SLA Management and Service Composition of Virtualized Applications in Mobile Networking Environments

G. Landi[1], Thijs Metsch[2], P.M. Neves [3], J. Mueller [4], A. Edmonds [5], P.S. Crosta [6]

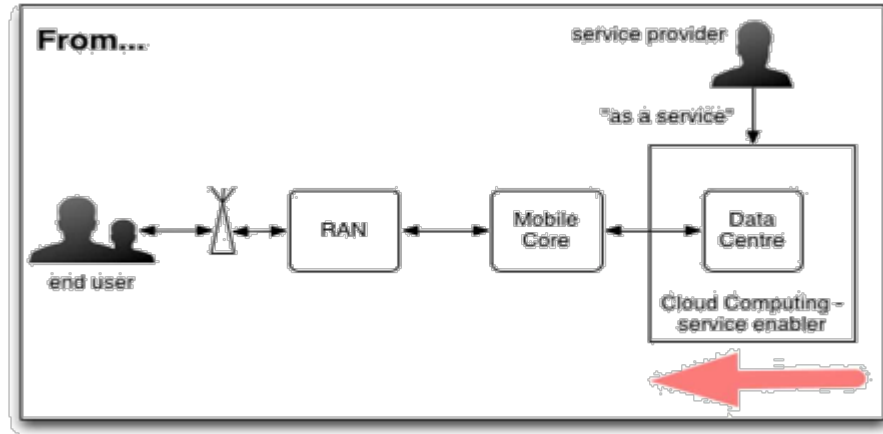[1] Nextworks, Italy - [2] Intel, Ireland - [3] Portugal Telecom Inovação, Portugal
[4] Technical University Berlin, Germany - [5] Zurich University of Applied Science, Switzerland
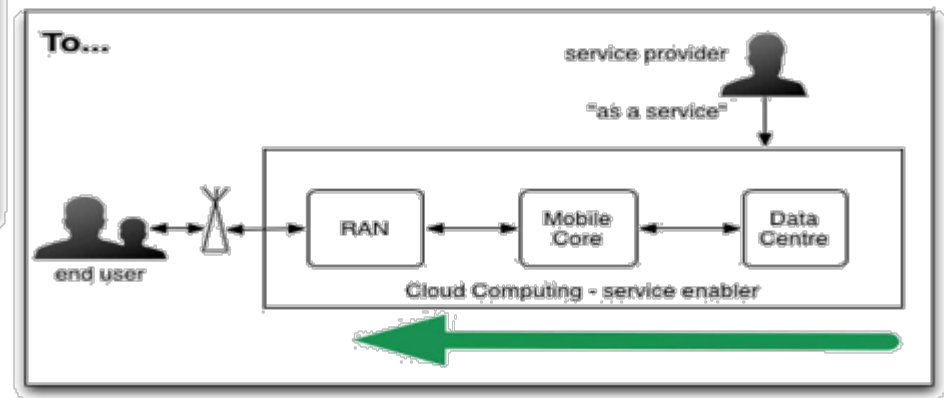[6] Italtel, Italy

