

5GZORRO Platform

The future of multi-party 5G networks in automated, secure, and trustful way

*Gino Carrozzo, Pietro G. Giardina
Nextworks s.r.l.*

Contents

Beyond the basic 5G: challenges & priorities.....	1
5GZORRO platform for 5G Telecom Marketplaces and AIOps.....	2
Design principles and reference architectural patterns.....	4
5GZORRO Platform components.....	4
Release plan for 5GZORRO Platform software.....	7
References.....	7

Beyond the basic 5G: challenges & priorities

Future communication networks are built on the convergence between established technology assets such as 5G, edge computing, software-defined networks, and emerging breakthroughs such as AI, cloud-native solutions and distributed ledgers.

5G network solutions currently deployed do not yet enable the full potential of pervasive networking and computing in 5G initial visions: security, trust, and automation are limited today and deployments do not span among multiple operators.

From multiple sources it is agreed that the next challenge in 5G network management will be the implementation of highly pervasive shared network infrastructures. 5G operators need to become capable of managing really complex chains of end-to-end services, built on assets from different resource providers for better CAPEX prospects, and are strongly driving their network and service transformations towards deep virtualization and sharing of resources being them from asset, computing, transport, radio and spectrum domain.

In this context, it appears more and more critical also to:

- Embrace full automation of networks and services management
- Support multiple parties to develop a profitable business in 5G
- Run all the phases of service chains creation across operators/domains, with security and trust

Virtualization and orchestration solutions are needed for 5G/6G which can enable multiple stakeholders, across different geographical areas, to trade/lease heterogeneous resources, such as spectrum, computing, network, storage, and virtual network functions (VNF/CNF). Such platforms are requested to be capable to optimize the available network resources and establish 5G/6G services in an easy, flexible, automated, secure, and trustful manner, ultimately fulfilling the need for securing and allocating resources according to demand.

In [5GZORRO project](#) we are working on the consolidation of 5G towards its full potential relies on **automated end-to-end network operations**, use of distributed Artificial Intelligence (AI) for **cognitive network orchestration and management** and minimal manual interventions (**zero-touch automation**) to transform 5G into a low energy distributed computer. Through them, 5G networks can truly implement flexible connections with the envisaged ultra-fast data rates and minimal latency [1].

5GZORRO platform for 5G Telecom Marketplaces and AIOps

The [5GZORRO project](#) has implemented a new distributed orchestration, security and trust platform solutions which is capable to implement multi-domain and multi-stakeholder smart resource selection and trading, with zero-touch orchestration and security in 5G and beyond networks.

With 5GZORRO [2] it is possible to execute smart discovery and selection of various types of 5G resource, from physical to virtual and including spectrum, then to establish smart contracts which regulate the access and use of them with specific SLAs, and finally implement zero-touch lifecycle management of all the networks resources for the better performances. To implement this, the 5GZORRO platform uses novel technologies such as Distributed Ledger Technologies (DLT) and Artificial Intelligence (AI) in complement to virtualization and cloud-native solutions for 5G.

The 5GZORRO platform concept builds on four major logical blocks that group together critical functionalities (see Figure 1)

The **5G Marketplace sub-system** leverages DLT technologies (R3 Corda) including Smart Contracts technologies to enable the trade of 5G resources managed by the zero-touch Service Management and Orchestration. The 5GZORRO Marketplace is realised through a mesh of distributed Marketplace instances, each anchored to one Marketplace DLT node, and it is envisaged that each Communication Service Provider hosts at least one 5G Marketplace instance. The 5G Marketplace features an end-user portal front-end, a decentralized catalogue for 5G Resource offers and 5G Service offers, as well as the life-cycle management of smart contracts for offers and agreements between providers and consumers.

