WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION E-89-02

WIRELESS ADVANCED METERING INFRASTRUCTURE (AMI) SYSTEMS

1. Scope

This standard specification stipulates the requirements on providing a wireless Advanced Metering Infrastructure system ("wireless AMI System") in a building, structure or premises.

The AMI System is formerly known as Automatic Meter Reading (AMR) System. For the avoidance of doubt, "AMI System" is also deemed as equivalent to "AMR Outstations" as adopted in other documents.

(a) The Works shall comprise:

- submission of proposals and reports for the AMI System to the WSD for approval;
- supply, installation, testing and commissioning of the wireless AMI System;
- programming and configuration of the wireless AMI System according to the parameters and settings given by the WSD;
- handing over of the wireless AMI System together with the record drawings to the WSD for operation and maintenance upon successful commissioning of the same; and
- provision of 24-month warranty for the wireless AMI System against defects and poor workmanship after handing over of the same.

(b) Unless otherwise specified, all equipment and devices provided shall be suitable to operate 24/7 at ambient conditions of relative humidity up to 95 % and temperature up to 50℃.

(c) If electrical or building services works are involved, they shall comply with the latest edition of the Code of Practice for the Electricity (Wiring) Regulations issued by Electrical and Mechanical Services Department (EMSD), HKSAR Government and the General Specification for Building Services Installation in Government Buildings of the Hong Kong Special Administrative Region issued by Architectural Services Department (ArchSD), HKSAR Government, where applicable.

2. Overview of Wireless AMI System

The entire AMI system of the WSD collects metering data from remote wired and wireless smart water meters and automatically manages and analyzes metering data, provides output for billing and water supplies management and disseminates useful information to customers.

The part of the infrastructure for wireless meters consists of wireless smart water meters at various sites and the AMI master station of WSD.

Unless otherwise specified, the wireless AMI System required for a building, structure and premises shall include wireless smart water meters and minimum building services installation as specified hereunder.

The wireless smart water meters shall comprise a water meter and a wireless interface device. A typical wireless water meter interfacing device (WMID) takes the form of a detachable meter interface unit (MIU), equipped on a mechanical water meter, or a separate wireless pulse counter connected to an electromagnetic/ultrasonic water meter, for which 4G LTE (Long-Term Evolution) connectivity is enabled by a SIM card inserted/embedded in the MIU/pulse counter.

The AMI master station of the WSD comprises necessary backend hardware and software, and is equipped with the required network communication and security equipment.

The water meters will be supplied by the WSD. The Developer, or his contractor (hereinafter referred to as "the Contractor"), shall supply, install and commission the wireless water meter interfacing devices and associated facilities/equipment according to the requirements as specified by the WSD.

3. Wireless Smart Water Meters

3.1 Water Meters

Water meters will be provided by the WSD for installation by the Contractor. Based on the water consumption of customers, the water meters shall be of mechanical, electromagnetic, ultrasonic or other types as deemed appropriate by the WSD.

(a) Mechanical water meters

Mechanical water meters are inline water meters of volumetric rotary piston type complete with a small rotatory disc driven by the gears of the meter. A sector of the disc with angle not smaller than 120^{o} degree is covered with metal and the remaining sector with non-metal.

(b) Electromagnetic (EM) water meters/Ultrasonic water meter

EM water meters/ultrasonic water meters are equipped with a flow converter capable of generating electric pulse output for AMI applications.

If the EM water meter or ultrasonic water meter operates on a 220V a.c. auxiliary

power supply, a 220V 13A IP 54 fused spur unit, of non-switched type and with neon light to avoid unintentional switching off power and enable easy identification of power outage of fused spur unit by visual checking, shall be provided close to the water meter by the Contractor.

3.2 Wireless Water Meter Interfacing Devices (WMIDs)

(a) Wireless WMIDs shall be provided by the Contractor. The devices shall be procured by the Contractor on his own and at his cost subject to the approval of which by the WSD.

(b) They shall be designed to collect metering data from the water meter and transmit them to the AMI master station at the WSD.

(c) Wireless smart water meters of size less than DN50 shall comprise a mechanical base water meter and a detachable MIU to be assembled with the water meter.

(d) Water meters of size equal to or greater than DN50 are usually EM/ultrasonic water meters. A separate wireless pulse counter with pulse input for interfacing with the water meter is required and shall be provided. The wireless pulse counter shall be battery-powered and properly fixed or mounted at a secure location near the water meter. The pulse counter shall come with multi-core pulse cable which is not less than 2 m with plain end for pulse output and readily connected to the pulse output wiring terminal of the EM/ultrasonic water meter.

(e) The wireless WMIDs shall communicate with the AMI master station of the WSD using 4G LTE network based on 3GPP(Third Generation Partnership Project) standard. They shall record the meter readings and store in their internal memory with date and time stamps and upload the stored data to the AMI master station at a pre-defined interval.

(f) They shall be able to measure and compensate for reverse flow such that the mechanical register of the water meter and the electronic register of the wireless WMID are identical.

(g) The operation shall be immune to electromagnetic interference level to EN50082-1 and EN50082-2,or EN61000-6-1 and EN61000-6-2, as well as complying with the emission limit to EN50081-1 and EN50081-2, or EN 61000-6-1. Type test certificates shall be provided to substantiate these requirements if so requested.

(h) The radio equipment supplied shall also comply with the requirements of the Office of the Communications Authority (OFCA) in respect of radiation safety, spurious emissions and others. Type test certificates shall be provided to substantiate these requirements if so requested.

(i) The enclosure of the device shall be at least IP68 to BSEN 60529. Type test report shall be provided to substantiate these requirements if so requested.

(j) They shall accept SIM card with assigned mobile network operator (MNO) files in MFF2 (Miniaturised Form Factor 2) size (i.e. embedded SIM card in 5x6mm size) or in 4FF (Fourth Form Factor) size (nano-SIM card). The SIM card shall be embedded/inserted in the MIU at the Contractor's works.

