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Developing Smart Cities: Regulatory and Policy Implications for the State of Qatar

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ABSTRACT

Smart cities represent an emerging trend that may have policy and regulatory implications for telecoms regulators in many countries including Qatar. This paper draws on a review of interdisciplinary literature on regulatory governance and smart cities besides primary data collected from interviews with telecom and urban planning experts as well as regulatory members of staff to offer illustrations of the regulatory challenges and policy implications facing the development of smart cities with special focus on the state of Qatar. The paper emphasizes that regulatory policy-makers are required to go beyond the obvious and immediate benefits of smart cities to capture the full picture of potential impacts on regulatory and policy processes. For the transition towards smart cities to be handled successfully, regulatory policy-makers are required to address the new regulatory challenges by developing proactive rather than reactive approaches in dealing with the implementation of smart city initiatives.

KEYWORDS

Smart cities; regulation policies; smart ICT; State of Qatar

Introduction

“Every animate and inanimate object on Earth will soon be generating data, including our homes, our cars, and yes, even our bodies”¹.

Many countries are trying to capitalize on the revolution in ICT by employing smart tools and applications in an attempt to improve people’s standards of living and to achieve sustainability. The efforts made by the Government of the State of Qatar in the context of implementing its National Vision 2030 is a case in point. The vision emphasizes the need to employ information and communication technology through the construction of smart cities. At the outset, smart cities provide a model that depends on connecting many smart applications besides linking such applications to the people living in smart cities. Despite the benefits that can be achieved in smart cities by providing services to users more easily and faster around the clock, the application of this idea faces many challenges particularly at the regulatory and policy levels.

The regulation of smart cities is an important aspect that presents a major challenge to the regulatory bodies in telecoms sectors. For decades, telecommunication regulators have been trying to manage and control aspects related to service delivery in those sectors. They were trying their best to catch-up with the rapid technological progress, which distinguishes telecoms

from other economic sectors. The idea of smart cities adds to the complexity of telecoms regulation by requiring high-speed connectivity among many applications and devices, which may communicate with each other directly without any form of human intervention. A great deal of regulatory issues can be at stake in such machine-to-machine communicative environment. From this angle, smart cities pose new challenges for regulators in the telecom sectors and raises many valid and fundamental questions. Should we regulate smart cities? How? Is the concept of regulation in its conventional meaning as a set of rules backed by the sanctions of the state applicable for smart cities? Do we need new forms of regulatory policies? What are the most important regulatory issues posed by smart cities?

Considering the public interest element involved in designing and developing smart cities, this paper argues that embedding intelligence in an existing city or building a new smart city requires a set of legal, regulatory and technical foundations. Smart cities use a range of smart applications, which help in providing a wider range of options for policy and decision-makers in managing infrastructures and prioritizing urban planning. Nonetheless, in the absence of adequate legal and regulatory frameworks, the deployment of smart devices and applications, which keep collecting, analysing and exchanging data about humans and infrastructures, may endanger the interests of the people and put the national interests of respective countries at risk.

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Following on from the above, this paper attempts to provide some answers to the main regulatory and policy questions related to smart cities through a review of the literature of the regulation and in particular the regulatory governance of smart cities. The aim here is to shed light on the nature of smart cities and the new challenges they pose to telecom regulators. The paper also aims to study the state of smart cities in Qatar in an attempt to figure out their policy and regulatory implications. To this end, the starting point would be the examination of the existing legal and regulatory environments in an attempt to evaluate their suitability for the development of smart cities.

Conceptualising smart cities

What is a city? Cities are “complex and dynamic socio-technical systems” (Finger & Razaghi, 2017). They are designed and developed around people’s needs and for the benefits of those people. As Shakespeare puts it on the tongue of Sicinius, act 3, scene 1, of *Coriolanus* “what is the city but the people?” This human aspect of cities draws the attention to the fact that cities are not just buildings, facilities, and infrastructures. Behind all that stands the human element represented in the people who are going to live in the city. The city inhabitants should find what they aspire for in their living spaces. The services as well as all the material elements of the city should cater for the residents’ needs. From this angle, one can conclude that all smart city initiatives are means to an end. The end is to make city residents happier.

As noted by Caragliu et al. (2009) the concept of the ‘smart city’ has recently been introduced as a strategic device to encompass modern urban production factors in a common framework and, in particular, to highlight the importance of ICT in the last 20 years for enhancing the competitive profile of a city. Nonetheless, the term ‘smart cities’ made its first appearance as an object of scientific enquiry in 1992 in a book entitled “The Technopolis Phenomenon: Smart Cities, Fast Systems, Global Networks” (Gibson et al., 1992). Since that date, the subject of smart cities and the relationship between ICT innovations and the development of smart cities initiatives has attracted the attention of scholars from different disciplines (Albino et al., 2015; Graham & Marvin, 1996). Despite the agreement on the end goal of creating smart cities among the majority of scholars, the notion itself was not clear. In other words, the concept of smart cities means different things to different people. The term can be used in a narrow sense to refer to the utilization of ICT in small projects such as installing waste disposal sensors to improve waste collection

efficiency. From this perspective, Finger and Razaghi (2017) has defined smart cities as “the penetration of cities by the information and communication technologies”. In this regard, ICT can be regarded as innovations supporting a new science of cities (Batty, 2014). As noted by Hall et al. (2000):

The smart city is the urban centre of the future, made safe, secure environmentally green, and efficient because all structures—whether for power, water, transportation, etc. are designed, constructed, and maintained making use of advanced, integrated materials, sensors, electronics, and networks which are interfaced with computerized systems comprised of databases, tracking, and decision-making algorithms.

