Solution Architecture Template (SAT) for interoperability testing

v1.0.0

Change control

Modification	Details
Version 1.0.0	

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1 INTRODUCTION

This document contains the description for a Solution Architecture Template (SAT) for solutions that support the delivery of cross-border public services that also need to offer to their user communities a means to perform interoperability or conformance testing.

This SAT is based on EIRA© v2.0.0.

The ArchiMate© source model is embedded in this document in the "Archi format" as well as in the "Open Group ArchiMate Model Exchange File Format".

SAT_interoperability_testing_v1_0_0.arch

SAT_interoperability_testing_v1_0_0.xml

1.1 Purpose of this document

Enterprise and Solution architects can use this document when defining the architecture of their solution in order to introduce a platform to support interoperability and conformance testing. This assumes that the solution in question is required to foresee a well-defined means to enable such testing for its user community.

1.2 List of acronyms used in this document

Table 1-1: List of acronyms

Acronym	Definition
ABB	Architecture Building Block
API	Application Programming Interface
EIRA	European Interoperability Reference Architecture
GITB	Global eBusiness Interoperability Testbed
GITB TDL	GITB Test Description Language
GITB TRL	GITB Test Reporting Language
GITB TRR	GITB Test Registry and Repository
SAT	Solution Architecture Template
SBB	Solution Building Block
SOAP	Simple Object Access Protocol
SUT	System Under Test
XML	Extensible Markup Language
WSDL	Web Service Definition Language

2 GOAL, DESCRIPTION AND TARGET AUDIENCE

This chapter describes the ISA² interoperability test bed service as an interoperability testing solution and identifies the target audience for this Solution Architecture Template (SAT).

2.1 Goal

The purpose of this SAT is to define how the ISA² interoperability test bed service can be used in a solution's architecture in order to realise its interoperability or conformance testing needs. The approach taken is holistic by addressing the test bed's legal, organisational, semantic and technical aspects and illustrating how these relate to the solution that it serves. Doing this by means of an SAT allows alignment to the EIRA© and helps establish a common understanding for its potential users over its key building blocks.

The focus of this SAT is *not* to define how a new interoperability testing solution is to be implemented but rather to document how the existing, shared and reusable ISA² interoperability test bed service can be used in a solution's architecture.

2.2 What is the ISA² interoperability test bed service

The ISA² interoperability test bed provides generic testing facilities to initiatives that create interoperability solutions in a cross-border context or linked to European Legislation. It offers:

- A test bed service that can run conformance and interoperability tests.
- The possibility to host reference implementations of specifications and services for clients to test against.
- A test registry and repository to store test artefacts (assertions, test cases, validation schemas etc.) and federate test services (validation services, simulator services etc.).

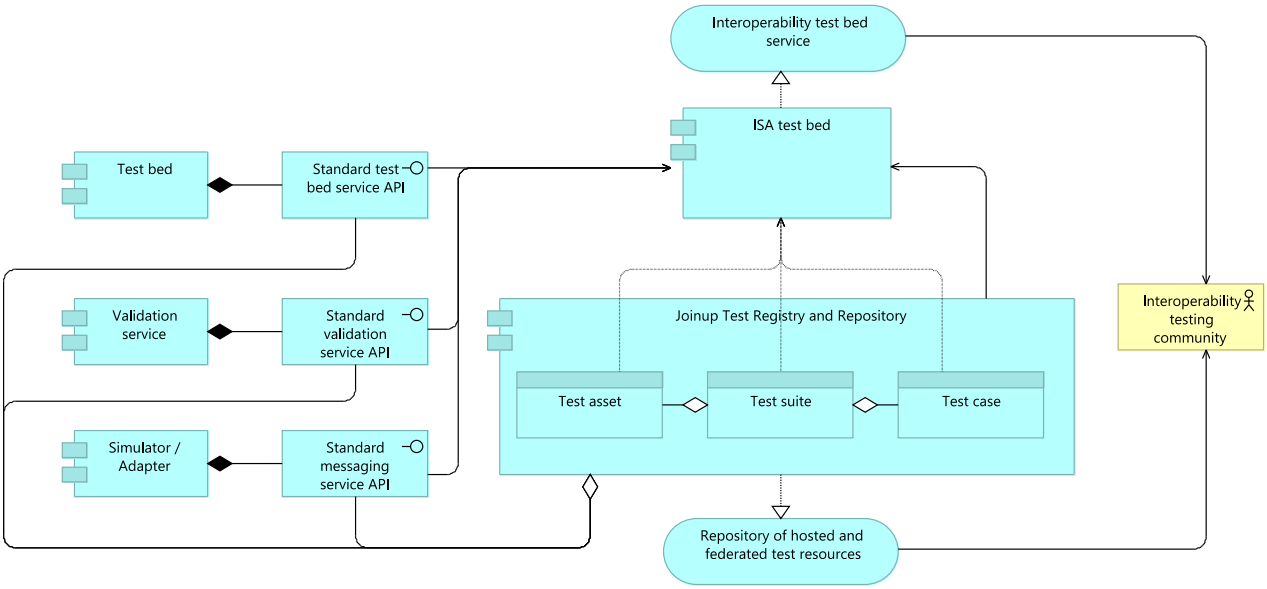


Figure 1: The ISA² interoperability test bed service

The ISA² interoperability test bed is a central, reusable service that can be used both for interoperability and conformance testing, ranging from the verification of complex message

exchanges as complete conversations, to validation of content, received through a variety of communication channels. Tests are visualised through an intuitive web user interface that allows a tester to follow exchanged messages between systems under test (SUTs), simulators and reference implementations, inspect and export their content, and analyse the reports of failed validations. Test progress and reports are also exposed through standardised, machine-readable formats.

The world of test beds, test services, validators and simulators is a fragmented one, with different organisations exposing distinct services per domain, often overlapping in terms of features and purpose. The ISA² interoperability test bed is designed to address this by accepting this fragmentation as a fact and seeking to enable as much as possible the reuse of existing services. This is achieved by means of standardised service APIs used to control the execution of a remote test, validate content, simulate responses, or support diverse communication means. This standardisation support is provided through the concept of service compliance established by the CEN GITB Workshop Agreement[1], which also is the source of the ISA² test bed software.

2.2.1 The GITB test bed software and specifications

The GITB project represents a CEN standardisation initiative funded by the European Commission's DG GROW to provide the specifications for a generic interoperability test bed and their implementation in the form of the GITB test bed software.

The project's purpose is not only to identify what is needed to support testing but also to make test bed elements modular and reusable. This reusability extends the confines of a single test bed, in that testing resources and components can be remotely reused as long as they follow the same specifications. This results in the concept of GITB compliance, which includes (among other types of specification compliance) a set of standard web service APIs for test beds, validation services, processing services and simulators. These compliant web services are furthermore federated in the Test Registry and Repository (TRR)[2], implemented in the European Commission's Joinup platform, as a single point of reference.

