The
Semantic Event Broker

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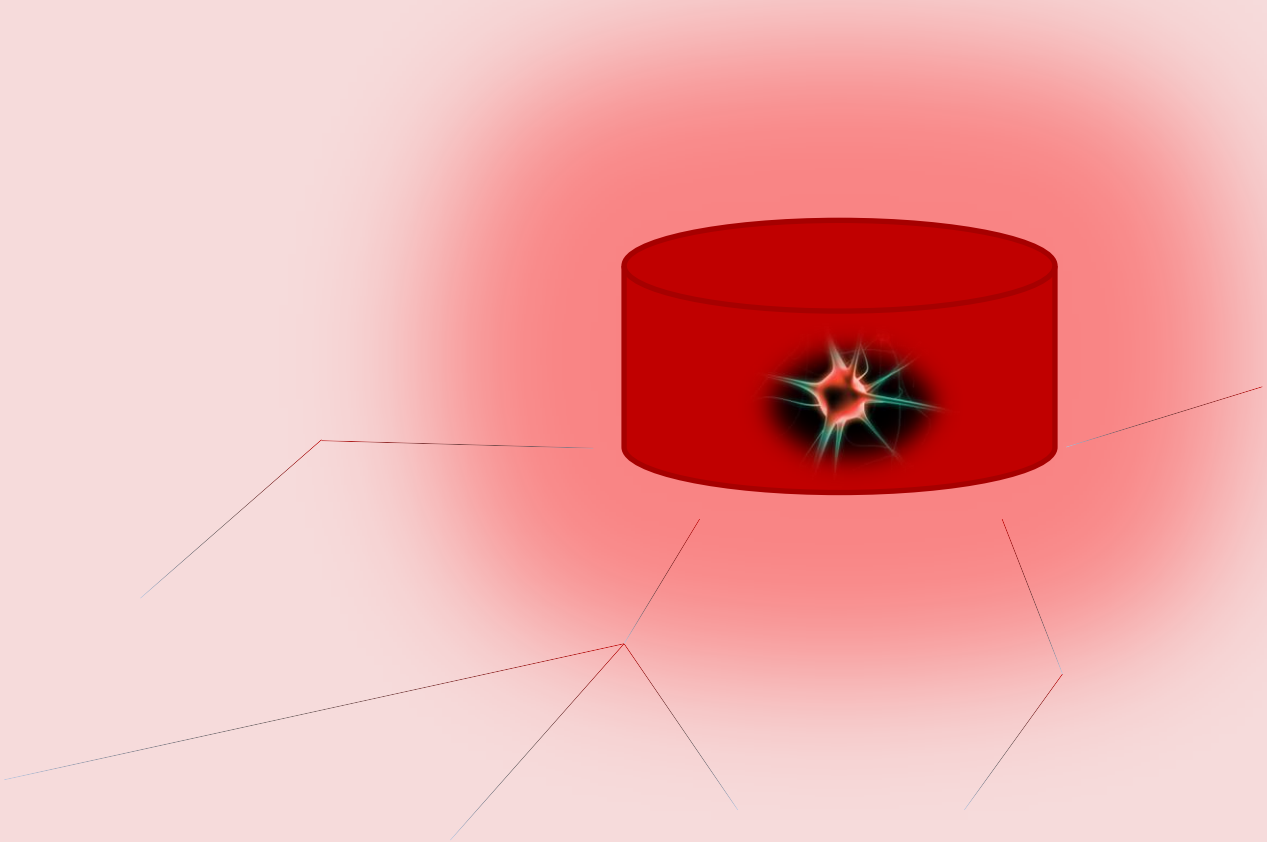


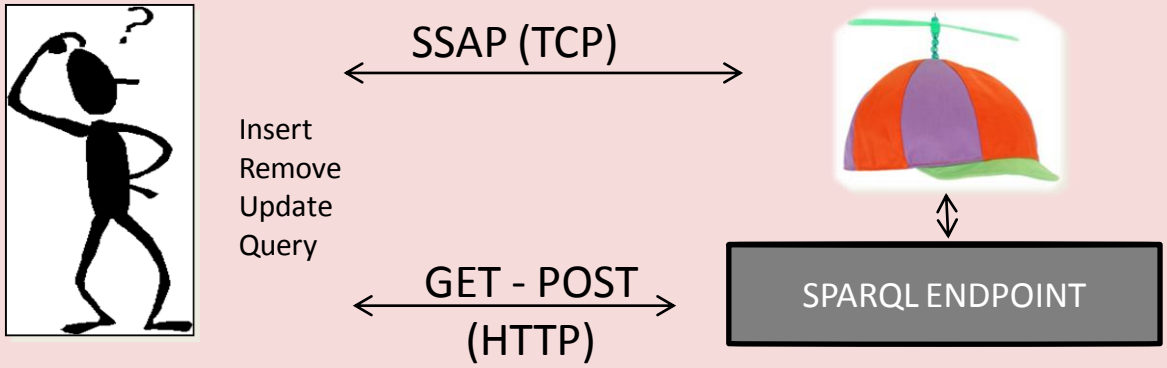
What are we doing and what future for Smart M3?

