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JSON Format Extensions for Traffic Engineering (TE) performance metrics  
in the ALTO Information Resource Directory  
[draft-wu-alto-json-te-00](#)

## Abstract

The base ALTO specification defines two properties for cost metric attribute in the Cost MAP, including 'hopcount' and 'routingcost'. This specification adds five new properties and one new parameter for Traffic Engineering(TE) performance related constraint attribute associated with cost metric attribute 'routingcost' in the ALTO Information Resource Directory: Link Delay, Delay Variation, Packet Loss, Residual Bandwidth, Available Bandwidth, linkstate.

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## **1. Introduction**

The ALTO protocol [I.D-ietf-alto-protocol] uses a REST-ful design [Fielding-Thesis], and encodes its requests and responses using JSON. In ALTO architecture [I.D-ietf-alto-protocol], the ALTO server allows alto information to be gathered from multiple systems(e.g., routing protocol). [I.D-ietf-ospf-te-metric-extensions] describes extensions to OSPF TE called "OSPF TE Metric Extensions", that can be used to distribute network performance information (such as link delay, delay variation, packet loss, residual bandwidth, and available bandwidth). The mechanism defined in [I.D-ietf-ospf-te-metric-extensions] can be used by an ALTO Server to retrieve the necessary performance information supplementing the prefix and network topology data gathered from other sources in the underlying network.

In the ALTO Information Resource Directory, Network and Cost Map are two core ALTO Information provided to clients. The TE performance metric can be represented using Cost MAP. The base ALTO specification [I.D-ietf- alto-protocol] defines one typical cost metric attribute for Cost Type in the Cost MAP (i.e., 'routingcost') and uses constraint attribute to list additional constraints to which elements of the Cost Map are related. This specification adds five new properties and one new parameter for constraint attribute associated with 'routingcost' cost metric attribute in alto information service: Link Delay, Link Jitter, Packet Loss, Residual Bandwidth, Available Bandwidth, linkstate.



## **2. Conventions used in this document**

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119](#) [[RFC2119](#)].

Syntax specifications shown here use the augmented Backus-Naur Form (ABNF) as described in [[RFC5234](#)], and are specified as in the base JSON specification [[RFC4627](#)].

### **3. Cost Metric Extensions: properties**

#### **3.1. property: linkdelay**

Namespace:

property name: linkdelay

Purpose: To specify the average link delay between two directly connected neighboring peers in the network.

Value type: A single number value containing an integer component that may be prefixed with an optional minus sign, which may be followed by a fraction part and/or an exponent part.

Cardinality: \*1

Member parameters: N/A

Description: This is intended to be a cost constraint attribute used together with cost metric attribute 'routingcost'. 'routingcost' may also be used with other cost constraint attributes that is used to specify cost constraints. If 'linkdelay' is present, 'routingcost' MUST have at most one 'linkdelay'.

Format definition:

```
LINKDELAY-param =  
"VALUE"("gt"/"lt"/"eq"/"ge"/"le") ("number" / "object")  
LINKDELAY-value = number / object  
; Value type and VALUE parameter MUST match.
```

Examples:

```
"data": {  
  "cost type": {  
    "cost-mode": "numerical",  
    "cost-metric": "routingcost",  
    "constraints" : {"linkdelay"},  
    "endpoints": {  
      "srcs": [ "ipv4:192.0.2.2" ],  
      "dsts": [  
        "ipv4:192.0.2.89",  
        "ipv4:198.51.100.34",  
        "ipv4:203.0.113.45"  
      ]  
    }  
  }  
  "map": {  
    "ipv4:192.0.2.2": {
```





```
"ipv4:192.0.2.89": 0.0[linkdelay eq 0.0],
"ipv4:198.51.100.34": 15.0[linkdelay eq 3.0],
"ipv4:203.0.113.45": 1.0[linkdelay eq 12.0],
  }
}
```

### **3.2. property: linkjitter**

Namespace:

Property name: linkjitter

Purpose: To specify the average link delay variation between two directly connected neighboring peers.

Value type: A single number value containing an integer component that may be prefixed with an optional minus sign, which may be followed by a fraction part and/or an exponent part.

Cardinality: \*1

Member parameters: N/A

Description: This is intended to be a constraint attribute value used together with 'routingcost' cost metric attribute. 'routingcost' may also be used with other cost constraint attributes that is used to specify cost constraints. If 'linkjitter' is present, 'routingcost' MUST have at most one 'linkjitter'.

