Semantics Mediation

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Overview

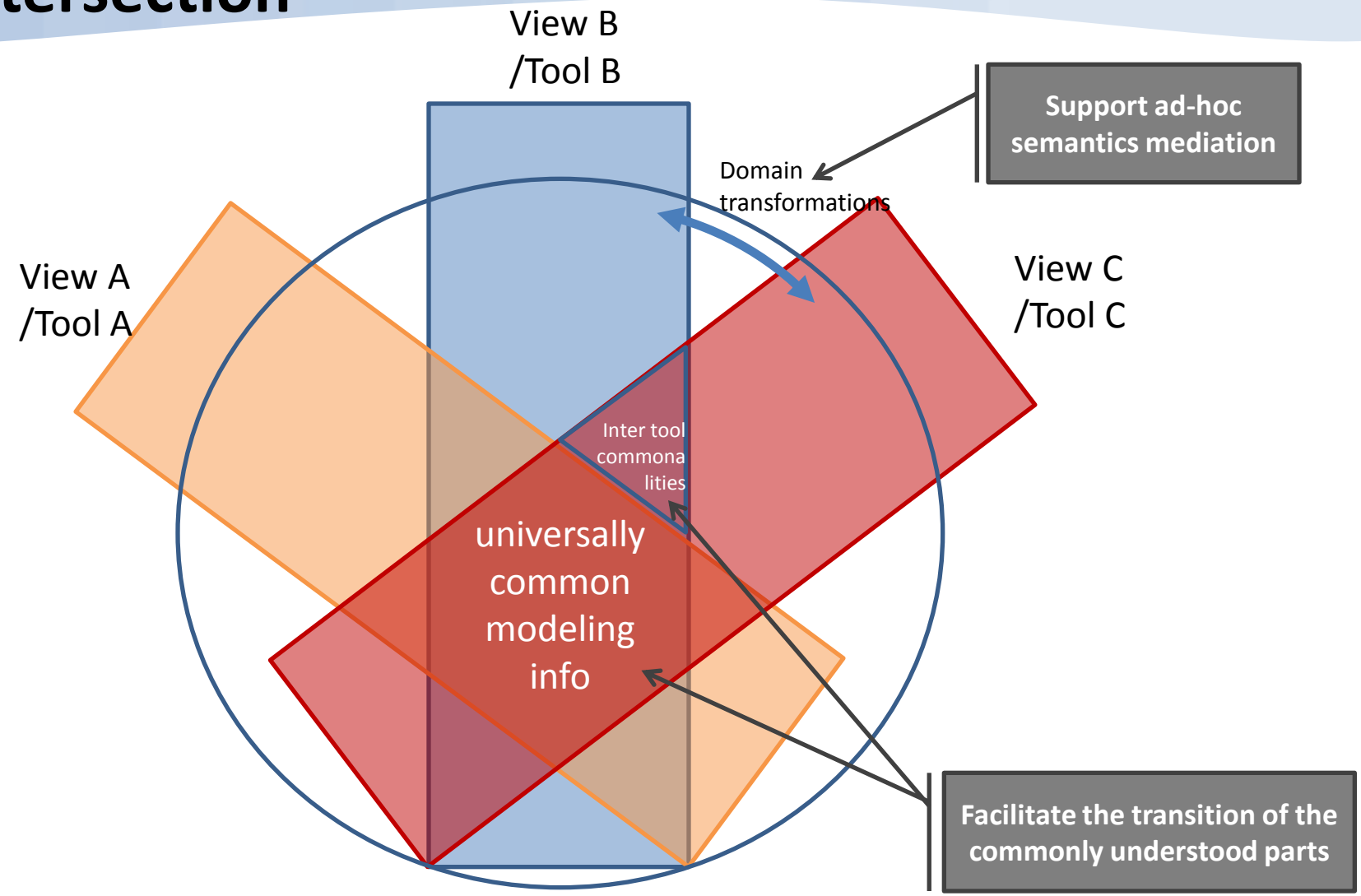
- SPRINT Use Cases & Challenges
  - Heterogeneous modeling tools, semantics, MOCs
  - Distributed modeling
  - Over the internet design & integration
- State of the Art in the distributed Systems engineering
  - Transformations
  - Heterogeneous model exchange
    - Point-To-Point Integration, Star Integration
    - Common Meta Model (Speeds, Cesar)
    - Transformation Chains (ModelBus, iFest)
  - Comparison
- Knowledge management
  - Open World Assumption (OWA)
  - Closed World Assumption (CWA)
  - Example
- Semantic Mediation
  - Technological approach
- Conclusions

