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BGP attribute for North-Bound Distribution of Traffic Engineering (TE)  
performance Metrics  
draft-wu-idr-te-pm-bgp-02

## Abstract

In order to populate network performance information like link latency, latency variation, packet loss and bandwidth into Traffic Engineering Database(TED) and ALTO server, this document describes extensions to BGP protocol, that can be used to distribute network performance information (such as link delay, delay variation, packet loss, residual bandwidth, and available bandwidth).

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## 1. Introduction

As specified in [[RFC4655](#)], a Path Computation Element (PCE) is an entity that is capable of computing a network path or route based on a network graph, and of applying computational constraints during the computation. In order to compute an end to end path, the PCE needs to have a unified view of the overall topology [[I-D.ietf-pce-pcep-service-aware](#)]. [[I-D.ietf-idr-ls-distribution](#)] describes a mechanism by which links state and traffic engineering information can be collected from networks and shared with external components using the BGP routing protocol. This mechanism can be used by both PCE and ALTO server to gather information about the topologies and capabilities of the network.

With the growth of network virtualization technology, the needs for inter-connection between various overlay technologies (e.g. Enterprise BGP/MPLS IP VPNs) in the Wide Area Network (WAN) become important. The Network performance or QoS requirements such as latency, limited bandwidth, packet loss, and jitter, are all critical factors that must be taken into account in the end to end path computation ([[I-D.ietf-pce-pcep-service-aware](#)]) and selection which enable establishing segment overlay tunnel between overlay nodes and stitching them together to compute end to end path.

In order to populate network performance information like link latency, latency variation, packet loss and bandwidth into TED and ALTO server, this document describes extensions to BGP protocol, that can be used to distribute network performance information (such as link delay, delay variation, packet loss, residual bandwidth, and available bandwidth).

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## 2. Conventions used in this document

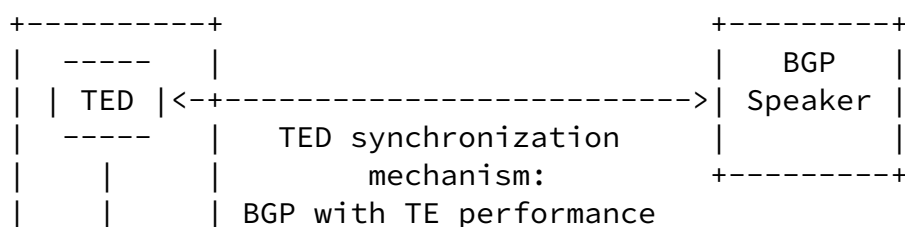
The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119](#) [[RFC2119](#)].

### [3.](#) Use Cases

#### [3.1.](#) MPLS-TE with PCE

In inter-AS path computation, PCE in each AS participant in different IGP. In Hierarchy of PCE, A child PCE must be configured with the address of its parent PCE[RFC6805]. Configuration system is challenged by handling changes in parent PCE identities and coping with failure events, especially when parent PCE and child PCE are not a part of the same routing domain.

The following figure shows how a PCE can get its TE performance information beyond that contained in the LINK\_STATE attributes [I.D-ietf-idr-ls-distribution] using the mechanism described in this document.



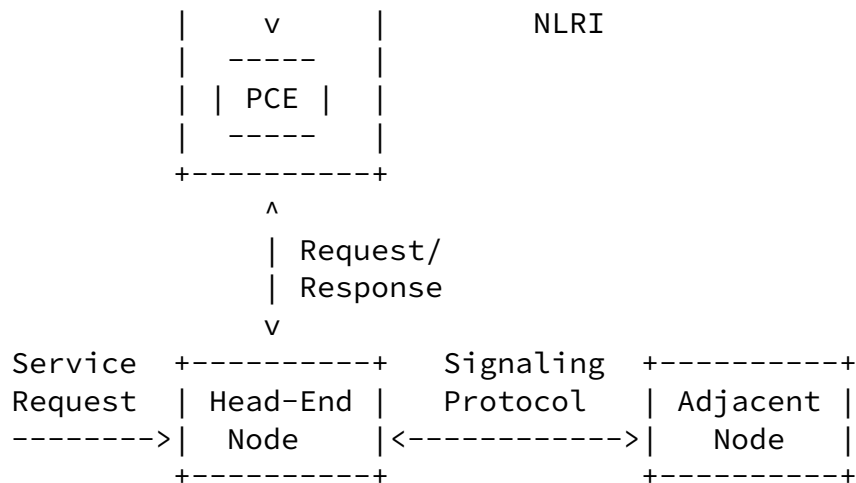


Figure 1: External PCE node using a TED synchronization mechanism

### 3.2. ALTO Server Network API

The ALTO Server can aggregate information from multiple systems to provide an abstract and unified view that can be more useful to applications.

