ALTO-based Broker-assisted Multi-domain Orchestration - 00

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Agenda

1. Multi-domain Orchestration
2. Broker-assisted Multi-domain Orchestration Approach
3. Required ALTO Extensions
   a. Property Map
   b. Filtered Cost Map
Multi-domain Orchestration

- 5G network scenarios call for multi-domain orchestration models.
- Multi-provider orchestration operations will require the information exchange across Multi-domain Orchestrators (MdOs).
- Information to be exchanged:
  - Abstract network topology
  - Resource availability (e.g., CPUs, Memory, and Storage)
  - IT Capabilities (e.g., supported network functions)
  - Orchestrator entry points
- Challenges:
  - Lack of abstractions
  - Discovery of candidate autonomous systems
  - Scalability, Flexibility, Complexity
Our Proposed Approach

❖ Proposal:
  ➢ A federation networking paradigm where a broker-plane works on top of the management and orchestration plane.

❖ Main Goal:
  ➢ Discover resource and topology information from different administrative domains involved in the federation.

❖ ALTO-based:
  ➢ The ALTO services (with the proposed protocol extensions) offer abstract maps with a simplified view, yet enough information about MdOs involved in the federation.
Architecture

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

❖ The ALTO server MUST return multiple values for each property in the Property Map.
   ➢ MdOs exchange a list NFs and SAPs which are supported by them. So in this scenario, an array of values can provide sufficient information that is not possible with single string values.

❖ Specifications (based on 4.6 of [DRAFT-PM]):
   ➢ The specification for the "Media Types", "HTTP Method", "Accept Input Parameters", "Capabilities" and "Uses" remain unchanged.
   ➢ "Response" Specification: For each property name defined in the resource's "capabilities" list, the corresponding property value MUST be encoded as JSONArray instead of JSONObject.
Example: Property Map Service

- The ALTO client wants to retrieve the entire Property Map for PID entities with the "entry-point", "cpu", "mem", "storage", "port" and "nf" properties.
Filtered Cost Map Extension (1/2)

- The ALTO server MUST provide connectivity information for every SG link in the SG path for an E2E requirement.
  - This information is the AS-level topological distance in the form of path vector, and it includes all possible ways for each (source node, destination node) pair in the SG link.

- Specifications (based on Section 6.1 of [DRAFT-PV]):
  - The specifications for the "Media Types", "HTTP method", "Capabilities" and "Uses" are unchanged.
  - "Accept Input Parameters" Specification: If "sg" is present, the ALTO Server MUST allow the request input to include an SG with a formatted body as an NFFG object.
Specifications (based on Section 6.1 of [DRAFT-PV]):

- **Response Specification**: If the ALTO client includes the path vector cost mode in the "cost-type" (or "multi-cost-types") field of the input parameter, the response for each SG link in each E2E requirement MUST be encoded as a JSONArray of JSONArrays of JSONStrings.

- Moreover, as defined in Section 6.3.6 of [DRAFT-PV], if an ALTO client sends a request of the media type "application/alto-costmapfilter+json" and accepts "multipart/related", the ALTO server MUST provide path vector information along with the associated Property Map information, in the same body of the response.
The ALTO client requests the path vector for a given E2E requirement:

- SAP1->NF1->NF2->NF3->SAP2

**SG Request:**

- Three NFs (NF1, NF2, and NF3).
- Two SAPs (SAP1 and SAP2).
- Four Links connecting the NFs and SAPs ("sg_links" tag).
- An E2E requirement ("reqs" tag) with information about the order in which NFs are traversed from SAP1 to SAP2.

**Note:**

- The request accepts "multipart/related" media type. This means the ALTO server will include associated property information in the same response.
Example: Filtered Cost Map (2/2)

- The ALTO server returns connectivity information for the E2E requirement.
- The response includes Property Map information for each element in the path vector.
  - In this case, it is retrieved a Property Map with the "entry-point" property, i.e., the URL of the MdO entry point for the corresponding network.

```json
HTTP/1.1 200 OK
Content-Length: [112]
Content-Type: multipart/related; boundary=example
--example
Content-Type: application/alto-endpoint-cost+json
{
  "meta": {
    "cost-type": {
      "cost-mode": "array",
      "cost-metric": "ame-path"
    }
  },
  "cost-map": {
    "SAP1": {
      "SAP2": {
        "NF1": [
          [ "AS1", [ "AS1", "AS2", "AS3" ]
        ],
        "NF2": [
          [ "AS1", "AS2" ], [ "AS3", "AS2" ]
        ],
        "NF3": [
          [ "AS2", "AS1" ], [ "AS2", "AS3" ]
        ],
        "SAP2": [
          [ "AS1", "AS2", "AS3" ], [ "AS3" ]
        ]
      }
    }
  }
}
--example
Content-Type: application/alto-propmap+json
{
  "property-map": {
    "pid:AS1": {"entry-point": "http://172.25.0.10:8888/escape"},
    "pid:AS2": {"entry-point": "http://172.16.0.10:8888/escape"},
    "pid:AS3": {"entry-point": "http://172.27.0.10:8888/escape"}
  }
}````
Road Ahead

- Collect WG feedback
- Should the extensions be adopted?
- Define a more elaborated NFFG object to support extended parameters. E.g.:
  - Monitoring parameters
  - Resource requirements, etc.
- Present this work in the upcoming IEEE WCNC'18 (Barcelona, Spain)
- Publish the PoC source code in our public repository.
PoC Implementation
Thanks!

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Multi-domain Orchestration Challenges

❖ **Scalability:**
  ➢ Involves the distribution of topology and resource information in a peer-to-peer fashion (MdO-to-MdO). Multi-operator multi-domain environments where the information distribution is advertised in a peer-to-peer model scales linearly.

❖ **Flexibility:**
  ➢ Considers that a distributed approach does not allow domains without physical infrastructure to advertise resource capabilities and networking resources. Such procedures consist in deploying and configuring physical peering points for these domains.

❖ **Complexity:**
  ➢ Refers to the discovery mechanism to pre-select candidate domains, accounting for resources and capabilities, necessary for an end-to-end network service deployment.