Development, Operation, and Quality Assurance of Trustworthy Smart IoT Systems

Results

Project Information

ENACT

Grant agreement ID: 780351

Funded under H2020-EU.2.1.1.

Closed project

Overall budget € 4,928,542.50

EU contribution € 4,928,542.50

Coordinated by SINTEF AS Norway

Start date 1 January 2018
End date 31 March 2021

Deliverables

Documents, reports (9)

Agile Integration Methodologies and tools
This deliverable will present a catalogue of agile methodologies and tools for continuous integration suiting the needs of the ENACT DevOps Framework.

Survey and requirements of Risk-driven Continuous Delivery of Trustworthy Smart IoT Systems
This deliverable will provide an overview of the state-of-the-art mechanisms for the risk-driven continuous delivery of trustworthy SIS. In addition, this deliverable will characterize the requirement, including trustworthiness requirements, to be considered.
ENACT DevOps Framework Architecture
This deliverable will present the ENACT DevOps architecture and design

Requirements and conceptual design of techniques and methods for trustworthy & agile operation of smart IoT systems
This deliverable will provide an overview of the state-of-the-art mechanisms for the operation of IoT systems. In addition, it will characterize the requirement, including trustworthiness requirements, to be considered and provide an initial design of the solutions developed in WP3.

Use case definition and requirements, & validation and evaluation plan
The use cases definitions and scenarios, the use case requirements and the evaluation and validation plan.

ENACT roadmap
This deliverable presents the ENACT roadmap, summarizing the research and business challenges solved during the project, reporting on the experiences of using the ENACT, and presenting a roadmap for open challenges of interest for the community.

Final evaluation and validation Report
This deliverable will summaries the findings and remaining issues that arisen during the case studies design and implementation, providing validation and evaluation of the applicability of ENACT results.

Trustworthiness mechanisms specification
This deliverable provides an overview of the state-of-the-art mechanisms for trustworthiness in particular related to end-to-end security and privacy monitoring and control as well as resilience and robustness.

First evaluation and validation Report
The initial findings and issues that will arise during the case studies design and implementation, thereby providing evaluation of the applicability of the ENACT results.

Other (10)

Trustworthy & agile operation of smart IoT systems - Final version
This deliverable provides the ENACT Agile Operation toolkit. This includes the developments made in all WP3’s tasks (T3.*).

Case studies implementation - Final version
The final implementations of the use cases demonstrating the final ENACT DevOps Framework.

Case studies implementation—First version
The first version of the use case implementations demonstrating the initial ENACT DevOps Framework.

Trustworthiness mechanisms for smart IoT Systems - Final Version
This deliverable provides the final version of the Security and Privacy Monitoring and Control Enabler and the Robustness and Resilience Enabler of the ENACT Trustworthiness toolkit. This includes the developments made in all WP4’s tasks (T4.*).

ENACT DevOps Framework- Final version
This deliverable provides the ENACT DevOps platform and the integration platform.

ENACT DevOps Framework- First version
This deliverable provides the ENACT DevOps platform and the integration platform.

Risk-driven Continuous Delivery of Trustworthy Smart IoT Systems —Final Version
Provide the ENACT Continuous Delivery toolkit (including the Orchestration and Continuous Deployment Enabler and the Test, Simulation and Emulation Enabler) and the Risk-Driven Decision Support Enabler.

Trustworthy & agile operation of smart IoT systems - First version
This deliverable provides the ENACT Agile Operation toolkit. This includes the developments made in all WP3’s tasks (T3.*).

Risk-driven Continuous Delivery of Trustworthy Smart IoT Systems —First Version
Provide the ENACT Continuous Delivery toolkit (including the Orchestration and Continuous Deployment Enabler and the Test, Simulation and Emulation Enabler) and the Risk-Driven Decision Support Enabler.

Trustworthiness mechanisms for smart IoT Systems - First Version
This deliverable provides the first version of the Security and Privacy Monitoring and Control Enabler and the Robustness and Resilience Enabler of the ENACT Trustworthiness toolkit. This includes the developments made in all WP4’s tasks (T4.*).

Websites, patent fillings, videos etc. (2)
This deliverable will describe the business models enabled by the ENACT technologies for the different stakeholders: App Developers, App Operators, App Owners and End users.

ENACT website
Public online website to promote ENACT results and activities

Open Research Data Pilot (1)

Data Management Plan
Report on how data will be handled in ENACT during the project's lifetime and after its completion, in accordance with the guidelines on FAIR Data Management in H2020.

