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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Human Factors (HF).

Modal verbs terminology

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Executive summary

The present document provides an analysis and evaluation of the current requirements for citizen-related standards actions in relation to smart cities and communities. A *citizen* is an inhabitant of, or visitor to, a smart city or community.

To assess the current standardization landscape, the analysis has leveraged an online survey, distributed across the many smart city networks. 52 % of survey responses were from citizens or organization which represent citizens. Six specific citizen requirements were identified, having been ranked by the online survey respondents, from the most important through to the least important, with the top three being: facilitating citizen participation in decisions, access to services online and offline and effective measurement. Other priorities not proposed at first, but suggested by respondents as needing to be included, were internet availability and the need for cities to co-design services with citizens.

The present document assesses the different citizen-related issues that smart city-related standardization in the ICT domain needs to address. The present document lists relevant current and proposed standards and other related activities such as indicators and certification, identifying their limitations. Regarding smart city standardization, the major issues for improvement relate to the unawareness from cities or their unavailability to participate in standardization, along with the incoherence of where to start or find the right information. Moreover, city services need to be better designed, accessible for citizens, and provide better solutions for privacy and personal data management.

The present document provides recommendations to the standards organizations, first from an organizational perspective, so cities can overcome the issues listed above, and with more specific proposals grouped into three categories: Guidance (high-level approach that smart cities could adopt in order to deal with a number of citizens requirements), Codes of Conduct (precise approaches to the development of solutions for specific issues) and Standards (defining new work items that Standards Developments Organizations could potentially integrate within their standards development plans).

Introduction

The present document concerns the standardization requirements from the perspective of the citizen, in the context of being an inhabitant of, or visitor to, a smart city or community.

The smart community offers considerable opportunity not only for citizens to have an improved living environment in which they can benefit from effective services, but also for them to influence matters affecting their daily lives. At the same time, equal treatment for all citizens needs to be ensured and account needs to be taken of data privacy concerns relating to their personal information. Thus far the needs of the citizens themselves have been somewhat set aside in the debates concerning smart communities, but, more than ever in a post-Coronavirus world, it will be important to keep these needs at the forefront of societal development.

Since industrialization, our world has been considerably weakened by unsustainable development and rampant over-consumption. Humanity faces several environmental sustainability challenges including, but not limited to, declining biodiversity, degraded land and soil, depleting natural resources, polluted air and water, and increasingly severe climate changes. Closely interlinked are issues of population increase and rural-to-urban migration, which is occurring at an extraordinary pace: since 2008, more than half of the global population has been and is living in cities. By 2050 the global population is forecast to grow to 9 billion, 80 % of which will inhabit cities.

Adapting to these challenges will require increased cooperation among local actors, along with comprehensive systems that can create and maintain synergies for sustainable urban societies in which people want to work, live, and maximize their well-being. Cities can also be seen as one of the driving forces in generating European economic and sustainable growth, given, for example, the opportunities provided by the green economy. Linking and upgrading infrastructures, technologies, and services in key urban sectors (transport, buildings, energy, ICT, etc.) in a smart way will improve quality of life, competitiveness, and sustainability of our cities.

Cities are becoming more and more of a focal point for our economies and societies at large, particularly because of on-going urbanization, and the trend towards increasingly knowledge-intensive economies, as well as their growing share of resource consumption and emissions. To meet public policy objectives under these circumstances, cities need to change and evolve, but in times of ever tighter budgets this change needs to be achieved in a smart way: our cities need to become smart and sustainable cities and communities. In addition, though, improving the lot of the city-dweller should not be at the expense of the citizens living in rural communities, smart communities should be available to everyone.

Digitization in a smart community offers extensive opportunities for the introduction of citizen-centred design processes and for citizens to become more involved in the decisions affecting their daily lives. Enormous benefits can derive from this, for example, from consultation concerning the way services are designed and made interactive and available to all members of the community.

At the European level, the CEN-CENELEC-ETSI Smart and Sustainable Cities Co-ordination Group (SSCC-CG) originally proposed the development of a Technical Report on these citizen-related issues, later taken up in the European Commission ICT Standardization Rolling Action Plans for 2016 and 2017.

The present document is intended to clarify whether further standardization is needed on citizen issues related to smart cities (e.g. on what, where, when, etc.), and to take full account of other standards activities under way. The present document also supports recommendations that are being made at policy levels.

1 Scope

The present document assesses the different citizen-related issues that smart city-related standardization in the ICT domain needs to address. These include fundamental aspects such as accessibility, usability, interoperability, personal data protection and security, and how services to citizens are to be designed to maximize benefits to the community.

For each of these issues, the present document:

- provides a short statement of the subject area;
- makes a short statement of the key citizen concerns (for example accessibility or privacy) related to the subject;
- lists relevant current standards and ongoing relevant standards activities;
- assesses whether it appears the activities are in practice taking reasonable account of the smart city/community dimension from the perspective of citizen welfare, and if not, what might be needed to rectify the position;
- identifies any further general legal and ethical issues that require attention outside the standardization domain, or other issues not covered.

The issues which the present document assesses are grouped into the following:

- citizens' general needs - smart cities should have citizen welfare at their core. The needs of the citizens should therefore be properly considered in every standardization activity relevant to smart cities;
- citizens and their local authorities - the standards aspects of citizens' day-to-day interfaces with their local authorities;
- citizens and their local services - the standards aspects of citizens' day-to-day interfaces with the providers of their local services;
- citizen indicators - how the impact of smart city solutions on the citizens can be measured;
- recommendations - to improve citizen outcomes, filling gaps in, or making adjustments to, existing standards; aspects not related to standardization, including policy aspects.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

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 EG 201 013: "Human Factors (HF); Definitions, abbreviations and symbols".

[i.2] CEN EN ISO 9241-11:2018: "Ergonomics of human-system interaction - Part 11: Usability: Definitions and concepts".

[i.3] ETSI EN 301 549: "Accessibility requirements for ICT products and services".

[i.4] European Commission: "Public Procurement".

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[i.8] Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union (known as the NIS Directive).

[i.9] BSI PAS 185:2017: "Smart Cities. Specification for establishing and implementing a security-minded approach".

[i.10] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

[i.11] BSI PAS 183:2017: "Smart cities. Guide to establishing a decision-making framework for sharing data and information services".

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[i.15] Regulation (EU) No 1025/2012 of the European Parliament and the Council on European standardisation, amending Council Directives 89/686/EEC and 93/15/EEC and Directives 94/9/EC, 94/25/EC, 95/16/EC, 97/23/EC, 98/34/EC, 2004/22/EC, 2007/23/EC, 2009/23/EC and 2009/105/EC of the European Parliament and of the Council and repealing Council Decision 87/95/EEC and Decision No 1673/2006/EC of the European Parliament and of the Council.

[i.16] ISO 37106:2018: "Sustainable cities and communities. Guidance on establishing smart city operating models for sustainable communities".

[i.17] ISO 37120:2018: "Sustainable cities and communities - Indicators for city services and quality of life".

[i.18] ISO 37122:2019: "Sustainable cities and communities - Indicators for smart cities".

[i.19] ISO 37123:2019: "Sustainable cities and communities. Indicators for resilient cities".

[i.20] ETSI TS 103 463 (all parts): "Access, Terminals, Transmission and Multiplexing (ATTM); Sustainable Digital Multiservice Communities; Key Performance Indicators for Sustainable Digital Multiservice Areas".

[i.21] ETSI GS OEU 019: "Operational energy Efficiency for Users (OEU); KPIs for Smart Cities".

[i.22] European Commission (2017): "Making public procurement work in and for Europe".

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[i.23] United Nations Sustainable Development Goals: "Goal 11: Make cities inclusive, safe, resilient and sustainable".

NOTE: Available at https://www.un.org/sustainabledevelopment/cities/.

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[i.30] The Sector Forum on Smart and Sustainable Cities and Communities.

NOTE: Available at https://www.cencenelec.eu/standards/Sectorsold/SmartLiving/smartcities/Pages/default.aspx.

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[i.34] OASC (2019): "What Will Keep the Smart City Industry Busy in 2019?".

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[i.36] EUROCITIES: "About Us".

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[i.51] W3C Recommendation 05 June 2018: "Web Content Accessibility Guidelines (WCAG) 2.1".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EG 201 013 [i.1] and the following apply:

accessibility: extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of user needs, characteristics and capabilities, to achieve identified goals in identified contexts of use (from CEN EN ISO 9241-11:2018 [i.2])

NOTE 1: Context of use includes direct use or use supported by assistive technologies.

NOTE 2: The context in which the ICT is used may affect its overall accessibility. This context could include other products and services with which the ICT may interact

access space: space intended to be occupied by the person, including their Assistive Technology, while they are using the product

assistive technology: hardware or software added to or connected to a system that increases accessibility for an individual

NOTE 1: Examples are Braille displays, screen readers, screen magnification software and eye tracking devices that are added to the ICT.

NOTE 2: Where ICT does not support directly connected assistive technology, but which can be operated by a system connected over a network or other remote connection, such as telecare or voice assistants can also be considered assistive technology.

citizen: design and delivery of city services driven by the needs of citizens rather than the functional structures of a city's silos (from ISO 37016:2018 [i.16])

NOTE: The term citizen in this context includes residents, visitors and businesses within the city.

consumer: natural person who is acting outside the scope of an economic activity (trade, business, craft, liberal profession)

cyber-physical system: system which comprises interacting digital, analogue, physical, and human components engineered for function through integrated physics and logic

NOTE: These systems will provide the foundation of our critical infrastructure, form the basis of emerging and future smart services, and improve our quality of life in many areas.

Information and Communication Technology (ICT): technology, equipment, or interconnected system or subsystem of equipment for which the principal function is the creation, conversion, duplication, automatic acquisition, storage, analysis, evaluation, manipulation, management, movement, control, display, switching, interchange, transmission, reception, or broadcast of data or information

NOTE: Examples of ICT are web pages, electronic content, telecommunications products, computers and ancillary equipment, software including mobile applications, information kiosks and transaction machines, videos, IT services, and multifunction office machines which copy, scan and fax documents

smart city: City that increases the pace at which it provides social, economic and environmental sustainability outcomes and responds to challenges such as climate change, rapid population growth, and political and economic instability. By fundamentally improving how it engages society, applies collaborative leadership methods, works across disciplines and city systems, and uses data information and modern technologies to deliver better services and quality of life to those in the city (residents, businesses, visitors), now and for the foreseeable future, without unfair disadvantage of others or degradation of the natural environment.

NOTE 1: A smart city also faces the challenge of respecting planetary boundaries and taking into account the limitations these boundaries impose.

NOTE 2: There are numerous definitions of a smart city. This one is used by ISO Technical Committee 268, whose work is dedicated to the topic.

3.2 Symbols

Void.

3.3 Abbreviations

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

ADR	Alternative Dispute Resolution
AHA	Active and Healthy Ageing
ANEC	European Association for the Co-ordination of Consumer Representation in Standardisation (*French acronym)*
BSI	British Standards Institution
CEN	Comité Européen de Normalisation (European Standards Committee)
CENELEC	Comité Européen de Normalisation Electrotechnique (European Electrotechnical Standards Committee)
DESI	Digital Economy and Society Index
EC	European Commission
EFTA	European Free Trade Association
EN	European Norm
ETSI	European Telecommunications Standards Institute
EU	European Union
GDPR	General Data Protection Regulation
ICT	Information and Communication Technology
IEC	International Electrotechnical Commission
IoT	Internet of Things
ISG	Industry Specification Group
ISO	International Organization for Standardization
IT	Information Technology
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication Standardization Sector
JTC 1	Joint Technical Committee 1 [of ISO and IEC]
NIS	Network and Information Security
OASC	Open and Agile Smart Cities
PAS	Publicly Available Specification
SDO	Standards Development Organization [nowadays used to describe both formal standards bodies and consortia]
TC	Technical Committee
U4SSC	United 4 Smart Sustainable Cities
UNECE	United Nations Economic Commission for Europe
UN-Habitat	United Nations Human Settlements Programme

4 Setting the scene

4.1 Citizens and cities

The United Nations estimate that over half of humanity, approximately 4,2 billion, lives in cities today, projecting an increase of this number to 7,5 billion by 2050 [i.49]. Due to this overwhelming growth of population, cities are struggling to continue creating jobs and prosperity without straining land and resources and are responsible for around 78 % of the global energy consumption and produce more than 60 % of the greenhouse gas emissions [i.29].

