WISHI

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Workshop on IoT Semantic/Hypermedia Interoperability

- 8 calls after the IETF 100 WISHI hackathon - topics include:
  - Review of existing semantic capabilities - IPSO/LWM2M, OCF, Web links, W3C WoT, CORAL
  - Semantic annotation with RDF ontologies
  - Using third party vocabularies (QUDT, SOSA, SSN, iotschema)
  - Design patterns for semantic metadata integration
  - Layered semantic stack, e.g. SenML + RDF
  - The nature of abstract semantics; high level data and interaction models
  - Binding abstract semantics to concrete protocols
  - Semantic annotation for the context of connected things, features of interest
  - Extend the collaboration with other SDOs around semantic interoperability
  - Planning for IETF Hackathons
  - Interoperability across data types and engineering units
Wishi Hackathon at IETF 101 - High Level Goals

- Bring diverse connected things to interoperate
- Start with directory based discovery using semantic annotation
- Experiment with software adaptation to data models and protocols
- CoAP, HTTP, MQTT protocols
- Simple application scenarios; turn on a light with a motion sensor
- First hands-on experiments
Wishi Hackathon at IETF 101

● What implementations do we have?
  ○ W3C WoT
  ○ YANG & CoMI
  ○ OMA LwM2M Managed Server and Client
  ○ Ad-hoc device APIs and data models
  ○ Connected home and automotive domains

● How can we make them work together?
  ○ Role of W3C Web of Things technology

● Results
  ○ Thing Descriptions (TD) generated from LwM2M management server
  ○ CoMI implementation described by YANG re-described with TD
  ○ TDs stored in Thing Directory, and consumed by WoT implementation
  ○ WoT implementation communicating directly with all three implementations
W3C Web of Things - Thing Description

- TD is a file format and mediatype of RDF
- Describes abstract Interactions with things
  - Read temperature
  - Lock the door
  - Change the brightness of a light
- Binds to concrete instances that implement the interactions
  - Defines data shape, payload structure
  - Defines data types and range
  - Transfer layer instructions including URI, methods, options
- Applications use abstract interactions to decouple from the underlying implementation
- Any application, any network, any connected thing, using automated software adaptation
Layered Scope in Data Models and Information Models

- **Information Models**
  - iot.schema.org
  - Capabilities (Event, Action, Property)

- **Data Models**
  - W3C WoT Thing Description (Application Facing Media Type)

- **Device Specific Protocols**
  - OCF, LWM2M, IPSO, dotdot, Vendor defined

- **Protocol Binding**
  - "What I want to do"

- **Semantic Annotation**
  - "How to do it"
Thing Directory

- Things register their metadata with semantic annotation to a Thing Directory
- Applications can discover the capabilities of registered things based on the semantic annotation
- One or more thing directories with well known entry points
- Semantic discovery and thing integration into the application
  - Submit a semantic query to the Thing Directory indicating the required capability types (temperature measurement, light control, door lock)
  - Retrieve Thing Descriptions from registered things that satisfy the query
  - Select Things to integrate into the application that have the required interactions (e.g. color temperature control for a light)
  - Use the protocol binding part of the TD to construct payloads and perform methods on the desired things
CoMI device integration

YANG-TD-description → W3C WoT Thing Directory → W3C WoT servient → CoMI Device
HTTP Device Integration

HTTP device TD → W3C WoT Thing Directory → W3C WoT servient → HTTP Device
LwM2M Client & Server integration

- **LwM2M-TD Adaptor**
- **W3C WoT Thing Directory**
- **W3C WoT servient**
- **LwM2M Server**
- **LwM2M Client**
- **LwM2M (over CoAP)**

The integration involves a flow of information from the LwM2M server to the LwM2M client, passing through the W3C WoT Thing Directory and the W3C WoT servient, with CoAP as the communication protocol.
Putting things together with

LwM2M-TD Adaptor → W3C WoT Thing Directory → Web of Things Application

W3C WoT servient → HTTP Device

LwM2M Server → LwM2M Device → CoMI Device
Next Steps

- Experiment with semantic annotation and discovery using CoRE RD and CoRE Link-format
- Experiment with more diverse end device protocols and data models
- More automation of semantic queries - SPARQL syntax from URI-query options
- Automation of protocol bindings using software adaptation or translation
- Binding device capabilities to external Features of Interest (binding an instance of a thing with door lock capability to a specific door of your house) for contextual discovery
- More sophisticated applications, device to device orchestration