

# Web-based Digital Twins for Smart Cities at TPAC 2025

W3C Invited Expert

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# Agenda for today

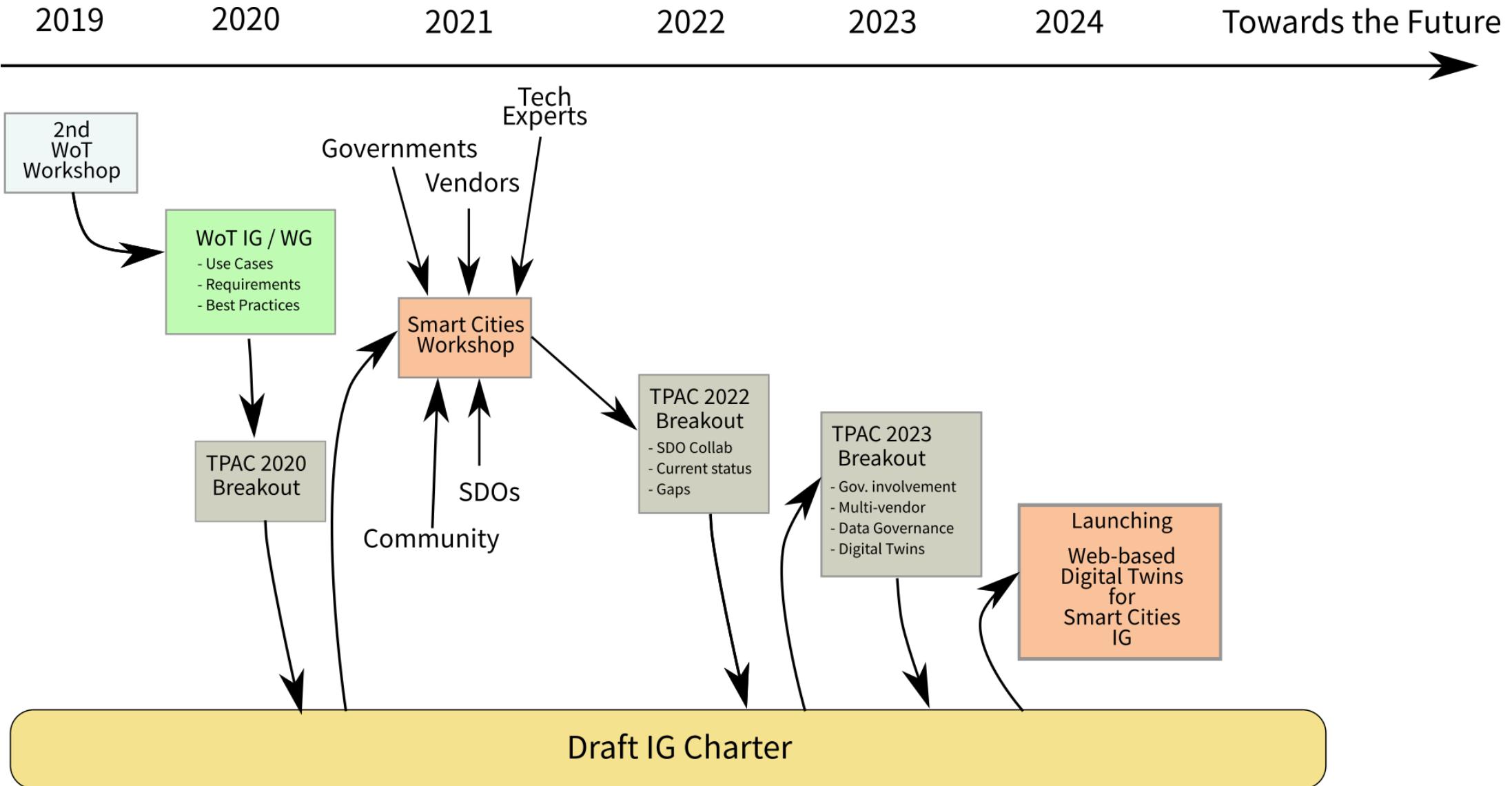
1. Review the discussion so far
2. Get input from stakeholders
3. Discussion on the next steps

# Discussion so far

# Difficulties with Smart Cities

- "Smart Cities" consists of too many stakeholders (vendors, users, governments, ...) and technologies (Web, IoT, Software, Hardware, ...).
- So strong need:
  - To identify and document **possible use cases**,
  - To obtain **feedback from all the stakeholders**,
  - To gather **experts' input on important features**, and
  - To provide a **forum for technical and business discussions**.

