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DOME

(Distributed Open Marketplace for Europe)

D3.5 DOME Technical Infrastructure (v2)

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Acronyms

Acronym	Definition
BAE	Business API Ecosystem
CI/CD	Continuous Integration / Continuous Delivery
IaC	Infrastructure as Code
IAM	Identity and Access Management
JWT	JSON Web Token
NGSI	Next Generation Service Interfaces
NGSI-LD	Next Generation Service Interfaces - Linked Data
NLP	Natural Language Processing
ODRL	Open Digital Rights Language
OIDC4VCI	OpenID Connect for Verifiable Credentials Issuance
OID4VP	OpenID Connect for Verifiable Presentations
PDP	Policy Decision Point
PEP	Policy Enforcement Point
VC	Verifiable Credential
VP	Verifiable Presentation

1 Introduction

Cloud computing is identified as a central piece of Europe's digital future, giving European businesses and public organisations the data processing technology required to support their digital transformation. The European Commission thereby stepped up its efforts to support cloud uptake in Europe as part of its strategy, notably with the pledge to facilitate "the set-up of a cloud services marketplace for EU users from the private and public sector". DOME will materialise the envisioned online marketplace, providing the means for accessing trusted services, notably cloud and edge services, building blocks deployed under the Common Services Platform and more generally any software and data processing services developed under EU programmes such as the Digital Europe Programme, Horizon 2020 or Horizon Europe. Relying on Gaia-X concepts and open standards, DOME will serve as the final piece in the technical architecture that the Digital Europe Program is constructing to accelerate the growth and adoption of trusted Cloud and Edge services in Europe. It will serve as a central hub, fostering trustworthy connections between customers and service providers. DOME will take the form of a federated collection of marketplaces connected to a shared digital catalogue of cloud and edge services. Each of the federated marketplaces will be independent or connected to the offering of given cloud providers which, in turn, can be classified as cloud IaaS providers or cloud platform providers (each of which provide a platform targeted to solve the integration of vertical data/application services from a given vertical domain, like smart cities or smart farming, or the integration of certain type of data/application services, e.g., AI services). DOME relies on the adoption of common open standards for the description of cloud and edge services and service offerings, as well as their access through a shared catalogue.

1.1 Executive Summary

DOME is designed as a federated ecosystem comprising independent providers and marketplaces interconnected through a shared digital catalogue of cloud and edge services. In addition to these marketplaces, DOME incorporates the full functionality of a marketplace itself, providing visibility to all the services across the federation, and including a central portal where cloud and edge service providers can publish their offerings, and end customers can procure products. The planned features of the DOME marketplace are the result of an in-depth analysis of stakeholder requirements[1] [2], the evaluation of various business models[3], and the conceptualisation study[4] initiated by the European Commission.

To bring this envisioned federation and central marketplace to fruition, the DOME environment is built around three major subsystems:

- **Trust and IAM Framework:** This ensures secure and trusted operations without relying on a central authority for all interactions.

[1] Project deliverable D2.1 "DOME requirements (v1)
[2] Project deliverable D2.5 "DOME requirements (v2)
[3] Project deliverable D5.1 "DOME Business Model (First version)
[4] https://digital-strategy.ec.europa.eu/en/library/building-european-cloud-marketplace-conceptualisation-study

- **Decentralised Persistence Layer:** This subsystem provides essential storage and persistence capabilities for marketplace catalogues and transactional data.
- **DOME Central Marketplace:** This serves as the DOME-operated marketplace and as a reference implementation of a federated marketplace, featuring value-added services that enhance trust and streamline the procurement process, operated by DOME with a provider-neutral approach.

To ensure efficient and reliable software development, the project follows a robust integration and release strategy grounded in Continuous Integration/Continuous Deployment (CI/CD) principles. This approach accelerates development cycles, fosters collaboration, and delivers high-quality software to users. Supporting tools have been carefully selected and implemented for development, release, planning, and monitoring activities. While briefly introduced here, the specifics of this process are detailed in project tasks T4.1 and T4.2, and documented in deliverables D4.1 and D4.3.

Development and integration activities began early in the first year of the project, following established guidelines and platform design principles. An initial release plan was established to support regular releases (almost monthly) and ensure a production-level deployment during the second year. This deployment aimed initially to collect feedback from a broader user base beyond the consortium members; currently it consists of the actual production-level marketplace instance, exposing product offerings from consortium partners and is the object of extensive dissemination and networking activities promoting the initiative.

This document accompanies the release of the second version of the DOME marketplace core technology, representing a significant step in realising the DOME reference architecture. The release comprises 23 components developed or integrated within WP3, offering the current implementation of the platform; the reported components also include those delivering customer support and certification compliance, developed or integrated within WP4. The document details the released artefacts, their functionalities, download and installation instructions, licensing, and support contacts.

Aligned with the project schedule, this is the second of three major releases planned at the end of each project year, each accompanied by a corresponding deliverable and milestone:

- **First release:** Delivered at M12 and documented in D3.2.
- **Second release:** Delivered at M24 and documented in D3.5 (this document).
- **Third (final) release:** Scheduled for M36 and to be documented in D3.8.

The live instance of the current release is available at https://dome-marketplace.org.

1.2 Intended audience

This document is meant to provide valuable information, guidance and references to:

- Owner of the DOME marketplace (a.k.a. DOME Operator) to gather all required software artefacts and documentation to initiate the deployment and maintenance of the DOME software platform.
- DOME project partners, in particular federated marketplaces and providers, willing to deploy and run local instances of (part of) the DOME platform for development and testing purposes.

- Potential federated marketplaces and providers outside the consortium, wishing to gain knowledge on the open-source technical foundation of the DOME platform.

1.3 Structure of the document

This document is structured as follows:

- Section 2 DOME Marketplace Overview - recalls the main architecture of the DOME platform, including the functional role of each composing module and major interactions among them.
- Section 3 Integration and Release Process - provides an overview of the approach adopted for integration and release of the DOME platform, based on CI/CD principles and practices, their planning and monitoring.
- Section 4 DOME Marketplace second release - provides detailed information and references for each component introduced in section 2 that has been released as of December 2024.
- Section 5 Conclusions

1.4 Related documents and resources

Following is a list of valuable links to relevant documents and resources:

- EU Digital Identity Wallet Architecture and Reference Framework
- DSBA Technology Convergence: Discussion Document
- Digital Signature Service - DSS
- DID ETSI Legal person Semantic Identifier Method Specification (did:elsi)

Also, this document is related to other technical deliverables produced within the DOME project:

- Deliverable D1.2 “Technical Management Plan”
- Deliverable D2.5 “DOME requirements (v2)”
- Deliverable D3.4 “DOME Reference Architecture and Specifications (v2)”
- Deliverable D3.6 “DOME APIs (v2)”
- Deliverable D4.1 “Real deployment scenarios and DOME validation (Initial version)”
- Deliverable D4.2 “Methodological framework for the continuous compliance of cloud services in DOME.”
- Deliverable D4.3 “DOME operation report (v1)”

2 DOME Marketplace Overview

The **DOME Marketplace** is a comprehensive online catalogue of cloud and edge product offerings, available through a federation of independent marketplaces and diverse product and service providers. Its unique value lies in its ability to generate and utilize **verifiable credentials**, ensuring the publication and facilitating the procurement of trusted services in compliance with EU regulations. This enables a standardized process to verify that services and providers are both certified and trustworthy.

Key Benefits of the DOME Marketplace

The **DOME Marketplace** offers significant advantages to its users:

- **Trusted and Standardized Access**: ensures seamless access to service providers' offerings that match customer demands.
- **Verified and Comparable Services**: facilitates the comparison of services and products based on verified qualifications.
- **Transparent Transactions**: simplifies procurement and management processes through a straightforward and transparent approach.

With its single aggregated catalogue, populated exclusively by pre-validated European suppliers, the **DOME Marketplace** streamlines the procurement journey, enhances vendor selection, reduces search and evaluation times, enables easier product comparison, accelerates purchasing processes, and simplifies spending analysis. These features benefit both buyers and suppliers, creating value across the entire European digital ecosystem.

How the DOME Marketplace Works

At its core, and as described in Deliverables D3.1 and D3.4, the **DOME Marketplace** operates as a federated collection of marketplaces interconnected by a shared digital catalogue of cloud and edge services, classified into data, application, and infrastructure services. Each federated marketplace can be independently operated or linked to the offerings of cloud/edge infrastructure providers, including IaaS and platform services.

Besides this federation, DOME implements all the functionalities of a marketplace itself (see https://dome-marketplace.org), including a marketplace portal through which cloud/edge service providers may register their product offerings and end customers can procure offered products. Moreover, the DOME Marketplace introduces advanced **brokerage components**, such as catalogue management, ordering, provisioning, usage tracking, billing, invoicing, tailored offerings, and revenue-sharing mechanisms.

Supporting EU Digital Strategy

Aligned with the *Conceptualisation Study for Building a European Cloud Marketplace*[5], the DOME Marketplace ecosystem is designed to serve both customers and providers in a **trusted and secure business environment**. It supports tailored procurement journeys through flexible configurations, diverse offerings, and adaptable pricing/payment models.

[5] https://digital-strategy.ec.europa.eu/en/library/building-european-cloud-marketplace-conceptualisation-study

This platform is especially valuable for European public and private entities that are navigating their digital transformation. Its role in increasing the adoption of trusted cloud and edge services is pivotal to achieving the EU's objectives for strategic digital autonomy and innovation in sectors critical to Europe's economic and societal resilience.

The figure below presents a comprehensive listing of actual and planned DOME services, clustered according to their concern and differentiated as system services to be integrated or developed and supporting services to support and promote the marketplace to the community:

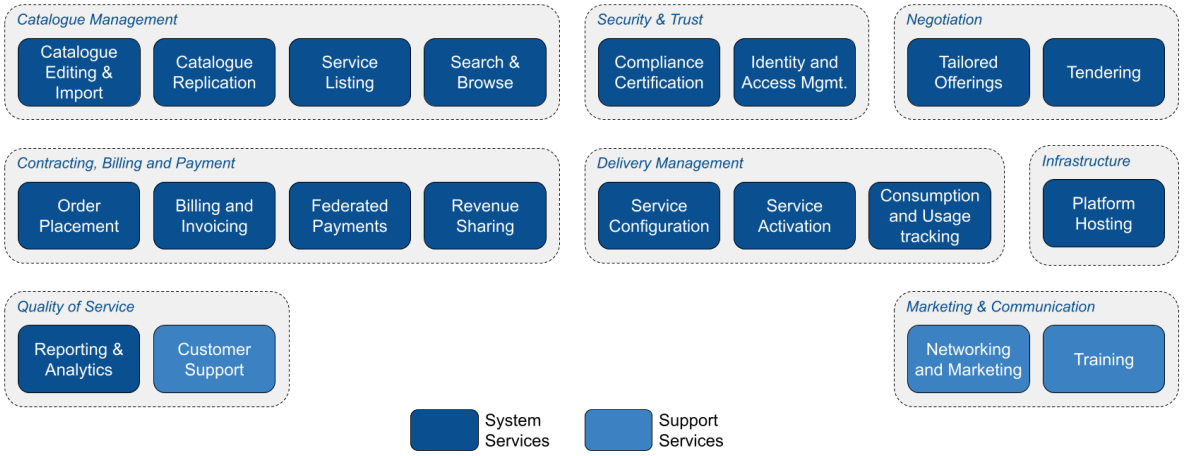


Fig. 1: List of planned DOME services clustered according to their concern

System services have been analysed, designed and realised to different degrees of detail and maturity (see deliverable D3.4). Similarly, support services are being designed or - in some cases - are already being operated (see D2.6 and D2.7 regarding Marketing and Networking future deliverable D4.3 regarding Training).

2.1 DOME high-level architecture

The high-level view of the DOME architecture is recalled below[6], including major technical building blocks (blue and yellow boxes on the right) along with relevant stakeholders involved in marketplace processes.

