# Information Modeling

## Service-Oriented Architecture

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# Service Oriented Architecture Definitions

- **Service Oriented Architecture (SOA) is a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains**

**OASIS Reference Model for Service Oriented Architecture 1.0 - (emphasis mine)**

- **Set of services business wants to expose:**
  - Customers
  - Partners
  - Other portions of the organization

**Source: IBM – (emphasis mine)**

# Information Modeling in SOA

- **In order for a SOA to work, it is critical that service providers have a common understanding of the structure and meaning of the data being exchanged**
- **Therefore, a "model" of some kind is needed**
  - What form should this model take?
- **Is it possible to have a single, agreed upon model?**
  - What about different technological requirements?
  - What about different viewpoints?

# Information Architecture

- **Information Architecture is the analysis and design of the data used in information systems**
  - Modeling semantics and reference knowledge common to a wide range of artifacts
  - Leveraging the semantics to ensure consistency across models/artifacts
  - Using the same semantics as a basis for logical and physical database model generation, software component and service generation, rule development (e.g., in production rule-based systems), etc.
- **It's all about logical consistency, validation, and reuse**
- **It's also about ensuring interoperability within an enterprise and between that enterprise and its trading partners**

# Information Architecture (cont.)

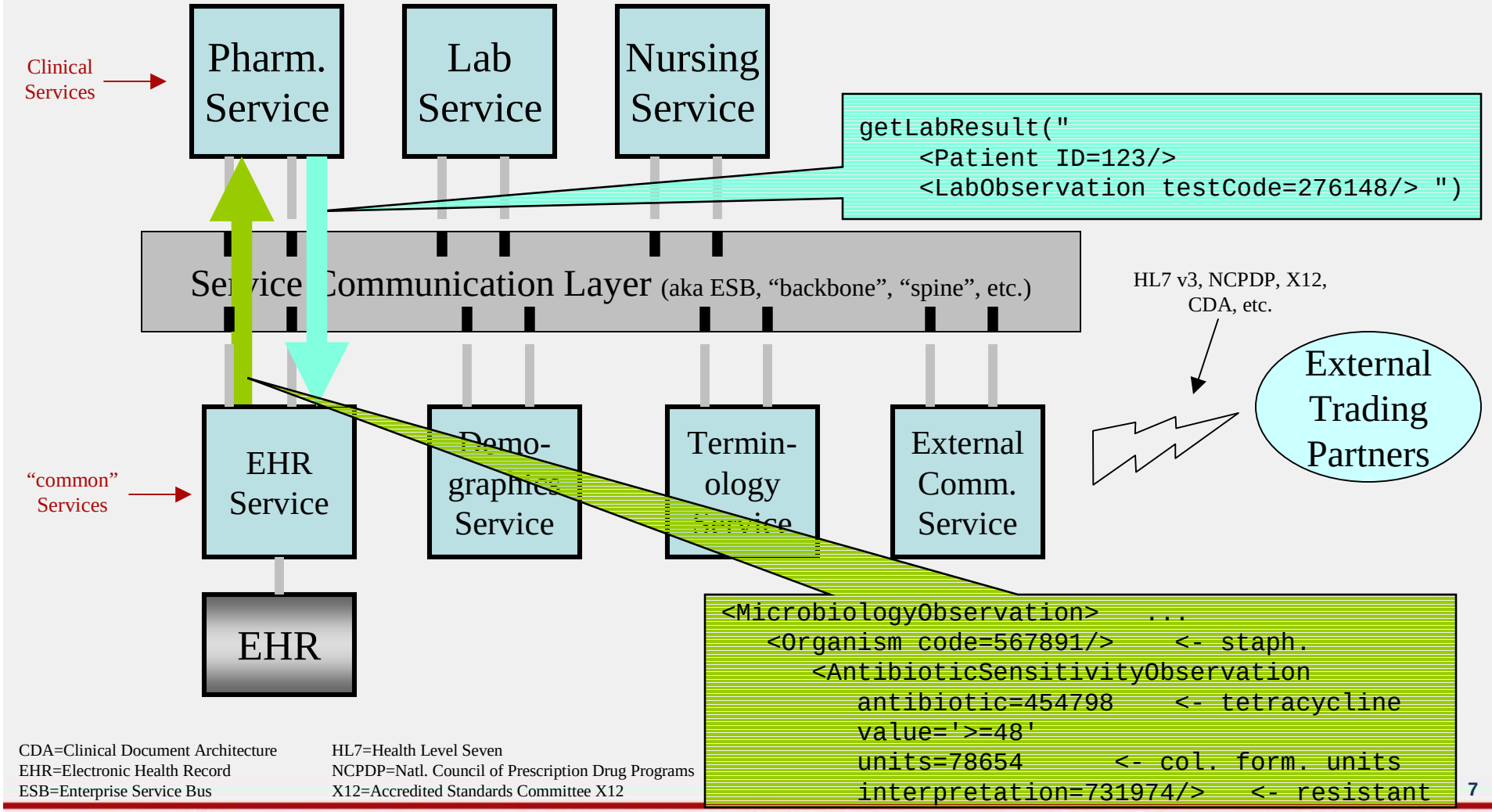
- **The art and science of understanding the objectives of information in the context of the intended audience**
- **Information Architecture relates the Business Architecture to Information Technology**
  - It's the high level description of business information and communication
  - Enables the translation of business perspectives to/from IT
- **Business Strategy and Information Architecture are closely related**
  - Information Architecture enables the existing Business Strategy
  - Information Architecture fosters new Business Strategies

