

IETF - ALTO Virtual Interim Meeting

# ALTO-based Broker-assisted Multi-domain Orchestration

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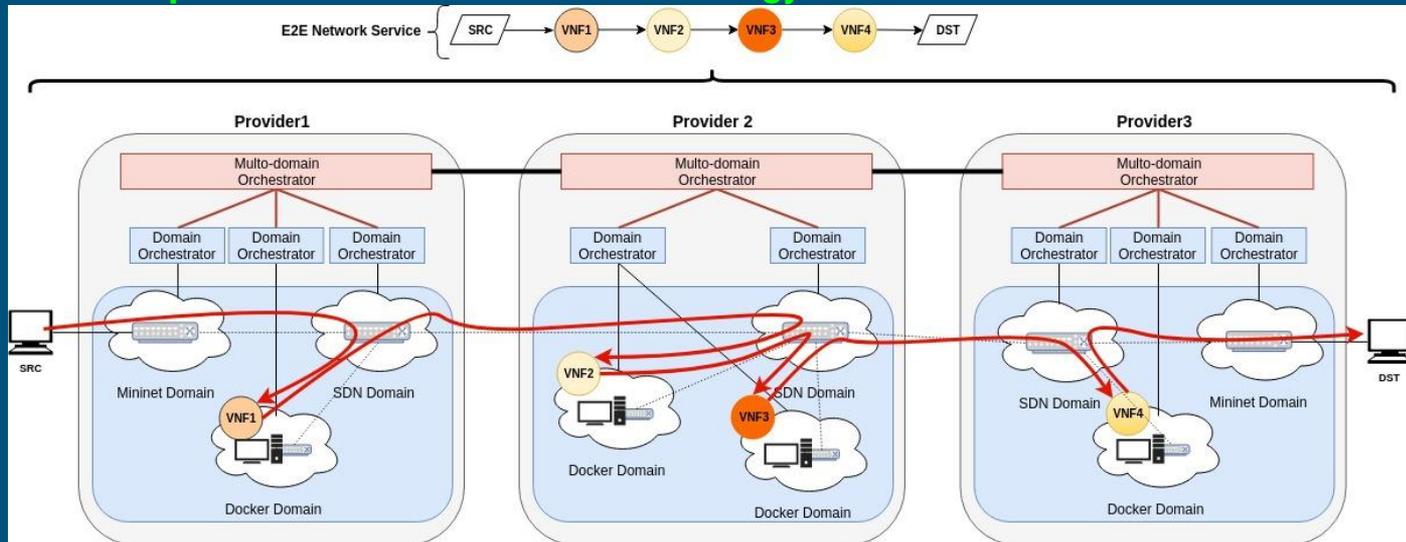
# Presentation in a nutshell

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- 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)

