WHITE PAPER

FOR A

SECTOR NEUTRAL

INTEROPERABILITY PROCESS

Association Austrian Rail Industry • Technology Platform Smart Grids Austria
University of Applied Sciences Technikum Wien • University of Applied Sciences St. Poeölten

Index

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1 Introduction

This White Paper describes a sector neutral process that specifies and facilitates the adoption of profiles of selected standards to support carefully defined Use Cases that depend on electronic information exchange. It accelerates the worldwide implementation of standards targeted to achieve the interoperability of information exchange between software applications within enterprises and across various other settings.

Interoperability of ICT systems is a key factor for the successful transition to digital business
Digital tools are becoming increasingly important in our society and economy. Successful online business (e-business) depends on data that flows seamlessly within and between organizations. The ICT systems must be scalable, both in terms of additional functions and the number of transactions and business partners and suppliers involved. The integration profiles and integration processes described here support the definition, implementation, testing and deployment of interoperable ICT systems for different business domains. This enables communities and businesses to develop cost-efficient and scalable integrated ICT-Infrastructures and applications that can support our society and economy.

Available communication standards allow for a large degree of flexibility. When integrating software solutions for specific business transactions, all vendors must agree on coordinated restrictions on the standards used. Governments, interest groups, vendors and users can together document these agreements in interoperability profiles. The basis of the methodology is to ensure acceptance and technical feasibility. This approach to interoperability covers the steps from the description of the business domain, the specification of the interoperability profiles to interoperability testing and deployment in real-world ICT systems.

The approach provides a common understanding and framework to develop and reuse solutions for data exchange: interoperability profiles instead of proprietary solutions. The transparency of the process ensures a sustainable investment protection for vendors and fosters competition, increases product quality and performance at lower costs.

The approach to interoperability has been developed based on established processes in the healthcare sector and was adopted for the energy and railway sector but can be used for any type of data exchange of ICT systems and also for other sectors.

The greater vision: From an initiative to a European organisation
It is important that harmonization processes take place on an international level to ease implementation and facilitate the required communication of the future digitalized systems. The cooperation between this initiative and relevant actors, further European initiatives and relevant EU projects should be encouraged. This initiative offers collaboration with interested stakeholders in other EU Member States and provides expertise such as process support, training, provision of test systems and tools to support a growing community in Europe.

1.1 Scope

This White Paper describes how the approach to Interoperability specifies and facilitates profiles of selected standards to support carefully defined use cases that depend on electronic information exchange. It accelerates the worldwide adoption of standards targeted at achieving interoperability between software applications within enterprises and across enterprise settings.

1.2 Terms and Definitions

For the purposes of this document, the following terms and definitions apply:

1.2.1 Actor

Functional component of a system that exchanges transactions with other actors as defined in an integration profile.

1.2.2 Content profile

Coordinated set of standards-based information content exchanged between the functional components of communicating IT systems and devices.
NOTE It also specifies a specific element of content (e.g., a document or message) that may be conveyed through the transactions of one or more associated Integration Profile(s).

1.2.3 Connectathon

A testing event at which developers have registered their system implementations for supervised interoperability testing with other systems implementations. Each participating system is tested for each registered combination of an Actor and Integration or Content Profile.

1.2.4 Development Process

The part of the process that identifies and prioritizes use cases, selects interoperability standards, defines the necessary constraints, and documents these specifications in the form of either an Integration Profile or a Content Profile.

1.2.5 Domain

A field of technology related activities in a specific industry or application.

1.2.6 Draft Supplement for Public Comment

A specification candidate for addition to a Technical Framework (e.g., a new Profile) that is issued for comment by any interested party.

1.2.7 Integration Profile

An Integration Profile specifies the information exchanges to support a specific business process. It is a coordinated set of interactions exchanged between the functional components of communicating IT systems and devices. These functional components are called actors. An Integration Profile specifies their interactions in terms of a set of coordinated, standards-based transactions.

1.2.8 Technical Framework

A collection of Profile specifications related to a Domain and its specific technological focus.
Profiles are assigned to a Technical Framework but can also be used across the board.

1.2.9 Transaction

A transaction is a specification for a set of messages exchanged between pairs of actors in support of an integration profile.

