**SIGFOX SINGAPORE PTE LTD**

# RESPONSE TO TELECOM REGULATORY AUTHORITY OF INDIA CONSULTATION PAPER –

# SPECTRUM, ROAMING AND QOS RELATED REQUIREMENTS IN MACHINE-TO-MACHINE ("M2M") COMMUNICATIONS

## 1. INTRODUCTION

1.1. Sigfox Singapore Pte Ltd ("Sigfox") refers to the Telecom Regulatory Authority of India ("TRAI") public consultation paper dated 18 October 2016 on the Spectrum, roaming and QoS related requirements in machine-to-machine ("M2M") communications ("Consultation Paper").

1.2. Sigfox is a company providing a worldwide connectivity solution for Internet of Things ("IoT") applications based on billions of devices connected to the Internet while consuming as little energy as possible and driving the total cost of ownership to a minimum in order to unlock the full potential of mass IoT. In order to reach those objectives, Sigfox has developed an innovative technology based on an Ultra Narrow Band ("UNB") system operating in the unlicensed sub 1-GHz spectrum and transmitting IoT data via Internet to the Sigfox's cloud. Sigfox global network is comprised of base stations, software defined cognitive network nodes which are IP-connected through DSL, 3G or satellite to a centralised backend.

1.3. Sigfox welcomes the opportunity to make this submission on the Consultation Paper by TRAI. Sigfox has taken this opportunity to provide its comments based on its experiences as regards to the technical and social-economic aspects of M2M and more generally of IoT.

1.4. This submission is structured as follows:

Section 1 – Introduction
Section 2 – Executive Summary
Section 3 – Sigfox's Views and Comments on M2M Service Provider Framework
Section 4 – Sigfox's Views and Comments on Identification of Spectrum Bands Suitable for M2M Communications
Section 5 – Sigfox's Views and Comments on Security and Privacy of Data
Section 6 – Sigfox's Views and Comments on QoS Issues
Section 7 – Sigfox's Views on Other Relating Matters

1.5. Sigfox would be pleased to clarify any of the views and comments expressed by the company in this document, as appropriate.

1.6. Sigfox contact person: Mary Lim at mary.lim@sigfox.com.

## 2. EXECUTIVE SUMMARY

2.1. UNB systems already perform a valuable role in the IoT. They are effective technology for cellular (star-technology) Low Power Wide Area ("LPWA") sensor / control networks for a wide range of applications in domains which include smart cities, utilities, security and infrastructure networks, smart agriculture, environment monitoring, transport/logistics/tracking, manufacturing & industry 4.0 and healthcare.

2.2. UNB technologies provide an unprecedented spectrum efficiency and traffic capacity capabilities for Massive Machine Type Communications ("MMTC"), designed to operate in a shared spectrum under license-exempt regime. For example, the unlicensed Short Range Device ("SRD") / Radio Frequency Identification ("RFID") spectrum bands[1] (e.g. 868 – 879 MHz range, 902 – 928 MHz range). LPWA systems using UNB technologies are ideal for applications requiring low throughput, low cost and for which long battery life is a critical criterion. UNB base stations are deployed outdoors at a typical density of 0.01 to 0.1 base station per square km and with a transmit power of 500 mW to 1000 mW, in a bandwidth of 200 kHz. LPWA devices transmit at a very low power range of 25 mW to 250 mW.

2.3. UNB systems are intended for carrying a low volume of traffic per end-point: uplink, from an end-device to a base station, and downlink from a base station to an end-device. Examples of applications and use cases for LPWA systems in the Table 1. Sigfox network is designed to provide low throughput connectivity for LPWA IoT applications. The connected devices send and receive messages with a payload from 0 to 12 bytes length, with a maximum of 140 messages per day.

[1] It is also known as Industrial, Scientific and Medical ("ISM") band.

