

Changes to OAM sublayer

1. Parser: add action parameter from OAM client
2. Multiplexer: add action parameter from OAM client
3. Add action and loopback time to OAM_Information TLV (new state information)
4. Change 55.4 (see below)
5. Add PICS entries

Changes to 55.4

55.4 OAM loopback

OAM provides a data link layer frame-level loopback mode, which is controlled remotely. Loopback is used to test the performance of a link. ~~During loopback, a device is permitted to send variable-length frames with varying data fields.~~ Statistics from both the local and remote device can be queried and compared at any time while the remote device is in OAM loopback mode. These queries can take place before, during or after loopback frames have been sent to the remote device. In addition, an implementation may analyze loopback frames to determine additional information about the health of the link (i.e. determine which frames are being dropped due to link errors). Figure 55-3 shows the path of frames traversing the layer stack of both the local and remote devices.

55.4.1 Initiating OAM loopback

To initiate remote loopback, the local MAC Client stops sending data frames to the remote device and the local OAM Client sets its action parameter to DISCARD. The local OAM Client sends a Loopback Control OAMPDU (See 55.6.3.3) with a non-zero loopback time. Within one second of receiving the Loopback Control OAMPDU, the remote OAM Client first sets the action parameter via the OAM_CTL.request primitive to LOOPBACK, and then sends an Information OAMPDU with updated state information reflecting the non-zero loopback timer value and its action set to LOOPBACK.

55.4.2 During OAM loopback

This subclause elaborates on Figure 55–3 and describes the flow of frames within the local and remote devices and across the link during loopback mode. While in loopback mode:

1. The local device transmits frames from the MAC Client and OAMPDUs sourced by the local OAM Client or OAM Control.
2. Within the remote OAM sublayer entity, every non-OAMPDU is looped back.
3. OAMPDUs received by the remote device are passed to the remote OAM Client.
4. The remote device is permitted to send OAMPDUs to the local device.
5. Frames received by the local device are parsed by the OAM sublayer. OAMPDUs are passed to the OAM client and all other frames are discarded.

55.4.3 Extending OAM loopback

At any time, the local OAM client may extend the duration of the OAM loopback test. The local OAM client sends a Loopback Control OAMPDU with a non-zero loopback time. Within one second of receiving the Loopback Control OAMPDU, the remote OAM client sends an Information OAMPDU with updated state information reflecting the new non-zero loopback timer value and its action set to LOOPBACK.

55.4.4 Exiting OAM loopback

When the local device wishes to end the OAM loopback test, the local MAC client stops sending frames. The local OAM client then sends a Loopback Control OAMPDU with a zero loopback timer.

Within one second of receiving a Loopback Control OAMPDU with a zero loopback time, the remote OAM client first sends an Information OAMPDU with updated state information reflecting the zero loopback timer value and action set to FORWARD and then sets the action parameter via the OAM_CTL.request primitive to FORWARD. After receiving an Information OAMPDU with a zero loopback time value and action set to FORWARD, the local OAM client sets its action parameter to FORWARD and resumes sending MAC Client frames.

55.4.5 Expiration of the loopback timer

It is possible for the remote OAM client's loopback timer to expire prior to receiving a Loopback Control OAMPDU with a zero loopback time. Within one second of the loopback timer expiring, the remote OAM client sets its action parameter via the OAM_CTL.request primitive to DISCARD and then sends an Information OAMPDU with updated state information reflecting the zero loopback timer value and action set to DISCARD. After receiving an Information OAMPDU with zero loopback timer value and action set to DISCARD, the local OAM client may elect to either resume the OAM loopback test, following the steps outlined in 55.4.1 or end the OAM loopback test, following the steps contained in 55.4.4.

55.4.6 Loss of OAMPDUs during OAM loopback

There is the possibility of OAMPDU loss both before, during and after OAM loopback tests. Of particular interest to the operation of OAM loopback is the loss of Loopback Control OAMPDUs and Information OAMPDUs. The local OAM client is able to determine whether or not the remote OAM client received Loopback Control OAMPDUs by examining all received Information OAMPDUs. Since Information OAMPDUs are continually sent to keep the OAM link alive, the occasional loss of an Information OAMPDU should not adversely impact the operation of OAM loopback mode.

