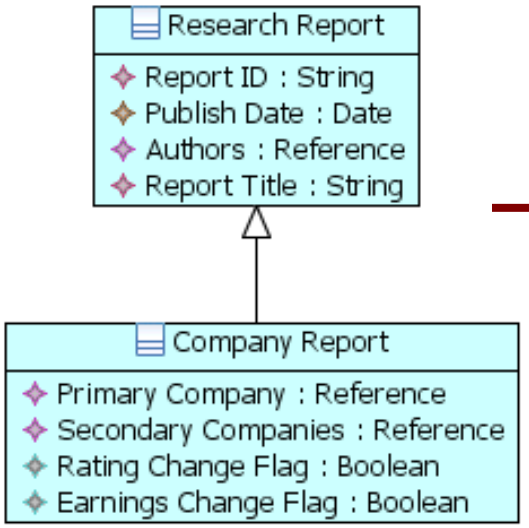
Generated Java API

MODeX - Key Features

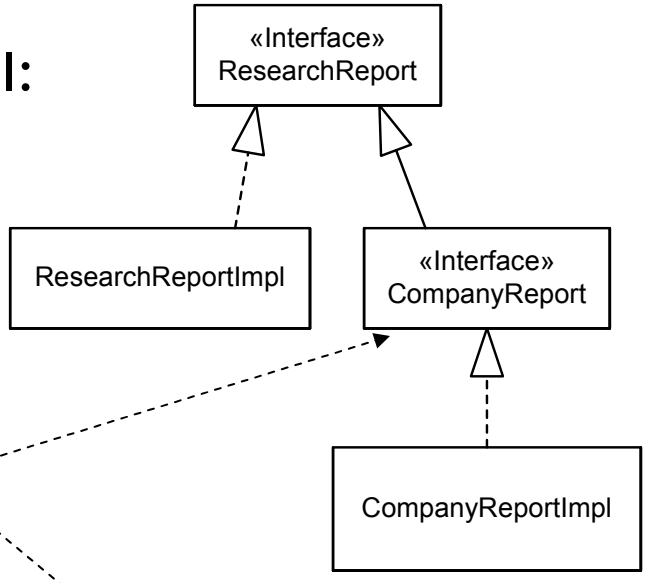
Inheritance and Subtype Roles
Field Value Constraints and Enumerations
Views and Payload Contracts
Full-Fidelity Messaging
Entity-Centric API
Data Aspects
Model Documentation - Modelpedia

Inheritance and Subtype Roles

Entity Definitions:

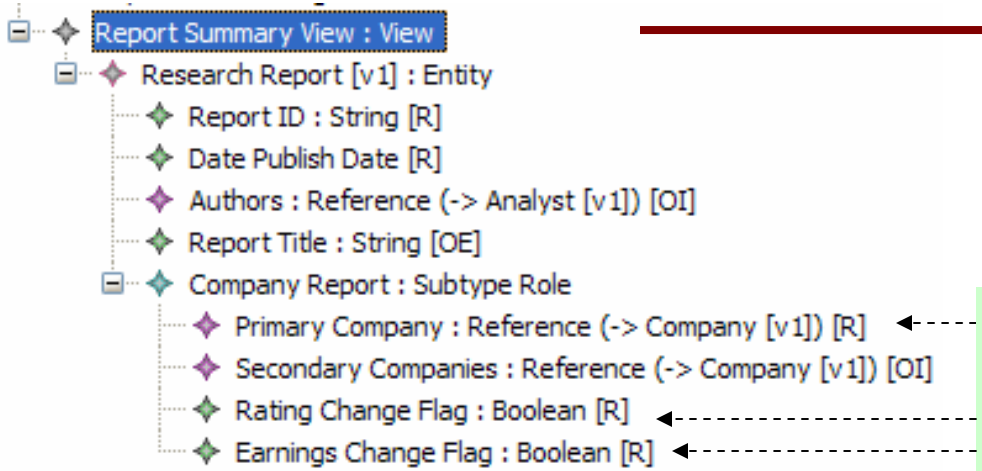


Generated Domain API:

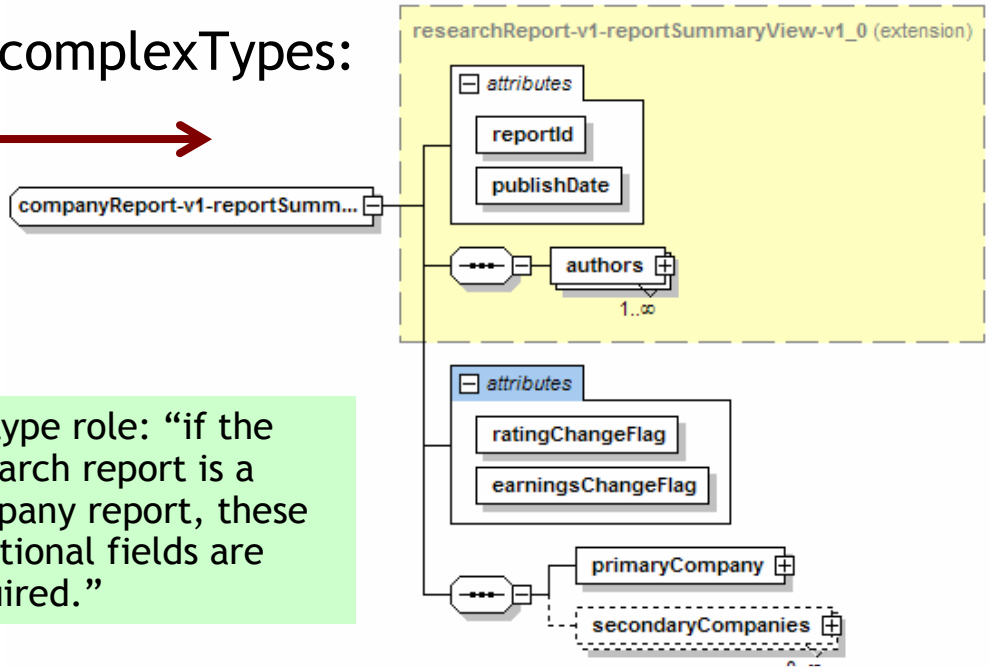


Types are substitutable in the generated API and Schema.

View Definitions



Schema complexTypes:



Subtype role: “if the research report is a company report, these additional fields are required.”

Field Value Constraints, Enumerations

Field Value Constraints based on a subset XML Schema facets:

- Range
- String Length
- Regular Expression
- Numeric Format

Static Enumerations (current):

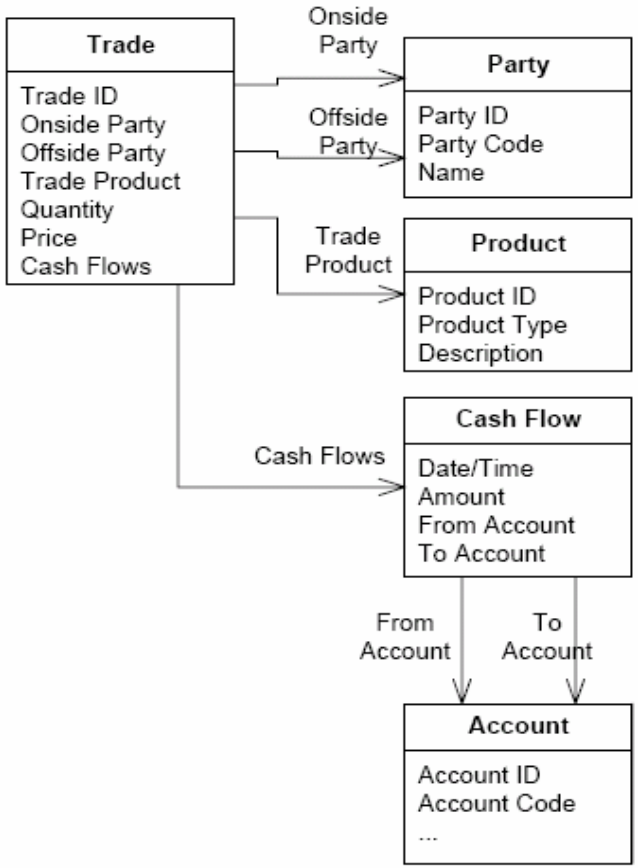
- Available for any primitive type
- Translate to a true enum in Java
- Translate to a “typesafe enum” pattern in C#, C++

Semi-Static Enumerations (planned):