SPRINT Use Cases & Challenges

- Distributed, over the cloud design & integration
- Heterogeneous design
  - Different tools
  - Different semantics (Multi domain, aspect, MoC modeling)
- Continuous design (design teams all over the globe: 24/7 availability)
- Support data-model evolution
  - Flexibility on the data representation
  - Data migration of the evolving data representations
- Assert models & data consistency

- Represent information to the user in his format of choice
  - Avoid introduction of additional tooling (extra skills & costs)
  - Data has to be mediated and not just link tools

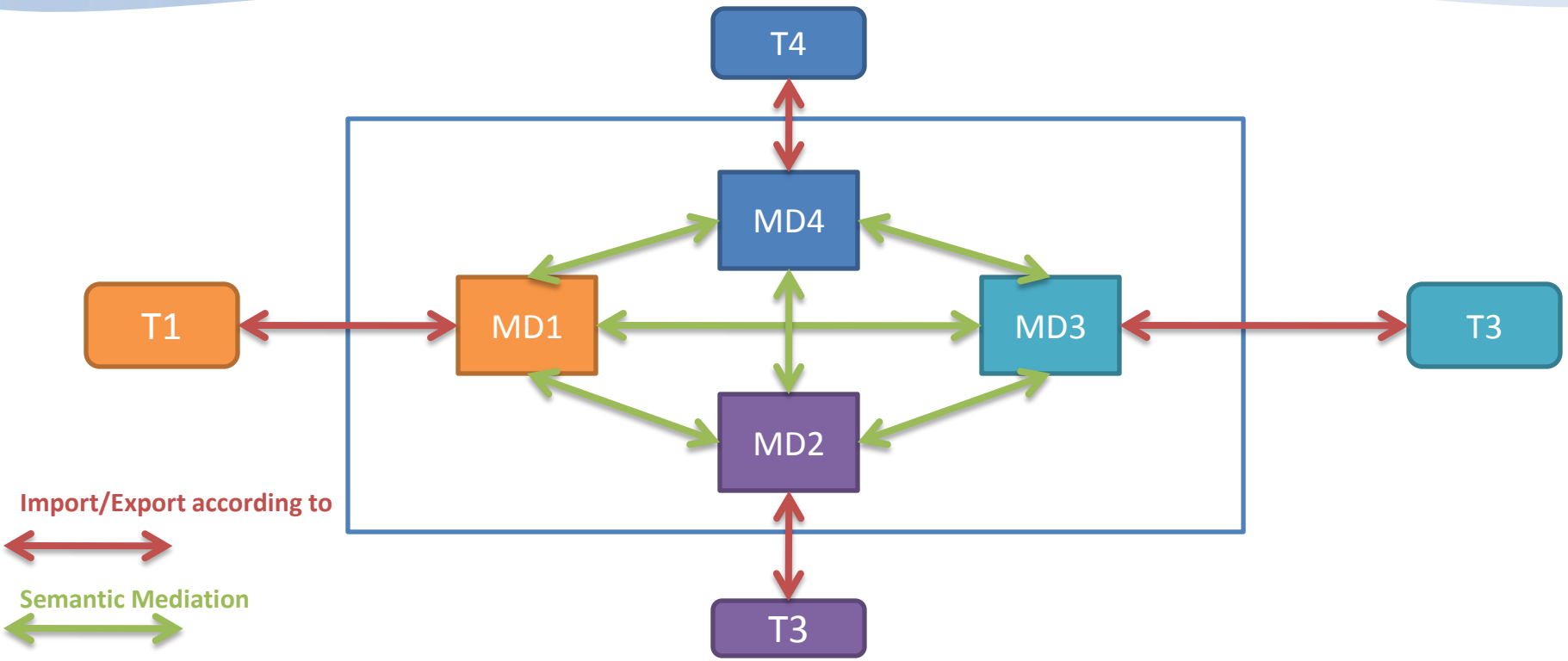
Heterogeneous modeling “intersection”



