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TECHNICAL SPECIFICATION

Access, Terminals, Transmission and Multiplexing (ATTM); Sustainable Digital Multiservice Cities (SDMC); Broadband Deployment and Energy Management; Part 1: Overview, common and generic aspects of societal and technical pillars for sustainability

Reference

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

The present document is part 1 of a multi-part deliverable covering Sustainable Digital Multiservice Cities (SDMC), as identified below:

Part 1: "Overview, common and generic aspects of societal and technical pillars for sustainability";

Part 2-1: "Multiservice Networking Infrastructure and Associated Street Furnitures; Sub-part 1: General requirements";

Part 2-2: "Multiservice Networking Infrastructure and Associated Street Furniture; Sub-part 2: Femtocell 5G connectivity on light poles".

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Executive summary

The main objectives of cities are to improve citizens' lives, local economy dynamics and to attract new residents and companies to establish locally. Strong evolutions in the fixed and mobile Internet connectivity have impacted the expectations and behaviours of the people and the enterprises they are working for.

Digital services have become an important part of the daily life, crossing many activities within the day from personalized morning news, through latest updates on the transportation schedule (bus, train, road traffic), the operations at work or schools even up to shopping at the supermarket. This digital revolution has also entered the area of services and operations delivered by public services such as the city. To adopt this evolution, the Information Communication Technology (ICT) platforms of the city services should be rethought and changed from the silo strategy to an integrated approach. To achieve this goal, the ICT of the city should rely on a unified digital multi services infrastructure that combines cable-based and wireless networks.

This digital multi services infrastructure is supposed to be economic, safe, multi purposed and future proof to enable the sustainability of the city with regard to its digital services strategy and roadmap.

Up till now silo and vertical ICT have been mainly taken into consideration to deploy services. For a few years, various smart city efforts and initiatives suggest to strongly adopt a transversal approach in which services share a common Internet Protocol (IP) network, co-operate between each other and furthermore enable third parties to leverage the value offered by the power of data mining and big data processing.

A common and shared multi services architecture for the city's digital services is therefore needed to achieve the city's goals and ambitions at reasonable cost of ownership and of operation while strongly taking into consideration the eco efficiency of the different elements of the ICT deployments.

Introduction

Today digital life is leading major evolutions in the expectations that people and enterprises have towards public administrations. As the local representative and interface, the municipality is on the front line. The boom of the mobile Internet economy has created many new types of services which requires the city to evolve and adapt to such new behaviours from their target audiences.

City parking or tourism attractiveness are two simple examples of the digital revolution. In both cases, one expects to have access to digital services which respectively facilitates the discovery of an available parking place or to the accessibility of a local public transportation facility such as buses, trams and even city bikes.

These digital services have increased the requirements of the ICT infrastructures of the city and amplified the need for a more sustainable Information Technology (IT) design. Smart digital city parking service requires sensors to be deployed within the field, that their real-time status (busy or available parking place) is transmitted through a data network and that a digital service leverages this information to be made available to the driver but also to the financial department in case the parking usage has to be charged.

Today many city applications are to be seen as island or silo applications and have their own networks, own software platforms and as a result have different operations and maintenances. A common architecture will reduce this multiplication of networks and software solutions while improving the economical and energy efficient costs.

The present document contains information which covers topics such as Data Governance, cross-domain information, Open Data, Key Performance Indicators, digital network divide, user security and privacy which constitutes the theoretical pillars behind any network and services deployments of a digital multiservice city.

1 Scope

The present document introduces the common and generic aspects of the societal and technical pillars to achieve sustainability objectives behind the deployment of smart new services within the IP network of a single city or an association of cities administratively clustered.

Clause 4 identifies and presents a general overview of a city from small entity to significantly large municipality clustering several cities and villages.

Clause 5 presents the pursued objectives behind the concept of smart city.

Clause 6 describes the general theoretical pillars which bear the engineering requirements to deploy a digital multi service city.

Clause 7 identifies the general needs from the cities.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] CENELEC EN 50173-2: "Information technology - Generic cabling systems - Part 2: Office spaces".

[2] CENELEC EN 50173-4: "Information technology - Generic cabling systems - Part 4: Homes".

[3] CENELEC EN 50174-1: "Information technology - Cabling installation - Part 1: Installation specification and quality assurance".

[4] CENELEC EN 50174-2: "Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings".

[5] CENELEC EN 50174-3: "Information technology - Cabling installation - Part 3: Installation planning and practices outside buildings".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TS 105 174-5-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment and Energy Management; Part 5: Customer network infrastructures; Sub-part 1: Homes (single-tenant)".

[i.2] ETSI TR 105 174-5-2: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment - Energy Efficiency and Key Performance Indicators; Part 5: Customer network infrastructures; Sub-part 2: Office premises (single-tenant)".

[i.3] ETSI TS 105 174-5-4: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment - Energy Efficiency and Key Performance Indicators; Part 5: Customer network infrastructures; Sub-part 4: Data centres (customer)".

[i.4] ETSI TR 105 174-2-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment - Energy Efficiency and Key Performance Indicators; Part 2: Network sites; Sub-part 1: Operator sites".

