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?
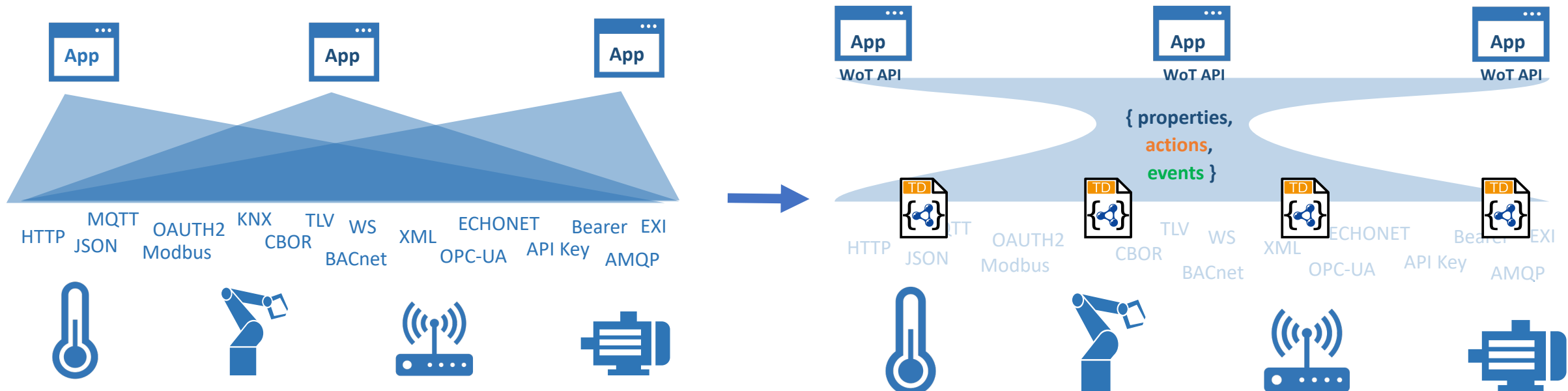
Descriptive Interoperability: TDs

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

Handle = Affordance

What?   How?

