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Routing Timer Parameter Synchronization
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Abstract

This document describes a mechanism for a link state routing protocol to coordinate the value of a routing timer parameter amongst routers in the flooding domain. The document also defines the solution to one specific case: the agreement of a common convergence timer value for use by routers in network convergence.

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1. Introduction

There exist use cases where it desirable for a network to use a common value for a routing timer parameter across all nodes. In the past, these types of use case have been addressed by setting the parameter to a constant value in the protocol definition itself, or by requiring that the same value of the parameter be configured at every node.

Setting the routing timer parameter to a constant value in the protocol definition makes it difficult to change the parameter, since a change would require formal modification to the protocol. In practice, such a change is impractical, so the constant value needs to be chosen conservatively. This may impose a fundamental restriction on the eventual use of the protocol.

Manual or "static" configuration of the timer parameter is fraught for two reasons. First, it is can be difficult to ensure that the correct, identical, value is installed in all of the routers. Second, if any change is introduced into the network that results in a need to change the value (for example due to a change in hardware or software version) then all of the routers need to be reconfigured

to use the new timer parameter value. Such consistency may be ensured by deploying automated means such as enforcing the new value by invoking the management interface of all involved routers. For example, a central management entity may be responsible for communicating the new configuration value by means of vendor-specific command line interface (CLI), NETCONF[RFC6241], etc. This approach may be attractive if all involved nodes expose technology-agnostic and vendor-independent interfaces to modify a given network-wide configuration parameter.

This document describes a protocol extension that propagates a routing timer parameter throughout the flooding domain, which can be used as an alternative to the centralized approach described above. The method of choosing between one or more different advertised values, the flooding scope, and the action to be taken when the parameter changes MUST be provided in the definition of the parameter type.

This document also creates one parameter type: Convergence Timer intended for use in IP Fast-reroute applications [RFC5714] [RFC5715].

Note that this protocol is only intended to be used for the propagation of parameters needed to support the operation of the routing system. It MUST NOT be used as a general purpose parameter exchange protocol, and in particular it MUST NOT be used as a parameter negotiation protocol, since such use may degrade the ability of the underlying link-state routing protocol to carry our its essential purpose.

2. Requirements Language

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 RFC2119 [RFC2119].

3. Overview of Mechanism

Routing Timer parameter values that can be disseminated by means of the attribute defined in this specification MUST be defined as a configurable parameter or a default parameter in the corresponding specification.

A new information element is introduced into the routing protocol that specifies the parameter. Each router taking part in the parameter synchronization is expected to advertise a specific value of the parameter, which that router determines based mainly on considerations local to that router. In general, different routers in the flooding domain may advertise different values of the

parameter. How the values advertised by a router are determined is out of scope of this document.

A router receiving the parameter values advertised by all routers in the flooding domain will use a well-defined method to select the operational value of the parameter that it uses in the running of the protocol. All routers MUST use the same method applied to the same set of advertised parameter values. All routers SHALL therefore choose the same operational value for the parameter.

Note the operational value for the parameter selected SHOULD NOT directly affect the value for the parameter advertised by a router, since this introduces a form of negotiation leading to additional routing protocol traffic and possibly to instability in the routing protocol.

The method of selecting from a range of advertised parameter values MUST be provided in the parameter definition.

The definition of the parameter MUST specify the action to be taken when a new parameter value is advertised that would cause a change in the selected value.

The definition of the parameter MUST specify the action to be taken in the legacy/migration case, where not all routers advertise the parameter.

4. Protocol Details

This section describes the protocol extensions needed to implement this functionality.

4.1. ISIS

A new Routing Timer Parameter Synchronization (RTPS) sub-TLV is introduced into the IS-IS Router CAPABILITY TLV (TLV #242 defined in [RFC7981]). The setting of the S-bit in TLV #242 (indicating whether the parameter should be leaked between levels) MUST be included in the specific routing parameter definition.