*Table 1 Smart City Applications (source: European Telecommunications Standards Institute ("ETSI") TR 103 435)*

| Need | Period | Payload (NOTE 1) |
|---|---|---|
| **Street Parking** | 1/min to 1/hour, depends on traffic. ~ 30s Uplink latency required | bytes |
| **Street Lighting** | 2/day Uplink (event log + meter reading); downlink commands as necessary (none if everything is operating OK). | 100-200 bytes |
| **pH Level monitoring** | 1 day | 1-15 bytes |
| **Bicycle rental** | 1/day to 20/day | 1-15 bytes |
| **Smart garbage collection** | 1/day to 5/day | 1-15 bytes |
| **Watering / irrigation** | 1/day to 5/day | 1-15 bytes |
| **Sewage management** | 1/day to 5/day | 1-15 bytes |
| **Flood Management (incl. highway gully monitors)** | 1/day to 5/day | 1-15 bytes |
| **Pollution monitoring** | 1/day to 5/day | 1-15 bytes |
| **Tracking dust storms** | Occasionally | 10-bytes to 100 bytes |
| **Weather monitoring to mitigate icy roads** | 1/day to 20/day | 1-15 bytes |
| **Automated safety alert networks** | Occasionally | 10 bytes to 100 bytes |
| **Networked road barriers** | 1/day to 5/day | 1-15 bytes |
| **Infrastructure safety e.g. bridges** | 1/day to 5/day | 10 bytes to 100 bytes |
| **Tracking prisoners on parole** | 1/day to 20/day | 1-15 bytes |
| **Gunshot monitoring** | Occasionally | 10 bytes to 100 bytes |
| **Earthquake monitoring** | Occasionally | 10 bytes to 100 bytes |

NOTE 1: These payload figures are application payloads optimised for LPWA/UNB networks. Different UNB systems use different mechanisms in transmission of application payloads.

2.4. Strategy Analytics, for example, forecasts over 1 billion of LPWA connections globally by 2018 and more than 5 billion by 2022, these forecasts are based on all LPWA technologies that Strategy Analytics expects to be available in the market. LPWA connectivity is widely used in both developed and emerging markets.

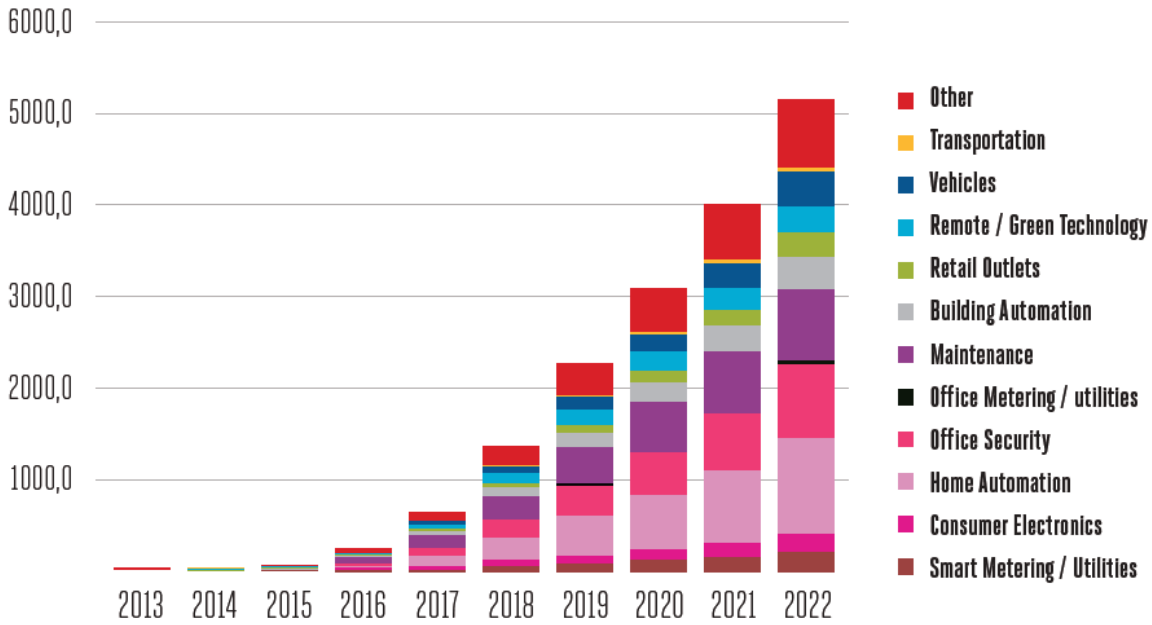


*Figure 1 Global LPWA connections share, by applications (millions). Source: Strategy Analytics*

2.5. LPWA technologies fill the gap between the mobile (3G, long-term evolution ("LTE")) and short-range wireless (e.g. Bluetooth, Wi-Fi and ZigBee) networks. LPWA technologies are designed for machine communications, to provide connectivity for devices and applications that require low mobility and low levels of data transfer, and will therefore be critical in the development of the IoT.

