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INTERNATIONAL TELECOMMUNICATION UNION

No. 2 | 2016

ITU NEWS

itunews.itu.int

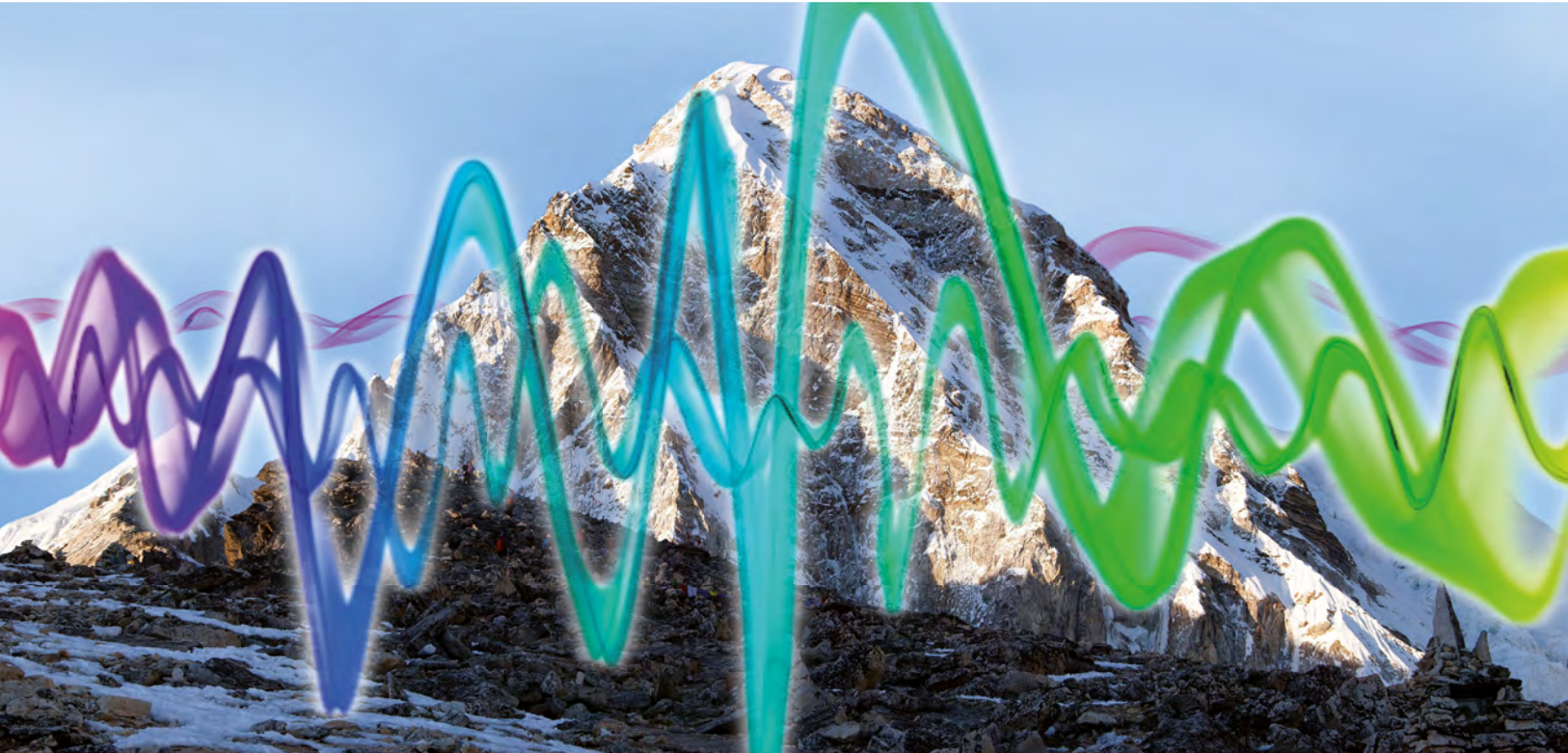
Building tomorrow's Smart Sustainable Cities

Tools and insight to move forward



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Accelerating the development of Smart Sustainable Cities

Houlin Zhao, ITU Secretary-General

As the Internet of Things (IoT) era gathers pace, ITU is accelerating its unique contribution to building the Smart Sustainable Cities of tomorrow.

Given that an estimated 70% of the world's population will live in cities by 2050, sustainable urbanization has become a policy priority for administrations across the world. Information and communication technologies (ICTs) have a crucial role to play by increasing efficiency across industry sectors and enabling such innovations as intelligent transport systems (ITS), “smart” water, energy and waste management.

There is wide recognition that building “smart” technologies into an existing city — or developing a Smart Sustainable City from the ground up — is a complex undertaking. It calls for improved cooperation and more integrated decision-making by a variety of stakeholders. This is a key area where ITU can provide valuable assistance.

That's why in January ITU helped launch the World Smart City online **community**, which is also part of the build-up to the first World Smart City Forum, to be held in Singapore on 13 July 2016. That's also why ITU is working to ensure a coordinated United Nations contribution to the work of Habitat III, the UN Conference on Housing and Sustainable Urban Development to be held in Quito, Ecuador, from 17 to 20 October 2016.

Major efficiency improvements could be achieved in cities by horizontally interconnecting systems such as energy, water, sanitation and waste management, transportation, security, environmental monitoring and weather intelligence. The interconnection of these systems will demand standardized interfaces. This is an area where ITU also has a particularly important role to play.

From 2013–2015, the ITU Telecommunication Standardization Sector (ITU-T) Focus Group on Smart Sustainable Cities helped stakeholders identify the standardized frameworks needed for the integration of ICT services in Smart Sustainable Cities. Then in June 2015 ITU members established a new ITU-T study group to address the standardization requirements of IoT technologies, with an initial focus on IoT applications in smart cities.

You can read more about ITU-T Study Group 20's work, and the focus group's technical reports and specifications in this special edition of *ITU News*. You'll also find Thought Leader insights about how to build the integration and scale needed for Smart Sustainable Cities to truly realize their potential for humanity in the IoT era.

ITU, and especially ITU-T Study Group 20, are at the forefront of this global transformation, ushering in an exciting era of opportunity and inclusiveness.

Building tomorrow's Smart Sustainable Cities

Tools and insight to move forward



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ISSN 1020-4148
itunews.itu.int
Six issues per year
Copyright: © ITU 2016

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■ Pathway for Smart Sustainable Cities: A guide for city leaders

By Silvia Guzmán, Chairman, ITU Focus Group for Smart Sustainable Cities

Since the Iron Age, the human race has advanced steadily towards becoming a sophisticated manipulator of all factors of production. Man's move from agriculture to capitalization, industrialization and specialization of labour has led to growth in modern-day cities, bringing with it both positive and unwelcome consequences. Socio-economic growth has exploded at unprecedented rates, but alas, at equally unprecedented environmental cost. People are moving to cities for better educational and employment opportunities and higher incomes. The global urban population has been rising by an average of

65 million people annually during the past three decades, the equivalent of adding seven Chicagos a year.

As of 2014, there are 28 megacities in the world, home to 453 million people. With 54% of the world's population now living in urban areas, cities are experiencing a range of different problems emanating from an ever increasing rural-to-urban migration. These include acute scarcity of basic amenities, environmental crises, and rising pollution levels — all of which threaten to burst the seams of already suffocated cities and their ageing infrastructure.

Projections indicate that these trends will continue. The total global population living in cities is expected to rise to 66% by 2050. Cities can usually account for up to 75–80% of a country's gross domestic product (GDP), and are considered the primary engines of global economic growth. The flip side, however, which may not be sufficiently factored in by city planners, is that cities account for 50% of global waste along with 60% of global greenhouse gas (GHG) emissions.

There is increasing pressure on the availability of natural resources such as water, land and fossil fuels. There are now growing concerns about the viability of existing transportation infrastructure, the provision of adequate health care, access to education, and overall safety for the increasing population in urban areas.

