ROUTING CONSORTIUM

Virtual Router Redundancy Protocol Version 3
Interoperability Test Suite

Technical Document

Draft Version

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TABLE OF CONTENTS

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INTRODUCTION

Overview

The University of New Hampshire's InterOperability Laboratory (UNH-IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. This suite of tests has been developed to help implementers evaluate the functionality of their VRRPv3 based products. This test suite has been designed to test interoperability of the device under test with other VRRPv3 capable devices. This test suite focuses on testing configurations of the network that could cause problems when deployed if the device under test does not operate properly with the devices that it is connected to.

The tests do not determine if a product conforms to the VRRPv3 standard but they are designed as interoperability tests. These tests provide one method to isolate problems within the VRRPv3 capable device that will affect the interoperability performance. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other VRRPv3 capable devices. However, these tests do provide a reasonable level of confidence that the RUT will function well in most VRRPv3 environments.

Acronyms

Acronyms used in this Test Suite:

TR: **T**esting **R**outer
RUT: **R**outer **U**nder **T**est
N: **N**etwork
VRID: **V**irtual **R**outer **ID**

When several entities of the same type are present in a test configuration, a number is appended to the acronym to yield a label for each entity. For example, if there were three testing routers in the test configuration, they would be labeled TR1, TR2 and TR3.

TEST ORGANIZATION

This document organizes tests by group based on related test methodology or goals. Each group begins with a brief set of comments pertaining to all tests within that group. This is followed by a series of description blocks; each block describes a single test. The format of the description block is as follows:

Test Label: The test label and title comprise the first line of the test block. The test label is composed by concatenating the short test suite name, the group number, and the test number within the group, separated by periods. The **Test Number** is the group and test number, also separated by a period. So, test label **VRRP.1.2** refers to the second test of the first test group in the VRRP suite. The test number is 1.2.

Purpose: The Purpose is a short statement describing what the test attempts to achieve. It is usually phrased as a simple assertion of the feature or capability to be tested.

References: The References section lists cross-references to the specifications and documentation that might be helpful in understanding and evaluating the test and results.

Discussion: The Discussion is a general discussion of the test and relevant section of the specification, including any assumptions made in the design or implementation of the test as well as known limitations.

Test Setup: The Test Setup describes the configuration of all devices prior to the start of the test. Different parts of the procedure may involve configuration steps that deviate from what is given in the test setup. If a value is not provided for a protocol parameter, then the protocol's default is used for that parameter.

Procedure: The Procedure of the test description contains the step-by-step instructions for carrying out the test. These steps include such things as enabling interfaces, unplugging devices from the network, or transmitting a packet from a test station. The test procedure also cues the tester to make observations, which are interpreted in accordance with the observable results given for that test part.

Observable Results: The Observable Results lists observable results that can be examined by the tester to verify that the RUT is operating properly. When multiple observable results are possible, this section provides a short discussion on how to interpret them. The determination of a pass or fail for each test is usually based on how the RUT's behavior compares to the results described in this section.

Possible Problems: The Possible Problems contains a description of known issues with the test procedure, which may affect test results in certain situations.

REFERENCES

The following documents are referenced in this text:

- [RFC 5798] "Virtual Router Redundancy Protocol (VRRP) Version 3 for IPv4 and IPv6"

ABSTRACT

The following tests cover the operation of the Virtual Router Redundancy Protocol Version 3 (VRRPv3). VRRPv3 specifies an election protocol that dynamically assigns responsibility for a virtual router to one of the VRRPv3 routers on a LAN. The VRRPv3 router controlling the IP address(es) associated with a virtual router is called the Master, and forwards packets transmitted to these IP addresses. The election process provides dynamic fail over in the forwarding responsibility should the Master become unavailable. This allows any of the virtual router IP addresses on the LAN to be used as the default first hop router by end-hosts. The advantage gained from using VRRPv3 is a higher availability default path without requiring configuration of dynamic routing or router discovery protocols on every end-host.

GROUP 1: Interoperability

Scope:

The following tests verify the general operation of a VRRPv3 router and are not specific to any single section of the specification.

Overview:

These tests have been designed to test the Interoperability of the RUT with other VRRPv3 capable devices. This test group focuses on testing configurations of the network that could cause problems when deployed if the RUT does not operate properly with the devices that it is connected to. The tests in this group do not determine if a product conforms to the VRRPv3 standard but they are designed as interoperability tests. The test routers in this section are complete implementations of VRRPv3. The tests in this section can be run for any IP version implementation. For example, these tests can be run for an IPv4 implementation or for an IPv6 implementation. These tests will have to be run twice in order to test both an IPv4 and an IPv6 implementation.

