

ISO/IEC JTC1 WG11

City Data Standard for Public Health Emergencies

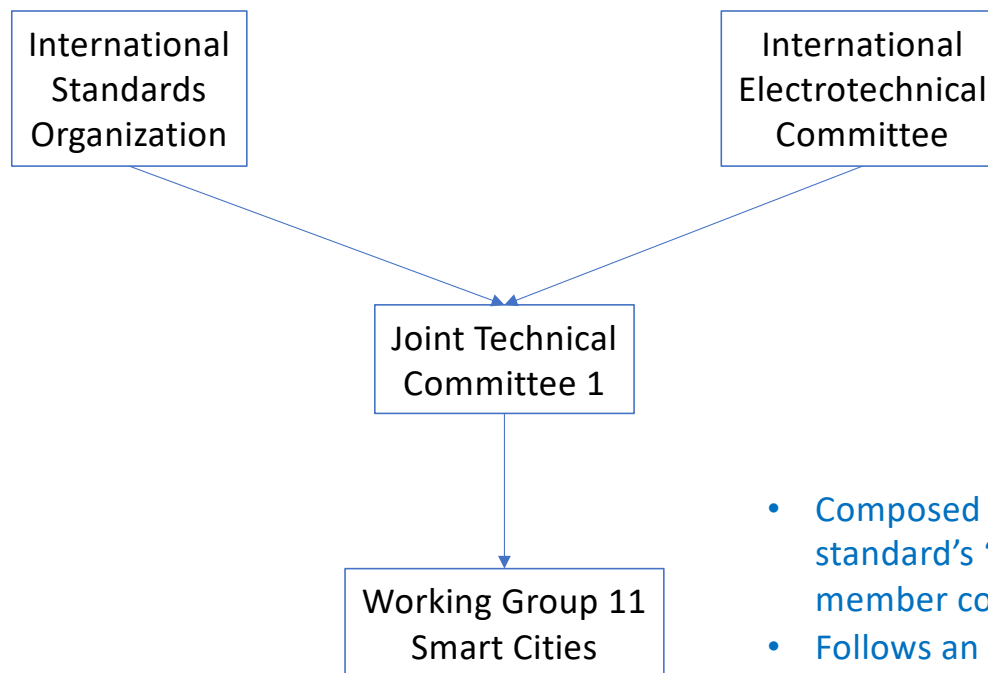
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ISO/IEC JTC1 WG11 Smart Cities



- Composed of subject matter experts and standard's "bureaucrats" representing member countries.
- Follows an iterative review process where each stage expands the reviewers beyond the working group members.
- Process takes 2-3 years.

