

Emulex® LPe31000-Series and LPe32000-Series HBA Firmware and Boot Code

**Releases 12.6.240.22, 12.6.240.40, 12.6.240.42,
and 12.6.240.55**

Purpose and Contact Information

These release notes describe the new features, resolved issues, known issues, new firmware features or resolved issues that require a host reboot, technical tips, and license notices associated with this firmware and boot code release for Emulex® LPe31000-series and LPe32000-series HBAs.

For the latest product documentation, go to www.broadcom.com. If you have questions or require additional information, contact an authorized Broadcom® Technical Support representative at ecd-tech.support@broadcom.com.

New Features

Release 12.6.240.55

This release adds support for new flash devices.

NOTE: If you downgrade the firmware to a version earlier than 12.6.240.55 on an HBA that has a new flash device, the firmware is not installed and an error message is displayed.

Release 12.6.240.42

This release adds support for Boot from SAN on NVMe over FC on the VMware ESXi 7.0 U1 operating system. For implementation instructions, see [Technical Tips Item 5](#) in these release notes.

Release 12.6.240.40

No new features were added to this release.

Release 12.6.240.22

This release adds support for Arm servers. Boot from SAN and NVMe over FC functionality are not supported on Arm servers. Refer to the *Emulex Drivers for Linux Release Notes* for additional information.

NOTE: In some cases, a firmware update requires either a firmware reset or a basic PCIe reset, depending on the features available in the new firmware. A firmware reset is performed automatically if it is needed, regardless of the operating system. In some cases, a full reboot is required to activate new firmware, to enable a new feature, or to take advantage of a resolved issue. In such a case, the application that updated the firmware produces a message indicating what is needed.

See the [New Firmware Features or Resolved Issues That Require a Host Reboot](#) section for a list of new features or resolved issues that require a host reboot after a firmware update.

Resolved Issues

Release 12.6.240.55

No firmware or boot code issues were resolved in this release.

Release 12.6.240.42

Firmware

No firmware issues were resolved in this release.

Boot Code

When you add or configure NVMe boot devices, the NVMe namespaces list in the **Add NVMe over FC Boot Device** menu is no longer empty.

Release 12.6.240.40

Firmware

No firmware issues were resolved in this release.

Boot Code

1. Booting from SAN using NVMe no longer results in Windows Server 2019 going into repair mode.
2. The Emulex UEFI configuration utility now discovers an NVMe target on an IBM FlashSystem 900 array.

Release 12.6.240.22

Firmware

Running the `dporttest` command with the `-time` parameter from a Brocade® switch no longer causes erroneous port failure messages.

Boot Code

The link speed setting correctly changes to `AUTO` when using the using the Emulex x86 BIOS utility `reset default` option.

Known Issues

General

1. Beginning with software release 11.2, FC HBAs and OneConnect[®] converged network adapters (CNAs) have independent software kits. Before updating earlier drivers and applications to the software in this release, refer to the *Emulex Software Kit Migration User Guide* for special instructions and considerations for using the 11.2 and later software kits for FC HBAs and OneConnect CNAs.
2. Updating the NVMe BFS installation from RHEL 8.1 to a later RHEL 8.x release requires a special procedure.
You must use the `rhel8u1_upgrade.sh` script contained in the `nvme-fc-dm--1.rhel8.tar.gz` kit to update an NVMe BFS installation from RHEL 8.1 to RHEL 8.2 or later. The script ensures that the NVMe BFS setup is maintained through the update process.
Before you run the script, you must configure the yum repository for the new operating system. The script uses this new repository to update the `nvme-cli` utility.
The update script performs the following actions:
 - Backs up the `hostnqn` file
 - Removes the `RHEL8u1 nvme-fc-dm` package
 - Upgrades the `nvme-cli` utility to the RHEL 8.2 or later package
 - Restores the `hostnqn` file
 - Installs a new version of the `nvme-fc-dm` packageYou can update the operating system at any time after you have run the script.
3. Boot from SAN is not supported if FC-SP-2 authentication (DH-CHAP) is enabled.

Hardware and Drivers

1. On LPe31000-series and LPe32000-series adapters, the system might stop responding when the HBA tries to send commands to the HBA driver. This occurs in a system with a large number of LUNs when the driver lags behind the HBA in processing I/Os.