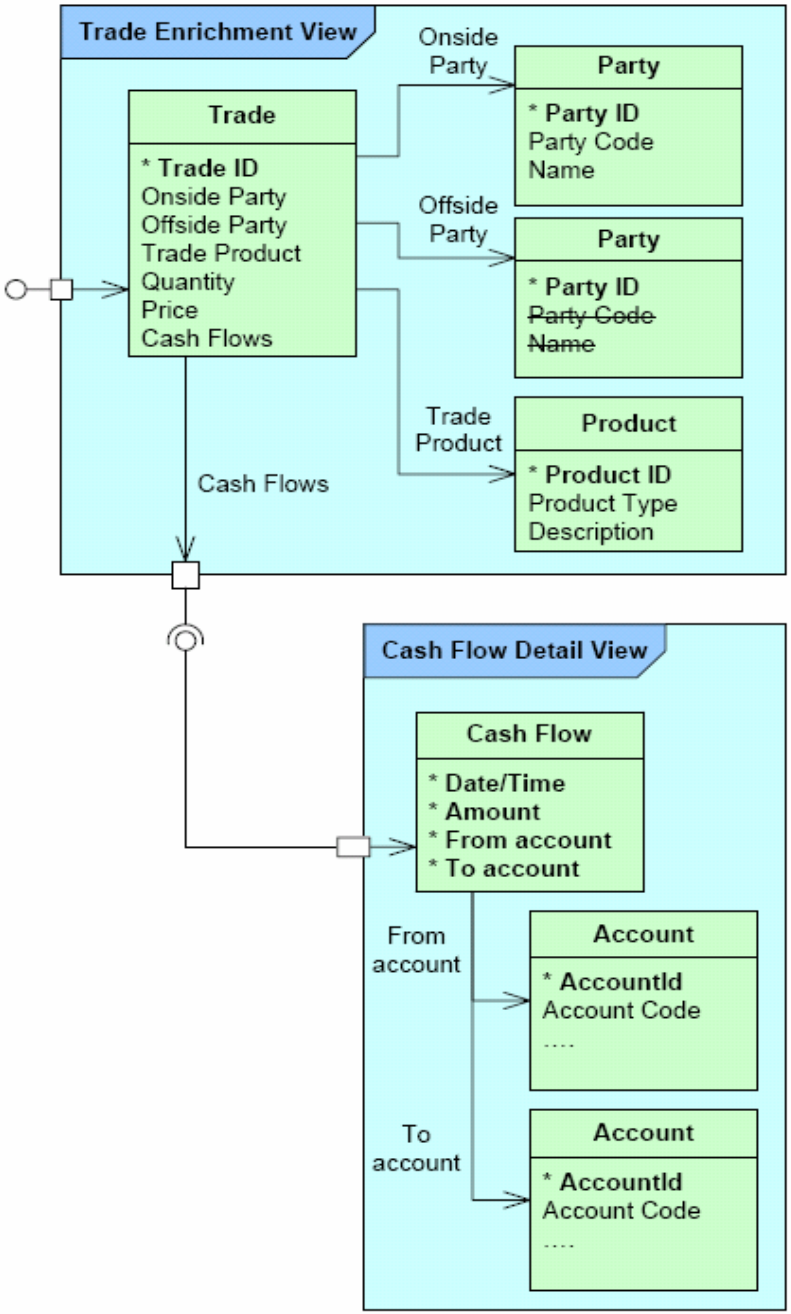
- Allowable values determined at runtime by a lookup into a database or data service.
- Enable/Disable validation, set expiration policy by configuration