(k) The communication protocol of them shall be 4G LTE Cat. 1 and supporting MQTT (Message Queuing Telemetry Transport), or other approved means.

(l) They shall be able to detect abnormalities and record them in alarms including but not limited to battery low and tampering[1].

(m) Each meter read value recorded by them shall be stored in non-volatile memory with corresponding time-stamp and alarm code. The value shall be uploaded to the end server with the corresponding time-stamp and alarm code.

(n) They shall be able to perform the over-the-air (OTA) firmware updates.

(o) No programming of WMIDs shall be necessary during installation at site. And no re-programming shall be necessary if the battery fully discharged before replacement.

(p) They shall be able to immediately record the meter reading and upload the metering data to the backend server, and available for retrieval by field configuration tool, upon local activation by approved means such as NFC (Near Field Communication) or magnetic device. The same means shall also be used for waking up the wireless WMIDs for communicating with a field configuration tool.

(q) Telegram format and protocol of the wireless WMIDs shall be provided for WSD's acceptance.

(r) The wireless WMIDs shall comply with the technical and functional requirements as stated at **Appendix A** of this Specification.

3.2.1 Operating Conditions

The wireless WMIDs supplied by the Contractor shall be robust in construction and suitable for outdoor operations. The enclosure of the WMIDs shall have strong UV and abrasion resistance.

3.2.2 Particular Requirements of MIU

[1] Tampering is defined as interruption to the wireless water meter interfacing devices by means of opening the device.

(a) The MIU shall be designed and built specifically for the corresponding water meter supplied by the WSD with no cable connections to form a complete water metering unit.

(b) The MIU shall be secured to the water meter by fixing screw(s) or other approved means to ensure the sensor of the MIU always aligns with the rotatory disc of the base meter.

(c) Each MIU shall be mounted and sealed on the water meter without the need to have the water meter open up for installation. After installed, the MIU shall not obstruct the counter window and low flow indicator (if provided) of the water meter so that manual meter reading would not be impeded.

(d) The MIU shall detect the no. of times the rotatory disc of the base meter rotates by using LC (inductor-capacitor) sensors to determine the water flow. The MIU shall be able to detect and compensate for reverse flow such that the reading of mechanical register of the base meter is always the same as its electronic register.

(e) Self-calibration circuit shall be incorporated in the MIU such that the sensing circuit can still work reliably under low frequency, variation of temperature and humidity or other adverse factors.

(f) The Contractor shall provide dimensioned drawings, design parameters and other technical documents deemed necessary to prove the proposed MIU is compatible with the water meter provided by the WSD upon request.

3.2.3 Particular Requirements of Pulse Counter

(a) The pulse counter shall be designed and built specifically for the corresponding water meter supplied by the WSD to form a complete water metering unit. The pulse counter shall be connected to the water meter by pulse signal cable provided by the Contractor.

(b) The pulse counter shall be wall or pipe mounted close to the water meter by stainless steel mounting kit.

(c) The pulse counter shall be properly designed to avoid mis-counting of pulse due to low insulation between the signal cable or vibration nearby.

(d) Signal filtering/conditioning circuit shall be incorporated in the pulse counter to eliminate false counts in electrically noisy environments.

3.2.4 Particular Requirements of Battery

(a) The WMIDs shall be equipped with an internal battery for normal operation.

(b) The battery shall be non-rechargeable, sealed type and maintenance free.

(c) The supplier of the WMIDs shall substantiate with detailed calculations on the lifespan of the battery for the WSD's acceptance if so requested.

(d) The battery shall be safe for use and complied with international standard such as EN60086-4 and UN38.3 Transportation Testing – Lithium Batteries. Related certificate or tests report shall be provided to WSD upon request.

(e) The battery shall comply with the technical and functional requirements as stated at **Appendix A** of this Specification.

3.2.5 Particular Requirements of Field Configuration Tools

(a) The wireless WMID and the field configuration tool shall be communicated by Bluetooth, infrared, NFC or other approved means.

(b) Field configuration tools shall be provided, for viewing and editing, including but not limited to, the following setting:

i) Meter ID,
ii) Initial meter reading,
iii) Recording frequency,
iv) Uploading frequency,
v) Data in each uploading,
vi) Volume of water per cycle or per pulse,
vii) Destination IP, and
viii) Access Point Name (APN).

(c) The tools shall allow users to view and reset, including but not limited to, the following information stored in them:

i) Latest meter reading, and
ii) Latest alarm record.

(d) The tools shall allow users to view, including but not limited to, following information of them:

i) Last time of setting modification,
ii) Last time of data uploading,
iii) Last time of data recording,

iv) IMEI number,

v) ICCID of the SIM Card inserted to it,

vi) Operator for the local network, and

vii) Latest battery voltage.

3.3 4G LTE Cat 1 Network Service

(a) The wireless smart water meters shall be located where the 4G LTE signal strength in terms of RSRP ≥ -105 dBm or other higher values as recommended by the manufacturer of the wireless WMIDs provided by the Contractor. Signal strength test record at the locations installed with wireless WMIDs shall be provided to substantiate these requirements.

(b) If the required signal strength cannot be achieved at the water meter installation locations, the wireless smart water meters or wireless WMIDs shall be relocated. Otherwise, the Contractor shall provide proper and legal signal improvement/boosting devices such as common antenna system to ensure indoor mobile coverage at his own cost. The improvement/boosting devices are not part of the wireless AMI System to be handed over to the WSD.

(c) The SIM cards for the mobile network service shall be provided by the Contractor. The SIM cards shall be prepaid for 15 years of mobile network service with minimum 20MB monthly data usage allowance. The Contractor shall provide the network service plan and payment receipt for the SIM cards upon request.

(d) The mobile network service shall be fixed IP and with private Access Point Name.

