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Business Rules with MDA

**UML for Enterprise Applications:
Model Driven Solutions for the Enterprise Workshop**

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Overview

- ▶ **MDA and Business Rules Introduction**
- ▶ **Reference Model of Open Distributed Processing**
- ▶ **Business Rules case study**
 - ▶ **CIM models**
 - ▶ **Business terms, facts, and rules**
 - ▶ **PIM models**
 - ▶ **Information invariant, static, and dynamic schemata**
 - ▶ **Computational model**
 - ▶ **PSM models**
 - ▶ **Engineering model**
 - ▶ **Technology model**
- ▶ **Summary**

MDA and Business Rules Introduction

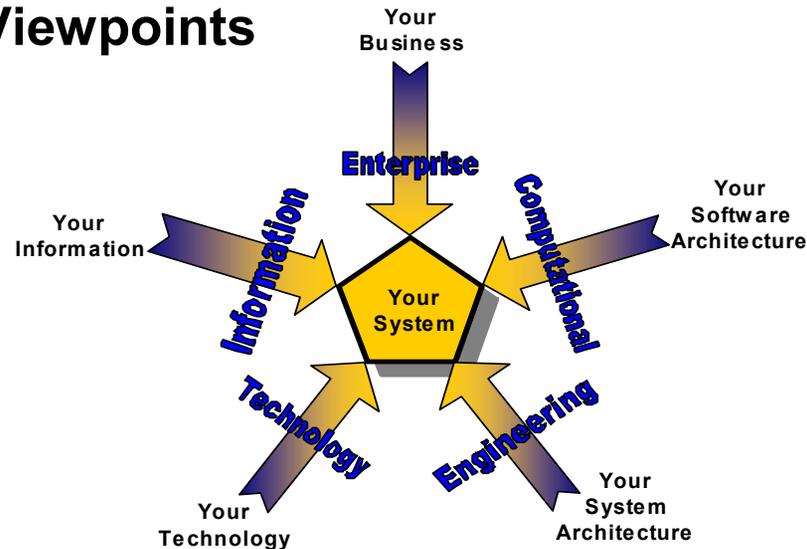
MDA Model Architecture:

CIM	Computation Independent Business Model
PIM	Platform Independent Model
PSM	Platform Specific Model

- ▶ **CIM is the provenance of business rules**
- ▶ **Business rules build on business facts, which are expressed in business terms in a natural language**
- ▶ **Business rules, facts, and terms in CIM have corresponding elements in PIM and PSM, obtained through transformations**
- ▶ **Mapping the correspondences provides traceability of business rules between origin and implementation**

Reference Model of Open Distributed Processing

The 5 RM-ODP Viewpoints



- ▶ Specifies architectural concepts and structuring rules in order to focus on the particular concerns within a system that make up each of the RM-ODP viewpoints.
- ▶ International standard for specification languages.
 - ▶ ISO/IEC 10746 | ITU-T X.900
- ▶ Referenced by MDA and other OMG specifications.

RM-ODP Viewpoints and MDA

<i>RM-ODP</i>	<i>MDA</i>	<i>Audience</i>	<i>Content</i>
Enterprise Viewpoint	CIM	Business Owners, Planners, Managers, Users	Business model. System requirements.
Information Viewpoint	PIM	System Analysts	Information model. Information processing model.
Computational Viewpoint	PIM	Software Architects	Object model. Object interaction model.
Engineering Viewpoint	PIM or PSM	Systems Architects System Administrators	Distribution model.
Technology Viewpoint	PSM	Programmers, Component Vendors	Program code. API's.