Continuous improvement

Urban stakeholders are faced with daunting dilemmas as to whether to promote cities as drivers of economic growth or to pay heed to issues related to the increasing population, such as resource overuse and dependence. It is in response to this challenge that the ITU's Focus Group on Smart Sustainable Cities (FG-SSC) sought to set out a path for guiding cities to become both smart and sustainable.

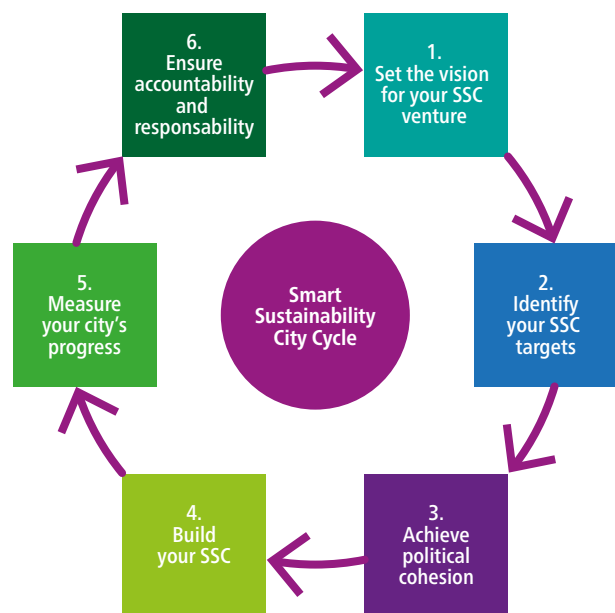
"Smart Sustainable Cities" is a concept which emerged more than a decade ago. It intends to leverage the potential of information and communication technologies (ICTs) in urban governance systems to create cities which are not only economically and socially advanced, but are also designed to achieve environmental sustainability.

ITU acknowledges that for cities wishing to become Smart Sustainable Cities, each one starts from a different baseline. However, it is important to understand that building a Smart Sustainable City means embarking on a continuous journey of holistic improvement, rather than achieving an "ultimate solution".

A guide for city leaders

Bearing in mind the above, a pathway has been outlined in the Focus Group on Smart Sustainable Cities "**Technical Report on Smart Sustainable Cities: a guide for city leaders**", based on which urban stakeholders can envisage and establish their very own Smart Sustainable Cities. This guide has been officially referenced in the Habitat III Issue Paper on Smart Cities as an input to the UN-Habitat III Conference on Housing and Sustainable Urban Development, to be held in Quito, Ecuador, from 17 to 20 October 2016.

The pathway to Smart Sustainable Cities presented by the Focus Group redefines the way in which smart city infrastructures are planned and built, services are offered, citizens are engaged, and systems are linked. The aim is to transform cities into more sustainable, smart, robust and resilient living environments, also taking into account disaster resistance, reduced GHG emissions, protection against crime and ensuring cybersecurity.



THE PROMISE OF SMARTER CITIES

Pathway for Smart Sustainable Cities: A guide for city leaders



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Information on the work of the ITU Focus Group on Smart Sustainable Cities can be found at: www.itu.int/en/ITU-T/focusgroups/ssc

ICTs and Smart Sustainable Cities

The integration of ICTs into key Smart Sustainable City processes is pertinent to achieving sustainability. ICTs can assist with the establishment of Smart Sustainable Cities through innovation, as well as redesigning of existing processes. This can include new applications, technologies and systems for smart energy, smart transportation, smart buildings, smart water management and smart government.

ICTs can provide an integrated strategic approach to sustainability and smartness in Smart Sustainable Cities, making them key enablers of urban development. ICT integration into the existing urban infrastructure also plays a vital role in the achievement of the UN post-2015 Sustainable Development Goals (SDGs), with particular reference to **Goal 9** aimed at building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation; and **Goal 11** aimed at making cities and human settlements inclusive, safe, resilient and sustainable. It can also play a crucial role in improving levels of education, attaining gender equality, raising awareness on human rights issues, and strengthening global cooperation for development.

In essence, ICTs act as catalysts in achieving the three pillars of sustainable development — economic growth, social inclusion and environmental balance. In terms of environmental issues, ICTs can provide support through monitoring and reporting schemes on greenhouse gas emissions and energy consumption. ICTs also help provide sustainable products using environmentally conscious design principles and best practices, covering development and manufacture as well as end-of-life treatment.

The ITU–T Focus Group on Smart Sustainable Cities concluded its work in May 2015, and in June 2015 ITU members established the new ITU–T Study Group 20 to look at “Internet of Things and its applications including smart cities and communities”. ITU–T Study Group 20 is developing, inter alia, standards that leverage IoT technologies to address urban-development challenges.

Towards this end, the Smart Sustainable city vision can fulfil the dreams of billions of citizens to enjoy a better quality of life. The Smart Sustainable City option is no longer an option — it is a necessity.

Infrastructure for new Smart Sustainable Cities

*By David Faulkner, Director, Climate
Associates Ltd*

In some countries, rapid growth in industrialization is causing populations to migrate from rural to urban environments, seeking higher paid employment. This trend started some years ago, and is expected to continue until at least 2050. While this situation exacerbates problems in many urban areas, it also provides opportunities for city planners to design new cities or districts starting from a clean sheet of paper.

Until now, city infrastructure, and the incorporation of information and communication technologies (ICTs), has evolved in a piecemeal fashion, to meet the needs of “organic growth” as villages have grown into towns, and then developed into cities, fed by ever-increasing populations. Each new building or group of buildings has been planned and built at different times.

New city planning

When city planners are embarking upon a new city design project, the following question is raised: “How should ICT infrastructure be planned for a new city, given that it has to be both ‘smart’ and ‘sustainable’?”.

“A Smart Sustainable City” is an innovative city that uses ICTs 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.



Masdar City — A smart city in the United Arab Emirates

To begin with, a unique opportunity arises, when designing a new city, for the ICT infrastructure to be planned holistically. A comprehensive set of technical requirements must be drawn up, providing for growth and upgradability. Once planned, relevant specifications can be written, drawing upon the wealth of existing ICT specifications and standards.

This approach assumes that the city or district is to be built with no existing structures above or below ground. This could save additional costs of retrofitting services, such as a sensor layer network and peripheral devices, which may be directly connected to the Internet, or more specifically, to the Internet of Things (IoT). Sensors may be connected directly to a source of power such as an electricity cable or metallic pair. Sensors requiring high bandwidth could be connected by optical fibre and stand-alone sensors, using wireless communication, which would need long-life batteries to provide power.

The importance of infrastructure sharing

Building and maintaining telecommunications and sensor layer networks is expensive, especially when installed piecemeal on a reactive basis to meet emerging demand. To reduce costs, infrastructure sharing could be a viable solution. As a starting point, the infrastructure could focus on a central location, such as the main railway station or city centre, or based in city districts where high-capacity services are distributed towards the periphery of the city. Shared infrastructure can save significant costs, especially when provision is made for maintenance, upgrade and growth over the lifecycle.

The primary concern for all types of installation is safety. For example, if a utility tunnel is planned to include a public railway or gas supply there may be a need to provide reinforced concrete barriers to provide protection against accidents or gas leakage.

Opportunities for infrastructure sharing occur when several services need to be provided along a common path to buildings or other locations, such as where sensors or actuators are to be located. Examples include urban corridors with direct trenching, utility tunnels and utility shafts within buildings.

When facilities are shared between ICTs and other utilities, ICTs can be used to support the utilities at a lower cost than using separate infrastructures. Sensors can facilitate better monitoring and control and give advance warning of failure or blockages. Possible examples include flood or fire detection sensors in utility ducts, temperature sensors in electric cables, gas leakage detectors, traffic flow monitoring, street lighting control and water utility monitoring and control.