Message Contracts

1 Entity Model



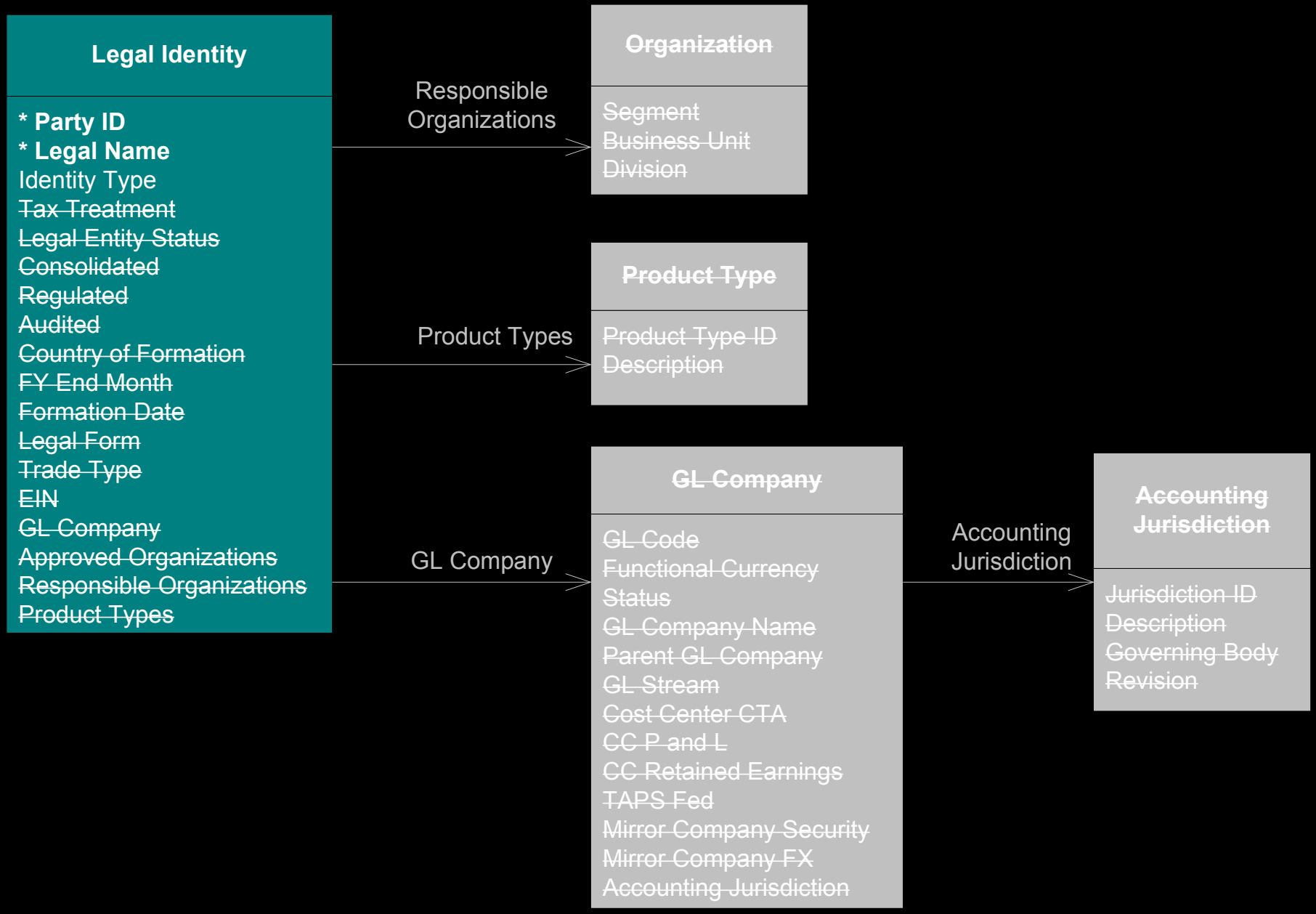
2 Message Payload Model



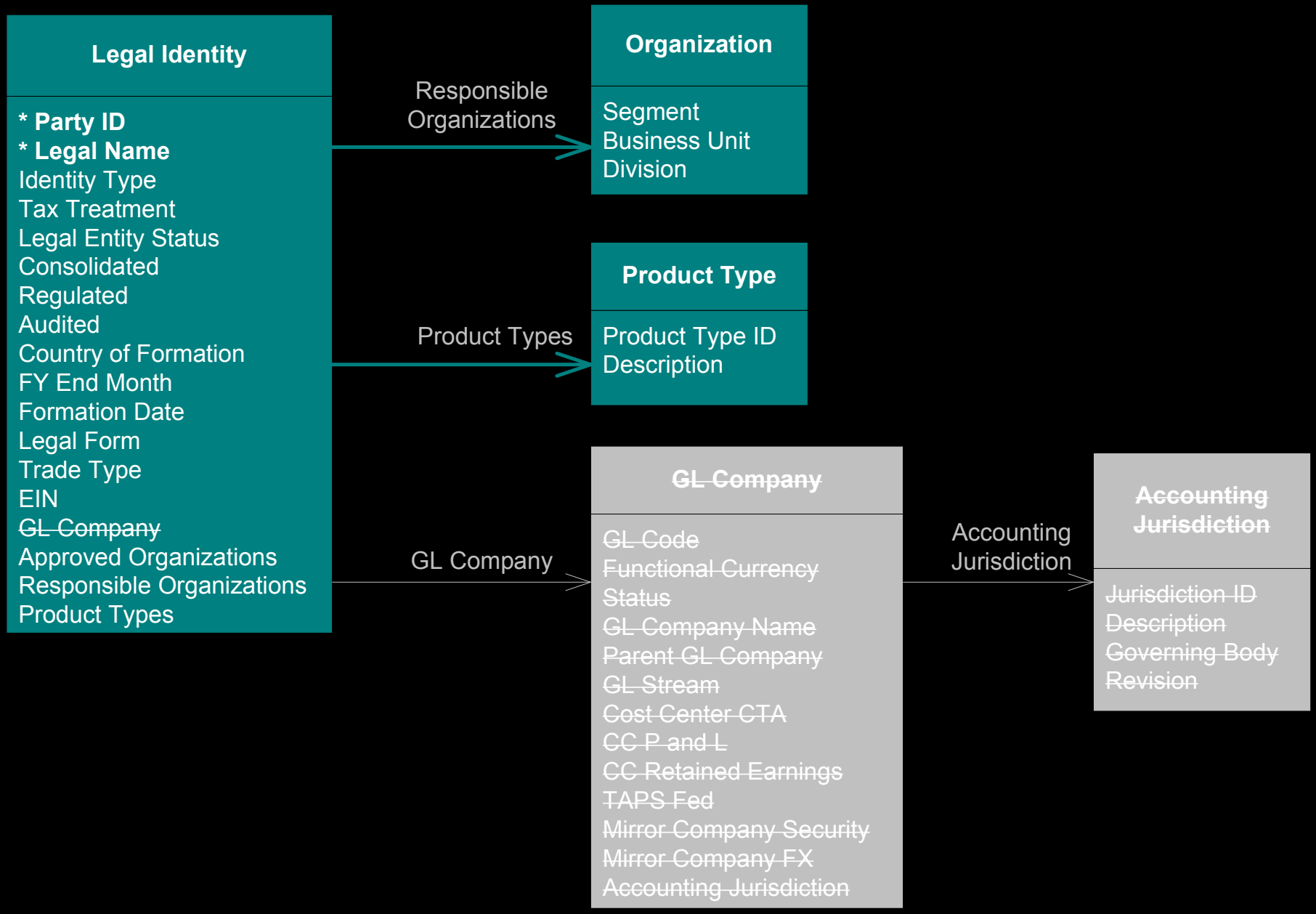
3 XML Message

```
<Trade
  tradeId="123" >
  <OnsideParty
    partyId="P1" />
  <OffiseParty
    partyId="P2" />
  <Product
    productId="xyz"
    productType="bond" />
  <CashFlows
    dateTime="2007-08-24 09:25:35"
    amount="982734987"
    fromAccount="A01231"
    toAccount="A89034" />
  <CashFlows
    dateTime="2007-08-26 11:02:15"
    amount="789342"
    fromAccount="A01231"
    toAccount="A89034" />
</Trade>
```

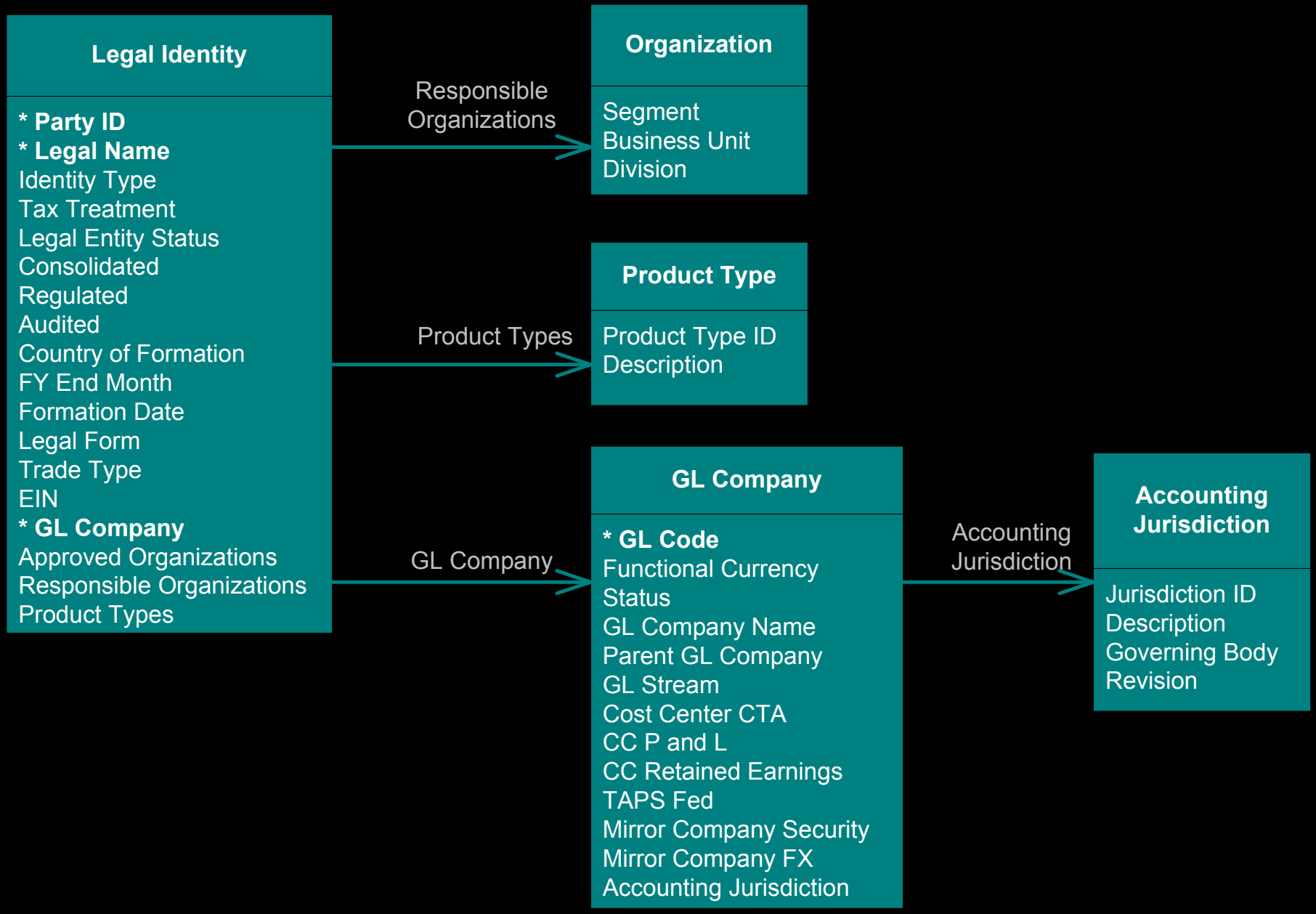
Views Example – Stage 1



Views Example – Stage 2



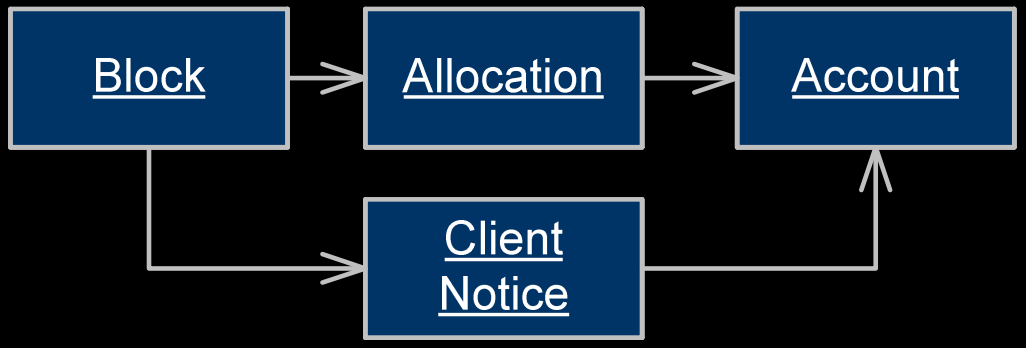
Views Example – Stage 3



Full-Fidelity Messaging

Objects:

- Object Graphs may contain shared references and cycles



XML:

- Shared objects are detected by the marshaller, and assigned a unique ID.
- The unmarshaller will reconstruct the object graph with full fidelity.

```
<Block blockId="8927340">
  <Allocation allocationId="982734">
        <Account modex:objectId="1"
                          accountId="12349087"
                          accountCode="ABC"
                          type="DEF" />
  </Allocation>
  <ClientNotice date="2007-09-17" status="sent">
        <Account modex:objectId="1" />
  </ClientNotice>
</Block>
```

API:

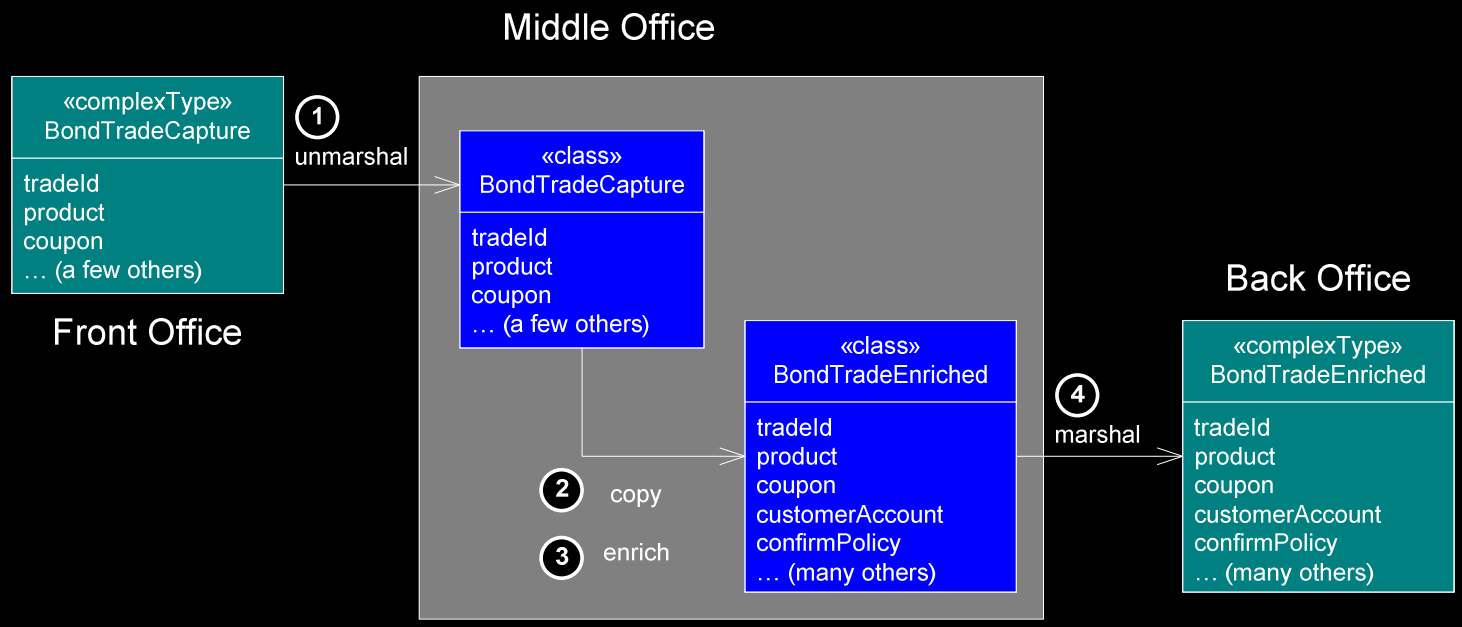
- Traversal over the object graph across any path yields full access to all fields.

```
Block b = BlockMsg.unmarshalFromDocument(doc);
ClientNotice cn = b.getClientNotice();
String accountCode =
        cn.getAccount().getAccountCode();
```

Entity-Centric API

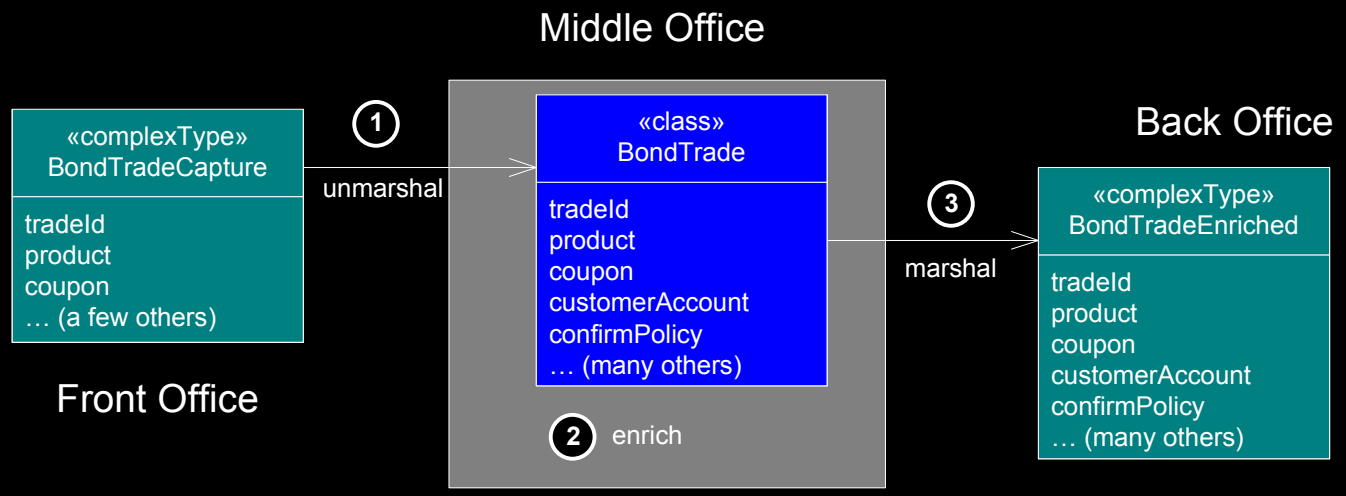
Schema-Based Code Gen:

- Separate class for each complexType.
- Enrichment and request/response scenarios require copying from one representation to another.
- Additional memory footprint, performance overhead and development effort
- Effects multiply with number of types, clients, services, and message formats.



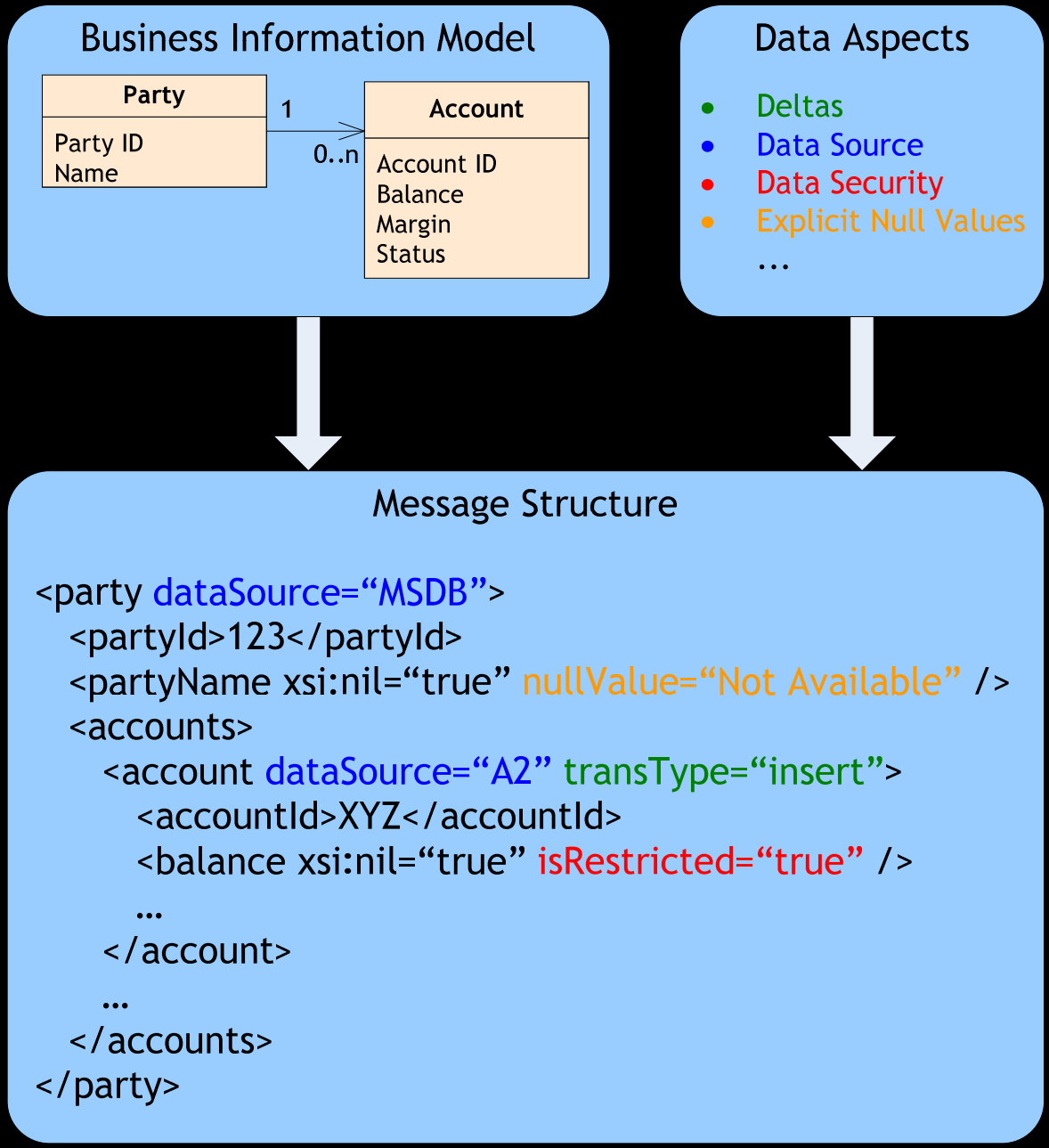
Model-Based Code Gen:

- Single class/interface each entity
- An entity class can be marshalled to multiple views, validated against multiple contracts
- API decoupled from specific message format.



