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L. Gong
W. Cheng
China Mobile
C. Lin
New H3C Technologies
A. Lindem
Arrcus, Inc.
R. Chen
ZTE Corporation
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Advertising Unreachable Links in OSPF
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Abstract

In certain scenarios, it is necessary to advertise unreachable links in OSPF, which should be explicitly excluded from the related SPF calculation. This document specifies using `LSLinkInfinity(0xffff)` to advertise an OSPF link as unreachable.

Stub Router Advertisement (RFC 6987) defines `MaxLinkMetric(0xffff)` to indicate a router-LSA link should not be used for transit traffic. This document updates RFC 6987 and RFC 8770. When an OSPFv2 router supports the Unreachable Link support capability defined in this document, the OSPFv2 stub router `MaxLinkMetric(0xffff)` MUST be updated to `MaxReachableLinkMetric(0xfffe)`.

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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1. Introduction

In specific scenarios, there is a requirement to advertise unreachable links in OSPF, which MUST NOT be considered during the standard SPF computation. For example, a link may be available for Traffic Engineering (TE) purposes but not suitable for hop-by-hop routing. Another example is an OSPF link with dedicated resources for a network slice included in a Flexible Algorithm (Flex-Algorithm) but excluded from the default topology.

his document specifies using `LSLinkInfinity(0xffff)` to advertise an OSPF link as unreachable.

1.1. 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.

2. Use Cases

2.1. Case 1: Traffic Engineering

A network topology is shown in Figure 1. There is a link available for Traffic Engineering only between Node A and E. If this link is included in the SPF calculations, best-effort traffic may be routed over the link.

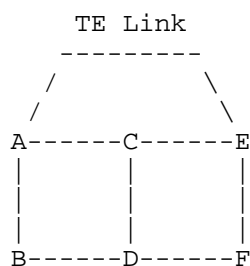


Figure 1: Network Topology

2.2. Case 2: Flexible Algorithm

A network topology is shown in Figure 2. The links between nodes A, and B and between C and D are to be used exclusively for a flex-algorithm devoted to specific traffic. These links have an Extended Administrative Group (EAG) [RFC7308] attribute specifying the "Red" color.

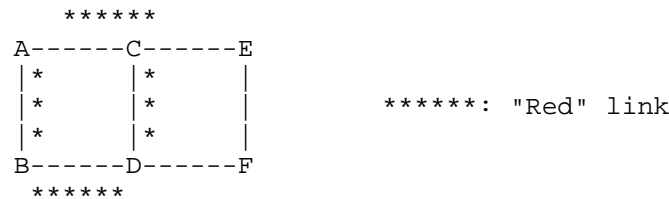


Figure 2: Network Topology

Flex-Algorithm 128 is enabled on Nodes A, B, C, and D, with an EAG rule including "Red" and the Metric-Type is designated to be a type other than the IGP metric. Flex-Algorithm allows OSPF to compute the paths along the constrained topology. The topology used by Flex-Algorithm 128 is shown in Figure 3.



Figure 3: Topology of Flex-Algorithm 128

Flex-Algorithm 128 is used for routing particular flows, such as those for specific traffic. The "Red" links used by Flex-Algorithm 128 are sub-interfaces with dedicated queues for guaranteed bandwidth. Sub-interfaces in other traffic and default topology are omitted from the example figure for clarity. So, it is expected that only the particular flows are routed on these links using Flex-Algorithm 128. However, these links are also contained in the default topology computed by the normal SPF calculation, and these links may also be used for best-effort traffic. Therefore, it is a problem that the dedicated links for Flex-Algorithm are still reachable in base SPF calculation.

If the IGP metrics for all the "Red" links are advertised as unreachable, the base topology will be as shown in Figure 4, excluding all the "Red" links. This allows Flex-Algorithm 128 to route only specific traffic on the "Red" links.

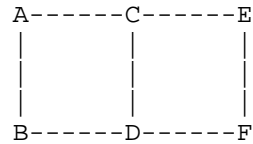


Figure 4: Base SPF Topology Excluding Unreachable Links

3. LSInfinity-Based Solution

3.1. Unreachable Link Advertisement

This document specifies that if the IGP metric of a link is advertised as LSLinkInfinity (0xffff), it MUST NOT be considered during the related SPF computation. This applies to both the Flex-Algorithm SPF and the base SPF as long as LSLinkInfinity is specified for the IGP metric.

