

# HP Network Node Manager i Software

## Causal Analysis White Paper

Software Version 9.00



Communications and data networks have grown significantly in size and complexity, and so have the number of faults that occur. A single failure can trigger many alarms. Distinguishing the real problem from the anecdotal alarms has become a bottleneck for the network operator. Traditional event correlation systems are able to reduce alarms, but these systems fall short in terms of identifying the root cause in an automated way.

The HP Network Node Manager i-series Software (NNMi) Causal Engine technology applies **root cause analysis (RCA)** to network symptoms, using a causality-based approach to incident generation. NNMi event correlation actively models the behavioral relationship between managed objects, determining root cause and impact based on a MINCAUSE algorithm. The causal analysis software handles both ambiguity and partial symptoms.

NNMi actively solicits symptoms during analysis and reacts dynamically to topology changes. NNMi provides an end-to-end diagnosis of network faults and uses a hierarchy of models.

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## The Causal Engine and NNMi Incidents

Communications and data networks have grown significantly in size and complexity, and so have the number of faults that occur. A single failure can trigger many alarms. Distinguishing the real problem from the anecdotal alarms has become a bottleneck for the network operator. Traditional event correlation systems are able to reduce alarms, but these systems tend to fall short in terms of identifying the root cause in an automated way.

The HP Network Node Manager i-series Software Causal Engine technology applies **root cause analysis (RCA)** to network symptoms, using a causality-based approach to incident generation.

### Causal Engine Technology

Causal Engine technology provides the following features:

- Uses the `NmsApa` (NMS Active Problem Analyzer) jboss service to analyze your network
- Uses a model-based approach to RCA
  - o Models the behavioral relationship between managed objects
  - o Uses an object model in addition to event causality to drive analysis
  - o Determines root cause and impact based on the MINCAUSE algorithm
  - o Effectively handles ambiguity and partial symptoms
- Is Dynamic
  - o Actively solicits symptoms during analysis
  - o Reacts dynamically to topology changes
- Is Extensible
  - o Employs a hierarchy of modules (import/export)
  - o Provides an end-to-end diagnosis of network faults
  - o Provides the ability to add rule sets in future offerings

### Approach to Incident Generation

Causal Engine technology uses the following sequential approach to incident generation:

1. Formally define the root-cause problems and symptoms.
2. Perform analysis by relating symptoms to root-cause problems using the behavioral and object models. Symptoms come from two sources:
  - o StatePoller, where the symptoms are state changes
  - o Events, where the symptoms are traps
3. Generate conclusions that relate to the root cause.

Causal Engine conclusions track details related to its analysis, including the following:

- Generated incidents
- Correlated incidents
- Suppressed incidents
- Cancelled incidents
- Status on relevant objects

The goal of the `NmsApa` service is to present a single incident that the operator or network engineer can investigate. To do this, the `NmsApa` service uses the concept of an episode. An episode exists for a specific duration, during which secondary failures are either correlated or suppressed based on incident configuration.

#### Incident Suppression Example

The `Address Not Responding` incident is suppressed by the `Interface Down` incident, according to the following scenario:

- When an IP address stops responding to ICMP, an episode begins, which exists for the duration of 60 seconds.
- Within that duration, if the interface associated with that IP address goes down, the `NmsApa` service concludes that the interface down condition caused the IP address to stop responding.
- Only the `Interface Down` incident is generated. (The `Address Not Responding` incident is suppressed.)
- To ensure that the `Interface Down` incident is detected within the duration, the `NmsApa` service issues a request to check the status for that interface.
- If the interface does not go down during the episode, the `NmsApa` service generates an `Address Not Responding` incident. If the interface goes down after the episode, NNMI generates an `Interface Down` incident. In this case, the network engineer treats the two problems separately.

#### Incident Correlation Example

The `Node Down` incident correlates the `Interface Down` incident from one-hop neighbor interfaces, according to the following scenario:

- When an interface goes down, a `Node Down` episode begins for the neighboring node, which exists for the duration of 300 seconds.
- Within that duration, if the node goes down, NNMI correlates the `Interface Down` incident beneath the `Node Down` incident.
- The `Interface Down` incidents from all one-hop neighbors are correlated beneath the `Node Down` incident. You can review the `Interface Down` incidents as supporting evidence for the `Node Down` incident.

## Object Status

In addition to incident manipulation, the `NmsApa` service sets status on relevant objects. Status indicates the overall health of an object and is determined from the outstanding Conclusions. Every Conclusion has a severity associated with it. The status reported is the most severe of all outstanding Conclusions. In addition, Conclusions inform the user of the underlying cause (or reason) for an object's status.

The `NmsApa` service uses the following status categories in decreasing order of severity:

- Unknown
- Disabled
- Critical
- Major
- Minor
- Warning
- Normal

- No Status

## What Does NNMi Analyze?

NNMi analyzes a variety of network objects, including Nodes, Interfaces, and Addresses. NNMi monitors these devices using either the SNMP protocol or ping to retrieve information about the network object.

The following list shows the specific network objects that NNMi monitors and analyzes:

- Card
- Card Redundancy Groups
- Connections
- Field-Replaceable-Unit (FRU) Card
- Interface
- IP Address
- Node
- Node Components
- Node Groups
- Link Aggregated Connections
- Link Aggregated Ports
- Redundant Router Groups
- SNMP Agent

### Cards

A **card** is a physical component on a device which generally has physical ports that contain one or more interfaces used to connect to other devices. A card can also contain sub-cards. The card containing another card is known in NNMi as the Parent Card. The sub-card is known as a Daughter Card. NNMi supports Daughter cards one level deep.

NNMi reports the status of a card as follows:

- Unknown – Indicates either of the following:
  - The SNMP Agent associated with the card does not respond to SNMP queries.
  - The NmsApa service cannot determine the health because the cardOperStatus and cardAdminStatus values cannot be measured.
- Disabled – Indicates the card is administratively down (cardAdminStatus = down).
- Critical – Indicates the card is operationally down (cardOperStatus = down).
- Normal – Indicates the card is operationally up (cardOperStatus = up).
- Minor – Indicates the card is neither up nor down (cardOperStatus = unknown or other)
- No Status – Indicates the card is not polled.

### Card Redundancy Groups

A **Card Redundancy Group** is a set of card modules that are configured to provide card redundancy on the device. These cards are management modules on Cisco and HP Procurve platforms. The number of cards supported in a group on both platforms is two. The Card Redundancy Group has one card acting as the primary member, the other acting as the secondary. If the primary card fails, the secondary card takes over as the primary card.

NNMi reports the status of Card Redundancy Groups as follows:

`Unknown` - Indicates all member cards in the group are in Unknown status.

`Critical` - Indicates the group has no acting primary card or has both cards acting as primary.

`Warning` - Indicates the group has no acting secondary card.

`Normal` - Indicates the group is functioning correctly.

`No Status` - Indicates the group has not yet been fully discovered or populated.

### Connections

**Connections** are Layer 2 physical connections and Layer 3 network connections. NNMi discovers connection information by reading forwarding database (FDB) tables from other network devices and by using devices that support discovery protocols such as Cisco Discovery Protocol (CDP) and Extreme Discovery Protocol (EDP). NNMi reports the status of a connection as follows:

`Unknown` - Indicates all endpoints of the connection have Unknown status.

`Disabled` - Indicates one endpoint of the connection is disabled.

`Critical` - Indicates all endpoints are operationally down.

`Minor` - Indicates one endpoint is down.

`Warning` - Indicates endpoints have unknown and non-critical status.

`Normal` - Indicates all endpoints are operationally up.

`No Status` - Indicates one endpoint is not polled.

### Field Replaceable Units (FRU Card)

A **Field-Replaceable-Unit (FRU) card** is a card that can be replaced on a device that is operationally active (not powered down). When an FRU card is removed from or added to the device, NNMi reports the occurrence with an incident. If an FRU card is not recognized by the device, NNMi reports the unrecognized card with an incident.

NNMi reports the status of an FRU card as follows:

`Unknown` - Indicates either of the following:

- The SNMP Agent associated with the card does not respond to SNMP queries.
- The NmsApa service cannot determine the health because `cardOperStatus` and `cardAdminStatus` values cannot be measured.

`Disabled` - Indicates the card is administratively down (`cardAdminStatus = down`).

`Critical` - Indicates the card is operationally down (`cardOperStatus = down`).

`Normal` - Indicates the card is operationally up (`cardOperStatus = up`).

Minor – Indicates the card is neither up or down (`cardOperStatus = unknown or other`)

No Status – Indicates the card is not polled.

## Interfaces

An **interface** is a physical port that can be used to connect a node to the network. NNMi reports the status of an interface as follows:

Unknown – Indicates either of the following:

- The SNMP Agent associated with the interface does not respond to SNMP queries.
- The `NmsApa` service cannot determine the health because `ifAdminStatus` and `ifOperStatus` values cannot be measured.

Disabled - Interface is administratively down (`ifAdminStatus = down`).

Critical - Interface is operationally down (`ifOperStatus = down`).

Normal - Interface is operationally up (`ifOperStatus = up`).

No Status - Interface is not polled.

## IP Addresses

An **IP address** is a routable address that responds to ICMP. IP addresses are typically associated with nodes. NNMi reports the status of an IP address as follows:

Disabled - Indicates the interface associated with this IP address is administratively down or disabled.

Critical - Indicates the IP address does not respond to ICMP queries (ping the device).

Normal – Indicates the IP address responds to ICMP queries.

No Status – Indicates the IP address is not polled.

## Nodes

A **node** is a device that NNMi finds as a result of the Spiral Discovery process. A node can contain interfaces, boards, and ports. You can separate nodes into two categories:

- Network nodes, which are active devices such as switches, routers, bridges, and hubs
- End nodes, such as UNIX or Windows servers

NNMi typically manages network nodes, reporting node status and node component status as follows:

Unknown – Indicates that NNMi is unable to manage the node because of the following:

- The SNMP Agent associated with the node does not respond to SNMP queries
- Polled IP addresses do not respond to ICMP queries.

Critical – Indicates any one of the following:

- The node is down as determined by neighbor analysis.
- The node is marked as important and is unmanageable. (NNMi cannot access the node from the NNMi server).
- The node is an island (it has no neighbors) and, therefore, is unmanageable.



- The NmsApa service cannot determine if the node is down or if the incoming connection is down.
- A fan (Node Component) failure is detected.

**Minor** – Node status can be Minor if a managed object contained in the node has a problem, including any of the following:

- The SNMP Agent associated with the node does not respond to SNMP queries.
- One or more interfaces in the node are down.
- One or more IP addresses on the node do not respond to ICMP.

**Normal** – Indicates the SNMP Agent, polled interfaces, and polled IP addresses of the node are up.

**No Status** – Indicates the SNMP Agent, all interfaces, and all IP addresses of the node are not polled.

### Node Components

Large (or more sophisticated) network devices often require special environments and components to function properly. Examples are power supplies, fans, voltage regulators, and internal computers. These **Node Components** can be monitored by component health sensors.

An administrator can monitor the health of these components to know when any of them has failed or is operating marginally. NNMi reports the status of Node Components as follows:

**Critical** – Indicates the component is not functioning properly.

**Normal** – Indicates the component is operating properly.

**No Status** – Indicates the component is not polled.

### Node Groups

A **Node Group** is a logical collection of nodes created by an NNMi administrator to customize polling configuration. For example, some nodes, such as routers, are critical to a business and should be polled more frequently. In such cases, the NNMi administrator would define a Node Group containing the critical routers and configure them for a shorter polling cycle.

An NNMi administrator can also configure Node Group status calculations. The out-of-the-box configuration propagates the most severe status as follows:

**Critical** – Indicates at least one node in the group has Critical status.

**Major** – Indicates no nodes in the group have Critical status, and at least one node in the group has Major status.

**Minor** – Indicates no nodes in the group have Critical or Major status, and at least one node in the group has Minor status.

**Warning** – Indicates no nodes in the group have Critical, Major, or Minor status, and at least one node in the group has Warning status.

**Normal** – Indicates no nodes in the group have Critical, Major, Minor, or Warning status, and at least one node in the group has Normal status.

**Unknown** – Indicates no nodes in the group have Critical, Major, Minor, Warning, or Normal status, and at least one node in the group has Unknown status.

**No Status** – Indicates all nodes in the group have No Status.

### Link Aggregated Connections

A **Link Aggregated Connection** is a connection with endpoints that are link aggregated ports. These are usually high-bandwidth connections that link switches. Link aggregated connections have a

designated master connection and member connections. An administrator can monitor the overall health of the aggregated connection to know when the connection is degraded in any way. (For example, the master is down or any of the members is down.)

NNMi reports the status of a link aggregated connection as follows:

*Unknown* – Indicates any member of the aggregation is unknown.

*Critical* – Indicates the master and/or all member connections of the aggregation are operationally down.

*Minor* – Indicates some member connection (but not all connections) of the aggregation is operationally down.

*Normal* – Indicates all members of the aggregation are operationally up.

*No Status* – Indicates all member connections of the aggregation are not polled.

### Link Aggregated Ports

A **Link Aggregated Port** is a set of ports (interfaces) on a switch that are linked together, usually for the purpose of creating a trunk (high bandwidth) connection to another device. Port aggregations have a designated master port and member ports. An administrator can monitor the overall health of the aggregated port to know when the port is degraded. (For example, the master is down, or any of the members is down.)

NNMi reports the status of a Link Aggregated Port as follows:

*Unknown* – Indicates all members of the aggregation are unknown.

*Critical* – Indicates the master or all members or both master and all members of the aggregation are operationally down.

*Minor* – Indicates some member (but not all members) of the aggregation is operationally down.

*Normal* – Indicates all members of the aggregation are operationally up.

*No Status* – Indicates all members of the aggregation are not polled.

### Router Redundancy Groups

A **Router Redundancy Group** is a set of routers that are configured to provide redundancy in the network. Such groups use the following two types of protocols:

- Hot standby router protocol (HSRP)
- Virtual router redundancy protocol (VRRP)

Router Redundancy Groups usually have a single device acting as the primary, a single device acting as a secondary, and any number of standby devices. If the primary device fails, the secondary device should take over as primary, and one of the standby devices should become secondary. The router groups employ either the HSRP or VRRP protocol to designate the primary, secondary, and standby routers.

NNMi reports the status of Router Redundancy Groups as follows:

*Critical* – Indicates the group has no acting primary router.

*Major* – Indicates the group primary router is not properly configured (for example, multiple primary routers exist).

*Minor* – Indicates the group secondary router is not properly configured (for example, no acting secondary router exists).

*Warning* – Indicates the group is functioning, but is in some way degraded.

`Normal` – Indicates the group is functioning properly.

`No Status` – Indicates the group is not yet fully discovered or populated.

### SNMP Agents

An **SNMP agent** is a process running on the managed node, which provides management functions. The SNMP agent is responsible for managing interfaces and ports on the managed node. An SNMP Agent can be associated with one or more nodes.

The following list shows the possible NNMi status categories associated with an SNMP agent:

`Critical` – Indicates the SNMP Agent does not respond to SNMP queries.

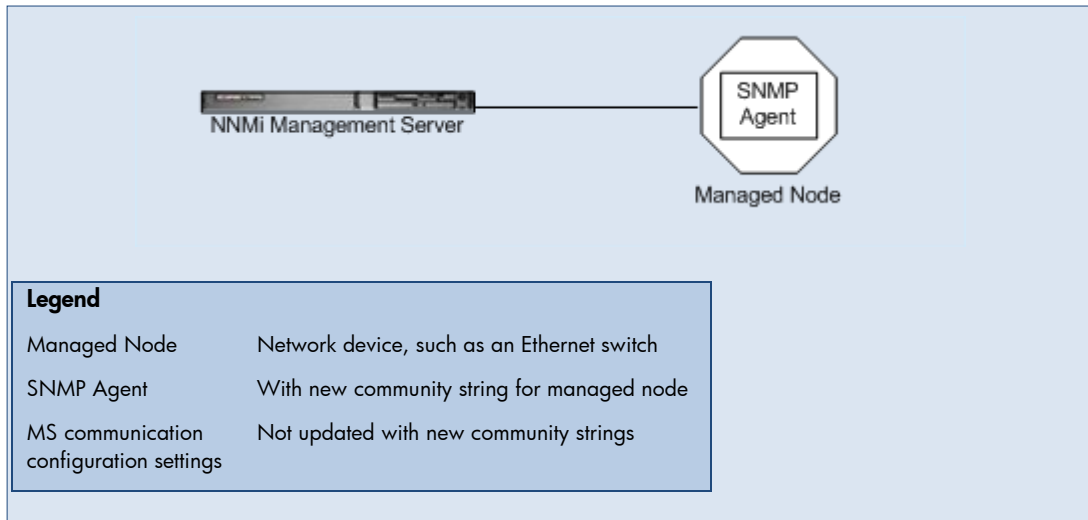
`Normal` – Indicates the SNMP Agent responds to SNMP queries.

`No Status` – Indicates the SNMP Agent is not polled.

## Failure Scenarios

The following sections describe the fault scenarios that the NNMi Causal Engine analyzes and how the failures are diagnosed. These scenarios describe the symptoms of the failure, as well as the status, conclusions, and incidents that the Causal Engine generates for the failure.

### SNMP Agent Not Responding to SNMP Queries



**Scenario:** The SNMP agent is not responding. For example, the community string for this SNMP agent has been changed, or NNMi's communication configuration settings have not yet been updated, but the node is operational (IP addresses can be pinged).

