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Interoperability Testing of the Application-Layer Traffic Optimization
(ALTO) Protocol
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Abstract

The Application-Layer Traffic Optimization (ALTO) protocol is designed to allow entities with knowledge about the network infrastructure to export such information to applications that need to choose one or more endpoints to connect to among large sets of logically equivalent ones. This document provides a collection of messages that may be used to test the functionality and interoperability of an ALTO client and an ALTO server.

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1. Overview

The Application-Layer Traffic Optimization (ALTO) protocol is designed to allow entities with knowledge about the network infrastructure to export such information to applications that need to choose one or more endpoints to connect to among large sets of logically equivalent ones.

This document contains a set of messages that may be used to test the functionality and interoperability of an ALTO client and an ALTO server.

This document is informational and is NOT NORMATIVE on any aspects of the ALTO protocol. The normative behavior of ALTO entities is prescribed in [[RFC7285](#)].

The key ALTO services include Information Resource Directory retrieval, Map Service, Map-Filtering Service, Endpoint Property Service, and Endpoint Cost Service. Some services MUST be provided by an ALTO server, and other services MAY be provided by an ALTO server. In [[RFC7285](#)], some services are defined as "MUST", others are defined as "MAY", this document categorizes the test cases into mandatory cases (MUST cases) and optional (MAY cases). The aim of the document is to focus on areas that highlight the key offerings of the ALTO protocol, rather than giving all possible cases.

Note that it is not expected that an ALTO client and server implementation generate requests and responses in the same format as shown in this document. The syntax related to representing each request or response is left to each individual implementation as long as the payload is syntactically valid and semantically equivalent to any other representation of the same payload.

In the test cases of this document, an ALTO server is assumed to be available at the URL `http://alto.example.com`. Requests are directed towards it. This document assumes that the ALTO server URL has been discovered by the ALTO discovery protocol, however, it does not provide further details on the discovery protocol itself. Wherever possible, relevant HTTP headers are shown in the test cases, however, for the sake of brevity not all headers are depicted.

2. Maps: Network Map and Cost Map

To uniformly interpret the contents of the ALTO messages, a default topology is presented below. This topology is divided into a network map and a cost map. The network map contains a series of PIDs, a provider-defined network location identifier as specified in [[RFC7285](#)]. In the test cases of this document, this network map is

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represented as "my-default-network-map".

PID	IP Address Block
-----	-----
mypid1	10.0.0.0/8, 15.0.0.0/8
mypid2	192.168.0.0/16
mypid3	192.168.10.0/24
peeringpid1	128.0.0.0/16
peeringpid2	130.0.0.0/16, 2001:DB8::/32
transitpid1	132.0.0.0/16
transitpid2	135.0.0.0/16
defaultpid	0.0.0.0/0, ::/0

Figure 1: A Default Network Map

A cost map corresponding to the above network map is shown below. The cost map defines path costs amongst sets of source and destination network locations. path cost is the end-to-end cost from the source to the destination. Path costs have Cost Metric and Cost Mode as their attributes. In this cost map, cost metrics are routingcost, cost modes are numerical and ordinal.

Source PID	Destination PID	Cost Mode	
		Numerical	Ordinal
-----	-----	-----	-----
mypid1	mypid1	0	1
"	mypid2	0	1
"	mypid3	0	1
"	peeringpid1	0	1
"	peeringpid2	0	1
"	transitpid1	5	3
"	transitpid2	10	7
"	defaultpid	4	2
mypid2	mypid1	0	1
"	mypid2	0	1
"	mypid3	0	1
"	peeringpid1	0	1
"	peeringpid2	0	1
"	transitpid1	7	5
"	transitpid2	8	6
"	defaultpid	4	2
mypid3	mypid1	0	1
"	mypid2	0	1
"	mypid3	0	1
"	peeringpid1	0	1
"	peeringpid2	0	1
"	transitpid1	8	6
"	transitpid2	8	6

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```
"      defaultpid      5.1      4
```

Figure 2: Corresponding Cost Map

Note that the above represents a sparse cost map, i.e., the ALTO server is not defining a path cost from each source PID to each destination PID. It is only defining the costs that it is interested in serving.

3. Mandatory Cases

Mandatory cases are corresponding to the services that **MUST** be provided in [\[RFC7285\]](#).

3.1. Information Resource Directory

3.1.1 Case: Test-IRD-1

The Information Resource Directory (IRD) enumerates URIs at which an ALTO server offers Information Resources to an ALTO client.

