Lightweight Cloud Slicing: The NECOS Project

Who?

Motivation

- Unprecedented **availability** of computing, storage, and network **resources** to support novel services and workloads.

- Telecom 5G services are expected to be provisioned over **multiple-technologies** and spanning across **multiple operators**.

- Network operators and cloud computing service providers need to extend the capillarity in a world of geographically **spread cloud capabilities.**

Motivation

- **Multi-tenancy** is the solution to manage and control the computing infrastructure, based on **network slicing**.

- For **5G services** more reliable, faster, and simpler, **slicing** is associated with the **partitioning of resources**, and being able to create and redefine these partitions as needed.
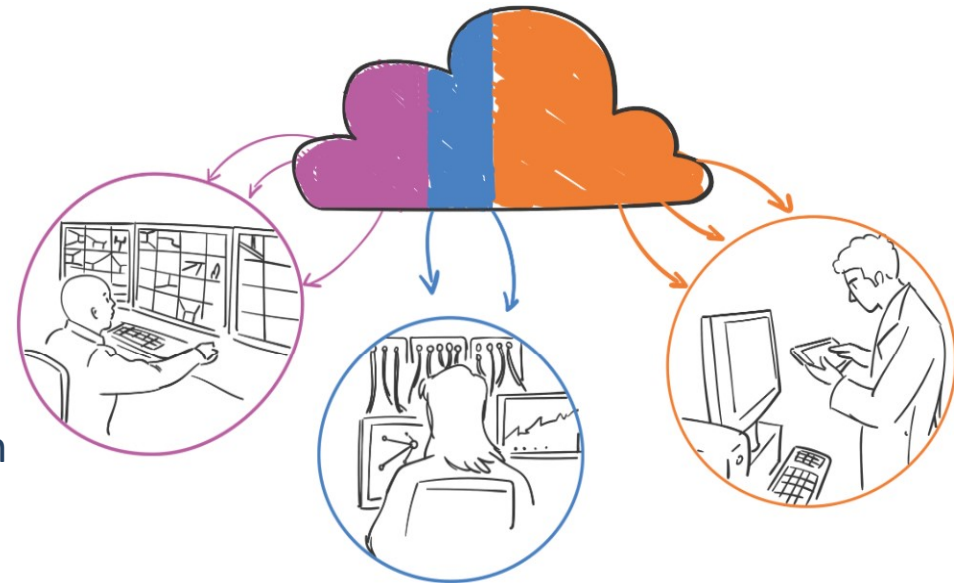
Slicing covers the entire network segments not being fully addressed up to now comprehensively by the industry. It is required to continue exploring the e2e slicing. NECOS approaches this intending to define a lightweight mechanisms for that in interconnected federated cloud environments.

Problem addressed

- The paradigms of network virtualization **(NFV),** and network programmability **(SDN)** have fostered this evolutionary view. However, these two paradigms are **not sufficient for network slicing**.

- There are **few current solutions** and those **lack** essential features such as slice isolation, slices discovery, and mechanisms for cross-domain slice federation.

