



## **D2.1: ECOSYSTEM DEFINITION AND REQUIREMENTS**

### **ANNEX 3: TECHNICAL REQUIREMENTS ANALYSIS**

This section provides a deep dive into COP-PILOT's technical requirements, classified across five categories corresponding to the discrete architectural layers outlined in Annex 2 (1.1)

## D2.1: Ecosystem definition and requirements

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<p><b>Abstract</b></p>	<p>The COP-PILOT platform is an open collaborative system for managing services across IoT, edge and core computing environments. COP-PILOT is built to enable secure and intelligent operations that connect diverse sectors.</p> <p>This document brings together an ecosystem of technical blueprints and services models across 5 main domains to support the development of these infrastructures. With a focus on seamless cross domain integration, it lays the foundation for private edge deployments and digital ecosystems across Europe.</p> <p>This deliverable sets the direction for building a platform that drives smarter, more secure, and collaborative digital transformations across multiple industries.</p>
<p><b>Keywords</b></p>	<p>IoT Interoperability. Edge Computing. 5G Connectivity, System Intelligence, Automation, Private Edge Systems, Large Scale. Mining, Ports and Logistics, Energy, Agriculture, Viticulture,</p>

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\* R: Document, report (excluding the periodic and final reports)

DEM: Demonstrator, pilot, prototype, plan designs

DEC: Websites, patents filing, press & media actions, videos, etc.

DATA: Data sets, microdata, etc.

DMP: Data management plan

ETHICS: Deliverables related to ethics issues.

SECURITY: Deliverables related to security issues

OTHER: Software, technical diagram, algorithms, models, etc.

## TECHNICAL REQUIREMENTS ANALYSIS

The objective of this section is to provide a deep dive into COP-PILOT’s technical requirements, focusing on large modules of the COP-PILOT system. These requirements are classified across 5 different categories, each corresponding to a discrete layer of the initial COP-PILOT architecture presented in [Annex 2](#).

### MODULE REQUIREMENTS FOR THE COP-PILOT BM-L

Table 3.1 provides a list of business management requirements that need to be ensured by the COP-PILOT platform at the BM-L.

*Table 3.1: Functional business management requirements.*

Requirement ID	Requirement Analysis
FNR.BML.LLM1	Description: ETSI OpenSlice LLM MUST interface with the domain orchestrator via TMF service management API blueprints and calls
	Affected Components: BM-L, DDO-L
	Contributing Partners: UOP
	Comment: To be integrated in the OSL portal in 2025
FNR.BML.LLM2	Description: Maestro LLM MUST interface with the End-to-End Service Orchestrator via TMF service management API blueprints and calls
	Affected Components: BM-L, ESO-L
	Contributing Partners: UBI
	Comment: Not available today, but planned in early 2026
FNR.BML.LLM3	Description: The COP-PILOT portal MUST interface with the Domain Orchestrator and End-to-End Service Orchestrator via TMF service management APIs
	Affected Components: BML-L, ESO-L, DDO-L
	Contributing Partners: AGE, UBI, UOP
	Comment: Expectation to incorporate LLM agents into the common COP-PILOT portal
FNR.BML.LLM4	Description: LLM-Based User Interaction / LLM-assisted Service Composition MUST interface with the Domain Orchestrator & End-to-End Service Orchestrator via TMF service management APIs
	Affected Components: BML-L, ESO-L, DDO-L
	Contributing Partners: ONE, UBI, UOP
	Comment: Not available today / planned early 2026 Based on COP-PILOT needs and other partners efforts
FNR.BML.LLM5	Description: LLM & agents I/O guardrails MUST interface with the E2E Service Orchestrator, other Business Portal Components with which LLM interacts (e.g. Party Management, Observability) via Python or HTTP REST APIs exposable
	Affected Components: BM-L, ESO-L
	Contributing Partners: IPN, UBI
	Comment: Not available today, planned in end 2025 / early 2026
FNR.BML.LLM6	Description: LLM-Based Intent Recognition Engine MUST interface with the Domain orchestrator via HTTP REST APIs for orchestration

	Affected Components: BM-L, DDO-L
	Contributing Partners: KON, UOP
	Comment: N/A
FNR.BML.PM1	Description: ETSI OpenSlice Party Management Portal and APIs MUST interface with the Domain Orchestrator via TMF Party Management APIs
	Affected Components: OSL PM, DDO-L
	Contributing Partners: UOP
	Comment: N/A
FNR.BML.PM2	Description: Maestro Party Management Portal and APIs MUST interface with the End-to-End Service Orchestrator via TMF Party Management APIs
	Affected Components: Maestro PM, ESO-L
	Contributing Partners: UBI
	Comment: N/A
FNR.BML.PM3	Description: The COP-PILOT portal MUST interface with Domain Orchestrator and End-to-End Service Orchestrator
	Affected Components: Portal, ESO-L, DDO-L
	Contributing Partners: AGE, UBI, UOP
	Comment: Expectation to unify both portals above under a common one for COP-PILOT
FNR.BML.DE1	Description: Maestro Domain Expansion Portal MUST interface with the End-to-End Service Orchestrator via TMF Party Management APIs/TMF Location Management APIs
	Affected Components: Maestro, ESO-L
	Contributing Partners: UBI
	Comment: Uses the TMF Party Management API to peer with adjacent orchestrators in other domains. TMF Location Management APIs are used to denote the location of these orchestrators/domains. View not available today, but planned by the end of 2025
FNR.BML.DE2	Description: The COP-PILOT portal MUST interface with the End-to-End Service Orchestrator via TMF Party Management APIs/TMF Location Management APIs
	Affected Components: Portal, ESO-L
	Contributing Partners: AGE, UBI
	Comment: Expectation to incorporate this view into the common COP-PILOT portal
FNR.BML.DE3	Description: Domain Expansion APIs MUST interface with the End-to-End Service Orchestrator via TMF Location Management APIs
	Affected Components: BM-L, ESO-L
	Contributing Partners: ONE, UBI
	Comment: We are also interested in understanding how to integrate new domains and adjacent orchestrators
FNR.BML.OUI1	Description: Maestro Telemetry MUST interface with the End-to-End Service Orchestrator via Prometheus
	Affected Components: Maestro, ESO-L
	Contributing Partners: UBI
	Comment: Service-level metrics Based on Prometheus