**NOTE:** Ping is not enabled out-of-the box. This scenario requires that at least one address is polled.

**Root Cause:** The SNMP Agent is not responding.

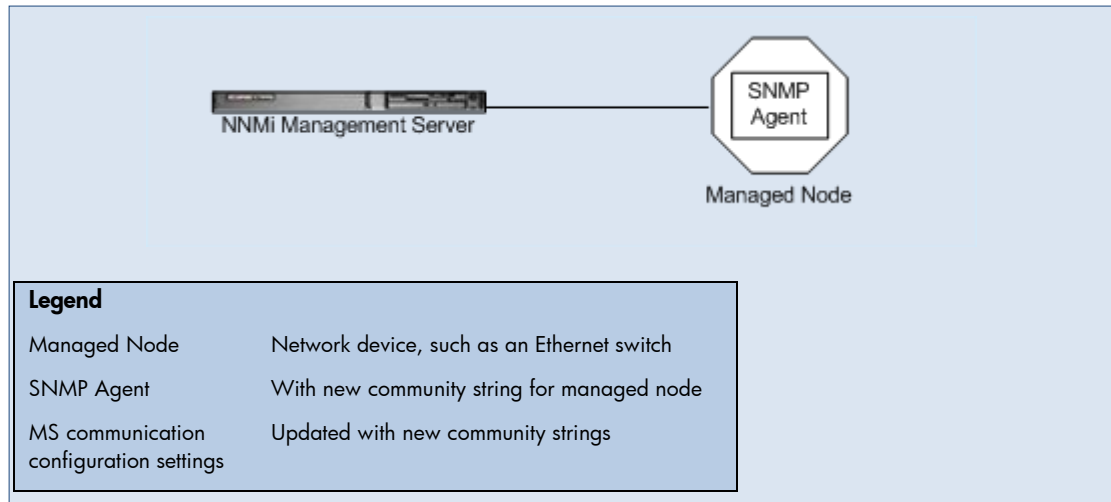
**Incident:** None generated.

**Status:** The SNMP Agent is in Critical status.

**Conclusion:** `SNMPAgentNotResponding`

**Effect:** The node status is Minor. The Conclusion on the node is `UnresponsiveAgentInNode`. All polled interfaces and cards, including Daughter cards have Unknown status because they cannot be managed by NNMi. The Conclusion on each interface is `InterfaceUnmanageable`. The Conclusion on each card is `CardUnmanageable`.

## SNMP Agent Responding to SNMP Queries



**Scenario:** This scenario continues the previous “SNMP Agent Not Responding to SNMP Queries” scenario. An NNMI administrator has updated the communication configuration settings to include the new community string. The SNMP agent for the managed node starts responding to SNMP queries.

**Root Cause:** SNMP Agent is responding.

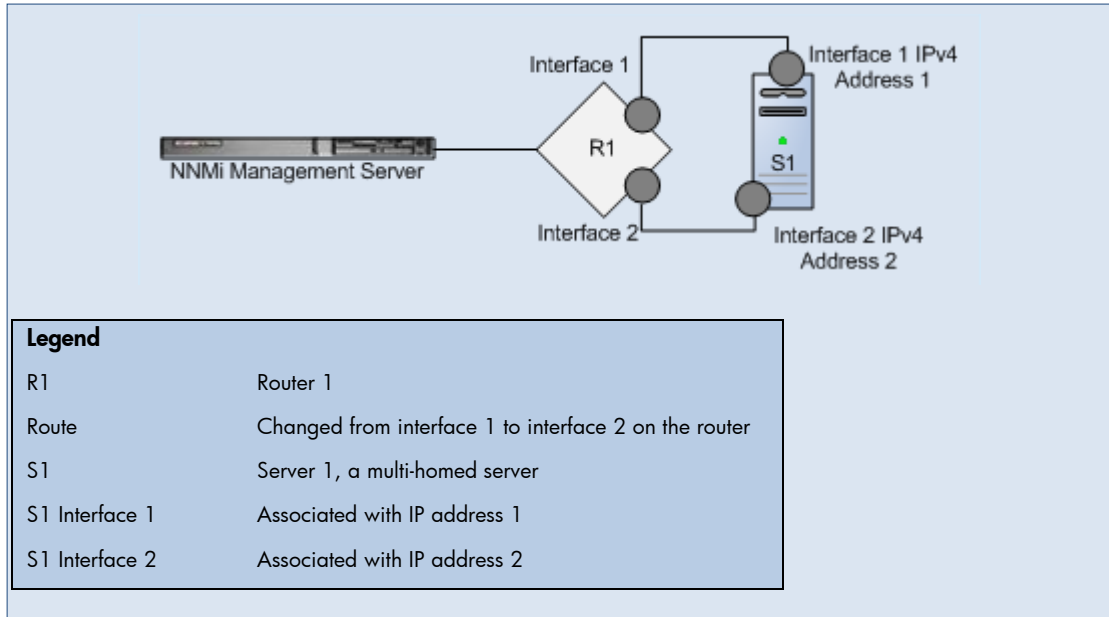
**Incident:** None generated.

**Status:** SNMP Agent is in Normal status.

**Conclusion:** `SNMPAgentResponding`

**Effect:** Node status is Normal. The Conclusion on the node is `ResponsiveAgentInNode`. `InterfaceUnmanagable` is cleared from all polled interfaces and the interfaces return to their previous status. `CardUnmanagable` is cleared from all polled cards including Daughter cards with their status restored to the previous status.

## IP Address Not Responding to ICMP



**Scenario:** IP address 1 on Server 1 (S1) is not responding. For example, the route on Router 1 (R1) has changed from Interface 1 to Interface 2, so that packets destined for the interface 1 on Server 1 are now routed out of Interface 2 on Router 1. The associated interface is operational, and the node can be reached because you can ping some IP addresses. The SNMP agent is up.

**NOTE:** Ping is not enabled out-of-the box. This scenario requires that at least one address is polled.

**Root Cause:** IP address is not responding.

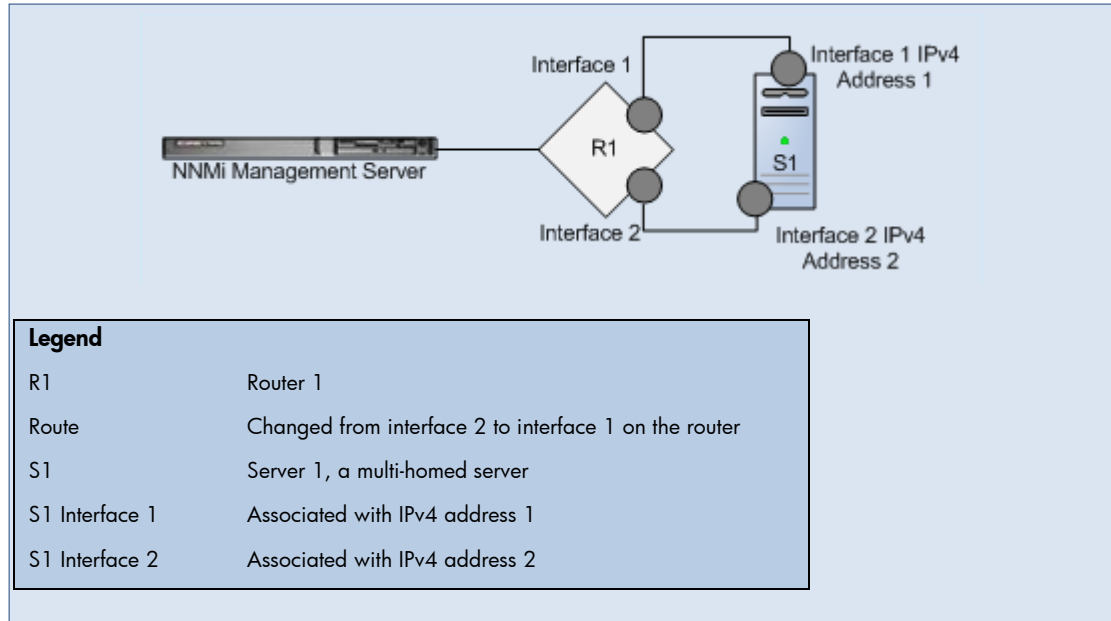
**Incident:** An `AddressNotResponding` incident is generated.

**Status:** IP address is in Critical status.

**Conclusion:** `AddressNotResponding`

**Effect:** The node status is Minor. The Conclusion on the node is `SomeUnresponsiveAddressesInNode`.

## IP Address Responding to ICMP



**Scenario:** This scenario continues the previous "IP Address Not Responding to ICMP" scenario. The IP address is now responding, the associated interface is operational, and the node can be reached. (For example, you can ping some IP addresses and the SNMP agent is up, or both.)

**Root Cause:** IP address is responding.

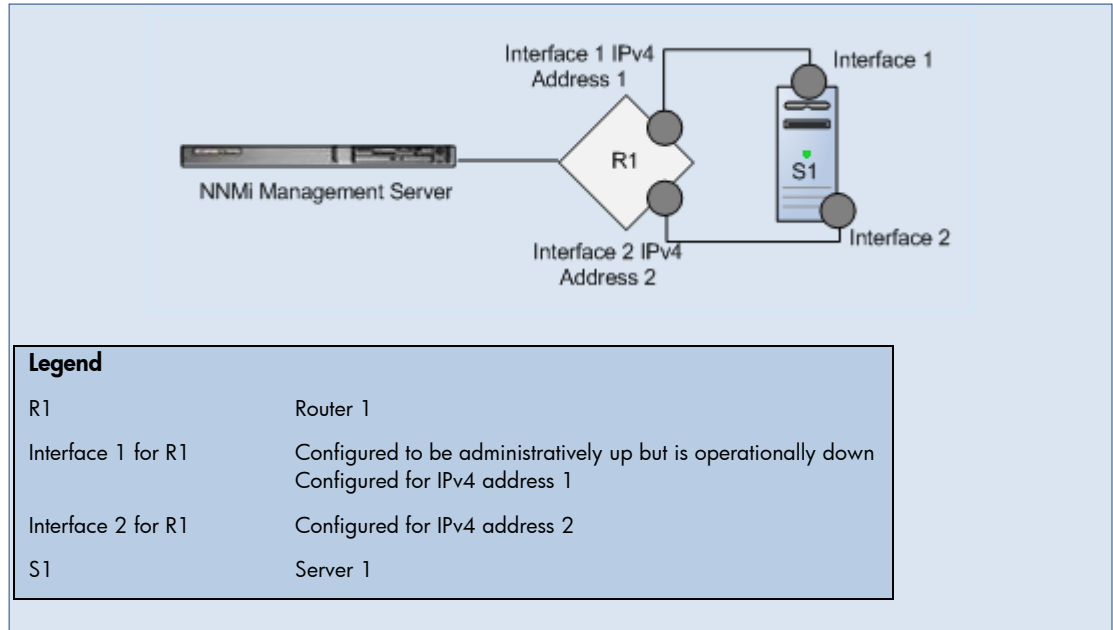
**Incident:** None generated. The `AddressNotResponding` incident is closed.

**Status:** The IP address is in Normal status.

**Conclusion:** `AddressResponding`

**Effect:** The node status is Normal. The Conclusion on the node is `ResponsiveAddressesInNode`.

## Interface Is Operationally Down



**Scenario:** Interface 1 is operationally down (`ifOperStatus = down`) and administratively up (`ifAdminStatus = up`). Router 1 sends a `linkDown` trap. Router 1 can be reached because some IP addresses, such as IP Address 2, respond to ping. The SNMP agent is up. IP Address 1 is associated with Interface 1. IP Address 1 has stopped responding to ICMP.

**Root Cause:** The interface is down.

**Incident:** An `InterfaceDown` incident is generated. The `LinkDown` incident is correlated beneath the `InterfaceDown` incident.

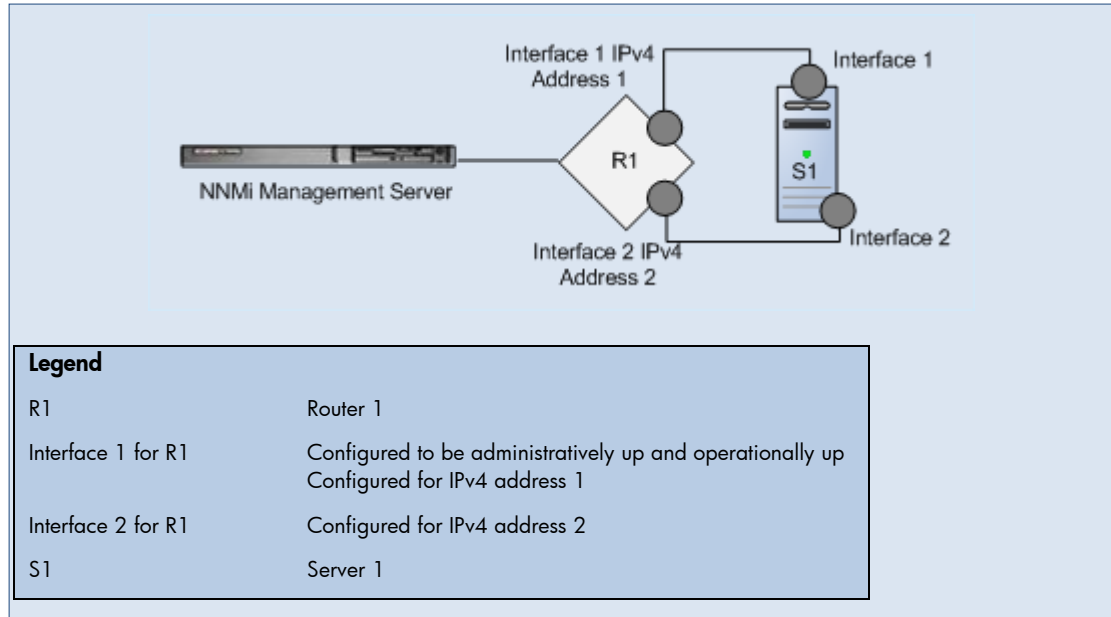
**Status:** The interface is in Critical status.

**Conclusion:** `InterfaceDown`

**Effect:** The node status is Minor. The Conclusions on the node are `InterfacesDownInNode` and `SomeUnresponsiveAddressesInNode`. The address associated with the interface is in Critical status; however, no `AddressNotResponding` incident is sent because this incident is suppressed by the `InterfaceDown` incident.



## Interface Is Operationally Up



**Scenario:** This scenario continues the previous “Interface is Operationally Down” scenario. Interface 1 on Router 1 is now operationally up (`ifOperStatus = up`). The node can be reached. All of its IP addresses respond to ping. The SNMP agent is up.

**Root Cause:** The interface is up.

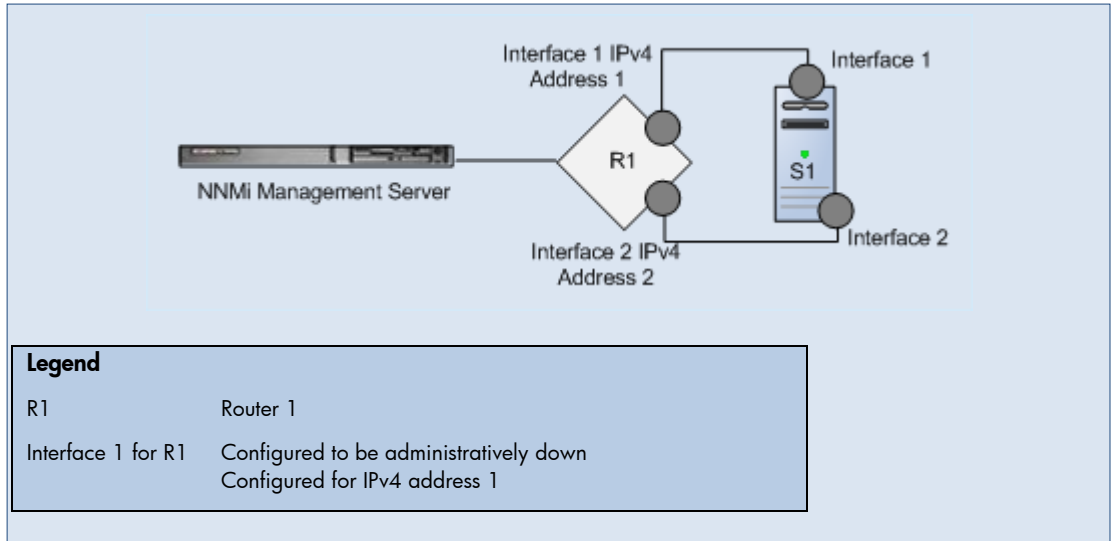
**Incident:** None generated. The `InterfaceDown` incident is closed.

**Status:** The interface is in Normal status.

**Conclusion:** `InterfaceUp`

**Effect:** The Node status is Normal. The Conclusion on the node is `InterfacesUpInNode`.

## Interface Is Administratively Down



**Scenario:** Interface 1 on Router 1 is administratively down (`ifAdminStatus = down`), but the node (Router 1) can be reached. For example, Interface 2 responds to ping and the SNMP agent is up. Disabling Interface 1 brings that interface operationally down. The IP address associated with this interface, IP Address 1, stops responding to ICMP.

**Root Cause:** Interface 1 is disabled.

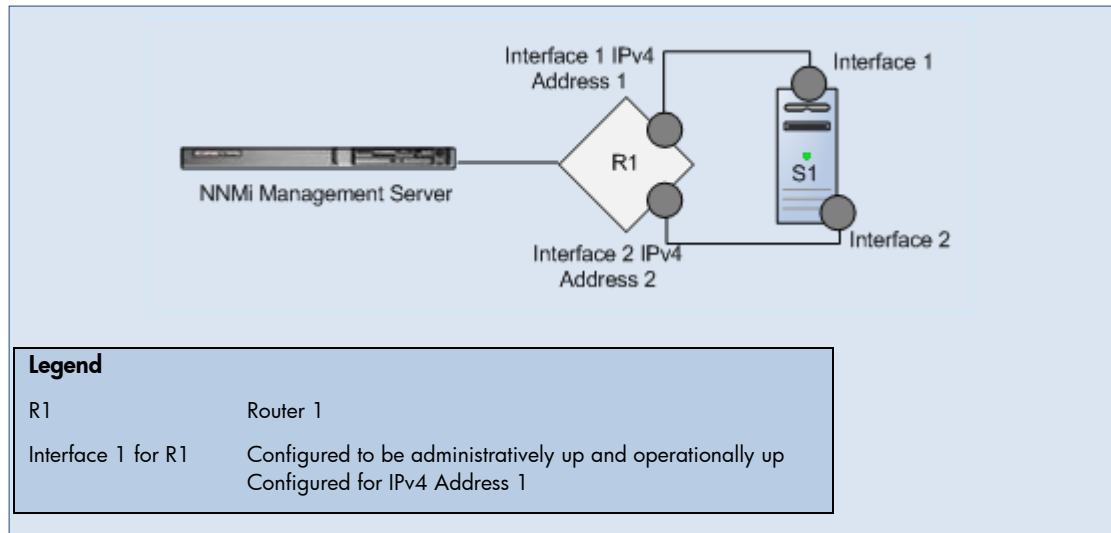
**Incident:** None generated.

