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Extended Encoding Scheme for Shared List Link Group (SRLG)
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Abstract

SRLGs play a key role in routing resiliency and capacity planning of multi-domain and multi-layer networks. Notion of SRLG are used to select a backup path that is disjoint from the primary path, to ensure disjointness of circuits and to avoid catastrophic partitioning outages.

In the current specifications, SRLG is identified as a 32 bit number that is unique within an IGP domain [[RFC4202](#)]. There are many limitations to this approach of encoding SRLGs, especially in a multi-layer network. This draft outlines these limitations and suggests components of extended SRLG encoding scheme to address them.

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](#)].

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[1.](#) Introduction

[RFC4202] defines notion of Shared Risk Link Group (SRLG). OSPF and IS-IS extension for flooding SRLGs are defined in [\[RFC4203\]](#) and [\[RFC5307\]](#), respectively. RSVP-TE signaling extensions for SRLG exclusion and recording are defined in [\[RFC4874\]](#) and [\[DRAFT-SRLG-RECORDING\]](#), respectively.

In current specifications, SRLG is identified as a 32 bit number that is unique within an IGP domain. There are many limitations to this approach encoding SRLGs, especially in multi-domain and multi-layer networks. Section 2 outlines these restrictions and states the associated requirements. Section 3 outlines components of the extended SRLG encoding format to address the requirements. The extended SRLG encoding format and the associated protocol extension(s) are intentionally left for a future version/ companion document(s).

[2.](#) Requirements

The section outlines the requirements for extending SRLG beyond an IGP scoped 32 bit number. Some of these requirements are also noted in [\[DRAFT-SRLG-INFERENCE\]](#).

[2.1.](#) SRLG Scaling

A zealous operator could assign an SRLG for each risk, including (but not limited to) a building, a floor of a building, a bridge, a side of a road, a track, a side of a highway, and an amplifier. This operator could easily create hundreds of SRLGs for Label Switch Paths (LSPs) transiting domain it operates. Similarly, there are technologies (e.g., DWDM) where it is possible to create hundreds of SRLGs associated with LSPs using such underlying technology.

This presents a scaling issue with operations of the network, e.g., during constrained-based path computation of intra-domain LSPs. This also presents a scaling issue when such networks are used in multi-domain and multi-layer

environment, e.g., in IP over DWDM network, there may be hundreds of SRLGs along a given IP/ MPLS link (inherited from underlying DWDM LSP). It may not scale for the IP/ MPLS layer to learn hundreds of SRLGs per link and flood them into its IGP database. This may impact flooding speed, topology database size and especially constrained-based path computation complexity and performance.

In the light of the above, finding mechanism(s) to scale SRLG is a requirement for GMPLS networks, especially in inter-domain/ inter-layer environment.

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[2.2.](#) Global SRLG Identification

Currently SRLGs are defined and supported within domains. This limits the usefulness of SRLGs in an inter-domain environment, as elaborated in the following cases.

- There are cases where two different Service Providers (SPs) may be sharing the same facility (facility) for TE links within domains administrated by the same operator. For example, if a client Service Provider SP-C leases two LSPs LSP1 and LSP2 respectively from two server SPs SP-S1 and SP-S2 who themselves own the fibers from the same submarine duct, the SP-C would like to know when the two LSPs LSP1 and LSP2 share the same submarine risk. With current definition of SRLGs this is not possible. This is because SP-S1 uses SRLG numbering completely independent from SP-S2. For example, SP-S1 may identify the submarine risk as SRLG23 while SP-S2 identifies it as SRLG47. Even if client SP (SP-C) is able to discover SRLGs along LSP1 and LSP2 (e.g., using SRLG recording [[DRAFT-SRLG-RECORDING](#)] SP-C learns that LSP1 is exposed to SRLG23 and LSP2 exposed to SRLG47), the SP-C problem is not resolved: it has no way to know that LSP1 and LSP2 are actually sharing the same risk.
- If SP-C in the above example would like to request LSP2 to be SRLG diverse from LSP1 using SRLG recording [[DRAFT-SRLG-RECORDING](#)] and SRLG XOR/ E [[RFC4874](#)], there is no guarantee that LSP2 route is SRLG diverse. This is because knowing that LSP1 is exposed to SRLG23, SP-C cannot realize a link from SP-S2 which is disjoint from SRLG23 of SP-S1 (as SRLG23 means something else for SP-S2). Similarly, SRLG inclusion also does not work using the current SRLG encoding scheme.

