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MODEM - Reengineering the MODAF meta-model based on the IDEAS foundation model

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SWEDISH ARMED FORCES
HEADQUARTERS

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- Introduction and strategic issues: Mikael
- Architectural frameworks: Lars-Olof
- Semantic technology: Chris
- MODEM patterns and examples: Lars-Olof
- UK MOD statement of intent: Patrick
- Conclusions: Mikael

Introduction and strategic issues

International Defence Enterprise Architecture Specification (IDEAS)

- 2005-2009: Development of a Model (IDEAS Foundation) for Coalition Architecture Interoperability.
- Based on semantics to deal with semantic heterogeneity between the nations national Architecture Frameworks by the use of an approach based on Business Objects Reference Ontology (BORO)™ Methodology.
- IDEAS Foundation has been exploited by US DoD for DODAF 2.
- MODEM (MODAF Ontological Data Exchange Model) is the result of a Swedish led effort within IDEAS aiming for an evolution of M3 by exploiting the IDEAS foundation.

Rationale on one slide

- **MODEM has been developed to be used by the tool vendors in order to create a means of unification, reusability and exchange of architectural artefacts between different tools.**
- **MODEM is an evolution of M3 based on IDEAS work.**
- **MODEM will, together with the national architecture frameworks in the IDEAS nations, be a building block for a future common defence standard.**
- **NATO will be invited to make use of MODEM in NAF.**

The Swedish Armed Forces (SweAF) involvement

- **The Swedish Armed Forces Joint CIO - Capt (N) Peter Haglind is the Swedish Armed Forces government sponsor for MODEM.**

- **The requirement is practical applicability in terms of a stable product that can act as a means of standardization between UML tool vendors and non-UML tool vendors for defence EA purpose.**

The Swedish Armed Forces (SweAF) involvement

- **Defence EA needs to be standardized so that data exchange in a semantic coherent way can be achieved regardless of repository or tooling environment.**

- **MODEM should be recognized as the current standard semantic foundation and the quality assured baseline for the future development towards defence EA framework convergence.**

The history and current status of

- During the late summer (August) 2010 and throughout the autumn of 2010, two phases of IDEAS foundation integration in MODAF M3 1.2.004 have taken place with the aim of creating a semantic meta-model independent of UML implementation constraints labelled MODEM.

- Phase 1 concentrated on elements within the views OV-2 and OV-5 and also the bridging and pattern constructs needed to go from the foundation to the MODAF M3 based elements.

The history and current status of

- **In November 2010 phase 2 started which concentrated on dealing with the behaviour pattern within UML as well as the remaining StV view, the SOV view, the SV view and the AcV views elements.**

- **As phase 2 was completed and delivered in March 2011, some 60% of MODAF M3 was covered.**

- **Phase 3 has started in December 2011 with the aim of completing the MODAF M3 coverage by the end of august 2012.**

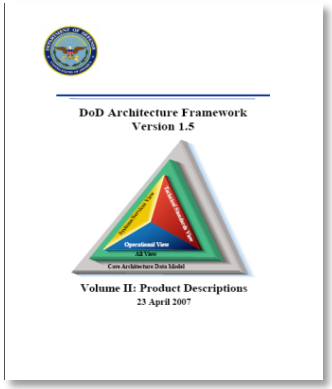
Architectural frameworks

There are a lot of different frameworks and standards

TOGAF

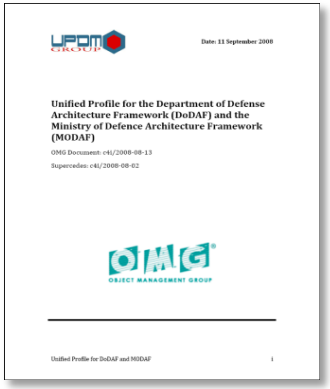
NAF 3.1

DoDAF v1.5


DoD Architecture Framework
Version 1.5

Volume II: Product Descriptions
23 April 2007

UPDM

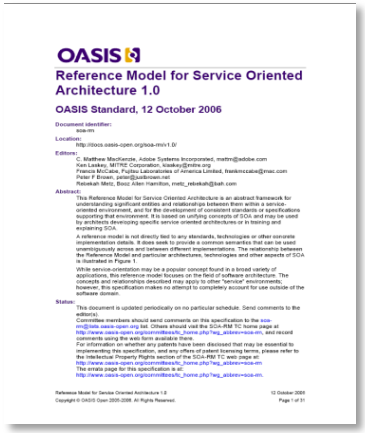

Unified Profile for the Department of Defense Architecture Framework (DoDAF) and the Ministry of Defence Architecture Framework (MODAF)

SoaML


Service oriented architecture Modeling Language (SoaML) - Specification for the UML Profile and Metamodel for Services (UPMS)

OMG Adopted Specification
Finalisation Task Force Beta 2 document (FTF Beta 2)

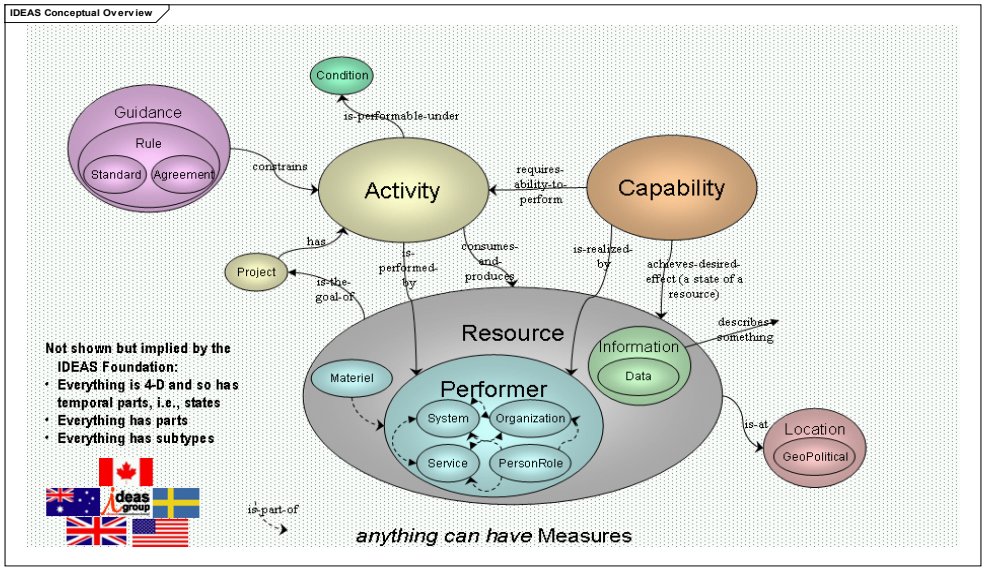
OASIS


OASIS

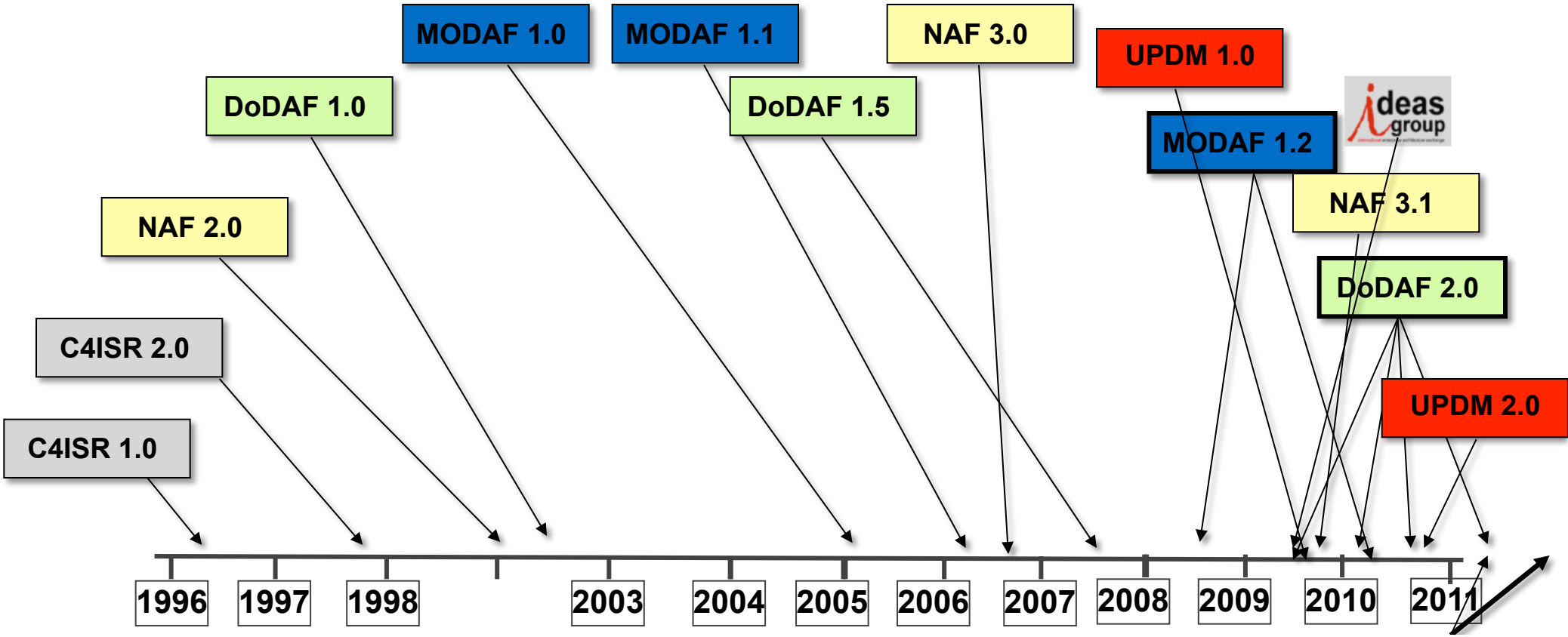
Reference Model for Service Oriented Architecture 1.0

OASIS Standard, 12 October 2006

DoDAF 2.0



Frameworks in different versions have been around for awhile....



modem

What do defence EA frameworks provide?

- **Prior to MODAF 1.0, DoDAF as well as NAF (version 2.0) were really about filling out defined forms based on written instructions as to what to include in each form.**

- **MODAF 1.0 was a first attempt at providing a meta-model (called M3) where the elements in each form (views) were defined and where it was shown how they related to one another.**

What does a semantic meta-model for an architecture framework provide?

- It could be said that the MODAF/ NAF meta-model provides a grammar for speaking architecture in accordance with a framework.

- It defines the type of words that may be used and how they can be combined (related) to form architectural “sentences”.

What does modem give us that MODAF M3 does not ?

a semantic foundation for enterprise architecture

- **Consider the following text:**

  'Twas brillig, and the slithy toves
  Did gyre and gimble in the wabe;
  All mimsy were the borogoves,
  And the mome raths outgrabe.

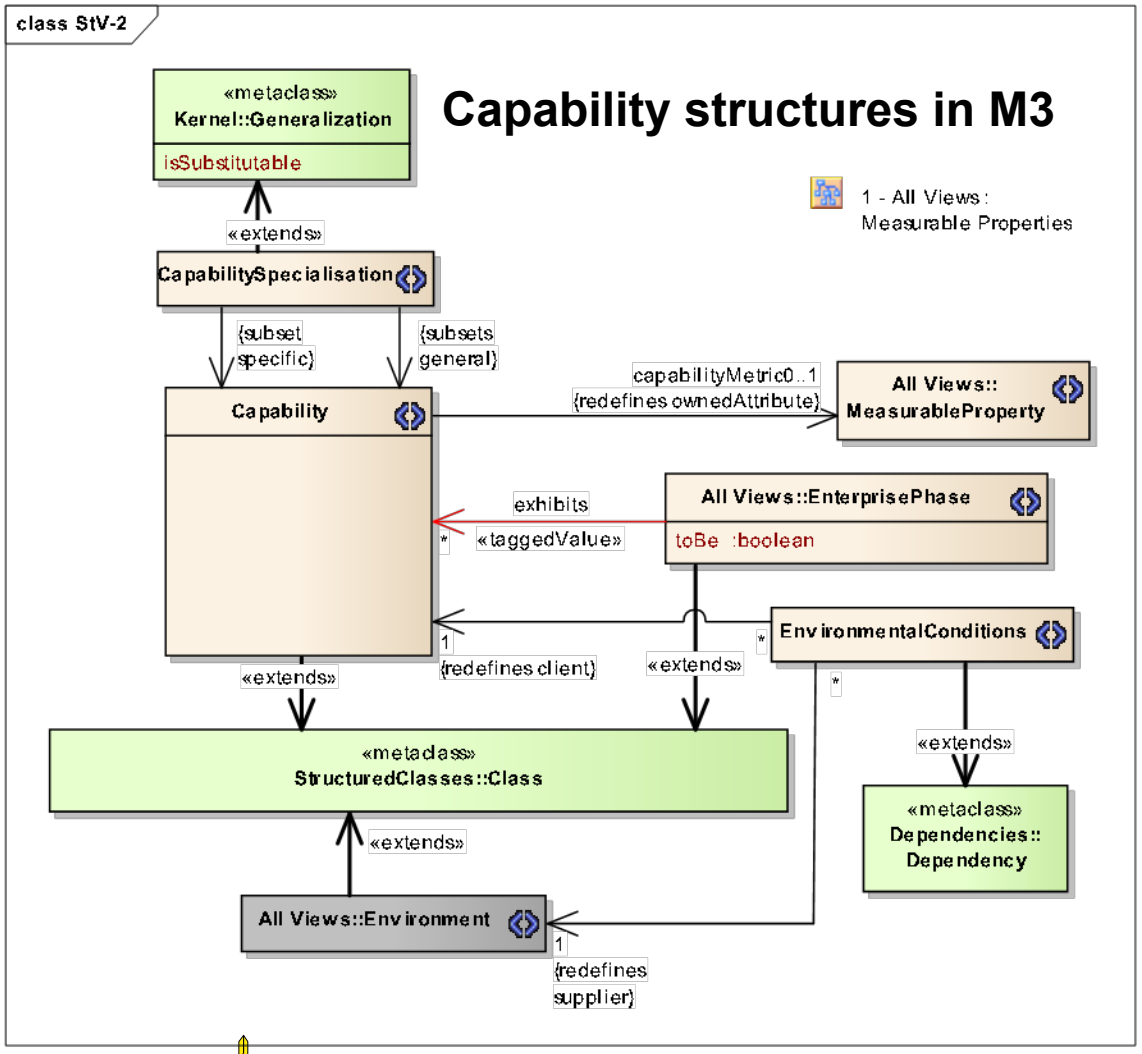
  - A portion of Jabberwocky: A poem by Lewis Carroll published as part of: Through the looking-glass, and what Alice found there (1872)

An analogy .....