Many countries will face challenges in meeting the needs of their growing urban populations, including for housing, transportation, energy systems and other infrastructure, as well as for employment and basic services such as education and health care. Integrated policies to improve the lives of both urban and rural dwellers are needed, while strengthening the linkages between urban and rural areas, building on their existing economic, social and environmental ties.

These issues affect numerous cities and have become more difficult to solve using traditional technology. The concept of smart growth, which is recently adopted in city planning requires a more intelligent method of urban management. It implies achieving greater city efficiency and better coordinating the forces that lead to growth: transportation, economic development as well as land speculation and conservation.

Considering that cities are complex adaptive systems not only comprising physical resources and processes, they need to consider residents and visitors. A clear definition of smart city has proven to be challenging. Definitions first appeared in the literature around the late 1990s, more recent definitions present many alternatives from metropolitan-wide information and communications technology (ICT)-based environment, up to large-scale living labs for innovation testing, while not disregarding smart energy consumption, transportation and other hard asset management, smartness footprint measured with capacity indexes (people, economy, living, environment, mobility and governance) [i.5] and innovative solutions - not limited to but mainly based on the ICT - that improve urban everyday life and enhance local sustainability in terms of people, governance, economy, mobility, environment and living.

According to the European Commission (EC), a smart city is a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business [i.24]. The former funding programmes from the European Commission already envisioned the city as a platform to enhance citizen engagement and their willingness to co-create, as a user-driven open innovation environment, with such openness being applied as multiple kinds of relationships between people, services, infrastructure and technology.

If the concept of the smart city has been extensively considered, the place of the citizen in that concept on the evidence available, has not. There have been European project funding programmes [i.28], but it is very difficult to see specific impacts from these except in the narrow field of activity within the scope of the specific projects.

Standardization bodies have also shared their vision on the concept of a smart city, especially international ones. The European Telecommunications Standards Institute (ETSI), notes that ICT plays an important role connecting key city services and infrastructures (transport, energy, healthcare, water and waste management) to securely manage the massive amounts of data generated by them. With the constant rise of population in urban areas, placing new demands on these services, a smart city uses digital technologies to enhance the city performance and the wellbeing of the citizens, reduce operational costs and the city resource consumption, while engaging more effectively and actively with its citizens [i.25].

The International Standards Organization (ISO), specifically Technical Committee 268 (Sustainable cities and communities), describes a smart city as one that increases the pace at which it provides social, economic and environmental sustainability outcomes and responds to challenges such as climate change, rapid population growth, and political and economic instability by fundamentally improving how it engages society, applies collaborative leadership methods, works across disciplines and city systems, and uses data information and modern technologies to deliver better services and quality of life to those in the city (residents, businesses, visitors), now and for the foreseeable future, without unfair disadvantage of others or degradation of the natural environment, which is the definition adopted for the present document [i.27].

The International Telecommunications Union Telecommunication Standardization Sector (ITU-T) analysed around 120 definitions and published a report providing an insight into what is meant by a smart sustainable city (SSC) and the underlying factors that make a city smart. ITU-T also gives a lot of importance to ICT and considers a smart sustainable city as an innovative city that uses information and communication technologies 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 [i.26].

The EC defines priorities and strategies for smart cities as going beyond the use of information and communication technologies (ICT) for better resource use and less emissions. This is to be achieved through smarter urban transport networks, upgraded water supply and waste disposal facilities, more efficient ways to light and heat buildings, safer public spaces. In order to meet the needs of an ageing population cities require a more interactive and responsive city administration. To become globally effective, cities are lacking the complete roll-out of scalable, interoperable and sustainable solutions in the areas of energy, transport, mobility, infrastructure and ICT. This requires a standardization approach to be holistic and cross-sectorial, breaking the vertical silos of the diverse domains.

The Sector Forum on Smart and Sustainable Cities and Communities [i.30], organized by CEN, CENELEC and ETSI, states that standards for smart cities provide a common language and understanding. This approach facilitates consensus driven solutions and boosts private and public partnerships. It is also being used to monitor technical and functional performance and ensure safety, interoperability, costs' reduction, efficient and strategic planning and management of resources. This includes an assessment using city indicators and the sharing of good practice. Finally, standards represent tools and guidelines for cities for the deployment of city solutions with high market potential and broad stakeholders' acceptance.

Standards should bring added value to municipalities, their decision-makers and ultimately to the citizens. There are a great number of Standards Developing Organizations (SDOs) researching the best approaches in multiple and different domains for smart cities, as documented in the present document. Not only it is important to understand the scope and results of these standardization initiatives, but it is essential to involve the cities as participants in the process. Industry has driven cities to the current results. Networks of cities together with stakeholders from both research and industry have worked together to identify, adapt, pilot and validate the published specifications. Incorporating the needs of the citizens into the standards making process will help cities immeasurably to leverage the benefits of standards.

4.2 Variety of citizen profiles

There is no concept of something as the citizen, there are only citizens. To efficiently capture the broad range of citizen requirements, one needs to keep in mind that the citizen is a rationalization and an abstraction. For the present document the definition of citizen used is from TC 268 (as defined in clause 3.1) and refers to citizenship and the rights and obligations associated. Actually, the citizen will correspond to a large variety of potential profiles with specific characteristics and requirements. Some of these characteristics are listed below (without any indication of priority). Each characteristic has some associated requirements and may or may not be present in the profile of a given citizen.

The present document does not make any specific recommendations here, it discusses rather the citizen's need to be at the forefront of the recommendations for standards activities listed in clause 10, including the organizational recommendations.

Consuming

In most cases, the citizen is also a consumer, in particular of goods and services that are available in the context of the city. Though it is in general not the role of the city to intervene in private transactions, this can be necessary when goods consumed are part of services provided by the city such as energy, transport or communications (depending on the city offering).

Associated requirements: redress procedures

Impaired

In Europe alone, around 16 % of citizens have a disability that ranges from mild to severe. This means that around 80 million people need to have equal rights assured to fully take part in society as well as in economy without being disadvantaged by the barriers they face. This is true for physical aspects (street access, transport, etc.) as well as the Information Technology related aspects.

Associated requirements: (enforceable) accessibility standards

Impatient

In general, citizens are very busy and need to address many issues in parallel to cope with their life. As a result, they cannot spend much time in the interaction with the city services, in particular the on-line ones. A slow and poorly designed web service will generate frustration that may lead to rapidly giving up. Another example is the average time of 6 seconds that a citizen is willing to spend before giving consent for data collection, giving up due to the huge amounts of privacy terms and conditions.

Associated requirements: citizen-centred design processes, simple privacy standards

Interacting

In the face of the growing complexity of the city environment, the days of the passive citizen are gone. Citizens require growing access to all sorts of city services, beyond the traditional ones associated to emergencies, employment or welfare. This requires part of the existing services being moved to on-line services and creating new services. The potential access to a growing number of on-line services can generate citizens expectations (with required clear and transparent prioritization) and the need for the city to have a city-wide and coherent offer that can serve all citizens.

Associated requirements: citizen-centred design processes

Private

Though the interactions between the citizen and the smart city are happening in the public space, some elements of these interactions need to be kept private. As an example, the simple history of the exchanges might give significant information to unscrupulous third parties. This may be obvious in the case of interactions related to health, but it equally applies to citizens' financial data or any other personal data.

Associated requirements: enforceable privacy standards

Public

Citizens are asking for the ability to contribute to the decision-making processes within the city. The cities themselves have embraced this trend, proposing new ways to include citizens by providing them with a variety of public data as well as including them in the design of the on-line services.

Associated requirements: open data, citizen-centred design processes

Vulnerable

A smart city is a highly complex ecosystem in which many new threats exist in addition to traditional public service risks which also need to be managed. A major primary need is for the citizen to benefit from a safe environment that can guarantee at best physical well-being and protection against all forms of cybercrime. A safer environment should not be granted at the expense of the citizen's right to privacy and data protection.

Associated requirements: city-wide approach to security, including cybersecurity and privacy

As a result, the development of smart city services for the citizen will have to take into account somewhat conflicting requirements. An effective form of citizen participation will need to be based on citizen-centred design processes in order to provide usable, intuitive, accessible and protective services.

There are many opportunities for the citizen arising from the digitalisation of the people's living environment in cities and communities that can bring effective solutions for the development of citizen-centred design processes. However, there are still barriers to citizen participation, such as the lack of human interaction, accessibility issues, or the digital divide. These problems need to be addressed with a clear understanding of the issues, clarification of the improvement approaches needed, and objective ways to measure progress. From this perspective, it is recommended that standardization can support digitization.

4.3 Challenges for the city

The European Innovation Partnership on Smart Cities and Communities (EIP-SCC) [i.35] is an initiative supported by the European Commission to address city-specific challenges from different policy areas such as energy, mobility and transport, and ICT. EIP-SCC is organized in six Action Clusters, each tackling a specific challenge (or focus area) for the city. The Action Clusters are assemblies of partners committing to work on specific issues related to smart cities, by sharing the knowledge and expertise with their peers, giving added-value to their national and local experience and identifying gaps that need to be fulfilled at European level [i.45]. As detailed in annex C, the work of each Action Cluster is collected under thematic Initiatives, which pool the efforts of the various partners around a particular objective. This promotes learning beyond project and geographic borders, and opens the results to the world at large, linking with EU-funded projects to allow results to be consumed by the thousands of people active on the Marketplace.

Apart from the EIP-SCC, there are other relevant networks and associations, joining cities with research and industry, to share their knowledge, experience, and potential collaborations to solve their challenges:

- EUROCITIES was established in 1986 to further economic, political and social development in its member cities. Now linking the local governments of more than 140 largest cities of Europe and over 45 partner cities, EUROCITIES is organized in six thematic forums: Culture, Economic Development, Environment, Knowledge Society, Mobility and Social Affairs, which monitor developments in these specific policy areas, addressing issues and coordinating activities, providing a platform for sharing knowledge and exchanging ideas [i.36].

- Major Cities of Europe is an organization composed of experts in Innovation in cities, contributing to the continuous improvement of the value proposition of the association. They organize a yearly conference to interact and exchange directly with other European municipalities in a non-commercial environment. They discuss the real challenges that municipalities currently face with digitization, as well as understanding how to include citizens in designing and achieving better outcomes [i.37].

- Open and Agile Smart Cities (OASC), a non-profit, international smart city network of more than 140 cities have a goal to create and shape the nascent global smart city data and services market. By working based on city needs, with support of the industry, OASC focuses on standards for city data. They have a vision to create an open smart city market based on the needs of cities and communities, they advocate cities adopt de facto standards with a driven-by-implementation attitude [i.38].

According to EUROCITIES, the priorities for 2019 started with the campaign Cities4Europe - Europe for citizens, where people come first and where trust between people and public authorities is strengthened [i.39]. Moreover, the group will continue to support long term investments at the local levels and monitor the implementation of new EU procurement measures [i.19]. They engage cities on the implementation of the European Pillar of Social Rights [i.20], as well as continuing a dialogue with policy makers on circular economy, waste management, water and noise pollution.

From the perspective of OASC, three major challenges (with respect to technology and business) are being faced by the smart city value chain [i.34]:

- Data security, sustainability and governance, where a variety of issues remain to be solved, especially in relation to public-private infrastructure partnerships.

