Mediator based Approach for Smart Spaces Integration

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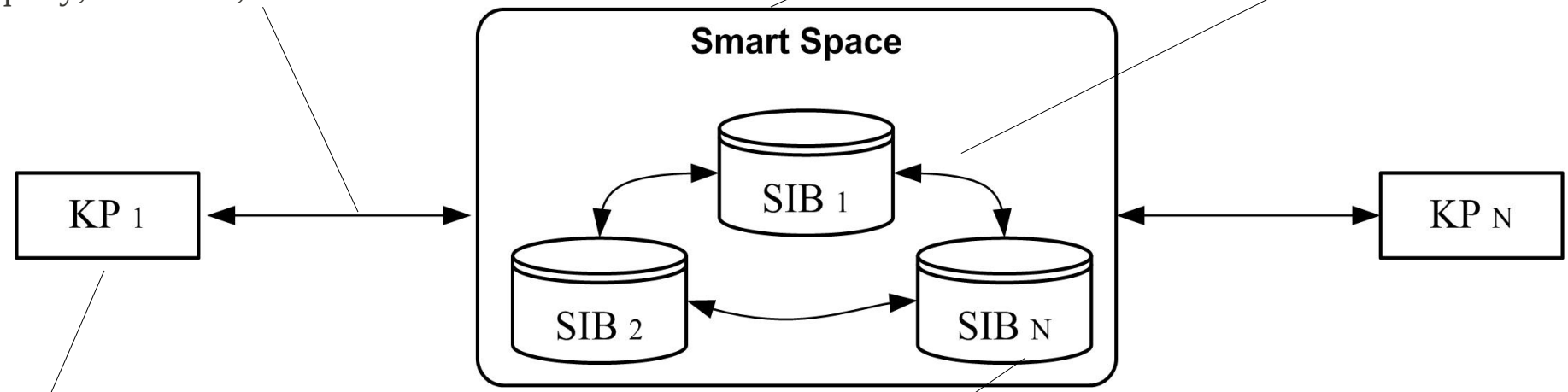
Smart Spaces and Smart-M3 infrastructure

Triple governance transactions using Smart Space Access Protocol (SSAP): join, leave, insert, remove, update, query, subscribe, unsubscribe.

Smart Space: a named search extent of information.

Physical distribution of a Smart Space.