# Discussion around Web-based Smart Cities@W3C



# Collaboration with related SDOs

# ECHONET

- Smart home appliances
  - ECHONET spec
  - ECHONET Lite spec
  - ECHONET Lite Web API spec ⇒ referring to the W3C WoT spec
- New features for real-world system development
  - Registration of a set of operations first, then execution later
  - History management
  - Authentication and authorization

# IEC SC3D

- Common Data Dictionary (CDD)
  - Methodology and products ontology
    - Standardization for representation of technical information along the life cycle of a product
      - Services
      - Devices
      - Systems
      - Software
      - Plants, etc.
    - Classes, Properties, Identification for various industry areas
      - Machine-interoperable methodology
      - Available for all ISO, IEC products and systems
      - Standardized product ontology DB: <https://cdd.iec.ch/>

# IPA DADC

## => Smart Building Co-Creation Organization

- Smart building use cases and system development
  - Takenaka Corporation has developed a data platform for smart buildings based on the **W3C WoT standard**.
    - Based on the lambda architecture which is a best practice for **real-time data processing**.
    - WoT is used to implement **data models and APIs**.
  - The platform is the foundation for various services such as **energy management, AI control, personal control and digital twin**.
    - Must manage **many devices** and **tons of associated measurement and control points**.
    - So it is impossible to generate a WoT TD for each device manually.
    - Need to extend the WoT standards for batch property acquisition.

# ISO/IEC JTC1

- Various standards on Smart Cities
  - ISO/IEC 30146:2019
  - ISO/IEC 21972:2020
  - ISO/IEC 30145-3:2020
  - ISO/IEC 30145-2:2020
  - ISO/IEC 30145-1:2021
  - ISO/IEC 24039:2022
  - ISO/IEC DIS 5087-1
  - ISO/IEC CD 5087-2
  - ISO/IEC AWI 5087-3
  - ISO/IEC CD 5153-1
- Pre-research and gap analysis
  - Standards needs and roadmap analysis for smart city standards from the ICT aspects
  - Data Use in Smart City
  - City digital twin and operating system
  - Unified Digital Infrastructure — ICT Reference Architecture
  - City Knowledge Trustworthiness Evaluation
  - Terminology-Ontology in Smart City System
  - ICT support in Public Health Emergency

# ITU-T SG20

- Already done
  - SG20 – Lead group on IoT and Smart Cities & Communities
  - FG-DPM (Data Processing and Management)
  - Web of Things
  - Data models (basic interoperability)
- To be done
  - Smart cities ontology (semantic interoperability)
  - Digital Twin for smart cities
  - AI and data context
  - Artificial Intelligence of Things: CG-AIoT activities