- Unlocking the potential of open data, where open data portals should consider uniform, standards-based APIs if they are to attract larger developer communities.

- 5G-ready cities, paying increasing attention to infrastructure partnerships, especially as they relate to cities and network operators' respective roles, benefits and revenue streams.

While such innovation is happening in Europe, SMEs and start-ups are facing barriers to accelerate market uptake. Public procurers need to open up procurement processes and integrate SMEs and start-ups to stimulate innovation. There is a need to unlock the barriers SMEs and start-ups face with procurement. There is also an urgent need to define policy strategy and bring together both the supply-side and demand-side of the market. Prioritization of unlocking issues related to procurement, funding and scaling innovation beyond pilot implementations is needed.

4.4 The challenge of public procurement

Public procurement accounts for a substantial amount of public investment (around €2 trillion per year, representing 14 % of EU GDP), with high-quality public services depending on modern, well-managed and efficient procurement. Improving it can yield big savings: the EC evaluated that even a 1 % efficiency gain could save €20 billion per year. The European Commission's public procurement strategy focuses on six strategic policy priorities that were set out in the 2017 Communication Making public procurement work in and for Europe, aiming to improve EU public procurement practices in a collaborative manner by working with public authorities and other stakeholders [i.4].

As one of the European Commission priorities [i.6] and one of the most discussed topics in the latest Major Cities of Europe Conference [i.40], eProcurement remains one of the major challenges for municipalities, as part of their digitalization process. On the one hand, it can act as an enabler for smart city opportunities, especially for cities of lower dimensions or less equipped, while on the other, it requires training the staff of the local services to enable them to help citizens taking advantage of these opportunities. Smart cities need to be able to choose from a set of instruments (local, national, financial or not) to create opportunities for businesses, jobs and help improve people's quality of life. The ability of cities to effectively use social, environmental and innovation clauses in their public procurement has a long-term impact on jobs and sustainable growth [i.22].

Public procurers need to open up procurement processes and integrate SMEs and start-ups to stimulate innovation in order to unlock the barriers SMEs and start-ups face with procurement. There is an urgent need to define policy strategy, to bring together both the supply-side and demand-side and prioritize the needs to unlock issues related to procurement, funding and scaling innovation beyond pilot implementations.

5 Citizens' general needs

5.1 What are these?

In a future smart city context, citizens need:

- services that meet their needs effectively;
- ease of use for, and intuitive understanding of, city smart services so as not to require too much time to understand services and use them;
- transparent information about the public and commercial services being provided in a smart/sustainable city/community, what is their cost, what are their rights and the redress procedures when they go wrong, etc;
- a healthy environment with inclusion and social cohesion mechanisms that respect diversity to ensure their individual voice is heard;
- assurances that besides their safety and well-being, the security of their personal information is properly protected and that this data will not be misused for commercial purposes;
- support for education, training and learning opportunities for those unable to take immediate and full advantage of smart community living; a physical environment that ensures accessibility for very young and older people and those with disabilities.

These citizen needs were confirmed in an on-line survey (clause 7) carried out within ETSI TC HF and used to preparing the present document. Six specific issues related to citizen requirement needs were identified. The online survey asked respondents to rank citizen requirement needs from the most important through to the least important. These six general needs are presented in order of importance based on priorities determined by survey respondents:

- facilitating citizen participation in decisions;
- access to services, online and offline;
- effective measurement of citizen services;
- protecting people's physical and cyber security;
- declaring ethical priorities;
- ensuring people's' privacy and the protection of their data.

The top three most important city standardization requirements of those proposed in the survey were deemed to be facilitating citizen participation in decisions, access to services online and offline and effective measurement. Other priorities suggested by respondents which needed to be included, were internet availability and the need for cities to co-design services with citizens.

See annex A.

5.2 Access to city services

Access to services is a priority area for future standardization. Smart cities have so far approached the transformation required by introducing technology for both existing and new services. The roadmap many cities are using for this transformation is to prioritize a move to the provision of online services instead of purely offline city services.

This is an understandable approach but in practice there are serious issues related to digital inclusion. Apart from the need for accessible and inclusive connectivity (for example free Wi-Fi®/Internet), across Europe not all citizens are digitally included. These people include the elderly and disabled, who frequently by definition will need assistance to access online services. No less than 47 % of our survey respondents asserted that smart cities would continue to need to provide physical buildings to manage offline city services. This physical service provision (which could of course include support staff visiting peoples' homes) seems necessary to be able to continue to provide appropriate services (digital or traditional) to digitally excluded citizens **(Recommendation 1)**.

5.3 Citizen complaint and redress procedures

As citizen services increasingly move online it is important that cities ensure from a citizen perspective, issues with services can be easily communicated to their staff, using a variety of mechanisms, both online and offline. A citizen complaint and appropriate redress processes need to consider not just how the city addresses the complaint, but also the communication which needs to be made about it. Appropriate feedback mechanisms, and possibly dialogue with the citizen, will need to be created to ensure the resolution of the issue. It is important that the move to online city services provide complaint and redress mechanisms which are both online and offline, and which support the citizen make any appeal regarding city decisions. A city needs to clearly communicate the redress the city will make as a result of addressing the complaint, taking into account any accessibility needs of the citizen.

On-line procedures should be aligned as far as possible with the European Union principles laid down for Alternative Dispute Resolution between traders and consumers [i.7]. It would be advantageous to consider dedicated standardized guidance to help cities establish complaint and redress procedures **(Recommendation 7).**

5.4 Ethical priorities

Generally smart cities have deployed technology without any specific citizen communication, regard for the ethical concerns of citizens, or in the design of the transformed services they create. The introduction of European legislation to articulate privacy and security considerations for an increasingly digital world has caused some cities to review this. For example, a small number of smart cities have created a specific charter to communicate their approach to citizens.

These ethical considerations are an area which should be considered for standardization activity. As a minimum the creation of guidance material to support smart cities to produce a transparent and open declaration of the ethical approach a city has taken to the design and delivery of citizen services is needed **(Recommendation 8)**. The requirements for improved service design are considered in clause 7.

5.5 Improvement of citizen outcomes

5.5.1 Introduction

International standardization has focused for a number of years on the publication of indicators. Indicators allow comparisons of city data to be made based on agreed data and definitions related to the structure and services of cities specifically to measure a cities performance. A series of indicator standards have been developed for sustainable cities and communities. Clause 9 contains more detailed information on indicator standards.

5.5.2 Improvement of outcomes

Citizen standardization requirements are not however focused on measurement of city performance, they are focused on outcomes, specifically the improvement of outcomes for citizens as a result of the design, transformation and delivery of citizen services.

In our survey 83 % of respondents asserted that smart cities are not measuring the impact of their activities, 67 % asserted that outcomes are not improving for citizens, 33 % asserted that outcomes were known to be improving by the use of surveys, availability of City KPIs, and noticeable improvements in specific services for example the travel time taken for a specific transport service.

In order to improve outcomes respondents suggested that codes of conduct and guidance for cities should also be considered as part of citizen standardization activities. These standards are deemed to be needed due to the fact that existing standardization is top down, too complex, and needs a more practical approach to be taken. Standardization with an outcomes-based approach would directly support the inclusion of citizens in the delivery of citizen services.

Current measurement is via KPIs or indicators related to the service provision in a city, focused on city performance. Citizen requirements are for smart cities to measure how they are changing the outcomes and citizens' experience. The focus needs to move from the publication of indicators related to city service provision and performance, to measurable differences which is focused on the improvements smart cities are making for citizens and the outcomes they experience. The creation of a local Digital Economy and Society Index (DESI) would provide the relevant outcomes measures to track the evolution of city services and the benefits they are providing to citizens **(Recommendation 3).**

5.5.3 Use of Certification

In our survey respondents suggested that certification could be used as a mechanism to improve outcomes for citizens. Smart cities are at the beginning of their journey to utilize technology to deliver better outcomes for citizens. Whilst certification at some point may be an appropriate mechanism to support the delivery of outcomes for citizens this could be considered an additional burden and barrier to cities as they begin their transformation journey. Whereas codes of conduct and guidance would by comparison be easier to establish and not present an additional burden and barrier to cities.

5.6 Keeping a safe environment

5.6.1 Overview

Smart cities are complex, each city has its own priorities and specific communities which form the focus for the services it provides for its citizens. In addition, cities are at the centre of complex ecosystems, where city services are increasingly provided by non-government organizations and third parties. Individual city services vary considerably between cities, and services are based on the identified and evolving citizen needs and the resources available to elected leaders. In order to manage this complicated environment, cities will need to declare their key priorities which determine the focus of city service provision, such as health transport or environment.

However, despite the individual focus of each smart city there are a number of areas where a more horizontal approach to meeting citizens' requirements needs to be taken.

5.6.2 Being security-minded

Smart cities deploy complex distributed technologies which have required a new holistic approach to city security concerns which are not confined to traditional cyber security methods. The holistic approach includes physical, cyber security, cyber-physical and personnel security. This holistic approach is referred to as a security-minded approach and is based on an appropriate and proportional response to security in a smart city.

In the case of the UK, a British Standards Institute Publicly Available Specification PAS 185:2017 [i.9] has been developed to support the introduction of a security-minded approach for cities. This PAS combines existing UK Critical National Infrastructure security approaches and the NIS Directive, to address the specific security-minded approach which should be adopted by smart cities [i.8].

5.6.3 Preserving privacy

The complex provision of city services by many organizations, alongside those provided by the local authority, requires a new trust model to be developed with citizens. The approach which has been taken both in Europe and internationally is to use a privacy-preserving approach to the change and development of city services. This privacy-preserving focus in Europe has also been required as a result of the General Data Protection Regulation (GDPR) [i.10]. Smart cities need to share and exchange personal information and personally identifiable information across a complex services ecosystem, in a multi-agency model setting. The way in which privacy is preserved for city services varies between different smart cities, based on the purpose for which data is exchanged and shared, and the city service where this applies.

BSI PAS 183:2017 [i.11] has been published to articulate the implementation of the GDPR in the complex smart city setting. PAS 183 has been adopted internationally and is being fast-tracked to an international standard in 2020 by ISO/IEC JTC 1 SC40.

5.6.4 International approaches to security and privacy

European privacy regulation and cyber legislation has influenced international smart cities and nation states. For most international settings security and privacy legislation is complex.

Internationally smart cities have increasingly utilized technology to create online services for citizens which has led to both the security-minded and privacy guidelines being adopted by nation states. It is important that the city setting is understood in the context of the particular national jurisdiction, as the specific implementation of the principles vary between nation states. The complex smart city multi agency model which creates a safe environment in smart cities is particularly important to understand in the context of infrastructure provision due to the variety of data which needs to be exchanged and/or shared.

In advance of PAS 183 becoming an international standard as referenced above, additional international data-sharing standards are emerging that support the complex data exchange and sharing needs of smart cities and the city infrastructure which provides city services.

For example, ISO 37156 [i.12] and ISO 37160 [i.13] were also published in 2020.

5.7 Elements relating to citizen security

5.7.1 Introduction

Due to the complexities of the services provided for citizens or visitors to a smart city a multi-layered approach is needed when considering the requirements to be met for citizens' cyber security. The provision will vary between cities and will need to take account of the requirements of specific communities with the development of an appropriate governance approach.

This is in addition to existing measures that are already in place to manage safety in a smart city. Safety measures are aimed at reducing unacceptable risk in the city, where the city has control over all the aspects which might compromise safety for citizens. Conversely citizens' security requires management of risks where the city does not have control over all aspects of unacceptable risk.

In all cases to manage the security risks, cities need to consider what is required and appropriate for each service across the city or community on a regular basis. Additionally, citizen security requirements need to be considered on an exceptional one-off basis, for example during an emergency, or for a city-wide event.

The key areas a city needs to consider for the citizen security requirement are addressed below.