Business Terms (CIM) – Consumer Credit Example

- ▶ **loan application** a document containing a request for a loan
- ▶ **applicant** a person who is applying for a loan
- ▶ **credit score** a positive whole number taken as a measure of credit worthiness. The higher the credit score, the greater the credit worthiness.
- ▶ **employment** a person's trade or profession
- ▶ **purpose** the use to which loan proceeds will be put
- ▶ **amount [of a loan application]** the amount of money requested to be loaned
- ▶ **payment plan** a plan for repayment of a loan
- ▶ **rate** an interest rate, in percent per year
- ▶ **reject reason** a reason given for possibly rejecting a loan application

Business Facts (CIM) – Consumer Credit Example

- ▶ A loan application has at least one applicant
- ▶ A loan application has a purpose
- ▶ A loan application has an amount
- ▶ A loan application has a payment plan
- ▶ A loan application may have a credit score
- ▶ A loan application may be in a low income census tract
- ▶ A loan application may have many reject reasons
- ▶ An applicant may have a credit score
- ▶ An applicant may have zero or one current employment
- ▶ An applicant may have zero, one or more previous employments
- ▶ An employment has a monthly salary
- ▶ An employment has a number of months of employment
- ▶ A payment plan has a rate
- ▶ A payment plan has a number of payments
- ▶ A payment plan is identified by a name

Business Rules (CIM) – Consumer Credit Example

- ▶ A credit score must be determined independently for each applicant of a loan application
- ▶ The credit score of a loan application must be the greatest credit score of any applicant of the loan application
- ▶ Assume an applicant has good credit; the credit score of an applicant must initially be set at 25
- ▶ The credit score of an applicant is incremented by an amount determined by the number of months in the current employment, according to the following table:

>= 60 months	+5
24 to 59 months	+3
< 24 months	+1

- ▶ The credit score of an applicant is incremented by an amount determined by the number of months in the previous employment, according to the following table:

>=60 months	+3
< 60 months	+1

Business Rules (CIM) – Consumer Credit Example, cont'd.

- ▶ For loan applications whose purpose is 'Home Loan', the applicant's credit score for a particular payment plan is incremented by an amount based on the applicant's payment-to-income ratio, according to the following table:

<i>payment ratio</i>	<i>increment</i>	<i>reject reason</i>
$\leq .10$	+5	
$> .10$ and $< .21$	+4	
$\geq .21$ and $< .28$	+3	
$\geq .28$	+0	Debt service is too high.

- ▶ For loan applications whose purpose is 'Home Loan', the applicant's credit score for a particular payment plan is incremented by an amount based on the total debt service ratio, plus an additional increment if the application is in a low income census tract, according to the following table:

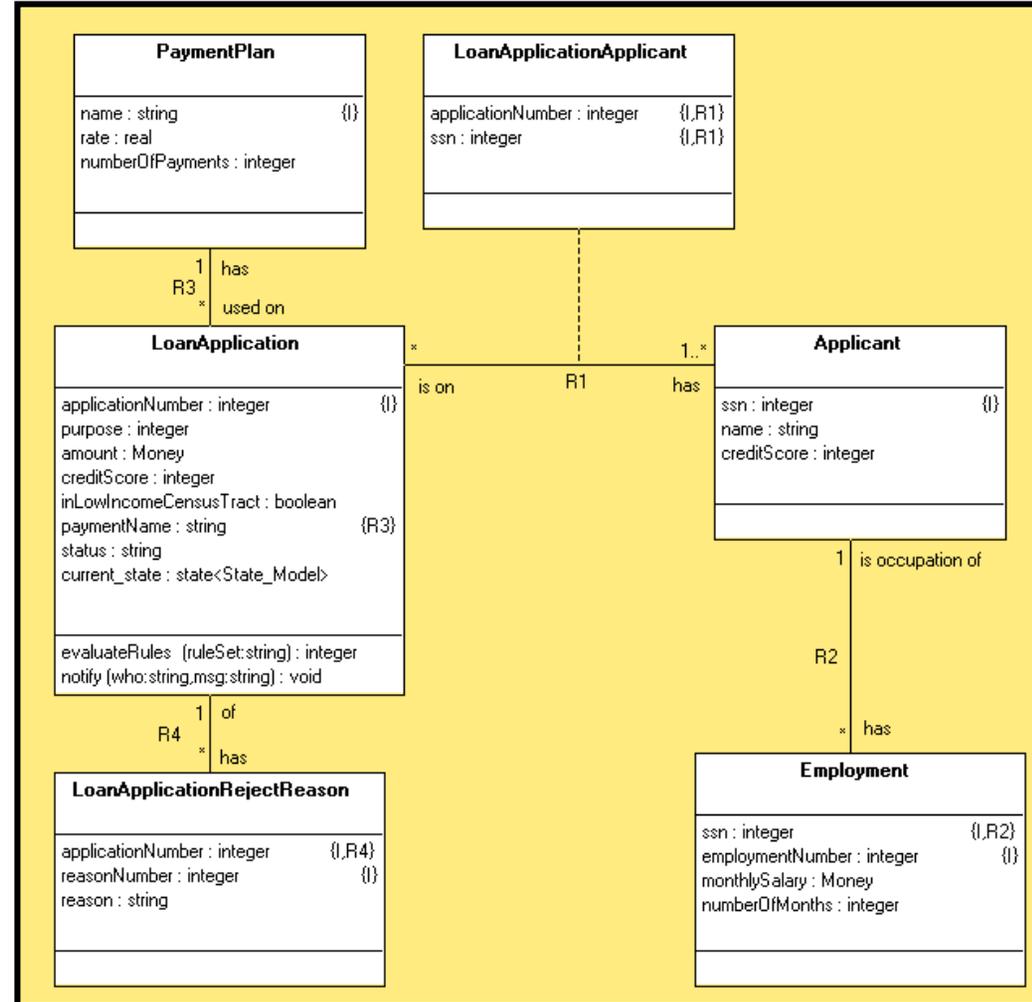
<i>debt ratio</i>	<i>increment</i>	<i>additional LICT increment</i>	<i>reject reason</i>
$\leq .10$	+10	+3	
$> .10$ and $< .28$	+8	+2	
$\geq .28$ and $< .41$	+2	+1	
$\geq .41$	+0	+1	Debt service is too high.

