

Deliverable D200.7

Flspace Integrated Release V3

WP 200

Project Acronym & Number:	Flspace – 604 123
Project Title:	Flspace: Future Internet Business Collaboration Networks in Agri-Food, Transport and Logistics
Funding Scheme:	Collaborative Project - Large-scale Integrated Project (IP)
Latest version of Annex 1:	2013-10-03
Start date of the project:	01.04.2013
Duration:	24
Status:	Draft
Editor:	Said Rahma (ATOS)
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Document Identifier:	Flspace-D200.7-Flspace_Integrated_Release_V3-CORE-v0.4.docx
Date:	27.02.2015
Revision:	004
Project website address:	http://www.Flspace.eu

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The Flspace Project

Leveraging on outcomes of two complementary Phase 1 use case projects (Flnest & SmartAgriFood), aim of Flspace is to pioneer towards fundamental changes on how collaborative business networks will work in future. Flspace will develop a multi-domain Business Collaboration Space (short: Flspace) 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, Flspace 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. Flspace 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

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Dissemination Level

PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	X
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, TOC proposal	09.12.2014
002	Update of the contents, added new chapter Flspace documents references	29.01.2015
003	Internal review process, checking URL links to the Flspace Web online documentation, adding the conclusion Update of the abbreviation table, update of the references table Final version ready for submission of approved document	06.02.2015
004	Update of the coordinator information in the section " <i>More Information</i> ", Added Flspace development repository and documentation references, formatting improvement Added a section related to the development updates, update of the table related to the documents annexes, update of the chapter " <i>Conclusion</i> " Final version ready for submission to EC	27.02.2015
005		
006		

Document Summary

This document aims at describing the third release (V3) of the Flspace platform corresponding to the milestone M21, encompassing the implementations along with usage guidance and technical documentation of each Flspace component.

This deliverable reports on the Flspace platform development as carried out under WP 200 (“Flspace Development”). It reports on the description concerning the architecture, and the references to the document annex which describe the development and implementation of the core components that comprise the Flspace platform and their underlying components.

This document is the core deliverable of the D200.7 “Flspace Integrated Release V3” (Milestone M21), which provides the entry points and references to the set of annexes or artifacts related to the D200.7 deliverable that describe the development and implementation of the Flspace core components. This deliverable includes separate referenced documents that extend and complete this deliverable.

These related documents are organized by components and guides that are available as resources for downloading through the public Flspace online documentation web site [13] (<http://dev.flspace.eu/doc/wiki/Home>).

Specifically this deliverable includes:

- Chapter 1: Introduction to the document, including the scope and purpose of the document, and the intended audience.
- Chapter 2: Flspace platform Architecture overview presented as the high level architecture and giving an architectural context that links to the mentioned downloadable documents.
- Chapter 3: Flspace development updates that provide an overview of the main development activities and updates for each Flspace core components that have been performed until the milestone M21.
- Chapter 4: Description and location of the dependencies of the documents and artifacts references related to the Flspace core components, users guideline, developers and business architects guidelines, introducing the main changes or updates of the developments of the Flspace platform corresponding to the integrated release V3.
- Finally, the chapter 5 summarizes the tasks that have been carried out in this deliverable, describing the work and developments performed and the conclusions reached.

Abbreviations

AAA	Authentication, Authorisation, and Accounting	IDE	Integrated Development Environment
ACSI	Artifact-Centric Service Interoperation	IDM	Identity Management
AdvB	Advisory Board	i.e.	id est = that is to say
AJAX	Asynchronous JavaScript + XML	IE	Integration Environment
API	Application Programming Interface	IEC	International Electrotechnical Commission
App	Software Application	IETF	Internet Engineering Task Force
B2B	Business-to-business	I/O	Input / Output
B2C	Business-to-Consumer	IoT	Internet of Things
BCM	Business Collaboration Module in Flspace	IP	Intellectual Property
BCO	Business Collaboration Objects in Flspace	IP (protocol)	Internet Protocol
BE	Business Entities	IPR	Intellectual Property Rights
BPPC	Business Process Participant Configuration	IPsec	Internet Protocol Security
BSS	Business Support Systems	IT	Information Technology
CDR	Charging Detailed Records	ITU	International Telecommunication Union
CEP	Complex Event Processing	ISO	International Standardization Organisation
CSB	Cloud Service Bus	J2SE	Java 2 Platform, Standard Edition
CSS	Cascading Style Sheets	JDK	Java Development Kit
CSV	Comma-Separated Values	JDT	Related to Eclipse Java Development Tools
D	Deliverable	JMX	Java Management Extensions
DAO	Data Access Object	JRE	Java Runtime Environment
DB	Database	JS	JavaScript
DoW	Description of Work	JSON	JavaScript Object Notation
EC	European Commission	JSP	Java Server Page
EDI	Electronic Data Interchange	JVM	Java Virtual Machine
EE	Experimentation Environment	KPI	Key Performance Indicator
e.g.	Exempli gratia = for example	LPA	Logistics Planning Application
EPA	Event Processing Agent	M	Month
EPM	Event Processing Module in Flspace	MTBF	Mean Time Between Failures
ESB	Enterprise Service Bus	MVC	Model–View–Controller
EU	European Union	OASIS	Organization for the Advancement of Structured Information Standards
FIA	Future Internet Assembly	OAuth	Open standard Authentication protocol
FI-PPP	Future Internet Public Private Partnership	OMG	Object Management Group
FP7	Framework Programme 7	OSS	Operational Support Systems
GA	Grant Agreement	P2P	Peer-to-peer
GE	Generic Enabler	PaaS	Platform as a Service
GUI	Graphical User Interface	PDE	Related to Eclipse Java Development Tools
HTML	HyperText Markup Language	PE	Production Environment
IaaS	Infrastructure as a Service	PIA	Product Information App
ICT	Information and Communication Technology		

PIE	Preliminary Integration Environment
PKI	Public Key Infrastructure
PM	Person Month
POM	Project Object Model (used by maven tools)
Proton	IBM Proactive Technology Online
QoS	Quality of Service
RBAC	Role-Based Access Control
RCP	Rich Client Platform
REST	Representational State Transfer
RFC	Request for Comments
RSS	Revenue Sharing System
RTD	Research and Technological Development
SaaS	Software as a Service
SDI	System and Data Integration layer in Flspace
SDK	Software Development Kit
SME	Small and Medium Sized Enterprise
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SOA-RM	(OASIS) Reference Model for Service Oriented Architecture
SPT	Security, Privacy and Trust Framework
SSH	Secure Shell
SSL	Secure Sockets Layer
SSO	Single Sign On
ST	Sub-Task
SWT	Standard Widget Toolkit

T	Task
TCP	Transmission Control Protocol
TIC	Tailored Information for Consumers
TLS	Transport Layer Security
TPM	Transport Planning Module
UAA	User Management, Authentication and Authorisation
UI	User Interface
UML	Unified Modeling Language
URI	Universal Resource Identifier
URL	Universal Resource Locator
USDL	Unified Service Description Language
VM	Virtual Machine
VPN	Virtual Private Network
W3C	World Wide Web Consortium
WADL	Web Application Description Language
WLAN	Wireless Local Area Network
WP	Work Package
WS	Web Service
WSDL	Web Services Description Language
XLS/XLSX	Microsoft Excel file Format
XML	eXtensible Markup Language
XSD	XML Schema Definition

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1 Introduction

This document aims at describing the third release (V3) of the Flspace platform corresponding to the milestone M21, encompassing the implementations along with usage guidance and technical documentation of each Flspace component.

