T2TRG: Thing-to-Thing Research Group

IETF 101
March 22, 2018, London

Chairs: Carsten Bormann & Ari Keränen

Note Well

- You may be recorded

- The IPR guidelines of the IETF apply:
  see **http://irtf.org/ipr** for details.

Administrivia (I)

- Pink Sheet

- Note-Takers

- Off-site (Jabber, Hangout?)

  - **xmpp:t2trg@jabber.ietf.org?join**

- Mailing List: **t2trg@irtf.org** — subscribe at: **https://www.ietf.org/mailman/listinfo/t2trg**

- Repo: **https://github.com/t2trg/2018-ietf101**

Agenda

Time	Who	Subject	Docs
15:50	Chairs	Intro, RG Status	[draft-irtf-t2trg-iot-seccons](#) [draft-irtf-t2trg-rest-iot-00](#)
16:00	Michael Koster / Chairs	Report from WISHI and Hackathon	
16:20	Jan Jongboom, ARM	Deep learning on microcontrollers	
16:50	Soumya Kanti Datta, EURECOM	Semantic Interoperability Testing - Current Trends and Future Outlook	
17:15	Michał Król, UCL	Secure Computations in Decentralized Environments	
17:40	Chairs	Meeting Planning, Wrapup	[OCF/W3C-WoT](#)

T2TRG scope & goals

- Open research issues in turning a true "Internet of Things" into reality

    - Internet where low-resource nodes ("things", "constrained nodes") can communicate among themselves and with the wider Internet

- Focus on issues with opportunities for IETF standardization

    - Start at the IP adaptation layer

    - End at the application layer with architectures and APIs for communicating and making data and management functions, including security

Recent activities

- Work on IoT/Semantic Hypermedia Interoperability (WISHI)

- Finalizing "State-of-the-Art and Challenges for the IoT Security" draft

- NDSS Workshop on Decentralized IoT Security and Standards (DISS)

- Side meeting on network coexistence at IETF 101

- Joint WebEx session with OCF on security and ACE

NDSS DISS

- Network and Distributed System Security Symposium (NDSS) is a premier security conference

- Workshop on Decentralized IoT Security and Standards (DISS, 2018-02-18) combined:

  - Non-centralized approaches to IoT security

  - Standardization of IoT security

- 12 papers, from a security analysis of current IETF work to much more speculative ideas (yes, with blockchain)

- Later in this meeting: Updated version of one of the talks, "Secure Computations in Decentralized Environments"

Next meetings

- OCF-W3C WoT joint meeting in Prague tomorrow
- Regular <u>WISHI</u> calls (~ monthly)
- WebEx meetings with OCF
- F2F with OCF?
- Montreal IETF 102
  - More WISHI? Distributed discovery? TBD

RG Doc Status

- "State-of-the-Art and Challenges for the IoT Security" in IRSG review

  - Thorough reviews in particular from Jim & Stephen (thank you!); lots of list discussion

- "RESTful Design for IoT"

  - New hypermedia design guidance PR in review

 - PATCH & FETCH guidance TBD

Network co-existence

- Side meeting Monday, ~ 30 attendees (draft-feeney-t2trg-inter-network-01)

- Main ideas

  - diverse, administratively unrelated networks experience radio interference

  - recent research results suggest that protocol-level interactions lead to episodes of severe performance degradation

- Discussion

  - performance evaluation: hackathon, tests, simulation...set expectations

  - touches many IETF protocols

  - IETF/IEEE border: MAC has to do most of the work, but limited by independence between networks

  - various possibility of active / explicit coordination at high level (synchronization, database as for whitespace spectrum)