Open   Pull

Turn

Door = Thing
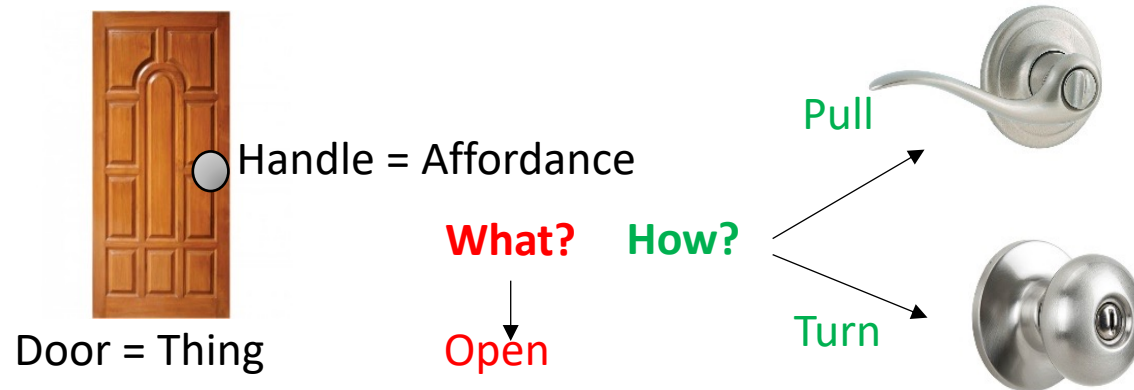
WoT Thing Description (TD)

```json
{
  "@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