(e) The Contractor shall install the SIM cards into the WMIDs. All the necessary disassembly and reassembly of the WMIDs shall follow the instructions given by the manufacturer of the devices to ensure the IP rating of which is maintained afterwards.

4. Electricity Power Supply and Internet Service

(a) Unless a fused spur unit has already been provided for the auxiliary supply to EM/ultrasonic type water meter, a spare 13A IP 54 fused spur unit with normal 220V 50Hz a.c. power supply at 1,350 mm AFFL shall be provided in close proximity to all indoor water meter installation locations and the equipment panel stated in (b) below. For instance, each water meter cabinet shall have at least one fused spur unit provided inside it. The fused spur units shall be supplied from dedicated MCBs which are provided solely for the use of Water Authority.

(b) An IP54 weatherproof stainless steel equipment panel in the size of W300mm x H450mm x D220mm shall be provided at agreed location on rooftop of each building. A spare 20mm dia. conduit complete with steel draw wire shall be provided between the equipment panel and the nearest ELV room where access to

direct service from any Internet service provider is/will be available. The spare conduit shall be terminated to the equipment panel and a BS4662 switchbox with blank cover at agreed location inside the ELV room.

(c) All power supplies mentioned above including those for the in-building cellular boosting equipment such as repeater for 4G signal which are necessary for the 24/7 operation and proper functioning of the wireless WMIDs shall be provided free of charge to the Water Authority. Such power supplies shall also be maintained continuously and without interruption and faults after the AMI System are handed over to the Water Authority.

(d) All surface conduits shall be Class 4 hot-dipped galvanised steel conduits. All surface boxes shall be cast iron boxes unless otherwise specified. Adaptable boxes shall be complete with a galvanized steel cover.

(e) The Contractor shall provide a copy of the Work Completion Certificate WR1 forms duly signed and endorsed for the relevant electrical work in the wireless AMI System installation.

5. Intellectual Property and Proprietary Rights

(a) If the equipment supplied by the Contractor requires intellectual property rights, appropriate licences shall be obtained from the relevant rights owners and copies of which shall be furnished to the WSD prior to handing over of the system.

(b) All technical information, documents and manuals furnished to the WSD shall have the license, copyright or written permission from the proper rights holder for using of those materials by the WSD.

(c) Documentary evidence of all licences of all software for the Works shall be provided prior to handing over of the AMI System to the WSD.

6. Testing and Commissioning (T&C) of WMIDs

(a) Before delivery to the site, the wireless WMIDs shall be tested, with routine test and sample test, satisfactorily at the manufacturer's works. Method of the tests shall be submitted for WSD's approval in advance. The test records shall be provided to the WSD for information upon request.

i) The routine test shall be conducted on each wireless WMID. It shall include but not limited to the following:

- Dimensional check on overall length and height;
- (MIU only) Trial assembly with a sample water meter of the model designated by the WSD (Sample water meter could be lent from WSD upon request);

- Initial settings check;
- Functional test in accordance with those described in Clause 3.2; and
- Battery voltage measurement.

ii) The sample test shall be conducted on selected samples of the wireless WMIDs of the same type under the same project, which collectively known as the same batch.

- The Contractor shall randomly select the number of wireless WMIDs according to the single sampling plan for general inspection level II and acceptable quality level 0.4 specified in BS 6001-1:1999 (ISO 2859-1:1999) +A1:2011. Examples of the sampling plan are given in table below. Sampling plan for other quantities shall be referred to the stipulated standard.

- If any one number of the selected samples fails in any part of the sample test as specified in this sub-clause, it shall be treated as one non-conforming unit. A batch of wireless WMIDs of the same type will be deemed to pass the sample test if the number of non-conforming units found in the selected samples is equal to or less than the respective number shown in Column III of the table below:

Single Sampling Plan for General Inspection
(BS 6001-1:1999 (ISO 2859-1:1999) +A1:2011)

Column (I)	Column (II)	Column (III)
Quantity of Wireless Water Meter Interfacing Devices (No.)	Quantity of Samples to be Selected (No.)	**Pass** (Maximum No. of Non-conforming units)
1 to 50	all	0
51 to 500	50	0
501 to 1200	80	1*
1201 to 3200	125	1*
3201 to 10000	200	2*

* to be replaced with conforming units before shipment.

- The sample test shall verify the output accuracy of the wireless WMIDs which shall be within +/- 0.5% deviation, regardless the +/- 1L deviation due to the analogue and digital conversion, at the equivalent water flowrates, setting and durations as follows:

MIU

Size of Meter	Volume of Water for one cycle (L/cycle)	Nominal Flowrate Q3 (m3/hr)	Maximum Flowrate Q4 (m3/hr)	Minimum Flowrate Q1[2] (m3/hr)	Transitional Flowrate Q2 (m3/hr)
DN15	1	2.5	1.25 x Q3	Q3/160	1.6 x Q1
DN25	1	6.3	1.25 x Q3	Q3/160	1.6 x Q1
DN40	1	16	1.25 x Q3	Q3/160	1.6 x Q1

Q2 shall be tested for at least 75 minutes and Q4 shall be tested for at least 10 minutes at an ambient temperature of not higher than 30°C.

Pulse Counter

Size of Meter	Volume of Water for one pulse (L/pulse)	Nominal Flowrate Q3 (m3/hr)	Maximum Flowrate Q4 (m3/hr)	Minimum Flowrate Q1[3] (m3/hr)	Transitional Flowrate Q2 (m3/hr)
DN50	1	40	1.25 x Q3	Q3/500	1.6 x Q1
DN80	10	160	1.25 x Q3	Q3/250	1.6 x Q1
DN100	10	250	1.25 x Q3	Q3/200	1.6 x Q1
DN150	100	400	1.25 x Q3	Q3/160	1.6 x Q1
DN200	100	630	1.25 x Q3	Q3/160	1.6 x Q1
DN250	100	1600	1.25 x Q3	Q3/250	1.6 x Q1
DN300	100	1600	1.25 x Q3	Q3/160	1.6 x Q1

Q2 shall be tested for at least 75 minutes and Q4 shall be tested for at least 5 minutes at an ambient temperature of not higher than 30°C.