SDNMO 2014

SEVENTH FRAMEWORK PROGRAMME

MCN
Mobile Cloud Networking

Cloud-based mobile networks: the concept

MCN
Mobile Cloud Networking

Moving cloud computing beyond datacenters…
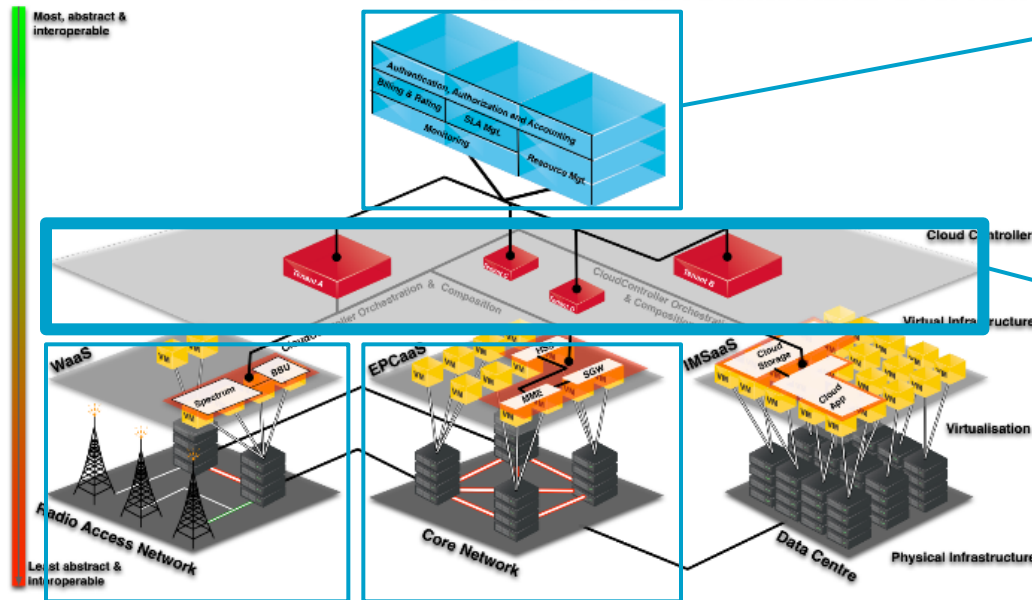
… towards the mobile end-users.

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

LTE systems on the cloud: the MCN approach

MobileCloud Architectural Overview

Support services
A full set of integrated services for end-to-end management solutions

Cross-domain control and management plane
The fundamental enabler for the *automated, seamless orchestration and composition* of heterogeneous cloud/net services and resources

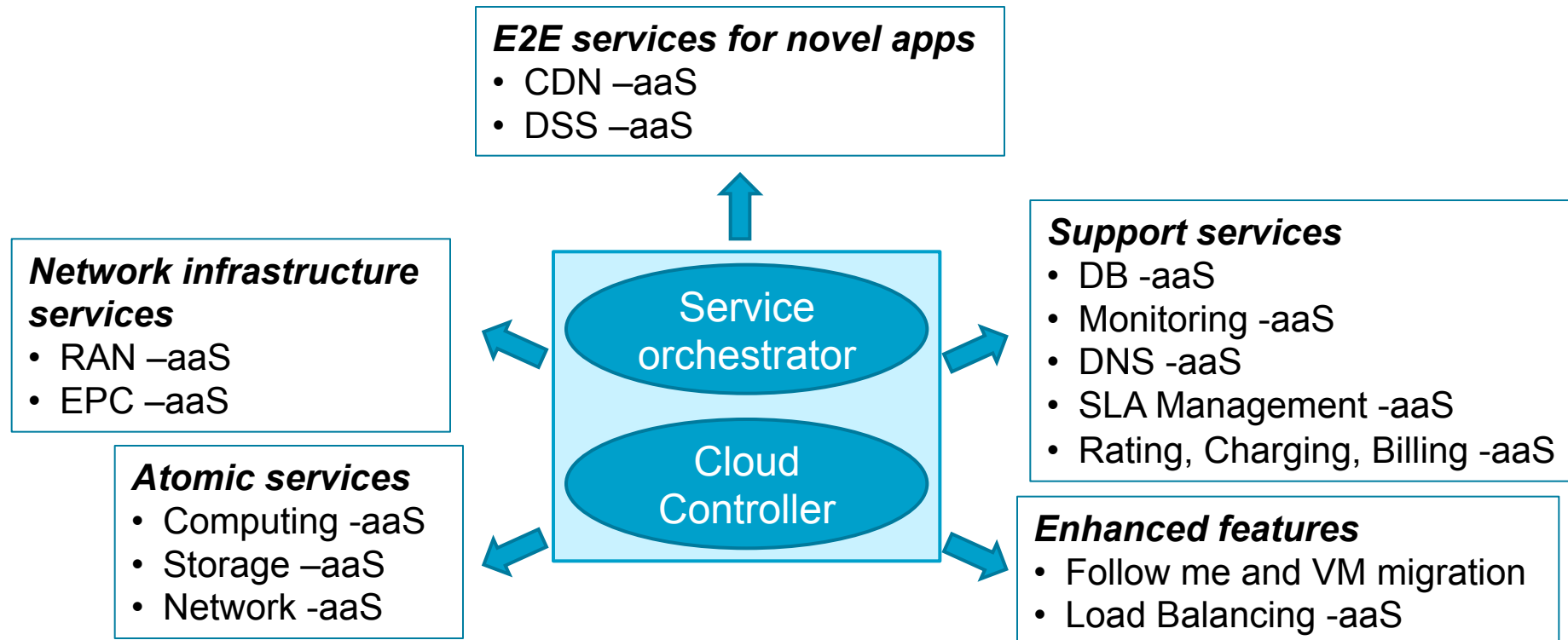**Mobile Core Network as a Service**
3GPP EPC data plane and control plane components provisioned on-demand and dynamically operated on the cloud

