PoC on “Automation across multi-site and multi-stakeholder environments”

PoC Presenter: Georgios P. Katsikas UBITECH ubiquitous solutions

ACROSS and COP-PILOT projects’ Technical Coordinator

PoC Participants:

UBI, UOP, PNET, NOVA, K3Y, CTTC, WINGS, LMI, TID, UPM

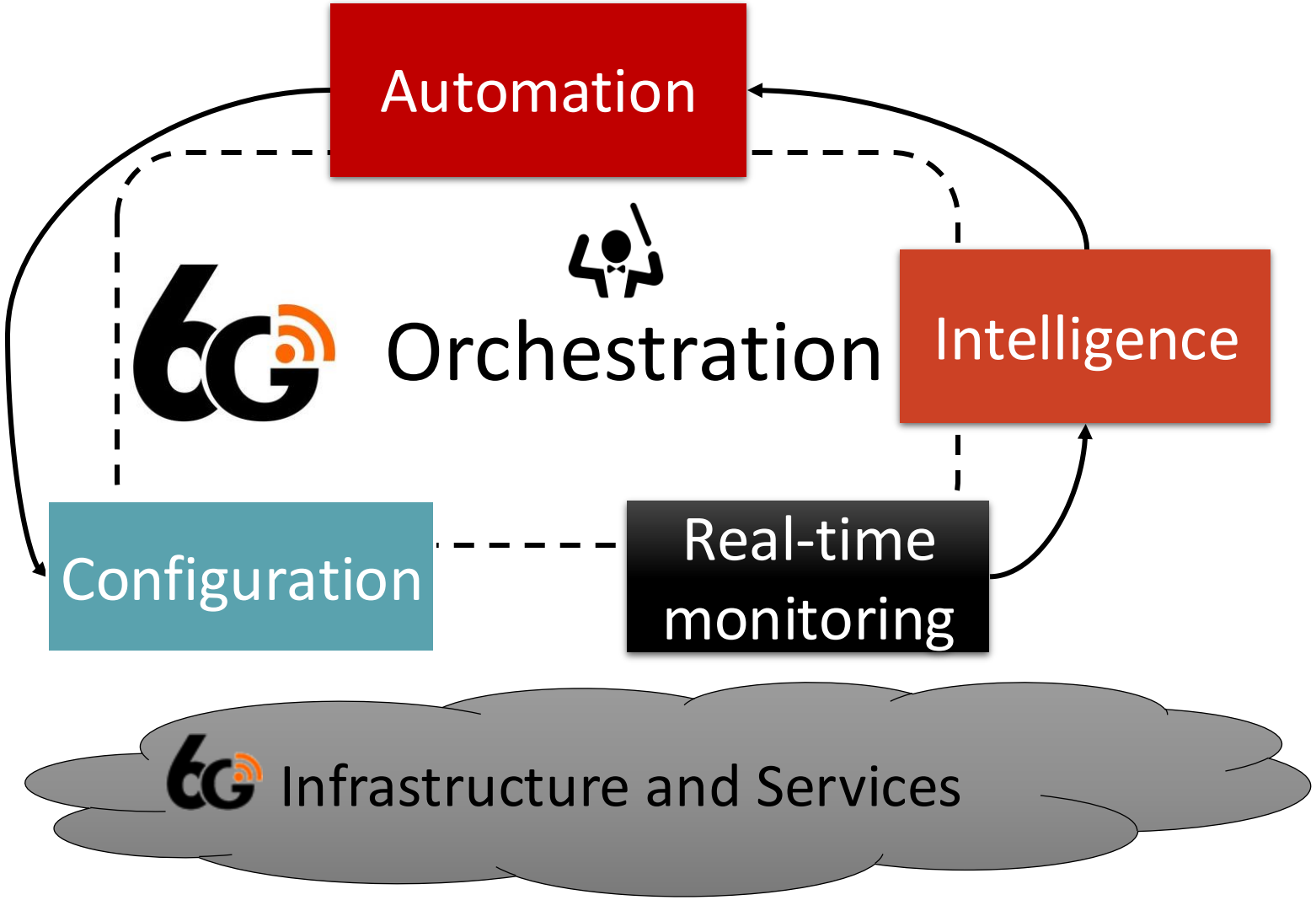
EVENT ETSI ISG ZSM#32 Plenary meeting

ETSI HQ, Sophia Antipolis, France

September 09, 2025

Introduction

Introduction



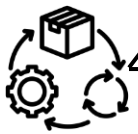
PoC Objective

PoC Objective

Showcase a comprehensive orchestration use case deployed across multiple administrative domains with minimal manual configuration

Platform Lifecycle

- **Expansion** of the **infrastructure** to a new **private** domain
- **Dynamic service provisioning** over **on-demand** compute and network **resources**
- **End-to-end** (multi-domain) **SLA-driven service management**



Service Lifecycle

PoC Infrastructure

PoC Domains' Locations

PoC Domains' Roles

Domain A
Athens, GR

End-to-end service management

+

Zero-trust connectivity fabric

Domain C
Madrid, ES

Network planning

Domain B
Patra, GR

Private edge infrastructure and end users

PoC Domains' Capabilities

Domain A
Athens, GR

UBITECH
ubiquitous solutions

Cloud infrastructure

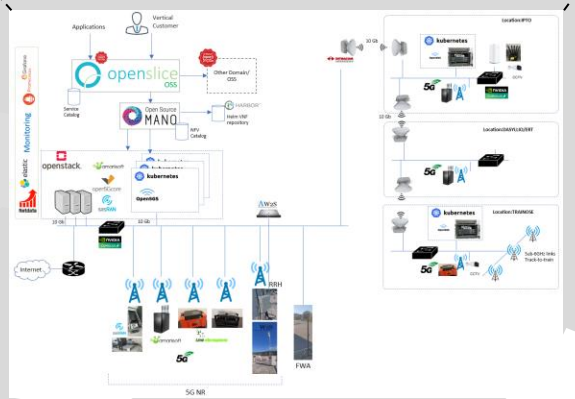
Compute

Domain B
Patra, GR

Users

Network

Compute



Patras 5G Testbed

Domain C
Madrid, ES

Compute

Telefónica

Cloud infrastructure

PoC Setup

PoC Setup – Initial testbeds' state

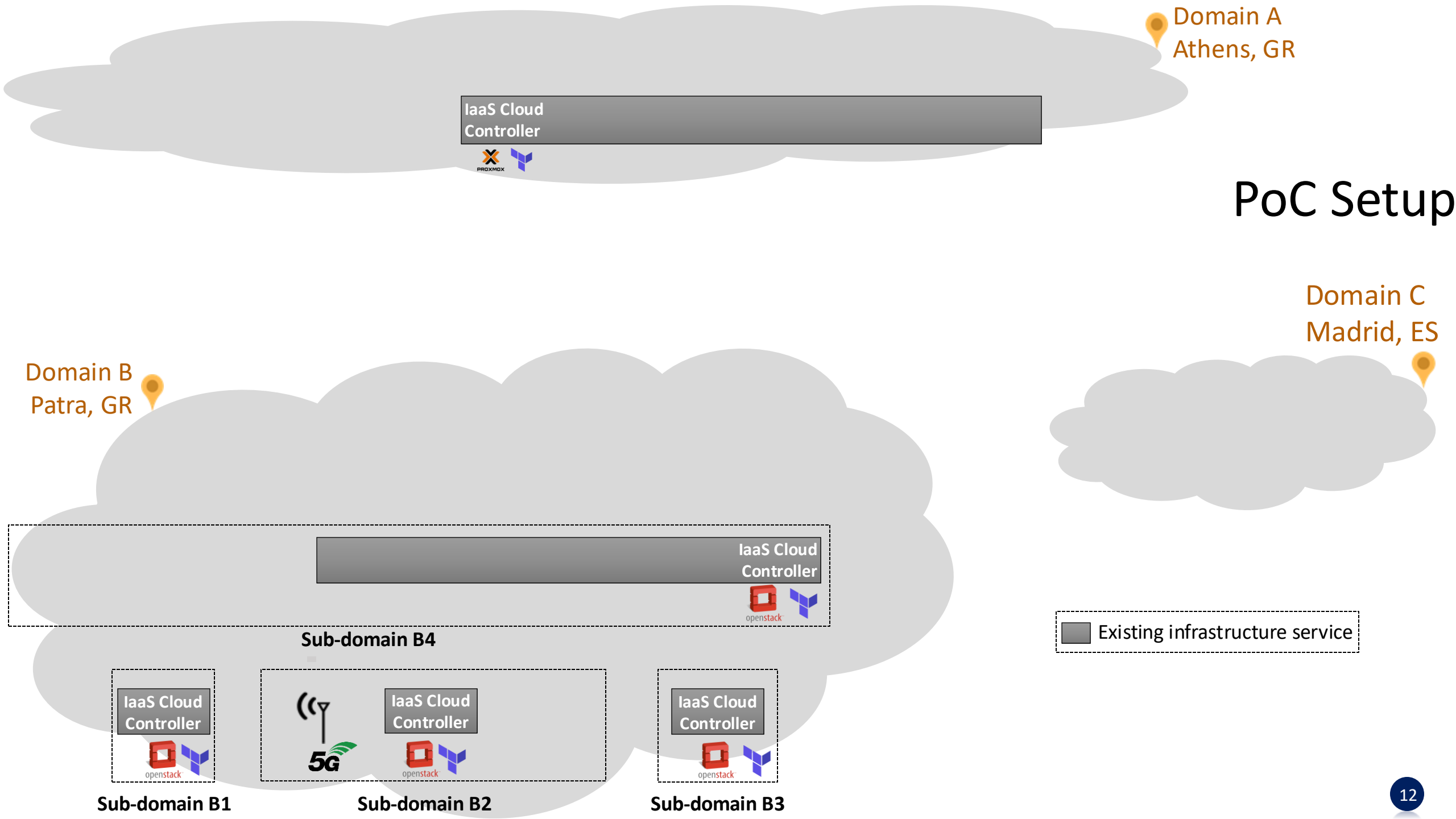
Outline the state of the platform before the PoC

Domain A serves as the central domain for the platform

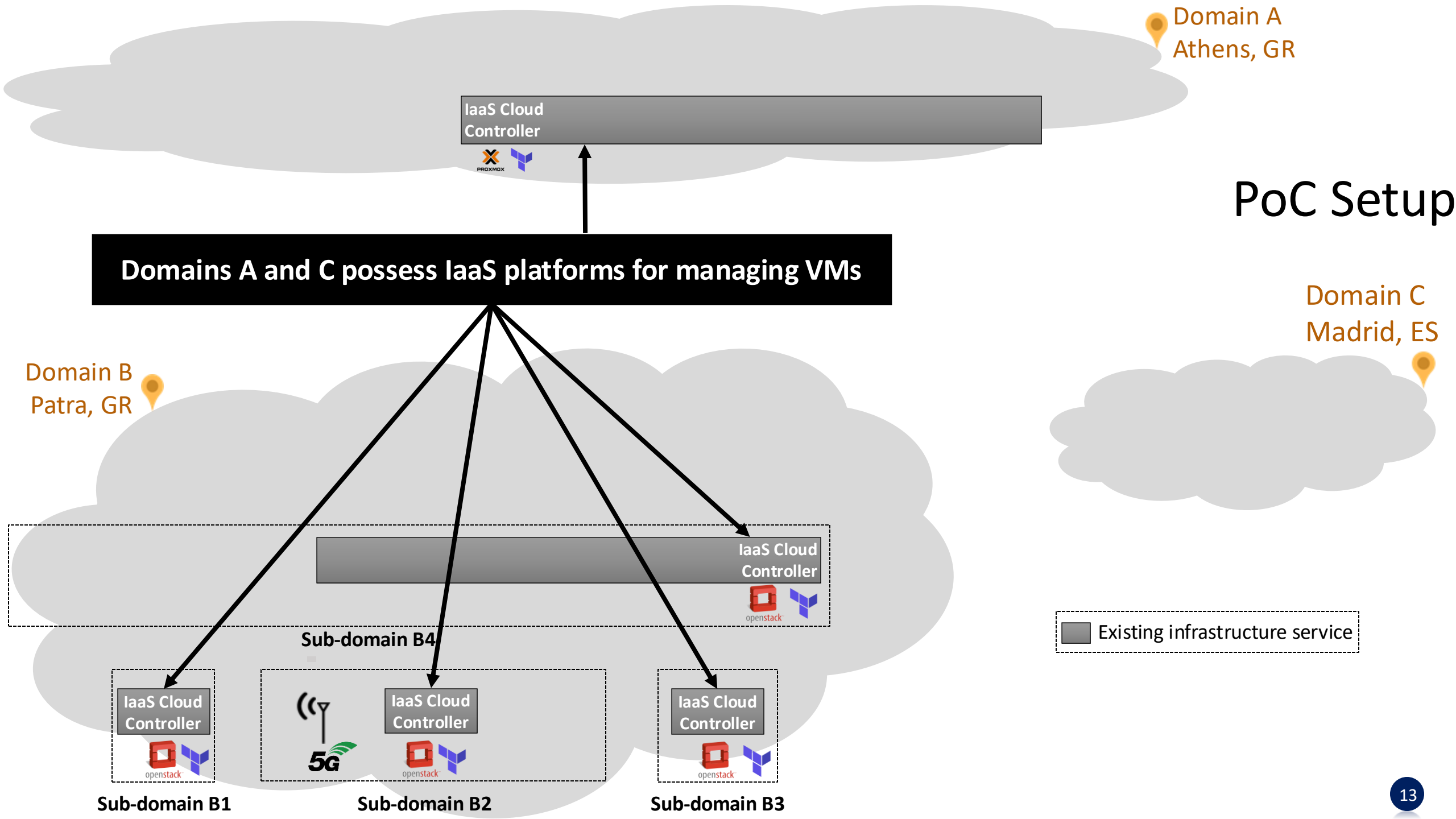
Domain C is used by the platform for offline network planning

Let's see what components are deployed in advance, where, and why?

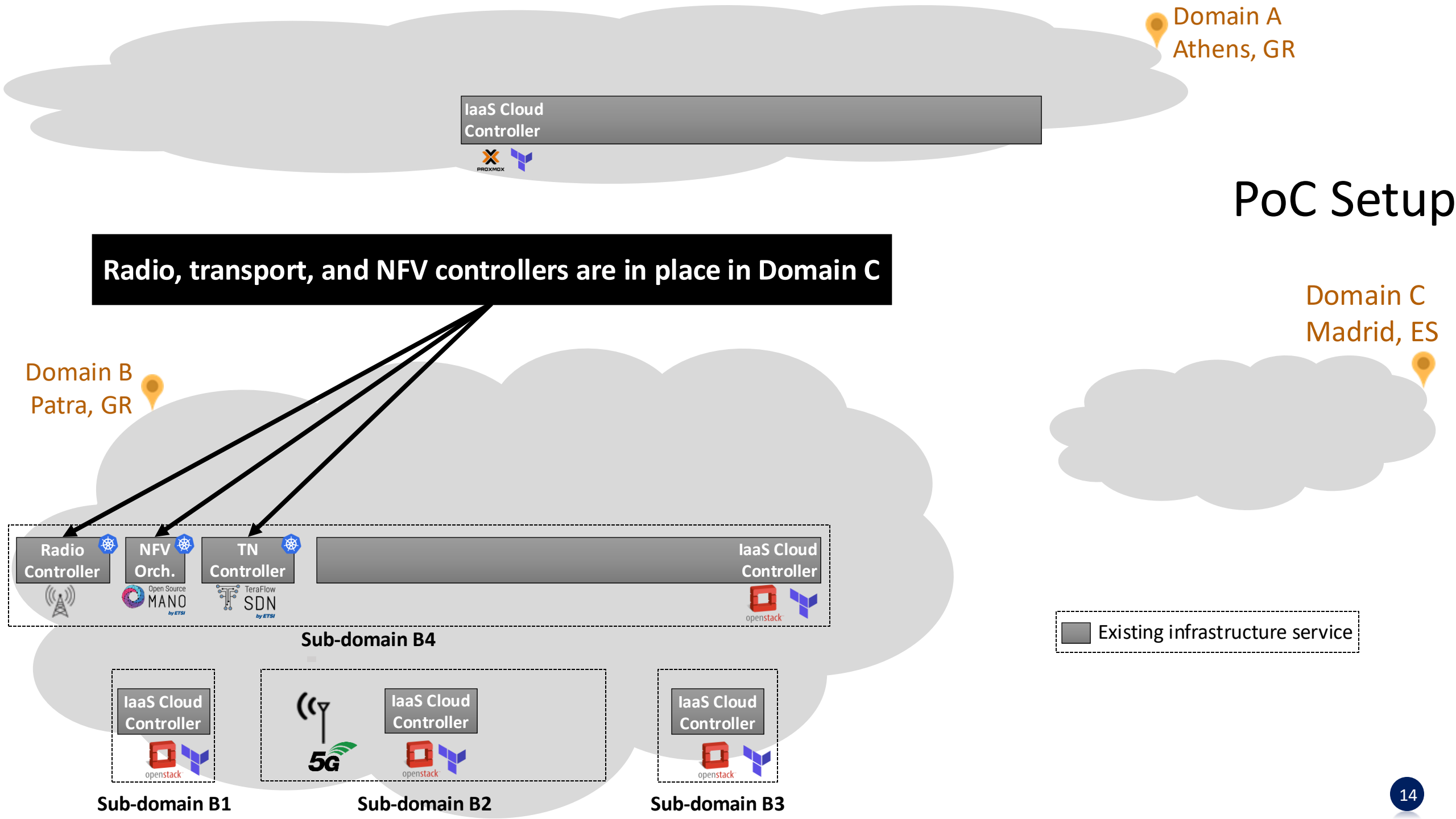
PoC Setup


Domain A
Athens, GR
IaaS Cloud Controller
PROXMOX
Domain C
Madrid, ES
Domain B
Patra, GR
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
Existing infrastructure service

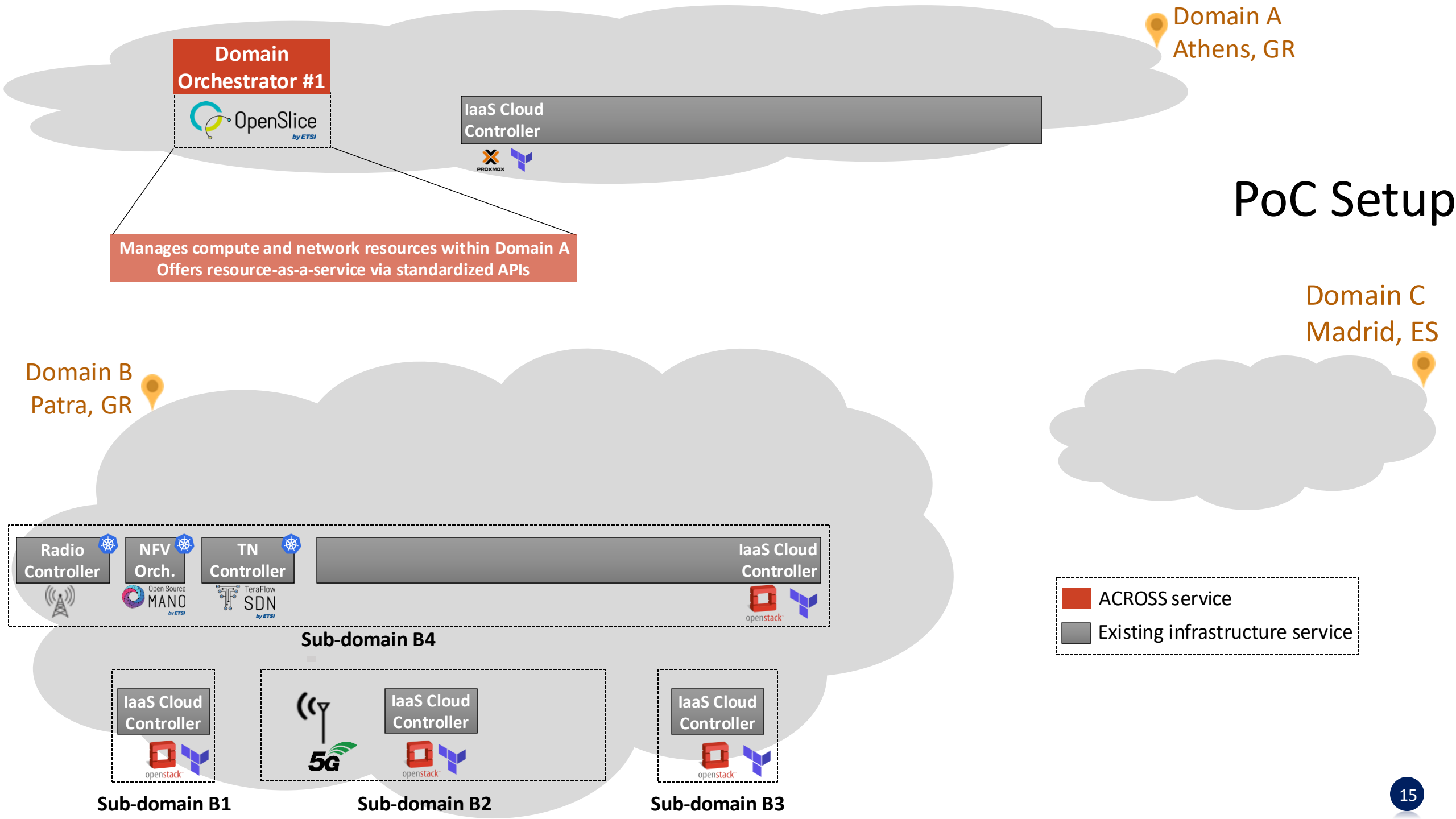
PoC Setup


Domain A
Athens, GR
IaaS Cloud Controller
PROXMOX
Domains A and C possess IaaS platforms for managing VMs
Domain C
Madrid, ES
Domain B
Patra, GR
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
IaaS Cloud Controller
openstack
5G
IaaS Cloud Controller
openstack
Sub-domain B1
Sub-domain B2
Sub-domain B3
Existing infrastructure service

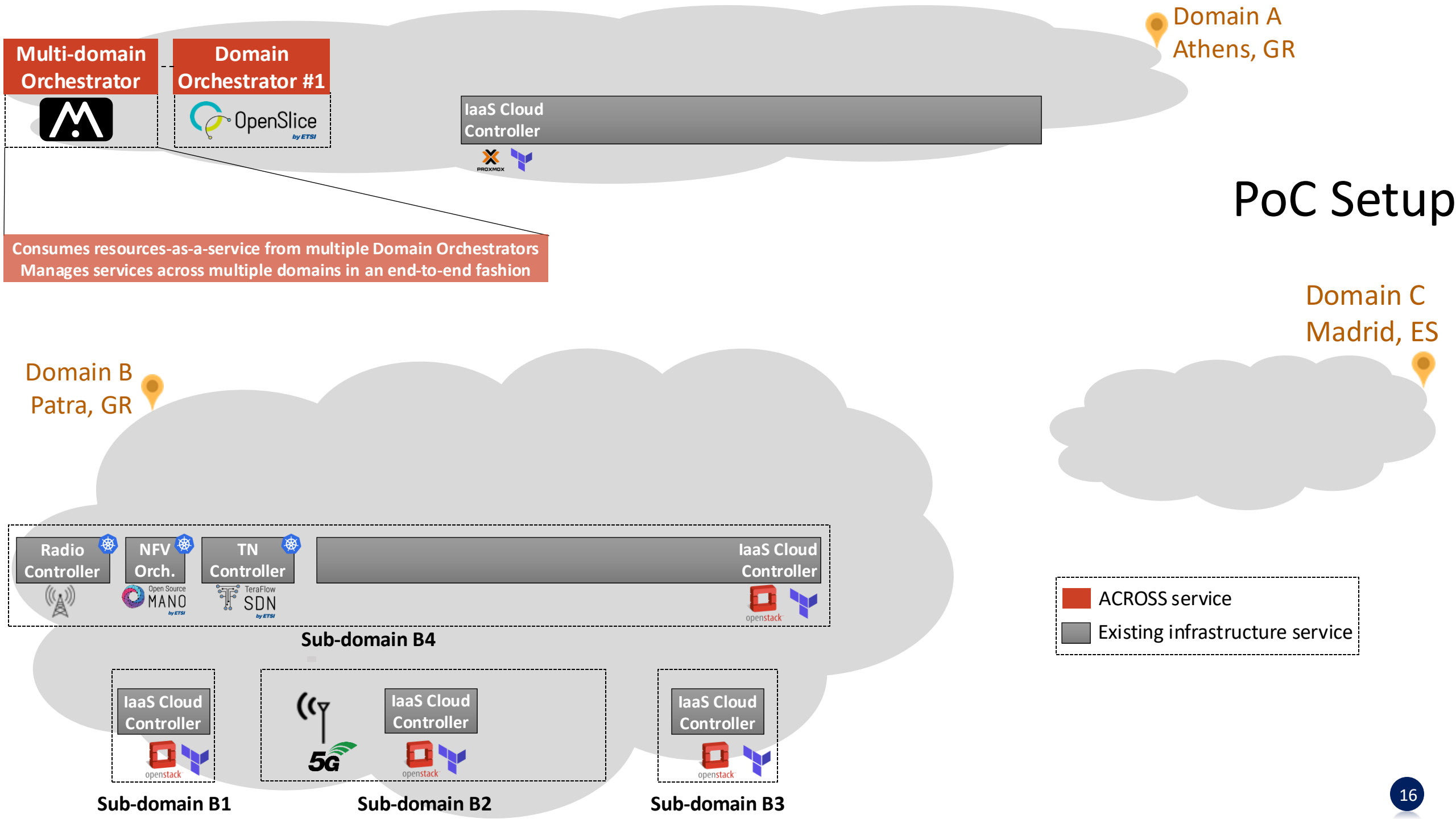
PoC Setup


Domain A
Athens, GR
IaaS Cloud Controller
Radio, transport, and NFV controllers are in place in Domain C
Domain C
Madrid, ES
Domain B
Patra, GR
Radio Controller
NFV Orch.
TN Controller
IaaS Cloud Controller
Sub-domain B4
IaaS Cloud Controller
IaaS Cloud Controller
IaaS Cloud Controller
Sub-domain B1
Sub-domain B2
Sub-domain B3
Existing infrastructure service