State of the Art (SPRINT D3.1)

- Transformations
  - Important Characteristics
    - Multidirectional
    - Incremental
    - Conservative (no duplication o on subsequent transformations)
    - Traceability capability
  - Model Transformation Languages
    - ATL
    - QVT
- Heterogeneous models-information integration
  - Point-To-Point Integration, Star Integration
  - Common Meta Model (Speeds, Cesar)
  - Transformation Chains (ModelBus, iFest)

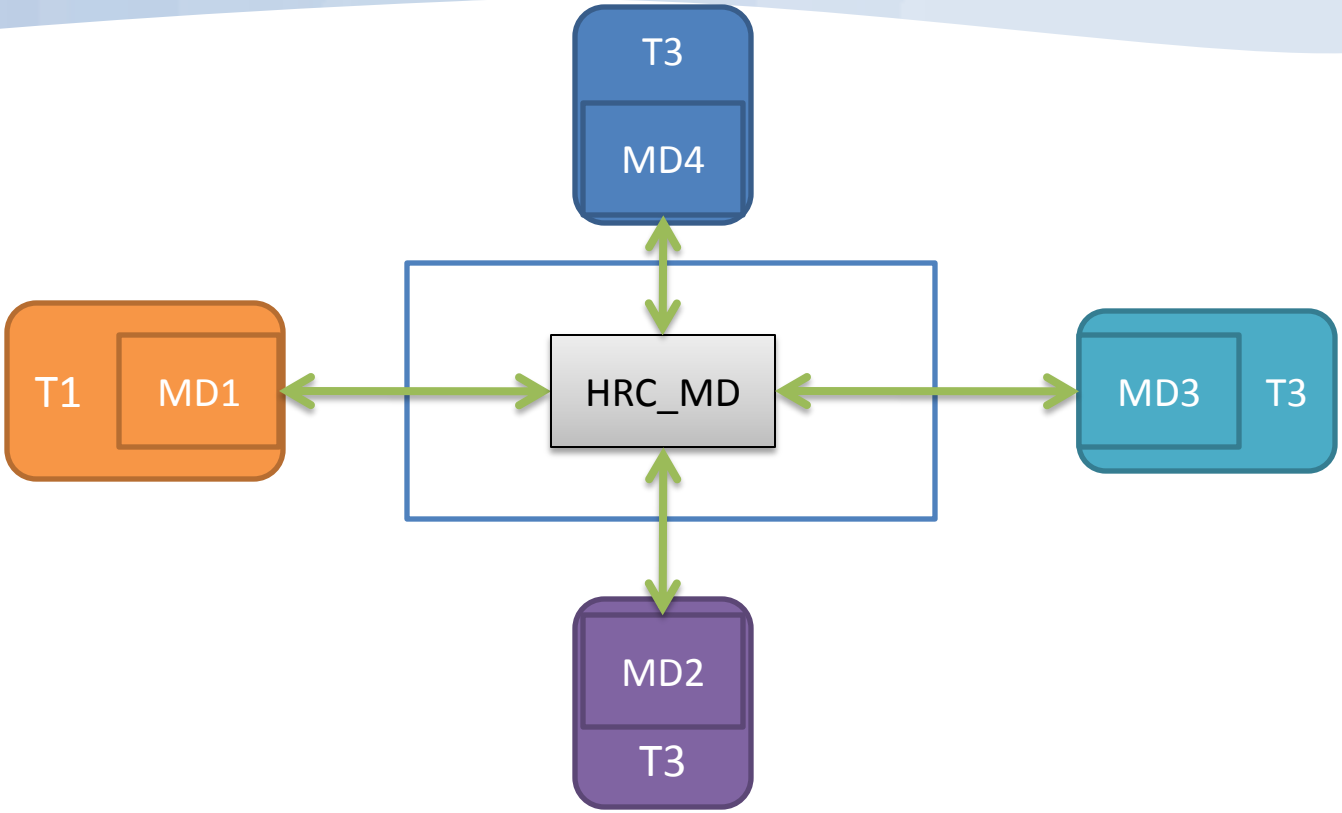
Point-to-point semantic mediations



- Each tool imports/exports models on its own meta-data
- Semantic mediation relations established between each pair of meta-data