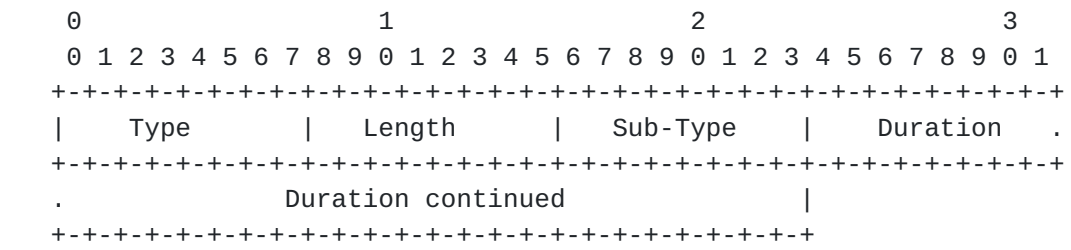

Figure 1: Routing Timer Parameter Synchronization ISIS Sub-TLV

The Type (1 octet) of this sub-TLV to be assigned by IANA.

Length is variable (minimum value 5, multiple of 5 octets) and represents the total Length of the field.

Sub-Type consists of a one octet identifier of the timer type.

Duration is a 32 bit value representing is the length of the timer in milliseconds. This is capable of expressing a time in the range 1ms to just under 50 days.

4.2. OSPF

A new OSPF Router Information LSA TLV is defined. This may be carried in a type 10 or type 11 OSPF Opaque LSA depending on the required flooding scope.

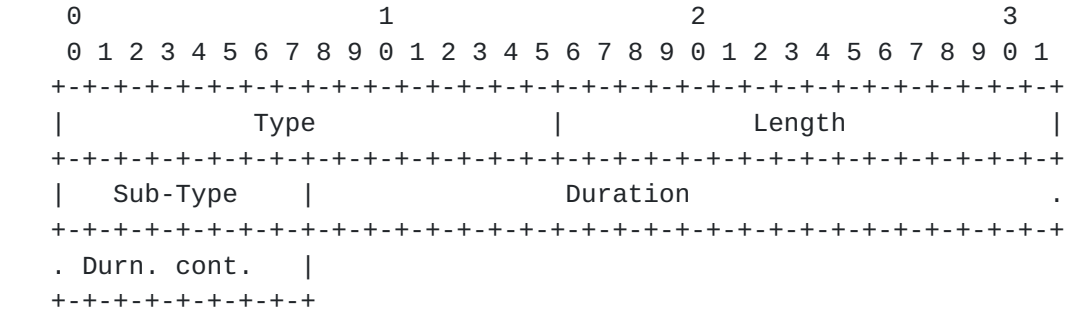

Figure 2: Routing Timer Parameter Synchronization OSPF TLV

The Type (2 octets) of this sub-TLV to be assigned by IANA.

Length is variable (minimum value 5, multiple of 5 octets) and represents the total Length of the field.

Sub-Type consists of a one octet identifier of the timer type.

Duration is a 32 bit value representing is the length of the timer in milliseconds. This is capable of expressing a time in the range 1ms to just under 50 days.

5. Convergence Time

Routers running a fast-reroute mechanism such as Maximally Redundant Tree (MRT) [RFC7812] fast re-route require a network wide convergence time value so that know how long they need continue using the repair path before it is safe to use the base path. This time is set to be the worst case time that any router will take to calculate the new topology, and to make the necessary changes to the FIB.

The time taken by a router to complete each phase of the transition will be dependent on the size of the network and the design and implementation of the router. It can therefore be expected that the optimum delay will need to be tuned from time to time as the network evolves.

5.1. Required Properties

The Convergence Time mechanism MUST have the following properties:

- The operational convergence delay time MUST be consistent among all routers that are converging on the new topology.

- The operational convergence delay time MUST be the highest delay time advertised by any router in the new topology.