Publications

Conference proceedings (24)

Feature-Modell-geführtes Online Reinforcement Learning für Selbst-adaptive Systeme
Author(s): A. Metzger (UDE), C. Quinton (U Lille), Z. Mann (UDE), L. Baresi (Polimi), K. Pohl (UDE)

Actuation Conflict Management Enabler for DevOps in IoT
Author(s): Thibaut Gonnin, Frank Dechavanne, Gérald Rocher, Stéphane Lavriotte, Jean-Yves Tigli, Laurent Capocchi, Jean-François Santucci
Published in: 10th International Conference on the Internet of Things Companion, 2020, Page(s) 1-4
DOI: 10.1145/3423423.3423474

An Actuation Conflicts Management Flow for Smart IoT-based Systems
Author(s): Gerald Rocher, Thibaut Gonnin, Franck Dechavanne, Stephane Lavriotte, Jean-Yves Tigli, Laurent Capocchi, Jean-Francois Santucci
Published in: 2020 7th International Conference on Internet of Things: Systems, Management and Security (IOTSMS), 2020, Page(s) 1-8
DOI: 10.1109/iotsms52051.2020.9340196
IoT-based Systems Actuation Conflicts Management Towards DevOps: A Systematic Mapping Study

Author(s): Stéphane Lavirotte, Gérald Rocher, Jean-Yves Tigli, Thibaut Gonnin
Published in: Proceedings of the 5th International Conference on Internet of Things, Big Data and Security, 2020, Page(s) 227-234
DOI: 10.5220/0009355102270234

Model-based fleet deployment of edge computing applications

Author(s): Hui Song, Rustem Dautov, Nicolas Ferry, Arnor Solberg, Franck Fleurey
Published in: Proceedings of the 23rd ACM/IEEE International Conference on Model Driven Engineering Languages and Systems, 2020, Page(s) 132-142
DOI: 10.1145/3365438.3410951

A Light-Weight Approach to Software Assignment at the Edge

Author(s): Rustem Dautov, Hui Song, Nicolas Ferry
Published in: 2020 IEEE/ACM 13th International Conference on Utility and Cloud Computing (UCC), 2020, Page(s) 380-385
DOI: 10.1109/ucc48980.2020.00060

Auto-Adjusting Self-Adaptive Software Systems

Author(s): Zoltan Adam Mann, Andreas Metzger
Published in: 2018 IEEE International Conference on Autonomic Computing (ICAC), Issue 2018, 2018, Page(s) 181-186
DOI: 10.1109/icac.2018.00030

Multi-layered Adaptation for the Failure Prevention and Recovery in Cloud Service Brokerage Platforms

Author(s): Nicolas Ferry, Franck Chauvel, Brice Morin
Published in: 2018 11th International Conference on the Quality of Information and Communications Technology (QUATIC), 2018, Page(s) 21-29
DOI: 10.1109/quatic.2018.00014

Engineering Software Diversity - a Model-Based Approach to Systematically Diversify Communications

Author(s): Brice Morin, Jakob Høgenes, Hui Song, Nicolas Harrand, Benoit Baudry
Published in: Proceedings of the 21th ACM/IEEE International Conference on Model Driven Engineering Languages and Systems - MODELS '18, 2018, Page(s) 155-165
DOI: 10.1145/3239372.3239393

A security policy enforcement framework for controlling IoT tenant applications in the edge
Author(s): Phu H. Nguyen, Phu H. Phung, Hong-Linh Truong
Published in: Proceedings of the 8th International Conference on the Internet of Things - IOT '18, 2018, Page(s) 1-8
DOI: 10.1145/3277593.3277602

The preliminary results of a mapping study of deployment and orchestration for IoT

Author(s): Phu H. Nguyen, Nicolas Ferry, Gencer Erdogan, Hui Song, Stéphane Lavriotte, Jean-Yves Tigli, Arnor Solberg
Published in: Proceedings of the 34th ACM/SIGAPP Symposium on Applied Computing - SAC '19, 2019, Page(s) 2040-2043
DOI: 10.1145/3297280.3297617

A Systematic Mapping Study of Deployment and Orchestration Approaches for IoT

Author(s): Phu Nguyen, Nicolas Ferry, Gencer Erdogan, Hui Song, Stéphane Lavriotte, Jean-Yves Tigli, Arnor Solberg
Published in: Proceedings of the 4th International Conference on Internet of Things, Big Data and Security, 2019, Page(s) 69-82
DOI: 10.5220/0007675700690082

Advances in Deployment and Orchestration Approaches for IoT - A Systematic Review

Author(s): Phu Nguyen, Nicolas Ferry, Gencer Erdogan, Hui Song, Stephane Lavriotte, Jean-Yves Tigli, Arnor Solberg
Published in: 2019 IEEE International Congress on Internet of Things (ICIOT), 2019, Page(s) 53-60
DOI: 10.1109/iciot.2019.00021

Implementing the MDETools'18 challenge with ThingML

Author(s): Jakob Høgenes and Brice Morin
Published in: MDETools'18 Workshop co-located with IEEE/ACM MODELS conference, 2018, Page(s) 9

