



Deliverable D6.3

Report on RERUM Outreach Activities in Y2 & Y3 Planning

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Abstract

This deliverable documents RERUM's outreach activities undertaken during the second year of the project, followed by planning for the final year. This deliverable summarises the achievements of three tasks of Work Package 6, namely Dissemination (Task 6.1), Standardisation (Task 6.2) and Co-ordination with other EU initiatives (Task 6.4). (Activities undertaken as part of task T6.3 – Exploitation are recorded in a separate deliverable D6.2). Highlights of Dissemination during the second year included the publication of 20 scientific papers, delivery of demonstrations with early results, and a strong participation in IERC related events at the IoT Week and Net Futures. In terms of standardisation, RERUM has identified and has been following the activities of relevant bodies and has participated in two meetings (IETF and ETSI). Lastly, highlights of co-ordination with other initiatives were RERUM's contributions to the IoT European Research Cluster (IERC) cluster book and to the IERC Activity Chain 3 position paper.

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Executive summary

This deliverable presents a detailed overview of RERUM's second year activities on Dissemination (Task 6.1), Standardisation (Task 6.2) and Co-ordination with other EU initiatives (Task 6.4). It includes activities undertaken during RERUM's second year and sets out a plan for the final year of the project.

In terms of dissemination, RERUM published a high number of 20 research papers, organized workshops adjunct to high profile international and European conferences, coordinated and participated in special sessions, panel discussions, poster sessions and delivered demonstrations of the work performed within the project along with the project vision and plans. With these activities, RERUM has reached a wide list of stakeholders of the Smart Cities domain.

RERUM had a strong presence in two high-profile events: Net Futures 2015 and IoT week 2015 in Lisbon. For the final year, we have a high number of already submitted publications to increase the number of scientific as well as of non-scientific publications. Demonstration activities will ramp up to showcase the RERUM solution as it becomes more complete and mature, and will be associated and complemented with press releases. Overall, we expect a very high level of dissemination activity and participation at a large number of relevant events.

In terms of standardisation, RERUM has provided a draft to the IETF, which was also presented and discussed during the IETF93 ACE (Authorization in Constrained Environments) WG meeting in Prague in July, 2015. The name of the draft is: Privacy-Enhanced Tokens for Authorization in ACE (draft-cuellar-ace-pat-priv-enhanced-authz-tokens-00). The current plan in the ACE WG is to integrate the RERUM draft into a common solution.

Lastly, in terms of Co-ordination with other EU initiatives, notably in the frame of the IoT European Research Cluster (IERC) RERUM practically took over leading IERC Activity Chain 5, Governance, Privacy and Security issues and became co-chair of the Activity Chain 3 on IoT Innovation and Pilots. This meant that RERUM

- co-ordinated the production and edited the relevant chapter for security and privacy in the IERC year book and contributed heavily to the chapter for pilots and demonstrations,
- organised the Security and Privacy in IoT session as part of the IoT week and also the joint workshop with CHIST-ERA (which in 2015 selected Security and Privacy in IoT as one of its two focal areas for its open call), and
- co-organised the session for innovation and experiences from large scale IoT deployments and demonstrators,
- co-organised a workshop (together with project SMARTIE and COMPOSE) on Citizens Engagement to the IoT: Security and Privacy Challenges as part of EuCNC.
- organized several F2F meetings with COMPOSE in order to find synergies. The RERUM Pseudonym-generation has been adopted by the EU Project COMPOSE for a new scenario (not included in the scenarios of RERUM).

List of authors

Company	Author	Contribution
Eurescom	Ádám Kapovits	Eurescom report on Y2 activities and Y3 planning, IERC related activities
Siemens AG	Jorge Cuellar	Siemens report on IETF, cooperation with COMPOSE and Y3 planning
ATOS	Jose Luis Gato	ATOS Y2 Activities and planning for Y3
UNIVBRIS	George Oikonomou	UNIVBRIS report of Y2 actions
	Theodore Tryfonas	UNIVBRIS planning of Y3 activities
LiU	Vangelis Angelakis	Editor & LiU Y2 Actions / Y3 Plan
UNI PASSAU	Henrich C. Pöhls	UNI PASSAU report of Y2 actions and Y3 planning
Zolertia	Marc Fàbregas Bachs	Zolertia reporting and planning
FORTH	Elias Z. Tragos	FORTH report on Y2 and plan for Y3 actions and description of project demonstrators and IERC joint events.
CYTA	Athanasios Lioumpas	CYTA report of Y2 activities and planning of Y3
AJTGN	Xavier Reina	AJTGNA report of Y2 actions and Y3 planning.
HER	Costis Mochianakis, Manolis Fotakis	HER report on Y2 activities and Y3 planning
SSRL	Septimiu Nechifor	SSRL report of Y2 actions and Y3 planning

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1 Introduction

The objective of this deliverable is to document RERUM WP6's activities during year 2 and to present a plan for the third year of the project. This deliverable focuses on Dissemination (Task 6.1), Standardisation (Task 6.2) and Co-ordination with other EU initiatives (Task 6.4). Exploitation is the objective of a separate deliverable (D6.2) and is therefore not included in the present document.

1.1 Document Structure

This deliverable contains three sections focusing respectively on each of the WP6 tasks reported here; specifically: Section 2 documents general dissemination activities undertaken during the second year of the project, including academic publications, press releases, demonstrations (including RERUM's participation in the IoT week), website, etc. Lastly, the same section lays out a dissemination plan for the final year.

Section 3 contains details about RERUM's standardisation activities during the second year and sets a plan for the final year of the project.

Section 4 focuses on activities concerning co-ordination with other EU initiatives, such as the IERC cluster.

Section 5 concludes the deliverable and provides indicators for assessing the quality of the dissemination plan during the project's second year. It also sets targets for the third and final year of the project.

2 Dissemination

Promotion and dissemination of project achievements and solutions are key in creating broad impact. Here we first provide a comprehensive account of the general promotion and dissemination activities performed in the period in a structured way. As part of this, first we highlight a few major events with considerable RERUM involvement and contribution, to then go on and list achievements according to their nature/type. Finally, we provide an outlook and plans concerning the final period of the project.

2.1 Dissemination Conducted During Year 2

2.1.1 Organization of events and activities therein

2.1.1.1 At the IEEE CAMAD Workshop 2014

RERUM co-organized **two special sessions** in the 19th IEEE International Workshop on Computer Aided Modelling and Design of Communication Links and Networks, in Athens, Greece, in December 2014.

- 1) **RESONANT**¹ - Resource Optimization in Heterogeneous Wireless Access Networks, was chaired by V. Angelakis (LiU),
- 2) **RED-IoT**² - Recent advances in secure management of data and resources in the IoT, was chaired by E. Tragos (FORTH).

The sessions were held one after the other at the same room and, together, were attended by over 60 workshop participants.



Figure 1: A. Lioumpas of CYTA (left) and A. Fragkiadakis of FORTH (right) presenting papers at the IEEE CAMAD 2014 RERUM organized special sessions

2.1.1.2 At the IEEE VTC 2015 Spring

RERUM co-organised with EU-FP7 Marie Curie project MESH-WISE a **full-day workshop** at the VTC-Spring 2015 held in Glasgow UK on May 11 2014. The title of the workshop was the **Workshop on Heterogeneous Networking for the Internet of Things**³ which attracted over 25 participants, a quite significant number, considering the large number of parallel sessions that were held at VTC Spring this year. LiU and FORTH were the co-organisers of the workshop for RERUM, which apart from paper presentations included a **demo session** with V. Angelakis from LiU, demonstrating the considerations for the UC-O1 (Smart Transportation) mobile app and the overall RERUM concept and an Italian SME (MobiMESH) on Smart Home applications. A **panel** titled *“Networking and data in smart city IoT use cases: challenges and opportunities”* and included, among others, as speakers Dr. V. Angelakis (LiU),

¹ <http://www.ieee-camad.org/2014/resonant.html>

² <http://www.ieee-camad.org/2014/red-IoT.html>

³ http://www.ieeevtc.org/vtc2015spring/workshops.php#wkshp_11

Dr. E. Tragos (FORTH) and Mr. S. Nechifor (Siemens SRL) from RERUM. More details can be found at <http://mesh-wise.eu/VTC15HNIoT/>. Finally a **poster session** was organized to have more face-to-face time with participants of VTC that were not necessarily participating at the workshop.

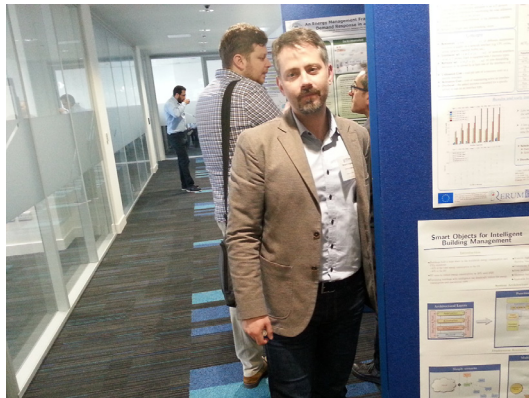


Figure 2: B. Ekelund of Ericsson Research delivers the workshop keynote (top), V. Angelakis of LiU (bottom left) and E. Tragos of FORTH (bottom right) showing RERUM posters at the workshop's poster session

2.1.1.3 At the IoT week 2015 in Lisbon

RERUM had a strong participation at the IoT week in Lisbon in June 2015. RERUM was a member of the organisation committee of the event and co-organised two sessions at the Industry Day, the **IoT Security & Privacy Workshop** (organised by Adam Kapovits and Elias Tragos) and the **Innovations and experiences from IoT deployments and demonstrators**, which was co-organised by Elias Tragos jointly with the Almanac project. Both included invited talks by experts on the respective areas.

The IoT Security & Privacy Workshop organised by RERUM had a double focus. On the one hand, the workshop discussed preserving security when breaking the silos in the IoT world. This was considered as a very timely topic, as IoT needs to overcome the current fragmentation, being a collection of purpose specific, often niche solutions, fragmented along sectors and markets, and the emergence of more encompassing, general purpose, commodity like solutions cutting across the traditional silos are expected in the near future as IoT matures. However, under such circumstances security becomes an even more important factor. So the first part the workshop addressed this challenge with the help of contributions from Leonard Ciprian Pitu (Siemens Romania, project COSMOS), Alexandros Fragkiadakis (FORTH, project RERUM, concerning how to implement on-device security in the IoT world) and Antonio Jara (HOP UBIQUITOUS S.L.).

