Communications
Regulatory Authority
State of Qatar

هيئة تنظيم
الاتصالات
دولة قطر

PUBLIC CONSULTATION

Position Paper on IoT and M2M in the State of Qatar

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Terms and Definitions

AI	Artificial Intelligence
BLE	Bluetooth Low Energy
CRA	Communications Regulatory Authority of Qatar
CSP	Connectivity Service Provider
eSIM	Embedded SIM. A chip that is hard-wired into as mobile device that can have SIM profiles downloaded to it.
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity. A technical number used by mobile networks to identify a user.
IoT	Internet of Things. A network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves.
IoT Device	A component in IoT that are programmed for certain applications, and which can transmit data over the internet or other networks
IoT End User	A person or organization that interacts with an IoT device.
IoT Sensor	A component in IoT that collects data from the environment.
IoT Service Provider	An organization that provides services that are used by IoT devices.
IoT-M	IoT - Machine. A service offered by mobile networks which is optimized for machine-to-machine communications.
ITU	International Telecommunication Union, the United Nations specialized agency for digital technology
IP	Internet Protocol
IPv6	The latest addressing scheme for internet connected devices.
LoRa	Long Range. A low power radio link protocol
LoRaWAN	LoRA Wide Area Network.
LTE	Long Term Evolution. Otherwise known as 4G.
M2M	Machine to Machine Communications.
MAC Address	A unique physical address specific to an Ethernet network.
MNO	Mobile Network Operator

MQTT	Message Queuing Transport and Telemetry. A protocol for transmitting messages between devices without reliable connectivity.
MSISDN	Mobile Subscriber ISDN Number. A number that mobile networks use identify a subscriber.
NB-IoT	Narrow Band IoT. A service offered by mobile networks, which provides low power communications but with low data rates.
P-GW	Provider Gateway, a device in a mobile network that connects mobile user to external networks, including the internet.
Service Provider	An organization, typically an MNO, that offers commercial telecommunications services.
SIM	A module that is inserted into a mobile device providing an identify for mobile network.
Telecommunications Equipment	Physical hardware that plays a role in delivering telecommunications services.
Type Approval	A certificate of conformity that is granted for a device make and model which authorizes its use in a particular country.

1 Context and Objectives

1.1. Executive Summary

The rapid pace of innovation in the ICT sector means that markets players often face the challenge of introducing new products and services into the market without a well-defined regulatory framework. An example of such recent emerging technology developments are Internet of Things (IoT) and Machine to Machine (M2M), which are broadly referred to as networks of devices that exchange data with other devices. These technologies are being implemented currently globally to build digital solutions and services and are also considered to have significant commercial implications for the telecom service providers and the rest of the IT industry in Qatar. Broadly, government, enterprises and consumers will stand to benefit from the opportunities that IoT/M2M technologies can provide in terms of operating efficiencies and new data related services. With an increased uptake, IoT/M2M does raise a number of regulatory issues (for example, spectrum, numbering, data security), with currently no specific regulatory framework for it in Qatar. This creates uncertainty and risks for service providers and end users in terms of safety and security, commercial viability and technical implementation.

One of the current strategic initiatives of Communications Regulatory Authority (CRA) aims at developing an IoT/M2M regulatory framework. This paper sets out on a high level the key elements and areas for CRA as considered for this framework, which will be further developed and finalized following feedback to the proposed approach.

Similarly, the Third Qatar National Development Strategy (NDS3)[1] emphasizes development of Qatar's digital economy and long-term strategic capabilities in emerging technologies to drive its growth.

CRA aims to develop IoT regulations aligned with the strategic priorities and targets set by QNV2030, NDS3 and Digital Agenda 2030 that focus around creating an environment for innovation, attracting investments, and positioning Qatar as an open for business regional and global digital hub and a leader in innovation and adoption of emerging technologies, accelerating progress towards a diversified, knowledge-based economy and sustainable development by 2030.

The global IoT ecosystem is transformative, providing significant benefits such as

[1] https://www.psa.gov.qa/en/nds1/nds3/Documents/QNDS3_EN.pdf

improved efficiency, cost savings, enhanced data insights, and the ability to create new business models and services. It is a key instrument to attract foreign investment, promote local entrepreneurship, and to generate employment opportunities, which aligns with Qatar's vision for a dynamic and diversified economy. However, IoT as an emerging technology also poses challenges, including the need for robust security, data privacy, and regulatory compliance.

Therefore, it is the aim of the CRA to establish a framework that fosters innovation and digital growth while compelling providers to act responsibly and not place consumers or the state at risk. Effective regulation shall ensure IoT deployments prioritize user privacy, data security, and interoperability, building stakeholder trust and encouraging adoption. The aim of the CRA is to be as light touch as possible.

The CRA is publishing this positioning paper detailing the potential regulatory approach so that stakeholders may comment and provide feedback.

1.2. Document Scope and Approach

This document outlines the CRA's regulatory positioning on IoT/M2M with the goal to provide guidance to Internet of Things (IoT) ecosystem – government stakeholders, investors, entrepreneurs, service providers and IoT providers, and to promote safe, secure, and efficient adoption of IoT technologies and support Qatar's economy digitalization and diversification. The CRA regulatory position aims to support the national development goals and ensure compliance with international standards. The document provides an overview of the IoT and M2M as emerging technologies and summarizes use cases before going into some detail about those considered most relevant for the Qatar context. It concludes with a section on how CRA sees further the IoT regulatory framework implemented and suggests aspects considered for a public consultation.

We shall note that regulatory aspects seen relevant to IoT ecosystem need to be addressed by at least several governmental authorities in Qatar. For example, regulations for IoT security aspects fall within the domain of the National Cyber Security Agency. This document does not aim to detail regulatory approaches that fall within the mandate of other authorities; however, the main regulatory aspects have been reviewed in a holistic manner on a high level.

In order to derive a comprehensive set of regulatory focus areas (Section 4), a framework of the ecosystem has been developed using a value chain approach as shown in Section 2. We have also performed a global trends benchmark and considered the ones relevant to Qatar. A key input to the process is the strategic vision laid out in QNV2030 and the NDS3. Although IoT is not explicitly mentioned in QNV2030 or NDS3, emerging technologies in general are stated as pivotal for Qatar's economic diversification, growth and sustainability.

Earlier in 2023, the CRA has conducted an extensive study, 'Developing a Governance Framework for the Digital Economy in Qatar', which identified the key stakeholders and established the strategic importance of IoT, among other emerging technologies, as relevant to Qatar. This study concluded that there are no government bodies currently that specifically license or have an authorization regime for IoT services and applications, apart from the general business registration process that needs to be followed by companies.

This draft Position Paper has been developed considering comprehensive inputs from 30+ key industry stakeholders consulted, including ministries (Ministry of Communications and Information Technology (including TASMU), Ministry of Commerce and Industry, etc.) and other industry stakeholders (telecom service providers, businesses, Qatar Investment Authority, etc.). Summary of the insights built is presented in Section 3.3.

1.3. Definition of IoT and M2M

The terms Internet of Things (IoT) and Machine-to-Machine (M2M) are often used interchangeably, but they refer to slightly different concepts within the broader landscape of connected devices. Both IoT and M2M involve the communication between devices, but the scope and functionality of each are distinct.

For the purposes of this positioning paper, the following definitions have been adopted:

Internet of Things (IoT):

IoT refers to a network of interconnected physical devices embedded with sensors, software, and other technologies that enable them to collect and exchange data over the internet. These devices, ranging from household appliances to industrial machinery, can communicate with each other and with central systems, allowing for the automation of processes, real-time monitoring, and enhanced decision-making. IoT facilitates seamless integration between the digital and physical worlds, creating opportunities for improved efficiency, innovation, and user experiences across various sectors.

Machine-to-Machine (M2M):

Machine-to-Machine (M2M) communication is a subset of IoT that focuses specifically on the direct exchange of data between devices without human intervention. M2M technology enables devices to connect and communicate over wired or wireless networks, allowing them to perform tasks such as monitoring, control, and automation. This technology is commonly used in applications like remote monitoring, smart meters, and industrial automation, where devices need to transmit data to central systems or other machines for analysis and action.

IoT and M2M both involve the communication between devices, enabling the monitoring, control, and automation of various processes, often without human involvement. However, while M2M is primarily concerned with direct, point-to-point communication between specific machines, often within closed networks, IoT encompasses a broader and more complex network of devices that communicate over the internet.

M2M typically involves one-to-one or one-to-few relationships, using cellular or wired connections for specific industrial or business applications. In contrast, IoT creates an interconnected ecosystem where data from various sources is aggregated, analyzed, and utilized across multiple platforms and applications, enabling interactions not just between machines but also between machines and humans.

In essence, M2M is a foundational technology within the broader IoT landscape. While M2M focuses on direct device-to-device communication, IoT expands this concept by integrating devices into a larger digital ecosystem, offering more extensive functionality, scalability, and integration possibilities.

1.4. Strategic Importance of IoT Regulation

The CRA recognizes the strategic importance of IoT in shaping the nation's future. By establishing a clear and robust position on IoT, the CRA can play a pivotal role in driving adoption and unlocking its full potential. This proactive stance is essential as IoT technologies can help drive economic growth, enhance quality of life, and foster innovation.

Economic Growth

IoT technologies are instrumental in driving economic growth through several mechanisms:

- **Operational Efficiency**: IoT enables businesses and industries to optimize operations by collecting real-time data from connected devices. Analyzing data, monitoring, tracking and remotely controlling devices improves efficiency, reduces downtime, and minimizes waste in production processes.

- **Cost Reduction**: IoT helps businesses reduce operational costs by automating processes and enabling predictive maintenance. For example, IoT-enabled predictive maintenance in manufacturing can prevent costly equipment breakdowns.

- **New Business Models**: IoT opens up opportunities for new revenue streams and business models. Companies can offer IoT-enabled services such as predictive analytics, remote monitoring, metering, point-of-sale and subscription-based models, attracting new customers and foreign investment.

- **Job Creation**: The deployment of IoT often requires new skills and expertise, leading to job creation in technology development, AI, data analytics, UX/UI design and system integration. Moreover, IoT can stimulate entrepreneurship as new businesses emerge to capitalize on IoT innovations.

Enhancing Quality of Life

IoT technologies significantly enhance the quality of life by improving various aspects of daily living. Below are some examples:

- **Smart Cities**: IoT enables the creation of smart cities, where interconnected devices monitor and manage city infrastructure in real-time. This includes smart traffic management, efficient energy usage, waste management, and improved public safety.

- **Healthcare**: IoT facilitates remote patient monitoring, personalized medicine, and telemedicine services. Patients can receive better care at home, healthcare providers can make more informeddecisions based on real-time data, and overall healthcare outcomes can be improved.