# Information Architecture in Health Care

- **Legal Electronic Medical Record**
  - Definition and additional data about “metadata” elements that are deemed to be officially part of the Legal Electronic Medical Record
- **Message “payload” design**
  - Definition of the contents of data sent to/from software systems as they fulfill business workflows
- **Database and warehouse design**
- **Data standardization and data quality efforts**
- **Data requirements for quality improvement programs**
- **Medical research**
- **Clinical decision support**

# A Health Care SOA Scenario

Note that these services might be "home-grown" or commercial products



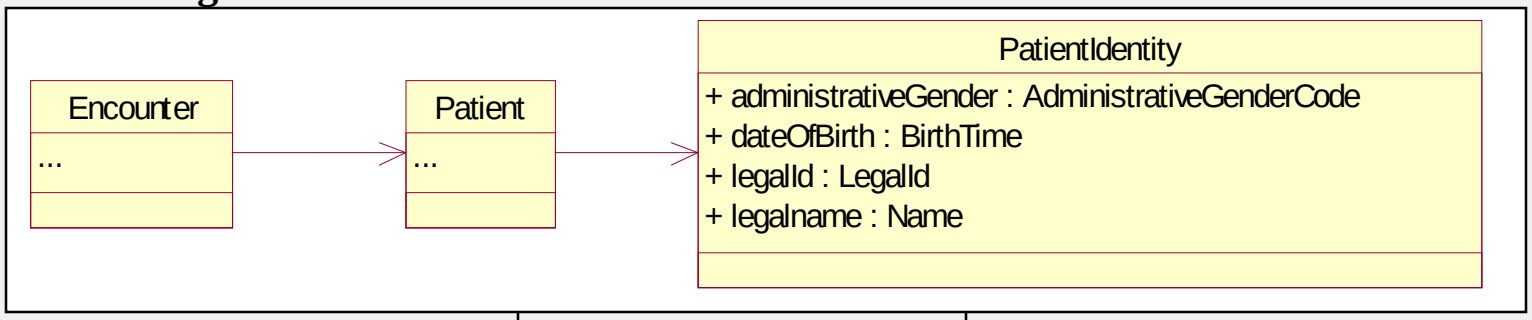

CDA=Clinical Document Architecture
EHR=Electronic Health Record
ESB=Enterprise Service Bus
HL7=Health Level Seven
NCPDP=Natl. Council of Prescription Drug Programs
X12=Accredited Standards Committee X12