The second part of the workshop tried to link privacy and innovation. Considering that on the Internet social networks and portals flourish in which environments privacy is of secondary importance at best,

one would assume that privacy is something that is less valued (at least by the younger generations), and is probably something difficult to sell. At the same time the organisers were convinced that the notion of privacy as most of us know it is still of value and needs to be maintained and protected. Therefore the second part of the workshop had a focus on innovation and privacy, approaches and best practices that support the innovation process and lead to actual privacy solutions that sell on the market. This part of the workshop was supported by Klaus Moessner (University of Surrey, project SOCIOTAL), and Jesper Algren (Smart Aarhus). (A full report from the workshop is provided in Annex A – report from the Security and Privacy in IoT workshop 18th June 2015).

The session on **Innovations and Experiences from IoT Deployments and Demonstrators** included many speakers from the Smart City projects and discussed the opportunities for and the issues of innovation in the IoT area. E. Tragos presented the RERUM deployment scenarios, the problems faced and the solutions identified for large scale deployments in Smart City environments.

RERUM also contributed at the session on **IoT and 5G** at the Research Day, in which E. Tragos presented the RERUM view on the requirements that IoT is giving for the development of the 5G technologies and how RERUM sees the benefits of 5G for the project activities.

RERUM also presented a comprehensive **demonstration**, showcasing the operation of RERUM middleware components. The demonstration was set-up in a joint effort by the Siemens SRL team in RERUM, and the FORTH team in RERUM. Setting up and organizing the demo also helped with the fine tuning of components and served as a public alignment with peer IERC projects like CityPulse. More information regarding the demonstrator at the IoT week are given in Section 2.1.4.

2.1.1.4 Workshop organization in EUCNC

RERUM co-organised a workshop at the EUCNC 2015 in Paris, in June 2015. The workshop titled **Citizens Engagement to the IoT: Security and Privacy Challenges** was jointly organised by RERUM, COMPOSE and SMARTIE, three EU-FP7 projects that were accepted at the Smart Cities call. The goal of the workshop was to discuss with the audience the challenges for engaging citizens in IoT-based Smart City applications and how to provide incentives to the citizens. Furthermore, the technologies developed within the three projects for addressing the security and privacy issues of smart city applications were also discussed. An invited speaker (Dr. Claudio Pastrone – ISMB) from Almanac presented also the views of this project on the subject. RERUM invited also Dr. Marit Hansen, a member of the Advisory Board of the project to give a talk on *Privacy and data protection challenges in smart city applications*. The workshop attracted just 15 people in total as an audience, but the discussions were very stimulating. More details here <http://eucnc.eu/?q=node/115>.



Figure 3: Discussion between C. Doukas (COMPOSE) and M. Hansen at the EUCNC workshop.

2.1.1.5 Ongoing Organization of an IEEE Globecom Workshop

RERUM is currently organizing a half-day workshop at the IEEE Globecom 2015, one of the flagship conferences in of the IEEE ComSoc with high visibility and impact in the communication sector, held in December, this year in San Diego, USA. The workshop is titled **Optimizing Heterogeneous Networking Technologies for the Internet of Things** and is jointly organised by Vangelis Angelakis (LiU) and Elias Tragos (FORTH). The workshop attracted 20 paper submissions which are under the review process as of this moment and seven or eight will be accepted, depending on the availability of invited keynote speakers. More details here <http://www.ics.forth.gr/tnl/Glob15-IoT/>

2.1.2 Publications in Peer-Reviewed Magazines, Journals, and Books

In

Table 1 we present an overview of the scientific papers produced during RERUM's year 2.

Table 1: Journal Publications

Authors	Contribution Title	Journal/book Title	Partners	Status
Dario Ruiz Lopez	Reducing IoT-PbD Dilemma by enriching authorization with reputation mechanisms*	Reducing IoT-PbD Dilemma by enriching authorization with reputation mechanisms	ATOS	Submitted to be published (in issue #103)
E. Tragos, V. Angelakis, S. Papadakis	Fighting Networking Heterogeneity in the Internet of Things	ERCIM News 101: The Internet of Things and the Web of Things	FORTH, LiU	Published http://ercim-news.ercim.eu/en101/special/fighting-networking-heterogeneity-in-

				the-internet-of-things
A. Fragkiadakis, E. Tragos, A. Makrogiannakis, S. Papadakis, P. Charalampidis, M. Surligas	Signal processing techniques for energy efficiency, security, and reliability in the IoT domain	Springer: Internet of Things (IoT) in 5G Mobile Technologies	FORTH	Under review

2.1.3 Publications in Proceedings of Refereed Conferences / Workshops

In

Table 2 we present an overview of the scientific papers published at the proceedings of peer-reviewed conferences and workshops during RERUM's year 2.

Table 2: Conference Publications

#	Authors	Contribution Title	Conference Acronym	Location, Date	Partners	Status
1	Konstantinos Maraslis, Theodoros Spyridopoulos, George Oikonomou, Theo Tryfonas, Mo Haghighi	Game Theoretic Approach for Smart Sensor Data Trustworthiness Problems	IFIP SEC 2015	May 26–28, 2015, Hamburg, Germany	UNIVBRIS	Published http://dx.doi.org/10.1007/978-3-319-18467-8_40
2	Beichen Chen, Zhong Fan, Fengming Cao, George Oikonomou, Theo Tryfonas	Class Based Overall Priority Scheduling for M2M Communications over LTE Networks	VTC Spring 2015	May 11-15 2015, Glasgow, UK	UNIVBRIS	Published
3	Henrich C. Pöhls, Ralf C. Staudemeyer, George Oikonomou, Marcin Wojcik	Privacy for the IoT beyond encryption: Towards unobservable communication of things	IEEE IoT WorldForum 2015	December 14-16 2015, Milan, Italy	UNI PASSAU and UNIVBRIS	Submitted

4	Henrich C. Pöhls	JSON Sensor Signatures (JSS): End-to-End Integrity Protection from Constrained Device to IoT Application	esIOT 2015	Juli 2015, Blumenau , Brazil	UNI PASSAU	Accepted, Presented Published
5	Henrich C. Pöhls, Kai Samelin	Accountable Redactable Signatures	ARES 2015	August 2015, Toulouse, France	UNI PASSAU	Accepted,
6	Henrich C. Pöhls, Benedikt Petschkuhn, Johannes Rückert, Max Mössinger	Aggregation and Perturbation in Practice: Case-Study of Privacy, Accuracy & Performance	IEEE CAMAD 2015	December 2014, Athens, Greece	UNI PASSAU	Accepted, Presented Published
7	Daniel P. Martin, Elisabeth Oswald, Martijn Stam, Marcin Wojcik	A Leakage Resilient MAC	Fifteenth IMA International Conference on Cryptography and Coding	December 2015, Oxford, UK	UNIVBRIS	Submitted
8	Alexandros Fragkiadakis, Vangelis Angelakis, Raphael Navas, George Vasilakis, Elias Tragos	CS-based crowd-sourcing IoT applications	CAMAD 2014 Demo	Athens, Greece, 1-3 Dec. 2014	FORTH, LiU	Presented
9	Stefanos Papadakis, Antonis Makrogiannakis, Manolis Surligas	Low-cost Multiple Primary & Secondary Users Emulation Platform for Cognitive Radio Testbeds	CAMAD 2014 Demo	Athens, Greece, 1-3 Dec. 2014	FORTH	Presented
10	Alexandros Fragkiadakis, Elias Tragos, Stefanos Papadakis, Pavlos Charalampidi	Experiences with deploying Compressive Sensing and Matrix Completion techniques in IoT devices	CAMAD 2014	Athens, Greece, 1-3 Dec. 2014	FORTH	Published http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7033237
11	Manolis Surligas, Stefanos	Empowering the IoT Heterogeneous	VTC 2015-Spring	Glasgow, UK, May	FORTH	Presented (to be published)

	Papadakis, Antonis Makrogiannakis	Wireless Networking with Software Defined Radio		11-14 2015		
12	Pavlos Charalampidis, Alexandros Fragkiadakis, Elias Tragos	Rate-adaptive compressive sensing for IoT applications	VTC 2015-Spring	Glasgow, UK, May 11-14 2015	FORTH	Published http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7146042
13	George Stamatakis, Elias Tragos, Apostolos Traganitis	A two-stage Power and QoS aware Dynamic Spectrum Assignment scheme for Cognitive Wireless Sensor Networks	QoMEX 2015	Costa Navarino, Messinia, Greece, May 26-29, 2015	FORTH	Published, http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7148086
14	George Stamatakis, Elias Tragos, Apostolos Traganitis	Periodic collection of spectrum occupancy data by energy constrained cognitive IoT devices	IWCMC 2015	Dubrovnik, Croatia, August 26-29, 2015	FORTH	Accepted
15	S. Fowler, j. Sarfraz, M. M. Abbas, and V. Angelakis.	Multimedia streaming, multicast and broadcast services; Convergence of communication and global services	IEEE ICC	London, UK,	LiU	Presented June 2015
16	I. Avgouleas, N. Pappas, and V. Angelakis	Cooperative Wireless Networking with Probabilistic On/Off Relaying Workshop on Heterogeneous Networking for the Internet of Things,	IEEE Vehicular Telecommunications Conference 2015 – Spring (VTC2015-Spring),	Glasgow, UK,	LiU	Presented May 2015 http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7145762
17	V. Angelakis, I. Avgouleas, N. Pappas, and D. Yuan	Flexible allocation of heterogeneous resources to services on an IoT device	IEEE Conference on Computer Communications Workshops	Hong Kong	LiU	http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7145762

			(INFOCOM Workshops) 2015			umber=7179362
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2.1.4 Demonstrations

Apart from standard paper presentations in international conferences, RERUM partners have been quite active in disseminating the project, its goals and the potential impact it will have in the areas of Internet of Things, security, privacy and smart city applications. In this respect, we have performed the following demonstrations

2.1.4.1 In the IEEE CAMAD Workshop 2014

FORTH's members presented **two demos** at the IEEE CAMAD conference that was held in December 2014 in Athens, Greece.



Figure 4: A. Fragkiadakis and E. Tragos (left), and A. Gavaletakis, S. Papadakis, M. Surligas and A. Makrogiannakis (right) at IEEE CAMAD 2014 exhibition area.