FNR.BML.OUI2	Description: ETSI OpenSlice Telemetry (Metrico) MUST interface with the Domain Orchestrator via Prometheus + TMF 628 Performance Management API
	Affected Components: OSL, DDO-L
	Contributing Partners: UOP
	Comment: Based on Prometheus metrics to TMF 628 metrics
FNR.BML.OUI3	Description: The COP-PILOT portal MUST interface with Domain Orchestrator and End-to-End Service Orchestrator via Prometheus + TMF 628 Performance Management API
	Affected Components: Portal, ESO-L, DDO-L
	Contributing Partners: AGE, UBI, UOP
	Comment: Expectation to incorporate these views into the common COP-PILOT portal
FNR.BML.OUI4	Description: NetFoundry BrowZer MUST interface with the Domain Orchestrator via Rest API
	Affected Components: SIF-L, DDO-L
	Contributing Partners: TATA, UOP
	Comment: Clientless endpoint for 'dark UI' (applies to the entire business portal)
FNR.BML.OUI5	Description: Models Observability + XAI Dashboard MUST interface with LLM, Other AI Engines via Rest API
	Affected Components: BM-L, DDO-L
	Contributing Partners: SUITE5, UBI, UOP
	Comment: Based on AI-DAPT and XMANAI project where we monitor models performance and build XAI dashboards
FNR.BML.BP1	Description: The portal must support role-based access for: - End-users/customers: browse, request, monitor services. - Service developers: onboard, describe, and test services. - Service providers/operators: manage deployments, monitor resources.
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP2	Description: Authentication/authorization must support federated identity (OAuth2, Keycloak)
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP3	Description: The portal must enable uploading or describing services in different formats: - Structured descriptors (YAML/JSON). - Multimodal inputs (text prompt, image, code snippet).
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP4	Description: Integration with LLM-based service descriptor generator to transform natural input into orchestration blueprints.
	Affected Components: Portal

	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP5	Description: Validation of submitted descriptors (schema checks, compliance with COP-PILOT orchestration standards).
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP6	Description: Lifecycle management features: Onboarding -> Testing -> Deployment -> Update -> Decommission.
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP7	Description: Provide intuitive web-based front-end, responsive (desktop, tablet, mobile).
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP8	Description: Dashboard views tailored by role: - Customers -> available services, usage status, billing. - Developers -> service onboarding, logs, validation results. - Providers -> system monitoring, orchestration overview.
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP9	Description: Guided onboarding wizard (step-by-step) with both manual and AI-assisted (LLM) modes.
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP10	Description: Portal must communicate with COP-PILOT orchestrator APIs
	Affected Components: Portal
	Contributing Partners: AGE, UBI, INTRA
	Comment: N/A
FNR.BML.BP11	Description: Service onboarding outputs must be directly consumable by orchestrators (ETSI OSM, Kubernetes, FIWARE).
	Affected Components: Portal
	Contributing Partners: AGE, UBI, INTRA
	Comment: N/A
FNR.BML.BP12	Description: Ensure logging, monitoring, and status feedback loops from orchestrator to portal dashboard.
	Affected Components: Portal
	Contributing Partners: AGE, UBI, INTRA
	Comment: N/A
FNR.BML.BP13	Description: Accept multimodal input (text, images, artefacts).
	Affected Components: Portal
	Contributing Partners: AGE

	Comment: N/A
FNR.BML.BP14	Description: Translate user input into service descriptors (blueprints) using LLM.
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP15	Description: Provide explainability: show users how their input was translated (e.g., preview of generated YAML before deployment).
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP16	Description: Allow human override/editing of AI-generated descriptors.
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP17	Description: Ensure data privacy (no leakage of proprietary service info to external AI without safeguards).
	Affected Components: Portal
	Contributing Partners: AGE
	Comment: N/A
FNR.BML.BP18	Description: consume Domain Service Mgmt APIs (Catalogs, Order, Inventory) and offer the respective GUI
	Affected Components: Portal
	Contributing Partners: UoP
	Comment: DDO-side portal
FNR.BML.BP19	Description: consume Domain Resource Mgmt APIs (Catalogs, Order, Inventory) and offer the respective GUI
	Affected Components: Portal
	Contributing Partners: UoP
	Comment: DDO-side portal
FNR.BML.BP20	Description: consume Party Mgmt APIs and offer the respective GUI
	Affected Components: Portal
	Contributing Partners: UoP
	Comment: DDO-side portal
FNR.BML.BP21	Description: offer the respective GUI to design domain-relevant services, also incorporating telemetry sources if needed
	Affected Components: Portal
	Contributing Partners: UoP
	Comment: DDO-side portal
FNR.BML.BP22	Description: provide the respective GUI to design data management-related domain services and offer them as-a-Service (aaS)
	Affected Components: Portal
	Contributing Partners: UoP, FIWARE
	Comment: DDO-side portal
FNR.BML.BP23	Description: offer a "shopping card" GUI that enables users to order exposed domain services for deployment

	Affected Components: Portal
	Contributing Partners: UoP
	Comment: DDO-side portal

## MODULE REQUIREMENTS FOR THE COP-PILOT ESO-L

Table 3.2 provides a list of end-to-end multi-domain service & resource orchestration requirements that need to be ensured by the COP-PILOT platform at the ESO-L.

Table 3.2: Functional end-to-end service & resource orchestration requirements.

Requirement ID	Requirement Analysis
FNR.ESOL.01	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> offer service catalogs for storing relevant service specifications
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners
	Comment: N/A
FNR.ESOL.02	<u>Description:</u> Each service catalog offered by ESO <b>MUST</b> contain one or more service categories. End-user services catalog should contain at least 4 service categories, one per vertical sector: (i) Smart Industries, (ii) Smart Buildings, (iii) Smart Farming, (iv) Smart Energy Management Platform services catalog should contain at least three categories of services: (i) Compute services, (ii) Network Services, and (iii) Data Services
	Affected Components: ESO, DO
	<u>Contributing Partners:</u> UBI and T3.1 partners, UOP and T3.2 partners
	<u>Comment:</u> DO is related because platform services are advertised by the DO's catalog and ESO incorporates them in its catalog.
FNR.ESOL.03	<p><u>Description:</u> Each service category offered by ESO <b>MUST</b> contain one or more service specifications.</p> <ul style="list-style-type: none"> <li>• Smart Industries category should contain as many services as those related to Clusters 1 and 4.</li> <li>• Smart Buildings category should contain as many services as those related to Cluster 2.</li> <li>• Smart Farming category should contain as many services as those related to Cluster 3A</li> <li>• Smart Energy Management category should contain as many services as those related to Cluster 3E</li> </ul>