[i.5] ETSI TR 103 290: "Machine-to-Machine communications (M2M); Impact of Smart City Activity on IoT Environment".

[i.6] ETSI TR 102 898: "Machine to Machine communications (M2M); Use cases of Automotive Applications in M2M capable networks".

[i.7] ETSI TR 102 935: "Machine-to-Machine communications (M2M); Applicability of M2M architecture to Smart Grid Networks; Impact of Smart Grids on M2M platform".

[i.8] ETSI TR 102 857: "Machine-to-Machine communications (M2M); Use Cases of M2M applications for Connected Consumer".

[i.9] European Innovation Partnership on Smart Cities and Communities: "Operational Implementation Plan".

NOTE: Available at http://ec.europa.eu/eip/smartcities/files/operational-implementation-plan-oip-v2_en.pdf.

[i.10] European Innovation Partnership on Smart Cities and Communities: "Strategic Implementation Plan".

NOTE: Available at http://ec.europa.eu/eip/smartcities/files/sip_final_en.pdf.

[i.11] European Innovation Partnership on Smart Cities and Communities: "Humble Lamppost".

NOTE: Available at https://eu-smartcities.eu/commitment/6670.

[i.12] ETSI GS OEU 009: "Operational energy Efficiency for Users (OEU); Global KPI Modelling for Green Smart Cities".

[i.13] ETSI GS OEU 019: "Operational energy Efficiency for Users (OEU); KPIs for Smart Cities".

[i.14] ETSI TS 103 463: "Access, Terminals, Transmission and Multiplexing (ATTM); Key Performance Indicators for Sustainable Digital Multiservice Cities ".

[i.15] IEEE 802.11: "Wireless LAN; 802.11-2012 -- IEEE Standard for Information technology -- Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

[i.16] Market Place of the European Innovation Partnership on Smart Cities and Communities.

NOTE: Available at http://eu-smartcities.eu.

[i.17] European Innovation Partnership on Smart Cities and Communities "s[m2]art".

NOTE: Available at https://eu-smartcities.eu/commitment/7434.

[i.18] Recommendation ITU-T Y.4900: "Overview of key performance indicators in smart sustainable cities".

[i.19] Recommendation ITU-T Y.4901: "Key performance indicators related to the use of information and communication technology in smart sustainable cities".

[i.20] Recommendation ITU-T Y.4902: "Key performance indicators related to the sustainability impacts of information and communication technology in smart sustainable cities".

[i.21] Recommendation ITU-T Y.4903: "Key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals".

[i.22] ISO 37120:2014: "Sustainable development of communities -- Indicators for city services and quality of life".

3 Definition of terms and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

digital multiservice cities: cities using digital infrastructure which consists of a single unified high-speed networking infrastructure that allows the ICT systems of the complete city services departments to interconnect seamlessly and securely to each other

street furniture: collective term for objects and pieces of equipment installed on city streets, city roads, and public areas under responsibility of the city for various purposes. These objects and equipment belong to the wider terminology of the urban assets as named by cities

urban asset: collective term to qualify the physical assets which belong to a city and which are located across its territory, in streets, roads, public parks and associated urban constructions

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

API	Application Programming Interface
ATTM	Access, Terminals, Transmission and Multiplexing
CCTV	Closed-Circuit TeleVision
EIP	European Innovation Partnership
EIP-SCC	European Innovation Partnership on Smart Cities and Communities
GS	Group Specification
ICT	Information and Communication Technology
IEEE	Institute for Electrical and Electronics Engineers
IoT	Internet of Things
IP	Internet Protocol
ISG	Industrial Specification Group
ISO	International Organization for Standardization
ISP	Internet Service Provider
IT	Information Technology
ITS	Intelligent Transportation Systems
ITU	International Telecommunication Union
KPI	Key Performance Indicator
LAN	Local Area Network
M2M	Machine to Machine
MAC	Media Access Control
OEU	Operational energy Efficiency for Users
SME	Small and Medium Enterprise
SOHO	Small Office Home Office

TR	Technical Report
Wi-Fi	Wireless Fidelity
WLAN	Wireless LAN

4 General overview of a city

4.1 Reaching sustainability through digital multiservice city networks

Municipality facilities range from a single premise to multiple buildings located across the city territory. Single premise municipality comes from the origin of this administrative facility: "the city house" where the mayor was living and where all government administrative duties were performed.

Through the centuries, the mayor has been supported by more and more complementary staff creating by purposes respective services departments. Along this employment growth, city property availabilities or acquisitions, services offices started to span either across several physical building facilities within the city area either across larger geographical areas when the administrative entity spanned on multiple contiguous cities or villages.

Municipalities nowadays have also undertaken several other responsibilities such as safety, education, waste management, recycling, healthcare, water and electricity distribution, public transportation and potentially many more.

