The RASSA Initiative – Defining a Reference Architecture for Secure Smart Grids in Austria

Marcus Meisel[1(✉)], Angela Berger[2], Lucie Langer[3], Markus Litzlbauer[1], and Georg Kienesberger[1]

[1] Technische Universität Wien, Gußhausstaße 27-29, 1040 Vienna, Austria
{meisel,kienesberger}@ict.tuwien.ac.at, litzlbauer@ea.tuwien.ac.at
[2] Technologieplattform Smart Grids Austria, Mariahilferstr. 37-39, 1060 Vienna, Austria
angela.berger@smartgrids.at
[3] Digital Safety and Security Department, AIT Austrian Institute of Technology GmbH, Donau-City-Straße 1, 1220 Vienna, Austria
lucie.langer@ait.ac.at

Abstract. The goal of the *Reference Architecture for Secure Smart Grids in Austria (RASSA)* initiative is to design and establish a technical reference architecture specification in coordination with all relevant stakeholders. This goal is realized across multiple projects. This paper first motivates the need for developing a coordinated smart grids reference architecture for Austria involving all relevant actors, such as infrastructure operators, manufacturers, and public agencies. After a description of most prominent international reference architecture efforts, first results on how to develop a reference architecture serving as a blueprint for further smart grids solutions is described. Necessary coordination and communication efforts to achieve a nationally accepted and internationally aligned process are described. The paper closes with an outlook on a practical application of the principles defined in order to meet stakeholder requirements through target-group-specific involvement.

1 Motivation

Global electricity systems are undergoing a radical change. In the course of intensive efforts to raise the share of renewable energy sources, new innovative smart grids solutions have been developed in the past years in order to integrate decentralized volatile generation. With the introduction of smart grid technologies, an interconnection with communication technologies has taken place, changing the accessibility of previously isolated assets especially in the distribution grid. This has lead to challenges in system design in terms of cybersecurity, interoperability, and security of supply.

Over the past years, the necessity of a holistic approach to achieve a national secure smart grid reference architecture, dealing with critical requirements not addressed by European standardization organizations or the Smart Grids Reference Group, was frequently discussed within the Technology Platform Smart

S. Gottwalt et al. (Eds.): EI 2015, LNCS 9424, pp. 51–58, 2015.
DOI: 10.1007/978-3-319-25876-8_5

Grids Austria. As a consequence, the Platform launched the RASSA initiative as its core undertaking. The objective of the RASSA initiative is to develop a national reference architecture for smart grids, building on European and international activities and considering stakeholder needs. Aspects like operational safety, cybersecurity, and privacy are considered throughout the design and evaluation of the architecture ("by design"). A successful development of a reference architecture is only possible if all relevant stakeholders, like network operators, energy suppliers, regulators, and public agencies, are involved from the very beginning. This is challenging as the number of actors is high due to the significant economic relevance and criticality of the energy supply system.

The comprehensive stakeholder process is therefore a core part of the RASSA initiative. Experts and decision makers from the energy sector, manufacturing industries and public bodies are closely involved. This ensures that a solution for the specific Austrian needs is found, while taking into account Austria's situation within the European network as well as maintaining full compatibility with international standards.

While the *RASSA Architecture* project focuses on the development of the Austrian reference architecture, the *RASSA Process* project aims at providing methodological support and establishing a sustainable stakeholder involvement. The stakeholder process builds upon existing good contacts of the coordinating Technology Platform Smart Grids Austria, as its members are part of the relevant stakeholder groups. Furthermore, the Platform has developed a solid basis for discussion with actors outside the energy sector, such as ministries, public agencies, and international players. The designed stakeholder concept has to accompany the whole development process of smart grids in Austria and must therefore be sustainable. As relevant preparatory work the Technology Platform Smart Grids Austria developed a Technology Roadmap for Smart Grids in the last year [1], in which a broad agreement of the energy sector regarding the next necessary steps for the transformation of the energy system towards smart grids was expressed. One of the key steps identified was the development of an overall ICT architecture for smart grids. Based on these results, the development of the Austrian reference architecture has a great chance to become widely accepted from a national point of view.

