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# OSPF Routing Extension for Links with Variable Discrete Bandwidth
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## Abstract

Packet switching network MAY contain links with variable discrete bandwidth, e.g., copper, radio, etc. The bandwidth of such link MAY change discretely in reaction to changing external environment. Availability is typically used for describing such links during network planning. This document describes an extension for OSPF routing for route computation in a Packet Switched Network (PSN) which contains links with variable discrete bandwidth by introducing an OPTIONAL Availability sub-TLV.

## 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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Table of Contents



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 RFC-2119 [RFC2119].

The following acronyms are used in this draft:

OSPF Open Shortest Path First

PSN Packet Switched Network

SNR Signal-to-noise Ratio

LSP Label Switched Path

ISCD Interface Switching Capacity Descriptor

PE Provider Edge

LSA Link State Advertisement

## 1. Introduction

Some data communication technologies allow seamless change of maximum physical bandwidth through a set of known discrete values. For example, in mobile backhaul network, microwave links are very popular for providing connection of last hops. In case of heavy rain, to maintain the link connectivity, the microwave link MAY lower the modulation level since demodulating lower modulation level need lower signal-to-noise ratio (SNR). This is called adaptive modulation technology [EN 302 217]. However, lower modulation level also means lower link bandwidth. When link bandwidth reduced because of modulation down-shifting, high priority traffic can be maintained, while lower priority traffic is dropped. Similarly the cooper links MAY change their effective link bandwidth due to external interference.

The parameter availability [G.827, F.1703, P.530] is often used to describe the link capacity during network planning. Assigning different availability classes to different types of service over such kind of links provides more efficient planning of link capacity. To set up an LSP across these links, availability information is required for the nodes to verify bandwidth satisfaction and make bandwidth reservation. The availability information SHOULD be inherited from the availability requirements of the services expected to be carried on the LSP. For example, voice service usually needs ''five nines'' availability, while non-real time services MAY adequately perform at four or three nines availability.

For the route computation, the availability information SHOULD be provided along with bandwidth resource information. In this document, an extension on Interface Switching Capacity Descriptor (ISCD) [RFC4202] for availability information is defined to support in routing signaling. The extension reuses the reserved field in the ISCD and also introduces an OPTIONAL Availability sub-TLV.

If there is a hop that cannot support the Availability sub-TLV, the Availability sub-TLV SHOULD be ignored.

## 2. Overview

A node which has link(s) with variable bandwidth attached SHOULD contain a <bandwidth, availability> information list in its OSPF TE LSA messages. The list provides the information that how much

bandwidth a link can support for a specified availability. This information is used for path calculation by the PE node(s).

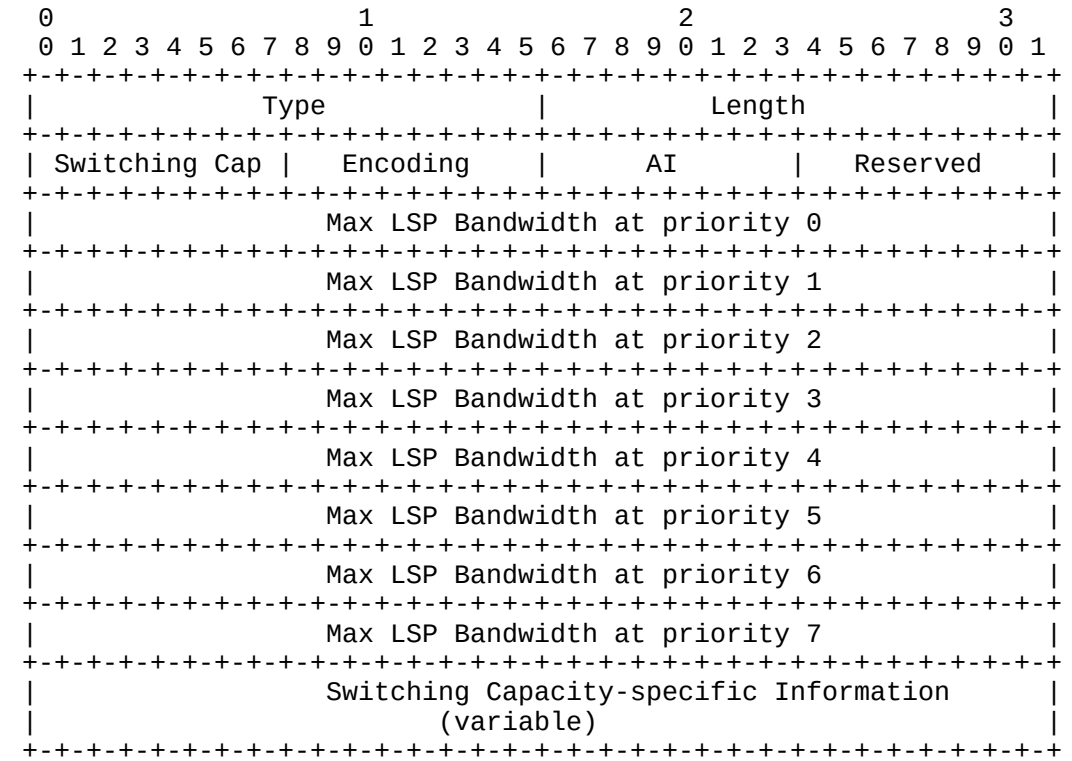
To setup an label switching path (LSP), a PE node MAY collect link information which is spread in OSPF TE LSA messages by network nodes to get know about the network topology, calculate out an LSP route based on the network topology and send the calculated LSP route to signaling to initiate a PATH/RESV message for setting up the LSP.

