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IDE for MDA
Based on Executable Enterprise Modeling
with
UML/CWM

Presented to:

OMG's Third Workshop on UML for Enterprise Applications:

Model Driven Solutions for the Enterprise

October 22, 2002

By:

Michael Latta

Yngvar D. Tronstad

Agenda

- Overview
  - EAI Market Trend
  - The Challenges
  - The Next Generation EAI suites
- Executable Model Overview
  - ODM → AIM
  - AIM (Process)
  - AIM (Process + Data)
  - AIM (Execution)
- Summary, Future Direction, Q&A

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Mission Statement

To simplify the design and management of diverse artifacts of EAI by creating a single *extensible* tool where the artifacts can all be *modeled* and then *generated* from the model *and* *automatically deployed* into a *scalable execution environment*, based on OMG's MDA concept

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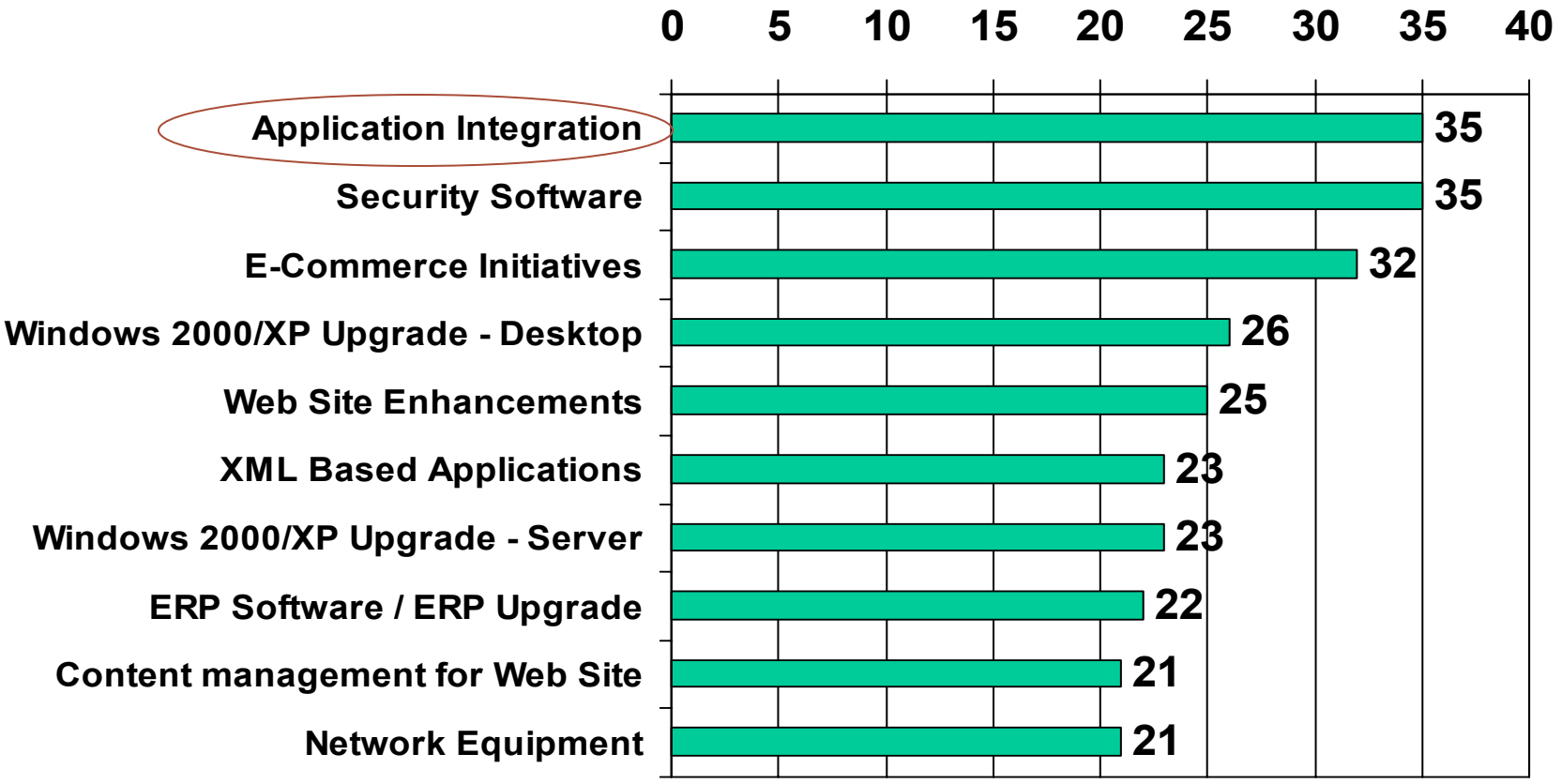
Top 10 IT Spending Areas for 2002



Source: Morgan Stanley CIO Survey, 2002

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Integration Framework

- **Most integration projects are using hand-coded point-to-point approaches instead of using an integration framework**
- **Handcoded integration is deceptive, it seems easier and cheaper to implement then integration framework, but it ends up being far more expensive and aggravating to maintain**
- **Companies that use integration frameworks spend less on maintenance and more on projects that add value**

Integration Framework Bottom Line

- 11% less on
  - ✓Maintenance
  - ✓Services
  - ✓Headcounts

Source: AMR Research, October 2001, Survey of 686 companies over 14 key vertical markets

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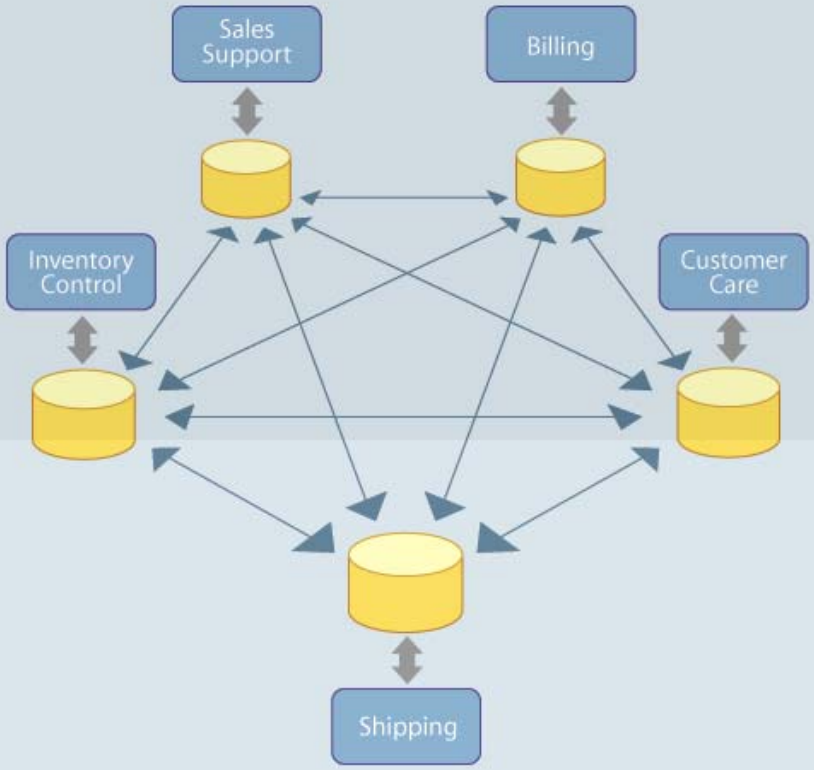
Point-to-Point Integration

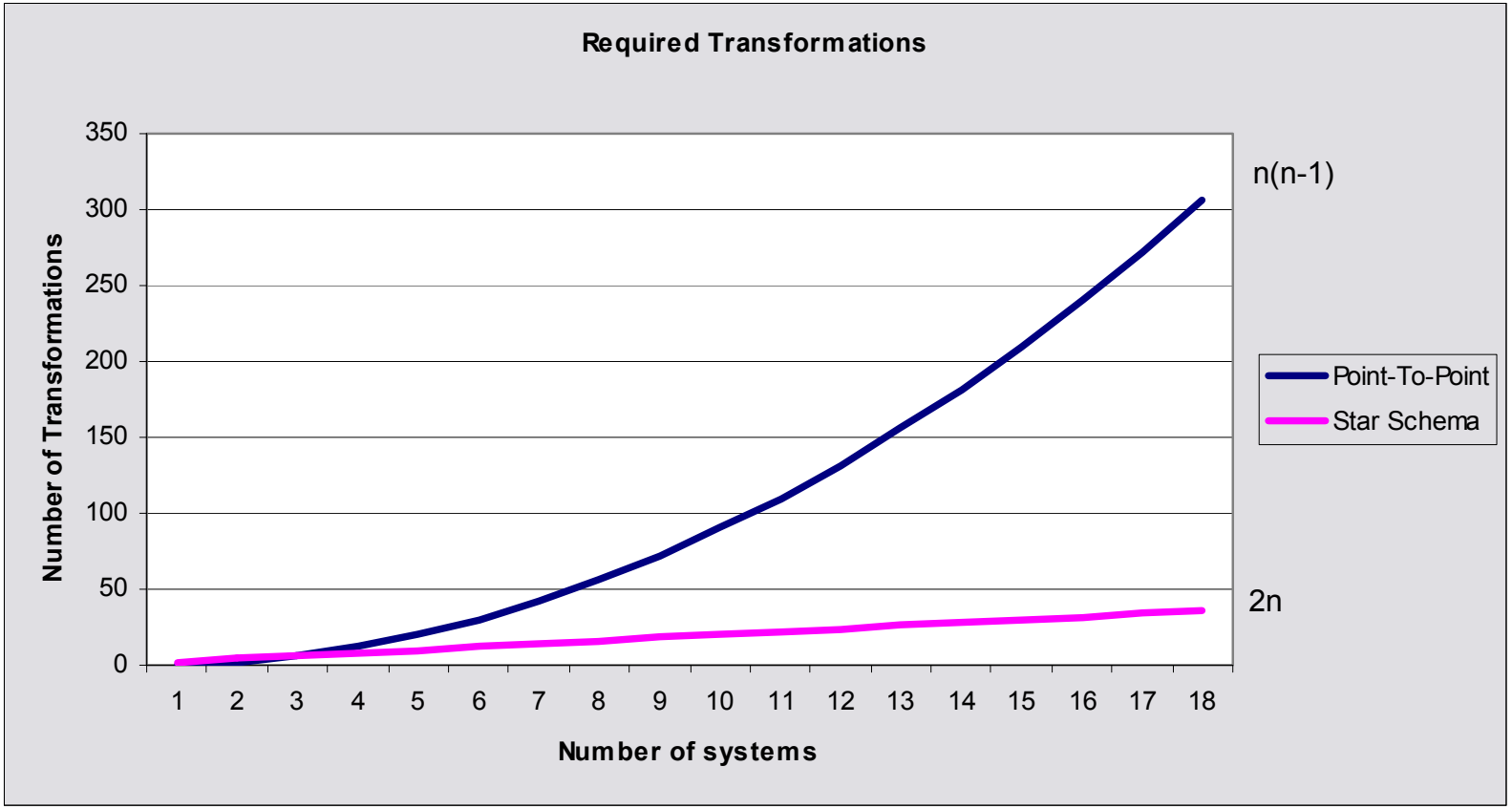


In the past, complex point-to-point integrations were used to construct an end-to-end business process.

