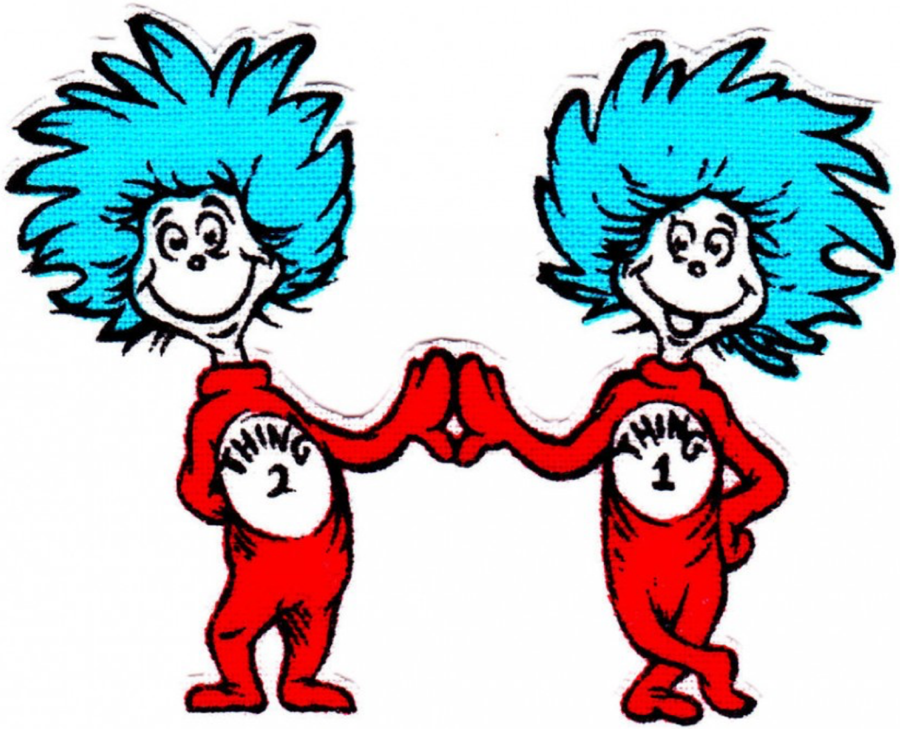
# WISHI

Michael Koster + Chairs


THING
2
THING
1

# **W**orkshop on **I**oT **S**emantic/**H**ypermedia **I**nteroperability

- 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

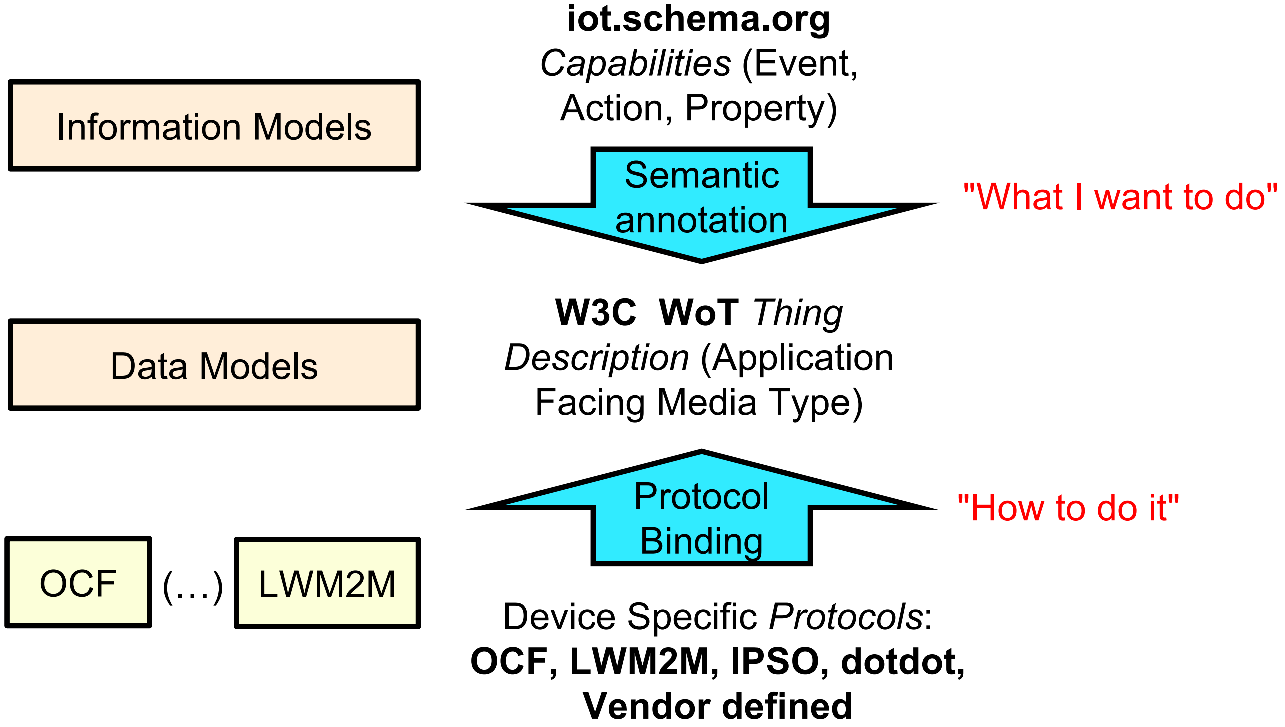
# Wishi Hackathon at IETF 101

- 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)

Semantic annotation