(b) Upon delivery of wireless WMIDs to site, the Contractor shall prepare a delivery list in excel format. The list shall contain the serial no. of each wireless WMID together with the IMEI no. of its cellular modem, the ICCID of the SIM card embedded and other ID nos. as requested by the WSD.

(c) Before installation, one sample unit of each type of the wireless WMID shall be selected for a data transmission test. The sample shall transmit a series of test datagrams from the site to the AMI master station designated by the WSD for verifying its compliance with the data format requirements.

(d) After completing the installation of the wireless WMIDs, individual devices shall be tested to ensure that it performs in accordance with the specified requirements and is in satisfactory working conditions.

[2] The Q1 value stated in this Specification is the default value only. In any cases that the Meter available for WMIDs installation is deviated from the default value, WSD will advise the value in the reply of Technical Proposals.
[3] Ditto

(e) Before T&C of the wireless WMIDs, the Contractor shall ensure all the wireless WMIDs are installed in accordance with the Meter Installation Table (MIT), which shall include Meter ID and corresponding identification number/serial number of the wireless WMIDs, as agreed with the WSD.

(f) During T&C, the Contractor shall follow the standard site test procedure described hereunder to test and commission the wireless WMIDs. Depending on the complexity of the devices, the Contractor may be requested by the WSD to perform additional tests to verify the specific functionality of the wireless AMI System.

(g) The T&C procedure shall include, but not limited to, the following:

i) General and functional checks of each component in accordance with Clause 3.2;

ii) Configuration and operation check on the WMID;

iii) Synchronization of both the electronic and mechanical registers of each smart water meter; and

iv) Integrity test of the smart water meter data on the AMI master station.

(h) After T&C, the Contractor shall submit a full set of T&C report covering all the items in the wireless AMI System and a stock taking list to WSD.

(i) If the T&C Report and the stock taking list are found in order, WSD representative will conduct a joint inspection to the AMI System with the Contractor. If any defects are found in the inspection, the Contractor shall rectify the defects in an agreed period and make request for inspection again.

7. <u>System Transfer for Operation and Maintenance and Warranty</u>

(a) After the joint inspection of the wireless AMI System is carried out satisfactorily, the whole wireless AMI System installation, including spare items (if any), will be considered as ready for handing over to the Water Authority for operation and maintenance.

(b) The WSD will issue a letter certifying the completion of the wireless AMI System for the building/structure/premises with the official handover date of which to the Applicant of the water supply upon receipt of :-

(i) Two (2) complete sets of hardcopy of the final T&C report and the stock

taking list with softcopy in pdf format in a CD-ROM.

(ii) Field configuration toolkits and special O&M tools (if any) as follows:

Total no. of wireless water meter interfacing devices with the same make and model under the same installation	No. of Field Configuration Toolkits required	No. of special O&M tools (if any)
Less than or equal to 50	1	5
More than 50 and less than or equal to 500	3	10
More than 500	5	20

Each field configuration toolkit shall come with the corresponding set of hardware (e.g. Infrared reader) and software for configuring and diagnosing the wireless WMIDs on the site with a laptop or smart phone.

(c) All devices and equipment in the wireless AMI System supplied by the Contractor shall be subject to a warranty against defects and workmanship for 24 months from the official handover date.

8. Submissions

(a) An AMI System Proposal including but not limited to the equipment proposal, the equipment layout and the programme of the Works shall be submitted to the WSD for approval prior to commencement of the Works.

(b) A Testing and Commissioning (T&C) Report including but not limited to the T&C test reports, as-built information and the stock taking list, shall be submitted to the WSD before inspection to be conducted by WSD.

(c) The flowchart for submission requirements can be found in the **Appendix E**.

(d) The checklists on documents to be included in the submissions can be found in the **Appendix B** and **Appendix D**.

9. Special Arrangement for Acquiring WMIDs through WSD

(a) Term contracts for supplying conforming WMIDs to the WSD for use in existing buildings and premises within the territories of HKSAR exist.

(b) For their convenience, the Contractors may choose to acquire WMIDs under the same term contracts through the WSD subject to advance agreement. The latest unit rates of the WMIDs and relevant handling fees to be charged by the WSD for such arrangement can be found on the following website:

https://www.wsd.gov.hk/en/plumbing-engineering/automatic-meter-reading/index.html

(c) If the WMIDs are procured through the WSD, the requirements on submission,

testing, commissioning and warranty of such WMIDs under this Specification will be exempted from the Contractor's responsibility.

(d) All mechanical type water meters for AMI application will be provided to the Contractor with the WMID pre-installed.

(e) The WMIDs acquired through the WSD are, by default, pre-installed with SIM cards from the WSD. The Contractor shall pay to the Water Authority a one-off charge for each SIM card provided to the Contractor, which is equivalent to 15 years of the network service cost, at the time of settling payment for the WMIDs.

(f) The Contractor can opt to acquire the SIM cards on their own. In such case, The Contractor shall follow the requirements as stated in Clause 3.3 (c) and (d). The Contractor shall submit the detailed network service plan (e.g. validity period, monthly data usage allowance, etc) and technical information of the SIM cards (e.g. size, communication protocol, etc) with the Technical Proposal for approval. The T&C Report shall include a spreadsheet showing the ICCID of each SIM card installed to the corresponding WMID and a copy of the payment receipt for the prepaid SIM cards.

