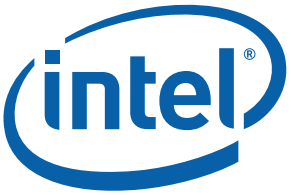


Recovery Mode for Intel® Ethernet Products

Application Note

Ethernet Products Group (EPG)

July 2020

Revision 1.2
606286-003

Revision History

Revision	Date	Comments
1.2	July 23, 2020	Updates include the following: • Added support for Intel® Ethernet Controller E810.
1.1	October 30, 2019	Updates include the following: • Added support for Intel® Ethernet Controller X710-TM4/AT2
1.0	November 19, 2018	Initial public release.

1.0 Introduction

Starting n Release 23.4, Intel has implemented a Recovery Mode capability that increases the resiliency of the Ethernet solution by enabling recovery of a corrupted or misconfigured NVM. Examples of events leading to this include partial or failed device firmware upgrade or downgrade attempts, or device driver installation errors.

The enhancement adds a NIC Recovery capability (referred to as Recovery Mode) that is available in this release.

The table in Section 1.1 shows the Software Driver, Tools, and NVM version of the initial version of recovery mode for a given product line.

The Intel® Ethernet Controller X710-TM4/AT2 (X710-TM4/AT2) and the Intel® Ethernet 800 Series Controllers (800 Series) contain Recovery Mode with their initial production releases.

1.1 Products Affected

Ethernet Device	New NVM Version	Software Driver & Tools
Intel® Ethernet 800 Series Controllers	2.00/2.02	Release 25.2
Intel® Ethernet 700 Series Controllers (X710/XXV710/XL710)	6.80[1]	Release 23.4
Intel® Ethernet Controller X710-TM4/AT2 (X710-TM4/AT2)	7.00[2]	Release 24.2
Intel® Ethernet Controller X550	2.00[1]	Release 23.4
Intel® Ethernet Connection X722	4.00[1]	Release 23.4
Ethernet Controller in the Intel® Xeon® Processor D-1500 Product Family LAN Controller	2.00[1]	Release 23.4
Ethernet Controller in the Intel Atom® Processor C3000 Series	2.00[1]	Release 23.4

1. Products with NVM versions prior to this release do not have Recovery Mode implemented.
2. The X710-TM4/AT2 and the 800 Series contain Recovery Mode with their initial production releases. Therefore, the following installation procedures and restrictions do not apply, as the feature is automatically supported in all production releases of these devices.

1.2 Installation of Release 23.4 or Later from a Release Prior to 23.4

Installation uses normal upgrade installation procedures.

- Normal NVM Upgrade (Intel® Ethernet NVM Update Tool) can be used to enable the new features.
- Reboot required. A/C power cycle is not required when updating from the previously-released version. Intel recommends following the instructions provided with the NVM Update tool.
- NVM update to Release 23.4 of later enables anti-rollback mode. After upgrading, downgrade to previous NVM versions is not possible.

  Note: The design of Recovery Mode precludes rollback to prior versions of the NVM. This is because the addition of the Recovery Mode capability changed the definition of some regions of the NVM to be write-protected. Rollback to a prior version requires access to these write-protected regions, and thus, the rollback would fail.
- Recovery Mode has no impact to normal operation.
- To fully support Recovery Mode, the updated Ethernet NVM, software driver, and software tool in Release 23.4 or later must all be used.

2.0 Recovery Mode Flow

Recovery Mode Assuming Pre-Installation of Release 23.4 or later:

Recovery Mode is only enabled by updating to the drivers, tools, and NVMs in Release 23.4 or later.

High-Level Flow:

Figure 1. Flow Chart

2.1 Host Recovery

Various initial causes may result in damage or corruption to the device NVM image. Some examples include, but are not limited to:

- Partial or failed device firmware upgrade or downgrade attempts.
- Device driver installation errors.

Before initiating device recovery, the integrity of the host operating system, device drivers, and firmware utilities must be verified and reinstalled if necessary.

