

Intel® Rapid Storage Technology enterprise (RSTe) NVMe LED Management

Revision 1.1

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Revision History

Revision Number	Description	Intel® RSTe Release Version	Revision Date
1.0	• Initial Release of this document	4.3	October, 2015



1 About This Document

1.1 Purpose and Scope of this Document

The purpose of this document is to provide the OEMs/ODMs with the requirements, and corresponding APIs, to enable them to develop and implement a custom Dynamic Link Library (DLL) plug-in that is required to enable RSTe NVMe LED management.

There isn't a standardized SGPIO like interface to manage NVME SSD enclosure status LEDs, each enclosure may have its own implementation. To help ensure that Intel® RSTe NVMe LED management functionality properly interfaces to the enclosure status LEDs, OEM/ODMs are required to develop the DLL based off the specific enclosure contained in the platform.



2 Intel® RSTe NVMe LED Management

Intel® RSTe NVMe support provides a mechanism to manage the status LEDs in an NVMe drive enclosure.

2.1 An Overview of LED Management Support in PCIe Enclosures

In order to manage status LEDs in a PCIe NVMe enclosure, several SW/HW combinations have been considered but none of them have been widely implemented yet.

Unlike the standard PCH architecture where there is a single controller independent of the drives attached, every NVMe SSDs has its own built-in storage controller. This integration of the NVMe controller with each drive forces the LED management functionality to reside outside of the NVMe controller so that LED management can be maintained even when one of the NVMe drives fails. As a result, LED management must remain outside of the NVMe subsystem. While NVMe management standards describe how to get the status from the NVMe subsystem, translating this status information into a visual indication is not standard and therefore is vendor specific.

To support LED management for a system running Intel® RSTe NVMe, an enclosure specific DLL plug-in must be created. This enclosure specific plug-in provides the interface between Intel® RSTe NVMe and the NVMe enclosure.

2.2 LED Blinking Support in RSTe NVMe

In order for Intel® RSTe NVMe to deliver support for managing LEDs on different enclosures, a plug-in based architecture has been implemented. It allows a platform vendor to write a small portion of code, compile it into a DLL and put it into the directory accessed by RSTe. This plug-in provides the necessary communication with the NVMe enclosure.

2.2.1 LED Management Information Flow

The Intel® RSTe System Service provides the information about RAID member disk's states. The information is passed to the plug-in DLL in the form of a callback.