GeneSIS: Continuous Orchestration and Deployment of Smart IoT Systems

Author(s): Nicolas Ferry, Phu Nguyen, Hui Song, Pierre-Emmanuel Novac, Stephane Lavriotte, Jean-Yves Tigli, Arnor Solberg
Published in: 2019 IEEE 43rd Annual Computer Software and Applications Conference (COMPSAC), 2019, Page(s) 870-875
DOI: 10.1109/compsac.2019.00127

Towards Early Prototyping of Services based on Open Transport Data: A Feasibility Study

Author(s): Nicolas Ferry, Aida Omerovic, Marit Natvig
Published in: Proceedings of the 9th International Conference on Cloud Computing and Services Science, 2019, Page(s) 257-262
DOI: 10.5220/0007675402570262
Towards IoT Diversity via Automated Fleet Management

Author(s): Rustem Dautov, Hui Song
Published in: Joint Proceedings of the Workshop on Model-Driven Engineering for the Internet of Things (MDE4IoT) & of the Workshop on Interplay of Model-Driven and Component-Based Software Engineering (ModComp), Issue Vol-2442, 15-Sep-2019, 2019, Page(s) 47-54

Model-driven Evidence-based Privacy Risk Control in Trustworthy Smart IoT Systems

Author(s): Muntes-Mulero, Victor and Dominiak, Jacek and Gonzalez, Elena and Sanchez-Charles, David
Published in: Joint Proceedings of the Workshop on Model-Driven Engineering for the Internet of Things (MDE4IoT) & of the Workshop on Interplay of Model-Driven and Component-Based Software Engineering (ModComp), Issue Vol-2442, 15-Sep-2019, 2019, Page(s) 23-30

Towards Model-Based Continuous Deployment of Secure IoT Systems

Author(s): Nicolas Ferry, Phu H. Nguyen
Published in: 1st International Workshop on DevOps at MODELS (DevOps@MODELS) colocated with MODELS, 2019

Challenges of DevOps ready IoT Testbed

Author(s): Janis Judvaitis, Krisjanis Nesenbergs, Rihards Balass, Modris Greitans
Published in: Joint Proceedings of the Workshop on Model-Driven Engineering for the Internet of Things (MDE4IoT) & of the Workshop on Interplay of Model-Driven and Component-Based Software Engineering (ModComp), Issue Vol-2442, 15-Sep-2019, 2019, Page(s) 3-6

Towards Agile Management of Containerised Software at the Edge

Author(s): Rustem Dautov, Hui Song
Published in: 2020 IEEE Conference on Industrial Cyberphysical Systems (ICPS), 2020, Page(s) 263-268
DOI: 10.1109/icps48405.2020.9274764

A Systematic Mapping of Patterns and Architectures for IoT Security

Author(s): Tanusan Rajmohan, Phu Nguyen, Nicolas Ferry
Published in: Proceedings of the 5th International Conference on Internet of Things, Big Data and Security, 2020, Page(s) 138-149
DOI: 10.5220/0009583001380149
Bridging MQTT and Kafka to support C-ITS: a feasibility study

Author(s): Asmund Hugo, Brice Morin, Karl Svantorp
Published in: 2020 21st IEEE International Conference on Mobile Data Management (MDM), 2020, Page(s) 371-376
DOI: 10.1109/mdm48529.2020.00080

Research Landscape of Patterns and Architectures for IoT Security: A Systematic Review

Author(s): Tanusan Rajmohan, Phu H. Nguyen, Nicolas Ferry
Published in: 2020 46th Euromicro Conference on Software Engineering and Advanced Applications (SEAA), 2020, Page(s) 463-470
DOI: 10.1109/seaa51224.2020.00079

Peer reviewed articles (6)

An IOHMM-Based Framework to Investigate Drift in Effectiveness of IoT-Based Systems

Author(s): Gérald Rocher, Stéphane Lavriotte, Jean-Yves Tigli, Guillaume Cotte, Franck Dechavanne
Published in: Sensors, Issue 21/2, 2021, Page(s) 527, ISSN 1424-8220
DOI: 10.3390/s21020527

Continuous Quantitative Risk Management in Smart Grids Using Attack Defense Trees

Author(s): Erkuden Rios, Angel Rego, Eider Iturbe, Marivi Higuero, Xabier Larrucea
Published in: Sensors, Issue 20/16, 2020, Page(s) 4404, ISSN 1424-8220
DOI: 10.3390/s20164404

Automating IoT Data-Intensive Application Allocation in Clustered Edge Computing

Author(s): Rustem Dautov, Salvatore Distefano
Published in: IEEE Transactions on Knowledge and Data Engineering, Issue 33/1, 2021, Page(s) 55-69, ISSN 1041-4347
DOI: 10.1109/tkde.2019.2923638

Continuous Deployment of Trustworthy Smart IoT Systems.