Data Aspects

- Concept borrowed from aspect-oriented programming
- Represent cross-cutting concerns in message contracts.
- Data Aspects are included and configured in view definitions.
- Data Aspects contributed “properties” to the XML schema and API



Modelpedia - Model Documentation

Collaborative Web-Based tool for model documentation.

Shows relationships among models entities, across domains.

Searchable data dictionary includes entity types, fields, message contracts.

Browse generated artifacts, including code and schema

Future plans:

- Tie-in to model publishing lifecycle
- User-contributed content
- Wiki markup
- Discussions, change requests
- Hyperlinked diagrams
- Usage Statistics

Evolving Features

Cross-Domain Modeling and Code-Gen

Versioning

Advanced Validation

SOA Toolkits Integration

Advanced Modeling Features

Model Mapping and Transformation

Evolution: Cross-Domain Modeling

Goal: Enable Re-use of model constructs across domains:

- Inherit from entity in another domain.
- Reference an entity in another domain.
- Define a message contract for an entity in another domain.

Architectural Requirements:

- Federated enterprise model repository
- Cross-domain modeling in MODeX Designer
- Cross-domain code generation
- Cross-domain runtime marshaling and validation.
- Model lifecycle management.

Evolution: Versioning

- Minor versions can add optional fields.

  Runtimes support minor version bridging, and unknown field data pass-through.

- Major versions can completely alter fields: add, remove, delete, change optional/mandatory status.

  Does not work with existing contracts, but tooling can allow smoother major version migration.
- Modeling tool maintains multiple copies of Entity for every version, minor or major.

Trade	v1	v1.1	v2
Id	M	M	D
Symbol	M	M	M
Market	M	M	O
Quantity		O	M
Price		O	M

M = Mandatory
O = Optional
D = Deleted

Evolution: Advanced Validation

MODeX validation constraints are embedded in message contracts.

All validation happens in-memory, independent of wire format.

Available equally to message sender and receiver, runtime is configurable to perform selected validations on send or receive.

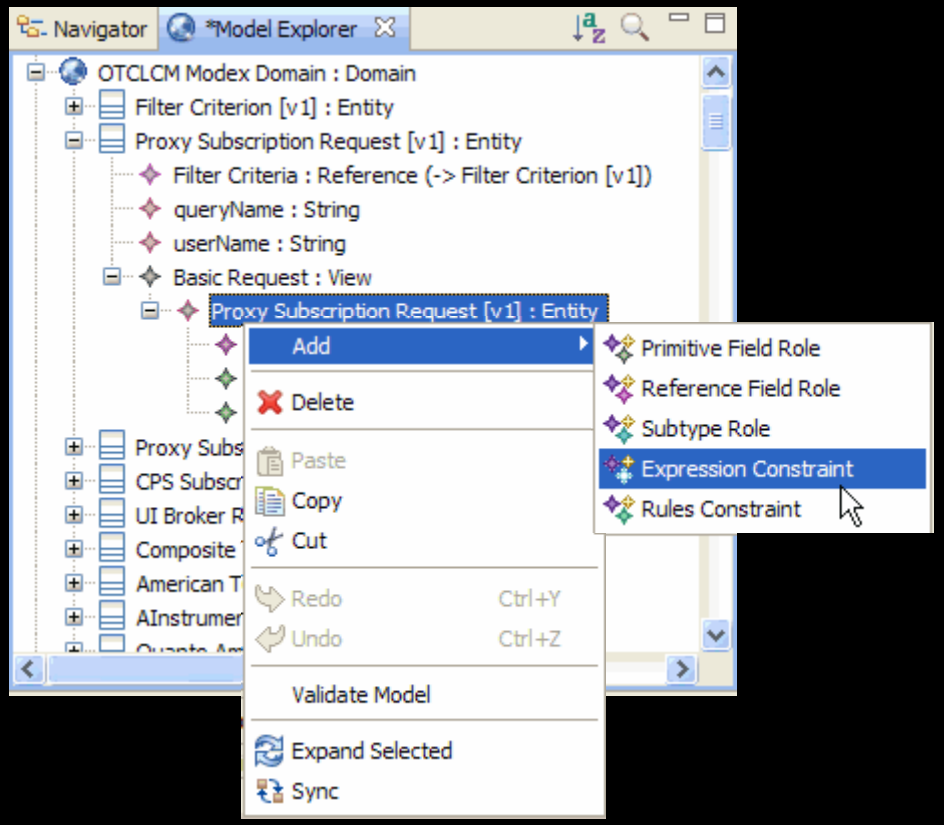
Validation produces detailed list of violations that can be inspected, logged, transmitted in a message.

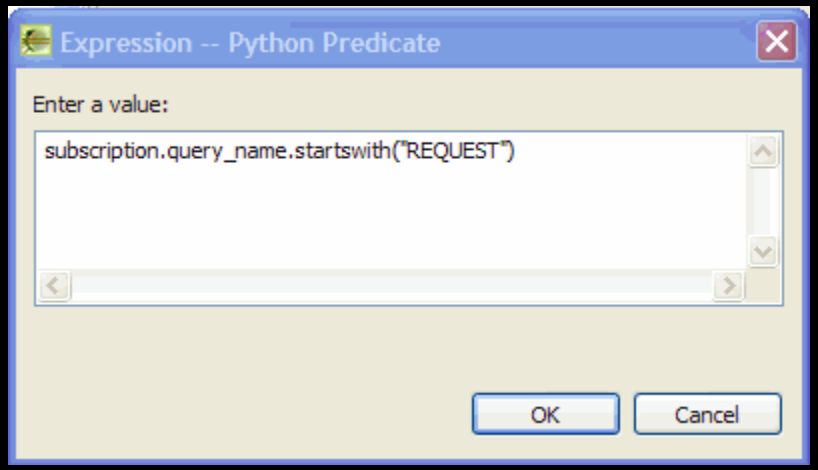
Expression Constraints

- Pluggable expression dialects, default is based on Python expression syntax.
- Executes cross-platform
- Allow arbitrarily complex validation expressions.

Rule Constraints

- Pluggable rules engine, default is JBoss Rules
- Forward-chaining rules engine allows rules to enrich the data, fire other rules based on enriched data.