1.2.10   Trial Implementation Supplement

A specification candidate for addition to a Technical Framework (e.g. a new Profile) that is issued for early implementation by any interested party. The authoring Technical Committee expects developers feedback.

1.2.11   Use Case

A textual and graphical depiction of the actors and operations that address information exchange in the context of a set of specific tasks for a workflow performed by different systems or devices.

1.3 Abbreviations

CEN	European Standardization Committee
EIF	European Interoperability Framework
IEEE	Institute of Electrical and Electronics Engineers
IES	Integrating the Energy System
IETF	Internet Engineering Task Force
IHE	Integrating the Healthcare Enterprise
IRS	Integrating the Railway System
LOINC	Logical Observation Identifiers Names and Codes
OASIS	Organization for the Advancement of Structured Information Standards
SDO	Standards Development Organization

2 Global Process Overview

The approach to interoperability provides a common understanding and framework to develop and reuse solutions for data exchange: interoperability profiles instead of proprietary solutions. The transparency of the process ensures a sustainable investment protection for vendors and fosters competition, increases product quality and performance at lower costs.

The European Interoperability Framework (EIF)[1]
The lack of interoperability is a major obstacle to progress on the digital single market. Using the EIF to steer European interoperability initiatives contributes to a coherent European interoperable environment, and facilitates the delivery of services that work together, within and across organizations or domains.

The "European Interoperability Framework for European public services" recommends to "formalize cooperation arrangements in interoperability agreements", addressing four interoperability layers:
- Legal interoperability: Defines the legal basis for cooperation
- Organisational interoperability: Defines business processes necessary for collaboration
- Semantic Interoperability: Describes the meaning and value of information
- Technical Interoperability: Describes the required technologies and standards

The presented approach to interoperability covers all mentioned interoperability layers and describes the process how to specify Integration Profiles that support selected Use Cases that depend on information exchange. These profiles accelerate the normative use of standards achieving interoperability between software applications that require cooperation across interconnected systems.

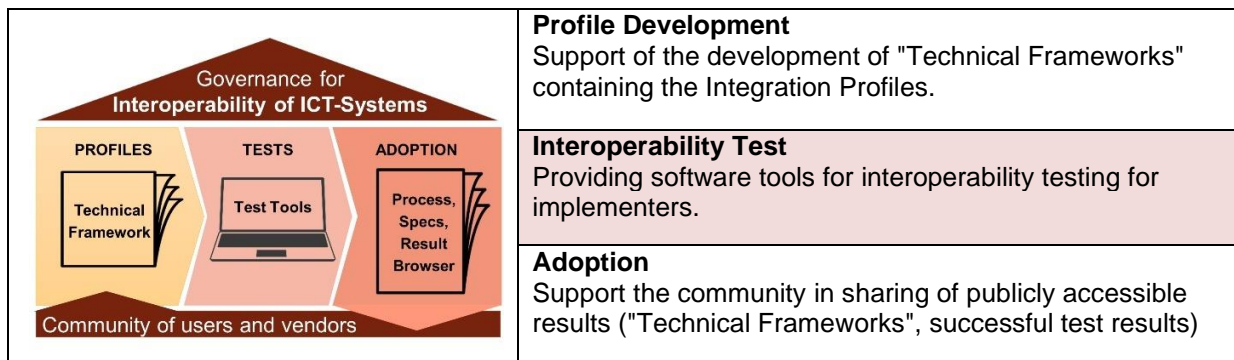|	
	Profile Development Support of the development of "Technical Frameworks" containing the Integration Profiles.
	Interoperability Test Providing software tools for interoperability testing for implementers.
	Adoption Support the community in sharing of publicly accessible results ("Technical Frameworks", successful test results)

Figure 1: The three pillars of the interoperability process

The approach to interoperability is a tailor-made service offer for every step of the process chain. Domain experts are accompanied in a moderated process in the specification of the Integration Profiles. Vendors who have implemented these, are supported in the preparation and implementation of interoperability tests.

The approach to interoperability provides the publication of the specified profiles to ensure the highest possible acceptance and thus their use. The successful tests at the Connectathons will also be made publicly available. This brings important information to users and increases the visibility of the vendor.