```
GET /directory HTTP/1.1
```

```
Host: alto.example.com
```

```
Accept: application/alto-directory+json,application/alto-error+json
```

```
HTTP/1.1 200 OK
```

```
Content-Length: ****
```

```
Content-Type: application/alto-directory+json
```

```
{
  "meta" : {
    "cost-types": {
      "num-routing": {
        "cost-mode" : "numerical",
        "cost-metric": "routingcost"
      },
      "ord-routing": {
        "cost-mode" : "ordinal",
        "cost-metric": "routingcost"
      }
    },
    "default-alto-network-map" : "my-default-network-map"
  },
  "resources" : {
    "my-default-network-map" : {
      "uri" : "http://alto.example.com/networkmap",
      "media-type" : "application/alto-networkmap+json"
    }
  }
}
```

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```
    },
    "numerical-routing-cost-map" : {
      "uri" : "http://alto.example.com/costmap/num/routingcost",
      "media-type" : "application/alto-costmap+json",
      "capabilities" : {
        "cost-type-names" : [ "num-routing" ]
      },
      "uses": [ "my-default-network-map" ]
    },
    "ordinal-routing-cost-map" : {
      "uri" : "http://alto.example.com/costmap/ord/routingcost",
      "media-type" : "application/alto-costmap+json",
      "capabilities" : {
        "cost-type-names" : [ "ord-routing" ]
      },
      "uses": [ "my-default-network-map" ]
    },
    "endpoint-property" : {
      "uri" : "http://alto.example.com/endpointprop/lookup",
      "media-type" : "application/alto-endpointprop+json",
      "accepts" : "application/alto-endpointpropparams+json",
      "capabilities" : {
        "prop-types" : [ "my-default-network-map.pid" ]
      },
    },
    "endpoint-cost" : {
      "uri" : "http://alto.example.com/endpointcost/lookup",
      "media-type" : "application/alto-endpointcost+json",
      "accepts" : "application/alto-endpointcostparams+json",
      "capabilities" : {
        "cost-constraints" : true,
        "cost-type-names" : [ "num-routing", "ord-routing" ]
      }
    }
  }
}
```

[3.2.](#) Maps Service

[3.2.1](#) Case: Test-MAPS-1

An ALTO client retrieves a complete network map from an ALTO server.

```
GET /networkmap HTTP/1.1
Host: alto.example.com
```

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Accept: application/alto-networkmap+json,application/alto-error+json

HTTP/1.1 200 OK

Content-Length: ***

Content-Type: application/alto-networkmap+json

```
{
  "meta" : {
    "vtag": {
      "resource-id": "my-default-network-map",
      "tag": "3ee2cb7e8d63d9fab71b9b34cbf764436315542e"
    }
  },
  "network-map" : {
    "mypid1" : {
      "ipv4" : [ "10.0.0.0/8", "15.0.0.0/8" ]
    },
    "mypid2" : {
      "ipv4" : [ "192.168.0.0/16" ]
    },
    "mypid3" : {
      "ipv4" : [ "192.168.10.0/24" ]
    },
    "peeringpid1" : {
      "ipv4" : [ "128.0.0.0/16" ]
    },
    "peeringpid2" : {
      "ipv4" : [ "130.0.0.0/16" ],
      "ipv6" : [ "2001:DB8::/32" ]
    },
    "transitpid1" : {
      "ipv4" : [ "132.0.0.0/16" ]
    },
    "transitpid2" : {
      "ipv4" : [ "135.0.0.0/16" ]
    },
    "defaultpid" : {
      "ipv4" : [ "0.0.0.0/0" ],
      "ipv6" : [ "::/0" ]
    }
  }
}
```

