Feedback on ALTO lightning talk at PANRG – IETF100

“The IETF ALTO protocol and its extensions”

Helping end hosts and applications to have a topology-aware insight into end to end paths

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PANRG research and objectives

• Goal of PANRG
  • extend path awareness from the control plane to the edge with mechanisms allowing:
    • Endpoint discovery of paths,
    • Explicit association of properties to paths by endpoints,
    • Explicit endpoint selection of paths.

• The identified underlying hard problems are mainly:
  • Conflict of interest between hosts and networks,
  • Path property exposition by the network to third parties considering
    • network confidentiality and information aggregation level,
    • diversity of timescale for configuration, discovery, selection and dissemination.

• The PANRG would like to leverage its work on existing IETF protocols and their potential extensions.
Lightning talk: ALTO extensions relevant to PANRG

- ALTO presented as helping to address following PANRG questions
  - How are path properties defined and represented?
  - How do endpoints get access to trustworthy path properties?
  - How can endpoints select paths to use for traffic in a way that can be trusted by the network?

- See https://datatracker.ietf.org/meeting/100/materials/slides-100-panrg-04-the-ietf-alto-protocol-and-its-extensions/
Relevance of ALTO identified at PANRG

• Brian Trammel one of PANRG chairs presented a draft on open questions to be addressed at PANRG
  • See https://datatracker.ietf.org/meeting/100/materials/slides-100-panrg-06-open-questions/

• Among questions
  • "how do endpoints discover trustworthy path properties?"

• Presentation mentions that
  • SCION (a path-aware Internet architecture presented at IETF99) and ALTO represent points in this design space.
ALTO-PANRG discussions desirable

- To see how ALTO can serve PANRG goals.
- Given that PANRG focuses on the mechanisms leveraging on protocols rather than on protocols themselves,
- To see what use cases PANRG finds relevant to ALTO
- What particular ALTO feature would are existing or needed
- What existing and future protocol extensions may help for those use cases
Back-up slides

• ALTO ligthing talk at PANRG session – IETF 100
Open questions in PANRG & challenges

• See https://tools.ietf.org/html/draft-trammell-panrg-questions-01 11/07

• How are path properties defined and represented?

• How do endpoints get access to trustworthy path properties?

• How can endpoints select paths to use for traffic in a way that can be trusted by the network?

• How can interfaces to the transport and application layers support the use of path awareness?

• How can a path aware network in a path aware internetwork be effectively operated, given control inputs from the network administrator as well as from the endpoints?

• Some challenges gathered from list discussions
  • Different priorities for hosts and networks
  • Privacy concerns on both sides
    • “pseudo” instead of “real” path information more appropriate for end points and more realistic from networks’ controller
  • What is the appropriate level of exposure?
The IETF ALTO protocol

• Exposes abstracted operator-centric network view to applications and end hosts
• Goal: guide applications for a topology-aware selection among several endpoints
  • Trading operator cost efficiency with equal or better application performance
• To this end, ALTO offers RESTful APIs to convey provider-defined
  • **ALTO network map**: set of network location groupings with Provider-Defined Identifier (PID) and enumerated endpoints in each group.
  • **PID**: indirect and network agnostic manner to aggregate network endpoints that share some characteristic: subnet, POP, autonomous system, central office, …
  • **ALTO cost map**: pairwise e2e path costs amongst sets of source and destination PIDs or endpoints.
• ALTO thus hides complexity and confidentiality
  • Network can protect confidential network state information, by abstracting real metric values into non-real numerical scores or ordinal ranking
• ALTO information assumed not available to 3rd parties by other means
• Requires mutual trust between operator and applications
- "single node" topology abstraction
- 1 path per destination
- Specifies and conveys 1 single "routingcost" metric between src and dest

GET /costmap/num/routingcost HTTP/1.1

HTTP/1.1 200 OK

{  "meta" : {    "cost-type" : {      "cost-mode" : "numerical",      "cost-metric" : "routingcost"    },      "cost-map" : {        "PID1" : { "PID1" : 1, "PID2" : 5, "PID3" : 8, "PID4" : 6 },        "PID2" : { "PID1" : 5, "PID2" : 1, "PID3" : 1, "PID4" : 8 },        "PID3" : { "PID1" : 5, "PID3" : 8, "PID3" : 1 },        "PID4" : { "PID1" : 6, "PID2" : 10, "PID3" : 1 }      }  }  }

