



## CHAPTER 2

# Methodology

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This chapter contains the following sections:

- [Test Cycle, page 2-1](#)
- [Sample Test Case, page 2-7](#)

## Test Cycle

The test cycle consists of the following steps:

1. Network configuration and verification
2. Image upgrade and rollback with ISSU
3. Induce network disruptions at each layer (see [Network Disruption Test Cases, page 2-1](#))
4. Scale control-plane peers and routes for both unicast and multicast routing at the core layer
5. Scale the number of access level switches and hosts to stress ARP and IGMP at the aggregation layer
6. Extended uptime monitoring to check for CPU and memory usage anomalies

## Network Disruption Test Cases

The following sections describe the test disruptions and the verification criteria:

- [System Level, page 2-2](#)
- [Edge Layer, page 2-2](#)
- [Core Layer, page 2-4](#)
- [Aggregation Layer, page 2-4](#)
- [Access Layer, page 2-6](#)

## System Level

Disruption	Verification
Image upgrade and rollback with ISSU	Hitless upgrade/rollback for all configured features with parallel enhancement

## Edge Layer

Disruption	Verification
Router Link Failure/Recovery between Edge and Public Cloud	<ul style="list-style-type: none"> <li>• BGP reconvergence (control-plane &amp; data-plane)</li> <li>• IGP and Multicast services reconvergence (control-plane &amp; data plane)</li> <li>• MPLS/VPN and LDP reconvergence (control-plane &amp; data-plane)</li> <li>• BFD peer detection and client notifications</li> <li>• GRE Tunnel re-route due to transport disruption</li> </ul>
Member of Port-channel Failure/Recovery between Edge and Public Cloud	<ul style="list-style-type: none"> <li>• Traffic load-sharing for port-channels</li> <li>• LACP interoperability</li> <li>• Unidirectional Link Detection (UDLD)</li> </ul>
Clear IGP Neighbors/Process at Edge	Stress test for control-plane recovery
Clear IPv4/IPv6 Unicast Routes at Edge	Stress test for control-plane recovery
Clear IPv4/IPv6 Multicast Routes at Edge	Stress test for control-plane recovery
Edge Switch System Failure/Recovery	<ul style="list-style-type: none"> <li>• BGP reconvergence (control-plane &amp; data-plane)</li> <li>• IGP and Multicast services reconvergence (control-plane &amp; data plane)</li> <li>• MPLS/VPN and LDP reconvergence (control-plane &amp; data-plane)</li> <li>• BFD peer detection and client notifications</li> <li>• GRE Tunnel re-route due to transport disruption</li> <li>• VDC failure does not impact other VDCs</li> </ul>
Edge Switch Power Redundancy	Partial Power loss causes no impact to control/data plane
Edge Switch Supervisor High-Availability	<ul style="list-style-type: none"> <li>• SSO/NSF, in-chassis and on peers</li> <li>• SSO/NSF interoperability</li> </ul>

Disruption	Verification
Edge Switch Fabric High-Availability	Fabric module failure causes no impact to control/data plane
Line Card OIR at Edge Switch	<ul style="list-style-type: none"><li>• Hitless operation for non-affected ports</li><li>• Traffic load-sharing for distributed port-channels</li><li>• IGP and PIM reconvergence (control-plane &amp; data plane)</li><li>• BFD peer detection and client notifications</li><li>• LACP interoperability for distributed port-channels</li><li>• Unidirectional Link Detection (UDLD)</li></ul>

## Core Layer

Disruption	Verification
Router Link Failure/Recovery between Core and Edge	<ul style="list-style-type: none"> <li>• IGP and PIM reconvergence (control-plane &amp; data plane)</li> <li>• BFD peer detection and client notifications</li> </ul>
Member of Port-channel Failure/Recovery between Core and Edge	<ul style="list-style-type: none"> <li>• Traffic load-sharing for port-channels</li> <li>• LACP interoperability</li> <li>• Unidirectional Link Detection (UDLD)</li> </ul>
Clear IGP Neighbors/Process at Core	Stress test for control-plane recovery
Clear IPv4/IPv6 Unicast Routes at Core	Stress test for control-plane recovery
Clear IPv4/IPv6 Multicast Routes at Core	Stress test for control-plane recovery
Core Switch System Failure/Recovery	<ul style="list-style-type: none"> <li>• IGP and PIM reconvergence (control-plane &amp; data plane)</li> <li>• BFD peer detection and client notifications</li> <li>• PIM Rendezvous Point redundancy &amp; Back-up verification</li> <li>• VDC failure does not impact other VDCs</li> </ul>
Core Switch Power Redundancy	Partial Power loss causes no impact to control/data plane
Core Switch Supervisor High-Availability	<ul style="list-style-type: none"> <li>• SSO/NSF, in-chassis and on peers</li> <li>• SSO/NSF interoperability</li> </ul>
Core Switch Fabric High-Availability	Fabric module failure causes no impact to control/data plane
Line Card OIR at Core Switch	<ul style="list-style-type: none"> <li>• Hitless operation for non-affected ports</li> <li>• Traffic load-sharing for distributed port-channels</li> <li>• IGP and PIM reconvergence (control-plane &amp; data plane)</li> <li>• BFD peer detection and client notifications</li> <li>• LACP interoperability for distributed port-channels</li> <li>• Unidirectional Link Detection (UDLD)</li> </ul>

