Deliverable D200.2

FIspace Technical Architecture and Specification

WP 200

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The FIspace Project

Leveraging on outcomes of two complementary Phase 1 use case projects (FInest & SmartAgriFood), aim of FIspace is to pioneer towards fundamental changes on how collaborative business networks will work in future. FIspace will develop a multi-domain Business Collaboration Space (short: FIspace) that employs FI technologies for enabling seamless collaboration in open, cross-organizational business networks, establish eight working Experimentation Sites in Europe where Pilot Applications are tested in Early Trials for Agri-Food, Transport & Logistics and prepare for industrial uptake by engaging with players & associations from relevant industry sectors and IT industry.

Project Summary

As a use case project in Phase 2 of the FI PPP, FIspace aims at developing and validating novel Future-Internet-enabled solutions to address the pressing challenges arising in collaborative business networks, focussing on use cases from the Agri-Food, Transport and Logistics industries. FIspace will focus on exploiting, incorporating and validating the Generic Enablers provided by the FI PPP Core Platform with the aim of realising an extensible collaboration service for business networks together with a set of innovative test applications that allow for radical improvements in how networked businesses can work in the future. Those solutions will be demonstrated and tested through early trials on experimentation sites across Europe. The project results will be open to the FI PPP program and the general public, and the pro-active engagement of larger user communities and external solution providers will foster innovation and industrial uptake planned for Phase 3 of the FI PPP.

Project Consortium

- DLO; Netherlands
- ATB Bremen; Germany
- IBM; Israel
- KocSistem; Turkey
- Aston University; United Kingdom
- ENoLL; Belgium
- KTBL; Germany
- NKUA; Greece
- Wageningen University; Netherlands
- PlusFresc; Spain
- FloriCode; Netherlands
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- LimeTri; Netherlands
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- University Duisburg-Essen; Germany
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Dissemination Level

PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Change History

Version	Notes	Date
001	Creation of the document	10.09.2013
002	Draft version incorporating updates on modules	04.10.2013
003	Incorporating results from technical meeting	14.10.2013
004	Internal review version	20.10.2013
005	Final version	30.10.2013

Document Summary

This deliverable reports on the FIspace architecture and Open Specification, targeting stakeholders that aim at exploiting the FIspace platform either by building value-added offerings on top of the FIspace platform (App Developers) or by configuring and personalizing the platform (Business Architects). To this end, it provides an overview of the features of the core modules and components of the FIspace platform, as well as the API specification and developer documentation of those modules.

In addition, this deliverable provides an introduction to the operational model of FIspace. The operational model describes how App Developers can develop and publish value-added offerings, and how Business Architects can combine those Apps along collaborative workflows to support business users.

Finally, the document describes the key technological aspects for what concerns terms and conditions for the usage of the FIspace platform components and services, considering involved GEs and their terms and conditions (stipulated by FI-WARE).

As the document is targeted at App Developers and Business Architects, internal design considerations and detailed architectural descriptions of individual platform modules are not in the scope of this document. This information is provided as part of D200.1 (“FIspace Design and Release Plan”).

In order to ensure most accurate and up-to-date information is available to App Developers, deliverable D200.2 will be provided as two complementary parts: (1) the document at hand, which provides key information on modules and the FIspace operational model, (2) online documentation, including API specifications, hosted on a dedicated web-site (https://bitbucket.org/fispace/doc/wiki), complementing and being linked from http://www.fispace.eu/.

Abbreviations

App	Software Application
AdvB	Advisory Board
D	Deliverable
DB	Database
DoW	Description of Work
EC	European Commission
e.g.	Exempli gratia = for example
EU	European Union
FIA	Future Internet Assembly
FI-PPP	Future Internet Public Private Partnership
FP7	Framework Programme 7
GA	Grant Agreement
ICT	Information and Communication Technology
i.e.	id est = that is to say
IP	Intellectual Property
IPR	Intellectual Property Rights
KPI	Key Performance Indicator
M	Month
PM	Person Month
RTD	Research and Technological Development
SDK	Software Development Kit
SME	Small and Medium Sized Enterprise
ST	Sub-Task
T	Task
WP	Work Package

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1 Introduction

This deliverable reports on the FIspace architecture and Open Specification (i.e., the interface specifications for accessing FIspace platform features), targeting stakeholders that aim at exploiting the FIspace platform either by building value-added offerings on top of the FIspace platform (*App Developers*) or by configuring and personalizing the platform (*Business Architects*). To this end, it provides an overview of the features of the core modules and components of the FIspace platform, as well as the API specification and developer documentation of the FIspace modules.

In addition this deliverable provides an introduction to the operational model of FIspace. The operational model describes how App Developers can develop and publish value-added offerings, and how Business Architects can combine those Apps into collaborative workflows to support business users.

Finally, the document describes the strategy for what concerns terms and conditions for usage of specific enablers (i.e., the FIspace platform components and/or services), considering involved GEs and their terms and conditions (stipulated by FI-WARE).

Overall, this deliverable aims at providing a specification of the FIspace modules as necessary to start working and interacting with the external IT community, thereby fostering interaction with App Developers and interested stakeholders (such as Business Architects and Users) in order to incubate the FIspace ecosystem. More specifically, the FIspace Open Specification provides relevant information for Phase 3 proposers, allowing them to align their efforts with the pre-investments made in Phase 2 of the FI PPP programme.

As the document is targeted at App Developers and Business Architects, internal design considerations and detailed architectural descriptions of individual platform modules are not in the scope of this document. This information is provided as part of D200.1 (“FIspace Design and Release Plan”).

In order to ensure that most accurate and up-to-date information is available to the external IT community, D200.2 will be delivered in two forms: (1) The document at hand, which summarizes the main outcomes and approach, (2) online material provided through dedicated online tools (https://bitbucket.org/fispace/doc/wiki), complementing and being linked from http://www.fispace.eu/.

The remainder of the document is structured as follows:

- Section 2 provides an introduction to the FIspace overall architecture, as well as its operational model (and thus reports on the outcomes of tasks T210 and T220-T280).
- Section 3 provides an overview of the documentation and API specification for each of the FIspace modules, as well as links to detailed online material (and thus reports on the outcomes of tasks T210 and T220-T280).
- Section 4 describes key technical considerations that are considered for establishing terms and conditions for FIspace platform usage, specifically taking into account terms and conditions of FI-WARE Generic Enablers (and thus reports on the outcomes of task T210, jointly with WP500).
- Section 5 concludes this document.

2 FIspace Architecture and Operational Model

Section 2.1 introduces the main building blocks of the FIspace architecture to provide a high-level view of the FIspace platform's features and capabilities (those are detailed in Section 3).

Section 2.2 provides an elaboration of the FIspace operational model, which is intended to explain how App Developers can contribute to the FIspace ecosystem and how Business Architects will be able to configure the FIspace for specific Industry Users.

2.1 Architectural Overview

FIspace will be a Future-Internet-based *extensible* SaaS-platform that will enable the seamless, efficient, and effective business collaboration across organizational boundaries and will facilitate the establishment of ecosystems with business benefits for both stakeholders from industrial sectors as well as the ICT industry (see the illustration in Figure 1). Extensibility of the FIspace platform is achieved by (1) addition of functionality through Apps, (2) configuration of the platform for dedicated industry users through collaborative workflows (see Section 2.2 for more details).

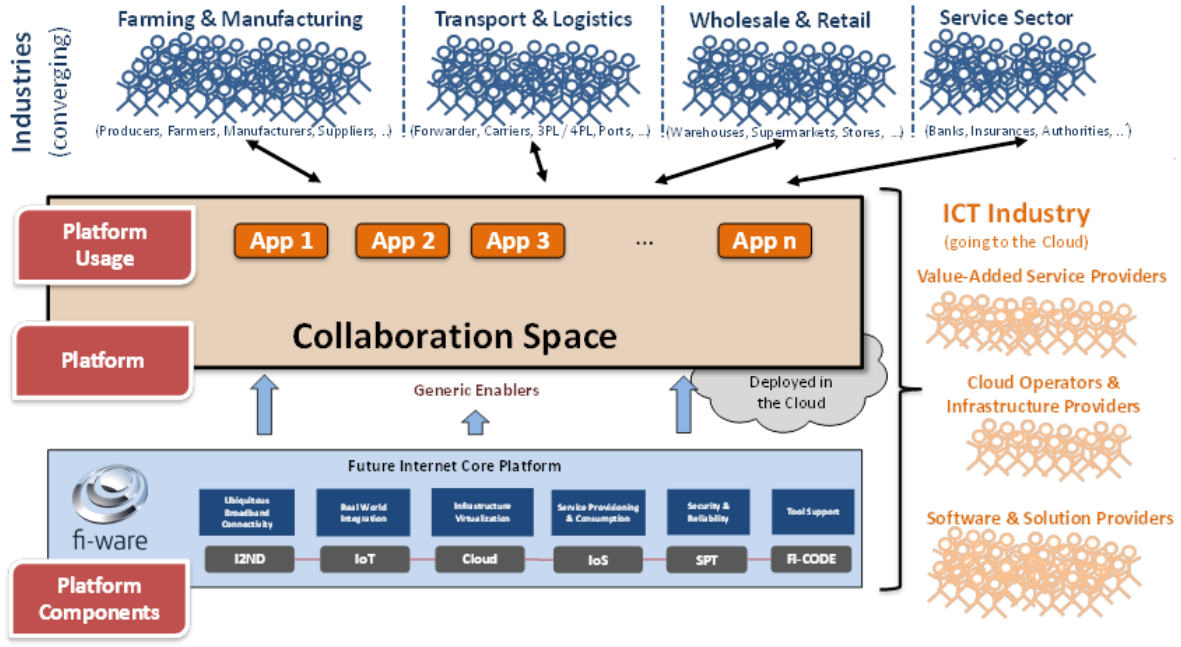


Figure 1: FIspace Platform Approach

Seven major building blocks (called *modules*) constitute the FIspace platform as illustrated in Figure 2. Each of those modules provides dedicated capabilities, which we briefly summarize below and elaborate in Section 3.1.