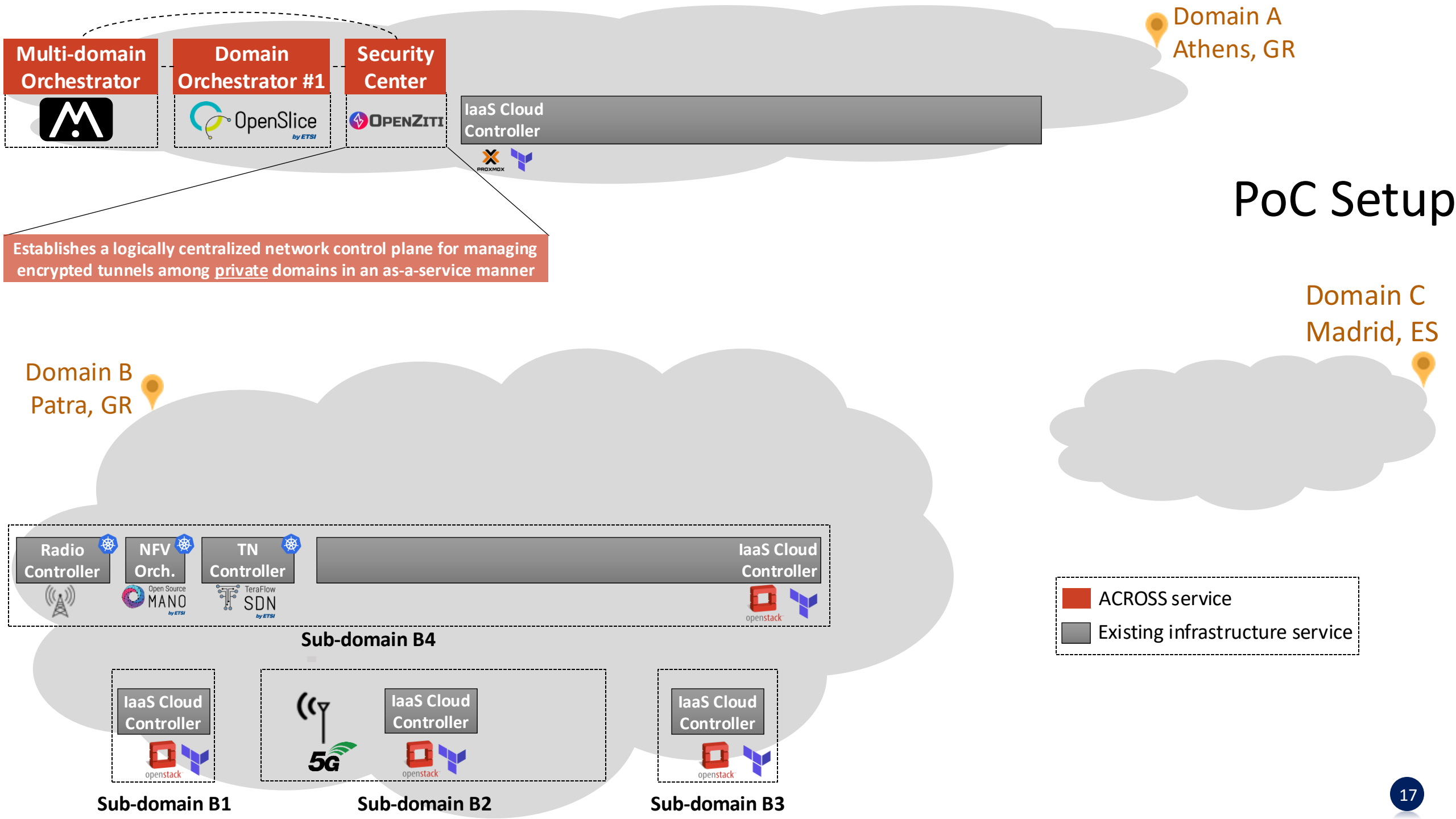
PoC Setup


Domain A
Athens, GR
Domain Orchestrator #1
OpenSlice by ETSI
IaaS Cloud Controller
PROXMOX
Manages compute and network resources within Domain A
Offers resource-as-a-service via standardized APIs
Domain C
Madrid, ES
Domain B
Patra, GR
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service

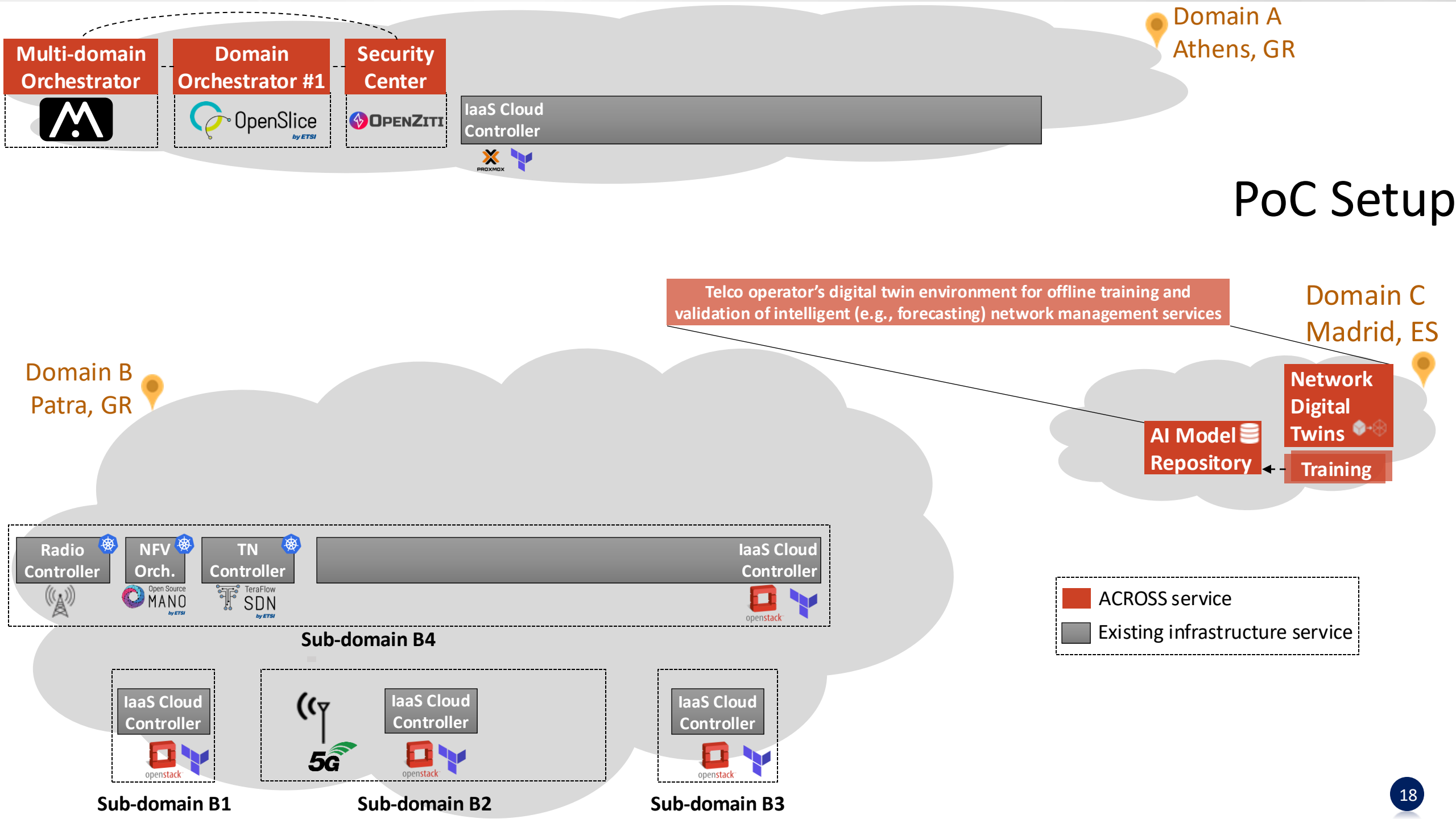
PoC Setup


Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
IaaS Cloud Controller
PROXMOX
Domain A
Athens, GR
Consumes resources-as-a-service from multiple Domain Orchestrators
Manages services across multiple domains in an end-to-end fashion
Domain C
Madrid, ES
Domain B
Patra, GR
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service

PoC Setup


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
PROXMOX
Establishes a logically centralized network control plane for managing encrypted tunnels among private domains in an as-a-service manner
Domain C
Madrid, ES
Domain B
Patra, GR
Radio Controller
NFV Orch.
TN Controller
IaaS Cloud Controller
Open Source MANO by ETSI
TeraFlow SDN by ETSI
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
5G
IaaS Cloud Controller
openstack
IaaS Cloud Controller
openstack
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service

PoC Setup


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OPENZITI
IaaS Cloud Controller
PROXMOX
Telco operator's digital twin environment for offline training and validation of intelligent (e.g., forecasting) network management services
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service

PoC Setup – Remarks

Explains the basic environment before starting the PoC

- Domain A is equipped with orchestrators and the network fabric to connect to other domains
- Domain C has the necessary NDT services for network planning purposes
- Domain B is not yet associated with the platform (non-orchestrated), but contains the necessary infrastructure services to do so

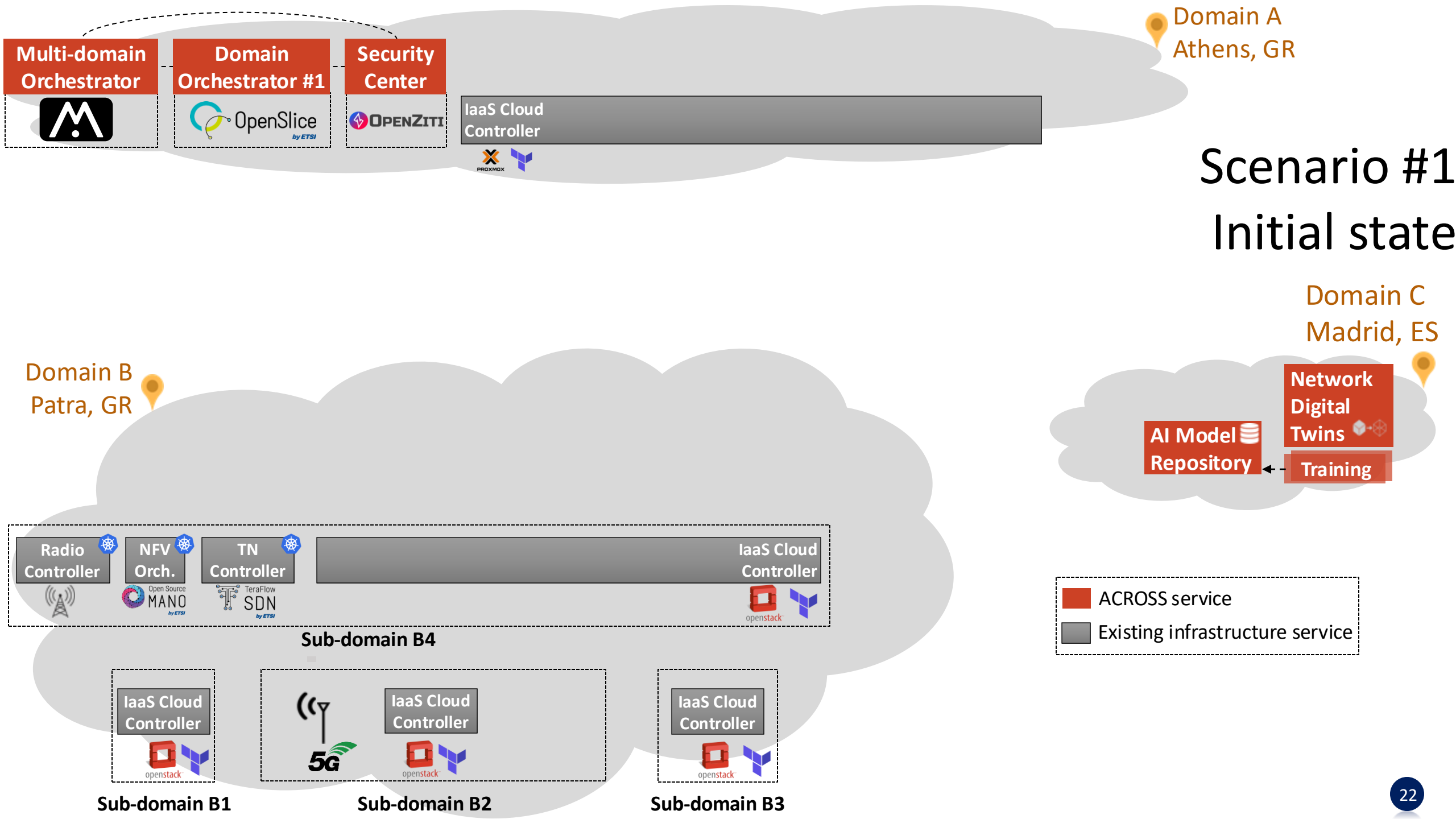
PoC Stories – Scenario #1

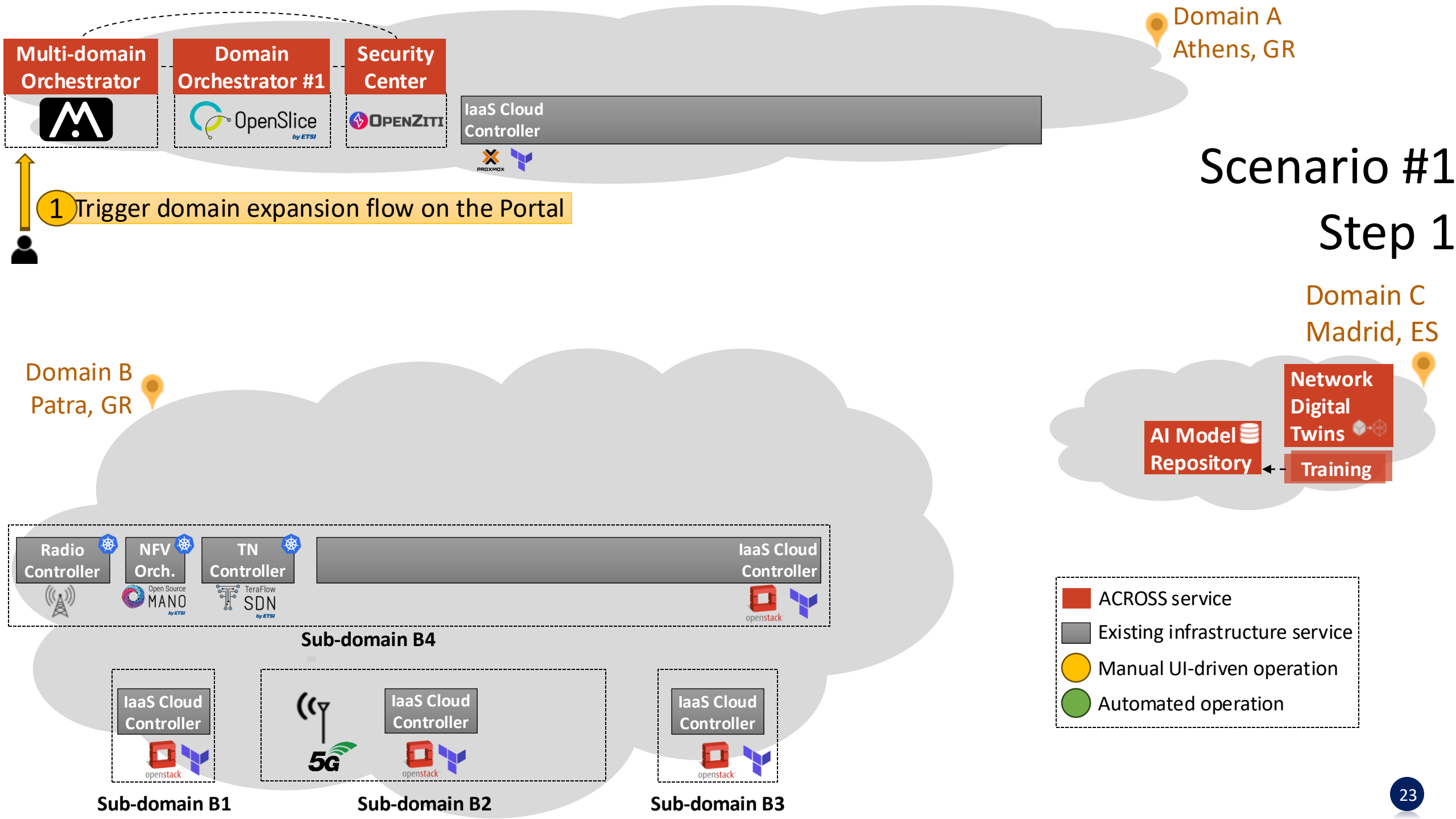
PoC Scenario #1 – Platform expansion to private domain

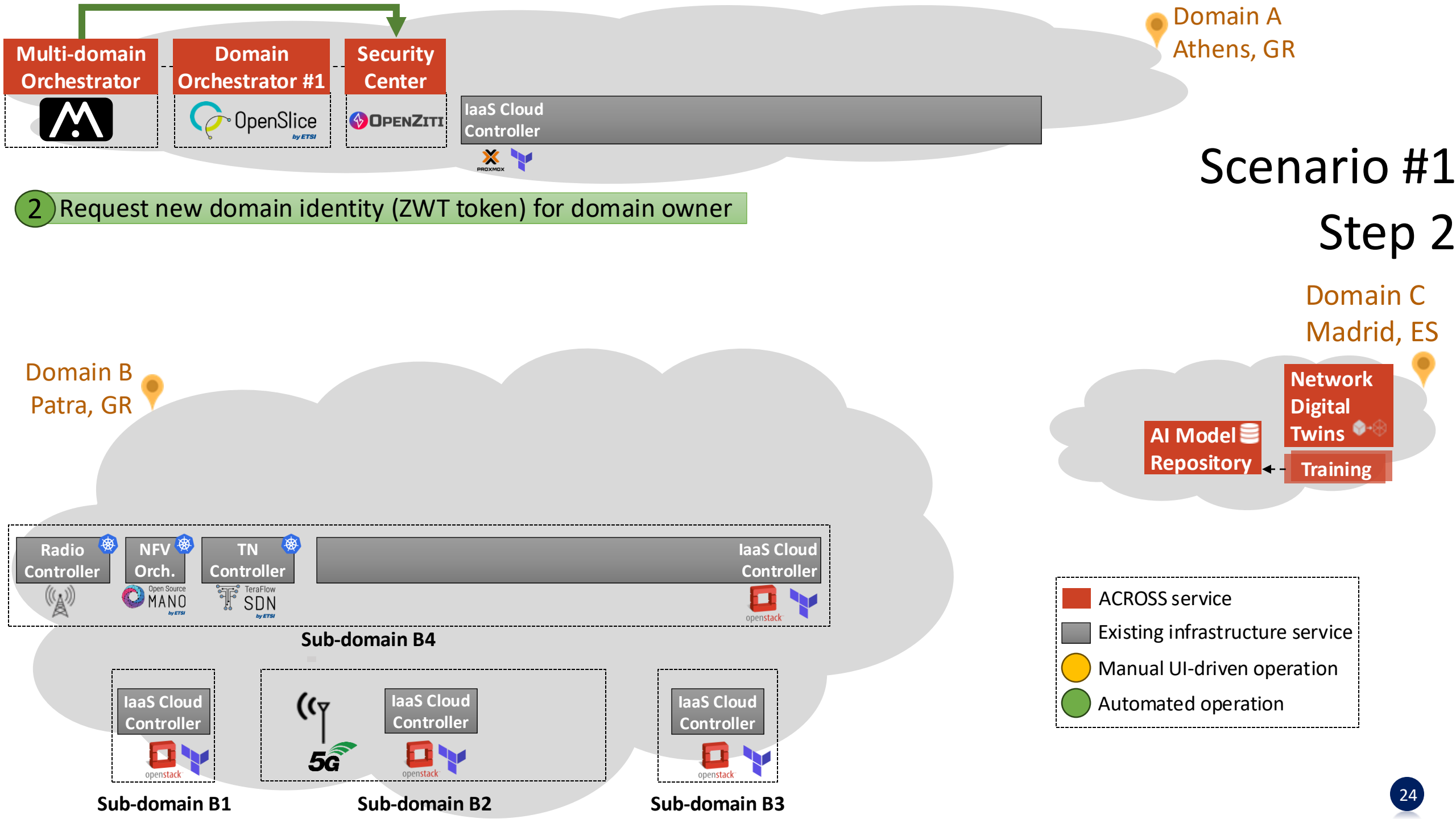
The owner of a new private edge domain (domain B) wants to add this domain under the platform's realm

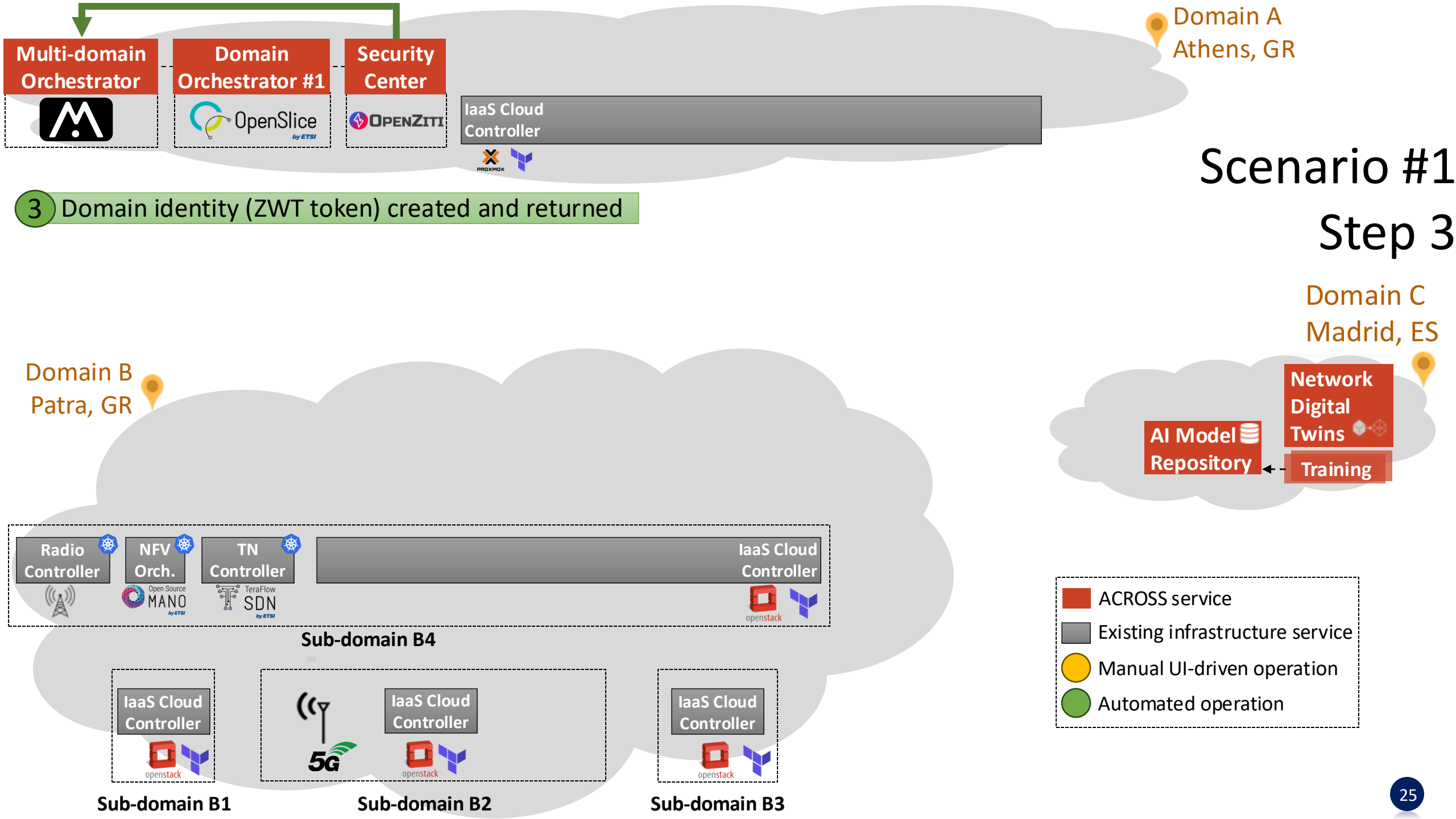
The platform should greatly-facilitate this process without compromising security and trust

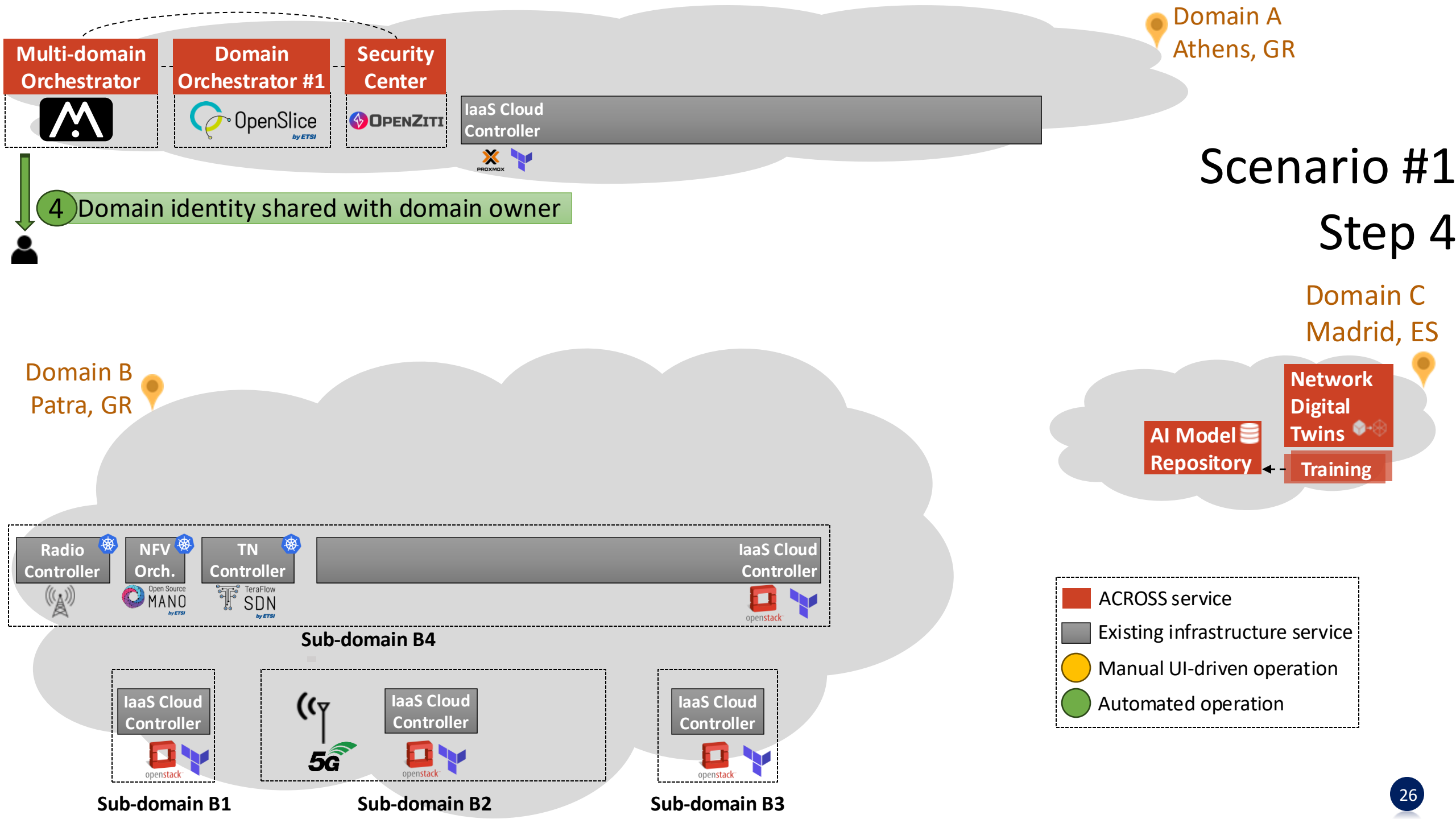
The scenario unfolds a UI-driven flow which automates most of the required operations for secure expansion of the platform in Domain B