The first demo was a joint work between FORTH and LiU and was related with showing the performance of secure transmission techniques both for Android devices and sensor platforms (Zolertia Z1). Secure transmission was performed using the Compressive Sensing (CS) technique that achieves simultaneously encryption and compression of the gathered measurements, decreasing the numbers of transmissions and prolonging the lifetime of the devices. Figure 4 (left) shows A. Fragkiadakis and E. Tragos in front of this demo exhibition desk at IEEE CAMAD 2014 exhibition area.

The second RERUM demo at CAMAD 2014 was related with showing the adaptation of Software Defined Radio (SDR) techniques into the IoT world. FORTH demonstrated an innovative way of emulating primary users' transmissions with SDRs in order to utilize that for performing experiments of lightweight spectrum sensing for cognitive radio sensor devices. Figure 4 (right) shows the four members of FORTH in front of their desk at the IEEE CAMAD 2014 exhibition area.

2.1.4.2 RERUM at Net Futures 2015

RERUM delivered a **demonstration at the Net Futures 2015** in Brussels, executed jointly by UNIPASSAU, FORTH and SSRL. The RERUM booth attracted a lot of interest with many visitors (approximately 50) that were quite interested on the activities of the project. For example, Fig. 6 (left) shows the Prof. Giuseppe Bianchi discussing with Benedikt Petschkuhn from UNI PASSAU about the implementation of the integrity verification mechanism on the Zolertia Z1 device. Fig. 6 (right) shows the whole RERUM team in front of the booth.

Specifically, RERUM presented the first integrated demo of the project, showing the RERUM middleware (developed by SSRL) that was gathering information from 4 different RERUM Devices. Furthermore, two applications were consuming the services and displaying graphs. The security mechanisms that were showcased were the compressive sensing mechanism developed by FORTH and the integrity verification mechanism developed by UNI PASSAU. For the latter, we showed the workflow where sensors sign and verify data. This demonstrated that in RERUM all messages can be strongly integrity protected and all message's origin can be verified using asymmetric key cryptography.

A **poster** for offline use at NET-FUTURES and a pair of **demo videos** of the research prototype components were made. The poster was also used at **SIDO** and at **IEEE VTC 2015 Spring**. The videos can be found here: <https://ict-rerum.eu/jss-ecdsa-prototype/> and here: <https://ict-rerum.eu/sdr-prototype/>

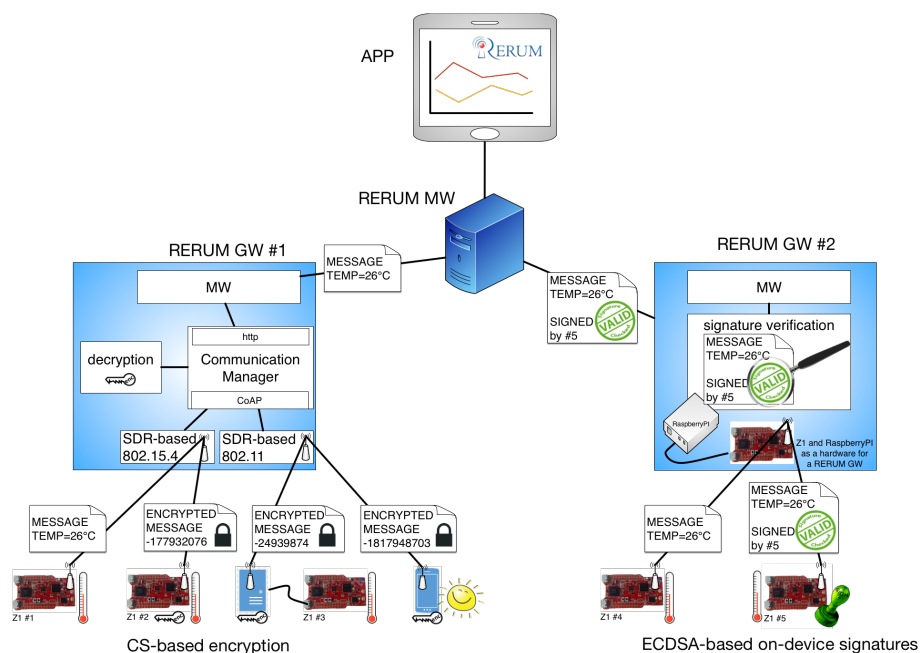


Figure 5: Schematic of the RERUM Net Futures 2015 prototypes demo, (part of the poster).



Figure 6: Prof. G. Bianchi as a visitor of the RERUM booth at NET Futures 2015 (left), the RERUM team at the project booth (right).

2.1.4.3 RERUM at IEEE VTC Spring 2015

At the demo session of the Heterogeneous Networking for the Internet of Things Workshop, V. Angelakis from LiU, demonstrated the outline of the UC-O1 (Smart Transportation) mobile app and the overall RERUM concept focusing both on the privacy preserving aspects of the participatory sensing and the architecture of the use case. The demo was attended by nearly thirty workshop participants including researchers from the MESH-WISE project which also has some smart city use cases.

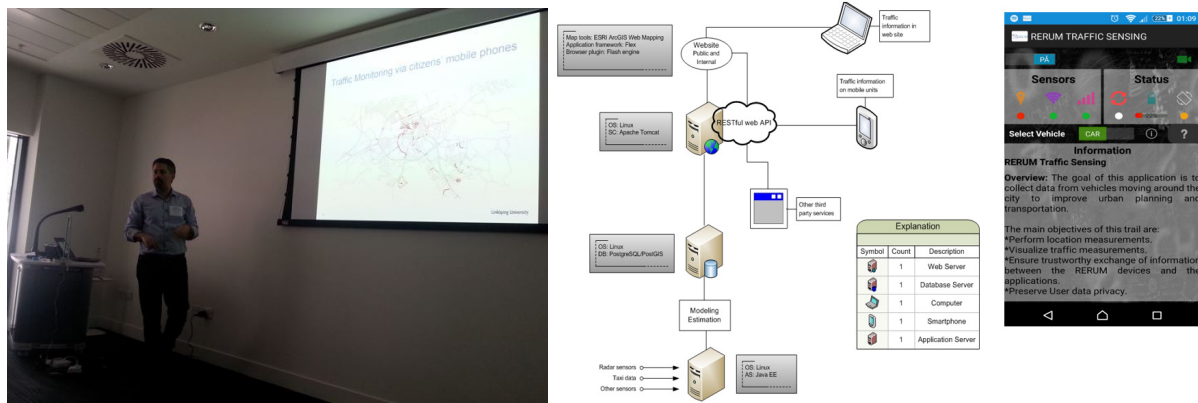


Figure 7: V. Angelakis of LiU demonstrates an early version of the RERUM UC-O1 (Smart Transportation) Android app and details how a traffic estimation service can run over RERUM (left), the schematic of the demo and an early version of the citizen application front-end (right).

2.1.4.4 IoT Week 2015

RERUM also showcased a demo at the IoT Week 2015 in June in Lisbon, with the participation of FORTH, Siemens SRL, and Atos. There, an upgraded version of the integrated RERUM demo was showcased, with an enhanced version of the mechanisms and the SDR-based IoT gateway handling both IEEE 802.15.4 and IEEE 802.11 traffic from the Android phones and the Zolertia Z1 devices. Fig. X5 shows members of the RERUM team at the RERUM booth. As it can be seen in Fig. 8, the booth attracted a lot of people at the breaks between the sessions (approximately 80 people visited the booth). Significant interest at the project activities was also shown by Mr. Thibaut Kleiner, the Head of Unit for Network Technologies.



Figure 8: Members of the project team (left) and visitors of the IoT week 2015 RERUM booth (right).



Figure 9: The RERUM team at the IoT week 2015 social event.

2.1.5 Other publications

The EURESCOM Message magazine⁴ in the Autumn 2014 edition focused on the Internet of Things. The introduction to the cover theme was provided by RERUM co-ordinator Adam Kapovits, and RERUM

⁴ The EURESCOM Message is a European ICT magazine with a focus on research, development and innovation in the communications sector produced by Eurescom and published two times a year with a circulation of 3,000 hard copies –

contributed with a joint article from FORTH, UNI PASSAU and LiU regarding IoT security, titled “RERUM – On-device intelligence for a better IoT”. The article can be retrieved from: <http://www.eurescom.eu/news-and-events/eurescommmessage/eurescom-message-2-2014/rerum-on-device-intelligence-for-a-better-iot.html>

2.1.6 Participation in Other Events / In-Person Outreach Activities

In this section we outline in-person outreach activities undertaken by RERUM consortium members during year 2.

- **Eurescom** participated at the Connected Smart Cities conference in Brussels, January 2015 to broaden links towards Smart Cities
- **Eurescom** participated at the Monetizing the IoT conference in Frankfurt am Main, April 2015 to gain a better insight into the business aspects, gauge potentially successful approaches monetizing IoT technology and associated services.
- **AJTGNA** participated in the Workshop about Tarragona’s environmental indicators – December the 17th, Tarragona. In the workshop several public bodies (Catalonian Government, Tarragona’s Harbour Authority, Tarragona’s Rovira I Virgili University and units from Tarragona’s Council) shared their work on the environmental monitoring field. Among other topics AJTGNA presented the RERUM objectives and its use cases. The event was organized by Tarragona’s Smart Mediterranean Foundation.
- **AJTGNA** participated in the Symposium about how to guarantee individuals privacy in smart cities technologies – June the 15th, Palace of the Parliament of Catalonia, Barcelona. In a session to share the “Catalonian municipalities’ experiences in Smart Cities”, AJTGNA presented from a high-level perspective the work done in the RERUM project, highlighting the citizen’s security and privacy. The symposium was organized by the Catalan Data Protection Authority (APDCAT).
- **AJTGNA** at Ciber@gora 2015, July the 9th, Tarragona. Every year Tarragona’s Council organises a one day conference to promote the knowledge among the citizens about Information, Communications and smart cities technologies. In the 2015 edition the RERUM project was presented in a round table to discuss among others the threats and risks in the information society. The conference was organized by Tarragona’s Council.
- **AJTGNA** published some of the project dissemination actions through the Council’s social media channels (Twitter) and its Intranet portal.
- **AJTGNA**: has also promoted RERUM dissemination actions through third parties:
 - The Tarragona Smart Mediterranean City Foundation is entitled to coordinate and disseminate Tarragona’s smart cities projects. In 2015 the foundation attended the following events where the RERUM use cases and objectives were presented as part of Tarragona’s smart cities projects.
 - At the Smart City Expo World Congress 2014. November 18-20th, Hospitalet de Llobregat (Barcelona) Tarragona had a stand, where different projects (included RERUM) were spotted advertised and explained to the visitors.
 - Presentation of RERUM (as part of Tarragona's smart city project) to other municipalities in its metropolitan area. May 29th, 2015.
- **AJTGNA**: Tarragona's Smart Mediterranean City Foundation hosts regular meeting by IT responsible at several municipalities around Tarragona, where smart city projects are discussed. RERUM was extensively presented during the latest of such meetings.