This deliverable reports on the Flspace platform development as carried out under WP 200 ("Flspace Development"). It reports on the description concerning the architecture, the description of the development and implementation of the core components that compose the Flspace platform and their underlying components.

1.1 Document structure and links

The content of this document is structured into the following chapters:

- An introduction to the document, including the scope and purpose of the document, and the intended audience.
- A reminder of the Flspace platform Architecture overview presented as the high level architecture and giving an architectural context that links to the mentioned downloadable documents.
- An overview of the main development activities and updates for each Flspace core components that have been performed until the milestone M21.
- A description and location of the dependencies of the documents and artifacts references related to the Flspace core components, users guideline, developers and business architects guidelines, introducing the main changes or updates of the developments of the Flspace platform corresponding to the integrated release V3.
- Finally, a chapter that summarizes the tasks that have been carried out in this deliverable, describing the work and developments performed and the conclusions reached.

In the following subsections, this task is linked to other tasks and also within the overall project.

1.2 Link to the Flspaces project structure

The work package WP 200 is structured in eight tasks divided in several sub-tasks which goals are specified as follows in the DoW (Description of Work):

- Task 210 - "Technical Architecture, FI PPP Core Platform Validation, and Development Coordination "
- Task 220 – "Flspace Front-End Development "
- Task 230 – "Flspace Store & Revenue Management "
- Task 240 – "Flspace Real-time B2B Collaboration "
- Task 250 – "System & Data Integration (SDI)"
- Task 260 – "Flspace Operating Environment"
- Task 270 – "Flspace Security, Privacy and Trust"
- Task 280 – "Development Environment"

The WP 200 “Flspace Development” includes this document D200.7 – “Flspace Integrated Release V3” which describes and refers to the core components and the work done in the development activities to implement these components.

The sources of requirements for the Flspace development are:

- Mainly the results from the previous deliverable of WP 200: D200.1 [1], D200.2 [2], D200.3 [3] and D200.4 [4], D200.5 [5] and D200.6 [6].
- Information, work done and results of existing platforms, systems, services and Generic Enablers (GEs) implemented and validated in FIWARE, FI-PPP.
- The DoW (Description of Work) as a basic legal reference to be fulfilled.
- The extensive experience of the Flspace consortium partners in Future Internet domain as well as in the management of systems, cloud and communication infrastructure.
- The capacities of the Flspace consortium to setting up, to planning, developing and performing complex system based on components related to several domains of application, business collaboration and Future Internet objectives in the context of the Flspace Project activities.

1.3 Link to the Flspaces annexes and Flspace deliverables

The Flspace “Flspace Integrated Release V3” encompasses the results of the Flspace tasks and the related deliverables as annexes.

Document	Name
D200.1	“ <i>Flspace Design and Release Plan</i> ” where the nature of the dependency is related to the work plan for the Flspace design and implementation including the methodology, tools, and infrastructure to be used for development, the initial release plan for the Flspace with the planned features and a consolidated conceptual design of the Flspace components.
D200.2	“ <i>Flspace Technical Architecture and Specification</i> ” where the nature of the dependency is related to the Technical Architecture of the Flspace along with the detailed technical specification of each of its components. Specifying terms and conditions for usage of specific enablers, also taking into account the involved GEs and their terms and conditions for usage as specified by FI WARE.
D200.3	“ <i>Flspace Integrated Release V1</i> ” where the nature of the dependency is related to the first release (V1) of the Flspace, encompassing the implementations along with usage guidance and technical documentation of each Flspace component.
D200.4	“ <i>Flspace Development Progress Report and V1 Updates</i> ” where the nature of the dependency is related to report on Flspace development progress with updates on the release plan and on the technical architecture and implementations of the Flspace components from release V1 where necessary.
D200.5	“ <i>Flspace Integrated Release V2</i> ” where the nature of the dependency is related to the second release (V2) of the Flspace, encom-

	passing the implementations along with usage guidance and technical documentation of each Flspace component.
D200.6	“ <i>Flspace Development Progress Report and V2 Updates</i> ” where the nature of the dependency is related to report on Flspace development progress with updates on the release plan and on the technical architecture and implementations of the Flspace components from release V2 where necessary.

Table 1: Overview about the document links

1.4 Scope

The aim of this document is mainly to describe and detail the Flspace core components at development and implementation level including the creation of the SDK tools, giving detailed and technical information related to the design and the implementation as well as information about the related technologies and standard taken as a reference to build each component.

In this context, the main challenge of the design, development and implementation of the Flspace core components, which interact between them, is to have in mind also that each component must be deployed and integrated in the corresponding cloud infrastructure (for each release of the Flspace platform, there might be several Integration Environments, Experimentation and Production Environments with their corresponding hosts and VMs for each components), integrating also the sub-systems provided by the Generic Enablers coming from FIWARE that are used by some Flspace core components.

Along this development activities and tasks, there is a set of resources, online documentation, tutorial and other external resource that refer to the Generic Enablers that can provide more technical information and user guides for the community and people who want to use the Flspace platform for Business collaboration or developers who want to create and develop business application (Apps developer) for a specific domain of application.

Table 2 shows the links to other online resources related to Flspace project and FIWARE.

Description	Link
Flspace Business collaboration web site	http://www.fispace.eu/
Flspace Developer Documentation web site	http://dev.fispace.eu/doc/wiki/Home
Flspace Deliverables web site	http://www.fispace.eu/deliverable.html
Flspace Tutorial web site	http://www.fispace.eu/tutorials.html
FIWARE web site	http://www.fi-ppp.eu/projects/fi-ware/
FIWARE Catalogue of the Generic	http://catalogue.fi-ware.org/

Enablers (GEs)	
FIWARE community web site	http://www.fi-ware.org/community/

Table 2: Other Flspace and FIWARE resources

Table 3 shows the links to the Wirecloud online documentation.

Description	Link
FIWARE - Catalogue - Application Mashup - Wirecloud	http://catalogue.fi-ware.org/enablers/application-mashup-wirecloud
FIWARE - Catalogue - Application Mashup - Wirecloud Documentation	http://catalogue.fi-ware.org/enablers/application-mashup-wirecloud/documentation
FIWARE - Application Mashup - Wirecloud - User and Programmer Guide	https://forge.fi-ware.org/plugins/mediawiki/wiki/fiware/index.php/Application_Mashup_-_Wirecloud_-_User_and_Programmer_Guide
Dashboard - Wirecloud home page	http://conwet.fi.upm.es/wirecloud/
Dashboard - The WireCloud Mashup Platform	http://conwet.fi.upm.es/docs/display/wirecloud/The+WireCloud+Mashup+Platform
Dashboard - Welcome to CoNWeT-Wirecloud Confluence	http://conwet.fi.upm.es/docs/dashboard.action
Dashboard - User Guide	http://conwet.fi.upm.es/docs/display/wirecloud/WireCloud+User%27s+Guide
Dashboard - WireCloud Installation and Administration Guide	http://conwet.fi.upm.es/docs/display/wirecloud/Wire-Cloud+Installation+and+Administration+Guide

Table 3: Wirecloud online documentation

Table 4 shows the links to the WStore online documentation.