SLICE ISOLATION

SLICES DISCOVERY

CROSS-DOMAIN SLICE FEDERATION

NECOS use cases and scenarios

Provider oriented

- 5G Networks
- vCPE

End-user oriented
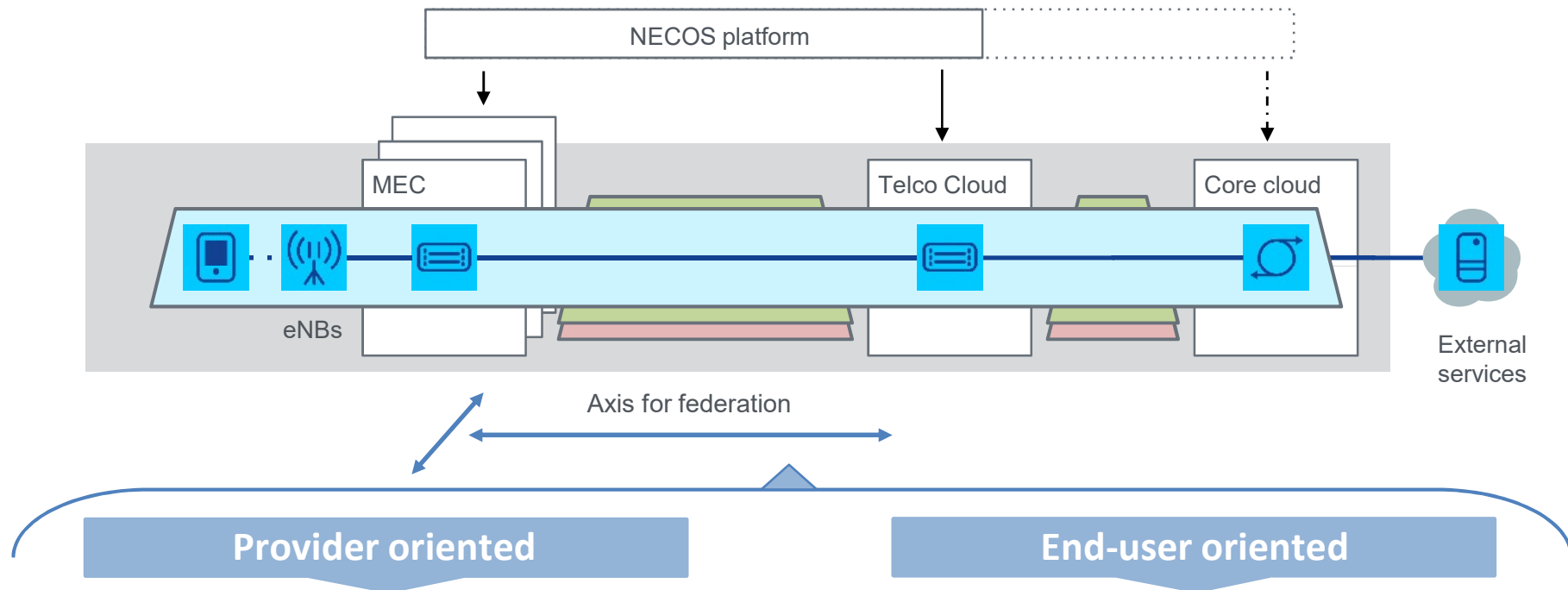
- Touristic services
- Emergency scenario

Slice-as-a-Service

- **Slice as** a grouping of physical or virtual (network, compute, storage) resources which can act as a seemingly **independent sub-cloud,** sub-network and can accommodate service components.

