W3C Web of Things (WoT) Update

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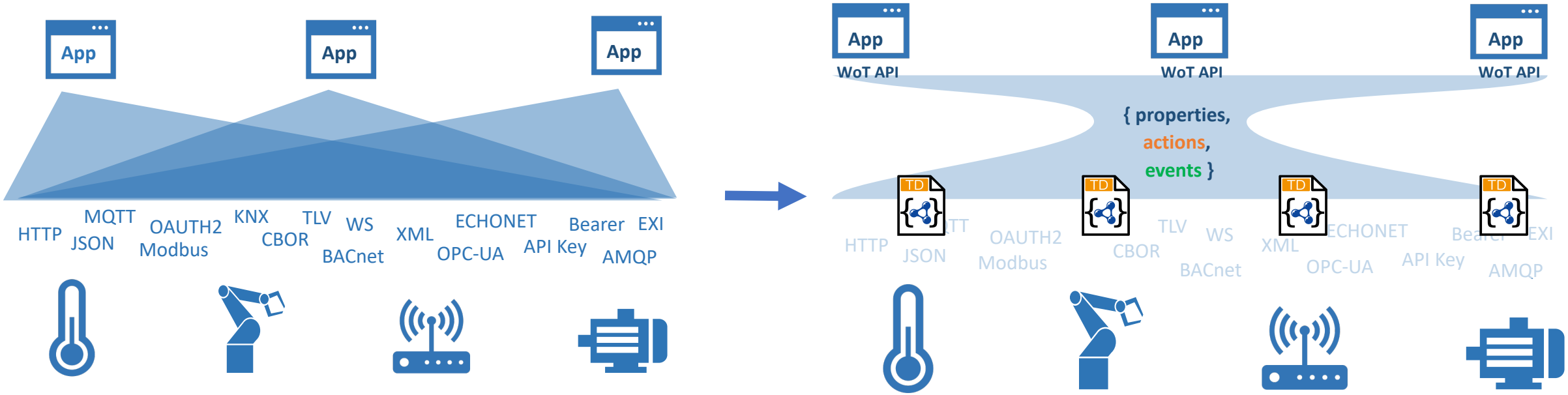
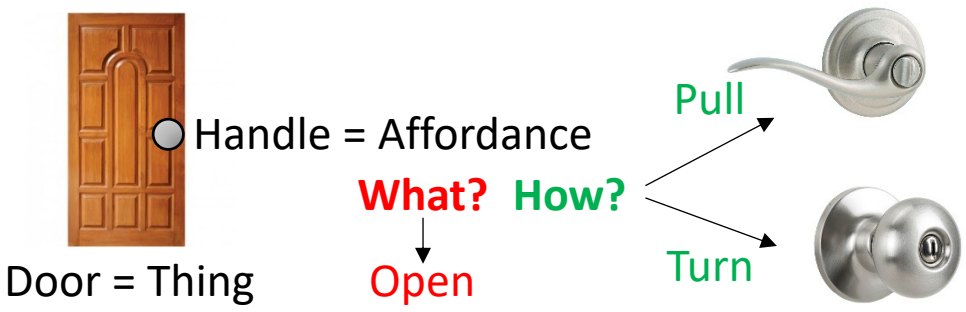
W3C Web of Things (WoT)

- **W3C WoT Working Group goal:** Adapting web technologies to IoT
- **Published:** Thing Description (TD) metadata format
  - TD describes the available interactions (network API) of a Thing
- **In Progress:** TD 1.1 Update, Thing Models, Discovery, Profiles
  - How to obtain TDs? How to ensure interoperability?



WoT Thing Descriptions

- WHAT the possible choices are
  - Properties
  - Events
  - Actions
- HOW to interact with the Thing
  - Protocol operations and options
  - Data schemas and content types
  - Security requirements




```
{
  "@context": [
    "https://www.w3.org/ns/td",
    { "iot": "http://iotschema.org/" }
  ],
  "id": "urn:dev:ops:32473-WoTLamp-1234",
  "title": "MyLEDThing",
  "description": "RGB LED torchiere",
  "@type": ["Thing", "iot:Light"],
  "securityDefinitions": ["default": {
    "scheme": "bearer"
  }],
  "security": ["default"],
  "properties": {
    "brightness": {
      "@type": ["iot:Brightness"],
      "type": "integer",
      "minimum": 0,
      "maximum": 100,
      "forms": [ ... ]
    }
  },
  "actions": {
    "fadeIn": {
      ...
```

New Deliverables

- Thing Description 1.1
  - Canonicalization (and WIP, Signing)
  - Validation levels
  - Thing Model
  - various other extensions, e.g. to security, data schemas, etc.
- Discovery
  - Introductions: DNS-SD, DID, CoRE RD
  - Directory Service: HTTP API for searchable database of TDs
  - Self-Description: .well-known, fetching of TD directly from Things
- Profiles
  - Emphasis on "hub" use-case, http/json
- Use Cases and Requirements (informative document)

Thing Description 1.1: Updates

- Canonicalization and Signing
  - WIP, but proposal is based on JOSE/JWS/JWA (incl. RFC 8037)
  - Can extract parts of a TD to sign using JSONPointer/JSONPath/XPath queries
- Security Scheme Improvements
  - URI Templates
  - Security information in body
  - OAuth "device" flow
- Thing Model
  - TD describes instance, TM describes class
  - Provides templating/parameterization mechanism
  - TD can reference *one* TM using a link
  - TMs can reference or extend other TMs (and *parts* of other TMs)

