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Methodology for Forwarding Information Base (FIB) based Router Performance

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Abstract

The forwarding performance of an IP router is highly dependent on the information in its forwarding information base. This document describes the methodology to be used to determine the IP packet forwarding performance of an IP router as a function of the routers ability to properly form and optimize its forwarding information base.

1. Introduction

This document covers the measurement of the IP packet forwarding performance of IP routers on the basis of the routers ability to properly form and optimize its forwarding information base (FIB). [FIB-TERM] describes the terminology associated with this document.

This version of the document describes a more general approach to the determination of router performance than previous versions. As a result, it is the intent of the authors that this document serves as a catalyst for further discussions concerning the approach outline in this

draft. The purpose of this document is to describe a methodology for measuring the impact of FIB generation from a given routing information base (RIB) on the forwarding performance of a router. The objective is to determine whether a router can maintain performance levels as the RIB grows in size and complexity.

This document utilizes the methodology described in [METHOD] for measuring the FIB-dependent throughput, FIB-dependent latency and FIB-dependent frame loss rate of IP packets as they traverse the router under test. The forwarding performance of a router should be observed under different RIB sizes and compositions.

2. Terms Of Reference

This document utilizes the methodologies for packet throughput, latency and loss measurements described in [METHOD].

Definitions unique to this test methodology are covered in [FIB-TERM].

The application of methodologies described in this document is not limited to IP forwarding; however, it is beyond the scope of this document to explicitly describe their application. In this document, use of the term IP is protocol version independent. Traffic, RIB and FIB may be IPv4, IPv6 or both.

3. Overview

The methodology described in this document is based on the precept that the FIB is formed from information in the RIB and, possibly, other configured variables. The methodology is independent of the particulars associated with populating the RIB or setting these variables; however, this SHOULD be done using routing protocols, e.g., OSPF [OSPF]. RIB and FIB contents MAY be determined either through observing traffic forwarding or management information base (MIB) queries. For completeness, this determination SHOULD be made using both. Generation of the FIB from the RIB based on three major components:

- Interface Identifier - Route Optimization - Routing Policies

The following three sub-sections describe these components and their

effect on FIB generation.

3.1 Interface Identifier

The interface identifier entry in the FIB establishes the physical path for datagram forwarding. If the interface not active or down, the path is no longer available and the entry SHOULD be removed from the FIB. Descriptions of interface identifiers are contained in [MIB-BGP] and [MIB-OSPF]. 3.2 Route Optimization

Route optimization seeks to minimize the overall effort on the part of

the router to forward datagrams. Optimization has three basic components:

- Route Aggregation - Route Flap Damping - Route Metrics

Route aggregation seeks to minimize the number of entries in the FIB corresponding to a set of reachable address prefixes. These prefixes could be contiguous or overlapping. Methods for route aggregation are described in [IDR].

Route flap damping seeks to minimize unnecessary re-generation of the FIB based on unstable routing information. Methods for route flap damping are described in [BGP-FLAP].

Route metrics assign a relative weight or merit to a particular routed path. Descriptions of these metrics are found in [MIB-BGP] and [MIB-OSPF].

3.3 Routing Policies

Routing policies are administrative restrictions or requirements on the FIB. The take two major forms:

- Access Control Lists - Route Filters

Access control lists can be used to explicitly allow or deny access to physical interfaces of network prefixes. This can be done either on the basis of individual protocol addresses or entire prefixes.

Route filters are a set of protocol addresses or prefixes against which a given route will be matched. The resulting action of a match will depend on the use of the route filter.

4.0 Methodology

The methodologies for determining the effects of the three components of FIB generation are still under investigation. The authors look to the BMWG for guidance, suggestions and constructive input.

5. Security Considerations

As this document is solely for the purpose of providing performance methodologies and describes neither a protocol nor a protocol's implementation; therefore, there are no security considerations associated with this document.

6. Informative References

[IPROC] Bradner, S., "The Internet Standards Process -- Revision 3", BCP 9, RFC 2026, October 1996. [FIB-TERM] Trotter, G., " Terminology for Forwarding Information Base (FIB) based Router Performance", RFC 3222, December, 2001. [METHOD] Bradner, S., McQuaid, J., "Benchmarking Methodology for Network Interconnect Devices", RFC 2544, March 1999 [OSPF] Moy, J, "OSPF Version 2," RFC 2328, April 1998. [MIB-BGP] Willis, S., Burrus, J., Chu, J. "Definitions of Managed Objects for the Fourth Version of the Border Gateway Protocol (BGP-4) using SMIv2," RFC 1657, July 1994. [MIB-OSPF] Baker, F., Colton, R., "OSPF Version 2 Management Information Base," RFC 1850, November 1995. [IDR] Chen, E., Stewart, J., "A Framework for Inter-Domain Route Aggregation," RFC 2519, February 1999. [BGP-FLAP] Villamizar, C., Chandra, R., Govindan, R., "BGP Route Flap Damping," RFC 2439, November 1998.

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