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| ETSI_logo_Office_Colour_Small | ToR STF BQ (TC SmartM2M) |
| Version: 1.3 |
| Author: Omar Elloumi – Date: 25 April 2017  |
| Last updated by: Gavin Craik – Date: 07 July 2017 |
| page 1 of 10 |

Terms of Reference - Specialist Task Force

STF BQ (TC SmartM2M)

Architecture and Components for Virtualised IoT

Summary information

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| --- | --- |
| Approval status | Approved by TC SmartM2M, Recommended for 2nd allocation by STF Review Panel but with reduced budget.To be approved by Board#113 (21-22 June 2017). |
| Funding | **Maximum budget: 73 000 € ETSI FWP** |
| Time scale | October 2017 to August 2018 (TB approval of final deliverables) |
| Work Items  | 3 TRs under approval in TC SmartM2M* DTR/SmartM2M-103527 (TR) “SmartM2M; Virtualized IoT Architectures with Cloud Back-ends”
* DTR/SmartM2M-103528 (TR) “Landscape for open source and standards for cloud native software for a Virtualized IoT service layer “
* DTR/SmartM2M-103529 (TR) “Virtualized IoT over Cloud back-ends: a Proof of Concept “
 |
| Board priority  | [ETSI STF funding criteria](https://portal.etsi.org/STF/STFs/Funding/ETSIbudget.aspx): Innovation in Mature Domains (expanding the reach of IoT/oneM2M to cloud-based architectures); Emerging Domain for ETSI (IoT cloud-based systems) |

Part I – Reason for proposing the STF

# Rationale

oneM2M, the global standards initiative for M2M communications and the IoT, has published its new set of oneM2M specifications (release 2) which is a major improvement of the oneM2M initial set of specifications, designed to enable basic connectivity between applications and devices. A major focus of these new specifications has been to offer a broad support to interoperability and to open up the IoT ecosystem to new IoT devices that enable interworking between complex IoT systems in various industrial contexts. Similarly, the release 2 has also particularly addressed security by enabling end-to-end secure information exchange between any devices or servers, as well as implementing dynamic access control.

Interoperability and security are key requirements for IoT/M2M systems. Considering this, the IoT (mass) market will address billions of devices that must be able to interact within complex systems and to be protected from intrusions and interference that could compromise personal privacy or threaten public safety. Beyond these two key enablers to the development of large IoT systems, a new one is emerging as another key condition of success: the deployment of IoT systems must be possible not just within closed and secure administrative domains but also over architectures that support the dynamic usage of resources that are provided by virtualisation techniques over cloud back-ends.

This new challenge for IoT requires that the elements of an IoT system can work in a fully interoperable, secure and dynamically configurable manner with other elements (devices, gateways, storage, etc.) that are deployed in different operational and contractual conditions. To this extent, the current architectures of IoT will have to be aligned with those that support the deployment of cloud-based systems (private, public, etc.).

TC SmartM2M, as a partner of and contributor to oneM2M, is interested in addressing these questions ahead of the required evolution of the IoT High-Level Architectures (HLA). This will be achieved by understanding which adaptations of the existing architectures (IoT-based and cloud-based) are required, what are the components that may be needed in support of this, and by making an early Proof of Concept (PoC) based on these initial findings.

Considering that this topic is at the intersection of IoT, Cloud Computing and virtualization, TC SmartM2M cannot rely on voluntary efforts of its members and requires a specific funding. It is important that the approach proposed is addressed – and as much as possible - validated rapidly, in order to make sure that it may be positively confronted with the alternatives coming from other sources, in the IoT or the Cloud Computing communities.

# Objective

The objective of this proposal is to identify the requirements for the extension/adaptation of the IoT architectures in order to better integrate with the cloud computing architectures, referred to as Virtualized IoT or Containerized IoT. The rationale for such adaptations will be clarified by an early proof of the validity of the approach based on a significant use case and on a prototype implementation of that use case. The purpose of the activity is to provide a set of results that will serve as an input and an accelerator to further standardization work, in particular through the contributions of SmartM2M to the work of oneM2M and possibly collaborations with ETSI ISG NFV.