The **Zero-touch Multi-stakeholder MANO with Trust & Security sub-system** is the main responsible for control of 5G resources including Radio Spectrum resources, Transport Networking resources and Computing resources (at data centers and at edge computing nodes) as well as existing legacy resource controllers from previous 5G deployments. 5G Resources offered in the 5GZORRO Marketplace are managed through a Resources Manager interface (including Resource offer status management and Monitoring Data Exposure) while the Network slice and service orchestrator manages the life-cycle of slices and associated services at domain level and across different domains. The zero-touch Service Management and Orchestration Platform leverages data lake features (data transformation, analytics and real-time actions) to achieve the automation of some resource management procedures including a proactive scaling

mechanism to increase or decrease the infrastructure capacity by using external resources published in the marketplace by Resource Providers. The zero-touch Service Management and Orchestration Platform features a Trust and Security framework to enable trustworthy usage of external resources.

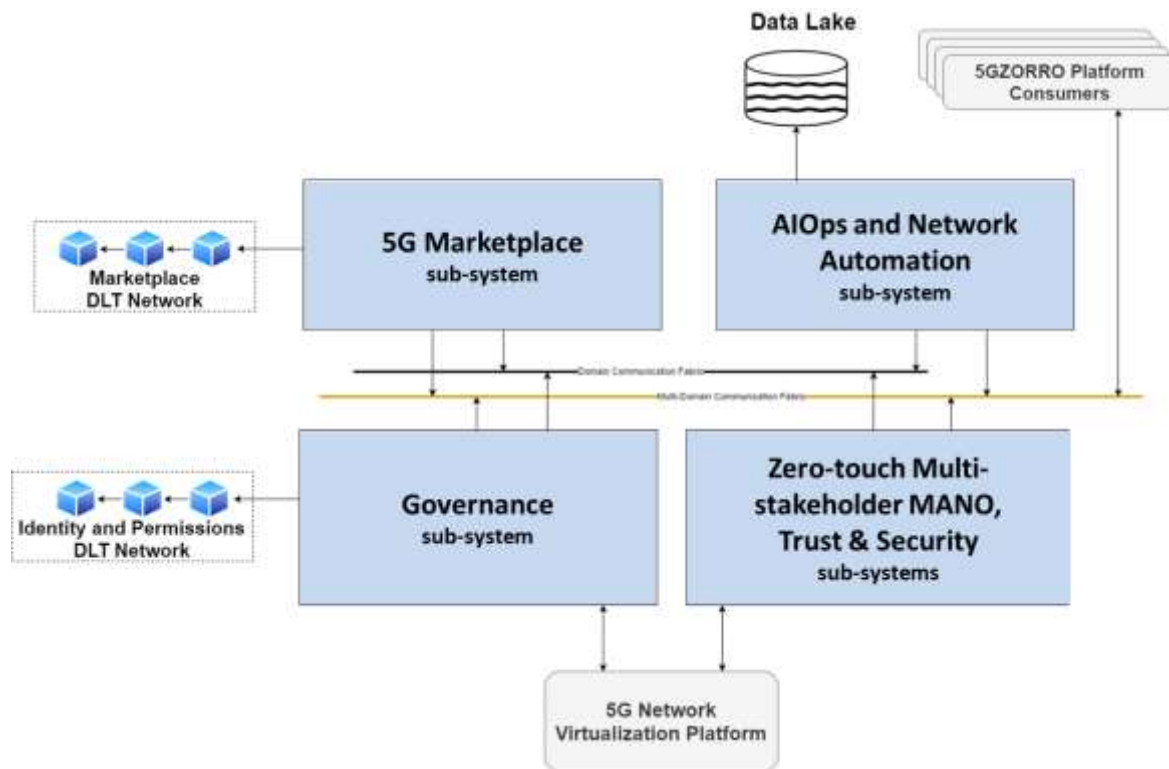


Figure 1: 5GZORRO Platform sub-systems

The **AIOps and Network Automation sub-system** mainly comprises the cross-domain functionalities from the Analytics & Intelligence for AIOps logical elements. In particular, it leverages distributed data lake and AI technologies to provide data persistence, data share and data analytics across domains. It includes functionalities like the ingestion and transformation of monitoring data as well as the automation of complex resource management procedures across-domain. The prediction of SLA breaches and the discovery of the most appropriated resources available in the marketplace are two examples of such resource management procedures automation. Permissions to publish resource data and to read aggregated shared data or cross-domain analytics are managed by the Governance Platform.