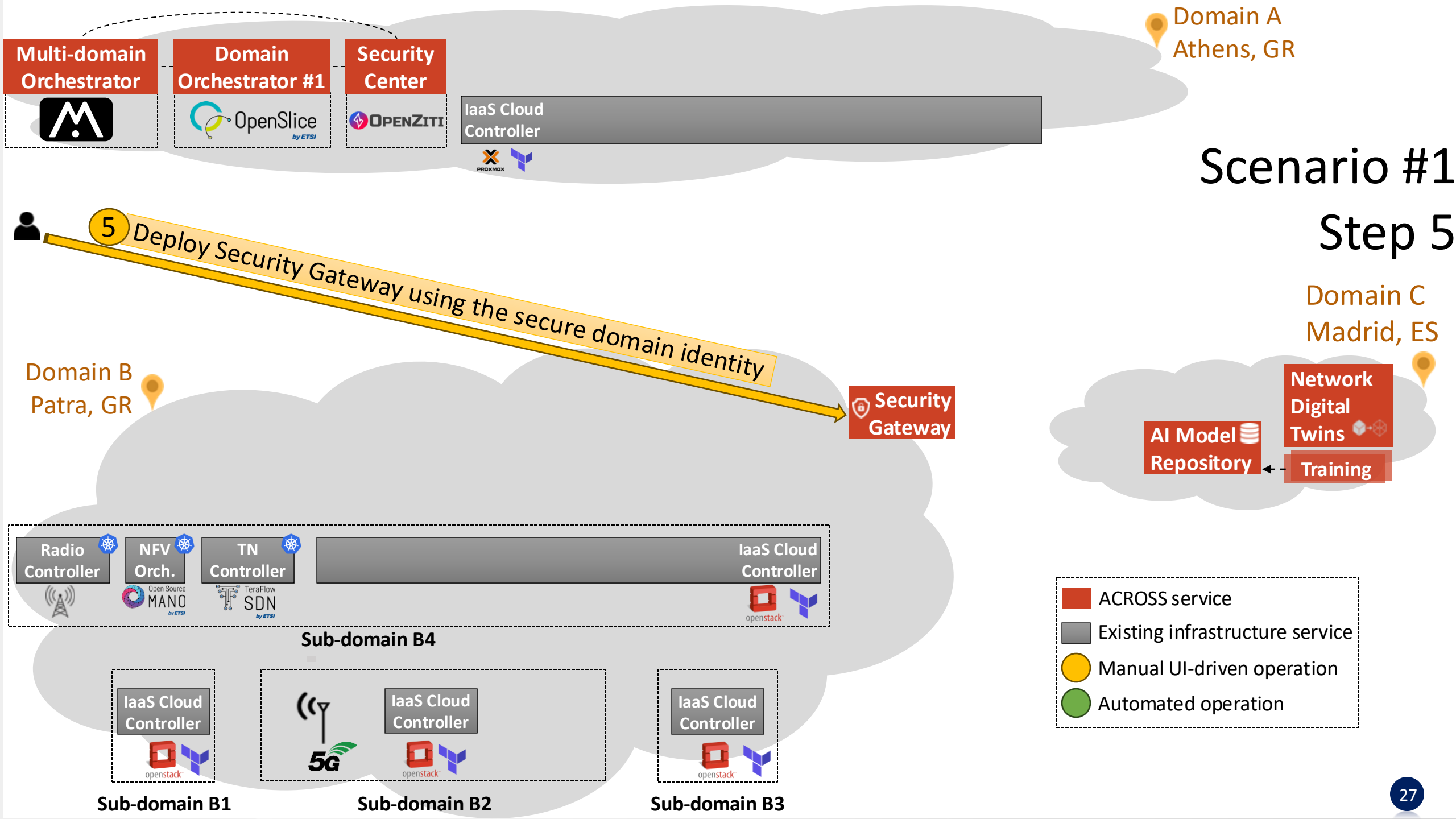

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
PROXMOX
Scenario #1
Initial state
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Radio Controller
NFV Orch.
TN Controller
IaaS Cloud Controller
Open Source MANO by ETSI
TeraFlow SDN by ETSI
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service

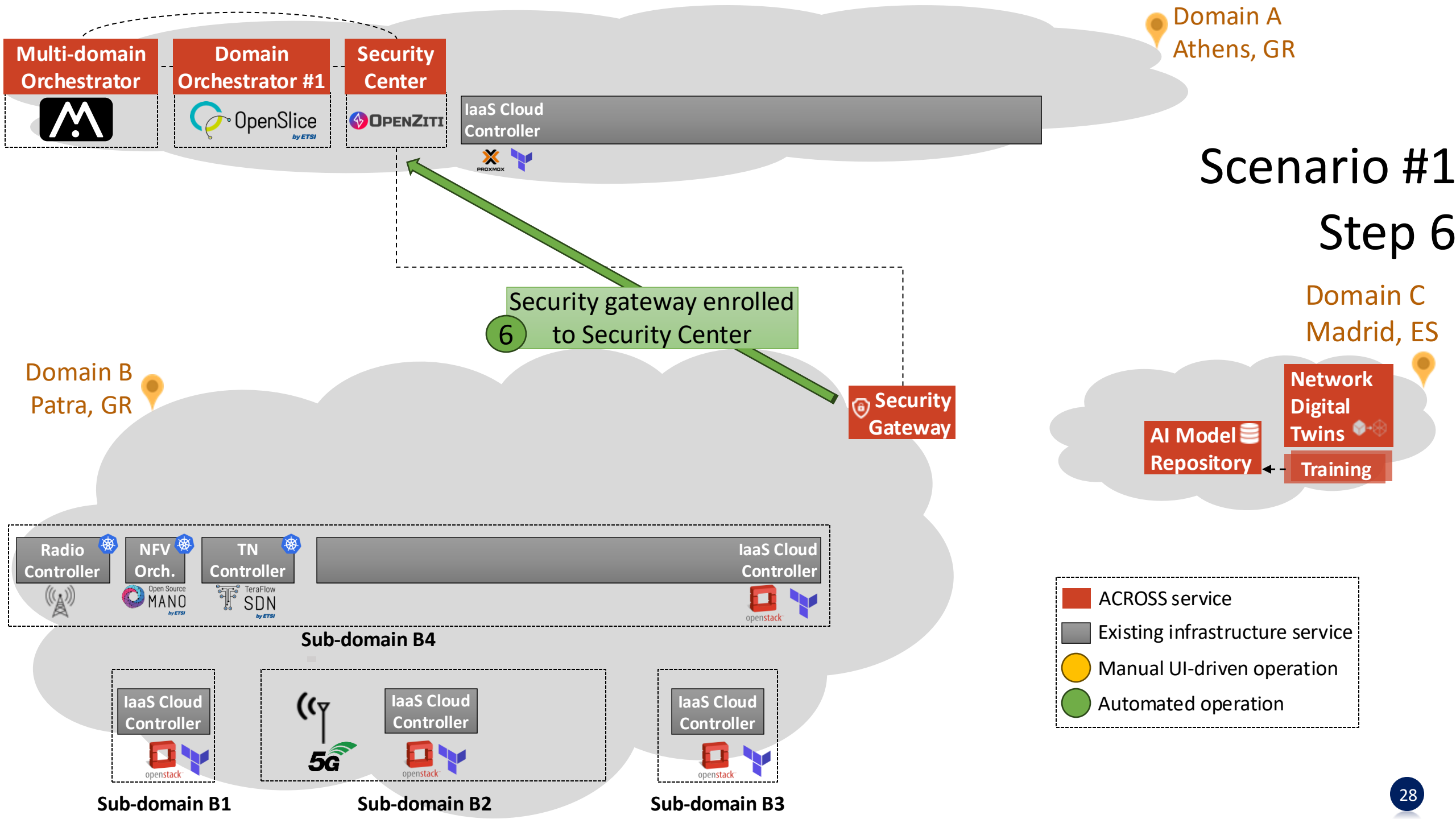

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OPENZITI
IaaS Cloud Controller
PROXMOX
1 Trigger domain expansion flow on the Portal
Scenario #1
Step 1
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
Manual UI-driven operation
Automated operation

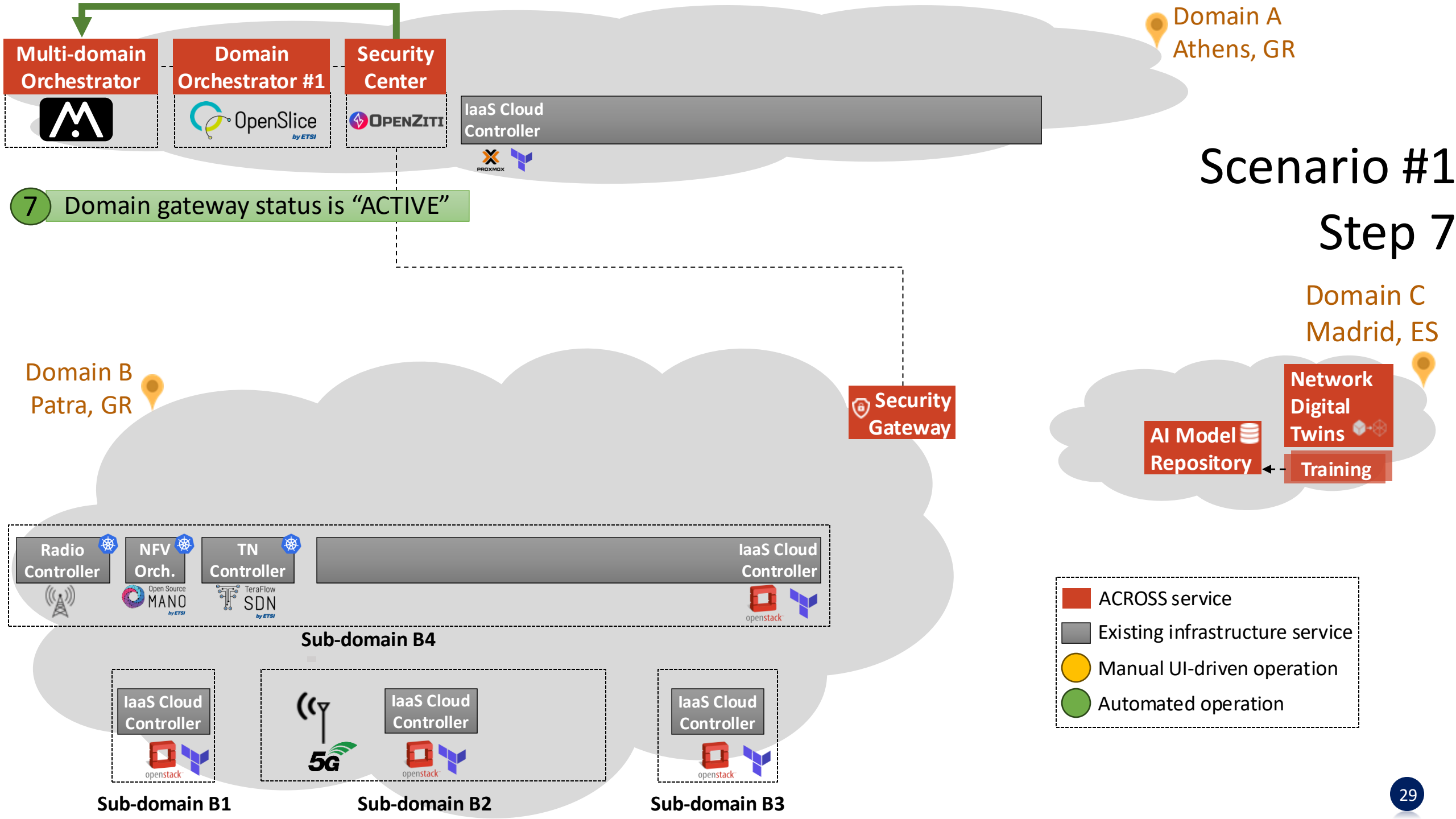

Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OPENZITI
IaaS Cloud Controller
PROXMOX
Domain A
Athens, GR
2 Request new domain identity (ZWT token) for domain owner
Scenario #1
Step 2
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
Manual UI-driven operation
Automated operation

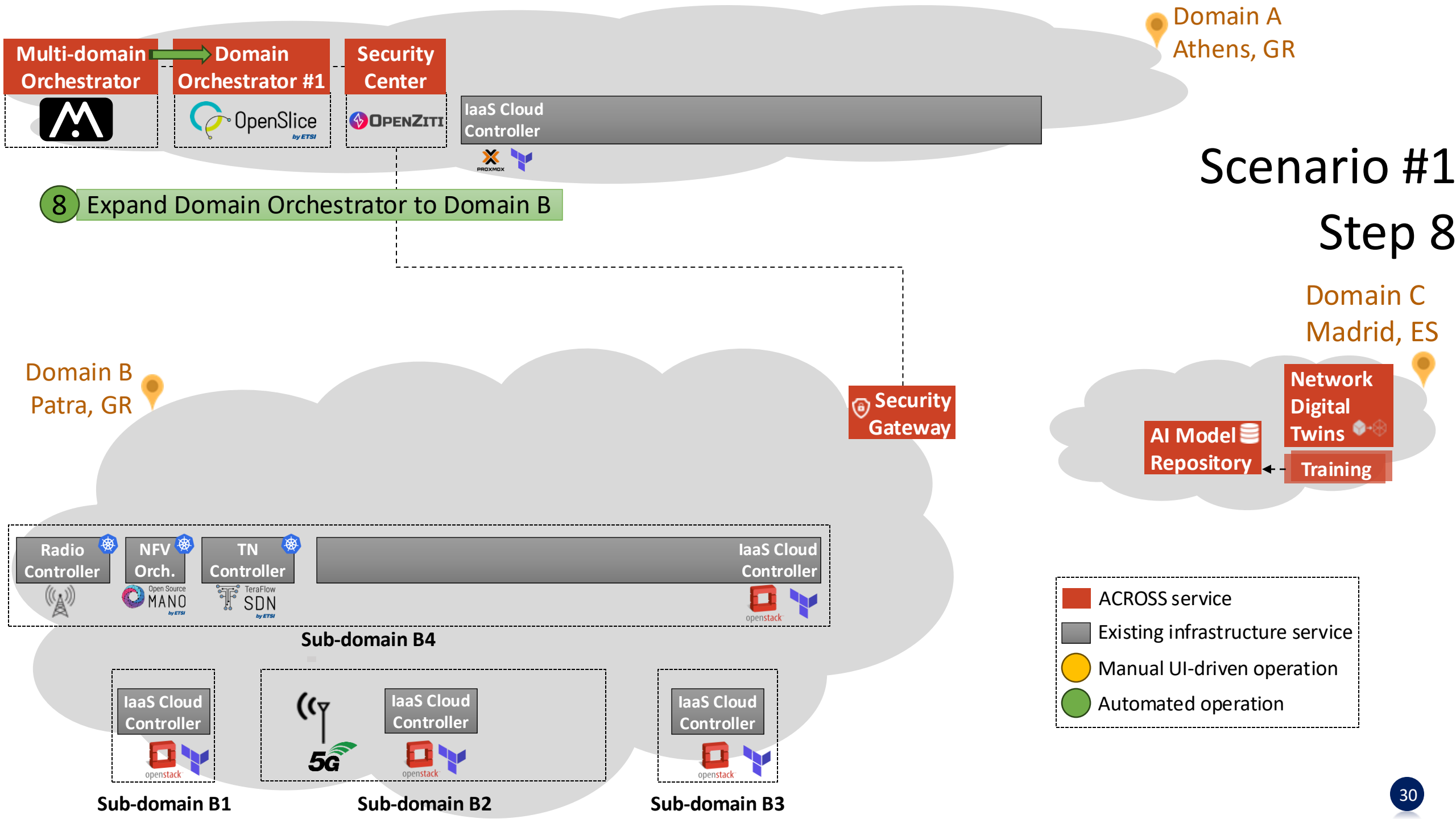

Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
PROXMOX
Domain A
Athens, GR
3 Domain identity (ZWT token) created and returned
Scenario #1
Step 3
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
Manual UI-driven operation
Automated operation

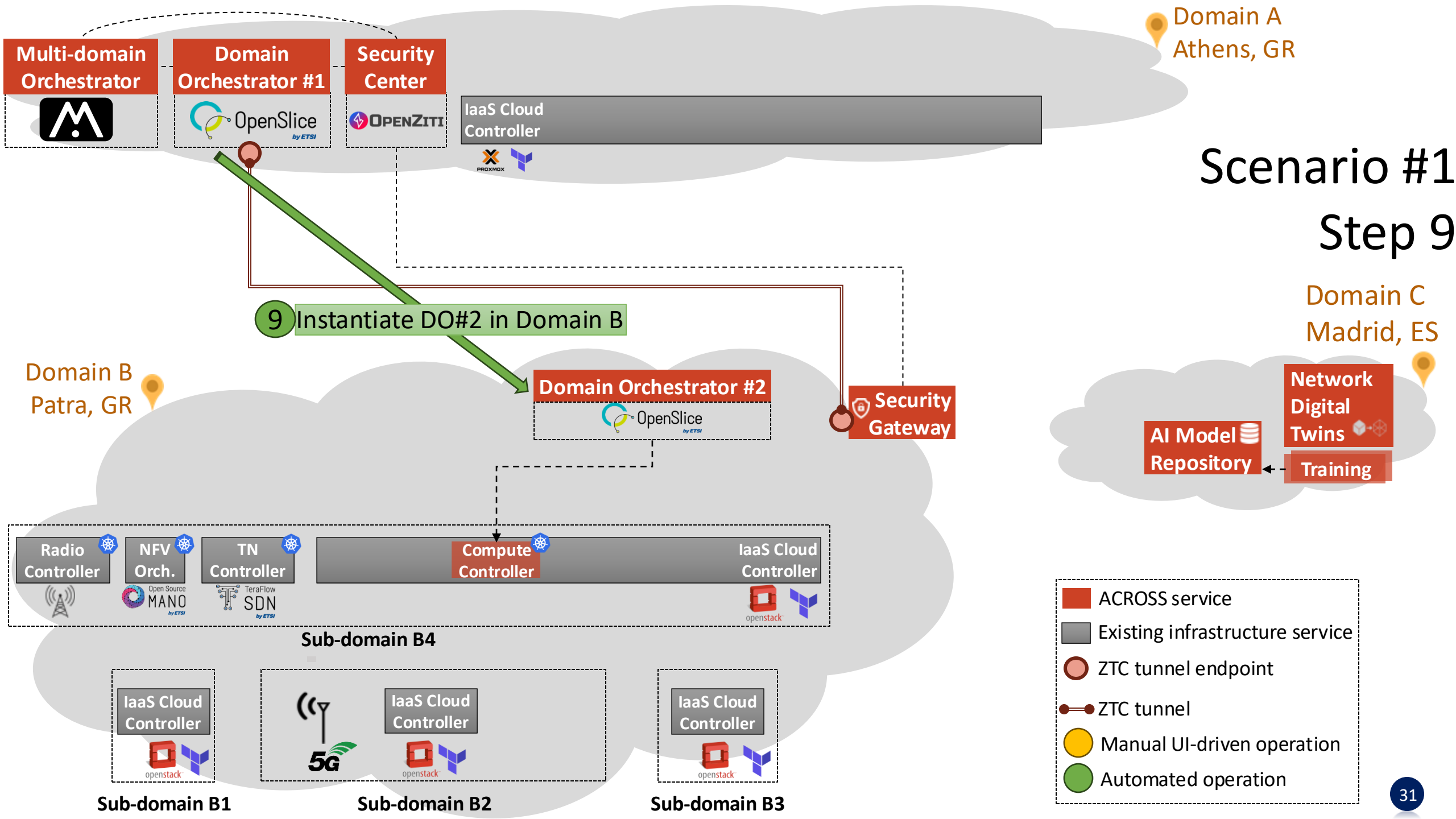

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
PROXMOX
4 Domain identity shared with domain owner
Scenario #1
Step 4
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Radio Controller
NFV Orch.
TN Controller
IaaS Cloud Controller
Open Source MANO by ETSI
TeraFlow SDN by ETSI
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
Manual UI-driven operation
Automated operation

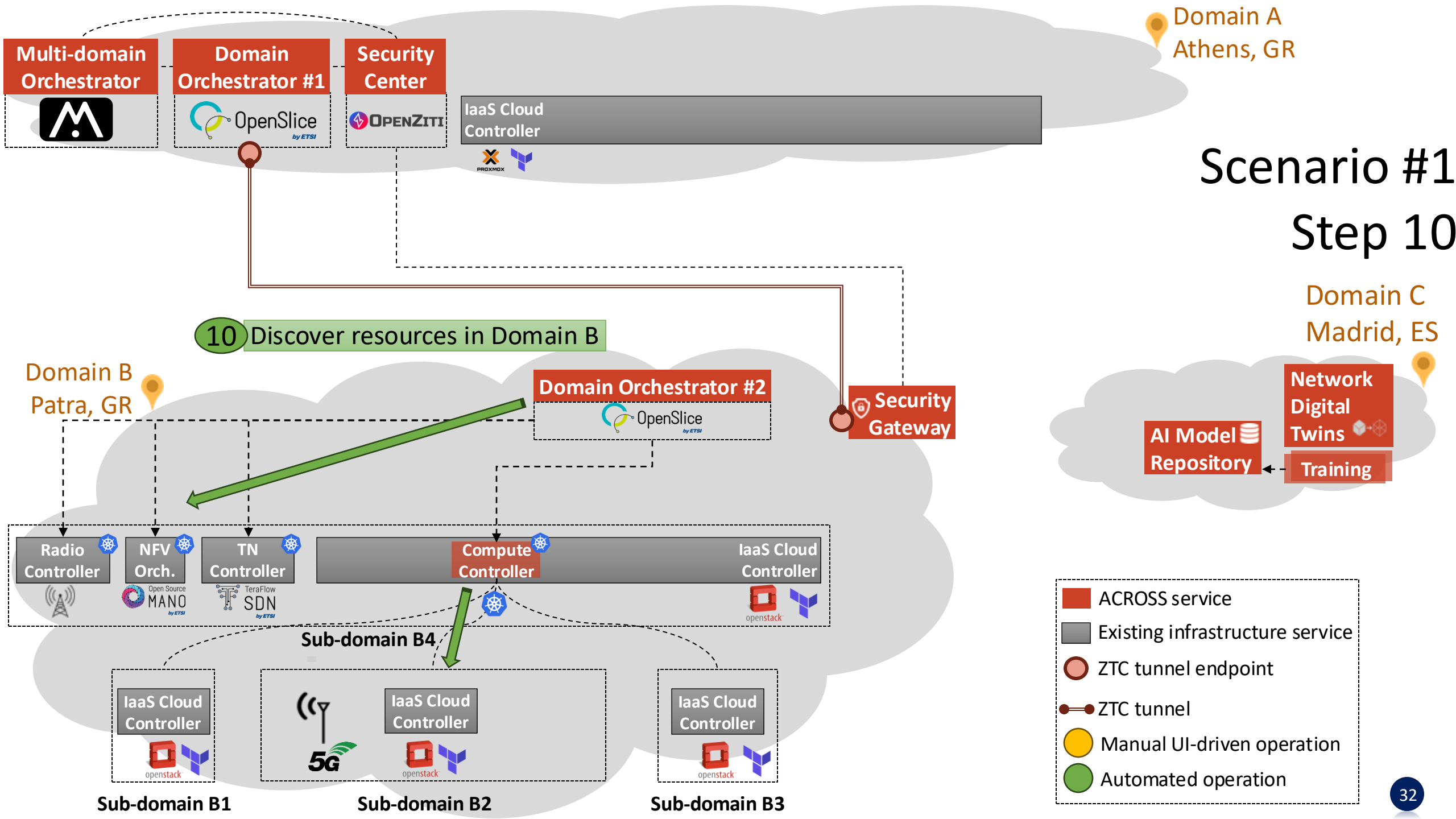

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OPENZITI
IaaS Cloud Controller
PROXMOX
Scenario #1
Step 5
5 Deploy Security Gateway using the secure domain identity
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
Manual UI-driven operation
Automated operation

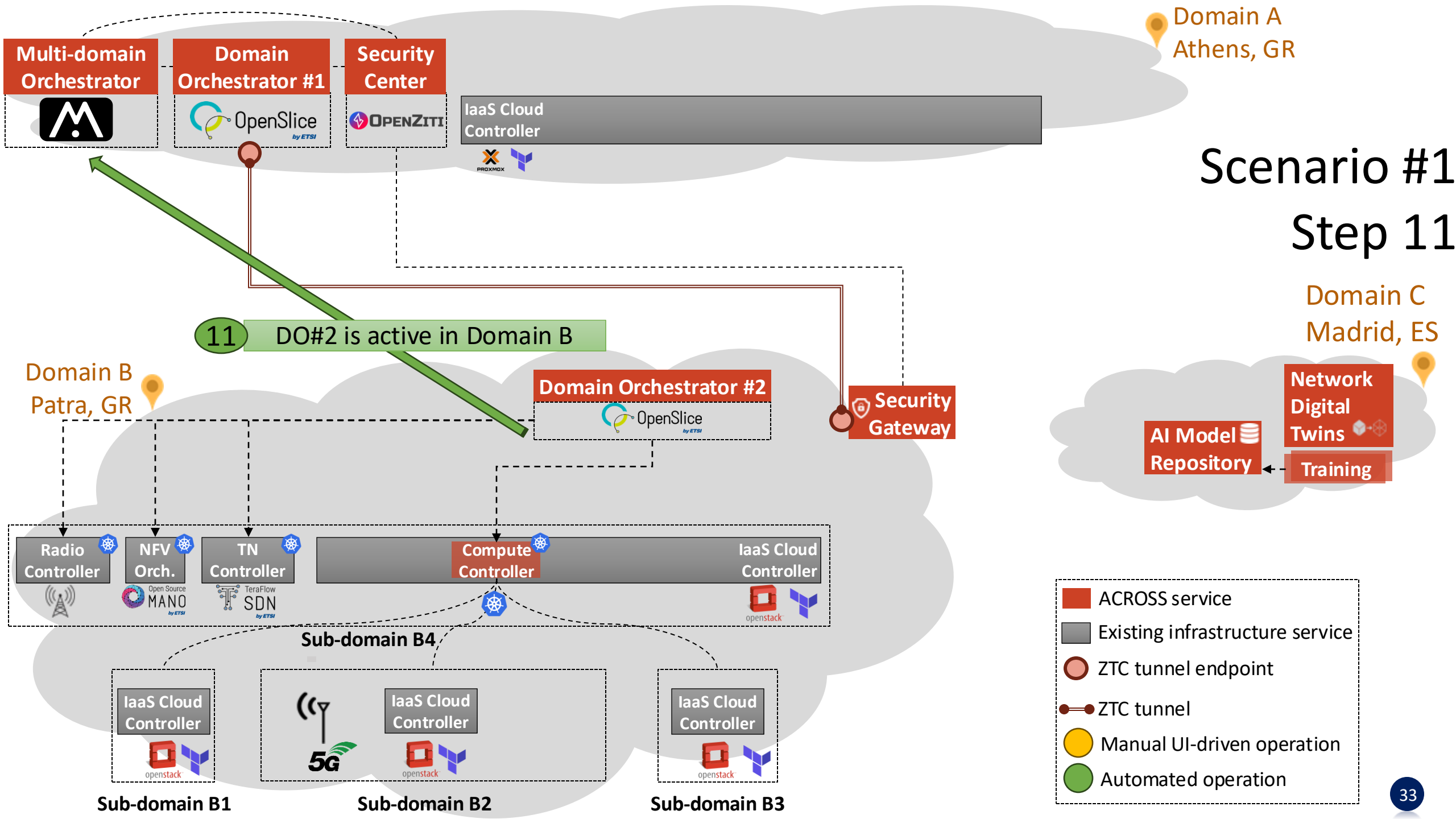

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OpenZiti
IaaS Cloud Controller
PROXMOX
Scenario #1
Step 6
Security gateway enrolled to Security Center
6
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
Manual UI-driven operation
Automated operation