Evolution: SOA Toolkits Integration

Phase 1 (Complete):
- Interop Message Format

Phase 2 (Planned):
- MarshalStack Integration with CxF and WCF

Phase 3 (TBD):
- MODeX Types in WSDL Contracts

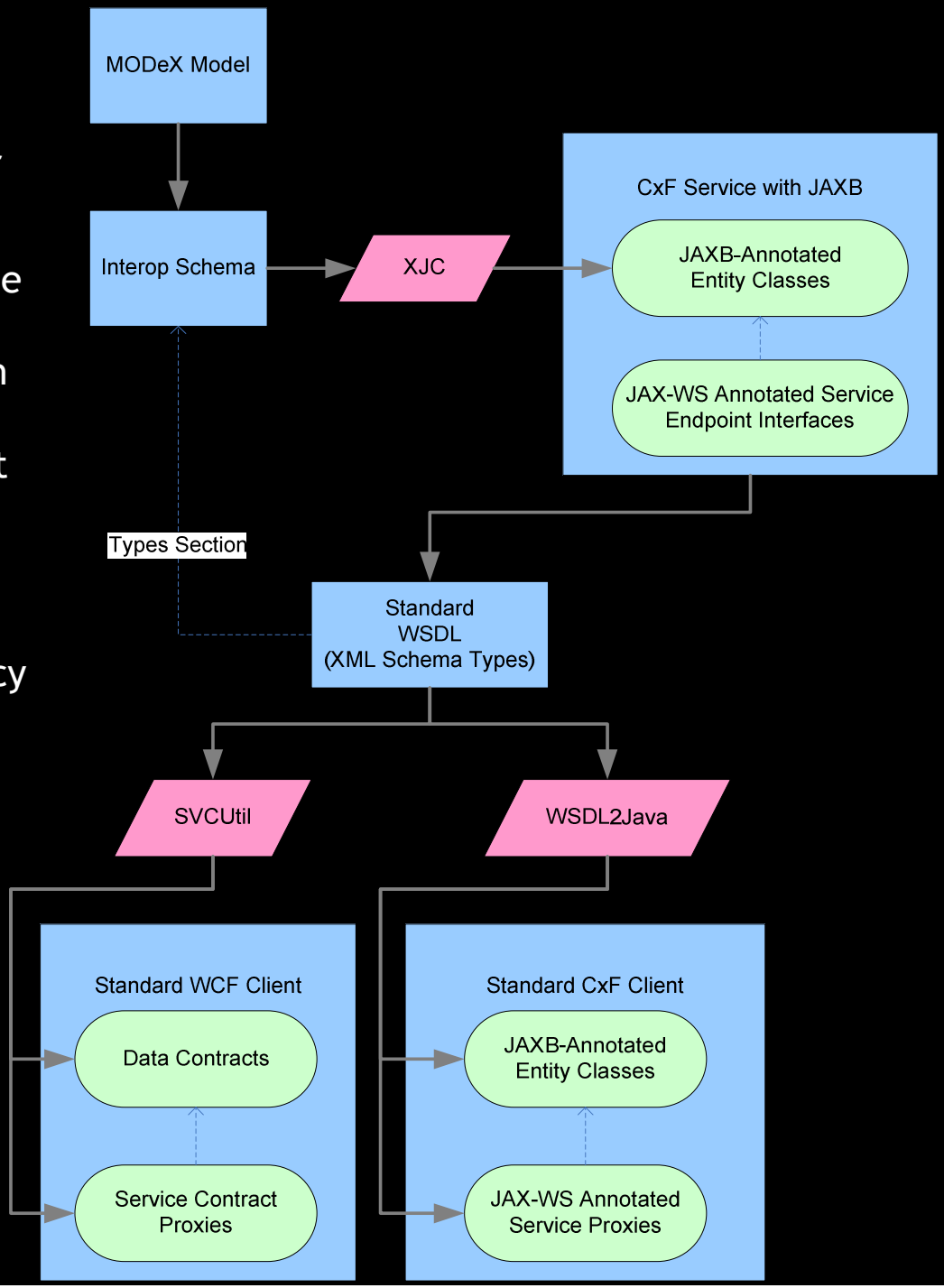
SOA Toolkits Phase 1

Interop Message Format

* New message schema generated by MODeX Designer

* Specifically designed to produce a straightforward API when used with CxF/JAXB and WCF/Data Contract Serializer

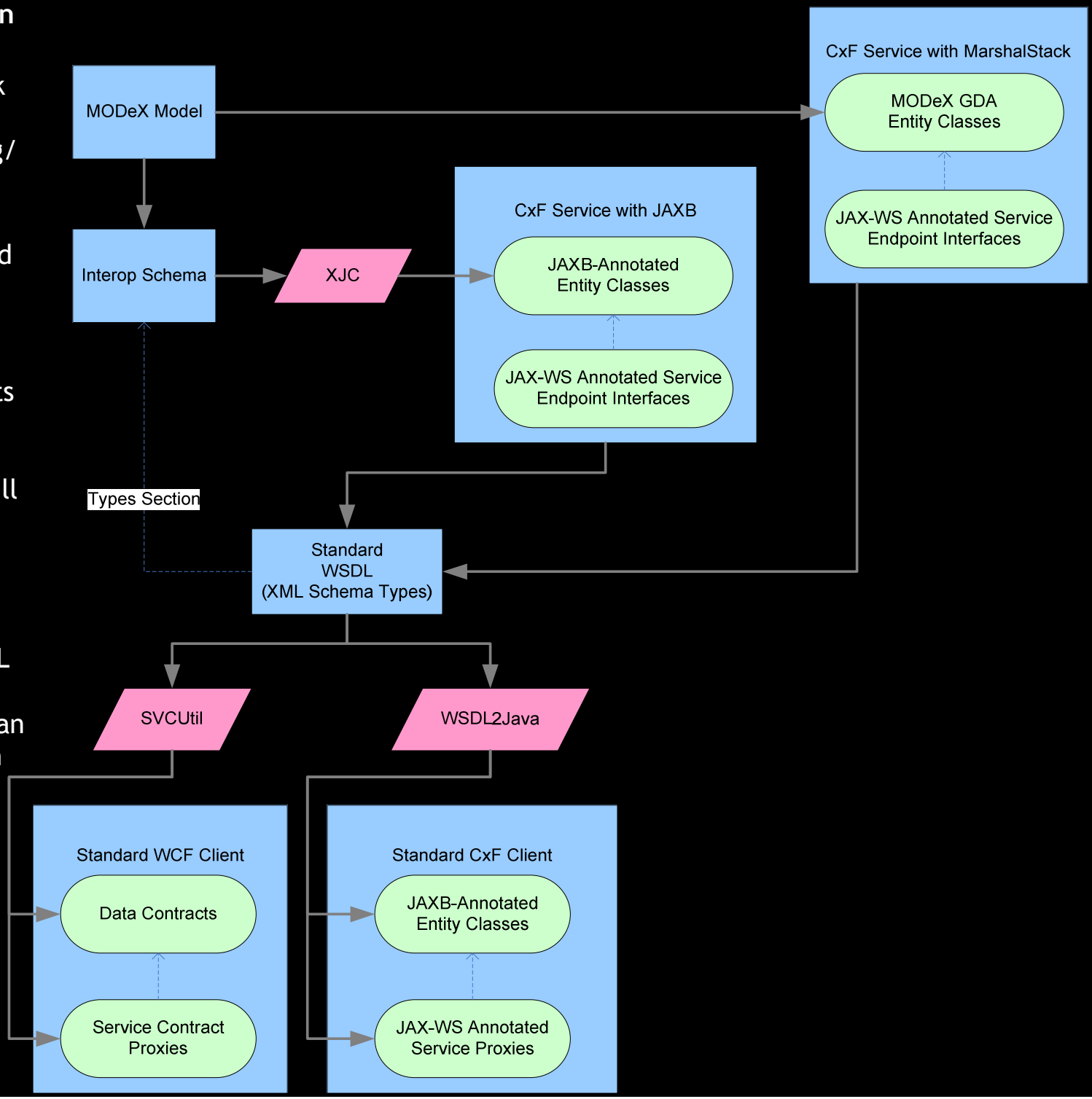
* Pure WSDL solution, with no runtime dependency on MODeX



SOA Toolkits Phase 2

MarshalStack Integration with CxF and WCF

* MODeX MarshalStack runtime plugs in as a first-class marshalling/ serialization option.
* Generated entity interfaces can be used as WebMethod arguments and return types.
* Provides full benefits of MODeX on the server:
Entity-Centric API, Full Fidelity Messaging, Advanced Validation, Field Promotion
* Service consumers can choose pure WSDL import with Interop message format, or can use MODeX GDAs with MarshalStack.