The proposed work will rely on three main activities:

* The analysis of the architecture implications, in relation with some of the activities undertaken in relevant organisations such as the oneM2M PP, the AIOTI WG3, the SDOs involved in IoT architecture (e.g. ITU-T or IEEE), ETSI ISG CIM, ETSI ISG MEC and some emerging fora such as the OpenFog consortium.
* The selection and definition of a relevant use cases in particular ones that validate the need for:
	+ **Horizontal scalability:** adding cloud resources at run time without any disruption to ongoing operations in terms of communication, processing, storage, and monitoring.
	+ **No single point of failure for the service layer:** Fault tolerance through node replication techniques or disaster recovery site.
	+ **Use of network slicing** by an IoT service layer
	+ **Dissociation and scaling of front-end** (based on oneM2M) and back-end (big data) architecture (see oneM2M blueprint for Smart Cities as depicted in the following whitepaper: http://www.onem2m.org/images/files/oneM2M\_WhitePaper\_SmartCitiesDoneSmarter.pdf)
	+ **High data throughputs** needed for massive amounts of connection or massive data sets (e.g. generated by video streams or data logs)
	+ **Low latency** at service layer
	+ Fine-grained **micro-services** architecture, lightweight container deployment and service orchestration.
	+ **DevOps** with holistic service monitoring and decentralized continuous delivery.
	+ End-to-End Security and Privacy: Authentication, Authorization and Accounting.
* The development of a PoC implementation for the horizontal scalability use case using oneM2M service layer and taking into account the architecture analysis. This development will be based on available Open Source components which will be surveyed in a separate TR. The PoC code will be documented and provided (fully released) to ETSI for future evolutions and reuse.

The STF will deliver three Technical Reports. The first TR will describe use cases for virtualized IoT and the new architectural elements (components, required mappings, etc.) that are required to address a Virtualised/Containerized IoT on a cloud back-end. The second deliverable will provide a survey of Cloud Native open sources that could be used for Virtualizing IoT. The third TR will describe in deeper terms the use case selected for the PoC (namely, Horizontal Scalability for oneM2M); its implementation, in particular the main components developed and how they can be applied for a oneM2M based service layer. While oneM2M will be used to validate the concept, the principles would still be applicable to other and complementary IoT service layers.

# Relation with ETSI strategy and priorities

The proposed architecture and Proof of Concept (PoC) activities in this STF are directly related and in line with the two ETSI STF funding criteria:

* “Innovation in Mature Domains" by expanding the reach of oneM2M standards to cloud-based architecture and new component models;
* "Emerging Domain for ETSI" by addressing the wider support of oneM2M standards by virtualisation, and the definition of components in support.

This proposed STF is in line with the following objectives of the ETSI Long Term Strategy:

* "Being at the Heart of Digital". This proposal supports the efforts of ETSI as a major point for ICT related standardization, in particular by allowing ETSI - as a partner of oneM2M – to ensure that new architectures and deployment models are supported by oneM2M standards;
* "Being an Enabler of Standards". This STF aims at providing blueprints for the specification and development of components that support a wider adoption of oneM2M standards;
* "Being Global". This STF is supporting the applicability of oneM2M standards to a wider range of IoT architectures and systems worldwide and across multiple industry domains.

# Context of the proposal

## ETSI Members support

At the time of writing this proposal, the following companies have expressed support. Some others may join when the discussion on the SmartM2M work items will be finalised.

|  |  |  |
| --- | --- | --- |
| **ETSI Member** | **Supporting delegate** | **Motivation** |
| Telecom Italia | Enrico SCARRONE |  |
| Nokia | Omar ELLOUMI |  |
| Sensinov | Mahdi BEN ALAYA |  |
| CNRS | Khalil DRIRA |  |
| CommLedge | Emmanuel DARMOIS |  |
| Huawei Technologies Sweden | Francisco Da Silva |  |
| Deutsche Telekom AG  | Roland Hechwartner |  |

## Market impact

The availability of an initially validated architecture that describes how IoT systems can be deployed over – potentially proprietary - cloud back-ends will greatly help the definition of IoT systems that can make use of cloud back-ends while remaining interoperable, secure and manageable. This would have an impact on the IoT market by enabling a wider range of open IoT systems.

Conversely, the potential extension of the oneM2M standards support to this new kind of architectures will enrich the footprint of oneM2M standardization and support a larger number of actors and activities.