Opportunities for infrastructure sharing at street level include wireless mast sharing, such as the installation of small base stations on street lampposts to improve broadband speeds and coverage. To obtain maximum benefit, the interconnection of street-level devices needs to be planned along with underground ducts. For example, optical cables could interconnect with wireless base

Utility tunnel



Source: Nilesh Puery, Presentation on "Gujarat International Finance Tec-City" made at the ITU Training Event "Leveraging ICTs for Smart Sustainable Cities for Asia-Pacific Region", New Delhi, India, 24–26 March, 2015.

stations on lampposts. Such cables can be fully dielectric to avoid the need for lightning protection required for metallic cables.

Opportunities for infrastructure sharing in the software domain may also represent a cost-saving advantage at the service layer. Each service requires termination onto a server, data storage or smart processor, as well as connection to devices including personal devices, sensors and controllers. In many cases, these can run on a common application platform. Most existing cities have a multiplicity of platforms to support a range of services, and expertise for managing them resides in separate organizational departments, or “silos”.

In contrast, when building a new Smart Sustainable City from scratch, planners have the option to select a service which can handle the bulk of the software functions required by application developers on a single platform. A wide range of applications are

envisaged for a Smart Sustainable City ranging from e-health to e-transport. For example, an “open-data” approach to transport can greatly extend the opportunities for improved efficiency. Application developers can ensure that real-time information is available for citizens and for visitors who may be using a range of different transport types.

All the information concerning available service facilities can then be collected and converged onto a holistic platform, such as a city-level integrated management system. With integrated management, the sensors and sensing networks can function in an organized way to detect various infrastructure events or incidents, such as emergencies that can be rapidly detected and assessed. This may be followed by analysis and dissemination of information across the concerned agencies, helping achieve the goal of making cities smarter, and more sustainable.

WHY COOPERATION IS IMPORTANT

ITU-T Study Group 20: A new collaboration



The first meeting of ITU-T Study Group 20 was held at ITU Headquarters in Geneva, from 19 to 23 October 2015

ITU-T Study Group 20: A new collaboration

*By Nasser Al Marzouqi, Telecommunications Regulatory Authority,
United Arab Emirates, Chairman of ITU-T Study Group 20*

National policy initiatives around the world are encouraging the development of “Smart Sustainable Cities”. Here information and communication technologies (ICTs) have a crucial role to play by increasing environmental efficiency across industry sectors and enabling innovations such as intelligent transport systems and “smart” water, energy and waste management.

Smart Sustainable Cities are a key application area for Internet of Things (IoT) technologies. Integrating IoT technologies into city systems will map these systems in the virtual world, improving our understanding of how complex city ecosystems behave. Smart

Sustainable Cities maximize the use of data produced by IoT-enabled systems, with the aim of improving environmental sustainability, resilience, and social and economic equality.

In recent years, the convergence of technologies and industry sectors has seen the ICT sector gain a diverse range of new stakeholders. We are faced with the challenge of addressing the standardization requirements of the many vertical industries applying ICTs as enabling technologies. This is particularly evident in the field of IoT, where IoT platforms are being developed independently, according to the specific needs of each sector.

The vision of a Smart Sustainable City is one of a highly efficient “system of systems” built on the horizontal and vertical integration of city processes, making full use of the data generated by IoT-enabled systems. In the context of smart cities, we cannot allow “silos” to emerge in different sectors.

It was against this backdrop that ITU’s Telecommunication Standardization Sector (ITU-T) Members called for the establishment of a new “vertically oriented” ITU standardization expert group. At its meeting in June 2015, the **ITU Telecommunication Standardization Advisory Group (TSAG)** answered these calls with the creation of the new ITU-T Study Group 20 on “**Internet of Things and its applications including smart cities and communities**”.

An introduction to Study Group 20

The decision to establish ITU-T Study Group 20 (SG20) marked the first time that TSAG had created a new study group related to Smart Sustainable Cities, attesting to the importance that ITU-T Members ascribe to the growing need to improve the coordination of IoT and smart city development and deployment.

SG20 has taken up this challenge, providing government, academia and industry with a unique global platform to engage and collaborate in the development of international IoT standards.

The Study Group is building on over ten years of ITU-T experience in IoT standardization. We are developing international standards to enable the coordinated development of IoT technologies, including machine-to-machine (M2M) communications and ubiquitous sensor networks. A central part of this study is the standardization of end-to-end architectures for IoT, and mechanisms for the interoperability of IoT applications and datasets employed by various vertical industries. An important aspect of SG20’s work is the development of standards that leverage IoT technologies to address urban-development challenges.

A platform for collaboration

SG20 is taking an innovative approach to IoT standardization by placing ITU’s technical expertise in IoT standardization at the service of national and local governments, city planners and a wide range of vertical industries.

This model of collaboration is the right approach to standardization for IoT and Smart Sustainable Cities. SG20’s top priority is to bring greater cohesion to IoT standardization. Success in this endeavour will improve the coordination of smart-city development.

The development of Smart Sustainable Cities requires efficient multi-stakeholder collaboration. ITU-T is in a unique position to achieve this, with its work driven by a diverse membership representing government, industry and academic and research institutes.

SG20 has already demonstrated the strengths of ITU-T standardization, building cooperation among the various stakeholders to develop standards that provide an equitable basis for the development of IoT and Smart Sustainable Cities.

Unity in diversity

SG20 has been successful in attracting the diverse set of participants necessary to achieve its aims.

The ITU-T Focus Group on Smart Sustainable Cities concluded its work in May 2015 with the delivery of 21 Technical Reports and Specifications to fuel the international standardization work of SG20. Many of the Focus Group’s participants, myself included, have taken their work into SG20. We are also very appreciative of the good collaboration that we enjoy with other ITU-T study groups as we have worked to ensure a smooth transition of ongoing IoT standardization work to SG20.

SG20 has met twice in addition to the frequent e-meetings of our working groups. Our first meeting was held in Geneva in October 2015 and the second in Singapore in January 2016. We match our physical meetings with forums open to ITU members and non-members to ensure that our standardization work keeps up to date with the requirements of as broad a range of stakeholders as possible.

WHY COOPERATION IS IMPORTANT

ITU-T Study Group 20: A new collaboration

Two new standards approved

Two new international standards developed by SG20 have been approved by the ITU-T membership.

Recommendation ITU-T Y.4702 — “Common requirements and capabilities of device management in the Internet of Things” — identifies common parameters for remote activation, diagnostics, software upgrades and security management to improve the efficiency with which IoT devices and applications are managed. This new standard is expected to provide the basis for the development of further standards to enable the large-scale deployment of IoT and M2M communications.

Recommendation ITU-T Y.4553 — “Requirements of the smartphone as sink node for IoT applications and services” — provides for smartphones to collect IoT data such as monitored health parameters, device status, video and audio feeds. Smartphones provide Internet connectivity for wearable technologies and home-monitoring devices, giving this new standard the potential to support a range of smart healthcare initiatives.

Join our work

Many more standards are nearing completion as we continue to develop 47 draft texts outlined in the SG20 **work programme**.

SG20 is working to build the cohesive model of behaviour necessary for the coordinated development of IoT standards and Smart Sustainable Cities. This need to build greater cohesion in stakeholders' actions is a result of the great diversity of the interests that hold a stake in the future of IoT and Smart Sustainable Cities. It is essential that the work of SG20 answers to the needs of all of these stakeholders.

I encourage you to make your requirements known to our Study Group. All requirements in the sphere of IoT and smart cities — whether relevant to technology, business, economics or policy — are relevant to the work of SG20.

The next meeting of SG20 will be held in Geneva from 25 July to 5 August 2016, in conjunction with a joint ITU/UNECE Forum on IoT: The Way to Smart Sustainable Cities that will be held on 25 July 2016.

I look forward to seeing you there.

