PAS 182:2014

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

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Contents

List of tables

Summary of pages

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Foreword

This PAS was sponsored by the UK Department for Business, Innovation & Skills (BIS). Its development was facilitated by BSI Standards Limited and it was published under licence from The British Standards Institution. It came into effect on 31 October 2014.

Acknowledgement is given to Paul Davidson of the Local e-Government Standards Body (LeGSB), as the technical author, and the following organizations that were involved in the development of this PAS as members of the steering group:

- BSI Consumer and Public Interest Network
- Cabinet Office
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- W3C

Acknowledgement is also given to the members of a wider review panel who were consulted in the development of this PAS.

The PAS process enables a guide to be rapidly developed in order to fulfil an immediate need in industry. A PAS can be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

Relationship with other documents

This PAS is issued as part of a suite of BSI publications related to smart cities:

- PAS 180, *Smart cities – Vocabulary*, which defines terms for smart cities, including smart cities concepts across different infrastructure and systems elements and used across all service delivery channels;
- PAS 181, *Smart city framework – Guide to establishing strategies for smart cities and communities*, gives guidance on a good practice framework for decision-makers in smart cities and communities (from the public, private

and voluntary sectors) to develop, agree and deliver smart city strategies that can transform their city's ability to meet future challenges and deliver future aspirations;

- PD 8100, an overview document that will provide guidance on how to effectively communicate the value of smart cities to key decision-makers;[1)]
- PD 8101, *Smart cities – Guide to the role of the planning and development process*, which gives guidance on how the planning and implementation of development and infrastructure projects can equip cities to benefit from the potential of smart technologies and approaches.

Use of this document

As a guide, this PAS takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

Presentational conventions

The guidance in this PAS is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Spelling conforms to *The Shorter Oxford English Dictionary*. If a word has more than one spelling, the first spelling in the dictionary is used.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a PAS cannot confer immunity from legal obligations.

1) In preparation.

0 Introduction

0.1 General

A defining feature of smart cities is the ability of the component systems to interoperate. This PAS defines a concept model, and gives guidance to decision-makers on applying it to promote interoperability for data created, used, and maintained by a city across all sectors, on behalf of, and in collaboration with, its citizens.

Data is a resource that can transform the capability of a city, enabling the development of systems and services, and supporting informed decisions. However, decision-makers and citizens are unlikely to have the necessary expertise and are likely to rely on data specialists to deliver benefits from data to meet the objectives for their city.

Data is often labelled using language and terms from the sector that initially collected it for the provision of a service. For example, the health sector might refer to a patient and a care plan, social services might refer to a client, the education sector might refer to a pupil and a curriculum, and the transport sector might refer to a passenger and a travel plan.

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. See Annex A for an example where terms from the health informatics concept model have been mapped to the SCCM. Mapping terms from many sectors to the SCCM provides a basis for discovering and sharing data about the same thing, from many sources.

Sharing data across a city requires more than the interoperability covered by the SCCM. For example, ensuring compliance, privacy, security, integrity, availability, and quality of data also needs to be considered by decision-makers. For example, data protection legislation and its provisions for usage of personal data is likely to impact some of the structural relationships between data from different systems that such sharing would introduce.

Although these concerns are beyond the scope of this PAS, which focuses on the semantics of data, the bibliography provides a list of UK good practice materials that address these wider considerations. PAS 181 provides guidance on the governance of a smart city programme and the management of data assets within it, and PAS 182 is a tool to help with the implementation of this.

It is critical that decision-makers are involved in the development of a data ecosystem to support the development of the city. In the current landscape datasets are typically created by an organization for one particular purpose, and the potential for secondary use is not unlocked.

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. Use of the SCCM over time could increase the data literacy of non-specialists, allowing further value in city data to be unlocked, and reused, either in its original form, or as derived insight.

Each city is likely to take its own approach to organizing its data, reflecting the priorities and needs of the city, and the agencies and people participating. A citywide data ecosystem based on the SCCM, combining data from many sources, for the benefit of both the city and the citizen could support the reuse of data to improve services and gain insight into the quality of life of the city's citizens.

0.2 Relevance

This PAS aims to look beyond the current use of data to facilitate city services, and encourage decision-makers to explore the reuse of data as a resource to innovate the future direction of systems and services. This approach could help organizations to develop a future landscape based on the interoperability of data, an approach that is relevant not just in cities, but also wherever many organizations provide many services to many communities within a place.

The SCCM assumes that structured, semi-structured and unstructured data is present in a city, and can be modelled using the concepts presented.

Four key types of insight have been assumed to be required when sharing data in a city:

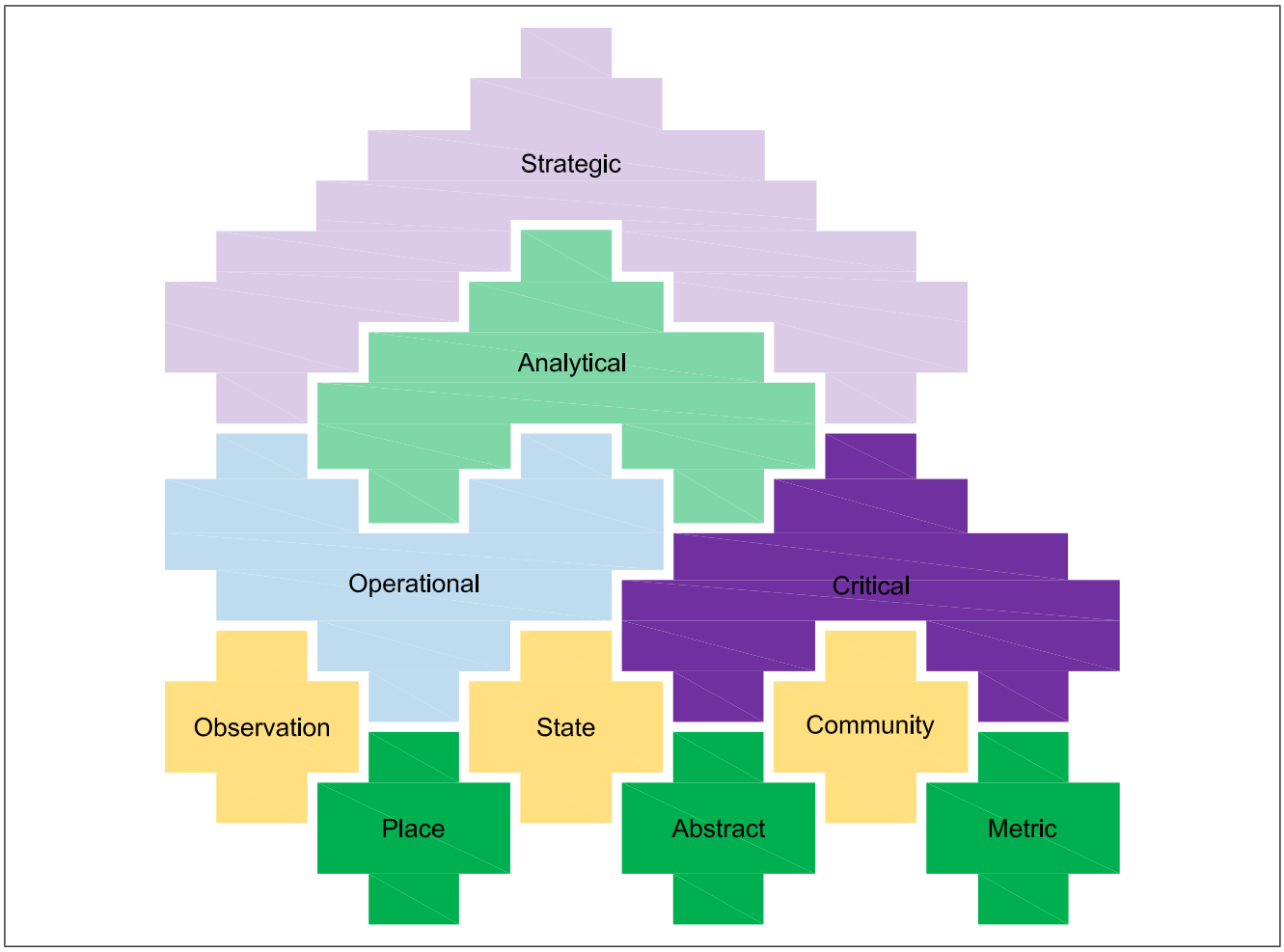
- **Operational insight** – which examines characteristics of things such as buildings, communities and organizations, using data to evidence and improve their value for the city;
- **Critical insight** – the real-time monitoring of incidents and current cases, involving all relevant organizations from across sectors, who work together to achieve the desired outcome or response;
- **Analytical insight** – the exploration of the data ecosystem to determine patterns, correlations and predictions. This allows the development or innovation of systems or services, impact assessment of proposed changes to systems or services, or the evidencing of challenges and opportunities for the city; and
- **Strategic insight** – an overarching approach that examines outcomes related to strategic objectives, decisions and plans.

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.

Figure 1 illustrates the four levels of insight identified as present in a city. The diagram is not intended to represent insights as a hierarchy, rather it identifies that these insights will be present and might be stored and used in a variety of ways. The interlocking representation is designed to identify the fluid nature of the data within a city, constantly evolving and usable for all of the insights that might be gained from city data.

Also illustrated are a number of the SCCM concepts and how they are likely to be present to enable the insight to be gained, and subsequent action taken using the data.

Figure 1 **Smart city levels of insight**



The SCCM is assumed to be used for a variety of unstructured and semi-structured data streams as well as the structured data which currently powers many cities and organizations. An example of how the SCCM might be used in a city is a "Mobility Action Plan", a 110-page document from a UK city. This document contains a variety of useful data such as:

- METRIC: The public transport system has to cope with around half a million trips per day within the city.
- ASSUMPTION:
  - There could be up to an additional 150,000 people in the city by 2031.
  - It is estimated that the total demand for travel on the public transport system could rise to 4 million trips per day by 2031.
- OBJECTIVE:
  - Fewer cars on the road than today, despite significant population growth.
  - A public transport system that enables people to easily and quickly access all areas of the city.
  - Safer roads for pedestrians and cyclists.

Making data available, using the SCCM, enables organizations in a city to collaborate, for instance by sharing ASSUMPTIONs or OBJECTIVEs to gain strategic insight.

The strategic insight gained could also use operational insight from sensors in a city, such as data related to the average speed of traffic at a location over a period of time, this data would be represented in the SCCM as:

> An OBSERVATION of average speeds (STATEs) of the traffic (ABSTRACT) at a location (PLACE).

In order to gain critical insight a Twitter stream might also be used which after processing might contain entries such as:

> "@cityX stuck in traffic for an hour in the city centre" created_at Fri Jul 20 *15:20:00 +0000 2014*
>
> "@cityX where is the bus #stranded" created_at Fri Jul 20 *15:20:54 +0000 2014*
>
> "@cityX nowhere to park again!" created_at Fri Jul 20 *15:21:03 +0000 2014*

Cities might choose to use certain Twitter handles or hashtags to allow citizens to contribute to the critical insight of their city.

After sentiment analysis of the Twitter stream the critical insight would be represented in the SCCM as:

> Number of commuters (COMMUNITY) who are dissatisfied (METRIC).

0.3 Data sharing

The sharing of data for the benefit of all stakeholders is at the heart of smart city aspirations. Data can be used in real time, from sensors and tracking devices, through to the use of data to develop longer term plans to improve the well-being of citizens and businesses.

The traditional approach to data sharing has required organizations to create individual agreements for each initiative where data is shared. Where a single organization has needed to share data from many sources, this would have required a multitude of agreements, relationships, data formats, and vocabularies.

A smart city consists of organizations across all sectors, facilitated by the sharing of data, based on a common framework of its meaning, and consistent use of identifiers and classifications. Cities organized in this way could experience the following benefits:

- reduced cost as the need to re-collect and verify data is removed;
- integrated city systems and services driven by data;
- a common understanding of the needs of communities;
- shared objectives, collaboratively developed and evidenced using data;
- engaged and enabled citizens and communities;
- transparency in decision-making;
- development of partnership models;
- businesses and communities co-creating innovation; and
- consequently, improved quality of life for citizens.

1 Scope

This PAS describes, and gives guidance on, a smart city concept model (SCCM) that can provide the basis of interoperability between component systems of a smart city, by aligning the ontologies in use across different sectors. It includes:

- concepts (e.g. ORGANIZATION, PLACE, COMMUNITY, ITEM, METRIC, SERVICE, RESOURCE); and
- relationships between concepts (e.g. ORGANIZATION has RESOURCEs, EVENT at a PLACE).

The SCCM does not replace existing models where they exist, but, by mapping from a local model to a parent model, questions can be asked about data in a new and joined-up way.

This PAS is aimed at organizations that provide services to communities in cities, and manage the resulting data, as well as decision-makers and policy developers in cities.[2)]

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

This PAS does not cover the data standards that are relevant to each concept in the SCCM and does not attempt to list or recommend the sources of identifiers and categorizations that cities map to the SCCM.

The SCCM has been devised to communicate the meaning of data. It does not attempt to provide concepts to describe the metadata of a dataset, for example, validity and provenance of data.

This PAS covers semantic interoperability, that is, defining the meaning of data, particularly from many sources. This PAS does not cover other barriers to interoperability, some of which are described at **3.2**.

2 Terms and definitions

For the purpose of this PAS, the terms and definitions given in PAS 180 and the following apply.

2.1 category
code for a definition of one or more common characteristics that can be used to classify things

2.2 class
specialization of a concept with common properties that can be the template for a specific data structure

2.3 concept
generalization of a type of thing; describing its essential features

2.4 concept model
set of defined concepts and the relationships between them, chosen to be independent of design or implementation concerns, that can be used to describe a domain

2.5 dataset
managed collection of structured data

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2) Decision-makers and policy developers are further described in PAS 181.

2.6 directed graph
diagram in which concepts are represented as nodes, and relationships as edges between nodes, where the direction of the edges corresponds to the label for the relationship

2.7 entity
thing with distinct and independent existence for which a concept can be assigned

2.8 identifier
unique name or code that identifies an individual entity

2.9 interoperability
ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together

[SOURCE: PAS 180:2014, **3.1.40**]

2.10 ontology
definition of a set of representational primitives with which to model a domain of knowledge

2.11 relationship
way in which two concepts can be connected

2.12 sector
classification for organizations that provide complementary functions

2.13 smart city
effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens

[SOURCE: PAS 180:2014, **3.1.62**]

3 Using the SCCM

3.1 General

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 in a city.

A web site has been created to accompany this PAS at http://www.smartcityconceptmodel.com. Each of the definitions and views from the PAS are shown at the web site. Additionally, the site contains a decision tree to help to identify which concept to use, and registered users can map data to the model.

PAS 181 provides guidance on the development, agreement and delivery of smart city strategies. It presents this as a set of guidance notes, all of which need to be considered throughout the enactment of a smart city programme.

Those that have particular applicability to data interoperability and sharing are listed in Table 1. All guidance notes should be reviewed within any smart city data-sharing project.

Table 1 **Relevance of PAS 181 guidance notes to PAS 182**

PAS 181 guidance note	Relevance to PAS 182 [3)]
[B1] City vision	Data sharing activities need to be able to be related to the city vision.
[B2] Transforming the city's operational model	Deliverables need to contribute to the new integrated operating model and its information architecture.
[B3] Leadership and governance	Overarching leadership and governance need to be applied to data-sharing activities.
[B4] Stakeholder collaboration	Stakeholder engagement needs to include data owners and planned users.
[B5] Procurement and supplier management	Contractual arrangements need to address the maintenance and availability of data for as long as it is required.
[B6] Mapping the city's interoperability needs	Policy products that identify barriers to interoperability and address the mapping of city concepts.
[B7] Common terminology & reference model	Provides a common vocabulary for concepts across the city and their relationships.
[B9] Empowering stakeholder and service transformation	Where legally possible, shared data needs to be made open by incorporating it into an open data platform for downstream exploitation by citizens and businesses.
[B10] Delivering city-led service transformation	There needs to be an integrated business and information architecture within which data-sharing initiatives sit to guard against the building of new silos.
[B11] Identity and privacy management	Trust by citizens and businesses needs to not be threatened by data-sharing activities.
[B13] Resources mapping and management	Key assets need to be mapped and governance processes established to allow them to be managed separately from their original intended use. Effective data asset management is essential.
[B14] Open, service-oriented, city-wide IT architecture	Key principles underpinning the architecture need to address the means of holding data securely and, where appropriate, making it open for reuse.

3.2 Other barriers to interoperability

This PAS focuses on semantic interoperability, that is, defining the meaning of data from many sectors. However, there are many other barriers to interoperability across a city. A city should also consider a framework for interoperability for each of the topics listed in Table 2.

[3)] This column only provides a high-level indication of the relevance of a PAS 181 guidance note and is not intended to be exhaustive. That document and those generated by the smart city programme as a result of its use need to be referred to for the full details.

Table 2 **Other barriers to interoperability**

Barrier	Description
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 reused for a new purpose.
Provenance	The traceability of data, from collection, through each transformation, analyses and interpretation.

4 Concept, relationship and the SCCM

4.1 Concept

A concept defines a generalization of a type of thing. The definition of a concept in the SCCM is unlikely to be sufficient to describe a piece of data, but can be the foundation for data sharing between organizations that otherwise don't share a common business language.

Each concept has been selected for relevance in describing data that is valuable to share across a city, and for applicability across different sectors.

Each concept is defined by:

- a name;
- a definition that is sufficient to consider if an entity fits a concept;
- where relevant, notes that explain how the concept is used;
- examples of classes that would fit the concept.

When considering definitions for each concept in the SCCM, the *Oxford English Dictionary* [1] definition for each concept was taken into account.