The **Governance sub-system** is operated by stakeholders with permissions to take decisions according to the Marketplace Governance Model i.e., stakeholders playing the Governance Administrators business role. The Governance Platform also features the decentralized management of global (cross-domain) identifiers (stakeholder identifiers and 5GZORRO resource identifiers) according to Self-sovereign Identity principles and by leveraging DLT technologies. It supports the creation, verification and revocation of certificates as well as authentication and authorisation of identities across all 5GZORRO domains.

The **Multi-Domain Communication Fabric** and **Per-Domain Communication Fabric** are the two different types of Communication Fabrics in the 5GZORRO Platform; the former allows modules to communicate with other modules inside the same domain, and the latter allows modules to communicate with modules in other domains. They implement Communication fabrics functional block and, according to ETSI ZSM, the communication can be based on both publish/subscribe and request/response paradigms. The 5GZORRO

Platform design uses both communication paradigms, by preferring the publish/subscribe for the interaction between the new services implemented from scratch during the project, whilst a traditional request-response paradigm is maintained for all the legacy MANO services (e.g., at NFV Orchestrator).

Design principles and reference architectural patterns

The core inspiring idea of the 5GZORRO Platform is to expose composing services/functions with the following key properties:

- **Loosely coupled**, i.e., implemented by minimizing dependencies between services
- **Highly maintainable and testable**
- **Independently deployable** (as much as possible) from other services and **scalable** if needed
- **Configurable at runtime**

Two main architectural patterns are considered in this Platform architecture: the *Service Oriented Architecture* (SOA) and the *Microservice Architecture* (MSA). Both patterns present pros and cons and, although they could be somehow overlapped, they are characterized by several important differences. In SOA, the platform is structured as a collection of services. Each service implements a complete (and even complex) functionality and all services communicate by means of an Enterprise Service Bus (ESB), which enable discovery, connectivity and routing between services. Similarly, in MSA the platform is also structured as collection of services, but each service, called "micro-service", implements usually one simple functionality and exposes an interface towards the final users or other services. Hence, microservices are typically in the order of hundreds whilst services in SOA can be in the order of tens. Complex tasks are implemented making microservices communicate directly with each other through well-defined interfaces using lightweight communication mechanisms, such as REST API, without the need of a central bus. In addition, in MSA, each service should maintain its own database with its data.

A third way is represented by the *Service-Based Architecture* (SBA). To the best of our knowledge, a formal definition of such an architectural pattern does not exist. In [4], SBA is described as a middle ground between SOA and MSA. Nevertheless, SBA has been chosen by 3GPP as architectural pattern for the design of the 5G System Architecture [5] and by ETSI for the definition of the ZSM Architecture [6].

In particular, we consider ETSI ZSM as the main reference architecture for the design of the 5GZORRO platform as it is closer to the scope of the platform itself. It offers a guideline for the implementation of a zero-touch platform and, with respect to 3GPP 5G System Architecture, ETSI ZSM does not define any specific technology or protocol to be used, so becoming more suitable as "architectural template" for the aims of 5GZORRO.

5GZORRO Platform components

A detailed overview of the 5GZORRO platform is presented in Figure 2, which expands the four sub-systems with the specific software modules which implement the 5GZORRO functionalities described in [2].

From an architectural point of view, each module implements a service and communicates with other modules through the Communication Fabrics, thus formally avoiding any form of point-to-point dedicated interfacing. In order to realize the 5GZORRO services and the related operational workflows, explicit interactions between the different modules must occur in the platform.

