

MAS²TERING

**Multi-Agent Systems and Secured coupling of Telecom and Energy gRIDs
for Next Generation smartgrid services**

FP7 – 619682

2nd periodic report M13-24 (Sept. 2015 – Aug. 2016)

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Abstract

This report gives an account of the activities lead in the MAS²TERING project during the second period (from September 2015 to August 2016). The report includes a publishable summary, a detailed account of the activities lead in the various tasks and work-packages, a summary of progress and achievements, a summary of the use of resources and financial data. It also includes a summary of the recommendations from the intermediary technical review (M18) and the actions taken accordingly by the project.

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| Abstract (for dissemination) | This report gives an account of the activities lead in the MAS ² TERING project during the second period (from September 2015 to August 2016). The report includes a publishable summary, a detailed account of the activities lead in the various tasks and work-packages, a summary of progress and achievements, a summary of the use of resources and (tentative) financial data. It also includes a summary of the recommendations from the intermediary technical review (M18) and the actions taken accordingly by the project. |
| Keywords | Reporting, Management. |

1 Publishable summary

Mas2tering is a three-year technology-driven and business-focussed project, aimed at developing an innovative information and communication technology (ICT) platform for the monitoring and optimal management of local communities of prosumers. Mas2tering combines an original business vision, aimed at the enablement of local energy aggregation markets, with a set of enabling technologies from the artificial intelligence, communication and security domains. Last-mile connectivity solutions will be combined with a distributed optimisation platform, and the security of communications enhanced, to enable for effective and secured electricity management at distribution level and create new business opportunities. Doing so, the project aims at enabling new collaboration opportunities between grid operators and telecom and energy companies, both from technology and business perspectives.

Mas2tering builds upon five pillars:

- Interoperability to enable effective interactions between distribution grid stakeholders;
- Reliability and security for trusted services provision and enhanced resilience;
- Decentralised and self-organising architecture for enhanced flexibility and increased resilience through self-healing;
- Smart ICT components for monitoring and optimal energy management at distribution level;
- Innovative business models to foster adhesion of the local energy market stakeholders to the project vision.

The project consortium includes industries, SMEs and research institutes from the European energy, telecom and security fields. The nine project partners are CEA (Fr), Smart Metering Systems (UK), R2M Solutions (IT), ENGIE (Fr), Airbus CyberSecurity (Fr), Telecom Italia (IT), Cardiff University (UK), Waterford Institute of Technology (IR) and Laborelec (BE).

1.1 Project overview and objectives

Mas2tering aims at delivering a self-organized, integrated ICT platform for interoperable, secure, and trusted communication between distribution grid stakeholders. The objective is to allow for optimal monitoring and management of local communities of prosumers, at distribution grid level, thanks to ICT breakthrough (optimization, security, and interoperability) and business innovation. To this end, the project targets the following Scientific and Technology Objectives:

[STO1] Design and deliver middleware components for flexible multi-protocol smart grid management, enabling massively distributed and secured smart grid monitoring and management strategies. This objective will focus on PLC / wireless communication software development and design and development of agent communication interfaces.

[STO2] Design and deliver software components for smart grid security enhancement, with two main targets: software components for secure communication between the platform agents; and tools and methods for security risk awareness at distribution level.

[STO3] Design and develop optimization software, based on multi-agent systems, for optimal management and self-healing of local communities of prosumers, with four main focuses: home automation user profile optimization; renewable production prediction & energy community-level flexibility management; local balance and self-healing.

[STO4] Review and investigate the interplay between security, communication and smart grid standards; evaluate them on use case scenarios using the Mas2tering platform and extract guidelines for future enhancements and propose updates through the relevant project dissemination channels.

[STO5] Devise business models for flexibility services for in-home optimization, exemplifying how individual and collective prosumer communities can benefit from flexibility; flexibility services for DSO capacity management; decentralized energy management at prosumer community-level. Business models will be evaluated using business cases linked to the project use cases.

[STO6] Thoroughly assess and validate the effectiveness and technological impact of the MAS-based Mas2tering platform on the project use cases, relying on simulation and experimental validation activities, based on actual grid data.

[STO7] Engage actively with energy stakeholders and standardisation organisations to get an industrial / business feedback on the project results through the organization of a series of focused workshops and the setting up of a compact Value-Driven Advisory Group and to the development and/or update of a selection of standards.