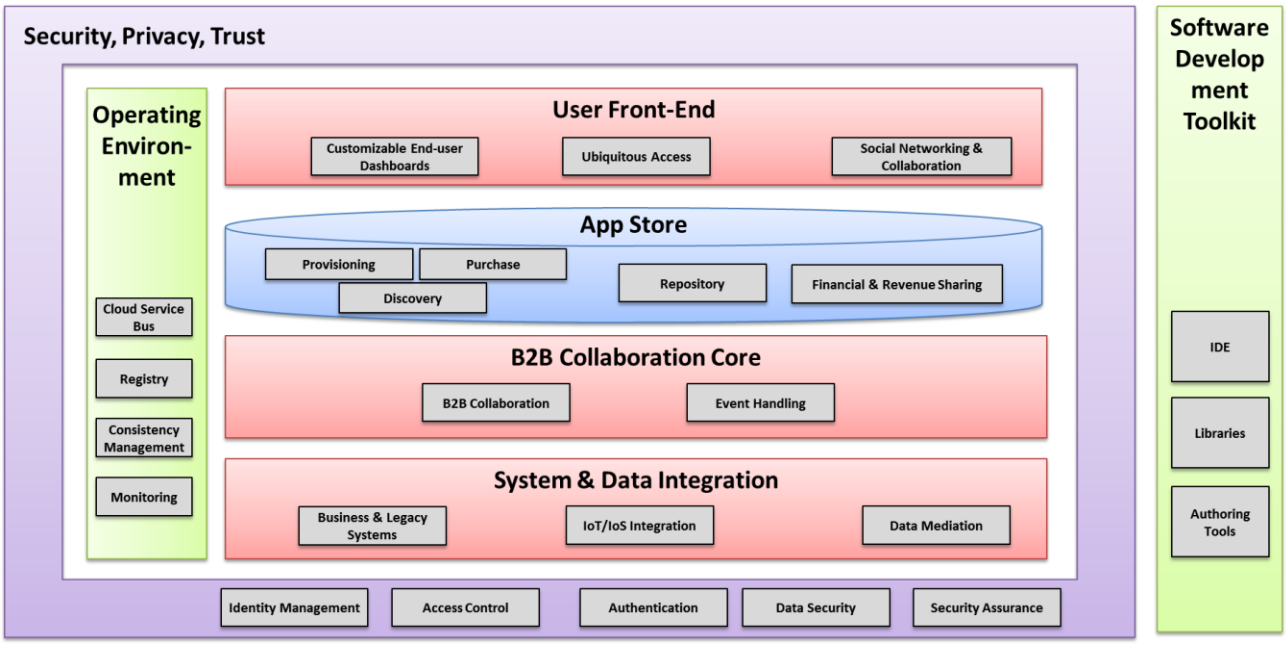


Figure 2: FIspace High-level Conceptual Architecture

Core Layers / Tiers: The FIspace platform core consists of the following three major tiers (or layers):

- **User Front-End:** The User Front-End serves as the main point of access for users of the platform services and Apps, and constitutes a configurable and graphical user interface.
- **B2B Collaboration Core:** The B2B Core ensures that all information and status updates are provided to each involved stakeholder in real-time. The B2B core allows for the creation, management, execution, and monitoring of collaborative workflows (business processes) in the FIspace platform.
- **System & Data Integration:** The System and Data Integration Layer allows for the integration of existing legacy and business systems as well as the integration of external systems and services. It includes facilities for data mediation.

App Store: The App Store provides the tool-supported infrastructure for providing, finding, and purchasing FIspace Apps, which provide re-usable IT-solutions supporting business collaboration scenarios and which can be used and combined for the individual needs of users.

Security, Privacy and Trust Framework: The Security, Privacy & Trust framework provides secure and reliable access and, where needed, exchange of confidential business information and transactions using secure authentication and authorization methods that meet required levels of security assurance. Authentication, authorization and accounting technologies will provide user management & access control features.

Design and Run-time Support: Two key elements of the FIspace platform provide support for design-time and run-time activities:

- **Software Development Toolkit:** The SDK provides tool-support for the development of FIspace Apps. The SDK will ease the work of App developers during the implementation of the Apps, providing specific tools and libraries that hide the more complex apsects of the platform.

- **Operating Environment:** The Operating Environment ensures the technical interoperability and communication of (possibly distributed) FIspace components and FIspace Apps and the consistent behaviour of FIspace as a whole. Its main feature is the Cloud Service Bus (CSB) providing event bus and pub/sub capabilities.

2.2 The FIspace Operational Model

2.2.1 Introduction

As mentioned above, the extensibility of the FIspace SaaS platform is achieved by means of two key mechanisms:

- **Addition of functionality through Apps:** Apps will provide value added services and wrapped software capabilities; FIspace Apps thus aggregate capabilities in a reusable fashion such as to become attractive for many users. They will be offered through a dedicated App store. For example, such Apps could offer features such as spraying advice, bad weather alerts, pricing proposals, exception reporting and decision support, shipment status, meat transparency information, or augmented reality product information.
- **Configuration through collaborative workflows:** FIspace allows Apps to be composed along collaborative workflows and mashed-up into personalized dashboards for users. In addition, FIspace can be configured to allow flexible integration of data sources of users and linking those data sources to Apps along collaborative workflows. As an example, one could envision that a meat transparency information App is composed with an augmented reality product information App through a collaborative workflow involving meat producers, shippers and retailers.

It should be noted that different from typical smartphone Apps, FIspace Apps will not be built towards a given (and possibly fixed) programming interface (API). Rather, one key aspect of FIspace Apps is that *they* will declare what input data or events they *require*. In this regards, the FIspace App model is much closer to the software (Web) service or the component based software-engineering model, where reusable features are offered through interfaces defined by the service/components, and interested parties can select and mashup those services/components into more complex service compositions[1].

Given the business setting in which the FIspace solutions will be employed, three major types of stakeholders are involved in the overall value chain:

- **Users:** the actual (industry) users of the collaboration services and Apps provided by FIspace; those will be supported in their daily business activities, with special focus on their interaction and collaboration with business partners; Examples of those users include farmers, shippers, freight forwarders, cargo carrying airlines, and regulatory agencies;
- **Business Architects:** the experts (internal or external to the User organization) that are in charge of configuring FIspace for their individual business needs; particularly they will define customized collaborative workflows and connect those workflows with FIspace Apps and backend systems;

[1] E.g., see E. Di Nitto, C. Ghezzi, A. Metzger, M. P. Papazoglou, and K. Pohl, “A journey to highly dynamic, self-adaptive service-based applications,” Autom. Softw. Eng., vol. 15, no. 3-4, pp. 313–341, 2008.

- **App Developers**: the software and system providers who offer "packaged" / componentized solutions and applications in form of Apps.

The remainder of this section will elaborate on the activities of those roles, thereby describing the operational model of the FIspace platform.

2.2.2 Illustration of the Operational Model – The "Greenhouse" Scenario

To provide a rather concrete illustration of the FIspace operational model, we refer to one of the trial scenarios developed in the project. More specifically, we use the "Advice Request" scenario of the "Greenhouse Management & Control" trial (for more details, please refer to deliverable D400.10[2]). The (industry) User of the FIspace configuration for that trial will be a Farmer that would like to be provided with spraying advice in case there is a deviation from expected environmental conditions. Environmental conditions are provided by a Greenhouse Management System, which links to a sensor network in the green house in order to measure the environmental conditions. In addition, the Greenhouse Management System can be used to control the green house (e.g., execute concrete spraying actions).