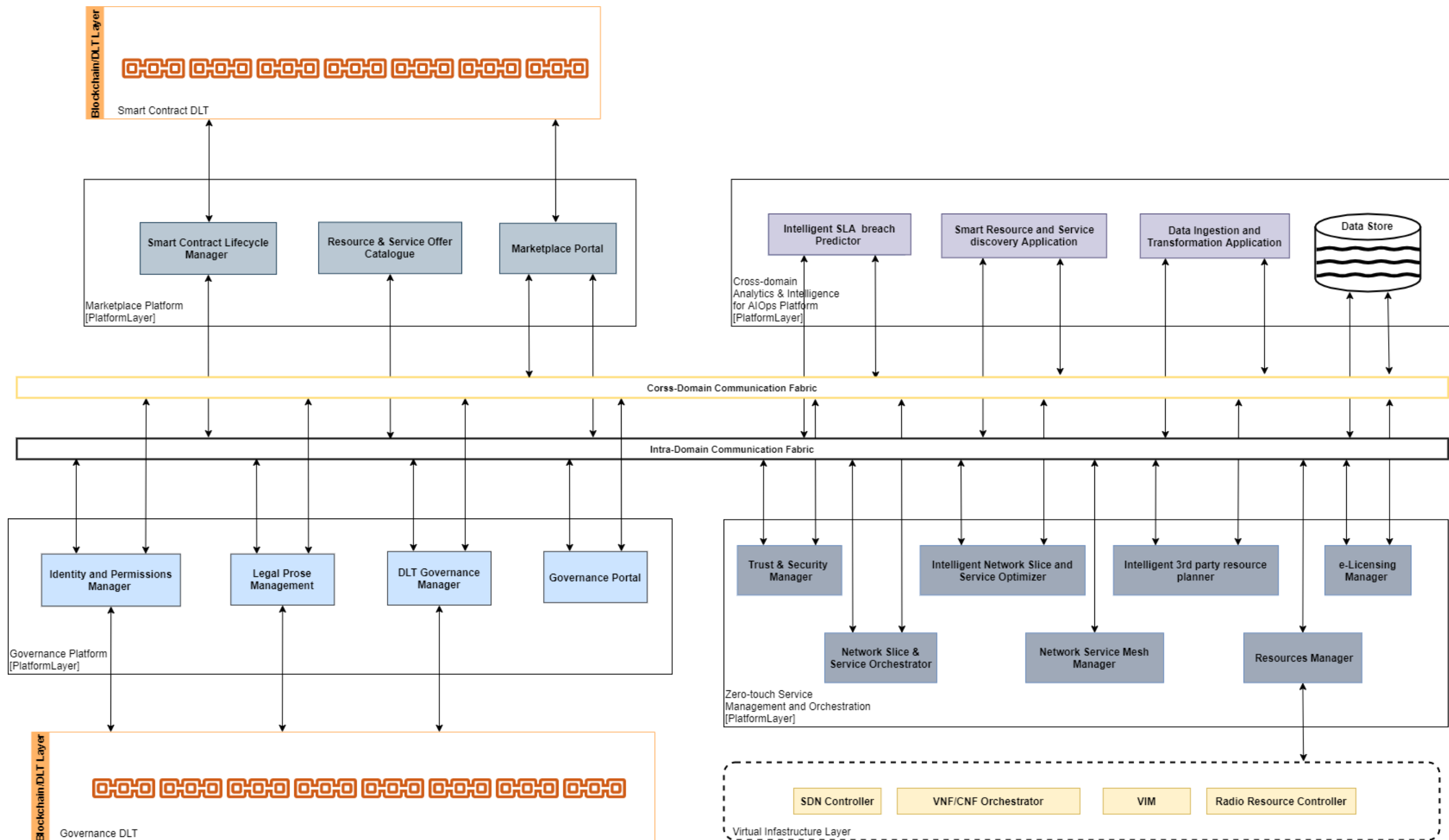


Figure 2: Detailed overview of the 5GZORRO Platform

An example of specific interfaces activated in case of setup of Smart Contract with related Network slice is presented in Figure 3. Here, the interactions are highlighted in terms of reference points between the different modules in order to implement the workflows described in [2].