Format definition:

```
LINKJITTER-param =
  "VALUE"("gt"/"lt"/"eq"/"ge"/"le") ("number" / "object")
LINKJITTER-value = number / object
  ; Value type and VALUE parameter MUST match.
```

Examples:

```
"data": {
  "cost type": {
    "cost-mode": "numerical",
    "cost-metric": "routingcost",
    "constraints": {"linkdelay", "linkjitter"}
    "endpoints": {
      "srcs": [ "ipv4:192.0.2.2" ],
      "dsts": [
        "ipv4:192.0.2.89",
```



```
        "ipv4:198.51.100.34",
        "ipv4:203.0.113.45"
      ]
    }
    "map": {
      "ipv4:192.0.2.2": {
        "ipv4:192.0.2.89": 0[linkdelay eq0.0,linkjitter eq0.00],
        "ipv4:198.51.100.34": 5[linkdelay eq3.0,linkjitter eq1.0],
        "ipv4:203.0.113.45":2[linkdelay eq12.0,linkjitter eq5.0],
      }
    }
  }
```

### 3.3. property: linkloss

Namespace:

Property name: linkloss

Purpose: To specify a percentage of the total traffic sent over a configurable interval between two directly connected neighboring peers.

Value type: A single number value containing an integer component that may be prefixed with an optional minus sign, which may be followed by a fraction part and/or an exponent part.

Cardinality: \*1

Format definition: This is intended to be a constraint attribute value used together with 'routingcost' cost metric attribute. 'routingcost' may also be used with other cost constraint attributes that is used to specify cost constraints. If 'linkloss' is present, 'routingcost' MUST have at most one 'linkloss'.

Format definition:

```
LINKLOSS-param =
"VALUE"("gt"/"lt"/"eq"/"ge"/"le") ("number" / "object")
LINKLOSS-value = number / object
; Value type and VALUE parameter MUST match.
```

Examples:

```
"data": {
  "cost type": {
    "cost-mode": "numerical",
    "cost-metric": "routingcost",
    "constraints" : {"linkloss"}
  }
  "endpoints": {
```



```
        "srcs": [ "ipv4:192.0.2.2" ],
        "dsts": [
            "ipv4:192.0.2.89",
            "ipv4:198.51.100.34",
            "ipv4:203.0.113.45"
        ]
    }
    "map": {
        "ipv4:192.0.2.2": {
            "ipv4:192.0.2.89": 0 [linkloss eq0],
            "ipv4:198.51.100.34": 1 [linkloss eq0.0001],
            "ipv4:203.0.113.45": 0 [linkloss eq0],
        }
    }
```

### **3.4. property: residualbandwidth**

Namespace:

Property name: residualbandwidth

Purpose: To specify Maximum Link Bandwidth minus the bandwidth currently allocated between two directly connected neighboring peers. For a link, residual bandwidth is defined to be Maximum Bandwidth minus the bandwidth currently allocated to RSVP-TE packets. For a bundled link, residual bandwidth is defined to be the sum of the component link residual bandwidths.

Value type: A single number value containing an integer component that may be prefixed with an optional minus sign, which may be followed by a fraction part and/or an exponent part.

Cardinality: \*1

Member parameters: N/A

Description: This is intended to be a constraint attribute value used together with 'routing cost' cost metric attribute. 'routingcost' may also be used with other cost constraint attributes that is used to specify cost constraints. If 'residualbw' is present, 'routingcost' MUST have at most one 'residualbw'.

Format definition:

```
RESIDUALBANDWIDTH-param =
"VALUE"("gt"/"lt"/"eq"/"ge"/"le") ("number" / "object")
```



RESIDUALBANDWIDTH-value = number / object  
; Value type and VALUE parameter MUST match.

Examples:

```
"data": {
  "cost type": {
    "cost-mode": "numerical",
    "cost-metric": "routingcost",
    "constraints" : {"residbw"}
    "endpoints": {
      "srcs": [ "ipv4:192.0.2.2" ],
      "dsts": [
        "ipv4:192.0.2.89",
        "ipv4:198.51.100.34",
        "ipv4:203.0.113.45"
      ]
    }
  }
  "map": {
    "ipv4:192.0.2.2": {
      "ipv4:192.0.2.89": 0[residbw eq0.000000],
      "ipv4:198.51.100.34": 5[residbw eq12.5],
      "ipv4:203.0.113.45": 2[residbw eq5.9],
    }
  }
}
```

### [3.5.](#) property: availablebandwidth

Namespace:

Property name: availablebandwidth

Purpose: To specify the available bandwidth on a link between two directly connected neighboring peers. For a link, available bandwidth is defined to be residual bandwidth minus the measured bandwidth used for the actual forwarding of non-RSVP-TE packets. For a bundled link, available bandwidth is defined to be the sum of the component link available bandwidths.