Figure 3 below shows the key elements of how FIspace would be used for that trial and how each of the above three stakeholders (Users, App Developers, and Business Architects) participate.

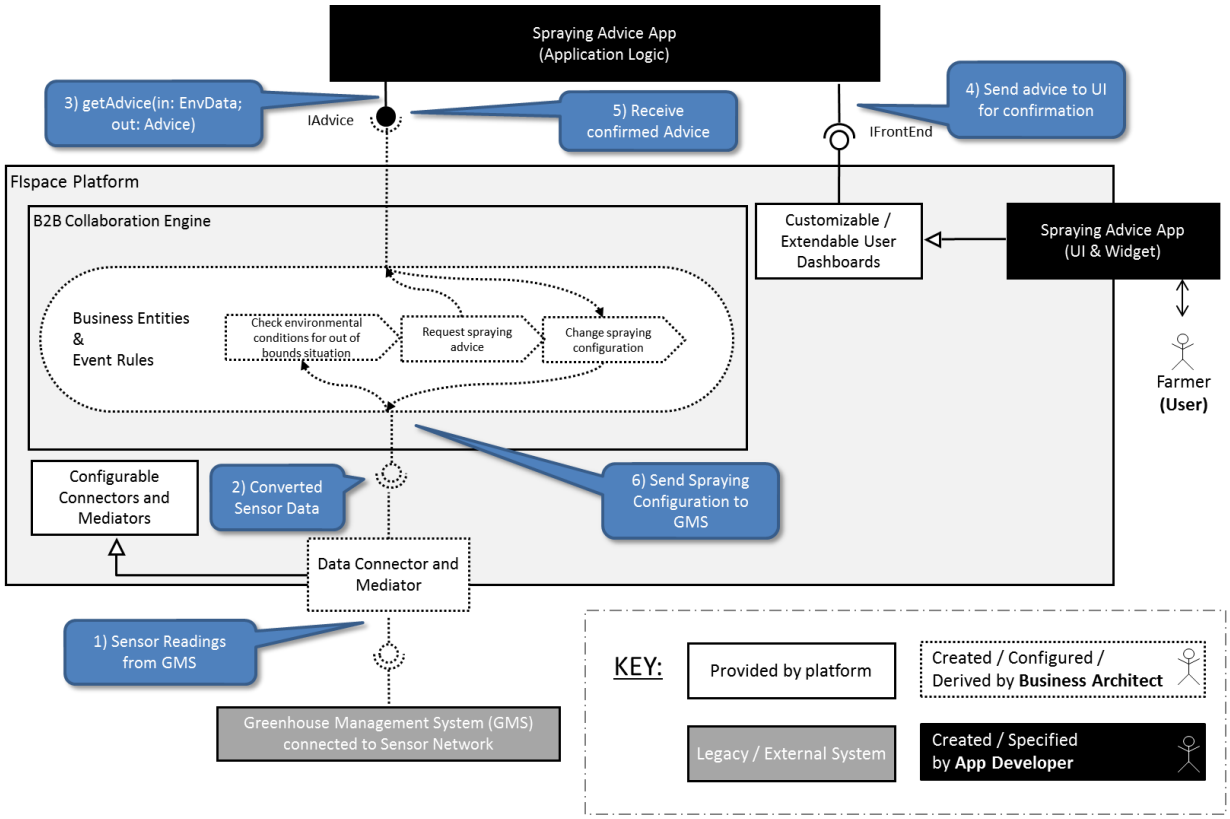


Figure 3: Illustration of FIspace Operational Model

[2] Please note that – for illustrative purposes and sake of conciseness -- this scenario is a simplified and slightly modified version from the initial one introduced in Section 2.2 of deliverable D200.1 and the detailed one depicted as part of the trial in WP400.

First, the App Developer offers a packaged expert system that provides spraying advice based on a list of specific environmental conditions. As can be seen, similar to a Web Service, the App would announce (through the *IAdvice* interface) that it can be called "getAdvice()" and that it requires EnvData (in a specific format) as input. In order to visualize the spraying advice and solicit confirmation from the user (in this case the farmer), the App provides a dedicated widget which is deployed through a set of standard APIs (in this case *IFrontEnd*) by the platform (note that for this second type of functionality, the App model is closer to the smartphone App model).

Now that the App has been defined and implemented, a Business Architect can search (using the store and marketplace) the App and can start setting up a collaborative workflow involving this App.

To this end, the Business Architect needs to define a collaborative workflow that reflects the stages in checking the need for advice, soliciting advice and executing the advice. Note that this workflow includes the description of the business processes stages and data, as well as event rules that react on and aggregate events. The Business Architect then connects this workflow with a) the App that provides the advice, and b) the backend system that delivers the environmental data based on which the need for an advice is computed. The Business Architect is supported by the platform (i.e., by authoring tools and configurable components) to define collaborative workflows, as well as to define connectors and mediators to channel the data into the platform and thus ultimately to the App.

After having configured the platform for the Farmer, the five steps of the scenario as depicted in Figure 1 execute as follows:

1. Sensor data is read from the Greenhouse Management System and sent to FIspace through a respective connector and mediator (configured by the Business Architect).
2. After mediation, the data is pushed as events to the collaborative workflow. By matching those events, with event rules (as defined by the Business Architect), the B2B Collaboration Engine can determine whether an out-of-bounds situation in environmental data is observed and thus whether a spraying advice is needed and thus should be solicited.
3. In case of need for advice, the platform calls the Spraying Advice App (that has been connected to the collaborative workflow by the Business Architect) and transmits the required input (i.e,. *in:EnvData*) to the App.
4. The App computes the spraying advice (typically relying on some expert system on the side of the App provider). It then sends the computed spraying advice to the widget which runs in the dashboard of the Farmer and waits for confirmation of the spraying advice.
5. Once confirmed, the App returns the advice to the workflow (return value from getAdvice call, i.e. *out:Advice*).[3]
6. As soon as the B2B Collaboration Engine receives the confirmed spraying advice, the spraying configuration (as contained in the advice) is sent to the Greenhouse Management System through respective outgoing mediators and connectors.

It should be noted that, although not discussed above for reasons of conciseness, all interactions between FIspace platform components and Apps will commence through

[3] Note, that we chose synchronous interaction for simplicity. FIspace also supports asynchronous interactions.

the Cloud Service Bus (CSB), which is part of the FIspace Operating Environment. The CSB is based on overlay technology, and each component and module will connect with a respective agent to the overall FIspace overlay. This approach allows flexibility, federation and consistency of the platform operations and thus makes the overall operational model agnostic to the actual deployment of the modules and Apps.

To further stress this aspect, it should be noted that Figure 3 does not indicate how the various modules and Apps are deployed. For instance, the App Logic could be hosted by the App provider, by some third-party cloud provider, or even within the same Cloud that hosts the FIspace platform modules. In addition, not all Apps have to come with App Logic that needs to be hosted. Very simple Apps, which for instance merely visualize events or data, may only provide widgets that directly plug into the FIspace platform user front-end.

As a final important design consideration, it should be noted that if an App needs to connect to a backend system at the side of the App provider (for instance the expert system mentioned in the above example), it should not do this through the B2B Collaboration Engine and System and Data Integration. This would violate the Operational Model of FIspace, as Apps should be built as "self-contained" software capabilities and should be independently built by App Developers without the need for interacting with Business Architects. As it is the Business Architects that do the configuration of data connectors and mediators of the platform, it would not be a FIspace compliant design if an App would require such wiring to work. The System and Data Integration module is intended to support the connection with legacy systems and existing services not built towards the FIspace App model.

Finally, it should be noted that where FIspace Apps will connect to the CSB directly, external systems will do so through Data Connectors and Mediators (see Figure 3), which offer technical interfaces such as REST or EDI.

2.2.3 Description of Key Roles as part of Operational Model

To provide a more detailed and extensive explanation of the different activities that the three key roles App Developer, Business Architect and User are envisioned to perform with respect to the FIspace platform, the below three tables list and describe those activities[4]. **Boldface** text marks the FIspace modules which are employed resp. relevant for the activities described.