[1] CEN GITB WA: http://www.cen.eu/work/areas/ict/ebusiness/pages/ws-gitb.aspx
[2] GITB TRR in Joinup: https://joinup.ec.europa.eu/catalogue/repository/gitb-trr

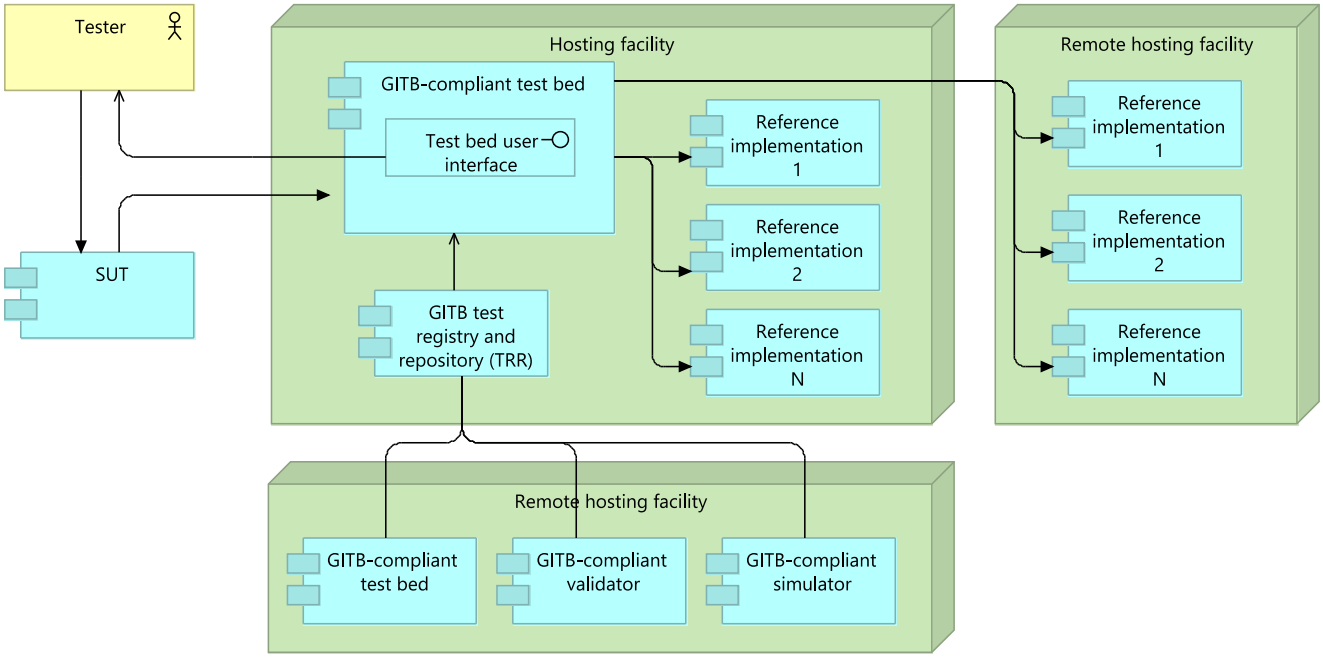


Figure 2: The GITB test bed software used in the ISA² interoperability test bed service

2.3 What is a solution architecture template (SAT)

A Solution Architecture Template (SAT) is a specification extending the EIRA© providing support to solution architects in a specific solution domain. An SAT contains a motivation (principles, requirements), a goal and a description of the supported functionalities, a set of Architecture Building Blocks (ABBs) covering the four views that can be core EIRA© ABBs or domain-specific extensions, and, as appropriate, specific Solution Building Blocks (SBBs) where existing solutions exist that are mandatory or strongly advised. The SAT's views are complemented by a narrative per view that adds context and helps with the model's understanding.

The benefits of a SAT are the following:

- It provides architects with a common approach to cope with a specific interoperability challenge. It also places the focus on the key points you need to consider.
- An architect can create a solution architecture by mapping existing Solution Building Blocks (SBBs) to a SAT, based on the interoperability specifications that are provided. This is done by providing SBBs for the ABBs identified in the SAT.
- When an architect creates a SAT, he/she can define the interoperability specifications for the SAT's ABBs and moreover recommend specific SBBs which produces faster and more interoperable results.
- An SAT can be created within and across the different views of the EIRA©. A SAT can then support architects specialised in different interoperability levels.

2.4 Target audience

This document has the following target audience:

Table 2-1: Target audience for the interoperability testing SAT

Audience	Description
Architects	Enterprise/solution architects that need to foresee a solution for interoperability and/or conformance testing and are considering using the ISA^2 interoperability test bed service.
Project managers of standardisation projects	Projects that produce as their main or supporting outcome a semantic or technical specification often need to offer to their user community an appropriate conformance testing solution. This could be used to facilitate the development of testing artefacts and also the eventual conformance testing of software implementing the specification. The project managers of such projects would stand to benefit by the current SAT by improving their understanding of how the ISA^2 interoperability test bed could fulfil their testing needs.

3 THE ISA² INTEROPERABILITY TEST BED MAPPED TO THE EIRA

This chapter contains for each EIRA© view the corresponding ArchiMate© model and narrative. Next to the SAT's EIRA© ABBs, the ArchiMate© model includes, where applicable, the related specifications and motivation.

The models have been scaled down to fit with the text; they are included in bigger format in the appendix.

3.1 How to use this SAT

An architect that uses this SAT typically wants to perform a gap-analysis between an existing solution and this SAT, or he/she wants to model a new solution and include from the start the ISA² interoperability test bed service as its approach for interoperability and/or conformance testing.

3.1.1 Gap Analysis

Using this SAT for a gap analysis, the architect can map the building blocks of the solution to the ones in this SAT and identify which building blocks are missing. These building blocks can either indicate missing functionality or missing interoperability specifications.

3.1.2 Building a solution

When building a solution the architect is expected to use the four different EIRA© views and provide a solution in the form of SBBs for the ABBs that are indicated. This is done by replacing each ABB with an annotated SBB. The existing SBBs in this SAT should not be removed and replaced, however, the acknowledgement of reusing these building blocks can be done by removing the ABBs which they specialise.

The result will be a solution architecture that will contain only SBBs: all ABBs should have been removed (in the case this SAT already suggests SBBs to realise them) or replaced by SBBs (solutions that implement the ABB).

The SAT is a document describing the needed ABBs for a desired solution. This should not be taken as restrictive but as advisory. When an ABB is present for which there is no implementation foreseen in the form of a SBB, it is *strongly* recommended, but not mandatory, to take this ABB into consideration in the final solution.

3.2 High-level viewpoint

The High-level viewpoint contains the focal EIRA© ABBs and SBBs of each view. In the current SAT it is provided as a management summary that presents an overview of the elements needed to use the ISA² test bed service in a target solution. Details here are provided in brief with further elaboration in the chapters covering the specific views.

