ALTO Extension: General Cost Types for Path Vector and Others

draft-yang-alto-general-cost-type-00
draft-yang-alto-pv-topology-01

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Motivation: Path Vector as Path (Cost) Property

- To make progress on the ALTO path-vector extension, we need to define its encoding
  - In –pv-topology-01, we used a new cost-mode called "path-vector", but this design does not look convincing yet

```
HTTP/1.1 200 OK
...
application/alto-costmap+json
{
  "meta" : {
    "dependent-vtags" : [...],
    "cost-type" : {"cost-metric": "bw", "cost-mode" : "path-vector" } 
  },
  "cost-map" : {
    "PID1": { "PID1":[], "PID2":["ne56", "ne67"], "PID3":[], "PID4":["ne57"]},
    "PID2": { "PID1":["ne75"], "PID2":[], "PID3":["ne75"], "PID4":[]}, ...
  }
}
```
ECMP for eh1 -> eh3, single path through sw6 for eh2 -> eh4

- PID1 -> PID3: [{"ne": "sw5-6", "w": 0.5},
               {"ne": "sw6-8", "w": 0.5},
               {"ne": "sw5-7", "w": 0.5},
               {"ne": "sw7-8", "w": 0.5}]

- PID2 -> PID4: [{"ne": "sw5-6", "w": 1},
                 {"ne": "sw6-8", "w": 1}]
Summary of Issue

• Authors of [RFC7285] anticipated that Cost may need to be generic and used JSONValue

object {
    CostMapData cost-map;
} InfoResourceCostMap 
   : ResponseEntityBase;

object-map {
    PIDName -> DstCosts;
} CostMapData;

object-map {
    PIDName -> JSONValue;
} DstCosts;

• To allow a client to correctly parse JSONValue, ALTO protocol must indicate its type: CostMap and EndpointCostMap are polymorphic (generic) types that need type indicator:
  – CostMap<T>
  – EndpointCostMap<T>
One Interpretation of Current Design

• The “cost-mode” field of the “cost-type” field of “meta” is the type indicator

```json
object {
    CostMetric cost-metric;
    CostMode cost-mode;
    [JSONString description;]
} CostType;
```

• Hence, one interpretation of current design is CostMap<cost-mode>, i.e., CostMap<numerical> and CostMap<ordinal>
  – “numerical” are floating point numbers {6.1.2.1}
  – “ordinal” are “non-negative” integers {6.1.2.2}

• “cost-metric”: indicates the semantics (routingcost, bw, ...)
  – CostMap<numerical> routingcost, bw
  – CostMap<ordinal> routingcost, bw
  – EndpointCostMap<numerical> routingcost, bw
  – EndpointCostMap<ordinal> routingcost, bw
For path vector, the “cost-mode” field is a new generic, reusable data type, e.g., string-vector (or vector<string>), that is similar to numerical, ordinal, so that the data type can be reused by others.

```
HTTP/1.1 200 OK
...
application/alto-costmap+json

{
  "meta" : {
    "dependent-vtags" : [...],
    "cost-type" : {
      "cost-metric": "path-elements",
      "cost-mode" : "string-vector"
    }
  },
  "cost-map" : {
    "PID1" : { "PID1" : [], "PID2" : ["ne56", "ne67"], "PID3" : [], "PID4" : ["ne57"]},
    "PID2" : { "PID1" : ["ne75"], "PID2" : [], "PID3" : ["ne75"], "PID4" : []}, ...
  }
}
```
One More Example

- How do we allow statistics on a cost metric (e.g., routingcost)

```
HTTP/1.1 200 OK
...
application/alto-costmap+json

{
  "meta" : {
    "dependent-vtags" : [...],
    "cost-type" : {"cost-metric": "latency-stat", "cost-mode" : "basic-stat-object" } 
  },
  "cost-map" : {
    "PID1": {
      "PID1":{"min": 1, "max": 2, "avg": 1.5},
      "PID2":{"min": 2, "max": 5, "avg": 2.5},
      ...
    }
  }
}
```
Summary and Remaining Issue

• We interpret current design of CostMap and EndpointCostMap as polymorphic types parameterized by cost-mode
  – CostMap<cost-mode> EndpointCostMap<cost-mode>

• We plan to generalize cost-mode to a broader set of data types (e.g., string-vector, numerical-vector, basic-stat-object)

• Remaining issue: How to specify the schema (i.e., cost-mode)
  – Use an existing data model language, e.g., YANG, JSON Schema
  – Develop one for ALTO
Backup Slides
## Examples of CostMap, EndpointCostMap

<table>
<thead>
<tr>
<th>HTTP/1.1 200 OK</th>
<th>HTTP/1.1 200 OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content-Length: 341</td>
<td>Content-Length: 274</td>
</tr>
<tr>
<td>Content-Type: application/alto-costmap+json</td>
<td>Content-Type: application/alto-endpointcost+json</td>
</tr>
</tbody>
</table>

```json
{
    "meta": {
        "dependent-vtags": [
            {
                "resource-id": "my-default-network-map",
                "tag": "75ed013b3cb58f896e83958258ce670f"
            }
        ],
        "cost-type": {"cost-mode": "numerical",
                      "cost-metric": "routingcost"}
    },
    "cost-map": {
        "PID1": { "PID1": 0, "PID2": 1, "PID3": 2 }
    }
}
```

```json
{
    "meta": {
        "cost-type": {"cost-mode": "ordinal",
                      "cost-metric": "routingcost"}
    },
    "endpoint-cost-map": {
        "ipv4:192.0.2.2": {
            "ipv4:192.0.2.89": 1, "ipv4:198.51.100.34": 2,
            "ipv4:203.0.113.45": 3
        }
    }
}
```

---

**POST /costmap/filtered**

**POST /endpointcost/lookup**