2 State of the Art

This section summarizes existing international work which will be drawn upon for the design of the Austrian reference architecture. Although plenty of material exists in this regard, the migration path from existing to future grid implementations is rather unclear, and has to be defined on a national basis. The collection of national efforts to create a smart grid landscape for Austria as a basis for the migration path is still ongoing; early results are presented in Sect. 4 of this paper.

2.1 The Smart Grid Architecture Model (SGAM)

The widely-accepted Smart Grid Architecture Model (SGAM) has been defined as part of CEN-CENENELEC-ETSI's response [2] to the EU Smart Grid Mandate M/490. SGAM is defined by *zones, domains*, and *interoperability layers* (see Fig. 1). While the zones are derived from the hierarchical levels of information management in power systems (from field via process, station towards operation, and enterprise level), the domains reflect the different stages of power generation, transmission, distribution, and consumption within the electrical energy conversion chain. Electrical domains and information management zones span the *smart grid plane*. In the third dimension, SGAM features five interoperability layers which are an abstracted and condensed version of the originally eight GridWise interoperability layers [3], and represent different stakeholders' views. The base layer is the component layer, which represents physical devices and software components. On top of that, communication protocols and mechanisms for the exchange of information between different components are represented in the communication layer. The information layer represents information objects or data models required to fulfill functions and to be exchanged by communication. The function layer represents logical functions or applications independent from physical implementations, and the uppermost business layer describes business models and regulatory requirements.

SGAM has proven useful for describing use cases within a given European grid, establishing a common view between different stakeholders. The Austrian reference architecture under development will also be mapped to SGAM, which requires specifying the national particularities on each interoperability level.

2.2 BSI Protection Profiles

Germany's Federal Office for Information Security (BSI) has developed a Common Criteria Protection Profile for the Gateway of a Smart Metering System and its Security Module [4,5]. Based on a threat analysis, both profiles define a set of minimum security requirements. While these documents are important input to the reference architecture definition in terms of security and privacy aspects for smart meter devices, a different legal standing applies within Austria. Furthermore, additional parts of a smart grid have to be considered.

2.3 NIST Reports and Frameworks

The U.S. National Institute of Standards and Technology (NIST) developed the Roadmap for Smart Grid Interoperability Standard (NIST-SR 1108R3) [6] and a multitude of reports on smart grids, such as the Guidelines for Smart Grid Cyber Security (NIST-IR 7628) [7]. This report identifies seven smart grid domains and a logical interface architecture used to define categories of interfaces within and across those seven domains. The security requirements for these interface categories are identified through a risk assessment process, which relies on a top-down and a bottom-up approach. Whilst the top-down approach defines

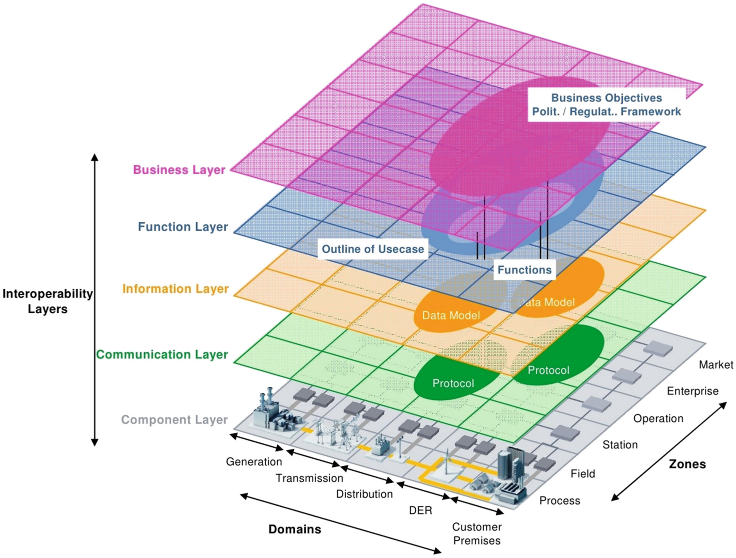

Fig. 1. Smart grid architecture model by CEN-CENELEC-ETSI [2]

smart grid components and interfaces, the bottom-up approach focuses on cybersecurity issues in power grids, such as user authentication, key management for meters, and intrusion detection for power equipment. NIST-IR 7628 can be used to design and integrate smart grid technologies and is therefore a useful tool in the reference architecture development process.