- **While the grammar of the poem is sound, i.e. adjectives, nouns and verbs can be identified and they seem to relate to one another as they should, the meaning is less than clear.**

- **The difference between MODAF M3 and MODEM could be visualised by saying that in MODAF M3 the Jabberwocky poem would be accepted as correct as it only checks the grammar, whereas MODEM would also provide the semantic meaning.**

An example ...Capability



- **MODAF M3 defines Capability textually in the following manner:**
  - **A high level specification of the enterprise's ability.**
  - Note: A capability is specified independently of how it is implemented.
- ***But what is Capability?***
- The definition makes at least the author less than sure.

What is capability in MODEM?

The set of everything

The set of all sets

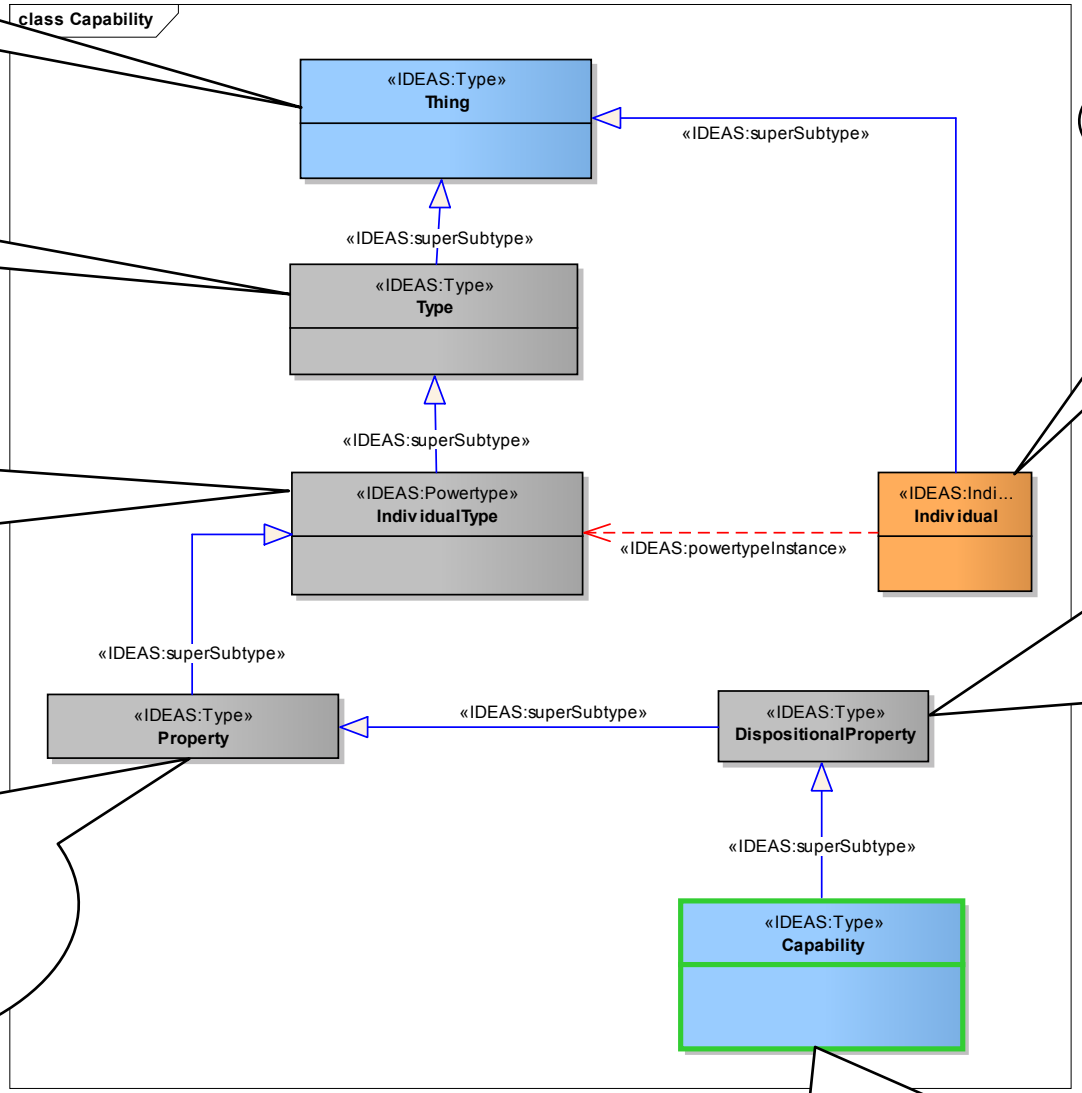
The set of all subsets of the set of all individuals

The set of all individuals

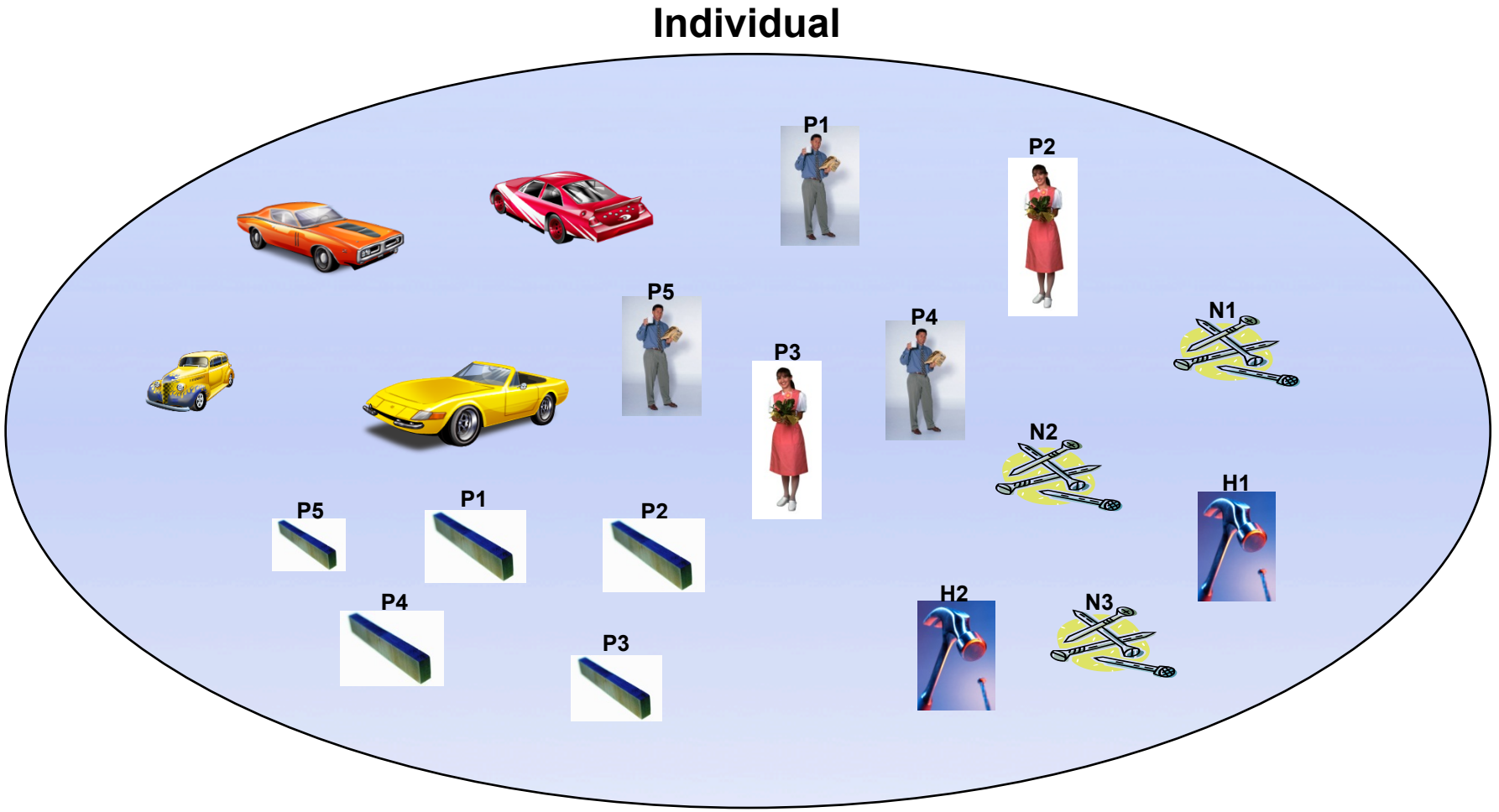
A subset of individualType where the instances refer to sets whose members (individuals) all exhibit a common trait or feature

A subset of the Property set where the instances refer to sets whose members are Individuals that have the property of being capable to manifest a Property under certain conditions

A subset of DispositionalProperty where the instances refer to sets whose members are capable of achieving a particular outcome.



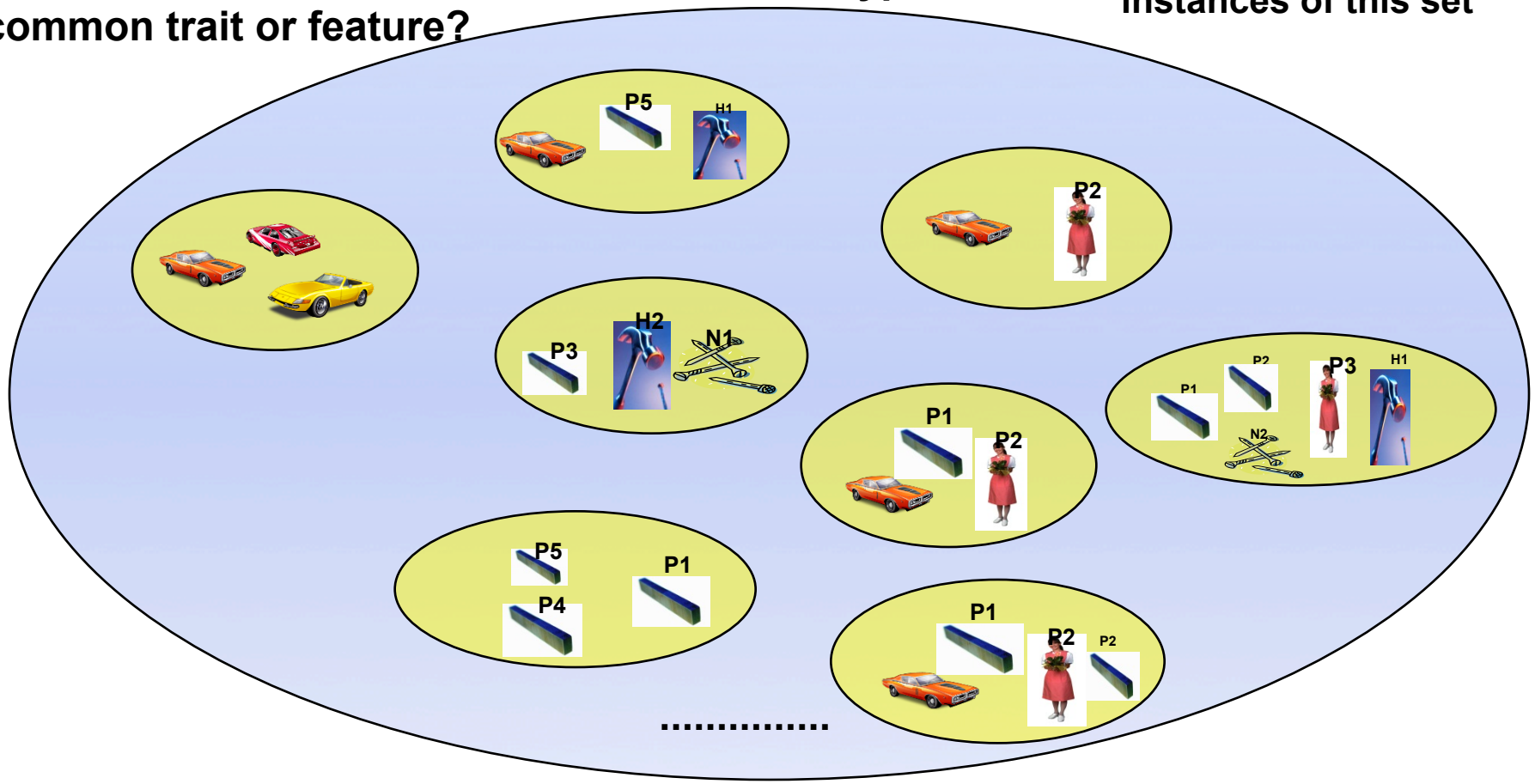
It is probably best to exemplify this .....



The Individual Type .....

