GME-MOF: The MOF-Based GME Metamodeling Environment

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Motivation

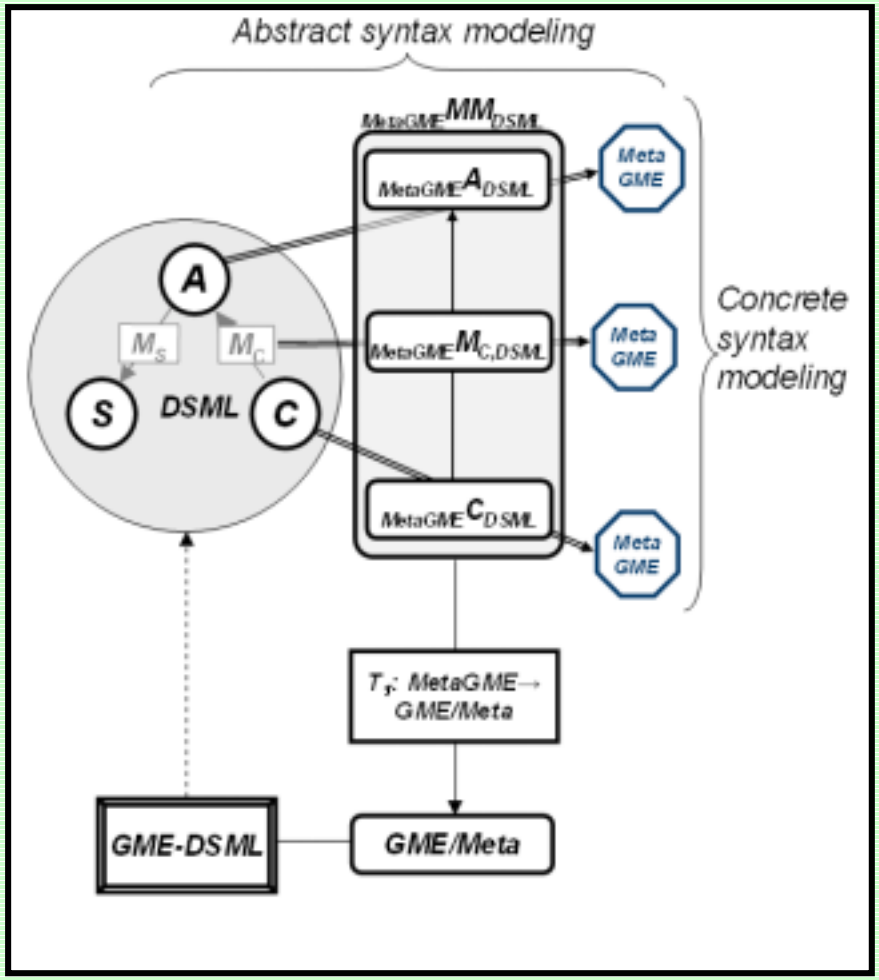
- The core of MIC is the development of DSMLs.
- GME provides MetaGME, a metamodeling language for DSLM specification.
- The OMG has adopted MOF as the standard metamodeling language

- What is the technical merit of the MOF standard vs. MetaGME?
- How can GME adapt to meet this standard with minimum pain?