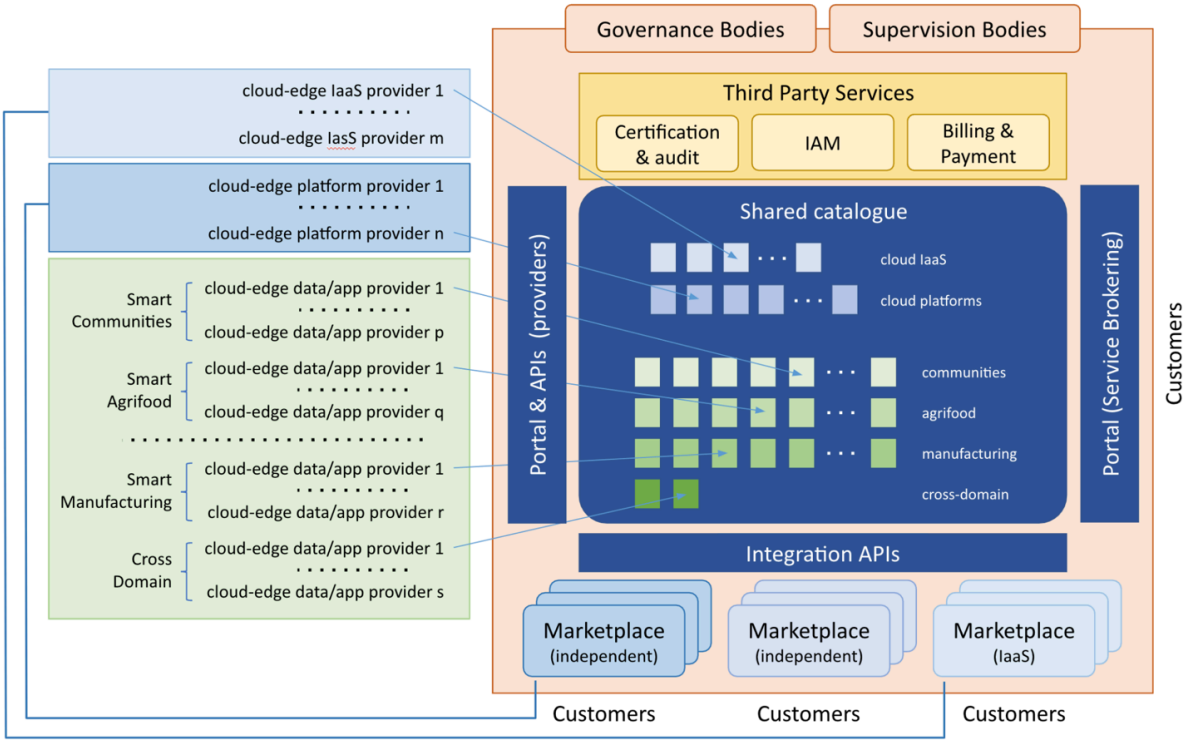


Fig. 2: DOME High-level vision of DOME architecture, operating model and roles

An alternative system view, with a more technical focus, is the following:

[6] A detailed discussion of all aspects of the DOME architecture has been presented in deliverable D3.4 “DOME Reference Architecture and Specifications (v2)”. It is not the goal of this section to report any additional design choice; rather, it is intended to provide a short recap to ease the reading.

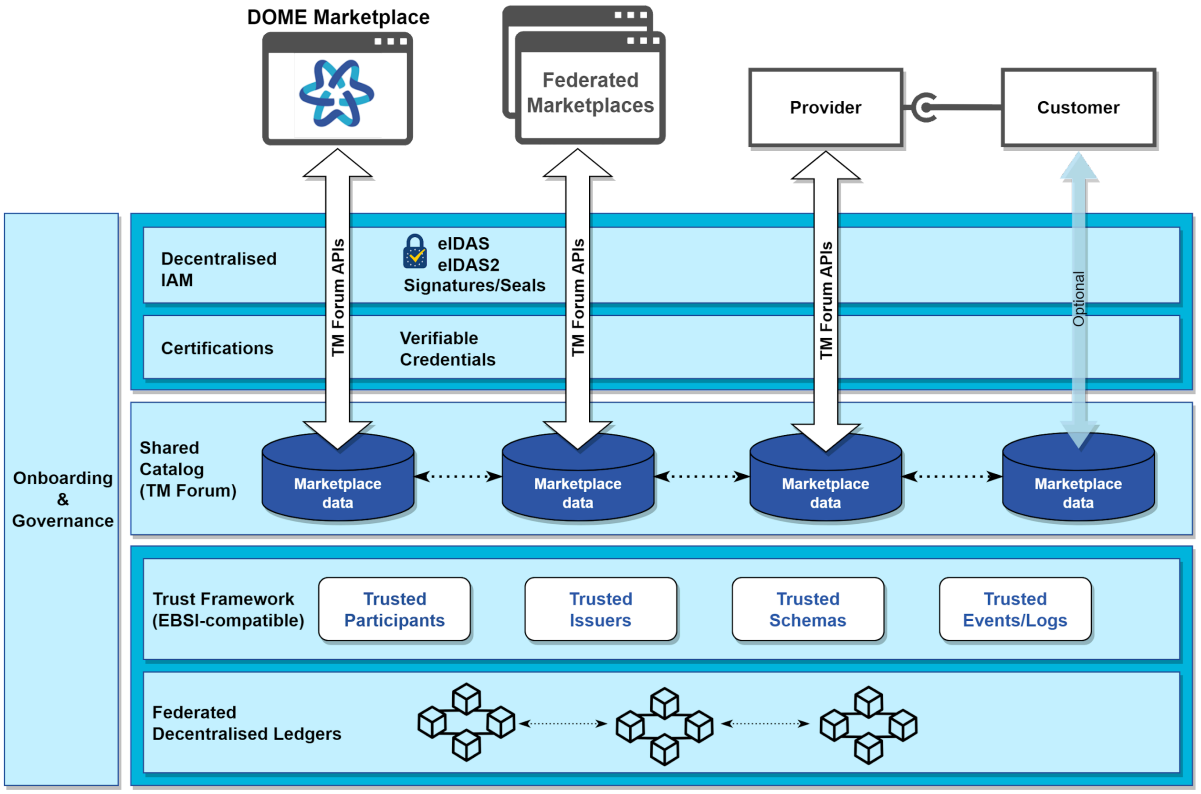


Fig. 3: DOME system view

Stepping from these overall views, three major subsystems have been identified to cope with corresponding enabling and business features, namely:

- The Trust and IAM Framework - to enable the trusted operation with the system without requiring a central entity intermediating in all interactions.
- Decentralised Persistence Layer - to provide the necessary persistence and storage capabilities for marketplace catalogues and transactional data.
- The DOME central marketplace and value-added services - a reference implementation of a federated marketplace, enriched with features enhancing the quality and trust of the procurement process and operated by DOME with a provider-neutral approach.

Within such wide subsystems, a number of components have been identified to be developed and/or integrated to deliver a set of features for customers and providers, as most relevant stakeholders. The full listing of such components is provided in Section 4, later in this document,

2.1.1 The Trust and IAM Framework

The Trust framework ensures that the information published on DOME is trustful. It defines and enforces a set of rules that actors in the DOME ecosystem (data/app service providers, federated marketplace providers, end customers) agree to follow. By following them, all organisations can use their digital identities and characterise services in a consistent and trustful manner. This lowers the barriers for organisations to complete transactions or share information with other organisations.

The IAM framework, on the other hand, enables actors in the DOME ecosystem to authenticate into DOME services (i.e., the DOME Portal, federated marketplace portals or TM Forum APIs implemented on top of the DOME Persistence Layer) and help to manage proper access to those services based on their profiles. This IAM framework relies on Verifiable Credentials/Verifiable Presentations and leverages the Trust framework to provide an efficient, scalable, and decentralised IAM that participants can use. The Trust and IAM framework implemented in DOME is not only for managing authentication and authorization in the interaction with the DOME services, but it is also available for data/app services which may use it for managing the interactions between them and their users.

2.1.2 The Decentralised Persistence Layer

The goal of the DOME Persistence Layer is to provide the necessary persistence and storage capabilities for the two conceptual components: the Shared Catalog, and the Transaction Ledger.

The Shared Catalog stores descriptions and specifications (Product Specification and Product Offerings) of cloud and edge services in the form of Verifiable Credentials and/or Verifiable Presentations, and other information for the DOME ecosystem consumption.

The Transaction Ledger securely records transactions, including products (the instances of the Product Specifications), Product Orders, and Product Usage.

2.1.3 The DOME central marketplace

On top of the foundation technologies introduced earlier, the DOME project realises an open standard-based, vendor-neutral reference framework to support federation of marketplaces.

Among those marketplaces, a notable instance is represented by the DOME marketplace itself, operated according to provider-neutral, inclusion and equality principles. The DOME central marketplace provides the needed backend and portal services for a) service providers to administer the description of their services and monitor their lifecycle as well as for b) end users to discover services and transition to marketplaces through which they will activate them for actual use, typically on environments setup on the cloud or edge by IaaS or Platform providers.

2.1.4 Value-added DOME services

In addition to the core features delivered by the DOME central marketplace and the mechanisms enabling the federation of marketplaces, DOME will include additional services enhancing the quality and trust of the procurement process. In particular:

- In terms of certification of providers, marketplaces and published offerings, DOME developed a formal process and methodological framework to verify the **compliance against reference standards**; such a process is supported by tools to automatically and continuously monitor the validity of the certificates and that security requirements are being fulfilled.
- A **payment subsystem**, including payment gateway connection handling, payment instrument saving and managing clearing and settlement (in case of the centralised

payment gateway account management version), including the handling of bank transfers as well.

- **Brokerage facilities**: DOME is progressively including services enabling a seamless procurement process in a federated environment. Each aspect of the procurement journey is considered in a potential federated scenario (i.e. catalogue management, ordering, provisioning, usage tracking, billing, invoicing, tailored offerings, and revenue sharing).
- **NLP-enabled search capabilities** with the goal of connecting customers with relevant and coherent services as quickly as possible. The subsystem will feature search algorithms specific to the customer's sector to provide results taking into account the customer's particularities. It also will exploit additional information (e.g., service ratings, click rates) to prioritise/rank search results.
- **Monitoring, reporting and analytics capabilities on business-level KPIs**. It is intended to be used by different DOME user classes, like the service providers and consumers, federated marketplaces operators and the DOME operator. It allows the creation of datasets out of different database data sources, which are either located on the DOME infrastructure or on the federated Marketplaces infrastructure, and their visualisations that can be combined into dashboards, according to the user's preferences.
- **Customer support capabilities** powered by an AI-based chatbot, a trouble ticketing system and a knowledge base, with the goal of solving any kind of need the portal user may express in relation to the usage and usability of the DOME portal (thus including the DOME central marketplace but also value-added services mentioned here)

3 Integration and release process

Within the DOME project, a coherent and extensible framework for integration and release has been meticulously established to maintain the integrity and efficiency of software development and deployment processes. This framework is anchored in the principles of Continuous Integration and Continuous Deployment (CI/CD), bolstered by state-of-the-art tools, environments, and monitoring techniques.

This section provides a short summary of the approach, tools and procedures adopted, while details are included in project deliverables D4.1 “Real deployment scenarios and DOME validation (Initial version)” and D4.3 “DOME operation report (v1)”.

3.1 Version control and repository Management

DOME leverages on GitHub[7] as the cornerstone of its version control system, facilitating collaborative initiatives, meticulous version tracking, and comprehensive code reviews. Predominant repository categories include:

- **Application Code Repository:** Each component of the DOME architecture is allocated a dedicated repository, under the stewardship of the respective development teams.
- **Infrastructure as Code (IaC) Repository:** A centralized repository dedicated to deployment configurations, maintained by a specialized GitOps team.

The integration process hinges on Pull Requests (PRs), which are mandated to encompass:

- Manifest Files: Detailed specifications on functionality, dependencies, and environmental settings.
- Dependency Lists: Exhaustive cataloging of libraries and other dependencies.
- Static Code Analysis: Code quality is assured through the use of tools such as SonarQube.

3.2 GitOps Deployment Workflow

The GitOps methodology, executed via ArgoCD, orchestrates deployments across varied environments, positioning Git repositories as the definitive source of truth for system configurations. ArgoCD facilitates declarative, automated, and version-controlled deployments, thereby maintaining reliability across environments.

DOME implements the "App of Apps" pattern, offering a holistic perspective of the system's state and efficient management of interdependent applications.