Business Rules (CIM) – Consumer Credit Example, cont'd.

- ▶ If a loan application's credit score is ≥ 65 , the loan application must be accepted
- ▶ If a loan application's credit score is ≥ 58 and < 65 , the loan application requires evaluation by a Loan Officer
- ▶ If a loan application's credit score is < 58 , the application must be rejected
- ▶ If a loan application is accepted, determine if the applicant also qualifies for additional products for the same purpose

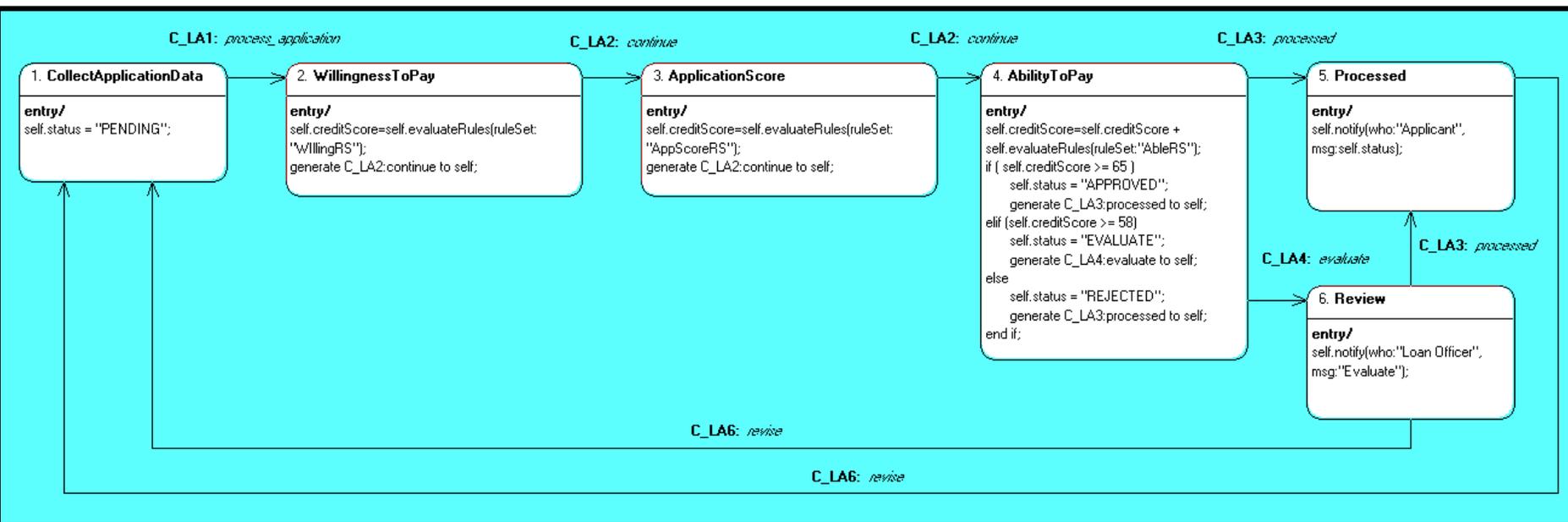
Information Model (PIM) – Invariant Schema