- **Environmental Sustainability**: IoT contributes to sustainability by optimizing resource consumption. Smart meters can monitor and regulate energy and water usage, smart agriculture can enhance crop yields while conserving resources, and IoT-enabled transportation systems canreduce carbon emissions through efficient route planning.

Fostering Innovation

- **Ecosystem Collaboration:** IoT encourages collaboration among different sectors and stakeholders. For example, in smart cities, technology companies, government agencies and regulatory bodies, as well as academia collaborate to develop integrated solutions that improve urban living.

- **Continuous Improvement:** IoT promotes a culture of continuous improvement and adaptation. By collecting and analyzing real-time data, organizations can identify trends, predict future needs, and innovate to stay competitive in rapidly evolving markets.

- **Emerging Technologies:** IoT serves as a foundation for emerging technologies such as artificial intelligence (AI), machine learning, and blockchain. These technologies leverage IoT data to automate decision-making processes, enhance security, and drive further innovation across industries**.**

1.5. Legal Basis

This paper has been created by the CRA that derives its powers from Decree No. (34) of 2006 and its amendments No. (17) of 2017 issuing the Telecommunications Law (the "Telecom Law"); where:

- Article 2(1) of Telecommunication law promulgated by Decree-Law No. (34) of 2006, as amended mandates that the CRA achieves the objective of "developing the Telecommunications sector in order to promote national, social and economic development".

- Article 2(2) of Telecommunication law promulgated by Decree-Law No. (34) of 2006, as amended mandates that the CRA must perform its duties and exercise its authority to, "improve the performance of the Telecommunications sector in the State, by encouraging competition and promoting reliance on Telecommunications services".

- Article 2(4) of Telecommunication law promulgated by Decree-Law No. (34) of 2006, as amended mandates that the CRA must carry out its duties and exercise its authority to, "increase benefits to customers and protect their interests".

- Article 4(1) of Telecommunication law promulgated by Decree-Law No. (34) of 2006, as amended mandates that the CRA must carry out its duties and exercise its authority to, “grant, modify, renew, suspend and revoke Class Licenses and Permits and Licenses to use The Frequency Spectrum, and determine the conditions and procedures for their issuance”.

- Article 4(3) of Telecommunication Law promulgated by Decree-Law No. (34) of 2006, as amended mandates that the CRA must carry out its duties and exercise its authority to, “develop and manage the Frequency Spectrum plan and other scarce resources ensuring optimal use and maximizing their revenues to the extent required by International Rules”.

- Article 4(7) of Telecommunication Law promulgated by Decree-Law No. (34) of 2006, as amended mandates that the CRA must perform its duties and exercise its authority to, “draw up and manage the National Numbering Plan, and allocate numbers to Service Providers.

- Article 4(11) of Telecommunication law promulgated by Decree-Law No. (34) of 2006, as amended mandates that the CRA must perform its duties and exercise its authority to verify “compliance with the provisions of this Law and its implementing regulations, and the rules and decisions issued in the implementation procedure. The Secretariat-General, in order to achieve this, may use the services of specialized agencies, and academic or technical institutions or qualified consultants, to help perform some tasks and functions and cooperate and coordinate with ministries and other government agencies, bodies and public institutions.

Furthermore, the following laws have also been considered as listed below:

- Law No. (13) of 2016 on Privacy and Protection of Personal Data.

- Law No. (8) of 2018 on Consumer Protection.

- Law No. (16) of 2010 on Electronic Commerce and Transactions.

Additionally, the following references are relevant to the issues discussed in this document. Resolution of the Board of Directors of the Supreme Council for Communications and Information Technology No. (1) of 2009 issuing the executive regulations of the Telecommunications Law:

- Article (24) Clause (3) stating “Ensure that the use of radio spectrum is consistent with the national frequency assignment plan, related allocations and assignments, any applicable international treaties, commitments, protocols and standards and Radio Spectrum License conditions, including taking related compliance and enforcement actions.”.

- Article (24) Clause (5) stating “Determine, allocate, and assign, and re-allocate or re-assign, radio frequencies and frequency bands and channel assignments, and issue Radio Spectrum Licenses or radio frequency Authorizations, in accordance with the national frequency assignment plan”.

- Article (24) Clause (10) stating “Issue regulations, rules, orders or notices relating to the use of radio spectrum as the General Secretariat deems appropriate”.

- Article (24) Clause (11) stating “Determine any other matters relating to the transmission of radio-communications whether by satellite, terrestrial or other transmissions”.

The Communications Regulatory Authority (CRA) is the communications regulator of the State of Qatar established by virtue of the Emiri Decision 42 in 2014.

- Article (4) Clause (7) stating “Managing scarce resources, such as radio spectrum, numbers and domain names, and ensuring optimal use thereof”.

- Article (4) Clause (10) stating “Specifying standard criteria for the quality of performance of various services and monitoring compliance with these criteria by the authorities licensed to provide such services”.

- Article (4) Clause (11) stating “Establishing the standards and procedures that are necessary for the accreditation of telecommunication devices and equipment, including the devices and equipment that have been already accredited from other countries, and issuing licenses and approvals related thereto”.

- Article (4) Clause (15) stating “Any other duties or competences vested in it under the legislations in force”.

2 IoT Landscape

2.1. IoT Ecosystem and Value Chain

The IoT ecosystem encompasses a vast and intricate network of interconnected devices, systems, and services that work together to collect, analyze, and act upon data. These devices range from simple sensors to complex machinery, all capable of communicating with each other and with central systems over the internet. The IoT ecosystem includes several key components:

1. **Devices/Sensors:** The physical objects equipped with sensors that gather data.
2. **Connectivity:** The communication networks that link devices, including cellular, Wi-Fi, Bluetooth, and other wireless technologies.
3. **Data Processing:** The infrastructure and software used to process and analyze data collected from IoT devices.
4. **Platforms:** The operating systems required for aspects such as ECO provisioning, billing, application development, device and customer service management.
5. **User Interface:** The applications and interfaces through which users interact with IoT devices and data.
6. **Security:** The measures in place to protect IoT devices and data from cyber threats and unauthorized access.

The various entities that make up the ecosystem and their roles are shown in the value chain in Figure 1 below. Note that the three entities (connectivity service provider, platform provider and IoT service provider) may be aggregated together as one or two entities. This means that a single entity may offer connectivity services, operating processes and sector specific applications.

Figure 1: IoT Value Chain: Key Players and Roles

IoT Value chain

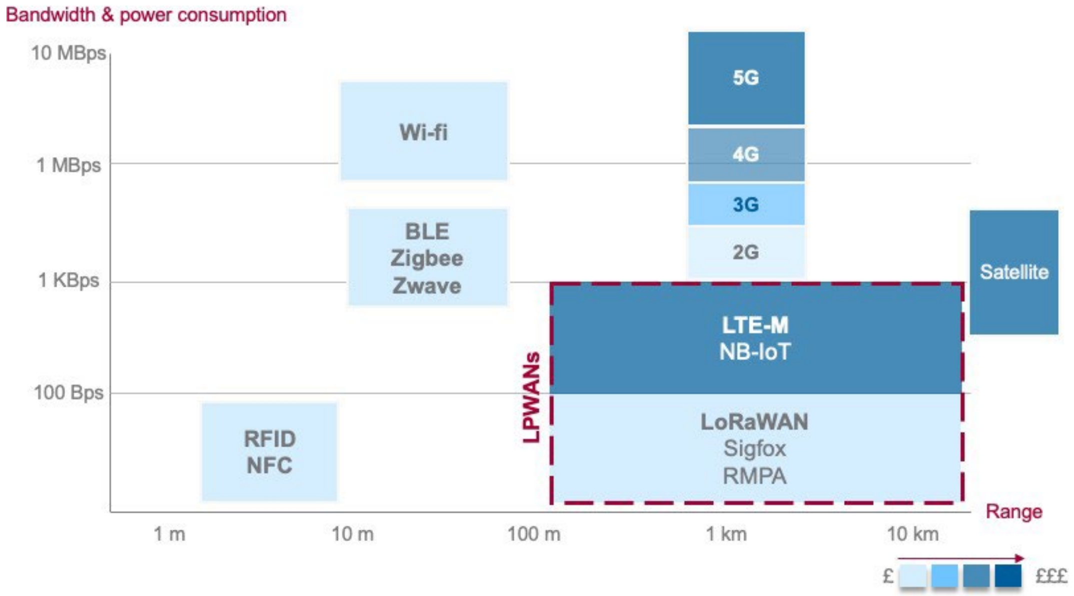
Entity	Mobile Network Operator (MNO)	Connectivity service provider	Platform provider	IoT service provider	Device manufacturer	IoT User
Description	Provides the cellular network infrastructure and services that enable IoT devices to connect to the internet and communicate with other devices and systems	Offers various connectivity options beyond cellular networks, including Wi-Fi, Bluetooth, and LPWAN (Low Power Wide Area Network) to support different IoT applications	Supplies the software platforms that aggregate, process, and analyze data from IoT devices, enabling applications and services to extract meaningful insights and drive actions	Delivers end-to-end IoT solutions, encompassing device deployment, data collection, analytics, and actionable insights to meet specific industry needs. Provides the user interfaces, including mobile apps, web dashboards, and voice assistants	Manufactures IoT devices equipped with sensors, actuators, and communication modules to capture and transmit data	Consumers, businesses, and government entities. Main applications in Qatar: • Smart cities • Healthcare • Industry • Energy & environment • Sports • Transport & logistics • Business • Homes
Role	• Ensure robust and reliable network coverage. • Facilitate data transmission between IoT devices and platforms. • Offer IoT-specific connectivity solutions such as NB-IoT and LTE-M.	• Provide diverse connectivity solutions tailored to specific IoT use cases. • Manage connectivity services to ensure seamless device communication. • Support integration with IoT platforms and services.	• Develop and maintain IoT platforms for data management. • Offer analytics and visualization tools. • Ensure interoperability and integration with various IoT devices and systems.	• Design and implement IoT solutions. • Monitor and Manage device lifecycle and data flow. • Provide support and maintenance services.	• Design and produce reliable IoT hardware. • Ensure device compatibility with various networks and platforms. • Implement security features at the hardware level	• Utilize IoT solutions to improve efficiency, productivity, and quality of life. • Provide feedback for continuous improvement of IoT services. • Ensure responsible usage and compliance with data privacy regulations.

By relating to the value chain and addressing the issues to resolve the bottleneck for the supply chain, CRA can help establish a robust and secure IoT ecosystem that enhances the quality of life for Qatari citizens and residents and positions the country as a leader in the global IoT landscape.

2.2. Technologies for IoT Connectivity

An IoT service depends, to a large extent, on the ability of IoT devices to communicate with each other, together with cloud-based services availability. Typically, these are based on wireless technologies, and a wide number of standards exist to facilitate this. The choice of radio technology generally depends upon the goals of the application,and there are usually trade-offs between communications speed, distance and power utilization. This is shown in the diagram below.

