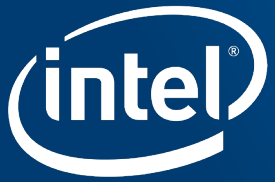


CONVERGING STANDARDS FOR SMART CITIES: NEXT STEPS IN THE W3C

Eric Siow
Michael McCool

Part 1 – Crossing the Chasm through Standards Convergence
Part 2 – Standards Development Progress and Plans

OUTLINE

Part 1

- **State of the Union – Internet of Things (IoT)**
  - Where are we?
- **History of cellular standards & lessons for Smart Cities**
- **A Look at Smart Cities**
- **What can the W3C and ASEAN Smart Cities Community Do?**

Part 2

- **Convergence plan for IoT data standards**
- **Discussion and ideas for collaboration**

Smart Cities – PART 1

Crossing the Chasm through Standards Convergence

Eric Siow
Intel Corporation

STATE OF THE UNION (IOT)

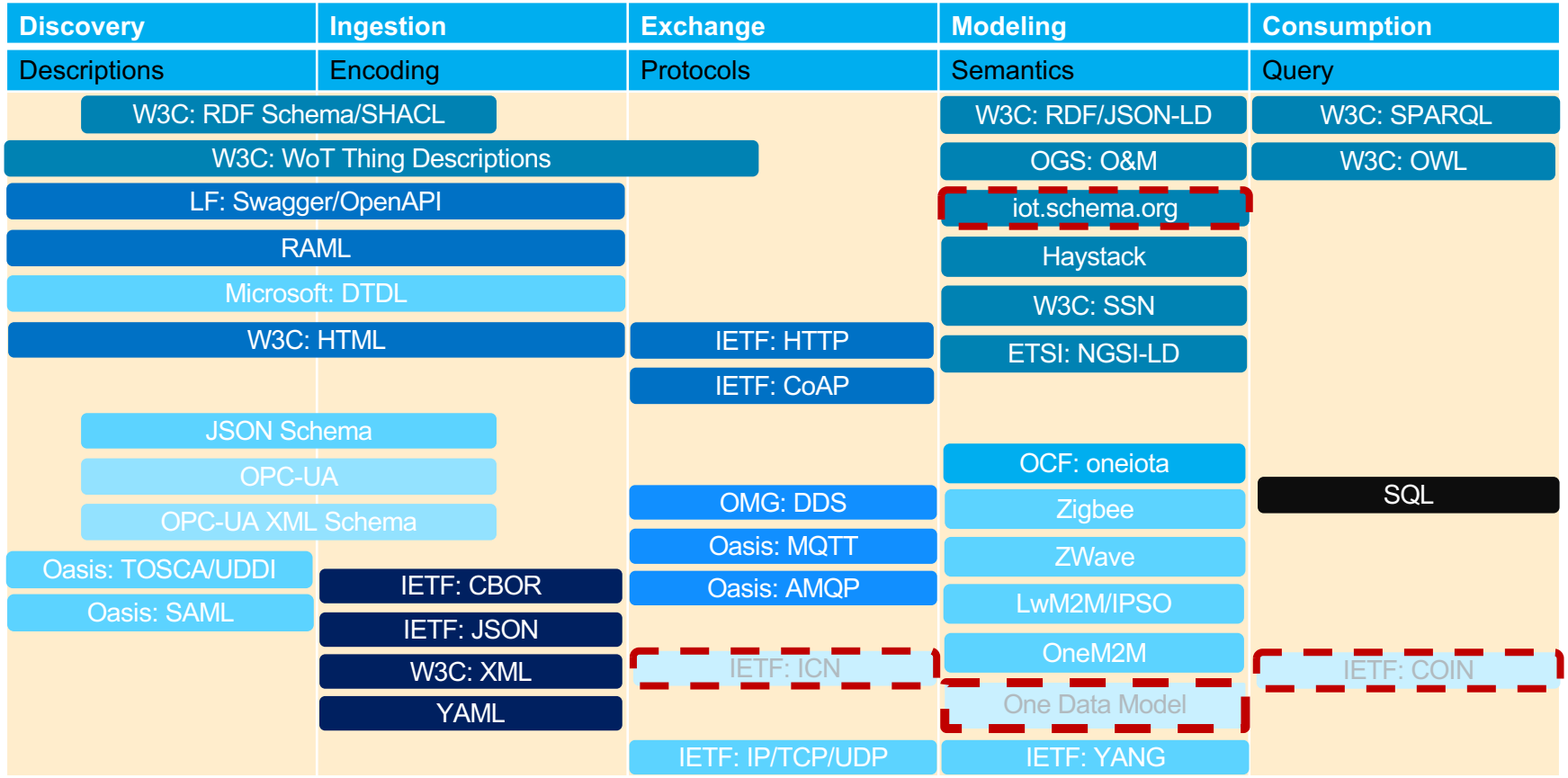
- IoT is about 11 years old
- Hype has been much greater than present reality
- IoT is “biting off more than it can chew”:
- Trying to address too many markets
- Involves too many and mostly uncoordinated SDOs and SIGs
- Investments in IoT may be at risk

