Mobile Cloud Networking (MCN): Motivation, Vision, and Challenges

Thomas Michael Bohnert (TMB, Technical Coordinator)
Giovanni Toffetti

MCN Project

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- 15.7 M

SAP AG, Germany

FRANCE TELECOM CA, France

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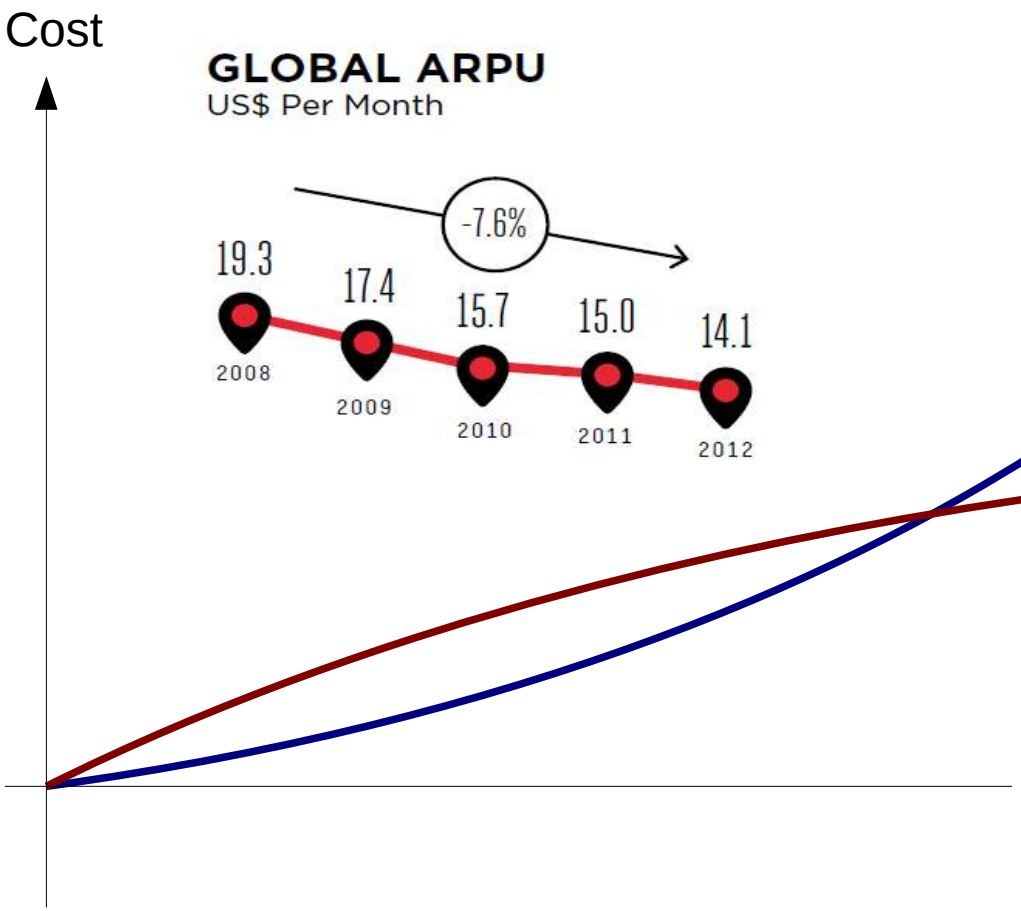
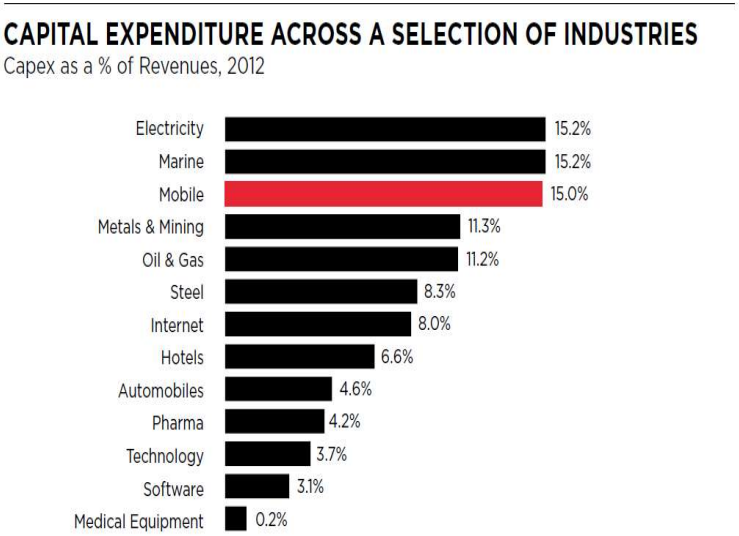
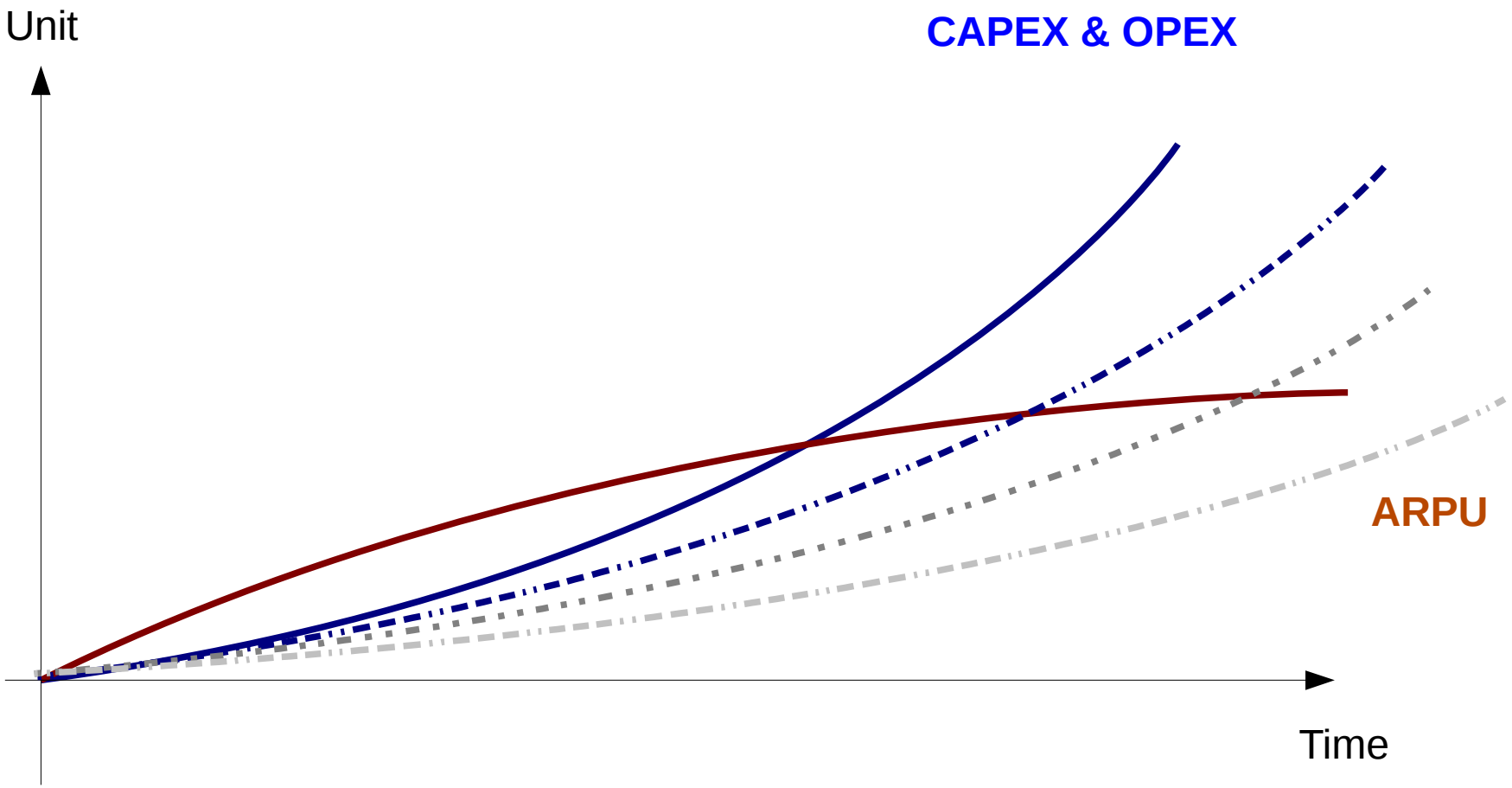
Mobile Telco Industry: Status Quo





GSMA, The Mobile Economy 2013

Options I – Same Service, at lower CAPEX and OPEX



How low is possible?

Options II – Value Added Services

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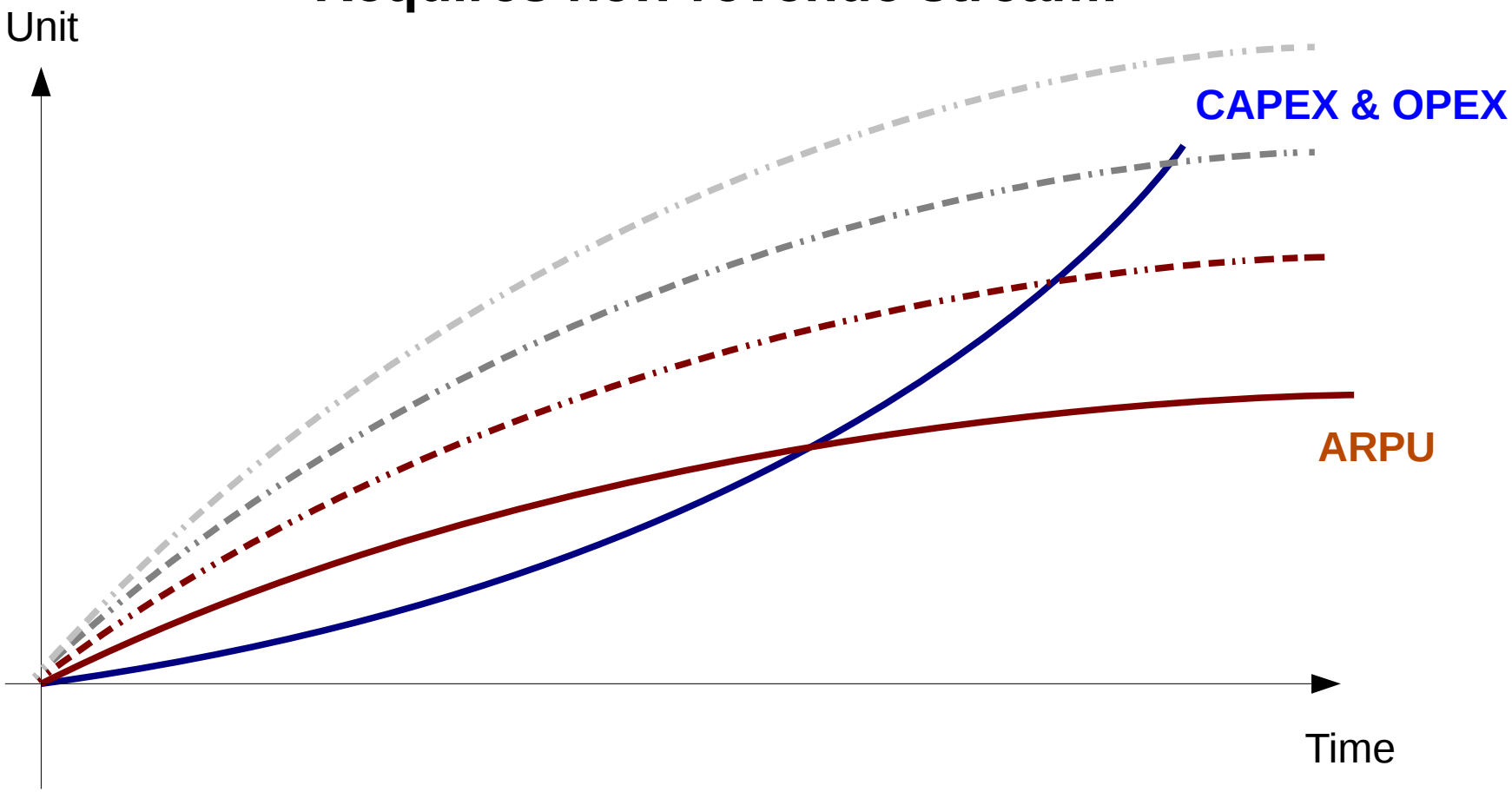
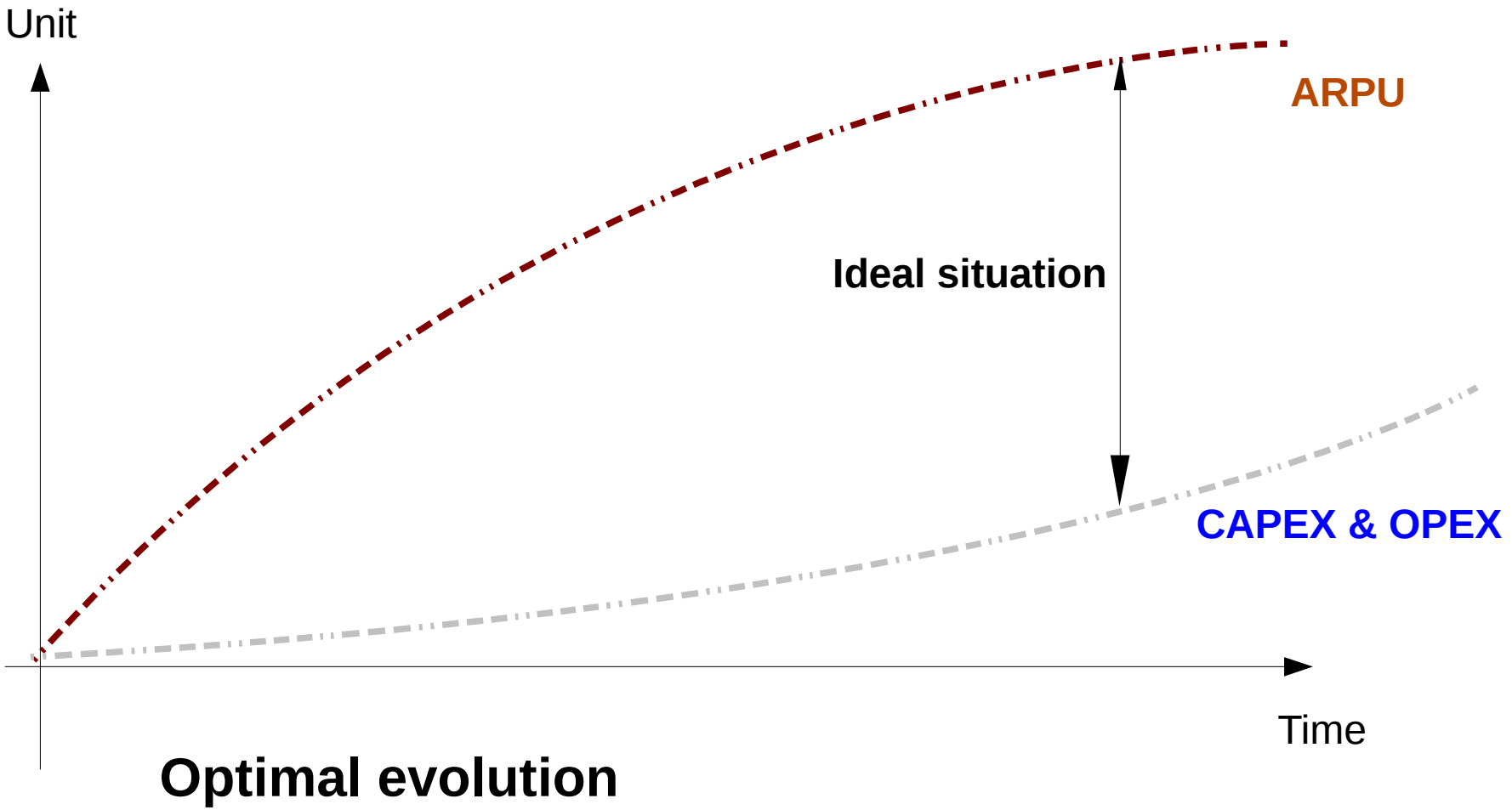
Requires new revenue stream!