Structure of an Interoperability Organisation

To establish this interoperability process, an independent European (non-profit) organisation is required. Its activities focus on the methodological groundwork, tools, and policy-concepts. These activities can happen independent of a sector.
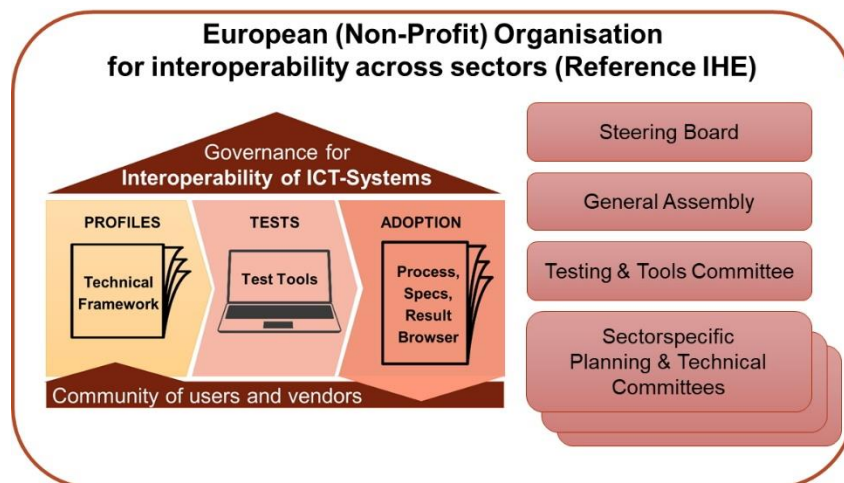

Figure 2: The Organigram of the Interoperability Organization

The approach to interoperability should be led by sponsors who represent decision makers and users of the domains, thus providing the necessary independence from the developers of ICT systems. Developers of technology solutions or products implementing Interoperability Profiles are engaged and welcomed in the approach to interoperability. This ensures their buy-in and accelerates adoption in commercially available products, without allowing control of the overall standards adoption process, including the conformance testing process.

The organisation shall consist of a Steering Board and other Committees, that carry out profile development and organisation of tests and test-events („Connectathons")

In the domain-specific Planning and Technical Committees users and vendors jointly formulate practical requirements in the form of Use Cases, identify relevant standards and develop technical guidelines, so-called profiles. Vendors implement the interfaces of their software products based on the developed profiles.

The Testing and Tools Committee is responsible for supervising and coordinating the testing activities and the development of testing software and other tools used in the testing process.

The Approach on interoperability is based on an existing method from ICT in healthcare, where interoperability of various systems has long been achieved. Integrating the Healthcare Enterprise (IHE)[2] is a global non-profit organisation that engages many different actors to achieve interoperability of the ICT-systems. Therefore, IHE serves as best practice for the three pillars of the specification process and the establishment of an independent organization for the described approach.

Specifying profiles and test cases

The independent organisation provides facilitation, framework and support for the committees that are part of the process, and a community of users and vendors is responsible for profiling, which can be cross-industry or adapted to the needs of a specific industry. Their activities should be focused internationally from the beginning.

The Technical Framework is the centre of the approach to interoperability. Technical Frameworks are specifications with a defined structure. They are specified to the associated Use Case description. Released Technical Frameworks are public and available for download.

