Enabling rapid and adaptive network applications deployment

Net Futures 2015
Session: Network Applications – how to unleash the full innovation-potential of SDN and NFV

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Network –and not only- “softwarization”

- *The Future Internet is the **Future Internet “Software”**.*
- *Era of a **software revolution** through the design of **infrastructural agnostic applications**.*
- *Applications and services provided **without** the definition of **strict** “borders” and “control” points.*
- ***“Softwarization”** seen as a **game-changer** for the Telecom, Cloud and ICT domains.*

A new world of network applications

- ***Reconfigurable by design*** *applications.*
- *Exploit* ***programmability*** *of the underlying infrastructure.*
- ***Dynamically adaptive*** *according to network conditions and policies.*
- *Need for* ***novel programming paradigms*** *and* ***open APIs****.*
- *Avoid vendor lock-in.*

A win-win situation

*The **applications developer** perspective*

- Develop applications in an infrastructural agnostic way;
- Provide hints for optimal deployment and execution;
- Introduce novelty based on new paradigms.

*The **communication services provider** perspective*

- Provide novel, reliable and scalable services;
- Optimal use of the available resources;
- Reduce administration overhead;
- Respect high level network policies.

*The **equipment vendor** perspective*

- Unaware of the services/applications running;
- Flexibility to design generic boxes - support of software based functions.

The applications developer view

*Definition of **Service Chaining**.*

*Description of envisaged **customization** of the execution part through **annotations**.*

Deployment** of the application by an **Orchestrator

- initial allocation of resources in a virtualized environment;
- dynamic composition of the service – instantiation of the software components;
- deployment and operation in a distributed fashion;
- guarantees for scalable and reliable operation.

*Improvement in **QoE** of end users.*

Challenges to be faced

- *Definition of **service chaining schemes**.*
- *Optimal **placement of services/applications**, especially in **distributed** environments.*
- ***Dynamic allocation** of resources.*
- ***Vertical** and **horizontal** scaling.*
- *Deployment in **multiple IaaS** environments.*

Enabling Technologies

Network Function Virtualization

- Deployment and management of applications;
- Carrier grade and scalable solutions.