WHY COOPERATION IS IMPORTANT

Four ways political leaders can help build Smart Sustainable Cities



■ Four ways political leaders can help build Smart Sustainable Cities

By Rick Robinson, IT Director for Smart Data and Technology, Amey

The goal of a Smart Sustainable City — an idea that has been around for about 20 years — is to invest in technology to stimulate economic growth, foster social progress and improve environmental conditions. That is an economic and political challenge, not a technology trend; and it is made imperative by the risks we face in today's world.

While the demands created by urbanization and growth in the global population threaten to outstrip the resources available to us, those resources are under threat from man-made climate change;

and we live in a world in which access to resources is becoming increasingly unequal.

Surely, then, there should be an urgent political debate on how city leaders and authorities can enact policies to steer investments in the most powerful tool we have ever created, digital technology, to address those challenges. That debate is not really taking place. Few discussions about Smart Sustainable Cities tackle the issues of financing, investment and policy. They are more likely to describe projects using new technology solutions for transport and energy

WHY COOPERATION IS IMPORTANT

Four ways political leaders can help build Smart Sustainable Cities

systems, for example, that are likely to be unsustainable because they rely on one-off research and innovation grants. In the meantime, vast investments are being made in technology by the private sector in the interests of competitiveness, efficiency and customer experience; but there is no systematic alignment of the outcomes of those investments with city priorities.

Smart Sustainable City ideas could be an answer to many of the challenges we face today; but they won't be until we can persuade more of our city and political leaders that they are a practical solution for real places, and to focus on realistic ways to finance them.

Cities, towns, and regions around the world have set out their visions of a smart future, but we have not adapted the machinery — the policies, procurement practices, or development frameworks — to incentivize the private sector to create them.

Political leaders can drive forward policies to encourage investment in Smart Sustainable Cities in four ways.

1. **Include Smart City criteria in the procurement of services by local authorities.** Sunderland, a city in the United Kingdom (UK), and Norfolk, a UK county, have shown that by emphasising city and regional aspirations in procurement criteria it is possible to incentivize suppliers to invest in smart solutions that contribute to local objectives. For example, when procuring a new, cloud-based IT infrastructure to run the City Council's IT services, Sunderland demanded that providers demonstrate the specific ways in which they would help the Council use the cloud platform to provide enabling services to small local businesses, charities, and social enterprises, thereby eventually securing IBM's support in enabling those organizations to become more successful through the use of digital technology.
2. **Encourage development opportunities to include "Smart" infrastructure.** The regulations that govern property and infrastructure investment can be adapted to mandate the inclusion of investment in digital infrastructure. The multi-GBP 100 million East Wick and Sweetwater development in the

London Olympics legacy was awarded to its developer based in part on its commitment to invest in this way. The successful development consortium demonstrated in its proposal how it would invest in digital technology infrastructure to support specific initiatives such as online community portals, smart transport schemes, and business support services that would not just improve the development for local residents and businesses, but would also benefit neighbouring communities.

3. **Commit to entrepreneurial programmes.** Many new urban or public services are created by entrepreneurial organizations that develop new business models enabled by technology. Uber and Airbnb are well-known examples that contribute to traveller convenience (though the nature of their overall impact on city economies is the subject of some controversy). Casserole Club, a service that uses social media to connect people who cannot provide their own food, with neighbours who are happy to cook an extra portion, is an example with more obvious social benefits. Innovation Birmingham's iCentrum development and Sheffield's Smart Lab (UK), encourage such businesses by linking local investment funds and support services for entrepreneurial businesses to their Smart City objectives. In Sheffield, for example, eight start-up companies were provided with business support services, access to mentors, and investors to develop new technology solutions to assist business growth in city centre retailers and to support longer independent living.
4. **Enable and support social enterprise.** The objectives of Smart Sustainable Cities align with the "triple bottom line" objectives of Social Enterprises that earn revenues from products or services, but that commit themselves to social, environmental or economic outcomes. Many Smart Sustainable City initiatives emerge when these organizations innovate using technology; and cities can tap into this reservoir of beneficial creativity by supporting them, as the Impact Hub in Birmingham shows.

WHY COOPERATION IS IMPORTANT

Four ways political leaders can help build Smart Sustainable Cities

All of those approaches need both political leadership from a local authority and collaboration with regional stakeholders. Successful initiatives demonstrate four “C’s”:

Commitment — The direct leadership of the most senior local government leaders, including elected mayors, council leaders and chief executives, is needed. In many cities that are actually making real progress, their leaders have appointed a dedicated executive officer with a mandate to create, communicate and drive a Smart Sustainable City programme.

Collaboration — A collaborative, empowered regional stakeholder forum is needed to convene local resources. This is because most local authorities directly control only a fraction of regional resources, and do not directly set many local priorities.

Consistency — Regional stakeholders need to agree on a clear, consistent, local vision that is co-created. It cannot be set solely by a local authority. The vision provides a context in which to take decisions by combining individual interests with shared objectives; and against which to frame convincing bids for funding and investment.

Community — The only people who really know what a Smart Sustainable City should be like are the citizens, communities and businesses who live and work in it and pay for it through their taxes. It is their bottom-up innovation that will give rise to the most effective initiatives. Their voice — heard through events, consultation exercises, town hall meetings, social media and so on — should inform the visions and policies to create an environment in which they can flourish.

‘Translational leadership’ needed

In “Resilience”, Andrew Zolli defines “translational leadership” as the ability to overcome the institutional and cultural barriers to collaboration between small-scale, informal innovators in communities and large-scale, formal institutions with resources. This is precisely the ability that Smart Sustainable City leaders need in order to properly understand how the “top-down” forces within their influence — policies, procurements and investments — can be adapted to empower and enable real people, real communities and real businesses.

Translational leaders understand that their role is not to direct change but to create the conditions in which others can be successful. The architect Kelvin Campbell’s concept of “massive/small smart urbanism” tells us how to create the conditions for successful, innovative urban places through “massive amounts of small-scale innovation”.

In the information age, that should include making digital infrastructures adaptable through the provision of open data interfaces, and accessible from open source software on cloud computing platforms — the digital equivalents of accessible public space and human-scale, mixed-used urban environments.

Our world is investing in Smart technology at a phenomenal rate. Now we need Smart leaders to help us take advantage of it as a society.



■ Integrated management for Smart Sustainable Cities

*By Prof. Nengcheng Chen, Wuhan University and
Dr Ziqin Sang, Fiberhome Technologies Group*

Rapid economic development and population growth have given rise to a range of challenges to the sustainability of our societies and economies. Our cities are burdened by increasing pollution and traffic congestion. City infrastructure has struggled to advance at a pace matching urbanization, and the challenges resulting from the pressures of urbanization will be amplified by the increasing prevalence of extreme weather events that our cities will be forced to withstand as we progress further into the 21st century.

The transition to Smart Sustainable Cities is a socio-economic imperative, and these cities of the future will be built on technical innovation and new approaches to city management. However, the rapid proliferation of technical and city-management solutions for Smart Sustainable Cities has bred a lack of uniformity in the application of these solutions. The solutions themselves are not at fault. Each has the potential to contribute to improved urban management, but uncoordinated implementations of these solutions

has often achieved the opposite effect, increasing the complexity of urban management and thus diminishing its efficiency.

City administrations have a wide choice of smart-sustainable-city solutions at their disposal. But ensuring the efficient organization and management of these solutions is of paramount importance if we are to realize the vision of Smart Sustainable Cities as a “system of systems” with benefits greater than the sum of its parts.

Integrated management of city infrastructure, operations and citizen interaction will be one of the defining features of a Smart Sustainable City, and the importance of the topic is compounded by the power of management processes to ensure the success of all of a Smart Sustainable City’s components.