Description	Link
FIWARE - Catalogue - Store - WStore	http://catalogue.fi-ware.org/enablers/store-wstore
FIWARE - Catalogue - Store - WStore Documentation	http://catalogue.fi-ware.org/enablers/store-wstore/documentation
FIWARE - Store - W-Store - User and Programmer Guide	https://forge.fi-ware.org/plugins/mediawiki/wiki/fiware/index.php/Store_-_W-Store_-_User_and_Programmer_Guide

<p>FIWARE - Store - W-Store - Store - W-Store - Installation and Administration Guide</p>	<p>https://forge.fiware.org/plugins/mediawiki/wiki/fiware/index.php/Store - W-Store - Installation and Administration Guide</p>
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Table 4: Store online documentation

Table 5 shows the external development tools references.

Description	Link
<p>Java Environment, JVM, JRE, JDK (Oracle)</p>	<p>http://www.oracle.com/technetwork/java/javase/downloads/index.html</p>
<p>Eclipse IDE (Integrated Development Environment)</p>	<p>https://www.eclipse.org/, https://www.eclipse.org/downloads/</p>
<p>Maven</p>	<p>http://maven.apache.org/, http://maven.apache.org/download.cgi</p>

Table 5: External development tools references

Table 6 shows the Flspace development repository and documentation references based on the bitbucket tools for collaborative development.

Bitbucket is a hosting site for the distributed version control systems (DVCS) Git (<http://git-scm.com/>) and Mercurial (<http://mercurial.selenic.com/>). The service offering includes an [issue tracker](#) and [wiki](#), as well as integration with a number of popular [services](#) such as Basecamp, Flowdock, and Twitter.

Description	Link
<p>Bitbucket Flspace repository home page</p>	<p>https://bitbucket.org/fispace</p>
<p>Bitbucket Flspace core component home page</p>	<p>https://bitbucket.org/fispace/core/wiki/Home</p>
<p>Bitbucket Flspace Roadmap page</p>	<p>https://bitbucket.org/fispace/core/wiki/roadmap</p>

Table 6: Bitbucket collaborative environment for Flspace development

1.5 Intended audience

The main interest groups of this deliverable are the participating teams and the responsible partners of Flspace project involved in the development activities, setup and preparation of the development phase. This document is relevant to the software engineer, programmers and developers who are the persons directly involved in the development, participating effectively on the design and implementation of the Flspace platform and the underlying components and sub-systems who want to know more about some technical information intrinsic to the Flspace platform.

At the technical level this document is relevant to: system architects; information systems designers; system developers and application developers; software engineers; other audiences who provide design services and applications using relevant standards and the recommendations of standards bodies like IETF, ITU, ISO, W3C, etc.

Partners involved in the integration tasks include: system integrators; people to test, validate and evaluate the Flspace platform and associated systems; can be also interested.

1.6 General remark

This document follows the ISO/IEC Directives, Part 2: Rules for the structure and drafting of International Standards w.r.t. the usage of the word “shall”. The word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this specification.

2 FIspace platform Architecture overview

FIspace will be a Future-Internet-based extensible SaaS-platform. 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 (as shown in Figure 1).

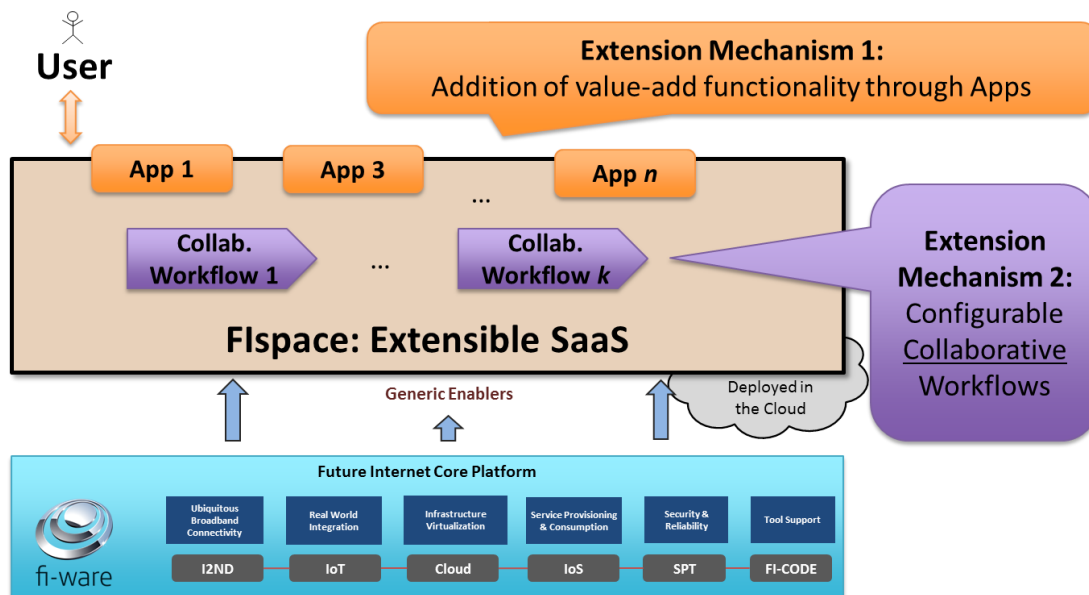


Figure 1: FIspace Platform Approach

2.1 FIspace High-level Conceptual Architecture

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 below.