	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners, Clusters
	Comment: N/A
FNR.ESOL.04	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow users to Create/Read/Update/Delete (CRUD) service catalogs via API calls and the BM Portal.
	Affected Components: BMP, ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners, AGE and T3.4 partners
	Comment: N/A
FNR.ESOL.05	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow users to Create/Read/Update/Delete (CRUD) service categories via API calls and the BM Portal.
	Affected Components: BMP, ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners, AGE and T3.4 partners
	Comment: N/A
FNR.ESOL.06	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow users to Create/Read/Update/Delete (CRUD) service specifications via API calls and the BM Portal.
	Affected Components: BMP, ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners, AGE and T3.4 partners
	Comment: N/A
FNR.ESOL.07	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> offer service catalogs, categories, and specifications via a standardized API.
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners
	Comment: N/A
FNR.ESOL.08	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow users to add a service specification into a "shopping cart" to facilitate service ordering.
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners
	Comment: N/A
FNR.ESOL.09	<u>Description:</u> When a service specification is added into a shopping cart, COP-PILOT ESO <b>MUST</b> suggest default values (via API call and BM Portal) per service spec. characteristics, to guide the user on how to fill in a service order
	Affected Components: BMP, ESO

	<u>Contributing Partners:</u> UBI and T3.1 partners, AGE and T3.4 partners
	Comment: N/A
FNR.ESOL.10	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow users to place an order for an end-user service atop a new compute cluster.
	<u>Affected Components:</u> BMP, ESO, Compute Controller
	<u>Contributing Partners:</u> UBI and T3.1 partners, AGE and T3.4 partners
	Comment: N/A
FNR.ESOL.11	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow users to place an order for an end-user service atop an existing compute cluster (already deployed by a previous service order).
	<u>Affected Components:</u> BMP, ESO, Compute Controller
	<u>Contributing Partners:</u> UBI and T3.1 partners, AGE and T3.4 partners
	Comment: N/A
FNR.ESOL.12	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow users to place orders for platform services.
	Affected Components: BMP, ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners, AGE and T3.4 partners
	Comment: N/A
FNR.ESOL.13	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow users to place orders with more than one service specifications.
	Affected Components: BMP, ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners, AGE and T3.4 partners
	<u>Comment:</u> To support composite vertical services.
FNR.ESOL.14	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow service orders for single-domain and multi-domain services via a standardized API.
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners
	Comment: N/A
FNR.ESOL.15	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> offer service inventory via a standardized API.
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners
	Comment: N/A

FNR.ESOL.16	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> advertise customer-facing vertical service characteristics of the deployed services.
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners
	<u>Comment:</u> To allow service providers to modify application-level characteristics in real-time.
FNR.ESOL.17	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> advertise runtime compute service characteristics for end user services.
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners
	<u>Comment:</u> To allow service providers to scale compute resources for a service on demand.
FNR.ESOL.18	<u>Description:</u> The COP-PILOT ESO <b>COULD</b> advertise runtime network service characteristics for end user services that consume an underlying network service.
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners
	<u>Comment:</u> For services that operate on configurable network slices
FNR.ESOL.19	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow users to modify the configurable service characteristics of an active service in real-time.
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners
	Comment: N/A
FNR.ESOL.20	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> integrate with public service registries without authentication
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners, COP-PILOT service providers
	<u>Comment:</u> To pull public service artefacts for deployment
FNR.ESOL.21	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> integrate with any private service registry, given that the user has inserted the relevant secrets (username and password) into ESO's encrypted service registry.
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners, COP-PILOT service providers
	<u>Comment:</u> To pull private service artefacts - after secure authentication to the registry - for deployment

FNR.ESOL.22	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> support both HTTP-based and OCI-based service registries
	Affected Components: ESO
	<u>Contributing Partners:</u> UBI and T3.1 partners, COP-PILOT service providers
	Comment: N/A
FNR.ESOL.23	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> offer a secure and trusted storage service for user secrets required to access private service registries/repositories.
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To ensure privacy for service providers
FNR.ESOL.24	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> encode individual parties into its Party Management schema.
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To model the COP-PILOT ecosystem of individual stakeholders as entities of the platform.
FNR.ESOL.25	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> encode organization parties into its Party Management schema.
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To model the COP-PILOT ecosystem of organizations as entities of the platform.
FNR.ESOL.26	<u>Description:</u> The COP-PILOT ESO Party Management schema <b>MUST</b> allow relationships between (individual and/or organizations) parties
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	Comment: N/A
FNR.ESOL.27	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> provide a northbound API for managing Parties.
	Affected Components: ESO, BMP
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To allow managing the parties via API calls or a Portal
FNR.ESOL.28	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> ensure that the Party management API relies on open standards

	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To ensure a standardized way of managing parties.
FNR.ESOL.29	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> be able to federate remote telemetry services from multiple domains
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To support multi-domain telemetry.
FNR.ESOL.30	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> perform telemetry federation in a secure and trusted manner.
	Affected Components: ESO, SIF
	<u>Contributing Partners:</u> UBI and T3.1 partners, TATA and T3.5 partners
	<u>Comment:</u> To fortify multi-domain telemetry with security and trust
FNR.ESOL.31	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> expose a northbound telemetry API for multi-domain services.
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To offer Telemetry-as-a-Service.
FNR.ESOL.32	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> offer telemetry dashboards on top of multi-domain service telemetry data.
	Affected Components: ESO and BMP
	<u>Contributing Partners:</u> UBI and T3.1 partners, AGE and T3.4 partners
	<u>Comment:</u> To visualize multi-service performance.
FNR.ESOL.33	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> allow users to customize telemetry data according to their SLAs
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To enable SLA monitoring.
FNR.ESOL.34	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> be able to manage (add, remove, list) one or more SIF instances via an API.
	Affected Components: ESO, SIF
	<u>Contributing Partners:</u> UBI and T3.1 partners, TATA and T3.5 partners
	<u>Comment:</u> To enable the expansion of the platform to new territories.