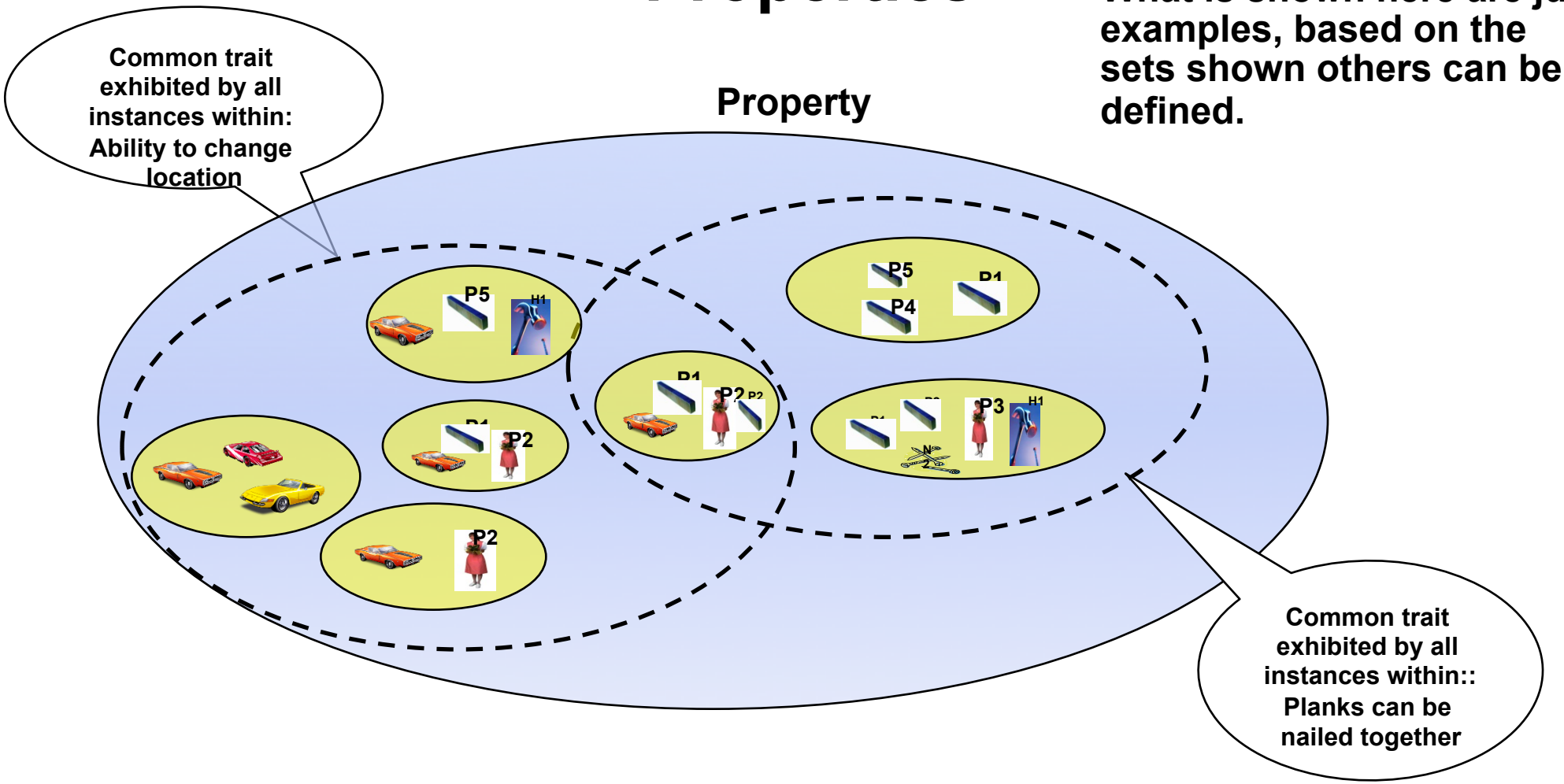
- Which of these sets share a common trait or feature?

- Given the number of individuals shown, there are more than 524288 possible instances of this set

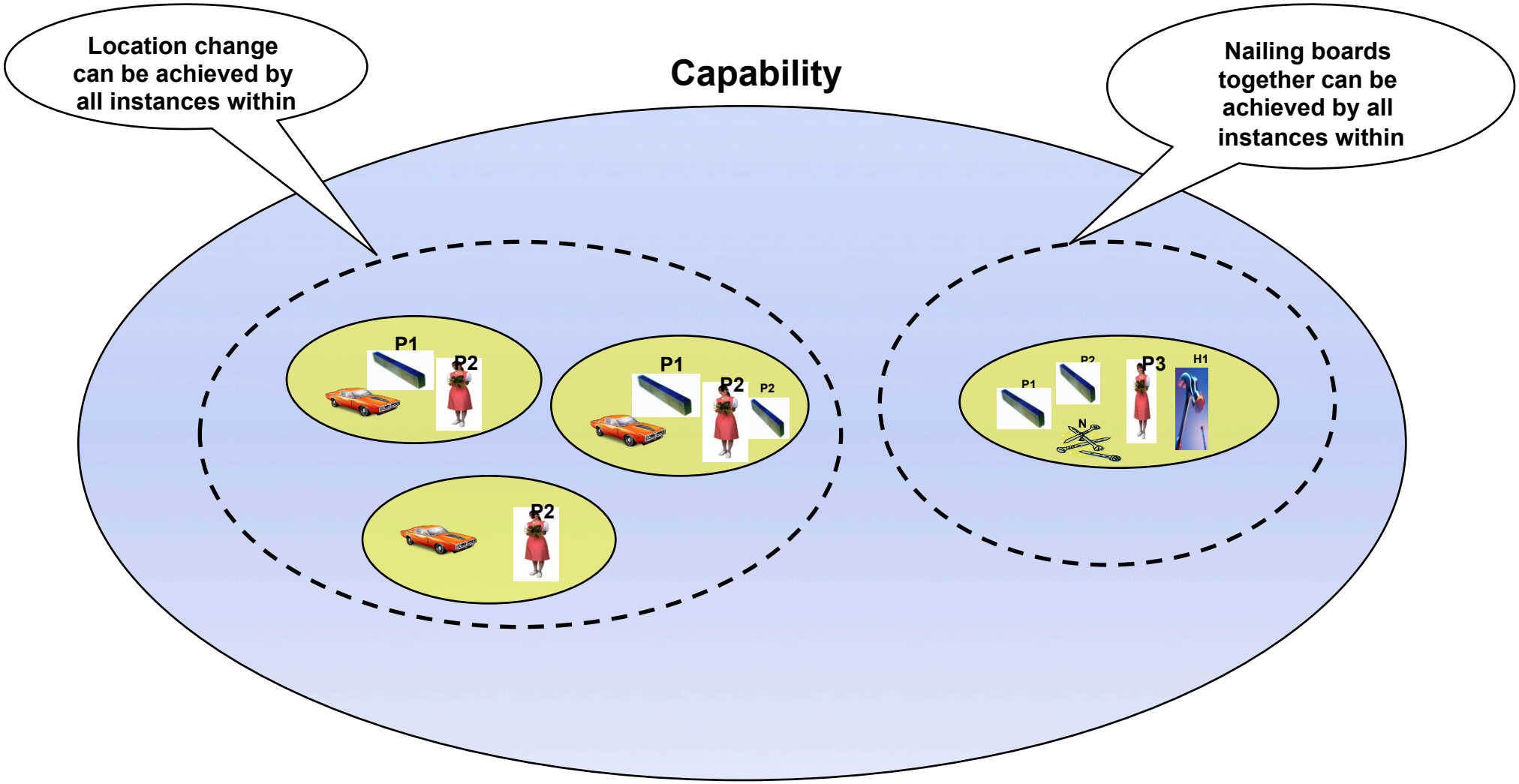


Properties

- What is shown here are just examples, based on the sets shown others can be defined.



Capabilities .....

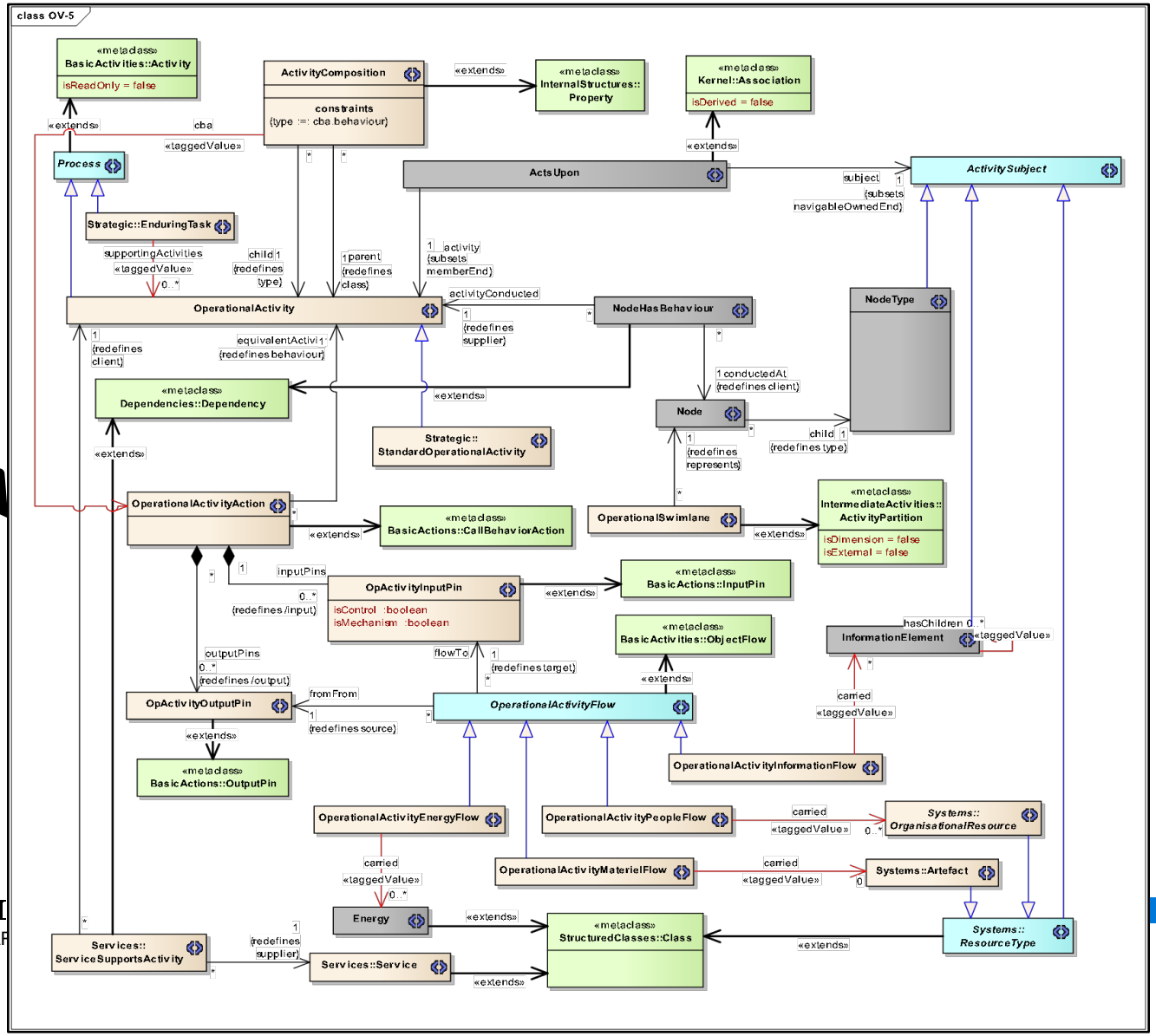


modem

a semantic foundation for enterprise architecture

simplifies the meta-model

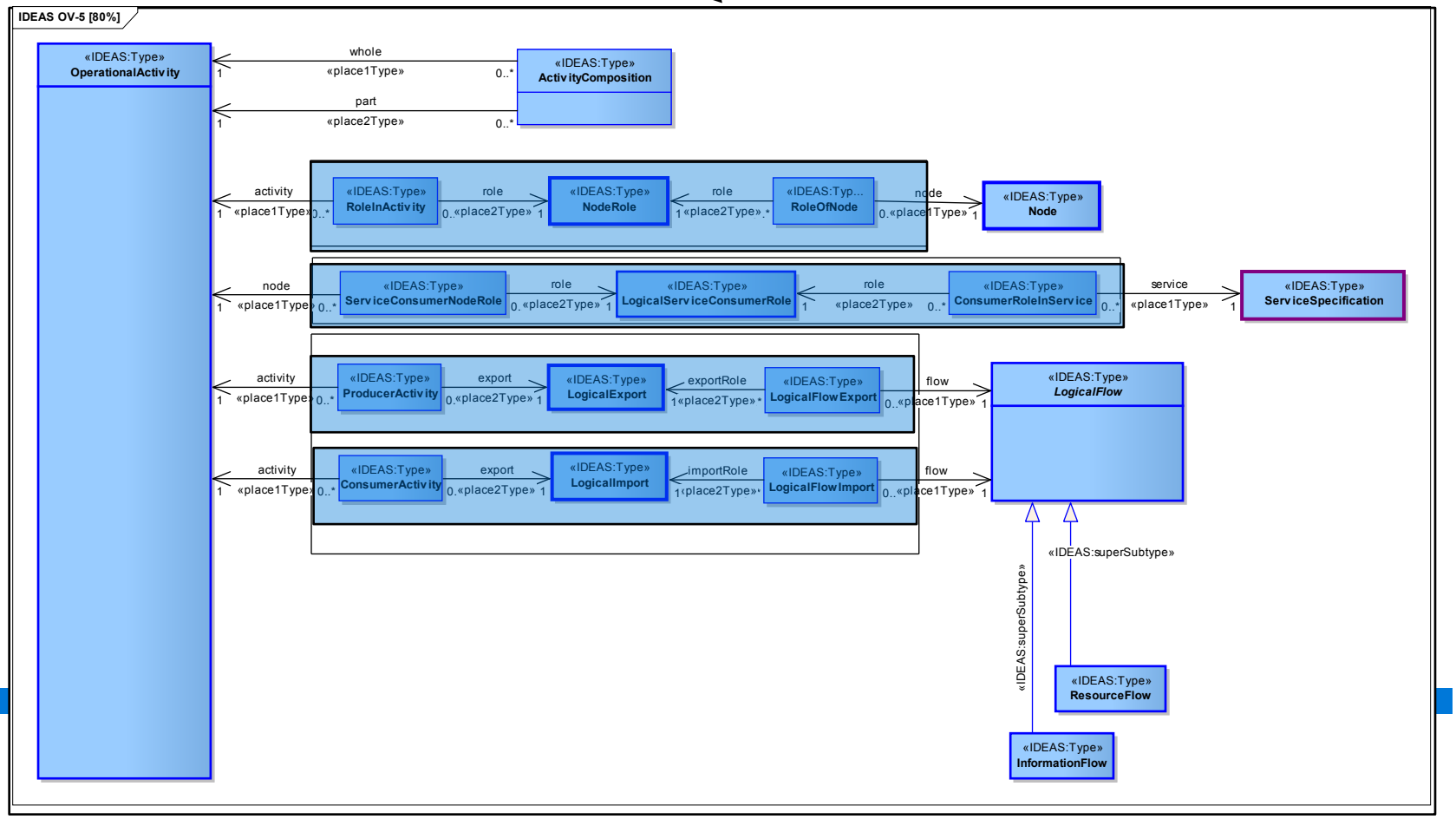
This is the meta-model for OV-5 in MODAF M3