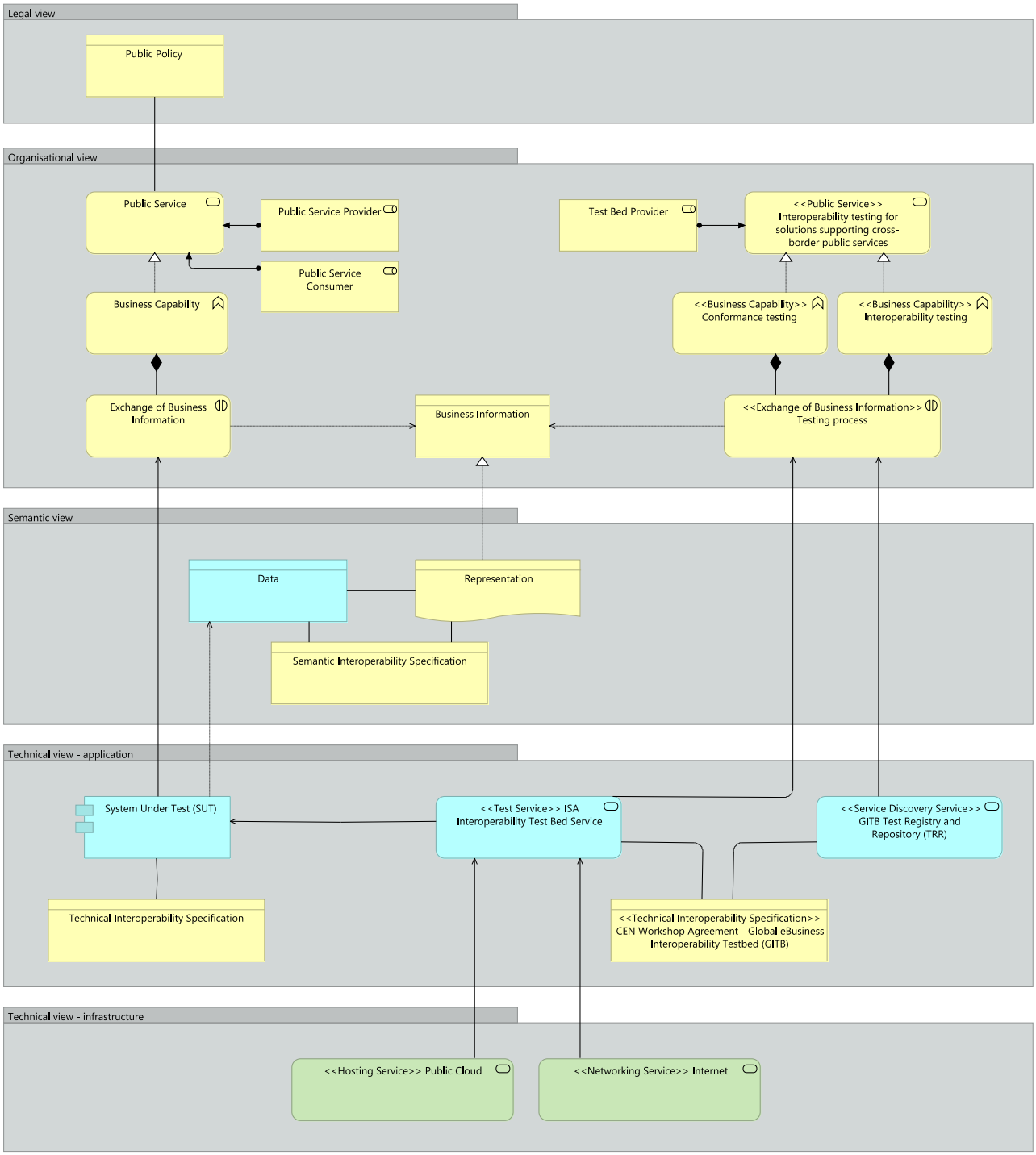


Figure 3: High-level viewpoint

The target solution for which this SAT is being used serves a public policy implemented by a public service with a well-defined provider and consumer. This public service is realised by one or more

business capabilities that exchange business information, which is the same business information that is used in testing processes. These testing processes, pertinent to interoperability and conformance testing, are offered as a public service to the target solution's user community. Regarding the business information used by the target solution and during testing, this is realised by data with a given representation that follow a semantic interoperability specification which is the focus of the testing activity.

From a technical perspective, the key building blocks offered to the target solution are the ISA^2 interoperability test bed service that exposes a web-accessible common testing platform to manage and drive the testing process, and the GITB Test Registry and Repository (TRR) through the Commission's Joinup platform, for the discovery, sharing and reuse of test resources. The test bed service is the one that is used in the target solution to test the conformance of systems under test to a given technical specification. Finally, from an infrastructure perspective, the test bed service is hosted on the public cloud and is accessible over the internet.

3.3 Legal View

The Legal view consists of the following sub-set of EIRA© ABBs as well as certain defined SBBs:

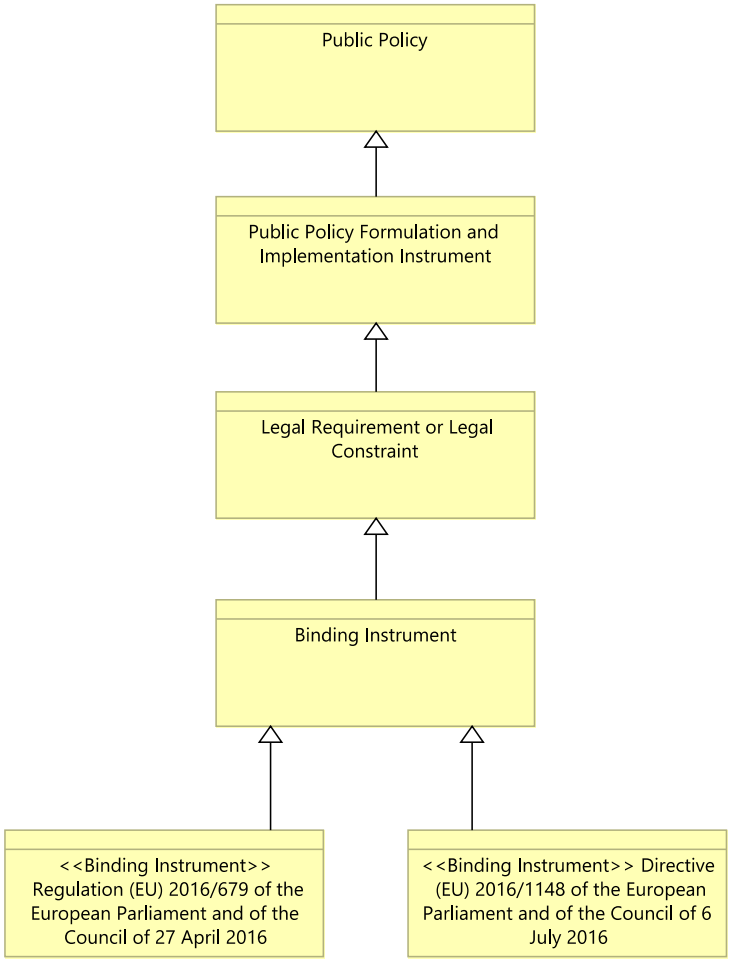


Figure 4: Legal view

The ISA^2 interoperability test bed service is a cross-domain service that is policy agnostic. It neither implements any specific legal instrument, nor is it mentioned or described itself in a legal text. As such, the building blocks of the Legal view shall be those related to the solution that is making use of the test bed service for its interoperability and conformance testing needs.

An important point to highlight however relates to the target solution's information security and data privacy needs. The test bed service itself offers very relaxed security considering that its goal is to be as flexible as possible allowing connections from diverse systems under test that shall exchange different types of content over non-predetermined message exchange protocols as part of the overall testing process. With relation to the exchanged test data, this is expected to be non-sensitive in nature and is recorded in order to facilitate subsequent test reporting. The target solution needs to thus take the required measures to curate appropriate test data rather than, e.g. use potentially sensitive extracts from production environments.

To emphasise this point, this SAT includes two SBBs for the Legal view:

- **Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016** concerning measures for a high common level of security of network and information systems across the Union.

- **Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016** on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

These need to be considered by the target solution's architect in order to evaluate whether it has such a legal basis regarding security and data protection, taking note that the test bed service itself has not. If the foreseen testing processes require high security (e.g. connectivity constraints that cannot be met by the test bed service) or data protection (e.g. sensitive data cannot be excluded from tests) an alternate option would be to not use the shared test bed service but rather install and manage the test bed software locally. This option is further covered in chapter 3.6, "Technical View – Application".

Aside from these considerations, the Legal view ABBs foreseen by this SAT represent the key ABBs that the target solution will need to include and specify in accordance with its policy domain and legal foundation.

