BSI Standards Publication

Smart cities – Vocabulary

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Contents

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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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This PAS is not to be regarded as a British Standard. It will be withdrawn upon publication of its content in, or as, a British Standard.

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]

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[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.

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[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 educations 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]

NOTE 2   Data ownership is the act of having legal rights and complete control over a single piece or set of data elements. It defines and provides information about the rightful owner of data assets and the acquisition, use and distribution policy implemented by the data owner.

[http://www.techopedia.com/definition/29059/data-ownership]

3.1.22   data protection
legal, administrative, technical or physical measures taken to avoid unauthorized access to and use of data

[ISO 5127:2001, 7.3.3.1.01]

NOTE   In the UK primary legislation is in place – the Data Protection Act 2011 – providing statutory control on the use of personal data. The Data Protection Act controls how personal information is used by organisations, businesses or the government. See The Data Protection Act 1998 (Commencement No. 3) Order 2011.

3.1.23   demographic change
change in rate of births, deaths, income, or the incidence of disease, in human populations

NOTE   The European Union is facing unprecedented demographic changes (an ageing population, low birth rates, changing family structures and migration). The demographic change will affect public services and the relationship between people and the state. In the light of these, a drastic change in the delivery model of services and policies is needed.

[http://ec.europa.eu/social/main.jsp?catId=502&langId=en; http://www.parliament.uk/business/committees/committees-a-z/lords-select/public-services-committee/news/call-for-evidence/]

3.1.24   denial of service
prevention of authorized access to a system resource or the delaying of system operations and functions, with resultant loss of availability to authorized users

[ISO/IEC 27033-1:2009, 3.9]

3.1.25   device discovery
act of determining the set of all devices present on a particular transport or platform that are physically or logically accessible

ISO 15740:2013, 3.8

3.1.26   discovery process
process of execution of discovery activities

3.1.27   distributed platform
group of computers on a network accomplishing a common task

NOTE 1   Also referred to as a virtual platform.

NOTE 2   The point of having several computers may be specialization or fault tolerance or both.

[http://stackoverflow.com/questions/2326887/what-the-heck-is-a-distributed-platform-context-embedded-systems]

3.1.28   eavesdropping
activity leading to loss of **confidentiality (3.1.17)**, in which a third party obtains data sent between the trusted electronic units, knowledge of which it is not entitled to possess

[ISO 15764:2004, 3.8]

EXAMPLE   The interception of credit card numbers or classified information – the interception of any communications information may render the eavesdropper useful information.

3.1.29   encryption
function of transforming data by the discipline of cryptography so as to make the data undecipherable to anyone other than the legitimate sender and receiver

[ISO 24100:2010, 3.9]

*NOTE   As used in a network security context, **encryption** is usually accomplished by putting the data through any of several established mathematical algorithms developed specifically for this purpose.*

3.1.30   environmental sustainability
state in which components of the ecosystem and their functions are maintained for the present and future generations

[Adapted from ISO 15392:2008, definition 3.20]

NOTE   This is important in a world where resources are scarce, and where cities are increasingly basing their development and wealth on tourism and natural resources: their exploitation must guarantee the safe and renewable use of natural heritage.

[http://toolkit.smallbiz.nsw.gov.au/part/17/86/371, http://en.wikipedia.org/wiki/Smart_city]

3.1.31   feedback loop
section of a control system that allows for feedback and self-correction and that adjusts its operation according to differences between the actual output and the desired output

[http://www.thefreedictionary.com/feedback+loop]

NOTE 1   Also known as real time feedback.

NOTE 2   A feedback loop is a common and powerful tool when designing a control system. Feedback loops take the system output into consideration, which enables the system to adjust its performance to meet a desired output response.

[http://en.wikibooks.org/wiki/Control_Systems/Feedback_Loops]

3.1.32   hacking
unauthorized access to or use of data, systems, servers or networks, including any attempt to probe, scan or test the vulnerability of a system, server or network or to breach security or **authentication (3.1.7)** measures without express **authorization (3.1.8)** of the owner of the system, server or network

[www.myschooladvice.com/optoutem/aup.php]

3.1.33   indicator

3.1.33.1   assessment indicator
sources of objective evidence used to support the assessors' judgment in rating process attributes

[ISO/IEC 15504-1:2004, 3.4]

3.1.33.2   performance indicator
particular quantified aspect of a building

[ISO/TR 16344:2012, 2.1.111]

NOTE   Performance indicators define a set of values used for measuring performance. In urban planning and management; performance indicators are used to evaluate performance and assess progress against specified targets concerning a variety of urban systems, processes and services.

3.1.34   information
facts, concepts, or instructions

[ISO 15531-43:2006, 3.1.15]

NOTE   Information is data that have been processed so that they are meaningful. It is the crucial element for a smart city in which people/machine rely on information from different sources to make decisions/take actions.

3.1.35 information security

preservation of **confidentiality (3.1.17)**, integrity and availability of information; in addition, other properties such as authenticity, accountability, non-repudiation and reliability can also be involved

[ISO 19092:2008, 4.35]

EXAMPLE   Key for encryption or detection of tampering, access permissions for reading and writing objects, audit trails for modifications to data.

3.1.36 innovation

changes made to something established, or a new introduction as new methods, ideas, or products, to achieve desirable outcomes that result in small but significant improvement

*NOTE   In the context of smart city systems, the use of **broadband connectivity (3.4.6)** and the content and information flows to create economic opportunities by attracting and engaging a knowledge base workforce.*

3.1.37 integrated

combined and compatible operation of different city systems and exchange of data and information with the aim of achieving more effective outcomes with least resource input

NOTE   Such city systems include transport, healthcare, social services, education, cultural services, employment services, etc.