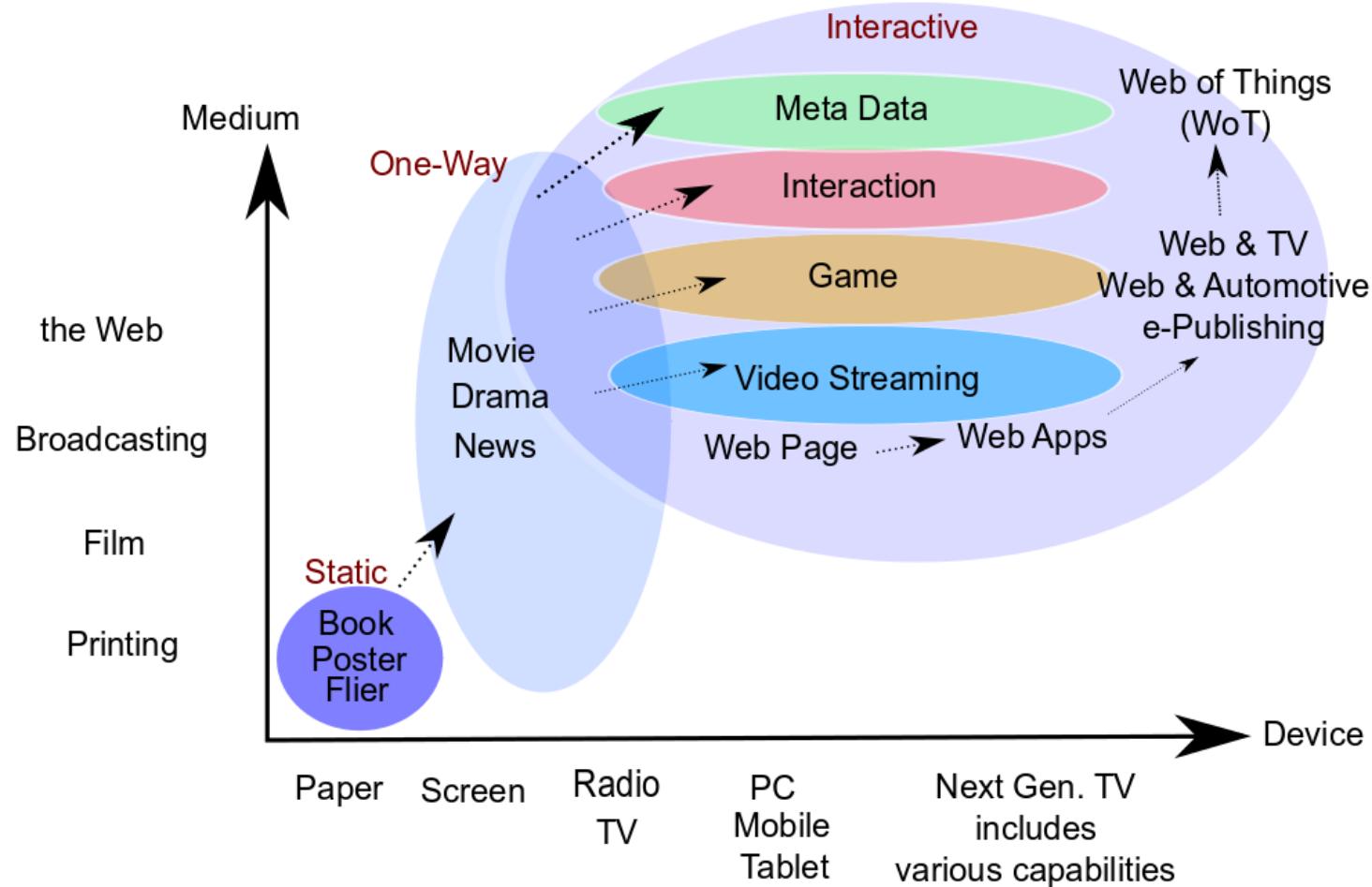
# OGC

- OGC Standards and Emerging Digital Twins
  - Tools for representing and observing space
    - General feature model
    - Simple features
    - City GML – CityJSON
    - 3D Tiles – I3S
    - WaterML
    - GeoSciML
    - MUDDI Underground Info
    - OGC API Features
    - Observations and Measurements
    - SensorThings API
    - OGC API Processes
    - Moving features
    - GeoPose
    - IMDF
    - LAS
  - OGC Innovation and Future Digital Twins
    - Looks the same, behaves the same, is not the same
    - Location powers urban digital twins
      - Urban digital twin summit
    - 3D-IoT – Modern spatial data infrastructure
      - Integrated digital built environment
    - Simulation, Prediction, Digital Twins in the Metaverse

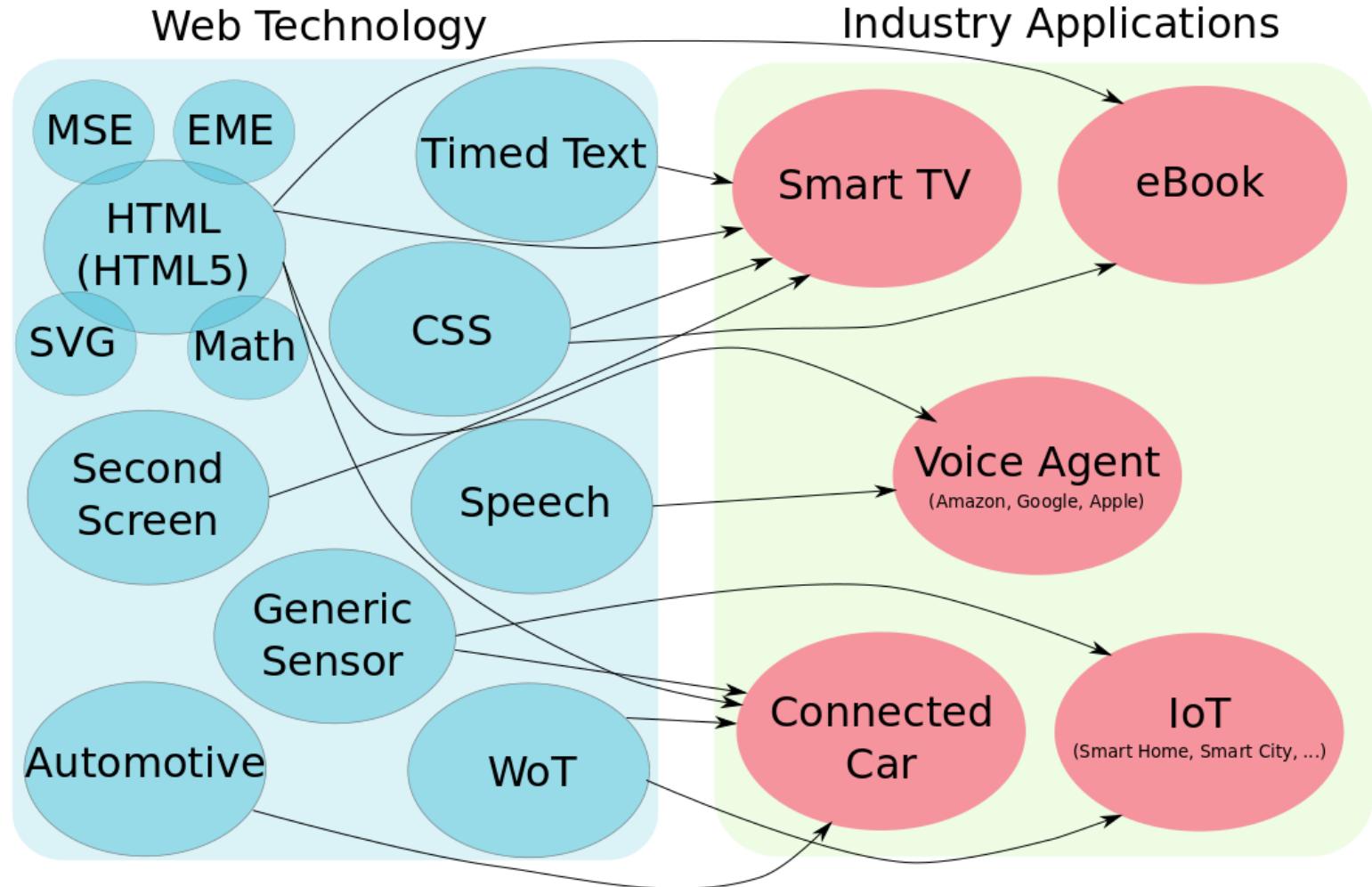
# W3C's Web Standardization related to Smart Cities