Table 1: Activities of App Developer

Activity	Involved FIspace Modules

(optional) Find existing Apps to build upon
• Search / browse **App Store**
• Investigate for suitability & re-usability
  ○ Features & functionality
  ○ Interfaces, Data Structures
  ○ Options for configuration, exten-
	App Store
	• App Search & Discovery facilities
	• Support for Detailed Investigation (features, functionality, technical details, pricing models, terms & condition for re-use

[4] Note: Those tables reflect the progress that has been made in understanding and realizing the FIspace operational model and thus differ from the ones initially presented in deliverable D200.1.

sion, re-sue ○ Pricing models, terms & conditions for re-use	• App Purchase Support for re-use • Ratings of Apps by FIspace Community
Develop App • Using **Software Development Toolkit** to develop an App to comply with the FIspace operational model and in particular: ○ **UI Framework** & Technology ○ Technical Interfaces & Interaction Protocols ○ Usage of **security, privacy, and trust** technologies • Define provided interface (including functions that can be called and data/events required by App)	**Software Development Toolkit** • Compliance with FIspace operational model and frameworks (UI technology, technical interfaces & interaction protocols, security techniques) • Link with libraries required to connect to FIspace Cloud Service Bus (**Operating Environment)** and **SPT** mechanisms
Publish new App in **App Store**, incl. • Creation of App Description (required / provided interfaces) • Configure / define pricing models, usage terms & conditions • Conduct FIspace App Publication Process	**App Store** • Publication Process for Apps • Configuration / definition of pricing models, usage terms & conditions • 'Compliance' Check (does App follow operational model and framework constraints?)

Table 2: Activities of Business Architect

Activity	Involved FIspace Modules
Find & get relevant Apps • Search / browse **App Store** • Investigate for suitability ○ Features & functionality ○ Interfaces, Data Structures ○ Options for configuration, extension, re-sue ○ Pricing & payment models • Purchase relevant Apps (for company / org. unit / individuals)	**App Store** • App Search & Discovery facilities • Investigation Support for Consumers (features + pricing models) and for Developers (technical details) • App Purchase Support • Ratings of Apps by FIspace Community
Create customized Solution • Use **B2B Core** to design desired Workflow for Users ○ Sequence / Process of Apps ○ Data models and relevant systems	**B2B Core's Authoring Tools** (encompasses various tools for business architects) • Configuration / Extension for Collaboration Artifacts & Event Handling Rules • Customization of Apps (configuration,

○ Interaction & collaboration with business partners • Configure / extend / define data structures and technical workflow for **B2B Core** to integrate Apps ○ Configure / extend Collaboration Artifacts + Event Rules (or define new / additional ones) ○ Configure / extend selected apps (hide / rename data fields, resp. add additional functionality) ○ Orchestrate Apps into desired workflow: define / 'mash-up' execution sequence & technical interaction models • Use **System and Data Integration** facilities to connect relevant systems ('legacy' systems and external systems & services) and integrate them into the customized workflow ○ Define & create connectors to between FIspace Apps and systems ○ Define 'data mediators' to integrate data systems <-> FIspace	extension) • Mash-Up & Orchestration of Apps **System & Data Integration** • Tool-supported techniques for connecting business systems (legacy & standard systems, ...) • Tool-supported techniques for connecting external systems & services (e.g. IoT-enabled sensor system, 3rd-party services) • Data mediation & integration facilities
Provide customized solution to Users • Provision to relevant Users by making the customized solution accessible in the personal **User Front-End** of relevant Users • Pre-configure for Users: Access Rights, setting for notifications + communication (**SPT**) • Configure pricing & payment models (for company / org. unit / individual level) with the support of the **App Store's** revenue sharing facilities	**Front-End** • Personalization & Configuration for individual Users **SPT (via Front-End)** • Configuration (Access Rights, Notification & Comm. Settings) **App Store** • Selecting payment options / model

Table 3: Activities of User

Activity	Involved FIspace Modules
Registration & User Profile Maintenance through **User Front-End (& SPT)** • Register & Log-In to FIspace	**Front-End** • Registration & Log-in Process • User Profile Management

• Create & Maintain User Profile (individual / organizational unit / company level):
  ○ Select / define role
  ○ Provide basic profile information
• Personalize Cockpit (appearance, basic notification & communication settings)
	• Personalization Features
	Security (indirect, integrated in Front-End)
	• Secure Log-In & Usage
	• Access management

Find & Manage Business Partners through **User Front-End**
• Find business partners (known & unknown)
  ○ Via public user profiles
  ○ Via offered business services
• Manage your business contacts
  ○ Maintain contact data
  ○ Seamless communication via social networking & collab. features
• Manage business partners
  ○ Set-up & manage contracts
  ○ Rate partners (public + private)
• Create Business Communities (for e.g. areas of interest, establishing networks, …)
	Front-End
	• Search for public user profiles
	• Basic Contact Management
	• Basic networking & collab. features
	• Formation of communities
	SPT (indirect)
	• Information Security
	• Access management

Get & customize pre-configured Apps for Business Activities (from **App Store**)
• Find & get need Apps
  ○ Pre-configured by Business Architects
  ○ Apps that do not need configuration by business architect (such as weather App, time of day App, etc.)
• Customize for individual needs (only 'personal configuration', such as user name, appearance, etc.)
	Front-End
	• Personalization & Configuration for Apps (selection, personal appearance, look & feel)
	• Access Apps (consume Apps via UIs that are provided in Front-End)
	App Store
	• Use pre-configured Apps / customized solution provided by associated Business Architects of User organization

Use Apps & FIspace Platform Features for conducting daily business, incl.: • Define specific notification & communication settings for business activities • Use collaboration features for specific business activities and transactions • Continuously manage business partners	**Front-End** • Access to Apps (UIs integrated in Front-End) • Personalization & Configuration Features • Embedded social networking & collaboration features (basic + advanced) • Access to statistics on App Usage,

	Business Partner Information, etc. **App Store** • Payment of App / Platform usage

3 Documentation and API Specification

Section 3.1 describes the main *envisioned* features of the individual FIspace building blocks introduced in the previous section. A concrete roadmap on when which of feature will be available, together with a more extensive documentation of each building block (including the programmatic access through to its capabilities by means of APIs) will be provided online. To this end, for each module links to the respective online material are presented.

Section 3.2 summarizes how the online documentation is made available and which formats are followed.

3.1 Overview of FIspace Platform Modules

3.1.1 User Front-End

The User Front-End serves as the main point of access for users of the platform services and Apps. It includes the following main features:

- **Customizable user dashboards**: To ensure our applications are usable, the front-end strives to provide an environment where they feel comfortable, i.e., provide interaction patterns that understand limitations and offer potential opportunities to the users;
- **Social networking and collaboration features** for business partners;
- **Access from anywhere across multiple devices**.

The User Front-End builds the main access point for users of the FIspace platform. Through the integration of external widgets (e.g., from the store, externally developed Apps or other external providers), the User Front-End facilitates an 'all you need in one place' user experience and creates a central access point. To support the diversity of FIspace users and devices the User Front-End will be adaptable to specific needs, tasks and roles. Beyond the adaptation to different devices, the User Front-End also supports the configuration of the user interface. This allows the interface personalization in order to address specific user needs or enable custom brandings for companies. The Front-End also enables users to create relations to business partners to facilitate the communication among them (comparable to modern social networks).

Online documentation for User Front-End:

https://bitbucket.org/fispace/doc/wiki/gui

3.1.2 B2B Core

At the heart of the envisaged FIspace platform reside the Business-to-Business Core Modules. The B2B Core ensures that all information and status updates are provided to each involved stakeholder in real-time. The B2B core allows for the creation, management, execution, and monitoring of collaborative business processes in the FIspace platform. The B2B Core consists of two interrelated components:

- A **Collaboration Engine** that captures, in form of so-called *Business Entities*, the information that are to be exchanged among collaborating stakeholders along with status and control of the a collaborative business processes. The BCM component is

responsible to orchestrate the different processes from different stakeholders and assure the correct sequence of the tasks execution;

- An **Event Processing Engine** that detects and analyses events coming from activities in the collaborative processes or from IoT devices. The Event Processing Module (EPM) component monitors events and detect situations of interest, i.e., situations that require appropriate reactions;
- **Authoring tools:** Both engines will be accompanied by respective authoring tools that allow defining business entities resp. event rules.

The BCM component is responsible to orchestrate the different processes from different stakeholders and assure the correct sequence of the tasks execution. The BCM is based on the entity-centric approach (for more details, please refer to deliverable D400.10). This approach relies on the notion of *entities* (aka, as business entities, artefacts, or dynamic artefacts, or business collaboration objects). These provide a holistic marriage of data and process, both treated as first-class citizens, as the basic building block for modelling, specifying, and implementing services and business processes. A (business) entity is a key conceptual concept that evolves as it moves through a business (or other) process. An entity type includes both a data schema and a lifecycle schema which are tightly linked. The data schema provides an end-to-end conceptual view of the key data for this entity type. The lifecycle schema of an entity type specifies the different ways that an entity instance might evolve as it moves through the overall process. In FIspace we will use the GSM (Guards, Stages, and Milestones) model to specify the lifecycle schema of the business entities.

The Event Processing Module (EPM) component monitors events and detect situations of interest, i.e. situations that require appropriate reactions. The events sources (aka events producers) can be the actual execution of the collaboration (i.e., the BCM), external systems, or sensors. The EPM processes these events and by applying pattern matching derives situations of interest (for a background on event processing refer to [7]). Examples of situations of interest can be: Missing documentation at a certain point in time, a sensor reading outside a permitted range, a delay in a delivery. In general, we can distinct between situations that result from the actual execution of the process or collaboration and situations that result from external events (i.e., events coming from external systems or sensors).