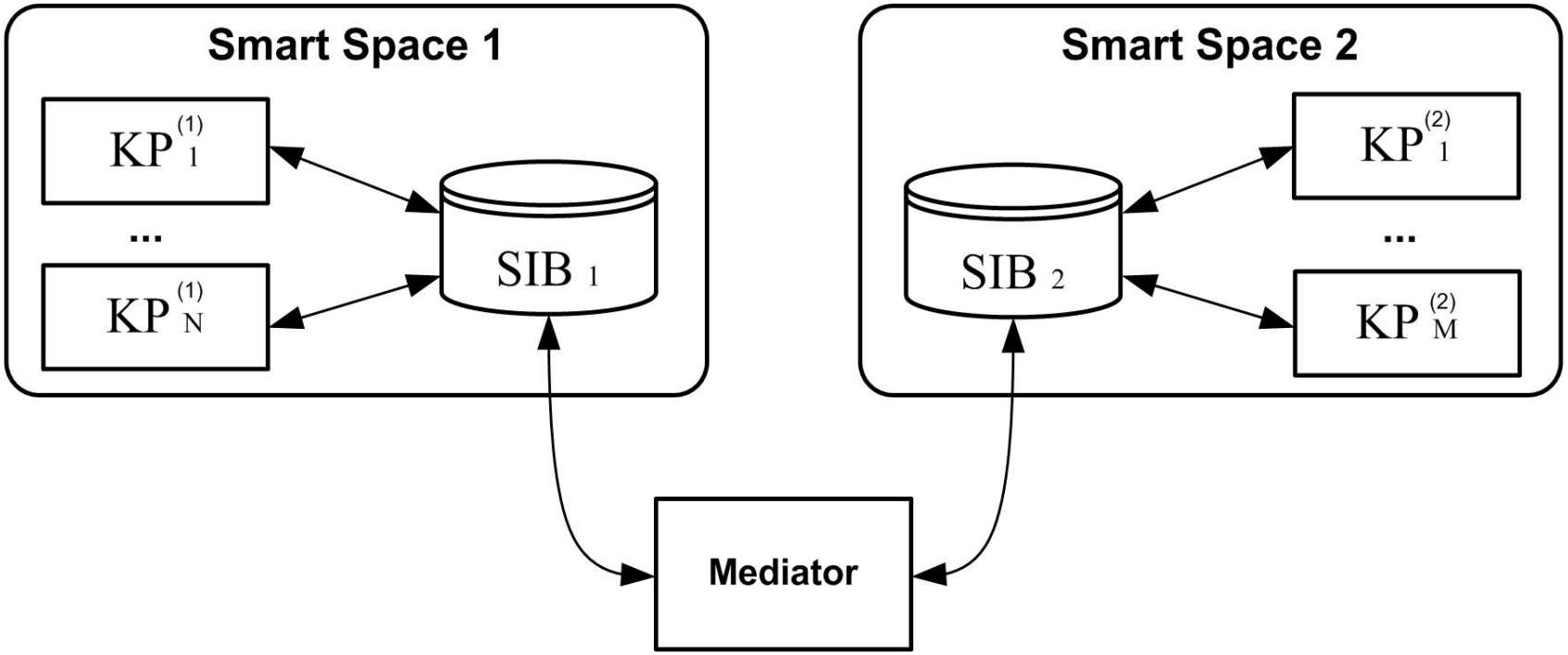


Knowledge Processor (KP): An entity contributing to (insert/remove) and/or reading (query/subscribe) content according to ontology relevant to its defined functionality. A KP needs one or more partner KPs for useful sharing of content, implying an agreed semantics for the used ontology.

Semantic Information Broker (SIB): An entity performing triple governance in possible co-operation with other SIBs for one Smart Space. A SIB may be a concrete or virtual entity.

Interoperability problem

· Problem of integration of independent applications processing multiple heterogeneous data sources.
· Integrated systems exist independently and know nothing of each other.



Application Integration Interface

Example of service interface:

```
public String findInCache(String key);
```

Web Services

```
<wsdl:message name="findInCacheRequest">
<wsdl:part name="key"
type="soapenc:string"/>
</wsdl:message>

<wsdl:message name="findInCacheResponse">
<wsdl:part name="result"
type="soapenc:string"/>
</wsdl:message>
```