Stringent checks are in place to ensure that the device enters Recovery Mode only when necessary. Device drivers supplied with this updated NVM release report to the user when device recovery mode is activated. However, some device recovery flows require a full platform power cycle to completely re-initialize the device. Device re-initialization triggers additional device internal integrity and startup checks to detect abnormal operating conditions. As a consequence, a full platform power cycle is required to recover from all possible device configuration corruption issues.

2.2 Recovery Mode Detection

A device can enter recovery mode if the device firmware detects a problem with the LAN device, mandating NVM reprogramming to restore normal operation. After internally attempting to restore normal operation (typically less than 10 minutes, but in some corner case could be longer), the NIC enters Recovery Mode and the driver notifies the user with the following message:

"Firmware Recovery mode detected."

2.3 Recovery Mode Operation

In Recovery Mode, firmware and software operation is restricted to allow only functionality required for NVM reprogramming.

Device firmware reports to the software drivers and tools that the device is in Recovery Mode and software operation is restricted to NVM programming functions. This allows NVM update tools to restore to the factory defaults appropriate for the SKU.

NVM Update follows normal NVM update flow. After NVM is updated, an A/C power cycle is required to return to normal operation.

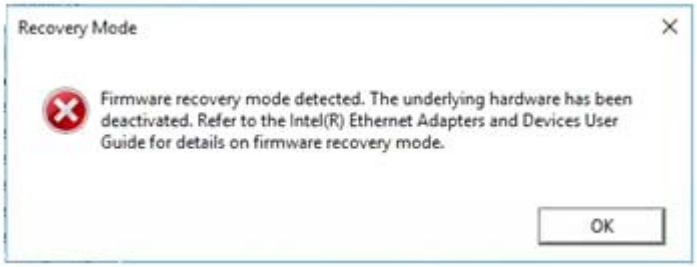
2.4 Recovery Mode Restrictions

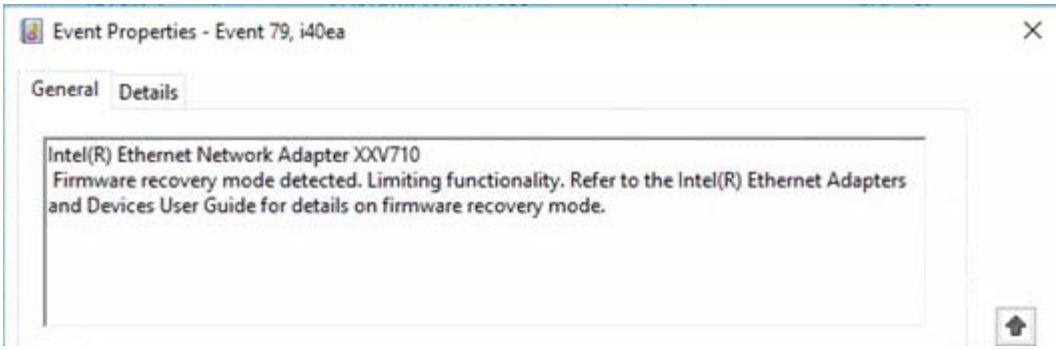
Recovery Mode has the following restrictions:

- NVM may not return to the exact image.
- NVM and VPD preservation are not guaranteed.
- Device is not guaranteed to link up with the link partner during Recovery Mode. After entering normal operation, link is restored to initial configuration.
- Device sideband functionality is disabled during Recovery Mode.
- To ensure proper recovery, Systems Manufacturers must provide the exact image programmed on the board prior to the device having entered Recovery Mode.
- Recovery Mode cannot be user initiated.