# Web as platform for data transfer in general

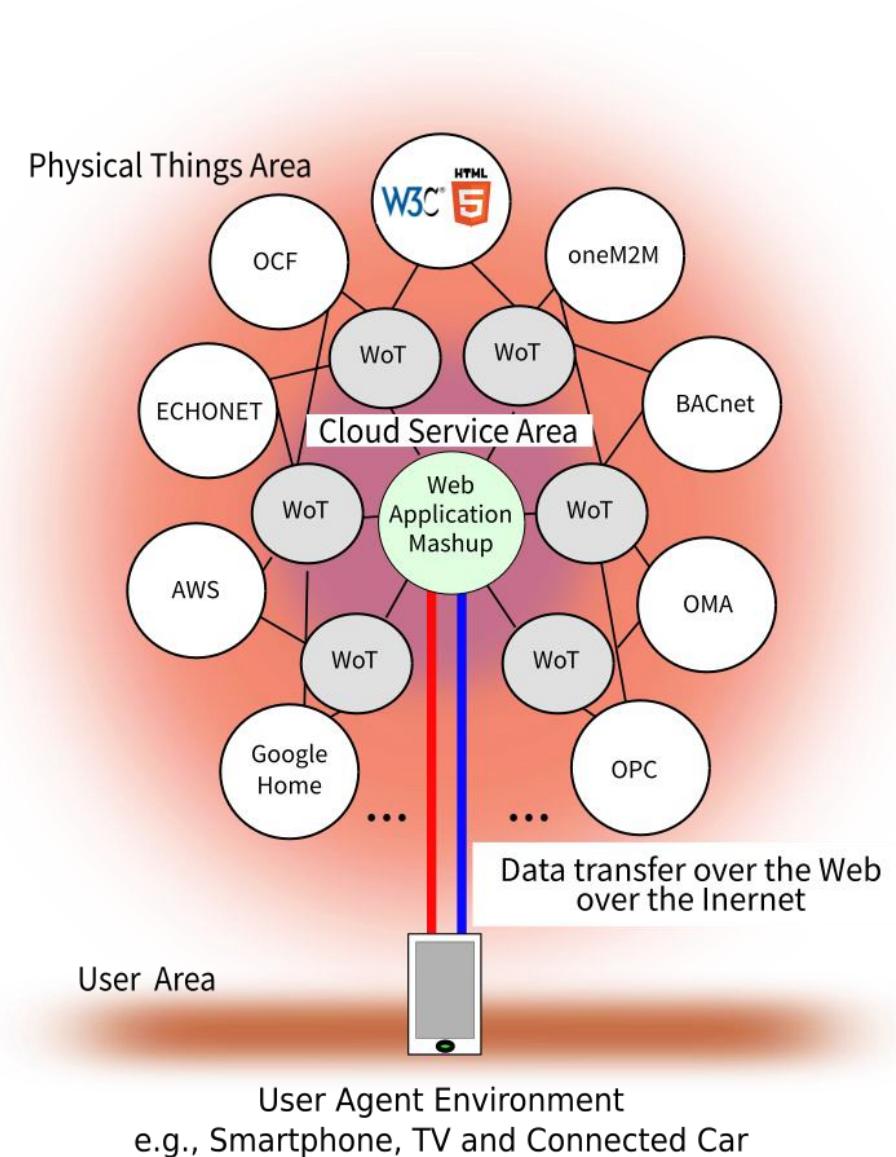
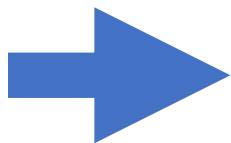
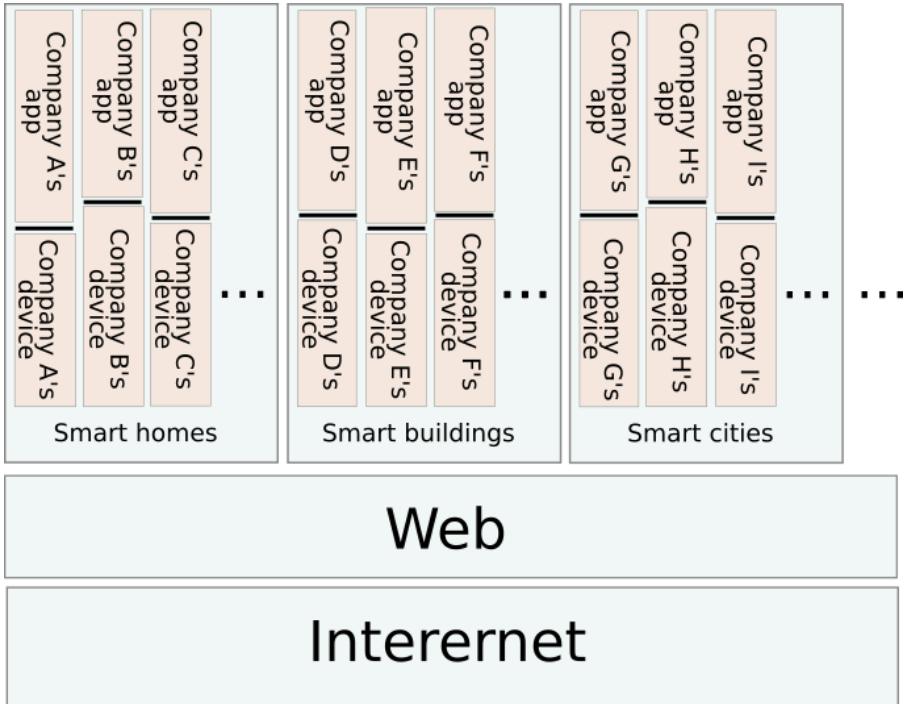
- Independent from devices or OSs