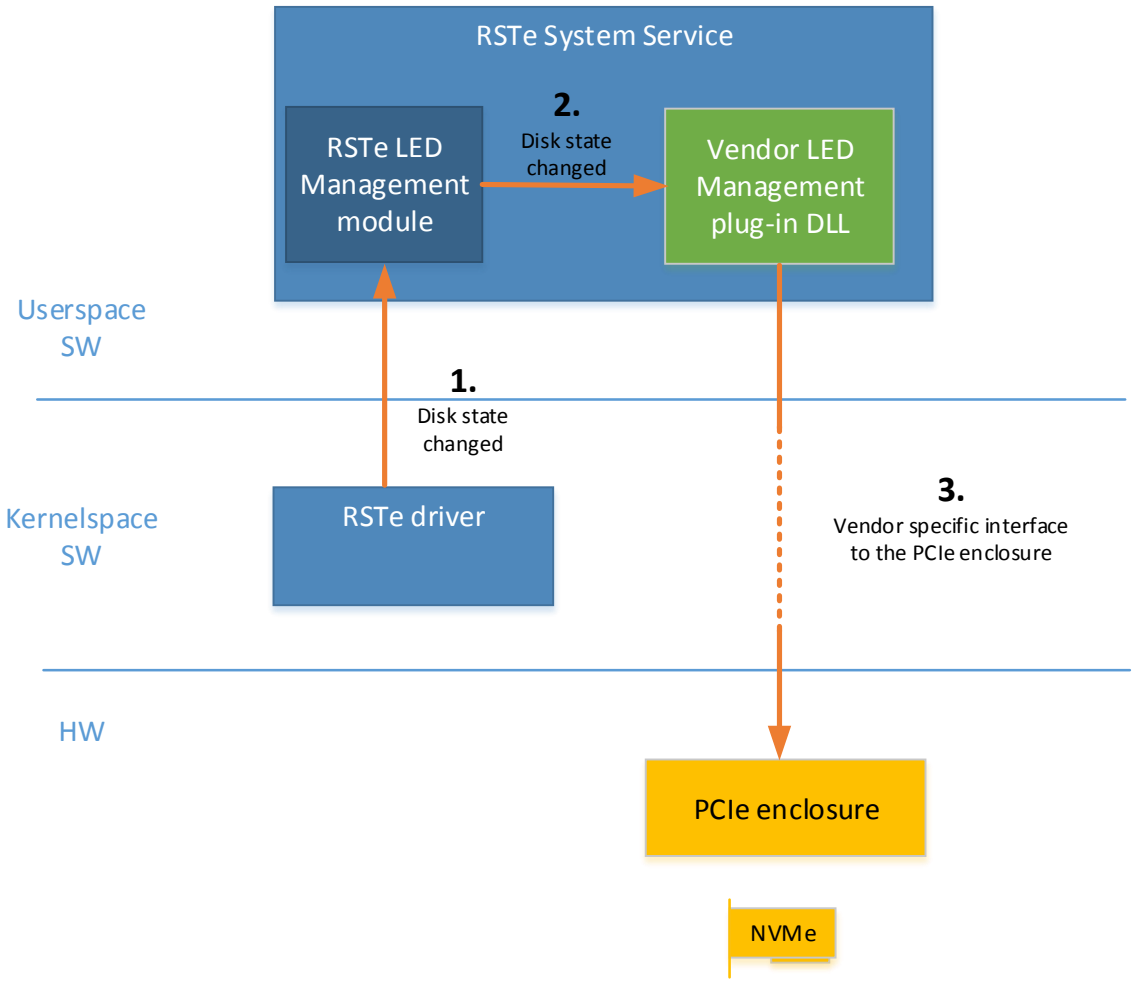


Figure 1: The flow of disk state changes resulting in LED Management

2.3 LED Blinking Plug-in

2.3.1 The interface

The interface which must be implemented by the Vendor plug-in:

```
public interface LedEnclosurePlugin
{
  string Name { get; }
  bool Blink(
    BlinkState State,
```



```
    byte Bus,
    byte Device,
    byte Function
    );
}
```

2.3.2 'Name' Property

Defines the name of the plug-in. This property is used for debug purposes.

2.3.3 'Blink' Method

Arguments:

Argument name	Description
BlinkState	Enum defining the disk state, in regard to LED blinking (See BlinkState values mapping to SFF-8489 specification table)
Bus	Bus number of PCI device (part of BDF)
Device	Device number of PCI device (part of BDF)
Function	Function number of PCI device (part of BDF)

BlinkState values mapping to SFF-8489 specification:

SFF specification value	BlinState value
Locate (identify)	eStateLocate eStateLocateOff*
Fail	eStateFailed
Rebuild	eStateRebuild
PFA	eStatePFA
Hotspare	eStateHotSpare

In A Critical Array	eStateCriticalArray
In A Failed Array	eStateFailedArray

*eStateLocateOff is sent after LedLocateTimeout expires (see 2.4)

Return values:

Value	Description
True	The blinking related information was successfully passed to the enclosure
False	The Blink function failed

2.4 Plug-in Deployment

When Intel® RSTe NVMe System Service is started, the Intel RSTe LED Management Module searches for the Vendor plug-in DLL. The search is performed in the directory defined in system registry in the following location:

HKLM\SOFTWARE\Intel\RSTe

or

HKLM\SOFTWARE\Wow6432Node\Intel\RSTe

1. Add two registry entries in
   HKLM\SOFTWARE\Intel\RSTe
   or
   HKLM\SOFTWARE\Wow6432Node\Intel\RSTe
   (depending on whether it is 32 bit or 64 bit architecture):
   a. First entry defining full plugin path (without the DLL filename) i.e.: C:\Program Files (x86)\Intel\Intel(R) Rapid Storage Technology enterprise\ Enclosure LED plugins):
      i. name: EnclosurePluginPath
      ii. type: String value
   b. Second entry defining led locate timeout value:
      i. name: LedLocateTimeout
      ii. type: dword
2. Copy plugin file to path specified in point 1a
   (i.e.: put file SampleEnclosurePlugin.dll in C:\Program Files (x86)\Intel\Intel(R) Rapid Storage Technology enterprise\LedPlugin):



a. Plugin must implement interface LedEnclosurePlugin from library IAStorEnclosurePlugin.dll. This file is located within INVMe_ALL.zip files included with each relase.

The Intel® RSTe installer default path is:

C:\Program Files (x86)\Intel\Intel(R) Rapid Storage Technology enterprise\Enclosure LED plugins

NOTE: With each release of the RSTe NVMe Package, a new version of IAStorEnclosurePlugin.dll will be included. As a result, the custom Enclosure LED plugin DLL must be recompiled and distributed with the new RSTe NVMe Package..