Optimum – Value Added Services plus lower CAPEX and OPEX



Motivations

From traditional Mobile Network Operators…

… towards Mobile Cloud providers

MNOs concepts today

- Traditional connectivity & voice business
- Few value-added services only, trend towards over-the-top (OTT) provided by competitors
- Infrastructure and Platform sharing (MVNOs)
- Infrastructures, networks, and platforms …
  - Pre-sized, Pre-provisioned, Pre-customized, Huge CAPEX

MNO concepts tomorrow

- Adopt IaaS and PaaS for network functions
  - Resource pooling, On-demand, Elastic, Pay-as-you-go
- **Reduce costs**, move from CAPEX to OPEX
  - Exploit cloud principles for network operations
  - New approach to MVNO, new customers for traditional mobile telco business
- **New Business**: Mobile Network + Computing + Storage
  - End-to-end platform for novel applications
  - Eco-system, developers, new revenue stream

Top-Level Directions

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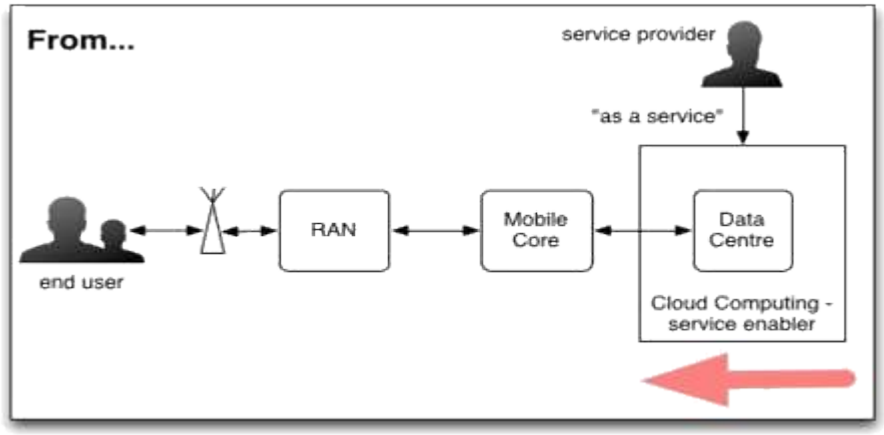
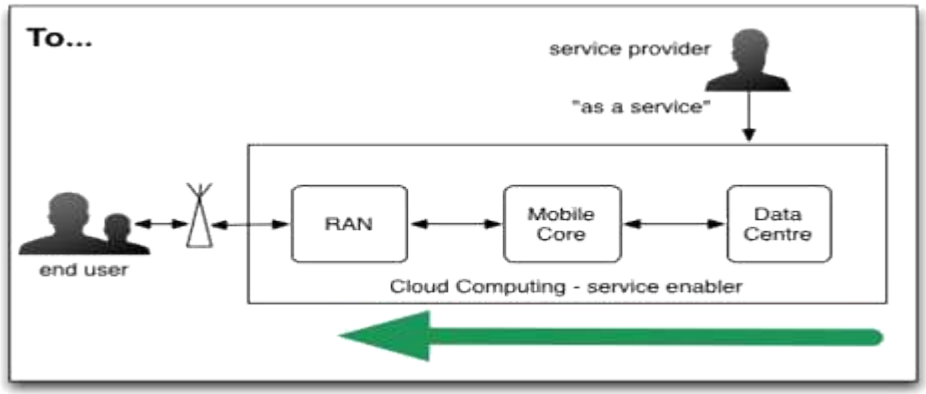
Scenario 1:
Using the Cloud

Scenario 2:
Extending the Cloud

Cloud-based mobile networks: the concept



Moving cloud computing beyond datacenters…



… towards the mobile end-users.

Mobile Connectivity
Decentralized Computing
Smart Storage
offered as a single end-to-end service

- On-demand and self-service
- Elastic
- Multi-tenant
- Pay-as-you-go

MCN Enabling Assumptions

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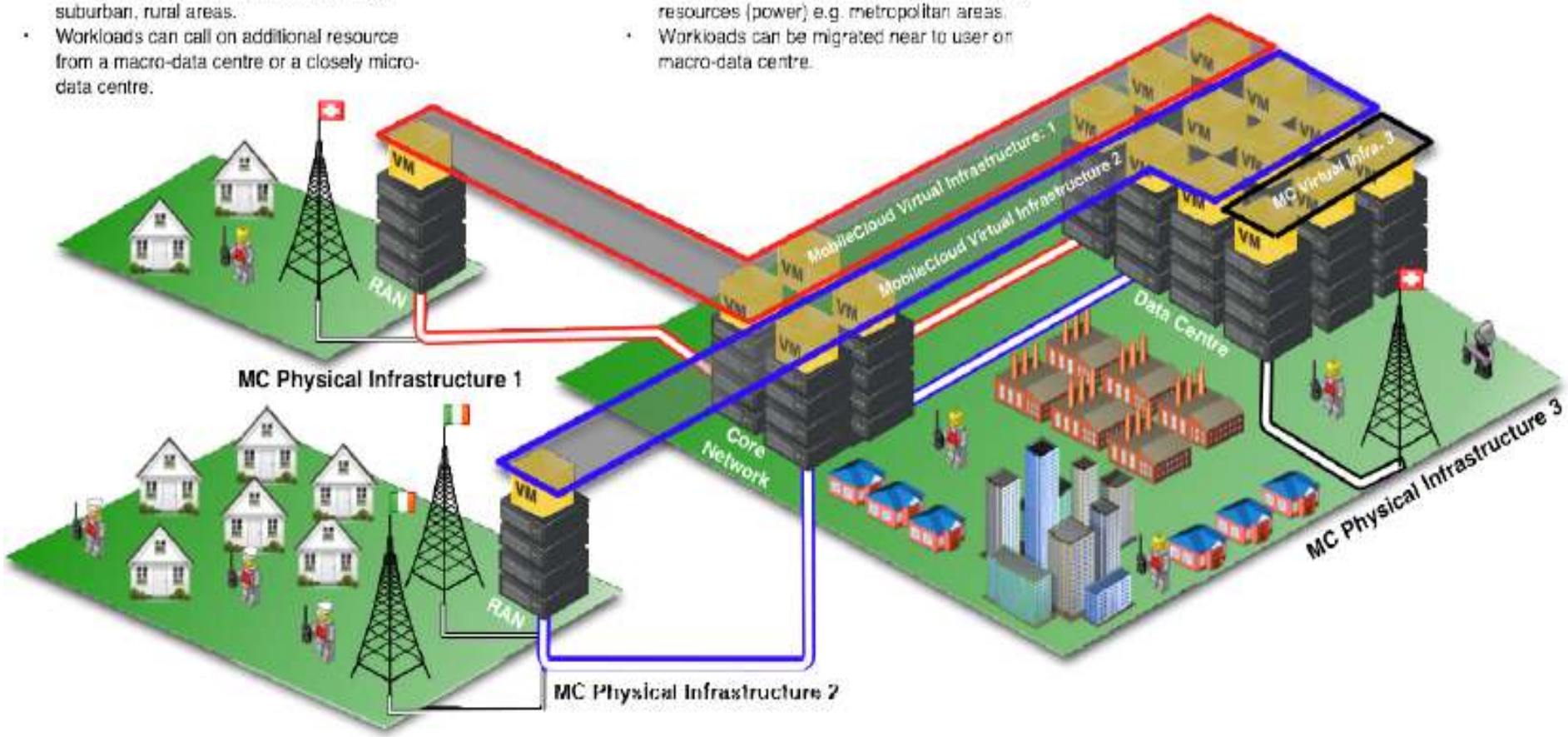
Micro-Data Centre Deployments

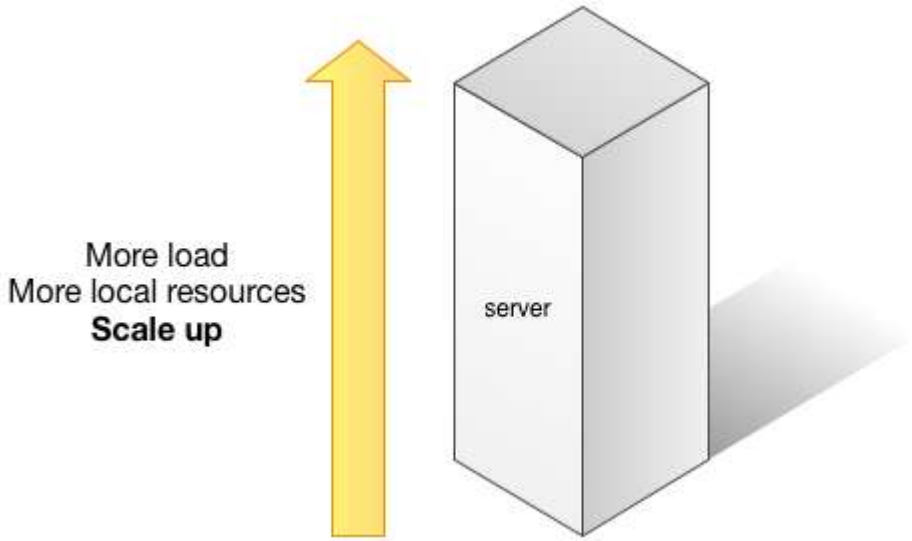
- Local deployments limited resources e.g. suburban, rural areas.
- Workloads can call on additional resource from a macro-data centre or a closely micro-data centre.

Macro-Data Centre Deployments

- Centralised deployment with access to cheap resources (power) e.g. metropolitan areas.
- Workloads can be migrated near to user or macro-data centre.

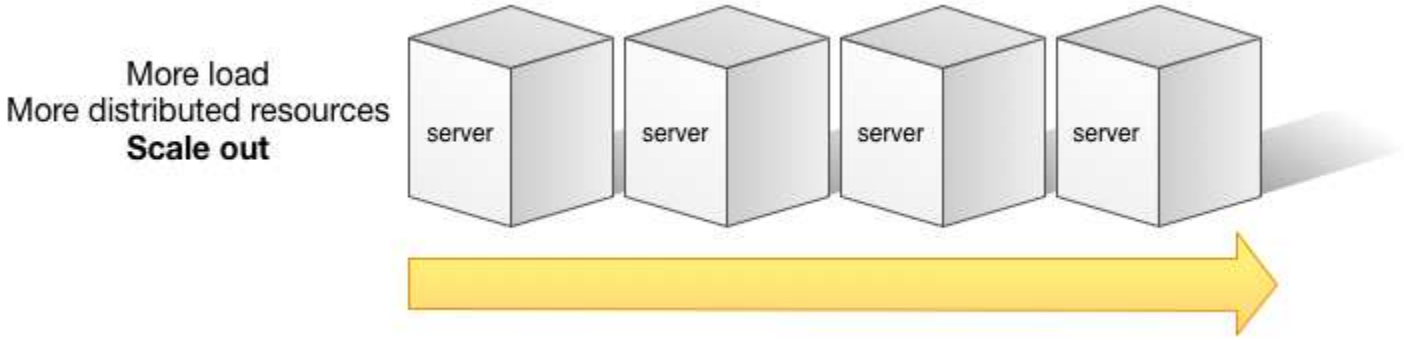


From ….



- System is contained to local resources
- Scaling is limited by local resources
  - Difficult beyond - requires rearchitecting
- Many ***existing*** systems are built like this

… to a cloud-native design



- System is not contained to local resources
- Scaling is adding as many resources/nodes that are available
- Elasticity enabled grow and shrink as needed
- Existing systems are **not built for this**
- Requires **additional** orchestration and management

Goals of MCN Architecture

- Modularity, reusability
- Creation of composed (end-to-end) services
- Adhere to the NIST cloud computing definition
- Enable cloudification of services e.g. EPC
  - keep functional arch, adapt software arch
- Common framework and lifecycle to design services that accommodates all identified scenarios
- No technology specific dependencies
- Leverage & influence suitable/relevant standards to ensure interoperability and integration