4.2 Relationship

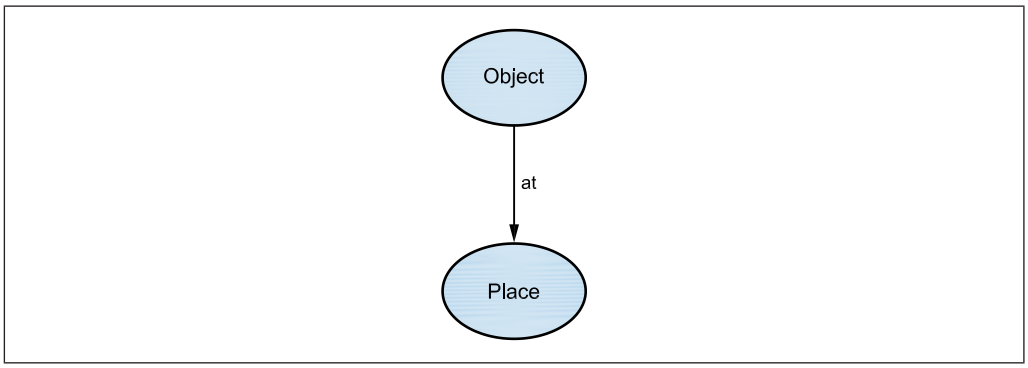
A relationship describes how two concepts are connected when describing data for a city.

Concepts and relationships in the SCCM are simple truisms that apply to all sectors and uses of data across a city.

The relationships defined in the SCCM are not exhaustive; that is, any concept can be related to any other concept. The relationships defined in the SCCM have been selected to illustrate common patterns that occur across many sectors.

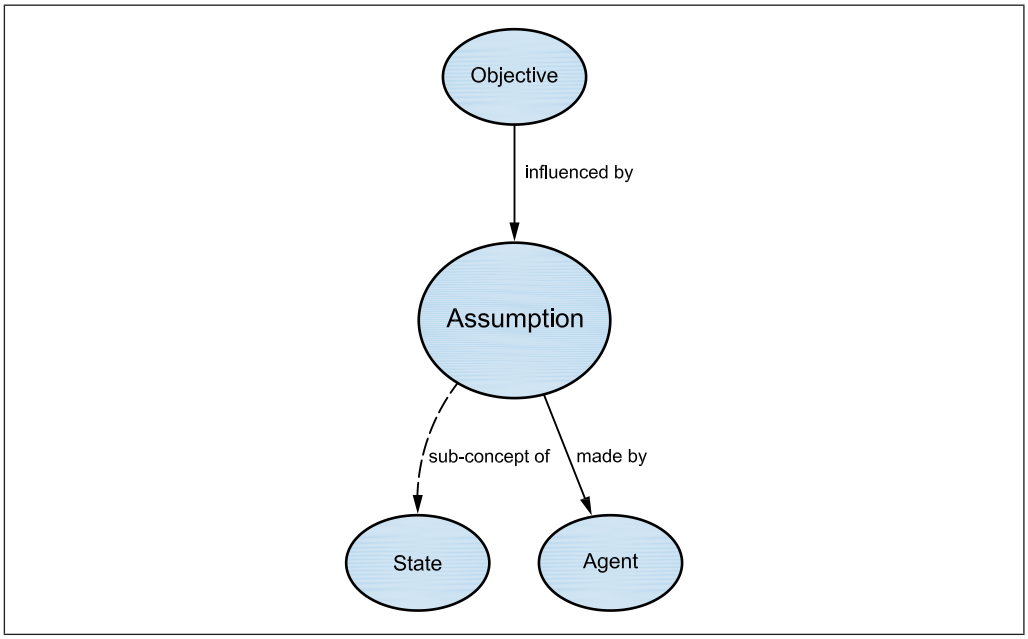
The SCCM shows concepts and relationships as directed graphs (Figure 2).

Figure 2 **Example of a directed graph**



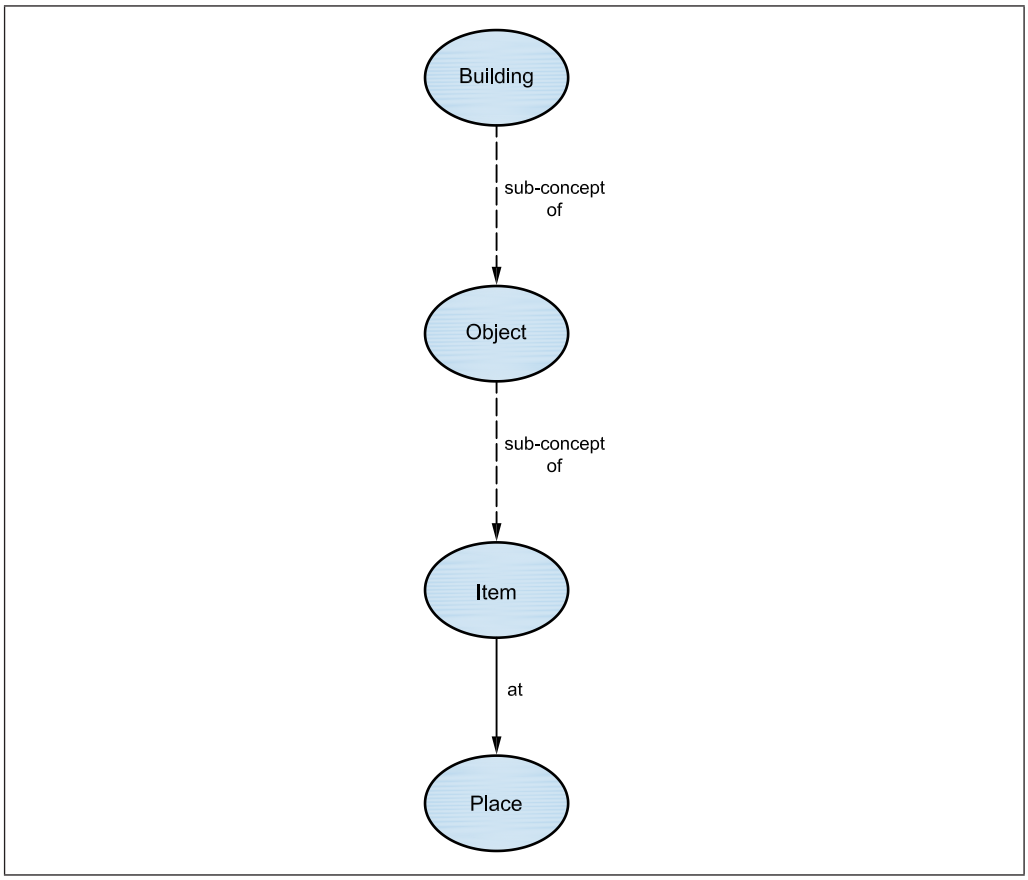
A directed graph is shown for each concept in the SCCM, defining each of the relationships for that concept (Figure 3).

Figure 3 **Example of a directed graph for a concept**



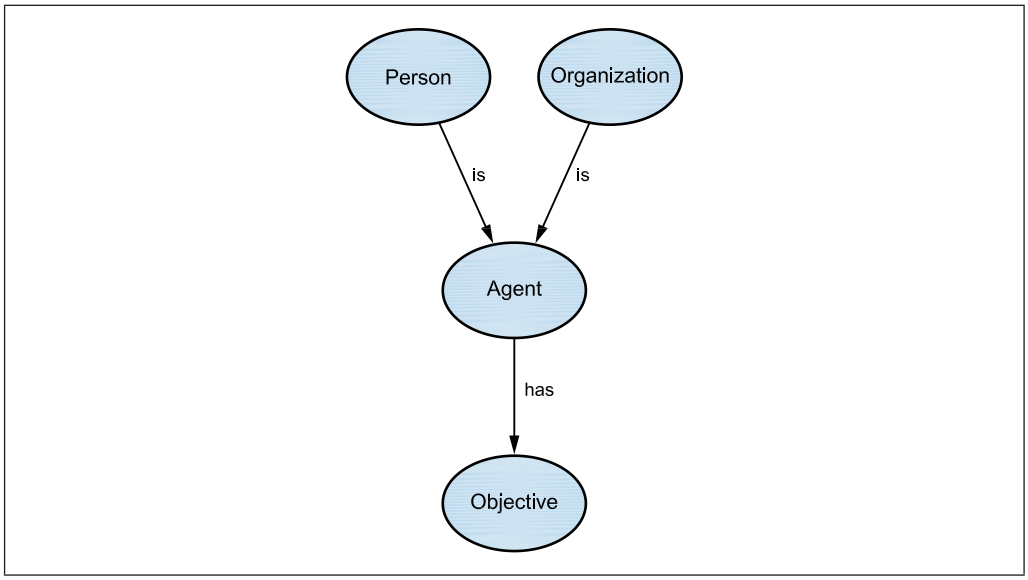
Some concepts are defined as sub-concepts of other concepts. These are defined where specializing a concept is particularly relevant to a city, such as BUILDING. Relationships that are defined for a concept are also valid for its sub-concepts (Figure 4). Sub-concept relationships are shown using dashed lines.

Figure 4 **Example of sub-concepts**



Some concepts in the SCCM have been created to represent a group or choice of concepts. These are designed to reduce the number of relationships that would otherwise have been created. For example, the AGENT concept combines the concepts of PERSON and ORGANIZATION, which then enables a single relationship to be valid for both (Figure 5).

Figure 5 **Example of a group concept**



When the SCCM is viewed in its entirety, the number of concepts and relationships can be overwhelming and it becomes hard to see how data would be mapped to it. The SCCM contains a series of views in which a small number of concepts and relationships have been selected to illustrate a data sharing scenario across a city.

Further views can be created by selecting concepts and relationships from the SCCM.

5 Mapping a dataset to the SCCM

5.1 Dataset

A dataset is a container of information, where that information has some repeating structure.

Where a dataset can be mapped to the SCCM, it can be linked to other related data and shared with organizations and people from beyond the originating sector.

The first step to mapping a dataset to the SCCM is to identify the separate entities that the data describes. An entity is a thing with distinct and independent existence, particularly when other data, from other sources, might also refer to the same thing. Figure 6 gives an example of a dataset in a city.

Figure 6 **Example of a dataset listing reported faults to lamp posts**

Case Number	Lamppost Reference	Location	Reported Date	Reported By	Fault
1234	ab123	Outside number 10 Hugh Street.	04/03/2014	Bert Smith	Light flickering

In this example, there are entities for:

- the case;
- the lamp post;
- the location of the lamp post;
- the reporting of the fault;
- the person reporting the fault; and
- the condition of the lamp post.

Mapping these entities to the SCCM would give:

Entity	Concept
Case	CASE
Lamp post	OBJECT
Location	PLACE
Report	EVENT
Reporter	PERSON
Condition	STATE

5.2 Class

Concepts from the SCCM are unlikely to be sufficient to adequately define the meaning of data. The meaning and structure of entities in datasets are likely to be fully defined in a data model, as a class. Where these classes can be mapped to the SCCM, it becomes possible to read the same, or related, data across datasets.

5.3 Identifier and category

For entities of the same class, an organization can use a set of codes to uniquely identify an individual instance (e.g. the lamp post reference in **5.1**). By using a consistent code in many datasets, an organization can join up its data where it refers to the same entity.

An organization can create its own codes, or it can reuse codes from another organization, particularly where that organization is a definitive source of information for that class of entity. For example, Companies House provides a registration number for each company in England and could be considered the definitive source for that information.

These codes are identifiers when they can be used to name an individual instance of an entity.

Where a city can agree a common identifier set for a type of entity, different organizations can share information about it. For example, using common identifiers for lamp posts could join up data about:

- energy use;
- accidents; and
- faults.

Categories provide a set of terms that can be used to group things for a type of entity (e.g. a type of health condition). By using consistent categories for a type of entity, organizations can discover groups of data, statistics and insight.

The SCCM proposes a set of concepts that can be used to organize and promote consistent use of identifiers and categories across a city. Organizations might then also publish the types of entity that their data describes as a class.

5.4 Prime concept

A prime concept is one that can be used to map city data.

A list of prime concepts is provided at Table 3. Each concept is described in detail in Clause **7**.

5.5 Group concept

A group concept is defined to represent a group or choice of concepts. It is designed to reduce the number of relationships that would otherwise have been created. It is preferable to use a prime concept when mapping a dataset to the SCCM; however, there might be occasions where the data could refer to more than one concept, in which case a group concept is used. For example, a dataset about a payment EVENT may refer to the payee, which might be a PERSON or an ORGANIZATION, in which case, the AGENT group concept is used.

Table 4 provides a list of group concepts. Each concept is described in detail in Clause **7**.

Table 3 **Alphabetical list of prime concepts**

Name	Definition	Sub-concept of
ACCOUNT	A container of information, held by an AGENT, in which to record data arising from EVENTs that relate to an ITEM in a role.	ABSTRACT
AGREEMENT	A negotiated arrangement between AGENTs as to a course of action.	ABSTRACT
ASSUMPTION	A predicted or presumed STATE.	STATE
BUILDING	A man-made structure, with a fixed or temporary PLACE, intended for sheltering PERSONs or other OBJECTs.	OBJECT
CASE	A container for information recording the history of EVENTS initiated by a SERVICE demand.	ABSTRACT
COMMUNITY	A group of PERSONs and/or ORGANIZATIONs that share common characteristics such as PLACE, circumstance, etc.	ITEM
DECISION	A conclusion or resolution reached after consideration [1].	ABSTRACT
EVENT	An occurrence that has happened or might happen.	
FUNCTION	A COLLECTION of SERVICEs.	COLLECTION
METHOD	A pre-determined procedure, or series of steps, designed to accomplish an OBJECTIVE.	ABSTRACT
METRIC	A measure of demography, characteristics, activity or performance.	STATE
OBJECT	A physical ITEM.	ITEM
OBJECTIVE	An achievement desired by an AGENT.	ABSTRACT
OBSERVATION	An EVENT in which a STATE is recorded.	EVENT
ORGANIZATION	A group of PERSONs with a collective goal.	AGENT
PERSON	An individual human being [1].	AGENT
PLACE	A geographic or virtual part of space.	
PLAN	A list of steps with times and RESOURCEs, used to achieve an OBJECTIVE.	ABSTRACT
RULE	An explicit or understood regulation or principle governing conduct or procedure within a particular area of activity.	ABSTRACT
SERVICE	The capacity to carry out one or more METHODs.	ABSTRACT
STATE	A circumstance or condition of an ITEM at a time.	
TARGET	A desired STATE.	STATE

Table 4 **Alphabetical list of group concepts**

Name	Definition	Sub-concept of
ABSTRACT	Existing in thought or as an idea but not having a physical existence.	ITEM
AGENT	An ITEM, but most often a PERSON, or ORGANIZATION, providing a SERVICE or taking a role in an EVENT.	ITEM
COLLECTION	A grouping of ITEMS, as defined by an AGENT, that needs to be managed, or operated upon together.	ABSTRACT
ITEM	An individual article or unit, especially one that is part of a list, collection, or set [1].	
RESOURCE	An ITEM that can be drawn on by an AGENT to produce a benefit.	

5.6 Concepts that are not included in the SCCM

5.6.1 Time

Time is not a concept in the SCCM, but does apply to every statement that can be made using the model.

Dates, times, durations and intervals appear in data for many concepts, and also describe relationships, for example:

- a PERSON may have a date of birth; and
- a PERSON may be at a PLACE, for a period of time.

5.6.2 Role

Role is not a concept in the SCCM, but instead is represented as a relationship, which enables ITEMs to be related to EVENTs, CASEs and ACCOUNTs.

6 Views illustrating how concepts are typically related

6.1 General

The SCCM contains a series of views in which a small number of concepts and relationships have been selected to illustrate a data-sharing scenario across a city.

A full list of relationships in the model is provided at Annex B.

6.2 ITEMs view

Figure 7 shows the ITEMs view.

A city contains ITEMs, which might be referred to in data from many organizations. Where a city can agree a common identifier for an ITEM, different organizations can provide information about it.

Most obviously, an ITEM might be an OBJECT such as a lamp post, a BUILDING, or a road, but an ITEM might also be:

- an ORGANIZATION, such as a local council or an energy supplier;
- a PERSON, such as a resident or user of a service; or
- a COMMUNITY, such as commuters or low-income families.

The SCCM contains sub-concepts of ITEM for these. The relationships that are defined for ITEM are therefore also true for these sub-concepts.

A city also needs to refer to non-physical things, such as a service, a contract, a decision, or a case. These non-physical things are also ITEMs, and the SCCM uses the sub-concept ABSTRACT to group them together. A number of further sub-concepts within ABSTRACT are defined in the SCCM.

An ITEM might be associated with a PLACE, most obviously, to describe where an ITEM is. Although ABSTRACT ITEMs don't have a physical existence, they can still be related to a PLACE (e.g. to describe their coverage).