Space-based computing

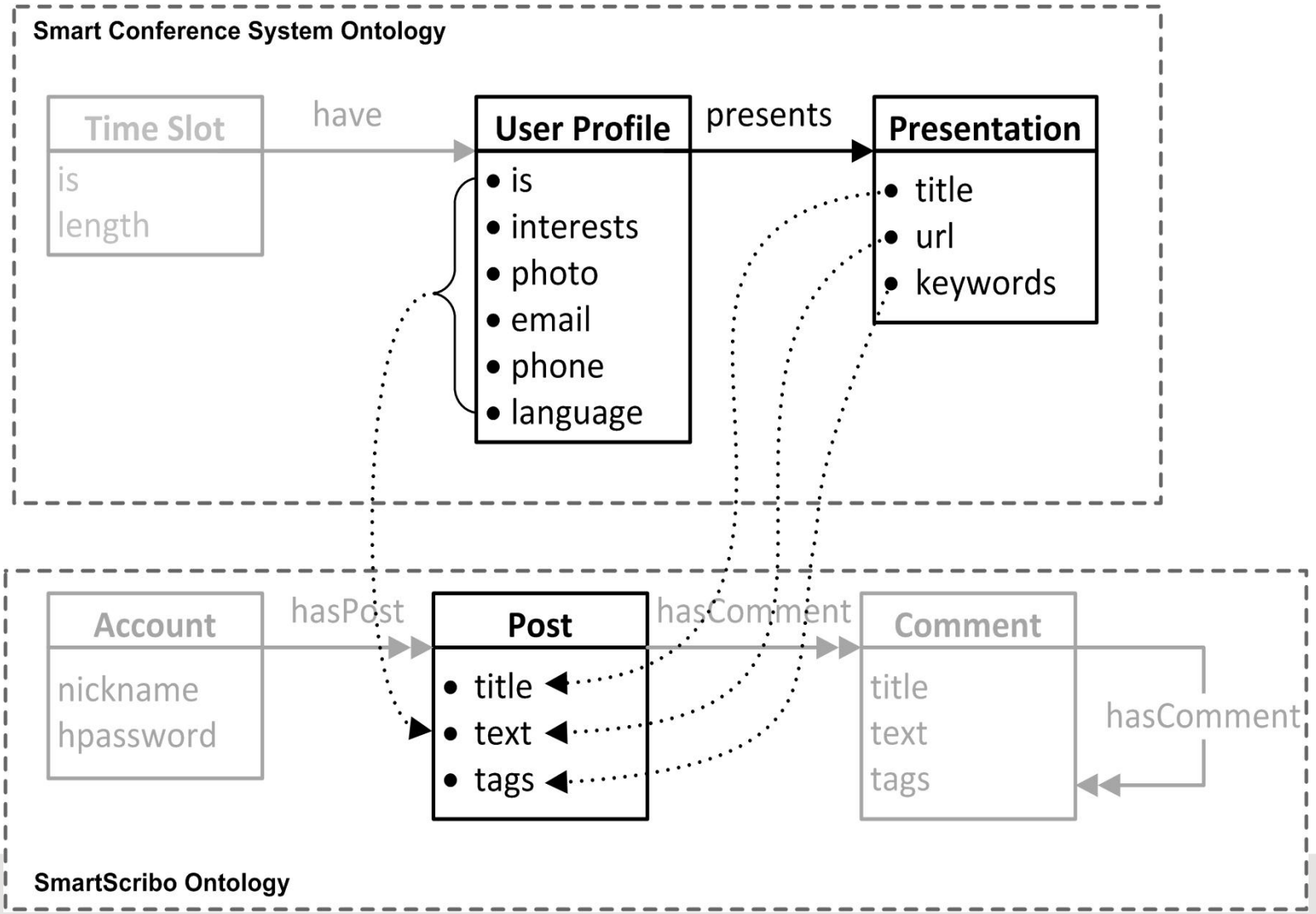
```
(<request_ID>,
'findInCacheRequest',<request_data_ID>);
(<request_data_ID>,'rdf::value',<key>);
(<request_data_ID>,'rfd::type','xsd:string');

(<request_ID>,
'findInCacheResponse',<response_data_ID>);
(<response_data_ID>,'rdf::value',<result>);
(<response_data_ID>,'rfd::type','xsd:string');
```

Smart Space Applications Integration Definition

1. Smart space applications matching: process of establishing logical correspondences between elements of the source and target ontologies of integrated applications. As a result of this process integration scenarios are formed.