[STO8] Within the project timeframe, perform 8 esteemed scientific presentations and, jointly (ICT + Energy) author and publish 5 conference papers and 3 journal articles in ICT / energy conferences / journals.

1.2 Summary of activities, main achievements and take-up of review recommendations

The M13-24 period can actually be divided into two sub-periods: The M13-17 period, which aimed at implementing the project roadmap but also to solve the significant deviations identified at M12 by the reviewers and the EC, and the M18-24 period, during which the consortium aimed at achieving the challenging targets of the second period in terms of deliverables and milestones. For the sake of clarity and exhaustiveness, this paragraph (and the remainder of this report) addresses the two periods, reminding when relevant some elements from the previous report (M13-17).

The main corrective actions taken after the M12 review were the following:

- To finalize the signature of the consortium agreement;
- To resubmit rejected and conditionally accepted deliverables: respectively D8.2 (periodic report) and D1.6 (Use cases and business models vision I) and, D8.1 (Project handbook), D2.1 (Mas2Tering platform technical requirements) and D5.2 (Standards Assessment, Strategies for Power and IT combination standards).
- Preparation of an amendment of the DoW to formalize the changes occurred during the first period and their impacts on the workplan.

All these actions were performed in conformance with the EC. The M17 review outcomes¹ confirmed the compliance of the project with the M12 review recommendations and underline the improvement of the project in terms of technical achievements and focus. However, some remaining weaknesses and risks were also highlighted. The main ones were:

- The business strategy of the project requiring clarifications;

¹ Technical review report, Ref. Ares(2016)2106637 - 03/05/2016.

- Some deliverables still lacking focus and being too lengthy;

The M17 review also pointed that:

- In relation to STO#2, the advancement in WP4 (security) was difficult to assess because of the lack of deliverables during the M13-17 period;
- In relation to STO#4, the strategy of the project with respect to standardization impact (in relation to WP1, 4 and 5) was still unclear;
- In relation to STO#8, the implementation of the dissemination roadmap was still at an early stage.

In the light of M17 review, the consortium had three main objectives during the M17-24 period:

- Implementing the technical roadmap and achieving the significant number of deliverables planned over the period in all technical areas: Multi-Agent Systems (MAS) and prediction in WP3; Security in WP4; Communication in WP5; Integration in WP2. In particular, the aim was to deliver a first version of the integrated platform at M24 as planned. Also, it was paramount to ensure a smooth development of WP4 in order for the M24 review to properly assess achievements in the area of security.
- Developing a business vision that would highlight the business positioning of the services provided by the Mas2tering flexibility management platform and related benefits. This mostly relates to the delivery of D1.5 “Business Strategies and Collaboration Opportunities” at M24. Also, ensuring that this business vision is in line with the project use cases (WP6).
- Finalizing the detailed validation scenarios and detailing the validation activities that will be performed over the 3rd period, in the scope of the three project use cases. This relates to WP6, with the delivery of D6.1 at M21 and the preparation of D6.2.1 (first part of the D6.2 planned at M33) that details the implementation strategy of validation use case.

In addition, the project made significant efforts to progress towards the achievement of dissemination targets, with e.g. a special session organized at IEEE Smart City 2016 conference (September 2016, Trento, Italy). Also, the consortium focused its strategy with respect to standardization, e.g. through a closer collaboration with the USEF (Universal Smart Energy Framework) foundation. Eventually, quality guidelines were reminded throughout the period to make sure that deliverables would have the right focus and to avoid excessively lengthy documents.

Despite some deviations (documented in section **Erreur ! Source du renvoi introuvable.**), the project has progressed significantly towards the achievement of these objectives, as shown by the following table, which summarizes the main achievements with respect to each STO:

| STO | Activities | Achievements to date |
|--|---|---|
| #1: Design and deliver middleware components for flexible, multi-protocol smart grid management. | Resubmission of D5.2 (communication standards); definition of communication requirements as part of D2.2 (platform design); Integration of communication aspects in use cases (D6.1, validation scenarios); preparation and delivery of D5.3 (Global MAS communication design) and D5.4 (MAS Communication components); Progressing D5.5 (HAN | The design of the communication components of the Mas2tering platform is fully achieved and documented in D2.2 and D5.3. The implementation of the MAS communication components has also been achieved with the delivery of D5.4. The development of HAN interoperability software is progressing as planned and the software shall be delivered as scheduled. Communication between the components has already been tested as part of the preparation of D2.3 (first version of the integrated platform). This STO can therefore |

