Purpose

This article provides information about the Intel® Volume Management Device (Intel® VMD) enabled NVMe Driver LED Management Tool for VMware®. This Intel VMD LED Management tool interfaces with the Intel VMD-enabled NVMe driver to drive specific blinking patterns to the backplane on Intel® Xeon® Scalable platforms with PCIe Solid State Drives attached to Intel VMD enabled domains.

Intel VMD is hardware logic inside of the Intel® Xeon® processor. Intel VMD aggregates the NVMe PCIe SSDs attached to its root port and acts much like an HBA today does for SATA and SAS. Intel VMD provides Error management, Surprise Hotplug, and LED Management. This topic will be focusing on the Intel VMD LED Management tools.

PCle Solid State Drives (SSD) storage lacks a standardized method to blink LEDs visually and represent the status of the device. Locating a drive through a visual indicator is crucial for storage administrators to remove and replace a precise PCIe SSD with a new one in a data center with multiple racks of storage. Without location indicators there is much greater risk of data loss occurring if the wrong drive is removed.

*Green LED below is the activity LED coming directly from the SSD. Amber LED represents the LED coming from the slot on the backplane; this Amber LED is what Intel VMD is responsible for.
Intel VMD LED Management offers the IBPI style of LED management as defined by the SFF-8489 standard. Intel VMD brings a standardized method to PCIe SSD storage to control LED indicators on both direct attached and switch attached PCIe storage. For PCIe register interface technical details necessary to support the Intel VMD method of LED management refer to the references section of this paper.

### Intel® Xeon® Scalable platform VPP Bits Used By Enclosure

<table>
<thead>
<tr>
<th>Bit</th>
<th>Direction</th>
<th>PCIe Signal Name</th>
<th>CPLD Signal Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Output</td>
<td>ATNLED</td>
<td>FAULT</td>
</tr>
<tr>
<td>1</td>
<td>Output</td>
<td>PWRLED</td>
<td>LOCATE</td>
</tr>
<tr>
<td>2</td>
<td>Output</td>
<td>PWREN#</td>
<td>Not Used Debug Only</td>
</tr>
<tr>
<td>3</td>
<td>Input</td>
<td>BUTTON#</td>
<td>Not Used Debug Only</td>
</tr>
<tr>
<td>4</td>
<td>Input</td>
<td>PRSNT#</td>
<td>PRSNT_N</td>
</tr>
<tr>
<td>5</td>
<td>Input</td>
<td>PWRFLT#</td>
<td>Not Used Debug Only</td>
</tr>
<tr>
<td>6</td>
<td>Input</td>
<td>MRL#/EMILS</td>
<td>Not Used Debug Only</td>
</tr>
<tr>
<td>7</td>
<td>Output</td>
<td>EMIL</td>
<td>Not Used Debug Only</td>
</tr>
</tbody>
</table>

**Product Overview**

This release of the Intel® VMD LED Management Tool includes a simple command line tool, installed as a vib file on VMware* ESXi* 6.5 and VMware* ESXi* 6.7 operating systems. This tool requires the prior installation of Intel VMD-enabled NVMe driver on the VMware* ESXi* operating system.

Accompanying this tool is a VMware* ESXi* Intel® VMD Framework Plug-in. This framework allows the Intel VMD LED management tool to be used as a vSphere Disk Serviceability Plugin.

**Download**

This version of Intel VMD LED management tool and VMware* ESXi* LSU Framework Plug-in are available on Intel Download center.

[intel.com/download/28288/Intel-VMD-ESXi-Tools](http://intel.com/download/28288/Intel-VMD-ESXi-Tools)

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**Known Issues in This Release**

Some Switch models are **WRITE ONLY**, therefore, when attempting to send the command to read the slot control registers for LED Status, the tool will not return the LED Status. In this case, manual interpretation by sight viewing the LED Blinking pattern is required to verify the PCIe Slot Control Registers have been correctly configured for the desired blinking pattern.

**Installation Details**

Intel VMD-enabled NVMe driver are available on VMware site and can be installed in ESXi 6.5 and ESXi 6.7 versions.

Intel VMD-enabled NVMe Driver for Out-of-Box installations as of this writing:

- VMware* ESXi* 6.5 and VMware* ESXi* 6.7
  - `INT_bootbank_int-esx-intel-vmd-user_1.6-2.vib`

Intel VMD LED Management command line tool: `int-esx-intel-vmd-user-1.6-2.vib`

VMware LSU Framework plug-in: `lsu-intel-nvme-vmd-plugin-1.0.0-4vmw.680.0.0.00000.i386.vib`

Assuming the vibs has been downloaded to the "tmp" directory, install the vibs using the following syntax:

```
Esxcli software vib install –v “tmp/<vibName.vib>”
```

**System Requirements**

Intel® Xeon® Scalable platform with The Intel VMD enabled on NVMe PCIe SSD connected PCIe lanes.

Intel VMD-enabled NVMe driver is installed.