Technical Frameworks are organised in several volumes. While Volume 1 provides a high-level view of the supported Use Case, identifying actors and transactions or content, Volume 2 provides detailed technical descriptions of each transaction or content modules, used in the Integration Profiles. Furthermore, a specific Volume can define national or regional specifics to accommodate certain practices, that may require extensions to the baseline definitions in a domain.
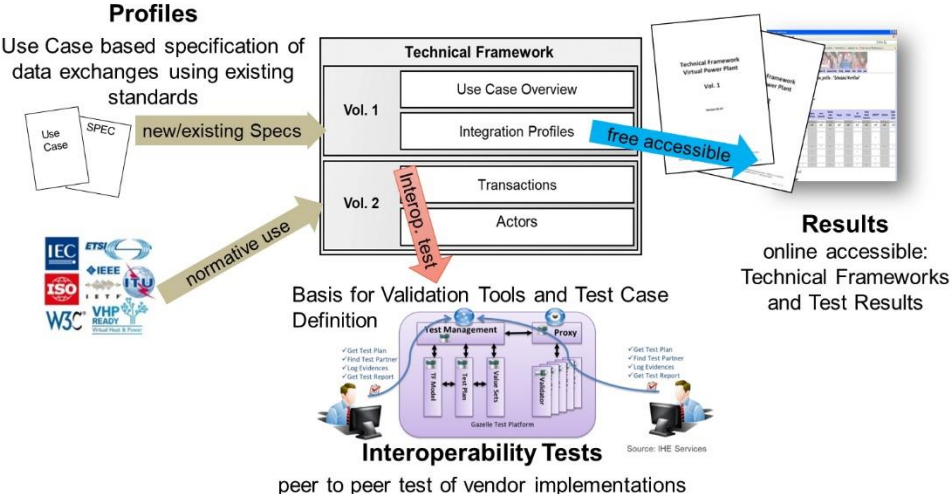

Figure 3: The Technical Framework in the centre of the entire process

Detailed implementation and testing processes enable vendors to implement standards-based interoperability of their communication systems. Part of the approach to interoperability is the regular organisation of test events; Connectathons. There it is possible to carry out peer-to-peer interoperability testing with other vendors against the specifications.

Connectathons offer vendors the ideal environment to pre-test the interoperability of their systems. A broad applicability and acceptance of test systems ensures that the necessary interoperability is guaranteed in future systems. The low-entry-barriers for integration enable high cost-efficiency during IT infrastructure investments.

3 Roles and Responsibilities

The approach to interoperability is not organized as a typical Standards Development Organization (SDO). This is due to its objective: address commonly needed specific information exchange related Use Cases by leveraging widely recognized standards for interoperability. It is focused at bridging the gap between the development of standards and the effective and efficient deployment of standards-based information exchange of ICT-Systems.

But like an SDO, the approach to interoperability shall bring together many organisations and individuals as stakeholders. It offers co-creation process to participate on a B2B level in the initiative and contributes to achieving its objective. This vendor-independent methodology gives SMEs and Start-Ups a chance to positively impact the market, bringing more innovations and lower prices as a long-term effect. Interoperability contributes to accelerating the development of cross-border, intersectoral activities in communication, data-exchange, and commerce while ensuring security and data protection. Stakeholders take an active part in the definition, development, and use of a growing number of innovative products, while decreasing prices motivate the end-user to support the transformation to new processes, fuelling innovation. While the end-user profits from products, that seamlessly interact, the vendors can save costs in the implementation making the products more competitive.

3.1 Stakeholder participation - the Committees

This section describes the different modes of participation and is not intended to describe the governance process used to make decisions, but to focus on the roles that support the process.

Each organisational unit (board, committees, ...) shall be represented by two co-chairs, one of which ideally represents the vendor and one the user.

3.1.1 Steering Board

The Steering Board is responsible for overall management, direction, coordination, and governance. It is composed of representatives of professional specialities and organisations from across the spectrum of involved sectors. It performs this by management of development activities, oversight of the deployment activities conducted by the partner national and regional deployment organisations. It should be comprised equally by representatives of vendors and users. Furthermore, members of the category „General Interest ", may also be voted into the Steering Board.

3.1.2 Planning Committee

Each Domain has a Planning Committee open to all stakeholders' representatives (end users, vendors, etc.) interested in that domain. The Planning Committee is responsible for setting the development priorities for the domain on a yearly cycle and maintains a multi-year roadmap on a longer-term basis. The Planning Committee in a domain regularly surveys its environment and considers what interoperability problems should be addressed in a defined period, ensures that adoption barriers are reasonably low, and that a range of policy constraints are identified. The Planning Committee will work with its peer Technical Committee and ultimately decides a short list which interoperability problems should be formally documented and solved during each yearly cycle.

