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Benchmarking Applicability for
IGP Data Plane Route Convergence

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ABSTRACT
This draft describes the applicability of IGP Route Convergence
benchmarking methodology [1] and IGP Route Convergence bechmarking
terminology [2]. The methodology and terminology is to be used
for benchmarking route convergence and can be applied to any
link-state IGP such as ISIS [3] and OSPF [4]. The data plane is
measured to obtain the convergence benchmarking metrics described
in [1].

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1. Introduction
IGP Convergence is a critical performance parameter. Customers
of Service Providers use packet loss due to IGP Convergence as a
key metric of their network service quality. Service Providers
use IGP Convergence time as a key metric of router design and
architecture. Fast network convergence can be optimally achieved
through deployment of fast converging routers. The fundamental
basis by which customers of service providers benchmark convergence
is packet loss, which is an externally observable event having
direct impact on their application performance. IGP Route
Convergence is a Direct Measure of Quality (DMOQ) when benchmarking
the data plane. For this reason it is important to develop a standard
router benchmarking methodology and terminology for measuring IGP
convergence that uses the data plane as described in [1] and [2].
This document describes all of the factors that influence a
convergence measurement and how a purely black box test can be
designed to account for all of these factors. This enables accurate
benchmarking and evaluation for route convergence time.

2. Existing definitions

For the sake of clarity and continuity this RFC adopts the template
for definitions set out in Section 2 of RFC 1242. Definitions are
indexed and grouped together in sections for ease of reference.

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.

3. Factors for IGP Route Convergence Time

There are four major categories of factors for the measured Router
IGP Convergence Time, as described in [5], [6], [7], [8] and [9].
These are Event Detection, SPF Processing, IGP Advertisement, and
FIB Update. Each of these factors has numerous components to
influence the convergence time. These are listed as follow:

     -Event Detection-
     SONET failure indication time
     PPP failure indication time
     IGP Hello Dead Interval

     -SPF Processing-
     SPF Delay Time
     SPF Hold time

SPF Execution time

          -IGP Advertisement-
          LSA/LSP Flood Packet Pacing
          LSA/LSP Retransmission Packet Pacing
          LSA/LSP Generation time

          -FIB Update-
          Tree Build time
          Hardware Update time

   Each of the factors listed above will have a varying amount of
   influence on the convergence result with each router vendors'
   architecture and IGP implementation. It is necessary to design a
   convergence test that considers not just one or a few of these
   components, but instead all of these components. The additional
   benefit of designing a test for all components is that it enables
   black-box testing in which knowledge of the routers' internal
   implementations is not required. It is then possible to make
   valid use of the benchmarking metrics when comparing routers from
   different vendors.

   4. Network Events that Cause Convergence

   There are different types of network events that can cause IGP
   convergence. These network events are administrative link
   removal, unplanned link removal, and route change such as
   withdrawal, flap, next-hop change, and cost change. When
   benchmarking a router it is important to measure the convergence
   time for local and remote occurrence of these network events.
   The convergence time measured will vary whether the network event
   occurred locally or remotely due to varying combinations of
   factors listed in the previous sections. This behavior makes it
   possible to design purely black-box tests that isolate
   measurements for each of the components of convergence time.

   5. Use of Data Plane for IGP Route Convergence Benchmarking

   Customers of service providers use packet loss as the metric for
   convergence time. Packet loss is an externally observable event
   having direct impact on customers' application performance.
   For this reason it is important to develop a standard router
   benchmarking methodology and terminology that is a Direct Measure
   of Quality (DMOQ)for measuring IGP convergence. Such a
   methodology uses the data plane as described in [1] and [2].

   An additional benefit of using packet loss for calculation of
   IGP Route Convergence time is that it enables black-box tests to
   be designed. Data traffic can be offered at line-rate to the
   device under test (DUT), an emulated network event can be forced
   to occur, and packet loss can be externally

observed to measure the convergence time. Knowledge of the DUT
architecture and IGP implementation is not required. There is no
need to rely on the DUT to produce the test results. There is no
need to build intrusive test harnasses for the DUT.

   Use of data traffic and measurement of packet loss on the data
   plane also enables Route Convergence methodology test cases that
   consider the time for the Route Controller to update the FIB on
   the forwarding engine of the hardware. A router is not fully
   converged until all components are updated and traffic is
   rerouted along the correct path. As long as there is packet
   loss, routes have not converged. It is possible to send diverse
   traffic flows to destinations matching every route in the FIB
   so that the time it takes for the router to converge an entire
   route table can be benchmarked.

6. Security Considerations

   Documents of this type do not directly effect the security of
   the Internet or of corporate networks as long as benchmarking
   is not performed on devices or systems connected to operating
   networks.

7. Acknowledgements

   Thanks to Curtis Villamizar for sharing so much of his
   knowledge and experience through the years. Also, special
   thanks to the many Network Engineers and Network Architects
   at the Service Providers who are always eager to discuss
   Route Convergence.

8. References

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