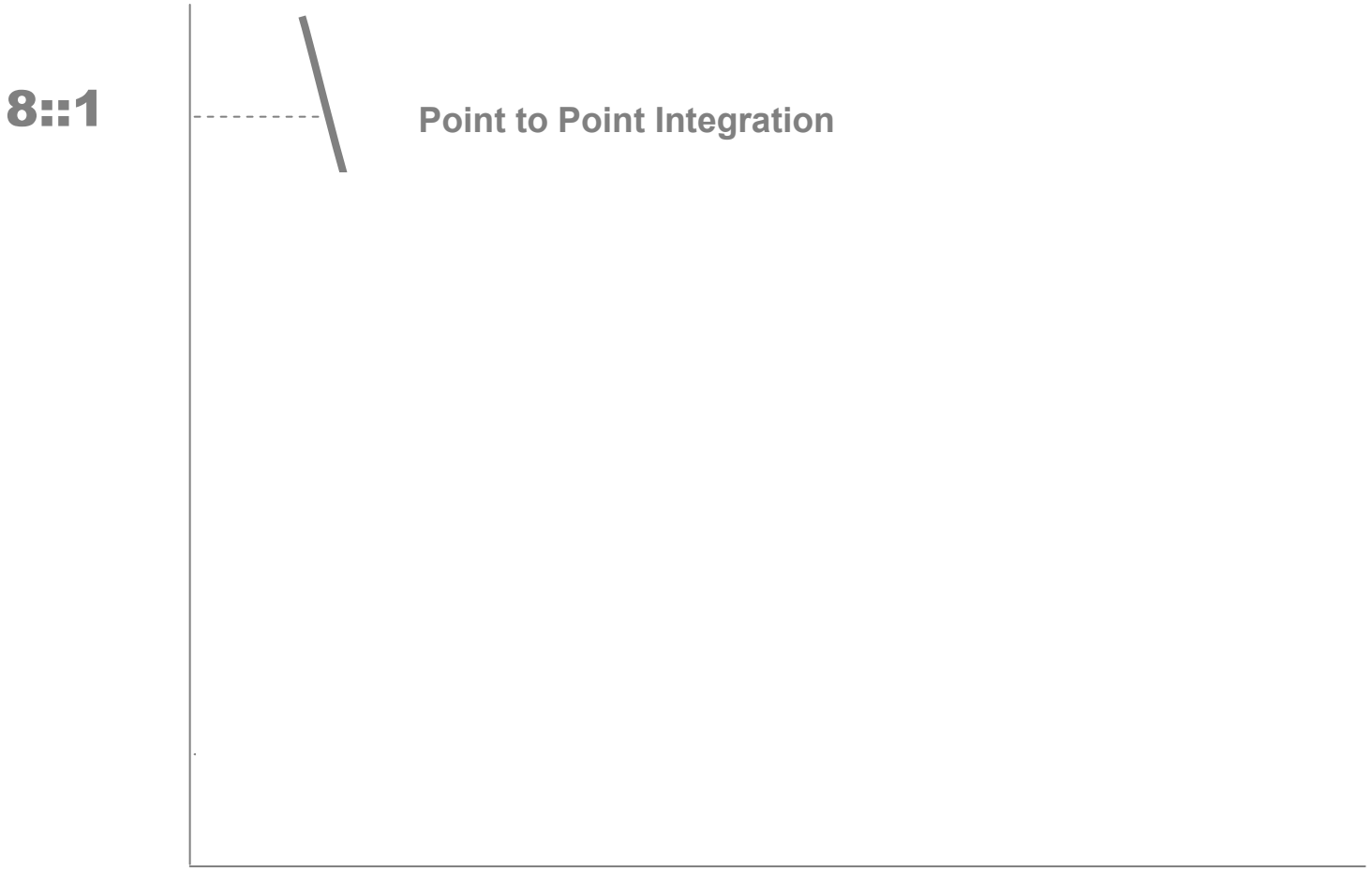
The disadvantages:

- Interface Complexity
- Inability to quickly modify processes following initial implementation
- Expensive to maintain and extend

Large Scale Integration Problem



Implementation Costs vs License Costs



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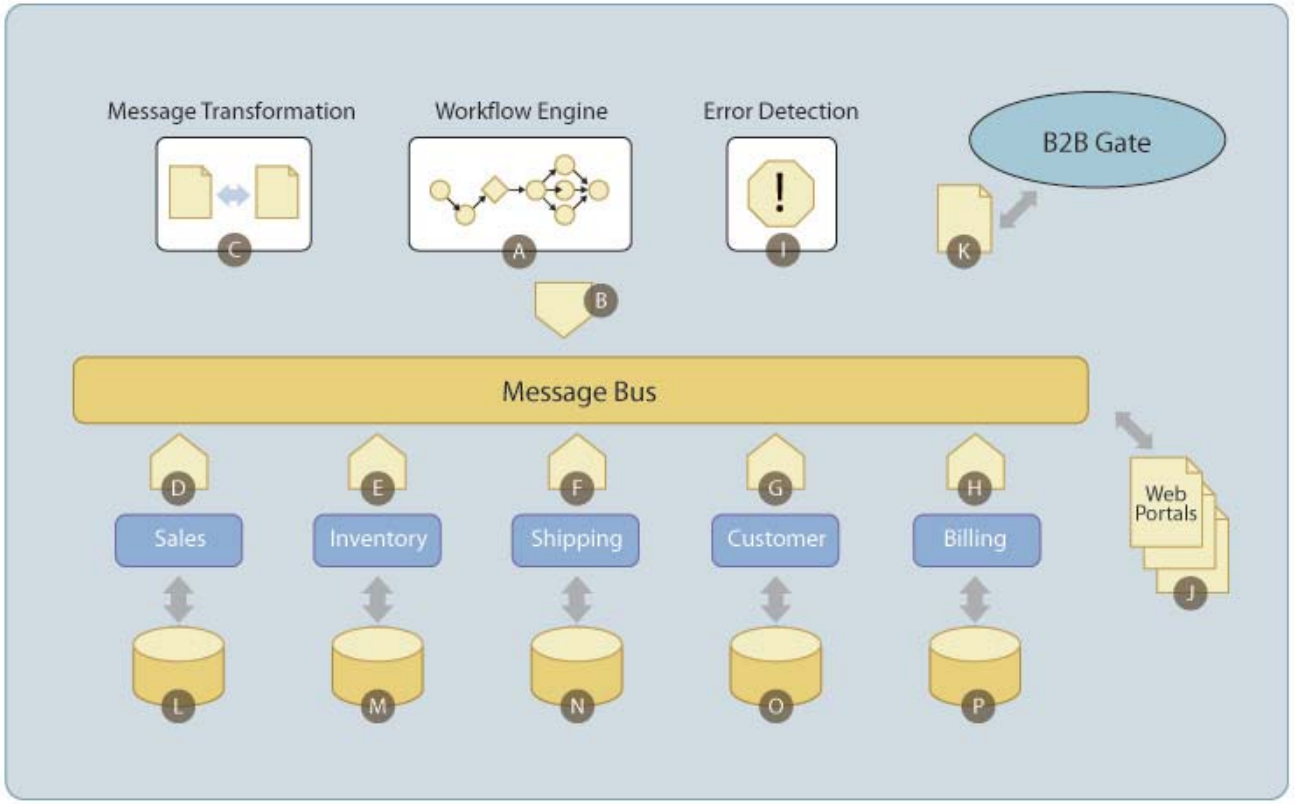
State of the Art integration environment, using middleware solutions

Configured piece by piece, organizations must carefully coordinate all of the implementation artifacts to build the final end-to-end solution.



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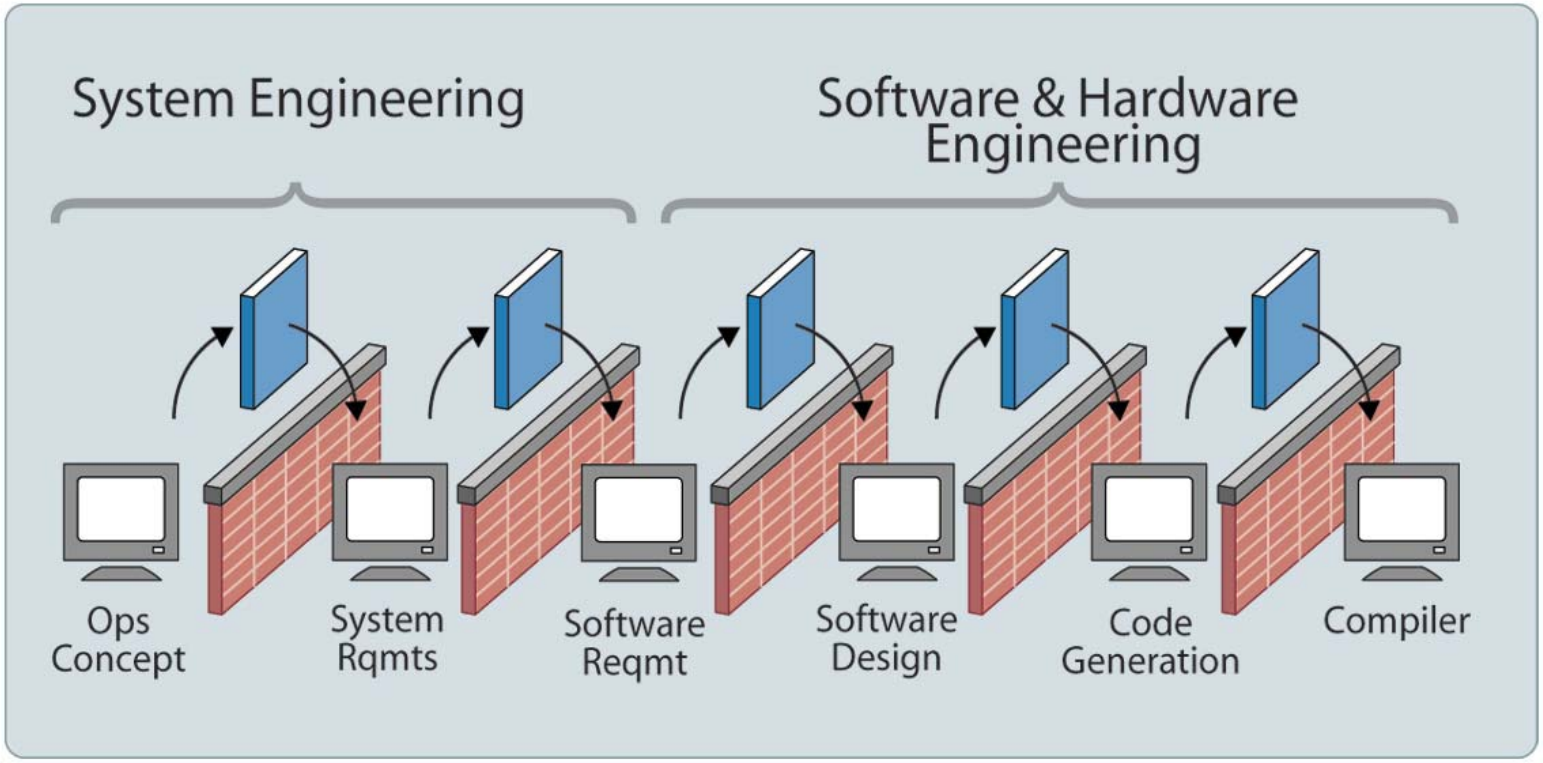
Typical Conceptual walls separate the Life Cycle Steps