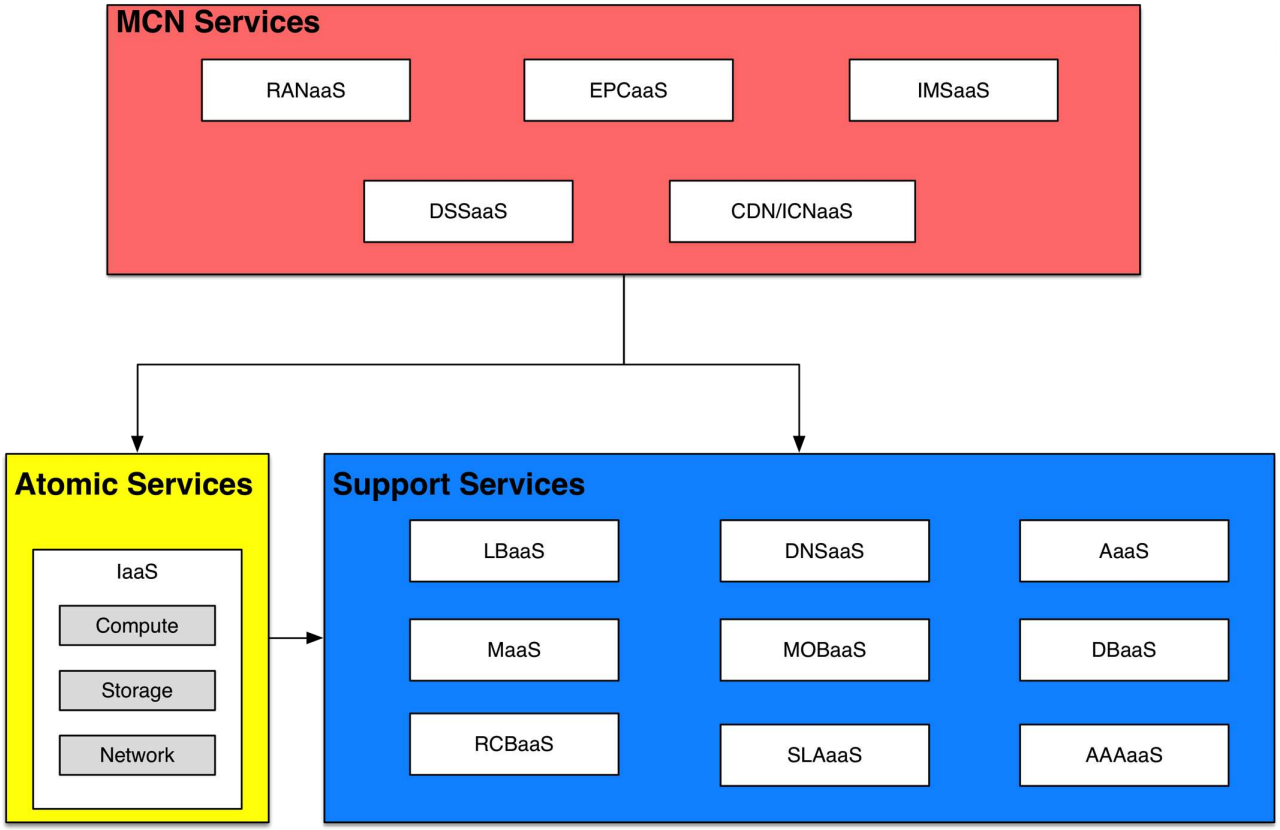
Terminology

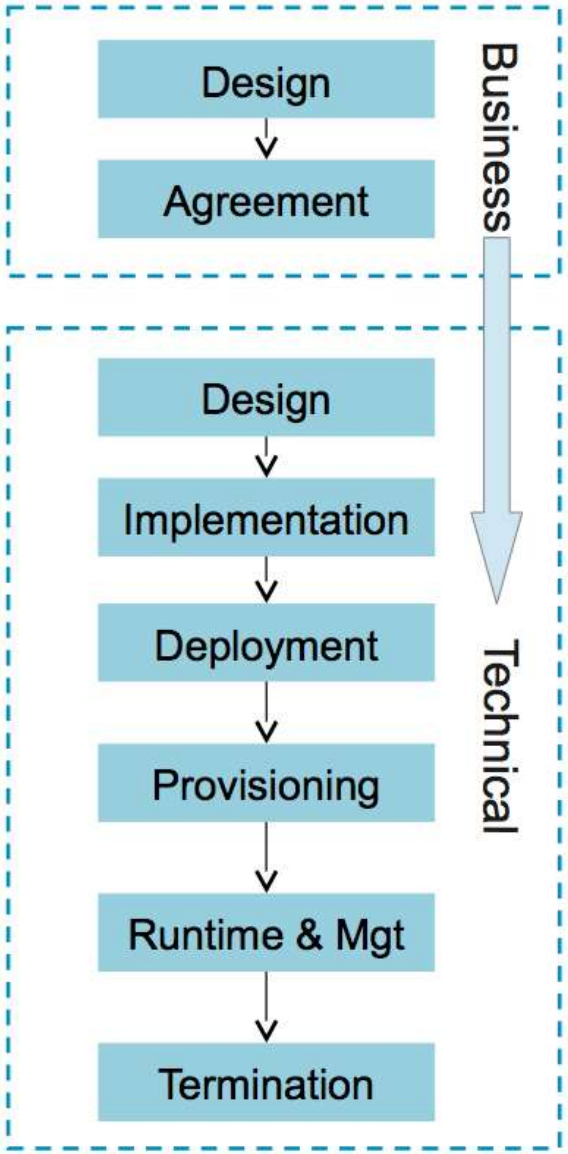
- **Service**
  - *E.g. CDNaaS*
- **Service Instance**
  - *E.g. CDN service instance for customer X*
- **Service Instance Components (SIC)**
  - *E.g. MME or DSS cache*
- **Resources** (Physical/Virtual) build services

MCN Service Categories

Service Category	Description
Atomic	An indivisible service that executes a particular singular business or technical function and generally implemented using a service provider's resources.
Composed	A service that is created by combining two of more services, including atomic or even other composed services.
Support	Platform[13] services of MCN that provide targeted, specific functionality for use by any service.
MCN	A service offering implemented within MCN whose implementation consists of a service manager, one or more service orchestrators and it's the service functionality, including other deployables such as VMs, code bundles etc.

Lifecycle of a MCN Service





MCN Services

- **RANaaS**, Wireless-as-a-Service, enabled by RAN virtualisation, that is Remote Radio Head (HW) / Base Band Unit (SW) separation with Base Band Units deployed on-demand on elastic IaaS running on top of micro data centres close to antennas.
- **EPCaaS**, Evolved Packet Core as a Service (EPCaaS) that is on-demand deployment of distributed EPC instances on top of elastic IaaS on micro and/or macro data centres based on individual needs.
- **IMSaaS**, that is on-demand deployment of IMS (IP-Multimedia-Subsystem) instances for complementing voice/video services on top of elastic IaaS on micro- and macro-data centres and based on individual needs.
- On-demand and elastic content / storage / application distribution services, on top of IaaS on micro and macro data centres exploiting cloud-storage services (Follow-Me cloud).
- **End-to-End MCN Service Orchestration** (infrastructure, platform, services).
- Mobile Cloud Networking AAA, SLA, Monitoring, Rating, and Charging compliant with XaaS.

MCN Key Arch Elements

Service Manager

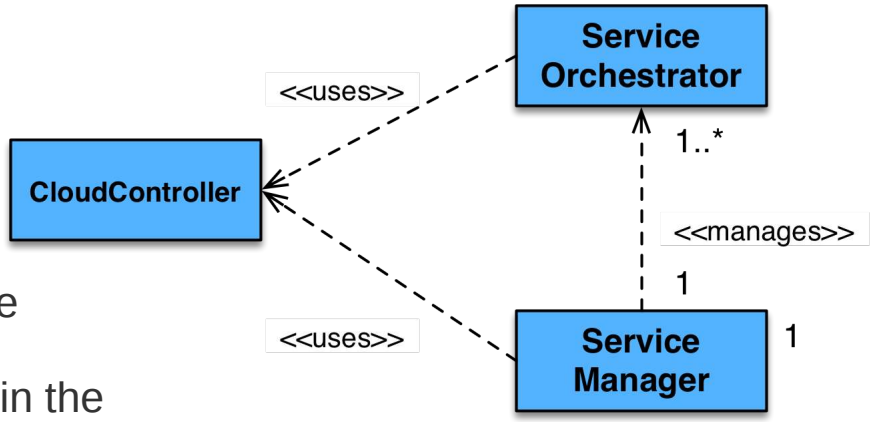
- Provides an external interface to the user
- Business dimension: encodes agreements
- Technical dimension: Management Service Orchestrators of a particular tenant

Service Orchestrator

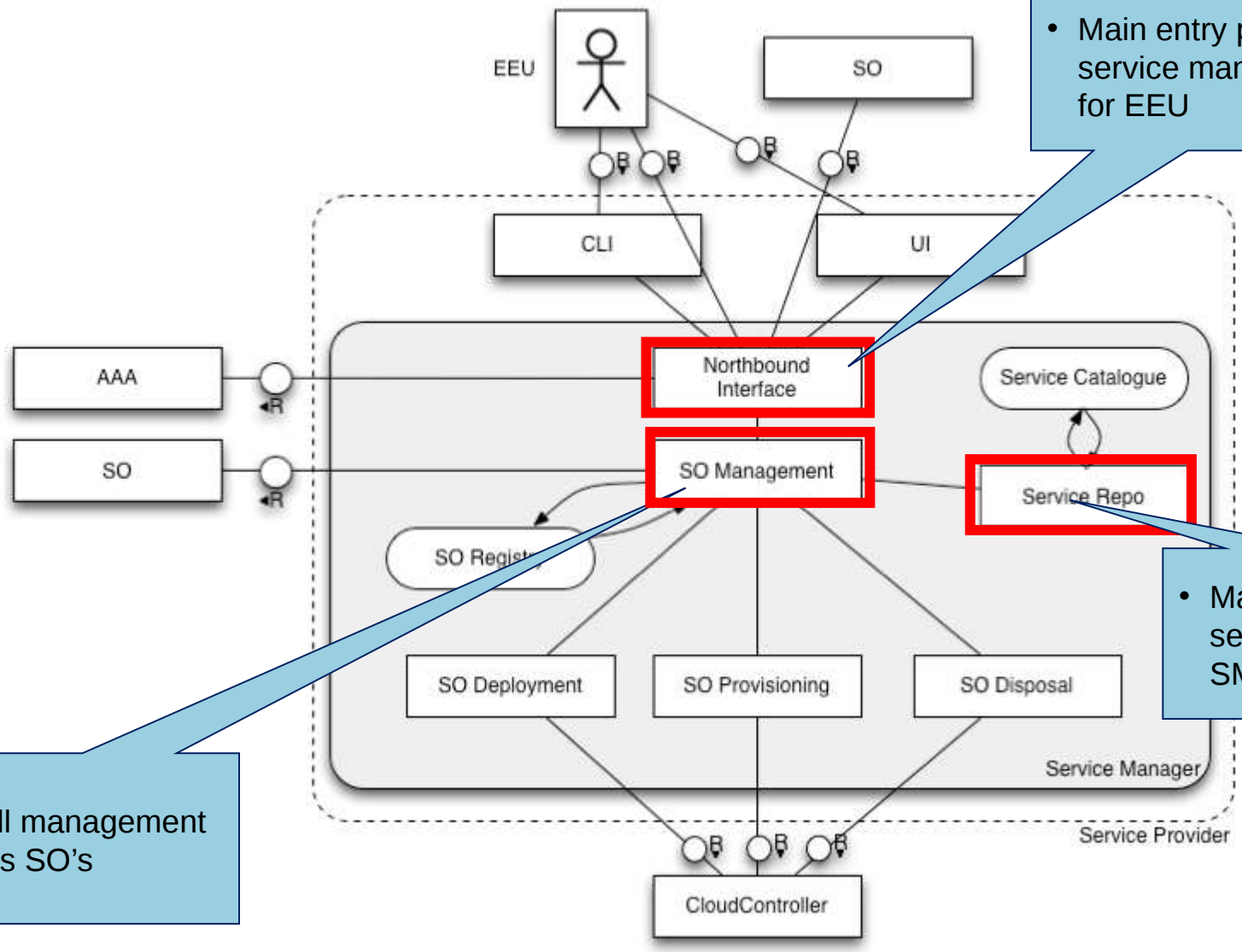
- Oversees E2E orchestration of a service instance
- Domain specific component
- Manages service instance
- 'Runtime & Management' step of the Service Lifecycle
- One SO is instantiated per each tenant within the domain
- SO is associated with a Service Manager
- Monitors application specific metrics and scales (SOE/SOD)

CloudController

- Supports the deployment, provisioning, and disposal of services
- Access to atomic services
- Access to support services
- Configures atomic services (IaaS)

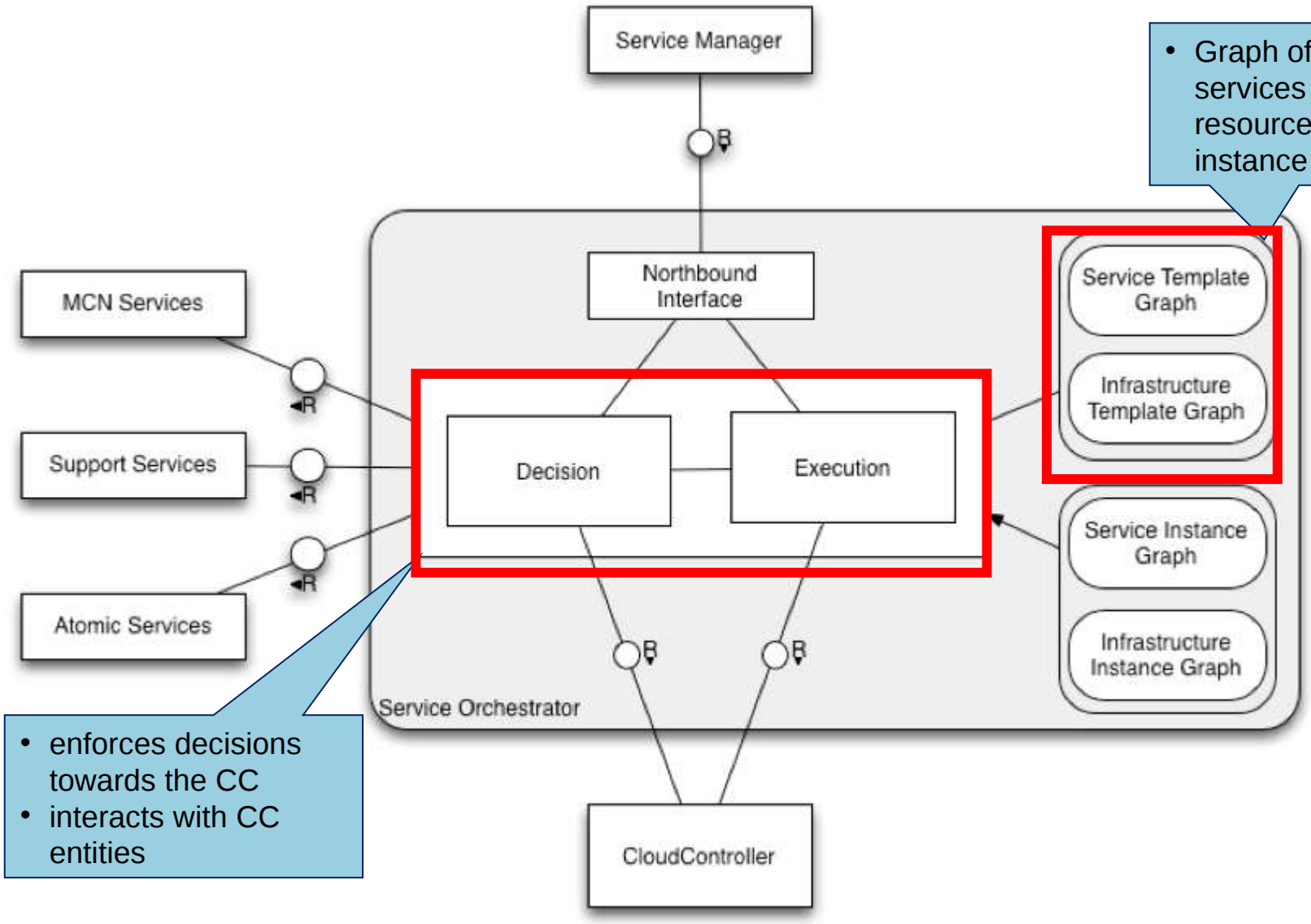


Service Manager Internals

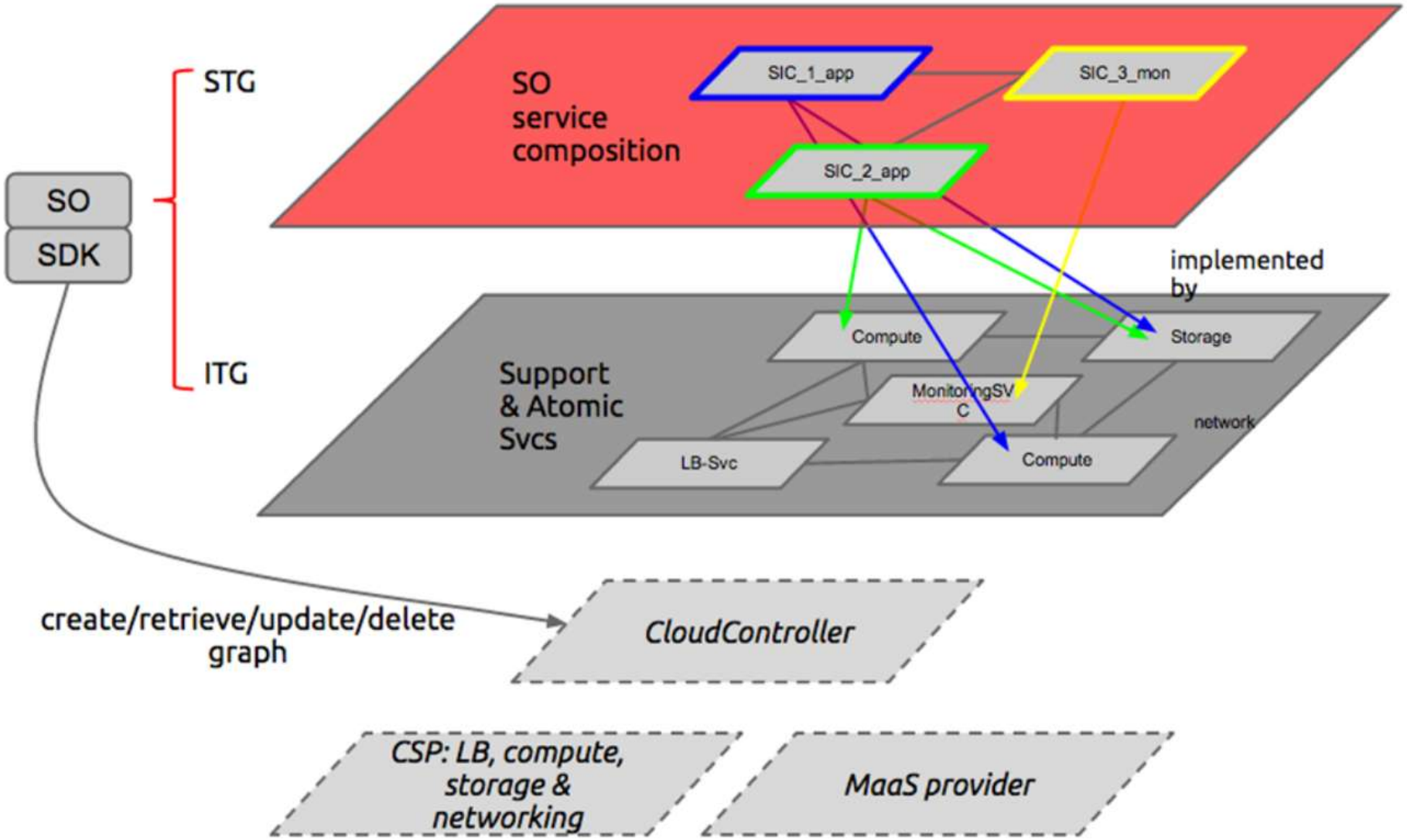


- Main entry point so service management for EEU
- Maintains list of services offered SM
- Overall management of SM's SO's