- these slices will be **orchestrated** to fulfill **on-demand** end-to-end quality requirements, **independently** each one from the others, and **spanning across** a shared infrastructure of several administrative **domains.**

- Created with the purpose that customer users can run one or several application services on top.
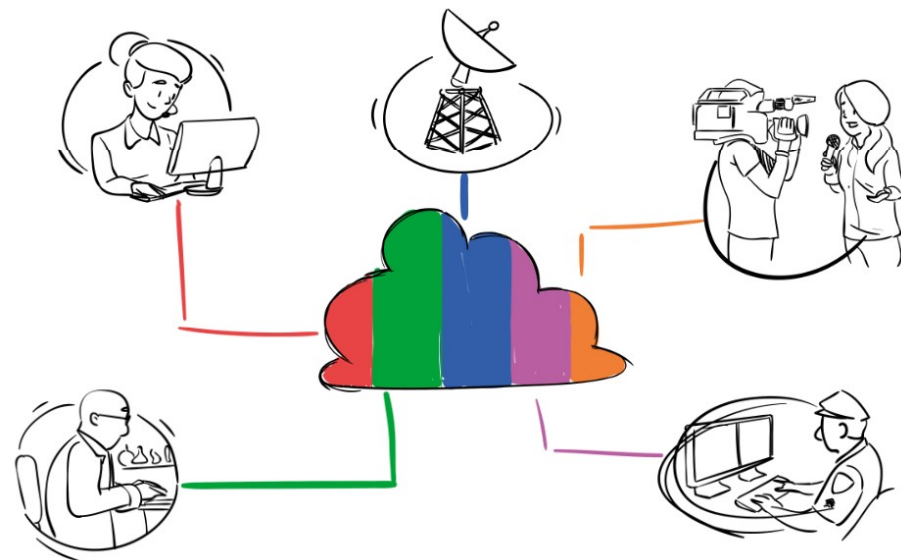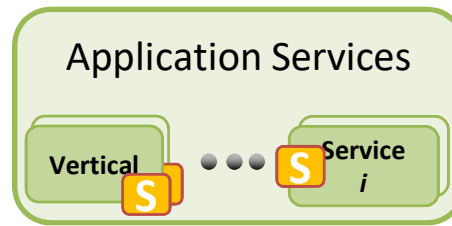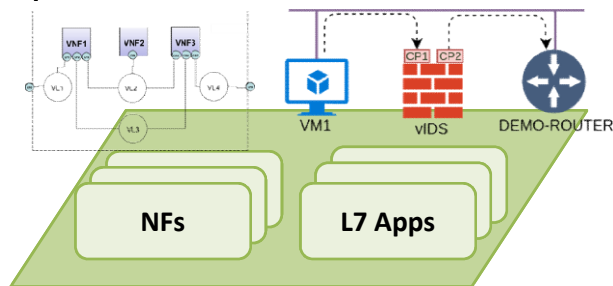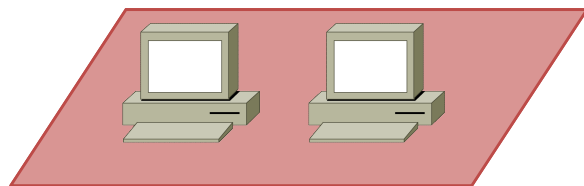
Slicing Models & Approaches