The EPM in FIspace supports two types of situation detection capabilities: reactive and proactive. Reactive rules analyse past events and derive situations by applying pattern matching over a single or a set of events over time. Proactive rules, on the other hand, relate to situations that are likely to happen in the (near) future. In general, we refer to proactive event-driven computing as the ability to mitigate or eliminate undesired states, or capitalize on predicted opportunities—in advance. This is accomplished through the online forecasting of future events, the analysis of events coming from many sources, and the application of online decision-making processes.

Online documentation for B2B Collaboration Core:

https://bitbucket.org/fispace/doc/wiki/b2b

3.1.3 System & Data Integration

The System and Data Integration Layer allows for the integration and continued usage of existing legacy and business systems as well as the integration of external systems and services, including support for:

- **Connecting business and legacy systems** used by individual users by means of Tool-supported mechanisms, supporting the creation of “connectors” (using common interface standards such as EDI) to business and legacy systems;
- **Connecting external services** (e.g., IoT or 3rd party services) by means of APIs for importing / exporting data (such as REST or SOAP);
- Handling heterogeneous data by means of mechanisms for **data mediation**;

The overarching purpose of System and Data Integration is to provide a robust and scalable infrastructure that enables seamless integration of external legacy systems/IoT systems with the FIspace platform and applications deployed on it. Outputs from the task will facilitate the implementation of Web based, FIspace-driven applications by providing unifying data models, data mediation tools and system integration APIs.

Online documentation for System & Data Integration:

https://bitbucket.org/fispace/doc/wiki/sdi

3.1.4 App Store

The App Store provides the infrastructure for providing, finding, and purchasing FIspace Apps, which provide re-usable IT-solutions supporting business collaborations and can be used and combined for the individual needs of users; the FIspace Store includes:

- The **software infrastructure** to support the provisioning, discovery, purchase, and use of FIspace Apps, including a **registry of Apps**;
- **Facilities for financial management** of the FIspace Apps (pricing, payment, revenue sharing).

The FIspace Store is concerned with the software infrastructure to allow for the provisioning and consumptions of FIspace Apps, therewith providing the core elements for the monetization throughout the ecosystem that shall be facilitated by FIspace. All FIspace Apps shall be made available in the Store and consumer will be supported with easy to use search and consumption features. The consumption includes the purchase support as well as deployment and runtime support. Features for the former contain an App purchase processes. Features for the latter include capabilities for dynamically connecting the Apps (which may run on different servers) to the Cloud Service Bus of the FIspace platform. Finally, for App customers are informed about the mandatory and optional rights the App requires (before purchase) and enables him or her to configure those for each App (after purchase). For App developers, publication support is provided together with an integrated compliance check for publishing new Apps in a simple way in the FIspace store. An important part of the App Store will be also the application's lifecycle support, including bug fixes and upgrades and connection with the users that purchased the App.

Finally, Financial management is part of the FIspace Store which enables App providers to run statistics and share revenue with involved partners (e.g., developer of re-used component) using different revenue models.

Online documentation for FIspace Store:

https://bitbucket.org/fispace/doc/wiki/store

3.1.5 Security, Privacy & Trust (SPT) Framework

The aim of the Security, Privacy & Trust framework of the FIspace platform is to provide secure and reliable access and, where needed, exchange of confidential business information and transactions using secure authentication and authorization methods that meet required levels of security assurance. Authentication, authorization and accounting technologies will provide user management & access control features.

The main features of the SPT framework have been driven by an initial analysis of the SPT functionalities that will be required by industrial actors that will be users of the FIspace platform, and industrial technology suppliers who will exploit the FIspace platform to provide Apps and associated services to the industrial actors. The main feature categories that have been considered in the design of the SPT framework for FIspace are:

- **Identity and Trust:** Current situation is that often two business actors establish identity and trust to ex-change information based on some previous knowledge of one another, having been in physical communication. In more advanced and eventually more common scenarios, actors will not be able to rely on having physical contact with other FIspace actors, and strategies such as exploiting online profiles, reputation (ranking), certification or registration data bases, etc. will be supported.
- **Access Control:** This will include features in order to validate a user's identify and thus only allow individuals and organizations that are authorized to connect and that they can only access the information and data they are allowed to access.
- **Authentication:** This will include facilities for authenticating individual users, third-party systems, networked resources, and it will need to go down to fine-grained events, and data objects to ensure that only authentic entities are allowed to connect and communicate with the FIspace platform.
- **Data Security:** Those mechanisms will ensure that data is being encrypted and does not leave the FIspace premises unencrypted, as well as that data can only be accessed by users with the respective credentials;
- **Security Assurance:** FIspace will provide strong security assurance that commercial information and transactions are secure, can be trusted and are not vulnerable to malicious actions. FIspace will use a compositional security assurance and accounting process, separating concerns where possible. In a component based design process, independently developed components are assessed and matched to specific system security requirements to determine if they meet the system security objectives. For independently developed components such as Apps it is possible to provide assurance provided we can verify an App adheres to a set of system-wide and App-specific security policies. As the cost of full verification of independent Apps is costly and time consuming, FIspace complements the verification of security policy adherence by Apps with monitoring mechanisms to detect and prevent unacceptable or unexpected App behaviour;
- **Developer support** to ensure correct usage of necessary security mechanisms in FIspace: SPT patterns and guidelines underlie the Development Toolkit (see Section 3.1.5) to ensure that SPT issues are considered by App developers.

Concerning privacy and data ownership, one important design consideration that should be mentioned is that operational and business data per se is typically not stored persistently in the FIspace platform (i.e., in the Cloud). Rather data resides with the data owner (and on its premises) but FIspace will provide access to this data (programmatic and access rights) to the entities that require to get access to this data. Typically, only "me-

ta-data" such as events about actual data objects that have changed (change event) will be stored and managed by the platform, as well as user registration information.

Online documentation for SPT Framework:

https://bitbucket.org/fispace/doc/wiki/spt

3.1.6 Software Development Toolkit (SDK)

The Software Development Toolkit (SDK) provides tool-support for the development of FIspace Apps. The SDK will ease the work of **App developers** during the implementation of the Apps, providing specific tools and hiding the complexity of the platform.

Particularly, the SDK will include:

- **Tooling** (specifically an **Integrated Development Environment, IDE**), which is built on Eclipse. Eclipse is widely adopted by the development community and supported by the Eclipse foundation. The FIspace SDK will offer functionalities such as
    - integration of Eclipse JDT (e.g., classpath containers) or Eclipse PDE;
    - providing access to Javadoc for all referenced elements (FIspace modules) and auto-completion support;
    - visual management of components and case modelling will be provided.
- **Libraries** to link with the respective modules of the FIspace, such as security, privacy and trust, or the Cloud Service Bus (CSB).

Complementing the SDK, there will be a set of tools **targeted to business architects** for customizing and extending the FIspace to the individual needs of Users (cf. Section 2.2). This includes tools for authoring of Business Entities and Event Rules (see Section 3.1.2), as well as configuring mediators and connectors to backend systems (see Section 3.1.3).

Online documentation for SDK:

https://bitbucket.org/fispace/doc/wiki/sdk

3.1.7 Operating Environment

The Operating Environment ensures the technical interoperability and communication of (possibly distributed) FIspace components and FIspace Apps and the consistent behaviour of the FIspace, including:

- **A Cloud Service Bus (CSB)** to support the interaction of FIspace components and Apps, which is based on peer-to-peer overlay technology, supporting (1) eventual consistency, (2) events bus, (3) management logic, (4) Pub/Sub abstraction for information dissemination, (5) a bulletin board abstraction for filtering and orchestration, (6) queues supporting various QoS for delivery and execution (e.g., once only or multiple readers);
- **Replication and consistency service** to ensure fault-tolerance and transaction support, which is partition tolerant and guarantees strong consistency (when needed);
- Facilitation of the **management** of the "composed service (application)" life-cycle, based on IaaS Cloud related OSS and BSS (planned to be provided by FI-WARE);
- **Operational registry** for maintaining runtime attributes and supporting real-time operations;

- **Multi-tenancy support**, with the least effort from the developers (both FIspace developers and App developers);
- **Monitoring** of KPIs and health, automate the operation, enforce the SLA, facilitate the problem determination, continuous optimizing the runtime.

The Operating Environment provides automation supporting the application lifecycle and support a “scale out” design model that is decentralized with redundancy for failure tolerance and auto recovery. It supports eventual consistency, as well as strong consistency asynchronous models.