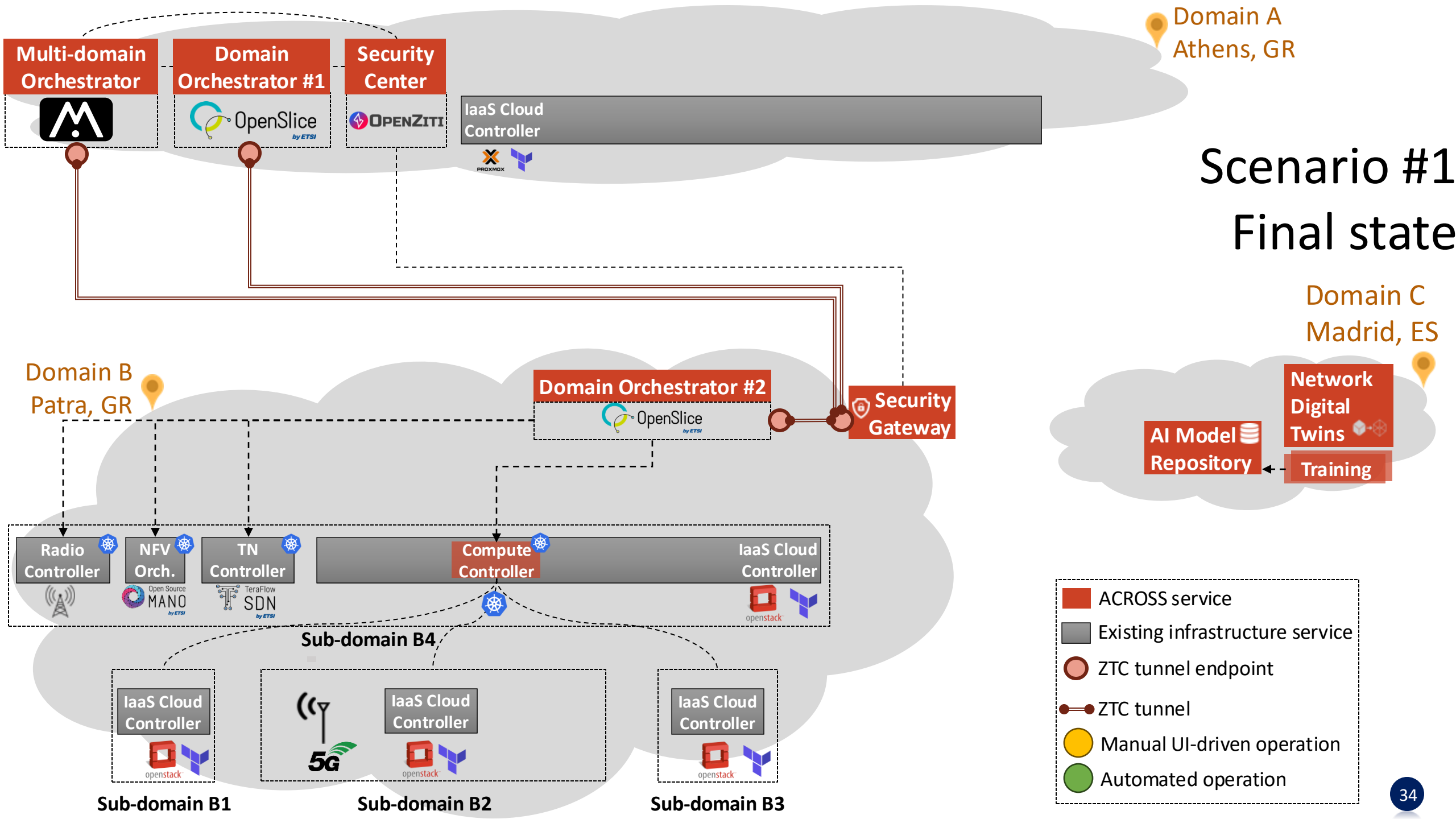

Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OpenZiti
IaaS Cloud Controller
Proxmox
Domain A
Athens, GR
7 Domain gateway status is “ACTIVE”
Scenario #1
Step 7
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
Manual UI-driven operation
Automated operation


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OpenZiti
IaaS Cloud Controller
PROXMOX
8 Expand Domain Orchestrator to Domain B
Scenario #1
Step 8
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
Manual UI-driven operation
Automated operation


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
PROXMOX
Scenario #1
Step 9
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
9 Instantiate DO#2 in Domain B
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OpenZiti
IaaS Cloud Controller
Proxmox
Scenario #1
Step 10
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
10 Discover resources in Domain B
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
5G
IaaS Cloud Controller
openstack
IaaS Cloud Controller
openstack
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OpenZiti
IaaS Cloud Controller
Proxmox
Scenario #1
Step 11
11
DO#2 is active in Domain B
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
5G
IaaS Cloud Controller
openstack
IaaS Cloud Controller
openstack
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
Proxmox
Scenario #1
Final state
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation

PoC Scenario #1 – Remarks (1/2)

East-West expansion of the platform to a new private domain (Domain B)

- Domain B is now orchestrated by a new DO#2 instance (East-West expansion of the DO)
- Domain B's local orchestrator (DO#2) has automatically discovered the underlying resources
- Domain B's local orchestrator (DO#2) is accessible by the MDO

Amount of Automation ≈ 82%

$$\frac{9 \text{ Automated steps}}{11 \text{ Total number of steps}}$$

PoC Scenario #1 – Remarks (2/2)

Amount of Automation > 90% is possible if we sacrifice security (not recommended)

- Allow MDO to auto-deploy the Security Gateway on a pre-defined IP:port in Domain B
- This is nearly impossible in the real world as no domain administrator would allow this

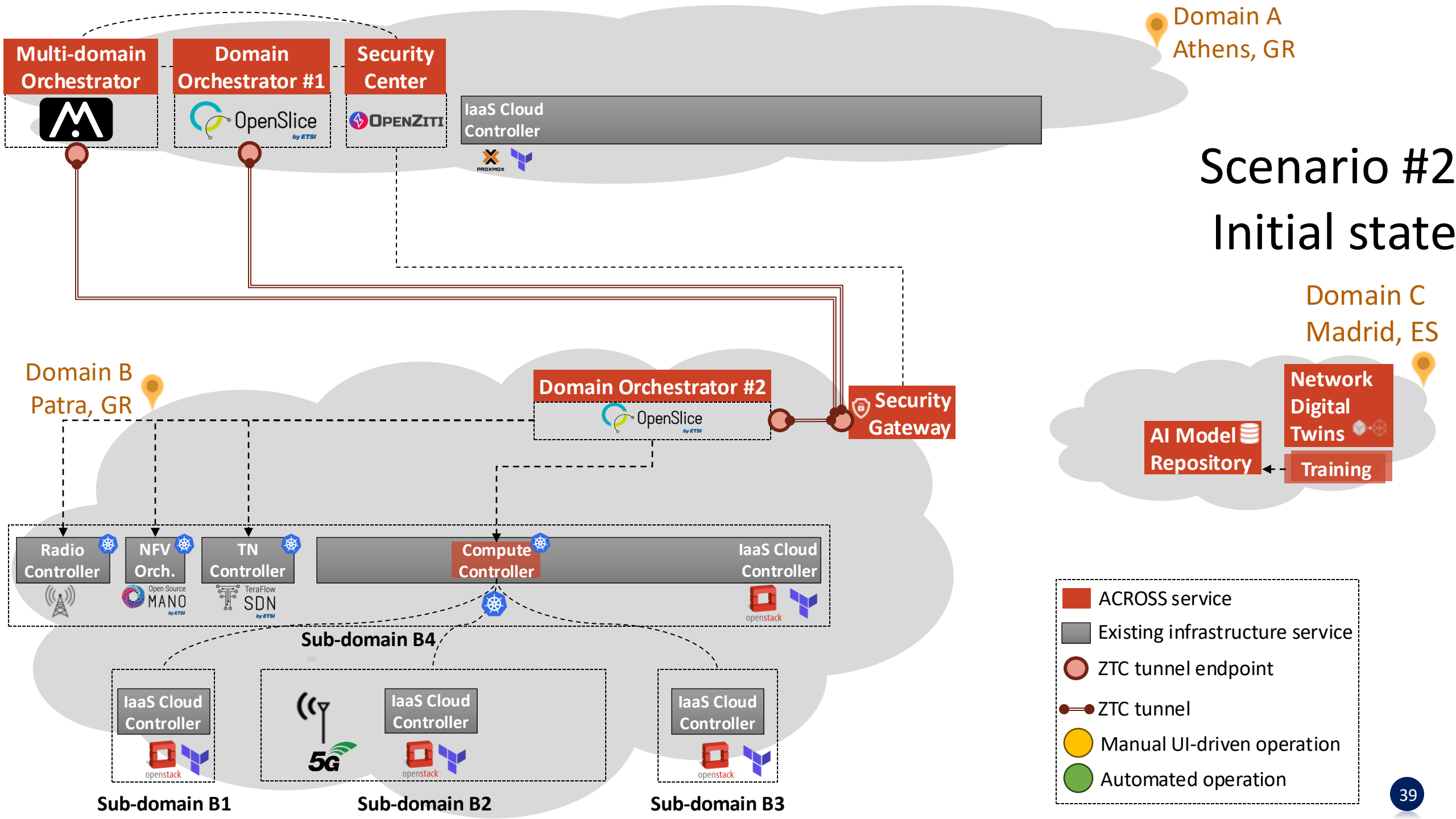
PoC Stories – Scenario #2

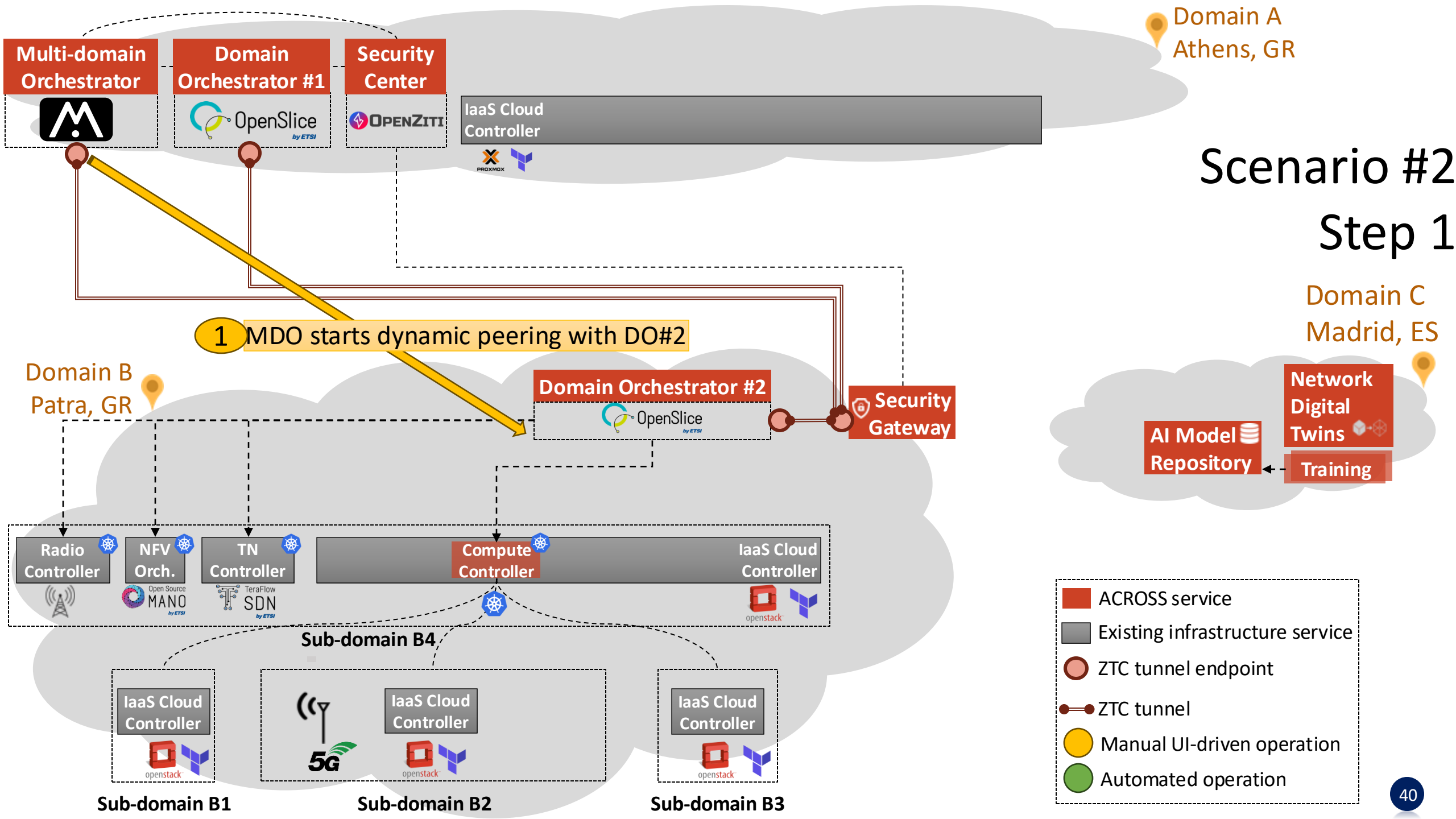
PoC Scenario #2 – Automated Service Provisioning

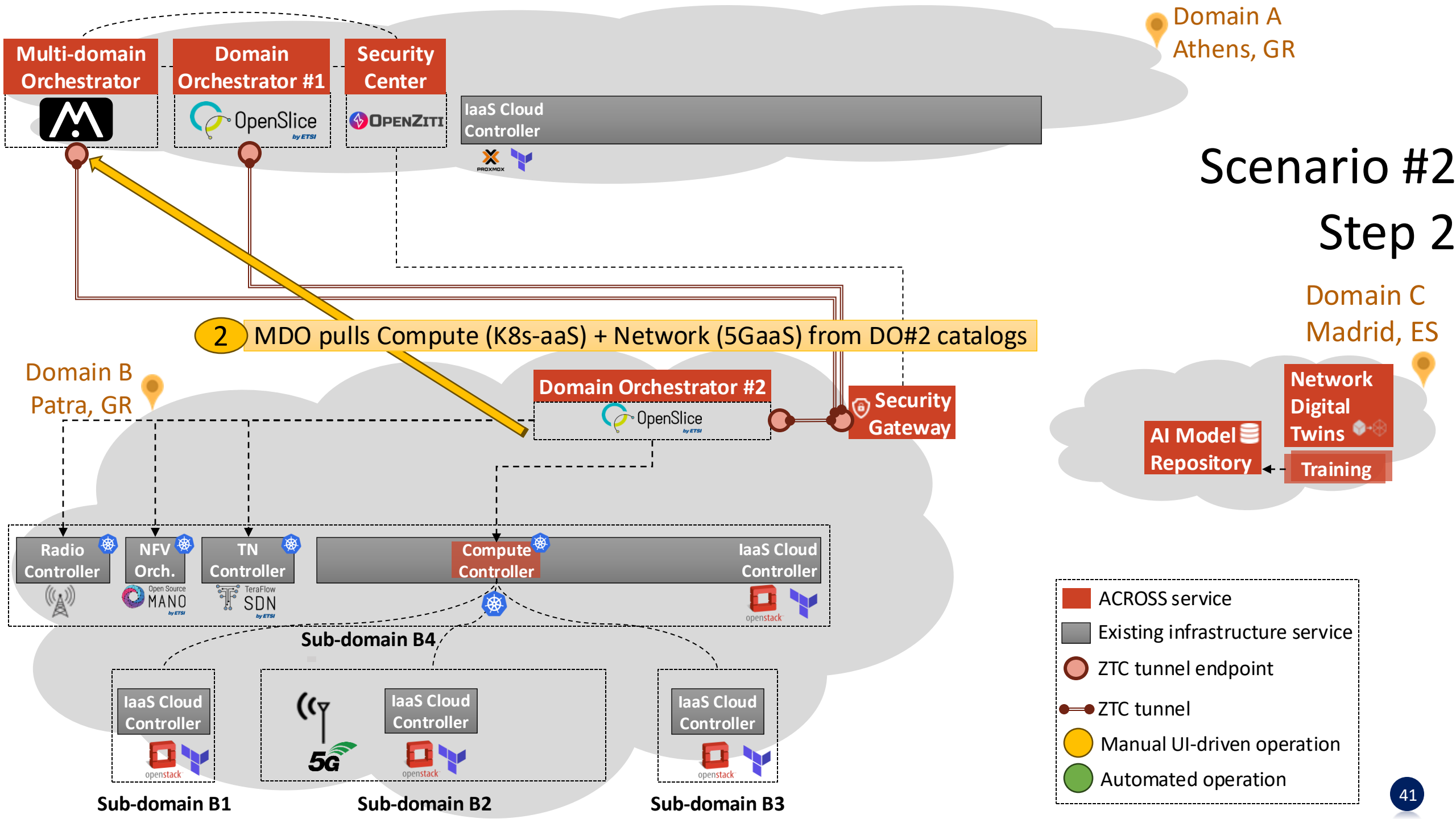
- A 5G video streaming service should be provisioned in Domain B
- Streaming clients should connect to a streaming server via 5G
- End-to-end telemetry data must be collected for this service

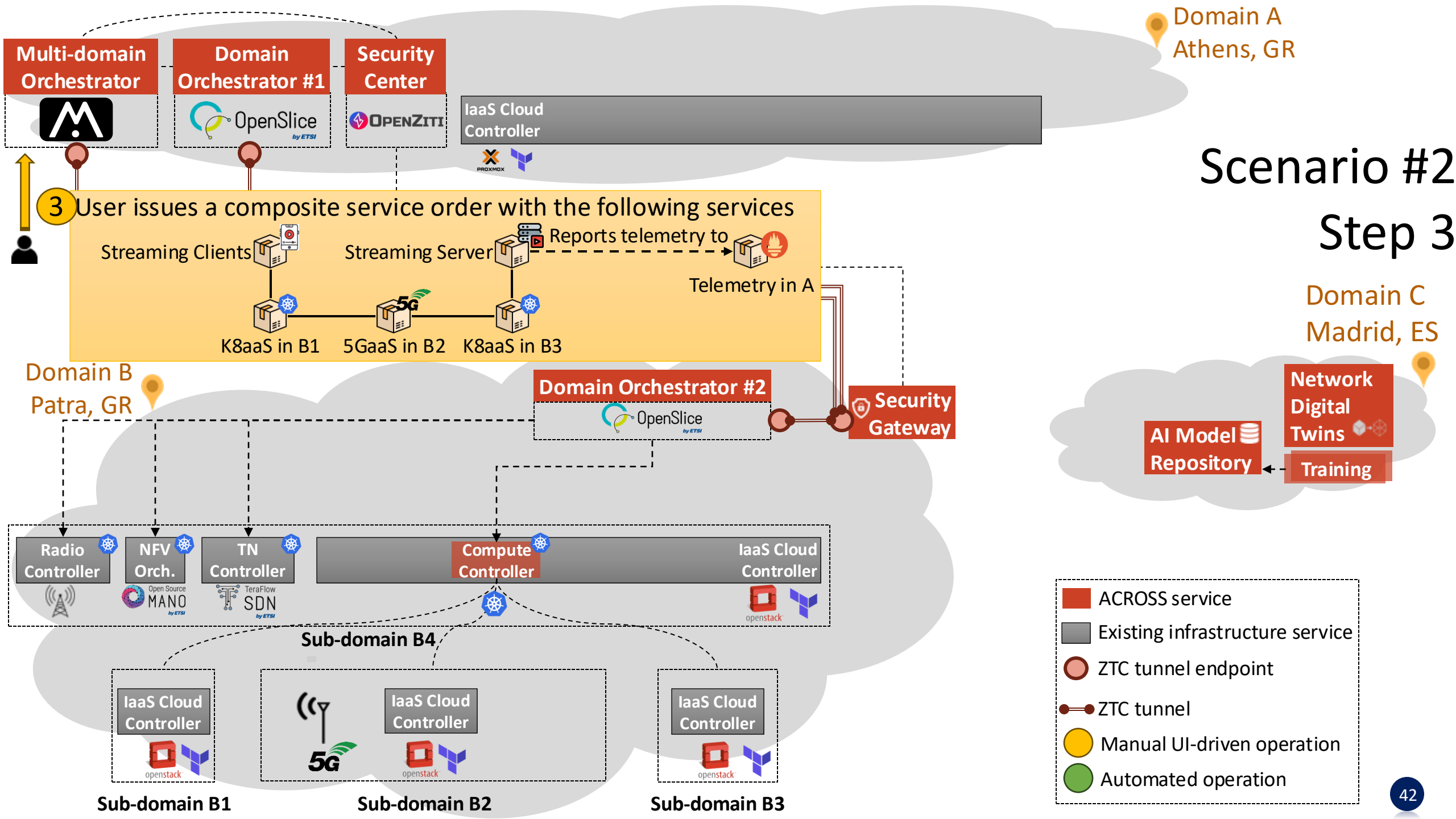
The platform should greatly-facilitate the end-to-end service provisioning, ideally via a single service order

The Multi-domain orchestrator (MDO) co-operates with the Domain Orchestrator (DO#2) to offer a composite service bundle that greatly automates service provisioning

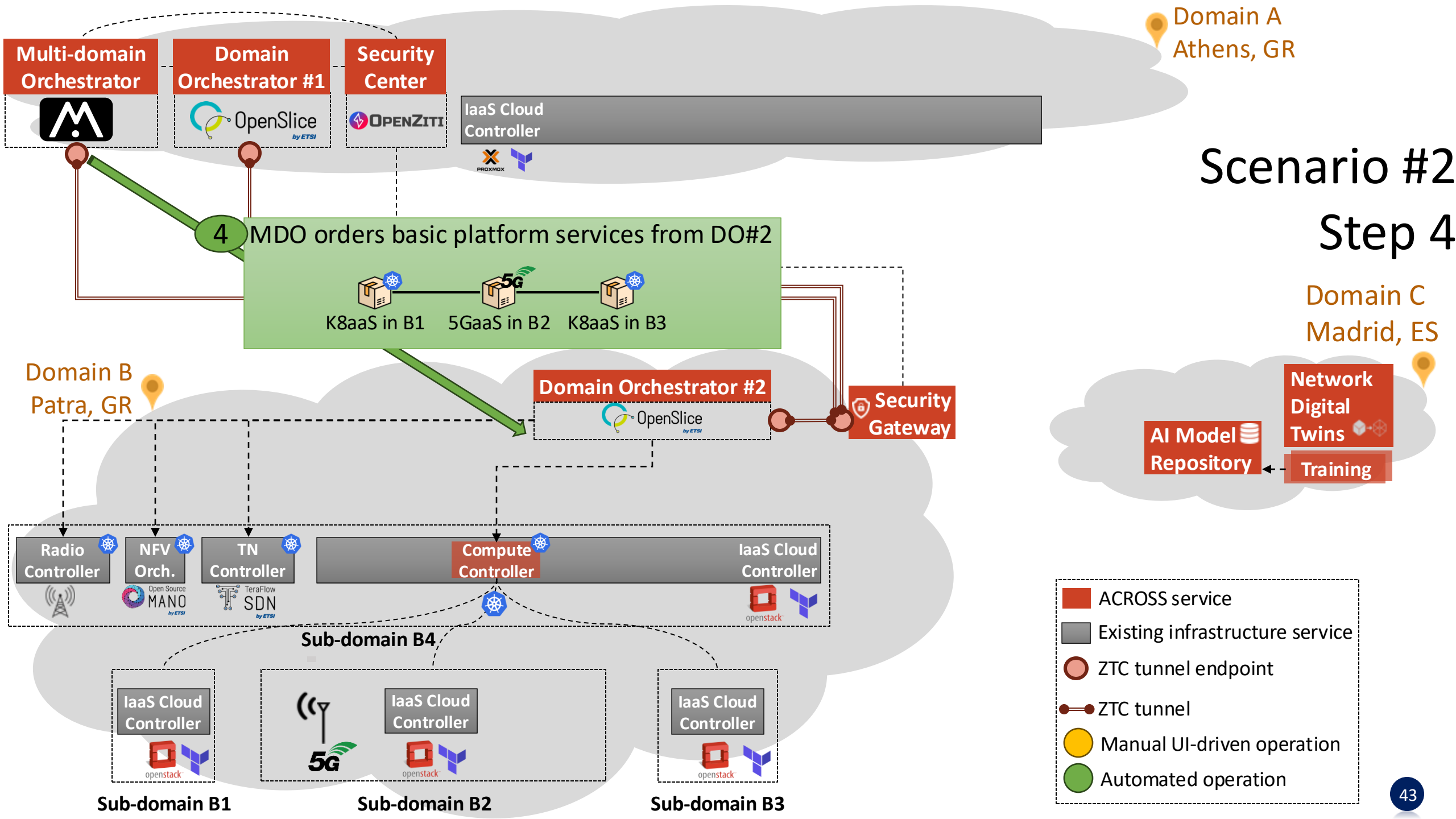

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OpenZiti
IaaS Cloud Controller
Proxmox
Scenario #2
Initial state
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
Proxmox
Scenario #2
Step 1
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
1 MDO starts dynamic peering with DO#2
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
5G
IaaS Cloud Controller
openstack
IaaS Cloud Controller
openstack
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation

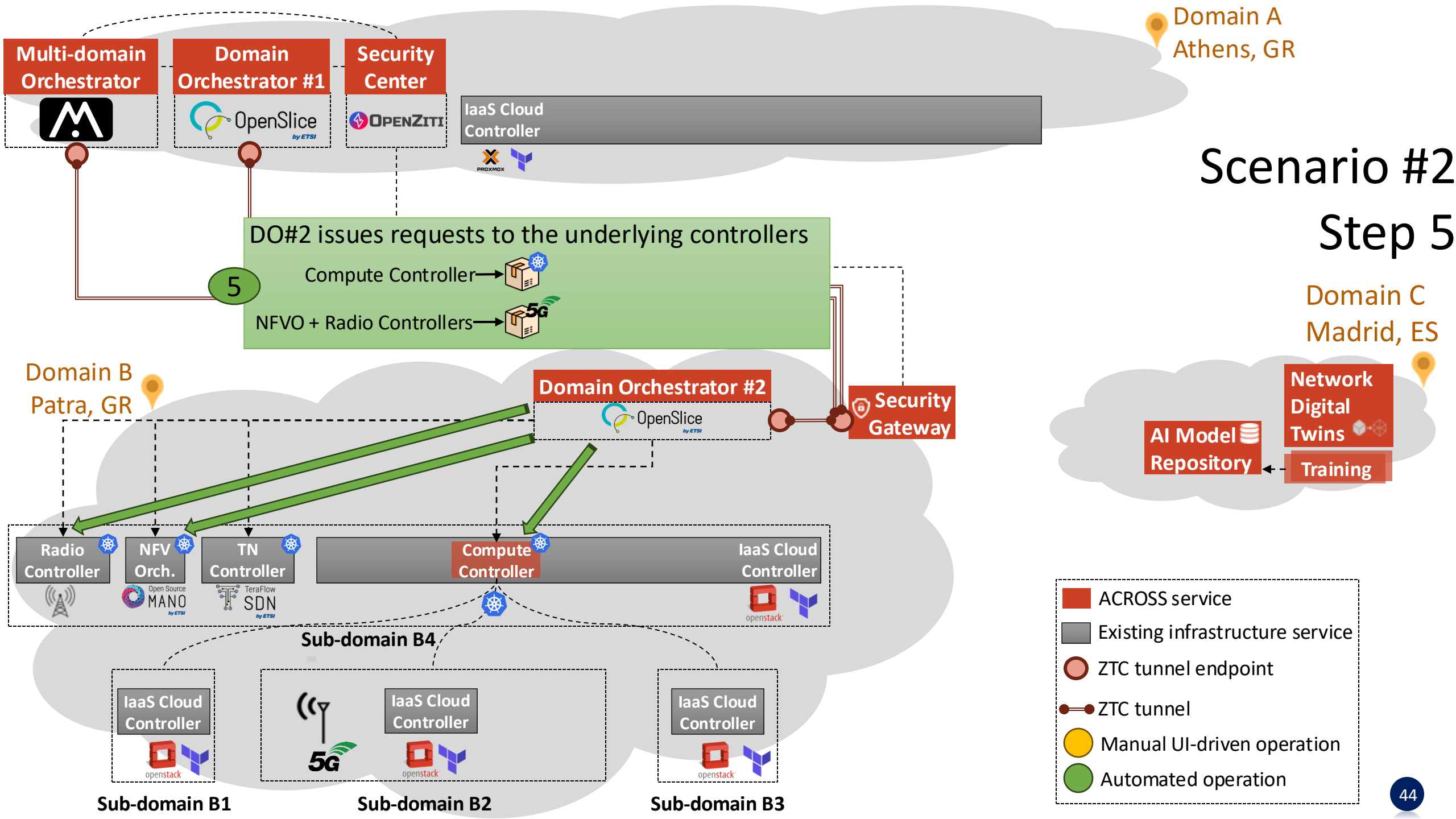

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OpenZiti
IaaS Cloud Controller
Proxmox
Scenario #2
Step 2
Domain C
Madrid, ES
2 MDO pulls Compute (K8s-aaS) + Network (5GaaS) from DO#2 catalogs
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
Network Digital Twins
AI Model Repository
Training
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation

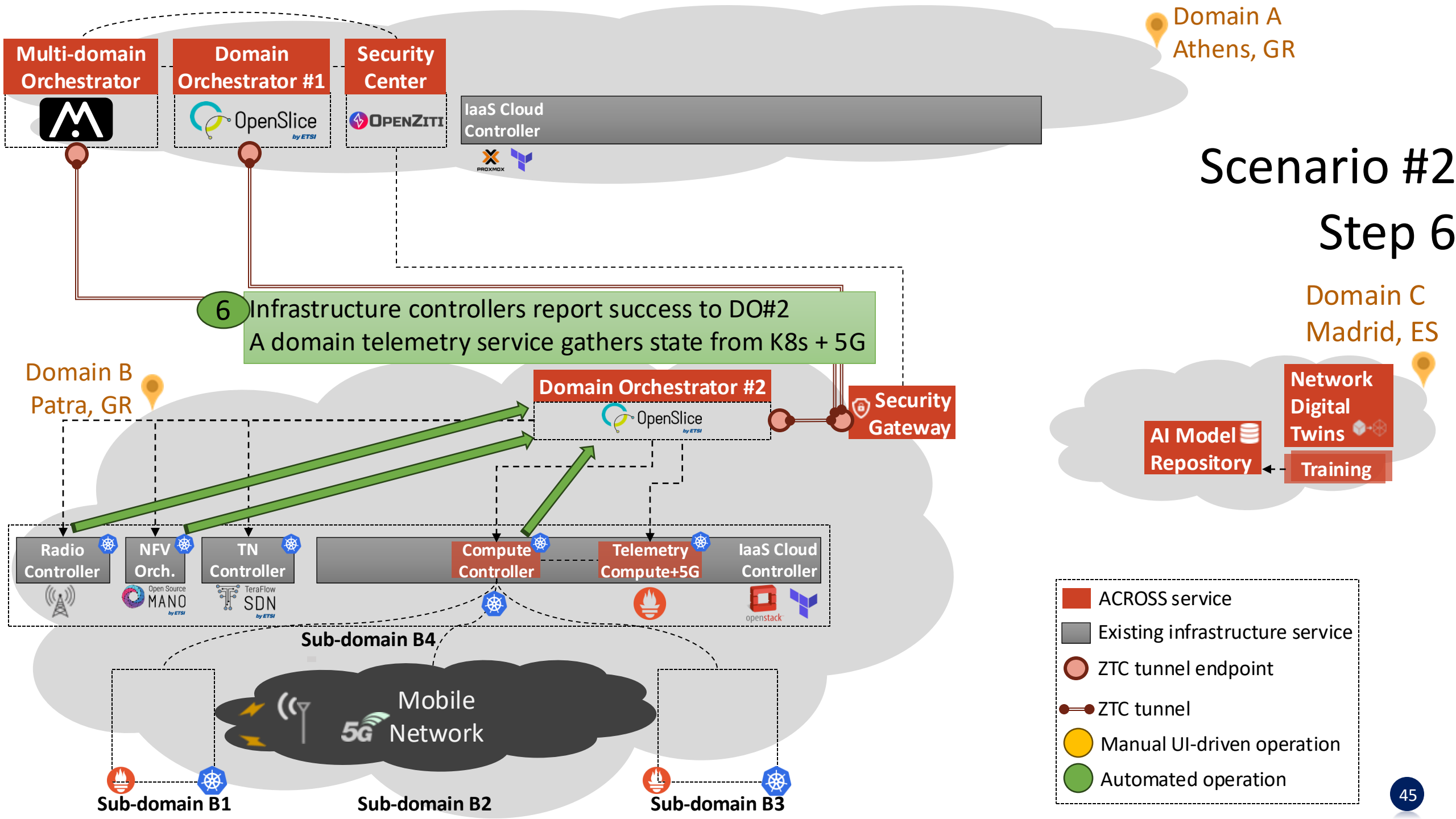


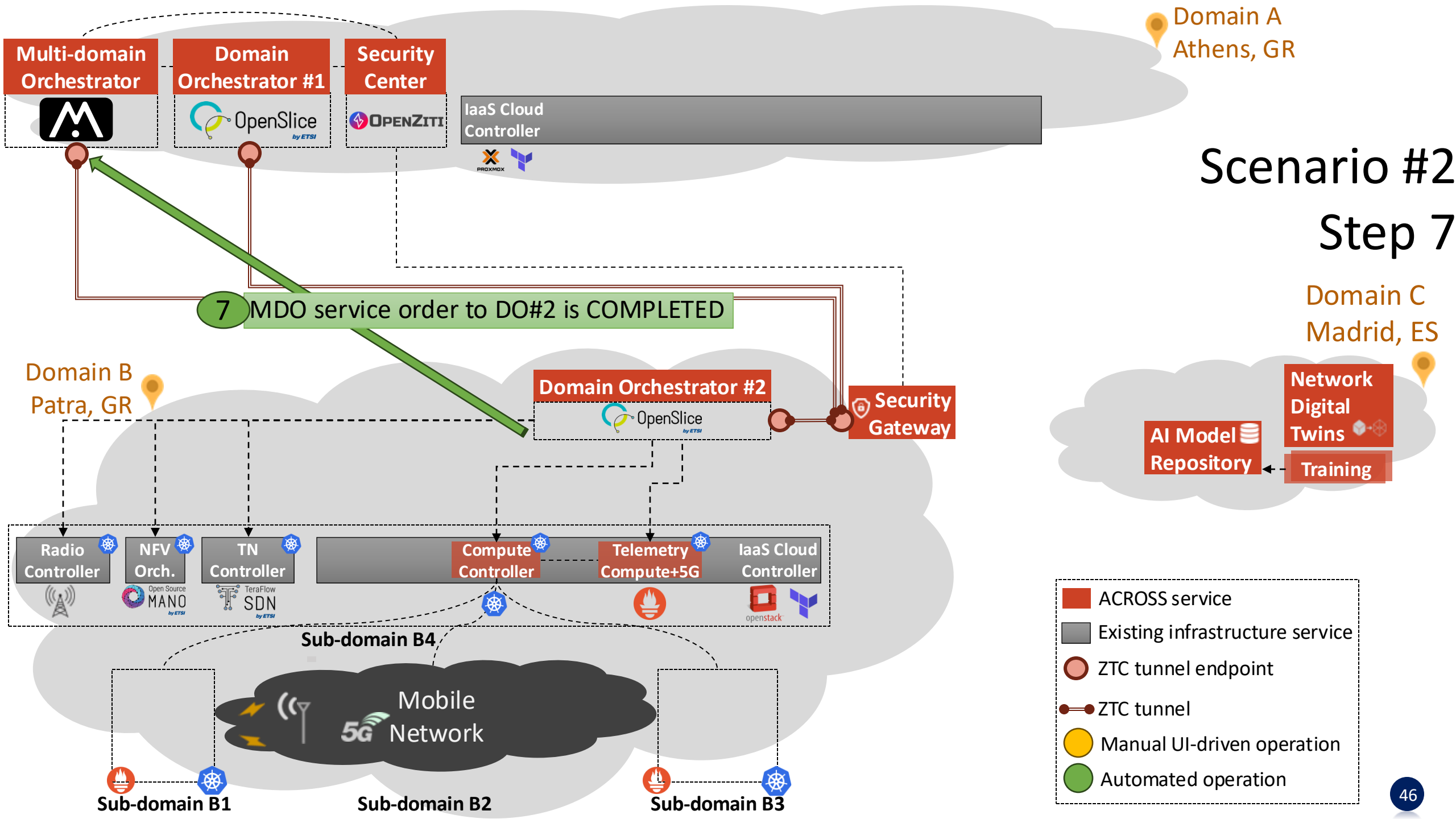
Scenario #2
Step 3

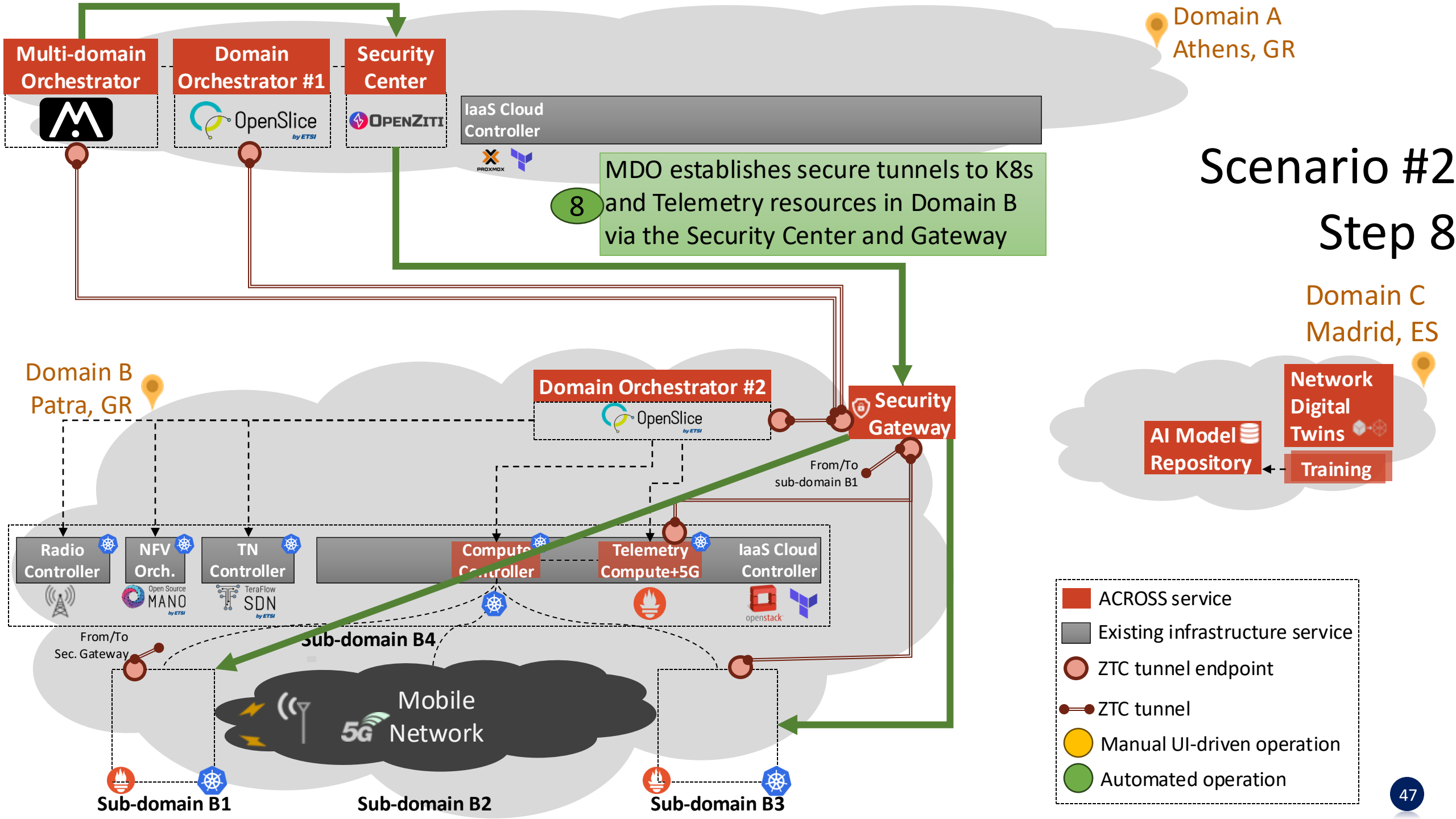

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OpenZiti
IaaS Cloud Controller
Proxmox
Scenario #2
Step 4
4
MDO orders basic platform services from DO#2
K8aaS in B1
5GaaS in B2
K8aaS in B3
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
IaaS Cloud Controller
openstack
Sub-domain B4
IaaS Cloud Controller
openstack
Sub-domain B1
5G
IaaS Cloud Controller
openstack
Sub-domain B2
IaaS Cloud Controller
openstack
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation

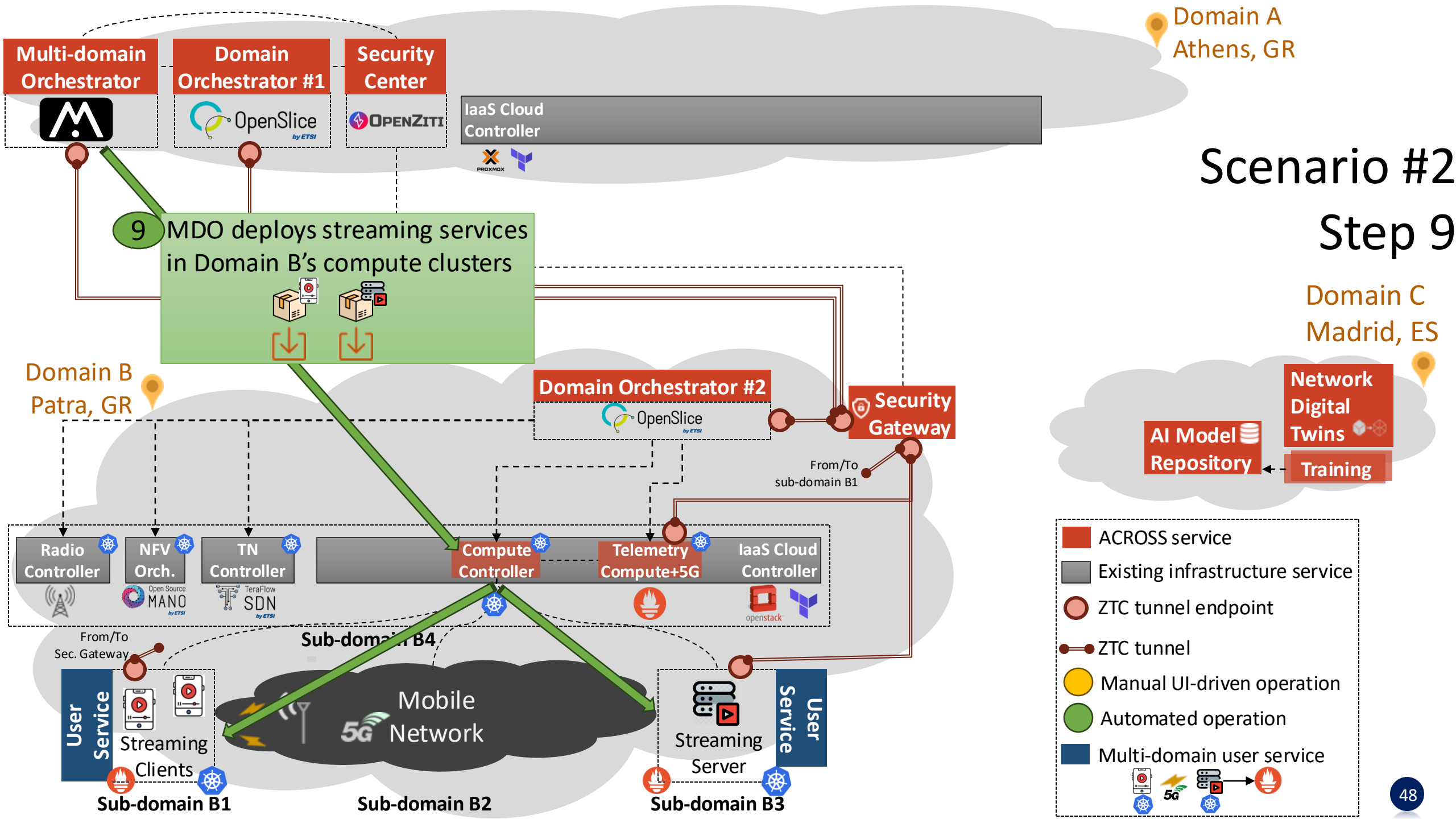
Scenario #2
Step 5



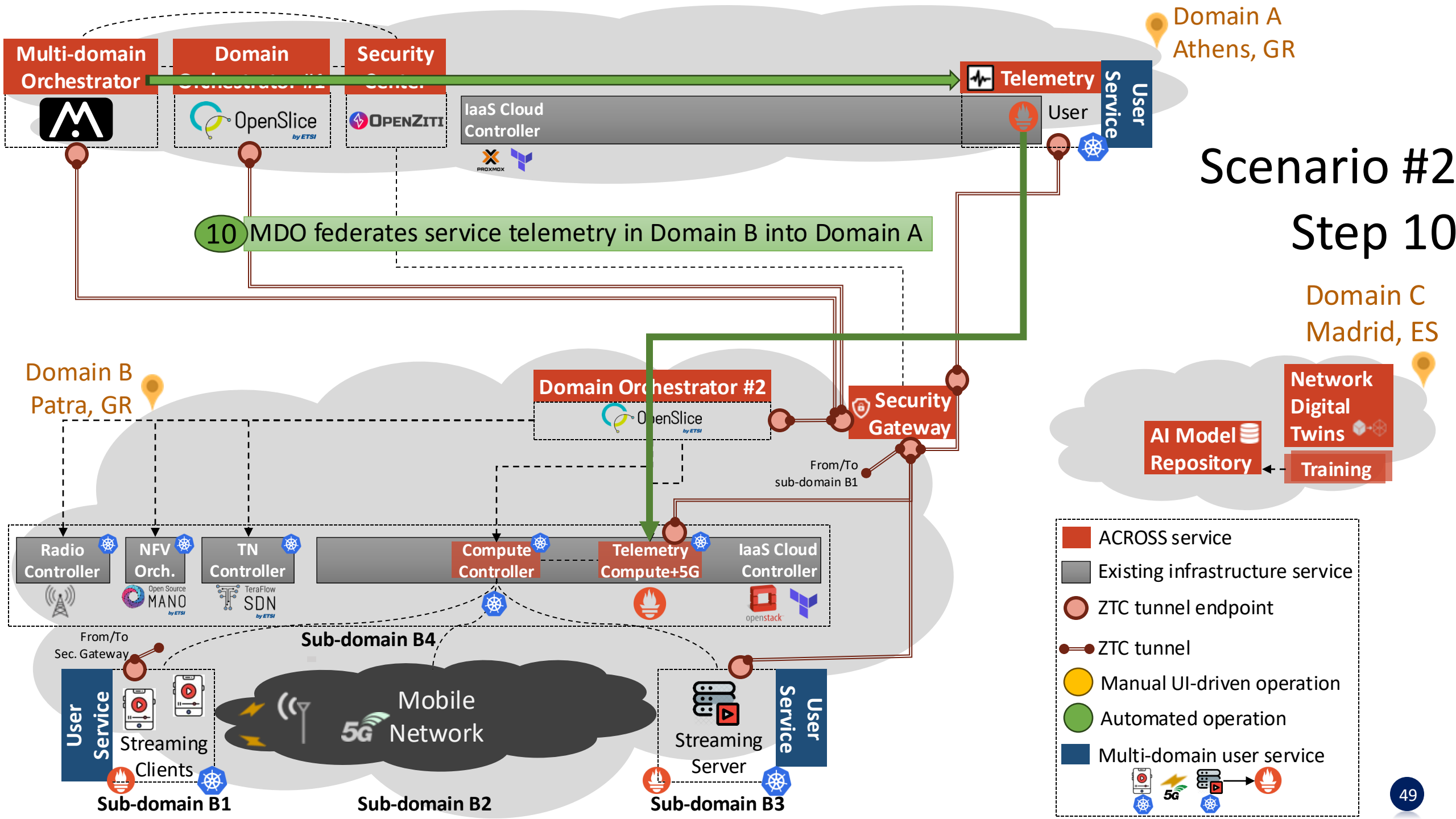

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
PROXMOX
Scenario #2
Step 6
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
6
Infrastructure controllers report success to DO#2
A domain telemetry service gathers state from K8s + 5G
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
Sub-domain B4
Mobile Network
5G
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation

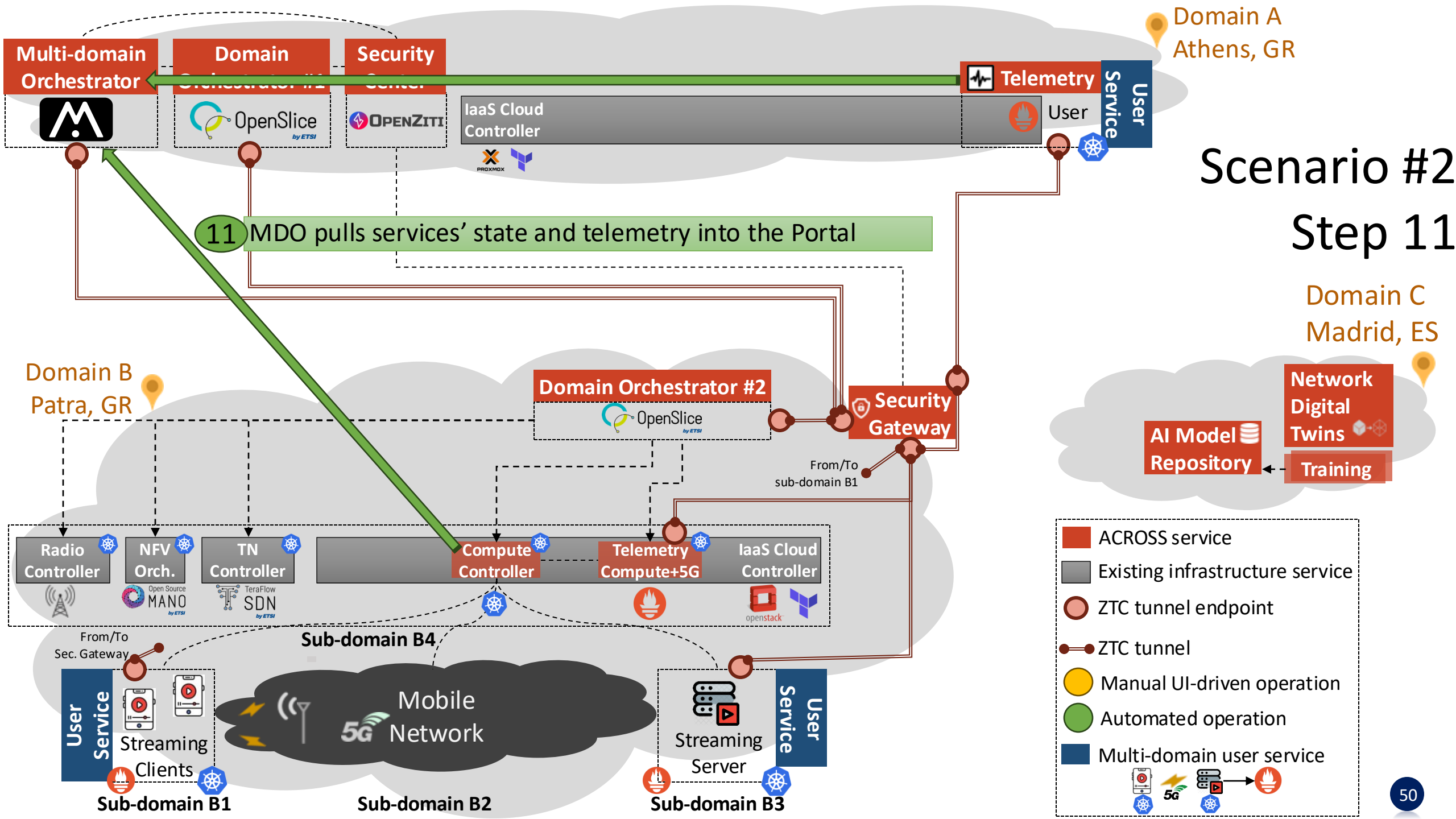

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
PROXMOX
Scenario #2
Step 7
Domain C
Madrid, ES
7 MDO service order to DO#2 is COMPLETED
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
Network Digital Twins
AI Model Repository
Training
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
Sub-domain B4
Mobile 5G Network
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation

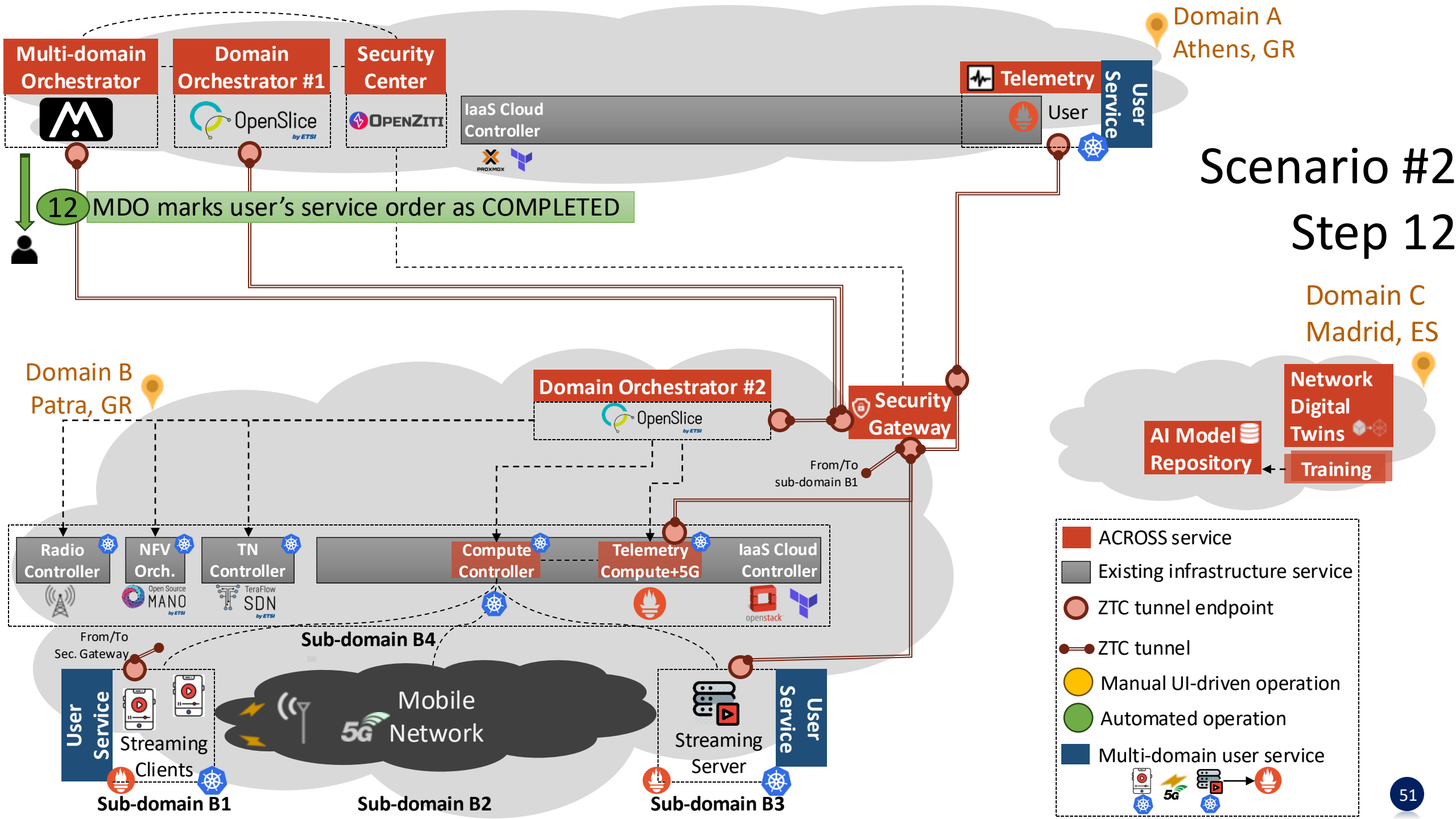

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice
Security Center
OpenZiti
IaaS Cloud Controller
Proxmox
8
MDO establishes secure tunnels to K8s and Telemetry resources in Domain B via the Security Center and Gateway
Scenario #2
Step 8
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO
TN Controller
TeraFlow SDN
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
From/To Sec. Gateway
Sub-domain B4
Mobile Network
5G
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation

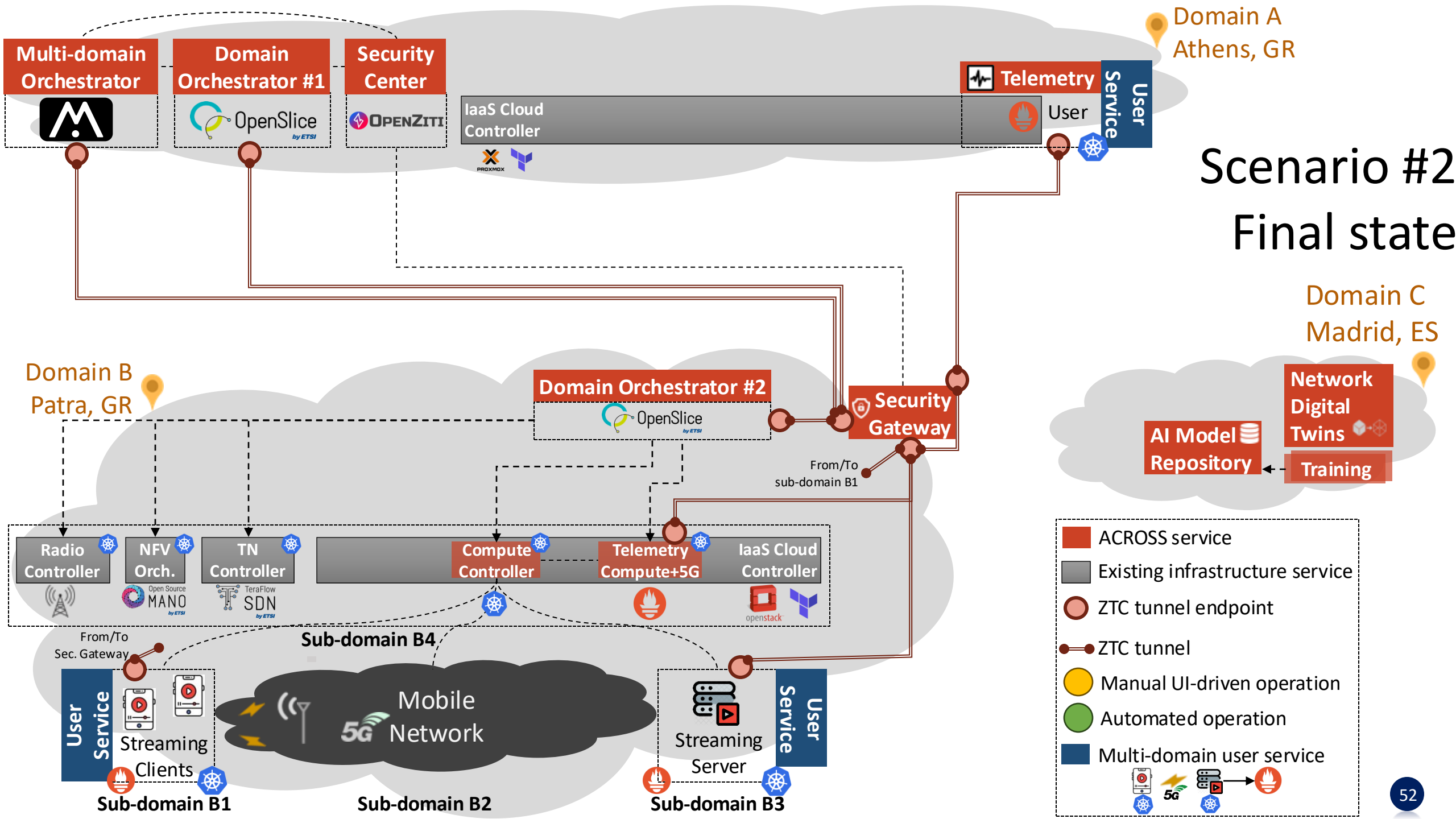


Scenario #2
Step 9


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
PROXMOX
Telemetry
User Service
User
Scenario #2
Step 10
10 MDO federates service telemetry in Domain B into Domain A
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
Athens, GR
Multi-domain Orchestrator
Domain
Security
OpenSlice
OpenZiti
IaaS Cloud Controller
Telemetry
User
User Service
11 MDO pulls services' state and telemetry into the Portal
Scenario #2
Step 11
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO
TN Controller
TeraFlow SDN
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice
Security Center
OpenZiti
IaaS Cloud Controller
Telemetry
User
User Service
12 MDO marks user's service order as COMPLETED
Scenario #2
Step 12
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO
TN Controller
TeraFlow SDN
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G

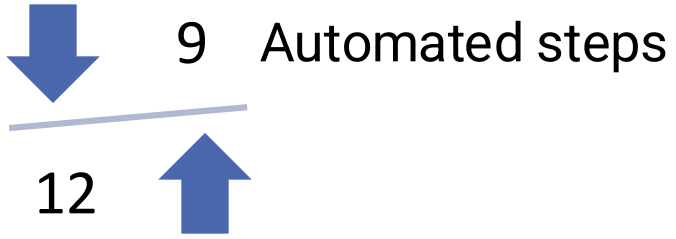

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice
Security Center
OpenZiti
IaaS Cloud Controller
Telemetry
User
User Service
Scenario #2
Final state
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO
TN Controller
TeraFlow SDN
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G

PoC Scenario #2 – Remarks (1/2)

Multi-domain and telemetry-assisted **service provisioning** over on-demand compute (K8s) and network (5G) resources

- DO#2 manages compute and network (platform) services within domain B
- MDO deploys end-user services atop platform services
- MDO federates telemetry across Domains A & B to acquire the state of the deployed services

Amount of Automation = 75%



PoC Scenario #2 – Remarks (2/2)

Amount of Automation = 100% is possible if we sacrifice dynamicity and user-experience

➡ Static synchronization of catalogs (peering) between MDO and DO#2

MDO portal prioritizes UX via dynamic, user-driven peering

➡ Automated service order upon release of a new service version

MDO allows tight integration with the service provider

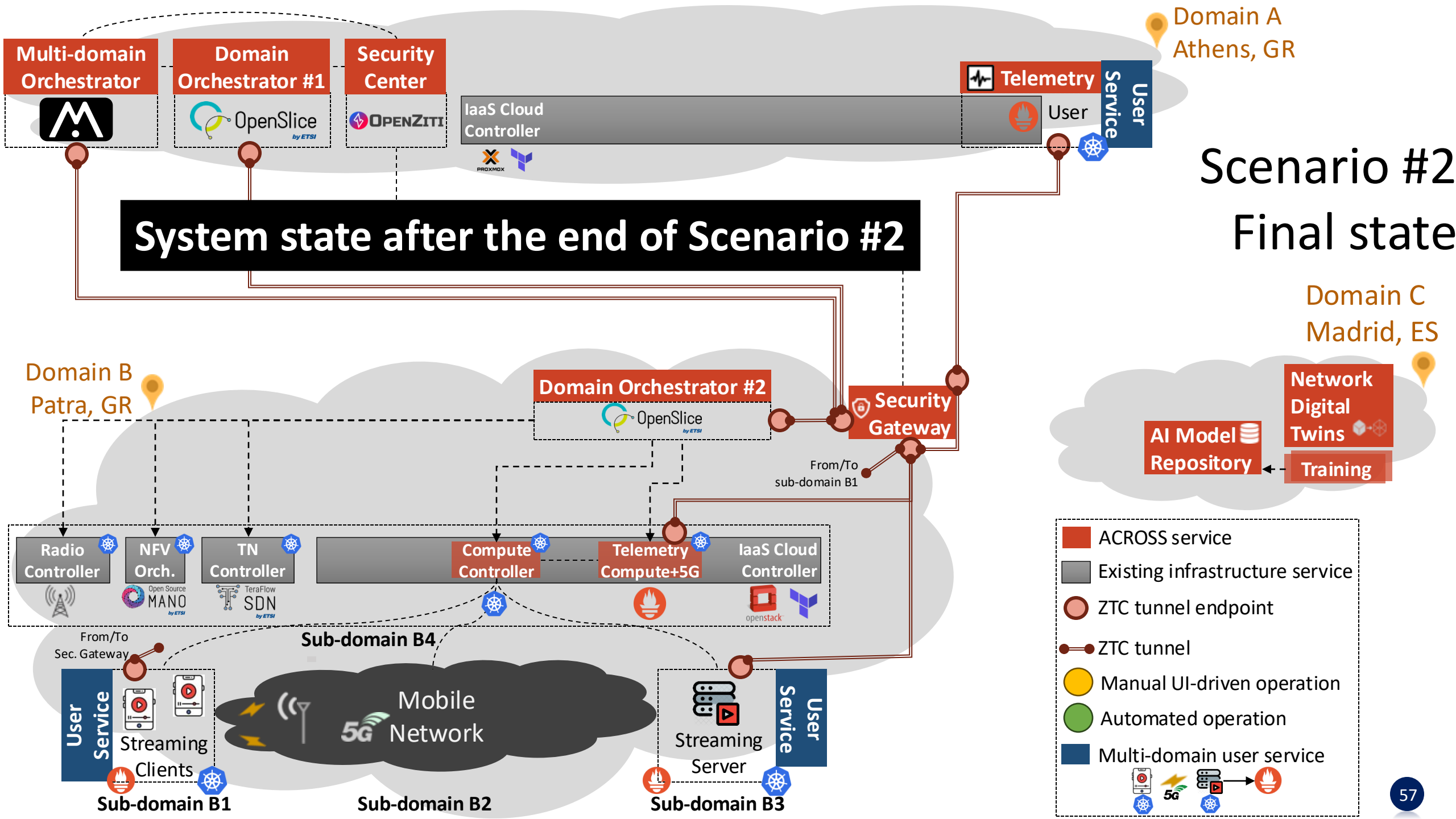
PoC Stories – Scenario #3

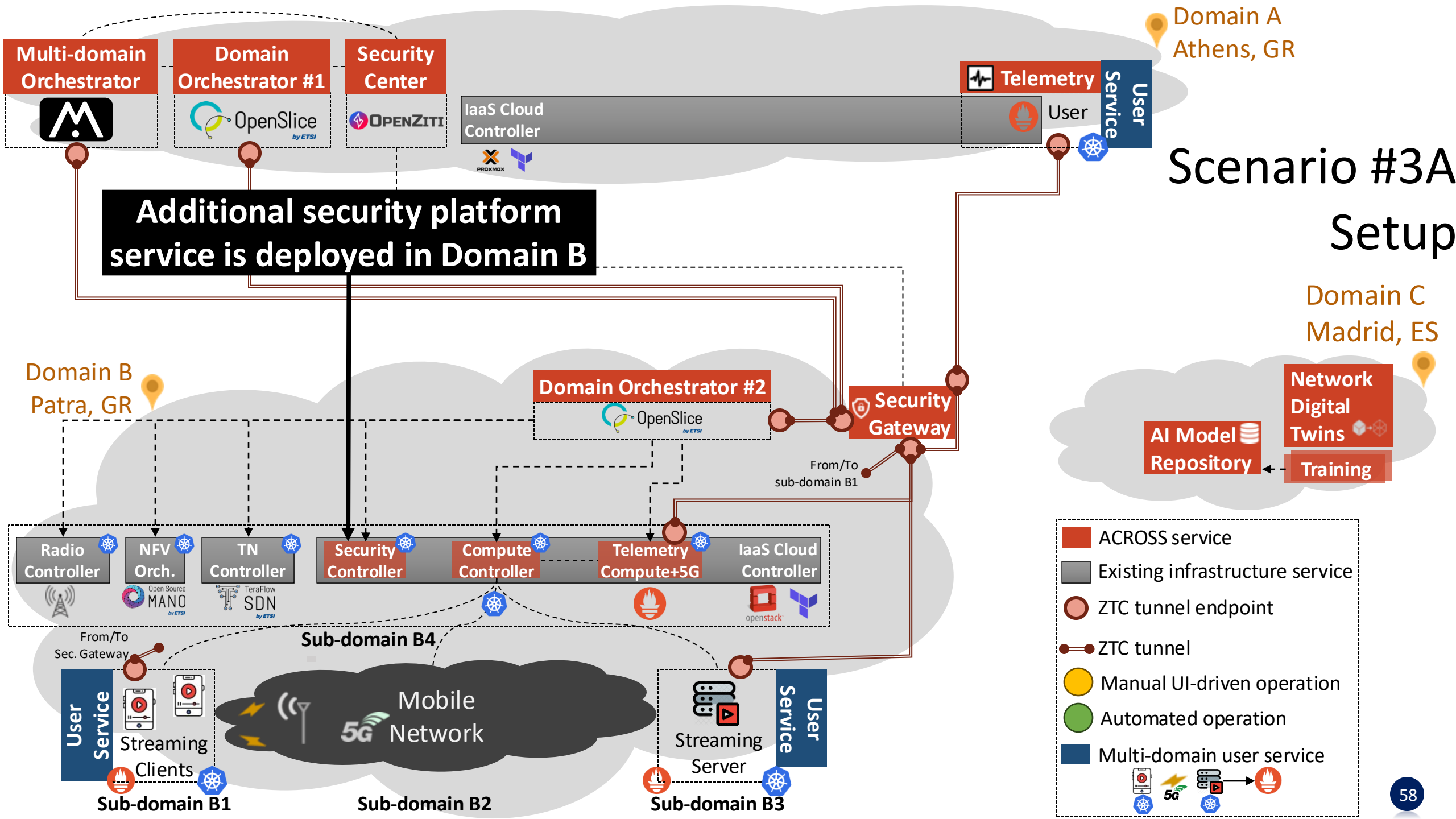
PoC Scenario #3 – On-demand Service Security & Predictive SLA Preservation

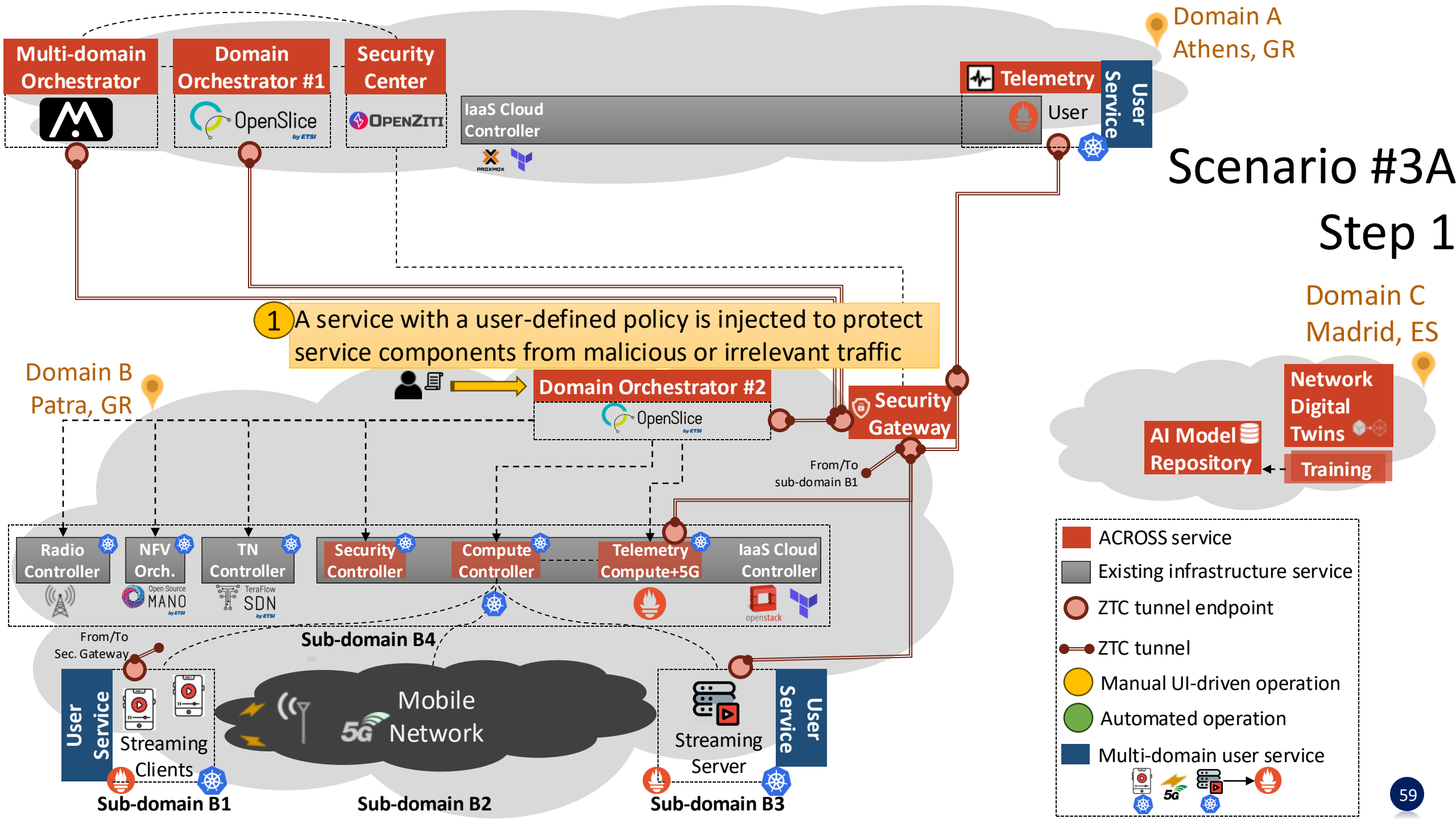
Service provider requests:
- a security SLA for protecting some service components (on demand)
- a performance SLA which should be preserved in a proactive fashion

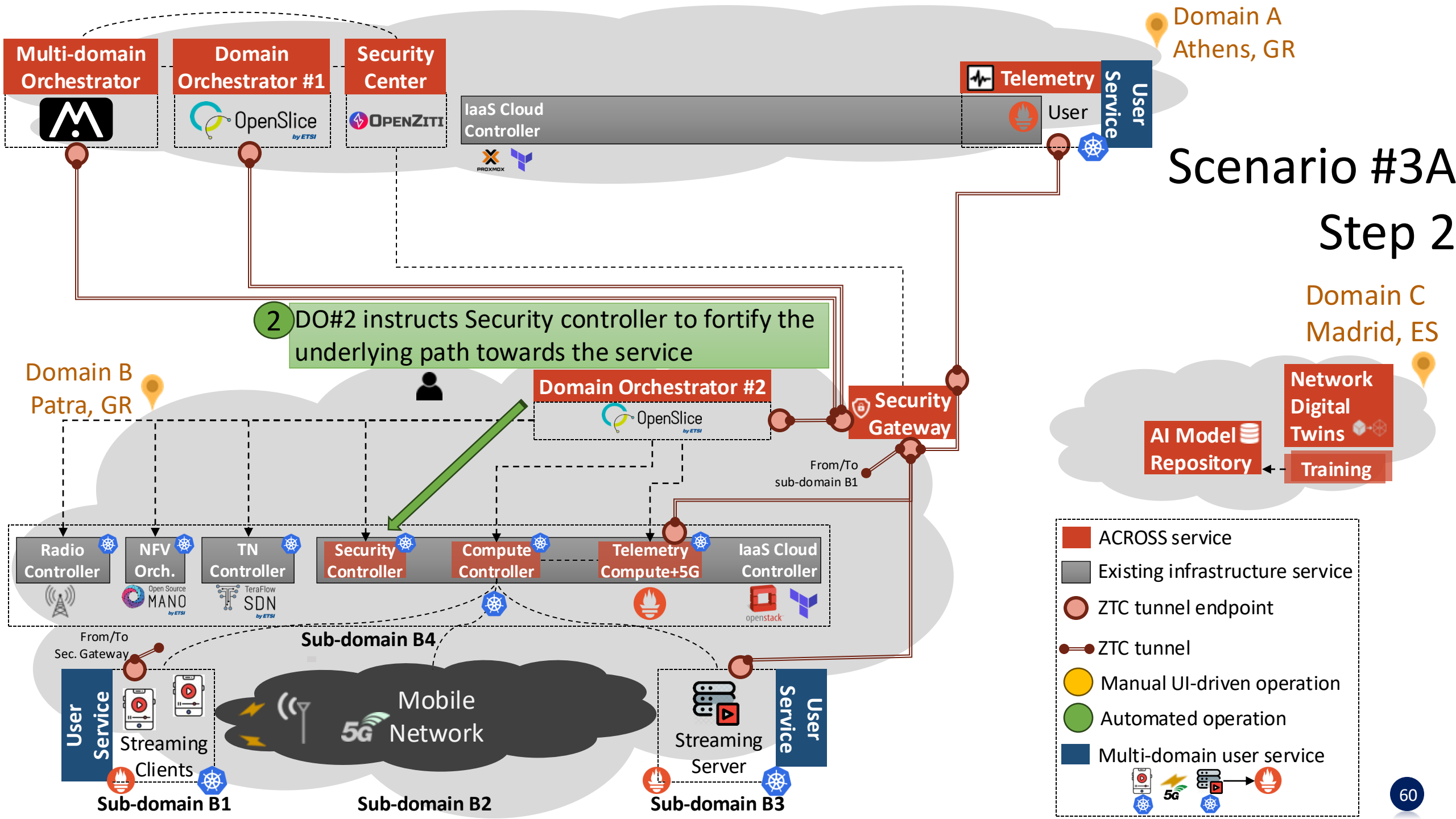
The platform should offer means to facilitate both on-demand service security and proactive SLA preservation

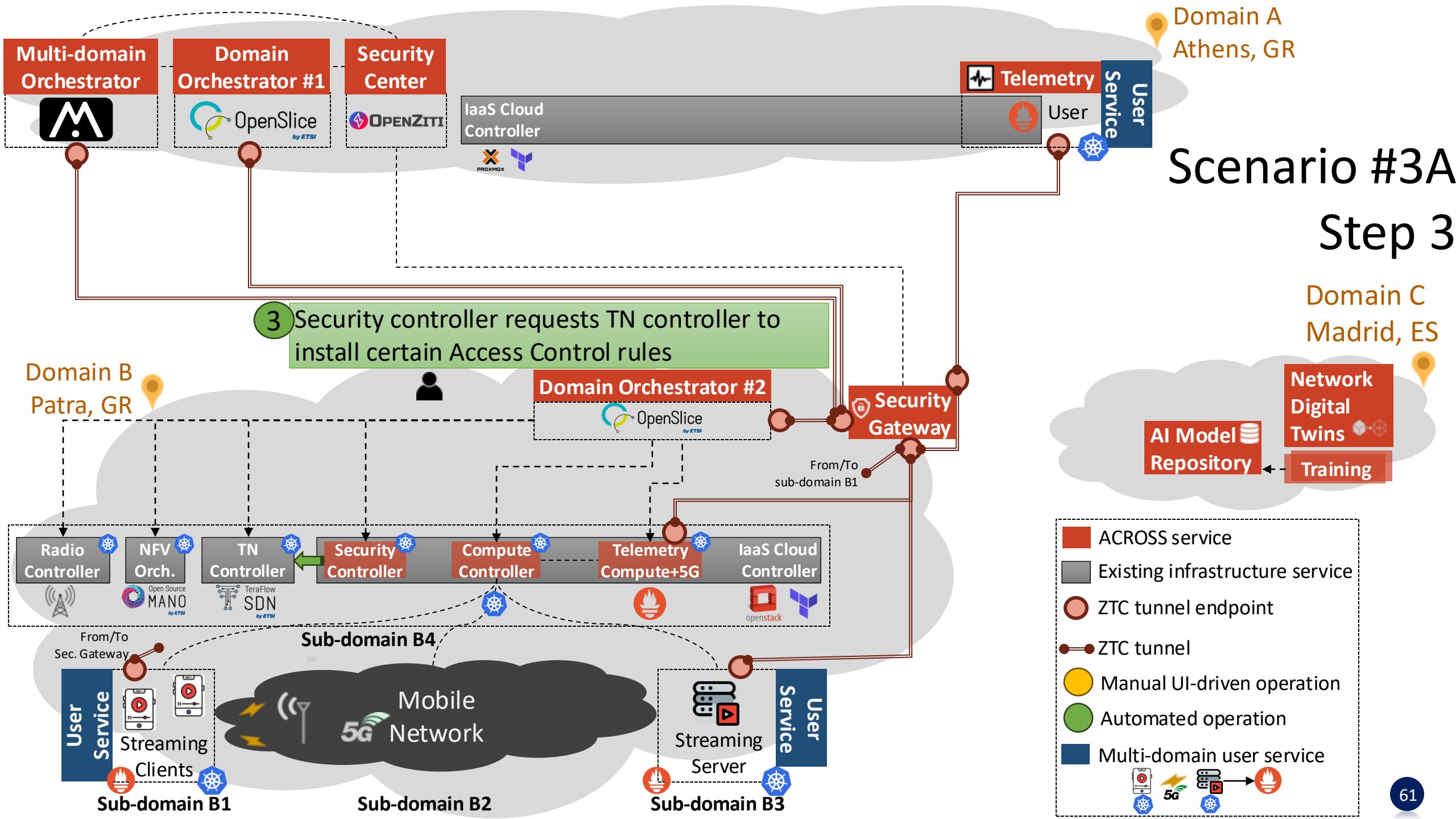
- Additional services are employed in Domain A (Automation and Intelligence for SLA) and Domain B (Service Security)
- A closed loop is designed and employed