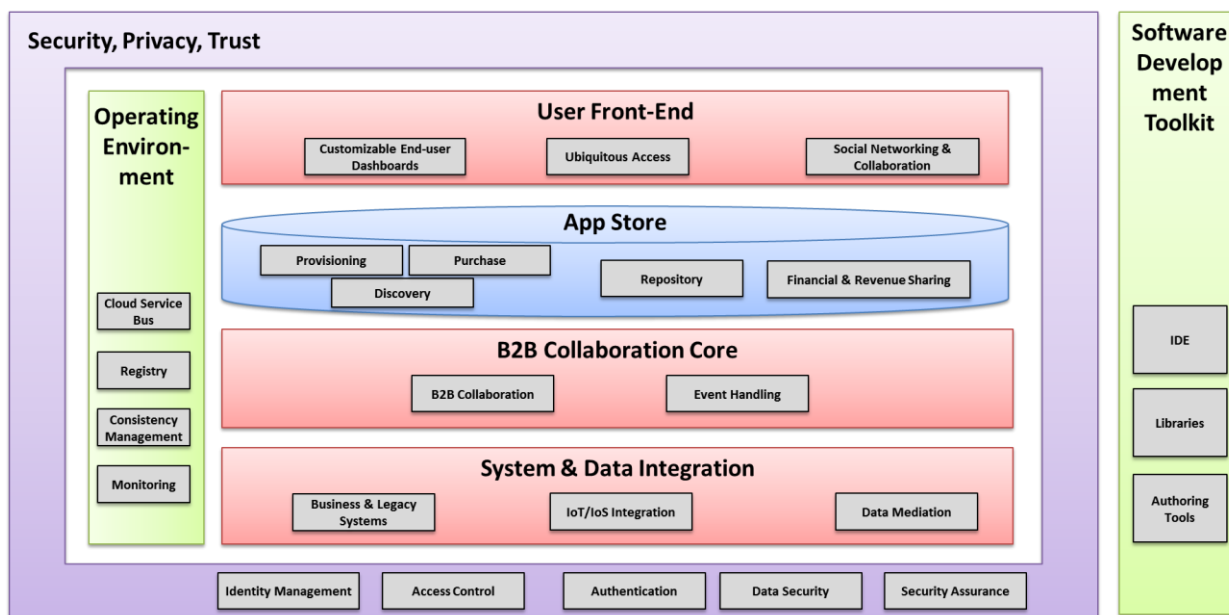


Figure 2: FIspace High-level Conceptual Architecture

Core Layers / Tiers: The Flspace 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 Flspace 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 Flspace 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 Flspace platform provide support for design-time and run-time activities:

- **Software Development Toolkit:** The SDK provides tool-support for the development of Flspace 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 aspects of the platform.
- **Operating Environment:** The Operating Environment ensures the technical interoperability and communication of (possibly distributed) Flspace components and Flspace Apps and the consistent behaviour of Flspace as a whole. Its main feature is the Cloud Service Bus (CSB) providing event bus and pub/sub capabilities.

2.2 System Environment

Flspace will foster the seamless, efficient, and effective business collaboration across organizational boundaries. It will thereby 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 3).

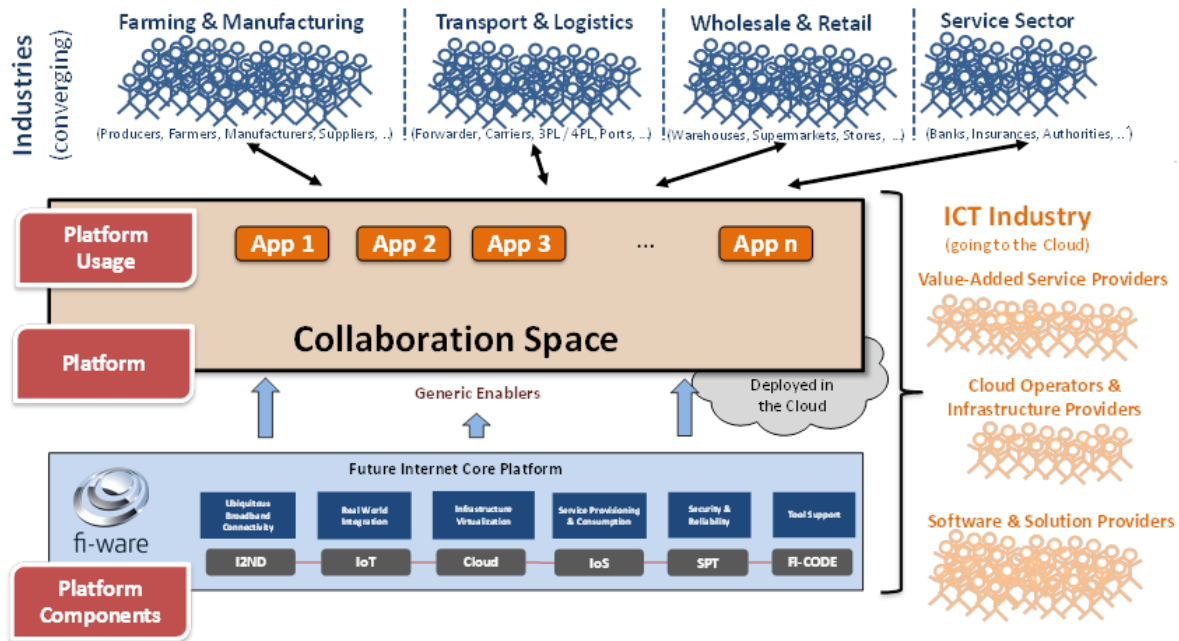


Figure 3: Flspace Platform Approach

2.3 Core Components

2.3.1 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 Flspace 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 Flspace 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: <http://dev.flspace.eu/doc/wiki/gui>

2.3.2 B2B Core

At the heart of the envisaged Flspace 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, manage-

ment, 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 refers to Section “*B2B – Event Processing Module/Business Collaboration Module (EPM/BCM)*” in the document related to the “*Business to business (B2B) component*”). 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 Core: <http://dev.fispace.eu/doc/wiki/b2b>

2.3.3 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 Flspace platform and applications deployed on it. Outputs from the task will facilitate the implementation of Web based, Flspace-driven applications by providing unifying data models, data mediation tools and system integration APIs.

Online documentation for SDI: <http://dev.fspace.eu/doc/wiki/sdi>

2.3.4 App Store

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

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

The Flspace Store is concerned with the software infrastructure to allow for the provisioning and consumptions of Flspace Apps, therewith providing the core elements for the monetization throughout the ecosystem that shall be facilitated by Flspace. All Flspace 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 Flspace 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 Flspace 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 Flspace 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 Flspace Store: <http://dev.fspace.eu/doc/wiki/store>

2.3.5 Security, Privacy & Trust (SPT) Framework

The aim of the Security, Privacy & Trust framework of the Flspace 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 Flspace platform, and industrial technology suppliers who will exploit the Flspace 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 Flspace are:

- **Identity and Trust:** Current situation is that often two business actors establish identity and trust to exchange 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 Flspace 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 identity 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 Flspace platform.
- **Data Security:** Those mechanisms will ensure that data is being encrypted and does not leave the Flspace premises unencrypted, as well as that data can only be accessed by users with the respective credentials.
- **Security Assurance:** Flspace will provide strong security assurance that commercial information and transactions are secure, can be trusted and are not vulnerable to malicious actions. Flspace 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, Flspace 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 Flspace: SPT patterns and guidelines underlie the Development Toolkit (see Section 2.3.6) 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 Flspace platform (i.e., in the Cloud). Rather data resides with the data own-

er (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 “meta-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: <http://dev.fispace.eu/doc/wiki/spt>

2.3.6 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 [26] and corresponding IDE. 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 (Eclipse Java Development Tools) (e.g., classpath containers) or Eclipse PDE (Eclipse Plug-in Development Environment).
 - 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 2.3). This includes tools for authoring of Business Entities and Event Rules (see Section 2.3.2), as well as configuring mediators and connectors to backend systems (see Section 2.3.3).

Online documentation for SDK: <http://dev.fispace.eu/doc/wiki/sdk>

2.3.7 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)” lifecycle, based on IaaS Cloud related OSS and BSS (planned to be provided by FIWARE);

- **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: <http://dev.fispace.eu/doc/wiki/csb>

3 Flspace development updates

This chapter aims to describe the main development updates related to the Flspace core components.