Most of today's municipalities are supported by Information and Communications Technologies to help the city staff to perform the daily work, communicate with each other and with the higher authorities. In that concern, municipalitie's operations should be considered as an enterprise ranging from a Small Office Home Office (SOHO), a Small and Medium Enterprise (SME) up to large enterprise. According to the respective type of enterprise the city can be matched to, technical recommendations which apply to homes and offices ICT deployments such as ETSI TS 105 174-5-1 [i.1], ETSI TR 105 174-5-2 [i.2] and ETSI TS 105 174-5-4 [i.3] or to telecommunication services providers such as ETSI TR 105 174-2-1 [i.4] should be considered to improve the energy management of the city ICT deployment.

Indeed, from a networking perspective municipalities have various challenges to face.

4.2 Inside-building connectivity cabling infrastructure

Regularly the buildings which host the municipal staff are not contemporary and have not been designed with IT in mind. Furthermore, in important cities, these buildings are often classified heritage buildings and construction works are heavily constrained.

The result is that network cabling is regularly a concern. It is common to see physical deployments where rooms are not correctly equipped with appropriate network access sockets, that network cables are inappropriately installed, that technical facilities such as cable patch panels are imperfectly installed or simply missing, etc. Finally, poor cross-domains vision leads often to the installation of several independent physical network cabling setups such as:

- Network cablings for analog/digital telephony services.
- Network cablings for emergency (e.g. alarms, elevators) services.
- Network cabling for IT data networking service.
- Network cabling for IP telephony service.
- Network cabling for analog/digital video surveillance service.
- Network cabling for IP video surveillance service.

There is a clear need to unify these ICT independent infrastructures through a common multi-services physical engineering architecture.

Requirements, specifications and best practices for the deployment of these physical cabling infrastructures are covered by various norms such as CENELEC EN 50173-2 [1], CENELEC EN 50173-4 [2], CENELEC EN 50174-1 [3] and CENELEC EN 50174-2 [4].

4.3 Inter-buildings connectivity cabling infrastructure

Nowadays, in many cases municipal facilities are spread across many buildings which may or may not be near to one another. Besides the constraint of classified heritage buildings, distances between facilities may be large. In that regard and according to the capabilities, municipalities either opt to deploy their own inter-building cablings or either opt for contracting external service provider(s).

Similarly to the local cabling, poor cross-domains vision regularly leads to the installation of several independent physical network cabling setups thus establishing multiple service contracts with service providers.

There is a clear need to improve the engineering architecture which interconnects the various facilities spread across the territory.

Requirements, specifications and best practices for the deployment of these physical cabling infrastructures are covered by various norms such as CENELEC EN 50174-1 [3] and CENELEC EN 50174-3 [5].

4.4 Digital services availability

IP networking technology leverages numerous IT services such as data transfer, digital telephony, video surveillance, IoT operation and monitoring, etc. IT staff availability within the municipality shall be taking into account and due to financial constraints regularly missing (small cities, villages) or outsourced to external services providers. The consequence is that there is limited or a missing engineering view on the deployment of the digital services. It is a common situation where the IP data network is unfortunately fragmented into multiple independent IP networks isolated from one another and even requires to pass through externals service providers for internal communications.

By example, when migrating from analog/digital telephony or video security to IP telephony or video security, lack of technical engineering and poor global networking views often lead to mirror traditional POTS (Plain Old Telephone Service) or situation. Municipalities often deploy independent and isolated IP networks per service and per site (even per building) whereas technically engineered design would suggest to architecture the deployment as a single unified IP voice or video platform leveraging a multi service network spanning across the building facilities.

The engineering of a multi-services network would also open the way to innovative IT solution such as voice and video convergences while also enabling communication between:

- physical IP phones and softphone running on municipal employee's computer,
- access to IP camera video streams from authorized computer within the network.

4.5 Network access coherence

Local or inter-buildings physical networking connectivity has constrained the municipal authorities to fragment their local IP networks into isolated networking areas. Access to the Internet, or specific national network resources, with such engineering implies to install a dedicated physical connection to a network service provider (e.g. ISP) within each local network. Unfortunately, it is also common to have cities where Internet connections are even physically linked to single agent computers therefore removing the capability to share the service provider access with the agent department.

The engineering of a multi-services network would also improve the accessibility to the Internet as well as to other specific external services (e.g. national citizen or enterprise's registries) such as those provided by higher authorities of the government.

5 General considerations about digital multiservice city

Renowned technology organizations such as the ITU-T describes the concept of the sustainable city with the following terms:

"A smart sustainable city is an innovative city that uses ICT and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects".

This definition has been developed based on the work carried out by FG-SSC and UNECE in ITU-T SG5.

The point of view of internationally recognized analysts share a strong position that technology organizations emphasise the importance of a transversal approach across the various services which build the organization of a city:

"A smart city is based on intelligent exchanges of information that flow between its many different subsystems. This flow of information is analysed and translated into citizen and enterprises services. The city will act on this information flow to make its wider ecosystem more resource-efficient and sustainable. The information exchange is based on a smart governance operating framework designed for cities sustainable" (Gartner, 2011).

An increasing number of everyday machines and objects are now embedded with sensors or actuators and have the ability to communicate over the Internet. Collectively they make up the Internet of Things (IoT).