[7] https://github.com/DOME-Marketplace

3.3 Deployment Strategy and Environments

The DOME deployment strategy incorporates four distinct environments to enhance integration and testing:

- Prototyping (SBX): Serves as the initial testing ground for early-stage validation.
- Development (DEV): An optional environment dedicated to thorough integration testing and API validation.
- Pre-Production (DEV2): The conclusive testing ground for Quality Assurance (QA).
- Production (PRD): The live deployment environment for end-users.

Preferred Pathway:

- SBX → DEV2 → PRD: This pathway corroborates that components are validated incrementally from prototyping to production.

Weekly Deployment Cycle:

- Adhering to a weekly deployment cycle, a feature freeze is imposed one week prior to release to stabilize the codebase and mitigate production risks. The PRD environment utilizes a blue-green deployment[8] strategy to reduce downtime and facilitate quick rollbacks if necessary.

3.4 Integration Pipeline Framework

The integration pipeline underpins DOME's CI/CD framework, embodying the following processes:

- Code Management: Source code is systematically versioned and maintained across GitHub repositories.
- CI Pipelines: Automated builds, static analysis (SonarQube), and security scans (OWASP ZAP) ensure code quality and compliance.
- Testing:
  - Unit Testing: Validates individual components.
  - Integration Testing: Evaluates inter-component interactions.
  - Performance Testing: Executed with tools like Apache JMeter and Gatling.
- Containerization: Applications are encapsulated within Docker containers, ensuring portability and consistency.
- Deployment Automation: ArgoCD synchronizes deployment environments to the predefined state within Git.

[8] Blue-green deployment strategy involves the use of two identical environments, one production (live) and one pre-production (where final testing of updates is performed). Once the pre-production environment with the updates is tested, the servers are swapped, ensuring a nearly instant update of the live environment, with no downtime.

3.5 Support to release planning and monitoring

The DOME project relies on **Jira**[9] as a central platform for development and release management. DOME has adopted a customised hybrid approach that integrates **Scrum**[10] and **Kanban**[11] principles, fostering a flexible and adaptive structure. Unlike rigid sprint cycles, DOME follows a more adaptable method that leverages a backlog alongside standard Kanban Boards, enhancing the visibility and organization of DOME issues. This approach empowers developers to seamlessly transition items through various states based on ongoing releases and work progress.

Releases are identified and crafted during project management meetings, and individual issue progress is closely monitored during project calls. This regular assessment within the Kanban methodology fosters effective communication and enables timely adjustments, ensuring the project stays on track.

Release management is a crucial aspect of our software development and project management strategy. In Jira, releases are referred to as "*versions*", signifying specific points in time within the project. This framework allows us to systematically schedule and control the delivery of features and improvements (at the time of writing this updated document, the target release to be considered is "*2024.12 Matterhorn*"). See chapter 4 for detailed information about releases.

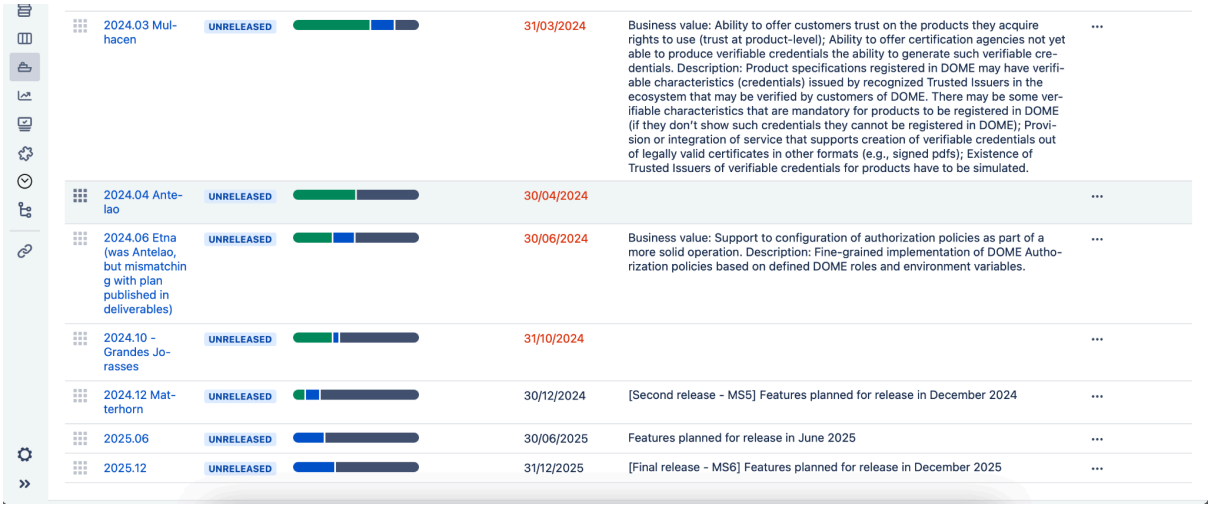


Fig. 4: Releases overview in Jira

All development teams are tasked with populating the Jira Backlog and allocating items to specific releases based on project requirements. As teams actively engage with specific tasks, they must update the status of items, adhering to the workflow outlined in the Kanban Boards.

The Kanban Boards have been improved with the addition of new columns compared to the previous version of this document. These enhancements were implemented to provide a better user experience and align the project's needs with Jira. This continuous improvement

[9] https://www.atlassian.com/software/jira
[10] https://www.scrum.org
[11] https://en.wikipedia.org/wiki/Kanban_(development)

process has been driven by regular feedback and discussions during weekly meetings, allowing us to consistently refine and optimize the tool.

The columns are now organized as follows (see picture below):

- **TO DO**: This column is intended for adding items that teams plan to work on within a specific time frame chosen individually by each development team.
- **InProgress/Coding**: This column tracks all items currently in progress, covering both development tasks and other project activities (such as drafting project deliverables, skill acquisition, weekly calls, etc);
- **SBX (Sandbox)**: This is the first staging step for software components that are under active development and intended to contribute to the final marketplace product. Items in this column are not yet ready for production but are moving towards pre-production;
- **PRE (Pre-Production)**: As the name suggests, this column represents the stage before production, where final testing and validation occur;
- **PROD (Production)**: This column includes all items that are live in the production environment and accessible to external users;
- **DONE**: This column is for activities or developments that have a defined start and end but are not part of the production environment. It may include outdated code versions, internal setups, published deliverables, or other non-production artifacts;

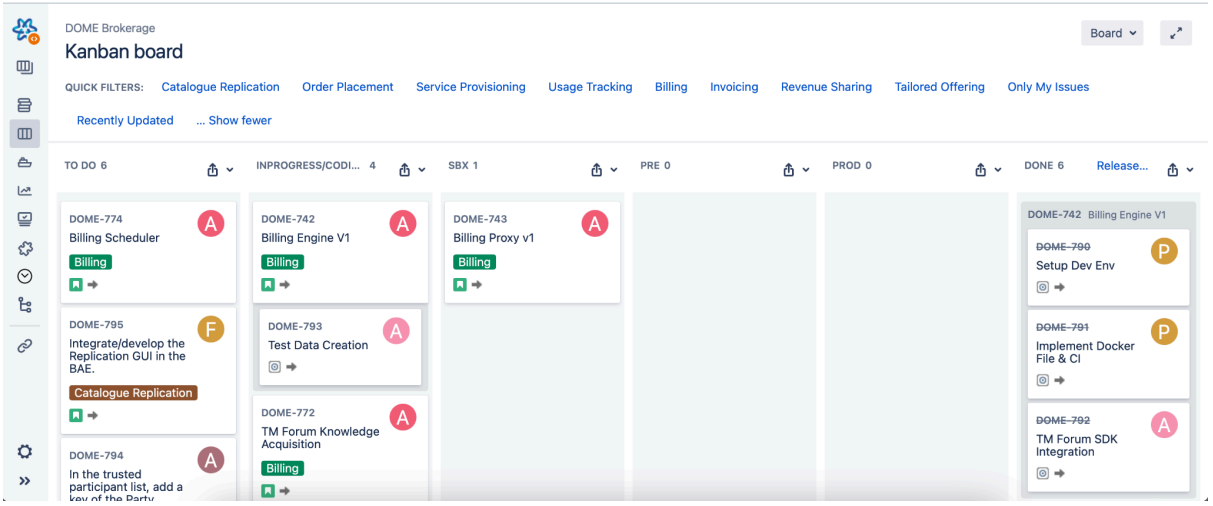


Fig. 5: Kanban boards overview

In this context, the **Backlog** remains a central repository for all project items (Epics, Tasks, and User Stories), which are periodically promoted to the TO DO column based on project priorities and team focus.

Finally, to enhance usability and improve tracking of the progress across various components, Quick Filters based on Jira “labels” have been implemented. These filters provide an instant overview of the different components, making it easier to monitor their status.

The adoption of agile hierarchical elements (such as Epics, Stories, and Sub-Tasks) continues to bring several benefits, enhancing the overall organization, planning, and execution of tasks within the project:

- **Epics** serve as high-level containers for large bodies of work, encapsulating major functionalities or features. They provide a macro-level view of project objectives and milestones.
- **Integration with Components**: each Epic is associated with specific Jira components, representing categorized modules within the project (e.g., DOME Portal, Brokerage, TMForum API, Customer Service, Marketplace Integration, and more). This ensures alignment with the project's logical breakdown and supports focused development efforts.
- **User Stories** provide granular, user-focused descriptions of software features or functionalities. These concise narratives outline the user, their goal, and the benefit derived from the described feature.
- **Sub-Tasks** represent smaller units of work associated with a User Story. They allow for detailed planning and tracking of development efforts.

In summary, Jira remains a pivotal tool for DOME's success. The newly updated Kanban Board layout, tailored configurations, integration of the Kanplan methodology (Kanban + Backlog), logical project components, quick filters, and strategic use of releases contribute to achieving efficient, adaptable, and transparent project goals. This reflects DOME's commitment to delivering high-quality software solutions in a dynamic and evolving environment.

As concerns monitoring and alerting system, DOME relies on the following configuration and components based on Grafana dashboards that enables real-time visibility across various environments as reported below:

- Cloud Infrastructure Monitoring: Monitors system performance and resource utilization.
- Application Monitoring: Sheds light on service health and response times.
- User Service Monitoring: Ensures compliance with Service Level Agreements (SLAs)
- Automated alerts swiftly detect performance degradation or anomalies, prompting immediate notifications to teams for timely issue resolution.
- Static Code Analysis: SonarQube guarantees code quality.
- Dynamic Security Scanning: Tools such as OWASP ZAP identify vulnerabilities.
- Functional Testing: Automated testing workflows validate functionality.
- Performance Testing: Conducted via Apache JMeter and Gatling to appraise system performance.

Moreover, a robust incident management strategy is in place for swift recovery, including pre-deployment snapshots for rapid rollbacks and incident logging characterized by severity-level resolutions.

4 DOME Marketplace releases

During the first stages of the project, the technical team decided to implement an approach combining Agile with the subsequent delivery of a Minimum Viable PoC (Proof of Concept that, based on maturity of features, turned into a Minimum Viable Product). The idea was to continually deliver updates of a MV PoC (first phase) and Product (second phase) based on a plan of subsequent milestones.

Within this overall approach, a number of considerations were done:

- A MVP is available on the DOME runtime environment at the end of every milestone, ready for showcasing;
- A number of features will be implemented and incorporated in the product from one milestone to the next;
- Distance between two consecutive milestones will not be the same along the project; the time needed to deliver a milestone depends on the number and complexity of features to be implemented and integrated for one milestone;
- Development for a given milestone may start earlier than finalisation of the previous one, since the goal is to adjust the Work In Progress (WIP) to the capacity of the various development teams.

4.1 First Major Release

The first major release of the DOME platform was made available in December 2023 (project month M12). This release corresponded to Milestone 3 (codenamed *Musala*). With this Minimum Viable PoC, the DOME platform embedded an initial and consistent set of marketplace features enabling customers and providers to experience basic trading along their respective journeys. Within the DOME central marketplace (based on the FIWARE Business API Ecosystem, BAE), catalogue management functionalities have been made available, as well as early order placement and corresponding service activation and delivery to the customer. Secure access to the marketplace is granted through user authentication based on Verifiable Credentials. Furthermore, this release lays out the foundation to support transparency and audit lifecycle of product/service/resource specifications, offerings and orders, providing proof of associated transactions; in fact, *Musala* includes a first implementation of the TMForum APIs on top of a combination of a blockchain and an off-chain local storage.