2.4.1 Potential Deployment Issues

1. If the plug-in location contains more than one plug-in only one will be loaded, but there is no guarantee which one.
2. If the plug-in location contains DLLs which do not meet the requirements of a plug-in they will be ignored.
3. If the plug-in code performs an illegal operation (e.g. illegal memory access), RSTe components do not crash, but the LED blinking functionality may stop working until a system restart.
4. If the DLL is not loaded properly the “Locate LED” option will not appear in Disk Properties in the Intel® RSTe GUI.

2.5 Example Enclosure Plugin Code

Example source code is available to help start the DLL plugin effort included in this package.

NOTE: This sample code is not a fully functional solution. It does contain the necessary files to begin the process of building the customer DLL to support NVMe LED management.

2.6 Example of the Build Environment

This is an example of a successful DLL software build environment:

- Microsoft Visual Studio Professional 2013
  Version 12.0.31101.00 Update 4
  Microsoft .NET Framework
  Version 4.5.51650
- Installed Version: Professional



- LightSwitch for Visual Studio 2013 06177-004-0447006-02393
  Microsoft LightSwitch for Visual Studio 2013
- Team Explorer for Visual Studio 2013 06177-004-0447006-02393
  Microsoft Team Explorer for Visual Studio 2013
- Visual Basic 2013 06177-004-0447006-02393
  Microsoft Visual Basic 2013
- Visual C# 2013 06177-004-0447006-02393
  Microsoft Visual C# 2013
- Visual C++ 2013 06177-004-0447006-02393
  Microsoft Visual C++ 2013
- Visual F# 2013 06177-004-0447006-02393
  Microsoft Visual F# 2013
- Visual Studio 2013 Code Analysis Spell Checker 06177-004-0447006-02393
  Microsoft® Visual Studio® 2013 Code Analysis Spell Checker
- Portions of International CorrectSpell™ spelling correction system © 1993 by Lernout & Hauspie Speech Products N.V. All rights reserved.
- The American Heritage® Dictionary of the English Language, Third Edition Copyright © 1992 Houghton Mifflin Company. Electronic version licensed from Lernout & Hauspie Speech Products N.V. All rights reserved.
- Windows Phone SDK 8.0 - ENU 06177-004-0447006-02393
  Windows Phone SDK 8.0 – ENU
- Application Insights Tools for Visual Studio Package 1.0
  Application Insights Tools for Visual Studio
- ASP.NET and Web Tools 12.4.51016.0
  Microsoft Web Developer Tools contains the following components:
  - Support for creating and opening ASP.NET web projects
    Browser Link: A communication channel between Visual Studio and browsers
    Editor extensions for HTML, CSS, and JavaScript
    Page Inspector: Inspection tool for ASP.NET web projects
    Scaffolding: A framework for building and running code generators
    Server Explorer extensions for Microsoft Azure Websites
    Web publishing: Extensions for publishing ASP.NET web projects to hosting providers, on-premises servers, or Microsoft Azure
- ASP.NET Web Frameworks and Tools 2012.2 4.1.21001.0
  For additional information, visit
  http://go.microsoft.com/fwlink/?LinkID=309563



- ASP.NET Web Frameworks and Tools 2013 5.2.21010.0
  For additional information, visit http://www.asp.net/
- Common Azure Tools 1.3
  Provides common services for use by Azure Mobile Services and Microsoft Azure Tools.
- Debugging Tools for Windows 6.3.9600.17029
  Integrates the Windows Debugger functionality (http://go.microsoft.com/fwlink/?linkid=223405) in Visual Studio.
- Microsoft Advertising SDK for Windows Phone
  Microsoft Advertising SDK for Windows Phone
  Build
- Microsoft Azure Mobile Services Tools 1.3
  Microsoft Azure Mobile Services Tools
- NuGet Package Manager 2.8.50926.663
  NuGet Package Manager in Visual Studio. For more information about NuGet, visit http://docs.nuget.org/.
- Office Developer Tools for Visual Studio 2013 ENU 12.0.30626
  Microsoft Office Developer Tools for Visual Studio 2013 ENU
- PowerShell Tools 1.3
  Provides file classification services using PowerShell
- PreEmptive Analytics Visualizer 1.2
  Microsoft Visual Studio extension to visualize aggregated summaries from the PreEmptive Analytics product.
- SQL Server Data Tools 12.0.41012.0
  Microsoft SQL Server Data Tools
- Windows Driver Kit 6.3.9600.17246
  Headers, libraries, and tools needed to develop, debug, and test Windows drivers (msdn.microsoft.com/en-us/windows/hardware/gg487428.aspx)
- Windows Phone 8.1 SDK Integration 1.0
  This package integrates the tools for the Windows Phone 8.1 SDK into the menus and controls of Visual Studio.
- Workflow Manager Tools 1.0 1.0
  This package contains the necessary Visual Studio integration components for Workflow Manager.