5.7.2 Citizen security considerations

Smart city services are a blend of technology, with both offline and online provision. City personnel are often the facilitators who orchestrate the service and deal with issues and complaints. Guidance is needed for cities to include citizen security considerations as part of the implementation of the security measures across the city, and for individual city services. A focus on citizen security requirements is a standardization opportunity which would have direct benefit to citizens **(Recommendation 4)**.

There are other consumer digital safety issues that are particularly relevant for cities. For example, 5G is offering the potential for interaction times with remote IoT objects of more or less a few milliseconds to open up remote control by central services (including vehicles in future). If that interaction time is critical to the safe operation of the remote item then there are safety risks associated with slow 5G data transfer in bad weather, loss of 5G service, central service applications hanging or going off-line. As 5G will grow fastest in cities, it is recommended that there is a study into these issues (**Recommendation 9**).

5.7.3 Personnel security

A security-minded approach to the procedures and policies to manage the risk related to city personnel who have legitimate access to city services and technology is required. This is an area which should be considered for guidance to ensure that exploitation or unauthorized use of this legitimate access to city services does not compromise citizen security. Staff training will be a significant issue, and a code of good practice for management of these aspects would be of benefit (**Recommendation 5**).

5.7.4 Physical security

The physical security of city services, the built environment or infrastructure requires a layered security approach to deter the misuse, attack or delay which may compromise the security of the citizen. Physical security arrangements in cities often present a single point of failure for city services, as a result of a combination of physical barriers and procedures staffed by people.

Physical security arrangements need to be specifically reviewed by cities in the context of the vulnerabilities these create for city services, and the requirements to ensure the safety and security of citizens. This layered approach to physical security in a city will be specific to an individual city and needs to be created based on the vulnerabilities which have been identified **(Recommendations 6 and 10)**.

5.7.5 Cyber-physical systems

Increasingly technology is deployed by cities to improve or create new city services, or technology may be deployed in response to efficiency drives. The connectivity of devices across cities may support a single city service, may be city-wide, or for the benefit of a specific community. Citizens' requirements are not usually the prime reason for the choice of the technology or the way in which devices are deployed in a city. Citizens may be unaware of these cyber-physical systems and how they may affect their own security requirements. There are also aspects of cyber-physical systems which may affect not just citizens' cyber security but also their privacy requirements.

Whilst there are standardization activities in place to consider individual cyber-physical assets within a city or specific city services these activities are from a device perspective not from the perspective of a city or citizen. As referenced above, BSI PAS 185 [i.9] addressed the key security-minded requirements with the participation of UK cities. This UK work did not include the requirements from a citizen perspective or include the participation or consultation of citizens. Our consultation has indicated this is a key area which highlights citizen security as a future standardization opportunity **(Recommendation 4)**.

5.8 Citizen data

The transparency movement has focused on the release of open data from government. This work has been echoed by cities with the creation of open data portals allowing citizens and other interested parties, such as entrepreneurs and journalists, to consume the data being published.

However only 3 % of the world's data has so far been opened due to both privacy and security concerns. Additionally, the evolution of technology has highlighted the ease with which it is possible to impute pattern of life data, even if personal data or personally identifiable data are not included.

International smart city standardization has created a new approach to data about the citizen which classifies smart city data as part of a data spectrum recognizing data as *open, closed or shared* irrespective of whether the data is personally identifiable. The use of shared data has highlighted the importance of understanding for what purpose the data is being shared, what purpose it is being used, and what security and access controls are required to meet both privacy-preserving and security-minded requirements for the citizen.

This data spectrum approach has unlocked new business and commercial models for smart cities and created a custodian role for the city. Whilst the citizen may be the owner of the data the city assumes a custodian role on behalf of the citizen to create and improve city services. New publication models have also emerged as a result of the use of shared city data underpinned by data sharing agreements for organizations delivering city services.

Citizen uses and requirements of open data have been considered as part of the current smart city standardization activities, however this has not generally led to increased citizen participation irrespective of the type and volume of open data released. The emergence of the data spectrum and the opportunities that shared data unlocks for smart cities and their citizens has yet to be explored and represents a significant standardization opportunity **(Recommendation 11**).

5.9 Accessibility

5.9.1 Accessibility priorities

According to the European Accessibility Act [14], 1 in 6 people in the EU has a disability that ranges from mild to severe, making around 80 million people who are often prevented from taking part fully in society and the economy because of barriers they face. It is expected that by this year, there will be 120 million people with disabilities in the EU. European Commission issued the European Disability Strategy 2010-2020, in line with Article 9 of the UN Convention on the Rights of Person with Disabilities [i.5]. The European Disability Strategy refers to accessibility as meaning that people with disabilities have access, on an equal basis with others, to the physical environment, transport, information and communications technologies (ICT) and systems, and other facilities and services open or provided to the public. Therefore, accessibility should be one of the first priorities for the smart cities seeking to become accessible to citizens with specific emphasis on ensuring diverse teams are engaged who represent the population.

Europe has a comprehensive legal framework to support accessible ICT, the Accessibility Act, the Web Accessibility Directive which relates to the accessibility of the websites and mobile applications of public sector bodies. The Public Procurement Directive also refers [i.31].

In support of this legislation in the ICT arena ETSI EN 301 549 [i.3] provides minimum accessibility criteria for different ICT domains. This standard is innovative in that it represents a joint initiative of all three European Standardization Organizations. Extracts from the requirements of the standard relevant to smart cities are provided in annex D of the present document.

Specific to smart cities, Spanish national standard UNE 178105 [i.33] addresses the human dimension, referencing the broad Spanish legislative requirements at national, regional and local levels.

Public and private organizations can make use of the EN 17161 [i.50] on achieving accessibility following a design for all approach, including the use of this as a selection criterion in public procurement.

For the particular issue of Active and Healthy Ageing (AHA), the relevant European Integrated Project has compiled a list of standards which they consider relevant for that domain, including a specific section on smart cities [i.47].

5.9.2 Functional accessibility aspects

The European Accessibility Act [14], which will enter into force in 2023, aims to improve the functioning of the internal market for accessible products and services by removing barriers created by divergent legislation.

The European Accessibility Act covers the products and services that have been identified as having the highest risk of being concerned with diverging accessibility requirements across the EU countries:

- computers and operating systems;
- ATMs, ticketing and check-in machines;
- smartphones;
- TV equipment related to digital television services;
- telephony services and related equipment;
- audio-visual media services such as television broadcast and related consumer equipment;
- services related to air, bus, rail and waterborne passenger transport;
- banking services;

- e-books;
- e-commerce.

All the above products and services can be considered as key enabling components in smart cities and any accessibility requirements related to them will facilitate the work of businesses active in smart cities. A focus on accessibility by smart cities will bring benefits for citizens with disabilities, and elderly people.

Smart Cities and businesses will benefit from:

- common rules on accessibility in the EU leading to cost reduction in building and maintaining the city;
- easier cross-border trading and interoperability;
- inclusion of assistive technologies and smart transport services;
- more market opportunities for their accessible products and services.

Persons with disabilities, and elderly people as citizens of smart cities will also benefit from:

- more accessible products and services in the city;
- accessible products and services at more competitive prices in smart cities.

Special attention should be given not only to having more accessible products and services in smart cities but also for any product or service to be comprehensive and usable by all citizens in smart cities irrespective of the digital skill base, including people with disabilities and the elderly.

5.9.3 Universal service design

Usability of the design of city services is a key enabler to facilitate citizen participation. Universally designed city services with a focus on user needs is required. Accessibility and a lack of digital skills of citizens are a key service design consideration. Universally designed solutions rather than ad hoc solutions are preferred for citizens with accessibility needs. European procurement frameworks support the use of selection criteria to recognize vendors who respect this approach to meeting accessibility needs.

6 Citizens' and their local authorities

6.1 What is involved?

Digitization has already extensively changed citizens' interactions with their local authorities. These have taken advantage of the money-saving opportunities offered by electronics, in terms of saving administrative burden and hence manpower. In terms of citizens' perceptions of service provision, things are not so clear: often service provision is thought to have deteriorated, with a large reduction in the opportunity to engage in dialogue with the provider of the service. Often, however, this may be the result of pure cost-cutting as a consequence of recession, rather than simple digitization.

This said, enlightened local cities and communities will use the advantages offered by the digital revolution to try not just to preserve citizen engagement, but to enhance it. A number of possibilities may be used to do this, for example:

- clear and easy-to-use electronic interfaces, with background supporting information easily available, supported by inclusive connectivity such as free Wi-Fi/Internet access;
- human interface possibilities always there (in whatever form) as back-up;
- avoidance of digital divide issues, by providing special interfaces designed for the less able, and support provided for these persons.

Standardization in this area is rudimentary. Performance standards work on efficiency rather than customer experience. There are opportunities to provide standardization, in terms of the basic elements for service design in a smart city (as discussed in clause 7 below), and also to create principles for guidance, for example in terms of best practice for citizens' interactions with their local authorities and of meeting their service needs. This requirement emerged in particular from our stakeholder survey.

6.2 Designing services for the citizen

At present many design aspects take more account of the convenience requirements of service providers than of citizens. Work needs to be done to encourage good practice in design of services, whether these are new services or existing ones which are being increasingly digitized.

The level of maturity of services poses different considerations, for example:

- **Current mature service:** smart city objectives should be to keep services the same, but deliver them at lower cost, better quality and faster. This requires a review citizen needs.
- **Enhancing current service:** smart city objectives should be to enhance facilities, or to provide additional features to meet citizen needs better. This requires a review to check that incremental improvements do in fact do this.
- **New service:** smart city objectives should be to innovate to meet new needs with a review that captures and tests citizens' needs and ensures their correct implementation.

Standardization of city service design is largely absent; such work needs to be centred around the requirements of the citizens using the city services, with a specific focus on user interface design and supporting accessibility needs of citizens **(Recommendations 2 and 12**).

6.3 Related city services

Depending on the context in individual countries, these services may in practice be public sector, or provided by the private sector under contract, or purely private. But the essential requirements of citizens being served are likely to be the same. In the case of private sector-provided services, the citizens' interests and those of consumers will overlap.

The range of services is extremely wide. Citizens interact with local service providers in an enormous range of ways, for example concerning:

- mobility and transport;
- education and child-care services;
- Support services for persons with disabilities;
- recreational services;
- healthcare services;
- sanitation;
- utilities;
- emergency services.

There are standardization activities in respect of all of these (though for some services more comprehensively than others). So far many of these efforts do not take sufficient account of smart city or citizen aspects.

6.4 Individual services

Based on existing smart city standardization work there are barriers to the transformation of city services. However smart cities can implement a decision-making framework for sharing data and information which directly address the mechanisms to unlock the barriers to the interoperability of city services.

The decision-making framework which unlocks the barriers needs to include:

- the utilization of a concept model to ensure the interoperability of smart city data;
- a strategy to implement a data spectrum, which contains open, shared and closed data. This will enable the creation of a data sharing culture;
- establish the roles and responsibilities for all organizations in the data value chain;
- define the purpose of data and information services in the city;
- use declarations for the data states which apply in the framework;
- control access rights to data and information services;
- define the data formats and the format of transportation used for city services.

BSI PAS 183 [i.11] is the normative reference for this work and is itself being fast tracked to an International Standard in ISO/IEC. The data and IT services decision-making framework contained in this specification can be used by cities to decide on their city service priorities. This was used as the basis of the consultation to understand the priorities and gaps in current standardization work, as discussed further below. Although individual city services are not discussed in any detail, there are specific issues and requirements for some city services which need to be considered in the context of future citizen standardization.