Discovery: Goals

Capabilities

- Support both local and global/remote discovery (unconstrained by network domain)
- Support "localizable" discovery (constrainable by location)
- Support both "syntactic query" (keywords) and "semantic query" (linked data)
- Support a directory service for searching large repositories of Things
- Support peer-to-peer (self-identifying "smart object") discovery

Privacy-Preserving Architecture

- Respect device and information Lifecycle
- Distribute TDs only to authenticated and authorized users
- Don’t leak private data to unauthorized users
- Don’t leak data that can be used to INFER private information to unauthorized users

Alignment with Existing and Evolving Standards

- IETF CoRE Resource Directories, CoRE Link Format, DID, OGC, WGS84, XPath, …
- Compatible with WoT Scripting API

Discovery: Two-Phase Architecture

Phase 1: Introduction

- “First Contact” Protocol
  - Answers the question: How to initiate discovery from zero knowledge?
- Open
  - Can be accessed with no or limited access controls
  - Based on existing standards, and can be extended to new standards
- Lightweight
  - Does not use significant resources on responder
  - Resistant to Denial of Service attacks
- Provides intentionally limited information
  - Avoid leaking any metadata that can be used to infer private data
  - This includes types of devices, device ids, owners, timestamps, etc.

Phase 2: Exploration

- Authentication and authorization required
- Supports more complex query and filtering capabilities (JSON Path, XPath, SPARQL)
- Provides access to rich metadata (TDs)
- Access controls can limit data returned

Discovery: Status

Introductions

- DNS-SD (including mDNS) – new service names
- CoRE RD – resource types
- DID – endpoint types
- Well-known URLs: to "guess" URL from an IP
- Direct: anything else that returns a URL
- **Note:** link types distinguishing a Directory and a Thing are useful but not mandatory

Exploration

- "Smart Objects": Retrieve TD directly from Thing
- Directory service API: described using a TD
- Provides multiple query types:
  - JSONPath – mandatory
  - XPath – optional
  - SPARQL – optional
- Pagination, etc.

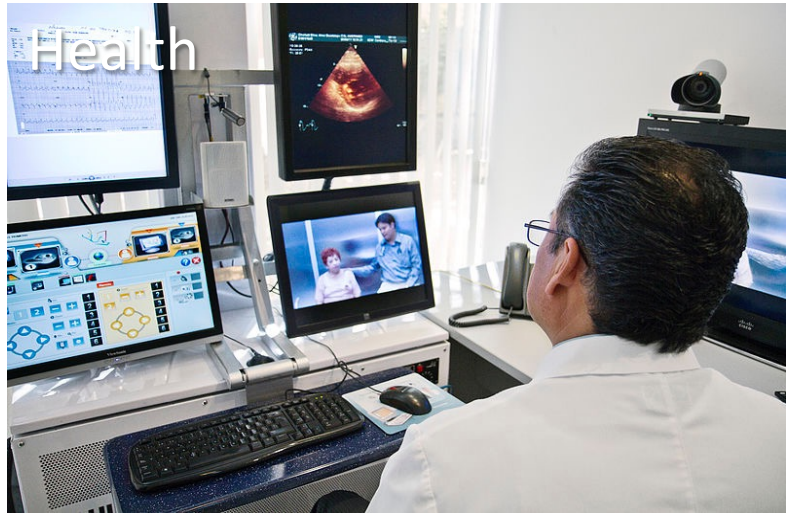
Profiles: Constraints

Constraints on	*Rationale*	*Example*
vocabulary of Thing Description classes	guaranteed set of metadata fields	Make specific vocabulary terms mandatory, remove others
class relationships	unambiguous structure	limited cardinality, e.g. only one form per operation per interaction affordance.
values of vocabulary terms	simplified processing	Limit the length of characters per string. Always use arrays, where the spec permits a string or an array of strings.
data schemas	simplified processing	Limits on nesting
security	reduced implementation effort	Only a restricted set of security mechanisms
protocol binding	guaranteed protocol semantics	limited protocol(s) and protocol features, Example: predefined mapping of http verbs (GET/PUT) to operation verbs, similar constraints for other protocols.

Profiles: Current Work

- Defining a core/baseline profile with a HTTP binding.
- Identifying constraints and rules on the data model.
- Unambiguous interaction semantics for properties, actions and events.
- Constraints on payload formats.
- Protocol binding semantics, e.g. headers, response codes.
- Security constraints.
- Representation format constraints.

Use Cases: W3C Smart City Workshop



Others

- Law Enforcement
- Parking
- Accessibility
- Traffic and Logistics
- Public Transportation
- Air Quality and Weather
- Cultural Space Mgmt
- Construction Services
- Land Management
- Emergency Services
- Water Management
- Hybrid Ruralization

Documents and Resources

New/Updated Normative Documents in Draft Status:

- Architecture 1.1: https://github.com/w3c/wot-architecture
- Thing Description 1.1: https://github.com/w3c/wot-thing-description
- Discovery: https://github.com/w3c/wot-discovery
- Profiles: https://github.com/w3c/wot-profile

New/Updated Informative Documents in Draft Status:

- Binding Templates: https://github.com/w3c/wot-binding-templates
- Scripting API: https://github.com/w3c/wot-scripting-api
- Use Cases and Requirements: https://github.com/w3c/wot-usecases

Other Resources:

- Web Site: https://www.w3.org/WoT/

Contacts

https://www.w3.org/WoT

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Backup

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