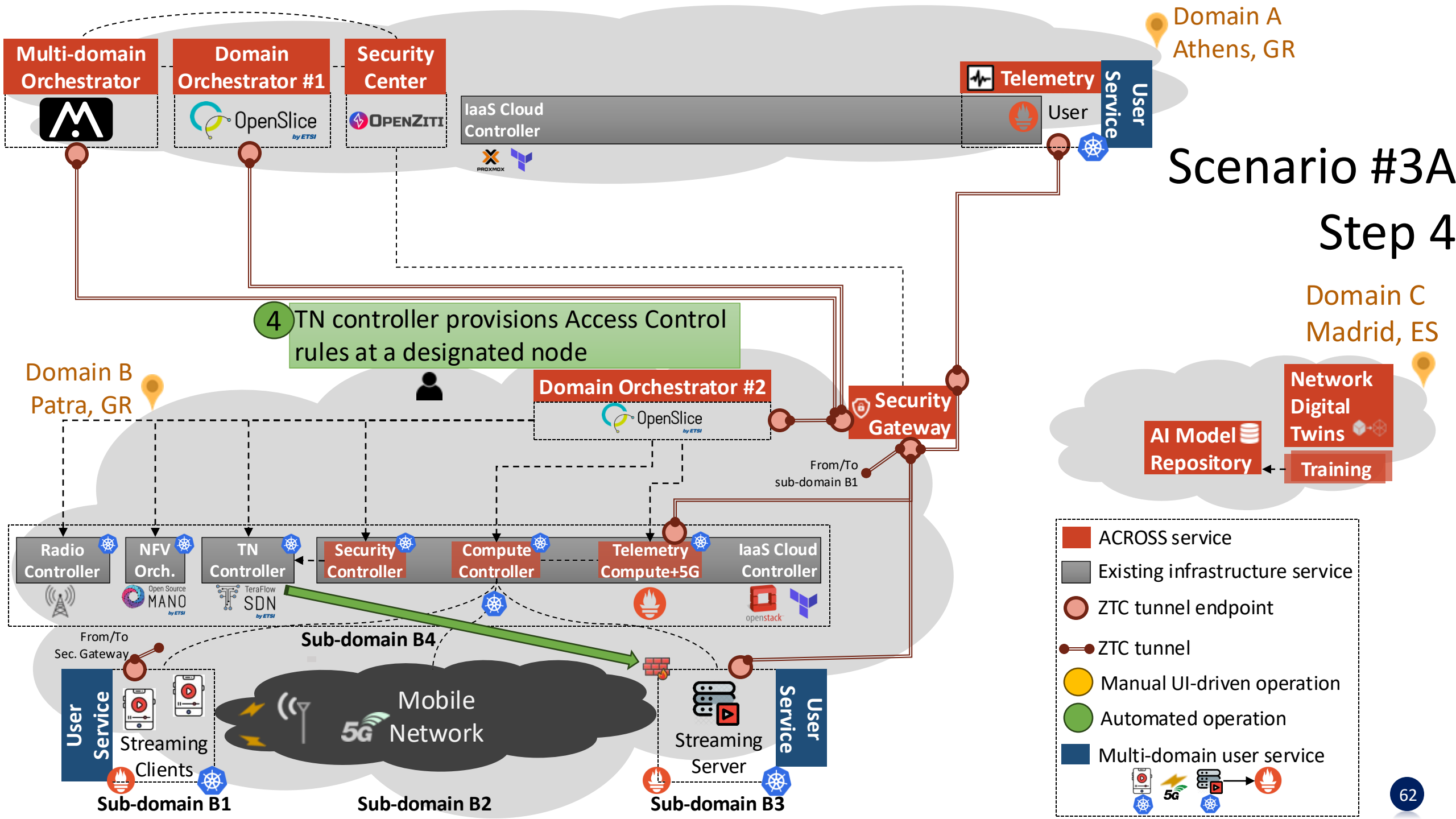

Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
OpenSlice by ETSI
OpenZiti
IaaS Cloud Controller
PROXMOX
Telemetry
User
User Service
Domain A
Athens, GR
System state after the end of Scenario #2
Scenario #2
Final state
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Sub-domain B1
Mobile Network
5G
Sub-domain B2
Streaming Server
User Service
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G

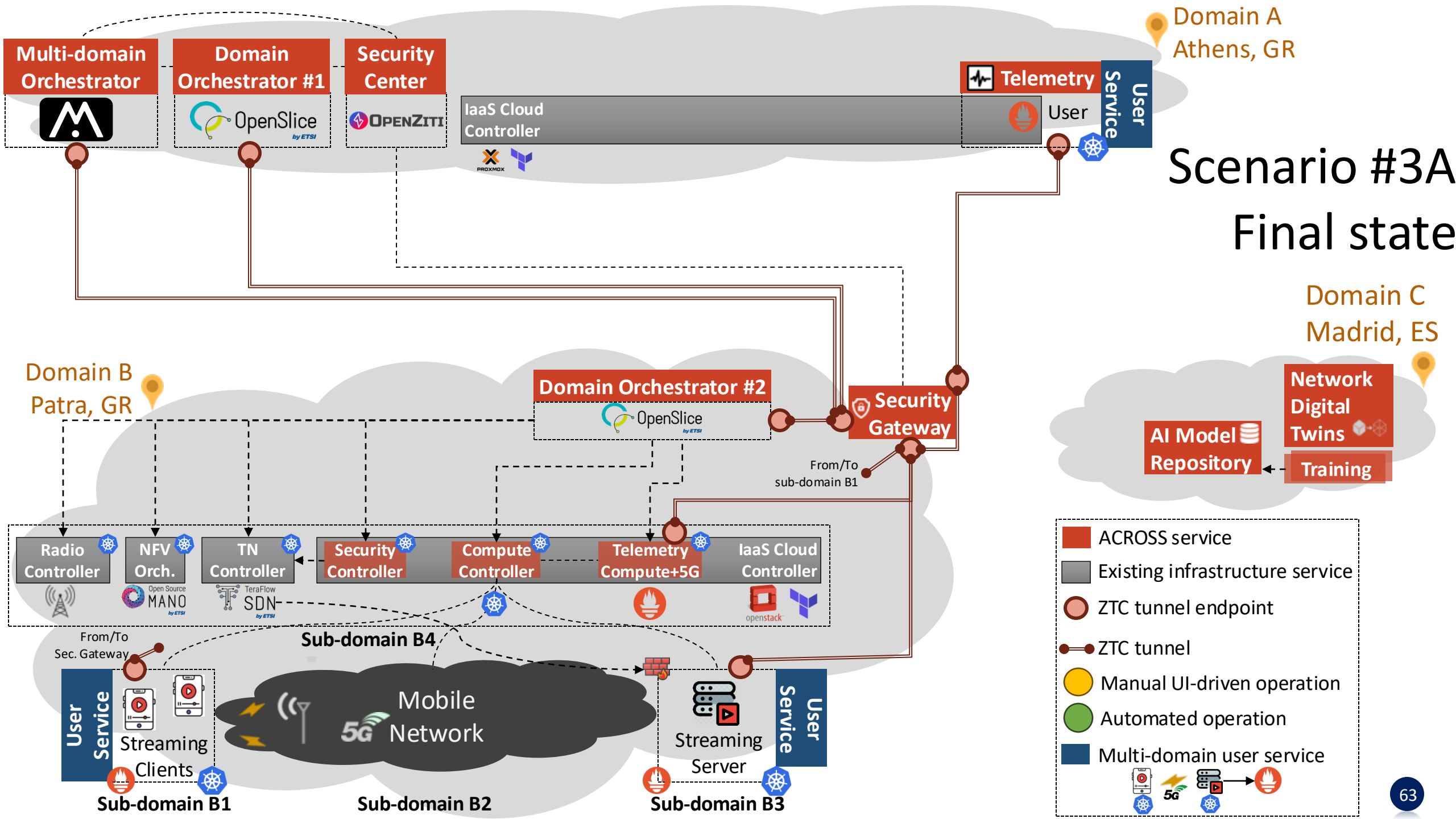

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OpenZiti
IaaS Cloud Controller
PROXMOX
Telemetry
User
User Service
Scenario #3A Setup
Additional security platform service is deployed in Domain B
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile 5G Network
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OPENZITI
IaaS Cloud Controller
PROXMOX
Telemetry
User
User Service
Scenario #3A
Step 1
Domain C
Madrid, ES
1 A service with a user-defined policy is injected to protect service components from malicious or irrelevant traffic
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
From/To sub-domain B1
Network Digital Twins
AI Model Repository
Training
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
Sub-domain B4
From/To Sec. Gateway
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OPENZITI
IaaS Cloud Controller
PROXMOX
Telemetry
User
User Service
Scenario #3A
Step 2
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
2 DO#2 instructs Security controller to fortify the underlying path towards the service
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OPENZITI
IaaS Cloud Controller
PROXMOX
Telemetry
User
User Service
Scenario #3A
Step 3
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
3 Security controller requests TN controller to install certain Access Control rules
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
Sub-domain B4
From/To Sec. Gateway
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice
Security Center
OpenZiti
IaaS Cloud Controller
Telemetry
User
User Service
Scenario #3A
Step 4
4 TN controller provisions Access Control rules at a designated node
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO
TN Controller
TeraFlow SDN
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile 5G Network
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G

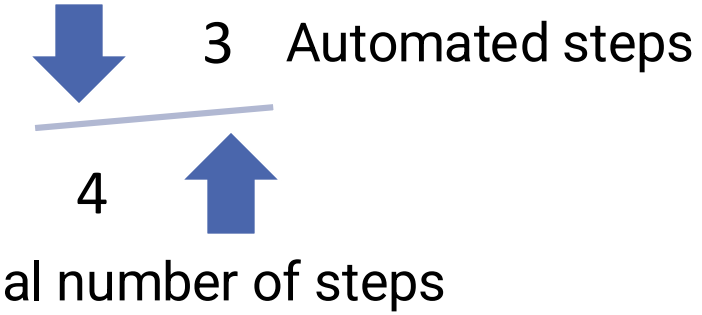

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice
Security Center
OPENZITI
IaaS Cloud Controller
PROXMOX
Telemetry
User
User Service
Scenario #3A
Final state
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO
TN Controller
TeraFlow SDN
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
Sub-domain B4
From/To Sec. Gateway
User Service
Streaming Clients
Sub-domain B1
Mobile Network
5G
Sub-domain B2
Streaming Server
User Service
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G

PoC Scenario #3A – Remarks (1/2)

Policy-based runtime service adaptation to control access towards service components

- DO#2 service designed with rule injection at certain state of the LCM
- DO#2 integration with Security controller and the underlying TN controller
- In-network dynamic filtering of traffic towards end-user services

Amount of Automation = 75%

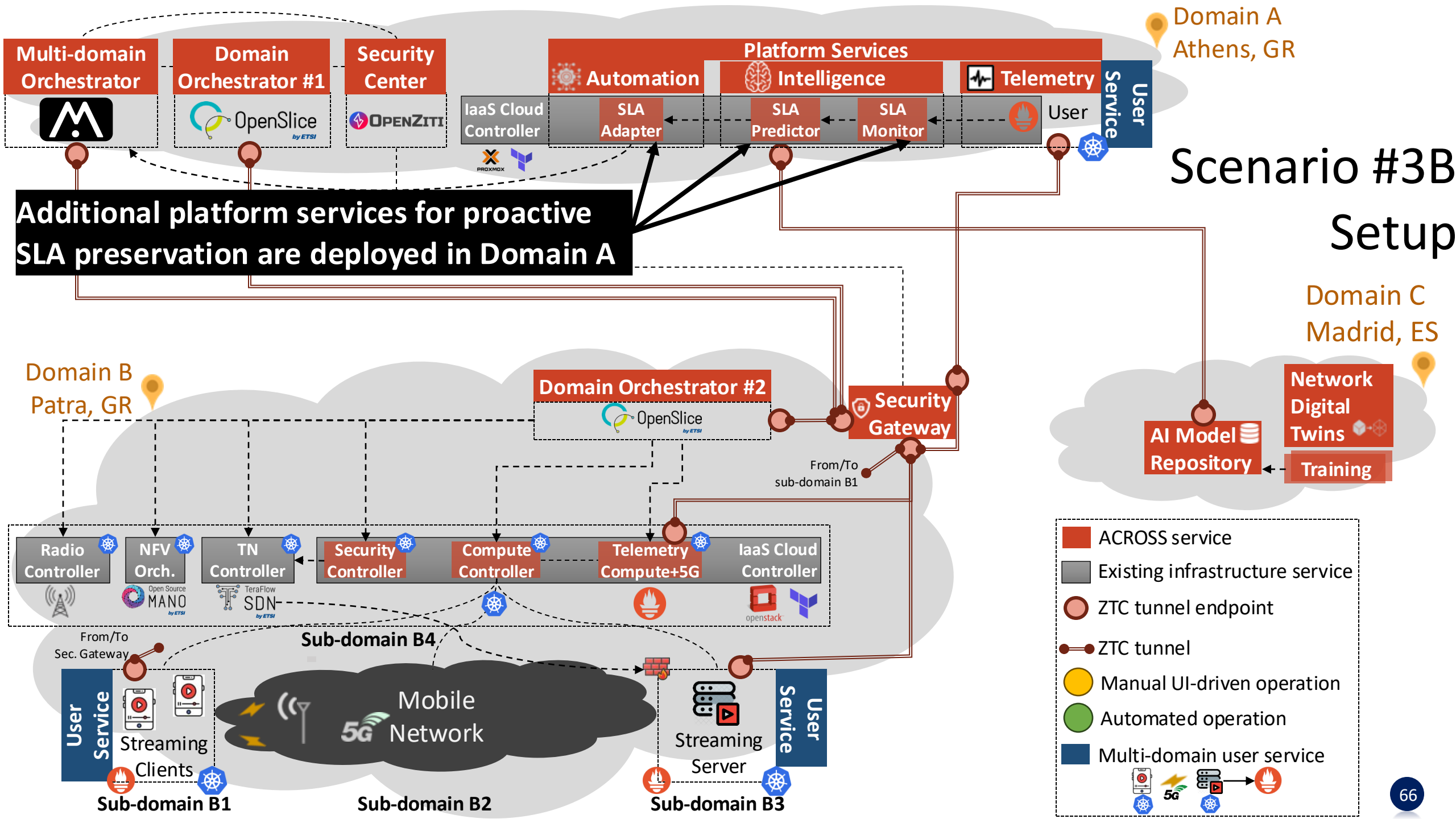


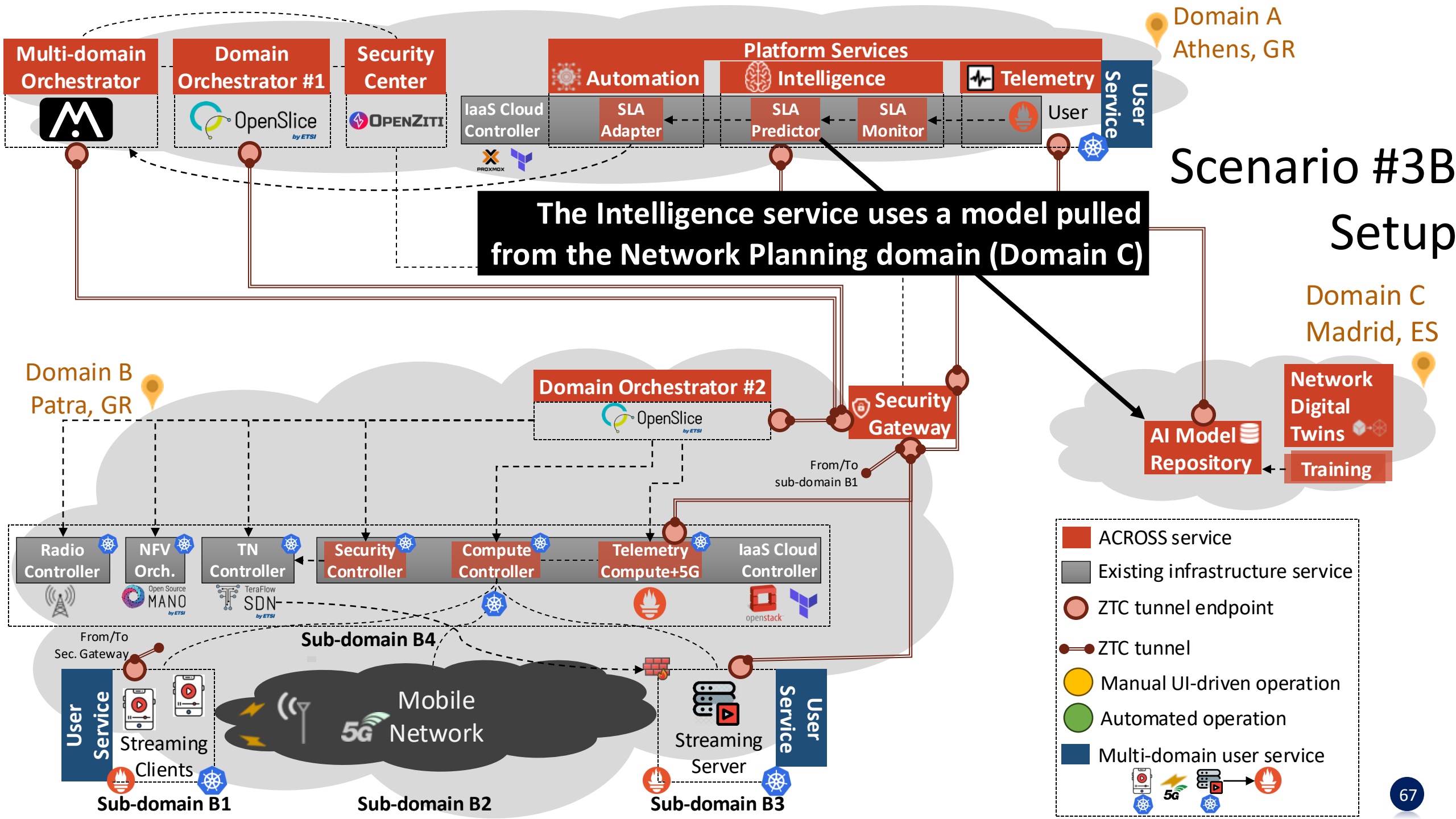
PoC Scenario #3A – Remarks (2/2)

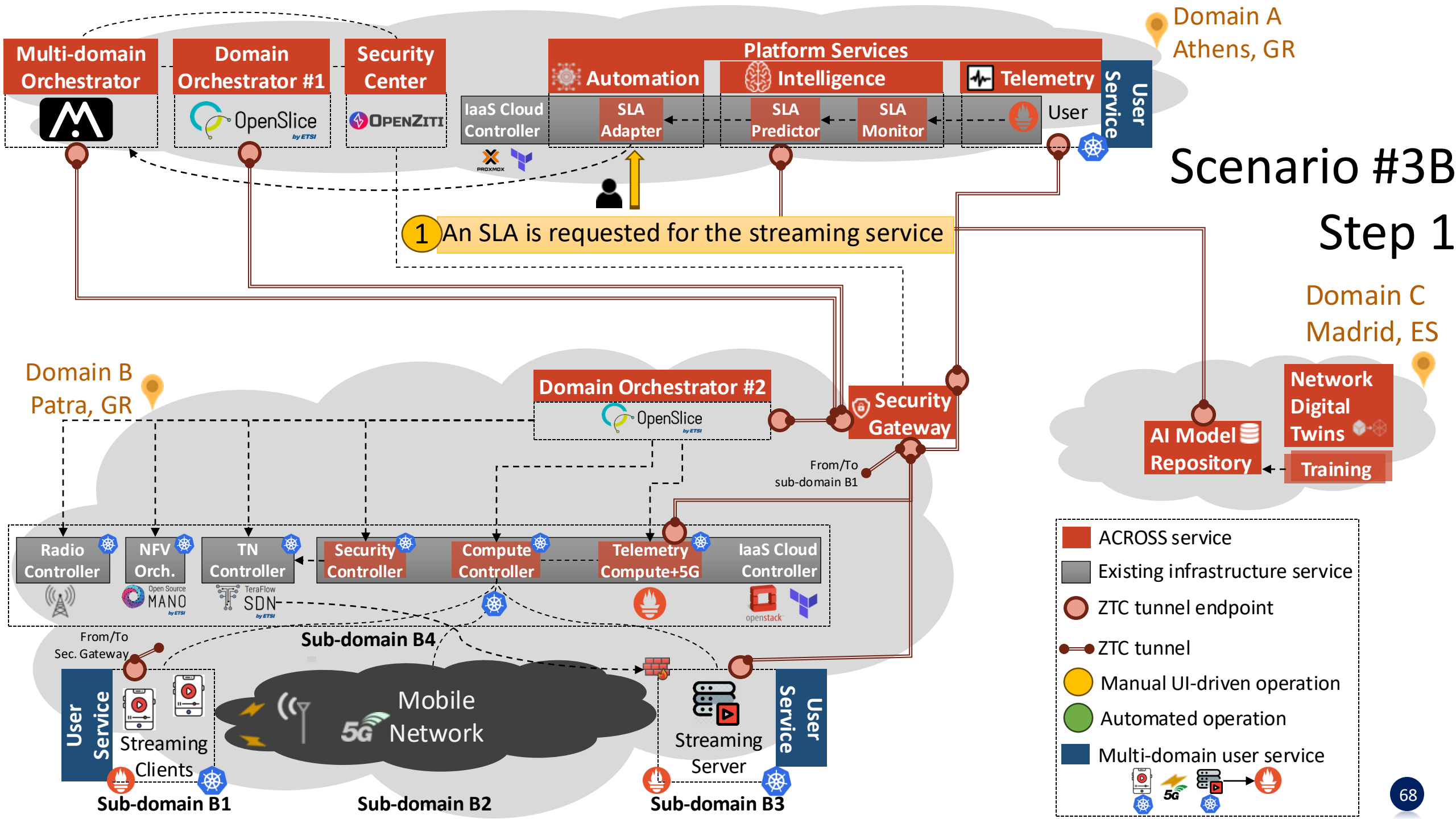
Amount of Automation = 100% is possible using gitops, but we opted for a user-designed service with embedded security policy that can be ordered on demand

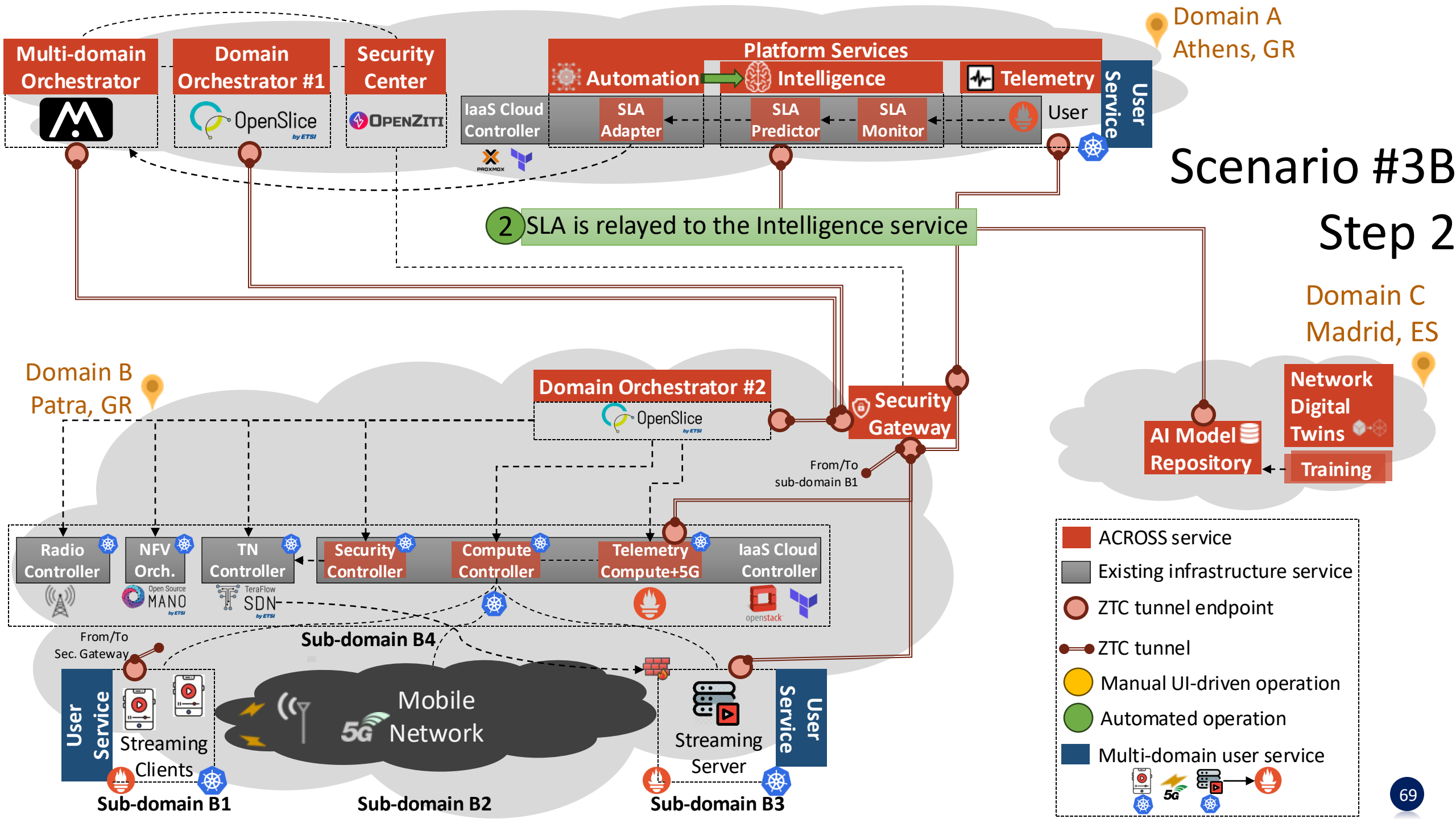
➡ Automated service order upon an event (e.g., when the end user service gets installed in domain B3)