3.1.38 integrity

property that information is not altered in any way, deliberately or accidentally

[ISO/TS 22600-2:2006, 2.19]

3.1.39 intelligent transportation system

integrated application of communications, control and information processing technologies to the transportation system

3.1.40 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

[ISO 14813-5:2010, B.1.66]

3.1.41 internet of things (IoT)

state where things (e.g. objects, environments, vehicles and clothing) have more and more information associated with them and may have the ability to sense, communicate, network and produce new information, becoming an integral part of the internet

[TSB IoT SIG brochure: https://connect.innovateuk.org/c/document_library/get_ file?p_l_id=2140879andfolderId=2543615andname=DLFE-73702.pdf]

*NOTE   A revolution is already under way that is seeing a growing number of internet-enabled devices that can network and communicate with each other and with other web-enabled gadgets. Sometimes referred to as the "pervasive internet" or "ubiquitous computing" – and manifesting itself through connected environments, **smart cities** and smart homes.*

3.1.42 management information system

information processing system that supports the decision-making of a community, city or organization

[Adapted from ISO/IEC 2382-17:1999, 17.01.05]

3.1.43 metric

defined measurement method and measurement scale

[ISO/IEC 14102:2008, 3.4]

3.1.44 monitoring

act of periodically checking processes, equipment and environment in order to detect any changes

[adapted from ISO 8468:2007, 3.1.36]

NOTE Checking can include process checks

3.1.45 open data

content or data that is free to use, reuse, and be redistributed, subject only, at most, to the requirement to attribute and/or share-alike

[http://opendefinition.org/]

3.1.46 open innovation

paradigm that assumes that firms can and should use external and internal ideas, and internal and external paths to market

[Chesbrough, Henry, *Open Innovation*, Harvard Business School Press, 2003]

NOTE Open innovation combines internal and external ideas into architectures and systems whose requirements are defined by a business model (3.2.1). The business model (3.2.1) utilizes both external and internal ideas to create value, while defining internal mechanisms to claim some portion of that value.

3.1.47 open platform

software system based on open standards

[Adapted from: http://en.wikipedia.org/wiki/Open_platform]

NOTE For example, published and documented external application (3.1.5) programming interfaces (API) that allow the software system to function beyond the scope of the original programmer's specification, without requiring modification of the source code. Using these interfaces, third parties can integrate with the platform to add functionality.

3.1.48 open standard

standards for software interoperability, data and document formats

NOTE According to the UK Government, an open standard will exhibit all of the following criteria:

a) *collaboration – the standard is maintained through a collaborative decision-making process that is consensus based and independent of any individual supplier;*

b) *transparency – the standard has a transparent decision-making process;*

c) *due process – the standard is adopted by a specification or standardisation organization, or a forum or consortium with a feedback and ratification process to ensure quality;*

d) *market support – other than in the context of creating innovative solutions, the standard is mature, supported by the market and demonstrates platform, application (3.1.5) and vendor independence;*

e) *fair access – the standard is published, thoroughly documented and publicly available at zero or low cost;*

f) *rights – rights essential to implementation of the standard, and for interfacing with other implementations which have adopted that same standard, are licensed on a royalty free basis that is compatible with both open source and proprietary licensed solutions.*

[https://www.gov.uk/government/publications/open-standards-principles]

3.1.49 physical resource

tangible resource

NOTE Also known as a "tangible asset". Examples include land, buildings and plant.]

[http://wps.pearsoned.co.uk/wps/media/objects/2459/2518409/glossary/glossary.html]

3.1.50 physical security

measures used to provide physical protection of resources against deliberate and accidental threats

[ISO 7498-2:1989, 3.3.41]

EXAMPLE   A self-opening and closing door for wheelchair access, compliant with standards for such devices.

3.1.51 predictive analytics

statistical and analytical techniques used to develop models that predict future events or behaviours

NOTE   The form of these predictive models varies, depending on the behaviour or event that they are predicting. Most predictive models generate a score (e.g. a credit score), with a higher score indicating a higher likelihood of the given behaviour or event occurring.

[http://www.aicpu.org./doc/predictivemodelingwhitepaper.pdf]

3.1.52 priority

relative ordering given to a process or action with respect to other processes

EXAMPLE   Life critical processes may have a higher priority than other user processes

3.1.53 privacy

freedom from intrusion into the private life or affairs of an individual when that intrusion results from undue or illegal gathering and use of data about that individual

[ISO/TS 27790:2009, 3.56]

NOTE   Privacy can also apply to an organization.

3.1.54 reliability

degree to which a measure repeatedly and consistently produces the same result

[ISO 11620:2008, 2.38]

NOTE   Reliability has to do with the quality of measurement. In its everyday sense, reliability is the "consistency" or "repeatability" of the measures.

[http://www.socialresearchmethods.net/kb/reliable.php]

3.1.55 resilience

ability of a community, city, organization or system to resist being affected by disruptions

[Adapted from ISO/IEC 27031:2011, 3.14]

NOTE 1   A resilient community can minimize its vulnerabilities through a practical approach to risks, accounting for social, economic, environmental and technical vulnerabilities.

[http://incheon2010.iclei.org/future-of-cities/resilience.html][http://incheon2010.iclei.org/future-of-cities/resilience.html]

NOTE 2   "A Resilient City is one that has developed capacities to help absorb future shocks and stresses to its social, economic, and technical systems and infrastructures so as to still be able to maintain essentially the same functions, structures, systems, and identity."

[http://www.resilientcity.org/index.cfm?pagepath=andid=11449]

NOTE 3   A key component of resilience is agility: the ability to anticipate, prepare, respond and reconfigure in a timely fashion.

http://www.resilientcity.org/index.cfm?pagepath=andid=11449]

3.1.56 resource depletion

unsustainable use of resources of all forms

NOTE   Such as the extraction of natural resources, where no policy of replacement or renewal is implemented.

3.1.57 safety

state of being certain that adverse effects will not be caused by some agent under defined conditions.