The following section provides an overview of the main development activities and updates for each Flspace core components that have been performed until the milestone M21, summarizing the new features, functionalities and improvement in addition to the features and functionalities already implemented during the previous milestones.

Fundamentally most of the work was to consolidate and extend the security aspects at all levels and for more Flspace core components, consolidating the Single Sign-On capability (SSO) and adopting the OAuth 2.0 specification and protocol to secure the interface of communication from several external entities (SDK, client apps / backend,...).

More detailed description of the new features and functionalities, improvement and technical information are available as a downloadable resource that is provided as a D200.7 document annex corresponding to each components where the references are listed in Table 7.

The following points enumerate the main updates and improvements:

- **Front-End:**

- The Graphical User Interface (GUI) of the Front-End has been updated and improved. A look and feel has been implemented where most of the visual interfaces and user interaction dialogs have been modified, reorganized and improved.
- The login process has been updated and consolidated using the GUI provided by the security component based on Keycloak [32] open source software.
- Profile management GUI has been updated and reorganized.
- Company management GUI has been updated and reorganized.
- Partnership management GUI has been updated and reorganized as well as the notifications icon.
- Language and Flspace customization has been extended.
- The new feature “Guided tour options” has been implemented.
- The new feature “My communities”, as the community’s management, has been implemented allowing to create and remove communities and advanced search for communities.
- The new feature related to the business and capabilities management has been implemented allowing to create and remove business process templates and capabilities.
- Some technical elements involved on the Front-End Web application has been changed concerning new javascript frameworks based on JQuery technologies, the web application server based on Wildfly (<http://wildfly.org>) has been adopted, the security framework based on Keycloak functionalities and identity management (IDM) capabilities has been integrated, the internal Front-End API has been extended to support new functionalities (communities, business and capabilities, extended notifications, advanced search,...), among others.

- **Store:**
 - Security aspects of the store component and underlying FIWARE generic enabler (Wstore) have been integrated with Keycloak technology, modifying the Wstore GE in order to provide a single sign on (SSO) mechanism.
 - The Flspace store component based on the Flspace store API has been consolidated and extended to support secure communication between other components, managing apps and connecting to the CSB, among others.
 - Technological solutions have been investigated and implemented to support and correct some issues intrinsic to the FIWARE generic enablers (Wstore, RSS, Repository,...) and also related to the security capabilities.
 - The Revenue Sharing System (RSS) has been studied and investigated in order to implement and integrate this generic enabler with the Wstore and the communication with Flspace store, preparing the code and environment to implement aspects related to the purchase and monetization functionalities, which is foreseen to complete for the next milestone and corresponding releases.
- **Business to business (B2B):**
 - The main development has been to integrate the security functionalities to the B2B modules based on Keycloak technology which allow establishing secure connections between component interfacing with the B2B components.
 - Development and implementation have been made to extend and improve the interface with the SDI through the CSB component.
 - The management of the business process templates and the management of the capabilities have been consolidated taking into account business process templates, BCM and EPM components integrated with the CSB and BCM Bridge and the corresponding tooling.
 - Access and connections to the ACSI tools has been modified in order to be accessed securely from external entities, i.e. from the Flspace SDK, and to manage the business process configuration.
 - The Business architect manual has been updated to reflect the last changes.
- **System and Data Integration (SDI):**
 - The SDI component, related API and services and external communication, has been secured integrating the SPT functionalities based on Keycloak and integrated in the SSO solution.
 - SDI API, new messages domains and business process template and capability information have been extended and implemented.
 - Management of the business process template and capability information has been improved and implemented.
 - The SDI implementation of the Flspace core API has been updated to include the new specifications of the Flspace core API.
- **Operating environment (Cloud Service Bus – CSB and monitoring):**
 - As the CSB component was a most stable component, which is part of the operative environment, it was studied and investigated to integrate the

monitoring capabilities and functionalities at the service bus coordination level, nodes and client side.

- A prototype of CSB that includes monitoring functionalities has been developed and implemented and tested locally for development purposes (i.e. not integrated in the current Flspace platform and in the release corresponding to the milestone M21). It is foreseen to implement and integrate completely the monitoring capabilities for the next milestone and corresponding releases.
- **Security, Privacy & Trust (SPT):**
 - The SPT component has been consolidated to resolve the security issues and integrating the Keycloak software in the overall components and to extend the Single Sign-On functionality standardizing the access between the Front-End, WireCloud and WStore components.
 - The SPT component currently provides major security functionalities including; user authentication, SSO and Single Log Out for browser applications, user registration and OAuth Clients which provide the security information and credential to authenticate several kind of entities and resources against the Flspace platform.
 - The internal SPT REST API have been improved and extended.
 - Security solutions have been provided in order to correct and improve the security related to the FIWARE generic enablers (Wstore, Wirecloud), which are integrated in the Flspace platform.
 - The logout functionality has been improved at the level of the Front-End to resolve the issues related to correct correctly the ending of the sessions of the FIWARE generic enablers.
 - The security information related to the configuration of the security policy have been generated and provided for each element to secure (components, API and interface of communication) as well as at the level of the apps management.
 - Role Based Access Control functionalities has been provided under the “realm” - concept of a Keycloak.
- **Software Development Kit (SDK):**
 - The security aspect from the SDK point of view has been improved and implemented in order to access securely the resources and the Flspace platform through the SDI component.
 - The SDK OAuth client has been implemented for the authentication process necessary to access Flspace platform.
 - The number of plugins has been extended to provide new features and new functionalities for the developers of application.
 - New plugins have been developed and implemented (sketches plugin, import and export plugin, uploader plugins,...) in addition to the plugins already implemented.
 - Flspace Studio has been improved and adapted to works with the last version of the Eclipse IDE.
 - New archetype related to create apps template have been developed and implemented.

- A set of Flspace connectors have been implemented for various languages of programming (JavaScript, C# - .NET, PHP).
- The Flspace SDK has been consolidated and improved resolving issues and bug fixing.

4 Flspace document references

This chapter aims to present the list of the documents referenced in this deliverable, providing the entry points and references to the documents related to the D200.7 deliverable, which is composed by separate set of documents that extend and complete this deliverable.

This core document references a set of document annex located on the Flspace online web site documentation. This set of documents describe the core components involved in the Flspace core platform, the developments currently performed and the corresponding implementations, the main features developed, the related technologies and the environments required, as well as various guidelines targeted to the users, developers and business architects.

This description is presented in a table format with the following information of the columns:

- **ID:** Identifier of items.
- **Description:** Provide information as a short description related to the corresponding document.
- **Type:** Type of document, scope or target audience.
- **File name:** Formalized name of the corresponding deliverable as the original source of document.
- **Web file name:** Formalized web name for the upload / download document.
- **URL download:** This is the full URL scheme to access the documents.
- **Web page location:** Information about the pages where the document is referenced to access and/or to download the document.

Table 7 shows and establishes the relationships between the referenced documents and the links to the website of the Flspace online documentation.