The ITU–T Technical Report on integrated management

A Technical Report on integrated management for Smart Sustainable Cities was one of the final deliverables of the ITU Telecommunication Standardization Sector (ITU–T) Focus Group on Smart Sustainable Cities. The Focus Group offered an open peer-learning platform to guide city leaders in their adoption of master plans for urban development. The group concluded its activities in May 2015 with the delivery of 21 Technical Reports and Specifications which are now fuelling the international standardization work of the new ITU–T Study Group 20 on Internet of Things and its applications including Smart Sustainable Cities and communities.

The ITU–T Technical Report presents a framework for the integrated management of Smart Sustainable Cities which aims to identify or construct a set of metamodels, fusion processing workflows, and service interface specifications to facilitate the development of Smart Sustainable Cities.

The report includes:

- ▶ Technical specifications for resource metamodels, such as metamodels for nodes, events, models, sensors, and observations.
- ▶ Technical specifications for the workflows of resource fusion processing, covering specifications relevant to the fusion of nodes, events, models, sensors, and observation resources with toponyms and maps.
- ▶ Technical specifications for service interfaces, such as service interfaces for data, models, and events.
- ▶ Use cases of integrated management for Smart Sustainable Cities, describing typical applications of smart-sustainable-city metamodels, fusion processing workflows, and service interfaces.

How does it work?

The framework and procedure for the integrated management of a Smart Sustainable City can be represented as events detected by sensors and recorded by observations. These observations would be analysed and processed by models, and this procedure would conclude with decisions made according to nodes.

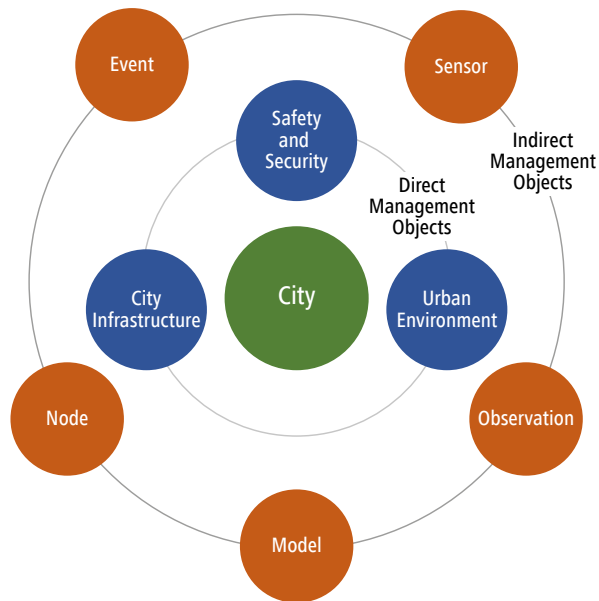
Events, sensors, observations, models, and nodes are the information resources of Smart Sustainable Cities. Integrated management seeks to improve the efficiency of city management through the metamodeling, fusion processing and unified servicing of these information resources.

These information resources are represented according to the unified representation models of an integrated management framework. These information resources are then fused with one another to enhance or complement the information through the adoption of fusion processing workflows. It follows that these resources can be shared and managed through the uniform service interfaces of an integrated management framework.

These five types of multi-source, heterogeneous information resources (as depicted in the figure below) are indirect management objects of an integrated management framework. The relationships that bind together these information resources are essential in enabling comprehensive, integrated city management.

WHY COOPERATION IS IMPORTANT

Integrated management for Smart Sustainable Cities



Direct and indirect objects of integrated management

The benefits of integrated management

Integrated management will help urban administrations to understand their roles and responsibilities in the operation of a Smart Sustainable City. Users of integrated management frameworks will access information resources very rapidly, locating exactly where events have occurred and taking precise actions in response.

The ITU–T Technical Report on the subject describes the representations, fusions and services of smart-sustainable-city resources to assist city stakeholders in their construction of integrated management frameworks.

Municipal authorities, branches of government and relevant policy-making entities will have the ability to synthesize all the information gleaned from Smart Sustainable Cities to develop strategies targeting more efficient daily city operations and more effective responses to emergencies.

Enterprises, including water and power suppliers and other utilities, will have the ability to participate in municipalities' efforts to improve the integrated management of Smart Sustainable Cities.

Citizens are the main beneficiaries of integrated management. Citizen-centric Smart Sustainable Cities will provide citizens with important notifications from municipal authorities, and citizens will also play a greater role in city governance by notifying these authorities of emergencies or the challenges that they face in their daily lives.

The ITU–T Technical Report on integrated management for Smart Sustainable Cities puts forward a theoretical foundation for integrated management. Urban planners are encouraged to look to the report for guidance on how to improve the overall efficiency of information-resource collecting and sharing, as well as that of information fusion processing. Cities will adapt this theory to their contexts, but putting this theory into practice is sure to promote greater coordination in the development and management of Smart Sustainable Cities.



■ Cybersecurity: A safety net for Smart Sustainable Cities

By Giampiero Nanni, Government Affairs EMEA, Symantec

News media carry near-daily reports of high-profile cybersecurity incidents. Most organizations, in most industry sectors, will have suffered some form of cyberattack, granting the topic a vivid position in most of our minds and especially in those of leaders in the private and public sectors.

An ITU Telecommunication Standardization Sector (ITU-T) Technical Report on “**Cybersecurity, data protection and cyber resilience in Smart Sustainable Cities**” takes a direct approach to its discussion of the most prominent cyberthreats to smart cities.

The report analyses the general technical architecture of a Smart Sustainable City to illustrate the complex security challenges faced by strategists and implementers. In analysing the functional components of a smart city, the report pinpoints vulnerabilities in the security of the sophisticated technologies that make cities “smart”. Following an examination of the conceptual basis of cybersecurity, data protection and resilience, the report provides guidance on how to protect against, detect, respond to, and recover from cyberattacks.

With the help of a number of sample scenarios, the report explores how any “smart” development needs to account for the fact that the information and communication technology (ICT) systems managing these developments are inevitably and increasingly prone to cyberattacks, carried out by a diverse set of malicious actors, with varying motivations and with growing determination, sophistication and an expanding set of tools at their disposal.

Every new connection opens a new door to cyberattacks

The capabilities of Smart Sustainable Cities will be enacted not only by traditional ICTs, but also by advanced emerging technologies including the Internet of Things (IoT), Radio-Frequency Identification (RFID), Machine-to-Machine (M2M) communications, Bluetooth®, Cloud Computing and Big Data.

We are connecting more and more of the components of a city, exploiting the potential of networking to increase the efficiency and sustainability of city processes. Typical examples of smart-city applications include smart traffic lights and the incorporation of sensors in public and private vehicles to optimize traffic flow; mobile apps to report minor traffic accidents; smart energy and water grids; and smart meters collecting data on energy and water consumption.

Numerous sensors and devices embedded within a smart city will give rise to unprecedented capabilities to deliver innovative new services to city dwellers. However, increasing ICT complexity and augmented connectivity — together with the vast amounts of data generated — will also increase the vulnerability of smart-city systems to both malicious cyberattacks and unintentional incidents. Every new device connected to an Internet address opens a new door to malicious attacks aimed at disrupting city services or gaining unauthorized access to data.

It is essential that next-generation urban systems are conceived with cybersecurity and data protection in mind if city administrators are to ensure service continuity and the safety and wellbeing of citizens and businesses.

A Smart Sustainable Cities will host an abundance of opportunities for hackers, and the scope of the challenge is clear when we consider that the security of critical infrastructure and services is at stake. Disrupting a city’s transportation systems, energy grid or any of the other engines supporting urban life would be sure to bring a city, or at least parts of it, to its knees.

This scenario might sound abstract or unrealistic, but it is in fact a very plausible one given the wide range of technologies used in current urban infrastructure and lessons learnt from past instances of such attacks.