Discovery process

If the quality of link degrades to the point that no OAMPDUs are received by the local OAM client for a period exceeding the `lost_link_timer`, the local OAM client will reset its Discovery process and send this updated state to the remote device via the Information OAMPDU. The remote OAM client, upon detecting UNSTABLE without a remote OAM_Information TLV from the local device, sets action to FORWARD and clears loopback timer to zero.

If the quality of the link degrades to the point that no OAMPDUs are received by the remote OAM client for a period exceeding the `lost_link_timer`, the remote OAM client will reset its Discovery process. Passive remote devices will then wait until the local Active device resumes sending Information OAMPDUs thus initiating the Discovery process, setting action to FORWARD and clearing loopback timer to zero.

55.4.7 Loss of test frames during OAM loopback

While the link is operating in loopback mode, MAC Client frames originating from the remote device are not transmitted by the subordinate OAM sublayer. Depending upon the remote device's implementation of loopback, not every frame received is guaranteed to be looped back to the local device. Clock differences between the local and remote devices may also be a source of lost frames, as the delta in the rate of frames transmitted and received may overrun buffers within either device. As always, frames that incur errors during transit will be dropped by the MAC sublayer receiving the frame. Also, OAMPDUs inserted by the remote device impacts the bandwidth available to loopback frames. Implementations should take into account the topology (i.e. point-to-multipoint, asymmetrical links) when determining the rate at which to send frames during loopback.

Loopback frames that are discarded by the OAM sublayer within the remote device will be counted. This counter will aid in determining the health of the link by distinguishing between frames discarded due to link errors and those discarded within the OAM sublayer.

55.4.8 Timing considerations for OAM loopback

For effective OAM loopback operation, it is necessary to place an upper bound on the response time of the remote OAM client after receiving Loopback Control OAMPDU.

Reception of a Loopback Control OAMPDU shall not effect the transmission of a frame that has been submitted by the OAM sublayer to the subordinate sublayer (i.e., the MAC's TransmitFrame function is synchronous, and is never interrupted).

Within one second of receiving a Loopback Control OAMPDU with a non-zero loopback time, the remote OAM Client:

1. Sets the action parameter via the OAMPDU_CTL.request primitive to LOOPBACK
2. Sends an Information OAMPDU with updated state information reflecting the non-zero loopback timer value and its action set to LOOPBACK.

Within one second of its loopback_timer expiring, the remote OAM client:

1. Sets the action parameter via the OAMPDU_CTL.request primitive to DISCARD
2. Sends an Information OAMPDU with updated state information reflecting the loopback_timer equal to zero and its action set to DISCARD.

Within one second of receiving a Loopback Control OAMPDU with a zero loopback time, the remote OAM Client:

1. Sends an Information OAMPDU with updated state information reflecting the zero loopback timer value and its action set to FORWARD.
2. Sets the action parameter via the OAMPDU_CTL.request primitive to FORWARD.

55.8 PICS entries

Item	Feature	Subclause	Value/Comment	Status	Support
TTX	Effect of Loopback Control OAMPDU on a frame already submitted to subordinate sublayer	55.4.6	Has no effect	M	Yes []
TBEG1	Delay from receiving valid Loopback Control OAMPDU with non-zero loopback_timer, to transmission of loopback frames	55.4.6	Delay at MDI \leq 1 second	M	Yes []
TBEG2	Delay from receiving valid Loopback Control OAMPDU with non-zero loopback_timer, to transmission of Information OAMPDU with non-zero loopback_timer and action set to LOOPBACK	55.4.6	Delay at MDI \leq 1 second	M	Yes []
TEXP1	Delay from expiration of loopback_timer, to cessation of transmission of loopback frames	55.4.6	Delay at MDI \leq 1 second	M	Yes []
TEXP2	Delay from expiration of loopback_timer, to transmission of Information OAMPDU with zero loopback_timer and action set to DISCARD	55.4.6	Delay at MDI \leq 1 second	M	Yes []
TEND1	Delay from receiving valid	55.4.6	Delay at MDI \leq 1	M	Yes []

	Loopback Control OAMPDU with zero loopback_timer, to transmission of Information OAMPDU with zero loopback_timer and action set to FORWARD		second		
TEND2	Delay from receiving valid Loopback Control OAMPDU with zero loopback_timer, to transmission of MAC Client frames	55.4.6	Delay at MDI ≤ 1 second	M	Yes []