## 1.1 Specifications of LoRaWAN Gateway

### 1.1.1 LoRaWAN Gateway (Outdoor)

LoRaWAN Gateway to be supplied and installed shall fully comply with the minimum requirements specified in the technical specification below:-

| Gateway (Outdoor) | |
|---|---|
| Cellular | 4G-LTE Category 4, with HSPA+ 42/GPRS fallback;<br>Global frequency band suitable for use in Hong Kong including 4G: 1800(B3)/2600(B7); 3G: 900(B8)/2100(B1); and 2G: 900/1800 |
| Processor & Memory | ARM9 processor with 32-Bit ARM & 16-Bit Thumb instruction sets<br>400 MHz, 16K Data Cache, 256 MB Flash Memory, 16K Instruction Cache, 128X16M DDR RAM |
| Packet Data | Up to 100 Mbps downlink, Up to 50 Mbps uplink |
| Radio Frequency LoRa | Compatible with AS 923MHz |
| Radio Frequency Wi-Fi & BT/BLE | 802.11 a/b/n/g 2.4 GHz and 5 GHz & BT Classic BLE 4.1 |
| Storage | Micro SD |
| Input Voltage | Power over Ethernet (PoE) 48VDC 25W compliant to IEEE802.3at |
| Local Ethernet internet | IEEE802.3 10/100 Base T compliant |
| Ethernet Connector | 1 x RJ-45 Ethernet 10/100 port |
| USB Connector | 2 x USB Ports: USB Host (Type-A), USB Device (Micro-B) |
| Serial Connector | 1 x Debug Serial: USB Micro-B |
| Antenna | Equipped with 2 nos. of at least 3dBi antenna for 4G LTE; 1 no. of at least 3dBi antenna for LoRa; & 1 no. of GPS antenna |
| SIM Connector | Micro SIM (3FF) |
| Accessories | Equipped with all necessary accessories, including antennas and mounting kit |
| Weight | Less than 3kg |
| Chassis Type | IP67 Rated, Aluminium |
| Environmental ratings | Operation temperature : $0^{O}$C to +$55^{O}$C or better;<br>Relative humidity : 20% - 90% or better, non-condensing; |
| Certification | Electromagnetic compatibility: EN 55022 Class B, EN 55024 compliant; |

| Gateway (Outdoor) | |
|---|---|
| | Safety: IEC 60950-1 2nd Ed compliant; and<br>Radio: EN 300 220 compliant. |
| Software Requirement | Enhanced and embedded Linux platform or equivalent;<br>LoRa packet forwarder;<br>WAN Connection;<br>Cellular PPP, Dynamic DNS, DHCP Server/Client;<br>WAN connection via Ethernet or cellular;<br>LAN/WAN Security;<br>Secure firewall with NAT and port forwarding;<br>Static routing;<br>Node-RED integration;<br>Built-in Node-RED application development environment;<br>Language Support;<br>C, C++, Python, Javascript, node.js, bash;<br>Router/Modem management;<br>Graphical web interface for configuration and management;<br>Remote Access;<br>Configuration backup & restore; and<br>Easy firmware upgrade through web interface |

1.1.2 LoRaWAN Gateway (Indoor)

LoRaWAN Gateway to be supplied and installed shall fully comply with the minimum requirements specified in the technical specification below:-

| Gateway (Indoor) | |
|---|---|
| Cellular | 4G-LTE Category 4, with HSPA+ 42/GPRS fallback;<br>Global frequency band suitable for use in Hong Kong including 4G: 1800(B3)/2600(B7); 3G: 900(B8)/2100(B1); and 2G: 900/1800 |
| Processor & Memory | ARM9 processor with 32-Bit ARM & 16-Bit Thumb instruction sets<br>400 MHz, 16K Data Cache, 256 MB Flash Memory, 16K Instruction |