10. Coordination and Responsibility

The Developer shall employ a delegate for the duties including but not limited to the following:

(a) Coordinate and communicate with the WSD in the submission and approval of the wireless AMI System;

(b) Arrange, check and endorse all submissions including proposals, drawings, T&C procedure, T&C report and technical information to the WSD;

(c) Oversee all aspects of the Works including planning, organising, coordinating, supervising and monitoring of the supply, installation, T&C and handing over of the wireless AMI System under the Works;

(d) Supervise and monitor the Works to ensure the wireless AMI System is supplied, installed and handed over in accordance with the proposal, requirements and drawings approved by the WSD;

(e) Monitor and report the work progress, and ensure the Works are completed within the required time frame;

(f) Coordinate with utility companies including the mobile network operator as necessary to ensure the wireless AMI System will work properly after handover.

(g) If the WMIDs are not supplied under the term contracts of the WSD, the delegate shall also possess competence and experience in electrical or building services installations for overseeing the submission, procurement, installation, testing and commissioning of the WMIDs.

11. Reference Documents

The Contractor shall further note the requirements specified in the documents issued by the WSD, which can be obtained via the following website, in relation to the WSD AMI requirements:

http://www.wsd.gov.hk/en/plumbing-engineering/index.html

12. Terms, Definitions and Abbreviations

"Works"	The work or services to be carried out, completed, maintained and/or supplied in accordance with the scope and requirements of this Standard Specification and includes temporary works.
"Developer"	The person, firm, company or the Purchaser (as defined in the Conditions of Sale) responsible for the execution of the Works.
"Contractor"	The person, firm or company employed by the Developer for the execution of the Works.
"Smart Water Meter"	Water meter equipped with water meter interfacing device.
"Wireless Smart Water Meter"	Water meter equipped with wireless water meter interfacing device.

Appendices:

Appendix A	-	Functional Requirement for Wireless Water Meter Interfacing Device
Appendix B	-	Cover Page and Submission Checklist for Technical Proposal of Wireless AMI System
Appendix C	-	Wireless Signal Coverage Test Form
Appendix D	-	Cover Page and Submission Checklist for T&C Report of Wireless AMI System
Appendix E	-	Flowchart for the Submission Requirement of Wireless AMI Systems

Functional Requirement for Wireless Water Meter Interfacing Device

1 Scope and General Overview

1.1 This document specifies the technical and functional requirements for the Wireless Water Meter Interfacing Device, including Meter Interfacing Unit (MIU) and Pulse Counter, to be used with water meters. The Wireless Water Meter Interfacing Device shall collect, store, and transmit water consumption data to a central server via MQTT, operating reliably under various environmental conditions, supporting remote configuration, and ensuring long-term functionality with minimal maintenance.

2 General Requirements

2.1 The Wireless Water Meter Interfacing Device shall use a timestamp format internally and for recording capable of handling dates up to the year 2106 with a minimum resolution of 1 second. A modified Unix timestamp using an unsigned 32-bit integer is acceptable.

2.2 The Wireless Water Meter Interfacing Device shall support obtaining the current time from the mobile network. If mobile network time is unavailable, it shall synchronize its clock with the MQTT server.

2.3 The internal real-time clock shall maintain an error of less than 15 seconds per day under all operating conditions.

2.4 Meter values shall be stored as unsigned 32-bit integers, representing water consumption in liters (e.g., a value of 0xa1b2c3d4 represents 2,712,847,316 liters).

2.5 The Wireless Water Meter Interfacing Device shall store at least 1,500 timestamp-meter value pairs in non-volatile memory, dynamically shared between volume-based and time-based recording.

2.6 The Wireless Water Meter Interfacing Device shall adjust its clock from the mobile network or MQTT server after all upload and download activities, just before going offline.

2.7 For backward time adjustments, the Wireless Water Meter Interfacing Device shall not record new data until the adjusted clock surpasses the time of the latest stored record.

2.8 For forward time adjustments causing skipping of scheduled time-based recording, the Wireless Water Meter Interfacing Device shall immediately store one record based on the adjusted time.

2.9 The Wireless Water Meter Interfacing Device shall include an LED status indicator displaying colors and/or blinking patterns to indicate states such as powered on, data transmission in progress, waiting before going offline, error, and low battery. The LED shall only be active within 5 minutes after manual triggering and remain off otherwise to conserve power.

2.10 The Wireless Water Meter Interfacing Device shall have tampering detection and alerting capabilities.

2.11 The Wireless Water Meter Interfacing Device shall achieve a battery life of at least 12 years in typical usage (assuming one upload per day, normal signal levels, 1L volume-based recording, and one time-based recording per day).

2.12 The Wireless Water Meter Interfacing Device shall use a 3.6V Lithium Thionyl Chloride battery with a capacity of no less than 8,500 mAh.

2.13 A supercapacitor of suitable voltage and capacity shall be connected in parallel with the battery to handle peak current demands.

2.14 The Wireless Water Meter Interfacing Device shall provide an accurate estimation of remaining battery capacity percentage based on prior activities and mobile signal strength.

2.15 The Wireless Water Meter Interfacing Device shall be rated IP68 for dust and water resistance, operate within a temperature range of 0°C to +50°C, and withstand relative humidity up to 90% non-condensing. The enclosure shall be UV resistant.

2.16 The Wireless Water Meter Interfacing Device shall be designed and constructed with durable material suitable for outdoor use with a lifetime of minimum of 15 years.

2.17 The Wireless Water Meter Interfacing Device shall support over-the-air (OTA) firmware updates via the MQTT server, verifying firmware integrity before updating and rolling back to the previous version if the update is unsuccessful or problematic.

2.18 The Wireless Water Meter Interfacing Device shall have stamped, etched or engraved markings on the enclosure, including text and a QR code for the Wireless Water Meter Interfacing Device ID, readable when installed.

2.19 (For MIU only) The Wireless Water Meter Interfacing Device shall not obstruct the display of the base mechanical water meter after installation.