- ▶ **UML Class Diagram**
- ▶ **Normal form**
- ▶ **Corresponds to Terms and Facts in the CIM (Enterprise Viewpoint).**
- ▶ **Corresponds to certain Computational Viewpoint classes.**
- ▶ **Corresponds to database schema in the PSM (Technology Viewpoint).**



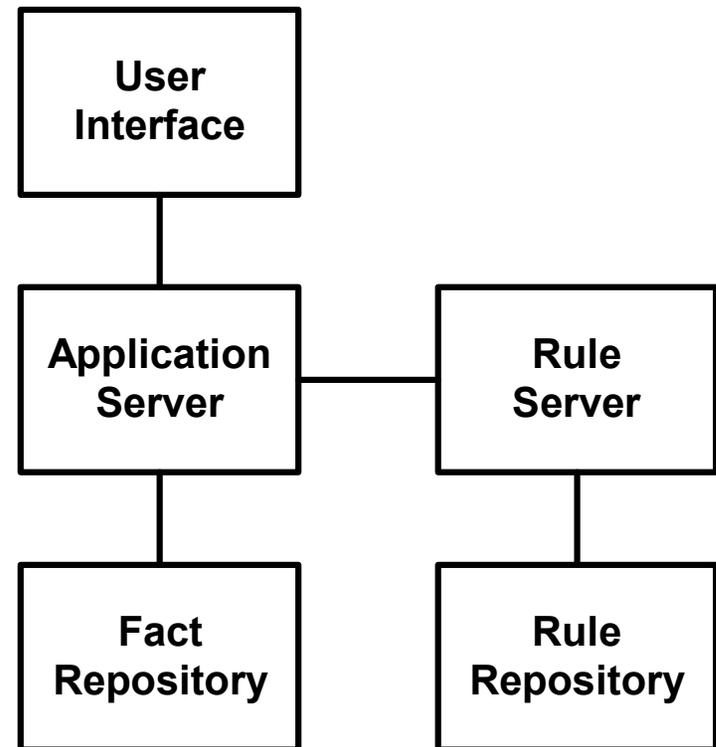
Information Model (PIM) – Static and Dynamic Schemata

- ▶ **UML State Chart of the LoanApplication class**
- ▶ **Corresponds to the application processing decision rules in the Enterprise viewpoint**
- ▶ **May correspond to other Technology objects**



Computational Model (PIM)

- ▶ **UML Collaboration Diagram**
- ▶ **Shows the architectural classes of the system and their interactions**
- ▶ **Fact Repository contains facts based on the Invariant schema**
- ▶ **Rule Repository contents correspond to Business Rules**



