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A. Smirnov
Cisco Systems, Inc.
A. Retana
Huawei R&D USA
M. Barnes
Cisco Systems, Inc.
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OSPF Routing with Cross-Address Family Traffic Engineering Tunnels
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Abstract

When using Traffic Engineering (TE) in a dual-stack IPv4/IPv6 network, the Multiprotocol Label Switching (MPLS) TE Label Switched Paths (LSP) infrastructure may be duplicated, even if the destination IPv4 and IPv6 addresses belong to the same remote router. In order to achieve an integrated MPLS TE LSP infrastructure, OSPF routes must be computed over MPLS TE tunnels created using information propagated in another OSPF instance. This issue is solved by advertising cross-address family (X-AF) OSPF TE information.

This document describes an update to [RFC5786](#) that allows for the easy identification of a router's local X-AF IP addresses.

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[1.](#) Introduction

TE Extensions to OSPFv2 [[RFC3630](#)] and OSPFv3 [[RFC5329](#)] have been described to support intra-area TE in IPv4 and IPv6 networks, respectively. In both cases, the TE database provides a tight coupling between the routed protocol and advertised TE signaling information. In other words, any use of the TE link state database is limited to IPv4 for OSPFv2 [[RFC2328](#)] and IPv6 for OSPFv3 [[RFC5340](#)].

In a dual stack network, it may be desirable to set up common MPLS TE LSPs to carry traffic destined to addresses from different address families on a router. The use of common LSPs eases potential scalability and management concerns by halving the number of LSPs in the network. Besides, it allows operators to group traffic based on business characteristics and/or applications or class of service, not constrained by the network protocol used.

For example, an LSP created based on MPLS TE information propagated by an OSPFv2 instance can be used to transport both IPv4 and IPv6 traffic, as opposed to using both OSPFv2 and OSPFv3 to provision a separate LSP for each address family. Even if in some cases the

address family-specific traffic is to be separated, calculation from a common database may prove to be operationally beneficial.

During the SPF calculation on the TE tunnel head-end router, OSPF computes shortcut routes using TE tunnels. A commonly used algorithm for computing shortcuts is defined in [[RFC3906](#)]. For that, or any similar, algorithm to work with a common MPLS TE infrastructure in a dual-stack network, a requirement is to reliably map the X-AF addresses to the corresponding tail-end router. This mapping is a challenge because the LSAs containing the routing information are carried in one OSPF instance while the TE calculations may be done using a TE database from a different OSPF instance.

A simple solution to this problem is to rely on the Router ID to identify a node in the corresponding OSPFv2 and OSPFv3 databases. This solution would mandate both instances on the same router to be configured with the same Router ID. However, relying on the correctness of configuration puts additional burden and cost on the operation of the network. The network becomes even more difficult to manage if OSPFv2 and OSPFv3 topologies do not match exactly, for example if area borders are chosen differently in the two protocols. Also, if the routing processes do fall out of sync (e.g., having different Router IDs for local administrative reasons), there is no defined way for other routers to discover such misalignment and to take corrective measures (such as to avoid routing traffic through affected TE tunnels or alerting the network administrators). The use of misaligned Router IDs may result in delivering the traffic to the wrong tail-end router, which could lead to suboptimal routing or even traffic loops.

This document describes an update to [[RFC5786](#)] that allows for the easy identification of a router's local X-AF IP addresses. Routers using the Node Attribute TLV [[RFC5786](#)] can include non-TE enabled interface addresses in their OSPF TE advertisements, and also use the same sub-TLVs to carry X-AF information, facilitating the mapping described above.

The method specified in this document can also be used to compute the X-AF mapping of the egress Label Switching Router (LSR) for sub-LSPs of a Point-to-Multipoint LSP [[RFC4461](#)]. Considerations of using Point-to-Multipoint MPLS TE for X-AF traffic forwarding is outside the scope of this document.

[2.](#) Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP

14 [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

[3.](#) Operation

[[RFC5786](#)] defined the Node IPv4 Local Address and Node IPv6 Local Address sub-TLVs of the Node Attribute TLV for a router to advertise additional local IPv4 and IPv6 addresses. However, [[RFC5786](#)] did not describe the advertisement and usage of these sub-TLVs when the address family of the advertised local address differed from the address family of the OSPF traffic engineering protocol.

