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May 2, 2015

# BGP Link-State Information Distribution Implementation Report draft-ietf-idr-ls-distribution-impl-04

## Abstract

This document is an implementation report for the BGP Link-State Information Distribution protocol. The editors did not verify the accuracy of the information provided by respondents. The respondents are experts with the implementations they reported on, and their responses are considered authoritative for the implementations for which their responses represent. Respondents were asked to only use the YES answer if the feature had at least been tested in the lab.

## Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on November 3, 2015.

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## 1. Introduction

In order to share network link-state and traffic engineering information collected with external components using the BGP routing protocol a new BGP Network Layer Reachability Information (NLRI) encoding format is required.

This document provides an implementation report for the BGP Link-State Information Distribution NLRI Format as defined in [I-D.ietf-idr-ls-distribution].

The scope of the interoperability test is sucessful encoding and decoding of BGP-LS advertisements. No application specific logic has been verified.





The editors did not verify the accuracy of the information provided by respondents or by any alternative means. The respondents are experts with the implementations they reported on, and their responses are considered authoritative for the implementations for which their responses represent. Respondents were asked to only use the YES answer if the feature had at least been tested in the lab.

## 2. Implementation Forms

Contact and implementation information for person filling out this form:

IOS-XR
- Name: Manish Bhardwaj
- Email:manbhard@cisco.com
- Vendor: Cisco Systems, Inc.
- Release: IOS-XR
- Protocol Role: Sender, Receiver, Originator

JUNOS
- Name: Balaji Rajagopalan
- Email: balajir@juniper.net
- Vendor: Juniper Networks, Inc.
- Release: JUNOS
- Protocol Role: Sender, Receiver, Originator

OpenDaylight
- Name: Dana Kutenicsova
- Email: dkutenic@cisco.com
- Vendor: OpenDaylight Project, Inc.
- Release: ODL Hydrogen
- Protocol Role: Receiver

Telecom Italia
- Name: Roberto Morro
- Email: roberto.morro@telecomitalia.it

Vendor: Telecom Italia, SpA
Release: 5.0
Protocol Role: Originator

Netphony
Name: Oscar Gonzalez
Email: oscar.gonzalezdedios@telefonica.com
Name: Victor Lopez
Email: victor.lopezalvarez@telefonica.com
Company: Telefonica
Release: 1.0.1





Protocol role: Sender, Receiver, Originator

CTTC
Name: Ramon Casellas
Email: ramon.casellas@cttc.es
Company: CTTC
Release: 4.9 (PCE)
Protocol role: Sender, Receiver, Originator

CNIT
Name: Francesco Paolucci
Email: fr.paolucci@sssup.it
Company: CNIT/Scuola Superiore Sant'Anna
Release: IdealistPCE v1.0
Protocol role: Originator, Sender

## 3. NLRI subtypes

Does the implementation support the Network Layer Reachability (NLRI) subtypes as described in Section 3.2 of [I-D.ietf-idr-ls-distribution] ?

N1: Node NLRI

N2: Link NLRI

N3: IPv4 Topology Prefix NLRI

N4: IPv6 Topology Prefix NLRI





| | IOS-XR | JUNOS | ODL | TI | NPHY | CTTC | CNIT |
|---|---|---|---|---|---|---|---|
| Rcv.N1 | YES | YES | YES | NO | YES | YES | NO |
| Snd.N1 | YES | YES | NO | NO | YES | YES | YES |
| Org.N1 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.N2 | YES | YES | YES | NO | YES | YES | NO |
| Snd.N2 | YES | YES | NO | NO | YES | YES | YES |
| Org.N2 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.N3 | YES | YES | YES | NO | NO | NO | NO |
| Snd.N3 | YES | YES | NO | NO | NO | NO | NO |
| Org.N3 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.N4 | YES | YES | YES | NO | NO | NO | NO |
| Snd.N4 | YES | YES | NO | NO | NO | NO | NO |
| Org.N4 | YES | NO | NO | NO | NO | NO | NO |

## 4. Link NLRI TLV support

Does the implementation support the TLVs described in Section 7 of [I-D.ietf-idr-ls-distribution] ?