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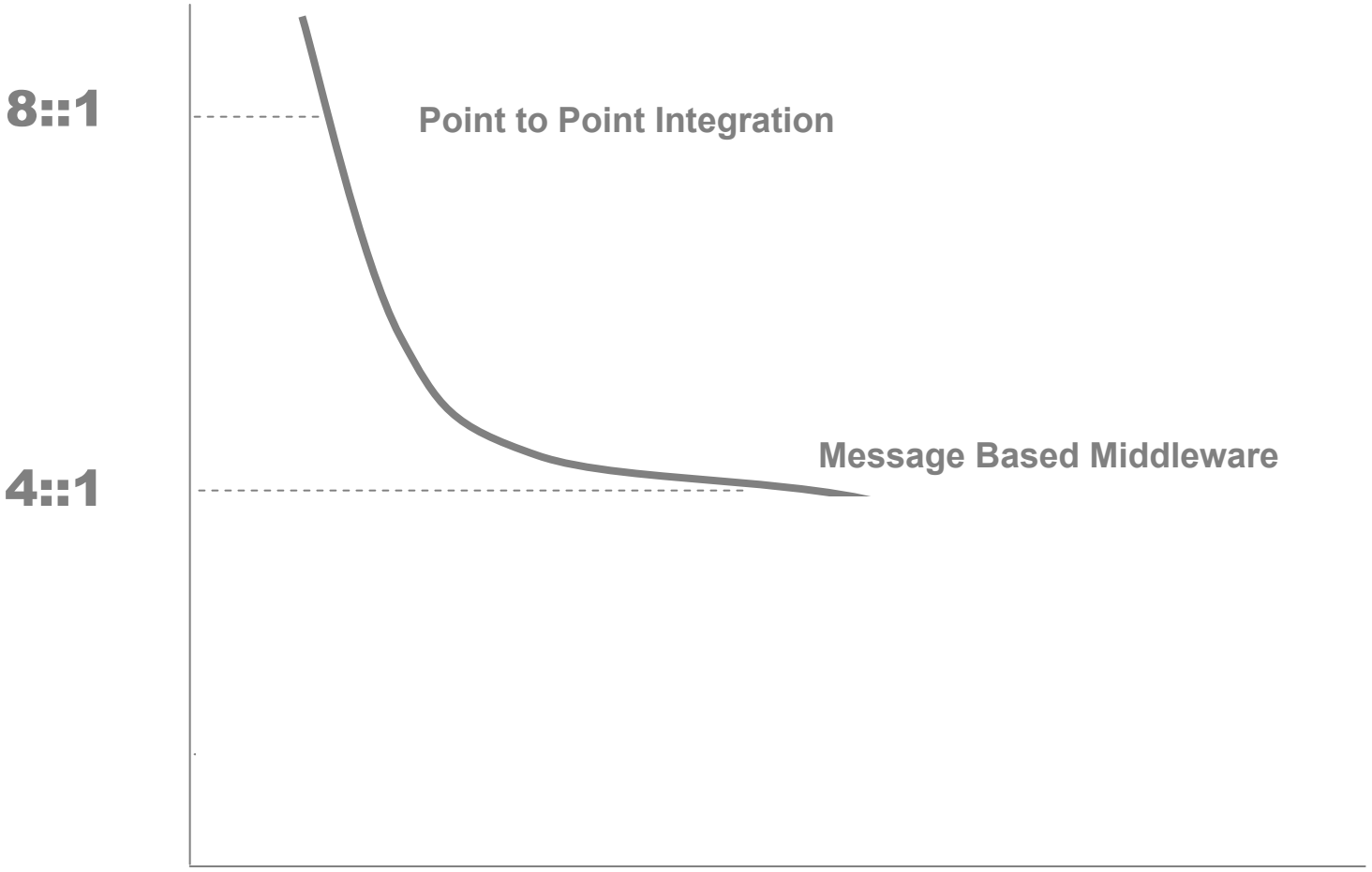

Value Added by MDA Tool

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- **EAI complexity can be addressed by ingenious tools**
  - **Holistic toolset for end-to-end visibility**
  - **Top-down abstraction and decomposition that through succesive refinements maintains the business logic as an invariant from high level design to implementation**
  - **Auto-deploy to multiple execution platforms**

Ceira's Two Part Architecture

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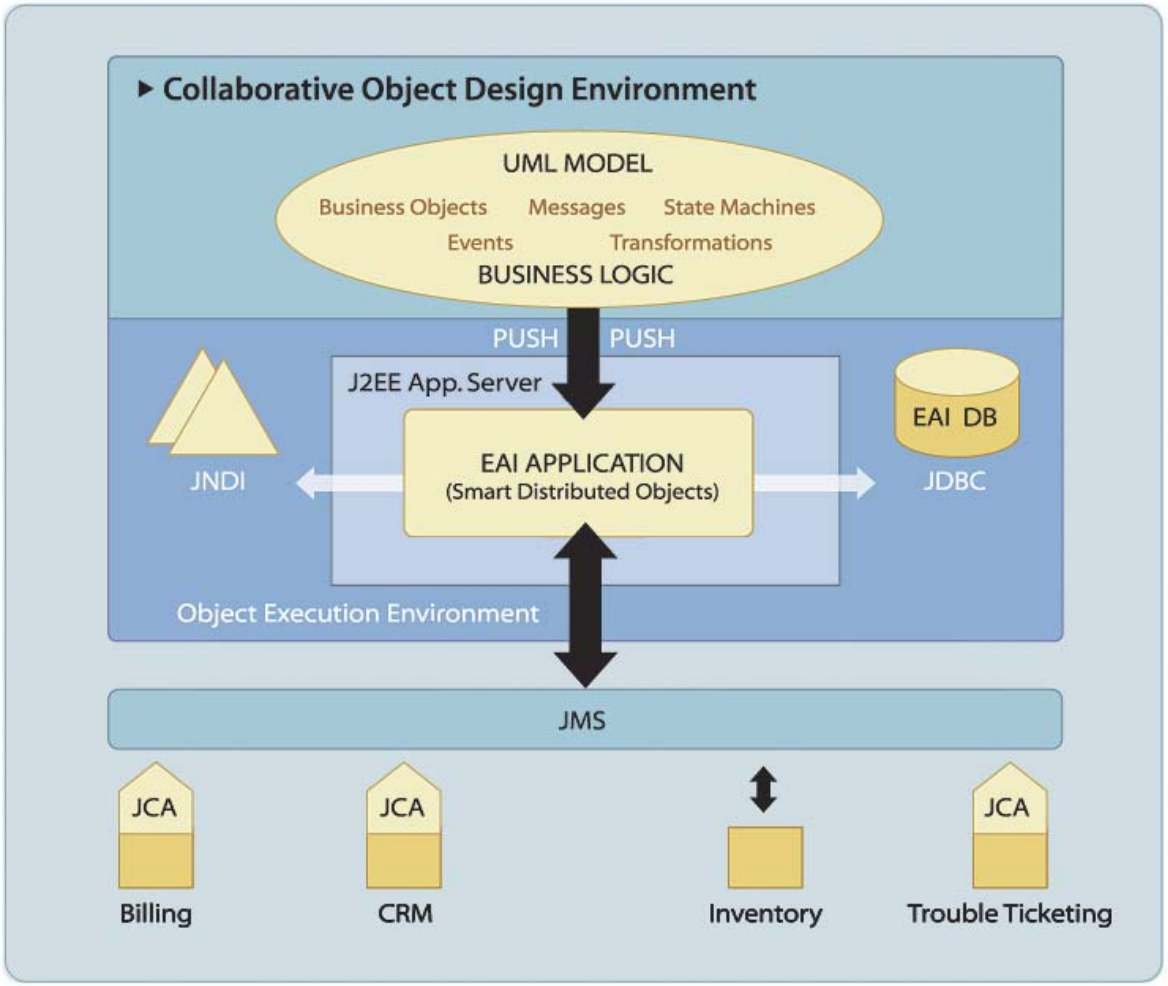
Part 1: Authoring