Figure 2: Map of Radio Technologies Against Bandwidth and Range



Wireless devices operate in defined frequency ranges, and radio spectrum in Qatar is allocated by CRA and is divided into licensed frequency bands[2] and bands designated for Wireless Home Area Networks (WHANs)[3]. Allocations to MNOs constitute licensed spectrum upon which LTE / 5G data, NB- IoT and LTE-M services can be provided for IoT use. Where IoT users make use of such services,the provision of radio spectrum is the responsibility of the MNO and falls within the licensing regimeof the MNOs. There are no specific regulatory conditions relevant to IoT services, however, the CRA considers it necessary to formally approve IoT devices that are used on mobile networks to ensure that they do not disrupt other users or compromise the integrity of the networks.

WHAN spectrum, such as that used for Wi-Fi (2.4 GHz, 5GHz and 6GHz) and the UHF band used for low power household remote controls and devices (433 MHz) may be used for private IoTnetworks, such as LoRaWAN. LoRaWAN may be operated at 433Mhz, 915 MHz, 868 MHz and 2.4GHz. Devices using WHAN frequencies[4] have the potential to raise security concerns and cause interference over a large geographical area and strict power limits are applied to avoid this.

The CRA supports the use of such spectrum but recommends type approval for such devices to ensure fair use of WHAN frequencies.

[2] Per the Decision no. 1 of 2009 - The Executive By-law of Telecoms Law Article 25, clauses 3, 5, 10 and 11, which covers, in brief summary, the power to determine, allocate and assign spectrum to ensure the radio spectrum is consistent with the national frequency assignment plan, compliance, the issuing of regulations, rules, orders and notices and to determine on any other matters relating to the transmission of radio-communications.
[3] As defined in "Class License for Wireless Home Area Networks (WHANs) Issued by the Communications Regulatory Authority (CRA) Doha – 7 May 2020"
[4] See Qatar National Frequency Allocation Plan and Specific Assignments, February 2022, for permitted use of unlicensed spectrum.

Although desirable, radio connectivity cannot be assumed to be fundamentally reliable. As IoT devices can move around, they may be also out of contact, or switched off / disconnected frompower. The MQTT messaging protocol has emerged to address this challenge. In this case, messages from and to IoT devices may be queued in the event that they are not immediately available, so as to ensure that messages are not lost.

The CRA recommends that designers of IoT applications should adopt MQTT where desirable, and feasible. There is also a role to play for MQTT brokers. However, many IoT applications are processing data that should be considered to be sensitive (either for personal privacy or for state security), and therefore should not be processed using servers located outside of Qatar. The CRA therefore recommends that MQTT brokers offering services to IoT providers in Qatar should have a physical establishment in Qatar.

LoRa, Z-Wave, and Zigbee are radio-based technologies that provide low-power, efficient, short-range communications and are especially suitable for small, cheap devices. These technologies enable many IoT applications, from smart home devices to industrial sensors.

LoRaWAN and NB-IoT are designed to provide long-range communication and low power consumption, each with strengths and ideal use cases.

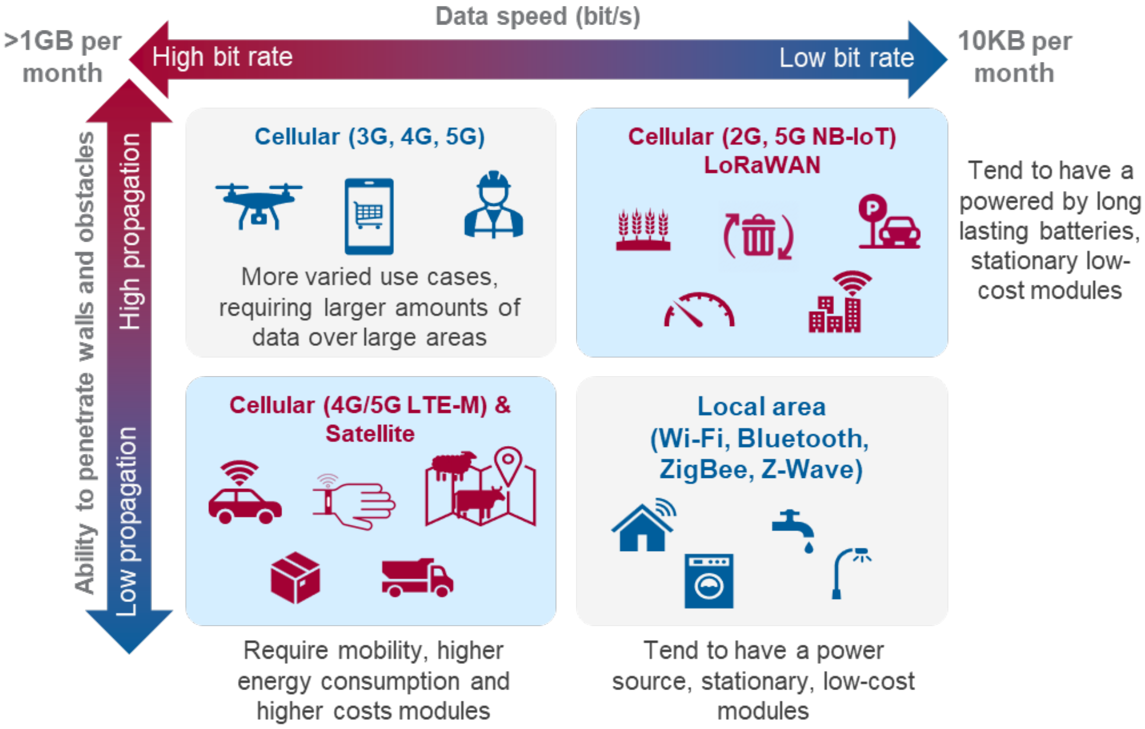
- LoRaWAN: Often chosen for scenarios where cost and flexibility are critical. It operates in the unlicensed spectrum, making it a cost-effective solution for many applications.

- NB-IoT: Preferred for applications that require high reliability and operate within the licensed spectrum of cellular networks. It offers robust connectivity, making it suitable for critical applications.

LoRaWAN and NB-IoT are leading LPWAN technologies, each offering unique benefits for various IoT applications. They play a significant role in developing sustainable and efficient IoT ecosystems, supporting environmental sustainability goals and enhancing the quality of life through more competent resource management.

The type of technology utilized in IoT use cases is summarized in the chart below, which highlights that the technology is dependent on the need to penetrate walls and obstacles (propagation) and the bandwidth / speed required.

Figure 3: IoT Connectivity Types Based on Speed and Propagation


Data speed (bit/s)
>1GB per month
High bit rate
Low bit rate
10KB per month
Ability to penetrate walls and obstacles
High propagation
Low propagation
Cellular (3G, 4G, 5G)
More varied use cases, requiring larger amounts of data over large areas
Cellular (2G, 5G NB-IoT) LoRaWAN
Tend to have a powered by long lasting batteries, stationary low-cost modules
Cellular (4G/5G LTE-M) & Satellite
Require mobility, higher energy consumption and higher costs modules
Local area (Wi-Fi, Bluetooth, ZigBee, Z-Wave)
Tend to have a power source, stationary, low-cost modules

2.3. IoT and the Environment

The Environmental Impact and Need for Proper Disposal Policies

Lithium batteries, while crucial to IoT applications for their efficiency, reliability, and longevity, also pose a significant threat to our environment. Their improper disposal can contaminate soil and water, releasing hazardous materials like lithium, cobalt, and other metals. Moreover, these batteries can become a fire hazard if not handled correctly at the end of their life cycle.

Addressing these environmental challenges is a collective responsibility. By implementing comprehensive policies and ensuring responsible handling and recycling, the impact on the environment could be significantly reduced. In alignment with the State of Qatar's Environmental Policy, the CRA advises all users to follow these guidelines for the proper disposal of lithium batteries:

Recycling Centers: *Take your used lithium batteries to designated recycling centers.*

Authorized Collection Points: *Use collection points for electronic waste. Many electronics retailers and service providers have taken-back programs for batteries and other electronic components.*

Special Disposal Containers: *Utilize special disposal containers for batteries, often* *found in public places such as malls, office buildings, and schools. These containers are designed to collect and store batteries for recycling safely.*

Follow Local Regulations: *Adhere to local regulations and guidelines issued by the Ministry.*

These guiding principles are designed to minimize the environmental impact of hazardous materials.

By promoting recycling programs, raising public awareness, and encouraging manufacturer responsibility, the CRA can play a pivotal role in mitigating the environmental impact of lithium batteries and supporting the sustainable growth of IoT technologies. For more information, the CRA advises relevant parties to refer to the Ministry of Municipality and Environment's official guidelines on electronic waste disposal.

2.4. IoT Global Trends

Several trends are emerging that impact IoT adoption. These may be summarized as:

- **Falling Costs** - as the cost of IoT devices and subscriptions fall, lower barriers to adoption allow for smaller companies and grows the volume and variety of use cases. Reasons for the decrease include increasing competition, improving technology and falling wholesale rates (as volumes increase).

- **Value Added Services** – value added services are becoming more tailored towards specific industries / verticals (for example, bespoke solutions for connected cars, smart cities, industrial IoT, healthcare).

- **Data Strategies** - managing and analyzing the data from devices is the real added value that IoT can bring. Data analysis, machine learning and AI are playing an increasing role, with companies developing new platforms and strategies.

- **Security Focus** - with billions of devices connected, security breaches become exponentially riskier, and it will be imperative to secure data through software and hardware. Microsoft has launched Azure Sphere, an end-to-end platform with a secure system-on-chip (SoC) device (hardware), a secure operating system (software), and a secure cloud service.

- **Cloud Platforms -** large tech players are developing IoT platforms to offer centralized management of IoT devices, from connectivity to data analytics. Examples include AWS IoT SiteWise, Azure IoT, IBM Watson IoT and Cisco Cloud Connect.

- **Industry 4.0 -** use of large-scale IoT deployments to drive operational efficiency through automation, connectivity, improved communication, real- time monitoring, robots and enhanced analytics.

- **AI -** linked to data, AI innovations lead to significant cost savings – this will result in benefits such as predictive analytics, predictive maintenance to adaptive systems.

- **Platform Architecture -** there is a growth in service delivery platforms aggregating connectivity, enabling service delivery and developer community integration.

- **Converged Connectivity –** there is a growth in services utilizing satellite for connectivity, and increasingly using a combination of cellular and satellite, for example is critical communications applications such as military, transportation and agriculture. Direct to Device (D2D) services, which facilitate connecting mobile phones to satellites, from companies such as SpaceX, Iridium and Qualcomm have become viable in 2024. However, this sector is in its infancy at this stage.