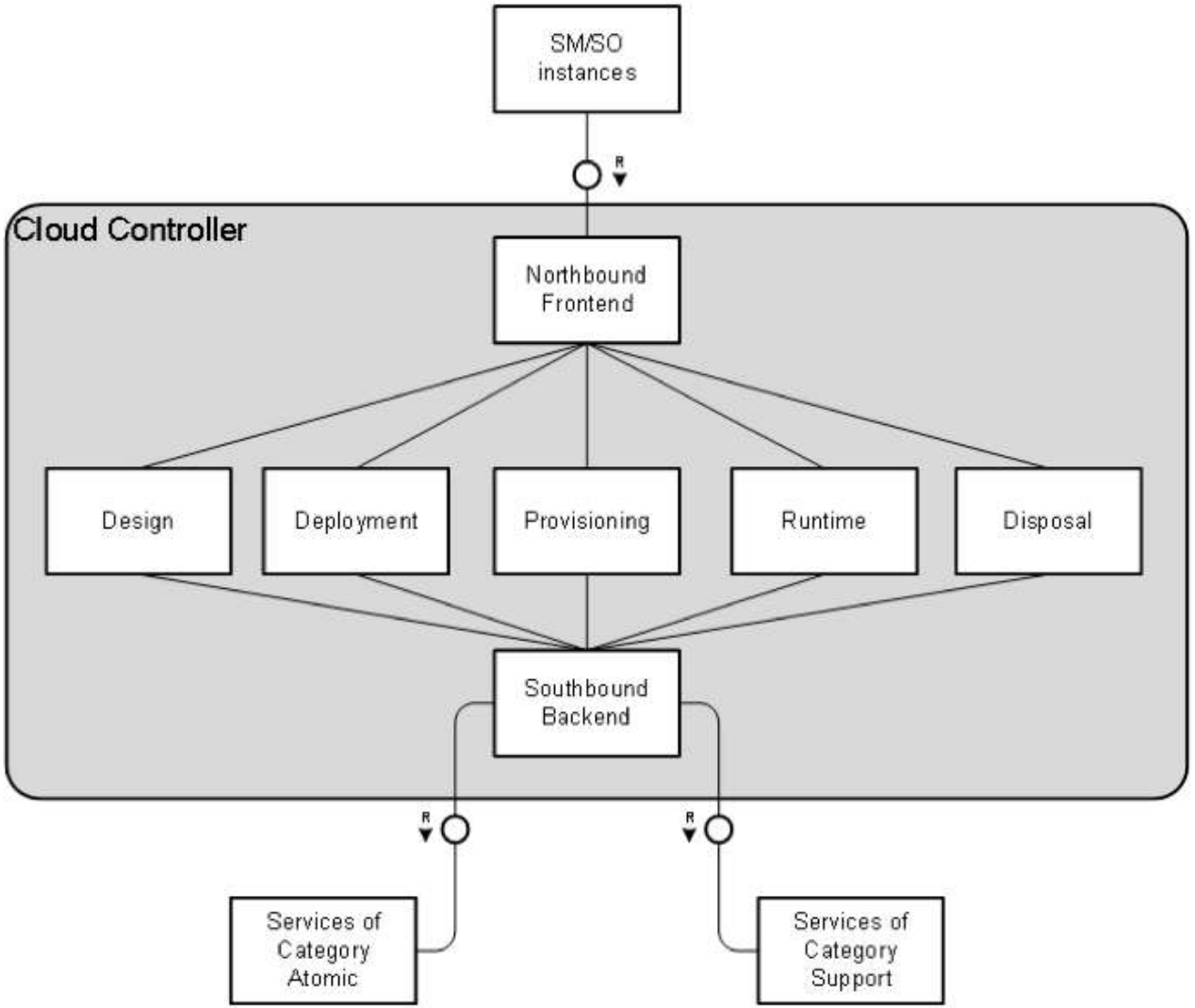
Service Orchestrator Internals



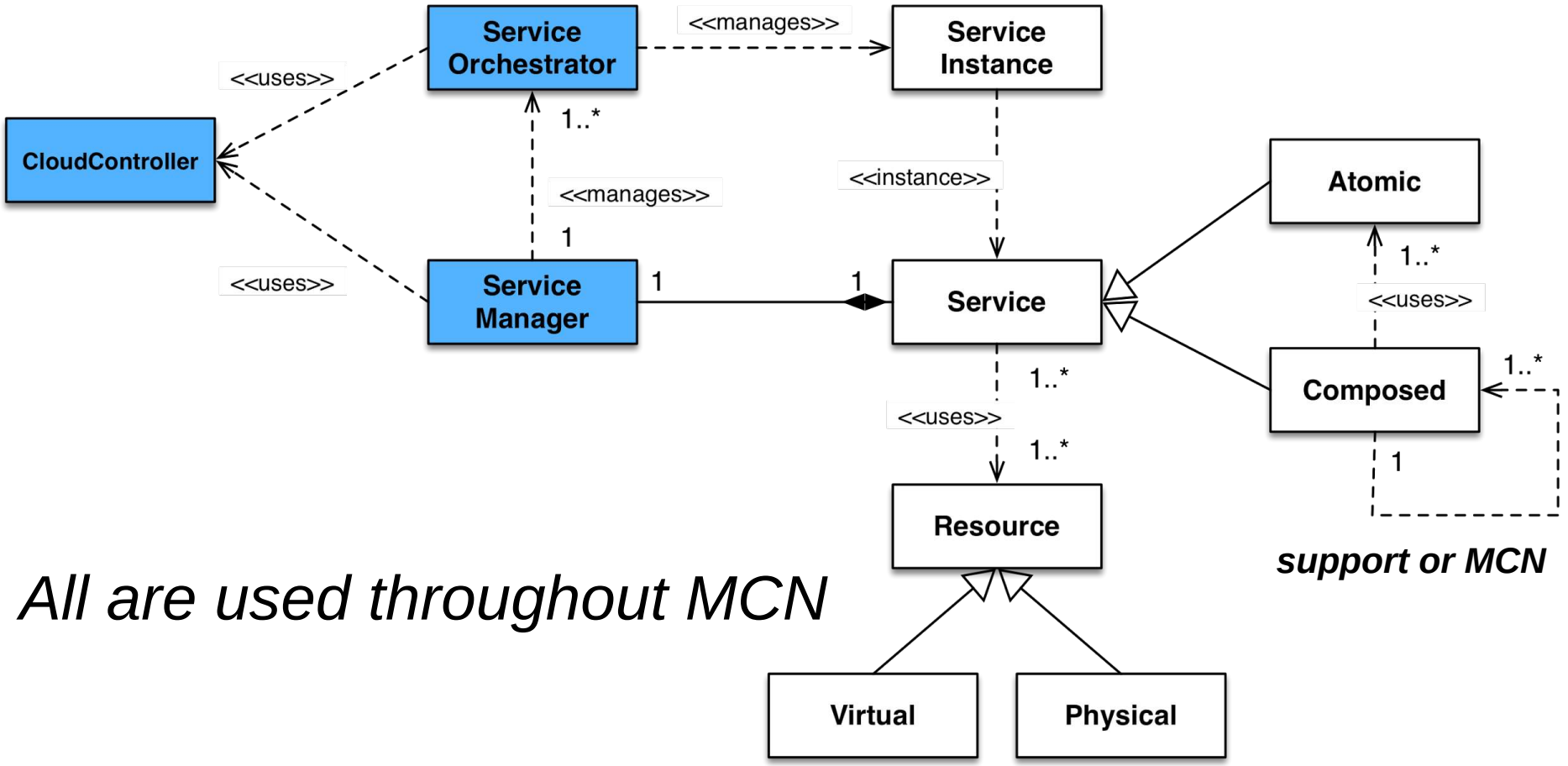
Orchestration graphs



CloudController Internals



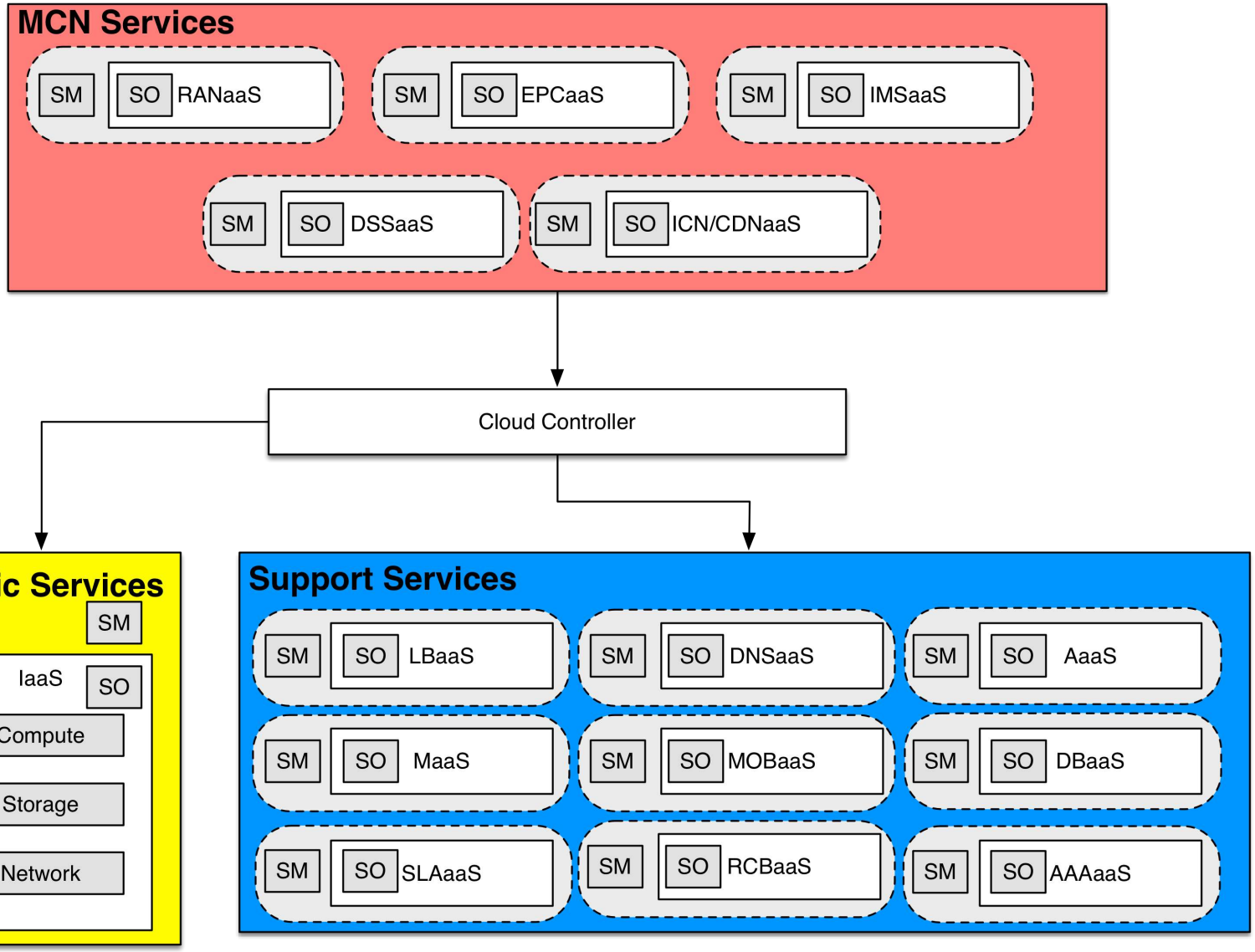
MCN Key Arch Elements Overview



All are used throughout MCN

support or MCN

MCN Services and Arch Elements



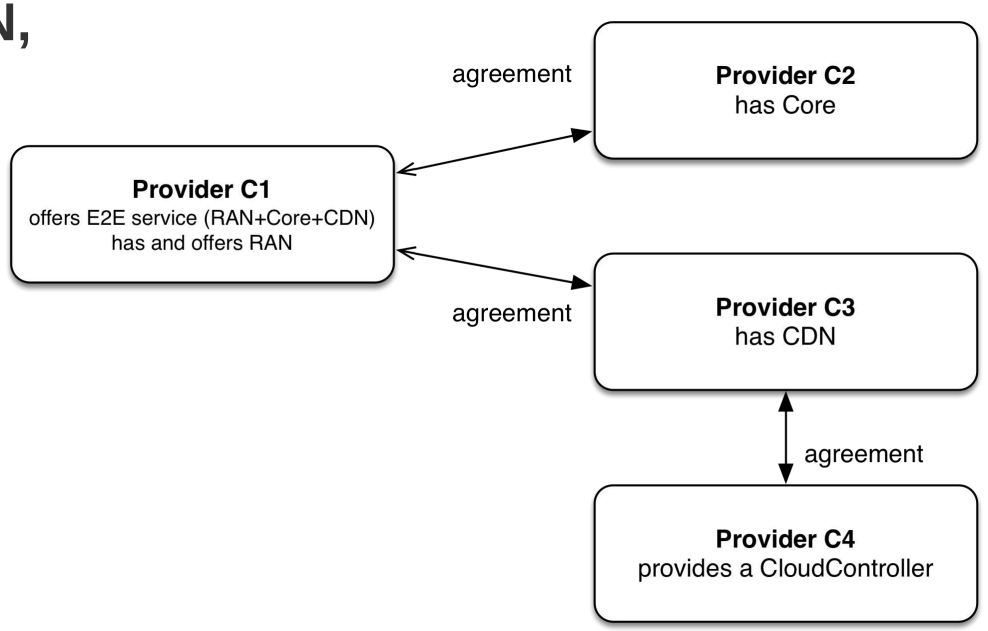
How is a MCN service instance deployed?

