



# W3C Web of Things and Geolocation

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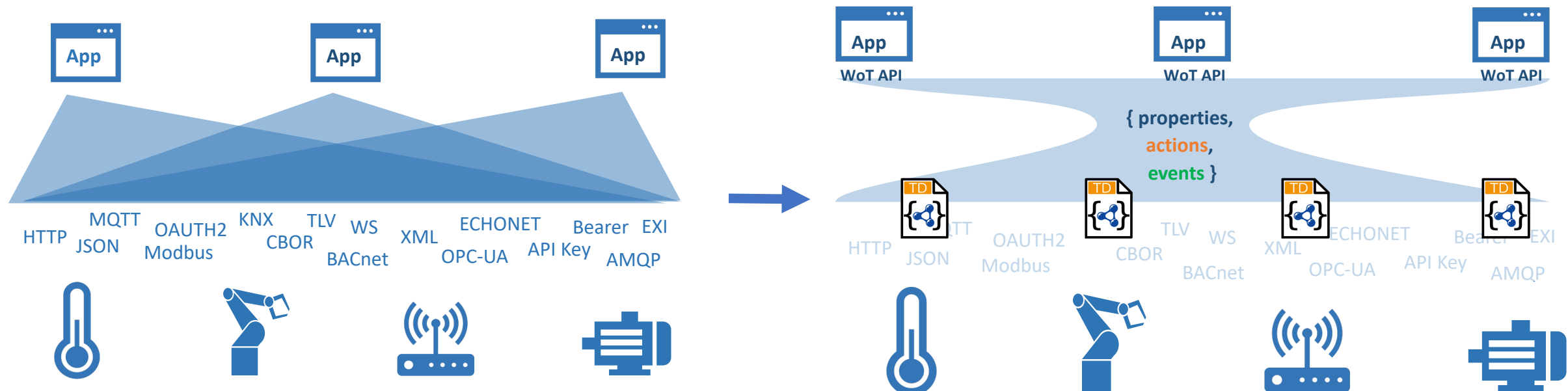
Presented to IEEE P2874

# Outline

- What is WoT?
  - Applying and extending web standards for IoT
  - Descriptive interoperability: Thing Descriptions
  - Recent Activity
  - Finding Thing Descriptions: Discovery
- Discussion
  - Gaps and Future Work
  - Geolocation
    - Data: Dynamic and Static
    - Geolocation queries for Discovery
  - Time Series Databases
    - Interval queries

# W3C Web of Things (WoT)

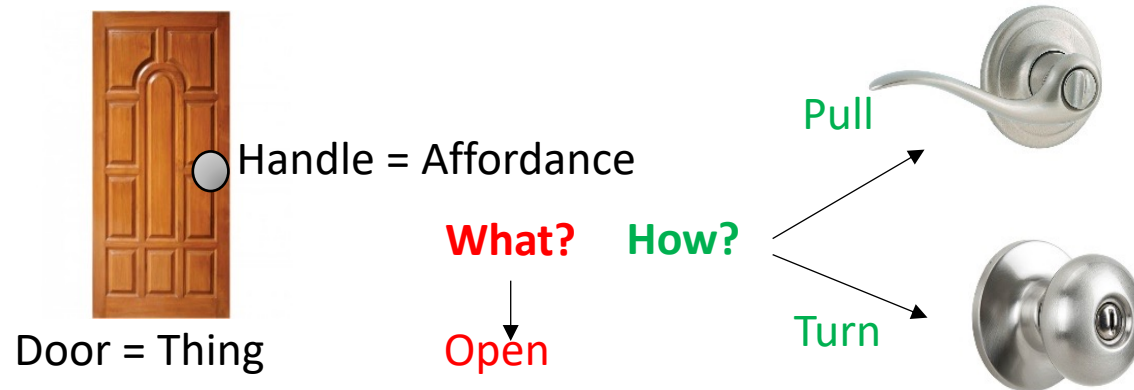
- W3C Working Group goal: Adapting web technologies to IoT
- Already published: Thing Description (TD) metadata format
  - TD describes the available interactions (network API) of a Thing
- New deliverables in progress, including Discovery
  - How does a potential user obtain the TD for a Thing?