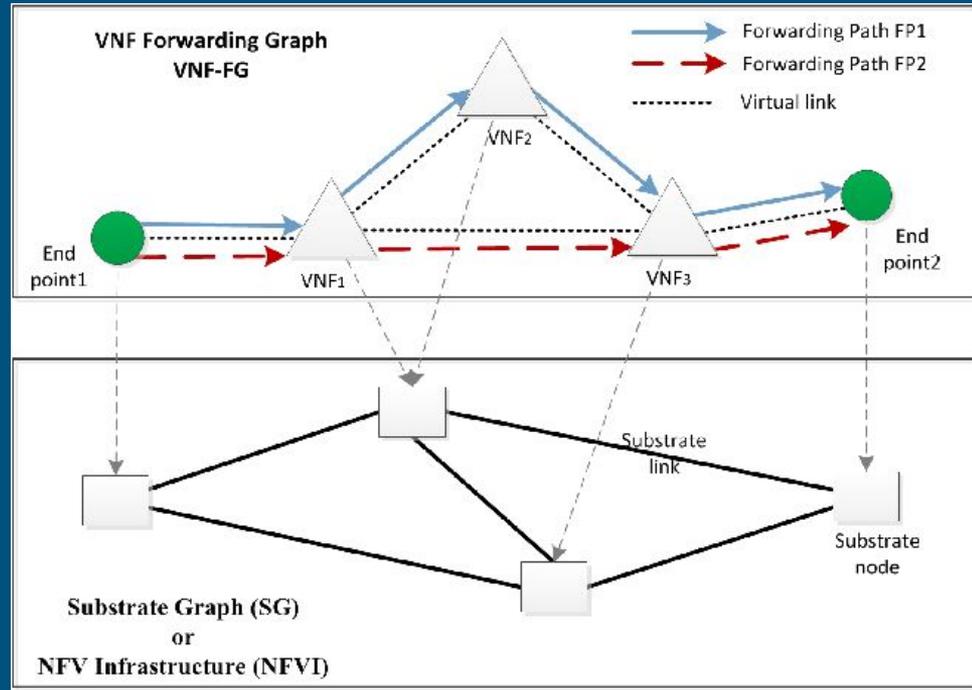
- E2E network services often require **VNFs and their specific order** [\[RFC7665\]](#).
  - Network services with specific requirements in **terms of resources** (e.g., cpu, memory, hard-disk) and **performance objectives** (e.g., bandwidth, latency).
  - Such demands are usually composed by distributed resources which are expected to be 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**



**Placement Decisions**

# ALTO for Multi-domain E2E Network Service

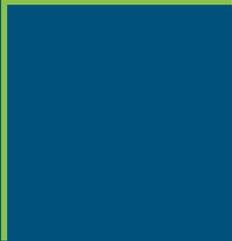
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- WHY ALTO?

- 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 candidate 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.

```
object {  
  [NFFG sg;]  
} ReqFilteredCostMap;
```

```
object {  
  JSONString nfs<1..*>;  
  JSONString saps<1..*>;  
  NextHops sg_links<1..*>;  
  REqs reqs<1..*>;  
} NFFG;
```

```
object {  
  JSONNumber id;  
  JSONString src-node;  
  JSONString dst-node;  
} NextHops;
```

```
object {  
  JSONString id;  
  JSONString src-node;  
  JSONString dst-node;  
  JSONNumber sg-path<1..*>;  
} REqs;
```

# Data Model: Network Service Definition

- ETSI NFV MANO<sup>1</sup>
  - 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<sup>2</sup>
  - 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)<sup>3</sup>
  - The TOSCA specification provides a language to describe service components and their relationships using a service topology
- OpenStack HEAT<sup>4</sup>
  - HEAT has a template-driven engine called HEAT Orchestration Template (HOT) which describes and automates the deployment of infrastructure.

<sup>1</sup> [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)

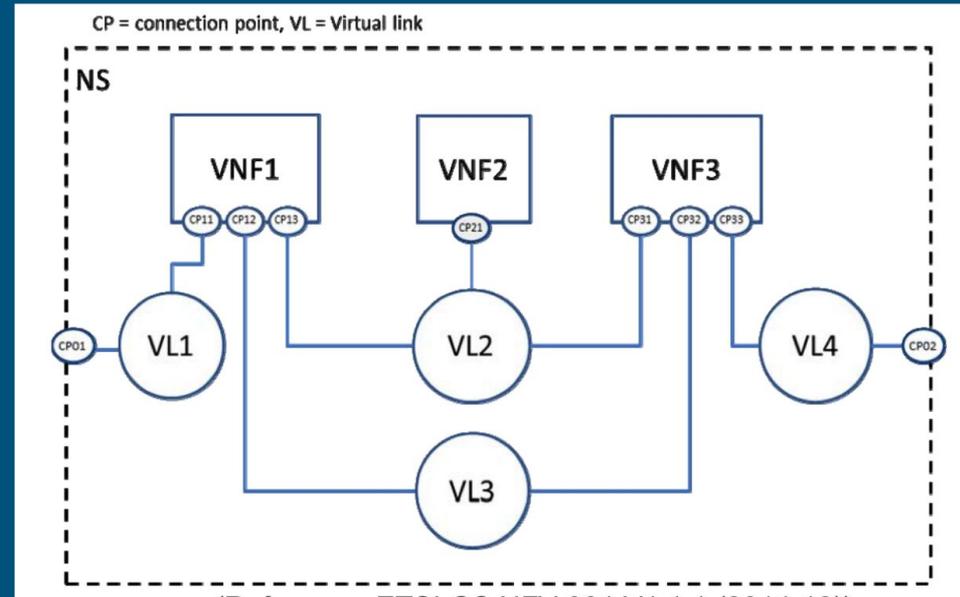
<sup>2</sup> [https://www.eict.de/fileadmin/redakteure/Projekte/Unify/Deliverables/UNIFY-D3.2a-Network\\_Function\\_Forwarding\\_Graph\\_specification.pdf](https://www.eict.de/fileadmin/redakteure/Projekte/Unify/Deliverables/UNIFY-D3.2a-Network_Function_Forwarding_Graph_specification.pdf)