Smart cities can also be used to denote the construction of an entirely new city using smart ICT to design and deliver comprehensive solutions to its inhabitants (Webb Henderson, 2015). From this angle, digitalization is becoming a cornerstone in the development of smart cities. In the words of Finger and Razaghi (Finger & Razaghi, 2017, p. 7) smart cities can be perceived as “a combination of urban infrastructure systems on the one hand and digitalization, on the other”. The concept of digitalization in this regard encompasses three main building blocks: data generation, data connection, and data analysis (Ibid). In this context, Odendaal (2003) has emphasised that smart cities capitalises on the opportunities presented by ICT in promoting its prosperity and influence. Partridge (2004) has also concluded that new technologies are actively embraced in smart cities provide easy access to improved services in an efficient and cost-effective manner.

At the terminological level, different terms are used to refer to this new notion including digital, electronic, virtual, cognitive, and smart cities. The common element among all these terminologies is the creation of modern cities that are increasingly dependent on smart technologies, knowledge, and artificial intelligence. Consequently, the concept of smart cities provides an umbrella for several definitions, which include urban planning, ecology, and information technology.

From an information technology perspective, Belissent et al. (2010) describe a smart city as “a ‘city’ that uses information and communication technologies to make the critical infrastructure components and services of a city more aware, interactive, and efficient”. In the same vein, the ITU has defined a smart city as “an innovative city that uses ICT in order to improve the quality of life, and to increase the efficiency of operations and services, as well as competitiveness” (ITU Academy, 2016). In this context, the utilization of ICT will improve services such as city administration, education, health-care, public safety, real estate, transportation, and

utilities. As put by Paskaleva (2009), a smart city “takes advantages of the opportunities offered by ICT in increasing local prosperity and competitiveness—an approach that implies integrated urban development involving multi-actor, multi-sector and multi-level perspectives”.

In that sense, “smartness” can be perceived in terms of the utilization of information technology and data in order to achieve sustainability, openness, innovation, and resilience. In other words, a smart city provides a creative system that combines knowledge-based activities and institutions. The aim is to increase problem-solving capacity in the city by developing creative solutions via research and education. The digital space provides the arena wherein all interactions and communications in smart cities take place. In other words, in smart cities, everything is better connected; people are connected to things and things are connected to things via smart architecture and applications. A smart city should have a sophisticated system that monitors its apparatuses using real-time data and information. As such, all the components of smart cities including, infrastructure, services, and residents are all connected and controlled communication networks.

In this context, smart city is a city that uses information technology to improve the performance of diverse areas. These areas include among other things electricity, water use, parking and traffic, waste management. The main delivery methods include smart ITC applications, which improve communications and help managing complexity, increasing efficiencies, reducing costs and improving quality of life. Data and information provide the backbone for smart cities. The influx of data generated from smart devices are being utilized via smart technologies and analytics to improve the city’s infrastructure performance and investment decisions (Ranchordas & Klop, 2018). From this ICT angle, smart cities can be conceived as the amalgamation of different technological innovations including the Internet of Things (IoT), or ubiquitous computing, big data; and the cloud (Edwards, 2016). Through IoT, for example, smart cities can capitalize on big data via open access and open data policies in order to develop new smart applications that improve the quality of decision-making processes and provide better innovative solutions to the city problems (Ahlgren et al., 2016).

From an urban planning perspective, smart cities can be conceptualised as modern urban centres. The driving forces behind the development of smart cities were the need to cope with the ever-growing population of the cities by developing and maintaining smarter infrastructure. As reported by ictQatar (2014, p. 2) “Migration and rapidly rising standards of living are contributing to an

unprecedented worldwide surge in urbanization”. The majority of the world’s populations live in urban centres and produce about 80% of the global GDP. In the same vein, the United Nations has reported that 66% of the world’s population are expected to live in urban areas by 2050. The majority of that increase will be in Asia and Africa almost 90% (UN Department of Economic and Social Affairs, 2014). The surge in urbanization has forced many countries including Qatar to embark on cities’ modernization initiatives in order to provide their citizens with high-quality life and better services. From this angle, smart cities’ initiatives should be considered within the overall cities’ modernization policies.

As modern urban centres then, smart cities go far beyond what most people might realize to provide what can be called “networked urbanism” wherein the overall capacity of the city in terms of addressing urban issues, improving economic growth, achieving environmental sustainability and improving citizen participation will increase (Kitchin, 2015). A smart city systematically seeks to find and promote innovations via smart technologies in all areas including urbanization, digital containment, public administration, and transportation. That in turn changes the relationship between the creation of economic and social value on the one hand and the consumption of resources on the one hand. Hence, the smart city can only be smart when investments in human and social capital besides the traditional and modern infrastructures support sustainable economic development, and help creating a high quality of life, with sound management of natural resources. This all should be done through collective action and commitment from the citizens of the smart cities using participatory management (Smart Cities Council, 2015). As indicated by Giffinger et al. (2007) a smart city is built on the ‘smart’ combination of endowments and activities of self-decisive, independent and aware citizens. In other words, smart cities are about how people are empowered, through using technology, for contributing to urban change and realizing their ambitions (Schaffers et al., 2012).

From an ecological point of view, the concept of smart cities focuses on the relationship between those new constructs and the issue of sustainability. From this angle, smart cities can be conceived as “an extraordinary rich ecosystem to promote the generation of massive deployments of city-scale applications and services for a large number of activity sectors” (Hernández-Muñoz et al., 2011). The notion of “smartness” in smart cities in that sense can be measured in relation to the idea of sustainability (Fücks, 2013). As noted by Lazaroiu and Roscia (2012) a new city model, called ‘the smart city’, which represents a community of average technology size,

interconnected and sustainable, comfortable, attractive and secure. In this regard, a smart economic growth for instance, can only be described as such if it is a sustainable growth. Consequently, a smart city enhances the quest for sustainable development. Accordingly, sustainable, efficient, and clean energy systems that transform energy production and consumption must be part of the future of any smart city (Gartner, 2013).

