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A Smart Space-Based Design of Semantic Layer for Advancing Museum Information Services

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The History Museum of PetrSU

- It has the museum information system (MIS).
- Exhibits are presented as photographs and various textual documents, newspapers, academic journals, etc.
- It is oriented to everyday life history.
- Virtual exposition is presented on eight touch-screens.

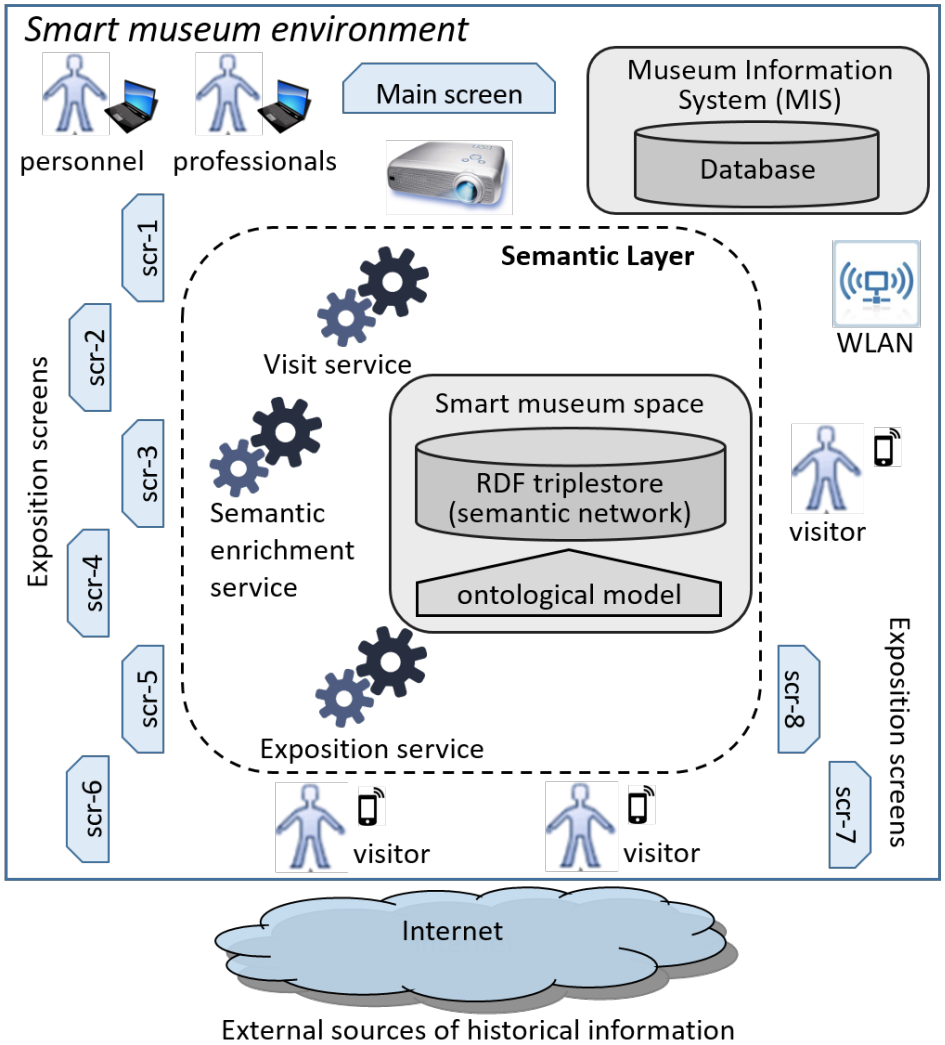
Semantic Layer in a Smart Museum

The layer aims at solving the following application problems:

1. adding text and voice semantic annotation about the exhibits by the visitors and museums personnel collectively;
2. semantic information linking of annotations about the exhibits in the museum collection;
3. personalized search for information about the exhibits based on user requests taking into account the context;
4. automatic generation of a virtual exposition based personalized context information.

