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| ***ToR STF 628 (DIGITAL TWINS)***  ***(Ref. Body TC SmartM2M)*** |
| Version: 2.1 |
| Author: Enrico Scarrone – Date: 2021-07-20 |
| Last updated by: ETSI Secretariat – Date: 2022-11-07 |
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**Terms of Reference –Specialist Task Force Proposal**

**STF 628 (Ref. Body TC SmartM2M)**

**DIGITAL TWINS**

**Summary information**

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| --- | --- | --- | --- |
| Approval status | Approved by Ref. Body TC SmartM2M (doc ref: SmartM2M(22)063012) on 21-22 September 2022 | | **YES** |
| Approved by Board#139 (06-08 September 2022) | | **YES** |
| Reference Body | Ref. Body TC SmartM2M | | |
| ETSI Funding | **Maximum budget: 88 000 EUR  76 000  EUR + 12 000 EUR of travels** | | |
| Minimum of 4 ETSI Members Support | **YES** | | |
| Time scale | **From** | 2023-02-01 | |
| **To** | 2024-07-31 | |
| Work Items  **Approved by SmartM2M on 6 September 2021 and planned to be revised on 27 August 2022.** | * D1: [DTR/SmartM2M-103844](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63608) Digital Twins and standardization opportunities in ETSI * D2: [DTS/SmartM2M-103845](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63609) Digital Twins communication requirements * D3: [DTS/SmartM2M-103846](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63610) Digital Twins: Functionalities and communication Reference Architecture * D4: [DTR/SmartM2M-10384723179](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63611) Digital Twins communication support in oneM2M * D5: [DMI/SmartM2M-123180](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63612) Standardization of Digital Twins communication in oneM2M and ISO JTC1/SC41 | | |
| Board priority | [ETSI STF funding criteria](https://portal.etsi.org/STF/STFs/Funding/ETSIbudget.aspx)   |  |  | | --- | --- | | **Priority Criteria** |  | | Maintenance of standards in mature domains |  | | Innovation in mature domains |  | | Emerging domains for ETSI | X | | Horizontal activities (quality, security, etc.) |  | | Societal good / environmental |  | | | |

**Part I – STF Technical Proposal**

# Rationale & Objectives

## Rationale

During the last decade, due to the dynamic and quick Internet of Things (IoT) technological evolution, several application scenarios opened to the possibility of a real-time merge between the physical and the digital worlds. This scenario became attractive both for the Academia and the Industry, revitalizing the concept of Digital Twin (DT) originally introduced between 1999 and 2002. A DT provides a digital copy of a physical object mirroring all its sensors, actuators, data and behaviours in real-time through an efficient bidirectional communication. Beyond device simulation and analytics, DTs enable intelligent functionalities augmenting the features associated with the original physical object. Gartner classified the technology as one of the top 10 strategic trends of the last years and the forecast previews that their market will reach 35 billion USD by 2025.

The combination of IoT and digital twins have been traditionally approached through cloud-driven, vertical and domain specific architectures with massive fragmentation, a reduced interoperability and a limited modularity. On the one hand, this generates some isolated interesting applications in disparate fields but, on the other hand, it limits the real potential of DTs and IoT by creating an unnecessary substrate of heterogeneous implementations. Latency and reliability issues may also introduce disruption to DTs since the linkage between the physical and the logical object is effective only if the refresh time is lower than the average access time of applications using the twin. DTs cannot be delegated only to the cloud but should instead be handled through a multi-tier architectural vision with the possibility to be executed also as close as possible to the physical devices in order to maximize their efficiency.

The adoption of distributed DTs recently started representing a fundamental pillar for cyber-physical applications and already showed some interesting results in the area of networking, IoT and IIoT (Industrial IoT), intelligent systems engineering and simulations. Despite these advancements, they are still mainly associated with model-driven, simulative or descriptive vision through vertical and closed solutions. Each implementation is different from the others without a uniformed view or standard able to identify their common properties and capabilities, a shared and effective representation and allowing their cooperation within multi-tier architectures.

In this context a set of platforms and solutions has been developed by major industries. It is worth mentioning the vision of GE Digital, Siemens, Amazon, Google, Bosch the Azure Digital Twin. The latter, in particular, provides a comprehensive approach for designing and developing cross-domain digital twins, including -- among the other features -- a language called DTDL (Digital Twin Definition Language) which makes it possible to describe graphs of digital twins, representing both their properties and their relationships. In that perspective, digital twins can be dynamically created and run in distributed and heterogeneous computational environments, exploited as-a-service by software agents and applications possibly across different organisations. Unfortunately, the standardisation activities are at an early stage (such as the Digital Twin Consortium) and existing services are still highly fragmented and mainly focused on legacy systems design and siloed implementations unable to talk to each other and requiring development effort for the integration within applications and services.

There is the concrete need to support a cross-domain and cross-vendor DT interoperability in order to avoid closed siloes solutions. It is not reasonable to think that each country (e.g., the National Digital Twin Program), company or service will design a new and different DT by creating a plethora of heterogeneous implementations.

