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Annex 3 TO REQUEST FOR TENDERS

TECHNICAL SPECIFICATION

Codice CIG n. 75400928C0

Applicable to the "Smart.met" project as referred to the action entitled 'PCP for Water Smart Metering — SMART.MET as described in the Grant Agreement No 731996 associated with document Ref. Ares(2016)6330258 - 09/11/2016 available on the EU Commission participant portal

Annex 3 - Technical specification

The SMART.MET team has provided a need elicitation, which has been declined in functional requirements that were prioritized and subjected to a detailed SoA analyses to assess in how far the defined need could yet been satisfied by currently available technologies on the market or close to market. On the basis of this preparatory exercise the following challenge description was established:

1. Challenge description

The desire of SMART.MET public procurers' group is to improve the quality and/or efficiency of the water metering service, as well as to provide new features in the future.

The need expressed by the procurers' group is to develop (a) solution(s) able to transfer data and information bidirectionally between meters and a Control Room system.

In order to avoid the problems of the difference of "languages" or of technical specs for the communication among the different reference Architecture Layers, the development must be focused on the adoption and the definition of a common open communication and application standard, to assure interoperability and interchangeability among components from different manufacturers.

The core of the innovation lies in the renewed automation of meter reading and the remote management of the devices, enabling access to accurate data that Smart Water Metering can provide to decrease operating costs through the identification of network performance issues, the improvement of customer service and a better driven prioritization in planning infrastructure investments and initiatives.

SMART.MET strongly paves the way to a more efficient management providing for example automatic reading of the household meters and a more customer aware billing, real time assessment of water balance for leak detection (both on network side and on household side), detection of abnormal customer behaviors and water consumption awareness-raising, ability to identify defaulting meters and to provide a better service level to the end user.

2. Functional requirements

We have acknowledged that the need cannot be satisfied by State of the Art solutions and that its satisfaction requires:

1) the integration of functionalities currently available in different solutions but not altogether in one solution;

2) the adoption of suitable Open standards and common / consistent data modeling and protocols that can guarantee Interchangeability / Interoperability;

3) the technological development of 3 breakthrough functionalities currently not available in any solution commercialized on the market, nor protected by patent or otherwise mentioned in the literature as close to market:

- **Network Sided Water Leakage Detection (req. U_{11a}),** leveraging on installed smart meters as distributed sensors to perform analysis and detect whether or not a leakage occurs and, with a certain accuracy level, where the leakage detection can be, without any need of a special infrastructure.

- Smart Meter **Schedulable On-Demand Communication (req. U_4)** as a technology to implement advanced complex workflow driven activities on NAN network) involving an interactive bi-directional real-time communication within a limited timeframe preventing battery depletion while ensuring high performance interaction. In other words it should be an innovative energy saving transmission mode to address the use of a tightly interactive communication to support complex process workflows (e.g. Network Sided Leakage Detection analysis activities) or special data communication.

- **Centralised Backup and Synching in Water smart metering (req. I_4)**, offering the potential to make smart meter installation process significantly more efficient, the smart meter configuration procedure less error prone and to free up time of field engineers to be better dedicated to higher value activities.

3. Technical requirements

We divide the requirements into different sections. All the requiremenst within the sections are classified according to the following Legenda:

Legenda:

Functionality Phase
I: related to Installation & Replacement (Phase I)
U: related to Use and management (Phase II)
M: related to Maintenance (Phase III)
D: related to Disposal (Phase IV)

Functionality ranking
F: "fundamental" requirement
NH: "nice-to-have" requirement

3.1 Basic requirements for the required Solutions currently not available on the market

Functionalities	F/NH	Performance / KPIs
I_1 The solution component must be interoperable complying with an industry market standard defined or yet to be defined	**F**	**1** KPI : Operational tests must be carried out to check the compatibility of different devices from center to periphery and backwards and of different AMM/AMR software components in executing the same commands.
U_3 The Smart Meter, Data Transfer and Control Room Layer should be based on an open, solid, tested, efficient and resilient interconnection standard	**F**	**3** KPI : in case of an architecture with gateways for interconnecting the NAN (Neighbor Area Network) and the WAN (Wide Area Network) networks, the communication standards can be different on the two sides, one from Smart Meters to Gateways (NAN), another one from Gateways to Control Room (WAN)