Workaround

Limit the number of outstanding I/Os each LUN can have by changing the LUN queue depth using the `lpfc_lun_queue_depth` driver parameter. For example:

```
lpfc_lun_queue_depth=6
```

Alternatively, you can limit the number of outstanding I/Os each HBA can have by changing the HBA queue depth using the `lpfc_hba_queue_depth` driver parameter:

```
lpfc_hba_queue_depth=64
```

NOTE: The optimal array configuration is affected by a variety of factors, including the following:

- Number of LUNs configured
- LUN queue depth setting
- HBA queue depth setting
- Response time of the array
- CPU speed

2. Some LPe31000-series and LPe32000-series adapters were shipped without the shunt that allows you to enable the secure firmware jumper.

Workaround

Refer to section on setting the secure firmware jumper in the *Emulex Fibre Channel Host Bus Adapters Installation Guide* for instructions.

To obtain a replacement shunt, contact an authorized Broadcom Technical Support representative, as described in [Purpose and Contact Information](#).

3. Locked optics are not supported on Broadcom 16Gb/s transceivers with serial numbers prior to SN:x@1319xxxxx. The serial number (SN:) is located above the bar code on the Broadcom manufacturer's label that is affixed to the transceiver.

Firmware

1. If a firmware update requires a system reboot, you cannot perform a firmware dump until the reboot has occurred.

Workaround

None.

2. Performing a firmware update on the second port of a two-port HBA using the Emulex HBA Manager application on a Linux operating system might cause the operating system to stop responding.

Workaround

Update the firmware on the first port of the HBA. It is not necessary to update firmware on the second port of an LPe31002 or LPe32002.

3. Using the Brocade `portdporttest` command with the `stop` option causes the HBA to stop responding when running D_Port tests from the switch. Disabling a port while running D_Port tests from the switch can cause the switch port to get stuck in D_Port mode.

Workaround

Do not stop D_Port tests while they are running from the switch. Do not disable a port while D_Port tests are running from the switch.

If the HBA stops responding, remove the D_Port configuration from the switch port by issuing the following command:

```
portdisable p#; portcfgdport --disable p#; portenable p#
```

Refer to the Brocade switch documentation for more information.

If the switch port is stuck in D_Port mode, use the `portdporttest --exit` command to clear the configuration.

4. Performing a firmware update using `sysfs` on certain inbox Linux operating systems might cause the misleading message `3199 Firmware write complete: Firmware write complete: Firmware reset required to instantiate` to be displayed.

The following Linux inbox drivers are affected:

- RHEL 7.7
- RHEL 8.1
- SLES 12 SP5
- SLES 15 SP1

Workaround

Instead of performing a firmware reset, perform a PCI bus reset to activate newly downloaded firmware. For instructions on issuing a PCI bus reset, refer to the *Emulex Drivers for Linux User Guide*.

x86 BIOS Utility

After logging in to the switch, connected adapter ports appear as G_Ports until you log in to the fabric.

Workaround

None.

UEFI Configuration Utility

1. If FEC is disabled and either a cold boot or a system reboot is performed, the setting reverts to enabled.

Workaround

Use the Emulex UEFI configuration utility to reset FEC to disabled, and perform a warm boot.

2. When configured for NVMe boot support, the Emulex UEFI environment does not understand the various levels of Asymmetric Namespace Access (ANA), also called I/O multipathing. It assumes all boot devices are fully accessible and active. If a boot device that is in an ANA un-optimized or inaccessible state is configured, or if the boot device transitions to such a state over time, the UEFI boot environment might significantly slow or stop its boot sequence. Messages such as `Option ROM POST Error: 2110... Controller I/O timeout failure...` might appear.

Workaround

When you configure UEFI boot devices with storage that supports NVMe ANA, attempt to have optimized paths configured ahead of non-optimized or inaccessible device paths. If the storage array state changes for boot devices, reconfigure the boot device list to order optimized paths ahead of non-optimized or inaccessible storage. Refer to Knowledge Base article #1211251400308 for further information.

3. A value for FA-PWWN that was configured in the Emulex HBA Manager application is not reflected in the Emulex UEFI configuration utility.

New Firmware Features or Resolved Issues That Require a Host Reboot

This section lists the new firmware features or resolved issues that require a host reboot to be activated after they are installed through a firmware update.

Firmware Version 12.6.240.55

Support was added for new flash devices.

Firmware Version 12.6.240.42

No new firmware features in this release require a host reboot after a firmware update.

Firmware Version 12.6.240.40

No new firmware features in this release require a host reboot after a firmware update.

Firmware Version 12.6.240.22

No new firmware features in this release require a host reboot after a firmware update.