2.20 (For MIU only) The combined height of the base mechanical water meter with the Wireless Water Meter Interfacing Device installed shall not exceed 155 mm.

3 Communication Requirements

3.1 The Wireless Water Meter Interfacing Device shall support DNS resolution for connecting to MQTT servers.

3.2 The Wireless Water Meter Interfacing Device shall support MQTT v3.1.1 or 5.0 with QoS 1, using TLS 1.2 or above for secure communication and supporting authentication via username and password.

3.3 The Wireless Water Meter Interfacing Device shall support connection to the MQTT server using TCP or TLS and allow the installation of custom CA certificates.

3.4 The Wireless Water Meter Interfacing Device shall be configurable to connect to one main MQTT server and one backup MQTT server. If communication with the main server fails, it shall attempt to connect to the backup server.

3.5 If connections to both main and backup MQTT servers fail, the Wireless Water Meter Interfacing Device shall implement an exponential retry delay starting at 15 minutes, doubling with each failure (e.g., 30 minutes, 60 minutes), capped at a maximum of 7 days or the configured upload period whichever is smaller.

3.6 The Contractor shall propose and submit all message types and formats for the employer’s approval.

4 Recording of Meter Data

4.1 The Wireless Water Meter Interfacing Device shall store both a timestamp and meter reading for every record.

4.2 For volume-based recording, the Wireless Water Meter Interfacing Device shall record data after a configurable volume of water in litres has passed (e.g., a value of 0x0001 indicates a recording interval of 1 litre). A value of 0 shall disable this feature.

4.3 For time-based recording, the Wireless Water Meter Interfacing Device shall support a configurable number of seconds between records in one day, with the last record always taken at 23:59:55. Examples:

4.3.1 A value of 1800 seconds results in records at 00:29:55, 00:59:55, etc., up to 23:29:55 and 23:59:55.

4.3.2 A value of 65534 seconds results in records at 05:47:41 and 23:59:55.

4.3.3 A value of 65535 seconds or larger results in one record only at 23:59:55 daily.

4.3.4 A value of 0 shall disable this feature.

4.4 If both volume-based and time-based recording are disabled, the Wireless Water Meter Interfacing Device shall override with a volume-based setting of 0 and a time-based setting of 65,535 seconds.

5 High Flow Rate Alert

5.1 The Wireless Water Meter Interfacing Device shall support three sets of sustained high flow rate alert settings, triggered when the flow rate in litres per minute exceeds a configured threshold for a configured duration in seconds.

6 Uploading of Stored Meter Data and Status

6.1 After successful data upload, the uploaded data shall be cleared from the Wireless Water Meter Interfacing Device.

6.2 The Wireless Water Meter Interfacing Device shall upload stored data to the MQTT server at configurable intervals (e.g., every 24 hours) within a random window (e.g., 3600 seconds) set by the MQTT server.

6.3 The Wireless Water Meter Interfacing Device shall support a one-shot definite upload time configured by the MQTT server.

6.4 The Wireless Water Meter Interfacing Device shall record one additional reading during each data upload.

6.5 The Wireless Water Meter Interfacing Device shall initiate an upload when storage reaches 95% capacity, regardless of the scheduled upload time.

6.6 The Wireless Water Meter Interfacing Device shall trigger an upload when tampering occurs, with the LED remaining off during such uploads.

6.7 The Wireless Water Meter Interfacing Device shall trigger an upload when the lifetime backflow volume increases by a configurable threshold since the last upload triggered by this event.

6.8 The Wireless Water Meter Interfacing Device shall trigger an upload when a sustained high flow rate alert is activated.

6.9 Manual upload shall be triggered via a physical button, touch sensor, or magnetic switch.

6.10 When the estimated remaining battery percentage drops below a configurable low battery level (e.g. 15%), the upload frequency shall reduce to once every 14 days, and the Wireless Water Meter Interfacing Device shall store only one record daily at 23:59:55.

6.11 When the estimated remaining battery percentage drops below a configurable critical battery level (e.g. 8%), the Wireless Water Meter Interfacing Device shall trigger one final data upload and cease automatic uploads. In this state, upload triggered by tampering may occur a maximum of once.

6.12 Manual triggering of upload shall always be allowed, regardless of battery level.

6.13 To reclaim storage space when internal storage is nearly full and data cannot be uploaded for a prolonged period:

6.13.1 When total storage occupied by volume-based and time-based records reaches 90%, the Wireless Water Meter Interfacing Device shall delete every alternate volume-based record. If time-based recording is enabled, it shall keep the last time-based record of each day and delete every alternate time-based record within the same day. The Wireless Water Meter Interfacing Device shall then double both volume-based and time-based recording intervals. After a successful upload, the original recording intervals shall be restored.

6.13.2 When storage occupied by time-based records alone reaches 95%, the Wireless Water Meter Interfacing Device shall delete every alternate time-based record.

6.14 The Wireless Water Meter Interfacing Device shall upload its status every time it is online, after data upload and before configuration download, including Wireless Water Meter Interfacing Device ID, IMEI, ICCID, firmware version, Wireless Water Meter Interfacing Device clock, battery voltage, estimated remaining battery, temperature, lifetime backflow volume in litres, lifetime backflow volume increase flag, final data upload flag, data reduction occurred flag, tamper flag, sustained high flow rate alert flag, storage mode flag, cell ID, RSSI, RSRP, RSRQ, SNR, and other information useful for the Wireless Water Meter Interfacing Device or for system administration. All flags shall be cleared after successful status upload.

6.15 Before going offline, the Wireless Water Meter Interfacing Device shall wait for a configurable time, during which the MQTT server may update the configuration. Immediately before going offline, the Wireless Water Meter Interfacing Device shall upload a message containing the original clock before adjustment, the new clock after adjustment, and the next upload time chosen by the Wireless Water Meter Interfacing Device.