ID	Description	Type	File name	Web file name	URL download	Web page location
D200.7-FE-GUIDE	The Front-End user guide describes the main features and functionalities of the Front-End component presented as a user guideline related to the business collaboration activities. It describes the graphical user interface (GUI) and the user interaction to login, manage its account and profile among other features.	User guide	FIspace-D200.7-Annex_Front-End_User_Guide-v0.4.pdf	FIspace-Front-End_User_Guide.pdf	http://dev.fispace.eu/doc/downloads/FIspace-Front-End_User_Guide.pdf	http://dev.fispace.eu/doc/wiki/Home http://dev.fispace.eu/doc/wiki/End%20User%20Intro http://dev.fispace.eu/doc/wiki/gui
D200.7-SDK-GUIDE	The SDK developer guide describes the main functionalities of the FIspace Software Development Kit (SDK) presented as a user and developer guideline related to the environment of development and corresponding Integrated Development Environment (IDE).	Developer guide	FIspace-D200.7-Annex_SDK_User_Developer_Guide-v0.4.pdf	FIspace-SDK_User_Developer_Guide.pdf	http://dev.fispace.eu/doc/downloads/FIspace-SDK_User_Developer_Guide.pdf	http://dev.fispace.eu/doc/wiki/Home http://dev.fispace.eu/doc/wiki/App%20Developer%20Intro http://dev.fispace.eu/doc/wiki/sdk
D200.7-BIZ-GUIDE	The Business architects guide is presented as a user guideline related to the business collaboration activities. It provides an overview about the B2B core module, describes the steps to “getting started” with the BCM and EPM modules and the corresponding tools.	Business architects guide	FIspace-D200.7-B2B_Core_Modules_documentation_for_business_architects v0.4.pdf	FIspace-B2B_Core_Business_Architects_Guide.pdf	http://dev.fispace.eu/doc/downloads/FIspace-B2B_Core_Business_Architects_Guide.pdf	http://dev.fispace.eu/doc/wiki/Home http://dev.fispace.eu/doc/wiki/Biz%20Architect%20Intro http://dev.fispace.eu/doc/wiki/b2b
D200.7-FE-TECH	The Front-End technical document describe technical aspects concerning the Front-End core component, at development and implementation level, giving detailed and technical information related to the design and the implementation.	Technical	FIspace-D200.7-FIspace_Integrated_Release_V3-Front-End-v0.4.pdf	FIspace-Front-End-Tech.pdf	http://dev.fispace.eu/doc/downloads/FIspace-Front-End-Tech.pdf	http://dev.fispace.eu/doc/wiki/End%20User%20Intro http://dev.fispace.eu/doc/wiki/gui
D200.7-STORE-TECH	The Store technical document describe technical aspects concerning the Store core component, at development and implementation level, giving detailed and technical information.	Technical	FIspace-D200.7-FIspace_Integrated_Release_V3-Store-v0.4.pdf	FIspace-Store-Tech.pdf	http://dev.fispace.eu/doc/downloads/FIspace-Store-Tech.pdf	http://dev.fispace.eu/doc/wiki/store

ID	Description	Type	File name	Web file name	URL download	Web page location
	mation related to the design and the implementation.					
D200.7-B2B-TECH	The B2B technical document describe technical aspects concerning the B2B core component, at development and implementation level, giving detailed and technical information related to the design and the implementation.	Technical	FIspace-D200.7-FIspace_Integrated_Release_V3-B2B-v0.4.pdf	FIspace-B2B-Tech.pdf	http://dev.fispace.eu/doc/downloads/FIspace-B2B-Tech.pdf	http://dev.fispace.eu/doc/wiki/Biz%20Architect%20Intro http://dev.fispace.eu/doc/wiki/b2b
D200.7-SDI-TECH	The SDI technical document describe technical aspects concerning the SDI core component, at development and implementation level, giving detailed and technical information related to the design and the implementation.	Technical	FIspace-D200.7-FIspace_Integrated_Release_V3-SDI-v0.4.pdf	FIspace-SDI-Tech.pdf	http://dev.fispace.eu/doc/downloads/FIspace-SDI-Tech.pdf	http://dev.fispace.eu/doc/wiki/sdi
D200.7-CSB-TECH	The operative environment (CSB and monitoring) technical document describe technical aspects concerning the CSB core component and monitoring functionalities, at development and implementation level, giving detailed and technical information related to the design and the implementation.	Technical	FIspace-D200.7-FIspace_Integrated_Release_V3-CSB-v0.4.pdf	FIspace-CSB-Tech.pdf	http://dev.fispace.eu/doc/downloads/FIspace-CSB-Tech.pdf	http://dev.fispace.eu/doc/wiki/csb
D200.7-SPT-TECH	The SPT technical document describe technical aspects concerning the SPT core component, at development and implementation level, giving detailed and technical information related to the design and the implementation.	Technical	FIspace-D200.7-FIspace_Integrated_Release_V3-SPT-v0.4.pdf	FIspace-SPT-Tech.pdf	http://dev.fispace.eu/doc/downloads/FIspace-SPT-Tech.pdf	http://dev.fispace.eu/doc/wiki/spt
D200.7-SDK-TECH	The SDK technical document describe technical aspects concerning the SDK tools, at development and implementation level, giving detailed and technical information related to	Technical	FIspace-D200.7-FIspace_Integrated_Release_V3-SDK-v0.4.pdf	FIspace-SDK-Tech.pdf	http://dev.fispace.eu/doc/downloads/FIspace-SDK-Tech.pdf	http://dev.fispace.eu/doc/wiki/App%20Developer%20Intro http://dev.fispace.eu/doc/wiki

ID	Description	Type	File name	Web file name	URL download	Web page location
	the design and the implementation.					i/sdk
D200.7-CORE-TECH	This document itself.	Core deliverable index	FIspace-D200.7-FIspace_Integrated_Release_V3-CORE-v0.4.pdf	FIspace-CORE-Tech.pdf	http://dev.fispace.eu/doc/downloads/FIspace-CORE-Tech.pdf	http://dev.fispace.eu/doc/wiki/Home

Table 7: Documents index and references to the D200.7 annexes

5 Conclusion

The main objective of this document is to provide a clear vision of the development and implementation activities carried out until the milestone M21, corresponding to the Flspace Integrated Release V3.

This deliverable is composed by a set of independent documents. The list of available documents is provided in Table 7. Furthermore, these documents are available online and can be downloaded. There are two types of documents: technical and guides.

Each technical document presents the technical detail related to the different Flspace components focused on viewpoints and models (interface / API operations – class model, data model, interaction model and high level composite architecture), and the related technology.

The previous documents enhance internal information related to the software development of the Flspace core components. These documents are devoted to people who want to know technical detail of these components.

Each guide document provides information for each type of target audience (end-users, developers and business architects).

Moreover, the Flspace core platform system is defined to cover and to encompass the set of features necessary for the End user, the Business Architect and the Apps developer.

Currently the integrated Flspace platform V3 contains and integrates all the core components as referenced in this document and corresponding artifacts, conforming an operative platform for the business collaboration.

The main challenge tackled during this period has been to extend the security functionalities to all the components and entities that interact with the Flspace platform.

