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**APT REPORT ON**

**SURVEY ON CURRENT STATUS AND FUTURE PLAN OF IMPLEMENTATION AND DEPLOYMENT OF INTERNET OF THINGS IN ASIA-PACIFIC COUNTRIES**

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**APT Report on**

**survey on current status and future plan of implementation and deployment of Internet of Things in Asia pacific countries**

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# Introduction

IoT defined as a global infrastructure for the information society, enabling advanced services by interconnecting things based on existing and evolving interoperable information and communication technologies.

The goal of the IoT is to enable things to be connected anytime, anyplace, with anything and anyone ideally using any path/network and any service. Analysts predict that new IoT products and services will grow exponentially in next few years. IoT, as an industry, is still nascent, but that hasn’t stopped many tech companies from developing IoT devices, software and systems.

In many countries, especially Technology developed countries including some APT members country, the enterprises, institutions of higher learning, research centers and individual professionals have taken up the idea of IoT. There is a dramatic race to pick up and adopt IoT with the enthusiasm that was not seen in the past decade. Some countries provided a detailed plan for the implementation and deployment of IoT. These countries are integrating IoT in their day to day activities.

The ITU-R Radio Assembly 2015 (RA-15) has recognized that the globally connected world of IoT builds on the connectivity and functionality made possible by Radiocommunication networks and that the growing number of IoT applications may require enhanced transmission speed, device connectivity, and energy efficiency to accommodate the significant amounts of data among a plethora of devices. RA-15 has approved Resolution 66 on the “Studies related to wireless systems and applications for the development of the Internet of Things”, and resolved to conduct studies on the technical and operational aspects of radio networks and systems for IoT in collaboration with ITU-T and relevant standards development organizations.

In general, IoT industrial ecosystem has two major networking landscapes: (i) unlicensed spectrum (e.g. LoRa, Sigfox) relying on shared-spectrum; and (ii) licensed spectrum with 3GPP standards (e.g. NB-IoT) relying on harmonised IMT exclusive spectrum.

In response to Resolution 66, ITU has adopted a comprehensive report dedicated to LPWAN as non-cellular IoT networks relying on spectrum harmonised for SRD operation (ITU-R SM.2423 on “Technical and operational aspects of low-power wide-area networks for machine-type communication and the Internet of Things in frequency ranges harmonised for SRD operation”).

ITU-R WRC-15 has set WRC-19 agenda including agenda item 9.1.8 on IoT and MTC under WP-5D as the lead group. Issue (3) of the Annex to Resolution **958 (WRC-15)** resolved to conduct urgent studies in preparation for WRC-19 on “*Studies on the technical and operational aspects of radio networks and systems, as well as spectrum needed, including possible harmonized use of spectrum to support the implementation of narrowband and broadband machine-type communication infrastructures, in order to develop Recommendations, Reports and/or Handbooks, as appropriate, and to take appropriate actions within the ITU Radiocommunication Sector (ITU-R) scope of work.*”

# Abbreviations

APT Asia-Pacific Telecommunity

AWG APT Wireless Group

EIRP Equivalent Isotopically Radiated Power

3GPP 3rd Generation Partnership Project

GURL-SRD General User Radio License for Short Range devices

IoT Internet of Things

IMT International Mobile Telecommunication

IP Internet Protocol

ITU International Telecommunication Union

LPWA Low Power Wide Area

LPWAN Low Power Wide Area Network

LTE Long-Term Evolution

LTE-M Long-Term Evolution for Machine

MTC Machine Type Communications

NB-IoT Narrowband Internet of Things

SCADA Supervisory Control and Data Acquisition

SMEs Small and Medium Enterprises

SRD Short Range Device

RFID Radio Frequency Identification

TG-IoT IoT Task Group

# Scope

IoT is a new form of interactions between devices and applications, or among devices, that do not necessarily require human interaction. Such MTC is also about collecting and distributing data, in real-time or non-real-time, managing connected devices, providing fitting connectivity. With a wide range of potential applications, MTC/IoT is gaining an interest among network/service providers, devices makers, vertical industries, entrepreneurs, start-ups, and SMEs.

In-order to achieve one of the terms of reference made at the AWG-22 meeting for the TG-IoT on “information about IoT on current status of regulation and frequency use in Asia-Pacific region, relevant technical standards, technical evolving trends, and studies upon IoT in relevant international and regional organisation”, the TG-IoT initiated a questionnaire on “Current Status and Future Plan of Implementation and Development of IoT in Asia Pacific Countries”.

This report is based on the feedbacks for the mentioned questionnaire from Administrations listed below.

AWG-23-INP-13 from Australia

AWG-23-INP-16 from Iran

AWG-23-INP-25 from New Zealand (NZ)

AWG-23-INP-34 from Papua New Guinea (PNG)

AWG-23-INP-45 from the Republic of Korea

AWG-23-INP-69 from Vietnam

AWG-23-INP-74 from Thailand

AWG-23-INP-77 from Japan

AWG-23-INP-108 from Bangladesh

AWG-23-INP-115 from Malaysia / AWG-24-INP-35 from Malaysia

AWG-24-INP-49 from India

AWG-24-INP-50 from Ericsson Thailand and Ericsson Vietnam

AWG-25-INP-44 from the Republic of Korea

AWG-26-INP-15 from Japan

AWG-25-INP-42 from the People’s Republic of China

# IoT Applications

IoT is the next step in automation in almost every field including home automation, automation of healthcare devices over IP networks. IoT applications are limitless, however there are several key vertical markets which are emerging as areas where it is likely to scale first, offering major benefits for people and businesses alike.

|  |
| --- |
| ***Survey Question 2:*** Which type of IoT applications have been deployed in your country? Please provide any other IoT categories should it not listed in the table below.  ***Survey Question 15:*** Which type of IoT applications (e.g. Smart cities, Smart industry, Smart agriculture, Healthcare, etc) are intended/planned to be deployed in your country? Please provide any other IoT categories should it not listed in the table below. |

Table 1 Type of IoT applications deployed

| **Category** | **Example of Use Cases** | **Very Popular** | **Popular** | **Rare** | **Non** |
| --- | --- | --- | --- | --- | --- |
| Smart City | * Street lights management |  | Japan | Bangladesh  Iran  Malaysia  NZ  Thailand  Vietnam | PNG |
| * Road and structure sensors |  | Japan | Bangladesh  Iran  Malaysia  NZ  Thailand  Vietnam | PNG |
| * Waste management |  |  | Bangladesh  Iran  Japan  Malaysia  Thailand  Vietnam | NZ  PNG |
| * Automatic locker |  | Japan |  |  |
| * Bending machine monitoring and payment control | Japan |  |  |  |
| * Water leak detector |  | Japan |  |  |
|  | * Vending machines |  | India |  |  |
| Smart Home | * Water leak detector |  |  | Bangladesh  Japan  Malaysia  PNG  Thailand  Vietnam | NZ |
| * Smart lighting |  |  | Bangladesh  Japan  Malaysia  NZ  PNG  Thailand  Vietnam |  |
| * Video entry phone with internet connection |  | Japan  India |  |  |
| * Air conditioning management |  | Japan |  |  |
| * Smart metering |  | India |  |  |
| Smart Agriculture | * Animal monitoring |  | Iran  Japan | Malaysia  NZ  Thailand  Vietnam | Bangladesh  PNG |
| * Crop management |  | Iran  Japan | Malaysia  Thailand  Vietnam | Bangladesh  NZ  PNG |
| Smart Transportation | * Traffic management | Japan | Iran  NZ | Bangladesh  Malaysia  Thailand  Vietnam | PNG |
| * Parking management | Japan | Iran  NZ | Bangladesh  Malaysia  Thailand  Vietnam | PNG |
| * Billboard monitoring |  | Iran  Japan  NZ | Bangladesh  Malaysia  Thailand  Vietnam | PNG |
| Smart Environment | * Measure level of water and flow | Japan | Bangladesh  Iran | Malaysia  NZ  Thailand  Vietnam | PNG |
| * Air quality monitoring | Japan | Bangladesh  Iran | Malaysia  NZ  Thailand  Vietnam | PNG |
| * Electricity Metering |  | NZ  Vietnam |  |  |
| * Earthquake monitoring and alarm | Japan |  |  |  |
| * Meteorological observation | Japan |  |  |  |
| Smart Industry | * Product management |  | Japan  Thailand | Bangladesh  Iran  Malaysia  NZ  PNG  Vietnam |  |
| * Energy saving |  | Japan  Thailand | Bangladesh  Iran  Malaysia  NZ  PNG  Vietnam |  |
| * Product tracking |  | Japan  Thailand | Bangladesh  Iran  Malaysia  NZ  PNG  Vietnam |  |
| Healthcare | * Fall assistant |  | Japan  India | Bangladesh  Iran  Malaysia  Thailand  Vietnam | NZ  PNG |
| * E-health |  | Japan  India | Bangladesh  Iran  Malaysia  NZ  Thailand  Vietnam | PNG |
| * Fitness trackers |  | NZ  India |  |  |

Table 2 Type of IoT applications intended to be deployed

| **Category** | **To Implement** | **Country** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bangladesh** | **India** | **Korea** | **Malaysia** | **PNG** | **Thailand** | **Vietnam** |
| Smart City | Yes/No | Not yet defined | Yes | Yes | Yes |  | Yes | Yes |
| Timeline | Not yet defined |  | 2020 | N/A |  | 2017 | On-going |
| Smart Home | Yes/No | Not yet defined | Yes |  | Yes |  | Yes | Yes |
| Timeline | Not yet defined |  |  | N/A |  | 2017 | On-going |
| Smart Agriculture | Yes/No | Not yet defined | Yes |  | Yes | Yes | Yes | Yes |
| Timeline | Not yet defined |  |  | N/A |  | 2017 | On-going |
| Smart Transportation | Yes/No | Not yet defined | Yes |  | Yes |  | Yes | Yes |
| Timeline | Not yet defined |  |  | N/A |  | 2015 | On-going |
| Smart Environment | Yes/No | Not yet defined | Yes |  | Yes |  | Yes | Yes |
| Timeline | Not yet defined |  |  | N/A |  | 2017 | On-going |
| Smart Industry | Yes/No | Not yet defined | Yes |  | Yes |  | Yes | Yes |
| Timeline | Not yet defined |  |  | N/A |  | 2018 | On-going |
| Healthcare | Yes/No | Not yet defined | Yes |  | Yes | Yes | Yes | Yes |
| Timeline | Not yet defined |  |  | N/A |  | 2018 | On-going |

# Non-cellular IoT: LPWAN, ZigBee, RFID

IoT applications share specific connectivity and equipment requirements such as long range, low data rate, low energy consumption and cost effectiveness. The widely used short-range radio technologies (e.g. ZigBee, Bluetooth, RFID) can be used but not for scenarios that require long range transmissions. Therefore, IoT applications’ requirements have driven the emergence of a new wireless communication technology, LPWAN.