<sup>3</sup> <http://docs.oasis-open.org/tosca/TOSCA/v1.0/os/TOSCA-v1.0-os.pdf>

<sup>4</sup> [https://docs.openstack.org/heat/latest/template\\_guide/hot\\_guide.html](https://docs.openstack.org/heat/latest/template_guide/hot_guide.html)

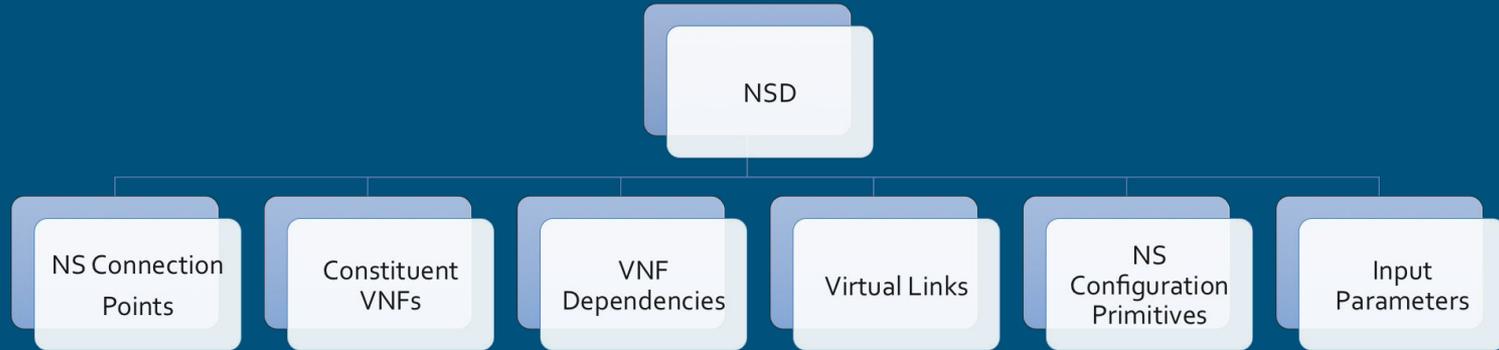
# ETSI NFV MANO

- 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)