➔ To cover all transformations, we need (N*(N-1)) / 2 relations

Common Meta Model (Speeds, Cesar)

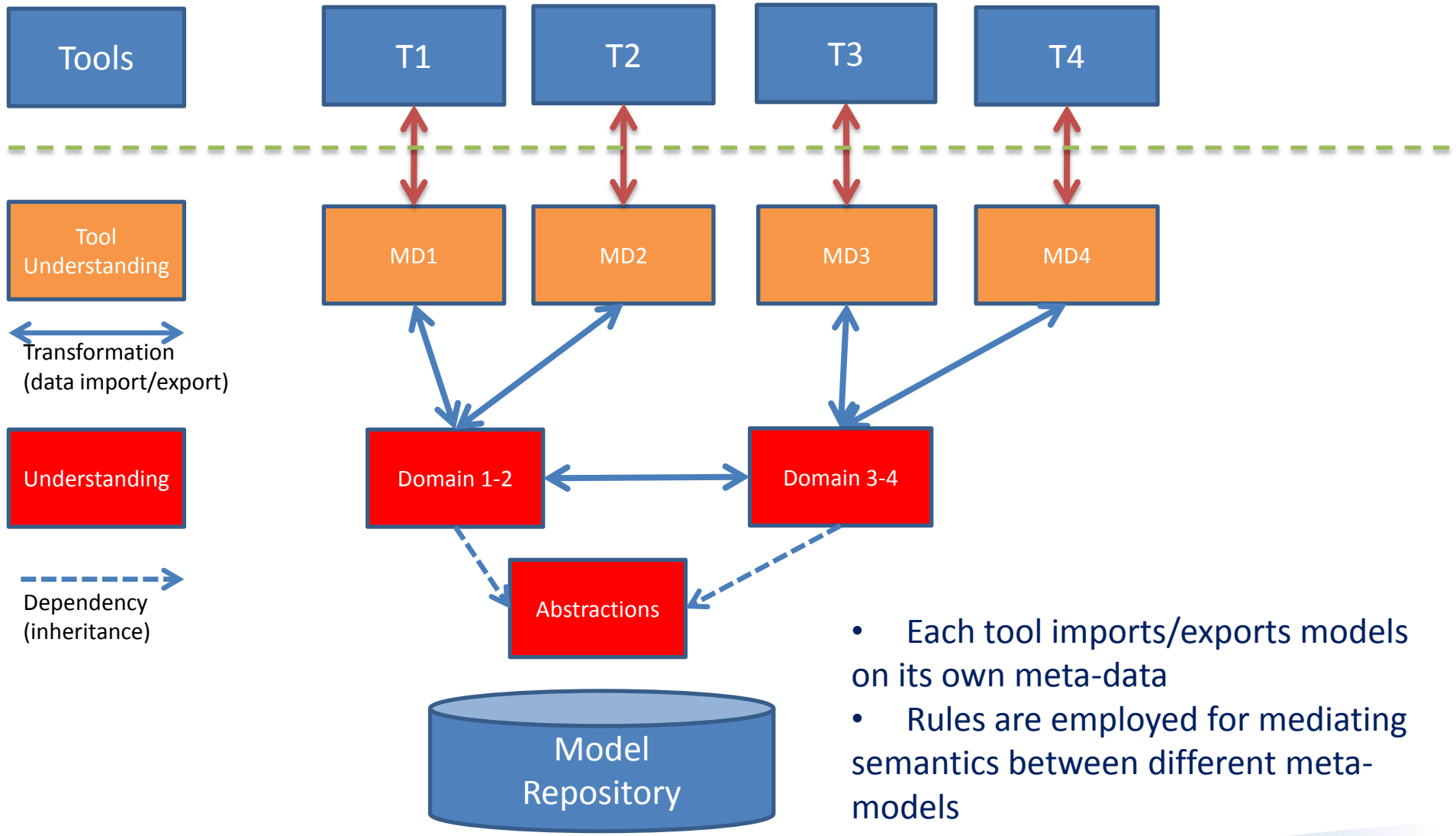


Import/Export according to

Semantic Mediation

- Each tool imports/exports models on the universal, commonly agreed meta-data
- Semantic mediation is guaranteed by the usage of the unique meta-data for the exchange of models