6.5 Supporting citizen participation

Survey respondents and research across the international landscape have highlighted the need to co-design with citizens the changes to city services in smart cities. This new co-design approach is designed to create an opportunity for citizens to participate in smart city changes. Currently smart cities use open data to inform citizens regarding smart city services. Since the introduction of GDPR and the NIS directive and a move towards privacy preserving and security-minded principles using shared data need to be developed. The development of BSI PAS 183 [i.11] was accompanied by 10 case studies only one of which demonstrated how shared data can be used to resolve privacy and security concerns and facilitate a citizen participation agenda. **(Recommendation 13**).

Another important set of issues to consider, though usually outside the scope of standardization, are the greatly enhanced possibilities for citizen involvement in community democracy that digitalization offers. The scope of the issues to consider ranges from simple consultation measures affecting one locality, through easier dialogue with citizens' local representatives, to citizen involvement in wider civic decisions.

7 An online survey

7.1 Introduction

An online survey was created which could be distributed easily across the many smart city networks which exist to understand the current standardization landscape for citizens.

The survey contained 29 questions sent to many networks with many hundreds of members, despite reminders only 36 responses were received. This is a low number of survey returns, however, despite the low numbers, valuable responses were received. 100 % of the survey respondents wished to be kept informed of the progress of the STF.

For a full summary of the survey analysis, see annex A.

7.2 Survey respondents

The stakeholder survey received 52 % of its responses, from citizens or organizations which represent citizens. 36 % of respondents were involved in standardization, the remainder of respondents were from local authorities, vendors, and researchers. All survey responses were checked to ensure that views were current, i.e. within the last two years.

67 % of survey respondents were not currently involved in smart city standardization, although 58 % were aware of current smart city standardization efforts. 70 % were not using standards from other domains. Accessibility requirements were considered a priority by 94 % of survey respondents.

7.3 Citizen requirements

Respondents ranked the top three citizen requirement priorities proposed as access to services, effective measurement, and protecting people's privacy and data security. Other priorities not proposed in the survey, were suggested by respondents as needing to be included as citizen requirements, were internet availability and the need for cities to co-design services with citizens.

7.4 Future services

The Future of citizen services were predicted to be online by respondents, however 47 % still expected physical buildings to be needed to support the citizen requirements for smart city services.

All respondents submitted ideas for smart cities to meet citizen requirements. 75 % of respondents did not think that citizens were considered specifically either by the use of surveys, consultations or the engagement of expert resources.

Some additional areas raised such as data privacy and security issues and data management standards are already under development in Europe and internationally, in the latter case sometimes specifically related to smart city aspects.

Some additional ideas such as how to achieve citizen co-design, and how to anticipate or ensure accessibility of city services are not the subject of current smart city standardization. This represents a future standardization opportunity to meet citizen requirements from cities.

7.5 Outcomes

In the survey 83 % of respondents asserted that smart cities were not measuring the impact of their activities and 67 % asserted that outcomes were not improving for citizens. 33% asserted that outcomes were known to be improving by the use of surveys, availability of City KPIs, and noticeable specific improvements, such as improved travel times for a transport service.

In order to improve outcomes, respondents suggested that codes of conduct, guidance and certification for cities should also be considered as part of standardization activities. These activities are deemed to be needed as existing standardization is thought to be top down, complex, and needs to be a more practical approach which will allow citizens can be included. The specific recommendations are explored in detail in clause 10.3.

Measuring the impact of smart cities and demonstrating the improvement of outcomes for citizens represents a major standardization opportunity for smart cities. **(Recommendation 3).**

7.6 Citizen strategy

The survey sought to understand whether any smart cities had a citizen strategy in place. 64 % of respondents said *no*, of the 36 % who said *yes*, 30 cities were cited as having a citizen strategy. The cities highlighted do have a strategy for developing their cities largely with a technology focus, but they do not have a published smart citizen strategy. However, these cities are predominantly large urban cities with considerable resources, whereas 85 % of European smart cities are termed *small giants* and typically do not have any resources which they can utilize to create a citizen strategy. This represents a significant standardization opportunity to support all cities change the focus from one of technology implementation to improving the city and services for citizens. **(Recommendation 14).**

8 The smart city standards landscape

8.1 Introduction

As part of a non-exhaustive standardization overview exercise which was conducted in the CEN-CENELEC-ETSI Smart and Sustainable Cities and Communities Sector Forum [i.30] hundreds of standards have been identified as potentially applicable to smart cities. Note that first and foremost, only a very few of these were drawn up with smart cities in mind. Many are focused on technology aspects and have focused on addressing the interoperability issues a key area for smart cities.

In addition, the end-users - consumers or non-ICT industries - are rarely present in the development of these technological standards. The current European Regulation (EU) No 1025/2012 [i.15] governing standards processes has helped to encourage the participation of societal stakeholders (consumers, environmental organizations and the labour movement), the resource and expertise available to these stakeholder categories remains very limited in comparison with industry. The participation of local authorities is also very limited.

Furthermore, understanding and participation is not helped by a bewildering landscape of standards organizations, both formal at national, European and international levels, and informally through industry standards consortia (both open and closed).

The present clause is no more than a high-level overview of the current landscape. Ways in which the current landscape - at least at European level - can be made more transparent and helpful to smart cities are discussed in clause 10. Information on how to navigate through the CEN-CENELEC-ETSI Mindmap is available online [i.48] and an overview is provided in annex B.

8.2 International smart city standardization

At international level the International Organization for Standardization (ISO) and ISO/IEC Joint Technical Committee (JTC 1) have specific smart city standardization activities. The International Electrotechnical Committee (IEC) does not create smart city standards, it has a Systems Committee which focuses on electrotechnical needs of smart cities. ITU-T (a UN Agency) coordinates telecommunication standardization for smart cities, and the drafting processes are open to any interested party [i.26].

Within ISO, there is a dedicated Technical Committee for smart city issues, TC 268 - Sustainable Cities and Communities [i.27]. The TC 268 scope includes "the development of requirements, frameworks, guidance and supporting techniques and tools related to the achievement of sustainable development considering smartness and resilience, to help all Cities and Communities and their interested parties in both rural and urban areas become more sustainable".

Most TC 268 standards have a management system, infrastructure and technical focus, and ISO is seeking to encourage the adoption of these international standards in collaboration with cities across the world. A Task Group TG2, "Collection of cities' good practices and needs", works with cities to consider how a package of TC 268 standards can be used to meet the objectives of the city. This activity creates a feedback loop where the cities can identify needed changes to existing standards, or new standard requirements.

International smart city infrastructure standards have taken account of the European Legislation and Regulation to frame the data exchange and sharing requirements, and have based these smart city standards on BSI PAS 183 [i.11]. This smart city infrastructure standard implements both privacy-preserving and security-minded principles within the setting of the smart city's national jurisdiction.

ITU-T SG20 is the lead study group on:

- Internet of things (IoT) and its applications;
- Smart Cities and Communities (SC&C), including its e-services and smart services; and
- Lead study group for Internet of things identification.

ITU-T's Joint Co-ordination Activities on the Internet of Things and Smart Cities and Communities (JCA-IoT and SC&C) have published a standardization roadmap and database containing over 500 standards on smart cities. Information on the current SG20 work items can be found online [i.43].

There are many different Technical Committees in the three formal international standardization organizations formed for other purposes which have some interest in smart city issues, and there have been efforts to improve co-ordination.

8.3 International standardization alignment

Smart cities standardization implementation has been recognized as not serving the ultimate customers, the cities. This has now been deemed a priority` area for SDO alignment between ISO, IEC and ITU-T. They have created a Joint Smart Cities Task Force to improve co-ordination.

The Global Standards Collaboration, which embraces ITU-T and regional communications standards organizations, including ETSI, and has participation from other organizations such as IEEE, has also considered how to improve co-ordination on smart city standards issues.

8.4 European standardization

Co-ordination at European level is assured by the CEN-CENELEC-ETSI Sector Forum [i.41]. This is not a standardization body but coordinates policies at a strategic level, with the participation of national standards organizations and interested associations at a European level, such as ANEC, EUROCITIES and OASC.

CEN Technical Committee 465 has been established to focus on adopting relevant international standards from ISO TC 268 as European ones, and the Committee will also explore the scope for additional European Standards.

Smart cities issues are within the scope of a number of ETSI Technical Committees and Industry Specification Groups, strategic co-ordination is assured through the ETSI Board.

8.5 National standardization

At national level, standards organizations are the members of CEN and ISO and/or CENELEC and IEC. ETSI also has assigned national standards organizations in Europe to facilitate the approval of formal European Standards.

A number of national organizations have Technical Committees or other groups looking at smart city standards issues. These are currently usually what are termed "mirror committees" to facilitate national consensus on proposals emerging from ISO/IEC and ITU-T. In addition, some countries, notably Spain and the United Kingdom have been more active at a national level, although rarely with citizen focused standards. National organizations have also a role to play in securing improved city awareness of and participation in standardization. Smart cities are a horizontal topic covering a very large scope. It will be essential that standardization bodies and governments improve their communication.

There has been some national work referencing a citizen-based approach with the release of a Publicly Available Specification from BSI which has now been withdrawn and has been fast tracked as an International Standard, ISO 37106 [i.16]. This is a guide to establishing strategies for smart cities and communities. Guidance is 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. Three concrete recommendations take a citizen-centric approach:

Smart city leaders should:

a) Provide stakeholders with public services which are accessible multi-channel and designed to meet user not city needs.

b) Curate an integrated data framework to support a holistic view of the city which is focused on the delivery of city services for citizens.

c) Provide a phased, low-cost and low-risk way of rolling out city services to serve specific customer segments that sit within the existing delivery structures of the city.

9 Citizen indicators

9.1 What's involved?

In general, indicator standardization activities have focused on helping to assess the performance of smart city tools, services and projects, at different levels. These indicators can then be used to justify particular guidelines and processes when replicating best practice from other smart cities. However, as described in clause 5.5.2, citizens requirements extend beyond city performance, cities need to understand the outcomes the city creates for citizens.

9.2 Citizens' concerns

When cities look for solutions that solve their current issues or challenges, it is usual for them to leverage on objectives, key performance indicators and thresholds of success to assess the performance of the selected tools and validate their effectiveness. For instance, the project CITYkeys [i.42], funded by the European Union, has provided a validated, holistic performance measurement framework for monitoring and comparing the implementation of Smart City solutions, with the objective of speeding up the transition to low carbon, resource-efficient cities, whose results have been used as reference in several activities in ETSI.

CITYkeys organized two questionnaires to gather input from a small sample of twenty cities involved in EU-funded Smart City projects as well as from their citizens and stakeholders. The project attempted to incorporate citizens' needs in its outputs, cities' stakeholders were asked to give their opinion on what makes a "smart city" project useful for the citizens [i.46]. One of the highlights of the answers is the need for a city to involve citizens in the process from the beginning but also give priority to projects that maximize the outcomes of public interest. With the projects' results split in four categories, citizens/stakeholders were asked to indicate the most important ones per category, which led to the following classification.

Table 1: Citizens' major needs

City governance	People	Environment	Economy
Better city governance	More/better recreation	Cleaner city	New jobs
Improvement of city attractiveness	Better education & skills building	Cleaner energy	Economic growth
Participation of the citizens	New skills for the citizens	Protection of natural resources	Less costly projects
More transparency in city operations	Improvement of the housing conditions	Better & cleaner private transportation	Increase of city competitiveness
	Better health	Better & cleaner public transportation	Better telecommunications
	Improvement of the social and human capital	Decrease in noise	New digital infrastructure & e-services
	Creation of cultural value	More sustainability	Creation of innovation & knowledge
	Increase of security	Protection of the environment	Creation of local enterprises
	Better integration/ acceptance of the foreigners in the city		
	Better quality of life	Better integration/ acceptance of the foreigners in the city	
	Protection of the most vulnerable citizens		

According to the surveys, citizens and stakeholders follow adequately what their cities plan and implement, looking for better results [i.46] especially for three objectives:

1) improvement of quality of life;

2) better services from the city to the citizens; and

3) creation of an innovative city, competent and with high skilled jobs.