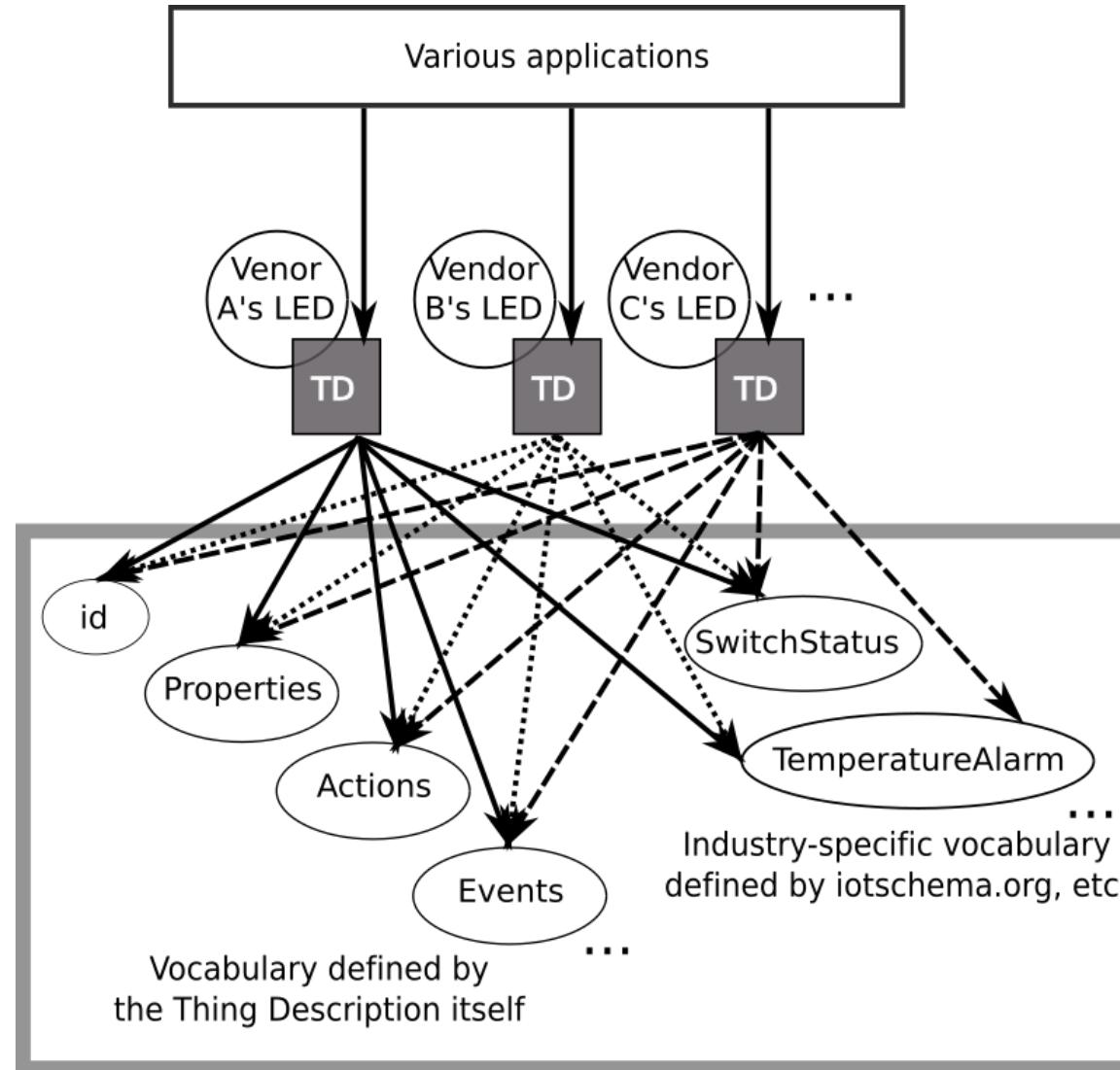
# Web standards applied to various industries