# Model Transformations

- **How can one static data model meet all the implementation needs (database, domain model, payload structure)?**
- **Answer: Model transformations**
  - Computational Independent Model (CIM)
    - Conceptual model, aka Domain Analysis Model
  - Platform Specific Model (PSM)
    - Adds concepts needed by a type of platform, e.g., keys
  - Platform "Model"
    - Language used by platform, e.g., DDL, WSDL, CORBA
- **Model Driven Architecture (MDA) and Unified Modeling Language (UML) provide tools for automating model transformations**

# UML Transformed to Other Languages

## Class Diagram



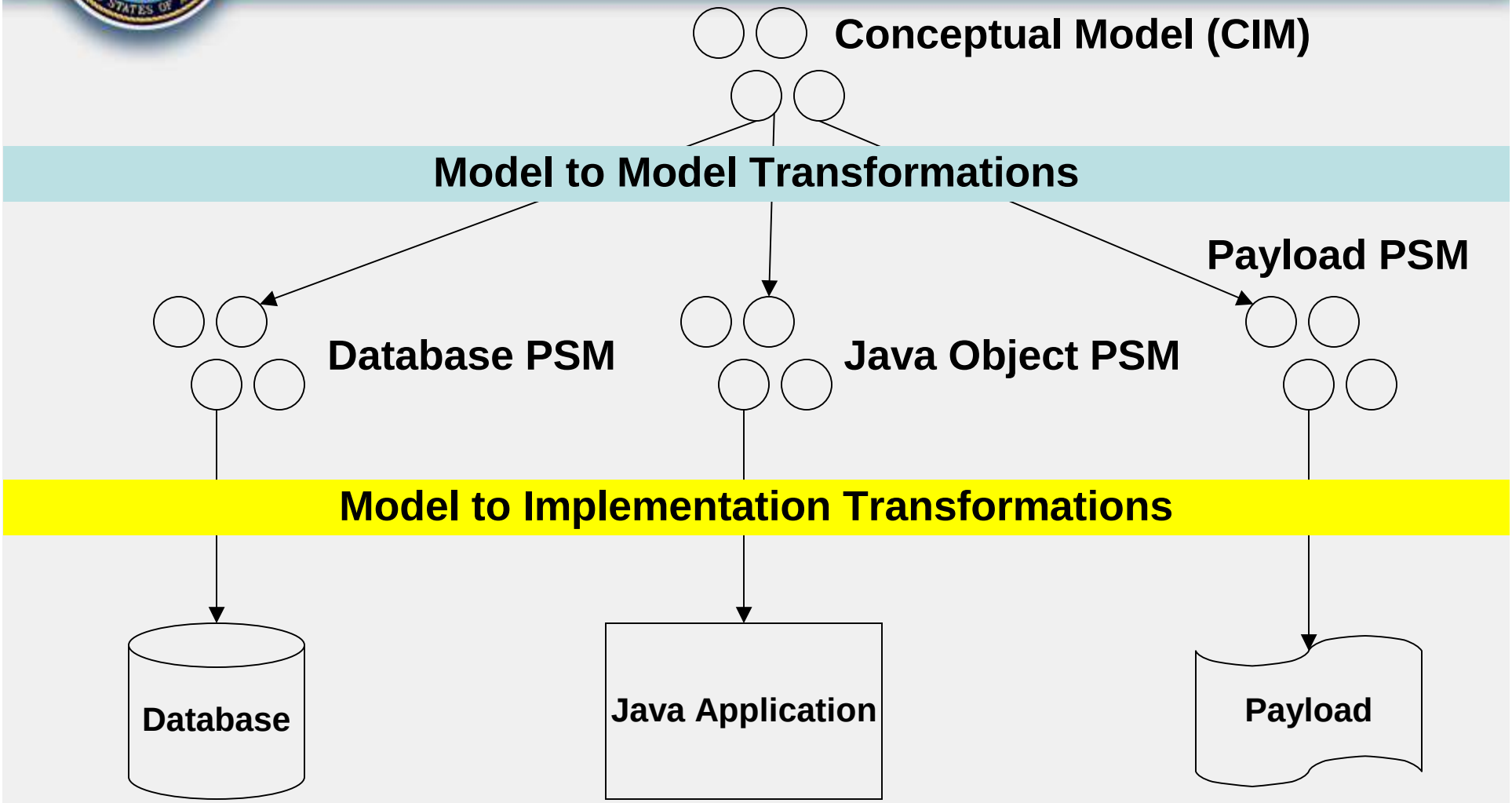

## XML Schema Definition

```
<xs:element name="PatientIdentity" type="VaIdentity"
substitutionGroup="personIdentity" />
- <xs:complexType name="PatientIdentity">
- <xs:complexContent>
- <xs:extension base="PersonIdentity">