RAN as a Service
Offer heterogeneous radio access as a service, moving the BBU processing into DCs

MCN holistic vision

A dynamic and orchestrated composition of heterogeneous resources, atomic functions, supporting services and applications
Everything provided as-a-Service!
But how to manage SLAs for this service composition?

E2E services for novel apps
- CDN –aaS
- DSS –aaS

Network infrastructure services
- RAN –aaS
- EPC –aaS

Atomic services
- Computing -aaS
- Storage –aaS
- Network -aaS

Service orchestrator

Cloud Controller

Support services
- DB -aaS
- Monitoring -aaS
- DNS -aaS
- SLA Management -aaS
- Rating, Charging, Billing -aaS

Enhanced features
- Follow me and VM migration
- Load Balancing -aaS

SLA management in MCN: the challenges

End-to-end service chain of cloud infrastructures, virtualized network functions, support services & applications

- Offered by a single provider or through federation of multiple providers
- Composition of heterogeneous, but interdependent service components
- Sharing of cross-domain cloud/net infrastructures among multiple tenants

SLA management as an integrated support service of the MCN platform

- Enforcement and validation of end-to-end SLAs for complex services
- Exploiting the monitoring functions offered by the MCN platform
  - Combination of heterogeneous parameters, from different layers (net/cloud infrastructure or service performance) and belonging to different domains
- Support for pay-as-you-go and SLA-oriented charging models
- Trigger for customer-driven service elasticity and baseline for service reliability

MCN Reference Architecture

MCN framework based on a *service-oriented* architecture
- All the functional elements are modelled and delivered as services

Service Manager: the entry-point for all the service requests
- Business dimension to encode the business agreements
- Tecnical dimension to manage the Service Orchestrator instances

Service Orchestrator: a domain-specific component responsible of the *orchestration and binding* of MCN services and applications
- Manages inter-dependencies among service components

Cloud Controller: the component coordinating the *end-to-end provisioning* of atomic and support service resources