3.4 Organisational View

The Organisational view consists of the following sub-set of EIRA© ABBs as well as certain defined SBBs:

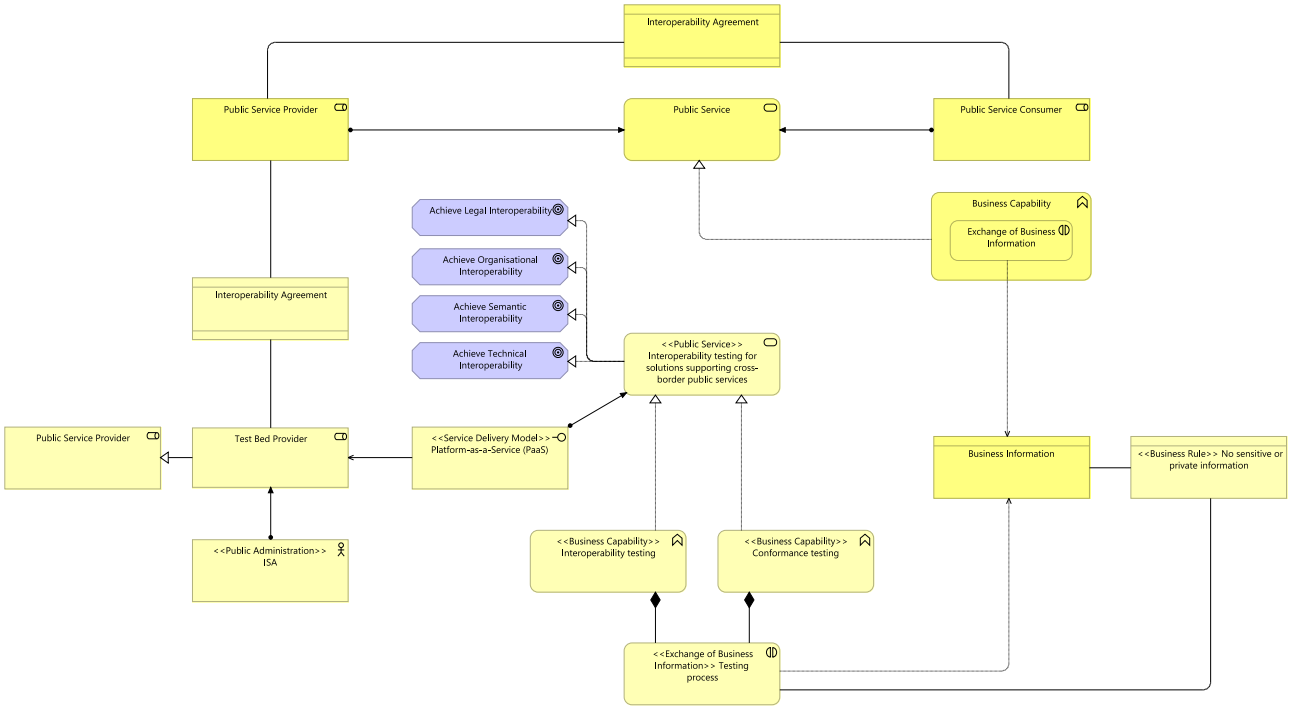


Figure 5: Organisational view

The SAT highlights a set of ABBs on the Organisational view (presented with bright yellow in the top part of the view) that relate to the target solution. This solution in short, is expected to offer a public service that is provided by a public service provider and consumed by public service consumer, whose relation is ideally formalised using an interoperability agreement. The public service itself is realised by one or more business capabilities that include an exchange of business information. This can be considered as the core organisation-level structure that any solution is expected to have in accordance to the EIRA©.

The additional ABBs and SBBs represent those related specifically to the use of the ISA[2] interoperability test bed service. The public service that is enabled by the test bed is the interoperability testing for solutions that support cross-border public services. This is considered as a public service and not an internal technical detail considering that a well-defined testing platform is often expected by a solution's user community as part of the target solution's service offering. Typical examples would be cases where the target solution defines a semantic or technical specification that needs to be implemented by third parties to establish peer to peer connectivity or connection to a central hub. This could even extend to requiring conformance certification as a tendering prerequisite where a qualification process of third party software is involved. Definition and use of such a test-focused service serves the goals of achieving interoperability on all level as reflected in the SAT using the EIRA©'s motivation elements.

The interoperability testing public service is realised through two business capabilities: conformance testing (i.e. a solution tests that it has correctly implemented a specification) and interoperability testing (i.e. two conformant solutions can interact as expected). Both these business capabilities depend upon the exchange of information as part of a testing process that makes use of the same business information that the target solution uses. As previously

mentioned, it is important to highlight that the business information used for testing should not include private or sensitive information, a requirement that is reflected in the SAT as a mandatory business rule in relation to the testing process.

With regards to the testing service, this is offered using a Platform-as-a-Service (PaaS) delivery model, meaning that the target solution is expected to simply use the shared test bed service rather than build it or run it itself. The test bed service is provided by DIGIT's ISA^2 Unit with which the target solution's service provider needs to define an interoperability agreement. Regarding this, there is no fixed template available, considering that the operational model selected could vary significantly. This agreement serves primarily to define the split of responsibilities between the ISA^2 test bed team and the target solution's service provider. Points that should be covered in this include:

- The responsibility in terms of implementing test scenarios and required test components (i.e. the domain-specific test artefacts), including expected support effort. If this is the responsibility of the service provider, support would be offered by ISA^2 in relation to test bed specifics. If undertaken by ISA^2, support would be offered by the service provider with respect to the target solution's policy domain and business context.
- The responsibility of test bed administrative tasks such as defining and managing users and test suites.
- Definition of help desk responsibilities to assist users of the test bed by e.g. establishing a first-level support by the service provider for issues relative to the solution or specification itself, with second-level support by ISA^2 for issues that are test bed specific. This becomes additionally important if a separate test bed instance is setup for the target solution in which case ISA^2 does not have a direct operational role.
- Service availability requirements for the test bed.
- Training, support and consulting effort by ISA^2 test bed experts provided to staff of the target solution's service provider.
- Potential use of the test bed's hosting infrastructure to host test components related to the target solution.

3.5 Semantic View

The Semantic view consists of the following sub-set of EIRA© ABBs:

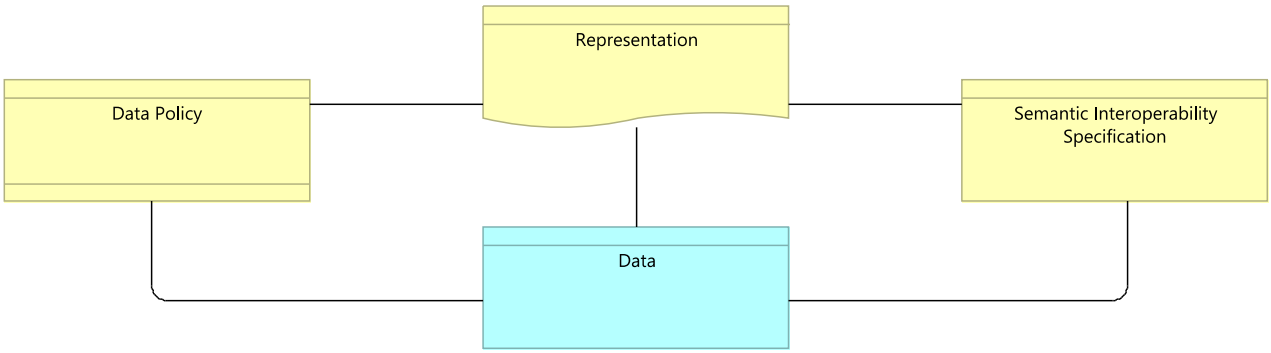


Figure 6: Semantic view

The ISA^2 test bed service is itself not tied to specific data or representations. These are expected to be defined as part of the target solution for which the data, representation and data policy ABBs are defined in this SAT, as the focal ABBs in the EIRA©'s Semantic view. However it is important to highlight that, if the target solution requires an interoperability or conformance testing approach, there is forcibly one or more semantic or technical interoperability specifications that it defines or reuses which are key in its overall business information exchange. This is precisely the focus of the test bed and what will be supported through domain-specific test scenarios and test components. Clearly modelling these semantic and/or technical interoperability specifications is of critical importance, and is the reason why the semantic interoperability specification ABB is included in this SAT. Technical interoperability specifications are addressed in the Technical – Application view that is the focus of the next chapter.