[3.2.2](#) Case: Test-MAPS-2

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An ALTO client retrieves a complete cost map for the numerical cost mode from an ALTO server. In the response, the version tag of the cost map ("dependent-vtag") corresponds to the network map of the same version shown in test case Test-MAPS-1. In this document, assume that all version tags correspond to the same network map.

```
GET /costmap/num/routingcost HTTP/1.1
```

```
Host: alto.example.com
```

```
Accept: application/alto-costmap+json,application/alto-error+json
```

```
HTTP/1.1 200 OK
```

```
Content-Length: ***
```

```
Content-Type: application/alto-costmap+json
```

```
{
  "meta" : {
    "dependent-vtags" : [
      { "resource-id": "my-default-network-map",
        "tag": "3ee2cb7e8d63d9fab71b9b34cbf764436315542e"
      }
    ],
    "cost-type" : { "cost-mode" : "numerical",
                   "cost-metric": "routingcost"
    }
  },
  "cost-map" : {
    "mypid1": { "mypid1" : 0, "mypid2" : 0, "mypid3" : 0,
                "peeringpid1" : 0, "peerinpid2" : 0,
                "transitpid1" : 5, "transitpid2" : 10,
                "defaultpid" : 4},
    "mypid2": { "mypid1" : 0, "mypid2" : 0, "mypid3" : 0,
                "peeringpid1" : 0, "peerinpid2" : 0,
                "transitpid1" : 7, "transitpid2" : 8,
                "defaultpid" : 4},
    "mypid3": { "mypid1" : 0, "mypid2" : 0, "mypid3" : 0,
                "peeringpid1" : 0, "peerinpid2" : 0,
                "transitpid1" : 8, "transitpid2" : 8,
                "defaultpid" : 5.1}
  }
}
```

[3.2.3](#) Case: Test-MAPS-3

An ALTO client retrieves a complete cost map for the ordinal cost

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mode. In the response, the version tag of the cost map ("dependent-vtag") corresponds to the network map of the same version shown in test case Test-MAPS-1

```
GET /costmap/ordinal/routingcost HTTP/1.1
```

```
Host: alto.example.com
```

```
Accept: application/alto-costmap+json,application/alto-error+json
```

```
HTTP/1.1 200 OK
```

```
Content-Length: ***
```

```
Content-Type: application/alto-costmap+json
```

```
{
  "meta" : {
    "dependent-vtags" : [
      { "resource-id": "my-default-network-map",
        "tag": "3ee2cb7e8d63d9fab71b9b34cbf764436315542e"
      }
    ],
    "cost-type" : { "cost-mode" : "ordinal",
                    "cost-metric": "routingcost"
                  }
  },
  "cost-map" : {
    "mypid1": { "mypid1" : 1, "mypid2" : 1, "mypid3" : 1,
                 "peeringpid1" : 1, "peeringpid2" : 1,
                 "transitpid1" : 3, "transitpid2" : 7,
                 "defaultpid" : 2},
    "mypid2": { "mypid1" : 1, "mypid2" : 1, "mypid3" : 1,
                 "peeringpid1" : 1, "peeringpid2" : 1,
                 "transitpid1" : 5, "transitpid2" : 6,
                 "defaultpid" : 2},
    "mypid3": { "mypid1" : 1, "mypid2" : 1, "mypid3" : 1,
                 "peeringpid1" : 1, "peeringpid2" : 1,
                 "transitpid1" : 6, "transitpid2" : 6,
                 "defaultpid" : 4}
  }
}
```

[3.3.](#) Endpoint Property Service

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Endpoint Property Service provides information about endpoint properties to ALTO clients. An ALTO server MUST define "pid" endpoint property type. Note that the longest prefix match is used to retrieve the corresponding PID property.