With the development of the IoT, more and more of the information systems present in the city are now offered technologies which enable real-time data harvesting and almost real-time data processing and sharing.

Within ETSI, the SmartM2M Technical Committee (TC) is focusing on the specifications and requirements to enable end to end interoperability between Machine-to-Machine (M2M) communications.

The scope of the following documents covers topics such as smart grids, connected cars, home automation and smart cities. The work program includes:

- to develop and maintain an end-to-end overall telecommunication high level architecture for M2M;
- to identify gaps within existing standards and provide specifications to fill these gaps.

TC SmartM2M has initiated several developments of standards for communication between Smart Appliances. The standards are based upon ETSI's functional architecture for Machine to Machine communications, and includes a common data model and the identification of communication protocols for several use cases such as transport, water management, building management, culture & tourism, described in ETSI TR 103 290 [i.5], ETSI TR 102 898 [i.6], ETSI TR 102 935 [i.7] and ETSI TR 102 857 [i.8].

To be sustainable in servicing or introducing new digital services, the city needs to have an ICT infrastructure which enables seamless end to end communications at the lowest possible cost of installation, energy consumption and operation. By enabling a common infrastructure, structural expenses can be shared amongst the variety of services that the ICT of a digital city has to cover.

6 Theoretical pillars for a digital multiservice city

6.1 Convergence path

From villages to megacities, across urban cities, all of these living places can be qualified by some 'smart' attributes within the different delivered services: energy (electricity, gas) delivery, water management (distribution, recycling), waste (organic, plastic, generic) management, transportation (bus, metro, train), education, healthcare, public security and mobility (road, traffic light). The daily operations of the administration, which could be considered as the enterprise behind the scene, are also areas where smart process and smart management, smart building, etc. could be realized.

It is now clear that with the maturity of various ICT technologies, most of these public order services could benefit from the data era to improve their efficiency, sustainability and increase the level of quality for the resident citizen, the municipal workforces or the enterprise's commuters.

From data collection (e.g. consumption metering, traffic flow, air/water quality monitoring) to data analytics, all these types of data processing may receive the added values behind the sustainablility mindset. Nevertheless, before any specific ICT terminology this road has to be first defined in terms of functional aims which are presented in figure 1.

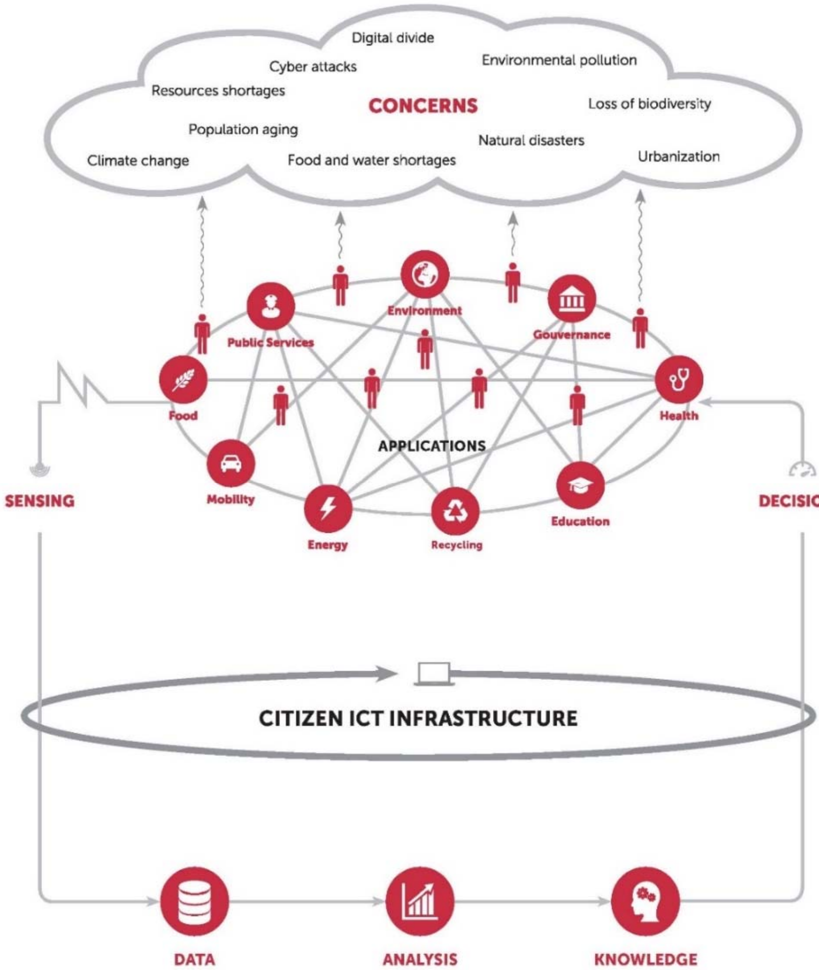

Figure 1: Functional aims of a digital multiservice city

6.2 Cross domain

The municipal services provided to residents, in return of their local taxes, depend on numerous factors: size of the territory, number of inhabitants, history, geographical location, etc. Basic services expected by the city authorities range from water delivery, sanitation sewer, sanitation refuse & waste, street/parking/public transport (bus, metro, etc.) and lighting for mobility, schools and public libraries for education, police and fire departments for security, hospitals and ambulances for healthcare, etc. For ages, these services have been the concern of several different municipal employees who often belong to separate and independent departments. This underlying administrative structure, "*bigger the city,bigger the gap*", has lead cities to adopt an operational model which inducts the silos mentality.