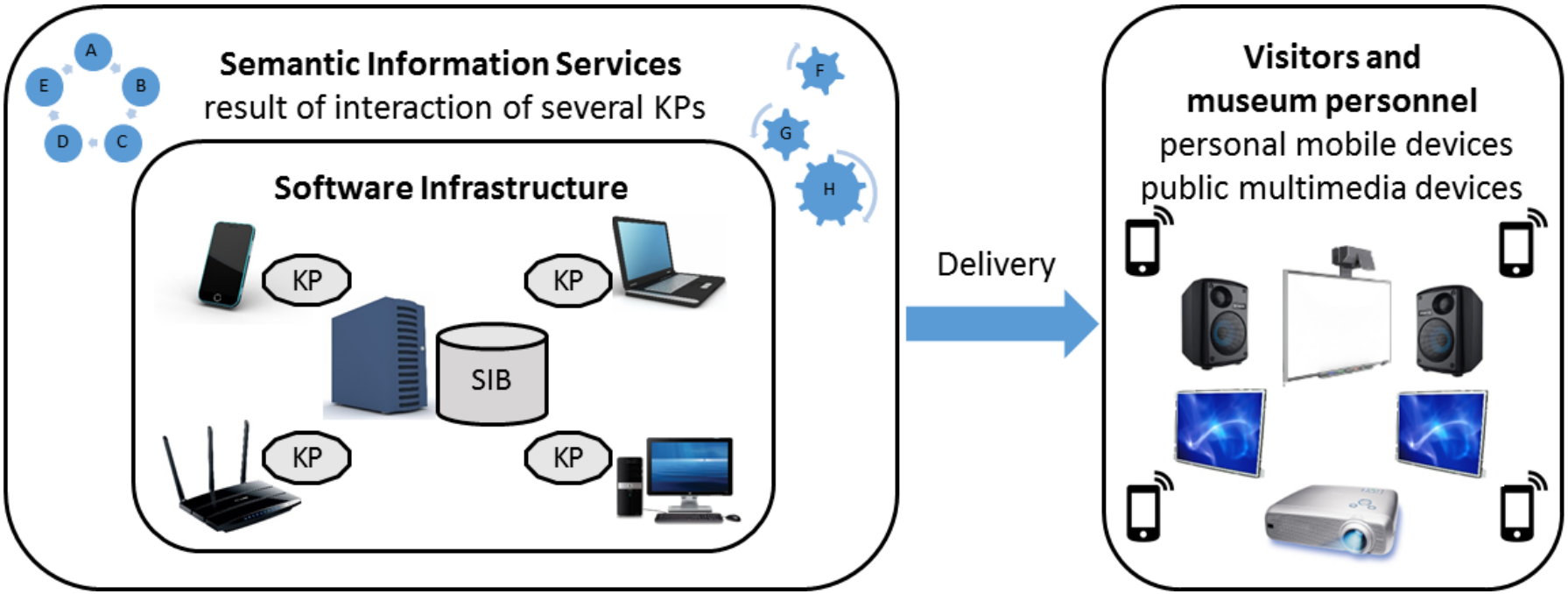
Smart Museum Environment

- The layer becomes responsible for construction and delivery of semantic services:
  - visit service;
  - exhibition service;
  - semantic enrichment service.
- Smart museum space follows an ontology and is represented using RDF.
- The semantic network is a directed graph consisting of nodes, which represent exhibits, events, persons, etc.



Software Infrastructure

- Software infrastructure implements the semantic layer as the multi-agent service-oriented information system.
- Software infrastructure is based on Smart-M3 platform.
- It consists of the semantic information broker (SIB) and knowledge processors (KP).