- Is it possible to consider today Smart M3 still a «triplestore» or an «endpoint» alternative? Modern SPARQL Endpoint (like Jena, Sesame, Virtuoso...) have:

> Experience (in some cases almost 20 years)
> Improved database distributed managment
> Multithred architecture
> Big communities

(... the only «smart» answer is no.)

- Smart M3 should be a **layer** over existing triplestore or endpoint, providing new **capabilities** for Smart Environments (or CPS) .
- New alghoritms for adding new functionalities and for improving performances.
- Avoiding the «**stupid hat**» on top of a perfectly working platform.



The legacy of the SOFIA project and the particularities of our Semantic Web

- The SIB can be considerate a dynamic real time context handler, so generally has to store a **“limited” amount of triples** coming from the real scenarios. We can consider the Smart Environment and the SIB related by a bijective function of entities.

- The RDF content **changes continuously** with relatively **“small” triples updates** (“update” will be referred to insert, remove or insert-remove operations) for these reasons:

  > Many of commercial sensors produce periodical updates of a limited number of basic parameter (e.g. temperature, pollution, hearth rate, weight, pressure...)

  > Aggregator KPs generically send few triples per time as result of some elaborations, or just some triples for triggering actuators.

  > Actuator KPs generally are notified and consequently update the Smart Space with some (generally few) results coming from the feedback of the operation.

The legacy of the SOFIA project and the particularities of our Semantic Web

- The SIB store context information is structured for retreiving almost real time data from the ontology knowledge with **no historical purpose**. Every historical service must be done externally (KPs based) for not drammatically affecting the performances. This problem generally does NOT depends from the specific application.

- The SIB must avoid **syncronization** between KPs who share multiple access to the same resources.

- One of the most powerful feature in Smart M3 is the **publish-subscribe** implementation. This allows the KP to ba automatically waken (without consuming resources) whenever the required parts of graph change, allowing logical composition of sub-graphs and filtering operations.

Overcoming the SIB

- **SPARQL 1.1** (query and update) is now the **official** W3C language for RDF. All **other methods** for quering, subscribing and updating the SIB (RDF operations, other query methods...) can be considered **obsolete** . Particularly all the RDF operations can be considered specific SPARQL sub-cases.

- **SPARQL applyied to publish subscribe** can become extremely powerful, similar to rules or **event language** taking all the advantages of the **semantic**. For allowing this a particular alghoritm has been implemented for improving performances and exploiting the multithreading functionalities.

- **A Time Managment** mechanism is absolutely necessary in the SIB for allowing syncronization and wathdogs (the latter *extremely* difficult to implement in Smart M3).

To the Semantic Event Broker: The programming model

The reference behaviour: Event Languages.

E.g. TESLA* event based (Running on powerful parallel HW, like CUDA):
Events are more powerful due to the time integration and performances.

```
define Fire (Val)
from Smoke () and
each Temp(Val > 45) within 5 min from Smoke
where
Val = Temp.Val
```

Possible to have the same behaviour with the added value of the semantic ?
(Related Article C-SPARQL, EP-SPARQL, ...)

Extremely **difficult** to implement a rule like this in Smart M3 ordinary KP..