SLA management in MCN
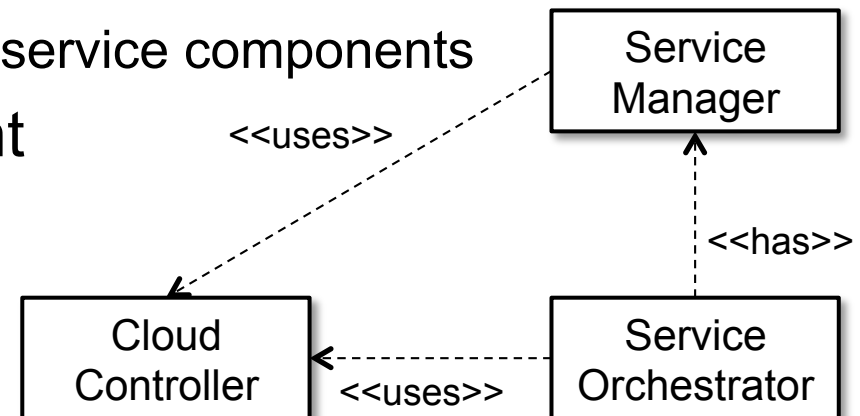
Objective: enable MCN providers to deliver end-to-end composed services compliant with the established SLAs
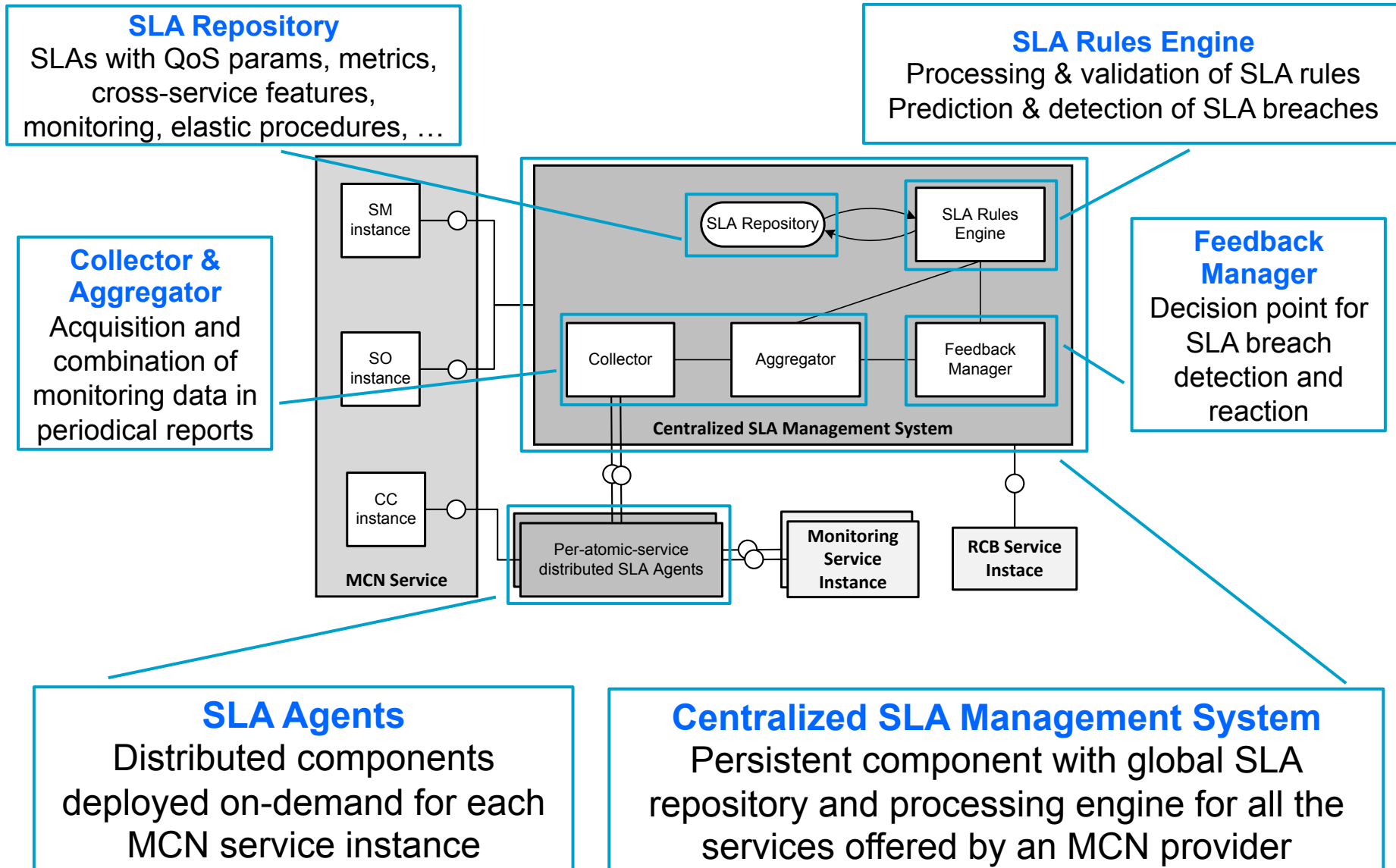
- Service Level Objectives at the single AND composed service level