**Status:** The interface is in Disabled status.

**Conclusion:** `InterfaceDisabled`

**Effect:** The IP address associated with Interface 1 on Router 1 has a status of Disabled. The Conclusion on the IP address is `AddressDisabled`.

## Interface Is Administratively Up



**Scenario:** This scenario continues the previous “Connection is Administratively Down” scenario. Interface 1 on Router 1 is now administratively up (`ifAdminStatus = up`). Some of the IP addresses of that interface respond to ping. The SNMP agent is up. Enabling Interface 1 on Router 1 brings it operationally up. The IP address associated with this interface starts responding to ICMP.

**Root Cause:** The interface is enabled.

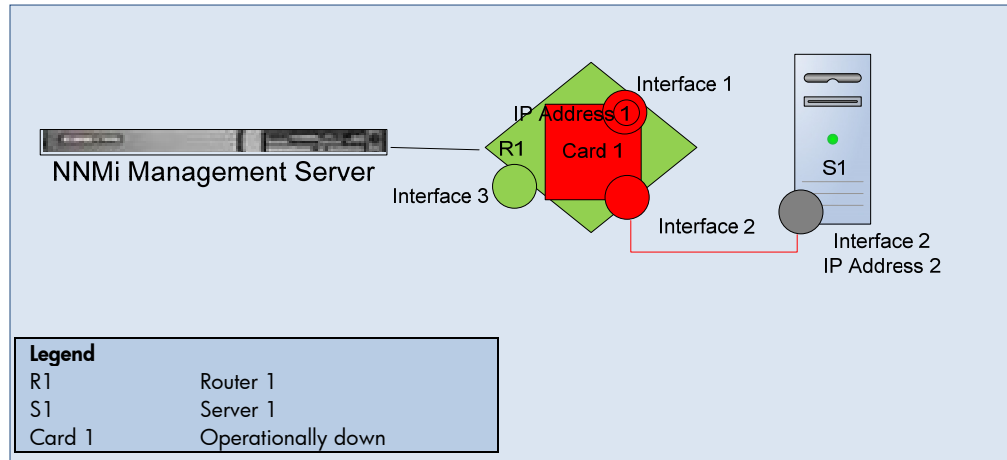
**Incident:** None generated.

**Status:** The interface is in Normal status.

**Conclusion:** `InterfaceEnabled`

**Effect:** The IP address associated with Interface 1 on Router 1 has a status of Enabled. The Conclusion on the IP address is `AddressResponding`.

## Card Is Operationally Down



**Scenario:** Card 1 is operationally down (`cardOperStatus = down`) and administratively up (`ifAdminStatus = up`). Router 1 (R1) sends a `moduleDown` trap. If Card 1 is an FRU card, the trap sent is a `CiscoModuleStatusChange` trap. Router 1 can be reached because Interface 3 responds to SNMP. The SNMP agent is up. Interface 1 and Interface 2 are associated with ports on Card 1 and are down. IP Address 1, associated with Interface 1, has stopped responding to ICMP. Interface 2 on Card 1 is down. The connection to Interface 2 on Server 1 (S1) is also down.

**Root Cause:** Card 1 is down.

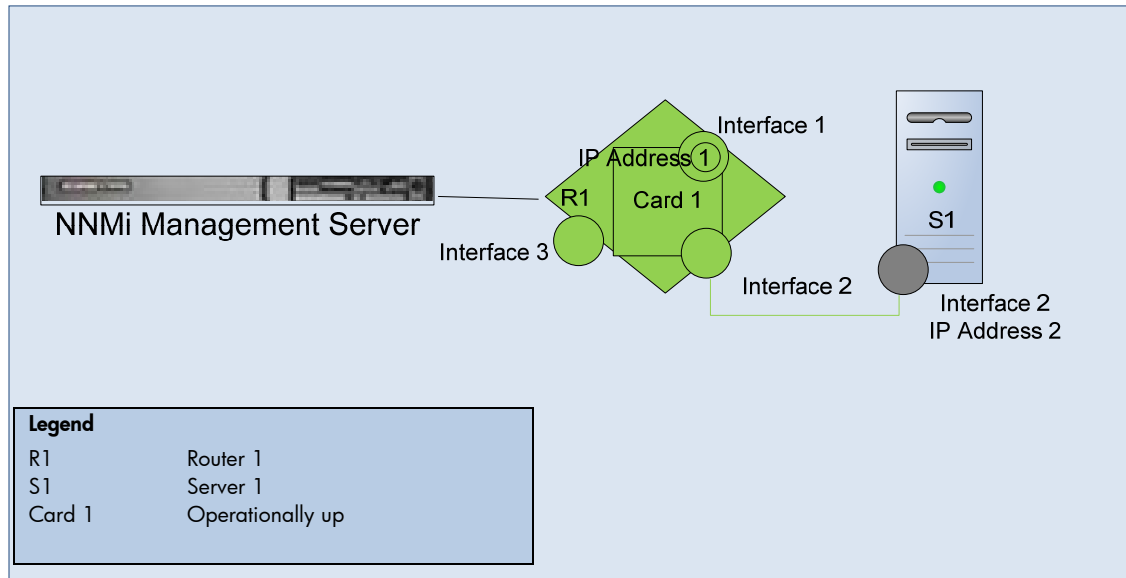
**Incident:** A `CardDown` incident is generated. The `moduleDown` or `CiscoModuleStatusChange` incident is correlated under the `CardDown` incident. The `InterfaceDown` incident for Interface 1 and the `ConnectionDown` incident between Interface 2 on Router 1 (R1) and Interface 2 on Server 1 (S1) are correlated under the `CardDown` incident. The `InterfaceDown` incident for Interface 2 is correlated under `ConnectionDown`.

**Status:** The card is in Critical status.

**Conclusion:** `CardDown`

**Effect:** The node status is Minor. The interfaces associated with the card and the addresses on those interfaces are in Critical status. Conclusions on the node are `CardsDownInNode`, `InterfacesDownInNode`, and `SomeUnresponsiveAddressesInNode`. No `AddressNotResponding` incident is sent because this incident is suppressed by the `InterfaceDown` incident.

## Card Is Operationally Up



**Scenario:** This scenario continues the previous “Card is Operationally Down” scenario. Card 1 is operationally up (`cardOperStatus = up`). The node (Router 1) can be reached and all of its IP addresses respond to ping. The card is up and all the interfaces and connection on Card 1 are back to normal. The SNMP agent is up.

**Root Cause:** The card is up.

**Incident:** No incidents are generated. The `CardDown` incident is closed. The `InterfaceDown` and `ConnectionDown` incidents correlated under the `CardDown` incident are also closed.

**Status:** The card is in Normal status.

**Conclusion:** `CardUp`

**Effect:** The node status is Normal. The Conclusion on the node is `CardsUpInNode`.

## Card Is Neither Operationally Up nor Operationally Down

**Scenario:** A card on the router is reporting an “Unknown” state (`cardOperStatus=Unknown`) or an “Other” state (`cardOperStatus=Other`). This implies that the card is not healthy.

**Root Cause:** The card might be in some faulty state.

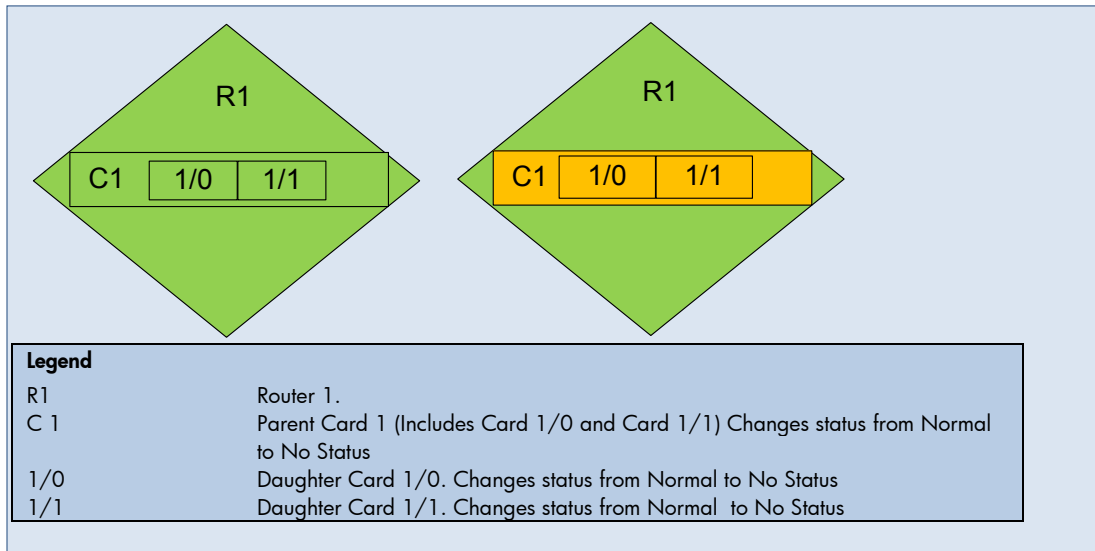
**Incident:** `CardUnderterminedState`

**Status:** The card has Minor status.

**Conclusion:** `CardUndeterminedState`

**Effect:** The node status is Minor. The conclusion on the node is `CardsUnderdeterminedStateInNode`.

## Parent Card Management Mode is Unmanaged or Out-Of-Service



**Scenario:** Router 1 is managed and is polled. All cards on Router 1 are up. The Parent Card, Card 1, management mode is set to Unmanaged or Out-Of-Service.

**Root Cause:** The Parent Card is not polled.

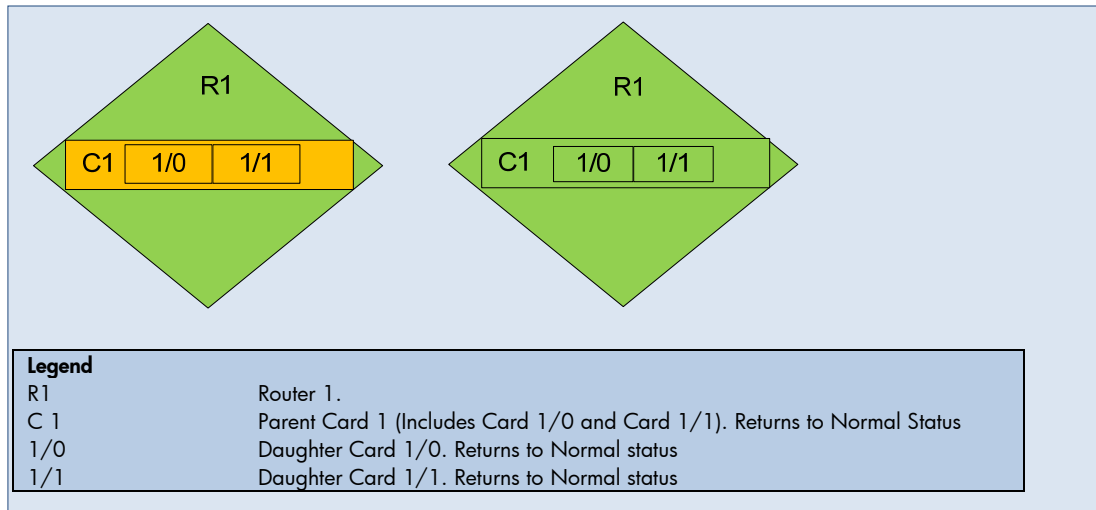
**Incident:** None generated.

**Status:** The Parent Card status changes to NoStatus.

**Conclusion:** None

**Effect:** The Daughter cards, Card 1/0, Card 1/1 change to a status of NoStatus. The management mode of the Daughter cards is inherited from the Parent Card so the Daughter cards become unpolled.

## Parent Card Management Mode is Inherited



**Scenario:** This scenario continues the previous “Parent Card Management Mode is Unmanaged or Out-of-Service” scenario. The Parent Card management mode is now set to Inherited. This means the Parent Card’s management mode is inherited from its container node (Router1), which is Managed.

**Root Cause:** The Parent Card is polled.

**Incident:** None generated.

**Status:** The Parent Card status is restored to its previous status.

**Conclusion:** None

**Effect:** The status of the Daughter cards (Card 0/1 and Card 1/1) are restored to their previous status.

## Field Replaceable Unit (FRU) Card is Added

**Scenario:** An FRU card is added to the device. The device sends an `FRUInserted` trap with information on the added card module.

**Root Cause:** The card is successfully added.

**Incident:** A `CardInserted` incident is generated. This is an Informational incident. The `FRUInserted` trap is correlated under the `CardInserted` incident.

**Status:** The new card status changes from `No Status` (unpolled at the beginning) to a polled status.

**Conclusion:** None

**Effect:** If the new card is not in a Normal status, the card status will propagate to the node. In the common case, the node status should remain unchanged from its previous status.

## Field Replaceable Unit (FRU) Card is Removed

**Scenario:** An existing FRU card is removed from the device. The device sends an `FRURemoved` trap with information on the removed card module.

**Root Cause:** The device stops reporting the existence of the card module on rediscovery.

**Incident:** A `CardRemoved` incident is generated. This is an Informational incident. The `FRURemoved` trap is correlated under the `CardRemoved` incident.

**Status:** None

**Conclusion:** None

**Effect:** If the node status was previously affected by a faulty FRU card, the node status is restored to a Normal status when that card is removed.



## Field Replaceable Unit (FRU) Card is not Recognized

**Scenario:** An inserted FRU card is not recognized by the device. The device sends a `CiscoUnrecognizedFRU` trap with information on the unrecognized card module.

**Root Cause:** The device does not recognize the card module. One possible reason is that the card might have an incompatible module version.

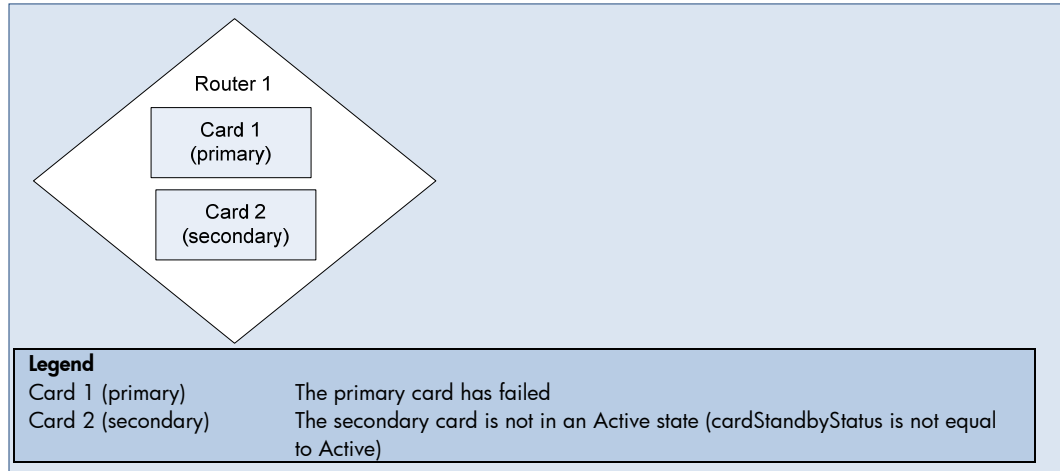
**Incident:** The `CiscoUnrecognizedFRU` incident is an SNMP trap. It is an Informational incident with a severity of Warning. No additional management event is provided.

**Status:** None

**Conclusion:** None

**Effect:** None

## Card Redundancy Group has no Primary Member



**Scenario:** A Card Redundancy Group does not have a primary member. The `cardStandbyStatus` of the primary card (Card 1) is not Active. Router 1 sends a `CiscoRFProgressionNotif` or a `CiscoRFSwactNotif` trap on the Card Redundancy Group state changes.

A properly functioning Card Redundancy Group should have one operational primary card one operational secondary card.

**Root Cause:** The primary card fails and the secondary card fails to switch to primary role.

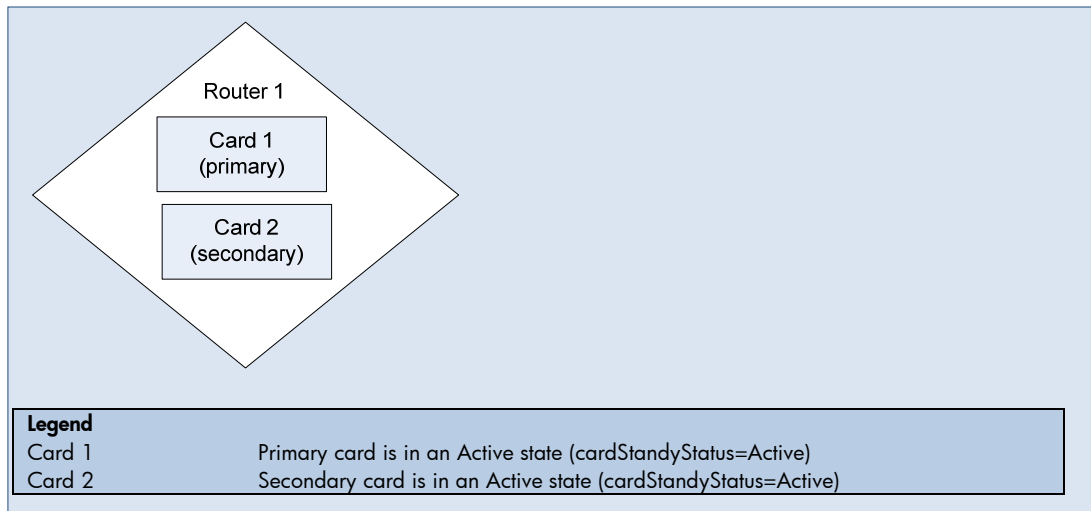
**Incident:** A `CrgNoPrimary` incident is generated as a Service Impact incident. If there is an identified root cause such as `CardDown`, the `CardDown` incident is correlated under the `CrgNoPrimary` incident as an Impact Correlation.