FNR.ESOL.35	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> exploit the management API of a SIF instance for managing SIF entities.
	Affected Components: ESO, SIF
	<u>Contributing Partners:</u> UBI and T3.1 partners, TATA and T3.5 partners
	<u>Comment:</u> To manage every SIF instance in a programmatic way.
FNR.ESOL.36	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> expose the management API of the SIF instances towards the business portal.
	Affected Components: ESO, SIF, BMP
	<u>Contributing Partners:</u> UBI and T3.1 partners, TATA and T3.5 partners, AGE and T3.4 partners
	<u>Comment:</u> To manage the COP-PILOT networks in a user-friendly manner.
FNR.ESOL.37	<u>Description:</u> The COP-PILOT ESO <b>COULD</b> possess a mechanism that verifies the availability of already peered SIF instances, otherwise remove them from the platform
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To ensure consistent state management of the underlying SIF platforms.
FNR.ESOL.38	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> be able to manage (add, remove, list) one or more private domains, while managing their authentication (identities) against SIF.
	Affected Components: ESO, SIF
	<u>Contributing Partners:</u> UBI and T3.1 partners, TATA and T3.5 partners
	Comment: N/A
FNR.ESOL.39	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> expose the management API of the private domains towards the business portal.
	Affected Components: ESO, SIF
	<u>Contributing Partners:</u> UBI and T3.1 partners, TATA and T3.5 partners
	Comment: N/A
FNR.ESOL.40	<u>Description:</u> The COP-PILOT ESO <b>COULD</b> possess a mechanism that verifies the availability of already connected private domains, otherwise remove them from the platform
	Affected Components: ESO, SIF
	<u>Contributing Partners:</u> UBI and T3.1 partners, TATA and T3.5 partners
	<u>Comment:</u> To ensure consistent state management of the underlying SIF domains.

FNR.ESOL.41	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> be able to manage (add, remove, list) a Domain Orchestrator instance.
	<u>Affected Components:</u> ESO, DO
	<u>Contributing Partners:</u> UBI and T3.1 partners, UOP and T3.2 partners
	<u>Comment:</u> N/A
FNR.ESOL.42	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> expose the management API of the Domain Orchestrators towards the business portal.
	<u>Affected Components:</u> ESO, DO
	<u>Contributing Partners:</u> UBI and T3.1 partners, UOP and T3.2 partners
	<u>Comment:</u> N/A
FNR.ESOL.43	<u>Description:</u> The COP-PILOT ESO <b>COULD</b> possess a mechanism that verifies the availability of already connected Domain Orchestrators, otherwise remove them from the platform.
	<u>Affected Components:</u> ESO, DO
	<u>Contributing Partners:</u> UBI and T3.1 partners, UOP and T3.2 partners
	<u>Comment:</u> To ensure consistent state management of the underlying Domain Orchestrators.
FNR.ESOL.44	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> be able to manage (add, remove, list) a compute cluster via the respective DO API.
	<u>Affected Components:</u> ESO, DO, Compute cluster
	<u>Contributing Partners:</u> UBI and T3.1 partners, UOP and T3.2 partners, Compute cluster providers across all Clusters
	<u>Comment:</u> N/A
FNR.ESOL.45	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> expose the management API of the compute clusters towards the business portal.
	<u>Affected Components:</u> ESO, DO, Compute cluster
	<u>Contributing Partners:</u> UBI and T3.1 partners, UOP and T3.2 partners, Compute cluster providers across all Clusters
	<u>Comment:</u> N/A
FNR.ESOL.46	<u>Description:</u> The COP-PILOT ESO <b>COULD</b> possess a mechanism that verifies the availability of already active compute clusters, otherwise remove them from the platform.
	<u>Affected Components:</u> ESO, DO, Compute cluster
	<u>Contributing Partners:</u> UBI and T3.1 partners, UOP and T3.2 partners, Compute cluster providers across all Clusters
	<u>Comment:</u> To ensure consistent state management of the underlying clusters.

FNR.ESOL.47	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> expose a northbound API for service providers to manage (create, read, delete) SLAs for their services.
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To ensure SLA management of multi-domain services.
FNR.ESOL.48	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> ensure that the SLA management API relies on open standards.
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To ensure adoption of this API by the industry.
FNR.ESOL.49	<u>Description:</u> The COP-PILOT ESO <b>MUST</b> be able to parse an SLA request for a multi-domain service and break it down to sub-SLA requests towards different Domain Orchestrators.
	Affected Components: ESO
	Contributing Partners: UBI and T3.1 partners
	<u>Comment:</u> To ensure multi-domain SLAs are managed in every domain.
FNR.ESOL.50	<u>Description:</u> The COP-PILOT ESO <b>COULD</b> exploit the same SLA Management API with the DO to facilitate SLA management.
	Affected Components: ESO, DO
	<u>Contributing Partners:</u> UBI and T3.1 partners, UOP and T3.2 partners
	<u>Comment:</u> To promote a unified way of managing SLAs.

## MODULE REQUIREMENTS FOR THE COP-PILOT DDO-L

Table 3.3 provides a list of domain-level service and resource orchestration requirements that need to be ensured by the COP-PILOT platform at the DDO-L.

Table 3.3: Functional domain-level service & resource orchestration requirements.

Requirement ID	Requirement Analysis
FNR.DDOL.DO.01	<u>Description:</u> The COP-PILOT DO <b>MUST</b> offer service catalogs for storing domain-relevant service specifications
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A

FNR.DDOL.DO.02	<u>Description:</u> Each service catalog offered by DO <b>COULD</b> contain 1 or more service categories
	Affected Components: DO
	Contributing Partners: T4.1 partners
	Comment: N/A
FNR.DDOL.DO.03	<u>Description:</u> Each service category offered by DO <b>COULD</b> contain 1 or more service specifications
	Affected Components: DO, ESO
	Contributing Partners: T4.1 partners
	Comment: ESO needs to be aware of the created service specifications' identifiers
FNR.DDOL.DO.04	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the definition (type, default value, etc.) of service specification characteristics that distinguish the specification
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.05	<u>Description:</u> The COP-PILOT DO <b>MUST</b> offer service catalogs, categories, specification management via standardized APIs
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: Compliance with TMF633 Service Catalog Management
FNR.DDOL.DO.06	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the issuing of a service order based on exposed service specifications
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: ESO will issue service order requests to DO
FNR.DDOL.DO.07	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the combination of two or more service specifications under the same service order
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A