2. Run time instance mapping: process of mapping the instances between several smart spaces.

Integration of Smart Conference System and SmartScribo System



Smart Space Applications matching

The expert must determine:

1. The events that initiate the process of integration;

```
(<application_ID>,<notification_name>,<data_id>);
```

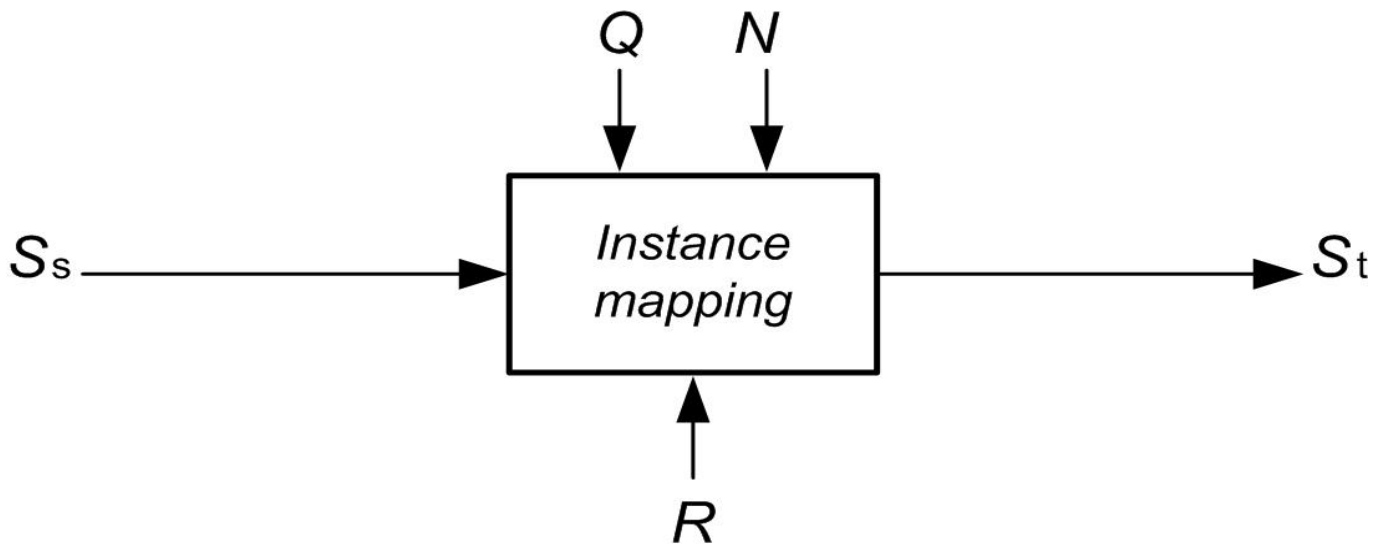
2. Input data for integration;

```
SELECT *
WHERE {
   ?person foaf:name ?name .
   ?person foaf:mbox ?email .
}
```

3. Mapping rules to transform entities of the source smart space to entities of target smart space.

```
'title'(postId, titleValue) :-
   'Title'(presentationID, titleValue),
   generateUID(postId).
```

Run time instance mapping



Ss is a source smart space;
N is a data loading notification;
Q is a set of graph queries to the source smart space;
R is a set of mapping rules for the source and target smart spaces;
St is a name of the target smart space.