Scenario

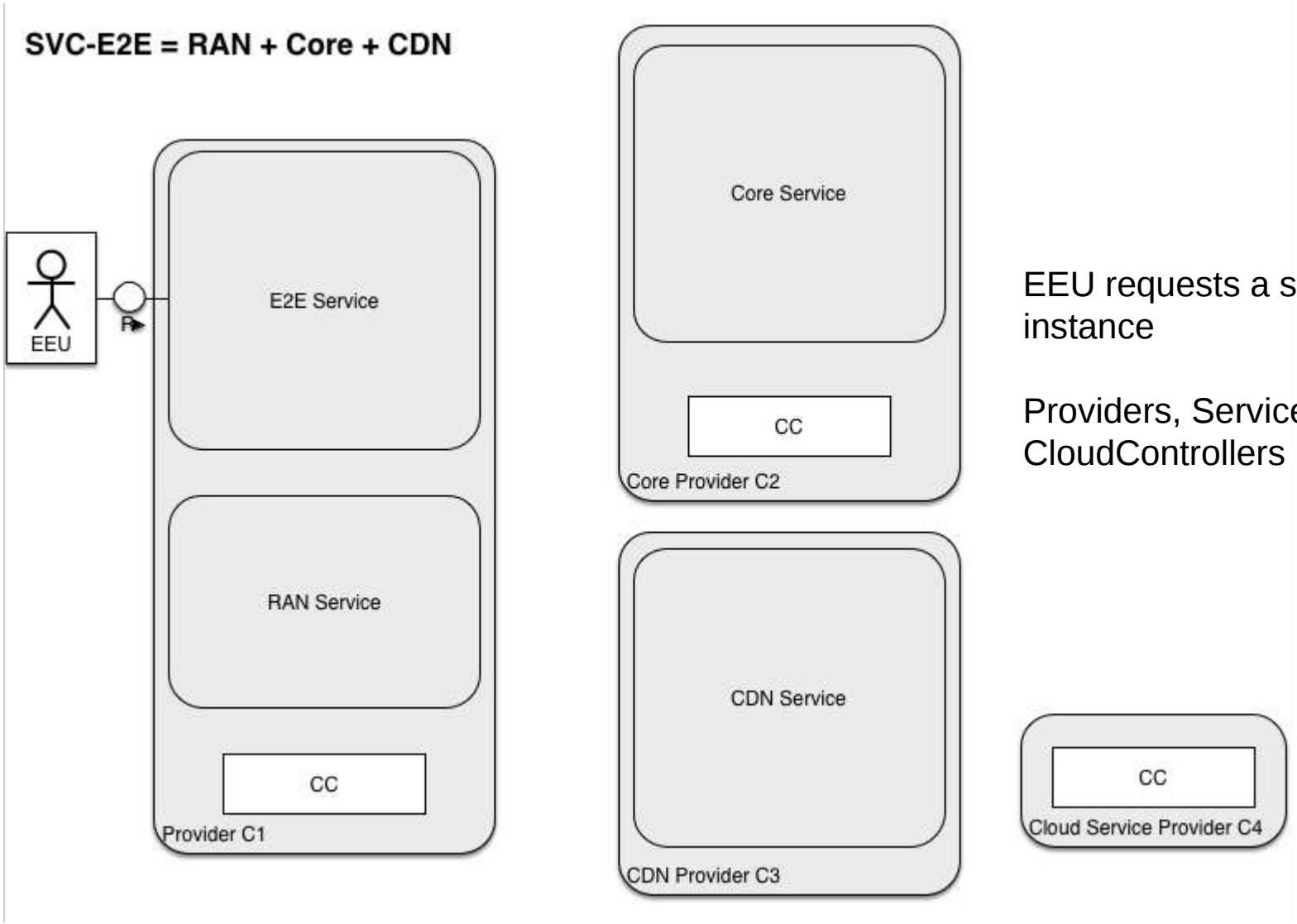
- 4 service providers (C1-C4)
- 3 services orchestrated - **RAN, Core, CDN**
- 1 value added E2E service offered to the enterprise end user
- Both public and private cloud resources

Scenario Assumption

- Service designed and implemented



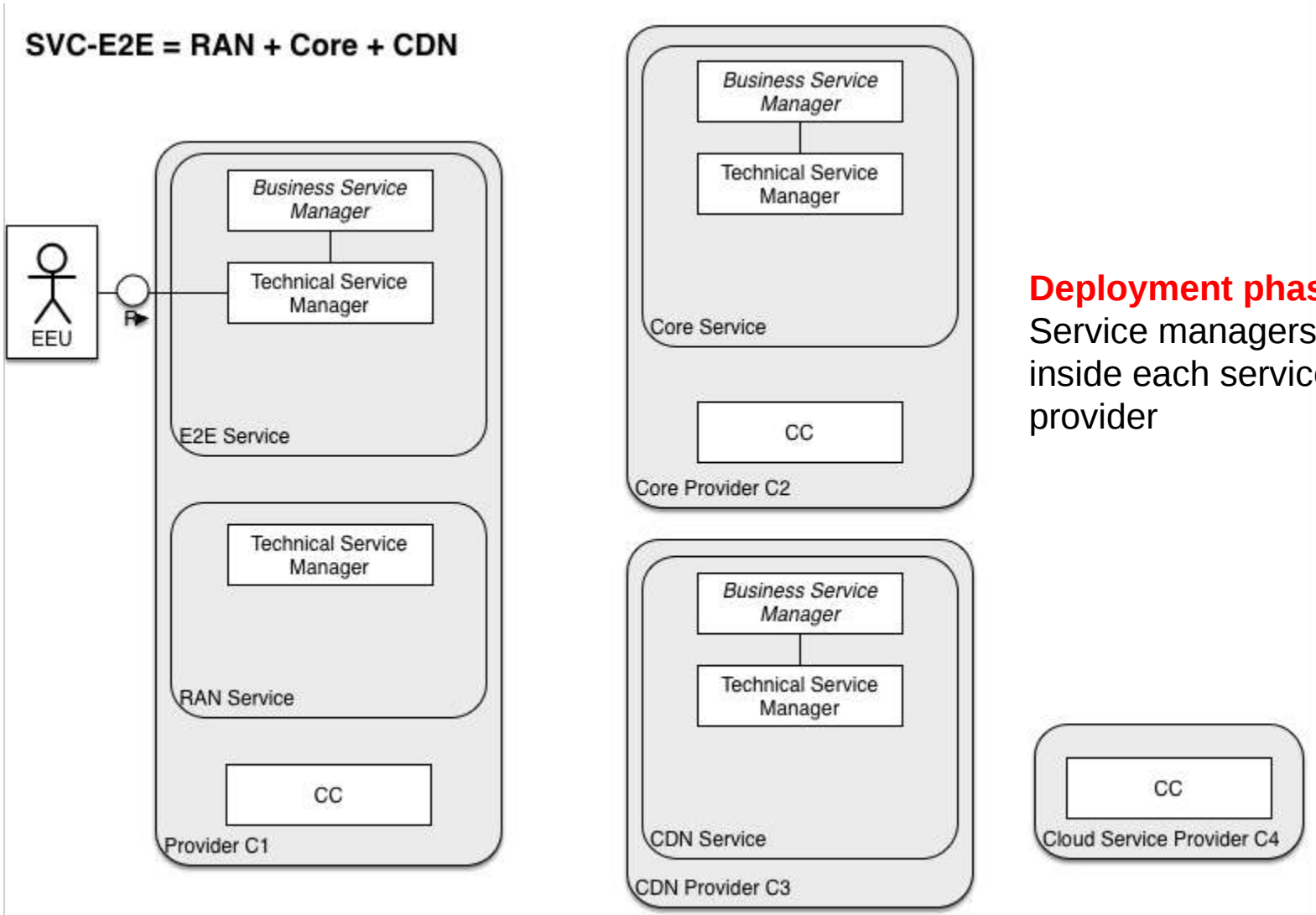
How is a MCN service instance deployed (1)?



EEU requests a service instance

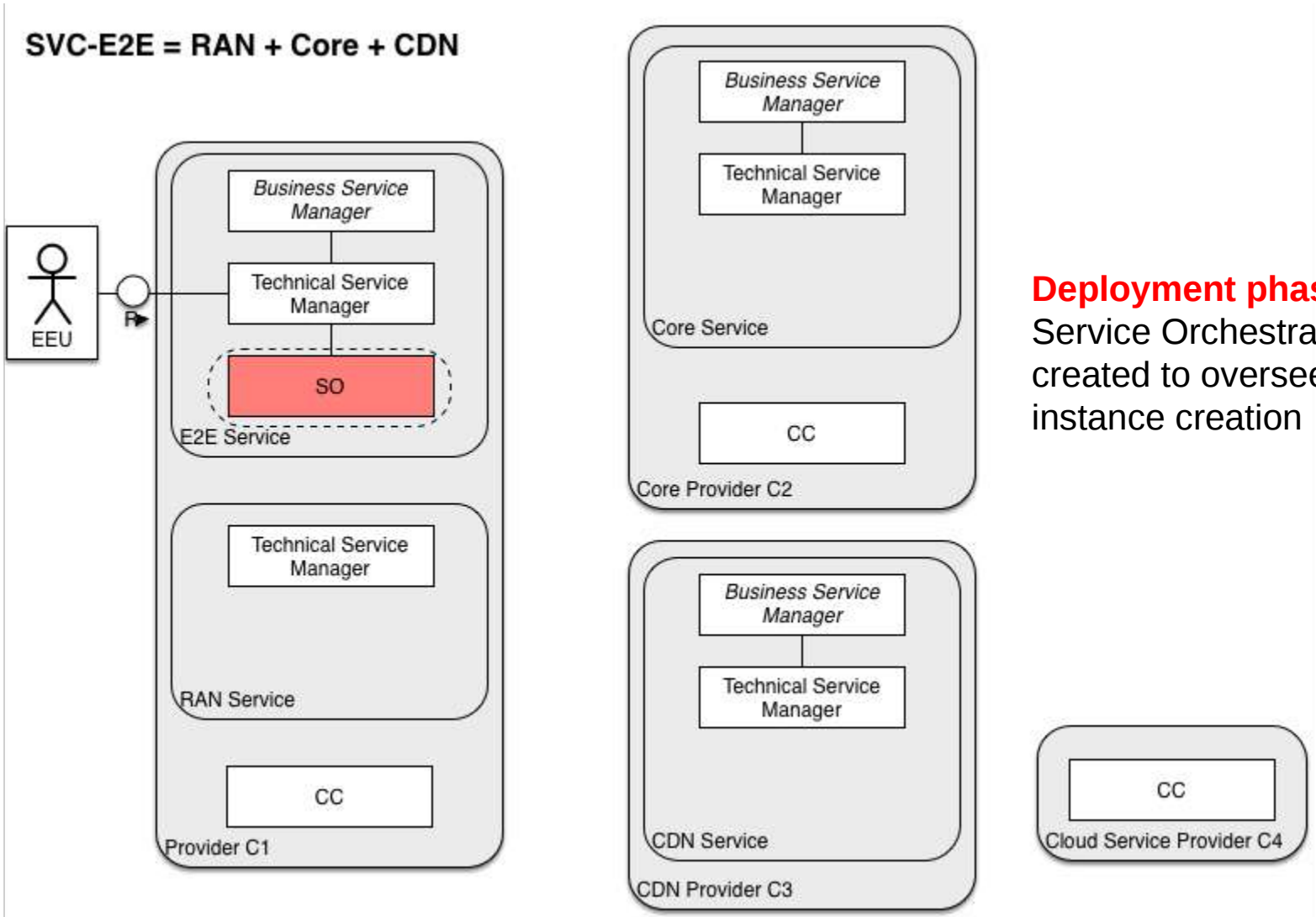
Providers, Services and CloudControllers

How is a MCN service instance deployed (2)?



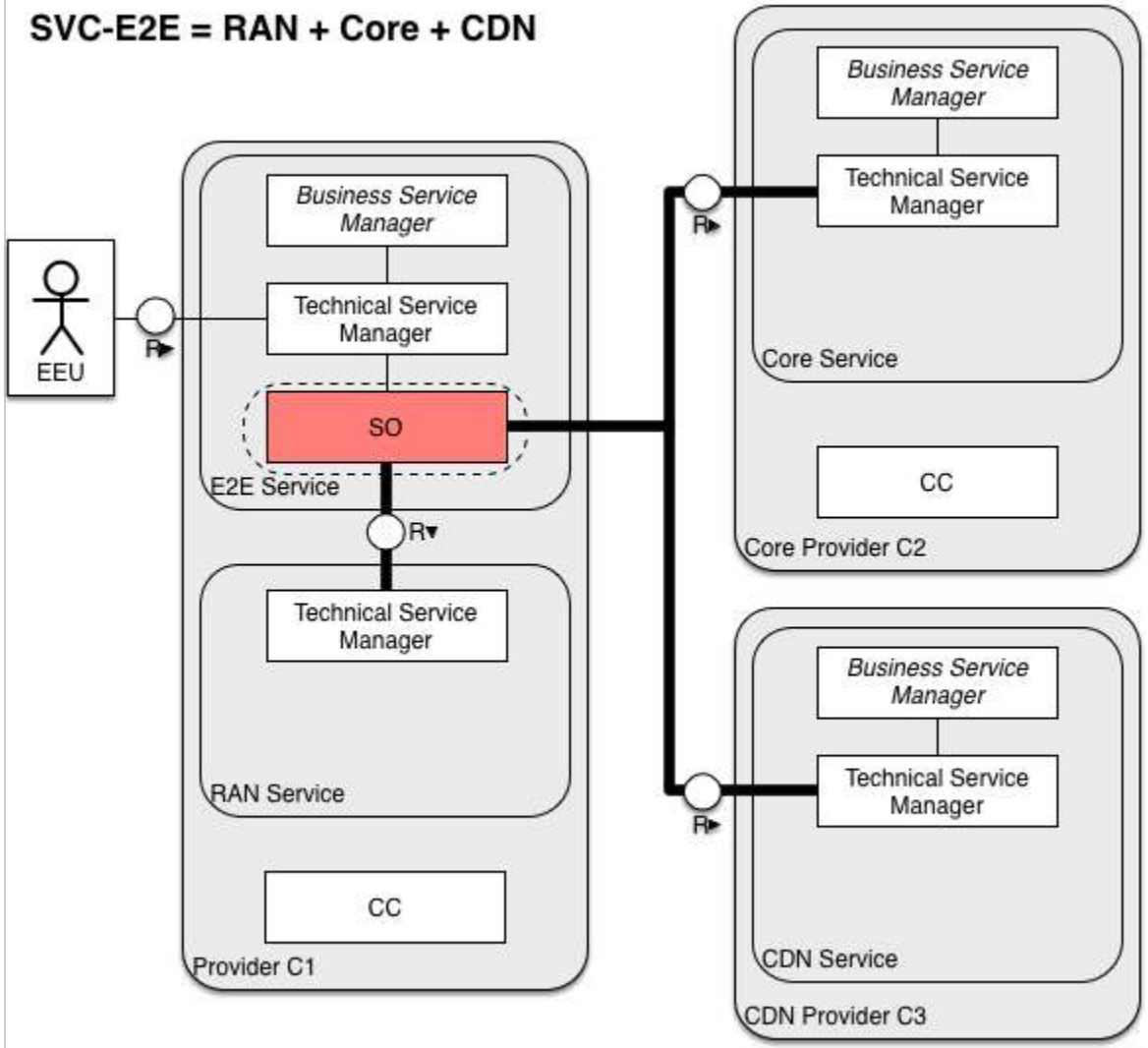
Deployment phase
Service managers inside each service provider

How is a MCN service instance deployed (3)?