Business (Application & Service) plane

Control & Management plane

Infrastructure

Application Services

Vertical ... Service i

Monitoring

Service-based Slicing [3]
[Service Slice aaS]

Network Service Orchestration

Slicing

(R) Orchestration

Slicing NIM

Slicing VIM

Monitoring

MANO-based Slicing [2]
[NFV aaS]
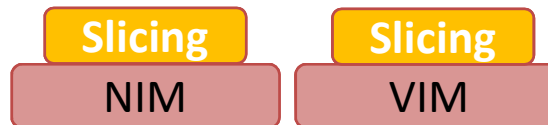
VIM-dependent Slicing [1]
[Resource Slice aaS]

Slicing
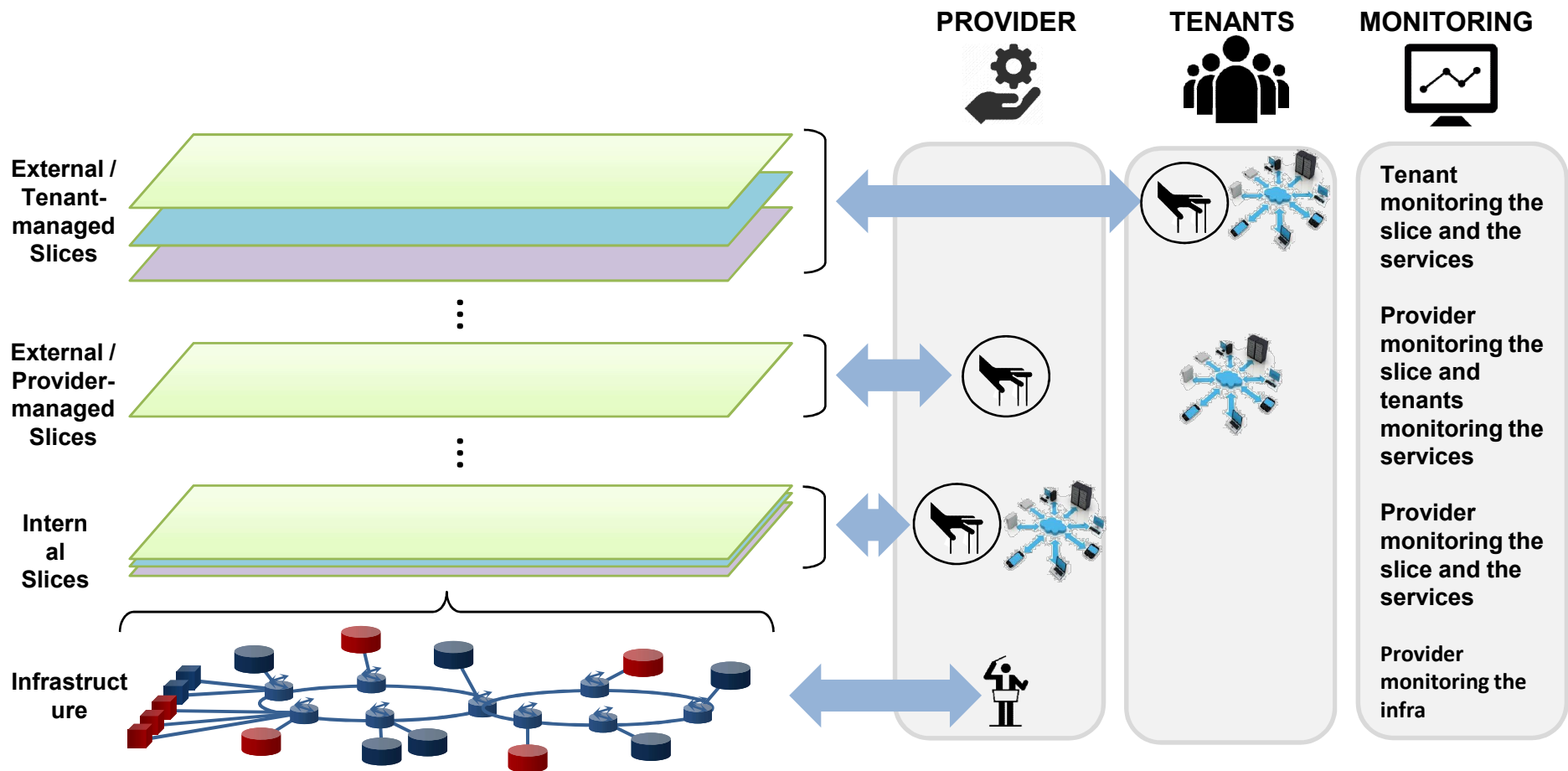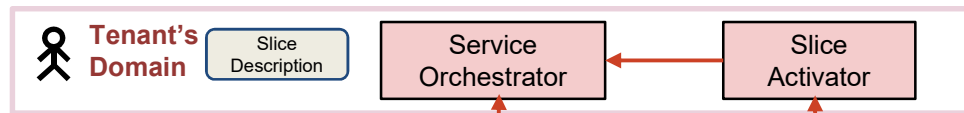
Network Resources

Compute Resources
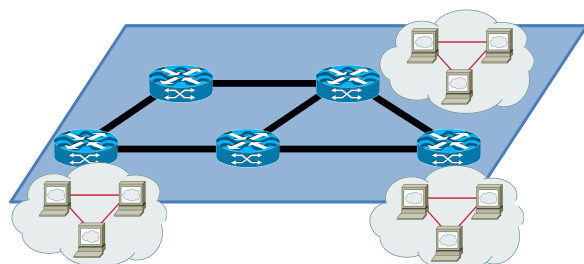
Monitoring

VIM-independent Slicing [0]
("Bare-metal")
[Infrastructure Slice aaS]