## Non-cellular IoT Implementation and Deployment Status

|  |
| --- |
| ***Survey Question 1:*** Is there any IoT implementation and deployment in your country? If yes, please describe.  ***Survey Question 14:*** Do you have plan to implement any other application (except those mentioned in question 1) and/or allow IoT deployment in your country? |

Table 3 Current status and future deployment plans for non-cellular IoT

| **APT Member Country** | **Current status** | **Future plan** |
| --- | --- | --- |
| Australia | * Existing [class licensed](https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Class-licences) (analogous to unlicensed in other countries) smart metering applications in the 915-928 MHz frequency band * Expanding LPWAN for industrial sensing, monitoring and switching applications in the 928-935 MHz frequency band   Numerous other frequency bands and services are used for IoT deployments including WiFi, fixed point-to-point, point-to-multipoint, land mobile and satellite services[[1]](#footnote-1). | NIL |
| Bangladesh |  | Not yet decide |
| China |  | None at this stage |
| India | The leading service providers in the country are currently carrying trials in LoRa based IoT deployments. LoRa based IoT solutions for enterprises are already operational in India. | The National Digital Communication Policy 2018 recognizes the need for IoT/ M2M connectivity services in sectors including Agriculture, Smart Cities, Intelligent Transport Networks, Multimodal Logistics, Smart Electricity Meter, Consumer Durables etc. |
| Iran | 1. *Metering of power consumption:*   Operation of the network has started two years ago and its purpose is gathering information from energy metering devices. Type of the network is LoRaWAN. This network has been developed in two major cities including Tehran and Isfahan. Almost 20,000 devices installed at this project.   1. *IoT in Agriculture field:*   The objective of the project is improving productivity of land by better management of irrigation. It is done by measurement of soil moisture, air temperature, air pressure, wind speed and direction as well as sunlight. The land area is about 100 km2.   1. *Tracking transportation goods between customs (RFID field)*   The project has run by customs administration for better supervision and controlling of vehicles that are carrying goods between customs by tracking through RFID networks. This project improves customs process from the point of saving transportation time and cost. | No |
| Japan | Several radio communication systems relating to the IoT are deployed, for example, SIGFOX, LoRa, Wi-Fi, Wi-Fi HaLow, Wi-SUN, ZigBee, and Bluetooth. | No |
| Korea | From the IoT Association’s survey results conducted at the first half year in 2018, 232 kinds of IoT services implemented in the Republic of Korea | NIL |
| Malaysia | There are IoT implementations and deployments in Malaysia, i.e power industry, medical industry, etc. | Yes, plan to implement smart grid/utilities for power and water |
| NZ | There are numerous deployments of IoT network in New Zealand using a range of technologies, including LoRa/LPWAN systems. | No |
| PNG | Very limited applications for private use. No public implementations | Yet to be determined |
| Thailand | There are trials and deployment of LPWAN, and IoT using Short-Range Devices. The applications include smart home, precision farming, healthcare, and logistics. | Yes |
| Vietnam |  | Not yet |

## Regulatory Framework for Non-cellular IoT

An appropriate regulatory framework plays an important role in IoT development. Therefore, it is essential for the administration to put in place an appropriate regulatory framework for IoT solutions and services based on unlicensed spectrum band(s), to promote innovation through the development of IoT solutions such as LPWAN technology.

### Applicable Licensing Regime for Non-cellular IoT

|  |
| --- |
| ***Survey Question 3:*** Is there any regulatory licensing regime applied on IoT (operator) in your country? (e.g. spectrum license, network license, etc) If yes, please indicate what kind of license.  ***Survey Question 4:*** Do you impose license fee and/or spectrum fee for IoT?  ***Survey Question 5:*** How many IoT operator for each license are currently operating in your country? Please describe for each license issued.  ***Survey Question 16:*** Do you intend/plan to impose licensing regime and other regulation(s) on IoT (operator)? If yes, please describe in detail for each application mentioned above. |

Table 4 Licensing Regime for non-cellular IoT

| **APT Member Country** | **Licensing Regime Applicable for non-cellular IoT**  **(e.g. Spectrum License, Network License)** |
| --- | --- |
| Australia | All licence types apply, e.g. to facilitate the applications listed under section 3:   * Existing industrial sensing and control links and networks are authorized through conventional [apparatus licensing](http://archive.acma.gov.au/WEB/STANDARD/pc=PC_1292) (per device licensing) regime * Sensing, metering monitoring and switching applications (generally) authorised through [class licensing](https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Class-licences) regime |
| Bangladesh | Till now there is no licensing regime applied on IoT in our country but an instruction regarding importing IoT Device and providing IoT services to the clients in standalone made (i.e smart buildings etc.). |
| India | There are no IoT specific regulatory licensing regime applicable in India. However, DoT is contemplating to introduce M2M Service Provider registration process wherein all such entities who intend to provide M2M/IoT based services have to register with DoT (no need of license to provide such services). The existing Licensees of DoT can provide M2M/IoT application-based services but they also have to register for separate M2M Service Provider registration process being formulated by DoT. DoT is also contemplating to introduce new soft touch license for the connectivity providers using LPWAN technology. |
| Iran | A class license for IoT devices the same as SRD devices. The license is including some regulations such as allowed radio channels, power transmitter limitation and other specifications, IoT devices should consider these regulations and the license is public. IoT networks before establishing and running should be notified to the regulatory |
| Japan | Licensing regime generally applies radio stations or equipment including that for the IoT.   1. A license for a radio station or equipment with specific spectrum channel assignment. 2. A blanket license that covers specified radio stations within an operator. 3. The Technical Regulations Conformity Certification System can be applied for specified radio station or equipment. It will not require a license. |
| Korea | A variety of MTC/IoT services have been deployed in the license-exempt bands (see Annex A). |
| Malaysia | Network Facility Provider (Individual) License (NFP-I), Network Service Provider (Individual) License (NSP-I). IoT spectrum usage is provided under Class Assignment (unlicensed). |
| NZ | Any operator can deploy IoT network and provide services and it is not compulsory to obtain a “network operator” status in New Zealand. However, IoT operators could choose to become a “network operator” if one requires special rights to carry out a telecommunication business, including land access for laying lines or constructing telecommunication facilities.  For IoT network based on LoRa and LPWAN systems, these networks typically operate within frequency bands permitted under GURL-SRD. This GURL provides for certain classes of radio transmitters to be used without the need for the user to obtain an individual licence in New Zealand. This is similar to a licence-exempt regime where frequency use is on a no-interference no-protection basis. |
| PNG | Operator licenses – General license for ICT infrastructure  Spectrum License – Required for utilization of licensed Radio frequency |
| Thailand | Equipment Licenses and Telecommunication Network/Service Licenses |
| Vietnam | IoT applications use unlicensed spectrum.  For the IoT devices operating on unlicensed spectrum, they must comply with our regulation on technical and operational requirements. The operation of IoT devices in unlicensed spectrum is on a non-interference and non-protected basis. |

Table 5 Licence/Spectrum fee and Number of licence issued for non-cellular IoT

| **Country** | **Impose licence fee and/or spectrum fee for non-cellular IoT** | **Number of licensed non-cellular IoT operator** |
| --- | --- | --- |
| Australia | * Class licensed devices pay no fee | Operations authorised under a class licence do not require any interaction with the administration (analogous to unlicensed use in other countries), so devices/systems are not registered. It is therefore not possible to provide an estimate of how many IoT operators are licensed within Australia. |
| Bangladesh | No | N/A |
| China | Spectrum License: Not Free；  Radio Station License: Free. | 3 |
| India | There are no IoT specific license fee, or spectrum allocation in India. Telecom service providers may deliver IoT services using their existing licenses under non-interference and no protection basis. | N/A |
| Iran | The IoT networks that are included the class license, we don’t impose any fee. | There isn't any IoT operator in Iran. |
| Japan | Each license holder shall pay for a usage fee for spectrum. | Because IoT operator is not listed on the current licensee category, this item is under survey. |
| Korea | No | There is no dedicated IoT operator in Korea. |
| Malaysia | No fees are imposed for Class Assignment (unlicensed bands). |  |
| NZ | For IoT network based on LoRa and LPWAN systems, the use of frequency bands permitted under GURL-SRD is free of charge. | N/A |
| PNG | Operator and spectrum fees will be applicable | No commercial operators |
| Thailand | Fees are imposed for IoT systems with high power devices operating in unlicensed bands. | Three operators are requesting for IoT service licenses for systems operating in ISM bands. |
| Vietnam | IoT using unlicensed spectrum will be exempted from license and spectrum fee. | We have not issued any frequency band license for IoT operator yet. There is one operator to be granted frequency channels usage license for smart metering.  For other kinds of license such as IoT network license or service license, it is under further consideration. |

Table 6 Plans on imposing licence and regulations for non-cellular IoT

| **Country** | **Licensing regime** | **Other regulations** |
| --- | --- | --- |
| Australia | No, apart from already described | No, apart from already described |
| Bangladesh | Not yet defined | Not yet defined |
| China | None at this stage | None at this stage |
| Korea | No | No |
| Malaysia | Yes, with reference to provisions in our Communications and Multimedia (Licensing) Regulations 2000. |  |
| NZ | No | No |
| PNG | Yet to be determined | Yet to be determined |
| Thailand | No current plan to issue licenses specific to applications. Only network/telecommunications service licenses are now applied. | |
| Viet Nam | N/A | N/A |

### Spectrum Policy for Non-cellular IoT

#### “Technology Neutral” Spectrum Policy for Non-cellular IoT

|  |
| --- |
| ***Survey Question 6:*** Do you apply or plan to apply ‘Technology Neutral’ spectrum policy for IoT? |

1. Australia

In general, yes, spectrum arrangements do not specify any technology types. However, the spectrum management arrangements that are in place for LPWA IoT are optimised to accommodate established or emerging technologies such that domestic industry and consumers can leverage economies of scale and keep pace with international developments.

Australia observes that there are myriad communications bearer types that can carry IoT application data at different levels. It is therefore somewhat nebulous and therefore difficult to list the frequency bands that carry IoT applications (to some extent, much of the spectrum could be in-part attributed to IoT in some way or another). The table below thus contains key examples only:

Table 7 Technologies adopted for each IoT category in Australia

| **Frequency Band Allocation** | **IoT Category (Examples)** | | **Type of Technologies (e.g. ZigBee, Wi-Fi, RFID, LPWA, etc)** |
| --- | --- | --- | --- |
| 915-928 MHz |  |  | Smart metering |
| Throughput | Low | ZigBee, RFID, LPWA |
| Latency | Mid-high | ZigBee, RFID, LPWA |
| Resiliency | Low | ZigBee, RFID, LPWA |
| Coverage | Long range | ZigBee, RFID, LPWA |
| 928-935 MHz | Throughput | Low | LPWA |
| Latency | High | LPWA |
| Resiliency | Mid | LPWA |
| Coverage | Long range | LPWA |
| 2400-2483 MHz/  5725-5875 MHz | Throughput | High | Wi-Fi |
| Latency | Low-mid | Wi-Fi |
| Resiliency | Low-mid | Wi-Fi |
| Coverage | Short range | Wi-Fi |

1. Bangladesh

Not yet.

Table 8 Technologies adopted for each IoT category in Bangladesh

| **Frequency Band Allocation** | **Type of Technologies (e.g. ZigBee, Wi-Fi, RFID, LPWA, etc)** |
| --- | --- |
| 818-824 MHz | General SRD |
| 863-869 MHz | General SRD |
| 922-925 MHz | RFID |
| 2400-2450 MHz | SRDs  RFID, Wi-Fi |
| 2450-2483.5 MHz | SRDs  RFID, Wi-Fi |
| 2483.5-2500 MHz | SRDs  RFID |
| 5725-5830 MHz | Wi-Fi, SRDs |
| 5830-5850 MHz | Wi-Fi, SRDs |
| 5850-5925 MHz | Wi-Fi, SRDs |

1. India

India is following a technology neutral approach for all services offered on spectrum bands auctioned. The Indian service providers are currently trialling LoRa based IoT solutions.

1. Iran

Technology neutral for:

* 433.05 – 434.79 MHz
* 863 – 875.8 MHz

1. Japan

No.