2.6. LPWA networks will play a key role in connecting up the billions of new devices for the growing IoT market. LPWA technologies, such as Sigfox's UNB, serve a diverse range of vertical industries and support a range of applications and deployment scenarios, which existing mobile and short range technologies cannot provide in an appropriate and cost effective way.

2.7. Although with the development of Narrowband IoT ("NB-IoT") cellular technology plays a role in the wide area M2M/IoT markets which suitable for high capacity required applications, Sigfox is in view that LPWA UNB technology is most suitable for devices that need to send small amount of data over a long range, while maintain long battery life. Sigfox LPWA UNB connectivity solution complement effectively other higher bandwidth connectivity solution such as LTE, NB-IoT.

2.8. Sigfox recommends to design a clear regulatory framework for M2M/IoT applications based unlicensed spectrum bands in India. This regulation should be made as simple as possible and based on technology neutral principle in order to foster new innovation and ensure an equal access to the market for all business models.

2.9. Considering the key role played across the world by unlicensed spectrum in the Sub-1GHz band, additional spectrum bands should be liberalised in the 865 – 870 MHz and 915 – 928 MHz (or 915 – 925 MHz) ranges. These additional attributions would secure the necessary bandwidth required by IoT applications in a near future and support economy of scale as well as opportunities of interoperability and trade growth with other countries in Asia and beyond.

## 3. SIGFOX'S VIEWS AND COMMENTS ON M2M SERVICE PROVIDER FRAMEWORK

**Q1 What should be the framework for introduction of M2M Service providers in the sector? Should it be through amendment in the existing licenses of access service/Internet Service Provider ("ISP") license and/or Licensing authorisation in the existing Unified License and UL ("VNO") license or it should be kept under OSP Category registration? Please provide rationale to your response.**

3.1. Sigfox is of the same view that it is essential to have a policy framework in place, well in time, to foster the M2M/IoT communication so that complete benefits of this innovation can be passed on to the citizens.

3.2. In general, the LPWA industrial ecosystem has two major networking landscapes; unlicensed (e.g. LoRa, Sigfox and Ingenu, which are mentioned in the Consultation Paper) and licensed spectrum with 3rd Generation Partnership Project ("3GPP") standards NB-IoT which are mainly provided by Mobile Network Operators ("MNOs") or Mobile Virtual Network Operators ("MVNOs"). Therefore, it is also essential for TRAI to put in place and define a regulatory framework for unlicensed spectrum band(s), to promote innovation through the development of IoT solutions such as LPWA UNB technology. It is essential for TRAI not to impose service or technological restrictions that hold back innovation in the unlicensed spectrum band(s).

3.3. In European Union ("EU"), the regulators allow LPWA IoT applications in the Sub-1 GHz SRD/RFID band(s), given that the LPWA IoT equipment/device comply with the ETSI standard EN 300 220. For examples, Belgium, Czech Republic, Denmark, Finland, France, Italy, Ireland, Germany, Luxembourg, Malta, Mauritius Island, Spain, U.K., Netherlands, etc. There is no license required in the European countries since it comply to the ETSI standard. The Telecom Service Provider ("TSPs") are only required to notify the local regulator, to deploy and operate the LPWA IoT network in the country.

3.4. In U.S. and Mexico, the regulators also allow LPWA IoT applications to operate in the 902 – 928 MHz band, given that the LPWA IoT equipment/device comply with the FCC Part 15-247 standard. Similar to Europe, there is no license required in U.S. and Mexico since it comply to the FCC standard. In most Regional Commonwealth in the Field of Communication ("RCC") countries, SRD maybe use without license should the equipment comply with the requirement prescribed by national regulators.