4.2 Second Major Release

4.2.1 Overview

The most recent versions of available components of the DOME platform are made available as of December 2024 (project month M24). This release corresponds to Milestone 5 (codenamed *Matterhorn*).

In this second release, the plan shifts towards delivering stable and production-ready functionalities starting from June 2024 when a first version of the DOME marketplace was publicly made available. Since then, the initially-supported *'inform model'* where the marketplace acts as a mere listing of services, gradually incorporated further features of the procurement journey such as product configuration, support for richer price plans, price-previewing and ordering management; also, significant enhancement and maturation were applied to identity and access-management features.

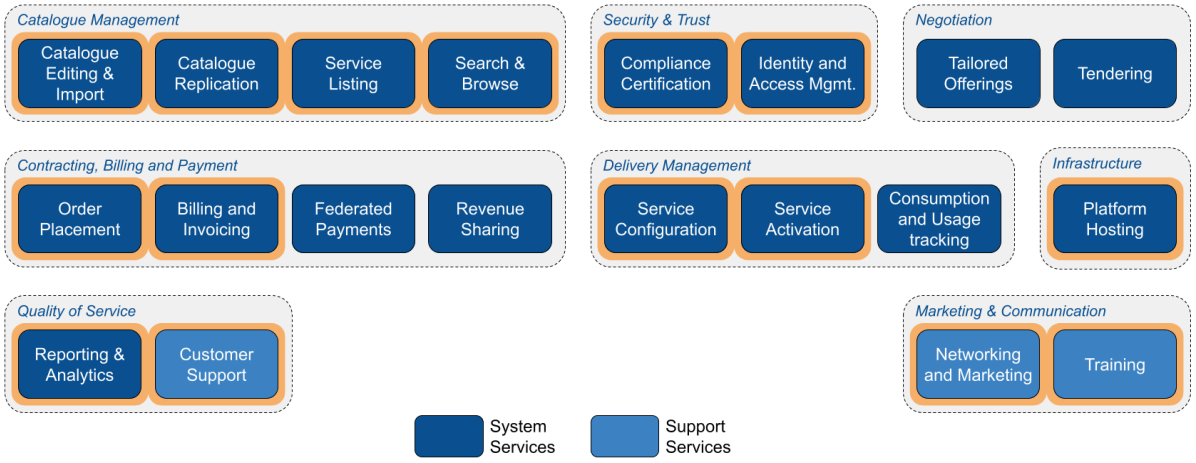


Fig. 6: Features included in the second DOME release "Matterhorn"

As with the first release, marketplace features have been available in the DOME-operated central marketplace and as DOME satellite services. Considerable effort was put in improving the stability and usability of the DOME access-node, i.e. the required entry point for providers and marketplaces willing to join the DOME federation for automated management of the procurement process. In fact, beyond delivering full support for federated procurement, activities in project year 3 will increase the focus on the integration of marketplaces and providers (both from the consortium and including external early adopters) in the DOME federation.

By December 2024, the transition to the "*transact model*" phase is scheduled to begin, although gradually. This means that while some functionalities are already operational in the production environment[12], other features are available in the sandbox (SBX) environment for project partners evaluation and feedback, and additional features are planned for release in February 2025 and beyond.

[12] https://dome-marketplace.org

For instance, regarding the Brokerage functionalities, an operational billing engine is being released within the M24 milestone, although with limited support for price plans at this stage. Similarly, the invoicing functionality will, for now, be restricted to B2B transactions between EU member states, exclusively supporting the Euro as the currency.

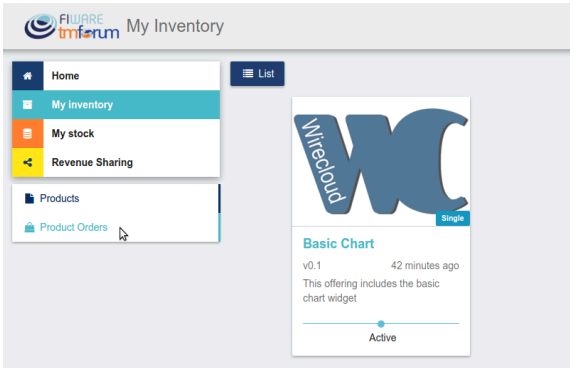
This phased approach ensures a balance between delivering immediate value and maintaining the flexibility to expand and refine capabilities in subsequent releases.

4.2.2 UI/UX enhancements

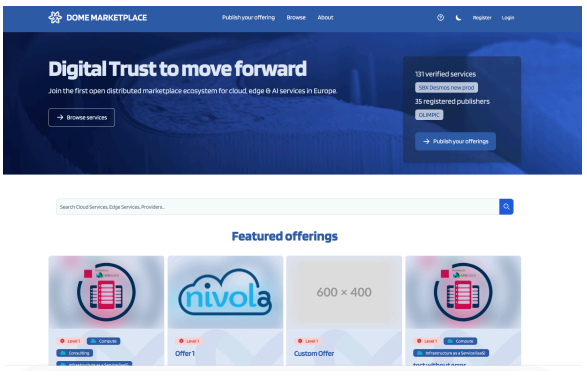
Besides technical improvements, to further enhance the marketplace experience, a dedicated team of UI/UX experts has been established during this second project year. This team is working closely with both the marketing and technical teams with a strong focus on enhancing the experience for both end users and providers. These enhancements are aimed at increasing usability, accessibility, and engagement, addressing key feedback from the initial version of the platform:

The **Marketplace Home Page** has been entirely redesigned to serve as a more effective landing page. It now includes:

- Call-to-Actions (CTAs)**:** Prominent CTAs such as *"Publish Your Offering"* encourage providers to engage directly with the marketplace, streamlining their interaction and reducing friction.
- Header and Hero Section: The hero section now highlights key providers already registered on the platform, promoting trust and credibility while showcasing the ecosystem's value.
- Quick Search Bar**:** A prominently placed quick search bar allows users to locate products or services efficiently, improving discoverability and reducing time-to-action.
- Product Cards**:** These cards display essential information at a glance, enabling users to assess offerings without needing to navigate to detailed pages. This approach enhances decision-making efficiency for both casual browsers and serious buyers.



Original Marketplace Home Page



Current Marketplace Home Page

Benefits Section and Improved Navigation

- Benefits Section**:** A new dedicated section highlights the key advantages of using DOME, targeting potential new users and reinforcing the platform's value proposition.
- Enhanced Navigation Bar**:** The top navigation bar has been restructured with more intuitive, user-friendly menus, making it easier for users to access different sections of the platform.

Design and Accessibility Improvements

The redesign incorporates best practices in UI/UX to ensure a visually appealing and accessible experience:

- Typography, Colors, and Layouts: All textual and visual elements have been carefully chosen to align with accessibility standards ensuring readability and usability for a diverse audience, including users with disabilities.
- Mobile Responsiveness**:** The marketplace has been optimized for mobile devices, with layouts, font sizes, and interactive elements adapting seamlessly to smaller screens.

Onboarding and Certification Sections

Work is ongoing to refine the onboarding process, simplifying it for new providers and end-users. Similarly, the certifications section is being enhanced to better display the provider's qualifications and build trust among users.

By addressing key points from the initial version and integrating new design principles, the DOME marketplace now offers a significantly improved user journey. These enhancements demonstrate a commitment to providing a platform that is not only functional but also engaging, accessible, and aligned with the expectations of users and providers. Additional features and optimizations will be rolled out over the coming months, leveraging insights from early adopters to further tailor the platform to the needs of users.

4.2.3 Release Content

This section describes the second major release of the DOME platform. In particular it provides useful information and references for the following released modules, grouped according to the major areas introduced in Section 2.

Trust and IAM Framework

The Trust and IAM Framework is built around different components ensuring trust between the participants (onboarding services and a Trusted Participants Registry). It also provides the needed functionalities to enable authentication based on VCs.

The Trust and IAM framework consists of the following components:

- Credential Issuer
- Trusted Issuers List
- Verifier (Identity Provider)
- Wallet

Decentralised Persistence Layer

The Decentralised Persistence Layer operates through interconnected Access Node instances on a Blockchain and on a Access Nodes Peer Network enabling the interconnection of individual marketplaces. Access to local data (managed by Scorpio Context Broker) is granted through uniform interfaces (TMForum API). Desmos Replication Service and DLT Adapter are instead responsible for all interactions with the Blockchain and other Access Node peers in a transparent way.

The Decentralised Persistence Layer consists of the following components:

- TMForum API
- Scorpio Context Broker
- Desmos Replication Service
- DLT Adapter

Central Marketplace

The Marketplace features are being implemented in DOME as part of the FIWARE BAE. This system is made up of two different software components that provide the portal as well as, orchestrate and provide business logic to the TMForum API implementations.

The DOME Central Marketplace consists of the following components:

- Business Ecosystem Logic Proxy
- Business Ecosystem Charging Backend

Compliance Tools

The certification compliance subsystem allows Cloud Service Providers (CSP) to upload the certificates and provide specific information about the available certifications. It also enables validators to access the requested information and manually assess their validity. Finally it triggers the issuance of the corresponding Verifiable Credentials (VC) by the VC Issuer, leaving to the CSP task of attaching them to the corresponding product in the DOME Marketplace.

The Certification Compliance subsystem consists of the following components:

- Certification Compliance Frontend
- Certification Compliance Backend

Advanced Search

The Search engine provides basic and advanced features to search, index, analyse and correlate information to be retrieved, with the goal of connecting consumers with relevant and coherent services as quickly as possible. The component has specialised parts implementing groups of functionalities: the Search and Retrieval section focuses on the management of queries submitted by the DOME user; functionalities for advanced search operations and results creation and presentation are also exposed. The Indexing section is specialised in strategies to index Offerings, public items and catalogues in terms of their contents. The Search engine also integrates the NLAPI Services, used to categorize product

offerings based on the product textual description. They are exploited in the Indexing process, assigning to each product offering one or more category for each of the three taxonomies that are used to facilitate product navigation:

- Technical approach
- Business domain
- Professional services

The Advanced Search subsystem consists of the following components.

- Search Engine
- NLAPI Services

Billing and Invoicing

The Billing feature is delivered through a combination of components supporting several pricing plans, both at purchase time (i.e. price preview) and during billing cycles (i.e. consolidated bills). The DOME billing is made available as an optional feature for providers who might opt for using DOME's billing engine on a per-offering basis.

Additionally, an Invoicing Engine takes care of applying the applicable taxes (depending on the two involved parties) to each and every transaction; as with billing, both preview and consolidated scenarios are supported.

The Billing and Invoicing subsystem consists of the following components:

- Billing Engine
- Billing Proxy
- Billing Scheduler
- Invoicing Engine

Reporting & Analytics

The reporting and analytics module is composed by other submodules, as introduced in deliverable D3.4. The Web Analytics Module and Engine have been deployed making it possible to track visits and actions on the DOME portal. Front-end and analytics have been prepared but are not yet released in the production user interface.

The Reporting and Analytics subsystem consists of the following components:

- Web analytics module: to track visitors and actions on the DOME central marketplace
- Web analytics engine: engine to process and store web statistics
- Analytics engine module: consolidates data only from the web statistics (not the TMForum API)

Onboarding Tools

The onboarding process (i.e. the process that an organisation has to undergo to gain the status of DOME participant either as Buyer, Seller or Marketplace) is supported by tools guiding actors through correct steps and facilitating the handoff of tasks. The M24 milestone includes support for Providers and Marketplaces.

- Online onboarding forms

Customer Support

The Customer Support technology platform is not directly integrated in the DOME technology platform, but being part of the technology solution supporting the overall service deserved to be noted and described in this document. This toolset is the core of the Customer Management process handling the capability to track the Customer's requests and their follow up, collecting all the needed support information in a single centralized information library where both the DOME users (Customers and Providers) and the DOME operator staff can find all the information that may be needed and with an automated chatbot supporting the conversational interaction with the platform users and feeded with the knowledge library contents.