- **Siemens AG (SAG)** presented the RERUM PETs (Privacy Enhancing Technologies) on December 10, 2014 at the Aspern Smart City Research Center, ASCR Aspern; 1220 Wien, Seestadtstraße 27. The title of the presentation was: "*Privacy Enhancing Technologies for Smart Cities*".
- **Siemens AG (SAG)** presented on January 14, 2015 at the seminar of the Chair of Lehrstuhl für Wirtschaftsinformatik I - Informationssystemen Regensburg (Faculty of Business, Economics and Management Information Systems, Prof Pernul), a summary of the RERUM Security and Privacy Methods. *The title of the presentation was: "Security and Privacy in the Internet of Things Start", University of Regensburg Universitätsstraße 31 93053 Regensburg*
- **Siemens AG (SAG)** presented on February 5, 2015 at the First International Workshop on Data Privacy Management in eHealth Event (see: <http://www.meaningfulmodels.com/wordpress/dpm15>) in the Nguyễn Văn Bảo Industrial University of Ho Chi Minh City, phường 4, Gò Vấp Hồ Chí Minh, Vietnam. The title of the presentation was: "*Authentication, Authorization & Privacy in Internet-of-Things Applications*".
- **Siemens AG (SAG)** has presented a semester course during the Summer Semester 2015 at the University of Passau, entitled "System Security" (5622UE - Software-Sicherheit), containing, among others the main results of RERUM. The contents of RERUM were discussed in detail in 4 "Doppelstunden" (each one, about 90 minutes, for a total of about 6 full hours).
- **Siemens AG (SAG)** presented an IETF draft at the IETF93 meeting in Prague on July 22, 2015 during the ACE WG session, based on the results of RERUM and presented on the name of the project (see: <https://tools.ietf.org/wg/ace/minutes>).
- **UNIVBRIS:** Held repeatedly meetings with Bristol City Council "Bristol Futures" group. Bristol has been awarded with a £3M grant by UK's Technology Strategy Board to develop a smart city demonstrator platform. Activities include the development of an Open Data platform and the deployment of an RF mesh. Bristol has also been named European Green Capital 2015. Oikonomou and Tryfonas have repeatedly met with Bristol City Council's "Bristol Futures" group. During these meetings, there have been discussions about security and privacy in a Smart Cities context and the RERUM project has been introduced.
- **UNIVBRIS / UNI PASSAU:** George Oikonomou gave a two day workshop on 'Programming the IoT with Contiki and Re-MOTE' to MSc. students and PhD. students and academic staff (total of 18 participants) at the University of Passau.
- **ZOLERTIA/UNIVBRIS:** Zolertia team developed in collaboration with George Oikonomou, during his stage on the Zolertia premises to implement the porting for the RE-Mote to Contiki, a demonstrator of the technology using a simulated Super Mario Bros. coin box object connected to Internet that was presented to the Barcelona makers community through a Meetup event celebrated on 26th of February at Makers Of Barcelona (MOB), as a warm-up for the Mobile World Congress.
- **ZOLERTIA:** Antonio Liñán was invited as a speaker to participate in the 2015 ICTP workshop about Internet of Things where he organised the hands-on sessions to work on Contiki OS using the RE-Mote platform, among others, getting a valuable feedback from the attendees and other speakers, specially regarding the value proposal of a secure and privacy-aware framework to enable real IoT applications we are tackling in RERUM.
- **UNI PASSAU:** Meetings with city representatives of Porto Alegre and representatives from computer science and technical engineering faculties of selected Universities in Porto Alegre. The city in southern Brazil (Rio Grande do Sul) is among the first wave of Connected Smart Cities (CSC) that participate in the Open & Agile Smart Cities (OASC) initiative launched March 2015 at CeBIT

(Hannover, Germany). Henrich C. Pöhls presents RERUM's privacy centric approach and the latest results in an effort to raise awareness of these problems - also outside of the EU (known for its larger focus on privacy) - as well as present RERUM's vision and achievements.

- **UNI PASSAU:** Henrich C. Pöhls got invited due to his role in the security in RERUM and RERUM being an IoT project. The Web of Things Interest Group was currently gathering use cases and had a first face-to-face meeting. The Web of Things IG is looking at facilitating an open ecosystem based upon open standards. This includes standards for identification, discovery and interoperation of services across platforms from different vendors, and will involve the need for rich descriptions and shared data models, as well as close attention to security, privacy, scalability and accessibility. Henrich C. Pöhls went to the first face-to-face meeting of the Interest Group of the W3C to monitor their view on security and privacy and to promote these topics and the RERUM project further. He might get involved as an invited expert.
- **UNI PASSAU:** Joachim Posegga participated and contributed to the NIS Platform WG3 meeting on EU industry Innovation and Competitiveness by attending a meeting in Brussels. He hereby continued his interaction with the NIS Platform (started last year) to (a) identify and (b) influence current trends EU research in the fields of secure ICT. He uses the research vision and the research output of RERUM to take a stand that the EU needs to research and work on applicable (reliable and efficient) and holistically secure (and private) Internet of Things technologies in order to sustain business and allow a high quality of life in ever growing cities.
- **UNI PASSAU:** Henrich C. Pöhls, went to the 31st Chaos Communication Congress (31C3). The conference was showcasing a lot of security issues; main pressing issues raised in several presentations/talks: (1) IoT shall not become a big brother (2) always add encryption to all data links. Henrich C. Pöhls was able to link up with several experts and used the event to monitor technical, as well as social trends in the IT security/hacker community that was gathering at that event.
- **UNI PASSAU:** Joachim Posegga participated in the "Seminar on Road Mapping Cybersecurity Research and Innovation" organised by NIS WG3/CAPITAL/CSP FORUM that was held on Oct. 8 2014 in Florence. The one day event was focus on Cybersecurity roadmapping activities, and Joachim Posegga discussed the current thoughts of RERUM and the Privacy and Security implications that the IoT will have in the emerging areas of Information Technology and the various topics tackled by the Network and Information Security EU Platform (NIS P) Working Group 3.
- **UNI PASSAU:** Henrich C. Pöhls and Prof. Posegga supervise currently 5 MSc. students working on topics very related to or within the research scope of RERUM.
- **UNI PASSAU:** Henrich C. Pöhls initiated a co-operation in order to closer gather the opinions of citizens and end-users. RERUM currently co-operates with the Bavarian research cluster FORSEC. FORSEC also works in the areas of IoT Security and Security Awareness. FORSEC is a Bavarian research association that spans eight professors from five different Bavarian research institutions. More information about FORSEC and the two projects can be found here: <https://www.bayforsec.de/en/subprojects/cluster-ii/>. More information of the planned co-operation can be found in D5.1.
- **UNI PASSAU:** Ralf C. Staudemeyer gave an invited lecture on privacy in IoT based on RERUM's results and privacy-by-design being part of the IT-Security summer-school at the Ecole Nationale d'Electronique et des Télécommunications de Sfax (ENET'COM) in Tunisia.
- **ATOS:** Conference about Road4Fame European Project in Brussels May 2015: <https://de.amiando.com/road4fame-consultation.html?page=1232995>

- **ATOS:** Bringing together experts from various fields of ICT, from cyber-physical systems (CPS), the Internet of Things (IoT) to Factories of the Future (FoF), this full-day event explored respective visions on a smarter world that is imagined to be highly performing, progressive, energy saving, socially and environmentally sustainable, but yet competitive. The event gathered high-level speakers from the European Commission, as well as academia and relevant industries and gives you the opportunity to build ground for cooperation.
- **ATOS** was invited and represented by Jose Gato as Head of Internet of Everything Lab. During his presentation it was shown an Internet of Everything Platform, developed by Atos, where the RERUM's Stream Processor is a key component. RERUM was also presented as explained remarking their efforts to create a secured Internet of Things.
- **FORTH:** Elias Tragos was invited to give a talk about the activities of RERUM for Smart Cities at the Bahrain eGovernment Forum 2015. E. Tragos gave a speech entitled "RERUM: fighting for security and privacy in IoT-based Smart City applications" at a session with more than 100 participants at the Bahrain International Circuit conference center, providing the audience with a general overview of the security and privacy issues in Smart City applications and how RERUM can be used to mitigate the threats.

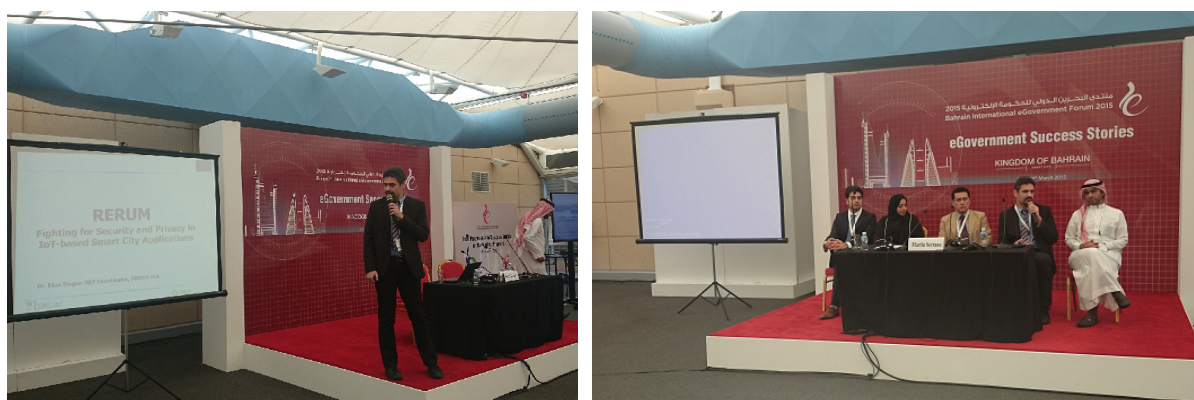


Figure 10: E. Tragos giving an invited talk at the eGovernment success stories workshop in Bahrain at a panel at the eGovernment success stories workshop panel.