| Gateway (Indoor) | |
|---|---|
| | Cache, 128X16M DDR RAM |
| Packet Data | Up to 100 Mbps downlink, Up to 50 Mbps uplink |
| Radio Frequency LoRa | Compatible with AS 923MHz |
| Radio Frequency Wi-Fi & BT/BLE | 802.11 a/b/n/g 2.4 GHz and 5 GHz & BT Classic BLE 4.1 |
| Storage | Micro SD max size 32GB (HSMCI) |
| Input Voltage | 9V to 32VDC |
| Local Ethernet internet | IEEE802.3 10/100 Base T compliant |
| Ethernet Connector | 1 x RJ-45 Ethernet 10/100 port |
| USB Connector | 2 x USB Ports: USB Host (Type-A), USB Device (Micro-B) |
| Serial Connector | 1 x Debug Serial: USB Micro-B |
| Antenna | Female SMA;<br>Equipped with 2 nos. of 2dBi antenna for 4G LTE; 1 no. of GPS antenna; and 1 no. of WiFi/BT antenna |
| SIM Connector | SIM/USIM (2FF) |
| Accessories | Equipped with LoRa module and at least 3dbi RP-SMA antenna for LoRa, power supply/adaptor and mounting kit, etc. |
| Weight | Less than 1kg |
| Environmental ratings | Operation temperature : $0^{O}C$ to $+55^{O}C$ or better;<br>Relative humidity : 20% - 90% or better, non-condensing; |
| Certification | Electromagnetic compatibility: EN 55022 Class B compliant;<br>Safety: IEC 60950-1 2nd Ed compliant; and<br>Radio: FCC Part 22, 24, 27 compliant |

| Gateway (Indoor) | |
|---|---|
| Software Requirement | Enhanced and embedded Linux platform or equivalent;<br>LoRa packet forwarder;<br>WAN Connection;<br>Cellular PPP, Dynamic DNS, DHCP Server/Client;<br>WAN connection via Ethernet or cellular;<br>LAN/WAN Security;<br>Secure firewall with NAT and port forwarding;<br>Static routing;<br>Node-RED integration;<br>Built-in Node-RED application development environment;<br>RS-232, RS-485;<br>Language support;<br>C, C++, Python, Javascript, node.js, bash;<br>Router/Modem management;<br>Graphical web interface for configuration and management;<br>Remote Access;<br>Configuration backup & restore; and<br>Easy firmware upgrade through web interface |

### 1.1.3 LTE Router

LTE Router to be supplied and installed shall fully comply with the minimum requirements specified in the technical specification below:-

| LTE Router | |
|---|---|
| Bands | LTE bands 1, 3, 7, 8, 20<br>(800(B20), 900(B8), 1800(B3), 2100(B1), and 2600(B7) MHz |
| Download (DL)/ Upload (UP) speeds | 100 Mbps (DL) and 50 Mbps (UP) |
| Features | (a) Auto-switch fallover between primary and backup link;<br>(b) Multichannel-interface-processor (MIP) profile configuration;<br>(c) CDMA Data Retry;<br>(d) 3G MIB with 3G MIB extension and traps;<br>(e) Remotely initiated data callback using voice;<br>(f) Remotely initiated data callback using Short Message Service (SMS);<br>(g) Remote firmware upgrade over 4G LTE;<br>(h) Virtual diagnostic monitoring;<br>(i) Mobile Equipment Personalization (MEP) lock and unlock capabilities;<br>(j) SIM lock and unlock capabilities. |
| SIM slot | Dual SIM support, hardware-ready, high reliability, and cellular multi-homing support for Dual SIM card socket compliant with ISO-7816-2 (SIM mechanical) |
| SMS and Global Positioning System (GPS) | (a) GPS antenna: SMA connector;<br>(b) Send and receive SMS (maximum 160 characters);<br>(c) Standalone GPS;<br>(d) Separate active GPS with SMA;<br>(e) Configure multiple profile. |
| MIBs | (a) Enhanced 3G MIB with 4G MIB extension;<br>(b) Entity MIB;<br>(c) IF MIB;<br>(d) 3G WWAN MIB persistence. |

| LTE Router | |
|---|---|
| 4G LTE network management and diagnostics | (a) In-band and out-of-band management using Telnet and SNMP, including MIB II and other extensions;<br>(b) Industry-standard 4G LTE diagnostics and monitoring tools (QUALCOMM CDMA Air interface Tester (CAIT) and Spirent Universal Diagnostic Monitor (UDM)) |
| Modem | Modem form factor: Embedded Peripheral Component Interconnect (PCI) minicard |
| Wireless technologies | LTE 800MHz (band 20), 900MHz (band 8), 1800MHz (band 3), 2100MHz (band 1), and 2600MHz (band 7);<br>Backward compatible with UMTS and HSPA+: 900 and 2100MHz, and DC-HSPA+, Tri-band EDGE, GPRS, and GSM. |
| Accessories | Accessories including Two multiband dipole antennae and one extender. |