*NOTE   As an **actuator (4.1.1)** becomes progressively more remote from a device or action, the scope for actions that may result in unsafe conditions increases. This problem is accentuated when there are two or more **actuators (4.1.1)** acting on that device or action.*

3.1.58 security

combination of **confidentiality (3.1.17)**, integrity and availability

[ISO 21549-3:2004, 3.10]

3.1.59 security requirements

purpose, objectives and success criteria applied to an **application (3.1.5)** or service

*NOTE   This definition is focused on security in relation to levels of interoperability that cover both **physical security (3.1.50)** and **information security (3.1.35)** and these must be combined with **safety (3.1.57)** and other considerations such as the permission and **priority (3.1.52)** of access, discovery, configuration and management.*

3.1.60 service owner

individual or organization taking primary responsibility for a service [or asset], including its design, objectives and progression

[www.itilpeople.com/Glossary/Glossary_s.htm]

3.1.61 smart

the application of autonomous or semi-autonomous technology systems to achieve greater utilization of resources, limiting or reducing per capita resource consumption to maintain or improve quality of life

3.1.62 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

3.1.63 smart city indicator

measures of the impact and success of smart city initiatives, programmes and projects

NOTE 1   High level indicators include, but are not restricted to:

a)   ***broadband connectivity (3.4.6)**, including GPS, wi-fi and satellite availability;*

b)   *knowledge workforce;*

c)   ***digital inclusion (3.2.4)**;*

d)   ***innovation (3.1.36)**;*

e)   *marketing and advocacy.*

[Bell, R; Jung, J and Zachirilla, L, "Broadband Economies: Creating the Community of the 21st Century. Intelligent Community Forum",(New York, 2008.]

NOTE 2   Indicators specify aspects of smart city for the purpose of measuring performance and progress against set base values and future targets.

NOTE 3   Smart cities will need to resolve a number of challenges and make measurable progress in addressing the following areas:

a)   *growing and changing populations;*

b)   *access to **broadband (3.4.5)** including access to GPS, **wi-fi (4.3.6)**, satellite, etc.;*

c)   *energy and water;*

d)   *transport networks;*

e)   *sustainable waste management systems;*

f)   risk management (climate hazard risks);

g)   sustainable building design and green spaces.

NOTE 4   For further information on this topic, see PAS 181:2014, Smart city framework – Guide to establishing strategies for smart cities and communities.

3.1.64   smart city system
system of **digital infrastructure (3.2.5)** and digital services to monitor, manage and control physical and social resource

NOTE   These systems are capable of providing a diverse range of functions, including providing a context to encourage and enable economic activity – particularly SMEs.

3.1.65   smart grid
electricity network that uses ICT to integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies

[Adapted from IET (http://www.theiet.org/policy/key-topics/smart -grid)]

3.1.66   smart operations management
real-time pro-active management of a city's resources and space

3.1.67   smart system
distributed system that incorporates functions of sensing, actuation and control

NOTE   Such devices are capable of describing and analysing a situation, and taking decisions based on the available data in a predictive or adaptive manner, thereby performing smart actions. In most cases the "smartness" of the system can be attributed to autonomous operation based on closed loop control, energy efficiency and networking capabilities.

[http://en.wikipedia.org/wiki/Smart_Systems][http://en.wikipedia.org/wiki/Smart_Systems]

3.1.68   shared use system
localized electricity grid that manages generation and storage and has a bi-directional relationship with the regional or national grid

3.1.69   social sustainability
personal and societal assets, rules and processes that empower individuals and community to participate in the long term and fair achievement of adequate and economically achievable standards of life, based on self-expressed needs and aspirations within the physical boundaries of places and the planet as a whole

[[http://oisd.brookes.ac.uk/sustainable_community/resources/SocialSustainability_Metrics_and_Tools.pdf]

3.1.70   specification
document stating requirements

[ISO 17665-1:2006, 3.46]

NOTE   Specification can also refer to the various means of meeting and/or supporting such documents.

3.1.71   system
set of objects or processes working together as parts of a mechanism or an interconnecting network; a complex whole

[http://oxforddictionaries.com/definition/english/system]

3.1.72   system of systems (SoS)
large system that delivers unique capabilities, formed by integrating independently useful systems

[ISO/IEC/IEEE 24765:2010, 3.2991]

NOTE   A widely used descriptive framework for characterising a system of systems is "Maier's five criteria": of the elements:

a)   Component systems must be able to operate independently when not integrated in the SoS (are useful on their own).

b)   Component systems keep operating independently to some extent while integrated in the SoS.

c)   A SoS grows and evolves with time and experience .

d)   A SoS is able to perform functions that cannot be found in any component system, and these functions are the main SoS objectives.

e)   A SoS is distributed over a large geographic extent.

[Maier, M. W. 1996. "Architecting Principles for Systems-of-Systems." 6th Annual International Symposium of INCOSE, Boston, MA, USA, p. 567-574.]

3.1.73   urban realm
spatial components of the city, consisting of often dispersed, independent zones or realms linked together by the public realm (streetscape, public spaces, parks, etc.) to form the metropolitan framework

3.1.74   urbanization
process by which people become residents of cities

NOTE   This process again pushes the need for change in the delivery and model of how a city should run.

[http://dictionary.cambridge.org/dictionary/british/urbanization]

3.1.75   web application
application (3.1.5) providing functionality to the user through a browser or other type of user agent using web formats and protocols

[ISO 9241-151:2008, 3.34]

3.2   Public and private service delivery models

3.2.1   business model
abstract description of a (part of a) business area showing the main business processes and business concepts relevant to this (part of a) business area

[ISO 20022-1:2004, 3.9]

NOTE 1   A plan implemented by a company to generate revenue and make a profit from operations, including the components and functions of the business, as well as the revenues it generates and the expenses it incurs.

[http://www.investopedia.com/terms/b/businessmodel.asp]

NOTE 2   This describes the method or means by which a company tries to capture value from its business. A business model may be based on many different aspects of a company, such as how it makes, distributes, prices or advertises its products.

The business model concentrates on value creation. It describes a company's or organisation's core strategy to generate economic value, normally in the form of revenue.

The model provides the basic template for a business to compete in the market place, it provides a template on how the firm is going to make money, and how the firm will work with internal players (firm's employees and managers) and external players (stakeholders such as customers, suppliers, and investors).

The business model indicates how the firm will convert inputs (capital, raw materials and labour) into outputs (total value of goods produced) and make a return that is greater than the opportunity cost of capital and delivers a return to its investors. This means that a business model's success is reflected in its ability to create returns that are greater than the (opportunity) cost of capital, invested by its shareholders and bondholders.