This document updates [[RFC5786](#)] so that a router can also announce one or more local X-AF addresses using the corresponding Local Address sub-TLV. In other words, to implement the X-AF routing technique described in this document, OSPFv2 will advertise the Node IPv6 Local Address sub-TLV and OSPFv3 will advertise the Node IPv4 Local Address sub-TLV, possibly in addition to advertising other IP addresses as documented by [[RFC5786](#)].

A node that implements X-AF routing SHOULD advertise, in the corresponding Node Local Address sub-TLV, all X-AF IPv4 and IPv6 addresses local to the router that can be used by Constrained SPF (CSPF) to calculate MPLS TE LSPs. OSPF MUST advertise the IP address listed in the Router Address TLV [[RFC3630](#)] [[RFC5329](#)] of the X-AF instance maintaining the MPLS TE database, and SHOULD include additional local addresses advertised by the X-AF OSPF instance in its Node Local Address sub-TLVs. An implementation MAY advertise other local X-AF addresses.

If the Node Attribute TLV carries both the Node IPv4 Local Address sub-TLV and the Node IPv6 Local Address sub-TLV, then the X-AF component MUST be considered for the consolidated calculation of MPLS TE LSPs. Both instances MAY advertise the required information and it is left to local configuration to determine which database is used.

On Area Border Routers (ABR), each advertised X-AF IP address MUST be advertised into at most one area. If OSPFv2 and OSPFv3 area border routers coincide (i.e., the areas for all OSPFv2 and OSPFv3 interfaces are the same), then the X-AF addresses MUST be advertised into the same area in both instances. This allows other ABRs connected to the same set of areas to know with which area to associate computed MPLS TE tunnels.

During the X-AF routing calculation, X-AF IP addresses are used to map locally created LSPs to tail-end routers in the Link State Database (LSDB). The mapping algorithm can be described as:

Walk the list of all MPLS TE tunnels for which the computing router is a head-end. For each MPLS TE tunnel T:

1. If T's destination address is from the same address family as the OSPF instance associated with the LSDB, then the extensions defined in this document do not apply.
2. Otherwise it is a X-AF MPLS TE tunnel. Note tunnel's destination IP address.
3. Walk the X-AF IP addresses in the LSDBs of all connected areas. If a matching IP address is found, advertised by router R in area A, then mark the tunnel T as belonging to area A and terminating on tail-end router R. Assign the intra-area SPF cost to reach router R within area A as the IGP cost of tunnel T.

After completing this calculation, each TE tunnel is associated with an area and tail-end router in terms of the routing LSDB of the computing OSPF instance and has a cost.

The algorithm described above is to be used only if Node Local Address sub-TLV include X-AF information.

Note that for clarity of description the mapping algorithm is specified as a single calculation. Actual implementations for the efficiency may choose to support equivalent mapping functionality without implementing the algorithm exactly as it is described.

As an example, consider a router in a dual-stack network respectively using OSPFv2 and OSPFv3 for IPv4 and IPv6 routing. Suppose the OSPFv2 instance is used to propagate MPLS TE information and the router is configured to accept TE LSPs terminating at local addresses 198.51.100.1 and 198.51.100.2. The router advertises in OSPFv2 the IPv4 address 198.51.100.1 in the Router Address TLV, the additional local IPv4 address 198.51.100.2 in the Node IPv4 Local Address sub-TLV, and other Traffic Engineering TLVs as required by [\[RFC3630\]](#). If the OSPFv3 instance in the network is enabled for X-AF TE routing (that is, to use MPLS TE LSPs computed by OSPFv2 for IPv6 routing), then the OSPFv3 instance of the router will advertise the Node IPv4 Local Address sub-TLV listing the local IPv4 addresses 198.51.100.1 and 198.51.100.2. Other routers in the OSPFv3 network will use this information to reliably identify this router as the egress LSR for MPLS TE LSPs terminating at either 198.51.100.1 or 198.51.100.2.

[4.](#) Backward Compatibility

Only routers that serve as endpoints for one or more TE tunnels MUST be upgraded to support the procedures described herein:

- o Tunnel tailend routers advertise the Node IPv4 Local Address sub-TLV and/or the Node IPv6 Local Address sub-TLV.
- o Tunnel headend routers perform the X-AF routing calculation.

Other routers in the network do not need to support X-AF procedures.

[4.1.](#) Automatically Switched Optical Networks

[RFC6827] updates [\[RFC5786\]](#) by defining extensions to be used in an

Automatically Switched Optical Network (ASON). The Local TE Router ID Sub-TLV is required for determining ASON reachability. The implication is that if the Local TE Router ID Sub-TLV is present in the Node Attribute TLV, then the procedures in [\[RFC6827\]](#) apply, regardless of whether any X-AF information is advertised.