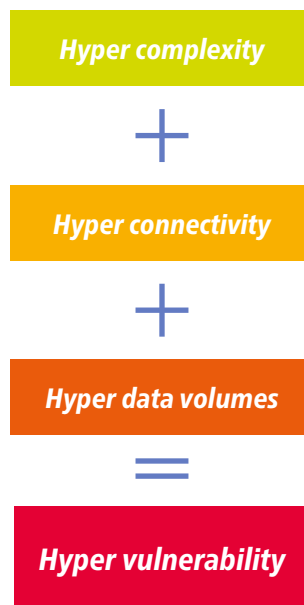
Turning the tide on cyberattacks

Ultimately, cybersecurity, information protection, privacy and system resilience are issues first and foremost relevant to policy and governance, and then to technology.

These themes require the attention of public administrators and decision-makers, especially considering the gravity of the consequences of malicious attacks on critical infrastructure, which would deprive citizens of essential services in areas spanning from transportation to utilities, health care, emergency services, public safety and more.

As it stands, the confrontation between cyberattackers and defenders is asymmetrical, with attackers holding the upper hand.

Attacks are increasingly complex, sustained, persistent, targeted and astute. Defenders are constantly playing a game of catch-up, always a few steps behind attackers. In other words, cyberattackers are leap-frogging defences in ways organizations lack insight to anticipate. Unlike



cyberattackers, cybersecurity is not the core occupation of these defenders, forcing them to strike a balance between the strength of their defences and the business impact of their construction.

Can we restore balance in this fight, tilting the scales in favour of defenders? That depends on the overall cybersecurity posture of an organization. This posture will be determined not only by the composition of technical cybersecurity measures, but also by the prevailing attitude and culture of an organization with respect to cybersecurity. The organization, as it relates to a Smart Sustainable Cities, will be made up of city administrations and the wider ecosystem of smart-city stakeholders.

The ITU–T Technical Report on Cybersecurity, data protection and cyber resilience in Smart Sustainable Cities provides guidance on the effective protection of data and applications from malicious attacks, in terms of processes, people, and technology. With appropriate processes in place, multi-stakeholder collaboration and good governance, technology can provide tangible solutions to the challenges facing cybersecurity, information protection and system resilience.

Appropriate processes, teams and skills should be put in place at the city level, making full use of threat intelligence and Computer Security Incident Response Teams (CSIRTs).

Technical solutions enabling encryption, strong authentication and data-loss prevention should be deployed to protect systems and data, together with suitable back-up and recovery techniques to ensure the resilience of the systems involved and the continuity of the services that they support.

And perhaps most importantly, city leaders should nurture a culture of cybersecurity among the individuals of the extended city administration, building a sound security posture where cybersecurity processes and technical measures are supported by safe attitudes and habits.

The new ITU–T Study Group 20 on “**IoT and its applications including smart cities and communities**” aims to be a valuable partner to cities intent on building a sound security posture. The group offers technical assistance to city stakeholders as they pursue their smart-city ambitions. One of the chief aims of Study Group 20 is to provide a platform for the collaboration of the many stakeholders in the smart-city arena. Only through collaboration will we understand the contributions expected of us in building a culture of cybersecurity in smart cities.



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■ How “Smart” is Smart Water Management?

*By Dr Ramy Ahmed, Director of Digital Services,
National Telecommunication Regulatory Authority (NTRA), Egypt*

Water is the natural resource most essential to the sustenance of life. A reliable supply of clean water is fundamental to human life, the operation of our economies and political stability. However, access to clean water remains difficult to achieve for a large percentage of the global population. United Nations’ estimates highlight that 85% of the world’s people live in the driest parts of the world, around 783 million people do not have access to clean water, and almost 2.5 billion people lack access to adequate sanitation.

Our growing demand for clean water is placing increasing pressure on water supply, and climate change is expected to aggravate

this challenge. Smart water management will be crucial in protecting the quality and consistency of the water supply, ensuring food security and encouraging sustainable agricultural development, hydropower generation, and other life-sustaining economic activity.

Mismanaged water resources

The mismanagement of water resources can be more of a problem than water supply. Traditional water-management practices were based solely on mechanisms to control and monitor water supplies, reserves and quality. The water-management ecosystem

was composed of independent “silos”, where authorities responsible for the management of water resources were somewhat isolated from their potential sphere of impact and influence.

As information and communication technologies (ICTs) began to play a greater role in water management, there was an assumption that the effectiveness and efficiency of water management would be guaranteed. This assumption did not hold true. “Smart” automation technologies or computerized systems cannot, in themselves, guarantee smart water management. These innovations are valuable components of the water-management process, but the collective benefits of these innovations are far greater if they are implemented and managed as part of an integrated, holistic system for smart water management.

The challenge today is to enable the integration of traditionally independent components of water-management systems. The goal of smart water management is to provide a decision-making mechanism common to all stakeholders in water management, and ICTs should be viewed as the tools necessary to achieve this.

What is smart water management?

Smart water management utilizes the knowledge and participation of all water-management stakeholders, as well as a variety of ICT resources and infrastructures, to build a water-management system that exploits aquatic ecosystems in a way that does not compromise social, economic or environmental sustainability.

ICTs play a central role in smart water management by improving the efficiency with which water is distributed, managed and allocated.

From the ICT viewpoint, smart water management can be seen as a set of technologies, services, infrastructures and communications that enable cohesion in all aspects of water management.

An ITU Telecommunication Standardization Sector (ITU-T) Technical Report on smart water management was one of the final deliverables of the ITU-T Focus Group on Smart Sustainable Cities. The Focus Group offered an open peer-learning platform to guide city leaders in their adoption of master plans for urban development, concluding its activities with the delivery of 21 Technical

Reports and Specifications which are now fueling the international standardization work of the new ITU-T Study Group 20 on Internet of Things and Smart Cities.

The Focus Group’s Technical Report on “**Smart water management in cities**” provides decision-makers with an overview of the main technical considerations relevant to the effective design and implementation of systems for smart water management in the urban context.

The report highlights how ICTs enable the operation of an integrated water-management system, one that utilizes existing infrastructures to the greatest extent possible while also making accommodation for future innovation.

The technologies underlying a system for smart water management are expected to perform the following tasks:

- ▶ **Stakeholder Management:** Providing detailed information to all stakeholders on their water-use behaviour in the interests of achieving smart, consumption-oriented water use that minimizes costs and maximizes economic and environmental efficiency.
- ▶ **Pollution and Water Quality Control:** Protections against pollution, quality tests and control of wastewater.
- ▶ **Monitoring for Emergency Prevention and Detection:** Preventing floods and other water-related disasters, including the ability to react to such disasters as quickly as possible.
- ▶ **Economic and Financial Management:** Management of the prices, taxes and billing systems relevant to water usage.
- ▶ **Information Management:** Multisource real-time data access, oriented to cloud computing.
- ▶ **Smart Water Distribution:** Advanced information management systems — encompassing innovations such as smart water pipes or resource geolocation — providing information on the status of the water network, allowing decisions and corresponding actions to be taken in a faster and more controlled way, allocating resources wherever necessary and saving resources wherever possible.

Thanks to the extraordinary pace of ICT innovation, we will see continued growth in the range of ICT solutions applicable to smart water management. This range of solutions already includes

Integrated ICTs in Water Management

Mapping of water resources and weather forecasting <ul style="list-style-type: none"> Remote sensing from satellites In-situ terrestrial sensing systems Geographical information systems Sensor networks and Internet 	Asset management for the water distribution network <ul style="list-style-type: none"> Buried asset identification and electronic tagging Smart pipes Just in time repairs
Setting up early warning systems and meeting water demand in cities <ul style="list-style-type: none"> Rain/storm water harvesting Flood management Internet of Things (IoT) Smart metering, and M2M Process knowledge systems 	Just in time irrigation in agriculture and landscaping <ul style="list-style-type: none"> Geographical information systems Sensor networks and Internet Precision agriculture Internet of Things (IoT) Machine to Machine (M2M)
Pollution and water quality control UV-Vis spectrophotometry <ul style="list-style-type: none"> Fibre-optic sensors Electrochemical sensing Mass spectrometry Process knowledge systems Electromagnetic waves sensors 	Decision support systems <ul style="list-style-type: none"> Business intelligence tools Artificial intelligence Big Data analytics Hydrological models

crowd-sourced applications which report water-related incidents, hazards and demands; over-the-top management platforms; Geographical Information Systems (GIS); Big Data analytics; Internet of Things (IoT) technologies and applications; and ICT tools for stakeholder collaboration and engagement. The figure illustrates some of the areas of water management that can benefit from ICTs.