[http://lexicon.ft.com/Term?term=business-model]

3.2.2 city protocol

open, global, and progressive working framework for cities worldwide to assess and improve performance in **environmental sustainability (3.1.30)**, economic competitiveness, quality of life and city services

NOTE 1   Such improvement may be achieved by innovating and demonstrating new leadership models, new ways of engaging with community and individuals, and by taking advantage of new information and communication technologies (ICT).

NOTE 2   Urban anatomy – a description of the various systems that make up a city and the way they relate to one another.

[http://cityprotocol.org]

3.2.3 digital exclusion

exclusion from use of digital technology, either directly or indirectly, reducing the opportunity to improve the lives and life chances of all citizens and the places in which they live

[Adapted from http://www.litrg.org.uk/Resources/LITRG/Documents/2012/05/digital_exclusion_-_litrg_report.pdf, quote from William Gibson (quoted in The Economist, 23 June 2000)]

NOTE   The definition of digital exclusion is much debated – it is a complicated phenomenon with a number of different dimensions and root causes.

3.2.4 digital inclusion

provision of digital connectivity to communities, especially in deprived areas to achieve universal access to **broadband connectivity (3.4.6)**

NOTE   In the UK c.14% of the population is digitally excluded [http://www.ons.gov.uk/ons/rel/rdit2/internet-access-quarterly-update/q3-2013/index.html], disallowing access to digital content and services. An earlier study (Lane-Fox, M., "Champion for Digital Inclusion – The Economic Case for Digital Inclusion"; Price Waterhouse Coopers; October 2009) identified an objective cost to those people who are digitally excluded as being c.£600 per annum, because of their inability to access low cost products and services on-line.

3.2.5 digital infrastructure

integrated software and hardware required for digital communications allowing reception of data and information services delivered externally, and for the transmission of digital data and information

3.2.6 integrated supply chain (ISC)

network of close collaborative relationships with integrated data and business processes

NOTE 1   These processes are internal integration, customer integration, relationship integration, technology and planning integration, measurement integration and supplier integration.

NOTE 2   The ISC has full responsibility across the corporation (including different divisions, business units and geographies) for the planning and management of all activities involved in end-to-end supply chain processes, including direct sourcing and procurement, conversion/manufacturing, and all logistics management activities.

[http://www.scribd.com/doc/29423764/Integrated-Supply-Chain]

3.2.7 integration

the process of combining software components, hardware components, or both into an overall system

[ISO/IEC/IEEE 24765:2010, 3.1465]

NOTE   Can also apply to physical assets, services and people.

3.2.8   **interworking**

functionality to interconnect dissimilar networks in terms of communication technology and/or information manipulation

[ISO/IEC 29182-2:2013, 2.8.4]

3.2.9   **joint venture (JV)**

legal organization taking the form of a short-term partnership in which the persons jointly undertake a transaction for mutual profit

NOTE   *Generally each person contributes assets and share risks. Like a partnership, joint ventures can involve any type of business transaction and the "persons" involved can be individuals, groups of individuals, companies, or corporations.*

[http://www.law.cornell.edu/wex/joint_venture]

3.2.10   **key performance indicator (KPI)**

indicator of performance deemed by an organization to be significant and giving prominence and attention to certain aspects

[BS EN ISO 14031:2013, 3.17]

NOTE   *BS EN ISO 14031:2013,* Environmental management – Environmental performance evaluation – Guidelines *sets standards for environmental performance indicators (EPIs), management (EMIs) and operational indicators (OPIs).*

3.2.11   **knowledge workforce**

labour force that creates economic value through acquisition, processing and use of information

3.2.12   **local authority**

public body given the authority by legislation or directives of a higher level of government to set general policies, plans or requirements

[ISO/TR 14069:2013, 3.4.1]

3.2.13   **point of liability**

state of being legally responsible for something

[http://oxforddictionaries.com/definition/english/liability]

3.2.14   **policy**

set of legal, political, organizational, functional and technical obligations for communication and cooperation

[ISO/TS 22600-1:2006, 2.13]

3.2.15   **private finance initiative (PFI)**

public sector (3.2.19) procurement (3.2.17) of services to the quality standards it requires, instead of procuring a capital asset or other equipment then operating it itself

[http://www.gateshead.gov.uk/Education%20and%20Learning/Schools/pfi/What%20is%20PFI.aspx]

3.2.16   **private sector**

part of the national economy that is not under direct state control

[Shorter English Oxford Dictionary]

NOTE   *Includes for-profit and not-for-profit organizations, formal and informal structures, commerce and industry, private emergency response organizations, and private voluntary organizations.*

[www.fema.gov/oer/reference/glossary.shtm]

3.2.17 procurement

process which creates, manages and fulfils contracts relating to the provision of goods, services and engineering and construction works or disposals, or any combination thereof

[ISO 10845-2:2011, 2.19]

3.2.18 public private partnership (PPP)

business relationship between a **private sector (3.2.16)** company and a government agency for the purpose of completing a project that will serve the public

NOTE   Public-private partnerships can be used to finance, build and operate projects such as public transportation networks, parks and convention centres.

[http://www.investopedia.com/terms/p/public-private-partnerships.asp]

3.2.19 public sector

part of an economy that is controlled by the state

[Shorter English Oxford Dictionary]

NOTE   This includes government departments and agencies, and national and local authorities, as well as state-owned or state-run organizations.

3.2.20 public services

public facility, department, agency, board, commission, service, capability or resource, operated, or managed by or on behalf of the government, a political subdivision, or an agency thereof, or a tax-exempt private agency established to provide service to the public

[Adapted from http://www.michigan.gov/dmb/0,4568,7-150-9131_9347-29688--,00. html#P]

3.2.21 quality of service (QoS)

set of network technologies that enable a network to handle data traffic with a minimum amount of negative effects in a network environment used by many other users

[ISO/TR 16056-1:2004, 3.53]

NOTE 1   In the context of digital content, the measurement of transmission rates, error rates, and other characteristics as an indicator of quality of digital transmission.

