Test Methodology Journal

Definitive Guide to Carrier Ethernet Testing

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## Link-OAM

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Validating Link-OAM Discovery

Associated Standard

- IEEE 802.3ah

Objective

This test will validate the DUT’s ability to process and handle Link-OAM Discovery.

Overview

Two Spirent TestCenter™ ports will be used. Each port will be configured with a Link-OAM router. Each router will be started. Ensure Link-OAM enters the completed state.

Setup
1. Launch Spirent TestCenter™ and reserve the required ports for the test.

![Select Ports Window](image1)

2. Press the “Technologies...” button to open the Technology Selector window.

![Technology Selector Window](image2)
3. Once the Technology Select window opens, scroll down to Routing and select Link-OAM.

4. Rename the two ports to Network and Client. Also, uncheck the “Append Location to Port Name” check box.
5. Select All Routers ➔ Add to launch the Router Wizard.

6. Once the Router Wizard has launched, select both ports and press Finish. There is no need for additional protocols, VLANs or configuration of IP Addresses since Link-OAM is a Layer 2 protocol.
7. Two routers should be created, one on each port. Select the Link-OAM tab and activate both routers.

8. Select the “Start All Routers” button and make sure Local State changes to COMPLETED.

9. It is also possible to use pause the Link-OAM state machine at different places using Spirent TestCenter. To perform tests using the state machine, the Command Sequencer must be used. To use the Command Sequencer, select the Sequencer button.
10. In the Command Sequencer, select the Edit Sequence button.
11. Use the Command Category Filter to select Link-OAM. Next, select Link-OAM: Start Link-OAM and press the right arrow to add the command to the sequence.
12. Double-click the newly added command to open the Command Editor Window. Notice at the bottom of the Command Editor the “Pause at:” drop down menu. This menu contains options to pause Link-OAM discovery at: Fault, Active Send/Passive Wait, Send Local Remote, Send Local Remote OK, Send Any and None. Select the appropriate choice depending where Link-OAM Discovery should pause. When using the Link-OAM state machine during tests, verify with the DUT the correct state has been reached.
Validating Link-OAM Loopback Messages

Associated Standard
- IEEE 802.3ah

Objective
This test will validate the DUT’s ability to process and handle Link-OAM Loopback Messages.

Overview
Two Spirent TestCenter™ ports will be used. Each port will be configured with a Link-OAM router. Traffic will then be configured for transmission from the Network port to the Client port. Once traffic has successfully verified to be transmitted, a loopback message will be sent from the Network port. This should cause all the Network ports to also receive the transmitting data.

Setup
1. Launch STC and reserve the required ports for the test.

2. Press the “Technologies...” button to open the Technology Selector window.
3. Once the Technology Select window opens, scroll down to Routing and select Link-OAM.

4. Rename the two ports to Network and Client. Also, uncheck the “Append Location to Port Name” check box.
5. Select All Routers → Add. This will cause the Router Wizard to be launched.

![Spirent TestCenter Test Configuration](image)

6. Once the Router Wizard has launched, select both ports and press Finish. There is no need for additional protocols, VLANs or configuration of IP Addresses since Link OAM is a Layer 2 protocol.

![Spirent TestCenter Router Wizard](image)
7. Two routers should be created, one on each port. Select the Link-OAM tab and then activate both routers.

8. Select the “Start All Routers” button and make sure Local State changes to COMPLETED.

9. Select Network → Traffic Generator and use the Add drop down menu to select “Add Raw Stream Block”.

10. Select the Frame tab when Stream Block Editor appears.
12. Select the “Load per streamblock” radio button and use the drop down menu to select Rate based.

13. Set the Load to 100 and use the Load Unit drop down menu to select Kbps.

14. Next, start transmitting the traffic by selecting the “Start Traffic” button.

15. Change Results views to Router Protocols → Link-OAM Results and Port Traffic → Basic Traffic Results. To change the view, use the Change Result View drop down menu to select the appropriate view.

16. On the Port Traffic → Basic Traffic Results view, verify traffic is being sent from Network to Client at about 100 kbps.
17. Select Network → Routers → Link-OAM.