Types of slices and control responsibilities

PROVIDER

TENANTS

MONITORING

External / Tenant-managed Slices

External / Provider-managed Slices

Internal Slices

Infrastructure

Tenant monitoring the slice and the services

Provider monitoring the slice and tenants monitoring the services

Provider monitoring the slice and the services

Provider monitoring the infra

Source: [1] A Network Service Provider Perspective on Network Slicing. Luis M. Contreras and Diego R. López. IEEE Softwarization, January 2018
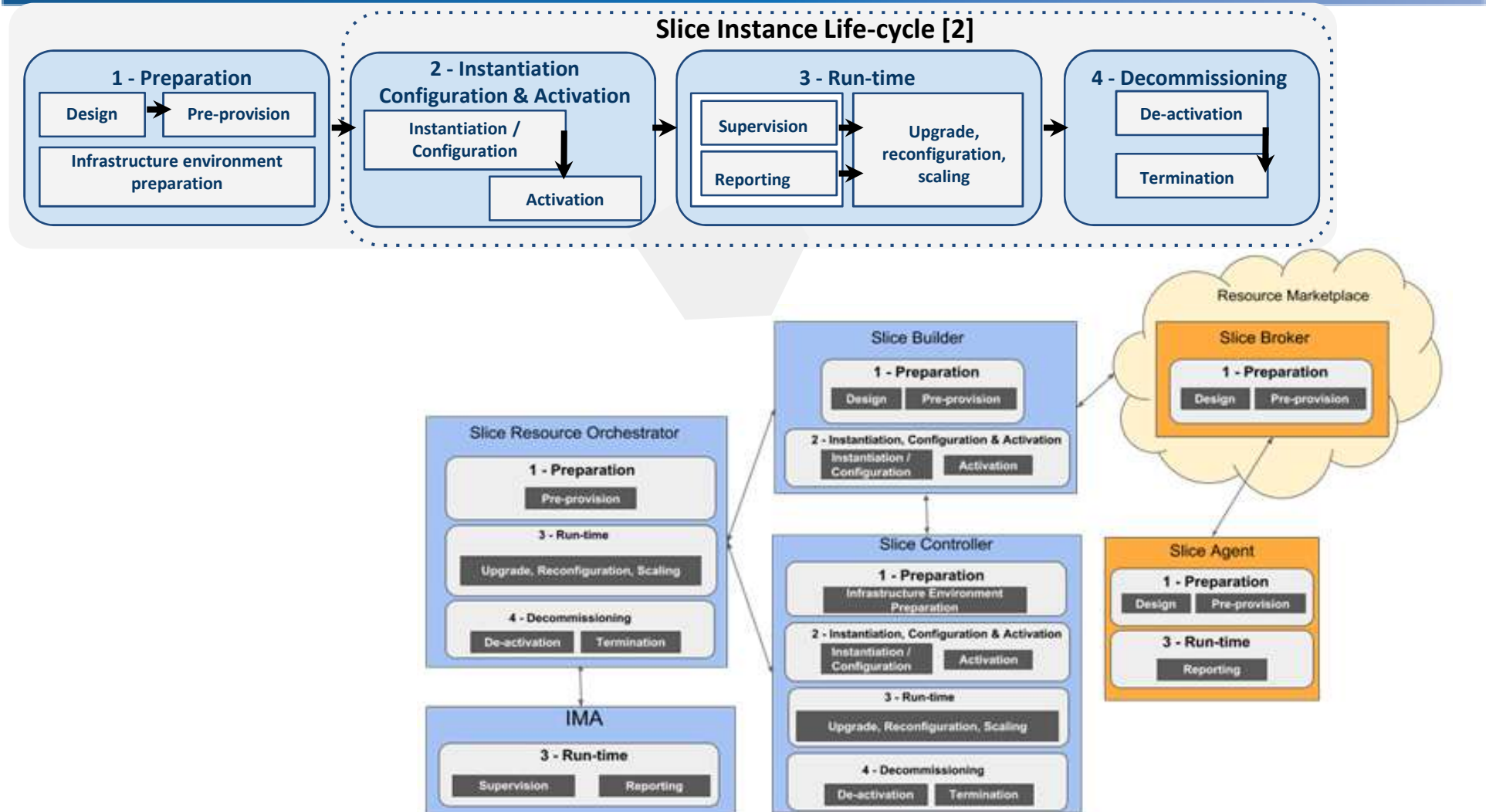
Solution