NOTE 2   This is a networking term which may be used in one of two ways. In the first way, it represents a quality of networking. In the second, referred to usually as "QoS", it represents a guarantee or commitment to not only a particular quality of network service but also a particular rate or minimum rate of data delivery, as well as maximum times between packets of data. Used where applications (3.1.5) are sensitive to delays, such as video conferencing.

NOTE 3   Initially a feature of automated teller machines (ATMs), it is now being incorporated into the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol and will eventually be available as a service on non-ATM networks. A statement that QoS is provided is distinct from one which says QoS guarantees are provided.

[http://www.oit.uci.edu/network/network-glossary.html]

3.2.22 service level agreement (SLA)

contract that defines the technical support or business performance objectives including measures for performance and consequences for failure the provider of a service can provide its clients

[ISO/IEC 18043:2006, 2.25]

NOTE 1   An SLA is a collection of service level requirements that have been negotiated and mutually agreed upon by the information providers and the information consumers. The SLA has three attributes: structure, precision and feasibility. This

agreement establishes expectations and impacts the design of the components of the data warehouse solution.

[http://uis.georgetown.edu/departments/eets/dw/GLOSSARY0816.html#S]

NOTE 2   The standing of the SLA depends on whether the service is being provided by an internal (in-house central department/function) or an external (bought-in) service provider.

[http://help.procureweb.ac.uk/goodpracticeguide/1177procurement/1007proc_ procedures/1065proc_processes/1278proc_sla/index.html]

3.2.23   small and medium sized enterprise (SME)
any entity engaged in an economic activity, irrespective of its legal form, including in particular, self-employed persons and family businesses engaged in craft or other activities, and partnerships or associations regularly engaged in an economic activity

[Commission Recommendation 2003/361/EC]

NOTE   The main factors determining whether a company is an SME are:

a)   *number of employees and*

b)   *either turnover or balance sheet total.*

Company category	Employees	Turnover	or **Balance sheet total**
Medium-sized	< 250	≤ € 50 m	≤ € 43 m
Small	< 50	≤ € 10 m	≤ € 10 m
Micro	< 10	≤ € 2 m	≤ € 2 m

These ceilings apply to the figures for individual firms only.

[http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/ index_en.htm]

3.2.24   smart-city marketing and advocacy
promotion concepts and benefits to the local community

NOTE   The success of local programmes to drive the development of smart city or community programmes has been shown repeatedly to depend on community champions leading and advocating the initiative. The role of these champions is to:

a)   *Promote the concepts and benefits to the local community;*

b)   *Engage with the commercial community to promote the benefits of the "smart community" and foster the growth of economic opportunities using the smart city system.*

3.2.25   statutory obligation
act or course of action to which a person is legally/statutorily bound

[http://oxforddictionaries.com/definition/english/obligation]

3.2.26   supply chain
linked set of resources and processes that upon placement of a purchase order begins with the sourcing of raw material and extends through the manufacturing, processing, handling and delivery of goods and related services to the purchaser

[ISO 28001:2007, 3.24]

NOTE   Supply chains relate to logistics — getting the right materials to the right people and places at the right time. Effective supply chain management is vital for organizations to be successful.

[http://www.fin.gov.on.ca/en/bpssupplychain/definitions.html]

3.2.27 telecommunication infrastructure

collection of those telecommunications components, excluding active equipment, that together provide the basic support for the distribution of all information within a building or campus

[ISO/IEC 18010:2002, 3.1.17]

*NOTE   According to an Ofcom report, the key components for the UK telecommunication infrastructure include fixed telephony, fixed **broadband (3.4.5)**, mobile 2G, mobile 3G, digital terrestrial television and digital radio.*

[http://stakeholders.ofcom.org.uk/binaries/research/telecoms-research/bbspeeds2011/infrastructure-report.pdf]

3.3 Resource management processes

3.3.1 footprint

effect of a behaviour or a set of resource demands on a particular set of systems with which it interacts

NOTE   For example, a "carbon footprint" describes the effect of a person, asset or organization's effect on the emission of CO_2 or the embedding of carbon in its design lifecycle. Other footprints can be observed in transport, in terms of congestion and mobility – the same is true of other resource infrastructures.

3.3.2 lifecycle

stages and activities spanning the life of the system from the definition of its requirements to the termination of its use covering its conception, development, operation, maintenance support and disposal

[ISO/TR 18529:2000, 006]

3.3.3 renewable energy

energy from a source that is not depleted by extraction, such as solar energy (thermal and photovoltaic), wind, water power, renewed biomass

[ISO 15928-5:2013, 3.12]

3.3.4 resource efficient

using the Earth's limited natural resources sustainably to minimize environmental impacts, enabling the creation of greater value with less input

NOTE   A key requirement of the extraction and exploitation of resources is to minimise, ideally eliminate, carbon emissions.

[http://ec.europa.eu/environment/resource_efficiency/]

3.3.5 smart community

community that maintains or improves its quality of life sustainably by minimizing its environmental impact, using natural resources and applying policies of renewal and replenishment, and running its economy and social life so that growth is decoupled from increasing and non-sustainable exploitation of natural resources

3.3.6 smart energy installations

community, or locally sited energy generation, distribution and consumption of energy schemes, using low – or nil – carbon emitting technologies in combination with electrical and heat storage technologies

NOTE   In the majority of cases community energy schemes will interact in real time with the national grid system with the aim of:

a)   Increasing resilience of supply.

b)   Increasing security of supply.

c)   Reducing carbon emissions associated with energy generation and consumption.

3.4 Technology and infrastructure

3.4.1 access control

prevention of unauthorized use of a resource, including the prevention of use of a resource in an unauthorized manner

[ISO 24534-5:2011, 3.1]

*NOTE 1   Access control becomes important when more than one entity or system is required to access a resource. In such cases and especially where safety is an issue, there may need to be levels of **access rights (3.1.11)** depending on the priority of the accessing application and the nature of the resource. Permission and ability to use an object for a specified purpose – requesting information from it, changing values of variables in it or modifying its state.*

EXAMPLE   Read access to a shared variable; permission to turn on, or off, i.e. execute certain operations.

