

IRS Cargo – Integrating the railway system

Interoperability of ICT-systems in the rail sector

www.bahnindustrie.at

IRS-Cargo – Integrating the Railway System

Exploratory project March 2022 – March 2023

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- Verband der Bahnindustrie
 - consortium leadership
- University of Applied Sciences Technikum Wien
 - Know-how interoperability in the health and energy sector
- University of Applied Sciences St. Pölten
 - Expertise in the fields of railway technology and logistics



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 Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie



Digitalization in the rail system

What are the current framework conditions?

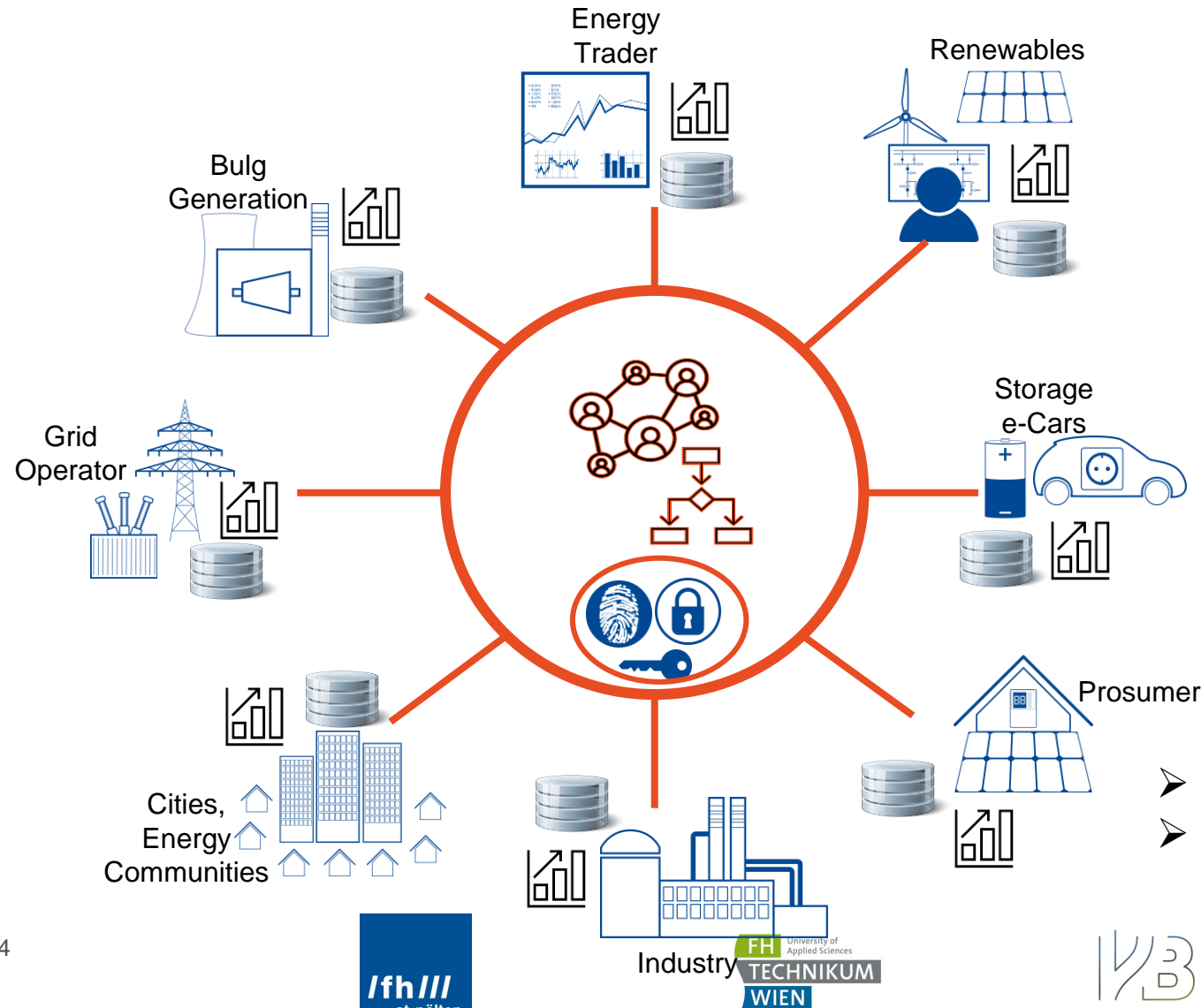


- **National Lock-in effects: structural lack of cross border traffic**
Cross border traffic of passengers and goods is prevented because of proprietary data silos and a lack of interfaces among national operation systems
- **System integration fails: competitive disadvantage of European rail system**
The cooperation of heterogeneous, national systems is only possible with difficulty and involves a great deal of effort
- **System costs increasing: more technology still leads to higher unit costs**
Proprietary solutions and their operation lead to higher system costs and prevent scaling effects and subsequent cheaper solutions in the technologies