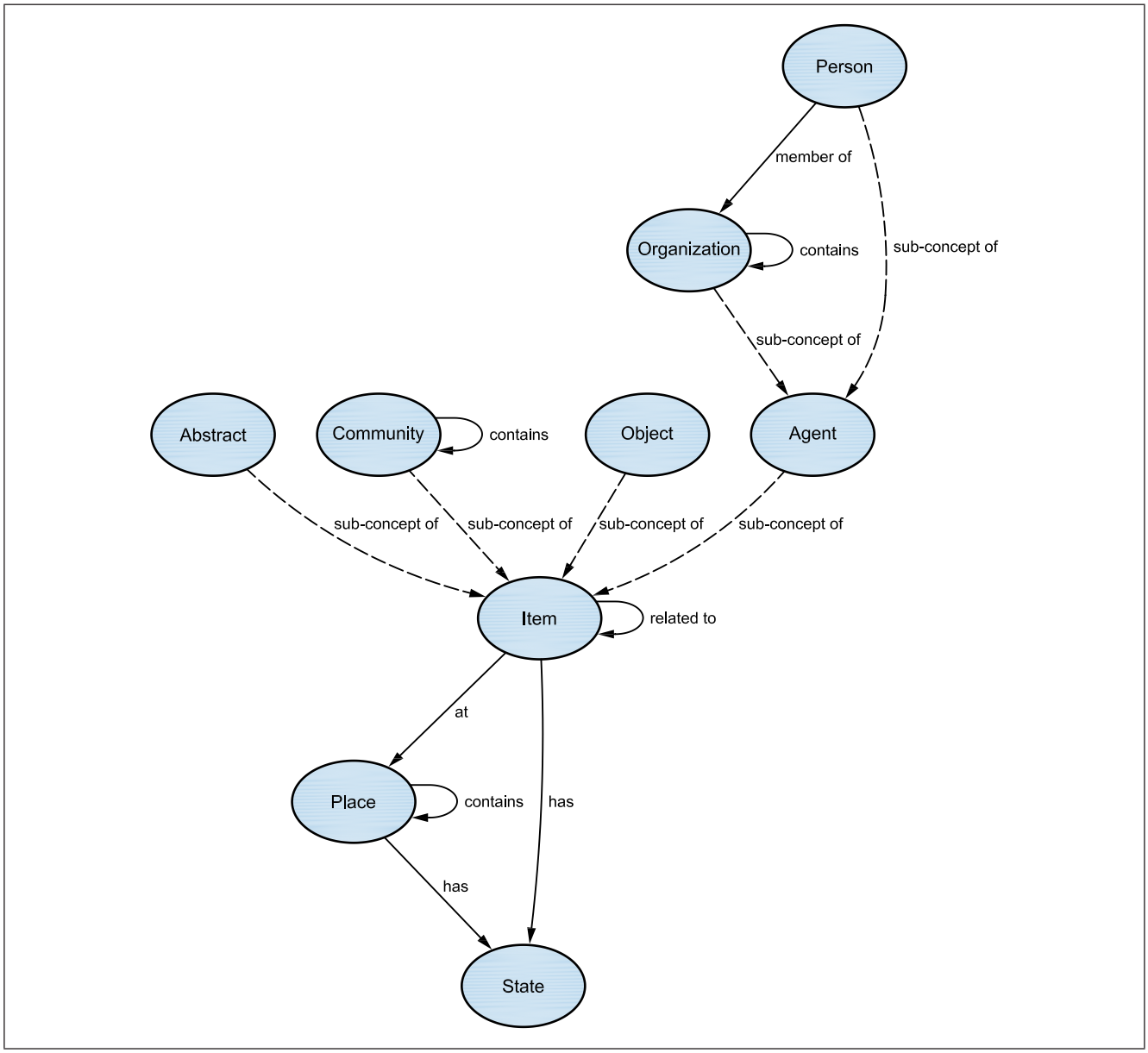
PLACE is used to describe a geographic position or area. Some PLACEs are described precisely with coordinates, and boundaries, while others are less precise, perhaps just with a locality name.

Both ITEMs and PLACEs can have a series of STATEs over time. Typically, a STATE describes the condition of an ITEM or PLACE.

A STATE might be described subjectively, from the point of view of an observer (e.g. the building condition is poor). A STATE might also be described quantitatively (e.g. the temperature of a room), or perhaps as a statistic (e.g. a community's deprivation index).

A smart city should base its decisions on a shared understanding of the STATE of ITEMs, either in real-time, or by implementing PLANs to bring about changes to STATEs.

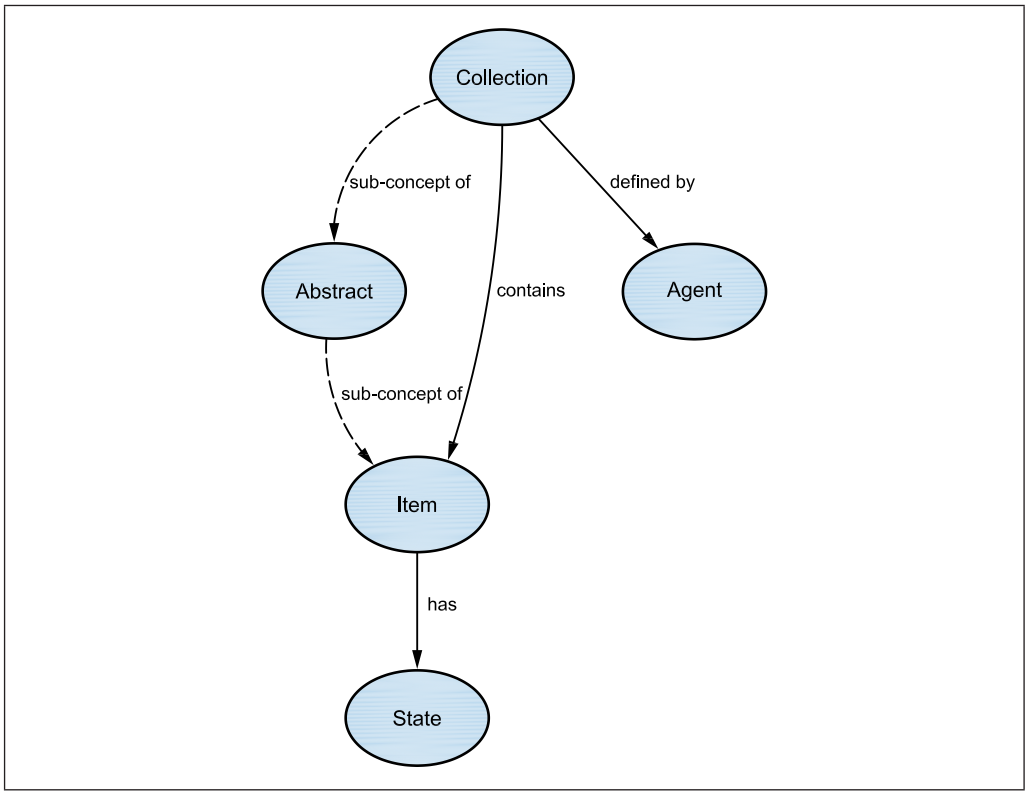
Figure 7 **ITEMs view**



6.3 COLLECTIONs view

Figure 8 shows the COLLECTIONs view.

Figure 8 **COLLECTIONs view**



ITEMs are often grouped together in a COLLECTION so that they can be managed, or operated upon together. For example:

- housing stock;
- vehicle fleets;
- manholes;
- roads; and
- contracts registers.

COLLECTIONs are defined by AGENTs so that the actual contents are either explicitly listed, or defined by a scoping statement.

COLLECTIONs enable lists of ITEMs to be defined, created and shared across a city.

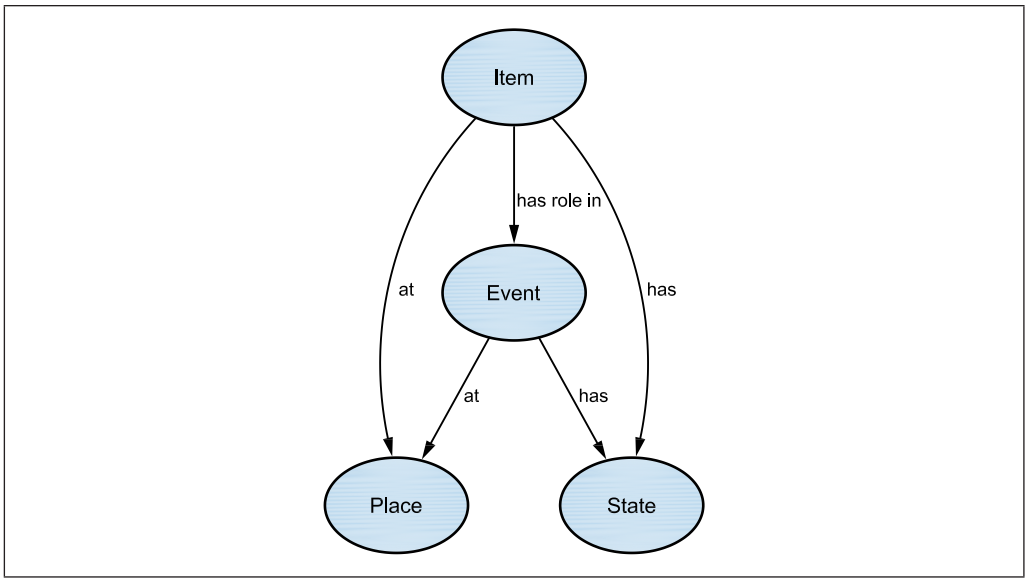
Although the contents of a COLLECTION can be physical ITEMs, a COLLECTION is an ABSTRACT ITEM.

As a COLLECTION is itself a sub-concept of ITEM, its STATE can be described and tracked over time.

6.4 EVENTs view

Figure 9 shows the EVENTs view.

Figure 9 **EVENTs view**



For a city, EVENTs might include:

- an incident;
- a measurement;
- a change of a setting;
- a transaction; and
- a use of a service.

An EVENT can refer to a number of ITEMs that take roles in the EVENT.

So, for example, a PERSON might take the role of applicant, in one EVENT, and the same person might take the role of patient, in another EVENT.

All types of ITEMs can take roles in an EVENT, so, for example:

- a candlestick as an OBJECT could be the murder weapon in a crime EVENT; or
- a tender as an ABSTRACT could be the subject of a contract signing EVENT.

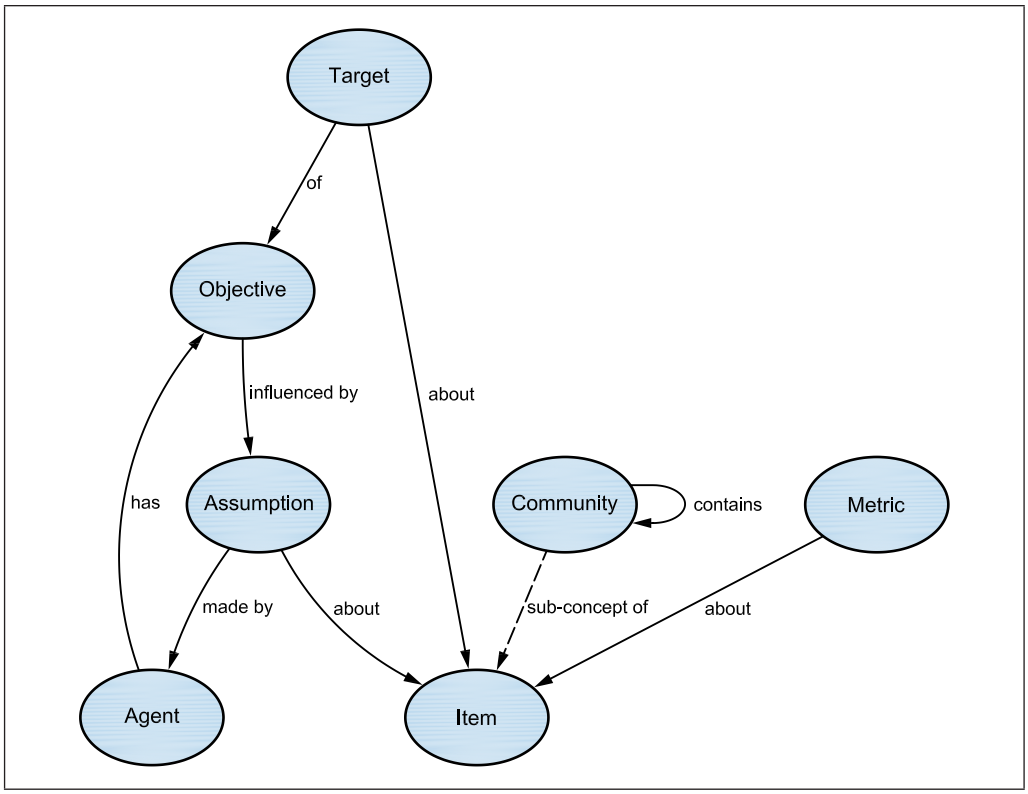
EVENTs occur over a period of time, and might cause a change in the STATE of a number of ITEMs.

For example, a driver being convicted of speeding might cause a change to the number of points on a driving licence, or to the eligibility to drive.

6.5 OBJECTIVEs view

Figure 10 shows the OBJECTIVEs view.

Figure 10 **OBJECTIVEs view**



ORGANIZATIONs and individual PERSONs have a series of OBJECTIVEs setting their reasoning and ambitions for the changes that they desire. Some of these might be long-term, for example:

- providing suitable housing;
- reducing carbon emissions; and
- reducing unemployment.

Others might be more immediate or real-time such as:

- optimum real-time energy use; and
- maintaining safe water levels.

The SCCM combines the concepts of PERSON and ORGANIZATION into the concept of AGENT. This simplifies the relationships that would often otherwise need to refer to either.

Where an OBJECTIVE can be quantified, it can be linked to a series of TARGETs that are the observable STATEs of the impacted ITEMs.

OBJECTIVEs can be set that have an impact on all manner of ITEMs. This view particularly illustrates where an ITEM might be a COMMUNITY, and therefore the OBJECTIVE is about the well-being of that COMMUNITY.

OBJECTIVEs can be set on the basis of a series of ASSUMPTIONs, which capture a predicted future STATE of one or more ITEMs. The gap between an ASSUMPTION and a TARGET can be used to define the change that is sought by the OBJECTIVE.

For example:

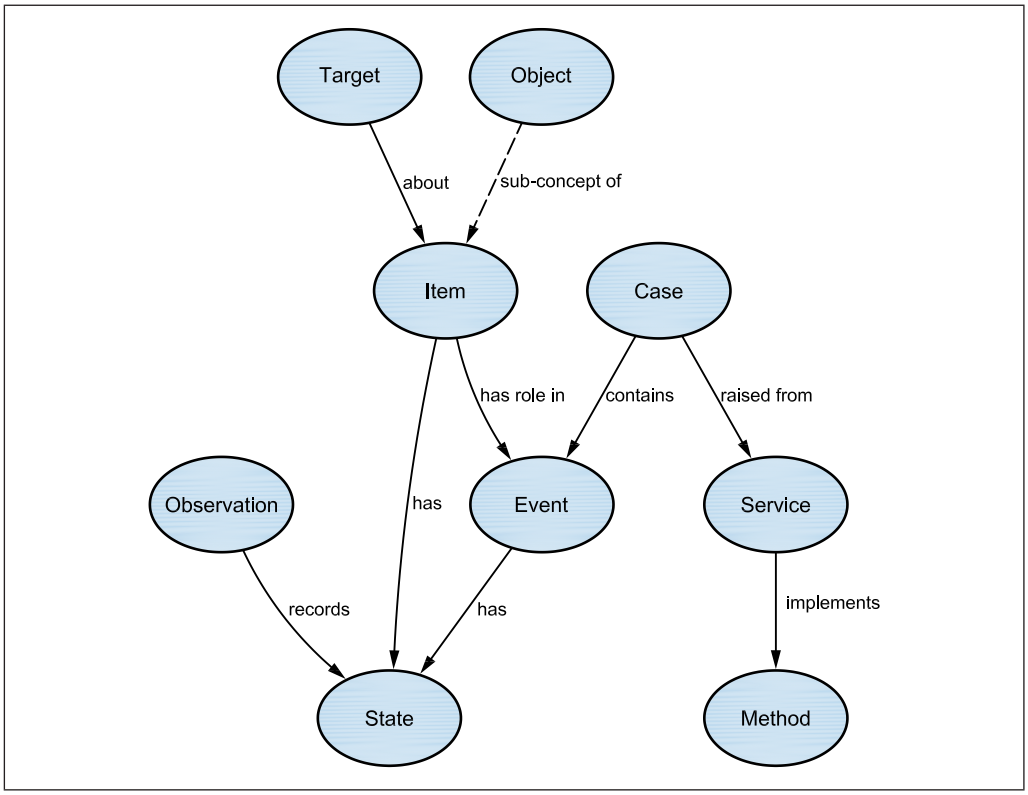
- COLLECTION: houses for rent under £400 per week;
- TARGET: 10 000 by 2016;
- OBJECTIVE: provide adequate affordable housing; and
- ASSUMPTION: 10 000 households will require affordable housing by 2016.

METRICs are regularly published that track the actual STATE of an ITEM, and can be used to consider if TARGETs have been achieved.

6.6 Observing and responding view

Figure 11 shows the observing and responding view.

Figure 11 **Observing and responding view**



A city might have a series of automated SERVICEs that respond in real-time to observed STATEs, to adjust settings to re-establish an optimum STATE.

For example, sensors and actuators can be used to:

- manage traffic flows;
- control temperatures; and
- reduce energy consumption.

The SCCM represents a sensor as an OBJECT, which can be related to a PLACE that describes where it is.

This view depicts three stages:

- determining OBJECTIVEs, and optimum STATEs of a system;
- readings being taken by a sensor; and
- a service responding to inputs by changing settings.

For the first stage, the system is represented as an ITEM, for which one or more TARGET STATEs can be defined.

For the second stage, a sensor takes a reading of the system, which is represented as an OBSERVATION capturing the STATE of an ITEM.

For the third stage, a further device or actuator might then be configured to automatically react to an observed STATE by changing settings.

The actuator is also an OBJECT, which has a role in an EVENT that changes a STATE. The change of settings is a SERVICE, implementing a METHOD, provided by an AGENT. A log of the OBSERVATIONs, and settings is recorded in a CASE.