Nevertheless, DTs interoperability potential is still underexplored and represents a relevant opportunity to design a new and shared approach aiming to achieve the seamless integration of data and services in heterogeneous IoT edge deployments. Through a last-mile DT digitalization it will be possible to handle physical heterogeneity as close as possible to the devices and to simplify the interaction and cooperation with upper layers.

The possibility to model the physical layer through standard DTs will open to the opportunity to:

* Define and uniform DTs’ roles, communication capabilities, responsibilities and relations across the different architectural layers (Edge, Fog, Cloud) and deployments
* Handle IoT heterogeneity and interoperability thanks to an effective one-to-one management of the physical assets
* Enable modularity through a fine-grained management of domain specific processing and legacy customization
* Augment physical functionalities with improved features or new behaviours that might otherwise be difficult or inefficient to update on the physical entity due processing constraints, software limitations, security and ownership
* Support composition allowing to link different DTs (and consequently devices) into aggregated DTs responsible to model a target context by simplifying the representation of complex physical deployments and the interaction between external applications and sup-components

## Objectives of the work to be executed

* The objective of this work is to cover the missing key elements of modelling and making uniform the communication concept IoT Digital Twins and their blueprint communication reference architecture
* The work should identify use cases and deployments where IoT Digital Twins can be effectively adopted in order to identify all the requirements and specifications associated to the definition of their functionalities and specifications
* Requirements and guidelines should be derived towards a horizontal cross-domain interoperability and standard, with the specification of minimum requirements for usability of professional and general public IoT services, whether they are critical or not
* Based on these use cases, requirements and guidelines IoT Digital Twins will be mapped within the oneM2M framework and contributed to ISO/JTC1/SC41through the definition of a set of new specifications in order to both embrace new functionalities and to effectively exploit the existing features (e.g., discoverability, security, modularity, etc ...)

## Previous funded activities in the same domain

TC SmartM2M will benefit of EU funded activities specifically related to SAREF Urban Digital Twins.

## Market impact

Digital Twins are a concept that is emerging in the industry context due to its wide field of application and the power of the services that it enables. In ETSI and in particular in oneM2M several relevant functionalities that are the base of the success of digital twins are already implemented, and the Digital Twins enablement can become explicit with a relatively limited effort and within a reasonable time.

There is a lack of a systematic standardization for Digital Twins, even for the functionality that are already available (or partially available) in the current standards.

For ETSI there is a possibility to lead this standardization, integrating it with its already strong position on IoT, that acts as enabler for the ETSI members and more generally for all the Digital market stakeholders.

## Consequences if not agreed

Digital twins are emerging in the industrial sector as service empowerment solution. Nevertheless there is a lack of a consistent communication model for digital twins, and standardization is missing, even in a context where several functionalities are already part of the ETSI standards. This context may lead to fragmentation, in favour of proprietary solutions, determining an increase of the costs and at the very end, a delay of the market due to the artificially increased required investment.

# Relation with ETSI strategy and priorities

Identify the relation between the objectives of the proposed activity and the Priority Criteria and provide a rationale [BOARD(19)123\_014]:

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| **Priority Criteria** | **Rationale** |
| Maintenance of standards in mature domains |  |
| Innovation in mature domains |  |
| Emerging domains for ETSI | Yes: Digital Twins are an essential component in the development of digitalization in the industry and in the society, with strong relation with IoT and with the adoption of AI technologies. |
| Horizontal activities (quality, security, etc.) |  |
| Societal good / environmental |  |

# ETSI Members Support

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| **#** | **ETSI Member** | | **Supporting delegate** |
| 1 | | TELECOM ITALIA S.p.A. | Enrico Scarrone |
| 2 | | HUAWEI Technologies Sweden AB | Francisco da Silva |
| 3 | | Facultad de Informatica | Raul Garcia Castro (UPM) |
| 4 | | Futurewei | John Strassner |
| 5 | | FBK | Mauro Dragoni (Fondazione Bruno Kessler) |
| 6 | | SBS aisbl | Massimo Vanetti |
| 7 | | INRIA | Luigi Liquori |
| 8 | | Deutsche Telekom AG | Thomas Kessler |
| 9 | | CNRS | Samir Medjiah |
| 10 | | JK Consulting and Projects | Joachim Koss (ETSI Applicant member) |
| 11 | | FBConsulting S.A.R.L. | Michelle Wetterwald |

# Deliverables

## Base documents

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| --- | --- | --- |
| **Document** | **Title** | **Status** |
| ETSI TS 118 104 | oneM2M Service Layer Core Protocol | published |
| ETSI TS 118 101 | oneM2M Functional architecture | published |
| ETSI TS 118 103 | oneM2M Security solutions | published |
| <https://www.ge.com/digital/applications/digital-twin> | (See webpage) | published |
| <https://new.siemens.com/global/en/company/stories/research-technologies/digitaltwin/digital-twin.html> | (See webpage) | published |
| <https://aws.amazon.com/it/iot/> | (See webpage) | published |
| <https://cloud.google.com/solutions/iot> | (See webpage) | published |
| <https://www.bosch-iot-suite.com/> | (See webpage) | published |
| <https://azure.microsoft.com/en-gb/services/digital-twins/> | (See webpage) | published |
| <https://www.cdbb.cam.ac.uk/what-we-do/national-digital-twin-programme> | (See webpage) | published |

## New deliverables

Together with the present ToR, the Work Items were approved by TC SmartM2M on 6 September 2021.