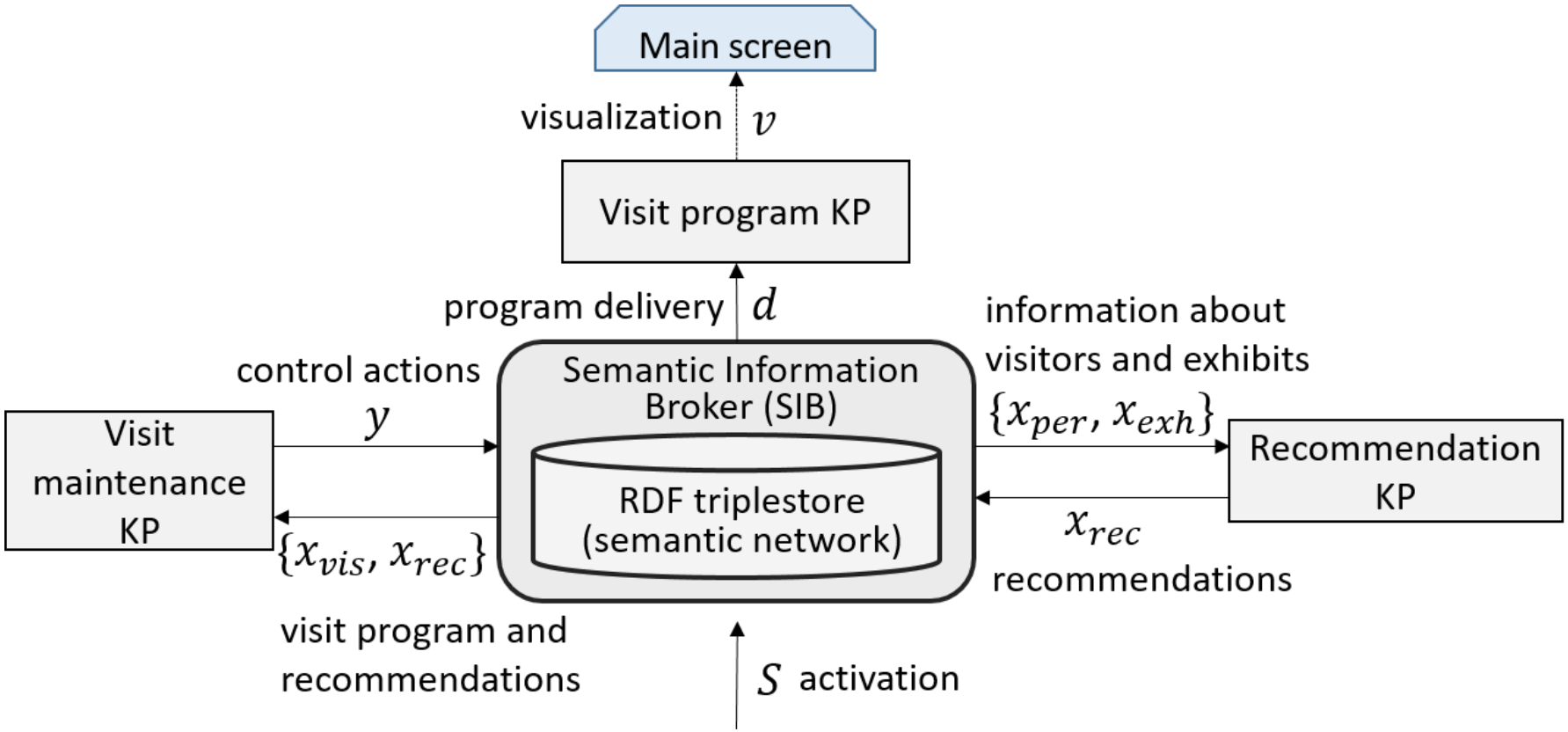


Classes of IoT-enabled devices

Class of devices	Description
Public multimedia devices	They include interactive screens, media projectors, and microphones. The devices are primarily for service consumption by visualization.
Personal mobile devices	They include smartphones, tablets, and laptops. The devices can be used for personalized service delivery and participation in the activity.
Server machines	They are responsible for data storage and processing functions. Typically the devices are non-local, e.g., a server is in the corporate network or in the Internet.
Local computers	They are responsible for service construction based on search and analysis of shared content in the semantic network. Typically, they are physically present in the room.
Smart IoT devices	They represent physical things augmenting them with processing and communication capabilities, e.g., a exhibit is equipped with RFID to provide description for close devices.
Network communication devices	They create local area networks such that all other participating devices can communicate locally as well as have access to external resources.