3.2 Additional required functionalities in the proposed solutions - Breakthrough technologies needed to be developed and integrated in a comprehensive solution that satisfies all other requirements as well

Functionalities	F/NH	Performance / KPIs
I_4 It has to be ensured the automatic centralized backup and synching of configuration parameters from the old meter to the new one at replacement time.	**F**	**4** KPI: the replacement operation, including the initialization of the new Smart Meter, cannot take more time than the current replacement installation for traditional meters. (The procurers are asked to specify how long time is required for the current replacement operations). Same additional consideration as the previous KPI
U_{11a} Remotely Operated Leakage Detection – a) Semi-Automated leakage detection at Distributor Meshed Network side	**F**	**11a** KPI could be the following: a) operation efficiency increase of 500% from old leakage detection process to new semi-automated process. The KPI is very demanding and is clearly under distributor responsibility (i.e. money to be invested).
U_4 A schedulable On-Demand communication feature is necessary. This is particularly useful for a complex work flow involving a strong interaction between centre - periphery and backwards or a complex data exchange communication. For instance a Leakage Detection Analysis Process and a remote Firmware Update) in order to have the benefit of a real-time interactive communication for a short period while saving battery consumption when the communication is no longer needed.	**F**	**4** KPI: The Scheduling of the On-demand communication is foreseen and can be booked with some adequate notice (for example 1 day before) This feature should be present in the application protocol chosen, if not it should be the subject of a companion standard.

3.3 Additional required functionalities in the proposed solutions - functional requirements already available in one or more solutions for water smart metering, or any other type of smart metering from which they can easily be transferred, and should all be included in the sought Solution.

Functionalities	F/NH	Performance / KPIs
I_2 The Smart Meter must fit the pipe section, thread, step and other technical characteristics currently in use, room occupation etc. for an easy installation and procurement compliance	**F**	**2** KPI: every procurer must specify pipe technical specs and room occupation for the Smart Meter to comply with. Indicator expressed as max acceptable mechanical quotes. Judgement is binary : C /NC
I_3 The meter and the related solution should be as simple as to require no special competences but the usual hydraulic skills to install	**F**	**3** KPI: same installation time of traditional meters. Indicator expressed as: Lower, Equal, Greater of a standard installation time. Mathematical function perhaps needed to interpolate intermediate levels of judgement. Technical weight shall increase with the lowering of installation time.
I_5 The Smart Meter size must allow easy installation with little or no masonry works	**F**	**5** KPI: it must comply with the tiniest niche size amongst the procurer's national standard (every procurer is requested to report the nationally regulated niche size to house the Smart Meter). Could be managed with the same KPI of **I_2**

U_1 Communication must be bi-directional from centre to periphery and backwards, preventing the end-user from a direct connection to the meter bypassing the Distributor's Control Room and BSS layers	**F**	**1** KPI: presence of secure and authentication methods for on-site operations and a secure encrypted and authenticated communication method for data transmission. This could split in a collection of several KPIs : **1.1 KPI**: is standard adopted compliant to NIST or EU standard ? Yes/Not **1.2 KPI**: in case the adopted standard is compliant, which type of security infrastructure? Public/Private keys or symmetrical Keys method. Evaluation taken from literature. **1.3 KPI 3**: In case symmetrical keys which Encrypt/ Authentication algorithm and key lengths adopted. Algorithm evaluation taken from literature Key length judged in terms of length (256 better than 128 bits) and easiness of evolution towards higher lengths. **1.4 KPI**: How many installation already done per each proposed method and how many positive feedbacks from the distributors. Qualitative judgment
U_3 The Smart Meter, Data Transfer and Control Room Layer should be based on an open, solid, tested, efficient and resilient interconnection standard	**F**	**3** KPI : in case of an architecture with gateways for interconnecting the NAN (Neighbour Area Network) and the WAN (Wide Area Network) networks, the communication standards can be different on the two sides, one from Smart Meters to Gateways (NAN), another one from Gateways to Control Room (WAN)
U_5 The Smart Meter should not be fed by end user's energy supply, but it should be autonomously powered.	**F**	**5** KPI : The autonomous power supply must comply with some defined Smart Meter lifetime duration. Performance measurement should be based on a usage profile against which the manufacturer shall declare the power supply life time.
U_6 The system must have a self-diagnostic alerting function in case of: 1) lack of water pressure, 2) measurement errors, 3)	**F**	**6** KPI : provide a list of at least 5 of the most fundamental alert messaging. It should be based on a table that each manufacturer [->]