Smart City investments also face the same issues

“Life is really simple, but we insist on making it complicated.”

Confucius

IOT DATA AND METADATA STANDARDS MAP



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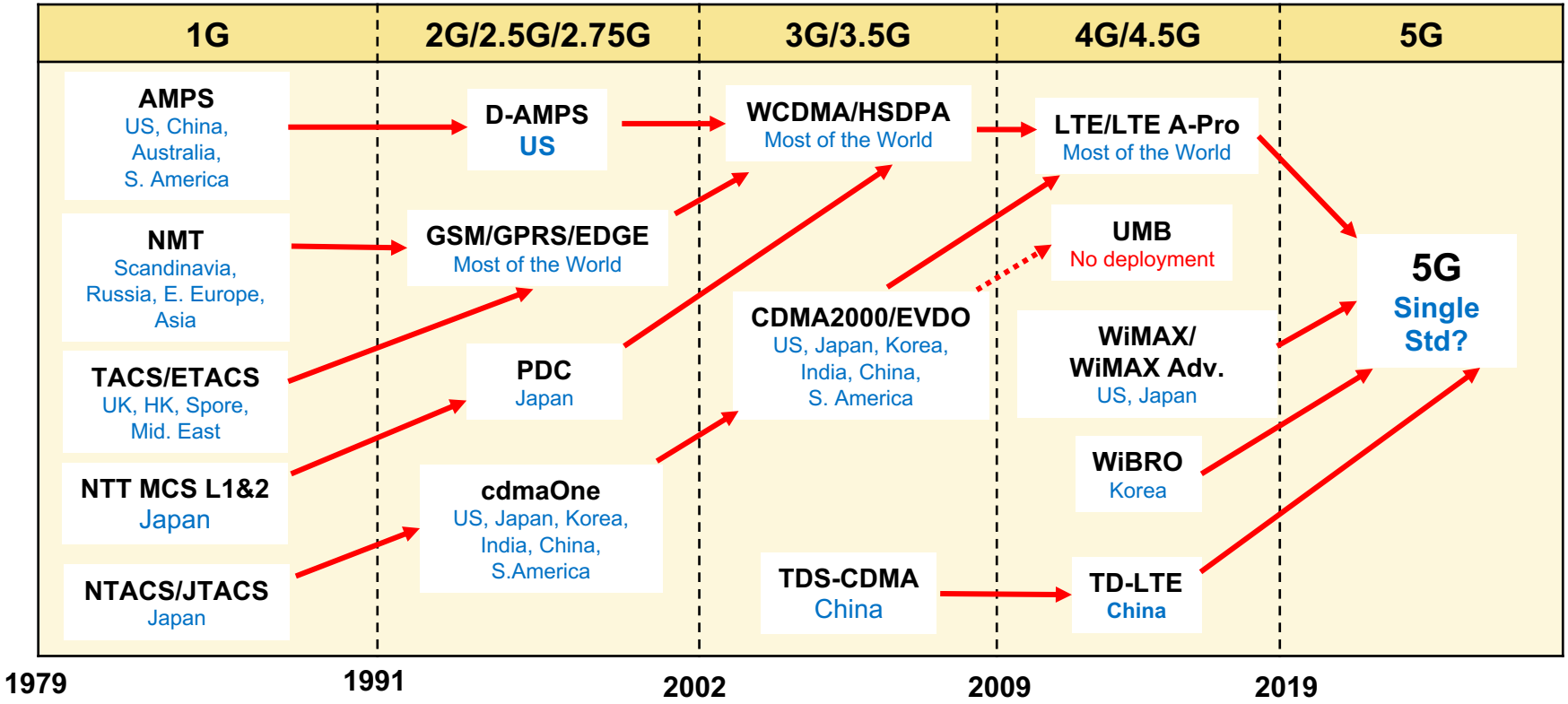
A LOOK AT HISTORY OF CELLULAR STANDARDS