3.3.1 Case: Test-EPS-1

An ALTO client retrieves a PID for IPv4 address 192.168.1.23 from an ALTO Server.

```
POST /endpointprop/lookup HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-endpointpropparams+json
Accept: application/alto-endpointprop+json,application/alto-error+json
```

```
{
  "properties" : [ "my-default-network-map.pid" ],
  "endpoints" : [ "ipv4:192.168.1.23" ]
}
```

```
HTTP/1.1 200 OK
Content-Length: ***
```

```
{
  "meta" : {
    "dependent-vtags" : [
      { "resource-id": "my-default-network-map",
        "tag": "3ee2cb7e8d63d9fab71b9b34cbf764436315542e"
      }
    ]
  },
  "endpoint-properties": {
    "ipv4:192.168.1.23" : { "my-default-network-map.pid": "mypid2" }
  }
}
```

3.3.2 Case: Test-EPS-2

An ALTO client retrieves a PID for IPv4 address 192.168.10.23 from an ALTO server.

```
POST /endpointprop/lookup HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-endpointpropparams+json
Accept: application/alto-endpointprop+json,application/alto-error+json
```

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```
{
  "properties" : [ "my-default-network-map.pid" ],
  "endpoints" : [ "ipv4:192.168.10.23" ]
}
```

HTTP/1.1 200 OK
Content-Length: ***

```
{
  "meta" : {
    "dependent-vtags" : [
      { "resource-id": "my-default-network-map",
        "tag": "3ee2cb7e8d63d9fab71b9b34cbf764436315542e"
      }
    ]
  },
  "endpoint-properties": {
    "ipv4:192.168.10.23" : { "my-default-network-map.pid": "mypid3" }
  }
}
```

3.3.3 Case: Test-EPS-3

An ALTO client retrieves a PID for IPv4 address 201.1.13.12 from an ALTO server.

POST /endpointprop/lookup HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-endpointpropparams+json
Accept: application/alto-endpointprop+json,application/alto-error+json

```
{
  "properties" : [ "my-default-network-map.pid" ],
  "endpoints" : [ "ipv4:201.1.13.12" ]
}
```

HTTP/1.1 200 OK
Content-Length: ***
Content-Type: application/alto-endpointprop+json

```
{
  "meta" : {
    "dependent-vtags" : [
      { "resource-id": "my-default-network-map",
        "tag": "3ee2cb7e8d63d9fab71b9b34cbf764436315542e"
      }
    ]
  }
}
```

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```

    ]
  },
  "endpoint-properties": {
    "ipv4:192.168.10.23" : { "my-default-network-map.pid": "mypid3" }
  }
}

```

3.3.4 Case: Test-EPS-4

An ALTO client retrieves a PID for an IPv4 and IPv6 address from an ALTO server.

```

POST /endpointprop/lookup HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-endpointpropparams+json
Accept: application/alto-endpointprop+json,application/alto-error+json

```

```

{
  "properties" : [ "my-default-network-map.pid" ],
  "endpoints" : [ "ipv6:1234::192.168.1.23",
                  "ipv4:132.0.10.12" ]
}

```

```

HTTP/1.1 200 OK
Content-Type: application/alto-endpointprop+json
Content-Length: ***

```

```

{
  "meta" : {
    "dependent-vtags" : [
      { "resource-id": "my-default-network-map",
        "tag": "3ee2cb7e8d63d9fab71b9b34cbf764436315542e"
      }
    ]
  },
  "endpoint-properties": {
    "ipv6:1234::192.168.1.23" : {
      "my-default-network-map.pid" : "defaultpid" },
    "ipv4:132.0.10.12" : { "my-default-network-map.pid" : "transitpid1" }
  }
}

```

3.4. Protocol Errors

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3.4.1 Case: Test-ERR-1

An ALTO client sends a parsing error body in the request --- a missing closing brace ('}').

```
POST /endpointprop/lookup HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-endpointpropparams+json
Accept: application/alto-endpointprop+json,application/alto-error+json

{
  "properties" : [ "my-default-network-map.pid" ],
  "endpoints" : [ "ipv4:192.168.10.23" ]
```

The server returns an HTTP response code of 400 with ALTO error code of E_SYNTAX (c.f., Table 1 [[RFC7285](#)]).

```
HTTP/1.1 400 Bad Request
Content-Type: application/alto-error+json
Content-Length: ***

{
  "code": "E_SYNTAX"
}
```

3.4.2 Case: Test-ERR-2

An ALTO client sends a malformed request --- the "properties" member for the Endpoint Property service is missing.