water reverse flow and automatic valve closure, 4) tampering and fraud alert, 5) low battery alert, etc.)		*[-> it follows from previous page]* should fill and using a specific rule it should produce a score. Such score should be used as a technical weight and it shall increase at the increasing of functionalities implemented. Weight = 1 will correspond to the set of minimum requirements
U_7 The technical life time, when we speak of Smart Meters, must be as long as the asset's useful life from accounting point of view.	**F**	**7** KPI: The technical life time of SM should span from a minimum (e.g. 12 years) up to a maximum (e.g. 16 years). This range is established by specific country regulations. The longest meter life time of 16 years as required by some of the partner countries and/or by accounting regulations. KPI judgement is binary: Yes/Not but graded the best while reaching 16 years
U_8 The Smart Meter should be dust and water resistant. IP minimum level required.	**F**	**8** KPI: required resistance to 8 hours exposition to dust, and resistance to submersion of at least 1.5 m depth for 30 minutes This means IP68 requirement
U_{10} The Smart Meter must sport a front display capable to show in sequence the most relevant register contents suitable for both end-users purposes and field technicians. The display should be made of low energy consumption components and implement an energy saving management system, turning off after a short time.	**F**	**10** KPI: The buyers should list the functions and data that must be available using the display. The functionality and the accessibility must comply with practical constraints. The evaluation could be based on a list of minimum requirements and the technical weight be increased at the increasing of additional useful data (based on practical considerations) to be easily accessed and displayed.
U_{12} The Smart Meter must be provided with anti-fraud and anti-tampering systems to detect and prevent both measurement fraud and device tampering. These functionalities will sense the attempt to infringe the meter integrity or meter measure capability and will issue an alert message towards the AMR/AMM system in the Control Room.	**F**	**12** KPI: the system should implement at least one kind of global alert to the Control Room. It is better to have the capability to return two apart alerts concerning anti tampering alert and anti-fraud alert. The evaluation should be based on a list of minimum requirements and the technical weight increased at the increase of how many extra cause of tamper or frauds (based on practical considerations) are satisfied by the Smart Meter.

U_{11b} Remotely Operated Leakage Detection – b) Fully Automated leakage detection at Household side, with a potential functional extension in terms of measurement inaccuracy detection (see requirement U_2.)	**F**	**11b** KPI could be the following: b) less than 3% errors in automated leakage detection
U_{13} All the solution components, from Smart Meters Layer, through Data Transfer Layer to Control Room Layer, must be compliant to the open protocol application and communication standard in order to ensure interoperability / interchangeability among components from different vendors.	**F**	**13** KPI: level of compliance to interoperability or interchangeability in the communication and application protocol shared among the devices (Smart Meters, and, if applicable, Gateways, Repeaters, Translators, etc.) and the application systems MDM, NM. The KPI level should be lower for a simple interoperability requirement, higher in case of a more advanced interchangeability requirement. [->] *[-> it follows from previous page]* A solution is defined to be interoperable when substituting anyone of the devices in the system with a similar one coming from a different manufacturer, the functionalities of the system in the AMR/AMM system shall not to be degraded, updated or changed. Data exchanges, parameters, primitives are always alive and supported at the system in the Control Room. On the other hand the solution is said to be interchangeable when substituting anyone of the devices in the system with a similar one coming from a different manufacturer, the functionalities, data, parameters and primitives of the two devices are exposed exactly the same and, in addition, also the installation and configuration procedures are the same. Evaluation criteria based on the level and adherence to an EU standard.
U_{14} The communication must remain stable and reliable regardless of meter locations (basements, dedicated meter rooms, technical rooms, etc.)	**F**	**14** KPI could be the ratio of Unreachable Commissioned Smart Meter number / Whole Smart Meter Commissioned Park, ratio >= 96% during operating system life time.