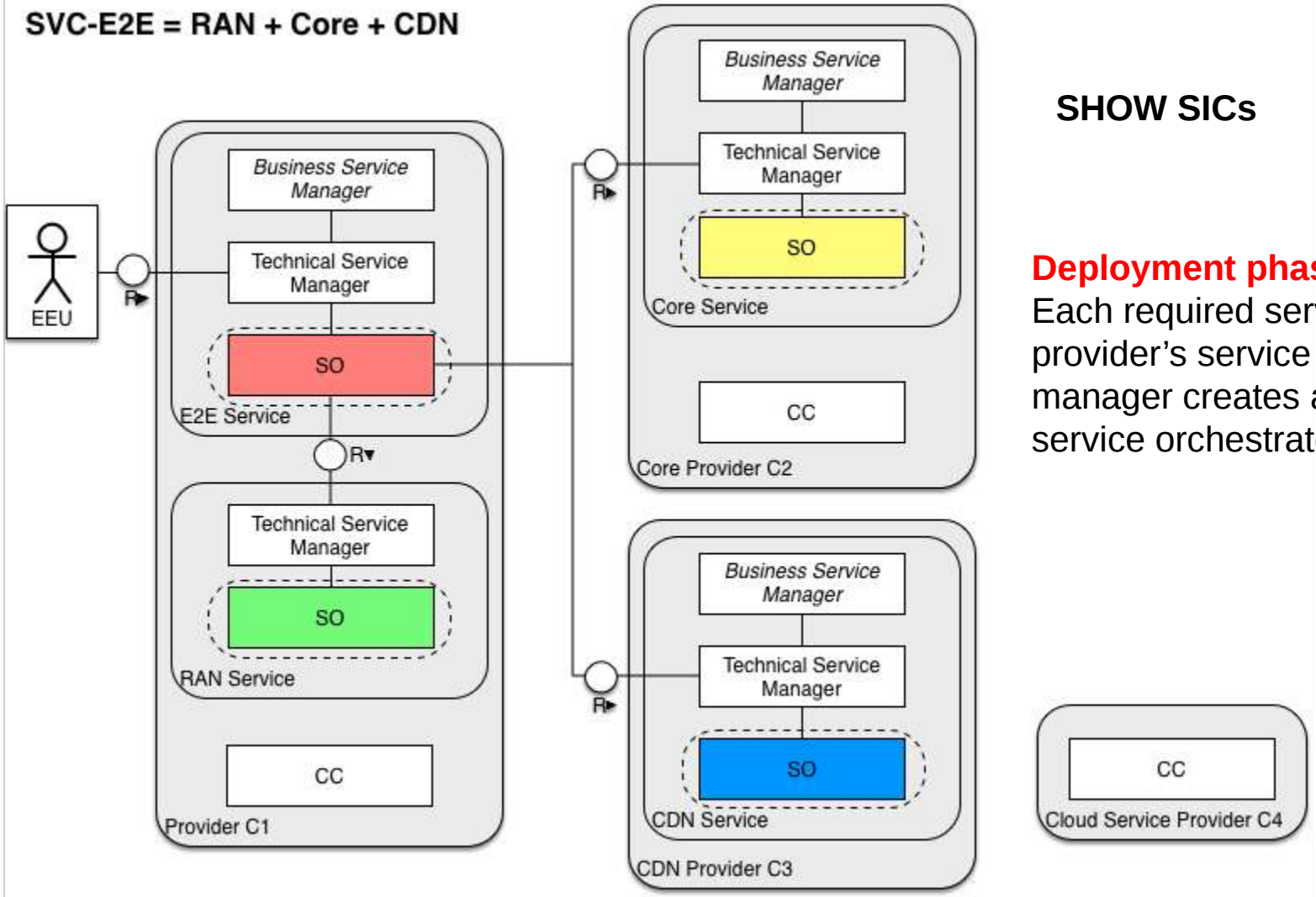
Deployment phase
Service Orchestrator created to oversee instance creation

How is a MCN service instance deployed (4)?



Deployment phase
Service Orchestrator requests necessary services creation

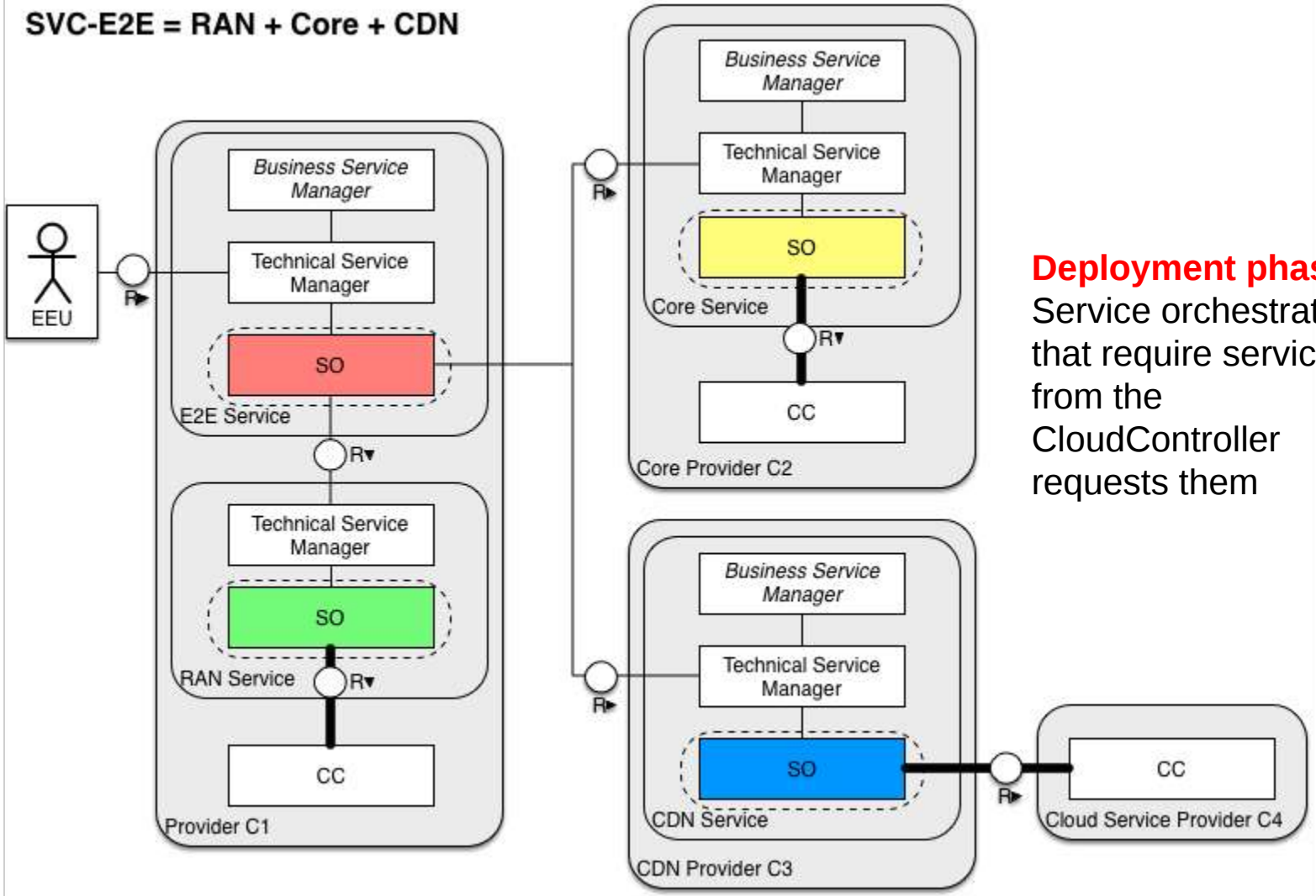
How is a MCN service instance deployed (5)?



SHOW SICs

Deployment phase
Each required service provider's service manager creates a service orchestrator

How is a MCN service instance deployed (6)?



Deployment phase
Service orchestrators that require services from the CloudController requests them

How is a MCN service instance deployed and provisioned?

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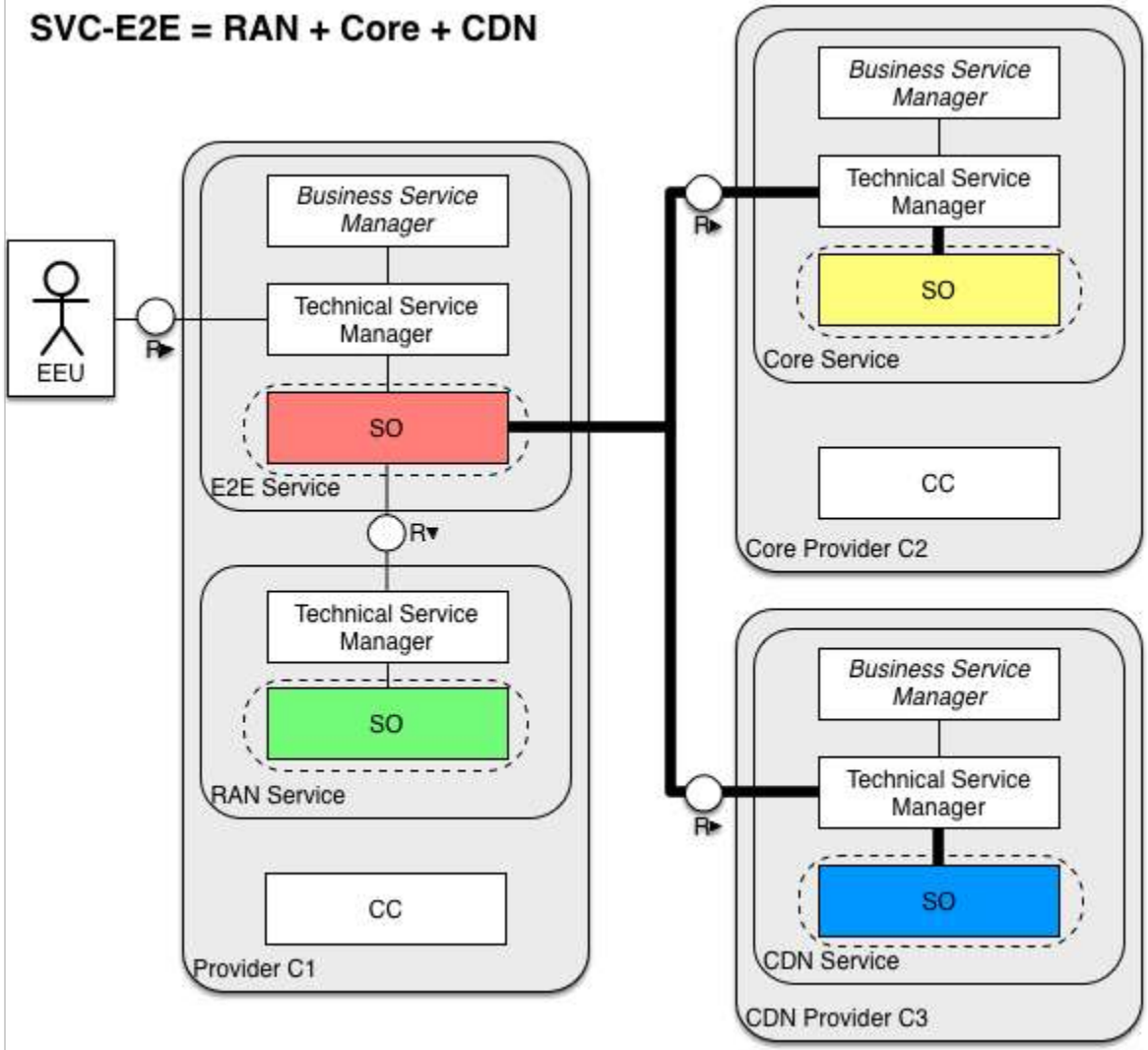
Where are we?

- Deployment phase is completed
- Eventually all services are created
- Not configured however

- Provisioning phase begins…

How is a MCN service instance provisioned?

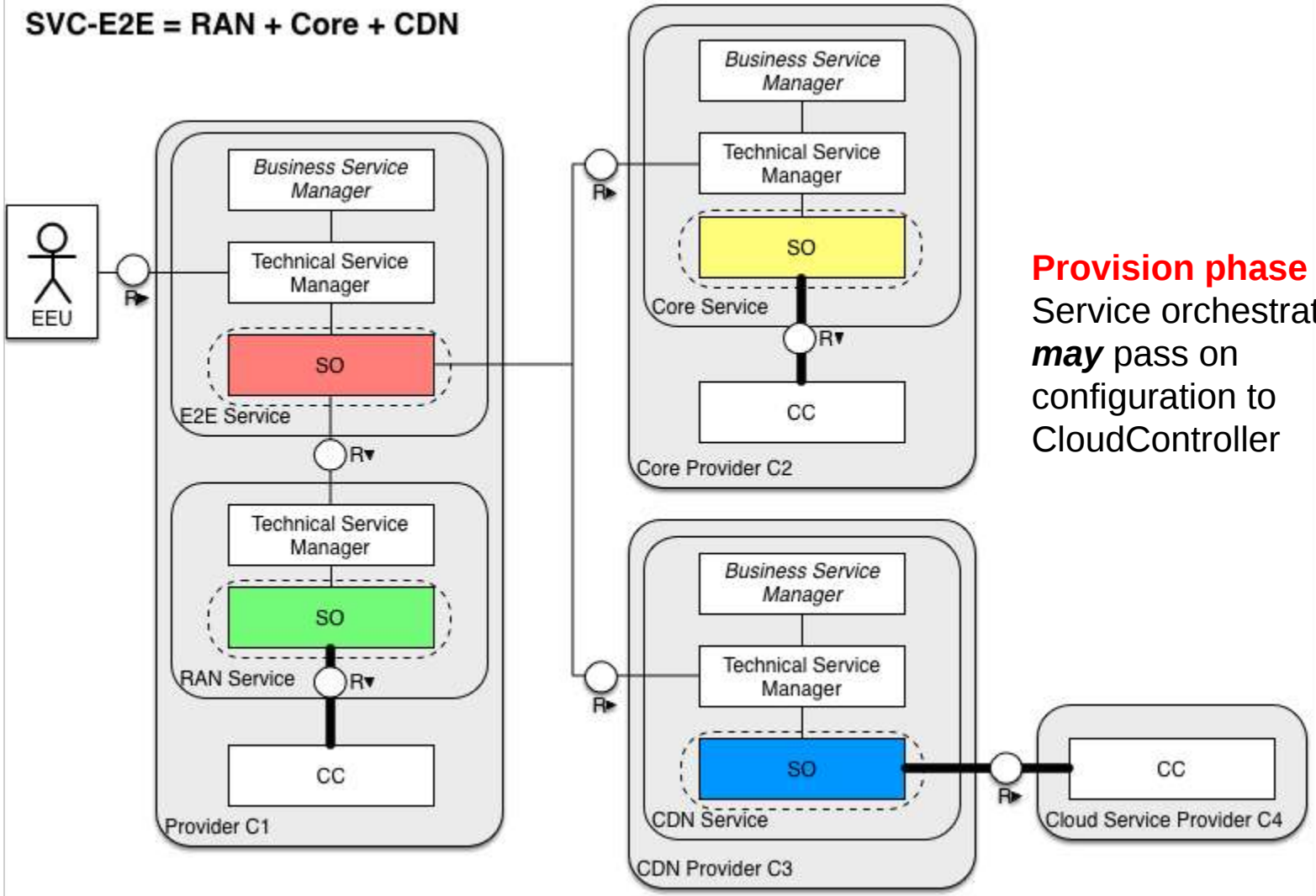


Provision phase

The SO has access to all other service instance management endpoints

Configuration information is supplied to these

How is a MCN service instance provisioned?



Provision phase
Service orchestrators ***may*** pass on configuration to CloudController

How is a MCN service instance created?