# Descriptive Interoperability: TDs

## WoT Architecture

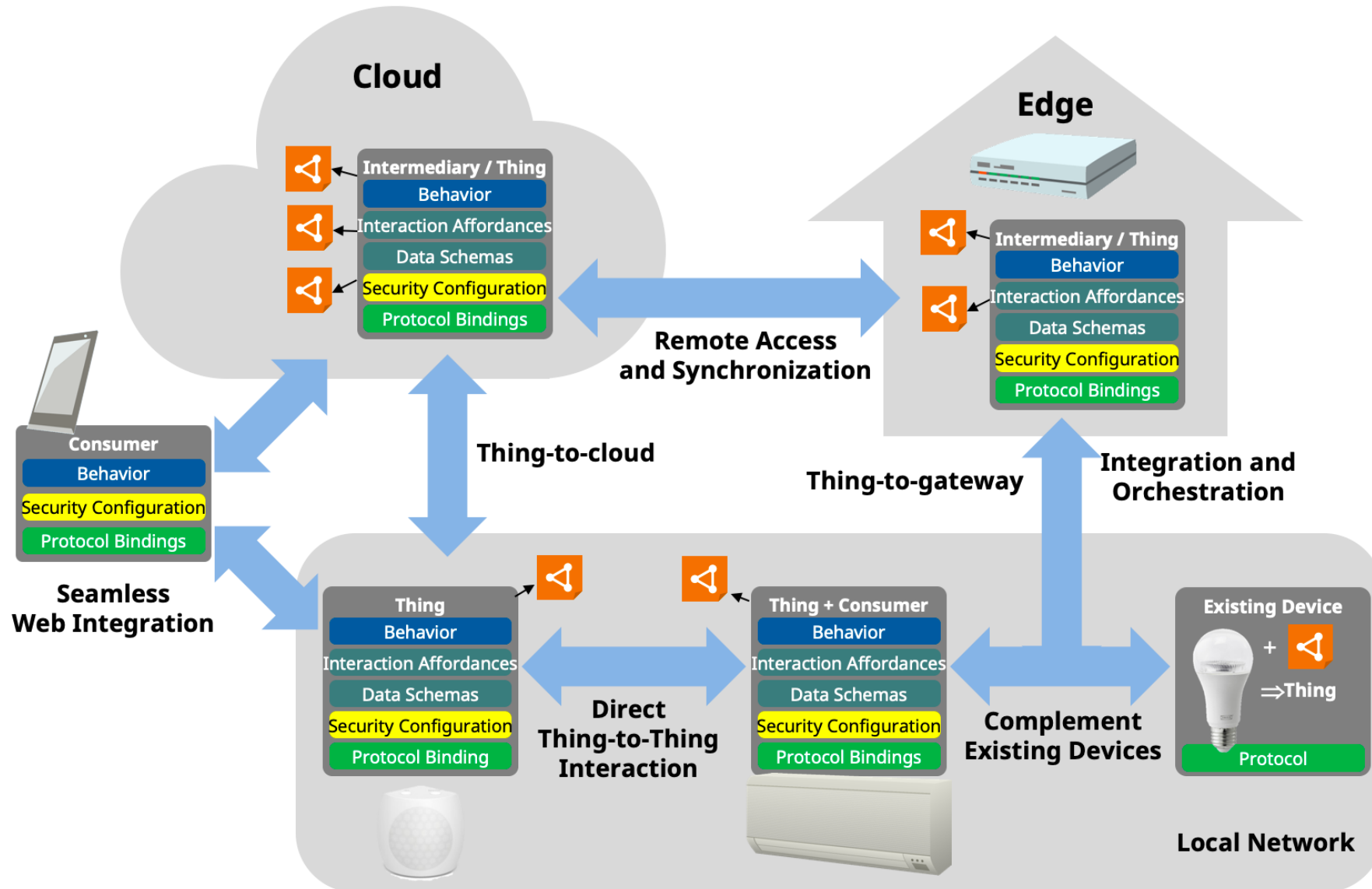
- Constraints
  - "Things" must have a TD
  - Must use URIs, IANA media types, etc.
- Thing Description Affordances
  - Describes WHAT the possible choices are
  - Describes HOW to interact with the Thing