What policy innovations are needed?

Today's reality is that many administrations do not apply holistic decision-making mechanisms that consider the impact of their decisions on the quality and quantity of our limited water reserves. 21st Century policymakers should seek to mainstream the consideration of water issues in decision-making processes.

ITU-T's Technical Report on the subject proposes a clear set of actions that stakeholders can take to achieve smart water management in cities.

Smart water management utilizes ICTs to achieve three main goals: coordinated management and distribution of water resources; enhanced environmental protection; and sustainable economic development and public-service provision.

Standardization is essential to the achievement of these goals. Standards stipulate criteria or guidelines to be used consistently in the development or implementation of ICTs; they provide a common reference with respect to required technical specifications and levels of quality, performance and reliability. Conformance with standards will ensure cohesion in the deployment and operation of the ICT solutions underlying smart water management.

Timing is very important when mandating conformance with standards. Calling for conformance with standards too early can constrain innovation unnecessarily, but, if timed correctly, it provides a common basis for innovation that maximizes the added value of new technologies. A well-planned standards strategy can serve as a risk-management framework and technology-implementation roadmap, enabling the effective execution of plans and projects aimed at smart water management.

Another important design goal should be to ensure the interoperability of the ICT solutions for smart water management. If solutions are not interoperable, their effectiveness is highly restricted, especially when it comes to enterprise networking. Here decision-makers should capitalize on the well-established capability of standards to improve interoperability.

Policies aimed at encouraging smart water management should encourage coherence in the application of standards and technologies. The development of such policies, as well as underlying standards and technology strategies, should be undertaken in collaboration by all concerned stakeholders. This collaboration is crucial to the construction of an integrated system for smart water management with the buy-in of all stakeholders responsible for its operation.



■ The open, inclusive architecture of a Smart Sustainable City

By Dr Paolo Gemma, Senior Specialist for Huawei and Dr Leonidas Anthopoulos, Associate Professor at the Technological Educational Institute of Thessaly

Innovation of information and communication technologies (ICTs) for Smart Sustainable Cities requires the support of appropriate guidelines and rules to aid urban stakeholders. For this reason, the ITU Telecommunication Standardization Sector (ITU-T) Focus Group on Smart Sustainable Cities created a set of ITU Technical Specifications titled **"Setting the framework for an ICT architecture of a Smart Sustainable City."** The Focus Group offered an open peer-learning platform to guide city leaders in their adoption of master plans for urban development, concluding its activities with the delivery of 21 Technical Reports and Specifications which are now fueling the international standardization work of the new ITU-T Study Group 20 on **"IoT and its applications including smart cities and communities."**

"The information and communication technology (ICT) architecture of a Smart Sustainable City should ensure openness and interoperability, achieved with coordinated adherence to common standards. A Smart Sustainable City will not only employ ICTs to improve the efficiency of individual industry sectors, but also to manage these processes in view of their role in the broader city ecosystem."

*ITU Secretary-General
Houlin Zhao*

The architectural framework proposed by the Focus Group's set of technical specifications offers a basis for the international standardization of a model ICT infrastructure for a Smart Sustainable City.

The technical specifications provide city leaders with architectural guidelines or "rules" to support ICT innovation in the urban environment. A notable feature of the proposed architectural framework is its applicability to existing cities in transition to smart sustainability, as well as "greenfield" projects aimed at building smart cities from the ground up.

The technical specifications outline a process to define a smart city's ICT architecture and establish the constraints within which ICT solutions and other installations should be deployed.

Inclusive design

The design of this meta-architecture was informed by the views of a wide variety of urban stakeholders and is thus consistent with established theory relevant to smart cities and ICT architecture as well as empirical findings drawn from smart-city projects around the world.

A smart city's ICT architecture facilitates the interrelationships between the overarching smart-city system and its subsystems, and this architecture should also support high-level analysis of the behaviour of a smart city's ICT components. The meta-architecture proposed by ITU's technical specifications is an inclusive one, intended to ensure cohesion in the deployment of smart-city solutions as well as holistic analysis of a smart city's interactions and their cumulative effects on a city's pursuit of smart sustainability.

The meta-architecture supports this holistic analysis by virtue of its inclusive design, recognizing:

- ▶ Soft infrastructure such as people and community;
- ▶ Hard infrastructure such as buildings and utilities;
- ▶ ICT and non-ICT-based innovation in hardware, software, planning and smart materials; and,
- ▶ The natural environment.

These four elements coexist and interact in the urban space and must therefore be organized in vertically integrated layers based on

the dynamics of the smart services that they support. Service provision is an important function of a Smart Sustainable City, making it crucial that smart-city processes achieve equilibrium between the forces of demand and supply in the smart-city context.

The proposed architectural framework intends to assist all cities in their efforts to deploy solutions of fundamental importance to smart sustainability, while also ensuring that cities have the flexibility necessary to adapt the proposed architecture to their unique contexts.

Sustainable solutions

A key feature of this framework is its promotion of sustainable solutions to improve life in our cities. It provides for sustainable improvements to smart-city management, proposing an architecture characterized by scalability, fault tolerance and resilience to natural disasters and threats to cybersecurity. The proposed architecture builds on common standards to support interoperability between heterogeneous ICT solutions, assisting the integrated management of smart-city services, while also protecting the privacy of citizens as information flows between the various elements of a smart city.

ITU's proposed architectural framework can be viewed from a variety of perspectives, with alternative viewpoints taking different 'snapshots' of the architecture (as described in the table).

Viewpoint	Snapshot
Functional	Purpose of building a Smart Sustainable City
Implementation	How ICT services can be developed and operated
Physical	Blueprints of the composition of the ICT components
Business process	Transactions and flows of information
Software engineering	Explain software-development processes

The development of ITU's proposed architectural framework followed the software-engineering view and concluded with two-, three- and five-tier snapshots. These multi-tier snapshots are taken

CRITICAL ISSUES

The open, inclusive architecture of a Smart Sustainable City



with respect to a Smart Sustainable City's ICT software presentation, users, logic, and data access and storage.

The "communications view" is another alternative to be considered, with this view taking into account physical networks (cable, wireless or sensor-based); connections (and appropriate interfaces); applications; and data distribution between users and the ICT sub-systems of a smart-city system. This view also results in a multi-tier architecture consisting of all these entities.

Modular architectures

Beyond multi-tier snapshots, ITU's proposed architectural framework also allows for modular architectures that take into consideration both the city type and the architecture view. However, it is important to note that modular architectures are more complex, consisting of a networking module accompanied by a protocol for information flows; an applications module incorporating all smart-city services; a business module addressing information management; a management module with corresponding rules

and processes; and a data module corresponding to information production, ownership and storage.

ITU's set of Technical Specifications propose an architectural framework capable of enhancing the overall efficiency of a Smart Sustainable City, increasing returns on existing smart-city investments and reducing the risks attached to future investments. The proposed architectural framework has the flexibility required to accommodate business growth and evolutions in the structure of a Smart Sustainable City.