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| **Deliv.** | **Work Item code**  **Standard number** | **Working title**  **Scope** | **Expected date for publication** |
| D1 | [DTR/SmartM2M-103844](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63608) | Digital Twins and standardization opportunities in ETSI  **Scope**: With reference to Digital Twins:   * Analysis the major characteristics and architectures * Identification major functionalities, * selection of the candidate communication functionalities for standardization * Collection, identification and Definition of uses cases for IoT and in particular industrial IoT * Identification of potential requirements. | 2023-11-02 |
| D2 | [DTS/SmartM2M-103845](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63609) | Digital Twins communication requirements  **Scope**: With reference to the findings and analysis in DTR/SmartM2M-123176 (D1)   * Definition of Digital Twins communication functionality and propetries * Standardization of Digital Twins communication requirements. | 2024-02-01 |
| D3 | [DTS/SmartM2M-103846](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63610) | Digital Twins: Functionalities and communication Reference Architecture  **Scope**: With reference to the findings and analysis in DTR/SmartM2M-123176 (D1) and the standardized functionalities and requirements in DTS/SmartM2M-123177 (D2)   * Definition of Digital Twins communication functionalities and properties * Guidelines for the adoption of Digital Twins * Standardization of Digital Twins communication reference architecture. | 2024-07-31 |
| D4 | [DTR/SmartM2M-103847](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63611) | Digital Twins communication support in oneM2M  **Scope:** Mapping of the Digital Twins communication reference architecture and functionalities as specified in DTS/SmartM2M-123178 (D3) on the oneM2M architecture and capabilities, clarifying the usage of existing functionalities in oneM2M and their extension to support the Digital Twins concepts, including the potential addition of new functionalities and functional entities. | 2024-07-31 |
| D5 | [DMI/SmartM2M-123180](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63612) | Standardization of Digital Twins communication in oneM2M and ISO /JTC1/SC41  **Scope**: Collecting the contribution provided by the STF and the result of the discussion with oneM2M and ISO/JTC1/SC41 taken during the transfer of the result of DTS/SmartM2M-123177 (D2) and DTS/SmartM2M-123178 (D3), including the preparation of the necessary oneM2M Work Items. Contribution to other relevant for are foreseen to be also potentially included. | 2024-07-31 (Date of Miscellaneous Work Item **completion**) |

# Maximum budget

## Task summary/Manpower Budget

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| **Task short description** | **Budget (EUR)** |
|
| Task 1: **Project Management and coordination with other organizations** | 8 000 |
| Task 2: **Digital Twins Context, use cases and requirements.**  Digital Twins context, functionality and requirements:   * Functionalities and responsibilities of Digital Twins in IoT * Use cases * Architectural and deployments requirements of Digital Twins * Digital Twins communication requirements for oneM2M | 26 000 |
| Task 3: **Digital Twins Functionalities and Reference Architecture.**  IoT Digital Twins modelling, description and architectural design:   * Functionalities and reference architecture * Guidelines for the adoption of Digital Twins * Mapping of the Digital Twins reference architecture and functionalities to oneM2M guiding to the usage of existing functionalities in oneM2M and developing potential extensions. | 32 000 |
| Task 4: **Dissemination.**  Dissemination, transfer and discussion with oneM2M and other relevant fora and associations of the results of Task 2 and Task 3 | 10 000 |
| **TOTAL** | 76 000 |

## Travel budget

Travel cost for working sessions will be included in the contract compensation (manpower cost). Presentation of results to the reference TB and other TBs will be reimbursed as real cost from the travel budget.

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| **Expected travels** | **Cost estimate** |
| Reference TB meetings (6 travels) | 4 000 € |
| Other ETSI TB / stakeholders’ meetings (3 travels) | 2 000 € |
| OneM2M (STF results contribution) (4 travels) | 6 000 € |
| **Total cost** | **12 000 €** |

**Part II – Details on STF Technical Proposal**

# Tasks, Technical Bodies and other stakeholders

## Organization of the work

The technical work is developed in 2 technical tasks covering

* Supporting analysis, Use cases and requirements for Digital Twins in IoT
* Standardization of functionalities, communication reference architecture and guidelines for Digital Twins

These tasks will provide a general solution as Digital Twins reference architecture. The instantiation of such general solution in the oneM2M context is also included. So that these tasks also include the preparation of the technical solution to be exported in oneM2M

A third task covers the dissemination towards oneM2M and other associations/fora representing potential stakeholders of the proposed standard.