*NOTE 2   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)**].*

3.4.2 active infrastructure

live network equipment for receiving, transmitting or distributing digital data and information

3.4.3 application

<in networks> system, including its associated transmission method, which is supported by telecommunications cabling

[ISO/IEC 14543-3-1:2006, 3.1.1]

3.4.4 bandwidth

data transmission rate of digital media

3.4.5 broadband

high-speed, "always on", internet access

*NOTE   The necessary **bandwidth (3.4.4)** is the amount of spectrum required to transmit the signal without distortion or loss of information. FCC rules require suppression of the signal outside the band to prevent interference.*

3.4.6 broadband connectivity

high speed internet access at speeds of hundreds of kilobits per second

*NOTE   Broadband **(3.4.5)** speeds are now more typically several 10s of Megabits per second (Mbps), up to c.100 Mbps.*

3.4.7 co-existence

existence of **objects** and **applications (3.1.5)** in the same environment with no conflict with one another

EXAMPLE   AA security service monitors events in a home via the smart electricity meter communicating via a Zigbee link to the home security gateway. Due to excessive traffic between other Zigbee connected devices, such as the Consumer Display Unit, the meter is temporarily too busy to relay security events and there is a delay in reporting a break-in. The systems do not coexist.

*NOTE   The functions of objects and **applications (3.1.5)** may, or may not, be dependent on one another.*

3.4.8 configuration

set of status parameters for an **object (3.4.20)** or device

*EXAMPLE   A device is connected to the application using a certain network address, its **objects (3.4.20)** are registered with **objects (3.4.20)** in other devices.*

3.4.9 configuration process

configuration (**3.4.8**) of parameters of an **object (3.4.20)** or objects or **applications (3.1.5)**

EXAMPLE   *The association of* **objects (3.4.20)** *in a device with those in other devices.*

NOTE   *This may be carried out by means of a* **configuration (3.4.8)** *tool and other actions that may be automatic and driven by other services and/or applications.*

3.4.10 internet

worldwide interlinked computer systems and computer networks connected via gateways that enable the transfer of data between them

[ISO 9241-151:2008, 3.12]

3.4.11 internet service provider (ISP)

commercial supplier providing access to digital content and services

3.4.12 interoperability framework

standard that defines what **object (3.4.20)** (device, network, **application (3.1.5)**, driver, thing) information must be available to systems for them to use them as part of an interoperable process

NOTE   *Also known as the Interoperability Framework Requirements Specification (IFRS). The IFRS has been put through the CENELEC Workshop Agreement process which has resulted in "standard" CWA50560:2010 IFRS. IFRS also provides methods for using the specifications.*

3.4.13 interworking

See **3.2.8**.

3.4.14 local area network (LAN)

network (3.4.18) in which computers, printers and other equipment are connected and data are transferred within one network

[Adapted from ISO/TR 11636:2009, 2.6]

NOTE 1   *LAN serves a local area (typically the area of a floor of a building, or a group of co-serviced buildings, and which may in some cases span a distance of several kilometres). Typical installations are in industrial plants, office buildings, college or university campuses, or similar locations. This type of* **network (3.4.18)** *is usually controlled by one administrative authority and it assumes other users of the LAN are trusted. The network usually has high speed and is always shared.*

[http://www.erg.abdn.ac.uk/~gorry/eg3561/intro-pages/lan.html.]

3.4.15 long term evolution (LTE)

standard for wireless communication of high-speed data for mobile phones and data terminals

EXAMPLE   *4G ("fourth generation") mobile phone mobile communication technology standards.*

NOTE   *LTE is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using a different radio interface together with core network improvements. The standard is developed by the 3GPP (3rd Generation Partnership Project) and is specified in its Release 8 document series, with minor enhancements described in Release 9.*

[http://en.wikipedia.org/wiki/LTE_(telecommunication)]

3.4.16 masterplan

set of documents laying out the plan and design, which takes into account every element of a city-wide development

NOTE   *Usually done at a strategic level without going into detail design of components within the plan.*

3.4.17 middleware

software which allows for interaction between two or more different software entities by hiding their structure and complexity from each other

[ISO/IEC 29182-2:2013, 2.7.4]

EXAMPLE 1   The IP routing functionality in a home gateway to ISP services provides middleware to connect with the ISP, register local devices for access to internet services and route IP packets between local processes and external ones.

*EXAMPLE 2   A smart meter provides middleware that authenticates application **objects (3.4.20)** downloaded into it before allowing them to use its communications services to implement specific **application (3.1.5)** functions.*

*NOTE   Middleware may be used for the purposes of **interoperability (3.1.40)** to translate the data presented by an **object (3.4.20)** under one specific home system specification to the requirements of another.*

3.4.18 network

collection of computers and devices interconnected by communications channels that facilitate communications among users and allow users to share resources and services

[ISO 2789:2013, 2.4.5]

3.4.19 non-repudiation

service providing proof of the integrity and origin of data (both in an unforgeable relationship) which can be verified by any party

[ISO/TS 22600-3:2009, 3.72]

EXAMPLE   A digital signature may provide proof of non-repudiation as it links the sender with the message.

3.4.20 object

embodiment of information as data structures and **operations (3.4.21)** upon the realized in electronic hardware, software, or embedded in a stream of data, that can be referenced and with which interaction can be achieved by processes, other **objects (3.4.20)** and users

3.4.21 operations

instance describing one complete procedure

[ISO 20242-3:2011, 3.5]

3.4.22 passive infrastructure

non-active parts of the **digital infrastructure (3.2.5)**

NOTE   This includes cables and outlet sockets and contain no active elements to process digital data and content, but permit the transmission of the information.

3.4.23 platform

combination of an operating system and hardware that makes up the operating environment in which a program runs

[ISO/IEC 26513:2009, 3.26]

3.4.24 replay attack

masquerade which involves use of previous transmitted messages

[ISO 24534-4:2010, 3.62]

3.4.25 repudiation

denial by one of the entities involved in a communication of having participated in all or part of the communication

[ISO 7498-2:1989, 3.3.44]

3.4.26 privacy
See **3.1.53**.