Following on from the abovementioned definitions and concepts of smart cities, three main pillars can be identified: *technical*, *environmental*, and *social*. From a technical point of view, a smart city utilizes a wide range of smart ICT technologies including wireless networks, virtual reality, and sensor networks. Such a multi-layered digital representation besides the aforementioned technical components are essential elements for the physical infrastructure of smart cities. As summarised by Alkandari et al. (2012) a smart city is one that uses a smart system characterized by the interaction between infrastructure, capital, behaviours and cultures, achieved through their integration.

Smart cities are also supposed to be environmentally friendly in the sense that they reduce negative environmental externalities (Monfaredzadeh & Krueger, 2015). That means energy production and distribution networks, environmental technologies, and the use of renewable energy are all pillars in the design of any smart city project. At the social level, smart cities are creative in the sense that they utilize the creativity of their populations as well as knowledge and research institutions in order to maximize the outcomes of digital communications and improve knowledge management processes (Gartner, 2013). In this regard, the active participation of the people in smart cities is a key (Smart Cities Council, 2015). Smart cities are not just about using modern and smart technologies. This utilization of technology has been realised before under digital and electronic government initiatives. What makes a city smart then is the way its people are connected and the way they communicate using their collective intelligence in an attempt to find solutions to the problems they face. In other words, instated of being passive recipients of electronic services in a digital smart city, the people in smart cities have a say in the way problems are defined and the way those problems should be solved. This social and human aspect of smart cities makes them different from other digitization projects (Procter, 2015).

Smart cities therefore can be regarded as urban centres supported by networks and digital technologies, offering interactive e-services in various fields. They have the ability to solve problems by investing in the intelligence of individuals, institutions and technologies. They also focus on

social and environmental sustainability in addition to knowledge-based economy to create competitiveness. The role of modern ICT infrastructure is paramount in order to achieve sustainable economic growth and better quality of life. As put by the Smart Cities Council (2015, p. 6), “A smart city uses information and communications technology (ICT) to enhance its liveability, workability and sustainability”. The technological enablers of smart cities then include; converged ICT systems, integrated high-speed broadband access network, sensing infrastructure, analytics, and a new generation of innovative services. Added to this, investments in a smart city’ human capital is equally important to the use of modern ICT in order to promote innovation and creative problem-solving techniques (Smart Cities Council, 2015). Thus, smart cities have been described by Schaffers et al. (2012) as an urban laboratories, urban innovation ecosystems, living labs, and agent of change.

Following on from the aforementioned conceptualisation, it can be concluded that the successful application of smart cities depends largely on three main intervening factors: the overall governance system, the availability of resources, and the quality of the people living in these cities. The development of smart cities aims primarily to achieve a safe, efficient and happy life for their citizens. A key requirement for the success in this endeavour is to develop an overall governance system that provides transparency in processes, results and performance. In that sense, the governance of smart cities would empower citizens and allow for accountability. At the same time, the development of smart cities requires large investments and the allocation of economic resources in order to develop the modern smart infrastructure. Regarding the quality of the people, the successful implementation of the notion of smart cities calls for an active participation of their citizens in its governance processes. In that sense, governments need to invest in the human capital the same way they invest in smart infrastructures (Beseiso et al., 2017). The aim is to create a more informed citizenry and to foster creativity, inclusivity, empowerment and participation. The reason for this is that we need smart, active, well-educated people to live in smart cities and to make the best use of their modern technologies (Kitchin, 2015).

Designing and implementing smart cities: policy and regulatory challenges

The aforementioned conceptualisation has indicated that ‘smart city’ is a multi-dimensional concept (Schaffers et al., 2012). The design and implementation of such a concept faces many challenges related to the diverse aspects

included in the notion of smart cities. One of the major challenges facing the development of smart cities is of a regulatory nature. One of the core questions posed in this regard is how to regulate these new urban centres? What are the areas to be regulated? Before addressing these questions, it might be useful to unpack the notion of regulation itself. As noted by Badran (2011) regulation is a much-used word rarely defined with precision. It is elastic and ill-defined term, as the word ‘regulation’ itself was not part of the common vernacular until recently. Traditionally, the term has been used by economists to refer to measures that affect the economic activities of enterprises such as market entry and exit, exchange rates, prices, profit structures, and competitive environments. This type of regulation is known in the literature as ‘economic regulation’. Regulation has also always been used in a broader sense to include, in addition to these economic factors, many other social aspects related to health, safety, environmental and consumer protection, and employment standards under what is called ‘social regulation’. Thus, regulation is used most often as a general term to describe the varied set of instruments by which governments, regulate the economic and social activities of citizens and organisations. Considering the different social, technical, economic, and environmental aspects of smart cities, it is fair to note that the regulation of such a multidimensional constructs call for a regulatory approach wherein the economic and social aspects of regulation come into play.