The 3 activities will start sequentially with partial overlap as described in the schedule.

It is anticipated that the majority of the work will be performed as drafting work remotely and electronically. Virtual meetings will be organized periodically for project management. Furthermore, a few additional face-to-face working sessions will be organized (Covid-19 permits), especially for clarification purposes with regard to the alignment of the various information sources and coordination of the technical results. It is planned to have around 3 face-to-face working sessions in total.

This STF should be performed under the guidance of TC SmartM2M, in liaison with oneM2M and other groups as required. The STF will take benefit of a Steering Group that is composed by the TC SmartM2M attendees, with the exception of the STF experts, but including the STF leader, and will meet during the regular TC SmartM2M meetings.

The Steering Group will be composed by the SmartM2M members and will correspond to the regular TC SmartM2M meeting (4 per year)

## Tasks for which the STF support is necessary

Specific technical expertise in the area of Digital Twins are not currently present within the associated technical committees. Therefore, under this proposed action, ETSI will become able to perform the work described above with the support of an ETSI Specialist Task Force (STF). This will inject the Digital Twins expertise on the strong IoT competences already present in TC SmartM2M and its expertise in developing standards in industrial IoT context.

The work of this STF will be essential to aid the drafting and preparation of the required deliverables as rapidly in order to maximise the resulting benefits and to publish the required standards meeting the stakeholders and market needs.

## Other interested ETSI Technical Bodies

oneM2M, TC SmartBAN and ETSI ISG MEC will be directly engaged with a close collaboration (liaisons, contributions, joint meetings).

The Digital Twins Expertise and standardization are of potential interest for other ETSI groups that may be engaged as needed (e.g. EP eHEALTH, ISG CIM, TC ATTM, TC ITS, etc).

## Other stakeholders

Digital Twins are of wide interest especially in the industry related sectors, so this work is expected to be relevant for a variety of stakeholders, ranging from companies, to industrial associations, including dedicated fora as identified in clause 1 of this proposal. The STF will look at the most promising and representative ones, leveraging also on well-established relations such as the one with AIOTI for consultation during the definition of the use cases to help to complement the ETSI view, ISO/IEC JTC 1/ SC41 which have recently opened activity in this area (ISO/IEC AWI 30172 Digital Twin — Use cases, ISO/IEC AWI 30173 Digital twin — Concepts and terminology), and establishing new relations with emerging relevant active associations, in particular the Industrial Digital Twin Association (IDTA).

**Part III: Execution of Work**

# Work plan, time scale and resources

## Task description

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| **Task #1** | **Project Management and coordination with other organizations** |
| **Objectives** | Provide appropriate development of the work in term of quality and timely delivery to ETSI TC SmartM2M. |
| **Input** | ETSI secretariat for STF management, TC SmartM2M to steer, review and approve the technical work, relations with other organizations inside / outside of ETSI, as described in section 6. |
| **Output** | STF progress reports, reports to TC SmartM2M (which is also the Steering Group), management of the STF activities and priorities, quality review. |
| **Interactions** | As described in clause 6 of this STF proposal. |
| **Resources required** | * STF management skills * Technical management skills and expertise in STF * Relation management skills * Good knowledge of ETSI, oneM2M IoT related specifications, familiarity with Digital Twins. |

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| **Task #2** | **Digital Twins Context, use cases and requirements** |
| **Objectives** | Digital Twins context, functionality and requirements:   * Functionalities and responsibilities of Digital Twins in IoT * Use cases * Architectural and deployments requirements of Digital Twins * Digital Twins communication requirements for oneM2M. |
| **Input** | It is part of the STF work to identify the relevant inputs on Digital Twins. |
| **Output** | D1 ([DTR/SmartM2M-103844](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63608)) Digital Twins and standardization opportunities in ETSI  D2 ([DTS/SmartM2M-103845](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63609)) Digital Twins communication requirements |
| **Interactions** | As described in clause 6 of this STF proposal. |
| **Resources required** | * Knowledge of Digital Twins * Knowledge on IoT, especially industrial IoT * familiarity on edge, centralized and fog architectures * familiarity of oneM2M. |

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| **Task #3** | **Digital Twins Functionalities and Communication Reference Architecture** |
| **Objectives** | IoT Digital Twins communication modelling, description and architectural design:   * Functionalities and communicatoion reference architecture * Guidelines for the adoption of Digital Twins   Mapping of the Digital Twins communication reference architecture and functionalities to oneM2M guiding to the usage of existing functionalities in oneM2M and developing potential extensions. |
| **Input** | D2 ([DTS/SmartM2M-103845](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63609)) Digital Twins communication requirements |
| **Output** | D3 ([DTS/SmartM2M-103846](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63610)) Digital Twins: Functionalities and communication Reference ArchitectureDigital Twins: Functionalities and communication Reference Architecture  D4 ([DTR/SmartM2M-103847](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63611)) Digital Twins communication support in oneM2M  Contributions and Work Items to be presented to oneM2M to support the mapping and the transfer of the standard developed in D3 ([DTS/SmartM2M-103846](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63610)). |
| **Interactions** | As described in clause 6 of this STF proposal. |
| **Resources required** | * Knowledge of Digital Twins. * Knowledge on IoT, especially industrial IoT * Knowledge of oneM2M. * Familiarity on edge, centralized and fog architectures. |