# WoT: Interconnection of IoT silos



# Unified vocabulary references by Thing Description



What is still missing  
for global “Smart Cities”?

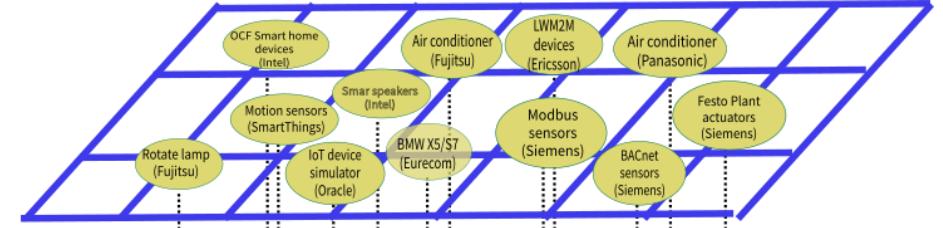
# Strong need for...

- Standardized platform for data transfer and distribution
  - Binding among various systems
  - ID authentication and management
- Standardized vocabulary
  - Semantic interoperability among various systems
  - Catalog for easy data access

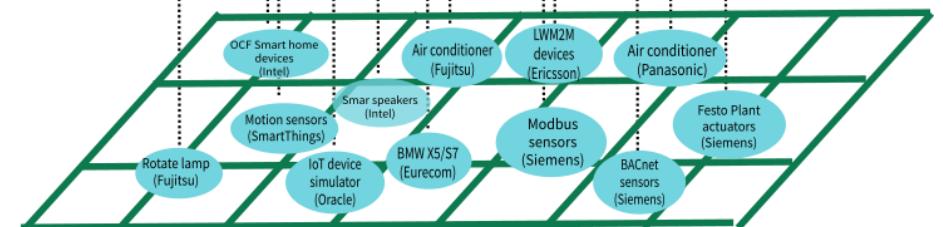
# “Digital Twins” as the Key Concept

- Virtualization of
  - Devices
  - Users
  - Services
- Correspondence between:
  - Virtual Layer
  - Physical Layer