The European Innovation Partnership on Smart Cities and Communities (EIP-SCC) has an initiative called CitizenCity [i.45] whose main objective is to develop tools and platforms to make citizens central in the delivery of smart projects. One of its major developments is a societal engagement toolkit which is trying to create a knowledge pool for cities to design better, finding a common approach and involving the citizens. Aimed at facilitating the implementation of the principles of the 'European Manifesto on Citizen Engagement', the toolkit intends to bridge the needs of cities with the supply of available tool resources, based on a methodology that uses indicators and metrics as means to assess performance of such tools in meeting citizens' needs.

Based on the inventory of indicators from 43 existing indicator frameworks, and due to the collaboration with the consortia of different EU-funded projects in the smart city domain (e.g. TRIANGULUM, REMOURBAN and SMARTER TOGETHER), CITYkeys has designed a set of indicators for assessing smart city projects and smart city performance, as well as suggesting new indicators to fill gaps in existing frameworks, mostly related to specific characteristics of smart city projects. The resulting indicator selection responds to the wishes of cities and citizens for the coverage of their priorities and reflects city goals, arranged in the triple bottom line of social sustainability relating to people, environmental sustainability relating to planet and economic sustainability relating to prosperity, extended to include the themes governance and propagation, and finally completed with specific smart city indicators.

9.3 Current standardization landscape

9.3.1 Overview

Some SDOs are working on standards and specifications that leverage strategies or indicators for citizens, as listed below.

9.3.2 ISO indicators

According to ISO, the International Organization for Standardization, cities need indicators to measure their performance. As part of a series of international standards being developed for a holistic and integrated approach to sustainable development and resilience, ISO created a set of standardized indicators to track and monitor progress on city performance to achieve sustainable development as well as quality of life, published in ISO 37120 [i.17]. Besides needing an annual compilation, the indicators are classified into themes according to the different sectors and services provided by a city.

The list of indicators is based on the following criteria:

- Completeness: indicators should measure and balance all relevant aspects for evaluation of the smart city.
- Technology neutral: not favouring one technology over another, existing or future.
  Simplicity: indicators can be expressed and presented in an understandable and clear way.
- Validity: indicators are an accurate reflection of the facts and data that can be collected using scientific techniques.
- Verifiability: indicators are verifiable and reproducible. Methodologies are rigorous enough to give certainty to the level of implementation of the criteria.
- Availability: quality data are available, or it is feasible to initiate a secure and reliable monitoring process that will make them available in the future.
- The categories of smart cities indicators included are Economy, Education, Energy and Climate Change, Finance, Governance, Health, Housing, Population and social conditions, Recreation, Safety, Solid waste, Sport and culture, Telecommunication, Transportation, Urban/local agriculture and food security, Urban planning, Wastewater, Water and Reporting and record maintenance.

ISO 37120 [i.17] also contains an annex with a list of profile indicators to provide basic statistics and background information to help cities determine which cities are of interest for comparisons.

In 2019 an additional dedicated international smart city indicator standard has been published, ISO 37122:2019 [i.18]. The smart cities indicator standard is designed to support the curation and measurement of individual city service and environmental data. This indicator standard uses ISO 37120 [i.17] as a normative reference and assumes that smart cities will adopt both standards.

In 2019 an additional indicator standard was published, as part of the family of smart cities and communities' indicator standards within the work of ISO TC 268, ISO 37123:2019 [i.19]. This may be applicable to some smart cities who are exploring the resilience of their city and addresses the indicators to be used to develop a reliance approach for smart cities and communities.

9.3.3 UN Sustainable Development Goals

Similar to ISO 37120 [i.17] which contains a mapping of the indicators to the Sustainable Development Goals (SDGs) for sustainability and quality of life, the United Nations have defined a blueprint to achieve a better and more sustainable future for all. The SDGs [i.32], address the global challenges mankind faces, including those related to poverty, inequality, climate, environmental degradation, prosperity, and peace and justice. The SDGs are interconnected, and in order to leave no one behind, it is important to achieve them all by 2030. This said, Goal 11 "Make cities inclusive, safe, resilient and sustainable" [i.23], is particularly important in the context of the present document.

United for Smart Sustainable Cities (U4SSC) is a UN initiative co-ordinated by ITU, UNECE and UN-Habitat. It has developed the Key Performance Indicators for Smart Sustainable Cities to support city worldwide in evaluating the role and contribution of ICTs in smart sustainable cities, and to provide cities with the tools for self-assessments in order to achieve the United Nations Sustainable Development Goals.

The KPIs for SSC consist of 91 indicators. Each indicator forms part of a holistic view of a city's performance in three dimensions: Economy, Environment and Society and Culture. There is a documented list of U4SSC KPIs [i.44].

9.3.4 ETSI work on community indicators

ETSI has published ETSI TS 103 463 [i.20] under the umbrella of the Technical Committee, Access, Terminals, Transmission and Multiplexing (ATTM), which describes the selection of indicators at a city level. Starting from the definition of a smart city, indicators have been selected that can function as Key Performance Indicators for tracking the progress towards city objectives. Based on the CITYkeys deliverable D1.4 [i.42], and with a starting point in the smart city definition, and considering the wishes of cities and citizens regarding smart city indicators, these are arranged in an extended triple bottom line sustainability framework, including the themes people, planet, prosperity, governance and propagation, and completed with specific smart city indicators.

For example, the indicators of the People theme cover the following subdomains:

- Encouraging a healthy lifestyle.
- Cybersecurity and Data Privacy, Inside Safety.
- Access to (other) services, like public transport, public and commercial amenities.
- Education and digital literacy.
- Quality of housing and the built environment.

ETSI has also published a Group Specification to define Key Performance Indicators for Smart Cities expressing city level in terms of People, Planet, Prosperity, Governance and Propagation ETSI GS OEU 019 [i.21]. Produced by ETSI's Industry Specification Group Operational Energy Efficiency for Users (ISG OEU), the document describes a selection of 73 indicators for assessing progress towards the objectives on a city level. Based on the CITYkeys deliverables, the majority of these indicators concern energy use, emissions from CO2 pollutants, and waste generation, with the resulting indicator selection responding to the wishes of cities and citizens for the coverage of their priorities and reflecting city goals. The ICT users' indicator set focusses on impact indicators, as these can be used for all types of interventions, together with a number of generalized inputs, outputs and outcome indicators that reflect the degree of smartness of a city.

9.4 Is standardization helping?

In general, standardization activities have specified several indicators capable of helping cities assess the performance of smart city tools, services and quality of life, at different levels. These indicators can then be used to justify particular guidelines and processes when replicating good practice from other smart cities. However, as recommended in clause 5.5.2, the indicator assessment could also benefit from standard processes and tools, to avoid reinventing new surveys whenever the need for gathering requirements and concerns from citizens arises.

10 Recommendations for standardization

10.1 Some major issues to address

Smart cities are a horizontal topic covering a very large scope and involving a great variety of actors, amongst which cities, governments and standardization organizations that need to work together.

Regarding smart city-related standardization, a number of major issues have been identified using in particular the survey results, as well as other outreach such as participation at relevant meetings and conferences. These issues are mostly related to the difficulty for cities to participate in a focused and relevant manner to the very complex standardization landscape of smart cities.

The recommendations made in this clause aims at suggesting ways to improve the way standardization organizations work with cities (large and small) and deliver useful outcomes. They are addressing the following major issues:

- **Cities do not know standardization**

  Yes, there are exceptions, but these are very few. How can cities be given sensible information about standardization and participation without over-saturating them with information they will not be able to assimilate?

- **Cities cannot participate in standardization**

  On the whole they have no resource and it is difficult to find funding to participate. A real Chicken-and-egg situation. Standards-makers will not be interested in providing useful deliverables if cities are not present. How can SDOs capture city requirements and involve cities without undue participation burdens?

- **Funding models are inadequate**

  Due to the lack of available funding cities compete for scarce resources. Alternative funding models need to be explored to develop a collaborative marketplace approach. Innovative SMEs should not be required to compete with larger competitors to deliver innovation in cities.

  Funding instruments are required to be developed which:

  - allow cities to scale innovation beyond the pilot interventions currently funded;
  - do not require SMEs to match fund. Match funding models are not appropriate for SMEs and the smart cities market is not considered a viable ecosystem for SMEs now innovation opportunities are plentiful;
  - facilitate the adoption of standards, which National Standards bodies are not funded to do;
  - support where appropriate their participation in important standards activities.

- **Standardization is incoherent**

  Standardization is a bewildering maze for cities. In Europe there is a Sector Forum, not many people outside a narrow circle are aware of it. Internationally, each of the SDOs has an activity on smart city standards issues, but collaboration is limited. How can standardization present a more coherent image?

- **Services are not designed for citizens**

  In most cases, services are not "designed" as such. Digital services tend to be a series of upgrades to non-digital services, with resulting differences in approach and incompatibilities. Citizens use of city services are often the last element to be considered.

- **Services are not accessible for citizens**

  Smart Cities do not generally support independent living of people with disabilities or other accessibility needs. Some efforts have been made in the health sector for improving quality of life and independent living of people with disabilities, but overall further focus is required on the accessibility of smart city services.

  Whilst there is gradual improvement in physical accessibility, for example in transport, building/street accessibility is largely unexplored. Use of digital technology, for example for people to call for specialized transport facilities, needs to be made more widely available.

  For specific digital services, the needs of people with particular accessibility issues are not generally considered. For example, if there are interactive screens to seek a service, are these made accessible for people with visual problems?

- **A better approach to citizen data is needed**

  In Europe the GDPR gives better protection, and standards aspects of data protection and privacy are being given some attention, the value of protected citizen data for cities themselves is not yet explored. How can citizens' interests be better served if cities do not have a coherent set of data on the use of their services?

10.2 Organizational recommendations

10.2.1 Introduction

The present document makes a number of specific recommendations concerning future smart city-related standardization activities that could benefit citizens, as well as the cities themselves. But even with goodwill on the part of standards organizations, in order to be as effective as possible, additional structural improvements are needed in terms of the way standardization engages with local government.

In particular, whilst there are some shining exceptions, very few cities have any interaction with standards organizations. Smart city standardization activities, almost by definition, face an uphill struggle if they cannot take a direct account as possible of the requirements of the target audience. This is true not only for large cities - amongst which most of the shining exceptions can be found - but even more so for smaller local authorities. Any improvement sought for the way standardization organizations work with cities should overcome this difficulty to define work processes that can relate to the vast silent majority of European cities.

Some of the major issues identified in clause 10.1 above address this specifically. Whilst these issues were not identified in the original scope of the current project, they are too important to ignore. The present document offers some suggestions to improve the current issues.

10.2.2 What standards organizations might do

- **Engage better with cities, smart or otherwise**

  At EU level, there is a bewildering array of representative associations for local authorities. There is not a single point where standards organizations can interface with local authorities about issues affecting them, rather a large network of different points dealing with different aspects of city issues.

  This constitutes a barrier to the engagement of local authorities; communication does not happen in the right way at the right time. Local authorities are also competing for scarce resources.

  This problem is not one that can be resolved easily. One approach which should be considered is the creation of a project within Horizon Europe, whose objective would be to dialogue with standards organizations and a wide range of associations and cities and, based on the results, try to reach agreement on proposals as to how engagement can be improved.

The highly successful Stand-ICT project under Horizon 2020 provides financial support for SMEs to participate in international standardization. Consideration should be given to a similar project specific to cities, to enable representatives to participate in standards meetings where appropriate.

- **Engage better with policy makers**

  Discussions in the CEN-CENELEC-ETSI Sector Forum on smart cities shows evidence that some national standards organizations have good contact and engagement with policy makers concerning smart cities at Government level, but this is certainly far from universally the case. It would therefore be helpful if such engagement could become systematic, for example by national organizations being in contact with the relevant ministries in charge of local government, to see if additional communication channels with cities can be opened up.