## Network Service Descriptor(NSD)

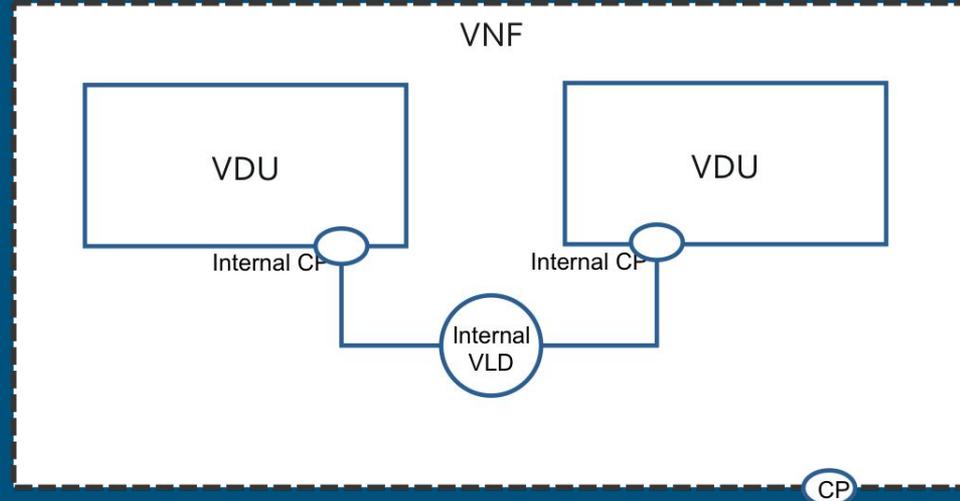
# NSD: High Level Objects



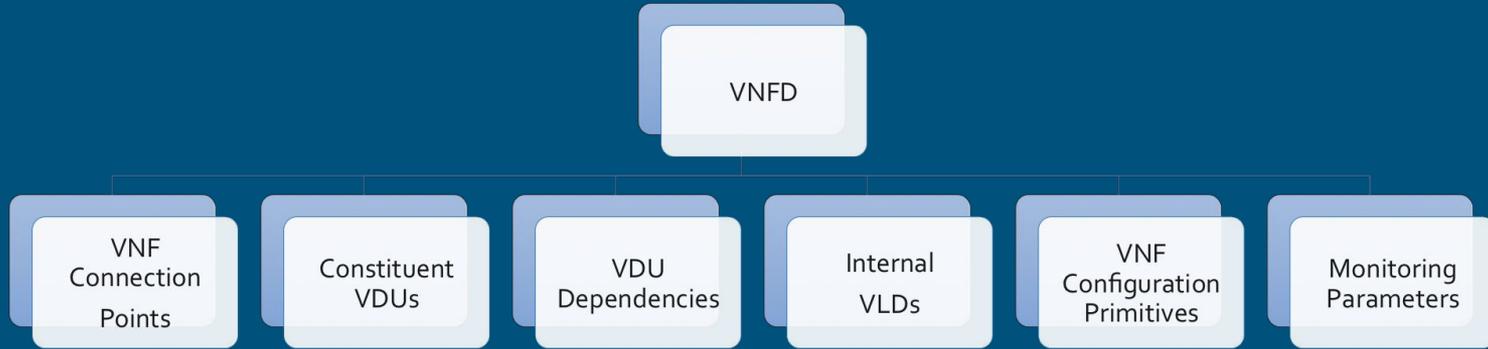
- **NS Connection Points:** Each NS has one or more external connection points **used to link the NS to other NS or to external networks.**
- **Constituent VNFs:** List of Virtual Network Function Descriptors (VNFDs) that are part of this network service.
- **VNF Dependencies:** List of VNF dependencies. 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 NSD are connected.**

# VNFD: Virtual Network Function Descriptor

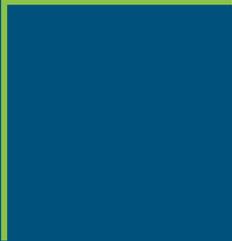
- VNFD describes a VNF in terms of deployment and operational behaviour requirements.
- NFD connects Virtual Deployment Units (VDUs) using the internal Virtual Links (VLs).
  - Each VDU represents a VM/Container.
- The VDUs attach to the internal VLs using the internal Connection Points (CPs).