40-YEAR HISTORY OF CELLULAR STANDARDS EVOLUTION



LESSONS FROM THE HISTORY OF CELLULAR STANDARDS

- **Market fragmentation is costly (especially to early adopters)**
  - High R&D expense
  - High implementation and upgrade cost
  - Risk of vendor lock-in
  - Lacks interoperability
  - Risk of obsolescence

- **Collaboration & co-operations amongst regional regulatory agencies, network operators and equipment vendors drove convergence**

Can we apply these lessons to accelerate Smart Cities?

A LOOK AT SMART CITIES

KEY CHALLENGES FACING SMART CITIES

- **Lack of coalescence around a set of complementary standards**
  - Increases cost of deployment; hinders scalability, interoperability and evolution
  - Need to simplify: Prioritize and define requirements → create product profiles

- **Regional regulatory differences adding to confusion**
  - Diverse requirements impede the scalability of the market
  - Need regulatory agencies to participate and help with standardization requirement

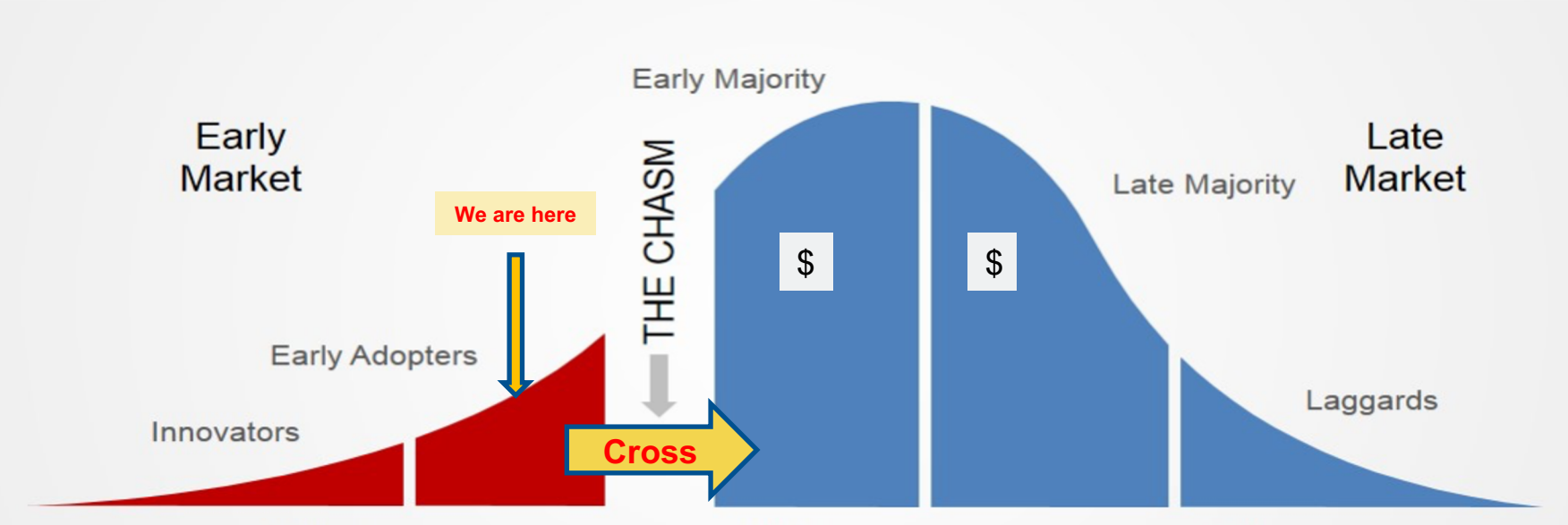
- **Lack of interoperability wastes up to 40% of IoT value[1]**

- **Cities and technology partners may waste up to $321 billion by 2025[2]**

(1) https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world
(2) https://machinaresearch.com/news/smart-cities-could-waste-usd341-billion-by-2025-on-non-standardized-iot-deployments/

CROSSING THE CHASM (SMART CITIES)

Adapted from “Crossing The Chasm” by Geoffrey Moore



Cross together as Allies to Early Majority:

1. Simplify technical complexity
2. Standardize key elements needed for interoperability
3. Lower deployment risk and lower cost through economy of scale
4. Be reference standard for industry peers to drive proliferation

WHAT CAN W3C AND ASEAN SMART CITIES DO?