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WISHI

Michael Koster + Chairs
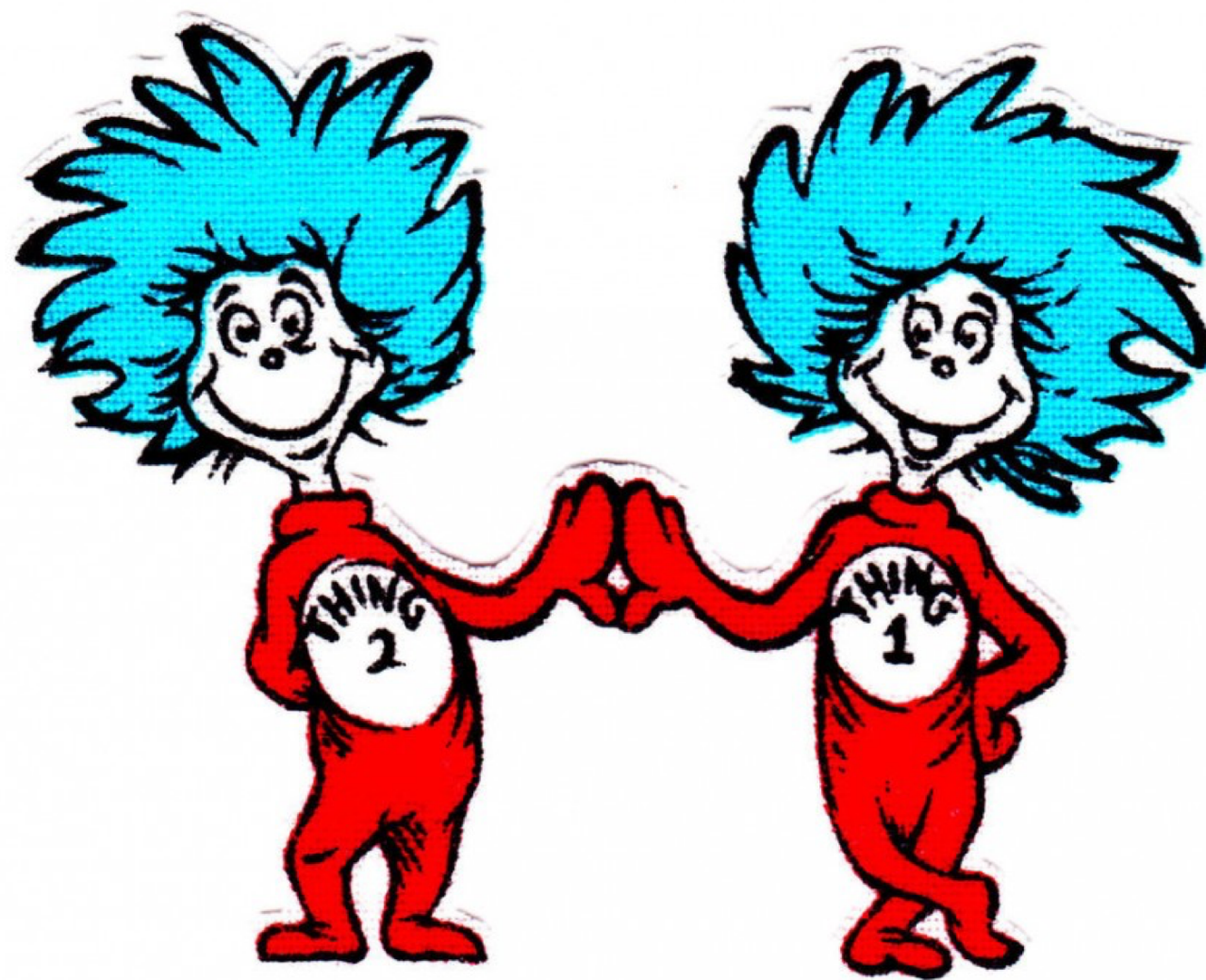
Workshop on IoT Semantic/Hypermedia Interoperability