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| **Task #4** | **Dissemination** |
| **Objectives** | Dissemination, transfer and discussion with oneM2M, IOS/JTC1/SC41 and other relevant fora and associations of the results of Task 2 and Task 3. |
| **Input** | D1 ([DTR/SmartM2M-103844](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63608)), D2 ([DTS/SmartM2M-103845](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63609)), D3 ([DTS/SmartM2M-103846](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63610)), D4 ([DTR/SmartM2M-103847](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63611)), specific contributions to oneM2M. |
| **Output** | D5 ([DMI/SmartM2M-123180](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63612)) Standardization inputs on Digital Twins in oneM2M, ISO/JTC1/SC41 and other relevant fora |
| **Interactions** | As described in clause 6 of this STF proposal. |
| **Resources required** | * Familiarity with Digital Twins * Knowledge of oneM2M * Communication skills * Relation managements skills. |

## Milestones

The **interim draft** status of work items used in Clauses 7.2 and 7.3 (Milestones and Task summary) corresponds to a draft status between early draft (table of content) and stable draft (for TS or TR deliverables)**.**

This “interim draft” status is not part of the ETSI official on-line work program work item schedule but is intended to be used in the STF related meeting minutes of the SmartM2M meetings to verify the progress of the STF deliverables:

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| **Code** | **Milestone** |
| 1 | Start of work |
| 2 | Early draft |
|  | ***Interim draft*** |
| 4 | Stable draft |
| 6 | Final draft for approval |
| 8 | TB approval |
| 8 A | Draft receipt by ETSI Secretariat |
| 12 | Publication |

For a **Miscellaneous Work** Item the ***interim draft*** (milestone) is between Start Of Work and Completion because there is no TS/TR Draft but working documents (presentations, contributions…) that can be in early and stable drafts ‘documents’ stage accepted by SmartM2M.

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| **Code** | **Milestone** |
| 1 | Start of work |
| *2* | *Early draft* |
| 5S | *<to be defined>=****Interim draft*** |
| *4* | *Stable draft* |
| 12 | Completion |

Reminder:

* D1: [DTR/SmartM2M-103844](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63608) Digital Twins and standardization opportunities in ETSI
* D2: [DTS/SmartM2M-103845](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63609) Digital Twins communication requirements
* D3: [DTS/SmartM2M-103846](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63610) Digital Twins: Functionalities and communication Reference ArchitectureDigital Twins: Functionalities and communication Reference Architecture
* D4: [DTR/SmartM2M-103847](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63611) Digital Twins communication support in oneM2M
* D5: [DMI/SmartM2M-123180](http://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63612) Standardization of Digital Twins in oneM2M, ISO/JTC1/SC41 and other relevant fora

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| **Milestone** | **Description** | **Cut-Off Date** |
| **S** | Start of work | 2023-02-01 |

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| **Milestone** | **Description** | **Cut-Off Date** |
| **MA** | Interim draft D1 and early draft D2 | 2023-06-15 |
| D1  D2 | Interim draft agreed by TC SmartM2M  Early draft agreed by TC SmartM2M |
| Progress Report | Progress Report#1 approved by SmartM2M |

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| **Milestone** | **Description** | **Cut-Off Date** |
| **MB** | Final draft D1, stable draft D2, early draft D3 and early draft D5 | 2023-09-15 |
| D1  D2  D3  D5 | Final draft version approved by TC SmartM2M  Stable draft agreed by TC SmartM2M  Early draft agreed by TC SmartM2M  Early Draft agreed by TC SmartM2M |
| Progress Report | Progress Report#2 approved by SmartM2M |

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| **Milestone** | **Description** | **Cut-Off Date** |
| **MC** | Final draft D2, interim draft D3, early draft D4 and interim draft D5 | 2023-12-15 |
| D2  D3  D4  D5 | Final version approved by TC SmartM2M  Interim version agreed by TC SmartM2M  Early draft agreed by TC SmartM2M  Interim version agreed by TC SmartM2M |
| Progress Report | Progress Report#3 approved by SmartM2M |

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| **Milestone** | **Description** | **Cut-Off Date** |
| **MD** | Stable D3, interim D4 and stable D5 | 2024-03-15 |
| D3  D4  D5 | Stable draft agreed by TC SmartM2M  Interim version agreed by TC SmartM2M  Stable version agreed by TC SmartM2M |
| Progress Report | Progress Report#4 approved by SmartM2M |