3.5. In Australia, a carrier license is required for any operator providing basic transmission infrastructure on which carriage and content services are supplied to the public, unless an exemption applies or a Nominated Carrier Declaration ("NCD") is in place. The TSPs could be licensed exempted, however, the TSPs could choose to obtain a license in view to ease of accessing the building rooftop for base station installation. In Singapore, Facilities-Based Operations ("FBO") license is required for any operator deploy and operate any form of telecommunication network, systems and/or facilities for the purpose of providing telecommunication services to business customers or the general public. The FBO license was recently amended to be applicable to non-SIM base M2M services, and the M2M Service Providers ("MSPs") do not require to notify the regulator to provide services with contracted TSP's IoT network.

3.6. Naturally unlicensed spectrum bands are spectrum that has been defined openly with no limitation on technologies and application, without registration or individual permission. Hence, Sigfox proposes the amendment to the existing policy framework for the unlicensed SRD/RFID bands to allow M2M/IoT equipment to operate on a license-exempted regime on the condition that it comply with the international standards such as FCC Part 15-247 and EN 300 220.

3.7. Sigfox is in view of no license to be imposed on TSPs which deploy and operate LPWA IoT network and MSPs which provide LPWA IoT service using the unlicensed spectrum in India. This enable applications or services to be addressed quickly and cheaply.

**Q2 In case a licensing framework for MSP is proposed, what should be the Entry Fee, Performance Bank Guarantee (if any) or Financial Bank Guarantee etc? Please provide detailed justification**

3.8. Since Sigfox is in view that there should not license to be impose for TSPs which deploy and operate LPWA IoT network and MSPs which provide LPWA IoT service in the unlicensed spectrum band(s), Sigfox proposes that there should not be an entry fee, performance bank guarantee or financial bank guarantee impose on these MSPs. It would facilitate market entry to India, with no requirement to acquire a licence and entry fee to deploy a service.

**Q3 Do you propose any other regulatory framework for M2M other than the options mentioned above? If yes, provide detailed input on your proposal.**

3.9. The density of devices in IoT applications varies widely from high density in the factory or processing plant to the low density of smart grid data collection. This requires an equally wide range of technical properties and regulatory allowance. Reference to Europe countries to allow LPWA IoT applications operate in the SRD

band with existing unlicensed spectrum band regulatory framework, Sigfox proposes for TRAI to adopt the same license-exempted regulatory framework.

## 4. SIGFOX'S VIEWS AND COMMENTS ON IDENTIFICATION OF SPECTRUM BANDS SUITABLE FOR M2M COMMUNICATIONS

4.1. As mentioned in the Consultation Paper Section 2.23, European Commission has suggested that a license-exempt model is most effective for IoT development. Sigfox agrees with European Commission's suggestion as LPWA UNB IoT generally user friendly types of wireless products with low spectrum load and good spectrum sharing properties. For example, Sigfox uses the spectrum band 868 – 879 MHz based on the EN 300 220 standards in Europe and the 902 – 928 MHz band based on the FCC Part 15-247 in Americas (include U.S.) and Asia, which co-share with existing SRD/RFID systems in the country.

**Q4 In your opinion what should be the quantum of spectrum required to meet the M2M communications requirement, keeping a horizon of 10-15 years? Please justify your answer.**

4.2. A 2014 study by Aegis Systems and M2M analysts Machina Research for Ofcom[2] concluded that it was likely the growing demand for M2M communication could not met by existing license-exempted spectrum bands allocated in Europe. The Conference of European Posts and Telecommunications Administrations ("CEPT") have been working towards an allocation for SRD in the bands 870 – 876 MHz and 915 – 921 MHz, adding to the existing 863 – 870 MHz SRD band in Europe. CEPT is setting out a roadmap to allocate additional spectrum for generic SRD, RFID and M2M/IoT.

4.3. With the existing 2 MHz SRD band, spectrum allocated for M2M/IoT communication in India would not be sufficient, as compared to the existing 24 MHz ISM band in Europe and 26 MHz SRD band in U.S. for M2M/IoT communication. In Asia Pacific, the regulators have allowed frequency band range from 4 to 20 MHz for M2M/IoT communication in the unlicensed spectrum band. Hence, Sigfox proposes to allocate frequency band of 5 to 18 MHz in the sub-1 GHz band on license-exempt basis allocation.