  - Describing inter-dependencies and expected service cooperation
- Automated combination and joint evaluation of mixed information
  - From the virtual infrastructure at the resource level
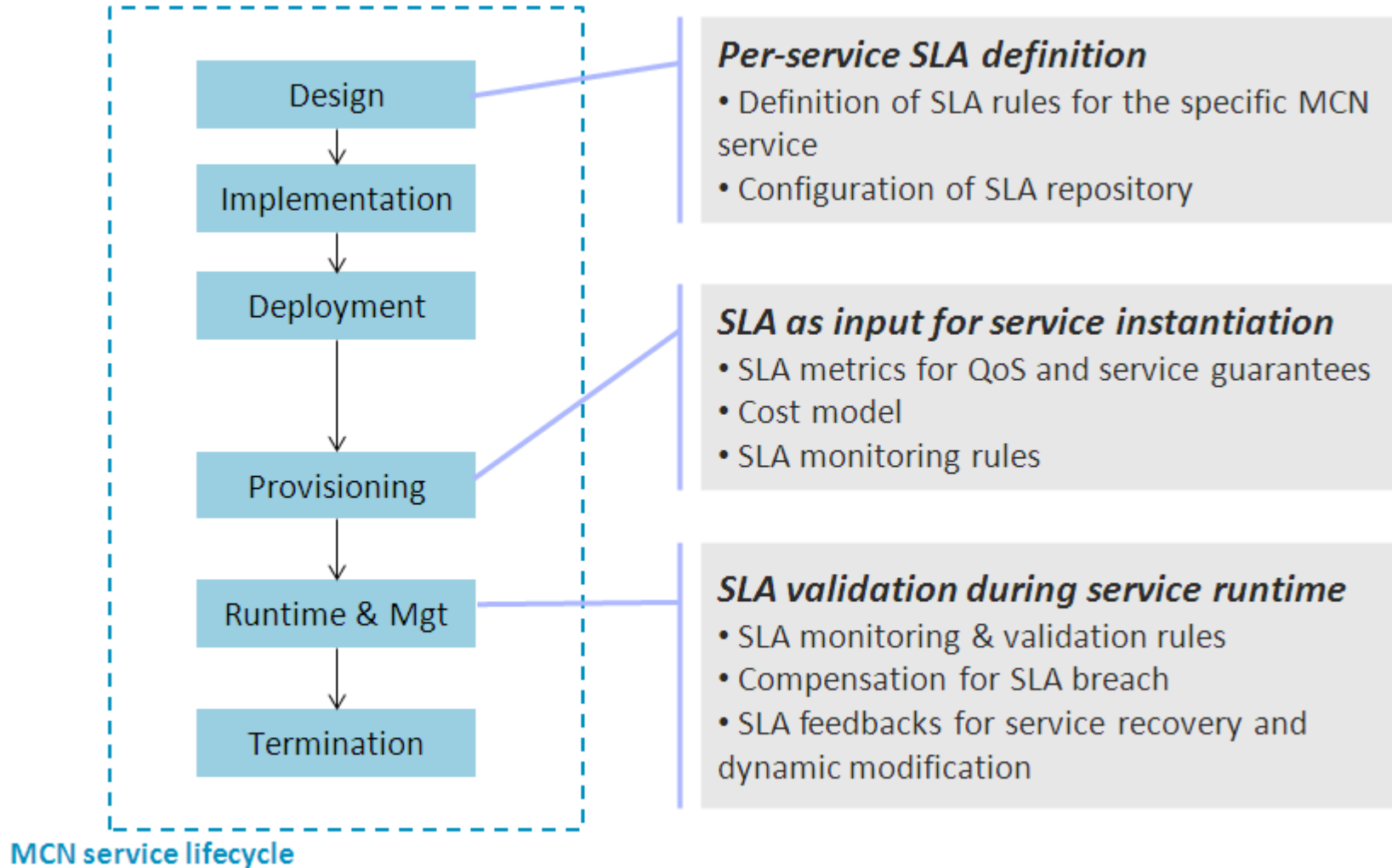 - From the different services at the application level