The multifaceted nature of smart cities and the need to integrate technical, social, and environmental components disrupt the traditional regulatory landscape and poses new challenges for regulators. From a technical perspective, regulators need to develop and enforce regulatory frameworks to control the licensing and spectrum management processes. In this regard, Intven and Tetrault, (Intven & Tetrault, 2000, pp. 2–4) have noted that, from a regulatory point of view, several objectives are usually pursued by the licensing processes. Such processes are required for example, to regulate provision of essential services as well as expansions of ICT networks and services needed for smart cities projects. Licenses are also needed for allocating scarce resources and protecting users. Focusing on the aspect of allocating scarce resources, spectrum management and numbering can be regarded a major regulatory issue for smart cities regulators. In this respect, regulators are required to develop a fair system for allocating finite resources especially frequency spectrum and numbering in addition to ensuring optimum usage of the frequency spectrum (Badran, 2011). As noted by the ITU, new telecommunication services require unique numbering and addressing capabilities. Given the increasing number of new smart services in smart cities initiatives,

managing this aspect can be a challenge for regulators. Added to this, roaming and data interoperability in terms of users’ ability to seamlessly interoperate and roam for voice, SMS and data in communications networks need also to be regulated in order to guarantee the functionality of the smart city model (Sanyal, 2011).

At the economic level, competition among service provider and private ICT companies provides another regulatory concern facing the regulation of smart cities. At the outset, regulators need to develop competition frameworks and rules to regulate the entry in the new smart cities markets. The absence of such rules may result in undesirable tendencies of monopolies (Sherman, 1989). In this respect, different regulatory approaches to achieving competition might be needed. Regulators may create competition in the market wherein multiple operators compete for customers. They may also create competition for the market where operators compete for the market by bidding for the right to provide services. Competition between markets is a third approach in which operators in different markets compete by comparing the efficiency and effectiveness of their operations and rewarding those with superior performance (Jamison et al., 2004; Van Dam & Went, 2001).

Socially speaking the issue of privacy, data protection and users’ security comes to the forefront of smart cities regulation. In this context, Edwards (2015) has underlined several issues associated with the development of smart cities initiatives, which interfere with users’ privacy and security. Chief among those issues is the lack of opportunity in an ambient or smart city environment for the giving of meaningful consent to processing of personal data. Another crucial issue relates to the degree to which smart cities collect private data from inevitable public interactions. Furthermore, the “privatisation” of ownership of both infrastructure and data alongside the repurposing of “big data” drawn from IoT in smart cities and the storage of that data in the Cloud are all major regulatory challenges that need to be addressed.

In order to set scene for the examination of smart city regulation in the case of Qatar the aforementioned regulatory challenges will be further discussed in the remainder of this section.

Licensing and spectrum management

In smart cities, machines and smart applications communicate through wired or wireless telecoms networks using short-range and longer-range radio protocols. Given the intensity of the communications and the large amount of produced and exchanged data, telecom experts expect that smart cities initiatives will add more load on the existing telecoms networks. Consequently,

the availability of the needed spectrum through licensing processes is a key component in the success of smart cities initiatives. In other words, the telecom regulators need to pay close attention to the available spectrum bands and the way these bands are allocated among different users in order to make sure that the capacity needed for the successful application of the smart cities projects can be realised. Added to this, the amount of spectrum available should be managed in a collaborative fashion from all telecom stakeholders including government agencies, telecom operators, and the end users in order to make the best use of this limited and finite resource. Despite the fact that new telecoms technologies and innovation are expected to minimize the amount of spectrum needed the issue of licencing and managing spectrum is still one of the major regulatory challenges facing the full realization of smart cities' goals and objectives.

Roaming and data interoperability

Most of smart applications used in smart city projects communicate via mobile telephony networks. The ability of smart applications' operators to switch between networks in addition to the ability of their machines to roam in different areas of the telecom networks are quite limited at the moment (Beseiso et al., 2017). Such switching and roaming ability is important in order to make sure that the operators of smart applications gets the best service and that smart applications can be efficiently connected globally and domestically. Additionally, increasing the roaming and switching ability is expected to have far-reaching consensus for the competition among the telecom operators (Brown, 2015). In this regard, one of main challenges facing telecoms regulators is how to facilitate the processes of switching and roaming in smart city projects. Linked to this issue is the data interoperability challenges. As mentioned before, data represents the backbone for smart city initiatives. The issue here is that users may have their data stored on scattered databases, which may not be accessible by all smart devices and applications. In such a context, each database can be regarded as a separate silo and without bridging the gap among existing data silos it would be difficult for smart city initiatives to reach their potentials (Beseiso et al., 2017). Some efforts have been done in order to standardise services at the technical level in a way that enable users to switch between operators. This is a good step forward however; it needs to be followed by other steps in order to provide greater flexibility and competition for the benefits of the users (Sanchez, 2014). Added to this, simple standard protocols are not sufficient for openness and interoperability. For smart cities to reach their potentials, open data and open access should be guaranteed for all

stakeholders including citizens in order to be able to develop new innovative solutions through smart applications (Ahlgren et al., 2016).

Addressing and numbering

Addressing and numbering provide another regulatory challenge when considering smart cities' initiatives. For smart devices to be reachable by the users, they must be identified via unique address. Given the large number of smart devices and applications in smart cities that a user may need to connect, the required address space is considerably hefty. The issue of addressing and numbering becomes more important in case that the smart devices need to be reached at a global level using the internet. What complicated this situation is the fact that the current Internet Protocol (IPv4) deployed by many internet service providers allows only a limited number of addresses (Brown, 2015). Nonetheless, with the roll-out of the Internet Protocol (IPv6) the availability of addresses will increase in a way that can accommodate the ever-increasing number of smart devices and applications. Telecoms regulators have a major role to play in encouraging the internet service providers to migrate to the IPv6 version in order to allow such huge capacity of addressing and numbering. This should be done via an overall identification scheme that takes account of major issues, such as performance, scalability, interoperability, efficiency, privacy preservation, ease of authentication, reliability, flexibility, extensibility, and mobility.