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| **Milestone** | **Description** | **Cut-Off Date** |
| **ME** | Final drafts D3, D4 and D5 | 2024-06-15 |
| D3  D4  D5 | Final version approved by TC SmartM2M  Final version approved by TC SmartM2M  Final version approved by TC SmartM2M |
| Progress Report | Final Report approved by SmartM2M |

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| **Milestone** | **Description** | **Cut-Off Date** |
| **F** | Closure of STF, all deliverable published | 2024-07-31 |

## Task summary

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| --- | --- | --- | --- | --- |
| **Code** | **Task / Milestone** | **Target Date** | | **Estimated Cost (EUR)** |
| **From** | **To** |
| Milestone S | Start of work | 2023-02-01 |  |  |
| T1 | Project Management | 2023-02-01 | 2023-07-31 | 8 000 |
| T2 | Digital Twins Context, Use Cases and Requirements | 2023-02-01 | 2023-12-31 | 26 000 |
| T3 | Digital Twins functionality and reference architecture | 2023-09-01 | 2023-07-31 | 32 000 |
| T4 | Dissemination | 2023-09-01 | 2023-07-31 | 10 000 |
| Milestone MA | Interim draft D1 and early draft D2  Progress Report#1 approved by SmartM2M |  | 2023-06-15 |  |
| Milestone MB | Final draft D1, stable draft D2, early draft D3 and early draft D5  Progress Report#2 approved by SmartM2M |  | 2023-09-15 |  |
| Milestone MC | Final draft D2, interim draft D3, early draft D4 and interim draft D5  Progress Report#3 approved by SmartM2M |  | 2023-12-15 |  |
| Milestone MD | Stable D3, interim D4 and stable D5  Progress Report#4 approved by SmartM2M |  | 2024-03-15 |  |
| Milestone ME | Final drafts D3, D4 and D5  Final Report approved by SmartM2M |  | 2024-06-15 |  |
| Milestone F | Closure of STF, all deliverable published |  | 2024-07-31 |  |
|  | | | | **76 000** |

Expected Travel Expenses: **12 000€**

**Workplan**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Task** | **Year 2023** | | | | | | | | | | | **Year 2024** | | | | | | |
| **Calendar month** | F | **M** | A | M | **J** | J | A | **S** | O | N | **D** | J | F | **M** | A | M | **J** | J |
| **STF\_month#** | 1 | **2** | 3 | 4 | **5** | 6 | 7 | **8** | 9 | 10 | **11** | 12 | 13 | **14** | 15 | 16 | **17** | 18 |
| Milestone  T1: Project management | **S** |  |  |  | MA  SMR |  |  | MB  SMR |  |  | **MC**  SMR |  |  | MD  SMR |  |  | ME  FSMR | **F** |
| T2: Digital Twins context, use cases and requirements |  | D1E |  |  | D1I  D2E | D1S |  | D1F  D2S |  | D1P | D2F |  | D2P |  |  |  |  |  |
| T3: Digital Twins functionalities and reference architecture |  |  |  |  |  |  |  | D3E |  |  | D3I  D4E |  |  | D3S  D4I | D4S |  | D3F  D4F | D3P  D4P |
| T4: Dissemination |  |  |  |  |  |  |  | D5E |  |  | D5I |  |  | D5S |  |  | D5F | D5P |

Status of deliverables: E= Early Draft, , I= interim Draft, S= Stable Draft, F= final.

FSMR= Final SmartM2M Progress Report; SMR= SmartM2M Progress Report

The months marked in **bold** correspond to the expected allocation of the SmartM2M plenary meetings, dedicated meeting will be set according to the STF needs.

The milestones marked in **bold** are the proposed STF payment-related ones.

D1E D2E D3E D4E D5E = D1,D2,D3,D4,D5 Early Draft

D1I D2I D3I D4I D5I = D1,D2,D3,D4,D5 Interim Draft

D1S D2S D3S D4S D5S = D1,D2,D3,D4,D5 Stable Draft

D1F D2F D3F D4F D5F = D1,D2,D3,D4,D5 Final Draft approved by SmartM2M

D1P D2P D3P D4P D5P = D1,D2,D3,D4,D5 Publication or Miscellaneous Work Item Completion

# Expertise required

## Team structure

3 providers are expected to ensure the following mix of competences:

|  |  |
| --- | --- |
| **Priority** | **Qualifications and competences** |
| High | Digital twins |
| High | IoT architectures |
| High | oneM2M |
| High | Industrial IoT |
| High | AI requirements and integration in IoT |
| Low | Edge architectures |
| Low | 5G architectures |
| Low | Big data solutions |

