



BSI Standards Publication

Smart cities – Vocabulary

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Summary of pages

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Foreword

This PAS was sponsored by the Department of Business, Innovation & Skills (BIS). Its development was facilitated by BSI Standards Limited and is published under licence from The British Standards Institution. It came into effect on 28 February 2014.

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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.

Relationships with other publications

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

- PAS 181, *Smart city framework – Guide to establishing strategies for smart cities and communities*, which gives guidance on a 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 cities ability to meet future challenges and deliver future aspirations;
- PAS 182, *Smart city concept model – Guide to establishing a model for data interoperability*, which will provide a framework that can normalize and classify information from many sources so that data sets can be discovered and combined to gain a better picture of the needs and behaviours of a city's citizens (residents and businesses);¹⁾

¹⁾ In preparation.

- 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 development*, a smart city planning document, which will provide guidance to local authorities on what they need to require or incentivize new infrastructure developments to support the overall smart city plans for their area.¹⁾

Presentational conventions

The terms in this PAS are arranged by topic and an index is provided so the location of each term can be identified easily.

When the terms defined in this PAS are used in the definition or notes of another term, they are shown in bold type. Spelling conforms to *The Shorter Oxford English Dictionary*.

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.

Introduction

Smart cities and smart city systems

Cities, or large urban conurbations, bring many positive benefits to communities and economies – locally, nationally and globally. Beneficial impacts range from the objective, e.g. economic impacts, to the cultural, for example – providing a context to support vibrant arts, music, literary & drama communities.

There is a cost to these benefits. The accelerating growth of cities and their disproportionate consumption of physical and social resources is assessed by the United Nations to be the greatest challenge to mankind since we became social.

Cities are currently occupied by c.51% of the global population of 7+billion but consume c.80% resources disproportionately consuming physical and social resource.

NOTE Figures taken from Fischer-Kowalski, M., et al, "Decoupling Natural Resource Use and Environmental Impacts From Economic Growth, A Report of the Working Group on Decoupling to the International Resource Panel", UNEP, 2011.

By 2050 the global population is forecast to grow to 9+ billion, 80% of which will inhabit cities. The increase in demand for all resources is unsustainable, as are traditional delivery mechanisms, which are unresponsive and too costly. To maintain quality of life expectations in the developed world, and match these in the developing world, we urgently need to identify and implement innovative delivery systems to more effectively manage and control resource use in the built environment – particularly cities.

Smart city systems are emerging as a major response to the joint challenges of resource management and economic recovery in cities – nationally and globally. These systems will displace traditional delivery vehicles for physical and social resources, potentially providing cost effective and innovative delivery channels.

Reducing complexity – a terminology and analytical language

In common with many natural and manmade systems, cities are complex. Our understanding of complex systems is achieved by reducing the complexity to a manageable number of well understood fundamental parameters – first principles.

To be able to specify meaningful and effective systems to monitor, manage and control resource use in our cities, we must first establish the first principles of cities' behaviour. At this stage of development we can empirically identify a number of vital issues that are likely to be shown part of the set of fundamental building blocks.

This empirical understanding can be used to develop first principles, and applied to develop an analytical language to inform the objective specification of smart city systems.

In the meantime an agreed set of working terms is needed to encourage convergence of the different discussions about the future of cities agenda, and the function of smart city systems in resolving the challenges facing cities, particularly resource use and management.

This PAS 180 is the first version of a "smart cities vocabulary", the beginning of a process to collate the diverse range of terms and expressions used in day-to-day discussions about smart city systems. The vocabulary aims to provide an agreed set of working terms to enable practitioners to better share a common understanding.

Structure of the vocabulary

At this stage of the vocabulary's development the collation of terms and expression is open, with no defined model or framework of what a smart city or smart city system may be. This is a deliberate choice to ensure a diverse collection of terms and expressions.

The vocabulary's working structure is as follows:

- a) Enabling concepts;
 - 1) Smart city systems;
 - 2) Public and private service delivery models;
 - 3) Resource management processes;
 - 4) Technology and infrastructure;
 - 5) Governance;
- b) Applications (output channels);
 - 1) Environment;
 - 2) Finance and economy;
 - 3) Mobility;
 - 4) Community, education and skills;
 - 5) Lifestyle, health and well-being.

This structure, like the definitions, is open to change and expansion in the future, but is sufficiently broad to capture the first collation rounds.

1 Scope

This PAS defines terms for smart cities, including smart city concepts across different infrastructure and systems elements and used across all service delivery channels.

It covers information, processes, methodologies and applications.

