W3C Web of Things
Summary and Applications

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Outline

• What is WoT?
  • Applying and extending web standards for IoT
  • Descriptive interoperability: Thing Descriptions
  • Finding Thing Descriptions: Discovery

• Use Cases and Applications
  • Use Cases and Requirements
  • Smart Buildings
  • Smart Cities

• Discussion
  • Gaps and Future Work
W3C Web of Things (WoT)

• W3C Working Group goal: Adapting web technologies to IoT
• Already published: Thing Description (TD) metadata format
  • TD describes the available interactions (network API) of a Thing
• New deliverables in progress, including Discovery
  • How does a potential user obtain the TD for a Thing?
Descriptive Interoperability: TDs

WoT Architecture

• Constraints
  • "Things" must have a TD
  • Must use URIs, IANA media types, etc.

• Thing Description Affordances
  • Describes WHAT the possible choices are
  • Describes HOW to interact with the Thing

WoT Thing Description (TD)

```
{  
"@context": [  
"https://www.w3.org/2019/wot/td/v1",  
{  "iot": "http://iotschema.org/" }  
],  
"id": "urn:dev:org:32473:1234567890",  
"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": {  
"..."  
}  
}
```
Usage Patterns Overview
Orchestration

Node-RED/node-gen

node-wot/Scripting API

```
WoTHelpers.fetch("coap://localhost:5683/counter").then(async (td) => {
  // using await for serial execution (note 'async' in then() of fetch())
  try {
    let thing = await WoT.consume(td);
    console.info("=== TD ===");
    console.info(td);
    console.info("==========");

    // read property #1
    let read1 = await thing.readProperty("count");
    console.info("count value is ", read1);

    // increment property #1 (without step)
    await thing.invokeAction("increment");
    let inc1 = await thing.readProperty("count");
    console.info("count value after increment #1 is ", inc1);

    // increment property #2 (with step)
    await thing.invokeAction("increment", {'step': 3});
    let inc2 = await thing.readProperty("count");
    console.info("count value after increment #2 (with step 3) is ", inc2);

    // decrement property
    await thing.invokeAction("decrement");
    let dec1 = await thing.readProperty("count");
    console.info("count value after decrement is ", dec1);
  }
  catch(err) {
    console.error("Script error:", err);
  }
})
```

```
Discovery

Goal: Obtain TD of interest
- Not limited to local network
- Scalable to many TDs
- Need to preserve privacy
- Phased access:
  1. Introduction: open
  2. Exploration: controlled
- Searchable via JSON Path, XPath, or SPARQL

- Future work:
  - Find "nearby" Things using geospatial data

Phase 1: Introduction

Phase 2: Exploration
Deliverables

New/Updated Normative Documents:
• 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:
• 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

Community Resources:
• Web Site: https://www.w3.org/WoT/
Recent Activity

• Plugfests
  • https://github.com/w3c/wot-testing/tree/main/events

• New Commercial Usages
  • Takenaka Construction – Smart Building Information Management systems
  • Netzo – IoT dashboards and device management

• Directory Implementations
  • WoT Hive, LogiLab (SPARQL based), Fraunhofer LinkSmart

• IETF Relationships: JSON Path, CoreRD, COSE/JOSE, ASDF

• Under Discussion:
  • Geospatial data, Embedded JSON Signatures
  • New Charters/New Deliverables
Use Cases and Requirements

Informative Deliverable: https://github.com/w3c/wot-usecases

Purpose and Process:
• Identify specific use cases
• Identify application domains
  • Collect use cases from other W3C groups
  • Collect use cases from other stakeholders and SDOs
• Identify usage patterns
  • For example, hubs, proxies, automation, etc.
• Identify relevant technologies
  • For example, edge computing, digital twins, etc.

→ Extract common requirements to drive current and future work
Use Cases / Requirements Process

- Use Case TF (IG)
- Use Case
- Shortlist
- Gaps
- New Building Block
- System Architecture / Configuration
- Requirement

Spec creation (WG)
- Security
- TD
- Scripting
- Discovery
- Profile

WoT Deliverables
WoT Use Cases Relevant to Smart Cities

• Smart City
  • Geolocation
  • Dashboard
  • Interactive Public Spaces
  • Meeting/Event Assistance
  • Smart Campus
  • Cultural Spaces

• Health
  • Public Health Monitoring

• Energy
  • Smart Grids (DER)

• Building Technologies
  • Smart Building
  • Connected Bldg Energy Efficiency
  • Automated Smart Bldg Management
  • Portable Bldg Applications

• Retail
  • All Stop Emergency Plunger
  • Door Sensor
  • Freezers and Refrigerators
  • Restrooms
  • Lighting
  • Canopies
  • Cameras
Recent Relevant Applications

Takenaka Corporation
• EQ House, Tokyo 2019
• BIM applications

Siemens
• Desigo CC
• BIM system

Netzo
• IoT Data Hub
• Dashboards
Gaps and Discussion

• GIS Integration
  • Geospatial data and discovery
• Data Management
  • Digital Twins and shadows
  • Event notifications
  • Data management
• Security
  • Key provisioning and onboarding
  • Secure LAN access
  • Proxy services
  • Access control and ad-hoc sharing
  • MUDS

• Accessibility
  • Sensory modality mapping
  • Textual/descriptive interfaces
  • Service location
  • Mobility services
• Advanced Use Cases
  • Transportation
  • Logistics
  • Distributed energy management
  • AR visualization
  • Analytics integration e.g. for health and safety monitoring
Resources and Contacts

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https://www.w3.org/WoT