Table 9 Technologies adopted for each IoT category in Japan

| **Frequency Band Allocation** | **IoT Category** | | **Type of Technologies** |
| --- | --- | --- | --- |
| 13.56MHz | Throughput | Low | RFID |
| Latency | Low | RFID |
| Resiliency | Low | RFID |
| Coverage | Low | RFID |
| 920MHz | Throughput | Low | LoRa, RFID, SIGFOX, Wi-SUN, ZigBee |
| Mid | Wi-Fi HaLow |
| Latency | Low | ZigBee, RFID |
| Mid | Wi-Fi HaLow |
| High | LoRa, SIGFOX, Wi-SUN |
| Resiliency | Low | RFID, Wi-SUN |
| Mid | Wi-Fi HaLow, ZigBee |
| High | LoRa, SIGFOX |
| Coverage | Short range | RFID, Wi-Fi HaLow, Wi-SUN, ZigBee |
| Long range | LoRa, SIGFOX |
| 2.4GHz | Throughput | Low | ZigBee |
| Mid | Bluetooth |
| High | Wi-Fi |
| Latency | Low | ZigBee |
| Mid | Wi-Fi |
| High | Bluetooth |
| Resiliency | Low | Bluetooth |
| Mid | ZigBee, Wi-Fi |
| Coverage | Short range | ZigBee, Wi-Fi |
| 5GHz | Throughput | High | Wi-Fi |
| Latency | Low | Wi-Fi |
| Resiliency | Mid | Wi-Fi |
| Coverage | Short range | Wi-Fi |

1. Korea

In some cases, technical regulations described bandwidth, modulation type, class of emission, etc., but in other cases power and spurious emission are regulated in terms of technology neutrality, especially in ISM bands.

1. Malaysia

Yes.

1. NZ

Yes.

1. PNG

Yet to be determined.

1. Thailand

NBTC maintains its role to promote the principle of technology neutrality.

For unlicensed frequencies, the regulation is designed to support all technologies to coexist in the bands.

#### Spectrum Allocation for Non-cellular IoT

|  |
| --- |
| ***Survey Question 7:*** Do you allocate any spectrum for IoT applications, in term of shared or dedicated, license or unlicensed? If yes, please provide the frequency band(s), channel arrangement/bandwidth and related IoT applications.  ***Survey Question 17:*** Do you have any plan (or possibilities) to assign new frequency band(s) or to make available the existing frequency band(s) for IoT in the next five years (including shared and/or dedicated spectrum)? If yes, please provide the information on frequency band(s), bandwidth, technolog(ies), standards, applications and other regulations (If available). |

1. Australia

Yes, as noted above all scenarios are catered for in Australian spectrum arrangements. One specific example is the allocation in the 928-935 MHz frequency band to support LPWA networks. Authorisation will be via class licence from 2021 onwards. This means a fee will not be payable, and operators will be free to operate without interaction with the administration as long as they meet specific conditions of the class licence, being:

* Devices operated as fixed installations (not less than six months)
* Authorisation is on a non-exclusive basis (i.e. no protection from other authorised devices, accordingly users will need to make their own assessment of the suitability of these arrangements for their proposed applications)
* EIRP not to exceed 25 mW (14 dBm)
* Radiated PSD not to exceed -14.5 dBm/kHz
* Duty cycle limits to apply (TBD – likely to be 0.1% averaged over one hour on any given frequency).

1. Bangladesh

|  |  |
| --- | --- |
| **Frequency Band** | **Technology** |
| 922 – 924 MHz | RFID |
| 433.05 – 434.79 MHz | LPWA |
| 863 – 869 MHz | LPWA |

Not decided yet to assign new frequency band(s) in future.

1. China

None at this stage

1. India

No specific spectrum band is identified for IoT applications.

DoT is conscious of the fact that there are requirements of the IoT industry for more spectrum needs. The need to open up more unlicensed bands for deployment of applications / services (technology neutral) will be considered if there is demand for same from the industry.

1. Iran

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bands** | **License/unlicensed** | **Shared/dedicated** | **bandwidth** | **applications** |
| 169 MHz | Unlicensed | Shared | 75 KHz | Short range devices |
| 433 MHz | 1.74 MHz | Short range devices |
| 860 MHz | 12.8 MHz | Non-3GPP Long range devices |
| 5.8 GHz | 150 MHz | Short range devices |
| 2.4 GHz | 83.5 MHz | Short range devices |

1. Japan

The bands for ISM are already assigned unlicensed shared spectrum and can also partly be used for IoT device.

1. Korea

Reference to Annex A.

Under consideration on new frequency bands in future.

1. Malaysia

Yes, for unlicensed[[2]](#footnote-2).

No plan currently to assign new frequency bands or to make available existing frequency bands for specifically IoT applications.

1. NZ

New Zealand does not allocate specific spectrum for IoT applications. We are aware that certain operators may have their own preference toward using certain frequency bands due to harmonisation in international standards and the availability of equipment ecosystem.

At the conclusion of a recent review of VHF spectrum in 174-230 MHz, it was decided that a block of 10 MHz spectrum in the frequency range 210-220 MHz will be reserved for short-term IoT trial in New Zealand. The intention of the short-term trials is to provide a less restrictive environment for industry stakeholders to test various innovative IoT applications that are not necessarily standardised yet.

A final decision to permanently allow IoT application in the frequency range 210-220 MHz in the long term would subject to the scale of the trials and the eventual demand from industry after the end of the trial period.

1. PNG

Yet to be determine on spectrum allocation for IoT application.

Still under consideration on new frequency bands in future.

1. Thailand

|  |  |  |
| --- | --- | --- |
| **Spectrum** | **Share type** | **License** |
| 30-50 MHz | Shared | Unlicensed |
| 54-57 MHz | Shared | Unlicensed |
| 300-500 MHz | Shared | Unlicensed |
| 700 MHz | Shared | Unlicensed |
| 920-925 MHz | Shared | Unlicensed |

No plan to allocate exclusive frequency bands for IoT. However, IoT systems can operate in the bands newly allocated for unlicensed devices in the future.

1. Vietnam

We do not allocate any dedicate band for IoT applications. Almost the IoT applications are using unlicensed spectrum, except for machine to machine communication applications (smart electrical metering) using licensed frequency channel (400 MHz range and bandwidth around 50 kHz).

The table below lists the frequency bands which have been used widely by IoT applications.

|  |  |  |
| --- | --- | --- |
| **Type of unlicensed radio devices** | **FREQUENCY BAND** | |
| Radio telemetry devices | 433.05 ÷ 434.79 MHz | Unlicensed spectrum[[3]](#footnote-3) |
| Non-specific short-range devices | 918.4 ÷ 923 MHz |
| 2400 ÷ 2483.5 MHz |
| 5725 ÷ 5850 MHz |

#### Concerns of Allocating Spectrum for Non-cellular IoT Applications

|  |
| --- |
| ***Survey Question 8:*** Do you have any concern of allocating spectrum for IoT application, such as co-and-adjacent channel interference, spectrum sharing within the same frequency band? Please write your concerns for each of the relative frequency band(s). |

Table 10 Concerns of allocation spectrum for non-cellular IoT applications

| **Country** | **Concern of Allocating Spectrum for non-cellular IoT applications (e.g. co-and-adjacent channel interference, spectrum sharing)** |
| --- | --- |
| Australia | No. In the example provided above there is a trade-off between interference management and efficiency when it comes to sharing. The identification of specific frequencies for non-exclusive LPWA carries the unavoidable consequence of interference potential between IoT users. Duty cycle limits will help mitigate this, but interference potential is inevitable – technologies and protocols will need to be implemented that take account of this. |
| Bangladesh | Not yet defined |
| China | None at this stage. |
| India | At present there is no such plan. |
| Iran | Yes, according to answer to the question 7, IoT bands have shared with another service, therefore having harmful radio interferences is possible. Based on this concern, technical regulations should be considered. |
| Japan | In ISM bands, coexistence is the most concerns. Interoperability in the world wide is also concerned for spectrum assignment of radio station or equipment. |
| Korea | Most IoT services are provided on a shared basis of spectrum in the ISM bands. |
| Malaysia | Yes, there are a few concerns:   1. Adjacent band with licensed services 2. Sharing within same band for various IoT applications 3. Use of spectrum for IoT shall not impose any constraint to existing services |
| NZ | In New Zealand, the frequency band in 915-928 MHz is one of the popular frequency choices for IoT deployment based on LoRa and LPWAN systems. Due to the frequencies immediately below 915 MHz have been designated for commercial mobile network, we have imposed a specific out-of-band emission limit for short range devices (including IoT applications) operating within 915-928 MHz through a special condition under GURL-SRD. This special condition aims to afford adequate protection for the operation of commercial mobile network immediately below 915 MHz. |
| PNG | Yet to be determined |
| Thailand | Yes. The Office of NBTC has two major concerns as follows:   * Co-and-adjacent channel interference due to different technologies operating in unlicensed bands. * Fair spectrum access and occupancy from different IoT technologies. |
| Vietnam | We are concern about the potential of interference from IoT devices to licensed radio systems, especially the systems providing public mobile services in the frequency range 920 MHz.  Particularly, in Vietnam, IoT devices are allocated the band 918.4-923 MHz with the transmitter power restriction of 25 mW ERP. In the recent time, some companies requested the Government to increase the maximum of output transmit power from 25 mW ERP up to 100 mW ERP as well as shift the frequency band 918.4-923 MHz to 918.4-923.5 MHz. The changes in permitted frequency band or transmitter output power may cause harmful interference to mobile services in adjacent bands if the Government do not investigate compatibility studies before approval. |

### Current Technical Specification/Standards for Non-cellular IoT

|  |
| --- |
| ***Survey Question 9:*** What is technical specification/standards the IoT require to comply with? |

1. Australia

928-935 MHz frequency band allocated to support LPWA networks. Authorisation will be via class licence from 2021 onwards. This means a fee will not be payable, and operators will be free to operate without interaction with the administration as long as they meet specific conditions of the class licence, being:

* Devices operated as fixed installations (not less than six months)
* Authorisation is on a non-exclusive basis (i.e. no protection from other authorised devices, accordingly users will need to make their own assessment of the suitability of these arrangements for their proposed applications)
* EIRP not to exceed 25 mW (14 dBm)
* Radiated PSD not to exceed -14.5 dBm/kHz
* Duty cycle limits to apply (TBD – likely to be 0.1% averaged over one hour on any given frequency).

1. Bangladesh

Not yet defined

1. India

Not yet defined.

1. Iran

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency Band**  **(**MHz**)** | **Technology** | **Transmit Power (EIRP)** | **Spectrum Access Technique (e.g. Frequency hopping, Duty cycle, Listen before talk, etc)** | **Max Transmission Duration** | **Channel Bandwidth** | **Spurious Emission** | **Others (please specify)** |
| 169.4-169.475 | According to answer of question 6 | 500 mW e.r.p. |  | ≤ 1.0 % duty cycle | ≤ 50 kHz | ECC/DEC/(05)02 | |
| 433.05-434.79 | 10 mW e.r.p. |  | ≤ 10 % duty cycle | Not specified | ETSI EN 300 220 | |
| 863-875.8 | ERC REC. 70-03 | | | | | |
| 2400-2483.5 | 10 mW e.i.r.p | - | - | - | EN 300 440 | |
| 5725-5875 | 25 mW e.i.r.p | - | - | - | EN 300 440 | |

