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The IDS Reference Testbed
Key in Development and Certification
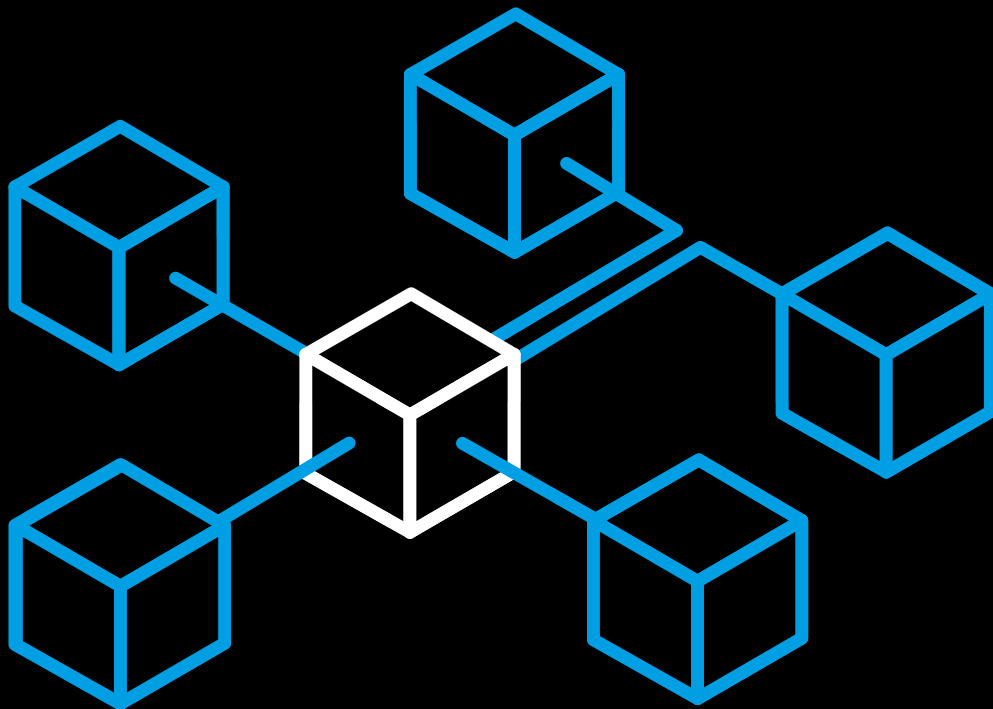
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1. The IDS Reference Testbed: key in the IDS adoption strategy

The work of the IDSA is pivotal in developing and deploying the concepts, architecture and components for realizing the European ambition of a federation of interoperable data spaces as expressed in the European Data Strategy [1] and being elaborated in various European initiatives such as the OPEN DEI initiative [2] and the Data Space Business Alliance (DSBA) initiative [3]. In the latter, the IDSA collaborates with the Gaia-X European Association for Data and Cloud AISBL (GAIA-X), the Big Data Value Association (BDVA), FIWARE Foundation, towards a common, aligned, coherent and standardized reference architecture for European data spaces.

The IDS Reference Testbed has a major role to fulfil in paving the way towards the common reference architecture for European data spaces and in realizing the IDSA strategy in striving for large scale adoption thereof.

The goals of this position paper on the IDS Reference Testbed are threefold:

1. to **describe the role and value add by the IDS Reference Testbed**, both for the development of IDS components by providing a testing environment and for the certification process of IDS-compliant components by providing an assessment environment;

2. to **describe the governance for the IDS Reference Testbed** encompassing both the IDS Reference Testbed development process to ensure completeness, adequateness and continuity in the capabilities it supports, and the IDS Reference Testbed deployment process to ensure optimal adoption and usage by the various IDS stakeholders;

3. to **help users of the IDS Reference Testbed to get started** by providing guidance on how to get started with the IDS Reference Testbed.

This position paper builds and extends upon the work done by the IDSA on the IDSA Rule Book [4].

The following chapters in this IDSA position paper subsequently address a short description of the IDS Reference Testbed (chapter 2), the intended usage scenarios (chapter 3) and its governance model, with stakeholders and their roles and responsibilities in development and deployment (chapter 4). The final chapter 5 describes how to get started with the IDS Reference Testbed.

2. Description of the IDS Reference Testbed

To oversee and guide the vast (open source) community, it is important to have a golden standard for IDS components. The IDS Reference Testbed provides a reference implementation for IDS components, which can be used for compliance and integration testing of new components and assessing (and explain) how IDS data spaces work.