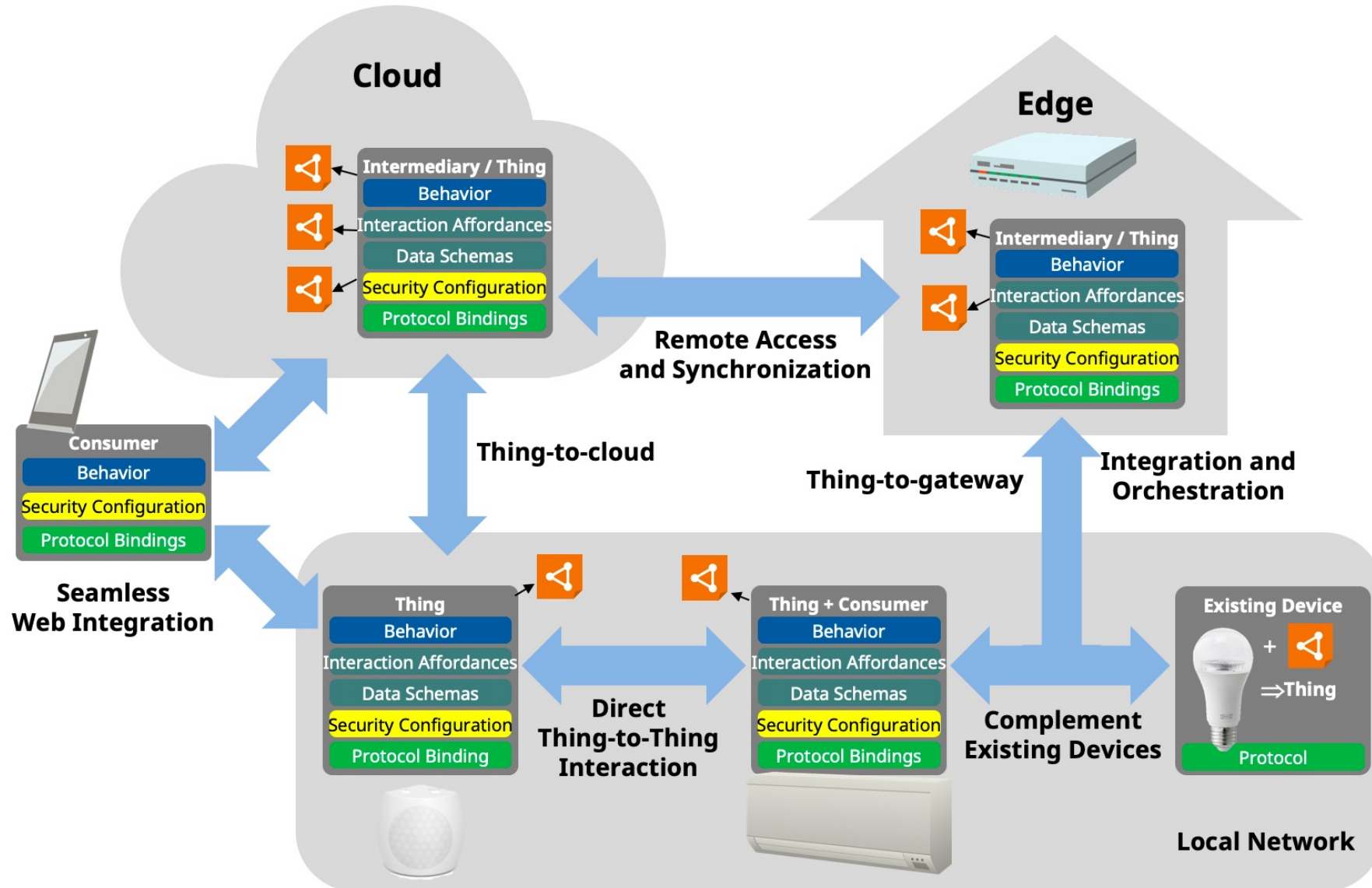
Orchestration

Node-RED/node-gen
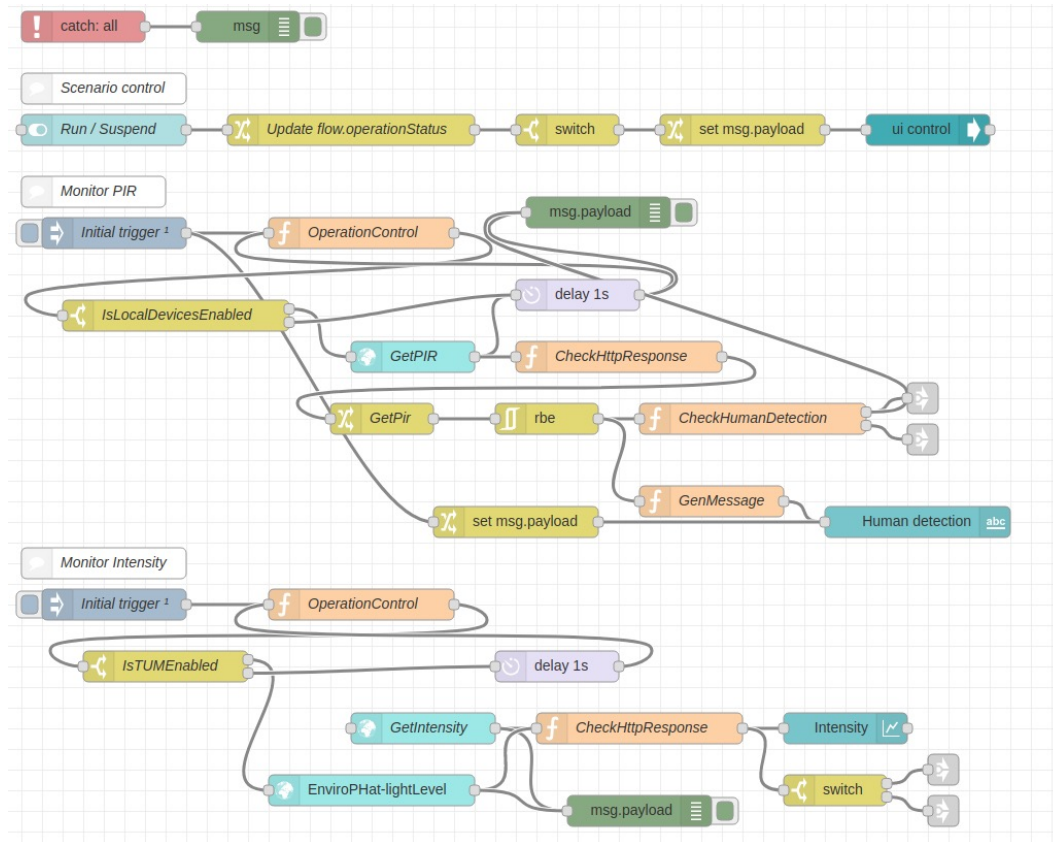
node-wot/Scripting API