modem simplifies the meta-model

a semantic foundation for enterprise architecture

This is the OV-5 equivalent in Modem



Semantic technology

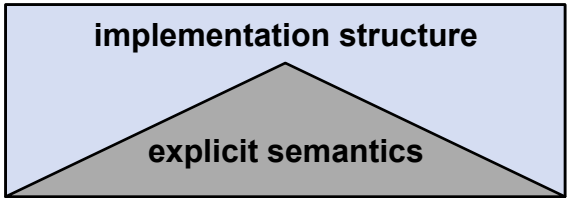
Harvesting the semantics for MODEM

- **There is a significant investment in MODAF, both directly in the MODAF meta-model and users' models and indirectly in the investment in UML. The MODEM migration aims to harvest and build upon this investment.**

Harvesting the semantics for MODEM

- **The MODEM migration aims to:**
  - harvest the relevant features of UML and the MODAF meta-model and migrate them to MODEM,
  - winnow out the irrelevant technical features – particularly the constraints that were siloing the UML meta-model and the MODAF meta-model built upon it,
  - provide a clearer picture of the enterprise – one which reveals the common underlying business patterns across what previously appeared as very different areas, and
  - provide a migration path for the existing MODAF models.

Harvesting the m3 semantics



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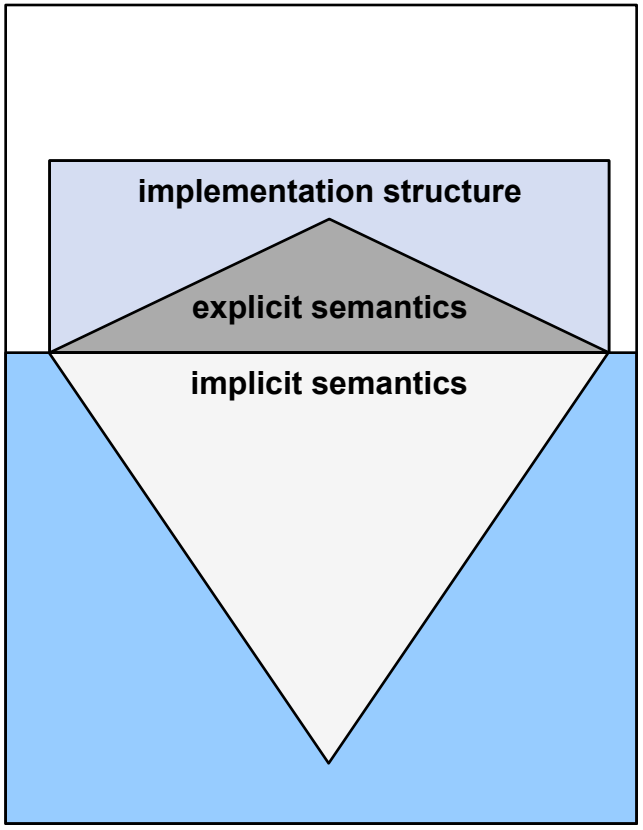
M3 was designed as a UML profile.

As a result it has both implementation structure and (explicit) semantics

Harvesting the m3 semantics



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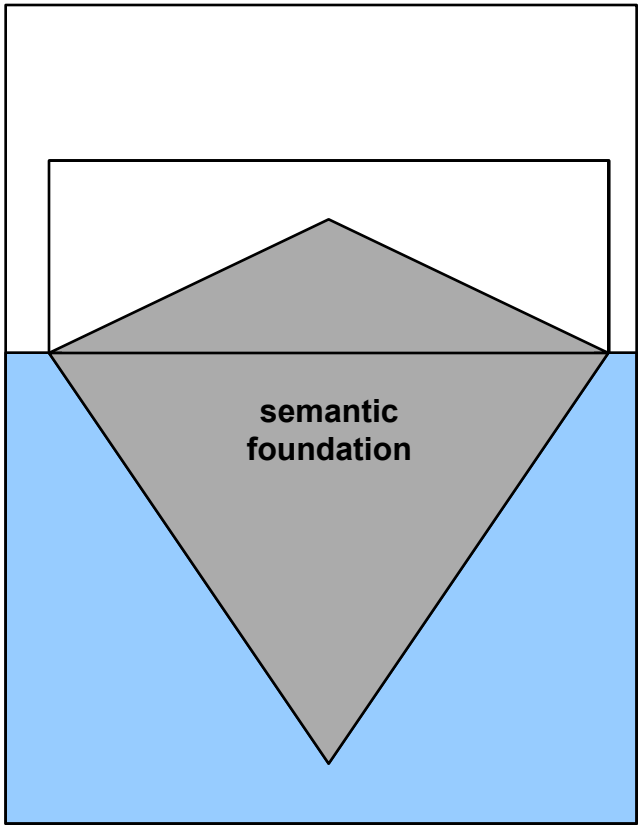
From a semantic perspective, it is like an iceberg, with visible 'explicit semantic' and hidden 'implicit semantics'.

Harvesting the m3 semantics



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M3 was designed as a UML profile.

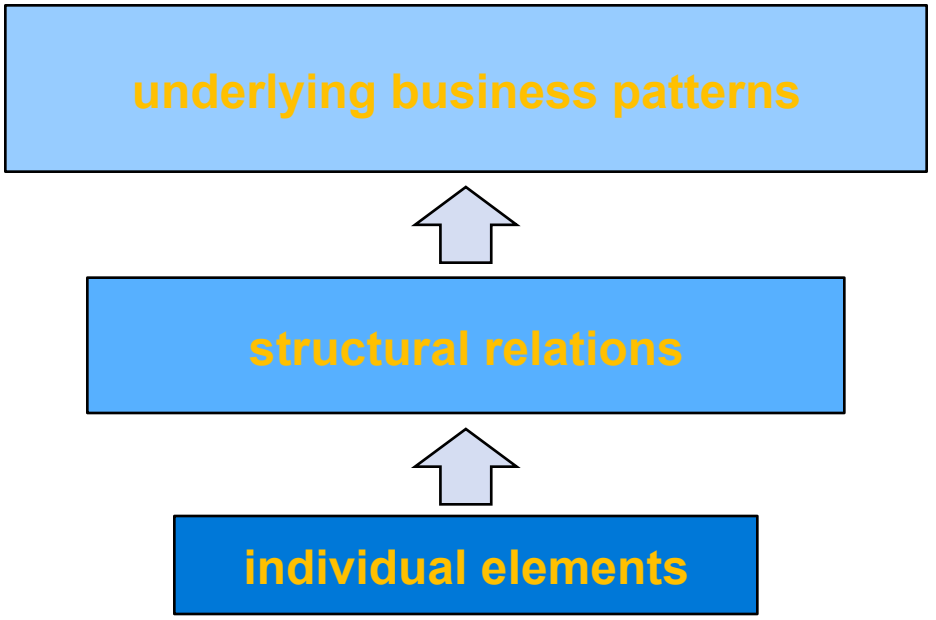
As a result it has both implementation structure and (explicit) semantics

From a semantic perspective, it is like an iceberg, with visible 'explicit semantic' and hidden 'implicit semantics'.

The goal is to:

- Peel off the implementation structure, and
- Make the implicit semantics explicit

Background:
Three levels of semantic maturity



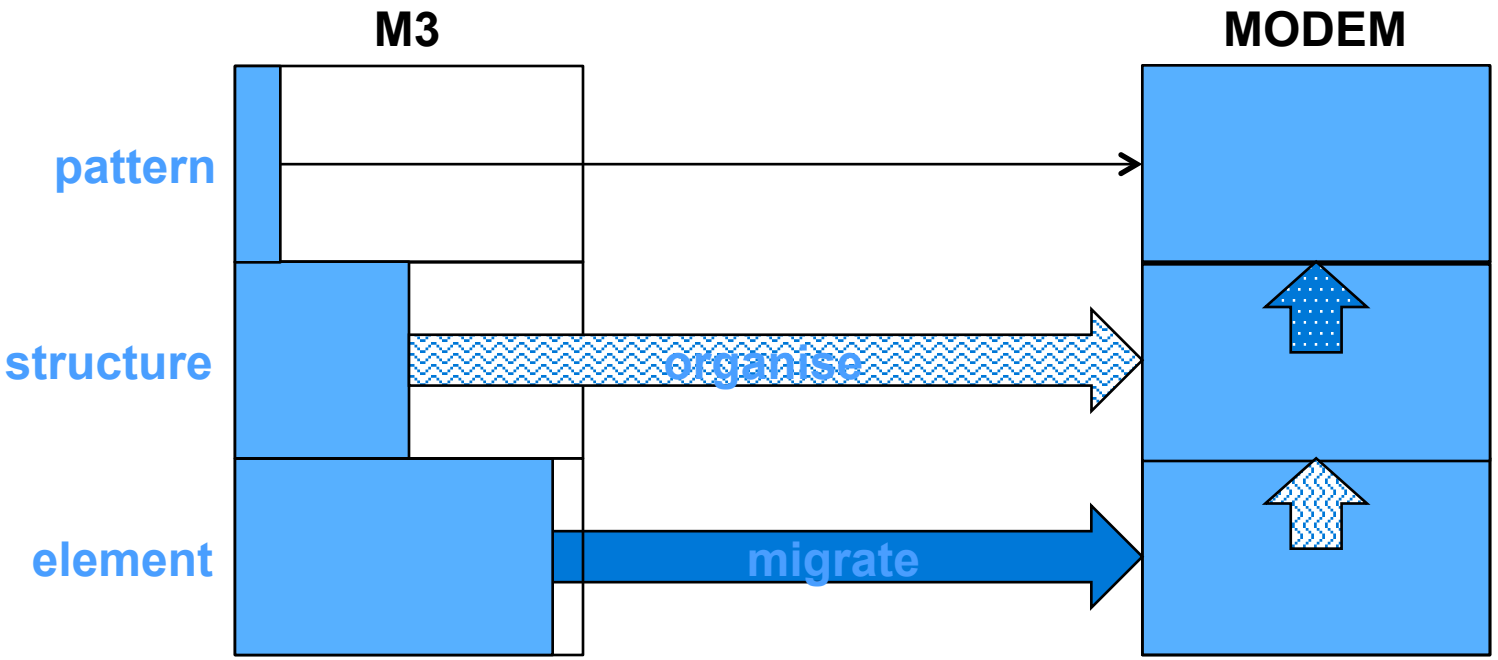
identify the general business patterns

organise the structural semantic backbone

semantically fix the individual items

Need to build MODEM at these three levels

migrating ‘M3 content’ semantics

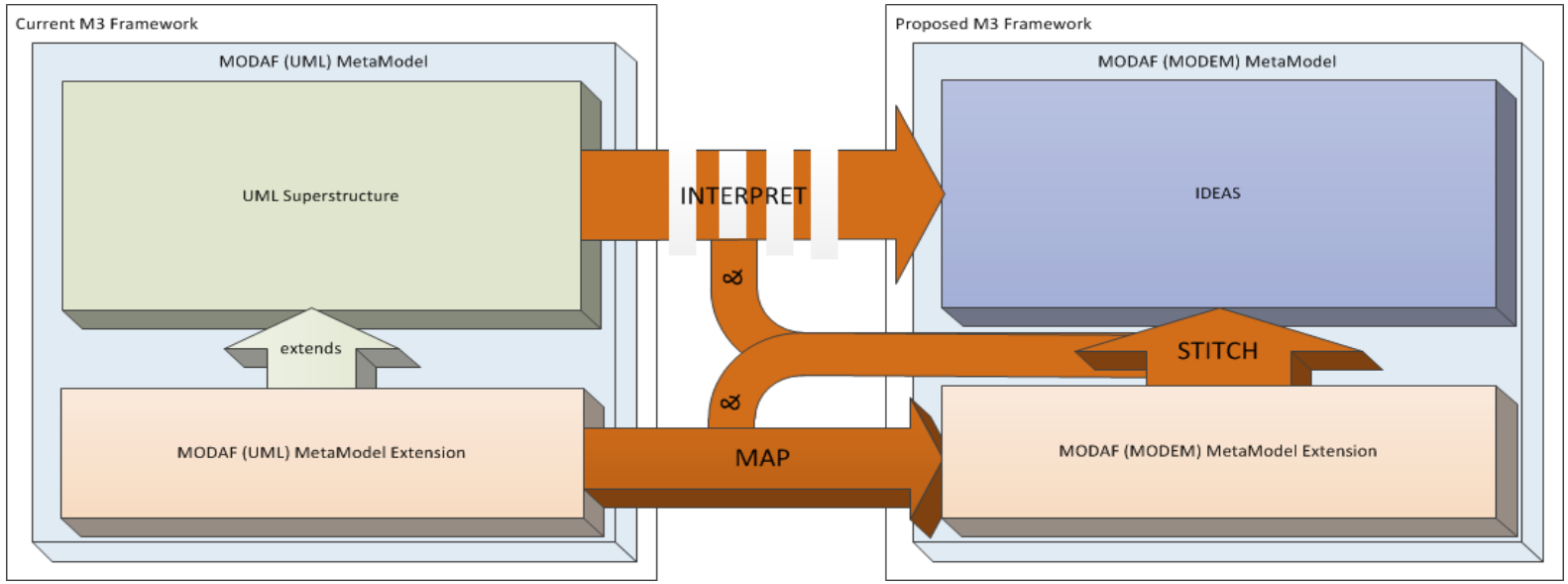


M3’s semantic content is strong at the individual elements level, but progressively weaker at the higher levels