Context: ISO/IEC AWI 5087 City Data Model

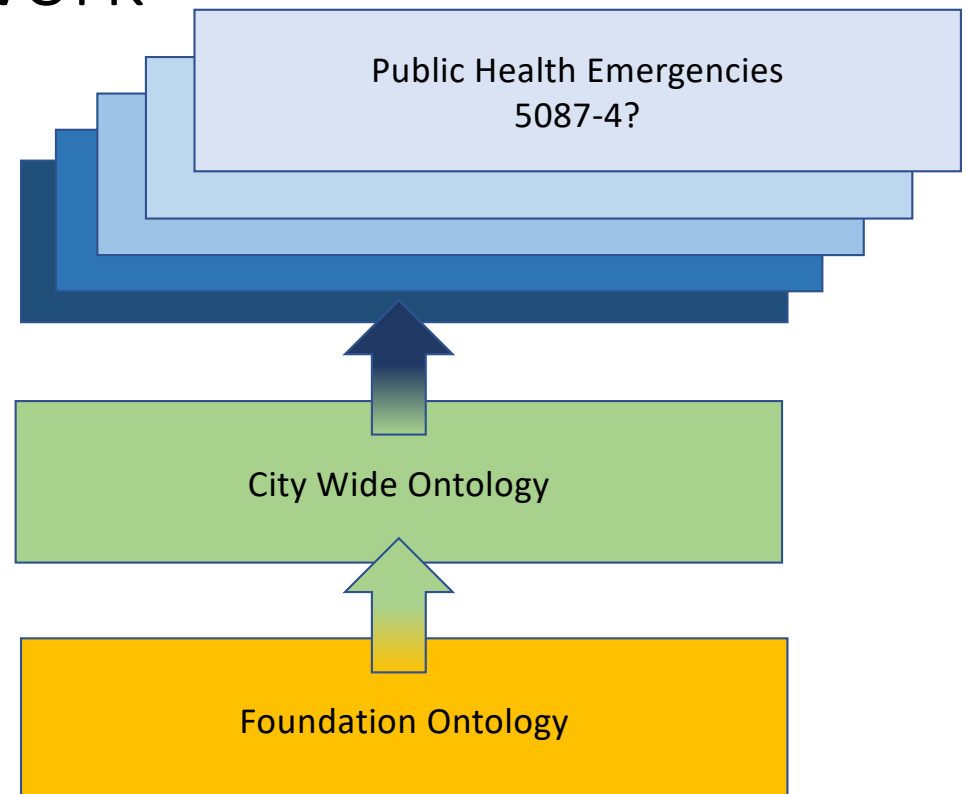
- A series of technical data standards for the representation and exchange of City Data
- This standard provides definitions in a machine-readable form using the Semantic Web Ontology language OWL
 - This enables the development of software tools that can consume, verify, and make inferences about city data.
 - It will ensure that data can be easily combined and shared in order to effectively support city planning and operations.

ISO/IEC AWI 5087 Framework

Service Level (5087-n) spans concepts commonly associated with a particular service but still shared with other services, such as Vehicles and Transportation network. *Can be read by multiple services, but updated only by one service.*

City Level (5087-2) spans concepts that are general to cities and span all services such as Households, Services, Residents. *Can be read and updated by multiple services.*

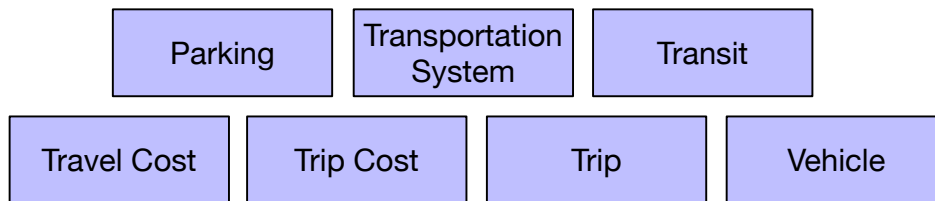
Foundation Level (5087-1) spans very general concepts such as Time, Location, and Activity, upon which other levels are based.



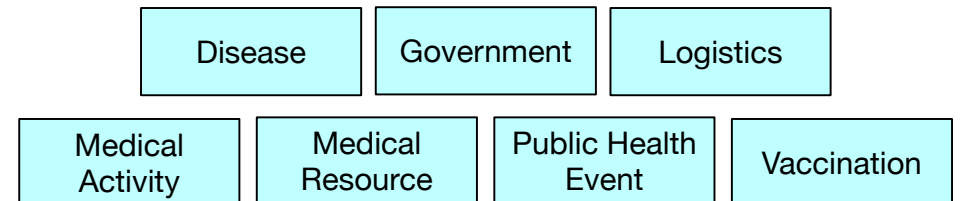
The process of development of this standard is to iteratively select a city service and apply the ontology engineering process to create, extend and/or modify each level of the standard.