FNR.DDOL.DO.08	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the preview of issued service orders and the monitoring of their progress
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.09	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the editing of the requested duration of issued service orders, as well as other order characteristics
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.10	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the termination of issued service orders upon request
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.11	<u>Description:</u> The COP-PILOT DO <b>COULD</b> allow simple user roles to issue and preview service orders, while introducing a privileged user role that can also acknowledge the issued orders for fulfilment
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.12	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow all the mentioned actions via a standardized API
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: Compliance with TMF641 Service Order Management
FNR.DDOL.DO.13	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the preview of deployed services and their runtime characteristics, created by fulfilled service orders
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A

FNR.DDOL.DO.14	<u>Description:</u> The COP-PILOT DO <b>MUST</b> be able to bind the deployed services with the respective service order
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.15	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the editing of the requested duration of deployed services, as well as other configurable service characteristics
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.16	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the termination of deployed services upon request
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.17	<u>Description:</u> The COP-PILOT DO <b>MUST</b> be able to differentiate between customer-facing and resource-facing services (that create resources)
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.18	<u>Description:</u> The COP-PILOT DO <b>MUST</b> display the association of a service with related services and/or resources
	Affected Components: DO, ESO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.19	<u>Description:</u> The COP-PILOT DO <b>MUST</b> offer detailed notes presenting the lifecycle stages of the deployed service
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A

FNR.DDOL.DO.20	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the addition of user-related notes to the deployed service
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.21	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow all the mentioned actions via a standardized API
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: Compliance with TMF638 Service Inventory Management
FNR.DDOL.DO.22	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the addition of user-related notes to the deployed service
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.23	<u>Description:</u> The COP-PILOT DO <b>MUST</b> capture acknowledged service orders and initiate their fulfilment
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.24	<u>Description:</u> The COP-PILOT DO <b>MUST</b> be able to handle several parallel service orders
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.25	<u>Description:</u> The COP-PILOT DO <b>MUST</b> decompose the service bundle that is requested through a service order and create the respective services
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A

FNR.DDOL.DO.26	<u>Description:</u> The COP-PILOT DO <b>MUST</b> create services in parallel, but also respect service creation dependencies when requested
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.27	<u>Description:</u> The COP-PILOT DO <b>MUST</b> inject custom logic in several lifecycle phases of the created services
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.28	<u>Description:</u> The COP-PILOT DO <b>MUST</b> decide which controller to employ to execute the logic behind the created services
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.29	<u>Description:</u> The COP-PILOT DO <b>MUST</b> control the full lifecycle of a service, e.g. creation, operation, supervision, termination, and/or failure
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.30	<u>Description:</u> The COP-PILOT DO <b>COULD</b> request service deployments towards external orchestrators
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.31	<u>Description:</u> The COP-PILOT DO <b>MUST</b> create the respective resources, stemming from the creation of resource-facing services
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A

FNR.DDOL.DO.32	<u>Description:</u> The COP-PILOT DO <b>MUST</b> control the full lifecycle of a resource, e.g., creation, operation, supervision, termination, and/or failure
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.33	<u>Description:</u> The COP-PILOT DO <b>MUST</b> store resource specifications, which represent domain-relevant resource controllers
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.34	<u>Description:</u> The COP-PILOT DO <b>MUST</b> enable the utilization of offered resource specifications in service specification(s) design
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.35	<u>Description:</u> Each resource specification offered by DO <b>MUST</b> allow the definition (type, default value, etc.) of resource specification characteristics that distinguish the specification
	Affected Components: DO
	Contributing Partners: T4.1 partners
	Comment: N/A
FNR.DDOL.DO.36	<u>Description:</u> The COP-PILOT DO <b>MUST</b> offer resource specification management via standardized APIs
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: Compliance with TMF634 Resource Catalog Management
FNR.DDOL.DO.37	<u>Description:</u> The COP-PILOT DO <b>MUST</b> ensure that the resource order entirely matches the respective service order's lifecycle
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A

FNR.DDOL.DO.38	<u>Description:</u> The COP-PILOT DO <b>MUST</b> ensure that the resource order is only triggered by the respective service order (of a resource-facing service specification) and it is an internal task of the Core Domain Orchestrator
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.39	<u>Description:</u> The COP-PILOT DO <b>MUST</b> ensure the creation of the respective resource, stemming from the related resource specification
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.40	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the preview of created resources and their runtime characteristics, created by fulfilled resource orders
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.41	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the preview of resource characteristics
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.42	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the preview of the stemming resource specification, which the resource is based upon
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.43	<u>Description:</u> The COP-PILOT DO <b>MUST</b> offer detailed notes presenting the lifecycle stages of the resource
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners

	Comment: N/A
FNR.DDOL.DO.44	<u>Description:</u> The COP-PILOT DO <b>MUST</b> display the association of a resource with related resources
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.45	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow all the mentioned actions via a standardized API
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: Compliance with TMF639 Resource Inventory Management
FNR.DDOL.DO.46	<u>Description:</u> The COP-PILOT DO <b>MUST</b> be able to integrate domain-owned monitoring systems (Prometheus instances)
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.47	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow the service designer to define the desired metrics retrieval URL, the retrieval interval, the retrieval duration, and the associated service from the Domain Service Inventory
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.48	<u>Description:</u> The COP-PILOT DO <b>MUST</b> retrieve and present metrics inherently through the Domain Service Inventory
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.49	<u>Description:</u> The COP-PILOT DO <b>MUST</b> update the service lifecycle with external monitoring data through lifecycle management rules
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners

	Comment: N/A
FNR.DDOL.DO.50	<u>Description:</u> The COP-PILOT DO <b>MUST</b> enhance the domain closed-loop management by integrating monitoring data
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.51	<u>Description:</u> The COP-PILOT DO <b>MUST</b> design the mentioned actions via a standardized API and data models
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: Compliance with TMF638 Service Inventory Management and TMF628 Performance Management
FNR.DDOL.DO.52	<u>Description:</u> The COP-PILOT DO <b>MUST</b> encode individual parties
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.53	<u>Description:</u> The COP-PILOT DO <b>MUST</b> encode organization parties
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.54	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allocate each service specification to its related party
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.55	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allocate each service to its related party
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A