## WoT Thing Description (TD)

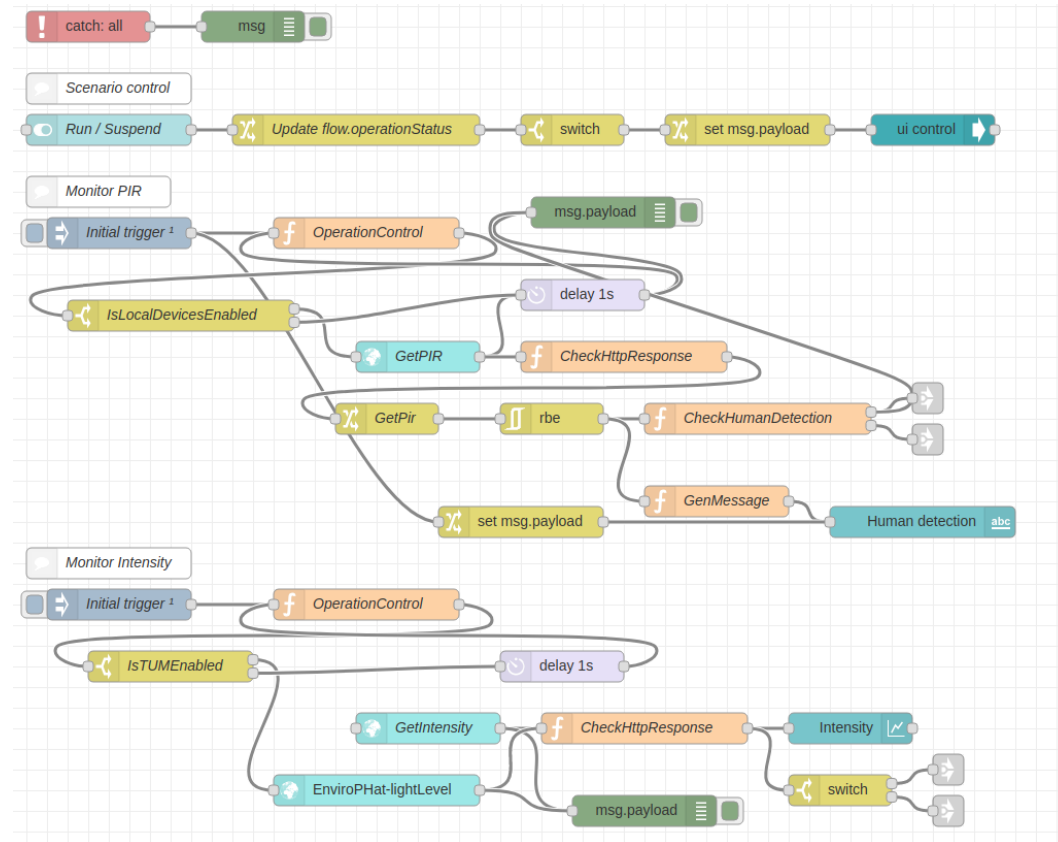
```
{
  "@context": [
    "https://www.w3.org/2022/wot/td/v1.1",
    { "iot": "http://iotschema.org/" }
  ],
  "id": "urn:dev:org:32473:1234567890",
  "title": "MyLEDThing",
  "description": "RGB LED torchiere",
  "@type": ["Thing", "iot:Light"],
  "securityDefinitions": {
    "default": {"scheme": "bearer"}
  },
  "security": ["default"],
  "properties": {
    "brightness": {
      "@type": ["iot:Brightness"],
      "type": "integer",
      "minimum": 0,
      "maximum": 100,
      "forms": [ ... ]
    }
  },
  "actions": {
    "fadeIn": {
      ...
    }
  }
}
```

