Network Slicing Roles and Interfacing in NFV Systems

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Context

- Current networks are evolving towards deeper virtualization schemes, mainly reflected in NFV.
- **Slicing** physical and virtual resources in NFV is essential for exploiting their capabilities.
- **Plasticity** and **composability** provide enormous benefit to current and future NFV systems.
- **Ubiquity** of VNF hosting services, in distributed datacenters, adds additional flexibility.
- Also improved isolation, scalability, and reusability.

Technical Viewpoints (I)

• From-Provider-to-Consumer:
  – NFV providers aim to maximize the exploitation of their resources.
  – NFV providers slice their infrastructure resources to get a larger set of smaller resources to “sell” to their customers:
    • The link between the original and resulting resources forms the main key of their management operations.
  – Sliced resources allow NFV providers to concentrate on their business:
    • Consumers will be responsible of embedding their infrastructure onto the new resource abstraction.
Technical Viewpoints (II)

• From-Consumer-to-Provider:
  
  - **NFV slice consumers** (NFV-O) aim...
    
    ...to meet the requirements of their networks (set by ASPs),
    ...reduce the cost of ownership and possibly operation,
    ...be able to adapt their networks to changing environments,
    ...adding and removing resources as they need,
    ...as fast as possible,

  - Therefore, they...
    
    ...obtain a **slice of resources**, possibly from different providers, possibly raw (e.g. L2 link) or processed (e.g. secured tunnel),
    ...and build an overlying service by integrating obtained resources as their main **business goal**.

  - The **two-hop link** that connects the final services to their slice and to the NFV provider is the **key** of their **management operations**.
Functional Roles (I)

- **NFV Provider (NFV-P):**
  - **Owns** the physical or virtual resources:
    - Links, switches, routers, computers, etc.
  - **Slices** the NFV infrastructure / resources to get:
    - Arbitrarily smaller portions => *Increased granularity.*
    - Easy/fast topology/purpose changes => *Enlarged flexibility.*
    - Dynamically specified parameters => *Enlarged plasticity.*
  - Interacts with upper layers (NFV-O) and execute their **CRUD** requests on the sliced resources.
  - The **main concerns** of the NFV-P are:
    - Managing their physical and virtual infrastructure
    - Addressing slice requirements.
    - Improving resource efficiency and efficacy.
Functional Roles (II)

- **NFV Operator (NFV-O):**
  - Manages *slices of VNFs* to build managed (or self-managed) network systems for upper layers.
    - Packages VNF-P resources into **Composite Services**.
  - Its main concern is requesting **CRUD** on VNFs.

- **NFV Controller (NFV-C):**
  - Main software solution used by NFV-O to control their resources through their corresponding underlying infrastructure controllers.
  - Interacts with the **Slice Manager** of the NFV-P and the **NFV Orchestrator** to reflect required adaptations.

- **Recursivity:**
  - An NFV-O can slice its resources and act as an NFV-P, so they will support an NFV-P protocol/interface transparently.
  - Example vertical structure:
    - **NFV-O ↔ NFV-P ↔ NFV-O ↔ NFV-P**.
Functional Roles (III)

• Application Service Provider (ASP):
  - Interacts with the end users.
  - Requests the NFV-O the **instantiation** and required adaptation of their network services:
    • Translated to VNF hierarchies.
  - Its main **business goal** is centered on negotiating, managing, and meeting **end user requirements**.
Functional Roles (IV)

- Variations:
  - The same entity plays all the roles (NFV-P, NFV-O, ASP).
  - Two entities, bottom:
    - An entity plays NFV-P and NFV-O,
    - Other entity plays ASP.
  - Two entities, top (most common):
    - An entity plays NFV-P,
    - Other entity plays NFV-O, ASP.
  - Each role is played by a separated entity (best option).
- Multiple, vertical NFV-Os (recursivity) can be easily fomented on the last variation.
Viewpoints, Roles, and Interfaces

Interaction, End Users

ASP

Applications and Services

Dynamic Requirements and Events

NFV-O

Virtual Network Slices

NFV-O

Multiple Layers

NFV-O

I1

I1

I1

I1

I3

I3

I3

I3

Resource Management

NFV-P

Physical / Virtual Infrastructure Slices

NFV-P

NFV-P

NFV-P

I1+I2

I1+I2

I1+I2

I1+I2

I2

I2

I2

I2

I4

I4

I4

I4
Interfacing Requirements

• NFV-O <=> ASP:  I1
  - ASP requests to CRUD on VNs.

• NFV-P <=> NFV-O:  I2
  - Allows the NFV-O to manage the “slice” of network resources from a provider.
    - Vertical interaction to request and instantiate (embed) virtual networks (VNs) onto the underlying physical infrastructure.
    - Possibly recursive when a NFV-O also acts as NFV-P.

• NFV-O <=> NFV-O:  I3
  - Allows NFV-Os to coordinate:
    - Inter-operator tasks (e.g. resource migration) requested by ASPs.
    - Interconnection and interoperability among VNFs managed by different operators.
  - Horizontal (non-recursive) communication among operators.

(?) NFV-P <=> NFV-P:  I4
  - Horizontal communication between providers to coordinate the interaction among slices of infrastructure resources, with some support for migrating VNFs among providers.
Thanks for Your Attention

Questions?