A KP for having this feature can be complex.
> Thread with Sleeps , couter thread with reset..
> Syncronizations

THE KP MODEL SHOULD BE SIMPLER AND BETTER DEFINED

To the Semantic Event Broker: The programming model

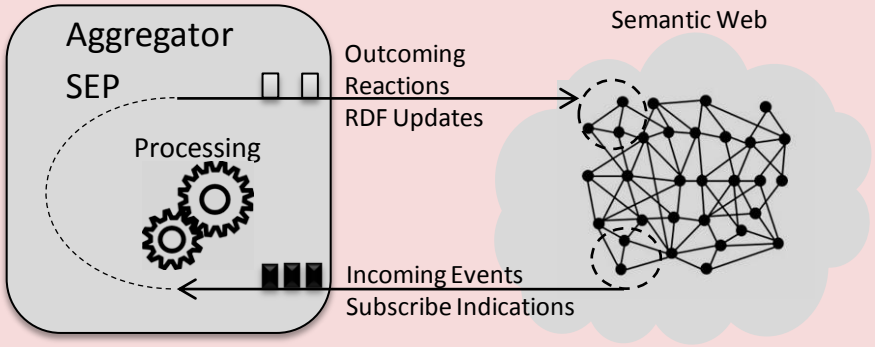
We can imagine to indroduce some new and specialized class of KPs, event-oriented and time-based: the Semantic Event Processor (SEP)

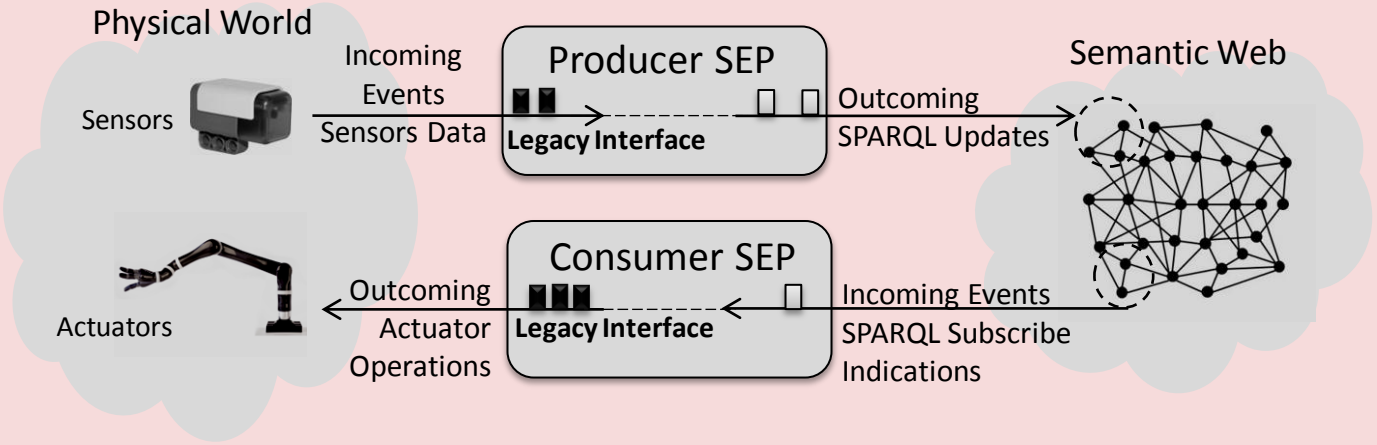
A SEP can interact only with the SEB:

- Aggregator SEP

Or even with with the Physical World:

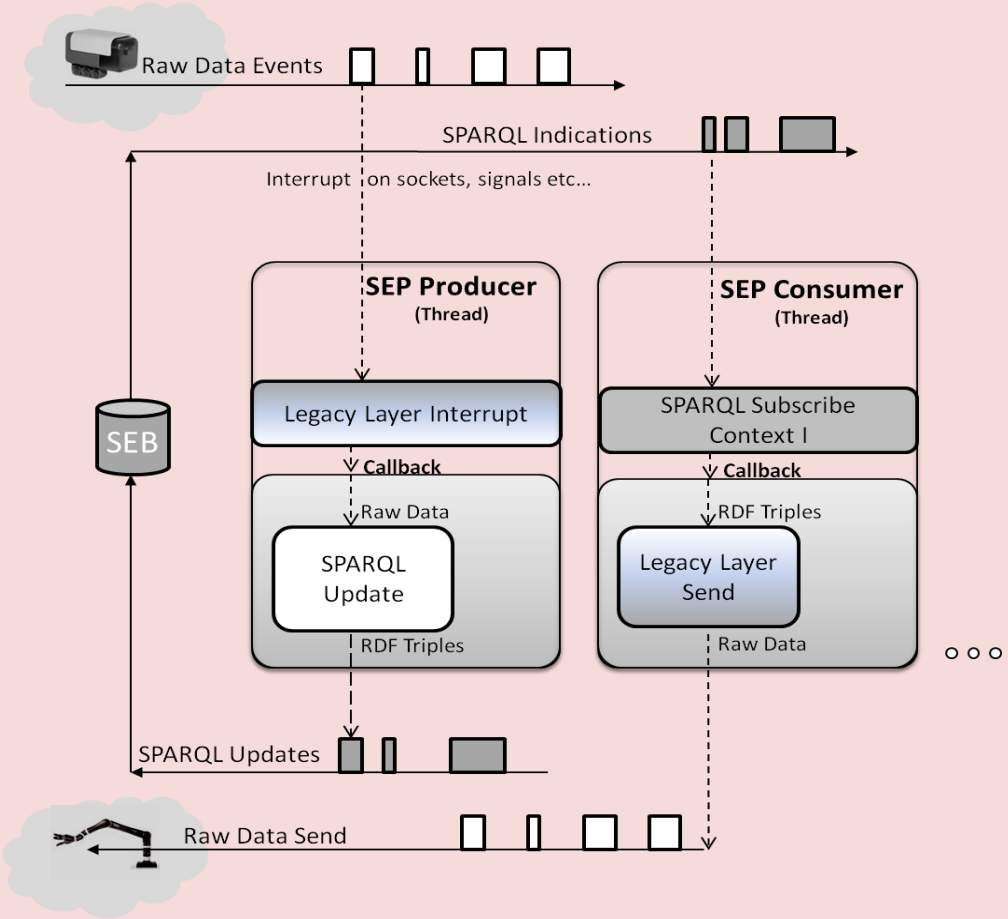
- Producer SEP
- Consumer SEP





To the Semantic Event Broker: The programming model

- Every Producer SEP is provided with a Legacy Layer (able to read data from the physical world) and performs SPARQL Updates on changes.
- Consumer KP holds a SPARQL Subscribe and send data to the legacy layer on every variation.

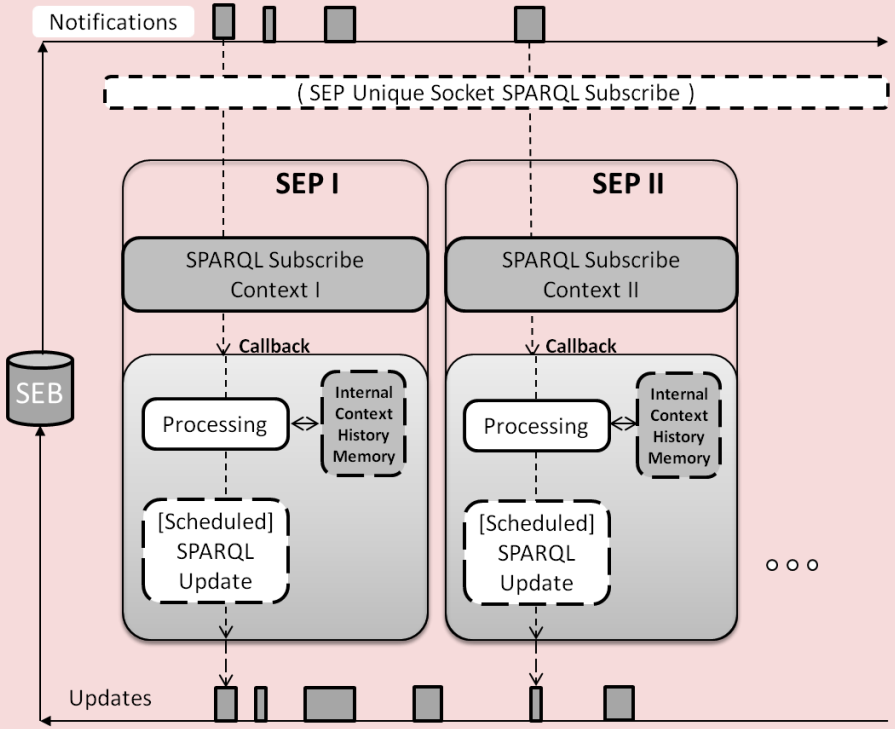


To the Semantic Event Broker: The programming model

Every aggregator SEP is based on :

- Context Subscribe (Sparql Subscribe)
- Callback
  - Processing (Combinatorial, Causal) [Optional]
  - Sparql Update (Scheduled[Optional])

And on time functionalities.