```
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);
  }

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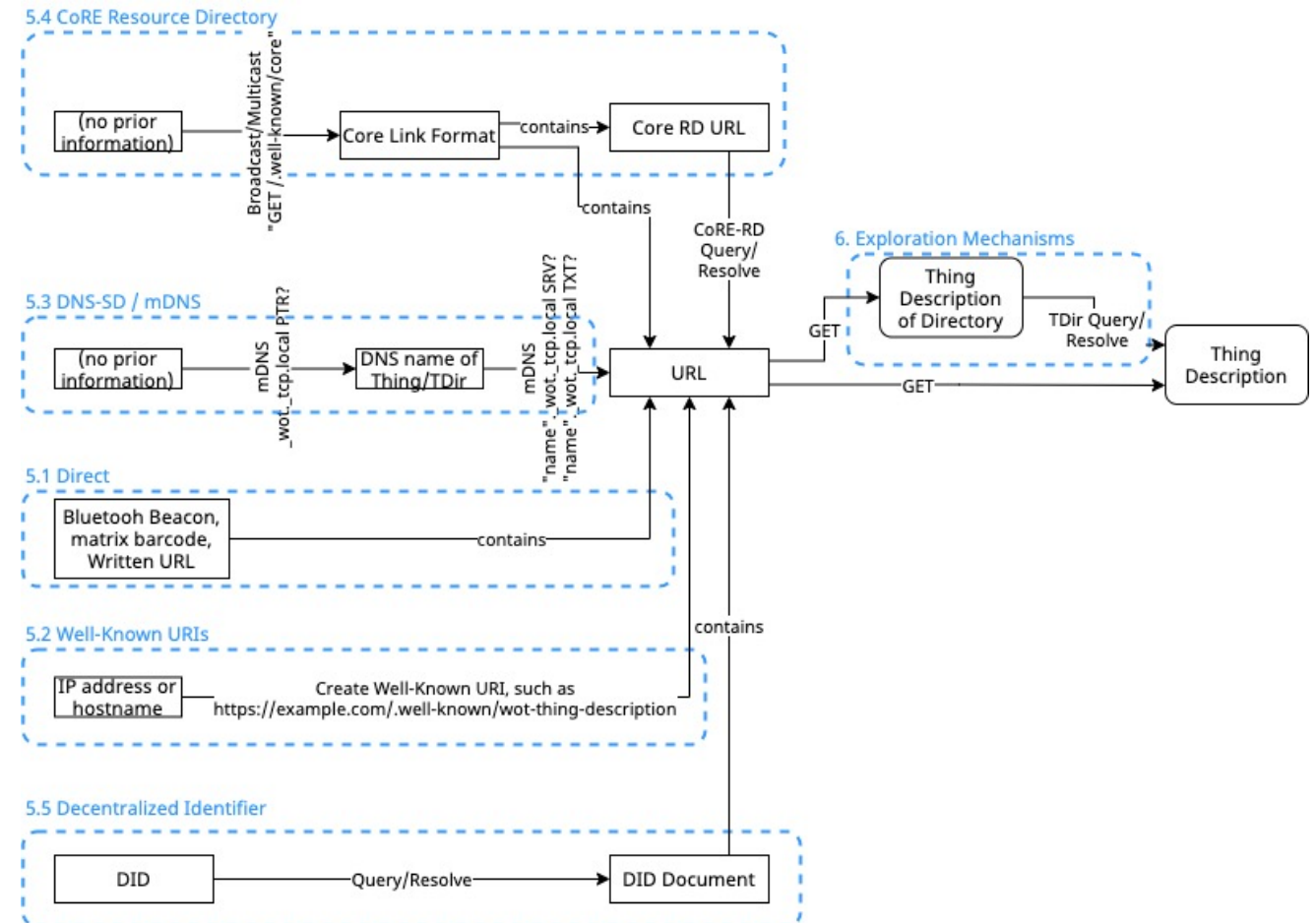
Discovery