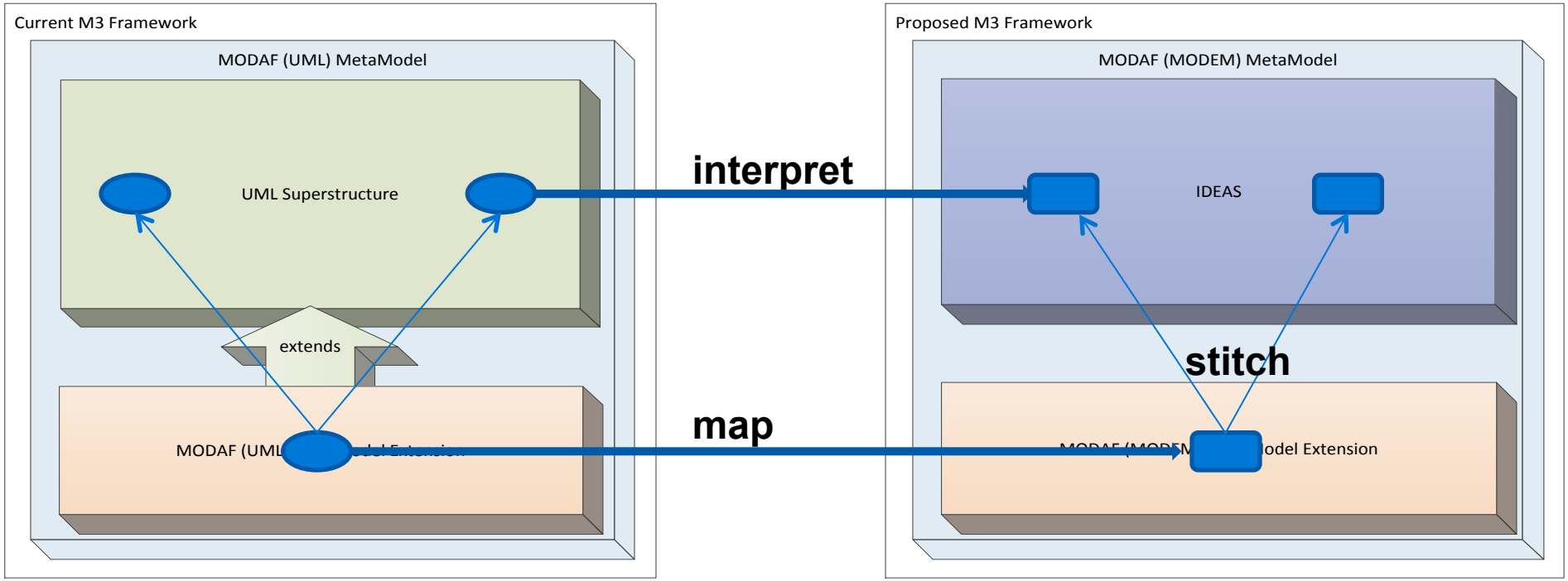
hence, a different build process for each level

MODEM Element Migration

- **Element Migration has three components, typically done in unison:**
  - Map,
  - Stitch and
  - Interpret.



MODEM Element Migration
Map, interpret and stitch



Note: some stitching into IDEAS will be driven by the semantics rather than the UML meta-model.

Map, interpret and stitch

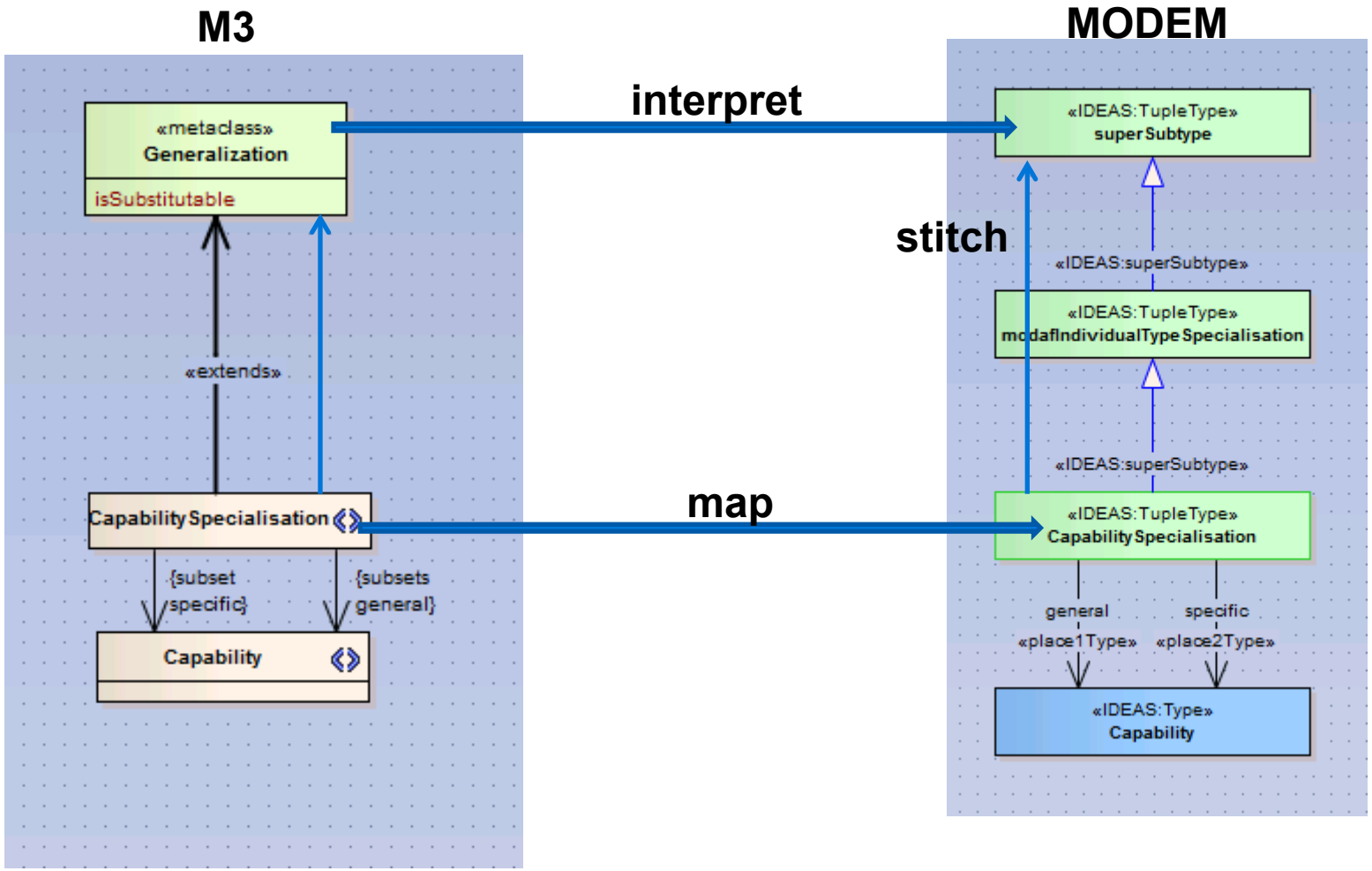
- **Mapping**
  - drives the migration
  - scope is total (most objects need to be migrated)
  - is typically one-to-one
    - » **does not always preserve shape**
      - A box could map to a line, a line to a box
        - i.e. finer or coarser grained
- **Stitching**
  - Guided by (1) interpretation and (2) implicit semantics
    - » **Reveals implicit semantics**
- **Interpretation**
  - guides the stitching
  - scope is partial
    - » **only semantically relevant structure is matched**
      - IDEAS structure is a good guide to what is semantically relevant

Building the core semantic structure

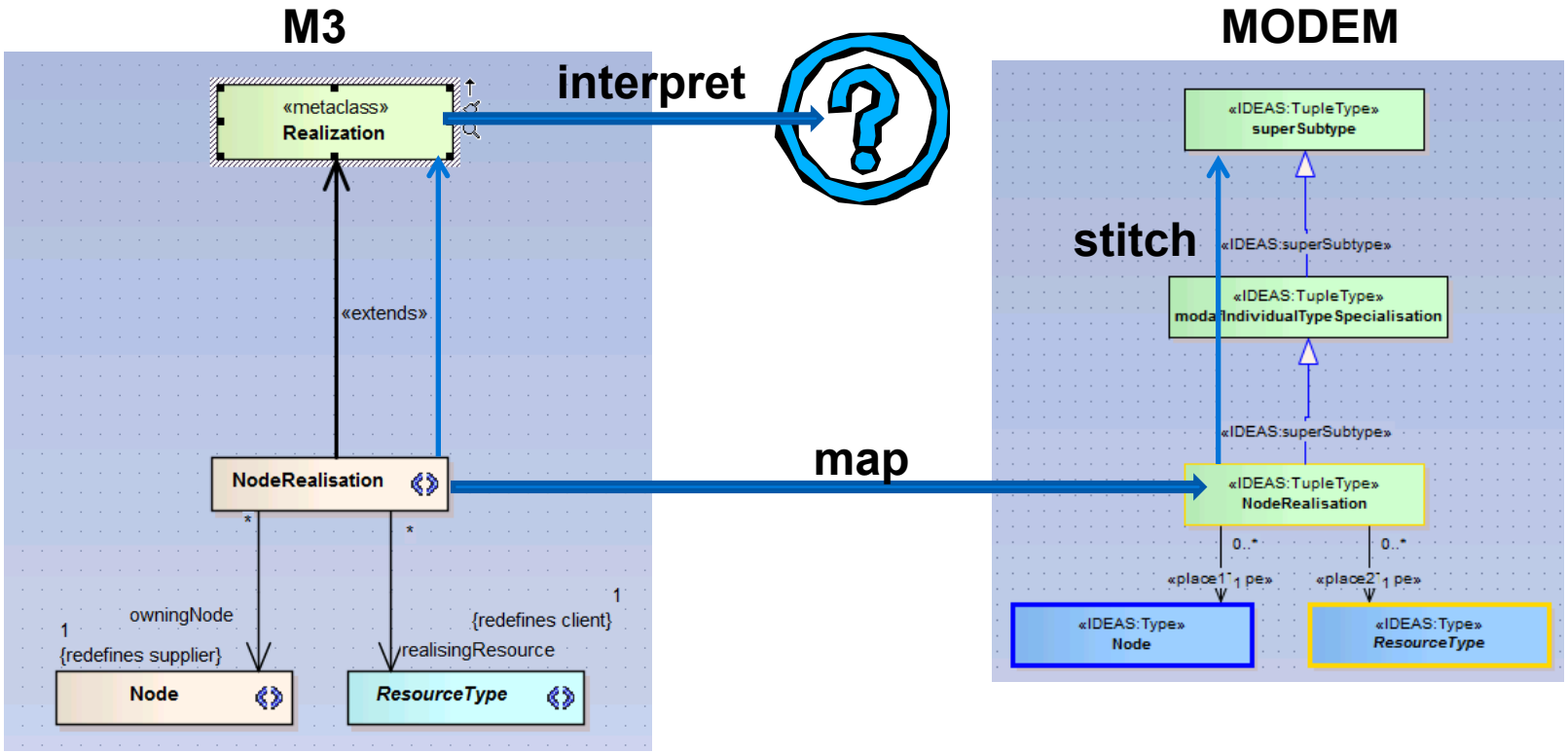
- **There are three core structural semantic relations that typically form the structural skeleton for semantic models:**
  - Super-sub-type
  - Type-instance, and
  - Whole-part

- **M3 – as a UML profile – does not have all the explicit semantics for these.**