Part 2: Execution

Third Party Messaging and Applications



Value Added by MDA

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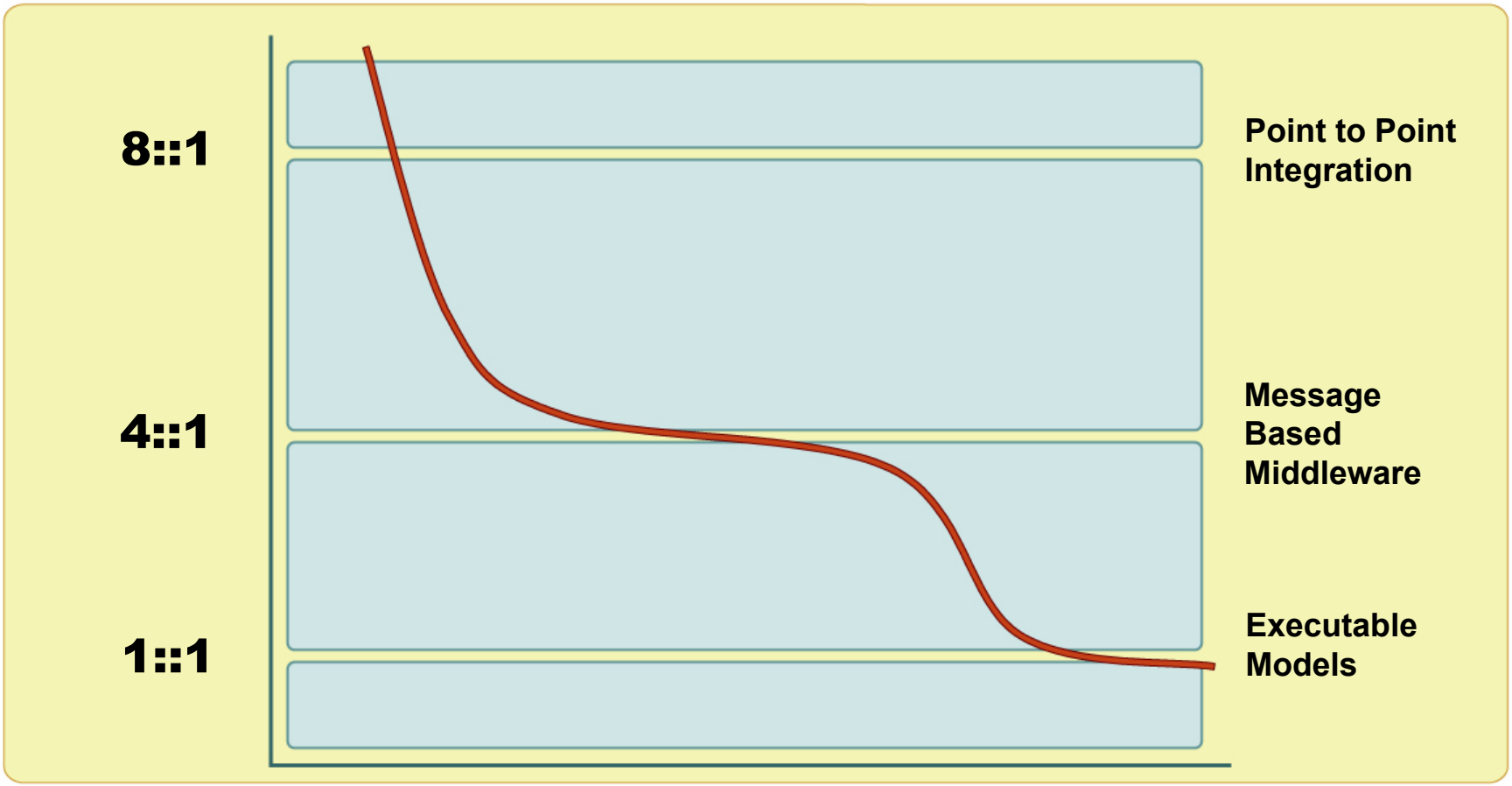
- **Divorce the details of the physical implementation from the logical view of the system, while ensuring completeness**
  - **Future Proof: Implementation mechanism can be modified without affecting the logical model**
- **Build-in layers of indirection (isolation layers) to reduce the impact of changes to any one detail**
- **Create a mechanism for communicating the EAI strategy in the form of the EAI model that is executable, ensuring that the model and the implementation do not drift apart**

Implementation Costs vs License Costs

Solution that compress Design and Implementation Timeframes



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  - The Next Generation EAI suites
- **Executable Model Overview**
  - **Extensible Framework**
  - **ODM → AIM**
  - **AIM (Process)**
  - **AIM (Process + Data)**
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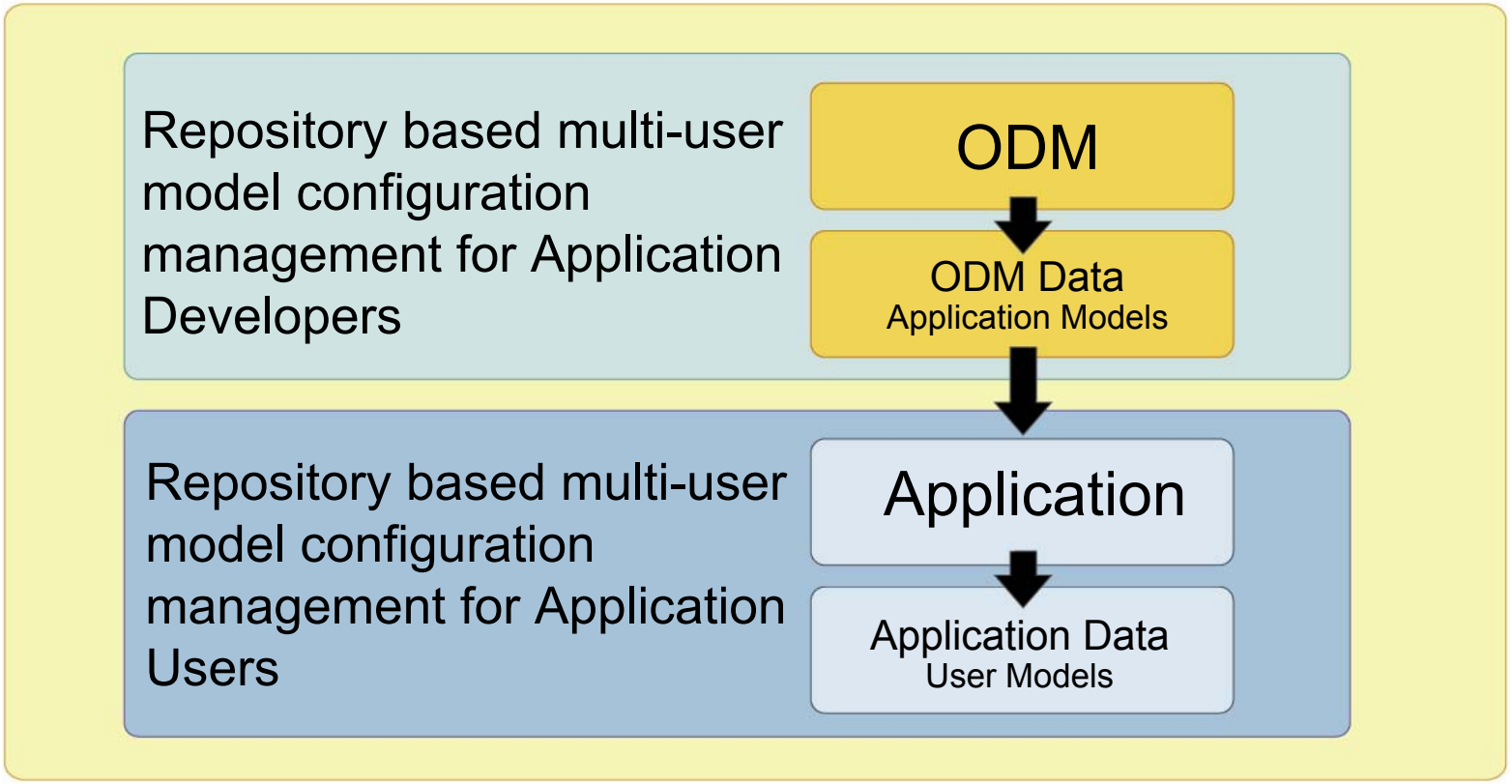
Executable Model Overview-ODM



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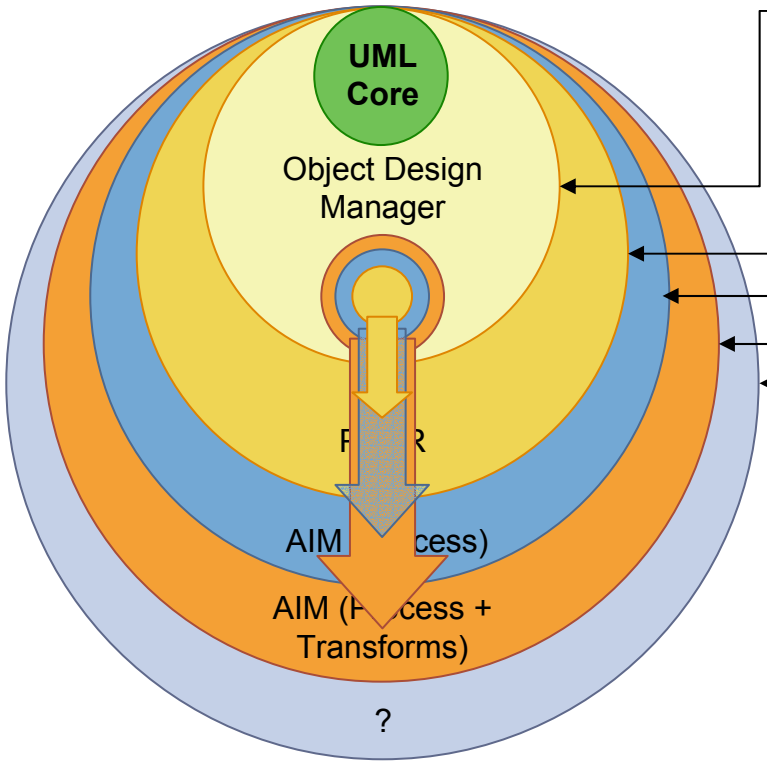
Executable Model Overview-Application Development

- Object Oriented UML based modeling environment
- Each application is modeled
  - The application model defines the application boundaries and artifacts
  - An application can be extended by modifying the application model and specifying the new behavior

Extensible Application Authoring Environment



Object Design Manager
This is an application that is used to create Application Models for app development

PEAR
This is used to model data structures which get pushed into a repository as UML Schema

AIM (Process)
This is the Application that allows the merging of MIM data models with behavior models (SM)

AIM (Process + Transforms)
This allows the modeling of DIMs with the MIM, with CWM based data transformations