# 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.

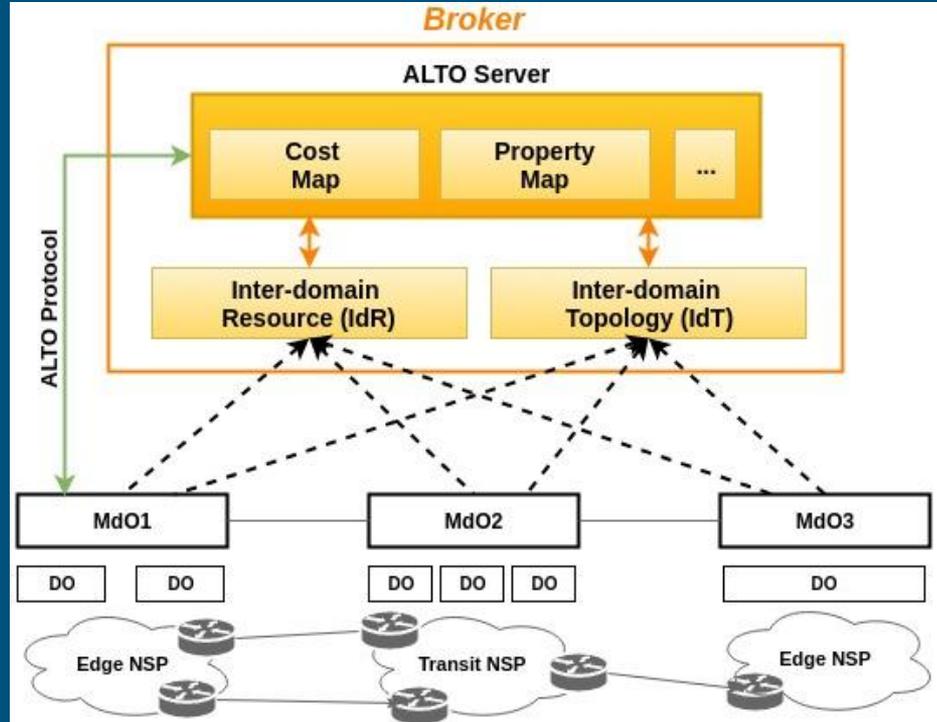


# Use Cases

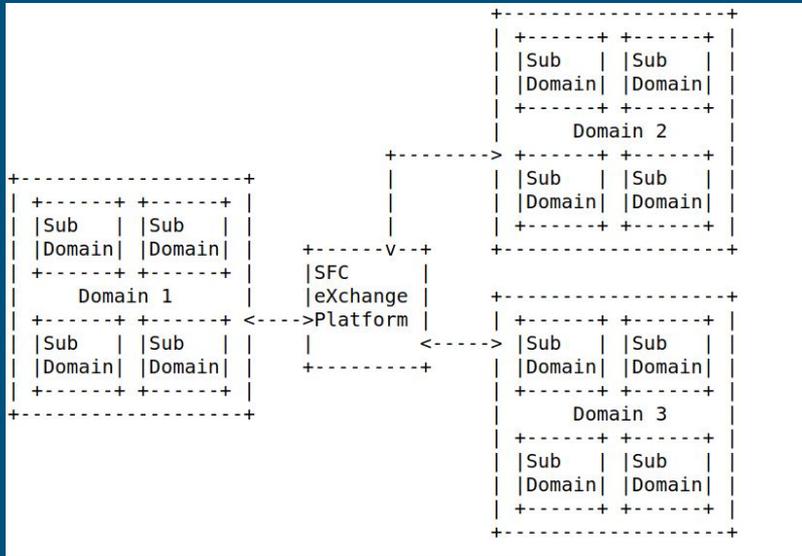


# UC1: Multi-Domain Orchestrator discovery

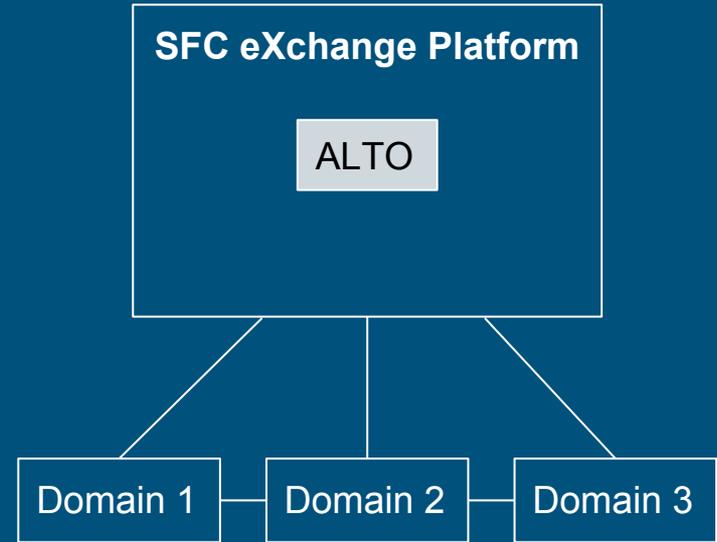
- ❖ ALTO Server
  - Property Map
  - Cost Map
- ❖ Inter-domain Resource (IdR)
  - Resource availability
  - VNFs/PNFs
  - SAPs
- ❖ Inter-domain Topology (IdT)
  - Hierarchical TED