- <xs:sequence>
- <xs:element name="administrativeGender"
type="AdministrativeGenderCode">
- <xs:annotation>
<xs:documentation>A value representing the gender (sex) of a person.
The allowable values for this field as specified by the DS DAT for
Demographics are: F (Female), M (Male) and UN
(unspecified).</xs:documentation>
</xs:annotation>
...
```

## Java

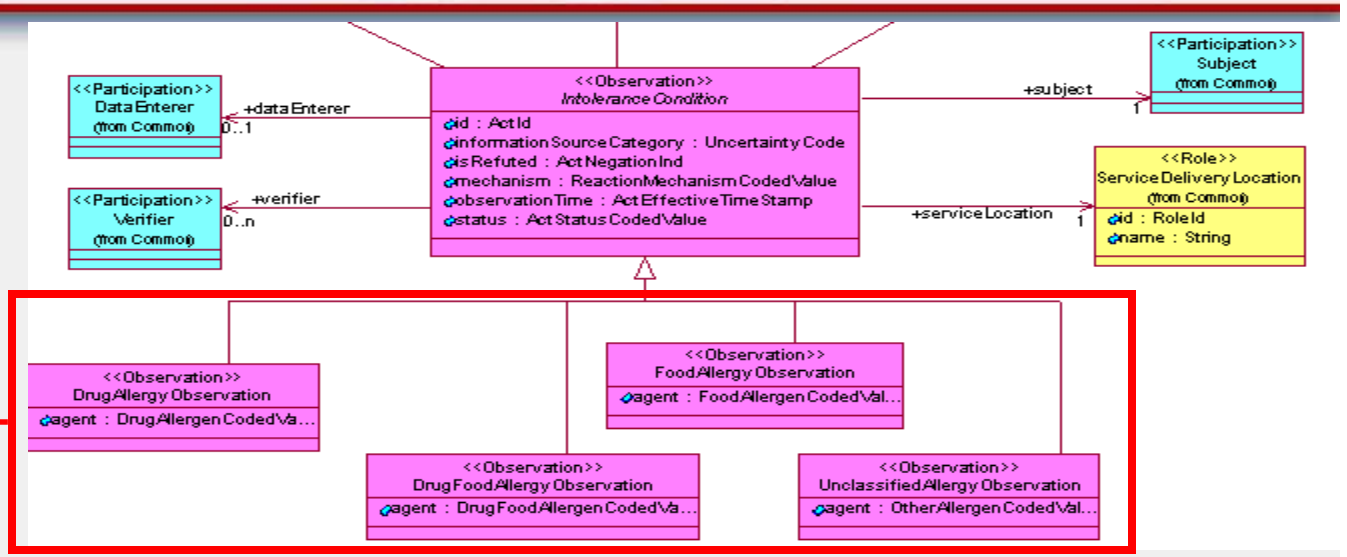
```
public interface PatientIdentity extends personSRDTs.PersonIdentity
{
    livingSubject.AdministrativeGenderCode getAdministrativeGender();
    void setAdministrativeGender(livingSubject.AdministrativeGenderCode
administrativeGender);
    livingSubject.AdministrativeGenderCode
addNewAdministrativeGender();
    livingSubject.BirthTime getDateOfBirth();
    void setDateOfBirth(livingSubject.BirthTime dateOfBirth);
    livingSubject.BirthTime addNewDateOfBirth();
...
```