3.1.3 Technical Committee

Each Domain has a Technical Committee open to all stakeholders' representatives (end users, vendors, etc.) interested in that domain. The primary responsibility of a Technical Committee is the development of Technical Frameworks for that domain and the subsequent maintenance of that documentation. The Technical Committee receives the short list from the Planning Committee on the issues to be resolved for the next cycle and advises the Planning Committee on the adequacy of the proposed scope of work. This balance of roles between the Planning Committee and the Technical Committee ensures that the right problem is addressed at the right time in a technically viable way that can be immediately implemented and achieve the desired interoperability solution.

3.1.4 Testing & Tools Committee

The Testing and Tools Committee is responsible for supervising and coordinating the testing activities and the development of testing software and other tools used in the testing process. The tasks of this committee include developing and maintaining quality procedures for testing processes and events, including Connectathons, as well as coordinating the requirements gathering process for test specifications and test assertions for the Profiles developed in the Technical Committee. Furthermore, the committee develops a consistent approach to ensuring testability of Profiles and coordinates the development and maintenance of infrastructure used in testing process, including websites.

4 The Development Process

The three pillars of the Profile Specification Process

The core of the integration profile specification process itself consists of the three pillars shown in Figure 4. Together, they foster sustainable and efficient development and deployment of interoperable complex systems.
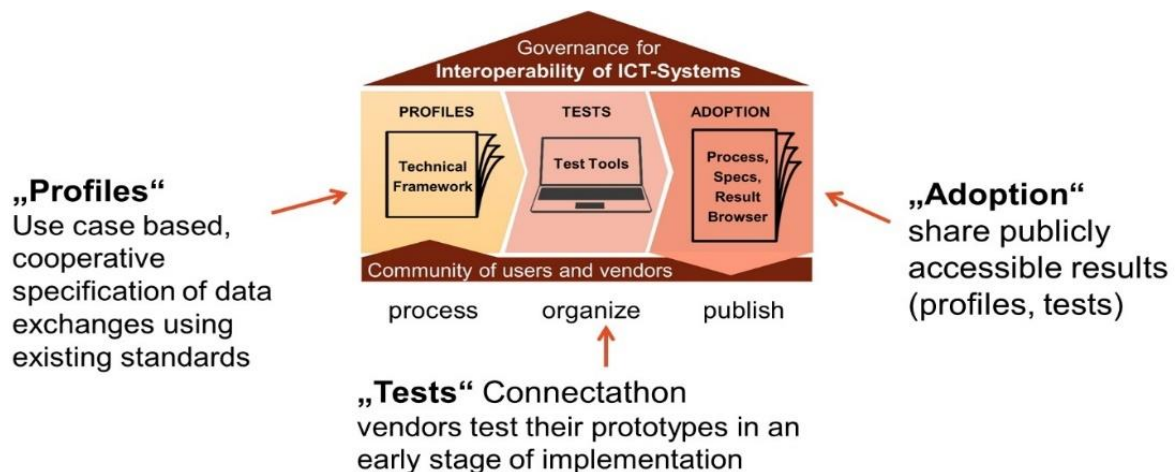

Figure 4: The three pillars of the Profile Specification Process

4.1 The Pillar "Profile Development": Specification of Integration Profiles

The subject of the methodology is agile cooperation between stakeholders. The participation in the profiling process has a low entry barrier and high transparency, contributing to its acceptance. Stakeholders who were not involved in the specification may also participate in the test-events under the same conditions, guaranteeing the process to be open.

In a structured document called "Technical Framework", the so-called Integration Profiles specify on the one hand informative descriptions of the functions and on the other hand a normative specification of the data exchange with existing standards. Technical Frameworks shall continuously be developed and grow in a co-creation process of users and vendors to solve more and more issues of the business domain they cover, with new Integration Profiles complementing the existing. Obsolete profiles remain available as a reference for legacy system integration attempts.

The essential steps of profiling

1. informative problem description
   through the definition of Use Cases and Integration Profiles, which require interoperability in Volume 1
2. normative description of the data exchange
   Development of Transactions, as a specification of the standardized application of existing standards regarding the defined Use Cases in Volume 2

Lessons learned from profiling from IHE

The experience of healthcare sector and IHE shows that:
- 80% of an interface can be specified (e.g., except country-specific requirements)
- Lower implementation and integration costs
- Reuse of proofed profiles for further Use Cases

4.2 The Pillar "Test Procedure": Interoperability Testing

Part of the process is the regular organisation of test events; Connectathons, where it is possible to carry out the interoperability test peer-to-peer with other vendors. Detailed implementation and testing processes enable vendors to implement standards-based interoperability of their communication systems. The possibilities that the interoperability approach can offer to test the implementations based on the technical frameworks in an early development phase are unique.