2.5 Examples of Recovery Mode Messaging

Following are examples of driver messages in Recovery Mode:



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i40e 0000:af:00.0: Firmware recovery mode detected. Limiting functionality.
i40e 0000:af:00.0: Refer to the Intel(R) Ethernet Adapters and Devices User Guide for details on firmware recovery mode.
```

3.0 Summary of Recovery Mode vs. Normal Mode

Recovery Mode	Normal Mode
Firmware operates with limited functionality.	Full firmware functionality.
Supports NVM update to restore to default NVM image.	NVM update with preservation.
Not expected to be entered in normal operation.	
Cannot be verified or tested by Systems Manufacturers or end users.	

4.0 Intel® Ethernet NVM Update Tool as a Recovery Tool

NVM Recovery is performed with the NVM Update Tool using standard NVM update flow, with the following key differences:

The NVM Update Tool tasked with the recovery process will:

- Check if the device is in recovery mode.
- Cooperate with firmware to retrieve the minimum information required for the recovery process.
- Look for images supporting the device being recovered.
- Flash the default image to the device without any user settings preservation.
- Request the user to power-cycle to finish the process.

Note: External PHY and OROM updates are excluded

At the end of process the NIC is returned to the default NVM image with MAC Addresses, four-part PCIe ID, and PBA (Intel adapters only) restored, but no other image preservation. In addition, for the 800 Series devices, the device Preserved Field Area (PFA), which includes the previously mentioned items, VPD and Netlist are restored to the at initial device programming set at manufacturing.

5.0 NVM Update Configuration File Changes

The NVM Update Tool continues to use a configuration file to determine the supported NVM update options, with the following new options:

- Support of NVM Recovery to recover the device.
  - Recovery is supported in the default case with the same entry as supported prior to Release 24.2.
- Recover to the latest image provided a proper entry in the configuration file.
- For all devices except the 800 Series:
  - EETRACK set at manufacturing is used to determine the oldest image at which to recover to when programming a board with Release 23.4 or later.
  - EETRACK used to update to Release 23.4 is considered the manufacturing EETRACK for those devices manufactured with older NVM versions.
- New optional entries for recovery in configuration file are separate from NVM update.
  - New MODE option defines if the entry is Recovery or Normal update.
  - This allows recovery to a different image than the one used for Normal update.

6.0 Recovery Mode Impact to NVM Update Packages

- By default, Intel NVM Update Packages recover:
  - Intel Adapters to latest default image.
  - LOMs/SoCs to the latest Dev Starter images. Images based on the Dev Starter are recovered to the Dev Starter image if the EETRACK is the same as the Dev Starter.
  - In the 800 Series, the device recovers to latest image provided in combination with settings saved at device manufacturing.
- OEMs with custom NVMs must provide the custom NVM in the NVM update package given to the end user.
  - For proper recovery, the latest image from manufacturing must be used. Failure to do so can restore some preserved fields in the NVM to the default values.
  - For the 800 Series, OEMs must set End of Manufacturing setting at product manufacturing to store device-specific settings, such as MAC Addresses, netlist topology, and VPD so they can be recovered if Recovery Mode is ever entered.

7.0 Rollback Mode for 800 Series Devices

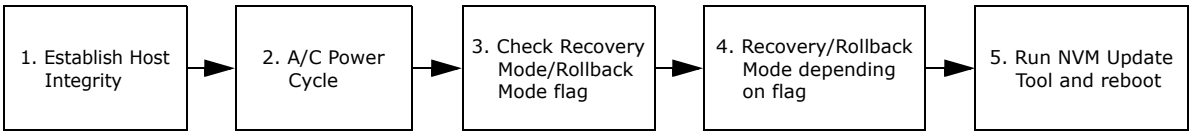

Figure 2. Rollback Flow Chart

Rollback Mode for the 800 Series is new feature added to the Recovery Mode flow. This allows the ability to boot from the previous NVM image when host recovery (Section 2.1) is started. Rollback to the previous NVM image is attempted first. If this fails, Recovery Mode is entered.

The pre-requisite to run the previous NVM image is that the previous NVM image should pass all the authentication and security checks. If the previous NVM image fails to load, Recovery Mode is initiated and it follows the process as described in the previous sections. If rollback mode is detected, Intel software drivers and tools inform the user similar to Recovery Mode, and the NVM Update Tool should be used to update the NVM to latest image and exit Rollback Mode.

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