Value type: A single number value containing an integer component that may be prefixed with an optional minus sign, which may be followed by a fraction part and/or an exponent part.

Cardinality: \*1

Member parameters: N/A





Description: This is intended to be a constraint attribute value used together with 'routing cost' cost metric attribute. 'routingcost' may also be used with other cost constraint attributes that is used to specify cost constraints. If 'availablebw' is present, 'routingcost' MUST have at most one 'availablebw'.

Format definition:

```
AVAILABLEBANDWIDTH-param =  
"VALUE"("gt"/"lt"/"eq"/"ge"/"le") ("number" / "object")  
AVAILABLEBANDWIDTH-value = number / object  
; Value type and VALUE parameter MUST match.
```

Examples:

```
"data": {  
  "cost type": {  
    "cost-mode": "numerical",  
    "cost-metric": "routingcost",  
    "constraints" : {"residbw", "availbw"}  
    "endpoints": {  
      "srcs": [ "ipv4:192.0.2.2" ],  
      "dsts": [  
        "ipv4:192.0.2.89",  
        "ipv4:198.51.100.34",  
        "ipv4:203.0.113.45"  
      ]  
    }  
  }  
}  
"map": {  
  "ipv4:192.0.2.2": {  
    "ipv4:192.0.2.89": 0[residbw eq0,availbw eq0],  
    "ipv4:198.51.100.34": 0[residbw eq12.5,availbw eq10.5],  
    "ipv4:203.0.113.45": 0[residbw eq5.9,availbw eq3.9],  
  }  
}
```



#### **4. Cost Metric Extensions: Parameters**

The following sections define Parameters used within Properties definitions.

##### **4.1. parameter: linkstate**

Namespace:

Parameter name: linkstate

Purpose: Used in a multi-valued property to indicate whether it is steady state link performance.

Description: When a property is multi-valued, LINKSTATE can be used to construct a steady state performancetopology for initial tunnel path computation, or to verify alternative failover paths. The LINKSTATE is set when the measured value of this parameter exceeds its configured maximum threshold. The LINKSTATE is cleared when the measured value falls below its configured threshold. LINKSTATE should be used together with properties we defined in the [section 3](#).

Format definition:

LINKSTATE-param = "LINKSTATE=" INDEX-value

LINKSTATE-value = integer

Examples:

```
object {
    JSONBOOL linkstate;
} linkdelay;

"data": {
    "cost type":{
        "cost-mode": "numerical",
        "cost-metric":"routingcost"}
    "constraints": {"linkdelay"}
    endpoints": {
        "srcs": [ "ipv4:192.0.2.2" ],
        "dsts": [
            "ipv4:192.0.2.89"
        ]
    }
}

"map": {
    "ipv4:192.0.2.2": {
        "ipv4:192.0.2.89": 0.0[linkdelay[linkstate eq 0] eq 10],
    }
}
```



## **5. Security Considerations**

The properties defined in this document present no security considerations beyond those in [Section 14](#) of the base ALTO specification [[draft-ietf-alto-protocol](#)].

## 6. IANA Considerations

IANA has added the following entries to the ALTO cost map Properties registry, defined in [Section 3](#) of [RFCXXX].

Namespace	Property	Reference
	linkdelay	[RFCxxxx], <a href="#">Section 3.1</a>
	linkjitter	[RFCxxxx], <a href="#">Section 3.2</a>
	linkloss	[RFCxxxx], <a href="#">Section 3.3</a>
	residbw	[RFCxxxx], <a href="#">Section 3.4</a>
	availbw	[RFCxxxx], <a href="#">Section 3.5</a>

IANA has added the following entries to the "ALTO cost map Parameters" registry, defined in [RFCxxxx] [Section 4.1](#).

Name-space	Parameter	Reference
	LINKSTATE	[RFCxxxx], <a href="#">Section 4.1</a>





## **7. Normative References**

- [ALTO] Alimi, R., "ALTO Protocol",  
ID [draft-ietf-alto-protocol-16](#), May 2013.
- [OSPF] Giacalone, S., "OSPF Traffic Engineering (TE) Metric  
Extensions", ID [draft-ietf-ospf-te-metric-extensions-04](#),  
June 2013.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate  
Requirement Levels", March 1997.
- [RFC4627] Crockford, D., "The application/json Media Type for  
JavaScript Object Notation (JSON)", [RFC 4627](#), July 2006.
- [RFC5234] Crocker, D., "Augmented BNF for Syntax Specifications:  
ABNF", [RFC 5234](#), January 2008.



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