2.5. Use Cases

The IoT ecosystem encompasses a variety of established use cases but also needs to be able to adapt to new ones that may arise. The TASMU platform, managed by MCIT, is one of the key entities enabling various IoT use cases across industry sectors. The CRA's analysis has identified the following use cases relevant to Qatar, primarily based on references to TASMU's initiatives.

Figure 4: Use Cases of Particular Relevance to Qatar

Connected Cities	Connected Healthcare	Connected Industry	Connected energy & environment	Connected Sports	Transport & Logistics	Connected business	Connected homes
Public transport	Connected HealthTech wearables	Agriculture + animal tracking	Smart metering	Fitness trackers	In-vehicle emergency call system	Alarms + alerts	Alarms + alerts
Environment & public safety	Clinical remote monitoring	Drones/aviation	Real time performance monitoring	Wearables	Cargo and asset tracking	Smart buildings	Smart buildings
Smart lighting	Assisted living	Fuel management	Smart grid & distribution	VT & AR experiences	Fleet management	CCTV	Household devices
Road traffic management	Telemedicine	Mining and Oil&Gas	Environment and weather monitoring	Connected fitness equipment	Roadside assistance	Networked equipment	Connected appliances
Smart parking	Hospital appointment scheduling	Automotive	Waste reduction, conservation, and sustainability goals	Smart stadiums	Usage based insurance	Office equipment	
Resilient energy and infrastructure		Lone worker security	Pipeline monitoring in oil & gas		Vehicle diagnostics	Asset tracking	
Drone management		Logistics, warehousing & storage			Vehicle navigation	Retail	
Local information provision		Manufacturing			Autonomous vehicle management		

It is important to note, however, that the CRA understands that there must be flexibility in the regulatory framework to support any new and emerging uses of IoT, and emerging innovations such as Direct to Device (D2D). This principle is central to the aims of this document.

3 Current State of IoT in Qatar

3.1. Qatar's Digital Vision

The State of Qatar has ambitious plans for the modernization of the economy, whilst preserving its traditions of trust, personal ties and family life. The Qatar National Vision for 2023 (QNV2030) sets out four pillars for achieving this: human development, social development, economic development and environmental development.

The Third National Development Strategy (NDS3) builds upon QNV2030 and commits to non-hydrocarbon growth of 4% per annum until 2030, with IT& Digital recognized as one of the enabling clusters, together with Financial Services and Education. Qatar is seen to develop its digital economy and long-term strategic capabilities in AI and other emerging technologies, including IoT. As the NDS3 puts it, "to grow this cluster and serve and enable the local market, Qatar will accelerate the private sector's adoption of emerging technologies through the National Applied Programs for Emerging Technology, establish the National Data & Analytics Program, advance the SMEs & Enterprises Digital Transformation Program, commercialize Qatar-based cloud capabilities on a global scale, refine the regulatory landscape, and develop a cybersecurity legal and enforcement framework".

In addition, at national level, digital innovation will be fostered by establishing national programs for emerging technologies. The national Digital Agenda 2023 (DA2023) specifically outlines a strategic program (SP10) which will build necessary knowledge and technical capabilities to enable seamless adoption of four identified key emerging technologies (AI, IoT, Metaverse, Blockchain).

As IoT is seen integral to Qatar's economic diversification and sustainability efforts in perspective, CRA is set to focus on developing regulations and eliminating bottlenecks in the supply chain to stimulate IoT adoption that will enable operational efficiencies, reduced costs, and will stimulate new business models and revenue streams for economic growth. This approach targets to attract foreign investment, promoting local entrepreneurship, and generating employment opportunities, aligning with Qatar's vision for a dynamic and diversified economy.

Furthermore, the CRA's regulatory approach to IoT would encourage collaboration in research and development activities involving both public and private sectors. This will help create a robust ecosystem and position Qatar as a regional leader in IoT technologies while supporting the national digital transformation agenda.

IoT's transformative potential extends beyond theoretical benefits to practical improvements in quality of life, economic growth, and fostering innovation. Regulatory frameworks shall ensure that IoT deployments prioritize user privacy, data protection, and accessibility. By doing so, they help create a safer, more efficient, and inclusive society.

Effective regulation ensures IoT deployments prioritize user privacy, data security, and interoperability, building stakeholder trust and encouraging adoption. Similarly, NDS3 emphasizes technological advancement and digital transformation to drive economic growth and improve its resident's quality of life.

By building IoT regulations as aligned with national strategic priorities, CRA shall deliver its part and support overall Qatar government efforts to create an environment for innovation, attracts investment, and positions itself as a regional leader in IoT, accelerating progress towards a diversified, knowledge-based economy and sustainable development by 2030.

3.2. Market Insights

The CRA has assessed the Qatari ecosystem and spoken to various stakeholders across key public and private sector entities, including service providers, public authorities, commercial organizations, educational and financial institutions, to understand their readiness and current state of IoT adoption across the country and noted that:

- **Organizations are already planning for IoT**: With well-defined IoT strategies and implementation roadmap, some entities are already making significant strides in leveraging IoT technology. This progress is a promising sign for the future of IoT adoption in Qatar.
- **Early benefits are already being achieved:** A significant majority of Qatari entities have embraced IoT technologies with at least one active use case integrated into their operations in some form. These use cases span a range of applications, with widespread implementations observed in areas such as asset tracking, traffic monitoring, and health and safety. Notably, advanced use cases like smart meters are also gaining traction, demonstrating a progressive approach to IoT adoption.
- **Taking a pragmatic view to implementation:** Although on-premises solutions are common in IoT deployments, many organizations see the benefits of using public, private, and hybrid cloud models to meet diverse business needs.
- **Data sovereignty:** Qatari entities consistently ensure that data collected stays within Qatar's borders, reflecting the global emphasis on data sovereignty in response to growing data privacy concerns and in adherence with the applicable local and global data privacy regulations.

In addition to the primary inputs received by key stakeholders, the CRA also conducted a benchmarking study to understand the adoption of IoT services globally and upcoming trends in this domain, and noted that:

- IoT adoption is on the rise worldwide, and regulators globally and in the Middle East region are developing various regulatory instruments and guidelines regarding the use of IoT services in their respective geographies.
- There is no unique numbering scheme for IoT and M2M devices. However, IP6-based numbering is emerging as a preferable choice for IoT devices. Issues with international connectivity and roaming limits affect IoT devices requiring extended connectivity.
- Inadequate guidance on data portability risks vendor lock-in, and challenges exist

with cross-border data flow and storing data within the country.

- Lack of clarity on SIM card usage and the large block sizes for number allocation hinder IoT service adoption. Additionally, non-telecom IoT service providers face regulatory compliance issues.
- The need for futureproofing IoT infrastructure, issues with uncertified devices, and interoperability challenges among devices from different manufacturers are prevalent. No single protocol is being used for integration and interoperability for IoT devices. However, organizations are adopting internationally accepted protocols like HTTPS, MQTT, and CoAP.
- Devices used for IoT solutions need to be approved by the relevant authorities. IoT devices used in national critical infrastructure have additional stringent requirements. Determining liability in cases of malfunction or accidents involving interconnected IoT devices is complex.
- IoT solutions mainly operate in the short range and are considered to be Wireless Home Network (WHAN) technologies. 5G is emerging as a key enabler for complex IoT solutions.
- Most countries have general data privacy/ cyber security laws, and organizations deploying IoT solutions are expected to abide by these Laws. As IoT devices collect and transmit large volumes of personal and sensitive data, concerns rise about data privacy and security. IoT systems crucial to safety in healthcare, transportation, and industrial operations face challenges related to maintaining resilience and ensuring service availability during disruptions. Issues related to the licensing and certification of IoT products and services impact quality and security.
- IoT systems crucial to safety in healthcare, transportation, and industrial operations face challenges related to maintaining resilience and ensuring service availability during disruptions.
- There is no dedicated law for IoT consumer protection. However, most countries have general consumer protection and data privacy laws and organizations deploying IoT solutions are expected to abide by these. Consumers face a lack of clear information about IoT device capabilities, limitations, and data practices, with insufficient mechanisms for addressing issues.
- The complex IoT environment with multiple stakeholders lacks a structured forum

or committee to address interdisciplinary challenges. Effective communication and coordination with stakeholders, including regulatory bodies, are necessary but challenging. There is a shortage of skilled professionals with expertise in IoT technologies, affecting the development and implementation of IoT solutions. Limited user awareness and knowledge about IoT technologies and their risks and benefits hamper adoption.

3.3. Issues and Challenges for Qatar

CRA research carried out among stakeholders in the State of Qatar have helped CRA to identify areas that may require regulatory intervention, and also find out the areas where market is functioning well and is likely to continue to do so. Therefore, any regulation to be developed by CRA in perspective will focus on addressing the former.

IoT Identifier:

- Currently, the Consumer Registration Policy has a restriction of 5 SIMs for expats in case of non-business connections. Such constraints on SIM card usage (maximum allowance of 5 per user) impacts IoT services uptake.
- As per current practices and processes, service providers (SPs) can only apply for 10,000 or 100,000 number block ranges. SPs believe that the CRA should create an incentive by making the IoT number allocation cheaper and in smaller blocks of 100-1000 number blocks.
- Lack of regulation on non-telecom IoT service providers. The use of SIM cards should be compliant with the provisions of the Consumer Registration Policy and MOI rules.

Equipment:

- To ensure that IoT infrastructure and solutions are fit for future use, stakeholders believe that it would be useful to mandate Dual-stack IPv4/6 standard on all new/imported IoT devices and deployments.
- There are instances where customers just purchase connectivity and not equipment. To deal with such scenarios, there is a need for guidance around the responsibilities of both SPs and customers, particularly where devices lack proper certification. This will ensure accountability for both parties.

- IoT devices from different manufactures may not always work seamlessly together. IoT guidelines should address interoperability standards to ensure that devices can communicate effectively.

Roaming:

- IoT devices need seamless connectivity across various regions internationally for an extended period. Service providers believe that CRA should provide guidance on permanent roaming of IoT devices.
- Service providers also believe that limiting foreign IoT SIMs inbound roaming and removing limits for Qatari IoT SIMs outbound roaming is crucial to encourage the development of a sustainable local IoT industry.

Interoperability:

- The challenge lies in effectively integrating IoT technologies across diverse sectors, where unique operational requirements and complex system architectures intersect. Many organizations have expressed interest in collaborating on the framework to tailor IoT solutions effectively to their respective sectors. For example, the Ministry of Public Health may partner with CRA to develop regulations pertaining to IoT in the public health sector, while the Ministry of Interior could collaborate on initiatives related to public safety.
- The absence of clear regulations in Qatar’s IoT sector leads to challenges with low-quality imported devices, resulting in interoperability, quality of service and security issues.