Mapping rules types

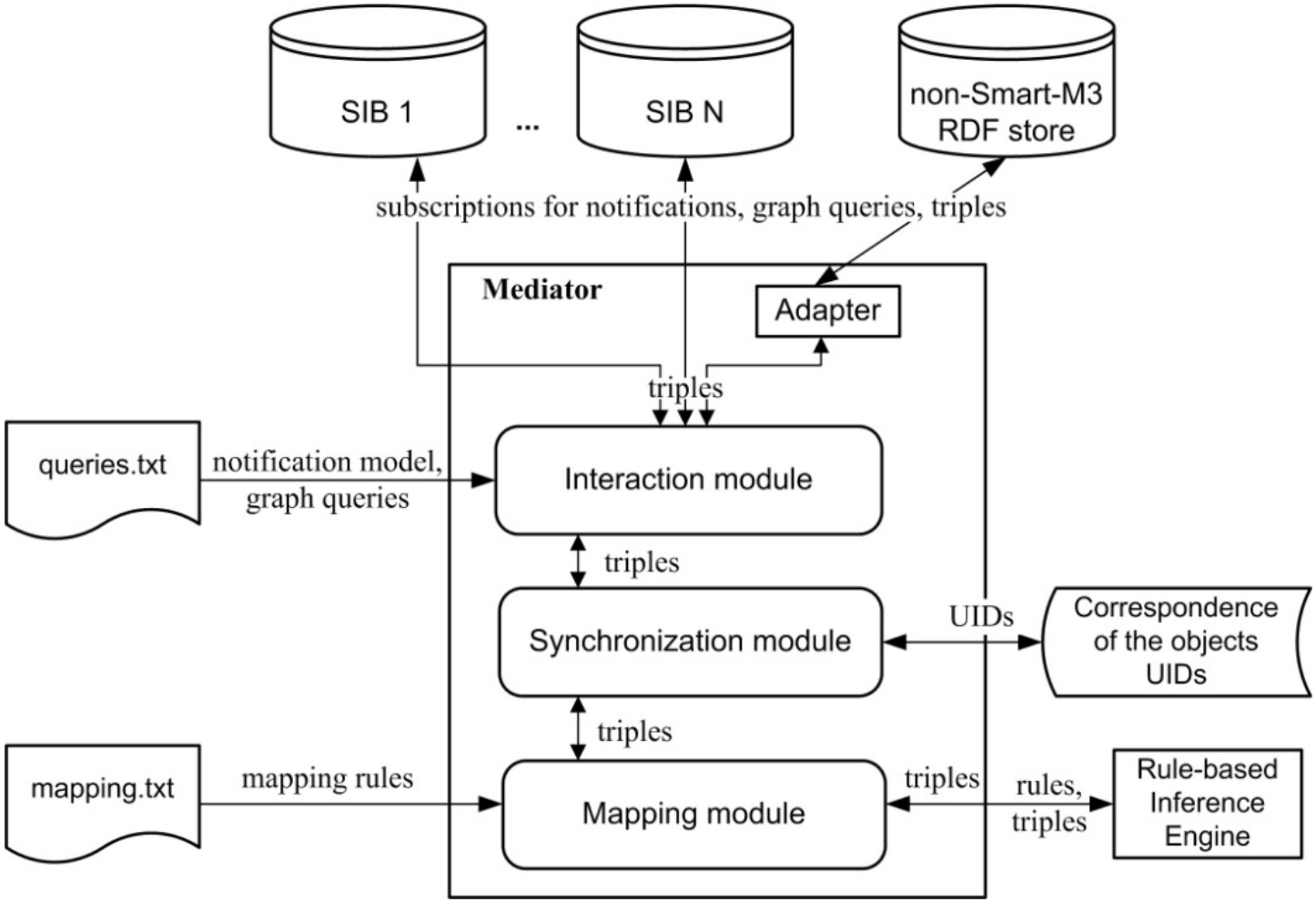
Ontology mapping

- Semantic equivalence:
  $O1 = O2$.
- Semantic subsumption:
  $O1 \subset O2$.
- Semantic intersection:
  $O1 \cap O2$.
- Semantic incompatibility:
  $O1 \neq O2$.