- **Join and form a W3C Smart Cities Interest Group**
  - Align on common problems and areas of focus e.g. interoperability
  - Define technical requirements & product profiles
  - Strategically rally other regions to build critical mass

- **Drive standards convergence**
  - In the W3C
  - In co-ordination with other SDOs

- **Focus on a Platform: Data Service & Interoperability**
  - Easier to align: Most pressing shared problem
  - Enable different devices and platforms to interoperable
  - Plays to W3C's and WoT's Core competences

Charter: Focus on what would be most impactful to ecosystem

Smart Cities - PART 2

Standards Development Progress and Plans

Dr. Michael McCool
Intel Corporation

WHAT CAN THE W3C DO?

Lead an intentional and concerted drive towards convergence

- Avoid contributing to further fragmentation
- Gather use cases and product profiles to define standards requirements
- Work with leading implementers and influencers to drive alignment
- Liaise with other relevant standards & SIGs to drive convergence
- ***Leverage and extend existing standards in the W3C and elsewhere***
- ***Identify gaps and develop new standards only when necessary***

RELEVANT W3C STANDARDS AND GROUPS

RDF and SPARQL:
Representation and query of linked semantic data.

JSON-LD 1.1:
Structured semantic data in a form compatible with modern web services.

Web of Things (WoT):
Descriptive metadata providing a unifying view of existing IoT services.

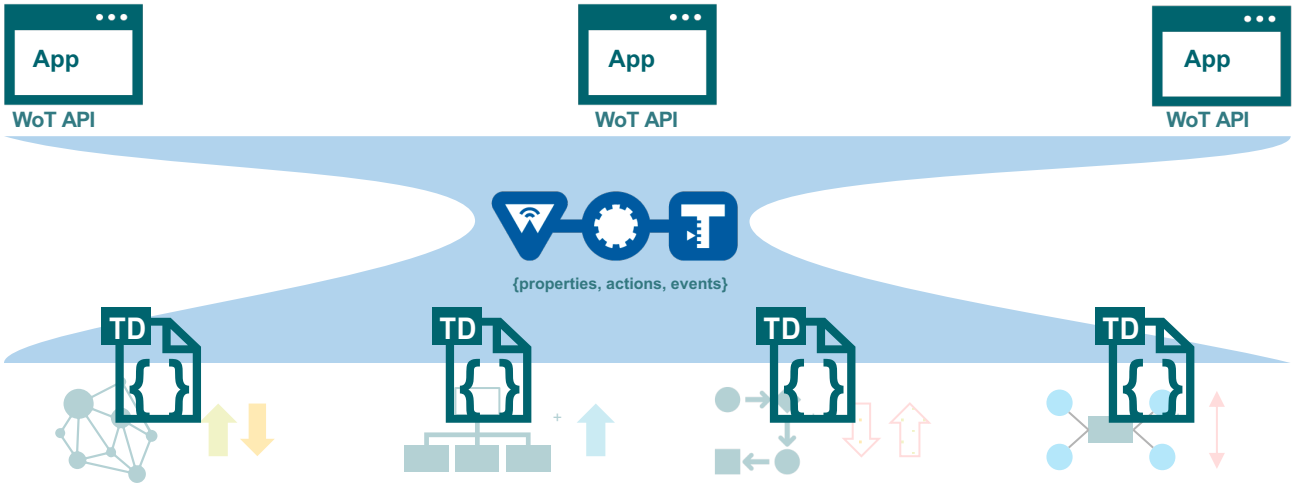
Decentralized Identifiers (DID):
Privacy-preserving secure identifiers for devices, services, and people.

Spatial Data on the Web:
Vocabularies and best practices for spatial and geolocation data.

Automotive:
Open web platform for exposing vehicle signals information.

W3C WEB OF THINGS (WOT)

- W3C Working Group whose goal is adapting web technologies to IoT
- Initial standard is a Thing Description (TD) metadata format
  - TD describes the interactions of an IoT device (“Thing”)
  - Applications use a high-level interaction model to interact with Things
  - Interaction model is based on simple properties, actions, and events
- Low-level details are automated
  - TDs also include protocol binding information for low-level protocols
  - It is not necessary for applications to deal with low-level protocols



OTHER RELEVANT STANDARDS

XML, JSON, CBOR, … + HTTP, CoAP, MQTT, 0MQ, AMQP, …
Various data payload representations + various communication protocols.