Spectrum Management:

- While the current spectrum plan is deemed sufficient, there is a consensus among entities that a review may become necessary should there be a surge in use cases within the country.

IoT Services Licensing and Regulation

- Light regulation on IoT services is expected. Relevant regulation is seen to ensure legitimacy and support for external vendors providing native IoT devices designed for the region.

- One of the main challenges in developing, obtaining, or adopting IoT-related licenses and approvals is the need to cooperate and coordinate with multiple external agencies. Stakeholders believe that providing clear requirements for licensing and certification will encourage adoption while ensuring the quality and security of IoT products and services.

Governance and Coordination with Stakeholders

- IoT environments are complex with multiple stakeholders and a lack of clarity around the current governance and supervisory landscape. Therefore, establishing some form of collaboration - a forum or committee to timely address interdisciplinary challenges and support service providers would be advisable.
- Some entities and stakeholders believe that multiple agencies may need to collaborate with the CRA to address specific requirements and provide clarity for various IoT services and use cases. For example, IoT- enabled healthcare services and citizen services may need to address public safety and security.

Cost of Technology and Budget Constrains

- High costs associated with developing IoT solutions is partly due to the limited scale of such initiatives.
- Currently entities do not allocate a specific budget for IoT; instead, IoT needs are typically accommodated within their overall IT budget.
- The high cost of connectivity for IoT applications poses a significant business challenge.

Skills Gap

- IoT technologies are continuously evolving, and there is often a shortage of experts who can design, implement, and maintain end-to-end IoT solutions, especially for specific domains. Entities in Qatar often struggle to find and retain skilled professionals with IoT technologies and domain knowledge.
- Entities believe CRA could be instrumental in guiding them towards necessary expertise.

User Awareness

- Generally, there is a lack of user awareness and knowledge about risk and opportunities offered by the IoT technologies and their various use cases. CRA should emphasize the importance of capacity building, knowledge sharing, and raising awareness about IoT best practices.

Data Management

- Lack of robust guidance on IoT data portability could result in vendor lock-in for the customer.
- It is important for data to flow easily across borders to unlock the full potential of IoT. A guideline to facilitate effective IoT data flow across borders would be useful.
- Some IoT hardware providers previously stored data outside Qatar, which posed challenges in vendor selection. However, with the recent publication of the Cloud Policy, these challenges are being addressed, allowing for more flexibility and compliance in data management.

Data Privacy

- With the increase in IoT devices and systems collecting and transmitting large volumes of personal and sensitive data, ensuring data privacy is a significant concern. Stakeholders believe that measures should be defined to secure the data being collected and processed by IoT devices and service providers.

Security and Resilience

- Some IoT systems, such as those in healthcare, transportation, and industrial operations, may be critical for customer safety. However, there is limited awareness and clarity around the measures and controls required to ensure the security, resilience, and availability of critical IoT services.

Consumer Protection

- Consumers have the right to be informed about the capabilities, limitations, and data practices for IoT devices/ services (QoS) they purchase or use which aren't currently available. Currently, consumers do not have access to effective complaint and redressal mechanisms in case of issues with IoT products or services.
- Stakeholders expect consumer protection measures to cover different layers of the value chain, such as platform providers and manufacturers of devices, while also considering that these entities may not operate within the jurisdiction.

Liability

- There is a lack of clarity in determining the liability and responsibilities of different stakeholders involved in the IoT ecosystem in case of malfunctions or accidents with IoT devices, especially when the devices are interconnected.

Legal and Regulatory

- Currently there is lack of clear IoT guidelines and standards in Qatar (for example, IoT specific licensing scheme, spectrum allotment, wholesale airtime access, IoT security and privacy, number allotment specific to IoT devices and services). Light regulation in terms of IoT guidelines and common standards would encourage collaboration and facilitate integration amongst various stakeholders.
- To ensure there is enforceability around the guidelines a class licensing system should be considered. This would enable the CRA to apply sanctions on bad actors. It will also allow different activities to be grouped together based upon their risk profile and additional conditions to be imposed on riskier IoT activities. The regulatory landscape governing IoT can be complex and at times conflicting, making it difficult for service providers to ensure compliance. This complexity leads to delays in the development of IoT solutions.

4 Regulatory Focus Areas

4.1. Introduction to Key Focus Areas

The CRA has assessed the feedback from stakeholders and highlighted areas requiring regulatory focus relevant to the adoption of IoT in the State of Qatar. This section sets out the current views of the CRA and how these should be addressed in terms of regulation and best practice.

Approach for each focus area has been developed based on the industry research undertaken by CRA and aligned with the CRA’s mandate. The objective, as far as possible, should be that where regulation is required, it should be relatively light touch.

Following this consultation, the CRA will develop a framework document setting out the specifics relating to IoT policy and regulations.

4.2. Network and Equipment

Separation of Connectivity and Equipment

The CRA believes that customers should have the flexibility to purchase connectivity independently of equipment for IoT and M2M services. This approach promotes consumer choice and fosters a competitive market environment, ensuring customers can select the most suitable and cost-effective connectivity solutions for their needs. By separating connectivity from equipment, the CRA encourages innovation and competition among service providers, ultimately benefiting consumers with better service quality and pricing.

This policy aligns with Qatar's vision to support the growth of emerging technologies and creates a dynamic and adaptable telecommunications ecosystem that meets the evolving demands of IoT and M2M applications.

Device Certification

The CRA's position is that all IoT and M2M service devices sold or used in Qatar must undergo a dedicated approval process by the CRA. Ensuring that the devices meet established certification standards is crucial for maintaining the telecommunications network's integrity, security, and reliability. Uncertified devices pose significant risks, including potential interference with network operations, security vulnerabilities, and compromised service quality. By enforcing stringent certification requirements, the CRA shall aim to protect consumers, promote a secure and robust IoT and M2M ecosystem, and support the sustainable growth of emerging technologies in Qatar. Type Approval process of CRA is expanded below.

Customer Advice

The CRA will publish periodic advice to users of IoT devices, highlighting the requirements for approval, as well as other advice which will help customers to understand their responsibilities.

The CRA advises customers to ensure that any devices they use for IoT and M2M services in Qatar are properly approved for use. Using uncertified devices can lead to significant risks, including network interference, security vulnerabilities, and compromised service quality. Customers should verify that their devices meet the established certification standards to protect themselves and ensure optimal performance. This measure is essential for maintaining Qatar's telecommunications network's integrity, security, and reliability.

4.3. Type Approval

All IoT devices sold in the State of Qatar will require Type Approval based on their perspective use and/or their connectivity with the existing communication networks for provisioning of IoT services. This is to prevent poor quality devices causing interference to other users or compromising the integrity of mobile networks. The CRA will provide a process for Type Approval. It is the responsibility of the supplier of devices to users to obtain such Type approval.

An exception exists whereby a device is legally registered on a mobile network outside of Qatar and is brought to Qatar and then connects to a Qatari mobile network (in-bound roaming). In this case, provided the device has type approval in the home country, then it may be permitted, subject to the permanent roaming conditions defined in this document. If, however, an MNO determines the device to be causing interference to other users, it may block the IMEI of the device. No such exception exists for devices that operate in unlicensed frequency bands.

The application process for Type Approval will be available on the CRA’s website. Applicants will be required to pay a processing fee, and provide relevant manufacturers data, which the CRA may vary from time to time. Under certain circumstances, the applicant may be required to make available a physical device for testing.

In the event that the CRA rejects the application for Type Approval, an appeal process will be provided, and an option for re-application will exist where manufactures are able to resolve underlying issues.

4.4. Connectivity Market Provision

The success of IoT depends upon innovation and competition among licensed connectivity suppliers and the CRA believes that there is a role that might be served by dedicated IoT wholesale connectivity providers. Such companies would likely resell services provided by the current MNOs and purchase IoT connectivity on a wholesale basis for supply to IoT customers.

In most of the use cases shown in Section 2, for example urban management for smart cities, connectivity must be high speed, reliable and low latency. The cost of data should not prohibit the commercial viability of developing user applications. Network operators should therefore be required to offer network capacity to 3rd party service providers on the same basis as their own direct customers with no restrictions.

The CRA prefers that such companies enter into mutually beneficial commercial relationships with MNOs but is prepared to intervene if this cannot be achieved without new regulation.

Following a review into CSP best practices, the CRA envisages MNOs making available LTE, 5G, NB-IoT and LTE-M services, along with the necessary network interconnectivity, policy control, provisioning and billing APIs, access to SIM / eSIM profiles, and relevant support services. Low latency services are considered important for some real-time IoT use cases.

IoT providers that offer services that are business critical or those that have high availability requirements, including safety critical applications, may decide to deploy devices with multiple redundant network connections. The obligation and associated liabilities for determining whether the service levels offered by MNOs are sufficient for the application rests with the designer of the application.

4.5. Identifiers

Number Allocation

Currently MSISDNs are allocated to licensed operators in blocks of 100,000 and/or 10,000 numbers provided that there is utilization of existing numbers greater than 70%.

Following consultation, it is evident that there is a strong demand for the CRA to assign smaller blocks to licensed operators. This approach will lead to more efficient overall resource utilization, foster enhanced market competition, and ensure better adaptability to technological changes. Thisis particularly advantageous for emerging technologies like IoT and M2M communications, which require numerous devices but not necessarily in large contiguous blocks. This flexibility is a crucialenabler for these technologies to grow and adapt, free from the constraints of rigid numbering plans.

It is important to acknowledge that this transition has its challenges. The potential for increased administrative overhead and the risk of numbering plan fragmentation are significant hurdles that must be addressed, as will the need for compliance with 70% utilization in previously issued blocks. However, the substantial benefits far outweigh these challenges, making this a necessary step forthe future of telecommunications in the State of Qatar.

Conversely, while the current restriction of 100,000 and/or 10,000 blocks simplifies management and reduces fragmentation, it leads to inefficient resource use and creates high market entry barriers. It is hopedthat there will be higher overall utilization of number blocks in IoT because numbers will be used for longer on average, and quarantine requirements (between the assignment to one customer andanother) can be shorter.

Balancing these factors, the CRA will benefit from adopting a more flexible approach that permits smaller blocks while implementing robust management strategies to mitigate potential downsides.This flexibility will lead to a more dynamic, competitive, and efficient telecommunications environment that supports the growth of emerging technologies and fosters innovation.

Number Range – Long MSISDNs

The CRA's position is to maintain the 12-character MSISDN format for Qatar. After a thorough evaluation, the CRA has determined that changing the MSISDN length does not provide sufficient benefits in the foreseeable future, even considering the growth of emerging technologies such as IoT and M2M. While a longer format could offer scalability, alignment with international standards, and efficient number portability management, it also introduces user inconvenience, increased administrative costs, and potential overprovisioning of resources. A comprehensive cost-benefit analysis and stakeholder engagement has reinforced that maintaining the current MSISDN length is the most practical and efficient approach, ensuring the telecommunications infrastructure meetspresent and future needs without unnecessary disruption.

