PAS 182:2014

Smart city concept model – Guide to establishing a model for data interoperability

Executive summary

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1 Introduction

Organizations and citizens of a city have a need to share data. At an operational level, component systems can interoperate, and at a strategic level, insight is used to evidence the effective use of resources to bring about beneficial change.

However, data is often labelled using language and terms from the sector that initially collected it. Each sector has its own models and terminologies that enable data to be discovered and understood within that sector, but form a barrier to interoperability with other sectors.

The smart city concept model (SCCM) outlined in this PAS addresses this lack of interoperability by defining an overarching framework of concepts and relationships that can be used to describe data from any sector. Mapping terms from many sectors to the SCCM provides a basis for discovering and sharing data about the same thing, from many sources.

The SCCM is relevant wherever many organizations provide services to many communities within a place.

This PAS is intended to facilitate discussions between decision-makers from each sector and the specialists who build and design the systems and services that enable the city to function. The components of the SCCM could form the basis of these discussions, by aligning ontologies to discover where data from different sectors is about the same thing or is related in a useful way.

2 The model

The SCCM defines a series of 27 concepts that can be used to describe the entities that are typically contained in city data, and goes on to highlight where those concepts are linked for city scenarios. Each concept has been selected for relevance in describing data that is valuable to share across a city and for applicability across different sectors.

Examples of concepts from the model include:

- community — a group of persons and/or organizations that share common characteristics such as place, circumstance etc.;
- assumption — a predicted or presumed state;
- objective — an achievement desired by an agent;
- service — the capacity to carry out one or more methods.

With a common understanding of these concepts, decision-makers can share and re-use information. With just the four concepts above, many organizations could publish information about:

- the services that they offer;
- the communities that they are targeted at;
- the assumptions that they have made about those communities;
- how they have shaped objectives, which in turn influences the design of services.

Where this information can be combined, it can form a valuable operational resource for a city's citizens and a basis for collaboration and innovation in the use of a city's resources.

Each concept has a definition, some explanatory notes, examples of how that concept might feature in city data and a diagram to show how it is typically related to other concepts in the model.

For example, the service concept, is described as:

Definition	The capacity to carry out one or more methods
Notes	A service exists even if it is not accessed. For example, an advice hotline exists as a service even if nobody calls it. A service is typically targeted at a community. A service can consume resources and give benefit. A case contains information about an instance of a use of a service.
Examples	• A hairdressing service • A street cleaning service • An energy supply • An advice service

A diagram is provided to show that the service concept is typically linked to other concepts in the model.