?
Applications can be easily extended to tailor them to new tasks

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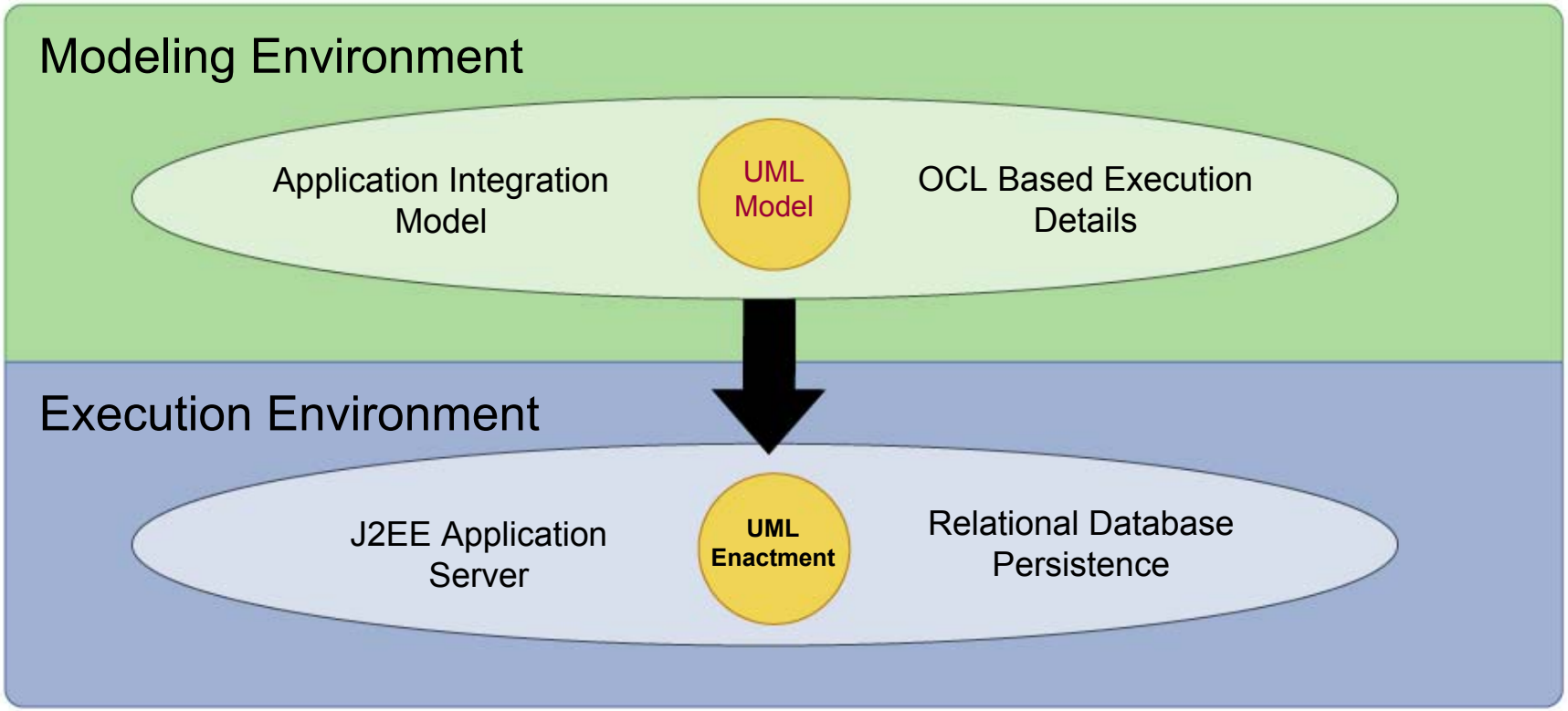
Overview



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The AIM tool is a multi-user, repository based, configuration managed EAI Integrated Development Environment

- Fulfills the modeling aspect of OMG's Model Driven Architecture (MDA)
- Star-schema modeling
- OMG UML (1.4) based object modeling (classes, associations)
- Process modeling using UML State Machines
- OCL for low level logic and execution
- OMG's Common Warehouse Metamodel (CWM 1.0 is based on MOF 1.3) based reusable transformation modeling
- Message and Event modeling
- Implementation of OMG's Object Constraint Language for specifying low level execution details as required by the MDA.

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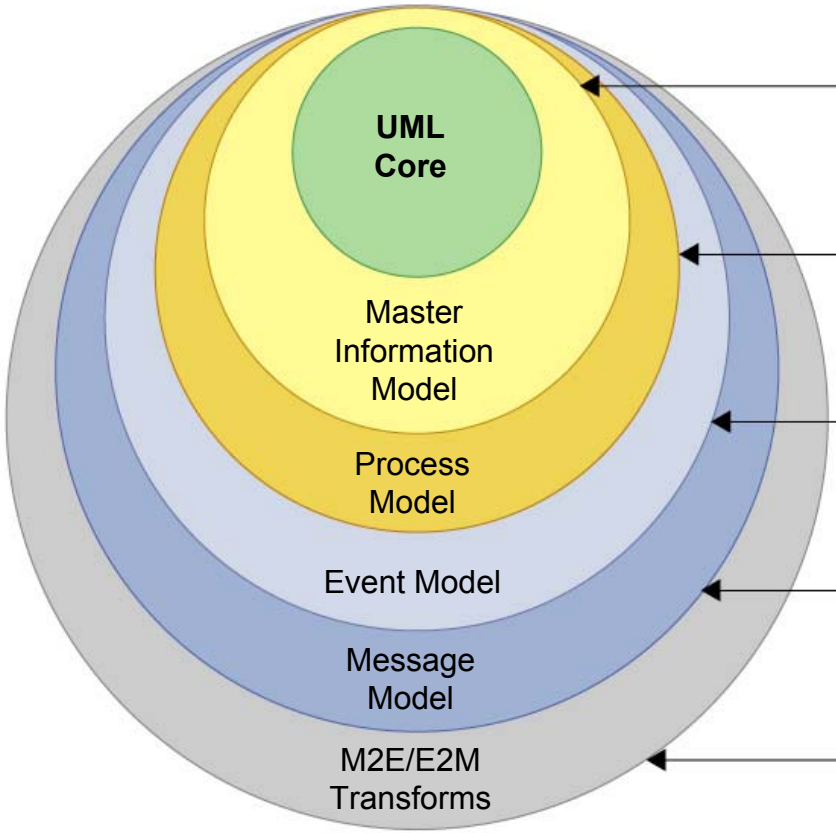
Modeling Aspects



Master Information Model
This is an abstract model of the entities that make up the enterprise

Process Model
The behavior of the entities as they participate in different business activities

Event Model
The external events that will trigger state transitions in the State Machine

Message Model
The messages that the system must send to other systems requesting actions

M2E/E2M Transforms
Transformation model that interprets messages received and events generated

Application User Level Reuse: Data Transformation Models

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- **The AIM (Process + Data) application allows the user to model the business processes that an enterprise entity participates in as well as the information models of the applications to be integrated and transformations between them**

- **Eliminates point-to-point transformations by extending the star-schema concept to the EAI domain (the Master Information Model or MIM concept)**
  - **Exponential** reduction in transformation artifacts through **reuse**
    - 2n vs. n(n – 1)

- **Allows for an extensible and holistic environment in which to model the entire EAI scope in a single tool**

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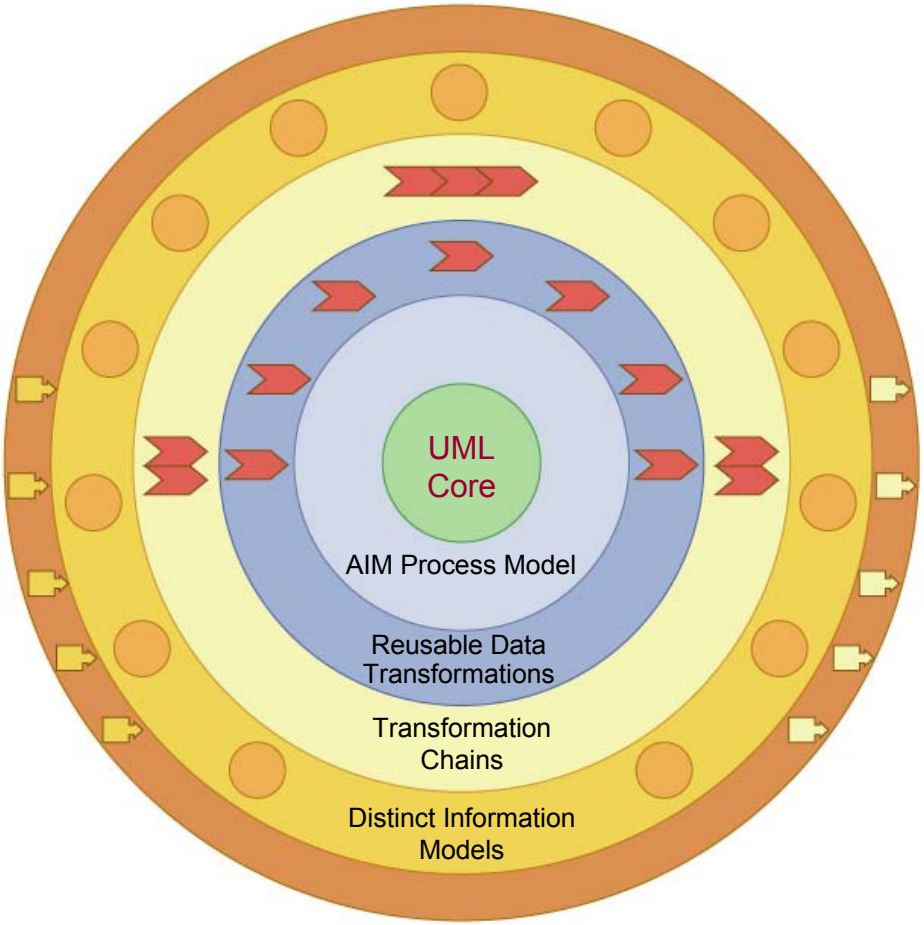
Modeling Aspects



Process Model
This is an abstract model of the entities that make up the enterprise and their behavior (MIM)

Reusable Transformations
Models transformation components that convert between information models

Transformation Chains
Models reusable transformation units that can be connected to the message triggers

Distinct Information Model
Models of the relevant schema of the remote systems that need to be integrated

M2D/D2M Transforms
Transformation models that converts messages to and from system specific definitions