3 RASSA Initiative Overview

The related work shows that international concepts are vital for highly interconnected smart grids. However, national peculiarities cannot be sustainably handled at that level and need to be broken down for a more detailed analysis, still without dictating a single specific solution on component or communication level. Instead, a holistic approach is required, which takes into account requirements from the institutional framework, which maps societal goals to legislative or regulatory framework conditions. The goals of the RASSA initiative can therefore be summarized as follows:

1. Define a consistent reference architecture for the Austrian smart grid, thoroughly considering aspects like security, safety, resilience, privacy,
2. Reach a consensus among all relevant stakeholders on contents and utilization of the reference architecture,
3. Foresee sufficient degrees of freedom to allow a competitive realization of the suggested reference architecture, and
4. Provide concrete guidance on the migration path from today's grid to a future smart grid infrastructure as expressed by the reference architecture.

The institutional framework has implications for business models and enterprise processes regarding how the various players interact and organize their business. The processes defined eventually affect the necessary information exchange and data models. In addition to this, the architecture solution of course has to consider available technology. The reference architecture development cannot simply build on a one-time acquisition of requirements, but rather is an iterative process which is continuously adapted to the ever-changing challenges of technology development.

The first project within this initiative, *RASSA Process*, is mainly concerned with establishing concepts for continuous stakeholder involvement. Details are described in Sect. 4. One of the result of the stakeholder process is a prioritization of topics in terms of high-level use cases. In addition to concept development, the project deals with the technical and scientific fundamentals of reference architecture development.

While the *RASSA Process* project aims at providing methodological support and establishing a sustainable stakeholder involvement, the *RASSA Architecture* project focuses on developing the core reference architecture (see Sect. 5). Figure 2 shows the relationship of the two projects and their thematic priorities. Follow-up projects within the RASSA initiative will focus on different aspects such as risk management for smart grids.