The following figure shows how an ALTO Server can get TE performance information from the underlying network beyond that contained in the LINK\_STATE attributes [I.D-ietf-idr-ls-distribution] using the mechanism described in this document.

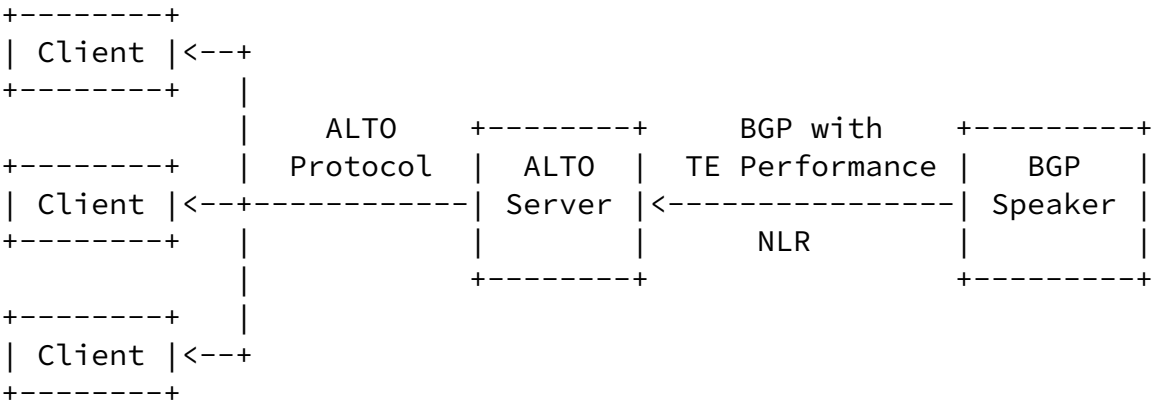


Figure 2: ALTO Server using network performance information

#### 4. Carrying TE Performance information in BGP

This document proposes new BGP TE performance TLVs that can be announced as attribute in the BGP-LS attribute (defined in [I.D-ietf-idr-ls-distribution]) to distribute network performance information. The extensions in this document build on the ones provided in BGP-LS [I.D -ietf-idr-ls-distribution] and BGP-4 [[RFC4271](#)].

BGP-LS attribute defined in [I.D-ietf-idr-ls-distribution] has nested TLVs which allow the BGP-LS attribute to be readily extended. This document proposes six additional TLVs as its attributes:

Type	Value
TBD1	Unidirectional Link Delay
TBD2	Min/Max Unidirectional Link Delay
TBD3	Unidirectional Delay Variation
TBD4	Unidirectional Packet Loss
TBD5	Unidirectional Residual Bandwidth
TBD6	Unidirectional Available Bandwidth

[ Editor Note: When this draft(v-01) was presented in the IDR WG session of Berlin meeting, John Scudder suggested to define new attributes(i.e., link utilization attribute, channel throughput attribute) added in the previous version of this draft in the [draft-ietf-isis-te-metric-extensions](#). After Berlin meeting, Hannes Gredler help initiate discussion with authors of IGP drafts(i.e., [draft-ietf-isis-te-metric-extensions](#) and [draft-ietf-ospf-te-metric-extensions](#)) on why two additional attributes should be added into IGP draft. After a few offline discussion with authors of IGP drafts, specially with John Drake, David Ward, Alia Atlas, Stefano Previdi, it was roughly agreed that

- o drop channel throughput attribute since it is node attribute rather than link attribute.
- o and add link utilization attribute into IGP drafts.

However the open issue is whether defining total Link Utilization as Currently Utilized Bandwidth or as Currently Utilized Bandwidth / Maximum Bandwidth. Until this open issue is resolved, the link utilization attribute will be added into the update of this draft as seventh additional TLV. ]

As can be seen in the list above, the TLVs described in this document



carry different types of network performance information. These TLVs include a bit called the Anomalous (or "A") bit at the left-most bit after length field of each TLV. The other bits in the first octets after length field of each TLV is reserved for future use. When the A bit is clear (or when the TLV does not include an A bit), the TLV describes steady state link performance. This information could conceivably be used to construct a steady state performance topology for initial tunnel path computation, or to verify alternative failover paths.