AIM (Process + Data): Star Schema

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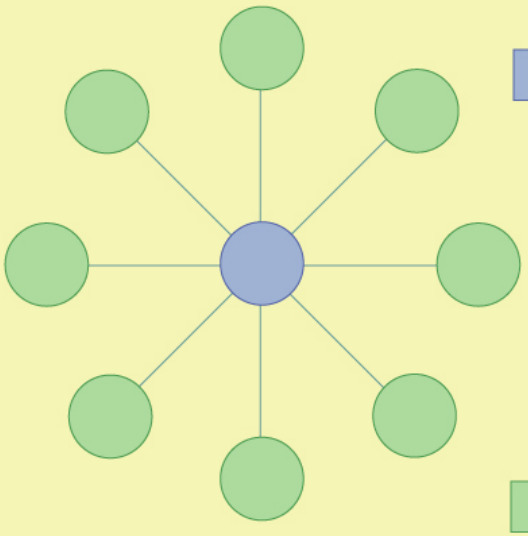
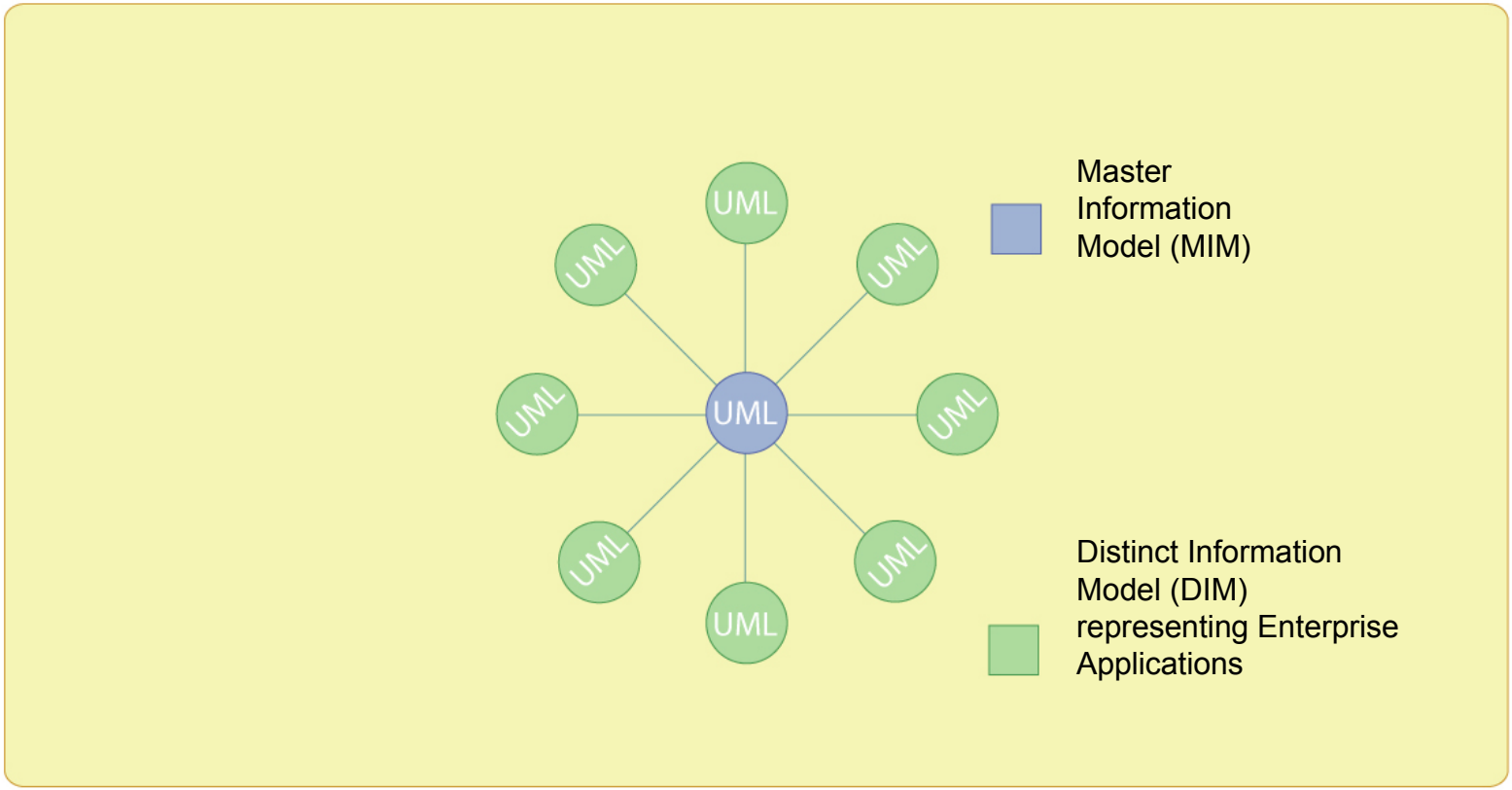
AIM uses the Star Schema pattern, extended for the EAI Domain



Master Information Model (MIM)

Distinct Information Model (DIM) representing Enterprise Applications

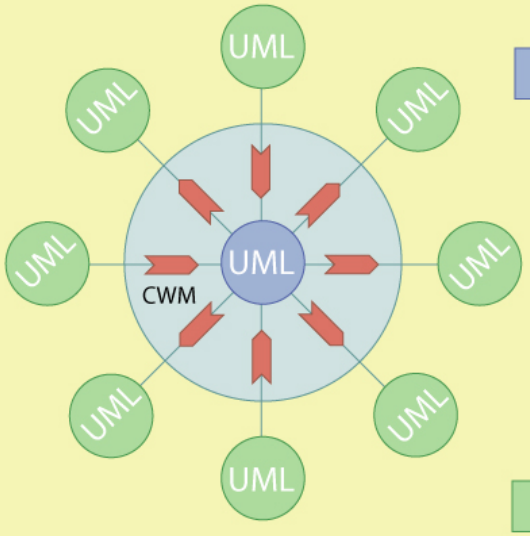
Each Information Model is created using UML Modeling Techniques



AIM: Reusable CWM Based Transforms

The Model contains a reusable library of CWM based transformations

Reusable CWM Based Transforms



Master Information Model (MIM)

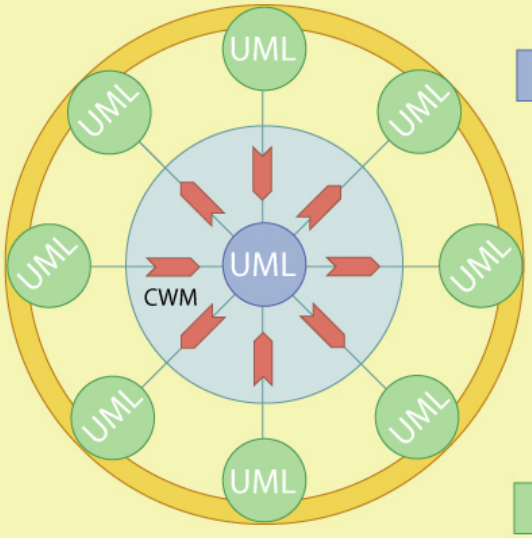
Distinct Information Model (DIM) representing Enterprise Applications

AIM: JMS Based Messaging Layer

The Model contains a JMS messaging layer that is active on deployment

Reusable CWM Based Transforms

JMS Based Messaging Layer for triggering transformations and state machines and sending notifications



Master Information Model (MIM)

Distinct Information Model (DIM) representing Enterprise Applications

AIM: Transformation Chains

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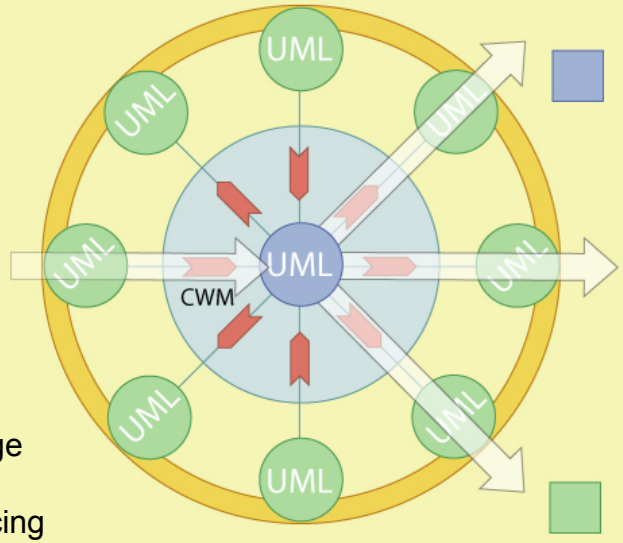
The Model contains Transform Chains attached to the message layer or states for sequencing transformations

Reusable CWM Based Transforms

JMS Based Messaging Layer for triggering transformations and state machines and sending notifications

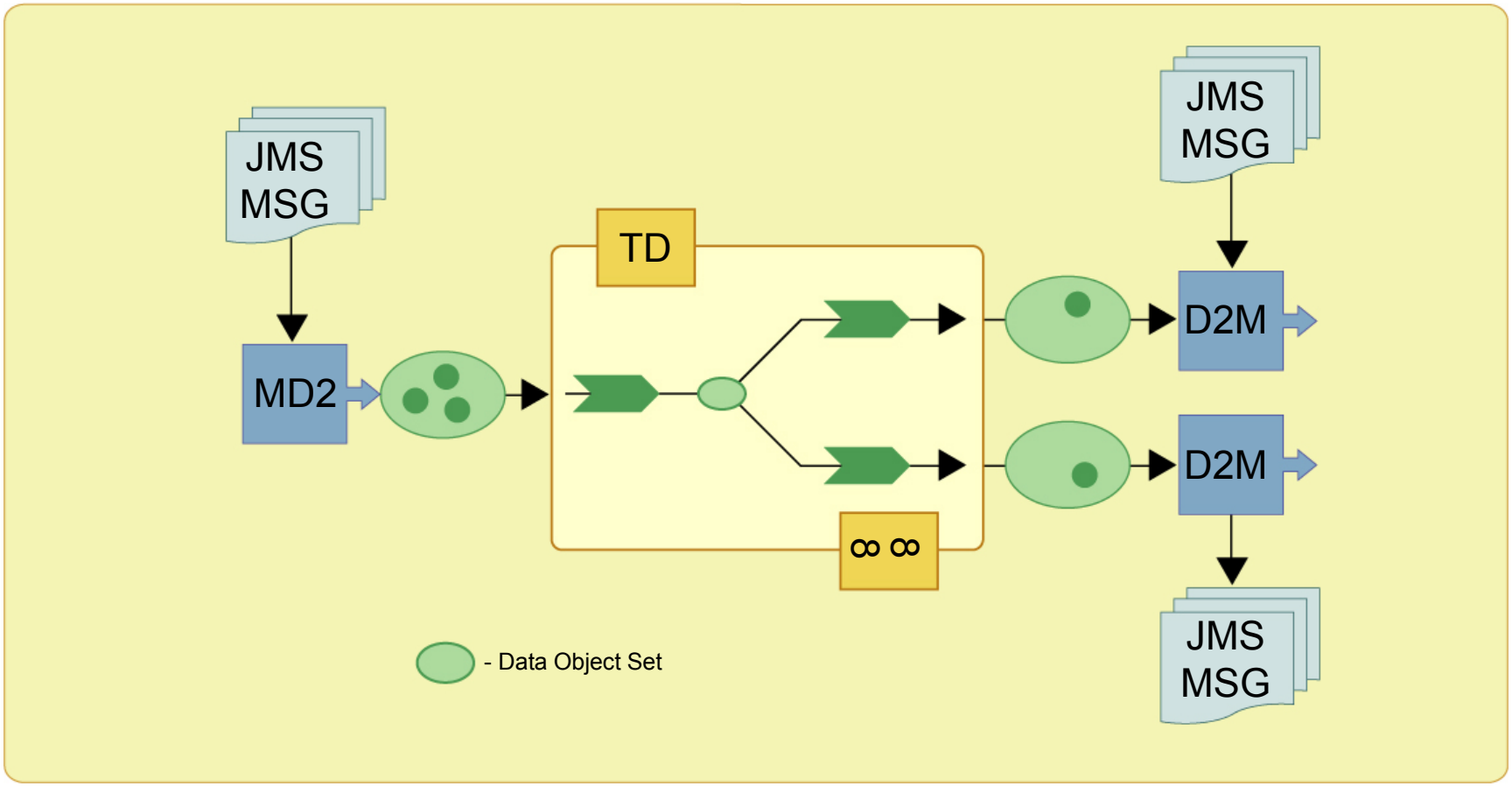
Transform Chains Attached to the Message Layer or states for transformation sequencing