Outline

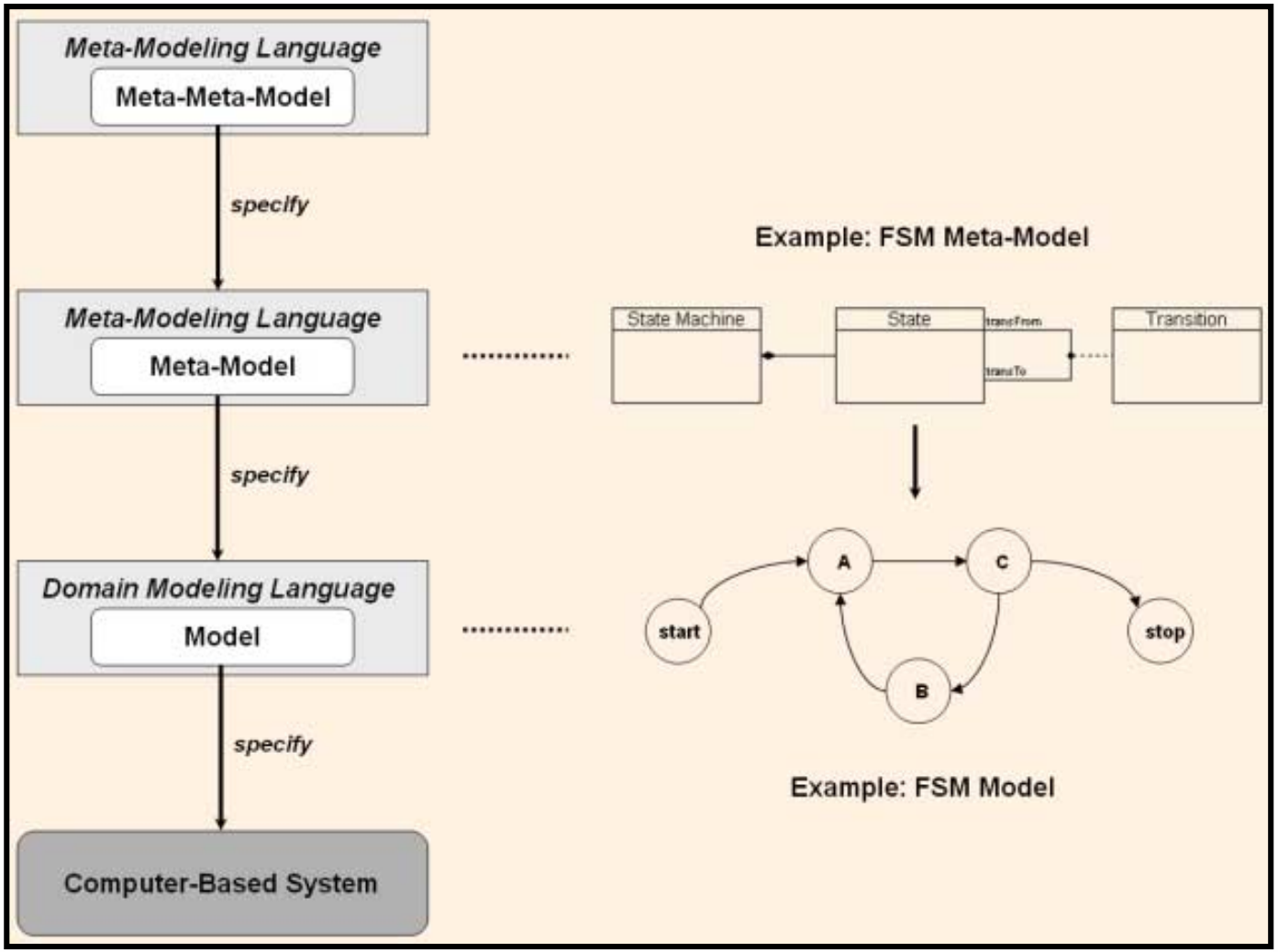
- Overview of GME and MetaGME
- Overview of MOF
- Evaluation of MOF vs. MetaGME
- GME-MOF: The MOF-based GME metamodeling environment

GME

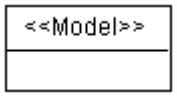


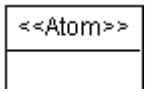
- Meta-programmable modeling tool
- Platform for the development of many model-based embedded systems tools
- Includes a metamodeling language which predates MOF: **MetaGME**

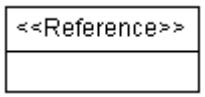
GME Modeling Hierarchy

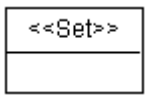


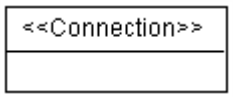
MetaGME

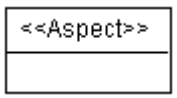
- Based on UML Class Diagrams and OCL
- Class Stereotypes imply the abstract syntax of elements in the metamodel:
  - 