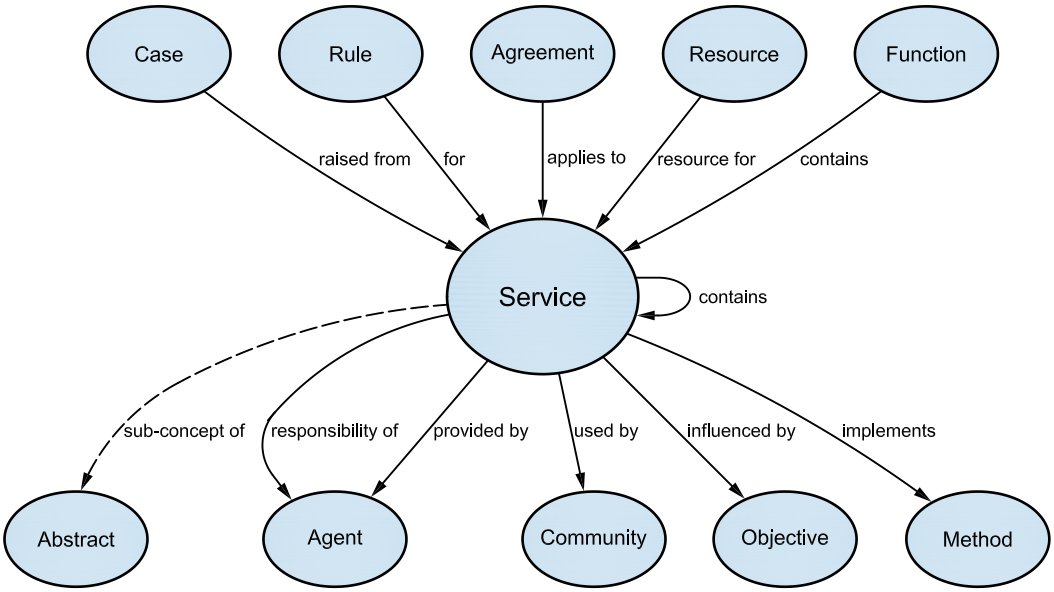


Figure 1 – Service relationships

3 Applying the model to smart city scenarios

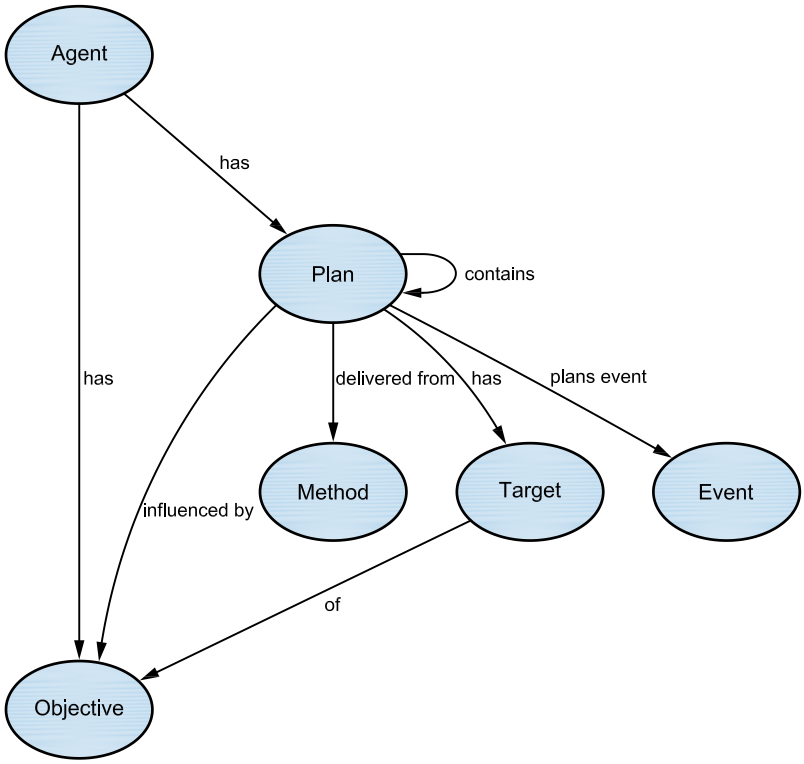
As well as listing each concept alphabetically, the PAS considers some typical smart city scenarios, and proposes a 'view' to illustrate how combinations of concepts and relationships can be used to share data.

The scenarios considered are shown in the Table 1.

Table 1 – Smart city scenarios

View	Scenario	Examples
• Items	Identifying items that are found in the city, their condition, and where they are located.	• lamppost; • building; • community.
• Collections	Grouping items together so that they can be managed.	• housing stock; • vehicle fleet; • roads.
• Events	Recording the role that items took in an event and the outcomes as changes of state.	• an incident; • a measurement; • a change of a setting; • a transaction; • a use of a service.
• Objectives	Engaging on the objectives held by one or a partnerships of organizations, by evidencing a gap between an assumed state and a target state of an item.	• providing suitable housing; • reducing carbon emissions; • reducing unemployment; • optimum real-time energy use; • maintaining safe water levels.
• Responding	Observing the state of an item and responding by altering the configuration of a service.	• manage traffic flows; • control temperatures; • reduce energy consumption.
• Services	Cataloguing the services in a city, grouped into functions.	• energy provision; • waste collection; • licensing; • car parking; • removing abandoned vehicles.
• Cases	Sharing case level information about how an item features in events raised from a service.	• a crime investigation; • planning application; • rectifying a fault on a network.
• Plans	Sharing the steps and decision points about a plan to achieve an objective.	• building a swimming pool; • changing a road layout.
• Resources	The decisions taken to allocate resources to plans and services.	• grants; • fees and charges; • numbers of traffic wardens.

As an example, the PAS contains a 'Plans' view shown below.



A plan records the steps and decision points that are applied to achieve a target state of an item or place, as a part of addressing an objective.

A plan might be derived from existing methods that have been devised to achieve the desired outcome.

As a plan is enacted, events occur that record the actual outcomes as compared to those planned.

A city might wish to discover and track the plans from many agents that apply to objectives for items or places.

Figure 2 – Plans view

4 Using the SCCM

The SCCM does not attempt to introduce a new ontology, or to replace existing models in use within sectors; rather, the SCCM is intended to facilitate discussions between decision-makers from each sector and the specialists who build and design the systems and services that enable the city to function. The components of the SCCM could form the basis of these discussions, by aligning existing ontologies to discover where data from different sectors is about the same thing or is related in a useful way.

The SCCM can be used to:

- catalogue data holdings from different organizations, leading to improved discovery and reuse;
- promote definitive and authoritative identifiers and categorizations as reference information for each concept against which city data can be harmonized and joined up;
- agree data standards for specialisms within a concept that are of particular interest to a city;
- understand datasets from other sectors;
- construct a local data ecosystem where data can be contributed and consumed by different organizations and people for a city.

The SCCM is relevant to both open data, shared under an open licence, and closed data, where the security and privacy of the content is protected. When the same concept model is applied to all, it becomes possible to track where statistics and analytics have been derived from operational data, and to observe the impact of strategic decisions.

The SCCM can be applied to a variety of unstructured and semi-structured data streams as well as the structured data which currently powers many cities and organizations. For example, an analysis of twitter streams and traffic sensors might lead to metrics and assumptions about how a community views its transport links.

PAS 182 lists a number of ways that the SCCM can be applied to guidance provided in PAS 181.

5 Other barriers to interoperability

This PAS focuses on semantic interoperability, that is, defining the meaning of data from many sectors. However, it also highlights other barriers to interoperability across a city and proposes that a city should also consider a framework for interoperability for each of these barriers.

Table 2 – Other barriers to interoperability

Privacy	Conforming to human rights and data protection requirements when handling data that refers to people. In the UK, the Information Commissioner's Office (ICO) is the regulator. Guidance from the ICO is listed in the bibliography.
Security	Protecting data from accidental or malicious destruction, or unauthorized access. Documents giving guidance about data security in the UK are listed in the bibliography.
Integrity	Avoiding data corruption as data is handled, copied, processed and transported.
Availability	The degree to which data needs to be consistently available to meet a purpose. Particularly relevant to real-time systems, which rely on the availability of data to perform. Availability can include normal operating services and the time necessary to recover from a disaster.
Quality	Characteristics of data such as completeness, validity, consistency, timeliness, accuracy, precision and tolerance. It is important to understand the quality of data when considering if it can be re-used for a new purpose.
Provenance	The traceability of data, from collection, through each transformation, analyses and interpretation.