Master Information Model (MIM)

Distinct Information Model (DIM) representing Enterprise Applications

Triggering Transformations: Direct Mode



AIM: UML Information Models

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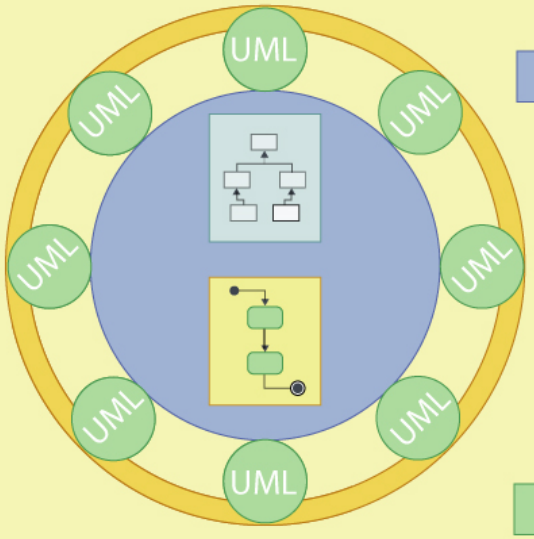
Information Models may contain hierarchical class structures, associations and numerous state machines that define their object behavior

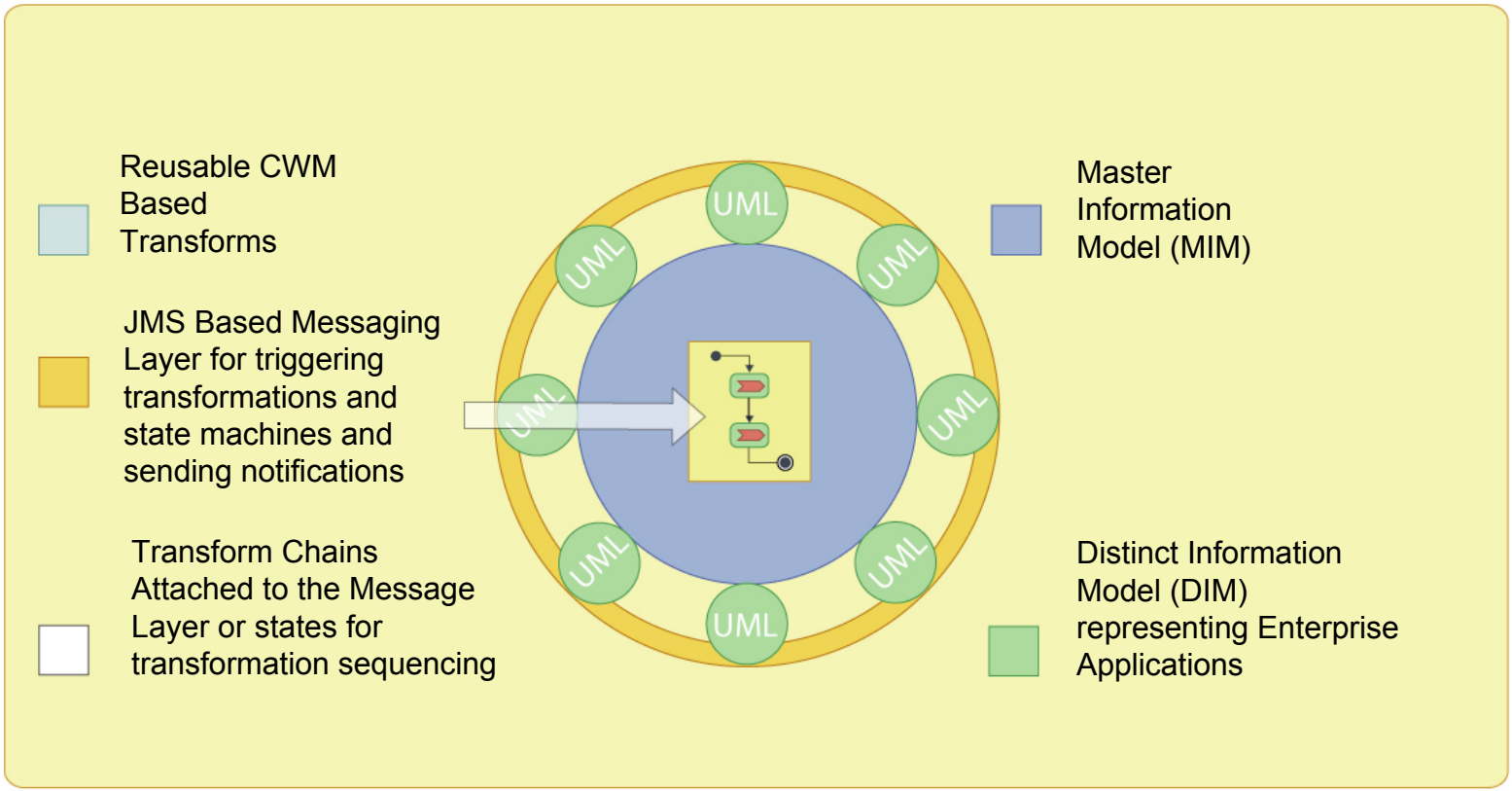


Master Information Model (MIM)

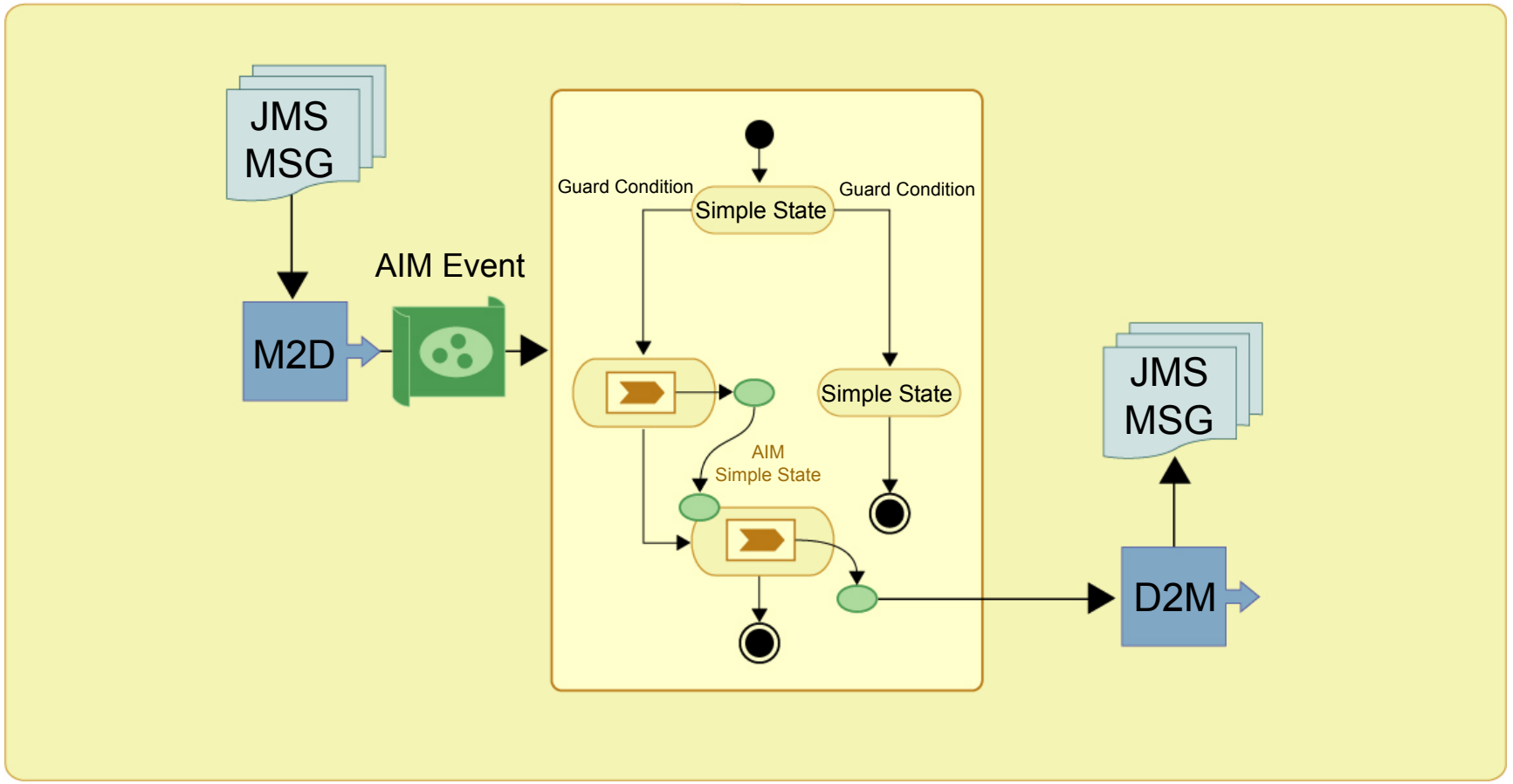
Distinct Information Model (DIM) representing Enterprise Applications