ISO JTC1/WG 11 Smart Cities: 5087

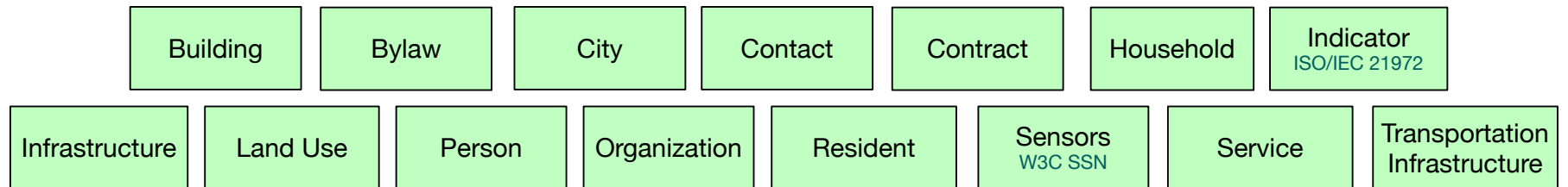
5087-3



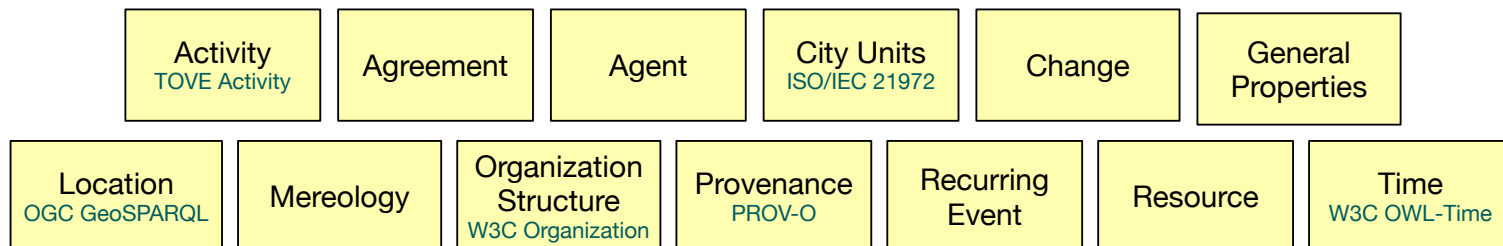
5087-4



5087-2



5087-1



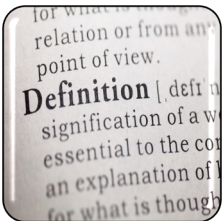
Ontology Light

Transportation Planning



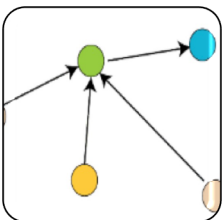
Micro-Theory

- Transportation Planning predicts transportation demand over a multi-decade horizon.
- In order to predict demand, it has to simulate how the city will change over those decades
- For example, how households and their members will change over time, and their changing transportation requirements as they age



Definition

-
-



Knowledge Graph

- Classes, Properties, Instances
- (boosted with) Taxonomy and Inheritance

- Residents, Households, members
- Transportation Network
- Vehicles

the age of 14, a
d will leave with a
les in, owns
erates a business
of at least one
the same address

City Resident

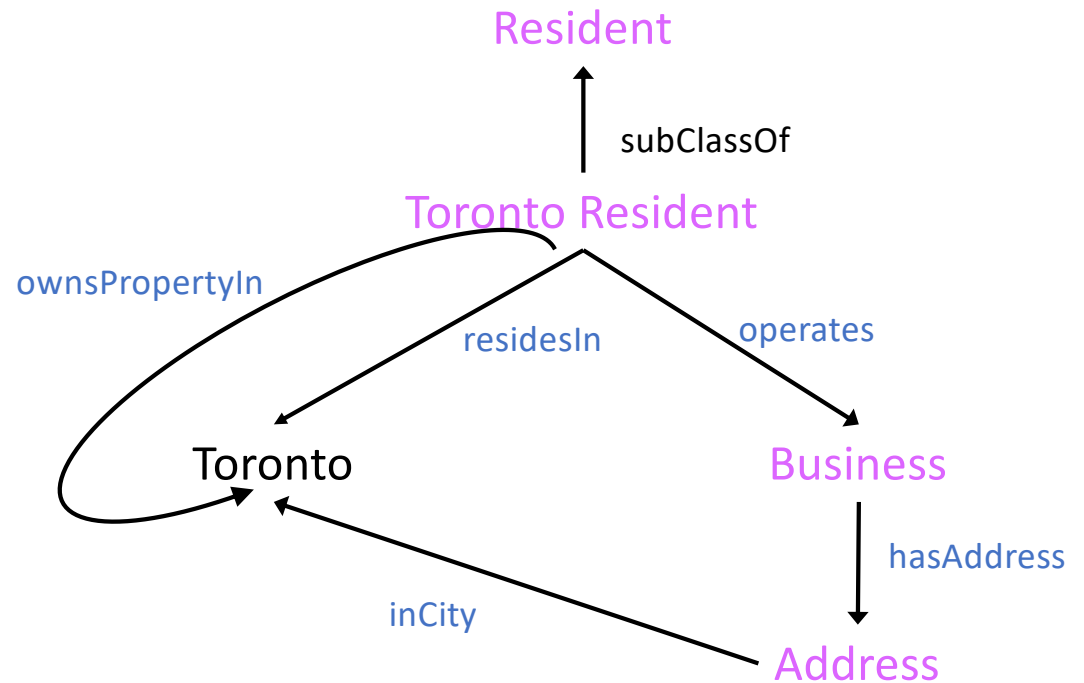
- Cities provide many services to their residents, but in order to receive those services, the validity of their residency must be determined.
 - For example, free transportation for senior residents
- Possible uses of an ontological description of a city resident include:
 - Verifying that a person who requests a service is a resident
 - Given a database of people, determining who are residents of the city
 - Validating manually provided classifications of residency
 - Inferring characteristics of residents
- How would an ontology help?