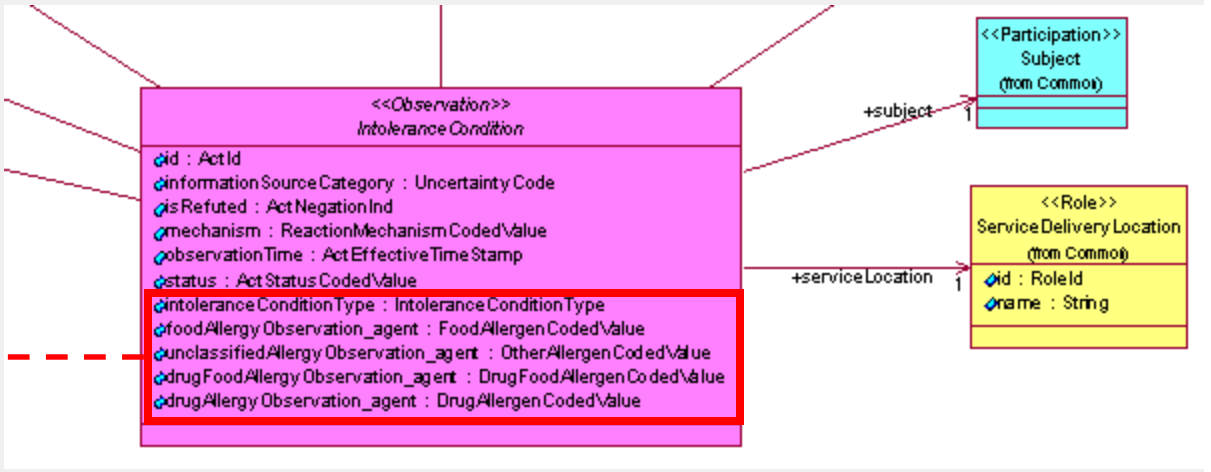
# MDA Transforms to Other Models



# CIM to PSM Example

Note the transformation from one model that has four subclasses to distinguish the type of the allergy, to another model that has a single class which uses an allergy type to distinguish the type of allergy



