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        RFC 2544 Applicability Statement: Use on Production Networks Considered
                                Harmful
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Abstract

   Benchmarking Methodology Working Group (BMWG) has been developing key
   performance metrics and laboratory test methods since 1990, and
   continues this work at present. Recent application of the methods
   beyond their intended scope is cause for concern. This memo
   clarifies the scope of RFC 2544 and other benchmarking work for the
   IETF community.

Status of this Memo

   This Internet-Draft is submitted in full conformance with the
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1. Introduction

   This memo clarifies the scope of RFC 2544 [RFC2544], and other
   benchmarking work for the IETF community.

   Benchmarking Methodologies (beginning with [RFC2544]) have always
   relied on test conditions that can only be reliably produced in the
   laboratory. Thus it was surprising to find that this foundation
   methodology was being cited in several unintended applications, such
   as:

   1. Validation of telecommunication service configuration, such as
       the Committed Information Rate (CIR).

   2. Validation of performance metrics in a telecommunication Service
       Level Agreement (SLA), such as frame loss and latency.

   3. As an integral part of telecommunication service activation
       testing, where traffic that shares network resources with the
       test might be adversely affected.

   Above, we distinguish "telecommunication service" (where a network
   service provider contracts with a customer to transfer information
   between specified interfaces at different geographic locations in the
   real world) from the generic term "service". Also, we use the
   adjective "production" to refer to networks carrying live user
   traffic. [RFC2544] used the term "real-world" to refer production
   networks and to differentiate them from test networks.

   Although RFC 2544 is held up as the standard reference for such
   testing, we believe that the actual methods used vary from RFC 2544
   in significant ways. Since the only citation is to RFC 2544, the
   modifications are opaque to the standards community and to users in
   general (an undesirable situation).

   To directly address this situation, the past and present Chairs of
   the IETF Benchmarking Methodology Working Group (BMWG) have prepared
   this Applicability Statement for RFC 2544.

1.1. 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 RFC 2119 [RFC2119].

2. Scope and Goals

   This memo clarifies the scope of [RFC2544], with the goal to provide
   guidance to the community on its applicability, which is limited to
   laboratory testing.

3. The Concept of an Isolated Test Environment

   An Isolated Test Environment (ITE) used with [RFC2544] methods (as
   illustrated in Figures 1 through 3 of [RFC2544])has the ability to:

   o contain the test streams to paths within the desired set-up

   o prevent non-test traffic from traversing the test set-up

   These features allow unfettered experimentation, while at the same
   time protecting equipment management LANs and other production
   networks from the unwanted effects of the test traffic.

4. Why RFC 2544 Methods are intended for ITE

   The following sections discuss some of the reasons why RFC 2544
   [RFC2544] methods were intended only for isolated laboratory use, and
   the difficulties of applying these methods outside the lab
   environment.

4.1. Experimental Control, Repeatability, and Accuracy

   All of the tests described in RFC 2544 assume that the tester and
   device under test are the only devices on the networks that are
   transmitting data. The presence of other unwanted traffic on the
   network would mean that the specified test conditions have not been
   achieved.

   Assuming that the unwanted traffic appears in variable amounts over
   time, the repeatability of any test result will likely depend to some
   degree on the unwanted traffic.

   The presence of unwanted or unknown traffic makes accurate,
   repeatable, and consistent measurements of the performance of the
   device under test very unlikely, since the actual test conditions
   will not be reported.

   For example, the RFC 2544 Throughput Test attempts to characterize a
   maximum reliable load, thus there will be testing above the maximum
   that causes packet/frame loss. Any other sources of traffic on the

network will cause packet loss to occur at a tester data rate lower
than the rate that would be achieved without the extra traffic.

4.2. Containment of Implementation Failure Impact

RFC 2544 methods, specifically to determine Throughput as defined in
[RFC1242] and other benchmarks, may overload the resources of the
device under test, and may cause failure modes in the device under
test. Since failures can become the root cause of more wide-spread
failure, it is clearly desirable to contain all DUT traffic within
the ITE.