- The mechanism MUST increase the delay when a new router in introduced to the network that requires a higher delay than is currently in use.

- When the router that had the longest delay requirements is removed from the topology, the convergence delay timer value MUST, within some reasonable time, be reduced to the longest delay required by the remaining routers.

- It MUST be possible for a router to change the convergence delay timer value that it requires.

- A router which is in multiple routing areas, or is running multiple routing protocols MAY signal a different loop-free convergence delay for each area.

How a router determines the time that it needs to execute each convergence phase is an implementation issue, and outside the scope of this specification. However a router that dynamically determines

its proposed delay value must do so in such a way that it does not cause the synchronized value to continually fluctuate.

5.2. Definition of the Convergence Timer

It is RECOMMENDED that the routing convergence timer be limited to a maximum of 60 seconds.

The routing convergence timer value selected is the largest value advertised.

If a routing protocol message is issued that changes the Convergence Timer value, but does not change the topology, the new timer value MUST be taken into consideration during the next network transition, but MUST NOT instigate a new transition.

If a routing protocol message is issued that changes both the Convergence Timer value and the topology, a transition is instigated and the new timer value MUST be taken into consideration.

The convergence mechanism MUST specify the action to be taken if a timer change (only) message and a topology change message are independently generated during the hold-off time.

All routers that support controlled convergence MUST advertise an RPS specifying their required Convergence Time.

If the parameter is carried in ISIS the S-bit is set to zero indicating that the Convergence Timer RPS MUST NOT be leaked between levels.

If the parameter is carried in OSPF it is only carried in a type 10 Opaque LSA which prevents propagation outside the OSPF area.

6. IANA considerations

6.1. ISIS

IANA is requested to allocate a new Sub-TLVs for TLV 242 from the IS-IS TLV Codepoints name space.

Value	Description	Reference
TBD	Routing Timer Parameter Synchronization	This Document

6.2. OSPF

IANA is requested to allocate a new OSPF Router Information (RI) TLV from the Open Shortest Path First (OSPF) Parameters name space

Value	TLV Name	Reference
TBD	Routing Timer Parameter Synchronization	This document

A value in the range 12 to 32767 is requested.

6.3. Routing Parameter Synchronization Registry

IANA is requested to create a new Routing Parameter Synchronization Registry within its own name space, and to allocate one value from it.

Value	Name	Reference
0	Reserved	This document
1	Convergence Timer	This document
2..255	Reserved	This document

Allocations within this registry require IETF Consensus. This link state protocol extension MUST NOT be used for any purpose other than one associated with the routing system.

7. Security Considerations

The introduction of this parameter advertising mechanism does not introduce a significant vulnerability into the base routing protocol and is secured in exactly the same way as the other TLVs that are carried.

In specifying a new parameter, consideration must be given to the impact of the additional parameter, and in particular the rate of change of that parameter, on the dynamics of the link-state routing protocol in use. In the specific case of the Convergence Timer, the amount of data being carried and the rate of change of the parameter value will have a negligible impact on the link-state routing protocol in use.

A rouge router deliberately introducing an anomalous parameter value is just as capable of introducing many other anomalies into the routing domain.

As far as possible, care should be taken to validate that the parameter is reasonable.

In the specific case of the Convergence Time RTPS, the following considerations apply.

If an abnormally large timer value is proposed by a router, the there is a danger that the convergence process will take an excessive time. If during that time the routing protocol signals the need for another transition, the transition will be abandoned and the default best case (traditional) convergence mechanism used.

It is RECOMMENDED that implementations prohibit the configuration of a router convergence timer value in excess of 60 seconds.

8. Acknowledgments

The authors thank Les Ginsberg and the other authors of [I-D.ietf-isis-segment-routing-msd] and [I-D.ietf-ospf-segment-routing-msd] , Mohamed Boucadair for their review comments and proposed text, and Tom Petch for his review comments.

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