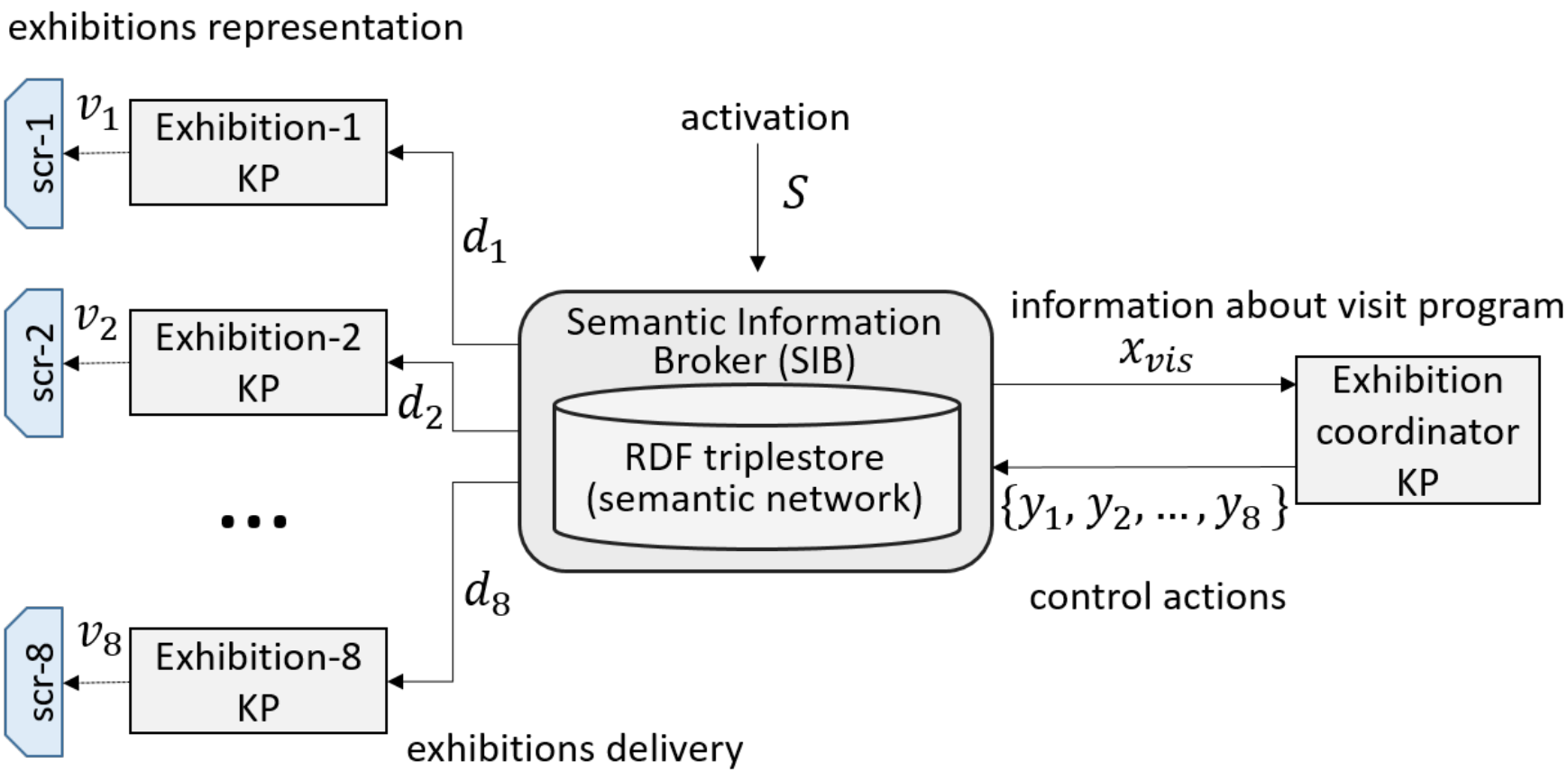
Visit service

The service is responsible for construction of a visit program and for visualization of this program on the main screen.