The Customer Support subsystem consists of the following components:

- Knowledge Base
- Ticketing System
- Chatbot

Ongoing and future features

At the time of writing, development and integration are ongoing in further functional areas (i.e. payment, pay-per-use tracking and billing), although not yet available in the testing environment. Those features will be released early in the third project year.

Others (i.e. tailored offerings) will start right after the current milestone. They will be gradually introduced within next year and reported in the next deliverable D3.8).

4.2.4 Summary information of released components

In this last part, a specific section for each released component provides summary information and references to external resources, namely:

- *Release Notes*: listing the main features included in the current release;
- *Source Code*: reference to the public repository where the source code of the component can be found;
- *Deployment*: documentation (or reference to it) about where to retrieve artefacts and how to deploy and configure them in the target environment;
- *Further documentation*: references to further documentation (e.g. administration, usage, migration, troubleshooting, etc.);
- *Licence* under which the component has been released;
- *Support and Contacts:* instructions (or reference to them) on how to report bugs, submit requests and post any other code-related issue.

4.2.4.1 Credential Issuer

The Credential Issuer is a Web App application to support issuance of the Verifiable Credentials (LEARCredentialEmployee and VerifiableCertification) through the OpenID Connect for Credential Issuance (OIDC4VCI) standard protocol.

Release Notes

The current release includes:

- Support for LEARCredentialEmployee and VerifiableCertification credentials
- Support same-device and cross-device for Credential Offers
- Support Grant-Type Pre-Authorized Flow with tx_code
- Support jwt_vc credential format
- Support W3C VC DATA version 2.0
- Sign credentials using Remote DSS service
- Organizations can manage credentials issued

Source code

The source code of the component is available at:

https://github.com/in2workspace/in2-issuer-ui

https://github.com/in2workspace/in2-issuer-api

https://github.com/in2workspace/in2-keycloak-extension

https://github.com/in2workspace/in2-dss-api

Deployment

The component is distributed as Container Image available at:

https://hub.docker.com/repository/docker/in2workspace/in2-issuer-ui/general

https://hub.docker.com/repository/docker/in2workspace/in2-issuer-api/general

https://hub.docker.com/repository/docker/in2workspace/in2-keycloak-extension/general

https://hub.docker.com/repository/docker/in2workspace/in2-dss-api/general

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for component is available at:

https://github.com/in2workspace/in2-issuer-api/blob/main/README.md

The component can be installed through the Helm-Chart (umbrella):

https://github.com/in2workspace/helm-charts/tree/main/charts/issuer

Licence

The components are released under the Apache 2.0 License.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/in2workspace/in2-issuer-ui/issues

https://github.com/in2workspace/in2-issuer-api/issues

4.2.4.2 Trusted Issuers List

The Trusted Issuers List is an implementation of the EBSI Trusted Issuers Registry API. It provides the Verifier information about issuers of Verifiable Credentials and their capabilities in an instance of the DOME Marketplace.

Release Notes

This release supports version 3 and 4 of the EBSI Trusted Issuers Registry. Additionally, a proprietary management API is provided.

Source code

The source code of the component is available at:

https://github.com/FIWARE/trusted-issuers-list

Deployment

The component is distributed as Container Image available at:

https://quay.io/repository/fiware/trusted-issuers-list

The component can be installed through the Helm-Chart:

https://github.com/FIWARE/helm-charts/tree/main/charts/trusted-issuers-list

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for component is available at:

https://github.com/FIWARE/trusted-issuers-list/blob/main/README.md

Licence

The component is released under the Apache 2.0 License.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/FIWARE/trusted-issuers-list/issues

4.2.4.3 Verifier Identity Provider

The Verifier IdP is an Authorization Server that provides the endpoints required for OID4VP compliant authentication flows.

In the DOME Platform it is required for authentication of users, verifies their Verifiable Credentials and exchanges them with JWT Tokens for usage in down-stream components.

Release Notes

The current release supports:

- the Same-Device and the Cross-Device Flow

- supports Keycloak integration as external IdP
- support Human-To-Machine Flow
- support Machine-To-Machine-Flow
- support only Client Authentication Private Key JWT
- support only OAuth Grant Types Authorization Code

Source code

The source code of the component is available at:

https://github.com/in2workspace/in2-verifier-api

Deployment

The component is distributed as Container Image available at:

https://hub.docker.com/repository/docker/in2workspace/in2-verifier-api/general

The component can be installed through the Helm-Chart:

https://github.com/in2workspace/helm-charts/tree/main/charts/verifier-api

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for component is available at:

https://github.com/in2workspace/in2-verifier-api/blob/main/README.md

Licence

The component is released under the Apache 2.0 License.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/in2workspace/in2-verifier-api/issues

4.2.4.4 Wallet

The Wallet is a Web App that allows users to manage digital credentials. It is designed to be used in a decentralized identity ecosystem, where users can store their credentials in a secure and private way.

Wallet Server includes the requested features described in the EUDI Wallet Architecture Reference, and it is EBSI compliance (EBSI test v3.4).

Release notes

- Create a key pair from the secp256r1/P-256 algorithm.
- Create did:key identifier from ES256 key algorithm.
- Create did:key:jwk_jcs-pub identifier from ES256 key algorithm.
- Complete flows compliant with EBSI for issuing and presenting digital credentials.
- Vault Integration Provides secure cryptographic storage for private keys using state-of-the-art vault technology.
- Cross-Device and Same-Device support.

Source code

The source code of the component is available at:

https://github.com/in2workspace/in2-wallet-ui

https://github.com/in2workspace/in2-wallet-api

Deployment

The component is distributed as Container Image available at:

https://hub.docker.com/repository/docker/in2workspace/in2-verifier-api/generalhttps://quay.io/repository/fiware/trusted-issuers-list

The component can be installed through the Helm-Chart:

https://github.com/in2workspace/helm-charts/tree/main/charts/verifier-api
https://github.com/i4Trust/helm-charts/tree/main/charts/vcverifier

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for component is available at:

https://github.com/in2workspace/in2-verifier-api/blob/main/README.md

https://github.com/FIWARE/VCVerifier/blob/main/README.md

Licence

The component is released under the Apache 2.0 License.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/in2workspace/in2-verifier-api/issues
https://github.com/FIWARE/VCVerifier/issues

4.2.4.5 TMForum API

Implementation of the TMForum APIs. Serves as the main API for the Marketplace implementations to interact with. Detailed information about the APIs and their usage in DOME can be found in D3.6 DOME APIs v2.

Release Notes

The current release includes implementations of the following APIs:

- Party Catalog
- Customer Bill Management
- Customer Management
- Product Catalog
- Product Inventory
- Product Ordering Management
- Resource Catalog
- Resource Function Activation
- Resource Inventory

- Service Catalog
- Account Management
- Agreement
- Usage Management

Source code

The source code of the component is available at: https://github.com/FIWARE/tmforum-api

Deployment

The component is distributed as Container Images available at:

- https://quay.io/repository/fiware/tmforum-party-catalog
- https://quay.io/repository/fiware/tmforum-product-inventory
- https://quay.io/repository/fiware/tmforum-service-catalog
- https://quay.io/repository/fiware/tmforum-resource-catalog
- https://quay.io/repository/fiware/tmforum-resource-function-activation
- https://quay.io/repository/fiware/tmforum-resource-inventory
- https://quay.io/repository/fiware/tmforum-customer-management
- https://quay.io/repository/fiware/tmforum-customer-bill-management
- https://quay.io/repository/fiware/tmforum-product-catalog
- https://quay.io/repository/fiware/tmforum-agreement
- https://quay.io/repository/fiware/tmforum-account
- https://quay.io/repository/fiware/tmforum-usage-management

The component can be installed through the Helm Chart at:

https://github.com/FIWARE/helm-charts/tree/main/charts/tm-forum-api

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for component is available at:

https://github.com/FIWARE/tmforum-api/blob/main/README.md

Licence

The component is released under the Apache-2.0 License.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/FIWARE/tmforum-api/issues

4.2.4.6 Scorpio Context Broker

Scorpio is an NGSI-LD compliant Context Broker. It implements the full NGSI-LD API as specified by the ETSI Industry Specification Group on cross cutting Context Information Management (ETSI ISG CIM).

As part of the DOME Platform, it serves as the storage backend to the TMForum APIs and provides the NGSI-LD API as a connection interface between the Access Node Instances.

Release Notes

This release includes a full implementation of the NGSI-LD API.

Source code

The source code of the component is available at:

https://github.com/ScorpioBroker/ScorpioBroker

Deployment

The component is distributed as Container Image available at:

https://quay.io/repository/fiware/scorpio

The component can be installed through the Helm Chart at:

https://github.com/FIWARE/helm-charts/tree/main/charts/scorpio-broker

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for component is available at:

https://scorpio.readthedocs.io/en/latest/

Licence

The component is released under the BSD 3-Clause License.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/ScorpioBroker/ScorpioBroker/issues

4.2.4.7 Desmos Replication Service

The Desmos Replication Service component plays a critical role in the DOME platform, acting as a bridge between blockchain technologies, other Access Nodes peers, and the local storage. It facilitates secure and efficient interactions with blockchain and Access Nodes, enabling seamless integration of data-based services. This component is essential for ensuring interoperability and operational efficiency in replication data operations within the platform.

Release Notes

The first release includes the following features:

- Set communication between Scorpio Context Broker and DLT Adapter.
- Set subscriptions to Entities.
- Create the transactions events to the blockchain network.
- Retrieve data using blockchain events transactions.
- Synchronize data with other Access Nodes using scheduled tasks, CLI or bootstrapping the solution.
- Audit all transactions processed, as a Producer and a Consumer.

Source code

The source code for the Desmos Replication Service component is available at:
https://github.com/in2workspace/in2-desmos-api

Deployment

The Desmos Replication Service component is distributed as Docker Image available at:

https://hub.docker.com/repository/docker/in2workspace/in2-desmos-api/general

The Desmos Replication Service component can be installed through Helm following the instructions at:

https://github.com/in2workspace/helm-charts/tree/main/charts/desmos

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for component Desmos Replication Service is available at:

https://github.com/in2workspace/in2-desmos-api/blob/main/README.md

Licence

The Desmos Replication Service component is released under the Apache 2.0 licence.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/in2workspace/in2-desmos-api/issues

4.2.4.8 DLT Adapter

The DLT Adapter, also referred to as the DLT Interface is a component used by the Blockchain Connector to interact with the Blockchain technology in a transparent way. It is provided as a REST API. The main objective of this component is to isolate the complexity of the interaction with the federated blockchain networks by providing an abstraction layer on top of them.

Release Notes

The main features of the DLT Adapter v1.5.1 are:

- Configuration of the connection to the chosen blockchain node.
- Publication of events derived from the TM Forum APIs to the blockchain.
- Subscription to events of interest.

Source code

The source code of this component is available at:

https://github.com/alastria/DOME-blockchain_connector-dlt_interface/tree/release/v1.5.1

Deployment

The DLT Adapter component is distributed as a Docker image available at:
https://quay.io/repository/digitelts/dlt-adapter

The DLT Adapter component can be installed through the following Helm chart:

https://github.com/alastria/helm-charts/tree/master/dlt-adapter

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for DLT Adapter component is available at:

https://github.com/alastria/DOME-blockchain_connector-dlt_interface/blob/release/v1.5.1/README.md

and

https://github.com/alastria/DOME-blockchain_connector-dlt_interface/tree/release/v1.5.1/docs

in the case of the OpenAPI specification.

Licence

The DLT Adapter component is released under the Apache 2.0 licence.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/alastria/DOME-blockchain_connector-dlt_interface/issues

4.2.4.9 Business Ecosystem Logic Proxy

The Business Ecosystem Logic Proxy component of the BAE provides the entry point to the system. This component serves the web interface that can be used to interact with the BAE features. On the one hand, It receives the requests to the different TMForum APIs, validates them and orchestrates the different flows calling the appropriate APIs.