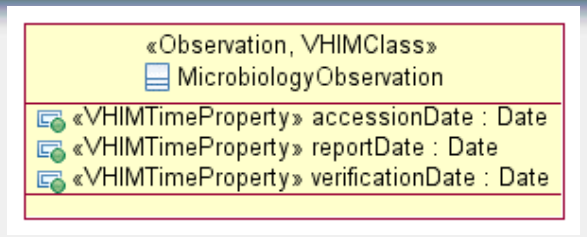



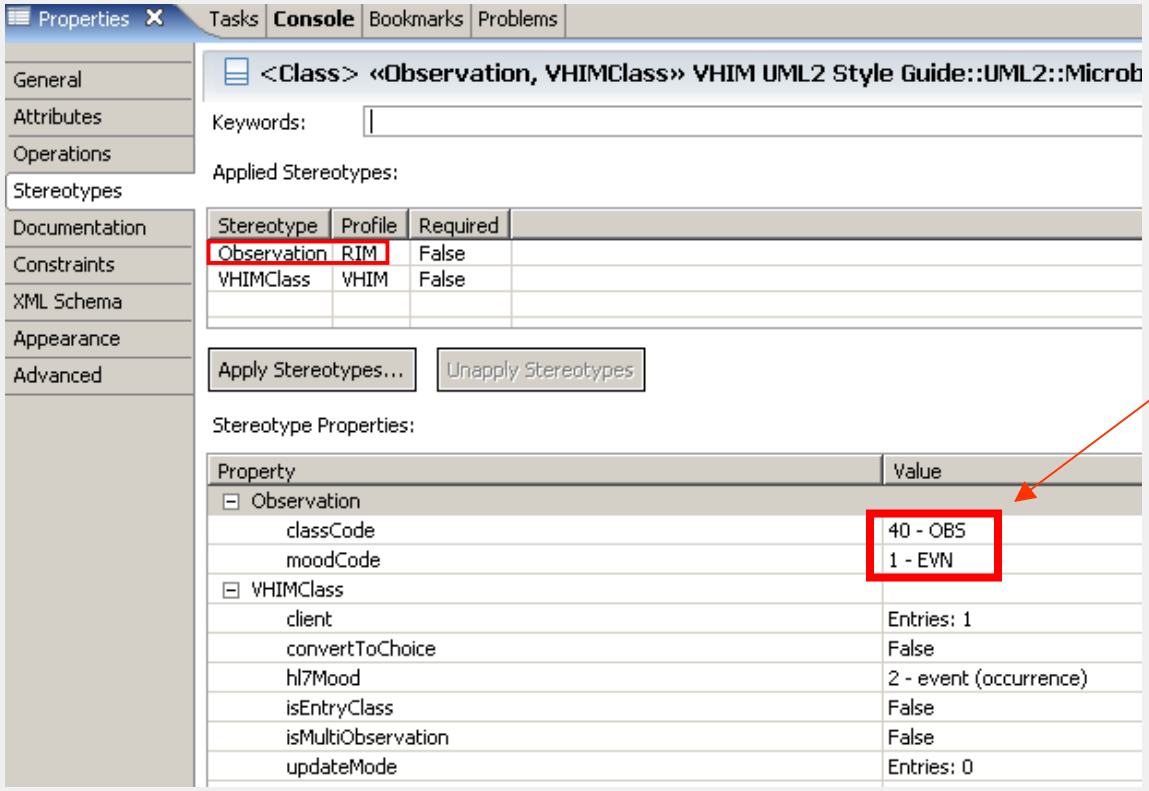
# Transformations and Standards

- **The HL7 Reference Information Model (RIM) is used as a UML Profile, allowing a rigorous transformation to/from HL7 version 3 artifacts**
  - One can import and export HL7 Model Interchange Format (MIF) files to/from the UML model
- **This can also be used to model other Standards**
  - NCPDP SCRIPT* being reverse-engineered
  - Efforts underway at ASC X12 as well
- **CDA authoring tooling is now being built**

* NCPDP SCRIPT is a messaging standard used to convey pharmacy insurance claim information