3.4.27 sensor node
sensor network element that includes at least one sensor and optionally **actuators (4.1.1)** with communication capabilities and associated data processing capabilities

[ISO/IEC 20005:2013, 3.9]

3.4.28 validation
act of examining information provided by a person (or a system) to ascertain what rights, privileges, or permissions they may (or may not) have to perform some action

3.4.29 verification
<in cryptography> testing the authenticity of a digital signature by performing special mathematical operations on data provided by a sender, to see if it matches an expected result

NOTE   If the information provided by the sender yields the expected result, the signature is valid, because calculating the proper answer requires secret data known only by the sender. Verification proves that the information was actually sent by the signer and that the message has not been subsequently altered by anyone else.

3.4.30 wide area network (WAN)
network (3.4.18) that provides communication services to a geographic area larger than that served by a **local area network (3.4.14)** or a metropolitan area network

[ISO/IEC 2382-9:1995, 09.07.11]

3.4.31 wireless mesh
network (3.4.18) relying on all nodes to propagate signals

*NOTE   Although the wireless signal may start at some base station (access point) attached to a wired **network (3.4.18)**, a wireless mesh network extends the transmission distance by relaying the signal from one computer to another. Used on the battlefield to provide path diversity, it is also used for sensor networks and personal computers.*

[http://www.pcmag.com/encyclopedia_term/0,2542,t=wireless+mesh+andnetworka ndi=54776,00.asp]

3.5 Governance

3.5.1 accountability
property that ensures that the actions of an entity may be traced uniquely to the entity

[ISO/IEC 13888-1:2009, 3.1]

3.5.2 civic engagement
involvement and participation of various civil society organizations, stakeholders, communities and citizens in policy-making and public debate

NOTE 1   Smart city applications can enhance civic engagement, for example through shared online platforms. At the same time, smart city applications may run the risk of disenfranchising certain communities.

NOTE 2   "Civic stewardship" is the responsible planning and management of resources in the public interest. In cities, stewardship groups are organizations or groups of people who work to conserve, manage, monitor, and advocate for, their local environment, such as urban parks and historic sites.

3.5.3 governance
effective **co-ordination (3.1.18)** and integration of policy- and decision-making processes within and across organizational structures, assisted by relevant information and communication technologies and systems

NOTE   Governance strategies and processes are particularly important to urban systems and sustainability initiatives, as they enable the networking within and between organisations and the integration across policy domains. Smart city technologies can be used to support and enhance the governance process.

3.5.4   public accountability

responsibility and public answerability of decision takers for processes and outcomes

*NOTE   The integration and **co-ordination (3.1.18)** of complex urban systems through various smart city tools and techniques create additional needs for public accountability, to ensure the transparency and legitimacy of decision processes, outputs and outcomes.*

3.5.5   social inclusion

implementation of policies and practices to ensure that all members and groups in society, particularly those in lower income bands, and those belonging to minority groups, can affordably access and use essential day-to-day rights and services

NOTE   For example, employment, adequate housing, health care, education, training, digital access, etc.

3.5.6   social exclusion

exclusion from the prevailing social system and its rights and privileges, typically as a result of poverty or the fact of belonging to a minority social group

[Shorter Oxford English Dictionary]

NOTE   Social exclusion is about the inability of our society to keep all groups and individuals within reach of what we expect as a society. It is about the tendency to push vulnerable and difficult individuals into the least popular places, furthest away from our common aspirations. It means that some people feel excluded from the mainstream, as though they do not belong. For a long time this has meant that inner city areas, and some large outlying council estates, increasingly vacated by people who can find an alternative, became a receptacle for problems (Power, A., Wilson, W.J., "Social Exclusion and the Future of Cities", Centre for Analysis of Social Exclusion, London School of Economics, London, 2000 http://eprints.lse.ac.uk/6470/1/Social_Exclusion_and_the_Future_of_Cities.pdf).

3.5.7   transparency

openness of decision processes and outputs, enabled by the availability of information and data in accessible language

*NOTE   The introduction of **smart city systems (3.1.64)** and techniques can make information more complex; at the same time, open and shared access to information can be enhanced through smart city applications.*

4   Applications (output channels)

4.1   Environment

4.1.1   actuator

device that performs actions such as turning things on or off or making adjustments in an operational system

[http://publib.boulder.ibm.com/infocenter/pvcsensa/v6r1m0/index.jsp?topic=/com.ibm.wrps.doc_6.1.0.1/ov_rfid.html]

NOTE   Valves and switches are examples of actuators.

4.1.2   node

element of a **network (3.4.18)** that represents a junction or intersection

[ISO 6707-1:2004, 7.1.23]

*NOTE   The main components of a **sensor node (3.4.27)** are a microcontroller, transceiver, external memory, power source and one or more **sensors (4.1.3)**.*

4.1.3 sensor

device that detects a condition in a system or component and produces an output signal

[ISO 5598:2008, 3.2.649]

NOTE   A thermometer is an example of a sensor.

4.1.4 smart meter

energy meter that can both send and receive information using an external electronic communications network

4.1.5 urban planning

technical and political process concerned with the use of land and design of the urban environment, to guide and ensure the orderly development of settlements and communities

4.1.6 wireless sensor network (WSN)

spatially distributed autonomous **sensors (4.1.3)** monitoring physical or environmental conditions, and co-operatively passing their data through a **network (3.4.18)** to a main location

NOTE   WSNs are used nowadays in many areas of daily life. A sensor network is made up of spatially distributed **sensor nodes (3.4.27)**, which interact with one another independently and, depending on the **application (3.1.5)**, with the existing infrastructure by radio. This serves the purpose of acquiring, processing, forwarding and providing digitalized information from the physical environment. Sensor networks may vary in terms of the type of networking, topology and direction of data flow. [[http://www.iis.fraunhofer.de/content/dam/iis/en/dokumente/Embedded-Communication/KOM_WSN_MAL-1000563-0202-1109_Wireless%20Sensor%20Networks.pdf]

4.2 Finance and economy

4.2.1 broadband economy

product of the build-out of low-cost, high-speed communications and information technology *at* both the global and local levels

NOTE   During the 100 years from 1870 to 1970, the number of people living on more than US$1 per day, adjusted for inflation, grew by 157 million. At the same time, however, the number living on less than 1 dollar a day also grew by 45 million. That's not bad: a net gain of over 100 million people who moved out of the most abject poverty. But compare that to the decade from 1990 to 2000. The number of people living on more than 1 dollar a day grew by 890 million, while the number living on less shrank by 139 million. What made the difference? The explosive growth of global networks that reduced costs, boosted trade volumes and made us all more productive.