Finally, we used the Keycloak open source software to replace the previous security FIWARE generic enabler GE (Digital Self GE and Access Control GE). The Flspace team established a mitigation plan to provide the Security, Privacy and Trust component, when the security GEs became obsolete. This plan was based on using the Keycloak open source software, what was considered the more suitable and concrete solution. Inevitably, the development and implementation of the core components with dependencies with the former security GE have been affected with this replacement.

Also, these changes have affected to the FIWARE GE used in the project. We have faced several problems with the Wirecloud GE, Wstore GE, Repository GE and RSS GE, these problems have affected to, among others:

- GUI integration with the security solution and the Wirecloud GE.
- Unclear or missing functionalities related to the Wstore GEs (RSS, offering, payment,...).
- Integration of the security solution in order to manage the identity (IDM) and roles in the context of SSO concept.
- Several bugs in some GEs have appeared.

These problems have been solved or are in the process of being resolved. Even the support of the FIWARE GEs owners has been needed. For this reason, it has been necessary to create forks of the repository of these FIWARE GEs (Wstore) in order to implement the adapted solution for Flspace in our repositories.

For the next milestone, it is planned to provide a more consolidated and robust Flspace platform improving security of the components, functionalities, optimising the code, adding more features, providing updated information for the users and developers of the application (Apps developers).

In summary, for the next milestone, it is planned to achieve the following goals:

- Ease user management and interaction, role based business configuration, consistent look and feel.
- Monetize the Apps using different payment schemes.
- Complete business process management support and execution level.
- Complete registration, support user access control level.
- Provide the mechanism to monitor the platform and supporting high availability requirements.
- Conclude the comprehensive integrated security (Single Sign-On, Access control, Role-based access control).
- Deliver the FlspaceStudio Tool (visual tool for developer)

6 Glossary

The glossary provides the coherent terminological framework used in this document.

6.1 Terms and definitions

This section provides definitions of any terms that may be needed in order for the reader to understand the terminology used in the document. The author should define any definition/acronym or technical term used in the document that may be unfamiliar to the reader, and it is best to err on the side of too many rather than too few definitions. This also allows the author to frame a word within a specific context, which provides the reader with a common understanding of the author's definition.

Access control

Authorisation (or denegation) for performing a certain action (based on privileges management). The access control is carried out once the Identification and Authentication procedures have been performed.

Accounting

Process of gathering information about the usage of resources by subjects.

Acceptance and trust

Acceptability indicates the degree of approval of a technology by the users. It depends on whether the technology can satisfy the needs and expectations of its users and potential stakeholders. Within the framework of introducing new technologies, acceptability relates to social and individual aspects as well.

Application

Use of capabilities, including hardware, software and data, provided by an information system specific to the satisfaction of a set of user requirements in a given application domain.

Application Domain

Integrated set of problems, terms, information and tasks of a specific thematic domain that an application (e.g. an information system or a set of information systems) has to cope with.

Application Schema [ISO/FDIS 19109:2003]

Conceptual schema for data required by one or more applications.

Architecture (of a system) [ISO/IEC 10746-2:1996]

Set of rules to define the structure of a system and the interrelationships between its parts.

Architecture (of a system) [ISO/IEC 10746-2:1996]

Set of rules to define the structure of a system and the interrelationships between its parts.

Authentication

Process of verifying the identity of a certain subject. In other words authentication indicates whether a subject is who/what it seems to be.

Generally speaking, this proof can depend on a secret that can be, e.g. what somebody has (key, smart card, ...), what somebody knows (password, ...), what somebody is (biometrical data, ...)

Authorisation

Process of determining whether a subject is allowed to have the specified types of access to a particular resource. This is done by evaluating applicable access control information contained in a so called authorisation context. Usually, authorisation is carried out after the identification and authentication. Once a subject is identified and authenticated, it may be authorized (or not) to perform different types of access.

Availability

Availability refers to the degree to which a system, subsystem, or equipment is in a specified operable and committable state at the start of a mission, when the mission is called for at an unknown, i.e., a random time. So, availability is the proportion of time that a system is in operating condition.

Capability

Capabilities are a set of functionalities, through a combination of software and hardware, used to provide services and data. They can reside in a system or for example in a terminal itself as embedded capabilities or they can be available through the network services and infrastructure and others communication technologies as external capabilities.

Catalogue [derived from <http://www.opengeospatial.org/resources/?page=glossary>]

Collection of entries, each of which describes and points to a feature collection. Catalogues include indexed listings of feature collections, their contents, their coverages, and of meta-information. A catalogue registers the existence, location, and description of feature collections held by an Information Community. Catalogues provide the capability to add and delete entries. A minimum Catalogue will include the name for the feature collection and the locational handle that specifies where these data may be found. Each catalogue is unique to its Information Community.

Certificate Authority

A Trusted Third Party, responsible for ensuring the binding between the public keys and the personal data of their respective owners.

Component

Hardware component (device) or Software Component.

Conceptual model [ISO/FDIS 19109:2003(E); ISO 19101]

Model that defines concepts of a universe of discourse.

Conceptual schema [ISO/FDIS 19109:2003(E); ISO 19101]

Formal description of a conceptual model.

Coverage [ISO 19123]

Function from a spatial, temporal or spatiotemporal domain to an attribute range. A coverage associates a position within its domain to a record of values of defined data types. Thus, a coverage is a feature with multiple values for each attribute type, where each direct position within the geometric representation of the feature has a single value for each attribute type.

Data acquisition

Methods of data acquisition include methods to collect background data, digitally acquire data from sensors, and subjective data (such as data acquired from questionnaires). In addition, data in the form of manually or automatically transcribed data and reductions of collected data is also considered sensor acquired data (but with a manual sensor – the analyst).

Description Logics

Family of logic based knowledge representation languages that are a decidable subset of first order logic with well-defined semantics and inferencing (problem decision procedures). In Description Logics, a distinction is made between the terminological knowledge and the assertional knowledge. This distinction is useful for knowledge base modelling and engineering: for modelling it is just natural to distinguish between concepts and individuals; for engineering it helps by separating key inference problems.

Digital Certificate

A kind of digital document that contains structured information about the identity of its owner along with her/his public key, signed all together with a Certificate Authority's private key.

Digital Signature

The encrypted form of a message with the private key of the owner, indicating in a secure way the creator of the message, as well as the identity of a signed data.

Encryption

The act of modifying the contents of a message in an algorithmic and secure way, so that it can not be observed or altered in while in transit.

End-User

All users that are involved in an application domain and that use the applications, the services built by the system users according to the system and service Architecture.

Feature [derived from ISO 19101]

Abstraction of a real world phenomenon [ISO 19101] perceived in the context of an Application. In this general sense, a feature corresponds to an "object" in analysis and design models.

Framework [<http://www.opengeospatial.org/resources/?page=glossary>]

An information architecture that comprises, in terms of software design, a reusable software template, or skeleton, from which key enabling and supporting services can be selected, configured and integrated with application code.

Generic

A service is generic, if it is independent of the application domain. A service infrastructure is generic, if it is independent of the application domain and if it can adapt to different organisational structures at different sites, without programming (ideally).