Silos Mentality is a mindset present when certain departments or sectors are unable or do not wish to share information with others in the same organization. Such low working relationships and lack of cooperation have also impacted the way ICT technologies have been introduced into the operational engine of the cities. In most cases IT applications have been designed and developed to answer specific service needs independently from one another. It is also likewise that these applications evolve independently of each other. Consequences of such a behaviour reduce the efficiency in the overall operation but also do not contribute to productivity improvement.

The presence of these silos has numerous impacts such as:

- Information fragmentation:
  - In the presence of different and non-interworking applications and systems, the data tends to remain isolated whereas specific cross domains exchanges would be beneficial. For example, crossing real-time household data on water consumption with the water pumping station operational network would probably reduce the leakage in delivery in some under provisioned areas at critical moments of the day.
- Inability to think of the economy of scale:
  - Existing silo-based model leads to multiple procurements for similar infrastructures or applications. For example, installing outdoor IEEE 802.11 [i.15] WLAN (Wi-Fi) networks for public Internet access, deploying another for the video security purposes while also setting up separated backbone networks would imply both cost increase in procurements, management and support but also constraints on technical aspects such as radio frequency interferences, physical asset limitations and urbanistic headaches.
- Lack of uniform technical specifications:
  - Independent applications or network infrastructures design, non-coordinated procurements result in heterogeneous technological platforms, which are more difficult and costly to manage, maintain and evolve. For example, area-wide villages or municipalities have often their employees and workers spread across several buildings situated in different locations. The local IT networking infrastructures are commonly independent from one another leading regularly to situations where both networks cannot talk to each other and most probably have their standalone Internet access. Such an unplanned situation would seriously impact the setup and Total Cost of Ownership of an IP telephony platform.

It is therefore clear that cross domain thinking shall be applied when possible. The various levels where this specific exercise should be realized are:

- service business logic on both functional and operational levels;
- network (wired & wireless) architecture on Local Area Networks, Metropolitan Area Networks and Wide Area Networks;
- applications data structure, semantic and correspondences;
- data access methods;
- application software architecture.

By embracing cross domain mentality versus silos mentality, serious operational improvements could be achieved thus strengthening the adoption of the smart city. As an example, real time crossing data of city parking availabilities, city traffic status, and street traffic lights might enable both free parking locations suggestions to car drivers while making traffic more fluid through the avoidance of congestion areas where many drivers will converge. Furthermore, this fluidity in the traffic could be reflected by influencing the traffic lights in a positive manner.

6.3 Data Culture & Open Data governance

For ages, municipalities have been servicing public interests and citizen needs generating numerous information of different kinds not shared with any party outside the city. Even in the presence of ICT technologies, these data have been locked within the specific business applications in which there were processed.

One key feature of digital multiservice city is the adoption of the cross-domain approach. When ICT technologies are designed with this mentality many innovations may emerge.

To remain competitive and achieve sustainable growth, cities shall embrace the Data Culture philosophy. By changing the way government officials look at and use data such a mindset enables the ICT ecosystem to be creative and this out of the box. Indeed, rather than limiting the usage of a specific set of data within a city department to its specific business processing, sharing this set with other departments but also with a third party outside the city sphere could benefit to the overall community.

For example, it is the water department which usually manages the fire hydrant locations as they belong to the water infrastructure city assets. However, the primary beneficiaries of this location data set are entities like the fire department and public safety. The water department has traditionally the responsibility for disseminating this information to those that need it. By embracing the Data Culture, instead of keeping these locations records and the associated operational status (operational valve, water flow, water pressure, etc.) closed and communicating these only once in a while, sharing dynamically these precious data with the outside could be of a great benefit and even can save lives.

Opening Data outside the traditional scope of single or multiple city departments often faces technological and political barriers. Indeed, many city data are decades old, and extracting information to release as Open Data can be time consuming and difficult. Furthermore, some fear that releasing information could be used by outside parties to evaluate their performances.

Open Data does not mean providing access to anyone or in any way. When adopting this practice, data governance should be associated. Indeed, data should be structured in understandable formats, with defined semantics, open access should be presented according to their respective scope and usage should be logged. Furthermore, Open Data does not mean Free Data. Data Culture of a municipality is therefore also the ability to both operate as a free public service but also as an enterprise minded organization.

6.4 Data Culture & Open Data governance

When it comes to IT, there are important inequalities between the cities. According to the size of the area, the number of inhabitants, the variability in the publicly provided services, the specificities (industrial, vacation, port, university, etc.) or the status (village, capital, etc.), the obligations and the finances (through regional/governmental subsidy or local taxes) are different. These differences have an impact on the level of use of IT and therefore on the service level and service quality which could be achieved through the digital infrastructure within reasonable limits.