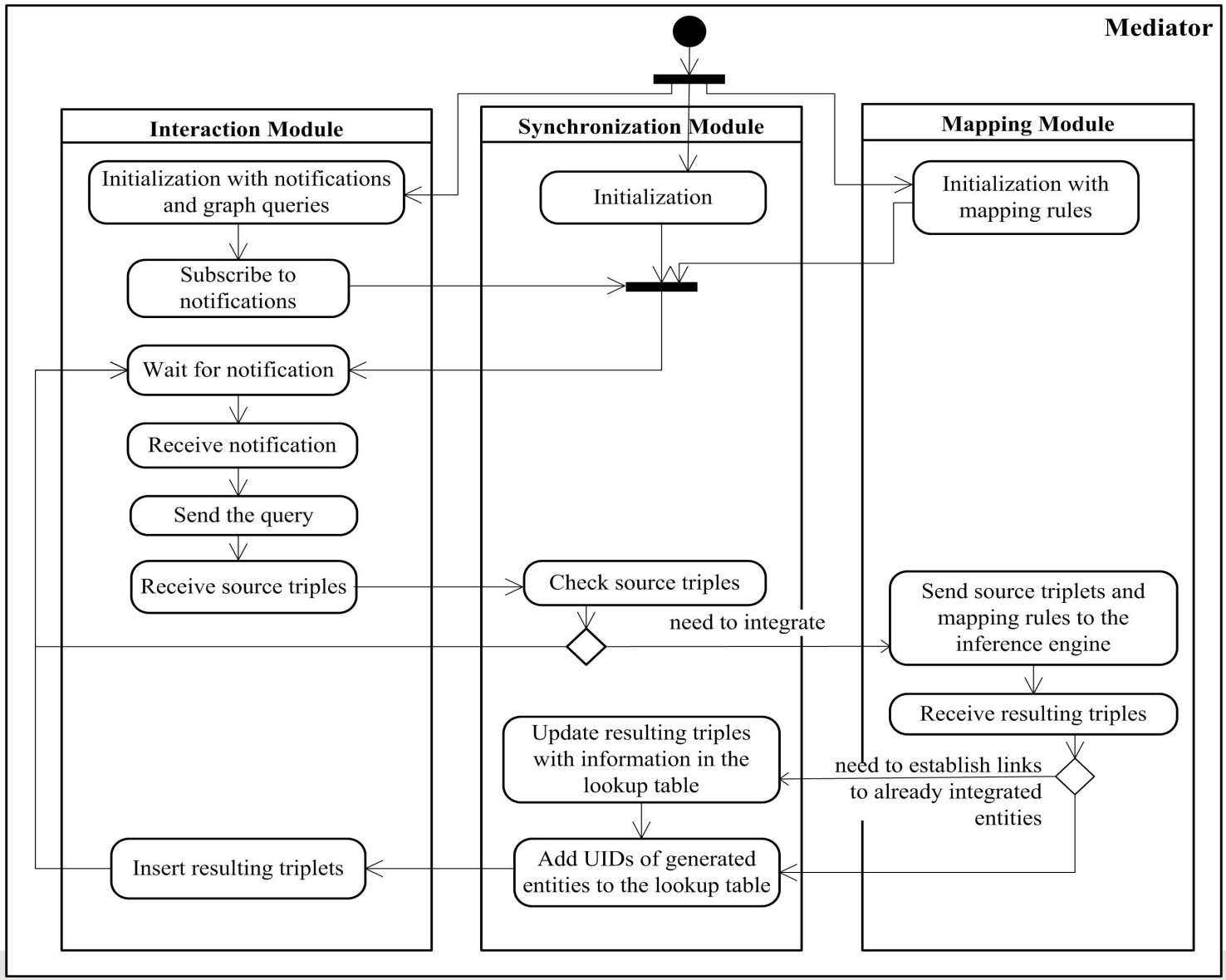
Run time instance mapping in Smart Space

- Simply copying the attributes;
- UIDs (URIs) generation;
- Manipulations with
  - numbers;
  - strings;
  - date and time;
- Comparison with previously integrated entities;

Mediator Architecture



Mediator Activity Diagram



Conclusion and Future work

Results

· the idea of mediator-based agent for the integration of Smart Conference System and SmartScribo System was successfully demonstrated at the 9th and 10th Conference FRUCT.
· specified input information that uniquely describes the scenario of integration smart space application.
· defined the general architecture of a mediator that can automatically integrate the smart space applications.

Plans

· to develop a software platform for automatic integration of several smart spaces using the integration scenarios defined by an expert.

· to develop a declarative domain-specific modeling language which best defines the smart space integration process.