## Tasks for which the STF support is necessary

As outlined above, the proposed work will rely first on the analysis of the architecture implications, in relation with some of the activities undertaken in relevant organisations such as oneM2M PP, AIOTI WG3, SDOs involved in IoT (e.g. ITU-T or IEEE) and some emerging fora. Additionally, the STF will explore state of the art open source projects such as Docker, Kubernetes, Apache Kafka, ELK stack, etc. The STF will provide expertise on these topics that may not be directly available in SmartM2M.

The definition of the use case will be done by the STF with the support of TC SmartM2M. But the development of a PoC implementation taking into account the architecture analysis and the nature of the use case will have to rely on the resources provided by the STF. The final code will be available on an ETSI source code repository (the practical details for such repository will be defined separately in agreement with ETSI).

## Related voluntary activities in the TB

The TC SmartM2M and the oneM2M ETSI members supporting the creation of the STF are committed to supporting this STF in terms of participation in the STF Steering Group, providing input and review to the STF.

## Previous funded activities in the same domain

N/A

## Consequences if not agreed

The STF will provide significant architecture and implementation results that would have to be recreated in the case the STF is not accepted. This work might be added to the work plan of Smart M2M and/or oneM2M but with no guarantee that it will be done in time.

If no progress on the adaptation of the IoT architectures towards Cloud Computing architecture is done in SmartM2M/oneM2M, the footprint of proprietary solutions could become dominant in the definition of the next generation of IoT systems, thus preventing the definition of more open solutions that can benefit from the best of both worlds.

Part II - Execution of the work

# Technical Bodies and other stakeholders

## Reference TB

TC SmartM2M will be the TB responsible for the monitoring and technical guidance of the STF.

## Other interested ETSI Technical Bodies

ETSI ISG NFV has been working on virtualization for network functions. The ISG has also considered use cases for IoT virtualization. The results of this STF should also provide relevant input for the ETSI ISG NFV.

The oneM2M Partnership Project will also benefit from the STF results.

## Other stakeholders

The Open Source Communities around oneM2M may benefit from the results of the STF and take the output of the development of the STF PoC into their roadmaps.

# Base documents and deliverables

## Base documents

|  |  |  |  |
| --- | --- | --- | --- |
| **Document** | **Title** | **Current Status** | **Expected date for stable document** |
| ETSI TS 118 101 V2.10.0 (2016-10) | oneM2M; Functional Architecture (oneM2M TS-0001 version 2.10.0 Release 2) | Published |  |
| ETSI TS 118 109 V2.6.1 (2016-09) | oneM2M; HTTP Protocol Binding (oneM2M TS-0009 version 2.6.1 Release 2) | Published |  |

## Deliverables

|  |  |  |
| --- | --- | --- |
| **Deliv.** | **Work Item code****Standard number** | **Working title****Scope** |
| D1 | DTR/SmartM2M-103527 (TR) “SmartM2M; Virtualized IoT Architectures with Cloud Back-ends” | Working title: Virtualized IoT Architectures with Cloud Back-endsScope: identification of new architectural elements (components, required mappings, etc.) that are required to address IoT on a cloud back-end. Description of use cases that benefit from virtualization. |
| D2 | DTR/SmartM2M-103528 (TR) “Landscape for open source and standards for cloud native software for a Virtualized IoT service layer “ | Working title: Landscape for open source and standards for cloud native software applicable for a Virtualized IoT service layerScope: provides a detailed description of open source projects, their key features and their level of maturity for the purpose of building a virtualized IoT service layer |
| D3 | DTR/SmartM2M-103529 (TR) “Virtualized IoT over Cloud back-ends: a Proof of Concept“ | Working title: IoT over Cloud back-ends: a Proof of Concept.Scope: deep description of the use case Horizontal Scalability and its implementation, in particular the main components developed and how they can be possibly mapped within the oneM2M framework. |

## Deliverables schedule:

The following schedule applies to the 3 WI created in ETSI TC SmartM2M. Three provisional work items have been created and submitted for approval by ETSI TC SmartM2M:

* [**SmartM2M(17)042003**](https://docbox.etsi.org/SmartM2M/SmartM2M/05-CONTRIBUTIONS/2017/SmartM2M%2817%29042003_Requirement___Feasibility_study_for_Smart_Lifts_in_IoT.zip)
* [**SmartM2M(17)042004**](https://docbox.etsi.org/SmartM2M/SmartM2M/05-CONTRIBUTIONS/2017/SmartM2M%2817%29042004_Virtualized_IoT_Architectures_with_Cloud_Back-ends.zip)**a1**
* [**SmartM2M(17)042005**](https://docbox.etsi.org/SmartM2M/SmartM2M/05-CONTRIBUTIONS/2017/SmartM2M%2817%29042005_Landscape_for_open_source_and_standards_for_cloud_native_sof.zip)