- 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
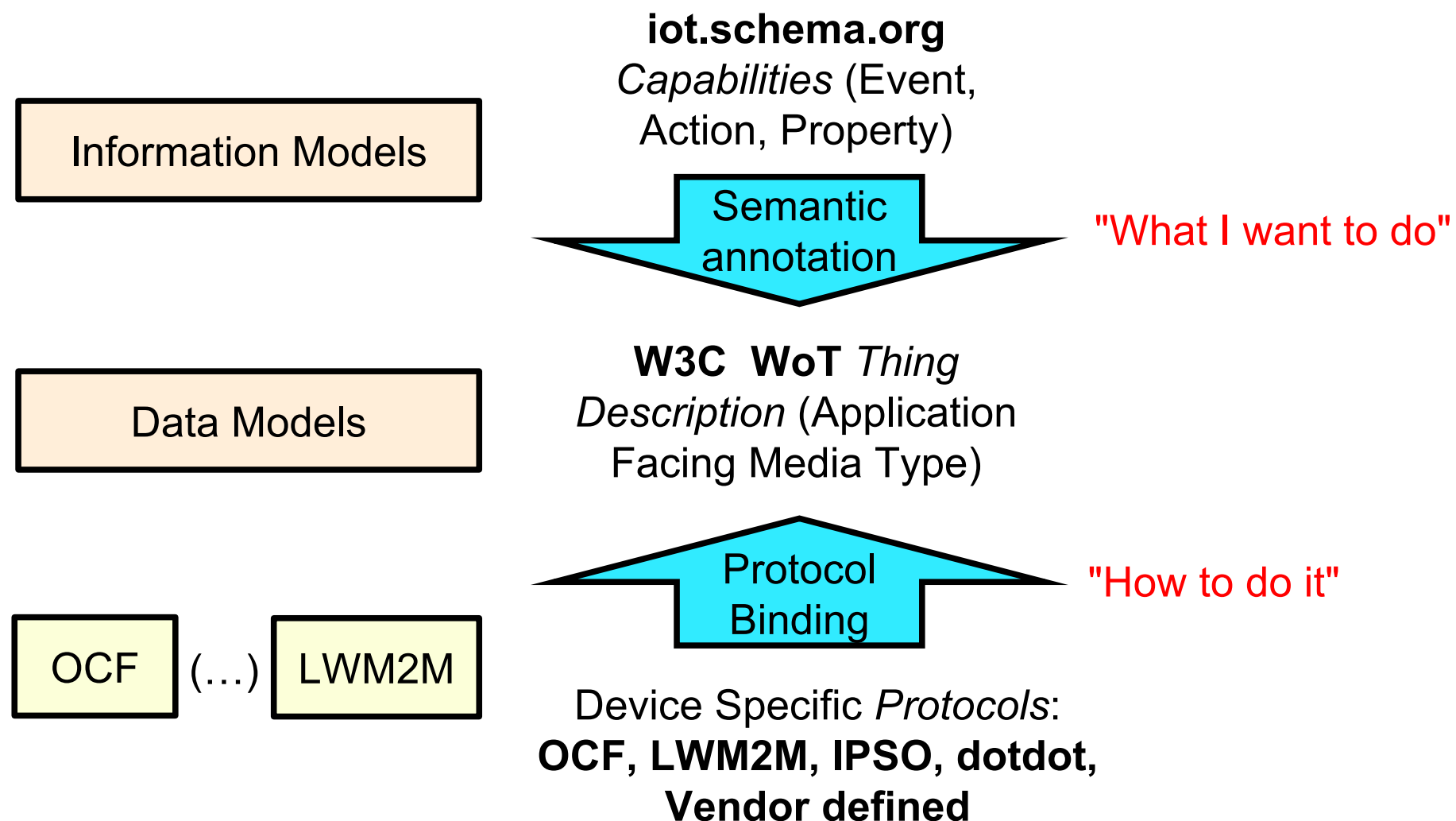- First hands-on experiments

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

iot.schema.org
Capabilities (Event, Action, Property)

Information Models

Semantic annotation

"What I want to do"