<table>
<thead>
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<th>Router Interface</th>
<th>Add...</th>
<th>Delete</th>
<th>Edit</th>
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<td>Spirent TestCenter</td>
<td>Link-OAM</td>
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<td>All Ports</td>
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<tr>
<td>All Routers</td>
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<tr>
<td>All Hosts</td>
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<tr>
<td>All Traffic Generators</td>
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<tr>
<td>All Stream Blocks</td>
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<td>All Traffic Analyzers</td>
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<td>Ports</td>
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<tr>
<td>Routes</td>
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</tr>
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</table>
18. Right-click and select Link-OAM → Start Loopback.

19. On the Port Traffic → Basic Traffic Results, verify traffic is being only received on the Network port.
20. Verify the Network port's Remote Parser Action is set to LB under the Link-OAM Results view.

21. Right-click and select Link-OAM ➔ Stop Loop Back.
22. Verify traffic is being forwarded as expected under the Port Traffic → Basic Traffic Results.

<table>
<thead>
<tr>
<th>Port Name</th>
<th>Total Tx Count (Frames)</th>
<th>Total Rx Count (Frames)</th>
<th>Total Tx Rate (bps)</th>
<th>Total Rx Rate (bps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>60,667</td>
<td>42,637</td>
<td>87,544</td>
<td>2,608</td>
</tr>
<tr>
<td>Client</td>
<td>709</td>
<td>20,417</td>
<td>504</td>
<td>87,552</td>
</tr>
</tbody>
</table>

23. Verify the Network port’s Remote Parser Action is set to FWD under Router Protocols → Link-OAM Results.

<table>
<thead>
<tr>
<th>Port Name</th>
<th>Router Name</th>
<th>Remote Link Fault</th>
<th>Remote Multiplexer Action</th>
<th>Remote Parser Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>Router 1</td>
<td>OFF</td>
<td>FWD</td>
<td>FWD</td>
</tr>
<tr>
<td>Client</td>
<td>Router 2</td>
<td>OFF</td>
<td>FWD</td>
<td>FWD</td>
</tr>
</tbody>
</table>

24. If no issues or errors were encountered while performing the above Link-OAM Loopback test, then the DUT is able to process and handle Link-OAM Loopback messages appropriately. If any trouble was encountered while performing the test, make sure the DUT has been correctly configured and that it supports Link-OAM.
Validating Link-OAM Dying Gasp

Associated Standard
- IEEE 802.3ah

Objective
Validate the DUT is able to process a Dying Gasp message and end the current session. Once the session has successfully been terminated, the link will try to be restored.

Overview
Two Spirent TestCenter™ ports will be used and a Link-OAM router on each port will be created. One of the Link-OAM routers will be stopped to verify that a Dying Gasp has been sent and processed correctly.

Setup

![Diagram showing network, DUT, and client with Dying Gasp message]
1. Launch Spirent TestCenter™ and reserve the required ports for the test.

2. Press the “Technologies...” button to open the Technology Selector window.
3. Once the Technology Select window opens, scroll down to Routing and select Link-OAM.

4. Rename the two ports to Network and Client. Also, uncheck the "Append Location to Port Name" check box.
5. Select All Routers → Add to launch the Router Wizard.

6. Once the Router Wizard has launched, select both ports and press Finish. There is no need for additional protocols, VLANs or configuration of IP Addresses since Link-OAM is a Layer 2 protocol.
7. Two routers should be created, one on each port. Select the Link-OAM tab and activate both routers.

8. Select the “Start All Routers” button and make sure that Local State changes to COMPLETED.

9. After the routers have successfully been started, stop the router on the Network port. Do this by selecting Network → Routers → Link-OAM and the stop router button.
10. In the Router Protocols → Link-OAM Results view, verify a Dying Gasp message has been sent.

<table>
<thead>
<tr>
<th>Port Name</th>
<th>Router Name</th>
<th>Dying Gasp Tx</th>
<th>Dying Gasp Rx</th>
<th>Link Fault Tx</th>
<th>Link Fault Rx</th>
<th>Multiplexer Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>Router 1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>PWD</td>
</tr>
<tr>
<td>Client</td>
<td>Router 2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>PWD</td>
</tr>
</tbody>
</table>

11. Login to the DUT and verify within the DUT that the Dying Gasp has been received and correctly processed (if DUT supports this ability).