The IDS Reference Testbed consists of a set-up with open-source IDS components complying to the IDS specifications for establishing connections and communication. The initial basic version of the testbed (as released in December 2021) consists of a Certificate Authority (CA), a Dynamic Attribute Provisioning Service (DAPS), a Meta Data Broker and two Dataspace Connectors as depicted in Figure 1. Additional components will be integrated in the subsequent versions of the testbed.
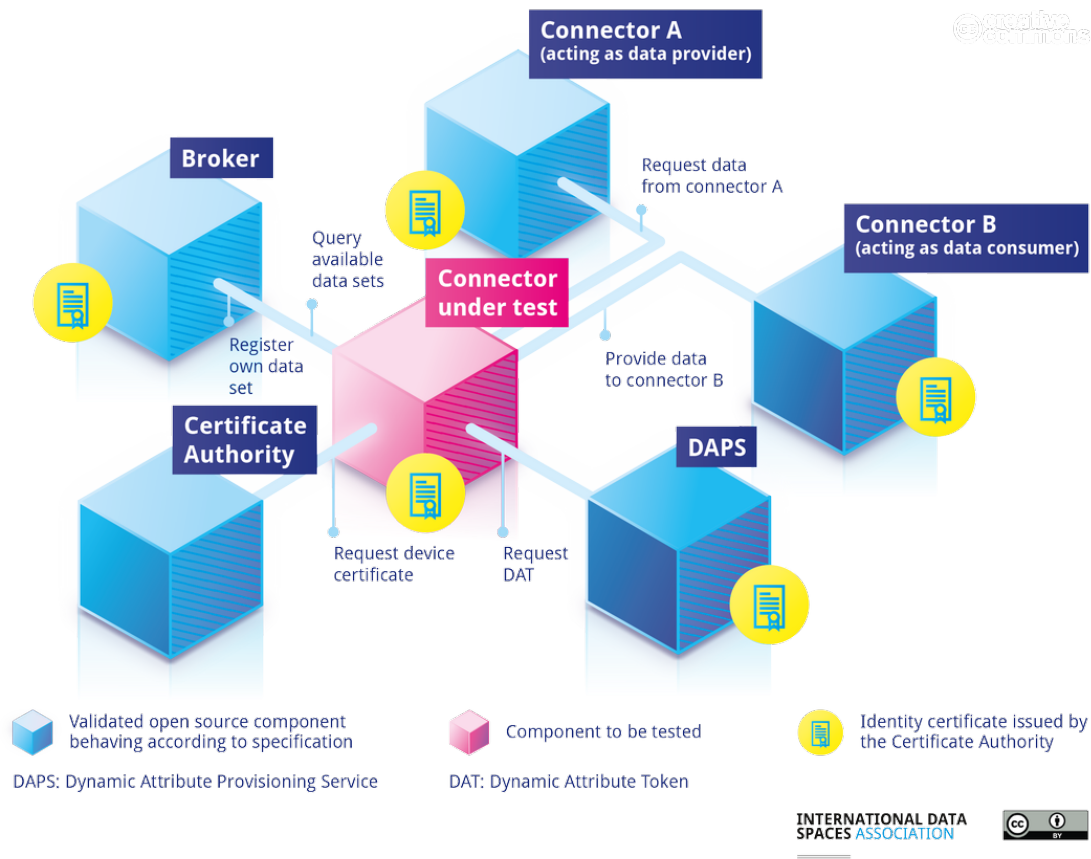
Figure 1: Overview components in testbed (initial basic version)

Moreover, an automated test suite is included for testing a data connector on criteria for interoperability and compliance to the IDS specifications. For testing on those certification criteria (as it requires configuration of the IDS Reference Testbed according to the data connector under test), a questionnaire tool will become available that guides through those aspects.

3.   Usage scenarios for the IDS Reference Testbed

Three main usage scenarios for the IDS Reference Testbed are distinguished and described in the following sections: the IDS Reference Testbed to support the development of IDS components, to support deployment scenarios and to support the IDS certification process.

3.1.   The IDS Reference Testbed to support the development of IDS components

The IDS Reference Testbed is an environment that supports the development of IDS components. As such, the IDS Reference Testbed supports both component behaviour testing of individual IDS components and for interoperability testing of a set of IDS components in conjunction, jointly constituting an IDS data space instance.

The types of development testing that are foreseen for the IDS components with the IDS Reference Testbed are component compliance, interoperability and integration testing:

- For compliance and interoperability testing of individual IDS components during development, a local version of the IDS Reference Testbed can be instantiated. This may for instance be done as part of a Continuous Integration / Continuous Development (CI/CD) process.

- Integration testing can be done against the overarching set of IDS components as depicted in Figure 1, i.e. with Dataspace Connectors, DAPS, CA and a Metadata Broker.

3.2.   The IDS Reference Testbed to support deployment scenarios

The IDS Reference Testbed can serve as a starting point for the creation of data space deployment scenarios, including a Minimal Viable Data Space offering. It has the functionality for deploying the basic data space capabilities, for developing its data services and business flows and for doing data space ecosystem analysis.