The **high-level NECOS architecture** can be described in terms of its constituting functions, and from that point of view, four functional domains can be distinguished: **Slice Provider / Resource Marketplace / Resource Domain / Tenant's Domain**
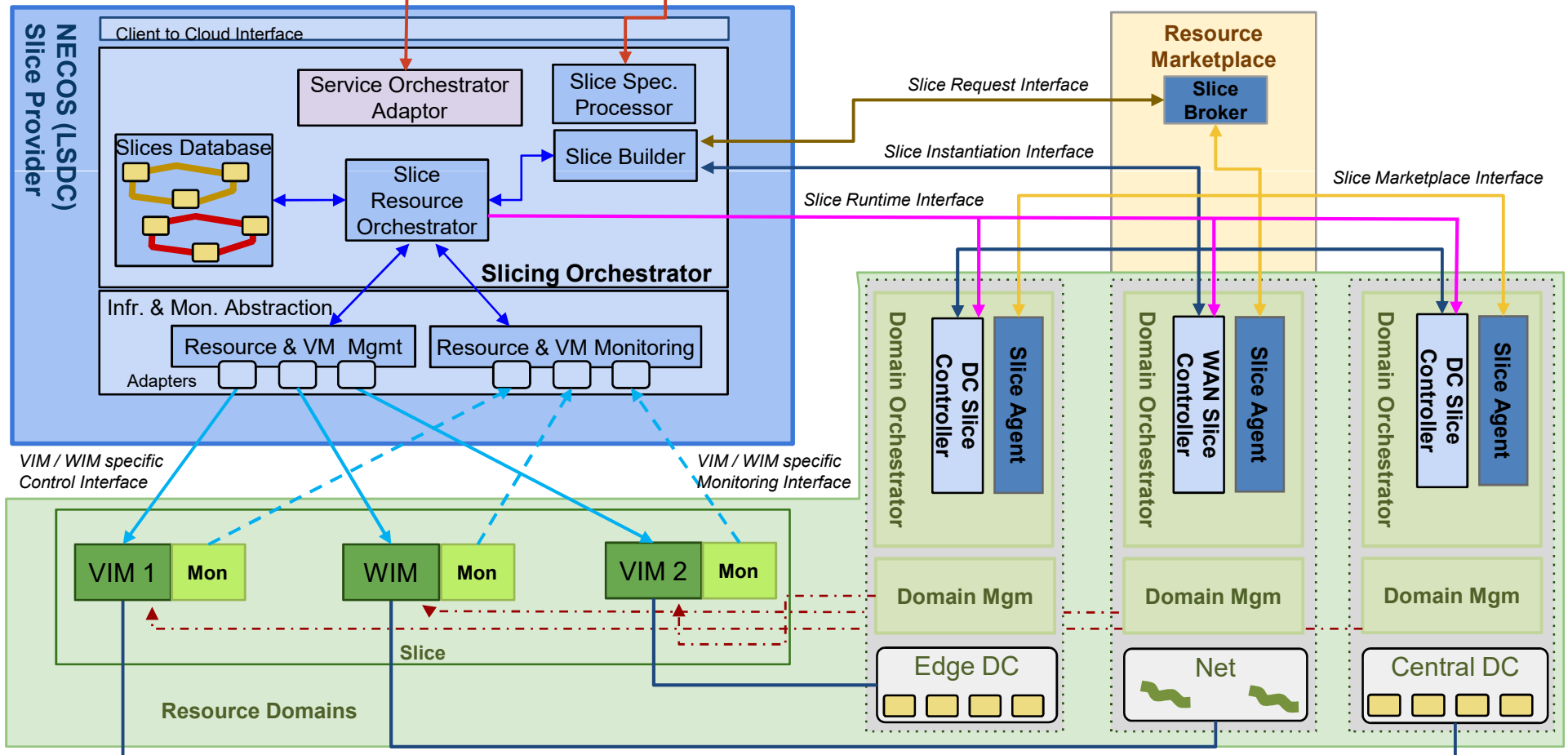
Mapping of slice lifecycle operations and NECOS components

Source: [2]   3GPP TR 28.801: "Study on management and orchestration of network slicing for next generation network"
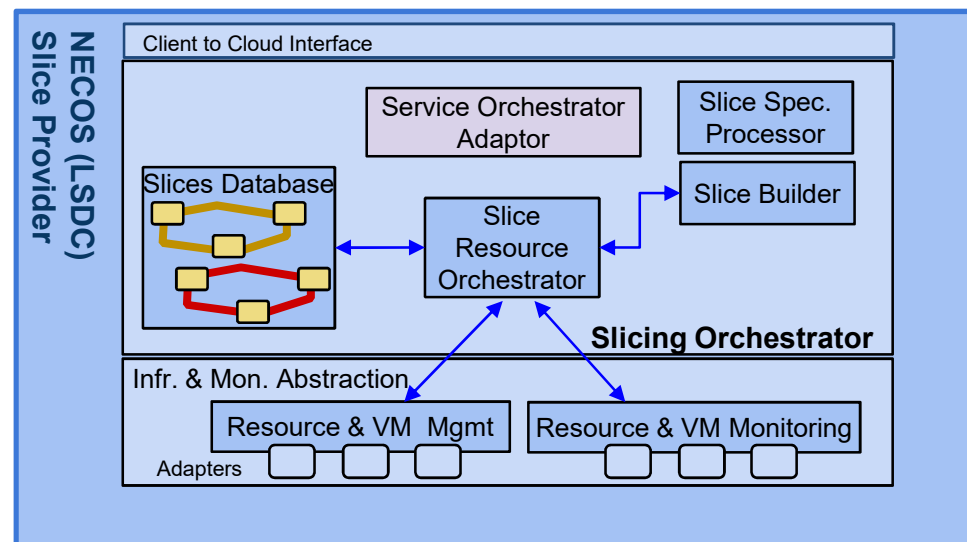
Solution