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| --- | --- | --- | --- |
| DocumentType | DocumentNumber\* | Title | Schedule (TP No.) |
| Start  | Change Control  | Freeze | Approval |
| TR | TR 103 527 | IoT Architectures in support of IoT virtualization | 09/2017 | 11/2017 | 12/2017 | 02/2018 |

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| --- | --- | --- | --- |
| DocumentType | DocumentNumber\* | Title | Schedule (TP No.) |
| Start  | Change Control  | Freeze | Approval |
| TR | TR 103 528 | Landscape for open source and standards for cloud native software for a Virtualized IoT service layer | 09/2017 | 11/2017 | 02/2018 | 04/2018 |

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| --- | --- | --- | --- |
| DocumentType | DocumentNumber\* | Title | Schedule (TP No.) |
| Start  | Change Control  | Freeze | Approval |
| TR | TR 103 529 | Virtualized IoT over Cloud back-ends: a Proof of Concept | 09/2017 | 03/2018 | 05/2018 | 07/2018 |

# Work plan, time scale and resources

## Organization of the work

The STF will be under the monitoring and responsibility of TC SmartM2M.

A Steering Group (SG) will be formed comprising members of ETSI TC SmartM2M, oneM2M WG TST and stakeholders from the organisations mentioned in section 4 of this proposal. The SG will be set up and jointly led by the chair and the vice-chair of TC SmartM2M.

The STF will provide regular reports to the Steering Group. Conference calls will be held when appropriate. Face-to-face meetings will occur in connection with the relevant TC meetings and Working Group meetings.

## Task description

Task 1 – Project Management and Code Review

Objectives: Project Management (This task will be carried out by the STF Leader)

Input:

Output: Professional project management and high quality of the results produced

Interactions: TC SmartM2M – oneM2M

Resources required

* good knowledge of relevant oneM2M standards;
* good experience of cloud computing standards, open source and techniques;
* good knowledge of software engineering and open source techniques;

Task 2 – Identification of Architecture Evolutions

Objectives: Analysis of the architecture requirements and use cases. Definition of the architectural evolutions required.

Input:

Output: A Technical Report.

**Interactions**: TC SmartM2M – oneM2M TST WG – Prioritization of the tests to be implemented and verification of the produced test cases

Resources required

* good knowledge of relevant oneM2M standards;
* expert knowledge of cloud computing standards and architectures;

Task 3 – Landscape for open source and standards for a Virtualized IoT service layer

Objectives: Overview of Open Source projects / standards applicable for virtualization of IoT..

Input:

Output: A Technical Report.

Interactions: TC SmartM2M

Resources required

* expert knowledge of relevant oneM2M standards;
* expert knowledge of cloud computing standards and techniques;

Task 4 – Use case definition and implementation

Objectives: Specification of the use case. Definition and realization of the implementation.

Input:

Output: A Technical Report. Open Source code available in ETSI repository

Interactions: TC SmartM2M – oneM2M

Resources required

* expert knowledge of relevant oneM2M standards;
* good experience of cloud computing standards and techniques;
* expert knowledge of software engineering and open source techniques;