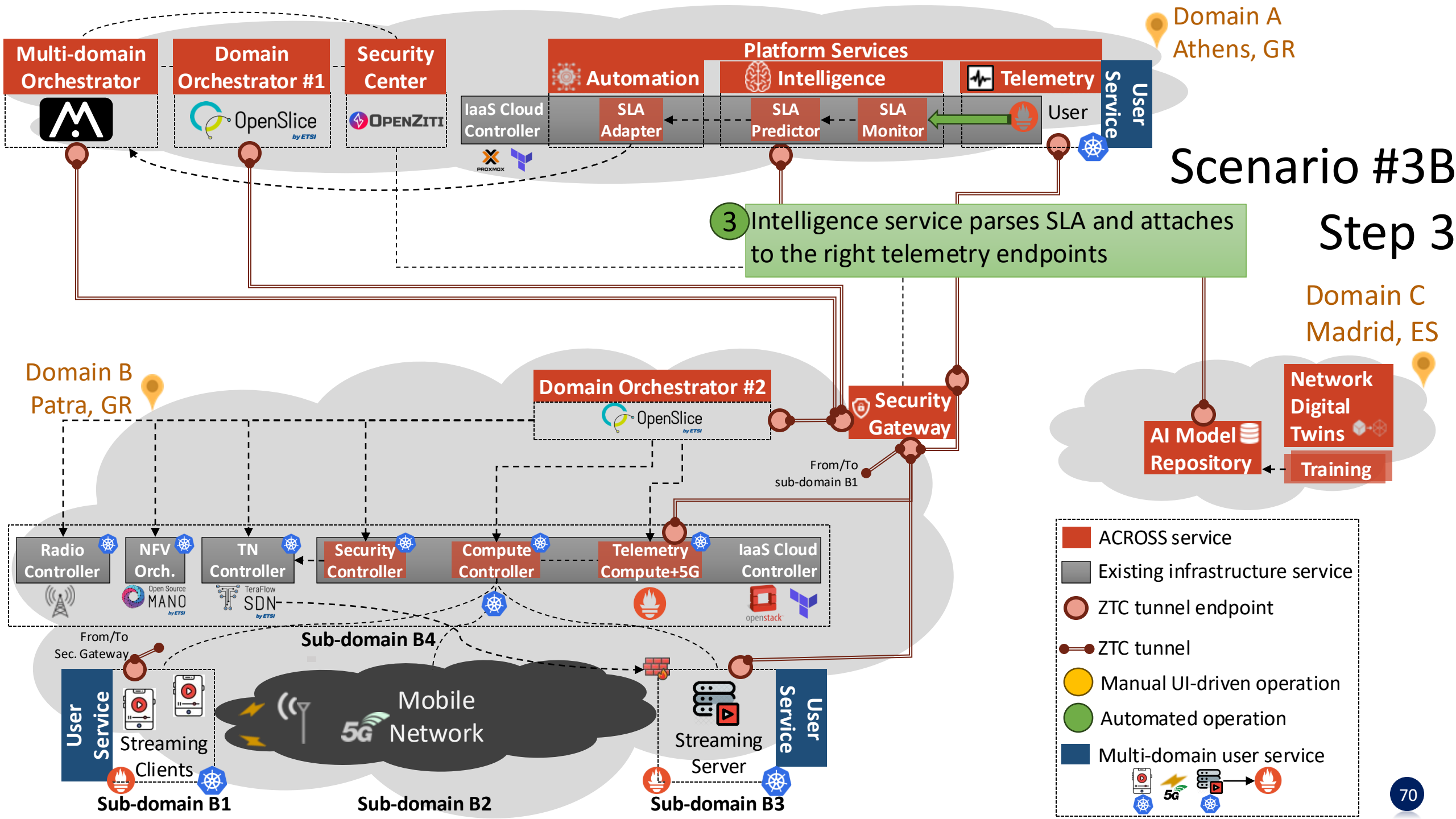
DO supports tight integration with gitops platforms

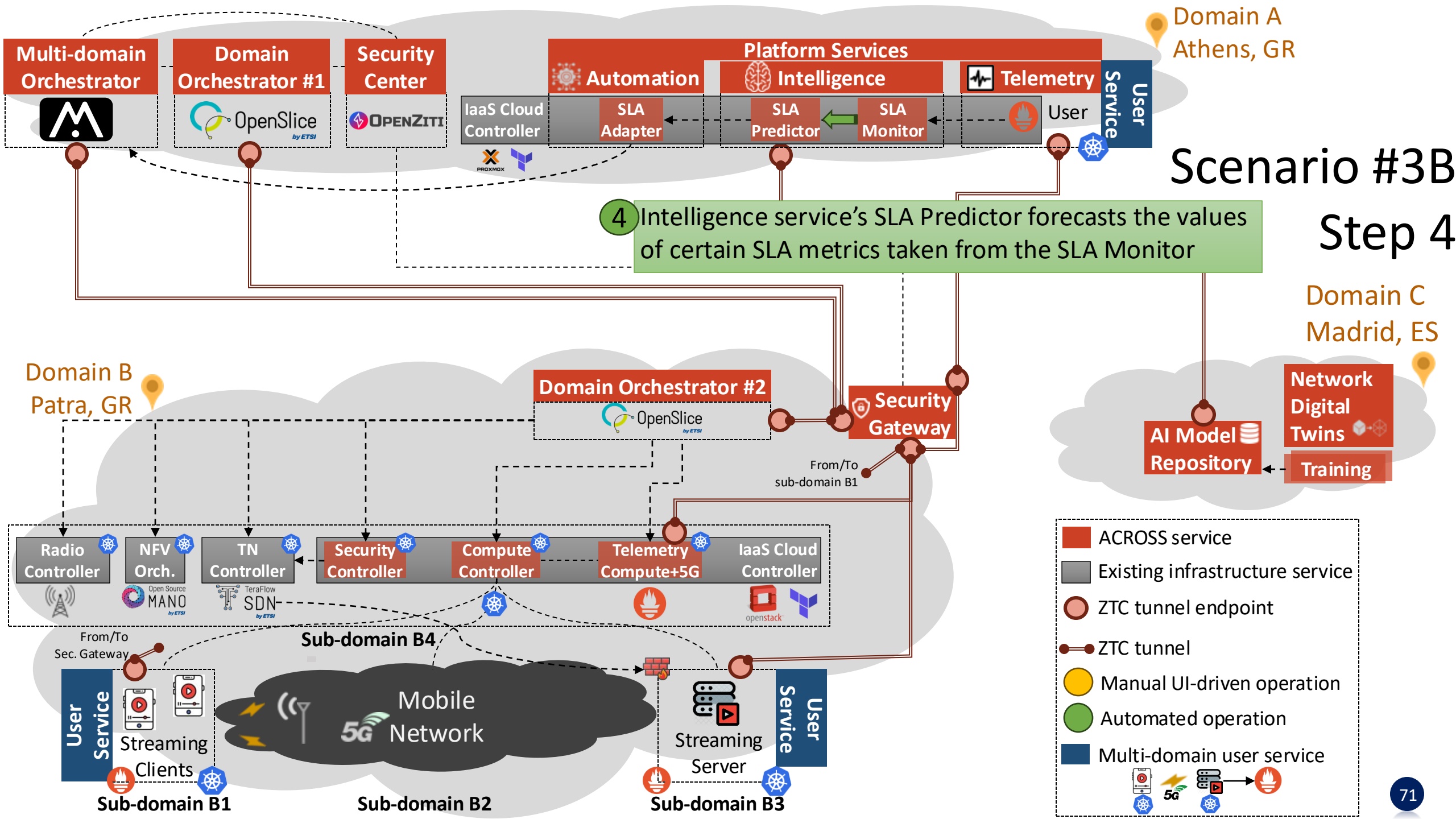

Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
Platform Services
Automation
Intelligence
Telemetry
User Service
IaaS Cloud Controller
SLA Adapter
SLA Predictor
SLA Monitor
User
Additional platform services for proactive SLA preservation are deployed in Domain A
Scenario #3B Setup
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
TN Controller
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
Sub-domain B4
From/To Sec. Gateway
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
Platform Services
Automation
Intelligence
Telemetry
User Service
IaaS Cloud Controller
SLA Adapter
SLA Predictor
SLA Monitor
User
OpenSlice
OpenZiti
Scenario #3B Setup
The Intelligence service uses a model pulled from the Network Planning domain (Domain C)
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
TN Controller
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
Open Source MANO
TeraFlow SDN
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
Platform Services
Automation
Intelligence
Telemetry
User Service
IaaS Cloud Controller
SLA Adapter
SLA Predictor
SLA Monitor
User
Scenario #3B
Step 1
1 An SLA is requested for the streaming service
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
TN Controller
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
68


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
Platform Services
Automation
Intelligence
Telemetry
User Service
IaaS Cloud Controller
SLA Adapter
SLA Predictor
SLA Monitor
User
OpenSlice
OpenZiti
Scenario #3B
Step 2
2 SLA is relayed to the Intelligence service
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
TN Controller
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
Open Source MANO
TeraFlow SDN
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OPENZITI
Platform Services
Automation
Intelligence
Telemetry
User Service
IaaS Cloud Controller
SLA Adapter
SLA Predictor
SLA Monitor
User
PROXMOX
Scenario #3B
Step 3
3 Intelligence service parses SLA and attaches to the right telemetry endpoints
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
From/To sub-domain B1
Radio Controller
NFV Orch.
Open Source MANO by ETSI
TN Controller
TeraFlow SDN by ETSI
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
openstack
Sub-domain B4
From/To Sec. Gateway
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
OpenSlice by ETSI
Security Center
OPENZITI
Platform Services
Automation
Intelligence
Telemetry
User Service
IaaS Cloud Controller
SLA Adapter
SLA Predictor
SLA Monitor
User
PROXMOX
Scenario #3B
Step 4
4 Intelligence service's SLA Predictor forecasts the values of certain SLA metrics taken from the SLA Monitor
Domain C
Madrid, ES
Network Digital Twins
AI Model Repository
Training
Domain B
Patra, GR
Domain Orchestrator #2
OpenSlice by ETSI
Security Gateway
From/To sub-domain B1
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Open Source MANO by ETSI
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IaaS Cloud Controller
openstack
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Sub-domain B1
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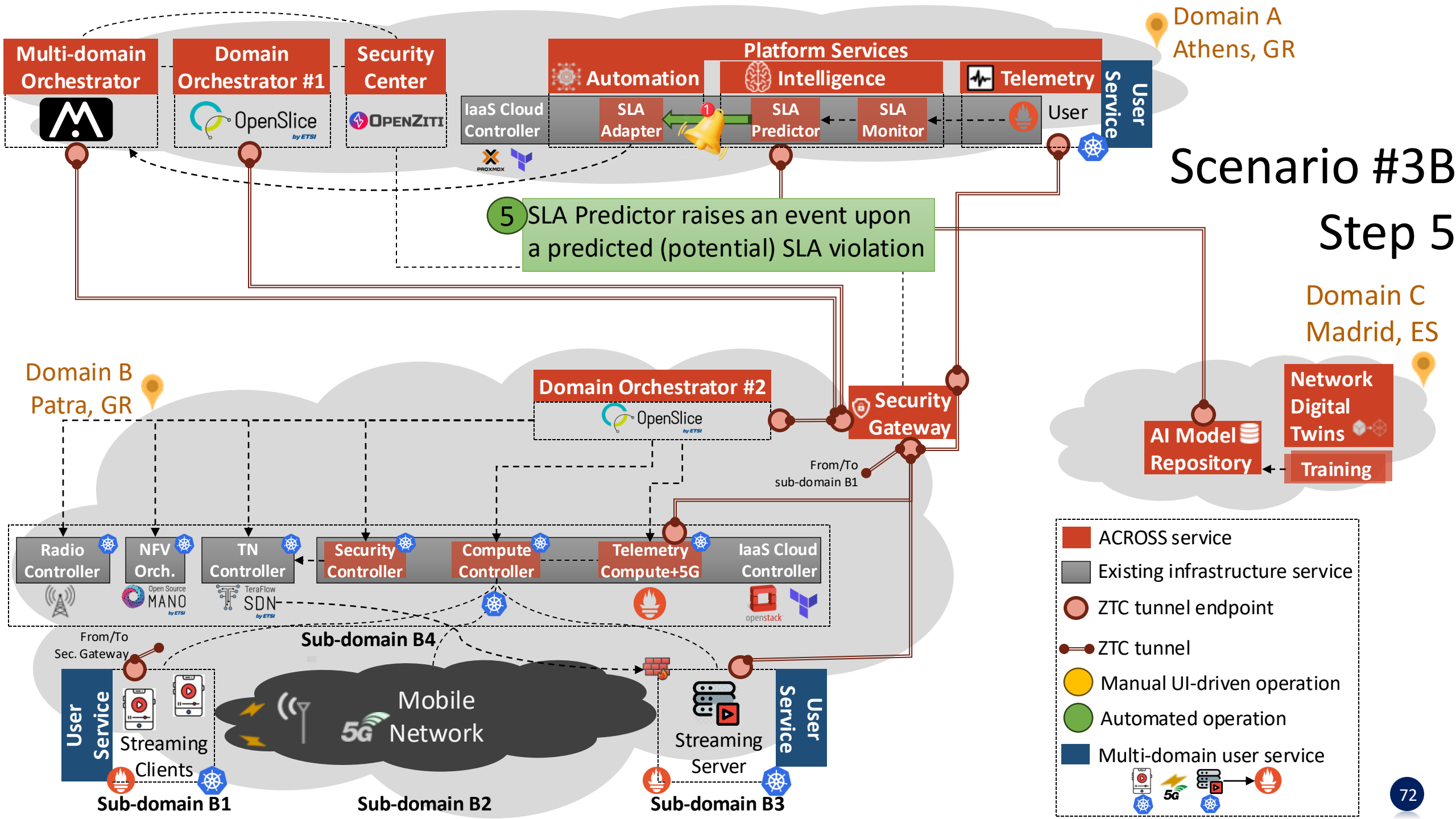
5G
Sub-domain B2
Streaming Server
User Service
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
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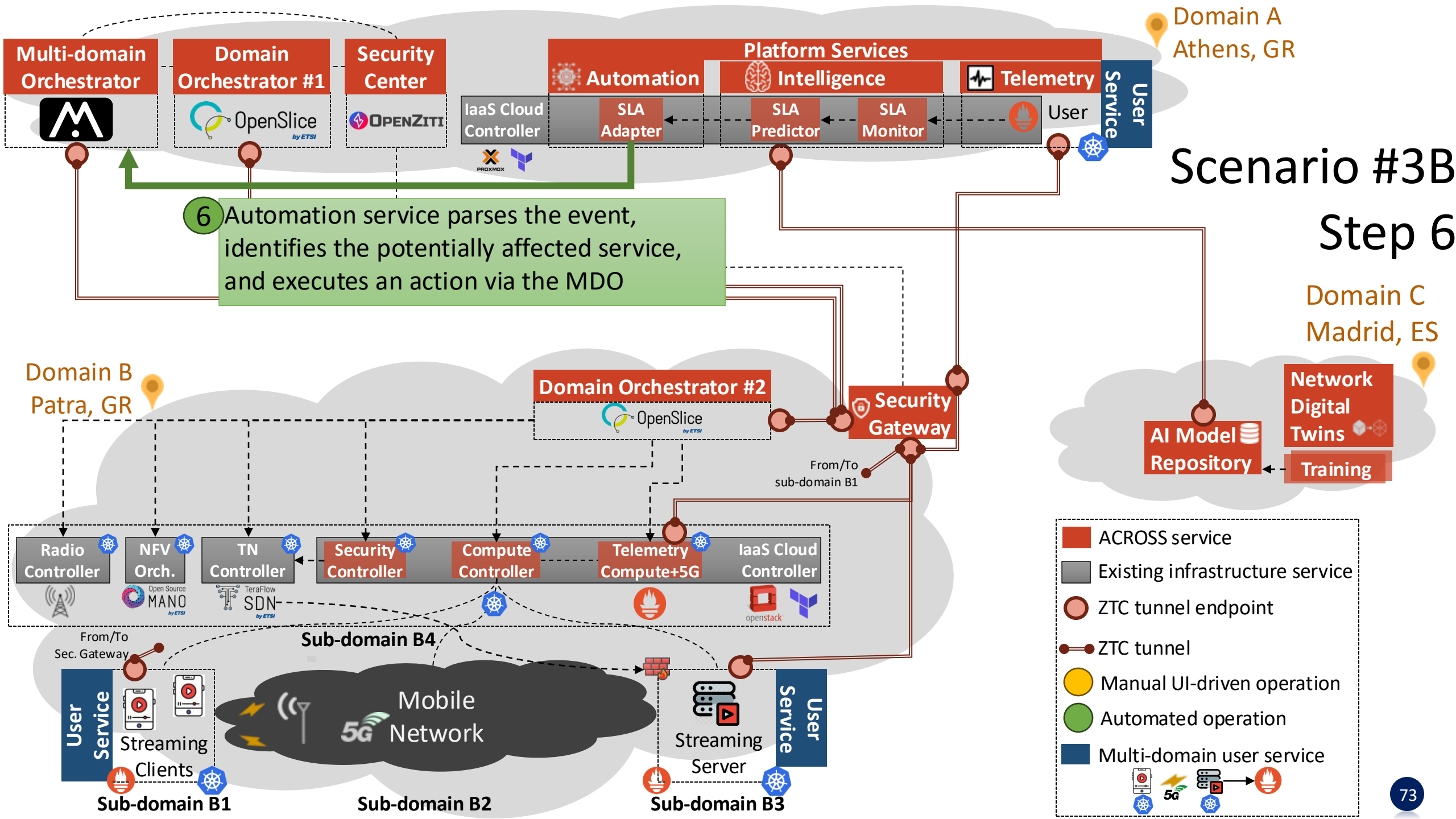
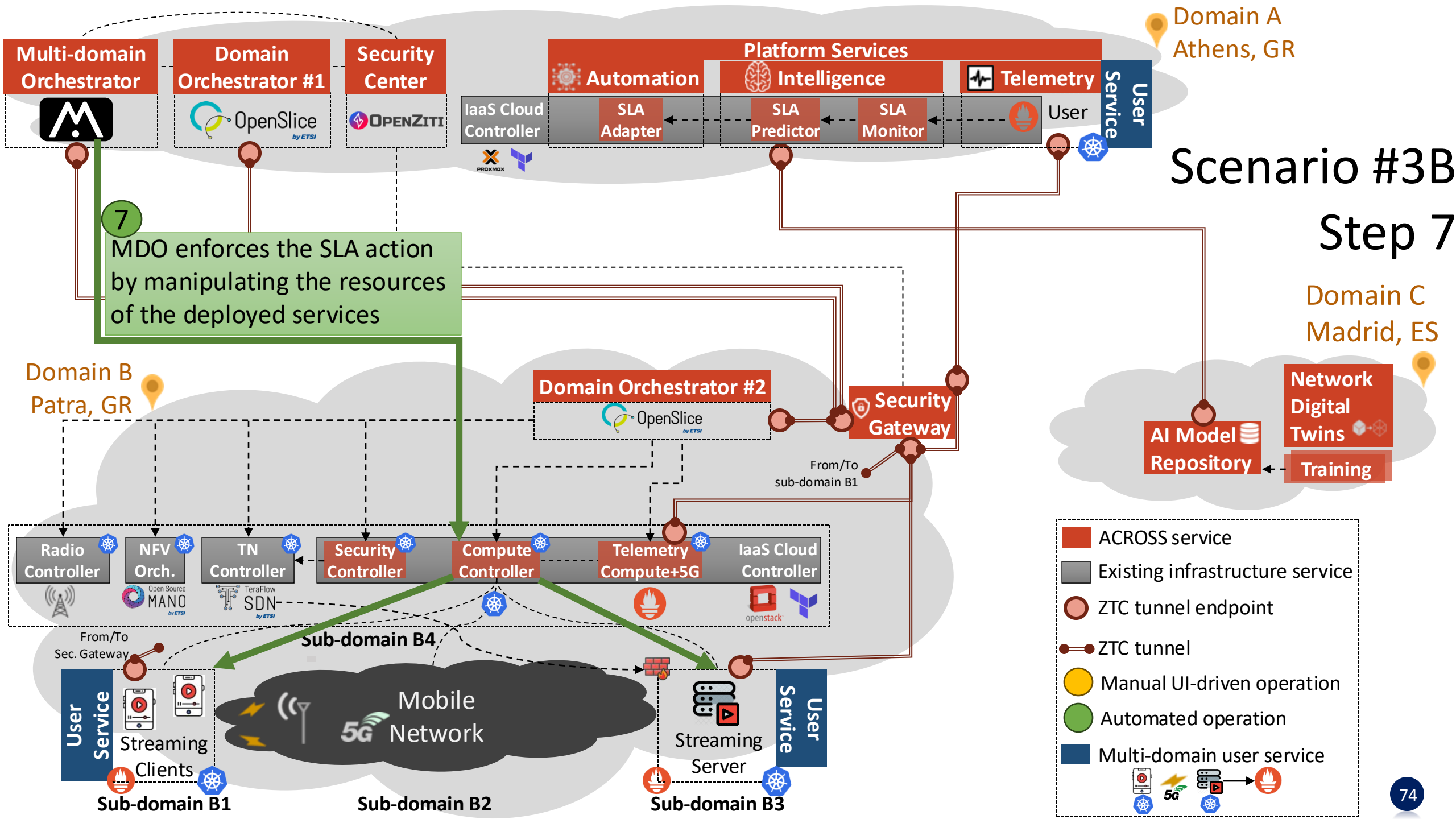
Domain Orchestrator #1
Security Center
Platform Services
Automation
Intelligence
Telemetry
User Service
IaaS Cloud Controller
SLA Adapter
SLA Predictor
SLA Monitor
User
OpenSlice
OpenZiti
Scenario #3B
Step 5
5 SLA Predictor raises an event upon a predicted (potential) SLA violation
Domain C
Madrid, ES
Domain B
Patra, GR
Domain Orchestrator #2
Security Gateway
Network Digital Twins
AI Model Repository
Training
From/To sub-domain B1
Radio Controller
NFV Orch.
TN Controller
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
Open Source MANO
TeraFlow SDN
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile 5G Network
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service
5G


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
Platform Services
Automation
Intelligence
Telemetry
User Service
IaaS Cloud Controller
SLA Adapter
SLA Predictor
SLA Monitor
User
OpenSlice
OpenZiti
Scenario #3B
Step 6
6 Automation service parses the event, identifies the potentially affected service, and executes an action via the MDO
Domain C
Madrid, ES
Domain B
Patra, GR
Domain Orchestrator #2
Security Gateway
Network Digital Twins
AI Model Repository
Training
From/To sub-domain B1
Radio Controller
NFV Orch.
TN Controller
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
Open Source MANO
TeraFlow SDN
openstack
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile 5G Network
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service


Domain A
Athens, GR
Multi-domain Orchestrator
Domain Orchestrator #1
Security Center
Platform Services
Automation
Intelligence
Telemetry
User Service
IaaS Cloud Controller
SLA Adapter
SLA Predictor
SLA Monitor
User
Scenario #3B
Step 7
7
MDO enforces the SLA action by manipulating the resources of the deployed services
Domain C
Madrid, ES
Domain B
Patra, GR
Domain Orchestrator #2
Security Gateway
Network Digital Twins
AI Model Repository
Training
From/To sub-domain B1
Radio Controller
NFV Orch.
TN Controller
Security Controller
Compute Controller
Telemetry Compute+5G
IaaS Cloud Controller
From/To Sec. Gateway
Sub-domain B4
User Service
Streaming Clients
Mobile Network
5G
Streaming Server
User Service
Sub-domain B1
Sub-domain B2
Sub-domain B3
ACROSS service
Existing infrastructure service
ZTC tunnel endpoint
ZTC tunnel
Manual UI-driven operation
Automated operation
Multi-domain user service

PoC Scenario #3B – Remarks (1/2)

Proactive AI-based **SLA preservation** using a multi-domain closed loop

- NDT used for (offline) training of a relevant Analytics model
- Intelligence platform service pulls the Analytics model from Domain C
- A real-time Intelligence service predicts violation of certain SLA metrics in Domain A
- Automation integrated with Intelligence platform service to receive SLA violation alerts
- Automation service integrated with MDO to enforce service adaptation upon an alert

Amount of Automation ≈ 86%

$$\frac{\text{6 Automated steps}}{\text{7 Total number of steps}}$$

PoC Scenario #3B – Remarks (2/2)

Amount of Automation = 100% is possible using gitops, but we opted for an explicit user-triggered SLA request

PoC Findings

Identified gaps in current standards, future work, and/or other ZSM proposals

PoC – Findings and Potential Gaps

- The Security Center and Security Gateway components of the PoC are fully-aligned with the concept of the ETSI ZSM Integration Fabric as per the **ETSI GS ZSM 002 v1.1.1 (2019-08): "Zero-touch network and Service Management (ZSM); Reference Architecture"**

  ➡ The proposed approach goes one step beyond by adding security and trust by design

- The proposed end-to-end (compute, 5G, telemetry, end-user) service provisioning approach is fully aligned with **ETSI GS ZSM 003 v1.1.1 (2021-06): "Zero-touch network and Service Management (ZSM); End-to-end management and orchestration of network slicing"**

- The proposed NDT environment approach is aligned with **ETSI GS ZSM 018 v1.1.1 (2024-12): "Zero-touch network and Service Management (ZSM); Network Digital Twin for enhanced zero-touch network and service management"**

PoC – Future Work

- Tighter integration between the orchestration platform and the NDT could be studied

➡ An AI model drift detector could be:
(a) linked with a real service in a domain via the Secure Integration Fabric
(b) detect data drift of existing AI models in real-time
(c) Ask NDT to re-train the model with additional data
(d) rollout (hot swapping) a new version of the model in the real system for increasing its accuracy

Tentative PoC Demo

PoC – Tentative Demo Date(s)

ETSI ISG ZSM Webinar (Online)

Possible dates:

- November 13-14, 2025
- November 24-28, 2025

PoC Participants, Open-Source Systems & Funding

PoC Participants

PoC – Open-Source Systems and Related Standards

MAESTRO	Maestro: A 6G-ready multi-domain service orchestrator	link
OpenSlice by ETSI	An open-source, community-driven Operations Support System (OSS) for Network-as-a-Service	link
Open Source MANO by ETSI	An open-source, community-driven NFV Orchestrator	link
TeraFlow SDN by ETSI	An open-source, community-driven, and highly disaggregated SDN Controller	link
OpenZiti	An open-source, community-driven, and programmable platform for Zero-Trust Networking	link

tmforum ETSI World Class Standards 3GPP A GLOBAL INITIATIVE IETF

Thank You! Questions?

Across

Automated zero-touch cross-layer provisioning framework for 5G and beyond vertical services

across-web @horizon_across @across-horizon-europe

HORIZON-JU-SNS-2022 **ACROSS** project with GA number 101097122

coppilot

Collaborative Open Platform (COP) for seamless end-to-end orchestration across service domains, fostering a standards-aligned, market-oriented, and cross-sector computing environment

cop-pilot-web @cop-pilot-horizon

HORIZON-CL4-2024-DATA-01-03 **COP-PILOT** project with GA number 101189819