3.6 Technical View – Application

The Technical application view consists of the following sub-set of EIRA© ABBs as well as certain defined SBBs:

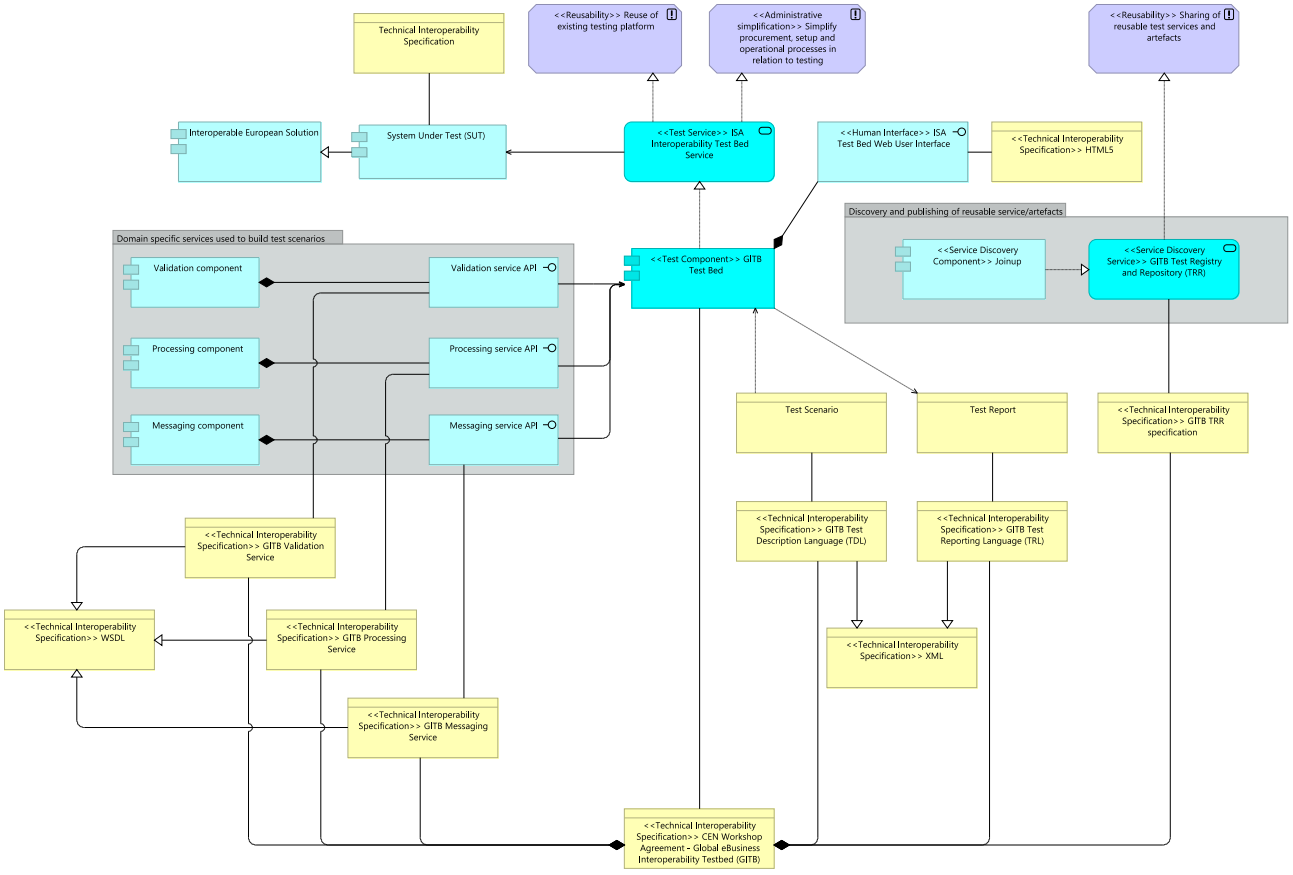


Figure 7: Technical view - Application

A set of SBBs have been highlighted in this view (in bright blue) to indicate the main reusable SBBs in relation to conformance and interoperability testing. The key reusable SBB is the ISA[2] test bed service that is modelled in the SAT as a test service. This represents the shared online platform[3] that is accessed by the target solution's user community as their testing solution, thus serving the principles of reusability and administrative simplification (modelled using the EIRA©'s motivation elements). The target solution also defines the technical specification(s) that systems under test (SUTs) need to conform to and for which the discussed testing services are needed.

The test bed service is realised by means of the GITB test bed software that itself is reusable and can be installed separately as a standalone test component through an easy and well documented process[4]. Such a separate installation could be interesting in cases where complete control over the test bed's operation is desired or in cases where security and data privacy requirements apply also to the testing process, thus forcing the test platform to not be publicly accessible or shared with other user communities. The GITB test bed is accessible to users through a web-based user

[3] The online ISA[2] test bed service is available at: http://isaitb.northeurope.cloudapp.azure.com:9000/#/

[4] The installation guide for the GITB test bed software is part of the test bed handbook documentation, available at: https://joinup.ec.europa.eu/asset/itb/asset_release/introduction-test-bed

interface for the purpose of managing test suites, triggering test sessions and inspecting their reports.

A further key SBB that has been highlighted in this view is the GITB Test Registry and Repository (TRR), implemented in the Commission's Joinup platform[5], which acts as a service discovery service for test artefacts and services. The TRR can host test artefacts such as test cases but can also federate available test services, running from the test bed's hosting infrastructure or from any other publicly available environment, which can be used by the interoperability testing community. These services can be, but are not limited to, GITB-compliant test services to perform validation, processing or messaging simulation as described in chapter 2.2.1, "The GITB test bed software and specifications". The TRR is of interest for the target solution's architecture to first help in discovering potentially reusable test resources, but also as a platform through which implemented test resources can be shared for reuse.

The test bed service and underlying software act as a test-focused orchestration platform that remains generic in nature. In order to implement the domain-specific testing needs for the target solution, two elements are required:

- A set of test scenarios that capture the different test cases that systems under test are expected to test against.
- A set of services, implemented outside the test bed itself, to carry out complex domain-specific tasks required by the test scenarios.

The test scenarios are authored in the GITB Test Description Language (GITB TDL) which is an XML-based syntax to express the key testing steps. Such steps could be the submission of content from the system under test to the test bed, its validation, a processing step to transform it, and finally the sending of an appropriate response. Such steps are represented by GITB TDL constructs for which a controlled vocabulary is also defined[6] to facilitate the test cases' documentation and potential reuse. Test reports produced by the test bed follow the GITB Test Reporting Language (GITB TRL), also a XML-based syntax, to capture the outcome of test sessions.