- **FORTH/LIU:** Elias Tragos, Alexandros Fragkiadakis and Vangelis Angelakis promoted RERUM at the 1st SOrBet summer school that was held in Heraklion 27-31 July 2015.
- **Heraklion:** Petros Iniotakis participated in the 3rd Smart Cities Conference that was held in April 22nd in Athens, Greece and gave an invited talk entitled "Heraklion smart city: from theory to practice", in which he promoted the participation of Heraklion in RERUM and the use cases that will be deployed in the city.⁵
- **Heraklion:** Costis Mochianakis presented the activities of the project in the Commitment meeting of the eu-smartcities.eu cluster. This commitment is being implemented by the municipalities of Athens, Thessaloniki and Heraklion⁶.
- **Heraklion:** Costis Mochianakis gave an invited talk at an event at the Technological Educational Institute (TEI) of Kalamata, Greece. The talk was entitled "Smart cities: urban identities and local development, management and promotion of city IDs" and included a presentation of RERUM and

⁵ <http://smartcitiesconference.boussiasconferences.gr/default.asp?pid=4&la=1>

⁶ <https://eu-smartcities.eu/commitment/7948>

how Heraklion wants to exploit its results for becoming a smarter city contributing to the local growth.⁷

- **Heraklion:** Costis Mochianakis gave an invited talk at an event of the European Commission in Greece for “the European Strategy for a Digital Single Market”. The talk was entitled “Smart Cities and their role on the digital economy” and mentioned RERUM’s smart applications as potential contributors to improving the local economy in the city.⁸
- **LiU:** David Gundlegård and Vangelis Angelakis are within the founding members of the LiU Transport Analytics Lab (TAL), inaugurated in May 2015. TAL is leveraging the activities of four smart city and mobile analytics projects to promote the research conducted within the Communications and Transportation Systems division in LiU. During the inauguration of TAL RERUM provided presentations of the activities of the LiU group and the plans for Y3.
- **LiU:** RERUM was disseminated to the students open day to promote both findings of the project and the research performed within the ITN department of LiU.

2.1.7 Special Interest Group within the IEEE COMSOC CSIM technical committee

As part of the project dissemination and outreach activities, Dr. Elias Tragos has proposed the formation of a Special Interest Group (SIG) at the Communications Systems Integration and Modeling (CSIM) technical committee of the IEEE Communications Society (COMSOC). The SIG is titled “OnIoT: Optimization of Networking Technologies for the Internet of Things” and is co-chaired by Dr. Elias Tragos and Prof. Matteo Cesana of Politecnico di Milano (POLIMI). The SIG has been accepted officially at the CSIM meeting at ICC 2015 in London. Currently the web page of CSIM is being updated and shortly the new SIG will be found at the specific web page of CSIM for the SIGs.⁹

The target of this SiG is to bring together researchers focusing on modeling and optimization of networking technologies to support the diverse QoS requirements of the IoT applications aiming to identify solutions for addressing the key challenges that IoT brings to the networking domain. The groups interests span:

- Architectures and protocols optimization for IoT
- Cellular IoT
- Performance modelling of future IoT networks
- Co-existence issues of future heterogeneous networks for the IoT
- Resource management mechanisms for future heterogeneous networks
- Optimized and robust dynamic spectrum access on IoT
- Modeling of IoT traffic
- Scalability in IoT
- Energy efficiency in IoT networks
- Quality of Service in future heterogeneous wireless IoT networks
- Case studies, prototypes, and test-beds on IoT
- IoT and 5G

⁷ <http://dasta.teikal.gr/Career/Events/8984.html>

⁸ http://ec.europa.eu/greece/images/20150629_digital_agenda_programme.jpg

⁹ http://cms.comsoc.org/eprise/main/SiteGen/TC_CSIM/Content/Home/CSIM_Special_Interest_Groups__SIGs_.html

The expected core activities of the SiG will be devoted to:

- foster interaction among experts in optimization of networking technologies for the IoT,
- provide an open forum for information exchange among them, and
- facilitate new collaboration activities between them.

2.1.8 Project website

The main public interface of the project, and also the main channel to communicate towards the general public is the project website. The website is regularly maintained, and project relevant information – both concerning major project achievements, but also high impact external recent advances or changes – are posted as news items. Relevant events are also being monitored and reported. The project website also includes videos of the working RERUM prototypes.

2.1.9 Project YouTube channel

The project has launched a YouTube channel for uploading videos of demonstrations, prototypes, presentations, etc. YouTube has been acknowledged as a very powerful dissemination tool that the project will exploit in order to promote its activities and its results on a wide audience, not only the researchers, but also the general public. RERUM has already uploaded its videos of the prototypes for on device signatures and for CR-inspired IoT gateway and Compressive Sensing based data gathering. The RERUM YouTube channel can be found here

https://www.youtube.com/channel/UCX3c1TC8p2ZvI_X6WlaYLyw.

2.1.10 RERUM on other pages and blogs

The official Contiki OS blog upon the release of Contiki 3.0 features an entry on “New and Exciting Hardware” (available at: <http://contiki-os.blogspot.se/2015/08/contiki-30-released-new-hardware-from.html>). The entry discusses at some length the Zolertia Re-Mote one of the main achievements of RERUM.

2.1.11 Promotional Material

- **ATOS: RERUM appears inside the ATOS Research and Innovation brochure 2014.**

This document presents the yearly report of the Research and Innovation group of Atos (ARI). Although Research, Development and Innovation (RDI) activities have been carried out in Atos Spain for more than 28 years, recent years are characterized by a wider strategic integration of research and innovation activities with Atos approach to business. This document is internally distributed with account managers and Atos sale’s force in order to be presented to clients and partners.

- **Zolertia: Zolertia** designed and produced a large number of promotional pens integrated with USB sticks and the RERUM logo. These pens were distributed at the IoT week and were very well-received by the participants. The sample pen can be seen below in the figure.



Figure 11: The RERUM pen.

- **University of Bristol, FORTH, University of Passau: RERUM brochure:** A brochure for the RERUM project was designed by the RERUM partners and distributed at the SIDO event and at the IoT week 2015. The brochure is available online **here** https://ict-rerum.eu/wp-content/uploads/2015/08/RERUM_leaflet.pdf.
- **LiU:** At the inauguration of the Transport Analytics Lab, each of the participating projects contributed a (non-alcoholic) beverage, labelled accordingly. A small number of RERUM bottles was produced for the event.



Figure 12: The RERUM beverage.

2.2 Dissemination Planning for Year 3

Internal dissemination will continue taking place in the form of informal project meetings, seminars and tutorials. These internal sessions will disseminate information about the project and allow achieving consensus and fruitful conclusions about various aspects of the project through discussions, presentations and suggestions.

Furthermore, we will exchange information about other projects in the area as well as further related activities and initiatives in Europe and world-wide, including discussions on their impact on RERUM. As a result, RERUM will be able to assess the potential of eventual adaptations of the project work plan

and be able to give concrete reasons for it. The website and other communication tools mentioned earlier will be used to support the internal dissemination.

In terms of academic dissemination, we have identified relevant conferences and journals for potential dissemination. An indicative list is:

- Conferences: CPDP – Computers, Privacy and Data Protection; IFIP – International Information Security and Privacy Conference; IEEE Symposium on Security and Privacy; CCS – ACM Conference on Computer and Communications Security; Annual Privacy and Security Conference; ACM Conference on Data and Application Security and Privacy; ARES Conference on Availability, Reliability and Security; SECRIPT – International Conference on Security and Cryptography; PETS – Privacy Enhancing Technologies Symposium; SOUPS – Symposium On Usable Privacy and Security; ISC – Information Security Conference; ESORICS – European Symposium on Research in Computer Security; iThings – The IEEE International Conference on Internet of Things; Smart SysTech – European Conference on Smart Objects, Systems and Technologies; ruSMART – Conference on Internet of Things and Smart Spaces.
- Journals: Elsevier Ad-Hoc Networks; Springer Wireless Personal Communications; IEEE Sensors, IEEE Transactions in Industrial Informatics, IEEE Internet of Things Journal, Advances in Internet of things (Scientific Research open access); International Journal of Internet of Things (Scientific and Academic publishing); EURASIP Journal on Information Security; Springer International Journal of Information Security; Springer Mobile Networks and Applications; Springer Telecommunications Systems; Springer Wireless Personal Communications; Elsevier Network Security; Elsevier Computer Communications; ACM Transactions on Information and Systems Security.
- Magazines: IEEE Communications Magazine; IEEE Wireless Communications Magazine
- IEEE Globecom: RERUM will organise in the third year of the project a workshop at IEEE Globecom 2015. More info are given in Section 2.1.4.
- MeetIoT: RERUM aims to participate in the MeetIoT event that will be held in October 1-2 in Torino, Italy, promoting the project's activities with a poster presentation and a live-demo showcase. The details of the RERUM participation are not yet final and are under discussion with the event organisers.
- WF-IoT 2015: RERUM has already submitted two papers at the venue; one from LiU (*Distributed Adaptive Scheme for Reliable Data Collection in Fault Tolerant WSNs*) and one from UNI PASSAU with UNIVBRIS (*Privacy for the IoT beyond encryption: Towards unobservable communication of things.*) Both stand good chances to be accepted and therefore RERUM will have a strong presence in this event
- Springer book: RERUM partners have taken an initiative to organise the editing of a Book on “Smart Cities: Urban Design to IoT Solutions”. The book has been prepared in the second year of RERUM, but will be finalized during the final year of the project and will be delivered and published by February 2016.

2.2.1 Eurescom

In the final year of the project with the maturing of concepts and the emergence of more rich and complete project results Eurescom will keep focusing on the co-ordination with other EU initiatives, and in particular with the IERC. Follow-ups are planned in particular regarding RERUM's engagement at the IoT week, but also presenting RERUM at more industry oriented events.

2.2.2 ATOS

ATOS will continue dissemination activities in Y3 by promoting results or useful information from RERUM in:

- IoT European Research Cluster (IERC) cluster events such as IoT week.
- Company's internal bulletin, including information about relevant milestones of the project.
- Company's internal news, at national and global level.

During Y3 more active demonstration activities will be possible, due to the higher mature level of developments and integrations of software solutions. This will enable the participation in technological events and workshops.

2.2.3 Siemens (SAG and SSRL)

Siemens will plan and implement at least one join demo with IERC projects with a special focus on CityPulse and COSMOS. Those demos will target the use of the largest possible number of components and will search composed scenarios. Same time, internal R&D community working around IOT will be informed and consulted. Siemens will use academic partnerships to generate awareness of RERUM outcomes and naturally extend the research community interest around project topics.