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```
POST /endpointprop/lookup HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-endpointpropparams+json
Accept: application/alto-endpointprop+json,application/alto-error+json

{
  "properties" : [ ],
  "endpoints" : [ "ipv4:192.168.10.23" ]
}
```

The server returns an HTTP response code of 400 with ALTO error code of E_JSON_FIELD_MISSING (c.f., Table 1 [[RFC7285](#)]).

```
HTTP/1.1 400 Bad Request
Content-Type: application/alto-error+json
Content-Length: ***

{
  "code": "E_JSON_FIELD_MISSING"
}
```

3.4.3 Case: Test-ERR-3

An ALTO client sends a request with an unexpected type for a JSON value.

```
POST /endpointprop/lookup HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-endpointpropparams+json
Accept: application/alto-endpointprop+json,application/alto-error+json

{
  "properties" : [ "my-default-network-map.pid" ],
  "endpoints" : "ipv4:192.168.10.23"
}
```

The server returns an HTTP response code of 400 with ALTO error code of E_INVALID_FIELD_TYPE(c.f., Table 1 [[RFC7285](#)]).

```
HTTP/1.1 400 Bad Request
Content-Type: application/alto-error+json
Content-Length: ***

{
```

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```
    "code": "E_INVALID_FIELD_TYPE"  
  }
```

3.4.4 Case: Test-ERR-4

An ALTO client sends a request with a wrong value for a correct field.

```
POST /endpointprop/lookup HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-endpointpropparams+json
Accept: application/alto-endpointprop+json,application/alto-error+json

{
  "properties" : [ "my-default-network-map.pid" ],
  "endpoints" : [ "192.168.10.23" ]
}
```

The server returns an HTTP response code of 400 with ALTO error code of E_INVALID_FIELD_VALUE (c.f., Table 1 [[RFC7285](#)]).

```
HTTP/1.1 400 Bad Request
Content-Length: ***
Content-Type: application/alto-error+json

{
  "code": "E_INVALID_FIELD_VALUE"
}
```

[4.](#) Optional Cases

Optional cases are corresponding to the services that MAY be provided in [[RFC7285](#)].

[4.1.](#) Map-Filtering Service

[4.1.1](#) Case: Test-FILTER-1

An ALTO client sends a request to get a filtered network map of PID mypid2 from an ALTO server.

```
POST /networkmap/filtered HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-networkmapfilter+json
Accept: application/alto-networkmap+json,application/alto-error+json

{
  "pids": [ "mypid2" ]
}
```

```
HTTP/1.1 200 OK
```

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Content-Length: 255

Content-Type: application/alto-networkmap+json

```
{
  "meta" : {
    "vtag" : {
      "resource-id": "my-default-network-map",
      "tag": "3ee2cb7e8d63d9fab71b9b34cbf764436315542e"
    },
    "network-map" : {
      "mypid2" : {
        "ipv4" : [ "192.168.0.0/16" ]
      }
    }
  }
}
```

[4.1.2](#) Case: Test-FILTER-2

An ALTO client sends a request to get a filtered cost map from asource PID to a set of destination PIDs.

POST /costmap/filtered HTTP/1.1

Host: alto.example.com

Content-Type: application/alto-costmapfilter+json

Content-Length: ***

Accept: application/alto-costmap+json,application/alto-error+json

```
{
  "cost-type" : {"cost-mode" : "numerical",
                 "cost-metric" : "routingcost",
  },
  "pids" : {
    "srcs" : [ "mypid1", "mypid3" ],
    "dsts" : [ "mypid2", "peeringpid1", "transitpid2" ]
  }
}
```

HTTP/1.1 200 OK

Content-Length: ***

Content-Type: application/alto-costmap+json

```
{
  "meta" : {
    "dependent-vtags" : [
      {"resource-id": "my-default-network-map",
       "tag": "3ee2cb7e8d63d9fab71b9b34cbf764436315542e"
      }
    ]
  }
}
```

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```

    ],
    "cost-type": { "cost-mode" : "numerical",
                   "cost-metric" : "routingcost"
    },
    "cost-map" : {
        "mypid1": { "mypid2": 0,  "peeringpid1": 0,
                    "transitpid2": 10 },
        "mypid3": { "mypid2": 0,  "peeringpid1": 0,
                    "transitpid2": 8 }
    }
}

```

4.1.3 Case: Test-FILTER-3

An ALTO client sends a request to get the cost map subject to certain constraints from an ALTO server.