**Status:** The status of the Card Redundancy Group is Critical.

**Conclusion:** `CrgNoPrimary`

**Effect:** The node status is Warning. The Conclusion on the node is `CrgMalfunctionInNode`.

## Card Redundancy Group has Multiple Primary Members



**Scenario:** A Card Redundancy Group has both members reporting as the primary card. The `cardStandbyStatus` of both cards is Active. A properly functioning Card Redundancy Group should have only one operational primary card.

**Root Cause:** This scenario could be due to a misconfiguration of the Card Redundancy Group.

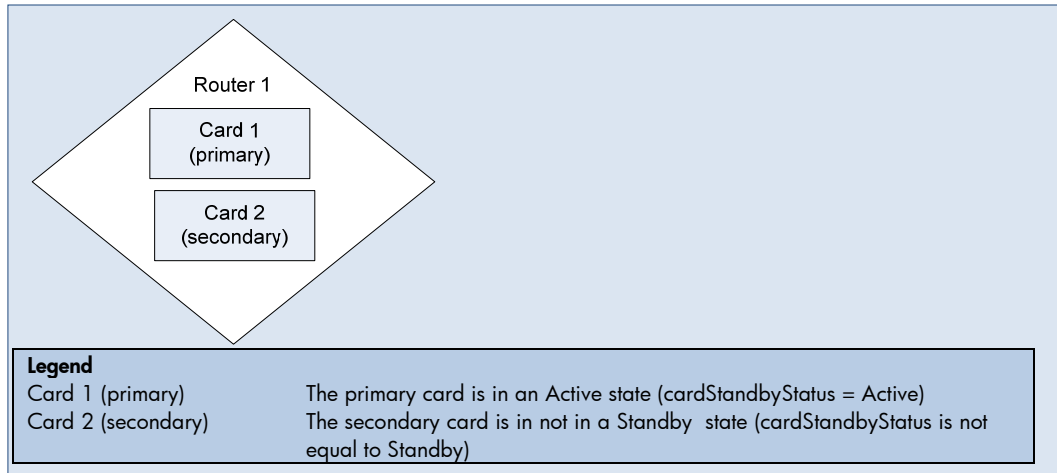
**Incident:** A `CrgMultiplePrimary` incident is generated.

**Status:** The status of the card redundancy group is `Critical`.

**Conclusion:** `CrgMultiplePrimary`

**Effect:** The node status is `Warning`. The Conclusion on the node is `CrgMalfunctionInNode`.

## Card Redundancy Group has no Secondary Member



**Scenario:** A Card Redundancy Group does not have a secondary member. Neither card has a `cardStandbyStatus` equal to `Standby`. A properly functioning Card Redundancy Group should have one operational primary card and one operational secondary card.

**Root Cause:** This scenario could result from the secondary card failing or from a misconfiguration of the Card Redundancy Group.

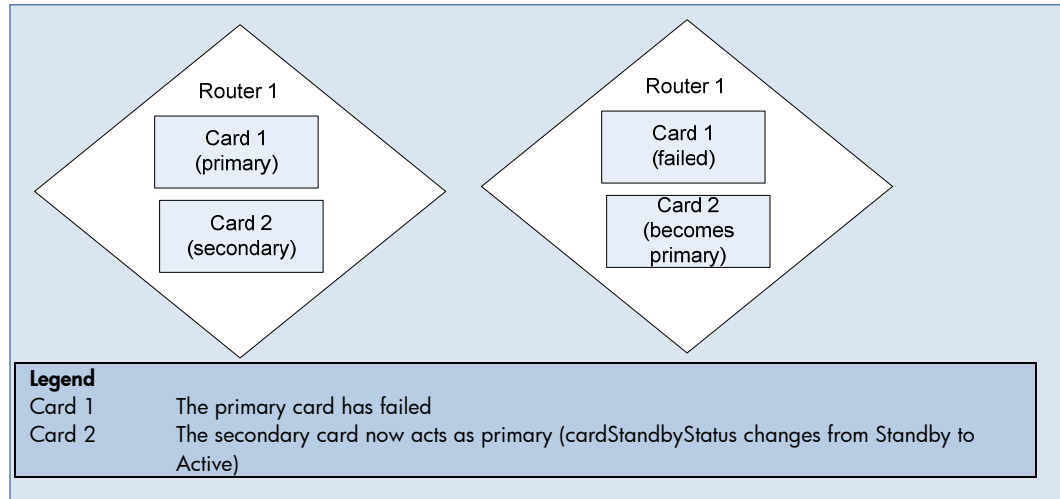
**Incident:** A `CrgNoSecondary` incident is generated. If there is an identified root cause such as `CardDown`, the `CardDown` incident is correlated under the `CrgNoSecondary` incident as an Impact Correlation.

**Status:** The status of the Card Redundancy Group is `Warning`.

**Conclusion:** `CrgNoSecondary`

**Effect:** The node status is `Warning`. The Conclusion on the node is `CrgMalfunctionInNode`.

## Card Redundancy Group Fail Over



**Scenario:** A Card Redundancy Group has a failure on the primary card. The `cardStandbyStatus` on the secondary card changes from the value of Standby to Active. This Active card takes over as the primary member. In this case, the Card Redundancy Group is functioning as intended.

**Root Cause:** This scenario is most likely due to a failure on the primary card.

**Incident:** A `CrgFailover` incident is generated. If there is an identified root cause such as `CardDown`, the `CardDown` incident is correlated under the `CrgFailover` incident as an Impact Correlation.

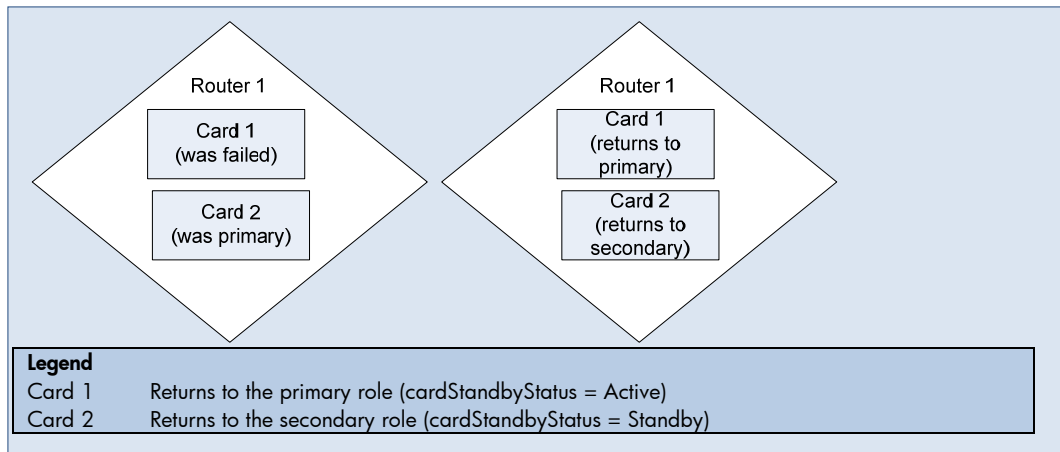
A `CrgNoSecondary` incident is also generated as neither card member is in a Standby state.

**Status:** The failover status generates a status of Normal. The status of the Card Redundancy Group is Warning because there is no secondary.

**Conclusion** `CrgFailover` and `CrgNoSecondary`

**Effect:** The node status is Warning. The Conclusion on the node is `CrgMalfunctionInNode`.

## Card Redundancy Group Failback



**Scenario:** This scenario is a continuation of the previous scenario “Card Redundancy Group Fail Over “. Card 1 is now functional and acts as the primary card. Card 2 resumes the secondary role.

**Root Cause:** The faulty primary card is now working correctly or the Card Redundancy Group misconfiguration is corrected.

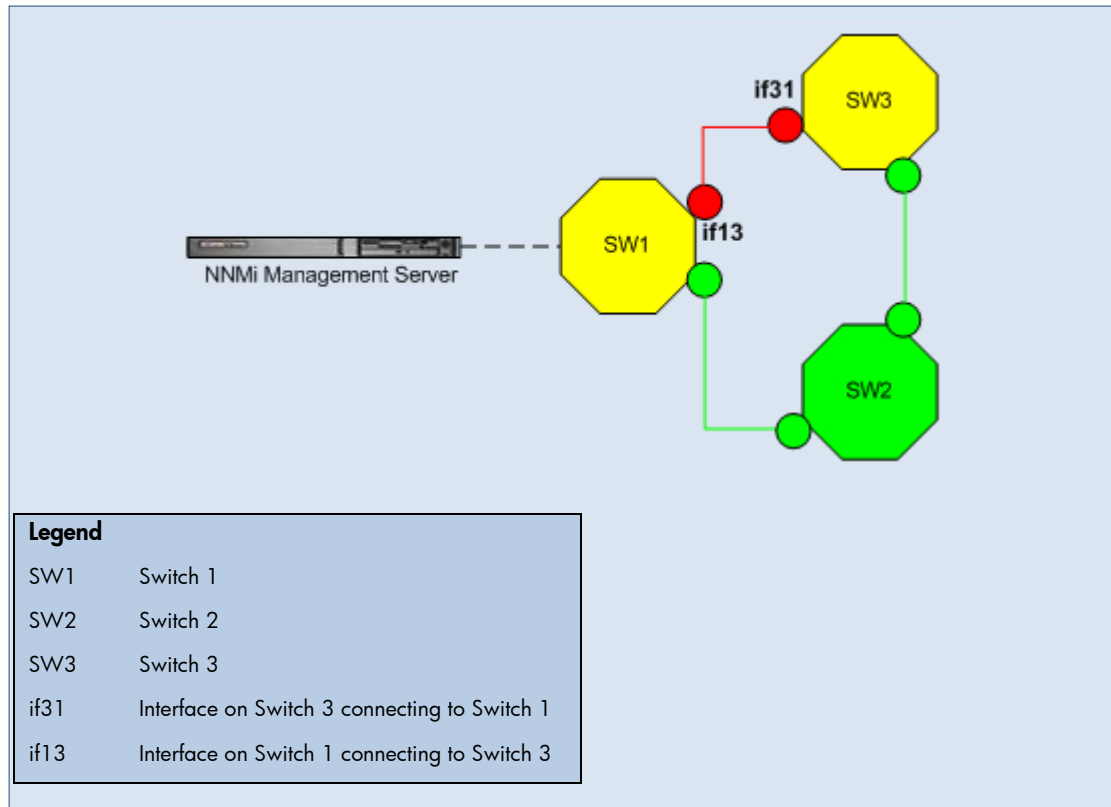
**Incident:** The incident `CrgFailover` is closed. The `CrgNoSecondary` incident is also closed.

**Status:** Normal

**Conclusion:** `CrgNormal`

**Effects:** The Conclusion on the node is `CrgNormalInNode`.

## Connection Is Operationally Down



**Scenario:** The connection between the interface on Switch 3 connecting to Switch 1 (if13) and the interface on Switch 1 connecting to Switch 3 (if31) is down. Traffic flows from the Management Server through Switch 1 (SW1) and Switch 2 (SW2). Both if13 and if31 are marked down.

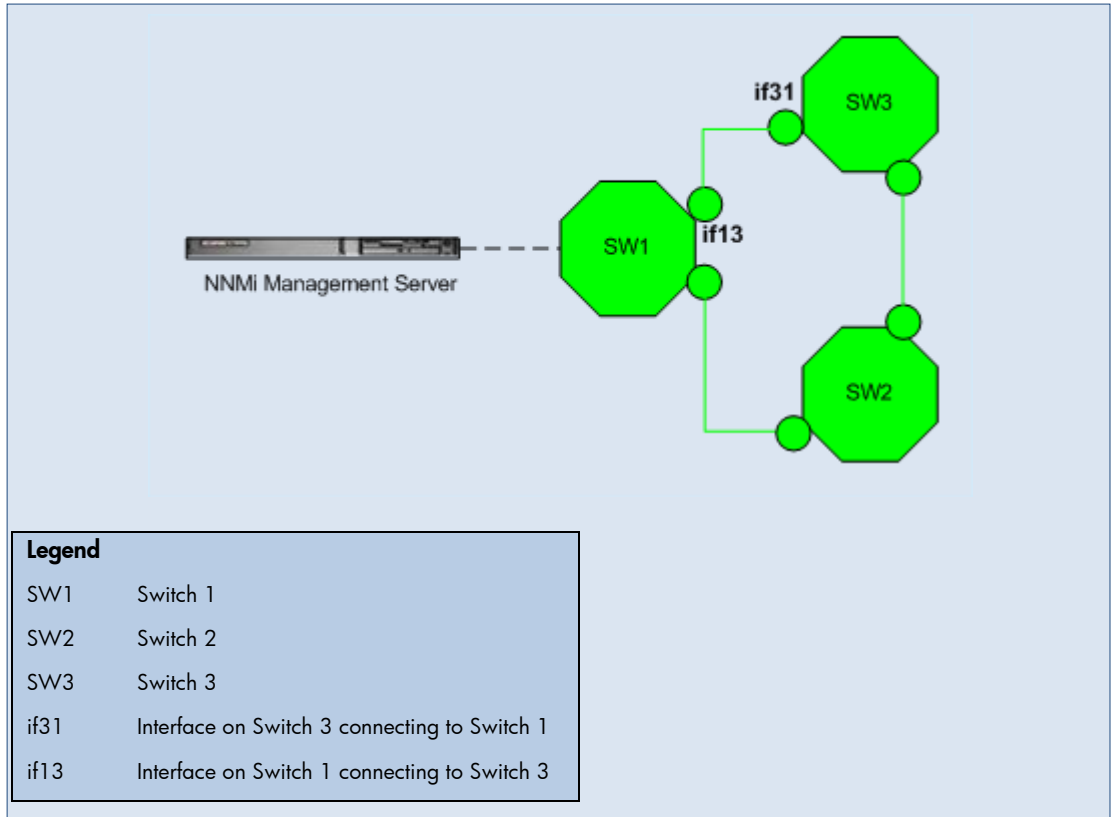
**Root Cause:** The connection between if13 and if31 is down.

**Incident:** A `ConnectionDown` incident is generated. The `InterfaceDown` incidents from if13 and if31 are correlated beneath `ConnectionDown`.

**Status:** The connection is in Critical status.

**Conclusion:** `ConnectionDown`

## Connection Is Operationally Up



**Scenario:** This scenario continues the previous “Connection is Operationally Down” scenario. The connection between if13 and if31 is now up.

**Root Cause:** The connection between if13 and if31 is up.

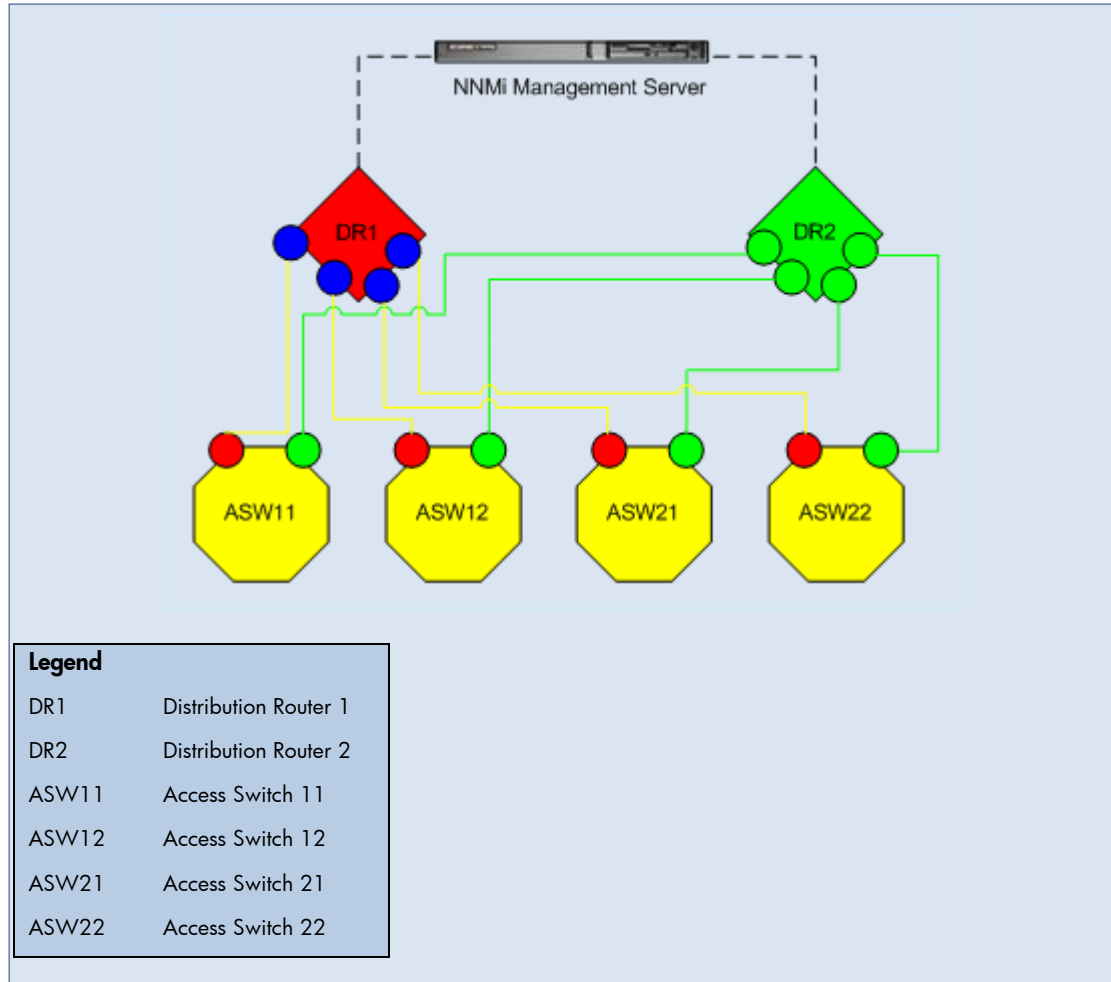
**Incident:** None generated. The `ConnectionDown` incident is closed.