1. Japan

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency Band** | **Technology** | **Transmit Power (EIRP)** | **Spectrum Access Technique (e.g. Frequency hopping, Duty cycle, Listen before talk, etc)** | **Max Transmission Duration** | **Channel Bandwidth** | **Spurious Emission** | **Others (please specify)** |
| 13.56MHz | RF-ID |  |  |  |  |  |  |
| 312-315.25MHz | SRD | ≤ 250mW |  |  | ≤1000 kHz |  |  |
| 312-315.05MHz | SRD | ≤ 25mW |  |  | ≤1000 kHz |  |  |
| 426.025-426.1375 (12.5 kHz spacing) | SRD | ≤ 16.4 mW( |  |  | ≤ 8.5kHz |  |  |
| 426.0375-426.1125 (25 kHz spacing) | SRD | ≤ 16.4 mW( |  |  | > 8.5  ≤ 16 kHz |  |  |
| 429.175-429.7375 (12.5 kHz spacing) | SRD | ≤ 16.4 mW( | Carrier sence |  | ≤ 8.5kHz |  |  |
| 429.8125-429.9250 (12.5 kHz spacing) | SRD | ≤ 16.4 mW( | Carrier sence |  | ≤ 8.5kHz |  |  |
| 449.7125-449.8250 (12.5 kHz spacing) | SRD | ≤ 16.4 mW( | Carrier sence |  | ≤ 8.5kHz |  |  |
| 449.8375-449.8875 (12.5 kHz spacing) | SRD | ≤ 16.4 mW( | Carrier sence |  | ≤ 8.5kHz |  |  |
| 469.4375-469.4875 (12.5 kHz spacing) | SRD | ≤ 16.4 mW( | Carrier sence |  | ≤ 8.5kHz |  |  |
| 916-928 (100 kHz spacing) | SRD | ≤ 2 mW | Carrier sence |  | ≤ 200kHz |  |  |
| 920.6-928 (100 kHz spacing) | LoRa, SIGFOX | ≤ 40 mW | Carrier sence |  | ≤ 200kHz |  |  |
| 916.1-927.9 (100 kHz spacing) |  | ≤ 2 mW | Carrier sence |  | > 200 ≤ 400kHz |  |  |
| 920.7-927.9 (100 kHz spacing) |  | ≤ 40 mW | Carrier sence |  | > 200 ≤ 400kHz |  |  |
| 916.2-927.8 (100 kHz spacing) |  | ≤ 2 mW | Carrier sence |  | > 400 ≤ 600kHz |  |  |
| 920.8-927.8 (100 kHz spacing) |  | ≤ 40 mW | Carrier sence |  | > 400 ≤ 600kHz |  |  |
| 916.3-927.7  (100 kHz spacing) |  | ≤ 2 mW | Carrier sence |  | > 600 ≤ 800kHz |  |  |
| 920.9-927.7  (100 kHz spacing) |  | ≤ 40 mW | Carrier sence |  | > 600 ≤ 800kHz |  |  |
| 916.4-927.6  (100 kHz spacing) |  | ≤ 2 mW | Carrier sence |  | > 800 ≤ 1000kHz |  |  |
| 921.4-927.6  (100 kHz spacing) |  | ≤ 40 mW | Carrier sence |  | > 800 ≤ 1000kHz |  |  |
| 928.15-929.65  (100 kHz spacng) |  | ≤ 2 mW | Carrier sence |  | ≤ 100 kHz |  |  |
| 928.2-929.6  (100 kHz spacing) |  | ≤ 2 mW | Carrier sence |  | > 100 ≤ 200 kHz |  |  |
| 928.25-929.55  (100 kHz spacing) |  | ≤ 2 mW | Carrier sence |  | 200 ≤ 300 kHz |  |  |
| 928.3-929.5  (100 kHz spacing) |  | ≤ 2 mW | Carrier sence |  | 300 ≤ 400 kHz |  |  |
| 928.35-929.45  (100 kHz spacing) |  | ≤ 2 mW | Carrier sence |  | 400 ≤ 500 kHz |  |  |
| 1 216-1 217 (50 kHz spacing) |  | ≤ 16.4 mW | Carrier sence |  | ≤ 100kHz |  |  |
| 1 252-1 253 (50 kHz spacing) |  | ≤ 16.4 mW | Carrier sence |  | > 100 ≤ 200kHz |  |  |
| 1216.0125-1216.9875 (25 kHz spacing) |  | ≤ 16.4 mW | Carrier sence |  | > 200 ≤ 300kHz |  |  |
| 1252.0125-1252.9875 (25 kHz spacing) |  | ≤ 16.4 mW | Carrier sence |  | > 300 ≤ 400kHz |  |  |
| 1216.5375-1216.9875 (25 kHz spacing) |  | ≤ 16.4 mW | Carrier sence |  | > 400 ≤ 500kHz |  |  |
| 1252.5375-1252.9875 (25 kHz spacing) |  | ≤ 16.4 mW | Carrier sence |  | ≤ 16kHz |  |  |
| 917-927  (1MHz spacing) | Wi-Fi | ≤ 1 mW | Carrier sence |  |  |  |  |
| 920MHz | Wi-SUN |  | Carrier sence |  |  |  |  |
| RF-ID |  | Carrier sence | ≤ 1s |  |  |  |
| ≤ 100ms@duty10% |  |  |  |
|  | ≤ 100ms@duty0.1% |  |  |  |
| Wi-Fi | ≤ 1 mW (16 dBm) | Carrier sence |  |  |  |  |
| ZigBee |  | Carrier sence |  |  |  |  |
| 2 400-2 483.5MHz | Bluetooth | ≤ 4.9 mW/MHz | Frequency hopping |  | FH or FH/DS: ≤ 85.5 MHz |  |  |
| Wi-Fi | ≤ 16 mW/MHz | Carrier sence | ≤ 4ms | ≤ 26 MHz |  |  |
| ZigBee |  | Carrier sence |  |  |  |  |
| 5 150-5 250 MHz | Wi-Fi | 20 MHz system: ≤ 10 mW/MHz  40 MHz system: ≤ 5 mW/MHz | Dynamic Frequency Selection and Transmit Power Control are required for the key station. | ≤ 4ms | 20 MHz system:  ≤ 19 MHz 40 MHz system: ≤ 38 MHz |  | (indoor use only) |
| 5 150-5 350 MHz | Wi-Fi | 20 MHz system:  With TPC: ≤ 10 mW/MHz  Without TPC: ≤ 5 mW/MHz  40 MHz system:  With TPC: ≤ 5 mW/MHz  Without TPC: ≤ 2.5 mW/MH | Dynamic Frequency Selection and Transmit Power Control are required for the key station. |  | 20 MHz system:  ≤ 19 MHz 40 MHz system: ≤ 38 MHz |  | (indoor use only) |
| 5 470-5 725MHz | Wi-Fi | ≤ 50 mW/MHz (17 dBm/MHz) | Dynamic Frequency Selection and Transmit Power Control are required for the key station. |  | ≤ 19.7 MHz |  |  |
| 57-66 GHz | Wi-Fi | ≤ 10 mW (not specified) | Not required |  | ≤ 9 GHz |  |  |
| >  10 mW  ≤ 400 mW | Not required |  | ≤ 9 GHz |  |  |

1. Korea

Refer to Annex A

1. Malaysia

| **Frequency Band** | **Technology** | **Transmit Power (EIRP)** | **Spectrum Access Technique (e.g. Frequency hopping, Duty cycle, Listen before talk, etc)** | **Max Transmission Duration** | **Channel Bandwidth** | **Spurious Emission** | **Others (please specify)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 3155 kHz - 3400 kHz | Technology neutral | According to Malaysia’s Class Assignment (2nd Schedule) | | | | | |
| 6765 kHz - 6795 kHz |
| 10200 kHz - 11000 kHz |
| 13553 kHz - 13567 kHz |
| 26.957 MHz - 27.283 MHz |
| 40.660 MHz - 40.700 MHz |
| 87.5 MHz - 108 MHz |
| 433 MHz - 435 MHz |
| 916 MHz - 919 MHz |
| 919 MHz - 923 MHz |
| 923 MHz - 924 MHz |
| 1880 MHz - 1900 MHz |
| 2400 MHz - 2500 MHz |
| 5150 MHz - 5350 MHz |
| 5470 MHz - 5650 MHz |
| 5725 MHz - 5875 MHz |
| 24 GHz - 24.250 GHz |
| 57 GHz - 64 GHz |
| 76 GHz - 77 GHz |
| 122 GHz - 123 GHz |
| 244 GHz - 246 GHz |

1. NZ

Any transmitters operating in IoT network based on LoRa and LPWAN systems must confirm to the prescribed limits and standards that relates to the licence that they are operating under. In this case, IoT network operating within the frequency bands permitted under GURL-SRD shall meet the technical parameters and emission limits as laid out in the special condition of the GURL as well as the applicable standards prescribed in the New Zealand Radio Standards Notice.

1. PNG

None at this stage.

1. Thailand

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency Band** | **Technology** | **Transmit Power (EIRP)** | **Spectrum Access Technique (e.g. Frequency hopping, Duty cycle, listen before talk, etc)** | **Max Transmission Duration** | **Channel Bandwidth** | **Spurious Emission** | **Others (please specify)** |
| 920-925 MHz | Neutral | 500mW | DC at 10% or Frequency Hopping | 0.4 sec in 4 seconds | Maximum at 500 kHz | Following  ETSI EN 300 220-1 or FCC Part 15 |  |

1. Vietnam

| **Frequency Band** | **Technology** | **Transmit Power (EIRP)** | **Spectrum Access Technique (e.g. Frequency hopping, Duty cycle, Listen before talk, etc)** | **Max Transmission Duration** | **Channel Bandwidth** | **Spurious Emission** | **Others (please specify)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 433.05 ÷ 434.79 MHz | Technology neutrality | ≤ 10 mW ERP | N/A | N/A | N/A | ≥ 40 dBc at a distance of 3 m |  |
| 918.4 ÷ 923 MHz | Technology neutrality | ≤ 25 mW ERP | Yes | Duty cycle limitation of 1%. | N/A | According to spurious emission limit 2 |  |
| 2400 ÷ 2483.5 MHz | Technology neutrality | ≤ 10 mW EIRP for generic devices.  ≤ 100 mW EIRP and ≤ 100 mW/100KHz EIRP for devices using FHSS modulation or ≤ 10 mW/1MHz EIRP for devices using other spread modulations | N/A | N/A | N/A | According to spurious emission limit 2 |  |
| 5725 ÷ 5850 MHz | Technology neutrality | ≤ 25 mW EIRP | N/A | N/A | N/A | According to spurious emission limit 2 |  |

Note 2: Spurious emission limit 2

|  |  |  |
| --- | --- | --- |
| **Frequency (f)** | **Active mode** | **Standby mode** |
| 47 MHz ≤ f ≤ 74 MHz;  87.5 MHz ≤ f ≤ 118 MHz;  174 MHz ≤ f ≤ 230 MHz;  470 MHz ≤ f ≤ 862 MHz | -54 dBm (4nW) | -57 dBm (2nW) |
| In the other frequencies below 1000 MHz | -36 dBm (250nW) | -57 dBm (2nW) |
| In the frequency f ≥ 1000 MHz | -30 dBm (1µW) | -47 dBm (20nW) |

### Current Non-cellular IoT Deployment Conditions/Restrictions

|  |
| --- |
| ***Survey Question 10:*** Please provide the IoT deployment conditions/restrictions for each IoT technology mentioned in question 6 (reference Table):   * Approximately number of IoT devices are operated in each authorised frequency band. * Maximum deployment density for assumed typical use-cases. * Location of typical deployment. * Maximum expected speed for the typical mobility use-case.   ***Note:*** *Please complete one table for each technology.* |

1. Bangladesh

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No** | **IoT Technology** | **Authorized Frequency Bands / Frequencies** | **No. of Devices (in each band)** | **Max. Deployment Density Per km2 (typical use-case)** | **Location**  **of Use** | **Maximum Expected Speed** |
| 1 | RFID | 922-924 | 09 Approx Tag/Bar code Reader |  | Indoor large room (eg factory) | Fixed |
| 922-924 | 100+ Toll calculating RFID Device |  | Outdoor urban/ Outdoor rural | Fixed |

1. India

The deployment density is a function of the use case. The smart meters deployed currently in dense urban areas assume over 10,000 devices per square Km. Some other use cases like smart tracking has a different low value for the density

• Location of typical deployment.

• Maximum expected speed for the typical mobility use-case.