Competition

From a competition point of view, smart cities are expected to have an impact on telecoms markets structures as well as the competition rules governing telecoms players. Those telecom operators and smart applications companies, which have the financial ability to invest in developing new smart technologies and networks, will have better access to information about the telecoms markets the matter that is expected to increase their market power. Those big and powerful players in telecoms markets may use their market powers to stifle competition and to drive out small telecom operators. As such, the telecoms market structures may change to reflect the formation of a 'core' big telecoms players competing with each other while other telecoms operators have no choice but to use their facilities in order to provide their services. This in turn creates a market structure wherein small telecoms operators especially those which are reluctant to invest in smart technologies and applications are heavily dependent on the main players. In other words, in a market a structure that favour the big players at the expense of smaller ones there would an entry

barrier represented in the initial investments required in the area of smart technologies. Without such an investment, new telecom players and the existing ones that reject to invest in the mentioned areas will be left out and will not be able to enter the market. In order to address this issue, telecoms and competition regulators have to keep an eye on the competition frameworks adopted in telecoms markets and to make sure that dominant players are not using their market powers to stifle competition and to prevent smaller operators from entering the market. In this context, any practice of policy that may have a negative impact on the competition in or for the market should be revised and updated. This is a key in order to provide a level playing field for all players in the newly created markets for smart applications. As such, innovation-one of the main building blocks in smart cities- will be fostered and creativity will be guaranteed.

Privacy and security

In smart cities, with machines and smart applications communicating with each other lacking any form of human intervention, including the user himself, the issues of privacy and security of personal information are put on the line (Edwards, 2016). Sensors and other smart devices deployed in smart cities are collecting, analysing, and storing data about everything from private spaces including homes and cars as well as individuals day and night (Smart Cities Council, 2015). Huge amounts of information are produced and timely used for taking decisions by machines on behalf of the users. This issue provides a regulatory challenge as it may bypass the traditional way of regulating and protecting personal data. Much of the information and data collected about people in smart cities could be sensitive and private data that people may not want other parties to know anything about. However, mistakes happen and the private data about the users may be sent to other people intentionally or unintentionally in a way that jeopardise their security. At the same time, infrastructure systems, such as traffic control centres, tunnels, bridges, hospitals and airports can be attacked via hacking the vulnerable smart devices in the system leaving the lives of the people at a huge risk. From this angle, without the right security and privacy regulations in place the threats of smart cities could be enormous (Zoonen, 2016).

Despite the efforts to develop new technologies in order to minimize the potential privacy and security threats in smart cities, the cost is still considerably high. Added to this, many of the developed technologies will have an impact on smart devices' functionality, size, and interoperability. Given the complexity of the issues related to privacy and security in smart cities, the solution to these issues does not lie at the hand of an

individual agency. A collaborative mechanism that coordinates all the efforts from the regulatory agencies, manufacturing companies and consumer protection organizations should be established and put in place. At the regulatory level, telecom regulators and other regulatory agencies have to make sure that the right set of privacy and security rules are in place and enforced effectively. Incentive schemes for smart devices manufacturing companies to adopt security and privacy by design approaches could be another regulatory tool that help addressing the privacy and security issues in smart cities. At the same time, manufacturing companies have to take all the necessary precautions including running security and privacy impact assessments for their products in order to make sure that the smart devices are secured and safe to be used by end-users (Brown, 2015).

By doing so, privacy and security measures will become at the heart of the design process of any smart device. That should minimize the risks and the threats associated with the utilization of smart devices. The role of the consumer protection organizations will come to the forefront when consumers' data and information being exposed due to faulty smart devices. The affected users in that case have to receive the right compensation for the harm they incurred. Added to this, consumer protection groups could also play a major role in educating the end-users and raising the awareness among people about the existing privacy and security rules and regulations. This included the importance of receiving an explicit consent form any user before collecting or sharing his or her data in addition to the right of consumers to withdraw from any data collection system at any time and with no technical or organizational obstacles. In all cases, personal data collected and stored by smart devices should be minimal in order to reduce any risk of exposing such data.

Developing and regulating Smart Cities in Qatar

Following on from the previous discussion of the regulatory challenges and conceptualization of smart cities, this section focuses on the analysis of smart cities initiatives in the state of Qatar. The aim is to locate the notion of smart cities within the wider ICT vision of the state of Qatar in addition to underlining the main regulatory issues facing the realization of such vision.

Smart Cities in Qatar: making the transition

The concept of smart cities has made its first appearance in policy documents in Qatar in a white paper published in 2014 and entitled "Emerging ICT Trends: The Future Is Now". In this paper, smart cities were regarded as the cities of the future and the way forward for designing

and developing new urban centres in Qatar. Relying on data, innovations, and smart applications in the area of ICT, smart cities were seen as a catalyst for developing other sectors including education, healthcare, transportation and mobility, urban planning, infrastructures, government services and environment (Ministry of Information and Communications Technology, 2014).

As noted by a telecoms policy expert in one of the interviews, “the transition to smart cities is risky and there are many issues from technical and regulatory point of views that have to be addressed”. Changing the traditional way of working and delivering services in government for instance, and shifting to smart applications is expected to face resistance from telecom stakeholders. Such resistance needs to be properly managed using change management strategies in order to make sure that the transition to the smart city model is smooth. Raising people’s awareness regarding the potential of smart cities’ applications can also facilitate the transition towards smart cities and assure the telecom stakeholders that their investment in these new urban centres are safe and profitable. As reported by Gartner (2013), the shift towards more sustainable models in Qatar including smart cities development requires a change in mentality in order to focus more on long-term commitments rather than short-term benefits in addition to altering people’s social behaviours in relation to resources consumption and the way they receive services.