1.1.4 Supply / Installation / Relocation of Gateway and necessary accessories

The Contractor shall supply designated gateways, install, relocate (if necessary) the gateways and accessories, with supply and installation of other associated accessories and services including but not limited to supply and installation of antenna, coaxial cable, signal cable, power supply, charger, power cable, power point, power meter, surge arrestor, electrical devices, waterproof cabinet / housing (at IP66 or better rating), SIM card, dismantle of necessary equipment and accessories (for relocation of gateways), configuration and registration for the gateways supplied and / or installed under this Contract such that the gateways and other equipment operate normally as a completed system in the designated location and environment. The specification of the system components shall comply with the requirements stipulated in other clauses of this specification. The Contractor shall submit the proposed system design and material submission for approval by the Engineer's Representative(s).

1.1.5 Supply and installation of additional Lightning Protection

The Contractor shall supply and install appropriate lightning protection rods, conductors and all necessary fittings and accessories in accordance with BS EN 62305 to provide lightning protection for the installed Gateway and associated antenna system. The Contractor shall submit proposed mounting method and shall be responsible for verification and proposing the mounting height and location such that the lightning protection system can fully cover and protect the installed Gateway and associated antenna system. All connections and joints shall be mechanically and electrically connected to the

existing lightning protection system installed at the relevant venues, and shall be protected from corrosion by the operating environment.

1.1.5.1 Lightning Arrestor / Surge Protector

- LAN interface: Dual RJ-45 10/100/1000
- 802.3at Power-Over-Ethernet Plus (PoE+) compatible
- RoHS compliant
- Ground Lug: 10 AWG Max.
- DC spark-over voltage: 75V +-25%
- Impulse spark-over voltage at 100V/us <=500V, at 1kV/us <=600V
- Operation temperature: 0°C~ +55°C

1.1.6 Supply and installation of LTE Router and necessary accessories

The Contractor shall supply and install a separate LTE router and other associated accessories and services including but not limited to the supply and installation of power supply, charger, cablings, antenna, surge arrestor, waterproof cabinet/ housing (at IP 66 or better rating) for the gateways supplied and / or installed under this Contract such that the gateways, injectors and other equipment operate normally as a completed system in the designated location and environment. The specification of the system components shall comply with the requirements stipulated in other clauses of this specification.

1.1.7 Supply and installation of PoE+ injector and necessary accessories

The Contractor shall supply and install a Power-Over-Ethernet Plus (PoE+) injector and other associated accessories and services including but not limited to the supply and installation of power supply, charger, cablings, waterproof cabinet/ housing (at IP66 or better rating) for the gateways supplied and / or installed under this Contract such that the gateways, routers, other equipment operate normally as a completed system in the designated location and environment.

The PoE+ injector shall support sufficient output power (e.g. supporting 30W output power or other output power) for the gateway installed and support IEEE 802.3at with power supply for use in Hong Kong.

1.1.8 Supply and installation of cabinet for gateway

The Contractor shall supply and install a waterproof cabinet (at IP66 or better rating) with a mechanical lock with key for housing each gateway, associated antennae, Ethernet and power cables supplied and / or installed under this Contract. The cabinets supplied and installed shall be tailor-made (including all necessary materials and works inside the cabinet, e.g. cables, holes, openings, screws, connectors, cable glands, etc.) to fit each individual gateway, antennae, lightning arrestors / surge protectors (upon requested by the engineer's representative) and the associated accessories. The material of the cabinets shall

be of stainless steel or plastic enclosure or other materials as approved by Engineer's Representative(s). The Contractor shall submit the final design of the cabinet for each installation scenario to the Engineer's Representative(s) for approval.

1.1.9 Supply and installation of additional 3dBi antenna for indoor gateway with accessories

The Contractor shall supply and install an external 3dBi antenna of omni-directional type or directional type for indoor use as approved by the Engineer's Representative(s) with associated accessories and services including coaxial cable, signal cable, connector, mounting bracket, mounting pole, cabinet, etc., in additional to or in replacing the existing antenna of the gateway. The Contractor shall be responsible for antenna mounting design service.

