IP Packet loss rate measurement testing and problem statement
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Abstract

This document describes common methods for measuring packet loss rate and their effectiveness. Issues encountered when using the methods and necessary considerations are also discussed and recommended.

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1. Introduction

IP packet loss rate is one of the important metrics that are frequently used to measure IP performance of a data path or link. A general framework of IP performance metrics is provided in [RFC2330], including fundamental concepts definition and issues related to defining sound metrics and methodologies. [RFC2680] and [RFC6673] further define metrics for one-way and round-trip packet loss.

In practical network operation, a number of methods are used by network engineers to calculate packet loss rate, and one of the common ways is to use ping. By checking ping statistics, people expect to get the idea of traffic transmission condition on the link. This document describes a test on packet loss rate measurement with multiple methods using routers from different vendors, followed by issues that should be taken into consideration during the measurement. Causes analysis and processing mechanisms of routers are also covered. It is expected that an operable measurement scheme with consistent testing results and equal treatment of network components can be reached.

2. Methods for packet loss rate measurement

This section describes frequently used methods nowadays for measuring packet loss rate.

1. Ping

Ping (ICMP echo request/reply) is a useful tool to examine the connectivity and performance of the link between two nodes in the network. The source node generates echo request packets with configured size, interval, count and other settings, and the destination node sends back an echo reply packet once it receives a request. Then we count the packets sent out and received and get the round-trip packet loss rate on the link between source and destination. This approach is clear and convenient, and is frequently used by engineers when packet loss rate is needed.

In practical network operation, the ping testing can be initiated manually and directly on the node by engineers, for example through the command line interface (CLI) of a router, or activated indirectly by instructions, for example through SNMP messages sent from network management system.

No matter through CLI or SNMP, ping testing can be conducted directly on the endpoint devices of the link to be tested, or other nodes as long as the request/reply packets pass through the link. Those nodes
are often referred to as probes, which can be a router or a PC server, directly connected or indirectly reachable to the endpoints. Usually the probes and paths to the endpoints are not supposed to be congested to avoid affecting the ping testing result.

2. Diagnosis toolset

Routers have diagnosis toolsets to provide automatic detection of IP performance. An example of the toolsets is Juniper’s RPM. By necessary configurations on the router, toolset support multi-service testing of multiple queues on an interface, including ICMP, TCP/UDP, and HTTP. Packet loss rate can be measured with ICMP ping function of the toolset. Routers send out ping packets automatically according to the configured parameters, so toolset is working in a similar way as ping method described above.

3. Interface statistics report

Forwarding devices maintain statistics report of every interface. The report shows the detailed status of the interface as well as traffic information, including inbound and outbound speed and packet count. For a typical router, traffic statistics show number of packets transmitted and discarded by an interface, and even on the basis of QoS queue, so the entire packet loss rate of a link or packet loss rates regarding different queues can be calculated. Traffic data on the report can be displayed through CLI or obtained using SNMP which allows automatic packet loss sampling.

3. Test on packet loss rate measurement

This section describes test result on packet loss rate measurement using different methods. Test equipment covers routers from several vendors. Results show the diverse outcome of the methods used, and the diverse responding mechanism of routers.

Details are to be added.

4. Measurement Issues

This section describes issues encountered when measuring the packet loss rate of a link using different testing methods.

1. Ping

Routers from every vendors have their unique processing procedure when sending and receiving ICMP packets, thus resulting in diverse
ping packet loss rates, as described in the section above. Errors exist using the ping method, and in some cases ping no longer reflects the actual packet loss rate correctly. Relevant issues that have to be taken into account include:

a) Forwarding class

When sending ping packets locally, routers are likely to put the packets into a certain QoS queue/class although the DSCP field of ICMP packets is kept zero. QoS queue of ping may be different than that of the traffic to be measured, and even ping packets sent by CLI commands and SNMP are in different queues by default. Usually forwarding class can be adjusted by CLI or SNMP commands.

b) Inner priority

For some routers, although ping traffic and service traffic will not be treated differently by QoS, packets sent out by the router itself, for example ping packets, are put into an inner high priority while other forwarding service traffic into low priority. These kinds of inner priority are valid within the interior of routers and do not rewrite the packets. One of the purposes of using the priorities is to get the protocol packets (ping included) processed in prior. These priorities are set by vendor and may not be able to adjust, so in this case ping will not give the correct packet loss rate as ping packets are not processed and discarded together with service traffic.

c) Ingress line card

If the ping testing is conducted on a probe which is connected or IP reachable to the router, then the ping packets will be treated by the router as forwarding traffic, eliminating the queue and priority issues. However, the location of interfaces through which ingress traffic is received matters when using some types of routers. In this case, the router employs a polling schedule which allows traffic from different line cards or modules to get forwarding chance. For a card with small volume of traffic, the chance will be little but not none. So if ping packets come through a card different from the high-volume service traffic, the packets would probably get enough forwarding resources as ping traffic itself requires little bandwidth. As a result, ping will suffer little from congestion and shows disaccord in packet loss rate.

2. Diagnosis toolset

Although diagnosis toolsets provide integrated automatic testing method, the basic principle is still to ping from the router itself.
So it is believed toolset method will experience the same issues about class and priority as local ping from router does. We did not test diagnosis toolsets, and the discussion is left to be further continued.

3. Interface statistics report

Interface statistic is the most direct and accurate way to get performance of an interface. Packet loss rate calculated from traffic statistics is in accordance with the expected value. By referring to statistics collected from the endpoint routers, bidirectional packet loss rate can easily be obtained.

However, this approach requires access to routers, while in some scenarios it is difficult to do that. For example, if we would like to know the inbound packet loss rate of the interconnection link to another service operator, we may have to rely on statistics provided by the peering router. Normally, this information is not easily shared by interworking operators.

5. Considerations and recommendations

TBD.

6. Security Considerations

TBD.

7. IANA Considerations

This memo includes no request to IANA.

8. Normative References


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