Digitalization in of data exchange processes

Communication Infrastructure required

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Central Datahub:

- Loss of data sovereignty
- No governance
- Not possible for critical infrastructure

Communication Infrastructure

- Data „only once“
- Common governance
- Standardized interfaces

- Data access only per defined Use Case
- Data exchange is also possible cross vertical and cross border

European Interoperability Framework

Layers of Interoperability

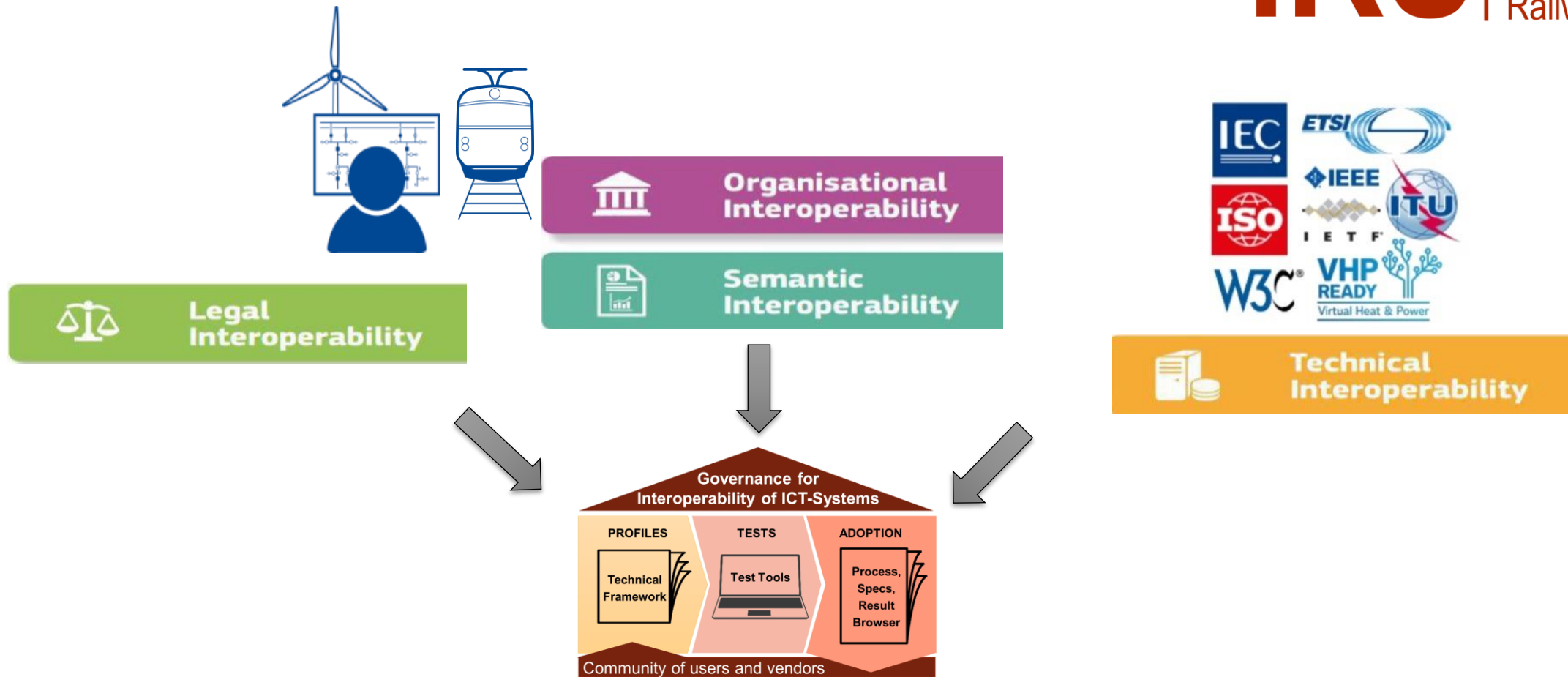
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- **Legal Layer**
 - defines the legal basis for data exchange
- **Organizational Layer**
 - defines the business processes required for data exchange
- **Semantic Layer**
 - describes the meaning and value of exchanged data
- **Technical Layer**
 - Describes the required technical systems and standards