"What I want to do"

Data Models

**W3C WoT** *Thing Description* (Application Facing Media Type)

Protocol Binding

"How to do it"

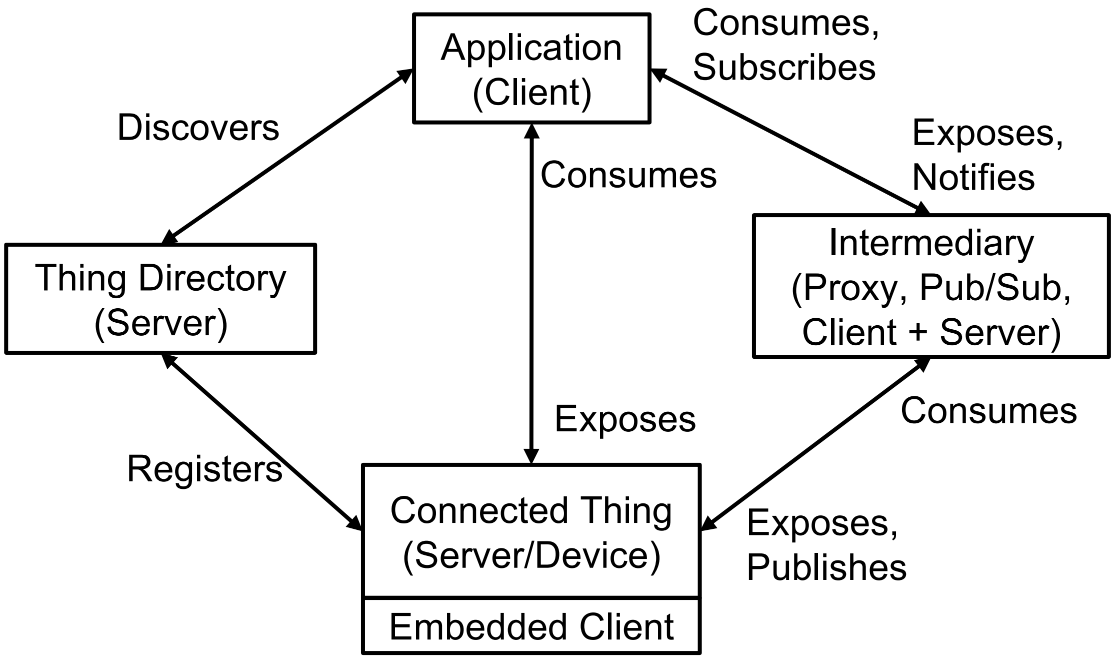
OCF (…) LWM2M

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

# 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

# Interop Schematic Diagram – Roles and Interactions



Application (Client)