U_{17} The Meters should respect regulation about toxic agents and chemicals of materials.	**F**	**17** KPI: it must comply to the strictest set of rules deriving from the assessment of the procurers national standard (every procurer is requested to report the nationally regulated tolerances to toxic agents and chemicals of materials as to Smart Meter) Evaluation criteria : Y/N
U_{18} The Smart Meter should be sediment and abrasion resistant	**F**	**18** KPI: Smart Meter replacement due to sediment or abrasion of exposed parts less than 3% of the installed fleet (value to be confirmed by procurers) on the whole lifetime period But defined in this way it gives no possibility to the distributor to exercise its rights against a poor quality product. It should be defined as % per year (e.e. 1.5% / year) In this way it would be enough to wait for 1 year to have the possibility to act against a poor quality product.
U_{20} The solution minimizes the request of equipped sites (e.g. gateways, repeaters, translators, etc.) and is economically convenient.	**F**	**20** KPI: In order of preference 1) Smart Meter Direct network connection to the Control Room, 2) connection through gateway of high concentration rate (more than 2000 smart meters per gateway). Both with the constraints of not affecting battery lifetime nor other required functionalities. The point 2) introduced only to select among several system proposals that for all the other requirements are more or less comparable. It seems better if procurers define a table with several system entries with the purpose to judge and select in terms of system delay , system complexity, system cost vs minimum functionalities satisfied. The highest the [->] *[-> it follows from previous page]* weight the less the delay and the complexity and the costs . Interpolation function needed to obtain final weight, to be proposed and discussed.
U_{21} The Smart Meter joints/threads should be resistant to the same tightening torque of joints/threads of the current	**F**	**21** KPI: Procurers must provide the value for the current max tolerance for tightening torque (N.m) of joints /threads during traditional meter installation. Evaluation criteria is binary :

traditional meter pipes.		Y/N
U_{22} The communication should be wireless from the meter side to AMR/AMM system on the Control Room side through the Data Transfer Layer.	**F**	**22** KPI: Yes for wireless without affecting battery lifetime nor other required functionalities. In order of preference for each portion of the Data Transfer Layer connection (from Smart Meter to GWY, from GWY to Control Room) 1) bandwidth available, 2) Energy consumption for the same content transmitted over the period. A ranking will be arranged based on the combination of these two indicators. Interpolation function needed to obtain final technical weight, to be proposed.
U_{23} Network Management System (NM) has to be provided as part of the solution for monitoring, reporting and administration of network devices, as well as Meter Data Management System (MDM) must be provided for the governance of meter reading and command operations execution. The two of them must be apart but tightly integrated.	**F**	**23** KPI: 1) open standard application interface to ensure modularity and 2) full functional integration between the two system (NM and MDM) in order to make up a seamless solution. The interface should be in any case open and even better if complying with a renowned international standard for AMM/AMR communications. The KPI value could be: 0.5 in case only condition 1) is satisfied , 1.0 in case both conditions are satisfied . But definitely 0.0 in case of proprietary not std solutions
U_{24} Capability to measure flows in both directions - this is necessary to check measurement accuracy and for reverse flow detection	**F**	**24** KPI: minimum measureable flow (l/min) coupled to MPE - Maximum Permitted Error of let's say 5% for residential customers . Procurers are asked to provide a desired value for this indicator. Traditional or SoA water meters are approved for MID class 2 (=2% MPE from 25 L/h up to 1600 L/h in case of DN15 , 5% below 25L/h)
U_{26} The Smart Meter must be MID certification compliant also with reference to measurement accuracy.	**F**	**26** KPI (Yes/No)
U_{27} The Smart Meter must have a Measurement Rate /Reading Log rate of, at least, every 15 minutes.	**F**	**27** KPI: this will describe the resolution in terms of amount of samples of usage daily curve by means of the reading frequency rate, the higher the better.

		(E.g.: quarter hourly = 96 samples; every 5 minutes = 288 samples; etc.)
M_3. The system must have consumables and asset lifecycle aligned in order to minimize the costs related to consumables (batteries) replacement in terms of materials and operations	**F**	**3** KPI: Should be based on the formula (average energy drained per day) times (the expected number of days of lifecycle) < (the available energy in the batteries) plus (the energy that may be harvested by means of a possible battery self-recharging system) (if applicable). The evaluation criteria should be based on a typical usage profile and the manufacturer shall supply the result of calculation. By the way this calculation shall be described completely by the manufacturer and possibly to be repeated autonomously by the distributor.
M_4 Capability to execute an On the Air Smart Meter Remote Firmware Update	**F**	**4** KPI: Smart Meter unsuccessful remote firmware update < 3% of the installed park (value to be confirmed by procurers) on the whole lifecycle period. It is clear that in case FW upgrade is mandatory, it remains the above described KPI as the only parameter for evaluation of system performance.