: Compositional containers
  - 

: Primitive objects
  - 

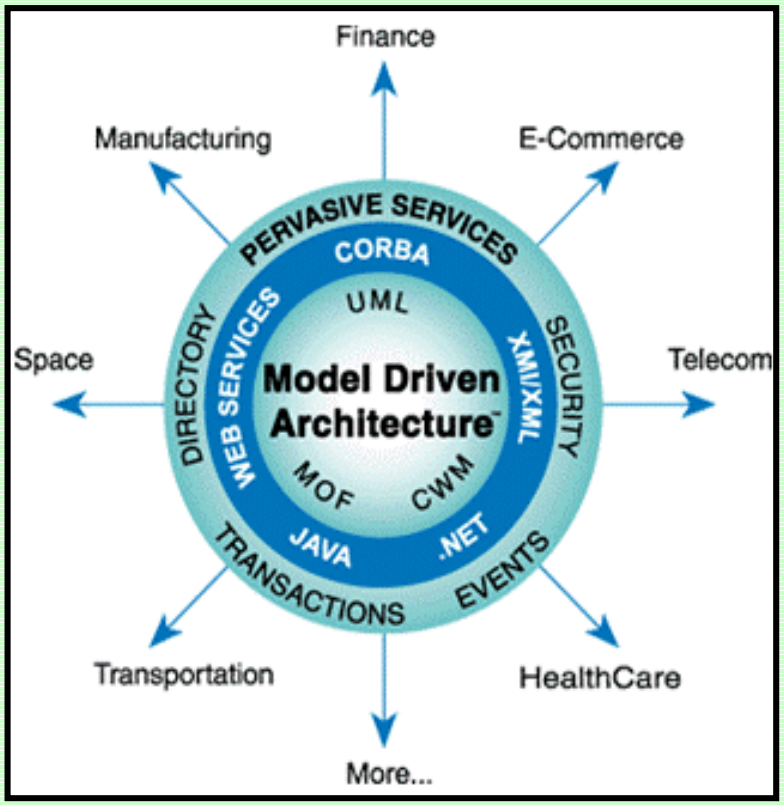
: Pointers to model objects
  - 

: Aggregate containers
  - 

: Analogous to UML Association Classes
  - 

: Logical visual partitions of a system

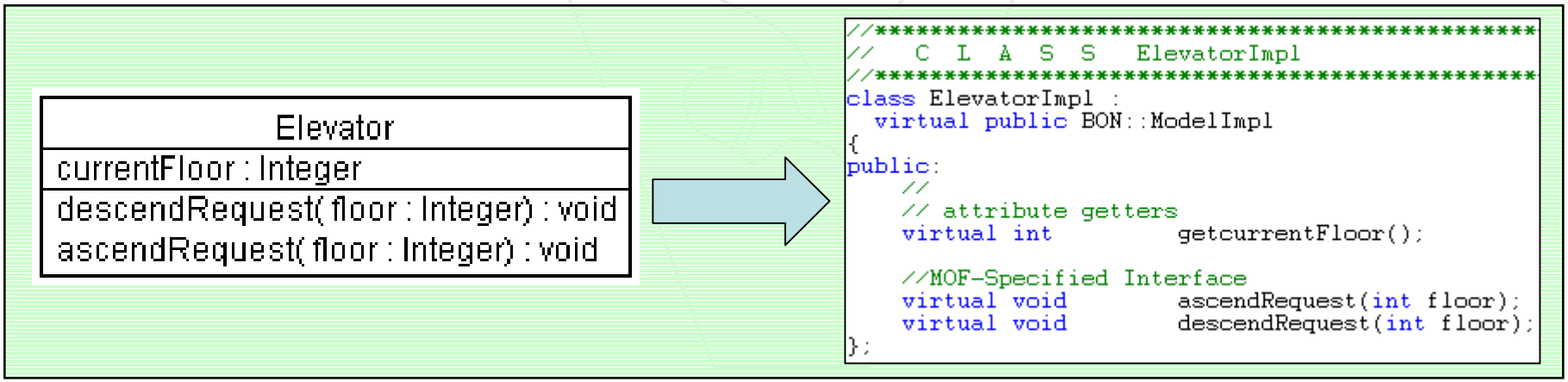
MOF



- OMG Standard metamodeling language
- Simplification of UML Class Diagrams
- Used as definition language for many OMG specifications:
  - UML
  - CWM
  - OCL
  - XMI
- One use case is the specification of DSMLs

MOF vs. MetaGME: Technical Merit

- MOF Operations, Parameters, and Exceptions
  - Specify interface to operational semantics
  - Aids creation of model interpreters