Intel VMD LED management command line tool is installed on the following VMware* ESXi operating system versions: 6.5 & 6.7

**Note:** If using VMware* ESXi* 6.7, and replacing the Intel VMD-enabled NVMe inbox driver with the async Intel VMD-enabled NVMe driver v. 1.4 or newer, the inbox VMware LSU Framework plug-in should be removed and the newer LSU Framework plug-in NVMe LED Management and Int-esx-intel-vmd-user-1.6-2.vib command line tools should be installed.

Remove the following inbox vibs using the syntax; esxcli software vib remove –n [driver_name]*

```
inTEL-esx-vmdcli (if present)
lsu-intel-vmd-plugin
```

Example:

```
esxcli software vib remove –n “intel-esx-vmdcli”
```

**Note:** On ESXi systems, the tool only works on PCIe NVMe drives on Intel VMD enabled domains using the Intel VMD-enabled NVMe driver.
Intel VMD LED Management Tool in VMware* ESXi* environment

For each Intel VMD-enabled domain, the Intel VMD-enabled NVMe driver will enumerate the devices behind the Intel VMD root port. ESXi will assign the HBA Controller ID prefix to the controller, as vmhba# i.e. vmhba0, vmhba3, etc. and also map a SCSI target ID to the NVMe device.

The mapping between SCSI target ID and the device name (t10.NVMe____xxxx) can be found by the command:

```
# esxcfg-mpath -L
```

Below is the example output from this command:

```
vmhba1:C0:T1:L0 state:active t10.NVMe____INTEL_SSDPE2MD016T4_PHFT5462005Q1P6JGN____00000001
vmhba1 0 1 0 NMP active local pscsi.vmhba1 pscsi:0:1
vmhba1 = VMD Adapter Device
T1 = Disk NUM = 1
scsdev = t10.NVMe____INTEL_SSDPE2MD016T4_PHFT5462005Q1P6JGN____00000001
```

After installing the “intel-vmd-user” vib, the tool will be found in the following directory, and must be ran from this directory:

```
/opt/intel/bin
```

Example to Set the LED State

```
./intel-vmd-user set-led <device> -d <disk NUM> -l <off | fault | identify | rebuild>
```

Example to set disk NUM 0 on VMD Adapter device vmhba2 with led state = fault

```
./intel-vmd-user set-led vmhba2 -d 0 -l fault
Targeting Disk:0 with LED:fault
Set LED completed
```

In this example we will set LED status on disk NUM ‘1’ on device vmhba2 to the LED state of ‘identify’

```
./intel-vmd-user set-led vmhba2 -d 1 -l identify
Targeting Disk:1 with LED:identify
Set LED completed
```

Next, we can send the “get-led” command to make sure that the Status Register is set correctly to “fault” LED:

```
./intel-vmd-user get-led vmhba2 -d 0
Targeting Disk:0
LED state:fault
```

Command to send rebuild blink pattern to NVMe disk NUM 3 on device vmhba2:

```
./intel-vmd-user set-led vmhba2 -d 3 -l rebuild
```

Command to turn off blinking pattern to disk NUM 3 on device vmhba2:

```
./intel-vmd-user set-led vmhba2 -d 3 -l off
```
VMware VMD LED Framework Plug-in in ESXi Environment

The Intel VMD-enabled NVMe driver and Intel VMD-enabled LED Command line interface tool must first be installed on the system.

Install the VMware* ESXi* VMD LED Framework Plug-in according to installation steps above.

The following blinking patterns are supported with the Framework Plug-in:

- `locator`
- `error`
- `off`

Use the following Syntax:
`Esxcli storage core device set -d <scsidev> -l <blinking pattern>`

Locator blink example:
```
# esxcli storage core device set -d
t10.NVMe___INTEL_SSDPE2MD016T4_PHFT5462005Q1P6JGN__00000001 -l locator
```

Off Blink example:
```
# esxcli storage core device set -d
t10.NVMe___INTEL_SSDPE2MD016T4_PHFT5462005Q1P6JGN__00000001 -l off
```
LED Management with the Framework Plug-in for VMD in VMware vSAN

VMware® ESXi® LED management Framework can be helpful to use in the VMware vSAN environment.

The following blinking patterns are supported:
- **Locator**
- **Off**

**Pre-Condition:**
The Intel VMD-enabled Driver, Intel VMD LED Command Line Tool, and VMware VMD LED Framework Plug-in are all installed on the system, and Intel VMD is enabled.

**Procedure:**
Ensure vSphere Disk Serviceability Plugins for test driver is installed.

- Log in to VCenter Server
- Go to Disk Management in vSAN Cluster
- Turn on LED of capacity drives in every disk group
  - select disk group
  - select drive
  - turn on locator (amber LED should start blinking)
  - or click All Actions -> Turn Locator LED on
- Turn off LED of capacity drives in every disk group
  - Select disk group
  - Select drive
  - Turn off locator (amber LED should be off)

- Or click All Actions -> Turn Locator LED off

Contact Information

If assistance is needed with the installation, or if problems occur using the tool, issues may be filed through Intel IPS, or directly notify: jay.l.cassio@intel.com