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| | interoperability software components). | be considered as close to completion. |
| #2: Deliver software components for smart grid security enhancement. | As part of WP4: delivery of D4.1 (State of the art standards and technologies for cyber-security of smart grids), D4.2 (Privacy protection and anonymization components) and D4.3 (Cyber risk assessment and early warning components). As part of WP2: contribution to the platform architecture design for cybersecurity aspects. As part of WP6: Integration of security aspects in the refinement of use cases. | All security components have been delivered (D4.2 and D4.3) as planned. They cover the security areas targeted by the platform: encryption, authentication, anonymization of data, and cybersecurity monitoring and awareness of LFA (Local Flexibility Aggregator) home energy monitoring devices. A first step of integration of security components has been achieved in D2.3, which will be lead further and finalized in D2.4. Early demonstrations of the components were performed at the M17 review, and additional ones are planned at the M24 review. Security concerns have also been duly integrated in WP2 and WP6 deliverables, and are reflected in the architecture of platform and the refinement of the use case scenarios. This STO can be considered as close to completion, with only integration and testing activities left ahead. |
| #3: Design and develop optimization software, based on multi-agent systems, for smart grid dynamic balance and network self-healing. | In the scope of WP3: Design and development of Mas2tering agents (delivery of D3.1 at M21); development of prediction algorithms (delivery of D3.2 at M24); progressing the development of optimization algorithms in task 3.3. In the scope of WP2: integration of agents and optimization in the platform design (D2.2) and first version of integrated platform (D2.3). In the scope of WP6: Refinement of optimization objectives in the project use cases. | The development of Mas2tering agents (task 3.1) is completed as planned. The development of prediction algorithms (task 3.2) is completed as planned. A first step of integration of the agents in the platform has been achieved in WP2. Optimization algorithms development has progressed, with the aim to iteratively deliver algorithms for use case 1, 2 and 3 (expanding from home scale to low-voltage grid scale). However, the development of optimization algorithms is delayed, as documented in section Erreur ! Source du renvoi introuvable.. This STO, while significantly advanced, still requires attention during the coming months. |
| #4: Review and investigate the interplay between security, communication and smart grid standards and extract and disseminate guidelines for future enhancements | The review of standards has covered three areas: business (as part of WP1), communication (as part of WP5), security (as part of WP4). The outcomes of this review work is included in D1.6, D5.1 and D5.2, and D4.1, all delivered. The consortium has also made connections to relevant standard bodies (e.g. USEF, IEEE). | As part of D1.6, D5.1, D5.2, and D4.1; a thorough assessment of smart-grid communication and security standards, as well as business frameworks has been lead. In the light of this assessment, the consortium has established connections in the area of communication with Energy@Home (through Telecom Italia), with USEF and IEEE (through R2M) in the business area. The aim is eventually to transfer some key results from the project (business vision, data models). The area of security is also being investigated – connections with the cybersecurity agencies (e.g. French ANSSI with CCS) are considered. |