During a Connectathon, information systems from different vendors exchange data in a structured and controlled P2P test environment. A Connectathon provides detailed validation of the interoperability of the participating vendors as well as their compatibility with the developed Interoperability profiles and relevant communication standards.

An open-source software testbed (Gazelle) provides test management and capabilities for participants supporting the interoperability testing.

All participants contribute jointly to a test case with a common goal: to pass the test. A multi-day Connectathon allows vendors to jointly identify why something does not work as it should, e.g., due to different interpretation of the Integration Profiles. The comments and bugs recorded at the test event are extremely valuable for improving integration profiles. This practice-oriented feedback supports the further development of the integration profiles.

The Connectathon is a connectivity test marathon

- Provides a week-long face-to-face testing of the participating products' interoperability.
- Sanity checks whether the Profiles are specified clear enough and can be implemented consistently
- Participants are allowed to improve code during the event.
- Hundreds of transactions are verified amongst the thousands of possible transactions.
- Encourages vendors, large and small, to work closely together to solve issues.
- At the end of the event successful vendors are registered in the Connectathon Results Report

The essential steps for the tests of interoperability
1. Implementing the profiles in software systems
2. Specification and implementation of test cases and test procedures to verify interoperability in the test platform
3. Carrying out vendor-neutral interoperability tests (Connectathon)

The advantage of interoperability testing

The experience of in healthcare sector and IHE shows that:
- Test of prototypes reduces later integration costs
- The test event provides a steep training curve for implementers

4.3 The Pillar: "Adoption": Benefits for stakeholders

As relevant part of the governance of the approach all the results, like specifications and test-results are accessible online. The methodology provides the formation of a community that supports users and manufacturers in promoting the interoperable interconnection of ICT systems in a specific system and in any other sector.

The jointly developed Technical Frameworks are publicly available. These can serve as references for tenders by users or procurers and used by manufacturers for implementation.

The successfully tested products are made transparent, which increases the manufacturers visibility on the market.

The essential benefits of the publication of the results of the entire process

- **Benefits for vendors from the interoperability approach**
  - Defined functionality scope
  - Less effort for implementation
  - 80% of an interface can be specified, according to the experience with IHE
  - Visibility for vendors of interoperable products
- **Benefits for users and purchasers from the interoperability approach**
  - The adequacy of the solution is easy to judge
  - Profile can be a reference for tenders

4.4 The rolling process of the profile development:

The long-term goal is to implement a rolling process for the development of Integration Profiles, that brings users and vendors of ICT systems together.
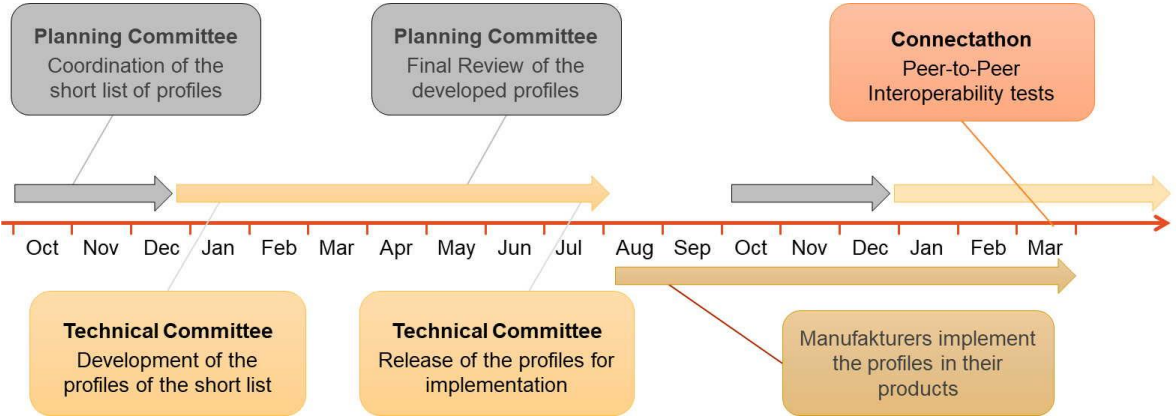