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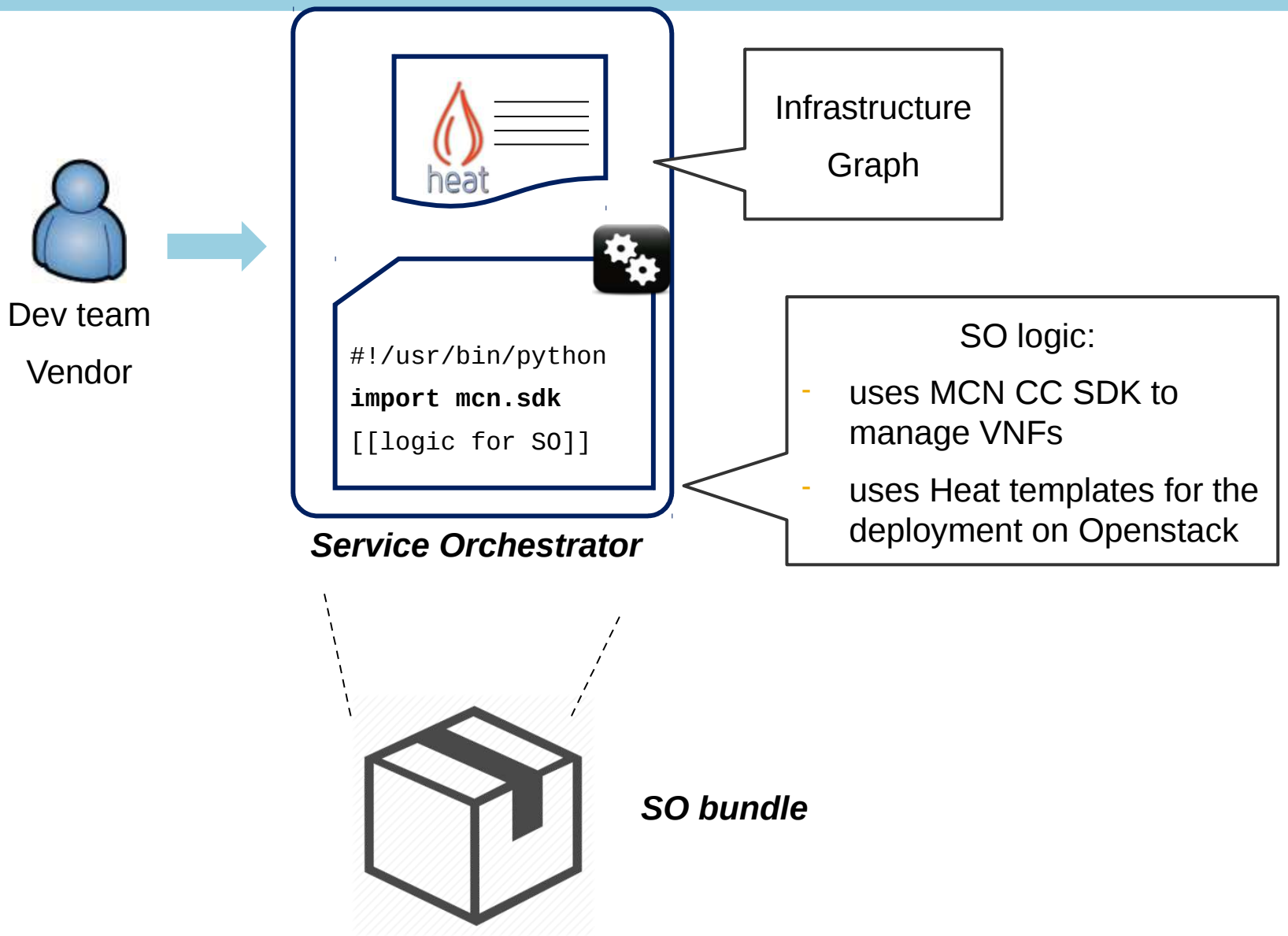
Where are we?

- Ready for service
- Deployment & provisioning phase completed
- Service instance management interfaces are available to the EEU
- EUU can use & further customise the service instance
  - *degree of configurability is dependent on service provider*
- SO of all service instances manage runtime
  - SOD & SOE

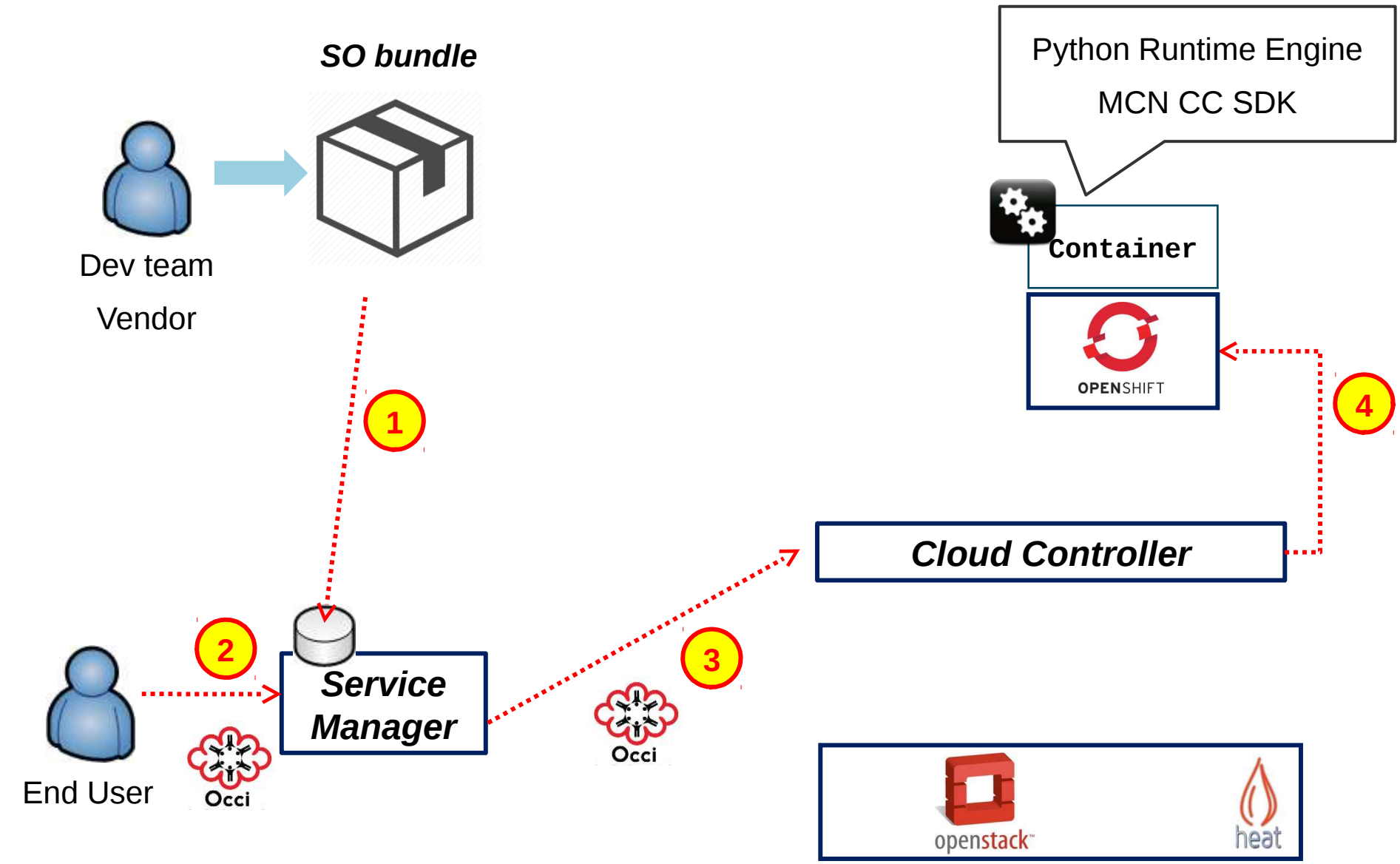
Short demo

- Orchestration Video

Creating a service with MCN



Deploying a service instance with MCN



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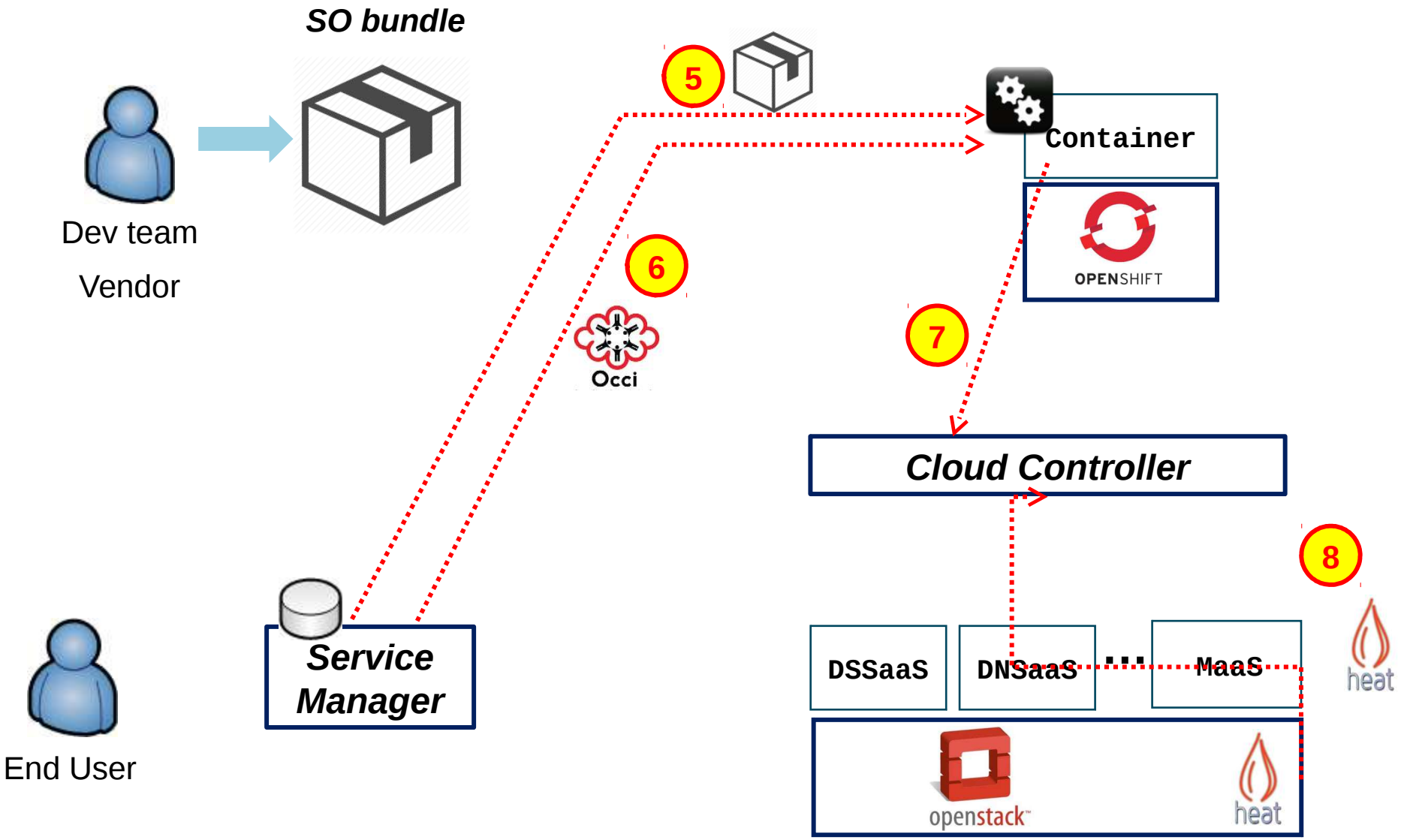
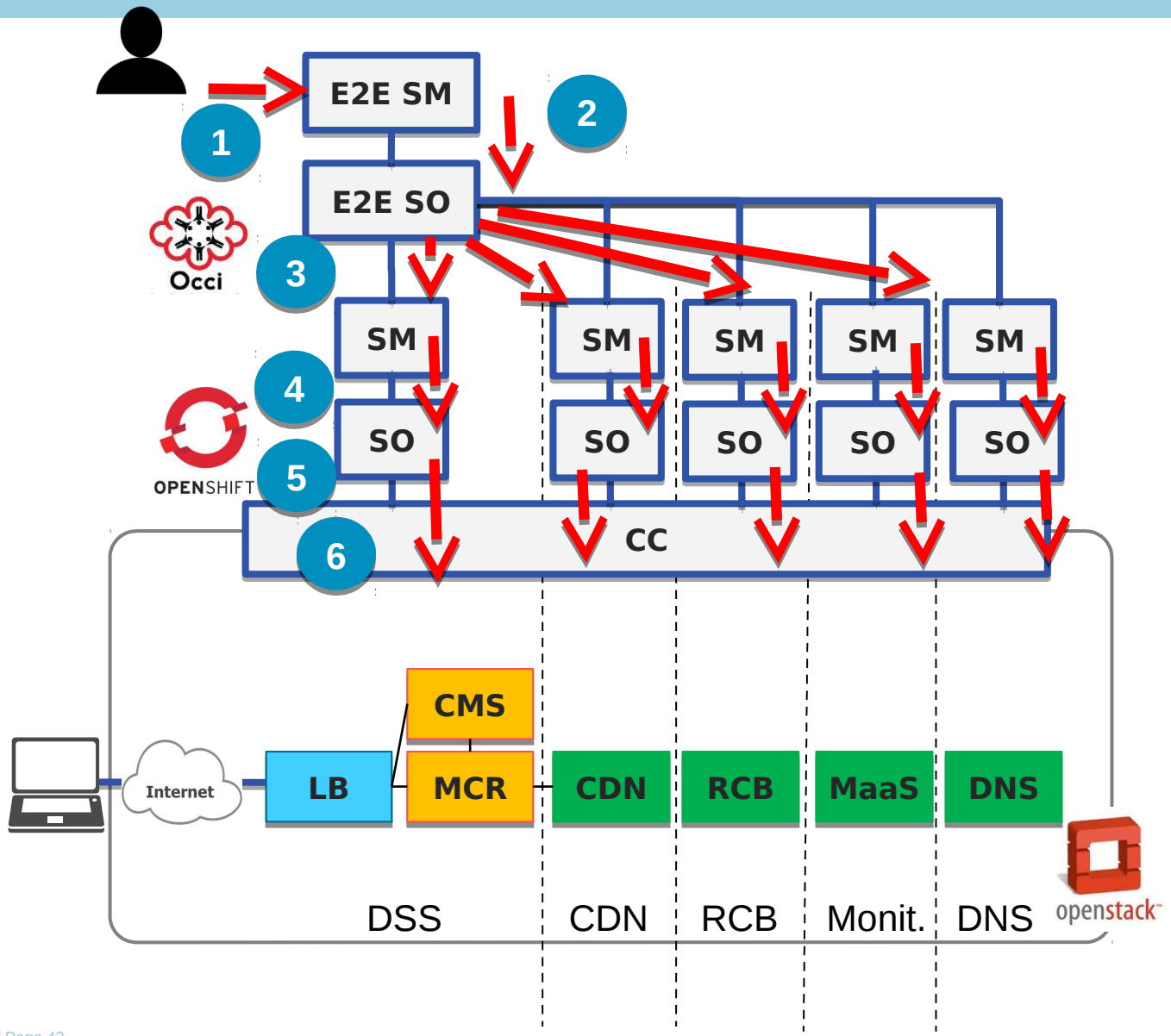
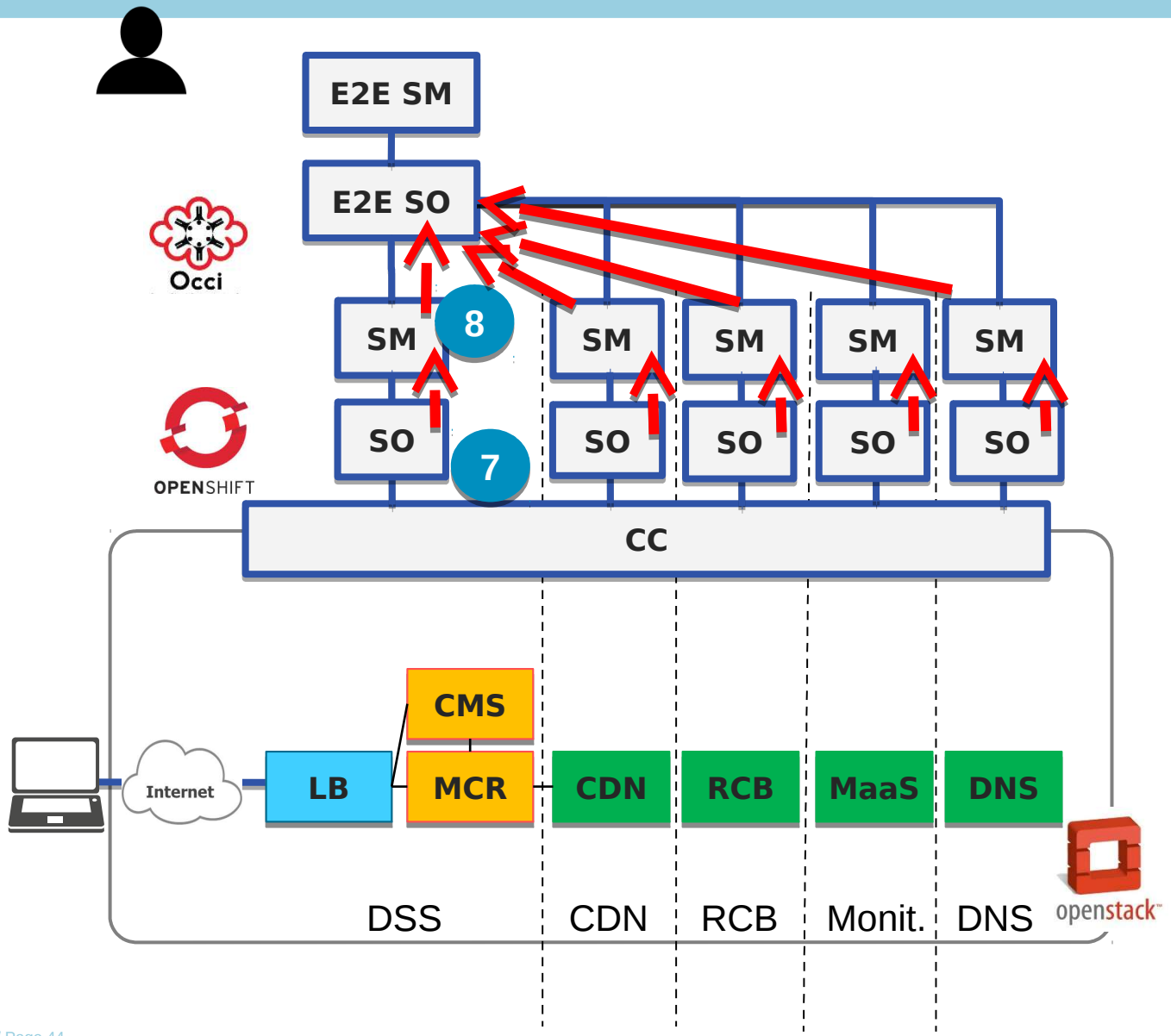