Simple example

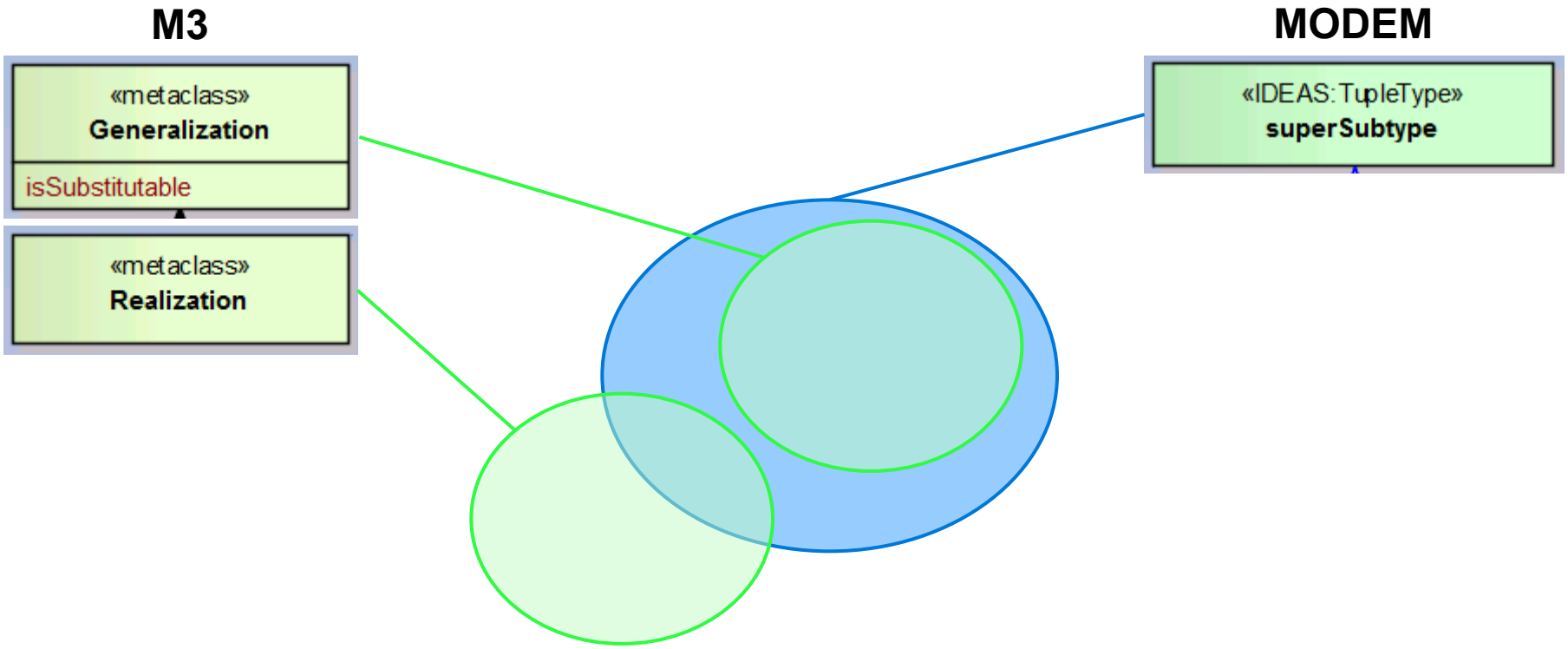


Another example



Issue here is that things other than 'Generalisation' map onto superSubType. And that other extensions of 'Realization' map onto things other than 'Generalisation'

Mismatching structure (within M3)

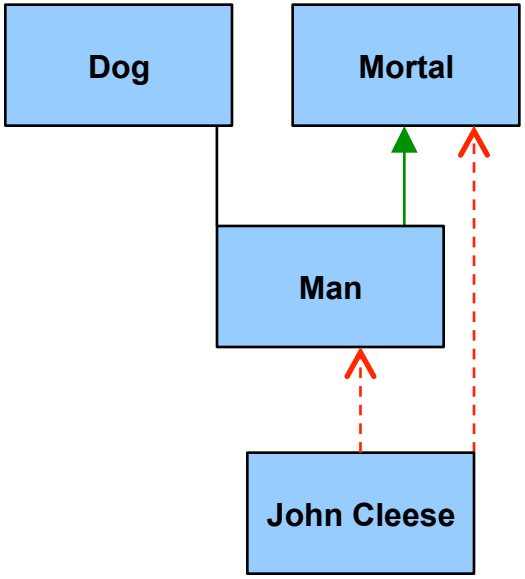


Need to harvest where it matches, and
Refine where it does not.
M3's explicit semantics does not capture all the core semantic structure

Why semantics can be important

The problem with not knowing all the super-sub-types

Semantic Model

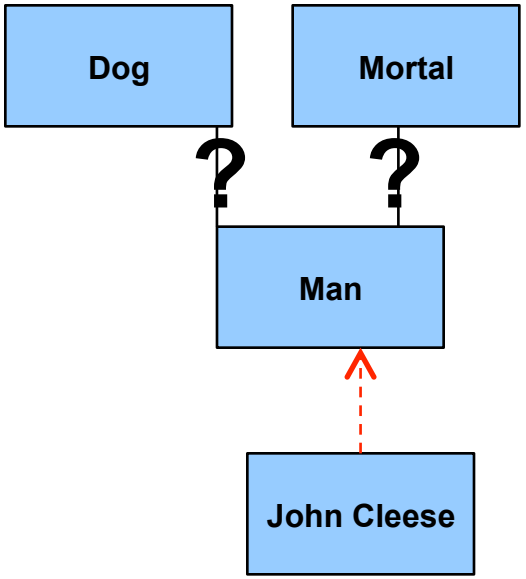


John Cleese is a man

Men are Mortal
Dogs are Men's best friend

John Cleese is Mortal

Non-Semantic Model



If we do not identify the semantics, we cannot make the inference.
And, in a sense, the model does not know what the link 'means'.

MODEM patterns and examples

Patterns

- **As part of the integration efforts patterns of repeatable relationships between different types of elements have been identified and included as part of MODEM**
- **These patterns are quite powerful and have been reused again and again as part of the reengineering effort.**
- **The basic set of patterns include examples such as:**
  - Overlap and intersection
  - Exchange
  - Behaviour
  - Agent
  - Process

Patterns

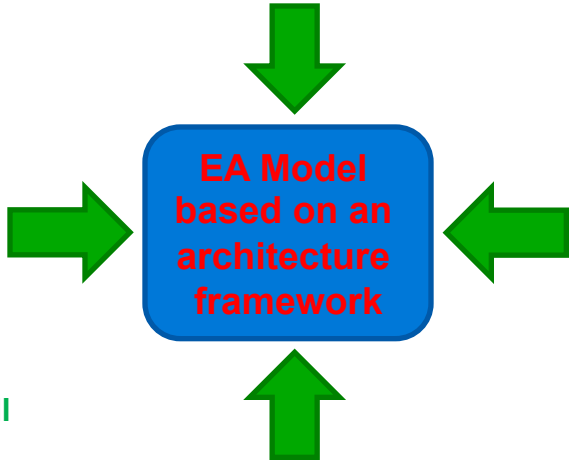
- **It should be remembered that an architect interested in developing an architecture model is not expected to work directly with these patterns but at a much higher level where the detailed structure, while existing within the tool supporting the architecture model development, will be invisible.**

- **MODEM representation is required in order to be able to achieve semantic interoperability when exchanging architecture data and in order to facilitate detailed queries towards the stored data.**

EA using a meta-model based framework should make it possible to get the model to answer questions of the following nature:

posed by a customer (examples)

- What are we capable of at a certain point in time?
- What happens if the tasks or partners are modified or exchanged?
- What happens if we reallocate resources?
- When do we achieve a specified capability?
- What capabilities do we get for the money we are spending?



dealing with traceability (examples)

- How do we deliver a given capability configuration??
- Why should we have B that costs C?
- What happens if we delete solution D?
- How does a change impact on the overall capability of the enterprise?

Dealing with transition/ change (examples)

- Can we deliver a capability configuration in time?
- What does the costs look like?
- How are requirements met?
- What to own and what to outsource?

pertaining to systems development (examples)

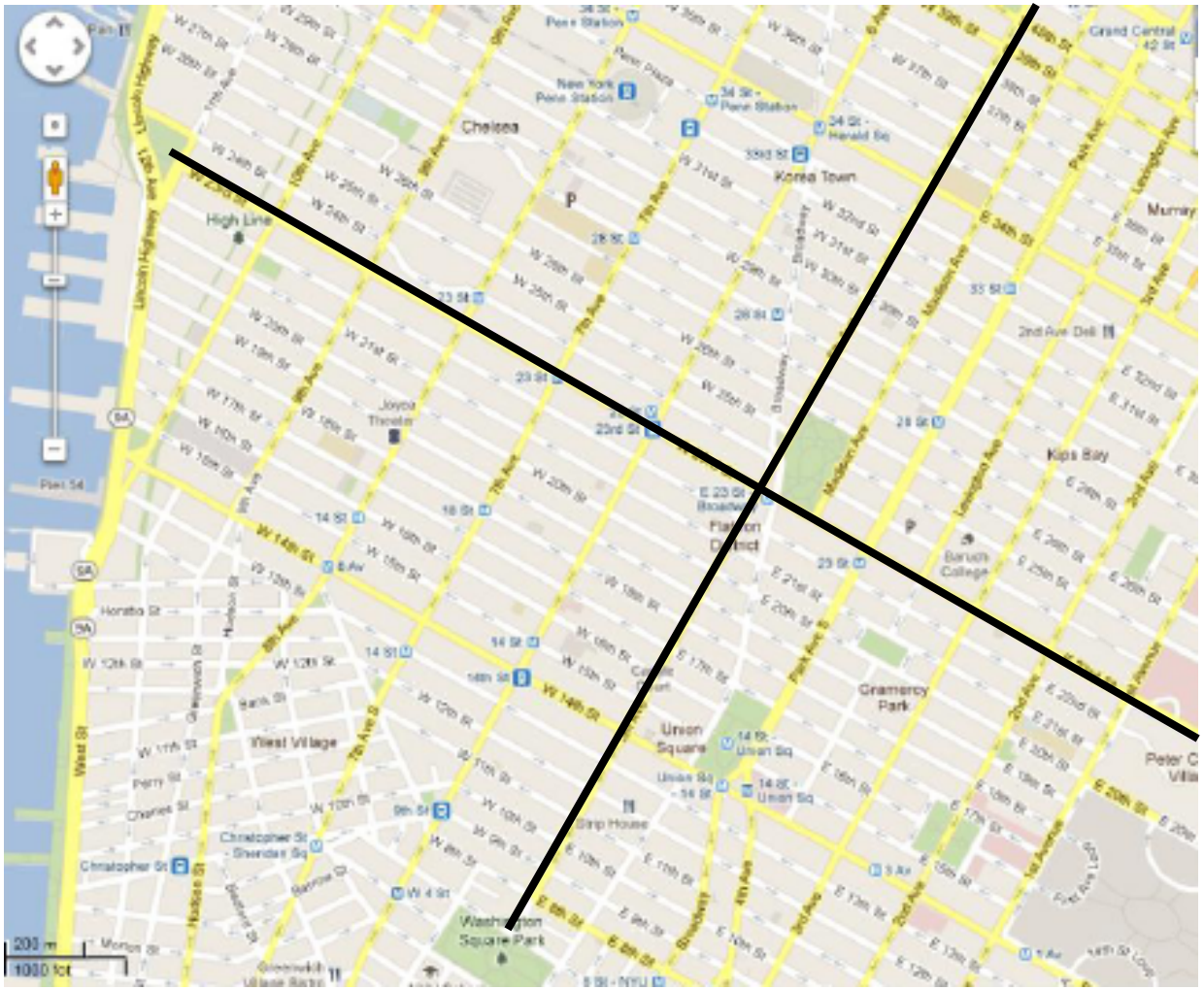
- What do the interfaces to the systems look like?
- What systems does system A interface with?
- What does the interaction between systems look like?
- What are the parts of the system?
- Are there alternative solutions?

Too often, this has not been achieved due both to the way users deal with EA and due to how tools support EA development.