1. Iran

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **IoT Technology** | **Authorized Frequency Bands / Frequencies** | **No. of Devices (in each band)** | **Max. Deployment Density Per km2 (typical use-case)** | **Location**  **of Use** | **Maximum Expected Speed** |
| 1 | Zigbee | 2400-2483.5 | B | B | A, B, C, D |  |
| 5725-5875 | B | B | A, B, C, D |  |
| 2 | Wi-Fi | 2400-2483.5 | B | B | A, B, C, D |  |
| 5725-5875 | B | B | A, B, C, D |  |
| 3 | RFID | 433.05- 434.79169 | B | B | A, B, C, D |  |
| 2400-2483.5 | B | B | A, B, C, D |  |
| 5725-5875 | B | B | A, B, C, D |  |
| 4 | LPWA | 863-875.8 MHz | B | B | A, B, C, D |  |

1. Japan

This item is under survey.

1. Thailand

| **No.** | **IoT Technology** | **Authorized Frequency Bands / Frequencies** | **No. of Devices (in each band)** | **Max. Deployment** **Density Per km2 (typical use-case)** | **Location**  **of Use** | **Maximum Expected Speed** |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Wi-Fi | 2.4-2.5 GHz | D | C | A,B | A,B,C |
| 5.725-5.850 GHz | Unknown | Unknown | A,B,C | A,B,C |
| 2 | RFID | 920-925 MHz | D | C | A,B,C | A,B,C |
| 433 MHz | Unknown | Unknown | A,B,C | A,B,C |
| 3 | LPWA | 920-925 MHz | B | C | C,D | A,B,C |

1. Vietnam

N/A

### Other Regulations Applicable to Non-cellular IoT

|  |
| --- |
| ***Survey Question 11:*** If there are other regulations, please describe. |

Table 11 Other regulations application for non-cellular IoT

|  |  |
| --- | --- |
| **Country** | **Other Regulations Applicable for non-cellular IoT** |
| Bangladesh | Not yet decided |
| China | None at this stage. |
| Iran | No |
| India | N/A |
| Japan | Extremely low power radio stations and specified radio stations operating for a certain purpose and using radio equipment under certain conditions do not require a license. |
| Korea | No |
| Malaysia | None |
| New Zealand | N/A |
| Papua New Guinea | None at this stage |
| Thailand | No |
| Vietnam | N/A |

## Current Issues Encountered Relating to Non-cellular IoT Communication System

|  |
| --- |
| ***Survey Question 12:*** Is there any issue related to IoT communication system? |

Table 12 Issues encountered for non-cellular IoT

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Very Serious** | **Serious** | **Rare** | **No** |
| Congestion of frequency band | Malaysia | Iran  Thailand | NZ | PNG  Japan[[4]](#footnote-4)  Vietnam |
| Security | Iran | Malaysia  NZ  Thailand |  | PNG  Japan4  Vietnam |
| Performance |  | Iran | Malaysia  NZ  Thailand | Japan4  PNG  Vietnam |
| Interference between IoT and SRD/RFID/others within the same frequency band |  | Iran | Malaysia  NZ  Thailand  Vietnam | Japan4  PNG |
| Interference between IoT and services in the adjacent frequency band | Iran | Malaysia | NZ  Thailand | Japan4  PNG  Vietnam |

## Other Issues to be Addressed in Non-cellular IoT Implementation and Deployment

|  |
| --- |
| ***Survey Question 18:*** Is there any issue related to IoT communication system? |

Table 13 Issues to be addressed in non-cellular IoT implementation and deployment

| **Country** | **Issues to be addressed in non-cellular IoT implementation and deployment** |
| --- | --- |
| Australia | No |
| Bangladesh | N/A |
| China | None at this stage |
| India | * 1. The issue of data privacy, data protection, data security and data ownership in the IoT is of significant importance and deliberations around it with sharing of best practices and evolving a mechanism to deal with it may be considered for study in the region.   2. The interoperability of various IoT platforms and related applications to avoid creation of silos is possible only if we follow some standards based approach in such deployments. It is critical for smart city planners. Deliberations, suggestions and adoption of such standards based approach from the region on this aspect will boost the growth of IoT ecosystem.   3. Security of telecom networks is of vital importance and accordingly it is embedded in various standards related to telecom networks deployments. In IoT landscape also, security is equally critical, more so when we deal with billions of sensors and therefore we need to evolve secured communications protocols for M2M/ IoT as well. |
| Iran | 1. One of the top concerns in IoT projects is poor cybersecurity implementations in applications, networks, data and equipment, 2. Spectrum needs, 3. Conditions of IoT data storage, 4. Lack of Confidentiality, 5. Privacy. |
| Japan | No |
| Malaysia | No |
| New Zealand | No |
| Papua New Guinea | None at this stage |
| Thailand | Yes. The additional issues are follows:   1. interoperability among different technologies 2. privacy 3. redundancy of IoT infrastructure 4. class of critical applications |
| Vietnam | N/A |

# Cellular IoT

## Cellular IoT Implementation and Deployment Status

|  |
| --- |
| ***Survey Question 1:*** Is there any IoT implementation and deployment in your country? If yes, please describe.  ***Survey Question 14:*** Do you have plan to implement any other application (except those mentioned in question 1) and/or allow IoT deployment in your country? |

Table 14 Current status and future deployment plan for cellular IoT

| **APT Member Country** | **Current status** | **Future plan** |
| --- | --- | --- |
| Australia | * Existing industrial sensing and control links and networks (e.g. SCADA in 400 MHz and 800 MHz bands) * Expanding trials and deployments of 3GPP-standardised cellular IoT capabilities such as Cat M1 and NB-IoT on existing mobile networks | NIL |
| Bangladesh | IoT is an embedded system which is recently introduced in small scale like NMS for maintaining BTS, water/fuel level measurement system, smart home alarm systems etc. | Not yet decide |
| China | There are different types of IoT systems deployed in China, for example, NB-IoT, eMTC. | None at this stage |
| India | The leading service providers in the country are currently carrying trials in NB-IoT, eMTC based IoT deployments.  Many M2M/IoT solution providers in India are providing SIM based IoT services in collaboration with MNOs apart from using other unlicensed frequency bands for provision of services. | The National Digital Communication Policy 2018 recognizes the need for IoT/ M2M connectivity services in sectors including Agriculture, Smart Cities, Intelligent Transport Networks, Multimodal Logistics, Smart Electricity Meter, Consumer Durables etc. |
| Iran | NIL | No |
| Japan | Several radio communication systems relating to the IoT are deployed, for examples LTE, LTE-M, NB-IoT | No |
| Korea | 232 kinds of IoT services implemented in the Republic of Korea | NIL |
| Malaysia | There are IoT implementations and deployments in Malaysia, i.e power industry, medical industry and etc. | Yes, plan to implement smart grid/utilities for power and water |
| NZ | There are numerous deployments of IoT network in New Zealand using a range of technologies, including IMT systems. | No |
| PNG | Very limited applications for private use. No public implementations | Yet to be determined |
| Thailand | there are trials and deployment of Cellular NB-IoT. The applications include smart home, precision farming, healthcare, and logistics. | Yes |
| Vietnam | Almost IoT implementation in Vietnam is for private network or vertical sectors such as smart home, smart metering, smart card, smart agriculture. Notably, there is one private smart metering network with above 7 million of IoT devices has been implemented by electrical metering utilities for several years.  It was expected for Government to develop regulatory policy and standardized connectivity interfaces/platforms for IoT powering smart cities vision in next few years. | Not yet |

## Regulatory Framework for Cellular IoT

### Applicable Licensing Regime for Cellular IoT

|  |
| --- |
| ***Survey Question 3:*** Is there any regulatory licensing regime applied on IoT (operator) in your country? (e.g. spectrum license, network license, etc) If yes, please indicate what kind of license.  ***Survey Question 4:*** Do you impose license fee and/or spectrum fee for IoT?  ***Survey Question 5:*** How many IoT operator for each license are currently operating in your country? Please describe for each license issued.  ***Survey Question 16:*** Do you intend/plan to impose licensing regime and other regulation(s) on IoT (operator)? If yes, please describe in detail for each application mentioned above. |

Table 15 Licensing Regime for cellular IoT

| **Country** | **Licensing regime applicable for cellular IoT**  **(e.g. Spectrum License, Network License)** |
| --- | --- |
| Australia | All licence types apply, e.g. to facilitate the applications listed under section 3:   * Existing industrial sensing and control links and networks are authorized through conventional [apparatus licensing](http://archive.acma.gov.au/WEB/STANDARD/pc=PC_1292) (per device licensing) regime * 3GPP-standardised IoT on existing mobile networks captured under existing mobile network licences – generally under wide area [spectrum licensing](https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Spectrum-licences) regime |
| Bangladesh | Till now there is no licensing regime applied on IoT in our country but an instruction regarding importing IoT Device and providing IoT services to the clients in standalone made (i.e smart buildings etc.). |
| China | The Cellular IoT systems, include NB-IoT and eMTC, deployed in China. The administrations for them are as follow:  It is necessary to obtain the radio station license and radio spectrum license. |
| India | There are no IoT specific regulatory licensing regime applicable in India. However, DoT is contemplating to introduce M2M Service Provider registration process wherein all such entities who intend to provide M2M/IoT based services have to register with DoT (no need of license to provide such services). The existing Licensees of DoT can provide M2M/IoT application-based services but they also have to register for separate M2M Service Provider registration process being formulated by DoT. DoT is also contemplating to introduce new soft touch license for the connectivity providers using LPWAN technology. |
| Iran | The first section is license of mobile broadband operators. According to the license, operators can run narrow band IoT networks as a value-added service in their bands. |
| Japan | Licensing regime generally applies radio stations or equipment including that for the IoT.   1. A license for a radio station or equipment with specific spectrum channel assignment. 2. A blanket license that covers specified radio stations within an operator. 3. The Technical Regulations Conformity Certification System can be applied for specified radio station or equipment. It will not require a license. |
| Korea | A variety of MTC/IoT services have been deployed in the licensed bands granted to mobile communication operators based on LTE technologies (see Annex A). |
| Malaysia | Network Facility Provider (Individual) License (NFP-I), Network Service Provider (Individual) License (NSP-I). |
| New Zealand | Any operator can deploy IoT network and provide services and it is not compulsory to obtain a “network operator” status in New Zealand. However, IoT operators could choose to become a “network operator” if one requires special rights to carry out a telecommunication business, including land access for laying lines or constructing telecommunication facilities.  For IMT-based IoT deployed by mobile network operators, these networks typically operate within frequency bands of commercial mobile network where the necessary long-term spectrum rights have been assigned to those mobile network operators through competitive spectrum auction. In New Zealand, the spectrum rights are assigned on a technology-flexible approach where mobile network operators could manage their spectrum resources and choose to whether deploy IoT in some or all of those frequency bands. |
| Papua New Guinea | Operator licenses – General license for ICT infrastructure  Spectrum License – Required for utilization of licensed Radio frequency |
| Thailand | Equipment Licenses and Telecommunication Network/Service Licenses |
| Vietnam | IoT applications use licensed spectrum.  For IoT devices operating on licensed spectrum, the frequency channels (bands) licensing regime will be applied. Their operation will be protected from harmful interference. |