MOF vs. MetaGME: Technical Merit

- Superior facilities for metamodel reuse
  - Package Importation as well as Generalization
    - MOF Package Importation allows type re-use for any purpose but instantiation
    - MOF Package Generalization is for metamodel extension
    - MetaGME Relies on GME Library Import (similar to MOF Package Generalization)
  - Package Merge in MOF 2.0
    - Intelligent algorithm for merging metamodels
    - Identifies metamodel "join points" as metamodel elements with identical names
    - MetaGME requires case-by-case identification of join points

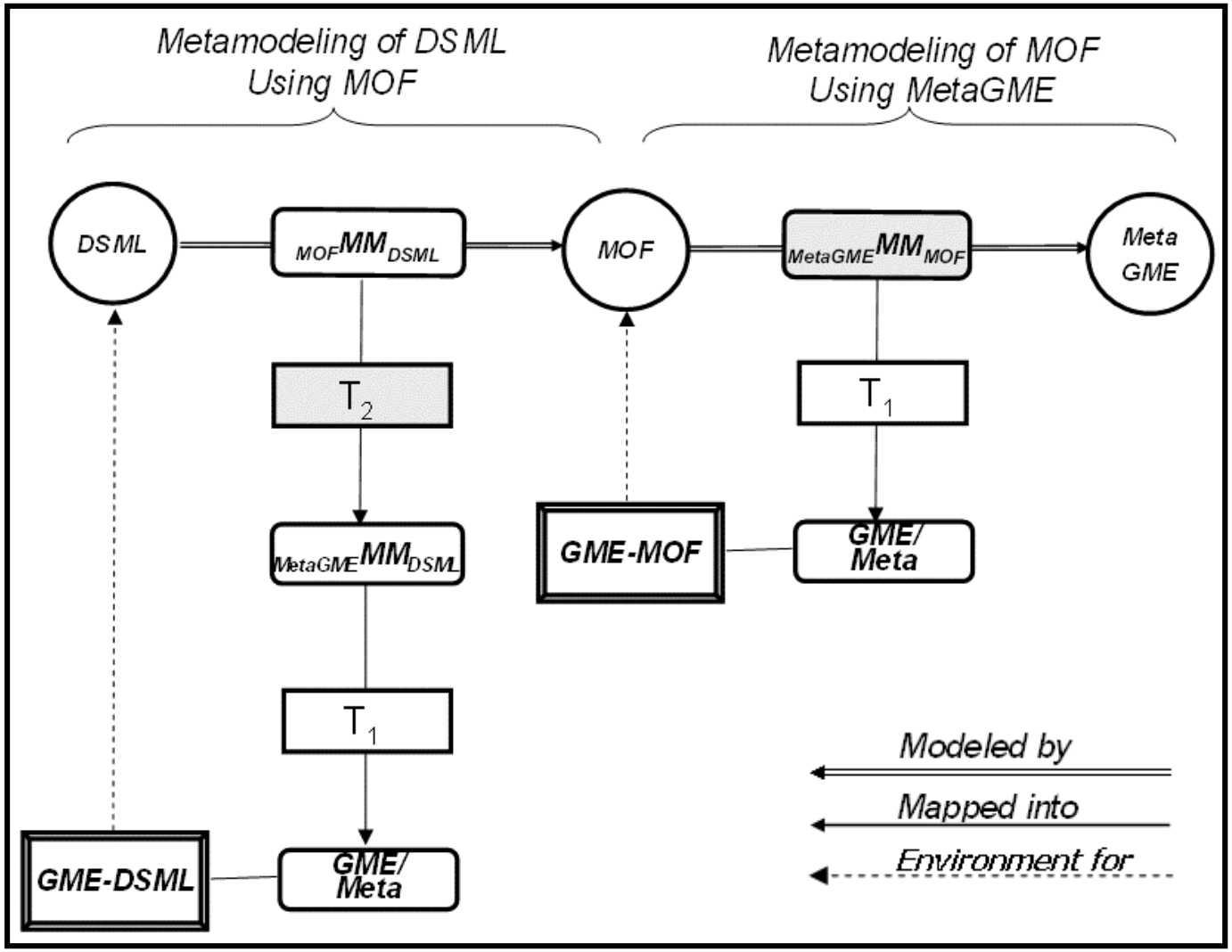
MOF vs. MetaGME: Technical Merit

- MOF lacks an easy facility for specifying modeling language concrete Syntax
  - No way to specify how models are visualized
  - Aids in tool independence
  - Inconvenient when working in GME
- No multi-aspect modeling
  - Cannot logically partition systems concerns at the system modeling level