SLA management as a Service:

- Support service deployed and provisioned on-demand on the cloud
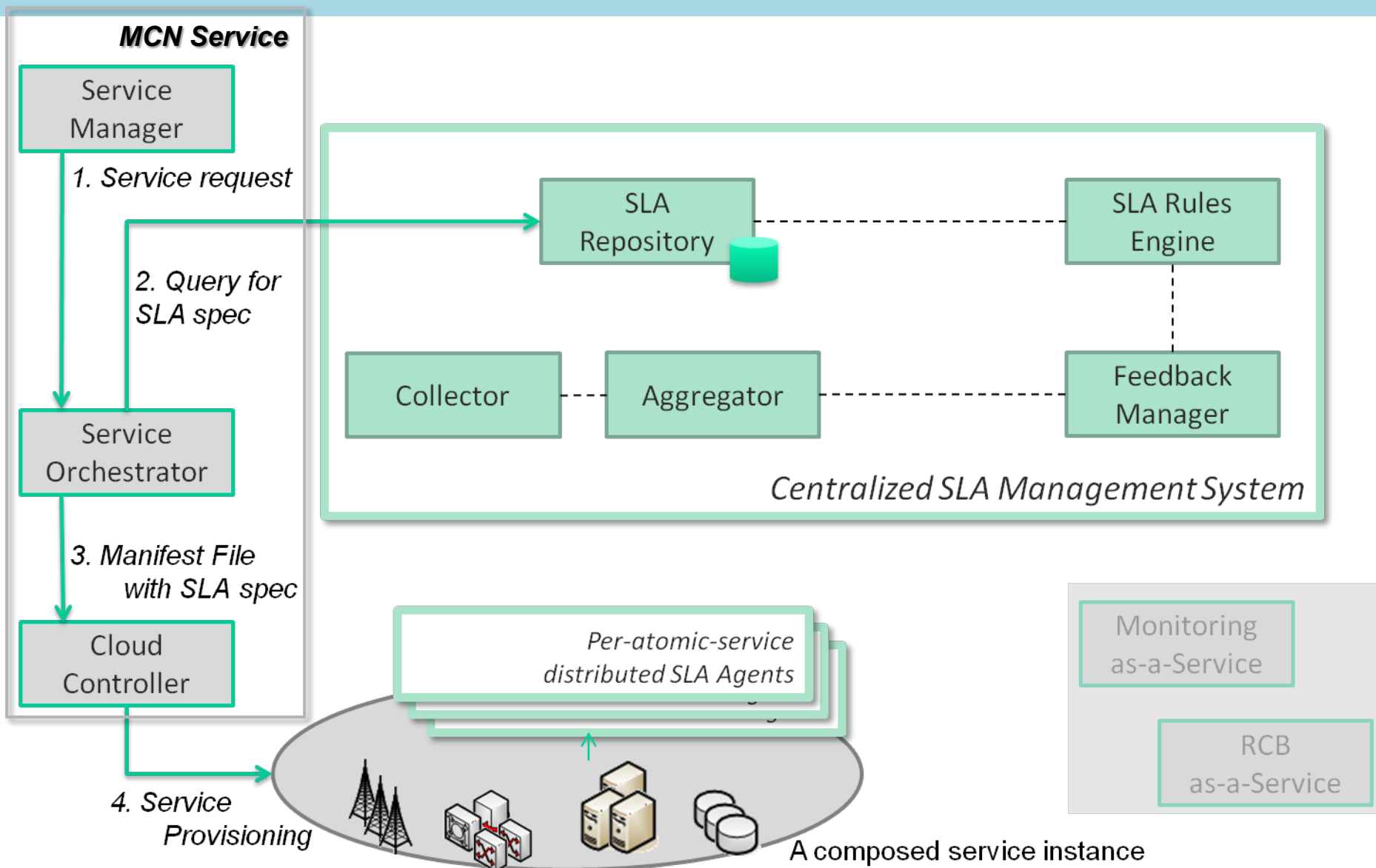- Automated adaptation to the dynamicity of the other services

Features:

- SLA repository for all MCN services
- SLA enforcement in support of the Service Orchestrator
- SLA verification to detect and react to SLA violations

SLA Management System

SLA Repository
SLAs with QoS params, metrics, cross-service features, monitoring, elastic procedures, …

SLA Rules Engine
Processing & validation of SLA rules
Prediction & detection of SLA breaches

Collector & Aggregator
Acquisition and combination of monitoring data in periodical reports