Siemens will also promote the results of the RERUM projects in publications as well as different venues and meetings, internal and external. Concrete plans are:

- Publication of the collaborative work with the COMPOSE project on using the Pseudonym generation and agreement protocols for the COSMOS Cloud.
- Book Chapter about "*IoT privacy*", in the forthcoming IET (Institution of Engineering and Technology) book "Engineering Secure Internet of Things Systems" edited by Benjamin Aziz, Alvaro Arenas and Bruno Crispo.
- Full Semester course on Privacy Enhancing Technologies, Winter-Semester Univ Passau
- Presentation of new developments at the ACE WG of the IETF in the meetings 94, 95, and 96.

2.2.4 UNIVBRIS

UNIVBRIS will continue its academic dissemination activities by publishing scientific papers, placing emphasis in the IoT research community, as well as the community conducting research in the area of networking for severely constrained embedded devices. Additionally, UNIVBRIS aims to:

- Promote the project to students of the "Systems and Technologies for Smart Cities" unit, offered to undergraduate students at the Faculty of Engineering
- Promote the project through existing links with the Bristol City Council.
- Continue developing the project's web site and creating content for it.

2.2.5 LiU

LiU does not plan to change significantly its dissemination activities in the aforementioned outlets targeting to promote its project technical achievements to the research community in the areas of Internet of Things interconnectivity and networking resource management. This will be done through:

- Demonstrating the joint technical achievements by giving presentations and demonstrations of proof-of-concept prototypes in scientific peer-reviewed conferences, workshops, or other relevant events.
- Promote the project to students of the university, via (a) the “Smart Cities” 5th year course in the LiU KTS/TLS programs being currently developed by the LiU SiC, and to be given in the fall semester, (b) the “Network programming and security” course in the LiU MIT program.
- Promote RERUM to other projects with joint actions similar to the IEEE VTC workshop organization. Special focus will be given to further promoting the project in the local community of the university, since the local Municipality has funded the LiU group for a smart traffic oriented project.
- LiU/FORTH have been jointly contacted by the EU-FP7 ICSI project (<http://www.ict-icsi.eu>) to investigate ways to jointly promote research outcomes and explore the potential for cross-fertilization. Since ICSI focuses on Intelligent Transport Systems, this is a good opportunity to promote the work performed in UC-O1 and put it in context with other projects, under the ICSI dissemination activities.

2.2.6 UNI PASSAU

UNI PASSAU aims to continue the strong dissemination strategy in order to:

- Disseminate the project’s technical achievements to the research community in the areas of security, privacy, and IoT. In order to do so, scientific publications in highly respected conferences and workshops, as well as in journals and magazines with a high impact factor will be planned. The list of tentative targets includes: ARES 2016, esIoT 2016, AIANA 2016, ISC 2016, ACNS 2016, or the Journal of Computer Security.
- Contribute to RERUM demos with content related to research prototypes that UNI PASSAU is developing.
- Contribute with content and opinion pieces to the project’s website.
- Co-ordinate and supervise the started co-operation for a joint user study between the FORSEC project.
- Co-ordinate and potentially run another user evaluation study on privacy during our work in Task 5.1 on the evaluation of RERUM’s results.
- Promote the project’s content and raise awareness to its research questions to students of the university by continuing to offer and supervise M.Sc. thesis topics in adjacent areas, e.g. development of cryptographic algorithms on Zolertia’s Re-MOTE.

2.2.7 Zolertia

Zolertia aims to continue its project dissemination activities in Y2 with:

- Dissemination of the initial technical achievements of the project to the WSN community and, in particular, to the Zolertia customers through newsletters and press releases.
- Update on the RERUM’s website with news related to the project, especially those ones more business oriented.
- Participation, at least, on one conference related to IoT and M2M hardware and devices.

2.2.8 FORTH

FORTH aims to continue making a strong promotion of the project in various events. The targets for the final year of the project are:

- Disseminate the project's technical achievements to a wide research audience that deals with the areas of security, privacy, internet of things, cognitive radios and smart city applications. In order to do so, research publications in highly respected conferences and workshops, as well as in journals and magazines with a high impact factor will be pursued.
- Demonstrate the technical achievements through presentations of demos in conferences, workshops and other top tier relevant European events.
- Update the web-site of RERUM with content related to events that FORTH is participating, as well as with other IoT related events, discussing them from the point of view of the project.
- Promote the project through professional social media and especially LinkedIn, publishing any relevant activities of RERUM.
- Organise special sessions and workshops in top-tier conferences, like the IEEE Globecom 2015.
- Publish press releases to promote the project's results and achievements.
- Promote the project to schools and universities by organising talks by FORTH experts.
- Continue promoting the project to schools and external experts that are very often visiting FORTH. This is a great opportunity for informing the visitors about the project, showing them live the technical demos and informing them about the dangers of IoT and how RERUM can help them protect their privacy.
- Organise open public days with the municipality of Heraklion and Cyta to jointly disseminate and promote the project and the deployed use cases to the citizens.
- Organise a hackathon jointly with the municipality of Heraklion and the University of Crete, in which students of the university will be invited to develop applications based on the RERUM framework and the deployed smart applications in the city of Heraklion.
- Contribute to a Book Chapter on "*Securing Communications Among Severely Constrained, Wireless Embedded Devices*", in the forthcoming IET (Institution of Engineering and Technology) book "Engineering Secure Internet of Things Systems" edited by Benjamin Aziz, Alvaro Arenas and Bruno Crispo.

2.2.9 Cyta

Cyta Hellas presented two papers at the International Workshop on Computer-Aided Modelling Analysis and Design of Communication Links and Networks (CAMAD) and specifically to the special sessions:

- RESONANT: Resource Optimization in Heterogeneous Wireless Access Networks
- Recent advances in secure management of data and resources in the IoT (RED-IOT).

Cyta will continue dissemination activities during Y3 aiming to disseminate the project technical achievements mainly to the industry community in the areas of Internet of Things and particularly to forums (e.g., Infocom World 2015) related to smart home applications.

2.2.10 AJTGNA

Tarragona's dissemination actions for the project's last year will be aimed to give visibility to the RERUM impact in the city. Therefore the actions will be targeted to: (a) the citizens, to inform them of the technologies deployed in the city; (b) the volunteers who will participate in the city trials --as defined in D5.1-- are going to be informed about the project, their part in it and how their privacy will be respected; (c) other public bodies, to share our experience on RERUM from a technical point of view and also from the point of view of a European-funded R&D smart cities project.

Furthermore, Tarragona will continue their work to promote awareness amid their citizens on ICT/smart cities technologies by, among other means, using RERUM as example or channel.

To accomplish the above items Tarragona will do the following dissemination actions:

- Press releases and news on social media channels or websites.
- Cooperate with other public bodies and universities.
- If possible, participate in public-administration aimed conferences and workshops.
- Special actions to disseminate the project among the volunteers as a part of the city trials.

2.2.11 HERAKLION

The municipality of Heraklion aims to employ a strong dissemination strategy within the third year of the project. The objective is to promote the project to the citizens giving them the opportunity to: (i) express their concerns for security and privacy in smart city applications, (ii) express their views and their concerns about deploying the project's use cases within the city area, (iii) propose places that need to be monitored by the environmental monitoring use case, (iv) learn about the project, its goals and the benefits for the citizens, (v) set the basis for the participation of the citizens in the trials.

In this respect, the municipality of Heraklion aims to organise jointly with FORTH and Cyta at least three (3) open public days, in which FORTH and Cyta will give technical presentations about the project and answer to the questions of the citizens, while municipality officers will give speeches on the benefits of the project for the city and how the deployed use cases will help the citizens and protect them. These events will be covered by the media to give more publicity to the events and to let any citizen have an opportunity to be informed about the project activities. These events will also give to the citizens' information about the deployment of the use cases within the city area and get feedback from them.

The municipality of Heraklion will also organize at least one (1) hackathon together with FORTH and the University of Crete. The hackathon will target students and will give a prize for the best application that will exploit the RERUM framework and the RERUM use cases.

Heraklion will also continue publishing press releases to the local media with the advances of the project's applications that will be installed in the city area. Furthermore, articles on the municipality's web page, media talks, etc. will also be published during the final year of the project.

Finally, Heraklion members will continue to promote the project to various conferences and events with invited talks.

3 Standardisation

3.1 Standardisation Activities

Where: In order to be able to contribute to standardisation it is necessary to know the opportunities for possible contributions. This requires an analysis of the current situation in the standardisation field i.e. what are current trends and topics in standardisation area. This includes consideration of different Standard Bodies, which are responsible for specific topics in the RERUM domains of interest and identify which of them are relevant and play a leading role in the particular standardisation field. The analysis should focus not just on the specific fields of interest that are covered by those organizations, but it should also go deeper and describe the structure of these organizations in more detail (clusters, study groups, etc.) to have clearer view of how they work and what particular activities they cover. It is preferable and better aligned to the scope and duration of the project to provide contribution to an existing activity or work item rather than create a new work item. Based on these, we have identified some standardisation bodies, their working groups, their working items or other parts, which are focusing on the areas that are close to the topic of RERUM project and thus can be relevant for project. In order to contribute to standardisation bodies, every member of consortium has to investigate if any links have already been established between his organization and these standardisation bodies that can be helpful in contacting them and offer opportunities to providing a contribution to the standardisation.

What: Once the relevant standardisation bodies and the current topics in standardisation are known we have to find synergies between them and the topics that will be covered by the RERUM i.e., try to match them to the standardisation activities. This can be used to evaluate the relevance of the standardisation activity to the project. To be able to do so, we have to identify the concrete results and assets of the project. However, the identification of the results and assets of the project, as well as the topics for standardisation, can lead to the situation where these assets and results come from an area that is not covered by already selected standardisation bodies, but can create opportunity for contribute to standardisation activity. This means that monitoring of relevant standardisation bodies needs to be performed during the whole duration of the task as it can have impact on the project's capability to contribute to standardisation.

Who and When: Based on the project's assets and results as well as the topics for standardisation, the Standardisation plan will be updated and enhanced in the second year of the project. It will encompass the selected most relevant standardisation bodies and allocate work for relevant contribution in a few of them. In addition, it will identify concrete events where partners should attend and responsible partner for every event. Once the standardisation plan will be created, partners will act according to it and contribute to the selected bodies.

3.1.1 Identification of Relevant Standardisation Efforts

During the early stages of the project we already identified some European and International standardisation bodies that could be potentially relevant and targeted by the RERUM project. For example: European Telecommunications Standards Institute (ETSI), World Wide Web Consortium (W3C), 3GPP Machine Type Communications, International Organization for Standardisation (ISO), European Computer Manufacturers Association (ECMA), Organization for the advancement of Structured Information Standards (OASIS), EPCglobal, Institute of Electrical and Electronics Engineers (IEEE), European Research Cluster (IERC) Activity Chain 6, Internet Engineering Task Force (IETF), etc.