While the interpretation of LSLinkInfinity is only required in the base topology as other topologies are optional, OSPF routers supporting this specification MUST consistently interpret LSLinkInfinity as unreachable during the related SPF computation. This applies to both the Flex-Algorithm SPF and the base SPF as long as LSLinkInfinity is specified for the IGP metric.

An IGP metric with LSLinkInfinity indicating a link is unreachable is applicable to the following TLVs/LSAs:

- * The Router-LSA [RFC2328] and [RFC5340]
- * The OSPFv2 Extended Link TLV of OSPFv2 Extended Link Opaque LSA [RFC7684]
- * The Router-Link TLV of OSPFv3 E-Router-LSA [RFC8362]

3.2. Unreachable Link Backward Compatibility

Prior to this specification, OSPF treated links advertised as LSLinkInfinity as reachable [RFC2328]. Hence, partial deployment of this specification may result in routing loops due to inconsistent interpretation of LSLinkInfinity. For example in the network shown in Figure 5, link D-F is advertised with LSLinkInfinity (65535/0xffff). Router B supports LSLinkInfinity as unreachable, but router A doesn't. Router A considers link D-F as reachable, and the shortest path to F is A->B->D->F. Router B considers link D-F as unreachable, and the shortest path to F is B->A->C->E->F. As a result, A forwards the packets to B, but B returns them to A, which results in a routing loop.

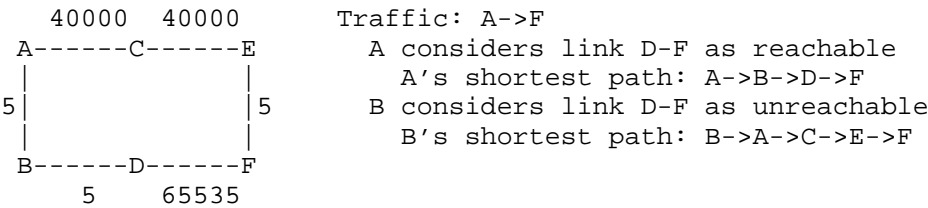


Figure 5: Inconsistent LSLinkInfinity Interpretation Causing Loops

To provide backward compatibility, this document defines that routers supporting LSLinkInfinity for unreachable links MUST advertise a Router Information (RI) LSA with a Router Functional Capabilities TLV [RFC7770] including the following Router Functional Capability Bit:

+=====+	
Bit	Capabilities
+=====+	
TBA	Unreachable Link support
+-----+	

Table 1

OSPF Routers MUST NOT treat links with an advertised metric of LSLinkInfinity as unreachable unless all routers in the OSPF area have advertised this capability. If all OSPF Routers in the area have advertised this capability, then links with an advertised metric of LSLinkInfinity MUST be treated as unreachable. Upon detection of a change in the number of routers in the area not supporting the Unreachable Link support capability changes to 0 or from 0 to greater than 0, all OSPF routers in the area MUST recalculate their routes.

3.3. Stub Router Advertisement Backward Compatibility

Stub Router Advertisement [RFC6987] defines MaxLinkMetric (0xffff) to indicate a router-LSA link should not be used for transit traffic.

This document updates [RFC6987] and [RFC8770]. When an OSPFv2 router supports the Unreachable Link support capability defined in this document, the OSPFv2 stub router MaxLinkMetric(0xffff) MUST be updated to MaxReachableLinkMetric(0xfffe).

When an OSPFv2 router supports [RFC6987] and the Unreachable Link support capability defined in this document, it MUST also support advertise all its non-stub links with a link cost of MaxReachableLinkMetric (0xfffe). Since MaxLinkMetric will not be used to indicate a link is unreachable unless all OSPFv2 routers in the area support this specification as specified in Section 3.2, all

routers in the area will also support the usage of `MaxReachableLinkMetric` to discourage the usage of stub router links for transit traffic.

An OSPFv3 router can simply advertise R-bit in its router-LSA options [RFC5340] to prevent usage stub router links for transit traffic. Similarly, OSPFv2 routers supporting [RFC8770] can advertise the H-bit in the router-LSA options.