Interoperability requirements for Use Cases in interconnected systems

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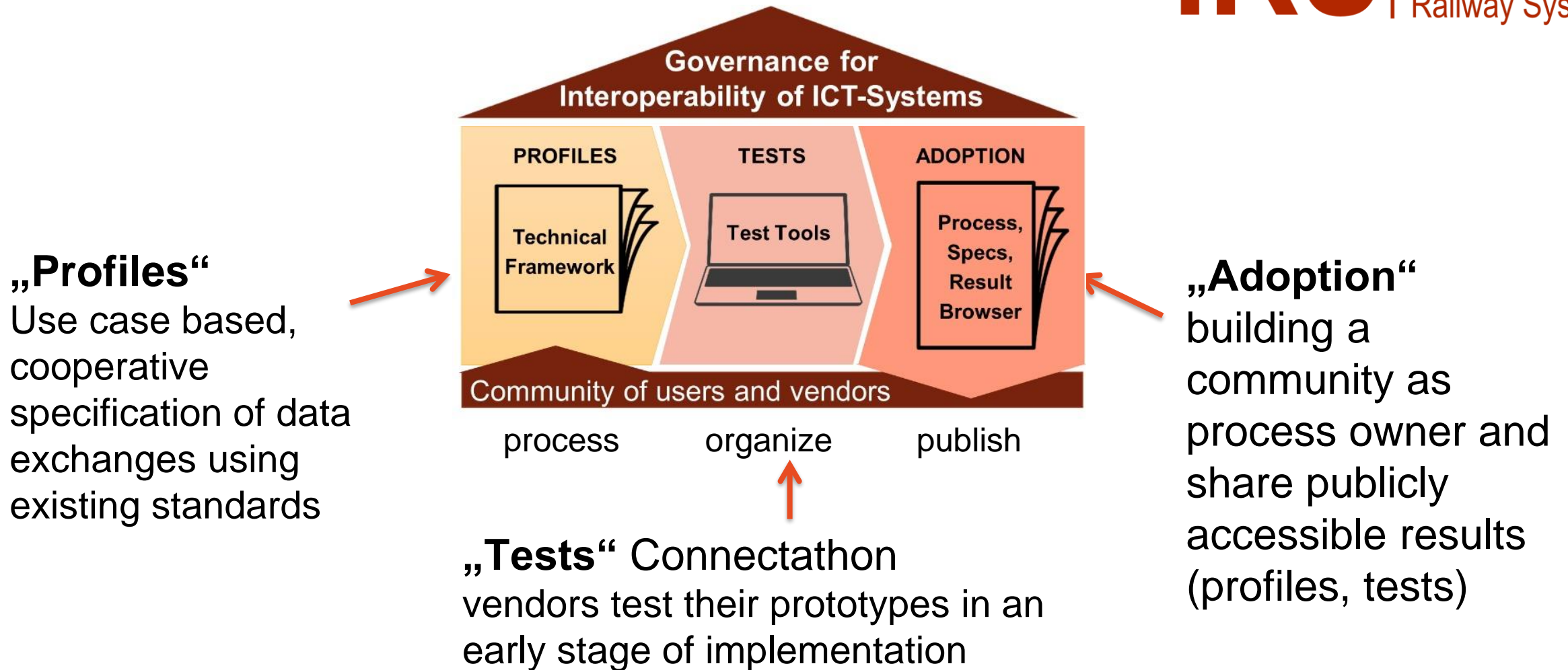


Need of a **cooperative** and **transparent** process

Three pillars of the entire Process

Process chain to achieve Interoperability

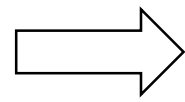
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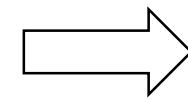
Interoperability process as Cross-sector Know-how Transfer

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IHE | Integrating
the Healthcare
Enterprise



IES | Integrating
the
Energy System



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Health sector:

- 1989 Founding of the non-profit organization IHE
- has a governance for open cooperation (ISO TR 28380)

Energy sector:

- 2016-2019
- first cross-sector know-how transfer
- Adaptation of the IHE methodology (ISO TR 28380)
- Proof of Concept

Railway sector:

- 2022-2023
- Cross-sector know-how transfer
- Based on IHE / IES experience
- White Paper for standardization of the sector neutral model process

Interoperability Testing

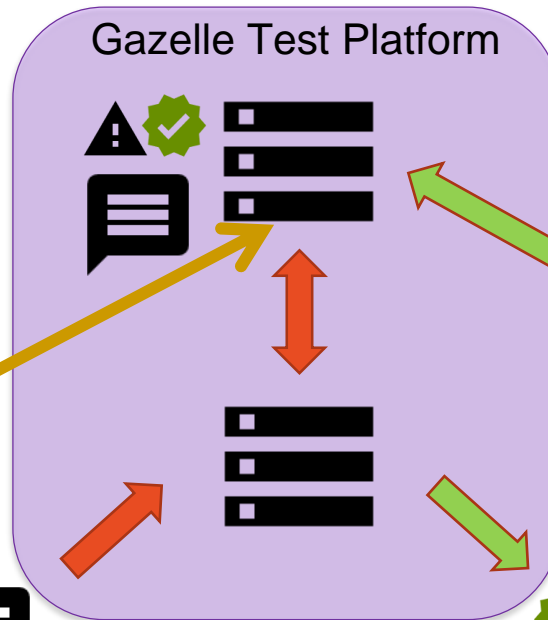
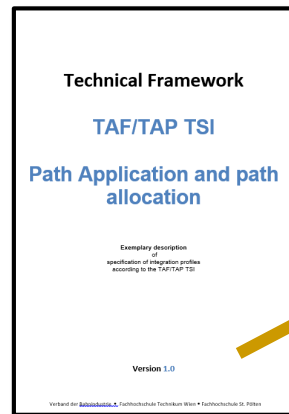
IHE Interoperability testing - synergy for other sectors

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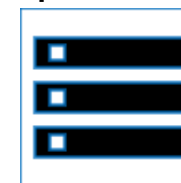
Gazelle Validators
Check message conformance

Gazelle Test Management
Keep track of things



What do we need to add a new sector or domain?