TLV 256: Local Node Descriptor

TLV 257: Remote Node Descriptor

TLV 258: Link Local/Remote Identifier

TLV 259: IPv4 Interface address

TLV 260: IPv4 Neighbor address

TLV 261: IPv6 Interface address

TLV 262: IPv6 Neighbor address

TLV 263: Multi-Topology IDs

TLV 512: Autonomous System

TLV 513: BGP-LS Identifier

TLV 514: Area ID

TLV 515: IGP Router ID

TLV 1028: IPv4 router-ID of Local Node





TLV 1029: IPv6 router-ID of Local Node

TLV 1030: IPv4 router-ID of Remote Node

TLV 1031: IPv6 router-ID of Remote Node

TLV 1088: Administrative group (color)

TLV 1089: Maximum link bandwidth

TLV 1090: Maximum reservable link bandwidth

TLV 1091: Unreserved link bandwidth

TLV 1092: TE default Metric

TLV 1093: Link Protection Type

TLV 1094: MPLS Protocol Mask

TLV 1095: IGP Metric

TLV 1096: Shared Risk Link Group

TLV 1097: Opaque Link attribute

TLV 1098: Link name attribute

| | IOS-XR | JUNOS | ODL | TI | NPHY | CTTC | CNIT |
|---|---|---|---|---|---|---|---|
| Rcv.TLV 256 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 256 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 256 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 257 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 257 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 257 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 258 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 258 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 258 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 259 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 259 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 259 | YES | YES | NO | NO | NO | NO | NO |
| Rcv.TLV 260 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 260 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 260 | YES | YES | NO | NO | NO | NO | NO |
| Rcv.TLV 261 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 261 | YES | YES | NO | NO | NO | NO | NO |





| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Org.TLV 261 | NO | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 262 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 262 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 262 | NO | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 263 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 263 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 263 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 512 | YES | YES | YES | NO | YES | YES | NO |

| Snd.TLV 512 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 512 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 513 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 513 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 513 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 514 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 514 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 514 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 515 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 515 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 515 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 1028 | YES | YES | YES | NO | YES | NO | NO |
| Snd.TLV 1028 | YES | YES | NO | NO | YES | NO | YES |
| Org.TLV 1028 | YES | YES | NO | NO | NO | NO | YES |
| Rcv.TLV 1029 | YES | YES | YES | NO | YES | NO | NO |
| Snd.TLV 1029 | YES | YES | NO | NO | YES | NO | NO |
| Org.TLV 1029 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1030 | YES | YES | YES | NO | YES | NO | NO |
| Snd.TLV 1030 | YES | YES | NO | NO | YES | NO | YES |
| Org.TLV 1030 | YES | YES | NO | NO | NO | NO | YES |
| Rcv.TLV 1031 | YES | YES | YES | NO | YES | NO | NO |
| Snd.TLV 1031 | YES | YES | NO | NO | YES | NO | NO |
| Org.TLV 1031 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1088 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 1088 | YES | YES | NO | NO | YES | YES | NO |
| Org.TLV 1088 | YES | YES | NO | YES | NO | YES | NO |
| Rcv.TLV 1089 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 1089 | YES | YES | NO | NO | YES | YES | NO |
| Org.TLV 1089 | YES | YES | NO | NO | YES | YES | NO |
| Rcv.TLV 1090 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 1090 | YES | YES | NO | NO | YES | YES | NO |
| Org.TLV 1090 | YES | YES | NO | YES | YES | YES | NO |
| Rcv.TLV 1091 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 1091 | YES | YES | NO | NO | YES | YES | NO |
| Org.TLV 1091 | YES | YES | NO | YES | YES | YES | NO |
| Rcv.TLV 1092 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 1092 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 1092 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 1093 | YES | YES | YES | NO | YES | NO | NO |
| Snd.TLV 1093 | YES | YES | NO | NO | NO | NO | NO |