OpenAPI/Swagger:
Descriptive metadata for HTTP-based web services.

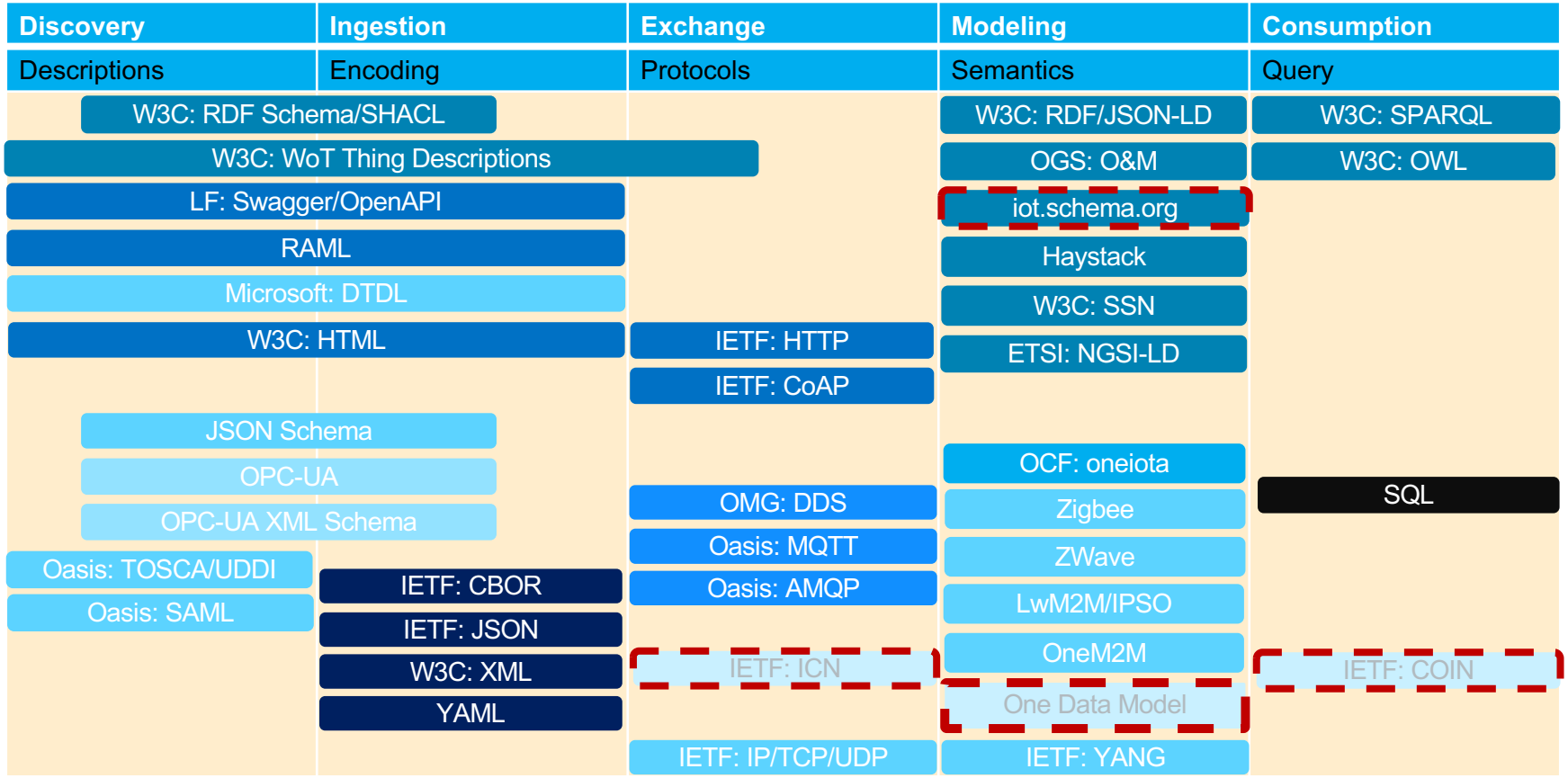
JSON Schema:
Data models for JSON payloads (often extended to CBOR, XML, etc).