Transformation Chains (ModelBus, iFest)



- Each tool imports/exports models on its own meta-data
- Rules are employed for mediating semantics between different meta-models
- Inheritance of rules is possible

Knowledge Management

- Closed World Assumption (CWA)
  - Everything (currently) not known to be true, is false
    - Assumption: you know everything of relevance and have modeled it
  - Advantages:
    - Easier to compute
    - Quicker to model (less information needed)
  - Disadvantages:
    - Limited expressiveness (“no modeling of the unknown”)
- Open World Assumption (OWA)
  - Adding new knowledge or information never falsifies previous assumptions.
  - Assumption: you don’t know everything of relevance and have to explore and incrementally model
  - Advantages:
    - Easy to extend
    - It is possible to ‘Represent’ unknown knowledge
  - Disadvantages:
    - Hard to retrieve/compute final conclusions/data
    - Adding information may lead to conflicts
    - More information needs to be modeled

CWA vs. OWA Example

- CWA
- Knowledge
  - Michael is Swimmer
  - Christian is Swimmer
- Query
  - is Sandra Swimmer?
- Answer
  - No!

- OWA
- Knowledge
  - Michael is Swimmer
  - Christian is Swimmer
- Query
  - is Sandra Swimmer?

More Computation

- Answer:
  - Unknown!

CWA vs. OWA Example

- CWA
- Knowledge
  - Michael is Swimmer
  - Christian is Swimmer
  - Sandra is Swimmer
- Query
  - is Sandra Swimmer?
- Answer
  - No-> Yes!

- OWA
- Knowledge
  - Michael is Swimmer
  - Christian is Swimmer
  - Sandra is Swimmer
- Query
  - is Sandra Swimmer?
- Answer:
  - Unknown -> Yes!

CWA vs. OWA Example

- CWA
- Knowledge
  - Michael is Swimmer
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- Query
  - is Sandra Swimmer?
- Answer
  - No!