Identification

The identification process allows relating a person/device with the service environment. The “electronic identity” is something like a credential or a “business card”, suitable to be verified throughout the authentication process.

Implementation [<http://www.opengeospatial.org/resources/?page=glossary>]

Software package that conforms to a standard or specification. A specific instance of a more generally defined system.

Info-structure Service

Service that is required to operate a system oriented service in the sense that it plays an indispensable role in the operation of an architecture or system oriented service.

Interface [ISO 19119:2005; <http://www.opengis.org/docs/02-112.pdf>]

Named set of operations that characterize the behaviour of an entity.

The aggregation of operations in an interface, and the definition of interface, shall be for the purpose of software reusability. The specification of an interface shall include a static portion that includes definition of the operations. The specification of an interface shall include a dynamic portion that includes any restrictions on the order of invoking the operations.

Interoperability [ISO 19119:2005 or OGC; <http://www.opengeospatial.org/resources/?page=glossary>]

Capability to communicate, execute programs, or transfer data among various functional units in a manner that require the user to have little or no knowledge of the unique characteristics of those units [ISO 2382-1]. (<http://www.opengeospatial.org/ogc/glossary/i>)

Loose coupling [W3C; <http://www.w3.org/TR/2004/NOTE-ws-gloss-20040211/#loosecoupling>]

Coupling is the dependency between interacting systems. This dependency can be decomposed into real dependency and artificial dependency: Real dependency is the set of features or services that a system consumes from other systems. The real dependency always exists and cannot be reduced. Artificial dependency is the set of factors that a system has to comply with in order to consume the features or services provided by other systems. Typical artificial dependency factors are language dependency, platform dependency, API dependency, etc. Artificial dependency always exists, but it or its cost can be reduced. Loose coupling describes the configuration in which artificial dependency has been reduced to the minimum.

Middleware [<http://www.opengeospatial.org/resources/?page=glossary>]

Software in a distributed computing environment that mediates between clients and servers.

Open Architecture [based on (Powell 1991)] [39]

Architecture whose specifications are published and made freely available to interested vendors and users with a view of widespread adoption of the architecture. An open ar-

chitecture makes use of existing standards where appropriate and possible and otherwise contributes to the evolution of relevant new standards.

Operation [ISO 19119:2005; <http://www.opengis.org/docs/02-112.pdf>]

Specification of a transformation or query that an object may be called to execute. An operation has a name and a list of parameters.

Performance indicators definition (PI)

PIs are quantitative or qualitative measurements, agreed on beforehand, expressed as a percentage, index, rate or other value, which is monitored at regular or irregular intervals and can be compared with one or more criteria.

Platform (Service)

Set of infrastructural means and rules that describe how to specify service interfaces and related information and how to invoke services in a distributed system.

Reference Model [ISO Archiving Standards; <http://ssdoo.gsfc.nasa.gov/nost/isoas/us04/defn.html>]

A reference model is a framework for understanding significant relationships among the entities of some environment, and for the development of consistent standards or specifications supporting that environment. A reference model is based on a small number of unifying concepts and may be used as a basis for education and explaining standards to a non-specialist.

Reliability

Reliability is the ability of a system or component to perform its required functions in routine circumstances, as well as hostile or unexpected circumstances, under stated conditions for a specified period of time.

Resource

Functions (possibly provided through services) or data objects.

Service [ISO 19119:2005; ISO/IEC TR 14252; <http://www.opengis.org/docs/02-112.pdf>]

Distinct part of the functionality that is provided by an entity through interfaces.

REST

Representational state transfer (REST) is an abstraction of the architecture of the [World Wide Web](#); more precisely, REST is an architectural style consisting of a coordinated set of architectural constraints applied to components, connectors, and data elements, within a distributed [hypermedia](#) system. REST ignores the details of component implementation and protocol syntax in order to focus on the roles of components, the constraints upon their interaction with other components, and their interpretation of significant data elements.

Service [ISO 19119:2005; ISO/IEC TR 14252; <http://www.opengis.org/docs/02-112.pdf>]

Distinct part of the functionality that is provided by an entity through interfaces.

Session

Temporary association between a subject and a principal as a result of an authentication process initiated by the subject. Information about a session is stored in authentication session information.

SOAP

Simple Object Access protocol is a [protocol](#) specification for exchanging structured information in the implementation of [web services](#) in [computer networks](#). It uses [XML Information Set](#) for its message format, and relies on other [application layer](#) protocols, most notably [Hypertext Transfer Protocol](#) (HTTP) or [Simple Mail Transfer Protocol](#) (SMTP), for message negotiation and transmission.

Software Component [derived from component definition of <http://www.opengeospatial.org/resources/?page=glossary>]

Software program unit that performs one or more functions and that communicates and interoperates with other components through common interfaces.

Source System

Container of unstructured, semi-structured or structured data and/or a provider of functions in terms of services. The source systems are of very heterogeneous nature and contain information in a variety of types and formats.

Support Service

Service that facilitates the operation of an architecture or system oriented service, e.g. providing an added value by combining the usage of Info-Structure Services.

System [ISO/IEC 10746-2:1996]

Something of interest as a whole or as comprised of parts. Therefore a system may be referred to as an entity. A component of a system may itself be a system, in which case it may be called a sub-system.

Note: For modelling purposes, the concept of system is understood in its general, system theoretic sense. The term "system" can refer to an information processing system but can also be applied more generally.

System User

Provider of services that are used for an application domain as well as IT architects, system developers, integrators and administrators that conceive, develop, deploy and run applications for an application domain.

Terminal

Terminals are a mobile device that is capable of running mobile services and/or mobile applications.

Use case

A common definition of use cases is the one described by Jacobson (Jacobson et al (1995) [40]): “*When a user uses the system, she or he will perform a behaviourally related sequence of transactions in a dialogue with the system. We call such a special sequence a use case*”. In Other words, a use case is a textual presentation or a story about the usage of the system told from an end user’s perspective.

The use cases provide some tools for people, with different skills (e.g. software developers and non-technology oriented people), to communicate with each other. The use

cases are general descriptions of needs or situations that often are related to basic scenarios and that are independent of the technologies and implementations of the underlying system.

User

Human acting in the role of a system user or end user of the service and system.

WADL

The Web Application Description Language is a machine-readable [XML](#) description of [HTTP](#)-based [web](#) applications (typically [REST web services](#)) WADL models the resources provided by a service and the relationships between them. WADL is intended to simplify the reuse of web services that are based on the existing HTTP architecture of the Web. It is platform and language independent and aims to promote reuse of applications beyond the basic use in a web browser.

Web Service

Self-contained, self-describing, modular service that can be published, located, and invoked across the Web. A Web service performs functions, which can be anything from simple requests to complicated business processes. Once a Web service is deployed, other applications (and other Web services) can discover and invoke the deployed service.

W3C Web Service [W3C, <http://www.w3.org/TR/2004/NOTE-ws-gloss-20040211/#webservice>]

Software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically WSDL). Other systems interact with the Web service in a manner prescribed by its description using SOAP-messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards.

7 References

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