Feedback Manager
Decision point for SLA breach detection and reaction

SM instance

SO instance

CC instance

MCN Service

SLA Repository

SLA Rules Engine

Collector

Aggregator

Feedback Manager

Centralized SLA Management System

Per-atomic-service distributed SLA Agents

Monitoring Service Instance

RCB Service Instace

SLA Agents
Distributed components deployed on-demand for each MCN service instance

Centralized SLA Management System
Persistent component with global SLA repository and processing engine for all the services offered by an MCN provider

SLA management in MCN service lifecycle

MCN service lifecycle

Per-service SLA definition
- Definition of SLA rules for the specific MCN service
- Configuration of SLA repository

SLA as input for service instantiation
- SLA metrics for QoS and service guarantees
- Cost model
- SLA monitoring rules

SLA validation during service runtime
- SLA monitoring & validation rules
- Compensation for SLA breach
- SLA feedbacks for service recovery and dynamic modification

SLA enforcement @ service provisioning

MCN Service

- Service Manager
  - 1. Service request
  - 2. Query for SLA spec
- Service Orchestrator
  - 3. Manifest File with SLA spec
- Cloud Controller
  - 4. Service Provisioning

Centralized SLA Management System

- SLA Repository
- SLA Rules Engine
- Collector
- Aggregator
- Feedback Manager

Per-atomic-service distributed SLA Agents

A composed service instance

Monitoring as-a-Service

RCB as-a-Service

A composed service instance