Number Portability

Number portability exists to allow customers the ability to change service provider without the inconvenience of losing their phone number. Although some IoT use cases depend upon the devicehaving an MSISDN, the specific number used is less relevant. MSISDNs in IoT are mainly used forSMS communication, and since M2M is device to device, the numbers used are necessarily used by other devices, which can be reprogrammed to use new numbers.

The most common use cases for IoT exclusively involve packet data sessions and MSISDNs are not used. The CRA, therefore, does not regard number portability to be a major concern for IoT services provided by MNOs.

International Numbers and Roaming

The ITU makes available +88 country codes for international services. In agreement with the ITU, MNOs operating in the State of Qatar may provision such numbers on their networks for use by their customers. Outbound roaming with these numbers then follows the same conditions as for Qatar based numbers, and subject to the conditions stated in Section 4.7

MNO may also allow inbound roaming for subscribers using international numbers if the appropriateroaming arrangements are in place with the home network operator, subject to the conditions stated in4.7

IPv6

Usage of IP addresses is very common in IoT ecosystem. Most IoT devices utilize private IP addresses. The CRA encourages IPv6 adoption for IoT in Qatar as a critical initiative. As the demand for IoT devices continues, the existing IPv4 number space faces limitations in addressingthe vast number of devices expected to come online. IPv6, with its virtually limitless address space,is essential for supporting the exponential growth of IoT, enabling seamless connectivity and communication among devices.

In cases where IoT devices require global IP address, IPv6 adoption is vital for ensuring scalability, improved security features, and efficient routing. By promoting IPv6, the CRA aims to foster an innovative ecosystem, enhance Qatar's technological infrastructure, and ensure the nation remains at the forefront of global digital transformation.

CRA supports the adoption of IPv6 by service providers and recommends its implementation. MNOs might be able to offer IoT services on dedicated infrastructure that supports IPv6 (such as having a dedicated P-GW for IoT services) in order to facilitate the early adoption of IPv6.

4.6. SIM Card Registration

Regulation permits Qatari residents to own up to five mobile subscriptions for their devices, which is sufficient for most users and prevents illicit distribution. MNOs are required to verify and record the identities of the owners of SIM cards and eSIMs. However, the CRA understands that the proliferation of IoT devices is likely to mean that individuals will own more than five IoT devices.

Suppliers of IoT devices that provide a subscription service with the device, or an MNO /

CSP that provides a dedicated IoT subscription plan, associated with a type approved IoT device where the SIM / eSIM cannot be physically removed from the device, will be exempted from the requirement to limit the number of subscriptions for individuals. It will, however, still be necessary for connectivity providers to validate the identity of their customer, as per the current process.

4.7. Permanent Roaming

Roaming is a well-established principle in mobile telephony. It allows individuals to “roam” on mobile networks in other countries while travelling outside their home country. This is usually attractive for the “visited network” because it brings additional revenue, which accompanies the costs of hosting the in-bound roamer. It should be noted that while roaming for IoT-M services is relatively common, NB-IoT is not at present.

IoT devices often have very low data volumes, often so low that the costs of hosting an in-bound roamer exceed the revenues billed for services. When very large numbers of in-bound IoT roamers exist, this can have a material effect on the operating costs of the visited network and tie up resources that cannot then be used by home subscribers. The CRA wishes therefore to discourage a situation where IoT devices with foreign network subscriptions freely roam onto Qatari networks. For this reason, permanent in-bound roaming to Qatar will not normally be permitted, and an IoT device with an IMSI belonging to a network outside the state of Qatar will be automatically blocked from accessing Qatari networks after a period of 90 days if it has attempted to access a Qatari network at least once a week during those 90 days. Once blocked, the IMSI will remain blocked for a further period of 90 days.

MNOs may, at their discretion, permit permanent roaming for commercial reasons, for example, where a bilateral agreement exists.

The CRA defines an IoT device in this context as any IMSI that has attached to a Qatari mobile network but has less than 10 minutes of chargeable voice traffic, less than 10 mobile originated SMS, and less than 200 MB of data in the week under consideration.

A further issue is that devices from Qatar may be taken to other countries and used on foreign networks. The CRA supports such activity provided data sessions are ‘home-routed’, via the subscriber’s home network.

4.8. Consumer Protection

To increase trust and in furtherance of IoT adoption in Qatar, consumer protection is a necessary component in establishing trust and support to consumers and the market as it develops. We consider the consumer protection aspect should be broken down into two main aspects as follows:

1. Cyber security, data security and privacy.
2. Contractual consumer terms.

Whilst some cybersecurity, data security and privacy are dealt with elsewhere in this positioning paper, the remainder of this section shall cover the contractual consumer elements.

Current Regulations: CRA Telecommunications Consumer Protection Policy

IoT service providers at each step of the provision of connectivity services shall be required to adhere to existing Telecommunications Consumer Protection Policy and Qatar Consumer Laws as may be updated. These consumer protection measures shall apply to all entities including hardware, service, or connectivity providers when interacting with consumers and such obligations shall apply to any provider no matter if they are established within Qatar or elsewhere.

As a minimum, IoT service providers shall be required to comply with all consumer protection regulations and legislative rules and requirements as set out in the Telecommunications Law (mainly Chapter 10) and the Telecommunications Consumer Protection Policy from the Regulatory Authority Ministry of Information and Communication Technology (ictQATAR), the CRA's predecessor, and all consumer protection policies, guidelines and instruments issued by the CRA (together the **"Qatar Consumer Laws"**).

IoT Class License Consumer Protection

CRA may consider establishing an IoT Class License with License terms similar to those in the current Class License for the Resale of Retail Telecommunications Services CRARAC 2022/06/20-1.

The CRA is accordingly considering that IoT Class Licenses ought only to be granted to IoT Service Providers' who are in compliance with applicable consumer protection rules (to be defined) in order to provide consumers with adequate protections and information so they can make informed and clear decisions about the services theyare purchasing or subscribing to, and under what terms. This includes protection from deceptive practices, including by requiring (and enforcing) the provision of accurate and reliable billing.

Whilst the National Cyber Security Agency regulates cyber security and data more generally, the CRA would also recommend good practices for managing consumer related data privacy requirements as part of the IoT Class License.

Consumers should be kept informed about the capabilities, limitations and data collection practicesof their IoT devices and services they purchase or use. In line with the CRA’s Cloud Policy Framework and other applicable legislation, data should be stored within Qatar.

The IoT service provider (if they do collect data about the end users) are not to use the data exceptas permitted or required by the Qatar Consumer Laws, the IoT Class License and other applicable legislation.

Consumers should have reasonable control over their personal data. The IoT Class License shall require, where the personal data processing is necessary for the purpose of operating the IoT connectivity, this should be notified to the consumer at point of initiation.

Consumer Choice in Relation to IoT Providers

To increase consumer choice, once a consumer has initiated services with one or more IoT providers under the IoT Class License, they may seek to switch to another IoT provider. The IoT Class License would require that licensees, within reasonable time frames, will assist with consumer transfers to another IoT provider without undue delay, cost or prohibition. As stated in the consultation Qatar Spectrum Outlook 2022 Consultation CRA-SM-CON-001-20 consumer choice, and an open market for growth, is a stated Qatari objective for the sector.

Liability and Enforcement

Liability for malfunctions or accidents can be complex when interrelated. If necessary, the CRA may issue guidance to clarify responsibilities and liability in the IoT ecosystem. The position is that every IoT licensee is required to provide a contact for notification, and enforcement that will need to be registered in Qatar. This will make enforcement by the CRA easier.

The notification structure of the IoT Class License would hold each licensee as liable for the applicable Qatar Consumer Laws and any other required regulatory elements. Failure by an IoT provider to properly notify the CRA under the IoT Class License, would be a breach of Qatari law and the CRA has the right to use all relevant enforcement powers. If the CRA fails to take enforcement action, it will duly explain the reasons for such inaction. Decisions by the CRA in relation to IoT shall not be subject to challenge or appeal.

As a minimum consumers should be afforded access to an effective complaint and redress mechanisms under the Qatar Consumer Laws and the IoT Class License in case of issues with IoTproducts and services.

4.9. Data Retention and Data Access

MNOs in Qatar are subject to processes that allow the relevant authorities to carry out lawful investigations that relate to users of Qatar’s mobile networks. These apply in the same way to IoT users which have connectivity provided by MNOs. Additionally, the CRA requires that providers of public IoT services, and in particular MQTT brokers maintain records (logs) of activity for a period of no less than six months. These shall be made available upon presentation of a lawful request to the relevant authorities. Note, it is not expected that the content of messages be maintained, only the meta-data associated with messages, which might include time and date, location, sending and receiving IP address, device information (such as MAC address or serial number), and associated customer account.

MNO’s and service providers when handling data will also need to be compliant with the CRA Cloud Policy Framework[5] dated July 2022. This includes the data classification requirements, data localization security, data interoperability and portability as well as other recommendations. Providers of IoT services may also, in response to a lawful request, be required to cooperate with the authorities in response to an ongoing investigation. This could foreseeably include providing real-time data about specific users. This is especially relevant for threats related to national security.

4.10. Cybersecurity

CRA recognizes that IoT devices have historically employed limited security measures, which has provided threat actors with opportunities for compromising the functions of the IOT devices, accessing personal and sensitive data, and providing entry points for attacks on other systems. Large numbers of IoT devices can be compromised or

[5] https://www.cra.gov.qa/en/document/cloud-policy-framework

disabled, or devices operated by key entities can be accessed, threatening Qatar's national security.

The Qatar National Cyber Security Agency publishes various policies, frameworks and guidelines (for example, Qatar Cyber Security Framework 2022 and National Information Assurance Standard)[6]. All suppliers and operators of IoT devices in Qatar must follow the full provisions outlined in such publications.

4.11. Data Security and Privacy

Users of IoT devices have the right to expect that their data is held securely and only used for the stated purposes. Although the definition of data security and privacy does not fall within the remit of the CRA, the relevant guidelines published by the National Cyber Security Agency (NCSA) Qatar's National Data Privacy Office (NDPO) are mandatory regarding data security and privacy. Providers should also refer to the relevant privacy laws with regards to the protection of personal data.

4.12. Interoperability

As the Internet of Things (IoT) ecosystem in Qatar continues to grow, ensuring seamless interoperability among devices, platforms, and services becomes increasingly important. Interoperability refers to the ability of different IoT systems, devices, and networks to work together and exchange data effectively, regardless of the manufacturer, service provider, or technology used.