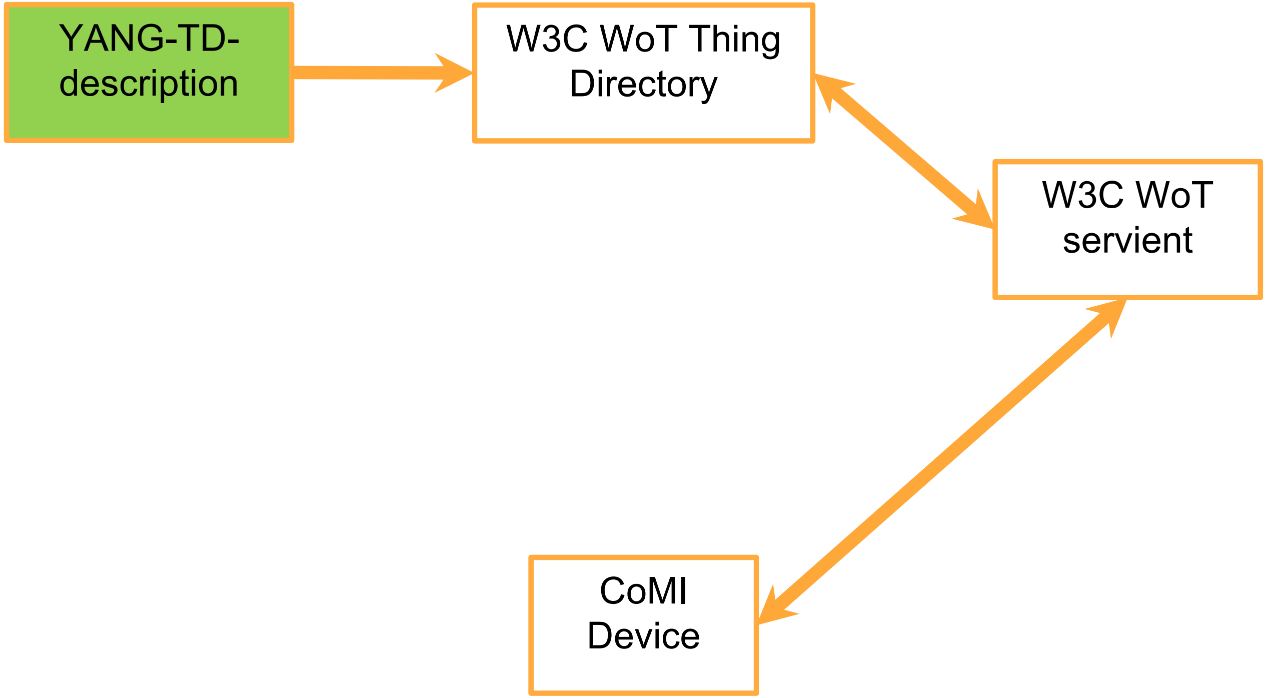
Thing Directory (Server)

Intermediary (Proxy, Pub/Sub, Client + Server)