Add new validators. Keep the rest.



Software under Test generate and receive messages



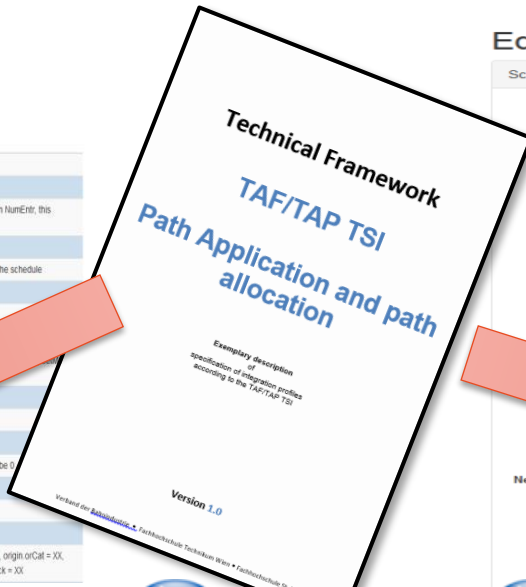
Interoperability Test Platform Gazelle



Testing: Technical Framework from specification to interoperability test

| Step Index | Initiator Role | Responder Role | Transaction | Secured | Message Type | Option | Description |
|---|-------------------|--------------------|-------------|--------------------------|-----------------------------------|----------|--|
| 10 | TPKInitiator_FSCH | TPKTResponder_FSCH | SPS-01 | <input type="checkbox"/> | SPS-01_SchdIntv_Units | Required | Send Unit from Schedule Intervale |
| Input and Output Contextual Information (0 - 0) | | | | | | | |
| 15 | TPKInitiator_FSCH | TPKTResponder_FSCH | SPS-01 | <input type="checkbox"/> | SPS-01_VaASG_Unit | Required | Write the physical unit of the VaASG. Based on the number communicated in NumEnt; this message SHALL be sent multiple times |
| Input and Output Contextual Information (0 - 0) | | | | | | | |
| 20 | TPKInitiator_FSCH | TPKTResponder_FSCH | SPS-01 | <input type="checkbox"/> | SPS-01_NumEnt_SetVal | Required | Communicate the number of values (i suffix in VaASG) that are included in the schedule |
| 30 | TPKInitiator_FSCH | TPKTResponder_FSCH | SPS-01 | <input type="checkbox"/> | SPS-01_SchdIntv_Units | Required | Send Unit from Schedule Intervale |
| Input and Output Contextual Information (0 - 0) | | | | | | | |
| 40 | TPKInitiator_FSCH | TPKTResponder_FSCH | SPS-01 | <input type="checkbox"/> | SPS-01_VaASG_SetMag_multipleTimes | Required | Based on the number communicated in NumEnt; this message SHALL be a FLOAT32 |
| Input and Output Contextual Information (0 - 0) | | | | | | | |
| 50 | TPKInitiator_FSCH | TPKTResponder_FSCH | SPS-01 | <input type="checkbox"/> | SPS-01_StTm_SetCal | Required | Set start time |
| Input and Output Contextual Information (0 - 0) | | | | | | | |
| 60 | TPKInitiator_FSCH | TPKTResponder_FSCH | SPS-01 | <input type="checkbox"/> | SPS-01_InhPer_SetVal | Required | SetVal for InhPer; 0 means no repetition of the schedule. SHALL be 0 |
| Input and Output Contextual Information (0 - 0) | | | | | | | |
| 70 | TPKInitiator_FSCH | TPKTResponder_FSCH | SPS-01 | <input type="checkbox"/> | SPS-01_SchdReuse_setVal | Required | Defines whether the schedule is reusable. setVal SHALL be 0 |
| Input and Output Contextual Information (0 - 0) | | | | | | | |
| 80 | TPKInitiator_FSCH | TPKTResponder_FSCH | SPS-01 | <input type="checkbox"/> | SPS-01_VidReq | Required | Sending the Validate Request (Oper type "Oper_Boolean", with cVal = true, origin orCat = XX, origin orIdent = "testname", cNum = 0, T = currentTime, Test = false, Check = XX) |