As such, the IDS Reference Testbed may be used for new data space deployments, providing the basis for system development and assessment together with data space partners, e.g. on integrating and interacting with the ecosystem of data space partners providing various IDS components (e.g. data connectors, CA, DAPS and Metadata Broker), and on the devel-opment of data apps and services.

3.3.   The IDS Reference Testbed to support the IDS certification process

For organizations to feel comfortable sharing data by means of IDS data spaces, they must be able to trust their implementation. IDS certification helps to bridge the trust gap. IDS-certification means that an organization meets specific security criteria agreed within the International Data Spaces Association (IDSA) with respect to a particular component or operational environment. Components and participants of data spaces that work according to

these standards can demonstrate this with an IDS certificate, assuring compliance with the certification scheme as developed by the IDSA Working Group Certification.

A data connector, for example, is based on a complex software stack. Developers must integrate the functional requirements of their infrastructure and different kinds of services allowing them to process data according to the expectations. While many requirements are based on best practices, their correct implementation needs to be ensured. Moreover, interoperability with other IDS components is crucial. Certification ensures that all components of an IDS ecosystem can interact with each other. In other words: it makes sure that IDS is fully interoperable.

Many organizations will not perform these assessments themselves. That is why transparent processes are so valuable. They enable certification by independent third parties and help reduce the time and effort required for an organization to prove its own trustworthiness. In this way, they reduce the transaction costs associated with accessing, using, and sharing data.

The IDS Reference Testbed can serve to improve efficiency in preparing certification, specifically at the component level. The certification of the IDS components is executed using the IDS Reference Testbed, the same testbed which is publicly available for organizations to test their implementations. This ensures that the technical certification of the IDS components is transparent and that most issues can be resolved by the companies before the actual certification process. Therefore, reducing costs and efforts.

Finally, existing (open-source) implementation of the IDS components can be integrated into the testbed to further help the companies to get familiar with the IDS requirements. In certain cases, companies might use one of the available implementations as basis for their solution. If these (open-source) implementations are already integrated with the IDS Reference Testbed and already certified, this significantly reduces the efforts required in certification of the complete solution.

4.   Governance of the IDS Reference Testbed

For the three main usage scenarios for the IDS Reference Testbed as described in the previous chapter (i.e. to support the development of IDS components, to support deployment scenarios and to support the IDS certification process) various IDS stakeholders can fulfil a specific role with respect to the IDS Reference Testbed and provide them with business opportunities.

4.1.   Roles for the IDS Reference Testbed

Table 1 provides an overview of the activities per role for the IDS Reference Testbed in both the usage scenarios for the IDS component development, the IDS-deployment, and the IDS certification, distinguishing between the roles of user, provider and maintainers of the IDS Reference Testbed, respectively.

Table 1: Activities per role in the various usage scenario .		
IDS development	**IDS deployment**	**IDS certification**
IDS Reference Testbed user		
Develops individual IDS components, including interoperability with the components and the test-scenarios of the IDS Reference Testbed.	Assesses a set of IDS components in conjunction to evaluate their integration within a joint IDS data space instance.	Does a self-assessment of individual IDS components on compliance with the associated IDS component certification criteria and the test-scenarios of the IDS Reference Testbed
IDS Reference Testbed provider		
Provides an up-to-data instance of the IDS Reference Testbed as service to IDS Reference Testbed users for IDS component testing.	Provides an up-to-data instance of the IDS Reference Testbed as service to IDS Reference Testbed users for assessing a set of IDS components in conjunction as (minimum viable) joint IDS data space instance.	Provides an up-to-data instance of the IDS Reference Testbed as service to IDS Reference Testbed users for self-assessment of IDS components on compliance with the IDS certification criteria.
Provides support to IDS Reference Testbed users on using the IDS Reference Testbed.		
IDS Reference Testbed maintainer		
Provides regular releases of the IDS Reference Testbed and testing scenarios to IDS Reference Testbed providers for testing individual IDS components.	Provides regular releases of the IDS Reference Testbed and testing scenarios to IDS Reference Testbed providers for assessing and deploying a set of IDS components in conjunction as (minimum viable) joint IDS data space instance.	Provides regular releases of the IDS Reference Testbed and certification self-assessment scenarios to IDS Reference Testbed providers for self-assessment of IDS components on compliance with the IDS certification criteria.
Provides support to IDS Reference Testbed providers on deploying the IDS Reference Testbed.		

Moreover, each of the roles of user, provider and maintainers of the IDS Reference Testbed has the possibility to report on IDS Reference Testbed failures and options for (functional, technical) improvement.