**Status:** Connection is in Normal status.

**Conclusion:** `ConnectionUp`



## Directly Connected Node Is Down



**Scenario:** Access switches ASW11, ASW12, ASW21, and ASW22 are redundantly connected to the distribution routers, as shown. The distribution routers DR1 and DR2 are directly connected to one another. The distribution router DR1 goes down.

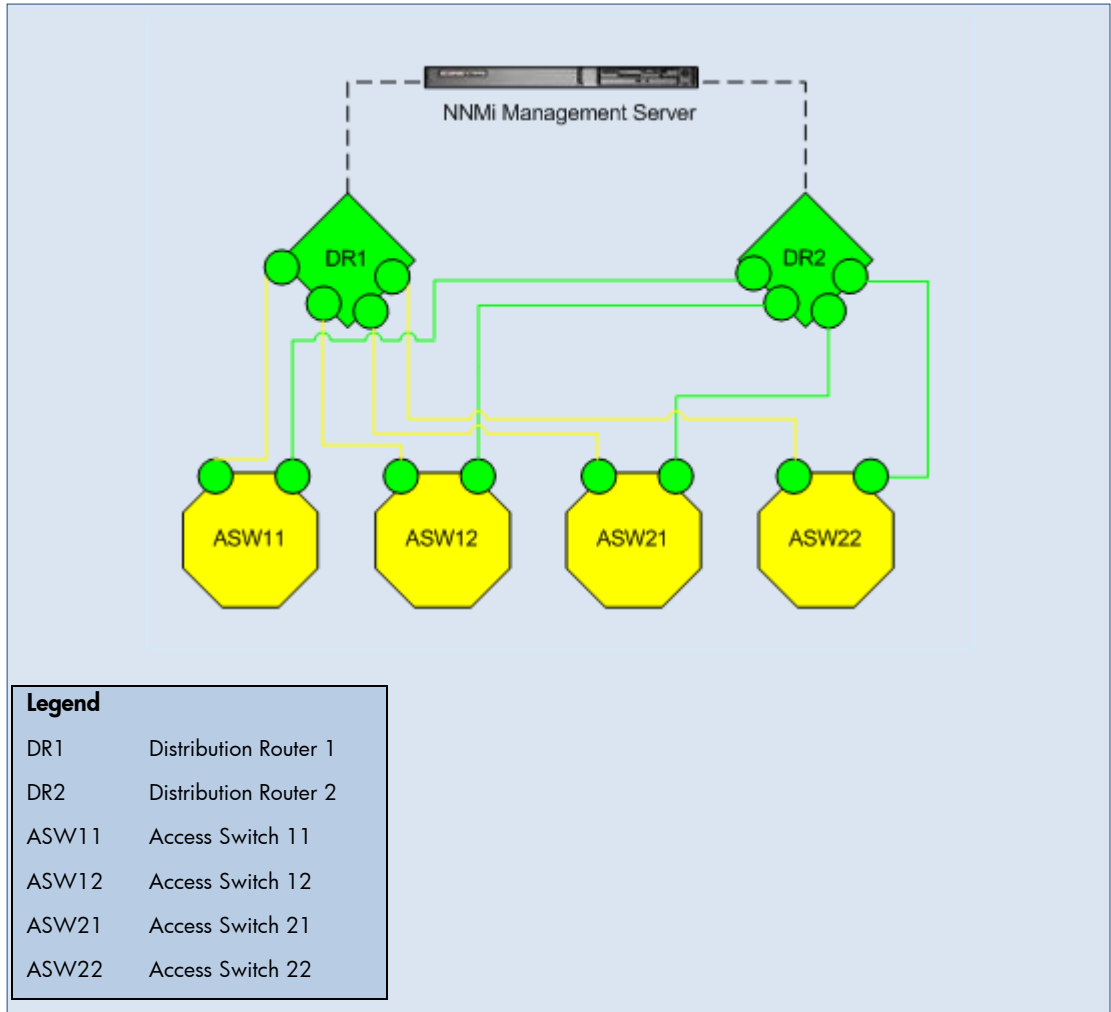
**Root Cause:** Node DR1 is down according to neighbor analysis.

**Incident:** A `NodeDown` incident is generated. The `InterfaceDown` incidents from one-hop neighbors are correlated beneath the `NodeDown` incident.

**Status:** The node is in Critical status.

**Conclusion:** `NodeDown`

## Directly Connected Node Is Up



**Scenario:** This scenario continues the previous “Directly Connected Node is Down” scenario. The distribution router DR1 comes back up.

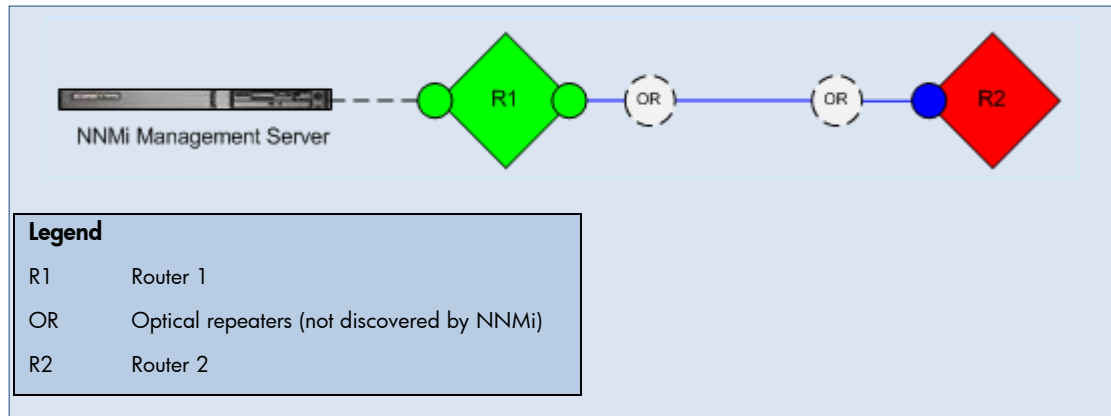
**Root Cause:** Node DR1 is up.

**Incident:** A NodeUp incident is generated. The NodeDown incident is closed by the NodeUp incident, and the NodeUp incident is also closed.

**Status:** The node is in Normal status.

**Conclusion:** NodeUp

## Indirectly Connected Node Is Down



**NOTE:** The diagram is conceptual. It does not represent an actual NNMI topology map or workspace view.

**Scenario:** This scenario can occur with any indirect connection where NNMI cannot discover the intermediate devices. In this example, Routers R1 and R2 appear to be directly connected in NNMI topology maps, but in reality these two routers are indirectly connected through optical repeaters. (The optical repeaters do not respond to SNMP or ICMP queries, so they are not discovered by NNMI.)

Router 2 becomes unreachable, either because its connected interface is down or because the connection between the optical repeaters is down. The interface on Router 1 that indirectly connects it to Router 2 is still up because its optical repeater is still up.

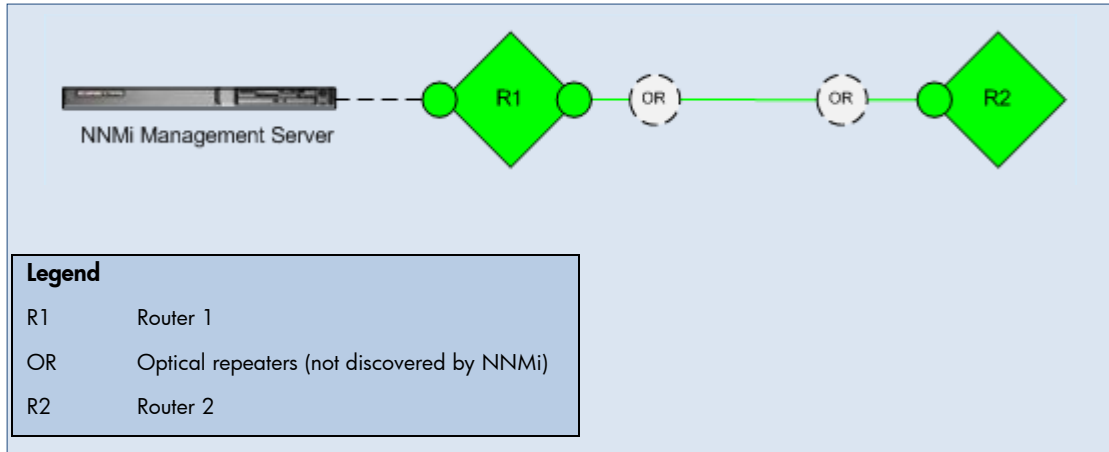
**Root Cause:** Router 2 is down according to neighbor analysis.

**Incident:** A `NodeDown` incident is generated.

**Status:** Node Router 2 is in Critical status.

**Conclusion:** `NodeDown`

## Indirectly Connected Node Is Up



**NOTE:** The diagram is conceptual. It does not represent an actual NNMi topology map or workspace view.

**Scenario:** This scenario continues the previous "Indirectly Connected Node is Down" scenario. The failed connection comes back up. Router 2 becomes reachable.

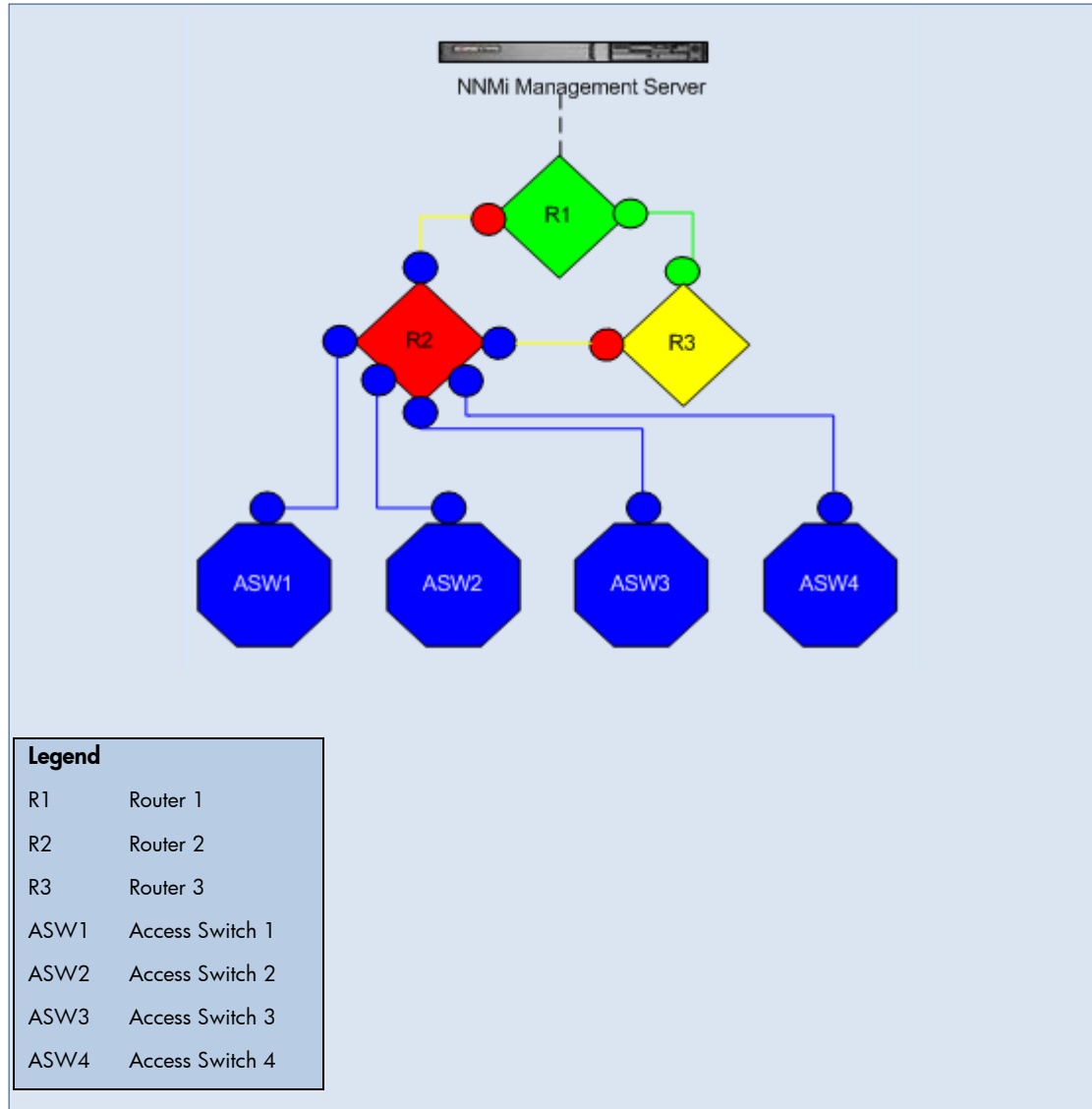
**Root Cause:** The connection between Router 1 and Router 2 is up.

**Incident:** A `NodeUp` incident is generated. The `NodeDown` incident is closed by the `NodeUp` incident. The `NodeUp` incident is also closed.

**Status:** Router 2's status is Normal. The connection status is Normal.

**Conclusion:** `NodeUp`

## Directly Connected Node Is Down and Creates a Shadow



**Scenario:** Router 2 (R2) goes down.

**Root Cause:** Node (Router 2) is down according to NNMI's neighbor analysis.

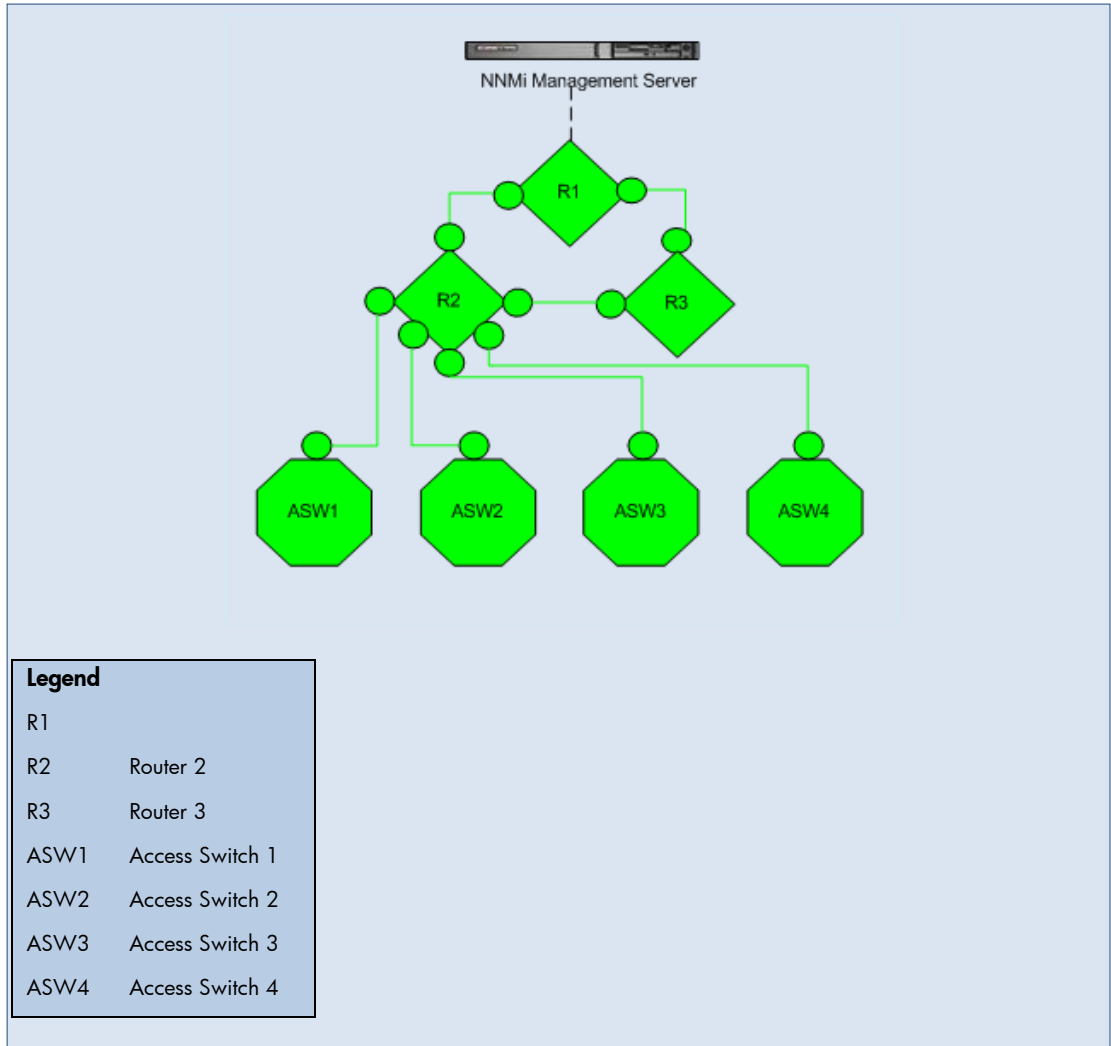
**Incident:** A `NodeDown` incident is generated. The `InterfaceDown` incidents from one-hop neighbors are correlated beneath the `NodeDown` incident.

**Status:** The node is in Critical status.

**Conclusion:** `NodeDown`

**Effect:** All of the access switches are unreachable. The status of all nodes in the shadow is `Unknown` and the `Conclusion` on each of them is `NodeUnmanageable`.