12. Restart the router and make sure the Local State changes to COMPLETED again.

<table>
<thead>
<tr>
<th>Port Name</th>
<th>Router Name</th>
<th>Local State</th>
<th>Critical Event</th>
<th>Dying Gasp</th>
<th>Link Fault</th>
<th>Critical Event Tx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>Router 1</td>
<td>COMPLETED</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>0</td>
</tr>
<tr>
<td>Client</td>
<td>Router 2</td>
<td>COMPLETED</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>0</td>
</tr>
</tbody>
</table>
## EOAM

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<tr>
<td>Validating EOAM Link-Trace Messages</td>
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</table>
Validating EOAM Connectivity Check Messages

Associated Standard
- IEEE 802.1ag

Objective
This test will validate the DUT's ability to process, handle and transmit EOAM Connectivity Check (CC) Messages.

Overview
A single Spirent TestCenter™ port will be used. The port should be connected to a port on the DUT that is transmitting CC messages. The Spirent TestCenter port will verify that it is correctly receiving the CC messages by monitoring CC message statistics and by performing a capture and then looking at the decode.

Setup
1. Launch Spirent TestCenter and reserve the required port.

2. Select the Wizards button. If Routing/EOAM/MA-MEG Generator is in the quick select menu then select this option and skip to step 4.

4. Select the only port and press Next.
5. Assign the DUT as MEP, press Next to continue.
6. Change the “Operation mode” to IEEE, press Next to continue.
7. Change the Number of MIPs per MEP to 1. As we are not concerned with the topology uncheck “Show preview after completion” and press Finish.
8. Once the port has been reserved, press the apply button. This should bring the port online and the port should start to receive CC messages.

9. The Results View should appear once apply has completed. Change one of the views to Port Traffic \(\rightarrow\) Basic Traffic Results and change the other view to Router Protocols \(\rightarrow\) EOAM Results \(\rightarrow\) CC Results. If either of the views needs to be updated, use the Change Result View drop down menu.

10. Once the view has been correctly changed, verify that frames are being received on the port in the Port Traffic \(\rightarrow\) Basic Traffic Results view.

11. Under the Router Protocols \(\rightarrow\) EOAM Results \(\rightarrow\) CC Results view verify that the frames being received are CC Messages.
12. If frames are being received, and debugging on any sort needs to be done, one can use the capture: select Port → Capture.

![Test Configuration](image)

13. Press the Start button to perform a capturing of frames on the port.

![Start](image)

14. Wait several seconds for frames to be captured and press the Stop button.

![Stop](image)

15. Verify frames have been captured.

![Statistics](image)
16. To view the captured frames, press the View button. If no decoder has been set, you will be prompted to configure the decoder; if this has already been done the decoder will automatically launch.

17. Once the decoder has launched, verify that CCM messages have been received on the port.

18. Select one of the CCM messages and expand the header fields and verify the CCM is correctly configured as expected.
Validating EOAM Loopback Messages

**Associated Standard**
- IEEE 802.1ag

**Objective**
This test will validate the DUT's ability to process and handle EOAM Loopback Messages.

**Overview**
Two Spirent TestCenter™ ports will be used. Each port will be configured with an EOAM router. Traffic will then be configured for transmission from the Network port to the Client port. Once traffic has successfully verified to be transmitted, a loopback message will be sent from the Network port. This should cause all the Network ports to receive the transmitting data.

**Setup**

![Diagram of setup](image)
1. Launch Spirent TestCenter and reserve the required ports.

2. Select the Wizards button.

4. Select both ports and press Next to continue.
5. Depending on your DUT's configuration, select the correct way to use the DUT (MIP or MEP). Next, configure the DUT MAC address and DUT MEP ID (if required). Press Next to continue.
6. Set the Number of IDs to a value of 5. Also, if you wish, update the “Levels for each ID set”. Changing these values will provide for a more interesting topology for this test. Press Next once completed.
7. Change the Number of MIPs per MEP to 30. Also, configure the VLANs as required to work with the DUT. Finally, make sure “Show preview after completion” is enabled. Press Finish.
8. The preview should appear, verify that everything is correctly configured and press Close. If needed, rerun the Wizard to redo the configuration.

9. Before any of the EOAM messages can be sent, change the Results View to Router Protocols → EOAM Results → LB Results. If the view needs to be changed, use the Change Result View drop down menu to do so.
10. Select All Routers ➔ EOAM tab. This will display all the newly created EOAM routers.