This set of Technical Specifications identifies requirements highlighted by other Technical Specifications developed by the Focus Group on topics such as security, privacy and quality. The specifications utilize existing standards as much as possible, incorporating existing specifications outlined by technical standards developed by ITU and other bodies. These specifications have been adjusted to architecture modules and entities, providing a toolkit of great value to ICT architecture developers, standards experts and other smart-city stakeholders.

CRITICAL ISSUES

Lessons from the United States' 'Smart City Challenge'



The Smart City Challenge puts an emphasis on connected-car technologies

■ Lessons from the United States' 'Smart City Challenge'

By Roger C. Lanctot, Associate Director in Automotive Practice, Strategy Analytics

The United States Department of Transportation (USDOT) was reportedly "blown away" by what it described as an overwhelming response to its Smart City Challenge. The agency noted receipt of 78 applications — an impressive response, given that "only" USD 50 million are at stake. (Compare that to the USD 14 billion on offer from the Indian government for its own 100-city Smart City Challenge.)

The Smart City Challenge is USDOT's effort to define and influence both the US and the global urban, connected transportation

agenda that is likely to unfold over the next three decades. While the dollars at stake are modest, the symbolism of the programme has been sufficiently powerful to attract the behind-the-scenes support of such companies as Alphabet's Sidewalk Labs, GE, HERE, Cisco, Philips, Itron, Xerox, Cubic, Mobileye and AT&T. The agency says 300 companies have expressed interest in partnering with applicants.

Indeed, USDOT can be proud of a successful first-phase launch of the Smart City Challenge. However, the initiative is too narrowly

focused on specific technologies and lacks the international ambitions and stronger integration with existing wireless networks that could have made it an even bigger success.

What is the 'Smart City Challenge'?

Focused on what it calls "mid-size" cities, the Smart City Challenge has two phases: In a preliminary round, seven US cities (Austin, TX; Columbus, OH; Denver, CO; Kansas City, MO; Pittsburgh, PA; Portland, OR; and San Francisco, CA.) were awarded USD 100 000 toward finalizing their proposal. In the second phase, an overall winner, to be announced in June, will receive the ultimate prize of USD 40 million in USDOT funding and a matching USD 10 million grant from Vulcan Partners to realize the plan.

The Smart City Challenge identifies 12 "vision elements" upon which applicants are judged. These vision elements reflect themes developed in the agency's Beyond Traffic report and include:

Technology elements

- ▶ Urban automation
- ▶ Connected vehicles
- ▶ Intelligent, sensor-based infrastructure

Smart City elements

- ▶ Architecture and standards
- ▶ Low-cost, efficient, secure and resilient information and communication technology
- ▶ Smart land use

Innovative approaches to urban transportation elements

- ▶ Urban analytics
- ▶ User-focused mobility services and choices
- ▶ Urban delivery and logistics
- ▶ Strategic business models and partnering opportunities
- ▶ Smart grid, roadway electrification and electric vehicles
- ▶ Connected, involved citizens

The USDOT programme is notable for its exclusion of the largest cities in the country, such as New York, Los Angeles, Chicago, Houston, Philadelphia, Phoenix, San Antonio, San Diego and Dallas. "We picked the middle range because it has the promise of things

that can be replicable by both large and small communities," said US Secretary for Transportation Anthony Foxx.

The greatest challenge in putting in place a smart city solution is bringing together constituents with different agendas, visions, data sets and business models. When it comes to connecting transportation and infrastructure, this means connecting the cellular-centric worlds of mobile electronic devices and connected cars with the RF-centric world of transportation infrastructure and its sensors, cameras, license-plate readers, RF-ID tags and wireless tolling systems.

Too narrow a focus?

The USDOT has made clear its interest in promoting the adoption of automated driving technologies for commercial, personal and public transportation. In its vision and goals of a successful Smart City, the agency has assigned priority to three key elements in particular: Urban automation; Connected vehicles; and Intelligent, Sensor-based Infrastructure.

By specifying the technologies and applications of greatest interest, USDOT has somewhat hamstrung the creativity of programme participants. For example, the Smart City Challenge specification emphasizes using connected-car technologies to increase vehicle throughput in and around cities, more than encouraging the use of alternative means of transportation including mass transit, bicycles and walking. The USDOT seems to have overlooked the increasing use of congestion fees and other such strategies around the world to discourage citizens from driving into the urban core.

What is missing from the Smart City Challenge is recognition or accommodation for existing smart-city or connected-transportation initiatives under development beyond the purview of the USDOT. In this respect, the US Smart City Challenge is a means for jumpstarting smart-city innovation in mid-sized cities, rather than serving as a ranking or evaluation of current smart city programmes in the largest cities.

Also missing from the requirements are more practical elements including multimodal payment and navigation schemes taking into account ride-hailing and ride-sharing options.

The US Smart City Challenge leaves it up to applicants to establish their own metrics for measuring the success of their plan. Herein lies an important shortcoming of the agency's programme. Rather than identifying a roster of specific technologies, standards and protocols to be utilized, USDOT might have been better off setting the metrics by which it intended to measure the long-term success of the proposed plans.

Metrics set by USDOT might have included reduced emissions, improved walkability, reduced travel times or congestion, and fewer transportation-related crashes and resulting injuries and fatalities. It is possible, however, that the emphasis on particular technologies was necessary to attract industry support, as reflected in the evidence of hundreds of interested partners.

It is evident that large corporations already have great interest in solving transportation challenges. Last year, Telefónica, Orange, Engineering and Atos, joined forces to push common smart-city standards based on the open-source FIWARE platform.

The four companies said the open-source initiative will not just be focused on providing more efficient services, but on "transforming cities into digital platforms enabling the development of innovative citizen services open to all." FIWARE is an open-source platform and public-private partnership between more than 40 organizations and the European Commission, and is being extended to other regions, starting with Latin America.

The US Smart City Challenge lacks the international ambitions or credentials of FIWARE. But another missing element is a stronger integration with existing cellular wireless networks in the US.

Success leveraging existing networks

While USDOT can brag of broad corporate support for the Smart City Challenge, the failure to integrate wireless carriers more directly into the process is something of a blind spot. The oversight is apparent when one takes into account the work of map-provider "HERE" and its Digital Transportation Infrastructure initiative in Colorado.

HERE and the Colorado Department of Transportation (CDOT) have announced the first cellular network-based connected vehicle alert system in North America.

CDOT will use the HERE Location Cloud and Digital Transportation Infrastructure (DTI) solution on the RoadX Connected Vehicle pilot to connect vehicles, smartphones and other devices, road infrastructure and traffic management centres. Utilizing existing cellular networks, the HERE Location Cloud and DTI are capable of ingesting, analysing, and distributing accurate, safety-critical information such as accidents or extreme weather in real time.

The HERE platform is interoperable, which enables seamless data sharing with CDOT, and is optimized for the continued integration of data generated by a vehicle's onboard sensors and the surrounding road infrastructure. The collaboration with HERE is the first partnership announced by CDOT following the launch of RoadX in October 2015 with US Transportation Secretary Foxx.

The I-70 Mountain Pilot builds on HERE's work with the Finnish Transport Agency's Nordic Way project, which was the first deployment of HERE DTI in support of C-ITS (Cooperative Intelligent Transport Systems) based on the Location Cloud capabilities in conjunction with cellular networks. With the successful completion of phase one, transportation agencies can see a path to solving many challenges without additional costly roadside infrastructure. HERE is also working with the Dutch government to deploy a similar ITS programme in the Netherlands.

CDOT will be seeking approximately 1000 vehicles to participate in the pilot which will begin its first phase during the 2016–2017 winter ski season.

The HERE-CDOT collaboration is but one example of how transportation agencies can leverage existing wireless networks to enhance traffic management and driving safety. USDOT can be proud of a successful first-phase launch of the Smart City Challenge in the US. Hopefully, this modest beginning can serve as the genesis for something more pervasive in its influence, and global in scope.

The views expressed in this article are the author's own and do not necessarily reflect the views of the ITU.