Regulating smart cities in Qatar: challenges and the way forward

The leadership in Qatar has early realized that the future is for those countries, which can harness the ICT developments for achieving social and economic growth. Such a vision has been materialized on the ground in connector actions in order to leave a lasting legacy for current and future generations. A major step on that path was the creation of the Supreme Council of Information and Communication Technology known shortly as (ictQATAR) in 2004 to become the nation’s first ICT regulator (ictQATAR, 2015). In a more advanced step, and in order to secure the independence of the newly established regulator, the Emiri Decree (42) in 2014 has created the Communications Regulatory Authority (CRA) as an independent regulatory agency to replace ictQATAR (The Ministry of Transportation and Communication, 2014). The main task for the ITC regulator is to help building the smart connected nation of Qatar, through effective and innovative ICT and postal regulation. To this end, the regulator has to develop and put in place a forward looking, transparent and consistent regulatory framework that enables the

development of a digital society and the postal sector for the social and economic benefit of Qatar. The ICT regulator of Qatar has also been assigned the task of fostering sustainable competition and promoting a fair market place for all telecoms stakeholders. Regarding telecoms customers, the Qatari regulatory agency has to assure the availability of smart, innovative, and high-quality services (The Communications Regulatory Authority, 2019).

This section is devoted to discuss and analyse the regulatory challenges facing the development of smart cities in Qatar. It draws on the analysis of the interview materials as well as the regulatory issues previously identified in the previous discussion. The aim is to find out how the regulatory agency in Qatar is dealing with the regulatory challenges facing smart cities and to identify the actions taken in order to respond to those challenges.

Licensing and spectrum management in Qatar

As previously noted, the development of smart cities and the deployment of smart devices will result in an increase in demand for radio spectrum. As clearly put by the President of Communications Regulatory Authority of Qatar “[T]he fact is, demand for radio spectrum in Qatar is high and growing every day, particularly because many advanced technologies require new radio spectrum alongside existing technologies” (International Institute of Communications, 2017). Given that the radio spectrum is a finite resource, the high demand for it means this resource has to be carefully planned, licensed, managed, and regulated. The analysis of the interview materials besides the content of policy documents available in the public domain has indicated that, the regulatory agency and the rest of concerned telecoms bodies are working collaboratively to secure the most efficient use of the radio frequency in order to meet the increasing demand resulting from smart cities initiatives. The role of the regulatory agency in this regard is to strike the balance between non-commercial and commercial demands for radio spectrum and to allocate access to different bands accordingly. As put by a regulatory member of staff at CAR, “the decisions about spectrum allocation have to consider the current as well as the future needs. At present, we need to make sure that the demand coming from the development and utilization of innovative technologies in smart cities is met adequately and the required licenses have been granted accordingly”. The assessment and allocation processes are governed by The National Frequency Allocation Plan (NFAP), which provides an overall framework for all parties involved in frequency assignment processes. The NFAP was described by the regulator as being a “comprehensive frequency allocation document that provides a transparent, non-discriminatory, and predictable approach to spectrum management and

reserves appropriate spectrum for future innovative technologies” (International Institute of Communications, 2017). CAR has the legal mandate in accordance with the telecoms Law No. (34), 2006 to coordinate the conflicting interests of the spectrum users and to make sure that frequency rights have been allocated clearly with no possible interference from other users. In doing so, the CRA has to take into account the current and planned radio services in Qatar (Communications Regulatory Authority, 2016b).

As the ICT regulator in Qatar, the CRA also represents the national interests of the country in area of spectrum management in both regional and international bodies. The telecom regulator in Qatar is working closely with the ITU particularly The International Telecommunication Union Radio communication Sector (ITU-R) and other regional and international bodies such as the Telecommunication Bureau of the GCC in order to secure the most efficient way of using spectrum bands. Such a collaboration, as noted by a spectrum management specialist, guarantees the harmonization of spectrum utilization and minimizes the possibility of interference in using spectrum resources among countries. In this context, the harmonization of spectrum management and allocation processes at national, regional, and international levels has been regarded by many interviewees as the best mechanism to ensure the efficient and equitable utilization of spectrum resources. Accordingly, such an efficient use of radio frequency will allow the accommodation of new and innovative technologies and smart devices used in smart cities.

Roaming and data interoperability in Qatar

As mentioned earlier, roaming and data interoperability in smart cities pose new regulatory challenge. Telecom regulators are required to develop and put in place a regulatory framework that facilitates open access to information and open data policies. Having such a framework in place is a prerequisite for smart cities initiatives to reach their goals. Nonetheless, the way in which data is managed and stored now does not help smart cities stakeholders making the best out of the databases available. As truly put by a telecoms expert, “. . . [F]or the success of smart city initiatives, we need to develop open systems and to go beyond specific standards. This will form the basis for interoperable system that accommodates the different forms global applications”. In other words, all data exchange processes among all government agencies and business organizations should be done following a comprehensive government approach based on open access (Government of Canada, 2018). By doing so, government agencies and business organizations can avoid the limited one-to-one form of data sharing prevailing particularly among government agencies in Qatar.