Nevertheless, whatever the city, critical services shall be treated with the same importance. ICT infrastructures and applications related to the critical domains (e.g. police, fire department, alerting system) shall be seriously analysed and associated with particular service levels such as:

- availability;
- interoperability;
- scalability;
- resilience.

Besides critical conditions where all these service levels shall be simultaneously associated, independent concerns should be applied in ICT fields such as to:

- avoid vendor lock-in and proprietary technologies;
- enable common information and meta-data semantic across vertical domains;
- enable open data interfaces/API between applications;
- enable infrastructures/platforms monitoring and proactive supervision.

By introducing these service level requirements, it is possible to embrace the concept of a digital multiservice city. As an illustration there are numerous city departments which may have valuable information serviceable to address the question of unoccupied dwellings:

- The revenue department views the notion of vacant property through their records which keep track of those who pay property taxes and those who do not.
- The water and electricity departments view the notion of vacant property through their records which keep track of those who have an active account and effective consumption and those who do not.
- The sanitation refuse and waste department views the notion of vacant property through their records which keep track of the collection passages and the weight of waste collected.

As there is not a department in charge of keeping track of vacant properties, there is not an appropriate view on this question. Several departments have some data on the problem of vacancy, but their interpretation of the question is approached through the lens of the service they deliver.

However, if these data sets are made available, in a digital and interoperable format, crossing them would give a better view and help reduce the vacancy rate. This will be of added value for the citizen (vacant properties negatively impact housing values), the real estate business (increase value proposition), the city (population growth) and even the police (vacant units are more likely to be vandalized or squatted).

6.5 Digital Equity

On the road to digital, cities are taking important decisions which impact the operation and delivery of their public services. From data scanning to e-Government, gradually the delivery model is modernized with digital assets and offering. While Municipal Service Counters are complemented with digital counterpart, some are simply replaced by their digital counterpart.

Digital Service Counters are of a great benefit to the population or the businesses/commerce. Residents who have mobility issues, poor health, the elderly and those living in geographically remote areas can take advantage of this delivery method. A local trader should no longer be forced to close shop to get to the administration offices and neither should business employees have to take breaks during work. Digital services provide also facilities for the administration to communicate with the population, alerting systems are in the first line for such improvement.

To illustrate these, it can be mentioned:

- alerting the inhabitant of a specific geographical zone in case of water contamination, fire and air pollution;
- notifying the inhabitants of a neighbourhood before the waste truck round;
- soliciting the citizen for the electoral duty;
- invoicing the inhabitant for the various city taxes;
- etc.

Public libraries, municipal schools, social services:

It seems obvious that these multi service facilities are permitted through the Internet. However, even if every day the penetration of the broadband access in increasing, there is still a large percentage of the population without Internet access or who do not have access at all. Literature refers to this inequality as the Digital Divide.

It is therefore essential that the digital multi service city does everything in its power to reduce and defeat this Digital Divide. Cities have some answers to fulfil the Digital Equity:

- Digital Public Space in some of the city property (e.g. city house, library house, library truck).
- In such places where anyone who wishes (children, adults, all social classes, all ages) can come to connect the available computers and access the Internet for all types research.
- Public Wi-Fi in some of the city property or areas (e.g. city house, city green park, city places).
- Facilitating (e.g. building permit, taxes incentives) Service Provider in their Broadband deployment (wired or wireless) within the city administrative scope.
- Specific education courses within the children schools or recycling courses for elderly.

6.6 Pledge of confidence

Municipalities collect and own numerous information about their inhabitants, companies established in the territory and commuters. On one side, they have immediate access to data such as electricity or water consumptions, the amount of produced waste, the financial income, the properties ownership, the various contacts information (addresses, phones numbers, etc.), the family status and composition, etc. On another side, when fostering smart city, through various deployed digital technologies, they may have access to people locations (e.g. Bluetooth kiosk on bus stops, Wi-Fi in hotspot, video security camera, Location Based App, etc.), to consuming habit (e.g. traffic through the public internet access), etc.

Many smart cities platforms collect, analyse and share the data about the citizen or produced by them. This extraordinary amount of information, combined with Big Data processing can really impact the privacy of the citizen. It is important that cities take action to analyse and define framework in domains such as data ownership, data privacy, data access transparency and also offer a way for the citizen to control these subjects.

Numerous studies have established that personal data are valuable. In the business data broker industry, monetization of personal data is common: one gets finance free access to a service but in exchange accepts to trade the data generated by the service usage. It is commonly known that an individual is worth around one euro. The market leads to multi-billion euro when brokers have access to abundant numbers of individual profiles.

Cities have often budget difficulties, particularly when it deals with ICT. It is important that city authorities are not attracted by such a kind of monetization and that they comply with the regulatory framework.

Besides their role of ensuring people's data privacy, cities shall also ensure the confidentiality of these data. It is important to apply this constraint to both data transfer and data storage.

6.7 Digital Infrastructure

Some of the services delivered by cities are associated with physical networks assets such as delivery (e.g. water, electricity, gas, lightning), collection (e.g. sewage), mobility (e.g. metro, tram) and telecommunication (e.g. data, voice, IoT sensors, traffic light, video security).