## Milestones

Milestone 1 – Architecture and use cases defined

Milestone 2 – OSS and standards landscape specified

Milestone 3 – Specification of detailed use case

Milestone 4 – Early delivery of use case prototype

Milestone 5 – Stable and frozen use case prototype

Milestone 6 – Deliverables adopted and published and STF closed

## Task summary

|  |  |  |
| --- | --- | --- |
| **N** | **Task / Milestone / Deliverable** | Target date |
|
| M0 | Start of work | 02/10/2017 |
| T1 | Project management and code review | from 02/10/2017-to 30/06/2018 |
| T2 | Identification of Architecture Evolutions and use cases | from 02/10/2017-to 31/12/2017 |
| T3 | Landscape for open source and standards for a Virtualized IoT service layer  | from 02/10/2017- to 31/12/2017 |
| M1 | Architecture and use cases defined | 31/12/2017 |
| M2 | OSS and standards landscape specified | 31/12/2017 |
| T4 | Use case implementation | from 01/12/2017-to 30/06/2018 |
| M3 | Specification of detailed use case | 31/12/2017 |
| M4 | Early delivery of use case prototype | 31/03/2018 |
| M5 | Stable and frozen use case prototype | 31/05/2018 |
| M6 | Deliverables adopted and published and STF closed | 01/07/2018 |
| **Total** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Task Milest.** | **Description** | **O** | **N** | **D** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** |
| T1 | Project management and code review |  |  |  |  |  |  |  |  |  |  |  |
| T2 | Identification of Architecture Evolutions |  |  |  |  |  |  |  |  |  |  |  |
| T3 | Landscape for open source and standards for a Virtualized IoT service layer  |  |  |  |  |  |  |  |  |  |  |  |
| M1 | Architecture evolutions specified |  |  |  |  |  |  |  |  |  |  |  |
| M2 | OSS and Standards landscape available |  |  |  |  |  |  |  |  |  |  |  |
| T4 | Use case implementation |  |  |  |  |  |  |  |  |  |  |  |
| M3 | Use case specified |  |  |  |  |  |  |  |  |  |  |  |
| M4 | Early delivery of use case prototype |  |  |  |  |  |  |  |  |  |  |  |
| M5 | Stable and frozen use case prototype |  |  |  |  |  |  |  |  |  |  |  |
| M6 | Deliverables published, STF closed |  |  |  |  |  |  |  |  |  |  |  |

## Working methods and travel cost

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. For other cases, refer to the travel budget table in Part III.

# Expertise required

## Team structure

The membership of the STF will ensure the following mix of competences:

* good knowledge of relevant oneM2M standards;
* expert experience of cloud computing standards and techniques;
* expert knowledge of software engineering and open source techniques;

Part III: Financial conditions

# Maximum budget

The maximum budget for this action is 73 000 €.

## Manpower cost

|  |  |
| --- | --- |
| **Description** | **Maximum estimated cost (€)** |
| Service contracts | **68 000** |

## Travel cost

The total action cost includes the travels required to attend the following events:

* Two or three STF representatives to support an extended code review (expected duration of approximately three days).
* Present STF Progress Report and deliverables to TC SmartM2M and ETSI ISG NFV meetings over the duration of the action (5 meetings)

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| **Expected travels** | **Cost estimate** |
| Extended code review | 2 000 |
| Meetings | 3 000 |
| **Total cost** | **5 000** |

## Other Costs

NA.

Part IV: STF performance evaluation criteria

# Key Performance Indicators

Contribution from ETSI Members to STF work

* Support to the STF work (e.g. provision of test–beds)
* Steering Group meetings (number of meetings / participants / duration)
* Number of delegates directly involved in the review of the deliverables
* Contributions/comments received from the reference TB
* Contributions/comments received from other TBs

Contribution from the STF to ETSI work

* Contributions to TC/WG meetings (number of documents / meetings / participants)
* Contributions to other TBs

Liaison with other stakeholders

* Stakeholder participation in the project (category, business area)
* Cooperation with other standardization bodies/organisations
* Potential interest of new members to join ETSI
* Liaison to identify requirements and raise awareness on ETSI deliverables
* Comments received on drafts (e.g. on WEB site, mailing lists, etc.)

Quality of deliverables

* Approval of deliverables according to schedule
* Respect of time scale, with reference to start/end dates in the approved ToR
* Comments from Quality review by TB
* Comments from Quality review by ETSI Secretariat

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

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

# Document history

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| --- | --- | --- | --- | --- |
|  | **Date** | **Author** | **Status** | **Comments** |
| 0.1 | 01-May-2017 |  | Draft |  |
| 0.3 | 05-May-2017 |  | Draft | For submission to STF review |
| 1.0 | 10-May-2017 | PGU, GC |  | For submission to STF review |
| 1.1 | 07-June-2017 | GC | For approval | For submission to Board#113 for approval on 21-22/06/2017. Update with updated budget following STF Review Panel with TC SmartM2M officials |
| 1.2 | 22-June-2017 | GC | Approved | Board#113 approved |
| 1.3 | 07-July-2017 | ETSI | Final | Clean version for CfE |
| 1.4 | 08-September-2017 | PM |  | Preparatory Meeting |