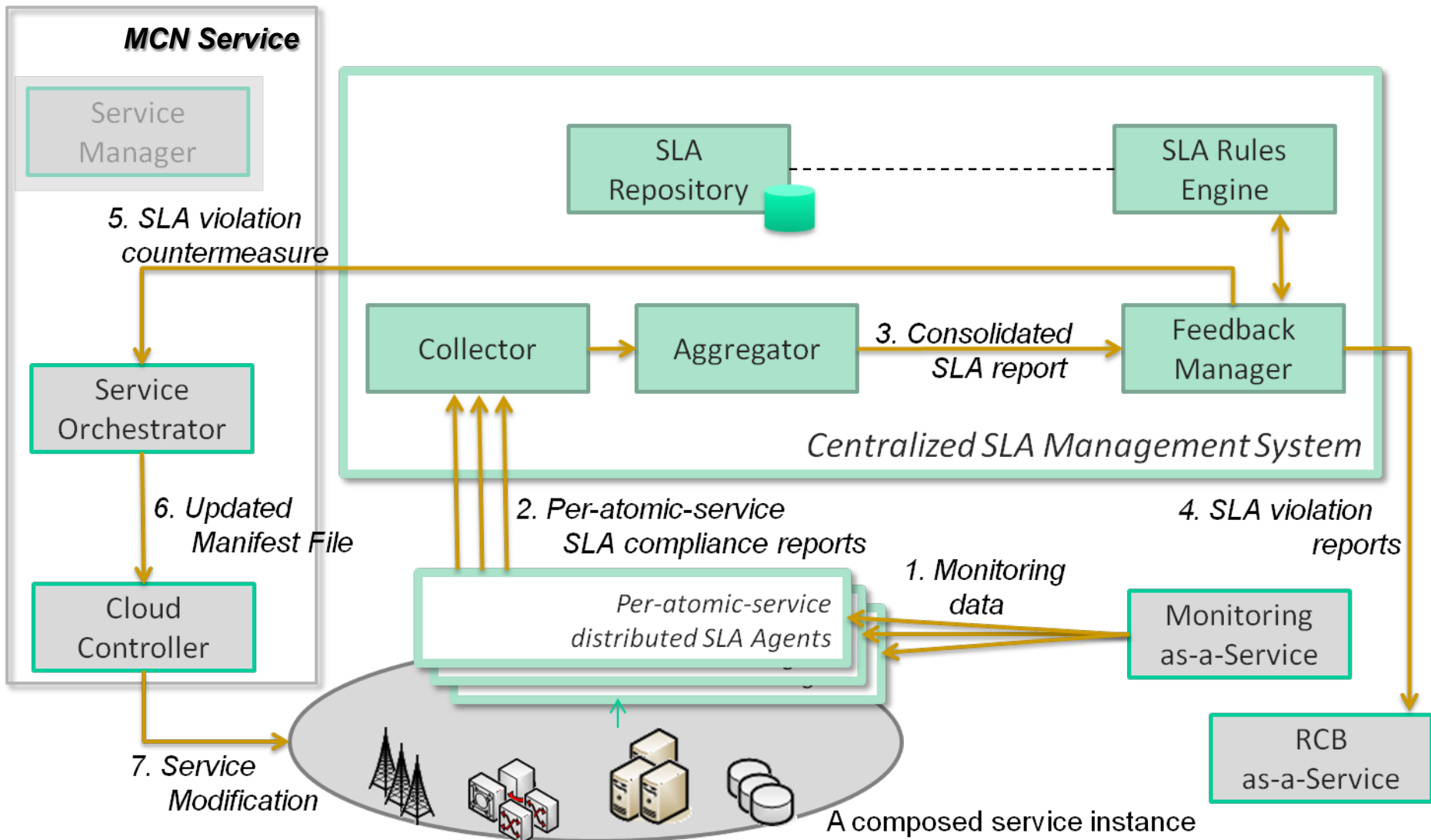
Monitoring for SLA verification: Monitoring as a Service
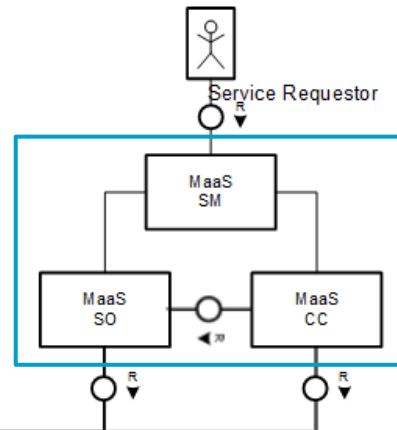
SLA Agents
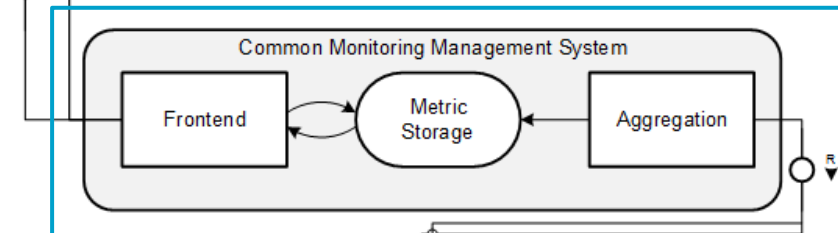as specific Monitoring Consumers deployed on-demand
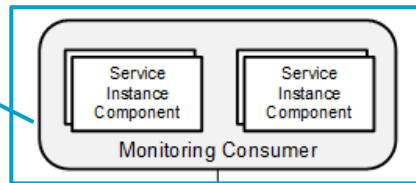
MaaS as MCN support service
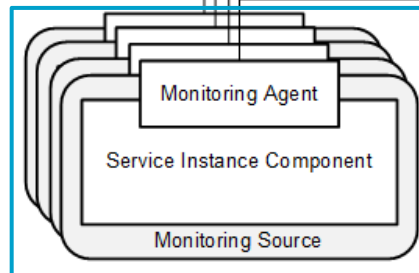Follows MCN services lifecycle: requested via SM, coordinated through SO, provisioned by CC

CMMS
Centralized elaboration & storage of heterogeneous monitoring data

Monitoring Agents
to collect information from a variety of service components

Conclusions

Many **opportunities for cloud-based mobile networks**…

- Full exploitation of cloud concepts
    - On-demand and self-service
    - Elasticity
    - Multi-tenancy
    - Pay-as-you-go
- Seamless integration of mobile connectivity + computing + storage resources
    - On-demand end-to-end services for novel applications

… with many **technical challenges**

- Radio Access and Mobile Core Networks moved on the cloud
- A full set of enhanced functions and support services for e2e cross-layer management
    - LoadBalancing-aaS, Monitoring-aaS, RCB-aaS…

A seamless and automated composition of cloud resources and services that requires an **integrated SLA management** service

- Active during the different service phases
- Supporting SLA enforcement and validation
- Combining a mix of heterogeneous monitoring data at infrastructure and service level

THANK YOU!

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