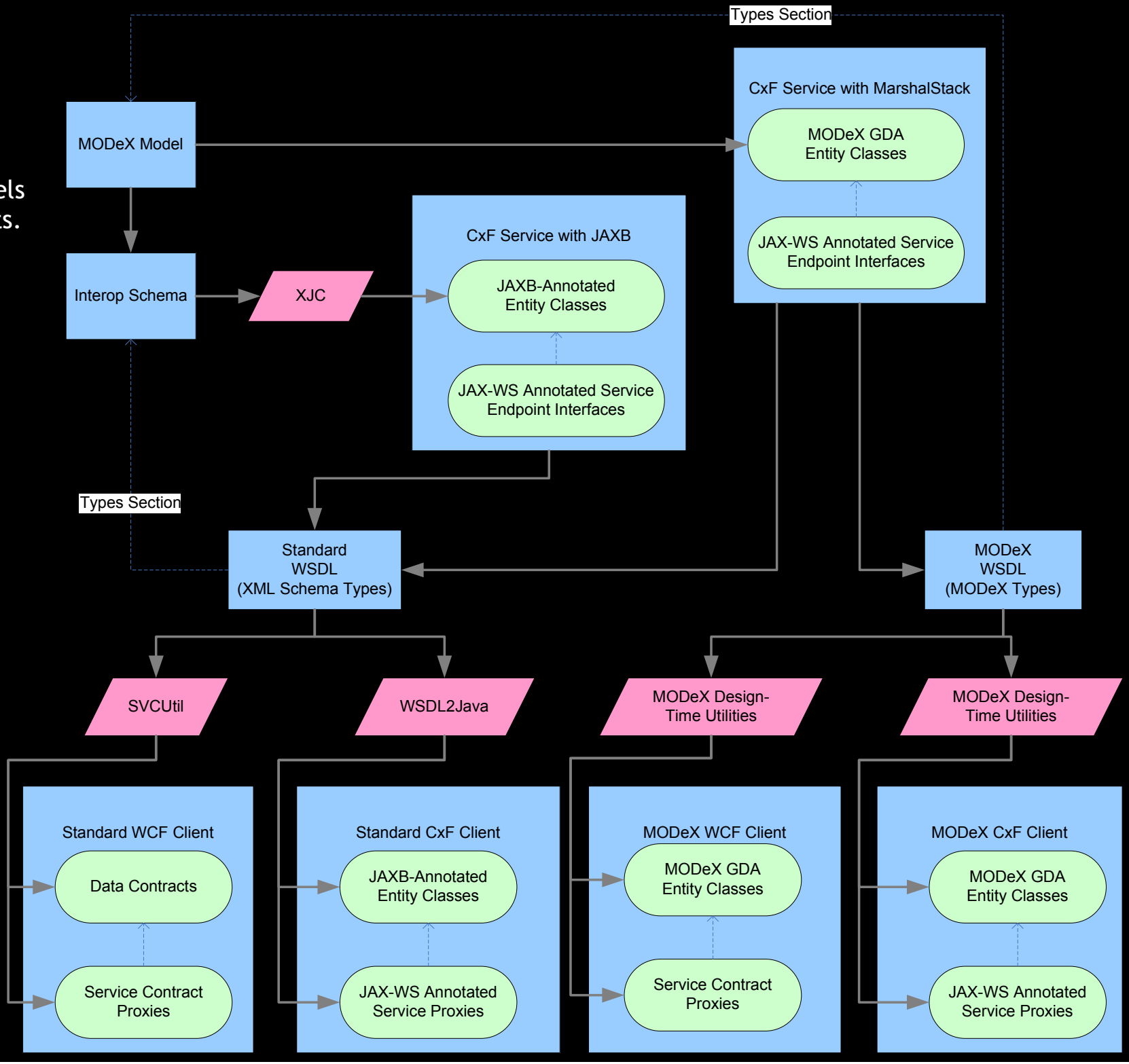
SOA Toolkits Phase 3

MODeX Types in WSDL Contracts

* Types section of WSDL expressed in terms of MODeX models and message contracts.

* Service exposes this WSDL on a separate port from standard, schema-typed WSDL.

* IDE tooling imports MODeX service contracts, required MODeX GDAs, and endpoint implementations that use the GDAs and MarshalStack transparently.



Evolution: Advanced Modeling Features

Design goal: provide a conceptual modeling language optimized for enterprise data.

- Capture essential technology-independent semantics.
- Map cleanly to multiple data representations.
- Facilitate human-to-human communication and documentation.

Features:

Model/Contract Separation

Rich, Extensible Constraints

Optional Rules Engine Integration

Borrows from multiple Multiple Paradigms:

- Object Oriented: References, Inheritance, Associations*
- AOP: Data Aspects
- Relational: Uniqueness Constraints, Semi-Static Enumerations, Queries*
- XML Schema: Derive by Restriction*
- Ontology: Multiple Classification*

* Proposed

Evolution: Model Mapping and Transformation

Bidirectional solution supports forward code generation or code-first mapping.

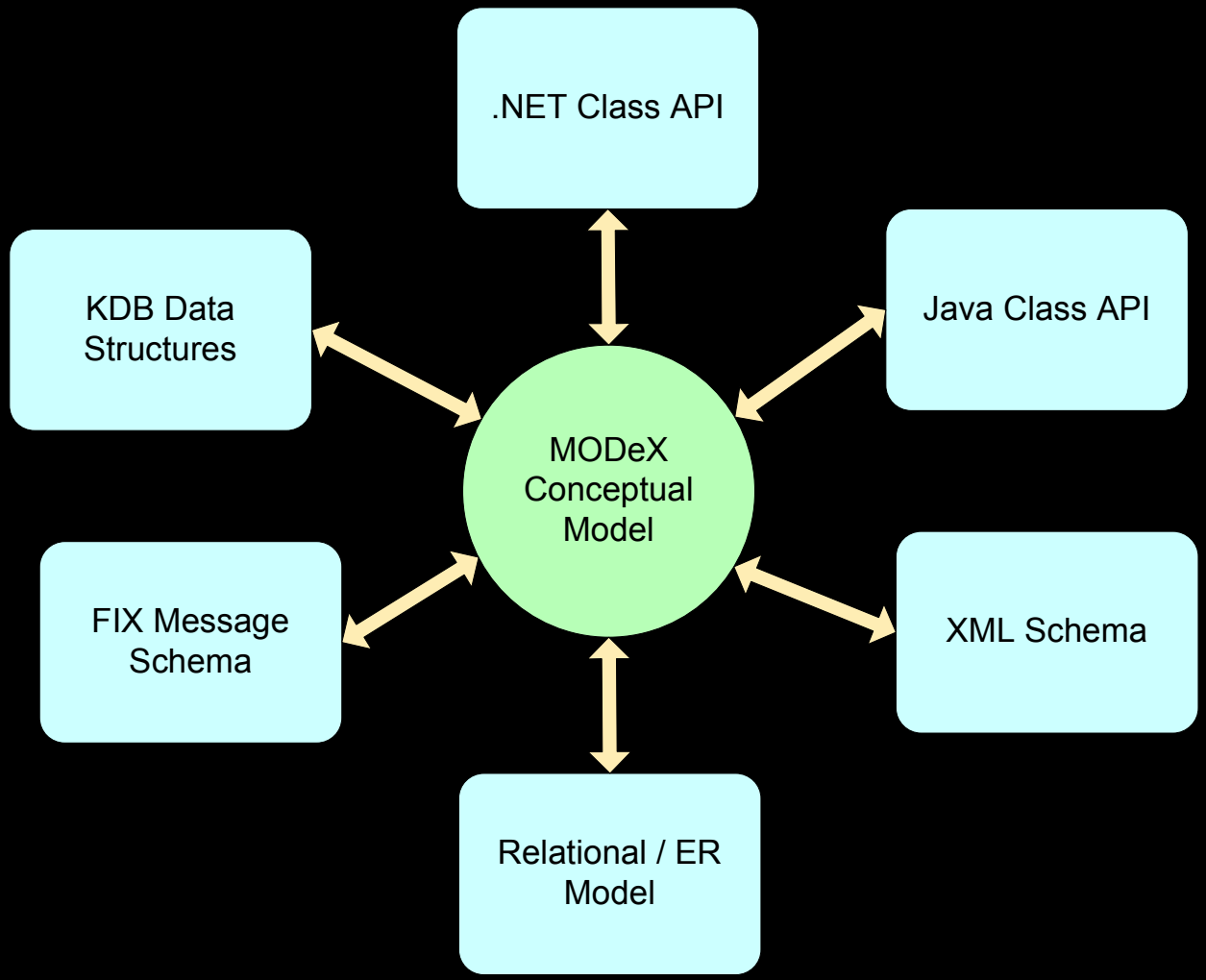
Maplet architecture maps a MODeX model to a technology-specific representation.

Maplet enables code gen or runtime transformation between model instances.

Captures syntactic and topological transformations.

Allows N-way transformations and runtime validation.

Import and Synchronization capabilities for design-time management.



Applications in Financial Services

Enterprise Data

- Shared, authoritative data definitions
- Centralized services
- Client-side API for enterprise data consuming applications.

Sales and Trading

- Common trade lifecycle model
- Data integrity controls with business transparency
- Seamless cross-platform interop

Investment Banking

- Improved business/IT collaboration, transparency
- SOA governance, consistent standards.
- Significantly improved reuse, developer productivity, time to market

Experience with Eclipse Technology

- Extremely bright, engaged community
- Highly evolved technology
- Center of activity and thought leadership for model-driven software development
- Significant learning curve to technology
- High investment, high payoff

Recap: How MODeX Addresses Enterprise Messaging Challenges

- Elevates the model to a first-class form of source code.
- Partitions enterprise information into domains of manageable scope, with clear ownership and managed lifecycle.
- Reduces integration barriers by defining message payloads in terms of a consistent information model.
- Provides an expressive, graphical language for message protocol definition.
- Provides multiple views of information depending on lifecycle and messaging context.
- Enables orderly model evolution with entity-level versioning.
- Preserves object topology, including shared references and cycles.
- Uses schema validation where appropriate, but allows for rich, rules-based validation where required.
- Hides the wire format from developers, providing a path to more efficient wire representations.
- Reduces impedance mismatch between messages and objects.