| Org.TLV 1093 | NO | NO | NO | NO | NO | NO | NO |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Rcv.TLV 1094 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1094 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1094 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1095 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1095 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1095 | YES | YES | NO | NO | NO | NO | NO |
| Rcv.TLV 1096 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1096 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1096 | YES | YES | NO | NO | NO | NO | NO |
| Rcv.TLV 1097 | YES | YES | NO | NO | NO | NO | NO |
| Snd.TLV 1097 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1097 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1098 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1098 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1098 | NO | NO | NO | NO | NO | NO | NO |

## 5. Node NLRI TLV support

Does the implementation support the TLVs described in Section 7 of [I-D.ietf-idr-ls-distribution] ?

TLV 256: Local Node Descriptor

TLV 263: Multi-Topology IDs

TLV 512: Autonomous System

TLV 513: BGP-LS Identifier

TLV 514: Area ID

TLV 515: IGP Router ID

TLV 1024: Node flag bits

TLV 1025: Opaque Node properties

TLV 1026: Node name

TLV 1027: IS-IS Area Identifier

TLV 1028: IPv4 router-ID of Local Node

TLV 1029: IPv6 router-ID of Local Node

| | IOS-XR | JUNOS | ODL | TI | NPHY | CTTC | CNIT |
|---|---|---|---|---|---|---|---|
| Rcv.TLV 256 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 256 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 256 | YES | YES | NO | NO | YES | YES | YES |
| Rcv.TLV 263 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 263 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 263 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 512 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 512 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 512 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 513 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 513 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 513 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 514 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 514 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 514 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 515 | YES | YES | YES | NO | YES | YES | NO |
| Snd.TLV 515 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 515 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 1024 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1024 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1024 | YES | YES | NO | NO | NO | NO | NO |
| Rcv.TLV 1025 | YES | YES | NO | NO | NO | NO | NO |
| Snd.TLV 1025 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1025 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1026 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1026 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1026 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1027 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1027 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1027 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1028 | YES | YES | YES | NO | NO | YES | NO |
| Snd.TLV 1028 | YES | YES | NO | NO | YES | YES | YES |
| Org.TLV 1028 | YES | YES | NO | YES | YES | YES | YES |
| Rcv.TLV 1029 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1029 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1029 | YES | NO | NO | NO | NO | NO | NO |

## 6. Prefix NLRI TLV support

Does the implementation support the TLVs described in Section 7 of [I-D.ietf-idr-ls-distribution] ?

TLV 256: Local Node Descriptor





TLV 263: Multi-Topology IDs

TLV 264: OSPF route type

TLV 265: IP Reachability information

TLV 1152: IGP Flags

TLV 1153: Route Tag

TLV 1154: Extended Tag

TLV 1155: Prefix Metric

TLV 1156: OSPF Forwarding Address

TLV 1157: Opaque Prefix Attribute

| | IOS-XR | JUNOS | ODL | TI | NPHY | CTTC | CNIT |
|---|---|---|---|---|---|---|---|
| Rcv.TLV 256 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 256 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 256 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 263 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 263 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 263 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 264 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 264 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 264 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 265 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 265 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 265 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1152 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1152 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1152 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1153 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1153 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1153 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1154 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1154 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1154 | NO | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1155 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1155 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1155 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1156 | YES | YES | YES | NO | NO | NO | NO |
| Snd.TLV 1156 | YES | YES | NO | NO | NO | NO | NO |
| Org.TLV 1156 | YES | NO | NO | NO | NO | NO | NO |
| Rcv.TLV 1157 | YES | YES | NO | NO | NO | NO | NO |
| Snd.TLV 1157 | YES | YES | NO | NO | NO | NO | NO |

| Org.TLV 1157 | YES | NO | NO | NO | NO | NO | NO |
+---+---+---+---+---+---+---+---+

## 7. Interoperable Implementations

List other implementations that you have tested interoperability of BGP-LS Protocol Implementation.