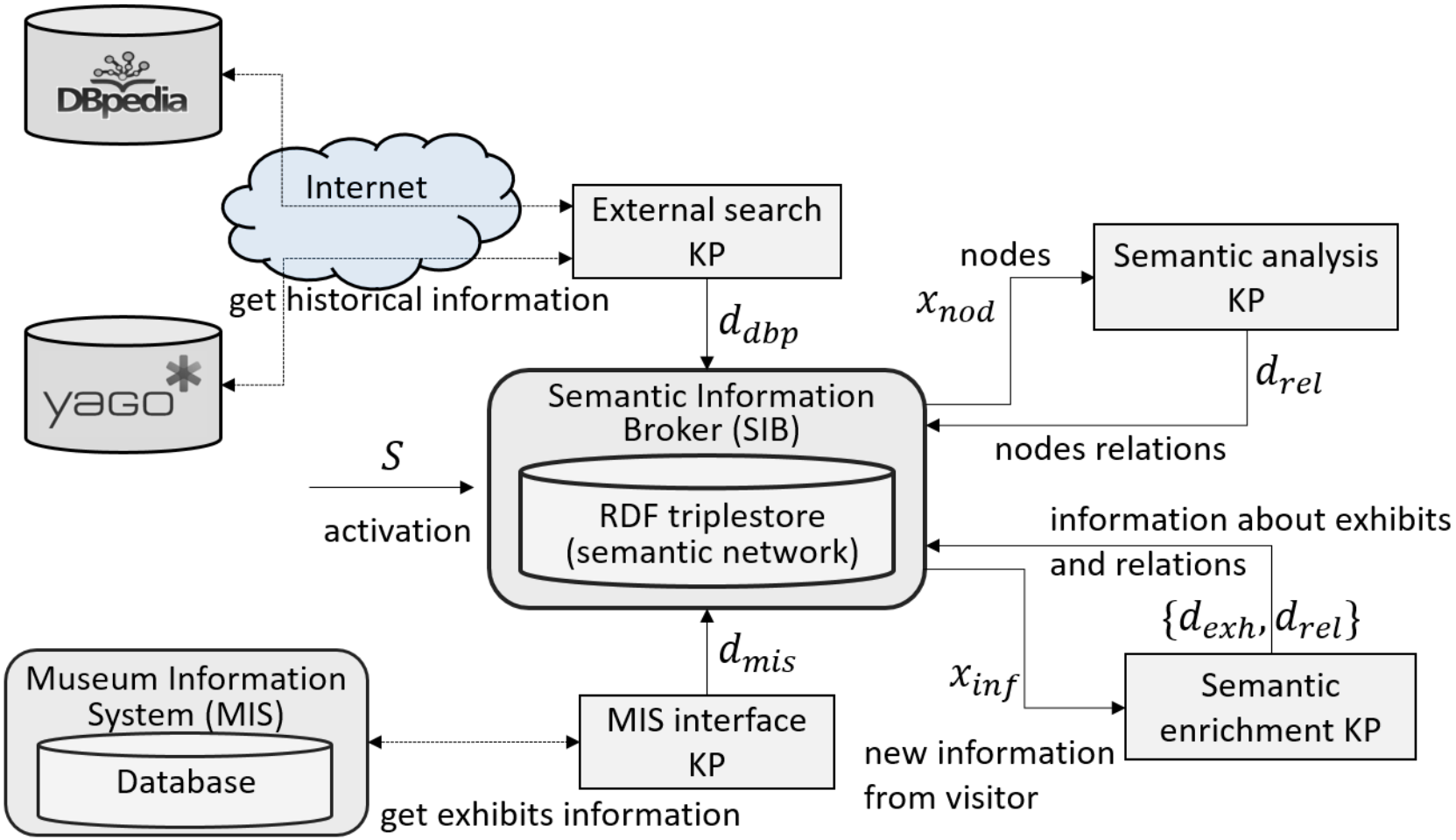
Exhibition service

The service performs selection of exhibits from the created visit program for formation of virtual exhibitions on a series of screens.



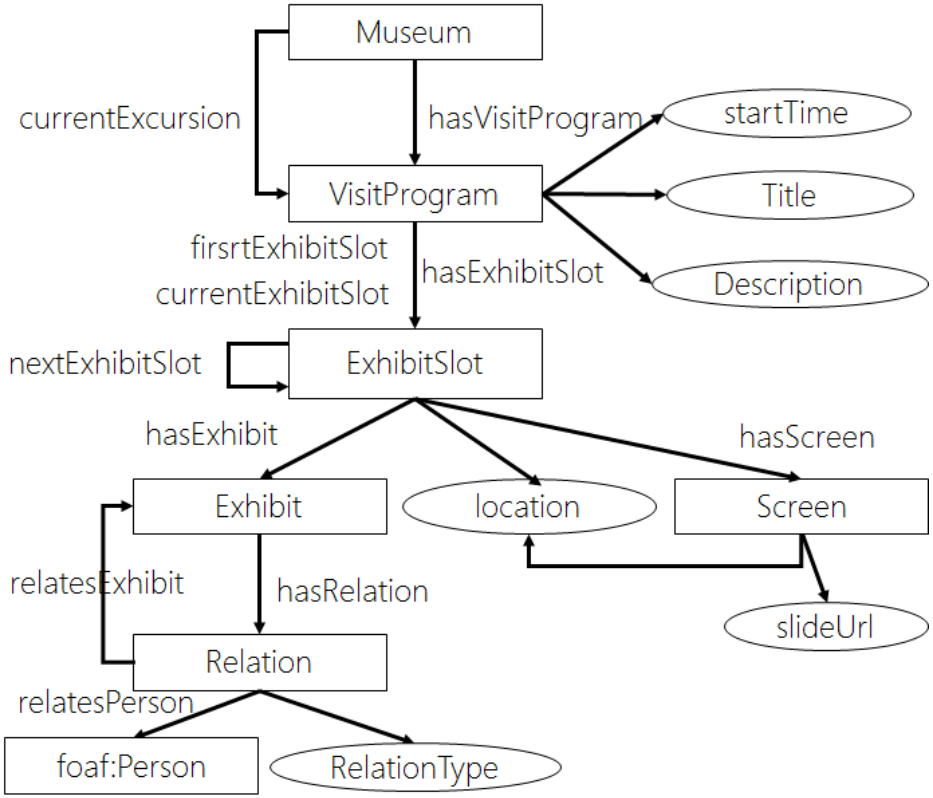
Semantic Enrichment Service

The result of the service is enrichment of museum information model.