Example: City Resident

- **Toronto:** “you are identified as a resident if you reside in, own property, or own or operate a business in Toronto” (311 Toronto).
- **Beijing:** “all individuals holding the nationality of the People’s Republic of China who [have] a domicile in Beijing and nowhere else. If the individual maintains a regular dwelling somewhere else, the more regular dwelling is considered their place of residence” (Li, 1991).
- **New York:** “the place which an individual intends to be his permanent home – the place to which he intends to return. It is the home with range of sentiment, feeling and permanent association. One must be domiciled in New York and maintain a home in New York, the time spent in the State is irrelevant” (McGladrey, 2009).
- **Germany:** “a resident of Germany generally refers to an individual who has a domicile in Germany or spends more than six consecutive months in Germany (habitual place of abode)” (Seidel, 2011).

Knowledge Graph: Core Concepts and Properties

“you are identified as a resident if you reside in, own property, or own or operate a business in Toronto”



Definitions and Constraints

Semantics of Toronto Resident

“you are identified as a resident if you reside in, own property, or own or operate a business in Toronto”

```
TorontoResident subClassOf Resident
    and (residesIn.Toronto
        or ownsPropertyIn.Toronto
        or operates.(Business
            and hasAddress.(Address and inCity.Toronto)))
```

Description Logic Definition

TorontoResident $\equiv$ Resident

$\sqcap$ (hasResidence.(Residence $\sqcap$ $\exists$ hasAddress.($\exists$ city.gn:6167865))
 $\sqcup$ $\exists$ owns.(ControlledEntity
 $\sqcap$ entity.((Building $\sqcup$ Organization) $\sqcap$ $\exists$ hasAddress.($\exists$ city. gn:6167865))))
 $\sqcup$ $\exists$ owns.(ControlledEntity
 $\sqcap$ entity.(LandArea
 $\sqcap$ (spatial:O. gn:6167865 $\sqcup$ spatial:is_part_of.gn:6167865)))
 $\sqcup$ $\exists$ operates.(ControlledEntity
 $\sqcap$ entity. (Organization $\sqcap$ $\exists$ hasAddress.($\exists$ city. gn:6167865))))

But in 5087 we only include partial definitions, in a table format, using Manchester syntax.

Data Standard for Public Health Emergency

“Allow me to share my humble experience to moderate 200+k FB public group on AI, ML, and DL, which had started from zero.

As everybody here, I hold in high esteem Ravi, and whatever he is doing.

Nevertheless, why such narrow topics agenda for the Ontology Summit, as "Data Standards for Public Health Emergencies", with respect to its authors.

Then there is a crying demand for real ontological topics, like as:

- Data Standards for Ontologies

- Data Standards for Science and Technology

- Data Standards for AI and ML...