Back to the Patterns.... Some descriptions

- **Overlap and intersection:**
  - Overlap deals with sets where the instances are also sets where all individuals in each instance set have a common part, i.e. they overlap. It is also possible to talk about sets overlapping.
- **Agent:**
  - An Individual capable of actively participating in Processes.
- **Process:**
  - An action with a defined start and end-time
- **Exchange:**
  - A Process where one Agent exchanges one or more Individuals with another Agent
- **Some examples would perhaps be a good idea …….**
- **Let us also try to alleviate user complexity**

Architect: I have a need to show roads that overlap as part of my architecture model



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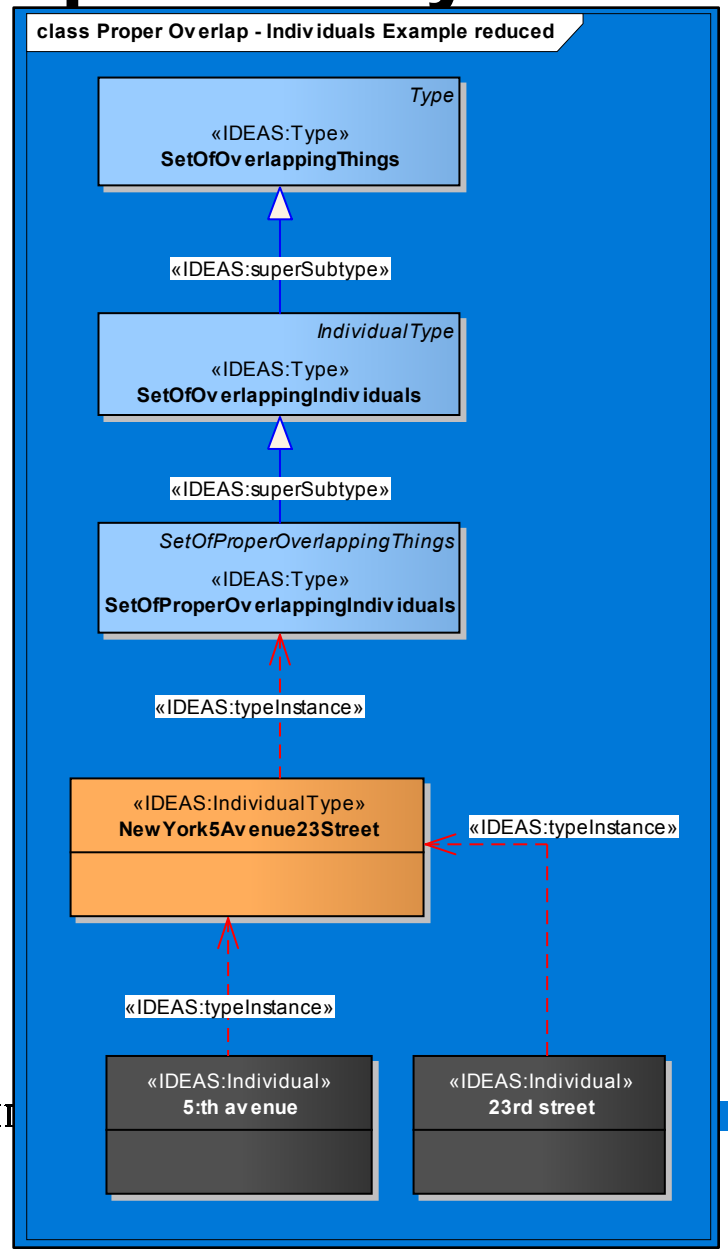
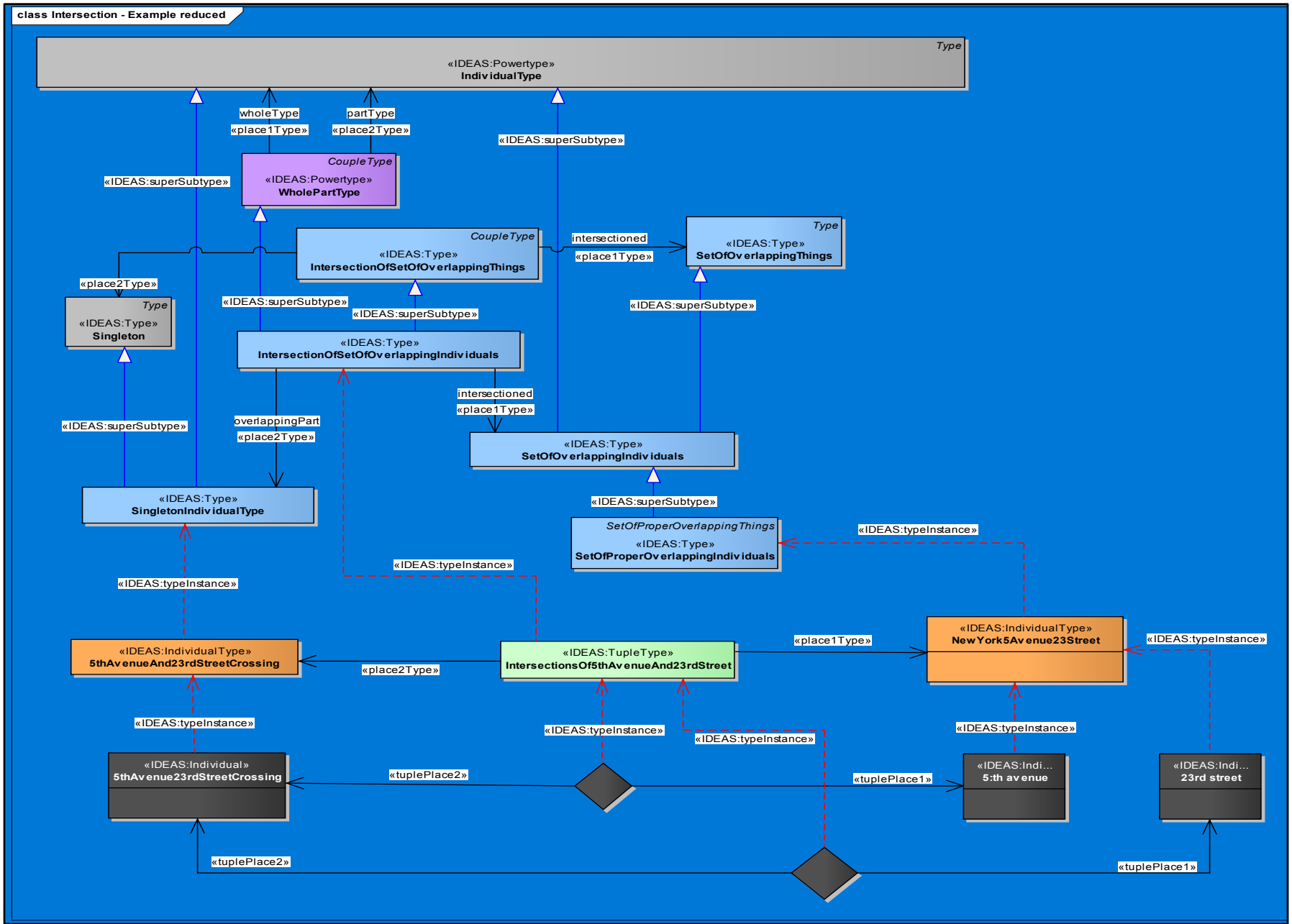
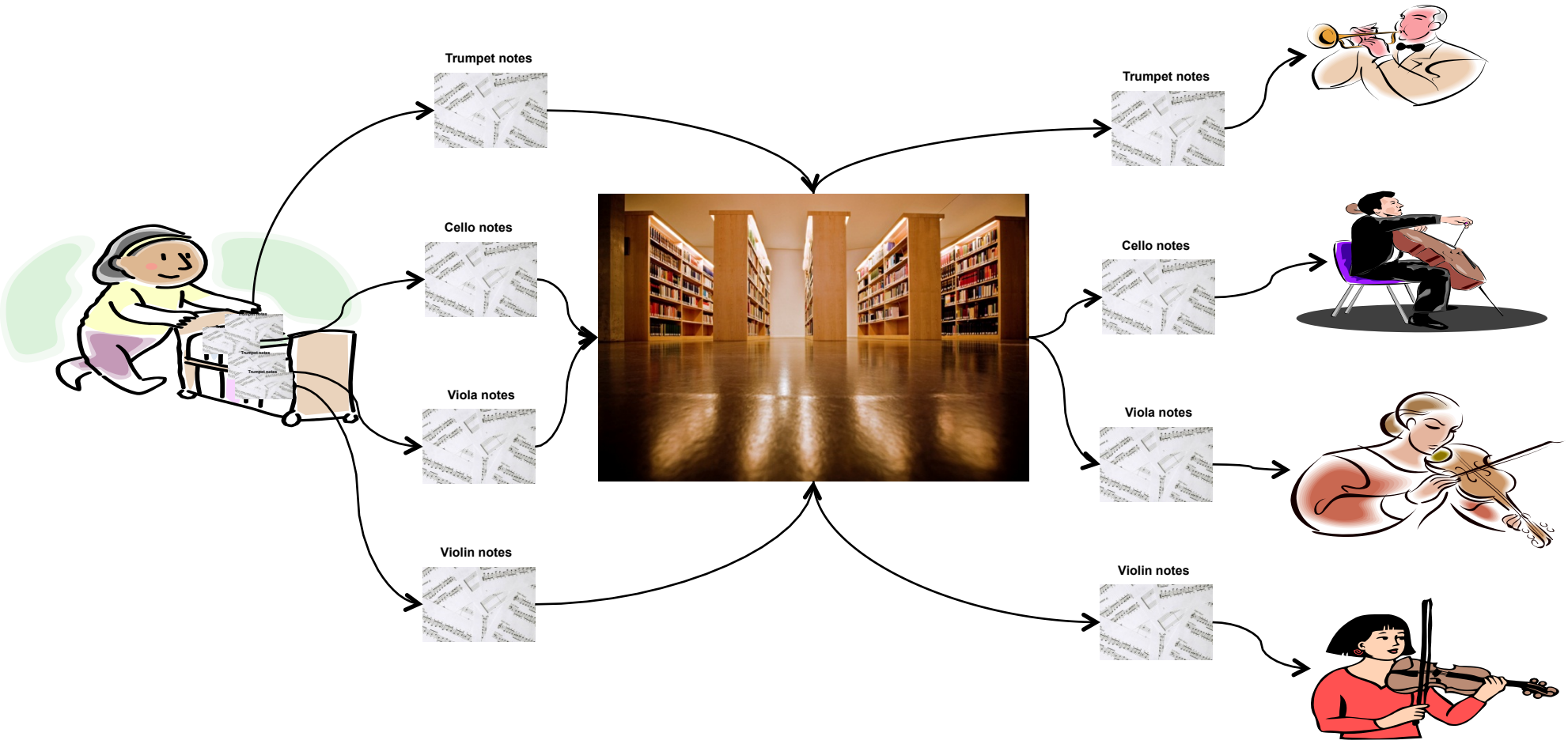


Architect: The actual intersection is of special interest

Architect: The actual intersection is of special interest



I want to show distribution (exchange) of music scores within a symphony orchestra