Table 16 Licence/spectrum fee and number of licence issued for cellular IoT

| **Country** | **Impose licence fee and/or spectrum fee for cellular IoT** | **Number of licensed cellular IoT operator** |
| --- | --- | --- |
| Australia | * Apparatus licensed systems pay an annual per-device or per-system fee * IoT operation on mobile networks is covered under existing spectrum licences, for which there is a fee payable for 15-year operation | In Australia, licenses are issued by service, rather than application. For example, an apparatus licence that authorises an industrial IoT application (e.g. SCADA) might be licensed as ‘fixed’ or ‘mobile’. |
| Bangladesh | No | N/A |
| China | Spectrum License: Not Free；  Radio Station License: Free. | 3 |
| India | There are no IoT specific license fee, or spectrum allocation in India. Telecom service providers may deliver IoT services using their existing licenses under non-interference and no protection basis. | N/A |
| Iran | No, we don’t impose any fee for IoT directly, in fact, the IoT networks have developed by the mobile broadband operators, we have received license fee when we issued the license them. | There isn't any IoT operator in Iran. It should be noted that all mobile broadband operators can provide all kind of narrow band IoT services. |
| Japan | Each license holder shall pay for a usage fee for spectrum. | Because IoT operator is not listed on the current licensee category, this item is under survey. |
| Korea | No | There is no dedicated IoT operator in Korea. |
| Malaysia | Spectrum fees are applicable for Apparatus and Spectrum Assignments (licensed bands). | Current mobile network operators are allowed to offer IoT applications. |
| NZ | For IMT-based IoT deployed by mobile network operators, the spectrum value (paid at auction) and the necessary spectrum licence fees would cover cost of spectrum access in deploying commercial mobile network. No additional fee would be charged when mobile network operators choose to deploy IoT within the same frequency bands of the commercial mobile network since IoT is considered as an application within the commercial mobile network. | N/A |
| PNG | Operator and spectrum fees will be applicable | No commercial operators |
| Thailand | Fees are imposed for IoT systems with exclusive use of spectrum | Five major IMT operators can deployed cellular IoT in the bands assigned with IMT licenses. |
| Vietnam | For IoT deployed in the licensed spectrum, the relevant organizations and individuals must pay for license fee and spectrum usage fee. | We have not issued any frequency band license for IoT operator yet. There is one operator to be granted frequency channels usage license for smart metering.  For other kinds of license such as IoT network license or service license, it is under further consideration. |

Table 17 Plans on imposing licence and regulations for cellular IoT

| **Country** | **Licensing regime** | **Other regulations** |
| --- | --- | --- |
| Australia | No, apart from already described | No, apart from already described |
| Bangladesh | Not yet defined | Not yet defined |
| Korea | No | No |
| Malaysia | Yes, with reference to provisions in our Communications and Multimedia (Licensing) Regulations 2000. |  |
| NZ | No | No |
| PNG | Yet to be determined | Yet to be determined |
| Thailand | No current plan to issue licenses specific to applications. Only network/telecommunications service licenses are now applied. | |
| Viet Nam | N/A | N/A |

### Spectrum Policy for Cellular IoT

#### “Technical Neutral” Spectrum Policy for Cellular IoT

|  |
| --- |
| ***Survey Question 6:*** Do you apply or plan to apply ‘Technology Neutral’ spectrum policy for IoT? |

1. Australia

In general, yes, spectrum arrangements do not specify any technology types. However, the spectrum management arrangements that are in place for LPWA IoT are optimised to accommodate established or emerging technologies such that domestic industry and consumers can leverage economies of scale and keep pace with international developments.

Australia observes that there are myriad communications bearer types that can carry IoT application data at different levels. It is therefore somewhat nebulous and therefore difficult to list the frequency bands that carry IoT applications (to some extent, much of the spectrum could be in-part attributed to IoT in some way or another). The table below thus contains key examples only:

| **Frequency Band Allocation** | **IoT Category (Examples)** | | **Type of Technologies (e.g. Cellular)** |
| --- | --- | --- | --- |
| Cellular bands (dedicated IoT frequency resources at operators’ discretion) | Throughput | Low-mid | Cellular (incl. NB-IoT, Cat-M1) |
| Latency | Low | Cellular (incl. NB-IoT, Cat-M1) |
| Resiliency | High | Cellular (incl. NB-IoT, Cat-M1) |
| Coverage | Wide area (short range, but with cellular topology) | Cellular (incl. NB-IoT, Cat-M1) |
|  |  |  |  |

1. Bangladesh

Not yet.

1. India

India is following a technology neutral approach for all services offered on spectrum bands auctioned. The Indian service providers are currently trialling NB-IoT and eMTC based IoT solutions.

1. Iran

Technology neutral for:

* 900, 1800, 2100 and 2600 MHz (as mobile broadband operator)

1. Japan

| **Frequency Band Allocation** | **IoT Category** | | **Type of Technologies** |
| --- | --- | --- | --- |
| 700MHz, 800MHz, 900MHz, 1.5GHz, 1.7GHz, 2.1GHz, 3.5GHz | Throughput | Low | NB-IoT |
| Mid | LTE-M |
| High | LTE |
| Latency | Low | LTE |
| Mid | LTE-M |
| High | NB-IoT |
| Resiliency | High | LTE, LTE-M, NB-IoT |
| Coverage | Long range | LTE, LTE-M, NB-IoT |

1. Korea

In some cases, technical regulations described bandwidth, modulation type, class of emission, etc., but in other cases power and spurious emission are regulated in terms of technology neutrality.

1. Malaysia

Yes.

1. NZ

Yes.

1. PNG

Yet to be determined.

1. Thailand

NBTC maintains its role to promote the principle of technology neutrality.

This principle is also applied to the licensed bands. Since the licensed bands are exclusively assigned to the operators in Thailand, it depends on a plan of the operators to choose technologies to operate in the assigned bands.

| **Frequency Band Allocation** | **IoT Category (Examples)** | | **Type of Technologies (e.g. Cellular)** |
| --- | --- | --- | --- |
| 895 – 915 MHz  1710-1765.3/  1805-1860.3 MHz  1920-1980/  2110-2170 MHz | Throughput | Mid / High | Cellular |
| Latency | Low |
| Resiliency | High |
| Coverage | Long range |

#### Spectrum Allocation for Cellular IoT

|  |
| --- |
| ***Survey Question 7:*** Do you allocate any spectrum for IoT applications, in term of shared or dedicated, license or unlicensed? If yes, please provide the frequency band(s), channel arrangement/bandwidth and related IoT applications.  ***Survey Question 17:*** Do you have any plan (or possibilities) to assign new frequency band(s) or to make available the existing frequency band(s) for IoT in the next five years (including shared and/or dedicated spectrum)? If yes, please provide the information on frequency band(s), bandwidth, technolog(ies), standards, applications and other regulations (If available). |

1. Bangladesh

|  |  |
| --- | --- |
| **Frequency Band** | **Technology** |
| 900/1800/2100 MHz | Cellular |

Not decided yet for new frequency bands in the future.

1. China

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency band** | **Technology** | **Licensed/unlicensed** | **Shared/dedicated** |
| 800MHz、  900MHz、  1800MHz、  1900MHz  and 2100MHz | eMTC | Licensed | Dedicated |
| 1447-1467MHz | eMTC | Licensed | Dedicated |
| 1785-1805MHz | eMTC | Licensed | Dedicated |
| 800MHz、  900MHz、  1800MHz、  2100MHz | NB-IoT | Licensed | Dedicated |

1. India

No specific spectrum band is identified for IoT applications.

DoT is conscious of the fact that there are requirements of the IoT industry for more spectrum needs. The need of spectrum for emerging applications/use cases of IoT which require huge bandwidth and minimum latency (critical applications) will be met through upcoming 5G deployments.

1. Iran

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bands** | **License/unlicensed** | **Shared/dedicated** | **Bandwidth** | **Applications** |
| 900 MHz | Licensed | Dedicated | 34.9 MHz | 3GPP Long range devices |
| 1800 MHz | 84.8 MHz |
| 2100 MHz | 55 MHz |
| 2600MHz | 35 MHz |

1. Japan

The bands for Cellular are already assigned licensed dedicated spectrum and can also partly be used for IoT device.

1. Korea

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency band** | **Licensed/unlicensed** | **Shared/dedicated** | **Bandwidth** |
| UL 829-849 MHz /  DL 874-894 MHz | Licensed | Guard band operation within licensed band | 200 kHz |
| UL 1735-1755 MHz /  DL 1830-1850 MHz | Licensed | Guard band operation  within licensed band | 200 kHz |

Other technical regulations are added to ANNEX A.

Up to now, there is no plan to assign new cellular IoT frequency band or make available existing band.

1. NZ

New Zealand does not allocate specific spectrum for IoT applications. We are aware that certain operators may have their own preference toward using certain frequency bands due to harmonisation in international standards and the availability of equipment ecosystem.

1. Malaysia

No plan currently to assign new frequency bands or to make available existing frequency bands for specifically IoT applications.

1. PNG

Yet to be determine on spectrum allocation for IoT application.

Still under consideration on new frequency bands in future.

1. Thailand

|  |  |  |
| --- | --- | --- |
| Spectrum | Share type | License |
| 800/900 MHz | Shared with IMT | License |
| 1800 MHz | Shared with IMT | License |
| 2100 MHz | Shared with IMT | License |

No plan to allocate exclusive frequency bands for IoT. However, IoT systems can operate in the bands newly allocated for IMT in the future.

1. Vietnam

We do not allocate any dedicate band for IoT applications. The table below lists the frequency bands which have been used widely by IoT applications.

|  |  |  |
| --- | --- | --- |
| **Type of unlicensed radio devices** | **FREQUENCY BAND** | |
| Smart metering (Machine to machine communication) | 408.925 MHz (BW@50 kHz) | Licensed spectrum |

We are investigating to revise the current regulation on IMT bands to support cellular IoT technologies such as NB-IoT, LTE-M.

#### Concerns of Allocating Spectrum for Cellular IoT Applications

|  |
| --- |
| ***Survey Question 8:*** Do you have any concern of allocating spectrum for IoT application, such as co-and-adjacent channel interference, spectrum sharing within the same frequency band? Please write your concerns for each of the relative frequency band(s). |

NIL.

### Current Technical Specification/Standards for Cellular IoT

|  |
| --- |
| ***Survey Question 9:*** What is technical specification/standards the IoT require to comply with? |

1. Bangladesh

Not yet defined

1. China

The IoT technologies, such as NB-IoT and eMTC, are based on 3GPP specifications, “Regulations on Spectrum of eMTC System (temporary)”, “Announcement of the Ministry of Industry and Information Technology of China No. 27 of 2017”, “Technical requirements for enhanced machine type communication (EMTC) terminal equipment in LTE digital cellular mobile communication network and Technical requirements for NB-IoT core network equipment for Internet of things”, etc.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency Band** | **Technology** | **Transmit Power** | **Spectrum Access Technique (e.g. Frequency hopping, Duty cycle, Listen before talk, etc)** | **Max Transmission Duration** | **Channel Bandwidth** | **Spurious Emission** | **Others (please specify)** |
| 800MHz、  900MHz、  1800MHz、  1900MHz  and 2100MHz | eMTC | Station: 26.8dBW; | According to 3GPP standards, radio administration document, and local standards. | | | | |
| 1447-1467MHz | eMTC | Station: 46dBm;  Equipment:23 dBm; | According to 3GPP standards, radio administration document, and local standards. | | | | |
| 1785-1805MHz | eMTC | Station: 33dBm/MHz;  Equipment:23 dBm/MHz; | According to 3GPP standards, radio administration document, and local standards. | | | | |
| 800MHz、  900MHz、  1800MHz、  2100MHz | NB-IoT | Station: 20W; | According to 3GPP standards, radio administration document, and local standards. | | | | |

1. India

The NB-IoT and eMTC technologies are based on 3GPP specifications.

In India, TSDSI has transposed the standards being developed by OneM2M (based on their recent release / Version) and same are being evaluated by TEC for making it National Standard. Even ITU has considered some of the recommendations of OneM2M for evaluation.

1. Iran

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency Band**  **(**MHz**)** | **Technology** | **Transmit Power (EIRP)** | **Spectrum Access Technique (e.g. Frequency hopping, Duty cycle, Listen before talk, etc)** | **Max Transmission Duration** | **Channel Bandwidth** | **Spurious Emission** | **Others (please specify)** |
| 880-914.9  /925-959.9 | According to answer of question 6 | According to 3GPP standards | | | | | |
| 1710-1785  /1805-1880 |
| 1925-1980  /2110-2170 |
| 2500-2570  /2620-2690 |

1. Japan

The NB-IoT, LTE-M, and LTE technologies are based on the 3GPP specifications.