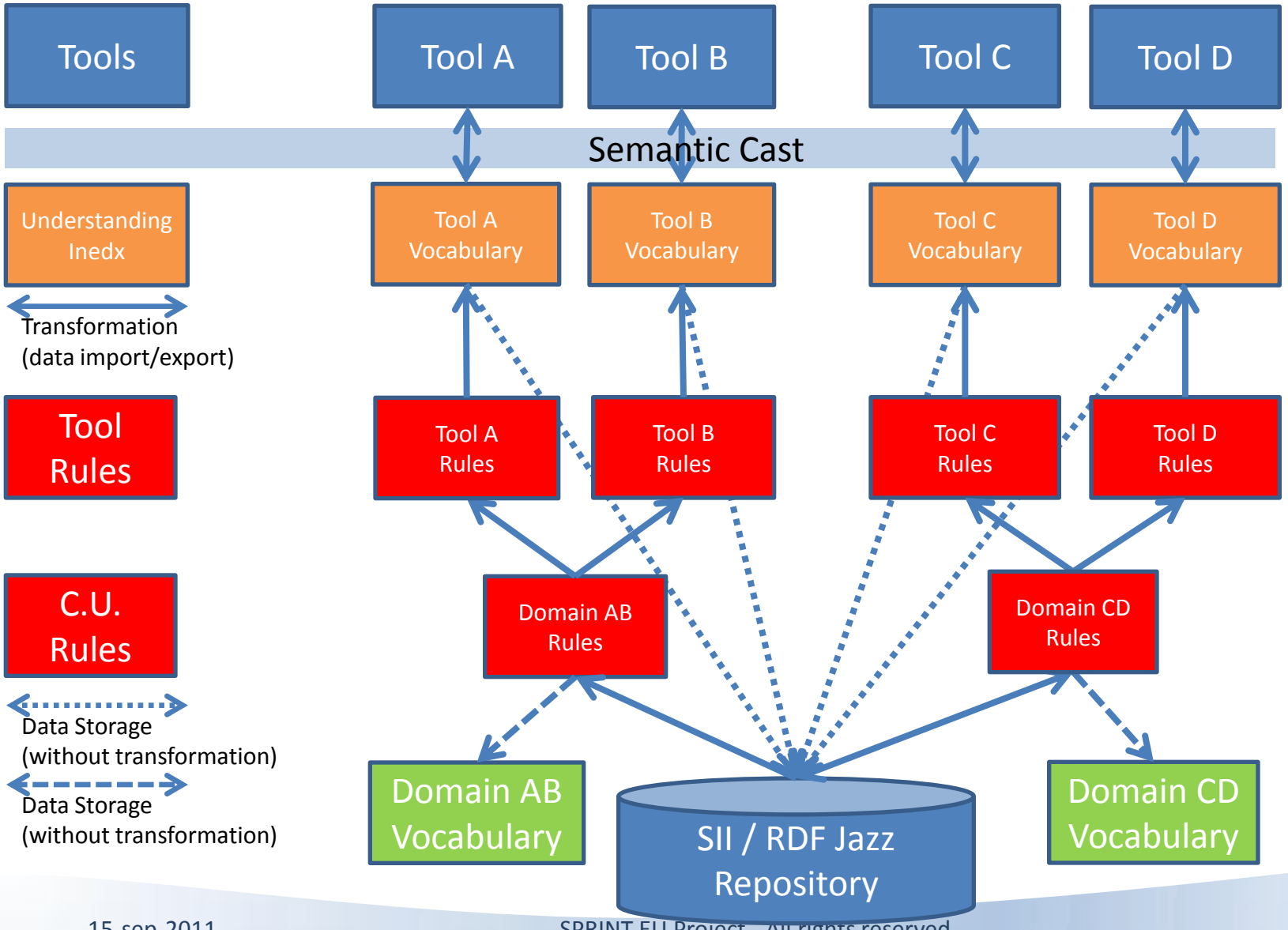
More Information

- OWA
- Knowledge
  - Michael is Swimmer
  - Christian is Swimmer
  - Sandra is Non-swimmer
  - Non-swimmer and Swimmer are disjoint
- Query
  - is Sandra Swimmer?
- Answer:
  - Unknown -> No!

Semantics Mediation
The SPRINT Approach

- Main concepts
  - Tools & Tools Vocabularies
    - Authoring/editing information & representing it
  - Domain Vocabularies (tools vocabularies are specific cases of these)
  - Rules relating vocabularies (all permutations of vocabulary types)
    - OWL language (first-order logic formulae) to describe these rules [*ongoing research- stay tuned for concrete examples*]
  - External “classical” point-to-point transformation
- Semantic Mediation application
  - *On demand* application of a rule or a classical transformation
  - Semantic Mediation Delegator to pick which semantic mediation to apply
  - Traceability of Mediations
    - Establishing a relation creates has a pointer to the applied rule
- Knowledge base
  - Populated by tools (commit/publish models)
  - Populated by Semantic Mediation application

Semantic Mediation



Which SM to choose?