[5.](#) Security Considerations

This document describes the use of the Local Address sub-TLVs to provide X-AF information. The advertisement of these sub-TLVs, in any OSPF instance, is not precluded by [\[RFC5786\]](#). As such, no new security threats are introduced beyond the considerations in OSPFv2 [\[RFC2328\]](#), OSPFv3 [\[RFC5340\]](#), and [\[RFC5786\]](#).

The X-AF information is not used for SPF computation or normal routing, so the mechanism specified here has no affect on IP routing. However, generating incorrect information, or tampering with the sub-TLVs may have an effect on traffic engineering computations. Specifically, TE traffic may be delivered to the wrong tail-end router, which could lead to suboptimal routing or even traffic loops. These threats are already present in other TE-related specifications, and their considerations apply here as well, including [\[RFC3630\]](#) and [\[RFC5329\]](#).

[6.](#) IANA Considerations

This document has no IANA actions.

[7.](#) Acknowledgements

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[8.](#) References

[8.1.](#) Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate

Requirement Levels", [BCP 14](#), [RFC 2119](#),
DOI 10.17487/RFC2119, March 1997,
<<https://www.rfc-editor.org/info/rfc2119>>.

- [RFC5786] Aggarwal, R. and K. Kompella, "Advertising a Router's Local Addresses in OSPF Traffic Engineering (TE) Extensions", [RFC 5786](#), DOI 10.17487/RFC5786, March 2010, <<https://www.rfc-editor.org/info/rfc5786>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in [RFC 2119](#) Key Words", [BCP 14](#), [RFC 8174](#), DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.

8.2. Informative References

- [RFC2328] Moy, J., "OSPF Version 2", STD 54, [RFC 2328](#), DOI 10.17487/RFC2328, April 1998, <<https://www.rfc-editor.org/info/rfc2328>>.
- [RFC3630] Katz, D., Kompella, K., and D. Yeung, "Traffic Engineering (TE) Extensions to OSPF Version 2", [RFC 3630](#), DOI 10.17487/RFC3630, September 2003, <<https://www.rfc-editor.org/info/rfc3630>>.
- [RFC3906] Shen, N. and H. Smit, "Calculating Interior Gateway Protocol (IGP) Routes Over Traffic Engineering Tunnels", [RFC 3906](#), DOI 10.17487/RFC3906, October 2004, <<https://www.rfc-editor.org/info/rfc3906>>.
- [RFC4461] Yasukawa, S., Ed., "Signaling Requirements for Point-to-Multipoint Traffic-Engineered MPLS Label Switched Paths (LSPs)", [RFC 4461](#), DOI 10.17487/RFC4461, April 2006, <<https://www.rfc-editor.org/info/rfc4461>>.
- [RFC5329] Ishiguro, K., Manral, V., Davey, A., and A. Lindem, Ed., "Traffic Engineering Extensions to OSPF Version 3", [RFC 5329](#), DOI 10.17487/RFC5329, September 2008, <<https://www.rfc-editor.org/info/rfc5329>>.

- [RFC5340] Coltun, R., Ferguson, D., Moy, J., and A. Lindem, "OSPF

for IPv6", [RFC 5340](https://www.rfc-editor.org/info/rfc5340), DOI 10.17487/RFC5340, July 2008,
<<https://www.rfc-editor.org/info/rfc5340>>.

[RFC6827] Malis, A., Ed., Lindem, A., Ed., and D. Papadimitriou,
Ed., "Automatically Switched Optical Network (ASON)
Routing for OSPFv2 Protocols", [RFC 6827](https://www.rfc-editor.org/info/rfc6827),
DOI 10.17487/RFC6827, January 2013,
<<https://www.rfc-editor.org/info/rfc6827>>.

Authors' Addresses

Anton Smirnov
Cisco Systems, Inc.
De kleetlaan 6a
Diegem 1831
Belgium

Email: as@cisco.com

Alvaro Retana
Huawei R&D USA
2330 Central Expressway
Santa Clara, CA 95050
USA

Email: alvaro.retana@huawei.com

Michael Barnes
Cisco Systems, Inc.
510 McCarthy Blvd.
Milpitas, CA 95035
USA

Email: mjbarnes@cisco.com