Similarlar to the behaviour that can be observed in the data silos generated by the independence of service departments, cities often suffer from important separations in the various networks.

To reach a correct level of sustainability, cities should rationalize and unify networks when possible. Telecommunication networks are appropriated for such operational merging through infrastructure sharing. Synergies are also possible with the other network assets:

- Fibre backbone and access can be deployed in aerially through the lamp pole infrastructure or underground through the sewage infrastructure.
- IoT sensors or Wi-Fi hotspots can be deployed through urban assets such as bus stops, public dustbins, or tourist information kiosks.

6.8 Metric and KPI

In order to measure the improvements that ICT technologies bring to the city services and the quality of life of its citizens and enterprise's commuters, it is crucial to define Key Performance Indicators (KPI) which are clear, understandable and realistic to determine.

These KPIs enable both the city to calculate the smart enhancements in the provided services but also to position itself into the regional, national and international scene. Through these indicators, the municipal authorities and their stakeholders should have a common understanding of the "smartness level" of the various fields of involvement of the city.

7 General needs from the cities

7.1 ICT users' position

Energy efficiency of data centre buildings, transmission node building, computer rooms, networks and IT systems is of high importance for the ICT Customers who are users of ICT System Installations e.g. Car manufacturers, Banks, Insurance Companies, Network Operators, Airplane Companies and Governmental Ministries.

Independently from the ICT systems integrators, service providers, producers and manufacturers of ICT system installations, in the perspective of EU Digital Agenda mechanism and law enforcements, these Users are proposing commonly agreed, proofed KPIs and framework of implementation.

Such energy management KPIs will help Users of Operational Architecture to easily identify, compare and scale the effective energy efficiency of their ICT installations internally and with the other Users.

The following Position Papers from the Industrial Specification Group Operational energy Efficiency for Users (ISG OEU), focusing on smart cities will be provided in order to complement these following ETSI standards:

- ETSI GS OEU 009 [i.12]: Global KPI Modelling for Green Smart Cities
  "Definition of Global KPI Modelling for Green Smart Cities. This modelling will cover ICT domain including residential and office areas".
- ETSI GS OEU 019 [i.13]: OEU KPIs for Smart Cities
  "The deliverable will define indicators (KPI) for Smart Cities expressing city level in terms of People, Planet, Prosperity, Governance and Propagation".

The following Technical Specification from the Sustainable Digital Multiservice Cities (SDMC), focusing on smart cities, transposes the position expressed by the users and complement the present document:

- ETSI TS 103 463 [i.14]: Key Performance Indicators for Sustainable Digital Multiservice Cities
  "Defining indicators (KPIs) for Smart Cities expressing city level in terms of People, Planet, Prosperity and Governance".

The following recommendation from the ITU-T Study Group 20, focusing on smart sustainable cities, gives a general guidance to cities and provides an overview of Key Performance Indicators in the context of smart sustainable cities:

- Recommendation ITU-T Y.4900 [i.18]: "Overview of Key Performance Indicators in smart sustainable cities".

It belongs to a series of recommendations and supplements about KPI definitions which also includes:

- Recommendation ITU-T Y.4901 [i.19]: "Key performance indicators related to the use of information and communication technology in smart sustainable cities".
  This recommendation lists the KPIs focusing on ICT use in smart sustainable cities.
- Recommendation ITU-T Y.4902 [i.20]: "Key performance indicators related to the sustainability impacts of information and communication technology in smart sustainable cities".
  This recommendation lists the KPIs used for ICT impact on sustainability.
- Recommendation ITU-T Y.4903 [i.21]: "Key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals".
  This supplement provides information regarding KPIs and evaluation index systems of smart cities, KPIs of sustainable cities, etc.

The following recommendation from the ISO/TC 268 technical committee, focusing on sustainable cities and communities, defines and establishes methodologies for a set of indicators to steer and measure the performance of city services and quality of life.

- ISO 37120:2014 [i.22]: "Sustainable development of communities -- Indicators for city services and quality of life".

Figure 2: ICT users' digital domains of interest

Annex A (informative): General needs from the cities

A.1 European Innovation Partnership on Smart Cities and Communities (EIP-SCC)

The European Innovation Partnership on Smart Cities and Communities (EIP-SCC) brings together cities, industries and citizens to improve urban life through more sustainable integrated solutions.

This includes applied innovation, better planning, a more participatory approach, higher energy efficiency, better transport solutions, an intelligent use of Information and Communication Technologies (ICT), etc.

EIP-SCC invitation for commitments was closed on June 2015 with 370 eligible commitments by over 3 000 partners.

All these are published on the online European Innovation Partnership marketplace [i.16] and the first public draft of the Operational Implementation Plan [i.9], the operational annex to the Strategic Implementation Plan [i.10] gives a wealth of detailed examples for integrated smart city solutions.