Architecture



Architecture



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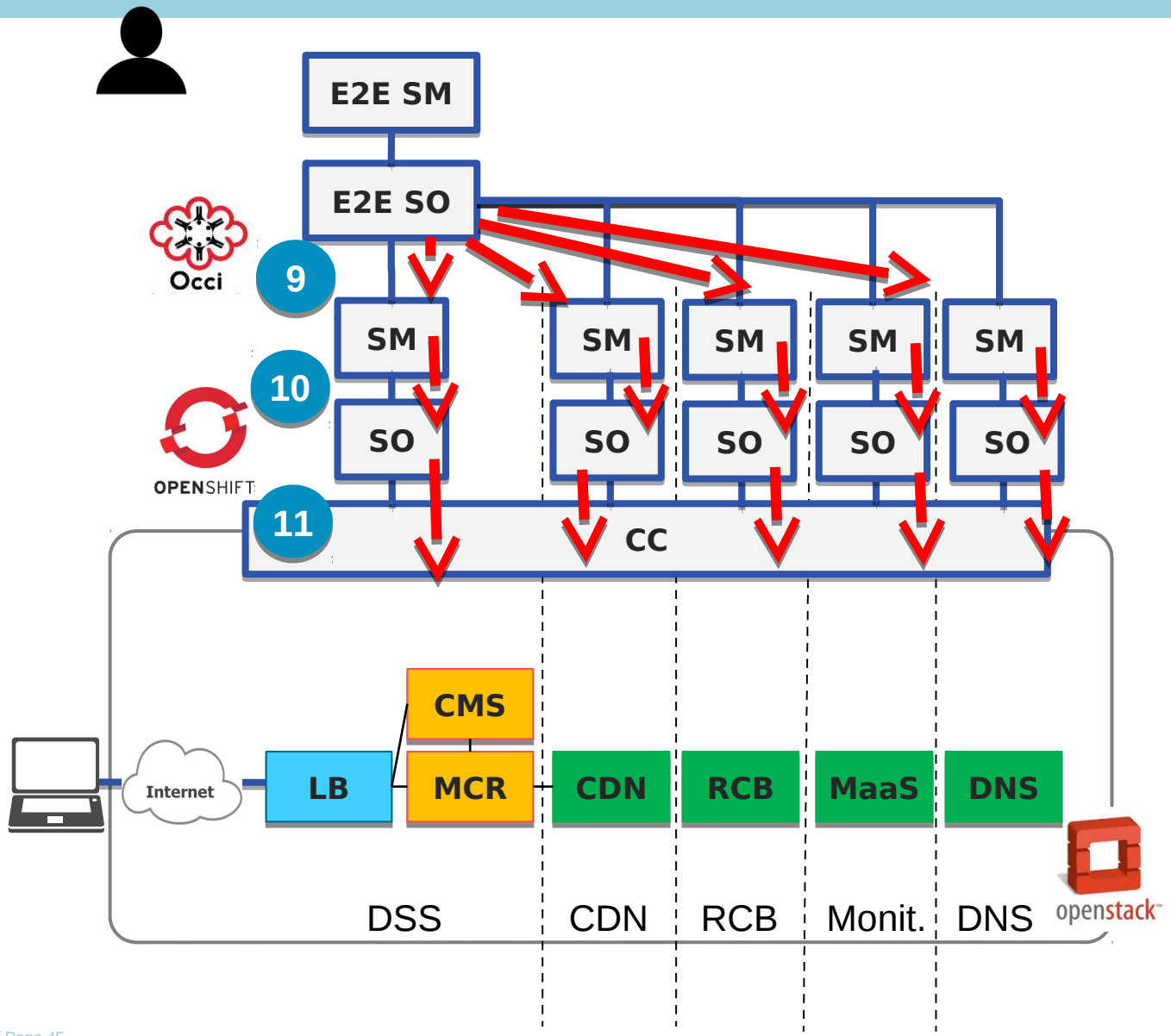
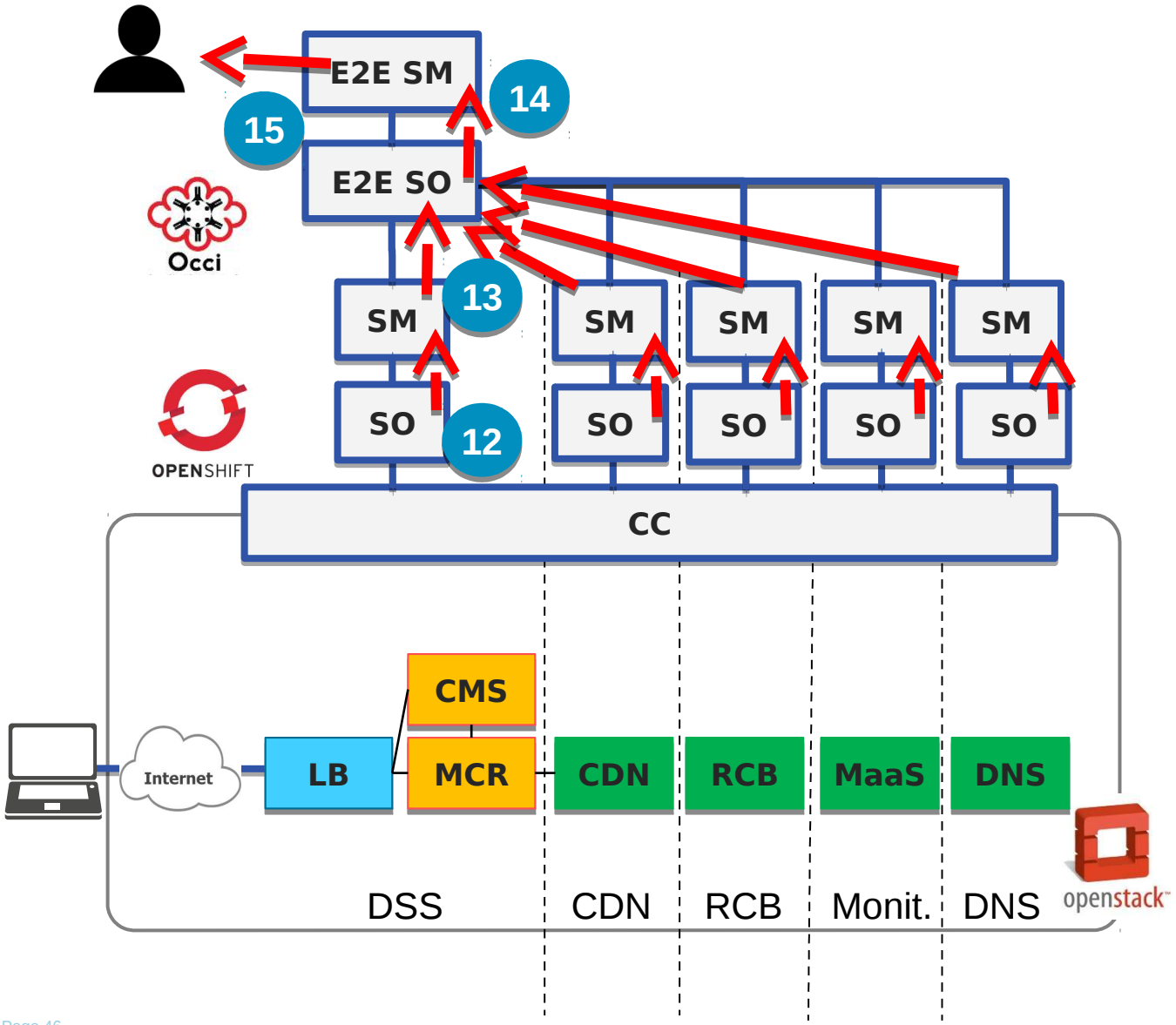
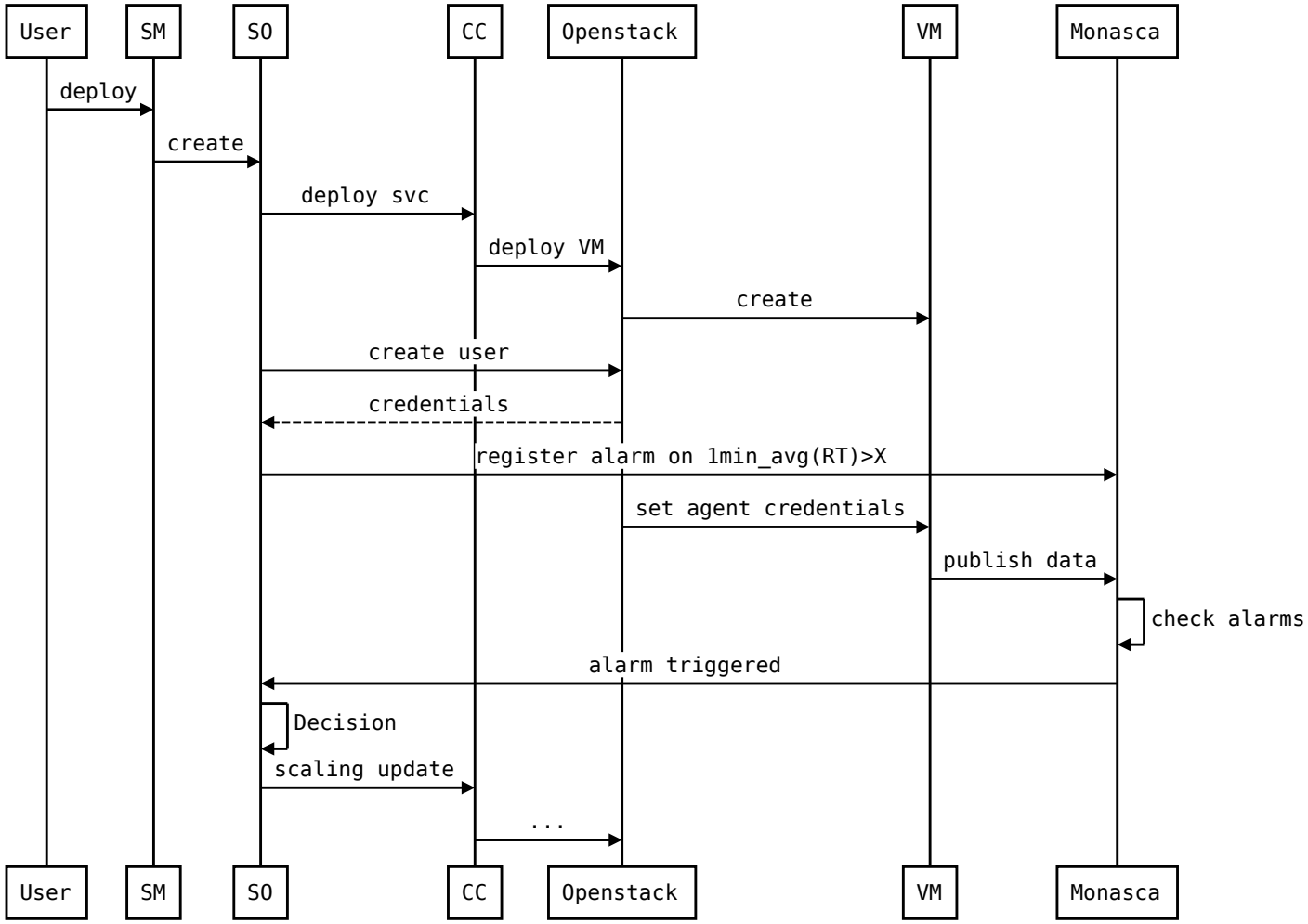


Architecture



Auto-scaling



MCN Experience

- Microservices principles:
  - loose coupled services with clear boundaries defined by interfaces
  - microservice independence:
    - performance and failure isolation
    - delegation to a single team
    - own release cycle
    - best technology for the task
    - decentralized data management
  - infrastructural automation
  - design for failure
- MCN is more about service composition
- Cloud-native services vs.
  - services depending on specific physical resources (sw replication not enough)
  - services with established communication channels
- Performance (latency) issues in RANaaS

THANK YOU!

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