```
POST /costmap/filtered HTTP/1.1
Host: alto.example.com
Content-Type: application/alto-costmapfilter+json
Content-Length: ***
Accept: application/alto-costmap+json,application/alto-error+json
```

```
{
  "cost-type" : {"cost-mode" : "numerical",
                  "cost-metric" : "routingcost",
                },
  "constrains" : ["gt 0", "le 10"],
  "pids" : {
    "srcs" : [ "mypid1", "mypid3" ],
    "dsts" : [ "mypid2", "peeringpid1", "transitpid2" ]
  }
}
```

```
HTTP/1.1 200 OK
Content-Length: ***
Content-Type: application/alto-costmap+json
```

```
{
  "meta" : {
    "dependent-vtags" : [
      { "resource-id": "my-default-network-map",
        "tag": "3ee2cb7e8d63d9fab71b9b34cbf764436315542e"
      }
    ],
    "cost-type": { "cost-mode" : "numerical",
                   "cost-metric" : "routingcost"
                 }
  }
}
```

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```
    }
  },
  "cost-map" : {
    "mypid1": { "transitpid2": 10 },
    "mypid3": { "transitpid2": 8 }
  }
}
```

[4.2.](#) Endpoint cost service

[4.2.1](#) Case: Test-ECS-1

An ALTO client requests cost information between individual endpoints from an ALTO server.

```
POST /endpointcost/lookup HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-endpointcostparams+json
Accept: application/alto-endpointcost+json,application/alto-error+json
```

```
{
  "cost-type": {"cost-mode" : "numerical",
               "cost-metric" : "routingcost" },
  "endpoints" : {
    "srcs": [ "ipv4:10.0.0.0", "ipv4:192.168.11.0",
              "ipv4:192.168.10.0"],
    "dsts": [
      "ipv4:10.0.0.0",
      "ipv4:15.0.0.0",
      "ipv4:192.168.11.0",
      "ipv4:192.168.10.0",
      "ipv4:128.0.0.0",
      "ipv4:130.0.0.0",
      "ipv4:0.0.0.0",
      "ipv4:132.0.0.0",
      "ipv4:135.0.0.0"
    ]
  }
}
```

```
HTTP/1.1 200 OK
Content-Length: ***
Content-Type: application/alto-endpointcost+json
```

```
{
  "meta": {
```

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```

    "cost-type": {"cost-mode" : "numerical",
                  "cost-metric" : "routingcost"
    },
    "endpoint-cost-map": {
        "ipv4:10.0.0.0": {
            "ipv4:10.0.0.0": 0.000000,
            "ipv4:15.0.0.0": 0.000000,
            "ipv4:192.168.11.0": 0.000000,
            "ipv4:192.168.10.0": 0.000000,
            "ipv4:128.0.0.0": 0.000000,
            "ipv4:130.0.0.0": 0.000000,
            "ipv4:0.0.0.0": 4.000000,
            "ipv4:132.0.0.0": 5.000000,
            "ipv4:135.0.0.0": 10.000000
        },
        "ipv4:192.168.11.0": {
            "ipv4:10.0.0.0": 0.000000,
            "ipv4:15.0.0.0": 0.000000,
            "ipv4:192.168.11.0": 0.000000,
            "ipv4:192.168.10.0": 0.000000,
            "ipv4:128.0.0.0": 0.000000,
            "ipv4:130.0.0.0": 0.000000,
            "ipv4:0.0.0.0": 4.000000,
            "ipv4:132.0.0.0": 7.000000,
            "ipv4:135.0.0.0": 8.000000
        },
        "ipv4:192.168.10.0": {
            "ipv4:10.0.0.0": 0.000000,
            "ipv4:15.0.0.0": 0.000000,
            "ipv4:192.168.11.0": 0.000000,
            "ipv4:192.168.10.0": 0.000000,
            "ipv4:128.0.0.0": 0.000000,
            "ipv4:130.0.0.0": 0.000000,
            "ipv4:0.0.0.0": 5.100000,
            "ipv4:132.0.0.0": 8.000000,
            "ipv4:135.0.0.0": 8.000000
        }
    }
}

```

[4.2.2](#) Case: Test-ECS-2

An ALTO client requests the ranking service for a source host to a set of destination hosts from an ALTO server.

POST /endpointcost/lookup HTTP/1.1

Host: alto.example.com

Accept: application/alto-endpointcost+json,application/alto-error+json

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Content-Type: application/alto-endpointcostparams+json

Content-Length: ***