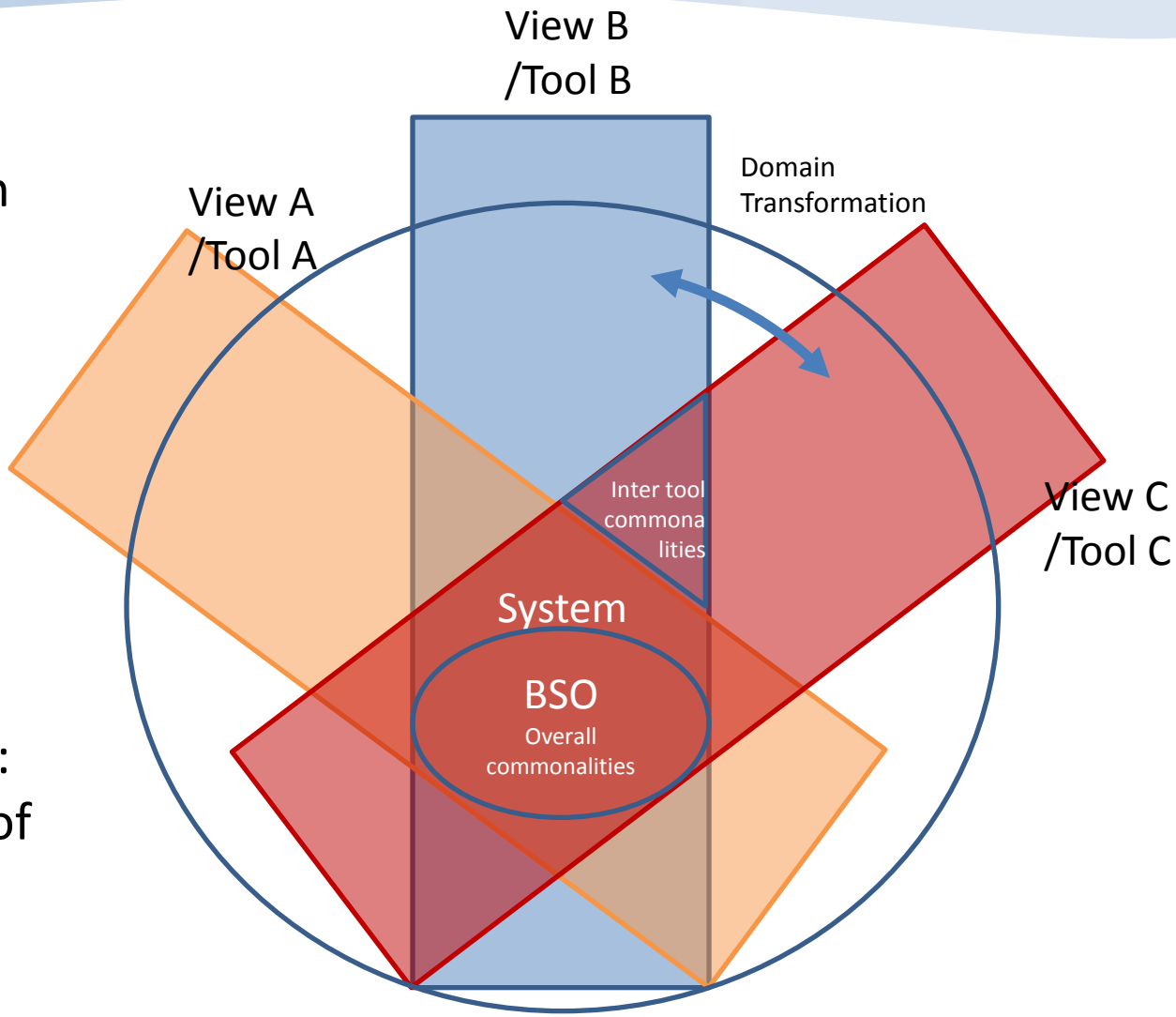
- Rule-based description is the OWL: mainly set inclusion

⇒ Simpler rules

⇒ Active research topic

⇒ Exploit the reasoning RDF(S)/OWL capabilities

- Model-transformation: richer expressiveness of the mediation



Conclusions

- Semantic Mediation in SPRINT
  - Enable **distributed, over the internet** authoring, editing & exchanging of models
    - "over the internet" is native in our RDF-based solution
  - Allow the **flexibility of evolution** of data and data representations
  - **Mediating data** in a flexible, reusable fashion
  - Currently vivid research topic
  - *Support the wide-spread and adopted meta-meta-modeling facility EMF Eclipse Framework (dissemination, exploitation & development efficiency)*

- Implementation Plan (*approx. & to be validated by the SPRINT consortium*)
  - EMF←→RDF Mapping Implementation (M14)
  - Definition of the Semantic Services Integration Layer (M17)
  - Semantic Mediation First Prototype Implementation (M19)
  - Semantic Mediation Implementation (M22)
  - Implementation of SSI Layer (M22)

Thank you! ***תודה***

Questions?

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