The CRA recognizes that a lack of interoperability can lead to fragmented ecosystems, increased costs, and reduced efficiency. It can also limit the scalability of IoT solutions and hinder the full realization of the benefits of IoT technologies. To address these challenges, the CRA proposes the following considerations for ensuring interoperability within Qatar's IoT ecosystem:

- **Adoption of International Standards:** The CRA encourages the adoption of widely recognized international standards for IoT communication protocols, data formats, and interfaces. This will help ensure that devices and systems from different manufacturers can work together seamlessly and that IoT solutions deployed.

- **Interoperability Testing and Certification:** The CRA may consider establishing a framework for interoperability testing and certification. IoT devices and systems

[6] https://www.ncsa.gov.qa/en/regulatory-tools/

should be tested to ensure they meet these standards before they are approved for use in Qatar. This would involve collaboration with international standards organizations and testing bodies to align Qatar's certification processes with global best practices.

- **Guidelines for Developers and Manufacturers:** The CRA will develop and publish guidelines for IoT developers and manufacturers, emphasizing the importance of designing products with interoperability in mind. These guidelines will include recommendations on the use of standard protocols, data formats, and interfaces to facilitate seamless integration across different platforms and networks.

- **Promoting Open APIs:** The CRA supports the use of open Application Programming Interfaces (APIs) to enable different IoT platforms and services to communicate and exchange data easily. Open APIs can reduce vendor lock-in, encourage innovation, and foster a more competitive market by allowing new entrants to develop interoperable solutions.

- **Stakeholder Collaboration:** The CRA will work closely with stakeholders, including device manufacturers, service providers, and industry associations, to promote interoperability across the IoT ecosystem. Collaborative efforts will focus on developing shared frameworks, best practices, and solutions to common interoperability challenges.

By prioritizing interoperability, the CRA aims to create a more cohesive and efficient IoT ecosystem in Qatar. This will not only enhance the user experience but also support the long-term growth and sustainability of IoT technologies in the country. The CRA invites stakeholders to provide feedback on these proposals and to suggest additional measures that could further promote interoperability within Qatar's IoT landscape.

5 Implementation Strategies

5.1. Licensing considerations

Introduction

IoT is an essential driver of future growth for the IT and telecommunications industries. Licensing and accountability are critical in establishing a structure for IoT service providers. The IoT licensing approach would be designed to support the growth of the IoT market in Qatar. The CRA aims to be flexible in its regulatory approach to align with stakeholders' needs and to create opportunities for commercial IoT development.

Licensing and regulatory oversight by the CRA will need to consider many aspects within the IoT ecosystem, such as spectrum usage, connectivity with telecom networks, and standard terms and pricing for wholesale connectivity. This aims to provide more options in the market for connectivity providers and support the growth of a diverse IoT device market for end-user customers.

Class License for IoT Provision

There are various approaches used to regulate the provision of IoT services across the globe. A solution that provides adequate information to the CRA and potentially other government authorities as needed, with a flexible and light touch approach on the other hand, is an approach that would create structure while also facilitating rapid growth in Qatar for the industry. On this basis, a general IoT Class License that sets out the operational requirements for licensees, with a notification requirement to the CRA, would give sufficient oversight whilealso fostering a transparent and efficient system for service providers. Therefore, the CRA considers that a specific IoT Class License should be adopted with a notification requirement, requiring all providers of IoT services in Qatar to:

1. appoint a local representative in Qatar; and
2. submit a notification to the CRA with the required details (including those of the local representative) and a brief description of the IoT service.

The IoT Class License (with notification) would provide structure, information and functionality for the IoT market. In line with the existing CRA class licenses, the IoT Class License would impose obligations and bind the licensees to implement any measures required by the applicable regulations and legislation including directions of the CRA.

As noted in the Qatar Spectrum Outlook 2022 Consultation response stakeholders showed interestin harmonization across the industry and potential in an MNO structured model.

The CRA considers that the IOT Class License should include the following aspects:

Eligible Uses and Flexibility

Similar to other CRA class licenses, the IoT Class License should initially contain a list of eligible uses for class licensees. The notification form will include an “other” category which will be subjectto CRA approval and additional information provision requirements. In this way the CRA will have the flexibility and discretion to authorize the development of new IoT services in Qatar.

Equipment Approval

Telecommunication equipment or IoT connectivity provided as subject to the requirements of the CRA’s Type Approval regime. This obligation will mainly apply to the manufacturers or distributorsof the IoT devices.

Consumer Protection

As set out above, the IoT Class License shall incorporate the relevant consumer protections, and apply to all licensees.

Notification Form

Notification as a service provider under the IoT Class License, and acknowledgment from the CRAwould have to be obtained before providing connectivity services. A notification form similar to the one set out in the Annex B – for the Class License for the Resale (Retail) of Telecommunications Servicesdated 10 July 2011 and amended 29 September 2013 (ICTRA 2011/07/10c) may be a format that is consistent with providing enough information for notification without imposing an undue burden on CSP’s or IoT Service Providers. As noted above, a simple but obligatory information section fornotification applications for “Other Uses” may be added when the Class License for IoT does not provide for a specific IoT device or usage.

Fees

The CRA shall have a right to require prospective licensees under the IoT Class License to pay a fee upon notification, update as to change of details, or annual fees, and other such communications. Licensees shall be responsible for their own costs, expenses or other financial commitments arising from the IoT Class License and use of their connectivity in line with applicableregulatory obligations.

Duration and Renewal

The licensee would be authorized to operate under the IoT Class License as long as they continue to comply with the terms and conditions of the license and all applicable regulatory obligations. TheIoT Class License duration may be set by the CRA and require occasional renewal, including updatednotification and fees.

Numbering

The IoT Class licensee would have the right to obtain blocks of numbers for IoT use from either theMNOs or the CRA. If an MNO refuses to grant numbering, then the IoT licensee would have the rightto request the CRA to require the MNO to provide the numbering.

IoT Class License Information Provision and Audit Right for CRA

The IoT Class License would include the right for the CRA to request that the licensee submit any necessary information. This information provision would be necessary for the CRA to effectively monitor compliance with the IoT Class License and other applicable regulations including the Decision no. 1 of 2009 - The Executive By-law of Telecoms Law Chapter (13)[7].

Assignment

In line with the regulatory requirements, licensees under the IoT Class License may not assign or transfer their licenses to another entity without prior written approval from the CRA.

Applicability of the IoT Class License

Notification Exemption for Hardware with IoT as Embedded Connectivity

When IoT connectivity is an integral service provided by means of the device as used by consumers, then IoT device provider will need to notify under the IoT Class License.

However, if there is a direct contract (for example, via a screen or app) between the consumer and the connectivity provider, the connectivity provider’s IoT Class License would be sufficient.

Where the IoT connectivity is ancillary, the hardware provider (for example a car manufacturerwith embedded SIMs) would not need to notify under the IoT Class License.

[7] Decision no. 1 of 2009 - The Executive By-law of Telecoms Law Articles 127, 128, 129, 130, 131 and 132.

Regulatory Compliance Throughout Contractual Chain

As seen in the image below in the section titled “Applicability of the IoT Class License in the IoT Ecosystem” certain agreements will apply between the parties’ supplying connectivity to the end user.

To ensure compliance, the obligations of the IoT Class License, including consumer protection, would apply where necessary to the contractual “chain” between the MNOs, CSPs and any resellers.The MNOs would be entitled to contractually require the flow down of part of their MNO license obligations, to the CSPs and any resellers.

Enforcement

The breach of the IoT Class License would be enforceable against the licensee, who will be liable for all breaches.

If there are reasonable grounds for breach, enforcement by the CRA via notification shall be sent, unless there is the risk of imminent and irreparable harm. The CRA shall have the power of inquiryor investigation stage, if there is harm from the breach to consumer detriment. In such cases the CRA may suspend the right to the licensed activity. These rights derive from the Enforcement rightsfrom CRA under Telecommunications Law Chapter 15 and 16.

There is also the legislative framework already established in Qatar, which expressly states in the *Numbering Regulation CRATA 2020/06/04 that:*

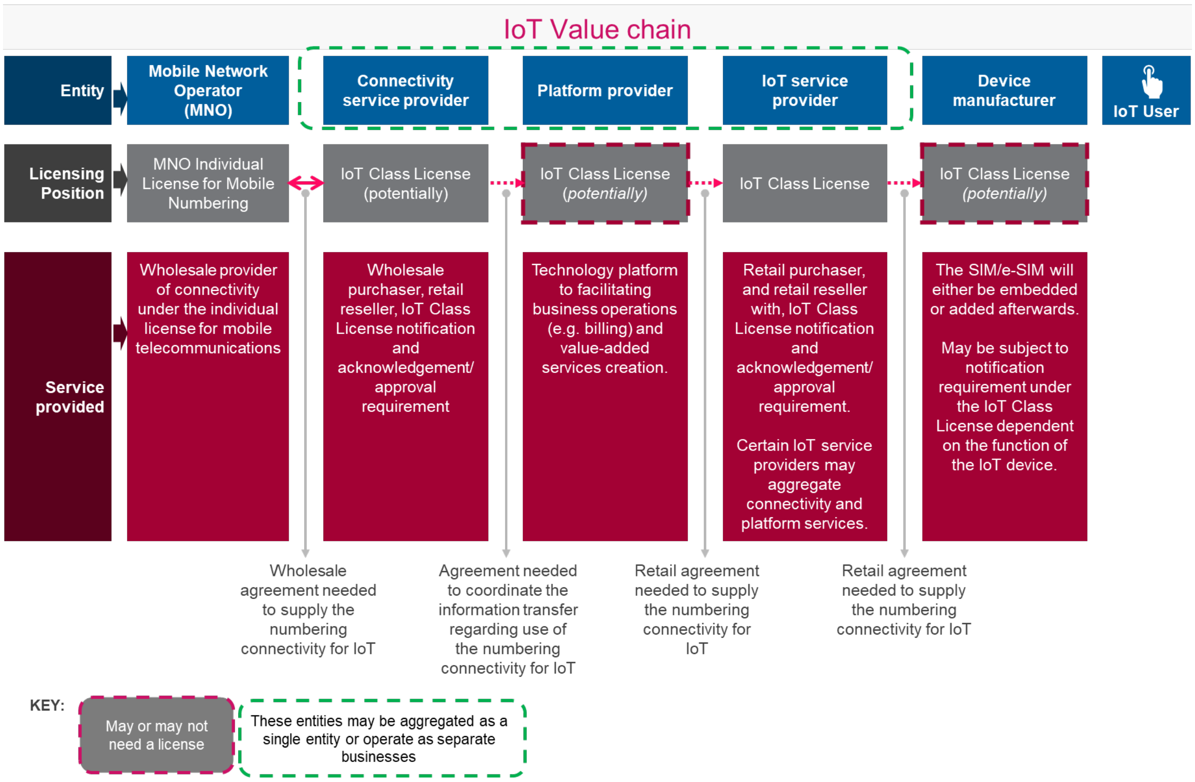
> Article 8: Unless otherwise expressly state in the National Numbering Plans or notified in writing bythe CRA, each Service Provider must: […]
>
> 8.19 only activate a SIM with a M2M or IoT Number for the provision of M2M or IoT Telecommunications Services.

