ALTO-based Broker-assisted Multi-domain Orchestration

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Presentation in a nutshell

- ALTO-based Broker-assisted Architecture
  - From initial discussions arose the possibility to propose a new ALTO service related to **E2E network service requirement** representation.
  - An initial proposal was presented as an extension for the ALTO filtered cost map.
Motivation (1/2)

- E2E network services often require **VNFs and their specific order** [RFC7665].
  - Network services with specific requirements in **terms of resources** (e.g., cpu, memory, hard-disk) and **performance objectives** (e.g., bandwidth, latency).
  - Such demands are usually composed by distributed resources which are expected to available across multiple domains with different technology and/or administration.
Motivation (2/2)

An E2E service request specifies **virtual nodes** and **virtual links**:

- Limited resources
- Located on different domains
- Discover "best" candidate resources
- Discover "best" feasible paths
ALTO for Multi-domain E2E Network Service

● WHY ALTO?
  ○ The WG is discussing the use of ALTO as an information model for representing network, resource, and services in multi-domain scenarios.
    ■ The Broker-assisted architecture for multi-domain orchestration in 5G networks [draft-alto-brokermdo-01]
    ■ The Unicorn architecture for multi-domain, collaborative data sciences [draft-alto-multidomain-analytics-01]

● Some advantages:
  ○ Use the ALTO Property Map service to get a clear global view (resource, service, topology information) of other potential candidates domains.
  ○ Use the ALTO Cost Map service (and extensions) to compute multi-domain service function paths.
    ■ Extension: ALTO Service Graph (ALTO-SG)
ALTO Service Graph Extension (ALTO-SG)
Initial Approach

- ALTO-based Broker-assisted MdO draft
- Specifications (based on Section 6.1 of [DRAFT-PV]):
  - "Accept Input Parameters" Specification: The ALTO Server MUST allow the request input to include an SG with a formatted body as an NFFG object.

Data Model: Network Service Definition

- **ETSI NFV MANO**¹
  - ETSI NFV defines the Network Service (NS) as “composition of Network Functions and defined by its functional and behavioural specification”.

- **Network Function Forwarding Graph (NF-FG) - UNIFY**²
  - The NF-FG model provides a joint model capable of covering service description as Service Graph (SG) and resource information as Resource Graph (RG).

- **TOSCA (Topology and Orchestration Specification for Cloud Applications)**³
  - The TOSCA specification provides a language to describe service components and their relationships using a service topology.

- **OpenStack HEAT**⁴
  - HEAT has a template-driven engine called HEAT Orchestration Template (HOT) which describes and automates the deployment of infrastructure.

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¹ [https://www.etsi.org/deliver/etsi_gs/NFV-MAN/001_099/001/01.01.01_60/gs_nfv-man001v010101p.pdf](https://www.etsi.org/deliver/etsi_gs/NFV-MAN/001_099/001/01.01.01_60/gs_nfv-man001v010101p.pdf)
² [https://www.eict.de/fileadmin/redakteure/Projekte/Unify/Deliverables/UNIFY-D3_2s-Network_Function_Forwarding_Graph_specification.pdf](https://www.eict.de/fileadmin/redakteure/Projekte/Unify/Deliverables/UNIFY-D3_2s-Network_Function_Forwarding_Graph_specification.pdf)
³ [http://docs.oasis-open.org/tosca/TOSCA/v1.0/os/TOSCA-v1.0-os.pdf](http://docs.oasis-open.org/tosca/TOSCA/v1.0/os/TOSCA-v1.0-os.pdf)
⁴ [https://docs.openstack.org/heat/latest/template_guide/hot_guide.html](https://docs.openstack.org/heat/latest/template_guide/hot_guide.html)
ETSİ NFV MANO

- Network Service Descriptor (NSD) defines a set of interconnected VNFs to realize a network service spanning multiple VNFs.

- The NSD connects VNFs using the Virtual Links (VLs)

- The VNFs attach to the VLs using the Connection Points (CPs)

(Reference: ETSI GS NFV 001 V1.1.1 (2014-12))
NSD: High Level Objects

- **NS Connection Points**: Each NS has one or more external connection points used to link the NS to other NS or to external networks.
- **Constituent VNFs**: List of *Virtual Network Function Descriptors (VNFDs)* that are part of this network service.
- **VNF Dependencies**: List of VNF dependencies. This specifies the order in which the VNFs inside the NS should be started.
- **Virtual Links**: List of Virtual Link Descriptors (VLD). The VLD describes how VNFs in the NS are connected.

[Links: https://www.etsi.org/deliver/etsi_gs/NFV-MAN/001_099/001/01.01.01_60/gs_nfv-man001v010101p.pdf
https://osm.etsi.org/wikipub/index.php/Release_0_Data_Model_Details]
VNFD: Virtual Network Function Descriptor

- VNFD describes a VNF in terms of deployment and operational behaviour requirements.

- NFD connects Virtual Deployment Units (VDUs) using the internal Virtual Links (VLs).
  - Each VDU represents a VM/Container.

- The VDUs attach to the internal VLs using the internal Connection Points (CPs).

https://www.etsi.org/deliver/etsi_gs/NFV-MAN/001_099/001/01.01.01_60/gs_nfv-man001v010101p.pdf
https://osm.etsi.org/wikipub/index.php/Release_0_Data_Model_Details
VNFD: High Level Object

- **VNF Connection Points**: The list for external connection points. Each VNF has one or more external connection points. As the name implies the external connection points are used for connecting the VNF to other VNFs or to external networks. Each VNF exposes these connection points to the orchestrator.
- **Constituent VDUs**: List of virtual deployment units. VDUs refer to individual VMs inside the VNF.
- **VDU Dependencies**: List of VDU dependencies. The orchestrator uses this list to determine the order of startup for VDUs.
- **Internal VLDs**: A list of internal virtual links to connect various VNF components.

[https://www.etsi.org/deliver/etsi_gs/NFV-MAN/001_099/001/01.01.01_60(gs_nfv-man001v010101p.pdf](https://www.etsi.org/deliver/etsi_gs/NFV-MAN/001_099/001/01.01.01_60(gs_nfv-man001v010101p.pdf)
Use Cases
UC1: Multi-Domain Orchestrator discovery

- **ALTO Server**
  - Property Map
  - Cost Map

- **Inter-domain Resource (IdR)**
  - Resource availability
  - VNFs/PNFs
  - SAPs

- **Inter-domain Topology (IdT)**
  - Hierarchical TED

UC2: Multi-Domain Service Function Chain Path Computation

Hybrid Hierarchical Multi-domain SFC

SFC eXchange Platform

ALTO

Domain 1 → Domain 2 → Domain 3

ONAP is an open source platform for real-time, policy-driven orchestration and automation of VNFs.

ONAP-HAS allows ONAP to deploy services automatically across multiple sites and multiple clouds.

UC3: Distributed Edge Cloud Infrastructure Enablement in ONAP (2/2)

Central ONAP

Request Cloud Infra Info / Services

Create central network inventory

Create ALTO-based Maps

Provide a list of
filter out candidates

https://wiki.onap.org/pages/viewpage.action?pageId=28381325
Next Steps

- **ALTO-based Broker-assisted MdO draft**
  - IETF104: -02 version
  - -01 version reviewed by Richard Yang:
    - Comments addressed in -02
  - Identify which issues need further discussion.
    - Problem Statement and Challenges
    - Terminology, etc.

- **ALTO Service Graph Extension (ALTO-SG)**
  - Define a concrete modular design
  - Refinement and improvement of the proposed use cases
  - IETF104: Write an initial draft
Thanks!

(More) Questions?