Where complex domain-specific processing is required, a GITB TDL test case may call upon separate GITB-compliant services. Such services are SOAP web services that can be remote or hosted on the test bed's infrastructure and are used for the following purposes:

- **Validation:** This is the most common case whereby a validation service can be used to validate arbitrary domain-specific content. A common example would be a service to validate XML-based content that uses a set of XML Schema and Schematron validation artefacts.
- **Processing:** A processing service can be used to transform input for subsequent use in the test case. An example could be a service to extract the contents from a received archive for further processing.
- **Messaging:** This is the most complex case whereby a messaging service is used to allow the test bed to send and receive messages by means of an arbitrary communication protocol that it does not natively support. An example would be the need to send and receive content through emails, which can be driven using such a service, managed by the test bed via SOAP web service calls.

[5] The TRR available through Joinup: https://joinup.ec.europa.eu/catalogue/repository/gitb-trr
[6] The GITB TDL controlled vocabulary: http://data.europa.eu/itw

The APIs for these services are specified as part of the GITB specification which defines the WSDLs for each service as well as the XML Schemas for the exchanged messages. These WSDLs, the specifications for the GITB TDL, and GITB TRL syntaxes, as well as additional specifications and supporting documentation are part of the GITB CEN Workshop Agreement specification.

3.7 Technical View – Infrastructure

The Technical infrastructure view consists of the following SBBs:

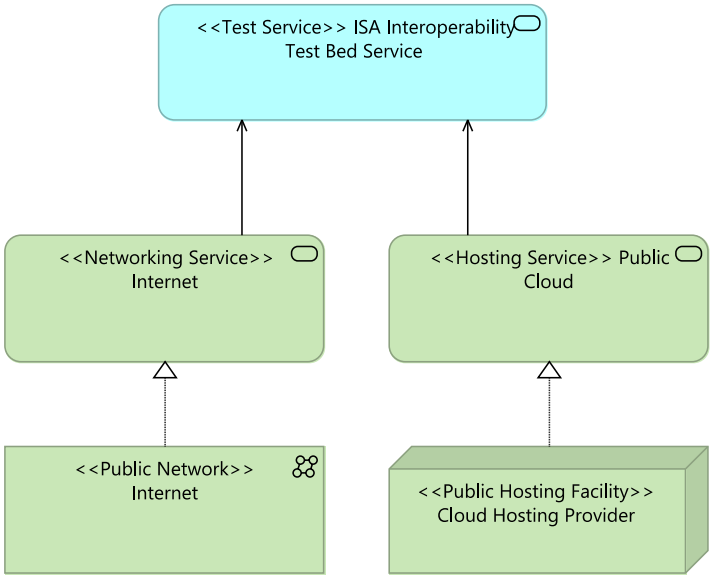


Figure 8: Technical view - Infrastructure

The information on this view is limited considering that this should reflect the infrastructure of the target solution and not the test bed service. This is more so the case considering that the test bed does not offer any Digital Service Infrastructure (DSI) components that would be additionally leveraged by the target solution.

An important point to highlight however with respect to the test bed is that it is hosted on the public cloud and specifically on a public cloud hosting provider engaged through DIGIT's Virtual Cloud Task Force. Access to the service is over the internet and open to all. The significance of these points is twofold:

- The target solution's user community can access its testing platform over the internet without need for special configurations or access to restricted networks.
- Any test-related components that are to be implemented for the target solution can make use of the test bed's hosting infrastructure. This could be an interesting option in case the target solution's provider faces complexities in procuring additional hosting infrastructure purely for testing purposes. Note that if such a hosting arrangement is to be made, this would be an item to specify in the interoperability agreement established between the target solution's provider and ISA[2] as described in chapter 3.4, "Organisational View".

4 REFERENCES

- European Interoperability Reference Architecture (EIRA©)

  https://joinup.ec.europa.eu/asset/eia/
- European Interoperability Framework (EIF)

  http://ec.europa.eu/isa/documents/isa_annex_ii_eif_en.pdf
- ArchiMate©

  http://www.opengroup.org/subjectareas/enterprise/archimate
- Archi©

  http://www.archimatetool.com/
- ISA^2 test bed

  https://joinup.ec.europa.eu/asset/itb/
- Online ISA^2 test bed instance

  http://isaitb.northeurope.cloudapp.azure.com:9000/
- GITB Test Registry and Repository (TRR)

  https://joinup.ec.europa.eu/catalogue/repository/gitb-trr

4.1 Legislative references

- Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union

  http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.194.01.0001.01.ENG
- Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

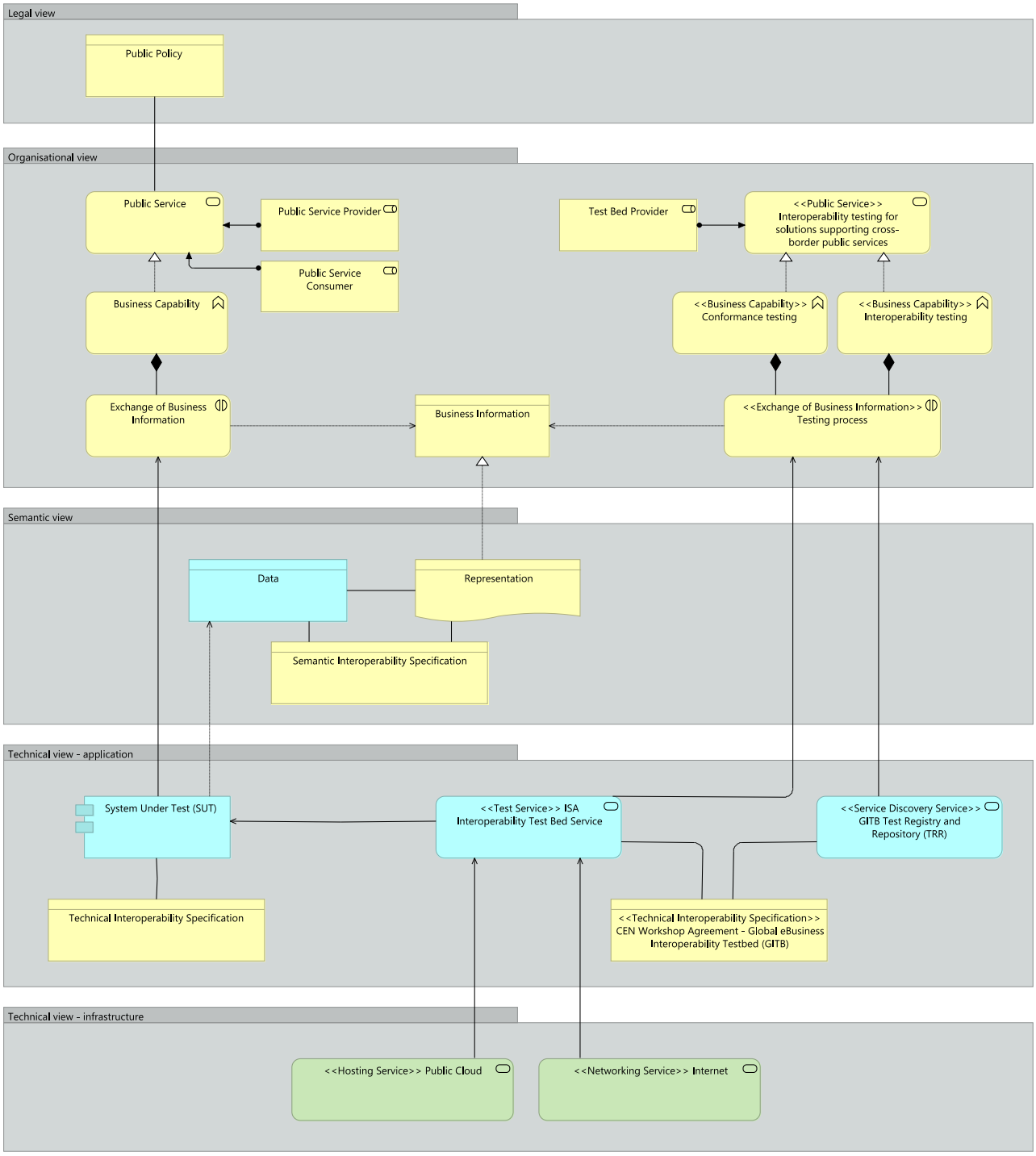
  http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32016R0679