- The **Tenant** of NECOS is an organization that is expected to **request a Slice** to a NECOS, and to run their own Service Orchestrator for **deploying and managing their own services on that allocated slice**.

- The Slice Description monitors information related to the service instances and provide as feedback to the Service Orchestrator so that it can perform proper services' lifecycle management and propagate lifecycle events to the NECOS slicing orchestrator if needed (via the Service Orchestrator Adaptor).

- The Slice Activator is responsible for : (i) allowing a Slice Description to be sent to the NECOS platform; and (ii) handling the response back from the NECOS Slice Provider.
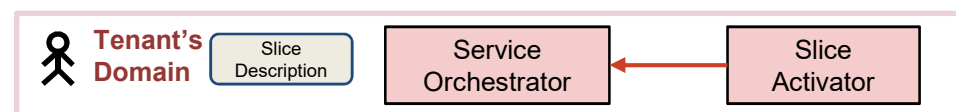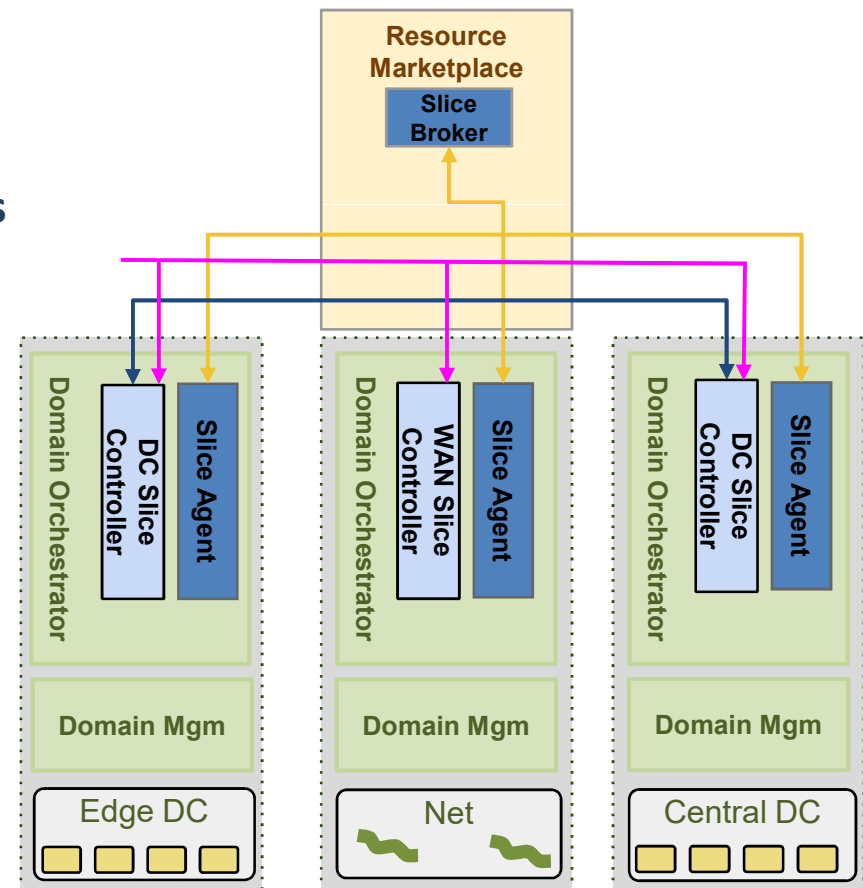
Solution

- **Slice Provider** is the sub-system that allows for the **creation of full end-to-end Slices** from a set of constituent Slice Parts.