7 Support for Remote Configuration from MQTT Server

7.1 The Wireless Water Meter Interfacing Device shall support remote configuration from the MQTT server for:

7.1.1 IP addresses of main and backup DNS servers

7.1.2 IP addresses or hostnames and ports of main and backup MQTT servers

7.1.3 Volume-based recording interval

7.1.4 Time-based recording interval

7.1.5 Data upload interval and random windows

7.1.6 One-shot definite upload time

7.1.7 MQTT topics for data upload, configuration download and server time

7.1.8 Sustained high flow rate alert settings (three sets)

7.1.9 Wait time before going offline

7.1.10 Low battery level and critical battery level

7.1.11 Lifetime backflow volume increase threshold

8 Storage Mode and Factory Default Configuration Restoration

8.1 Upon delivery, the Wireless Water Meter Interfacing Device shall be configured in storage mode to conserve battery life, minimizing power consumption by shutting down unnecessary components. It shall upload its once every 30 days with a 3600-second random window.

8.2 Activating the button, touch sensor, or magnetic switch for 30 seconds continuously shall restore the Wireless Water Meter Interfacing Device to storage mode, erasing all stored records and configurations. Default settings shall include primary and backup DNS servers, primary and backup MQTT server IP addresses and ports.

8.3 In storage mode, when a manual upload is triggered, the Wireless Water Meter Interfacing Device shall connect to the default or backup MQTT server, download a new configuration, adjust its clock to the mobile network or MQTT server time, initiate a status upload, and begin functioning according to the new configuration. It shall perform one additional data and status upload after 3 minutes to confirm functionality.

8.4 The Wireless Water Meter Interfacing Device shall support restoring to storage mode when requested by the MQTT server.

8.5 When configured by the MQTT server, the Wireless Water Meter Interfacing Device shall prevent local manual triggering of restoring to factory defaults and storage mode. In this state, upload triggered by local manual operation shall be limited to once per day.

--- End ---

Technical Proposal for Wireless AMI System

Part I – General Information

Address of Premises:	
Name of Applicant (in English) :	
(In Chinese) :	
ASN/CCID No. (if applicable):	
WSD AMI Reference No. (if applicable):	

To: Water Authority

I/We[#] will provide a wireless AMI system in the above premises. The proposal for the wireless AMI system installation is summarized as follows:

No. and Size of Water Meters Involved

Size	DN 15	DN 25	DN 40	DN 50*	DN 80*	DN 100*	DN 150*	DN 200*	DN 250*	DN 300*
No.										

* Pulse counter will be used

Please tick the appropriate box

The following items will be acquired through WSD[@]:

☐ Wireless MIUs ☐ Wireless Pulse Counters ☐ SIM Cards

[@] Payment to WSD for relevant items shall be settled at least 6 months before collection of Meters.

The following items will be acquired on my own with prior approval from WSD:

☐ Wireless MIUs ☐ Wireless Pulse Counters ☐ SIM Cards

☐ Other:_____
(Please Specify)

Target Date of Collection of Meters from WSD:_____
(Technical Proposal should be approved by the WSD beforehand)

Target Date of Effecting of Water Supply: _____
(Wireless AMI System should be completed beforehand)

Submitted by:		Company Name:	
Telephone No.:		Email Address:	
	Date of Submission:		

delete as appropriate

Encl.

Part II – Documents Enclosed with the Technical Proposal

Please tick the appropriate box

Item of Document		Included in the Proposal	Not Applicable
General			
(1)	Preliminary Drawings/Layout Plans showing: (a) The site location and boundary of the development; and (b) Locations of water meters (e.g. common floor plan).	 □ □	 □ □
(2)	Initial signal coverage test report showing: (a) The signal strength measured at each location of water meter; and (b) The proposed remedial plan for poor signal coverage locations.	 □ □	 □ □
(3)	Supporting Documents including: (a) Copy of related Special Conditions in Land Lease with covering letter showing date of issuance of the Land Lease (if applicable); (b) Appointment letter issued by the Developer to entrust the Works to the Contractor; and (c) AMI Outstation Design Change Request Form (for change of design from wired to wireless scheme); and (d) Form WWO1155 Request for Work to be Carried out by the Water Authority (if Wireless Water Meter Interfacing Device(s) are acquired through WSD).	 □ □ □ □	 □ □ □ □
(4)	Other information required by the Water Supplies Department (WSD). Please specify: _____	□	□
Please fill in the following part if the Meter Interface Units (MIU) and/or Pulse Counters will be acquired on your own with prior approval from WSD			

(5)	Design of the wireless water meter interfacing device including:		
	(a) General arrangement of the MIU assembled to the mechanical water meter in CAD files and drawings;	□	□
	(b) General arrangement of the pulse counter assembled to the ultrasonic/EM water meter (if any) in CAD files and drawings;	□	□
	(c) Brochure and technical schedule of the MIU and pulse counter (if any);	□	□
	(d) Brochure and technical schedule of the Field Configuration Tools;	□	□
	(e) Telegram of the MIU and pulse counter (if any);	□	□
	(f) Type test report to substantiate IP68 of the MIU and pulse counter;	□	□
	(g) Type test report to substantiate the electromagnetic interference level and emission limit in compliance with OFCA's requirements; and	□	□
	(h) Calculations to substantiate the lifespan of the battery.	□	□
(6)	Equipment Schedule including:		
	(a) A list of MIUs and pulse counters for the wireless AMI system with brand, model no., product brochure, technical data sheet;	□	□
	(b) A list of special tools required for disassembly and reassembly of the MIUs and pulse counters;	□	□
	(c) A list of special tools for fixing MIU on water meter (if any);	□	□
	(d) A list of field configuration tools for the proposed MIUs and pulse counters; and	□	□
	(e) Method Statement for the routine and sample tests of the MIUs and pulse counters.	□	□