### 7.1. Cisco Implementation

Cisco: The Cisco Systems, Inc. IOS-XR implementation should be interoperable with other vendor BGP-LS Protocol implementations. In particular, we have tested our interoperability with Juniper's JUNOS implementation.





### 7.2. Juniper Implementation

Juniper: The Juniper Networks, Inc. JUNOS implementation should be interoperable with other vendor BGP-LS Protocol implementations. In particular, we have tested our interoperability with the Cisco Systems, Inc. IOS-XR implementation and the Opendaylight implementation.

### 7.3. OpenDaylight Implementation

Opendaylight: The Opendaylight implementation should be interoperable with other vendor BGP-LS Protocol implementations. In particular, we have tested our interoperability with Juniper's JUNOS implementation and the Cisco Systems, Inc. IOS-XR implementation. BGP receiver is implemented in the OpenDaylight Hydrogen release. BGP sender functionality is planned in the upcoming Helium release.

### 7.4. Telecom Italia Implementation

The Telecom Italia implementation has been developed in the context of the EU-funded project IDEALIST, aiming at studying flexible grid optical networks. In this context, some extension have been defined to advertise Nominal Center Frequency (NCF) status. It has been tested against the Telefonica Netphony implementation (only receiver role). Telecom Italia implementation has been successfully tested

also against OpenDayLight Hydrogen and Helium releases.

### 7.5. Netphony Implementation

Netphony is an open-source implementation of networking protocols. The encoding of BGP-LS is available at Github [1]. Netphony BGP-LS implementation is known to interoperate with Telecom Italia Implementation, CTTC Implementation and CNIT Implementation.

### 7.6. CTTC Implementation

The CTTC implementation is part of the CTTC-PCE software, which uses BGP-LS as a north bound interface to export the TED used to other entities, or as an interface to provide the TED on which the PCE operates on. It has been developed in the context of the IDEALIST FP7 project. It has been tested with Telefonica implementation, in a multi-partner control plane testbed that uses a hierarchical PCE to perform multi-domain path computation. BGP-LS is used to export (abstracted or physical) domain TE information from the child PCE to the parent PCE.





### 7.7. CNIT Implementation

The CNIT implementation is part of the GMPLS-PCE control plane software suitably extended to handle Flexgrid and advanced bandwidth-variable transponders. The PCE includes a BGP-LS speaker module, developed in C++ and running on Linux, able to export TED topology, both in a static and dynamic fashion, triggered by PCEP notifications, update/report messages on LSP setup/teardown/modify/ adaptation events. Implementation includes updates of TE links, nodes and per-link nominal central frequencies utilization information. The BGP-LS speaker has been evaluated and tested with Telefonica implementation in a child PCE configuration controlling a real Flexgrid data plane domain and exporting link state information to a parent PCE performing inter-domain end to end path computation. Development has been done in the context of the FP7 IDEALIST project.

## 8. IANA Considerations

This document makes no request of IANA.

Note to RFC Editor: The IANA has requested that this section remain in the document upon publication as an RFC. This note to the RFC Editor, however, may be removed.

## 9. Security considerations

No new security issues are introduced by the BGP Link-State Information Distribution Protocol defined in [I-D.ietf-idr-ls-distribution].

## 10. Acknowledgements

The authors would like to thank Stefano Previdi and Jan Medved for their contributions to this document.

## 11. References

### 11.1. Normative References

[I-D.ietf-idr-ls-distribution]
Gredler, H., Medved, J., Previdi, S., Farrel, A., and S. Ray, "North-Bound Distribution of Link-State and TE Information using BGP", draft-ietf-idr-ls-distribution-10 (work in progress), January 2015.





### 11.2. URIs

[1] https://github.com/telefonicaid/netphony-network-protocols

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