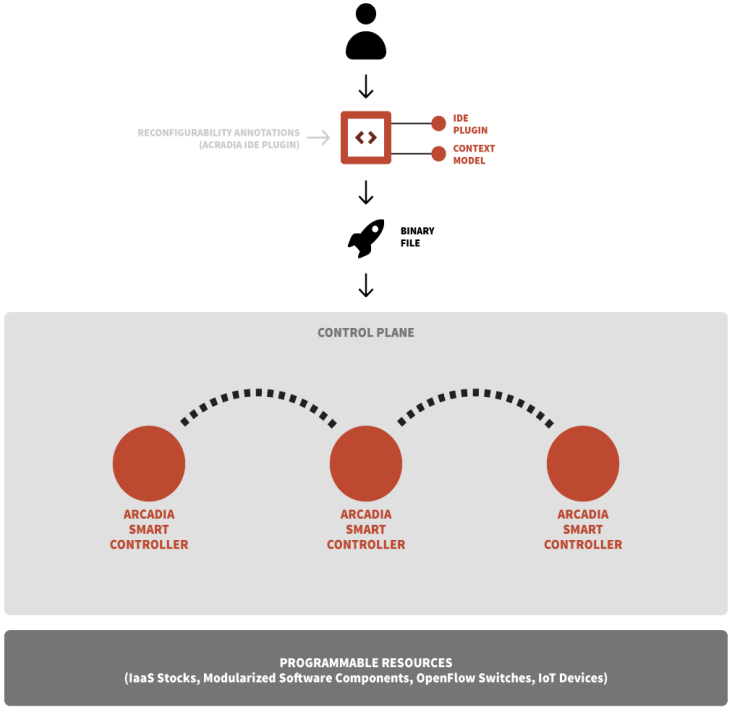
Software Defined Networking

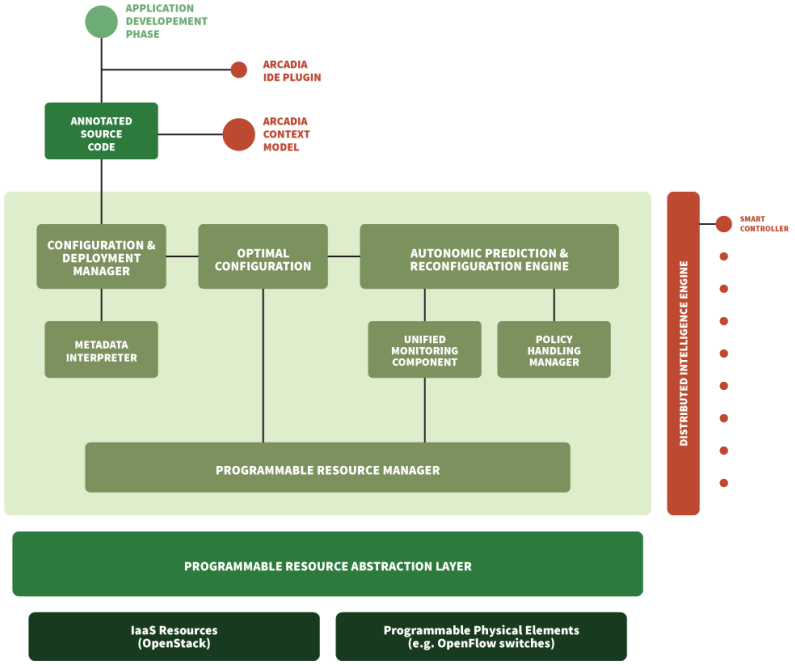
- Exploit network programmability;
- Management of NFV deployments.

Interpretable Software Annotations

- High level description of objectives;
- Configurability hints to orchestration components;
- Real time adaptation/re-configuration.

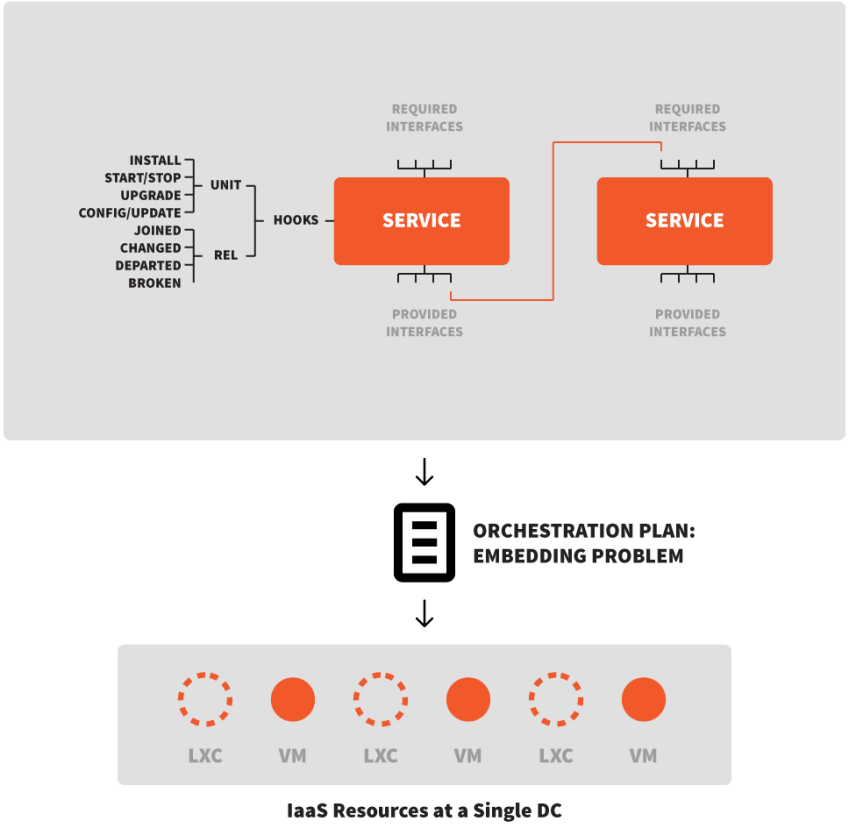
ARCADIA Conceptual Architecture





ARCADIA Horizon 2020 EU funded project
Call:H2020-ICT-2014-1
Start Date: 01/01/2015
http://www.arcadia-framework.eu

Service Composition and Orchestration based on Annotations

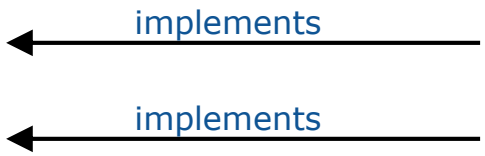


A specific type of composition is chaining.

Follow the Chain Of Responsibility pattern.