Wireless Signal Coverage Test Form (Before/After* Meter Installation)		
AMI Project No.:		
Site Address:		Test Date:
Testing Instrument:		
Instrument	Make and Type	Serial No

Note:
1. Location map and layout plan of the site should be attached to this form when submitted.
2. Each test point should be tested at least three times successively with minimum interval of 5 minutes.
3. Test should be conducted under real working conditions as far as practicable, e.g. access door of meter room in closed state.
4. If real-condition test cannot be carried out, e.g. building not ready, rough estimated signal strength losses should be allowed as follows:

Metal	Low-E and Tinted Glass	Concrete (6 inch)	Brick and Stone	Plaster	Wood	Clear Glass	Fibre-glass Insulation	Drywall
-50 dBm	-30 dBm	-15 dBm	-10 dBm	-10 dBm	-6 dBm	-4 dBm	-2 dBm	-2 dBm

Example: 4G signal at -70 dBm outside the building will pass through a glass pane, a brick wall and a wooden access door before reaching the smart meter. The resultant 4G signal strength at the meter position is -70 dBm + (-4-10-6) dBm = -90 dBm.

Test Results

Network Operator (e.g. China Mobile)	Technology (e.g. LTE 4G)	Frequency Band (e.g. B8)	Physical Cell Identification (PCI) No.	In-building Signal Booster installed (Y/N)
Reference Value	RSRP (dBm)			
LTE 4G	≥ -105			

Location Point	Floor (e.g. 40/F)	Time Stamp (e.g. 14:00)	RSRP (dBm)			Result (Pass-✓/Fail-✕)	SINR (dB)	Remark
			Measured	Estimated Signal strength Loss	Resultant			

Remedial Plan for Poor Signal Reception Locations

e.g. Network operator is agreed to provide cellular repeaters near the building for signal improvement before the occupation of the building.					
Tested by:		Post:	Witnessed by:		(Applicant's Representative)
Signature:			Signature:		
Company:			Company:		
Date:			Date:		

* delete as appropriate

Testing and Commissioning (T&C) Report for Wireless AMI System

Part I – General Information

Address of Premises:	
Name of Applicant (in English) :	
(In Chinese) :	
ASN/CCID No. (if applicable):	
WSD AMI Reference No. (if applicable):	

To: Water Authority

I/We# have completed the wireless AMI system installation in the above premises. The wireless AMI system is ready for handing over to the Water Authority. Details of the installation are summarized as follows:

No. and Size of Water Meters Involved

Size	DN 15	DN 25	DN 40	DN 50*	DN 80*	DN 100*	DN 150*	DN 200*	DN 250*	DN 300*
No.										

* Pulse counter is used

Please tick the appropriate box

The following items were acquired through WSD:

☐ Wireless MIUs ☐ Wireless Pulse Counters ☐ SIM Cards

The following items were acquired on my own with prior approval from WSD:

☐ Wireless MIUs ☐ Wireless Pulse Counters ☐ SIM Cards

☐ Other:_____
(Please Specify)

Date of Approval of Technical Proposal: _____

Target Date of Effecting of Water Supply: _____
(Wireless AMI System should be completed beforehand)

Submitted by:		Company Name:	
Telephone No.:		Email Address:	
		Date of Submission:	

delete as appropriate

Encl.

Part II – Documents Enclosed with the Report

Please tick the appropriate box

Item of Document		Included in the Report	Not Applicable
General			
(1)	Latest Drawings/Layout Plans showing:		
	(a) The site location and boundary of the development; and	□	□
	(b) Locations of water meters (e.g. common floor plan).	□	□
(2)	Final signal coverage test report showing the signal strength measured at each location of water meter	□	□
(3)	As-built Meter Installation Table (MIT) including:		
	(a) The service address of each water meter in the building that requires individually metered water supply;	□	□
	(b) The numbers, sizes and types of water meters;	□	□
	(c) IP address assigned to each meter; and	□	□
	(d) Serial No., IMEI, ICCID of the SIM card of each MIU and pulse counter (if any) installed to each meter.	□	□
(4)	Technical Documents including:		
	(a) Copy of the latest Technical Proposal approval letter;	□	□
	(b) Copy of the payment receipts for MIUs, pulse counters and/or SIM cards acquired through the WSD; and	□	□
	(c) Copy of network service plan and payment receipt for the SIM Cards (if SIM Cards are not acquired through the WSD).	□	□
(5)	Supporting Documents including:		
	(a) Copy of related Special Conditions in Land Lease (if applicable);	□	□

	(b) Appointment letter issued by the Developer to entrust the Works to the Contractor;	□	□
	(c) Delivery list of the MIU and pulse counter (if any); and	□	□
	(d) Copy of Work Completion Certificate Form WR1 for the relevant electrical works in the wireless AMI System.	□	□
(6)	Other information required by the Water Supplies Department (WSD). Please specify: _____	□	□
Please fill in the following part if the Meter Interface Unit and/or Pulse Counters were acquired on your own with prior approval from WSD			
(7)	Test Reports including:		
	(a) Routine test and sample test report;	□	□
	(b) Testing and Commissioning (T&C) test report; and	□	□
	(c) Result of additional tests as requested by the WSD (if any).	□	□
(8)	Full list of equipment installed and tools provided including:		
	(a) A list of MIUs and pulse counters for the wireless AMI system with brand, model no., product brochure, technical data sheet, summary of settings;	□	□
	(b) A list of special tools provided with details such as user manual; and	□	□
	(c) A list of field configuration tools provided with details such as login password (if any) and user manual.	□	□
(9)	Operation and maintenance instructions of major equipment including:		
	(a) Wireless MIUs and pulse counters (if any);	□	□
	(b) Field Configuration Tools and Special Tools; and	□	□

	(c) Others as requested by the WSD.	□	□

Flowchart for the Submission Requirements of Wireless AMI Systems