This PAS is aimed at UK city leaders. It can also be helpful to leaders of communities other than at city-scale – including both smaller urban areas and larger regional-scale initiatives – and for city leaders outside the UK. However, the prime intended audience, for whom the guidance has been developed and tested, is UK city leaders, including:

- policy developers in city authorities – both those responsible for the authority's service design, commissioning and delivery role, and also those responsible for its community leadership role, in particular:
 - elected leaders;
 - senior executives of local authorities (including chief executives, chief information officers and directors of key departments);
 - senior executives of other public bodies with a city-wide remit;
- other stakeholders interested in leading and shaping the city environment, including:
 - senior executives in the private sector who wish to partner with and assist cities in transformation of city systems to create shared value;
 - leaders from the voluntary sector organizations active within the city;
 - leaders in the higher and further education sectors;
 - community innovators and representatives.

2 General

2.1 Overview

There are two commonly used high level descriptors used – “smart cities” and “future cities” – in discussion about the subject area. These are often seen as competing terms. However, there is a meaningful and complementary role for both, which is laid out below.

The future of cities is the focus of the challenge facing humankind’s aspiration to attain or maintain a high quality, but sustainable, way of living. Smart cities can be seen as a response to this challenge. This complementary relationship between the two concepts suggests the following definitions:

2.2 The future of cities – the challenge

The future growth and health of cities and communities is challenged globally. Current trends in population growth and resource use are unsustainable. Much of the population migration into cities up to 2050, and beyond, will –under current models of operation – live in poverty. Failure to address the growing and increasingly urgent challenges of population growth, increasing poverty and unsustainable resource use will strain the management and operation of cities. Cities are primary engines of global economic activity; the strain placed on future cities will impact on the effectiveness of their operations, and thus on economic activity. New and sustainable models of resource consumption and economic growth are required to resolve the challenge of future cities to ensure future, sustainable economic activity, globally.

2.3 Smart cities – the response

“Smart cities” is a term denoting the effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens.

NOTE 1 This definition is deliberately presented as a “working definition” rather than intended as a “definitive definition” which all cities should follow. While there is a strong degree of commonality among the smart city strategies that are being developed around the UK, there is also significant diversity. All cities embarking on development of a smart city strategy can define their own reasons for doing so, in their own language; the process of discussion and debate between stakeholders to define what, for them, is meant by “Smart Aberdeen”, “Smart Birmingham” or “Smart Cambridge” is an important one.

Digital systems provide a mechanism for efficiently matching physical and social resource demand against availability through integrated real time monitoring and response. The efficient matching of resource demand against supply availability enables effective city management and economic activity. The reliable data models from real time demand-supply matching can additionally be used to inform long term planning of resource availability. A flexible design approach allows for options to be embedded upfront in the system for possible use at later stages.

NOTE 2 Cities are complex, and for them to become smarter – more economically, socially and environmentally sustainable and prosperous – they will need to holistically address a range of issues including:

- a) *planning and economic development;*
- b) *resilient clean air, water and food supply;*
- c) *integrated data and security systems;*
- d) *responsive transport networks;*
- e) *environment protection and sustainable resource management;*

- f) risk management (e.g. climate change);
- g) sustainable waste management systems;
- h) energy management;
- i) sustainable building design & green buildings; and
- j) cultural and social interaction.

Smart Cities use digital systems to communicate with citizens and organisational stakeholders, they exploit data and information for planning and service delivery and they nurture the digital skills required to participate in society and be economically successful.

3 Enabling concepts

3.1 Smart city systems

3.1.1 access rights

permission for a subject to access a particular **object** (3.4.20) for a specific type of operation

[ISO/IEC 2382-8:1998, 08.04.05]

EXAMPLE Requesting information from an **object** (3.4.20), changing values of variables in it or modifying its state, e.g. read-access to a shared variable; permission to turn on, or off (i.e. execute certain operations).

NOTE Where more than one service or **application** (3.1.5) requires access to an **object** (3.4.20) for one or more specific purposes, then levels of access must be defined, including the definition of the primary owner of the **access rights** (3.1.11) [possibly the owner of the **object** (3.4.20)].

3.1.2 action limits

control limits between which the statistic under consideration lies with a very high probability when the process is under statistical control

[ISO 3534-2:2006, 2.4.4]

3.1.3 adaptive system

system which becomes adaptive and learns its own behaviour, becoming a "self-learning system"

3.1.4 aggregator

website or computer software that aggregates a specific type of information from multiple online sources

NOTE There are various kinds of aggregators, e.g. data, news, polls, etc.

3.1.5 application

structures, data elements and program modules needed for performing a specific functionality

[ISO/IEC 7816-13 2007, 4.1]

3.1.6 application software

software, **application** (3.1.5) or program that is specific to the solution of an **application** (3.1.5) problem

EXAMPLE Devices in the smart house collaborate to execute an energy management application that the owner uses to reduce electricity consumption. No additional service is required.

NOTE This term is also used to refer to use of a technology, system, or product. An **application** (3.1.5) may consist of a number of elements or entities working together to provide a service or product. It may utilise specific elements in a system or technology in delivering the **application** (3.1.5). Alternatively, an **application** (3.1.5) may be a program that carries out a particular service within a computer, processor or (home) system. See also **web application** (3.1.75).