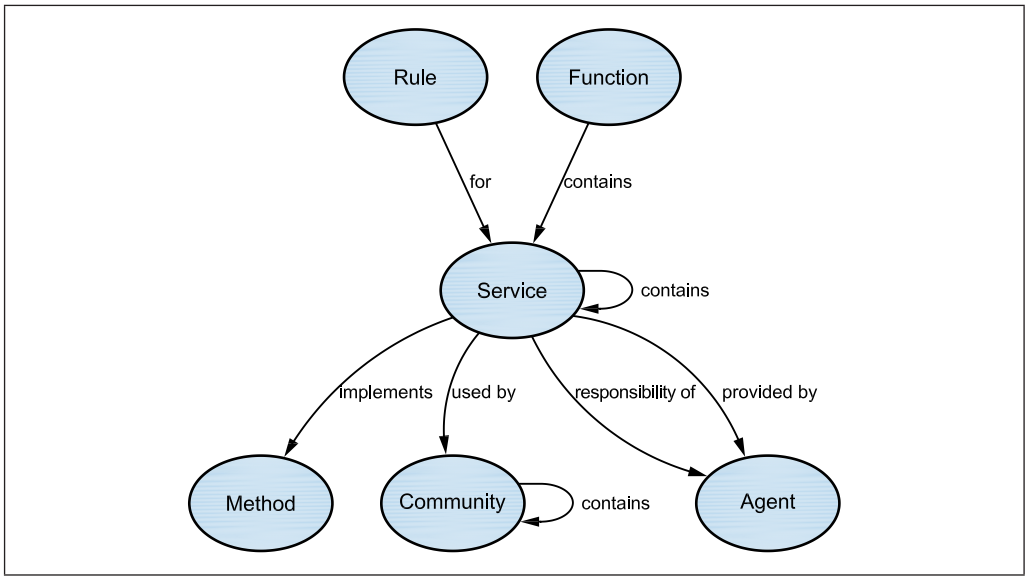
So for example:

- Stage 1: an optimum temperature (TARGET) of a room (OBJECT) can be set to reduce energy consumption (OBJECTIVE).
- Stage 2: a temperature sensor (OBJECT) takes a reading (OBSERVATION) of the temperature (STATE) of the room.
- Stage 3: a service (SERVICE) instructs (EVENT) the actuator (OBJECT) to change the valve setting (STATE) of a radiator (OBJECT). The impact of the change is then monitored via further OBSERVATIONs recorded within the CASE.

6.7 SERVICEs view

Figure 12 shows the SERVICEs view.

Figure 12 **SERVICEs view**



For a city, SERVICEs might include:

- energy provision;
- waste collection;
- licensing;
- car parking; and
- removing abandoned vehicles.

A SERVICE is the responsibility of an ORGANIZATION or an individual PERSON. The concepts of ORGANIZATION and PERSON are combined into the concept AGENT.

The AGENT providing a SERVICE is not necessarily the same as the AGENT responsible for it.

A SERVICE can be used by a COMMUNITY, which might be, for example:

- the residents of a city;
- the long-term unemployed;
- commuters; and
- families.

As both COMMUNITY and SERVICE are sub-concepts of ITEM, their STATEs can be recorded over time. For SERVICE, this enables actual and TARGET values to be recorded for throughput and performance, for example:

- the number of abandoned vehicles reported over a period; or
- the average time taken to remove a vehicle.

SERVICEs are often constrained by RULEs such as:

- legislation;
- eligibility; and
- terms and conditions.

A SERVICE implements one or more METHODs, which might be reused in other SERVICEs.

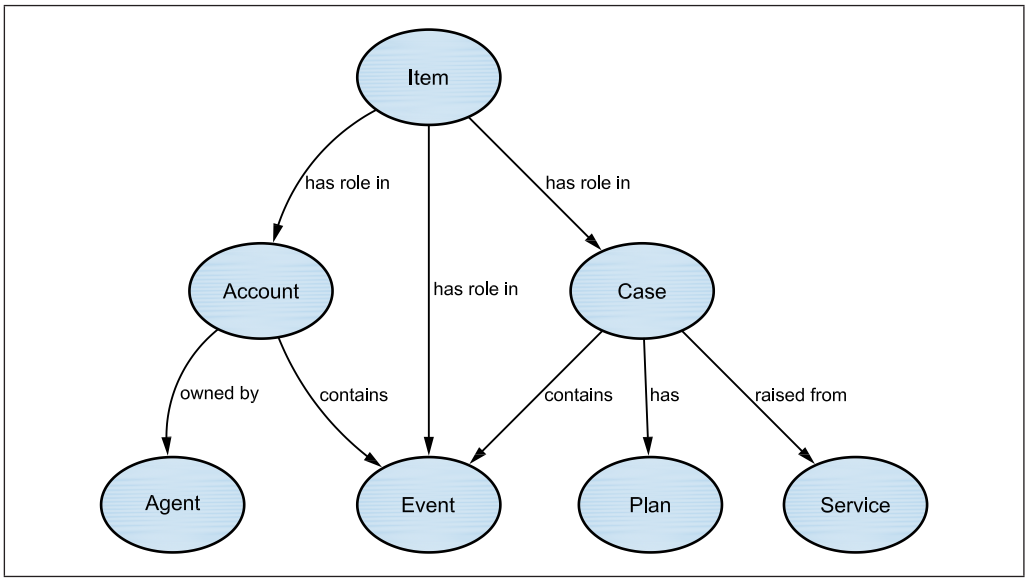
SERVICEs from many AGENTs can be grouped together into FUNCTIONs. FUNCTION is a sub-concept of COLLECTION.

A FUNCTION can list the SERVICEs that serve a particular COMMUNITY, for example, waste management (FUNCTION) might contain SERVICEs for refuse collection, recycling and waste disposal, and those SERVICEs might be provided by different ORGANIZATIONs in the city.

6.8 CASEs view

Figure 13 shows the CASEs view.

Figure 13 **CASEs view**



A CASE is raised when a SERVICE is used.

For a city, a CASE might be:

- a crime investigation;
- a planning application; or
- rectifying a fault on a network.

A CASE contains the EVENTs that are relevant to an individual use of a SERVICE, until the CASE is closed.

For some CASEs, a PLAN might be devised giving estimated times and RESOURCEs for future EVENTs.

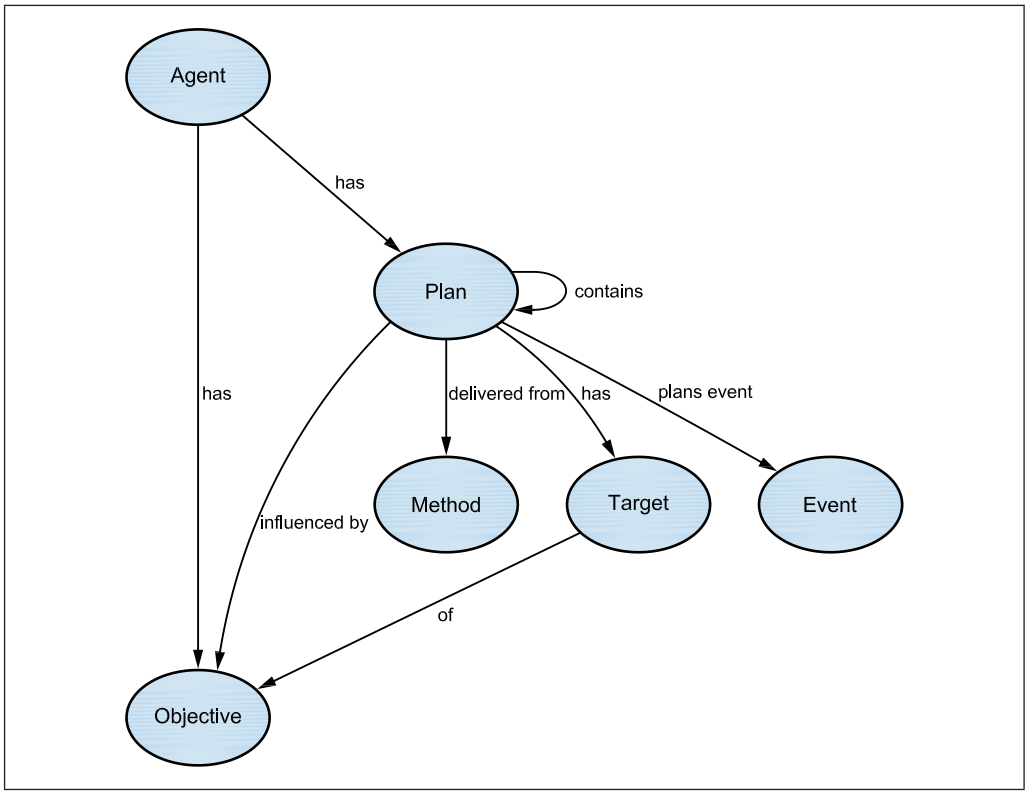
An AGENT might maintain a series of ACCOUNTs that contain a history of EVENTs which apply to one or more ITEMs, for example:

- a medical history;
- a customer history;
- a criminal record; or
- a building maintenance record.

6.9 PLANs view

Figure 14 shows the PLANs view.

Figure 14 **PLANs view**



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.

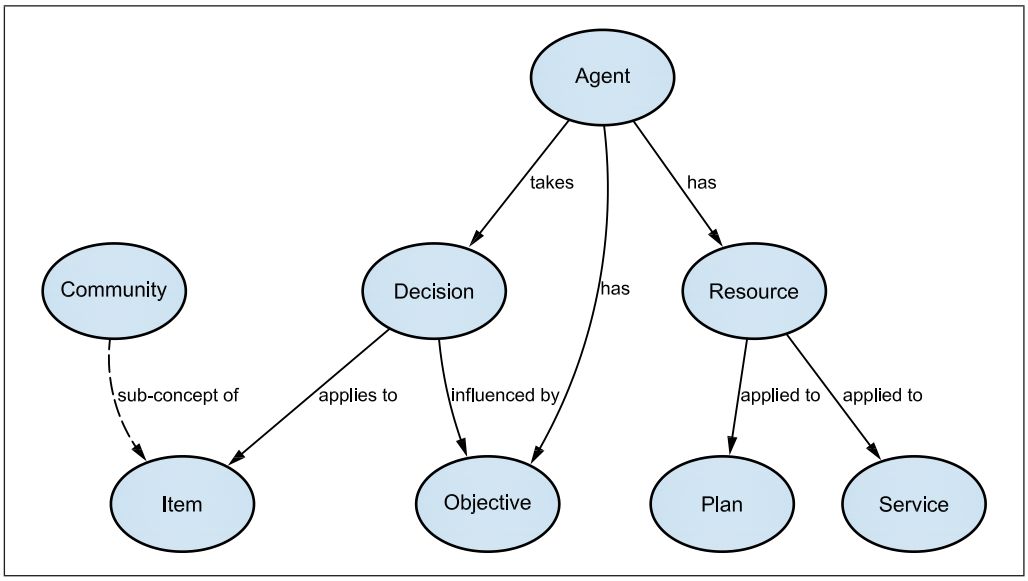
As a PLAN is enacted, EVENTs occur that record the actual outcomes as compared to those planned.

A city might wish to discover and track the PLANs from many AGENTs that apply to OBJECTIVEs for ITEMs or PLACEs.

6.10 RESOURCEs and DECISIONs view

Figure 15 shows the RESOURCEs and DECISIONs view.

Figure 15 **RESOURCEs and DECISIONs view**



A RESOURCE is an ITEM that can be put to use, for a benefit.

A RESOURCE can be allocated to a SERVICE or a PLAN.

AGENTs take DECISIONs about ITEMs, which are influenced by OBJECTIVEs. A DECISION can be made about the application of a RESOURCE.

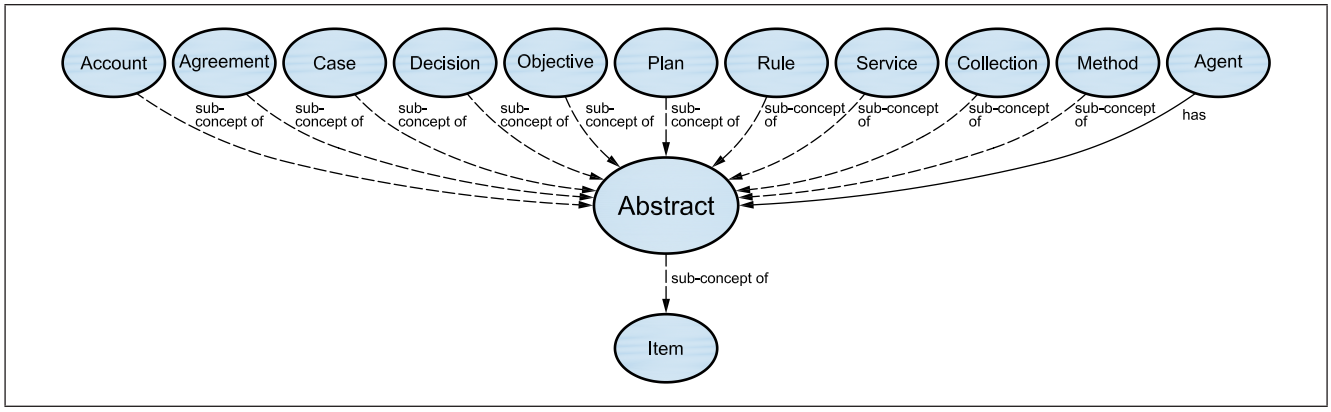
A city might engage stakeholders about DECISIONs, and particularly about how RESOURCEs are allocated over SERVICEs and PLANs to achieve OBJECTIVEs.

7 Definition of each concept and relationship in the SCCM

7.1 ABSTRACT

Definition	Existing in thought or as an idea but not having a physical existence.
Examples	• Fear of crime • Knowledge
Relationships	See Figure 16

Figure 16 **ABSTRACT relationships**



Sub-concept of

ITEM

Sub-concepts

ACCOUNT

AGREEMENT

CASE

COLLECTION

DECISION

METHOD

OBJECTIVE

PLAN

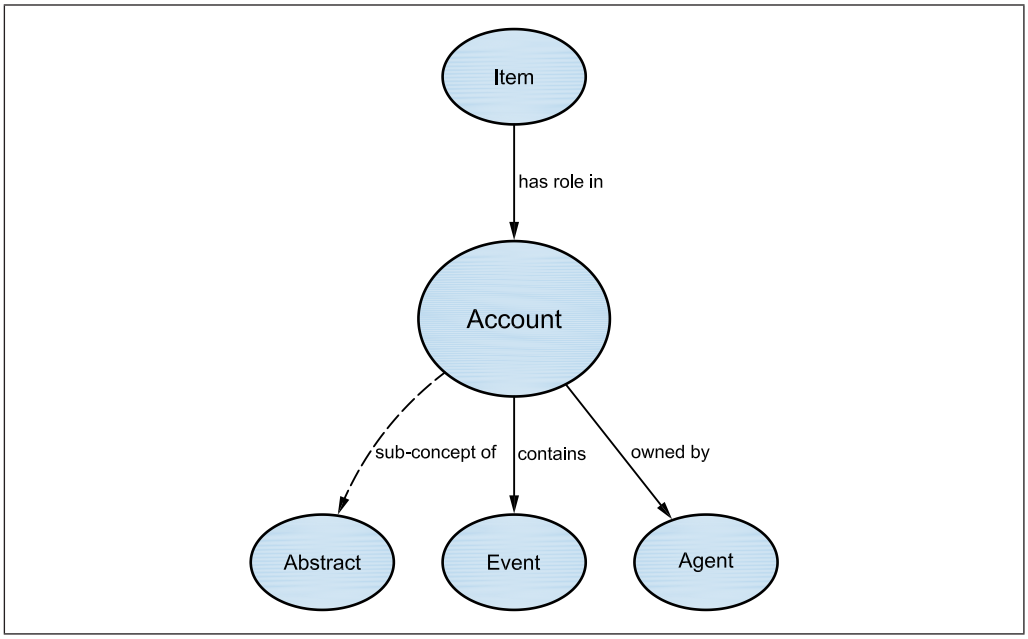
RULE

SERVICE

7.2 ACCOUNT

Definition	A container of information, held by an AGENT, in which to record data arising from EVENTs that relate to an ITEM in a role.
Notes	One of the *Oxford English Dictionary*'s definitions of ACCOUNT is "a report or description of an event or experience" [1]. An ACCOUNT then is a set of information that relates to one or more EVENTs. Those EVENTs have an ITEM in common in a role and thus the ACCOUNT becomes a history of information about that role.
Examples	• A customer account at a business • The history of a building • Regular welfare payments to a claimant • A medical history of a patient • Transactions that have been posted to a budget
Relationships	See Figure 17

Figure 17 **ACCOUNT relationships**



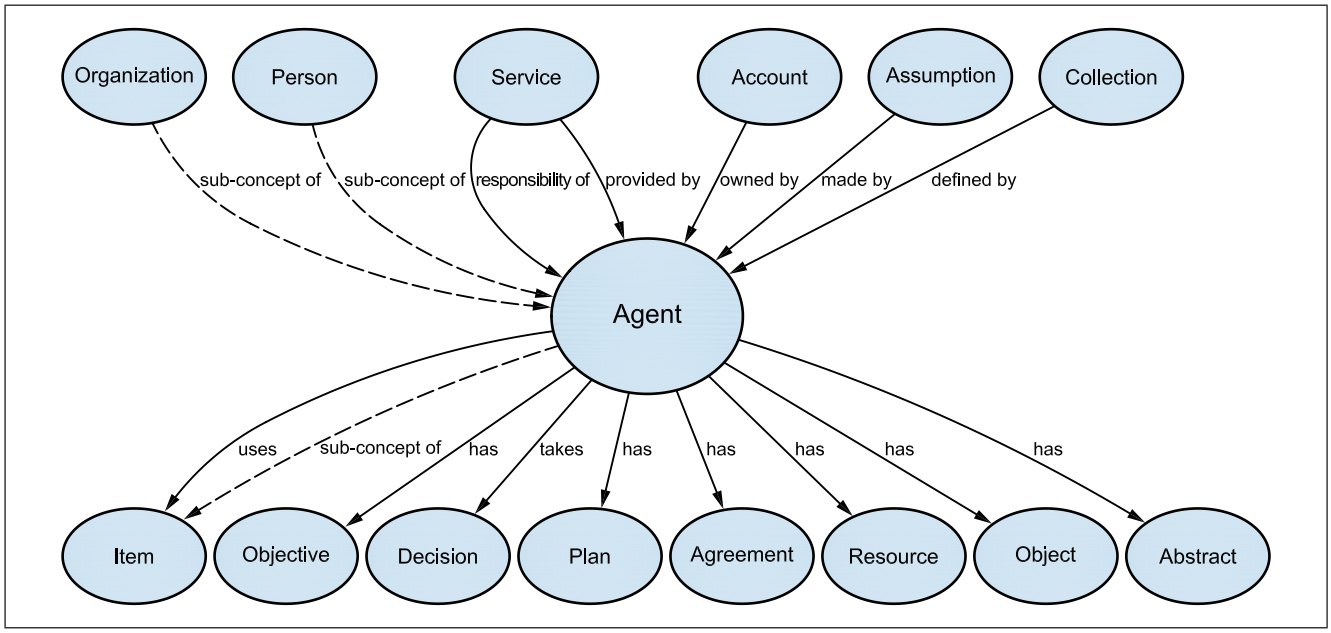
Sub-concept of

ABSTRACT

7.3 AGENT

Definition	An ITEM, but most often a PERSON, or ORGANIZATION, providing a SERVICE or taking a role in an EVENT.
Notes	One of the *Oxford English Dictionary*'s definitions of AGENT is "a person or thing that takes an active role or produces a specified effect" [1]. An AGENT is used to make relationships where the type of ITEM could be either a PERSON or an ORGANIZATION.
Examples	Supplier
Relationships	See Figure 18