  Similarly, at European level, the three ESOs could focus on strengthening their contact with the European Commission's DG REGIO, to improve their awareness of how standardization can help local authorities.

- **Take city views into account**

  The 2012 European legislation identifies certain categories of stakeholders, namely SMEs and societal stakeholders, as being particularly important contributors to standards processes, and lays down specific requirements to ensure their views are taken into account. Whilst of course local authorities have no such engagement requirements, there are similarities. The European Standards Organizations (and their counterparts at national level) could consider a similar approach whenever a standardization proposal specifically relates to smart cities.

  Thus, if direct city participation is not possible, the ESOs could adopt a policy to contact cities in advance of the drafting, to make sure that their requirements are understood, and then again when there is a draft available, to allow them to comment.

  This process could be facilitated through the nomination of a panel of experts familiar with cities and their requirements, who would have an informal remit to comment on standards proposals and draft texts. The panel would not have a formal role in established processes but would simply act as a focal point for city needs.

  The Horizon Europe project suggested above could examine the feasibility of such a panel and carry out a trial run.

- **Organize a standards summit**

  There are already many smart city-related "events" in the form of conferences. But few make more than a glancing reference to standards issues, few to citizen-related aspects, and almost none to both.

  It might be helpful to hold a dedicated standards-related event, where the issues outlined above can be explored. This needs to be organized with the collaboration of all three European organizations and involvement of at least some national standards organizations. The CEN-CENELEC-ETSI Sector Forum or TC 465 which is focused on European smart city standardization may be appropriate places to organize this.

  The intention would be to focus on high-level issues concerning participation and engagement, and it is hoped that the Commission services would participate fully. It is hoped that the consultations from such a summit would be very widely disseminated to cities to help support their standardization efforts.

10.3 Recommendations for standardization

10.3.1 Introduction

Recommendations related to smart city standardization have to take into account a variety of actors and situations. Amongst those in charge, within the city organization(s), of dealing with the citizens and their needs. A large number of different stakeholders are involved, with very different operational roles and responsibilities, for example front office, back office, technology development, integration and support teams, security enablement and enforcement, training.

Adoption and adherence to standards is the expectation in order for the benefits to be realized. In order for standardization to be effective it should take into account the needs of all stakeholders addressed by the recommendation. It is also important that the technology setting and business processes involved are understood.

This translates into different types, and levels of recommendations that are grouped in the remainder of the clause into three categories that have a growing proximity with the standardization agenda.

- Guidance. These recommendations relate to the high-level approach that smart cities could adopt in order to deal with a number of citizens requirements. They are, in particular, suggesting the development of guidelines for the smart cities across Europe and also more specific ones addressing particular topics, for example citizen strategies, safety and security.
- Codes of Conduct. These recommendations for smart cities relate to precise approaches to the development of solutions for specific issues for example design and delivery of services. The proposed Codes of Conduct are more binding than the guidance addressed in the previous paragraph.
- Standards. These recommendations are addressing the standardization agenda. They are defining new work items that Standards Developments Organizations could potentially integrate to their standards development plans.

10.3.2 Guidance

Recommendation 1: Ensure continued physical presence in management of city services, to support all user needs, but in particular those of vulnerable categories (clause 5.2).

Recommendation 2: Draw up guidance material for smart cities to help them to implement the proposed standard for service design and delivery (clauses 5.4, 5.5.2 and 6.2).

Recommendation 3: Prepare a Local Digital Economy and Society Index (DESI) for smart cities, which supports the cities to develop an outcome-based approach to city services, focused on improving outcomes for citizens (clauses 5.5 and 7.5).

Recommendation 4: Provide guidance for cities, oriented towards protection of the citizen, on security measures to be implemented across the city, and for individual services (clauses 5.7.2 and 5.7.5).

Recommendation 5: Provide guidance to city personnel who have legitimate access to city services and technology, to protect citizen security, including staff training and a code of good practice for management (clause 5.7.3).

Recommendation 6: Review physical security arrangements by cities in the context of the vulnerabilities these create for city services, and the requirements to ensure the safety and security of citizens (clause 5.7.4).

Recommendation 14: Provide guidance for cities to create a citizen strategy which articulates how to change the focus from one of technology implementation to a focus of prioritizing a citizen participation approach (clause 7.6).

10.3.3 Codes of conduct

Recommendation 7: Draw up dedicated codes of conduct for cities concerning service complaint and redress procedures, aligned as far as possible with the EU's ADR principles (clause 5.3).

Recommendation 8: Provide standardized codes of conduct to help smart cities ensure correct design and delivery of citizen services, including a transparent and open declaration of the ethical approach taken (clauses 5.4 and 6).

Recommendation 5: Provide guidance to city personnel who have legitimate access to city services and technology, to protect citizen security, including staff training and a code of good practice for management (clause 5.7.3).

10.3.4 Standards

Recommendation 7: Draw up dedicated standardized guidance for cities concerning service complaint and redress procedures, aligned as far as possible with the EU's ADR principles (clause 5.3).

Recommendation 9: Study the potential security difficulties for citizens arising from future over-dependency on ultra-fast 5G transmissions to manage and control apparatus in the city environment (clause 5.7.2).

Recommendation 10: Review physical security arrangements by cities in the context of the vulnerabilities these create for city services, and the requirements to ensure the safety and security of citizens (clause 5.7.4).

Recommendation 11: Explore a standardized approach to citizen uses for and requirements from the data spectrum (clause 5.8).

Recommendation 12: Standardize the basic elements of citizen-oriented service design, to provide clear and easy-to-use electronic interfaces, with background supporting information easily available, ensure human interface possibilities are always there (in whatever form) as back-up and avoid digital divide issues, by providing special interfaces designed for the less able, and support provided for these persons (clauses 6.1 and 6.2).

Recommendation 13: Create a standardized approach to citizen participation which resolves privacy and security concerns, utilizing the shared data case study in BSI PAS 183 rather than the current approaches which are using open data (clause 6.5).

11 Conclusions, acknowledgements

As far as can be ascertained, the present document has been the first attempt to set out citizen/consumer-related issues related to smart cities and communities in the context of standardization.

The present document gives an overview of a challenging problem, aspects of which are regularly considered a challenge in standards communities. Specifically, it is an issue how best to ensure societal stakeholders needs are taken into account in a balanced way in order to create standardization which unlock the benefits of the digital society.

To this dimension is added the serious constraint that cities, with smaller local communities, do not have the resource to engage with standardization, and this reduces the potential for the standards to reflect fully the needs of these communities and their citizens.

The present document provides a series of recommendations aimed at helping to bridge these gaps. It is expected that these can be taken forward within the European Standardization Agenda, and the wider eco-system of which it is a part.

The valuable support of the smart city standardization communities in CEN, CENELEC and ETSI in the preparation of this project is very much appreciated, as is the constructive and helpful approach of those who provided comments on the draft proposals. The assistance of the ETSI Events Team in organization of the Open Meeting held to consider the draft proposals has been invaluable. Finally, without the contributions of the European Commission and EFTA under the ICT standardization grant scheme, the publication of the present document would not have been possible.

Annex A:
Survey Analysis

Figure A.1 below shows the response results for the answers to Q3 on the stakeholder survey.

Q3. What do you think are the most important issues to help citizens in future smart communities?

There are six answers, and respondents were asked to rank the answers, giving a rank to every answer, using the rank values of 1 to 6 only once each, and using 1 for the most important through 6 for the least important. The order of the answers presented to respondents was not randomized. The number shown against each answer text is the answer position, so "1 Access to services, online and offline" appeared first in the list.

The left chart shows the answers ordered by the count of responses that selected that answer as the most important (so, rank = 1), described as "ordered by count of most important". The same chart shows the count of responses for all ranks for all answers. The rank values of 1 to 6 are shown at the bottom.

Having created the left chart, further analysis showed significant counts rank values other than one. To gain some better understanding of the rank values overall for an answer, the right chart was created.

The right chart shows the answers ordered by the total points accrued for each answer across all received responses, where 6 points are allocated for rank = 1, 5 points for rank = 2, and so through to 1 point for rank = 6.

The right chart also contains a visual breakdown of the contribution of each rank value to the total, by colouring the rank values, and also showing the response count value where there is sufficient space.

For both charts, the rank values are coloured on a blue ramp, where rank = 1 takes the deepest shade, and rank = 6 the lightest shade.

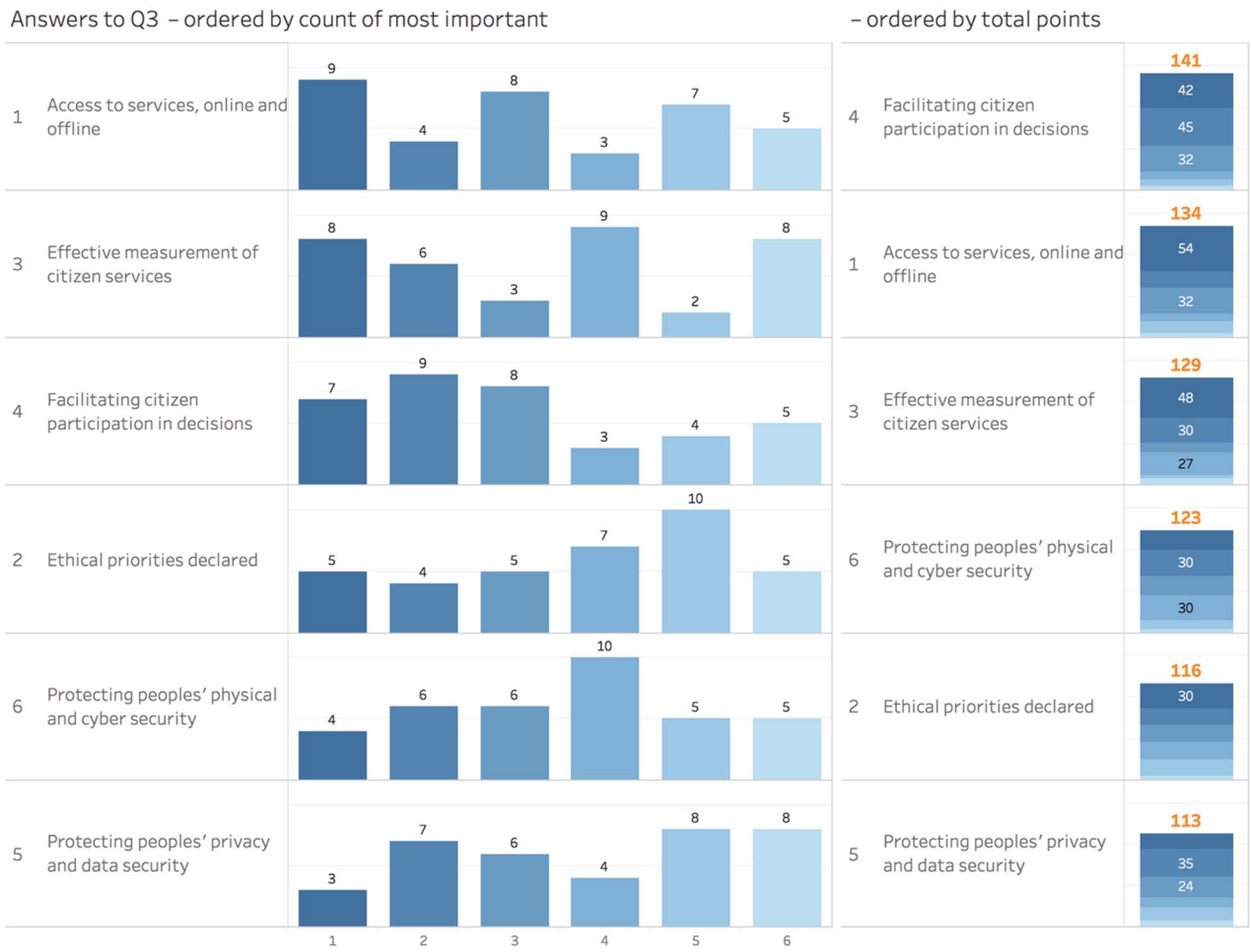

Figure A.1: Survey results of the most important issues to help citizens in future smart communities

Annex B:
Smart City Standards Mindmap

With 78 % of the European Union (EU) population living in cities and 85 % of the EU GDP generated in cities, they are considered the driving forces of European economic and societal growth. Urban areas are becoming smarter and more sustainable thanks to the widespread use of ICT to improve the quality of life and well-being of their citizens. While still being responsible for 70 % of the global energy consumption and energy-related greenhouse gas emissions, cities are lacking the complete roll-out of scalable, interoperable and sustainable solutions in the areas of energy, transport, mobility, infrastructure and ICT to become globally competitive. Standards for smart cities can be used to monitor technical and functional performance, but also to ensure safety, interoperability, costs' reduction, efficient and strategic planning and management of resources as well as assessment through city indicators and sharing of best practices. Standards provide a common language and understanding, facilitate consensus driven solutions, and boost private and public partnerships. Finally, they represent tools, guidelines for cities for deployment of city solutions with high market potential and broad stakeholders' acceptance.