## Directly Connected Node Is Up, Clearing the Shadow



**Scenario:** This scenario continues the previous “Node is Down and Creates a Shadow” scenario. Router 2 comes back up.

**Root Cause:** Node Router 2 is up.

**Incident:** A `NodeUp` incident is generated. The `NodeDown` incident is closed by the `NodeUp` incident. The `NodeUp` incident is also closed.

**Status:** The node is in Normal status.

**Conclusion:** `NodeUp`

**Effect:** All of the access switches are now reachable. The status of all nodes in the shadow is Normal.

## Important Node Is Unreachable

**Scenario:** A node that is part of the Important Nodes Node Group cannot be reached.

**NOTE:** You must add a node to the Important Nodes Node Group before the NmsApa service analyzes the node. If a node becomes unreachable before being added to the Important Nodes Node Group, the NmsApa service does not generate a NodeDown incident.

**Root Cause:** The node is down. The NmsApa service does not do neighbor analysis, but concludes that the node is down because it was marked as important.

**Incident:** A NodeDown incident is generated. There are no correlated incidents.

**Status:** The node is in Critical status.

**Conclusion:** NodeDown

## Important Node Is Reachable

**Scenario:** This scenario continues the previous "Important Node is Unreachable" scenario. The important node comes back up and can be reached.

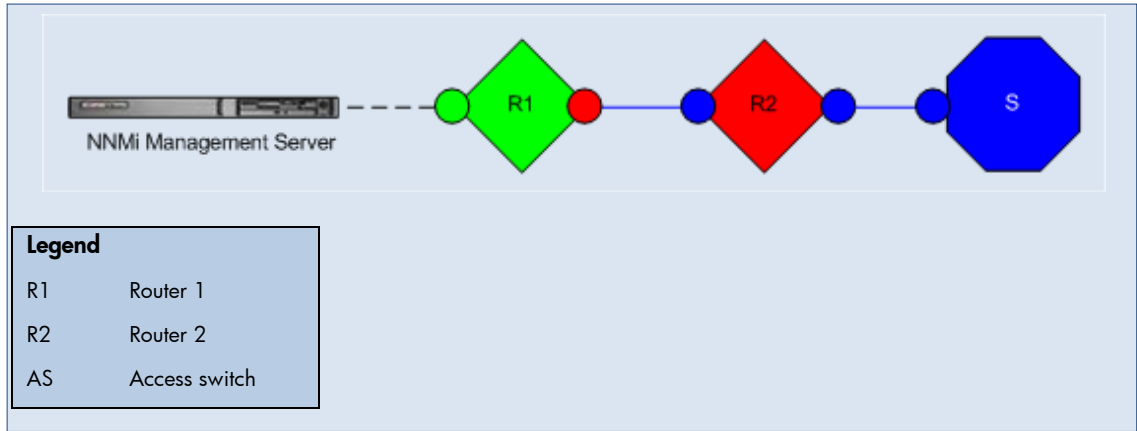
**Root Cause:** The node is up.

**Incident:** None generated. The NodeDown incident is closed by the NodeUp incident.

**Status:** The node is in Normal status.

**Conclusion:** NodeUp

## Node or Connection Is Down



**Scenario:** There is no redundancy to Router 2 (R2). Either Router 2 is down or the connection between Router 1 (R1) and Router 2 is down.

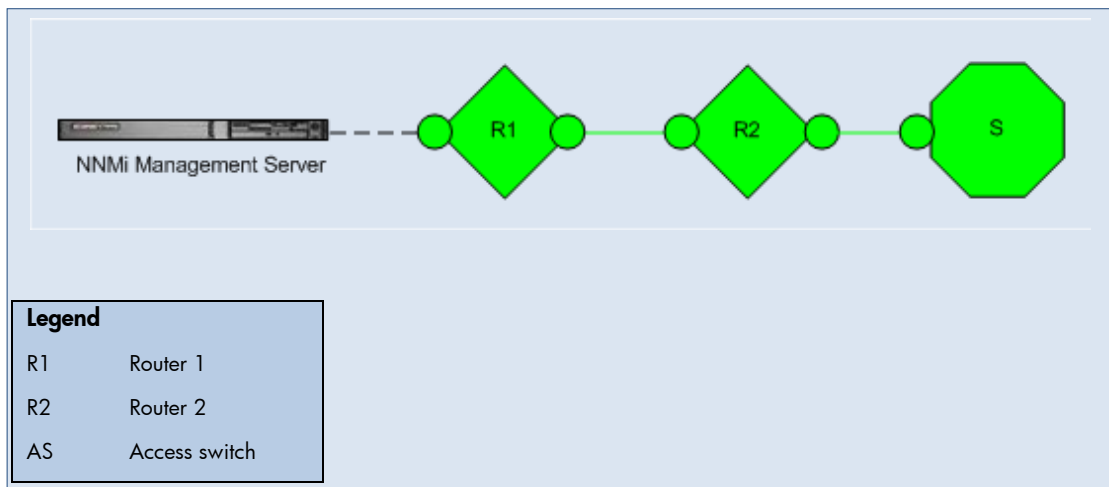
**Root Cause:** The node or the connection is down.

**Incident:** A `NodeOrConnectionDown` incident is generated. The Source Node in this scenario is Router 2.

**Status:** The Node is in Critical status. The connection is in Warning status.

**Conclusion:** `NodeOrConnectionDown`

## Node or Connection Is Up



**Scenario:** This scenario continues the previous "Node or Connection is Down" scenario. Router 2 is now up.

**Root Cause:** `NodeUp`

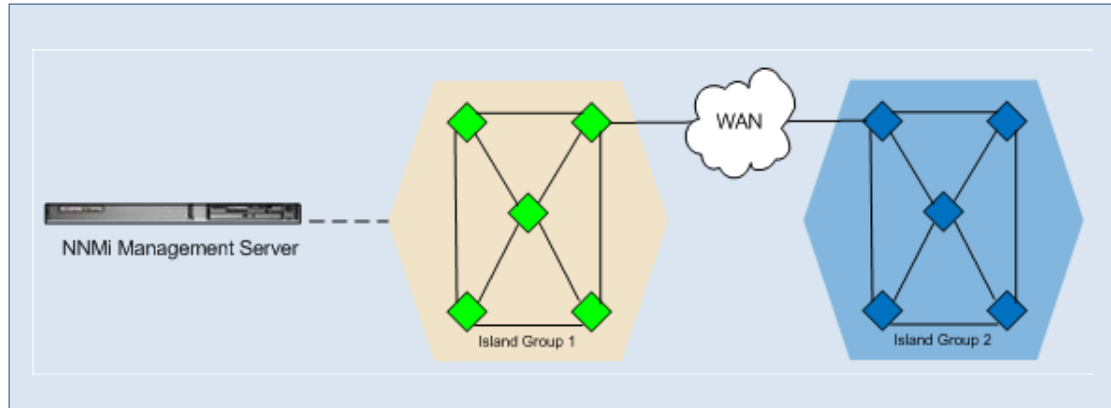
**Incident:** A `NodeUp` incident is generated. The `NodeOrConnectionDown` incident is closed by the `NodeUp` incident. The `NodeUp` incident is also closed.

**Status:** The node is in Normal status. The connection is in Normal status.

**Conclusion:** `NodeUp`



## Island Group Is Down



**NOTE:** The diagram is conceptual. It does not represent an actual NNMI topology map or workspace view.

**Scenario:** NNMI has partitioned your network into two Island Groups. The NNMI management server is connected to a node in Island Group 1. Island Group 2 has become unreachable due to problems in your service provider's WAN.

**NOTE:** Island Groups contain highly-connected sets of nodes that are not connected or are only minimally connected to the rest of the network. For example, NNMI can identify multiple Island Groups for an enterprise network with geographically distributed sites connected by a WAN. Island Groups are created by NNMI and cannot be modified by the user. For more information about Island Groups, see the NNMI help.

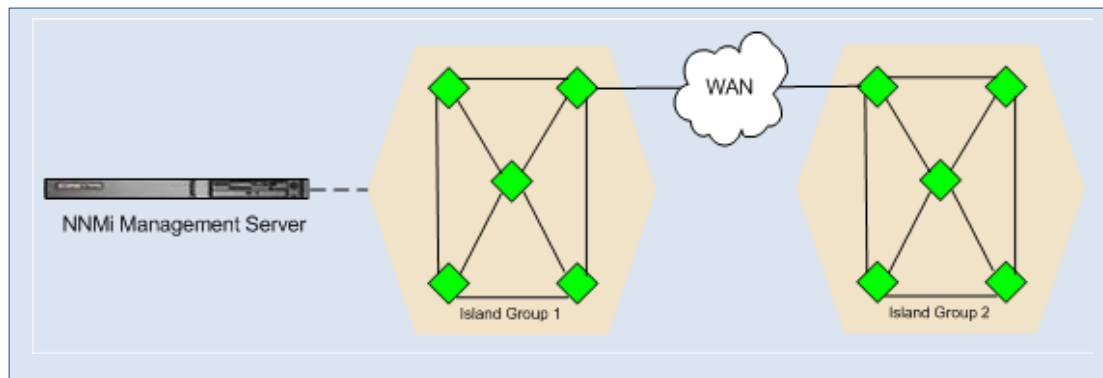
**Root Cause:** Island Group 2 is down according to neighbor analysis.

**Incident:** An `IslandGroupDown` incident is generated. NNMI chooses a representative node from Island Group 2 as the source node for the incident.

**Status:** The status of Island Group 2 is set to `Unknown`. Objects in Island Group 2 have unknown status. The connecting interface from Island Group 1 is up because the connection from the interface to the WAN is still up.

**Conclusion:** Not applicable for Island Groups.

## Island Group Is Up



**NOTE:** The diagram is conceptual. It does not represent an actual NNMi topology map or workspace view.

**Scenario:** This scenario continues the previous "Island Group is Down" scenario. The service provider's WAN problems are fixed, and Island Group 2 can be reached.

**Root Cause:** The WAN connection to Island Group 2 is back up.

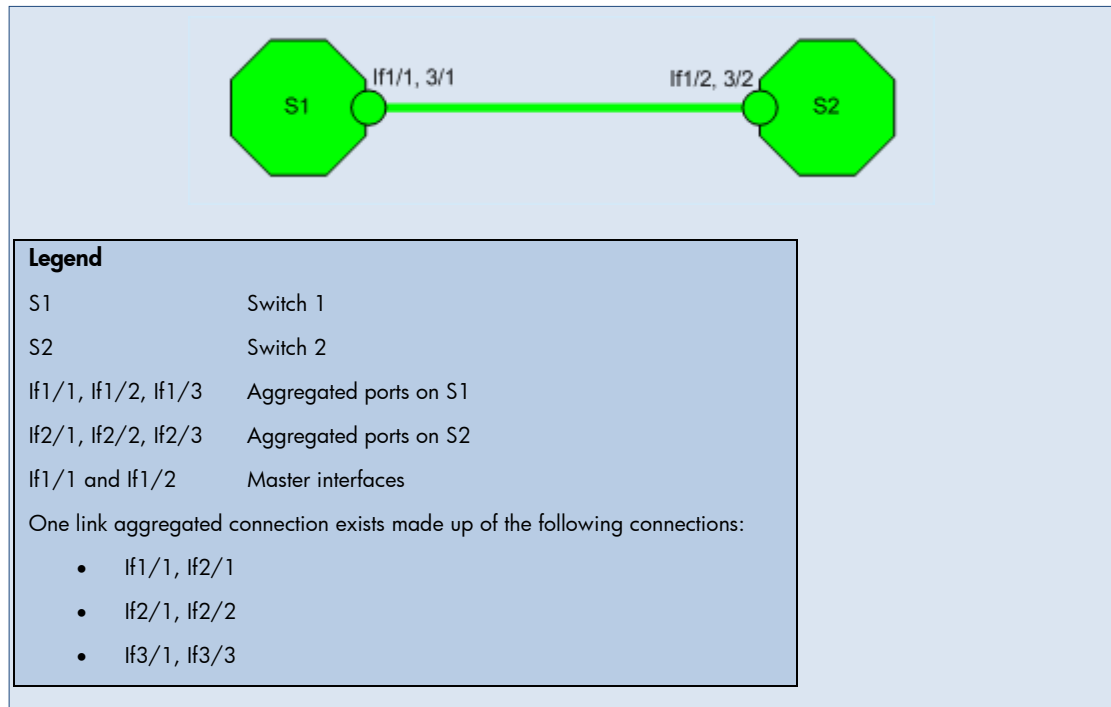
**Incident:** None generated. The `IslandGroupDown` incident is closed.

**Status:** The status for Island Group 2 is set to `Normal`. Objects in Island Group 2 return to `Normal` status.

**Conclusion:** Not applicable for Island Groups.

## Link Aggregated Ports (NNMi Advanced)

### Aggregator Is Up



**Scenario:** All ports within the port aggregator are operationally and administratively up.

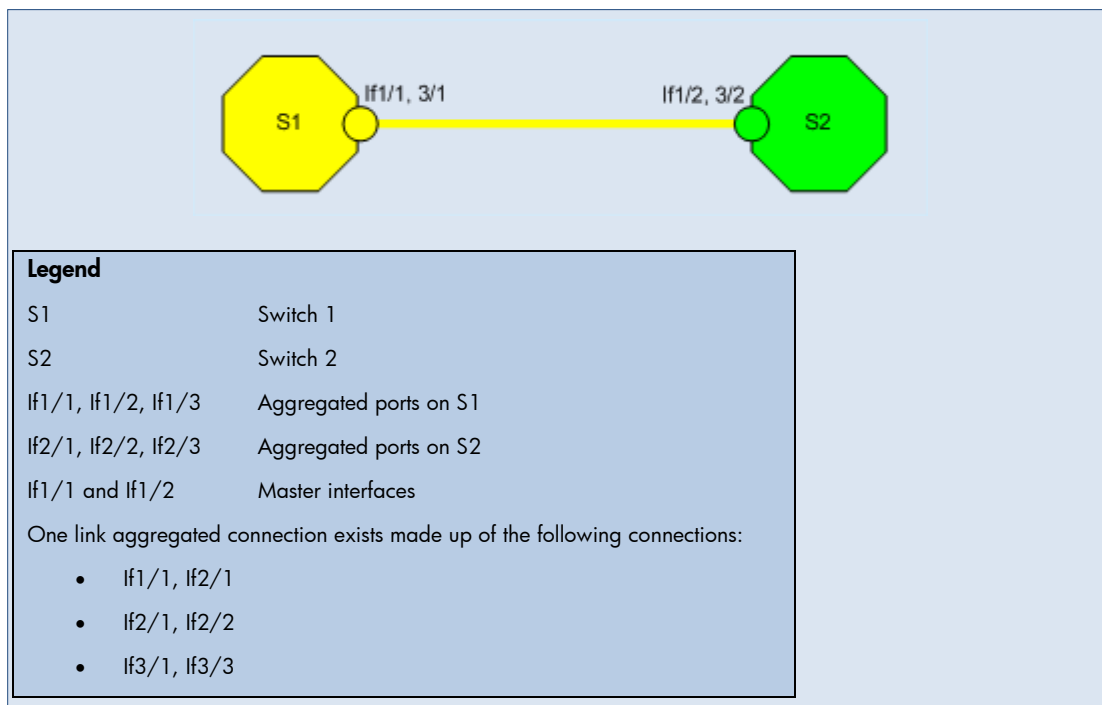
**Root Cause:** All operational and administrative states are up.

**Incident:** No incident is generated.

**Status:** The status of the aggregator is set to normal.

**Conclusion:** AggregatorUp

## Aggregator Is Degraded



**Scenario:** Some (but not all) ports within the port aggregator are operationally down.

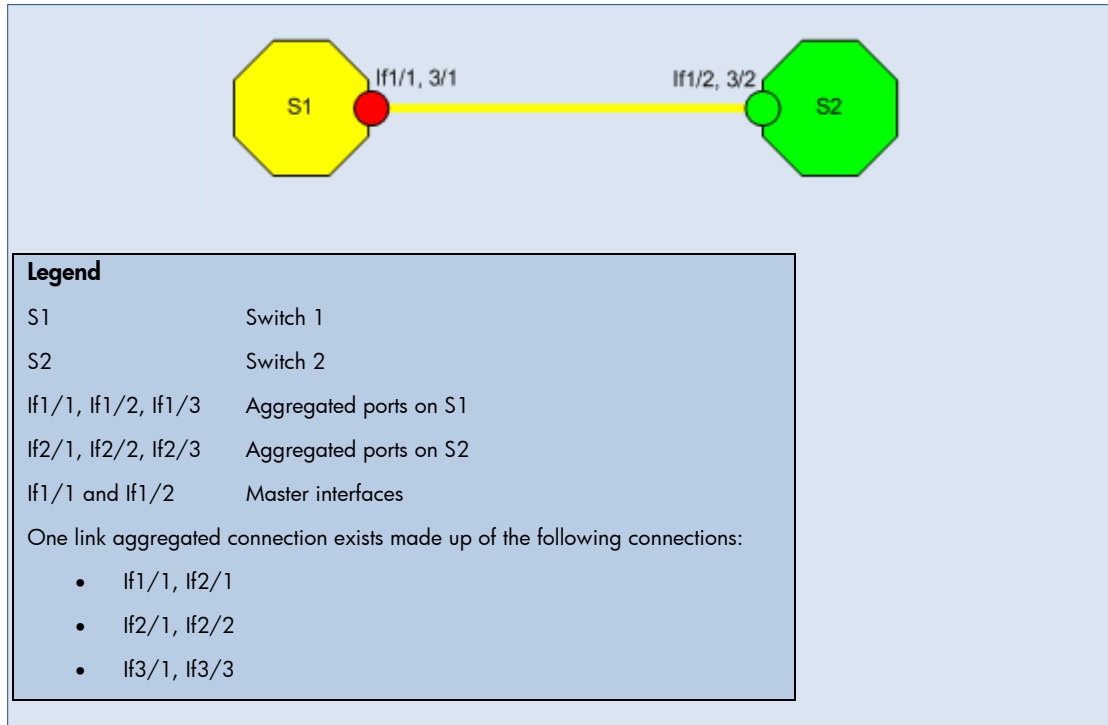
**Root Cause:** Operational states on some ports are down.