1.1.10 Supply and installation of additional 6dBi or 9dBi antenna for outdoor gateway with accessories

The Contractor shall supply and install an external 6dBi or 9dBi antenna of omni-directional type or directional type for outdoor use as approved by the Engineer's Representative(s) with associated accessories and services including coaxial cable, signal cable, connector, mounting bracket, mounting pole, cabinet, etc., in additional to or in replacing the existing antenna of the gateway. The Contractor shall be responsible for antenna mounting design service.

1.1.11 Cables and conduit

1.1.11.1 Power cables shall be 3-core PVC insulated, non-armoured, multi-strand with each copper conductors of not less than 2.5 $mm^2$ to BS6004 and with an overall protective sheath of PVC.

1.1.11.2 The non-armoured control cables used shall satisfy the following minimum characteristics and with an overall protective sheath of PVC:

(i) at least 7 strands per conductor;

(ii) strand diameter not to be less than 0.2 mm;

(iii) conductor resistance to be less than 90 Ohm/km;

(iv) insulation resistance to be better than 20 M Ohm/km measured between cores or between core and screen;

1.1.11.3 All class of cables installed in underground trenches shall be steel wire armoured.

1.1.11.4 Starting from 1 July 2007, a new Cable Colour System will be implemented for all fixed electrical installation in Hong Kong SAR. Contractor shall be fully aware of the

requirements under the new system and conduct their work accordingly. The information about the new cable colour system is available under the internet homepage of EMSD at www.emsd.gov.hk.

1.1.11.5 The Contractor shall supply and install the cable including CAT6 STP cable, antenna cable and / or power supply cable with GI conduit, adaptable box of various sizes and appropriate types, and necessary accessories included as stipulated in the Schedule of Rates. All the cables supplied shall be of appropriate shielding and protective coating for usage at outdoor / semi-outdoor environment and subject to the approval of the Engineer's Representative(s).

1.1.12 Engineering service for venues

The Contractor shall be responsible for all necessary works related to the supply and installation of gateways, sensors and other equipment and accessories under this specification for **each venue location** including **structural design and calculation**, Builder's and building services works (including power cables, antenna cables, CAT6 STP cables and conduits), coordination among works' related parties, **safety measures**, **working platforms/ scaffoldings for work at heights**, equipment configuration, documentation, maintenance within guarantee period.

The Contractor shall submit structural design and calculation for all mounting design of mounting brackets and or mounting poles for gateways, sensors, injectors, routes, antennae and associated accessories. The structural design and calculation for **each mounting scenario** unless previously or otherwise approved by the Engineer's Representative(s) shall be **certified by a Registered Structural Engineer (RSE)** for all the mounting details of the equipment installed under this specification.

The Builder's and building services works including provision of power points and electrical devices, lightning / surge protection devices for equipment, dismantle of and replacing existing cables of other systems for using existing conduits.

The Contractor shall perform the civil works to facilitate installation of gateway and sensor equipment, including but not limited to, underground utility detection, existing utility protection, statutory submission for temporary traffic arrangement, excavation and reinstatement works.

The Contractor shall perform configuration for all devices and equipment including gateways, PoE+ injectors, LTE routers, sensors, internet services (if applicable) and all 4G mobile data subscription for each LoRaWAN gateway to ensure its connection to the Internet.

The Contractor shall be responsible for appointing the required Prescribed Building Professionals (PBP) and Prescribed Registered Contractor (PRC) as stipulated in Buildings

Ordinance and Buildings Department's requirements for any building works subjected to Buildings Department's regulation.

1.1.13 4G mobile service subscription (each for 24 months)

1.1.13.1 The Contractor shall provide 4G LTE local mobile data subscription for 24-month of quantity as stipulated in the Schedule of Rates. Each data subscription shall come with a **public fixed IP address** for **unlimited** local LTE mobile data at an uplink speed not lower than **10Mbps**. The activation of the all LTE mobile data subscription shall not be earlier than the delivery of all LoRaWAN gateways, and shall be agreed with the EMSD.

1.1.13.2 In addition to above requirements, the Contractor shall provide High Priority 4G LTE local mobile data subscription for selected / critical gateways as per instruction of Engineer's Representative(s), i.e. reliable, high speed with high Quality of Service (QoS) as compared with the data plan services for general commercial customers.