**Part IV: STF performance evaluation criteria**

# Performance Indicators

|  |  |
| --- | --- |
| ***Select relevant Performance indicators applicable for these ToR (X)*** | |
| **Contribution from ETSI Members to STF work** | |
| *Direct financial contribution (co-funding)* |  |
| *Support to the STF work (e.g., provision of test–beds, organization of workshops, events)* | *X* |
| *Steering Group meetings (number of meetings / participants / duration)* |  |
| *Number of delegates directly involved in the review of the deliverables* | *X* |
| *Contributions/comments received from the Reference Bodies* | *X* |
| *Contributions/comments received from other Reference Bodies* | *X(oneM2M and ISO/JTC1 at least)* |
|  |  |
| **Contribution from the STF to ETSI work** | |
| *Contributions to Reference Body meetings (number of documents / meetings / participants)* | *X* |
| *Contributions to other Reference Bodies* | *X (oneM2M and ISO/JTC1 at least)* |
| *Presentations in workshops, conferences, stakeholder meetings* | *X* |
|  |  |
| **Liaison with other stakeholders** | |
| *Stakeholder participation in the project (category, business area)* |  |
| *Cooperation with other standardization bodies* | *X* |
| *Potential interest of new members to join ETSI* |  |
| *Liaison to identify requirements and raise awareness on ETSI deliverables* | *X* |
| *Comments received on drafts (e.g. on WEB site, mailing lists, etc.)* | *X* |
|  |  |
| **Quality of deliverables** | |
| *Approval of deliverables according to schedule* | *X* |
| *Respect of time scale, with reference to start/end dates in the approved ToR* | *X* |
| *Comments from Quality review by Reference Body* | *X* |
| *Comments from Quality review by ETSI Secretariat* | *X* |
|  |  |

**Time recording**

For reporting purposes, the STF experts shall fill in the time sheet provided by ETSI with the days spent for the performance of the services

During the activity, the STF Leader shall collect the relevant information, as necessary to measure the performance indicators. The result will be presented in the Final Report.

# Document history

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Date** | **Author** | **Status** | **Comments** |
| 0.0 | 2021-07-20 | TC SmartM2M | Draft | Result of the Digital Twins dedicated SmartM2M WS |
| 1.0 | 2021-08-24 | TC SmartM2M Chair | Draft | First version submitted to ETSI secretariat |
| 1.1 | 2021-09-07 | SmartM2M and Technical Officer | Final | 6 September **SmartM2M Approval** of the ToR + NWI and 7 September final review by Technical Officer on SmartM2M request |
| 1.2 | 2021-09-08 | ETSI Secretariat | Final | Update before Board submission |
| 2.0 | 2021-07-27 | TC SmartM2M Chair | Final | Resubmission of STF proposal |
| 2.1 | 2022-11-07 | ETSI Secretariat | Final | Update for CL publication |

Annex I Response to the Request for Proposals  
CfE – STF 628 (REFERENCE BODY SMARTM2M) Deadline: 11/01/2023

**If you are an ETSI Member \***

**ETSI membership status (Indicate your status):**

 Full

 Associate

 Observer

**If you are not an ETSI Member \***

Please indicate:

**Full name of the ETSI member supporting the application (list of ETSI members on etsi.org):**

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Official contact name of the ETSI member supporting the application:**

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Note: A formal confirmation of the support from the Official contact is required (e.g. by e-mail sent to STFLINK@etsi.org) and an “ETSI Member Support Letter” will be required if you are selected.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contractor information \*** | | | | |
|  | | | | |
| **Contractor name \*:**  *Indicate the Company/Organization Name* | |  | | |
|  | | | | |
| **Contact person for the technical aspects** | | **Contact person for Decision on ETSI financial offer to this project (if any)** | | |
| Title |  | Title |  | |
| First name |  | First name |  | |
| Last name |  | Last name |  | |
| Role |  | Role |  | |
| e-mail |  | e-mail |  | |
| Phone |  | Phone |  | |
|  | | | | |
|  | | **Yes** | | **No** |
| Do you or any employee of your Company/Organization hold an elected or appointed position in the Reference Body requesting the STF 628 creation? | | o  Indicate in which position:  ----------------------------------- | | o |
| **If you are self-employed candidate:**  Do you currently have other contracts in progress with ETSI? | | o | | o |

All fields marked with an asterix (\*) are mandatory

**1.1 Introduction**

A short presentation of the technical structure responsible for this activity, e.g.:

* Business area, number of employees, link to WEB site,
* Department(s)/team(s)/experts in charge of the technical activities related to this Project,
* Reference to products/services of your Company/Organization or supporting Member to which the standards developed by this Project will apply,
* Motivation for your Company/Organization or supporting Member to participate in this Project.