Technical Tips

1. D_Port and FA-PWWN cannot be enabled simultaneously.

Workaround

If D_Port is enabled and you want to enable FA-PWWN, you must first disable D_Port. If FA-PWWN is enabled and you want to enable D_Port, you must first disable FA-PWWN.

NOTE: You must disable D_Port using an Emulex application that allows you to do so, such as the Emulex HBA Manager application.

2. The Emulex UEFI configuration utility does not immediately display the adapter's default values after they have been set.

Workaround

Reset or reconnect the adapter. The Emulex UEFI configuration utility displays the new values.

3. The adapter firmware notifies the Cisco switch that the transceiver optical test is not supported when the reflector loopback capabilities are queried. Cisco HBA Link Diagnostics (Cisco MDS Tests) are not supported when the `Xcvr-optical` parameter is not supported.

Workaround

Replace the adapter's SFP with a supported SFP.

4. The `elx-nvmefc-dm-<build>-n.tar.gz` preinstallation kit must be used for both inbox and out-of-box drivers to configure BFS for NVMe over FC on Linux.
5. To configure Boot from SAN for NVMe over FC on the VMware ESXi 7.0 U1 operating system, perform the following steps:
 - a. Refer to the *NVMe over FC Boot Settings* section in the *Emulex Boot for the Fibre Channel Protocol User Guide* to configure NVMe over FC boot and to add an NVMe boot device using the UEFI utility.

NOTE: Before starting the installation, zone the target WWN appropriately to the initiator WWNs. Create the Namespace of an appropriate size in the NVMe target, and map it to the initiator NQNs as described in the *Emulex Boot for the Fibre Channel Protocol User Guide*.

- b. Attach the operating system installation media to the server, and reboot or power on the server using the **UEFI Boot Menu**.

NOTE: Use a custom ESXi 7.0 U1 ISO image with version 12.8.x.x FC driver and NVMe transport driver for ESXi 7.0 U1 for NVMe over FC BFS on VMware.

- c. When the installation GUI appears, wait for the **Welcome to the VMware ESXi 7.0.1 Installation** window to appear.
- d. Press **Alt+F1** to switch to the ESXi console window.
- e. Enter `root` as the login credential and press **Enter**. Leave the password blank, and press **Enter** to continue.
- f. Since `hostd` is not available, use `localcli` instead of `esxcli` to perform operations in this shell.
- g. At the command prompt, run the `localcli nvme info get` command to obtain the host NVMe qualified name (NQN).
- h. Make a note of the NQN string, and provide it to the storage administrator to configure the boot namespace in the NVMe target.
- i. Issue the `localcli storage core adapter list` command to obtain a list of available FC adapters.

- j. After the host NQN is configured on the target, trigger a discovery at the host to discover the newly configured namespace for `BOOT`. This discovery can be started using one of the following methods:
- Perform a Loop Initialization Primitive (LIP) reset to a given FC adapter by typing the following command:

```
#localcli storage core adapter list localcli storage san fc reset -A <vmhba#>
```
 - Use the following native `nvme fabrics` VMware command to discover an NVMe controller on the specified target port through the specified NVMe adapter:

```
#localcli nvme fabrics discover -a<vmhba#> -W=<Target WWNN> -w=<Target WWPN>
```
- For example:
- ```
localcli nvme fabrics discover -a vmhba66 -W=20:2c:00:a0:98:c1:fe:52
-w=20:6d:00:a0:98:c1:fe:52
```
- k. Verify whether the new subsystem and namespace are discovered using the following commands in the shell:
- ```
#localcli nvme controller list  
#localcli nvme namespace list
```
- l. After the new namespace is discovered, press **ALT+F2** to return to the installation GUI and continue the installation process.
- m. The newly assigned namespace for `BOOT` will appear in the **Select a Disk to install or Upgrade** menu under the **Remote:** section.
- n. Select the displayed namespace and continue the operating system installation following the on-screen prompts.
- o. After successful operating system installation, ensure that the Emulex adapter is configured as the first boot device in the BIOS and proceed with boot.

License Notices

Open SSL Notice

This is a copy of the current LICENSE file inside the CVS repository.

LICENSE ISSUES =====

The OpenSSL toolkit stays under a dual license, i.e. both the conditions of the OpenSSL License and the original SSLeay license apply to the toolkit. See below for the actual license texts. Actually both licenses are BSD-style Open Source licenses. In case of any license issues related to OpenSSL please contact openssl-core@openssl.org.