The operational plan suggests several Priority Areas amongst which the third is focused on "Integrated Infrastructures":

"Significant and yet insufficiently tapped value is offered by integrating the various existing and new infrastructure networks within and across cities - be they energy, transport, communications or others - rather than duplicating these needlessly. This point applies, both, to active and passive infrastructure. Many such infrastructures are ageing; budgets to replace them are stretched; they are procured and managed 'in silos'; yet the potential afforded to cities and their customers through new joined-up approaches, exploiting modern technologies is substantial. This is achievable. However, it will take sustained commitment from multiple parties to access value".

The "Integrated Infrastructures" Priority Area suggest 11 potential actions. Amongst these actions, some are strengthening and supporting the notion of digital multiservice city network infrastructure and related smart urban assets:

- Potential Action #1: The Humble Lamppost:
  - "*Reduce energy consumption and maintenance costs through implementing e.g. efficient long-lasting lighting; motion-sensing; PV-power. Use lamppost for e.g. Wi-Fi; CCTV (parking, safety, etc.). Test innovative business models".*
- Potential Action #3: Shared infrastructure planning:
  - "*Systematically exploit synergies between smart grid and broadband infrastructure, including shared engineering works, reuse of passive infrastructures, communications networks, data centres and services".*
- Potential Action #5: Road Systems:
  - "*Mobile ITS (location-based route/travel information + traffic light systems = optimized traffic flow to reduce emissions and energy consumption). Work with traffic management systems and automotive industry to re-use urban sensors deployed in street scenes. Exploit sensors and devices to predict traffic conditions/improve road and traffic management".*
- Potential Action #7: Parking systems:
  - "*Connect infrastructure, people and devices, and sensors to address the up to 25 % of congestion caused by people looking for parking. Mode shift through yield management pricing".*
- Potential Action #10: Adverse Events:
  - "*Connect key information sources with city monitoring systems (sensors, people); with city 'life-lines' infrastructures (transport, power, water, and communication) to build city resilience in the face of incidents and crisis*".

- Potential Action #11: Intelligent Bins:
    - "*Putting sensors on bins enables cities to communicate within the waste collection system, optimizing truck routing, minimizing energy consumption and congestion, and satisfying customers*".

A.2 Humble Lamppost

Amongst the commitments for integrated smart city solutions, the Humble Lamppost [i.11] is an illustration of urban asset (street furniture) valorization for sustainable city development through a digital multiservice city infrastructure.

Lighting in a city is everywhere. It is typically treated in a very tactical manner, evidenced by the ageing assets that exist, and the volume of citizen complaints (in some cities it represents 20 % of the contact centre calls). Light does not come cheap - savings on energy bills is of growing attractiveness. Quality low-energy lighting is required for 'place-making', for public safety and security. Lights are also too often swiched on when not needed - wasting power and money; and can result in light pollution. The lamppost is also typically a single purpose asset - for light; however that is not necessarily the only role it can play. New ICT-technologies can help transform the role of the "humble lamppost".

The goal is to demonstrate how lighting can deliver early rewards for cities providing investment funds through saving for further integrated solutions in the areas of environmental and building monitoring and traffic analysis for overall emissions reduction.

Firstly, in terms of using the existing physical infrastructure, enhanced with digital infrastructure, for multiple purposes: synergy across city services and goals.

Secondly, in significant financial terms: lighting can represent some 20 % of a cities electricity budget; and savings in energy costs and maintenance costs of 20 % and 70 % are not uncommon, through installation of more efficient lamps. This is therefore a "quick win" for smart cities. It addresses all three content domains of the EIP (to greater or lesser extents), and services the 20/20/20 energy and climate goals.

A.3 Shared infrastructure planning

The deployment of high-speed broadband networks can be made cheaper and faster by cooperating at infrastructure and services level between sectors. Various inefficiencies and bottlenecks in the rollout process exist, which lead to high costs and heavily administrative burdens for organizations wishing to deploy networks. It is estimated that up to 80 % of the costs of deploying new networks are civil engineering costs. It is also believed that savings up to 30 % could be achieved by adopting a set of simple measures, such as maximizing the use of existing passive infrastructure or co-deploying infrastructure.

The goal is to demonstrate synergies between the energy and telecommunication sectors at infrastructure and services levels whilst deploying Smart Grids in cities. In particular, the underlying vision is to work towards:

- creating a favourable business, and technological environment for a low carbon electricity grid;
- clarifying which data could be transmitted in support of Smart Grids via existing (and future) telecom network infrastructures and which data might need to have a dedicated connection/network for the purpose.

A.4 s[m2]art

Amongst the commitments for integrated smart city solutions, s[m2]art [i.17] is an illustration of street furniture valorization for sustainable city development through a digital multiservice city infrastructure.

The project aims at creating a scalable system of smart street furniture connected as nodes of a network for data collection and processing.

s[m2]art addresses the creation of innovative prototypes of smart street furniture which can offer smart services. In a user-friendly perspective, this furniture integrates physical objects, electronic components and digital services to meet the actual needs of users, public administrations and local utilities.

These smart street furniture address the challenges to assist reducing energy usage, environmental impact and carbon footprint while modernizing the infrastructure and creating high quality living environments.

History

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