1. Korea

The NB-IoT technology is based on 3GPP specifications.

Refer to technical regulations in ANNEX A.

1. Malaysia

| **Frequency Band** | **Technology** | **Transmit Power (EIRP)** | **Spectrum Access Technique (e.g. Frequency hopping, Duty cycle, Listen before talk, etc)** | **Max Transmission Duration** | **Channel Bandwidth** | **Spurious Emission** | **Others (please specify)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Within any licensed frequency bands allocated for mobile cellular and IMT system | Technology neutral | According to 3GPP standards and Malaysia’s Standard Radio System Plans | | | | | |

1. New Zealand

For the case of IMT-based IoT deployed by mobile network operators, any IoT application must conform to the technical parameters already prescribed for the respective spectrum rights. These parameters are typically in line with IMT specifications.

Any transmitters operating in IoT network based on LoRa and LPWAN systems must confirm to the prescribed limits and standards that relates to the licence that they are operating under. In this case, IoT network operating within the frequency bands permitted under GURL-SRD shall meet the technical parameters and emission limits as laid out in the special condition of the GURL as well as the applicable standards prescribed in the New Zealand Radio Standards Notice.

1. Papua New Guinea

None at this stage.

1. Vietnam

The IoT devices operating on the licensed spectrum, the national technical requirements will be respectively applied, depend on the types of applications and services.

### Current Cellular IoT Deployment Conditions/Restrictions

|  |
| --- |
| ***Survey Question 10:*** Please provide the IoT deployment conditions/restrictions for each IoT technology mentioned in question 6 (reference Table 1):   * Approximately number of IoT devices are operated in each authorized frequency band. * Maximum deployment density for assumed typical use-cases. * Location of typical deployment. * Maximum expected speed for the typical mobility use-case.   ***Note:*** *Please complete one table for each technology.* |

1. Bangladesh

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No** | **IoT Technology** | **Authorized Frequency Bands / Frequencies** | **No. of Devices (in each band)** | **Max. Deployment Density Per km2 (typical use-case)** | **Location**  **of Use** | **Maximum Expected Speed** |
| 1 | Cellular | 900/1800/2100 (sim based IoT devices) | 500 AMR water meter reading device |  | Outdoor urban | fixed |
| 900/1800/2100 | 1952 Network Management System for BTS |  | Outdoor urban,/Outdoor rural |  |

1. India

The deployment density is a function of the use case. The smart meters deployed currently in dense urban areas assume over 10,000 devices per square Km. Some other use cases like smart tracking has a different low value for the density

• Location of typical deployment.

• Maximum expected speed for the typical mobility use-case.

1. Iran

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **IoT Technology** | **Authorized Frequency Bands / Frequencies** | **No. of Devices (in each band)** | **Max. Deployment Density Per km2 (typical use-case)** | **Location**  **of Use** | **Maximum Expected Speed** |
| 1 | Cellular | **-** | A | A | A, B, C, D | **-** |

1. Japan

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **IoT Technology** | **Authorized Frequency Bands / Frequencies** | **No. of Devices (in each band)** | **Max. Deployment** **Density Per km2 (typical use-case)** | **Location**  **of Use** | **Maximum Expected Speed** |
| 1 | Cellular | 700MHz, 800MHz, 900MHz, 1.5GHz, 1.7GHz, 2.1GHz, 3.5GHz | Unknown | Unknown | Indoor small room,  Indoor large room,  Outdoor urban,  Outdoor rural | Fixed,  Nomadic stationary,  Pedestrian,  Vehicular low or medium |

1. Thailand

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **IoT Technology** | **Authorized Frequency Bands / Frequencies** | **No. of Devices (in each band)** | **Max. Deployment** **Density Per km2 (typical use-case)** | **Location**  **of Use** | **Maximum Expected Speed** |
| 1 | Cellular | **895-915 MHz** | C | C | A, B,C, D | A,B,C,D |
| **1800 MHz** | Unknown | Unknown | A, B, C, D | A,B,C,D |
| **2100 MHz** | Unknown | Unknown | A, B, C, D | A,B,C,D |

1. Vietnam

N/A

### Other Regulations Applicable to Cellular IoT

|  |
| --- |
| ***Survey Question 11:*** If there are other regulations, please describe. |

Table 18 Other regulation application for cellular IoT

|  |  |
| --- | --- |
| **Country** | **Other regulations applicable for cellular IoT** |
| Bangladesh | Not yet decided |
| China | None at this stage |
| Iran | No |
| Japan | No |
| Korea | No |
| Malaysia | None |
| New Zealand | N/A |
| Papua New Guinea | None at this stage |
| Thailand | No |
| Vietnam | N/A |

## Current Issues Encountered Relating to Cellular IoT Communication System

|  |
| --- |
| ***Survey Question 12:*** Is there any issue related to IoT communication system? |

Table 19 Issues encountered in cellular IoT

|  | **Very Serious** | **Serious** | **Rare** | **No** |
| --- | --- | --- | --- | --- |
| Congestion of frequency band | Malaysia | Iran  Thailand | NZ | PNG  Japan  Vietnam |
| Security | Iran | Malaysia  NZ  Thailand |  | PNG  Japan  Vietnam |
| Performance |  | Iran | Malaysia  NZ  Thailand | Japan  PNG  Vietnam |

## Other Issues to be Addressed in Cellular IoT Implementation and Deployment

|  |
| --- |
| ***Survey Question 18:*** Is there any issue related to IoT communication system? |

IoT applications that are time critical with low latency requirements and needing high reliability (this is also sometimes called URLLC - ultra reliable low latency communication) will likely use the cellular based technology. The applications are typically of real-time, control loop types such as industry automation with e.g. robotized assembly lines, process automation, unmanned vehicles in the factories, etc. Industries and other local type of usage of IoT would therefore need access to spectrum confined to their geographical areas which are typical very small (like a property-based, real estate area) compared to a nation or a region. Nation-wide and regional licenses do not necessarily match the needs of a local area coverage, although an operator can provide IoT services in such an area. But then there is a dependency of that specific network including the running of the network, and any changes in operation needs to be agreed with the larger operator and this may lead to difficulties. The development of IoT support in 4G and 5G, supporting e.g. industrial applications, would enable use of IMT spectrum. Methods for accessing licensed spectrum for local area high QoS networks needs to be further addressed.

Table 20 Issues to be addressed in cellular IoT implementation and deployment

| **Country** | **Issues to be addressed in cellular IoT implementation and deployment** |
| --- | --- |
| Australia | No |
| Bangladesh | N/A |
| China | None at this stage |
| India | 1. The issue of data privacy, data protection, data security and data ownership in the IoT is of significant importance and deliberations around it with sharing of best practices and evolving a mechanism to deal with it may be considered for study in the region. 2. The identification of critical IoT applications which require special treatment by MNOs in their network including measures to be taken for ensuring that such treatment do not violate principles of Net Neutrality. This aspect assumes greater significance when we deploy IoT use cases in 5G. 3. The interoperability of various IoT platforms and related applications to avoid creation of silos is possible only if we follow some standards based approach in such deployments. It is critical for smart city planners. Deliberations, suggestions and adoption of such standards based approach from the region on this aspect will boost the growth of IoT ecosystem. 4. Security of telecom networks is of vital importance and accordingly it is embedded in various standards related to telecom networks deployments. In IoT landscape also, security is equally critical, more so when we deal with billions of sensors and therefore we need to evolve secured communications protocols for M2M/ IoT as well. |
| Iran | 1. One of the top concerns in IoT projects is poor cybersecurity implementations in applications, networks, data and equipment, 2. Spectrum needs, 3. Conditions of IoT data storage, 4. Lack of Confidentiality, 5. Privacy, 6. Numbering in 3GPP IoT network. |
| Japan | No |
| Malaysia | No |
| New Zealand | No |
| Papua New Guinea | None at this stage |
| Thailand | Yes. The additional issues are follows:   1. interoperability among different technologies 2. privacy 3. redundancy of IoT infrastructure 4. class of critical applications |
| Vietnam | N/A |

# General Information

## R&D Activities on IoT Related Technologies and/or Devices

|  |
| --- |
| ***Survey Question 13:*** In your country, do you have any R&D activities on IoT related technologies and/or devices? If yes, please describe. |

Table 21 R&D activities

| **Country** | **R&D activities** |
| --- | --- |
| Bangladesh | An IoT lab established recently |
| China | None at this stage |
| India | There are several R&D activities in IoT related technologies The Center of Excellence, MEITY for IoT in India, at Bangalore, is a Digital India Initiative to jump start the IoT ecosystem in India taking advantage of India's IT strengths and help country attain a leadership role in the convergent area of hardware and software.   * The Centre for Development of Telematics (CDoT), a state-run telecom research and development organization, has successfully built and demonstrated a OneM2M-based machine-to-machine (M2M) communications platform |
| Iran | Some research activities carried out in Iran such as:   * What laboratory condition for compliance IoT devices with standards and issue type-approval certificate, * NB-IoT devices and prototype production, * Deployment IoT network in smart cities, * IoT devises basis of SRD devices, * Working on IoT standards. |
| Japan | R&D program for Expansion of Radio Wave Resources and Strategic Information and Communications R&D Promotion Programme are conducted by Ministry of Internal Affairs and Communications. |
| Korea | There are a number of ongoing R&D activities conducted by IoT industries. |
| Malaysia | Yes, some grants are provided for SMEs and universities for IoT related projects. |
| New Zealand | New Zealand government does not initiate or oversee any R&D activities specifically on IoT. The private sector typically leads major R&D work in New Zealand. |
| Papua New Guinea | None at this stage |
| Thailand | Yes. The R&D research activities ranges from the creation of sersors, RF Modules, applications, and software platforms. |
| Vietnam | On the way towards internet of things era, Vietnam ICT enterprises have been accelerating R&D activities on IoT related technologies and solutions in order to solve social problem as well as improve labour productivity. Our IoT projects focus on the products and solutions for smart home, smart transportation, smart city, and smart agriculture. |

## Information or Technology Trends Regarding IoT

|  |
| --- |
| ***Survey Question 19:*** Are there any information or technology trends regarding IoT that you would like to share with the APT Members? |

Table 22 Technology Trends

|  |  |
| --- | --- |
| **Country** | **Information or technology trends regarding IoT** |
| Australia | No |
| Bangladesh | No |
| China | None at this stage |
| India | The 3GPP IoT technologies of NB-IoT and eMTC are evolving, and will cover a broad spectrum of services including Industrial IoT, Automotive, AI, etc. |
| Iran | No |
| Japan | None at this stage |
| Malaysia | No |
| New Zealand | New Zealand’s industry sector has set up a new IoT Alliance. It provides an independent platform for bringing together industry leaders in IoT technologies, government agencies, academics and local IoT innovators. It aims to accelerate IoT innovation by promoting collaboration across industry and government. It will endeavour to identify strategic opportunities for economic growth. |
| Papua New Guinea | None at this stage |
| Thailand | No additional information at the present. |
| Vietnam | IoT and smart services can be used effectively with the frequency bands licensed to IMT, and unlicensed bands. Licensed spectrum provides connectivity for applications with the requirements of high level of Quality of Service and achievement of economies of scale. The IoT connectivity in the licensed spectrum is able to provide extended coverage in remote locations with low cost devices. On the other hand, unlicensed spectrum is less suitable to wide-area IoT applications, especially those requiring higher quality of service levels. This is due to the fact that the use of license-exempt spectrum is always bound by technical and operational requirements such as limited output power. Besides, the risk of interference is higher and is not guaranteed in unlicensed spectrum. |

Unlicensed bands can readily be used for applications not needing high QoS requirements such as monitoring and maintenance. The bands can freely be used by others in the same area and the issue is that there are no interference protection. However, to support IoT applications in areas where high QoS is needed, access to licensed spectrum is necessary. Different methods to provide the spectrum for local area networks is being developed in Europe where technologies like LSA is being evolved. Some different spectrum management solutions are: operator involvement to set up a network within the industry premises coordinating that with the nationwide system but adapting to the needs of the industry, leasing of spectrum where a national or regional operator can lease out spectrum to an industry wanting to deploy a local area high quality network, or a dedicated local area licensing scheme that can be defined on e.g. coverage of a real estate such as an industry plant. In Germany they have specifically assigned 3700-3800 MHz for regional and local use[[5]](#footnote-5)[[6]](#footnote-6) and similar approach has been considered by Sweden[[7]](#footnote-7).