Online documentation for Operating Environment:

https://bitbucket.org/fispace/doc/wiki/csb

3.2 Approach for Documentation and API Specification

As mentioned above, in order to ensure that most accurate and up-to-date information is available to the external IT community, online documentation and API specifications will be provided through dedicated online tools. Specifically, the documentation of the FIspace modules and their API specification are accessible online from: https://bitbucket.org/fispace/doc/wiki, which complements the material and is being linked from http://www.fispace.eu/.

For each FIspace module, this online documentation will contain two major pieces of information:

- The documentation of the FIspace module and a description of its features and capabilities, including a roadmap for feature releases;
- The API specification for the programmatic interfaces exposed by the FIspace modules.

All this information will be made available online through a collaborative, cloud-based development environment. The FIspace consortium has assessed and agreed to employ Atlassion bitbucket to this end. The tool is also used to host code repositories and issue trackers and thus ensures that the documentation and API specification is in sync with the code development in WP200. The setup and configuration of this online tool was performed as part of Subtask 513 of WP500 and is delivered as deliverable D500.1.3 (further details see there).

3.2.1 Documentation of FIspace Modules

The documentation of the FIspace modules together with the terms and conditions will be presented as Wiki pages, which are offered by the aforementioned tool: https://bitbucket.org/fispace/doc/wiki. The figures below provide screenshots of those pages. Figure 4 (end of this section) shows the landing page. Figure 5 (end of this section) shows the documentation for the Business-to-Business Core module as an example.

3.2.2 API Specification of FIspace Modules

The API Specification of the FIspace modules will be delivered online (https://bitbucket.org/fispace/doc/wiki). Links to the API specifications are accessible from the documentation of the modules (e.g., see bottom line of Figure 5 from above).

As the CSB (see Section 3.1.7) is used for communication between all components, a module's API consists of channels and messages. In order to express those messages and thus to document a module's API, we use POJOs (Plain Old Java Objects). They will be serialized in order to be transmitted as messages carrying byte arrays and sent through the CSB. All POJOs that define such APIs will comply to the following rules:

- Implement *java.io.Serializable*
- Contain a static field with the name *serialVersionUID* of the type *long;* the value of *serialVersionUID* is incremented on every non-backwards compatible interface change;
- Method parameters and return types (if not void) should be either primitives or String (arrays[] allowed);
- No enumerations as return or parameter type allowed;

The channel for which this message applies to will be stated in the javadoc comment of the message POJO.

The API Specification of the FIspace modules can thus be accessed in two forms: (1) as Java code of the message POJOs, see Figure 6 (end of this section); (2) as documentation generated from the javadoc of the message POJOs, see Figure 7 (end of this section).