Figure 18 **AGENT relationships**



Sub-concept of

ITEM

Sub-concepts

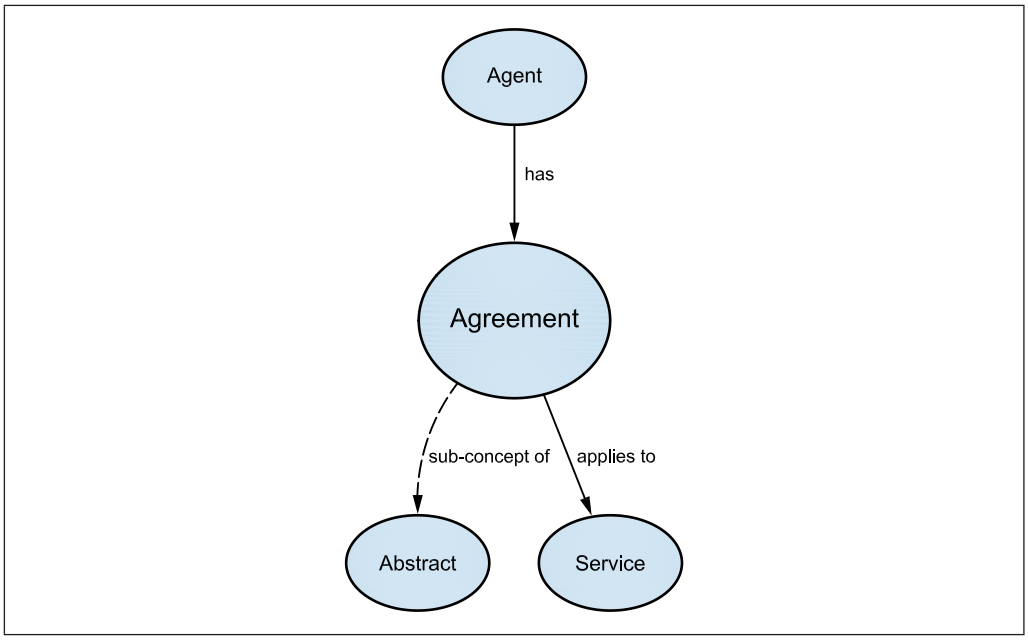
ORGANIZATION

PERSON

7.4 AGREEMENT

Definition	A negotiated arrangement between AGENTs as to a course of action.
Examples	• Contract • Memorandum of understanding • Code of connection
Relationships	See Figure 19

Figure 19 **AGREEMENT relationships**



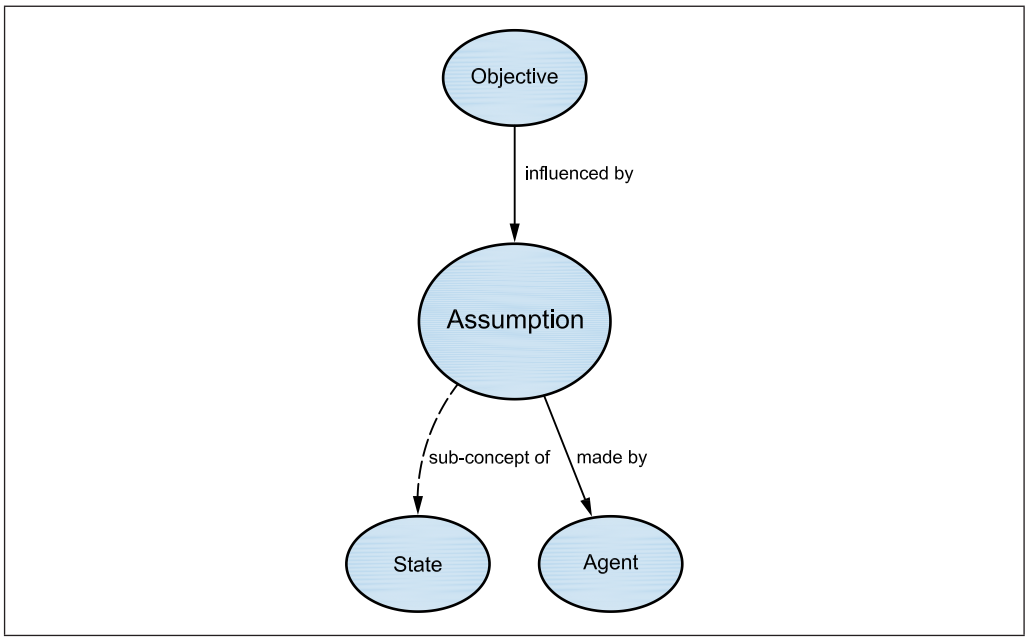
Sub-concept of

ABSTRACT

7.5 ASSUMPTION

Definition	A predicted or presumed STATE.
Notes	ASSUMPTIONs can support DECISIONs. Sharing ASSUMPTIONs across a city can enable ORGANIZATIONs and citizens to challenge or adopt them, in moving towards shared DECISION making.
Examples	• Prediction • Forecast • Extrapolation • Expectation • Estimate
Relationships	See Figure 20

Figure 20 **ASSUMPTION relationships**



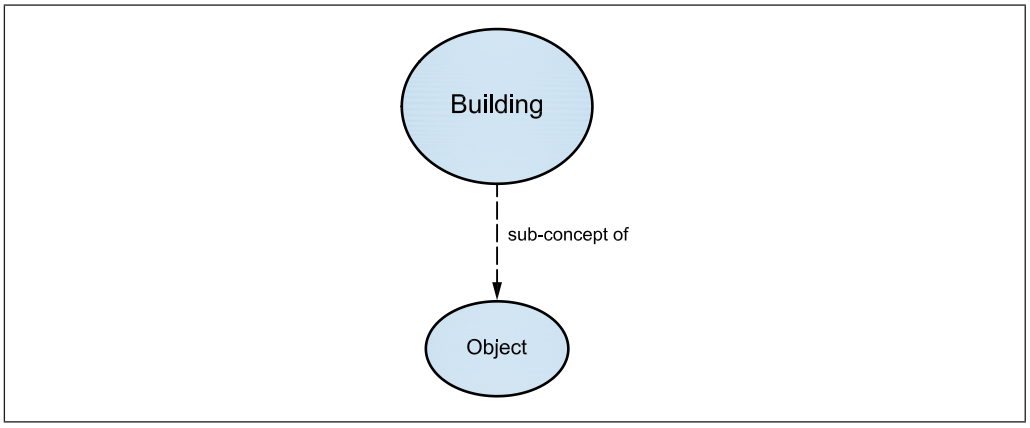
Sub-concept of

STATE

7.6 BUILDING

Definition	A man-made structure, with a fixed or temporary PLACE, intended for sheltering PERSONs or other OBJECTs.
Examples	• A house • A factory • A station • An office
Relationships	See Figure 21

Figure 21 **BUILDING relationships**



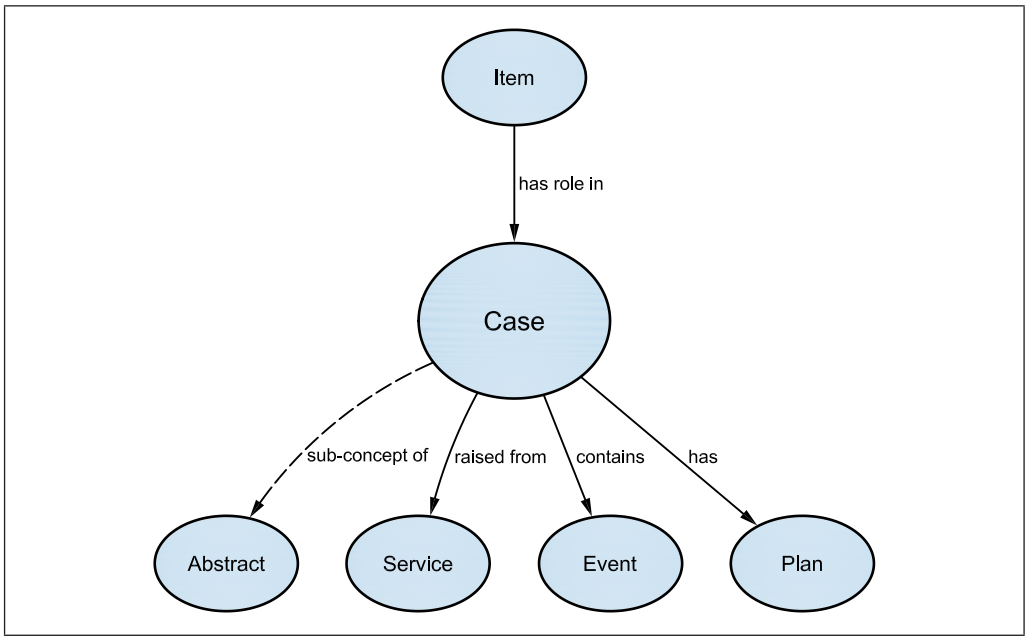
Sub-concept of

OBJECT

7.7 CASE

Definition	A container for information recording the history of EVENTS initiated by a SERVICE demand.
Notes	When a SERVICE is used, it typically raises a CASE where information is contained through to the resolution of the CASE.
Examples	• A planning application • An incident of fraud
Relationships	See Figure 22

Figure 22 **CASE relationships**



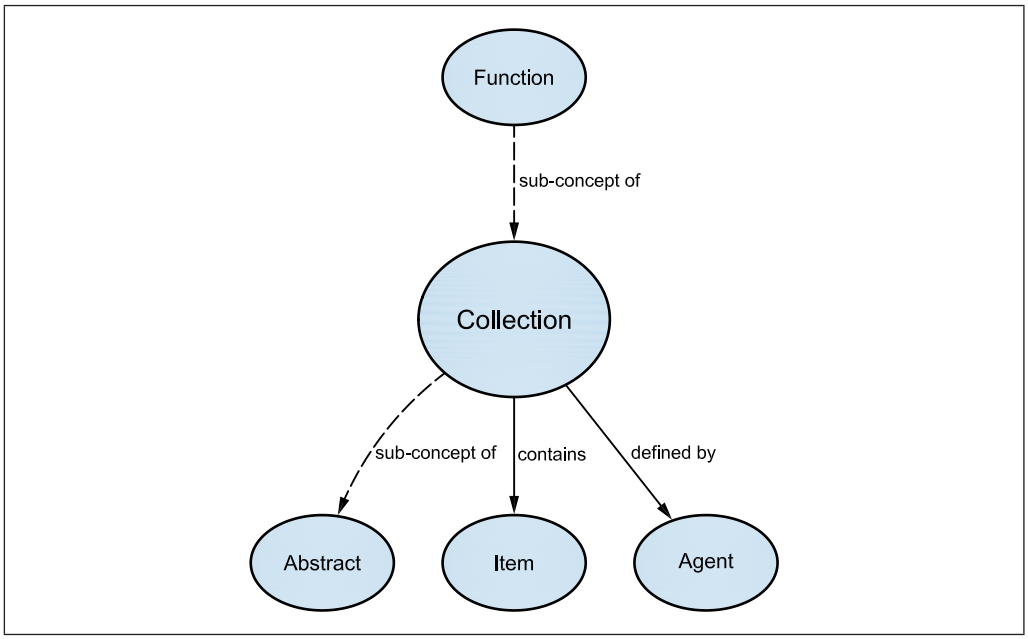
Sub-concept of

ABSTRACT

7.8 COLLECTION

Definition	A grouping of ITEMs, as defined by an AGENT, that need to be managed, or operated upon, together.
Notes	A COLLECTION is defined by an AGENT. The contents of a COLLECTION might be explicitly itemized (e.g. a jewellery collection) or be defined by a scoping statement (e.g. the properties available for rent).
Examples	• Stock • Lamp posts
Relationships	See Figure 23

Figure 23 **COLLECTION relationships**



Sub-concept of

ABSTRACT

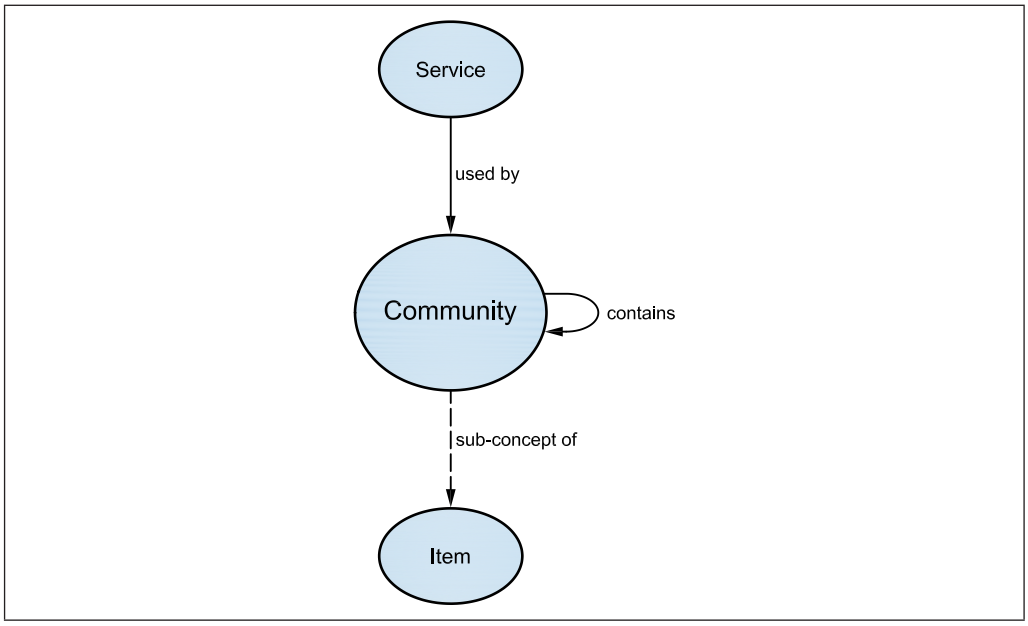
Sub-concept

FUNCTION

7.9 COMMUNITY

Definition	A group of PERSONs and/or ORGANIZATIONs that share common characteristics such as PLACE, circumstance, etc.
Notes	A COMMUNITY is defined by an AGENT, in terms of the common characteristics of the PERSONs and/or ORGANIZATIONs that are contained in it. The STATE of a COMMUNITY can be tracked without having to know the identity of each PERSON and ORGANIZATION. A COMMUNITY might be composed of more than one COMMUNITY. For example: • the business sector might be composed of the industrial sector, the tourism sector, the financial services sector, etc.; or • the youth of a town are contained in the residents of a town. The actual PERSONs or ORGANIZATIONs might change without changing the identity of a COMMUNITY, for example the long-term unemployed in a city remains the same COMMUNITY even though some people have left it, and others have joined it. Members of a COMMUNITY do not need to be aware of each other, and are not acting with a collective goal. If they are, then they are an ORGANIZATION. For example, the long-term unemployed is a COMMUNITY, whereas the jobseekers' club is an ORGANIZATION.
Examples	• Residents of a city or town • Commuters • Carers • The long-term unemployed • Low income families • The tourism industry • The retail sector
Relationships	See Figure 24

Figure 24 **COMMUNITY relationships**



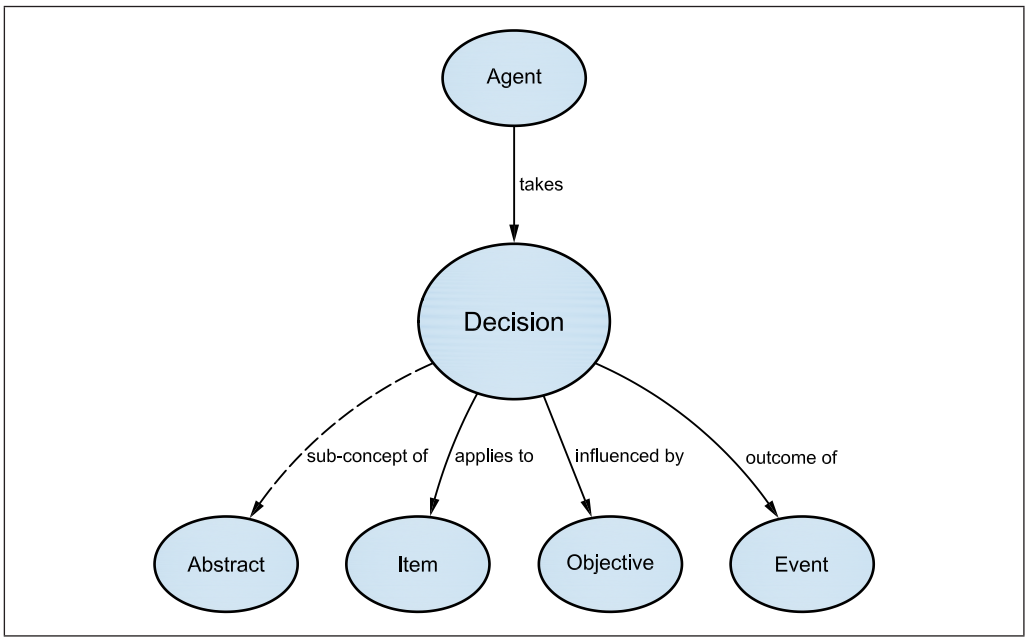
Sub-concept of

ITEM

7.10 DECISION

Definition	A conclusion or resolution reached after consideration [1].
Notes	A DECISION is the outcome of an EVENT, and not the EVENT itself. A DECISION, taken by an AGENT, has an effect on a number of ITEMs, and is influenced by OBJECTIVEs.
Examples	• To provide RESOURCEs • To agree a PLAN
Relationships	See Figure 25