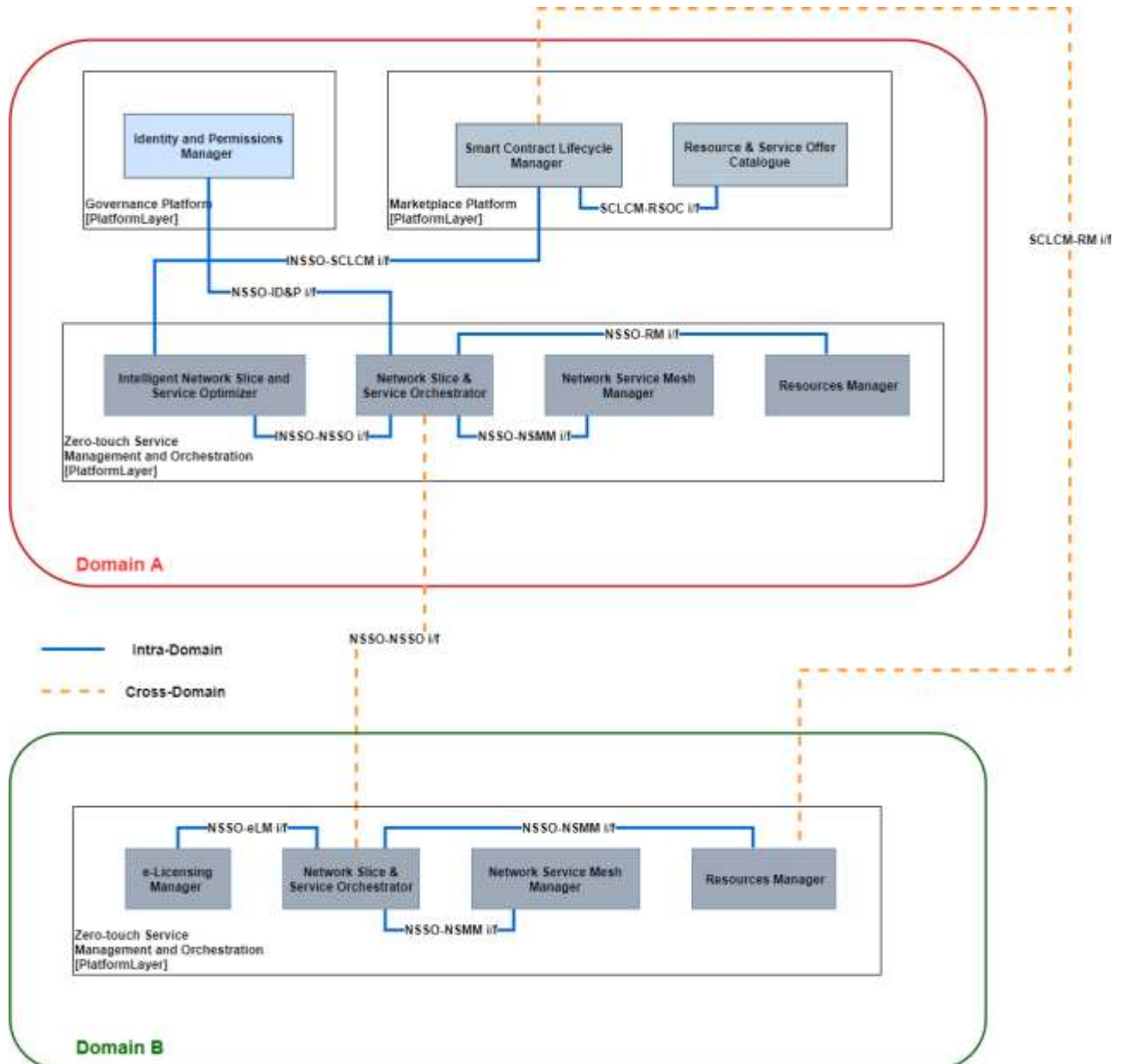


Figure 3: Interaction between several 5GZORRO platform modules to realize Smart Contract and Network slice setup workflows