Figure 5: Example for the rolling process for the development of Integration Profiles

The rolling process has a duration of 12 months and starts with the Planning Committee defining the short list of profiles to be developed. The specification process lasts several months where the Technical Committee develops the profiles. After 6-7 months the Planning Committee reviews the developed profiles and then the Technical Committee releases the profiles. From the time of the release vendors can implement the profiles in their products, and commence testing, which leads to a participation at a Connectathon as the last step of the interoperability process. Meanwhile a new short-list for specifications will be defined for the next period of 12 months.

5 The Technical Framework

The Technical Framework is a document containing a set of Integration and Content Profiles supporting interoperability for a specific domain or technology infrastructure. These Technical Frameworks share many common structural and conceptual principles.

Each Integration Profile, documented in a Technical Framework, identifies a subset of the functional components of communicating IT systems within information system environment, called actors, and specifies their interactions in terms of a set of coordinated, standards-based transactions.

For each actor, the Technical Framework defines only those functions associated with interoperability between information systems. The definition of a technical actor should not be taken as the complete definition of any product that might implement it, nor should the framework itself be taken to comprehensively describe the architecture of an information system or of a network of systems.

Each Technical Framework is continuously expanded by the Technical Committee for that domain, if necessary. Also, the feedback from the tests can lead to improvement of the specifications. The development and maintenance process of the Framework follows several principles to ensure stability of the specification so that both vendors and users may use it reliably in specifying, developing, and acquiring systems with interoperability capabilities.

6 The Deployment Process

The approach to interoperability uses established know-how to offer a tailor-made service, that accompanies an entire process ensuring Interoperability for ICT-Systems in a long-term scope, while supporting and empowering the stakeholders for every step of the process chain.

Support in Pillar Profile Development

For the profiling domain experts are accompanied in a moderated process in the specification of interoperability profiles.

While the approach for Interoperability offers the know-how for the process, sector-specific knowledge shall be provided by domain experts. The re-use of already specified profiles shall ensure a benefit of synergy effects.

The following services can be offered:
- Training of the methodology
- Support in creating the Technical Framework
- Support of cross-sector knowledge transfer

Support in Pillar Interoperability test

Vendors who have implemented the public available interoperability profiles are supported in the preparation and implementation of interoperability tests.

The following services can be offered:
- Adaptation of the test environment
- Support of the vendors in preparing for interoperability testing
- Organization and execution of the test events Connectathons

Support in Pillar Adoption

Part of the governance of the approach is, that the entire outcome is openly accessible online. This includes information about the process, the Technical Frameworks, as well as Test Results. This methodology fosters the build-up of a community that supports users and vendors in promoting the interoperability of IT systems in all sectors. Furthermore, vendors can easily adopt standards, even if they did not participate in its specification.

The following services can be offered:
- Dissemination of Know-how, specifications, and test results
- Set up and development of international activities for a growing Interoperability initiative

7 Activities for interoperability in European context

7.1 Healthcare Sector

Integrating the Healthcare Enterprise (IHE), [2]

IHE is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information. IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical needs in support of optimal patient care. Systems developed in accordance with IHE communicate with one another better, are easier to implement, and enable care providers to use information more effectively.

Interoperability profiles and processes – success stories and experience
Interoperability profiles are widely used in the healthcare sector, to successfully achieve interoperability nationally and internationally. In the global organisation "Integrating the Healthcare Enterprise" [2], vendors and users work together as a community. Together they ensure the interoperability of ICT systems in several medical business domains, e.g., radiology, laboratory, and IT Infrastructure. Use Cases for medical processes are formulated as Integration Profiles, e.g. During yearly events "Connectathons" around the world, vendors test the interoperability and conformity of their products.
Experiences showed that interoperability testing based on profiles makes it much easier for vendors and customers to integrate new components into existing IT-landscapes.
Based on the experience in the health sector, this methodology was already adapted to the energy and the railway sector, to improve interoperability of ICT-Systems wherever it is needed.