Test Case Definition



Edit Schematron

Schematron - ID 93

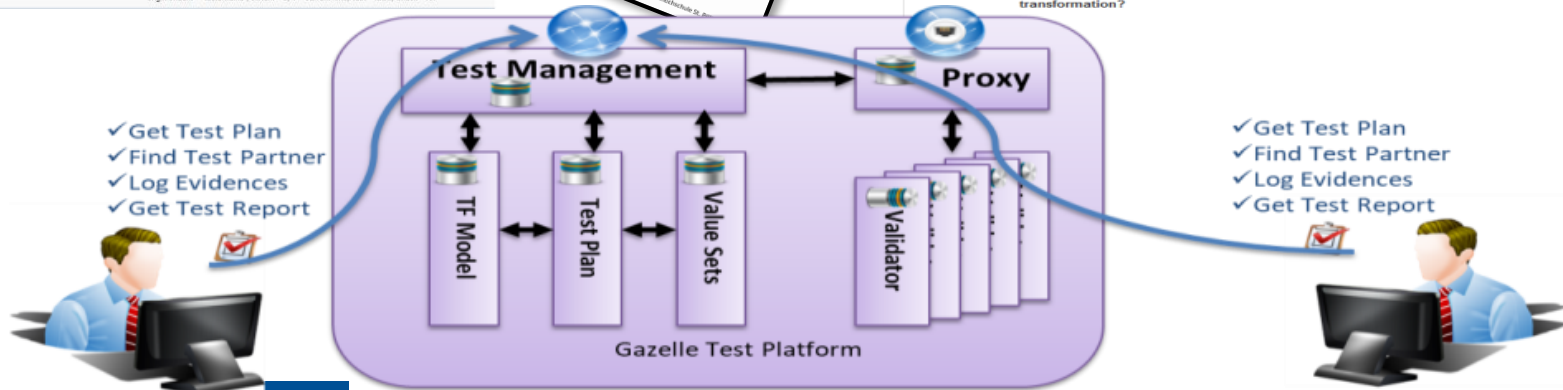
Label: MMS_HAGUE
Keyword: MMS_HAGUE
Version: 1
Author: [redacted]
Type: [redacted]
XSD Path: [redacted]

```

1 <?xml version="1.0" encoding="UTF-8"?>
2 <schema xmlns="http://purl.oclc.org/dsdl/schematron"
3   queryBinding="xslt2"
4   xmlns:sqf="http://www.schematron-quickfix.com/validator/process">
5
6   <pattern id="test">
7     <!-- Elements called Type -->
8     <rule context="Confirmed-RequestPDU/invokeID/type">
9       <!-- Taking their value -->
10      <let name="value" value="number(.)"/>
11      <!-- Is the value integer? -->
12      <assert test="floor(.) = $value">
13        The Type value is not an integer.
14      </assert>
15      <!-- Is the value between 0 to 50 -->
16      <assert test="$value &gt;= 0 and $value &lt;= 50">
17        The Type must be integer between 0 to 50.
18      </assert>
19    </rule>
  
```

Need daffodil transformation?
DFDL schema Keyword: [redacted]
Available:
Need report generation transformation?

Validation Tools

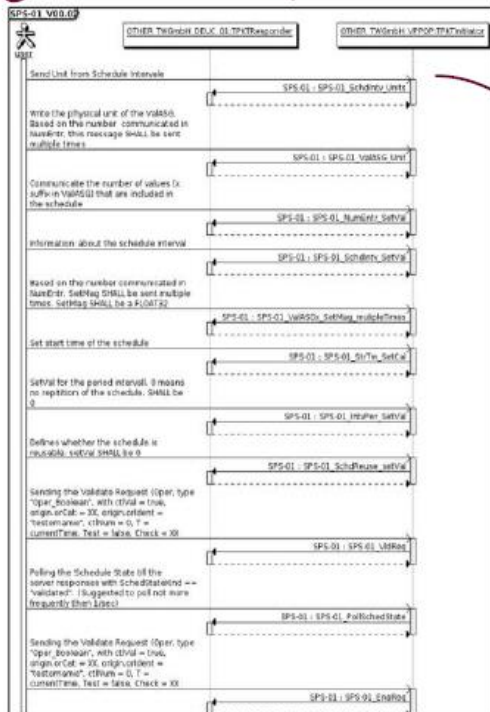


Interoperability Testing Test platform GAZELLE

Test Progress of

| | | | | | | | | | | |
|--------------------|-----|--------------|-----------|-----|-------|-------|----|-----|----|-----------|
| OTHER_TWGmbH_VVPOP | SPS | TPKInitiator | TPKT_FSCH | T | 1/0 | 33% | 0% | 50% | 0% | Please Se |
| Test | | Meta test | | | | | | | | |
| SPS-01_V00.02 | | + | R / 3 | 2/2 | 14806 | 14805 | | | | |