3.1.7 authentication

act of verifying the claimed identity of an entity

[ISO/IEC 2382-8:1998, 08.01.11]

EXAMPLE The validation of a claimed identity of a user can be made by verifying some secret knowledge, key, or property associated with that user, e.g. a password, a SSL key, a PGP private key, or a hand-written signature.

3.1.8 authorization

permission to perform certain operations or use certain methods or services

[ISO/TS 14265:2011, 2]

*EXAMPLE The permission is made by comparing the validated user's **access rights** (3.1.11) with the user's requested action(s) on an **object** (3.1.20), for example to read and to modify some content of an **object** (3.1.20).*

3.1.9 autonomous system

system capable of functioning on its own, without human intervention or direction

3.1.10 benchmark

standard against which results can be measured or assessed

[ISO/IEC 25010:2011, 4.3.2]

3.1.11 big data

high volume, high velocity, and or high variety of information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimization

[<http://www.gartner.com/DisplayDocument?id=2057415>]

3.1.12 building information modelling (BIM)

shared digital representation of physical and functional characteristics of any built object, including buildings, bridges, roads, process plant

[ISO/TS 12911:2012, 3.1]

*NOTE BIM is not just a 3D CAD, nor new technology **application** (3.1.5). BIM is essentially value creating collaboration through the entire **lifecycle** (3.3.2) of an asset, underpinned by the creation, collation and exchange of shared 3D models and intelligent, structured data attached to them.*

[<http://www.bimtaskgroup.org/bim-faqs/>]

3.1.13 building management system

system capable of making intelligent decisions based on information sent to it

[ISO/TR 25743:2010, 2.1]

3.1.14 climate change

any significant change in the measures of climate lasting for an extended period of time

*NOTE Climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer. Climate change is one of the main drivers for the concept of **smart cities** (3.1.62), as the society needs a different delivery model for much more effective use of available resource, and to avoid any potential catastrophic effect from climate change.*

[USEPA <http://www.epa.gov/climatechange/basics/>]]

3.1.15 cloud computing

scalable IT services accessible via the internet for a potentially large number of external customers, providing facilities for the storing and use of data and information on facilities remote from local computing facilities

[<http://www.gartner.com/newsroom/id/707508>]

NOTE 1 Cloud computing security is an active area of development by different national and international Standards Bodies, e.g. ISO (ISO/IEC JTC1 SC38), ETSI (TC Cloud) and other organizations concerned with Cloud computing security, e.g. the Global Inter-Cloud Technology Forum (GICTF) and the Organization for the Advancement of Structured Information Standards (OASIS).

NOTE 2 An international group of organisations developing cloud computing security standards have formed the Cloud Standards Customer Council (http://cloud-standards.org/wiki/index.php?title=Main_Page#Cloud_Standards_Customer_Council).

3.1.16 **commissioning**

proof of function to verify that the agreed system specification is met and is accepted by the user or his representative

[ISO 10083:2006, 3.1]

NOTE 1 As part of the commissioning process, services are regularly evaluated.

NOTE 2 Commissioning is a process of putting something into use and verification of the process on one part of the process.

NOTE 3 Under current practice the “commissioning council” assesses outsourcing (commissioning) an increasing number of public services from local authorities; often working through commissioning boards.

3.1.17 **confidentiality**

property that information is not made available or disclosed to unauthorized individuals, entities or processes

[ISO/TS 22600-1:2006, 2.9]

3.1.18 **co-ordination**

steps of city technology harmonization, characterized by increasing intelligence and synergy of interactions between elements of space and resource

3.1.19 **cyber security**

mechanisms and processes put in place to ensure the integrity of operation of computer systems, protecting their operations against malicious or unintentional intervention

*NOTE Examples of malicious or unintentional intervention include **eavesdropping (3.1.28)**, trojans, viruses and worms, phishing, **denial of service (3.1.24)**, rootkits and keyloggers.*

3.1.20 **data centre**

dedicated space where ICT infrastructure is hosted and operated on behalf of one or a number of organizations

NOTE 1 Examples of a unit include a company, a local authority, etc.

*NOTE 2 A data centre consists of the servers and storage equipment that run **application software (3.1.6)** and processes and store data and content. In the concept of smart cities, a data centre is crucial in order to ensure efficient and smooth data exchange/flow among services and operators, thus seamless and integrated services.*

[<http://www.interxion.com/data-centres/>]

3.1.21 **data ownership**

possession of and responsibility for data and information

NOTE 1 Ownership implies power and responsibility as well as control. The control of information includes not just the ability to access, create, modify, package, derive benefit from, sell or remove data, but also the right to assign these access privileges to others.

[<http://www.niu.edu/rcrportal/datamanagement/dotopic.html>]