Q&A

Appendix: Positioning Relative to Other Technologies

JAXB

SOA

CASE

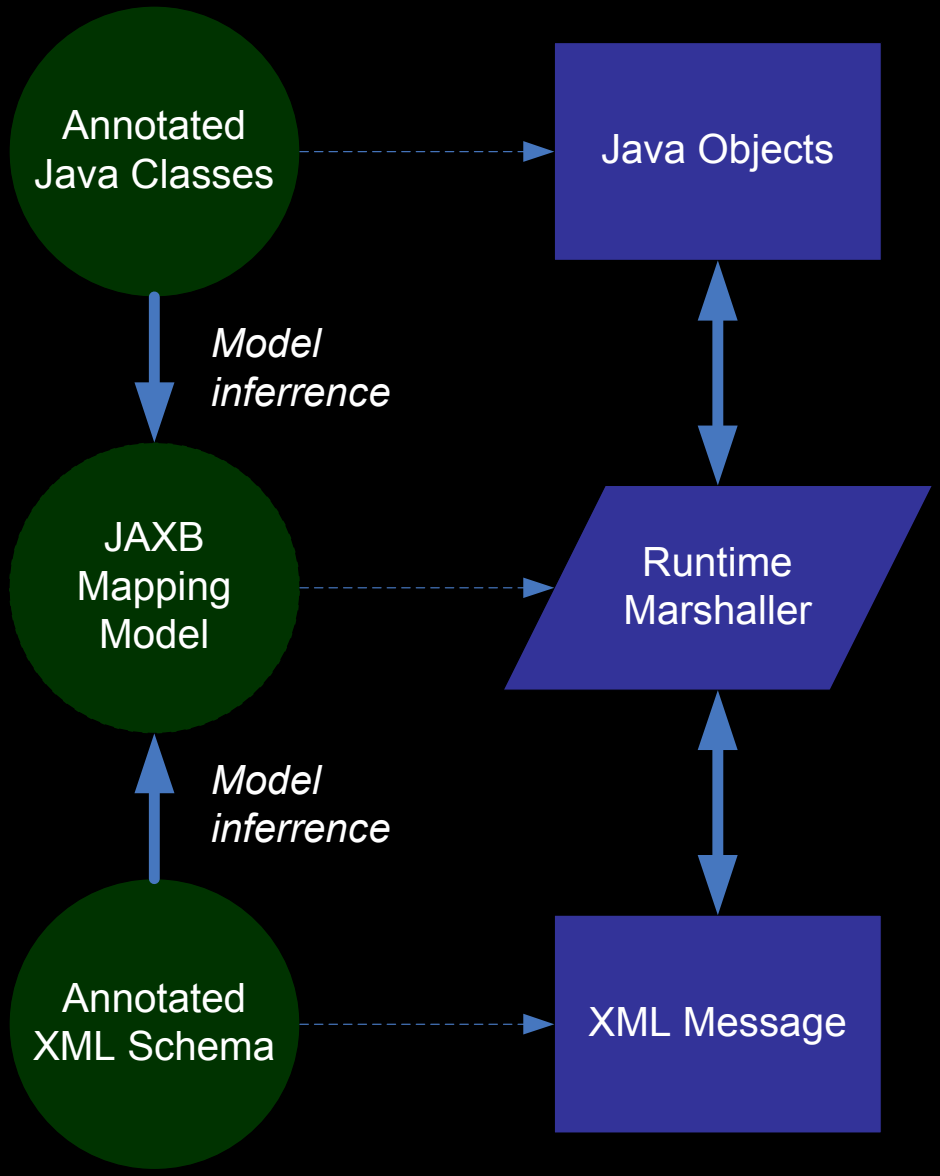
MODeX and JAXB

Limited to a single language.

Model is inferred from code, all other manifestations suffer.

Generic model inference does not encourage standard implementation.

Enforces one-to-one mapping of Java class to XSD type.



MODeX and JAXB

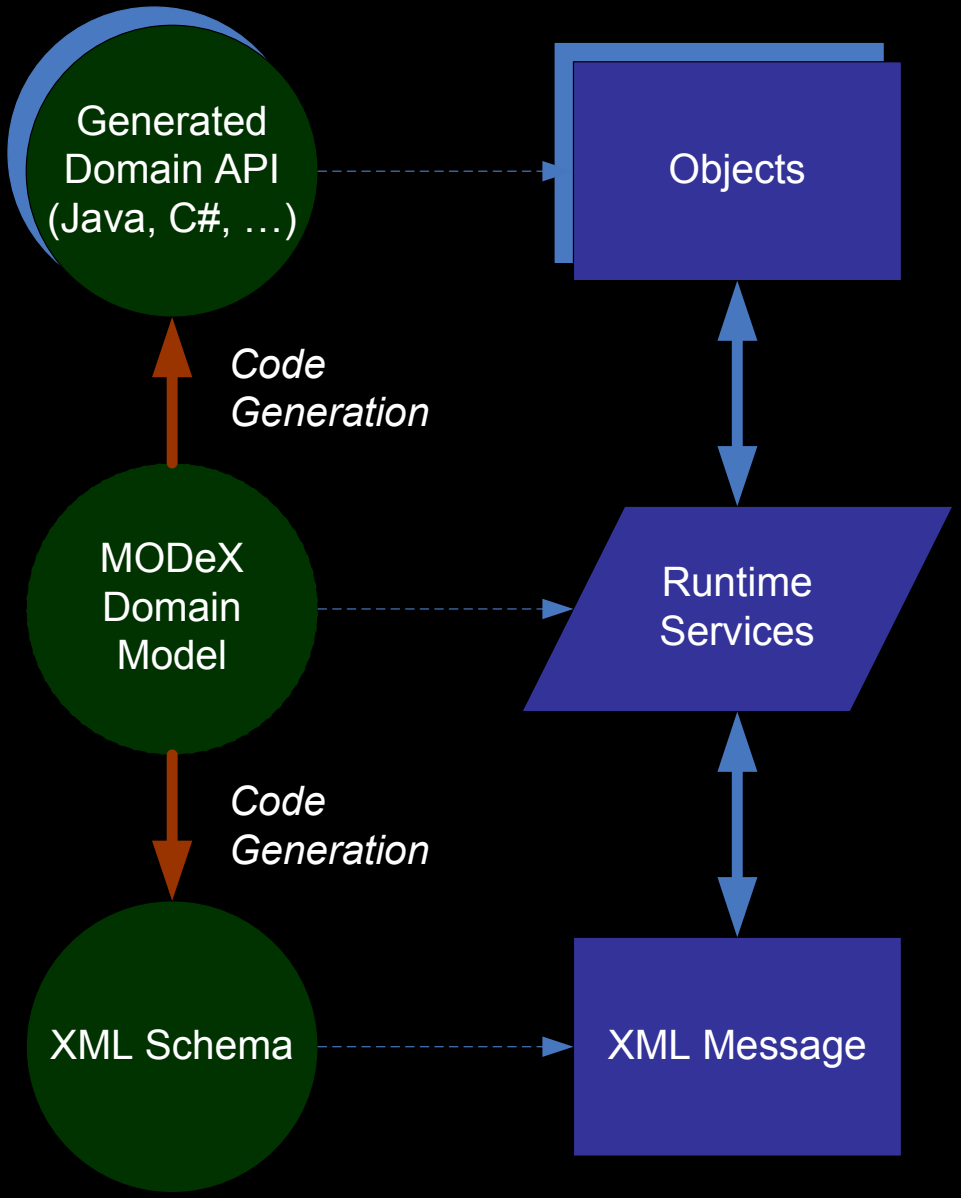
Putting the model at the center gives the power of abstraction.

Code generation guarantees standardized implementations.

Model captures rich semantics encompassing all target languages.

Allows mapping a single class to multiple XSD types.

Supports multiple languages.



MODeX and Service Oriented Architecture (SOA)

- SOA promotes reuse and transparency.
  - Services are composable building blocks for applications.
  - BPEL, SCXML & other orchestration languages build on this.
  - Service catalog forms a business-oriented vocabulary of available functionality.
  - SOA organizes the *verbs*.
- Problem: what about the *nouns*?
  - XML Schema fails as a modeling language.
  - Databases tend to be specialized, don't translate directly to services.
  - Object models are application-specific.
  - Result: Impedance mismatch at the boundaries, very little reuse
- MODeX provides the missing plank in the SOA platform.
  - Helps you organize around a shared set of entity definitions.
  - Expresses message contracts in terms of these entity definitions.
  - Schema and programmatic models are tied directly to the data definitions.
  - Frees SOA from dependencies on today's XML, WSDL and WS-* base technologies.

Model-Driven Development and CASE

"Isn't this the same promise that CASE tools were making in the 1980's and '90's? If it didn't succeed then, why do we think we can make it work now?"

CASE	Model-Driven Development
Focus on round-trip engineering	Focus on meaningful abstraction
General-purpose modeling	Domain-specific modeling languages
Monolithic design	Rich graphical modeling and IDE integration
Primitive, inflexible code generation	Sophisticated model-to-model and model-to-code transformation pipeline
Limited cross-platform design	Broad applicability to distributed software architecture