FNR.DDOL.DO.56	<u>Description:</u> The COP-PILOT DO <b>COULD</b> allow service categories and specifications exchange with registered organizations
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.57	<u>Description:</u> The COP-PILOT DO <b>COULD</b> allow service orchestration delegation to partnered organizations
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.58	<u>Description:</u> The COP-PILOT DO <b>COULD</b> allow partnered service preview, when created by a partnered orchestration delegation
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: N/A
FNR.DDOL.DO.59	<u>Description:</u> The COP-PILOT DO <b>MUST</b> allow party management via standardized APIs
	Affected Components: DO
	Contributing Partners: UOP and T3.2 partners
	Comment: Compliance with TMF632 Party Management
FNR-DDOL.DO.60	Description. COP-PILOT <b>MUST</b> be compliant with ColonyOS resource definition specification (based on OpenAPI specification) for deployment orchestration.
	Affected Component: DO
	Contributing Partner: UoP, Ubitech
	Comment: ColonyOS will deploy and configure Arrowhead

Table 3.4 provides a list of domain-level data management requirements that need to be ensured by the COP-PILOT platform at the DDO-L.

Table 3.4: Functional domain-level data management requirements.

Requirement ID	Requirement Analysis
FNR.DDOL.DM.01	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> provide declarative management of data resources across edge and cloud domains, leveraging the ColonyOS resource specification, reconciliation mechanism, and meta-file-system to control data placement, movement, and accessibility without enabling direct external control of mining infrastructure.
	Affected Components: DomainOrch (OpenSlice), ColonyOS (including ColonyFS meta-file-system)
	Contributing Partners: LTU, RISE, UoP
	Comment: Ensures governance-compliant data handling, including visibility, replication, and synchronization to support cloud bursting and cross-domain workflows while maintaining full control within the mining operator.
FNR.DDOL.DM.02	<u>Description:</u> The system <b>MUST</b> support secure integration and orchestration of IoT devices and industrial controllers using Arrowhead Framework services, enabling local automation within mining environments while maintaining strict isolation from external control.
	Affected Components: Arrowhead
	Contributing Partners: LTU, RISE
	Comment: Provides service discovery, access control, and secure communication primitives for IoT/OT, ensuring interoperability across heterogeneous mining equipment without compromising operational sovereignty.
FNR.DDOL.DM.03	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> be able to support aggregation and historical analytics storage.
	Contributing Partners: LTU, RISE
	Comment: N/A
FNR.DDOL.DM.04	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> guarantee high reliability and delivery confirmation
	Contributing Partners: LTU, RISE
	Comment: N/A
FNR.DDOL.DM.05	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> provide real-time event and alert management
	Contributing Partners: LTU, RISE
	Comment: N/A

FNR.DDOL.DM.06	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> guarantee time-series data integrity and traceability
	Contributing Partners: LTU, RISE
	Comment: N/A
FNR.DDOL.DM.07	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> support ingestion of the latest telemetry via MQTT, LoRaWAN, NB-IoT, etc.
	Contributing Partners: LTU, RISE
	Comment: N/A
FNR.DDOL.DM.08	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> expose a standardized Northbound API (NGSI-LD) for apps to make queries.
	Contributing Partners: LTU, RISE
	Comment: N/A
FNR.DDOL.DM.09	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> enable Federated and Hierarchical broker architectures for data synchronization.
	Contributing Partners: LTU, RISE
	Comment:
FNR.DDOL.DM.10	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> support real-time updates to internal apps via a Subscription (Pub/Sub) mechanism.
	Contributing Partners: LTU, RISE
	Comment: N/A
FNR.DDOL.DM.11	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> allow for granular filtering of context information shared between distributed brokers
	Contributing Partners: LTU, RISE
	Comment: N/A
FNR.DDOL.DM.12	<u>Description:</u> The COP-PILOT Data Management layer <b>MUST</b> support persistent storage and historical tracking of IoT device lifecycle states (e.g., deployment, activation, maintenance, reuse, decommissioning) using FIWARE-compliant data models.
	Affected Components: Distributed Domain Orchestration Layer (Data management)
	Contributing Partners: LTU, HOSCH, TAB, PAB, ROC, TID, AUA, TOR, BAR, AGA, ILINK,RZ, ONE
	Comment: Required to enable traceability of sensor reuse, lifecycle analytics, and sustainability KPIs.

FNR.DDOL.DM.13	<u>Description:</u> The COP-PILOT Data Management layer <b>MUST</b> support ingestion, aggregation, and historical storage of environmental, soil, irrigation, and weather-related data streams in near real-time
	Affected Components: Distributed Domain Orchestration Layer (Data management)
	Contributing Partners: LTU, HOSCH, TAB, PAB, ROC, TID, AUA, TOR, BAR, AGA, ILINK,RZ, ONE, TER
	Comment: Enables irrigation analytics, water optimization KPIs, and long-term soil performance analysis
FNR.DDOL.DM.14	<u>Description:</u> The COP-PILOT Data Management layer <b>MUST</b> support correlation and contextualization of multi-source data (e.g., satellite inputs, weather forecasts, field sensors) through harmonized FIWARE data models
	Affected Components: Distributed Domain Orchestration Layer (Data management)
	Contributing Partners: LTU, HOSCH, TAB, PAB, ROC, TID, AUA, TOR, BAR, AGA, ILINK,RZ, ONE, TER
	Comment: Required for hybrid irrigation strategies and predictive decision support.
FNR.DDOL.DM.15	<u>Description:</u> The COP-PILOT Data Management layer <b>MUST</b> support structured ingestion and historical storage of production-line data (e.g., machine states, OEE parameters, downtime events) via standardized APIs.
	Affected Components: Distributed Domain Orchestration Layer (Data management)
	Contributing Partners: LTU, HOSCH, TAB, PAB, ROC, TID, AUA, TOR, BAR, AGA, ILINK,RZ, ONE, JIG
	Comment: Necessary for OEE computation and operational analytics
FNR.DDOL.DM.16	<u>Description:</u> The COP-PILOT Data Management layer <b>MUST</b> support real-time ingestion, contextualization, and historical storage of energy-related metrics from renewable-powered 5G sites, including per-device energy consumption, site-level energy availability, and communication-related power usage.
	Affected Components: Distributed Domain Orchestration Layer (Data management)
	Contributing Partners: LTU, HOSCH, TAB, PAB, ROC, TID, AUA, TOR, BAR, AGA, ILINK,RZ, ONE, NOKIA
	Comment: Required to enable energy accounting per deployed and activated device, ensuring service availability monitoring and energy-efficiency analytics in isolated vineyard environments