OpenSSL License -----

```
/* =====  
 * Copyright (c) 1998-2011 The OpenSSL Project. All rights reserved.  
 *  
 * Redistribution and use in source and binary forms, with or without  
 * modification, are permitted provided that the following conditions  
 * are met:  
 *  
 * 1. Redistributions of source code must retain the above copyright  
 * notice, this list of conditions and the following disclaimer.  
 *  
 * 2. Redistributions in binary form must reproduce the above copyright  
 * notice, this list of conditions and the following disclaimer in  
 * the documentation and/or other materials provided with the  
 * distribution.  
 *  
 * 3. All advertising materials mentioning features or use of this  
 * software must display the following acknowledgment:  
 * "This product includes software developed by the OpenSSL Project  
 * for use in the OpenSSL Toolkit. (http://www.openssl.org/)"
```

*
* 4. The names "OpenSSL Toolkit" and "OpenSSL Project" must not be used to
* endorse or promote products derived from this software without
* prior written permission. For written permission, please contact
* openssl-core@openssl.org.
*
* 5. Products derived from this software may not be called "OpenSSL"
* nor may "OpenSSL" appear in their names without prior written
* permission of the OpenSSL Project.
*
* 6. Redistributions of any form whatsoever must retain the following
* acknowledgment:
* "This product includes software developed by the OpenSSL Project
* for use in the OpenSSL Toolkit (<http://www.openssl.org/>)"
*
* THIS SOFTWARE IS PROVIDED BY THE OpenSSL PROJECT ``AS IS'' AND ANY
* EXPRESSED OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
* IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR
* PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE OpenSSL PROJECT OR
* ITS CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL,
* SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT
* NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES;
* LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
* HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT,
* STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE)
* ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED
* OF THE POSSIBILITY OF SUCH DAMAGE.
* =====
*
* This product includes cryptographic software written by Eric Young
* (eay@cryptsoft.com). This product includes software written by Tim
* Hudson (tjh@cryptsoft.com).
*
*/

Original SSLeay License

/* Copyright (C) 1995-1998 Eric Young (eay@cryptsoft.com)
* All rights reserved.
*
* This package is an SSL implementation written
* by Eric Young (eay@cryptsoft.com).
* The implementation was written so as to conform with Netscapes SSL.
*
* This library is free for commercial and non-commercial use as long as
* the following conditions are aheared to. The following conditions
* apply to all code found in this distribution, be it the RC4, RSA,
* lhash, DES, etc., code; not just the SSL code. The SSL documentation
* included with this distribution is covered by the same copyright terms
* except that the holder is Tim Hudson (tjh@cryptsoft.com).
*
* Copyright remains Eric Young's, and as such any Copyright notices in
* the code are not to be removed.
* If this package is used in a product, Eric Young should be given attribution
* as the author of the parts of the library used.
* This can be in the form of a textual message at program startup or
* in documentation (online or textual) provided with the package.
*
* Redistribution and use in source and binary forms, with or without
* modification, are permitted provided that the following conditions
* are met:
* 1. Redistributions of source code must retain the copyright
* notice, this list of conditions and the following disclaimer.
* 2. Redistributions in binary form must reproduce the above copyright
* notice, this list of conditions and the following disclaimer in the
* documentation and/or other materials provided with the distribution.
* 3. All advertising materials mentioning features or use of this software
* must display the following acknowledgement:
* "This product includes cryptographic software written by
* Eric Young (eay@cryptsoft.com)"

* The word 'cryptographic' can be left out if the routines from the library
* being used are not cryptographic related :-).
* 4. If you include any Windows specific code (or a derivative thereof) from
* the apps directory (application code) you must include an acknowledgement:
* "This product includes software written by Tim Hudson (tjh@cryptsoft.com)"
*
* THIS SOFTWARE IS PROVIDED BY ERIC YOUNG ``AS IS'' AND
* ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
* IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
* ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTORS BE LIABLE
* FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
* DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
* OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
* HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
* LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
* OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
* SUCH DAMAGE.
*
* The licence and distribution terms for any publically available version or
* derivative of this code cannot be changed. i.e. this code cannot simply be
* copied and put under another distribution licence
* [including the GNU Public Licence.]
*/