AIM: Embedded Transformations

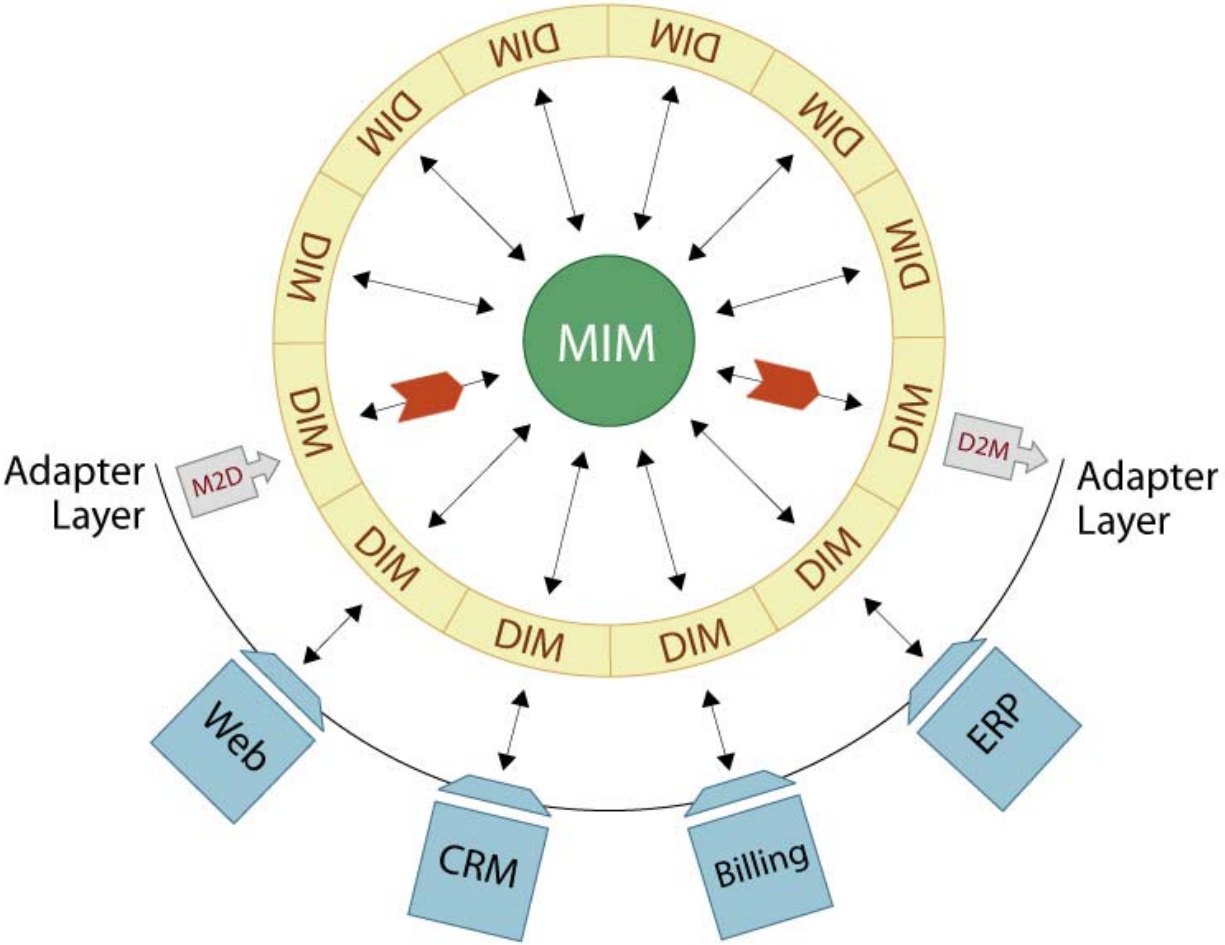
Messages can also trigger behavior embedded in processes to allow finer control over transformation sequencing



Triggering Transformations: Embedded Mode



AIM – Summary



Application User Level Reuse: Data Transformation Models

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- **Data Transformations based on the OMG's Common Warehouse Metamodel (CWM) standard**
  - Even the reduced number of transformation artifacts are built using a standard that promotes reuse
- **Allows for the modeling of reusable feature-level transformations (Feature Maps)**
- **Allows for the modeling of Classifier Maps, which are transformations between DIM classes in the periphery and the MIM classes (hub), in terms of re-usable Feature Maps**
- **Allows for the the modeling of Transformation Maps, which transform arbitrary sets of data types between a DIM and the MIM. Transformation Maps reuse Classifier maps as needed**
- **Allows for the modeling of Transformation Chains , which are comprised of re-usable Transformation Maps (or other chains) in series or parallel (Decomposable re-use)**

Application User Level Reuse: Data Transformation Models

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- **Transformation Chains can be triggered by messages and can also publish messages destined for remote systems**
  - **This allows the modeling of standard system responses to multiple stimuli using reusable components for quick assembly**
  - **The Chain itself is reusable**
    - Reusable as a component in another chain
    - Directly reusable because it can respond to similar messages from different systems with the same behavior (due to the Transport Isolation Layer)
  - **Combines the modeling of data and behavior in the same environment with several layers of indirection providing separation of concern and ensuring that changes are localized to a limited area of influence**
- **Never need to build logic more then once**

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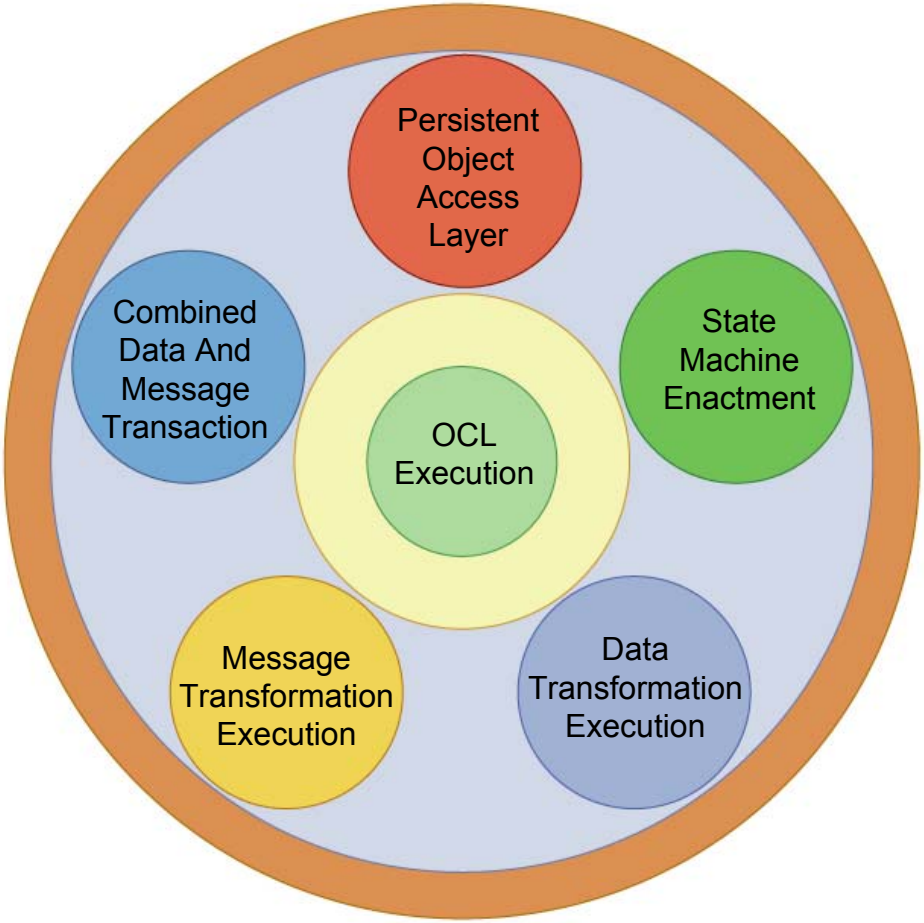
Product Overview



Transactional Integrity
Uses J2EE semantics and transactional Persistence to maintain transactional integrity

Persistent Object Access Layer
Seamlessly performs object persistence activities (Create, Read, Update, Delete) for ERA

State Machine Enactment
Executes the UML State Machine Diagram by evaluating OCL specified state actions

Data Transformations
Executes data Transformation Units by Decomposing into constituents

Message Transformation
This component executes OCL instructions to map data between messages and DIMs

OCL Execution Engine
OCL Executor evaluates all OCL expressions that are used to specify low-level details

JMS MDB Layer
Receives messages from and sends messages to Systems that are being integrated

AIM: Model Execution

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Model Execution is achieved by pushing the model into a scalable execution environment

- Fulfills the execution aspect of OMG's Model Driven Architecture (MDA)
- Information Models are pushed into a relational database as database schema
- All Message Schemas are pushed into the database as execution metadata
- All CWM based transformations described using OCL are compiled and stored in the database
- All State Machines and associated actions are compiled and stored in the database
- All Message transformations are stored in the database
- Specified J2EE Application Server is configured with JMS topics and Message Driven Beans
- Web Service based Admin Console is installed on the Application Server

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Summary

- **A MDA approach that is UML based ALL the Way from high level abstraction to low level details**
  - UML ➔ Business Logic (Classes, Association and StateMachine)
  - CWM/UML➔ Data modeling and transformation
  - UML/OCL➔ Authoring-time definition and Run-Time execution
  - UML ➔ Run-time persistense for Classes, Associations and SM
- **Ensuring continuum from Analysis to Implementation**

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Overview

- Introduce aspects of UML 2.0 (U2P) Enhancements that support Executable Models
- Top to bottom seamless semantics – no gaps as before
- Introducing views that have meaning for execution
  - Sequence Diagrams containing valid execution
  - Use Cases which have defined semantics to lower levels of decomposition
- Uniform treatment of the system as classes and behaviors
- Cleaner layering, which should make it easier to present to users and at the same time provide better visibility and support for executable models

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Use Cases

- Much better defined semantics.
- Less use of English to convey semantics.
- Cleaner decomposition to other model elements.

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Sequence Diagrams

- Defined relationship to execution semantics.
- Constrains set of valid executions.
- Can contain control structures, and other aspects that make them more than just “examples” of execution.
- Each diagram defines 3 categories of sequences: valid, invalid, and out of scope.
- This allows a set of sequence diagrams to cover the space without conflict

Richer Execution Semantics

- Activities add new execution semantics.
- Action Semantics integrated into common behavior framework.
- State Machines still available with some enhancements.
- Components are now explicitly modeled, which should enhance reuse

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Areas for Improvement

- Need the ability to model transaction boundaries and behavior.
  - A central part of most computing that is still missing.
- Need formalisms for failure handling, error recovery, and rework.
- Need to deal with versioning of system models and the relationship to executing systems.
  - Incremental deployment
  - Migration of active executions
  - Concurrent execution of different versions