The CRA would impose an obligation on the MNOs to monitor the use and deployment of allocatednumbering of the CSPs to prevent non-compliant usage. The CRA shall have the right to require the MNO to suspend services to a non-compliant CSP.

Permanent Roaming

The IoT Class License does not provide a right to the licensee to permanent roaming. However, nothing in the IoT Class License should prevent a licensee from negotiating or securing permanent roaming agreements with MNOs. Licensees would acknowledge this regulatory position and CRA oversight.

Figure 5: Applicability of the IoT Class License in the IoT Ecosystem



IoT Value chain

Entity	Mobile Network Operator (MNO)	Connectivity service provider	Platform provider	IoT service provider	Device manufacturer	IoT User
Licensing Position	MNO Individual License for Mobile Numbering	IoT Class License (potentially)	IoT Class License *(potentially)*	IoT Class License	IoT Class License *(potentially)*	
Service provided	Wholesale provider of connectivity under the individual license for mobile telecommunications	Wholesale purchaser, retail reseller, IoT Class License notification and acknowledgement/ approval requirement	Technology platform to facilitating business operations (e.g. billing) and value-added services creation.	Retail purchaser, and retail reseller with, IoT Class License notification and acknowledgement/ approval requirement. Certain IoT service providers may aggregate connectivity and platform services.	The SIM/e-SIM will either be embedded or added afterwards. May be subject to notification requirement under the IoT Class License dependent on the function of the IoT device.	

Wholesale agreement needed to supply the numbering connectivity for IoT

Agreement needed to coordinate the information transfer regarding use of the numbering connectivity for IoT

Retail agreement needed to supply the numbering connectivity for IoT

Retail agreement needed to supply the numbering connectivity for IoT

KEY:

May or may not need a license

These entities may be aggregated as a single entity or operate as separate businesses

The contractual “waterfall” (for example) may follow these lines:

1. **MNO** – wholesale provider of connectivity under a Class License for IoT;
2. **CSP** – wholesale purchaser, retail reseller with notification requirements under the ClassLicense for IoT;
3. **IoT Service Provider (*in some circumstances*)** – Retail purchaser, and retail reseller withnotification requirements under the Class License for IoT; and
4. **IoT Device Manufacturer/End Consumer** – Retail purchaser of IoT connectivity either as indirect or direct, may be subject to notification requirement.

CSP

As purchasers of IoT connectivity under the IoT Class License, the CSPs could then provide:

1. connectivity on a retail basis to IoT providers; or
2. directly to IoT device manufacturers; or
3. directly to end users.

The IoT Class License meets the obligations of the Art 9 License Requirements under chapter 3 ofthe Telecommunication Law No (34) of 2006, to obtain a license prior to providingtelecommunication services to the public.

To comply with the notification requirements for the IoT Class License CSPs prior to providing anyconnectivity service would need to:

1. provide notification and receive acknowledgement from the CRA for the provision within thedefined eligible uses under the IoT Class License; or
2. in the case of a new “other” use, the CSP shall notify the CRA and provide all requested information and receive approval from the CRA.

As noted above, the option of “other” use in the notification process for CRA approval, would flag new IoT developments within Qatar.

IoT Service Provider

There may develop a market where CSPs act as intermediaries in a longer contractual chain. Theonwards purchaser and reseller of connectivity services would be obligated to notify and receive acknowledgement or approval under the IoT Class License from the CRA as a license holder. Therefore, the CRA would have visibility of each connectivity provider. This meets the same obligations under the Art 9 License Requirements under chapter 3 of the Telecommunication Law No (34) of 2006.

End Consumer

The end user as the purchaser and user of the IoT device will need to be protected with the obligations imposed under the original IoT Class License for IoT as well as all applicable regulatoryobligations.

The end consumer may receive the IoT connectivity as an indirect service upon purchase of the IoT device (or subscription payment as bundle of associated services i.e., car connectivity along with other services). However, the end consumer should be provided with all reasonable required information and transparency documentation to ensure they are informed of their rights and obligations while using the IoT connected devices.

5.2. Pilot programs and sandboxes

Pilot programs and regulatory sandboxes could be instrumental for driving the adoption of emerging technologies in Qatar. They offer significant benefits, such as fostering innovation, ensuring regulatory compliance, boosting economic growth, and enhancing consumer trust. These initiatives are essential for deploying IoT technologies, as they can provide a controlled environment for testing and refining new innovations while ensuring they meet regulatory standards.

It is anticipated that industry will take a lead in the definition of sandboxes. With the CRA's active involvement, the country can effectively leverage these tools to build a dynamic and resilient technological landscape.

5.3. Public-private partnerships

As related to the IoT infrastructure deployment, public-private partnerships can support substantially and leverage resources, share expertise, and ensure that connectivity solutions meet the needs of consumers, businesses, and regulatory bodies alike.

6 Public Consultation Questionnaire

Taking into account the IoT ecosystem and focus areas requiring attention highlighted in this position paper, we request your response to the following questionnaire as detailed below. Readers may respond to the individual questions within this section and share their feedback, insights, and suggestions via email to the designated CRA focal points.

1. Regulatory Framework for IoT:

General Licensing Structure:

- Do you agree with CRA’s consideration of IoT Class License which would include requirements for notification, consumer protection and regulatory compliance?

- Do you agree with CRA’s consideration of appointing a local representative in Qatar for IoT service providers?

2. Connectivity Market Provision:

Role of Dedicated IoT Connectivity Providers:

- Do you agree with the potential role and regulation of wholesale connectivity providers (MNOs) dedicated to IoT services?

Network Access and Fair Competition:

- Do you think there is a requirement for MNOs to provide equal access to network capacity for third-party service providers, and to offer this with fair pricing?

3. Type Approval and Equipment Certification:

Device Certification:

- Do you agree that all IoT devices sold or used in Qatar should meet CRA certification standards to maintain network integrity and security?

Approval Process:

- Do you have any feedback on the proposed type of approval process, including the responsibilities of suppliers and possible exemptions?

4. Consumer Protection:

Transparency and Rights:

- Do you agree there is a need for enhanced transparency in IoT services, including clear communication about device capabilities, data collection practices, and consumer rights?

Redress Mechanisms:

- Do you agree that complaint and redressal mechanisms for IoT consumers should be outlined within the Class License or as a separate recommendation for the existing Qatar Consumer Laws?

5. Permanent Roaming and International Connectivity:

Roaming Regulations:

- Should the inbound roaming for IoT devices in Qatar be capped for a period of 90 days?

International Numbering:

- Please provide your feedback on the use of international numbers and the conditions for roaming with such numbers as described in this document.

6. Spectrum Management and IPv6 Adoption:

Spectrum Allocation:

- Please provide your feedback and suggestions for CRA for the potential adjustments to the spectrum plan to accommodate increased IoT use cases and the promotion of IPv6 adoption for IoT services.

Dual-stack IPv4/6 Standards:

- Please provide your suggestions around mandating dual-stack IPv4/6 standards for all new or imported IoT devices.

7. Interoperability and Standards:

Device Interoperability:

- Do you have any feedback on establishing interoperability standards to ensure seamless communication between devices from different manufacturers?

Guidelines for Standard Protocols:

- Do you agree with promoting the adoption of internationally accepted communication protocols like MQTT, HTTPS, and CoAP?

8. Public Awareness and Capacity Building:

Awareness Campaigns:

- Please provide your feedback on potential initiatives to raise public awareness and understanding of IoT technologies, including risks, opportunities, and best practices.

Skill Development:

- CRA understands the shortage of skilled professionals in the IoT domain. Do you have any suggestions around the potential steps that the CRA can undertake to address this issue?

9. Pilot Programs and Regulatory Sandboxes:

Innovation Testing:

- Are you content with the idea of exploring the implementation of pilot programs and regulatory sandboxes to test and refine IoT innovations while ensuring they meet regulatory standards?

- Please provide any additional pilot programs or initiatives that CRA should consider.

10. Public-Private Partnerships:

Collaboration Models:

- What are your thoughts on fostering public-private partnerships to leverage resources and share expertise for IoT infrastructure deployment?

11. Additional Comments:

- Please provide or suggest any additional use cases that you believe may be beneficial for either you organization or for Qatar.

- Do you believe that there are any specific challenges in the IoT supply chain where CRA can intervene and facilitate, for example, bottlenecks in the approval process, limited presence of leading global IoT vendors in Qatar, and so on?

- Please provide any other suggestions or feedback that you may have and would like CRA to consider.

These topics will help ensure that the regulatory framework developed is comprehensive, addresses the concerns of all stakeholders, and is aligned with both national objectives and international best practices. Public consultation on these areas will provide valuable input and help shape effective IoT regulations in Qatar.

7 Conclusion

The rapid evolution of IoT technologies presents both unprecedented opportunities and significant challenges for Qatar. As the country strides towards its vision of becoming a knowledge-based economy and global digital hub, the integration of IoT into its infrastructure, industries, and everyday life is inevitable and transformative. The key elements of the IoT regulatory framework as outlined in this paper are seen critical in ensuring that the deployment and expansion of IoT technologies in Qatar are conducted in a manner that aligns with national strategic goals, international standards, and the well-being of its citizens.

By establishing a forward-looking and flexible regulatory environment, CRA aims to foster innovation while safeguarding the interests of all stakeholders. This includes promoting competition, ensuring the security and privacy of data, protecting consumers, and maintaining the integrity of Qatar's telecommunications infrastructure. The proposed IoT regulatory framework is designed to be both comprehensive and adaptive, addressing current needs while being sufficiently robust to accommodate future technological advancements.

The CRA recognizes that IoT is not just a technological innovation; it is a catalyst for economic diversification, environmental sustainability, improved quality of life and stimulating investment, both local and foreign. As such, the CRA is committed to working collaboratively with all stakeholders, including government entities, private sector players, and the wider community, to implement this regulatory framework effectively.

Moreover, by encouraging public-private partnerships, supporting pilot programs and regulatory sandboxes, and ensuring clear and enforceable guidelines, Qatar is positioning itself as a leader in the global IoT landscape. The CRA's proactive approach to regulation aims to create an environment where IoT can thrive, driving progress towards Qatar's national development goals.

In conclusion, the CRA's strategic vision for IoT regulation in Qatar is both ambitious and necessary. It is designed to harness the full potential of IoT technologies, ensuring that their deployment contributes positively to the nation's development while mitigating any associated risks. As the regulatory framework evolves, the CRA will continue to engage with stakeholders to refine and adapt its approach, ensuring that Qatar remains at the forefront of technological innovation and regulatory best practices.