Figure 25 **DECISION relationships**



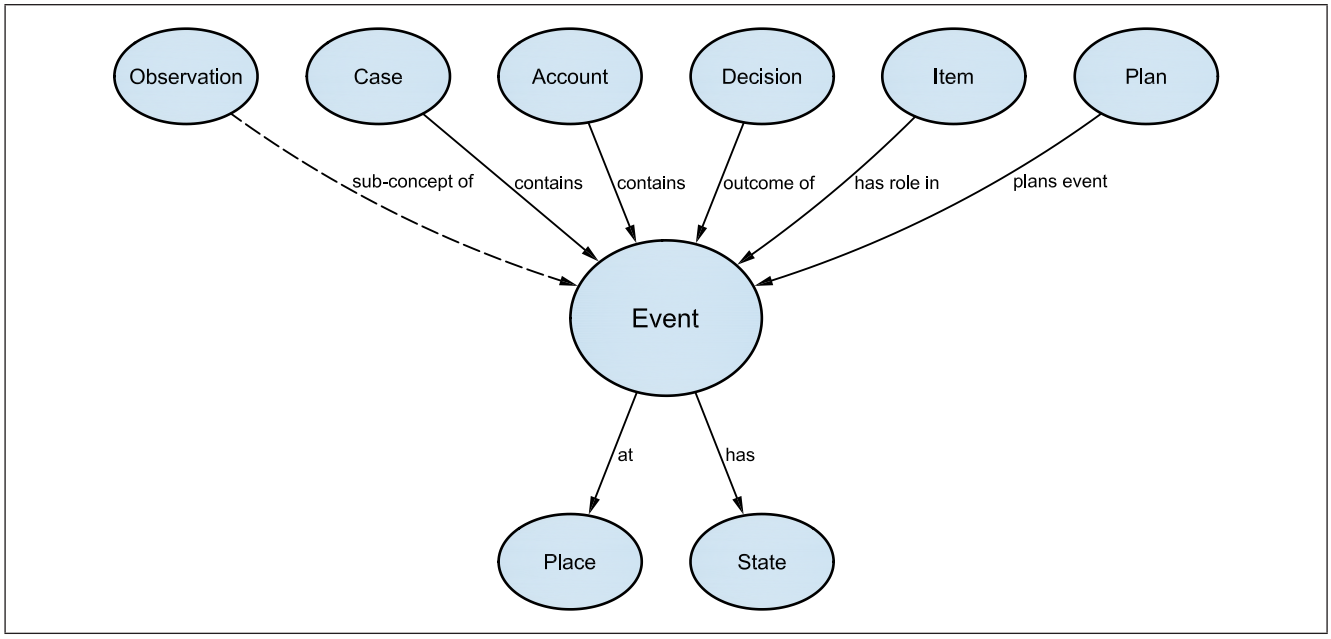
Sub-concept of

ABSTRACT

7.11 EVENT

Definition	An occurrence that has happened or might happen.
Notes	An EVENT might occur over a short period of time (e.g. a lightning flash), or a long period of time (e.g. formation of the continents). An EVENT can refer to a number of ITEMs that take roles in the EVENT, for example, a PERSON may take the role of applicant, in one EVENT, and the same person may take the role of patient, in another EVENT. All types of ITEMs can take roles in an EVENT, for example: • a candlestick as an OBJECT could be the murder weapon in a crime EVENT; or • a tender as an ABSTRACT could be the subject of a contract-signing EVENT.
Examples	• An accident • A birth • An application for a service
Relationships	See Figure 26

Figure 26 **EVENT relationships**



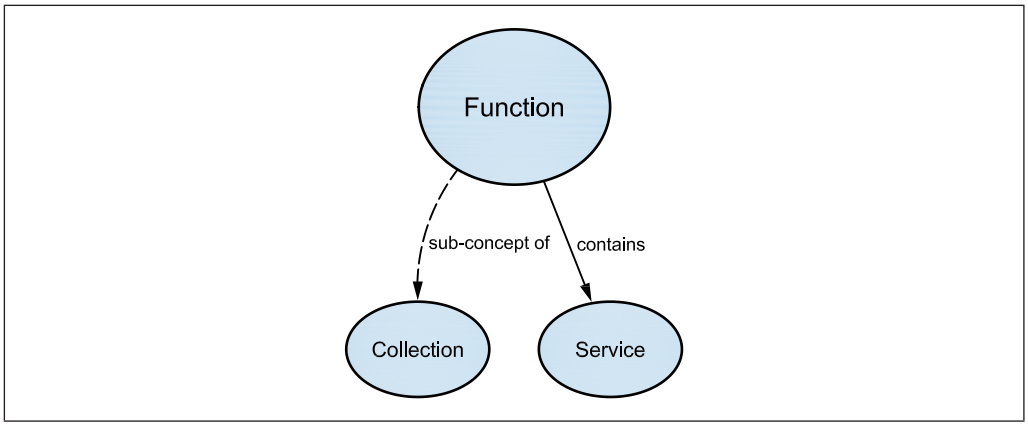
Sub-concept

OBSERVATION

7.12 FUNCTION

Definition	A COLLECTION of SERVICEs.
Notes	A FUNCTION might be made up of SERVICEs from many ORGANIZATIONs. A SERVICE might appear in many FUNCTIONs. A FUNCTION might be defined to: • bring together the SERVICES that are relevant to a COMMUNITY, and/or a PLACE; or • combine SERVICES for accounting purposes.
Examples	• Education • Waste management • Translation services The United Nations provides a category list of the functions of government at: http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=4 [2]. The esd-toolkit programme provides a list of functions at: http://id.esd.org.uk/list/functions [3].
Relationships	See Figure 27

Figure 27 **FUNCTION relationships**



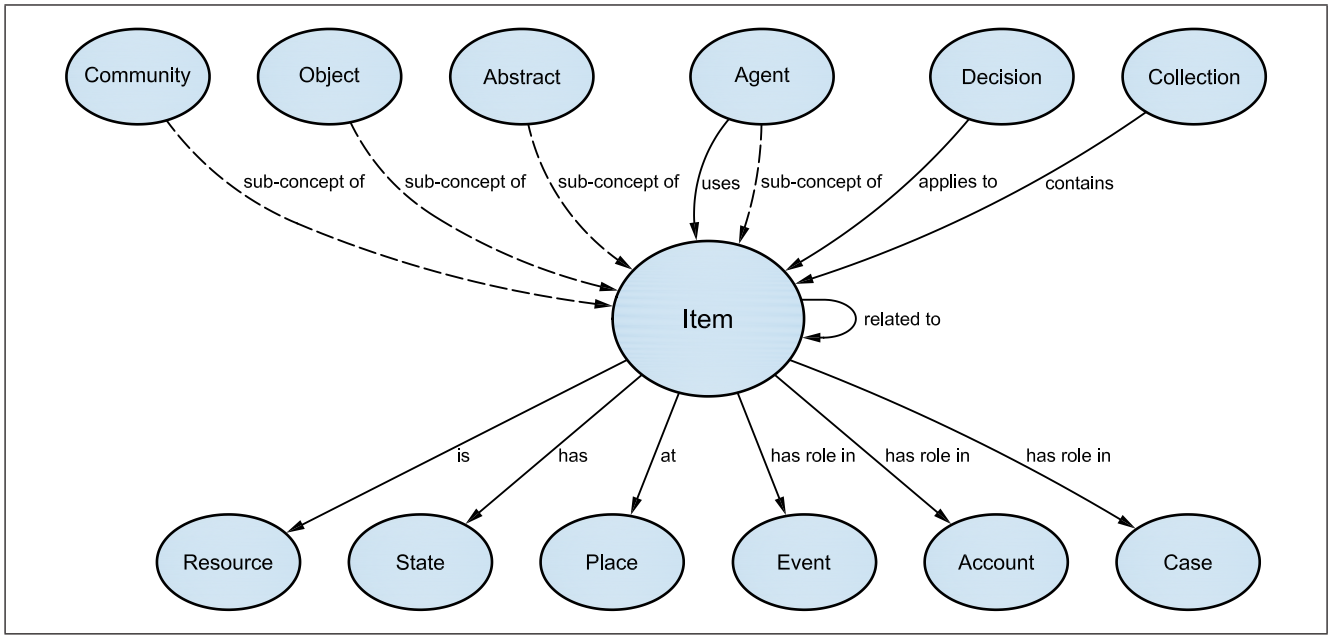
Sub-concept of

COLLECTION

7.13 ITEM

Definition	An individual article or unit, especially one that is part of a list, collection, or set [1].
Notes	Most ITEMs, except those that are ABSTRACT, can be associated with a PLACE. An ITEM has a STATE (conditions or circumstances), which can change over time. Usually, data refers directly to a sub-concept of ITEM: • OBJECT; • PERSON; • ORGANIZATION; • COMMUNITY; and • ABSTRACT.
Examples	See sub-concepts for examples.
Relationships	See Figure 28

Figure 28 **ITEM relationships**



Sub-concepts

ABSTRACT

AGENT

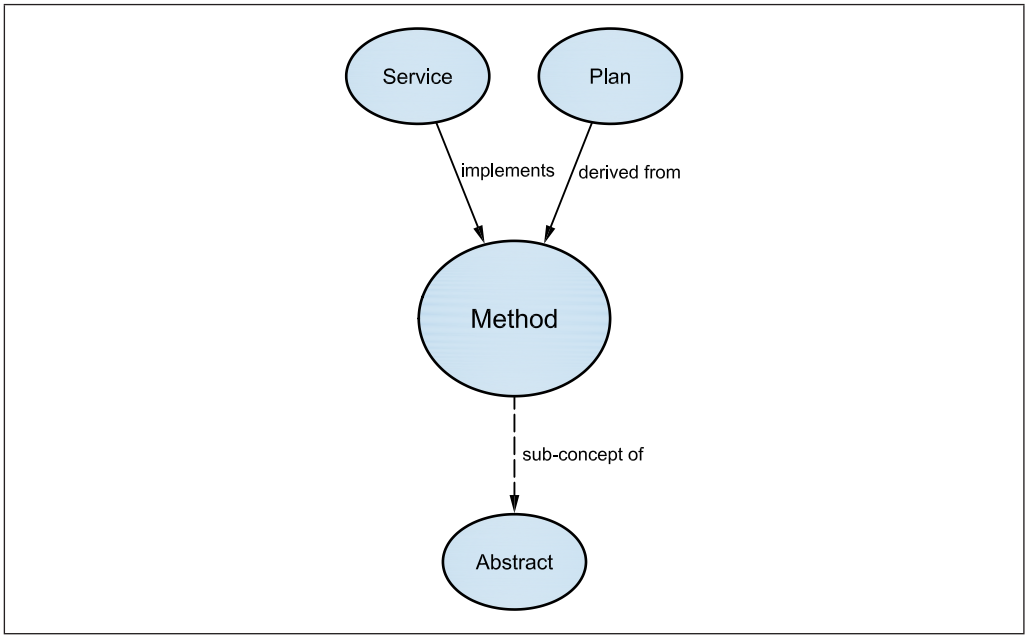
COMMUNITY

OBJECT

7.14 METHOD

Definition	A predetermined procedure, or series of steps, designed to accomplish an OBJECTIVE.
Notes	A number of METHODs might be associated with a SERVICE as options for achieving an OBJECTIVE.
Examples	• Payment method • Customer contact method • Debt recovery method • Medical procedure • MOT procedure
Relationships	See Figure 29

Figure 29 **METHOD relationships**



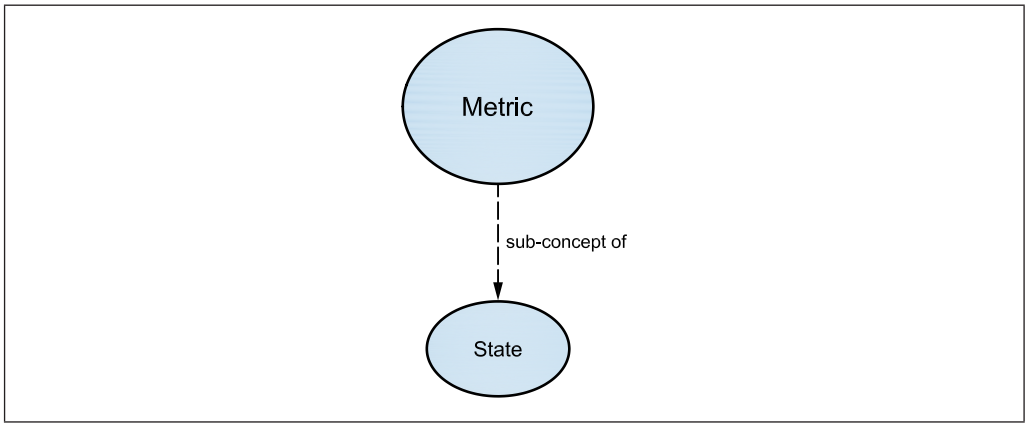
Sub-concept of

ABSTRACT

7.15 METRIC

Definition	A measure of demography, characteristics, activity or performance.
Notes	METRICs are often collected as statistics that describe the STATE of a SERVICE, COMMUNITY, or PLACE.
Examples	• Performance indicator • Deprivation index • Traffic count
Relationships	See Figure 30

Figure 30 **METRIC relationships**



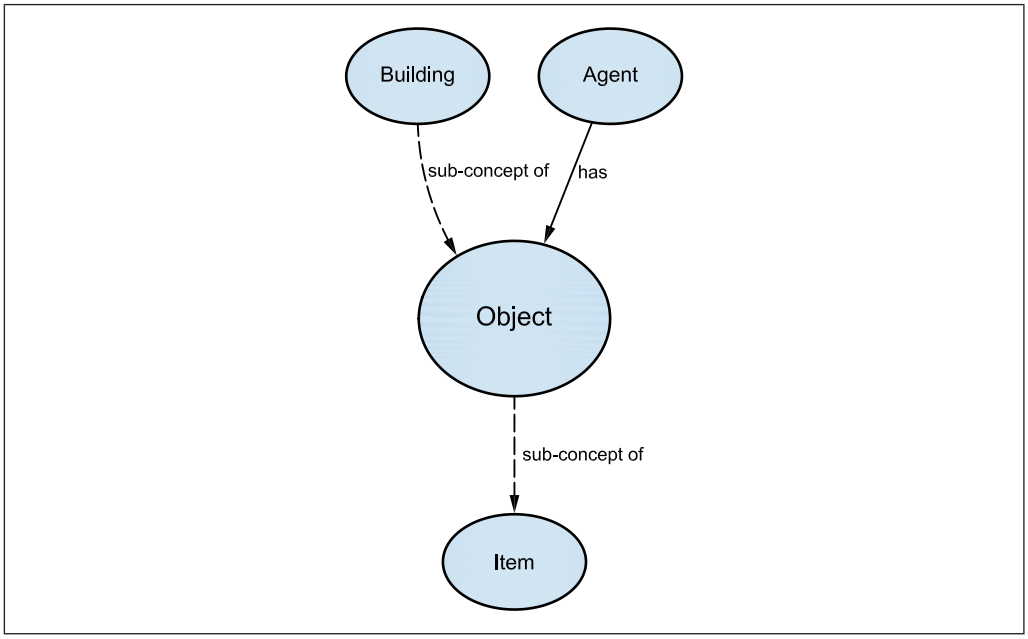
Sub-concept of

STATE

7.16 OBJECT

Definition	A physical ITEM
Notes	In a city there will be physical OBJECTs that make up the technical infrastructure.
Examples	• Building • Road • Car • Lamp post • Pipe • Cable • Duct
Relationships	See Figure 31

Figure 31 **OBJECT relationships**



Sub-concept of

ITEM

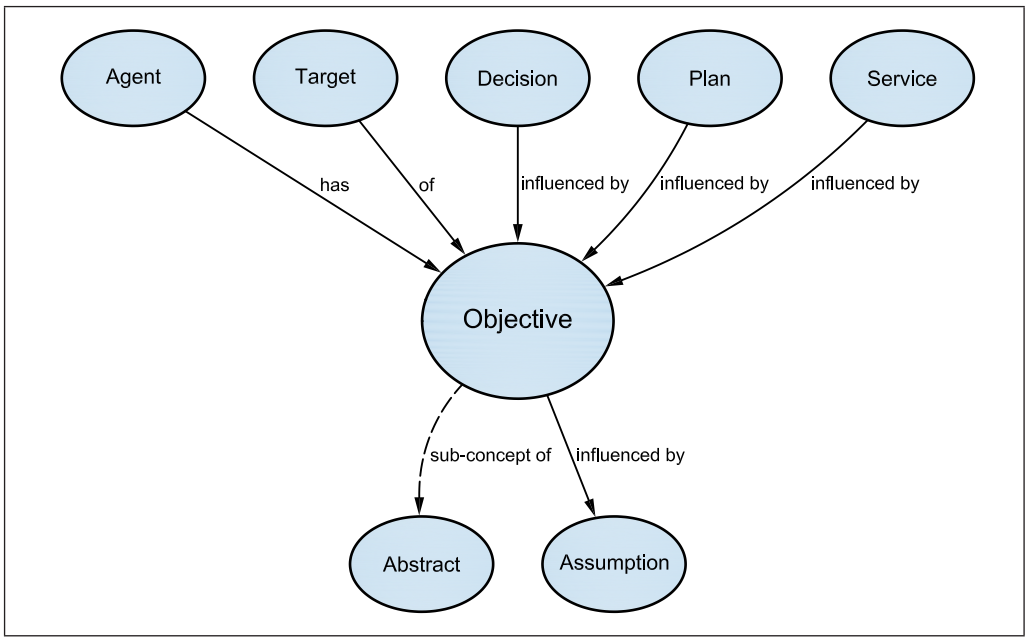
Sub-concept

BUILDING

7.17 OBJECTIVE

Definition	An achievement desired by an AGENT.
Notes	An OBJECTIVE refers to a desired change of condition or circumstances of something (an ITEM). Where the change can be quantified, the OBJECTIVE might be linked to one or more TARGETs. Where OBJECTIVEs are set for a COMMUNITY, the desire might be to change the size of the community, or the well-being of the PERSONs or ORGANIZATIONs in it.
Examples	• Create new jobs in the energy sector • Reduce carbon emissions in a city by 25% within five years
Relationships	See Figure 32