References from Healthcare Sector
The European Health Data Space ('EHDS') is the first proposal of several domain-specific common European data spaces [3]. The European Health Data Space ('EHDS') is based on the processes of IHE. The cross-sectoral knowledge transfer should make it possible to benefit from the existing know-how of the health sector.

Two large-scale implementations using the IHE approach are epSOS [4] in Europe and the Nationwide Healthcare Information Network [5] in the US.

7.2 Energy Sector

Project IES Austria - Integrating the Energy System (IES)[6]
The topic of interoperability was first tackled specifically for the energy sector in the project IES-Austria. By initiating a cross-sector knowledge transfer, the initiative IES draws from years of experience and know-how in the healthcare sector.

References in the Energy Sector
The methodology for establishing interoperability was already described in the Implementation Plan of SET-Plan Action 4 "Increase the resilience and security of the energy system" ([7]) as Activity A4-IA0-5 "Process chain for interoperability of ICT systems". This methodology is based on the results of the Austrian R&D project IES-Austria.

References for the IES methodology:
- The processes of the project IES Austria are applied for the first time in various ERA-Net Smart Energy Systems RegSys projects.[8]
- The Horizon Europe project IntNET [9], which aims to build an interoperability community, also references the results from the IES project.

7.3 Railway Sector

Project IRS-Cargo - Integrating the Railway system (IRS),[10]

The experts of IES Austria used the gained knowledge from the project IES-Austria and transferred it into a new exploratory study to deploy it within the railway sector. The Exploration Project IRS Cargo is funded by the Austrian Research Funding Society (FFG) under project number 891459.

References in the Railway Sector
The project identified the "Telematics Applications for Passengers and Freight", also known as the TAP/TAF TSI as a possible exemplary Use Case for applying the approach to interoperability in the Railway Sector. The TAP/-TAF TSI is a "Technical Specification for Interoperability", describing the communication needed for different processes in railway operations, providing an excellent opportunity to develop Integration Profiles, enhancing the Interoperability in an important process of rail traffic. Therefore, the content of the document 'COMMISSION IMPLEMENTING REGULATION (EU) 202/541' of 26 March 2021 amending Regulation (EU) No 1305/2014[11]) has been used and been expanded to a technical Framework Specification in order to describe the process of the Use Case "Path request and Path allocation" for a train operator in the EEA (European Economic Area) as an example.

8 Bibliography

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      Regulation (EU) No 1305/2014". Zugegriffen: 30. Januar 2023. [Online]. Verfügbar unter:
      https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0541&from=DE

9 About the Initiative

The IES Austria project succeeded in the proof of concept, which shows that the transfer of methods between the different sectors is possible. Since the completion of the IES project, the process has been applied in several projects and working groups within the energy sector to develop new technical frameworks and integration profiles. The experts of the IES Austria project used the knowledge gained from the project and transferred it to the railway sector. It was shown that a further transfer to other sectors using this industry-neutral process definition can be applied without any problems.

The experts from the project IES Austria used the gained knowledge from the project and transferred it into a new exploratory study to deploy it within the railway sector. Together with experts from the railway sector the exploration Project IRS-Cargo - Integrating the Railway System was started, which has received funding from the Mobility of the Future program, see Acknowledgements.

The Project team of IRS-Cargo consists of members of
Association Austrian Rail Industrie, www.bahnindustrie.at
Technology Platform Smart Grids Austria, www.smartgrids.at
University of Applied Sciences Technikum Wien, www.technikum-wien.at
University of Applied Sciences St. Pölten, www.fhstp.ac.at

Project Pages of the Partners

Verband der Bahnindustrie - IRS – Integrating the Railway System
IES Initiative - Smartgrids Austria
IRS – Cargo | FH Technikum Wien (technikum-wien.at)
IRS Cargo - Interoperability for ICT systems in rail freight transport. - Research (fhstp.ac.at)

White Paper for download:
Verband der Bahnindustrie - White Paper for an Interoperability Process

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