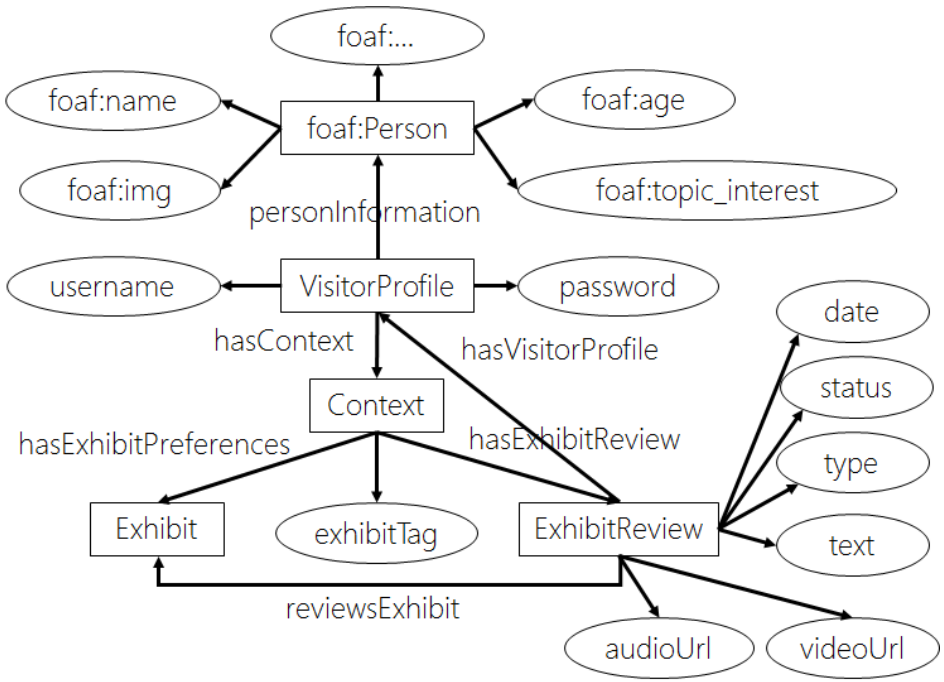
Ontology for Visit Program

- Class *Visit Program* stores a title, description, time stamp, and exposition structure.
- Property *firstExhibitSlot* is used to arrange the exposition structure.
- Class *Relation* provides linking capabilities of exhibits.
- Data property *RelationType* expresses relation between other exhibits and persons.



Ontology for Visitor Profile

- Class *Person* represents a visitor following the FOAF specification.
- Linking a person to profile provides search function for making recommendations.
- User context is the important point for semantic search.
- The user has preferences in the terms of interesting exhibits for her/him.



Notification Model

- Based on publish/subscribe model.
- Simplifying interaction between agents.
- Activity individual variant solves the task for notification of a concrete user about updates in her/his exhibits.

Name		**Description**
KP	Semantic Analysis	Carrying out additional analysis to discover new relations with appearance of new Exhibit.
Notification	newExhibit	
Parameter	Exhibit	
KP	Semantic Analysis	Carrying out additional analysis to discover new relations with appearance of new ExhibitReview.
Notification	newExhibitReview	
Parameter	ExhibitReview	
KP	Visit program	Screen content changing accordingly with parameter screenMode.
Notification	changeScreenMode	
Parameter	screenMode	
KP	Expositions coordinator	Changing current slide on screen.
Notification	changeSlide	
Parameter	slideUrl	

Conclusion

- Studied the semantic layer represents the opportunities for constructing services that enhance the existing MIS.
- Developed design of the semantic layer implements the latter as a Smart-M3-based software infrastructure.
- The proposed solutions were analyzed in respect to the case study of the History Museum of PetrSU.
- The proposed solutions can serve as reference ones for development of other museums and cultural heritage areas.

Thank you for attention

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