Availability information is required to carry in the signaling message to better utilize the link bandwidth. The signaling extension for availability can be found in [ASTE].

## 3. Extension to OSPF Routing Protocol

### 3.1. Interface Switching Capacity Descriptor

The Interface Switching Capacity Descriptor (ISCD) sub-TLV [RFC 4203] has the following format:



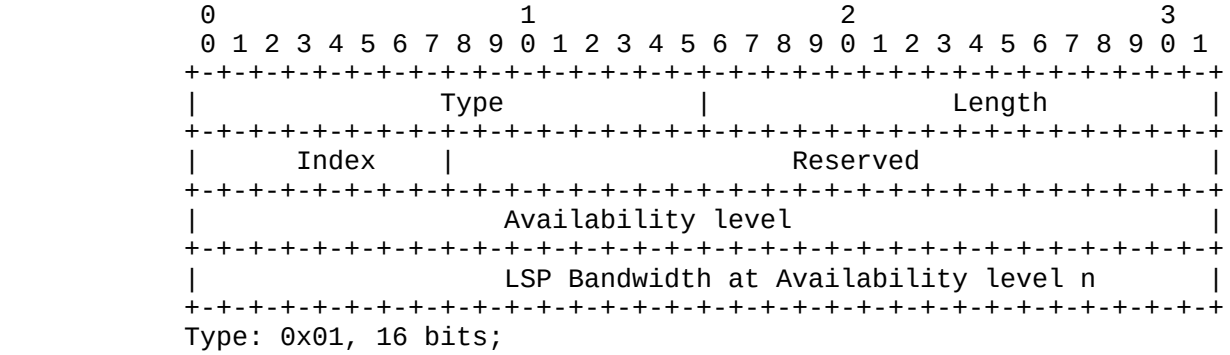
A new AI field is defined in this document.

AI: ISCD Availability sub-TLV index, 8 bits

This new field is the index of Availability sub-TLV for this ISCD sub-TLV.

### 3.2. ISCD Availability sub-TLV

When the Switching Capability field is PSC-1, PSC-2, PSC-3, PSC-4, the Switching Capability specific information field MAY include one or more ISCD Availability sub-TLV(s). The ISCD Availability sub-TLV has the following format:




Type: 0x01, 16 bits;

Length: 16 bits;

Index: 8 bits

This field is the index of this Availability sub-TLV, referred by the AI field of the ISCD sub-TLV.

Availability level: 32 bits

This field is a 32-bit IEEE floating point number which describes the decimal value of availability guarantee of the switching capacity in the ISCD object which has the AI value equal to Index of this sub-TLV. The value MUST be less than 1.

LSP Bandwidth at Availability level n: 32 bits

This field is a 32-bit IEEE floating point number which describes the LSP Bandwidth at a certain Availability level which was described in the Availability field.

### 3.3. Signaling Process

A node which has link(s) with variable bandwidth attached SHOULD contain one or more ISCD Availability sub-TLVs in its OSPF TE LSA messages. Each ISCD Availability sub-TLV provides the information about how much bandwidth a link can support for a specified availability. This information SHOULD be used for path calculation by the PE node(s).

A node that doesn't support ISCD Availability sub-TLV SHOULD ignore ISCD Availability sub-TLV.

## 4. Security Considerations

This document does not introduce new security considerations to the existing OSPF protocol.

## 5. IANA Considerations

This document introduces an Availability sub-TLV of the ISCD sub-TLV of the TE Link TLV in the TE Opaque LSA for OSPF v2. This document proposes a suggested value for the Availability sub-TLV; it is recommended that the suggested value be granted by IANA. Initial values are as follows:

| Type | Length | Format | Description |
|---|---|---|---|
| 0 | - | Reserved | Reserved value |
| 0x01 | 8 | see Section 3.2 | Availability sub-TLV |

## 6. References

### 6.1. Normative References

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[RFC3209] Awduche, D., Berger, L., Gan, D., Li, T., Srinivasan, V.,and G. Swallow, "RSVP-TE: Extensions to RSVP for LSP Tunnels", RFC 3209, December 2001.

[RFC3473] Berger, L., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions", RFC 3473, January 2003.

[RFC4202] Kompella, K. and Rekhter, Y. (Editors), ''Routing Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)", RFC 4202, October 2005.

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[G.827] ITU-T Recommendation, ''Availability performance parameters and objectives for end-to-end international constant bit-rate digital paths'', September, 2003.

[F.1703] ITU-R Recommendation, ''Availability objectives for real digital fixed wireless links used in 27 500 km hypothetical reference paths and connections'', January, 2005.

[P.530] ITU-R Recommendation,'' Propagation data and prediction methods required for the design of terrestrial line-of-sight systems'', February, 2012

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[ASTE] H., Long, M., Ye, Mirsky, G., Alessandro, A., Shah, H., ''RSVP-TE Signaling Extension for Links with Variable Discrete Bandwidth'', Work in Progress, February, 2014

## 6.2. Informative References

[MCOS] Minei, I., Gan, D., Kompella, K., and X. Li, "Extensions for Differentiated Services-aware Traffic Engineered LSPs", Work in Progress, June 2006.

## 7. Acknowledgments

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