CEN-CENELEC-ETSI Sector Forum on Smart and Sustainable Cities and Communities (SSCC-SF) created a mapping which aims at listing relevant standardization activities and published standards, relevant for the development of Smart Cities. It lists also the different policy and research initiatives in this respect.

The SSCC Mindmap in Figure B.1 consists of a set of rectangular boxes joined by curved lines. From the central node (a circle in the example below), there are curved lines to various topics, then from each topic a set of lines to sub-topics, etc. The most important branch has the header "Standards", but there are also branches for Global Trends, Use Cases, Organizations, Platform Examples and Execution Examples.

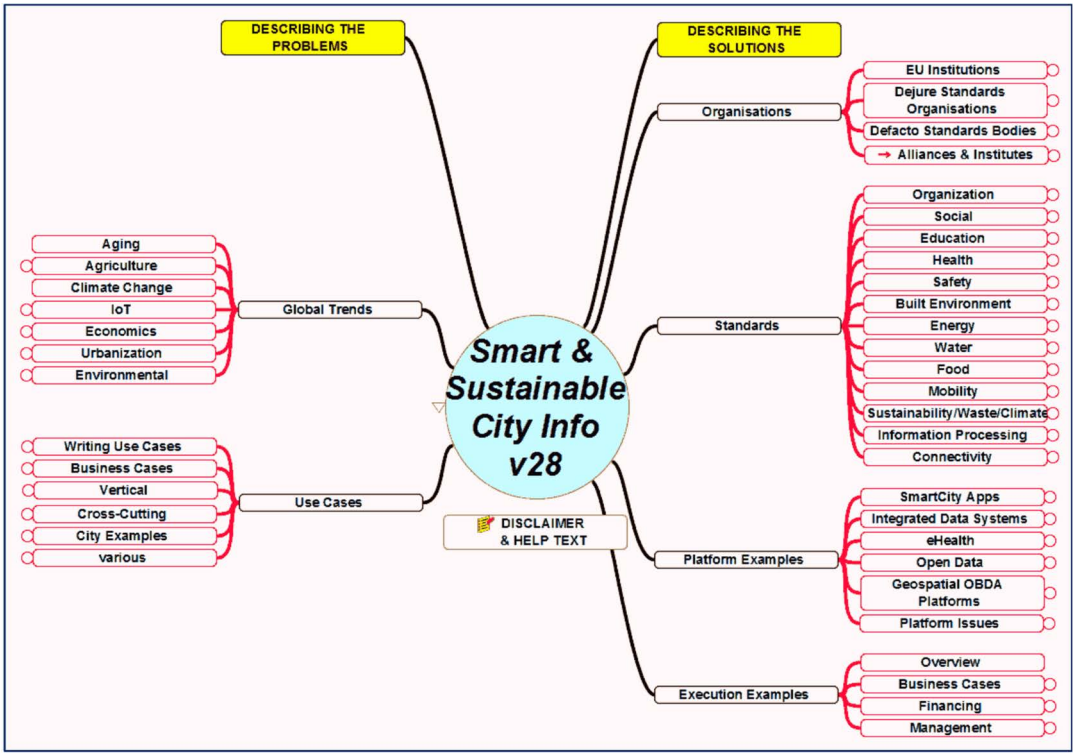

Figure B.1: Mindmap of Smart and Sustainable Cities and Communities Topics

Creating smart cities requires knowledgeable choices between various (interoperable) standards and specifications for technologies, as well as knowledge of best practice in implementing those choices, including change management, process design and control, risk management, etc. The main goals of this work are therefore to:

1) collect links to organizations (standards bodies, EU institutions, industry bodies) which create standards and specifications

2) collect links to documents which are useful in analysing Smart City issues and/or in describing solutions, usually in the form of standards and specifications, but also guidelines, market trends, reports or research publications

3) provide tools for users to find relevant standards and prioritize the various documents for their specific usage needs

In the Mindmap, every effort has been made to obtain web links for all documents and for the homepages of organizations and specifications. It is a living document with the aim to give an overview of useful information on work related to smart and sustainable cities, and to reference initiatives and standardization activities. Web links to original material are given, but there are no guarantees that the links are maintained or contain the same information as originally viewed. Some document links point only to webpages where the originals can be purchased, due to copyright constraints.

Annex C:
The European Integrated Project on smart cities and communities (EIP-SCC)

The European Innovation Partnership on Smart Cities and Communities [i.45] which assembles partners "*committing to work on specific issues related to smart cities, by sharing the knowledge and expertise with their peers, giving added-value to their national and local experience and identifying gaps that need to be fulfilled at European level*" is organized in six main clusters, listed in table C.1.

Table C.1

EIP-SCC Action Cluster	Description
Citizen Focus	*In a time of urban transformation and digitalisation of smart cities, too little attention is sometime given to citizens. Citizen Focus Action Cluster strongly believes in citizens as fundamental actors for the regeneration and development of smart cities. Civic engagement, empowerment, participation and co-creation are at the basis of our advocacy approach since we acknowledge that citizen voice can be pivotal in providing the demand-side pressure on government, service providers and organisations needed to encourage full response to citizen needs. It also ensures the setup of a trusted and sound relationship with local governments and a source of democratic legitimacy and transparency. In the context of smarter cities, citizens understanding of concrete problems and challenges can help local governments prioritise and respond consistently to inhabitants' need.*
Business Models, Finance and Procurement	*Existing business models, finance & funding instruments and procurement schemes do not always fit today's challenges within our cities. There is a strong need for knowledge sharing, innovation and expertise on business models, finance & funding and procurement. The Business Model Action Cluster is a platform where stakeholders work together to establish a dialogue, identify and remove the obstacles for the development of a smart cities market. The action cluster wants to be a focal point for the gathering and sharing of information on business models, financing opportunities and procurement methods.*
Integrated Infrastructures and Processes	*Significant and as 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.*
Integrated Planning, Policy and Regulations	*Integrated Planning, Policy and Regulation focuses on Innovative forms of smart city policies and regulations that are needed to enable large scale implementation and roll-out of smart cities. Cities need an adequate set of framework conditions in the field of policy and regulations in order to be able to smarten up. New governance concepts are required to coordinate and integrate smart city stakeholders - cities, businesses, and research organisations - within the change process so to identify strengths, weaknesses, opportunities and threats. Stakeholders need to jointly experience and learn with new forms of governance and policy concepts to further the process of becoming a sustainable, smart city.*
Sustainable Districts and Built Environment	*The main challenge in 'Sustainable Districts and Built Environment' is to reduce energy use, environmental impact and carbon footprint, entail competitive industries for jobs and growth and at the same time ensure societal and social development and the well-being of citizens. The investment needed to improve energy efficiency, generate low carbon energy, modernize infrastructure and create high quality living environments is enormous. At the same time, cities have limited access to planned financial resources for systemic change, which requires the activation of private capital combined with public investment.*
Sustainable Urban Mobility	*Without significant deployment and penetration of new urban mobility solutions, it will be impossible to reach European urban mobility goals. Getting wide-scale deployment can be achieved in many ways; scaling in other locations or working with new partners.* *The Sustainable Urban Mobility brings together cities and regions with companies to show-case innovative mobility solutions and support their replication at scale in key market segments. It aims to become the leading platform for understanding (and documenting) city needs, bringing stakeholders together, building the tools that support an innovation pipeline, and directly supporting individual networks and projects that are en-route to realisation.*

The work of each Action Cluster is collected under thematic *Initiatives*, which then pool the work of the various partners around a particular objective, promoting learning beyond project and geographic borders, and opening the results to the world at large, linking with EU-funded projects to allow results to be consumed by the thousands of people active on the Marketplace.

Annex D:
ICT Accessibility Requirements in ETSI EN 301 549

There is significant standardization activity with regard to the accessibility of ICT products and services. However, smart cities cannot claim that they improve the quality of life of citizens if they do not support the independent living of individuals with disabilities, this is a key challenge for smart cities. Accessibility standardization provisions need to be made in smart cities where standards can enhance the quality of life of citizens and facilitate the independent living of people with disabilities.

The main guidance in this area will focus on the electronic accessibility areas that ETSI EN 301 549 [i.3] follows and more specifically on:

- Generic Requirements
- ICT with two-way voice communication
- ICT with video capabilities
- Hardware
- Non-web content
- Non-web software
- Documentation and support services
- ICT providing relay or emergency service access

Following are some related use-case scenarios on each of the above areas:

1 Generic Requirements

This category includes ICT that uses biological characteristics. For example, citizens may have to use their fingerprints or the iris of their eye for identifying themselves and accessing specific services, for example access to their bank account, entrance to their house, making payments, etc. Therefore, such services should not rely exclusively on the use of a particular biological characteristic as the only means of user identification or for control of ICT.

2 ICT with two-way voice communication

ICT with two-way voice communication is quite common in smart cities, for example for giving oral commands and get a voice response back from an agent. However, citizens with hearing loss in most of the cases are not able to communicate via voice and they need to communicate via text or sign language. The introduction for example of Real Time Text (RTT) in smart city services as an alternative mode of communication can be beneficial for people with hearing or voice loss.

3 ICT with video capabilities

ICT with video capabilities is often used in smart cities for communication, accessing to information, entertainment, etc. However, citizens with sight loss require that ICT displays video with synchronized audio for accessing it as well as audio description options.

4 Hardware

Accessible hardware and more specifically access device are also one of the key issues in smart cities. For example, a future highly demanded feature in smart cities is all households to be controlled by one device. Such device should be fully accessible by people with sight/hearing loss, mobility or cognitive impairment.

5 Web

Most content in smart cities is being generated, consumed, shared and experienced on the web and consequently in order to be accessible by people with disabilities, it should comply currently with the Web Content Accessibility Guidelines 2.1 [i.51].

6 Non-web content

Any content outside the web (e.g. movie or public information) that has an associated user agent for accessing it such as a media player or an infokiosk respectively should be accessible by people with disabilities.

7 Documentation and support services

Provisions for smart cities that emerge from this clause of ETSI EN 301 549 [i.3] relate to the accessibility of product documentation provided with the ICT as well as to ICT support services such as help desks, call-centres, technical support, relay services and training services.

8 ICT providing relay or emergency service access

This clause in ETSI EN 301 549 [i.3] is applicable also in smart cities since it relates to the accessibility to relay services. These relay services enable users of different modes of communication e.g. text, sign and speech, to interact remotely through ICT with two-way communication by providing conversion between the modes of communication, normally by a human operator, and emergency services (e.g. accessibility to security or fire brigade).

History

Document history		
V1.1.1	September 2020	Publication