- At present, SRLG administration is completely up to the SPs. Therefore SRLG values in an inter-domain environment may collide. Considering the above example, SP-S1 may have assigned SRLG12 to a resource used by LSP1, whereas client SP-C may already be using SRLG12 to identify a different resource in its network. Even though these two resources may not share risk, they are not SRLG diverse (assumed to share risk in GMPLS control plane).

In the light of the above, finding mechanism(s) to maintain consistency of SRLG in an inter-domain environment is a requirement.

2.3. Risk Management

Not all resources in a network have same level of availability. Some resources are more prone to failures, e.g., a fiber trunk running close to utilities is more likely to suffer from accidental cuts than a fiber trunk running in isolation. Metro links are more susceptible to cuts than rural links, and aerial fiber is susceptible to storm induced outages.

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Consider the example where a client Service Provider (SP) SP-C leases LSP1 from server SP (SP-S1). Availability of LSP1 is typically part of service level agreement (SLA) between SP-C and SP-S1, e.g., SP-C may request 99.999 (five-nines) of availability. Given high availability requirement for LSP1, SP-S1 needs to route LSP1 such that it uses resources with better than 99.999% availability. Furthermore, given a set of underlying resources, SP1 should also be able to estimate availability of LSP1 connection. How availability of a connection given availability of its underlying resources is estimated is beyond the scope of this document but, if availability is represented as a number between 0 and 1, a multiply function can be used for this calculation.

In the light of the above, finding mechanism(s) to quantify risk associated with a resource is a requirement.

3. Components of Extended SRLG

This section outlines components that form basis for extended SRLG encoding scheme.

3.1. SRLG Filtration

A way to address SRLG scaling requirement mentioned in [Section 2](#) is to

associate a priority field to the SRLG and use it as a mechanism to observe SRLG filtering. For example, in a multi-layer network, only higher priority SRLGs may be requested or exposed to the client layer. Alternatively, the client may request all the SRLG's from the server and store them locally in its SRLG database but only flood in its client control-plane (ISIS, OSPF) more important (higher priority) SRLG's.

Examining a resource type associated with an SRLG may also be used to filter SRLG information in multi-domain/ multi-layer networks. E.g., SP-S1 may export SRLGs of amplifiers used along path of LSP1 to the client SP (SP running IP services). This document suggests characterization of the following resource types:

- Optical section: A fiber that connects two optical NEs(e.g., amplifiers). Also termed OTS in ITU parlance.
- Optical line: A fiber that connects two optical switching elements (ROADMs). Also termed OMS in ITU parlance.
- Optical path: an optical connection that connects two client ports, port P1 on node N1 to a port P2 on node N2. Also termed Och Connection in ITU parlance.
- Fiber Duct: Conduit carrying fibers (which represent optical sections).

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- Building: Building hosting multiple network elements, and represents a common risk, e.g., during a terror attack. Such a building may host both transport and client gear.
- Optical NE: Amplifier, ROADM or other optical NE used along an optical link.
- Power feed: a common power source feeding multiple NEs
- Geographic region: an area susceptible to a disaster such as earthquake or flood.
- More may be added in future revision(s).

[3.2](#). Globally Unique SRLGs

A way to address global uniqueness of the SRLG is to associate Autonomous System (AS) number of the AS that originated the SRLG value.

[3.3](#). SRLG Risk Management

Risk management requirements are discussed in [section 2](#). As SRLGs are used to characterize resources, associating a resource availability field to them can satisfy risk management requirements. Specifically, availability of a resource as defined in the following can be used for this purpose.

Availability = $MTBF / (MTBF + MTTR)$, where

MTBF is mean time between failures of the resource,

MTTR is mean time to repair a failure of the resource.

[4](#). Extended SRLG Encoding

Motivation for this version is to discuss components of SRLG and hence extended SRLG encoding is intentionally left for a future revision. Nonetheless the idea is to augment the currently defined 32-bit Shared Link Group Value with the following parameters:

- o SRLG priority.
- o Type of the SRLG resource.
- o Availability of the SRLG resource.
- o SRLG Originator's AS Number.

[5](#). Protocols extensions for extended SRLG Encoding

Extension(s) for protocols that use SRLG values for their operations (e.g., OSPF, ISIS, RSVP-TE, PCE, etc.) are to be added in future version of the document or companion document(s).

[6](#). Security Considerations

Security considerations related to the extended-SRLG encoding are left for future revision of the document.

[7.](#) IANA Considerations

This version of the document does not require any IANA considerations.

[8.](#) Acknowledgments

Authors would like to acknowledge valuable feedback from many service providers. Individual acknowledgements will be added in future version of the document.

[9.](#) References

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