Test Steps



| Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | a | b | c | d | e | f |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 00000000 | 03 | 00 | 00 | 8a | 02 | f0 | 80 | 01 | 00 | 01 | 00 | 61 | 7d | 30 | 7b | 02 |
| 00000010 | 01 | 03 | a0 | 76 | a0 | 74 | 02 | 01 | 3f | a5 | 6f | a0 | 2e | 30 | 2c | a0 |
| 00000020 | 2a | a1 | 28 | 1a | 0d | 4f | 50 | 45 | 4e | 4d | 55 | 43 | 49 | 45 | 44 | 4c |
| 00000030 | 44 | 31 | 1a | 17 | 4d | 52 | 5f | 46 | 53 | 43 | 48 | 31 | 24 | 43 | 4f | 24 |
| 00000040 | 56 | 6c | 64 | 52 | 65 | 71 | 24 | 4f | 70 | 65 | 72 | a0 | 3d | a2 | 3b | 83 |
| 00000050 | 01 | ff | a2 | 22 | 85 | | | | | | | | | | | |
| 00000060 | 6f | 65 | 62 | 6c | 40 | | | | | | | | | | | |
| 00000070 | 29 | 65 | 6e | 2e | 61 | | | | | | | | | | | |
| 00000080 | 60 | 41 | 8a | 83 | 01 | | | | | | | | | | | |

Message Sent

Transformed Message

```

<?xml:lang="http://example.com">
<HeaderInfo>3</HeaderInfo>
<HeaderInfo>46962873838554784788974603596746456735862</HeaderInfo>
<ConfirmedRequestREQ>
<length>116</length>
<invokeID>
<type>2</type>
<length>1</length>
<value>63</value>
</invokeID>
<confirmedServiceRequest>
<choice>15</choice>
<length>111</length>
<write>
<variableAccessSpecification>
<choice>16</choice>
<length>46</length>
<listOfVariable>
<variableSpecification>
<listOfVariable>
</variableAccessSpecification>
</listOfVariable>
<listOfVariables>16</listOfVariables>
<length>61</length>
</writeData>
</write>
</confirmedServiceRequest>
</confirmedRequestREQ>
  
```

Test Instance

Validation Result

Validation result

Information

File Name: 71562.M
 URI: 1.5.1.4.1.12559.11.1.2.1.10.200
 Schematron Validation: PASSED
 Validation Date: 4/10/12 12:00:05 PM (GMT+01:00)
 Model Based Validation: N/A (Not supported)
 Model Based Validation: N/A
 Data Visibility: 7851 (https://schm.schm-aria.at5/View/Details/Result.aspx?ID=8001133141125591112110200)
 Rule:

Validate again | Perform another validation

Validation Results

Schematron validation

XML Validation Report: PASSED

The document you have validated is supposed to be a well-formed XML document. The validator has checked if it is well-formed, results of this validation are put in this section.

XSD Validation detailed Result: PASSED

Your XML document has been validated with the appropriate XSD schema. Here is the detail of the validation outcome.

Interoperability Testing

What is a Connectathon?

Vendors perform Peer-to-Peer tests with other vendors according to the specifications



Exemplary implementation of IRS

Benefits for applying the methodology: Extension / Improvement / Implementation of existing regulations through use case description

TAP/TAF TSI

Use Case: Path Request

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- TAP/TAF TSI defines
 - principle business processes e.g. Path Request
 - data formats of messages
 - on European Level
- The implementation of the technical interface
 - requires some effort
 - Interoperability is not guaranteed

What does the IRS methodology provide?

- Structured, use case description based on TSI
- Specification of the interface between the systems
- Test options for vendors



The Technical Framework



Volume 1: informative description

- Technical Framework General information
- Chapter 1: Domain Overview: Outline of the application scope
Subsystem TAP/TAF TSI
- Chapter 2: Description of Use Cases
e.g. Path application and allocation
- Chapter 3: Integration profiles
„technical“ description of the Use Cases

Volume 2: normative specification

- Chapter 4: Transactions
Flow charts of transactions, Messages, ...

Volume X (optional)
national specifics

| | |
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Legal Interoperability

Organisational Interoperability

Semantic Interoperability

Technical Interoperability

Exemplary implementation of IRS

Benefits for applying the methodology: Use of a structured process via use case description for new interfaces to be developed

Possible Implementation of IRS: Digital Automatic Coupling

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Interoperability as a success factor

- Common definition of business processes
- Uniform interfaces through normalized application of standards

What does the IRS methodology provide

- Structured, moderated process for all levels of interoperability
- test options for vendors
- Cross-sector know-how transfer
- Reference and synergies with other sectors



Quelle: [Rail Cargo Group Blog](#)

The Technical Framework



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Volume 1: informative description

Chapter 1: Domain Overview

Overview of the DAC application area

Chapter 2: Use Cases

e.g. train inauguration, integrity check, autom. brake test, ...