FNR.DDOL.DM.17	<u>Description:</u> The COP-PILOT Data Management service of the DDO-L <b>MUST</b> support real-time ingestion, contextualization, and lifecycle management of parcel-centric agronomic data, including sensor streams, UAV imagery metadata, robotic intervention logs, and cultivation records.
	Affected Components: COP-PILOT Data Management
	Contributing Partners: AgroApps, AUA, TOR
	Comment: N/A
FNR.DDOL.DM.18	<u>Description:</u> The COP-PILOT Data Management service of the DDO-L <b>MUST</b> maintain state-aware data propagation across monitoring, intervention, certification, and logistics phases, ensuring consistent parcel-level data updates across domains.
	Affected Components: COP-PILOT Data Management
	Contributing Partners: AgroApps, ILINK, BAR
	Comment: N/A
FNR.DDOL.DM.19	<u>Description:</u> The COP-PILOT Data Management service of the DDO-L <b>MUST</b> ensure edge-to-cloud data consistency, including buffering, reconciliation, and version control of agronomic datasets generated by field devices during intermittent connectivity.
	Affected Components: COP-PILOT Data Management
	Contributing Partners: AgroApps, AUA, TOR, OTE
	Comment: N/A
FNR.DDOL.DM.20	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> support ingestion of data from heterogeneous sensor sources, including sensors operating under different communication protocols, data formats, and sampling rates.
	Affected Components: COP-PILOT Data Management
	Contributing Partners: ENIK, UoP, PPC, BPO
	Comment: N/A
FNR.DDOL.DM.21	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> enable data sharing across organisational and technical domain boundaries, ensuring interoperability between disparate systems and stakeholders.
	Affected Components: COP-PILOT Data Management
	Contributing Partners: ENIK, UoP, PPC, BPO
	Comment: N/A
FNR.DDOL.DM.22	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> provide local data storage capabilities, ensuring data persistence and availability independently of external network connectivity.

	Affected Components: COP-PILOT Data Management
	Contributing Partners: ENIK, UoP, PPC, BPO
	Comment: N/A
FNR.DDOL.DM.23	<u>Description:</u> The COP-PILOT Data Mgmt. <b>MUST</b> expose well-defined APIs to facilitate data ingestion into target applications, supporting both push and pull data transfer patterns.
	Affected Components: COP-PILOT Data Management
	Contributing Partners: ENIK, UoP, PPC, BPO
	Comment: N/A

## MODULE REQUIREMENTS FOR THE COP-PILOT DIS-L

Table 3.5 provides a list of infrastructure-level requirements that need to be ensured by the COP-PILOT platform at the DIS-L.

Table 3.5: Functional infrastructure management requirements.

Requirement ID	Requirement Analysis
FNR.DISL.01	<u>Description:</u> The COP-PILOT platform <b>MUST</b> be able to manage virtual machine-based compute resources exposed by relevant Virtual Infrastructure Management (VIM) controllers.
	<u>Affected Components:</u> DO, Compute Controllers
	<u>Contributing Partners:</u> Cluster infrastructure providers, UOP and T3.2 partners
	<u>Comment:</u> Ensures that the platform shall interface with well-known VIM platforms, such as OpenStack, Proxmox, etc.
FNR.DISL.02	<u>Description:</u> The COP-PILOT platform <b>MUST</b> be able to manage containerized compute resources exposed by relevant Container Infrastructure Management (CIM) controllers.
	<u>Affected Components:</u> DO, Compute Controllers
	<u>Contributing Partners:</u> Cluster infrastructure providers, UOP and T3.2 partners
	<u>Comment:</u> Ensures that the platform shall interface with well-known CIM platforms, such as Kubernetes.
FNR.DISL.03	<u>Description:</u> The COP-PILOT platform <b>MUST</b> be able to manage 5G Radio Access Network (RAN) Functions via an NFV Orchestrator.
	<u>Affected Components:</u> DO, Mobile Radio Controllers

	<p><u>Contributing Partners:</u> Cluster infrastructure providers, UOP and T3.2 partners</p> <p><u>Comment:</u> Ensures that the platform shall interface with well-known and standardized NFVOs.</p>
FNR.DISL.04	<p><u>Description:</u> The COP-PILOT platform <b>MUST</b> be able to manage 5G Core Network (CN) Functions via an NFV Orchestrator.</p>
	<p><u>Affected Components:</u> DO, Mobile Core Controllers</p>
	<p><u>Contributing Partners:</u> Cluster infrastructure providers, UOP and T3.2 partners</p>
	<p><u>Comment:</u> Ensures that the platform shall interface with well-known and standardized NFVOs.</p>
FNR.DISL.05	<p><u>Description:</u> The COP-PILOT platform <b>MUST</b> be able to manage legacy 5G network services.</p>
	<p><u>Affected Components:</u> DO, Legacy Mobile Network systems</p>
	<p><u>Contributing Partners:</u> Cluster infrastructure providers, UOP and T3.2 partners</p>
	<p><u>Comment:</u> Ensures interoperability with legacy 5G systems.</p>
FNR.DISL.06	<p><u>Description:</u> The COP-PILOT platform <b>MUST</b> be able to manage programmable transport network services via an SDN controller.</p>
	<p><u>Affected Components:</u> DO, SDN Controllers</p>
	<p><u>Contributing Partners:</u> Cluster infrastructure providers, UOP and T3.2 partners</p>
	<p><u>Comment:</u> Ensures that the platform shall interface with state-of-the-art SDN controllers.</p>
FNR.DISL.07	<p><u>Description:</u> The COP-PILOT platform <b>COULD</b> be able to manage fixed transport services via legacy TN management platforms.</p>
	<p><u>Affected Components:</u> DO, Legacy TN management systems</p>
	<p><u>Contributing Partners:</u> Cluster infrastructure providers, UOP and T3.2 partners</p>
	<p><u>Comment:</u> Ensures interoperability with legacy TN systems.</p>
FNR.DISL.08	<p><u>Description:</u> The platform <b>MUST</b> expose standardized APIs to enable secure and federated cross-domain data sharing across distributed infrastructures</p>
	<p><u>Affected Components:</u> DO, Data Connectors</p>
	<p><u>Contributing Partners:</u> FIWARE and T3.3 contributing partners</p>
	<p><u>Comment:</u> Ensures effective collaboration and interoperability between domains</p>