We also analysed some of them in more in detailed like IETF. We identified the need to monitor the activities of the following IETF Working Groups (WGs):

- **roll: Routing Over Low power and Lossy networks**
- **dice: DTLS in Constrained Environments (DTLS stands for Datagram Transport Layer Security)**

- **core: Constrained RESTful Environments**
- **6lo: IPv6 over Networks of Resource-constrained Nodes**
- **ace: Authentication and Authorization for Constrained Environments**

Working Groups of interest even though not immediately related to RERUM's scope are:

- **homenet: Home Networking**
- **6man: IPv6 Maintenance (6man)**
- **dnssd: Extensions for Scalable DNS Service Discovery**

We also identified the need to follow the discussions taking place in the **iot-dtls** mailing group, which focuses on DTLS enhancements for use in Constrained Application Protocol (CoAP)-based Internet of Things applications.

In particular, RERUM has provided a draft to the IETF, which was also presented -- by Jorge Cuellar of SAG in the name of the RERUM Consortium -- and discussed during the IETF93 ACE (Authorization in Constrained Environments) WG meeting in Prague in July, 2015. The name of the draft is: Privacy-Enhanced Tokens for Authorization in ACE (draft-cuellar-ace-pat-priv-enhanced-authz-tokens-00).

The IETF ACE group has already several solutions that propose the generation of Authorization Tokens for the purpose of Authorization of Clients to access resources provided by constrained devices. After a discussion of the pros and cons of the different solutions the wg decided to try to merge (unify) the current proposals into one.

The three main advantages of the RERUM draft seem to be: 1) it offers a rather general framework in which other proposals can be embedded, 2) the explicit support of privacy-enhanced tokens, (but it is fair to say that some other drafts may support this requirement) and 3) the explicit support of very low-energy consumption requirements. In particular, it seems relatively straight-forward to merge the RERUM proposal with DCAF (draft-gerdes-ace-dcaf-authorize-02), Fluffy (draft-hardjono-ace-fluffy-01), Two-way Authn(draft-schmitt-ace-twowayauth-for-iot-02), and OAuth 2.0 Bearer Token (draft-tschofenig-ace-oauth-bt-01). A series of meetings is planned for unifying the proposals and merging and the drafts.

The mentioned IETF drafts, including the RERUM one, can be downloaded via the Datatracker of the ACE WG, <https://datatracker.ietf.org/wg/ace/>.

UNI PASSAU was involved in the discussions and generation of the first draft submitted to IETF Prague.

3.1.2 Monitoring Standardisation Activities

In relation to the previous paragraph, George Oikonomou from UNIVBRIS participated in a networking event which followed the IETF meeting 90 in London. The event was attended by IETF stakeholders (e.g. members of the roll WG) and IoT enthusiasts. The discussion focused on the Contiki operating system for the Internet of Things with emphasis on security-related topics as part of Contiki's roadmap.

Henrich C. Pöhls used the meeting of the Web-of-Things working group to gather an overview of W3C's activities in this area. UNI PASSAU will continue to continuously monitor standardisation activities that are related to the security topics discussed and researched in RERUM. Currently, IETF's ace working group as well as the development around CBOR (RFC 7049) are of interest to ensure alignment of the signature usage on constrained devices in RERUM.

3.1.3 Standardization activities within the IERC Cluster

Apart from monitoring (and potentially contributing when appropriate) of the previous mentioned standardisation activities, RERUM aims to participate in standardisation activities within the European Research Cluster on the Internet of Things (IERC). As will be described in Section 6, RERUM is involved

in four Activity Chains (AC) of the IERC and one of them is mainly working on “Standardisation and pre-regulatory research”. RERUM aims to monitor closely the activities of this AC in order to identify new grounds for standardisation and to contribute to potential common standardisation efforts of the IERC.

The RERUM Pseudonym-generation has been adopted by the EU Project Compose for a new scenario (not included in the scenarios of RERUM). A common publication is in preparation.

3.2 Standardization Year 3 planning

The IETF activities for the ACE working group, related to merging the RERUM privacy and security mechanisms with the currently proposed activities of the WG will be prominent. Already several Face-to-face meetings with prominent ACE contributors are planned for August 2015 and the plan is to have a common specification within the lifetime of the project.

During Y3, the proposed draft, 'Privacy-Enhanced Tokens for Authorization in ACE', for the IETF ACE WG will be implemented in the way of prototype. This prototype implementation, together with a demo, will open new dissemination and standardization activities and a closer relation with working groups such as IETF-ACE (where the draft has been shown with good feedback) and AIOTI alliance. But also ETSI upcoming events, next IoT-Week and similar will be focused. Actually, ATOS is an active member of AIOTI, the experience implementing this prototype will be guided by feedback coming from his different working groups, especially from WG 3: IoT Standardisation.

4 Co-ordination with other EU initiatives

During its first year of the project, RERUM had started quite aggressively its participation in the IERC activities and this has continued in a more aggressive way in the second year of the project. RERUM participates actively in two Activity Chains that are very active within the IERC and monitors the activities of the other Activity Chains, intervening and contributing whenever required.

4.1 Activities During Year 2

In the next table we present an overview of RERUM's contributions to IERC's Activity Chains. In subsequent sub-sections we discuss RERUM's contributions in greater detail.

Table 3: Contributions to IERC's Activity Chains

Activity Chain	Topic	Contribution	Responsible partner
AC1	Architecture approaches and open platforms	Evaluate complementarity between architectural approaches for End to End use cases implementation.	SSRL
AC3	IoT innovation and pilots	RERUM contributed to the deliverable of AC3, to AC3's chapter at the IERC book and to the IoT week session of the AC3	FORTH
AC5	Governance, Privacy and Security issues	<ul style="list-style-type: none"> RERUM co-ordinated the production and edited the Privacy and Security chapter in the IERC yearbook RERUM organised the Security and Privacy in IoT session as part of the IoT week and also the joint workshop with CHIST-ERA (which in 2015 selected Security and Privacy in IoT as one of its two focal areas for its open call), RERUM co-organised a workshop (together with project SMARTIE and COMPOSE) on Citizens Engagement to the IoT: Security and Privacy Challenges as part of EuCNC 	FORTH, Eurescom, UNI PASSAU, SAG.
AC6	Standardisation and pre-regulatory research	-	-

4.1.1 Participation in IERC meetings

RERUM partners have participated and contributed to the following IERC meetings:

- **IERC meeting October 2014**
- **IERC meeting before Net Futures 2015**
- **IoT Week – June 2015**

4.1.2 Contributions to the various IERC Activity Chains

RERUM participated in the updated version of the AC5 white paper for security, privacy and governance. H. C. Pöhls and E. Tragos contributed to this deliverable on behalf of the project consortium discussing the technologies that are developed within the project for security, privacy and trust and the open issues in these areas. The last version of the document is here http://www.internet-of-things-research.eu/pdf/IERC_Position_Paper_IoT_Governance_Privacy_Security_Final.pdf

RERUM participated also in the deliverable of AC1 for innovation and pilots in the IoT area. E. Tragos from FORTH contributed to this deliverable describing the RERUM innovations and the trial scenarios. Furthermore, a TRL assessment of the project pilots and innovations was done. The document is to be delivered in August 2015.

Elias Tragos was invited to become vice-chair of the AC3 assisting the work of the chairman Maurizio Spirito of ISMB from the ALMANAC project.

RERUM was also invited to become the chair of AC5 for security, privacy and governance but the discussions have been stalled and the situation is frozen for now.

4.1.3 Contribution to IERC cluster book

RERUM co-ordinated the production and edited the Privacy and Security chapter in the IERC yearbook 2015 “Building the Hyperconnected Society – IoT Research and Innovation Value Chains, Ecosystems and Markets” under the heading “Securing the Internet of Things – Security and Privacy in a Hyperconnected World”. The chapter included significant contributions from the Joint Research Centre (JRC) of the European Commission, from FP7 project SMARTIE (GA no 609062) and iCore (GA no 287708) and the H2020 project PRISMACLOUD (GA no 644962), in addition to the content provided by RERUM.

RERUM participated also to the chapter for “Internet of Things Application Scenarios, Pilots and Innovation” that included the results of the activities of IERC AC3. E. Tragos contributed to this chapter on behalf of the RERUM consortium, discussing the most important innovations that are developed within the RERUM project, as well as the trial and pilot scenarios.

4.1.4 Participation in IERC Village at SIDO 2015

Recent outcomes of the RERUM project were presented at SIDO 2015, an international event where start-ups, manufacturers, tech companies, digital players, labs, investors, designers, contractors and media gather to explore the Internet of Things and make it the new economy. At SIdO, 9 projects funded by the EU in different application areas were present on the Village: Smart Action - Sociotal - City Pulse - Fitman - Almanac - RERUM - Fiesta - Vital – Cosmos. The EU – CHINA cooperation were also present.

RERUM’s booth attracted many individuals, as well as companies, finding the project’s approach particularly interesting. The majority of the people interested in RERUM expressed their feeling that major players in IoT industry rarely mention anything about privacy and security of data.

Furthermore, some IoT service providers expressed their interest to incorporate RERUM’s results (e.g., middleware) to 3rd party’s platforms in order to enhance their security and privacy mechanisms, acknowledging the fact that they play a crucial role in IoT business deployment.

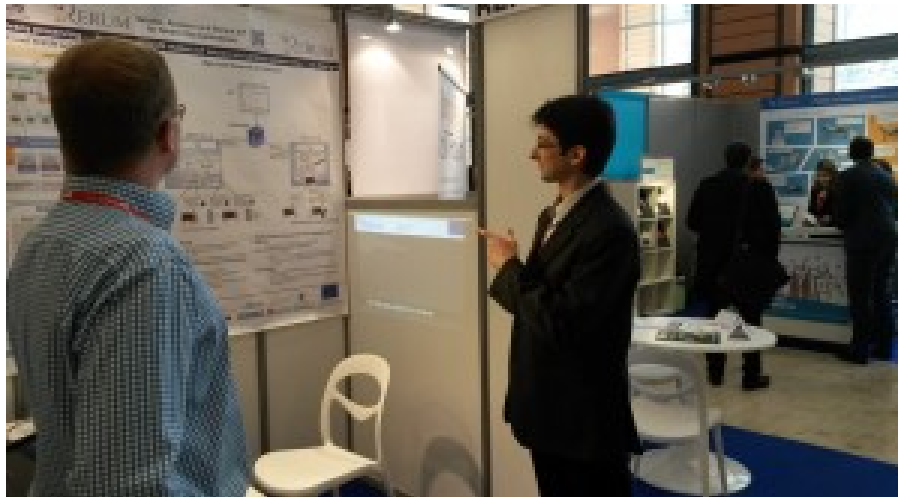


Figure 13: A. Lioumpas from Cyta representing RERUM at the IERC village at SIDO, Lyon.