# Usage Patterns Overview

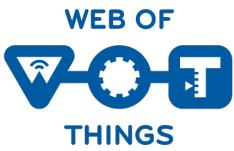


# Orchestration

## 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 {
```

```
    const thing = await WoT.consume(td);  
    console.info( "=== TD ===" );  
    console.info(td);  
    console.info( "===== " );
```



```
    // read property #1
```

```
    const read1 = await thing.readProperty( "count" );  
    console.info( "count value is" , await read1.value());
```

```
    // increment property #1 (without step)
```

```
    await thing.invokeAction( "increment" );  
    const inc1 = await thing.readProperty( "count" );  
    console.info( "count value after increment #1 is" , await inc1.value());
```

```
    // increment property #2 (with step)
```

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

```
    // decrement property
```

```
    await thing.invokeAction( "decrement", undefined, {  
      formIndex: getFormIndexForDecrementWithCoAP(thing);  
    });  
    const dec1 = await thing.readProperty( "count" );  
    console.info( "count value after decrement is" , await dec1.value());
```

```
  } catch(err) {  
    console.error( "Script error:", err);  
  }
```

```
}).catch( (err) => { console.error( "Fetch error:", err); });
```

# 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

- Upcoming Plugfest/Testfest: March 14-18
  - <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

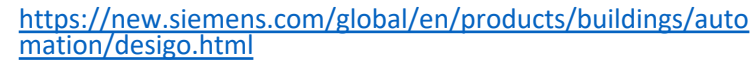




- CGLL Platform - BIM



- IoT Data Hub
- Dashboards



<https://www.evosoft.com/en/digitalization-offering/saywot/>

- Desigo CC – BIM
- Say WoT!



