Testing Semantic Interoperability

Soumya Kanti Datta
Research Engineer
Email – dattas@eurecom.fr
Roadmap

• Introduction
• Testing Semantic Interop
• Survey
• Conclusion
Introduction

• Interoperability - key to achieve the full potential of the IoT market.
• Due to the highly dynamic nature of the IoT, a strong need of interoperability at data level has emerged so that it becomes easier to combine/aggregate, process, manage and store the data/event coming from heterogeneous data sources.
• Semantic interoperability is a way to address the problem.
Introduction

• We need tests that validate the semantic compliance and interoperability among IoT systems.
  – To boost the acceptance and adoption of the semantic technologies by the IoT market.

• Testing semantic interoperability is identified as a gap in the current IoT research and industrial initiatives.

• SemTest, an Industrial Extension of EU H2020 F-Interop project addresses this part.
Two Types of Testing

• Conformance testing
  – To test if a piece of semantic data conform to a reference ontology

• Interoperability testing
  – To check if two parties understand correctly the exchanged semantic data
Requirements – Conformance Test

• Lexical check
• Syntactic check
  – Untyped of resources and literals
  – Ill-formed URIs
  – Problematic prefix and namespaces
  – Unknown classes and properties
• Semantic checks
  – Cardinality inconsistency
  – Problematic relationship or inheritance
Conformance Test Scenario

SUT

Send semantic data

Tester

Validation report

Lexical check

Syntactical checks

Semantical checks
Requirements – Semantic Interop Test

• Communication level check
• Lexical/format level check
• Data processing check
Objective: Test the semantic processing results from two systems

Pre-test condition:
- SUT1 and SUT2 both have semantic query processing capability
- Transmitted semantic data (D1) have been validated its conformance
- SPARQL query Q1 is prepared

Test Sequence:

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SUT 1 sends its semantic data D1 annotated to SUT 2</td>
</tr>
<tr>
<td>2</td>
<td>SUT 2 executes query Q1 upon the semantic data received D1, for example, to execute a query to get the resources that has X property(ies). SUT 2 gets result of the execution R1</td>
</tr>
<tr>
<td>3</td>
<td>SUT 2 sends the result R1 to SUT 1.</td>
</tr>
<tr>
<td>4</td>
<td>SUT 2 sends the query Q1 to SUT 1</td>
</tr>
<tr>
<td>5</td>
<td>SUT 1 executes the received query Q1 upon D1 and gets the result R1’</td>
</tr>
<tr>
<td>6</td>
<td>SUT 1 compares R1 and R1’. R1 and R1’ are equivalent</td>
</tr>
</tbody>
</table>
Semantic Interop Testing and oneM2M

AE – Application Entity
CSE – Common Service Entity
Semantic Interoperability Between Systems Scenario
Architecture
Interoperability at Data Level

Objective
Test the semantic data for checking if they share the same vocabulary

Pre-test condition
Transmitted semantic data (D1 and D2) have been validated its conformance

Test Sequence

<table>
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<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SUT 1 submits semantic data D1 to a third-party module (Tester)</td>
</tr>
<tr>
<td>2</td>
<td>Tester retrieves the vocabulary of D1: V1</td>
</tr>
<tr>
<td>3</td>
<td>SUT 2 submits semantic data D2 to Tester</td>
</tr>
<tr>
<td>4</td>
<td>Tester retrieves the vocabulary of D2: V2</td>
</tr>
<tr>
<td>5</td>
<td>Tester compare V1 and V2. They are identical to be interoperable 100%</td>
</tr>
<tr>
<td>6</td>
<td>The result from the previous step is communicated to SUT 1 and SUT 2</td>
</tr>
</tbody>
</table>
Data Level Interoperability Scenario Architecture
Survey

- Please complete our survey on Testing Semantic Interoperability (takes ~5 minutes)
  - https://goo.gl/forms/h3wgsyOpztxA3lSG2
Conclusion

• Testing for semantic interoperability is necessary in IoT.
• We propose two types of tests.
• Test scenarios are proposed to implement the semantic conformance and interoperability tests.
• Future work - we will implement the tests within the F-interop platform and report our results.
Acknowledgement

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Thank You

- Email: dattas@eurecom.fr
- Website: http://iot.eurecom.fr/