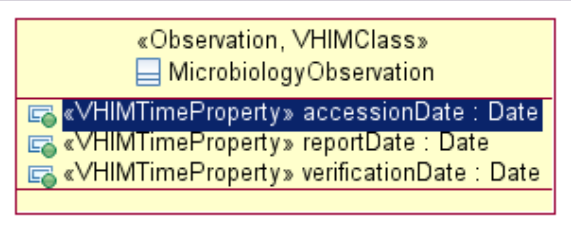
# Align Classes with HL7 v3

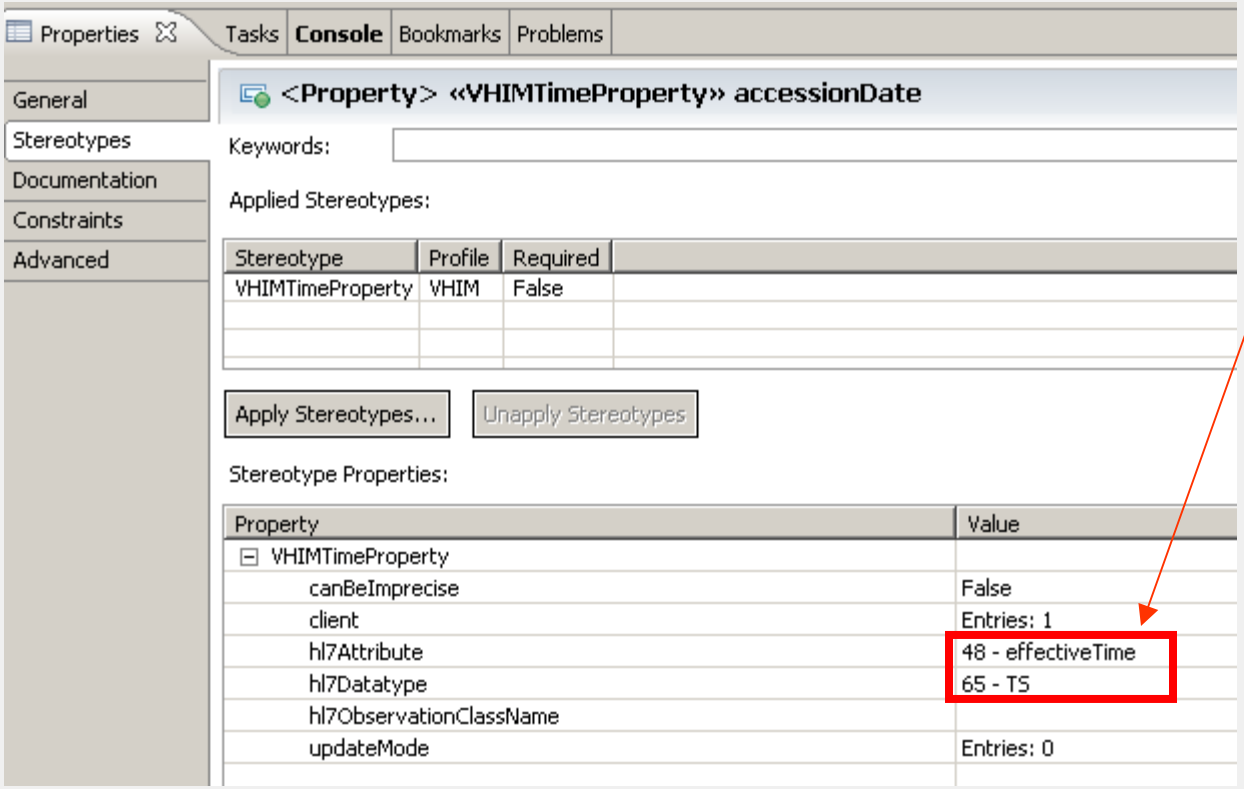



*The Class Code and Mood Code are explicitly identified in the model; allowing for computable transformations to/from HL7 v3 message structures*

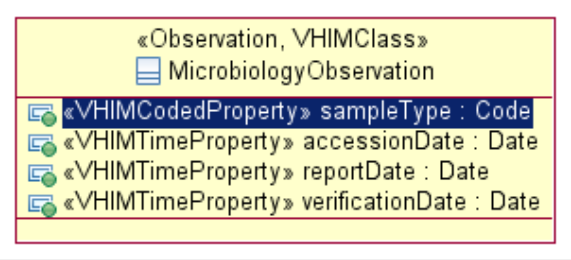
# Align Attributes with HL7 v3 (cont.)