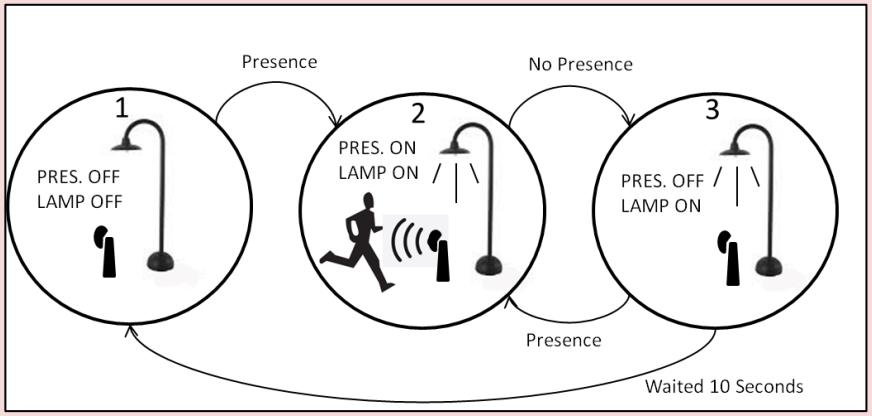


To the Semantic Event Broker: Example

The scenario includes a presence sensor and a lamp.
(the example is almost identical to the fire alarm of the events)

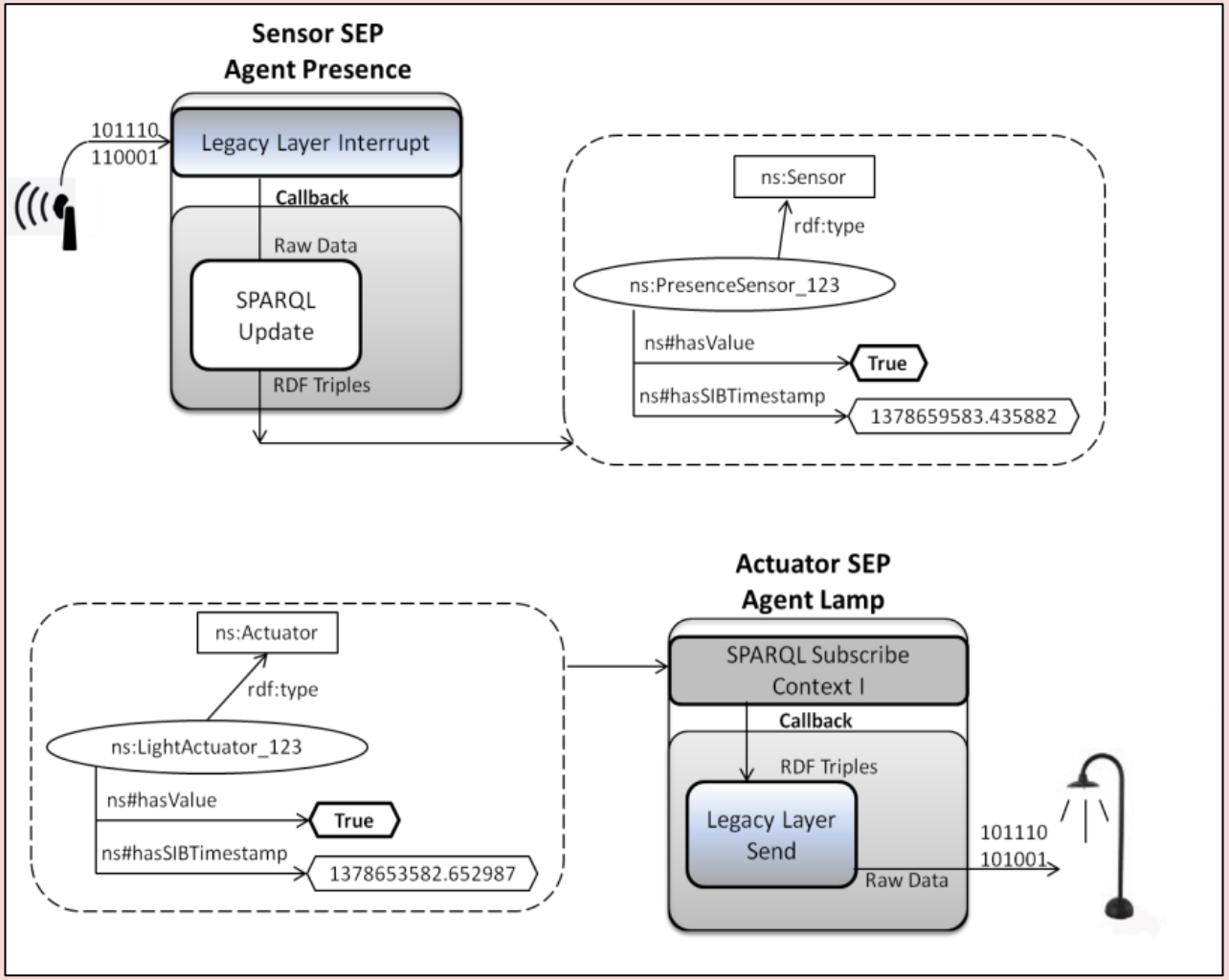
Behavior:

- If a presence is detected the lamp must be turned on.
- When the presence is no more detected for 10 seconds the lamp must be switched off.