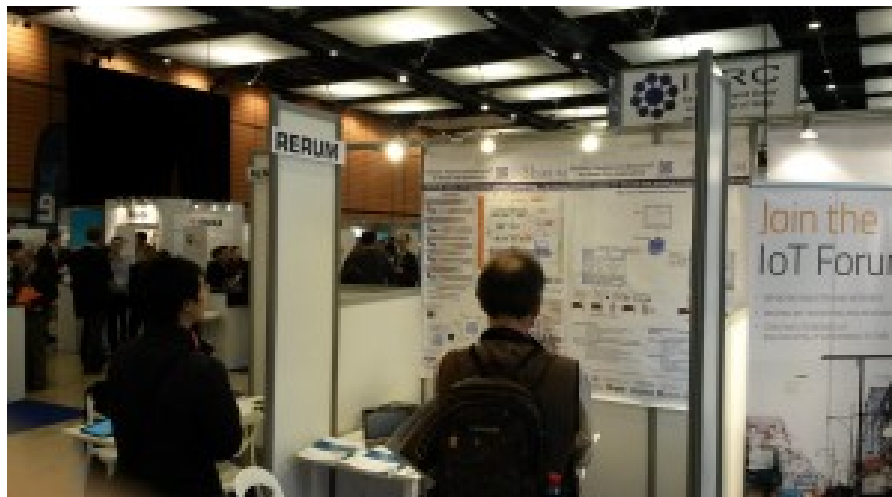


Figure 14: RERUM's booth at the IERC village at SIDO, Lyon.

4.1.5 Workshops and sessions organised in collaboration with other projects

RERUM organised a half a day workshop (together with project SMARTIE and COMPOSE) on Citizens Engagement to the IoT: Security and Privacy Challenges as part of EuCNC. Refer to section 2 for more details.

4.2 Coordination with other activities planning for Year 3

In Year 3, RERUM aims to continue having a strong impact on IERC. As mentioned above, E. Tragos (FORTH) has been named as assistant leader in Activity Chain 3, so it is expected to have a heavy involvement on the activities of this AC for innovation and pilots. There are already ideas on organising possible joint demos with other IERC projects exploiting the good relationships that have been established with them the previous two years.

Furthermore, in the last IERC meetings there were discussions with Peter Friess and Ovidiu Vermesan on the possibility to promote RERUM as the leader of the Activity Chain 5 for Security, Privacy and Governance, exploiting the expertise of the project on these areas and the excellent activities of the project until now. However, these discussions have frozen and it is unclear until now how this will progress.

RERUM aims also to continue organising joint meetings and events with other IERC projects exploiting the already established network of contacts in IERC (VITAL, ALMANAC, COMPOSE, SMARTIE, COSMOS).

RERUM aims to continue the excellent work done for IoT week 2014 and 2015 and participate in the IoT week of 2016, with the organisation of and participation in sessions and the demonstration of its technologies at a booth.

Finally RERUM will continue to contribute to the AC's whitepapers and to the IERC yearly Cluster Book.

5 Quality Assessment and Conclusion

This deliverable has documented outreach and communication activities (WP6) undertaken during RERUM's first year and has set a plan for the second year. The deliverable has focussed on Dissemination (Task 6.1), Standardisation (Task 6.2) and Co-ordination with other EU initiatives (Task 6.4). Exploitation activities have been documented in deliverable D6.2 and were not included here.

In Table 4 we summarise the outcome of activities undertaken during year 1, vis a vis the targets set one year ago, and we set respective targets for year 2.

Table 4: Overview and evaluation of Dissemination, Standardisation and Co-Ordination with other EU Initiatives.

Topic	Year 1	Target for Year 2	Year 2	Target for Year 3
<i>Dissemination</i>				
Peer-Reviewed Journal Papers	2	5	3	5
Papers in Proceedings of Conferences / Workshops	16	20+	17	20
Press Releases	2	2+	0	8
Participation in IoT Week		Maintain as Required	Achieved	Increase
Events	21	25+	36	30+
In-Person Outreach				
Demos	1	3+	5	6
Web site news entries	Numerous	Increase	Achieved	Maintain
<i>Standardisation</i>				
Monitored Activities	IETF, ETSI	Increase	Achieved	Continue ongoing contributions
Participation in Meetings	2	Increase	Achieved	2
<i>Co-Ordination with other EU Initiatives</i>				
Joint Sessions	2	2+	4	2+
Contribution to IERC publications	2	Maintain as Required by the IERC	1	Maintain as Required by the IERC
Participation in IERC meetings	2		2	
Participation in Other Events	FIA Athens 2014	Maintain as Required	Numerous	Maintain as Required

Overall one can see that the dissemination is proceeding well in line with the targets with a short delay in the publication of Journal papers. Press releases did not take place in Y2, therefore in Y3, with the launch of the Trials the cities along with the local research and development partners will have to make an additional effort for the promotion of the project in the local press. The Standardization activities are proceeding also according to plan while the coordination of project activities with other EU actions / initiatives is going well.

Annex A – report from the Security and Privacy in IoT workshop 18th June 2015

Abstract

The workshop had a double focus. On the one hand, the workshop discussed preserving security when breaking the silos in the IoT world. This was considered as a very timely topic, as IoT needs to overcome the current fragmentation, being a collection of purpose specific, often niche solutions, fragmented along sectors and markets, and the emergence of more encompassing, general purpose, commodity like solutions cutting across the traditional silos are expected in the near future as IoT matures. However, under such circumstances security becomes an even more important factor. So the first part the workshop addressed this challenge with the help of contribution from Leonard Ciprian Pitu (Siemens Romania, project COSMOS), Alexandros Fragkiadakis (FORTH, project RERUM) and Antonio Jara (HOP UBIQUITOUS S.L.).

The second part of the workshop tried to link privacy and innovation. Considering that on the Internet social networks and portals flourish in which environments privacy is of secondary importance at best, one would assume that privacy is something that is less valued (at least by the younger generations), and is probably something difficult to sell. At the same time the organisers are convinced that the notion of privacy as most of us know it is still of value and needs to be maintained and protected. Therefore the second part of the workshop had a focus on innovation and privacy, approaches and best practices that support the innovation process and lead to actual privacy solutions that sell on the market. This part of the workshop was supported by Klaus Moessner (University of Surrey, project SOCIOTAL), and Jesper Algren (Smart Aarhus).

Preserving security as IoT matures and consolidates from the current fragmentation

The contribution by Leonard Ciprian Pitu from Siemens highlighted that the number of attacks increased dramatically recently. Thus, hacking has become a major concern for manufacturers. It was stressed that security should start on device level, and on the hardware level. Life cycle risks: The impact of a large scale call back of for example white goods and the associated costs could be immense.

The contribution of Alexandros Fragkiadakis from FORTH highlighted that as IoT consists of highly heterogeneous networked entities and networks, a number of challenges have emerged including security, trust and privacy, scalability, legislation, and standardisation issues. The vast majority of the security challenges focus on authentication, access control, confidentiality, integrity, availability, and non-repudiation. A number of traditional security attacks (e.g. jamming), as well as novel attacks (e.g. primary user emulation attacks in cognitive radio systems), are difficult to be detected and mitigated in the IoT, for reasons related to the vague ownership of the IoT devices, the resource constrained nature of these devices, standardisation issues, and legislation shortcomings.

The final contribution to the security topic from Antonio Jara (HOP UBIQUITOUS S.L.) discussed that in order to successfully break the traditional silos multi purpose and generic solutions, generic enablers, commodity like solutions and re-use of components are needed. Naturally, this process is expected to further increase complexity and heterogeneity, however integration should handle and manage the resulting heterogeneity. Further to heterogeneity scale is also an issue. Bootstrapping and registration of devices should be automated to scale. Connectivity should be global.

Levels of security – a layered approach is envisioned. Basic security should be present, to which increased levels can be added.

Innovation and privacy – approaches and best practices that support the innovation process and lead to actual privacy solutions that sell on the market

Klaus Moessner from the University of Surrey emphasised that we should not forget that ultimately the goal of IoT is to support people – technology solutions are only the means but not the end themselves. This means that users need to be involved. In the project SOCIOTAL a co-creation process is adopted to generate applications and uses that are responding to actual user needs and demands. However, the process needs to be transparent for bootstrap and to gain trust. Example given is measuring use and mileage of elevators to schedule service and maintenance in large block of flats – the Novi Sad case.

Data ownership –in most cases the situation is not black and white. Following the bubble principle, privacy circle / sphere, sensors of my smart phone, or other device might collect data for someone else, upon the initiative of that person. In case of a decision later by that someone else, actual data collected must be removed, but the fact / event that some data was collected cannot be erased.

Also, SOCIOTAL does not directly focus on preventing passing on the data to third parties that was made available. However, there were other research efforts that focused exactly on that – the “sticky policy” approach investigated in iCore was provided as an example.

Open data – principle is that data collected using public money should be of public good and serve the purpose of the community. However, as the presentation from Smart Aarhus by Jesper Algren revealed privacy needs to be observed, which sometimes means that geographic accuracy / precision of data needs to be reduced, or only cumulative data (for example from a certain geographic area) needs to be stored to prevent traceability back to individuals. Furthermore, economic impact and interest should be of concern, as certain data generated might have severe negative impact on property valuation, etc.

Another observation made was that health data / records are immensely sensitive.

Open Data Aarhus, being a small player with administration backing can not afford mistakes similar to the XBOX case, when user data was leaked on a very large scale. Any such or similar incident would have a devastating effect on reputation of the initiative, and would mean the end of the project, political support would stop.

Suggestion from floor – Ivan Meseguer, Institut Mines-Télécom – that a more active international dialogue might be helpful, as the problems the different European countries are facing are similar in this relatively uncharted territory. Admittedly though there are historical and cultural differences also embedded in the various jurisdiction frames and practices. Still, a more active dialogue and sharing of best practices would support and ease the way forward, as opposed to acting in isolation.