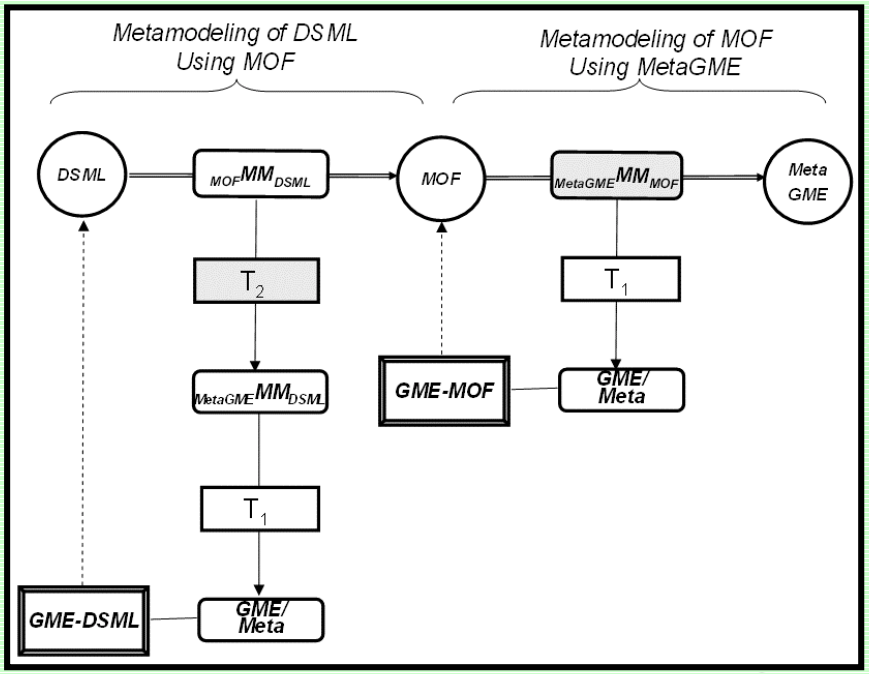
GME-MOF: Design Forces

- Tight correspondence between MetaGME stereotypes and GME configuration file entities
- Existing tools support, including:
  - Constraint Checker
  - Metamodel Interpreter
- Existing user base and modeling languages
- Kinship of MOF and MetaGME
  - Both based on UML Class Diagrams

GME-MOF


Metamodeling of DSML
Using MOF
Metamodeling of MOF
Using MetaGME
DSML
MOF MM DSML
MOF
MetaGME MM MOF
Meta
GME
T2
T1
MetaGME MM DSML
GME-MOF
GME/
Meta
T1
Modeled by
Mapped into
Environment for
GME-DSML
GME/
Meta

GME-MOF



- Leverages existing metamodeling language
- Leverages existing metamodel translation tool
- MOF provides an MDA-style interface for GME Metamodeling