Test VRRP.1.1: Basic VRRPv3 Interoperability

Purpose: To verify that a router can interoperate with other VRRPv3 implementations in a setup with a single virtual router.

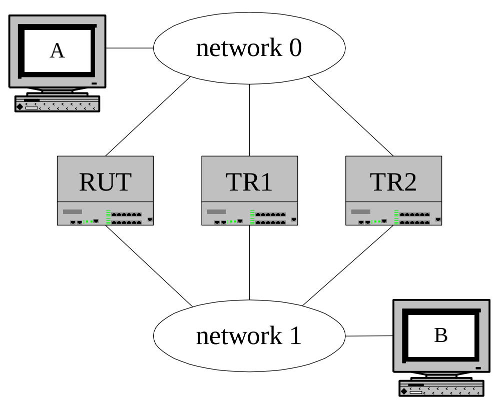
References: [5798] – Sections 3, 4 and 5

Discussion: This test verifies that the RUT can successfully exchange packets and develop a proper VRRPv3 configuration when directly connected to other VRRPv3 implementations on the same subnet.

Test Setup: Test Station A has a route to network 1 through the address of the virtual router with VRID 1 that is in the Master state on network 0. Test Station B has a route to network 0 through the address of the RUT's interface 2. Configure VRRPv3 parameters based on Table 1.

Table 1 VRRPv3 Configurations for RUT, TR1 and TR2

Device	Interface	Network	VRID
RUT	1	0	1
RUT	2	1	2
TR1	1	0	1
TR1	2	1	2
TR2	1	0	1
TR2	2	1	2



Procedure:

Part A: The RUT in the Backup state

1. Configure TR1 to associate a virtual router {VRID = 1} with the IP address of its first interface. TR1's Priority is 255; it owns the IP address of the virtual router.
2. Configure the RUT as backup, Priority 100, for the virtual router created in Step 1. Configure TR2 to also backup the virtual router created in Step 1 and to have a Priority of 99.
3. Enable VRRPv3 on the RUT, TR1 and TR2.
4. Ping Station B from Station A.
5. Observe the traffic on all networks.

Part B: Master Down

6. Disconnect TR1's interface 1 on Network 0.
7. Observe Master State for the virtual router created in Step 1.
8. Ping Station B from Station A.
9. Observe the traffic on all networks.

Part C: The RUT preempted by TR2

10. Configure TR2 as backup, with a Priority of 101, for the virtual router created in Step 1.
11. Observe Master state for the virtual router created in Step 1.
12. Ping Station B from Station A.
13. Observe the traffic on all networks.

Part D: The RUT owns the virtual router IP

14. Disable VRRPv3 on TR1, TR2 and the RUT. Return the network configuration to that given in the Test Setup section.
15. Configure TR1 and TR2 to backup a virtual router {VRID = 1} with the virtual router IP address equal to the IP address of the RUT's first interface. The Priority on TR1 is set to 100 and the Priority on TR2 is set to 99.
16. Configure the RUT to associate the virtual router {VRID = 1} with the IP address of its first interface. Its Priority is 255.
17. Enable VRRPv3 on the RUT, TR1 and TR2.
18. Observe Master state for the virtual router created in Step 1.
19. Ping Station B from Station A.
20. Observe the traffic on all networks.

Part E: Power failure

21. Power down the RUT.
22. Observe Master state for the virtual router created in Step 1.
23. Ping Station B from Station A.
24. Observe the traffic on all networks.

Observable Results:

Part A:
- Step 5: Traffic was forwarded onto Network 1 by TR1.

Part B:
- Step 7: After a delay of no more than 4 seconds, the RUT transitioned into the Master state.
- Step 9: Traffic was transmitted onto Network 1 by the RUT. TR2 remained in the backup state.

Part C:
- Step 11: After a delay of no more than 4 seconds, TR2 transitioned into the Master state, preempting the RUT.
- Step 13: Traffic was forwarded onto Network 1 by TR2.

Part D:
- Step 18: The RUT entered into the Master state.
- Step 20: Traffic was forwarded onto Network 1 by the RUT.

Part E:
- Step 22: After a delay of no more than 4 seconds, TR1 transitioned into the Master state.
- Step 20: Traffic was forwarded onto Network 1 by TR1. The ping failed because the reverse path from B to A failed once the RUT is down.