Chapter 3: integration profiles

more "technical" description of the use cases

Volume 2: normative specification

Chapter 4: Transactions

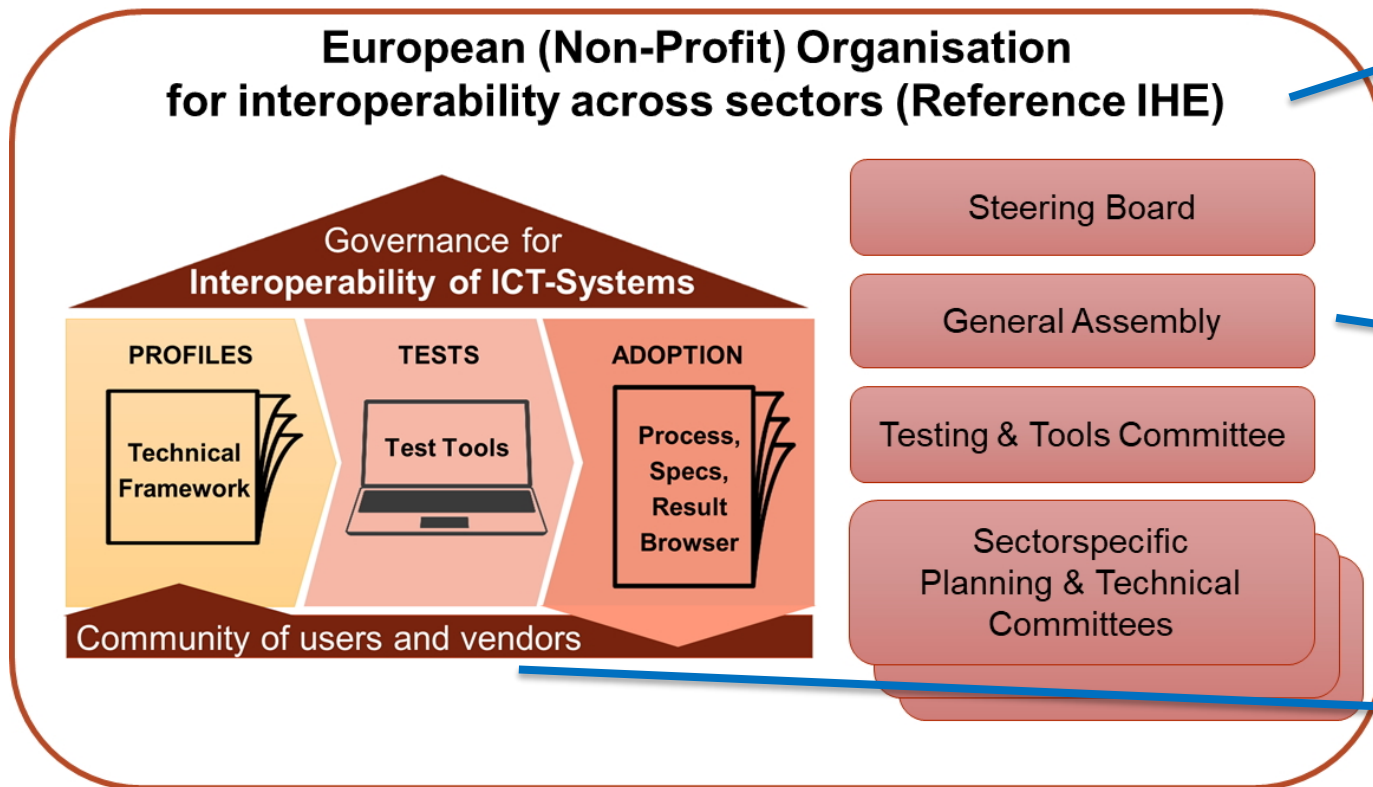
Flow of transactions, messages, ...

Volume X (optional)