Virtual Layer

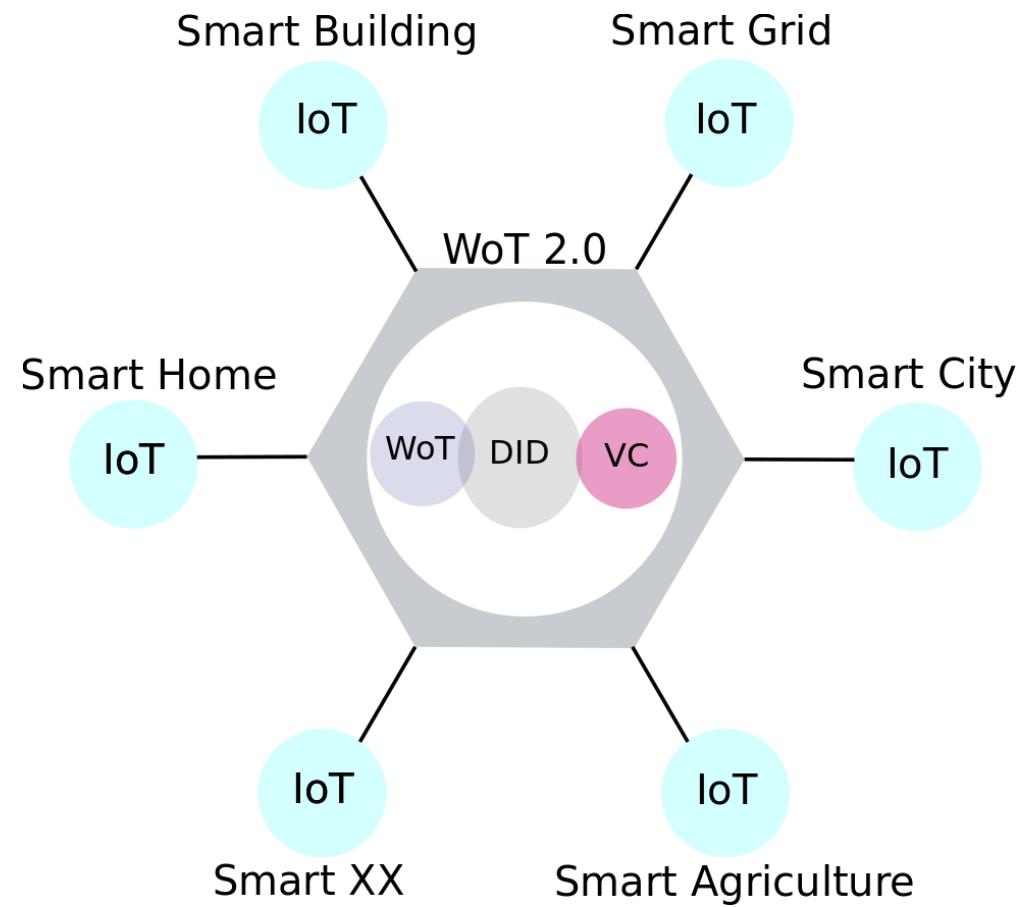


Physical Layer



⇒ Useful for easy handling from Web Applications

# Web-based Digital Twins Framework

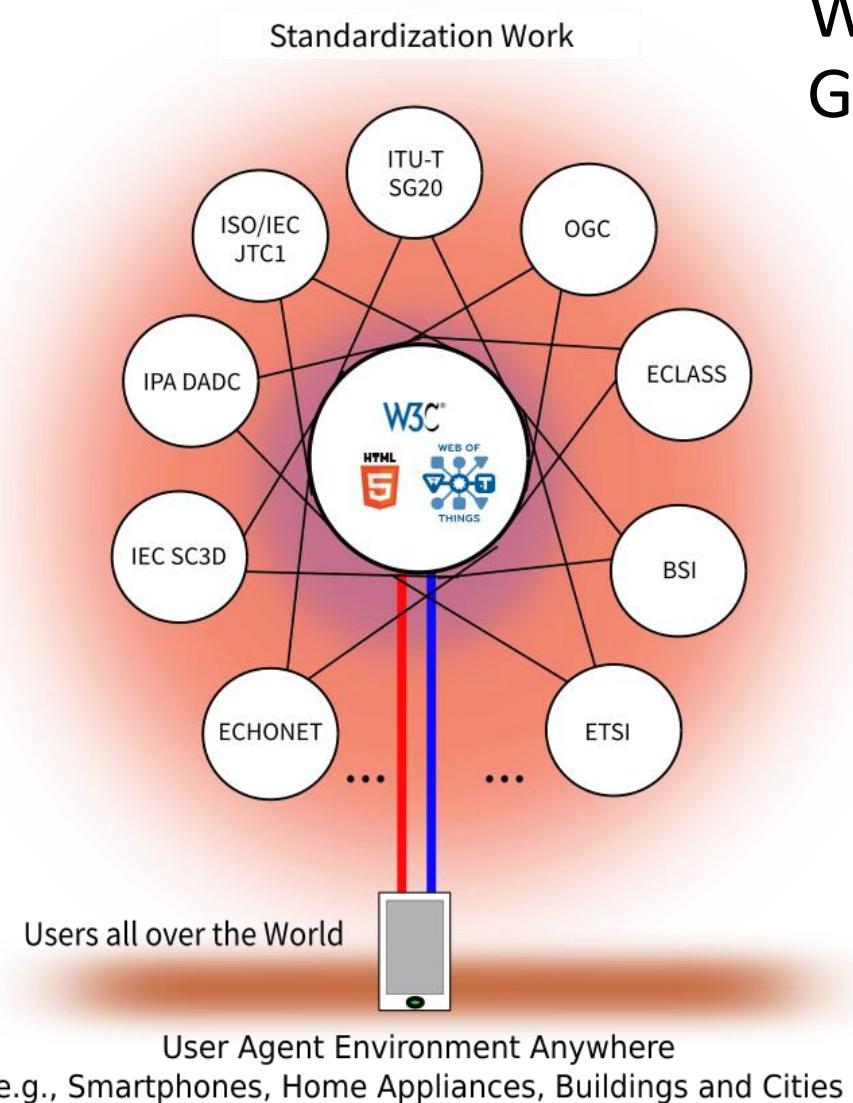


- Decentralized Identifiers (DID):
  - Unique identifier for the Virtual Layer
  - Identify Devices, Users and Services
- Web of Things (WoT):
  - Handling Devices on the Virtual Layer
  - Mapping to the Physical Devices
- Verifiable Credentials (VC):
  - Manage User Credential on the Virtual Layer
  - Describe User Credential for Device/Service access

# Need for Standardized Vocabulary

- Definition and References
- Ontology standards are provided by W3C:
  - [RDF](#) and [RDF Schemas](#)
  - [Web Ontology Language \(OWL\)](#)
  - [Rule Interchange Format \(RIF\)](#)
  - [Data Catalog Vocabulary \(DCAT\)](#)
- Proposal:
  - Let's have collative discussions at W3C as a hub to clarify what's done and what's missing!