Figure 32 **OBJECTIVE relationships**



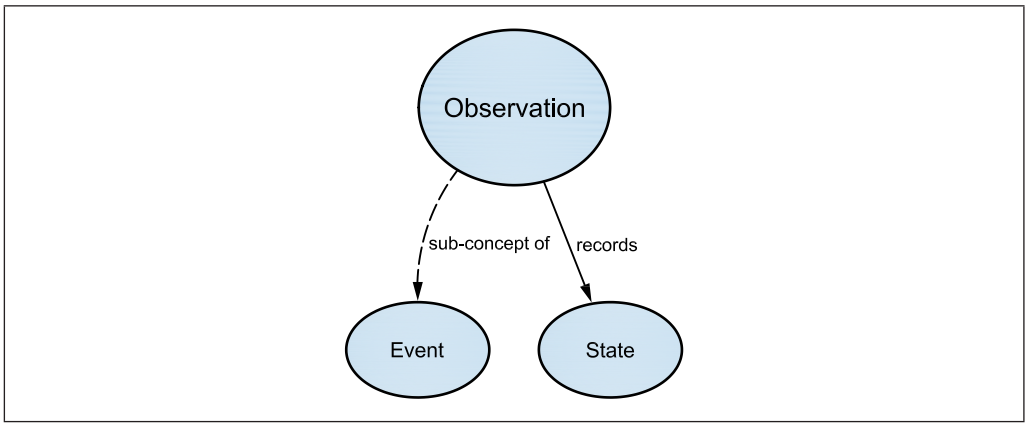
Sub-concept of

ABSTRACT

7.18 OBSERVATION

Definition	An EVENT in which a STATE is recorded.
Notes	The Open Geospatial Consortium [4] defines an observation as "an act at a discrete instant or period, through which a number or term is assigned to a phenomenon using a procedure, such as a sensor, instrument, or algorithm".
Examples	• Sensor reading • Medical assessment
Relationships	See Figure 33

Figure 33 **OBSERVATION relationships**



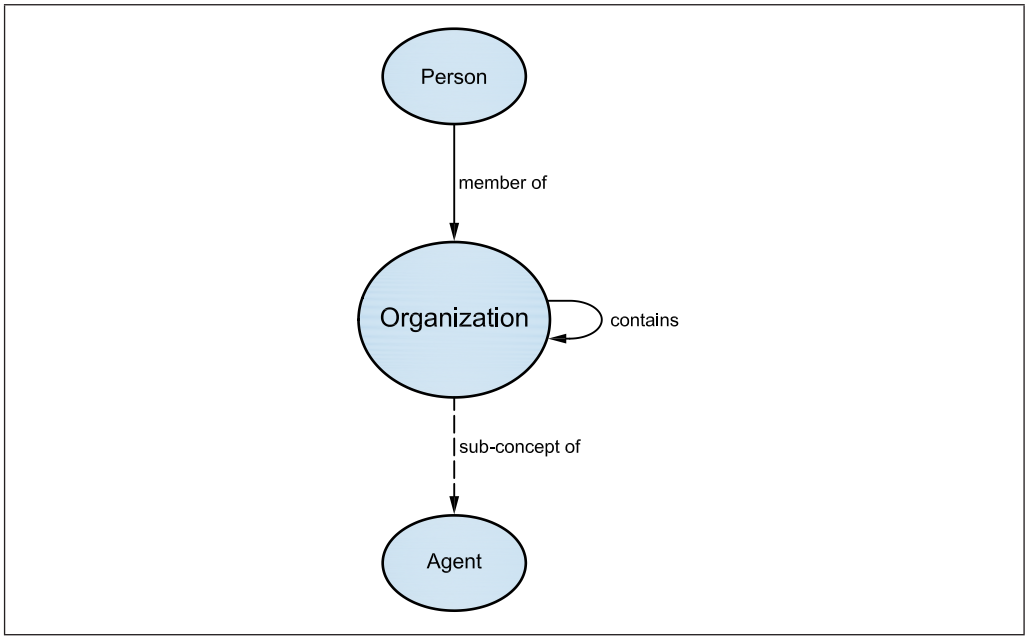
Sub-concept of

EVENT

7.19 ORGANIZATION

Definition	A group of PERSONs with a collective goal.
Examples	• A business • A public sector body • A charity • A household
Relationships	See Figure 34

Figure 34 **ORGANIZATION relationships**



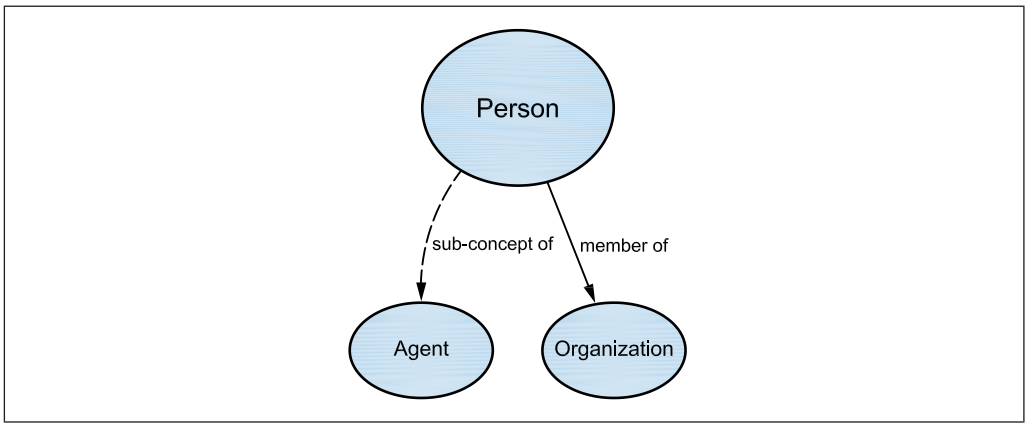
Sub-concept of

AGENT

7.20 PERSON

Definition	An individual human being [1].
Relationships	See Figure 35

Figure 35 **PERSON relationships**



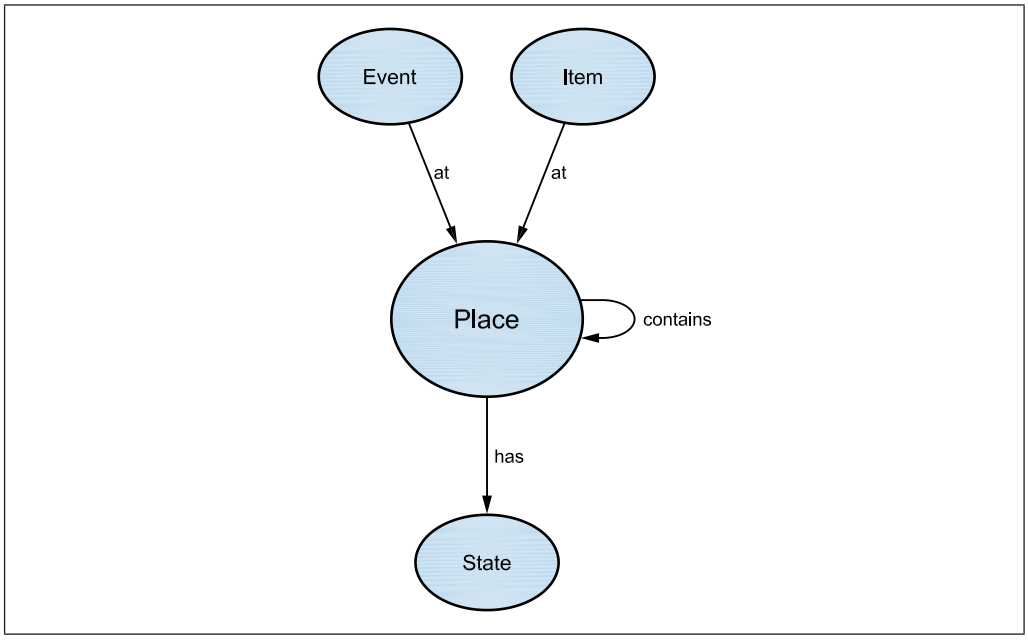
Sub-concept of

AGENT

7.21 PLACE

Definition	A geographic or virtual part of space.
Notes	A PLACE might have definite or indefinite boundaries. Geographic spaces can be a position, line, area, or volume.
Examples	Examples of geographic places may be: • a point defined by coordinates, e.g. the location of an incident; • a line, e.g. the route of a road or a pipe; • an area defined by a set of coordinates, e.g. a school catchment area; • a place referred to only by a name without attempting to define the area exactly, e.g. a town. Virtual places might include: • a forum.
Relationships	See Figure 36

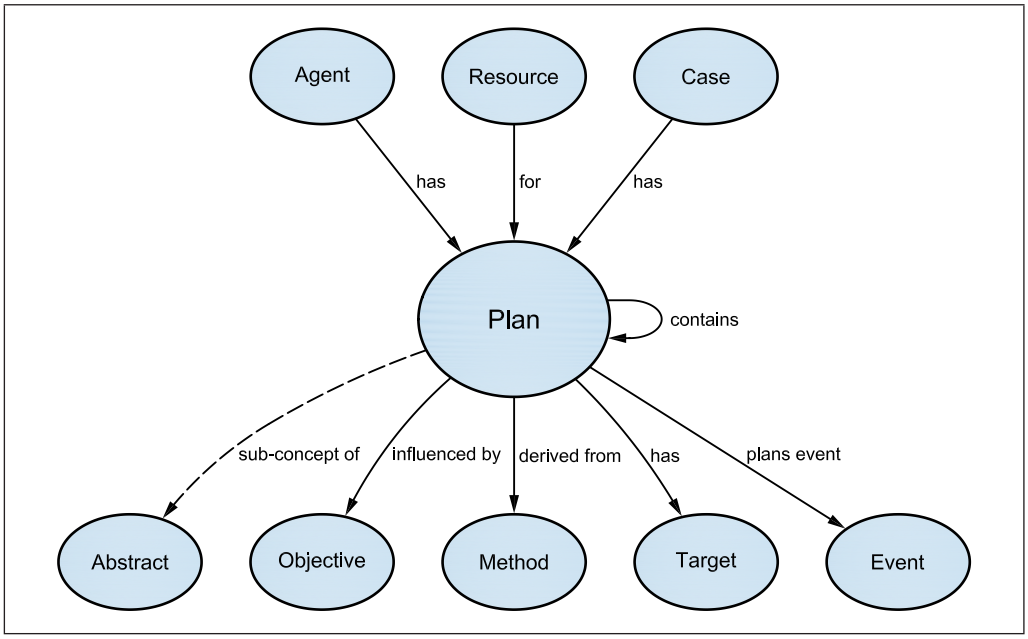
Figure 36 **PLACE relationships**



7.22 PLAN

Definition	A list of steps with times and RESOURCEs, used to achieve an OBJECTIVE.
Examples	• Corporate plan • Community plan • Marketing plan • Project plan • Strategy
Relationships	See Figure 37

Figure 37 **PLAN relationships**



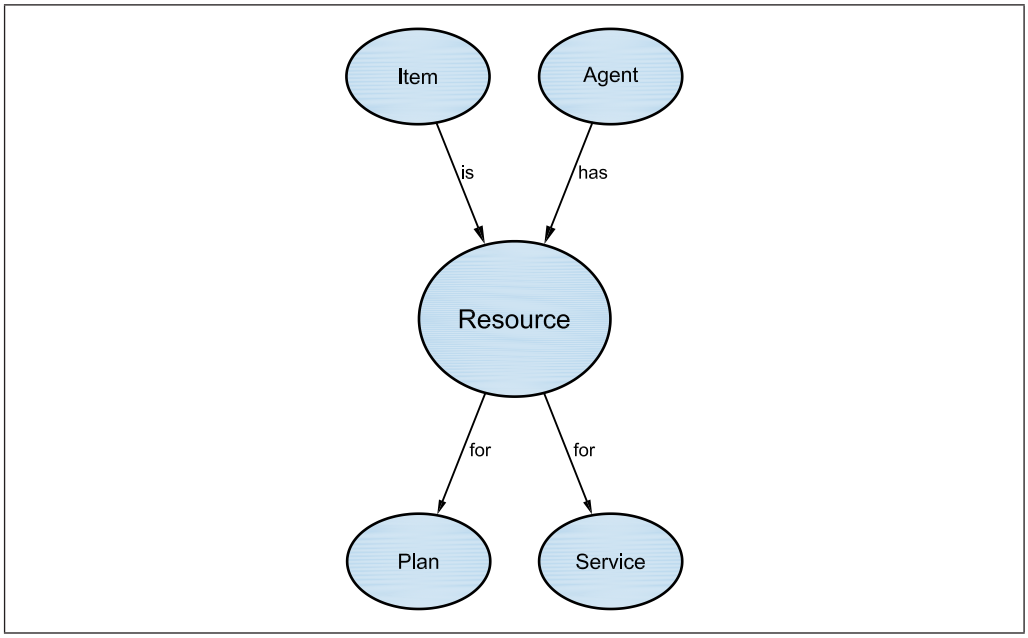
Sub-concept of

ABSTRACT

7.23 RESOURCE

Definition	An ITEM that can be drawn on by an AGENT to produce a benefit.
Notes	A RESOURCE is available to an AGENT to allocate to SERVICEs and PLANs to achieve OBJECTIVEs.
Examples	• Materials • Money • Staff • Assets
Relationships	See Figure 38

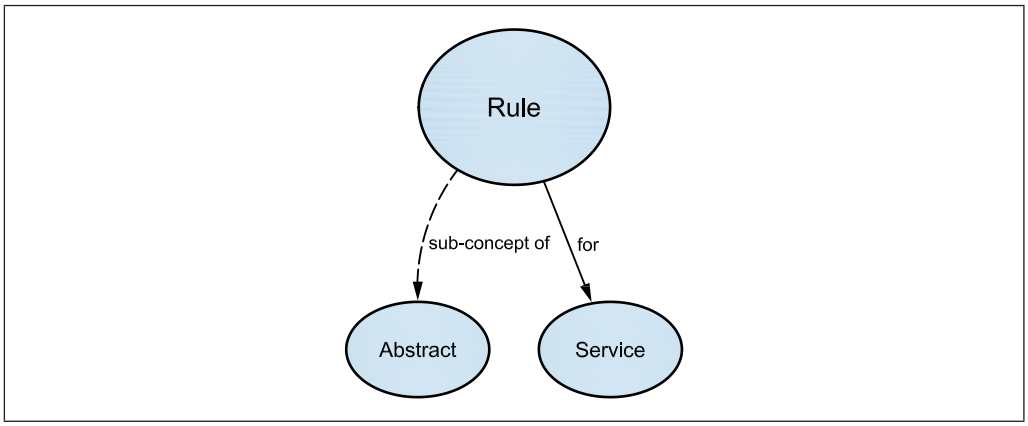
Figure 38 **RESOURCE relationships**



7.24 RULE

Definition	An explicit or understood regulation or principle governing conduct or procedure within a particular area of activity.
Notes	A RULE can constrain the design of a SERVICE.
Examples	• Legislation • Eligibility • Principle • Policy
Relationships	See Figure 39

Figure 39 **RULE relationships**



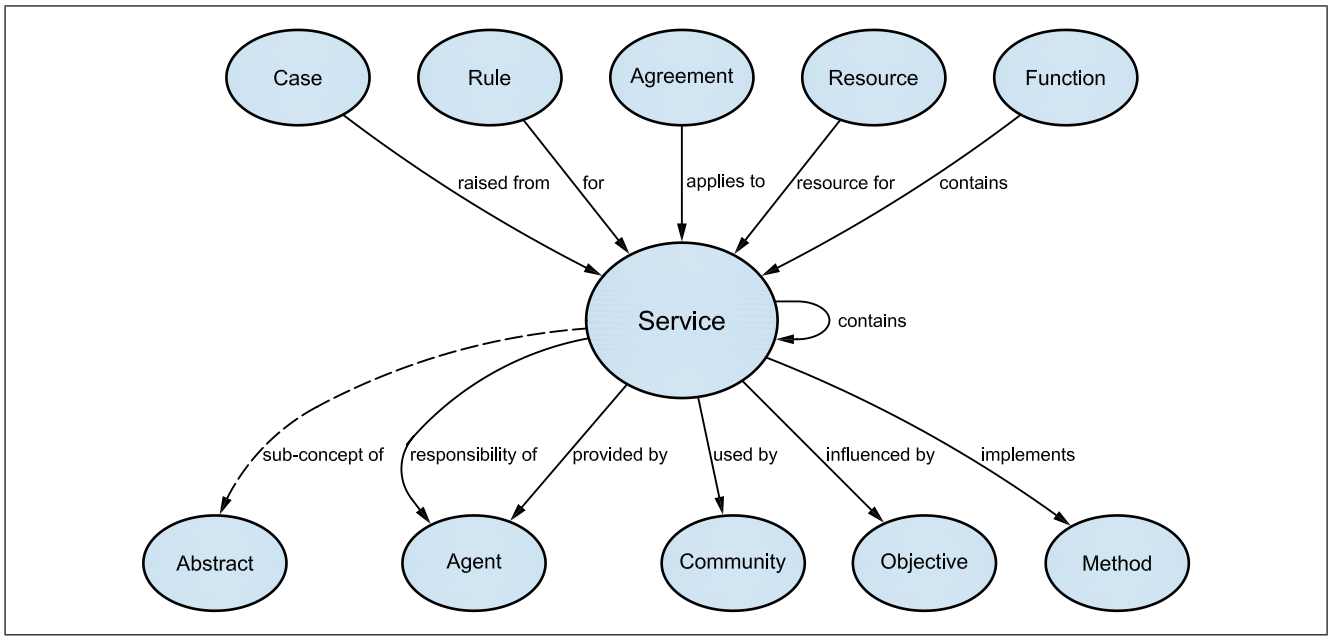
Sub-concept of

ABSTRACT

7.25 SERVICE

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
Relationships	See Figure 40