national characteristics

Vision for the implementation of the Interoperability Approach

Interoperability Community for a specific sector

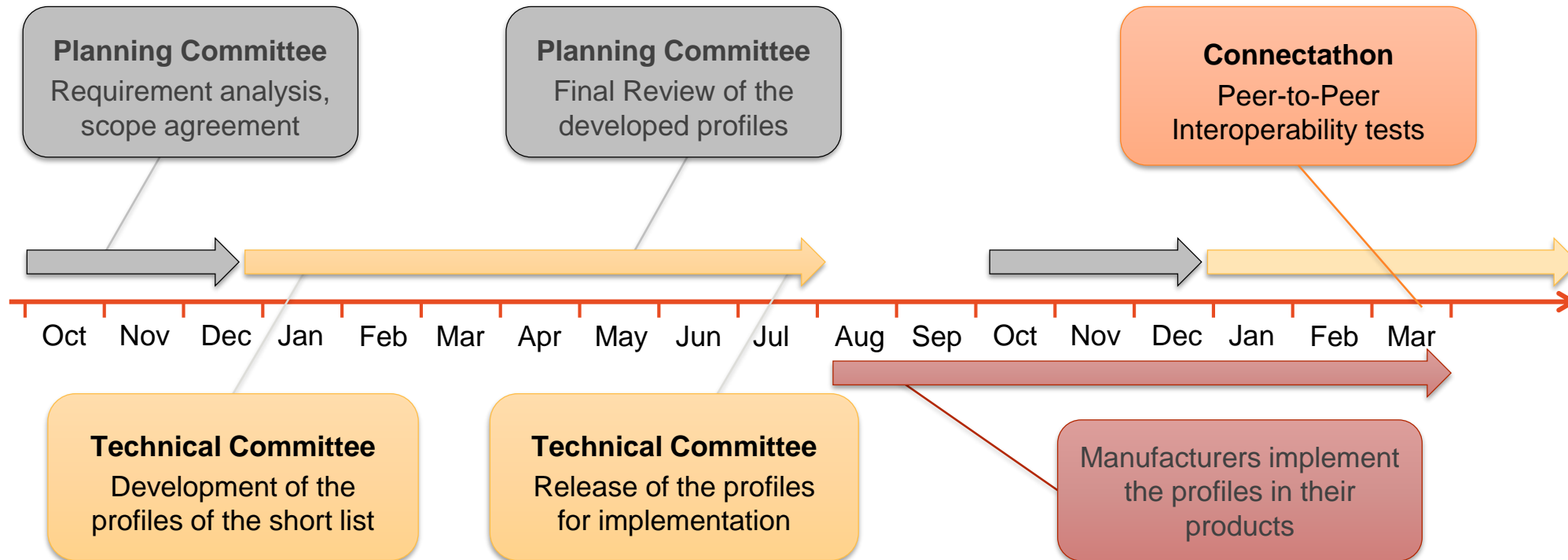


Policy: Formalised according White Paper (ISO TR 28380)
Legal Conditions: anchoring in Regulation, Guidelines, ...

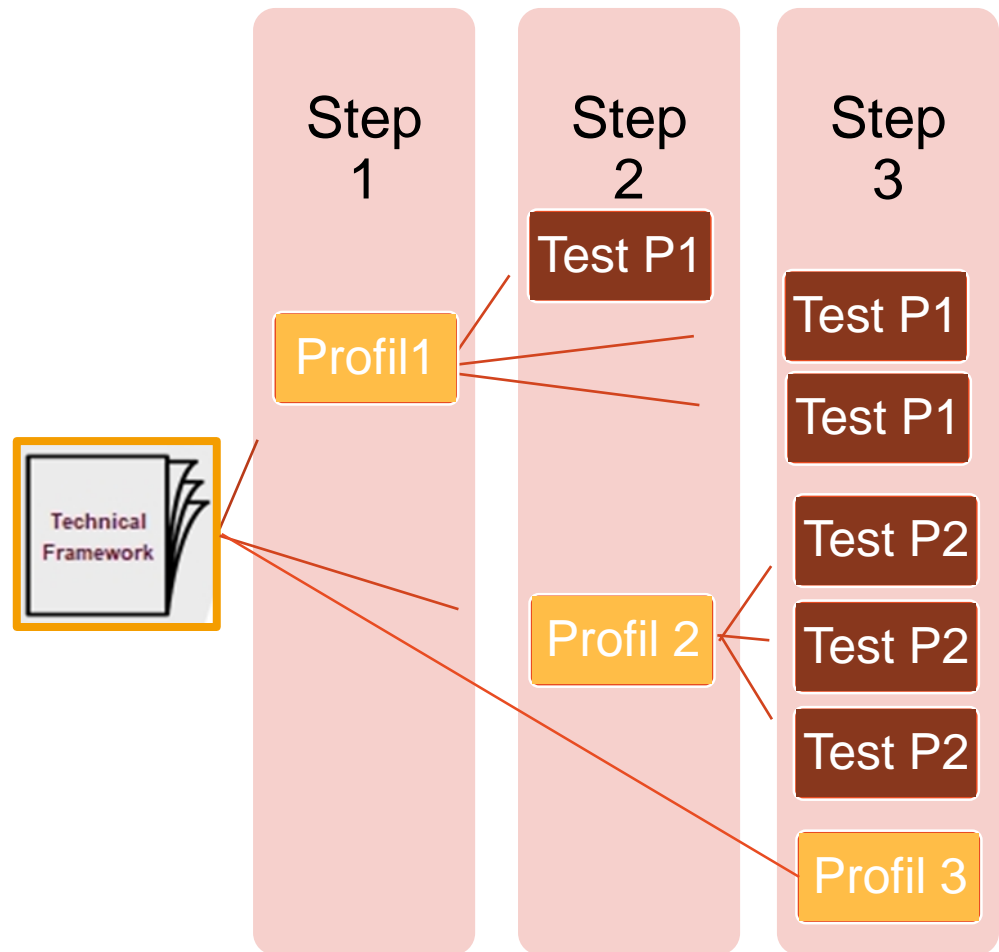
Process: Involvement of relevant stakeholders (public bodies, standardization, manufacturers, users)

Results: Specified digital interfaces

Governance: The interoperability process is a structured, rolling workflow of committees



Step by step to a Technical Framework reduces the complexity to implement a system



TF ... Technical Framework
 Profile ... Profile as part of a TF
 Test P ... Test of a profile

Interoperability is a key factor for the digital transition of ICT-systems

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*„Become part of the
Interoperability Initiative“*

Angela Berger

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