- Responsible for the **orchestration** of the Slices (SRO), including their **management** at the run-time of their lifecycle.

- And, interact (IMA) with various remote VIMs, WIMs, and **monitoring** sub-systems in a generic way.

Solution

- The **Resource Marketplace** provides the way for the NECOS (LSDC) Slice Provider to **find Slice Parts** across various participating Resource Domains to build up a slice.

- There is expected to be **multiple Slice Brokers** in various locations - maybe multiple per country.

- The **Slice Agent finds available resources** within the local resource domain, and then provide an offer for those resources to the Resource Broker, with a specified characteristics.

Solution

- The **Resource Providers** are organizations that can **provide the resources** required for the slice parts - namely, Data Center resources in the form of servers, storage, and network resources.

- Each provider will be capable of **providing slice parts, which will be part of a full end-to-end slice**.

- The Resource Provider also needs to provision the relevant **manager for each slice part**, meaning a VIM for a DC slice part, or a WIM for a network slice part.

- Similarly, for each network domain, a WAN Slice Controller.
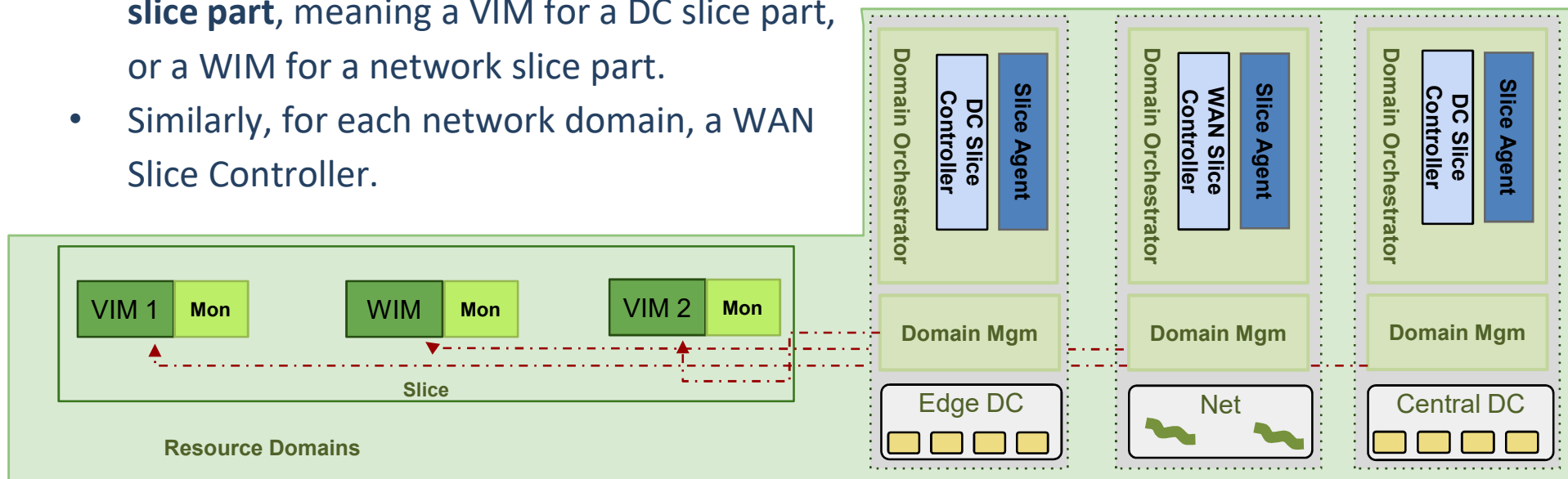
Conclusion

LSDC exhibits:

- Provisioning of **service-agnostic** slices, **adapted** to the desired service characteristics;

- Slice configuration automation in **multi-cloud environments**;

- Provision of a uniform **management** framework.

Autonomous

Management

SERVICE – AGNOSTIC SLICES

MULTI-CLOUD