Inter-Container Composition

@Service
@Component
ServiceAIface
ServiceAImpl
@Service
@Component
ServiceBIface
ServiceBImpl



Development Time

```
ServiceX {                          // (that requires ServiceA & ServiceB)
   @Autowired
   ServiceAIface instance1;
   @Autowired
   ServiceBIface instance2;
   intance1.doA();
   instance2.doB();
}
```

development takes place using interfaces and NOT reference implementations

we rely strongly on Dependency Injection

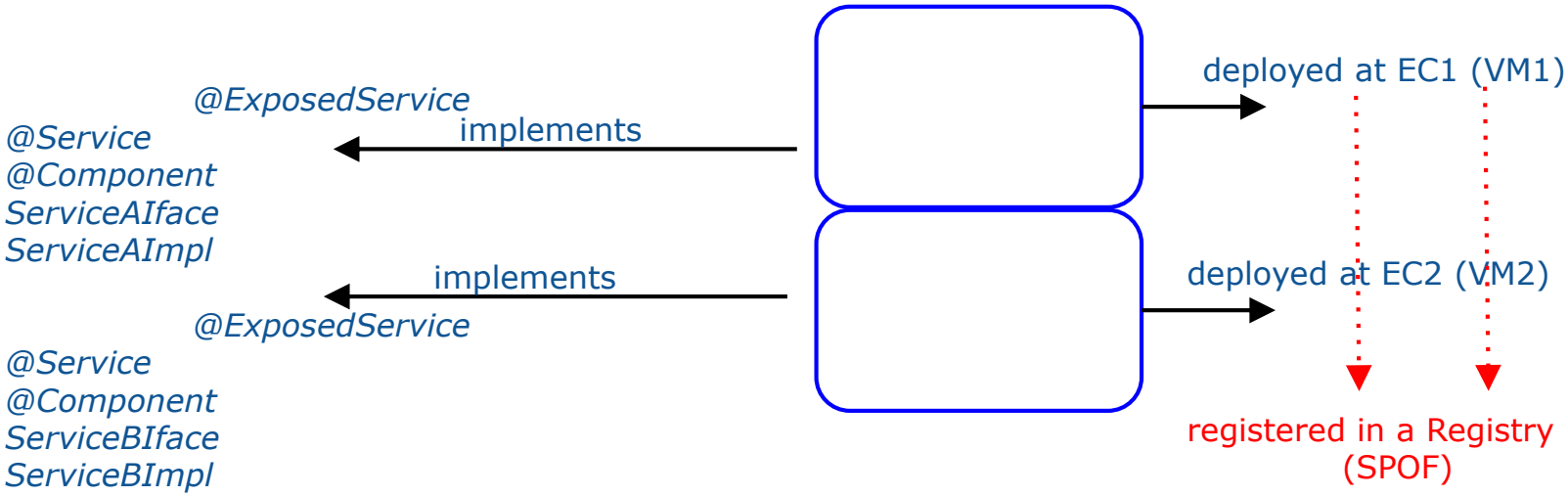
→ During Bootstrapping the Execution Container MAY provide guarantees that the Composed service cannot be executed
→ Yet self-healing and recovery is up to the Developer

But what happens when we move from a managed Execution Container to Distributed ones?

Porting to a Distributed Environment

- *When Composed Services use Services that do not exist in the local container there must be a **pattern of identifying them** and using them.*
- *A remoting technology must be used.*
- *The **Service Locator Pattern** can be considered as a functional solution.*
  - code to be added at run-time;
  - applications can optimize themselves at run-time by selectively adding and removing items.
- *The Service Locator is going to be implemented within the Orchestrator.*

Service Exposure & Registration

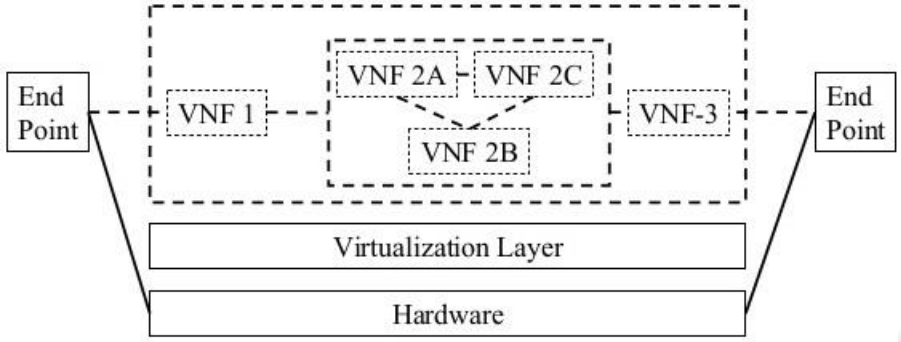


Development Time

```
ServiceX {                          // (that requires ServiceA & ServiceB)
   @ServiceLocateAndAutowire
   ServiceAIface instance1;
   @ServiceLocateAndAutowire
   ServiceBIface instance2;
   intance1.doA();
   instance2.doB();
}
```

Service Chaining according to Virtual Functions (VFs)