3.4 The following functional requirements are already available in one or more solutions for water smart metering, and it would be nice to have them incorporated in the Solution.

Functionalities	F/NH	Performance / KPIs
U_2 On site measurement Verification capability. The Smart Meter should offer a functionality and an automated or semi-automated process to detect a potential measurement error (negative or positive) and possibly to trigger an alert (in case of automated process). This requirement	**NH**	**2** KPI: is the evaluation of the time needed in both scenarios but also the complexity. The automated process should take no more than 10 minutes, while the semi-automated process should take no more than 30 minutes. In alternative to these cut off values, it should be better to have a range of values weighted in such a way the weight becomes worst at the increasing of the time declared and at the

goes along with requirement U11b for non-revenue water detection.		increasing of complexity. This last one measured considering how many steps to have access to it selecting from different menus and how many steps for the execution.
U_9 Meter valve management functionalities (flow limitation, manual on site reopening remotely enabled, automatic closure reaction time for emergency).	**NH**	**9** KPI: the Smart meter must be designed to operate in its lifetime at least one automatic emergency valve closure without impacting on battery charge (no impact meaning no measurable reduction of battery life). Better if the evaluation criteria is organized as written in point 5. It should be based on a usage profile (e.g. one closure in 2 years doing the normal activities, or once in 3 years doing the normal activities and so on until only once in lifetime). Then the manufacturer shall declare per each case the % of battery life used, as long as it will not give measurable effect =0%) . The better KPI will be when the meter will accept one operation per YY years , with the lowest % impact (ideally 0%) in the shortest YY period
U_{15} Reverse Flow Detection and Management - in case of reverse flow the Smart Meter is able to sense it and to autonomously close the valve to prevent network pollution sending a special alert message to the Control Room.	**NH**	**15** KPI could be: valve closure reaction time, the less the better (e.g. 10 seconds). Again better not to give a sharp amount of time, but a table with technical weights that become lower with the increasing of reaction time. Weight = 1 at the agreed basic request of reaction time (e.g. 10 sec). Weight > 1 for reaction time less than 10 sec.
U_{16} The meter, with reference to the combination table shown in table #3, can be of the following type: Main Meter, sub-meter, new gen and retrofitted old gen. Every typology must be compliant with the solution.	**NH**	**16** KPI: see the combination table #4 below. KPI worse in case of some lacking combination

U_{19} The meter could have a battery self-recharging system. In that case battery should be a rechargeable one.	**NH**	**19** KPI: in case of a mechanical self-recharging system, it should not let the pressure decrease more than a Delta_P from the nominal pressure of water distribution (e.g. less than 0.75 Bar) . The electrical characteristics of the recharging system are to be defined according to the electricity consumption behaviour defined by the vendor.
U_{25} NM and MDM Control Room Layer Systems must be scalable in case of PoD and related Smart Meter number increase.	**NH**	**25** KPI: performance deterioration not greater than 10% if compared to the original configuration. It would be better to deliver a table whose outcome is the deterioration of nominal performances at the increase of device population. Each performance deterioration weighted the most at the decreasing of deterioration for some fixed range of values of meter populations.
M_1 The meter should have a measurement technology to minimize frost damages, be it mechanical or electronic	**NH**	**1** KPI: Smart Meter replacement due to water freezing of exposed parts, less than 3% of the installed park (value to be confirmed by procurers) on the whole lifecycle period. Again should be better to have a parameter yearly based, otherwise would it be never possible for the purchaser to act against a poor quality meter.
M_2 The hydraulic section, regardless of the measurement technology of the meter has to be apart from the electronic communication section in order not to infringe metrological certification in case of maintenance activity with the need of removal of the electronic section or for replacement in case of communication technology update or upgrade.	**NH**	**2** KPI: less than 5 minutes for electronic part removal and replacement operations. Better to have a table to be filled with several maintenance time for evaluation. The resulting weight would be better at the decrease of the maintenance timing
D_1 Capability to separate electronic waste from hydraulic components	**NH**	1 KPI: recycling ratio not worse than integrated Smart Meters models. In any case both technologies must be fully compliant to RoHS/WEEE directives.