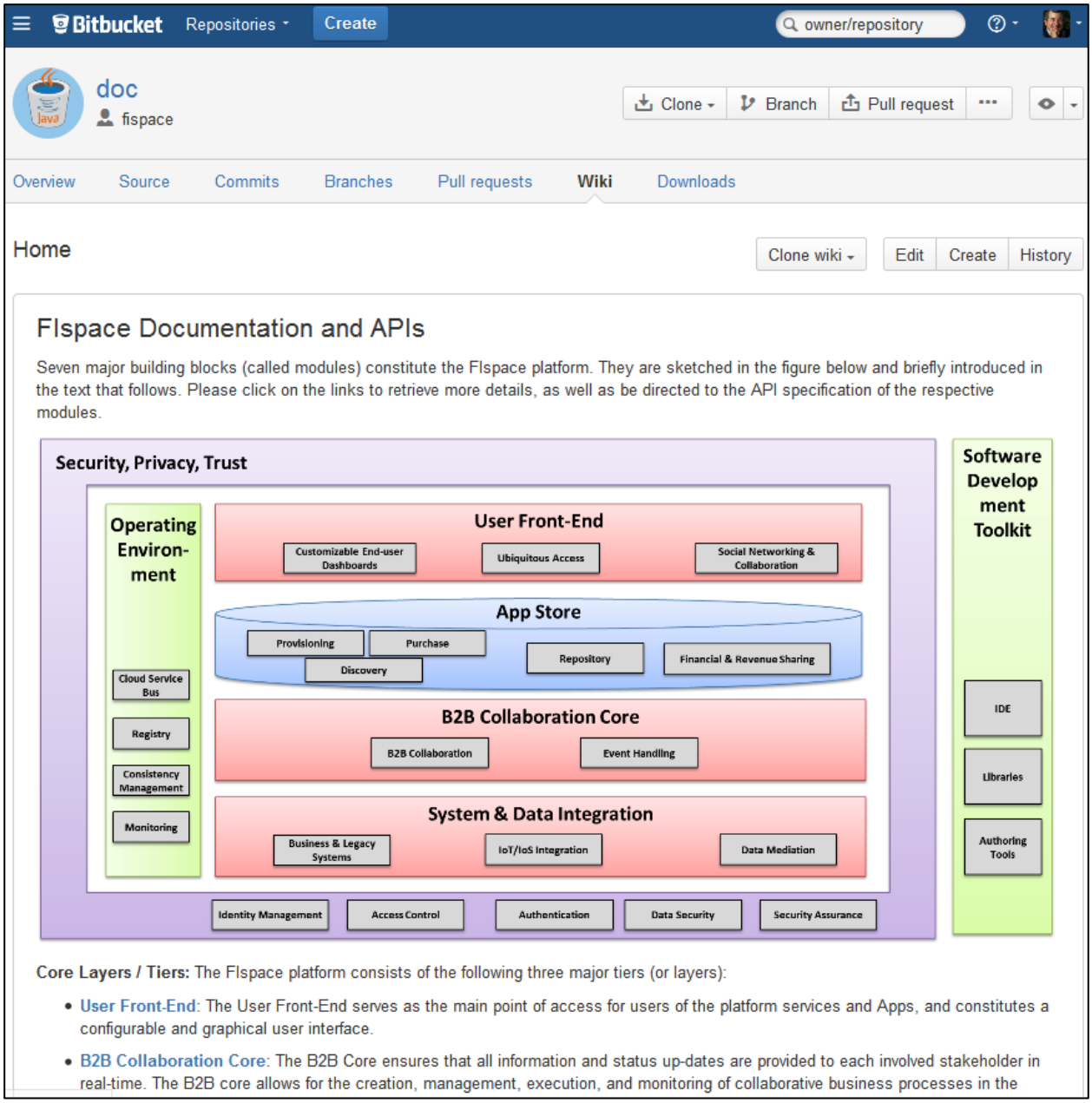


Figure 4: Documentation of FIspace Modules: Landing Page

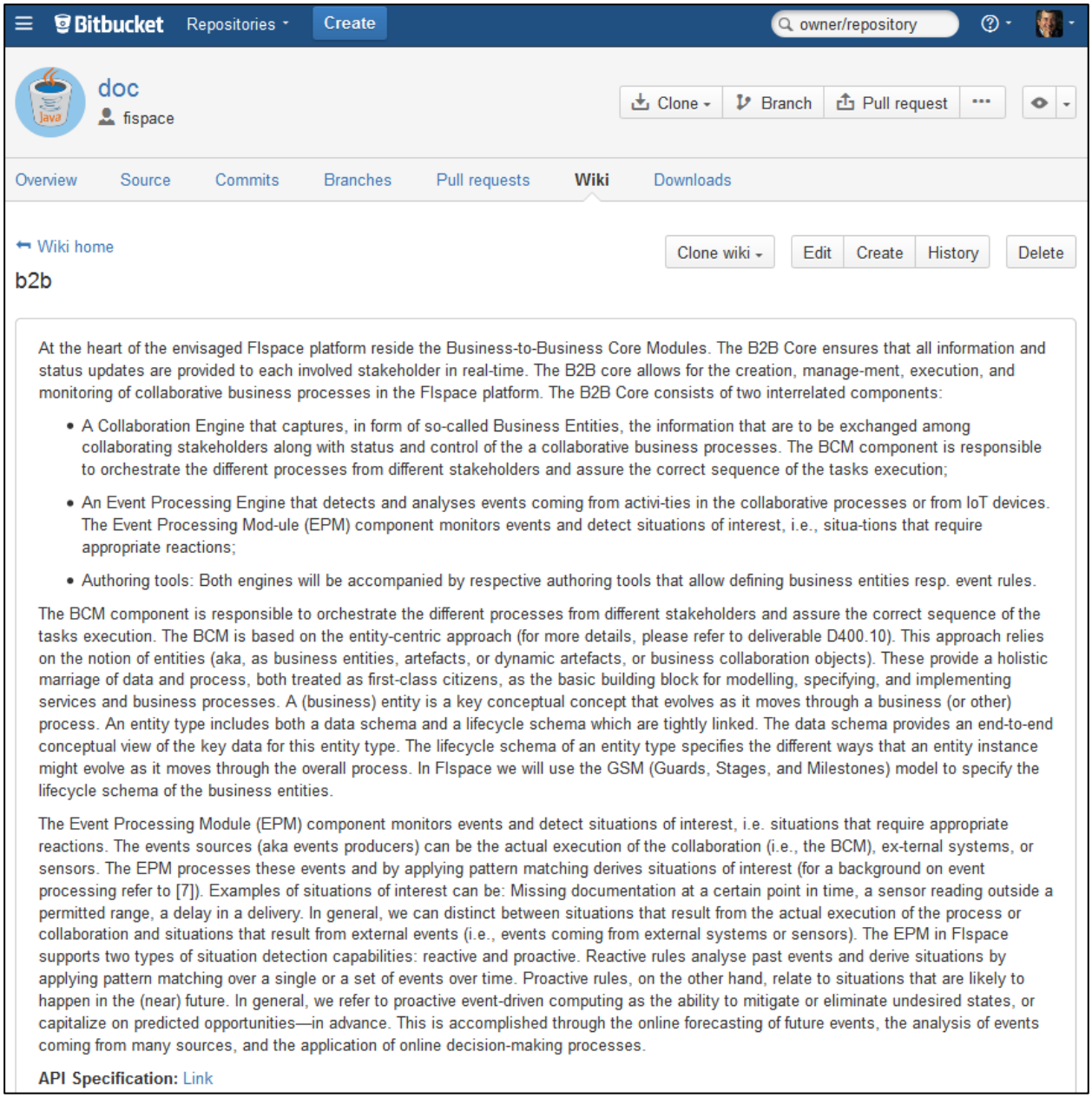


Figure 5: Documentation of FIspace Modules: B2B Core Module

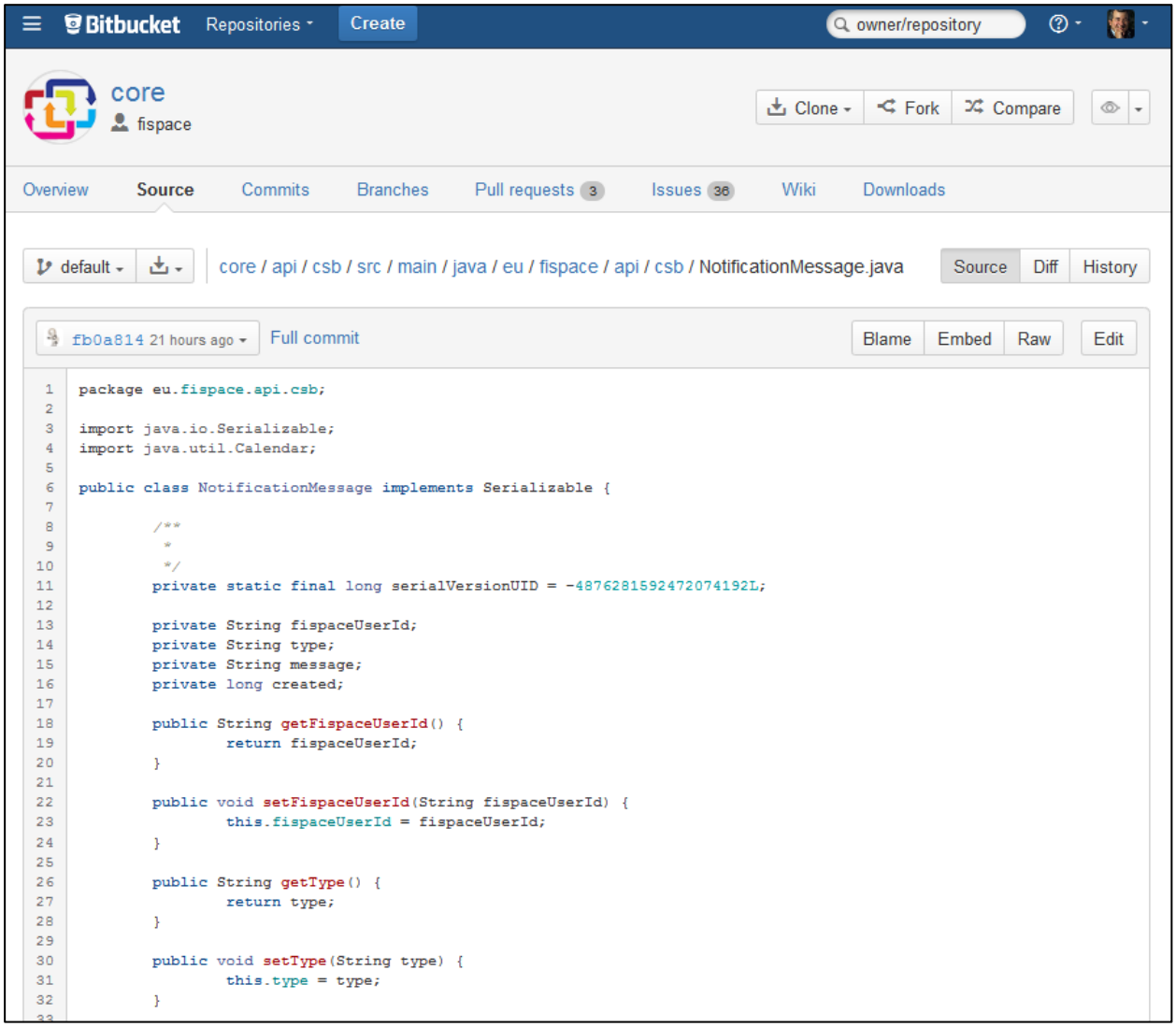
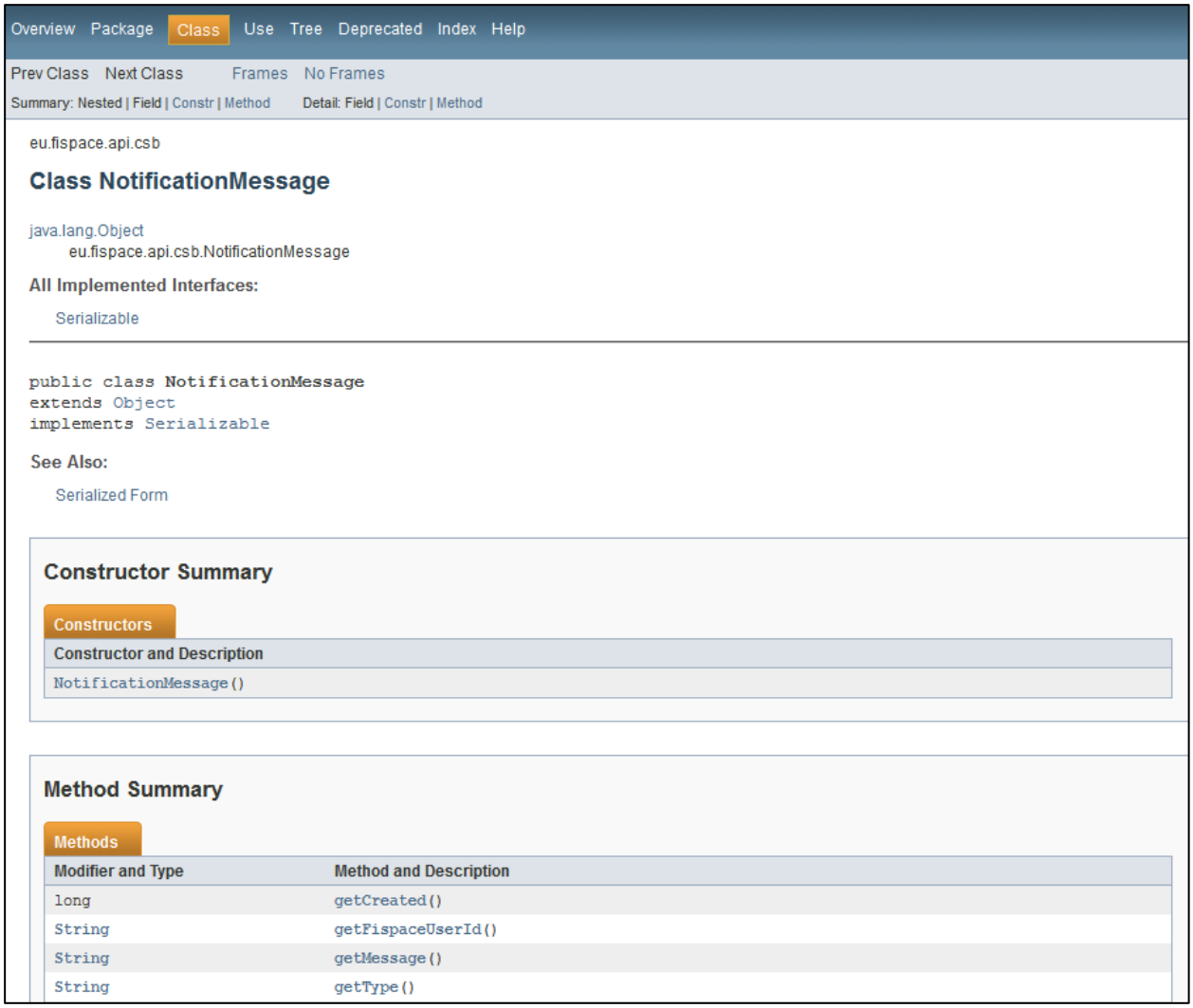


