ALTO Re-charter Item: Multidomain ALTO

IETF 109, Virtual (Bangkok) Event

Nov. 19, 2020
Problem (Relevance)

• RFC 7971: "The ALTO protocol is designed for use cases where the ALTO server and client can be located in different organizations or trust domains. ALTO is inherently designed for use in multi-domain environments. Most importantly, ALTO is designed to enable deployments in which the ALTO server and the ALTO client are not located within the same administrative domain."

• But existing core ALTO services including Endpoint Cost Service (ECS) and Cost Map Service query a single ALTO server for the ALTO properties (e.g., routing cost, latency, ...) of the whole network path, but the path may span multiple networks served by multiple ALTO servers.

• Multiple projects (e.g., [1][2]) identify systematic multi-domain design as a key missing feature of ALTO.

Problem (Relevance)

Which guidance should ISP1 give to Peer X (based on relative preference)?

1. Peer 1A
2. Peer 1B
3. Peer 2A, 2B (*)
4. Peer 3A, 3B (*)

(*) = A and B are on the same level of preference, because ISP1 might not know that they are wireline vs. wireless, doesn’t care (monetary cost is the same for ISP1), and/or wouldn’t dare to tell even if they knew

Is “all within my domain” or “not in my wireless network” more preferable?

Sebastian Kiesel presentation on Sept. 30, 2020
Problem (Relevance)

CONCLUSION AND FUTURE WORK

Key takeaways:
1. Opportunity to operate networks more efficiently
2. We enabled the first automated hypergiant-ISP collaboration
3. Lots of engineering and diplomacy involved
4. It works!

Next steps:
1. Different optimization functions
2. Federated FlowDirector (multi-ISP collaboration)
A Potential Solution (Feasibility)

• WG discussed at least one reasonably well-understood, feasible architecture called **ALTO Multi-Domain Abstractions (MDA)**
  • The path of a flow from a src to a dst consists of a sequence (vector) of **segments** from multiple networks
    • src -> net₁-e -> net₂-i -> ... -> netᵢ-e -> netᵢ₊₁-i -> ... -> netₙ-e -> dst
  • The cost of a path is a vector corresponding to the vector of **segments**

• The paths of a set of flows form a **flow graph**
  • Constructed by merging shared egress or ingress nodes of the segments
Simple ALTO Extensions to Realize ALTO MDA

- Ext 1: Segment discovery
  - `<flow, netid:ingress> -> <netid:egress, netid:next-ingress; [Sebastian proposal: next-alto-server-uri; handle blackhole...]>

- Ext 2: Path cost discovery (extend ECS/cost map service, ...)
  - `<segment-set, metric> -> <cost>

- Operation models for extensions [mechanisms, not policies]
  - iterative (client aggregation)
  - recursive (network helped aggregation)
  - hybrid
Remaining (Engineering) Issues

• A vector of path cost may no longer defines a total order; candidate designs MUST discuss clear guidelines to applications on how to utilize partial ordering, and the consequences (i.e., operations considerations)
  • Leverage SIGCOMM’20 multi-criteria routing design

• Incremental deployment: the chaining of domains may be broken due to incremental deployment (e.g., domain sequence is S -> A -> B -> C -> D, but C does not provide ALTO server)
  • Need to fix broken chains (e.g., proxy server based on BGP observation)
  • Need to discuss incentive for missing networks to deploy
Related References on Multidomain

- CERN use case
- Inter-ALTO communication protocol
- ALTO network-server, server-server API
Details: Who Will Work on It

- Y. Richard Yang, Yale U.
- Sebastian Kiesel, U. Stuttgart
- Kai Gao, SCU
- Bojre Ohlman, Ericsson
- Danny Perez, Unicamp
- Ingmar Poese, Benocs
- Harvey Newman, CalTech/CERN and the GNA-G DIS WG
- Qiao Xiang, XMU
Details: Potential Milestones (1-2 years)

• Now - Mar. 2021: Presentations and meetings to clarify use cases and requirements at related venues including LHC, GNA-G DIS, panrg, PRP, ...
• Mar. 2021 (IETF 110): Initial draft containing use cases, requirements, preliminary design (e.g., ALTO MDA)
• July 2021 (IETF 111): Prototyping of ALTO MDA and test
• Nov. 2021 (IETF 112): Report prototyping results, complete specification, propose WG adoption
• Mar. 2022 (IETF 113): Iteration
• July 2022 (IETF 114): Submit to IESG
Proposed Paragraph

Extensions of ALTO services to support multi-domain settings. The current ALTO framework has made clear how to provide network information from a single ALTO server for a single network (administrative domain), but the network devices traversed by a flow can be managed by multiple networks that are not in the same domain. The working group will investigate and extend the ALTO framework to (1) specify multi-ALTO-server protocol flow and usage guidelines when an ALTO service involves network paths spanning multiple domains with multiple ALTO servers, and (2) extend or introduce ALTO services allowing east-west interfaces for multiple ALTO server integration and collaboration. The specification and extensions should use existing services whenever possible. The specification and extensions should consider realistic complexities including incremental deployment, dynamicity, and security issues including access control, authorization (e.g., an ALTO server provides information for a network that the server has no authorization), and privacy protection in multi-domain settings.
Backup Slides
• ALTO protocol = one-way interface from the underlying IP network to an overlay, that is untrusted from network operator’s point of view, possibly unmanaged
  • P2P networks (BitTorrent)
  • Content Delivery Networks
• The overlay nodes have only one “freedom of choice”: to which other overlay nodes (IP addresses) to connect and send/request data
  • Decision made in the endpoint of the data transmission
  • Decision made at a central location (e.g. BitTorrent tracker)
• Incentive: the (postulated) “win-win situation”
  • Overlay network gets better performance
  • Cost-optimization in the underlying IP network → no price increase / no throttling for end-user
    • Traffic engineering in own network domain
    • Reduced cost for peering or upstream capacity

[Sebastian 9/30/2020]
Additional Questions

• The “routing cost” metric makes it difficult to aggregate different point of views
  • See also RFC 8686, Appendix C

• The “ALTO advice” runs in the opposite direction of the money
  • will it always stop at the peering points / Tier-1 carriers?
  • what if the advice given by ISP1’s ALTO server impairs ISP2’s traffic engineering?
  • will ISP1 be legally liable? Thus, will ISP1 refuse to give details wrt. ISP2 even if they knew?

[Sebastian 9/30/2020]