11. Use the Start drop down menu and select Loopback.

12. Select the correct “Loopback message type”; in this case, we are going to use Unicast though tests should be performed with both message types. Next, select the correct source and the desired MAC target. Once both ends have been selected, press the “Add Pair” button. Multiple pairs can be added. When completed, press OK.
13. Make sure the LB Message was sent and received.

<table>
<thead>
<tr>
<th>MP Name</th>
<th>LB Message Rx Count</th>
<th>LB Response Tx Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 178</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MP 179</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MP 180</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MP 181</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MP 182</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MP 183</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MP 184</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MP 185</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MP 186</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

14. Next, select the Loopback Detailed Results button.
15. In the detailed view, a great deal of information can be obtained. Notice the listing of MPs and the ability to see the Requestors and Responders.

16. Select the MP that was the source of the Loopback message. Note: Under the Requestors tab, it shows the MAC Address of where the Loopback message was sent, and then also shows the MAC Address of who responded. In this case, the MAC addresses are the same.
17. Select the MP that was the destination and then select the Responders tab. Notice the Message Rx Source Address is the MAC Address of the MP which sent the Loopback Message, and the Response Tx Destination Address is also the same MAC Address to which a replay was sent.

18. Other more complex tests can be accomplished. By increasing the number of MIPs from 30 to 254, the MA/MEG ID value can also be increased. Changing these values will create a different topology that will change the results of the test.
Validating EOAM Link-Trace Messages

**Associated Standard**
- IEEE 802.1ag

**Objective**
This test will validate the DUT’s ability to process and handle EOAM Loopback Messages.

**Overview**
Two Spirent TestCenter™ ports will be used. Each port will be configured with an EOAM router. Once each router has been configured, a link-trace message will be transmitted. A reply should be received from the end node and each hop between.

**Setup**
1. Launch Spirent TestCenter and reserve the required ports.

2. Select the Wizards button.

4. Select both ports and press Next to continue.
5. Depending on your DUT's configuration select the correct way to use the DUT (MIP or MEP). Next, configure the DUT MAC address and DUT MEP ID (if required). Press Next to continue.
6. Set the Number of IDs to a value of 5. Also, if you wish, update the “Levels for each ID set”. Changing these values will provide for a more interesting topology for this test. Press Next once completed.
7. Change the Number of MIPs per MEP to 30. Also, configure the VLANs as required to work with the DUT. Finally, make sure “Show preview after completion” is enabled. Press Finish.
8. The preview should appear, verify that everything is correctly configured and press Close. If needed, rerun the Wizard to redo the configuration.

9. Before any of the EOAM messages can be sent, change the Results View to Router Protocols $\rightarrow$ EOAM Results $\rightarrow$ LT Results. If the view needs to be changed, use the Change Result View drop down menu to do so.
10. Select All Routers ➔ EOAM tab. This will display all the newly created EOAM routers.

11. Use the Start drop down menu and select Link-Trace.

12. Select the correct “Link-Trace message type”; in this case, we will use Unicast but feel free to also perform tests with Multicast messages. Next, select a MEP source and a MAC target. Once both have been selected, press the Add Pair button. Repeat for as many pairs as needed. Press OK once completed.
13. Make sure the LT Message was sent and received.

14. Next, select the Link-Trace Detailed Results button.

15. This view will provide a great deal of information. On the left is a listing of all the MPs. By selecting a certain MP, it is possible to view the Requestors, Responders and the Link-Trace Path.
16. To view the Link-Trace path, select the Link-Trace Path tab. Also, notice most of the MPs are grayed out. Only certain ones are not – these are the ones for viewing the Link-Trace Path.

17. Notice after selecting a MP that has a Link-Trace path, more information is shown as to the exact MAC Address of the targeted router.
18. Select the “View path” button.

19. Notice the entire path is now visible with detailed information about the path. Verify the path provided is correct.

20. More complex tests can be accomplished. Increasing the number of MIPs from 30 to 254, the MA/MEG ID value can also be increased. Changing these values will create a different topology that will change the results of the test.
Spirent Communications is a worldwide provider of integrated performance analysis and service assurance systems for next-generation network technologies.

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