Author(s): Nicolas Ferry, Phu H. Nguyen, Hui Song, Erkuden Rios, Eider Iturbe, Satur Martinez, Angel Rego
Published in: The Journal of Object Technology, Issue 19/2, 2020, Page(s) 16:1, ISSN 1660-1769
DOI: 10.5381/jot.2020.19.2.a16

Stream Processing on Clustered Edge Devices

Author(s): Rustem Dautov, Salvatore Distefano
Published in: IEEE Transactions on Cloud Computing, 2020, Page(s) 1-1, ISSN
Agile risk management for multi-cloud software development

Author(s): Victor Muntés-Mulero, Oscar Ripolles, Smrati Gupta, Jacek Dominiak, Eric Willeke, Peter Matthews, Balázs Somosköi
Published in: IET Software, Issue 13/3, 2019, Page(s) 172-181, ISSN 1751-8806
DOI: 10.1049/iet-sen.2018.5295

8. Enabling Continuous Privacy Risk Management in IoT Systems

Author(s): Victor Muntés-Mulero, Jacek Dominiak, Elena González, David Sanchez-Charles
Published in: Security Risk Management for the Internet of Things: Technologies and Techniques for IoT Security, Privacy and Data Protection, 2020
DOI: 10.1561/9781680836837.ch8

Event-Based Customization of Multi-tenant SaaS Using Microservices

Author(s): Espen Tønnessen Nordli, Phu H. Nguyen, Franck Chauvel, Hui Song
Published in: Coordination Models and Languages - 22nd IFIP WG 6.1 International Conference, COORDINATION 2020, Held as Part of the 15th International Federated Conference on Distributed Computing Techniques, DisCoTec 2020, Valletta, Malta, June 15–19, 2020, Proceedings, Issue 12134, 2020, Page(s) 171-180
DOI: 10.1007/978-3-030-50029-0_11

Triggering Proactive Business Process Adaptations via Online Reinforcement Learning

Author(s): Andreas Metzger, Tristan Kley, Alexander Palm
Published in: Business Process Management - 18th International Conference, BPM 2020, Seville, Spain, September 13–18, 2020, Proceedings, Issue 12168, 2020, Page(s) 273-290
DOI: 10.1007/978-3-030-58666-9_16

Making the Internet of Things More Reliable Thanks to Dynamic Access Control

Author(s): Anne Gallon, Erkuden Rios, Eider Iturbe, Hui Song, Nicolas Ferry
Published in: Security and Privacy in the Internet of Things: Challenges and Solutions, 2020, Page(s) 61-75
DOI: 10.3233/aise200005
A Feasibility Study of an Agile and Data-Centric Method for Prototyping Services Based on Open Transport Data

Author(s): Nicolas Ferry, Aida Omerovic, Marit Kjøsnes Natvig
Published in: Cloud Computing and Services Science - 9th International Conference, CLOSER 2019, Heraklion, Crete, Greece, May 2–4, 2019, Revised Selected Papers, Issue 1218, 2020, Page(s) 87-100
DOI: 10.1007/978-3-030-49432-2_5

ENACT: Development, Operation, and Quality Assurance of Trustworthy Smart IoT Systems

Author(s): Nicolas Ferry, Arnor Solberg, Hui Song, Stéphane Lavriotte, Jean-Yves Tigli, Thierry Winter, Victor Muntés-Mulero, Andreas Metzger, Erkuden Rios Velasco, Amaia Castelruiz Aguirre
Published in: Software Engineering Aspects of Continuous Development and New Paradigms of Software Production and Deployment - First International Workshop, DEVOPS 2018, Chateau de Villebrumier, France, March 5-6, 2018, Revised Selected Papers, Issue 11350, 2019, Page(s) 112-127
DOI: 10.1007/978-3-030-06019-0_9

Next Generation Internet of Things

Author(s): Ovidiu Vermesan, Joël Bacquet
Published in: Next Generation Internet of Things, Issue 1, 2018, Page(s) 1-352
DOI: 10.13052/rp-9788770220071

Feature Model-Guided Online Reinforcement Learning for Self-Adaptive Services

Author(s): Andreas Metzger, Clément Quinton, Zoltán Ádám Mann, Luciano Baresi, Klaus Pohl
Published in: Service-Oriented Computing - 18th International Conference, ICSOC 2020, Dubai, United Arab Emirates, December 14–17, 2020, Proceedings, Issue 12571, 2020, Page(s) 269-286
DOI: 10.1007/978-3-030-65310-1_20

Online Reinforcement Learning for Self-adaptive Information Systems

Author(s): Alexander Palm, Andreas Metzger, Klaus Pohl
DOI: 10.1007/978-3-030-49435-3_11

Software