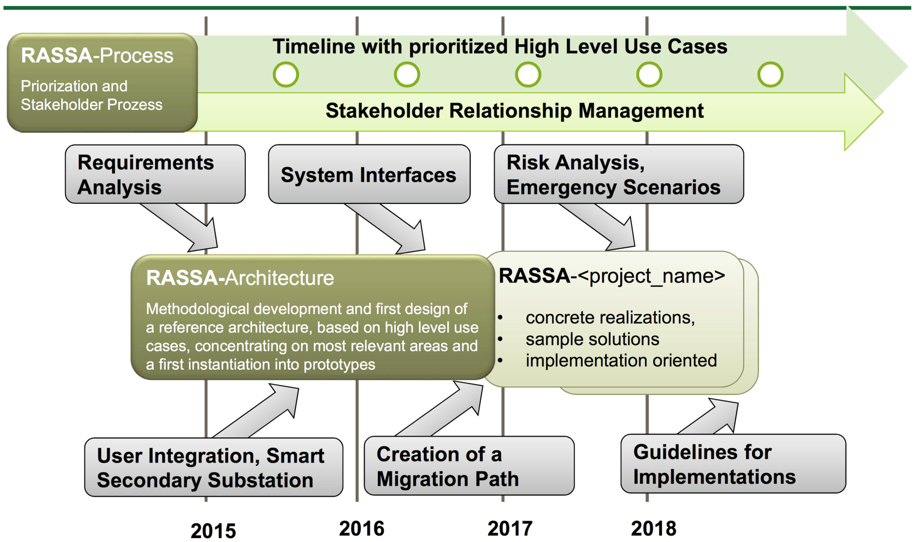

Fig. 2. Timeline of the projects part of the RASSA initiative

4 Preliminary Results of RASSA Process

A special feature of the RASSA initiative is its support by a broad institutional base, namely the partners of Technology Platform Smart Grids Austria from energy industry, regulation, technology, and research. However, the challenge of RASSA cannot be mastered by these actors alone, but requires coordination between all relevant stakeholders on different technical and organizational levels. Due to the large number of stakeholders only a structured approach can achieve wide acceptance of the solution. A key objective of the project is to clarify the working structures and interfaces of the different stakeholders. The work will build on previous activities in Austria and existing international models like SGAM and the NIST proposals, but will also extend beyond the boundaries of energy, communication and information systems.

4.1 Analyze Stakeholders

Beginning with *RASSA Process*, relevant stakeholders and their demands in relation to the energy infrastructure were identified. In Austria, responsibilities in the smart grids area such as energy, research, safety, and economy are divided among several ministries and agencies. Therefore, an integrated strategy development is difficult, but a coordinated approach is essential – especially in areas of critical infrastructure and security. It is now time to carry out this coordination within affected areas, in order to create a common strategy framework for industry and energy. Figure 3 illustrates different stakeholders and their diverse requirements regarding the energy infrastructure.

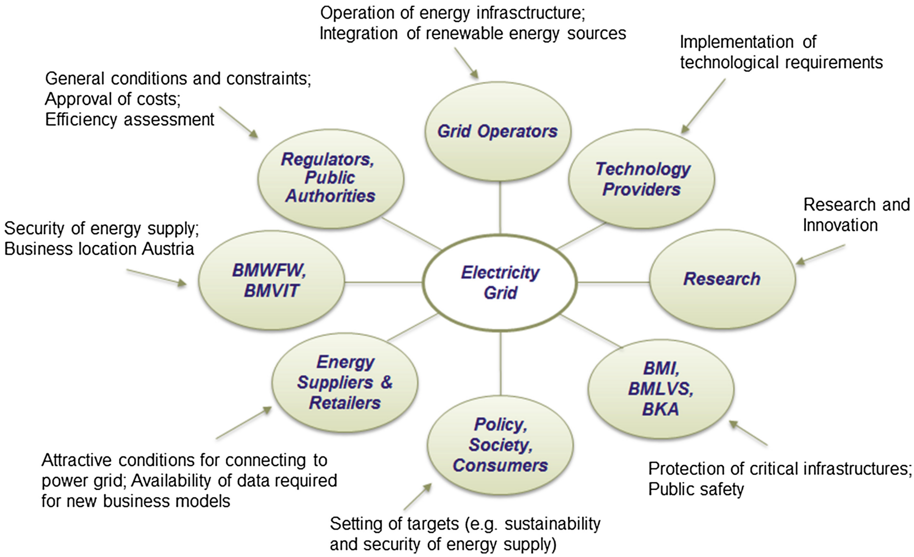

Fig. 3. Stakeholders and their requirements

4.2 Organize, Prioritize, and Contact Stakeholders

As a next step, the stakeholders were prioritized according to their impact on the development of the reference architecture. Currently, they are being contacted following target-group-specific approaches. The focus is on creating a common vision and to foster the willingness to work together. A stakeholder workshop has been held at Smart Grids Week in May 2015 to identify the existing knowledge gap and suitable scientific methods for the development of a reference architecture. Aspects considered were, for example:

- Where the Austrian reference architecture will differ from other countries,
- International regulatory issues and other constraints,
- Whether an Austrian reference architecture can serve as template for other countries, and
- Relevant use cases and methods for developing a reference architecture.

4.3 Define Concept for Stakeholder Involvement

As a final step, an information exchange concept will be defined to guarantee active involvement of stakeholders throughout the architecture development process. A coordination of stakeholder requirements and their consideration in architecture development is currently planned for *RASSA Architecture* and following projects (see Sect. 5). In addition to national activities, an international coordination is intended. Experience gained from European development processes, for example, in M/490 is provided through a subcontract with OFFIS. Workshops with international participation were already held, and especially the know-how exchange within the D-A-CH region is actively being pursued.