Possible Problems: None

Test VRRP.1.2: Advanced VRRPv3 Interoperability

Purpose: To verify that a router can interoperate with other VRRPv3 implementations on multiple subnets.

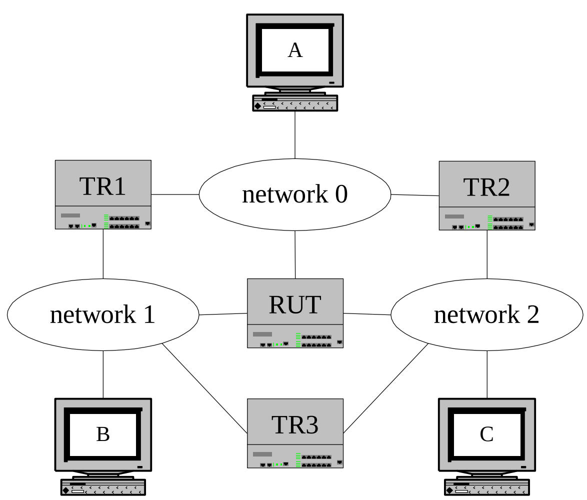
References: [5798] – Sections 3, 4 and 5

Discussion: This test verifies that the RUT can successfully exchange packets and develop a proper VRRP configuration when directly connected to other VRRPv3 implementations on multiple subnets.

Test Setup: Configure VRRPv3 parameters based on Table 2.

Table 2 VRRPv3 Configurations for RUT, TR1, TR2 and TR3

Device	Interface	Network	VRID	Priority
RUT	1	0	1	100
RUT	2	1	2	100
RUT	3	2	3	100
TR1	1	0	1	255
TR1	2	1	2	99
TR2	1	0	1	99
TR2	3	2	3	255
TR3	2	1	2	255
TR3	3	2	3	101



Procedure:

Part A: The RUT in the Backup state

1. Configure TR1 as the Master on Network 0, TR3 as the Master on Network 1 and TR2 as the Master on Network 2.
2. Enable VRRPv3 on the RUT, TR1, TR2 and TR3.
3. Ping Station C from Station B.
4. Observe the traffic on all networks.
5. Ping Station B from Station A.
6. Observe the traffic on all networks.
7. Ping Station A from Station C.
8. Observe the traffic on all networks.

Part B: The RUT in transition

9. Disconnect TR1 from Network 0 and TR2 from Network 2.
10. Wait at least Master_Down_Interval.
11. Observe Master state on all networks.
12. Ping Station B from Station A.
13. Observe the traffic on all networks.
14. Ping Station C from Station A.
15. Observe the traffic on all networks.
16. Ping Station C from Station B.
17. Observe the traffic on all networks.
18. Ping Station B from Station C.
19. Observe the traffic on all networks.

Part C: Preemption

20. Configure the interface to network 0 on TR1 to a Priority of 100 and that IP address to a value higher than that of the RUT. Configure the interface to network 2 on TR2 to a Priority of 100 and that IP address to a value higher than that of the RUT.
21. Reconnect TR1 to network 0 and TR2 to network 2.
22. Wait at least Master_Down_Interval.
23. Observe Master state on Network 0.
24. Ping Station B from Station A.
25. Observe the traffic on all networks.
26. Ping Station C from Station B.
27. Observe the traffic on all networks.
28. Ping Station B from Station C.
29. Observe the traffic on all networks.

Observable Results:

Part A:
- Step 4: Traffic was forwarded onto Network 2 by TR3.
- Step 6: Traffic was forwarded onto Network 1 by TR1.
- Step 8: Traffic was forwarded onto Network 0 by TR2.

Part B:

- Step 11: The RUT transitioned to the Master state for network 0. TR3 was the Master on both networks 1 and 2.
- Step 13: Traffic was forwarded onto Network 1 by the RUT (all replies were dropped).
- Step 15: Traffic was forwarded onto Network 2 by the RUT (all replies were dropped).
- Step 17: Traffic was forwarded onto Network 2 by TR3.
- Step 19: Traffic was forwarded onto Network 1 by TR3.

Part C:

- Step 23: The RUT transitioned to Backup state.
- Step 25: Traffic was forwarded onto Network 1 by TR1.
- Step 27: Traffic was forwarded onto Network 2 by TR3.
- Step 29: Traffic was forwarded onto Network 1 by TR3.

Possible Problems: None