Release Notes

The new release includes the following features:

- New Portal site implemented with Angular, Tailwind and Flowbite following a new design
- Add pages for updating and displaying the provider profiles linked to their product offerings
- Support for the compliance profile, allowing to upload existing certifications for the different products as well as provide the Verifiable Credential that certify such profile
- Support for an enhanced pricing model, allowing to define different price plans that can be composed of multiple price components. This model allows to define price plans that depend on configuration options selected by the customers
- Support for offline price plans, not managed by DOME
- A new price simulator has been included in the portal integrating the new pricing models, the configuration options and the Billing Engine
- Support for creating Product Orders selecting the price plan and the chosen configuration
- Improve the integration with the Verifier, supporting the OIDC4VP implementation

- Add an administration endpoint

Source code

The source code is available at:

https://github.com/FIWARE-TMForum/business-ecosystem-logic-proxy

Deployment

The component is distributed as Docker Images available at:

https://quay.io/repository/fiware/biz-ecosystem-logic-proxy

The component can be installed through the Helm chart:

https://github.com/FIWARE/helm-charts/tree/main/charts/business-api-ecosystem

Further documentation

Detailed and further documentation for the component is available at ReadTheDocs:

https://business-api-ecosystem.readthedocs.io/en/latest/

Licence

The component is released under the AGPL v3 licence

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/FIWARE-TMForum/business-ecosystem-logic-proxy/issues

4.2.4.10 Business Ecosystem Charging Backend

The Business Ecosystem Charging Backend includes the business logic of the BAE, processing product orders, calculating billing and providing procurement and activation features.

Release Notes

The new release includes the following features:

- Support for an enhanced pricing model, allowing to define different price plans that can be composed of multiple price components. This model allows to define price plans that depend on configuration options selected by the customers
- Support for offline price plans, not managed by DOME
- Support for processing Product Orders selecting the price plan and the chosen configuration
- Support for configuring external Billing Engines and integration with the Billing Engine developed in DOME

Source code

The source code is available at:

https://github.com/FIWARE-TMForum/business-ecosystem-charging-backend

Deployment

The component is distributed as Docker Image available at:

https://quay.io/repository/fiware/biz-ecosystem-charging-backend

The component can be installed through the Helm chart:

https://github.com/FIWARE/helm-charts/tree/main/charts/business-api-ecosystem

Further documentation

Detailed and further documentation for the component is available at ReadTheDocs:

https://business-api-ecosystem.readthedocs.io/en/latest/

Licence

The component is released under the AGPL v3 licence

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/FIWARE-TMForum/business-ecosystem-charging-backend/issues

4.2.4.11 Certification Compliance Tool Frontend

The Certification Compliance Frontend is the user entry point of the Certification Compliance Feature. CSPs can fill in the necessary information for subsequent validation. Certification Validators can review the data entered by the CSPs. This component relies on the Compliance Backend for processing and storage. It also interacts with the VC Verifier and the DOME VCAuth to ensure correctness of user VCs and to enforce the corresponding access rules.

Further details for this component can be found in deliverable “D4.2 Methodological framework for the continuous compliance of cloud services in DOME”

Release Notes

The first release includes the following features:

- Login using LEAR Credentials
- Form to request the validation of the certificates
- Module to visualize the current status of all requests
- Form to validate the authenticity of the certificates
- Email notifications

Source code

The source code of the component is available in public DOME GitHub repository:

https://hub.docker.com/repository/docker/noeliaguedek/dome-compliance-frontend/general

Deployment

The component is distributed as Docker Image available at:

https://hub.docker.com/repository/docker/noeliaguedek/dome-compliance-frontend

Further documentation

Detailed and further documentation for the component is available at https://drive.google.com/drive/folders/1pNz-vJ2yU31zHI-yqx-8HBw_PH366fV0

Licence

The DOME Compliance Frontend is released under the Apache 2.0 Licence.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/DOME-Marketplace/dome-certification-frontend/issues

4.2.4.12 Certification Tool Backend

The Certification Compliance Backend is responsible for orchestrating all communication with the persistence layer and with the user interface. It includes subcomponents to a) maintain structured certification data in a relational database (PostgreSQL) as well as files in different formats and b) email notification, to notify users about updates happening during the compliance process.

Further details for this component can be found in deliverable “D4.2 Methodological framework for the continuous compliance of cloud services in DOME”

Release Notes

The first release includes the following features:

- Login using LEAR Credentials
- Request the validation of the certificates
- Module to visualize the current status of all requests
- Validate the authenticity of the certificates
- Email notifications

Source code

The source code of the component is available in public DOME GitHub repository:

https://github.com/DOME-Marketplace/dome-certification-backend

Deployment

The component is distributed as Docker Image available at:

https://hub.docker.com/repository/docker/noeliaguedek/dome-compliance-backend/general

Further documentation

Detailed and further documentation for the component is available at https://drive.google.com/drive/folders/1pNz-vJ2yU31zHI-yqx-8HBw_PH366fV0

Licence

The DOME Compliance Backend is released under the Apache 2.0 Licence.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/DOME-Marketplace/dome-certification-backend/issues

4.2.4.13 Search Engine

The search-related features allow customers to easily find the specific product they are looking for. The features are achieved through the search engine, a component providing functionalities to manage queries submitted by the DOME user and to support the indexing of products, catalogs and items.

Release Notes

The current release includes the following features:

- services focused on the management of query by keywords, including also filtering parameters (e.g., categories);
- strategies to index products in terms of their contents.

Source code

https://github.com/DOME-Marketplace/search

Deployment

The component is distributed as Docker Image available at:

https://production.eng.it:8433/harbor/projects/55/repositories/search

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for the Search Engine is available at:

https://github.com/DOME-Marketplace/search/blob/main/README.md

Licence

The DOME SearchEngine is released under the Apache 2.0 Licence.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/DOME-Marketplace/search/issues

4.2.4.14 NLAPI

The NLAPI provided by EXAI are used to assign relevant categories to each product created in the catalog.

Release Notes

The current release includes the following features:

- Categorization of product offerings based on the product textual description.
- Three product taxonomies are supported:
  - Technical approach
  - Business domain
  - Professional services

Source code

Since the NLAPI is a hosted service, no source code is provided.

Deployment

The component is distributed as a REST API hosted by Expert.ai that can be invoked using a pre-shared API key. As such, it does not need to be deployed as a separate component. If different DOME environments need different versions of the NLAPI, a separate URL and a separate API key can be provided for each version.

Further documentation

Detailed and further documentation (usage, authentication, input and output format, etc.) for the NLAPI is available at:

https://docs.expert.ai/platform/latest/nl-flow-api

Licence

Since the NLAPI is a hosted service, no licence model is applicable.

Support and Contacts

Bugs, requests and other code-related issues can be reported by sending a mail to support@expert.ai or by opening a ticket at the address https://support.expert.ai

4.2.4.15 Billing Engine

The Billing Engine is a reference implementation of the DOME billing facility. It supports most common pricing schemas (e.g. one-off, recurring, pay-per-use, discounts). It is made available to providers who don't have or don't intend to expose their own billing facility.

Release Notes

The first release includes the following features:

- Calculation of costs for most common pricing plans observed in the marketplace (i.e. one-off and recurring, pre- and post-paid, characteristic-based pricing, discounts);
- Support for price preview, activated during the initial stages of the procurement process, on a Product Order being initialised by a customer;
- Support for consolidated billing, happening on an activated contract; based on the existence of a Product.

Source code

https://github.com/DOME-Marketplace/billing-engine

Deployment

The component is distributed as Docker Image available at:

https://production.eng.it:8433/harbor/projects/55/repositories/billing-engine

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for the Billing Engine is available at:

https://github.com/DOME-Marketplace/billing-engine/blob/main/README.md

Licence

The DOME Billing Engine is released under the Apache 2.0 Licence.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/DOME-Marketplace/billing-engine/issues

4.2.4.16 Billing Proxy

The Billing Proxy is a centralised intermediary in charge of orchestrating billing processes, facilitating seamless communication, and ensuring consistency in billing practices. It improves transparency, accuracy, and accountability in revenue distribution across participating marketplaces. In particular, it is responsible for selecting and dispatching billing/preview requests to the authoritative Billing Engine.

Release Notes

The first release includes the following features:

- Integration with the DOME Marketplace (BAE) for previewing cost of offerings, before actual purchase.
- Routing based on information made available by providers in the Product Offerings,

Source code

https://github.com/DOME-Marketplace/billing-proxy

Deployment

The component is distributed as Docker Image available at:

https://production.eng.it:8433/harbor/projects/55/repositories/billing-proxy

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for the Billing Proxy is available at:

https://github.com/DOME-Marketplace/billing-proxy/blob/main/README.md

Licence

The DOME Billing Proxy is released under the Apache 2.0 Licence.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/DOME-Marketplace/billing-proxy/issues

4.2.4.17 Billing Scheduler

The Billing scheduler is a background service responsible for triggering the computation of Bills at the end of each billing cycle. It interacts with the Billing Proxy to actually obtain the Bill computation and relies on the TMForum layer to monitor active products and to persist consolidated Bills.

Release Notes

The first release includes the following features:

- Monitoring of active products and triggering of billing and invoicing processes
- Aggregation of bills, when related to the same product items and customer
- Storage of bills/invoices in the DOME persistence layer

Source code

https://github.com/DOME-Marketplace/billing-scheduler

Deployment

The component is distributed as Docker Image available at:

https://production.eng.it:8433/harbor/projects/55/repositories/billing-scheduler

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for the Billing Scheduler is available at:

https://github.com/DOME-Marketplace/billing-scheduler/blob/main/README.md

Licence

The DOME Billing Scheduler is released under the Apache 2.0 Licence.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/DOME-Marketplace/billing-scheduler/issues

4.2.4.18 Invoicing Engine

The Invoicing Engine is responsible for the identification of applicable taxes (VAT in particular) to transactions between sellers and customers. For each transaction (i.e. each ‘bill’) it analyses the involved parties, the relevant legal and tax aspects (e.g. their country and the applicable tax rates) and enriches the bill with associated taxes.

Release Notes

The first release includes the following features:

- Support for tax calculation both in preview mode (i.e. during the early stages of the procurement process) or during regular billing (i.e. when the actual invoice is being issued, to proceed with payment).
- Integration with TEDB[13] REST services for the identification of correct VAT rate in place at a given time, for involved parties.
- Integration with the DOME billing engine and scheduler in a whole workflow.

Source code

https://github.com/DOME-Marketplace/billing-engine

Deployment

The component is distributed as Docker Image available at:

https://production.eng.it:8433/harbor/projects/55/repositories/invoicing-service

Further documentation

Detailed and further documentation (deployment, configuration, usage, troubleshooting, etc.) for the Invoicing Engine is available at:

https://github.com/DOME-Marketplace/invoicing-service/blob/main/README.md

Licence

The DOME Billing Engine is released under the Apache 2.0 Licence.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/DOME-Marketplace/billing-engine/issues

4.2.4.19 Monitoring, reporting and analytics

The module deals with monitoring, reporting and analytics capabilities and business level KPIs. The module consists of several submodules and utilises open source applications and implemented software and charts design to deliver intended functionality. This includes the following submodules:

- Web analytics module, that tracks visits and user actions on the marketplace,
- Web analytics engine, that stores webstat tracking data, utilising 'Matomo Analytics'[14]. Indicatively the following are tracked:
    - Visits and unique visits
    - Locations of visitors
    - Devices and browser used
    - Pages visits, entry and exit pages, transitions between pages
    - Time spend and bounce rate
    - In and out links

[13] TEDB: Taxes in Europe DataBase v4 - https://ec.europa.eu/taxation_customs/tedb
[14] https://matomo.org/

- Analytics engine module, that fetches data from data sources and pre-processes them so that they can be further processed in analytics and visualised,
- Analytics app, that allows the creation of datasets, dashboards and charts, including data processing for analytics, utilising 'Apache Superset'[15]