JSONPath:
JSON-based query language (see also XPath for XML)

One Data Model/IoTschema:
Emerging collaboration on a common semantic framework for IoT services.

OAuth2:
Flexible authentication framework allowing fine-grained access controls.

IOT DATA AND METADATA STANDARDS MAP: CURRENT STATUS



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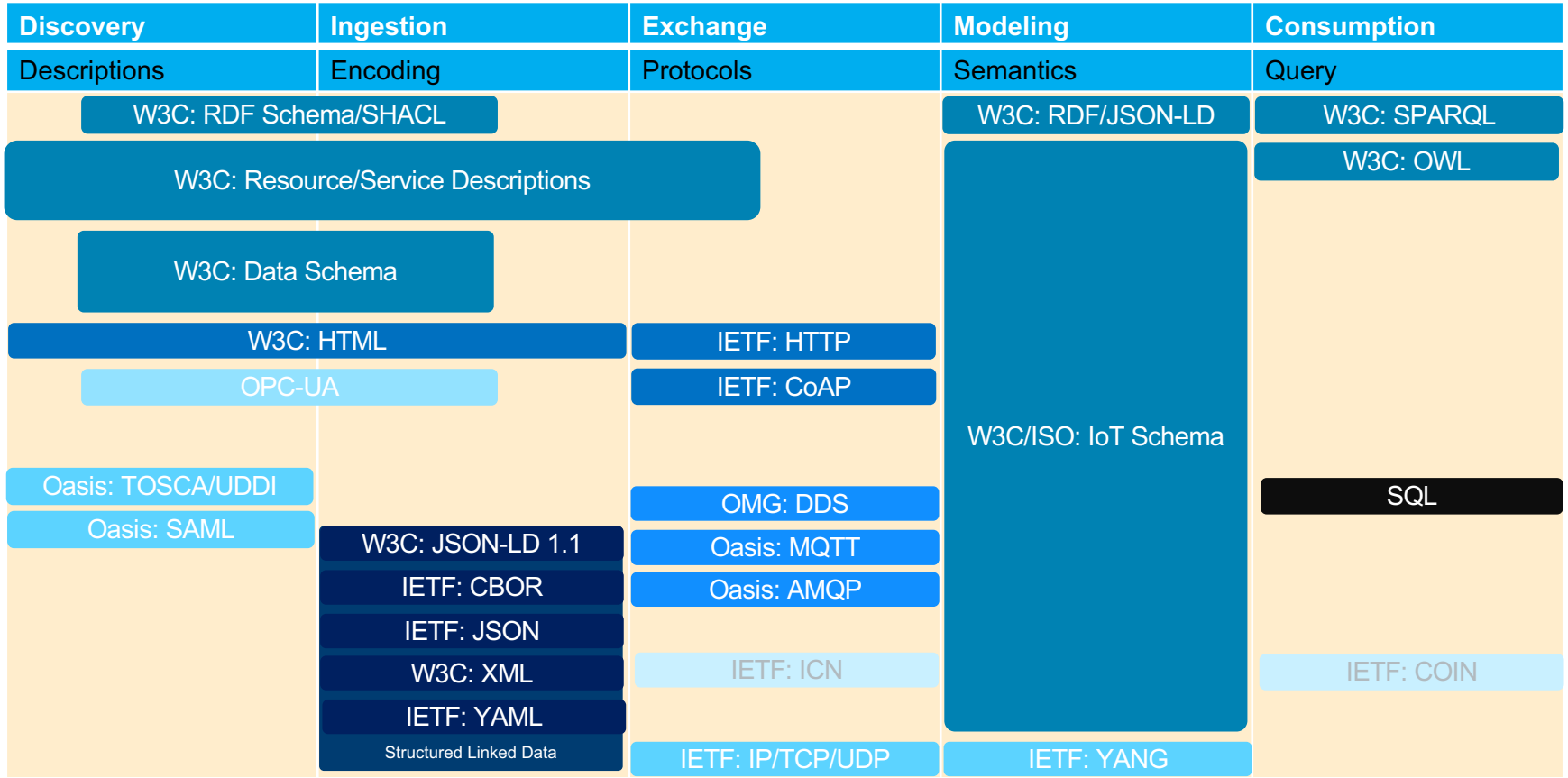
IOT DATA AND METADATA STANDARDS MAP: GOAL