Figure 40 **SERVICE relationships**



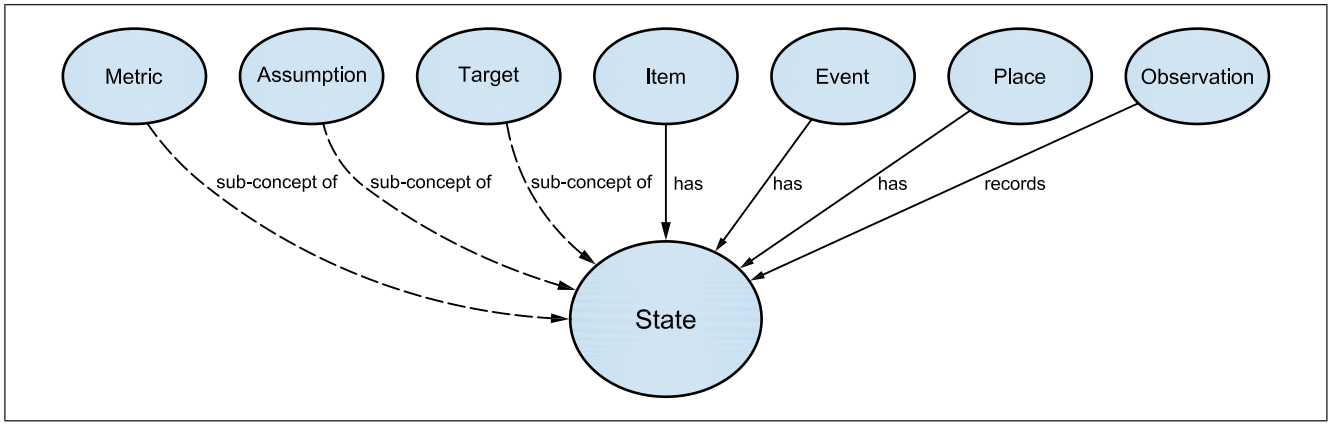
Sub-concept of

ABSTRACT

7.26 STATE

Definition	A circumstance or condition of an ITEM at a time.
Notes	The description and values of ITEMs change over time, but most of these are not tracked as a STATE. The decision as to when to track changes in the condition or circumstance of an ITEM will be where a city wishes to bring about a change of that STATE. Changes to STATE are often the outcome of EVENTs. An OBJECTIVE can be described in terms of a desired change of STATE. A STATE can be actual or potential, and can include risks and issues.
Examples	• Income • Housing • Repair
Relationships	See Figure 41

Figure 41 **STATE relationships**



Sub-concepts

ASSUMPTION

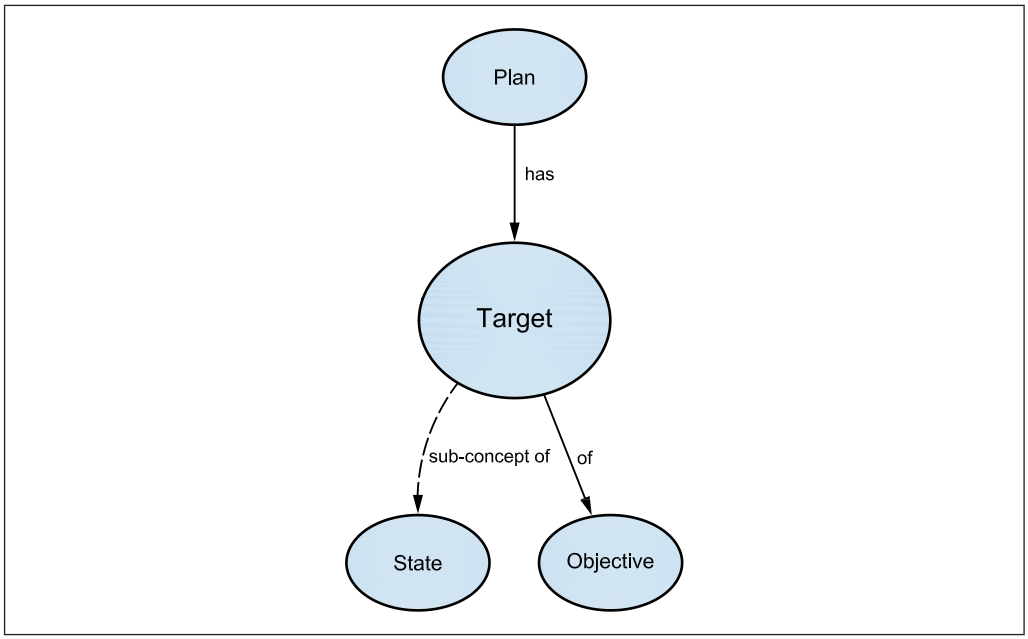
METRIC

TARGET

7.27 TARGET

Definition	A desired STATE.
Notes	A TARGET provides a value at a time in the future, for a STATE. TARGETs are linked to OBJECTIVEs, which are in turn linked to the AGENT that has set the TARGET. An OBJECTIVE might have many TARGETs over time, and a TARGET might relate to many OBJECTIVEs.
Relationships	See Figure 42

Figure 42 **TARGET relationships**



Sub-concept of

STATE

Annex A (informative) Examples of use of the SCCM

A.1 General

The SCCM has been founded on an initial comparison of concept models in use across sectors such as health, education and justice, combined with a local view from local authorities. Two workshops were run with local authorities, universities and data experts, to present and challenge the SCCM, and to map city data to it.

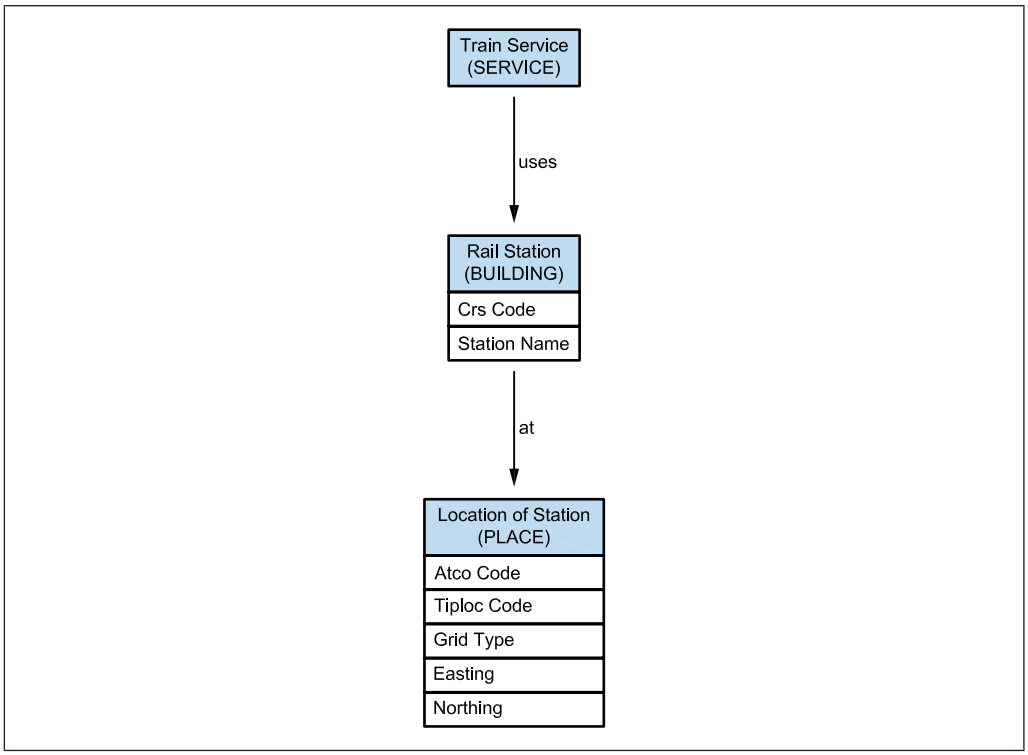
It is theoretically possible to describe any dataset using terms from the model, as it contains broad concepts such as ITEM, PLACE, and EVENT. However, more specialized concepts have been selected where they are particularly helpful to share data across a city. For example, the ITEM concept could have been used to describe a building, but as BUILDING is a useful concept for a city, it has been included as a sub-concept of ITEM. Similarly, the abstract concepts of OBJECTIVE and ASSUMPTION have been included to encourage the collaboration and leadership that is required across a smart city.

The SCCM can be viewed at http://www.smartcityconceptmodel.com, where registered users can map their data to it.

A.2 UK rail stations

Data about the location of UK rail stations is provided by the National Public Transport Access Node database (NaPTAN), which is described at: http://81.17.70.199/naptan/schema/2.4/doc/NaPTANSchemaGuide-2.4-v0.57.pdf. Mapping the data to the SCCM can start to populate a city register of SERVICEs, BUILDINGs, and PLACEs (Figure A.1).

Figure A.1 **UK rail stations data mapped to the SCCM**

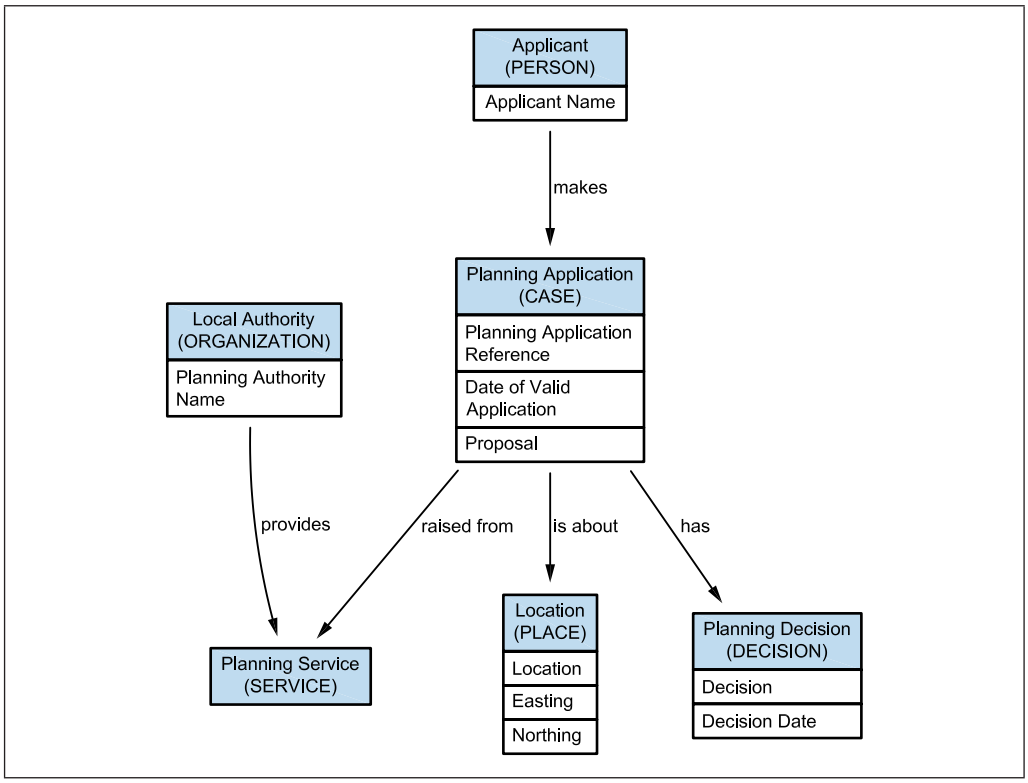


A.3 Planning applications

Data about planning applications, which might originally all be contained in a single row, can be split into entities, and published, linked to the SCCM (see Figure A.2). When organized like this, it can be combined, and queried with data about other topics, such as potholes. This might then prompt the following questions:

- What other CASEs are being considered in the area?
- What other SERVICEs does that local authority provide?
- What other DECISIONs have been made?

Figure A.2 **Planning application data mapped to the SCCM**



A.4 Mapping concepts from a sector to the SCCM

The concept model used by the NHS in the UK is currently being finalized as BS EN ISO 13940, *Health informatics — System of concepts to support continuity of care*[4)]. This is a good example of a concept model that works well within its sector, but where the terms may not translate well into other sectors. Concepts from the health informatics model are listed in Table A.1, which shows how they map onto the SCCM.

4) In preparation.

Table A.1 **Mapping the health informatics concept model to the SCCM**

Health informatics concept model	Definition	SCCM
subject of care	healthcare actor with a person role; who seeks to receive, is receiving, or has received healthcare	PERSON
demand for care	demand for healthcare provider activities expressed by a healthcare actor	EVENT
health condition	observed or potential observable aspects of the health state at a given time	STATE
target condition	potential health condition representing health objectives and/or healthcare goals	TARGET
health objective	desired ultimate achievement of a healthcare process addressing health needs	OBJECTIVE
healthcare provider	healthcare actor that is able to be assigned one or more care period mandates	AGENT
episode of care	health related period during which healthcare activities are performed to address one health issue as identified by one healthcare professional	CASE
healthcare treatment	healthcare activity element intended to directly improve or maintain a health state	EVENT
point of care	location where direct healthcare activities are performed	PLACE
healthcare funds	resource provided for funding healthcare delivery	RESOURCE
healthcare service	service that is the result of a healthcare process	SERVICE
protocol	customized clinical guidelines	RULE
clinical pathway	pathway for the healthcare activities informing the content of core care plans	METHOD
health record	data repository regarding the health and healthcare of a subject of care	ACCOUNT

Annex B (informative) Relationships in the SCCM

A list of relationships defined in the SCCM is given in Table B.1.

Table B.1 **List of relationships in the SCCM**

Property	Label	Inverse	Inverse label	Subject concepts	Object concepts
appliesTo	applies to	subjectOf	subject of	DECISION	ITEM
				AGREEMENT	SERVICE
assumptionMadeBy	made by	makesAssumption	makes	ASSUMPTION	AGENT
atPlace	at	placeOf	place of	ITEM	PLACE
			of	EVENT	PLACE
caseHasPlan	has	planForCase	for	CASE	PLAN
collectionContains	contains	containedInCollection	contained in	COLLECTION	ITEM
collectionDefinedBy	defined by	definesCollection	defines	COLLECTION	AGENT
contains	contains	containedIn	contained in	ORGANIZATION	ORGANIZATION
				SERVICE	SERVICE

Table B.1 **List of relationships in the SCCM**

Property	Label	Inverse	Inverse label	Subject concepts	Object concepts
				ACCOUNT	EVENT
				PLAN	PLAN
				FUNCTION	SERVICE
				PLACE	PLACE
				COMMUNITY	COMMUNITY
				CASE	EVENT
has	has	of	of	AGENT	OBJECT
				AGENT	ABSTRACT
hasAgreement	has	agreementWith	with	AGENT	AGREEMENT
hasObjective	has	objectiveOf	of	AGENT	OBJECTIVE
hasOutcome	has outcome	outcomeOf	outcome of	EVENT	STATE
hasPlan	has	planOf	of	AGENT	PLAN
hasResource	has	resourceOf	of	AGENT	RESOURCE
hasRoleIn	has role in	hasRoleFrom	has role from	ITEM	ACCOUNT
				ITEM	CASE
				ITEM	EVENT
hasState	has state	stateOf	about	ITEM	STATE
				PLACE	STATE
hasTarget	has target	targetOf	target of	PLAN	TARGET
influencedBy	influenced by	influences	influences	SERVICE	OBJECTIVE
				DECISION	OBJECTIVE
				PLAN	OBJECTIVE
				OBJECTIVE	ASSUMPTION
memberOf	member of	hasMember	has member	PERSON	ORGANIZATION
outcomeOf	outcome of	hasOutcome	has outcome	DECISION	EVENT
ownedBy	owned by	owns	owns	ACCOUNT	AGENT
planDerivedFromMethod	derived from	derivationOfPlan	derivation of	PLAN	METHOD
planForEvent	plans event	eventPlannedIn	planned in	PLAN	EVENT
providedBy	provided by	provides	provides	SERVICE	AGENT
raisedFrom	raised from	raises	raises	CASE	SERVICE
records	records	isRecordedBy	recorded by	OBSERVATION	STATE
relatedTo	related to			ITEM	ITEM
resourceFor	for	usesResource	uses	RESOURCE	PLAN
				RESOURCE	SERVICE
responsibilityOf	responsibility of	responsibleFor	responsible for	SERVICE	AGENT
ruleFor	for	hasRule	has	RULE	SERVICE
serviceImplementsMethod	implements	methodImplementedIn	implemented in	SERVICE	METHOD
takesDecision	takes	decisionTakenBy	taken by	AGENT	DECISION
targetOfObjective	of	objectiveHasTarget	has	TARGET	OBJECTIVE
usedBy	used by	uses	uses	SERVICE	COMMUNITY
				ITEM	AGENT

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