As depicted in Figure 3, only a subset of 5GZORRO platform modules is activated in each administrative domain for this usage scenario. In particular, for the case of Smart Contract and Network slice setup, CSP in Domain B manages the infrastructure targeted for the extension of an existing slices therefore, the only part of the platform that actually perform operations consists of a subset of modules belonging to the Zero-Touch Management and Orchestration platform. CSP in Domain A, instead, requests the network slice extension, and needs to perform additional operations with respect to the Domain B, consuming the services offered by the Marketplace (to

trade the additional resource) and the Governance (to perform identity check operations). Both Marketplace and Governance service requires a direct interaction with the respective DLT, not depicted in the figure for readability reasons. The orchestration stack in Domain A is also involved for the technical operation required to stitch the two network slices (one per domain) into a single e2e one. To realize this, cross-domain interactions between modules are requested, both for technical reasons (slices deployment and stitching) and administrative in order to check the availability of resources in a remote domain (Domain B, in the example) and perform trading operations.

Release plan for 5GZORRO Platform software

The entire 5GZORRO platform is published as open-source code in GitHub – see <https://github.com/5GZORRO> tag: **5gzorro-core-1.0-rc**.

This release allows to create product offers and announce them across the participating CSPs. Basic zero-touch automation functionalities are also made available.

At the time of publishing this blog post, the project has delivered 22 Public Repositories which implement the aforementioned functionalities plus supporting platform installation functions.

This software release is being validated in use case test as per [1] and [3] in two project testbeds, one at i2CAT Labs (part of [5GBarcelona](#) initiative) and the other at [STONIC](#) (Madrid).

The release plan consists of two next releases to be issued before the end of the project (Oct-22):

- Within Q2-2022: **5gzorro-full-alpha** which will include full functionalities of the Marketplace for smart contract purchasing and SLA monitoring and breach detection
- Within Q4-2022: **5gzorro-full-1.0** which will include full functionalities for AIOps and cross-domain security

References

- [1] 5GZORRO Consortium, Deliverable D2.1 – “Use Cases and Requirements Definition”, version 1.0, May 2020, available online at <https://doi.org/10.5281/zenodo.5211350>
- [2] 5GZORRO Consortium, Deliverable D2.2 – “Design of the 5GZORRO Platform for Security & Trust”, version 1.1, September 2021, available online at <https://doi.org/10.5281/zenodo.5561042>
- [3] 5GZORRO Consortium, Deliverable D5.1 – “Use case validation plan and testbed design”, version 1.0, May 2021, available online at <https://doi.org/10.5281/zenodo.5211925>
- [4] SliceNet, Deliverable 7.1 “Cross-Plane Slice and Service Orchestrator”, https://doi.org/10.18153/SLIC-761913-D7_1, May 2020
- [5] 5Growth, Deliverable 2.1 “Initial design of 5G End-to-End Service Platform”, https://5growth.eu/wp-content/uploads/2019/11/D2.1-Initial_Design_of_5G_End-to-End_Service_Platform.pdf, November 2019
- [6] ETSI zero-touch network and Service Management (ZSM), Reference Architecture, ETSI GS ZSM 002 V1.1.1, August 2019, available online: https://www.etsi.org/deliver/etsi_gs/ZSM/001_099/002/01.01.01_60/gs_ZSM002v010101p.pdf

Follow our updates on www.5gzorro.eu and on GitHub at <https://github.com/5GZORRO>.