The ministry of information and communication technology has made great efforts to provide an overall framework for managing data in Qatar in an attempt to bridge the gap between existing databases. The efforts of the ministry were materialized on the ground in the form of Policy on Data Management published in May 2015. The policy extends to cover all data and information in electronic forms that government agencies capture, retrieve, share or process for the provision of e-services to public (Ministry of Information and Communications Technology, 2015). The policy has adopted the definition of data management in accordance with Gartner’s definition to mean “the practices, architectural techniques and tools for achieving consistent access to and delivery of data across the spectrum of data subject areas and data structure types in the enterprise, to meet the data consumption requirements of all applications and business processes.” (Gartner IT Glossary, 2019). All this to be done without any violation to the laws and regulation of personal data protection and privacy. In its attempt to encourage open access and data sharing, the data management policy in Qatar is guided by three main principles (Ministry of Information and Communications Technology, 2015):

- (a) Data should be managed as a strategic resource that supports policy and decision-making, accountability and the efficient delivery of government programs and services;
- (b) Data collected or generated by each agency should not be viewed as belonging to one agency alone but is available for sharing with other agencies, within the limits of privacy, copyright, legal and security considerations;
- (c) Data should not be duplicated; it should be captured once and used for multiple generic purposes.

Taken together, these three principles provides a step forward to help exchanging and sharing data among government agencies in order to improve the processes of public services design and delivery. Added to this, one of the main objectives of the data management policy is to support the business information needs. This in turn should enable smart solutions that integrate data from various sources, build logically and physically inter-linked data models and perform predictive and multi-dimensional data analysis (ictQATAR, 2012).

Addressing and numbering in Qatar

As indicated earlier, addressing represents one of the major challenges facing telecom regulators with regard to responding to the increasing demand from smart cities initiatives for new internet addresses. The limited capacity

of IPv4 to accommodate new address has necessitated the migration to IPv6. Such a transition is a key to meet the growing demand created by newly deployed machines in smart cities. In this context, many countries including Qatar have developed and implemented national strategies and formed task forces in order to move to IPv6. In response to national and international drivers in IP ecosystems including smart cities initiatives, the Ministry of Information and Communications Technology has developed IPv6 National Implementation Strategy. The aim is to provide a road map for the migration from IPv4 to IPv6, which involves all concerned stakeholders. The main aims of IPv6 National Implementation Strategy are to achieve the following (The Ministry of Information and Communications Technology, 2014):

- To identify the players across the IP ecosystem and their interdependencies.
- To provide guidance to each group of stakeholders on the activities and associated implementation timing (to meet with internationally accepted best-practice guidelines on IPv6 migration).
- To identify suitable transition scenarios for the IPv6 Stakeholders.
- To provide supporting information, through the IPv6 task force, to assist organizations develop their migration plans and, where necessary, the associated business case.

In line with the IPv6 Implementation Strategy for the State of Qatar, the Qatar IPv6 Taskforce was instituted under the CRA in order to “drive, facilitate, and propagate IPv6 adoption in the State of Qatar by providing technical leadership, trainings, and bi-monthly meetings to ensure that Qatar’s ICT ecosystem is ready for the transition to the IPv6”. (The Communications Regulatory Authority, 2019). To reach this goal, the Qatar National IPv6 Task Force brought together representatives from government agencies, academic institutions, internet service providers, and manufactures, and other economic sectors who are working jointly to ensure the readiness of their network for IPv6 adoption. By doing so, the IPv6 Taskforce guarantees the smooth implementation of IPv6 in Qatar.

In a more precise fashion, the main objectives of the IPv6 Task Force have been identified by the CRA as including the following:

- To manage and lead the stakeholders to the optimum transition solutions to ensure the support of rapid economic growth and the ICT sustainability in the State of Qatar.

- To support and assist the stakeholders by providing the requisite knowledge and training workshops to achieve the planned goals included in the Qatar National IPv6 Strategy’s transition timeline.
- To facilitate a smooth and wide transition to IPv6 by developing a structured transition plans in phases to be followed by the Qatar’s IPv6 Community.

Issuing the IPv6 National Implementation Strategy and establishing the IPv6 Task Force means that the state of Qatar are handling the transition towards the new IP system in a coordinated fashion. The efforts done by the Qatari Government in this respect will facilitate meeting the demands for IP address for completing the smart city initiatives successfully.

Regulating competition in Qatar

Due to the initial large investments required for developing smart innovative technologies there has always been a fear that this situation may result in new markets, which favour large telecom players at the expense of small companies. In other words, the dominant position and market powers of the first entrants into the smart cities markets may hinder competition and provide entry barriers for smaller companies. Regulating competition in such an environment becomes necessary in order secure a fair play among big and small telecom companies. Hence, one of the main responsibilities of the CRA is to eliminate barriers to competition in telecom services through open standards, interoperability, and technology neutrality (Communications Regulatory Authority, 2015). To fulfil this task, the CRA has developed in 2015 a comprehensive competition policy framework aiming at creating a competitive and stable environment as well as preventing any practices, which might stifle competition in the telecom markets. In this context, the ICT regulator noted that, market competition is regarded as “a means to foster growth and innovation for everyone’s benefit” (International Institute of Communications, 2017).

Regulating privacy and security issues in Qatar

With the spread of smart cities initiatives in Qatar, creating and maintaining a safe and secure environment for all stakeholders has become an essential requirement for building confidence among all concerned parties including end-users. To create such a protective environment, all parties including public and private organizations have to work collaboratively to identify and respond to any security threats that may put users’ personal information at risk. In this regard, a part of the telecoms regulator’s mandate in Qatar is to “ensure that online transactions are safe for consumers and that their personal digital

information and data are handled responsibly and protected from misuse” (ictQATAR, 2015). As such, the CRA can be seen as a hub or a platform to collect, organize and share data and information about potential security threats among all smart cities stakeholders. Additionally, the CRA is collaborating with international agencies and groups concerned with cyber-attacks in order keep up-to-date records regarding new tools and approaches for protecting people’s privacy and addressing any security concerns.