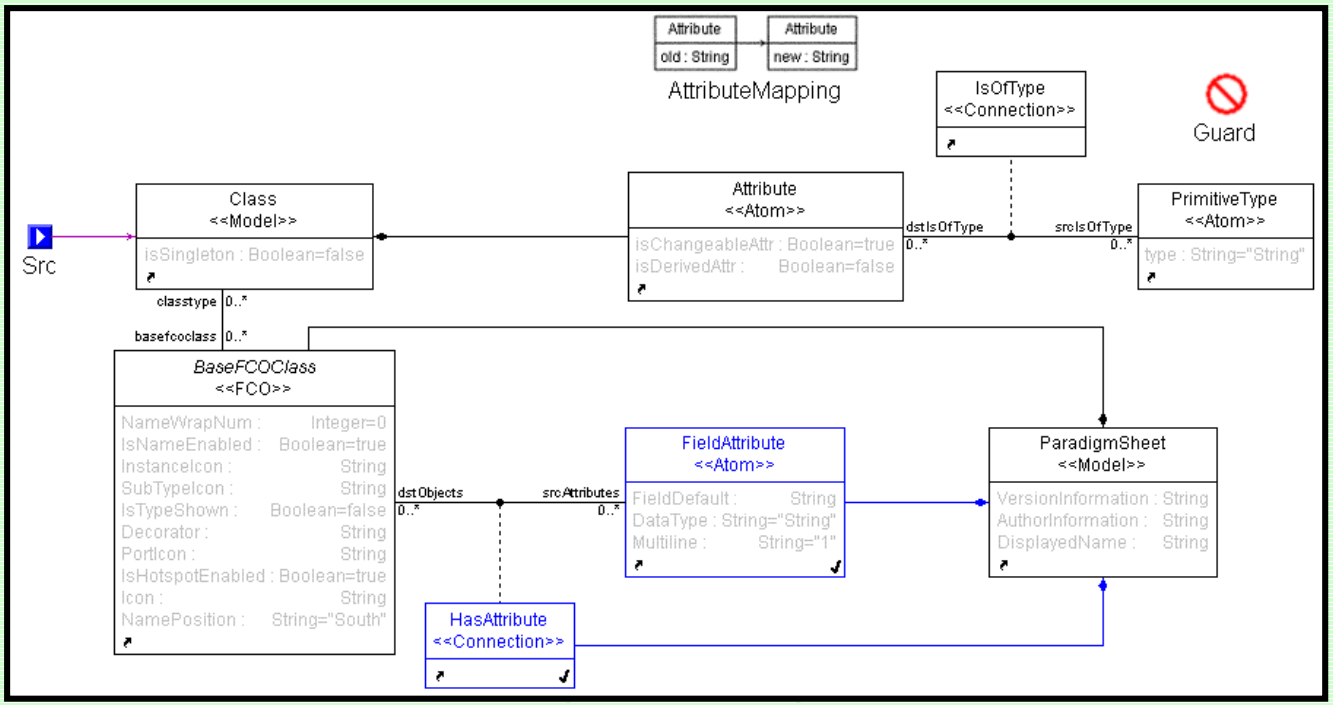
MOF-to-MetaGME Translation

MOF Concept	MetaGME Concept
Package	Folder
Class	Model, Atom, Set, Reference
Aggregate Association	Composition
Non-Aggregate Association	Connection, SetMembership, ReferTo
String-typed Attribute	FieldAttribute

- Model-to-model translation
- Design using the Graph Rewriting and Transformation Language (GReAT)
- Guided by MOF Tags
- Not isomorphic

Specifying the Translation

Mapping MOF Primitive-type Attributes to MetaGME FieldAttributes

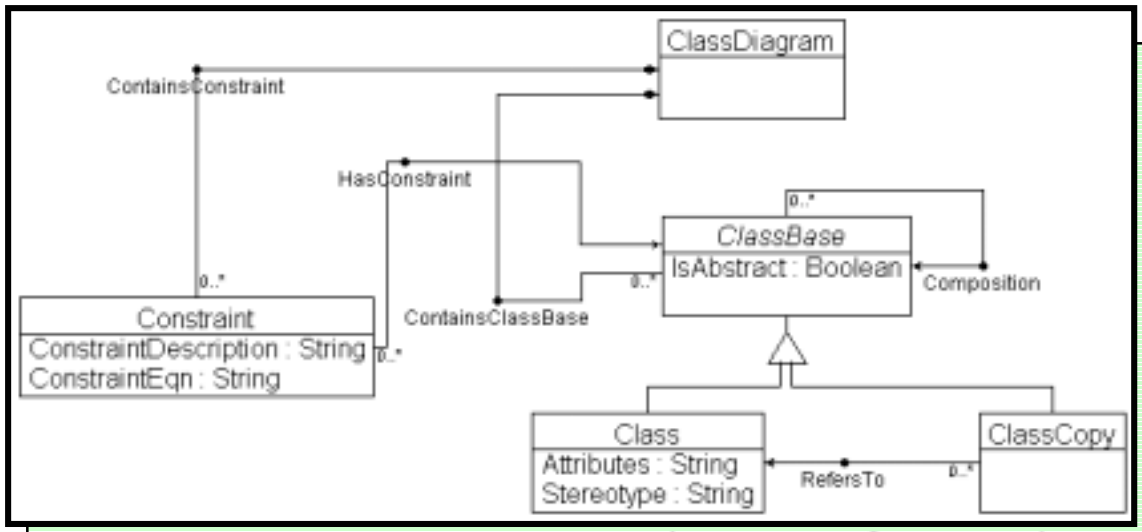


- **Match** the pattern visualized in black.
- **Create** the pattern visualized in blue.