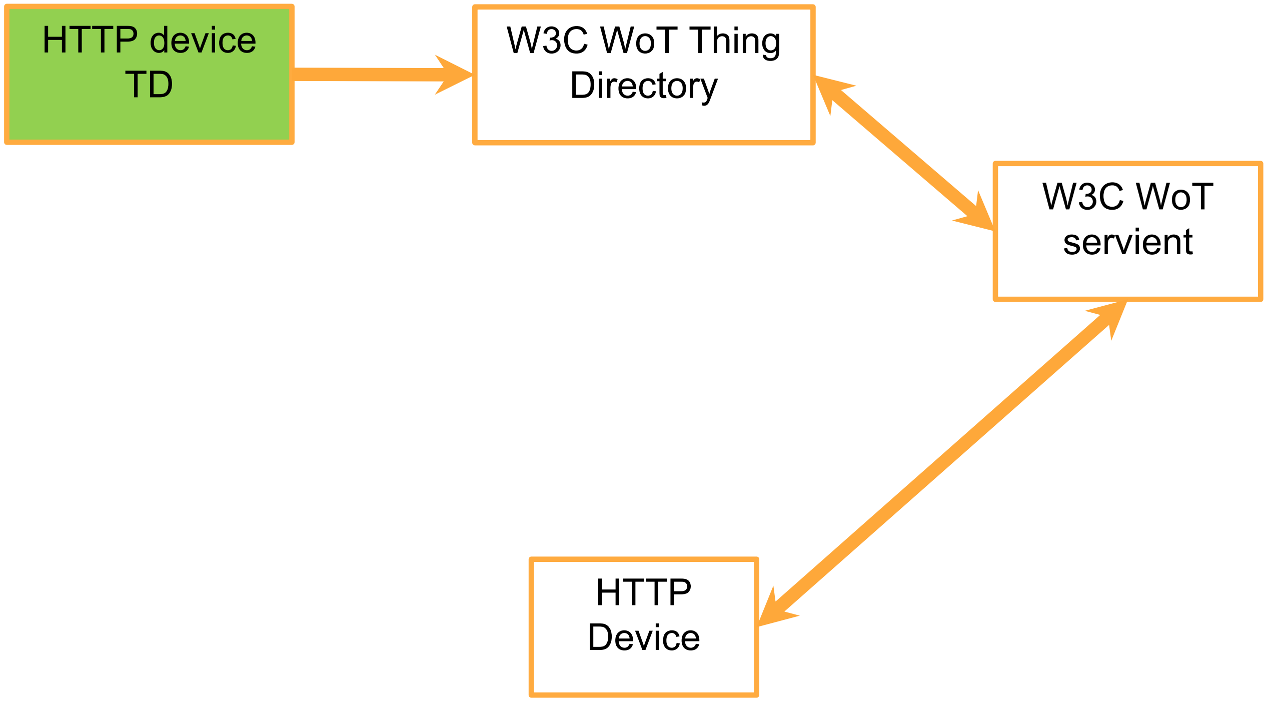
Connected Thing (Server/Device)