<https://www.linkedin.com/pulse/world-data-ontology-science-ai-ml-deep-learning-graph-abdoullaev/>

This could revive our 1000- slowly dying micro-forum, attracting much more aspiring members.

Again, the Summit could not be a summit with virtually 10-20 people.”

Azamat Abdoullaev, ontology-summit@googlegroups.com, 16 February 2022.

Why a PHE Data Standard?

- We just shut down the world for the last two years because of a PHE!
- In a world of limited resources and time, we need to better understand, coordinate and efficiently/effectively respond to the challenges that cities, states and nations face.
- Students of global cities, like myself, have a deep understanding of the extent to which legacy systems have created data silos across the departments/divisions.
- A first step to breaking down the silos is the creation of data standards.
- Stating that “Data Standards for X” is the most important is not helpful.

5087-4 Use Cases

1. Contact Tracing
2. Disease Tracing
3. Drinking Water Pollution Management
4. Emergency Medical Resource Management
5. Food Poisoning Management
6. Infection Prevention for Medical Personnel
7. Mental Health Management
8. Stakeholder Collaboration/Volunteer Management
9. Testing
10. Transportation Management
11. Vaccine Distribution Management
12. Vaccine Efficacy Management
13. Vaccination Management

Vaccine Distribution Management Use Case

The city/state/province/country receives vaccines from multiple sources both within the country and outside of it. The distribution team has to:

- know when and where and what type of vaccine they are receiving,
 - plan and implement distribution across the country - balance supply and demand,
 - manage distribution centres at both the regional and local levels,
 - access the inventory and status of all vaccines through the supply and distribution chain,
 - dynamically adapt to changes in supply and demand.
- What are the planned shipments of vaccine x that are to be received from manufacturer m during time period t ?
 - What is the inventory of vaccine x at location y ?
 - What is the status of vaccine x at location y ?
 - What is the planned allocation of vaccine x for location y during time period t ?
 - How many vials/doses of vaccine x were delivered to location y during time period t ?
 - How many doses of vaccine x were administered at location y during time period t ?
 - How many citizens have made an appointment today to be vaccinated at location y ?

5087-4 Concept Patterns

1. City
2. Disease
3. Emergency Medical Resource
4. Government
5. Logistics and Distribution
6. Medical Activity
7. Medical Personnel
8. Micro-Organism
9. Organization
10. Person
11. Public Health Event
12. Vaccination