- Eclipse Ditto - Digital twin

# 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 access
- Searchable via
  - JSON Path (IETF RFC pending)
  - XPath 3.1
  - SPARQL

## Architecture

- Phased access:
  - 1.Introduction: open
  - 2.Exploration: controlled access
- Introduction mechanisms
  - Direct, DNS-SD, CoRE-RD, DID
- Exploration mechanisms
  - TD Server, Self, Directory
- Searchable via
  - JSON Path (IETF RFC pending)
  - XPath 3.1
  - SPARQL

# Discovery

## Introduction Mechanisms

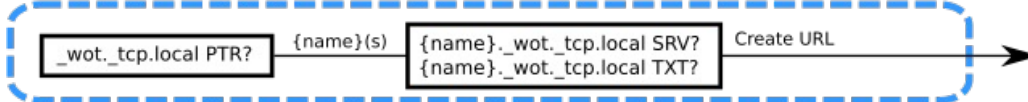
### Direct



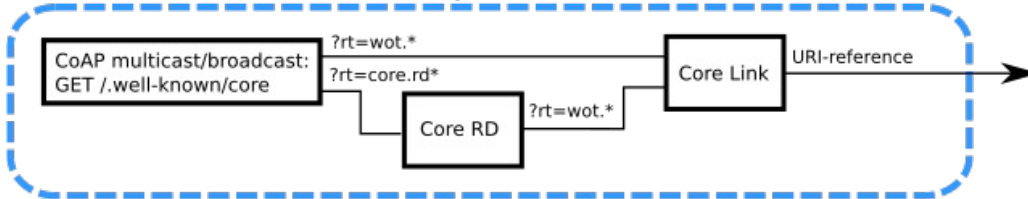
### Well-Known URIs



### DNS-Based Service Discovery



### CoRE Link Format and CoRE Resource Directory



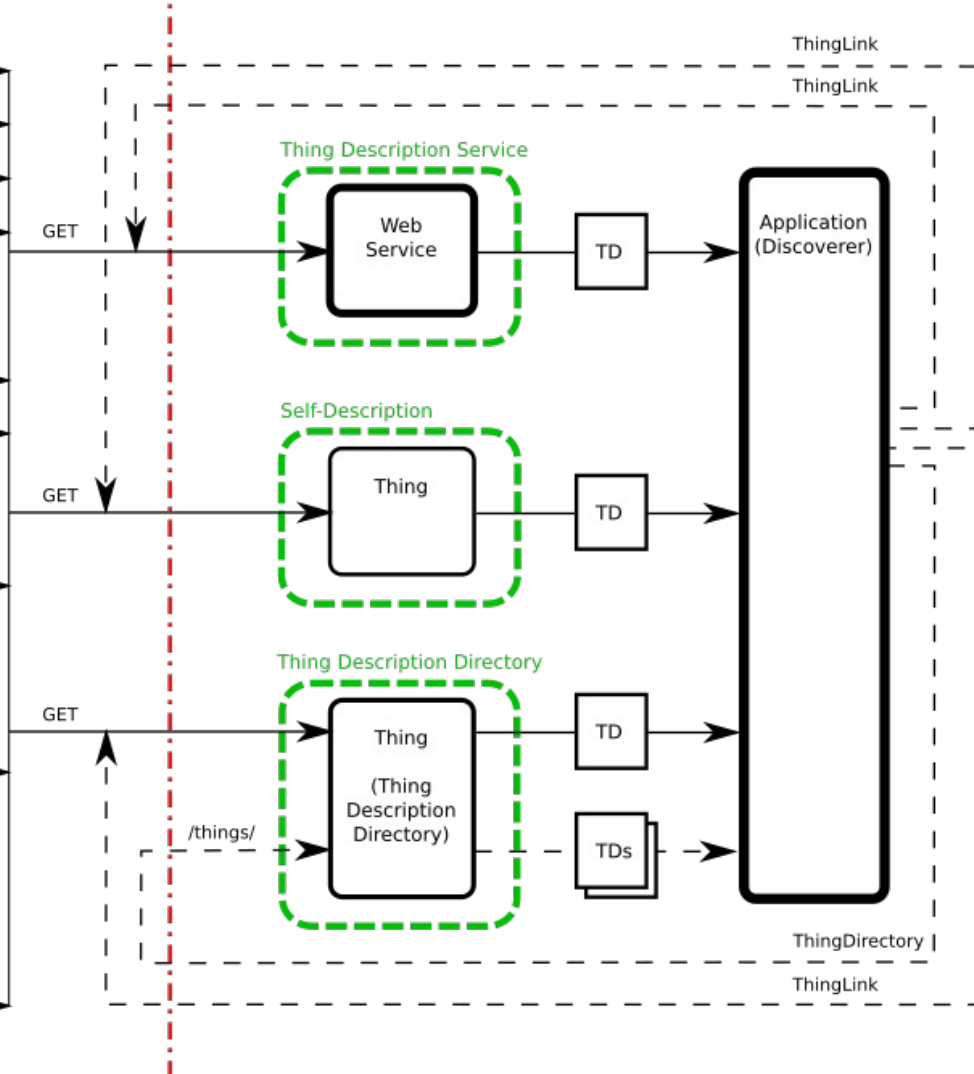
### DID Documents



## URLs

## Auth

## Exploration Mechanisms



# Discovery

- Possible future work:
  - Encode static geospatial data in Thing Descriptions
  - Provide ontologies for dynamic geospatial data
  - Index Things by location in TD Directories
  - Provide geolocation filters in Introduction mechanisms
    - e.g. geolocation filters in DNS-SD
  - Discover Things using geospatial queries
    - "find all Things within 100m of lat 49.2803175 long -123.1286623"
    - "find all HVAC sensors in Room 101 of Sheraton Wall Vancouver"
  - Both "quantitative" and "qualitative" locations important
  - Also store sensor data and search based on interval queries
- See: <https://github.com/w3c/wot-discovery/blob/main/proposals/geolocation.md>

# 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

<https://www.w3.org/WoT>

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