PID = City, Region, any name, ...
IETF ALTO WG extensions relating to PANRG

- Base protocol: [RFC 7285] = **WHERE to connect**
- The ALTO WG specifies protocol extensions for deeper insight in paths
- Relation to PANRG: **HOW to connect** given $N \geq 1$ paths / destination
  - ALTO Path Vector Cost Mode = multi-switch path [id-pvect]
    - Exposes abstraction of some intermediate steps of available paths
  - ALTO Contextual Cost Values: several costs per metric for one dest [pd-acont]
    - Exposes costs given qualitative parameters such as « access type » or others
  - Multi-Cost ALTO [RFC 8189]
    - Exposes costs IF path is feasible : w.r.t. constraints on cost values – path filtering
- **ALTO Network Performance Cost Metrics** [id-aperf]
  - Abstraction of network delay, jitter, packet loss, hop count, and bandwidth
- **WHEN to connect = ALTO Cost Calendars** [id-acal]
  - 1 or $N$ destinations, one path for each
HOW to connect - ALTO path vector- in progress

Provides abstracted details on paths
- Abstracted Network Elements (ANE)
  - Set of $N \geq 1$ switches, links, networks, …
  - ANE properties may be exposed in a separate « ANE property map »

HTTP/1.1 200 OK
...
{
"meta": {
  "dependent-vtags": [...],
  "multi-cost-types": [
    {"cost-mode": "array", "cost-metric": "ane-path"},
    {"cost-mode": "numerical", "cost-metric": "BWcapa"},

  vtag": { //information to get ANE properties}
  },
"cost-map": {
  "PID1": {
    "PID2": [["ane:L15", "ane:L56", "ane:L67", "ane:L72"], 100]},
  "PID3":
  "PID4": [["ane:L35", "ane:L57", "ane:L74"], 100]  }}

The application thus knows whether flows share bottleneck and how much total capacity they get

All link capacities = 100
HOW to connect - ALTO Cost Context – in progress

Several access paths possible
UE requests path Perf
• Given access type and SLA

HTTP/1.1 200 OK
Content-Length: [TODO]
Content-Type: application/alto-endpointcost+json
{
    "meta": {
        "cost-type": {
            "cost-mode": "numerical",
            "cost-metric": "BWscore"
        }
    },
    "context-params": [["cell", "wifi"], ["SLA-3"]]
}
"endpoint-cost-map": {
    "ipv4:192.0.2.2": {
        "ipv4:192.0.2.89": [10, 5],
    }
}
}

Array of 2 context-based values:
[cell AND sla3, wifi AND sla3]
HOW to connect – Multi-Cost ALTO with constraints

Client can request « routingcost » + « BW capacity »
On paths with EITHER lower cost and bandwidth
OR higher cost and bandwidth

ALTO response provided ONLY on paths meeting the constraints

POST /costmap/filtered HTTP/1.1
...

{ "multi-cost-types" : [ "cost-mode": "numerical", "cost-metric": "routingcost", "cost-mode": "numerical", "cost-metric": "BWcapa" ],
"or-constraints" : [["[0] le 30", "[1] le 70"]
["[0] le 50", "[1] gt 80"]],
"pids" : {"srcs" : [ "PID1" ],
"dists" : [ "PID2", "PID3" ]}
}

HTTP/1.1 200 OK
Content-Type: application/alto-costmap+json
{
"meta" : {
"dependent-vgtags" : [ ],
"multi-cost-types" : [...]
}"cost-map" : {
"PID1" : {
"PID2" : [40, 90]
}
}}
WHEN to connect – ALTO Cost Calendars – in progress

HTTP/1.1 200 OK
Content-Type: application/alto-costmap+json
Content-Length: ###
{
  "meta" : {...
    "cost-type" : {"cost-mode": "numerical", "cost-metric": « BWcapa"},

    "calendar-response-attributes" : {
      "calendar-start-time" : Wed, 18 Oct 2017 00:00:00 GMT,
      "time-interval-size" : "4 hour",
      "numb-intervals" : 6 }
  } // end meta

"cost-map" : {
  "PID1" : {
    "PID2" : [90, 70, 80, 90],
    "PID4" : [90, 80, 60, 80]
  } }

• Array of time-dependent cost values
• Attributes specifying how to understand them
References

• ALTO Status Pages
  • https://tools.ietf.org/wg/alto/

  • https://tools.ietf.org/html/rfc7285

• [id-pvect] « ALTO Extension: Path Vector Cost Mode »

• [pd-acont] « ALTO Contextual Cost Values »
  • https://tools.ietf.org/id/draft-randriamasy-alto-cost-context-02.txt

• [RFC 8189] « Multi-Cost ALTO »
  • https://tools.ietf.org/html/rfc8189

• [id-aperf] « ALTO Performance Cost Metrics »

• [id-acal] « ALTO Cost Calendar »
  • https://tools.ietf.org/html/draft-ietf-alto-cost-calendar-02