4. Management Considerations

Support of the Unreachable Link support capability SHOULD be configurable.

In some networks, the operator may still want links with maximum metric(0xffff) to be treated as reachable. For example, when auto-costing of links is used and there is a mix of low-speed and high-speed links. In such cases, the updated routers can disable the Unreachable Link support capability and still treat links with maximum metric as reachable.

It is also RECOMMENDED that implementations supporting this document and auto-costing limit the maximum computed cost to `MaxReachableLinkMetric` (0xffffe).

5. YANG Data Model

YANG [RFC7950] is a data definition language used to define the contents of a conceptual data store that allows networked devices to be managed using NETCONF [RFC6241] or RESTCONF [RFC8040].

This section defines a YANG data model that can be used to configure and manage the usage of OSPF `LSLinkInfinity` for unreachable links as defined in this document, which augments the OSPF YANG data model [RFC9129] and the YANG Data Model for Routing Management [RFC8349].

5.1. Tree for the YANG Data Model

This document uses the graphical representation of data models per [RFC8340].

The following show the tree diagram of the module:

```

augment /rt:routing/rt:control-plane-protocols
  /rt:control-plane-protocol/ospf:ospf:
  +--rw unreachable-link-advertisement
  +--rw enabled?    boolean
augment /rt:routing/rt:control-plane-protocols
  /rt:control-plane-protocol/ospf:ospf/ospf:areas/ospf:area
  /ospf:database/ospf:area-scope-lsa-type
  /ospf:area-scope-lsas/ospf:area-scope-lsa/ospf:version
  /ospf:ospfv2/ospf:ospfv2/ospf:body/ospf:opaque
  /ospf:ri-opaque/ospf:router-capabilities-tlv:
  +--ro router-functional-capabilities
  +--ro functional-capabilities*  identityref
augment /rt:routing/rt:control-plane-protocols
  /rt:control-plane-protocol/ospf:ospf/ospf:database
  /ospf:as-scope-lsa-type/ospf:as-scope-lsas
  /ospf:as-scope-lsa/ospf:version/ospf:ospfv2/ospf:ospfv2
  /ospf:body/ospf:opaque/ospf:ri-opaque
  /ospf:router-capabilities-tlv:
  +--ro router-functional-capabilities
  +--ro functional-capabilities*  identityref
augment /rt:routing/rt:control-plane-protocols
  /rt:control-plane-protocol/ospf:ospf/ospf:database
  /ospf:as-scope-lsa-type/ospf:as-scope-lsas
  /ospf:as-scope-lsa/ospf:version/ospf:ospfv3/ospf:ospfv3
  /ospf:body/ospf:router-information
  /ospf:router-capabilities-tlv:
  +--ro router-functional-capabilities
  +--ro functional-capabilities*  identityref
augment /rt:routing/rt:control-plane-protocols
  /rt:control-plane-protocol/ospf:ospf/ospf:areas/ospf:area
  /ospf:database/ospf:area-scope-lsa-type
  /ospf:area-scope-lsas/ospf:area-scope-lsa/ospf:version
  /ospf:ospfv3/ospf:ospfv3/ospf:body/ospf:router-information
  /ospf:router-capabilities-tlv:
  +--ro router-functional-capabilities
  +--ro functional-capabilities*  identityref

```

5.2. YANG Data Model for OSPF Advertising Unreachable Links

The following is the YANG module:

```

<CODE BEGINS> file "ietf-ospf-unreachable-links@2025-08-20.yang"
module ietf-ospf-unreachable-links {
  yang-version 1.1;
  namespace
    "urn:ietf:params:xml:ns:yang:ietf-ospf-unreachable-links";
  prefix ospf-unreach-link;