```
{
  "cost-type": {"cost-mode" : "ordinal",
                "cost-metric" : "routingcost"},
  "endpoints" : {
    "srcs": [ "ipv6:2001:DB8::ABCD:6789", "ipv4:192.168.10.1" ],
    "dsts": [
      "ipv6:2001:DB8::2345:5678",
      "ipv4:135.0.29.1",
      "ipv4:192.168.10.23"
    ]
  }
}
```

The server response is shown below. Note that the source IP address of "ipv6:2001:DB8::ABCD:6789", which occurs in PID "peeringpid2", is omitted in the response. This reflects the fact that the ALTO server does not know the source costs from the "peeringpid2" PID.

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```
HTTP/1.1 200 OK
Content-Type: application/alto-endpointcost+json
Content-Length: ***
```

```
{
  "meta": {
    "cost-type": {"cost-mode" : "ordinal",
                  "cost-metric" : "routingcost"},
    "endpoint-cost-map": {
      "ipv4:192.168.10.1": {
        "ipv4:192.168.10.23": 1,
        "ipv6:2001:DB8::2345:5678": 1,
        "ipv4:135.0.29.1": 6
      }
    },
  }
}
```

[4.2.1](#) Case: Test-ECS-3

An ALTO client requests the cost service subject to certain constraints from an ALTO server.

```
POST /endpoints/cost HTTP/1.1
Host: alto.example.com
Content-Length: ***
Content-Type: application/alto-endpointcostparams+json
Accept: application/alto-endpointcost+json,application/alto-error+json
```

```
{
  "cost-type": {"cost-mode" : "numerical",
                "cost-metric" : "routingcost"},
  "constraints": ["le 5", "ge 4"],
  "endpoints": {
    "dsts": [
      "ipv4:10.0.0.0",
      "ipv4:15.0.0.0",
      "ipv4:192.168.11.0",
      "ipv4:192.168.10.0",
      "ipv4:128.0.0.0",
      "ipv4:130.0.0.0",
      "ipv4:0.0.0.0",
      "ipv4:132.0.0.0",
      "ipv4:135.0.0.0"
    ],
    "srcs": [
      "ipv4:10.0.0.0",
      "ipv4:192.168.11.0",
      "ipv4:192.168.10.0"
    ]
  }
}
```

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```
]
}
}

HTTP/1.1 200 OK
Content-Length: ***
Content-Type: application/alto-endpointcost+json
{
  "meta": {
    "cost-type": {"cost-mode" : "numerical",
                  "cost-metric" : "routingcost"},
    "endpoint-cost-map": {
      "ipv4:10.0.0.0": {
        "ipv4:0.0.0.0": 4, "ipv4:132.0.0.0": 5
      },
      "ipv4:192.168.11.0": {"ipv4:0.0.0.0": 4}
    }
  }
}
```

5. Security Considerations

This document does not present any new security considerations above and beyond what is documented in the ALTO protocol [[RFC7285](#)].

6. IANA Considerations

This document does not require any action from IANA.

7. References

7.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.

7.2. Informative References

[RFC7285] Almi, R., Penno, R., Yang, Y., Kiesel, S., Previdi, S., Roome, W., Shalunov, S., and R. Woundy, "Application-Layer Traffic Optimization (ALTO) Protocol", [RFC 7285](#), September

2014.

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