Multi-domain Service Function Chaining with ALTO - 00

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This document focuses on how the Application Layer Traffic Optimization (ALTO) protocol can be used to advertise and discover abstract topology, resource and service information from different domains, and then compute inter-domain service function paths.

Another important concern of this draft document is to initiate a discussion (ALTO, SFC as well as other WGs) regarding if, how, and under what conditions ALTO can be useful to improve the multi-domain SFC process.
Multi-domain Approach

Building a complete end-to-end network service requires stitching services offered by multiple administrations or multi-domain single administrations.

- **Market Fragmentation:** Multiple Administrations
  - Having a multitude of telecommunication networks and cloud operators each with a footprint focused to a specific region.

- **Technology Fragmentation:** Multi-domain Single Administrations
  - Having different networks and different parts of a network built as different domains using separate technologies, such as optical or packet switched (with different packet switching paradigms included).
  - There are other reasons for having multiple domains within an operator, such as, different geographies, different performance characteristics, scalability, policy or simply historic (e.g., result of a merge or an acquisition)


Multi-domain SFC

- The delivery of end-to-end services often requires various Service Functions (SFs).
- Service Function Chaining (SFC) is constructed as an abstract sequence of SFs.
- Multi-domain SFC refers to the ability to deploy SFC across multiple domains (geo-location, technology, administration, etc.).
- To do so, an inter-domain communication process between different domains is necessary in order to:
  - Exchange topology, resource and service information,
  - And then compute inter-domain service function paths.

Multi-domain SFC - Related Work (1/2)

❖ IETF - SFC WG
  ➢ [hSFC] defines an architecture to deploy SFC in large networks. This draft proposes to decompose the network into smaller domains (domains under the control of a single organization).
  ➢ [DRAFT-HH-MDSFC] describes SFC crossing different domains owned by different organizations (e.g., ISPs) or by a single organization with administration partitions. It proposes the use of a SFC eXchange Platform (SXP) to collect and exchange information (topology, service states, policies, etc.) between different organizations.

❖ IRTF - NFVRG
  ➢ The draft [DRAFT-MD-VIRT] envisions a complete end-to-end logical network as stitching services offered by multiple domains from multiple providers. It also points to the need for creating solutions that enable the exchange of relevant information (resources and topologies) across different providers.

❖ ETSI - NFV ISG
  ➢ The document [ETSI-NFV-IFA028] reports different NFV MANO architectural approaches with use cases related to network services provided using multiple administrative domains.
Several projects include an architectural model integrating NFV management with SDN control capabilities to address the challenges towards flexible, dynamic, and on-demand service chaining.

- **[VITAL][T-NOVA]** follow a centralized approach where each domain advertises its capabilities to a federation layer which will act as a broker.
- **[5GEx]** aims to integrate multiple administrations and technologies through the collaboration between operators in the context of emerging 5G networking.
- The 5G-Transformer project **[5G-TRANSFORMER]** is defining flexible slicing and federation of transport networking and computing resources across multiple domains.
ALTO for Multi-domain SFC

- The ALTO protocol [RFC7285] provides abstract network information in the form of map services that can be consumed by applications in order to become network-aware and to take optimized decisions regarding traffic flows.

- 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 and service information) of other potential candidates domains.
  - Use the ALTO Cost Map service (and extensions) to compute inter-domain service function paths.
Motivating Use Case (1/3)

❖ To enable a highly customized multi-domains SFC, [DRAFT-HH-MDSFC] proposes a SFC eXchange Platform to realize inter-domain communication between top-level control planes.
  ➢ The SXP is a logical entity deployed in future Software-defined IXP (as a trusted third-party platform) or built by a single owner between different networks.

❖ On a high level, the scope of the SXP contains two main tasks:
  ➢ Provide end-to-end visibility through the collection of topology information, service states, and policies from different domains.
  ➢ Compute inter-domain service function path to select the service function location from multiple candidate domains.

❖ In this context, the SXP can take advantage of multi-domain ALTO services to obtain important inter-domain information to "guide" the resource/service provider selection process.
  ➢ So that the "best" domain or candidate domains (according to policies/metrics) can be selected.
Multiple SFC domains connected by a SFC eXchange Platform
Motivating Use Case (3/3)

AS-level topology:

AS1 <-> AS2 <-> AS3

Property Map

Cost Map

SF=Service Function
Open Questions

❖ The SFC WG is currently scoped to one single administrative domain.
   ➢ In the hierarchical SFC draft [hSFC], the assumption is that sub-domains are managed by the same administrative entity.

❖ Before going into protocol details regarding how to realize inter-domain service chains:
   ➢ Describe concrete uses cases which require SFs from distinct administrative domains. Related projects include large, collaborative science experiments (e.g., Large Hadron Collider).
   ➢ Justify why topology visibility is required.

❖ Security/Privacy Considerations
   ➢ Using ALTO extensions (e.g., Multi-Cost, Cost-Calendar, Unified Property, Path Vector) to provide fine-grained network information may raise new security / privacy concerns. A systematic study is required.
Next Steps

❖ Gather **feedback** from the WG
  ➢ Comments, questions, suggestions are greatly appreciated, especially on open questions.
  ➢ -00 version reviewed by Mohamed Boucadair:
    ■ Comments addressed in -01
Thanks!

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