**1.2 Proposed approach**

**Proposed contribution to tasks & related cost**

Identify the tasks to which your Company/Organization is proposing to contribute by filling-in the table below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tasks\_No** | **Tasks\_Description** | **Max\_Budget\_Allocated\_in\_Euro** | **Amount\_in\_Euro\_(mandatory)** | **%\_of\_whole\_Task\_(mandatory)** |
| 00 | Project Management and coordination with other organizations | 8000 | . | . |
| 01 | Digital Twins Context, use cases and requirements. Digital Twins context, functionality and requirements: - Functionalities and responsibilities of Digital Twins in IoT - Use cases  - Architectural and deployments requirements of Digital Twins - Digital Twins communication requirements for oneM2M | 26000 | . | . |
| 02 | Digital Twins Functionalities and Reference Architecture. IoT Digital Twins modelling, description and architectural design: - Functionalities and reference architecture - Guidelines for the adoption of Digital Twins - Mapping of the Digital Twins reference architecture and functionalities to oneM2M guiding to the usage of existing functionalities in oneM2M and developing potential extensions. | 32000 | . | . |
| 03 | Dissemination. Dissemination, transfer and discussion with oneM2M and other relevant fora and associations of the results of Task 2 and Task 3 | 10000 | . | . |
|  | **Total:** | 76000 |  |  |

**Amount in Euro (mandatory)**: Indicate the price offered for your contribution to the task(s)

**% of whole task (mandatory)**: Indicate to which percentage of the execution of the whole task your offer corresponds

Provide a description of the proposed approach, competences, reference to related activities:

* Explain which part of the task is corresponding to the requested percentage that your Company/Organization will handle,
* Explain the scope that your Company/Organization will cover,
* Explain your approach to the management of the quality and,
* Explain your approach to the management of the risks and their mitigation,
* Describe and justify the proposed costs to achieve this project objectives.

Annex II Terms and Conditions  
CfE – STF 628 (REFERENCE BODY SMARTM2M) Deadline: 11/01/2023

**2.1 Submission of Proposals**

All proposals in response to this CfE shall be submitted before the deadline indicated in thisCollective Letter, using exclusively the WEB application on the ETSI Portal at the following address: <https://portal.etsi.org/cfe>.

Proposals shall be composed of Curriculum Vitae of the proposed service providers’ personnel and the Annex I of this CfE duly filled-out.

Proposals that will be partial or incomplete at the deadline will not be accepted.

The Terms and Conditions in this Annex will apply.

**2.2 Modification and Withdrawal of Proposals**

Applicants may, without prejudice to themselves, modify or withdraw their proposal by written request, provided that the request is received by ETSI prior to the due date and time, at the address to which their proposal was submitted. The applicant may submit a new proposal provided that such new proposal is received prior to the deadline for responding which is specified in this Collective Letter.

**2.3 Assessment of Proposals**

The ETSI Director-General, in consultation with the Reference Body Chairman, is responsible for the selection of the service providers that will be contracted to perform this Project work. The ETSI Director-General and the Reference Body Chairman may be assisted by a Selection Panel to assess the applications received and make the final decision.

As per article 1.10.4 of the ETSI Directives, the Director-General may discard proposals that could be identified as creating potential conflict of interest.

The ETSI Secretariat will only communicate to the applicants the result of the selection (accepted or not accepted). Should applicants need more information on the rationale for the selection, they must address a formal request to the ETSI Director-General.

The following evaluation criteria will be applied to all proposals, in order of priority:

* Evidence that the applicant has the necessary structure and expertise to ensure delivery
* Reference to current or previous activities in the specific technical domain of this project
* Critical review of the most efficient way to achieve the objectives in this Project ToR
* Effective proposed approach/methodology for the execution of the tasks
* Implementation schedule
* Clear pricing policy

Compliance with the first two (2) criteria is mandatory.

Proposals that are not considered compliant with these criteria will be discarded.

Priority will be given to technical quality of the proposals. Pricing considerations will be taken into account to ensure that the best value for money is achieved. Compatibility with the maximum budget allocated to this Project will be verified before placing a Service Contract.

Following the assessment process, ETSI reserves the right to grant contracts to other than the cheapest proposals, to accept or reject any offer completely or in part, or to reject all proposals, without providing the reasons. If no offer is accepted, ETSI may decide to abandon the work or proceed in any other manner ETSI may select.

**2.4 IPR and confidentiality Agreements**

The information provided in this CfE, as well as the fact that the applicant has received the CfE, is considered confidential and protected under copyright laws. The applicant may not discuss, share, or use the information in this CfE for any purpose other than the response to this CfE.

ETSI will not disclose the content of any proposals to other applicants or any other party, with the exception of the persons involved in the assessment process described in §2.3 above.

However, ETSI reserves the right to make use of the information provided in this proposal to improve this project definition for the purpose of this CfE or any other manner in which ETSI may decide to proceed to select the service providers.

If successful, the applicant will be required to sign a Service Contract, which includes IPR and Confidentiality clauses aligned with the relevant policies in the ETSI Directives.

**2.5 Preparation cost**

ETSI will not be responsible for any costs or expenses that the applicant may incur in preparing and/or submitting the proposal.

**2.6 Service Contract**

A Service Contract will be proposed to the applicants that will be selected to perform the work.

Details on the Terms and Conditions of this contract can be found on the ETSI Portal, at the following address: <https://portal.etsi.org/STF/STFs/Contracts.aspx>