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
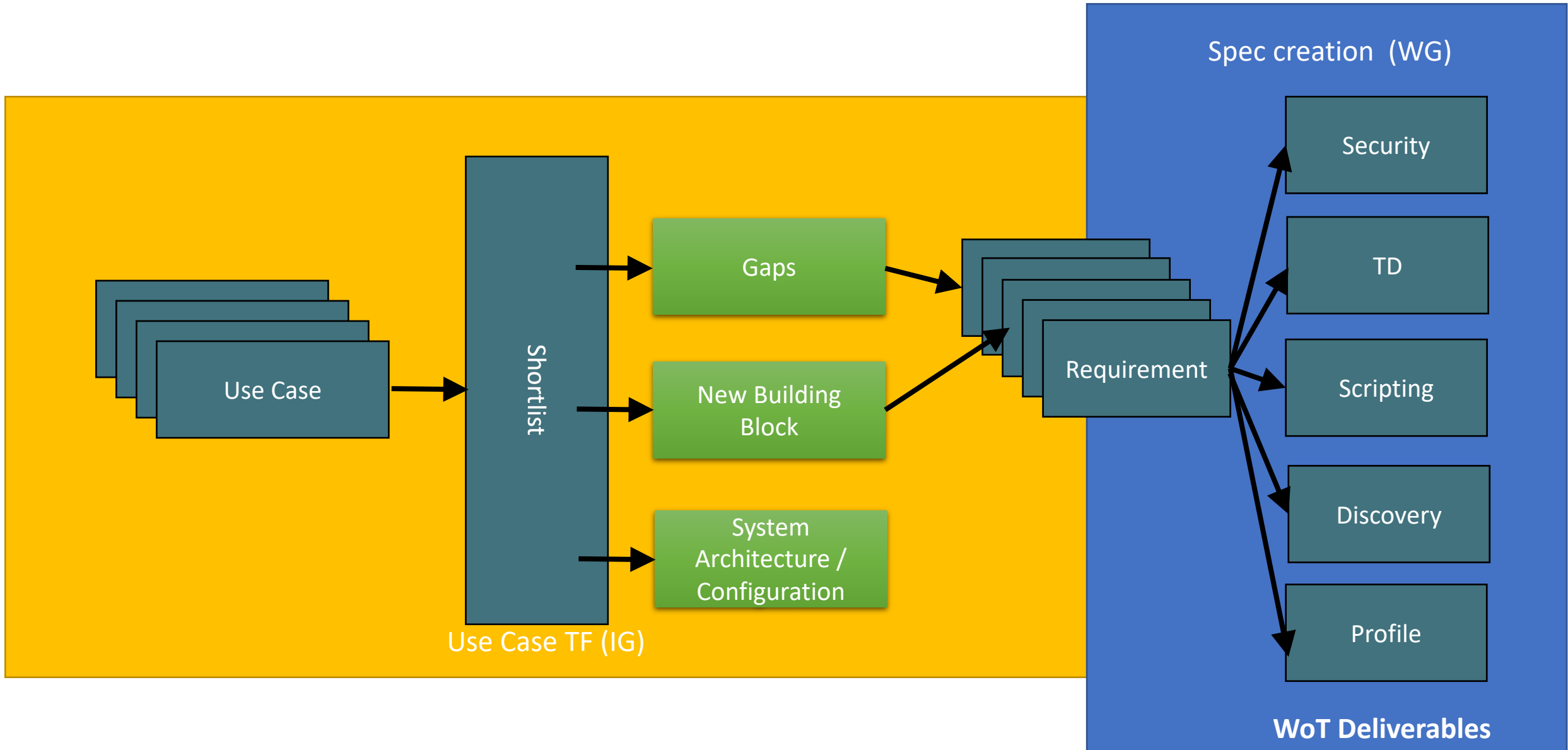
WoT Use Cases Relevant to Smart Cities

- Smart City
  - Geolocation
  - Dashboard
  - Interactive Public Spaces
  - Meeting/Event Assistance
  - Smart Campus
  - Cultural Spaces
- Health
  - Public Health Monitoring
- Energy
  - Smart GRids

- 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
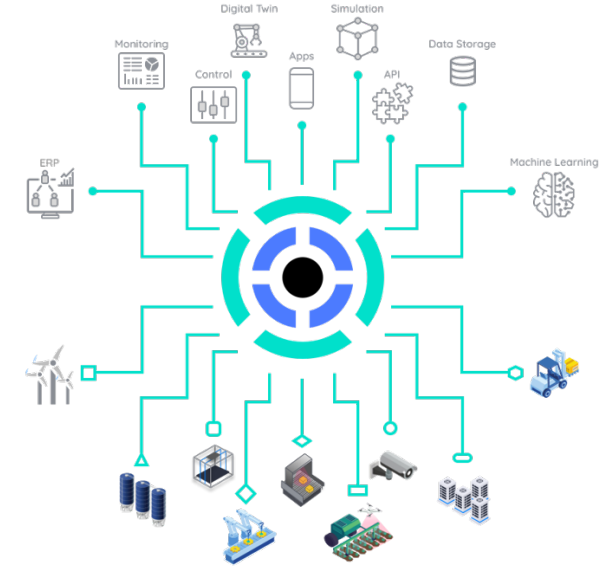 - Cameras

Recent Relevant Applications

Takenaka Corporation

• EQ House, Tokyo 2019

• BIM applications

Siemens

• Desigo CC BIM Viewer

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

https://www.w3.org/WoT

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