# W3C as the Hub for Collaborative Discussions!



## Web-based Digital Twins for Smart Cities Interest Group has been established!!!

**Web-based Digital Twins for Smart Cities Interest Group Charter**

The mission of the [Web-based Digital Twins for Smart Cities Interest Group](#) is

- to identify and document use cases and requirements that W3C specifications need to meet to support various services within Smart Cities,
- to obtain feedback from all stakeholders on the usage of Web technologies for those services,
- to gather expert input on important features for those services based on the Web technology, and
- to provide a forum for technical and business discussions related to those services.

[Join the Web-based Digital Twins Interest Group.](#)

Charter Status	See the <a href="#">group status page</a> and <a href="#">detailed change history</a> .
Start date	7 August 2024
End date	31 July 2026
Chairs	Michael Koster (Invited Expert)
Team Contacts	<a href="#">Kazuyuki Ashimura</a> (0.2 FTE)
Meeting Schedule	<b>Teleconferences:</b> Regular weekly calls will be held. <b>Face-to-face:</b> we will meet during the W3C's annual Technical Plenary week; additional face-to-face meetings may be scheduled by consent of the participants, usually no more than 3 per year. <b>Workshop:</b> A workshop with an open CFP and invited speakers may be organized to provide further feedback and input and the guide the group's agenda.

(<https://www.w3.org/2024/06/smart-cities/>)

# Further Collaborations during the Interest Group Calls

# Invited Guests from related SDOs

- Mark Fox, ISO/IEC JTC1/WG11/AHG16
  - Terminology and Ontology
- Torbjorn Lahrin, JWG between ISO/IEC JTC1 and IEC/SyC Smart Cities
  - Local Digital Twins Sweden Metaverse Including Citiverse
- Juanjo Hierro & Martin Bauer, ETSI / FIWARE
  - NGSI-LD, Data Exchange API
- Linda van den Brink, Geonovum
  - Geospatial information, e.g., OGC GeoPose

# Continue Discussion on Web-based Smart Cities

- Dedicated session NOW during the W3C TPAC!

The screenshot shows the homepage of the W3C TPAC 2025 website. At the top, there's a navigation bar with links for 'overview', 'schedule', 'videos', 'registration', 'practical / health', and 'help'. The main header features the text 'TPAC 2025' in large, bold letters, with '28 OCTOBER / 10-14 NOVEMBER HYBRID MEETING' in a smaller box below it. Below the header, there's a banner with icons representing various technologies and services. A downward arrow points from the bottom of this banner to a section titled 'W3C TPAC 2025'. This section includes a list of 'On this page:' items such as 'Introduction', 'Registration', 'Schedule', 'Venue', 'Official photos', 'Sponsors', and 'Get help'. To the right of this list is a detailed description of what TPAC is and what it aims to achieve.

The screenshot shows a GitHub issue page titled 'Web-based Digital Twins for Smart Cities #23'. The issue was opened by 'ashimura' on Oct 1 and edited by 'tpac-breakout-bot'. The 'Labels' section indicates that this is a 'session' type of issue. The 'Session description' section contains the following text:  
The mission of the Web-based Digital Twins for Smart Cities Interest Group (SCIG) is working on the following:

- identify and document use cases and requirements that W3C specifications need to meet to support various services within Smart Cities,
- obtain feedback from all stakeholders on the usage of Web technologies for those services,
- gather expert input on important features for those services based on the Web technology,
- and provide a forum for technical and business discussions related to those services.

The description also notes that participants will learn about current best practices for smart cities and how Web standards can counter fragmentation. On the right side of the issue page, there are sections for 'Assignees' (No one assigned), 'Labels' (session), 'Type' (No type), 'Projects' (No projects), 'Milestone' (No milestone), and 'Relationships' (None yet).

- Resources

- <https://github.com/w3c/smart-cities/blob/main/technology-categories.md>
- <https://github.com/w3c/smart-cities/blob/main/resources.md>

# Get input from stakeholders

- Latest updates, proposals, etc.

- Smart Building Co-creation Organization (SBCO)
- IEC SC3D
- ECHONET
- OGC
- ISO/IEC JTC1

# Discussion on the next steps

- How to proceed?

# Thank you!

May the Web always be with you  
and help you improve the world!