5 RASSA Architecture Outlook

The *RASSA Architecture* project started in June 2015 and runs till November 2017. Its aim is to develop a consistent and unifying reference architecture for smart grids in Austria, and establish its acceptance among all relevant stakeholders such as grid operators, energy suppliers, regulators, and public authorities. Based on existing standards and concepts including SGAM (see Sect. 2), the project will specify a reference architecture for Austria that can be used as a blueprint for smart grid implementations. By instantiating parts of the reference architecture within the boundaries given by its parameters, secure and interoperable smart grid solutions can be developed in a straightforward and consistent way. The reference architecture will not be unnecessarily prescriptive; sufficient degrees of freedom will allow grid operators and manufacturers to make their own decisions how to instantiate different components. This will allow innovation to continue in this important emerging market. The practical applicability of the reference architecture will be demonstrated in the areas of an innovative smart secondary substation and in the customer domain. This will be achieved by applying the conditions defined by the architecture to existing components that are provided by grid operators and manufacturers within the consortium. Special consideration will be given to customers by designing and integrating privacy-enhancing technologies (PETs) into the reference architecture.

A harmonized reference architecture for Austria, which is synchronized with Europe and further afield, will strengthen the competitiveness of Austrian companies and research organizations, by enhancing the Austrian market to become a pilot market with clear technical requirements.

Acknowledgment. This paper is based on findings of the project *Initiative Referenzarchitektur Sichere Smart Grids Austria – Projekt RASSA-Prozess*, which was commissioned by the Austrian Climate and Energy Fund as part of the *1st Call Stadt der Zukunft* in the topic *Smart Grids Reference Architecture*.

References

1. Technologieplattform Smart Grids Austria (TPSGA): Technologieroadmap Smart Grids Austria - Die Umsetzungsschritte zum Wandel des Stromsystems bis 2020. Technical report, Technologieplattform Smart Grids Austria, April 2015. http://www.smartgrids.at/index.php?download=372.pdf
2. Smart Grid Coordination Group: Smart grid reference architecture. Technical report, CEN-CENELEC-ETSI, November 2012. http://www.cencenelec.eu/standards/Sectors/SustainableEnergy/SmartGrids/Pages/default.aspx
3. GridWise Architecture Council Interoperability Framework Team: Interoperability Context-Setting Framework. Technical report, GridWise Architecture Council, July 2007. http://www.caba.org/resources/Documents/IS-2008-30.pdf
4. Kreutzmann, H., Vollmer, S.: Protection profile for the gateway of a smart metering system (smart meter gateway pp). Technical report BSI-CC-PP-0073, Bundesamt für Sicherheit in der Informationstechnik (BSI) Federal Office for Information Security, Germany, March 2014. https://www.bsi.bund.de/DE/Themen/SmartMeter/Schutzprofil_Gateway/schutzprofil_smart_meter_gateway_node.html
5. Federal Office for Information Security Germany: Protection profile for the security module of a smart meter gateway (security module pp). Technical report BSI-CC-PP-0077-V2, Bundesamt für Sicherheit in der Informationstechnik (BSI), December 2014. https://www.bsi.bund.de/DE/Themen/SmartMeter/Schutzprofil_Security/security_module_node.html
6. Smart Grid and Cyber-Physical Systems Program Office and Energy and Environment Division, Engineering Laboratory, Physical Measurement Laboratory, Information Technology Laboratory: NIST Framework and Roadmap for Smart Grid Interoperability Standards Release 3.0. Technical report SP 1108R3, NIST, February 2014. http://www.nist.gov/smartgrid/upload/NISTDraftFrameworkOct_2013.pdf
7. Smart Grid Interoperability Panel: Guidelines for smart grid cyber security. Technical report 7628, Cyber Security Working Group, (NIST), September 2010. http://www.nist.gov/smartgrid/upload/nistir-7628_total.pdf