Computational Model – Corresponding Business Rules

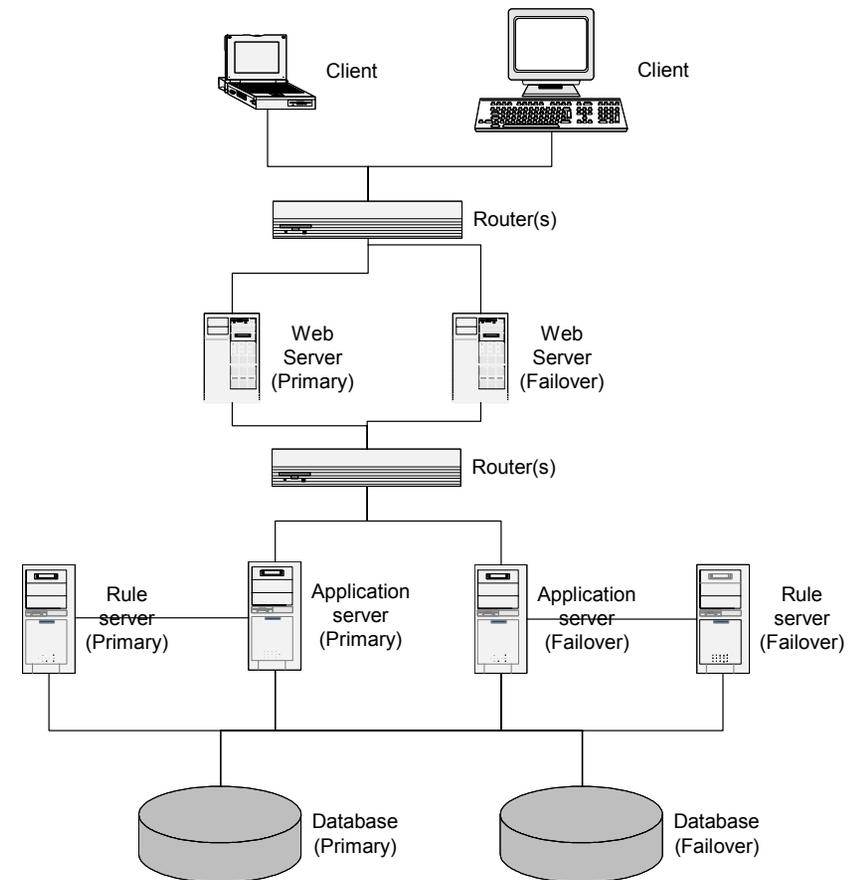
```
ruleset AbleRS for {application: a LoanApplication, monthlyPayment: a real}
  returning an integer is
{
  Income is a real initially computeIncome(application).
  otherPayments is a real initially computeOtherPayments(application).
  score is an integer initially 0.
  applicant is any Applicant in application.applicant.

  rule DebtServiceIsLessThanTwentyOnePercent is
  if (otherPayments + monthlyPayment) / Income > 0.10
    and (otherPayments + monthlyPayment) / Income < 0.21
  then {
    score = score + 8,
    if application.lowIncomeCensusTract is true
    then
      {score = score + 2},
    return score
  }

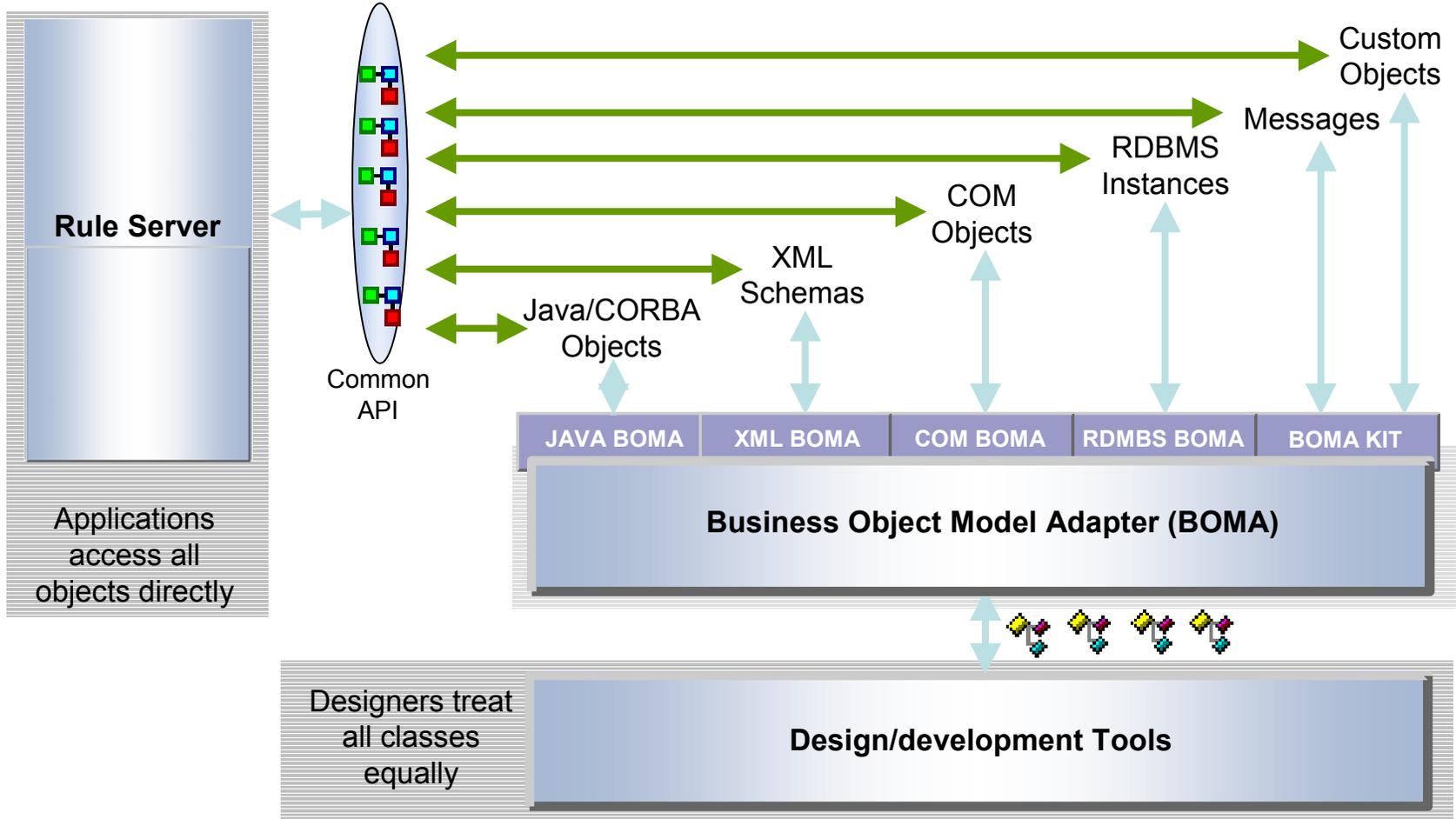
  rule DebtServiceIsLessThanThirtyOnePercent is
  if (otherPayments + monthlyPayment) / Income >= 0.21
    and (otherPayments + monthlyPayment) / Income < 0.31
  then {
    score = score + 5,
    if application.lowIncomeCensusTract is true
    then
      {score = score + 2},
    return score
  }
}
```