- *Develop **NFV-aware applications** - **Virtual Network Functions (VNFs)** are becoming more and more **application oriented**.*
- *VNFs require **support of application orchestration** beyond network resource configuration.*
- ***VFs** as abstraction of **VNFs**.*
- ***Service Chaining**: multiple VFs used in sequence to deliver a service - E2E Services composed through **VF Forwarding Graphs***



ETSI NFV Architecture, Network Functions Virtualisation (NFV); Management and Orchestration

Service Chaining according to VFs - Challenges

- *Definition of a **Northbound interface (NBI)** between the VFs and the applications.*
- *Design of **service chaining & service insertion** algorithms & protocols.*
- *Design of **optimization** mechanisms.*
- *Design of **NFV orchestration** algorithms.*
- *Support of **distributed** VFs.*

Services Description Models

TOSCA specification

- language to describe service components and their relationships;
- management procedures that create or modify services using orchestration processes;
- deployments in different environments to enable interoperable deployment of cloud services

TOSCA Simple Profile for Network Functions Virtualization (NFV) Version 1.0

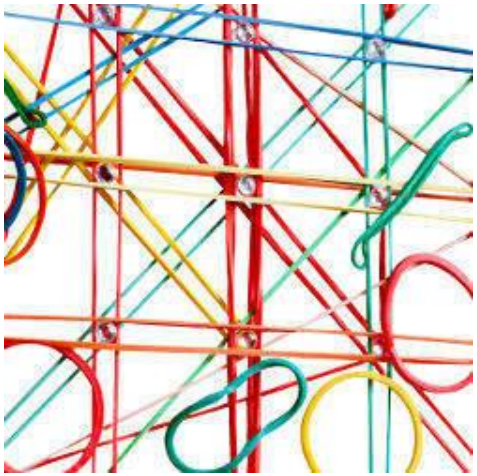
- define virtual application topologies, VNF dependencies and relationships, actions to be performed as part of a lifecycle.

Need for a standardized Modeling Language.

Elastic and Distributed VFs

Elasticity

- VF scaling within the local infrastructure or across different administrative domains;
- resiliency and service continuity;
- sensitivity in latency – high criticality VFs.



Most VNFs are currently stateful

- redesign is required;
- run on small VMs in a stateless mode or support state migration.

Take into account the whole VF FG during orchestration – across many NFVI PoPs.

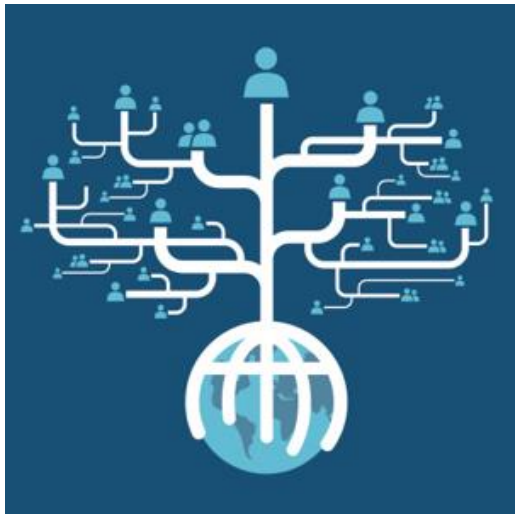
Distributed Applications/Services Embedding Problem

- ***Optimal placement*** *of VF Forwarding Graphs.*
- *Take into account* ***dependencies*** *with other service instances.*
- *Take the* ***whole service function chain's performance*** *into consideration.*
- *When placing VFs in distant locations, the* ***traffic created*** *has to be taken into account.*
- ***Lightweight virtualization*** *to be considered for* ***performance sensitive*** *applications.*

The Role of Software Defined Networking (SDN)

***SDN** can play a key role in the **orchestration** of the infrastructure (physical, virtual)*

- Provisioning and configuration of VFs
- Security & policy control
- Network monitoring
- Unified control & management plane



Service chaining

- Directing traffic flows to VFs
- Traffic flow characterization

*A SDN controller could be **part of the service chain**.*

Business Opportunities for ICT Industry

- ***Flexibility*** *to easily, rapidly, dynamically provision and instantiate new services in various locations.*
- *Increased* ***speed of time-to-market*** *by minimising the typical network operator cycle of innovation.*
- *More* ***service differentiation & customization****.*
- ***Software-oriented innovation*** *(including Open Source) to rapidly prototype and test new services.*
- ***Reduction*** *of* ***cost*** *and increased* ***energy efficiency****.*

SDN and NFV technologies seen as a unified software based networking –and not only- paradigm

ARCADIA

A novel reconfigurable by design highly distributed applications development paradigm over programmable infrastructure

http://www.arcadia-framework.eu

Thank you for your attention!

Questions?

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