**Annex A**

**Technical Regulations in the Republic of Korea**

Administrations may indicate additional information on channel spacing, necessary bandwidth,interference mitigation requirement, unwanted emission limit and applicable radio standards.

| **Technical Regulations for NB-IoT** | | | | |
| --- | --- | --- | --- | --- |
|  | **Typical Application Type** | **Authorized Frequency Bands / Frequencies** | **Maximum Field Strength / RF Output power** | **Remarks[[8]](#footnote-8)** |
| 1 | IoT | 829-849 MHz (UL)/874-894 MHz (DL)  1735-1755 MHz (UL)/1830-1850 MHz (DL) | BS: OBW X 0.4/kHz  UE: 340 mW | - BS and UE occupied bandwidth: 200 kHz  - Adjacent channel frequency offset: 225kHz for 10 MHz bandwidth  245kHz for 20 MHz bandwidth  - ACLR  BS: 40 dB (@300 kHz), 50dB (@500 kHz)  UE: 37 dB  - spurious emission  BS: -13 dBm  UE: -36 dBm for 30 MHz – 1 GHz,  -30dBm for 1 GHz – 12.75 GHz  - Additional unwanted emission for UE  -27dBm for 864 MHz – 869 MHz  -30 dBm for 869 MHz – 894 MHz |

| **Technical Regulations for Short Range Radiocommunication Devices** | | | | |
| --- | --- | --- | --- | --- |
| **Num** | **Typical Application Type** | **Authorized Frequency Bands / Frequencies** | **Maximum Field Strength / RF Output power** | **Remarks[[9]](#footnote-9)** |
|  | SRD with very weak electric field strength | 0 - 322 MHz  322 MHz - 10 GHz  10 GHz - 150 GHz  Above 150 GHz | 500 uV/m @ 3m  35 uV/m @ 3m  3.5f uV/m @ 3m(1)  500 uV/m @ 3m | The measured value for the frequency of less than 15 MHz should be multiplied by the near field measurement compensation factor (6π/λ), where λ is wavelength in meter.  (1)f :Frequency (GHz). |
|  | Data transmission | 173.0250, 173.0375,…, 173.2750 MHz  (21 channels with 12.5kHz space) | 5 mW (e.r.p.) | The maximum OBW is 8.5 kHz. |
|  | Data transmission | 173.6250, 173.6375,…173.7875 MHz  (14 channels with 12.5kHz space) | 10 mW (e.r.p.) | The maximum OBW is 8.5 kHz. |
|  | Data transmission | 219.000 (224.000), 219.025 (224.025) 219.050 (224.050), 219.075 (224.075)  219.100 (224.100), 219.125 (224.125)  (6 pair channels with 25kHz space) | 10 mW (e.r.p.) | The frequencies of 219.000 (224.000) MHz are for channel control.  The maximum OBW is 16 kHz.  Frequencies in ( ) are for duplex communication. |
|  | Data transmission | 311.0125, 311.0250,…, 311.1250 MHz  (10 channels with 12.5kHz space) | 5 mW (e.r.p.) | The maximum OBW is 8.5 kHz. |
|  | Data transmission | 424.7000, 424.7125,…, 424.9500 MHz  (21 channels with 12.5 kHz space) | 10 mW (e.r.p.) | The channel 424.7 MHz is for channel control.  The maximum OBW is 8.5 kHz. |
|  | Data transmission | 433.795 - 434.045 MHz | 3 mW (e.r.p.) | For tire pressure monitoring system (TPMS), Remote Keyless Entry(RKE) in car, and remote car parking systems. |
|  | Data transmission | 447.6000, 447.6125,…, 447.8500 MHz  (21 channels with 12.5 kHz space) | 5 mW (e.r.p.) | The maximum OBW is 8.5 kHz. |
|  | Data transmission | 447.8625, 447.8750,…, 447.9875 MHz  (11 channels with 12.5 kHz space) | 10 mW (e.r.p.) | The maximum OBW is 8.5 kHz. |
|  | Data transmission or voice radio paging | 219.150, 219.175, 219.200 and 219.225 MHz (4 channels with 25 kHz space) | 10 mW (e.r.p.) | The maximum OBW is 16 kHz. |
|  | Wireless microphone or audio transmission | 173.020-173.280 MHz 173.300 -174.000 MHz1) 216.000 -217.000 MHz1)217.250-220.110 MHz 223.000-225.000 MHz 740.000-752.000 MHz\*  925.000 - 937.500 MHz | 10 mW (e.r.p.) | The maximum OBW is 200 kHz.  1) For hearing aids and indoor use |
|  | Wireless access system including wireless LAN | 5 150 - 5 250 MHz1) | 2.5 mW/MHz | 1) Nominal antenna gain is 6 dBi. Conducted power density is 2.5mW/MHz in case of OBW 0.5-20MHz, or 1.25mW/MHz in case of OBW 20-40MHz, or 0.625mW/MHz in case of OBW 40-80MHz.  2) Nominal antenna gain is 7 dBi. Conducted power density is 10mW/MHz in case of OBW 0.5-20MHz, or 5mW/MHz in case of OBW 20-40MHz, or 2.5mW/MHz in case of OBW 40-80MHz. |
| 5 250 - 5 350 MHz2) | 10 mW/MHz |
| 5 470 - 5 725 MHz2) | 10 mW/MHz |
|  | Wireless access system including wireless LAN | 17.705 – 17. 715 GHz  17.725 – 17.735 GHz  19.265 – 19.275 GHz  19.285 – 19.295 GHz | 10 mW | Nominal antenna gain is 2.15dBi.  The Maximum OBW is 10MHz.  This SRD is only for Wireless LAN |
| 17.700 – 17.740 GHz  19.260 – 19.300 GHz | 1 mW/MHz | Nominal antenna gain is 23 dBi.  The OBW is 10 - 40MHz.  This SRD is only for fixed point-to-point operation. |
|  | Wireless for data communication  (Spread Spectrum, OFDM, etc) | 2400-2483.5 MHz 5725-5825MHz | 3 mW/MHz 1) 2) (for FHSS type)  10 mW/MHz  1) 3) (for other spread spectrum types and OFDM)  10 mW (e.r.p)4) (other types) | 1) The nominal antenna gain is 6 dBi (20 dBi for point-to-point application)  2) The peak power of a hopping channel divided by whole hopping frequency band (MHz).  3) 10mW/MHz in case of OBW 0.5-26MHz, 5 mW/MHz in case of OBW 26-40 MHz, and 2.5mW/MHz in case of OBW 40-80MHz.  Only for devices with OBW 40-60MHz in 2.4 GHz band, conducted power density is 0.1 mW/MHz .  4) The maximum OBW is 26 MHz for 2.4 GHz band and 70 MHz for 5.8 GHz band (center frequency, 5.775MHz). |
|  | Wireless data communication  (Analogue modulation techniques) | 2 410, 2 430, 2 450 and 2 470 MHz | 10 mW | The nominal antenna gain is 6 dBi (20 dBi for point-to-point application)  The maximum OBW is 16 MHz. |
|  | RFID | 13.552-13.568MHz | 93.5 dBuV/m @ 10m |  |
|  | RFID | 433.670-434.170 MHz | 3.6 mW (e.i.r.p.) |  |
|  | RFID/USN(Ubiquitous Sensor Network) | 917 – 923.5 MHz  (32 channels, 200 kHz step) | 4W(e.i.r.p) | Passive RFID on channel No. 2, 5, 8, 11, 14 and 17. |
| 200mW(e.i.r.p) | Outdoor point-to-multipoint operation on channel No. 20~32 |
| 10mW(e.i.r.p) | Any on channel No. 2, 5, 8, 11, 14, 17 and 19 ~ 32. |
| 3mW(e.i.r.p) | Any on channel No. 1, 3, 4, 6, 7, 9, 10, 12, 13, 15, 16 and 18. |
|  | USN | 940.1 – 946.3 MHz | 200mW(e.i.r.p) |  |
|  | UWB device | 3.1 - 4.8 GHz  7.2 - 10.2 GHz | -41.3 dBm/MHz (e.i.r.p) | The minimum 10-dB bandwidth is 450 MHz.  Interference mitigation function (DAA, LDC, etc) should be adopted in the band of 3.1 – 4.8 GHz.  However, devices are allowed to be used without any interference mitigation techniques in the 4.2 to 4.8 GHz band until the end of December 2016. |
|  | Non-specific SRD | 262- 264 MHz | 100 mW(e.i.r.p.) |  |
| 22 – 23.6 GHz | 100mW | Supplied power of Antenna |
| 57 – 66 GHz | 43dBm(e.i.r.p)  57dBm(e.i.r.p.) 1) | Nominal antenna gain is 16 dBi  1) 57dBm for fixed point-to-point application |
| 122-123 GHz | 100mW | Averaged power |
| 244-246 GHz | 100mW | Averaged power |

1. For further information see [IoT and Spectrum Availability](http://www.iot.org.au/wp/wp-content/uploads/2016/12/IoTSpectrumFactSheet.pdf)[,](https://manda-mckernan.squarespace.com/s/IoT-Spectrum-Fact-Sheet.docx) published by IoTAA,11 May 2016 [↑](#footnote-ref-1)
2. *More information on class assignment can be obtained at* <https://www.skmm.gov.my/skmmgovmy/media/General/pdf/Class-Assignment-No-1-of-2017-15112017.pdf>. [↑](#footnote-ref-2)
3. Note 1: The frequency bands listing above have been assumed to be the most common unlicensed band for non-cellular IoT deployment. Moreover, IoT devices are also allowed to use other frequency bands as long as their operation complies with technical and operational requirements of Circular No. 46/2016/TT-BTTTT. [↑](#footnote-ref-3)
4. Because IoT communication system is not defined, this answer is considered not only about IoT but also SRD and RFID. [↑](#footnote-ref-4)
5. <https://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/Areas/Telecommunications/Companies/TelecomRegulation/FrequencyManagement/ElectronicCommunicationsServices/FrequencyAward2018/20180514_Information_DecisionI&II.pdf;jsessionid=F94B617675C7F1DCB071C889C1AD0ED8?__blob=publicationFile&v=2> [↑](#footnote-ref-5)
6. https://www.bundesnetzagentur.de/EN/Areas/Telecommunications/Companies/FrequencyManagement/ElectronicCommunicationsServices/ElectronicCommunicationServices\_node.html [↑](#footnote-ref-6)
7. <https://pts.se/sv/bransch/radio/auktioner/3-5-ghz-bandet/>,

   <https://pts.se/globalassets/startpage/dokument/icke-legala-dokument/rapporter/2018/radio/preliminary-study-frequencies-5g-pts-er-2018-4.pdf> [↑](#footnote-ref-7)
8. [↑](#footnote-ref-8)
9. Administrations may indicate additional information on channel spacing, necessary bandwidth,interference mitigation requirement, unwanted emission limit and applicable radio standards. [↑](#footnote-ref-9)