As part of the efforts to modernize and complete the legal and regulatory environment for smart cities, the Law No (13), on protecting personal data was issued in 2016 and came into force on January 29, 2017 (SquirePattonBoggs, 2017). According to article 2 of the law, the individuals have the right to protect their personal data that is electronically processed (Qatarlaw, 2016). In that sense, the law “incorporates concepts familiar from other international privacy frameworks and enshrines an individual’s right to have their personal data protected” (Higham & Blyth, 2017).

The prior consent of individual users before sharing their data with a third party is now an obligation on all private businesses handling users’ personal information (The Ministry Of Transport and Communications, 2016). Added to this, all organizations must ensure that personal data is fully protected from loss, damage, modification, disclosure, or being illegally accessed by unauthorised parties. In case of non-compliance with the data protection law, a fine of 5 million QAR (US \$1.3 million) can be enforced on the violators (SquirePattonBoggs, 2017). A special attention was given to children in article 17, as the law requires all operators dealing with minors to develop clear policy guidelines on the way in which the information and data related to those children is handled and the measures taken to protect their data.

In smart cities, where smart infrastructure developments deploy smart applications and devices security becomes a major issue. The machines and applications used in smart infrastructure may provide weak points for attacking vital targets such as electrify grid, traffic control centres, hospitals, and airports. In order to address these concerns, the efforts to develop a national cyber-crime strategy and legislation were regarded as integrated parts of the legal and regulatory environment for smart city initiatives in Qatar. The overall aim is to “establish and maintain a secure cyberspace to safeguard national interests and preserve the fundamental rights and values of the Qatari society” (Ministry of Information and Communications Technology, 2014). To this end, the efforts have started in 2010, when the Ministry of Interior took the lead and worked collectively with a wide range of

stakeholders to develop a law that deals with cyber-crimes committed via electronic means (ictQATAR, 2015). These efforts have resulted in the promulgation of the Law No 14 of 2014 on Combating Cyber Crimes.

In its three sections the law addresses different aspects related to cybercrimes including types of crimes, such as the crimes pertaining to hacking information systems, information programs, information networks and websites (Chapter 1); content crimes (Chapter 2); crimes pertaining to electronic transactions cards (Chapter 4); and violating intellectual property rights (Chapter 5). Procedurally speaking, the law has covered evidence and investigation procedures, as well as the obligations on service providers. In order to secure compliance, the law on combating cybercrimes identified tough penalties for violators. For instance, article 8 stipulates that, a punishment of three-year imprisonment, plus a fine of 500,000 QAR, to be imposed on any person who “manages through an Information Network or any information technology technique to have an unlawful access to a website or an information system belonging to a state authority, body or entity or any affiliated corporation.” (SquirePattonBoggs, 2014).

In 2013, Qatar established the National Cybersecurity Committee in order to provide a governance structure for collaboratively addressing cybersecurity at the highest levels of its government. The efforts of this committee has resulted in the formation of Qatar National Cybersecurity Strategy published in May 2014. The strategy has five main pillars. Firstly, to safeguard the national critical information infrastructure. Secondly, to respond to, resolve, and recover from cyber-attacks through timely collaboration and information sharing. Thirdly, the strategy aims at establishing a legal and regulatory framework to enable a safe and vibrant cyberspace. Added to this, one of the main pillar of the strategy is to foster a culture of cybersecurity that promotes safe and appropriate use of cyberspace via the development of national cybersecurity capabilities (Ministry of Information and Communications Technology, 2014).

Developing legislations and strategies is not the end of the story for fighting cyber-crimes and securing infrastructures and transactions in smart cities mentioned a cyber-crime expert. Qatar still has a long way to go in other areas for the story to be complete. One of the major shortages that the country is suffering from is the lack of technical expertise and qualified national personnel who are able to proactively identify and prevent digital and security attacks. Hence, the question is not whether to regulate or not to regulate cyberspace. The question is how to do that. The answer of course is to have the right set of skills in place. That

means the legal and regulatory skills that are able to develop and more importantly to enforce regulations in a fast changing environment. At the same time, we need also to have the right set of technical skills, which enable the identification, and prevention of cyber-attacks. These two sets of skills go hand-in-hand for the successful regulation of cyberspace and the prevention of cybercrimes. As put by ictQATAR (2012, p. 3), developing Cybersecurity opportunity depends on favourable policies and regulations, human capital skills, and technologies.

Conclusions and policy recommendations

This paper examines recent trends in developing and regulating smart cities, with a special focus on the challenges facing the state of Qatar in its attempts to develop and regulate those new urban centres. Five main regulatory issues have been examined including licensing and spectrum management, roaming and data interoperability, addressing and numbering, regulating competition, and regulating privacy and security issues. In this context, the paper has concluded that the traditional reactive regulatory approaches do not fit the new reality of smart cities. Furthermore, the concerned regulatory agencies need to develop a new set of skills to be able to handle the security challenges posed by smart cities. Following on from these observations the following policy recommendations can be provided:

- Regulatory policy-makers are required to go beyond the obvious and immediate benefits of smart cities to capture the full picture of potential impacts on regulatory and policy processes.
- Despite the tremendous efforts by the Qatari government done to provide the legal and regulatory frameworks for smart city initiatives there are still some areas for improvements including the following:
- Developing and enforcing a new set of smart laws and regulations in order to ensure the successful implementation of smart city initiatives.
- Abandoning the traditional fire-fighting reactive regulatory approaches proved to be insufficient for dealing with the new regulatory issues posed by smart cities initiatives.
- Developing new proactive regulatory approaches to be followed by the concerned regulatory and government agencies to deal with the discussed regulatory challenges namely privacy and security and managing the scarce resources such as numbering and addressing.

Note

1. Anthony D. Williams, *The Human Face of Big Data* (2012)

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