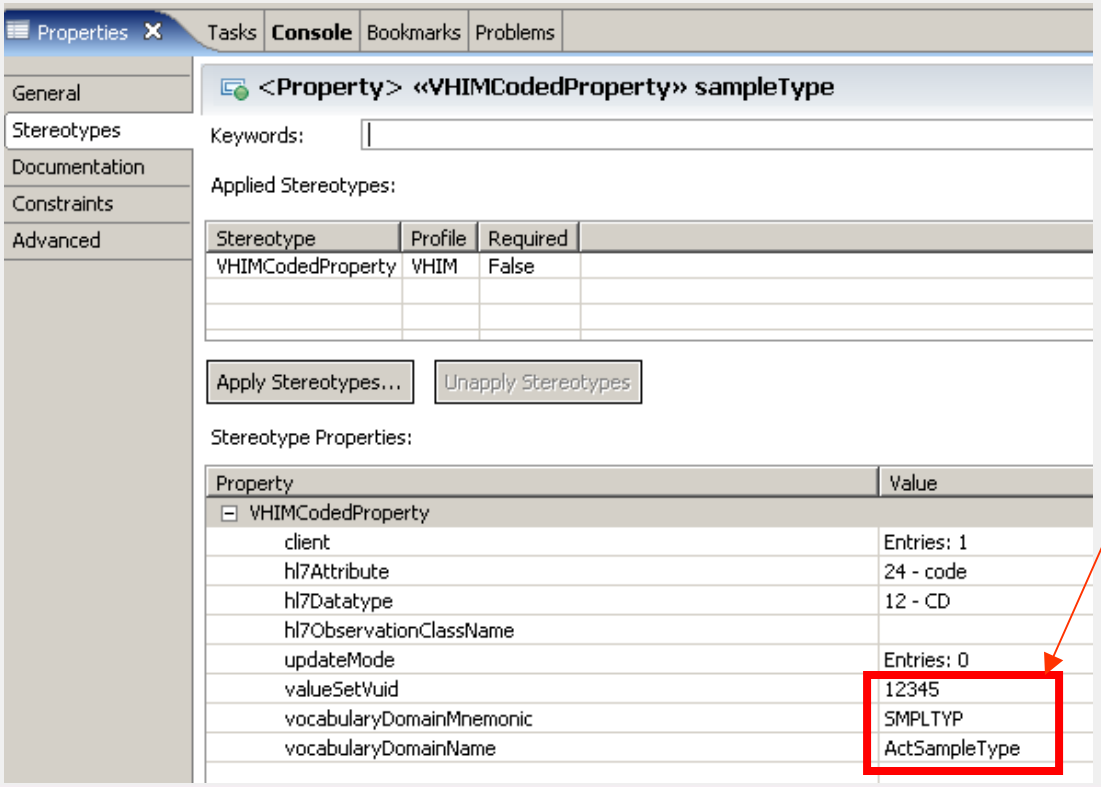



*The HL7 RIM Attribute and constrained datatype are identified in stereotype properties, not in the model itself*

# Mechanism to Align with Terminology




*The model explicitly links to both the VHA Unique concept Identifier (VUID) and to the HL7 value set*

# UML Style Benefits

- **The UML Style provides**
  - More computationally independent models; HL7-isms and XML-isms not in the diagrams
    - Easier for Subject Matter Experts to understand and validate
  - Ability to automate Quality Assurance checks based on the semantics of the model, not just structure
    - This is done through Eclipse extensions using the Eclipse Modeling Framework (EMF) Validation Framework

# Lessons Learned

- **There will be a time between the As-Is and the To-Be where you have a mixture of both**
  - Need to simultaneously maintain transforms to/from the UML model and HL7 v2 Electronic Data Interchange format, HL7 v3 XML, and CDA XML
  - “As-Is” systems do not understand the “To-Be” concepts and constructs – these need to be removed from As-Is artifacts
- **One challenge was the mapping to/from HL7 v2 data types and HL7 v3**
  - Certain v2 data types are needed for “backward compatibility”

# Lessons Learned (cont.)

- **Transformations require extensive testing**
  - Some HL7 messages might not conform to specifications
  - Validation of mappings is manually intensive and time consuming
- **Data migration/transformation will bring to light data quality issues**
  - Some data may be need to be cleansed
  - Adjustments may be needed to the UML model or the transformations
- **Some issues require the involvement of the authoritative source to make changes**
  - Important to have business input
  - Need a “Data Stewardship” program to ensure authoritative business “owners” for semantics, governance, and error resolution/data quality

# Future Work

- **Research is being conducted to explore the linkage between UML and RDF, OWL, and SBVR***
  - See the Object Management Group's (OMG) Ontology Definition Metamodel (ODM)
- **Exploration of the use of ontologies and semantic web technologies**
- **Can the structural and ontological modeling worlds be bridged?**

*
RDF=Resource Description Framework, a family of World Wide Web Consortium (W3C) specifications. See www.w3.org
OWL=Web Ontology Language, a family of knowledge representation languages for authoring ontologies. See www.w3.org
SBVR=Semantics of Business Vocabulary and Business Rules, an OMG standard. See www.omg.org

# Summary

- **To design a SOA, you need**
  - Dynamic (Behavioral) Models
  - Static (Information) Models
  - Terminology Models
- **UML can be used effectively for the first two**
  - Enables the benefits of Model Driven Architecture
  - Link to terminology in UML Profile
    - Further exploration of the linkages between Information and Terminology modeling is needed
- **Model Transformations allow a single model to satisfy multiple purposes**