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

Data Models

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
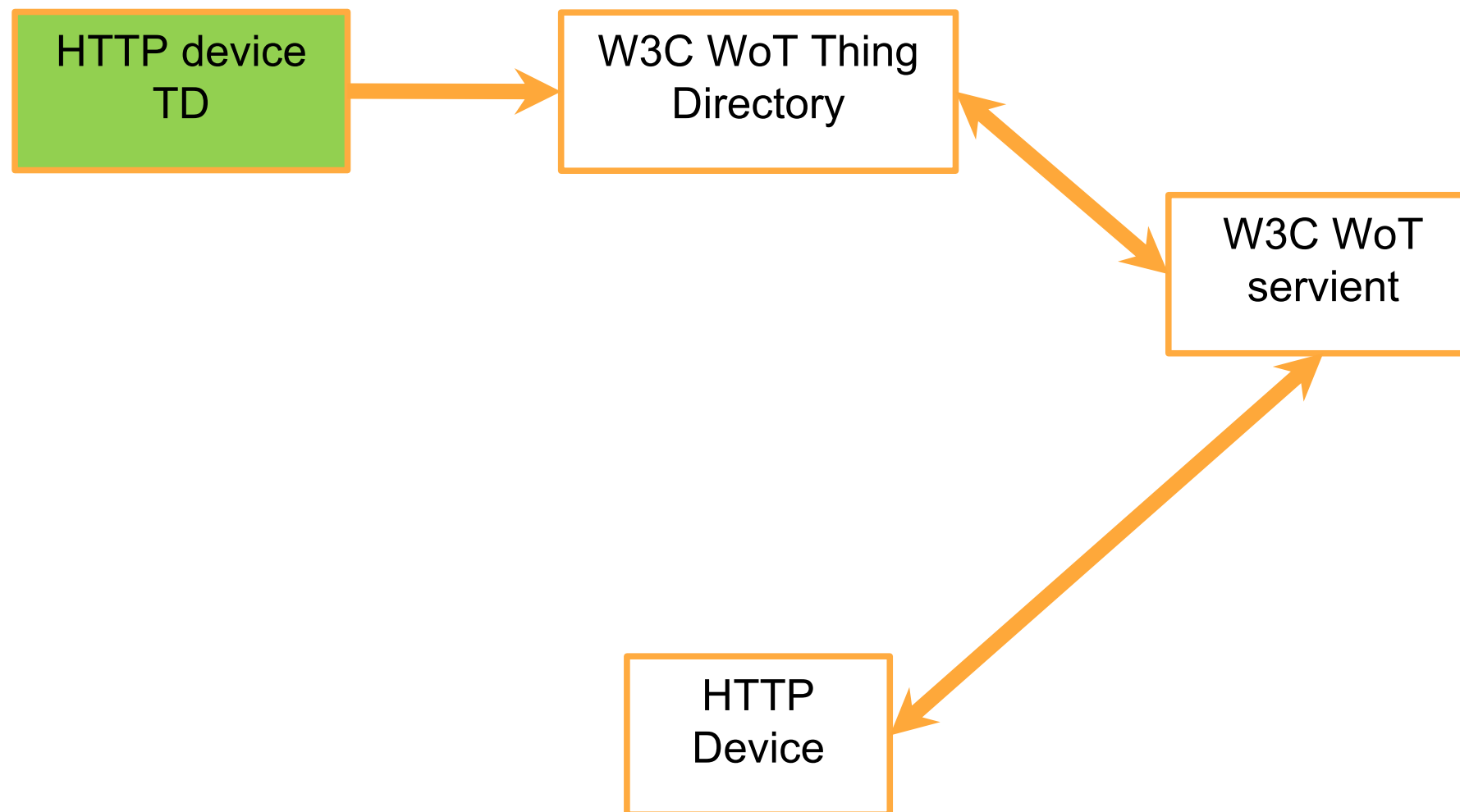
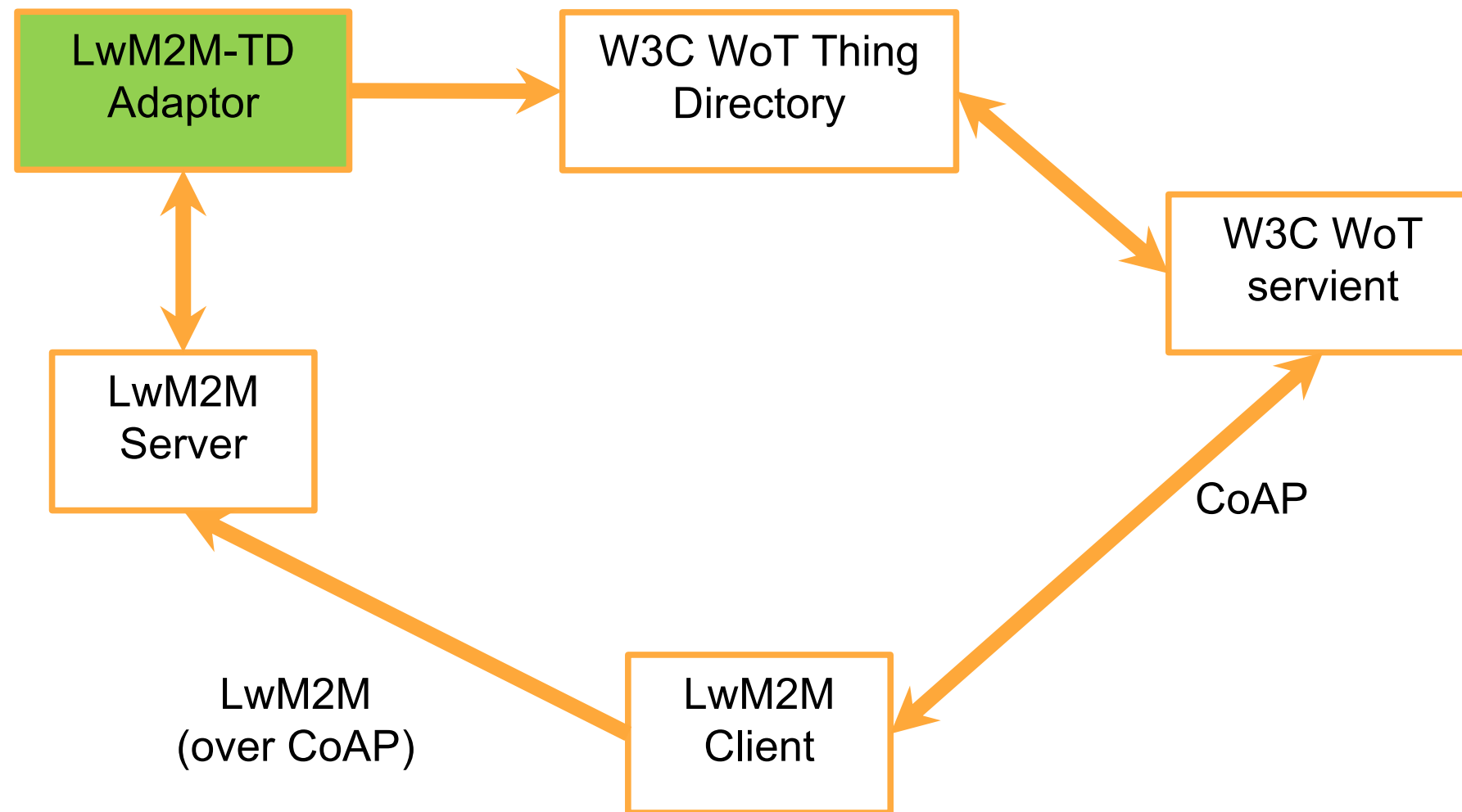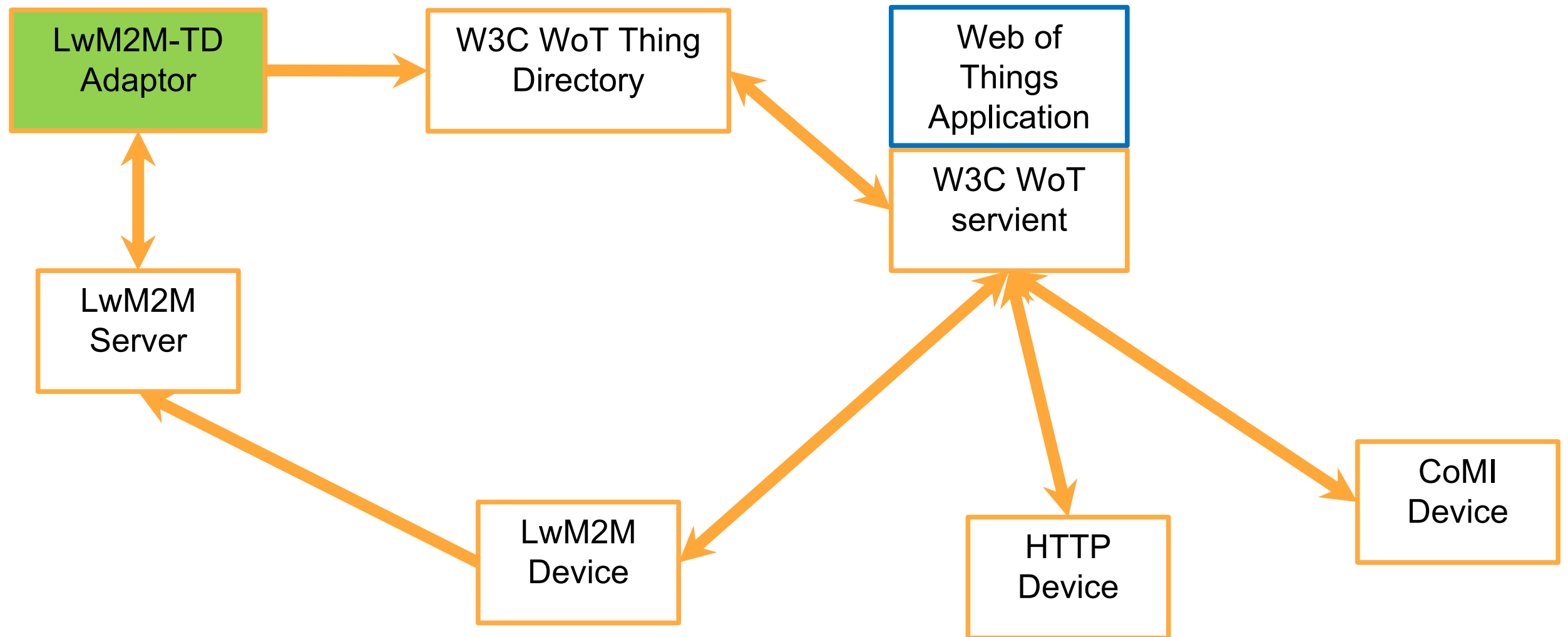# Interop