In addition, such testing can have a negative affect on any traffic
which shares resources with the test stream(s) since, in most cases,
the traffic load will be close to the capacity of the network links.

Appendix C.2.2 of [RFC2544] (as adjusted by errata) gives the private
IPv4 address range for testing:

"...The network addresses 198.18.0.0 through 198.19.255.255 have been
assigned to the BMWG by the IANA for this purpose. This assignment
was made to minimize the chance of conflict in case a testing device
were to be accidentally connected to part of the Internet. The
specific use of the addresses is detailed below."

In other words, devices operating on the Internet may be configured
to discard any traffic they observe in this address range, as it is
intended for laboratory ITE use only. Thus, testers using the
assigned testing address ranges MUST NOT be connected to the
Internet.

We note that a range of IPv6 addresses has been assigned to BMWG for
laboratory test purposes, in [RFC5180]. Also, the strong statements
in the Security Considerations Section of this memo make the scope
even more clear; this is now a standard fixture of all BMWG memos.

5. Advisory on RFC 2544 Methods in Real-world Networks

The tests in [RFC2544] were designed to measure the performance of
network devices, not of networks, and certainly not production
networks carrying user traffic on shared resources. There will be
unanticipated difficulties when applying these methods outside the
lab environment.

Operating test equipment on production networks according to the
methods described in [RFC2544], where overload is a possible outcome,
would no doubt be harmful to user traffic performance. These tests

MUST NOT be used on active networks. And as discussed above, the
tests will never produce a reliable or accurate benchmarking result.

[RFC2544] methods have never been validated on a network path, even
when that path is not part of a production network and carrying no
other traffic. It is unknown whether the tests can be used to
measure valid and reliable performance of a multi-device, multi-
network path. It is possible that some of the tests may prove to be
valid in some path scenarios, but that work has not been done or has
not been shared with the IETF community. Thus, such testing is
contra-indicated by the BMWG.

6. What to do without RFC 2544?

The IETF has addressed the problem of production network performance
measurement by chartering a different working group: IP Performance
Metrics (IPPM). This working group has developed a set of standard
metrics to assess the quality, performance, and reliability of
Internet packet transfer services. These metrics can be measured by
network operators, end users, or independent testing groups. We note
that some IPPM metrics differ from RFC 2544 metrics with similar
names, and there is likely to be confusion if the details are
ignored.

IPPM has not standardized methods for raw capacity measurement of
Internet paths. Such testing needs to adequately consider the strong
possibility for degradation to any other traffic that may be present
due to congestion. There are no specific methods proposed for
activation of a packet transfer service in IPPM.

Other standards may help to fill gaps in telecommunication service
testing. For example, the IETF has many standards intended to assist
with network operation, administration and maintenance (OAM), the
ITU-T Study Group 12 has a recommendation on service activation test
methodology.

The world will not spin off axis while waiting for appropriate and
standardized methods to emerge from the consensus process.

7. Security Considerations

This Applicability Statement is also intended to help preserve the
security of the Internet by clarifying that the scope of [RFC2544]
and other BMWG memos are all limited to testing in laboratory ITE,
thus avoiding accidental Denial of Service attacks or congestion due
to high traffic volume test streams.

All Benchmarking activities are limited to technology
characterization using controlled stimuli in a laboratory
environment, with dedicated address space and the other constraints
[RFC2544].

The benchmarking network topology will be an independent test setup
and MUST NOT be connected to devices that may forward the test
traffic into a production network, or misroute traffic to the test
management network.

Further, benchmarking is performed on a "black-box" basis, relying
solely on measurements observable external to the device under test/
system under test (DUT/SUT).

Special capabilities SHOULD NOT exist in the DUT/SUT specifically for
benchmarking purposes. Any implications for network security arising
from the DUT/SUT SHOULD be identical in the lab and in production
networks.

8. IANA Considerations

This memo makes no requests of IANA, and hopes that IANA will leave
it alone as well.

9. Acknowledgements

Thanks to Matt Zekauskas, Bill Cerveny, Barry Constantine, and Curtis
Villamizar for reading and suggesting improvements for this memo.

10. References

10.1. Normative References

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10.2. Informative References

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