4.2 Technical references

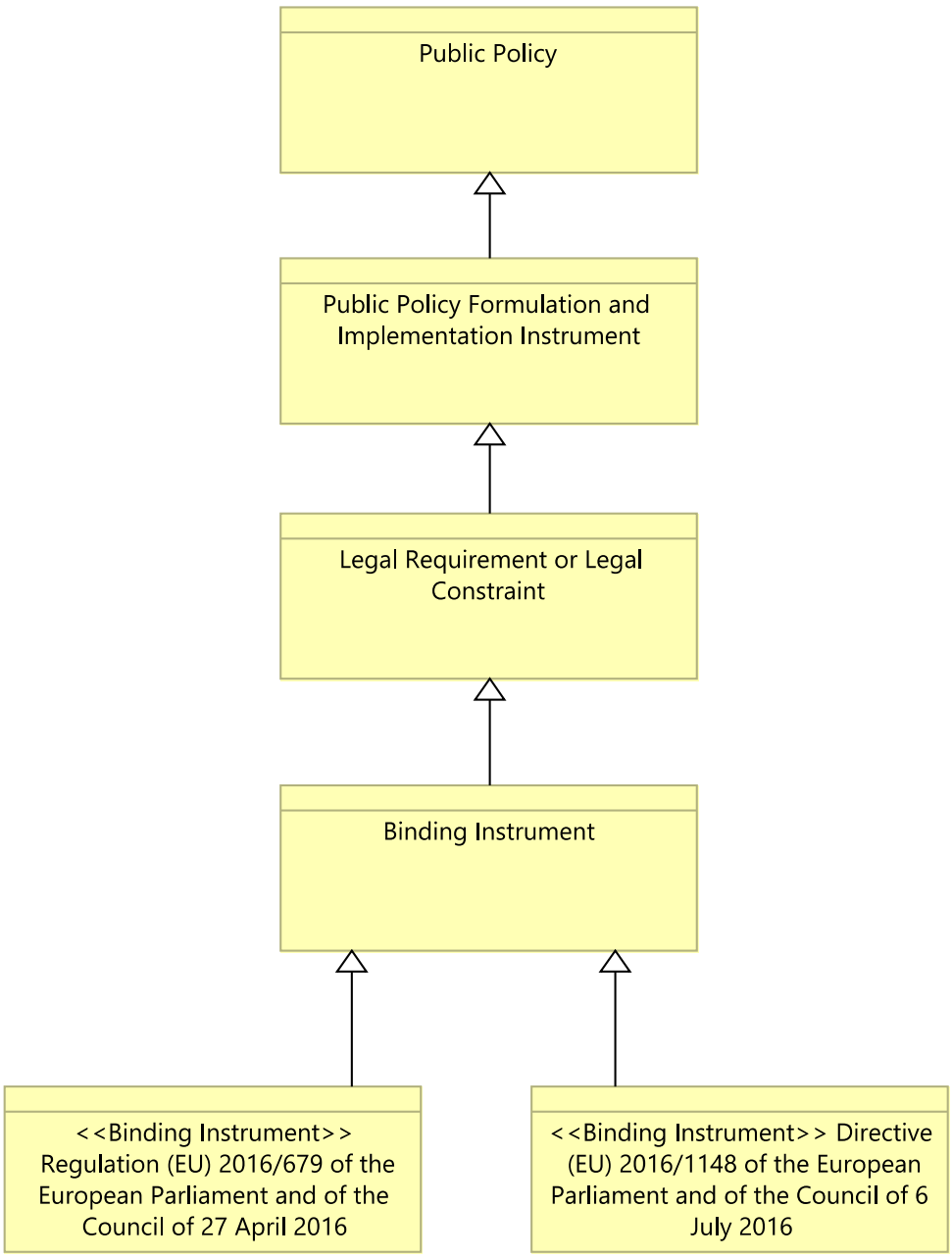
- CEN Workshop Agreement - Global eBusiness Interoperability Testbed (GITB)