Schematic Diagram – Roles and Interactions
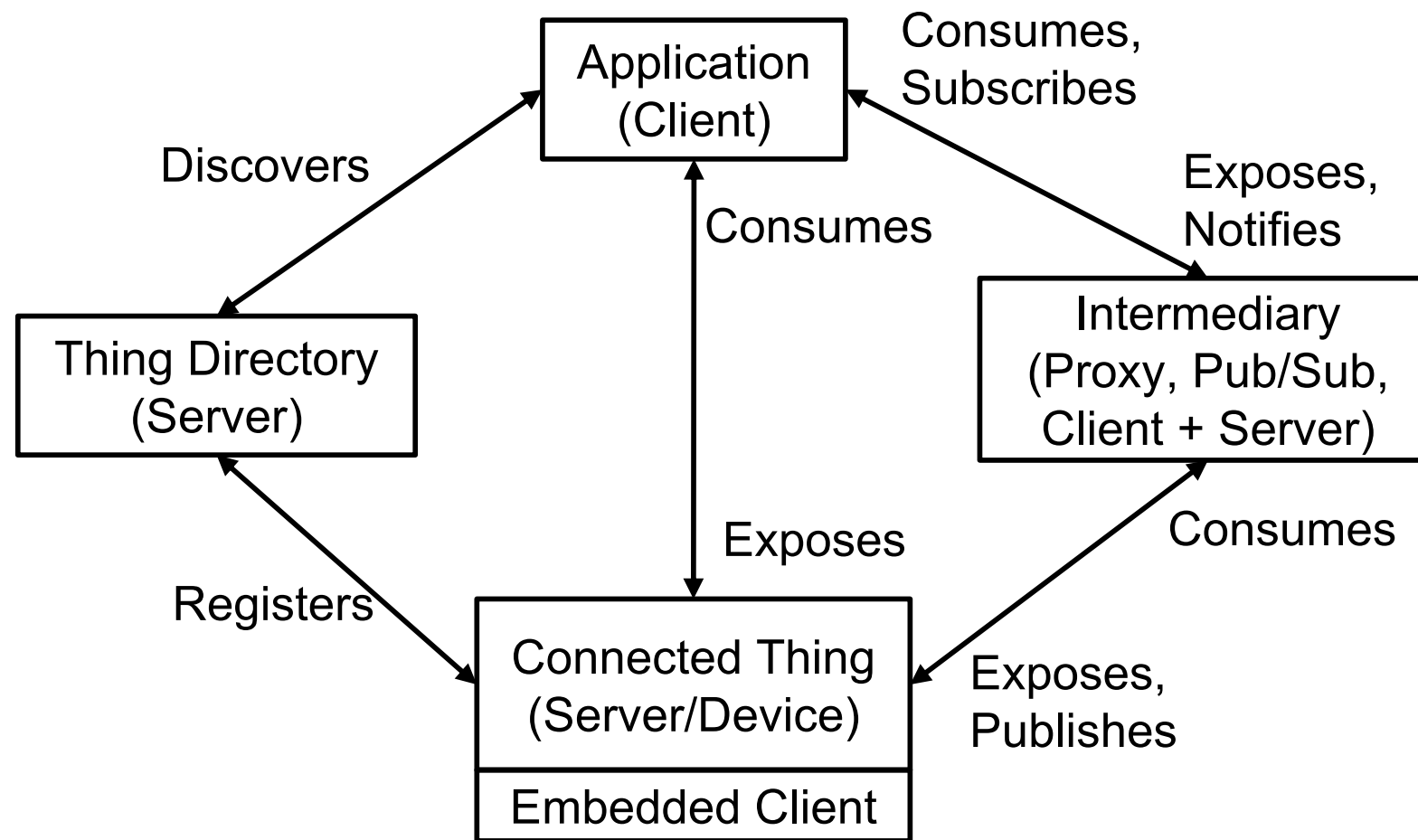
CoMI device integration
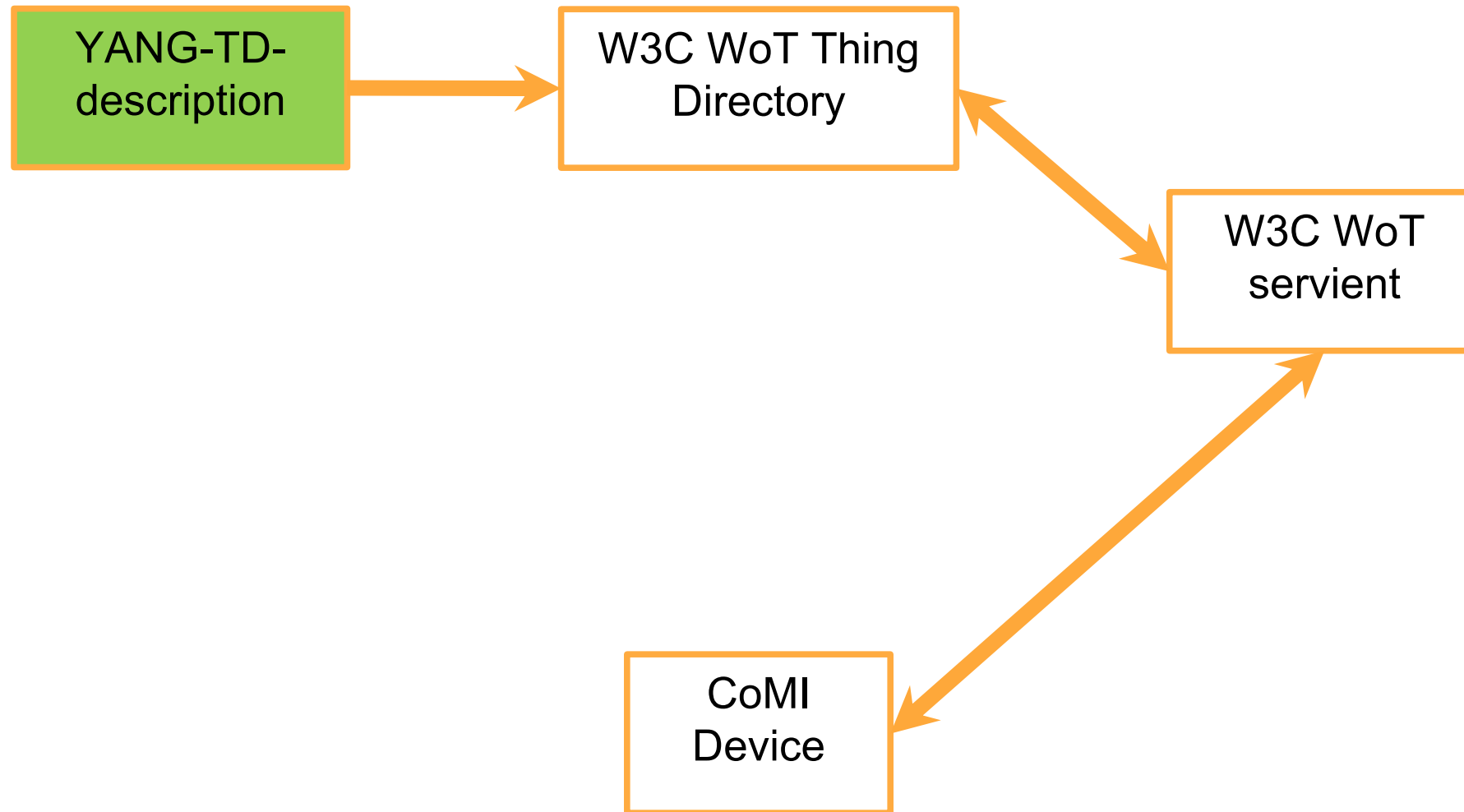
HTTP Device Integration

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

Meeting planning

OCF-T2TRG-W3C WoT meeting topics

- Status update of IETF/OCF coordination action items

- WISHI activities report

- Representation format of forms for IoT devices

- Model interoperability:
  WoT Thing Descriptions with OCF and IPSO models

- Push Models for Device data
  (pub/sub, non-traditional responses, ...)

- Links, Bindings, Interfaces, and Resource Representations

- "Base" CoAP (New Response Codes, RD alignment)

- ACE discussion continuation (multipoint security, etc.)

- Reference implementations and test case
  (CoAP, CoAP TCP, CBOR, ...)

  - Repo: **https://github.com/t2trg/2018-03-ocf-wot**