When network performance downgrades and exceeds configurable maximum thresholds, a TLV with the A bit set is advertised. These TLVs could be used by the receiving BGP peer to determine whether to redirect failing traffic to a backup path, or whether to calculate an entirely new path. If link performance improves later and falls below a configurable value, that TLV can be re- advertised with the Anomalous bit cleared. In this case, a receiving BGP peer can conceivably do whatever re-optimization (or failback) it wishes to do (including nothing).

Note that when a TLV does not include the A bit, that TLV cannot be used for failover purposes. The A bit was intentionally omitted from some TLVs to help mitigate oscillations.

Consistent with existing ISIS TE specifications [ISIS-TE- METRIC], the bandwidth advertisements, the delay and delay variation advertisements, packetloss defined in this document MUST be encoded in the same unit as one defined in IS-IS Extended IS Reachability sub-TLVs [ISIS-TE- METRIC]. All values (except residual bandwidth) MUST be calculated as rolling averages where the averaging period MUST be a configurable period of time.

## 5. Attribute TLV Details

Link attribute TLVs defined in [section 3.2.2](#) of [I-D.ietf-idr-ls-distribution] are TLVs that may be encoded in the BGP-LS attribute with a link NLRI. Each 'Link Attribute' is a Type/Length/ Value (TLV) triplet formatted as defined in [Section 3.1](#) of [I-D.ietf-idr-ls-distribution]. The format and semantics of the 'value' fields in some 'Link Attribute' TLVs correspond to the format and semantics of value fields in IS-IS Extended IS Reachability sub-TLVs, defined in [[RFC5305](#)]. Although the encodings for 'Link Attribute' TLVs were originally defined for IS-IS, the TLVs can carry data sourced either by IS-IS or OSPF.

The following 'Link Attribute' TLVs are valid in the LINK\_STATE attribute:

TLV Code Point	Description	IS-IS TLV/Sub-TLV	Defined in:
xxxx	Unidirectional Link Delay	22/xx	[ISIS-TE]/4.1
xxxx	Min/Max Unidirectional Link Delay	22/xx	[ISIS-TE]/4.2
xxxx	Unidirectional Delay Variation	22/xx	[ISIS-TE]/4.3
xxxx	Unidirectional Link Loss	22/xx	[ISIS-TE]/4.4
xxxx	Unidirectional Residual Bandwidth	22/xx	[ISIS-TE]/4.5
xxxx	Unidirectional Available Bandwidth	22/xx	[ISIS-TE]/4.6

Table 1: Link Attribute TLVs

[ Editor Note: The open issue is whether defining total Link Utilization as Currently Utilized Bandwidth or as Currently Utilized Bandwidth / Maximum Bandwidth? We will add link utilization attribute as seventh additional attribute(e.g.,Currently Utilized Bandwidth) when the open issue is resolved. ]

## 6. Security Considerations

This document does not introduce security issues beyond those discussed in [I.D-ietf-idr-ls-distribution] and [[RFC4271](#)].

## [7.](#) IANA Considerations

IANA maintains the registry for the TLVs. BGP TE Performance TLV will require one new type code per TLV defined in this document.

## [8.](#) References

### [8.1.](#) Normative References

[I-D.ietf-idr-ls-distribution]

Gredler, H., "North-Bound Distribution of Link-State and TE Information using BGP",  
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ID <http://tools.ietf.org/html/draft-ietf-alto-protocol-16>,  
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## [Appendix A.](#) Change Log

Note to the RFC-Editor: please remove this section prior to  
publication as an RFC.

### [A.1.](#) [draft-wu-idr-te-pm-bgp-02](#)

The following are the major changes compared to previous version 01:

- o Taking out link utilization metric and channel throughput metric from this version and will add link utilization metric back to the update when there was agreement on what measurement unit is used for link utilization.
- o Some additional texts in BGP extension [section 4](#) to explain how to position 'A' bit in the BGP TE performance TLV.

- o Add two editor notes to explain the status of this draft and open issue that need be resolved.
- o Some additional text in the use case sections to clarify how to use these TE performance metrics.

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