[https://www.intelligentcommunity.org]

4.2.2 circular economy

economy where the traditional production-consumption relationship has evolved from a linear relationship of make, use, and dispose, to one where the maximum value of resources are extracted during a product's lifecycle (through optimum use, maintenance and repair) and at the end of the life cycle by recovery and regeneration of products and materials

NOTE   A "circular economy" describes the interdependence between production and consumption. The consumer offers their labour to a producer in return for wages. These wages are then used to purchase goods or services from the producer. The circular economy can be further developed to include government. Both the producer and the consumer pay taxes to the government who in return provides services to the consumer such as health care and education. This benefits the consumer who receives a higher quality of life and the producer who has access to a higher skilled worker.

4.2.3 micropayment system

e-commerce transaction involving a very small sum of money in exchange for something made available online, such as an **application (3.1.5)** download, a service or web-based content

NOTE   There is currently no standardized definition on what amount of money may be considered to be a micropayment. A special type of system is required for such payments, which are too small to be feasible for processing through credit card companies.

[http://whatis.techtarget.com/definition/micropayment]

4.2.4 smart city system

See **3.1.64**.

4.2.5 smart economy

economy in which there is ubiquitous digital connectivity between a large proportion of the different elements of the economy, sustainably matching demand requirement against supply availability, ensuring minimum environmental impact and seeking to replenish or displace use of natural resources extracted to meet demand

NOTE   An example would be the allocation of scarce resources when resources are limited and wants unlimited. To this end resources are allocated efficiently by smart tools to realize a Pareto optimality so that a society's well-being is maximized and the opportunity cost of using resources is minimized. A smart economy also has to take into consideration the notion of stewardship of present resources for future generations.

4.3 Mobility

4.3.1 bandwidth

See **3.4.4**.

4.3.2 integrated transport

infrastructure supporting the end-to-end movement of people and goods through various transport modes

NOTE   Transport modes and facilities can include road, rail, maritime, air, foot and cycle.

4.3.3 local area network (LAN)

See **3.4.12**.

4.3.4 smart mobility

productive movement of people, information and goods

4.3.5 switch

primary active equipment interfacing external and internal networks of a building which connects digital devices in the building to form an internal **network (3.4.18)**

*NOTE   More than one switch may be needed in an internal **network (3.4.18).***

4.3.6 wi-fi

facility allowing computers, smartphones, or other devices to connect to the internet or communicate with one another wirelessly within a particular area

[Shorter Oxford English Dictionary]

*NOTE   Wi-Fi **networks (3.4.18)** use radio technologies called 802.11 to provide secure, reliable, fast wireless connectivity. A wi-fi network can be used to connect electronic devices to each other, to the internet, and to wired networks which use ethernet technology. Wi-Fi networks operate in the 2.4 and 5 GHz radio bands, with some products that contain both bands (dual band). They can provide real-world performance similar to basic wired networks.*

[[http://www.wi-fi.org/discover-and-learn]

4.4 Community support, education and skills

4.4.1 behavioural change
enabling and change in individual, family and community lifestyle patterns to facilitate sustainable living

NOTE   Such change could be enabled by, for example, using energy-saving devices in homes.

4.4.2 enabling infrastructures
"hard" infrastructures that support the activities of the city and society

NOTE   Examples of "hard" infrastructures include transport, waste, energy, ICT, built environment and water. Similarly, there is a set of enabled "soft" infrastructures that underpin the delivery of goods and services such as health, civil administration, defence and security, commerce and education.

4.4.3 public open data
objective, factual, non-personal data on which public services run and are assessed, and on which policy decisions are based, or which is collected or generated in the course of public service delivery

[Data Transparency Board]

4.4.4 telecare
personal and/or environmental **sensor (4.1.3)** in the home used to enable people to remain safe and independent in their own home for longer

NOTE   24-hour monitoring ensures that should an event occur the information is acted upon immediately and the most appropriate response put in train.

[DoH Whole System Demonstrator Programme http://www.dh.gov.uk/prod_consum_dh/ groups/dh_digitalassets/documents/digitalasset/dh_131689.pdf]

4.4.5 telehealth
electronic **sensor (4.1.3)** or equipment used to monitor vital health signs remotely

NOTE   These readings of vital signs are automatically transmitted to an appropriately trained person who can monitor the health vital signs and make decisions about potential interventions in real time, without the patient needing to attend a clinic.

[[DoH Whole System Demonstrator Programme http://www.dh.gov.uk/prod_consum_ dh/groups/dh_digitalassets/documents/digitalasset/dh_131689.pdf]

4.4.6 telemedicine
use of advanced telecommunication technologies to exchange health information and provide health care services across geographic, time, social and cultural barriers

[ISO/TR 16056-1:2004, 3.76]

4.5 Lifestyle

4.5.1 behavioural change
See 4.4.1.

4.5.2 health and well-being
condition of an individual or group

NOTE   Currently loosely defined, with different interpretation depending on application.

4.5.3 smart living
utilization of sustainable solutions for urban living

Bibliography

Further reading

UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP). 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". Nairobi: UNEP, 2011.

CHESBROUGH, H. *Open Innovation*. Boston: Harvard Business School Press, 2003]

LANE-FOX, M. *Champion for Digital Inclusion – The Economic Case for Digital Inclusion*. London: Price Waterhouse Coopers, 2009.

Index

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