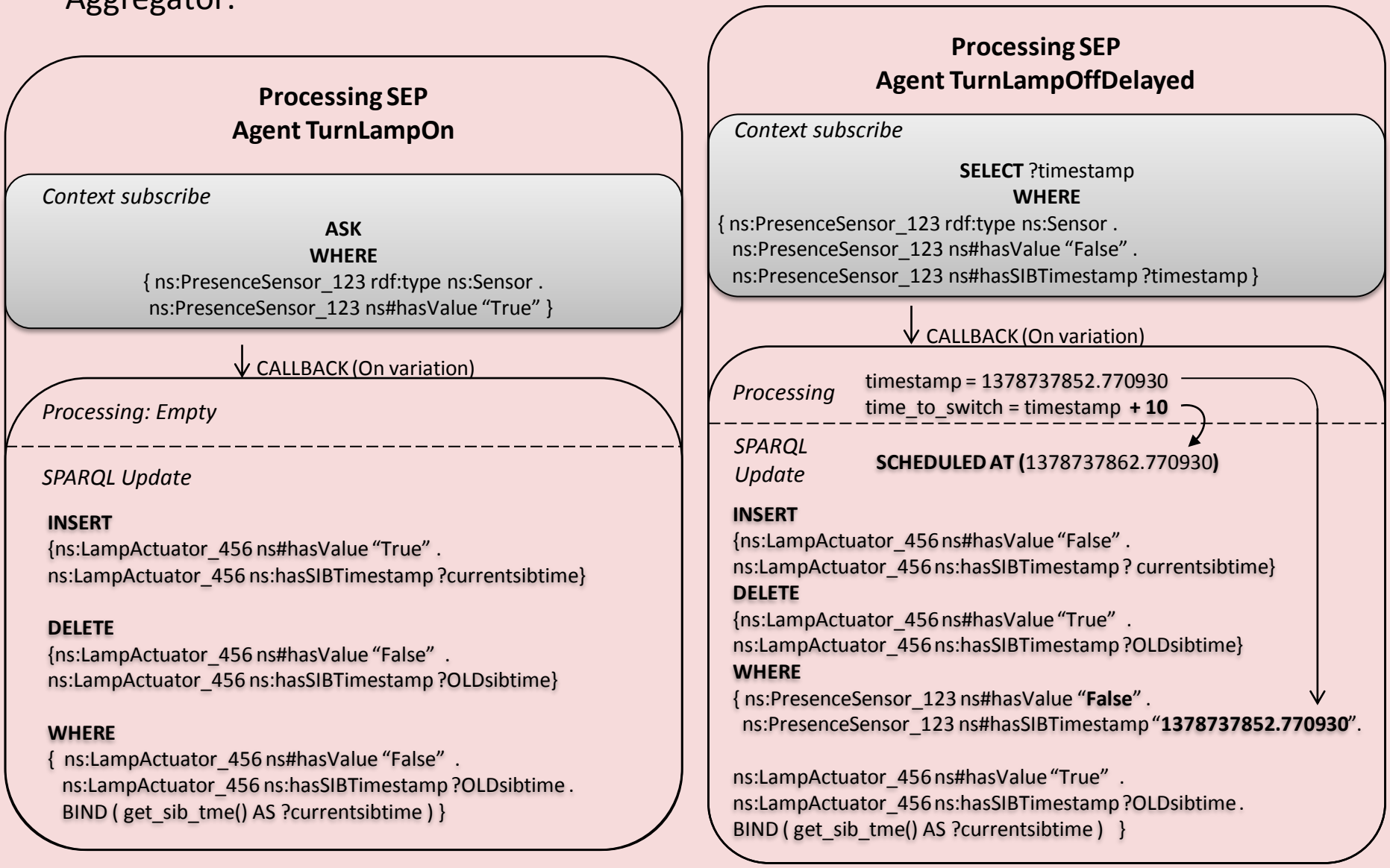
To the Semantic Event Broker: Example

Producer and consumer KP:



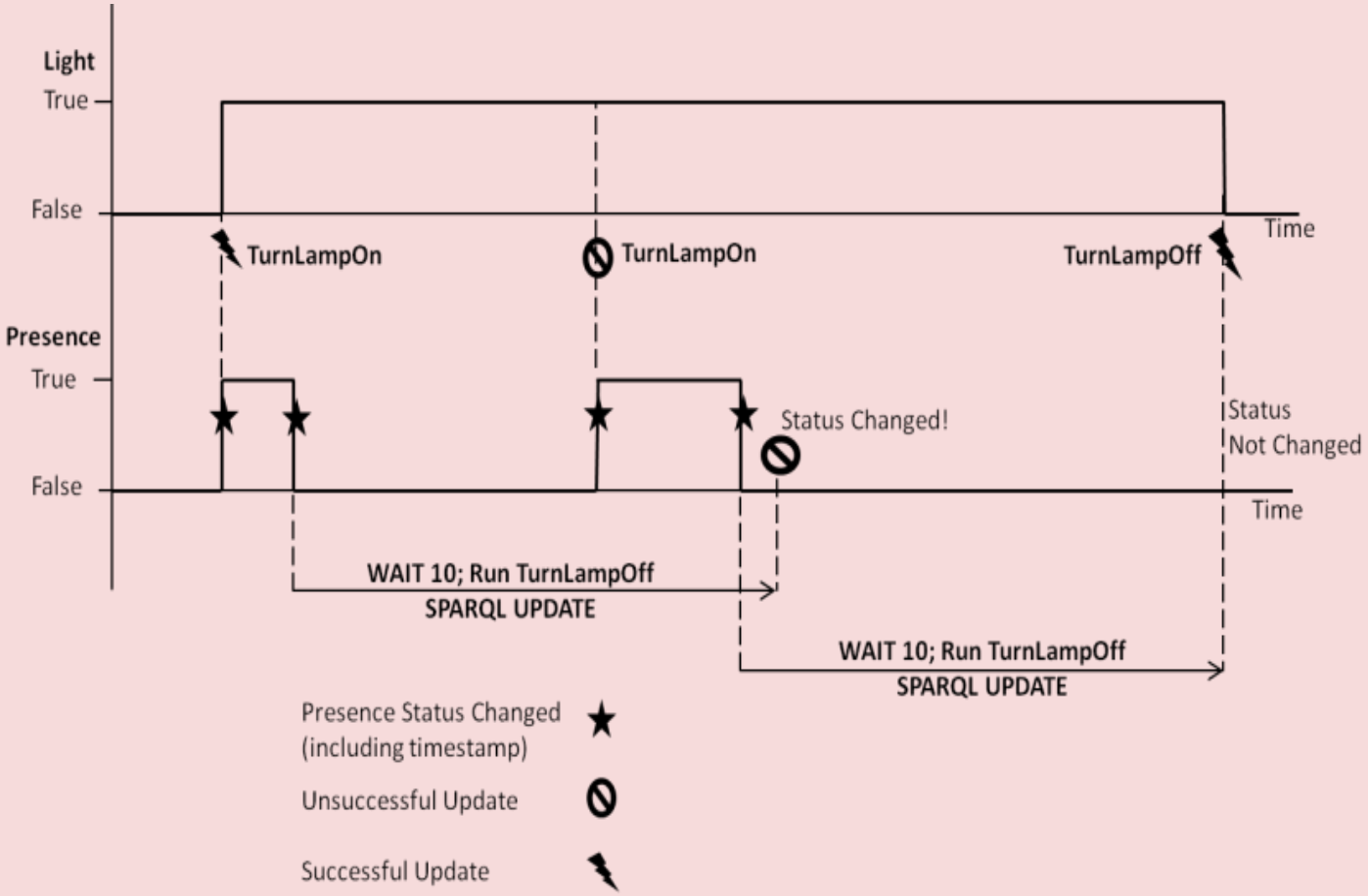
To the Semantic Event Broker: Example

Aggregator:



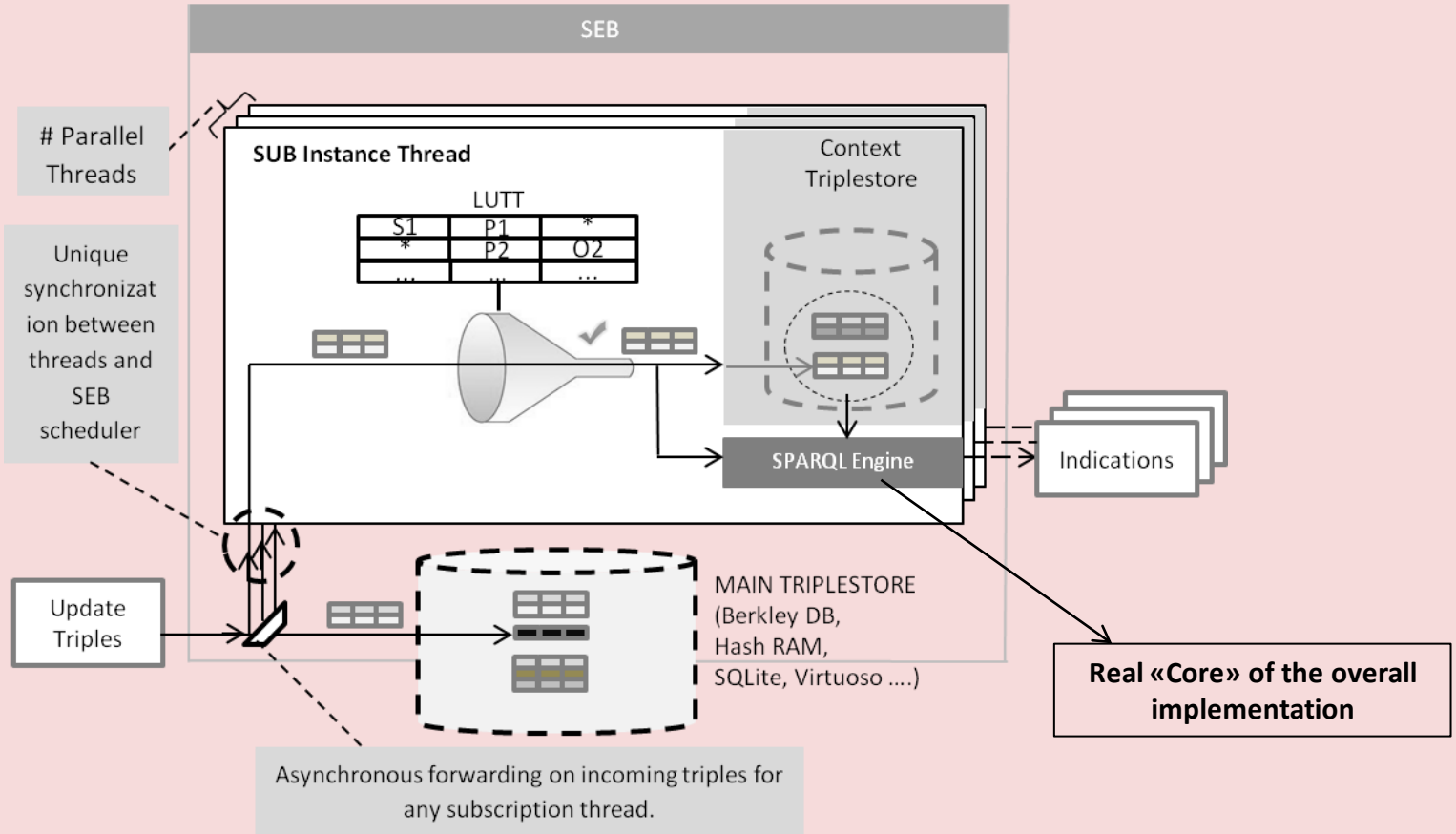
To the Semantic Event Broker: Example

Time behaviour:



To the Semantic Event Broker: The Internal Architecture

- Multithread for any active subscribe
- All the update operations are forwarded in to the threads throgh async queues
- Every subscription thread is provided by
  - LUTT
  - Internal Sub-Triplestore
  - Sparql Accellerator * (or Sparql Engine)
  - Dispatcher for Indications



Conclusions:

As simple triplestore, Smart M3 can be considered inadequate compared to most SPARQL Endpoints.

If we agree to consider Smart M3 a *layer* over existing TS the aim can be:

Create a convergence with the world of events by:

- A KP implementation philosophy based on only on SPARQL SUBSCRIBE, SPARQL UPDATE and time funcitionalities. (e.g. queries will become obsolete)

- An internal architecture based on :

  - SPARQL optimization for the subscriptions
  - Multithreading for subscriptions
  - Time managment managed as sleeps in theads (low resource)