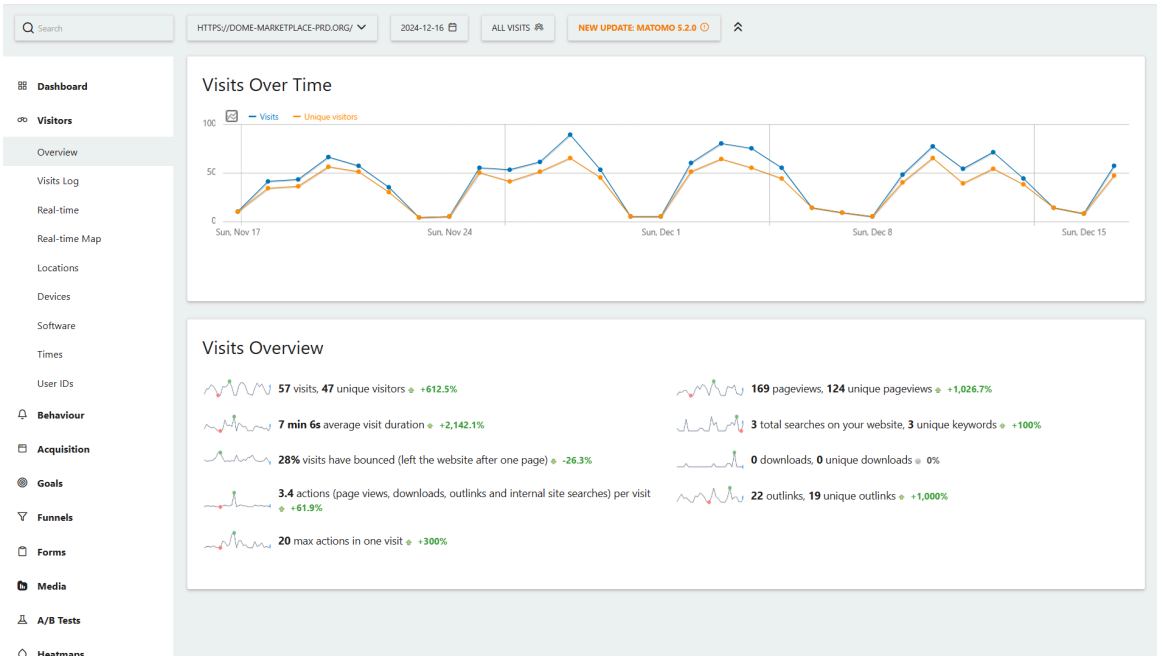


Fig. 7: Web analytics (basic front-end)

Additionally, data analytics charts based on the visits have been prepared. These include:

- Consolidated visits graph per page and total sum of visits (Fig. 8)
- Average time per page (Fig. 9)
- Exit rate per page (Fig. 9)
- Parallel plot of visits vs exit vs bounce rate to identify engaging sections (Fig. 9)
- Visit growth chart (Fig. 10)
- Visits per visitor per page (Fig. 10)

[15] https://superset.apache.org/

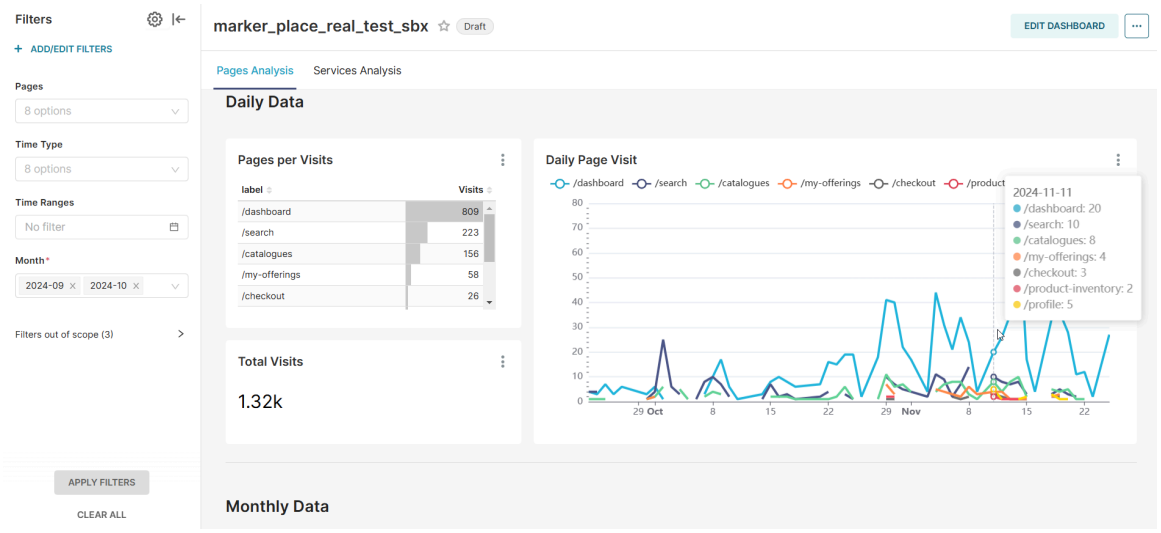


Fig. 8: Analytics: Pages per visit, Daily page visit, Total sum of visits

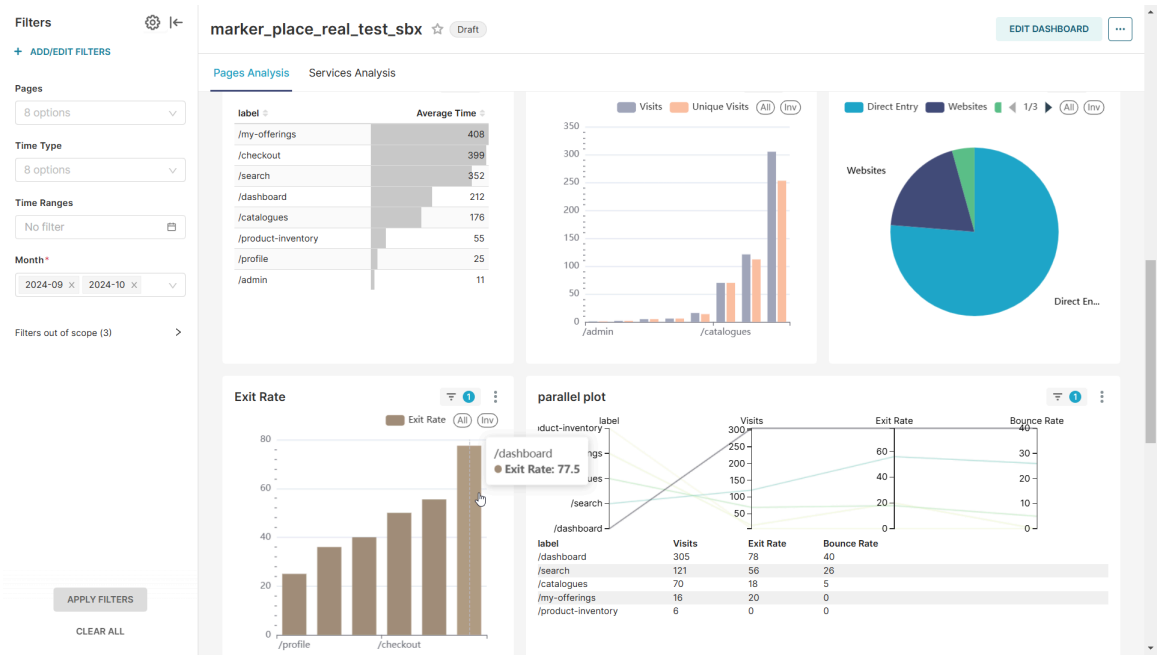


Fig. 9: Analytics: Average time per page, Visits and unique visits per page, source of visits, exit rate per page, parallel plot for page engagement

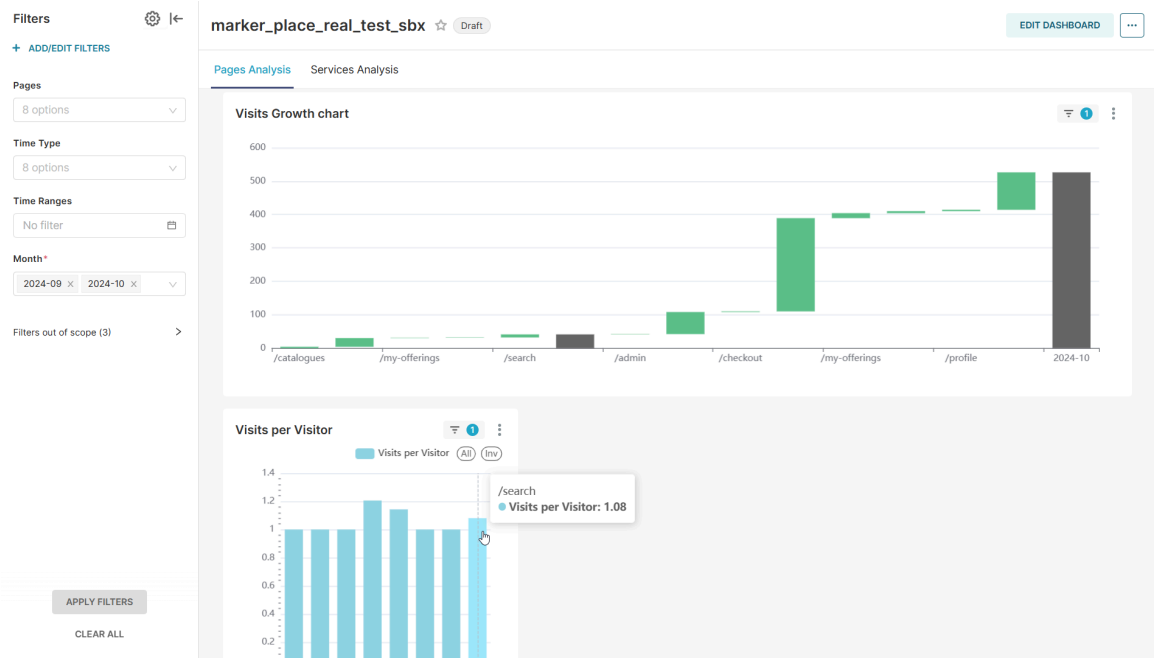


Fig. 10: Analytics: Visit growth chart, Visits per visitor per page

Release Notes

The first release includes the following features:

- Tracking and reporting of webstats from the marketplace portal
- Basic analytics based on visits

Source code

- Web analytics module: integrated in marketplace portal front-end source.
- Web analytics engine: https://github.com/matomo-org/matomo
- Analytics engine module: https://github.com/DOME-Marketplace/analytics-component
- Analytics app: https://github.com/apache/superset

Deployment

The module is not yet released as a complete package/docker image.

Further documentation

The overall app is preconfigured. However, further documentation for advanced features can be found at https://superset.apache.org/docs/using-superset/creating-your-first-dashboard

Licence

The submodules are under GPL and Apache licenses. The overall package is licensed under EUPL.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/DOME-Marketplace/analytics-component/issues

4.2.4.20 Online Onboarding Forms

The Online Onboarding Forms are meant to support an organisation (either a Cloud Service Provider or a Marketplace) to generate the documents required for the onboarding process and obtain an operational user account in the DOME Marketplace. It is currently delivered using GitHub Pages hosting feature by GitHub.