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| <p>#5: Devise business models for local energy flexibility management.</p> | <p>This STO mostly relates to the following WP1 activities: business context analysis; definition of business cases; refinement of use cases from business perspective; business stakeholders feedback collection; business vision definition. The outcomes of this work are included in D1.6, D1.5 and in the feedback from the project's business workshops.</p> | <p>The development of the business vision has been pointed as a source of risks for the project during in the two first reviews. Therefore, the issue has attracted considerable attention during the period. The first main thread of work has been the consolidation of the first version of the business vision, with the resubmission of D1.6 (Use cases and business models vision I). The second main objective has been the completion of D1.5 (Business strategies and collaboration opportunities) that aims at conceptualising the Local Flexibility Market Model and identifying related value flows, as well as giving a first hint of Mas2tering business models. This work has been supported by the expert feedback collected in the three project business workshops. The mapping to use cases has been enhanced thanks to a closer collaboration with WP6.</p> <p>The progress towards the achievement of this STO has been considerable during the period, but the 3rd period will be critical with the refinement of the business vision (D1.7) and the mapping to the exploitation roadmap defined in WP7.</p> |
| <p>#6: Assess and validate the effectiveness and technological impact of the MAS-based MAS2TERING platform.</p> | <p>This objective relates to WP6: refinement of use cases objectives and implementation path (including use of simulation tools and experimental facilities).</p> | <p>The refinement of the use cases has been achieved ahead the schedule. An advanced draft of D6.1 was made available for the M18 review, and the final version of the deliverable delivered at M21 as planned. In addition, during the M18-24 period, the validation implementation activities have been refined and made available internally (D6.2.1, first part of D6.2).</p> <p>This thread of activity is perfectly on track. However, the implementation of validation activities will require a lot of attention, in particular to mitigate the impact from delays on optimization in WP3.</p> |
| <p>#7: Engage actively with energy stakeholders and standardisation organisations (Value-Driven AG).</p> | <p>This objective relates to WP7 and WP1: identification of relevant stakeholders and setting up of the Value-Driven Advisory Group; collection of feedback through business workshops.</p> | <p>The advisory group is ready and the connection with the project is established. Three business workshops took place, which enabled us to get useful feedback about LFA business applicability and relevance. The refocused business vision (following the revision of D6.1) has been key in enabling more exploitable feedback from business stakeholders, e.g. as part of WS#3, which took place in June, 2016 at Sustainable Places 2016 conference. The activity will continue in the 3rd period.</p> |

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| <p>#8: Perform 8 esteemed scientific presentations and, jointly (ICT + Energy) author and publish 5 conference papers and 3 journal articles in ICT / energy conferences / journals.</p> | <p>This objective relates to WP7 (dissemination): publications about project concept and initial development.</p> | <p>Mas2tering intensified dissemination efforts in RP2 and deliberately targeted high visibility events. Three MAS2TERING special sessions (including an IEEE conference special session) contributed to this aim, producing a total of eight peer reviewed publications being accepted & presented by MAS2TERING partners at international events. The consortium now wish to concentrate their efforts on journal publications over the 3rd periods.</p> <p>Following the achievements of period 2, this STO is close to completion.</p> |
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Table 1: Progress for each STO

1.3 Expected final outcomes and potential impacts

Mas2tering aims at generating a breakthrough in the area of local electricity management, thanks to a combination of technology innovation, smart-grid standards leveraging and business awareness. The general belief of the project – that was expressed in the proposal and DoW and has been refined during the first half of the project – is that switching to local management of electricity through the enablement of local communities of prosumers and thanks to increased interactions, at distribution level, between utilities, ESCO, telco and DSO, would result in significant benefits. The main focus of the project, related to our use cases 2 and 3, is to allow energy for optimized energy management at local level (local communities of prosumers) and to assess the benefits of a more dynamic management of the distribution grid with respect to reliability and maintenance / evolution costs. In order to reach this objective, the project follows a multi-dimensional strategy:

- Analysis of regulatory / standard / business requirements,
- Technology innovation: distributed optimization for enhanced and flexible energy efficiency and resilience, communication enablement components (interoperability),
- Showcasing technologies through focused use cases (relying on a set of well-defined assumptions regarding the evolution of the grid, most importantly with respect to ICT deployment),
- Closing the loop with business stakeholders to present quantified evaluation of the financial and environmental benefits of the Mas2tering approach,
- Assessing the best paths to exploitation of Mas2tering innovation.

This way, Mas2tering has the potential to be game-changing and contribute to redefine the local energy management ecosystem, in particular with respect to interactions between ESCO, utilities, DSO and telco.

1.4 Consortium information

The consortium includes the nine following partners:

- CEA (French Atomic and Alternative Energy Commission). Contact: Sylvain Robert (sylvain.robert@cea.fr) and Marie-France Robbe (marie-france.robbe@cea.fr) . <http://www-list.cea.fr/>.
- SMS (Smart Metering Systems, formerly Utility Partnership Limited). Contact: Mario Sisinni (mario.sisinni@sms-plc.com) and James Sharman (james.sharman@sms-plc.com). <http://www.sms-plc.com/upl-landing-page>.

- R2M (Research to Market) Solutions. Contact: Thomas Messervey (thomas.messervey@r2msolution.com). <http://www.r2msolution.com/>.
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The consortium has not experienced any modification during the considered period.