**Incident:** An `AggregatorDegraded` incident is generated.

**Status:** The status of the aggregator is set to Minor.

**Conclusion:** `AggregatorDegraded`

## Aggregator Is Down



**Scenario:** All ports within the port aggregator are operationally down.

**Root Cause:** Operational states on all ports are down.

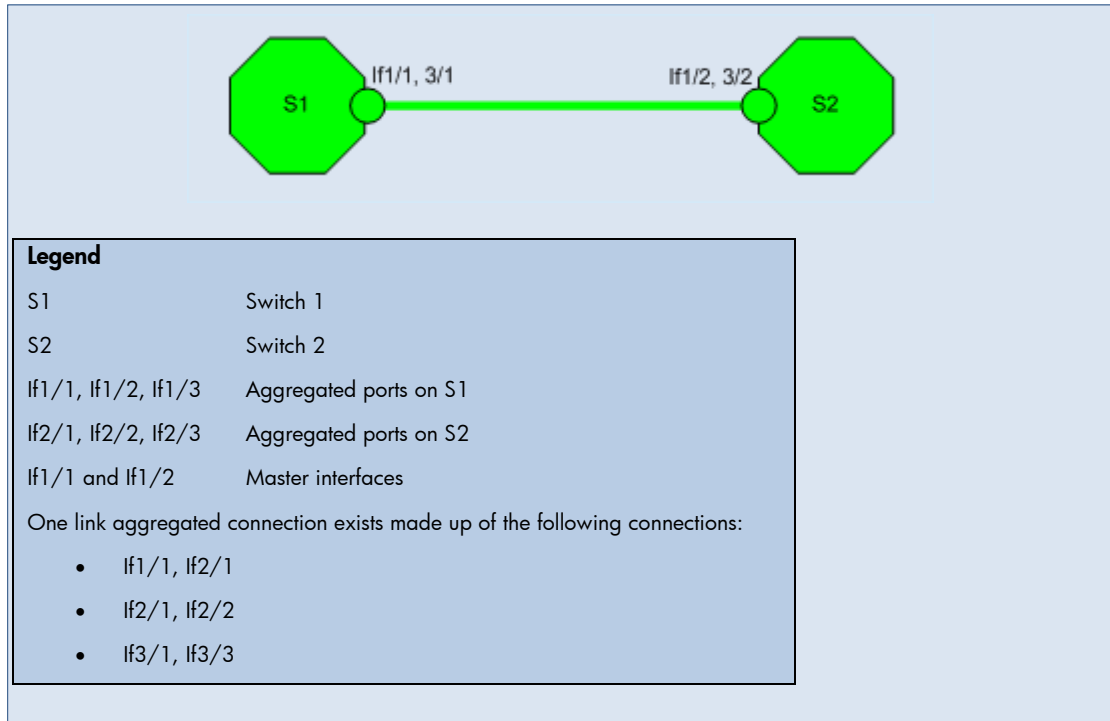
**Incident:** An `AggregatorDown` incident is generated.

**Status:** The status of the aggregator is set to Critical.

**Conclusion:** `AggregatorDown`

## Link Aggregated Connections (NNMi Advanced)

### Link Aggregated Connection Is Up



**Scenario:** All port aggregator members of the connection are up.

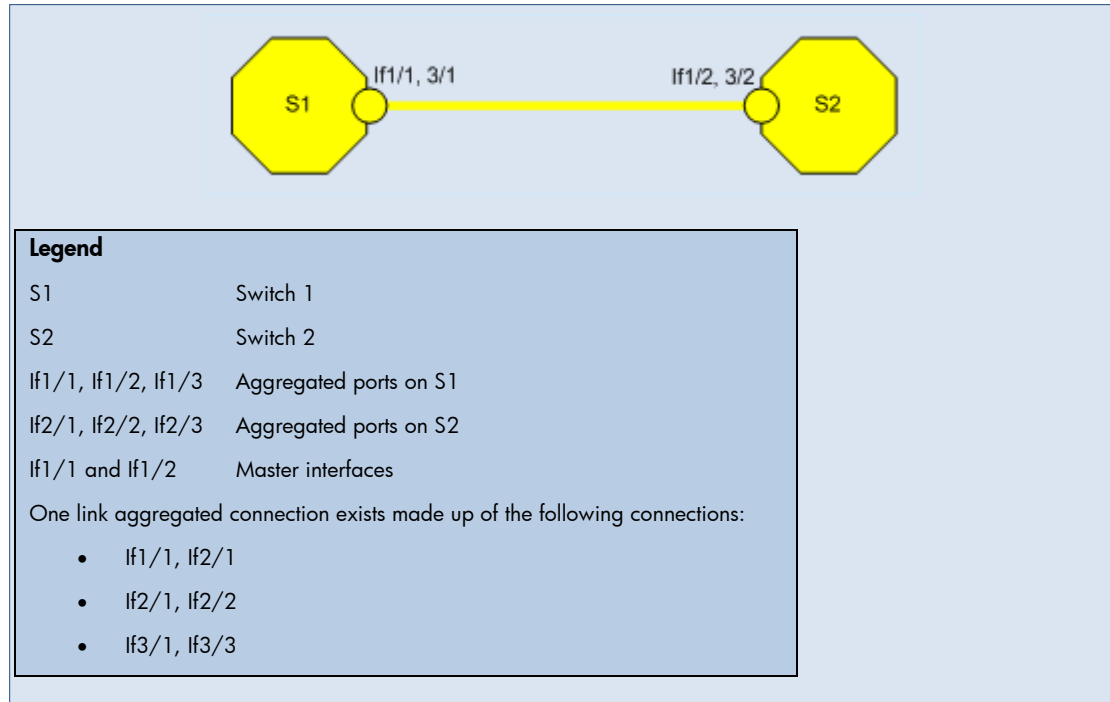
**Root Cause:** The aggregator is up on all members of the connection.

**Incident:** No incident is generated.

**Status:** The status of the aggregated connection is set to Normal.

**Conclusion:** AggregatorLinkUp

## Link Aggregated Connection Is Degraded



**Scenario:** Some (but not all) port aggregator members of the connection are down.

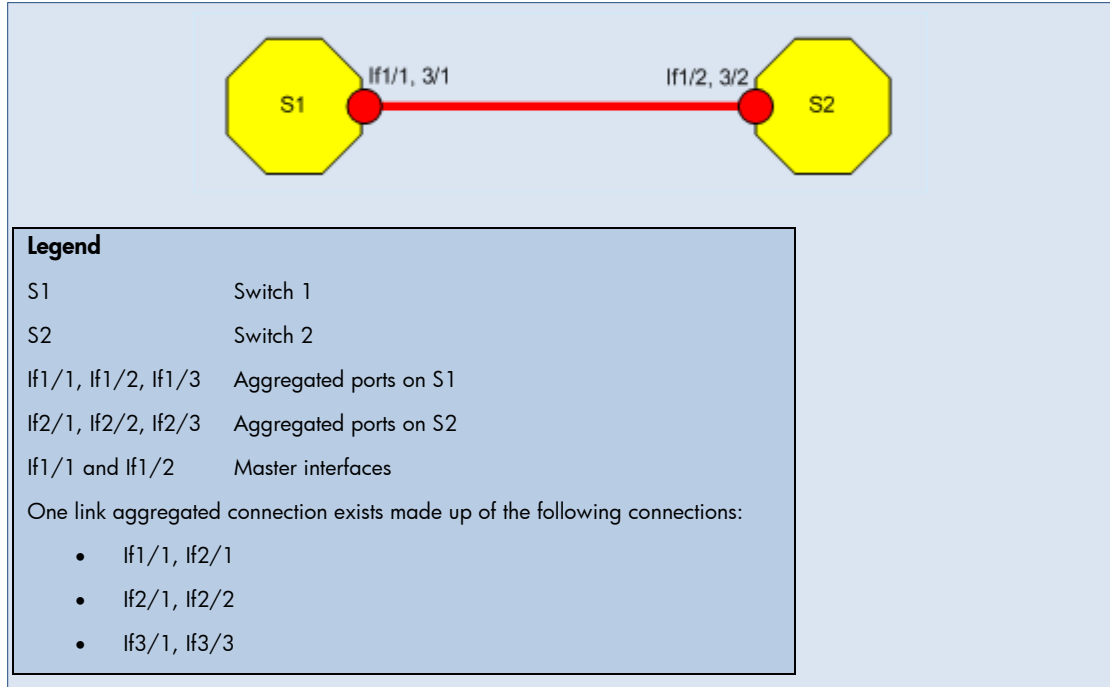
**Root Cause:** The aggregator is down on some members of the connection.

**Incident:** An `AggregatorLinkDegraded` incident is generated.

**Status:** The status of the aggregated connection is set to Minor.

**Conclusion:** `AggregatorLinkDegraded`

## Link Aggregated Connection Is Down



**Scenario:** All port aggregator members of the connection are down.

**Root Cause:** The aggregator is down on all members of the connection.

**Incident:** An `AggregatorLinkDown` incident is generated.

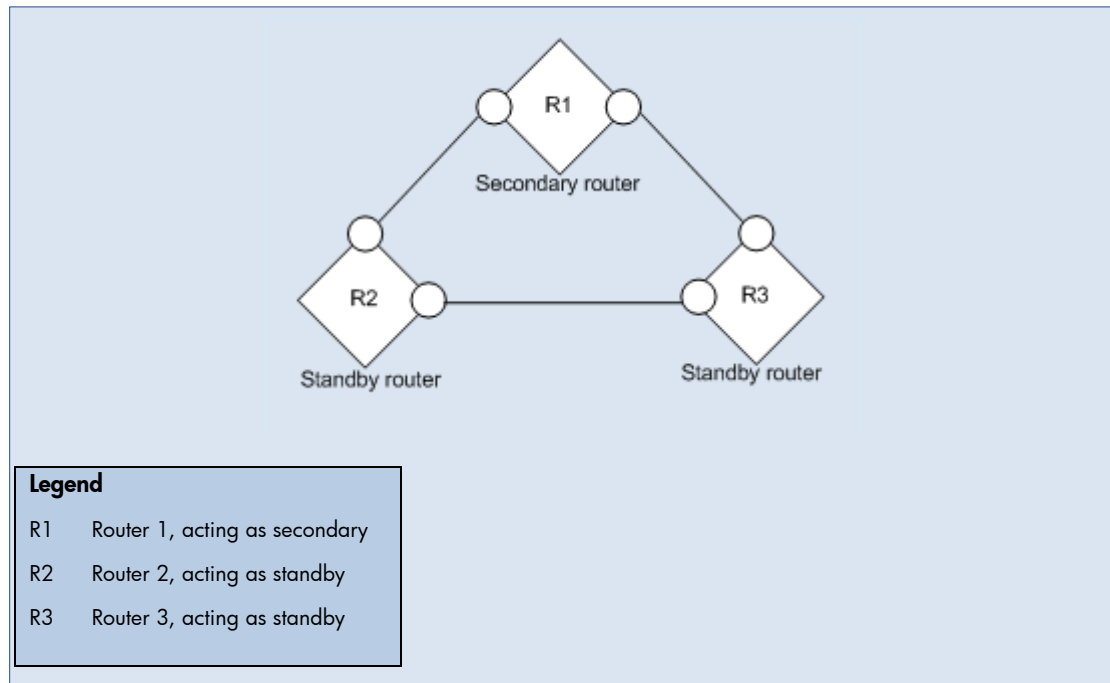
**Status:** The status of the aggregated connection is set to `Critical`.

**Conclusion:** `AggregatorLinkDown`



## Router Redundancy Groups: HSRP and VRRP (NNMi Advanced)

### Router Redundancy Group Has No Primary



**Scenario:** A Router Redundancy Group does not have a primary member. A properly functioning HSRP or VRRP Router Redundancy Group should have one operational primary router and one operational secondary router.

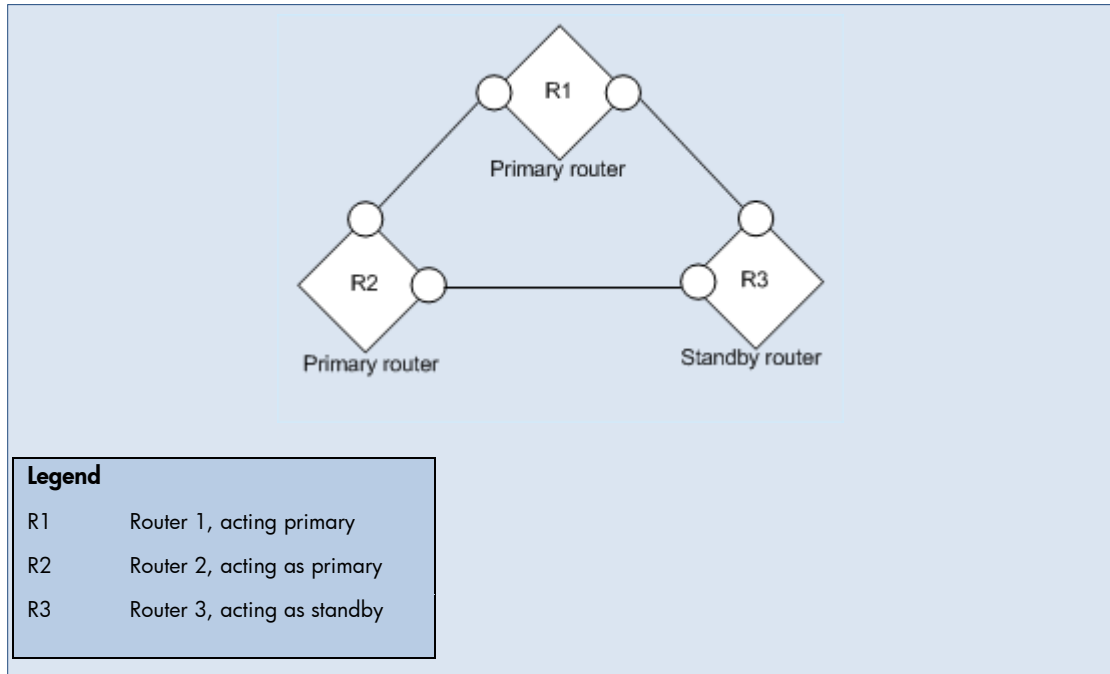
**Root Cause:** This scenario could be the result of an interface on the primary router failing, when the secondary was not active or a misconfiguration of the Router Redundancy Group.

**Incident:** An `RrgNoPrimary` incident is generated. If there is an identified root cause such as `InterfaceDown`, the `InterfaceDown` incident is correlated under the `RrgNoPrimary` incident as an Impact Correlation.

**Status:** The status of the Router Redundancy Group is set to `Critical`.

**Conclusion:** `RrgNoPrimary`

## Router Redundancy Group Has Multiple Primaries



**Scenario:** A Router Redundancy Group has multiple routers reporting as the primary router. A properly functioning HSRP or VRRP Router Redundancy Group should have only one operational primary router.

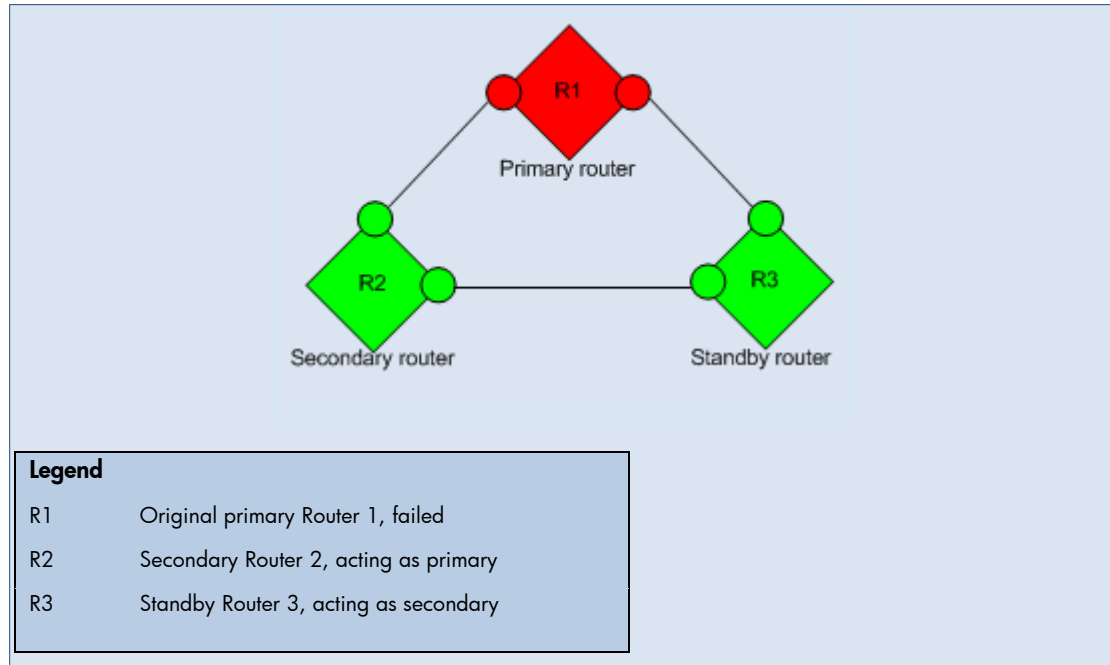
**Root Cause:** This scenario could be due to a faulty configuration of the Router Redundancy Group.