```

```
import ietf-routing {
  prefix rt;
  reference
    "RFC 8349: A YANG Data Model for Routing
      Management (NMDA Version)";
}
import ietf-ospf {
  prefix ospf;
  reference
    "RFC 9129: YANG Data Model for the OSPF Protocol";
}

organization
  "IETF LSR - Link State Routing Working Group";
contact
  "WG Web:    <https://datatracker.ietf.org/wg/lsr/>
  WG List:    <mailto:lsr@ietf.org>

  Author:     Yingzhen Qu
              <mailto:yqu@futurewei.com>
  Author:     Acee Lindem
              <mailto:acee.ietf@gmail.com>";
description
  "This YANG module defines the configuration and operational
  state for Advertising Unreachable Links in OSPF as defined
  in RFC XXXX.

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  authors of the code.  All rights reserved.

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  forth in Section 4.c of the IETF Trust's Legal Provisions
  Relating to IETF Documents
  (https://trustee.ietf.org/license-info).

  This version of this YANG module is part of RFC XXXX;
  see the RFC itself for full legal notices.";
reference
  "RFC XXXX";

revision 2025-08-20 {
  description
    "Initial version";
  reference
    "RFC XXXX: Advertising Unreachable Links in OSPF";
}
```

```
identity functional-capability {
  description
    "Base identity for router informational capabilities.";
}

identity unreachable-link {
  base ospf-unreach-link:functional-capability;
  description
    "When set, the router is capable of advertising unreachable
    links.";
}

grouping router-functional-capabilities {
  description
    "Grouping for OSPF router capabilities TLV types.";
  reference
    "RFC 7770: Extensions to OSPF for Advertising Optional
    Router Capabilities";
  container router-functional-capabilities {
    leaf-list functional-capabilities {
      type identityref {
        base functional-capability;
      }
      description
        "List of functional capabilities. This list will
        contain the identities for the functional
        capabilities supported by the router.";
    }
    description
      "OSPF Router Functional identity definitions.";
  }
}

augment "/rt:routing/rt:control-plane-protocols"
  + "/rt:control-plane-protocol/ospf:ospf" {
  when "../rt:type = 'ospf:ospfv2' or "
  + "../rt:type = 'ospf:ospfv3'" {
    description
      "This augments the OSPF routing protocol when used.";
  }
  description
    "This augments OSPF protocol with unreachable link
    advertisement.";
  container unreachable-link-advertisement {
    leaf enabled {
      type boolean;
      default "false";
      description
```

```
        "Enable advertisement of unreachable links.";
    }
    description
        "OSPF unreachable link advertisement configuration.";
}

augment "/rt:routing/"
+ "rt:control-plane-protocols/rt:control-plane-protocol/"
+ "ospf:ospf/ospf:areas/"
+ "ospf:area/ospf:database/"
+ "ospf:area-scope-lsa-type/ospf:area-scope-lsas/"
+ "ospf:area-scope-lsa/ospf:version/ospf:ospfv2/"
+ "ospf:ospfv2/ospf:body/ospf:opaque/"
+ "ospf:ri-opaque/ospf:router-capabilities-tlv" {
    when "derived-from(/rt:routing/rt:control-plane-protocols/"
        + "rt:control-plane-protocol/rt:type, 'ospf:ospfv2'))" {
        description
            "This augmentation is only valid for OSPFv2.";
    }
    description
        "OSPFv2 Opaque Area-Scoped Router-Information LSA Router
        Functional capabilities (RFC 7770).";
    uses router-functional-capabilities;
}

augment "/rt:routing/"
+ "rt:control-plane-protocols/rt:control-plane-protocol/"
+ "ospf:ospf/ospf:database/"
+ "ospf:as-scope-lsa-type/ospf:as-scope-lsas/"
+ "ospf:as-scope-lsa/ospf:version/ospf:ospfv2/"
+ "ospf:ospfv2/ospf:body/ospf:opaque/"
+ "ospf:ri-opaque/ospf:router-capabilities-tlv" {
    when "derived-from(/rt:routing/rt:control-plane-protocols/"
        + "rt:control-plane-protocol/rt:type, 'ospf:ospfv2'))" {
        description
            "This augmentation is only valid for OSPFv2.";
    }
    description
        "OSPFv2 Opaque AS-Scoped Router-Information LSA Router
        Functional capabilities (RFC 7770).";
    uses router-functional-capabilities;
}

augment "/rt:routing/"
+ "rt:control-plane-protocols/rt:control-plane-protocol/"
+ "ospf:ospf/ospf:database/"
+ "ospf:as-scope-lsa-type/ospf:as-scope-lsas/"
```

```

    + "ospf:as-scope-lsa/ospf:version/ospf:ospfv3/"
    + "ospf:ospfv3/ospf:body/ospf:router-information/"
    + "ospf:router-capabilities-tlv" {
when "derived-from(/rt:routing/rt:control-plane-protocols/"
    + "rt:control-plane-protocol/rt:type, 'ospf:ospfv3')" {
    description
        "This augmentation is only valid for OSPFv3.";
    }
description
    "OSPFv3 Area-Scoped Router-Information LSA Router
    Functional capabilities (RFC 7770).";
uses router-functional-capabilities;
}

augment "/rt:routing/"
    + "rt:control-plane-protocols/rt:control-plane-protocol/"
    + "ospf:ospf/ospf:areas/"
    + "ospf:area/ospf:database/"
    + "ospf:area-scope-lsa-type/ospf:area-scope-lsas/"
    + "ospf:area-scope-lsa/ospf:version/ospf:ospfv3/"
    + "ospf:ospfv3/ospf:body/ospf:router-information/"
    + "ospf:router-capabilities-tlv" {
when "derived-from(/rt:routing/rt:control-plane-protocols/"
    + "rt:control-plane-protocol/rt:type, 'ospf:ospfv3')" {
    description
        "This augmentation is only valid for OSPFv3.";
    }
description
    "OSPFv3 AS-Scoped Router-Information LSA Router
    Functional capabilities (RFC 7770).";
uses router-functional-capabilities;
}
}
<CODE ENDS>