  http://www.cen.eu/work/areas/ict/ebusiness/pages/ws-gitb.aspx

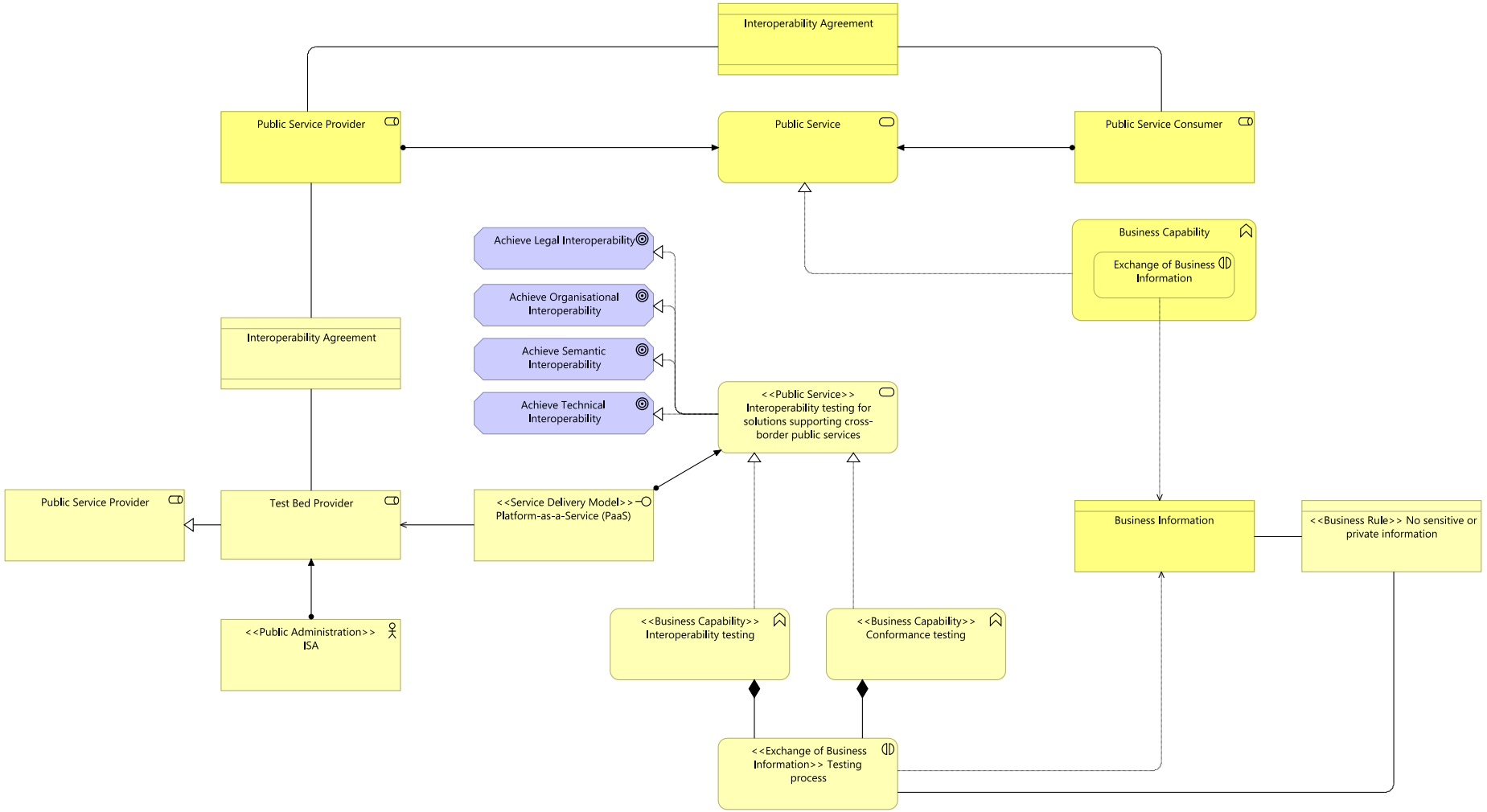
APPENDIX: HIGH-LEVEL OVERVIEW



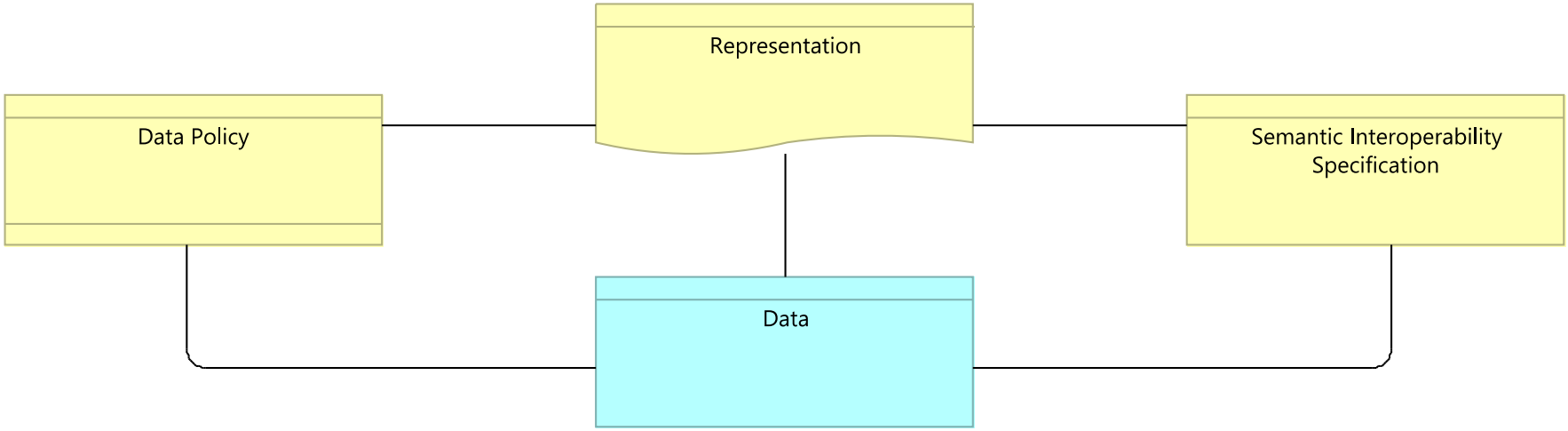
APPENDIX: LEGAL VIEW



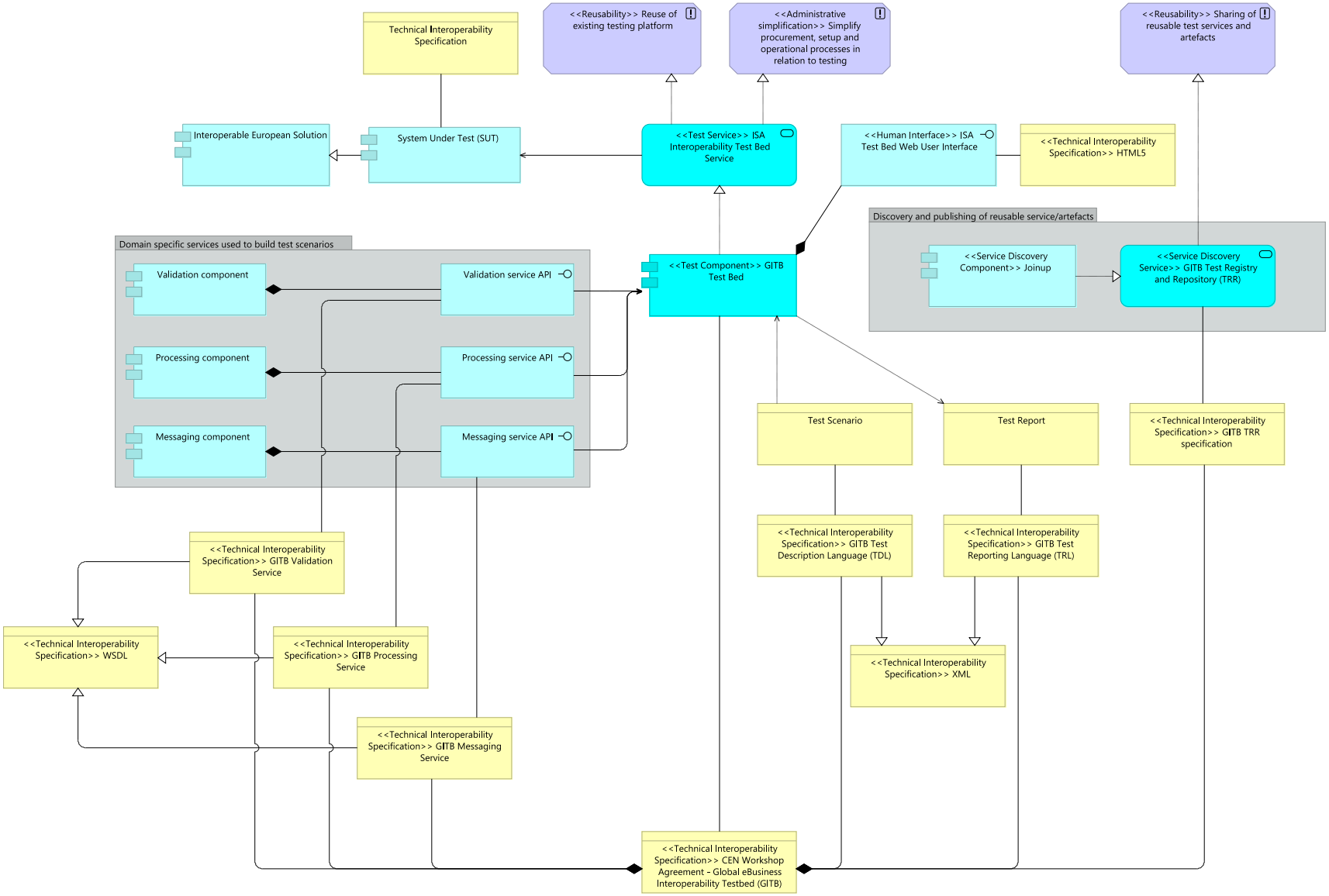
APPENDIX: ORGANISATIONAL VIEW



APPENDIX: SEMANTIC VIEW



APPENDIX: TECHNICAL VIEW – APPLICATION



APPENDIX: TECHNICAL VIEW – INFRASTRUCTURE