4.2. Stakeholders and opportunities

Successful development and deployment of the IDS Reference Testbed requires involvement of the various IDS stakeholders as identified in [4]. Each of the stakeholders has a different

role to fulfil with respect to the IDS Reference Testbed, providing them with associated business opportunities.

Data Space Instance

A Data Space Instance (DS) provides and governs a specific data space.

For data space instances it is of main importance to be IDS-compliant and interoperable, both internally and with other data spaces. As such, data space instances can use the IDS Reference Testbed in development and certification of its IDS components and the data space system and prepare for certification by means of self-assessment against the IDS Reference Testbed.

The initial business opportunities for data space instances are mainly on internal interoperability of the IDS components within the data space instance, as interoperability between multiple data spaces is still in its infancy, with associated interoperability architectures and interfaces requiring further standardization, although these may also be developed and become available on short notice.

International Data Spaces Association

The International Data Spaces Association (IDSA) is the chair of the IDS initiative and organizing body for the IDSA community, guardian for the IDS standards and leader / coordinator in the development and deployment of IDS over the various stakeholders.

The IDSA is responsible for the development and deployment of the IDS Reference Architecture Model. In order to ensure large-scale adoption, to ensure the availability and easy-of-use of IDS components and to promote and enable the certification thereof, the IDSA is the main driving force on developing, managing, maintaining and deploying the IDS Reference Testbed.

International Data Spaces Certification Body (IDS-CB)

The International Data Spaces Certification Body (IDS-CB) manages and monitors the certification process and is in charge of certifying Evaluation Facilities.

To ensure compliance and high quality of IDS components, the IDS-CB certifies, promotes and steers the development of the IDS Reference Testbed as a common standard for certification of IDS components across all Evaluation Facilities.

Service Provider

The Service Providers (SP) integrate IDS components as part of their product offering for End-Users and communities.

The Service Providers aim to provide services which are compliant with the IDS-specifications. As such, they are users of the IDS Reference Testbed for both supporting the development process and the certification process for IDS components as described in chapter 3.

The Service Providers need certification for their commercial product offerings as proof of quality and interoperability. The IDS Reference Testbed helps them to ensure that their software is already in line or 'pre-certified' according to the IDS certification criteria and accelerates the certification process.

Evaluation Facility

An Evaluation Facility (EF) evaluates and certifies IDS components and operational environments.

The IDS Reference Testbed provides the Evaluation Facilities an independent and generic way to evaluate third-party IDS components on compliance with the IDS certification criteria.

The Evaluation Facilities are therefore also financially benefitting from the IDS Reference Testbed, since they build certification processes around this testbed.

Contributor

A Contributor (C) contributes to the development of IDS components, e.g. RTOs, Service Providers or (data space) communities.

Contributors want to disseminate their technical knowledge and solutions to stimulate adoption. The IDS Reference Testbed helps them in both the development process and the certification process as described in chapter 3.

National IDS Hub

A National IDS Hub shares knowledge and expertise about IDS in specific countries.

The IDS Hubs can use the IDS Reference Testbed to let new organizations get acquainted with the fundamentals of IDS data spaces and hands-on experience with the IDS components.

Implementation partner

Implementation partners are experts on different fields (IDS Connectors, project management for innovation projects, etc.) that support supply and demand side in making their use case a success

Implementation partners can support with the implementation of the IDS Reference Testbed and of deployment scenarios.

It may be observed that the core beneficiaries of the IDS Reference Testbed are the Evaluation Facilities and the IDS Certification Body with close involvement of the Service Providers, the national IDS Hubs and the IDS Support Organization. Close collaboration between these stakeholders in the IDSA sub working group 'Testbed' (as part of the IDSA working group 'Certification') will both stimulate further development and adoption of the IDS Reference

Testbed. This will closely follow the IDS-RAM release schedule, as each new thereof requires an updated IDS Reference Testbed.

5. Getting started

The IDS Reference Testbed is available as open source software. The IDS Reference Testbed software and documentation are hosted in the IDSA repository on GitHub [5].

The GitHub repository contains a preconfigured environment providing all the required security certificates and an installation script that creates the docker containers for all the components in the testbed. The instructions for this can be found on the main page of the repository.

The repository also contains a set of postman scripts to configure the testbed and to test that is working correctly on your system.

TNO has tested the TNO Security Gateway (TSG) in the IDS Reference Testbed, for which the set-up and test scripts are available on GitHub [6].

To run the testbed, a Linux environment with docker and docker-compose are required.

6. References

[1]   European commission 2020. "A European Strategy for Data". Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions. URL: https://ec.europa.eu/info/sites/info/files/communication-european-strategy-data-19feb2020_en.pdf.

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[6]   TNO. "TNO - IDSA IDS Testbed installer". URL: https://github.com/newinnovations/ids-testbed-installer.

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