Embedded Client

# CoMI device integration



# HTTP Device Integration



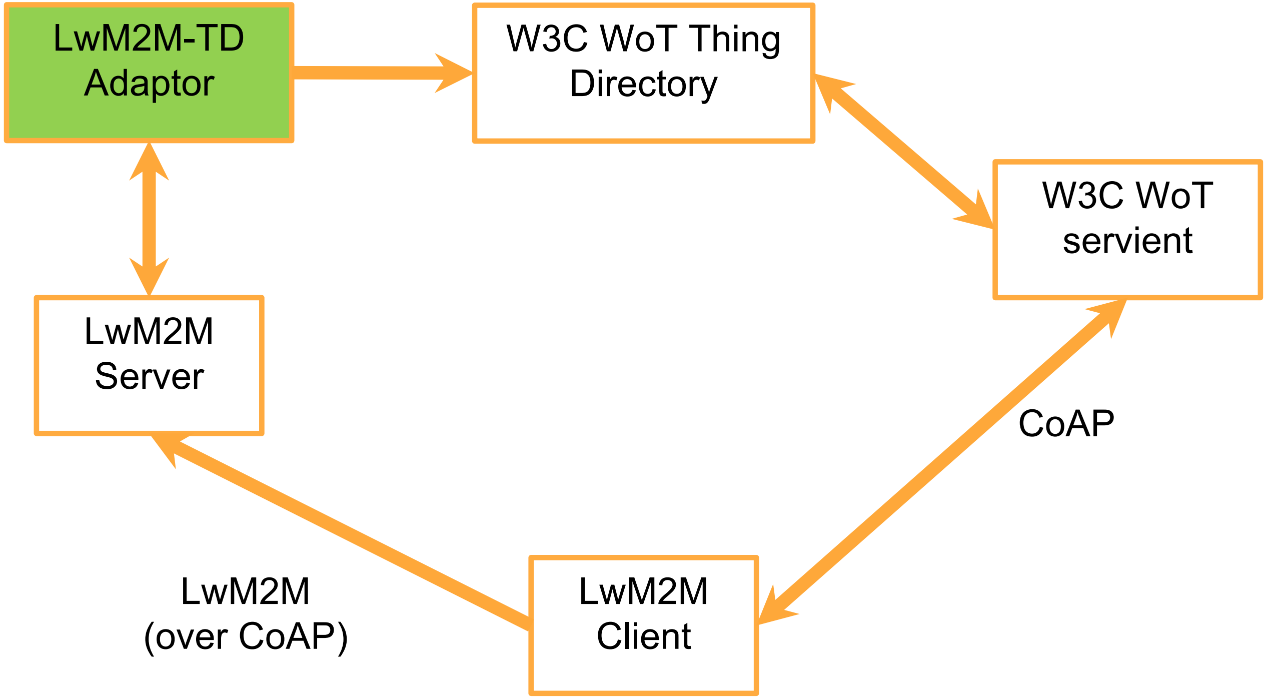
HTTP device TD

W3C WoT Thing Directory

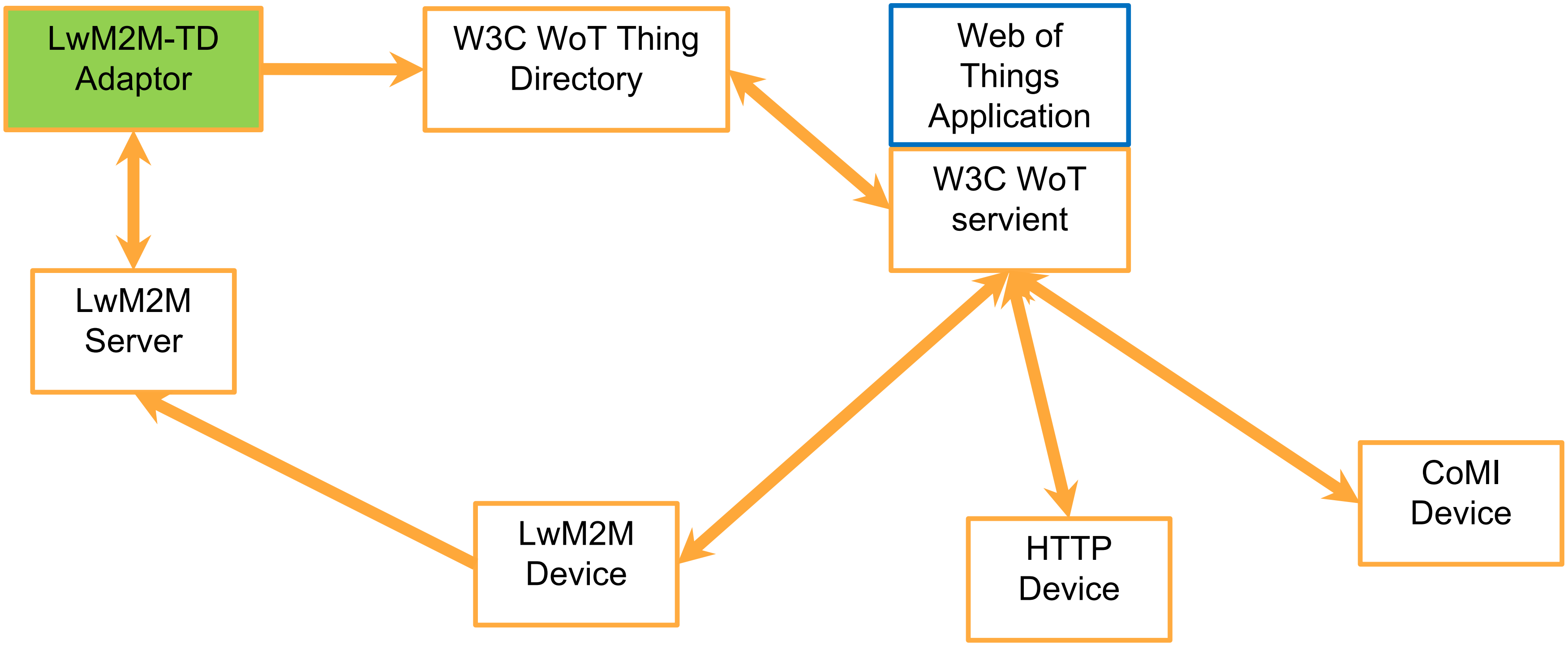
W3C WoT servient

HTTP Device

# LwM2M Client & Server integration



# Putting things together with



# 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