Translation Limitations

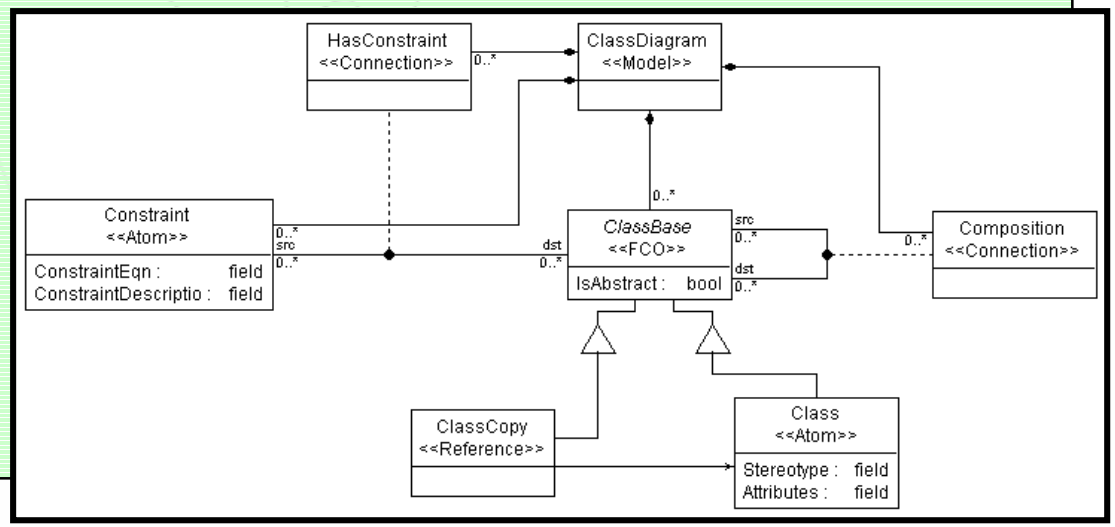
- How to meaningfully represent in GME:
  - Singleton Classes
  - Derived Attributes
  - Derived Associations
- Attributes of arbitrary types
- MOF-style metamodel importation

Translation Example: UML Class Diagrams

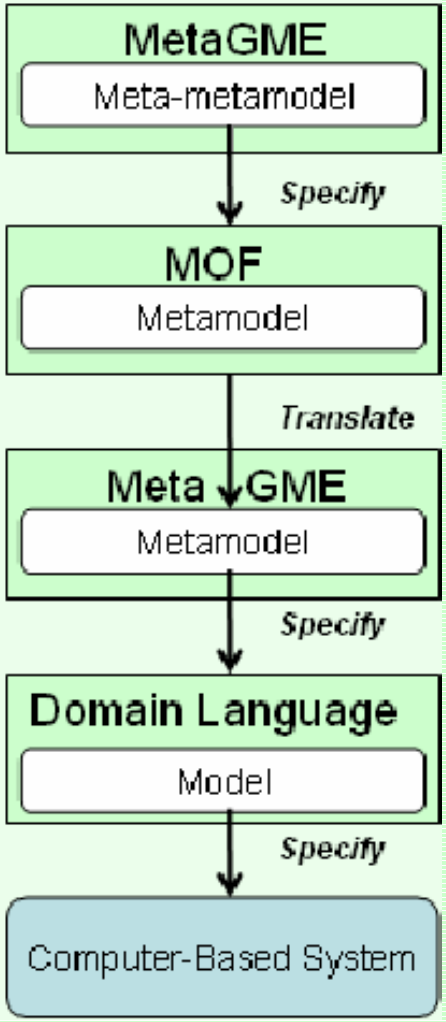


Input (MOF)

Output (MetaGME)



GME-MOF: An MDA Interface for GME



- Leverages existing metamodeling language
- Leverages existing metamodel translation tool
- MOF provides an MDA-style interface for GME Metamodeling
- Solution illustrates the versatility of metamodeling and meta-programmable tools

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