Secure Hash Algorithm (SHA-1) Notice

/*
* Written by Aaron D. Gifford <me@aarongifford.com>
*
* Copyright 1998, 2000 Aaron D. Gifford. All rights reserved.
*
* Redistribution and use in source and binary forms, with or without
* modification, are permitted provided that the following conditions
* are met:
* 1. Redistributions of source code must retain the above copyright
* notice, this list of conditions and the following disclaimer.
* 2. Redistributions in binary form must reproduce the above copyright
* notice, this list of conditions and the following disclaimer in the
* documentation and/or other materials provided with the distribution.
* 3. Neither the name of the copyright holder nor the names of contributors
* may be used to endorse or promote products derived from this software
* without specific prior written permission.
*
* THIS SOFTWARE IS PROVIDED BY THE AUTHOR(S) AND CONTRIBUTORS ``AS IS'' AND
* ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
* IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
* ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHOR(S) OR CONTRIBUTORS BE LIABLE
* FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
* DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
* OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
* HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
* LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
* OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
* SUCH DAMAGE.
*/

Secure Hash Algorithm (SHA-2) Notice

/*
* AUTHOR:Aaron D. Gifford - http://www.aarongifford.com/
*
* Copyright (c) 2000-2001, Aaron D. Gifford
* All rights reserved.
*
* Redistribution and use in source and binary forms, with or without
* modification, are permitted provided that the following conditions
* are met:
* 1. Redistributions of source code must retain the above copyright
* notice, this list of conditions and the following disclaimer.

```
* 2. Redistributions in binary form must reproduce the above copyright
* notice, this list of conditions and the following disclaimer in the
* documentation and/or other materials provided with the distribution.
* 3. Neither the name of the copyright holder nor the names of contributors
* may be used to endorse or promote products derived from this software
* without specific prior written permission.
*
* THIS SOFTWARE IS PROVIDED BY THE AUTHOR AND CONTRIBUTOR(S) ``AS IS" AND
* ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
* IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
* ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTOR(S) BE LIABLE
* FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
* DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
* OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
* HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
* LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
* OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
* SUCH DAMAGE.
*
*/
```

mbed TLS

Apache License
Version 2.0, January 2004
<http://www.apache.org/licenses/>

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object form, that is based on (or derived from) the Work and for which the editorial revisions, annotations, elaborations, or other modifications represent, as a whole, an original work of authorship. For the purposes of this License, Derivative Works shall not include works that remain separable from, or merely link (or bind by name) to the interfaces of, the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner or by an individual or Legal Entity authorized to submit on behalf of the copyright owner. For the purposes of this definition, "submitted" means any form of electronic, verbal, or written communication sent to the Licensor or its representatives, including but not limited to communication on electronic mailing lists, source code control systems, and issue tracking systems that are managed by, or on behalf of, the Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.
3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made, use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.
4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:
 - (a) You must give any other recipients of the Work or Derivative Works a copy of this License; and
 - (b) You must cause any modified files to carry prominent notices stating that You changed the files; and
 - (c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and
 - (d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute must include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works; or, within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The contents of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside

or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise, any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions. Notwithstanding the above, nothing herein shall supersede or modify the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.
6. Trademarks. This License does not grant permission to use the trade names, trademarks, service marks, or product names of the Licensor, except as required for reasonable and customary use in describing the origin of the Work and reproducing the content of the NOTICE file.
7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.
8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special, incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.
9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

APPENDIX: How to apply the Apache License to your work.

To apply the Apache License to your work, attach the following boilerplate notice, with the fields enclosed by brackets "[]" replaced with your own identifying information. (Don't include the brackets!) The text should be enclosed in the appropriate comment syntax for the file format. We also recommend that a file or class name and description of purpose be included on the same "printed page" as the copyright notice for easier identification within third-party archives.

Copyright [yyyy] [name of copyright owner]

Licensed under the Apache License, Version 2.0 (the "License");
you may not use this file except in compliance with the License.
You may obtain a copy of the License at

<http://www.apache.org/licenses/LICENSE-2.0>

Unless required by applicable law or agreed to in writing, software
distributed under the License is distributed on an "AS IS" BASIS,
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
See the License for the specific language governing permissions and
limitations under the License.

Broadcom, the pulse logo, Connecting everything, Avago Technologies, Avago, the A logo, Brocade, Emulex, and OneConnect are among the trademarks of Broadcom and/or its affiliates in the United States, certain other countries, and/or the EU.

Copyright © 2021 Broadcom. All Rights Reserved.

The term “Broadcom” refers to Broadcom Inc. and/or its subsidiaries. For more information, please visit www.broadcom.com.

Broadcom reserves the right to make changes without further notice to any products or data herein to improve reliability, function, or design. Information furnished by Broadcom is believed to be accurate and reliable. However, Broadcom does not assume any liability arising out of the application or use of this information, nor the application or use of any product or circuit described herein, neither does it convey any license under its patent rights nor the rights of others.