# UC2: Multi-Domain Service Function Chain Path Computation

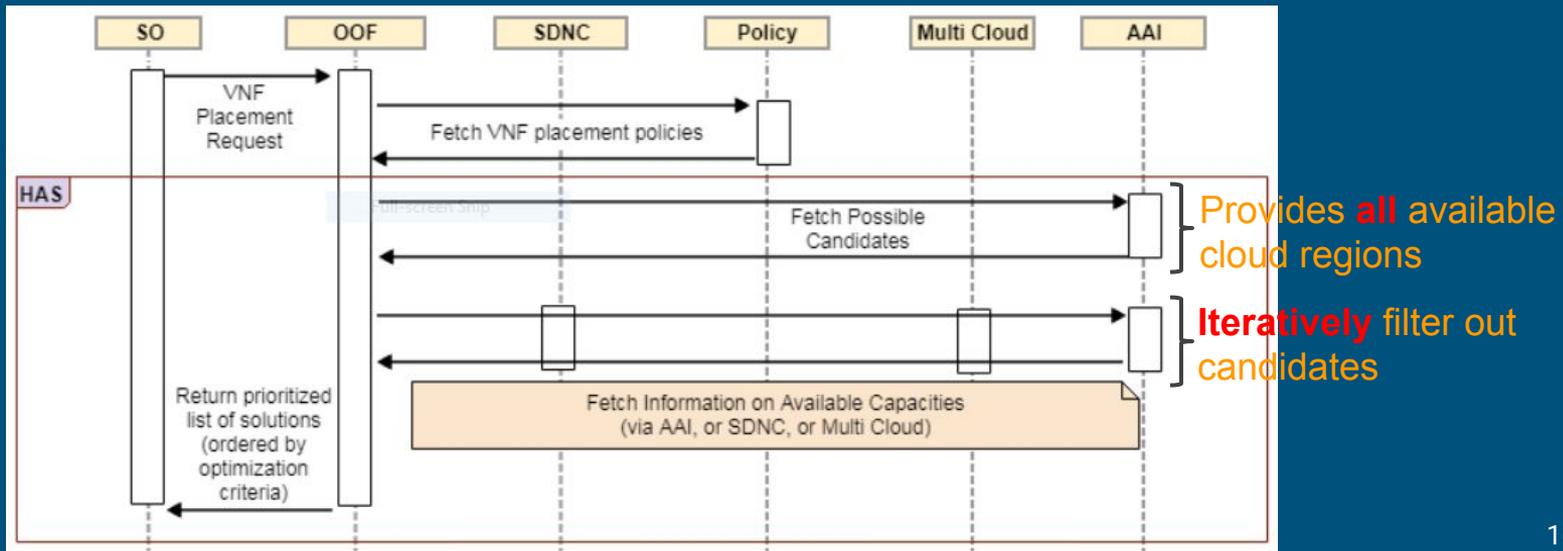


Hybrid Hierarchical Multi-domain SFC

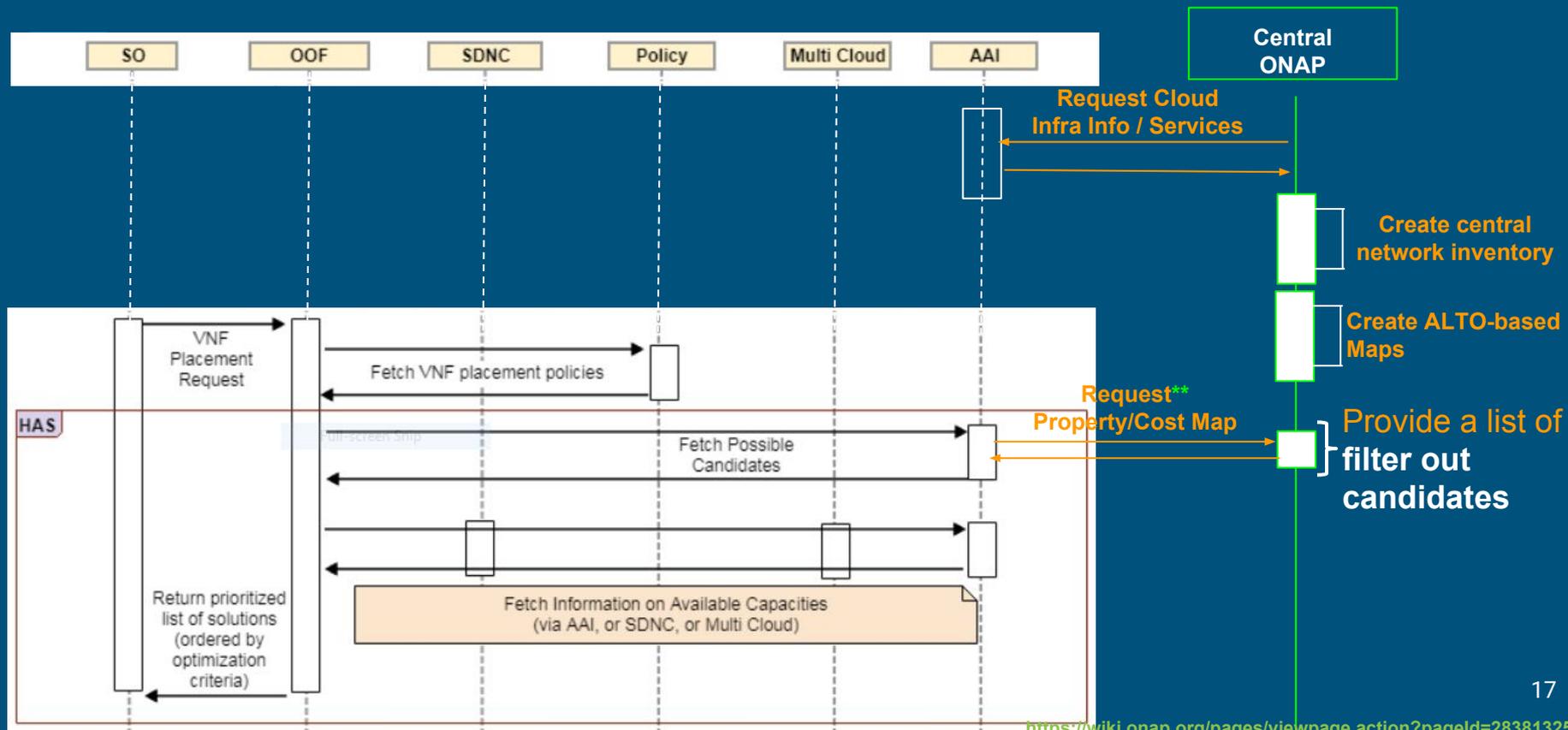


# UC3: Distributed Edge Cloud Infrastructure Enablement in ONAP (1/2)

- 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)



# Next Steps

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- 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?