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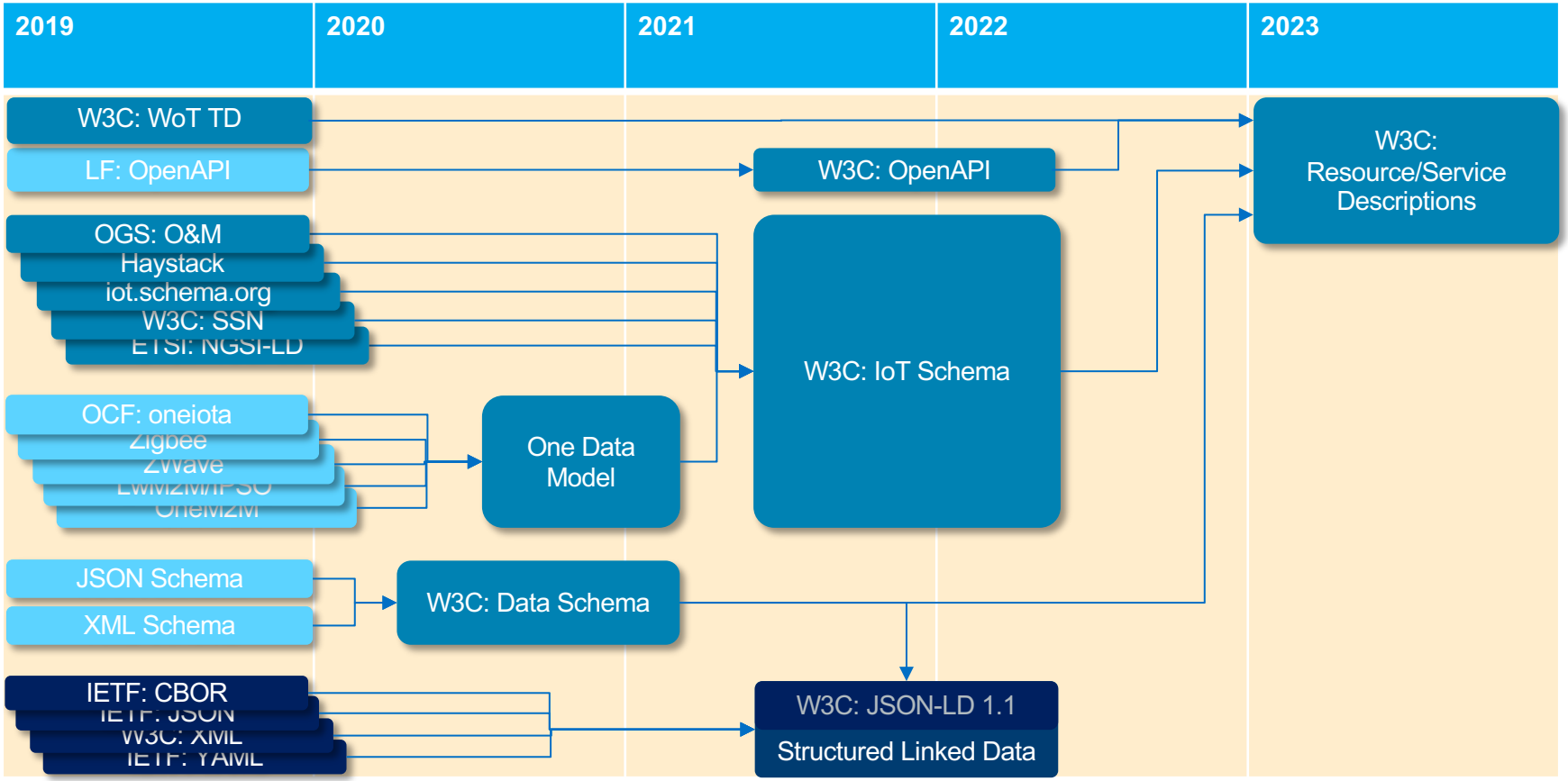
IOT DATA AND METADATA STANDARDS CONVERGENCE TIMELINE



RDF | Structured | Other

CALLS TO ACTION

1. **Define Smart City Use Cases and Requirements**
   - Motivate standards convergence with focused objectives
2. **Identify and Target Gaps**

   Example: Semantic definitions for Smart City services.
3. **Eliminate Redundancy**

   Example: Multiple service descriptions
   → Single unified service description
4. **Expand Generality of Existing Standards**

   Example: JSON Schema only defined for JSON
   → Data Schema suitable for all relevant payload encodings.