```

6. Security Considerations

The document does not introduce any new security issues for the OSPF protocol. The security considerations for [RFC2328],[RFC5340], [RFC6987], and [RFC7770] are applicable to protocol extension.

The ietf-ospf-link-unreach YANG module defines a data model that is designed to be accessed via YANG-based management protocols, such as NETCONF [RFC6241] and RESTCONF [RFC8040]. These protocols have to use a secure transport layer (e.g., SSH [RFC4252], TLS [RFC8446], and QUIC [RFC9000]) and have to use mutual authentication.

The NETCONF Access Control Model (NACM) [RFC8341] provides the means to restrict access for particular NETCONF or RESTCONF users to a pre-configured subset of all available NETCONF or RESTCONF protocol operations and content.

The following data nodes defined in the YANG module that are writable/creatable/deletable (i.e., config true, which is the default). The modifications to these data nodes without proper protection can have prevent interpreting the OSPF LSLinkInfinity metric as unreachable.

```
/ospf:ospf/ospf-unreach-link:unreachable-link-advertisement/ospf-
unreach-link:enabled
```

Some of the readable data nodes in this YANG module may be considered sensitive or vulnerable in some network environments. Exposure of the OSPF link state database may be useful in mounting a Denial-of-Service (DoS) attacks. These are the readable data nodes:

```
/ospf:ospf/ospf-unreach-link:unreachable-link-advertisement/ospf-
unreach-link:enabled
```

7. IANA Considerations

This document defines a new bit in the registry "OSPF Router Functional Capability Bits":

Bit Number	Capability Name	Reference
0(TBD)	Unreachable Link support	This document

Table 2

The IANA is requested to assign one new URI from the IETF XML registry ([RFC3688]). Authors are suggesting the following URI:

URI: urn:ietf:params:xml:ns:yang:ietf-ospf-unreachable-links
 Registrant Contact: The IESG.
 XML: N/A, the requested URI is an XML namespace

This document also requests one new YANG module name in the YANG Module Names registry ([RFC6020]) with the following suggestion :

```
name: ietf-ospf-unreachable-links
namespace: urn:ietf:params:xml:ns:yang:ietf-ospf-unreachable-links
prefix: ospf-unreach-link
reference: RFC XXXX
```

8. Contributors

The following individuals have contributed to this document:

Mengxiao Chen
New H3C Technologies
China
Email: chen.mengxiao@h3c.com

Yanrong Liang
Ruijie Networks Co., Ltd.
China
Email: liangyanrong@ruijie.com.cn

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Authors' Addresses

Liyan Gong
China Mobile
China
Email: gongliyan@chinamobile.com

Weiqiang Cheng
China Mobile
China
Email: chengweiqiang@chinamobile.com

Changwang Lin
New H3C Technologies
China
Email: linchangwang.04414@h3c.com

Acee Lindem
Arrcus, Inc.
United States of America
Email: acee.ietf@gmail.com

Ran Chen
ZTE Corporation
China
Email: chen.ran@zte.com.cn