4.4. In the Spectrum requirement for PLC and low power RF communications technical report[3] also mentioned that 2 MHz in the 865 – 867 MHz band and additional 1 MHz in the 433 – 434 MHz band would not able to cater to the billions of devices that would be deployed in the M2M/IoT/IoE/Smart Cities initiatives. In the same

[2] "M2M application characteristics and their implications for spectrum", May 2014

[3] "Spectrum requirement for PLC and low power RF communications" published by Telecommunication Engineering Centre Department of Telecommunications Ministry of Communications & Information Technology Government of India, dated November 2015.
http://tec.gov.in/pdf/M2M/Spectrum%20requirements%20%20for%20PLC%20and%20Low%20power%20RF%20communications.pdf

technical report, it is recommended to allocate a frequency band of 10 to 12 MHz for M2M/IoT devices.

**Q5 Which spectrum bands are more suitable for M2M communication in India including those from the table 2.3 above? Which of these bands can be made delicensed?**

4.5. It is envisioned that spectrum for M2M/IoT communications should be in the sub-1 GHz band since RF propagation characteristics favour lower frequencies (especially when indoor propagation is important, which will be the case for many M2M/IoT deployments). License-exempted spectrum bands are likely to be a key enabler of wireless M2M/IoT communication.

4.6. In Europe, the regulators permit LPWA IoT applications in the sub-1 GHz SRD/RFID band (868 – 879 MHz) and in U.S., the regulators allow LPWA IoT applications to operate in the 902 – 928 MHz band.

4.7. With M2M/IoT communications set to grow rapidly in the coming years, several regulators in Asia Pacific have authorised or are planning to review the SRD/RFID band(s) for LPWA IoT equipment, to make it even more attractive to the TSPs/MSPs. For examples:

(i) Australia regulator allows IoT to operate in its existing 915 – 928 MHz SRD band. Furthermore, Australia regulator made available up to 7 MHz in 928 – 935 MHz for new and innovative M2M applications and networks to support IoT in October 2016;

(ii) Singapore regulator amended its regulatory framework to allow M2M devices in 920 – 925 MHz SRD band;

(iii) Malaysia regulator allows IoT equipment to operate in its existing 919 – 923 MHz SRD band with its current unlicensed band framework;

(iv) Japan regulator established a new working group to review its regulation on specified radio station in the range of 917 – 928 MHz RFID band;

(v) Korea regulator amended the rule 30 on RFID and Ubiquitous Sensor networks (“USN”) of its wireless equipment regulation, to allow LPWA IoT operating in 917 – 923.5 MHz with transmit power up to 200 mW. Recently, the regulator further allows 6 MHz (940 – 946 MHz) for long-range IoT, with transmit power up to 200 mW;

(vi) New Zealand regulator expanded its unlicensed band from 921 – 928 MHz to 915 – 928 MHz with power limit up to 1W;

(vii) Hong Kong regulator is reviewing its regulatory framework to allow IoT to operate in its current 920 – 925 MHz RFID band;

(viii) Thailand regulator is reviewing its regulatory framework to allow general SRDs, including IoT equipment, to operate in its current 920 – 925 MHz RFID band; and

(ix) Viet Nam regulator is in plan to re-allocate 919 – 923 MHz for non-specific SRDs (including IoT).

4.8. With reference to Table 2.3 of the Consultation Paper, Sigfox proposes to broader the current unlicensed spectrum band 865 – 867 MHz with 3 MHz additional (865 – 870 MHz) for the use of SRD and LPWA communication systems and reframe accordingly the adjacent frequency band for cellular telecommunication systems in the 872 – 889 MHz range with 2 MHz guard band. This will align the spectrum arrangement in India with frequency allocation for SRD in Europe which is under massive M2M/IoT deployment.

4.9. In addition, Sigfox proposes to allocate the spectrum band 915 – 925 MHz or 915 – 928 MHz for LPWA communication systems and adjacent frequency band for cellular telecommunication systems in the 885 – 915 MHz / 930 – 960 MHz with 2 MHz guard band[4]. This will align the spectrum arrangement in India with the frequency allocation for SRD and/or LPWA in America and Asia Pacific.