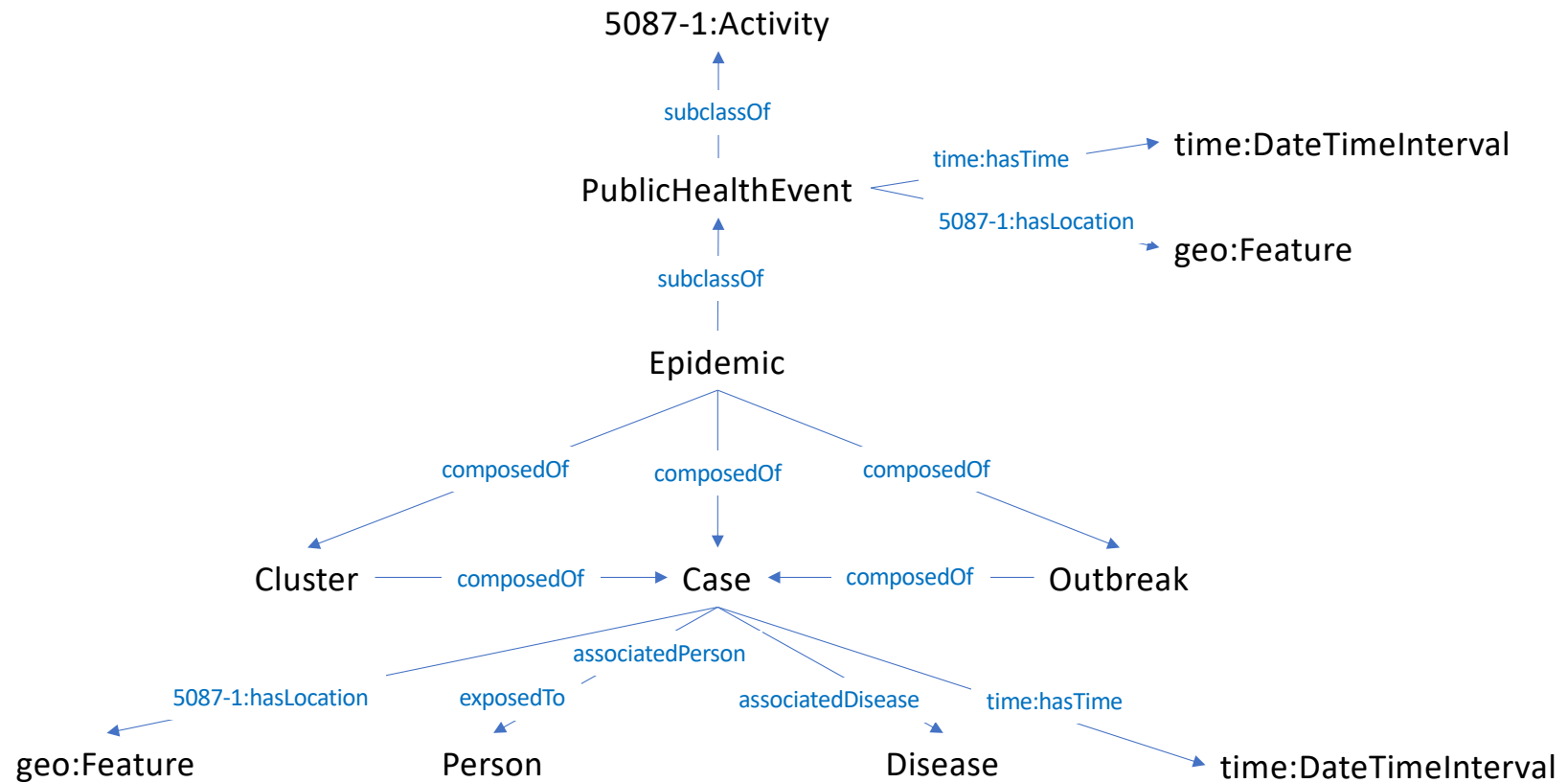
Patterns in Use Cases

Use cases	Testing	Contact tracing	Disease tracing	Vaccine distribution mngt	Vaccination mngt	Medical personnel mngt	Medical resource mngt	Mental health mngt	Movement mngt	Stakeholder collaboratio n mngt
Patterns										
City	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Disease	✓	✓	✓	✓	✓	✓	✓	✓		
Epidemiology	✓	✓	✓		✓					
Finance	✓				✓	✓	✓			
Infection transmission	✓	✓	✓							
Medical activity	✓	✓	✓		✓			✓		
Medical personnel	✓		✓		✓	✓	✓	✓	✓	
Medical resource	✓		✓	✓	✓		✓			
Organism	✓		✓							
Organization	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Person	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Statistics	✓	✓	✓		✓					
Vaccination				✓	✓					

Patterns in Existing “Ontologies”

	EPO	Apollo SV	BCEO	GCIH	GeMin A	BCO	CIDO	IDO Core	HL7 RIM	MF MD	HDS	CODO	COVIDC RFRA	OPM
City												✓		✓
Disease	✓	✓	✓		✓	✓	✓	✓		✓		✓	✓	✓
Epidemiology			✓		✓	✓			✓			✓		
Finance									✓		✓			
Infection Transmission	✓		✓		✓	✓		✓				✓		
Medical Activity	✓							✓	✓		✓	✓		
Medical Personnel				✓					✓				✓	✓
Medical Resource		✓				✓	✓		✓					
Organism		✓	✓			✓	✓		✓		✓			
Organization		✓		✓		✓			✓			✓		✓
Person		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Statistics	✓			✓										
Vaccination		✓							✓					

Public Health Event



Status

- Survey of existing vocabularies and ontologies related to public health has been conducted – paper available in draft form.
- Draft "ontology light" created – paper available in draft form.
- Approval to start the standards process being voted on by JTC1 members.