**Incident:** An `RrgMultiplePrimary` incident is generated. The `RrgMultiplePrimary` is affected.

**Status:** The status of the Router Redundancy Group is set to `Critical`.

**Conclusion:** `RrgMultiplePrimary`

## Router Redundancy Group Has Failed Over



**Scenario:** A Router Redundancy Group has had a failure on the primary router and the secondary router has taken over as primary. Usually the standby becomes the secondary, which is not a problem. The group is functioning as intended. The incident generated for this scenario is for informational purposes to report that the group has had a failover.

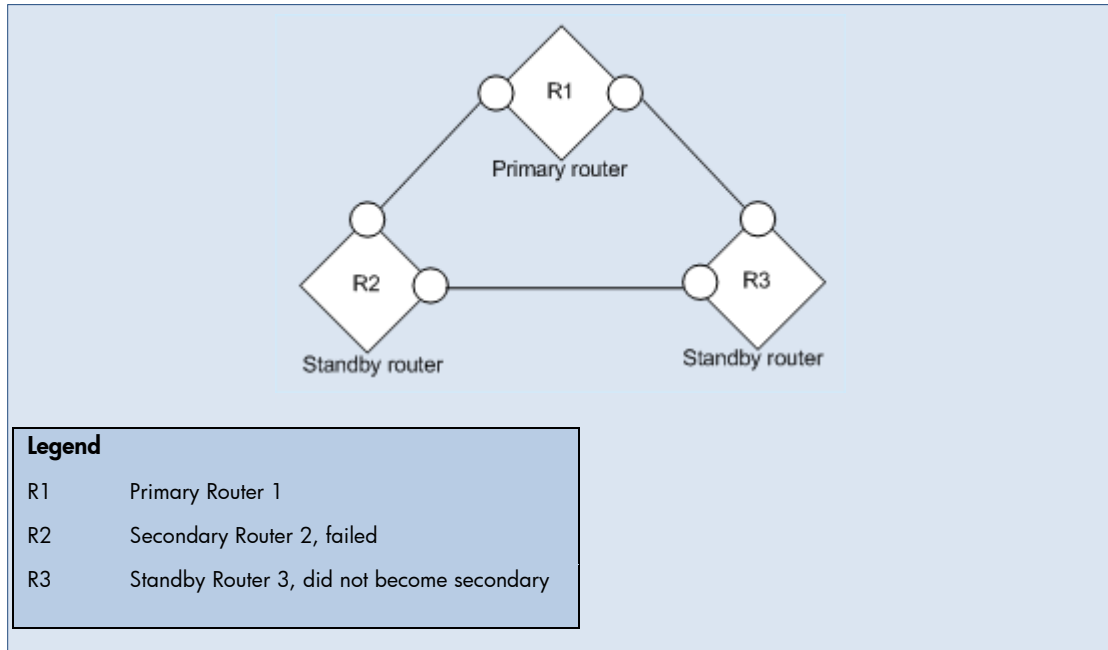
**Root Cause:** This scenario is most likely due to a failure on the primary router.

**Incident:** An `RrgFailover` incident is generated. The Correlation Nature of `RrgFailover` is Service Impact. If an identified root cause such as `InterfaceDown` exists, the `InterfaceDown` incident is correlated under the `RrgFailover` incident as an Impact Correlation.

**Status:** None.

**Conclusion:** `RrgFailover`

## Router Redundancy Group Has No Secondary



**Scenario:** A Router Redundancy Group has had a failure on the secondary router. Either there is no standby, or the standby did not take over as the secondary.

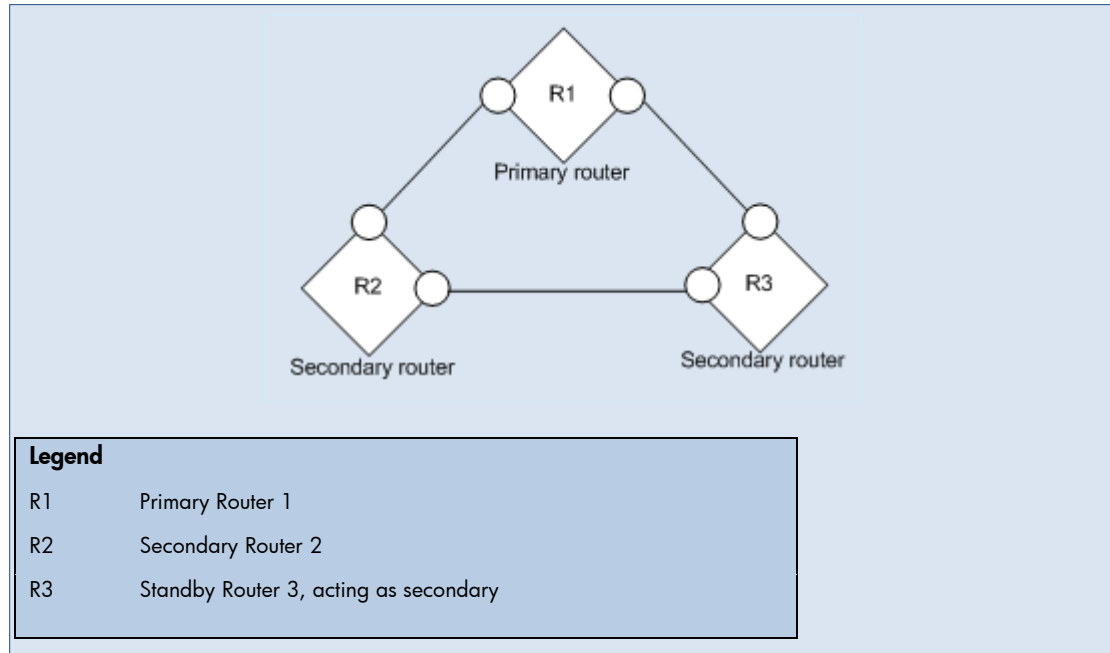
**Root Cause:** This scenario could be due to an interface failure on the router or some misconfiguration of the Router Redundancy Group.

**Incident:** An `RrgNoSecondary` incident is generated. The Correlation Nature of `RrgNoSecondary` is Service Impact. If an identified root cause such as `InterfaceDown` exists, the Correlation Nature between the `RrgNoSecondary` and `InterfaceDown` interfaces is Service Impact.

**Status:** The status of the Router Redundancy Group is set to Minor.

**Conclusion:** `RrgNoSecondary`

## Router Redundancy Group Has Multiple Secondaries



**Scenario:** A Router Redundancy Group has multiple routers reporting as the secondary router. A properly functioning HSRP or VRRP Router Redundancy Group should have only one operational secondary router.

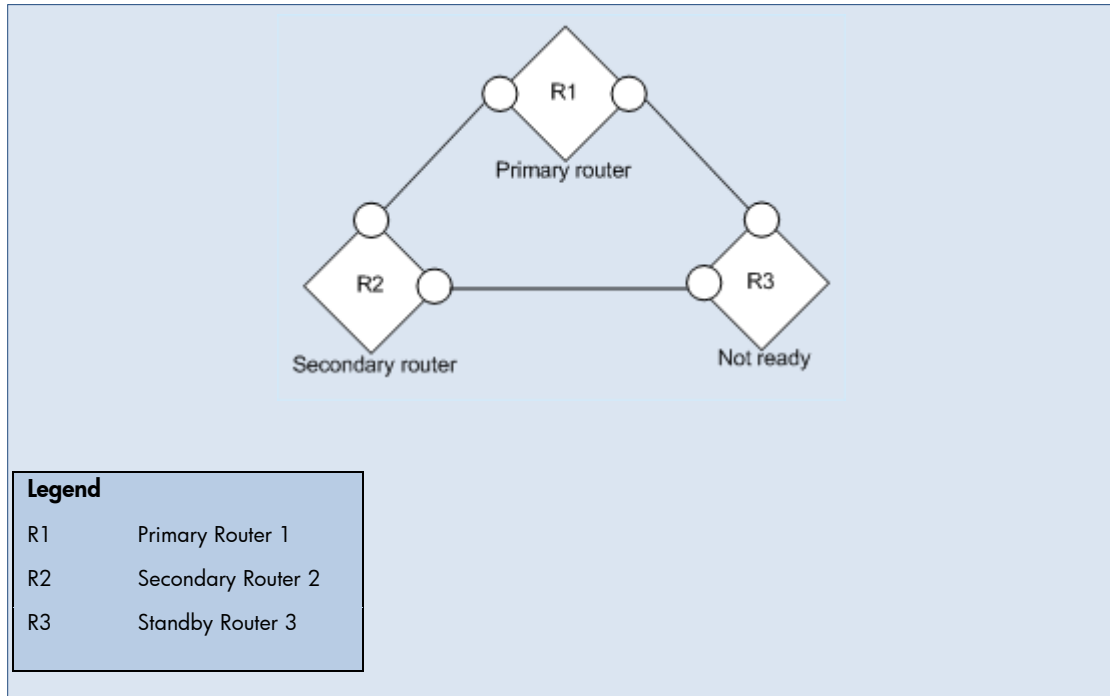
**Root Cause:** This scenario could be due to misconfiguration of the Router Redundancy Group.

**Incident:** An `RrgMultipleSecondary` incident is generated. The Correlation Nature of `RrgMultipleSecondary` is Service Impact.

**Status:** The status of the Router Redundancy Group is set to Minor.

**Conclusion:** `RrgMultipleSecondary`

## Router Redundancy Group Has Degraded



**Scenario:** The Router Redundancy Group has had some change. The group is functioning, and there are one primary router and one secondary router, but there is some non-normal condition that could be an issue. For example, there might be several routers not in a Standby state.

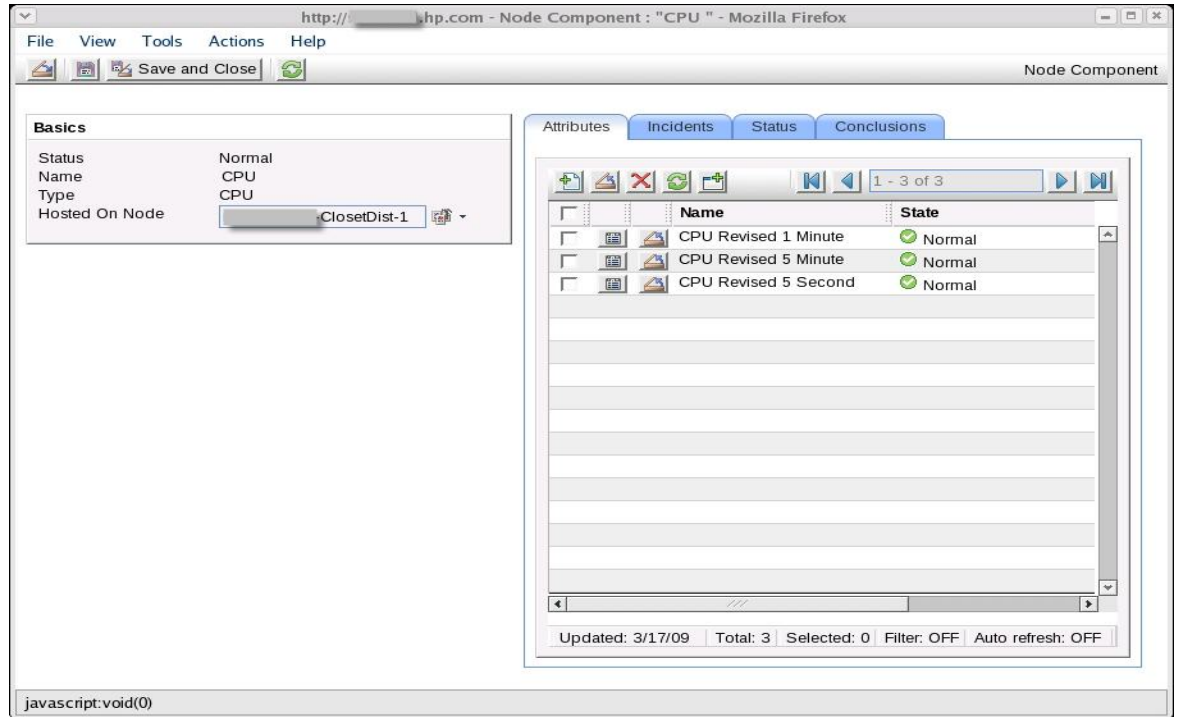
**Root Cause:** This scenario could be due to some misconfiguration of the Router Redundancy Group.

**Incident:** An `RrgDegraded` incident is generated. The Correlation Nature of `RrgDegraded` is Service Impact.

**Status:** The status of the Router Redundancy Group is set to Warning.

**Conclusion:** `RrgDegraded`

## Node Component Scenarios



### Fan Failure or Malfunctioning

**Scenario:** A fan sensor detects a failed fan in a chassis.

**Incident:** A `FanOutOfRangeOrMalfunctioning` incident is generated.

**Status:** The status of the fan sensor node component is Critical. A Minor status is propagated to the node.

**Conclusion:** `FanOutOfRangeOrMalfunctioning`

### Power Supply Failure or Malfunctioning

**Scenario:** A power supply sensor detects a failed power supply in a chassis.

**Incident:** A `PowerSupplyOutOfRangeOrMalfunctioning` incident is generated.

**Status:** The status of the power supply node component is Critical. The status of Minor is propagated to the node.

**Conclusion:** `PowerSupplyOutOfRangeOrMalfunctioning`

### Temperature Exceeded or Malfunctioning

**Scenario:** A temperature sensor detects a high temperature in a chassis.

**Incident:** A `TemperatureOutOfRangeOrMalfunctioning` incident is generated.

**Status:** The status of the temperature sensor node component is Critical.

**Conclusion:** `TemperatureOutOfRangeOrMalfunctioning`

## Voltage Out of Range or Malfunctioning

**Scenario:** A voltage sensor detects a voltage problem in a chassis.

**Incident:** A `VoltageOutOfRangeOrMalfunctioning` incident is generated.

**Status:** The status of the voltage sensor Node Component is Critical.

**Conclusion:** `VoltageOutOfRangeOrMalfunctioning`

## Buffer Utilization Exceeded or Malfunctioning (NNM iSPI for Performance)

**Scenario:** The device operating system detects a problem with buffer utilization.

**Incident:** A `BufferOutOfRangeOrMalfunctioning` incident is generated.

**Status:** The status of the buffer Node Component is Critical.

**Conclusion:** `BufferOutOfRangeOrMalfunctioning`

## CPU Utilization Exceeded or Malfunctioning (NNM iSPI for Performance)

**Scenario:** A CPU sensor in a chassis detects a CPU utilization problem.

**Incident:** A `CpuOutOfRangeOrMalfunctioning` incident is generated.

**Status:** The status of the CPU Node Component is Critical.

**Conclusion:** `CpuOutOfRangeOrMalfunctioning`

## Memory Utilization Exceeded or Malfunctioning (NNM iSPI for Performance)

**Scenario:** A memory sensor detects a memory problem.

**Incident:** A `MemoryOutOfRangeOrMalfunctioning` incident is generated.

**Status:** The status of the memory sensor node component is Critical.

**Conclusion:** `MemoryOutOfRangeOrMalfunctioning`



## Network Configuration Changes

During the span of a day, a network operator might complete several configuration changes. The following scenarios illustrate some common network configuration changes and show how NNMi responds to these changes.

### - Node updated

Suppose that a network operator modifies a node: for example, by swapping a failed interface board with a working replacement. When NNMi notices this change, the discovery process sends a notification to the `NmsApa` service. The `NmsApa` service completes the following tasks:

- Recalculate the status of the node.
- Close all registered incidents for the deleted IP addresses and interfaces on the node.

### - Interface moves to and from connections

Suppose that a network operator changes the way network devices are connected. When an interface joins a connection or leaves one connection to join another, the NNMi discovery process sends a notification to the `NmsApa` service. The `NmsApa` service recalculates the status of the connection.

### - Device-generated traps

**ColdStart** and **WarmStart** traps — The `NmsApa` service subscribes to notifications from the Events system for `ColdStart` and `WarmStart` traps. These notifications trigger the `NmsApa` service to initiate a rediscovery of device information from the node that generated the trap.

**LinkUp** and **LinkDown** traps — The `NmsApa` service subscribes to notifications from the Events system for `LinkUp` and `LinkDown` traps, as well as for some vendor-specific link traps. These notifications trigger the `NmsApa` service to initiate a rediscovery of device information from the node that generated the trap.

**NOTE:** For a complete list of the trap incident configurations that NNMi provides, see the NNMi help or select the **SNMP Trap Configuration** tab from the **Incident Configuration** view.

## NNMi Management Configuration Changes

During the span of a day, an NNMi administrator might complete several NNMi configuration changes. The following scenarios illustrate some common NNMi management configuration changes and show how NNMi responds to these changes.

- NNMi administrator does not manage an IP address or puts it out-of-service

The `NmsApa` service receives a notification from `StatePoller` after the `pingState` is set to `Not Polled`. The `NmsApa` service sets the status of the IP address to `No Status`.

- NNMi administrator manages an IP address or puts it back in service

The `NmsApa` service receives a notification from `StatePoller` after the `pingState` is set to the measured value. The `NmsApa` service calculates the status of the IP address based upon the measured value.

- NNMi administrator does not manage an interface or puts it out-of-service

The `NmsApa` service receives a notification from `StatePoller` after the `operState` is set to `Not Polled`. The `NmsApa` service sets the status of the interface to `No Status`.

- NNMi administrator manages an interface or puts it back in service

The `NmsApa` service receives a notification from `StatePoller` after the `operState` is set to the measured value. The `NmsApa` service calculates the status of the interface based upon the measured value.

- NNMi administrator does not manage a node or puts it out-of-service

The `NmsApa` service receives a notification from `StatePoller` after the `agentState` is set to `Not Polled`. `operState` is set to `Not Polled` for all interfaces, and `pingState` is set to `Not Polled` for all IP addresses. The `NmsApa` service sets the status of the node to `No Status`.

- NNMi administrator manages a node or puts it back in service

The `NmsApa` service receives a notification from `StatePoller` after the `agentState` is set to the measured value. `operState` is set to the measured value for all interfaces, and `pingState` is set to the measured value for all IP addresses. The `NmsApa` service calculates the status of the node.

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