**Q6 Can a portion of 10 MHz centre gap between uplink and downlink of the 700 MHz band ("FDD") be used for M2M communications as delicensed band for short range applications with some defined parameters? If so, what quantum? Justify your answer with technical feasibility, keeping in mind the interference issues.**

4.10. Sigfox has no comment on this question.

[4] When mobile base station Transmit is adjacent to any SRD receiver, the interfering signal will be further attenuated by the mobile transmission mask. SRD on the adjacent band is expected to experience some interference without guard band.

## 5. SIGFOX'S VIEW AND COMMENTS ON SECURITY AND PRIVACY OF DATA

5.1. The IoT has become a ubiquitous term to describe billions of devices that have sensing or actuation capabilities, and are connected to each other via the internet. A secure solution for embedded devices is needed (i) to ensure the device firmware has not been tampered with; (ii) to secure the data stored by the device; (iii) secure communication; and (iv) protect device from cyber-attacks.

5.2. Sigfox agrees with the opinion mentioned in the Consultation Paper Section 2.4.2.

**Q12 Will the existing measures taken for security of networks and data be adequate for security in M2M context too? Please suggest additional measures, if any, for security of networks and data for M2M communication.**

5.3. Sigfox complies with existent European standards for the security of networks and data. In fact, there is no specific regulation in the EU for M2M/IoT, but the EU has more numerous general regulations which allow for a high level of security. At this stage, Sigfox in view that it is not necessary to adopt specific regulations for M2M/IoT, the existent regulations should be sufficient to achieve a high level of security.

**Q13 (a) How should the M2M service providers ensure protection of consumer interest and data privacy of the consumer? Can the issue be dealt in the framework of existing laws?**

**(b) if not, what changes are proposed in Information Technology Act. 2000 and relevant license conditions to protect the security and privacy of an individual?**

**Please comment with justification.**

5.4. Sigfox compliant to the European standards relating to the personal data protection, in particular the new General Data Protection Regulation ("GDRR" – Regulation (EU) 2016/679) which will be in force by March 2018. The provisions of the GDRR would be sufficient to ensure a full protection of consumers' interests in the EU and also globally. Hence, Sigfox proposes TRAI could reference to the GDRR.

## 6. SIGFOX'S VIEW AND COMMENTS ON QOS ISSUES

6.1. Sigfox has 3 different types of SLAs to our customers, which are namely (i) IoT communication service availability; (ii) uplink delivery time; and (iii) availability of cloud access.

**Q14 Is there a need to define different types of SLAs at point of interconnects at various layers of Heterogeneous Networks (HetNets)? What parameters must be considered for defining such SLAs? Please give your comments with justifications.**

6.2. Sigfox has no comment on this question.

**Q15 What should be the distributed optimal duty cycle to optimise the energy efficiency, end-to-end delay and transmission reliability in a M2M network?**

6.3. Duty Cycle used in Europe and other countries which adopted European standard ETSI EN 300 220 for non-specific SRD and the related recommendation from Electronic Communications Committee ("ECC") ERC 70-03[5]. Sigfox proposes the Duty Cycle limit of 1% to 10%, depending on the application, and to allow TSPs and MSPs to determine the end-to-end delay and transmission reliability in M2M network based, as a commercial decision based on the positioning of its service proposition.

[5] ERC 70-03 definition: the duty cycle is defined as the ratio, expressed as a percentage, of Σ(Ton)/(Tobs) where Ton is the "on" time of a single transmitter device and Tobs is the observation period. Ton is measured in an observation frequency band (Fobs). Unless otherwise specified in the relevant Annex, Tobs is a continuous one hour period and Fobs is the applicable frequency band.

## 7. SIGFOX'S VIEWS ON OTHER RELATING MATTERS

**Q16 Please give your comments on any related matter not covered in this consultation paper.**

7.1. Standards and harmonisation are important to allow devices to be deployed in as many market as possible at the lowest cost and as such accelerate the adoption and the development of IoT solutions. Hence, Sigfox recommends to include a standard in the regulatory framework for IoT operating in the unlicensed bands, reference to the International standards such as ETSI EN 300 220, FCC Part 15-247.