## Aggregation Layer

Disruption	Verification
Router Link Failure/Recovery between Aggregation and Core	<ul style="list-style-type: none"> <li>• IGP and PIM reconvergence (control-plane &amp; data plane)</li> <li>• BFD peer detection and client notifications</li> </ul>
Member of Port-channel Failure/Recovery between Aggregation and Core	<ul style="list-style-type: none"> <li>• Traffic load-sharing for port-channels</li> <li>• LACP interoperability</li> <li>• Unidirectional Link Detection (UDLD)</li> </ul>

Disruption	Verification
Router Link Failure/Recovery between Aggregation and Access	<ul style="list-style-type: none"> <li>• STP reconvergence</li> <li>• IGMP reprogramming with snooping</li> <li>• MAC address re-learning</li> <li>• Security ACL &amp; FNF reprogramming</li> <li>• No FHRP impact</li> <li>• No ARP/ND impact</li> <li>• No BFD impact</li> <li>• vPC functionality</li> </ul>
Member of Port-channel Failure/Recovery between Aggregation and Access	<ul style="list-style-type: none"> <li>• Traffic load-sharing for port-channels</li> <li>• LACP interoperability</li> <li>• Unidirectional Link Detection (UDLD)</li> </ul>
Clear IGP Neighbors/Process at Aggregation	Stress test for control-plane recovery
Clear IPv4/IPv6 Unicast Routes at Aggregation	Stress test for control-plane recovery
Clear IPv4/IPv6 Multicast Routes at Aggregation	Stress test for control-plane recovery
Aggregation Switch System Failure/Recovery	<ul style="list-style-type: none"> <li>• STP reconvergence</li> <li>• IGP and PIM reconvergence (control-plane &amp; data plane)</li> <li>• BFD peer detection and client notifications</li> <li>• PIM Rendezvous Point redundancy &amp; Back-up verification</li> <li>• PIM DR/BDR functionality</li> <li>• IGMP Snooping &amp; Querier functionality</li> <li>• VDC failure does not impact other VDCs</li> <li>• Security ACL &amp; FNF reprogramming</li> <li>• FHRP redundancy</li> <li>• MAC address learning</li> <li>• ARP/ND re-learning</li> <li>• vPC functionality</li> </ul>
Aggregation Switch Power Redundancy	Partial Power loss causes no impact to control/data plane
Aggregation Switch Supervisor High-Availability	<ul style="list-style-type: none"> <li>• SSO/NSF, in-chassis and on peers</li> <li>• SSO/NSF interoperability</li> <li>• No impact to vPC peering status</li> </ul>
Aggregation Switch Fabric High-Availability	Fabric module failure causes no impact to control/data plane

<b>Disruption</b>	<b>Verification</b>
Line Card OIR at Aggregation Switch	<ul style="list-style-type: none"> <li>• Hitless operation for non-affected ports</li> <li>• Traffic load-sharing for distributed port-channels</li> <li>• IGP and PIM reconvergence (control-plane &amp; data plane)</li> <li>• BFD peer detection and client notifications</li> <li>• LACP interoperability for distributed port-channels</li> <li>• Unidirectional Link Detection (UDLD)</li> </ul>
vPC peer-link/keep-alive Failure/Recovery	vPC functionality and peering status
vPC Leg Failure/Recovery	<ul style="list-style-type: none"> <li>• No impact to STP overlay</li> <li>• IGMP reprogramming with snooping</li> <li>• MAC address re-learning</li> <li>• Security ACL &amp; FNF reprogramming</li> <li>• No FHRP impact</li> <li>• No ARP/ND impact</li> </ul>
vPC Leg member Failure/Recovery	<ul style="list-style-type: none"> <li>• Traffic load-sharing for port-channels</li> <li>• LACP interoperability</li> <li>• Unidirectional Link Detection (UDLD)</li> </ul>

## Access Layer

<b>Disruption</b>	<b>Verification</b>
Access/ToR Switch System Failure/Recovery	<ul style="list-style-type: none"> <li>• STP reconvergence</li> <li>• IGMP snooping reprogramming</li> <li>• MAC address re-learning</li> <li>• No impact to other vPCs</li> </ul>

# Sample Test Case

Sample Test Case	
<b>Title</b>	Link failure between aggregation and core layers
<b>Description</b>	Verify network control and data plane recovery after link flap
<b>Test Setup</b>	<ul style="list-style-type: none"> <li>• Reference topology</li> <li>• Reference network configuration setup test case</li> <li>• Reference test plan for control and data plane setup matrices</li> </ul>
<b>Procedure</b>	<ol style="list-style-type: none"> <li>1. Fail one of the links between the aggregation and core layers.</li> <li>2. Recover the above link.</li> <li>3. Repeat the same test at least 5 iterations to ensure consistent behavior for the devices and network.</li> <li>4. Repeat the above procedures for the other links between the aggregation and core layers.</li> </ol>
<b>Pass/Fail Criteria</b>	<ul style="list-style-type: none"> <li>• During the link failure, traffic should drop in proportion to the number of links and paths affected, and the traffic should be able to reconverge within the expected time relative to a previously-established Catalyst 6500 baseline.</li> <li>• Ensure that the unicast and multicast routing protocols have detected peer failure in order to start network reconvergence within the expected time.</li> <li>• Verify the convergence pattern is as expected.</li> <li>• Verify the CPU usage pattern is as expected.</li> <li>• Verify the memory usage is as expected.</li> <li>• Verify the route tables for both unicast and multicast routing are updated correctly on all switches in the network. Ensure that only affected switches show change in the forwarding tables.</li> <li>• Verify the hardware forwarding entries, line card programming, fabric programming, outgoing interface, forwarding engine entries, for both unicast and multicast routing are updated correctly on all switches in the network.</li> <li>• Verify Layer 2 forwarding tables on aggregation and access switches. They should not be affected by this failure.</li> </ul>