Engineering Model (PIM or PSM)

- ▶ A UML Deployment Diagram
- ▶ Shows all hardware nodes, peripherals, network protocols, network components, especially edge routers, as well as system backup, fail-over, load balancing, and transaction management design, etc.



Technology Model (PSM)

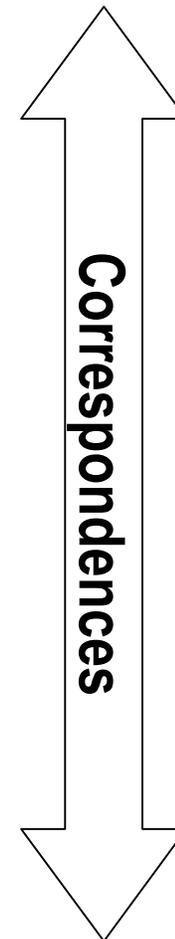


Applications access all objects directly

Designers treat all classes equally

Summary

- 1. MDA CIM (RM-ODP Enterprise viewpoint)**
 - Business rules
 - Business facts
 - Business terms
- 2. MDA PIM (RM-ODP Information viewpoint)**
 - Information model
 - Information processing definitions (ruleflows)
- 3. MDA PIM (RM-ODP Computational viewpoint)**
 - Computational object model
 - Rule services
 - Rulesets
 - Rules
- 4. MDA PSM (RM-ODP Engineering viewpoint)**
 - Distribution model
 - Rule service specifications for target middleware architecture
- 5. MDA PSM (RM-ODP Technology viewpoint)**
 - Rule service implementation for target middleware architecture
 - Associated implementation code; e.g., EJB



**Implementation-
independent
Business
Rules**

**Rule
Server
Implementation**