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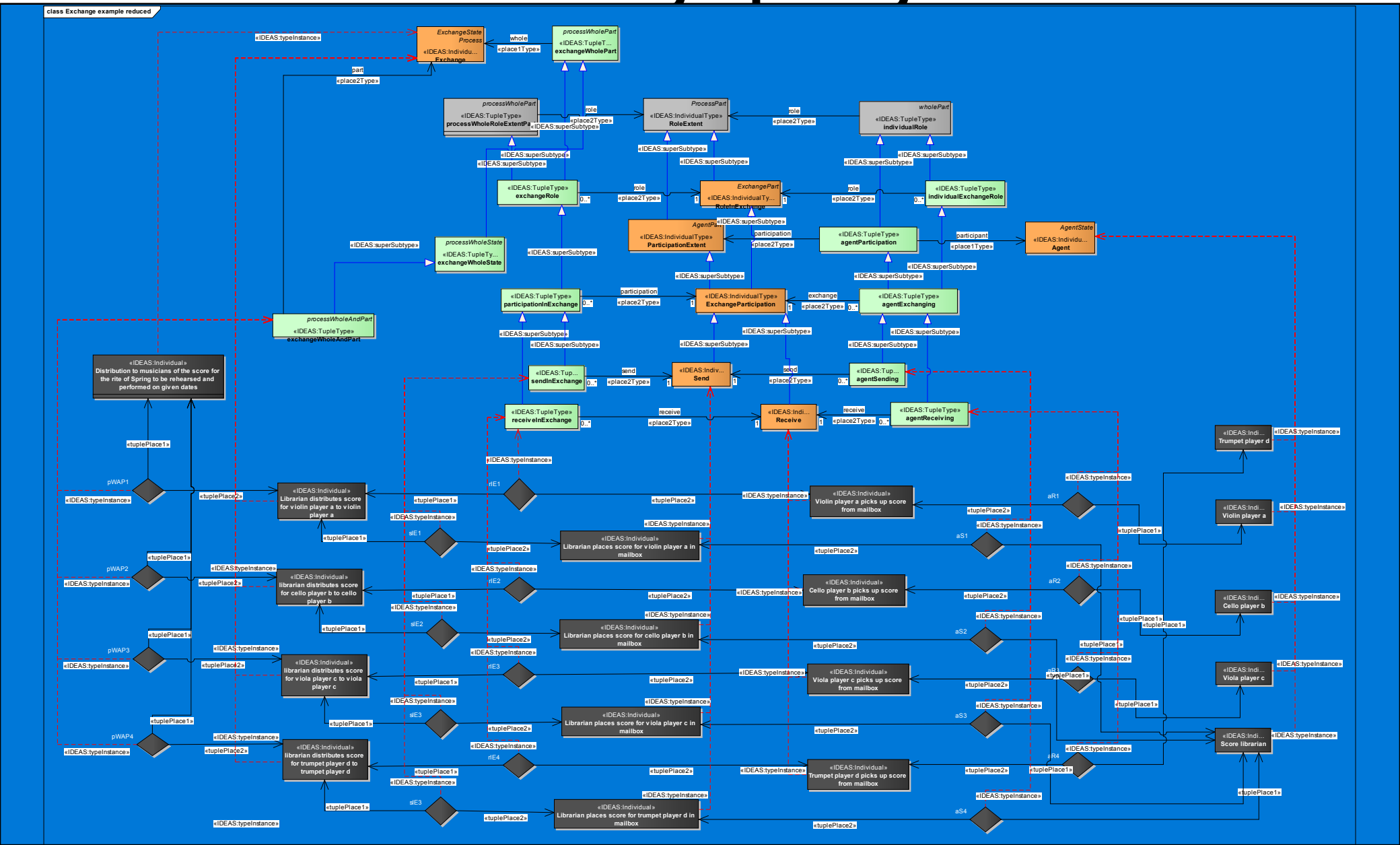
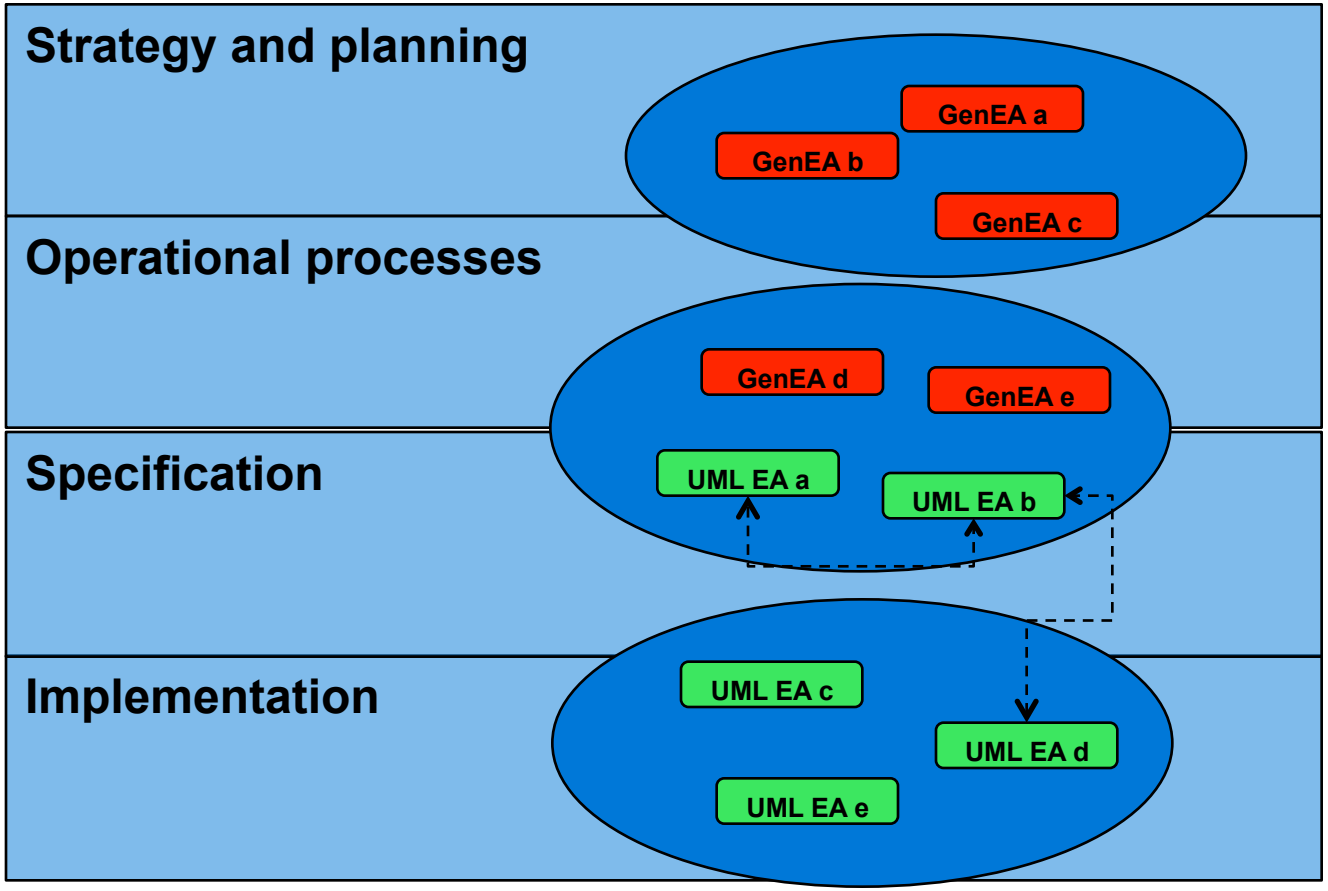
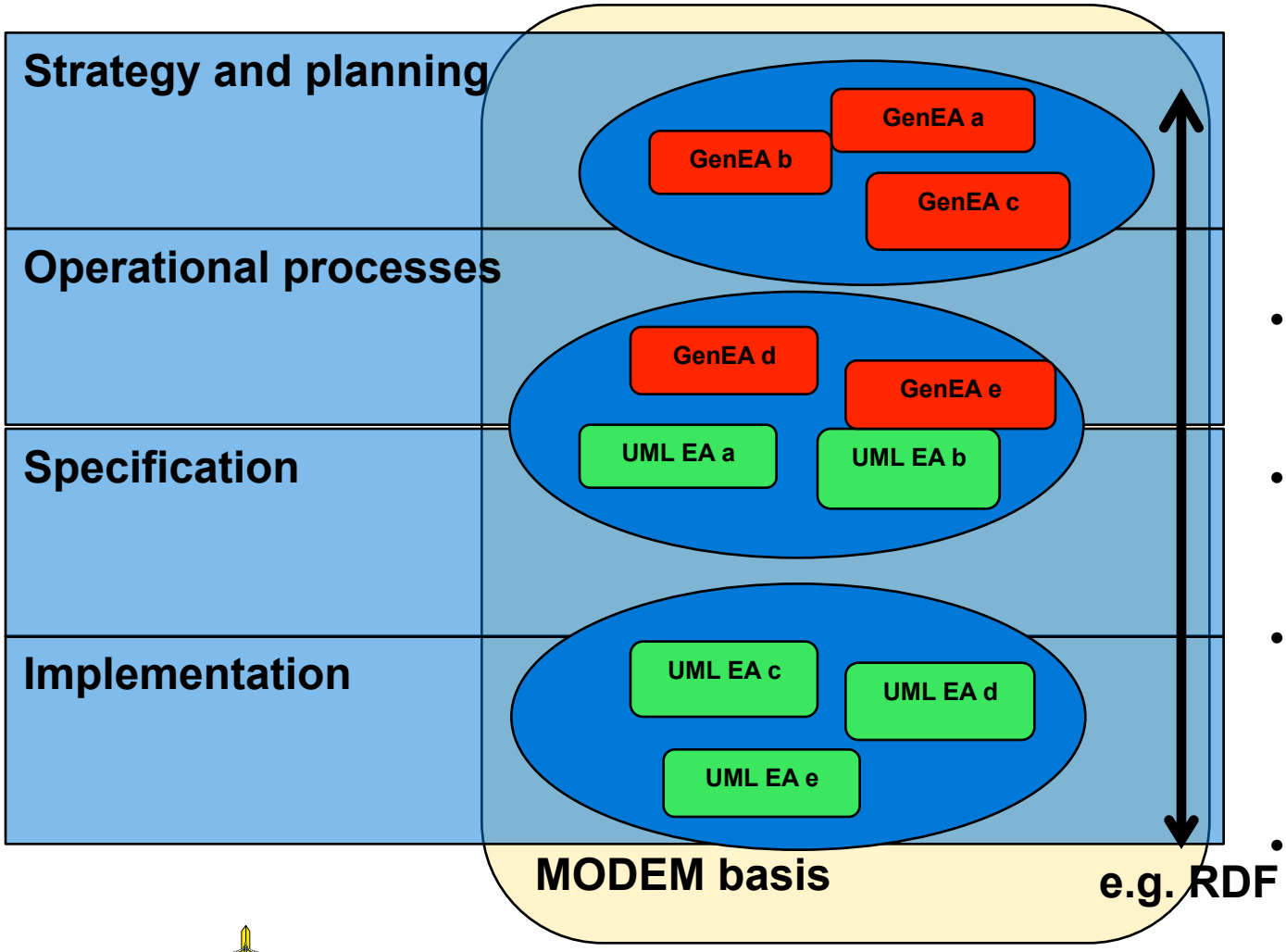


Why is MODEM needed?
Current tool situation



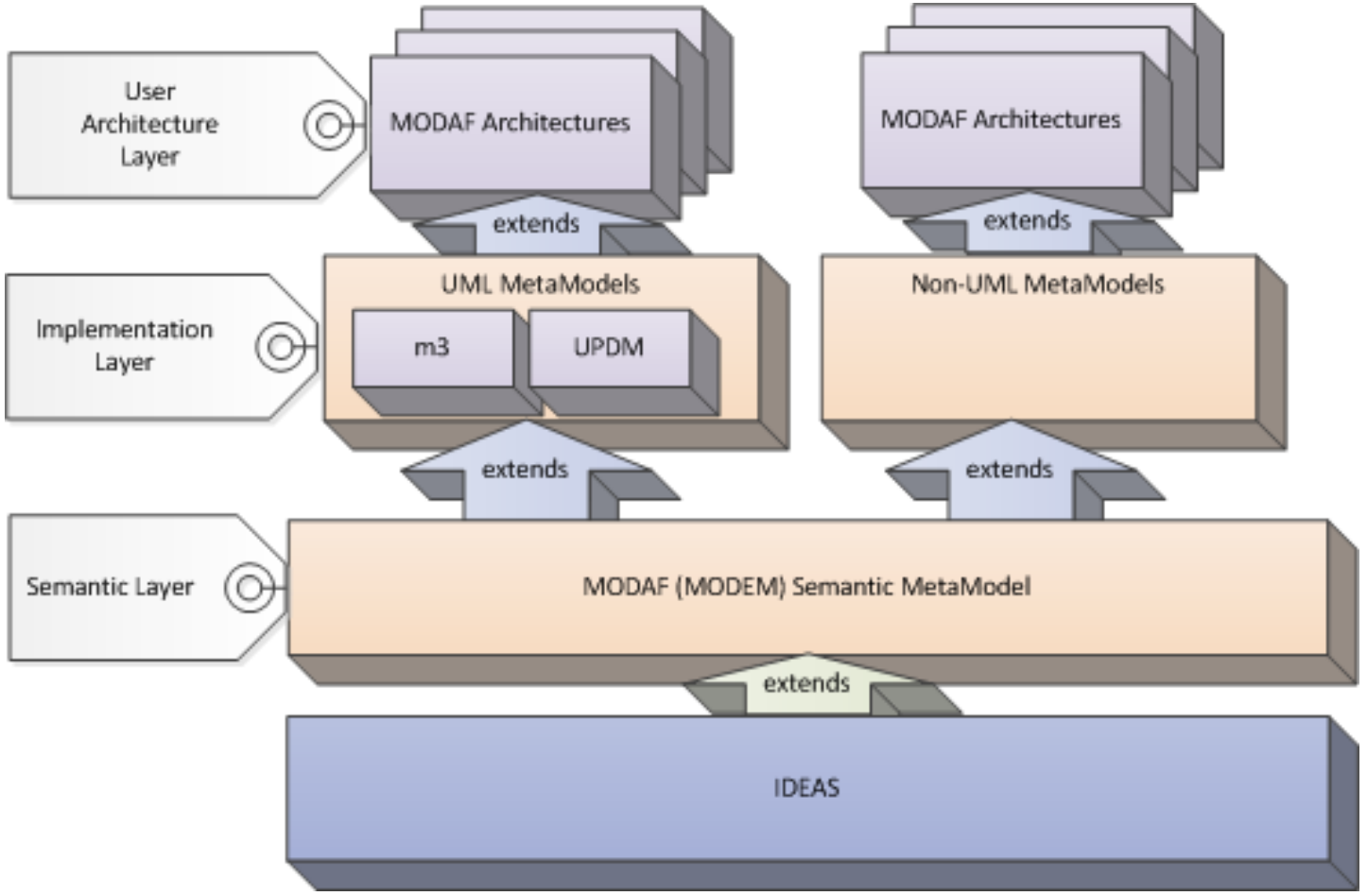
- Different tools are used in different domains.
- GenEA: General EA tools (ARIS, MEGA, SA, MooD etc.)
- UML tools with EA plugins (Magic Draw, Sparx, Rhapsody, Artisan etc.)
- They are islands on their own with no direct communication in between tools.
- They can not be used to enhance each other.

Possible tool situation based on MODEM



- A seamless transfer between tools without importing other tool conventions can be achieved if they are based on MODEM as an underlying basis.
- This will expand the usage as well as market for all tools.
- The interconnection ability will dramatically increase the use of each tool.
- The strengths of the different tools can be used to enhance the overall use of all tools.
- This will provide benefits to all areas of use and to all tools.

MODEM: Vendor Neutral Evolution of MODAF M3



MODEM and UPDM

- **Sweden and UK have invested heavily in the development of 'Unified Profile for DoDAF and MODAF (UPDM)', and are keen to reap some benefit from that investment and don't intend to "throw out the baby with the bath water;"**

- **UPDM provides a standard that can be used by UML / SysML tool vendors;**

- **Handling of UPDM based models by means of MODEM would have the aim of making UPDM based models available to non-UML tool vendors in such a way as to ensure semantic interoperability.**

MODEM and UPDM

- **Since UPDM can be considered an implementation of MODAF M3, a traceability to MODEM is possible, i.e. a migration from MODAF M3 to MODEM can be made to work also for UPDM 2.0 based models when used to create MODAF type models.**

- **By cooperating with other interested parties, a migration should also be possible for UPDM 2.0 based models when used to create DoDAF 2.0 models.**

- **MODEM can provide a semantic foundation for a UPDM future version.**

MINISTRY OF DEFENCE

MOD STATEMENT OF INTENT FOR THE IMPLEMENTATION OF MODEM

Patrick Gorman
Assistant Head Architecture Framework
MOD CIO

Future MODAF – What We Want To Do

On completion of MODEM (c. Sep 2012):

- Look to retire M3
- Update Policy for use of:
  - UPDM2 (UML / SysML Tools)
  - MODEM (Non-UML Tools)

- Ensure alignment of MODEM and UPDM

- Offer MODEM to NATO to support convergence of frameworks

Future MODAF – What We Need To Do To Get There

Primarily Stakeholder Engagement:

- **UK Defence Stakeholders – MOD and Partners.**
- **Software Tool Vendors.**
- **NATO and Nations.**

modem

a semantic foundation for enterprise architecture

Conclusions

Conclusions

- **MODEM enables the partners using MODAF to:**
  - take advantage of the significant historic investment made in the UML and non-UML based MODAF model,
  - while also providing access to the improved features of the new foundation.
- **And to do this:**
  - while moving to a more flexible foundation that provides a basis for significantly improved collaboration at the level of military enterprise architectures,
  - through the seamless sharing of architectures between the partner nations regardless of which modelling tool or repository they use.