FNR.DISL.09	<u>Description:</u> The COP-PILOT platform <b>MUST</b> expose standardized APIs and metadata models for distributed data lifecycle management, including ingestion, storage, and deletion policies
	Affected Components: DO, Data Connectors
	Contributing Partners: FIWARE and T3.3 contributing partners
	Comment: Enables consistent governance and synchronization of data streams, ensuring quality, integrity
FNR.DISL.10	<u>Description:</u> The COP-PILOT platform <b>MUST</b> enable seamless integration of multiple operational domains through a secure communication channel that provides encrypted, policy-based communication between distributed data and compute resources.
	Affected Components: SIF, DO, Data Connectors.
	Contributing Partners: TATA, FIWARE and T3.3, T3.5 contributing partners
	Comment: Ensures trusted interoperability between domains by enforcing data sovereignty, end-to-end encryption, and standardized federation interfaces.

## MODULE REQUIREMENTS FOR THE COP-PILOT SIF-L

Table 3.6 provides a list of connectivity and integration requirements that need to be ensured by the COP-PILOT platform at the SIF-L.

Table 3.6: Functional connectivity and integration requirements.

Requirement ID	Requirement Analysis
FNR.SIFL.01	<u>Description:</u> The COP-PILOT Secure Integration Fabric <b>MUST</b> enforce encrypted transmission and secure storage of data exchanged across distributed systems.
	Affected Components: COP-PILOT Secure Integration Fabric, Clusters
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment: N/A
FNR.SIFL.02	<u>Description:</u> The COP-PILOT Secure Integration Fabric <b>MUST</b> implement role-based and attribute-based access control policies governing data visibility for vertical sector actors.
	Affected Components: COP-PILOT Secure Integration Fabric, Clusters
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment: N/A
FNR.SIFL.03	<u>Description:</u> The COP-PILOT Secure Integration Fabric <b>MUST</b> be able to establish bidirectional encrypted channels ensuring the tamper-proof exchange of data and information among services

	Affected Components: COP-PILOT Secure Integration Fabric, Clusters
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment:
FNR.SIFL.04	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> assign a unique cryptographic identity to all participating entities (services, workloads, devices, users) to enable identity-based communication across domains.
	Affected Components: COP-PILOT Secure Integration Fabric, DO, ESO
	Contributing Partners: TATA, UBI, UOP, LTU, UPV, AGA, ONE
	Comment: Enables identity-first connectivity independent of IP addressing.
FNR.SIFL.05	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> support mutual authentication between communicating entities prior to establishing any communication channel.
	Affected Components: COP-PILOT Secure Integration Fabric, Clusters
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment: Ensures authenticate-before-connect model.
FNR.SIFL.06	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> enforce fine-grained, policy-based access control at the service level, defining which identities can communicate with which services.
	Affected Components: COP-PILOT Secure Integration Fabric, ESO
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment: Moves from network-level to service-level segmentation.
FNR.SIFL.07	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> support dynamic policy evaluation based on identity attributes, context, and service definitions.
	Affected Components: COP-PILOT Secure Integration Fabric, Clusters
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment: Enables ABAC and contextual access.
FNR.SIFL.08	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> enable service-to-service connectivity without requiring routable network exposure of endpoints.
	Affected Components: COP-PILOT Secure Integration Fabric, Clusters
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment: "Dark services" / no inbound exposure.
FNR.SIFL.09	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> establish connectivity on-demand based on successful authentication and authorization decisions.
	Affected Components: COP-PILOT Secure Integration Fabric, Clusters

	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment: No persistent open network paths.
FNR.SIFL.10	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> abstract underlying network topology, allowing services to communicate without dependency on IP addressing or network configuration.
	Affected Components: COP-PILOT Secure Integration Fabric, DO
	Contributing Partners: TATA, UOP
	Comment: Decouples connectivity from infrastructure.
FNR.SIFL.11	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> support secure federation between multiple domains, enabling controlled cross-domain service communication.
	Affected Components: SIF, ESO
	Contributing Partners: TATA, UBI
	Comment: Core to COP-PILOT vision.
FNR.SIFL.12	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> allow trust establishment between domains via exchange or validation of identity authorities (e.g., PKI, federated identity systems).
	Affected Components: COP-PILOT Secure Integration Fabric, Clusters
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment: Domain-to-domain trust model.
FNR.SIFL.13	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> provide audit logs of all communication sessions, including identities, services accessed, timestamps, and policy decisions.
	Affected Components: COP-PILOT Secure Integration Fabric, ESO
	Contributing Partners: TATA, UBI
	Comment: Identity-level audit (not just IP flows).
FNR.SIFL.14	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> expose telemetry on connectivity, policy enforcement, and session performance via standardized APIs.
	Affected Components: COP-PILOT Secure Integration Fabric, ESO
	Contributing Partners: TATA, UBI
	Comment: Integrates with telemetry federation already defined.
FNR.SIFL.15	<u>Description:</u> The COP-PILOT SIF <b>MUST</b> maintain connectivity resilience across heterogeneous networks, tolerating disruptions in underlying infrastructure.
	Affected Components: COP-PILOT Secure Integration Fabric, Clusters
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE

	Comment: Critical for edge / IoT / mining / agriculture use cases.
FNR.SIFL.16	<u>Description</u> : The COP-PILOT SIF <b>MUST</b> support distributed operation without a single point of failure in the connectivity control or data plane.
	Affected Components: COP-PILOT Secure Integration Fabric, Clusters
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment: Aligns with multi-domain robustness.
FNR.SIFL.17	<u>Description</u> : The COP-PILOT SIF <b>MUST</b> support operation in constrained or intermittently connected environments, including edge and remote deployments.
	Affected Components: COP-PILOT Secure Integration Fabric, Clusters
	Contributing Partners: TATA, LTU, UPV, AGA, UOP, ONE
	Comment: Important for COP-PILOT verticals.