Release Notes

The first release includes the following features:

- Collection of mandatory provider/marketplace legal and administrative information
- Generation of compiled forms for company/LEAR signature

Source code

https://github.com/DOME-Marketplace/onboarding

Deployment

The component is currently delivered using GitHub Pages hosting feature by GitHub:

https://dome-marketplace.github.io/onboarding

Further documentation

https://github.com/DOME-Marketplace/onboarding/blob/main/README.md

Licence

The Onboarding Forms are released under the Apache 2.0 Licence.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://github.com/DOME-Marketplace/onboarding/issues

4.2.4.21 Knowledge Base

Knowledge Base: Based on the Bookstack technology this platform provides direct access to all the available documentation for both internal operators and external users applying some visibility filter to avoid that internal information can be shared with the external audience:

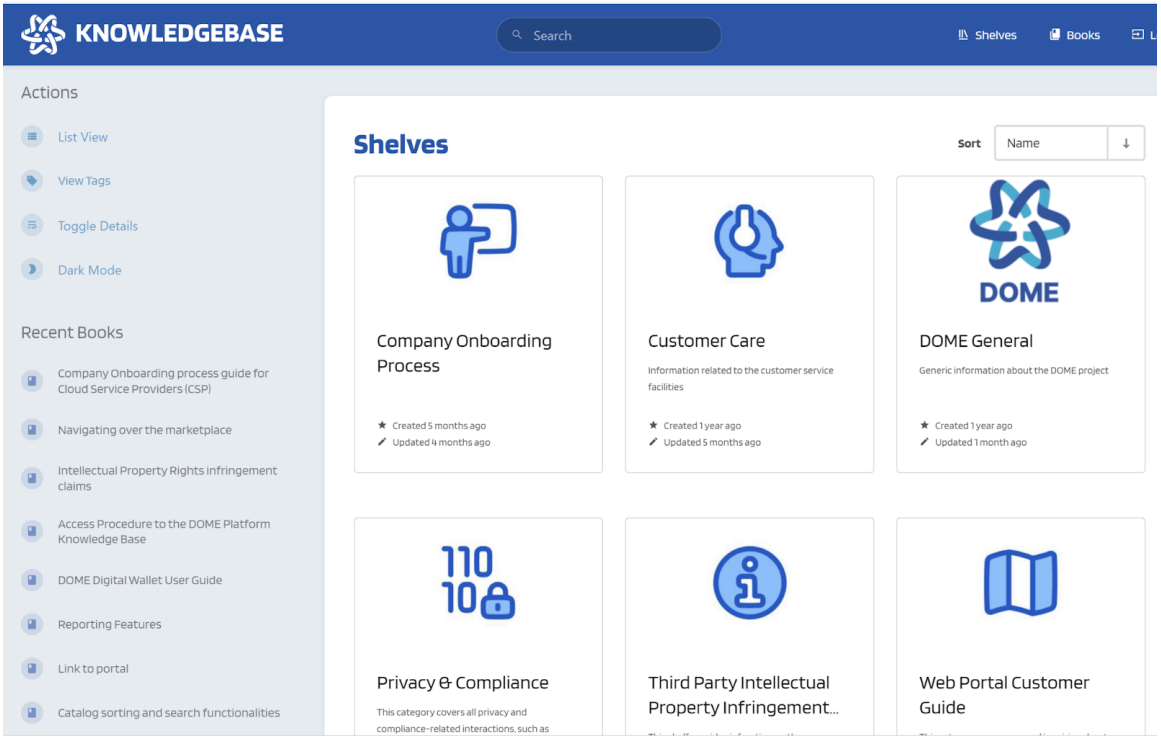


Fig. 11: DOME Knowledge Base

Release Notes

The first release includes the following features:

- Deployment of the platform
- Division of categories of interest by topics, ownership of those sections has been divided among the various members of the project
- Separation of access by roles. These gives preferential access to the users and the documentation to facilitate contents separation and visibility
- Versioning of the documentation
- Login brokered by keycloak that gives SSO functionality among the customer service applications

Source code

https://github.com/DOME-Marketplace/knowledgebase

Deployment

The component is distributed as Docker Image available at:

https://production.eng.it:8433/harbor/projects/55/repositories/knowledgebase

Licence

The knowledgebase is based on an application called Bookstack which is licensed under the MIT License, Copyright (c) 2015-2024, Dan Brown and the BookStack Project contributors.

The License is a short and simple permissive license with conditions only requiring preservation of copyright and license notices; it permits commercial use, modification, distribution and private use.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://ticketing.dome-marketplace-prd.org/

Creating a new ticket, in GROUP select " 05 - Customer Service Tools"
and select a problem with the nomenclature 'knowledgebase' in it

4.2.4.22 Ticketing System

Based on the Zammad[16] technology this component has the primary role to track down the Customer request allowing the proper followup by the support team. Organized in order to better fit the different processes, the platform is operational since the very beginning of the dome operations:

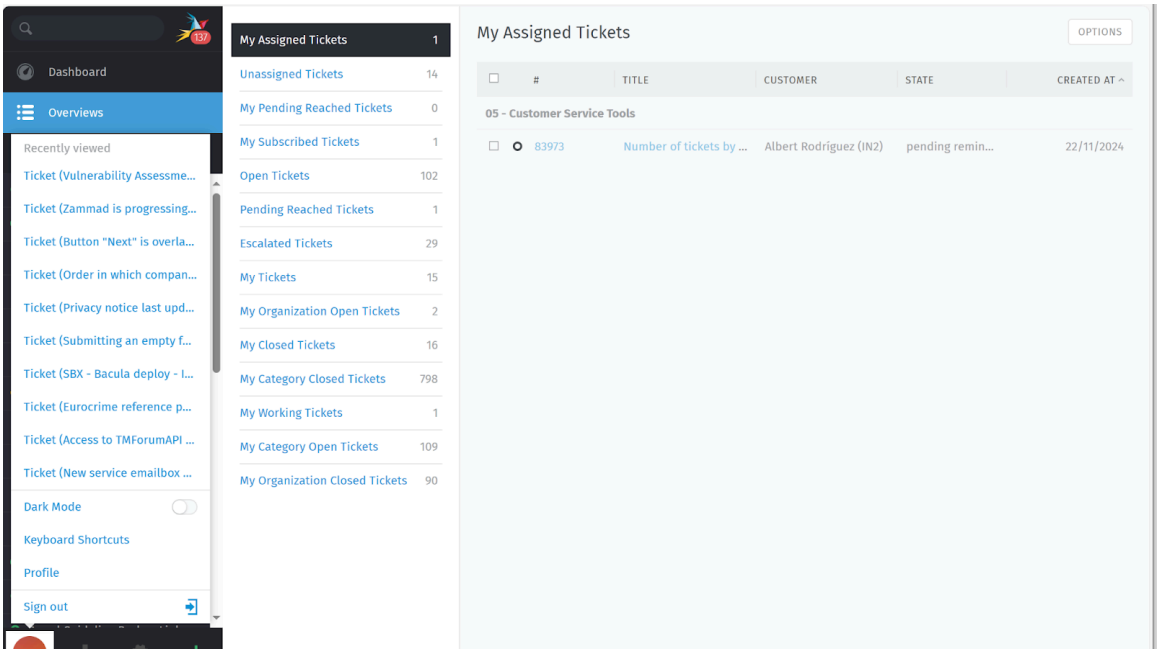


Fig. 12: DOME Ticketing System

To better support the quality of services the Customer Services team implemented also a periodical reporting tool extracting statistical analysis on the managed tickets to ensure proper operations:

[16] https://zammad.com

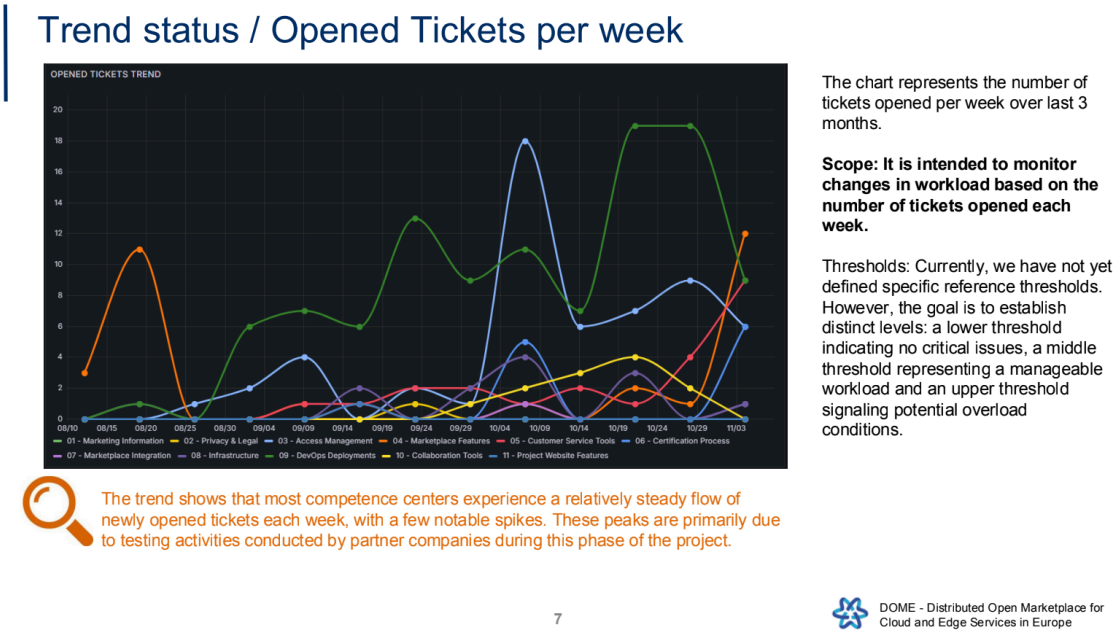


Fig. 13: Trends and Status charts in the DOME ticketing system

Release Notes

The first release includes the following features:

- Three user roles: Admin, Operator (manages tickets) and Customer (submits tickets).
- 11 specialized competence centers created, each focusing on specific ticket categories and relative sub problems.
- Tailored workflows for ticket creation and management using rules and triggers.
- SLA for first response, with options for additional SLAs and custom configurations.
- Service email to send notifications to all platform users.
- Personalized dashboards to group and filter tickets based on specific criteria.

Source code

https://github.com/zammad/zammad

Deployment

The component is currently delivered using Helm packages:

https://github.com/DOME-Marketplace/dome-gitops/tree/main/ionos_prd/zammad

Licence

Ticketing system is based on Zammad framework, an open-source helpdesk and customer support platform licensed under the GNU Affero General Public License (AGPL) version 3.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://ticketing.dome-marketplace-prd.org/

Creating a new ticket, in GROUP select “ 05 - Customer Service Tools”
and select a problem with the nomenclature ‘Ticketing ’ in it.

4.2.4.23 Chatbot

Built on a proprietary technology named ENGgpt, this conversational chatbot leverages AI technologies (GPT3.5 compatible) to automatically provide feedback to the Customers about any argument listed in the project Knowledge base. Being fed through a known reference source base this component is virtually free from the risk to provide wrong or corrupted information.

Release Notes

The first release includes the following features:

- Integration into the DOME portal for seamless accessibility.
- Role-based answer segregation to ensure responses are tailored to the user’s role.
- Conversation memory capabilities to provide context-aware and targeted responses.
- Knowledge-driven responses based on a predefined project knowledge base, reducing the risk of incorrect or corrupted information.

Source code

https://github.com/kingmanfri/eng-gpt-chatbot-widget

Being a proprietary solution no link to the original ENGgpt engine source code is provided but the binary code is available “as-is” for deployment. This is not a “core” marketplace functionality and the deployment of the chatbot component is optional.

Deployment

The component is currently delivered using GitHub Pages hosting feature by GitHub:

https://github.com/DOME-Marketplace/dome-gitops/tree/main/ionos_prd/chatbot/backend

Further documentation

https://www.eng.it/en/insights/stories/use-cases/enggpt-il-nostro-assistente-ai-per-le-aziende

Licence

Widget: None.

ENGgpt engine: commercial licence to be requested to Engineering Ingegneria Informatica S.p.A.

Support and Contacts

Bugs, requests and other code-related issues can be reported at:

https://ticketing.dome-marketplace-prd.org

Creating a new ticket, in GROUP select “ 04 - Marketplace Features” and select a problem with the nomenclature ‘DOMEGPT ’ in it.

5 Conclusions

This document presented the second major release of the DOME platform, showcasing an enhanced set of marketplace features and realising a step forward in the direction of the envisioned federated approach.

Its availability in a publicly-accessible environment (in June 2024) promoted visibility of the initial project results, exploited for demo purposes and used for training, experimentation and communication. Then, further features have been gradually introduced starting from those creating the backbone of a secure and robust platform (e.g. trust and identity management, persistence, onboarding process, provider's compliance verification, customer support, analytics) and continuing with procurement-related ones (e.g. product configuration and ordering, initial billing and invoicing support, provisioning. Also, relevant enhancements have been applied to the marketplace UI, significantly improving the quality of the user experience. Manu of the above features have already been delivered in the production environment, while some others are currently being tested and are expected to be released in early 2025 to support the planned *'transact mode'*.

DOME integrates, customises and develops a number of components built on top of cloud-native technologies like Docker, Kubernetes and Helm in order to achieve a high level of modularity, robustness and interoperability. The development, integration and release activities behind software releases followed the structured and consistent approach under the guidance of WP4.

One further major version of the DOME platform will be issued at M36 including the whole set of features and components developed during the project; it will be documented in deliverable D3.8. Nevertheless, the consortium is working towards progressively releasing most of them earlier during the third project year, prioritizing them on their business value.