Figure 6: Example for Java Code Expressing Module API by Means of Message POJO



Overview Package Class Use Tree Deprecated Index Help

Prev Class Next Class Frames No Frames

Summary: Nested | Field | Constr | Method Detail: Field | Constr | Method

eu.fispace.api.csb

Class NotificationMessage

java.lang.Object
eu.fispace.api.csb.NotificationMessage

All Implemented Interfaces:

Serializable

```
public class NotificationMessage
extends Object
implements Serializable
```

See Also:

Serialized Form

Constructor Summary

Constructors

Constructor and Description
NotificationMessage()

Method Summary

Methods

Modifier and Type	Method and Description
long	getCreated()
String	getFispaceUserId()
String	getMessage()
String	getType()

Figure 7: Example of Documentation (Javadoc) Generated from Message POJO

4 Terms and Conditions for FIspace Platform Usage

FIspace has set up a dedicated IPR team (see subtask 552 of WP500) for systematically and continuously addressing the IPR and exploitation of the FIspace platform. This team will deliver recommendations and results of an extensive IPR analysis and will deliver its findings in deliverable D500.5.5. The ultimate aim of that deliverable is that the terms and conditions for FIspace platform usage will be unambiguously described, both for stakeholders within the FI PPP (and which have signed the Collaboration Agreement), as well as for stakeholders outside of the FI PPP.

As a first step towards those terms and conditions of FIspace, this section discusses initial, yet key considerations for the IPR analysis from a technology-oriented point of view.

4.1 General Model for Access to Platform Components

Following the FI-WARE model, FIspace delivers an Open Specification, specifying open APIs for the platform modules (see the other sections in this document).

Where it is compatible with the exploitation plans of the individual FIspace members, the platform modules will be offered as open source implementations. Our ambition is to deliver as many of the FIspace modules as open source implementations as possible. At the time of writing, it was evident that the Cloud Service Bus and the Proactive CEP Engine will be *closed* source developments.

For the open source components of the FIspace platform, the GNU General Public License (GPL) v3 is going to set the basis for the respective licenses. GPL is a free, copyleft license for software and other kinds of works. Developers that use the GPL protect their rights along two steps: (1) assert copyright on the software, and (2) offering the license giving legal permission to copy, distribute and/or modify it.

As laid out by the provisions in the FI PPP Collaboration Agreement, independent of their open or closed source nature, the FIspace components are intended to be accessible by all stakeholders of the FI PPP who have signed the Collaboration Agreement. This especially holds for Phase III participants, thus maintaining access to the FIspace outcomes. To further elaborate the terms and conditions of FIspace, FIspace will align with the recommendations and proposals laid out in the INFINITY Whitepaper on “An overview on the Phase III and beyond by the FI-PPP Architecture Board”[5].

4.2 Dependency on Terms and Conditions of Employed Generic Enablers

It should be noted that the terms and conditions of the FIspace platform depend on the terms and conditions of the Generic Enabler implementations (GEis[6]) that have been used to build the FIspace modules. Table 4 provides an overview of the GEis that are used or considered for the FIspace modules’ design at the time of writing.

Each GE implementation may come with different terms and conditions and thus its implications need to be individually analysed for each GEi used by FIspace. This analysis

5 https://docs.google.com/document/d/1gF_V2tFLtr56IYbBFxu7VJ-nvODrV97uvhvQravG3Cg/edit?pli=1

6 Note that the term *Generic Enabler* (GE) refers to the Open Specification of reusable, generic Future Internet capabilities, while *Generic Enabler Implementation* (GEi) refers to the programmatic realization of those capabilities compliant with their respective GE specification.

process is a continuous process, partly due to the facts that (1) GE usage and validation is performed throughout the FIspace project lifespan (which means that the final list of GEis may differ from the current list), and that (2) terms and conditions of FI-WARE GEis may still evolve.

FIspace aims at hiding the complexities of the differing and evolving terms and conditions of GEis from the FIspace platform users as far as possible. This means that, while the platform's pricing model will be driven to a certain extent by how the GEis specify their usage and access approaches, we strive to limit the extent to which those licensing details are exposed to the App Developers, Business Architects or Users of the FIspace platform.

In order to achieve the aforementioned ambitions, FIspace considers it key that the terms and conditions of the FI-WARE GEis should be easy to understand and straightforward such as to ensure usability and uptake. Otherwise, it will be very challenging for FIspace to define the terms and conditions for its platform in a clear, easy to understand and easy to use form such as to foster update by SMEs and web entrepreneurs. To this end, FIspace highly welcomes the ambition set forth for the TF continuation project (FI-WARE follow-up) to offer open source, reference implementations of the Generic Enablers, following clear open source licensing models.

Table 4: Usage of FI-WARE GEs (X = used in design; (X) usage under evaluation)[7]

FI-WARE Generic Enabler	GE Implementation (GEi)	Usage by Fispace
Data Chapter		
Complex Event Processing (CEP)	IBM PROactive Technology ONline (PROTON)/ IBM	X
Publish/Subscribe Broker	Context Awareness Platform / Telecom Italia	X
Advanced FI-WARE Middleware	KIARA / several partners	X
Apps Chapter		
Service Description Repository	Service Description Repository / SAP	X
Service Registry	Service Registry / SAP	X
Marketplace	Marketplace / SAP	X
Store	- / UPM	X
Revenue Sharing	- / TID	X
Application Mashup	WireCloud / UPM	X
Mediator	Mediator_TI / Telecom Italia	X
Mediator	SETHA2 / Thales	(X)
IoT Chapter		
(Backend) Configuration Management	Orion Context Broker - TID	(X)
(Backend) IoT Broker	IoT Broker - NEC	(X)
(Backend) Device Management	IDAS DCA - TID	(X)
(Gateway) Data Handling	Esper4FastData / Orange, SOL-CEP / ATOS	(X)
(Gateway) Device Management	Gateway Device Management / Franhoufer	(X)

[7] An up-to-date list available from: https://docs.google.com/spreadsheet/ccc?key=0AqGGeaQGro3fdEd6bGhLQWtNai1jeGN5UnJMeEdxZ0E#gid=8

FI-WARE Generic Enabler	GE Implementation (GEi)	Usage by Fispace
Security Chapter		
Security Monitoring	Service Level SIEM (SLS) / ATOS; Attack Path Engine/Thales	X
Identity Management	One-IDM / NSN	X
Identity Management	DigitalSelf / NSN	X
Privacy	- / IBM-CH	X
Access Control	- / Thales	X
Data Handling	PPL / SAP	X
Secure Storage	SSS / Thales	X
Context-based Security & Compliance	PRRS/ATOS	X
DB Anonimyzer (Opt)	DBA / SAP	(X)
Malware Detection Service (Opt)	Morphus / Inria	X
Android Flow Monitoring (Opt)	Flowoid / Inria	(X)
Content-based Security (Opt)	CBS / Thales	(X)

5 Conclusion

This document (together with the online module documentation and API specification) has provided the first comprehensive Open Specification of the FIspace platform. It thus constitutes the achievement of the first major milestone in the FIspace platform release plan, i.e., the delivery of the "**Specification**" (see MS2 in the table below).

Table 5: FIspace Platform Releases

Release	Milestone	FIspace Platform
Specification	MS1: **Consolidation** (M 3)	Consolidated conceptual design; Detailed release plan; Development support facilities set-up
	MS2: Specification (M 6)	**Public release of FIspace specification (technical design)**
Aztec	**MS3: Release V1** (M 9)	**1st release of FIspace core feature prototypes ready for trials (internal)**
	MS4: Trial-Round 1 & Large scale expansion (M 12)	Maintenance updates of FIspace V1
Inka	**MS5: Release V2** (M 15)	**2nd release of FIspace (public)**
	MS6: **Trial-Round 2** (M 18)	Maintenance updates of FIspace V2
Maya	MS7: **Release V3** (M 21)	**3rd and final release of FIspace (public)**
	MS8: **Trial-Round 3** (M 24)	Maintenance updates of FIspace V3

What will follow after this "**Specification**" release are three major code releases for the FIspace platform ("**Aztec**", "**Inka**" and "**Maya**"), each providing incrementally more features and capabilities. The feature roadmap for each of the FIspace modules is made available online, together with the documentation and access to the respective code releases, and is accessible from the following URL: https://bitbucket.org/fispace/


FIspace
Business Collaboration